CASES ADJUDGED

IN THE

SUPREME COURT OF THE UNITED STATES,

AT

OCTOBER TERM, 1887.

THE TELEPHONE CASES.

Nos. 10, 361, 362, 709, 770, 771. Argued January 24, 25, 26, 27, 28, 31, February 1, 2, 3, 4, 7, 8, 1887.—Decided March 19, 1888.

DOLBEAR *v.* AMERICAN BELL TELEPHONE COMPANY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE DISTRICT OF MASSACHUSETTS.

MOLECULAR TELEPHONE COMPANY *v.* AMERICAN BELL TELEPHONE COMPANY.

AMERICAN BELL TELEPHONE COMPANY *v.* MOLECULAR TELEPHONE COMPANY.

CROSS-APPEALS FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK.

CLAY COMMERCIAL TELEPHONE COMPANY *v.* AMERICAN BELL TELEPHONE COMPANY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

Syllabus.

PEOPLE'S TELEPHONE COMPANY *v.* AMERICAN BELL TELEPHONE COMPANY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK.

OVERLAND TELEPHONE COMPANY *v.* AMERICAN BELL TELEPHONE COMPANY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK.

It appears from the proof in these causes that Alexander Graham Bell was the first discoverer of the art or process of transferring to, or impressing upon, a continuous current of electricity in a closed circuit, by gradually changing its intensity, the vibrations of air produced by the human voice in articulate speech, in a way to cause the speech to be carried to and received by a listener at a distance on the line of the current; and this discovery was patentable under the patent laws of the United States.

In order to procure a patent for a process the inventor must describe his invention with sufficient clearness and precision to enable those skilled in the matter to understand what his process is, and must point out some practicable way of putting it into operation; but he is not required to bring the art to the highest degree of perfection.

Bell's fifth claim under his patent of March 7, 1876, No. 174,465, is not confined to the magneto instrument, or to such modes of creating electrical undulations as could be produced by that form of apparatus.

Bell's fifth claim under his patent of March 7, 1876, also covered his invention of an apparatus to make useful his discovery of an art or process for electrical transmission of speech, and this invention was patentable under the laws of the United States.

The discovery and invention patented to Bell by his patent of March 7, 1876, were not described in the publication made by Charles Bourseul in Paris in 1854, nor in the publication in Germany in 1861–63 respecting the experiments and inventions of Philipp Reis, nor in the publication in Germany in 1862 of what are known as the Reis-Legat experiments; and they were not anticipated by the experiments of Dr. Van der Weyde in New York in 1869, nor by the invention of J. W. McDonough of Chicago in 1876, nor by the invention patented in the United States to C. F. Varley of London, June 2, 1868, nor by the invention patented to said Varley in England, October 8, 1870.

For reasons stated in its opinion the court holds that the alleged invention of the telephone by Daniel Drawbaugh prior to Bell's discovery and invention patented to him March 7, 1876, is not made out.

For reasons stated in its opinion the court holds that the charge of a fraudulent interpolation in Bell's specification after the filing of it in the Patent Office, between February 14 and February 19, 1876, is not sustained; and that not a shadow of suspicion can rest on any one, growing out of the misprint of the specification in the Dowd case.

The authority conferred by the special act of Massachusetts "to incorporate the American Bell Telephone Company," authorized the corporation organized under § 3, Mass. Stat. 1870, c. 224, to select its corporate name, and made the statutory certificate provided for by § 11 of that act conclusive proof of its corporate existence.

Section 4887 of the Revised Statutes does not invalidate an American patent which bears a different date from that of a foreign patent for the same invention, but only limits its term to the term of the foreign patent.

Letters patent No. 186,787, dated January 30, 1877, granted to Alexander Graham Bell for an improvement in electric telephony, is a valid patent, and the fifth claim under it was not anticipated by the magnet described by Schellen.

In Equity. The bills were filed in Circuit Courts of the United States by the American Bell Telephone Company and others, as owners of two patents, known as the Bell-telephone Patents, to enjoin the several defendants against infringements of those patents.

The two patents thus alleged to have come into the ownership of the complainants and to have been infringed were:

1. No. 174,465, dated March 7, 1876, granted to Alexander Graham Bell for new and useful improvements in telegraphy; and,

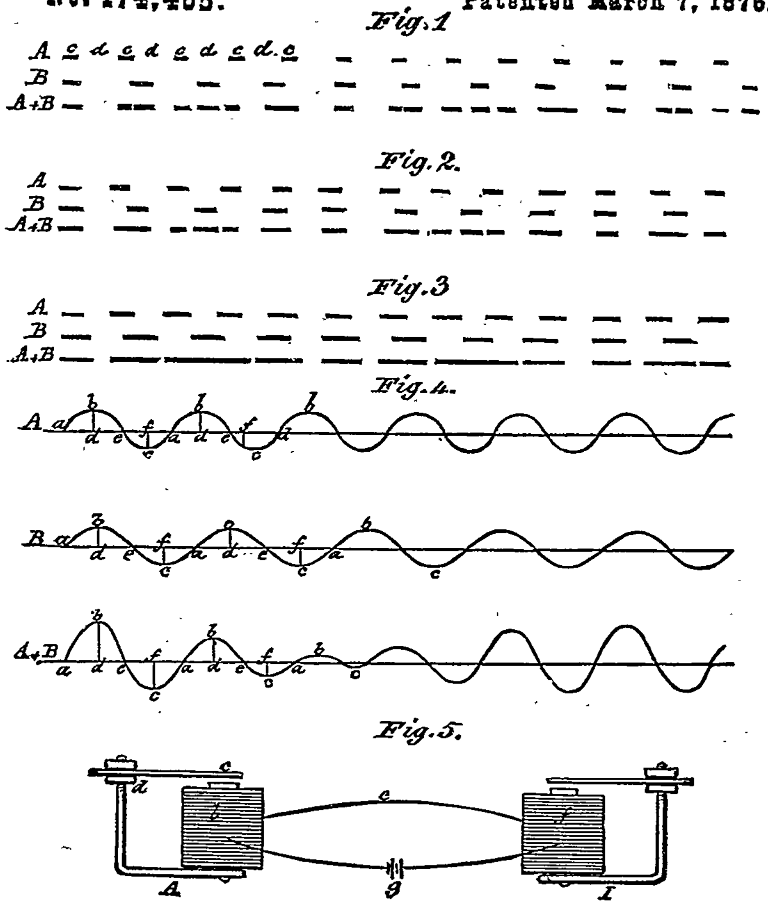
2. No. 186,787, dated January 30, 1877, granted to the same inventor for new and useful improvements in electric telephony.

The following are copies of the drawings and specifications of these two patents:

I. *Bell's Patent of March* 7, 1876.

A. G. BELL.
TELEGRAPHY.

No. 174,465. Patented March 7, 1876.



A. G. BELL.
TELEGRAPHY.

No. 174,465. Patented March 7, 1876.

Fig 6.

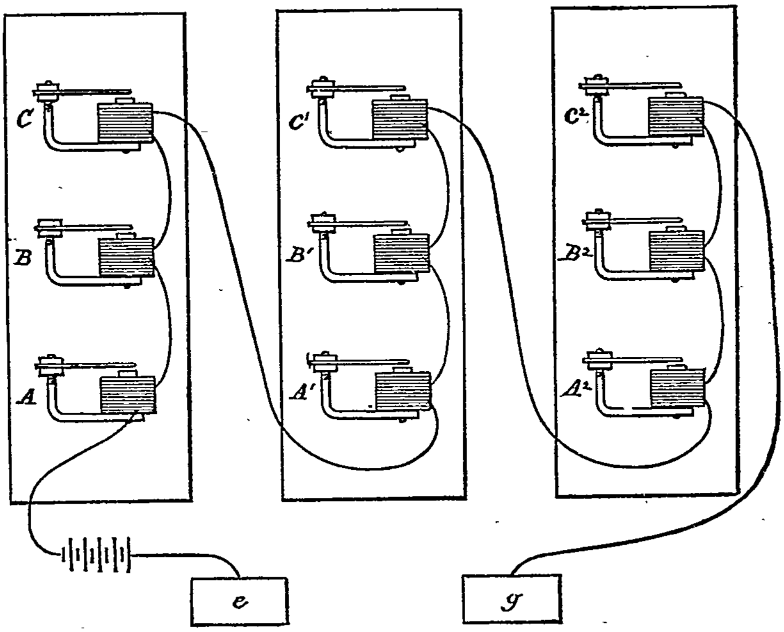
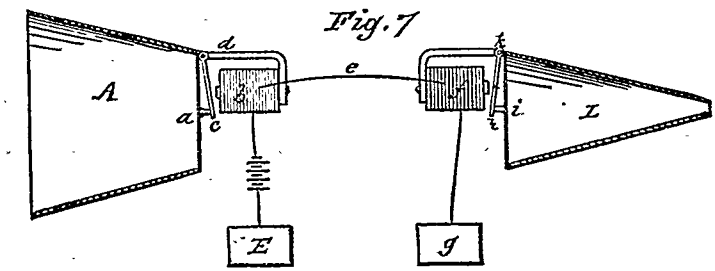


Fig. 7



"UNITED STATES PATENT OFFICE.

"ALEXANDER GRAHAM BELL OF SALEM, MASSACHUSETTS.

"IMPROVEMENT IN TELEGRAPHY.

"Specification forming part of Letters Patent No. 174,465, dated March 7, 1876; application filed February 14, 1876.

"*To all whom it may concern:*

"Be it known that I, ALEXANDER GRAHAM BELL of Salem, Massachusetts, have invented certain new and useful Improvements in Telegraphy, of which the following is a specification:

"In Letters Patent granted to me April 6, 1875, No. 161,-739, I have described a method of, and apparatus for, transmitting two or more telegraphic signals simultaneously along a single wire by the employment of transmitting instruments, each of which occasions a succession of electrical impulses differing in rate from the others; and of receiving instruments, each tuned to a pitch at which it will be put in vibration to produce its fundamental note by one only of the transmitting instruments; and of vibratory circuit-breakers operating to convert the vibratory movement of the receiving instrument into a permanent make or break (as the case may be) of a local circuit, in which is placed a Morse sounder, register, or other telegraphic apparatus. I have also therein described a form of autograph-telegraph based upon the action of the above-mentioned instruments.

"In illustration of my method of multiple telegraphy I have shown in the patent aforesaid, as one form of transmitting instrument, an electro-magnet having a steel-spring armature, which is kept in vibration by the action of a local battery. This armature in vibrating makes and breaks the main circuit, producing an intermittent current upon the line-wire. I have found, however, that upon this plan the limit to the number of signals that can be sent simultaneously over the same wire is very speedily reached; for, when a number of transmitting instruments, having different rates of vibration, are simultaneously making and breaking the same circuit, the effect upon the main line is practically equivalent to one continuous current.

"In a pending application for Letters Patent, filed in the United States Patent Office February 25, 1875, I have described two ways of producing the intermittent current — the one by actual make and break of contact, the other by alternately increasing and diminishing the intensity of the current without actually breaking the circuit. The current produced by the latter method I shall term, for distinction sake, a 'pulsatory current.'

"My present invention consists in the employment of a vibratory or undulatory current of electricity in contradistinction to a merely intermittent or pulsatory current, and of a method of, and apparatus for, producing electrical undulations upon the line-wire.

"The distinction between an undulatory and a pulsatory current will be understood by considering that electrical pulsations are caused by sudden or instantaneous changes of intensity, and that electrical undulations result from gradual changes of intensity exactly analogous to the changes in the density of air occasioned by simple pendulous vibrations. The electrical movement, like the aerial motion, can be represented by a sinusoidal curve or by the resultant of several sinusoidal curves.

"Intermittent or pulsatory and undulatory currents may be of two kinds, accordingly as the successive impulses have all the same polarity or are alternately positive and negative.

"The advantages I claim to derive from the use of an undulatory current in place of a merely intermittent one are, first, that a very much larger number of signals can be transmitted simultaneously on the same circuit; second, that a closed circuit and single main battery may be used; third, that communication in both directions is established without the necessity of special induction-coils; fourth, that cable despatches may be transmitted more rapidly than by means of an intermittent current or by the methods at present in use; for, as it is unnecessary to discharge the cable before a new signal can be made, the lagging of cable-signals is prevented; fifth, and that as the circuit is never broken a spark-arrester becomes unnecessary.

"It has long been known that when a permanent magnet is caused to approach the pole of an electro-magnet a current of electricity is induced in the coils of the latter, and that when it is made to recede a current of opposite polarity to the first appears upon the wire. When, therefore, a permanent magnet is caused to vibrate in front of the pole of an electro-magnet an undulatory current of electricity is induced in the coils of the electro-magnet, the undulations of which correspond, in rapidity of succession, to the vibrations of the magnet, in polarity to the direction of its motion, and in intensity to the amplitude of its vibration.

"That the difference between an undulatory and an intermittent current may be more clearly understood I shall describe the condition of the electrical current when the attempt is made to transmit two musical notes simultaneously—first upon the one plan and then upon the other. Let the interval between the two sounds be a major third; then their rates of vibration are in the ratio of 4 to 5. Now, when the intermittent current is used the circuit is made and broken four times by one transmitting instrument in the same time that five makes and breaks are caused by the other. A and B, Figs. 1, 2, and 3, represent the intermittent currents produced, four impulses of B being made in the same time as five impulses of A. *c c c*, &c., show where and for how long time the circuit is made, and *d d d*, &c., indicate the duration of the breaks of the circuit. The line A and B shows the total effect upon the current when the transmitting instruments for A and B are caused simultaneously to make and break the same circuit. The resultant effect depends very much upon the duration of the make relatively to the break. In Fig. 1 the ratio is as 1 to 4; in Fig. 2, as 1 to 2; and in Fig. 3 the makes and breaks are of equal duration. The combined effect, A and B, Fig. 3, is very nearly equivalent to a continuous current.

"When many transmitting instruments of different rates of vibration are simultaneously making and breaking the same circuit the current upon the main line becomes for all practical purposes continuous.

"Next, consider the effect when an undulatory current is employed. Electrical undulations, induced by the vibration of a body capable of inductive action, can be represented graphically, without error, by the same sinusoidal curve which expresses the vibration of the inducing body itself, and the effect of its vibration upon the air; for, as above stated, the rate of oscillation in the electrical current corresponds to the rate of vibration of the including body — that is, to the pitch of the sound produced. The intensity of the current varies with the amplitude of the vibration — that is, with the loudness of the sound; and the polarity of the current corresponds to the direction of the vibrating body — that is, to the condensations and rarefactions of air produced by the vibration. Hence, the sinusoidal curve A or B, Fig. 4, represents, graphically, the electrical undulations induced in a circuit by the vibration of a body capable of inductive action.

The horizontal line *a d e f*, &c., represents the zero of current. The elevations *b b b*, &c., indicate impulses of positive electricity. The depressions *c c c*, &c., show impulses of negative electricity. The vertical distance *b d* or *c f* of any portion of the curve from the zero-line expresses the intensity of the positive or negative impulse at the part observed, and the horizontal distance *a a* indicates the duration of the electrical oscillation. The vibrations represented by the sinusoidal curves B and A, Fig. 4, are in the ratio aforesaid, of 4 to 5 — that is, four oscillations of B are made in the same time as five oscillations of A.

"The combined effect of A and B, when induced simultaneously on the same circuit, is expressed by the curve A + B, Fig. 4, which is the algebraical sum of the sinusoidal curves A and B. This curve A + B also indicates the actual motion of the air when the two musical notes considered are sounded simultaneously. Thus, when electrical undulations of different rates are simultaneously induced in the same circuit, an effect is produced exactly analogous to that occasioned in the air by the vibration of the inducing bodies. Hence, the co-existence upon a telegraphic circuit of electrical vibrations of different pitch is manifested, not by the obliteration of the vibratory character of the current, but by peculiarities in the shapes of the electrical undulations, or, in other words, by peculiarities in the shapes of the curves which represent those undulations.

"There are many ways of producing undulatory currents of electricity, dependent for effect upon the vibrations or motions of bodies capable of inductive action. A few of the methods that may be employed I shall here specify. When a wire through which a continuous current of electricity is passing is caused to vibrate in the neighborhood of another wire, an undulatory current of electricity is induced in the latter. When a cylinder, upon which are arranged bar-magnets is made to rotate in front of the pole of an electro-magnet, an undulatory current of electricity is induced in the coils of the electro-magnet.

"Undulations are caused in a continuous voltaic current by the vibration or motion of bodies capable of inductive action, or by the vibration of the conducting-wire itself in the neighborhood of such bodies. Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery. The internal resistance of a battery is diminished by bringing the voltaic elements nearer together, and increased by placing them farther apart. The reciprocal vibration of the elements of a battery, therefore, occasions an undulatory action in the voltaic current. The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting-wire is immersed in the mercury or other liquid the less resistance does the liquid offer to the passage of the current. Hence, the vibration of the conducting-wire in mercury or other liquid included in the circuit occasions undulations in the current. The vertical vibrations of the elements of a battery in the liquid in which they are immersed produces an undulatory action in the current by alternately increasing and diminishing the power of the battery.

"In illustration of the method of creating electrical undulations, I shall show and describe one form of apparatus for producing the effect. I prefer to employ for this purpose an electro-magnet, A, Fig. 5, having a coil upon only one of its legs *b*. A steel-spring armature, *c*, is firmly clamped by one extremity to the uncovered leg *d* of the magnet, and its free end is allowed to project above the pole of the covered leg. The armature *c* can be set in vibration in a variety of ways, one of which is by wind, and, in vibrating, it produces a musical note of a certain definite pitch.

"When the instrument A is placed in a voltaic circuit, *g b e f g*, the armature *c* becomes magnetic, and the polarity of its free end is opposed to that of the magnet underneath. So long as the armature *c* remains at rest, no effect is produced upon the voltaic current, but the moment it is set in vibration to produce its musical note a powerful inductive action takes place, and electrical undulations traverse the circuit *g b e f g*. The vibratory current passing through the coil of the electromagnet *f* causes vibration in its armature *h* when the armature *c h* of the two instruments A I are normally in unison with one another; but the armature *h* is unaffected by the passage of the undulatory current when the pitches of the two instruments are different.

"A number of instruments may be placed upon a telegraphic circuit, as in Fig. 6. When the armature of any one of the instruments is set in vibration all the other instruments upon the circuit which are in unison with it respond, but those which have normally a different rate of vibration remain silent. Thus, if A, Fig. 6, is set in vibration, the armatures of A^1 and A^2 will vibrate also, but all the others on the circuit will remain still. So if B^1 is caused to emit its musical note the instruments B B^2 respond. They continue sounding so long as the mechanical vibration of B^1 is continued, but become silent with the cessation of its motion. The duration of the sound may be used to indicate the dot or dash of the Morse alphabet, and thus a telegraphic despatch may be indicated by alternately interrupting and renewing the sound. When two or more instruments of different pitch are simultaneously caused to vibrate, all the instruments of corresponding pitches upon the circuit are set in vibration, each responding to that one only of the transmitting instruments with which it is in unison. Thus the signals of A, Fig. 6, are repeated by A^1 and A^2, but by no other instrument upon the circuit; the signals of B^2 by B and B^1; and the signals of C^1 by C and C^2 — whether A, B^2, and C^1 are successively or simultaneously caused to vibrate. Hence by these instruments two or more telegraphic signals or messages may be sent simultaneously over the same circuit without interfering with one another.

"I desire here to remark that there are many other uses to which these instruments may be put, such as the simultaneous transmission of musical notes, differing in loudness as well as in pitch, and the telegraphic transmission of noises or sounds of any kind.

"When the armature *c*, Fig. 5, is set in vibration the armature *h* responds not only in pitch but in loudness. Thus, when *c* vibrates with little amplitude, a very soft musical note proceeds from *h*; and when *c* vibrates forcibly the amplitude of the vibration of *h* is considerably increased, and the resulting sound becomes louder. So, if A and B, Fig. 6, are sounded simultaneously, (A loudly and B softly,) the instruments A^1 and A^2 repeat loudly the signals of A, and B^1 B^2 repeat softly those of B.

"One of the ways in which the armature *c*, Fig. 5, may be set in vibration has been stated above to be by wind. Another mode is shown in Fig. 7, whereby motion can be imparted to the armature by the human voice or by means of a musical instrument.

"The armature *c*, Fig. 7, is fastened loosely by one extremity to the uncovered leg *d* of the electro-magnet *b*, and its other extremity is attached to the centre of a stretched membrane, *a*. A cone, A, is used to converge sound-vibrations upon the membrane. When a sound is uttered in the cone the membrane *a* is set in vibration, the armature *c* is forced to partake of the motion, and thus electrical undulations are created upon the circuit E *b e f g*. These undulations are similar in form to the air vibrations caused by the sound — that is, they are represented graphically by similar curves. The undulatory current passing through the electro-magnet *f* influences its armature *h* to copy the motion of the armature *c*. A similar sound to that uttered into A is then heard to proceed from L.

"In this specification the three words 'oscillation,' 'vibration,' and 'undulation,' are used synonymously, and in contradistinction to the terms 'intermittent' and 'pulsatory.' By the term 'body capable of inductive action,' I mean a body which, when in motion, produces dynamical electricity. I include in the category of bodies capable of inductive action brass, copper, and other metals, as well as iron and steel.

"Having described my invention, what I claim, and desire to secure by Letters Patent, is as follows:

"1. A system of telegraphy in which the receiver is set in vibration by the employment of undulatory currents of electricity, substantially as set forth.

"2. The combination, substantially as set forth, of a permanent magnet or other body capable of inductive action, with a closed circuit, so that the vibration of the one shall occasion electrical undulations in the other, or in itself, and this I claim whether the permanent magnet be set in vibration in the neighborhood of the conducting-wire forming the circuit, or whether the conducting-wire be set in vibration in the neighborhood of the permanent magnet, or whether the conducting-wire and the permanent magnet both simultaneously be set in vibration in each other's neighborhood.

"3. The method of producing undulations in a continuous voltaic current by the vibration or motion of bodies capable of inductive action, or by the vibration or motion of the conducting-wire itself, in the neighborhood of such bodies, as set forth.

"4. The method of producing undulations in a continuous voltaic circuit by gradually increasing and diminishing the resistance of the circuit, or by gradually increasing and diminishing the power of the battery, as set forth.

"5. The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth.

"In testimony whereof I have hereunto signed my name this 20th day of January, A.D. 1876.

"ALEX. GRAHAM BELL."

"Witnesses:

THOMAS E. BARRY,

P. D. RICHARDS."

Statement of the Case.

II. *Bell's Patent of January* 30, 1877.

A. G. BELL.
ELECTRIC TELEGRAPHY.

No. 186,787. **Patented Jan. 30, 1877.**

Fig. 4.

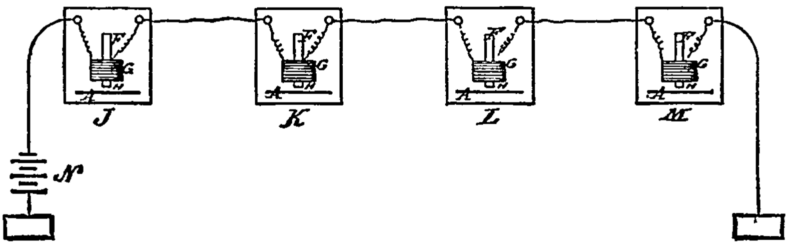


Fig. 5.

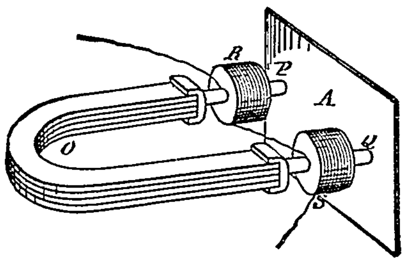
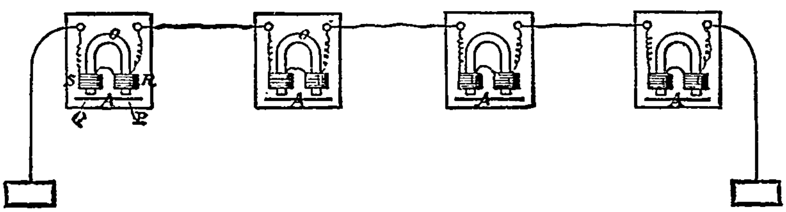


Fig. 6.



A. G. BELL.

ELECTRIC TELEGRAPHY.

No. 186,787. Patented Jan. 30, 1877.

Fig. 1.

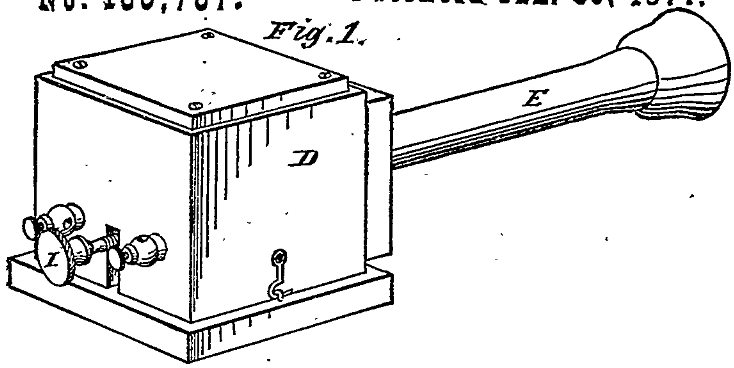


Fig. 2.

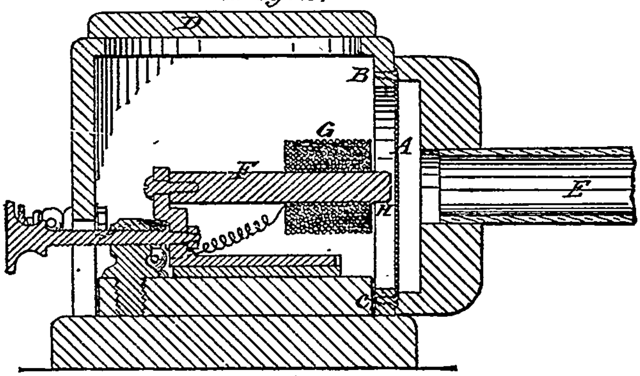
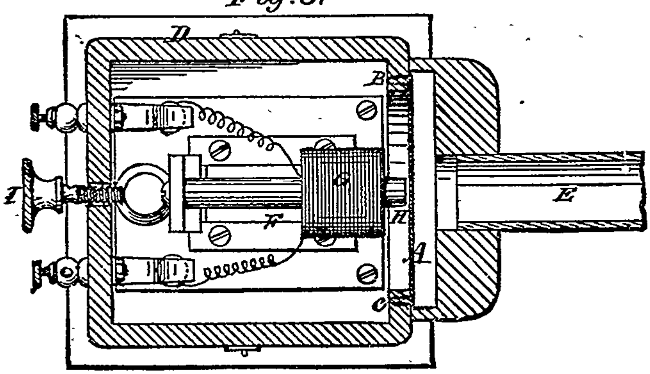


Fig. 3.



"UNITED STATES PATENT OFFICE.

"ALEXANDER GRAHAM BELL, OF BOSTON, MASSACHUSETTS.

"IMPROVEMENT IN ELECTRIC TELEGRAPHY.

"Specification forming part of Letters Patent No. 186,787, dated January 30, 1877: application filed January 15, 1877.

"*To all whom it may concern:*

"Be it known that I, ALEXANDER GRAHAM BELL, of Boston, Massachusetts, have invented certain new and useful Improvements in Electric Telephony, of which the following is a specification:

"In Letters Patent granted to me the 6th day of April, 1875, No. 161,739, and in an application for Letters Patent of the United States now pending, I have described a method of and apparatus for producing musical tones by the action of a rapidly interrupted electrical current, whereby a number of telegraphic signals can be sent simultaneously along a single circuit.

"In another application for Letters Patent now pending in the United States Patent Office I have described a method of and apparatus for inducing an intermittent current of electricity upon a line-wire, whereby musical tones can be produced and a number of telegraphic signals be sent simultaneously over the same circuit, in either or in both directions; and in Letters Patent granted to me March 7, 1876, No. 174,465, I have shown and described a method of an apparatus for producing musical tones by the action of undulatory currents of electricity, whereby a number of telegraphic signals can be sent simultaneously over the same circuit, in either or in both directions, and a single battery be used for the whole circuit.

"In the applications and patents above referred to, signals are transmitted simultaneously along a single wire by the employment of transmitting-instruments, each of which occasions a succession of electrical impulses differing in rate from the others, and are received without confusion by means of receiving-instruments, each tuned to a pitch at which it will be put in vibration to produce its fundamental note by one only of the transmitting-instruments. A separate instrument is therefore employed for every pitch, each instrument being capable of transmitting or receiving but a single note, and thus as many separate instruments are required as there are messages or musical notes to be transmitted.

"My invention has for its object, first, the transmission simultaneously of two or more musical notes or telegraphic signals along a single wire in either or both directions, and with a single battery for the whole circuit, without the use of as many instruments as there are musical notes or telegraphic signals to be transmitted; second, the electrical transmission by the same means of articulate speech and sound of every kind, whether musical or not; third, the electrical transmission of musical tones, articulate speech, or sounds of every kind, without the necessity of using a voltaic battery.

"In my Patent No. 174,465, dated March 7, 1876, I have shown as one form of transmitting-instrument a stretched membrane to which the armature of an electro-magnet is attached, whereby motion can be imparted to the armature by the human voice, or by means of a musical instrument, or by sounds produced in any way.

"In accordance with my present invention I substitute for the membrane and armature shown in the transmitting and receiving instruments alluded to above a plate of iron or steel capable of being thrown into vibration by sounds made in its neighborhood.

"The nature of my invention and the manner in which the same is or may be carried into effect will be understood by reference to the accompanying drawings, in which —

"Figure 1 is a perspective view of one form of my electric telephone. Fig. 2 is a vertical section of the same, and Fig. 3 is a plan view of the apparatus. Fig. 4 is a diagram illustrating the arrangement upon circuit.

"Similar letters in the drawings represent corresponding portions of the apparatus.

"A in said drawings represents a plate of iron or steel, which is fastened at B and C to the cover or sounding-box D. E represents a speaking-tube, by which sounds may be conveyed to or from the plate A. F is a bar of soft iron. G is a coil of insulated copper wire, placed around the extremity of the end H of the bar F. I is an adjusting-screw, whereby the distance of the end H from the plate A may be regulated.

"The electric telephones J, K, L, and M are placed at different stations upon a line, and are arranged upon circuit with a battery, N, as shown in diagram, Fig. 4.

"I have shown the apparatus in one of its simplest forms, it being well understood that the same may be varied in arrangement, combination, general construction, and form, as well as material of which the several parts are composed.

"The operation and use of this instrument are as follows:

"I would premise by saying that this instrument is and may be used both as a transmitter and as a receiver — that is to say, the sender of the message will use an instrument in every particular identical in construction and operation with that employed by the receiver, so that the same instrument can be used alternately as a receiver and a transmitter.

"In order to transmit a telegraphic message by means of these instruments, it is only necessary for the operator at a telephone (say J) to make a musical sound in any way in the neighborhood of the plate A — for convenience of operation, through the speaking-tube E — and to let the duration of the sound signify the dot or dash of the Morse alphabet, and for the operator who receives his message (say at M) to listen to his telephone, preferably through the speaking-tube E. When two or more musical signals are being transmitted over the same circuit all the telephones reproduce the signals for all the messages; but as the signals for each message differ in pitch from those for the other messages, it is easy for an operator to fix his attention upon one message and ignore the other.

"When a large number of despatches are being simultaneously transmitted it will be advisable for the operator to listen to his telephone through a resonator, which will reenforce to his ear the signals which he desires to observe. In this way he is enabled to direct his attention to the signals for any given message without being distracted or disturbed by the signals for any other messages that may be passing over the line at the time.

"The musical signals, if preferred, can be automatically received by means of a resonator, one end of which is closed by a membrane, which vibrates only when the note with which the resonator is in unison is emitted by the receiving-telephone. The vibrations of the membrane may be made to operate a circuit-breaker, which will actuate a Morse sounder or a telegraphic recording or registering apparatus.

"One form of vibratory circuit-breaker which may be used for this purpose I have described in Letters Patent No. 178,-399, June 6, 1876. Hence by this plan the simultaneous transmission of a number of telegraphic messages over a single circuit in the same or in both directions with a single main battery for the whole circuit and a single telephone at each station is rendered practicable. This is of great advantage in this, that for the conveyance of several messages, or signals, or sounds over a single wire simultaneously, it is no longer necessary to have separate instruments correspondingly tuned for each given sound, which plan requires nice adjustment of the corresponding instruments, while the present improvement admits of a single instrument at each station, or, if for convenience several are employed, they all are alike in construction, and need not be adjusted or tuned to particular pitches.

"Whatever sound is made in the neighborhood of any telephone — say at J, Fig. 4 — is echoed in fac-simile by the telephones of all the other stations upon the circuit; hence this plan is also adapted for the use of the transmitting intelligibly the exact sounds of articulate speech. To convey an articulate message it is only necessary for an operator to speak in the neighborhood of his telephone, preferably through the tube E, and for another operator at a distant station upon the same circuit to listen to the telephone at that station. If two persons speak simultaneously in the neighborhood of the same or different telephones, the utterances of the two speakers are reproduced simultaneously by all the other telephones on the same circuit; hence by this plan a number of vocal messages may be transmitted simultaneously on the same circuit, in either or both directions. All the effects noted above may be produced by the same instruments without a battery by rendering the central bar F H permanently magnetic. Another form of telephone, for use without a battery, is shown in Fig. 5, in which O is a compound permanent magnet, to the poles of which are affixed poll-pieces of soft iron, P Q, surrounded by helices of insulated wire, R S.

"Fig. 6 illustrates the arrangement upon circuits of similar instruments to that shown in Fig. 5.

"In lieu of the plate A in above figures, iron or steel reeds of definite pitch may be placed in front of the electro-magnet O, and, in connection with a series of such instruments of different pitches, an arrangement upon circuit may be employed similar to that shown in my Patent No. 174,465, and illustrated in Fig. 6 of Sheet 2 in said patent. The battery, of course, may be omitted.

"This invention is not limited to the use of iron or steel, but includes within its scope any material capable of inductive action.

"The essential feature of the invention consists in the armature of the receiving-instrument being vibrated by the varying attraction of the electro-magnet so as to vibrate the air in the vicinity thereof in the same manner as the air is vibrated at the other end by the production of the sound. It is, therefore, by no means necessary or essential that the transmitting-instrument should be of the same construction as the receiving-instrument. Any instrument receiving and transmitting the impression of agitated air may be used as the transmitter, although, for convenience and for reciprocal communication, I prefer to use like instruments at either end of an electrical wire. I have heretofore described and exhibited such other means of transmitting sound, as will be seen by reference to the proceedings of the American Academy of Arts and Sciences, Volume XII.

"For convenience, I prefer to apply to each instrument a call-bell. This may be arranged so as to ring, first, when the main circuit is opened; second, when the bar F comes into contact with the plate A. The first is done to call attention; the second indicates when it is necessary to readjust the magnet, for it is important that the distance of the magnet from the plate should be as little as possible, without, however, being in contact. I have also found that the electrical undulations produced upon the main line by the vibration of the plate A are intensified by placing the coil G at the end of the bar F nearest the plate A, and not extend it beyond the middle, or thereabout.

"Having thus described my invention, what I claim, and desire to secure by Letters Patent, is

"1. The union upon and by means of an electric circuit of two or more instruments, constructed for operation substantially as herein shown and described, so that if motion of any kind or form be produced in any way in the armature of any one of the said instruments, the armatures of all the other instruments upon the same circuit will be moved in like manner and form, and if such motion be produced in the former by sound, like sound will be produced by the motion of the latter.

"2. In a system of electric telegraphy or telephony, consisting of transmitting and receiving instruments united upon an electric circuit, the production, in the armature of each receiving-instrument, of any given motion by subjecting said armature to an attraction varying in intensity, however such variation may be produced in the magnet; and hence I claim the production of any given sound or sounds from the armature of the receiving-instrument by subjecting said armature to an attraction varying in intensity, in such manner as to throw the armature into that form of vibration that characterizes the given sound or sounds.

"3. The combination, with an electro-magnet, of a plate of iron or steel, or other material capable of inductive action, which can be thrown into vibration by the movement of surrounding air or by the attraction of a magnet.

"4. In combination with a plate and electro magnet, as before claimed, the means herein described, or their mechanical equivalents, of adjusting the relative position of the two so that, without touching, they may be set as closely together as possible.

"5. The formation, in an electric telephone such as herein shown and described, of a magnet with a coil upon the end or ends of the magnet nearest the plate.

"6. The combination, with an electric telephone such as described, of a sounding-box, substantially as herein shown and set forth.

"7. In combination with an electric telephone, as herein described, the employment of a speaking or hearing tube for conveying sounds to or from the telephone, substantially as set forth.

"8. In a system of electric telephony, the combination of a permanent magnet with a plate of iron or steel, or other material capable of inductive action, with coils upon the end or ends of said magnet nearest the plate, substantially as set forth.

"In testimony whereof I have hereunto signed my name this 13th day of January, A.D. 1877.

"A. GRAHAM BELL"

"Witnesses:

HENRY R. ELLIOTT,

EWELL A. DICK."

The complainants alleged infringement of claim five of the first patent by all the defendants below, and infringement of claims three, five, six, seven and eight of the second patent, or of some of them, by some of the defendants below.

The respondents all contested the validity of both of Bell's patents. They also contested the scope of claim five of the first patent. The question of infringement turned upon the scope of this claim, as none of the defendants used instruments which were indentical with the forms shown in the drawings of that patent. Dolbear's instrument differed from those of the other appellants, and his contention as to the scope of this claim varied from that of the others, as will appear more fully in the report of the arguments *infra*.

All the respondents denied that Bell was the original and first inventor of the things patented, as the patents were construed by the complainants' counsel, and by the courts below, and all maintained that if the construction given below to the fifth claim of the first patent was correct, it covered matters not patentable.

Dolbear, the Molecular Company, the Overland Company, and the Clay Commercial Company in their respective answers set out long lists of printed publications and patents[1] prior to

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[1] The following lists are taken from the answer of the Molecular Company.

1. *Persons by whom the invention patented by Bell's first patent had been invented and discovered prior to his invention.*

Philip Reis, then of Friedrichsdorf, Germany, now dead, at Friedrichsdorf and Frankfort, Germany.

Elisha Gray, of Highland Park, Ill., at Oberlin and Cleveland, Ohio; Highland Park and Chicago, Ill.; Milwaukee, Wis., Washington, D. C., and New York City.

Thomas A. Edison, of Menlo Park, N. J., at Menlo Park, N. J., and New York City.

Daniel Drawbaugh, of and at Eberly's Mills, in the county of Cumberland and State of Pennsylvania.

Amos E. Dolbear, of Somerville, Mass., at Somerville, Mass., and elsewhere in the United States.

Alfred G. Holcomb, of Granby, Conn., at New York City, N. Y., and elsewhere in the United States.

Philip H. Van der Weyde, of Brooklyn, at New York City, N. Y., and elsewhere in the United States.

James W. McDonough, of Chicago, Ill., at said Chicago, at New York City and elsewhere.

W. F. Channing, of Providence, R. I., at Providence, R. I.

Benjamin F. Edwards, now deceased, formerly of Boston, Mass., at Boston, Mass., Washington, D. C., and New York City, N. Y.

James Hamblet, Jr., of Brooklyn, N. Y., at Boston, Mass., Washington, D. C., and New York City.

Edward Farran, of Keene, N. H., at Keene, N. H.

Antonio Mencci, of Clifton, Staten Island, N. Y., at Staten Island and New York City.

W. S. Voelker, of Morton, Delaware County, Pa., at Philadelphia, Pa., Morton, Delaware County, Pa., and other places in the United States.

Edward C. Pickering, of Cambridge, Mass., at Boston and Cambridge, Mass the issue of Bell's patents, and averred that the inventions patented to him in his first patent had been substantially

2. *Letters Patent prior to Bell's first patent, describing the patented invention.*

Letters Patent granted by the United States to Thomas A. Edison and George Harrington, dated Aug. 12, 1873, No. 141,777.

Letters Patent of the United States granted to William Thompson, dated Nov. 17, 1874, No. 156,897.

Letters Patent of the United States granted to Elisha Gray, July 27, 1875, No. 166,096.

Letters Patent of the United States granted to Elisha Gray, July 27, 1876, No. 166,094.

Letters Patent of the United States granted to Elisha Gray, July 27, 1875, No. 166,095; caveat filed by Elisha Gray in the United States Patent Office, Feb. 14, 1876.

Letters Patent of the United States granted to Elisha Gray, April 11, 1876, No. 175,971.

Letters Patent of the United States granted to Elisha Gray, Jan. 16, 1877, No. 186,340.

British Letters Patent granted to C. F. Varley, 1870, No. 1044.

British Letters Patent granted to J. H. Johnston, July 29, 1874, No. 2646.

British Letters Patent granted to George T. Bousfield, dated May 4, 1876, and numbered 1874.

French patent granted to Leon Scott, dated March 25, 1857; certificate of addition to same dated July 29, 1859.

British Letters Patent granted to John Henry Johnston, dated March 16, 1875, No. 974.

British Letters Patent granted to Charles Wheatstone, dated Jan. 21, 1840, No. 8345.

British Letters Patent granted to David Hughes, dated April 27, 1858, No. 938.

United States Letters Patent granted to Elisha Gray, dated Feb. 15, 1876, No. 173,460.

3. *Letters Patent prior to Bell's second patent, describing the patented invention.*

United States Letters Patent to Elisha Gray, July 27, 1875, No. 166,095; to Elisha Gray, April 11, 1876, No. 175,971; to A. G. Holcomb, May 16, 1860; to Elisha Gray, July 20, 1875, No. 165,728; to Elisha Gray, Feb. 15, 1876, No. 173,460; and to the same of the same date, No. 173,618.

British Letters Patent to J. H. Johnston, July 29, 1874, No. 2646; to J. H. Johnston, March 16, 1875, No. 974; to George T. Bousfield, May 4, 1876, No. 1874.

Canadian Letters Patent to Elisha Gray, July 7, 1875, No. 4749.

described in these publications and patents; and they also set up a number of like publications and patents as anticipating his second patent.

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4. *Printed Publications prior to Bell's first patent, in which the patent was described.*

"Electricity and Magnetism," by Jenkins, a book printed and published in London, England, and in the city of New York, in 1873, at p. 334.

"Der Electromagnetische Telegraph," by H. Schellen, a printed book published in Brunswick, Germany, in the year 1867, at pp. 468 and 469.

"The Electric Telegraph," by R. Sabine, a book printed and published in London, England, 1867, at pp. 164, 165, 166 and 167.

"L'Eco d'Italia," 1860.

"Lehrbuch der Technischen Physik," by Hassler Pisko, a book published at Vienna, 1866, Vol. 1, p. 648.

Also in a printed publication in the German language entitled "Jahres Bericht des Physikalischen Vereins zu Frankfurt am Main," a book printed and published in 1862, and particularly at pp. 57–64.

A printed publication in the German language entitled "Zeitschrift des Deutsch-Oesterreichischen Telegraphen-Vereins," Vol. 9, a book printed and published at Berlin in 1862, particularly at pp. 125–130.

A printed publication in the German language entitled "Die Neueren Apparate der Akustik," von Dr. Prof. Fr. Jos. Pisko, printed and published in 1865, particularly at pp. 96–103 and pp. 241, 242.

Yearly report of the Physical Society at Frankfurt-a-M., 1860, 1861, at p. 57, etc.

A French publication entitled "Petit Traité de Physique," par M. J. Jamin, Paris, 1870, and particularly at p. 421.

The "Telegraphic Journal," published in London in 1872, Vol. 1, at p. 4.

"Electricity," by R. M. Ferguson, a printed book published in London and Edinburgh in 1867, at pp. 257 and 258.

"The Telegrapher," published in the city of New York in 1869, Vol. 5, No. 39, at pp. —.

"The Manufacturer and Builder," for May, 1869, a newspaper published in the city of New York in 1869, Vol. 1, at p. 129.

"Wonders of Electricity," by J. Baile, published in New York City in 1872, at pp. 140, 141, 142 and 143.

"The Telegraphic Journal," published in London in the year 1875, Vol. 3, at pp. 286, 287 and 288.

"Dingler's Polytechnic Journal" for 1863, Vol. 163, pp. 23 and 185, a book published at Leipsic in 1863.

"Cosmos" for 1864, Vol. 24, pp. 349, 352, a printed book published in Paris in 1864; article by M. St. Edmé.

"Description Reis Telephone, Koenig's Catalogue of Apparatus for 1865," a book printed and published in Paris.

"Applications de l'Électricité," by Du Moncel, Vol. 2, p. 255, etc., a printed book published in Paris in 1854 (Bourseul Apparatus).

In the arguments in this court those known as the Bourseul and Reis publications were chiefly relied upon, either to defeat

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"L'Anneé Scientifique" by Louis Figuier, 1858, Vol. 1, p. 62, a book printed and published at Paris, France, in 1858.

"Cosmos," by l'Abbé Moigno, 1859, eighth year, Vol. 14, No. 11; article about the "Scott Phonautograph," a book printed and published in Paris in 1859.

"Traité Elementaire de Physique," by M. Ganot; eleventh edition, 1854, p. 224; a book published in Paris in 1854; article, "Scott Phonautograph."

"Comptes Rendus de l'Académie des Sciences," Vol. 53, p. 108, 1861.

"Poggendorf Annalen," 1843, Vol. 59, p. 177, a book printed and published at Leipsic, 1843.

"Didaskalia," a journal published in Frankfort-on-the-Main, Sept. 28, 1854, No. 232, and on May 11, 1862, No. 130, and on May 14, 1862, No. 133.

"Du Moncel's Exposé des Applications de l'Électricité," a book published in Paris, France, in 1856 (p. 246), and in 1857 (p. 110).

"Frankfurter Konversationsblatt," a journal published in Frankfort-on-the-Main, Nov. 29, 1861, and June 30, 1863.

"Die Fortschritte der Physik," a journal published in Berlin (pp. 171, 173), and in 1863 (p. 96).

"Aus der Natur," published in Leipsic, 1862 (Vol. 21, pp. 470, 471 to p. 484).

"Müller Poillet's Lehrbuch der Physik und Meteorologie," published in 1862 in Germany, and in 1863, Vol. 2, p. 352, Fig. 325, and 1868, pp. 386, 388, Figs. 348–350.

"Friedrichsdorf Zeitung" a journal published in Homburg in 1862, and also that of 1867 and 1868 (pp. 386, 387, 388, 389).

"Jahres Bericht des Physikalischen Vereins" (Vol. 4, pp. 129 to 135), annual report for 1860, 1861, published in 1863, in Frankfort-on-the-Main.

"Böttgers Polytechnischen Notizblatt," Nos. 1–24 inclusive, pp. 65, 81–255, published in 1863.

"Deutsche Klinik," No. 48, pp. 468, 469, published in 1863 in Berlin.

"Deutsche Industrie Zeitung," published in 1863, in Chemnitz (pp. 184–208, 239 and 249).

"Die Gartenlaube," published at Leipsic, 1863 (pp. 807–809).

"Prospectus of Philipp Reis," published in 1863 in Frankfort, and in "Pisko's Die neueren Apparate der Akustik," published in Vienna, in 1863.

A further circular or addition to the preceding, published in Frankfort in 1863.

The two were published with the circular or prospectus of J. Wehl Albert, mechanician, in Frankfort, in 1863.

"Polytechnische Centralblatt," published in 1863, pp. 857, 858.

Letter of Philipp Reis to W. Ladd, Aug. 13, 1863.

"Tagesblatt der 39 Versammlung Deutscher Naturförscher," published in Giessen, in September, 1864.

the first patent or to limit its scope. The counsel for the People's Company referred to these, though not set up in their

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"Zöllner's Buch der Erfindungen," published in Leipsic and Berlin in 1865 and in 1872.

"Karl Kuhn's Handbuch der Angewandten Elektricitätslehre," pp. 1016–1021, published in 1866.

"Albert's Catalogue," in 1866 and 1872 and 1873.

"Kneeland's Annual of Scientific Discovery," in 1866 and 1867.

"New York Tribune," Jan. 8, 1869.

"Christian Union," New York, Dec. 25, 1875.

"Scientific American," New York, March 4, 1876.

"Scientific American" (Supplement), Feb. 5, 1876.

"Scientific American" (Supplement), No. 48, 1876.

"Electricity and Magnetism," by Jenkins, in London, 1876.

"Journal of the Franklin Institute of the State of Pennsylvania," Vol. 42, published in Philadelphia in 1869, pp. 419 *et seq.*

"The Manufacturer and Builder," April, 1870.

"Dublin Medical Press," 1863, Vol. 50, No. 1293, p. 471.

"Cosmos," 1863, Vol. 23, p. 705.

"Zeitschrift des Architectur und Ingenieur Vereins," 1866, Vol. 12, p. 147.

"The Electric Telegraph," by Dr. Lardner, new edition, revised by E. B. Bright, published in London, England, in 1867, at pp. 164, 165, 166 and 167.

"Transactions Royal Scottish Society of Arts," Edinburgh, Vol. 6, 1864, Appendix Q, pp. 184–187.

"Annual Report of American Association for the Advancement of Science" for 1869.

"Knight's American Mechanical Dictionary," 1876, Article "Telephone."

5. *Printed publications prior to Bell's second patent, in which the patented invention was described.*

"Der Electromagnetische Telegraph," by Dr. H. Schellen, published at Brunswick, Germany, in the year 1867, at pp. 411, 412, 413, 414, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 468 and 469.

"Zeitschrift des Deutsch-Oesterreichischen Telegraphen-Vereins," published at Berlin, Prussia, in the year 1862, Vol. 9, p. 125.

Yearly report of the Physical Society at Frankfort-a-M., 1860, 1861, p. 67, etc.

"Die Neuren Apparate der Akustik," von Dr. Prof. Jos. Pisko, printed and published in 1865.

"Journal of the German-Austrian Telegraph Association," Vol. 9, p. 125, 1862, and pp. 94–104.

"The Electric Telegraph," by R. Sabine, published in London, England, in 1867, at pp. 1[illegible]6, 137 and 138.

answer, it having been agreed that the court should treat all the evidence, in all the cases, as applicable to each one of them.

"The Telegraphic Journal," published in London in 1872, Vol. 1, p. 4.

"Electricity," by R. M. Ferguson, published in London and Edinburgh in the year 1867, at pp. 257 and 258.

"The Telegrapher," published in the city of New York in the year 1869, Vol. 5, No. 39, at p. —.

"The Manufacturer and Builder," published in the city of New York in the year 1869, Vol 1, at p. 129.

"Wonders of Electricity," by J. Baile, published in the city of New York, in the year 1872, at pp. 140, 141, 142 and 143.

"The Telegraphic Journal," published in London in the year 1875, Vol. 3, at pp. 286, 287 and 288.

"L'Eco d'Italia," 1860.

"Lehrbuch der Technischen Physik," by Dr. Hassler Pisko, published at Vienna, 1836, Vol. 1, 648.

"The Scientific American," of Oct. 20, 1860, p. 264, a newspaper published in the city of New York.

"Didaskalia," a journal published in Frankfort-on-the-Main, Sept. 28, 1854, No. 232; and on May 11, 1862, No. 130; and on May 14, 1862, No. 133.

Du Moncel's "Exposé des Applications de l'Électricité," a book published in Paris, France, in 1856 (p. 246), and in 1857 (p. 110).

"Frankfurter Konversationsblatt," a journal published in Frankfort-on-the-Main, Nov. 29, 1861, and June 30, 1863.

"Die Fortschritte der Physik," a journal published in Berlin (pp. 171, 173), and in 1863 (p. 96).

"Aus der Natur," published in Leipsic, 1862 (Vol. 21, pp. 470, 471–484).

"Müller Poillet's Lehrbuch der Physik und Meteorologie," published in 1862, in Germany, and in 1863, Vol. 2, p. 352, Fig. 325; and 1868, pp. 386–388, Figs. 348–350.

"Friedrichsdorf Zeitung," a journal published in Homburg, in 1862, and also that of 1867 and 1868 (pp. 386, 387, 388, 389).

"Jahres Bericht des Physikalisches Vereins" (Vol. 4, pp. 129–135), annual report for 1860, 1861, published in 1863, in Frankfort-on-the-Main.

"Böttger's Polytechnischen Notizblatt," Nos. 1 to 24 inclusive, pp. 65, 81, 225, published in 1863.

"Deutsche Klinik," No. 48, pp. 468, 469, published in 1863, in Berlin.

"Deutsche Industrie Zeitung," published in 1863, in Chemnitz (pp. 184–208, 239 and 249).

"Die Gartenlaube," published at Leipsic, 1863 (pp. 807–809).

"Prospectus of Philipp Reis," published in 1863 in Frankfort, and in Pisko's "Die neueren Apparate der Akustik," published in Vienna in 1863.

A further circular or addition to the preceding, published in Frankfort in 1863.

The Bourseul publication (there were several in the records) chiefly cited in argument was the original communication from M. Charles Bourseul printed in Volume XXIV. of "L'Illustration," Paris, August 26, 1854, of which the following is a translation:

"The electric telegraph is based on the following principle: An electric current, passing through a metallic wire, circulates through a coil around a piece of soft iron which it converts into a magnet. The moment the current stops, the piece of iron ceases to be a magnet. This magnet, which takes the

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The two were published with the circular or prospectus of J. Wehl Albert, mechanician, in Frankfort, in 1863.

"Polytechnische Centralblatt," published in 1863, pp. 857, 858.

Letter of Philipp Reis to W. Ladd, Aug. 13, 1863.

"Tagesblatt der 39 Versammlung Deutscher Naturförscher," published in Giessen, in September, 1884.

Zöllner's "Buch der Erfindungen," published in Leipsic and Berlin in 1865 and 1872.

"Karl Kuhns Handbuch der Angewandten Elektricitätslehre," pp. 1016–1021, published in 1866.

"Albert's Catalogue," in 1866 and 1872 and 1873.

"Kneeland's Annual of Scientific Discovery," in 1866 and 1867.

"New York Tribune," Jan. 8, 1869.

"Christian Union," New York, Dec. 25, 1875.

"Scientific American," New York, March 4, 1876.

"Scientific American" (Supplement), Feb. 5, 1876.

"Scientific American" (Supplement), No. 48, 1876.

"Electricity and Magnetism," by Jenkins, in London, 1876.

"Journal of the Franklin Institute of the State of Pennsylvania," Vol. 42, published in Philadelphia in 1869, pp. 419 *et seq.*

"The Manufacturer and Builder," April, 1870.

"Dublin Medical Press," 1863, Vol. 50, No. 1293, p. 471.

"Cosmos," 1863, Vol. 23, p. 705.

"Zeitschrift des Architectur und Ingenieur Vereins," 1866, Vol. 12, p. 147.

"The Electric Telegraph," by Dr. Lardner, new edition, revised by E. B. Bright, published in London, Eng., in 1867, at pp. 164, 165, 166 and 167.

"Transactions Royal Scottish Society of Arts," Edinburgh, Vol. 6, 1864, Appendix Q, pp. 184–187.

"Annual Report of American Association for the Advancement of Science," for 1869.

name of electro-magnet, can thus in turn attract and then release a movable plate (*plaque mobile*) which by its to-and-fro movement produces the conventional signals employed in telegraphy. Sometimes this movement is directly utilized, and is made to produce dots or dashes on a strip of paper which is drawn along by clockwork. The conventional signals are thus formed by a combination of those dots and dashes. This is the American telegraph, which bears the name of Morse, its inventor. Sometimes this to-and-fro movement is converted into a movement of rotation. In that way we have either the dial telegraph used on railroads, or the telegraph used in the government system, which by means of two line-wires and two indicating needles, reproduce all the signals of the aerial telegraph or semaphore which was formerly used. Suppose, now, that we arrange upon a movable horizontal circle letters, figures, signs of punctuation, &c. One can understand that the principle we have stated can be used to choose at a distance such and such a character, and to determine its movement, and consequently to print it on a sheet of paper appropriately placed for this purpose. This is the printing telegraph.

"We have gone still further. By the employment of the same principle, and by means of a mechanism rather complicated, it has been possible to reach a result which at first would seem to be almost a miracle. Handwriting itself is produced at a distance, and not only handwriting, but any line o. any curve; so that, being in Paris, you can draw a profile by ordinary means there, and the same profile draws itself at the same time at Frankfort. Attempts of this sort have succeeded. The apparatus has been exhibited at the London Exhibition. Some details, however, remain to be perfected. It would seem impossible to go beyond this in the region of the marvellous. Let us try, nevertheless, to go a few steps further. I have asked myself, for example, if the spoken word itself could not be transmitted by electricity; in a word, if what was spoken in Vienna may not be heard in Paris? The thing is practicable in this way:

"We know that sounds are made by vibrations, and are made sensible to the ear by the same vibrations, which are reproduced by the intervening medium. But the intensity of the vibrations diminishes very rapidly with the distance; so that even with the aid of speaking tubes and trumpets, it is impossible to exceed somewhat narrow limits. Suppose that a man speaks near a movable disk, sufficiently flexible to lose none of the vibrations of the voice; that this disk alternately makes and breaks the connection with a battery: you may have at a distance another disk which will simultaneously execute the same vibrations.

"It is true that the intensity of the sounds produced will be variable at the point of departure, at which the disk vibrates by means of the voice, and constant at the point of arrival, where it vibrates by means of electricity; but it has been shown that this does not change the sounds. It is, moreover, evident that the sounds will be reproduced at the same pitch.

"The present state of acoustic science does not permit us to declare *a priori* if this will be precisely the case with syllables uttered by the human voice. The mode in which these syllables are produced has not yet been sufficiently investigated. It is true that we know that some are uttered by the teeth, others by the lips, &c.; but that is all.

"However this may be, observe that the syllables can only reproduce upon the sense of hearing the vibrations of the intervening medium. Reproduce precisely these vibrations, and you will reproduce precisely these syllables.

"It is, at all events, impossible, in the present condition of science, to prove the impossibility of transmitting sound by electricity. Everything tends to show, on the contrary, that there is such a possibility. When the application of electromagnetism to the transmission of messages was first discussed, a man of great scientific attainments treated the idea as Utopian, and yet there is now direct communication between London and Vienna by means of a simple wire. Men declared it to be impossible, but it is done.

"It need not be said that numerous applications of the highest importance will immediately arise from the transmission of speech by electricity. Any one who is not deaf and dumb may use this mode of transmission, which would require no apparatus except an electric battery, two vibrating disks and a wire. In many cases, as, for example, in large establishments, orders might be transmitted in this way, although transmission in this way will not be used while it is necessary to transmit letter by letter, and to make use of telegraphs which require use and apprenticeship. However this may be, it is certain that in a more or less distant future, speech will be transmitted by electricity. I have made some experiments in this direction. They are delicate, and demand time and patience; but the approximations obtained promise a favorable result.

"CHARLES BOURSEUL.

"PARIS, August 18, 1854."

Of the Reis publications the record contained over sixty separate papers, from 1861 to 1876, and also a large amount of expert testimony concerning them. It is not practicable to reproduce most of this evidence, except as it is referred to by counsel in the synopses of their arguments. The following are the translations of some of the principal publications under this head, which were referred to in argument in this court. It appeared that Reis delivered two lectures before the "Physikalischer Vereins" of Frankfort. The first of the following papers was written by him as a report of those lectures.

JAHRESBERICHT DES PHYSIKALISCHEN VEREINS ZU FRANKFURT AM MAIN, für das Rechnungs Jahr 1860–1861. Published in 1862.

"[Yearly Report of the Physical Society at Frankfort-a-M., 1860–61, pp. 57–64.]

"On telephony by means of the galvanic current, by Philipp Reis.

"The extraordinary results in the field of telegraphy have probably often raised the question, If it might not be possible to transmit musical tones themselves [Tonsprache] to a distance? Experiments made in this direction could not, however, produce any result at all satisfactory, because the vibrations of sound-conducting media soon lose their intensity to such an extent that they are no longer appreciable by our senses.

"A reproduction of tones [Tönen] at certain distances by means of a galvanic current has probably been thought of, but the practical solution of this problem has certainly seemed the most doubtful to the very persons who, from their knowledge and appliances, were in the best condition to attack it. To a person having only a superficial knowledge of physics, the problem presents far less difficulties, simply because the most of them are unperceived. About nine years ago I also (having an extraordinary enthusiasm for what was new, and an insufficient knowledge of physics) had the boldness to attempt the solution, but was soon forced to desist, because the very first experiment convinced me of the impossibility of its solution.

"Later, after further study and experience, I came to see that my first experiment had been a very rough and by no means conclusive one; I did not, however, follow up the subject seriously, because I did not feel myself equal to the difficulties in the way.

"Youthful impressions, however, are strong, and therefore not easily effaced. I could never get rid of the thought of that first experiment and its occasion, notwithstanding all that reason says to the contrary, and thus, half unwillingly, this project of my youth was reviewed in hours of leisure; the difficulties and the means for overcoming them were weighed; but for the present, at least, no experiment was made.

"How indeed could a single instrument reproduce the combined effect of all the organs occupied in human speech? This was always the cardinal question; finally I got the notion of putting the question in another way:

"How is *our ear* affected by the totality of vibrations produced by the organs of speech all simultaneously active? Or more generally;

"How are we affected by the vibrations of several simultaneously sounding bodies?

"To answer this question, we must, in the first place, understand what must happen in order that we may perceive a single tone.

"Without our ear, any tone is nothing else than a recurrent condensation and rarefaction of some body repeated at least seven or eight times in a second. If this occurs in the same medium in which we are, the membrane of the ear is at each condensation forced towards the middle ear, to be moved at the subsequent rarefaction in the opposite direction. These vibrations produce a synchronous raising and falling of the hammer upon the anvil (according to other authorities, an approach or receding of the ear-bone particles), and a similar number of tremors in the fluid of the cochlea, in which the filaments of the auditory nerve are distributed. The greater the condensation of the sound-conducting medium at any given moment, the greater is the amplitude of vibration of the membrane and hammer, and consequently the more powerful the blow upon the anvil, and the vibration of the nerves by means of the fluid.

"The office of our organs of hearing is, therefore, to transmit with certainty up to the auditory nerve every condensation and rarefaction occurring in the surrounding medium. But the office of the auditory nerve is to bring to our consciousness the vibrations of matter which have occurred in a given time, both as regards number and amplitude. Here, for the first time, certain combinations receive a name; here, certain vibrations are *tones* or *noises* [*Töne* oder *Misstöne*].

"What our auditory nerve perceives is, then, simply the effect of a force coming within the range of consciousness, and this force can be represented both as to duration and magnitude graphically by a curve.

"Let *a b* represent any given time, and the curve above the line condensation (+), the curve below the line rarefaction (—), then any ordinate raised from the end of any abscissa will represent the degree of condensation, at the time represented by its base, in consequence of which the drum of the ear vibrates.

"Our ear can under no circumstances appreciate more than can be represented by these curves, and this indeed is entirely sufficient to give us a clear perception of any tone [Ton] or any combination of tones.

"If several tones [Töne] are produced at the same time, the conducting medium is subjected to the influence of several simultaneous forces, and the two following laws will hold good: If the forces act all in the same direction, the amplitude is proportional to the sum of the forces; if the forces act in opposite directions, the amplitudes are proportional to the difference of the opposing forces.

"If, for example, in the case of three tones, we draw the curve of condensation of each separately, then by a summation of the ordinates of corresponding abscissas, we can determine new ordinates and develop a new curve, which might be called the combination curve. This represents exactly what our ear perceives of the three simultaneous tones. The fact that the musician can distinguish the three tones need not surprise us any more than the fact that any one acquainted with the theory of colors can in green discover blue and yellow; but the combination curves in Plate I. show that this difficulty is a slight one, for in these curves all the relations of the components successively recur. In the case of chords of more than three notes, the relations are not so readily seen from the drawing, Plate II., for example. In the case of such chords, however, the skilled musician also finds difficulty in recognizing the separate notes.

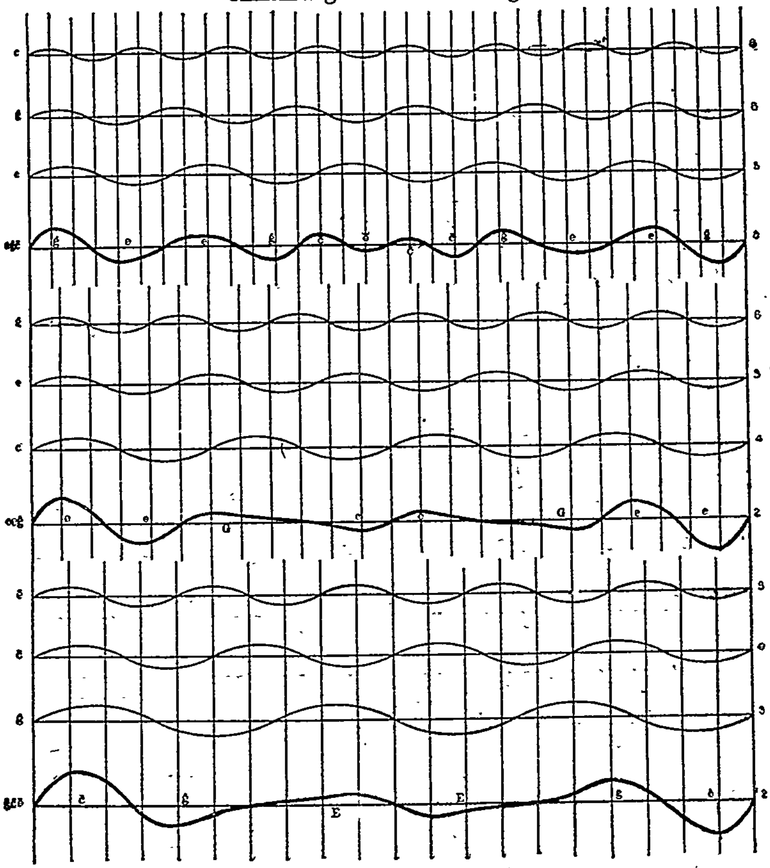
"Plate III. illustrates discord [Dissonanz]. Why discords impress us unpleasantly I will leave my readers to judge at this time, though I may perhaps return to the subject subsequently in another paper.

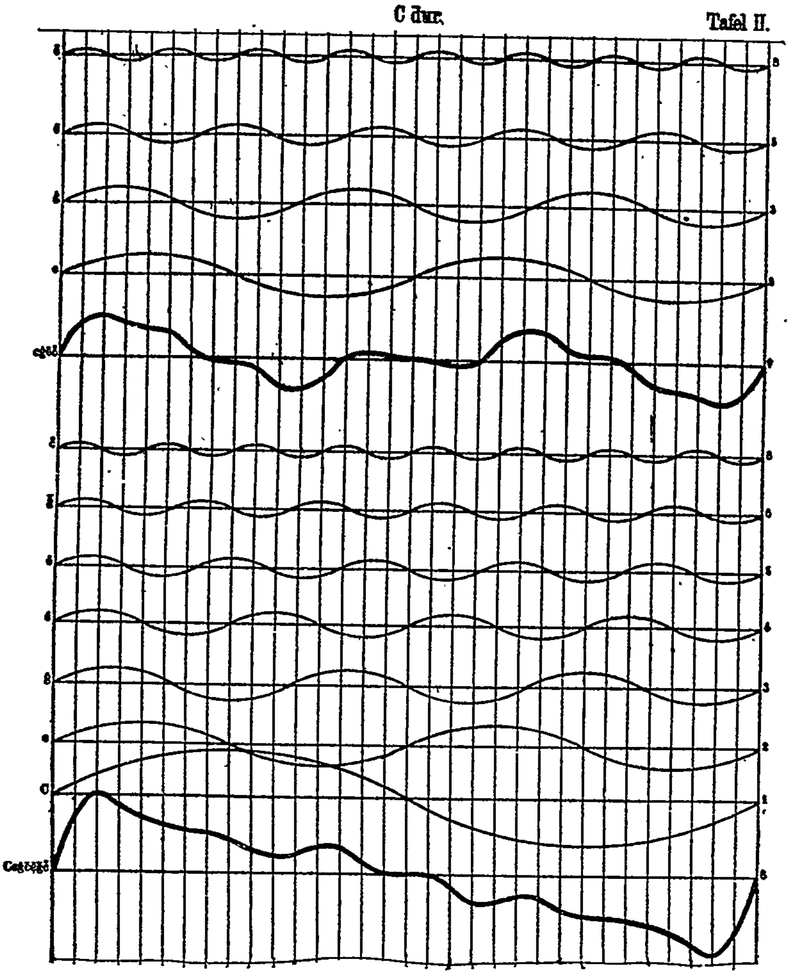
"From the preceding it follows:

"*First.* Every tone [Ton] and every combination of tones, on striking our ear, causes vibrations on the drum of the ear, the succession of which may be represented by a curve.

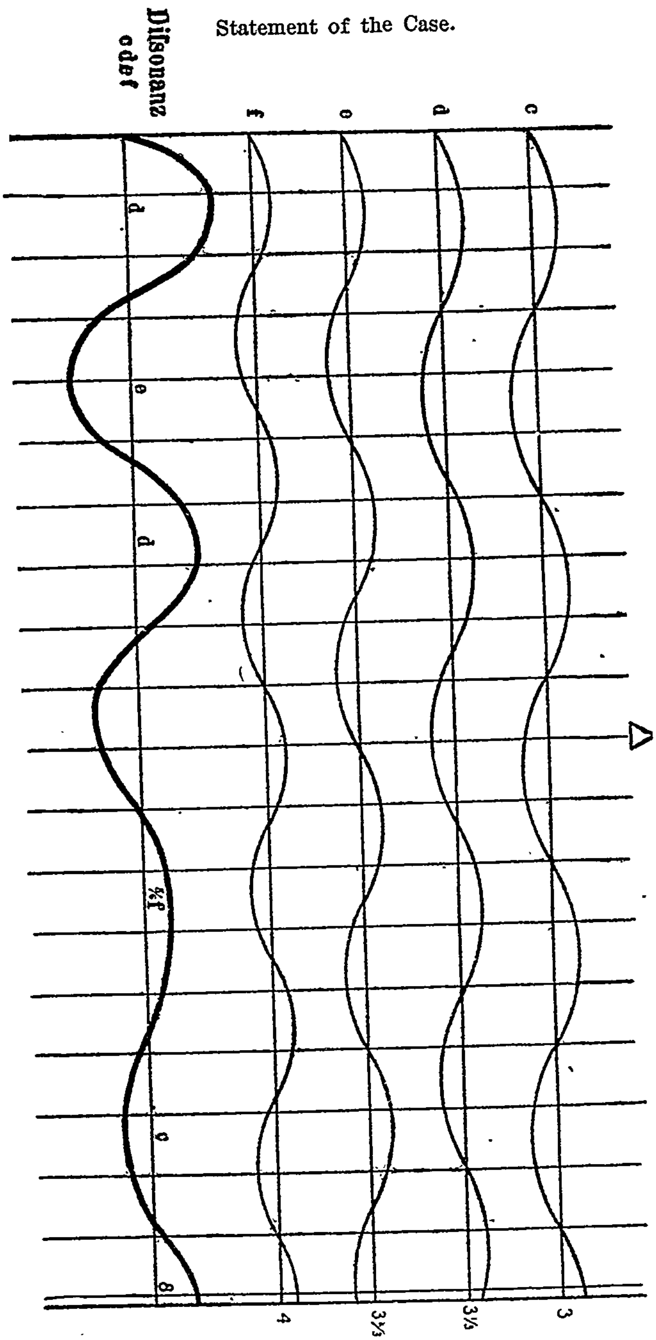
Statement of the Case.

Umkehrungen eines Dreiklanges. Tafel I.




C dur.
Tafel II.

Statement of the Case.

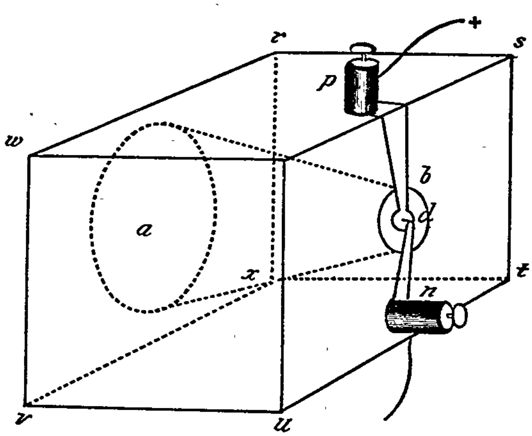


Tafel III.

"*Second.* The succession of these vibrations alone gives us a conception (sensation) of the tone, and every alteration changes the conception (sensation).

"As soon, then, as it is possible to produce, anywhere and in any manner, vibrations whose curves shall be the same as those of any given tone or combination of tones, we shall receive the same impression as that tone or combination of tones would have produced on us.

"With the above principles as a foundation, I have succeeded in constructing an apparatus with which I am enabled to reproduce the tones of various instruments, and even to a certain extent the human voice. It is very simple, and by means of the figure will be easily understood from the following explanation:



"In the cubical block of wood *r s t u v w x* there is a conical perforation *a*, closed at one end by a membrane *b* (pig's intestine), upon the middle of which there is cemented a conducting strip of platinum; this is connected with the binding screw *p* [auf deren Mitte ein stromleitendes Streifchen Platin, festgekittet ist. Dieses steht mit der Klemme *p* in Verbindung]. From the binding screw *n*, another thin strip of metal [ein dünnes Metallstreifchen] extends until over the middle of the membrane, and ends here in a platinum wire placed at right angles to its length and surface.

"From the binding screw *p*, a conducting wire runs through the battery to a distant station, being connected with a coil of silk-covered copper wire, and this again is connected with a conductor leading back to the binding screw *n*.

"The coil at the distant station is about six inches long, is composed of six layers of fine wire, and, as a core in its centre, has a knitting-needle which projects about two inches at both ends. By means of the projecting ends, the coil rests upon two bridges of a resonant case. (All this part can, of course, be replaced by any other apparatus by means of which the well-known 'galvanic tones' can be produced.)

"If now tones or combinations of tones are produced in the neighborhood of the block, so that sufficiently powerful waves enter the opening *a*, then these sounds cause the membrane *b* to vibrate. At the first condensation the hammer-like wire *d* is pushed back; at the rarefaction it cannot follow the retreating membrane, and the current traversing the strips remains broken [Strom bleibt so lange unterbrochen bis, etc.], until the membrane forced by a new condensation again presses the strip (proceeding from *p*) against *d*. In this way each sound wave causes a breaking and closing [ein Oeffnen und ein Schliessen] of the current [Stromes].

"At each closing [Schliessen] of the circuit [Kette], the atoms of the iron wire inside the distant spiral are moved away from each other (Pouillet Müller, p. 304, Vol. II., fifth edition); on breaking the circuit [beim Unterbrechen des Stromes], these atoms seek to regain their position of equilibrium. When this happens, in consequence of the reciprocal actions of elasticity and inertia, a number of vibrations are produced, and they give the longitudinal sound of the rod (see as above). This is the case if the making and breaking of the current [Unterbrechungen und Schliessungen des Stromes] occur with comparative slowness. If they occur more rapidly than the oscillations of the iron core, due to its elasticity, the atoms cannot complete their course. The paths described become shorter in proportion as the interruptions are more frequent, but then are just as numerous as these.

"The iron wire no longer gives its longitudinal normal tone, but a tone whose pitch corresponds to the number of interruptions [Unterbrechungen] (in a given time); this is the same as saying that *the rod reproduces the tone* [Ton] *impressed upon the interrupter* [dem Unter brechungsapparat]. The intensity also of this tone is proportional to that of the original one, for in proportion as this is more intense, the motions of the membrane are greater; the motions of the hammer, also, and finally the time during which the circuit remains opened, is greater; and consequently, up to a certain limit, the motions of the atoms in the reproducing wire are greater, we perceiving them as greater vibrations, in just the same way as we would have perceived the original sound-wave.

"As the length of the conducting wire can undoubtedly be made as great as in direct telegraphy, I have called my instrument 'telephone.'

"Now, in reference to the capabilities of the telephone, it may be stated that I was enabled to render audible to the members of a large assembly (The Physical Society at Frankfort-a-M.) melodies which were sung (not very loud) into the apparatus in another house (three hundred feet away) with closed doors.

"Other experiments showed that the sounding wire was capable of reproducing complete chords of three tones of a piano, upon which the telephone was placed, and that it reproduces equally well the tones of other instruments, accordion, clarinet, horn, organ pipes, etc., provided that the tones are within the compass F — $\bar{\bar{\text{f}}}$.

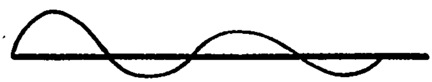
"Of course, in all experiments, sufficient precautions were taken to insure that there was no direct conduction of sound. This is very easily done by making a momentary short circuit immediately in front of the coil, by which means its action is temporarily interrupted.

"Hitherto it has not been possible to reproduce the tones of human speech [Tonsprache des Menschen] with a distinctness sufficient for every one. The consonants are for the most part reproduced pretty distinctly, but the vowels as yet not in an equal degree. The cause of this I will attempt to explain.

Statement of the Case.

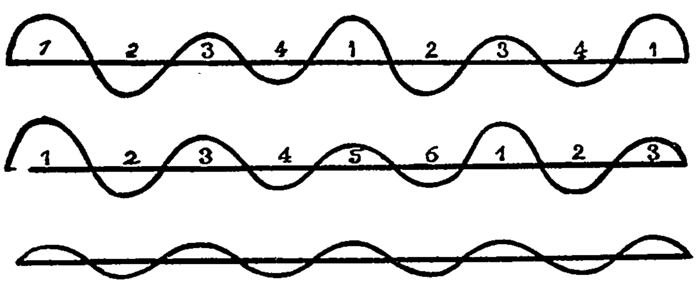
"According to the experiments of Willis, Helmholtz and others, vowel tones can be produced artifically, if the vibrations of one body are from time to time augmented by those of another, somewhat as follows:

"An elastic spring is set in vibration by the blow of a tooth on a toothed wheel; the first vibration is the greatest, and each subsequent one is smaller than the preceding.



"If, after a few vibrations of this kind (the spring not coming to rest in the mean time), the tooth wheel imparts a new stroke, the following vibration will be again a maximum, and so on.

"The pitch of the tone produced in this way depends upon the number of vibrations in a given time, but the character of the tone upon the number of swellings [Anschwellungen] in the same time. Two vowels having the same pitch would differ in about the way represented by the curve (Figs. 1, 2), while the same tone without any vowel character would be represented by the curve (Fig. 3).



"Our organs of speech probably produce the vowels in the same manner, through the combined action of the upper and lower vocal cords, or of these latter and the cavity of the mouth.

"My apparatus reproduces the number of vibrations, but with an intensity much less than that of the original ones; though, as I have reason to believe, to a certain degree proportional among themselves. But in the case of these generally small vibrations, the difference between large and small vibrations is more difficult to perceive than in the case of the original waves, and the vowel is therefore more or less indistinct.

"Whether or not my views as to the curves corresponding to sound combinations are correct could perhaps be decided by means of the new phonautograph of Duhamel ('Vierordt Physiologie,' page 254).

"It may be that for the practical application of the telephone much remains to be done; for physics it has already sufficient interest from the fact that it opens a new field for research.

"Friedrichsdorf, near Frankfort-a-M., December, 1861."

"DIE FORTSCHRITTE DER PHYSIK, Dargestellt von der physikalischen Gesellschaft zu Berlin, XVII., im J., 1861, pp. 171–173.

"[Progress in the Natural Sciences. Published by the Physical Society of Berlin. 1861, Vol. XVII., pp. 171–173.]

"PH. REIS. *Telephony by means of the electric current.* (*Annual Report of the Physical Society of Frankfort on the Main*, 1860–1, *pp.* 57–64.)

"By the name 'Telephone' the author designates the following apparatus of his own construction, by means of which and with the help of the galvanic current he is enabled 'to reproduce at a distance the tones [Tönen] of different instruments and even to a certain degree the human voice.'

"A wooden cube is bored through from one of the faces to the opposite one, the cavity taking the shape of a cone; the smaller opening is closed by means of a membrane [hog's intestine, Schweinsdünndarm]. On the middle of the membrane and parallel with it is a thin strip of platinum cemented fast at one end whilst the other end is held by a binding post

[Klemme] *p*. From another binding post *q* extends a similar thin strip of metal as far as over the centre of the membrane, and carries a little platinum wire directed towards the membrane at right angles to the strip and the surface of the membrane. From binding post *p* a conductor leads through a battery to a distant coil, which again is connected by another wire to binding post *q*.

"The coil at the distant station is about six inches long, consists of six layers of thin wire and encloses as a core a knitting needle which protrudes about two inches at each end. By these protruding ends the coil is supported on two bridges of a sound-board. If now tones or combinations of tones are produced in the vicinity of the large opening of the conical cavity so that sufficiently strong waves enter it, these waves will set the membrane into vibration; by the outward motion of the membrane the platinum strip cemented on it is pressed against the hammer-shaped wire *d* and the galvanic current [Strom] is closed [geschlossen]; by the inward motion of the membrane the current is reopened. The alternate magnetizings and demagnetizings of the core of the coil resulting therefrom will bring forth, if the alternation is slow, the longitudinal tone of the core, and if the alternation [aufeinanderfolge] is quicker, a longitudinal vibration of the same, the period of which corresponds to the period of the interruptions of the current [Unterbrechungen des Stromes] or of the vibrations of the membrane, and consequently to the rate or pitch of the tone which entered the conical cavity. That means according to the author that 'The rod [Stab] reproduces the tone which was impressed upon the interrupting apparatus [Unterbrechungsapparat].' 'The strength of this tone is also proportionate to the original tone, for,' as the author, though not very accurately, explains, 'the stronger this is, the greater the motion of the little hammer, the greater finally the time during which the circuit remains open, and consequently the greater, up to a certain limit, the motion of the atoms in the reproducing rod, which motions affect us as greater vibrations, as the original wave itself would have done.' By means of this telephone the author made audible to the members of a large meeting of the Physical Society in Frankfort-a-M. melodies sung not very loud into the apparatus, in a house situated about three hundred feet distant, with closed doors. 'Other trials showed that the resounding rod is capable of reproducing full chords [Dreiklänge] of a piano on which the telephone rests, and that, in short, it reproduces just as well the tones of other instruments, such as the harmonica, clarinet, horn, organ pipe, &c., provided the tones are within a certain range, from F to f^2 or thereabout.

"'As a matter of course, sufficient care was taken to ascertain whether direct transmission of the sounds had not a share in the result. This was ascertained very simply by establishing for a given time a good shunt circuit directly before the coil, in consequence of which, of course, the activity of the latter ceased for that time.

"'It was not possible thus far to reproduce spoken tones [Tonsprache des Menschen] with a distinctness satisfactory to all; the consonants are for the most part distinctly reproduced, the vowels not in the same degree.' The author attempts to explain this imperfect reproduction of the vowels by saying that the apparatus reproduces the vibrations to a certain extent indeed with proportionate, but also reduced strength, and the ear can no longer satisfactorily discern the relation of the proportionately great vibrations which determine the pitch [Tonhöhe] to the small vibrations on which vocal quality [vocal Farbe] depends."

"ZEITSCHRIFT DES DEUTSCH-OESTERREICHISCHEN TELEGRAPHEN VEREINS, Berlin, 1862. Vol. IX., p. 125.

["Journal of the German-Austrian Telegraph Association, Vol. IX., p. 125, 1862.]

"*Concerning the reproduction of sounds by means of galvanic electricity: by V. Legat, Royal Prussian Telegraph Inspector at Cassel, accompanied by copperplates VIII. and IX.*

"It might not be uninteresting to make known, in wider circles, the following ideas lately communicated by Mr. Philip Reis to the Society of Physics, and to the meetings of the Free German Institute, at Frankfort on the Main, concerning the reproduction of tones [Tönen] by means of galvanic electricity, and also what has been hitherto accomplished towards the realization of this project, in order that the accumulated experiments may serve as a foundation to build upon, and that the capacity of the electric current, which by human ingenuity has already been made serviceable for correspondence, may be developed in this direction also.

"In this essay we shall not deal with the electric current as to its capacity for operating telegraphic apparatus of whatever construction for the reproduction of *visible* signs, but of the application of this current to the production of *audible* signals, of *tones* [Tönen].

"The air waves, which by acting upon the ear excite in us the sensation of sound by primarily setting the tympanum of the ear into the vibratory motion, are, as is well known, transmitted to the interior parts of the ear and to the auditory nerves there located by means of a lever apparatus of wonderful delicacy, the auditory bones (hammer, anvil, stirrup); and the attempt to reproduce tones therefore depends upon this, to actuate an artificial imitation of this lever apparatus by means of the vibrations of a membrane corresponding to the membrane of the ear drum, and thereby to open and close (zum Oeffnen ŭ Schliessen) a galvanic circuit, connected with a distant station by a metallic conductor.

"Before describing the apparatus to be used, it would be proper to inquire how our ear apprehends the vibrations of any one particular tone, and the combined vibrations of all simultaneous tones acting upon it, because thereby we may determine the operations which are to be performed by the transmitting and receiving apparatus in the solution of the problem.

"Examining first the processes which take place in order that the human ear may apprehend any single tone, we find that each tone is the result of alternate rarefactions and condensations repeated within a fixed time. If this operation occurs in the same medium in which the ear is placed, then at each condensation the membrane is forced toward the cavity of the drum and toward the opposite side at each rarefaction.

"These vibrations cause corresponding movements in the auditory bones, and are thereby transmitted to the auditory nerves.

"The greater the degree of condensation of the sound-conducting medium is at a given time, the greater will be the amplitude of vibration of the membrane and auditory bones, and the greater the consequent result; and in the opposite case, so much the weaker. Hence it is evidently the function of the auditory apparatus to impart with faithfulness to the auditory nerves every condensation and rarefaction which occurs in the surrounding medium. On the other hand, the function of transmitting to our consciousness both the number and amplitude of the resulting vibrations occurring within a given time devolves upon the auditory nerves.

"It is here, in our consciousness, that a certain complex phenomenon receives a specific name; it is here, in our consciousness, that the transmitted vibrations become tones [Töne].

"Accordingly, that which is apprehended by the auditory nerves is the effect of a force, reaching to our consciousness, and which can be made more easy of comprehension as to duration and strength, by graphical delineation.

"For example, let the length of the line *a-b* represent a definite period of time, the curves above this line the condensations (+), and the curves below this line the rarefactions

a  b

(—); then every ordinate erected at the end of any abscissa will indicate at the moment of time indicated by this abscissa the degree of condensation in consequence of which the membrane of the drum vibrates.

"The ear is not capable of perceiving more than can be represented in this way, or more than can be represented by similar curves; this is, however, sufficient to convey to our consciousness any single tone [Ton] or any desired combinations of tones. For if several tones are generated simultaneously, then the sound-conducting medium is influenced by several forces, acting at the same time, and subject to mechanical laws.

"If all the forces act in the same direction, then the amount of motion is in proportion to the sum of all the forces; if on the other hand the forces act in opposing directions, then the amount of motion is in proportion to the difference between the opposing forces.

"From these principles it follows that the curves representing the condensations of a number of simultaneously generated tones may be combined in a single curve of condensation, which will indicate with precision what our ear apprehends through the reception of these simultaneously acting tones.

"The objection generally made to this proposition, that a musician, or any person, is able to distinguish the simple tones out of which these composite curves are formed or arise, should not be allowed to militate against it; as it is also possible for some who are familiar with the study of colors to distinguish, in green, for example, the mixture of yellow and blue, in their varied shades; and the one phenomenon as well as the other is referable to the fact that in both cases the observer is familiar with the factors of that product which has been conveyed to his consciousness.

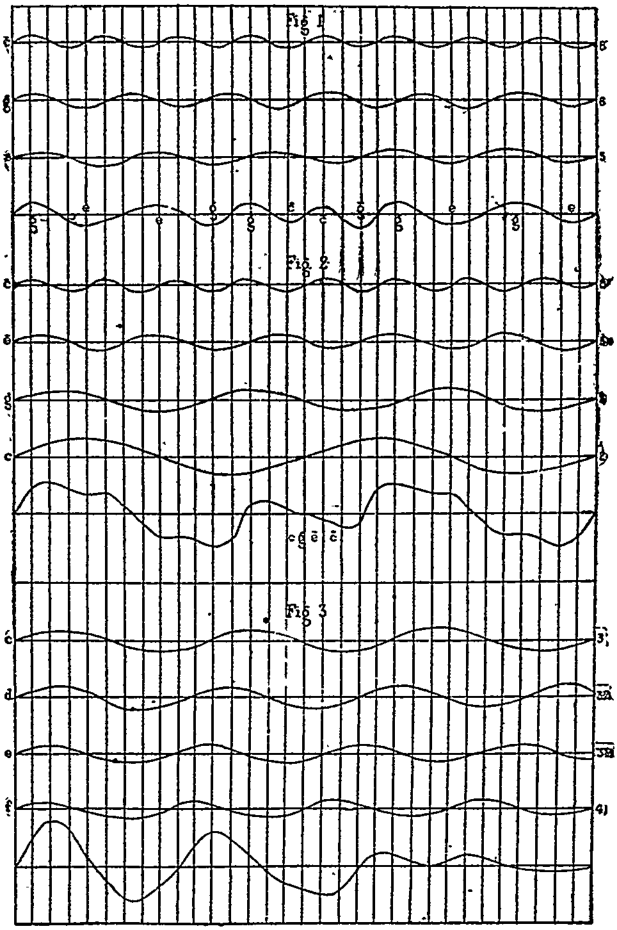
"By the explanations heretofore given, it is easy to construct the curves representing the condensations of various tones, chords, etc., and a few examples are given by way of illustration:

"Fig. 1, Plate VIII., represents a composite curve formed of three tones, in which all the proportions of the components recur successively.

"Fig. 2 represents a similar curve formed of more than three tones; in this case, however, it is no longer possible to represent the proportions so clearly in the drawing, yet an experienced musician will be able to discern them even here, although in practice it might be difficult even for him to recognize the separate tones in such a chord.

Jahrg. IX. Bl. VIII.

Legat Reproduction von Tönen auf elektro galvanischem Wege.



Ernst & Korn Berlin

"The advantage of representing the operation of tones upon the human ear after this manner is that it gives the clearest view possible of the process; the representation here given also shows why a discord [Dissonanz], Fig. 3, must affect the ear disagreeably.

"This apparent digression from the subject under consideration was necessary to demonstrate that as soon as we are able, in any place and in any manner, to reproduce vibrations of such curves and intensities as are equivalent to the curves and intensities of the vibrations of any particular tone, or of any particular combination of tones, we shall have the same impressions as were produced upon us by this original tone, or these original combinations of tones.

"The apparatus described hereafter offers the possibility of producing these vibrations in every manner desired; and by the use of galvanic electricity it is possible to evoke, at any distance, vibrations like [gleiche] those which have been so produced, and in this way to reproduce at any place the tones which have been generated at another place.

"In Plate IX., Fig. 4 A is the tone transmitter [Tonengeber], and B the tone receiver [Tonenpfanger], and these two instruments are set up at different stations. I must observe at the outset that the arrangement of the instruments for sending backwards and forwards is omitted for greater clearness; and likewise, as the whole thing is not presented as a completed fact, but only to call to the notice of a wider circle what has been already ascertained, the possibility of the working of the apparatus at a distance greater than the limited direct working allows at present is left out of consideration, since these points are easily accomplished by mechanical arrangements, and since the most important facts of the phenomena treated are not influenced thereby.

"Let us now turn to the tone transmitter, Fig. 4 A. This on the one hand is connected by the metallic conductor with the tone receiver, Fig. 4 B, at a neighboring station; on the other hand it is connected by means of the electric battery C with the earth (or with the metallic return conductor). The tone transmitter, Fig. 4 A, consists of a conical tube *a b*, about

15 centimetres in length, having a front opening of about 10 centimetres, and a rear opening of about 4 centimetres.

"(It appears by practical experiments that neither the material of this tube nor any increase in its length influenced the accuracy of the action of the apparatus. An enlargement of the diameter of the tube impairs the working of the apparatus, and it is desirable that the inner surface of the tube be as smooth as possible.) The smaller or rear end of the tube is closed by a collodion membrane *o*, and upon the centre of the circular surface of this membrane rests one end *c* of the lever *c d*, the supporting point *e* of which is sustained by a bracket, and is kept in electrical connection with the metallic conductor. The proper lengths of the respective arms *c e* and *e d* of this lever are regulated by the laws of the lever. It is advisable to make the arm *c e* longer than the arm *e d*, in order that the least motion at *c* may operate with greatest effect at *d*. It is also desirable that the lever itself be made as light as possible, that it may follow the movements of the membrane. Any inaccuracy in the operation of the lever *c d* in this respect will produce false tones at the receiving station. When in a state of rest the contact at *d g* is closed, and a delicate spring *n* maintains the lever in this position.

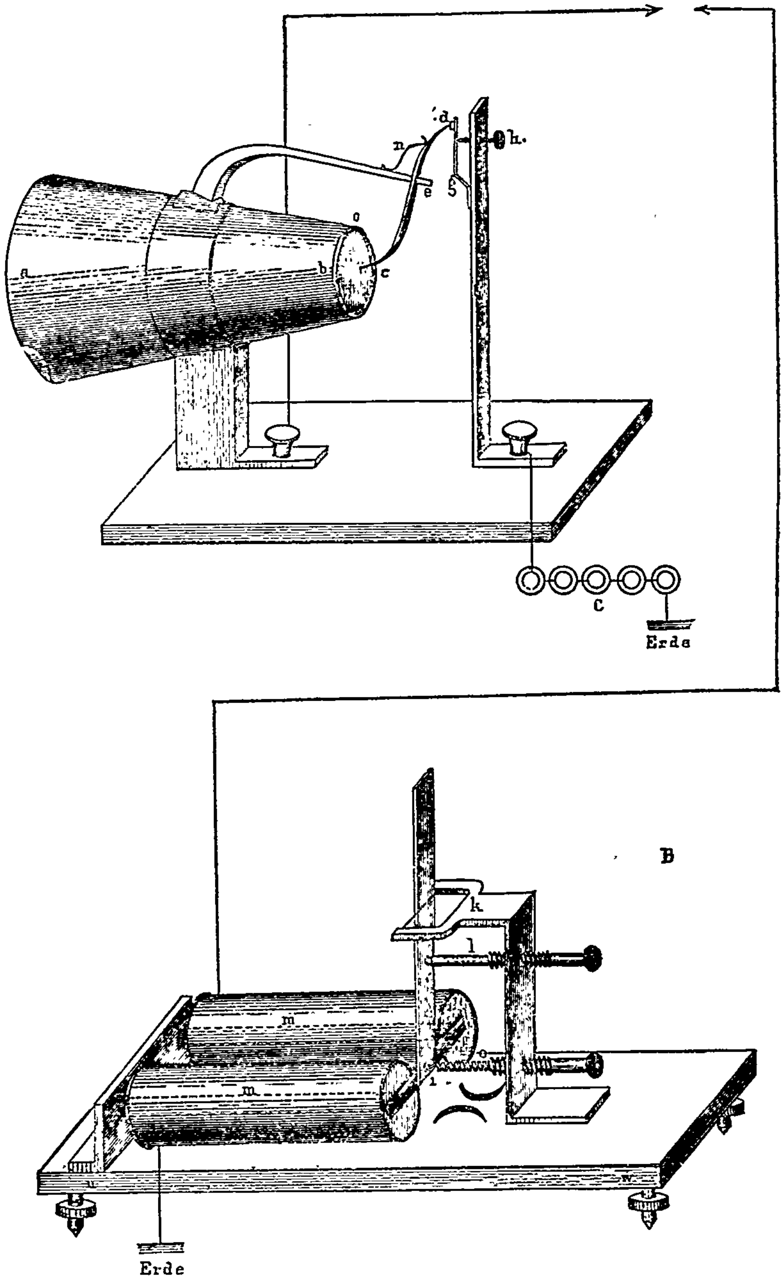
"The second part of the apparatus, the standard *f*, consists of a metallic support, connected with one pole of the battery C, the other pole of which is connected to the earth, or to a metallic return wire leading to the other station.

"Upon the standard *f* is arranged a spring *g*, with a contact point corresponding to the contact point *d* of the lever *c d*; the position of *g* is regulated by the screw *h*.

"In order not to impair the operation of the apparatus by the action of the air waves against the rear side of the membrane, it is desirable to place upon tube *a b*, a disk of about fifty centimetres in diameter at right angles to the longitudinal axis of the tube *a b*; this disk may be attached to the tube by a fastening surrounding its outer circumference.

"The tone receiver, Fig. 4 B, consists of an electro-magnet *m m*, which rests upon a sounding board *u w*; its coil is connected respectively with the metallic conductor and the earth or the metallic return conductor.

Statement of the Case.



"Facing the electro-magnet *mm* is an armature, to which is attached a very long but light and broad lever *i*.

"The lever *i* with the armature is suspended from the standard *k* in the manner of a pendulum, its motion being regulated by means of the screw *l* and the spring *q*.

"In order to increase the effect of the apparatus, the tone receiver may be placed at one of the focal points of an elliptically arched chamber of suitable size, and the listener may place his ear at the other focus of this chamber.

"The operation of the apparatus described is as follows:

"When at rest the galvanic circuit [Kette] is closed. When the air, which is in the tube *a b* of the apparatus, Fig. 4 A, is alternately condensed and rarefied, by speaking into it (or by singing or introducing the tones of an instrument), a movement of the membrane closing the smaller opening of the tube is produced, corresponding to such condensation or rarefaction. The lever *c d* follows the movements of the membrane, and opens and closes [öffnet und schliesst] the galvanic circuit [Kette] at *d g*, so that at each condensation of the air in the tube the circuit is opened, and at each rarefaction the circuit is closed [ein Oeffnen und ein Schliessen erfolgt].

"In consequence of this operation, the electro-magnet of the apparatus, Fig. 4 B, in accordance with the condensations and rarefactions of the column of air in the tube *a b*, Fig. 4 B, is correspondingly demagnetized and magnetized [demagnetisirt und magnetisirt], and the armature of the magnet is set into vibrations like those of the membrane in the transmitting apparatus. But the beam [Balken] *i* attached to the armature communicates these corresponding vibrations of the armature to the air surrounding the apparatus Fig. 4 B, which finally transmits the vibrations so produced to the ear of the listener.

"We have not here to consider the question of the transmission [Fortpflanzung] of tones by means of the galvanic current, but only of the conveyance [Uebertragung] of generated sounds to another place, and in this way, that at the latter place a similar cause is produced, and a similar effect obtained. It must not be ignored, however, that while the apparatus described reproduces the exact number of the original vibrations, but not of the same strength [die gleiche Stärke der reproducirten Schwingüngen noch nicht erreicht nurde]; and that the achievement of this result is reserved for an improvement of the apparatus.

"In consequence of the imperfection of the apparatus at this time, the minor differences of the original vibrations are distinguishable with more difficulty, — that is, the vowel sounds appear more or less indistinct, — inasmuch as each tone depends not merely upon the number of the vibrations of the medium, but also upon its condensation and rarefaction.

"This also explains why chords and melodies were transmitted with marvellous accuracy in the practical experiments hitherto made, while single words in reading, speaking, &c., were less distinctly recognizable, although even in these the inflections of the voice, as in interrogation, exclamation, surprise, calling, &c., were clearly reproduced.

"There is no doubt that the subject we have been considering, before it becomes practically valuable for use, will require considerable improvement; it will especially be necessary to perfect the mechanism of the apparatus to be employed; but I am convinced, by repeated practical experiments, that it is of the greatest theoretic interest to pursue these investigations, and also that a development of practical value will not elude our intelligent century."

DEUTSCHE INDUSTRIE ZEITUNG, CHEMNITZ, May 29, 1863.

Extract.

"A friendly communication was sent us some time ago by Mr. J. F. Quilling, of Frankfort-a-M., according to which the capacity of the apparatus to transmit tones to a considerable distance clearly and with their characteristic timbre (Klangfarbe), is fully established. Mr. Q. writes us that by means of the telegraphic conductor with which the apparatus of Mr. Ph. Reis was connected, two remote parts of the city were united, and although it was not possible with the present construction of the apparatus to transmit spoken words (gesprochenen worte), they succeeded so well with the tones that were sung that not only were the melodies of songs reproduced distinctly and perfectly at a tolerably remote station, but known voices could be recognized.

"All present capable of judging, Mr. Q. adds, who availed themselves of the opportunity of witnessing the experiment, agreed that the possibility is before us of making one's self understood verbally at any distance in the way shown by Mr. Reis."

JOURNAL OF THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS for March, 1883, No. 46.

REIS'S TELEPHONE.

The following is a copy of an autograph description of Reis's telephone which has been presented to the library by Mr. Wm. Ladd, Member:

"INSTITUT GARNIER,
"FRIEDRICHSDORF.

"*Dear Sir:*

"I am very sorry not to have been in Frankfort when you were there at Mr. Albert's, by whom I have been informed that you have purchased one of my newly invented instruments (telephons), though I will do all in my power to give you the most ample explanations on the subject. I am sure that personal communication would have been preferable, specially as I was told that you will show the apparatus at your next scientific meeting, and thus introduce the apparatus in your country.

"Tunes and sounds of any kind are only brought to our conception by the condensations and rarefactions of air or any other medium in which we may find ourselves. By every condensation the tympanum of our ear is pressed inwards, by every rarefaction it is pressed outward, and thus the tympanum performs oscillations like a pendulum. The smaller or greater number of the oscillations made in a second gives us, by help of the small bones in our ear and the auditory nerve, the idea of a higher or lower tune.

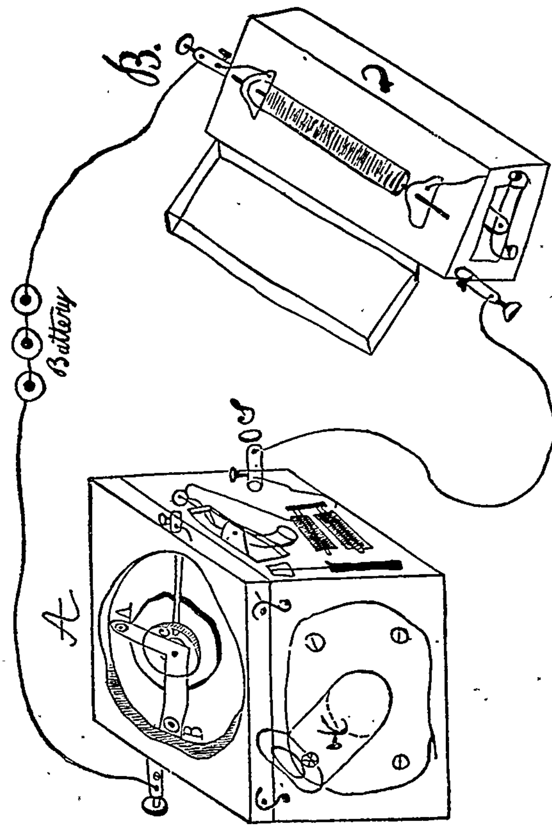
"It was no hard labor, either to imagine that any other membrane beside that of our ear could be brought to make similar oscillations, if spanned in a proper manner and if taken in good proportions, or to make use of these oscillations for the interruption of a galvanic current. However, these were the principles which guided me in my invention; they were sufficient to induce me to try the reproduction of tunes at any distance. It would be long to relate all the fruitless attempts I made until I found out the proportions of the instrument and the necessary tension of the membrane. The apparatus you have bought is now what may be found most simple, and works without failing when arranged carefully in the following manner: [See page 57 for plate.]

"The apparatus consists of two separated parts, one for the singing station, A, and the other for the hearing station, B.

"The apparatus A is a square box of wood, the cover of which shows the membrane, *c*, on the outside, under glass. In the middle of the latter is fixed a small platina plate to which a flattened copper wire is soldered, on purpose to conduct the galvanic current. Within the circle you will further remark two screws; one of them is terminated by a little pit in which you put a little drop of quicksilver, the other is pointed. The angle, which you will find lying on the membrane, is to be placed according to the letters, with the little hole *a* on the point *a*, the little platina foot *b* into the quicksilver screw; the other platina foot will then come on the platina plate in the middle of the membrane.

"The galvanic current coming from the battery (which I compose generally of three or four good elements) is introduced at the conducting screw near *b*, wherefrom it proceeds to the quicksilver, the movable angle, the platina plate and the complementary telegraph to the conducting screw *s*. From here it goes through the conductor to the other station B, and from there returns to the battery.

"The apparatus B, a sonorous box on the cover of which is fixed the wire spiral with the steel axis, which will be magnetic when the current goes through the spiral. A second little box is fixed on the first one, and laid down on the steel



Reis's Telephonic Apparatus.—Facsimile of Drawing sent by Reis to Mr. Ladd.

axis to increase the intensity of the reproduced sounds. On the small side of the lower box you will find the corresponding part of the complementary telegraph.

"If a person sing at the station A, in the tube *x*, the vibrations of air will pass into the box and move the membrane above, thereby the platina foot *c* of the movable angle will be lifted up, and thus will open the stream at every condensation of air in the box. The stream will be re-established at every rarefaction. In this manner the steel axis at station B will be magnetic once for every full vibration, and, as magnetism never enters nor leaves a metal without disturbing the equilibrium of the atoms, the steel axis at station B must repeat the vibrations at station A, and then reproduce the sounds which caused them. *Any* sound will be reproduced if strong enough to set the membrane in motion.

"The little telegraph which you find on the side of the apparatus is very useful and agreeable for to give signals between both of the correspondents. At every opening of the stream, and next following shutting, the station A will hear a little clap, produced by the attraction of the steel spring. Another little clap will be heard at station B in the wire spiral. By multiplying the claps and producing them in different measures, you will be able as well as I am to get understood by your correspondent.

"I am to end, Sir, and I hope that what I said will be sufficient to have a first try; afterwards you will get on quite alone. I am, Sir,

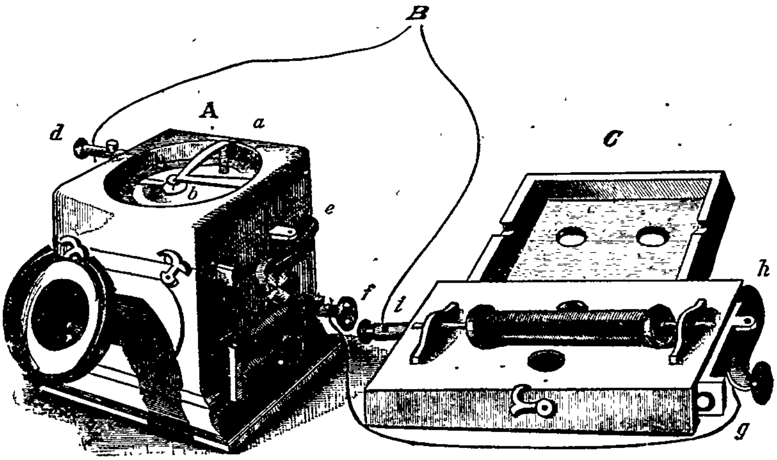
"Your most obedient servant,

"PH. REIS.

"FRIEDRICHSDORF, 13–7–63.

"To Mr. William Ladd."

CIRCULAR OF REIS.



"*Sir:*

"Having succeeded two years ago in demonstrating the possibility of reproducing tones with the aid of the galvanic current and in manufacturing an apparatus for that purpose, the subject has been so highly appreciated by the most renowned men of science, and I have received so many encouragements, that I have striven since that time to improve my originally very imperfect apparatus, in order to give to others also the facility of experimenting.

"I am now able to offer an apparatus which satisfies my expectations, and with which every physicist will succeed in repeating these interesting experiments regarding the reproduction of tone (Ton = reproduction) at distant stations.

"I believe that it is the wish of many that these instruments should come into the possession of laboratories; as, however, their manufacture demands a complete knowledge of the leading principles and a great experience in this matter, I have resolved to make the most important parts myself, and to intrust to the mechanician only the secondary parts and the external outfit. Mr. J. Wilh. Albert, mechanician at Frankfort on the Main, is commissioned to sell them. I have enabled him to offer them at the prices of 21 and 14 florins (12 and 8 Prussian thalers) in two qualities, which differ only in the external outfit. The instruments can also be had directly from me at the same price by cash payment. Every apparatus is examined by me before being shipped, and has attached my name, the serial number and the date of construction.

"FRIEDRICHSDORF b. HOMBURG, v. d. HÖHE,

"August, 1863.

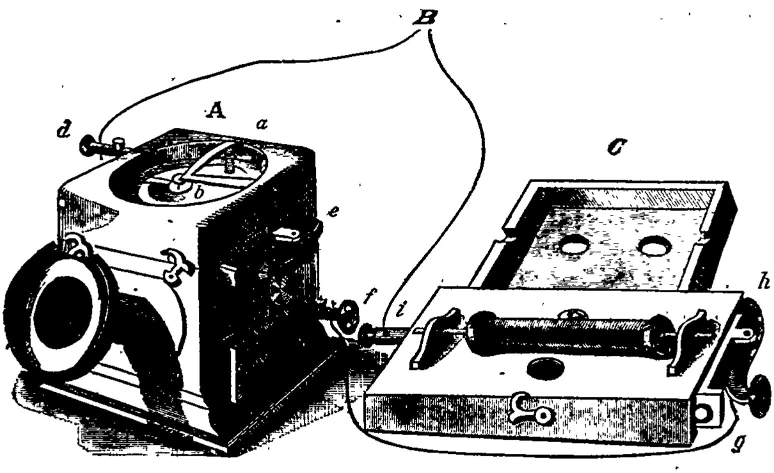
"PHIL. REIS,

"*Teacher at L. F. Garnier's Boys' Institute.*"

(In manuscript on the foregoing is the following:)

"Descriptions of the above are to be found in Müller-Pouillet's Lehrbuch der Physik, Braunschweig, Vieweg & Son; Pisko, die Neueren Apparate der Akustik, Wein; Gerold's Son, 1865."

REIS'S DESCRIPTIVE CIRCULAR.



TELEPHONE.

"The apparatus consists of two parts, as may be seen in the woodcuts above, the telephone proper A, and the reproducing apparatus C. These two parts are to be placed at such a distance from each other that singing or the sound of a musical instrument can be heard in no other manner except through the apparatus from one station to another.

"Both parts are connected with each other and with the battery B, the same as in an ordinary telegraph. The battery must be sufficient to produce at station A the attraction of the armature of the electro-magnet placed at one side (three or four six-inch Bunsen cells are sufficient for several hundred feet of distance).

"The galvanic current then goes from B to the binding post *d*, from there through the copper strip, to the platina disk in the centre of the membrane, then through the foot *c* of the angle towards the binding post B, *in the small hollow of which a drop of quicksilver is inserted.* From here the current goes through the small telegraph apparatus *e f*, then to the key of the station C and through the coil surrounding *i* back to B.

"If now sufficiently strong tones are produced before the mouthpieces, their vibrations will put in motion the membrane and the angular little hammer [winkelförmige Hämmerchen] which lies on it; for every full vibration the circuit is once opened and again closed [einmal geöfnet und wieder geschlossen], and thereby are produced at station C in the core of the coil, just the same number of vibrations [ebensoviele schwingungen hervor-gebracht] which are there perceived as tones or as combinations of tones [accords]. By placing the cover tightly over the axis of the coil the tones at C are greatly strengthened. Besides the human voice [menschlichen stimme] there can be reproduced (according to my experience) just as well the tones [töne] of good organ pipes from F to C and those of the piano; to that end the box *a* must be placed on the sounding board of the piano; out of thirteen chords a skilled experimenter could make out ten clearly. The telegraph apparatus placed on one side is evidently unnecessary for the reproduction of tones, but it is a very useful addition for convenient experimenting. With its aid it is possible to easily and surely make one's self intelligible [sich verständigen] with the person at the other station.

"This may be done somewhat in the following simple manner: After the apparatus has been put up completely, one satisfies one's self of the continuity of the connection and the strength of the battery by opening and closing the circuit whereby at A is heard a striking of the armature and at C a very perceptible ticking of the coil.

"By a quick succession of makes and breaks at A, C is asked whether he is ready for experimenting, whereupon C answers in the same manner.

"By agreement between the two stations simple signals can be given by opening and closing the circuit 1, 2, 3 or 4 times, *e.g.* one stroke — sing; two strokes — speak, etc.

"I telegraph words by numbering the letters of the alphabet and communicating their numbers.

1 stroke A,
2 strokes B,
3 strokes C,
4 strokes D,
5 strokes E, etc.

"Z would consequently be indicated by 25 strokes.

"But these numbers of strokes would take too much time and not be sure in counting. Therefore I put a dactyl for every 5 strokes, hence

— U U for E,
— U U and 1 stroke for F, etc.

"Z: – UU – UU – UU – UU – UU, which is quicker, and more easily executed and better understood.

"Still better is it to indicate the letters by numbers which are in inverse proportion to the frequency of their occurrence.

"9 August, 1863, Friedrichsdorf, near Homburg, v. d. Höhe.

"PHIL. REIS,

"*Teacher of A. L. Garnier's Boys' Institute.*"

"GARTENLAUBE REIS IMPROVED APPARATUS.

"(*The 'Gartenlaube,' No.* 51, *December*, 1863.)

"THE MUSICAL TELEGRAPH.

"The surprising results in telegraphing have often excited the question whether it may not be possible to communicate the language of sound itself to a distance. The trials made in this direction had, till now, produced no satisfactory results, because the vibrations of sound-conducting bodies soon diminish so much in force that they are no more perceptible for our senses.

"People, perhaps, had already thought of a reproduction of sound at certain distances with the aid of the electric current, but those who have been the best fitted to attack the question, by their knowledge and resources, were the ones who doubted the most of a practical solution of that question. Those who are but superficially acquainted with natural science do not see the many difficulties this problem offers, if they are at all acquainted with it. Thus, about eleven years ago, a young man, Mr. Philipp Reis, at present teacher of natural science at the Garnier Institute for Boys, at Friedrichsdorf, near Homburg, had the hardihood to work at the solution of this problem. But soon he was obliged to desist from it because his very first effort seemed to convince him of the impossibility of a solution. Later, however, after further studies and many experiments, he saw that his first effort was but a rudimentary one, and by no means convincing. However, he did not recommence to attack the question seriously for some time, not feeling himself strong enough to vanquish the obstacles on his road, although he never banished his early idea entirely from his thoughts.

"How can a single instrument reproduce simultaneously 'the combined effects of all the organs active in human speech?' This seemed to him the chief question. Later he put this question more methodically: 'How does our ear perceive the composite vibrations of all the organs of speech acting at the same time?' or, expressed more generally, 'How do we perceive the vibrations of several bodies sounding simultaneously?' If we throw a stone into quiet water there are produced on the surface uniform waves which progress symmetrically outward; the further they go the weaker they become, till they finally disappear.

"It is quite similar with that which we call sound and tone. A body made to vibrate through any impulse affects the surrounding air, and causes waves in it, which follow each other at the same rate as the vibrations of the body. As those rings on the water consist in swellings and depressions, so also the vibrations of the air consist of alternate condensations and rarefactions. If they reach our ear every condensation presses the tympanum towards the interior of the cavity, and puts in motion the adjacent group of small bones which communicates the motion to the liquid of the cochlea, in which the auditory nerves terminate. The latter are excited and produce the *sensation of sound.*

"Now, if the waves of vibration follow regularly and with a certain swiftness (sixteen in the second at least), we shall have the sensation of a musical *tone.* The latter is the *higher* the quicker the condensations follow each other and the louder the *stronger* or higher the waves rise, as it were.

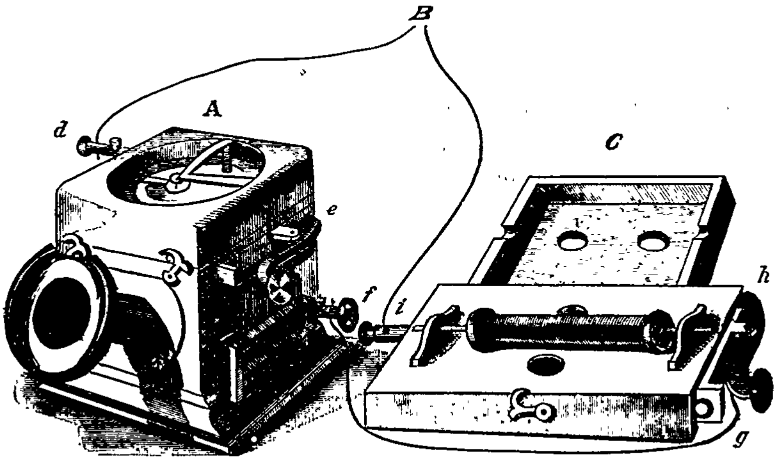
"Our ear cannot perceive anything except condensations and rarefactions, wave crests and wave hollows. And, nevertheless, we receive the most varied auditory impressions, we distinguish the sound of the voices, we hear at the same time in quite different directions and can distinguish the different sources; nay, in a complete large orchestra, each of the numerous instruments is specially noticed by its peculiar sound, so that we decompose at every moment the total impression into its several parts, according to the height and depth, strength and weakness, or according to the timbre (or quality) [Klangfarbe].

"Referring to our simile, this is about the same as if we throw two or more stones at different places into a calm pond. The wave lines cross each other, strengthen each other at some points, weaken each other at others, and the surface has a ruffled, hillocked aspect. But, nevertheless, our eye can detect the different systems of rings and can trace them back to their several causes. If we succeed in transmitting with the galvanic current the oscillations of a sounding body to a distance, so that there another body is put to equally rapid and, in respect to each other, equally strong oscillations, the problem of 'telephoning' is solved.

"For then exactly the same phenomena of waves are called forth on the distant points as the ear receives at the place of origin; therefore they also must make the same impression. The ear will distinguish at the distant points not only the single tones, according to their varying height and depth, but also to the proportionate force of the vibrations, and not only single melodies, but the performance of a whole orchestra; yes, even speech must be heard at the same time in places very distant from each other. Mr. Reis was the first one to prove by experiments the possibility of solving this problem. He has succeeded in constructing an apparatus to which he gives the name *Telephone*, and which enables one to reproduce tones, with the aid of electricity, at any given distance. Already, in October, 1861, he made rather successful experiments with a very simple, rudely made apparatus, before a numerous audience at Frankfort. On July 4th of the present year he presented an essentially improved apparatus at an assembly of the 'Physical Union,' which transmitted by closed doors and windows a melody sung moderately loud, to a distance of about three hundred feet, so that it could *be heard plainly.*

"In order to give an opportunity to larger circles, especially to scientific men, to convince themselves of the efficiency of this essentially improved apparatus, Professor Böttger of Frankfort-a-M. made lately (at an assembly of German physicists and doctors in Stettin, in the sectional meetings for natural sciences) several experiments which certainly would have been crowned with still more success if the hall in which the session was held had been located in a less noisy part of the city and filled with a less numerous audience.

"Although, for the present, we are not so far along as to be able to converse with a friend at a distance of several hundred miles, so much at least is certain, that with the aid of the telephone songs of all kinds, melodies, especially in the middle registers, can be reproduced most clearly at unlimited distances. These wonderful results are obtained with the following simple apparatus, which we show here in one-fourth of its size:



"A small box A (the telephone proper), a kind of hollow cube, has a mouthpiece S on the front side, and a somewhat smaller opening on the upper side of the box. The latter is closed with a fine membrane (skin from the intestines of a hog) tightly stretched. A narrow strip of platina *m*, connected with the screw post *d*, touches directly the membrane on its centre; a slender platina point *k*, attached to the angle *a b*, touches the strip of platina which rests on the membrane. If one sings into the mouthpiece S (by filling the same entirely with the mouth), the thin membrane vibrates, and the attached platina strip receives likewise a vibrating motion so that it is alternately pressed against and leaves the platina point *k*.

"From the binding post *d* which communicates with the platina strip resting on the membrane a conducting wire is connected with one of the poles of a galvanic battery B (about three to four six-inch Bunsen elements), and then the electricity is led through a wire attached to the second pole of the battery to the distant station C; there at *i* it passes through a coil *l l* formed of copper wire covered with silk thread, then back again to screw *f*, and there to the platina point *k*. At every vibration of the membrane an interruption of the electric current [unterbrechung des electrischen Stromes] takes place by the platina point parting from the platina strip.

"Within the wire coil at station C is a thin iron wire (a strong knitting-needle) which is about ten inches long, and which with its two ends projecting out of the coil for about two inches, each rests on two bridges of a sounding box. This is the *reproducing* apparatus.

"At every interruption of the current [Unterbrechung des Stromes] in the coil the iron rod is made to vibrate. If the motions follow with a certain rapidity, they produce a tone which is rendered audible by the sounding box. As the rate of the interruptions depends on the pitch of the tone that has been sung into the mouthpiece, the same tone is sounded with the same pitch from the sounding box. The length of the circuit has no influence upon this. It is true the electric current loses force the farther it goes, but there is no reason why relays should not be employed, the same as in telegraphing, and with their aid any number of reproducing apparatuses be set into simultaneous vibrations. Mr. Reis has endeavored to give to his improved apparatus a form which should also be pleasing to the eye, so that it might fill worthily its place in any physical laboratory. He has applied, moreover, to the side of the telephone, as well as to the reproducing apparatus, a small telegraph arrangement, which is a very good addition for convenient experimenting. (It is indicated in the drawing by the letters *e f h g*.) By alternately opening and closing the circuit with the key *e* or *h* the most varied signals may be given after mutual agreement; for instance, if one is ready for singing; if everything has been understood; whether one should stop singing or commence anew, &c.

"Mr. Reis himself manufactures the principal parts of the telephone, for which no small amount of physical knowledge and experience is necessary. The mechanician, Wilhelm Albert, at Frankfort, is charged with manufacturing the less important parts and the external outfit, as well as with the sale of the instrument at a low price."

ANNALEN DER CHYMIE UND PHARMACIE, Leipzig, 1864—1865, III., Supplementband, p. 134.

[Foot-note of an article by H. Buff, entitled "On the Tones generated in Iron Rods by the Electric Current."]

ARTICLE ITSELF COMMENCES ON P. 129.

"This tone, appearing only as a secondary phenomenon, has been utilized with success by Dr. Reis of Friedrichsdorf in the instrument which he invented and named 'the telephone,' for transmitting tones telegraphically by means of the periodic impact of the sound-waves of the same against an elastic skin.

"The arrangement is such that the skin, which vibrates in equal periods with a source of sound acting upon it, serves as a means for interrupting the electric current, which, at a distance, circulates around an iron wire, the ends of which are clamped upon a resonating plate.

"Unfortunately, by this otherwise ingenious arrangement, the pitch only of musical tones within several octaves, but not the quality [Wohllaut] of the same, could so far be transmitted through wire circuits."

HANDBUCH DER ANGEWANDTEN ELEKTRICITÄTSLEHRE, von Karl Kuhn, 1865, pp. 101–721.

[Manual of applied Electricity.]

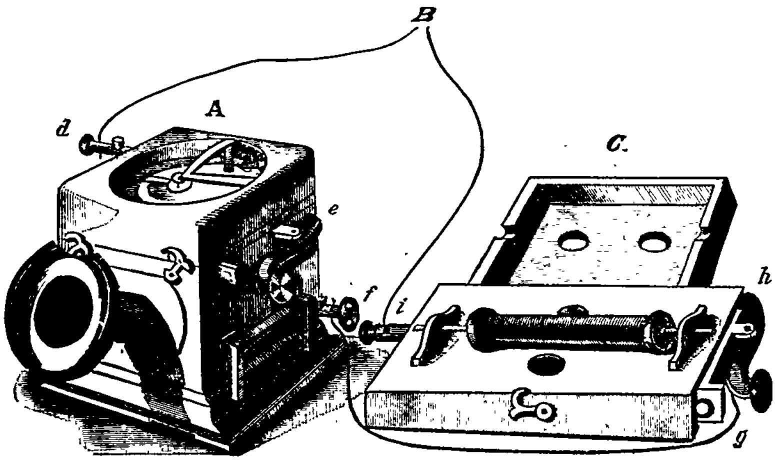
"The experiments made by Reis in Frankfurt-a-M., on the 26th October, 1861, have proved, however, that when the breaks of the current [Stromunterbrechungen] follow each other almost continuously and very quickly in a coil provided with a thin iron core, the iron wire can enter into longitudinal vibrations, and in this way be enabled to reproduce sounds of different pitch. An exact reproduction of the sounds does not take place, however, but only an imitation; for this reason it cannot be questioned here of transverse vibrations [transversal Schwingungen]. A phenomenon [Erscheinung] has otherwise been heard of, which belongs to the afore-mentioned class, in which the intensity and the timbre [Klang] of the sound accompanying it (the phenomenon) depend among other things on the strength of the current [Stromstärke] and on the number of breaks of the same, and in which, as it seems, the pitch of the tones also can vary under different circumstances. We can, however, hardly imagine by what arrangements it could be feasible to coax tones of any given height or depth out of an iron or metal tube split on one side, while it (the tube) is affected by the alternate currents of an induction apparatus the coil (Rolle) of which surrounds it. Yet the possibility cannot be controverted that the principle of Neef's circuit-breaker [Unterbrecher] might contribute to the solution of the problem in question. It has been employed for local purposes either with or without modifications in the study and investigation of acoustic phenomena. Thus Petrina has used the principle of Neef's circuit-breaker [Unterbrecher] for his electric harmonica in this way, that instead of the Neef hammer a little rod was chosen, the transverse vibrations of which rendered the tone. 'There are four little rods of various lengths side by side, the motions of which are checked by means of levers managed by finger keys.' That principle was used previously by Dove, in a modified manner, to set strained strings and elastic springs into acoustic vibrations of constant amplitude by means of an electric magnet, and, in this way, to be enabled to investigate constant tones. It appears from Legat's published communications that 'the ideas submitted by Ph. Reis of Friedrichsdorf in the Physical Society and in the meeting of the German Hochstift in Frankfurt-a-M. about the reproduction of sounds by means of electricity' referred to arrangements of a similar kind. Legat mentions in his paper all that has been done thus far towards the realization of that project, and we borrow from it that part only which throws some light on the construction of a telegraphic apparatus with which it is said to be possible to produce vibrations and make sounds in any desired manner and through which the employment of electricity is said to make it feasible to bring forth at any given distance vibrations similar to the first produced ones, and in this way to reproduce at a certain place tones originally produced at another place.

"This apparatus is composed of a transmitter and of a receiver. The transmitter (see page 53[1]) consists in a conical tube *ab* about 15 cm. long, 10 cm. at the front, 4 cm. at the back opening; the choice of the material as well as a greater length is indifferent; a greater width, on the contrary, is disadvantageous; the surface of the interior must be as smooth as possible. The narrower back opening is closed by a membrane of collodion *o*, and on the middle of the circular surface formed by this membrane rests one end *c* of lever *c d*, the fulcrum of which is held by a support and remains connected with the metallic circuit. This lever, one arm *c e* of which must be considerably longer than *e d*, should be as light as possible so as to follow easily the motions of the membrane, as an uncertain obedience [folgen] on part of lever *c d* would produce imperfect tones at the receiving station. In the state of rest, the contact *d g* is shut and a weak spring *n* holds the lever fast at rest. On the metallic support *f* which is connected with one of the poles of the battery is a spring *g*, with a contact which touches the contact of lever *c d* at *d* and the position of which is regulated by screw *h*; over tube *a b* a disk must be placed which encircles the outer circumference of the tube closely, so that the efficacy of the apparatus may not be impaired through the effect of the air-waves coming round and striking against the rear end. This disk at right angles with longitudinal axis of the tube measures about fifty(?) cm. in diameter. The receiver (page 53) consists of an electro-magnet *m m* which rests on a sounding board, and the coil of which is in connection with the metallic conductors and with the ground. Opposite the electro-magnet is an armature connected with a lever as long as possible, but light and broad, which latter, with the armature, is fastened pendulum-like on the support *k*. Its motions are regulated through screw *l* or spring *o*. 'In order to increase the efficacy of the apparatus,

[1] The cut given by Kuhn is a copy of that in the previous Legat article, page 50, *supra*.

this receiver can be placed in one focus of an ellipsoidal enclosing box of suitable size, while the ear of the hearer is placed at the other focus.' The working of the two apparatus (the mode of connection of which is visible in the wood-cuts), the transmitter being placed at one station and the receiver at the other, is as follows: By speaking, singing, or the intromission of instrumental sounds into tube *a b*, in consequence of the condensation and rarefaction of the column of air, a motion of the membrane *c* corresponding to these changes is brought about. Lever *c d* follows the motions of the membrane, and opens or closes the circuit, according as a condensation or a rarefaction of the air inside takes place. As a consequence the electro-magnet *m m* (Fig. 505) is correspondingly demagnetized or magnetized, and the armature affixed to it (as well as the armature lever) is set into similar vibrations as the membrane of the transmitter. Through lever *i* connected with the armature, similar vibrations are communicated to the surrounding air and (the increasing effect of the sounding board helping) the tones so produced finally reach the ear of the listener. In respect to the operations of this apparatus, the author remarks that the receiver does reproduce the exact number of the original vibrations, but that a reproduction of the original intensity has not yet been attained. For that reason, it is added, small differences in the vibrations are appreciated with difficulty, and in the practical experiments made thus far, it was possible to transmit with astonishing faithfulness chords, airs, etc., whilst in reading, speaking, etc., single words were more indistinctly heard. The apparatus just described is said to have been one of the constructions which Reis has used himself in his experiments. The underlying principles might give hopes of a farther improvement of the apparatus, but the telephone which, according to later reports, Reis has finally decided upon, has the disposition (represented on page 73), although the principle on which it is founded does not stand quite in harmony with the above-mentioned investigations of Wertheim, for instance.

"The telephone proper, A, consists of a hollow wooden box provided with a short sound-funnel S, and the upper side of which is open in the centre and covered over tightly with a delicate membrane. On the middle of the latter a thin platinum disk is fastened, from which on one side a platinum strip establishes circuit connection with the contact of the key at *e*, from which place the metallic connection is effected with one end of the coil of a small electro-magnet provided with a spring armature, whilst the other end is in contact with screw *f*. The reproducing apparatus C set up at the receiving station consists simply of a coil about six inches long formed by



winding six layers of copper wire; in the axis of the coil a thin iron wire ten inches long (a knitting needle), protruding out of each end of the coil about two inches, is so disposed that with its bridge-like supports it rests on a sounding board. By means of screw *i* and of the key at *h g* the coil is thrown into the circuit and the connection of both apparatuses is effected in the manner mentioned; a battery being placed at B, the course of the current is easily followed out. It can flow from B through *d c* and *c b* to *e* and *f*, and from here to the receiving station, and at *i* return to the battery, or it can start in the opposite direction according as *d* or *i* forms the starting point of the current. The circuit can be broken at will at each of the two stations by pressing the key lever, and a connection can be established thus in either direction, but the discontinuous currents which are to produce the sounding of the iron wire at C are obtained in this way: By singing or the blowing of instruments towards the sound-funnel S the membrane at A is made to vibrate; if this can be brought about, it will happen, as was demonstrated by the experiments, that the iron wire of the receiver assumes isochronal vibrations, and whenever this is the case, it reproduces the same tones which set the membrane to vibrating at the transmitting stations.

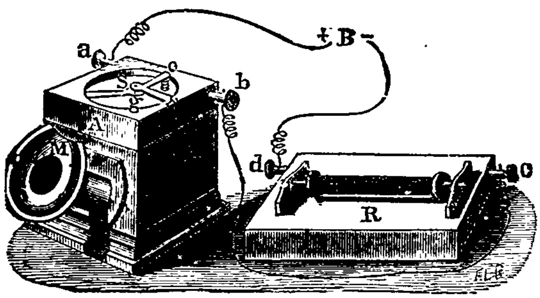
"My own experiments have demonstrated that every melody starting from *c* and embracing the entire extent of an average male voice, when sung into the telephone, can be reproduced by the receiver at C. The timbre [Klang] or quality of the sounds thus reproduced is not pleasant, — they are almost like the sounds of toy trumpets, at times also like the buzz of a fly caught in a spider's web and the like; yet the experiments of Reis are certainly interesting enough to challenge attention.

"A reproduction of the words spoken into the telephone with or without variation of pitch was audible at the receiver only in a corresponding noise [entsprechendes Geräusch], while a discriminate perception of single vocal sounds, syllable or words could not be had. According to communications made on this subject by Reis, he has succeeded in reproducing the tones of organ pipes not covered, and those of a piano; in this latter case the transmitter was placed on the sounding board of the piano."

ELECTRICITY, BY ROBERT M. FERGUSON. William and Robert Chambers, London and Edinburgh, 1867.

"The telephone. This is an instrument for telegraphing notes of the same pitch. Any noise producing a single vibration of the air, when repeated regularly a certain number of times in the second (not less than thirty-two), produces, as is well known, a musical sound. In Art. 115, we found that when a rod of iron was placed in a coil of insulated wire, and magnetized by a current being sent through the coil, it gave out a distinct tick when it was demagnetized by the stoppage of the current. A person when singing any note causes the air to vibrate so many times per second, the number varying with the pitch of the note he sings, the higher the note the greater being the number of vibrations. If we then, by any means, can get these vibrations to break a closed circuit in which the coil just mentioned is included, the note sung at one station can be reproduced, at least so far as pitch is concerned, at another. Reis's telephone (invented 1861) accomplishes this in the following way: —

"A A (Fig. 141) is a hollow wooden box with two round holes in it, one on the top, the other in front. The hole at the top is closed by a piece of bladder S, tightly stretched on a circular frame; a mouthpiece M is attached to the front opening.



"When a person sings in at the mouthpiece, the whole force of his voice is concentrated on the tight membrane, which in consequence vibrates with the voice. A thin strip of platinum is glued to the membrane, and connected with the binding screw *a*, in which a wire from the battery B is fixed. A tripod *e f g* rests on the skin. The feet *e* and *f* lie in metal cups on the circular frame over which the skin is stretched. One of these, *f*, rests in a cup containing mercury, and is connected with the binding screw *b*. The third foot *g*, consisting of a platinum point, lies on the circular end of the strip of platinum just mentioned. This point, being placed on the centre of the oscillating membrane, acts like a hopper, and hops up and down with it. It is easy to understand how, for every vibration of the membrane, the hopper will be thrown up for the instant from connection with its support, and how the close circuit is thus broken at every vibration. The receiving apparatus R consists of a coil of wire placed in circuit, enclosing an iron wire, both being fixed on a sounding box. The connections of the various parts of the circuit are easily learned from the figure. Suppose a person to sing a note at the mouthpiece which produces three hundred vibrations a second, the circuit is broken by the bladder three hundred times, and the iron wire ticking at this rate gives out a note of the same pitch. The note is weak, and in quality resembles the sound of a toy trumpet. Dr. Wright uses a receiving apparatus of the following kind: The line current is made to pass through the primary coil of a small induction coil. In the secondary circuit he places two sheets of paper, silvered on one side, back to back, so as to act as a condenser. Each current that comes from the sending apparatus produces a current in the secondary circuit which charges and discharges the condenser, each discharge being accompanied by a sound like the sharp tap of a small hammer. The musical notes are rendered by these electric discharges, and are loud enough to be heard in a large hall."

All contended that the inventions were not novel, and set up prior inventions and discoveries by other persons and other patentees. Of the many persons named in the answers by whom the inventions covered by the first patent were averred to have been invented, known or used prior to Bell's invention, in the arguments in this court the following were chiefly relied upon. (1) The Philipp Reis invention, already described; (2) The invention of Elisha Gray of Chicago; (3) The invention of Daniel Drawbaugh of Eberly's Mills in Pennsylvania; (4) the inventions patented to C. F. Varley in the United States, June 2, 1868, and in Great Britain, October 8, 1870; (5) the invention of J. W. McDonough of Chicago, for which he applied for a patent in 1876; and (6) the machine constructed in New York in 1869–70 by Dr. Van der Weyde.

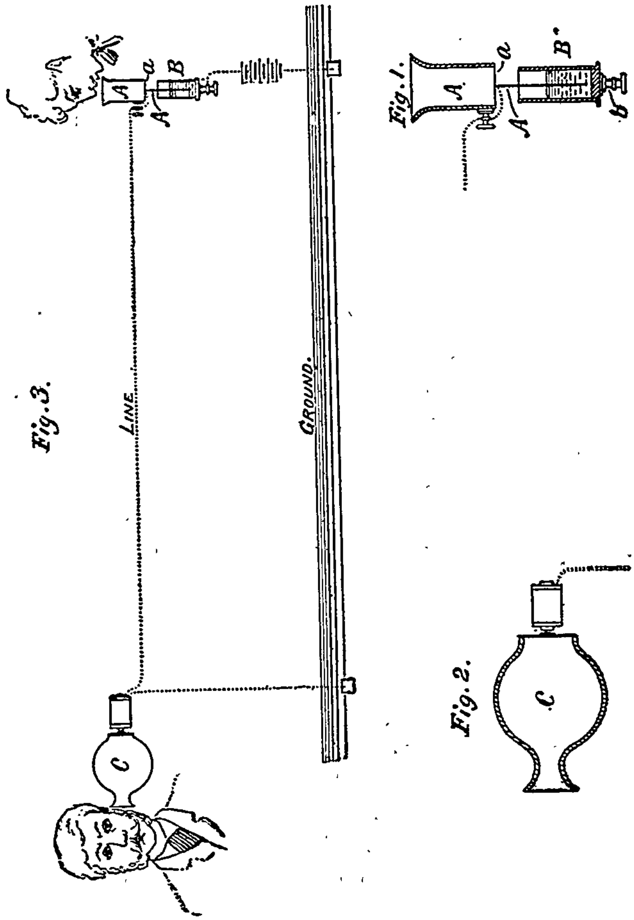
Statement of the Case.

The invention of Gray was set forth in a caveat filed in the patent office February 14, 1876. The following is a copy of that caveat, and of the office marks and proceedings therein:

ELISHA GRAY

INSTRUMENTS FOR TRANSMITTING AND RECEIVING VOCAL SOUNDS TELEGRAPHICALLY.

CAVEAT FILED FEBRUARY 14TH 1876.



"*To all whom it may concern:*

"Be it known that I, Elisha Gray, of Chicago, in the County of Cook and State of Illinois, have invented a new art of transmitting vocal sounds telegraphically, of which the following is a specification.

"It is the object of my invention to transmit the tones of the human voice through a telegraphic circuit, and reproduce them at the receiving end of the line, so that actual conversations can be carried on by persons at long distances apart.

"I have invented and patented methods of transmitting musical impressions or sounds telegraphically, and my present invention is based upon the modification of the principle of said invention, which is set forth and described in letters patent of the United States, granted to me July 27, 1875, respectively numbered 166,095 and 166,096, and also in an application for letters patent of the United States, filed by me February 23, 1875.

"To attain the objects of my invention, I devised an instrument capable of vibrating responsively to all the tones of the human voice, and by which they are rendered audible.

"In the accompanying drawings I have shown an apparatus embodying my improvements in the best way now known to me, but I contemplate various other applications, and also changes in the details of construction of the apparatus, some of which would obviously suggest themselves to a skilful electrician, or a person versed in the science of acoustics, on seeing this application.

"Figure 1 represents a vertical central section through the transmitting instrument.

"Fig. 2. A similar section through the receiver; and

"Fig. 3. A diagram representing the whole apparatus.

"My present belief is, that the most effective method of providing an apparatus capable of responding to the various tones of the human voice, is a tympanum, drum or diaphragm, stretched across one end of the chamber, carrying an apparatus for producing fluctuations in the potential of the electric current, and consequently varying in its power.

"In the drawings, the person transmitting sounds is shown as talking into a box, or chamber, A, across the outer end of which is stretched a diaphragm *a*, of some thin substance, such as parchment or gold beater's skin, capable of responding to all the vibrations of the human voice, whether simple or complex. Attached to this diaphragm is a light metal rod A′, or other suitable conductor of electricity, which extends into a vessel B made of glass or other insulating material, having its lower end closed by a plug, which may be of metal, or through which passes a conductor *b*, forming part of the circuit. This vessel is filled with some liquid possessing high resistance, such, for instance, as water, so that the vibrations of the plunger or rod A′, which does not quite touch the conductor *b*, will cause variations in resistance and consequently, in the potential of the current passing through the rod A′.

"Owing to this construction, the resistance varies constantly, in response to the vibrations of the diaphragm, which, although irregular, not only in their amplitude, but in rapidity, are nevertheless transmitted, and can, consequently, be transmitted through a single rod, which could not be done with a positive make and break of the circuit employed, or where contact points are used.

"I contemplate, however, the use of a series of diaphragms in a common vocalizing chamber, each diaphragm carrying an independent rod, and responding to a vibration of different rapidity and intensity, in which case, contact points mounted on other diaphragms may be employed.

"The vibrations thus imparted are transmitted through an electric circuit to the receiving station, in which circuit is included an electro-magnet of ordinary construction, acting upon a diaphragm to which is attached a piece of soft iron, and which diaphragm is stretched across a receiving vocalizing chamber *c*, somewhat similar to the corresponding vocalizing chamber A.

"The diaphragm at the receiving end of the line is thus thrown into vibration corresponding with those at the transmitting end, and audible sounds or words are produced.

"The obvious practical application of my improvement will be to enable persons at a distance to converse with each other through a telegraphic circuit, just as they now do in each other's presence, or through a speaking-tube.

"I claim as my invention, the art of transmitting vocal sounds or conversations telegraphically through an electric circuit.

"ELISHA GRAY.

"Witnesses:
"WM. J. PEYTON,
"WM. D. BALDWIN."

"STATE OF
"County of } ss:
"*District of Columbia,*

"ELISHA GRAY, the within named petitioner, being duly sworn, doth depose and say, that he verily believes himself to be the original and first inventor of the Art of Transmitting Vocal Sounds described in the foregoing specification; that he does not know or believe that the same was ever before known or used; and that he is a citizen of the United States.

"ELISHA GRAY.

"Subscribed and sworn to before me this 14th day of February, A.D. 1876.

"[SEAL.] JOHN T. ARMS,
Notary Public."

"*To the Commissioner of Patents:*

"The petition of Elisha Gray, of Chicago, in the County of Cook in the State of Illinois, respectfully represents, that he has made certain improvements in the Art of Transmitting Vocal Sounds telegraphically, and that he is now engaged in making experiments for the purpose of perfecting the same, preparatory to applying for letters patent therefor.

"He therefore prays that the subjoined description of his invention may be filed as a caveat in the confidential archives of the Patent Office.

"ELISHA GRAY."

Statement of the Case.

"Copy sent
Feb. 19,
S. R. A."

"DEPARTMENT OF THE INTERIOR,
U. S. PATENT OFFICE,
WASHINGTON, D. C., Feb'y 19, 1876.

"SIR — You are hereby notified that application has been made to this office for letters patent for Telephonic Telegraph, &c., with which the invention described in your caveat, filed on the 14th day of February, 1876, apparently interferes, and that said application has been deposited in the confidential archives of the office under provision of Section 4902 of the Revised Statutes of the United States, which section reads as follows:

"'SECTION 4902. Any citizen of the United States who makes any new invention or discovery, and desires further time to mature the same, may, on payment of the fees required by law, file in the Patent Office a caveat, setting forth the design thereof, and of its distinguishing characteristics, and praying protection of his right until he shall have matured his invention. Such caveat shall be filed in the confidential archives of the office and preserved in secrecy, and shall be operative for the term of one year from the filing thereof, and if application is made within the year by any other person for a patent with which such caveat would in any manner interfere, the Commissioner shall deposit the description, specification, drawings and model of such application in like manner in the confidential archives of the office, and give notice thereof, by mail, to the person by whom the caveat was filed. If such person desires to avail himself of his caveat he shall file his description, specification, drawings and model within three months from the time of placing the notice in the post office in Washington, with the usual time required for transmitting it to the caveator added thereto; which time shall be indorsed on the notice. An alien shall have the privilege herein granted if he has resided in the United States one year next preceding the filing of his caveat, and has made oath of his intention to become a citizen.'

"If you would avail yourself of your caveat it will be necessary for you to file a complete application within three months from date, three days additional, however, being allowed for the transmission of this notice to your place of residence.

"Very respectfully,
"R. H. DUELL,
Commissioner.

"ELISHA GRAY,
"Care W. D. Baldwin,
Present."

"EXAMINER'S ROOM No. 118,
U. S. PATENT OFFICE,
WASHINGTON, D. C., Feb. 19, 1876.

"E. GRAY,
"Care W. D. Baldwin:

"In relation to the foregoing notice in relation to your caveat it may be well to add that the matters in the App'n referred to seem to conflict with your caveat in these particulars, viz.:

"1st. The receiver set into vibration by undulatory currents.

"2d. The method producing the undulations by varying the resistance of the circuit.

"3d. The method of transmitting vocal sounds telegraphically by causing these undulatory currents, &c.

"Z. F. WILBUR,
Examiner."

"Copy sent
Feb. 25.
S. R. A."

"EXAMINER'S ROOM No. 118,
U. S. PATENT OFFICE,
WASHINGTON, D. C., Feb. 25, 1876.

"E. GRAY,
"Care W. D. Baldwin, Present:

"Caveat for Art of Transmitting Vocal Sounds Telegraphically.

"Feb. 14, 1876.

"The notice to complete having been given under a misapprehension of the rights of the parties is hereby withdrawn.

"Z. F. WILBUR,
Examiner."

"$10 Mail.

MEMORANDUM OF FEE PAID AT U. S. PATENT OFFICE.

Paper will be filed to-day.
Inventor,
E. GRAY."

"CAVEAT.
Invention,
Transmitting Vocal Sounds Telegraphically.
Date of Payment,
Feby. 14, 1876.
Fee,
$10.
Solicitor,
Wm. D. Baldwin.
Patent Office,
Feb. 14, 1876.
U. S. A.
(Official Stamp.)"

"1876.

No. CAVEAT. Wilbur, 48.

ELISHA GRAY,
Of Chicago, County of Cook, State of Illinois.
Art of Transmitting Vocal Sounds Telegraphically.

Rec'd,	Feb.	14,	1876.
Petition,	"	"	"
Affidavit,	"	"	"
Specification,	"	"	"
Drawing within,	"	"	"

Model,	" " "
Cert. dep.	" " "
1 cash, $10,	Feb. 14, 1876.
Circular,	" " "
2.	" " "
3.	" " "

"W. D. BALDWIN,
Present."

"1. Letter to Caveator, Feby. 19, 1876. (Notice to complete,
2. Letter, Feby. 25, 1876."

"Simmons
vs.
158 | S. X.

| 58"

"Copy sent
Sept. 20, 1877,
M. E. S."

"DEPARTMENT OF THE INTERIOR,
U. S. PATENT OFFICE,
WASHINGTON, D. C., Sept. 20th, 1877.

"ELISHA GRAY,
"Care Baldwin, Hopkins & Peyton, Present:

"'SIR: You are hereby notified, that application has been made to this office for Letters Patent for Speaking Telegraph, involving the use of a series of diaphragms in a common vocalizing chamber, with which the invention described in your caveat, filed on the 14th day of February, 1876, renewed February 14th, 1877, apparently interferes, and that said application has been deposited in the confidential archives of the office, under provisions of Section 4902 of the Revised Statute of the United States, which section reads as follows:

"'SEC. 4902. Any citizen of the United States who makes any new invention or discovery, and desires further time to mature the same, may, on payment of the fees required by law, file in the Patent Office, a caveat, setting forth the design thereof, and of its distinguishing characteristics, and praying protection of his right until he shall have matured his invention. Such caveat shall be filed in the confidential archives of the office and preserved in secrecy, and shall be operative for the term of one year from the filing thereof; and if application is made within the year by any other person for a patent with which such caveat would in any manner interfere, the Commissioner shall deposit the description, specification, drawings and model of such application in like manner in the confidential archives of the office, and give notice thereof by mail, to the person by whom the caveat was filed. If such person desires to avail himself of his caveat, he shall file his description, specification, drawings and model within three months from the time of placing the notice in the post office in Washington, with the usual time required for transmitting it to the caveator added thereto, which time shall be indorsed on the notice. An alien shall have the privilege herein granted, if he has resided in the United States one year next preceding the filing of his caveat, and has made oath of his intention to become a citizen.'

"If you would avail yourself of your caveat, it will be necessary for you to file a complete application within three months from date, three days additional, however, being allowed for the transmission of this notice to your place of residence.

"Very respectfully,

ELLIS SPEAR,

Commissioner of Patents."

"MEMORANDUM OF FEE PAID AT U. S. PATENT OFFICE.

108

Inventor,

$10

ELISHA GRAY.

Renewal of Caveat,
Filed Feb. 14, 1876.
Invention,
Telegraphy.

Date of Payment,
Feb. 14, 1877.
Fee,
$10.

Wm. D. Baldwin,
Solicitor.
Present.

Patent Office,
Feb. 14, 1877.
U. S. A.
[Official Stamp.]"

"1877.

48 Wilbur.

—

23

1st. Renewal of Caveat of Feb. 14, 1876.

No.

ELISHA GRAY,
Of Chicago, County of Cook, State of Illinois.
Art of Transmitting Vocal Sounds Telegraphically.
Telelogue.

Rec'd,	Feb. 14, 1877.
Petition,	" " "
Affidavit,	" " "
Specification,	" " "
Drawing,	" " "
Model,	" " "
Cert. dep.,	" " "

1. Cash $10, Feb. 14, 1877.
2. Circular, " " "
3.

Wm. D. Baldwin,
Present."

"Notice to Caveator,
Sept. 20, 1877."

One contention of all the respondents in regard to the Gray invention and caveat is stated in the answers of the Overland People's and Molecular cases in the following language: — "that it has long been notorious that for years past interferences have been and now are pending undetermined in the Patent Office between said Bell, Gray, Edison and many others, to determine who is the original and first inventor of the matters described, shown and claimed in said two patents here in suit and in each of them respectively; and that it has long been and still is notoriously understood and believed that the owners of the said Bell patents, distrusting the ultimate result of said pending interferences, and fearing the decision or decisions of the Commissioner of Patents declaring said Bell not to be the original and first inventor of the inventions shown in his said patent or patents, have entered into an agreement and contract, or agreements and contracts, with said Gray, Edison and others, or with their assignees, in writing, providing for the contingency of a decision of the Commissioner of Patents adverse to said Bell in said interferences, and of decisions of the court adverse to said Bell's claim as the original and first inventor of the matters claimed in his said patents or either of them, and arranged the terms and conditions upon which said Bell telephones shall be licensed by said Gray or by said Edison respectively, or by their respective assignees in the event that said Gray or said Edison shall be adjudged the original and first inventor thereof."

The Overland Company and the People's Company further contended that certain evidence cited by their counsel, and which is contained or referred to in the report of the argument of their counsel *infra*, justified the inference that the Gray caveat was filed in the Department of the Interior prior to the filing of Bell's application, specification and claims of 1876; that information of this caveat was surreptitiously furnished to Bell's solicitors; that Bell's specifications and claims as originally filed varied from his specifications and claims as stated in the patent in several important respects; that these changes were made within four days after the filing of Gray's caveat; and that, after they had been made, the altered copy was placed in the files of the Department as the original. The following copy of these specifications, known as the Bell George-Brown-specification, is from the record in the People's case, and is referred to in argument in this connection; and other evidence in this respect on which counsel on one side or the other relied is also referred to in the arguments. The origin and nature of this specification is fully set forth in the argument of counsel hereafter.

"BELL'S GEORGE-BROWN-SPECIFICATION, NO. V.

"UNITED STATES PATENT OFFICE.

"[ALEXANDER GRAHAM BELL OF SALEM, ASSIGNOR TO HIMSELF AND THOMAS SANDERS OF HAVERHILL, AND GARDINER G. HUBBARD OF CAMBRIDGE, MASSACHUSETTS.][1]

"To all whom it may concern, be it known, that I, Alexander Graham Bell of Salem, Massachusetts, have invented certain new and useful improvements in Telegraphy, of which the following is a specification:

"In [another application for] Letters Patent granted to me [in] April 6th, 1875 (No. 161,739), I have described a method of and apparatus for transmitting two or more telegraphic signals simultaneously along a single wire by the employment of *Transmitting Instruments*, each of which occasions a succession of electrical impulses differing in rate from the others; and of *Receiving Instruments* each tuned to a pitch at which it will be put in vibration to produce its fundamental tone by one only of the Transmitting Instruments; and of *Vibratory Circuit Breakers*, operating to convert the vibratory movement of the Receiving Instrument into a permanent make or break (as the case may be) of a local circuit in which is placed a Morse Sounder Register, or other telegraphic apparatus. I

[1] Words in square brackets [ ] erased in original.

have also therein described a form of Autograph Telegraph based upon the action of the above mentioned instruments.

"In illustration of my method of Multiple Telegraphy I have shown in the [application] PATENT[1] aforesaid, as one form of Transmitting Instrument an electro-magnet having a steel spring armature which is kept in vibration by the action of a local battery. This armature in vibrating makes and breaks the main circuit, producing an intermittent current upon the line-wire. I have found, however, that upon this plan the limit to the number of signals that can be sent simultaneously over the same circuit is very speedily reached; for when a number of Transmitting Instruments, having different rates of vibration, are simultaneously making and breaking the same circuit, the effect upon the main line is practically equivalent to *one continuous current.*

"My present invention consists in the employment of a vibratory or undulat[ing]ORY current of electricity in place of a merely intermittent one; and of a method of, and apparatus for, producing electrical undulations upon the line-wire. The advantages [claimed for the undulatory current over the] I CLAIM TO DERIVE FROM THE USE OF AN UNDULATORY CURRENT IN PLACE OF A merely intermittent one, are,

"1. That a very much larger number of signals can be transmitted simultaneously over the same circuit.

"2. That a closed circuit and single main battery may be employed.

"3. That communication in both directions is established without the necessity of using special induction coils.

"4. And that—as the circuit is never broken—a spark arrester becomes unnecessary.

"It has long been known that when a permanent magnet is caused to approach the pole of an electro-magnet a current of electricity is induced in the coils of the latter, and that when it is made to recede, a current of opposite polarity to the first appears upon the wire. When, therefore, a permanent magnet is caused to *vibrate* in front of the pole of an electro-

[1] Words in small capitals interlined in original.

magnet, an undulatory current of electricity is induced in the coils of the electro-magnet, the undulations of which correspond in rate of succession to the vibrations of the magnet, in polarity to the direction of its motion, and in intensity to the amplitude of its vibration. That the difference between an undulatory and an intermittent current may be more clearly understood, I shall describe the condition of the electrical current when THE ATTEMPT IS MADE TO TRANSMIT two musical notes [of different pitch are] simultaneously [transmitted along the same wire] FIRST UPON THE ONE PLAN AND THEN UPON THE OTHER. Let the interval between the two sounds be a major third. Then their rates of vibration are in the ratio of 4 : 5.

"Now, when the intermittent current is used the circuit is made and broken four times by one TRANSMITTING instrument in the same time that five makes and breaks are caused by the other [instrument].

"A[1] and B (Figs. I., II. and III.) represent the intermittent currents produced; four impulses of A being made in the same time as five impulses of B. *c*, *c*, *c*, &c., show where and for how long time the circuit is made, and *d*, *d*, *d*, &c., indicate the duration of the breaks of the circuit.

"The line A+B shows the total effect upon the current when the transmitting instruments for A and B are caused [to] simultaneously to make and break the same circuit. The resultant effect depends very much upon the duration of the make relatively to the break. In Fig. I. the rate is as 1 : 4; in Fig. II. as 1 : 2; and in Fig. III. the makes and breaks are of equal duration.

"The combined effect A+B (Fig. III.) is very nearly equivalent to a continuous current.

"When many transmitting instruments of different [pitch] RATES OF VIBRATION are simultaneously making and breaking the same circuit, the current upon the main line [loses altogether its intermittent character and] becomes for all practical purposes continuous.

[1] Three sheets of figures accompany the patent in the record. They are fac-similes of the original ink sketches, evidently intended to represent the same Figures which form part of the Bell patent of 1876.

"[But now] Next consider the effect when an undulatory current is employed.

"Electrical undulations induced by the vibration of a body capable of inductive action can be represented graphically without error by the same sinusoidal curve which expresses the vibration of the inducing body itself, and the effect of its vibration upon the air.

"For, as above stated, the rate of oscillation in the electrical current corresponds to the rate of vibration of the inducing body, that is, to the pitch of the sound produced; the intensity of the current varies with the amplitude of vibration, that is, with the loudness of the sound; and the polarity of the current corresponds to the direction of the motion of the vibrating body, that is, to the condensations and rarefactions of air produced by the vibration. Hence the sinusoidal curve A or B[1] (Fig. IV.) represents graphically the electrical undulations induced in a circuit by the vibration of a body capable of inductive action.

"The horizontal line (*a*, *d*, *b*, *f*) represents the zero of current; the elevations (*c*, *c*, *c*) indicate impulses of positive electricity; the depressions (*e*, *e*, *e*) show impulses of negative electricity; the vertical distance (*c d* or *e f*) of any [point on] PORTION OF the curve from the zero line expresses the intensity of the positive or negative impulse at the part OBSERVED; and the horizontal distance (*a*, *a*) indicates the duration of the electrical oscillation.

"The vibrations represented by the sinusoidal curves A and B (Fig. IV.) are in the ratio aforesaid, of 4 : 5;— that is, four oscillations of A are made in the same time as five oscillations of B.

"The combined effect of A and B, when induced simultaneously on the same circuit, is expressed by the curve A+B (Fig. IV.), which is the algebraical sum of the sinusoidal curves A and B. This curve (A+B) also indicates the actual motion of the air when the two musical notes considered are sounded simultaneously.

---

[1] "A or B" interlined in original.

"Thus, when electrical undulations of different rates are simultaneously induced in the same circuit, an effect is produced exactly analogous to that occasioned in the air by the vibration of the inducing bodies.

"Hence the coexistence [of] UPON a telegraphic circuit of electrical vibrations of different pitch is manifested, — not by the obliteration of the vibratory character of the current, but by peculiarities in the shapes of the electrical undulations; or, in other words, by peculiarities in the shapes of the curves which represent those undulations.

"[Undulatory currents of electricity may be produced in many other ways than that described above, but all the methods depend for effect upon the vibration or motion of bodies capable of inductive action.]

"There are many [other] ways of producing undulatory currents of electricity, but all of them depend for effect upon the vibration or motion of bodies capable of inductive action. A few of the methods that may be employed I shall here specify.[1]

"[I shall specify a few of the methods that may be used to produce the effect.]

"When a wire through which a continuous current of electricity is passing is caused to vibrate in the neighborhood of another wire, an undulatory current of electricity is induced in the latter.

"When a cylinder upon which are arranged bar-magnets is made to rotate in front of the pole of an electro-magnet an undulatory current is induced in the coils of the electro-magnet.

"Undulations may also be caused in a continuous voltaic current by the vibration or motion of bodies capable of inductive action, or by the vibration of the conducting wire itself in the neighborhood of such bodies.

"In illustration of the method of creating electrical undulations, I shall show and describe one form of apparatus for producing the effect.

---

[1] This paragraph (four lines) interlined in original.

"I prefer to employ for this purpose an electro-magnet (A, Fig. 5) having a coil upon only one of its legs (6). A steel spring armature (*c*) is firmly clamped by one extremity to the uncovered leg (*d*) of the magnet, and its free end is allowed to project above the pole of the covered leg. The armature (*c*) can be set in vibration in a variety of ways (one of which is by wind), and in vibrating it yields a musical note of a certain definite pitch.

"When the instrument (A) is placed in a voltaic circuit (*g*, *b*, *e*, *f*, *g*) the armature (*c*) becomes magnetic, and the polarity of its free end is opposed to that of the magnet underneath. So long as the armature (*c*) remains at rest no effect is produced upon the voltaic current, but the moment it is set in vibration to produce its musical note a powerful inductive action takes place, and electrical undulations traverse the circuit (*g*, *b*, *e*, *f*, *g*). The vibratory current passing through the coils of the distant electro-magnet (*f*) causes vibration in its armature (*h*), when the armatures (*c*, *h*) of the two instruments (A, I) are normally in unison with one another; but the armature (*h*) is unaffected by the passage of the undulatory current when the pitches of the two instruments (A, I) are different [from one another].

"A number of instruments may be placed upon a telegraphic circuit (as in Fig. VI.). When the armature of any one of the instruments is set in vibration all the other instruments on the circuit which are in unison with it respond, but those which have normally a different rate of vibration remain silent. Thus if A (Fig. VI.) is set in vibration, the armatures of A^1 and A^2 will vibrate also, but all the others on the circuit remain still. So also if B^1 is caused to emit its musical note the instruments B, B^2 respond. They continue sounding so long as the mechanical vibration of B^1 is continued, but become silent the moment its motion stops. The duration of the sound may be made to signify the dot or dash of the Morse alphabet, and thus a telegraphic despatch can be transmitted by alternately interrupting and renewing the sound.

"When two or more instruments of different pitch are simultaneously caused to vibrate, all the instruments of corresponding pitches upon the circuit are set in vibration, each responding to that one only of the Transmitting Instruments with which it is in unison. Thus the signals of A are repeated by A^1 and A^2, but by no other instruments upon the circuit; the signals of B^2 by B and B^1, and the signals of C^1 by C and C^2, whether A, B^2, and C^1 are successively or simultaneously set in vibration.

"Hence by these instruments, two or more telegraphic signals or messages may be sent simultaneously over the same circuit without interfering with one another.

"I desire here to remark that there are many other uses to which these instruments may be put, such as the simultaneous transmission of musical notes differing in *loudness* as well as in pitch, and the telegraphic transmission of noises or sounds of any kind.

"When the armature *c* (Fig. V.) is mechanically set in vibration the armature *h* responds not only in pitch but in loudness. Thus when *c* vibrates with little amplitude, a very soft musical note proceeds from *h*, and when *c* vibrates forcibly the amplitude of vibration of *h* is considerably increased, and the sound becomes louder. So if A and B (Fig. VI.) are sounded simultaneously (A loudly and B softly) the instruments A^1, A^2 repeat loudly the signals of A, and the instruments B^1, B^2 repeat gently those of B.

"One of the ways in which the armature (*c*) Fig. VI. may be set in vibration has been stated above to be by wind. Another mode is shown [by] IN Fig. VII. [which] WHEREBY motion can be imparted to the armature by means of the human voice, or by the tones of a musical instrument.

"The armature *c* (Fig VII.) is fastened loosely by one extremity to the uncovered pole (*d*) of the electro-magnet (*b*), and its other extremity is attached to the centre of a stretched membrane (*a*). A cone A is used to converge sound vibrations upon the membrane. When a loud sound is uttered in the cone the membrane (*a*) is set in vibration; the armature *c* is forced to partake of the motion, and thus electrical undulations are caused upon the circuit E, *b*, *e*, *f*, *g*. These undulations are similar in *form* to the air vibrations caused by the sound,—

that is, they [are] CAN BE represented graphically by similar curves. The undulatory current passing through the electro-magnet (f) influences [the] ITS armature (h) to copy the motion [s] of the armature (c). A similar sound to that uttered into A is then heard to proceed from L.

"[Having described my invention, what I claim and desire to secure by Letters Patent is as follows:

"1. A system of telegraphy in which the receiver is set in vibration by the employment of (vibratory or) undulatory currents of electricity.

"2. The method of creating an undulatory current of electricity by the vibration of a permanent magnet or other body capable of inductive action.

"3. The method of inducing undulations in a continuous voltaic current by the vibration or motion of bodies capable of inductive action.

"4. The method of and apparatus for transmitting vocal or other sounds telegraphically by (inducing in a continuous voltaic circuit) CAUSING ELECTRICAL undulations similar in form to the vibrations of the air accompanying said vocal or other sounds the whole for operation substantially as HEREIN shown and described.]

"In this specification the three words 'oscillation,' 'vibration' and 'undulation' are used synonymously.

"By the term 'Body capable of inductive action' I mean a body which, when in motion, produces dynamical electricity. I include in the category of bodies capable of inductive action, brass, copper and other metals, as well as iron and steel.

"Having described my invention, what I claim and desire to secure by Letters Patent is as follows:

"1. A system of telegraphy in which the receiver is set in vibration by the employment of undulatory currents of electricity.

"2. The combination of a permanent magnet, or other body capable of inductive action with a closed circuit, so that the vibration of the one shall produce electrical undulations in the other or in itself.

"Thus (a). The permanent magnet or other body capable of inductive action may be set in vibration in the neighborhood of the conducting wire forming the circuit.

"(*b*.) The conducting wire may be set in vibration in the neighborhood of the permanent magnet.

"(*c*.) The conducting wire and the permanent magnet may both simultaneously be set in vibration in each other's neighborhood; and in any or all of these cases electrical undulations will be produced upon the circuit.

"3. The method of producing undulations in a continuous voltaic current by the vibration or motion of bodies capable of inductive action, or by the vibration or motion of the conducting wire itself in the neighborhood of such bodies.

"4. The method of and apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds."

"(INDORSEMENT.)

"These papers were received by me from Professor Alex. G. Bell in the winter of 1875–6, shortly before I left for England. I can fix the exact date by reference to my books and papers, but have not these at hand now.

"GEO. BROWN.

"Toronto, 12 Novem., 1878."

Two of the publications respecting the Van der Weyde experiments were (1) from *The Manufacturer and Builder*, published in New York in May, 1869; and the other from *The Scientific American*, published in New York, March 4, 1876. They were as follows, omitting illustrations.

I. *From The Manufacturer and Builder, May, 1869.*

"One of the most remarkable recent inventions connected with telegraphy is the telephone, an instrument which transmits directly the pitch of a sound by means of a telegraph wire, — either an air wire or submarine cable; so that, for instance, when the operator at one end of the wire sings or plays on an instrument any tune, as 'Yankee Doodle,' or 'Hail Columbia,' it will be heard and distinguished plainly at the other end. This invention may, in its present state, have no direct practical application, but be a mere scientific, although highly interesting curiosity; but who can say that it does not contain the germ of a new method of working the telegraph, or some other useful practical purpose?

"The telephone is not the result of an accidental discovery, but of a thorough study of the laws of electro-magnetism and of sound. It is founded on the fact that the difference in pitch of different tones is caused by different velocities of vibrations of the elastic sounding body; which vibrations are transmitted to and by the air with exactly the same velocity, and from the air may be communicated to a properly stretched membrane, like a piece of bladder or very thin sheet of india-rubber, stretched like a drum head, which these also will vibrate with exactly the same velocity as the air and the original sounding body, be it the human voice, organ pipe, string or any musical instrument. If, now, at the centre of this little drum head there be attached a small disk of some metal not easily burned by electric currents, — for instance, platinum, — while at the same time a platinum point may, by means of a screw, be so adjusted as to come very nearly in contact with this small platinum disk, it is clear that, when the membrane is put in vibration, a succession of contacts between the disk and point will be produced, of which the number in each second will exactly correspond with the number of vibrations in each second of the sounding body or the tone produced by it. That part of the apparatus which serves to send off the tune or melody is represented in the illustration. It consists simply of a square wooden box, provided at the side with a kind of mouthpiece similar to that of a speaking-tube, and at the top with an opening, over which the membrane just mentioned has been stretched. The small piece of platinum attached to the centre of this little drum head is, by means of a very flexible strip of some metal that conducts well, attached to one pole of the galvanic battery, of which only one cup is represented in the figure, although for a long wire several cups will, of course, be required. The reason why this connection near the platinum disk is a flat, thin and flexible strip is, that any rigidity would interfere with the freedom of vibration of the membrane to which it is attached. The point coming in contact with this small vibrating disk is connected with the ground wire, the other pole of the battery with the air wire or submarine cable. It is clear, from this explanation, that at every contact of the platinum point a wave of electricity will be sent over the wire, and as many waves in a second as there are contacts; and as there are as many contacts as there are vibrations in every second, the number of electric waves will be always exactly equal to the number of vibrations corresponding with the pitch of each tone, be it fifty, one hundred, two hundred or five hundred in every second.

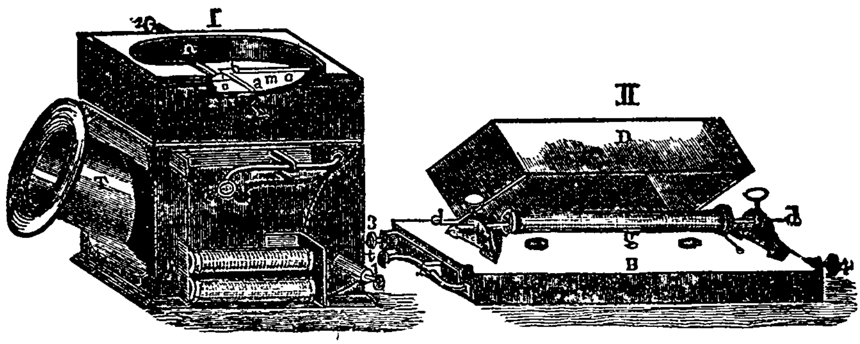
"The instrument in which this succession of waves is made audible at the other end of the telegraph wire is founded on the fact — first investigated by Professor Henry, of the Smithsonian Institute at Washington — that iron bars, when becoming magnetic by means of electric currents passing around them, become slightly elongated, and at the interruption of the current are at once restored to their original length. It is represented in the cut, and consists of an elongated wooden box, of which the top is made of thin pine wood, similar to the sounding-board of a stringed musical instrument, to which are attached two bridges carrying long pieces of moderately thick and very soft iron wire, which, for nearly their whole length, are surrounded by a coil similar to the coil of the electro-magnets used in telegraphing. One end of this coil is attached to the telegraph wire, the other to the ground wire, as represented in the figure. At every instant that a contact is established at the station where the sound is produced, and a current wave thus transmitted, these wires will become magnetic, and consequently elongated; and they will be shortened again at every interruption of the current. And as these currents and interruptions succeed each other with the same velocity as the sound vibrations, the elongations and shortenings of the magnetized iron wires will succeed each other with exactly the same velocity, and consequently they will be thrown into a state of longitudinal vibrations corresponding with the original musical tone, which vibrations will then be communicated to the sounding-board in exactly the same manner as is the case with the vibrations of the strings in all stringed instruments, thus becoming more audible at the receiving station.

"It is clear, from the foregoing explanations, that no quality of tone can be transmitted. Much less can articulate words be sent, notwithstanding the enthusiastic prediction of some persons, who, when they first beheld this apparatus in operation, exclaimed that now we would talk directly through the wire. It is from its nature able to transmit only pitch and rhythm, — consequently melody, and nothing more. No harmony nor different degrees of strength or other qualities of tone can be transmitted. The receiving instrument, in fact, sings the melodies transmitted, as it were, with its own voice, resembling the humming of an insect, regardless of the quality of the tone which produces the original tune at the other end of the wire.

"This instrument is a German invention, and was first exhibited in New York, at the Polytechnic Association of the American Institute, by Dr. Van der Weyde. The original sounds were produced at the farther extremity of the large building (the Cooper Institute), totally out of hearing of the Association; and the receiving instrument, standing on the table of the lecture-room, produced with its own rather nasal twang the different tunes sung at the other end of the line; rather weakly, it is true, because of the weak battery used, but very distinctly and correctly."

II. From The Scientific American, New York, March 4, 1876.

"In connection with Mr. Gray's application of the telephone to the simultaneous transmission of several different telegraphic messages over one wire at the same time, and his paper read before the American Electrical Society (published on p. 92, *Scientific American*, Supplement for Feb. 5), it may be interesting for the readers of this paper to obtain some information in regard to the invention of the telephone, by Reuss. As mentioned in the article above referred to, Page and Henry observed that, by rapid magnetization and demagnetization, iron could be put into vibrations isochronic with the interruptions of the current; and later, Marian experimented extensively in this direction, while Wertheim made a thorough investigation of the subject, which induced Reuss, of Friedrichsdorf, near Hamburg, Germany, to apply this principle to the transmission of musical tones and melodies by telegraph; and he contrived an apparatus which we represent in the engravings.



"The telephone of Reuss consists of two parts, the transmitting and the receiving instrument. Fig. I. represents the former, and is placed at the locality where the music is produced; Fig. II., the latter, is placed at the station where the music is to be heard, which may be at a distance of one hundred, two hundred, or more miles, in fact, as far as the battery used can carry the current, while the two instruments are connected with the battery and the telegraph wire in the usual manner. One pole of the battery is connected with the ground plate, the other with the screw, marked 2 of Fig. I., and thence over a thin copper strip *n*, with a platinum disk, *o*, attached to the centre of the membrane stretched in the large top opening of the hollow and empty box, K, intended to receive and strengthen the vibrations of the air, produced by singing before the funnel-shaped short tube attached to the opening in

T. Over the platinum disk, *c*, attached to the elastic membrane, is a platinum point attached to the arms *b c* and *b* K, while a set screw brings this point in slight contact with the platinum disk mentioned. A part of the box is represented as broken and removed in order to show the internal construction. The strip *a b c* is connected with the end *s*, of the switch *t s*, and the screw connection, 1, at the lower right-hand corner, and also through the telegraph wire, to the instrument Fig. II., at the receiving station, which may be situated at a distance of many miles. Here the current enters by the screw connection, 3, and passes through the spiral *g*, surrounding the soft iron wire, *d d*, of the thickness of a knitting needle, and leaves the apparatus at the screw connection, 4, whence it obtains access to the ground plate, and so passes through the earth back to the battery. The spiral and iron wire *d d* is supported on a hollow box, B, of thin board; while a cover D, of the same material is placed on top, all intended to strengthen the sound produced by the vibrations which the interruption of the current caused in the iron wire, *d d*, so as to make these vibrations more audible by giving a large vibratory surface, in the same way that the sounding board of a piano-forte strengthens the vibrations of the air, caused by the strings, and makes a very weak sound quite powerful.

"If a flute be played before the opening T, or if a voice be singing there, the vibration of the air inside the box K causes the membrane *m* to vibrate synchronically, and this causes the platinum disk *o* to move up and down with corresponding frequency. At every downward motion the contact of this disk with the platinum point, under *b*, is broken, and therefore the current is interrupted as rapidly as the vibrations occur. Let, for instance, the note C be sounded; this note makes sixty-four full vibrations in a second, and we have, therefore, sixty-four interruptions of the electric current, which interruption will at once be transmitted through the telegraph lines to the receiving instrument, and put the bar *d d* into exactly similar vibrations, making the very same tone, C, audible; and so on for all other rates of vibration. It is clear that in this way not only the rhythm of music can be transmitted (and this can be done by the ordinary telegraph), but the very tones, as well as the relative durations and the rests between them, can thus be sent, making a full and complete melody. The switch *t s*, Fig. I., is intended, in connection with a similar one in Fig. II., to communicate between the stations, with the help of the electro-magnet E, to ascertain if station, Fig. II., is ready to receive the melodies; then it gives the signal, by manipulating the switch, which is received by the attraction of the armature A, the latter arrangement being a simple Morse apparatus attached to the telephone.

"Professor Heisler, in his *Lehrbuch der technischen Physik* (3d edition, Vienna, 1866), says, in regard to this instrument: 'The telephone is still in its infancy; however, by the use of batteries of proper strength, it already transmits not only single musical tones, but even the most intricate melodies, sung at one end of the line, to the other, situated at a great distance, and makes them perceptible there with all the desirable distinctness.' After reading this account in 1868, I had two such telephones constructed, and exhibited them at the meeting of the Polytechnic Club of the American Institute. The original sounds were produced at the further extremity of the large building (the Cooper Institute), totally out of hearing of the Association, and the receiving instrument, standing on the table in the lecture-room, produced (with a peculiar and rather nasal twang) the different tunes sung into the box K, at the other end of the line; not powerfully, it is true, but very distinctly and correctly. In the succeeding summer I improved the form of the box K, so as to produce a more powerful vibration of the membrane, by means of reflections effected by curving the sides; I also improved the receiving instrument by introducing several iron wires in the coil, so as to produce a stronger vibration. I submitted these, with some other improvements, to the meeting of the American Association for the Advancement of Science, and on that occasion (now seven years ago) expressed the opinion that the instrument contained the germ of a new method of working the electric telegraph, and would undoubtedly lead to further improvements in this branch of science, needing only that a competent person give it his undivided attention, so as to develop out of it all that it is evidently capable of producing.

"Before leaving this subject, I wish to draw special attention to the fact that the merits of the invention consist chiefly in the absence of musical instruments, tuning forks, or their equivalents for producing the tones; any instrument will do: flute, violin, human voice, &c. If the aerial vibrations are only conducted into the box, Fig. 1, the apparatus will send the pitch as well as the duration of the different tones, with the rests between, therefore not only transmitting perfect rhythm, but a complete melody, with its long and short notes. The two parts of the apparatus may even be connected each to a separate piano-forte; and if this were done in a proper manner a melody played on the piano-forte connected with the transmitting instrument, Fig. 1, would be heard in the pianoforte at a great distance, connected with the receiving instrument, Fig. 2."

The following are the drawings and an extract from the specification in McDonough's application for a patent.

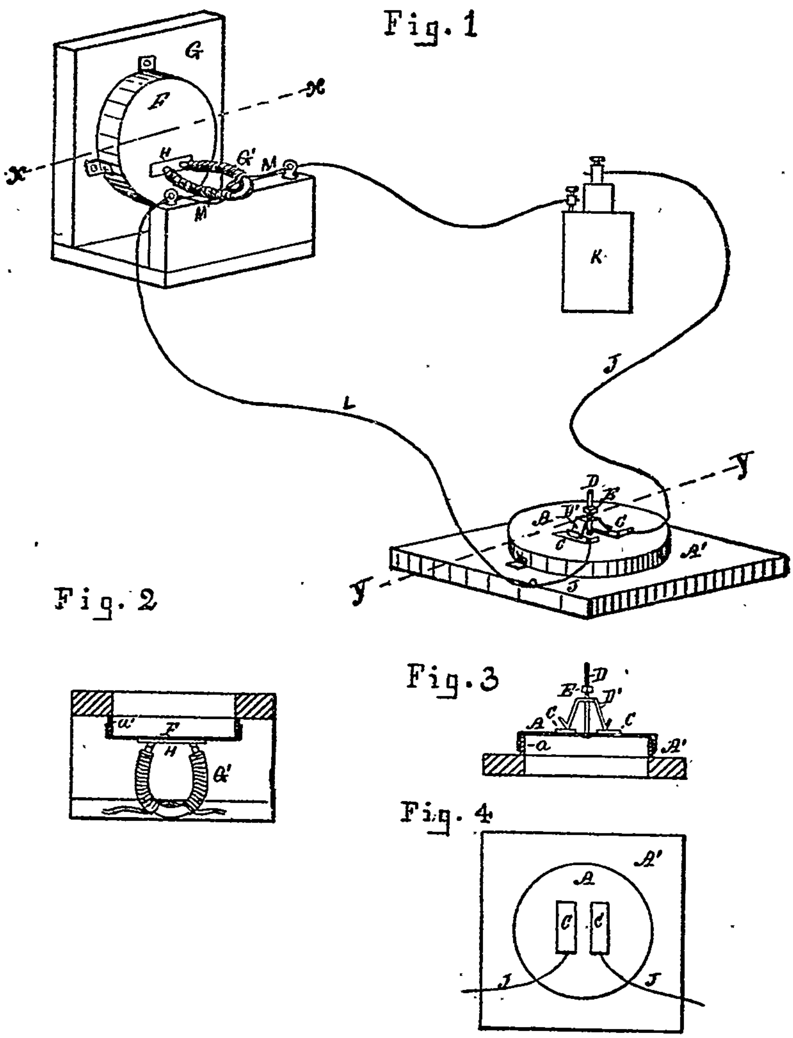


Fig. 1
Fig. 2
Fig. 3
Fig. 4

"The object of my invention is to provide a means for transmitting articulate sounds from one place to another through the medium of electricity, and it consists in the combination with an electrical battery circuit wires, armature, magnet and circuit-breaker, of a transmitting and a receiving membrane or sounding apparatus, so constructed as to vibrate in accord with the vibrations of articulate sound, and so arranged relative to the magnet and circuit-breaker that the vibrations of the transmitting membrane or apparatus produced by articulate sounds, are transmitted by the electrical current to the receiving membrane or apparatus, and so as to cause a like vibration of the receiving membrane or apparatus, and [cause] it to reproduce the articulate sounds transmitted from and by the transmitting membrane or apparatus. My invention also consists in the novel construction of the circuit-breaker, as is hereinafter more fully described.

"In the drawing A represents the transmitting membrane or apparatus, composed of vellum, or any suitable material that is sensitive to the vibrations of sound, which is stretched upon a metal hoop or band *a*, permanently attached to the bed A′, and is so arranged upon the hoop or band as to admit of being tightened or loosened at will. C C are metal plates attached to the upper surface of the membrane A, at its centre, and are insulated from each other. D is a metal bolt permanently attached at its lower end to said membrane A, centrally between the plates C C, and is insulated from them. D′ is the circuit-breaker, which consists of an arched-shaped piece of metal loosely secured at its centre upon the bolt D, and is bent upward at each end, and from the membrane A, as shown in Fig. 3, so as to form depending V-shaped points adapted to rest upon the respective plates C C. The circuit-breaker D′ is so fitted upon the bolt D as to admit of a free and easy ascending and descending movement, the limit of its ascending movement being determined by its contact with the nut E on the bolt, and the descending movement being limited by its contact with the plates C C. F is the receiving or sounding membrane, which is also composed of vellum or any suitable material that is sensitive to the vibration of sound, and is stretched upon a metal hook or band a', secured to the side frame G, of the receiving or sounding apparatus, as shown in Fig. 1, and is so adjusted as to admit of being loosened or tightened as may be required.

"G' is the magnet surrounded by a helix of insulated wire, and connected to the instrument immediately in front of the membrane F; and at a point near its centre. H is the armature plate permanently attached to the membrane F, between it and the magnet, as shown in Fig. 1.

"To each of the plates C C is connected a wire J, one of which is connected with the battery K, and the other with the ground wire L. To each of the poles of the magnet is connected a wire M, one of which is connected with the battery K, and the other with the ground wire, as shown in Fig. 1.

"The operation of my said teleloge is as follows: the transmitting membrane A, being sensitive to the vibrations of articulate sounds produced thereon, is caused to vibrate in sympathy therewith, thereby imparting an upward movement to the circuit-breaker at each vibration, and disconnecting it from the plates C C, and alternately breaking and closing the circuit, when the intermittent current alternately magnetizes and demagnetizes the magnet G', attracting the armature H, and causes it and the membrane F to vibrate simultaneously with the vibrations of the transmitting membrane A, and in accord therewith, and so that the said membrane F reproduces the articulate sounds transmitted from and by the membrane A.

"I do not limit myself to the construction and arrangement of the circuit-breaker D', as shown and described, as other means may be employed, as for example, only one of the plates C may be attached to the membrane, and the other made either in the form of a plate or needle and attached direct to the connecting wire, and adjusted to rest upon the plate, so as to break the connection by the vibrations of the membrane, which will accomplish the same result. It will be observed that each end of the circuit-breaker D' is bent upward from the membrane, the object being to prevent local attraction and render its action more sensitive to the lighter vibrations of the membrane. The articulate sounds may be taken direct from the magnet, or through any substance or material sufficiently sensitive to the vibrations of sound to reproduce them by contact with the magnet.

"Having thus described my invention, what I claim as new, and desire to secure by letters patent, is:

"1. The combination with the battery, circuit wires, magnet, armature and circuit-breaker, of the transmitting membrane A, and receiving membrane F, substantially as and for the purpose specified.

"2. The combination with the plates C C, of the circuit-breaker D′, whereby the circuit is alternately opened and closed by the vibrations of the membrane A, substantially as specified.

"3. The combination of the bolt D and adjusting nut E, of the circuit-breaker D′, substantially as and for the purpose specified."

There were two Varley patents. The United States patent, dated June 2, 1868, set forth the object of the invention thus: "The objects of my invention are to cut off the disturbance arising from earth-currents, to obtain a high speed of signaling through long circuits, and, should the conductor become partially exposed, to preserve it from being eaten away by electrolytic action"; and made the following claims:

"Having now described my invention, and the manner in which the same is or may be carried into effect, what I claim, and desire to secure by Letters Patent, is —

"1. In so arranging telegraphic apparatus as to work by the variation of the increment and decrement of electric potential, and not by the direct action of the electric current itself, as and for the purposes set forth.

"2. The use of an induction-coil at the receiving end of the cable, one of its wires being connected between the cable and the ground, and the other or secondary wire connected with the receiving-instrument, as and for the purposes set forth.

"3. The use of a condenser or condensers between the receiving end of the cable and the earth, with or without resistance-coils between the cable and the earth, as and for the purposes set forth.

"4. The use of a condenser at the sending end of the cable, with or without resistance-coils connecting its two armatures, as and for the purposes set forth.

"5. The use of a condenser at each end of the cable, the cable being connected with the ground through a resistance-coil and a battery, so as to keep the cable always negatively electrified, as and for the purposes set forth."

The object of the British patent, dated October 8, 1870, was said to be "the increase of the transmitting power of telegraph circuits by enabling more than one operator to signal independent messages at the same time upon one and the same wire to and from independent stations"; and the claims were as follows:

"Having thus described the nature of my invention and the manner of performing the same, I would have it understood that I claim the construction of electric telegraphs in such manner that current signals and wave signals may be simultaneously transmitted through the same line wire, and may be rendered sensible at the receiving station by separate instruments, the one sensitive to currents of appreciable duration, and the other to electric waves or vibrations.

"I also claim the construction of electric telegraphs with, at the transmitting station, an instrument capable of originating in the line wire a succession of rapid and regular electric waves, and at the receiving station a strained wire, a tongue, or such like instrument adjusted to vibrate in unison with the electric waves, and, being magnetized by them, oscillating to and from the pole or poles of a magnet in its vicinity.

"I also claim, in the construction of electric telegraphs, the dividing a conducting wire into sections by instruments which I have called 'echocyme,' which allow current signals to pass freely but stop wave signals, so that, whilst the wire is being used as a whole for through signals, the sections into which it is divided may each or all be employed for the transmission of local messages.

"I also claim the construction of electric telegraphs with, at the transmitting station, an instrument capable of originating in the line wire a succession of rapid and regular electric waves, and at the receiving station a condenser consisting of thin sheets capable of being agitated by such waves.

"I also claim the construction of electric telegraphs with, at the transmitting station, an instrument capable of originating in the line wire a succession of rapid and regular electric waves, and at the receiving station an instrument which, on receiving such waves, delivers a current of electricity to an indicating or receiving instrument suitable to be worked with ordinary current signals.

"I also claim the combination with Dr. Gintl and Frischen's double speaking apparatus of a hollow helix connected between the receiving instrument and the line wire, such helix having rods or pieces of iron inserted into it."

The People's Telephone Company claimed as assignees of Drawbaugh's inventions and of his rights, and in their answer made the following averments respecting them.

"11. Further answering, this defendant says, that Daniel Drawbaugh, of Eberly's Mills, Cumberland County, Pennsylvania, was and is the original and first inventor and discoverer of the art of communicating articulate speech between distant places by voltaic and magneto electricity, and of the construction and operation of machines and instruments for carrying such art into practice; that long prior to the alleged inventions by said Alexander Graham Bell, and long prior to the respective inventions of said Gray and said Edison, said Daniel Drawbaugh, then and now residing at said Eberly's Mills, constructed and operated practical working electric speaking telephones at said Eberly's Mills, and exhibited their successful operation to a great number of other persons resident in his vicinity and elsewhere; that the said electric speaking telephones, so constructed and successfully and practically used by him, as aforesaid, contained all the material and substantial parts and inventions patented in said patents No. 174,465 and

No. 186,787, granted to said Bell; and also contained other important and valuable inventions in electric and magneto telephony, and were fully capable of transmitting, and were actually used for transmitting, articulate vocal sounds and speech between distant points by means of electric currents; that some of the original machines and instruments invented, made, used, and exhibited to many others, long prior to the said alleged inventions of said Bell, or either of them, are still in existence, and capable of successful practical use, and are identified by a large number of persons who personally tested and used, and knew of their practical operation and use, in the years 1870, 1871, 1872, 1873, 1874, and both subsequently and prior thereto; that certainly more than fifty, and probably not less than one hundred persons, or even more, were cognizant of said Drawbaugh's invention and use of said telephones, and of his claim to be the original and first inventor thereof, prior to the alleged inventions of said Bell, or either of them; that said Drawbaugh, for more than ten years prior to the year 1880, was miserably poor, in debt, with a large and helpless family dependent upon his daily labor for support, and was, from such cause alone, utterly unable to patent his said invention, or caveat it, or manufacture and introduce it upon the market; that said Drawbaugh never abandoned his said invention, nor acknowledged the claims of any other person or persons thereto, but always persisted in his claims to it, and intended to patent it as soon as he could procure the necessary pecuniary means therefor; that said Drawbaugh never acquiesced in the public use of said Bell, Gray, Edison, Blake, or other telephones, nor in the claims of the alleged inventors thereof, nor gave his consent to such use; and that, in view of the facts aforesaid, neither said Bell nor any other person or persons whatever, except the said Drawbaugh, can now obtain a valid patent therefor, nor are the patents granted to said Bell as aforesaid, or either of them, of any validity or value whatever.

"12. Further answering, this defendant says, that the said Daniel Drawbaugh, after making, testing, using, and extensively exhibiting his invention to others, and allowing them experimentally to personally test and ascertain its successful practical operation and utility, as aforesaid, and after the full and repeated demonstration of its successful working, as aforesaid, conceived that its range and capacity of usefulness to the public might be very greatly enlarged; that many improvements of great value might be made and added to it which, without departing from its principle, might increase its value to himself and to the public, and therefore set himself at work to discover and invent such improvements; that he discovered and invented some of said additional improvements prior to any alleged invention by the said Bell; and that, notwithstanding his embarrassed and impoverished pecuniary condition, and his utter want of proper mechanical tools, materials, and appliances to conduct such work, he labored with all reasonable diligence to perfect and adapt his said improvements, and did finally, in due exercise of such reasonable diligence, perfect and adapt the same; and that, in so far as the said Bell has incorporated such improvements in his said two patents, or either of them, he, the said Bell, has surreptitiously and unjustly obtained a patent or patents for that which was in fact first invented by said Drawbaugh, who was using reasonable diligence in perfecting and adapting the same; and therefore the patent or patents of the said Bell therefor is, or are, invalid and void.

"13. Further answering, this defendant says that it has, by purchase, and for a valuable consideration, acquired the right, title, and interest of said Daniel Drawbaugh in and to all his said inventions, discoveries, and improvements in electric speaking telephones, and has full right, at law and in equity, to make, sell, and use electric speaking telephones, embodying the inventions, discoveries, and improvements of said Drawbaugh, without interference from or molestation by said Bell or his assigns, and without liability to these complainants therefor.

"14. Further answering, this defendant says that it has, in good faith, and relying upon its legal rights aforesaid, caused applications to be made and filed in the Patent Office for Letters Patent upon the inventions of the said Daniel Drawbaugh, with the intention of procuring interference proceedings to be instituted, in accordance with the statute, against the patents of said Bell, and the pending applications of said Gray, Edison, and others, in order that said Drawbaugh may be adjudged by the Commissioner of Patents to be, as he rightfully is, the original and first inventor of the electric speaking telephone, and may be adjudged entitled to receive a patent or patents therefor.

"15. This defendant, further answering, denies all and all manner of unlawful conspiracy and confederacy with other persons and parties, as charged in the complainants' bill of complaint; denies all knowledge of the alleged newspaper publications referred to in said bill, and calls for due proof of said alleged publications, if the complainants shall be advised that they are of any materiality to this suit, which this defendant denies; and denies all the allegations of the complainants' bill as to the said Drawbaugh invention, and, particularly, the allegations that said Drawbaugh's invention was a mere experiment, was incomplete, imperfect, unfruitful, and that knowledge of it was withheld from the public, except so far as disclosed by said alleged newspaper publications in said bill mentioned and set forth. And this defendant charges that the contrary of all said allegations is true; that this defendant has done no unlawful or inequitable act in the premises; that it is not responsible for said alleged newspaper publications; that said Drawbaugh's original invention was complete, successful, operative, and practically and successfully operated, and reduced to practice as a 'Speaking Telephone' on many occasions, in the presence and hearing of many other persons, and knowledge thereof was freely communicated to the public by said Drawbaugh; and that said Drawbaugh's improvements, additional to his said original invention, were complete, successful, and practical inventions; that all of his said inventions were fully reduced to practice and communicated to others; but that said other persons, having knowledge of his legal and equitable right in and to his said inventions, and respecting and acquiescing in the same, desisted and refrained from making and using his said inventions, and acquiesced in his right thereto, and never did, so far as this defendant is informed and believes, any act to impair his said rights or which would prevent the grant of a good and valid patent or patents to him, the said Daniel Drawbaugh, or his assigns, for any or all of his said inventions.

"16. This defendant, further answering, says that so far and to such extent as electric speaking telephones were put on sale and into public use in this country, by others than said Drawbaugh, prior to said Drawbaugh's application for a patent thereon, as aforesaid, such specific machines and instruments, so put on sale and into public use, were not the specific machines and instruments invented by said Drawbaugh, as aforesaid, but were machines and instruments invented by others, subsequently to the original and first invention of the electric speaking telephone by said Drawbaugh, and subsequently to the invention of his said improvements thereon, as aforesaid; and that, as this defendant is informed and believes, such machines and instruments were so put on sale and into public use, not from or by reason of any information derived from or through said Drawbaugh, but by an independent invention, or independent inventions thereof, by others subsequently to said Drawbaugh's original and first invention as aforesaid, and while said Drawbaugh was unable, by reason of his poverty and other controlling circumstances, as above set forth, to patent his said inventions; and that such public use and sales were without the consent, allowance, or acquiescence of said Daniel Drawbaugh.

"And this defendant, as advised by its counsel, further answers and says, that the alleged invention of the electric speaking telephone by said Bell, subsequently to said Drawbaugh's invention thereof, as aforesaid, conferred upon said Bell, or his assigns, no legal right to a patent or patents thereon, nor did it impair the legal right of said Drawbaugh to a patent or patents upon his own prior inventions; and that the alleged public use and sales of such subsequently invented telephones, without said Drawbaugh's consent, allowance, or acquiescence as aforesaid, and by reason of knowledge and information of their construction and operation, not derived from or through said Drawbaugh, have in law no effect to forfeit or bar said Drawbaugh's right to the exclusive use of his own prior invention, nor to prevent him or his assigns from obtaining a valid patent or valid patents thereon."

It was claimed by the People's Company, that Drawbaugh's inventions and the inventions covered by Bell's patents were for substantially the same thing. The main issues in this respect argued by counsel were issues of fact — whether Drawbaugh's instruments were made prior to Bell's discovery, and were practically operative, and whether the Drawbaugh witnesses to these points were to be believed. The record contains a great mass of testimony on these issues. Much of this is referred to in detail by the counsel on each side and by the court. It is not practicable to report it further than they have regarded it as material, and presented it in quotations and references.

There was before the court in the Drawbaugh case a book containing a series of plates, (with references and notes written upon them,) marked respectively from "A" to "Q," both inclusive. It was claimed on his behalf that these plates represented his invention at various stages of its development. The claim was made in the following language by his counsel:

"The story of Drawbaugh, and of the record, overwhelmingly corroborated by the witnesses for the defence, is as follows:

"Early conception and experiments with the continuous current, 1862, 1866, and 1867.

"Teacup transmitter and receiver, 1866, and 1867.

"Tumbler and tin cup and mustard can ('F' and 'B'), 1867 and 1869.

"Improvement upon 'B' ('C'), 1869, 1870.

"Further improvement upon 'C' and the more perfect magneto instrument 'I,' 1870, 1871.

"Mouthpiece changed to centre, and adjusting screw inserted (Exhibit 'A'), 1874.

"'D' and 'E' perfectly adjusted and finished magneto instruments, January and February, 1875.

"'L,' 'M,' 'G,' and 'O' from February, 1875, to August, 1876.

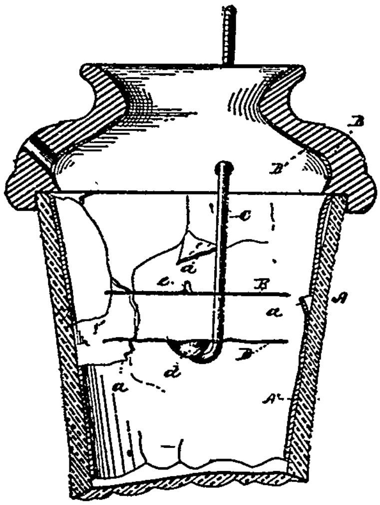
"'H,' August, 1876.

"'J,' 'N,' and 'P,' 1878.

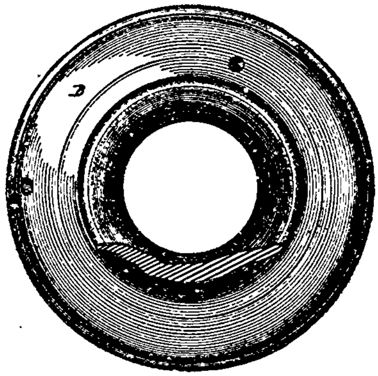
"With the exception of the old teacup transmitter, representations of all the instruments are in evidence, in whole or in part; parts of those produced prior to the instrument 'I' of 1871 being in evidence, and 'I,' with all thereafter produced being in evidence in their entirety."

The following are such of these plates, to which the counsel assigned a date prior to Bell's patent of March 7, 1876, as are deemed to be necessary for a proper understanding of the arguments of counsel, and of the opinion of the court, upon this point. They are arranged in the order of the dates in which Drawbaugh was said to have constructed the instrument which they represent.

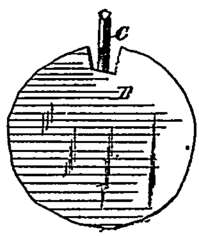
Instrument marked F. Full size. (Tumbler.)



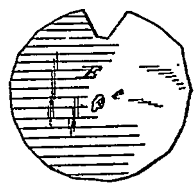
Longitudinal section.



Cap; top view.



Lower plate.

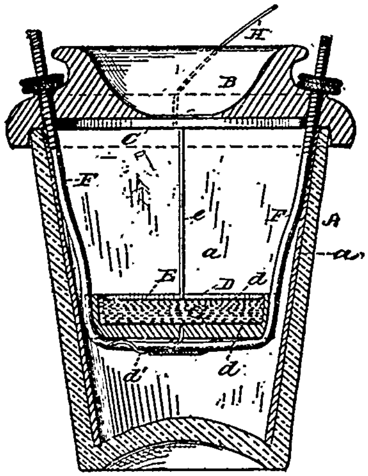


Upper plate.

REFERENCES.

A. Glass tumbler; bottom broken off.
B. Wooden cap.
B'. Plaster-paris lining to cap.
A'. Plaster-paris lining to tumbler.
a. Breaks in lining *A'*.
C. Adjusting rod for lower plate.
D. Lower plate.
d. Solder joint.
E. Upper plate.
e. Wire to plate *E*.

Instrument marked F Reproduced. Full size. (Tin Cup and Mustard Can.)



REFERENCES.

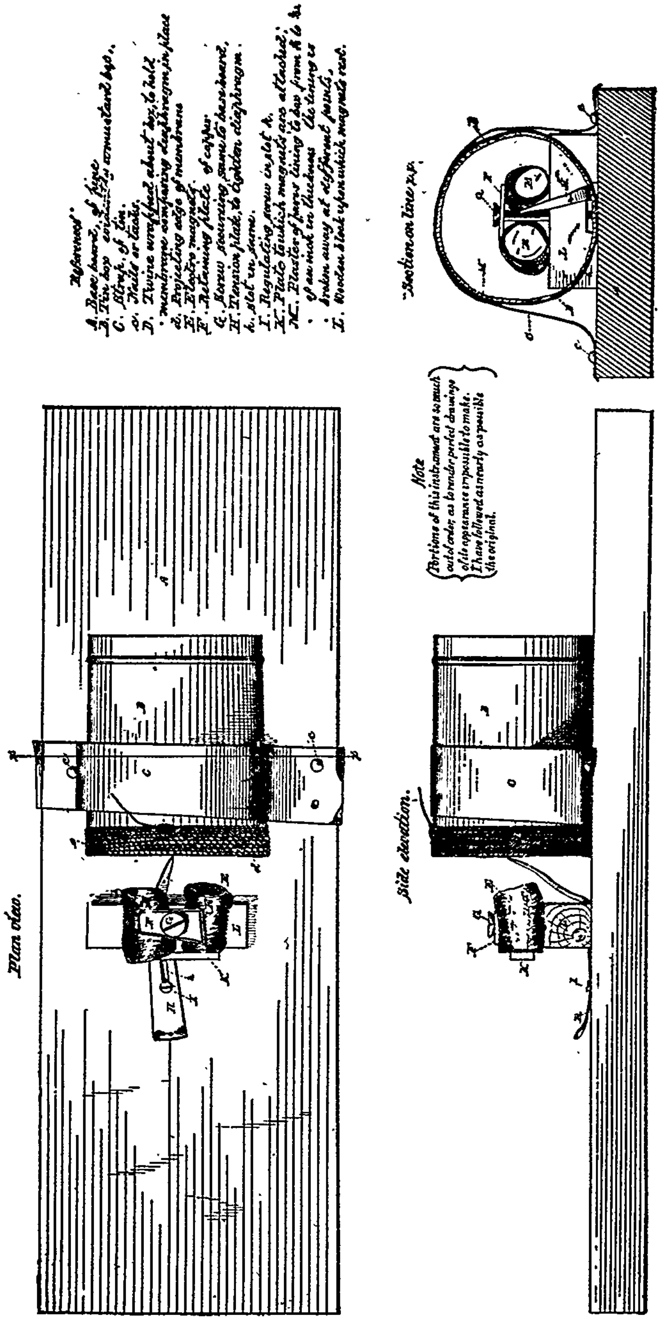
A. Glass tumbler.
a. Plaster-paris lining to same.
B. Wooden mouthpiece.
C. Diaphragm; tin.
D. Carbon holding cup; wood.
d. Metallic plate at bottom of *D*.
d'. Wire from plate *d* to adjusting posts.
E. Upper metallic plate in cup *D*.
e. Bar from plate *E* to diaphragm.
F. Adjusting posts.
G. Carbon in cup *D*.
H. Conductor to diaphragm.

NOTE.

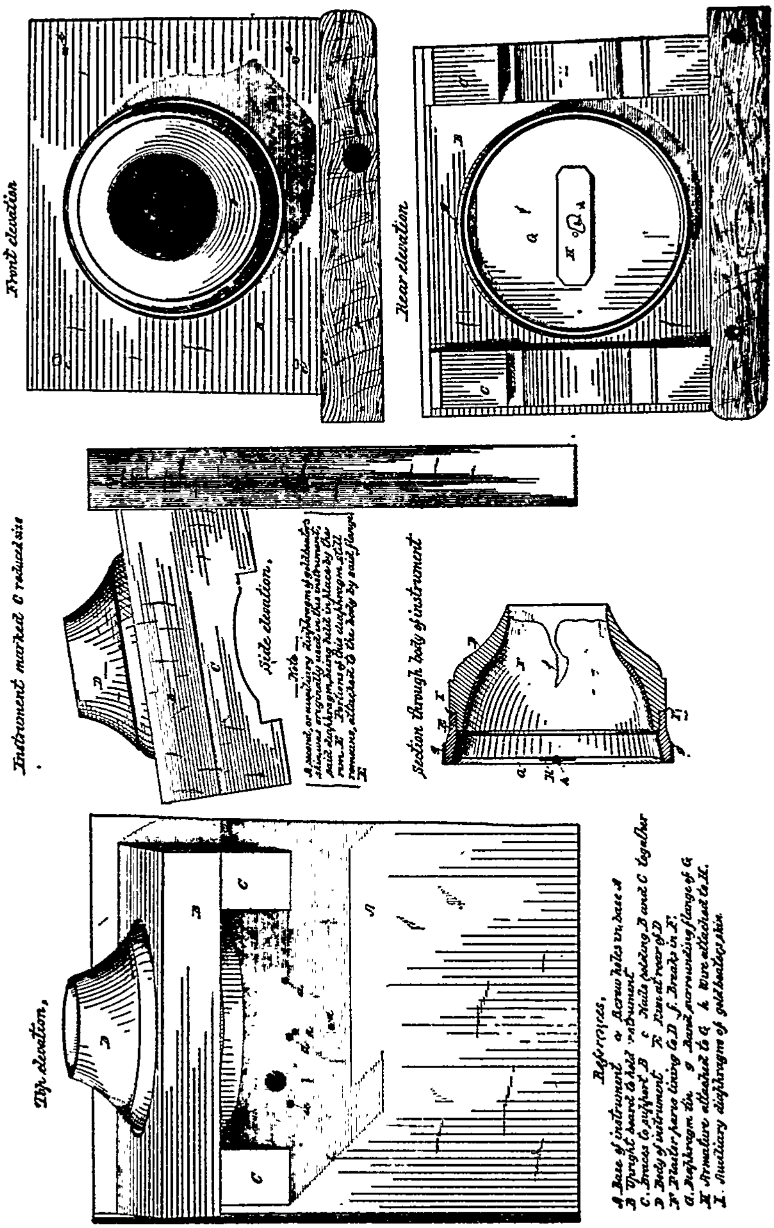
The conductor *H* is attached to the edge of the diaphragm; the opposite edge of the diaphragm is notched, to allow passage for a conducting wire (not on instrument) through the cap to the wire *d'*.

Statement of the Case.

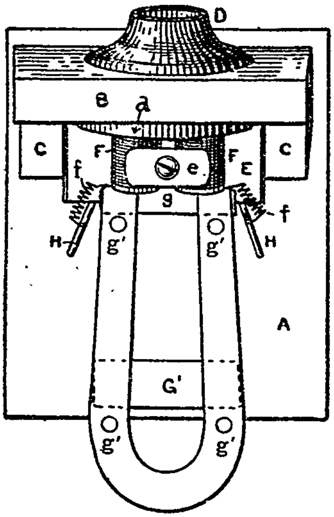
Instrument marked B. ½ size.



Statement of the Case.



Reproduction of Instrument C. Plan View.



REFERENCES.

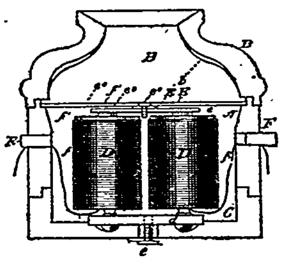
A. Base board.
B. Upright to hold body of instrument.
C. Supports of *B.*
D. Body of instrument.
d. Band on rim of *D* to hold diaphragm in place.
E. Block to support electro-magnets.
e. Plate to hold electro-magnets in place, brass.
e'. Screw to secure *e* and *E* to *A.*
F. Electro-magnets.
f. Wires to *F.*
G. Permanent magnet.
G'. Block to support *G.*
g. Paper to raise end of *G.*
g'. Rivets in *G.*
H. Studs in block *E* to receive wire.

NOTE.

This instrument is similar in all respects to original instrument marked *C* having armature attached to diaphragm, therefore I have thought two views sufficient in this case.

Instrument marked I. One form.

Longitudinal section showing electro-magnets and diaphragms.



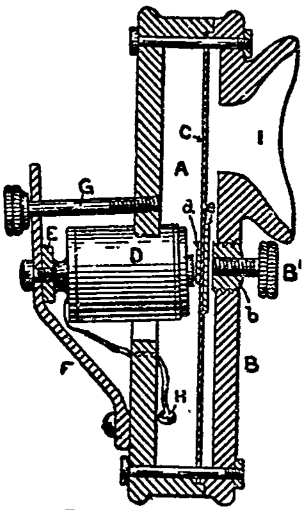
I. *Second State.* ½ *size.*

REFERENCES.

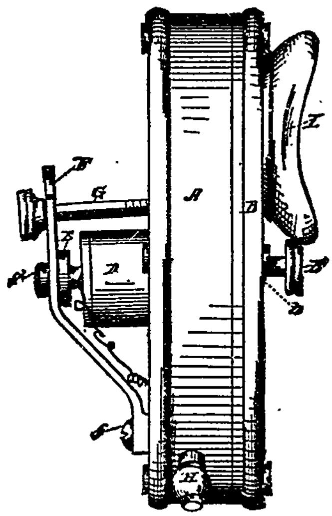
A. Body of instrument; black walnut.
B. Cap of instrument.
b. Plaster-paris lining to *B.*
C. Lower cap.
D. Electro-magnets.
d. Bar supporting magnets.
E. Upper diaphragm.
E'. Lower diaphragm.
e. Armature of magnets.
e'. Screw holding *d* in place.
e². Screw holding *E'* to *e.*
e³. Paper ring between *E* and *E'.*
e⁴. Paper ring or gasket above *E.*
F. Plugs to hold wire.
f Wire or conductors.

Statement of the Case.

Instrument marked A. ½ size.



Longitudinal section.

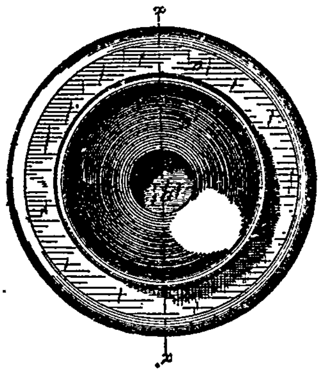


Side elevation.

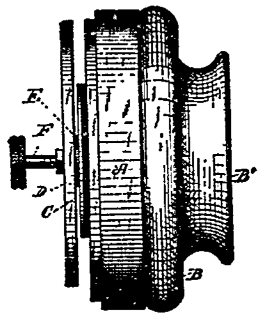
REFERENCES.

A. Case of black walnut.
B. Cover or cap to same.
B'. Adjusting screw for diaphragm; brass.
b. Screw block in cap through which *B'* passes.
C. Diaphragm; of thin black walnut.
c. Rubber cemented to *C.*
D. Electro-magnets.
d. Armature on diaphragm.
E. Plate connecting magnets.
F. Bracket to support magnets.
f. Screws securing same to case.
f². Screw holding plate *E* to bracket.
G. Adjusting screw for bracket.
H. Screw cups.
I. Mouth or ear piece.
i. Conductors or wires.

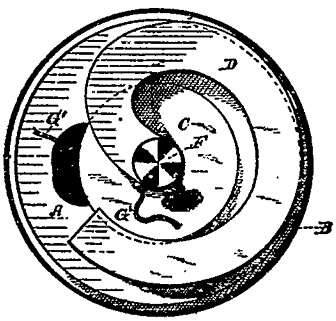
Instrument marked D.



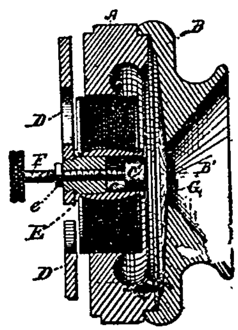
Front elevation.



Side elevation.



Rear Elevation.

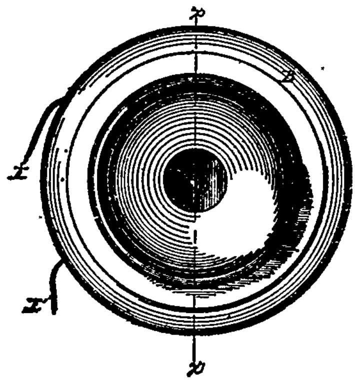


Section on

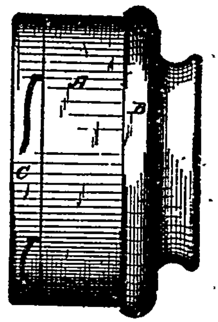
REFERENCES.

A. Body of instrument.
B. Cap of instrument.
B'. Mouthpiece.
C. Electro-magnet.
c. Hollow core of *C*; iron.
c'. Adjustable plug in *c*.
D. Permanent magnet.
E. Screw plug to support *D*
e. Jam nut on adjusting
F. Adjusting screw for *c'*.
G. Diaphragm tin.
G'. Conductors or wires.

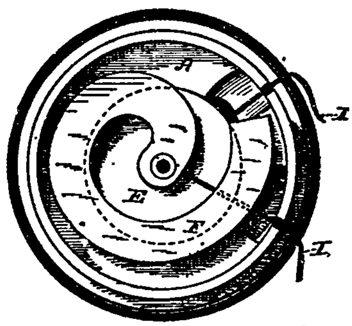
Instrument marked E. Full size.



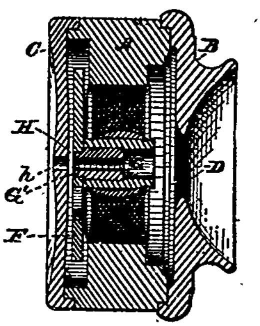
Front elevation.



Side elevation.



Rear elevation. Cap off.

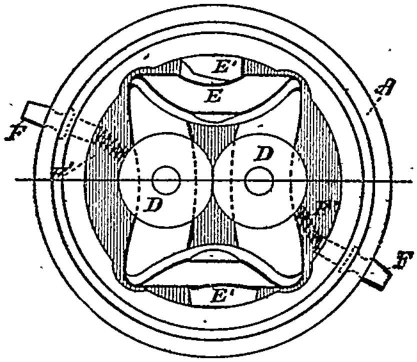


Section on line xx.

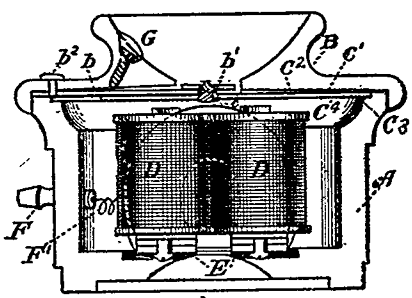
REFERENCES.

A. Body of instrument.
B. Cap of instrument.
C. Rear cap of instrument.
D. Diaphragm.
E. Electro-magnet.
F. Permanent magnet.
G. Hollow core of *E*; iron.
G'. Screw plug to support *F.*
H. Female screw in *G'.*
h. Aperture in *C.*
I. Wires.

Instrument marked L. ½ size.



Top view. Cap and Diaphragm removed.



Section on line xx.

REFERENCES.

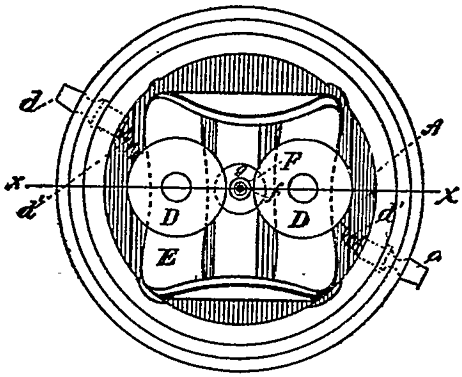
A	Body of instrument.	*B.*	Cap of same.
b.	Pressure spring.	*b'.*	Metal block on spring.
b².	Rivet in same.	*C.*	Compound diaphragm; two part.
C'.	Upper diaphragm.	*C⁴*.	Lower diaphragm.
C².	Perforations in *C'*.	*c.*	Rivet connecting *C'* and *C⁴*.
C³.	Paper ring between *C'* and *C⁴*.	*D.*	Electro-magnets.
E.	Permanent magnets.	*E'*.	Wood wedges to hold *E* in place.
F.	Binding-posts.	*F'*.	Wires from *D* to *F*.
G.	Adjusting screw to spring *b*.	*b²*.	Rivet holding spring *b* to cap.

NOTE.

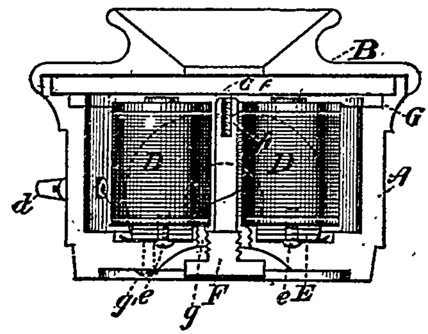
The upper diaphragm is made of copper, perforated; the lower one is made of iron.

Statement of the Case.

Instrument marked M.



Top view. Cap and diaphragm removed.



Longitudinal section on line xx. Top view.

REFERENCES.

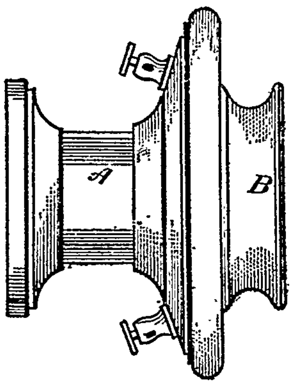
A. Body of instrument.
C. Diaphragm.
d. Binding posts.
E. Permanent magnet.
F. Adjusting screw or post.
G. Rubber ring.
g'. Screw to secure *E* to *A*.
B. Cap of instrument.
D. Electro-magnets.
d'. Wires.
e. Screws connecting *E* to *D*.
f. Recess for screw in end of *F*.
g. Nut in end of body *A* for adjusting post *F*.

NOTE.

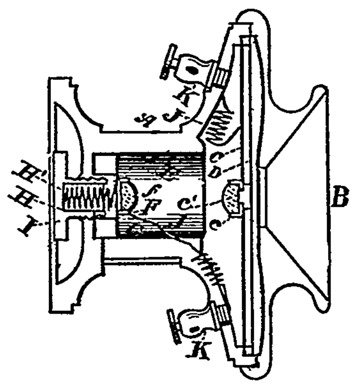
The magnet *E* is secured to the body of the instrument by screws, one of which is shown by dotted lines at *g'*.

At one time the diaphragm of this instrument was made of tin, and was rigidly attached to the post *F* by a screw which entered the recess *f* in the post *F*.

Instrument marked O. Full size.



Side elevation.



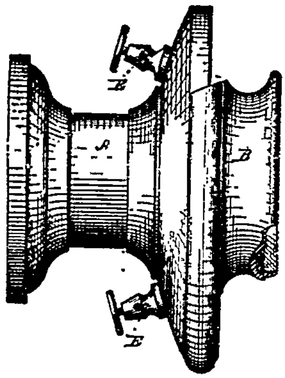
Longitudinal section.

REFERENCES.

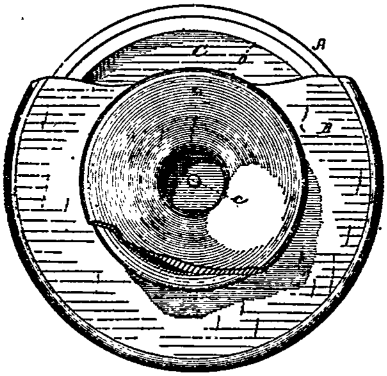
A. Body of instrument.
B. Cap of same.
C. Diaphragm.
c. Carbon cup on diaphragm; brass.
c'. Carbon ball in cup *c*.
D. Cardboard ring.
E. Recess for carbon holder.
F. Lower carbon cup; brass.
f. Carbon ball in same.
G. Wood ring.
H. Recess in adjusting screw.
H'. Spiral spring in same.
I. Screw; adjusting.
J. Wires or condutors.
K. Screw cups.

Statement of the Case.

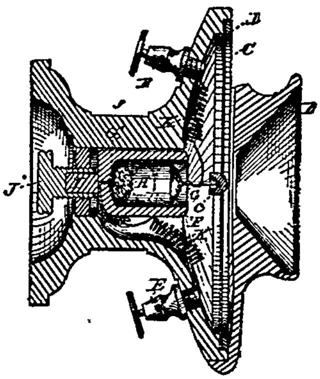
Instrument marked G. Full size.



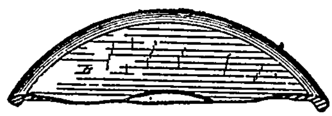
Side elevation.



Top plan view.



Longitudinal Section.



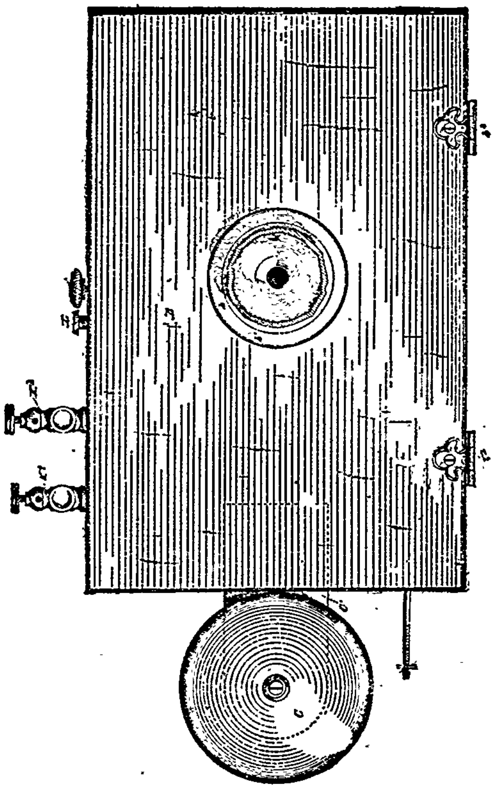
Fragment of cap.

Contact tips.

References.

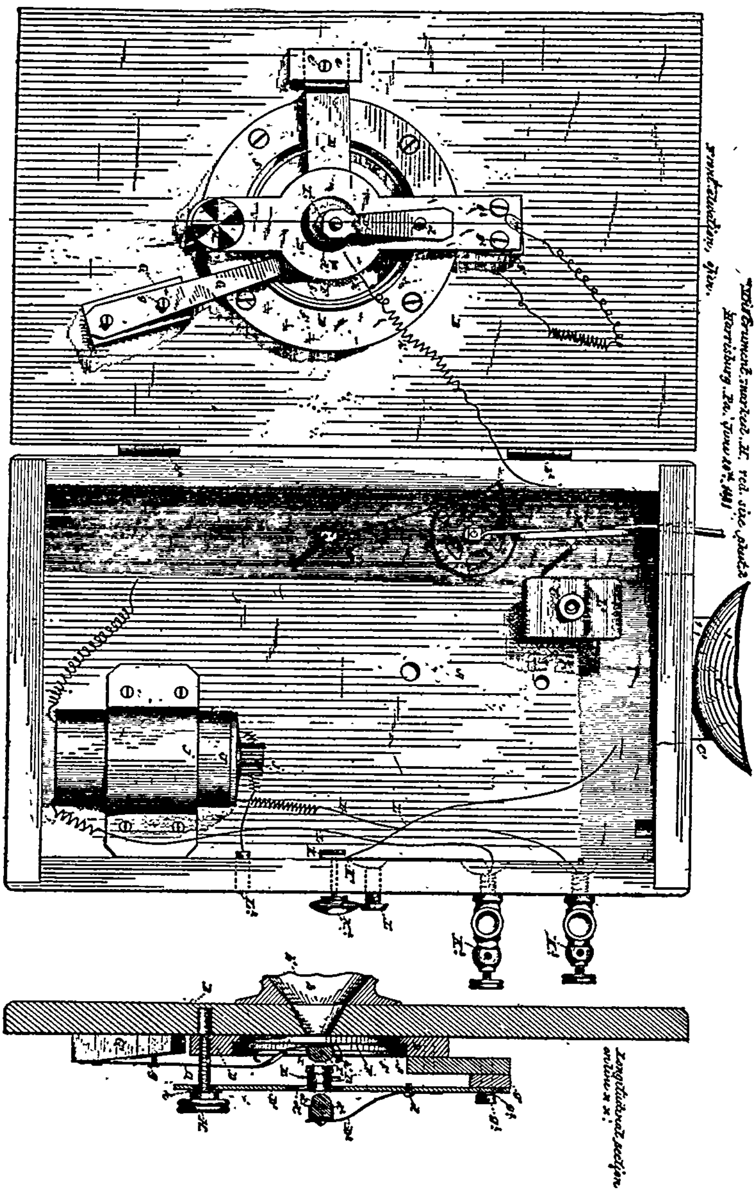
A. Body of instrument.
B. Cap of instrument.
C. Diaphragm.
c. Contact cup on diaphragm.
D. Paper ring.
E. Screw cups.
F. Carbon holder; wood.
GG'. Contact tips in holder.
H. Carbon ball.
I. Rubber spring in adjusting screw.
J. Adjusting screw.
K. Conductors.

Instrument marked H. ¼ size.



Elevation.

Statement of the Case.



Statement of the Case.

REFERENCES TO THE DRAWINGS OF INSTRUMENT H.

A. Body of instrument.
B. Door of instrument.
b. Mouthpiece.
b'. Break in *b*.
b^2. Hinges to door.
C. Bell to instrument.
C'. Support to bell.
D. Casting for supporting diaphragm; iron.
D'. Plate to support contact spring.
D^2. Contact spring.
d. Screw securing D^2 to D'.
d'. Aperture through D'.
d^2. Carbon holding cup; brass.
d^3. Carbon block in d^2.
E. Plate or bracket to hold intermediate carbon cup; brass.
e. Block of wood on end of *E*.
e'. Screw securing *e* and *E* to *B*.
F. Diaphragm; corrugated iron.
f. Rubber ring.
f'. Wire to hold diaphragm in place.
G. Pressure spring for diaphragm.
G'. Block to which *G* is attached,
g. Adjusting screw to *G*.
g'. Wood insulator between *D* and D'.
g^2. Screw securing D' to *D*.
g^3. Rubber sleeve insulating D' from g^2.
H. Adjusting screw to D'.
h. Rubber sleeve insulating D' from *H*.
h'. Wire to diaphragm; conducting wire.
I. Carbon holding cup.
I'. Carbon ball in *I*.
I^2. Intermediate carbon holding tube; wood.
J. Induction coil.
j. Band holding *J* in place; brass.
j'. Wire core of *J*.
K. Signal plate. K'. Contact spring.
K^2. Key. K^3. Binding posts.
L. Screw to secure switch.
L'. Conductors.
L^2. Switch contacts.
L^3. Plate to hold electro-magnets for bell in place.
l. Bolt to plate L^3.
M. Armature connected with bell hammer.
m. Pivotal point of *M*.
m'. Spring to *M*.
N. Cord to increase power of spring m'.

Dolbear's answer also made the following allegations.

"12. These defendants have never been concerned in the manufacture or sale of telephones embracing the inventions or either of them, or any substantial or material parts of either of them, described in either of the patents mentioned in the bill of complaint; but they admit the manufacture and use of telephones invented by the defendant Dolbear and described in his Letters Patent No. 239,742, dated April 5, 1881; No. 240,578, dated April 26, 1881; and aver that they have full right to manufacture, use, and sell such telephones, and that they are radically different in all substantial respects from any invention described in either of the said Bell patents. The transmitter used in the Dolbear telephone is in all material respects identical with the Reiss-Wright transmitter. It is a Reiss transmitter in a circuit of small resistance, having a helix as a part of it, with the transmitting core in that helix; the line is an open circuit, and is the first open circuit ever used for any practical purpose, and it was wholly unknown until Dolbear's discovery that such a line was capable of any practical use. The receiver is wholly new, wholly unlike any prior instrument, and operates upon a principle never before applied in any of the useful arts. The method invented by Dolbear, and the only method practised when his apparatus is used, is precisely the same as the Reiss-Wright method so far as concerns the use of the energy of the sound-waves to vary the electric current in a circuit of small resistance, and the use of the current so varied to vary the magnetic energy of the transmitter core; but is wholly new with Dolbear in all other respects, for the magnetic variations of the transmitter core must be converted into electric variations of many times greater electro-motive force than any ever before utilized for any practical purpose, and must be generated in a line whose resistance is practically infinite, and must be transformed directly into sound-waves. Dolbear's method is his own discovery and invention, is radically different from all other methods of transmitting sounds, except as to its first step, which is the same as that of the Reiss-Wright method, and is of the highest value and importance, inasmuch as it remedies fully some very serious faults in the Bell method, which was the best known before Dolbear's discovery."

The following are copies of those two patents.

UNITED STATES PATENT OFFICE.

AMOS E. DOLBEAR, OF SOMERVILLE, MASSACHUSETTS.

APPARATUS FOR TRANSMITTING SOUND BY ELECTRICITY.

Specification forming part of Letters Patent No. 239,742, dated April 5, 1881. Application filed October 11, 1880. (Model.)

To all whom it may concern:

Be it known that I, AMOS E. DOLBEAR, of Somerville, in the County of Middlesex and State of Massachusetts, have invented a new Apparatus for Transmitting Sound by Electricity, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, making a part hereof, in which—

Figures 1 and 2 are two views of the best form of apparatus for practising my invention. Fig. 3 is a cross-section, enlarged, of the receiver shown in Fig. 1. Fig. 4 is a plan of one of the plates. Fig. 5 is a diagram illustrating the system.

My invention consists, mainly, in a new mode of transmitting articulate and other sounds by an open circuit.

It also consists in new apparatus for this purpose.

My receiver is based upon the well-known principle that one terminal of an open circuit will attract the other terminal when both are charged; and my invention consists, mainly, in the arrangement of the enlarged terminal of the secondary coil of an induction-coil so that it will be vibrated toward and from the other terminal by variations in the electric state of the coil, and in such a manner as to reproduce sound-vibrations of all qualities, including articulate speech, when the primary circuit of the induction-coil contains a suitable transmitter.

Another feature of my invention relates to the system of

I. *Dolbear's Patent of April* 5, 1881.

(Model.) 2 Sheets—Sheet 2.

A. E. DOLBEAR.

Apparatus for Transmitting Sound by Electricity.

No. 239,742. Patented April 5, 1881.

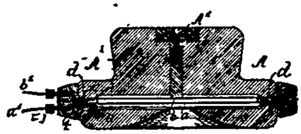


Fig. 3.

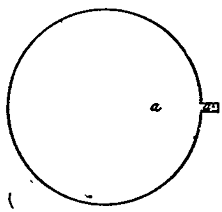


Fig. 4.

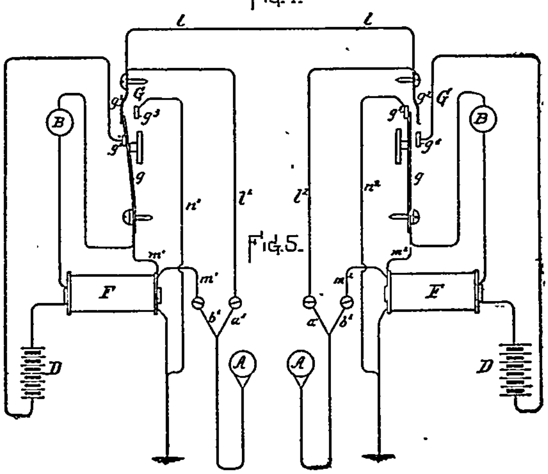


Fig. 5.

(Model.) 3 Sheets—Sheet 1.

A. E. DOLBEAR.

Apparatus for Transmitting Sound by Electricity.

No. 239,742. Patented April 5, 1881.

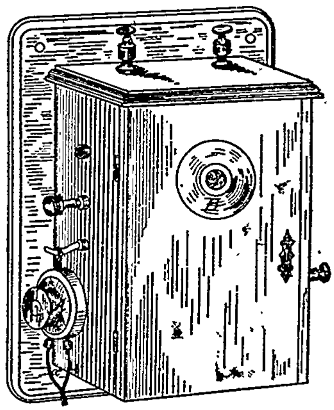


Fig. 1.

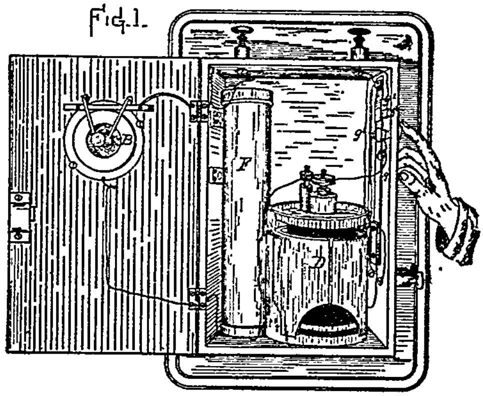


Fig. 2.

connecting two or more receivers and two or more transmitters for practical use; and it consists in the combination of two induction-coils, two receivers, and two transmitters in a novel manner, fully described below.

The best form of my receiver is that shown in elevation in Fig. 1, and in cross-section in Fig. 3.

In Fig. 3 the case of the receiver A is shown as made up of three pieces—a back piece, *r*, an ear-piece, *s*, and an annular connecting-piece, *t*, for connecting the pieces *r* and *s* together.

a b are thin elastic plates, preferably of iron, forming terminals of the secondary coil of an induction-coil. These plates are securely fastened about the edges and brought very near to each other, but not in contact, a thin annulus, *d*, lying between them. This is best effected by forming a thin flange, *d*, on the interior of the connecting-piece, *t*, and placing the terminals *a b* on opposite sides of this flange. The ear-piece *s* of the case holds the terminal *a* in place with the proper tension around the edge to insure mass vibrations of that terminal. The terminal *b* is held in place by the back piece, *r*, of the case. Each of the plates *a* and *b* is formed with a small tongue, a^2, (see Fig. 4,) with which the binding-screws are connected, as shown.

As the section-plane in Fig. 3 will pass through but one of the binding-screws, (that for the wire a',) the receiver is shown broken away at *x*, in order to show the binding-screw for the wire b'. Both are shown in Fig. 1. One of the binding-screws connects with plate *a*, the other with plate *b*. By the use of the tongues an even pressure around the whole edge of the plate is possible.

The adjustment of the instrument is effected by the screw A′; and this screw, by contact upon the back plate, *b*, prevents any vibrations of that plate which interfere with the proper vibrations of the front plate, *a*.

My system requires electricity of a very high electro-motive force, and this is best obtained by means of a secondary coil with a high resistance, the best results having been obtained from four or five thousand ohms of No. 36 copper wire.

Transmitters such as are in common use will answer with my receiver; but the best form of transmitter is that shown in the drawings, (which is not here described, as it forms the subject of an application for a patent filed by me May 31, 1880.)

The main advantages of my new system over all others known to me are, that it is not appreciably affected by ordinary induced currents on the line, it has no magnet to deteriorate, the adjustment is more simple and is not affected by barometric and hygrometric variations, and it lacks the fine-wire helix of the common receiver, which is very liable to get out of repair. It is very efficient also on very long lines.

The best system for the practical use of my invention is illustrated in the diagram, Fig. 5, and the best form of apparatus is that shown in Figs. 1 and 2. In these figures, A represents the receivers, B the transmitters, D the batteries, F the induction-coils, and G switches.

The transmitter B and battery D are in the circuit with the primary coil of the induction coil F, and this circuit is completed, when the transmitter is to be used, by throwing over the member g of switch G until it makes contact with the member g', thereby completing the battery-circuit through the transmitter and primary coil. The electricity induced in the secondary coil affects the plates in the distant receiver by means of that branch of wire m' which extends from one end of the secondary coil to member g of switch G, members g and g^2 of switch G, the line-wire l, which is a continuation of member g^2 of switch G, wire l^2, which is a branch of line-wire l, receiver-wires a' b', wire m^2, members g g^3 of switch G, wire n^2, to earth, thus cutting out the receiver at the sending-station (on the left of the diagram) and the secondary coil on the right of the diagram.

When the sending-station is at the right of the diagram, the switch G at the right will be arranged as is the switch G at the left, and the receiver at the left is electrified by means of wire l', receiver-wires a' b', (at the left of the diagram,) wire m', members g g^3 of switch G, (at the left of the diagram,) wire n', to earth.

The switch G is composed of two springs, g g^2, and two stops, $g' g^3$, arranged as shown, so that when spring g is brought in contact with stop g' it will also be in contact with spring g^2, and when spring g is in contact with stop g^3 it will be out of contact with both spring g^2 and stop g'. One end of the secondary coil on the left of the diagram is connected with spring g on the left of diagram by means of one branch of wire m' and with receiver-wire b' on the left of diagram by means of the other branch of wire m', and one end of the secondary coil on the right of the diagram is connected with spring g on the right of diagram by means of one branch of wire m^2, and with receiver-wire b' on the right of the diagram by means of the other branch of wire m^2.

I am aware of the apparatus mentioned as used by Dr. Wright in "Ferguson's Electricity," published by William and Robert Chambers, of London and Edinburgh, in 1867, pages 258 and 259, in which two sheets of paper silvered on one side were placed back to back and connected with the two ends of an induction-coil, the primary circuit of which contained a Reis transmitter; and I disclaim that apparatus. My receiver differs from it in that the sounds transmitted are reproduced by the mass vibrations of one of the terminals, while in the Wright receiving apparatus the sound produced was mainly, if not altogether, due to molecular motion, and not to mass vibrations. Moreover, Wright's sheets of silvered paper were so arranged that each would damp any mass vibrations of the other; and in his apparatus any slight mass vibrations, even if not wholly damped, would be necessarily so irregular as to be worthless as a means of reproducing sounds. The fact, also, that the mass vibrations of each sheet damped those of the other sheet would make all the mass vibrations worthless for this purpose.

I am also aware of English Patents No. 4934 of 1877 and No. 2396 of 1878, and disclaim all therein shown.

What I claim as my invention is—

1. The receiver above described, consisting of the plates $a\,b$, mounted in case $r\ s\ t$, and separated by the annulus d, in combination with induction-coil F, substantially as described.

2. In combination, two induction-coils, the primary of each

containing a battery, D, and transmitter B, and the secondary circuits, each containing receiver A, by means of switches G, consisting of members $g\ g'\ g^2\ g^3$, whereby the receiver at the sending-station and coil at the receiving-station are switched out of the line, substantially as described.

AMOS E. DOLBEAR.

Witnesses:

W. A. COPELAND,

J. R. SNOW.

UNITED STATES PATENT OFFICE.

AMOS E. DOLBEAR, OF SOMERVILLE, MASSACHUSETTS.

MODE OF TRANSMITTING SOUND BY ELECTRICITY.

Specification forming part of Letters Patent No. 240,578, dated April 26, 1881. Application filed February 24, 1881. (Model.)

To all whom it may concern:

Be it known that I, AMOS E. DOLBEAR, of Somerville, in the county of Middlesex and State of Massachusetts, have invented a new Mode of Transmitting Sounds by Electricity, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, making a part hereof.

My invention consists, mainly, in a new mode of transmitting articulate and other sounds by an open circuit.

It also consists in new apparatus for this purpose.

My receiver is based upon the discovery that one terminal of an open circuit will attract and be attracted by a neighboring body when the terminal is charged.

Figure 1 shows two modifications of my receiver, in section, connected in circuit with a transmitter and induction-coil. Fig. 2 shows another modification of my receiver.

Three forms of my receiver are shown in the drawings. In each the casing is formed of three pieces, *r* being the back-piece, *s* the ear-piece, and *t* the connecting-piece which connects *r* and *s* together. The plate *a* of receiver I is a thin

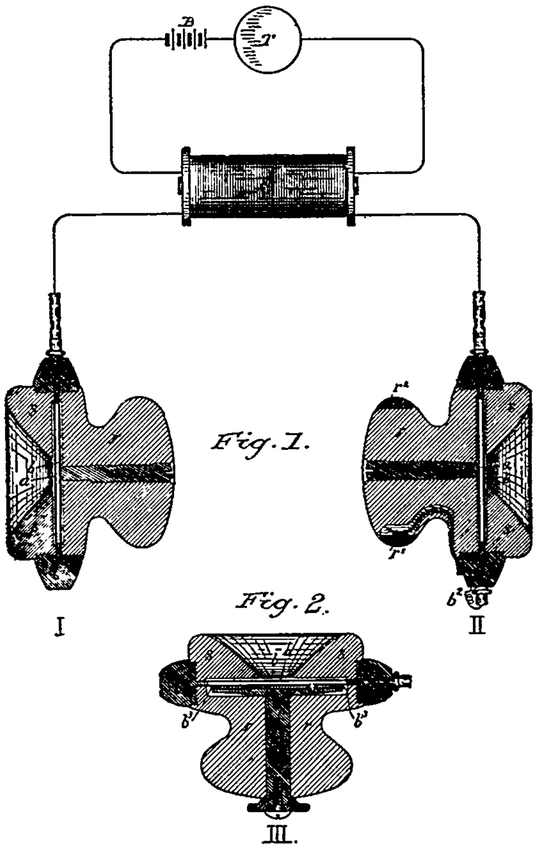
II. *Dolbear's Patent of April* 26, 1851.

(Model.)

A. E. DOLBEAR.

Mode of Transmitting Sound by Electricity.

No. 240,578. Patented April 26, 1881.



elastic disk, preferably of iron, the vibrations of which reproduce the sound which causes the diaphragm of the transmitter T to vibrate, T representing a transmitter of suitable construction, the form preferred being that shown in my application for a patent filed May 31, 1880, the transmitter T and the battery B being in circuit with the primary coil, as will be clear without further description.

In receiver I the plate *a* is one terminal of the secondary coil F, and any change in the electrical state of coil F varies the potential of this plate *a* in receiver I and causes it to attract plate *b*, which is mounted close to, but not in contact with, plate *a*; but as plate *b* in receiver I is so mounted that it cannot vibrate, plate *a* will vibrate as its potential varies. In receiver I the plate *b* and back-piece *r* and adjusting-screw *u* are all of metal.

It will be seen that neither the plate *b* nor back-piece *r* nor screw *u* of receiver I is connected to the coil F, but that only one terminal of coil F — viz., plate *a* — forms any part of the receiver I. The plate *b* may be made in one piece with back-piece *r*, but for purposes of adjustment is best made as shown.

The force of the attraction between the charged terminal *a* and any neighboring body is slight, unless the neighboring body be many times larger than the terminal and itself capable of being readily electrified, and for this reason, when the neighboring body is a plate, (as it is best made for purpose of adjustment,) it should be electrically connected with a larger body. Consequently the back-piece *r* of the case of receiver I is made of metal, and is in metallic contact with plate *b*. The neighboring body, which is attracted by plate *a* in receiver I, (being, in fact, the plate *b*, piece *r*, and screw *u*, which are all of metal and in metallic contact,) acts as one body in this receiver I; but, as will be clear, the back-piece *r*, plate *b*, and screw *u* may be one single piece of metal, and some other provision be made for the necessary adjustment.

In receiver I I the terminal *a* is mounted upon back-piece *r*, so that it cannot vibrate, and must therefore be insulated. Consequently the back-piece *r* is made of hard rubber. The plate *b*, which is the neighboring body in receiver I I, is connected by the wire b^2 with a metal band, r^2, upon back-piece *r*, in order to increase the attractive force due to the electrification of a greater mass than plate *b*, and without interfering with the proper vibration of plate *b*, which, in receiver I I, vibrates as the potential of terminal *a* varies.

It will be clear that either of the plates *b* may be grounded, and thereby increase the electrification of these plates; but it is not necessary to ground either of them, and the audibility of the sounds reproduced is practically as great when the back-piece of the receiver is held in the hand as when the plates *b* are both grounded; and it makes no difference whatever whether both be grounded or only one. In other words, receiver I will reproduce articulate and other sounds, even if back-piece *r* be of hard rubber or other non-conductor and plate *b* be wholly disconnected from coil F, but the sounds reproduced are faint, although distinct and audible. The sounds will be louder if the piece *r* be of metal, as above described, or if the plate *b* or metallic piece *r* be grounded; but the difference is very slight, the sounds being practically as loud when the metal piece *r* is used as when the plate *b* is grounded. And so of receiver I I the sounds are distinct and audible when wire b^5 and metal band r^2 are omitted, but louder when metal band r^2 and wire b^2 are used, as shown, or when plate *b* of receiver I I is grounded. Moreover, the reproduction of sound by receiver I does not depend at all upon the grounding of any part of receiver I I, for receiver I will act with plate *b* of receiver I I not grounded precisely as it does when plate *b* of receiver I I is grounded, and receiver I I will act when plate *b* of receiver I is not grounded precisely as it acts when that plate of receiver I is grounded.

In my application filed October 31, 1880, I have described a receiver in which both the plates *a* and *b* are connected with the coil F, and I therefore disclaim in this application any receiver having both the plates connected with that coil, my present invention consisting in a receiver in which only one terminal of the coil is used, as above explained.

Instead of making plate *b* of metal and connecting it metallically with back-piece *r* or band r^2, it may be made of any non-conductor, and in this case the increased loudness is produced by electrifying plate *b* before it is put in place; or, as shown in receiver I I I, where *b* is a rubber plate, and b^3 is a disk of felt fast to the hard-rubber support b^4, which is turned by the thumb and finger to electrify rubber plate *b* by friction.

What I claim as my invention is —

In combination, a primary coil in circuit with battery B and transmitter T, and a secondary coil with its enlarged terminal *a* mounted in case *r s t*, and arranged near plate *b*, plate *b* being also mounted in case *r s t*, but not connected with the secondary coil, all substantially as described.

AMOS E. DOLBEAR.

Witnesses:
J. E. Maynadier,
John R. Snow.

The answer of the Molecular Company further contained the following averment: "Defendants admit that the Molecular Telephone Company does intend and purpose when it shall have hereafter made the necessary arrangements to manufacture and use electric speaking telephone instruments of the character, kind and description substantially as described in said Letters Patent Nos. 228,824 and 228,825, but defendants allege that said Molecular Telephone Company has lawful right so to do. Defendants deny that the said instruments so described in said patents Nos. 228,824 and 228,825, and about to be used by defendant, the Molecular Telephone Company, are substantially like those described in either of said Bell patents, or that said instruments operate by or according to the method set forth in either of said Bell patents." No. 228,824 there referred to was granted to Robert M. Lockwood and Samuel H. Bartlett, June 15, 1880, for improvements in transmitters for telephones; and No. 228,825, to the same persons on the same date for an improvement in telephone receivers.

This company and the Overland Company also relied upon a description of a magnet used in the Hughes printing telegraph, printed in a German work by Schellen, (of which the following is a translation,) as anticipating the invention covered by claim 5 in Bell's second patent.

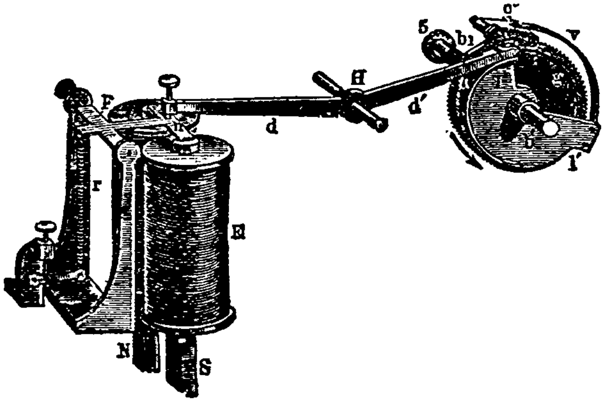


Fig. 375.

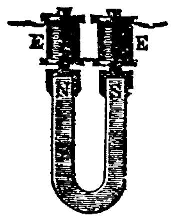


Fig. 376.

"The rapidity with which successive signals can be transmitted depends essentially upon the time required to charge and discharge the line. This time increases with the length and section of the conductor; moreover, as the discharge always occupies a longer interval than the charge, it follows that the signals will become indistinct at the receiving end if they are sent into the line before the discharge shall have been effected, as in this case the charge and discharge combine and cause a prolongation of the signals, causing them, as it were, to run together.

"It will be readily understood from this, that the armature of an electro-magnet or the needle of a galvanometer may be caused to move even before the current in the line has attained its permanent condition, and may in like manner return to a position of rest before the line is completely discharged.

"The armature of an ordinary electro-magnet is necessarily at a greater distance from its poles at the moment when it is attracted than at the moment when it is released after having been attracted; consequently, the strength of current which will be required to attract the armature must be much greater than that which will permit it to be released or drawn away by the retracting spring. Therefore, a telegraphic signal which is to be produced by means of the armature of an electro-magnet, cannot be completed until the current has attained the necessary strength to cause it to be attracted, and has again sufficiently diminished to allow it to be drawn away by the tension of the spring. The more nearly the values of these two strengths of current can be made to approximate each other, the more rapidly successive signals may be received. Consequently, when the receiving instrument consists of an electro-magnet, the rapidity of signalling depends essentially upon the distance of the armature from its poles, and upon the amount of play which the latter is permitted to have. The less the distance through which the armature moves, the more rapidly the signals may be made to succeed each other. The degree of sensitiveness of an electro-magnetic instrument has but little influence upon the rapidity with which the signals may be made to succeed each other. For example, let us suppose that the current in the permanent condition of the line is equal to 25, but that the armature of the electro-magnet is attracted as soon as the current has gained a strength of 10, and that it falls off again as soon as, by the disconnection of the battery, the strength of the current has diminished to 7. A distinct signal will be obtained in this case whenever the current increases from 7 to 10 and decreases again to 7. If the apparatus is made less sensitive by increasing the tension of the spring, then the current must be increased in order to overcome this tension and attract the armature. If we suppose that this attraction takes place when the current has attained the strength of 15, and that the armature is released when the current is diminished to 12, the margin will be as great, if not greater, in the latter case, and therefore the less sensitive instrument will operate at least as rapidly as the other.

"In the arrangement of the electro-magnet which was invented by Hughes, the action is entirely different. In its normal position of rest, the armature is held nearly in contact with a permanent magnet, the tension of the retracting spring being increased to an extent almost sufficient to overcome the attraction of the latter. When this permanent magnetism is diminished in the smallest degree by the action of the current, the armature instantly falls off, and is afterwards replaced in its original position, not by the action of the current, but by means of a mechanical device, which is set in action by the falling off of the armature. Therefore, the sooner the current attains sufficient strength to release the armature, the quicker the electro-magnet operates."

Dr. Van der Weyde was also relied upon as having anticipated some of the inventions claimed under the second patent.

The Clay Commercial Company contested the regularity of the formation of the Corporation complainant (the American Bell Telephone Company) and further made the following averments respecting the infringements of the Bell patents charged in the bill.

"This respondent denies it to be true, as in said bill alleged, that it has at the city of Philadelphia, or elsewhere, since the first day of February, in the year of 1884, or at any other time, made and used, or furnished to others to be used, or sold, or caused to be sold, electric speaking telephones, constructed and adapted for the transmission of articulate speech, by and according to the method described and claimed in said patent to the said Bell, No. 174,465, and embracing and embodying in one integral organization the alleged inventions and improvements, or material and substantial parts thereof, described and claimed in said patents to said Bell, No. 174,465 and No. 186,787 respectively. On the contrary, this respondent saith, that the telephones made, used and sold by it have been made and constructed under and in pursuance of certain Letters Patent of the United States, issued and granted, upon due application, and in conformity with law, unto one Henry Clay, as the first and original inventor of said patented improvements respectively, and by him duly assigned to this respondent, which said Letters Patent are respectively of the dates, numbers, and titles, following; to wit, May 8, 1883, No. 277,112, for a new and useful improvement in Telephones; July 3, 1883, No. 280,351, for Switch-board for Telephones; July 3, 1883, No. 280,451, for Telephone Call-bell; July 3, 1883, No. 280,580, for Transmitter for Telephones; Nov. 6, 1883, No. 288,017, for Telephonic Transmitter. And the respondent saith, that the devices and methods of operation set forth in these said several Letters Patent, and used by the respondent, are not similar to, but are wholly different from, the devices described and claimed in the said Letters Patent of the said Bell, and are not violations or infringements of said Letters Patent, and do not embody or embrace the method, principle, operation, or construction therein or thereby set forth described and claimed."

The Overland Company in its answer made the following averment respecting Drawbaugh's invention: "Because the said Bell, in obtaining said patent, surreptitiously and unjustly obtained a patent for that which was in fact invented by another, to wit, said Daniel Drawbaugh, who was using reasonable diligence in adapting and perfecting the same:" and the following denial of infringement of Bell's patents: "This defendant on information and belief denies that it has ever infringed the said two patents numbered 174,465 and number 186,787, here in suit, or either of them, but further answering, says that it has become the owner, by assignments from Myron L. Baxter, of Aurora, Kane County, Illinois, of certain inventions in transmitting and receiving telephones described and shown in two several Letters Patent of the United States, granted to said Baxter, to wit, Letters Patent No. 277,198, dated May 8, 1883, for transmitting telephone, and Letters Patent No. 277,199, granted to said Baxter May 8, 1883, for receiving telephone; and that it has on a few occasions within two or three months last past privately, and merely for experimental and test purposes, operated a few of said Baxter instruments, but that it has never sold any of said instruments, nor put them on sale, nor put them into use for gain or profit or for any business purpose, nor for any other purpose than merely to test their novelty, working capacity and value, and to determine whether any, and, if so, what, further improvements could be made upon them, and to ascertain to the satisfaction of its experts and counsel whether the said Baxter telephones infringe any lawful or valid patent or patents heretofore granted to others."

The proofs and record in a case known as the Dowd case, heard and adjudged in the Circuit Court of the United States for the District of Massachusetts, and in which the Western Union Telegraph Company, the American Speaking Telephone Company, and the Gold and Stock Company were the real parties defendant, and also the proofs and record in another case, known as the Spencer case, heard and adjudged in the same court, were imported into the Overland case. The Spencer case is reported 8 Fed. Rep. 509.

In the Dolbear case the final decree was "that the letters patent referred to in the complainants' bill, being letters patent of the United States, granted unto Alexander Graham Bell, No. 174,465, for improvement in telegraphy, dated March 7th, 1876, is a good and valid patent; and that the said Alexander Graham Bell was the original and first inventor of the improvement described and claimed therein; and that the said defendants have infringed the fifth claim of said patent and upon the exclusive rights of the complainants under the same;" and a perpetual injunction was ordered. From this decree the respondents appealed. See 15 Fed. Rep. 438, for the opinion of Mr. Justice Gray in granting the preliminary injunction; and 17 Fed. Rep. 604, for the opinion of Judge Lowell on final hearing.

In the Molecular case, 23 Blatchford, 253, the final decree was "that the several letters patent upon which this suit is brought, viz.: Letters patent granted to Alexander Graham Bell for an improvement in telegraphy, dated March 7, 1876, and numbered No. 174,465, and letters patent granted to said Bell for an improvement in electric telegraphy numbered No. 186,787, and dated January 30th, 1877, are good and valid in law; that the said Alexander Graham Bell was the original and first inventor of the inventions described in said several Letters Patent Nos. 174,465 and 186,787; that the title thereto, and to the inventions described and claimed therein, is vested in the complainants; and that the defendants have infringed the fifth claim of said letters patent No. 174,465, and the sixth, seventh, and eight claims of said Letters Patent No. 186,787, and the exclusive rights of the complainants under the same." The defendants appealed from the whole decree; and the complainants from it "in so far as it fails to adjudge that the fifth claim of Letters Patent No. 186,787 is good and valid in law, and that the defendants have infringed the same, and in so far as it fails to decree the relief prayed for in the bill of complaint herein under said fifth claim."

In the Clay commercial case it was decreed that the patents were valid, and that the defendants had "infringed the fifth claim of said Letters Patent, No. 174,465, and the third, fifth, sixth, seventh and eighth claims of said Letters Patent, No. 186,787, and the exclusive rights of the complainants under the same"; and a perpetual injunction was ordered. The defendants appealed from this decree.

In the Overland case the decree was that the patents were valid; "that the said Alexander Graham Bell was the original and first inventor of the inventions described in said several Letters Patent Nos. 174,465 and 186,787; that the title thereto, and to the inventions described and claimed therein, is vested in complainants; and that the defendants have infringed the fifth claim of said Letters Patent No. 174,465, and the third, fifth, sixth, seventh and eighth claims of said Letters Patent No. 186,787, and the exclusive rights of the complainants under the same;" and a perpetual injunction was ordered. The defendants appealed from this decree.

In the People's case (22 Blatchford, 531) the decree was "that the several letters patent, upon which this suit is brought, viz.: letters patent granted to Alexander Graham Bell for an improvement in telegraphy, dated March 7, 1876, and numbered No. 174,465, and letters patent granted to said Bell for an improvement in electric telegraphy, numbered

186,787, and dated January 30, 1877, are good and valid in law; that the said Alexander Graham Bell was the original and first inventor of the inventions described in said several Letters Patent, No. 174,465 and No. 186,787; that the title thereto and to the inventions described and claimed therein, is vested in the complainants; and that the defendants have infringed the fifth claim of said Letters Patent No. 174,465, and the fifth, sixth, and eighth claims of said Letters Patent No. 186,787, and the exclusive rights of the complainants under the same." Also see 22 Fed. Rep. 309; and 25 Fed. Rep. 725.

A perpetual injunction was ordered. The defendants appealed from this decree.

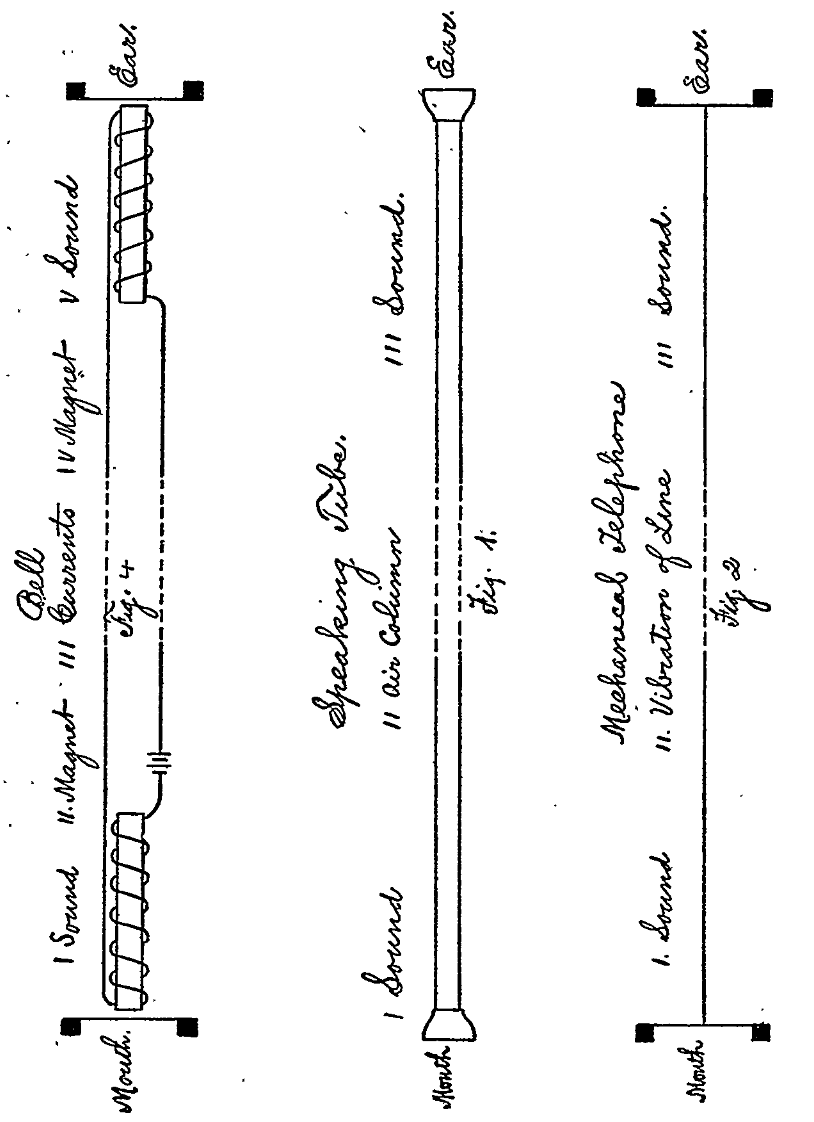
Mr. J. E. Maynadier for Dolbear. *Mr. Causten Browne* was with *Mr. Maynadier* on the brief.[1]

I. The Bell Patent of 1876 describes and claims but one method of transmitting vocal and other sounds, which method is: (1) convert the energy of sound-waves into (2) magnetic energy; convert that into (3) vibratory currents of electricity; convert those into (4) magnetic energy; and with that cause sound-waves; or, briefly (1) sound; (2) magnet; (3) currents; (4) magnet; (5) sound.

The undisputed prior methods are (*a*) The Speaking Tube; (1) sound; (2) vibrating in column; (3) sound. (*b*) The Mechanical Telephone; (1) sound; (2) vibration of line; (3) sound.

Bell carefully limits himself in his fifth claim to the *described apparatus;* that is, "to the apparatus for transmitting vocal or other sounds telegraphically, *as herein described* [that is to say] by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other

[1] In the oral argument counsel spoke in the following order: *Mr. Maynadier, Mr. Lowrey, Mr. Hill, Mr. Storrow, Mr. Ker, Mr. D. M. Dickinson, Mr. Edmunds, Mr. Storrow, Mr. E. N. Dickerson, Mr. Browne, Mr. Peckham, Mr. Crosby,* and *Mr. Hill.* The arguments of *Messrs. Maynadier, Lowrey, Storrow, Dickinson, Edmunds,* and *Dickerson* are reported from abstracts prepared by them for the use of the reporter.


Mouth.
I Sound
II. Magnet
III Bell Currents
IV Magnet
V Sound
Ear.
Fig. 4
Speaking Tube.
Mouth
I Sound
II Air Column
III Sound
Ear.
Fig. 1.
Mechanical Telephone
Mouth
I. Sound
II. Vibration of Line
III Sound
Ear.
Fig. 2

sounds, *substantially as set forth;*" and to the *described method;* that is, to the method of "transmitting vocal or other sounds telegraphically *as herein described,* [that is to say] by causing electrical undulations, similar in form, &c., *substantially as set forth.*

Bell's counsel, however, set up as the patented invention of Bell the transmission of speech *by means of "electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds,"* or, as they otherwise express it, "electrical changes which correspond to the sonorous motions of the air," rejecting one or both of the limiting clauses used by Bell, and contending that the patent should be construed broadly for the use of electricity for the purpose of transmitting articulate speech. No other construction than this will suffice to suppress the practice of the Dolbear method; but such a construction must be based upon a dangerously broad theory of invention, and their claim for the use of electricity to *transmit speech cannot stand. O'Reilly* v. *Morse,* 15 How. 62.

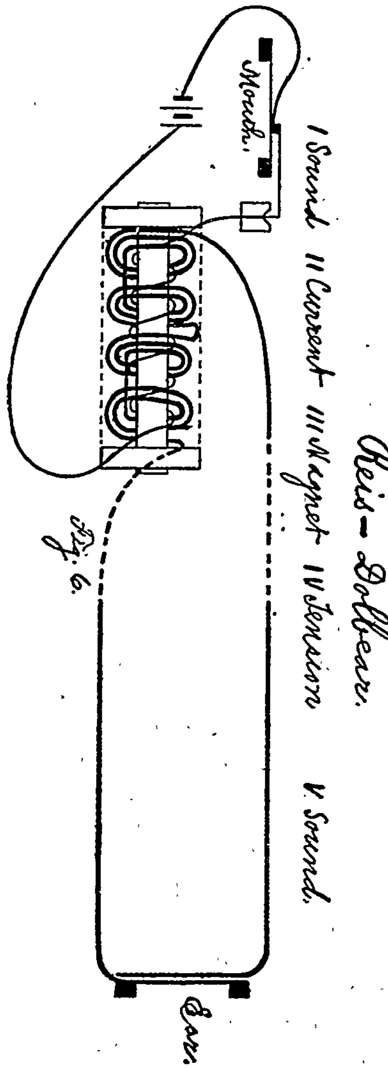
II. Bell never invented, so far as appears from the record, any other method of transmitting vocal or like sounds.

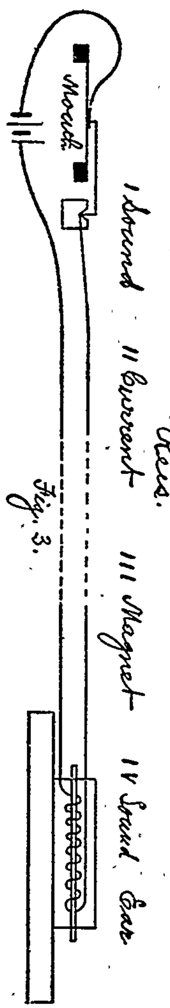
III. Bell in his 1876 patent takes the utmost pains to teach (what he, in fact, discovered) that, in order to produce currents in a closed circuit, like in form to sound-waves, the currents must be alternately negative and positive; that is, to and fro currents, so as thereby to copy the to and fro motions of the air particles constituting the sound-waves.

IV. Bell's apparatus is, in essence, (1) magnet; (2) coil; (3) closed circuit; (4) coil; (5) magnet, one magnet being supplied with the proper devices for causing the energy of sound-waves to vary the energy of the magnet, and the other magnet being supplied with the proper devices to cause its varying energy to produce sound-waves.

The characteristic of Bell's invention is the ring circuit, and is not, as Bell's counsel now contend, "form, not mere continuity." Before Dolbear's patent was granted, Bell's leading expert testified: "The electrical circuit of the instrument must always present an uninterrupted path by which the continually varying current may travel from the transmitter to the receiver, that is, *the circuit* containing the battery or source of electrical power, the transmitter, line wire, receiver, and earth or return wire, *must always be closed.*" Bell's specification describes no circuit but the ring circuit running from the positive pole around to the negative pole, and at the receiving station traversing the coils of an electro-magnet. Throughout his specification there is one constant and sole agent employed for transmitting the air vibrations and reproducing them to the ear, viz.: a closed circuit with a current converted into magnetism whose variations vibrate correspondingly the receiving armature. Strip away as immaterial everything which can, by the most liberal interpretation, be so regarded, and then, if anything in the description of the method of and apparatus for transmitting speech is characteristic of and essential to Bell's invention, it is this, that the current from transmitting station to receiving station on which the required electrical changes are to be impressed, is a current traversing the coils of an electro-magnet, and that the operative power for vibrating the receiving diaphragm is the varying magnetism so produced in the electro-magnet.

V. Bell's patent of 1876 does not cover either the Reis method or the Reis apparatus, but the Reis method — that is, (1) sound; (2) current; (3) magnet; (4) sound — and the Reis apparatus — that is, (1) a battery; (2) its circuit; (3) a transmitter diaphragm, and the electrodes governed by it; (4) a coil; (5) its magnet — are both public property; 1st, because of the printed publications, so fully describing that apparatus, that the Reis method will necessarily become familiar to any skilled person studying the operation of that apparatus; and 2d, because Mr. Bell carefully refrained from putting a single word in the specification of either of his patents which tended to show that the Reis current of unvarying polarity, but varying only in strength, was capable of being made similar in form to air-waves accompanying vocal or like sounds, and, by the very strongest implication, asserted in the 1876 patent that rapidly varying polarity was essential in order that the to and fro motions of the air particles of a sound-wave should be copied.


Mouth.
I Sound II Current III Magnet IV Tension V Sound.
Reis–Dolbear.
Fig. 6.
Ear.


Mouth.
I Sound II Current III Magnet IV Sound Ear
Reis.
Fig. 3.

VI. The battery, primary circuit, transmitter diaphragm, its electrodes, and the coil and magnet in the primary or transmitter circuit of the Dolbear apparatus do not involve the method described and claimed in Bell's 1876 patent, nor is the apparatus substantially the same as any apparatus described and claimed in Bell's 1876 patent, but this transmitter circuit and its parts are copied directly from Reis. Dolbear's apparatus is properly termed the Reis-Dolbear apparatus, and the method used in the Reis portion of the Dolbear apparatus is precisely that method which any skilled person must necessarily have become cognizant of from a study of the Reis apparatus when acted upon by vocal or other sounds not loud enough to break the circuit.

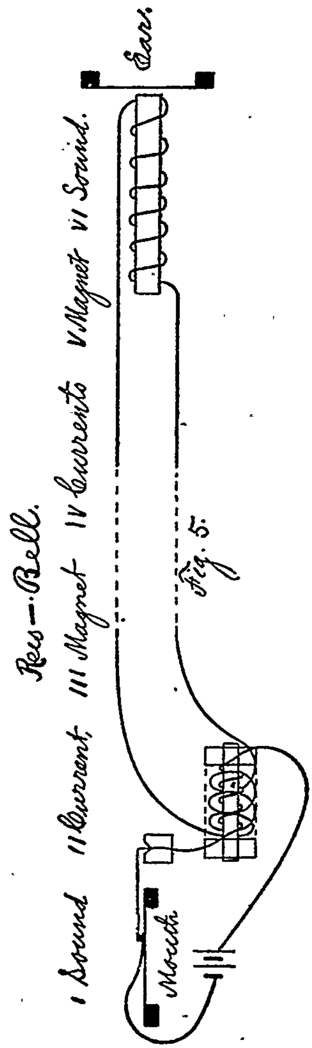
VII. The Dolbear secondary coil, line and receiver is radically unlike anything described or suggested in Bell's 1876 patent, and the Dolbear method involved in its use with the Reis apparatus as a transmitter is radically unlike any method described or suggested in Bell's 1876 patent, and is also radically unlike any method of utilizing electricity ever known before Dolbear discovered his method and apparatus. The primary circuit, the primary coil and its core in the Dolbear apparatus are copied directly from the Reis apparatus, but the variations of magnetic energy induced in the core by the flowing of the varying primary current spirally around the core are converted into electric variations of a kind wholly unknown until discovered by Dolbear. These electric variations of Dolbear are produced by variations of magnetic energy in the core of a secondary coil, and inasmuch as secondary coils containing a core whose magnetism is varied are old and well-known, it is clear that, speaking generally, the Dolbear variations are like the variations in other secondary coils; but there are, nevertheless, such marked and striking differences as make them radically new and entitle them to rank as an invention second to none in question in this case. The electric tension, pressure or head, is necessarily small in all telephones using a closed circuit. The Dolbear secondary coil forms no part of a closed circuit, and, in this particular, is radically unlike Bell's (Fig. 7) and the secondary coil of the commercial telephone. The fact that the Dolbear line-wire is always open or broken and never closed, prevents the flow of any current through any part of the receiver, and for this reason the electric tension, pressure or head is at the maximum positive or negative. In the Reis-Dolbear diagram the energy of the air-waves acts upon the diaphragm, which is a fac-simile of the Reis diaphragm; the vibrations of the air-waves move that diaphragm just exactly as they do in Reis; the diaphragm controls the voltaic or battery current, just exactly as in Reis; and variations in that current caused by the varying pressure of the electrodes one upon the other vary the magnetic energy of a magnet, just exactly as in the commercial telephone. So that Dolbear's first step is undoubtedly the variation by air-waves of the magnetic energy of a magnet, it being thereby like Bell's. The first step in the Bell method is the varying, by force of the air-waves, or of the sound-waves, of the energy of a magnet. Dolbear's first step is much the same. But, as one of the experts for the defendants states, here the resemblance ends. That is the only likeness, the sole likeness, between the Bell method, as described, and the Dolbear method. That is, the energy of the air-waves in both may properly and fairly be said to vary the energy of the magnet. Now, how to utilize that varying magnetic energy. Inasmuch as the energy of the air-waves varies the magnet, and is the sole cause for the variations in magnetic energy, it follows that the magnetic energy must be similar in form to the energy of the air-waves. Bell utilized it by producing plus and minus currents. How does Dolbear utilize it? Dolbear, in truth and in fact, produces no currents whatever, nor any current, on the line. No currents, nor any current, on the line. He produces simply variations in electric pressure, or in electric tension, or electric condensations and rarefactions; but no currents.

In the Reis-Dolbear diagram, at the end of the very large coil which is on the left there is a wire which goes out through the air, on the poles for instance, and terminates in a plate shown on the right. There is no connection between that plate and the other plate which is opposed to it. The second plate is fastened to the other end of that coil so that no current can flow through the Dolbear line. The Dolbear line is an open circuit of necessity. The Bell line is a closed circuit of necessity. That is a radical difference. There is no magnet, nor anything resembling a magnet, on the right of Dolbear's line; nor any coil, nor anything resembling a coil, on the right of the Dolbear line, and the electric condition of the Dolbear line is radically unlike that of Bell; the Dolbear receiver is radically unlike that of Bell, and is not a known substitute for Bell's receiver, but was wholly unknown, and not in use for any purpose whatever until Dolbear's discovery, after Bell took out his patent, that that contrivance would produce speech. This is well illustrated as follows: Take a cylinder, say three feet long and a foot in diameter, with a piston midway in that cylinder, and a pipe leading from the left of the cylinder (a small pipe), and going out say a mile, and there being connected air-tight with a spiral or helical pipe, and then another pipe at the lower end of that spiral pipe, coming back a mile into the right-hand end of the cylinder: then there will be an air apparatus which is very closely analogous to Bell's apparatus. If the piston which is midway at the start in the cylinder is moved, say from right to left, the air in the left-hand end of that cylinder will be condensed, and the air in the right-hand of the cylinder will be rarefied. But the air will not be either condensed or rarefied to any considerable extent, for the reason that these pipes make a conduit, connecting the right and left hand ends of the cylinder; and whenever the air tries to be condensed in one end, or to be rarefied in the other, the air will flow as a current through the pipe line, and through the helical pipe, and neutralize all condensation and rarefaction. This is also analogous to Bell. If it were true that the flowing of the air through this helical pipe would set up in a rod of some kind in the axis of that helix some form of energy, then it would be exactly analogous. The main point is that there is a conduit connecting the two ends of the generator of pressure, which conduit serves to allow a current to be produced, which current prevents and neutralizes any marked increase or decrease of pressure at the two ends of the generator. And it is by the flow of that current spirally around something that all the work is done.

Now, taking the same cylinder exactly, and the same piston exactly, and the same small pipe going a mile from the left-hand end, and the same small pipe going a mile from the right-hand end, but cutting out the helical pipe which is supposed to be in the Bell analogy, — cut that out, and screw a cap on the end of the left-hand pipe, and another cap on the end of the right-hand pipe, and have these caps air-tight, and there is something closely analogous to the Dolbear method. Moving the piston as before, all the air in the left-hand end of the cylinder, and all the air in the pipe leading from that end, and all the air in the cap at the end of that pipe is condensed, and all the air in the cap and pipe at the right-hand end of the cylinder is rarefied, and there is no current tending to diminish the condensation or rarefaction.

There can be no current, because the pipes are hermetically closed, and the current cannot flow. There are then, in fact, *two* pressure chambers, one a high-pressure chamber, and the other a low-pressure chamber; and the maximum high pressure and the maximum low pressure which the motion of the piston will give is obtained. But not so in Bell's. In Bell's nothing like the maximum high or the maximum low pressure can be obtained, because the current flows and prevents it. Stating the same thing exactly in the electrical language: in the Reis-Dolbear diagram the secondary coil is very much larger than it is in the Reis-Bell diagram, which represents the commercial Bell telephone.

The only difference between the coils is, — one is very much larger than the other. The secondary coil is the generator of the electro-motive force. Electro-motive force means electrical pressure, tension, or head. If a high electro-motive force be joined to a low one, or to a lower one, by a wire or conduit of any kind, the current will flow from the higher to the lower. Just as if a tank of water ten feet up be joined by a pipe to a tank of water one foot up from a certain level, a current of water will flow. What happens in Dolbear's method is


Reis—Bell.
I Sound
II Current,
III Magnet
IV Currents
V Magnet
VI Sound.
Mouth
Ear.
Fig. 5.

that, whenever the magnet varies in strength, then the big coil, which is the generator, generates an electric pressure at one end, and an electric vacuum at the other. *Plenum et vacuum.*

Electric plus at one end, and electric minus at the other end of the coil or generator. To the plus end of the coil a wire is attached; to the minus end of the coil a wire is attached. So far it is exactly like Bell's, except as to the size or power of the coil. But those wires are not in electrical contact anywhere. They must be in electrical contact in Bell. In Bell they must be joined by a coil, because the current must flow spirally around a soft iron core. In order to do Bell's work they must flow from left to right, and again from right to left, rapidly alternating. But the whole function of the secondary coil in Dolbear is to make a very large electrical pressure, plus at one end and minus at the other.

Dolbear relies on electrical attraction pure and simple. It appears throughout this case that for no practical purpose whatever was this *electrical attraction*, this static electricity, this *amberism*, ever used by anybody, anywhere, until Dolbear first used it in his telephone. It is therefore not a known substitute or anything like a known substitute for Bell's electrical currents.

VIII. In both the commercial telephone and the Dolbear telephone the Reis apparatus is used as a transmitter circuit in connection with a secondary coil which forms part of the line wire.

Although at first sight this fact may seem to make the Dolbear telephone substantially like the Bell commercial telephone in one important particular, yet it cannot have any weight whatever in view of the radical difference between the secondary coil and line of the Dolbear telephone and the secondary coil and line of the Bell commercial telephone, or the transmitting coil and line of Fig. 7 of Bell's patent; that is to say, Dolbear's secondary coil must be a generator of enormous electro-motive force, or electric tension, pressure, or head, while the generator of the Bell produces relatively trifling electro-motive force or tension, pressure, or head; an electrical conduit joining the positive and negative is essential to Bell and fatal to Dolbear, and Dolbear's line and its connected plate is charged to a very high potential tension, pressure, or head, alternately positive and negative, and there are no currents, properly speaking, in the Dolbear line, but only such flow as is necessary to charge the line and the plate or disc connected with it.

IX. Wholly disregarding Reis, and assuming that Bell is the first in the field, yet the Dolbear method and apparatus is substantially unlike any method or apparatus described or claimed in the Bell patent of 1876, for the reason that Dolbear does not utilize electrical undulations substantially the same as those described and claimed in the Bell patent of 1876, but utilizes electrical undulations radically unlike any other known until Dolbear discovered his method and apparatus, and for the reason that there is nothing in either the Dolbear method or apparatus copied from anything described or suggested in the Bell patent of 1876; and Bell's fifth claim is to be so construed as to enable inventors of substantially different methods of telephony to practise their methods. The *problem* of telephony was stated in a scientific article published in 1863, in which Reis's work up to that time was discussed. Let all the sonorous air vibrations of speech be electrically represented; let them all be translated into electricity; let there be electrical changes corresponding to the sonorous air vibrations, and let them reproduce sonorous air vibrations like the first; if you can do that, you will transmit speech. In the court below the Bell patent was construed to cover *doing* that, *no matter how*, and that construction is contended for in this court. But that construction cannot stand under the law.

The writer of the article published in 1863 as a commentary on Reis's work, says: "If we succeed in transmitting with the galvanic current the oscillations of a sounding body to a distance, so that there another body is put to equally rapid and, in respect to each other, equally strong oscillations, the problem of telephoning is solved, for then exactly the same phenomena of waves are called forth on the distant points as the ear receives at the place of origin; therefore they also must make the same impression. Even *speech* must be heard in places very distant from each other." Therefore the *problem*, the statement of which is called Bell's invention to-day, was as well recognized in 1863 as it is now. But Bell's patented invention is not the restatement of this problem, but the solution of it which he invented and patented. Bell undertook to solve and did solve the problem by one method. Dolbear subsequently undertook to solve and did solve the problem by another and substantially different method.

In *Tilghman* v. *Proctor*, 102 U. S. 707, which seems to be quite conclusive of this case, and to present a singularly close analogy to it, the patent was for a process of separating neutral fats into glycerine and free fat acids by the use of water — hot water — under such pressure as prevented its evaporation into steam. Upon a revision of the judgment of the court rendered in a previous case, it was held that a wide departure as to degree of heat, and a wide departure as to duration of exposure to heat, might well be included within the invention of the patentee, because he was the first man who used water, heat and pressure for the purpose at all, and his invention was of a process, and not of an apparatus. The opinion says, upon page 729: "The claim of the patent is not for a mere principle. The chemical principle or scientific fact upon which it is founded is that the elements of neutral fat require to be severally united with an atomic equivalent of water in order to separate from each other and become free.

"This chemical fact was not discovered by Tilghman. He only claims to have invented a particular mode of bringing about the desired chemical union between the fatty elements and water. He claims the process of subjecting to a high degree of heat a mixture continually kept up, of nearly equal quantities of fat and water, in a convenient vessel strong enough to resist the effort of the mixture to convert itself into steam. This is most certainly a process."

Now, in the present case also, there is a principle or scientific fact involved. If you would transmit speech, you must have the electrical condition of the wire vary with the varying conditions of the air brought about by speech, and produce again like varying conditions of the air. This is the alternative statement of transmitting speech by electricity. There is the problem. What is the solution? The parallel with the case of *Tilghman* v. *Proctor* seems to be perfect. In that case there was a problem. Find a way, if you can, to combine each atom of water with an atom of acid. If you can do that, then you can reach this important result of resolving the neutral fats into glycerine and acids. And Tilghman's solution of it was: Heat the water under such pressure that the water shall not pass into steam. This was his process; and he claimed, and the court justly allowed, great latitude in its application.

Now what was the method invented by Mr. Bell for solving the problem presented to him. The answer is plain.

When he took his patent, there was but one agent that had ever been used for variably attracting any object so as to make it vibrate and beat the air and give out audible sound. That agent was *magnetism*. There was but one practical use to which electricity had ever been put for the purpose of so causing a body to vibrate and give out audible sounds; and that was as a *flowing current making an iron core an electro-magnet*, the variations of current strength causing like magnetic variations. Mr. Bell found a way to get electrical changes, corresponding in form to the sound-waves, *in the current traversing the coils of an electro-magnet*, and so to produce corresponding variations in the magnet, and corresponding vibrations of a receiver armature. But under the broadest construction permissible, Bell's patent cannot include something which neither he nor any other man had then done or supposed could be done; that is to say, cause an armature to vibrate and give audible sounds by variations of *electrical attraction*, with no use of magnetism at all. It cannot include causing an armature to vibrate and give audible sounds by variations of *electrical attraction*, variations of that electrical charge of tension which is brought about by rubbing a piece of sealing-wax, for example, — in a word, by *amberism*, — which Dolbear has reduced to the service of mankind for the first time. Dolbear's receiver, though properly enough called a "condenser," is radically different from the old "condensers," for in the Dolbear receiver one of the plates is held firmly so that it cannot vibrate, and the other is held so as to be free to vibrate (according to the variations of electrical charge) and beat the air and give audible sound; the two plates being separated by a body of air so that no current can pass.

Here is a change of construction designed to produce a new operation, for a new purpose, without which change that operation could not be performed nor that purpose answered. No operation of vibrating either plate by variations of electrical charge was contemplated or performed in the old condensers. The arrangement of the parts or elements of the old condensers did not admit of its being performed.

To hold one element of a condenser still, so that it shall not vibrate, and suspend the other so that it shall vibrate, and then make use of its vibration according to variations of electric charge, was wholly and absolutely new. No such instrument existed. No such use of any instrument had ever been proposed or supposed to be possible. It cannot be said with any show of reason that any equivalent for it was found in any of the old condensers.

Mr. Grosvenor P. Lowrey for the Molecular Telephone Company. *Mr. Wheeler H. Peckham* and *Mr. H. D. Donnelly* were with him on the brief.

The judgment appealed from decides that the appellant's transmitter infringes the fifth claim of Bell's patent of 1876; which is for "5. The method of, and apparatus for, transmitting vocal or other sounds telegraphically, *as herein described*, by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, *substantially as set forth*:" and also that the receiver infringes the sixth, seventh, and eighth claims of Bell's patent of 1877.

Certain Errors to be corrected in Limine.

Two popular errors which have a tendency to mislead the judgment, should be corrected at the outset, viz.:

(1) That "vocal sounds" and "articulate speech" are convertible terms in acoustics or telegraphy.

"Vocal sound" is an utterance common to all animals possessing the organ of voice. "Articulate speech" is a series of sounds uttered in accordance with the laws of language in arbitrary sequence, to express ideas. At the date of Bell's patent "vocal sounds" was a term used in connection with multiple telegraphy, in which the signals were certain sustained or broken musical notes of a given pitch. The use of that term in the fifth claim does not, therefore, imply that articulate speech was contemplated.

(2) That this controversy relates to a telephonic device — the invention of Mr. Bell.

No part of the transmitting instrument so familiar to our eyes, in the commercial business of telephony, was invented or is claimed by him. When, therefore, the appellees speak of a Bell telephone, they refer not to any device which they claim was invented by Mr. Bell, but to any and every telephone which transmits speech "by causing electrical undulations similar in form to the vibrations of the air accompanying" the transmitted sound.

No telephone *can* transmit speech except by producing in the line wire *some* electrical action equivalent to the exciting cause.

What that action is cannot be known; but Mr. Bell and others have inferred — perhaps not unreasonably — that it consists in a series of changes in current strength; and one of them, Mr. Varley, in 1870, gave to these changes the name "undulations."

Bell having adopted the inference and the name, has — according to his present interpretation of the Patent Office language — patented the inference.

Points of Difference arising upon the Record.

The differences between the litigants in the Molecular case arise chiefly on the interpretation of the fifth claim. Certain particular facts and ideas affecting, modifying or arising out of these differences need to be indicated at the outset in order to relieve the later discussion from repetition.

Appellants' Construction of the 5th Claim.

The appellants concede the fifth claim to be *a* good claim when restricted to *a specific apparatus* (Fig. 7 of the patent), which includes a closed circuit *incapable of being opened*, and a continuous current *incapable of being intermittent*; and *the method* by which alone that apparatus can be operated.

Any broader interpretation they regard as an unauthorized enlargement of the words of the patent, resulting in a monopoly to (1) some things invented before Bell's time; (2) some other things invented afterwards, and in no sense derived from him; and to (3) scientific facts or laws of nature, the monopolizing of which no statute justifies.

Appellees' Construction.

The appellees regard this claim — and upon their persuasion the courts below have so interpreted it — as a "broad claim" to all electrical transmission of speech, which results from "causing electrical undulations similar in form to the vibrations of the air accompanying" the sound; on the ground that Bell first discovered that this is the way in which speech is transmitted electrically. In fact, the words of the claim are a mere formula to express that thing, whatever it may be, which occurs in the line wire when speech is transmitted.

A claim is thus virtually made to speech transmission *by the transmitting of* it; or, in other words, for all *such doing* of a thing as is *provable* by its *being done.*

The significance and far-reaching effect of such a claim (thus interpreted) needs only to be realized, to be rejected by an application of the *argumentum ab inconvenienti.* To test this an analogous claim covering speech transmission by the *air*, as a medium, may be formulated and compared with Bell's actual claim, as follows:

Claim for AIR *Transmission of Speech.*

1. A says: "I will *speak* to C."

2. B says: "I will *cause* by the action of my vocal organs, &c., an *undulation of air* particles between C and me, in a form similar to the originating movements in my vocal chords, mouth cavities, &c."

These two propositions are equivalents.

Claim for ELECTRICAL *Transmission of Speech.*

3. Reis, Bourseul and Bell each say: "We will by means of membranes, conductors and magnets *transmit* and *reproduce sounds electrically* (Bourseul and Reis add "speech," which Bell omits).

4. Reis and Bourseul say: "We will do this by speaking to a membrane connected with a wire and battery, and thus *cause the air vibrations* accompanying any sound to be *taken up* by an electrical current, and by *means of that current* to be *reproduced, so as* to give to the hearer the same sensation as the original vibrations would have done. To do this, however, the mechanical arrangement must be such as *will enable the syllables to reproduce* their *vibrations* — so that *none shall be lost* — throughout *all* the intervening *media*" (including of course the wire).

5. Bell says: "I will do this by 'method of and apparatus for *causing electrical undulations similar in form* to the *vibrations of the air* accompanying' such sounds."

These three propositions are equivalents.

If we now attempt to frame a patent claim for, say, proposition 2, it will be apparent that such a claim will cover proposition 1 — and that would be intolerable to common sense. If we attempt to patent proposition 5, which is Bell's precise claim (with its present interpretation understood), we shall find that we have covered proposition 3 — which is again intolerable as being too broad; and besides was anticipated by proposition 4, which was announced to the world at a much earlier date.

This broad construction has nevertheless been sustained upon an elaborate exposition, by counsel and experts, of the physical laws involved in the operation of telephony; and an assumption that (1) some of these essential laws and conditions were unknown before Bell, and were discovered by him; (2) that Reis failed in 1861 to transmit speech because he was ignorant of them; (3) that his system demands a mode of operation inconsistent with those laws; and that therefore it could never succeed.

Certain General Principles to be read into the Specific Work of Reis and others before 1861 — as due to a right understanding of them.

During all the period to which it is necessary to refer, a general principle of philosophy has fully possessed the scientific minds of the world, viz., that all forces of nature act and exist under certain laws of correlation which assume that energy is indestructible, and that its forms are capable of mutual conversion. It was not only believed but demonstrated that mechanical action (which is a motion of masses) may be transformed into heat and electricity (which was held to be a motion of the atoms of matter), and *vice versa*. These mutations were found to be rigidly subject to the laws of quantity, *i.e.* a given amount of one force was known to produce a definite quantity of another. This implies that where the originating force is variable, the resulting force will be correspondingly variable. These relations of the modes of energy commonly known by the phrase, "correlation of forces," or "persistence of forces," has formed a living element in scientific literature, and occupied the thoughts and guided the investigations of philosophical inquirers since about 1835.

It was also known that sound is a vibratory to and fro motion in ordinary matter; and that different sounds produce different vibrations both as to the number of to and fro motions which an air particle will make in a given time, and also in the extent or amplitude of these vibrations. The rate of the vibration was imputed as the cause of pitch in sounds; and the amplitude of the vibration was imputed as the cause of its loudness. As these varied, the pitch and loudness varied.

But besides pitch and loudness, a characteristic which in acoustics is called "quality" enters into sounds, and enables us to distinguish one voice, instrument or other sound-producing cause from another, while both are giving forth the same pitch and loudness; and this was also known prior to 1861. The physicists inferred that this effect must arise from something in the movement of the air particle besides its rate and amplitude. They concluded that the air-particle journey performed under the impulse of one voice, differed from that which, at the same pitch and loudness, it performed under the impulse of another voice.

Thus in one case the movement might rise to a maximum of speed quickly; and in the other, slowly. In one it might maintain a nearly uniform rate of increase and decrease throughout, while in the other, there would be apparent irregularities.

These variations they called the "form" of the motion; as its results had before been called the "quality" of the resulting sound. Probably the term "form" was adopted from the use of graphical curves, by which the order and succession of motions or events are exhibited in the shape of a curved line.

Particular Application of these Principles to Electric Telephony.

All these things being known prior to 1861, the date to which attention must be called, it results that any physicist engaged at that time upon an effort to transmit and reproduce sounds by electricity must be considered to have known that as the motion of the air particle accompanying the sound may vary in form, violence or amplitude, the electrical changes —

or "undulations"—into which that motion is to be transformed, must correspondingly vary.

Under the general philosophical principles above stated, and which were universally accepted at the dates of Reis's inventions and publications, it was also clear that nature's way of transforming mechanical energy (such as the to and fro movement of an air particle) with all its variations of force, into electrical energy of similar mutations, was, and necessarily must always be, by successively reducing or increasing in a corresponding manner the strength of an electrical current. The phrase "electrical undulations similar in form," etc., is, therefore, a mere restatement of that universally recognized law, for the purpose of applying it to the specific subject of electrical sound transmission. These things being understood, it remained for the inventor and man of science to devise mechanical means and processes by which to bring about these needed electrical mutations in an order and degree suitable to maintain and reproduce the air vibrations accompanying the particular sound whose reproduction at a distance was desired. The mechanical devices sought for might vary, and the processes which within themselves they were to develop might vary, but it was known that the process of nature—to wit, the creation of something, in the electrical field (called by Bell, "undulations") equivalent in sequence, power and form to the motion of the air particle accompanying a sound—was the only process by which those motions could be counterfeited at a distance. This last process being a recognized law of nature, which experimenters and investigators were endeavoring to find means to bring into action, has been in previous adjudications confounded by the courts with those other invented processes or methods which are provided to control the operation of the mechanical devices of man. It will be easy to see, in reading the decisions below, that in using the terms "means," "method," and "process," the courts sometimes intend the means, method, or process of Bell's apparatus for taking up the sound-wave and bringing its energy to bear upon the electrical current; and in other cases they intend the means, method, or process by which the electrical current, acting under a universal law, receives that energy and sustains and finally retransforms it; and these two meanings they confound to the prejudice of a correct intellectual judgment.

The appellants object to nothing in the judgments sustaining the fifth claim except that which grants to Mr. Bell a monopoly of the right to appeal to nature and to solicit her—acting according to her own laws—to receive, sustain, and retransform mechanical energy of sound-waves, when brought to the electrical current by an invented method and apparatus different from those of Mr. Bell.

Two different methods and apparatus by which sound-wave energy may be successfully transformed into electrical energy.

There are two mechanical methods by which man's invention is able to invoke and avail of this law of nature.

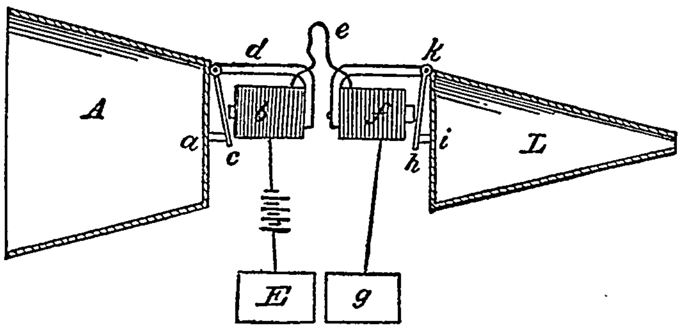
One was invented by Mr. Bell, and is called the "magneto-electric method." It involves a closed circuit and continuous current, without possibility of change.

The other was not invented by Mr. Bell, and is called the "variable resistance method." It involves a circuit which may be opened and a current which may be made intermittent, automatically and irregularly.

As is apparent from the construction of the Reis instruments, the latter was employed by Reis and he was under the impression that his instruments *regularly* continued their variation of the degree of resistance to a point at which it became infinite; that is to say, to the point of breaking the current altogether. That his opinions upon this point have no relevancy in this contest will be shown hereafter; as also that his opinion as to the operation of his instrument is probably a mistaken one. The method used by him of placing in his transmitting instrument two electrodes in normal contact which could be separated so that no current could pass, (but which under the impulse of air-waves were really intended to vary their degree of pressure and the consequent degree of resistance only so far as was necessary to accomplish the intended work), is now in universal use in telephony. There are numerous devices for operating by this principle. The Molecular Company's transmitter is one; and the Blake transmitter, used by the appellees, is another. Neither of these instruments could be used in the "closed circuit" method described by Bell in his patent, and by which method alone can the apparatus described in his patent (the magneto-electric telephone) be used.

1. *Bell's Magneto-Telephone and its Methods.*

"The method of, and apparatus for, transmitting vocal or other sounds telegraphically, *as herein described*," and "*substantially as set forth*," etc. 5th claim of Bell's patent of 1876.



The above drawing is copied from the patent, and together with the text of the patent, it clearly shows what "method" is applicable to what "apparatus."

The method may now be defined as follows: A method of transforming the mechanical energy of air-waves into electrical energy, by moving a piece of inductive material (diaphragm) in front of the poles of an electro-magnet, by which movement new electrical currents are set up in the coils of the electro-magnet; which, passing over a connected line in degrees of strength constantly varied by the movement of the inductive material, vary the magnetic power of a second electro-magnet; causing it to exercise a variable attraction on another diaphragm in its neighborhood; which second diaphragm is thus made to copy the movements of the first diaphragm and reproduce in the adjacent air-particles, vibrations similar to those which accompanied the original sound.

The novelty in all this consisted not in the idea of transmitting sounds; not in the use of a movable membrane, disc, or diaphragm, for that purpose; not in the use of the energy of air-waves to act upon the membrane, etc., and thus to reproduce sounds; not in the employment of electro-magnets, conductors, or other electrical means—for all these were old; but—simply—in using the energy of air-waves to actuate mechanically a little *dynamo machine* and to cause it—not to *mould* an existing current—but to *create* new currents.

The essential characteristic of operation which distinguishes this method, more abstractly stated, is: A magnetic field, disturbed by the shifting presence of an inducing body, which thereby creates electricity of varying direction and electromotive force, in the wire. The efficient is the magnetic force; its source is the magnetic field; and the battery current—where a battery is used (as shown in the drawing above),—is not in any sense the cause of work, being used merely to magnetize the cores of the electro-magnets. The current constantly varies in its direction as the diaphragm advances or recedes, and the circuit *is never and can never be broken*—there being one complete metallic or earth connection from the transmitter to the receiver and back again.

2. The Variable Resistance Method used by Appellees.

In the variable resistance method the operative current has its source in a battery without which it would have no life. The current flows from the battery with a constant energy and direction, and the needed changes in it are caused by a variation of the resistance to its flow.

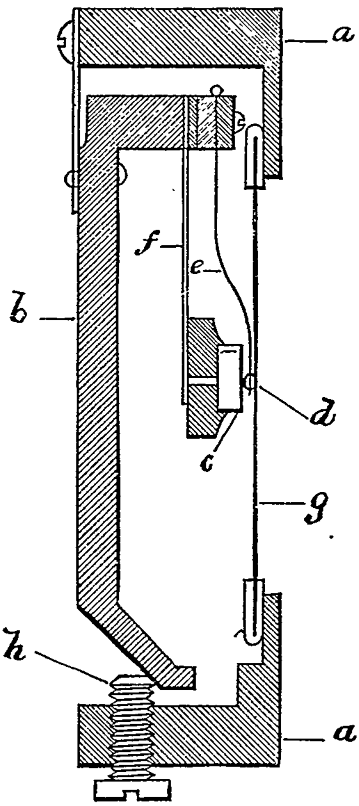
This is known in the arts as the "loose contact," "variable contact" or "variable resistance" method. In every apparatus devised to work by this method—beginning with that of Reis, in 1861—the necessity to keep the contact loose and variable introduces the possibility that the variation may be carried to the extent of breaking it altogether, by exceeding a certain degree of loudness in the tones which it is called on to take up and transmit. With this mechanical element in its construction, by which the apparatus, working automatically, constantly varies the connection of its parts — sometimes separating them entirely — the circuit cannot properly be spoken of as a "closed circuit" within the sense of this patent, because it may be broken.

In the variable resistance method the energy of sound-waves is taken up by a movable diaphragm, which being acted upon by the impact of the air particles, moves to and fro in such a way as to produce a constant variation of pressure between the electrodes, from one to the other of which a current must pass (in conventional phrase) from its source in the battery to the receiver. By a well-known law this variation of pressure results in a constantly changing degree of resistance to the passage of the current, which has the effect to weaken or strengthen the current momentarily throughout the entire line, whereby the magnetic attraction of the electro-magnet in the receiver is varied and its related diaphragm is moved accordingly. All this being done under the influence of the movements of the first diaphragm, the result is that the second diaphragm copies the movements of the first and thereby causes air vibrations at the receiving station similar to those accompanying the original sound.

These two ways of producing current changes by the energy of sound-waves are two different methods in the arts and the law; and would be proper subjects of separate patents. The magneto method, invented by Bell, as appellants insist, *is what is referred to by him* in the fifth claim as "The method of . . . transmitting," etc. Such a reading satisfies the facts, the context of the specification and every other demand except the cupidity of his assignees.

The essential characteristics — more abstractly stated — which distinguish the variable resistance method are: That the current originates in a battery; that the cause of work is a disturbance of the flow of that current by a variation of resistance in the conductor, thus creating undulations or vicissitudes of strength in the current; and that the working of the method depends on the circuit being capable of being open *or* closed — with a capacity for all degrees of pressure between the surfaces of the electrodes, from utmost contact to no contact.

In order that the apparatus capable of use in this may be contrasted with that capable of use in the other method, we exhibit an outline drawing of the Blake transmitter, a variable resistance instrument now in universal use by the Bell Company, and which is as incapable of being used by Bell's method, as Bell's apparatus is of being used by the Blake, or variable resistance, method.



[At this point *Mr. Lowrey* explained the principles and modes of operation of different telephonic apparatus, illustrating by large models of Bell's Fig. 7, as a pure example of the magneto telephone; and of the Blake and molecular transmitters, as examples of the variable resistance telephones, of which, as he stated, there are numerous forms. He contrasted the Blake transmitter with the Reis-Legat, deducing from the fact that both were provided with springs and adjusting screws by which to control the degree of pressure between the electrodes, that they are alike variable resistance instruments; and that the sole and entire effect of appellees' argument was to allow the Reis-Legat screw to be turned (say) twice—at which adjustment perhaps the transmitter would not transmit—and to prevent it being turned three times, at which adjustment speech could certainly be heard.]

The early judgments sustaining Bell's claim were founded on "concessions" which were not true—and were not conceded.

The claim of Bell to every transmission of sound "by causing electrical undulations similar in form to the vibrations of the air" (that being only another way of claiming the transmission of sound by transmitting it), needed a broad base to support it. This was supplied by the astounding concession made to him (by the court) in the Spencer case, that he is "admitted . . . to be the original first inventor of *any* mode of transmitting speech," and by the further statement, "but Bell *discovered a new art*,—that of transmitting speech by electricity,—and has a right to hold the broadest claim for it which can be permitted in any case; not to the abstract right of sending sounds by telegraph without any regard to means, but to all means and processes which he has both invented and claimed;" and that "the invention is nothing less than the *transfer to a wire* of electrical vibrations *like those which a sound has produced in the air*." 8 Fed. Rep. 511.

If these concessions had been true, the consequences inferred would be fairly disputable; but they are not true.

This Court must consider:

(1) Of what does this "art" consist?

(2) Had it not, as a generic art, been discovered and announced to the world prior to the date of Mr. Bell's investigations?

(3) Does not the state of the art at the date of Bell's invention necessarily limit his fifth claim to that natural interpretation which covers whatever is accomplished by uttering a sound before the transmitter of a *magneto telephone* connected in an hermetically closed circuit—that being his only invention.

The operating of such an apparatus, by the energy of air waves, is *a* method of setting on foot the transmission of sounds.

It is *the* method, and the *only* method described in the specification of the patent in connection with *the transmitting of sounds;* and it is the only method capable of use by the apparatus delineated and described in the same connection.

A claim for "the method of and apparatus for" doing any particular thing must mean a method by which *the* designated apparatus can work; and an apparatus by which *the* described method can be employed.

It is an axiom of patent law that an inventor may claim a NEW ART *by pointing out an old apparatus; but can he claim an* OLD *art by pointing out a* NEW APPARATUS?

Reis's "Telephone."

In 1861, Philipp Reis, of Germany, made an instrument intended for the electrical transmission of "*all sounds capable of being perceived by the human ear,*" and publicly described it in an article entitled, "On Telephony by Means of the Galvanic Current." This instrument was called a telephone. The means of using it, and the details of its action (both those which were observed and known, and those which were beyond the inventor's means for observation, and could therefore be spoken of speculatively only), were set forth. The acoustical and electrical principles which were then and are now supposed to underlie the operation of every telephone were explained in this paper. The sworn evidence of numerous witnesses is that the apparatus succeeded well in transmitting the tones of various instruments, and the tones of the human voice in the singing of words, and that it did also, on numerous occasions, transmit and reproduce the tones of the human voice in speaking. To this there is the testimony of Professor Quincke, at present vice-rector and actual head of the Heidelberg University;[1] Dr. Rudolph Messel, a well-known chemist of London; Johann Philipp Schmidt, paymaster in the Imperial German Navy; Heinrich Hold, of Friedrichsdorf; Johann Hausser, music teacher, in Wasselheim; and others.

From time to time other instruments similar in mechanical

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1 At page 217 of appellees' brief it is said: "Last year at the great anniversary of the University of Heidelberg Mr. Bell received an honorary degree which *declared* him to be THE INVENTOR OF THE TELEPHONE."

This is certainly important, if true. Let us see.

The exact language of the diploma is: "Nos decanvs senior ceteresqve professores ordinis medicorvm in litterarvm vniversitate Rvperto Carola qvibvs conditæ ante haec qvinqve saecula vniversitatis nostræ sollemnia concelebramvs in virvm egregivm Alexandrvm Gr. Bell, Scotvm, qvi vt apparatv telephonico ingeniose invento societati hvmanæ magna negotiorvm peragendorvm emolvmenta largitvs est atqve dies increscentia ita chronographo perfectissime excogitato tam physicen non mediocriter adivvit qvam physiologiæ ipsiqve arti medicæ instrvmentvm rervm sat gravivm definiendarvm svppeditavit ivra et privilegia Doctoris Medicinæ honoris cavsa rite contvlimvs et hoc diplomate sigillo ordinis nostri monito testati svmvs."

It is believed that the following will be approved by any careful scholar as a true translation:

"We, senior Dean and other Professors of the order of Physicians in the Ruperta Carola University of Letters, during the days in which we join in celebrating the solemnities of the founding of our university five centuries ago, upon the distinguished man, Alexander Gr. Bell, a Scotchman, who, *as he has by telephonic apparatus ingeniously invented*, furnished great and daily increasing aids in transacting the business of human society, and also by a chronograph very perfectly devised has in no small degree rendered service to Physics, and also furnished to Physiology and to the Medical Art in particular, an instrument for defining things of grave import, have, in due form, and for the sake of doing honor, conferred the rights and privileges of Doctor of Medicine, and have attested it by this Diploma, guarded by the seal of our body."

As "the inventor of THE telephone" is to "the inventor of *a telephonic apparatus* ingeniously invented," etc., so is the *false* interpretation of the fifth claim to the *true* interpretation thereof.

action were constructed by Reis for the same purpose. One of them was publicly explained by V. Legat, Royal Prussian Telegraph Inspector, in 1862. Concerning these different instruments, the evidence is now that without material change of any of their parts, they will, with care and proper adjustment, all transmit speech, though imperfectly. This adjustment is, in the case of the Reis-Legat instrument, by means of a set screw and spring by which the contact of the electrodes is controlled; in the case of the cubical box instrument, by proper weighting of the parts with the same object; and by similar means in the case of the bored block instrument. The witnesses to this are Professors Brackett and Young, of Princeton College; Prof. A. E. Dolbear, of Tufts College, Boston; Prof. Charles R. Cross (appellees' expert); Messrs. Channing, Waite, Green, Paddock, and others. There is proof by several witnesses that in 1869, in the City of New York, at a public exhibition, they heard such instruments — made by Prof. Van der Weyde — transmit and reproduce the tones of the human voice in singing, and were able to distinguish words, which they now repeat.

With what has been said it will now be convenient to consider various facts and arguments as to their bearing on the subject stated, and which may for convenience be restated as follows:

(1) The general history of the art of sound transmission, — which is to be examined with a view to determine whether the principles of that art were not known before Bell's investigations.

(2) The general language and true scope and meaning of the patent of 1876, — which is to be examined with a view to determine whether it has been unwarrantably expanded by construction; and

(3) Whether under any circumstances so broad an interpretation as that adopted in the courts below can be sustained.

The Principles of Sound Transmission.

Electric telephony rests upon the sciences of acoustics and electricity, or magnetism.

Acoustics is that branch of natural philosophy which treats of the physical nature of sound, and the laws of its origin, propagation and effects.

Sound may be considered as a physical, or as a physiological phenomenon.

Physically, it is a particular vibratory motion in ordinary matter. Its existence implies that the sound-producing body has been thrown by some means into a state of agitation or tremor, which motion has been communicated to the neighboring air particles.

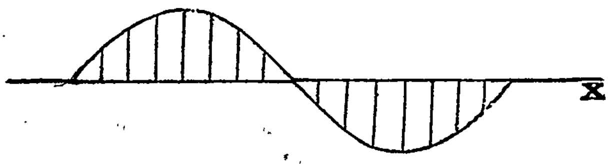
Considered in the physiological sense, sound is a sensation of the organ of hearing and of the brain. In order that the ear may be affected and the sensation of tone evoked, it is necessary that there should be interposed between the sounding body and the ear, one or more intermediate bodies (*media*) capable of molecular vibration. The air forms the most important medium for this purpose, but all matter may serve to transmit motion; that is to say, one particle or one mass of matter being by motion brought in contact with another, causes the other to move similarly, and in that way motion is said to be transmitted. The approximate cause of the sensation of sound is the condensation and rarefaction of the air lying against the ear drum. Thus sound begins in the motion of matter and results in the production of a physiological effect. In that effect the ear recognizes the character of the motion. It recognizes (1) pitch — that is, that the sounds are high or low; (2) intensity — that is, that the sounds are loud or soft; (3) quality — that is, they are distinguishable as emanating from one or another instrument, from the human voice, or from one or many of countless causes.

These effects arise from differences in (1) the extent, (2) the number and (3) the character of the vibrations made by an air particle in obedience to some motion of the sound-producing cause.

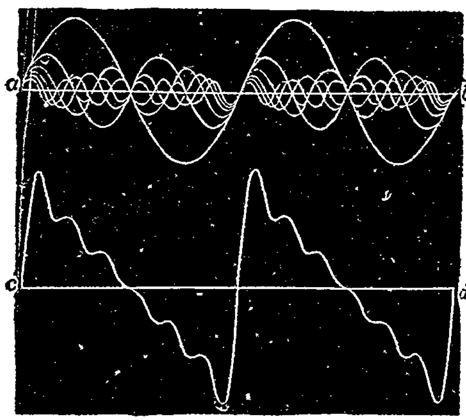
Simple and Compound Sounds.

All sounds capable of being appreciated by the ear are simple or compound; and among compound sounds, the most complex are the sounds of articulate speech.

A simple sound is one which causes the air particles to move in a straight line to and fro with a velocity of uniform increase and decrease; and is called pendular, because in this respect it is like the motion of a pendulum. That motion is represented by a curve called "sinusoidal," as follows:



A compound sound is one which is composed of several tones each of which, if sounded alone, would give to the air particle a pendular motion, but which, when sounded together, give it an irregular motion, compounded of all the forces of the different sounds. Compound sounds are variously represented, and are for illustration represented by the following plate, which shows by different lines from *a* to *b* all the mo-



tions of six different tones; while the line from *c* to *d* represents the actual motion which the air particle takes on in obedience to the simultaneous sounding of all these different tones. In this case it appears that the air particle sprang at once to a maximum of speed, which it reached—speaking roughly—before it had traversed one-sixth of its appointed journey—and then fell off rapidly at three intervals until it stopped, and returned by a motion almost exactly reversed.

In acoustics the principle of sound conduction is the same, therefore, whether the sound be complex or simple; that is to say, the principle is that the air particle will act in obedience to the particular sound, whatever it may be, by moving to and fro in a manner peculiarly deduced from the influence of the particular sound-producing cause or causes. As soon as a sound-producing body causes the air particles (1) not only to move to and fro a requisite number of times in a given time, but also (2) a definite distance backward and forward, and (3) also to do something else at the same time, so as to produce such difference in the sounds as will enable the listener to distinguish the sound-producing cause—then the sound is perceivable in all its elements of pitch, loudness and quality.

"Quality" is a term arbitrarily used by physicists for a long time, to indicate something done by the air particle outside of rate and amplitude of motion. What this something is, is entirely a matter of hypothesis.

Helmholtz, in his "Sensations of Tone," says:

"On inquiring to what external physical difference in the waves of sound the different qualities of tone correspond, we must remember that the amplitude of the vibration determines the force or loudness, and the period of vibration the pitch. Quality of tone can, therefore, depend upon neither of these. The only possible hypothesis, therefore, is that the quality of tone should depend upon the manner in which the motion is performed within the period of each single vibration."

Upon this hypothesis rests, therefore, the assumption at present universally made and accepted for purposes of scientific reasoning, that quality depends upon certain assumed or postulated eccentricities of conduct of the air particle while engaged in performing the certain number of journeys of a certain length in a certain time. Upon this Mr. Bell forms a similar hypothesis for electricity, and has drawn the conclusion that the electrical current similarly undulates, or undergoes changes of force,—and, in the case of his magneto system, also of direction.

This conclusion—built up, hypothesis upon hypothesis—may or may not be true. Upon ultimate analysis, therefore, the fifth claim (as interpreted) appears to be clearly, for an intellectual conclusion from hypothetical premises, only; and is therefore, merely, a patented hypothesis.

It has been necessary for appellees' counsel to treat "quality" as a new idea in physics, not known in 1861 when Philipp Reis produced the first instrument ever made for transmitting sounds electrically. It was necessary that they should do this in order to sustain a forced interpretation of the language of Reis in describing his instrument and its principles of operation. They say that Reis did not know of quality or its cause. This is not true, as may be seen in Young's Lectures on Natural Philosophy, published in 1807, Vol. I, p. 388, as well as in the other numerous citations in our brief of dates prior to 1861.

Philipp Reis, on introducing his telephone in 1861, wrote an article in which he said that the "ear can no longer satisfactorily discern the relation of the proportionally *great vibrations* which determine the pitch, to the *small vibrations* on which *vocal quality* depends."

In these early expressions, made before any pecuniary interest had arisen to stimulate men to great scrutiny and exactness, and before a scientific terminology had been evolved and adopted, it is natural that Reis should choose his own terms, and he did it well. The cut showing the curve of a compound sound, shows what Reis meant by "great vibrations" in distinction to "small vibrations on which vocal quality depends." The full length of one vibration forward and back is shown by the entire length of the curved line above the straight or zero line, and then across it and below it until it crosses the second time; and that is a "great vibration." The "zig-zag" shown both above and below the zero line represents those changes in velocity (and sometimes, for an infinitely short space, of direction) which are the "small vibrations" (included in the great vibration) "on which vocal" (or all) "quality depends."

Afterwards, in the same year, Reis read to the Physical Society of Frankfort a "Statement of a new theory about the perception of chords and the *quality* of sounds as a continuation of and supplement to the lecture on the telephone."

It should be considered as beyond dispute, that Reis understood that the air particle in doing its work represented quality by irregularity of movement; and that when he spoke of reproducing these movements electrically he knew that *none* of these "small vibrations" must be *lost* on their journey through the electrical field; or, in Bell's words, that the electrical undulations to be caused must be *similar in form* to the air vibration, &c.

The claim made for Mr. Bell, as already stated, that he first found out that quality needed something special for its transmission, is elucidated in a manner gratifying to appellants by Mr. Bell in an affidavit in the Drawbaugh case, that "Before this time, I had perfectly satisfied myself that the true and only method for the telegraphic transmission of vocal sounds involved as its fundamental element *an apparatus* which should transmit amplitude or intensity, as well as pitch — for quality, or timbre, or articulation, are ultimately resolvable into those two characteristics of vibration, &c., to be transmitted." Molecular Record, p. 2158.

Thus we find Mr. Bell stating that quality is resolvable into the two things, namely, amplitude (loudness) and rate (pitch), which are contemplated by Reis in his use of the term "great vibrations" as distinguished from "smaller vibrations" (quality). What was needed was "an apparatus."

We also find Prof. Cross testifying on this subject satisfactorily:

"The quality of a sound depends upon the number, loudness and relative pitch of the different partial tones. If the pitch and loudness of each partial tone can be accurately reproduced, the quality of the original sound can be reproduced." N. J. McDonough, R., p. 240.

"x-Int. 214. What do you understand him (Reis) to mean by the statement, 'Our ear can under no circumstances appreciate more than can be represented by these curves'?"

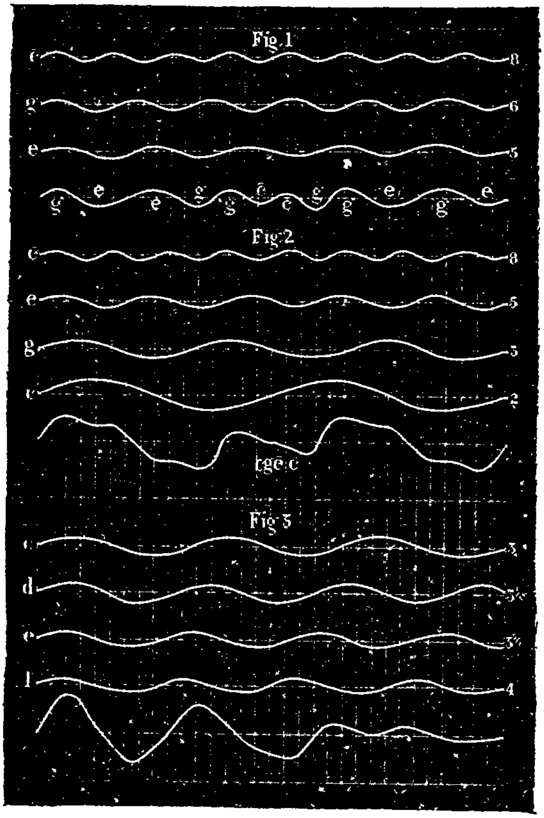
"Ans. *Reis knew that all the characteristics of sound* are due to *differences in the condensations and rarefactions* of the air conveying the sound-waves, and since these differences can all be represented graphically, he saw and stated, as in your quotation, that it was possible thus to represent all of the variation which affected the ear." *Ib.*, 186.

In the same examination, Prof. Cross says:

"x-Int. 218. In fact, the curve in the first diagram of Reis's lecture represents *only* the two characteristics of sound, —pitch and loudness?"

"Ans. On the contrary, it *represents quality* as well, though Reis makes no allusion to this." *Ib.*, 188.

The diagrams referred to are as follows:



Reis curves of three or four tones sounded simultaneously—and the combination or resultant curve in each case.

These diagrammatic curves prove that Reis understood the nature of "quality" and "form." The lines *c g e* are the curves of three separate simple sounds which being sounded together, produce a different curve, to wit, that from *g* to *e* in Fig. 1. In Fig. 2 the same comparative result is shown, as also in Fig. 3. These curves exhibit truly not only the motion of an air particle, but the rise and fall in strength of an electrical current which is being acted upon through suitable mechanism by the motion of the air particle. These curves

Reis made use of in connection with an instrument intended to transmit all sounds through the agency of electrical currents.

Resumé of Material Facts known to Physicists in 1861.

The material facts in acoustics, magnetism and electricity which were known prior to 1861, and knowledge of which must therefore be imputed to Philipp Reis, may be recapitulated as follows:

1. That sounds are propagated vibrations of matter.

2. That the loudness of any sound is determined by the amplitude of the vibration, or the distance through which the air particle moves to and fro.

3. That the pitch of a sound is determined by the number of times in which an air particle will traverse this amplitude in a given time.

4. That simple sounds give simple periodic and regular vibrations.

5. That all sounds are compound whose vibrations are the result of simultaneous action of several simple tones, whether resulting from one or from a number of sounding bodies.

6. That the term "quality" pertains to, and is predicable of, all compound sounds — of which articulate speech is only one class; and that the air particle, in obeying the impulses of the compound sound-producing causes, no longer makes the motion due to any one of them, but another motion, which is a compromise upon, and the algebraic sum of, all their varying and perhaps conflicting impulses.

7. That quality is expressed and represented by something in the manner in which the vibration is made — different from the amplitude and rate, but included within the amplitude.

8. That air vibrations can be taken up and reproduced by a plate or diaphragm.

9. That plate or membrane vibrations, derived from air vibrations, can be made to produce in a conductor, electrical changes corresponding to the air vibrations.

10. That by the use of an electro-magnet and a second plate,

the electrical vibration *will* produce another air vibration, in another place, corresponding to that which accompanied the original sound; or, in other words, that vocal and other sounds can be transmitted "telegraphically, by causing electrical undulations similar in form to the vibrations of the air accompanying the . . . sounds" (Bell's fifth claim).

With these observations upon the state of the art before 1861, we may next give attention to—

The First Conception of the Art of Transmitting Speech by Electricity.

Charles Bourseul, in 1854, published in a Paris journal his belief that a spoken word could be transmitted by electricity, and said:

"The thing is practicable in this way. We know that sounds are made by vibrations, and are made sensible to the ear by the same vibrations which are reproduced by the intervening medium. . . . Suppose a man speaks near a moving disk, sufficiently flexible to *lose none* of the vibrations of the voice; that this disk alternately makes and breaks the connection with a battery; you may have at a distance another disk which will simultaneously execute the same vibrations. . . .

"However this may be, observe that the syllables can only reproduce upon the *sense of hearing* the vibrations of the *intervening medium*. Reproduce *precisely* those vibrations, and you will reproduce precisely those *syllables*. . . . I have made some experiments in this direction. . . . The approximations obtained promise a favorable result."

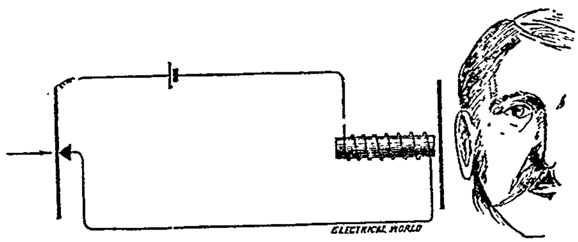
Except that it is now doubtful whether in case of successful speech transmission "this disk alternately makes and breaks the connection," etc., the language of Bourseul is a precise and complete statement of the law of operation expressed in and patented by Bell's fifth claim. One absolute condition is suggested by Bourseul, which is, with absolute fidelity, restated in Bell's claim, as will be seen by placing them side by side in the identical words of each author.

1854, Bourseul.

Bourseul is writing specifically of the transmission of "speech," by electricity over a wire, and its reproduction by suitable apparatus; and says:

"I have asked myself, for example, if the spoken word itself could not be transmitted by electricity; in a word, if what is spoken in Vienna may not be heard in Paris? . . . The thing is practicable in this way: . . ."

Then follows the suggestion of an apparatus which may be sufficiently shown by the following electrical diagram:



"We know that sounds are made by vibrations . . . observe that the syllables can only reproduce upon the sense of hearing" (*i.e.* at the distant receiving station of Vienna and Paris) "the *vibrations of the intervening* medium (the line wire) . . . reproduce precisely these vibrations" (*i.e.* the original syllable vibrations) "and you will reproduce precisely these syllables."

Reis and Bourseul Publications, page 3.

1876, Bell.

Bell is writing of the "electrical transmission" of "vocal and other sounds," which terms, as we have seen, do not necessarily include articulate speech; and says:

"I desire here to remark that there are many other uses to which these instruments may be put, such as the simultaneous transmission of musical notes, differing in loudness as well as pitch, and the telegraphic transmission of noises or sounds of any kind" (Specification, Patent No. 174,465).

* * * * * * *

"A cone is used to converge sound vibrations upon a membrane. When a sound is uttered in the cone, the membrane *a* is set in vibration . . . and thus electrical undulations are created upon the circuit. . . . These undulations are similar in form . . ." (*Ibid*).

"I claim:

"5. The method of, and apparatus for" (*i.e.* the *invented* process, etc., for producing desired undulations) "transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations similar in form to the vibrations of the air accompanying the . . . sound," etc. (*i.e. nature's* process of immediately transforming, and ultimately reproducing, sounds telegraphically).

Let us place ourselves now at the date of Bell's Patent; and contrasting these respective declarations inquire, whether on that day Bell had achieved anything new in discovery—except his magneto method of *creating* currents and their needed undulations, which is what is referred to in those words of the claim, "*as herein described*" and "*substantially as set forth*"?

Since down to that date neither Bourseul nor Bell had actually transmitted speech; and since one or the other is now to be awarded the fame of first discovering and expressing that *law* which must be conformed to, by proper mechanical apparatus and operation, whenever and by whomsoever speech is to be transmitted; and since the mere intellectual conception of this law, accompanied by the pointing out of suitable apparatus to work it, has heretofore been held to be the discovery of "a new art," etc., it becomes most interesting to repeat in more specific form our questions:

(1) WHAT CONSTITUTES AN ART—in the sense of the patent law?

(2) WHEN IS AN ART "DISCOVERED"—in that sense?

(3) WHEN WAS THE ART OF TRANSMITTING SPEECH and other sounds (*by preserving all the sound vibrations* through an electrical metamorphosis, and reproducing them identically as air vibrations), DISCOVERED—and by whom?

These questions can be fully answered only when the contributions of Philipp Reis to the operative part of this art are added to the theoretical announcements of Bourseul.

We have no evidence that Bourseul ever constructed any specific apparatus. His part in the evolution of this art consisted in recognizing and stating the *process of nature*, and thus opening to invention the task of providing *mechanical arrangements* by which to avail of that process.

To bring the process thus *discovered* and stated, within the control of man, was the work of *invention*. To reduce it to practice was a mechanical problem. The success at present attained is the joint achievement of Reis, Bell, Edison, Hughes, Blake, and numerous others; most of whom have asked and received patents for their specific devices. Bell alone has asked a patent for the *discovered* process of nature which all these invented devices serve; or in other words for achieving the natural result at which the mechanical efforts are aimed.

First realization of the transmission of speech and other sounds.

In 1861 Philipp Reis, at Frankfort, in Germany, published to the world a paper, entitled "On Telephony by means of the Galvanic Current," and exhibited an apparatus contrived, as he expressly states, for the purpose of transmitting speech and *all* other sounds. The acoustic principles involved are carefully explained, and the subject with all its difficulties is fully spread before the scientific world by the question:

"How, indeed, could a single instrument reproduce the combined effect of all the organs occupied in human speech? This was always the cardinal question; finally I got the notion of putting the question in another way —

"How is our ear affected by the *totality of vibrations* produced by the organs of speech all simultaneously active? Or more generally —

"How are we affected by the vibrations of *several simultaneously sounding bodies?*"

The instrument exhibited transmitted (according to the reports of the society to which the paper was read) melodies and the sounds of various musical instruments audibly.

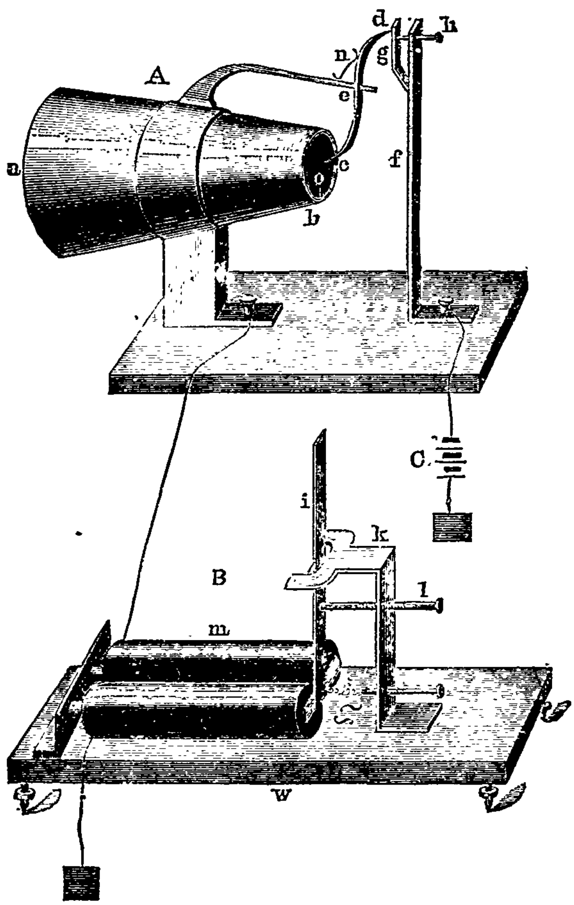
John Devereux

In the paper describing it Reis says:

"With the above principles as a foundation, I have succeeded in constructing an apparatus with which I am enabled to reproduce the tones of various instruments and even to a certain extent the human voice."

"Hitherto it has not been possible to reproduce the tones of human speech with a distinctness sufficient for every one. The consonants are for the most part reproduced pretty distinctly, but the vowels as yet not in an equal degree."

The Reis-Legat Telephone of 1863.



So much, however, proves as completely as the most perfect performance could do that the transmitter was intended—and in a degree was able—to mould the current into the forms of different sound vibrations. The instrument spoken of was succeeded by modifications and improvements, so that several forms of the Reis telephone were in existence as early as 1864; and notably one which is described in a public journal by V. Legat, Royal Prussian Telegraph Inspector, in 1863.

Concerning this instrument much testimony has been given, all to the effect that it will transmit speech without adding to or taking away any of its parts, merely by adjusting the pressure of the electrodes through means of a set screw and springs with which it is provided, and the functions and uses of which are explained.

The capacity of the Reis instruments to transmit speech is supported by the sworn testimony of many of the most eminent physicists of this and other countries; and by various witnesses of highest respectability in Germany who heard it talk during the lifetime of Reis. None of the Reis instruments are good telephones, as compared with the perfect instruments of this day, *but they are as good as the original Bell telephone.* They are capable of being made good through the application of the inventions of Hughes, Edison and others; upon which, and *not upon the inventions of Mr. Bell*, the efficiency of the telephone system used by the appellees depends. Their principle of operation when transmitting speech is a matter still in dispute.

To overcome the effect of these historical facts, appellees have been driven to take positions as follows:

1. That although Reis designed and wished to transmit speech—he never succeeded in doing so.

2. That he failed because his apparatus was "intended" to make and break the circuit—and did so.

3. That Bell adopted the plan of a closed circuit, and by that means succeeded.

These propositions are a mixture of truth and error, and require examination and sifting.

1. *That although Reis designed and wished to transmit speech, he never succeeded in doing so.*

To admit, as Prof. Cross does, that the Reis instrument will speak now, and at the same time to deny that with all his efforts to that end, the inventor made it speak in his time, in view of unimpeached and highly responsible testimony — old and new — to the contrary, has only boldness to commend it.

2. *That he failed because his apparatus was "intended" to, and did, make and break the circuit.*

The supposed make and break element in the Reis instrument has been the crucial test upon which the courts below have been able to disregard proven facts, and satisfy themselves by a shred of theory. Adopting the arguments of counsel in the place of proof, Judge Lowell declares that:

"A century of Reis would never have produced a speaking telephone by mere improvement in construction."

This was said in connection with a statement that:

"The deficiency was inherent in the principle of the machine. It can transmit electric waves along a wire, under very favorable circumstances, not in the mode *intended* by the inventor, but one suggested by Bell's discovery; but it cannot transmute them into articulate sounds at the other end, because it is constructed on a false theory. . . ."

There is a mischievous fallacy here which consists in imputing to Reis an "intention" that his instrument should make and break the circuit anyhow, whether it succeeded in transmitting speech or not; and to the instrument itself a construction incompatible with any other mode of operation than such make and break.

The evidence of an "intention" on the part of Reis is derived from one or two expressions in his writings, which are given, first, an interpretation contradictory to the real sense of the whole; and second, an importance disproportionate to their true significance. Honest construction of the few pages which Reis has given us requires us to bear in mind, *first*, his professed object, which was *to transmit speech* and all other sounds; *second*, the construction of his transmitters (for reasons of space the Reis-Legat only is referred to), which exhibit adjusting screws and springs so placed as to enable the operator to bring the electrodes together, and either render a separation impossible, or hold them in every degree of contact down to an actual separation of their surfaces; *third*, that at the time Reis wrote, many instruments of precision now in existence for making electrical tests were wanting; *fourth*, that the terminology of electrical science had not developed into general use any words by which to express *degrees* of make and break; *fifth*, that whether the instruments did or did not make and break was quite immaterial; and does not affect the sufficiency of his instructions to enable a skilled person to use his apparatus, *or the legal effect of his writings as published anticipations of Bell's fifth claim* (as interpreted).

The quotation chiefly in use to establish the assertion that he had built upon a wrong principle (Judge Lowell), or that he made *strenuous endeavors* to *prevent* a continuity of circuit (Prof. Cross), is found in his description of what he *supposed* to be the operation of his instrument. To know what value to give this description as evidence of the real fact, it should be considered that the separation of surfaces for $\frac{1}{50000}$ of a second of time, and a space of $\frac{1}{70000}$ of an inch would be sufficient to break a telephonic electrical current, as it is now used.

In the Frankfort lecture (Reis and Bourseul Publications, 16), Reis, after stating the principles of acoustics in such a way as to include the general law above stated, viz.: *that the intervening media between a sound-producing cause and a sound-perceiving organ must preserve all the original vibrations*, said:

"With the above principles as a foundation, I have succeeded in constructing an apparatus with which I am enabled to reproduce the tones of various instruments, and even to a certain extent the human voice."

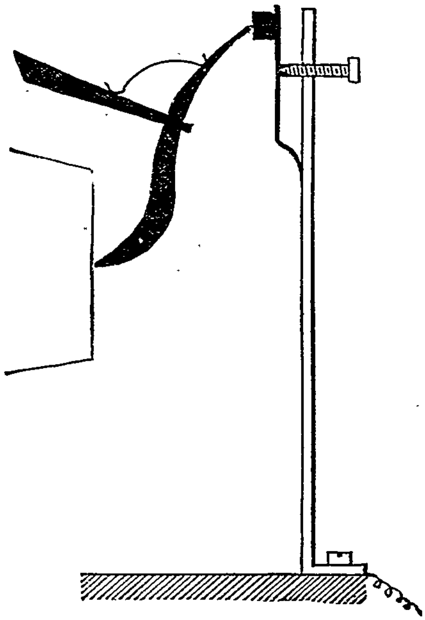
Then follows the clause in question:

"At the first condensation, the hammer-like wire *d* is pushed back; at the rarefaction it *cannot* follow the retreating membrane and the current traversing the strip remains broken until the membrane, forced by a new condensation again presses the strip against *d*. In this way each sound-wave causes a breaking and closing of the current."

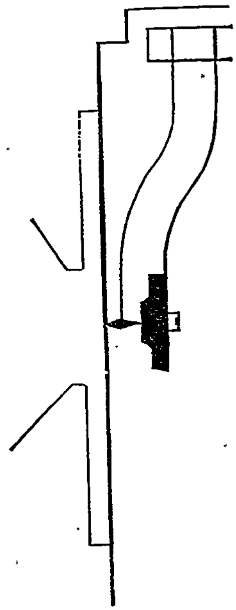
Upon this is rested the bold assertion that Reis adopted as the *principle* of his machine that it *must* make and break the current; and that he made "*endeavors to prevent*" the current from being *continuous*.

The language is before the court; the apparatus of the inventor and the principles of its construction are the subject of observation; the witnesses in respect to its performance have been heard.

It is seen to be an instrument of the class now universally known as microphone; and its action is what is known as microphonic action. Any two electrodes placed normally in contact with a slight pressure, and forming part of a circuit supplied with a current from a battery is a microphone. The principle of the microphone is the principle of the loose joint. The Blake transmitter is, up to this time, the most perfect and sensitive of all the microphones, but its relation to the Reis transmitter is genetic. Whatever may be done by a Blake transmitter may be done by a Reis transmitter; although more care will be needed with the Reis and less certainty will result; because the Blake is mechanically more perfect. The principle of the two is the same. Their objects are the same. Outline drawings of the workings of both are here shown. In each of these as will be seen there is a loose contact between the electrodes.



Reis-Legat Transmitter.



Blake Transmitter.

It is in the transmitter that the principle upon which Bell's broad claim is based does its work; it is here that the current is "moulded" into a "form similar," etc. The Blake transmitter has had the good fortune always to be mated with a good receiver; and when it "moulds" well the receiver is its witness. The Reis transmitter was in its origin mated with an insensitive and imperfect receiver. That receiver is doubtless chargeable with most of the failures to hear the words of the transmitter. The moulded undulations, similar in form, were there; but the receiver was inadequate to retransform them properly. When united to a good receiver the Reis instrument, as is admitted by the appellees, will talk; *thus proving that a Reis transmitter is "an apparatus"—and works by "a method"—capable of* "transmitting vocal and other sounds telegraphically, by causing electrical undulations similar in form to the air vibrations," etc. Professor Cross testifies:

"I have been able to transmit speech intelligibly by speaking *gently* into a Reis transmitter in circuit with a Bell magneto receiver."

But "gentle" speaking, since 1876, is forbidden, because, notwithstanding Reis, in 1861, had hinted this condition by saying:

"I was enabled to render audible to a large assembly (The Physical Society of Frankfort a.M.) melodies, which were sung (*not very loud*) into the apparatus in another house three hundred feet away" (Reis & Bourseul Publications, 17): still, Judge Lowell says, in effect, that singing "not very loud" is a "mode suggested by Bell's discovery." In short, in the view of that judge, it is lawful to sing loud enough to fail, but not gently enough to succeed.

Legat (Reis & Bourseul Publications, 33) is more explicit than Reis in the way of giving directions about adjustment, &c. After describing the transmitter shown, he says:

"The *proper lengths* of the respective arms *c e* and *e d* of this lever are regulated by the laws of the lever. It is advisable to make the arm *c e* longer than the arm *e d* in order that the *least motion* at *c* may operate with greatest effect at *d*. It is also desirable that the lever itself be made *as light as possible* that it MAY FOLLOW the movements of the membrane. *Any inaccuracy in the operation of the lever c d* in this respect will produce false tones at the receiving station. When in a state of rest, the contact at *d g* is closed and a delicate spring *n* maintains the lever in this position. . . . Upon the standard *f* is arranged a spring with a contact point corresponding to the contact point *d* of the lever *c d*. The position of *g* is regulated by the screw *h*."

From this it is made clear that Legat knew the electrodes must be kept together, mostly, if all sounds were to be effectively transmitted; and after this it was and is quite unimportant to know whether the current is sometimes, in fact, or only in the imagination, made and broken. Indeed, it is unimportant to know whether by that term Reis and Legat understood what we now understand by "make and break."

Describing the supposed operation he says:

"The lever *c d* follows the movement of the membrane and opens and closes the galvanic current at *d g* so that at each condensation of the air in the tube, the circuit is opened, and at each rarefaction the circuit is closed."

"In consequence of this operation, the electro-magnet of the apparatus in accordance with the condensations and rarefactions of the column of air in the tube *a b* . . . *is correspondingly* demagnetized and magnetized, and the armature of the magnet is set into vibrations *like* those of the membrane in the transmitting apparatus." . . .

He adds:

"In consequence of the imperfection of the apparatus at this time, the minor differences of the original vibrations are distinguishable with more difficulty; that is, the vowel sounds appear more or less indistinct,—inasmuch as each tone depends not merely upon the number of vibrations of the medium, but also upon its condensation and rarefaction."

"This also explains why chords and melodies were transmitted with marvellous accuracy, in the practical experiments hitherto made, while single words in reading, speaking, etc., were less distinctly recognizable, although even in these the inflections of the voice, as in interrogation, exclamation, surprise, calling, etc., were clearly reproduced."

"There is no doubt that the subject which we have been considering, before it becomes practically valuable, for use, will require considerable improvement; it will especially *be necessary to perfect the mechanism* of the apparatus to be employed; . . . " .

From all the foregoing it must be clear

(1) that *all* sounds are transmitted by means of electrical undulations similar to their original vibrations; (2) that Legat and Reis understood that in order to succeed in the transmission of sounds. *none of the vibrations* belonging to the original sound must be lost; (3) that they were under the impression that the electrodes of the transmitter were separated with each rarefaction of the air and that during that separation the current ceased to flow; (4) that what they said was an ex-

pression of opinion, and not of intention; nor a declaration of the principle of the machine.

If continuity of circuit is requisite to transmit speech, then the means for preserving that continuity were provided by Reis and applied; and the proof that all sounds, including the tones of the human voice, and articulate speech, were transmitted, is proof that the needed continuity was preserved.

3. *That Bell adopted the plan of a closed circuit and by that means succeeded.*

It is true that Bell adopted the idea of a closed circuit which cannot be opened. That is shown in the drawing annexed to his patent, and the term "closed circuit" when used in the patent, or when used in supporting its claims, must in fairness be construed to cover, not a circuit like the microphone circuit of Reis or Blake (which may be closed or may be opened, according to the degree of power brought to bear upon it), but a circuit like that of Fig. 7, which cannot by any force whatever be opened.

That speech may be transmitted by such a closed circuit is now known, though it was not experimentally known when Bell took out his patent, nor until a considerable time after.

That speech cannot be transmitted when the circuit is sometimes automatically opened and closed, cannot be proven. The opinions of physicists differ. The truth about that matter is not so material as it would be if Reis had, as appellees sophistically aver, based his claims to performance upon make and break *as a condition.* The terrible force of logic upon the necessities of the appellants' theory concerning the Reis instruments will be found in the evidence of Professor Cross.

"47 x-Int. Do you understand that an apparatus which is capable of transmitting sounds *other* than vocal sounds, not articulate words, by causing electrical undulations similar in form to such sounds, would embody the invention described in said fifth claim?

"Ans. I do." The Amer. Bell Tel. Co. *v.* Spencer, p. 129, O., p. 3954.

From this answer it is evident that they are driven to claim even the things which they must *admit Reis did*, viz.: the transmission of sounds *other than vocal sounds*, not articulate speech — *e.g.* the tones of the piano, accordion, clarionet, horn, organ pipe, etc., which were — of course — distinguishable only by their QUALITY (Reis & Bourseul Publications, 17).

Burdened with this necessity to stretch the 5th claim to the point of breaking, the witness elsewhere says:

"45 x-Int. At that time (1876) was the art of transmitting musical tones, including vocal musical tones, by electricity known?

"Ans. The art of transmitting the characteristic pitch of musical sounds, including the pitch of a sound produced by the voice, was known. The transmission of all the characteristics of *any* sound — its intensity, its pitch and its quality — was not known.

"46 x-Int. Don't you, in your last answer as to what was not known, describe an art which, if known, would have been the art of transmitting articulate speech?

"Ans. The *theoretical knowledge* of the manner in which the *one* could be done would, I think, *necessarily involve* the theoretical knowledge of the way in which the *other* could be done. The *practical realization* of an instrument which could transmit the three characteristics of pitch, intensity and *quality* of a musical sound would not necessarily involve the practical realization of the transmission of articulate speech." Molecular Record, 129.

"57 x-Int. Suppose a Reis transmitter of the form shown on page 10 or page 13 of said Prescott's work (being the form known as the Reis-Legat transmitter) is spoken into so softly as not to cause any actual separation of the electrodes, will not such transmitter act so as to vary the electric current so as to produce in such current an undulation corresponding in form to the sound spoken into such transmitter?

"Ans. When operated in the manner described, the transmitter figured on page 10 will do this.

"58 x-Int. In your opinion, will the efficiency of the Reis transmitter vary with the kind of material which is used in the electrodes?

"Ans. For use as a Reis transmitter, the efficiency is doubtless much influenced by the nature of the electrodes, which is well known to be the case in all circuit breakers.

"59 x-Int. Suppose a Reis transmitter of the form shown on page 10 of said Prescott's work is spoken to so softly as not to cause any actual separation of the electrodes, will not the transmitter produce in the electric currents in the line wire a series of undulations corresponding to the quality of the sounds spoken into such transmitter? I use the term quality in the sense in which you have used it in speaking of the characteristics of sound vibrations.

"Ans. It will." The Amer. Bell Tel. Co. *v.* Spencer, p. 131, O., pp. 3956–7.

This testimony alone contains all which is required to defeat Bell's claim to the discovery of a new art in such a sense as to entitle him to a broad claim.

The favorite definition by counsel of Mr. Bell's invention is that he found out how to "mould" the electrical current into the form of the air-waves. Manifestly this "moulding" occurs in the transmitter: and the evidence that moulding has taken place is that speech is heard. If, then, the Reis transmitter united with any receiver whatever, gives that evidence that the transmitter has "moulded" the current, this is proof that Mr. Bell is not the originator of this art of "moulding." Upon this point the testimony of Prof. Cross recently taken and read into this case by stipulation is instructive.

In former cases Prof. Cross had said:

"It is possible, with the Reis transmitter, to produce electrical undulations similar in form to the sound-waves producing them," and

"I do not deny the possibility that *in spite of the endeavors of Reis to prevent it*, the circuit may have remained unbroken, and some sounds have been transmitted by the production of electrical undulations" (Dolbear Record, 508 and 515).

In the McDonough case he said:

"x-Int. 74. Is there no practical method of determining whether, in any particular apparatus, the deformation and loss of portions of the electrical undulations have reached such a point as to place the apparatus outside the scope of Bell's fifth claim, or, in other words, so that the apparatus will cease to operate upon the method referred to in that claim?

"Ans. If an actual piece of apparatus, which could be experimented with were produced, it would be possible to determine whether it did or did not operate according to the method described in the fifth claim.

"x-Int. 75. What would be the practical test?

"Ans. One would observe the construction of the apparatus, the mode in which it was intended to operate if this were stated, *and the results actually obtained as apparent to the ear.*

"x-Int. 76. Could you determine the question by the last test alone?

"Ans. I have not found any difficulty in determining it in any apparatus that I have ever seen.

"x-Int. 130. Do you know of any method of adjusting a Blake transmitter so that it will operate efficiently otherwise than by listening to a receiver joined in the same circuit?

"Ans. *Not of any method which would be a practical one and satisfactory.* I know of no other which has been used.

* * * * *

"x-Int. 135. You know it to be a fact, do you not, that the electrodes of a Reis transmitter can be so adjusted relatively to each other by the mode in which the instrument is talked to that it will transmit speech?

"Ans. I have been able to transmit speech intelligibly by speaking gently to a Reis transmitter in circuit with a battery and Bell magneto receiver.

"x-Int. 136. At such times, as you understand it, the Reis instrument is producing undulations similar in form to the air waves?

"Ans. It is.

"x-Int. 137. And embodies the invention of Bell's fifth claim of the patent of 1876?

"Ans. I understand that it does when so operated.

"x-Int. 139. Did you find that you were also able with that same Reis transmitter to so adjust the electrodes in their relation to each other simply by your mode of talking to it that it would not transmit speech?

"Ans. When I talked to it loudly so that the circuit was broken frequently I was unable to transmit speech by it.

"x-Int. 140. Did it at such times embody the invention of Bell's fifth claim?

"Ans. I should say that it did not.

"x-Int. 141. Then, according to your belief, the determination of the question whether or not a Reis transmitter embodies the invention of the fifth claim of Bell's patent of 1876 does not depend upon the construction of the instrument or the relation of the parts to each other when at rest, but upon the mode in which the instrument is used; is that correct?

"Ans. It is." The N. J. McDonough Record, pages 152, 153, *et seq.*

From which it clearly appears that a Reis transmitter runs great risk of never being a Blake transmitter—in the hands of complainant's experts!!

The proofs as they affect the Reis instruments may be summed up as follows:

1. Reis devised an apparatus which he called a telephone for use in the transmission of language or words [1] (Tonsprache); the sounds of musical instruments; chords composed of simultaneously sounded notes, etc.

2. It is admitted that they were and are capable to trans-

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[1] The minute care which has been devoted to adjusting all facts and literature so as to be harmonious with the appellee's case concerning Reis is shown with respect to the translation of the word "Tonsprache" in the Reis article of 1861.

That article made its appearance first in the Spencer case in 1881, where "Tonsprache" was translated as "speech." In the next—the Dolbear—case, the article was (by stipulation between counsel) printed so as to substitute "musical tones" for "speech" as the true translation of "Tonsprache." From the latter case the exhibit has been adopted in subsequent cases by stipulation, apparently without any revision of the translation, so that the paper reads now "The extraordinary results . . . have . . . raised the question if it might not be possible to transmit *musical tones* themselves ('speech itself'—'Tonsprache') to a distance."

The first translation is correct. See testimony of Bjerregaard, Molecular Record, p. 673. O., p. 1070, and the standard authority Lucas' German Dictionary, Bremen, 1868, as follows:

Tonsprache—f., *language*, *words* (oppos. to Geberdensprache, *pantomime*), mit musical tones having quality, in such a way that the instruments can be distinguished.

3. It is proved that they did in the time of Reis, and will now — transmit words and sentences.

4. It is admitted that the Reis transmitter will transmit clearly and well when united to a good receiver.

5. It is proved that the Reis apparatus entire will "talk" when carefully handled — and that it will talk well without the addition of any element not already there, if slight changes in the mechanical construction (by a varying of the stiffness of springs, etc.) be made, and if the instruments be properly adjusted.

6. It is proved by Prof. Cross that any instrument capable to transmit any tone having quality is theoretically capable to transmit articulate speech; from which it results that to make it practically capable is a mechanical achievement, simply.

7. Whenever any transmitting telephone does actually transmit speech or any other sound possessing quality, it must necessarily have availed itself of some natural process in the line wire; which is probably the same process whether the impulse be received from a magneto transmitter or from a variable resistance transmitter; and which process Mr. Bell, under a name and description — the fitness of which appears as yet incapable of verification — has set forth in his fifth claim.

Upon this state of facts concerning the history of the art; and in view of the judgment below upholding the fifth claim because Mr. Bell is supposed to have discovered and announced in it a new art, to wit, "the new art of speech transmission," it now becomes material to consider certain legal questions.

1. *What is an art, in the sense of the patent law?*

2. *When may an art be regarded as discovered in contemplation of law?*

3. Who discovered the "art" portion of the practical business of speech and other sound transmission?

To conceive that a new thing can be done; to indicate in a correct though general way the laws of nature which must be availed of; to create suitable apparatus — although suitable only in a limited degree; to use the apparatus and succeed in the avowed purpose—though only in a limited degree; to publish the result with sufficient specification to reveal the whole purpose, and put the world fairly upon further inquiry, appears to result in the production of a new art, and to take the doing of that special thing out of the category of undiscovered arts.

From that stage, in the development of that art, it would seem that invention and discovery must be deemed limited to the improvement and perfecting of old or the invention of new, modes of mechanism.

This difference between the discovery of an art and the perfected price thereof is what the court is called on in this case to clearly distinguish.

The error below has in part consisted in the apparently unconscious assumption of a false premise, viz., that the art of transmitting speech was undiscovered in 1876, because no good way of practising it had yet been worked out.

As to the Specific Art of Electric Telephony or Speech Transmission.

It appears clearly that the art of sound transmission is one art, the principles of which are in no wise changed or varied on account of the special sound to be transmitted.

It would then appear that there was not a special art of speech transmission left to be discovered after the general art of tone transmission was known.

Examining the works and considering the language of Reis, it appears that he set to himself and to the world a problem in this form:

How shall we mechanically take up and control the air vibrations accompanying any sound or sounds, and by their own energy create electrical actions corresponding to them; and afterwards by the energy of these electrical actions create other air vibrations which shall be so like the first as to produce in the organ of hearing the sensation of tone which would have been produced in it by the original sound or sounds?

The problem was *mechanical.*

He essayed an answer to this mechanical problem by a variety of devices.

There is not a *scintilla* of proof that Reis *ever tried to break or not to break the current.* He tried to *speak* so as to be *heard.* The consequence of such speech to the current, he left to nature and the automatic action of the instrument.

The words, the "little hammer, . . . *cannot* follow," etc., *had reference only to the Bored Block transmitter of 1861, and was never repeated in respect to the subsequent "cubical box" or Legat forms.*

Make and Break and Continuous Current.

Mr. Lowrey urged that it is a moot question whether absolute continuity of current is requisite to speech transmission; saying that it is not proved that speech cannot be transmitted when the current is intermittent; and therefore that the fact of transmission by a current *capable* of being broken does not prove that it has at all times remained continuous.

It is undoubtedly proved that something occurs in the electrical field which has an agency in the reproduction of sounds. Whether it is some variation of the intermolecular relations of the conducting medium brought about by attaching the conductor to a source of electricity; or some change in the tension of whatever is the product of the battery or magnet, and therefore called electrical; or whether it is some other occult process as yet not recognized, which results in allowing motion to be transferred and reproduced is not known.

Mr. Bell has taken a step forward and given the name of "electrical undulations similar in form" to that something which occurs. Having thus embodied and personified the theory in an expression, he has taken a patent for the expression and is now in position to restrain all transmission of speech upon the ground that when it is transmitted, "undulations similar in form," &c., are caused, and his idea thereby infringed.

That Mr. Bell and his experts are wrong, and that the proximate cause of speech transmission may hereafter be found to be, *not* the *similarity in form* of the undulations, etc., is not only not impossible, but in view of the many instances in which scientific theories as reasonable and as strongly upheld as the present undulatory theory of electricity have proved untrue, is not highly improbable.

One thing, however, is certain, that the words "*as herein described*," etc., hold the appellees to an apparatus which like that described, *owns absolute continuity* as its invariable law.

Bell's Present Broad Interpretation of the 5th Claim results in a Monopoly of a Scientific Fact or Law of Nature.

There remains still the important question—granting all which is claimed in the patent to be novel, *How much is patentable invention* or discovery, and how *much is unpatentable discovery* of scientific facts or laws of nature.

This brings us to the consideration of *Tilghman* v. *Proctor*, and other process cases; and *O'Reilly* v. *Morse*.

In one of the cases on appeal (the Dolbear case) the court says:

"There can be no patent for a mere principle. The discoverer of a *natural force* or a *scientific fact* cannot have a patent for that."

But it proceeds to make this exception nugatory by confounding the natural process (or scientific fact) with the invented process for working the apparatus; sustaining the patent for the last upon a construction which blindly sweeps in the first:

"The evidence in this case clearly shows that Bell discovered that articulate sounds *could* be transmitted by undulatory vibrations of electricity, and *invented* THE way or *process* of transmitting such sounds by means of such vibrations. If THAT *art* or *process* . . . is . . . the only way by which speech can be transmitted by electricity, that fact does not lessen the merit of his invention or the protection which the law will give *it*. . . ."

" . . . The essence of his invention consists not merely in the form of apparatus which he uses, but in the *general process* or method of which that apparatus is the embodiment." . . .

"Whatever name may be given to a property or manifestation of electricity in the defendant's receiver, the facts remain that they availed themselves of Bell's *discovery* that undulatory vibrations of electricity *can* intelligibly and accurately transmit articulate speech as well as of *the process* which Bell invented, and by which he reduced his discovery to practical use."

As interpreted, therefore, by the court and the counsel who uphold it, the fifth claim is a claim for the electrical transmission of speech under the form of a pretended description of how nature does it! Having found that a result happens, and guessed at the explanation, Bell patented the guess; and evidence that the effect has been attained is permitted to prove that his conjectural method is infringed.

In fact, what Mr. Bell discovered — assuming now the novelty of his work and accepting his formula as a conventional way of expressing the conception of science, about *something* which happens — was, not that electrical undulations *can* (as if there were some choice on the part of the inventor), but that they *do*, transmit sounds by conforming themselves to the characteristics of the energy which creates the sound — and that they will do this in no other way.

This is a scientific fact.

If his theory is true, and his claim to originality genuine, he had detected a secret of nature; and had found out how from the energy of motion in ordinary matter (sound) she sets up equivalent action (undulations) in the molecular, magnetic or electrical states of a conductor, and afterwards causes the force or energy to emerge from that intermediate state or form of manifestation into its original form.

In fact, he has merely reasoned on the subject, and has not, in any true sense, "discovered" anything.

In other words, Mr. Bell thinks he has discovered that the law of the persistence or correlation of forces holds good in its application to this subject.

Having so reasoned, he proceeded promptly to patent, not only a particular method and apparatus for availing of that law, but also the *right to* avail of that law by any means whatever.

Thus considered *he has been able to monopolize a natural force, and patent a scientific fact.*

To show how clearly this case is within the reasoning used in the case of *O'Reilly* v. *Morse*, 16 How., let us drop the middle term in the fifth claim and read it as follows: "5. The method of, and apparatus for, transmitting telegraphically vocal or other sounds . . . substantially as set forth" (*i.e.* the process of speaking and listening in a circuit specially arranged). Does the middle term thus left out describe anything discovered by Mr. Bell, in the sense of the patent law? If electricity undulates, Mr. Bell did not invent that action. As the claim stands, interpreted, therefore, it is pure and simple for the action of electricity whenever and in whatever manner it transmits sounds.

Suppose Mr. Morse had learned or surmised that electricity, when employed in transmitting signals, gains heat or color, and is gray, or blue, or red, and had said "I claim not only an apparatus by which electricity can be put into a heated or colored state, but I claim electricity whenever it is hot or colored in the act of transmitting."

In what sense would this be different from his disallowed eighth claim, — if it is only in and by the predicated conditions that electricity performs its work?

In short, Mr. Bell's way of claiming this law of nature is the way of Morse in his famous, disallowed eighth claim, disguised only by the turn of a phrase. Morse claimed the use of electricity for transmitting signals, and this was disallowed. Bell claims the use of electricity *when undulating* in correspondence with air vibrations and transmitting sounds. Since electricity will not transmit, except by undulating, the claim is in effect broadly for the use of electricity *when transmitting.*

The Morse fifth claim, which was sustained, was for the system of dots and dashes, — an arbitrary and conventional arrangement by which ideas were conveyed. Morse, and the world knowing already that the flow of a current could be interrupted and renewed, invented a certain order of interruption and renewals which would produce certain signals, the meaning of which could be fixed by agreement. This was an artificial thing, and as such signals could be indefinitely varied, and the doing this was wholly the conception of his mind, he was given a patent for breaking up a current into any recognized succession of interruptions and renewals.

But the undulations of a current in the act of transferring mechanical movements of air particles is a natural system. Nobody wants it to undulate. It *will* undulate automatically when spoken to in certain right ways—of which Bell has one and the defendant another. The discovery of this fact belonged to the same class which the biologist makes, when, looking more and more closely into nature, he learns the process of ovation and germination.

To allow a patent claim for such a discovery might be likened to a claim for raising wheat by the germination of the seed: *leaving mankind free to produce wheat by all other methods!*

The Fifth as a Process Claim.

The arguments for sustaining the fifth as a claim to the process of transmitting sounds by causing electrical undulations, without reference to the means, has no support in the doctrine of Tilghman *v.* Proctor, *or any of the process cases.*

Mr. Lowrey argued, that in all the cases upholding a claim for a process, the process was one capable of being sensually perceived, verified and proved by oath—not as a matter of opinion, but as a matter of fact. That the process of transmission by undulations is plausible, and probably true; but is not proven; that we have merely adopted a term to signify something which happens, but the true nature of which remains as yet undiscovered; that the plausibility of the theory implied in the name, cannot justify a court of law in treating the theory as a proven fact, and sufficient basis for legal judgment affecting rights; that the theory of Sir Isaac Newton concerning the emission of light was no less plausible and remained for generations the accepted theory of the scientific world; yet now it is without a single believer. In the Tilghman case, for instance, the specifications say: "My invention consists of (1) a process for (2) producing free fat acids," &c.

Suppose the inventor had surmised some hidden chemical action as being a step in the operation; and, having obtained a patent for producing, etc., by causing that chemical operation, had insisted upon preventing all persons "from producing free fat acids," etc., by any means whatever, on the ground that the fact of production proves that his unseen and patented chemical process has occurred. We should then have a case analogous to this.

But that is not the case of *Tilghman* v. *Proctor*, 102 U. S. 707.

In Tilghman's specification the process is set out as follows: "I subject these fatty oily matters to the action of water at a high temperature and pressure," etc.

The court in interpreting the patent, says (p. 708): that it "is for a process of separating their component parts so as to render them better adapted to the use of the arts."

The claim was the manufacturing of fat, acids and glycerine from fatty bodies, *by the action of water at a high temperature and pressure.*

There was a process, all of which lay within ordinary means of observation and verification; being thus wholly unlike in material respects to the supposed process of creating undulations *in a continuous current*, which is Bell's claim.

It is believed, therefore, that so much of the fifth claim as by any construction is capable to be extended to the transmission of speech, should be expressly limited to what is accomplished by uttering—"as herein described"—the sound *before the transmitter of a magneto telephone.*

As this is not the appellant's way, he does not infringe the patent.

Varley and others.

The anticipations of Varley and others are treated fully in the Molecular Company's brief.

[Mr. Lowrey referred to the inventions of Varley and others as being fully set out in the brief of the Molecular Company as anticipations; and especially considered the claim that Bell's patent has by proper references included the variable resistance method among those pointed out by him for use in transmitting sounds "by causing," etc., together with the evidence offered to show that he did make some experiments at one time with a stretched wire to ascertain whether a varying resistance to a current could be made to produce undulations in its force.

He asserted that no serious evidence existed in the case that Mr. Bell had ever before the date of his patent contemplated the production of undulations for the transmission of sounds by any other than the magneto-telephone method; and left the further consideration of the history of Mr. Bell's investigations and experiments to other counsel.]

Mr. Lysander Hill for the People's Telephone Company [Drawbaugh], and for the Overland Telephone Company. The briefs in these cases were signed by *Mr. Hill*, *Mr. George F. Edmunds*, *Mr. Don M. Dickinson*, *Mr. Charles P. Crosby*, *Mr. T. S. E. Dixon*, *Mr. Henry C. Andrews*, and *Mr. Melville Church.*

There are four or five different interests here; and each one wants to be heard by its own counsel. But, if your Honors please, some of us are substantially agreed in our general mode of presenting the case, and we shall not overlap each other. I shall take up the subject, for example, as nearly as I can, where Mr. Lowrey left it; and I shall endeavor not to walk over the ground which he has traversed, but rather to advance from the point where he stopped.

The order in which I shall take up the subjects which I shall discuss will be, as near as I can follow it, substantially this: I shall first discuss briefly the history of what Mr. Bell did, and what he did not do, endeavoring to give the court some idea of exactly what Mr. Bell did and what he did not do, what he sought to do, what his plans, his thoughts, his theories were, as obtained from his own testimony. And, I must say to the court that in all I shall say I shall be discussing the complainants', the appellees' testimony. I shall not have occasion to refer to the testimony of the appellants at all. I get Mr. Bell's history from his own mouth, from his own documents and from complainants' documents, not from ours. And, after showing, if I can make a showing in the brief time that I have, what Mr. Bell did, and what he did not do, I shall then endeavor to take up his patents and consider the construction of his patent in view of his work. After which will follow the discussion of some questions relating to the validity of those patents.

Prior to the autumn of 1873 Bell had become impressed with the importance of discovering a means to enable telegraphic companies to transmit more than one message at the same time over the same wire. He had formed some theories of his own on the subject of multiple telegraphy (as we call that branch of telegraphy by which many messages may be transmitted over one wire at the same time) and his thoughts and theories led him to the subject of the harmonic telegraph; that is, to use a transmitter which should vibrate at certain specified rates per second, and, by means of electrical currents, cause the receiver to vibrate at the same number of rates per second; and then those receivers, acting through an old law, well known to musicians, would each pick out the number of vibrations, or the rate of vibrations, which was sent by the transmitter attuned to their own tune, and not attuned to any other. While thus occupied, he fell in with the Bourseul article. It taught him, as Mr. Lowrey has already explained, that if you make a sound upon a diaphragm, you set that diaphragm into vibration, and thereby cause it to interrupt a current of electricity, making and breaking the current, and you will obtain at the other end of the line vibrations which will correspond, at least in rate per second, or in pitch of the sound, to the vibrations of the transmitter, and of the sound actuating the transmitter. Bourseul had stated his belief that upon that principle an electric transmission of speech could be secured, although he had not secured it himself, as appears by the article. He no longer had to beat his own way for the discovery, or to think of the law; for Bourseul's article pointed out the law to him; and the great law, the foundation law of the whole science and art was simply this, that you must have a transmitter at one end — a connecting line — and a receiver at the other end; that you must have your transmitter so arranged that it would vibrate in exact response to the vibration of the sound waves; and that you must connect your receiver to it by currents so operating that the receiver would vibrate in the same exact relation to the sound waves. Then you would produce the same vibrations in the receiver that your sound produced in the transmitting diaphragm. You must necessarily have precisely the same sounds. That was a statement of the law of the telephone.

Before the winter of 1874–5, certainly before February, 1875, he had become acquainted with Reis's inventions. From this source, also, he learned that you must primarily use a diaphragm, a vibrating disc or membrane, so arranged that it would take up and respond to all motions of the air, and he further learned: (1) That you must have a receiver which will execute vibrations identical with the air vibrations made at the transmitter: (2) That the mechanism must be arranged so as to produce both the rate of vibration, and the varying amplitude of it, in order to transmit speech: and (3) That Reis had endeavored to carry out these principles in the construction of his apparatus.

He further learned from Reis to represent this mathematically, by drawing curves representing the sounds. He found in the articles of Reis full mathematical curves representing the various vibrations. He found the different parts of the curves described. He found a zero line representing the air as still, and rises of the curve above that zero line representing the condensation, or the forward movement of the air particles, forcing them a· ong each other, and then the descent of that curve line below the zero line representing the rarefaction of the air below its normal point, and so on. He also found that Reis had represented composite curves, made up of other curves, to show how various sounds could be made, and that they would all coalesce and form resultant curves, which can be represented in the same way or by algebraically adding those curves — adding both together when they are both plus, subtracting when some are minus, and adding when both are minus. Reis states this general principle very clearly thus:

"FIRST. Every sound and every combination of sounds, on striking our ear cause vibrations of the drum of the ear that may be represented by a curve.

"SECOND. The course of these vibrations simply gives us a conception (appréciation) of the sound, and every alternation changes the conception (appréciation).

"As soon, then, as it is possible to produce, anywhere and in any manner, vibrations whose curves shall be the same as those of any sounds or combination of sounds, we shall receive the same impression as that tone or combination of tones would have produced on us."

This was the general information which Bell had when he entered upon the study of the possible transmission of speech vibrations of sound. By these publications his vigorous and logical mind was directed to the very point to be investigated; the air vibrations, the motions of the particles of the air in the transmission of sound. Bourseul had not accomplished this transmission. The results achieved by Reis were defective. Consonantal sounds had been satisfactorily transmitted; vowel sounds not so well; words indistinctly.

Bell was well acquainted with the scientific theories on this subject. Sound created by vocal organs is caused by vibrating the organs. That vibration produces vibration of the air; at is, a back-and-forth movement. All sound consists primarily in the movement of air particles forward and back from the source of sound. Without this vibration there is no sound. The rate at which the air particles travel back and forth — that is, the number of movements per second — determine whether the sound is high or low. The upper notes of Patti, for instance, vibrate the air about fifteen hundred times per second; a heavy basso note about eighty times per second. One further characteristic, namely, the force or the distance through which the vibration occurred, distinguishes one sound from another. This difference in violence, in amplitude, determines the loudness of the sound.

Bell knew this, and understood that in order to reproduce a sound at a distance he must reproduce the vibration and must have the power to vary and copy both its rate and its amplitude. Those three characteristics, he said, constitute every sound; their difference represents the difference between one sound and another, and therefore I must reproduce those characteristics at the other end of the line.

This theory drove him to one particular kind of electric current—the induced magneto current. Reis had endeavored to copy those vibrational characteristics in his receiver, but had not thought of copying them in the current between the transmitter and the receiver. Bell saw that in order to copy them in the receiver, they must be got into the current which was the connecting medium. That led him to the magneto current, because that is the only form of current in which an electrical copy of the movement can be obtained. He saw that if he could take an armature, attach it to the diaphragm, and place it in front of an electro-magnet, and then speak to the diaphragm, that armature would be set in vibration, and the vibration would necessarily correspond to the sound waves, to the movement of the air particles back and forth, in every respect; and that, as it pushed the current, as long as it was moving in one way, and with violence proportioned to the violence of its movement in that way, and pulled it when it was moved back the other way, the current would necessarily be an exact copy, in electricity, of the aerial movement, and hence the receiver at the other end of the line would respond (being pulled by the current, or pushed by it) exactly, by copying the motions of the transmitting diaphragm, if the apparatus were properly constructed. As early as the autumn of 1874, as he tells us, he conceived, in a crude way, of the apparatus which he shows in Fig. 7 of his patent. But he thought that the movement of the armature by the infinitesimal changes of air in the sound waves would be so small that the inductive force created on the line would not amount to anything. He was so well satisfied of this that he did not take the trouble to find out how he should attach the armature or connect the diaphragm.

On the 2d of June, 1875, while experimenting with his multiple telegraph, he obtained an accidental result in the transmission of sound, which induced farther experiments in that direction. Instruments substantially like those in Fig. 7 of the patent were constructed; and he suspended other work in order to see whether he could create a vibration which would be sufficient to reproduce the same motions at the other end of the line. The experiments continued through July, 1875, and resulted in failure. The experiment in which he produced for the first time distinctly audible effects through this apparatus was made in April, 1876, after the date of his patent. The whole history of his experimentation before the issue of the patent is condensed into the month of July, 1875; and if your Honors can determine what he did in that month, you will have determined exactly what he did prior to the date of his first patent.

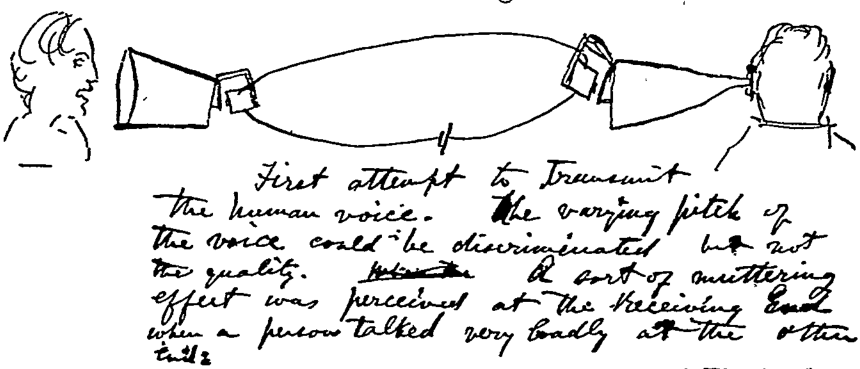
His letter to Hubbard of August 14, 1875, shows that he had abandoned the experiments, disgusted and disheartened. He says: "On glancing back over the line of electrical experiments, I recognize that the discovery of a magneto-electric current generated by the vibration of the armature of an electro-magnet in front of one of the poles, is the most important point yet reached. I believe that it is the key to still greater things. The effects produced, though slight in themselves, appear to me so great in proportion to their cause, that I feel sure that the future will discover means of utilizing currents obtained in this way on actual telegraph lines. So important does it seem to me to protect the idea that I think some steps should be taken immediately towards obtaining a caveat or patent." For what? "For the use of a magneto-electric current, whether obtained in the way stated above (by the vibration of permanent magnets, in front of electro-magnets) or in any other way. I should wish to protect it specially as a means of transmitting simultaneously musical notes differing in intensity as well as in pitch. I can see clearly that the magneto-electric current will not only permit of the actual copying of spoken utterance, but of the simultaneous transmission of any number of musical notes (hence messages) without confusion."

Then, further down, he says: "When we can create a pulsatory action of the current," — he had not then created it, —

"which is the exact equivalent of the aerial impulses, we shall certainly obtain exactly similar results."

Then he ends the letter with this: "Don't you think it would be well to take out a caveat for the use of the magneto-electric current? In its present undeveloped state, it might be unwise to let Gray know anything about it, unless, indeed, we could secure the principle of it in a patent." Thus he announced his purpose in advance to patent the principle without waiting to invent the mechanical means for its application.

In December, 1875, he went to Canada to induce Mr. George Brown of Toronto to take out in Europe patents for the invention which he was to patent here. Upon the 28th of December he gave Brown a memorandum on which he had made a sketch of which the following is a fac-simile.



Your Honors will see that the sketch is a copy of Fig. 7 of the patent. This is an admission that at that time he had not been able to obtain a word of articulate speech. He had heard nothing himself; his electrical assistant had been able to hear only faint sounds.

Now, we have got down to the point where Mr. Bell got a patent. We have found what he did and what he did not do, what he thought was the true plan or principle of a telephone and the only plan at the time of taking out that patent, and now we have got the patent. Let us see what that says.

This patent describes two inventions. It is entitled, "A patent for an improvement in telegraphy," and I think there is considerable force in the argument that the entire patent may be construed as a patent for multiple telegraphy. But I shall assume the most favorable construction that I can possibly place upon the intention, the meaning of Mr. Bell, in procuring this patent, — a construction that is substantially the construction of his counsel, so far as the facts and the language of the patent are concerned, — and shall endeavor to show that upon that assumption it is limited to the magneto-electric current, and the magneto-electric apparatus described in it. The patent contains long statements as to undulatory currents, for the purpose of operating multiple telegraph instruments. Multiple telegraph instruments have nothing to do with the quality of sound, nothing to do with the form of the vibrations. It is sufficient for multiple telegraph purposes that there be a vibration at such a rate per second. That we all agree to. Hence so far as this patent discusses the form of the sound waves, or the form of the electric movements, that is distinct from multiple telegraphy.

The patent describes or refers, first, to some prior inventions, for which he had filed applications for patents before. It then states the advantages, derivable from the undulatory current generally, advantages that belong to multiple telegraphy. It states five advantages, all five of them being multiple telegraph advantages, having nothing to do with the transmission of speech — but all having reference to his multiple telegraph; and I assume for the purposes of this discussion that he had sufficiently demonstrated his multiple telegraph to be able to patent that. Then he states certain electric facts and describes his multiple telegraph apparatus. He had exhibited it, particularly in Fig. 5 of the patent drawings. He had exhibited one of his multiple telegraph instruments separately. In Fig. 6 he had shown how he coupled them together on the line in pairs, so that they would send more than one message over the wire at the same time. He states here exactly the theory why they will do it: they will do it by undulatory current represented by curved lines. In his prior applications he says his currents were simply make and break currents, which could not be represented by curved lines. They were represented by dots and dashes like the Morse alphabet. Now he does not, even for his multiple telegraph purposes, propose to break the current, but he proposes to vary the force of it or strength of it for his multiple telegraph purposes. He proposes to undulate the current, cause it to vibrate, but make those vibrations continuous. In that way the movements will be represented by curved lines and the movements never will overlap or interfere with each other or suppress each other. There may be half a dozen of those movements, each represented by a curved line, and the united result of all of them on the line will be represented by a single curved line, which will be the resultant of the other curves. He explains that theory very fully, and then he describes his apparatus at Fig. 7, which he is apparently attempting to show as an apparatus for copying in electricity the movements of the air. I assume for the purposes of this discussion that Fig. 7 was an attempt to represent an apparatus, a diagram of the apparatus that he had tested the summer before, and was intended to illustrate his sound copying theory, and the patent states clearly his sound copying theory and claims that theory, that principle, as he had proposed to do in his letter to Hubbard.

He says, "It has long been known that when a permanent magnet is caused to approach the pole of an electro-magnet a current of electricity is induced in the coils of the latter, and that when it is made to recede a current of opposite polarity to the first appears upon the wire." The polarity means a current of an opposite direction appears on the line. "When, therefore, a permanent magnet is caused to vibrate in front of the pole of an electro-magnet, an undulatory current of electricity is induced in the coils of the electro-magnet, the undulations of which correspond, in rapidity of succession, to the vibrations of the magnet, in polarity to the direction of its motion, and in intensity to the amplitude of its vibration."

And further on he says, "Electrical undulations induced by the vibration of a body capable of inductive action"— inductive vibration — "can be represented graphically, without error, by the same sinusoidal curve which expresses the vibration of the inducing body itself, and the effect of its vibration upon the air; for, as above stated, the rate of oscillation in the electrical current corresponds to the rate of vibration of the inducing body — that is, to the pitch of the sound produced. The intensity of the current varies with the amplitude of the vibration, that is, with the loudness of the sound; and the polarity of the current corresponds to the direction of the vibrating body — that is, to the condensations and rarefactions of air produced by the vibration. Hence," he says, for these three reasons, "the sinusoidal curve A or B, Fig. 4, represents graphically the electrical undulations induced in a circuit by the vibration of a body capable of inductive action.

"The horizontal line *a d e f*, etc., represent the zero of current. The elevations *b b b*, etc., indicate impulses of positive electricity," — electricity going in one direction on a line, — "the depressions *c c c*, etc., show impulses of negative electricity," — the current going the other way, — "the vertical distance *b d* or *c f* of any portion of the curve from the zero line expresses the intensity of the positive or negative impulse at the part observed, and the horizontal distance *a a* indicates the duration of the electrical oscillation."

Now, there could be no clearer statement than that, that this vibratory current, this undulatory current, is to have three characteristics. It necessarily has three characteristics when it is excited by the induction of a vibrating body of inductive metal. And further, that that current itself and that alone can be represented by curves which contain elements representing those three characteristics. No other currents in the world, no variable resistance current, no current such as comes from the Reis instrument, or from the Blake transmitter, or from a wire dipped in liquid, could possibly contain those three characteristics: because a variable resistance current does not flow back and forth on the line, does not change polarity; but simply moves in one direction, always on the line. The description which he gives of this undulatory current, with its three characteristics, is therefore necessarily limited to the one magneto-electric current, and cannot be applied to the variable resistance.

Having made those statements about the character of the current, he proceeds to describe the instrument, Figure 7, which our friends tell us is a telephone instrument, and which I admit is a diagram placed there to illustrate this theory of his about these back and forth currents, the principle which he is trying to claim, as he said in his letter of August 14th. He says:

"The armature *c*, Fig. 7, is fastened loosely by one extremity to the uncovered leg *d*, of the electro-magnet *b*, and its other extremity is attached to the centre of a stretched membrane *a*. A cone, A, is used to converge sound vibrations upon the membrane. When a sound is uttered in the cone, the membrane *a* is set in vibration, the armature *c*"—you will see this is a magneto-electric device, it is an induction device, worked by an armature as a power—"the armature *c* is forced to partake of the motion, and thus electrical undulations are created upon the circuit E *b c f g*. These undulations are similar in form to the air vibrations caused by the sound"—there is a controlling and decisive statement in the patent bearing upon the construction of the patent. "These undulations are similar in form to the air vibrations caused by the sound—that is, they are represented graphically by similar curves"—that is the reason why he calls them similar in form.

There is no controversy here as to the first four claims. The fifth, which the other side says is a telephone claim, and which I regard as a claim for the use of the magneto-electric current, is as follows:

"The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds."

He could not claim in that claim all undulations. That would be equivalent to the eighth claim of Morse, which this court refused to sustain, for electric currents were known. He could not even claim that it was any particular kind of electric current. It must be defined. This court would never allow any man to claim an electric current produced by any apparatus, unless he defined that current specifically by its very characteristics, so that it could be distinguished from all other currents. Now, by what characteristics did Mr. Bell define that current? He did define it. Why, he says, it is "by causing electrical undulations similar in form to the vibrations of the air accompanying the vocal sounds." That is the kind of current. This current, produced by substantially this apparatus, must be a current which is in undulation, and the undulations must be similar in form to the air movements. When is a current similar in form? "Similar in form" means that the electrical undulations vibrate forward and back on the line just as the air particles vibrate forward and back; that they vibrate forward and back at the same rate per second, and that they vibrate with varying amplitude, back and forth, just the same. When they do that they can be represented graphically by the same curve. When they do not, they cannot. When they do it they come within the terms of his claim; when they don't do it, they don't come within the terms of his claim. The claim is a claim for a current. The specification describes a current, describes that form of current having those three characteristics. It is that current, when created by that mechanism or its equivalents, as shown in Figure 7 — that inductive mechanism.

There is no difference between counsel as to the meaning of the terms employed by Bell to describe the currents. An intermittent current is normally constant on the line, flowing in one direction from a battery. If at some point you break that wire and then hold it in your hand or attach it to a key, so that you can change it and connect it, you will break the current, you will create current impulses which are separated by little intervals of non-current, and that is what he calls the intermittent. He distinguishes the pulsatory current thus. Suppose you take the same continuous current, and attach in some way another battery, or some other means of increasing the force of the current, by which means you increase it instantly, not gradually, so that, when you touch a key you throw on that current, which is already moving over the line, a sudden electrical impulse, and that continues until you raise the key, and then it instantly stops, that would be what he calls the pulsatory current. The intermittent is a broken current; the pulsatory a suddenly increased or decreased current without change of direction; the undulatory current is a gradual change, represented by a curve.

Undulatory currents may be of two kinds. They may gradually change without reversing the polarity, without changing their direction. For instance, a current that is an intermittent current, if you take off the intermitting apparatus, and simply apply something which would gradually change the amount of the current; for instance, suppose you passed it through a wire, dipped through a liquid, having a liquid in the circuit, then when you raise the wire, so that the current has to travel a long distance through the liquid, you get a good deal of resistance, the current would not go so freely through the liquid. If you gradually depress the wire, the current has a shorter distan to travel through the liquid, it goes through more freely and it will increase the current. That would be gradually done, but it would be all in the same direction. On the other hand, if you take an electro-magneto apparatus, take a body of inductive material and vibrate it in front of the poles of an electro-magnet, when it is magnetized and in a circuit, then you get another form of undulatory current, not the variable resistance form, which is always going in one direction, and simply increasing and decreasing in quantity, so as to undulate in that sense — not that, but you get another form of undulatory current, to wit, a current that vibrates in direction as well as increases and decreases in electro-motive force; like the waves of the sea beating against a rock. There is an undulation and a constant propulsion and retraction of water against a rock, forward and backward. And while he describes in this patent that all forms of undulations may be used, it does not make any difference what kind of undulatory current it is, whether it is the variable resistance current or this magneto current, so far as multiple telegraph purposes are concerned, yet only one of those forms can be used for sound copying.

The effects of electrical currents closely resemble the effects of fluids in motion. The water in a waterpipe coming to a common washstand can be turned on or off, or the amount of its flow regulated by turning the spigot. No reversal of direction of the water in the pipe takes place. It flows in one direction from its source to its place of discharge. If I alternately turn it on and off, I produce an intermittent current. If I close it gradually and partially, and then open it in the same way, I make a current with a variable resistance. When I turn the valve around so that there is a straight hole through the valve, then the current runs through with its full force, there is nothing interposed in its way. When I turn the valve around so there is no hole at all to it, then the resistance is such as to shut the current off altogether; but when I turn it partially around, the fluid cannot get through, it is partially cut off. There is a resistance interposed. In the variable resistance transmitter, there is just such a gate. I might liken it to one of these doors which open here. A current of wind is flowing in the summer season through these doors and is refreshing us with its coolness. The servant stands by the door and opens that door and lets more of it flow, or closes it to let less of it flow. He varies the resistance to the current, but more or less flows through. Now, with the electrical conduit, where the wire represents the pipe or the doorway, and where something is interposed that represents the door or the cock in the pipe, we have precisely similar operations. Let us take the Blake transmitter as an illustration. In the Blake transmitter we have a wire coming up to the vibrating diaphragm, running over on the diaphragm to the centre or running through a spring which is operated by the diaphragm, to the centre of the diaphragm; there it has contact with a piece of carbon and from the other side of the carbon there goes off another wire that goes to the line. The current comes in from the line and comes around through the diaphragm to that piece of carbon, struggles through the carbon, because carbon is a resistance to it; carbon is not a good conductor, the current has difficulty in getting through, if the carbon was too thick it would have great difficulty; the carbon has to be proportioned so as not to offer too much resistance; but the current meets and struggles through that carbon and goes off the line. Now the nature of carbon is such that while it is true that in its normal condition and not under pressure, it offers a very considerable resistance to the passage of the current, to the flow of that current, just as the valve would when half closed, yet if we press that carbon a little it brings an infinite number of molecules in such a relation to each other, that the current leaps through it more readily. The slightest pressure on it will enable the current to pass through more easily than it did before the door was open. The door is opened in the carbon telephone by pressure upon the carbon, and the current passes through without obstruction, and it is opened by the slightest movement upon the carbon.

[In response to a request from the bench, Mr. Hill here explained how it was that the Blake transmitter operated differently in principle from the original transmitter of Bell, and continued:]

Bell's counsel agree that he contemplated that the electrical movements would be an exact copy of the movements of the air particles. He worked out by a line of reasoning, that such must be the form of current. Though his experiments failed, he still remained of that opinion. Writing to Hubbard he said, "If we can get the exact equivalent of aerial impulses we shall certainly get exactly similar results; therefore we must patent or caveat this magneto-electrical current" — saying it five times over, limiting it every time by the "magneto-electric," no other form; then going to his patent and describing why it is limited to the magneto-electric; it must copy the form of the air vibrations, he says in his claim; and explaining on the page before that what he means by copying the form. It must copy the form when you can describe its movements by graphic descriptions which will be the same; going back four pages and stating when you can describe it in graphic curves which will be the same, to wit, when it moves back and forth, we have a clear statement in his patent that the 5th claim of the patent is limited to that specific form of current, the magneto-electric current. In other words, that the patent is and was for precisely the thing that he stated in his letter of August 14, 1875, that he was going to make it — a patent for the use of the magneto-electric current, and nothing else. Now does that patent cover the defendants' instruments here, or any of them? The defendants' instruments are all variable resistance instruments; they are all carbon instruments, in which the current is varied in amount as it passes through the line, but not in direction. Are those instruments covered by this claim? How can they be? How can you read that patent, in view of its expressed terms, so as to make it cover a current which has not the three characteristics that are stated in the patent to be all equally essential? Suppose we take the current of the variable resistance and compare it for a moment with what Mr. Bell states of the current here. You have a current which moves straight along in one direction; a little more current is thrown on a line at one movement and a little less at another, but it is moving straight in one direction. Is there anywhere in this patent a statement that such a current as that can represent graphically by the same curve the motions of the air in the air movements of sound? Nowhere. The only statement in this patent that electric undulations are capable of being represented graphically by the same curve as the movements of the air particle, is made of the magneto current, confined to that; not only confined to that, but the reason is given why, and that reason applies only to that. That reason not only does not apply to the variable resistance current, but it excludes it. They can be represented graphically, because they have three characteristics, and the variable resistance current has not the three characteristics. Moreover, not only is the current different, but the *modus operandi* of the mechanism. The mechanism itself is structurally different, but its *modus operandi* is also different.

In Mr. Storrow's argument, it is stated very clearly that with a magneto-electric apparatus, your current and your variations of current all depend on the motion of the apparatus; on the motion of the diaphragm, not on its position. Well, is that true of the variable resistance current? No; it is exactly untrue; precisely the reverse is true of the variable resistance current. There, the variations in the current, the amount of current flowing, depend upon the position of the diaphragm and not on its motion. I want to make that clear, because that is a directly opposite mode of operation of the apparatus. You have an armature vibrating in front of the pole of an electro-magnet and it is the motion of the armature which creates the current.

In the Blake transmitter, the present telephone in use, we vary the resistance by pressing on the carbon. The diaphragm is arranged to press against the carbon, and as it presses it the current then can pass through the carbon freely. When the compression is removed and the carbon restored to its natural condition it will partially obstruct the current, so that the current has difficulty in getting through. Then as the diaphragm vibrates and varies the pressure it varies the amount of current passing through, because at times the current is resisted, and at other times the pressure of the diaphragm upon the carbon button takes away the resistance. Bell has got to have a metal diaphragm there and operate by induction, by the motion, and make the current. This diaphragm may be made of paper. I could use even this blotting paper for a diaphragm in this form of telephone. The material is of no consequence whatever. The mere pressure on that carbon button is the thing that does the whole work of varying the resistance of something that is already moving through that circuit. In the Bell telephone it is this movement that creates that something through the circuit. In the carbon telephone, the Blake transmitter that is in common use, that something is not created by the motion of the diaphragm; it is created by a battery down under that table. The diaphragm simply opens or shuts, more or less, the gate through which that something flows at this point. That is the difference. With the Bell telephone the position of the diaphragm is nothing; it is the motion of the diaphragm that does everything. When the motion is taking place the current variation is taking place; the current is being excited, just according to the motion. When the motion of the diaphragm stops the current stops; there is no current; that ends the current; it is done; it disappears. Now, how is it with the carbon transmitter — the variable resistance transmitter, I mean by the carbon transmitter. It is one form of variable resistance transmitter. How is it with this? The motion of the diaphragm has nothing to do with it. It is the position of the diaphragm only that does the work; that controls the amount of current, not the motion of the diaphragm. Now you see that diametrically opposite is the principle of operation, mode of operation, in those machines. In the one the motion is everything. It is the moment of motion; it is the act of motion that does the work. In the other it is not the act of motion; it is the position of the diaphragm. Get that diaphragm into that position by any means whatever, whether by sound waves or by a screw or a lever or your hand, and hold it there, and the effect will go on as long as that battery lasts.

There is nothing in the motion of the diaphragm that is peculiar to Mr. Bell, or any invention of his. What Bell did was to find a particular way of getting his diaphragm to do that work and do it on a particular plan, describing it and limiting himself to it. His theory, as he describes it, consists in making it produce certain movements of the current which can be represented graphically by certain curved lines, and those graphic lines, graphical curves, will correspond exactly to the lines of the air vibration. That is true of his current, because he has, in the motion of his current, every motion of the air wave. But when you take the variable resistance current and undertake to represent it graphically by lines, you find that those parts of the curve which, with the Bell instrument, were beyond the zero line, are with the other instrument up above the zero line or down below the zero line at the farthest limit. In other words, you have not the same curve. Yet he has told you in this patent that you have got to judge of similarity or non-similarity of the electrical movement to his claim here by the graphic curves which represent it; if the curves are not the same the things are not the same.

I now come to another branch of the case. The following passage in the patent of 1876 does not appear to be in harmony with any of its surroundings. "Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery. The internal resistance of a battery is diminished by bringing the voltaic elements nearer together, and increased by placing them farther apart. The reciprocal vibration of the elements of a battery, therefore, occasions an undulatory action in the voltaic current. The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting-wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current. Hence, the vibration of the conducting-wire in mercury or other liquid included in the circuit occasions undulations in the current. The vertical vibrations of the elements of a battery in the liquid in which they are immersed produces an undulatory action in the current by alternately increasing and diminishing the power of the battery."

All that matter stands by itself in the patent. The fourth claim of the patent, which is based upon it, stands by itself, disconnected, as it were, from the other things; not the same theory running through it; not the same form of current. If it is not in harmony with its surroundings in the patent, let us look in the record to find, if possible, an explanation.

While Mr. Bell was preparing his specification for the American Patent Office, being very desirous of taking a patent in Europe, and especially in his own country, England, where he conceived the invention to be equally as valuable under a patent as here, he sought, in the autumn of 1875, to interest certain parties in Canada—Mr. George Brown, of Toronto, was one—to get him if possible to proceed to Europe and take out patents on these inventions, including his multiple telegraph, and his theory of sound transmission—sound copying. He saw Mr. Brown at first, or had communication with him in some way, along about October when he was first preparing his American specification; and the negotiations dragged; Mr. Brown did not seem to be in very much of a hurry about concluding them, and when Christmas came Mr. Bell, using his Christmas vacation (for he was a teacher), thought he would go to Canada and stir up Mr. Brown and see if he could not bring things to a crisis. He left Boston about the 24th day of December, and arrived in Toronto about the 28th. On that evening he had an interview with Mr. Brown. On the 29th the negotiations were concluded, Brown agreeing to take an interest, and to go abroad and take out patents there, furnishing the money to pay all expenses. Bell returned and put the finishing touches to the specification between the 1st and 10th of January, 1876. On the 10th Hubbard took the rough draft to Bell's solicitor in Washington. On the 16th or 18th he wrote Bell that no changes were necessary, and on the 18th the solicitor sent Bell a fair copy engrossed for signature. Bell swore to it on the 20th, and returned it at once to be filed in the Patent Office. Brown arrived in New York about the 25th of January. Bell came there to meet him. Hubbard and Pollok, the solicitor, also came on to New York from Washington, the latter bringing with him the copy of the specification which had been prepared for filing in the Patent Office, and a fair copy of the same to be given to Mr. Brown. So that it appears from the evidence that on or about the 25th of January, Mr. Bell, Mr. Brown, Mr. Pollok and Mr. Hubbard were together in New York with the specification prepared for Mr. Brown to take to Europe, and the specification that Mr. Pollok had in his hands at Washington preparatory to filing it in the Patent Office.

[The copy which Mr. Brown had is set forth *supra*, pp. 88–96.]

All the evidence to which I shall refer in this connection is the complainants' evidence drawn out on cross examinations, and documents drawn from them or their counsel, put in at different times in the progress of the case, without either party seeing the connection of those documents with each other. I drew them out and put them in because I saw that some of them had some reference to these proceedings, and that they might prove to be important. But I did not appreciate the meaning of their contents when I put them in evidence, and I presume the same is true of the other side.

[Here a discussion ensued upon the propriety of this line of argument, and Mr. Hill being questioned as to the point he was seeking to establish said:]

Mr. Bell has testified over and over again that there was no change made in the specification which he filed in the Patent Office, from the time the document went into Mr. Pollok's hands on the 10th of January, 1876, until the time of its filing February 14th. It was sworn to on the 20th of January, 1876, and after that date, as was held in the Tanner car-brake case, after the date of its filing in the Patent Office, it could not be changed lawfully without a new filing, a new case, a new oath, and a new application. After the 20th January it could not be changed so as to introduce a new invention without a new oath. The evidence, as we contend, is that a change was made after that time. I shall endeavor to show that it must have been done after the 20th of January, after the oath of the American specification was taken. Mr. Bell has further stated that the specification which he swore to on the 20th of January, was the same specification without any change of phraseology, that he had sent to Pollok on the 10th of January, and of which Mr. Pollok had made a fair copy and returned it to him on the 18th to be sworn to. I will give you the history as briefly as I can.

I am not impeaching this patent for fraud, by way of setting up fraud as a defence in the answer. If we had set up in our answer in this case that the patent was obtained by fraud, that answer would be demurrable. There is no doubt about that. If we had attempted to introduce evidence on the part of the defendants to prove that fraud, that evidence would have been objectionable and would have been stricken out. The government alone can bring such a suit. But that is not the point. We stand upon another point, and if it is not correctly taken I have nothing further to say. It is for your Honors to decide. We have not raised that question in the answer. The complainants have come into a court of equity, producing a title deed, producing their evidence showing how that deed was obtained, how that deed was made, what it stated, what it was for, what it intended to convey; and in their evidence in support of their own title they have proved, as we submit, the fraudulent character of that title deed. If they come in here with that title deed and show by their own evidence that the deed is fraudulent, then I apprehend that in a court of equity they have not the standing which would entitle them to protection.

[One of the Justices having expressed a desire to hear the counsel on the line of argument he had marked out for himself, he was directed to proceed, and he continued:]

It appears, upon examination of the George Brown specification, that it had been carefully compared with the American application, and in many matters changed, in order to make it correspond. [Mr. Hill here reviewed the changes, which appear in the copy printed *supra*, pages 88 to 96.] Now when we come to compare the document which Mr. Bell sent to Europe cotemporaneously with his sending the document to Washington to obtain a patent upon this invention, we find that in this document which departed from New York in the last week in January, and which, therefore, was not accessible to Mr. Bell to change after that date, which was not accessible for interpolation after that date, there is not one word about a variable resistance current, a liquid transmitter, or any other method whatever except the induction telephone, the magneto telephone, with its back and forth current. But in the document which remained in this country, which went to the Patent Office and became accessible to Mr. Bell's attorneys at Washington, and remained accessible to them, there appears another and second invention of equal importance with the magneto telephone invention, to wit, the invention of a variable resistance telephone. The question is, how did that get in there; when did that get in there; where did it come from? As I remarked once before, if we look at the history of Mr. Bell's operations, we fail to find it. Up to that point not a word, not a thought can be discovered in Mr. Bell's history, with the severest lights that can be thrown upon it, of the idea of any of these mechanisms that are specified in that patent — a wire dipping in liquid, the vibrations of a wire, the vibrations of the elements of the battery to and fro, up and down in the current, or anything of that kind. They suddenly appear full blown in the American specification. But there is more than that. That is not all. In the paper sent to Europe there was an express and positive declaration to the effect that the variable resistance current could not be employed for this purpose — not in those words, but in equivalent words.

And further, there is an important statement in the Brown specification which is not in the American application. The original statement in the George Brown paper was this: "Undulatory currents of electricity may be produced in many other ways than that described above, but all the methods depend for effect upon the vibration or motion of bodies capable of inductive action." At some time that expression was stricken out from the Brown copy, and the following substituted for it: "There are many other ways of producing undulatory currents of electricity, but all of them depend for effect upon the vibration or motion of bodies capable of inductive action."

This is the same statement in different terms. In the American specification the word "dependent" is substituted for "but all of them depend for." That substitution means this. With this statement in the George Brown copy it would be an impossibility to proceed to set forth immediately afterwards that this effect could be produced by a current that was not induced by the vibration or motion of the body. The statement is here that all the ways depended, every way known to Mr. Bell when he wrote that statement, depended for effect upon the vibration or motion of bodies capable of inductive action. He knew of no other way. Now he toned that down to this statement: That there are many ways dependent upon the vibration or motion of bodies capable of inductive action; but there are, he proceeds to describe, many other ways not dependent upon it. It is not inconsistent with the immediate description following in the next line, if you please, of other ways not dependent. There are many ways dependent; there may be many ways not dependent. But in the George Brown specification the statement was emphatically and positively that there were many other ways, but all of them dependent. There was no room, then, for the description of any other way of doing it. That is one of the significant changes between the George Brown specification, which was sent to Europe after the American specification was sworn to; a change from an expression which excluded by its terms a variable resistance current, and made it improbable that it could have been thought of, to the flexible statement in the American application.

If this variable resistance description was not in the American specification on the 25th of January, when that copy was sent to Europe by Brown, then, according to his own testimony, it was not in the American specification when it was filed. If it was in the American specification on the 25th of January, when he was about to send to Europe and obtain a patent there, it is absolutely inconceivable that a copy could have been handed to Brown, and that Brown could have been allowed to depart for Europe and patent one-half of the invention there without the other half, and with that explicit statement that the other half was not patentable.

Now how could Bell learn of this? Where did this knowledge come from? Is there any source from which he could have derived this information prior to the issue of the patent, and been able to interpolate those words?

On the 14th of February, 1876, Mr. Elisha Gray filed a caveat in the Patent Office. See *supra*, pages 77–88. That caveat described the variable resistance current. The transmitting apparatus is what is called a liquid transmitter. Your Honors will find in the drawing in the lower right-hand corner a picture of the transmitter. It consists of a cone or box to speak into, closed at the lower end by a flexible diaphragm, which would take up the vibrations of the air, and a wire extending down from that diaphragm into a cup of liquid below. That wire and diaphragm of the transmitter were in the circuit, so that the current came in through the side of the transmitting box and ran down that wire into the liquid. The current comes in through the wire to the side of the transmitting cone. You will notice a screw binding-post, as electricians call it (a little screw that runs into a post, called a binding-post, because it binds the circuit wire to the instrument), at the left-hand side of the transmitting instrument. The wire comes in and is attached to the binding-post making the electrical connection. I think you will see dotted lines running down to show how the circuit of wire is made. The connection is with a little wire at the centre of the diaphragm that extends down into the liquid, so that the current coming into the line would enter the binding-post, run across to the central wire, and down the central wire to the liquid. Then at the bottom of the cup you will notice another binding-post, through which the line goes off. The current coming to the transmitter passes through the binding-post, down the centre line into the liquid, passes through the liquid, goes to the lower binding-post and there passes off the line, and goes to the receiver at the left hand of the drawing, the upper figure. A wire goes to the receiver, and runs down to the ground to a ground plate. The circuit is completed through the ground, and goes back to the ground plate at the right end of the drawing. Then it runs up on its way to the transmitting instrument; it passes through the apparatus that is represented by little parallel plates, some of them longer and some of them shorter. They indicate the battery. That is the conventional method adopted by electricians to indicate a battery. The variable resistance is produced by the fluid, and takes place in this way, and I ask your Honors' particular attention here. The liquid which Mr. Gray describes I ask your attention to, because it has some bearing on the question. That liquid was water. Water is a conductor of electricity. Electricity will pass through it. It will not interrupt a current of electricity. The current will pass through it, but it gives a certain resistance to the circuit. The current does not pass through it readily, as it does in the case of a copper or iron wire. Electricity will travel very easily over an iron or copper wire. It seems to pass through it as water would pass through an open tube. Hence, the current coming through this line over the copper or iron wire, and coming to the transmitting instrument and passing down through the wire at the bottom of the diaphragm into the liquid, passes freely and easily until it gets to the liquid, and then it has to pass through the liquid. But the liquid is something that it cannot get through so easily.

The liquid obstructs it. It has had an open field, but now it has got into the underbrush, so to speak. It has to force its way through the brambles, and it has to exert more force as it meets with more opposition. The theory of this liquid transmitter is this: That by attaching that little wire which dips down into the liquid to a diaphragm, then the sound spoken to the diaphragm will vibrate the diaphragm, causing the wire to rise and fall in the liquid. As the wire drops down it brings the good conductor nearer to the lower wire, and makes a shorter path of liquid for it to travel through. As the diaphragm rises up it pulls the wire up and makes a longer path of liquid for the current to travel through. Hence the current travels more easily through that liquid when the wire is depressed and when the diaphragm is vibrating down, because it has less distance to travel through the bad conductor; and it travels with more difficulty through the liquid when the wire is up, because it has a greater distance to travel through the bad conductor. But it travels all the time just the same. It is only a question how much of it will go through when the wire is up; some of the current will go through and go off the line all the time, and when the wire is down more of the current will go through. It does not change the direction of the current. The current is going in one way all the time. It simply changes the quantity that goes in that one way. The vibration of the diaphragm makes the wire go up and down in the liquid, but it does not vary the direction of the current at all. It simply varies the quantity.

Allow me here to call attention to the fact that there are three ways by which a vibrating diaphragm influences the character of the current on the line. The first way is that of Bourseul, published in 1854, by which the vibrating diaphragm comes in contact with the end of the circuit wire and breaks the contact. When it comes in contact the current coming through the diaphragm goes to the wire and passes along it. When it breaks the contact the current cannot get across and it remains on this side. That mode of vibrating the diaphragm into and out of contact with the end of the circuit wire makes a broken, a make and break current, an intermittent current, if you please; but it is the vibrating diaphragm which does it in that case. That is one of the currents made by vibrating the diaphragm. In Mr. Bell's patent the vibrating diaphragm is provided with an armature of inductive material. That was Mr. Bell's thought. That armature of inductive material must be placed in front of an electro-magnet or its equivalent, which is a necessity with that form of instrument. Now, when you vibrate the electro-magnet, the motion of the armature, the inductive material forces a current one way and draws it back the other as it vibrates. That is the second way by which a vibrating diaphragm can control the current on the line. There is a third way, and that is the way of Gray's caveat. There is no inductive material about the diaphragm. There is no electro-magnet present. It is not needed. You do not depend upon induction. You depart from the principle altogether, just as Bourseul had suggested in 1854. You simply extend the circuit wire from the diaphragm down into that bad conductor, the liquid, and vibrate it up and down in that poor conductor, changing the quantity of current, but not changing the current, nor reversing or alternating it. That was the third way. Those are the three ways of controlling the current by the vibrations of the diaphragm, and each differs in principle from the others.

The Bourseul way involves one principle; the Bell way another; the Gray way a third. There are three independent ways of doing it, involving different mechanism, different modes of operation, and producing different current effects on the line. In the Bourseul case it is a broken current; in the Bell case a back and forth current; and in the Gray case a current going in one direction all the time, simply changing in quantity from time to time.

Now how could Gray's caveat, which was a secret document in the Patent Office, become known to Bell before the interference on the 19th of February? The variable resistance passage was in his application on the 19th of February. If it was not there on the 14th, and was there on the 19th, how could he have known about the Gray caveat between those dates?

The complainants' evidence on another subject furnishes some light on this one. On the 19th of January, 1875, Gray filed two applications for multiple telegraphy, and on the 23d of February, 1875, he filed a third application. On the 5th of March, 1875, Bell wrote a letter to his parents in which he said: "In regard to the patents, my lawyers found on examination at the Patent Office that I had developed the idea so much further than Gray had done that they have applied for three distinct patents, in only one of which I come into collision with Gray. The first patent covers the principle of multiple telegraphy, basing my claim upon the instruments exhibited. The second patent covers the principle of using an induced current so as to permit a single wire to be employed. The third patent is for a vibratory circuit-breaker for the purpose of converting the vibratory motion of my receiving instrument into a permanent make or break of a local circuit."

He describes how this can be arranged so as to make an "autograph" telegraph. Then he says:

"My lawyers were at first doubtful whether the examiners would declare an interference between me and Gray, as Gray's apparatus had been there for so long a time. They feared I had but a poor chance, and my spirits at once fell to zero. They said it would be difficult to convince them that I had not copied. When, however, they saw the 'autograph' telegraph developed from the idea of that of multiple telegraphy, they at once said that was a good proof of independent invention, as Gray had no such idea. It further turned out that an examiner in the Patent Office (not, however, of electrical inventions) is a deaf mute, and knows me personally and by reputation, and could surely vouch for the fact of my being incapable of copying Gray."

Now on the day that that letter was written, Gray had no patent on multiple telegraphy. The things which were examined in the Patent Office were his applications, which were required by law to be kept secret. Thus it is clear that at that time Bell's solicitors had access to the secret archives of the Patent Office, learned exactly what Gray had done, and were able to compare what Gray had done, as shown by those papers, with what Bell claimed to have done. ot only did they find that they could compare Bell's papers with Gray's in the Patent Office, and find out just how much further Bell had gone than Gray claimed to have gone, but they directed Bell at once to file three applications in consequence of that information. They found, he says, that he had developed the idea so much further than Gray had done that they had applied for three distinct patents, using the information to direct and control Mr. Bell's operations in multiple telegraphy matters. That was the use they made of it. Now, it appears from Mr. Bell's statement in evidence that he did file three applications. The first of those three applications was filed on the 25th of February, 1875, two days after Gray's application was filed. How instantaneous was the knowledge which they obtained of Gray's papers! Gray's last application, the most important one, filed the 23d of February, and Mr. Bell, in the Patent Office for the purpose of interfering with that application on the 25th of February; and with the admission here that in the interval the attorneys had obtained the knowledge from Gray's papers and had caused him to file these applications to meet them. He describes various inventions, and then down at the bottom of the page he makes a further statement to show that he knew from those papers what Gray had done.

"When, however, they saw the autograph telegraph developed from the idea of that of multiple telegraphy, they at once said that was a good proof of independent invention, as Gray had no such idea."

How did they know? They could not tell; they could not know it without an examination of Gray's papers. But they did not have even to go to the Patent Office to get information, for in the same letter Bell says:

"Another fortunate circumstance was this. That the very examiner into whose hands this will come happened to be in Mr. Pollok's office one day when I called, so that I had a long interview with him, in which I explained everything to him, and I can't help thinking that he must have been convinced of my independent conception of the whole thing."

After the issue of his patents Bell endeavored to mislead Gray about the proceedings at the Patent Office. In a subsequent correspondence between them, Gray wrote Bell about his caveat. Bell replied: "I do not know the nature of the application for a caveat to which you have referred as having been filed two hours after my application for a patent, excepting that it had something to do with the vibration of a wire in water, and therefore conflicted with my patent. My specification had been prepared months before it was filed, and a copy had been taken to England by a friend." There is an admission that the copy given to Brown was a copy of the application on file in the Patent Office.

The subject matter in controversy between Bell and Gray was this variable resistance, and the only subject matter in controversy. Mr. Bell writes to Mr. Gray trying to convince him that that subject matter belonged to him, Bell, and he makes this statement: "I did not know anything about your caveat, except that it had something to do with the vibration of a wire dipping in water. My specification had been prepared months before it was filed" — months before the 14th of February, 1876 —"and a copy had been taken to Europe by a friend." What is the intimation to Mr. Gray? The intimation is, "It is of no use for you to contend about this variable resistance. It is in my patent. I can prove that I had it months and months before my application was filed, because I can prove that my application was made, written, months before it was filed, and I can prove it by the copy taken to Europe." But he could not prove it by the copy taken to Europe. That copy did not contain the subject matter in controversy between Mr. Gray and Mr. Bell. The copy had not a word in it about variable resistance. What was the assertion that Mr. Bell was making to Mr. Gray as a matter of fact? Was it true or was it false? If this statement was true, then it is true, that the paper taken to Europe by George Brown was a copy of the paper filed, and the specification as filed did not contain the variable resistance. If that be not a fact, then the letter is to all intents and purposes, as well as in terms, a falsehood, stated to Mr. Gray to mislead him. There is no escape from that alternative. When Mr. Bell said that he had prepared it months before it was filed, and a copy had been taken to England by a friend in order to mislead Mr. Gray and induce Mr. Gray to abandon his claims to it; then it is either true that the copy which was taken to England by a friend was a copy or it was not a copy. If it was a copy of the specification (we know what it was) the specification as filed did not contain the variable resistance. If it was not a copy this statement to Gray was false, for the purpose of deceiving him, and inducing him to abandon his claims.

But it may be said, if this was interpolated in the application of Bell, how could it have been interpolated? Why, the application on file was composed of a number of sheets fastened together by paper fasteners in the usual way. All you have to do, is to straighten up those paper fasteners, pick out the sheets, remove them, and substitute other sheets, or any material you want to put in. If you have access to the Patent Office, as these parties had with the Examiner there, it is a matter of a few minutes' work to go in there any evening after the clerks have gone, take any papers out and substitute any other papers in their place. Could they do it? Were they in a situation to do it? Why, this original copy is proved by Mr. Bell to have been made by his solicitors (the copy that was filed in the Patent Office), prepared at their office, written by one of their clerks; and thirty days afterwards it was just as easy for them to have taken that application and have other sheets written by the same clerk and substituted in it, as it was to put the original in. So that the road was open, the means were all there; the parties, as we know by the transactions of the year before in reference to Gray's pending application, were the very parties to carry out such projects.

[Mr. Hill closed by reviewing evidence in the record which he contended showed the subsequent conduct of Mr. Bell to be consistent with this theory:]

MR. JUSTICE BRADLEY: Your point I understand to be this: That the true construction of Bell's patent, so far as you deem it valid, and not claiming a mere principle, is a patent for a process, and that he is confined to the process which he describes, and that you use another process, a different process?

Mr. Hill: Yes, your Honor, if it be called a process.

MR. JUSTICE BRADLEY: There may be some dispute about words.

Mr. Hill: He called it a current. He sought to patent the magneto-electric current; and if we call that a process, then it is a process.

MR. JUSTICE BRADLEY: Then in regard to this last point, your position is that that portion of this patent which describes a varying resistance — a mode of obtaining variable resistance — and which claims it in the fourth claim, was not his invention, but was the invention of Mr. Gray and clandestinely obtained by him and inserted in his patent. That is your position on that?

Mr. Hill: That is my position on that.

MR. JUSTICE BRADLEY: You do not allege it as a ground for making void the whole patent and avoiding it, but as a matter of clandestine appropriation of another man's invention?

Mr. Hill: I think, your Honor, that we are entitled to use it to that extent. Whether it would go to the other extent or not is for the court to determine.

Mr. James J. Storrow for the American Bell Telephone Company. *Mr. E. N. Dickerson* and *Mr. Chauncey Smith*[1] were with him on the brief.

The charges of fraud in the Patent Office.—The Overland and Drawbaugh companies have made an elaborate argument, charging that the Patent Office files have been three times violated and three forgeries committed on them, and that these forgeries consist in writing into the Bell specification matter which they allege was learned by a dishonestly acquired knowledge of Elisha Gray's caveat. One defence pleaded is, that Bell unjustly and surreptitiously obtained his patent for that which

[1] It was arranged that Mr. Smith should take part in the oral argument. He fell ill during the progress of the hearing, and the part of the case which he intended to present was spoken to by his associates.

was in fact invented by Elisha Gray. The charge is competent under that issue, and must be passed upon.

They characterize the charge by the severest language, and they accompany it with protestations of the sense of responsibility under which it is made. They do not overstate the gravity of the crime if it has been committed, nor the awful responsibility which rests on them if the charge shall turn out to be false, and without justifiable foundation. But the brief filed in this court contains the first intimation ever made in this long litigation that such a charge was thought of. Under these circumstances, strained inferences, or the absence of specific disproof in the record, cannot establish so foul a crime; and our opponents pretend to nothing else to rest it upon. But fortunately there is that in the record which conclusively disproves it.

This charge, contained in the briefs signed by *Mr. Hill* and his partner, *Mr. Dixon*, is, that the application sworn to by Mr. Bell, January 20, 1876, and filed in the Patent Office February 14, 1876, contained no reference to the liquid transmitter, but was limited to a magneto telephone, operating, they say, by what they call a to-and-fro or wiggle-waggle current. They charge that within four days after the application was filed, Mr. Bell's solicitors obtained dishonest knowledge of the contents of Gray's caveat, which described a liquid transmitter; that thereupon, they, in Mr. Bell's absence, and without his knowledge, stole Bell's application from the Patent Office, dishonestly rewrote it or part of it, inserting a description of a liquid transmitter learned from Gray's caveat, adding a claim based thereon, and dishonestly replaced in the files the application with these interpolated sheets.

To understand the relation of the liquid transmitter part to the rest of the patent it should be stated that Mr. Bell first invented the "method" specifically described in his patent and in his fifth claim, and devised the "magneto" form of speaking telephone to embody it. They confess that his original application, by Fig. 7 and the letter press connected with it, described this magneto telephone and the novel method or principle by which it transmits speech, and contained his present fifth claim which is in terms for that "method." No attack is made on his originality as regards this, and the fifth claim is the only claim sued on. The liquid transmitter part of this patent is the sole subject of this charge. That part describes an alternative, or, if you please, an improved type of apparatus embodying the same "method" and principle, and claim 4 is a special claim for this particular modification. But the liquid transmitter as a form, is too inconvenient for practical use. As matter of law it is not needed to sustain the broad claim 5. The only use we make of its description in the patent is to base upon it the merely cumulative argument that the existence of an actual intention not to limit claim 5 to the magneto form is not an open question, because the patent itself points out that there are alternative forms.

I return now to the charge that the liquid transmitter part was copied from Gray's caveat — for that is the extent of the charge.

Gray's description calls for the use of water or some liquid of "high" electrical resistance. The description in the Bell patent specifies "mercury or some other liquid;" mercury is a liquid of "low" electrical resistance. They say that the suggestion of mercury, or any "low" resistance liquid, involves an electrical impossibility or absurdity proving that a good electrician like Mr. Bell never could have written that description, and that it must have been written in by some ignorant person — they say by his solicitors — presumably ignorant of electrical science, and without his knowledge. How or why a copyist could have made such a change they do not, however, and cannot, suggest. They say that this interpolation could not have been made except between February 14 and 19, 1876, because two independent official records in the Patent Office show that these clauses were in the application on February 19; and that is true. They agree that this proves that Mr. Bell could not have committed the alleged crime, for he was not in Washington during the whole of that month until February 26th. They aver that when he came to Washington, on February 26, he was informed of the forgery his solicitors had committed in his behalf, and joyfully ratified it; that he then went to the examiner's room to look over the application; by permission of the examiner sat down to make in pencil various purely verbal amendments of no importance; and that while making these he perceived that his solicitors had made their interpolations so clumsily that they had left in a part of the old specification which was specifically inconsistent with the liquid transmitter clauses; that he thereupon drew his pencil through the objectionable words, and, in pencil, interlined others consistent with the liquid transmitter, and wrote many other pencil emendations, thirty-eight in all, making the paper read as it now does in the patent; and that the specification issued in the patent is this twice-forged and corrupted paper. That is their story, and each one of these steps is a necessary part of it, constructed to account for some existing fact which they find they cannot dispute.

They are met at once with the fact that the original application now in the files of the Office, a photograph of which, taken in October, 1885, is in the case, is exactly, letter for letter, like the specification in the patent which was printed and left the Office March 7, 1876; and that that original paper now on file has every word fair-written in ink, without any sign or indication of any pencil interlineation whatever, and without any place where any interlineation or change could have been made. To this they reply that the present clean paper is itself a forgery, — for if it is not, it absolutely destroys their charge of interlineations. They say that the Bell company in April, 1879, procured a certified copy which showed all these mutilations, and that soon afterwards Mr. Bell, or some one in his interest cognizant of what they aver had been done, perceiving that its condition would disclose the alleged fraud, stole the supposed interlined and altered specification as it then existed in the files, rewrote it, making a fair, clean paper in ink, and placed this in the files as if it were the original; and they say that it is because of this third forgery that the paper in the files reads to-day in fair writing like the specification issued by the Office in March, 1876.

They are again met by certain facts. One is that the employment of some kind of a variable resistance (a liquid transmitter is one well-known instance of variable resistance) was in Mr. Bell's mind as a device to be employed in the transmitter as early as May 4, 1875, nine months before the Gray caveat existed, and was disclosed by him in a letter of that date which is in the record. They are also met by the fact that the character and structure of Mr. Bell's liquid transmitter is as different from that of the Gray caveat as one liquid transmitter can be from another; and by the further fact that, instead of the use of mercury being an electrical absurdity, it is a fact proved in the case that Mr. Bell actually made a mercury transmitter, and that it talked, while there is no evidence whatever even tending to show that the water transmitter of Gray ever did or ever could talk, the only proof touching the subject being that the one he tried to make in the summer of 1876 would not talk at all. Thus the idea of employing a variable resistance transmitter was expressed by Mr. Bell in writing nine months before Gray thought of the subject, and the form in which Mr. Bell embodied it was so strikingly different from that of Gray as of itself to prove originality and disprove copying. So Bell already had the idea, and did not copy the form. They are met by the further fact, stated in their brief, that the file of the Bell patent was, in 1879, well known and had been examined by many people. Indeed it is an essential part of their hypothesis that it was read and handled so much that many pencil marks which they aver were there in 1876, and were not there when a certain certified copy was made in April, 1879, had been entirely obliterated by handling. According to their story, there were thirty-eight different passages altered in pencil. It is impossible that such a peculiar and well-known paper in such an important case could have been at that time replaced by a clean copy, all written in ink, without at once attracting the attention of the official in charge of the file, and all of those who had occasion to examine it; and it is certain that any man must have known that such a substitution could not be concealed, but would at once draw attention, and therefore that no man would have attempted it.

These considerations, the infamous character of the act alleged, and the fact that no evidence supports it, dispose of the charge thus tardily made.

They say, however, that one piece of evidence does support it. They refer to a certain certified copy of the application procured by the Bell Company from the Patent Office April 10, 1879, soon afterwards filed in the Circuit Court at Boston and printed in the summer of that year in the Dowd case, the printed record of which was, by stipulation and for convenience, introduced into or reprinted in the other cases before this court. They aver that that certified copy (here called the Boston exhibit) had thirty-eight erasures or interlineations, indicated, as there printed, by parenthesis marks or by redundant words on the printed page; and they allege that that paper shows that when that certified copy was made, on April 10, 1879, the original was in that interlined and altered condition (because the habit of the Patent Office in making a copy of a specification is to make it, as near as may be, in facsimile) and that the clean paper now in the files must therefore be a forgery. That is the ground, and the only specific proof on which they assert this forgery. One answer to that is that this copy of 1879 was originally put in evidence by Mr. Bell himself, as part of his own deposition, and it is impossible to believe that he would have voluntarily put into the case conclusive evidence of these interlineations just at a time when, according to our opponents' story, he and his associates were so terrified at the prospect of the alleged interlineations being known that they were perpetrating a third forgery to conceal them. They do not produce the original certified copy of April 10, 1879, but rely on what they assume to be a correctly printed copy of it in the printed transcript.

Our opponents point to another circumstance. It appears that in the fall of 1875 Mr. Bell prepared several copies of an early draft of the specification in the condition in which it then was. One of these copies so written by Mr. Bell was afterwards much altered and amended by him; the changes were completed about the middle of January, 1876, when this particular paper went to Washington; and a fair copy of it as amended, made in his solicitors' office at Washington, became the application sworn to in Boston, January 20, and filed February 14, 1876. Another copy of the early draft went to Mr. George Brown of Toronto, who, on January 25, 1876, took it to England with several other specifications of Mr. Bell, intending to take English patents on all of them. Mr. Brown did not take out any English patents whatever, but brought back the papers with him, and in the fall of 1878 Mr. Bell obtained them from him and himself offered them in evidence. The specification as it now appears in the files, and the patent as issued in 1876 (both exactly alike), differ from the George Brown specification, in that they contain the liquid transmitter clauses and also vary in thirty-seven or thirty-eight other passages from the George Brown specification. Attention was not called in taking testimony, nor at the trial below, to these differences, but Mr. Bell, in giving a history of his work, stated that he repeatedly corrected and altered and improved his American specification up to the last moment, and did not complete his amendments until just as he sent it to Washington in the middle of January, 1876. Nor is there any specific testimony as to when he last touched pen to the George Brown specification. The proof is that he prepared it in October and November, 1875, and that on December 29, in pursuance of a previous verbal understanding of September, 1875, he made a contract with George Brown which required him to at once furnish the specifications. He testified that he began to prepare the specification for Brown early in October, 1875, and that he furnished it to Mr. Brown between the date of that contract and January 25, 1876, when Mr. Brown sailed for England. He did not remember during which part of that period the specifications were furnished, but the just inference is that it was a day or two after the contract, because they had been prepared some months previously in order to be furnished, and he agreed to furnish them at once, as Mr. Brown was expecting to immediately sail for England, and he returned from Toronto to Boston instantly upon the execution of the contract. There was nothing in the case which seemed to make the precise date material. The fair conclusion from the testimony is that immediately after signing the Brown contract of December 29, 1875, he furnished the specifications which he had had on hand two months for that purpose just in the condition in which they had been, — a rough paper with many corrections and interlineations, which is the condition of the paper, now an exhibit in the case; that he continued to improve and amend the American specification, and, after he had parted with the Brown one, during the ensuing two weeks before the American specification went to Washington, wrote the liquid transmitter clause into it. This is corroborated by the fact that a sworn paper filed by him in the Patent Office in 1878, states under oath that the precise form known as the liquid transmitter was devised by him in the first half of January, 1876, though the idea of employing some form of variable resistance as distinguished from the magneto transmitter had been expressed by him in a letter of May 4, 1875. The date thus stated for the liquid invention is between the time when we believe he furnished the drafts to Mr. Brown, and the day when he sent his last corrected specification to the solicitor at Washington. It is impossible therefore to draw from the George Brown papers any inference unfavorable to Mr. Bell.

To support their charges, our opponents have really but one piece of evidence, and that they rely on and have argued at great length in their brief. The printed copy of the Bell file found in the printed Dowd record, and reprinted in some of the other cases, contains thirty-eight instances of what appear to be interlineations or cancellations.

Thus one paragraph as there printed reads: "The duration of the sound may be used (made) to indicate (signify) the dot or dash of the Morse alphabet, and thus a telegraphic despatch may be indicated (can be transmitted) by alternately interrupting and renewing the sound."

They argue that this paragraph was written in the application as filed with one set of the synonymous words, *e.g.* "signify," regularly written in ink; that afterwards that word was cancelled by drawing a pencil mark through it, and the other word, "indicate," interlined in pencil; and that the printer printed both in the same line. There are thirty-eight passages which they point out as containing such changes. Among such supposed interlineations or alterations, generally indicated (but not always correctly) by parenthesis marks in the printed copy, are the clauses about the liquid transmitter, which are included in parenthesis in that Dowd print. Now, it is found in every one of these cases of a duplication of words, *e.g.* "indicate (signify)" etc., that one of the two words is the word of the patent as issued, and the other word is the word of the older George Brown specification. Our opponents say that this arose in the following way: That the application filed by Mr. Bell February 14, 1876, was an ink copy of the George Brown specification; that after it was filed he dishonestly altered it by pencil cancellation and interpolation, between February 27 and March 3, and that this altered copy became the patent; that the cancelling marks have been rubbed out by constant handling of the paper before April, 1879 (and it is an essential part of their hypothesis that the alleged cancelling marks were thus accidentally obliterated), while by some curious freak of nature every one of the interlineations remained, so that both sets of words appeared in the certified copy made April 10, 1879. From this they argue that the application as filed was a copy of the George Brown specification, and did not have the liquid transmitter part in it, and that that was interpolated afterwards in the dishonest and criminal manner alleged.

It may be assumed that the printed paper in the Dowd record which contains the duplication of words, one of which in each case is that of the George Brown specification, and the other of which in each case is that of the patent, could not have come into existence except by the act of some one who had both sets of words before him or in his mind, and was interlining one set into a paper which originally had the other. But whether the person had the George Brown form, and interlined the words of the patent, or whether he had the form of the patent and interlined the George Brown words, the paper would equally have the same two sets. The original paper itself, however, would show which he was doing. If he had a paper ink-written in the words of the patent, and was interlining the George Brown words, so as to show them also, then, in the actual paper, the words of the patent would be found regularly fair-written in ink, with the George Brown words interlined; if he were writing with pencil on a fair copy of the George Brown draft, to make it read like the patent, then the George Brown words would be fair-written in ink and the words of the patent interlined. Now, the copy, *as printed*, does not show in which of these two ways the duplication occurred. The original exhibit itself, filed in Boston, would show the fact, but they do not exhibit that to the court.

The truth about it is simply this: The certified copy of the application, procured April 10, 1879, by the Bell company, was a fair-written copy in ink, and that ink writing reads letter for letter, word for word, line for line, and page for page (it is the custom in the Patent Office to copy applications in such fac-simile) like the application now on file, a photograph of which is furnished to the court. Counsel for the Bell company, in preparing the Dowd case in 1879, took that certified copy, which was procured for his office use, and, with the George Brown specification beside it, proceeded to compare the two, to learn for himself the progress between November or December, 1875, when the one was completed, and January 20, 1876, when the other was sworn to. For greater convenience, he made memoranda of the differences of the two in pencil on the certified copy itself, by generally making pencil parenthesis marks around the words in the certified copy which were not in, or had no corresponding phrases in, the George Brown draft, and interlining in pencil, on the ink-written certified copy, George Brown words which were not in the certified copy. Subsequently, that certified copy was put in evidence in the Dowd case, without remembering to rub out the pencil marks. It was printed in the Dowd case,—not under the supervision of counsel, but by some one else, who printed the pencil marks and all, and the printer added some other parenthesis marks, according to his own notions. As the Dowd case was not argued, the attention of counsel was not called to the accident. Several hundred pages of the Dowd printed record were put into the Drawbaugh case and other later cases for convenience, by stipulation, these among them, and were there reprinted, and the accidental error still escaped notice. In February, 1886, however, counsel for the Bell company noticed the error, and at once wrote to the counsel for the Drawbaugh company that that paper was incorrectly printed in the Dowd record, saying, "there were some pencil marks on the copy that went to the printer in the Dowd case, with brackets, etc., and that got reproduced in your case." He asked that a new and correct copy be substituted and printed. This was agreed to in writing, a correct copy was printed by the defendants, and is a part of the record, and a further stipulation was made that the court, for greater accuracy, might refer to the originals.[1] The original

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[1] The correspondence between Mr. Storrow, counsel of the Bell company, and Mr. Andrews, counsel of the Drawbaugh company contained the following:

(*Bell counsel to Drawbaugh counsel.*)

"NEW ORLEANS, February 18, 1886.

"*Dear Sir,* — I want to make one correction in the original record of the Drawbaugh case. The file of the Bell patent is in evidence, but the copy of the application is not printed correctly. I believe there are no errors in it which are of any importance, but there were some pencil marks on the copy that went to the printer in the Dowd case, with brackets, etc., and that got reproduced in your case. There has been lately printed a very careful and accurate copy from a photograph of the original papers, and I directed two copies of this to be sent to you from Boston. I propose to you to substitute that for the print that now exists among our exhibits in the Drawbaugh record, and also to stipulate as inclosed that the court on appeal may, if it desires, refer to a certified copy made by the Patent Office, for greater accuracy."

(*Reply — Drawbaugh counsel to Bell counsel.*)

"NEW YORK, March 25, 1886.

"*Dear Sir,* — Herewith please find stipulation that parties may, on the appeal, refer to a copy of the Bell patent on file, certified to by the Patent Office."

(*Enclosure.*)

"It is agreed that upon the appeal of this case the Supreme Court may, if it desires, refer to a copy of the Bell patent and file made and certified by the Patent Office. L. HILL, Sol'r for Def'ts."

Similar correspondence took place with the counsel for the Overland company, and a corrected copy was reprinted in that case also.

of this paper is part of the files of the Dowd case, in the Circuit Court in Boston, where it has been since 1879. The clerk of that court is in this court room, with the paper in his possession, and I ask that he hand it to the court, and that the court examine it.

[A discussion ensued, and the court decided that under the stipulation this could be done, and the clerk handed the original to the Chief Justice.]

That paper, now in the hands of the court, shows this state of facts. It is asserted by my opponents as the basis of their hypothesis, — and it is true, — that the ink-written part of that Boston exhibit is a fac-simile of all that was in ink in the original application. Now what was in ink in that original application? It appears that the ink-written part of that Boston exhibit is in the exact words of the patent as issued, and that its ink-written part is exactly the same as the paper to-day in the files of the Patent Office. Its ink part is a fac-simile of that paper, — the same words, the same words in each line, the same lines on each page. Particularly the words which are in the patent, in the application on file at the Patent Office, and in the Boston exhibit, but are not in the George Brown draft, including the passage about the liquid transmitter, are fair-written in ink in the Boston exhibit, and generally (in the original Boston exhibit) have parenthesis marks around them in pencil. The words of the George Brown draft, which are not in the patent, are not in ink in the Boston exhibit, but are interlined in it with pencil. And the Dowd print is a copy of this paper, ink, pencil, and all, with a few typographical errors, but with the words printed consecutively, so that it does not show what is interlined and what is fair-written.

This will be better understood from examination of one passage by way of illustration.

From the Boston exhibit as printed in the Dowd case:

"The duration of the sound may be used (made) to indicate (signify) the dot or dash of the Morse alphabet, and thus a telegraphic despatch may be indicated (can be transmitted) by alternately interrupting and renewing the sound."

Fac-simile from the Boston exhibit.

made
The duration of the sound may be used
signify
to indicate the dot or dash of the Morse
alphabet — and thus a telegraphic despatch
can be ~~transmitted~~
may be indicated by alternately interrupting
and renewing the sound.

The words regularly written in the line are all in ink, and are the words of the patent. The words interlined are in pencil, and are the George Brown words. The parenthesis marks are in pencil and inclose words which are not in the George Brown draft. The paper itself absolutely proves, therefore, that the original specification was written in ink just as it now stands in the Patent Office, and as it was copied into the patent March 7, 1876.

The stress of the argument for the Drawbaugh and Overland companies on this point turned on one particular passage. The George Brown draft, made in November, 1875, described various instruments which would produce the patented undulations, but all of them did it by "inductive" action. The patent as issued states that they can also be produced by varying the resistance, which is not an "inductive" action. One passage in the George Brown draft reads:

"There are many ways of producing undulatory currents of electricity, but all of them depend for effect upon the vibrations or motions of bodies capable of inductive action."

Our opponents argue, and rightly, that an inventor who had described the variable resistance liquid transmitter contrivance in his specification would not write in it that "all" of the contrivances depended on "inductive" action.

The *patent*, on the other hand, reads:

"There are many ways of producing undulatory currents of electricity, dependent for effect upon the vibrations or motions of bodies capable of inductive action."

That statement is true. It is followed by the examples of "inductive" contrivances which are named in the George Brown draft and which are "dependent" on inductive action, and, after them, there follows in the *patent* the description of the variable resistance liquid contrivance, which does not depend upon inductive action.

Our opponents argue that the change in this passage from "all of them depend," found in the November, 1875, George Brown draft, to "dependent," the words of the patent, marks the instant when Mr. Bell put the liquid transmitter into his specification. We agree with them. When was it?

They say that the application, filed February 14, was in the George Brown language: that between February 15 and 19, Mr. Bell's solicitors stole the liquid transmitter from Gray's caveat and wrote it into Bell's application, but did not observe this telltale statement on another page of the paper. But Bell, they say, re-reading the dishonest specification on February 27, perceived this proof of the dishonest interpolation, and, in pencil, changed "all of which depend" to "dependent." The Dowd print again does not show what is in ink and what is interlined in pencil, but the original Boston exhibit does. Here is a fac-simile from it, the interlineation and the cancellation of "*ent*" being in pencil:

There are many ways of producing
undulatory currents of electricity, but all of them depen-
d~~ent~~ for effect upon the vibrations
or motion of bodies capable of induc-
tive action

Their contention is that what is *in ink* in the Boston exhibit constituted the application before Mr. Bell could have dishonestly touched it, and exactly as it remained on April 10, 1879.[1]

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[1] Brief of Mr. Hill, p. 101.

". . . The 1879 certified copy showed that the original Patent Office specification *was full* of erasures and interlineations which are faithfully reproduced for the most part in the 1879 copy."

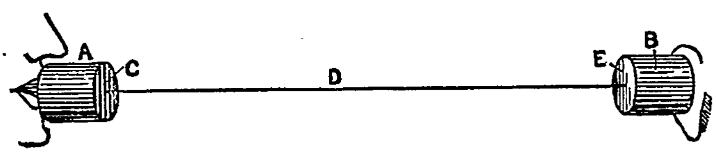
They are right in that. So the very paper to which they appeal proves upon their own theory, when the original is looked at, that this telltale phrase which establishes the contemporaneous presence of the liquid transmitter clause was in the application as filed February 14, 1876, and was written before the Gray caveat existed, and was not interlined by Mr. Bell afterwards. The whole story of forgery by the solicitors and interpolation by Mr. Bell is disproved the moment the paper they rely on is looked at. Their infamous charge of fraud is not only false, but it is based on the errors of a printed copy after they had been warned, and had agreed, that that copy was a misprint and contained those very errors in printing.

The case at large. — Eleven years ago Mr. Bell asserted that he was the first inventor of the electric speaking telephone and claimed for his invention and for his patent the same breadth and scope we insist upon. The Patent Office and many Circuit Courts have examined those claims in the most exhaustive and protracted litigation to which any patent ever gave rise. All his claims have invariably been sustained. Every tribunal in the Patent Office, and twelve judges in six circuits have entered judgment in his favor. The record before this court consists of twenty-two printed volumes, containing all the testimony in all the cases ever tried under this patent which have reached a final hearing. Some of these cases — as the Spencer and Dowd cases — have not been appealed, but their whole record has been put by our opponents, with our consent, into other cases which have been appealed. In the same way, substantially all the evidence that the Patent Office passed upon in the interferences between Mr. Bell and various claimants of his inventions is in these records. All these courts and the Patent Office, and every tribunal anywhere in Christendom before whom the question has come whether Mr. Bell was the first inventor of the speaking tele-

The brief of his partner, Mr. Dixon, pp. 217–230, is also based on the assumption that the 1879 copy is a fac-simile of the actual paper thus existing on the files in respect of what is fair-written in ink and what is interlined in pencil.

phone, both in this country and abroad, has always decided that he was.

What the Electric Speaking Telephone is.—Here is a string telephone, a contrivance at least two hundred years old. It consists of two tin tubes, A and B, generally two or three inches long, each with bladders, C and E, stretched over one end. A string, D, has one end passed through the centre of each diaphragm, and tied with a knot inside. The instruments are drawn apart until the string is stretched tight. A person speaks into one tube, as A, and the listener who places the other tube, B, to his ear, hears what is said. The sound vibrations produced by the voice in A cause its diaphragm to copy their vibratory motions. As this diaphragm C in its vibrations tugs at or relaxes the pull of the connecting string D, it pulls and relaxes alternately the diaphragm E, and thus compels it to copy the motions of the diaphragm C. The



diaphragm E, thus vibrating to and fro, throws the air inside of the tube B into the same vibrations, and those vibratory motions in the air strike upon the drum of the listener's ear. As the sensation of sound is due to vibrations in the air, and as the difference between one sensation and another is due to the difference in vibrations, it follows, and is a well-known fact, that the utterance of one word produces one particular set of vibrations, which, falling on the ear of the listener, produce the sensation of that word, and the utterance of another word produces a different set of air vibrations which, acting on the listener's ear, excite in him the sensation of that different word. In the case of the string telephone the vibrations excited in the air by the word "yes" in A cause similar vibrations to take place in the diaphragm C. These are imparted correctly by the string D to the diaphragm E, and thence to the air inside of the tube B. The consequence is that the air vibrations in B which impinge on the listener's ear are not only caused by the voice of the speaker, but they are *the same in "kind" or character* as the vibrations made in A by the speaker's vocal organs. The listener at B, therefore, acted on by vibrations exactly like those in A, is conscious of the sensation of the same word that he would be conscious of if he listened at A.

Mechanically, this contrivance consists of two diaphragms made to vibrate at stations distant from each other by causing the movements of the one to compel the other to copy the motions of the first. That when the second diaphragm was compelled to copy the movements of the first in all respects, the word uttered against one would be heard to proceed from the other, was thus a fact long known and used. No one in our time can claim any originality for discovering that.

What makes the second diaphragm copy the vibrations of the first is the mechanical connection by a string or wire. These instruments are called "mechanical" telephones, or "string" telephones If, now, *electricity* can be employed to make the second diaphragm copy the motions of the first, we shall have an "electric" speaking telephone. The problem left for the inventor of the first "electric" speaking telephone was, to discover how electricity could be employed to establish that connection and make the motions of the second diaphragm copy those of the first. That was his whole problem. The invention consists, therefore, in finding out how electricity can be used to accomplish that purpose. To state as Reis, an alleged anticipator of Bell, did, that *if* he could by electricity make a distant diaphragm copy the motions of one spoken to he would reproduce the sound, was not a statement of an invention, but a statement of what everybody knew was desired but had not been invented.

To produce at the ear of the listener, whether he be within earshot or at the end of a telephone line, the sensation of a particular word uttered by the speaker, it is not enough that the voice of the speaker at the sending station should produce *some* vibrations at the receiving station; it must there produce vibrations which shall have the characteristic motions belonging to that particular word as distinguished from those which belong to any other word. "Sound waves," as they are generally called, consist of zones of alternate condensation and rarefaction, produced at one place and propagating themselves onward. These condensations and rarefactions, however, are directly due to extremely short (perhaps 0.00001 of an inch), to-and-fro vibratory movements of the air particles, and it is usually more convenient to study those motions directly. Sonorous vibrations may vary, and therefore differ from each other, in several respects. The *length* of the path over which the vibrating air particle passes in its to-and-fro motion, or, as it is called, the *amplitude* of the vibration, may vary; the *time* occupied in passing over its total path from the beginning of one swing back to its starting point, or the number of times it will pass over it in a second, called the *rate* or *period* of vibration, may vary. The amplitude of the vibration determines the loudness of the sound; the rate, period or frequency of this vibration determines the pitch of the sound. But the differences between one word and another, or between the sound of a flute and of the human voice, for example, are not differences of loudness nor differences of pitch. The third characteristic of sound, which enables us to distinguish sounds from each other and recognize them, independently of pitch and loudness, is called "quality," a word here used with a specialized, technical meaning. It includes the difference between articulate sounds or different words as part of it. It depends, not upon the length of the path of the vibrating particle, nor on the frequency with which it passes over that path, but upon *the manner in which it performs its journey.* If it were to start from a definite point at a definite time, and return to the same point at the end of a definite time — that is, if it were strictly limited as to the amplitude and as to the period of its complete vibration — it might (and does) pass over that path in many different ways; it may move at first fast, then slow, then perhaps return a little, and then go on at a different speed, and still reach the same goal at the same time. It is the difference in the manner in which it performs its journey, as distinguished from the length of its journey, and from the time occupied, which gives rise to difference in the "quality" of the resulting sound. To produce the sensation of a word by vibrating at a distant station the diaphragm of a telephone, it is necessary, therefore, to make that diaphragm perform vibrations which, in their "*character*," as it is called, as distinguished from their frequency and their amplitude, correspond to that particular word. If we know how to produce this kind of control over the vibrations at the distant diaphragm, we shall know how to transmit speech; if we do not know how to do it, then we shall not know how to make a speaking telephone.

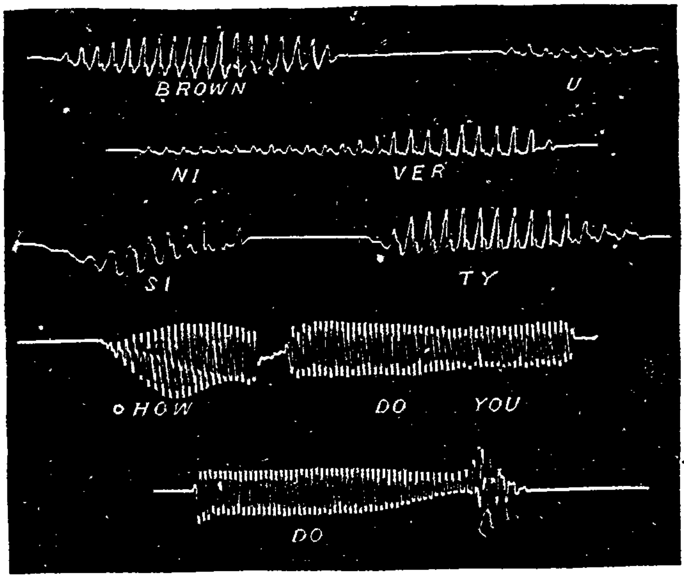
The invention of Mr. Bell consisted in finding out how to so employ electricity that not only would the voice of the speaker produce *some* vibrations in the moving part of the distant instrument, but would produce vibrations which *in their character* or "kind" would copy the movements caused in the air by the utterance of whatever word might be spoken for the moment at the transmitter.

There had long been known an instrument called the *Reis telephone*, in which words uttered into the transmitter did, by means of electricity, produce motions in the receiver. It was the most advanced instrument in those arts to which the speaking telephone pertains. But the motions thus produced in the receiver of the Reis telephone copied those of the transmitter only as respects the characteristic of period or frequency. The same number of complete swings as were performed by the transmitter at one end were performed by the receiver at the other, but the *character* of the swings at one end did not control the "character" of the vibrational swings at the other. That characteristic of sound which depends upon the number of vibrations per second, to wit, musical pitch, was therefore reproduced by this instrument; but the characteristic of sound which depends upon the *character* of vibration, or, as it is technically called, "*form*" of vibration, to wit, "*quality*," including those peculiarities which constitute articulation, was not reproduced by this instrument, and could not be reproduced by any instrument operating upon its principle. The distinction between this old musical telephone and the speaking telephone described in the Bell patent, consists, therefore, essentially in the difference of method or principle employed as well as in the difference in the kind of result produced. The method of Reis secured correspondence in frequency of vibration or pitch of sound, but did not secure, and could not secure, anything else. All the experts on both sides agree that this method was absolutely inadequate for speech, and was not only inadequate, but, while that method was being employed, the method adequate for speech could not be used at the same time in the same instrument.

It is obvious that that which particularly made Mr. Bell's instrument to be an *electric* speaking telephone was some electrical action not exhibited in the operation of the previous instrument which enabled it to control the character, as distinguished from the mere frequency, of the vibrations of the receiver diaphragm. In that electrical action will be found, therefore, his most important and characteristic novelty, and his leading patentable invention.

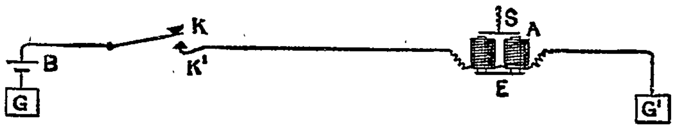
To signify that characteristic of sonorous vibration which gives rise to "quality" of sound as distinguished from loudness or pitch, the patent employs some technical phraseology of long known meaning. It is the habit of physicists to represent sound vibrations in a sort of graphic shorthand way by drawing curves which are not drawings of the movements actually made by the sounding body, but which are a graphical representation of a mental conception of the character of those movements. In the same way, the height of the thermometer or barometer at successive times, or the price of stocks or gold or cotton, is represented by curves which to the instructed mind tell a long story at a glance. From this habit there has arisen a scientific slang or technical term,—"*form* of vibration." It is used because each different "*character*" of vibration is represented by a particular characteristic of the curve which typifies it, and this particular characteristic, although it is not the only one shown in what would popularly be called the "shape" of the curve, is scientifically recognized as constituting what is called in acoustics its "form." Helmholtz, and all the other standard writers for many years before the Bell patent, employed the phrase "*form* of vibration" to signify that characteristic upon which "quality" or articulation depends; and the Bell patent, adopting this established use of the word, employs it to signify the reproduction of that particular characteristic of vibration.

By a form of speech which is adopted in science and is scientifically correct, the lines which thus graphically express the idea of sonorous vibrations are called curves, although to the eye they look jagged and sharp. The following cut is taken



from a tracing made by Professor Blake, of Brown University, by means of a photographic contrivance in which the vibrations of the telephone diaphragm, produced by shouting against it the words printed, were caused to inscribe certain curves characteristic of their motions on a sensitized paper drawn under a spot of light reflected from the quivering diaphragm. They are enlarged about 112 times from the most violent motion the voice could possibly give to the diaphragm in articulation, and the nicer differences are slurred over by the imperfection of the apparatus; but they convey an idea of the nature of the movements which constitute articulation, and which the receiving diaphragm of a telephone must copy.

The Morse telegraph and how it works.—This cut represents a single-circuit Morse telegraph,—the simplest typical form of an electric signalling apparatus. B is a battery; K is a key. In its present condition the circuit is "open," as it is called—



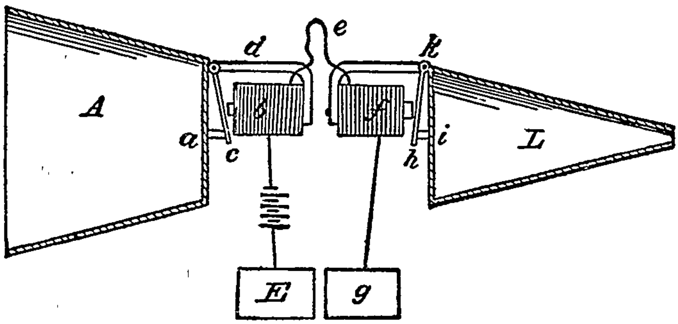
that is, K and K′, the two parts of the key, are out of contact, and no current can flow from the battery. If the key K is depressed, so that it touches the end of the wire K′, then the current flows from the battery B through K, K′, through the "line," through the receiving instrument E, down to the earth or "ground" at G′, through the earth to the other "ground," G, and up to the battery again. If the key K is raised, the electrical connection is destroyed by what is called "opening" the circuit—that is, opening the wires apart—and no current passes. The receiver E consists of an electro-magnet. That is composed of two small cylinders of iron, around which are wound coils of wire which form a part of the electric circuit. When the key K is depressed so as to touch K′, and the current flows, it passes through these coils. That makes the cores inside the coils (shown as little cylinders protruding from their upper ends) to be magnetic while the current flows, and that pulls down the flat piece of iron or armature, A, suspended above those cores by a spiral spring S, and holds it down so long as the current flows. When the key K is raised to its position shown in the cut, the current is "broken" and no longer flows, the cores of the electro-magnet cease to be magnetic, they no longer attract the armature A, and the spiral spring draws it up again. Each time, therefore, that the key K makes contact with its anvil K′ the armature A is pulled down; when the key K is lifted up, the armature A flies back. As often as the current is made and broken at K, by moving the key down and up, just so often is the armature A moved down and up again.

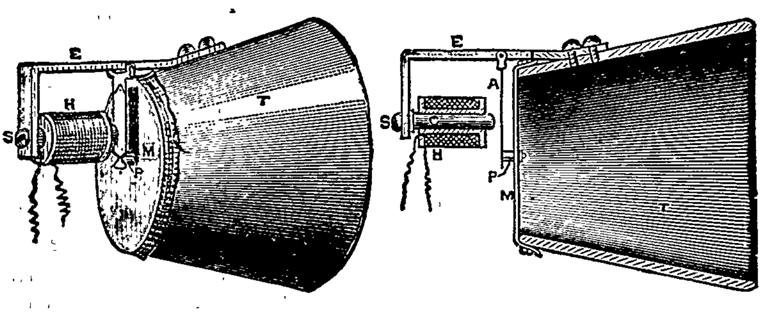
Musical or "pitch" telephones.—If now the key K be connected with the centre of a horizontal diaphragm which is vibrated by a sound, it will move up and down, and the parts can be so adjusted that when it moves down it will make contact with K′ and let the current flow, and when it moves up they will part contact and interrupt the current; each up and down motion of this diaphragm will thus cause an up and down motion in the armature A of the receiver. As many times as the key K vibrates up and down under the influence of words or other sounds, it interrupts the current at K K′, and therefore just so many times will the armature A vibrate up and down. The vibrating armature, A, will give forth a sound the pitch of which will depend upon the number of its vibrations per second, and as that number will agree with the number of interruptions of current caused by the vibrations of the diaphragm to which K is attached, it follows that that characteristic of the sound acting on the diaphragm and attached key at K which depends solely upon *the number* of vibrations will be reproduced by the vibratory motions of the armature A. That characteristic consists simply in musical pitch. This circuit-breaking machine, acting on the receiver by an interrupted current, will reproduce the musical pitch of the sound. But it will reproduce no other characteristic; it cannot therefore reproduce speech.

The speaking telephone.—The instrument Fig. 7 of Mr. Bell's patent has, however, an entirely different mode of operation. The first diagram here given is a fac-simile of Fig. 7 of the patent. The other is a view and section of an actual structure (a transmitter) built in literal conformity to the description of Fig. 7. The transmitter consists of a cone or flaring tube of wood, the large end of which is open so as to be spoken into, while the smaller end is closed with a tightly stretched membrane *a* (M).[1] To the frame is hinged at *d* a

[1] The *italic* lettering is that of Fig. 7 and the patent; the CAPITALS refer to the lettering of the second cut.

piece of soft iron, *c* (A), called the armature. The lower end of *c* (A) is fastened by a stud to the centre of the diaphragm *a* (M). The arm *d* (E) is of iron, and carries an electro-magnet *b* (H), consisting of a small core or cylinder of iron, the end of which is seen projecting towards *c* (C in the section), wound round with a coil of wire (H in the section). The receiving instrument L is the same as the transmitting instrument, except that for convenience the cone tapers down from the diaphragm to the small end which can enter the ear of the listener. When any sound is made into the cone A, its diaphragm *a* (M), is caused to vibrate in accordance with the particular sound uttered, just as in the case of a string telephone. The arma-

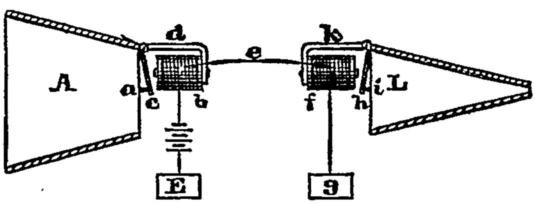




ture *c* (A), fastened to the centre of the diaphragm, partakes of that motion. When so vibrating it moves to and fro in front of the core of the electro-magnet *b* (H), which core is kept magnetic in this instrument by means of a current of electricity constantly passing through the whole apparatus from the battery shown by the cross-lines below *b*.

It is a fact in electricity, discovered by Faraday about 1831, that when an armature is moved in front of such a magnetized electro-magnet, that very motion itself generates ("induces" is the technical word) in the coils of the electro-magnet electrical disturbances which are shown as currents in telegraph wires properly connected, and that these disturbances or currents correspond to the movements of the armature in duration, in direction, and in strength. While the armature moves, these "induced" currents, as they are called, flow; when the armature, instead of moving towards the core moves away from the core, the direction of the so-called electrical flow is reversed. When the armature moves violently, the electric current is violent; and when gently, the flow is gentle. While the armature *c* (A), is made to vibrate to and fro in front of this electro-magnet by the action of sound vibrations or waves on the diaphragm, electrical disturbances or currents are all the while caused, but these vary from instant to instant as the motion of the armature varies, and, therefore, the variations in the flow correspond to the variations in that movement, in duration, in direction, and in violence. In accordance with the habitual usage of science, they may be, and are properly said to be, copies of the vibrational movements of the armature; that is, every change in one produces a corresponding change in the other.

When this current, varying in accordance with the sound waves that act on the transmitter, reaches the electro-magnet *f* of the receiver, it acts upon the core of that magnet, in front



of which is the armature *h*. The current from the battery always keeps that core somewhat magnetic, and therefore always pulls the armature *h* towards the little cylindrical core projecting from *f*. If the magnetic pull of *f* be increased, the armature *h*, and consequently the diaphragm *i* attached to it, is drawn nearer to *f*; if the magnetic pull be relaxed, the elasticity of the diaphragm draws *h* back again. Every variation in the magnetic strength of the core produces, therefore, a motion in the armature *h* and attached diaphragm *i*. It not only produces *some* motion, but produces a motion which corresponds at each instant with the variations in the magnetic strength of the core. The greater these variations, the more violent the motion; when the magnetic strength increases, the movement of the armature is towards the electro-magnet; when it decreases, the movement is in the other direction. The currents produced in the manner already stated, and varying like the sound waves of the sound uttered into the transmitter, reach the receiver electro-magnet *f*, by virtue of the well-known fact that every electrical change produced at one end of a telegraph wire is instantly felt in every part of it. These currents, corresponding to the sound waves which act on the transmitter, are added to the general and steady current from the battery, so that the total actual current passing through the electro-magnet of the receiver is now stronger, now weaker, in exact accordance with those sound waves. The stronger it is, the more magnetic is the core *f*; the weaker it is, the less magnetic is that core; and as the movements of the armature *h* depend upon and correspond to and copy the magnetic changes of the core *f*, and as these magnetic changes are due to and correspond to and copy the changes in the electrical current, so it follows that the vibratory movements of the armature *h* and attached diaphragm *i* of the receiver copy the changes in the electrical current. Every variation in that current produces not only *some* variation, but a *corresponding* variation in the vibratory motions of the armature *h* and diaphragm *i*.

It is evident upon reflection that all this correspondence between the movements of the diaphragm *a* and armature *c* of the transmitter and the currents its movements cause, and this correspondence between those currents and the movements of the armature *h* and diaphragm *i* of the receiver L which the currents in turn produce, holds not only for the greater and general disturbances and changes, but for each minute variation or variety of them. The consequence is that in this apparatus the *electrical changes* are copies of the sonorous movements at the *transmitting* end. The sonorous movements at the *receiving* end are copies of these electrical changes. They are therefore copies of the sonorous movements at the transmitting end of which these electrical changes themselves are copies. The final consequence is that the vibratory movements at the receiver are the same as those in the transmitter, not only as respects general frequency, but as regards *all* their characteristics; and the *result* is that the sound which actuates the transmitter is reproduced and heard to proceed from the receiver with *all* its characteristics, and not with the characteristic of its pitch alone. This instrument, therefore, is an instrument which can reproduce not merely the characteristic of pitch, but all the characteristics of sound; or, to state it in a more ordinary, concrete form, it will transmit not only musical notes but "noises and sounds of all kinds."

That is the telephone Fig. 7 of the patent, usually called the magneto telephone.

Comparing this with a string telephone we find that we have, in each, a diaphragm spoken to at one end and a diaphragm listened to at the other, and that, in each, speech is transmitted because the motions of the latter are copies of the motions of the former. But in Mr. Bell's telephone we have got rid of the mere mechanical connection or link formed by the string, and have employed electricity to connect the two. The knowledge how to use electricity for this link constitutes the invention of the *electric speaking telephone.*

It will be observed that, in the nature of things, the movements of the receiver copy the electrical changes which produce them, and necessarily must copy them, in any receiver where the attraction on the elastic diaphragm varies with the amount of electricity which arrives from the transmitter. Any form of instrument of which that holds true can therefore be substituted for Mr. Bell's precise structure without changing the apparatus as a whole, or its mode of operation, or its result. Those motions at the receiver are like the sound waves uttered into the transmitter, because the electrical changes which move the receiver, and which therefore its motions copy, are themselves copies of the sound waves uttered into the transmitter. What makes this apparatus to be an electrical machine is the employment of electricity in some form; but what makes it to be an electrical *speaking* machine is the presence, not only of *some* electrical current, but of an electrical current which copies the sonorous movements of the transmitter in those characteristics on which "quality" or articulation depends. In other words, in the figurative language of science, the electricity is here moulded into the form of the sound waves, and when that feature is present in the operation of the machine, speech will be transmitted; when it is not present, speech will not be transmitted. It is present in this apparatus of Mr. Bell's; his specification contains the first description of any apparatus which was ever intended or adapted to embody this idea and the first suggestion of the idea itself. This correspondence between the electrical current and the sound waves acting at the transmitting end, therefore, is exactly that which makes Bell's instrument a speaking telephone, and which, beyond any peculiarities of structure, distinguishes it in principle and idea from anything ever known before.

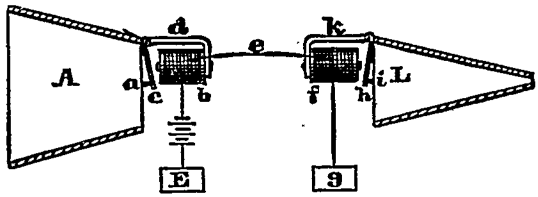
The Bell patent points out that this is the distinctive characteristic to which the new result is due; and claim 5 of the patent in terms secures to him this "method" as the means for the desired results.

The following is the description in the patent. After describing the use of one specified undulatory current apparatus, (Fig. 5) for the purpose of harmonic telegraphy, the patent says:

"I desire here to remark that there are many *other* uses to which these instruments may be put, such as the simultaneous transmission of musical notes, differing in loudness as well as in pitch, and the telegraphic *transmission of voices or sounds of any kind.*"

He then proceeds to state how this latter result can be accomplished.

"One of the ways in which the armature *a*, Fig. 5," [the telegraph instrument], "may be set in vibration, has been stated above to be by wind. Another mode is shown in Fig. 7, whereby motion can be imputed to the armature *by the human voice*, or by means of a musical instrument.



"The armature *c*, Fig. 7, is fastened loosely by one extremity to the uncovered leg *d* of the electro-magnet *b*, and its other extremity is attached to the centre of a stretched membrane *a*. A cone, A, is used to converge sound vibrations upon the membrane. When a sound is *uttered* in the cone, the membrane *a* is set in vibration, the armature *c* is forced to partake of the motion, and thus electrical undulations are created upon the circuit E *b e f g*. These undulations are *similar in form* to the air vibrations caused by the sound: that is, they are represented graphically by similar curves. The *undulatory current* passing through the electro-magnet *f*, influences its armature *h* to copy the motion of the armature *c*. *A similar sound to that uttered into* A *is then heard to proceed from* L."

"Claim 5. The method of and apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing *electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds*, substantially as set forth."

Professor George F. Barker, expert for the Overland company, characterized the invention very happily. He was of those who witnessed Mr. Bell's exhibition at the Centennial. He spoke of the interest excited by "the remarkable result" and their astonishment at hearing "for the first time the transmission of articulate speech electrically." He added: "The mode of operation of the instrument was obvious at once as soon as it was exhibited. It was one of those marvellously simple inventions that causes one to wonder, on seeing it, that it had not been invented long before."

Every speaking telephone used by all the defendants differs from every instrument before the Bell patent, and resembles the instrument of the Bell patent, in that it has these electrical changes which are copies of the sound waves. It transmits speech because it has them. That principle, that "method," and that mode of operation first came into the world in Mr. Bell's instrument and by the description in his patent. His was a speaking telephone because it had it; previous instruments could not be speaking telephones because they did not have it. It is in the defendants' apparatus, and it is because they have it that their instruments talk.

These electrical changes are not something that existed in nature and he found. He first created them. They are not the "result" which Mr. Bell sought to attain; the "result" is the transmission of noises and sounds of all kinds. They are the essential *means* to that result; and they are novel. The defendants' instruments owe their capacity to transmit speech to the employment of that means which is in common between them and Mr. Bell, and is not in common between them and any one who preceded Mr. Bell. There is no better test of infringement. *Howe* v. *Morton*, 1 Fish. Pat. Cas. 586, 588.

To this, Dolbear makes an objection. He says Mr. Bell cannot cover "all" ways of transmitting speech. We reply that our patent does not cover "all" ways, but only our way. "But," rejoins Mr. Dolbear, "I cannot find any other way, and I do not believe any other is possible. Your patent only appears to cover one way; yet, if there is no other way, you cover all ways. *O'Reilly* v. *Morse*, 15 How. 62, does not permit that."

In deciding the Dolbear case at the circuit, Mr. Justice Gray answered this argument. He said:

"The evidence in this case clearly shows that Bell discovered that articulate sounds could be transmitted by undulatory vibrations of electricity, and he invented the art or process of transmitting such sounds by means of such vibrations. If that art or process is (as the witnesses called for the defendant say it is) the only way by which speech can be transmitted by electricity, that fact does not lessen the merit of his invention or the protection which the law will give to it."

It is said in defence that the Reis circuit-breaker and several old instruments can *now* be compelled to so operate as to produce this peculiar character of electrical disturbance, and if they produce it they will talk; and that speech can now be transmitted by talking to a Morse or a House telegraph. But that is not material, if true. If Mr. Bell in 1876 had said: "I can make the Morse telegraph perform a new kind of operation, and produce a new kind of electrical changes, and by so doing I can transmit speech," and had told how, he would have improved the useful arts by inventive genius; he would have made a patentable invention. He could not patent the machine, for the Morse telegraph was old. He could patent his new mode of electrical operation, and that mode of electrical operation could only be described by pointing out the essential difference between the electrical changes that Morse produced and the electrical changes that Bell produced.

This court has given a perfect description of such an invention in the Fat Acids case (*Tilghman* v. *Proctor*, 102 U. S. 707). A man, said the court, may have a patent for "the means by him invented and described," and those means need not be a machine. What is the difference between a machine and a process? "A machine," said this court, "is something visible to the eye, the object of perpetual observation. A process is a conception of the mind, known only by its results when being executed or performed. Either may be the means of producing a useful result." Either, therefore, may be a patentable means. When my opponents say "What, patent a conception? Patent a result? Patent an operation which you cannot know except by its results?" the reply is obvious.

An inventor, until he has not only got a conception, but has described how that conception can be so applied and employed as to lead to a result,—"be known by a result,"—has not made his work a part of the useful arts; has not come within the language of this court; nor within the domain of the patent law. But when he has entered into the useful arts, and thereby got within the domain of the patent law, then one must be very blind and very narrow-minded who can see only the machine visible to the eye, and not the conception which gives life to it. That is the lesson of the Fat Acids case.

Is there any better statement of the great inventions that have improved the useful arts, than "a new idea introduced"?

In the Clay case, the defendants' counsel below said that this whole Bell patent and all the stories its counsel told about it were pure pieces of imagination; that they were asking the court to base its decrees upon nothing but imagination. "Why," said he in substance, "they talk about a 'form' of electrical undulations, and they say that there is a 'form' of electrical disturbances in their instrument, and the same 'form' in ours," and he pulled a piece of crooked wire out of his pocket, and said, "I can see the form of this, and if a man brings me another one I can see the form of that, and if the form of the electrical undulations is the same in those two instruments, why does not the Bell company pull them out and put them on the table, that the court may compare them?"

Apply that criticism to the great invention of Faraday which he described in his imaginative phrase "Lines of Force;" apply it to the decision in the Fat Acids case; it only destroys the critic. What is there so real, so enduring, or so useful as a new idea so stated that it can be employed and lead to a practical, useful result? There is no better statement of a great patentable invention — a new idea so stated that it can be employed and lead to a practically useful result; a new idea harnessed into the service of man. The harness is indeed requisite to use the idea, but the great thing, and the fruitful thing, is the new idea which is brought in.

The Patent Act, in express terms, says that the inventor is to describe his machine, and "the principle" thereof, "by which it may be distinguished from other inventions." The "principle" is the distinguishing characteristic in the patent law. The Act again formulates this idea still more explicitly. He is to describe, says the Act, "the best mode in which he has contemplated applying that principle," implying that there may be modes of application not described. And, with that idea brought forward, the statute provides in terms that the patent is to be for his "invention or discovery," and not for any particular mode of application. See *Bell* v. *Gray*, 15 O. G. 778; *Am. Bell Tel. Co.* v. *Spencer*, 8 Fed. Rep. 509; *Am. Bell Tel. Co.* v. *Dolbear*, 15 Fed. Rep. 448; *The Neilson Patent*, Webster Pat. Cas. 683, 715; *Davis* v. *Palmer*, 2 Brock. 298; *Evans* v. *Eaton*, 7 Wheat. 356; *McClurg* v. *Kingsland*, 1 How. 202; *Parker* v. *Hulme*, 1 Fish. Pat. Cas. 44; *Howe* v. *Underwood*, 1 Fish. Pat. Cas. 160, 180; *O'Reilly* v. *Morse*, 15 How. 62; *LeRoy* v. *Tatham*, 14 How. 156; *Winans* v. *Denmead*, 15 How. 330; *Corning* v. *Burden*, 15 How. 252; *Burr* v. *Duryee*, 1 Wall. 531, 567; *Jacobs* v. *Baker*, 7 Wall. 295; *Mitchell* v. *Tilghman*, 19 Wall. 287; *Tilghman* v. *Proctor*, 102 U. S. 707; *Cochrane* v. *Deener*, 94 U. S. 780, 787; *James* v. *Campbell*, 104 U. S. 356, 377; *McCormick* v. *Talcott*, 20 How. 403; *Waterbury Brass Co.* v. *Miller*, 9 Blatchford, 77; *Bischoff* v. *Wethered*, 9 Wall. 812; *Smith* v. *Nichols*, 21 Wall. 112, 118; *Blake* v. *Robertson*, 94 U. S. 728; *Clough* v. *Barker*, 106 U. S. 166; *Penn. Railroad* v. *Locomotive Truck Co.*, 110 U. S. 490; *Consolidated Valve Co.* v. *Crosby Valve Co.*, 113 U. S. 157; *Blake* v. *San Francisco*, 113 U. S. 679; *Miller* v. *Foree*, 116 U. S. 22.

This court has often spoken of the value of the mental idea which lies behind a particular machine, the first of its class in the arts. *Bischoff* v. *Wethered*, 9 Wall. 812. There is no illustration of that better than Faraday's great discovery that waving a magnet in front of an electro-magnet or a wire, generates electrical currents. That magnet, moved by his hand, was the first magneto machine that ever was. He discovered that fact; but that fact was only a small part of what he discovered. *He discovered the relation between the motions and the currents*, and he expressed that relation by a figure of speech — by the phrase "Lines of Force." If he had died on the day after he had so announced that discovery, the world would have been as much indebted to him as it is now. For though he had not then worked out all of its results, he had given the rule for doing it. Every man who makes a dynamo machine to-day, in calculating its form, its proportions, and its parts, to fit it for the particular use he wants, not only avails himself of the fact that Faraday discovered, but of the rule that Faraday laid down for all future constructors. He did the work of the originator as distinguished from the work of the improver.

So it is with this specification of Mr. Bell. It certainly described one speaking telephone. But its greatest merit was that it also laid down the rule for all future speaking telephones. It said,—get into the operation of your machine this which never was in any machine before, and get it in in accordance with a particular rule which it stated. Every man who has endeavored to improve the speaking telephone since that time, has endeavored not only to avail himself of the fact that Mr. Bell found, but has endeavored to conform more and more perfectly to the rule which Mr. Bell laid down.

One of my opponents said that it seemed to him that this whole telephone system was like a pyramid balanced on its apex; that this vast system all over the world to-day was based on this one little imperfect machine in the Bell patent. "Great oaks from little acorns grow," answers the nursery rhyme. That patent had the germ of life in it; and that is why this great structure grew out of it.

[Counsel then explained a number of details about the various forms of telephones, and the varieties in the curren which could be produced without departing from the essential characteristics already described.]

The Microphone.—It is obvious that any variations in the form of the transmitter which still enable it, under the influence of the spoken word, to produce a current which in its variations of strength corresponds to those vibrations, may be patentable themselves as improvements, but would still give an apparatus which as a whole employs Mr. Bell's method. The microphone transmitter is such a variation of form. The strength of an electric current can be varied by varying the electric energy poured into the circuit, or by varying the obstruction or electrical resistance which that energy has to overcome, just as the flow of gas in a pipe can be varied by varying the pressure at the gas works, or by turning more or less the cock which obstructs and regulates the flow. In the case of electricity the relation is simple, and was ascertained and expressed by Ohm (whence it is called Ohm's law) in the form:

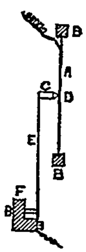
$$\text{Strength of current} = \frac{\text{Electro-motive force.}}{\text{Resistance of the circuit.}}$$

The strength of the current increases, therefore, in direct ratio to either an increase in the numerator or a diminution in the denominator of that fractional expression.

The "microphone" is an apparatus which so varies the electrical resistance. This cut is a diagram of a section of the device exhibited for this purpose by Emil Berliner in his caveat of April 14 and application of June 4, 1877. The line D represents a diaphragm, shown edgewise, supported by a framework at its edges. C is a pointed "electrode" or wire-end held in contact with the central part of the diaphragm. The current from the battery B goes by the wire to the diaphragm D, thence to the electrode C through the point of contact, thence through the receiver R (a Bell receiver, essentially like L of Fig. 7, but in the improved form of Bell's second patent). When the diaphragm D is vibrated by sound waves it moves towards the electrode C, or in the opposite direction. A movement towards C increases the pressure at the point of contact, and a movement in the opposite direction diminishes it.

In an uncut wire the electric current (the phrase by which the phenomenon of the propagation of electricity is expressed) passes from molecule to molecule with ease. If the wire be cut, and the two ends placed in contact, it will still pass, but less freely than before, because the union of the molecules of the two severed ends is less perfect than in the uncut wire. If the two ends (or "electrodes") are firmly pressed together, the union is more perfect, and the current experiences less resistance and is less enfeebled than if they touch lightly. This was a fact well known before the Bell patent, though such variations in pressure had never been directly utilized. In our microphone, therefore, the vibrations of the diaphragm will produce variations of pressure at the contact, and consequent variations of electrical resistance, and, consequently, corresponding variations of current.[1] This microphone may therefore be substituted for the transmitter A of Bell's Fig. 7, and the vibrations of its diaphragm, like those of the diaphragm of A, will produce electrical undulations similar in form to the actuating air vibrations. The same effect will be produced on the receiver as in Fig. 7, and the word will be transmitted by the method of the patent.

The chief mechanical essentials of the microphone are, (1) that there shall be no substantial break of contact, such as would be caused by the diaphragm vibrating entirely away from the electrode; (2) that variations of pressure shall be developed to as great an extent as possible; (3) that the variations of electrical resistance shall directly and uniformly correspond to the variations of pressure. Berliner's first papers show the electrode C made of German silver or other metal, and held rigidly, while the diaphragm was much strained, so that its excursions would be very small. Edison, who invented the microphone independently, showed in his application of July 20, 1877, a form indicated by this diagram.

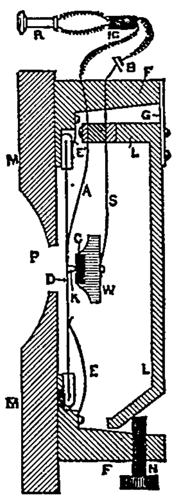


The electrode C is mounted on the end of an adjustable spring E, strained by the screw F to press towards the diaphragm. Afterwards he discovered that it was better to give a notable weight to a spring-carried electrode, C, because, while the spring gave an automatic freedom of adjustment, the inertia of the weight furnished a mechanical resistance which developed a large variation of contact pressure. He also in his application of July 20, 1877, and in a previous newspaper publi-

[1] It is a well-known law of electricity that electrical variations produced in one part of a good conductor are equally, exactly, and instantaneously (within any length of conductor usually employed) felt in all other parts. That is what enables electricity to be used for conveying signals to a distance.

cation, pointed out that carbon was the best material for one or both of the variable pressure electrodes. The reasons are that with carbon the range of variation of pressure without sudden break is greater, and the variations of electrical conductivity correspond more closely and evenly to the variations of pressure than when the usual metals alone are employed.

Early in 1878 Professor Hughes, in England, independently invented the carbon microphone in a very simple but excellent form, and gave it its name, "microphone." Finally, in the summer and fall of 1878, Mr. Francis Blake, formerly an officer in charge of the electrical determinations of longitude for the United States coast survey, and now a director of the Bell company, invented the highly organized Blake transmitter.



In it D is the diaphragm, K is a teat of platinum with a face about the size and shape of the head of a small pin, C is a bit of gas carbon, artificially hardened and polished, mounted in a piece of brass, W, which is carried on the end of a watchspring S. That spring is itself carried on a long lever L, hinged by a spring hinge at G, and capable of a very delicate adjustment by the screw N. The instrument is spoken to through the mouthpiece P. The current comes from battery B through the spring S to W, C, K, through the delicate spring A, and through the primary of the induction coil I C the secondary of which goes to the distant receiver R. The working contact is between the platinum teat K and the carbon C. The brass W usually weighs about 75 grains, and gives inertia to the freely suspended electrode C. The sheet-iron diaphragm is not screwed to its seat, but has its edges cushioned by folds of soft india-rubber (letter bands slipped over the edge), and is held in its seat by a short and narrow metal clip E′ and a long steel finger-spring E,—an arrangement which leaves it free to vibrate truly.

All these inventors did, in fact, make their microphones after the Bell patent, and for the express purpose of producing Bell's electrical undulations similar in form to the sound waves. They do produce such undulations, and for that reason their use has always been decided to infringe Mr. Bell's fifth claim.

Mr. Bell, moreover, in the patent itself, stated explicitly that the described variations of current could be produced by varying the electrical resistance instead of employing the magneto transmitter particularly shown, and he indicated a type of instrument (the liquid transmitter) which could be used to vary the resistance.[1] It is, however, the microphonic form of variable resistance instrument which is now generally commercially used. The Bell patent covers the use of a telephone apparatus which employs a microphone for its transmitting member, because the novel variations of current which constitute the essence of the Bell invention are employed as the essential means of transmitting speech by the microphonic form, as well as by the magneto form; and if Mr. Bell had described nothing but the magneto form, his claim would have that breadth. That it does have that breadth, however, is put beyond discussion, for the patent itself states that for its purposes the variable resistance mode is the equivalent of the magneto mode.

The following is the usual commercial form of the Bell magneto instrument invariably used as a receiver, and to some substantial extent also used as a transmitter:

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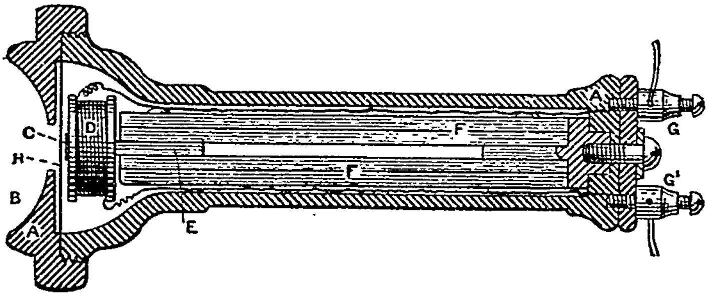
[1] After describing the magneto or "inductive" plan the patent says:

"Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit. . . . For instance, let mercury or some other liquid form part of a voltaic circuit; then, the more deeply the conducting wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current. Hence the vibration of the conducting wire in mercury or other liquid included in the circuit occasions undulations in the current."

Claim 5 was for his "method" as a whole. Besides that, he had one special and subordinate claim (3) for the inductive mode of working that method, and another special and subordinate claim (4) for the variable resistance mode of working it.

Claim 4. "The method of producing undulations in a continuous voltaic circuit, by gradually increasing and diminishing the resistance of the circuit or by gradually increasing and diminishing the power of the battery, as set forth."



The Bell Magneto Telephone in Commercial Use since December, 1877.

The diaphragm is H, placed in front of the small soft iron core C which is screwed into the permanent steel magnet F and around which a coil of fine wire D (usually 75 yards) is wound.

The origin of the Electric Speaking Telephone. — There are more than half a million of these telephones in daily use. They are so simple that anybody can make them, and anybody can use them. Where did they come from? Trace back the history of each one of them. Go to the man who made it, and ask him where he learned how an electric telephone must work in order to speak. Go to the man who put the last improvement into it, and ask him where he found a speaking telephone to improve, and where he learned the rule to improve it by. All these lines of search end in one man. Whatever anybody did or did not do secretly in his workshop before Mr. Bell's time, it is nevertheless a fact in history that every speaking telephone at work in the world traces its origin right up to Mr. Bell. No man ever used, and no man offered for use, any instrument for the purpose of transmitting intelligence by word of mouth for any practical or useful end, before Mr. Bell. There is no such pretence. Yet it is an invention which once known could not be kept secret, and when offered, every one wanted it.

There is no better way to find the origin of so striking an improvement in the useful arts, than to ascertain where it was that everybody learned it. When Mr. Bell exhibited his instrument at the Centennial, all the learned men and all the practical men, said, "This is a new and unheard-of thing." They did not say he had got a new way of doing an old thing; they said that the transmission of speech at all by electricity was a novelty. They went further than that. They said, "We know Reis and his publications; we know that the community got no speaking telephone from his work. Now that Mr. Bell has told us the true way, we see why his predecessors failed." This was the verdict of Professor Henry and his fellow judges at the Centennial, of the British Association, the American Academy, the Society of Telegraph Engineers, the French Academy of Sciences, of an assemblage in New York of all the men most prominent in commercial telegraphy and in science. No man denied it until the great commercial success of Mr. Bell's invention aroused infringers to assert in 1881 that publications in which no man up to that time had ever found a speaking telephone, could now be sworn to by experts as containing one.

The Reis Telephone. — Philip Reis, in Germany, attempted about 1855 to make an electric speaking telephone, and in 1861 first exhibited it and described it in print. From 1861 to 1874, he brought it extensively to the notice of scientific men and the public by exhibitions before scientific societies in Germany, and before the British Association in England. It was exhibited to the American Association in 1869 and 1870. In 1863 he advertised his instruments for sale, and, until the present time, they have been on sale by the principal dealers in philosophical apparatus. He manufactured them himself, and others were made from his models by Koenig of Paris, the most famous maker of acoustic apparatus in the world. He lived until November, 1874, but he never deviated from the form he adopted in 1863. He stated in his advertisements that that form satisfied all his expectations, and that with it unskilled persons could repeat all of his experiments. From 1861 until these suits began, the structure and operation of the apparatus were described by Reis, by Koenig and the other makers in their catalogues, by the principal standard writers on electricity and acoustics, and in the scientific and other periodicals. The instruments themselves were found in the cabinets of the Smithsonian and other institutions. His work, therefore, whatever it was, was perfectly well known. The best instrument makers applied their skill to the construction of his machine in accordance with his directions, and eminent scientific men personally experimented with it and published their results. Fifty such publications between 1861 and 1877 are in the record. If the thing was not known as a speaking telephone, it was not because it was not known, but because it was not a speaking telephone.

We assert that it was simply a circuit-breaking contrivance such as we have already described, reproducing the musical pitch of sounds, but not reproducing "quality" or articulation.

The actual standing of the instrument in the hands of the community is conclusive. Reis's own publications and conduct express that standing. In the prospectus furnished with the completed instrument of 1863, and from 1863 until his death in 1874, he advertised it as a contrivance which would reproduce the pitch of sounds made by the voice or any musical instrument, but did not pretend or suggest that the listener could ever recognize words. It was never offered, nor bought, nor attempted to be used by any purchaser as a speaking telephone, but only as a philosophical toy for the reproduction of pitch. This is not controverted. When Bell exhibited his apparatus scientific men hailed it as the first speaking telephone, and contrasted it with the Reis, saying that Reis tried to make a speaking telephone, but only produced a musical telephone or pitch transmitter. Neither Reis's well-known actual work nor the many publications about it ever did in fact give the art of transmitting speech to the community. Reis did not pretend that they would. There can be no higher proof of their insufficiency in fact and in law.

The history as read in the publications themselves by the unscientific reader is equally conclusive. In 1861 Reis made his first public exhibition and lecture. Of this there are two accounts. One, published in the local papers at the time, said, "Up to the present the reproduction of the tones is indeed weak and words cannot be reproduced. We leave here the question as to whether this hereafter will be successfully accomplished."

Some months later Reis wrote out his lecture and published it. He said that he had hoped to transmit speech, but had been disappointed, adding: "Hitherto it has not been possible to reproduce the tones of human speech with a distinctness sufficient for every one. The consonants are for the most part reproduced pretty distinctly, but the vowels are as yet not in an equal degree." That is the strongest statement Reis ever made. Subsequent experience led him in all his later papers to claim for it the transmission of pitch alone.

A writer, during the next year (1862), professing to speak of trials by others heard of at second hand, and not trials by himself, said that "the experimenters could even reproduce words, although indeed only such as had been often heard by them." This is the only intimation anywhere in literature, of the transmission of a single word. It is not legal evidence of any such fact. *Seymour* v. *McCormick*, 19 How. 107. Experimenters with telephones know what tricks imagination plays, and it appears specifically that upon the occasion referred to the circumstances were such that the transmission of words was impossible, for the listeners are shown by the publication itself to have been at such a distance from the instrument that only the loud, inarticulate sounds due to circuit-breaking could be audible.

On the other hand, the apparatus was universally called "The music telegraph"; no other writer out of the fifty, including Reis in his later writings, hints at the transmission of words, while all those who speak from personal experiment say that it was impossible to transmit them. Thus *Mr. Quilling* published in May, 1863, the results of actual experiments by Reis which he had just witnessed, saying: "It was not possible with the present construction of the apparatus to transmit spoken words." *Pisco*, in his standard treatise on "*Acoustic Apparatus*" (Vienna, 1865), says, as the result of a long series of experiments with it, that "the only means for the transmission of speech is the old speaking tube." *Mr. Ladd*, a celebrated instrument maker of London, having experimented with an original Reis instrument, under Reis's special instructions, before the British Association in 1863, reports that it will only transmit "*musical* notes and sounds." *Kuhn*, in *Handbuch der Angewandten Elektricitätslehre* (1865), says that he has experimented with it, but "a reproduction of the words spoken into the telephone with or without variation of pitch was audible at the receiver only in a corresponding noise (*entsprechendes Geräusch*), while a discriminate perception of single vocal sounds, syllables or words could not be had."

An elaborate series of experiments with it were carried on by Reis and Professor Buff of Giessen, in the laboratory of the latter in 1863-4. In September, 1864, Reis exhibited it in that laboratory to the physical section of the German Society of Natural Sciences. His lecture was not published, but was followed on the same afternoon by a lecture by Professor Buff; this was published at once in *Annalen der Chemie und Pharmacie*, 1864-5, iii, *Supplementband*, p. 134. In it Professor Buff says of the Reis:

"The arrangement is such that the skin which vibrates in equal periods with a source of sound acting upon it serves as a means for interrupting the electric current, which, at a distance, circulates around an iron wire, the ends of which are clamped upon a resonating plate. Unfortunately by this otherwise ingenious arrangement, the pitch only of musical tones within several octaves, but not the quality (*Wohllaut*) of the same could so far be transmitted through wire circuits."

All this agrees with the actual history of the instrument in the world. The strongest pretence in favor of Reis is that since these suits were brought some men have been found to testify in them, from a mere memory twenty years old, that they think they heard words at some private experiments which were never published. The worthlessness of such "memories" is shown by the fact that one of the most respectable of those persons—a professor at Heidelburg, says he remembers that at the occasion of the Buff lecture just quoted the audience were aroused to a high pitch of enthusiasm by the transmission of speech which the contemporaneous publication of course disproves. But there is not a pretence that the instrument, widely as it was known, was ever in fact a speaking telephone in the hands of the community.

This was summed up by the court in *Am. Bell T. Co.* v. *Spencer*, 8 Fed. Rep. 509, as follows:- "Reis appears to have been a man of learning and ingenuity. He used a membrane and electrodes for transmitting sounds, and his apparatus was well known to curious inquirers. The regret of all its admirers was that articulate speech could not be sent and received by it. The deficiency was inherent in the principle of the machine. . . . A century of Reis would never have produced a speaking telephone by mere improvement in construction."

The only method and mode of operation disclosed by the Reis publications is simple circuit-breaking, which will transmit pitch, but not quality or articulation.

A scientific examination of the published description shows that the Reis apparatus was not a speaking telephone, because the principle and mode of operation embodied in it are incapable of transmitting speech. Every publication stated that it was simply a circuit-breaker interrupting the current with a frequency corresponding to the pitch of the sound acting upon it. No other kind of operation is anywhere suggested or hinted at. Reis himself stated that such was his idea, such his intention, and such the actual operation of the machine in his hands. In his description of his latest form he said that this was "the principle that guided" him, and that he had carefully "proportioned" the tension of the diaphragm and the weight of the "hopping" piece to that end. Now this proportion is the mechanical element which determines the nature of the operation which will be performed under the influence of any given strength of sound waves. If the membrane is delicate so that it vibrates freely, and the "hopping piece" is light, the latter will be thrown up into the air and thus break the contact and interrupt the current. The contrary qualities will leave the vibrations insufficient to do this and the unbroken but varied current of the microphone will be produced. Indeed, an efficient production of *variations* as well as the prevention of breaks, requires a certain mass in the loose electrode. Now Reis made his membrane of thin sausage skin and gave to his free electrode a weight which represents the inertia resistance of a mass of 10 grains. The modern microphone employs a sheet iron diaphragm and a mass usually of 75 to 100 grains. Reis, moreover, expressly directed that the applied sounds should be "sufficiently strong." This will be more clearly understood when the Reis instruments are described.

The actual proof afforded by the publications (besides the unanimous express statements to that effect) is positive that such was the operation of the instrument in fact. Some experimenters describe the chattering noise of the "hopping" piece caused by alternately parting from and again striking the other electrode at each vibration. Others mention the continual presence of the "circuit-breaking" spark at the place of contact, — a sure proof of interruption of current by break of contact. The descriptions of the experiments say that they were made with the receiver on a table, and that several persons heard it at the same time. Now, a circuit-breaker will readily produce a musical note loud enough for this, but the delicate changes of current which transmit speech are absolutely and physically incapable of yielding any sound which would even be audible from a Reis receiver under such circumstances. Those experimenters who thought that they thus occasionally heard a familiar word are necessarily the victims of their imaginations.

Every expert of our opponents who testified about the Reis was forced to admit, in terms, on cross-examination, that such was the only operation described; and also to confess that it is absolutely impossible to transmit speech by that kind of operation. The reasons for this have been already explained. This fact is of itself fatal, for, as Reis's work was done in Germany, his mere *work* cannot, under our statute, defeat a patent. The Reis defence must rest on the publications, and the moment it is confessed that when following them speech cannot be transmitted, controversy is at an end. And if the Reis apparatus, adapted to readily operate in the way described in the Reis publications, will not, when so operated, transmit speech, it cannot anticipate a patent which describes a mode of operation by which speech can be transmitted, and which is diametrically different from the mode of operation stated by Reis.

Their only ground rests on the assertion that the Reis apparatus can to-day be made to transmit speech if the method of the Bell patent be applied to it. This possibility was never suggested until 1880, when the Bell patent was four years old. If this were true it would only show the perfection and the novelty of Bell's new method or mode of operation, which, when applied, would enable that which never had been a speaking telephone, to at once transmit speech. But it is not true. The Reis *transmitter* can, by great care and practice, be compelled to perform the Bell operation and thereby produce the Bell current to a feeble extent, but the Reis receiver, which is good enough for the coarse changes of his circuit-breaker, is too unsensitive to yield any intelligible results under the influence of such delicate *undulatory* currents as the Reis transmitter can be made to produce. This was the state of proof made by Professor Henry Morton, defendants' expert in *Spencer's* case, and repeated by him as expert for the *Molecular* and *Overland* companies in their cases, now before this court.

In *Dolbear's* case, the next after *Spencer's*, the defendants produced from Germany an exact fac-simile of an original Reis apparatus, and asserted that it would talk. Challenged to repeat their tests in the presence of witnesses, they did so on two successive days, the defendants themselves, by their experts, doing the talking and listening, but with a shorthand writer stationed at both ends. Upon comparing the results, it was found that out of about 1500 words uttered into the transmitter, the listener thought he heard 26, and out of these 26, 18 had not been spoken.

Whenever later experts undertook to say that they could talk with the Reis instrument, we challenged them to repeat their tests in the presence of witnesses, "as was done in Dolbear's case," and every one of them declined the challenge; while Professor Morton, for the defence, had to admit on the witness stand in the *Molecular* and *Overland* cases that after repeated trials, extending over several years, he found himself unable to understand anything with the Reis apparatus as a whole. It is also a fact proved in the case by the defendants' experts on cross-examination that the genuine Reis apparatus at the Smithsonian, when used as a whole, cannot talk. That apparatus was purchased by Professor Henry himself in 1874, shown by him to Mr. Bell in 1875, yet in his Centennial report of 1876 he officially declared Mr. Bell's instrument to be the first speaking telephone ever known,—styling it "the greatest marvel hitherto achieved by the telegraph;" "an invention yet in its infancy."

When any witnesses have testified that they got speech with a Reis instrument, it has been made substantially apparent in one way or another that they did it by altering the apparatus so as to prevent it from performing the Reis circuit-breaking operation, and compel it to perform the Bell current-varying operation. A slight physical change may suffice for that purpose, but any such change, or attempt at it, falsifies the instrument. The fact is that by the aid of knowledge acquired from the Bell patent, the Reis telephone can be made to perform the operation of that patent to some slight theoretical extent. But even then it is so ill adapted to that operation, for which Reis never intended it, and is so well adapted for the circuit-breaking operation for which Reis did invent it, that when the attempt is made to compel it to perform the Bell operation it does it so imperfectly that no intelligible speech results.

[In the course of this argument the various Reis publications were examined in detail and illustrated by some experiments performed in court.]

Reis made three forms of apparatus which he publicly described. The first two (1861 and 1862) were purely experimental and it is not known that more than one of each was constructed.[1] The third, made in 1863, was adopted by him as his final form, put on sale as a pitch transmitter, and continued to be the only form used by him until his death in November, 1874. It is shown in the following view of the whole apparatus (a fac-simile of the cut forming part of the advertisement he published from 1863 until his death). The

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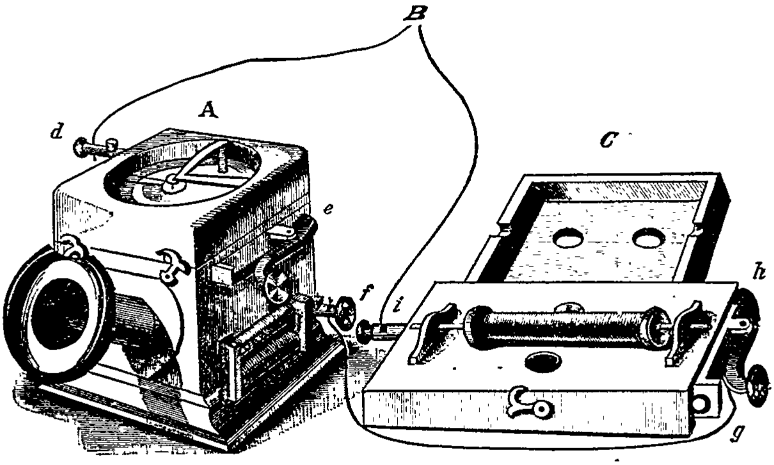
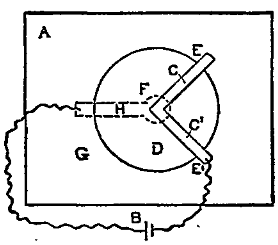
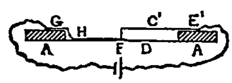
[1] These two forms are shown on pp. 40, 53, *supra*.



outline diagram below shows the working parts of the transmitter.

The transmitter A consists of a hollow box about four inches square and deep. The top or cover is pierced with a round hole over which is stretched a membrane diaphragm about $1\frac{1}{4}$ inches in diameter. To this is cemented a strip of flexible platinum foil (H in the diagram). A piece of brass (*a*, *b*, in the cut; C, C′ in the diagram) shaped like two sides of a right-angled triangle, is provided at the angle and at each extremity with a little leg made of a small pin of platinum, so that it can stand on the three like a tripod. Two of these legs (at *a*, *b*, in the cut; E, E′ in the diagram) rest on the frame of the instrument, while the third, placed at the angle, rests on the spatula-shaped end of the platinum foil, H, at the centre of the diaphragm. The instrument is so connected with





a battery B, that when at rest the current flows to the foil at G, through the foil H, to the platinum leg resting on it at F, through one branch C', of the angle piece to its leg at E, which is connected (usually by standing in a cup of mercury) with a wire leading back to the battery. The receiver (C of the view) is included in this circuit. If the angle piece be lifted from the foil the circuit is interrupted — "broken" — and the current stops.

Sound waves from any source that is vigorous enough enter the hollow box through the tube shown at the side. They throw the diaphragm into vibration, the angular "hopping piece" is thrown into the air, like a boy tossed in a blanket, the electrical connection between it and the foil is broken, and the current is interrupted, to again flow when the hopping piece falls back into place. Thus at each vibration the current is once interrupted. This intermittent current, passing to the receiver, compels it to vibrate once for each interruption, that is, the same number of times per second as the diaphragm of the transmitter. The pitch of the resulting sound is therefore the same as the pitch of the sound which acts on the transmitter.

Reis in his lecture of 1861, speaking of his first form (the bored block, p. 41, *supra*), says "each sound wave causes a breaking and closing of the current" and therefore the receiver "gives a tone whose pitch corresponds to the number of interruptions in a given time." The only description of the next form (Legat article, *Journal of the German-Austrian Telegraph Association*, vol. 9, p. 125, 1862, on p. 33, *supra*) says, "at each condensation of the air in the tube the circuit is opened and at each rarefaction the circuit is closed." In his printed advertisement of his perfected instrument of 1863 (the hollow box form shown in the cut on pp. 60, 290, *supra*), Reis offered it purely as an apparatus for scientific experiment in the reproduction of pitch. He says of it: "I am now able to offer an apparatus which satisfies my expectations and with which every physicist will succeed in repeating these interesting experiments," etc. What that instrument would readily and habitually do in the hands of any user was therefore all that he expected of it or had accomplished with it. Describing the operation he says, "for every full vibration the circuit is once opened and again closed and thereby are produced" in the receiver "just the same number of vibrations."

In a letter sent to Mr. Ladd, July 13, 1863, instructing him how to exhibit to the British Association the telephone Ladd had purchased of Reis a few days before, Reis writes in English (*Journal Soc. Tel. Engrs., March, 1883*):[1] "It was no hard labor, either to imagine that any other membrane beside that of our ear could be brought to make similar oscillations, if spanned[2] in a proper manner or *to make use of these oscillations for the interruption of a galvanic current.* However, these were the principles which guided me in my invention; they were sufficient to induce me to try the reproduction of tones at any distance. It would be long to relate all the fruitless attempts I made, until I found out *the proportion* of the instrument and the necessary tension of the membrane. The apparatus you bought is now what may be found most simple and works without failing when arranged carefully in the following manner.

"The apparatus consists of two separate parts, one for the singing station A, and the other for the hearing station B."

"If a person sings at the station A, in the tube *x*, the vibrations of air will pass into the box and move the membrane above, thereby the platinum foot C of the movable angle will be lifted up, and will open the stream [of electricity] at every condensation of air in the box. The stream will be reëstablished at every rarefaction. In this manner the steel axis at station B will be magnetic once for every full vibration," etc.

So, according to his own statement, "the *principles* which guided me in my invention" were "the interruption of the current" by throwing up the hopping piece so that it parted contact. Observers published that they noticed the chattering noise made by these blows and the "circuit-breaking-spark" which resulted.

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[1] This letter and Reis's sketch are on page 56, *supra*.

[2] Stretched.

Reis so constructed his machine as to insure this circuit-breaking operation. We have already pointed out (p. 286, *supra*) that whether the circuit-breaking operation or the new variable-pressure microphonic operation is performed depends upon the relation between the force of the sounds applied, the delicacy of the diaphragm and consequent freedom and violence of its vibrations produced by those sounds, and the lightness of the hopping-piece. Now Reis employed a diaphragm of thin sausage skin, says that the tension he gave even to this delicate membrane, and the proportions he gave to the parts, were essential, and expressly directs in his published directions for use that the actuating sounds are to be "sufficiently strong." These directions, contained in papers which state the circuit-breaking operation and none other, are statements that the structure is to be such as will insure that operation; and when these directions are followed, that operation invariably results. The modern microphone, on the other hand, restricts the range of vibration of the diaphragm by making it of sheet iron, or wood, or cork, and sometimes by dampening springs and other devices; increases the weight of the free electrode so that, instead of a weight of 18 grains distributed in such manner as to give an inertia resistance of 10 grains, which Reis had, an inertia resistance of 75 to 150 grains is now employed; while the voice is generally applied at four or five inches from the diaphragm.

As the operation depends upon a due "proportion" between the mass and the force acting upon it, some experts for the infringers, departing from the "proportion" "determined" by Reis, to make it break "without failing," have so altered the proportions that it will not break and will thus serve as a microphone. They have thus altered the proportions between the forces and the resistances, in order to introduce new relations of the parts when in action, to thereby set up a new mode of operation, and by it produce a new result. No ingenuity of experts can state the case otherwise.

In *Neilson* v. *Betts*, L. R. 5 H. L. 1, 15; *S. C.* Goodeves's Pat. Cas. 56; Lord Westbury said: "I must say that when we come to examine the scientific evidence I think I never met with a case where I was more pained to observe the manner in which the efforts of the men examined had all been directed, after their minds were fully informed of Betts's invention, to endeavor to strain the description of Dobbs, so as to include in the application made of Dobbs's design and Dobbs's processes, something which should approximate to the invention of Betts."

In *McCormick* v. *Talcott*, 20 How. 403, 409, this court spoke of such depositions as "the opinions (the reveries they may often be called) of a class of men styled experts; men as often skilful and effective in producing obscurity and error as in the elucidation of truth."

Such depositions will not overthrow the consensus of the scientific world and the verdict of history.

Consensus of the scientific world that Reis did not anticipate Bell. The moment Mr. Bell's invention became known, it was contrasted with the well-known Reis telephone, and all the learned societies agreed that Mr. Bell had introduced an entirely new mode of operation, and thereby accomplished a new result.

Professor Henry, in 1875, with a Reis instrument actually before him, praised Mr. Bell for his untried undulatory-current idea as *the first clue* to the transmission of speech, and in his Centennial report declared the transmission of speech at all to be an absolute novelty.

In 1877, Professor Barnard, President of Columbia College, and other scientific men, declared at a public meeting that the name of Mr. Bell would be handed down to posterity as that of "the inventor of the telephone"; and all the experts for the defence admit that, until they were employed by the infringers, they believed Bell to be the first inventor of the transmission of speech. Dolbear himself, in his published book on the telephone, says that Bell's "was the first speaking telephone that was ever constructed."

In 1877, Mr. Preece, the electrician at the head of the English Postal Telegraph, explained the telephone to the British Association. He asserted, and that body agreed with him, that the Reis machine was a mere musical telephone, and the report adds, "the interest in the subject culminated on the arrival of Professor Graham Bell, the inventor of the talking telegraph."

On October 31, 1877, the English Society of Telegraph Engineers, the most eminent electrical society in the world, held a special meeting "to welcome Mr. Bell to England," and to hear from Mr. Bell his account of what its president styled "one of the most interesting discoveries of our age." Mr. Latimer Clark, an eminent electrician, offered the vote of thanks to Mr. Bell, saying, "There has never been a subject brought before us since my connection with this society, and that is from its beginning, so interesting or so important as the one we have heard this evening, or one which will form a greater epoch in the history of electricity."

When the microphone was offered to the English public by Professor Hughes, in 1878, he, in his communication read by Professor Huxley before the Royal Society, and the other gentlemen who described it, declared that Reis merely produced music, but that Bell, by the correspondence of form which he introduced into the current, "reproduced all the delicacies of the human voice."

The French Academy of Sciences publicly expressed the same views, and on their recommendation Mr. Bell received the great Volta prize.

The Government of Reis's own country, Germany, indeed refused Mr. Bell a patent, as their patent law required, because he had himself published his own invention before he filed an application. But through its patent office it has declared, after two years' study, that the Reis was a mere circuit-breaker, and not a speaking microphone. It did this in terms in the patent granted in Germany to Lüdtge for a microphone, on an application filed January 12, 1878. It has since sustained that patent on the ground that the speaking microphone (which the Reis was, if it was a speaking telephone at all) had never been described in Germany before that application.

Finally, in the summer of 1886, at its 500th anniversary, the University of Heidelberg gave Mr. Bell a degree for inventing the speaking telephone.[1]

The courts treat such recognition as the highest proof that the invention was before unknown. *Tilghman* v. *Proctor*, 102 U. S. 707, 717.

Some authorities as to the effect of prior publications are: *Seymour* v. *Osborne*, 11 Wall. 516; *Cohn* v. *Corset Co.*, 93 U. S. 366; *Cahill* v. *Brown*, 15 O. G. 697 (Clifford J.); *Atlantic Giant Powder Co.* v. *Parker*, 16 O. G. 495 (Blatchford, J.); *Betts* v. *Menzies*, 10 H. L. Cas. 154; *Neilson* v. *Betts*, *L. R.* 5 H. L. 15.

Mr. Bell's history. — His father's profession (vocal physiology) for which he was fitting himself, led him from boyhood to study with peculiar care the nature of articulating sonorous vibrations. The effort to construct for himself Helmholtz's electrical vowel apparatus induced him to devote attention to electricity, and he made some important inventions in a new form of multiple harmonic or musical telegraph. In 1874, he thought out theoretically the speaking telephone in the form of Fig. 7 of his patent, such as has been described. It seemed to him, however, considering the feeble electrical forces due to currents generated solely by the action of the voice on that instrument, and comparing them with the forces needed to operate the most delicate instruments theretofore known, that

[1] Our opponents have attempted to argue that this University so honored Mr. Bell, not because he was the first inventor of the speaking telephone, but merely because he made a particular form of apparatus — the magneto transmitter. But, on their own showing, such action would have been an empty frivolity. They themselves aver that the magneto telephone is a practically worthless contrivance; and although this is not true, it is nevertheless a fact that the microphone has supplanted it in commercial use; and their claim is that Reis invented the microphone long before Mr. Bell was heard of. The construction of an inferior form of an existing instrument would not make Mr. Bell illustrious, nor lead that great University to send its degree, *honoris causa*, across the water. Nor could one describe the magneto telephone as an instrument which day by day ministered more to the convenience of men. Yet the language which their degree applied to Mr. Bell is, "*qui ut apparatu telephonico ingeniose invento societati humanæ magna negotiorum peragendorum emolumenta largitus est atque in dies crescentia,*" etc.

the electrical operation and consequent results at the receiving end, though necessarily perfect in kind, would be too feeble to be of practical utility. But the idea had taken firm possession of his mind. In March, 1875, he saw Professor Henry at Washington, and explained his views to him. He wrote to his father and mother a few days afterwards, describing that interview, saying (the capitals and italics are in the original):

"I felt so much encouraged by his interest, that I determined to ask his advice about the apparatus I have designed for the transmission of the human voice by telegraph. I explained the idea, and said, 'What would you advise me to do; publish it and let others work it out, or attempt to solve the problem myself?' He said he thought it was the germ of a great invention, and advised me to work at it myself, instead of publishing. I said that I recognized the fact that there were mechanical difficulties in the way that rendered the plan impracticable at the present time. I added that I felt that I had not the electrical knowledge necessary to overcome the difficulties. His laconic answer was, 'GET IT.'

"I cannot tell you how much those two words have encouraged me. I live too much in an atmosphere of discouragement for scientific pursuits. Good . . . is unfortunately one of the *cui bono* people, and is too much in the habit of looking at the dark side of things. Such a chimerical idea as telegraphing *vocal sounds* would indeed, to *most minds*, seem scarcely feasible enough to spend time in working over. I believe, however, that it is feasible, and that I have got the clue to the solution of the problem."

It further appeared that at that very interview Professor Henry showed him a Reis telephone, bought the year before in Paris. He had the clue, and left Professor Henry's room with a confirmed certainty that he was not fighting against a law of nature, and therefore that success was only difficult, and not impossible. Within a year from that time his patent had issued, and presently Henry, who had approved his conception, publicly proclaimed his success. Since in so short a time he went so far, it is impossible to criticise his methods of work or to accuse him of want of diligence.

In performing, on June 2, 1875, an experiment with a new form of multiple musical telegraph which employed two reeds or springs vibrated in front of an electro-magnet, like Fig. 5 and Fig. 6 of his patent, one of the springs was accidentally knocked, and thus set in vibration.[1] He found that this slight vibration produced a sound from the spring of another instrument connected in electrical circuit. With another man the trivial accident might have passed unnoticed. But he instantly joined it with his older thoughts. The marriage was fruitful and the speaking telephone was born. It thenceforth needed only nurture. It at once struck him that if he was right in his observation of this accident, then the feeble vibrations of a spring in front of an electro-magnet had developed sufficient electric currents to produce audible sonorous effects at a distance. He repeated the experiment for an hour or two, and sanguinely satisfied that his former fears about the feebleness of the currents were ill founded, he instantly gave orders for the construction of a speaking telephone with a membrane diaphragm, such as he had conceived and described eight months before to his friend Professor C. J. Blake, of Boston, and to others, two of whom have testified to his description. The instruments were ill-made, and broke to pieces at the first trial. He repaired them and tried them again.[2] His success was indifferent. It is not certain whether a single word was intelligibly understood. Nevertheless, his study of the subject and his experiment proved absolutely that the most he had to contend with was a question of workmanship or technical mechanical skill and nicety in the construction of precisely such a form of apparatus as he had made; and it has so turned out.

He was in great trouble financially, and in some other ways. He pawned his watch and borrowed of his friends, and for a time was heart-broken for other reasons. He was in no condition to go into elaborate experimenting, but he crystallized his ideas into a letter which he wrote August 14, 1875 (presently to be quoted), and in which he stated his pur-

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[1] The instrument is shown on p. 305, *infra*.

[2] The instruments are shown on p. 321, *infra*.

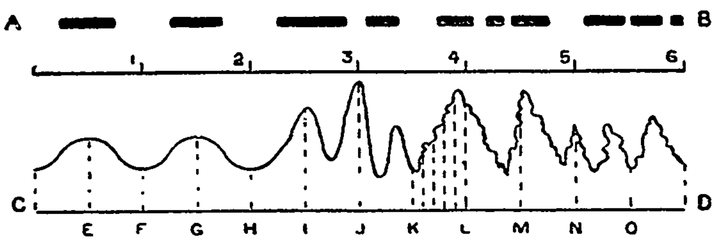
pose as *the transmission of speech*, and also the transmission of many telegraphic messages simultaneously over a single wire, described his "method" of electrical undulaticns similar to sound waves, and all the results that would flow from their employment, and debated with his correspondent whether he should file a caveat or take a patent. More mature reflection determined him to the latter course. He drew the specification and claims, every word of which, as they stand in the patent, are his work, and the patent issued.

I will assume that the pair of instruments he had made never yielded an intelligible word, but still the question of the validity of the patent does not depend upon previous experiments, but upon the sufficiency of the description. If the instruments of the patent will talk, will transmit vocal and other sounds so that the listener can know them apart, know each for what it is, doing all this *in the mode pointed out*, the patent is good; if they will not, then it is not good. Mr. Bell was so thoroughly convinced that he was right, that he determined to run the risk, and did. If he had died the moment after he wrote the specification (he wrote it all himself), without ever trying the experiment again, and that specification had gone to the world as a publication, the world would have had a speaking telephone. It would have had a rule by which to make all speaking telephones. No one after such a publication could ever have taken a patent as first inventor of the speaking telephone.

[Counsel then examined in detail the Bell telephone and the Reis telephone, and compared them, and performed some experiments in the presence of the court.]

The Bell patent No. 174,465, March 7, 1876. Its meaning and construction. — The signification of the technical phrases used must be understood. An "intermittent current" cannot, properly speaking, exist, but a current can flow for an instant and then be interrupted and cease for an instant, and a succession of such instants of current and no current is called for convenience an "intermittent" current. There is also no such thing in nature or art as an "undulatory" current, literally so called; but a current may be at this moment of one strength, and the next moment of a different strength; and if those successive strengths at successive instants bear to each other the relation which is expressed by a curve known as an undulatory curve, then for convenience the current is spoken of as an "undulatory" current. That does not mean that the current has waves on it like the waves of the sea; it means that at one instant it has one strength, and at a succeeding instant another strength, and that the relation of its strength at one instant and its strength at another, is expressed by a curve of an "undulatory" character, as indicated by the diagram on p. 301, *infra.* This phrase is borrowed from the language of acoustics. Physical vibrations which take place in the air, or in any mechanical medium transmitting sound, have many differences, but they all have in common one peculiarity which comes from the nature of the physical medium in which they take place. Every medium which transmits sonorous vibratory physical motions possesses both elasticity and inertia, and the peculiarities which the elasticity and inertness of a medium impress upon vibrations which take place within it consist in a certain gradualness, as distinguished from abruptness, of change. Although many of these changes, when exhibited by curves, sometimes seem extremely abrupt and sharp, yet, from their essential nature they are known as gradual, undulatory, or wave-like; or more specifically, to use a still more technical term, "sinusoidal" — the mathematical name of the curve which, either simple or in various combinations, expresses the free vibratory movements of elastic and inert bodies, and therefore all sonorous vibrations. An air vibration may be simple, such as is produced by a tuning fork; it may be extremely complex, such as is produced by the human voice or the violin. But whether simple or complex, the nature of the medium in which it takes place makes the mathematical statement of the character of the vibration necessarily capable of representation either by a simple sinusoidal curve, or by a line which though curiously curved, and apparently ragged, is nevertheless made up of certain combinations of simple sinusoidal curves.

All changes, whether in vibrations of the air, or fluctuations in the height of the barometer or thermometer, or of the tides, at successive hours, or in the strength of an electric current at successive instants, are often represented to the eye by such curves, which are used as a graphic shorthand representation of ideas and relations which would otherwise be expressed by pages of words. In Mr. Bell's patent they are so represented. The intermittent current is conventionally represented by a series of blocks, as A B in the upper line of this cut:



This does not mean that there are on the line at any one instant a succession of spurts of electricity — electricity at some parts of the line and not at others. It means that for a period of time represented by the length of one block, there is, all over the line, a current whose strength is represented by the height of the block; and that after that, for a period of time represented by the blank space, there is no current at all anywhere. That phenomenon is called an intermittent current.

If, now, the current varies, so that at one instant it is of a strength represented by the height of the line E, in the lower diagram C D, and at the next instant by a strength represented by the length of the perpendicular line F, and so on, and the variations of strength, or the curve which represents those variations by joining the tops of those lines, are "undulatory" in their character, then we speak of that current as undulatory, because of that variation in its strength at successive instants. Those are the symbols that are used in the patent.

Any succession of strengths of current can obviously be represented by drawing perpendicular lines of relative lengths, E, F, G, etc., representing the relative strengths at successive instants. Joining the upper ends of those perpendiculars, when they are taken very close, as between K L, gives a curved line whose contour represents, to the trained eye, the succession of lengths or strengths. From this graphic mode of expressing the facts arises the phrase "form" of current variations, or in abbreviation, "form of current," signifying the current whose changes are represented by a curve of a particular form.

An amendment to the application originally filed in the Patent Office was made by the usual correspondence; but it was merely explanatory and surplusage. It is entirely immaterial. That I may be free from criticism on that point, I shall read only those parts of the specification which stand in the patent itself exactly as they stood in the application originally filed; and my case may stand on that.

Mr. Bell, for some years before he took this patent, had been at work on a multiple telegraph which operated by the production of sounds of certain musical pitches, produced by circuit-breaking and by intermittent currents. They were like the circuit-breaking and intermittent currents of Reis, and they produced musical pitch just as the Reis did, although Mr. Bell worked his machine by mechanism, and not by the voice. His present patent, the contents of which are a picture of several years of his work and of the growth of the ideas in his mind during that time, begins by referring to his former circuit-breaking multiple telegraph, and states that he proposes to discard the instruments previously used in it in favor of a new kind. He says that he finds some advantages in the use of a current which is not chopped up into chunks, but varies its strength in accordance with the law of sound waves,— that is, a current which is not "intermittent," but is "undulatory,"—and he proceeds to state some advantages from the one kind of current rather than the other.

It is true that every sonorous movement of the air is "undulatory"; but it is not every sonorous movement of the air which gives rise to speech. That comes only when the undulations are of the peculiar kind or "form" belonging to the spoken word. Speech is not the necessary result even of aerial undulations, and it would have been untrue to say that speech would be one of the results of an undulatory current. Therefore Mr. Bell, in speaking in general terms of the advantages which flow from the use of a current, undulatory as distinguished from intermittent, in its character, but irrespective of the *form* of the undulations, named certain advantages and did not include speech among them, because the statement would have been untrue if he had included it. His multiple harmonic musical telegraph, Fig. 5 of this very patent, is worked by currents which are "undulatory," but which are not of the "form" requisite for speech, and which therefore do not yield speech. This same statement which I am making is found in substance in the letter written by Mr. Bell to Mr. Hubbard, August 14, 1875, six months before he filed his application. He says that the advantage of the undulatory current is that by its employment, whatever sonorous effects can be produced in the air can be produced by electricity. Musical sounds can be transmitted; many musical sounds at the same time can be transmitted; and *by giving the undulations the proper form*, speech, and indeed the utterances of several speakers at the same time, can be transmitted. He wrote in that letter (the *italics* are in the original):

"I can see clearly that the magneto electric current will not only permit of the actual copying of *spoken utterances*, but of the simultaneous transmission of *any* number of musical notes (hence messages) without confusion. . . .

"When we can create a pulsatory action of the current, which is the *exact equivalent* of the aerial impulses, we shall certainly obtain exactly similar results. *Any number of sounds* can travel through the air without confusion, and any number should pass along the same wire.

"It should even be possible for a number of spoken messages to traverse the same circuit simultaneously, for an attentive ear can distinguish one voice from another, although a number are speaking together."

If two tuning-forks of different pitches are sounding separately, we are affected by the sensation of sound, but what we perceive is not one sound, the mean of the two pitches; we hear each sound separately. The vibrations made by one fork, and the vibrations made by the other, different as they are, travel through the same air. In a mechanical sense, they coalesce and combine into one complex vibration, yet the ear unconsciously analyzes them out again as separate sounds. This which can be done in the air, Mr. Bell says, can be done by his undulatory current in electricity; and that is true. But he can do more than just that. As the voice in uttering a word produces a peculiar "form" of undulation, which gives rise to the sensation of that word *as one sound*, — no matter though it be in itself capable of scientific analysis into a principal and subordinate set of vibrations, expressed technically by the phrases "fundamental" tone and "overtones," combined and blended together, — so an undulatory current whose undulations are due to the voice, and are copies of its aerial impulses, can convey the complex undulations of a particular spoken word and yield the same result at the distant end. The conception which possessed Mr. Bell at that time was of electrical variations of current which were to be just like the sound waves, and which therefore could serve *all* of the same purposes. They were to transmit many messages by many pitches; spoken utterances; many spoken utterances, simultaneously; according to their combinations and forms. He was possessed with the idea of moulding or forming the current so that it should be like sound vibrations generally, and also in a given case like any particular sound vibrations that he wished to reproduce by it. That is the substance of his patent. That is the cardinal key and idea of his whole patent. It was an idea wholly novel in science and the arts.

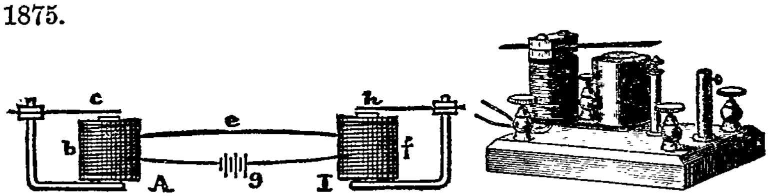
He illustrates his plan first by describing what takes place when the old "intermittent" current is used. Then he refers to what takes place when any *simple* undulatory current is used, and says that he cannot describe it better than by showing its likeness to sonorous vibrations in the air. Then he points out what happens when two independently created sets of simple electrical undulations are thrown upon the line wire at the same time, and points out that their effect in the total electrical current, and in the resulting sounds, is just like the effect produced by tuning-forks sounding simultaneously. The patent expresses this as follows:

"The combined effect of A and B, when induced simultaneously on the same circuit, is expressed by the curve A + B, Fig. 4, which is the algebraical sum of the sinusoidal curves A and B. This curve A + B also indicates the actual motion of the air when the two musical notes considered are sounded simultaneously. Thus, when electrical undulations of different rates are simultaneously induced in the same circuit, an effect is produced exactly analogous to that occasioned in the air by the vibration of the inducing bodies. Hence, the coëxistence upon a telegraphic circuit of electrical vibrations of different pitch is manifested, not by the obliteration of the vibratory character of the current, but by peculiarities in the shapes of the electrical undulations, or, in other words, by peculiarities in the shapes of the curves which represent those undulations."

These are his leading ideas. Now he proceeds to apply them. He says in the patent:

"In illustration of the method of creating electrical undulations, I shall show and describe one form of apparatus for producing the effect."

He then describes his *harmonic telegraph*, Fig. 5, consisting of the instruments here shown. The diagram is from the patent and shows the connection of the two in circuit. The perspective view is from one of the actual harmonic instruments he was using when he made the discovery of June 2, 1875.



When the armature *c*, which is a steel spring, vibrates, it produces in the air a simple undulation of a definite rate, and by the generation of magneto electric currents, as explained on pp. 265–9, *supra*, it produces on the wire a simple electrical undulation of the same rate; that, passing through the wire *e* to the receiving instrument, and operating on its electro-magnet, there causes its attuned reed *h* (the two instruments are just alike) to perform the same simple vibratory movement, and the same simple sound is heard. The patent describes how several sets of these can be connected with the same wire (as in Fig. 6 of the patent, p. 5, *supra*), and several notes produced at the same time from several different attuned reeds of several receivers, just as in the case of two tuning-forks in the air. It then shows that if you break up each set of notes into longs and shorts, you can telegraph the Morse alphabet by each set, and thus send two or more Morse messages at the same time over the single wire. The patent concludes the description just stated by saying:

"The duration of the sound may be used to indicate the dot or dash of the Morse alphabet, and thus a telegraphic despatch may be indicated by alternately interrupting and renewing the sound.

"Hence, by these instruments two or more telegraphic signals or messages may be sent simultaneously over the same circuit without interfering with one another."

The patent has now described the *multiple telegraph*, and it makes no further reference to that in the rest of the specification. It next advances one step further. It states that these electrical undulations, generically like sound waves, and available for pure musical tones when they are of the simplest form, can be used for other special results, and for special sounds, when they copy special sound waves:

"I desire here to remark that there are many *other* uses to which these instruments may be put, such as *the simultaneous transmission of musical notes, differing in loudness*, as well as in pitch, and *the telegraphic transmission of noises or sounds of any kind.*"

He then proceeds to describe Fig. 7 (cut on p. 309, *infra*), a different instrument from Fig. 5, and intended for this latter and different purpose. Some of the experts for the defence have said that they find first in this patent a multiple telegraph, Fig. 5, which is true. Then they say that because Fig. 5 is a multiple telegraph, they have a right to assume that

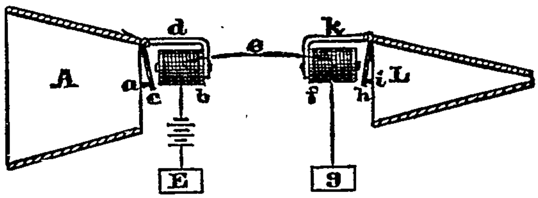
Fig. 7 is also. But the language of the patent itself is explicit. Having described the multiple telegraph, Fig. 5, it passes from that subject entirely, and then, going to Fig. 7, it says that that is intended for "other" uses, to wit, not merely the transmission and reproduction of pitch; not merely the reproduction of differences of loudness, as well as of pitch; that is, not merely the reproduction of musical tones, differing both in loudness and pitch, but "the telegraphic transmission of noises and sounds of any kind." This language is expressly used to distinguish the transmission of the characteristic called pitch, and the transmission of the characteristic called loudness, from the third thing which goes beyond all that,—the transmission of "noises or sounds of *any* kind;" which means their transmission in such a way that they can be distinguished from each other by that which distinguishes one *kind* of sound from another kind, and which, moreover, is something in addition to mere pitch or mere loudness. That is, he expressly contrasts the transmission of noises and sounds of *all* kinds, with the transmission of musical notes, and mentions it as something going beyond the transmission of musical notes.

This is again made clear by his description of the apparatus, for that shows new features introduced into Fig. 7 to fit it for new functions, leading to a new kind of result. First he describes the tuned-reed instrument, Fig. 5, to be vibrated mechanically; that necessarily causes its own pitch to be reproduced. That is the transmission of pitch simply. Then he says that that instrument, used differently, will also transmit loudness. In the particular case where you control the violence of the vibration of the transmitter reed, you will control the loudness of the sound at the further end. The patent states this as follows:

"When the armature *c* Fig. 5, is set in vibration, the armature *h* responds not only in pitch, but in loudness. . . .

"When *c* vibrates forcibly, the amplitude of the vibration of *h* is considerably increased, and the resulting sound becomes louder. So, if A and B, Fig. 6, are sounded simultaneously (A loudly and B softly), the instruments A^1 and A^2 repeat loudly the signals of A, and B^1 B^2 repeat softly those of B."

He has thus described how to produce a sound of the desired pitch. Next he has described how to control loudness. Finally we come to the third purpose stated, to wit, the transmission of "noises and sounds of any kind." Fig. 5 cannot do that, or at least not normally or effectively. The vibrating parts are tuned reeds, or tuning-forks, and the very essence of such an instrument is that it can be relied upon always to vibrate in its own way, and will not vibrate in any other. It therefore cannot copy "*any*" kind of vibrations, which must be done in order to produce "*any*" kind of sound. To accomplish that, the strong will of the instrument must be overcome, and it must be made subservient to the will of the operator, or rather to whatever may be at the moment the movement of the air particles set in vibration by his voice or by any other kind of sound to be transmitted. To accomplish this, Mr. Bell says that instead of having a *spring* armature (*c*) which can vibrate only in one way, he will cut the spring (he describes it as a clock spring which is a thin and light piece of metal), and put a hinge in its place and attach the whole to the diaphragm of a lover's telephone, which we know can vibrate in any way, in response to any kind of sound. He will then have got the mechanical conditions essential for the reproduction of "any kind" of sound. The patent then explains that when the transmitter of an apparatus of this sort is thrown into vibration by the sound waves — sound waves produced by the utterances of the human voice are the particular kind mentioned — it will produce electrical undulations on the line; and the electrical changes produced will not only be "undulatory," but they will be of *the peculiar kind of undulations belonging to the sound uttered.* Or, to state it in the then known language of acoustics, they will be "similar in form" to the air vibrations caused by the sound. These electrical undulations go over the line, and when they reach the receiver they, by reason of their peculiarity of form, influence the armature of the receiver to copy the motion of the transmitter in the manner stated on pp. 267–270, *supra;* and the result, he says, is that a similar sound to that uttered into the transmitter is then heard to proceed from the receiver. The paragraph is:



"The armature *c*, Fig. 7, is fastened loosely by one extremity to the uncovered leg *d* of the electro-magnet *b*, and its other extremity is attached to the centre of the stretched membrane *a*. A cone A is used to converge sound vibrations upon the membrane. When a sound is uttered into the cone, the membrane *a* is set in vibration, the armature *c* is forced to partake of the motion, and thus electrical undulations are created upon the circuit E *b e f g*. *These undulations are similar in form to the air vibrations caused by the sound;* that is, they are represented graphically by similar curves. The undulatory current passing through the electro-magnet *f* influences its armature *h* to copy the motion of the armature *c*. A similar sound to that uttered into A is then heard to proceed from L."

This apparatus produces this result by the employment of electrical changes which are undulatory in their character; but it produces it, not simply because they are undulatory in their character, but because they are of the precise "form" of undulation which belongs to the sounds uttered into the transmitter. That "similarity of *form*" is essential to the result, and as it is the most striking novelty, he thus summed up the whole invention in his claim:

"5. The method of and apparatus for transmitting vocal or other sounds telegraphically as herein described, by causing *electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds*, substantially as set forth."

"We cannot find that in any publication before Mr. Bell's time," say even all the defendants' experts. "So marvellously simple that the only wonder is that it was not known before," says Professor Barker. "I cannot transmit speech without that," says Professor Dolbear and his experts. That is the novelty. It is not only *a* novelty which distinguishes Mr. Bell's apparatus from what preceded him, but it is *the* novelty which makes it to be a speaking telephone. It is the very gist and soul of this invention.

The defendants' expert Professor George Barker, who witnessed Bell's exhibition at the Centennial, testified on cross-examination:

"I was greatly astonished and delighted to hear for the first time the transmission of articulate speech electrically. . . .

"I cannot speak of the others present. Perhaps very naturally their interest in the remarkable result that they had just witnessed led them to question Mr. Bell in regard to the theory of the telephone. As for myself, the mode of operation of the instrument was obvious at once as soon as it was exhibited; it was one of those marvellously simple inventions that causes one to wonder, on seeing it for the first time, that it had not been invented long before."

And yet the defendants want this court to believe that the result was old, instruments for producing it were well known, and that the operation stated is so purely imaginative that it is not statable and ought not to be accepted or believed.

The experts undertake to say that they would like to have the court believe that this patent is *only* for a telegraph, because the claim itself says "transmit vocal sounds telegraphically" which *ex vi termini*, they say, means by a Morse telegraph. Even their verbal criticism is absurd. The record contains many cases of the use of the phrases "telegraphic transmission of sounds"—and "vocal sounds," as applied to the speaking telephone by men of authority as writers. It appears from Mr. Bell's own letters before the patent, that "the transmission of vocal sounds" was the phrase which he generally used to express the transmission of speech. Sir William Thomson's formal report on Bell's speaking telephone at the Centennial, and Professor Henry's official report, both spoke of it as a form of "telegraph." They say that the transmission of speech by it was "the greatest marvel achieved by the electric *telegraph*." President Barnard, of Columbia College, one of the Centennial judges, wrote of it as "your plan of telegraphing vocal sounds." The old string instrument does nothing but transmit speech, and yet it is called the "lover's *telegraph*." The patent is in terms for the transmission of "noises or sounds of *any* kind," and the particular kind which is mentioned in illustration are the utterances of the human voice. The operation described will transmit noises or sounds of any kind, including speech (not speech exclusively) because, by natural laws, the apparatus, if sufficient for "any kind" of sound — the language of the patent — will transmit all; and a statement that it transmits "speech" would be less comprehensive and less true. Every court has so decided.

Yet some of the experts have labored to make the court believe that under that language he meant to include not "other" uses than the multiple telegraph, nor utterances of the human voice as everybody understands them, but a contrivance for multiple telegraphy alone, excluding those utterances of the human voice which distinguish articulate speaking man from the gibbering brute. But even the Gray caveat, which is set up as a model, uses the same language — "transmitting vocal sounds." It adds the clause, "It is obvious by this means that oral conversation can be transmitted." It *is* obvious, and no man could become the inventor of the art of transmitting speech, or ever even an improver in that art, by reprinting Mr. Bell's specification and adding this "obvious" conclusion in terms.

One of the defendants' experts (Dr. Channing), having first said that he could not find better language than the fifth claim of the Bell patent to express the operation by which the telephone transmits speech, afterwards criticised it, but finally had to say again, after eight years' study of the telephone, "No better form of expression occurs to me at this moment as a general statement."

The fifth claim is the only one sued on, but the third and fourth help to show its meaning and scope. Claim 3 is for producing the undulations by the magneto mode; claim 4 is for producing them by the variable-resistance mode. But claim 5 is not a claim for producing them by any particular mode. It is, as the Molecular brief well says, "for transmitting speech by means of them" when they are of the particular form specified. Claims 3 and 4 are for producing them in the machine, as means to be there used; but claim 5 is for transmitting speech *by* this means. They are the means, the novel means, and the effective means.

To this claim our opponents object that it specifies a mere conception — a law of nature — a mere idea. But that idea was the idea which gave birth to the speaking telephone. There were no speaking telephones before, because the world did not have that idea. Every speaking telephone since then has been the embodiment of that idea.

Watt's invention of the steam engine, or rather Watt's improvement in the steam engine, consisted simply in telling the public that instead of squirting cold water into the cylinder to condense the steam, they should let the steam escape into a separate box and squirt the water into that. "Because," said he, "squirting cold water into the steam cylinder cools it down, and when you next let the steam in you use a great deal of steam in simply heating the cylinder up again. So, have one hot chamber for a working chamber, and keep that hot, and let the steam escape into a cold chamber when you want to condense it, and keep that chamber cold." His patent had no drawings, and so far as this invention was concerned gave only the rudest description of an apparatus, which was found so imperfect in practice that it was of very little use. But, with the idea once stated, a good engineer could make a working machine. The infringers answered to his patent, "This is perfectly obvious; you have only stated an idea — a mere law of nature." But the judges said, in substance, "This man has created the steam engine that everybody wants, and the statement that he has made was all that was needed to enable people to make this engine. He has not only made his own very wretched form of engine," — indeed, he never made a working engine before he took his patent, — "but he has given the rule for future steam engines. If such an improvement cannot be encouraged by the protection of the Patent Law, then there is no Patent Law." And so every form of engine which embodied that idea was held to infringe.

Fifty years ago appeared another great invention — the Neilson hot blast. To smelt a ton of ore in a blast furnace requires about two tons of air to be blown in. It requires more fuel to heat that air than to heat the ore; and blowing in that vast amount of cold air cools the furnace and leads to very great difficulties. Neilson said, "Why don't you blow the air in hot?" That was the invention — that was the whole of it. Of course he had got to do a little more; he had got to tell them how to heat the air. "Why," said he, "build a fire around the pipe between the blowing engine and the furnace. Indeed, enlarge the pipe over that fire into a large receptacle, in proportion to the amount of air you want to get through; then the air will stay there longer and get hotter." That was the whole patent. No man who knew that the vapor from a still is condensed by pouring cold water on the pipe, or had seen the surface condenser of Watt's engine, would pretend that Neilson's contrivance as a mere machine for changing the temperature of the inclosed gas had invention enough to sustain a patent. Blowing a hot blast into a smelting furnace was his real invention. "A law of nature," everybody said. All the old women in England heat their teapots, so as not to cool the water when they pour it in to steep the tea. "As for your machine," said the iron makers, "a large receptacle to pass the air through is practically worthless. We shall build a fire around the pipe itself without any receptacle, letting the pipe take a good many turns backward and forward in the fireplace like the worm of an old still." "But," the court said, "you avail yourself of that idea which Neilson first introduced into the arts. His form was operative enough to sustain his patent, and you adopt yours not because it does not heat the blast, but because it heats it hotter." Their form was a great deal better than his. That is always the case with great originators. The next man who comes along and uses the brains of the first as a stepping stone will go far beyond him. The first Watt steam engine, the first Neilson hot blast contrivance, the first Morse telegraph, the first Howe sewing-machine, the first Bessemer plant, were not worth having in a commercial sense; indeed, all the users of the first Bessemer plant threw it away, because they could not make it work successfully. But the great inventor opened the door. All that the others had to do was to enter the new house and make it more comfortable.

Infringement. — It has been apparent that if the Bell patent be limited to the particular form of Fig. 7, and to the use of its method *only when practised with a magneto transmitter*, no defendant infringes the first patent for all use microphone transmitters. But if it has the scope we have asserted for it, the defendants cannot successfully deny infringement.

To this Dolbear's form of apparatus is no exception. He uses a microphone transmitter and a "condenser" receiver. He and his experts agree that his transmitter produces the undulations of the patent, and that it cannot transmit speech unless it does. They say in terms that so far as the *transmitter* goes their apparatus is, Bell's Fig. 7. But they insist that the difference in the receiver, and the changes of arrangement incident to that difference, relieve them.

Electricity has two long-known properties. When it flows *around* a piece of iron it makes that piece attract a plate in proportion to the amount flowing at each instant. When it flows *into* a piece of iron, it makes that piece attract a plate in proportion to the amount which has flowed into the plate and is in it at each instant. Bell used the first property to attract his plate; Dolbear used the second. But the novelty which makes the plate of the Bell receiver and the Dolbear receiver talk is not merely that the electricity produces an attraction proportioned to its amount, but that the amount of electricity sent from the transmitter to act on whatever receiver be placed at the distant end, varies in accordance with the rule laid down by Mr. Bell as constituting his method. The Dolbear talks because it follows this rule.

Indeed, if a Bell receiver be connected with the Dolbear line, the same electrical undulations sent from the Dolbear microphone transmitter will make the Bell receiver talk by one of its properties, and the Dolbear receiver talk by the other of its properties. Both employ the electrical undulations of the patent. In one their special and novel characteristics manifest themselves to the ear by one well-known property, and in the other by another well-known property. Dolbear's defence reduces itself to the same kind of attempt to narrow the patent which the other defendants make.

Breaks and Dead-Points.—Some of the defendants' experts, particularly Messrs. Young and Brackett, of Princeton, and Professor Sylvanus P. Thompson, of Bristol, England, (whose deposition was taken in this case,) used language which was intended to induce the court to believe that the microphone transmitter used by the defendants produced interruptions in the current; they insisted that the fifth claim of the Bell patent was technically limited to currents that were strictly continuous; and upon this they founded the argument that by reason of the alleged breaks in the current these microphones were taken outside of the Bell patent, and that the use of these instruments did not infringe.

To this there are several answers. One is, that the experiments and reasoning detailed in the testimony of Professor Cross and Professor Wright, experts for the Bell Company, prove that speech cannot be satisfactorily, or even intelligibly, transmitted by any instrument actuated by the voice, which causes breaks in a battery circuit (and a microphone is always necessarily placed in a battery circuit) as often as even once in each complete vibration. Another answer is, that if the averments of defendants' experts as to breaks were true, their current would still be substantially Mr. Bell's current, because it would possess, as the essential characteristic which enables it to transmit speech, that characteristic which Mr. Bell introduced into the current and described and claimed in his patent.

There is nothing in the phraseology of the Bell patent which limits it to strictly continuous currents. The word "continuous" does not occur in the patent. Continuous currents were old in telegraphy, and the patent itself points out and discards one kind of continuous current which it calls a "pulsatory" current, and which will not transmit speech. The patent makes the test of the described current to be its conformity to sonorous vibrations in the air. Any phenomena which are common to that current and to sonorous vibrations, and to which the term "break" may be applied, would therefore, if found in the defendants' current, be an element of similarity, and not of dissimilarity. Furthermore, any breaks which occur, if they are not sufficient to destroy speech, — as when they occur between words, or at the dividing line between one vibration and another, — if they can occur then without the destruction of speech, — would be negligible, and would not prevent the current in which they occurred from being substantially Mr. Bell's current. An outline of a pure curve may be substantially made, both in fact and in the patent law, by a dotted line, or by a broken line made as by the cross-stitch of worsted-work, or like the contour of a polygon of a great number of sides. *Winans* v. *Denmead*, 15 How. 330, 344; *Ives* v. *Hamilton*, 92 U. S. 430, 432.

Again, the distinction between the current of Mr. Bell and the current of Reis is, that Bell impressed upon his current those peculiarities of vibration which constitute "form" and give rise to "quality." It is absolutely certain that the current, which is the sole connecting link between the transmitter and the receiver, cannot convey these peculiarities from the transmitter to the receiver unless they are impressed upon it; they must be delivered to the messenger which is to carry them, or they will not be carried. Mr. Bell's invention and patent cover the use of a current upon which those peculiarities have been impressed, no matter what type of instrument be used as the transmitter to impress them. If it were true, as we believe it is not, that the microphone impresses them upon the current with substantial efficiency by means of a series of modified and modulated breaks (entirely different from the single, simple break of Reis) the current would be none the less substantially Bell's current, and infringe his patent.

Finally, it is clear that the statements of the defendants' experts on this subject turn chiefly on the ambiguous use of language. Thus, Professor Thompson, on cross-examination, admits that he means by "breaks" partial breaks over only part of the surfaces in contact; breaks which, while they weaken the current, do not entirely stop it; and Professors Young and Brackett adopt that statement as probably a correct explanation of the operation of the microphone. Dr. Cresson, in the *Clay* case, points out that in the to-and-fro motion of the air particle, as in every vibratory motion, there must be an instant of rest or no motion, or, as it is more properly called, a "dead point," when the particle, having moved in one direction, turns to move back in the other. The diaphragm of the telephone, he says, has these same instants of rest, and thus produces instants of no current in the line which connects with the receiver in the simple magneto apparatus, or in the microphone which uses an induction coil. But he was forced to confess that this phenomenon, by whatever name it may be called, occurs at each extremity of each complete vibration of the air particle, and at every subordinate change or reversal of the motion, and that its occurrence, therefore, in the current is an instance of resemblance and not of divergence.

The second Bell patent, No. 186,787, of January 30, 1877.— The patent of March 7, 1876, was for a "method" and for the first instrument which embodied it. This second patent is for improvements of detail in the structure of that magneto instrument.

The first patent showed the multiple telegraph instruments Figs. 5 and 6. This apparatus required for each set (1) two instruments specially adapted for a particular musical pitch; (2) that each pair, though at distant stations, should be always kept tuned in unison. (3) According to it, Fig. 7, an entirely different instrument, was required for speech. The second patent showed Fig. 7 so improved that (1) it would transmit speech better than before; (2) the same instrument that served for speech would also, and without tuning, serve for the multiple telegraph and for all pitches; (3) the battery of the first patent could be dispensed with.

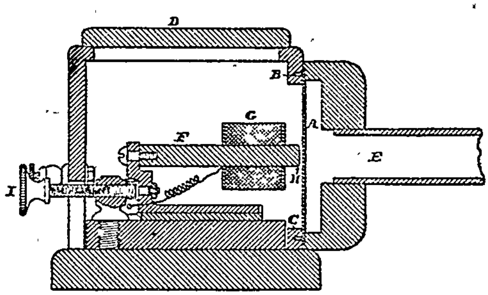
The leading features introduced by this second patent are:

(1) The use of an iron diaphragm in both transmitter and receiver, instead of a diaphragm of membrane with attached armature;

(2) The employment in the telephone of a different form of magnet combined with the other parts, giving much better results;

(3) New shapes of air spaces and casings which ward off extraneous and disturbing vibrations, and preserve the desired sound waves from distortion or weakening;

(4) The employment of a permanent magnet instead of a battery to magnetize the cores of the electro-magnets.



The Instrument of Bell's Patent, No. 186,787, *Jan.* 30, 1877.

This is Fig. 3 of the patent, which is in fact a drawing of the model filed. The diaphragm A is of sheet-iron, circular, screwed at its edges B and C to the framework. Behind it is the core F H, which the patent says is preferrably magnetized. Around one end of it is the short coil G. In front of the diaphragm is the thin air space which communicates with the operator's mouth or ear by the central opening E. When the box is large and heavy this opening is usually prolonged into a tube. By making the core F H permanently magnetic, the battery of the first patent may be dispensed with. The effect is enhanced by winding all the wire of the coil around one end of the core. The patent describes the core as made either of a single bar, with one coil, as in the model, or in a horse-shoe form, with a coil around the end of each limb as in Fig. 5. The patent also prefers to make the core of a steel bar, permanently magnetized, with a

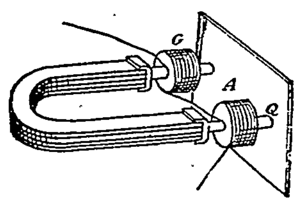


Fig. 5, *of No.* 186,787.

small piece of soft iron (pole piece) screwed into the end, the coil to be wound around that pole piece as in Fig. 5.

All these improvements have gone into universal use.

Drawbaugh asserts that he made all those inventions many years before Bell. Holcombe and some others make the same assertion as to some of them. Their stories are impostures.

The metal diaphragm. Claim 3.—Professor Pickering and Elisha Gray did upon two or three occasions, before 1876, experimentally, combine a sheet of iron and a magnet. It is clear that Gray used his sheet of iron—it was the bottom of a tin wash-basin or a tin cup—as an acoustic reflector or resonator to increase the well-known sound produced by the magnet itself (the so-called "Page effect"), and never thought of claiming for his contrivance any *magnetic* co-operation until long after he saw Bell telephones in commercial use. But apart from that, their work ranks as abandoned experiments. They did not use the contrivance in a speaking telephone, and did not make any attempt in that direction. On the contrary, when speaking telephones became known, both of them announced the opinion (Gray in his caveat) that for the feeble forces available in the telephone a delicate membrane like goldbeater's skin must be employed. Their contrivances were purely experimental in the strictest sense, used two or three times for entertainment merely, with circuit-breaking tuning-fork transmitters, to produce loud musical sounds by a powerful intermittent current, never supposed by either maker to be of any use, mentally and physically thrown away, abandoned and lost, or some of the parts only preserved by accident. Professor Pickering placed a magnet, temporarily, in front of a tin box, and has never made any claim to the invention. Mr. Gray claimed it only when the Western Union Company acquired his pretensions in the fall of 1877 and set him up as a "prior inventor." He did not describe that receiver in his caveat and had forgotten it until he joined the infringers in the fall of 1877. It remained for Mr. Bell to discover and to utilize the marvellous sensitiveness of a disk of sheet iron supported at its edges.

The special magnet in combination. Claim 5.—This magnet *per se* was old. But it had never been used to produce sound; it was not used or considered useful for any such operation as it performs in the telephone; and the reasons which make it a desirable form to combine with a diaphragm in a telephone are far outside of the ordinary knowledge of an electrical workman. Claim 5 is not for this magnet. It is for making a new form of speaking telephone which has this magnet as one member.

The peculiar form of the air spaces (claims 6, 7) is confessedly new.

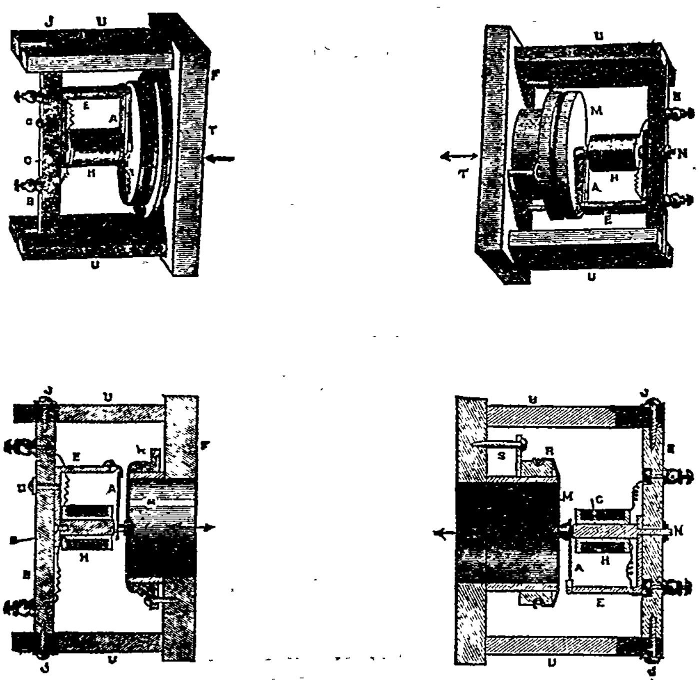
Bell's English Patent.—The inventions of this second patent were patented in England. The English patent was applied for December 9, 1876. The United States patent was applied for January 15, 1877, and was actually issued January 30, 1877. The English application was not completed by the filing of the full specification, the question of granting the patent was not passed upon by the law officers, and the patent itself was neither written, signed nor sealed, until after May 1, 1877. The invention therefore was not "patented" in England at the time the United States patent was granted. Mr. Bell could not, in January 1877, state the English patent, which did not exist until some months afterwards.

It is immaterial whether the English patent was then granted or not, because it has not yet expired, and upon either view the American patent is still in force.

See *Ex parte Bates*, L. R. 4 Ch. 577; Goodeve's Pat. Cas. 594; *Re Cutler's Patent*, 1 Webster's Pat. Cas. 420; *Re Henry's Patent*, L. R. 8 Ch. 167; *Brown* v. *Guild*, 23 Wall. 181; *Harrison* v. *Anderston Co.*, L. R. 1 App. Cas. 574; Goodeve, 223; *Newall* v. *Elliot*, 4 C. B. N. S. 269; Goodeve, 328; *Penn* v. *Bibby*, L. R. 1 Eq. 548; L. R. 2 Ch. 127; Goodeve, 369; *Stoner* v. *Todd*, L. R. 4 Ch. D. 58; Goodeve, 446; *Nordenfeldt* v. *Gardner*, Supplement to the Official Journal of the (English) Patent Office for March 25, 1884; *Holste* v. *Robertson*, L. R. 4 Ch. D. 9; *O'Reilly* v. *Morse*, 15 How. 62; *Smith* v. *Dental Vulcanite Co.*, 93 U. S. 486, 498; *The Corn Planter Patent*, 23 Wall. 211; *American Rock Boring Co.* v. *Sheldon*, 17 Blatchford, 303; *Gold & Stock Telegraph Co.* v. *Commercial Tele-*

gram Co., 23 Fed. Rep. 340; *Canan* v. *Pound Manufacturing Co.*, 23 Fed. Rep. 185.

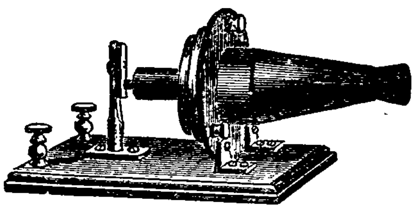
Early instruments constructed by Mr. Bell.—His first instrument was made June 2–5, 1875; another substantially like it was made shortly afterwards. Of these the essential working parts remain, to wit: most of the framework, including the straining rings which carried the membrane diaphragms, the electro-magnets with their heel-pieces, and the armatures. These prove the dimensions of all the parts. Reproductions were made in exact accordance with these, and these reproductions transmitted sentences in the presence of the counsel and expert for the Drawbaugh Company. The following are drawings of these reproductions, one-sixth of the size of the originals.



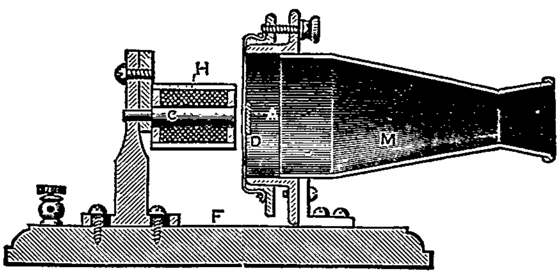
Bell's Telephones of June and July, 1875.

Mr. Bell exhibited at the Centennial Exhibition at Philadelphia, in June, 1876, the following speaking telephones.

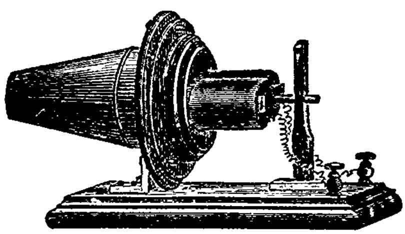
Two *membrane diaphragm magneto instruments*, capable of use either as transmitters or receivers, but in fact used as transmitters at the public test on June 25, 1876. The base is of black walnut, the frames are of brass castings, and the cones are of japanned tin. They differ only in that one has a single bar electro-magnet and the other a horse-shoe or double pole electro-magnet. The section is drawn to scale, one-fourth size. The membranes are three inches in diameter.



Bell's Centennial Single Pole Magneto Telephone.

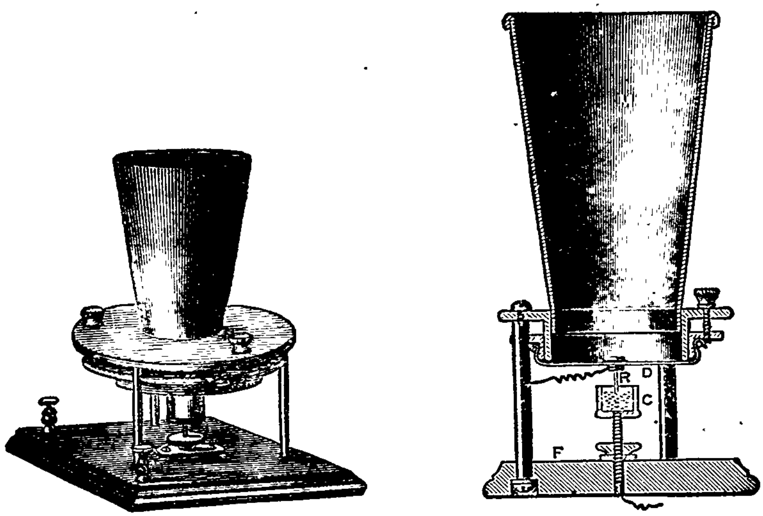


Section of Same.



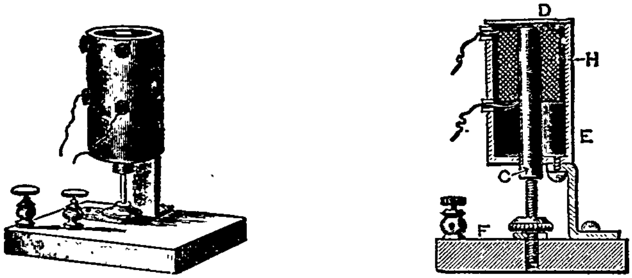
Bell's Centennial Double Pole Magneto Telephone.

He also exhibited a *liquid transmitter*. The sections given below are drawn to scale, and are one-fourth of the actual size. The frame carrying the diaphragm is the same casting used for the magneto transmitters.



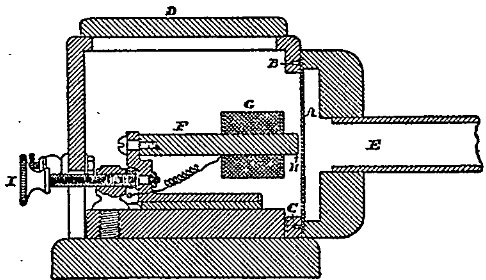
Bell's Centennial Liquid Transmitter.

The *receiver* used at the Centennial consisted of an iron tube E, on the top of which was laid a sheet-iron disc D, serving as the diaphragm. Inside the tube was a soft-iron core C, around which was the coil H. A battery of several cells was placed in circuit. The core C was in contact with the iron bottom of the iron tube E, which thus itself became magnetic.



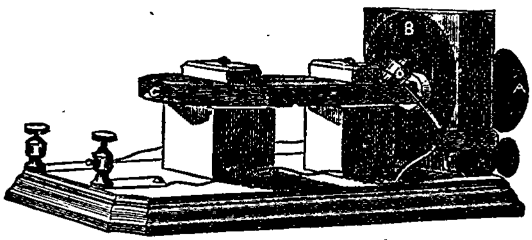
Bell's Centennial Iron Box Receiver.

On June 25, 1876, speech was transmitted in the presence of the Judges and an assemblage of 75 people, by means of the *membrane magneto transmitter* and the *iron box receiver*. During the following week the Judges transmitted speech with them, in their own pavilion, without assistance, transmitting newspaper sentences.

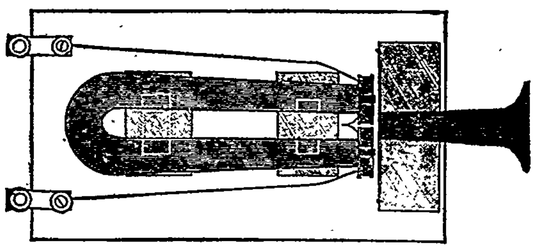


Model of Patent No. 186,787.

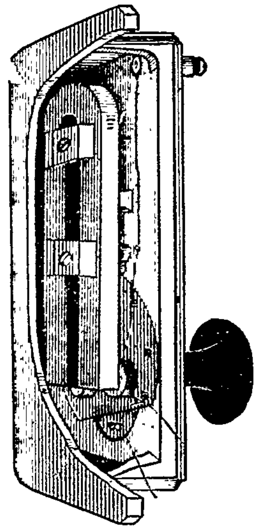
The magneto telephone went into commercial use in April, 1877, and the following are some of the early forms.



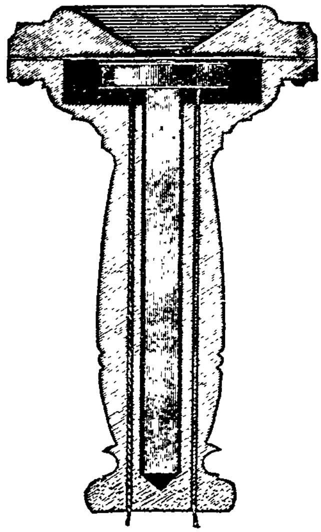
Box Magneto Telephone in use before April 5, 1877.
(*Cover Removed.*)



Plan of Same.

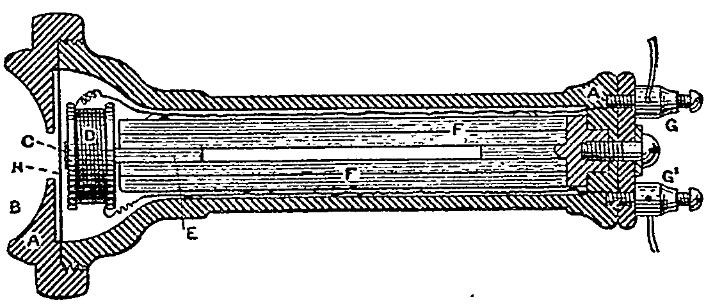


Box Telephone in use in August, 1877. *(Part of box and of diaphragm cut away.)*



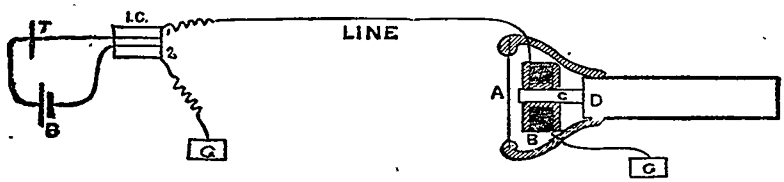
Hand Telephone of May, 1877. *(Wooden Handle.)*

About 25,000 of these magneto instruments went into use (chiefly of the upright box and the rubber handle forms) before the microphones appeared. Carbon microphones of the Edison and Blake (p. 279, *supra*) forms with induction coils went into commercial use in the summer and fall of 1878.



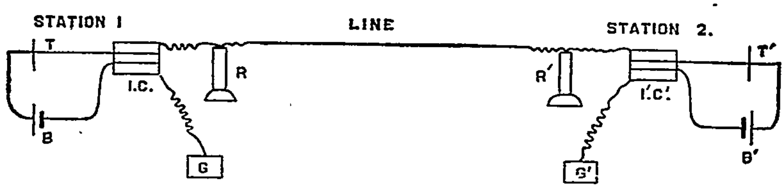
Hand Telephone, in use since December, 1877. *(Rubber Handle. ½ size.)*

Circuit connections for microphone with induction coil as commercially used.



T is the microphone transmitter in a short local circuit which includes the battery B (usually one cell) and the primary of the induction coil I C. Of the secondary coil one end goes to the LINE wire which connects with the coil B of the receiver. The return circuit is usually completed through the ground (G G,) though on very long circuits, as from Boston to Philadelphia, a return wire is employed because it gives much better results.

In order to talk both ways alternately the arrangement at each station is duplicated as follows in which T talks to R′, and T′ talks to R.



The first infringement was that of the Western Union, in 1878, and formed the subject of the Dowd suit. The next was that of the Eaton Company (Spencer case) in the summer of 1880. It was in that suit that it was first alleged that Reis invented the speaking telephone. At that time there were 140,000 speaking telephones in use under license from the Bell Company.

Mr. William W. Ker for the Clay Commercial Telephone.

It is alleged in the bill of complaint that the American Bell Telephone is "a corporation duly established under the laws of the Commonwealth of Massachusetts." This is a descriptive allegation. If a descriptive allegation is not proved as laid, it is a fatal variance. 1 Gr. Ev. 82, § 64. To prove the incorporation, the complainants offered in evidence a special Act of the Legislature of the Commonwealth of Massachusetts. It is entitled "An Act to Incorporate the American Bell Telephone Company." The name of the proposed corporation is not mentioned in the body of the act. When a corporation is erected, a name must be given to it, and by that name alone it must sue and be sued, and do all legal acts. Such name is the very being of its constitution. The name is the very knot of the combination, without which it could not perform its corporate functions. Bl. Com. Book I. ch. 18; Angell and Ames on Corporations (10 ed.), § 1; *Dartmouth College* v. *Woodward*, 4 Wheat. 518, 636. The act is entitled, "An Act to Incorporate the American Bell Telephone Company." The title cannot confer the name American Bell Telephone Company upon the corporation. Potter's Dwarris Stat. 102; Sedgwick Construction of Statutes (2d ed.), pp. 39, 40; *Mills* v. *Wilkins*, 6 Mod. 62; *Hadden* v. *The Collector*, 5 Wall. 107; *Coal Company* v. *Slifer*, 53 Penn. St. 71; *Union Passenger Railway Company's Appeal*, 81 Penn. St. 94. The special act, offered in evidence, enacts that Bell and his associates may associate themselves, and "organize a corporation according to the provisions of chapter 224 of the act of the year 1870, and the acts in amendment thereof and in addition thereto." Chapter 224 of the act of 1870 and its amendments are now known as chapter 106 of the Public Statutes of Massachusetts, and so much thereof as relates to this question is as follows:

"Section 4. Any such number of persons as is hereinafter provided, who associate themselves together by such an agreement in writing as is hereinafter described, with the intention of forming a corporation for any purpose hereinafter specified, upon complying with the provisions of section twenty-one, shall be and remain a corporation.

"Section 16. Such agreement shall set forth the fact that the subscribers thereto associate themselves together with the intention of forming a corporation, the corporate name assumed, the purpose for which it is formed, the town or city, which shall be in this Commonwealth, in which it is established or located, the amount of the capital stock, and the par value and number of its shares.

"Section 17. Any corporate name may be assumed which indicates that it is a corporation, and which is not in use by an existing corporation or company; and the name assumed shall be changed only by act of the General Court. If organized for the purposes mentioned in sections 9 or 10, the words 'co-operative' or 'fishing,' respectively, shall form part of the name."

To further prove the act of incorporation, complainants offered in evidence a certificate, under the seal of the Secretary of the Commonwealth of Massachusetts, certifying that W. H. Forbes and ten other persons had associated themselves under the name American Bell Telephone Company, with a capital of seven million three hundred and fifty thousand dollars. The special act does not give the persons named in it power to assume a name. It gives them power to *organize* a corporation. The assumption of a name was not one of the incidents which attached, even by implication, to the powers, purposes, or objects stated in the act. We are to look at what the Legislature actually did, and not what it intended to do. The act was a grant from a sovereign power, and is to be taken most beneficially for the sovereign, and against the grantee. 2 Black. Com. 347; Potter's Dwarris on Statutes, etc., pp. 146, 215; *Dartmouth College* v. *Woodward*, *supra*; *Commonwealth* v. *Erie & Northeast Railroad Co.*, 27 Penn. St. 339; *S. C.* 67 Am. Dec. 471. The special act was a later one. It does not incorporate chapter 224 in its provisions. It refers to chapter 224, by enacting that Bell and his associates might "organize a corporation according to the provisions of chapter 224." The powers conferred by the special act are limited to the precise language used. The language confers no authority upon the Secretary of the Commonwealth to issue such a certificate as has been offered in evidence. *Commonwealth* v. *Railway Co.*, 52 Penn. St. 52; *Bowling Green &c. Railroad Co.* v. *Warren County Court*, 10 Bush, 711; *Ellis* v. *Paige*, 1 Pick. 43; *Farmers' Loan and Trust Co.* v. *Carroll*, 5 Barb. 613; Angell and Ames on Corporations, §§ 81, 111. The Bell Telephone Company of Philadelphia is one of the complainants mentioned in the bill of complaint. It is described as "a corporation duly established under the laws of the State of Pennsylvania." Although, under the pleadings, the complainants were bound to prove the existence of the corporation, yet there was no act, law, charter, or evidence offered to prove that such a corporation ever did exist.

Mr. Ker also contended that the evidence showed that the complainants were not entitled to maintain a suit alone against the respondents; that Bell was not the original inventor of the inventions described in the patents; that material parts of the invention had been described in printed publications prior to the granting of letters patent; that the claims in the patent were not warranted by the descriptions and specifications set forth in it, or by the proofs and evidence; and that the apparatus was inherently unfit for telephonic purposes in the transmission of articulate speech.

Mr. Don M. Dickinson for the People's Telephone Company (the Drawbaugh Case) and for the Overland Telephone Company.

Two leading judgments of this court settle the rules applying to the issue of priority of invention between Bell and Drawbaugh. These are *Gayler* v. *Wilder* (the Fire Proof Safe Case), 10 How. 477, and *Coffin* v. *Ogden* (the Reversible Lock Case), 18 Wall. 120.

The simple question is, did Mr. Bell or Mr. Drawbaugh first conceive and apply the principle of the telephone and "clothe the conception in substantial forms which demonstrated at once its practical efficacy and utility?"

The principle is, that of transmitting articulate speech upon wires by a continuous electric current, with the addition of means to cause incidental undulations of the current corresponding with the incidental tones of the human voice.

When applied in the electric speaking telephone the practical result is, that the same air vibrations set in motion by the human voice, and producing sound by their impact upon the tympanum of the ear, are repeated with comparative exactness upon the tympanum or diaphragm of the transmitting instrument, are then by the process carried to a distance, and there with equal exactness repeated upon the tympanum or diaphragm of the receiver, and thence again repeated upon the tympanum of the listening ear.

The issue of fact here has been heard and decided upon the merits but once in any court below.

There was no hearing of this defence before granting the preliminary injunction in the Circuit Court for the Southern District of New York; and the Circuit Court for the Eastern District of Pennsylvania—Judges McKennan, Nixon and Butler sitting—refused a preliminary injunction after full hearing deferring decision until a final decree should be reached on pleadings and proofs in the Southern District of New York. So that the only judgment of any court which needs to be attacked by or which can be said to be adverse to this defence is that of the learned judge of the Circuit Court for the Southern District of New York which is printed in this record.

Our positions may be summarized as follows:

The defendants' testimony-in-chief, excluding Drawbaugh's, is of such positive character, relating to exceptional and unusual facts; is so copious from many and widely disconnected sources, and withal so consistent and harmonious, that, in the language of the learned Judge below, it "*is sufficiently formidable to overcome the legal presumption of the validity of the complainants' patent.*"

The complainants' proofs in reply, do not, under the settled policy of the law of evidence, create a flaw upon the face of the case made, much less destroy it.

Case authorities to the point, that doubtful direct testimony in support of the claims of an alleged inventor may be over-thrown by evidence of his inconsistent conduct, fraudulent fabrications or evil tendencies, have no application in weighing direct evidence of the higher order presented here. If it had been shown that he was a rogue and a falsifier, Drawbaugh would not be beyond the pale of the law for the protection of inventors, if the evidence otherwise established his claim to an invention.

But Drawbaugh's story, his character and conduct, and the conditions in which we find him, are all consistent with, and corroborate, the case otherwise made.

In this regard every premise of the opinion below, upon which this decree rests, is at fault. These premises are:

(*a*) That a man of Drawbaugh's education and environment could not have invented the telephone.

(*b*) That a man who busies himself with minor "mechanical contrivances" could not have produced a great invention. In other words, a great discovery in physics could not be made by a man unless his mind had always been on great discoveries; an *a priori* argument that to establish a claim to a great invention, the claimant must show some previous invention approximately as great.

(*c*) That the issue of an advertising card, to the farmers, millers, mechanics and housewives of a country village, soliciting trade for his shop, is an admission that he was not working upon and had no telephone at a period when seventy unimpeached witnesses, and himself, testify positively that he had the telephone, and that he was so working at that time.

(*d*) That Drawbaugh fabricated the story of his poverty, when the court records of his judicial district show judgment after judgment against him, on claims for the necessaries of life, medical attendance for his fatally ill children, and for the roof that covered his head; and when the community in which he lived corroborates the record.

(*e*) That Drawbaugh was a charlatan, because a provincial scribbler was florid in the style of a printed notice of him.

(*f*) That Drawbaugh and these witnesses, when they say that they talked through the more or less crude instruments made prior to 1875, falsify or are mistaken in their statements on the following grounds:

Some of the original parts have been lost or worn out, two sets of reproductions were made, both in exact correspondence with the original machines, and when tested at different times, one set being older and shaken out of adjustment, did not work perfectly; though the other with accurate and firm adjustments, stood all the tests as practical telephones.

The earliest possible date at which Bell's conception of the magneto instrument can be fixed is June 2, 1875.

Then from an accident in his experiment to the "Spring" instrument he was led to prepare a sketch for Mr. George Brown of Toronto. This sketch as he testifies was of his instrument of July, 1875, which was the result of experiments following and caused by the accident of June 2, 1875. He placed upon the sketch the words in his own hand: "*First attempt to transmit the human voice.*"

We present a history from the first idea conceived by Drawbaugh, of transmitting articulate speech over a telegraph wire in 1859-60, through various experiments by which the conception finally took on mechanical, though rude forms, and became of practical use, down to the finished and nicely adjusted mechanism; all prior to this as the date of Bell's invention.

This history rests for its general truthfulness, and for the accuracy of its details, not upon the testimony of interested witnesses; not upon the testimony of one, two, six or a dozen, but upon the direct and positive testimony of an entire community, and of the frequent and occasional visitors to that community, representing all classes of citizens, in every trade and occupation.

Over two hundred persons testify to knowledge of Drawbaugh's telephones as an accomplished invention prior to the date of Bell's. Over seventy talked through the machine. Over one hundred and thirty saw the machines, and most of these identify instruments.

There is nothing of inherent improbability in the proposition that so many people of various occupations and employments can give direct testimony in this case, as the fact comes in naturally, and is conceded on all sides, that in the country village of Eberly's Mills, well known throughout that part of the country, Drawbaugh's shop was a common resort for many people of the village and of the country side, and it was a place to which visitors were frequently taken as a place of local note, while Drawbaugh himself was considered a remarkable man among the people.

The great mass of evidence for the defence is essentially not of a class frequently criticised in such cases as being dependent upon the memories of illiterate or careless witnesses as to conversations, statements, or even plans and specifications with or submitted by an alleged inventor at some former time; but on the contrary is that kind of testimony which in every branch of the profession is admitted to be even superior to that of a mere learned or scientific person, where it bears upon the practical truth of novel results and effects as facts. There is no room for mistake.

It cannot be conceived that any honest witness could have made a mistake, or that his memory could be beguiled by imagination, "wrought upon by influences to which his ears were subjected," as to his having done so marvellous a thing as conversing through a machine and recognizing the tones of a human voice, at a distance over telegraph wires, at the time in question.

In the condition of the art, and of their knowledge at the time, a greater proportion of such witnesses would be impressed by such a fact as by a miracle.

So strong and vigorous was this class of testimony that the court below was constrained to hold as we have seen that "the case made by these witnesses is sufficiently formidable to overcome the legal presumption of the validity of the complainants' patent."

It is true that in all branches of jurisprudence instances are frequent in the cases, and illustrations common in the books, of the fallibility of direct testimony, from honest mistake.

Such instances and illustrations occur and are drawn, throughout the history of the law of evidence, from one general class of oral testimony.

It is that which depends for credence upon the unaided memory of the witness, in relation to some ordinary thing, not unusual, unnatural or striking, in and of itself. Thus, the testimony of an honest witness to the fact merely, that at a certain time and place, he saw two individuals together might be successfully assailed, while the statement of the same witness that he saw them together, and saw one of them strike the other or shoot the other, would be invulnerable.

So, by the same rule, direct testimony by the average witness as to ordinary conversations or statements at a distance of time, may be as unreliable as his recollection of the contents in detail of a letter, which, intrinsically, or to the witness, was of no particular interest; in both instances becoming less reliable in proportion to the lapse of time. Such evidence, while it may be competent, has little weight.

So, memory of such witness as to statements, and plans and sketches of inventors in ordinary machinery, or extraordinary machinery used for ordinary purposes; and even as to the parts and adjustment of the mechanical parts of such machine.

The history of patent litigation, judgments of courts in such cases, and the complainants' brief below and here, teem with modern instances of the application of proper caution and of absolute decision against this kind of direct evidence.

It is doubtless true that the misty and lineless impressions of men, especially of the unskilled and unlearned in the art, might easily be beguiled by subsequent events, interest or influences, into giving out a seemingly honest but mistaken description of well-defined parts and accurate adjustments. Strong circumstantial should overcome direct evidence in such cases, as in the *Howe Sewing Machine Cases*, 1 Fish. Pat. Cas. 162.

But the testimony here attacked is as far beyond the range of that doctrine as the target of a Columbiad is beyond the range of a bird gun.

Other and equally well-settled rules apply; if the circumstances narrated were likely to attract the attention of a person "in consequence of their importance, either intrinsic or with relation to himself, doubt is resolved in favor of the memory of the witness."

It is said of the King of Siam that he believed everything the Dutch traveller told him, until he said that in Europe the water in winter became so solid that men and even elephants could walk upon it. This, his majesty said, was impossible, and at once accused his entertainer of lying. (Locke, on the Human Understanding.) There can be little doubt that after the interview, the monarch's memory remained good of the fact that he had been told of this thing, and he would have remained a good witness to that particular part of the conversation for the rest of his life. If, in addition, he had been, for the first time, brought to view and test the ice of a frozen river in a country where water sometimes freezes in the season of winter, his testimony, at any subsequent period, that the water was frozen on the particular day of his view of the wonder, would be worth that of a hundred residents of its banks who should testify from mere memory, that the river was or was not frozen on that day.

In this case we have hundreds of witnesses whose circumstances and relations are in perfect harmony with the theory that they could have seen and heard the thing alleged if it had occurred; each individual describing either the knowledge of his own senses of a result, or of the hearing of a result, which, if in fact it occurred, or if in fact he heard of it, was the most startling and unheard-of thing in all his experience. To him it was a sharp and vigorous departure from the course of nature; becoming known of men, this thing equally moved and astonished the civilized world. As put by the learned Judge below, "a result of transcendent scientific interest," and the greatest by far of all the marvels of the electric telegraph.

Imagine a suit for an infringement against Fulton, and the testimony of a witness that he was on board on the trial trip, and then imagine counsel making the charge against him that he was beguiled by his imagination into honestly thinking that he saw the boat propelled against the current by steam or by unseen forces!

In the then state of knowledge, especially in the community of Eberly's Mills, the transmission of the voice by wire.

and of the tones of the voice by electrical machinery beyond ordinary hearing distance, was to present such a marvel as to challenge attention in the very nature of things.

It was not merely a wonderful mechanical contrivance like the sewing machine, which accomplished the seemingly improbable combination in mechanics, which could perform rapidly and perfectly a familiar work; but this was an unseen and mysterious cause, whose processes were not discoverable to the vision, whose force seemed rather of the unnatural, and whose *results alone* impressed the mind and memory.

No detail of mere machinery or adjustment needs to be remembered. If the machine *talked*, and the witness *heard* it, there can be no doubt of the accuracy the impression made. If the machine talked, we might well dispense with the fallible memory of some unlearned and unskilled witnesses as to the mechanism employed, because we know that the appliances used in the magneto and variable resistance instruments were the invention here in issue, as none others would or can transmit articulate speech by the electric current upon wires.

This brings us to another oft-repeated criticism of several individual witnesses for the defence. If the shrewdest and most able cross-examination could lead a witness to say that he had seen and talked through a certain instrument of the exhibits in evidence, identifying it, when it could be argued that at the exact time of the act the particular instrument identified was not perfected or in use, according to the testimony of Drawbaugh, or some other witness, the learned counsel profess themselves satisfied, and urge the court to agree with them, that the testimony is quite demolished. Their theory as to the fallibility of honest, direct testimony, given by the unskilled and unlearned, as to the existence of the machines, here disappears, and in its place we have the proposition that these particular witnesses are wicked falsifiers; and this, of ignorant men and women, "Pennsylvania farmers, gullible now, and gullible then," as counsel are pleased to call them.

While we have the testimony of the learned, as well as of the ignorant, yet, even of the latter, we submit that it is the strongest possible corroboration of their statements, and the strongest possible contradiction of the complainants' position (that these many witnesses either falsified wilfully, in concert, from corrupt collusion, or from the unconscious effect of consultation or "village tavern gossip"), that they do not agree in their memories of the, to them, novel parts of the instrument; or are at fault or are mistaken as to the identity of the instruments, or of the difference between the carbon or variable resistance machines and the magneto machines.

They are agreed in memory of the great, conclusive fact, that this machine *did talk.*

Running through the testimony from the population at and about Eberly's Mills, and its frequent visitors, we find repeated and constantly appearing support of the main facts testified to, in perfectly natural and consistent collateral matters.

For instance, we find the unlearned and unskilled remembering well the talking machine, when clothed in the familiar garb of a tin mustard box or common glass tumbler, and forgetting other details; we find others remembering the instruments with any peculiarity about them, like the spiral magnet, better than they can recall other parts, as that particularly struck their attention, and naturally would do so; we find the blacksmith remembering the shape and position of the permanent magnet with which he is familiar, and forgetting all about the electro-magnet, of which he knew nothing; we find many remember the common horse-shoe magnet as used, because they knew before what it was. We find a farmer, like Fetters, recalling all the details for applying electricity about the machines, but cease to wonder at his accuracy, when we find that the farmer had at some time before greatly interested himself about practical electrical machinery. We find the more familiar in such matters giving more details; the totally ignorant in such matters giving no details at all. The very diversity of detail, the absence of concurrence in circumstance, in occasion, and in time, presents this mass of testimony as impregnable against the complainants' theory, that it is the product of consultation or of preärrangement.

Neither their sharpest cross-examination, nor their swarm of agents and detectives employed from among well-known members of the community, as well as from without, have been able to bring out any admission or circumstance tending to show that the witnesses have been impressed by an exchange of views among themselves, by undue influence from interested parties, or that they are in conspiracy in framing their evidence.

Is it possible that complainants' counsel have not been able to break the "fabrications" of even one ignorant and gullible Pennsylvania farmer?

It is not possible, if such a conspiracy existed, and an entire population in it, that, in the course of years, no one of the hundreds of conspirators, in every walk of life, has ever been weak or careless, or off his guard, so as to betray the slightest hint of it, even in the conversations with his co-conspirators; yet if he has, the secret agents of the complainants, among the friends and neighbors of the conspirators, have not found it out. The breaking down of two or three, and no more, of the witnesses called upon the question of dates, strongly aids in the demonstration that the mass are unshaken in their testimony. It is rather further evidence that we have called the population to testify, and that in every community there are one, two, or three, covetous of the ephemeral distinction of the witness-stand, of the importance of figuring in a case of so much interest, and willing to gain it by a stretch of conscience.

Care has been taken, however, in summoning witnesses to testify, to call no man whose character or whose word could be successfully impeached by any methods known to the law. And it is remarkable, we submit, that in a case of this magnitude, with every means and resource at their command, the complainants, after years of effort and search in near and in the most remote paths, and in every collateral by-way, now rest the charges of conspiracy and of gullibility against these witnesses, only upon the bare statements of counsel. The lives of all the witnesses are clean, their characters for truth and veracity unassailed, and the evidence of any attempt to influence the memory or the impressions of any man called, cannot be successfully pointed out in this record.

We submit in our brief an analysis of the testimony, and call particular attention to the absolute certainty of the dates as fixed by collateral matters in every instance.

Complainants' Testimony.

As tending to show that Drawbaugh did not invent and use in his shop the electric speaking telephone, as testified to by the witnesses for the defence, the complainants introduced forty-eight witnesses from Eberly's Mills and from various parts of the United States, who are put upon the stand for the purpose of showing that they never saw the machines in his shop, *and never heard them spoken of.*

We shall see that of these but ten stand the test of cross-examination and rebuttal, even as to the point to which they testify; while the ten are disposed of on other grounds. Among these witnesses, the first and most important, and one whose means of knowledge and relations with Drawbaugh are claimed to strengthen complainants' theory more than any other witness, is Theophilus Weaver.

He describes himself as a "solicitor of patents, pattern-maker, builder, and experimental machinery manufacturer," and as "counsel in patent cases."

He testifies that he had acted in getting up specifications for Drawbaugh in various minor inventions, and, in a word presents himself as the man to whom Drawbaugh would most likely make known his telephone inventions, if they had existed. He then proceeds to testify, in chief, that he never knew that Drawbaugh had invented a telephone until the first half of 1878, and then it was a mere device to be connected with a clock, "to announce the hours vocally."

It transpired in his cross-examination that he had been employed by the complainants to get up testimony in the neighborhood, and to influence sentiment in the community, and had been so employed by an agent of the complainants, who was visiting the vicinity under an assumed name. It also appeared that he was not on good terms with Drawbaugh, for the reason that he, the witness, had grossly betrayed Drawbaugh as a client in a patent litigation, and had also attempted to pirate the invention himself by applying for an "improvement" upon it. He then endeavored to betray the person to whom he betrayed Drawbaugh. We cite the pages of the record to these points.

The cross-examination shows conclusively that this man has little notion of honor, and no regard for his word. It was a common practice with him to act as counsel or solicitor for mechanics, and others seeking patents on inventions, and then appropriate to himself the knowledge thus obtained in a professional capacity, by patenting "improvements" upon them. The man paints his own character clearly, and stamps his own testimony as unworthy of credence; a man of doubtful methods and of an easy conscience, we find him the accredited agent of the complainants, and he stands at the threshold of their testimony.

Complainants also called David A. Hauck in the same line of negative testimony. He is the person with whom Drawbaugh had the suit in which Mr. Weaver was counsel, above referred to. It appears clearly, from his cross-examination, that he was adjudged, both by the Examiner of Interferences, and subsequently upon appeal by the Board of Chief Examiners, to have made grave misstatements. Both these tribunals found not only that he had done so as to the facts in the case, but that his statements upon filing his application for a patent had not been true; that he was not at all the inventor of the faucet in controversy, but had it from his opponent Drawbaugh. He testified that, although frequently in Drawbaugh's shop, he had never seen any talking machine and never heard of one.

Without regard to the personal feeling or the character of the witnesses, especially in view of the fact that they contradict an exceptional number of men and women testifying as strongly to the memory of a positive and wonderful fact, we urge that this case affords an exceptionally striking illustration of the wisdom of those settled legal rules for valuing evidence, which give great weight to positive, and little weight to negative testimony.

This court has said of this rule, in *Stitt* v. *Huidekopers*, 17

Wall. 384, 394: "The court charged the jury, that 'it is a rule of presumptions, that ordinarily a witness who testifies to an affirmative is to be preferred to one who testifies to a negative, because he who testifies to a negative may have forgotten. It is possible to forget a thing that did happen; it is not possible to forget a thing that has never existed.' We are of the opinion that the charge was a sound exposition of a recognized rule of evidence of frequent application." See Collection of Cases, 14 U. S. Dig. 642; Gilbert on Evidence, 140; 1 Stark. Ev. § 32.

While no person possessing a memory could well forget having talked through one of these machines at the time in question, yet it may be true, that persons called to testify (as they are) that they never heard of it years before, or did not see it, tell the truth, from lack of opportunity to see or hear it. A very few, honest and disinterested, may be an exception to the rule, and may have actually forgotten the conversation or the view.

The differentiation in the ability of persons to recall facts, or impressions from the eye and ear, of things and conversations not in and of themselves remarkable, is a matter of common observation. In respect of this, may be considered the difference between the man of many affairs and the man of few; between the man of mental occupation and the man of other pursuits; between the man devoted to his own interests and the man interested in the affairs of his neighbors; and, finally, the difference of age and temperament which affect the proposition, that all men having seen or heard of a thing likely to make a greater or less impression, as men may vary, all would remember it.

And, too, the average lay mind has never yet comprehended that "don't remember" may not be resorted to in cases of self-interest; to avoid enmity, or to please a friend; or that it can amount to perjury or any wrong. Upon that answer no prosecution for perjury ever did stand, because of the practical impossibility of proving of the particular witness that his power of memory was equal to that of other men. No physical or psychological research, and no expert, could afford the proof, whether he in fact did remember; and witnesses are more easily influenced not to remember, as has been done according to the evidence in repeated instances, as shown by the record.

The usual question put to these witnesses was substantially as follows: "If Mr. Drawbaugh, for five or six years before speaking telephones were heard of elsewhere, had at his shop a talking machine, by which people at different places could carry on conversation with each other along a wire, and had frequently shown it to people, and had had them carry on conversation over it, so that they knew that it would do what he claimed for it, and had represented that it was going to supersede the telegraph, do you think you would have known of it?" And so the witnesses are made to swear, not only to the premises and conclusion of the syllogism of counsel, but also to his syntax and rhetoric.

There is one consideration appearing in complainants' own proofs that is at once conclusive against the value of this testimony. With a few exceptions, the entire number of witnesses are *offered* to give testimony tending to show:

(1) That the telephone never existed in Drawbaugh's shop prior to the Bell patent; and

(2) That it was not heard of in the community prior to the Bell patent.

With the few exceptions, to which we shall refer, the witnesses testify not only that they did not hear of the machines or know of them from 1867 to 1876, but go further and extend the period to 1878 and 1879 and 1880; so that by fixing the dates, the strength of their testimony is no greater to the point that the machines did not exist up to 1876, than that they did not exist in the later years mentioned. If not seeing or hearing of them establishes that they were not there up to 1876, the not seeing or hearing of them by the same witnesses in the same circumstances and conditions, in 1877, 1878 and 1879, would establish that they were not there in the latter years; but we have from the mouths of the complainants' own witnesses offered to prove that Drawbaugh's later machines could not have been constructed as early as 1876, because he showed the earlier ones, that there can be no question that at the earlier dates of 1876, 1877 and 1878, machines were in the shop in such a condition that they were perfect telephones, though in ruder forms than the later ones.

(Counsel here read at length from the testimony of complainants' witnesses, in illustration.)

As an illustration of the unsafety and utter worthlessness of this negative testimony, that of Nesbit is cited. He was called to prove that Drawbaugh did not mention telephones in 1878. Nesbit was there for the purpose of getting materials for an historical sketch of Milltown. In connection with his testimony the history compiled from the material was introduced, and it was silent as to the telephone, although treating quite fully of Daniel Drawbaugh. Upon the production of a manuscript made by Hull at the very same visit Nesbit made, it was shown conclusively that Drawbaugh did mention the telephones, both carbon and magneto, as his invention ("two kinds of telephones"). This manuscript is shown in the cross-examination of Nesbit, and then, on the demand of counsel, the complainants were obliged to put in another copy of the same history, which contained an appendix, with the substance of Hull's manuscript statement about telephones.

This testimony proves something else besides the unreliability of negative testimony.

Nesbit was an intelligent and honest man, telling of a comparatively recent visit, and had it not been for this manuscript his testimony would have stood to the effect that Drawbaugh did not mention telephones, and that he, Nesbit, did not hear of them there. It appears with perfect clearness that the agents of the complainants over and over again interviewed persons in Eberly whose memories were positive against their theories, and then failed to call them.

In this connection the history of the two Gregorys is interesting. One of the sharpest criticisms made upon the Drawbaugh defence at the first hearing was that those engaged about the shop with Drawbaugh, as workmen, were not called, and that it followed from the defendants' failure to call them, as well as by the testimony of Jacob Carnes, a workman for the complainant, that Drawbaugh's statement and the story of the witnesses for the defence were incredible, because the very workmen about the shop did not know of his telephone.

Before the second hearing in the Overland case, Emanuel Gregory, a member of the Drawbaugh Manufacturing Company in 1870, and his son, who worked in the shop in 1870, were found living in Massachusetts. They both of them testified they had not been in the State of Pennsylvania from the 10th day of December, 1870, until the day when they gave their testimony. They further testified that while at work in the shop with Drawbaugh they had many times talked through the telephone with him and aided in his experiments. It appeared further that they had been visited by the agents of the complainants, and had made their statements to them in regard to this matter before the first hearing of the cause.

Of this class of witnesses, that which seemed to the Circuit Court to be most conclusive against the defence, is that of Mr. James P. Matthews, managing editor of the *Baltimore American.* He has the place of honor in the opinion; as the court observed, "with a memory unusually retentive and active," and as "a careful, conscientious man."

He testifies that he went to the shop of Drawbaugh especially to see the electric clock in April, 1878, and he made some brief notes of what he learned, and subsequently wrote from them an article for his paper, published *November 28, 1878.* His testimony is chiefly to the point that he understood from Drawbaugh, at the interview in April, that, while he had experimented somewhat upon telephones, yet he never expected to transmit articulate speech, and that he saw there "no telephone, and nothing that looked like a telephone." This testimony is of the same class as several newspaper articles of 1878, tending to show that Drawbaugh was merely experimenting. The article in question is a tissue of errors in its conception and description of the clock which it purports to describe, and would of itself stamp that portion of the evidence as without value. The witnesses subsequently wrote a letter (Appendix, Add. proofs, p. 776) to complainants' counsel, called out in the argument below, in which he says: "I ought to have said in my affidavit, and in my subsequent examination, that at the time of the interview I had probably never seen a working telephone, and knew little or nothing about its mode of operation. The impression in the newspaper paragraph referred to may have been modified, colored or changed by conversations with other people on the subject after the interview and before the article was written." He further states in his letter, that, "the two wooden hemispheres," which he testified that Drawbaugh showed as parts of the telephone, and had been in his hands, he was mistaken about, and he cannot say whether Drawbaugh touched them or said anything about them. Further: "My recollection of the whole transaction is so vague that I never ought to have ventured to say anything about it, and the portions of my testimony relating to this matter certainly ought not to be considered by the court in making up its decision." He had testified that his impression was that Drawbaugh had entirely thrown aside telephone experiments; but he is contradicted in this by the complainants' own witnesses, Shapley, D. A. Landis, C. A. Landis, Orlando Kanney, A. L. Rupp, Geo. C. Rupp, Henry R. Mosser and Theodore Grisinger. If this were not enough as to the testimony of this witness, held by the court below to be of sufficient importance to figure as a chief factor in the destruction of the defence, we now quote from the complainants' own brief in the court below, bearing in mind Matthews' testimony is material and competent only as showing there was no telephone at Drawbaugh's shop in April, 1878, and that all there ever was of it was futile experiment, as follows (Brief below, p. 20):

"Our belief is that the *tumbler instrument was first made as an electric speaking telephone in 1877–8;*" they could say no less, as their theory had been, and their witnesses had sustained it, that the electric telephone was there not only in the winter of 1877–8, but also in October, 1876.

It is evident that the complainants were not seeking the truth so much as witnesses to sustain their theory, and that even for this purpose negative testimony is obtained not as representing the knowledge of the community upon the subjects testified about, but, after being carefully culled and selected, because it was thought, from the lapse of memory, from susceptibility to influence, or from other cause, the witnesses would be able to say, at least, that they had not seen the telephone, in such language as might be put into their mouths under the manipulation of shrewd examiners. The whole of it should be laid out of consideration.

The testimony of Kieffer and Wilson, persons to whom Drawbaugh had shown other inventions, and to whom he talked about his electrical business, standing by itself, has force; nevertheless, they are negative witnesses, and they cannot stand against the positive testimony of men who saw and talked through the telephone, remember the words, and identify the instruments.

Still, it is conceded that such negative testimony as Kieffer's and Wilson's and Lloyd's, unexplained and unanswered, would have greater value than that of ordinary negative testimony, and the Circuit Judge has given it almost controlling weight, because they were men with whom Drawbaugh had conversations about other inventions and electrical experiments, and because he did not speak of the telephone to them, and to whom it is assumed he would open his heart freely on the subject. As stated in the opinion in this connection, naming these witnesses with Weaver and Hauck (*supra*): "The proofs show that during the years from 1868 to 1878 he did not attempt to avail himself of opportunities for demonstrating his invention and bringing it to the notice of his friends, who were peculiarly qualified to appreciate it and were favorably circumstanced to assist him."

Without referring to the possible effect of influence upon the memories of these witnesses and complainants' influences upon all, we propose to show right here the radical error of this proposition, and to show by positive testimony that it has no material basis to rest upon.

Mr. Kieffer, Mr. Wilson, and Mr. Lloyd resided at Harrisburg, and were men of character without doubt. David A. Hauck resided at Mechanicsburg, and did not know Drawbaugh until he went to Eberly's Mills in the spring of 1873, for the Hauck Manufacturing Company. He is the witness heretofore discussed as having a litigation with Drawbaugh.

We reply as follows:

1. By the testimony of men of equal or of higher standing than these who figure in the opinion, who were more intimate and more likely to be applied to by Drawbaugh, that he did repeatedly apply to them and explain his invention to them; and,

2. As one reason why he did not speak of the telephone to the witnesses named in the opinion, or apply to them for help, that he was laughed at, derided and denounced as crazy by those men who knew him best, and were of as high character as those to whom he did not apply.

[Counsel here read from the testimony of twenty-seven witnesses on the first point and of many others on the second.]

We suggest that it would be presumable on such proof, aside from other reasons going to rebut this testimony, that the three or four witnesses testifying that Drawbaugh did *not* speak to them were omitted by him, because of discouragement or diffidence or experience of repeated rebuff, rather than that the positive testimony of himself, and of so many witnesses of character, is wickedly false.

Even Drawbaugh and his witnesses should now and then have the benefit of the old-fashioned, and still not obsolete, presumption, in favor of truth and honesty.

It was said by the learned Circuit Judge, that it was incredible that the statement of the witnesses could be true — that they could remember the words that they heard through the telephone.

We respectfully submit, that the criticism would be an apt as it is a usual one, if made of ordinary conversations, when the witness, after a long period of time, attempts to give the exact words; but, when a man is relating an exceptional experience, an astonishing result, a mystery connected with spoken words — it would be more incredible if he did not remember it.

Decrees and judgments cannot be based upon such reasoning, or against such testimony as we present, and they have not been.

To reach a result in this case resort has been had, not to the testimony, but to the somewhat vague and ill-defined theory of the inherent incredibility of the defence, and especially of the story of Daniel Drawbaugh himself.

We defer a discussion of the overwhelming evidence adduced and remaining uncontradicted in support of the priority of Drawbaugh's conception and invention, to consider somewhat the story of Drawbaugh as given in evidence, and Drawbaugh himself.

I now call Attention to Daniel Drawbaugh as a Witness.

At the outset, in considering Drawbaugh as a witness, there can be no question but that his history of himself and of his experiments and labors upon the electric speaking telephone from 1860 to 1879, inclusive, must be either a truthful statement, or one manufactured, in general and in detail, by a wicked mind; a mass of irredeemable perjury from beginning to end; and yet, none of the legitimate methods known to the profession but have been applied in this case, and no resource has failed to bring these methods to bear for the purpose of breaking down that testimony.

Upon the course and paths of his life, and his relations and dealings with all men from his boyhood down to his fifty-eighth year, the complainants have focused a light which has made luminous every detail.

Presumably, if his testimony could have been impeached, either by attacking his character or contradicting his statements by the direct testimony of others, it would have been resorted to. But we find that notwithstanding his difficulties, lawsuits, and controversies with men, by the testimony in behalf of the complainants, as well as of the defendants, that he bore a character, and had a life record, whose honesty and truthfulness could not be assailed. All bear testimony to his steadiness, his industry, his enthusiasm in physics, and especially in electric science. The worst that any man ever said of him was that he was crazy on the subject of the talking machine.

The record is full of evidence of the employment of "agents" from the community by the complainants in a search for matter wherewith to attack him. So that on the theory of the complainants and the theory of this decree, the wickedness and devilish cunning by which he sought to impose a fraud upon the public and to work out a great robbery must have been conceived after the publication of Bell's invention in 1876; and to further the scheme, that this witness fabricated a history in every detail and incident bearing on the controversy, covering a period of twenty years and over. He must have made and partially made telephones, having the necessary and harmonious appearance of age, of the most ingenious description, and prepared his story in that regard to stand the most scientific cross-examination in every detail, aided by trained experts.

While it may be true that a man may become suddenly vile, and change and radically contradict the evidence of the course of his life, and while there may be one or two or three illustrations of such monstrosities in the history of human nature, yet it has never been true in the history of jurisprudence that a fabricated story, lying in its general plan and lying in its detail, covering a long period and a series of transactions, could stand the tests applied to it in the courts of justice.

Drawbaugh's testimony covers 332 pages of closely printed matter in this record, of which 180 pages are cross-examination, and we think it may be said that the complainants commanded every available resource and all the ability and knowledge, both scientific, legal and common, in this work that could by any possibility be put into an attempt to break a witness by cross-examination.

A careful reading of this testimony, it seems to us, is convincing of itself and by itself of the truth of the story. The very faults of his memory, the immaterial contradictions and changing of immaterial dates only go to strengthen the conviction that the history as related is genuine and truthful. It is without a trace of the inflexibility which characterizes fabrication. The man that speaks is in harmony with the history of the man's character as related; in harmony with all knowledge of the honest, ingenuous, open-minded genius, as portrayed by the account of his life.

He will not corroborate Eberly, a preceding witness, as to a conversation in 1861–64 which was greatly in his favor, for the reason that he "cannot remember it."

He will not corroborate Lowrey's testimony that he was shown the cup instrument by Drawbaugh at an early time. He says: "I have been trying to recall it, but I cannot."

If he were cunning and corrupt, he certainly could, when examined in 1881, have been able to describe a rude receiving instrument, as he had described a rude transmitting one. Yet he says he cannot remember the first experiment in receivers, because there were so many different attempts and trials (11 Defts., p. 760), and so the instances of fairness occur throughout his testimony.

Drawbaugh not a Learned Man.

It is said by the complainants that Drawbaugh was not a learned man, and among the arguments to support their theory of inherent incredibility, thev say in effect that in the nature of things, no one but a scientist from the curriculum of the schools could have invented the telephone; that it was beyond his mental grasp; and it is said to sustain this proposition, that his inventions were of barrel machinery, jig-saws, nail-plate feeders, measuring faucets, and sundry electrical contrivances; or, as suggested by counsel, "mere mechanical contrivances and improvements;" and the fact of his busying himself with other inventions in mechanical contrivances is further used in support of the theory of inherent incredibility, as showing that he could not have conceived or had his mind upon so great a discovery as that of the transmission of articulate speech.

So far as the learning is concerned, we believe it can be shown that successful inventors are not the product of the universities, but of natural conditions and of tendencies common enough in American civilization. The tendency here is to learn and advance by experience. American genius cannot be said to be produced, though greatly aided, by school training and discipline. Genius is innate, and the man possessing it, who, even without books, learns of a natural principle or agent, like electricity, by handling and testing its properties, is the man who must advance in its use. No art and no words can portray upon the human mind the impression of a landscape that the actual view will give. No mere theory, though learned in all its technical formulæ, can give the accurate and ready knowledge which practice imparts.

Humboldt, in his "Personal Narrative of Travels in South America" (1799–1804), vol. 2, Bohn's ed., p. 111, says: "We found at Calabozo, in the midst of the Llanos, an electrical machine with large plates, electrophori, batteries, electrometers; an apparatus nearly as complete as our first scientific men in Europe possess. All these articles had not been purchased in the United States; they were the work of a man who had never seen any instrument, who had no person to consult, and who was acquainted with the phenomena of electricity only by reading the treatise of de Lafond and Franklin's Memoirs. Señor Carlos del Pozo, the name of this enlightened and ingenious man, had begun to make cylindrical electrical machines by employing large glass jars, after having cut off the necks. It was only within a few years he had been able to procure, by way of Philadelphia, two plates, to construct a plate machine, and to obtain more considerable effects. . . . I had brought with me electrometers, mounted with straw, pith-balls, and gold-leaf; also a small Leyden jar, which could be charged by friction, according to the method of Ingenhouse, and which served for my physiological experiments. Señor del Pozo could not contain his joy on seeing for the first time instruments which he had not made, yet which appeared to be copied from his own."

The Royal Society of London once elected to honorary membership a man who first demonstrated that lightning and electricity were one. It was the same man whose reports as to his experiments with a kite and a key it had formerly refused to receive and had made sport of. He stands in history and science as eminent, and is set down as among the most eminent of natural philosophers. He was a "Yankee tallow chandler's son, a printer runaway boy," for whom the schools did nothing.

Michael Faraday was the son of a blacksmith, and a bookbinder's apprentice. After attending four lectures of Sir Humphry Davy, he gave his attention to practical experiments with electricity. J. Clark Maxwell, Professor of Physics, Cambridge, says, of Faraday's "Experimental Researches," resulting in the discovery of the induction current: "It was at once made the subject of investigation by the whole scientific world, but some of the most experienced physicists were unable to avoid mistakes in stating, in what they conceived the more scientific language than Faraday's, the phenomena before them."

Maxwell on Electricity is largely devoted to reconciling the practical methods of Faraday with the theories of the professors.

Hugh Miller's great conceptions took form when, without education, he was working as a laborer at the Cromarty stone yards.

Ampère worked out difficult mathematical problems with sticks and stones before he had learned the names or forms of figures.

But, says the court below, "Drawbaugh was not only untutored, but he was isolated by his associations and occupation from contact with men of advanced science;" and on such reasoning it is found that he must be a swindler, because he dares to pretend that he invented the telephone.

But it is said Drawbaugh busied himself with mechanical contrivances of comparative insignificance.

In 1793, Robert Fulton conceived the idea of propelling vessels by steam, and we find, by a reference to his life (C. D. Colden, 1817): "His time was also much engrossed by devising a method of superseding the locks of canals by a plane of double incline, on which he obtained a patent in 1794. In the same year we find him obtaining patents for flax-spinning and rope-twisting machines and various other mechanical inventions," bearing upon the construction of canals. In 1797 he went to Paris and resided there seven years, during which time he projected the first panorama ever exhibited, and made important experiments in submarine explosives. It was not until

1806 that he made his successful experiment in propelling vessels with steam in America, and not until 1809 that he took out his first patent.

Guttenburg, pending the tardy recognition of his discovery of the art of printing, was engaged upon inventions for new methods of polishing stones, and manufactured looking-glasses. Franklin found time to acquire something of income from the printing-press invention, from improvements in stoves, "Poor Richard's Almanac," and various other contrivances.

Again, the attack is made upon the credibility of this story, upon the ground that such an invention would have been widely known, and would have commanded all the resources necessary to present it to the public. The great success of Bell after the exposition of 1876 is cited as an illustration. We suggest the marked contrast between the presentation of Bell's alleged invention, under the sanction of international commissioners, framed in the authority of the World's Exhibition at Philadelphia, and the invention of Drawbaugh, in the lowly village shop of Milltown, in a by-way not merely of the world, but a by-way of the State of Pennsylvania, and a by-way of County of Cumberland. We submit that the complainants can take nothing of benefit from the fact that such men as lived in that community, and such men as passed that way, should not care to invest in any telephone, which seemed a mystery and a novelty, but of no practical utility to the learned and the rich of the great cities, long after Bell's patents were issued.

Morse conceived the idea of the electric telegraph on the packet ship Sully, in 1832, and on that voyage made his rough drafts of the apparatus. For twelve years thereafter he struggled with poverty to perfect his invention, and to secure any consideration for it. During this struggle he denied himself the common necessaries of life. Not until 1836 was he able to exhibit it to his friends. In 1843 he got it sufficiently before the public to secure an appropriation, and it was used for the first time on the 24th of May, 1844.

Elias Howe for years suffered the pangs of poverty and failure to get friends or capital interested in the sewing machine in this country or in England. He never advanced to fame and fortune until his controversy commenced with Singer.

"And yet," says the learned court, following the theory of counsel, "such an invention is of a kind well calculated to excite public interest and to impress practical men with a quick appreciation of its commercial importance and its pecuniary value, . . . and its efficiency and importance as a factor in human intercourse could have been demonstrated to the public without appreciable inconvenience or expense. Drawbaugh fully appreciated its importance and value. He had the means to patent it himself, and friends to assist him in introducing it into public use. He had the talent to induce others to invest in his invention."

No better answer can be found than in Bell's own case. See New York *Tribune*, article November 9, 1876, C. Vol. 1, p. 250; *The Scientific American*, October 6, 1877, C. Vol. 1, p. 273; testimony of Hubbard, Bell's financial backer, C. Vol. 11, pp. 1, 613–4, 662; and Complainants' Exhibits, p. 959.

Exceptional Treatment of the Defence.

Now, what is there in this case that so distinguishes it in the domain of judicial investigation as to require a reversal of settled rules of evidence?

Direct and positive affirmative evidence, unimpeached and uncontradicted, seems to have failed of legal virtue when applied to this particular controversy; and the rule as to presumptions is so radically altered that the testimony of four doubtful witnesses, that they did not hear of a fact — nay, that they did not remember hearing of it — shall be received as finally closing the door against the possibility of its existence, and against the recognition of all direct and positive testimony of twenty-seven equally credible men and women, that they actually did see and hear of the thing.

Yet, we are told that if "he" (Drawbaugh) "had a practical telephone to exhibit, he would have selected just such men" as Kieffer, and Wilson, and Lloyd (who was "taken good care of," Complts., 1, 480); and Hauck (who was Drawbaugh's enemyand of doubtful veracity), "to demonstrate it to them and to enlist them to demonstrate its utility and value to the public." And although he did apply to twenty-seven others, it is conclusively assumed that he did not have a telephone, because he did not apply to these four gentlemen. As well might it have been assumed that Howe did not invent the sewing-machine, because it appeared after repeated attempts among his nearest friends, after suffering contumely and reproach in these efforts, that his heart and courage so failed him that he ceased his applications and departed for England without risking further coldness and refusal.

But it seems that this case is not only *sui generis* in jurisprudence, but the ordinary experience and history of human nature, of men's motives, of men's probity and intelligence, can teach us nothing by which to judge of Daniel Drawbaugh "and the cloud of witnesses who corroborate him." Although the biographies of science are full of instances of great discoveries by men of little or no scholastic discipline and who have had no contact with scientific men, yet as Drawbaugh was not a college professor, but a common citizen of Milltown, where he seldom met learned physicists, he could not by any possibility have invented the telephone.

Although the greatest inventors and discoverers, from the earliest to the latest, have either died in poverty or succeeded only after long failure to obtain recognition of their discoveries, and year after year have suffered every discouragement and the greatest distress; although this has been a common experience even at the most learned and wealthy and enterprising of the world centres; yet, because Drawbaugh, in the little village of Milltown, could not at once command recognition and influence and capital for the new machine whose uses were unknown, "this story must be a fabrication from beginning to end," and the learned Circuit Judge so holds.

And because a community corroborate him, it must be a population of knaves or fools. Even the fact that his fertile mind has produced many other inventions of less note and importance, this very evidence of a mind active in the direction of invention is turned into testimony that greater discoveries are beyond his scope.

The logical conclusion of all this reasoning must be, and by the opinion of the learned court is, that Drawbaugh himself is the malign necessity that demands a new and a special law of evidence and a reversal of all the commonly received notions of human nature to fit this case.

If his story be false, he has built a colossal structure of fiction. The lies in it are bricks in a great building for number, and a flaw in one would bring destruction to the whole.

As the complainants' whole theory and the decision of the court below rests upon the basis that Drawbaugh is a fraud, and has had the ingenuity to set up the story and the influence to get it so overwhelmingly corroborated, we submit from the record a brief sketch of—

Daniel Drawbaugh's History, Surroundings and Testimony.

If a charlatan, as he is set down by the court below, unlike his kind, he has not led an itinerant life. All that can be told of him from boyhood to age, all the evil or good that is known of him, all the evidences of character that a man leaves in the places that have known him, all the impressions which the course and methods of life of men place upon their environment, exist and are written of Drawbaugh in one place and upon one community.

The story from his earliest to his latest years is a very simple and homely one. If it be true that he developed into a Machiavelli in his fifty-third year, the incongruity is worth consideration from the moral philosophers.

Born in 1827, he has passed his life in the small village of Eberly's Mills, or Milltown, in Cumberland County, Pennsylvania. It is three miles from Harrisburg, and the centre of a farming community. He attended the common schools part of five winters, and in his early years was a reader of *The Scientific American*, when he could afford to pay his subscription; his scientific library consisted of Comstock's Philosophy, Youman's Chemistry, and two volumes of Tomlinson's Cyclopædia of Useful Arts, together with a publication on the International Exhibition of 1851.

Before the spring of 1860 he attended a course of lectures on physics by Professor S. B. Heighes, now Principal of the State Normal School, and for seven years professor of physical science at the York Collegiate Institute. During his attendance upon these lectures, we have it from Professor Heighes that Drawbaugh was giving attention to electric science, and the professor remembers distinctly that even at that early time he had conceived, and talked of, "*speaking through a telegraph wire by electricity.*"

The same witness remembers distinctly, and fixes the date positively between 1871 and 1874, that Drawbaugh showed him Exhibit "C," and told him that the voice produced "pulsations" upon the machine. It is undisputed that at that early time he was experimenting with electricity. Complainants' witness G. W. Heighes says: "He was an enthusiast on the subject of physics at that early time." He was familiar with the Everett acoustic telegraph and with the Leon-Scott phonautograph from about 1863. "The subject of electricity seemed to be his hobby."

He was a person of remarkable ingenuity and skill. At the age of thirteen he made a rifle for Daniel Balsey, and at a later period was remarkably skilful in wood-working. At the age of twelve he made a part of a clock. At the age of sixteen he manufactured a small steam engine, an automatic machine for sawing wooden felloes; the last being his own invention. In 1857–1859, he constructed and operated a photographic apparatus, making even the lenses himself. He made for his own use a solar transit and a machine for wrapping electric wires. He made his own galvanometers. Of his skill as a workman, complainants' own witness and his enemies have nothing but praise. Very few men would venture to offer advice to him, and he was applied to by others to invent, and did invent machines for them — the tack machine for Patton; the paper-bag machine for Sengiser; and a great many other machines for the pump company and for the axle company. A number of his inventions are enumerated in Dfts., vol. 2, pp. 895, 1061, 1062.

"He was a great mechanical genius" (Complts., vol. 2, p. 1550) and "a great inventor." (Id., vol. 1, p. 864.) All the witnesses concur as to his sobriety, his truthfulness, and his incessant and tireless industry, and his labors, extending far into the night.

He was careless of his own interests and generous and kindly in his nature. His children were sickly and died, and his wife made constant opposition to his schemes, as tending to take his attention from providing his family with the necessities of life.

The story of Mrs. Drawbaugh presents a picture of the man as he appeared in domestic life, so naturally drawn by this plain woman, that it carries conviction of its truth in every particular. He was negligent in money matters, and when he had money "he would give away the last cent." She refused to sign the deed when Drawbaugh wished to sell their little home, to put money into the talking machine. There is a vast amount of testimony as to his poverty, in addition to Mrs. Drawbaugh's, abounding in illustrations, to which we only briefly refer. [Counsel here cited and referred to a mass of testimony as to Drawbaugh's financial condition.]

Notwithstanding the undoubted testimony that his wife refused to join in utilizing the equity in the property to raise money to put into the talking machine, it is gravely urged against Drawbaugh that his story is improbable because he did not sell the homestead to raise money to introduce the telephone.[1] But the court below says, in effect, that the story of his poverty was a fabrication formulated in the answer. The answer was "formulated" and filed in January, 1881. The complainants' witness, Matthews, of whom the learned Judge speaks most approvingly in the opinion, in his Baltimore American article, in speaking of the impression made upon his mind by a visit to Drawbaugh in April, 1878, says: "This unlettered mechanic came very near anticipating Edison and Bell in the invention of the telephone. *Nothing but his poverty prevented him from conducting his experiments to a successful issue.*"

And the court below says that Drawbaugh is "dishonest" in his pretence of poverty.

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[1] See opinion, p. 16.

Was Drawbaugh a Charlatan?

The able opinion of the Circuit Judge is exhaustive in its treatment of Drawbaugh as a conspirator, a perjurer, and a general fraud.

We have discussed the evidence upon which this theory rests, with the exception of that on which this charge rests. It is found in J. C. Nesbit's testimony in "The History of Cumberland County, Pennsylvania, by Rev. Conway P. Wing, D.D., and others, 1879," published by the Herald Printing Co., of Carlisle, Pa., and containing at page 200 of said publication an article headed "Lower Allen Township, by H. C. Nesbit."

The court assumed that the biographical sketch was written by Drawbaugh himself; but it appears distinctly on the defendants' cross-examination of the witness and the production of the original manuscript, which was under the control of the complainants, and not by them at first produced, that it was in the writing of Hull. It even left the date of Drawbaugh's birth blank, which was supplied in the published article.

Now, the main facts in this biographical sketch are undoubtedly truthful, as is shown by the whole record here. The florid style of the article, on which alone the charge of charlatanry is based, is evidently that of the provincial newspaper man, and entirely foreign to Drawbaugh's. It abounds in terms not possible to Drawbaugh, as shown by his simple methods of thought and expression in the 332 pages of his deposition, which conclusively answers this last attempt to picture his opposite as Daniel Drawbaugh.

We now submit a Brief Sketch of the Conception and Progress of Drawbaugh's Telephone.

He himself says he cannot remember the date when he began to study the subject, and that "it was a long while ago." He had experimented with the vocal organs by placing his hand upon the throat and feeling the vibrations of the vocal chords, and the fact that sound had the effect to set up vibrations in solid substances, he had learned by noticing the effect upon the surface of partitions, and by experimenting in the effects produced by extending a light wooden bar between partitions, and then by causing a vibration upon one partition, discovering that the bar transmitted the same vibration to the opposite partition. He pursued the principle always, that the current must not be broken, and from the first his conception was of a continuous current.

His idea of pulverized matter is, in this connection, interposed in the current, not breaking it, but causing a greater or less flow, as the particles form a greater or less resistance to the passage of the current, as they might be pressed together with more or less force. He speaks of conversing with medical students at Washington, D.C., about the transmission of sound as long ago as January, 1861, the date of the visit being fixed positively by a receipt taken in Washington, and states that he then had his mind employed on the subject.

Henry B. Averly testifies that between 1861 and 1864, and during the war, Drawbaugh, in the mill office (Averly's grist mill), in the presence of several witnesses, including the witness, spoke of attaching an instrument to the office in the mill, by which he could hear all that was going on there without leaving his house. Averly moved away in 1873, in May, and has never been to the county since, and Drawbaugh moved out of that house in April, 1868, and never again lived in it while the witness was a resident of Cumberland County.

In the argument below, counsel for complainants said of David Stephenson, resident of Harrisburg, that he was a machinist, and "worked for and with the Faucet Company (of which Drawbaugh was superintendent), as a maker of patterns, in 1867 and 1868, and that he and Drawbaugh had many and intimate relations with each other ever since. They appear to have been partners or jointly engaged in the manufacture of certain pumps. He has been and still is a friend of Drawbaugh's. Now, here is a machinist and a machine-shop man, a keeper of machinist's supplies stores, intimate with Drawbaugh, having worked for him in his shop — quasi-partners. . . . If there was a telephone there, he must have known everything about it; but they did not put him upon the witness-stand." In the additional proofs taken in the *Overland* case, this gentleman, who is highly spoken of, was put upon the witness-stand, and he testifies that he *did* know all about Drawbaugh's Electric Speaking Telephone; that Drawbaugh showed it to him while Drawbaugh lived in that house close to the grist-mill, during Drawbaugh's first occupancy of that house, which occupancy terminated in the spring of 1868. He shows that Drawbaugh repeatedly experimented with the instruments, with his assistance. He shows that the instruments were connected by wires, and that the wire came from the outside of the building from a porch, and that the wires ran zig-zag (back and forth) "to give length to the wires," and that Drawbaugh told him that it was operated by electricity. He talked through the instrument from one room to another. Later, in 1874–5, he says: "He sent me to the cellar, and after giving me a small instrument in my hand, he suggested that he would go on to the upper floor and speak to me and I should let him know what he said, and how distinctly I heard it. . . . I heard him speaking in short sentences and singing, and then went up-stairs and met him coming towards me, and told him what he said. I heard him very clearly, and I didn't miss any words in repeating what he said, excepting his singing; I didn't repeat that."

Q. — "How did the sounds, heard through the machine that day, compare in loudness and distinctness with those which you heard through the old machine at the shop at the grist-mill, as you have testified?"

A. — "With more force and clearness at that last time."

He is corroborated as to the later dates by his daughter.

We have the testimony of Prof. Samuel B. Heighes as to Drawbaugh's great interest in physics and particularly in electricity, and of his talking of speaking through an electric wire by electricity in 1859 and 1860, and witness *saw* the telephone there in 1871–4. And we here refer to the testimony of many other witnesses of a similar character.

The story of Drawbaugh, and of the record, overwhelmingly corroborated by the witnesses for the defence, is as follows:

Early conception and experiments with the continuous current, 1862, 1866, and 1867.

Teacup transmitter and receiver, 1866 and 1867.

Tumbler and tin cup and mustard can ("F" and "B"), 1867 and 1869.

Improvement upon "B" ("C"), 1869, 1870.

Further improvement upon "C" and the more perfect magneto instrument "I," 1870, 1871.

Mouthpiece changed to centre, and adjusting screw inserted (Exhibit "A"), 1874.

"D" and "E," perfectly adjusted and finished magneto instruments, January and February, 1875.

"L," "M," "G," and "O," from February, 1875, to August, 1876.

"H" August, 1876.

"J," "N," and "P," 1878.

With the exception of the old teacup transmitter (2 D. p. 756), representations of all the instruments are in evidence, in whole or in part; parts of those produced prior to the instrument "I" of 1871 being in evidence, and "I" with all thereafter produced being in evidence in their entirety. The temporary experimental structures, the changes in parts and constructions, great and small, in working out the great discovery are not here, and of the thousand and one efforts made in the progress of the invention there is no memorandum. We submit it is not to be conceived that any mere memory could recall them.

Faraday's experiments, which resulted in the discovery of the induction current, marked an era in electric science, and to reach it he experimented from 1824 to 1831. He kept a record of his experiments. Had he not, imagine Faraday at a period subsequent to his discovery attempting to give from memory the first and second, and the myriad of other things, and details small and great, the smallest of the greatest results, and the greatest of the smallest, during these years leading up to the result. And yet, one of the strongest criticisms of Drawbaugh appearing in the arguments of counsel, and even in the opinion of the learned judge at circuit, was that he was unable to describe all of his first experiments.

In the series of instruments and drawings produced, the development from one to the other appears to have been perfectly natural, from the loose, pulverized, low conductor, to that of the closely confined, so that the pressure might be rendered more easily adjustable; the evolution from the first rude instrument sketched in Drawbaugh's testimony just referred to, to the tumbler transmitter "F." In this also is seen the progress to the wooden cover and mouthpiece upon the diaphragm, in which the membrane diaphragm had given place to the metal one.

In experimenting with the receiver we find him abandoning the unnecessary parts in the tin can "B," as from the latter is evolved the later and more perfect instrument. Upon using "C," and finding that it would transmit, though feebly, using "B" as a receiver, he then places a permanent magnet against the heel of the electro-magnet and finds a great improvement, and Exhibit "C" as a transmitter is the result.

In the next improvement in this machine he incloses the parts, and, of necessity, makes them compact. The experimental magnet is then arranged, and from this comes Exhibit "I" with its several improvements, until Exhibit "A" is the result; later "C" and "I," still having a large diaphragm, were observed to give out a false vibration, and then he conceived the idea of dampening them to prevent the false vibration, by means of an adjustable rubber pad, and then moved the mouth orifice to one side and applied the dampened pad and screw. This not succeeding, he then determined to reduce it in size, and found the best results. After having made crude instruments to test and settle the matter, and finding his conclusions verified, he reconstructed the two into two compact working instruments, "D" and "E," in February, 1875.

From the time of his discovery that the instrument "B," as improved in "C," would act as a transmitter by application of the permanent magnet, he had thus far proceeded directly in the line of improvement of the magneto transmitter, and had done nothing with the carbon instrument, although he used it quite commonly in connection with his other experiments. At this period, in 1875, he turned his attention again to "F," the carbon transmitting instrument. He experimented with carbon, and Halsinger saw him baking carbon composition into cakes. After experimenting with these cakes in the trial tumbler instrument he rearranged them and produced Exhibits "L" and "N," and combined in them the receiver and transmitter. Then he constructed a pair of transmitters with hard carbon, without combining the receiving mechanism in the same instrument, and from this we have "G" and "O."

In connection with the later instruments there is a piece of testimony that seems to us conclusive in favor of Drawbaugh, upon the question of his ability to invent the telephone, and in favor of our theory of the gradual progress of his experiments from the crude instrument, patentable and a speaking telephone, to the perfected and nicely adjusted one.

It is a matter of history, as well as in the record, that the Blake carbon transmitter is in use upon most of the Bell instruments at this time. Blake's sworn statement in the Patent Office, in an interference, shows that he never even conceived the Blake transmitter invention until after July 4, 1878, and that he never made a Blake transmitter until late in the fall of 1878. The other side have put in evidence Blake's patent, which was not granted until long after the date of the commencement of this suit, so that by law and by the rules of the Patent Office, Drawbaugh could have got no knowledge from it. It is further in evidence in complainants' testimony, that the Blake transmitter instruments were not put into use until the spring of 1880, and that the telephones in use prior to that time, were of a form known as the "Phelps's Snuff-box" instrument, and the "Crown" and "Pony Crown" instruments, so that it is not possible, under any conceivable circumstances, that Drawbaugh could have derived any ideas from the Blake transmitter as early as May, 1878. Drawbaugh's perfected carbon instruments "N" and "J," as shown by Stees and Johnson, who testify in the most minute, circumstantial and positive manner, corroborating Drawbaugh in his testimony, were taken to the office of William J. Stees, in Harrisburg, in 1878. They fix the time absolutely beyond doubt, as the 10th day of May, 1878, and that the instruments remained at Stees's office several months. They both identify the instruments positively, and testify that while they were at the office they put them on the telephone line and talked through them, and that they worked admirably; that they saw the instrument, Exhibit "J," and recognize the parts in it just as shown in the exhibit; and Stees further testifies to the important fact, that while the instrument "J" was at his father's office, he took it in his hands to carry it across the office, in order to change its location, when his father accidentally ran against him, and he dropped the instrument, and that he discovered at that time that the small, hard carbons which the instrument contained had become loose and fallen out.

William J. Stees is the gentleman who, the complainants show, introduced Drawbaugh to the Western Union Telegraph office, to look at a telephone, and was accidentally killed at the very outset of taking defendants' testimony in the case.

Drawbaugh was seen by Some of the Witnesses working with the Earlier Machines, after the Perfection of the Instruments "D" and "E," on other earlier Magneto Instruments. The Explanation is a simple one.

Some of the witnesses testify to seeing the tumbler "F" and the tin can "B" as late as 1877. But the fact loses all force against the defence, when it appears indisputably proved and is beyond the ability of conspiracy to have fabricated, that Drawbaugh, on discovering that the magneto receiver "B," as improved and organized in the improved "C" in 1870, would serve as a transmitter, temporarily abandoned the variable resistance transmitters "F" and "B," and did not return to experiments and progress on them till 1875. From them, through a series of experiments and improvements, came finally the perfect carbon instruments taken to Stees's office in 1878, above referred to.

Of the Comment that Drawbaugh was still experimenting, and said the Machine was not perfect, at times when defendants' evidence shows that he had accomplished the invention, we say:

Aside from the fact already shown, that he was at work on the magneto and carbon instruments at different times, there is a very simple answer which appears incidentally and naturally throughout the record. No effort was made to bring it out, and it appears in the testimony of witnesses, as in that of Drawbaugh, without consciousness on their part or his, that it was of any special consequence.

It is this: That the instrument in his view "was not loud enough for practical purposes" unless it would talk, without holding to the ear, and convey the sound as far as ordinary speech. He wanted it to talk out as a man talks.

As George Free puts it of his conversations with Drawbaugh in 1876, 1877, 1878 and 1879: "He told me that he wanted to accomplish, and could do it, to make a machine that you could stay in one corner of the room, and putting the machine in the other corner, and hear as distinctly as putting it to the ear," and that Drawbaugh told him that he had not done it yet, but "I am working at it, and I am going to get it accomplished."

When that journal of civilization, the *New York Tribune*, thought the only use of the telephone would be for "diplomats and lovers," when the *Scientific American* summed up the public opinion of it as "a beautiful scientific toy," when Gardner G. Hubbard, a telegraph manager and Professor Bell's financial backer, "did not then believe the transmission of speech could be made commercially valuable," when all his friends laughed at him, it cannot be wondered at that Drawbaugh, in the little village of Milltown, years before, should not have realized that his instrument had reached practical perfection, when it would talk only by holding the receiver to the ear.

Of the Criticism that Drawbaugh did not make known his Invention to his Associates in the Shops where he worked, we say:

This charge, like many others, has nothing to rest upon.

The Axle Company carried on business at the shop now occupied by Daniel Drawbaugh. It was composed of M. M. Grove, Wilson Baer and Captain J. A. Moore. It commenced on the 23d day of December, 1874, and dissolved on the 29th day of February, 1876. All three, Baer, Moore and Grove, testify to their knowledge of the talking machine during the operations of the company, and as we have seen, Drawbaugh applied for assistance to all of them.

Of the old Faucet Company, which commenced business in 1867, the secretary and treasurer, Dr. N. B. Musser, is dead; but it appears by the testimony of Prof. Samuel B. Heighes that Musser was with him at the examination of the talking machine in May, 1872. Musser was his brother-in-law. W. R. Gorgas, a bank clerk, now thirty-three years of age, residing at Harrisburg, testifies to the fact that the Faucet Company was a failure financially; that he left the shop in September, 1869, and took very little interest in the affairs of the company. He is not called by either party on the point of knowing anything about the talking machine. He testifies that he was sick of patent rights through the failure of the Faucet Company. He remembers that Drawbaugh came to him and wanted him to take a half interest in some invention, he forgets what; but as the witness had lost about $4000 in the old company, he "had had a surfeit of it and didn't pay any attention to it."

John F. Hursh was a member of the old Faucet Company until 1871, and he testifies that he didn't know of the talking machines. For the value of his testimony we have no comment to make, save to cite his manner of testifying.

Jacob A. Shettel, a member of the Clock Company, testifies, and fully and positively corroborates Drawbaugh.

Emanuel A. Gregory, a member of the old Faucet Company, and his son Joseph, who both worked in the shop, fully and positively corroborate Drawbaugh.

John C. Schrader and E. B. Hoffman, and David Stephenson, before referred to, connected with the Faucet Company, give the strongest possible testimony for the defence.

In the Axle Company, the work was largely done by Daniel, H. K. and J. B. Drawbaugh. Daniel Fettrow, John Wolf and Augustus Kahney, all testify to a perfect familiarity with the work on the machines and the machines themselves.

Theodore Grisinger (1 Comp., p. 511), a member of the Clock Company, testifies for the defence. The Clock Company started in the spring of 1878. He testifies to a conversation with Drawbaugh in the spring or summer. The tendency of his testimony is to show that there was no telephone there, and that Drawbaugh was merely experimenting; inasmuch as he swears he did not see Exhibits "F" and "B," and swears that, as a fact, he could not have seen them and forgotten them, while we know that they were there, from the complainants' testimony, and they are admitted to have been there in 1876 and 1877, as we have seen, we submit his testimony is of no weight. He did see two telephones at some time, and says that he has seen Exhibit "A" somewhere, and must have seen it at Drawbaugh's shop.

The other member of the Clock Company is dead.

Jacob Carnes (Comp. 1, p. 883), worked in the machine shop at Eberly's Mills for the Drawbaugh Manufacturing Co., from 1868 to 1871, and boarded in Drawbaugh's family. He testifies that he did not see any telephone and never heard that one had been invented *previous to 1880*. He is thoroughly contradicted by Mrs. Margaret Brenneman (D. Surreb., p. 103), who lived in the family at the time Jacob Carnes was a boarder there, and she is corroborated by her mother, Mary M. Darr (Id., p. 109), and by John C. Schrader, who boarded with him, *supra*. Of course, his testimony is absurd, because it is beyond question, and is admitted on all hands, that all the telephones were made prior to 1880.

Defendants' Testimony.

We now refer to the testimony at length, of the members of the community at and about Eberly's Mills, of the visitors there, and of the former residents of that place, covering the period of Drawbaugh's history of his invention of the telephone, and of the various stages in its improvement.

Ephraim R. Holsinger and his Publication of a Card for Drawbaugh, not including in its List of Inventions the Talking Machine.

He was a newspaper man and a job printer and lived at Eberly's Mills from September 13th, 1873, to November 27th, 1876, but was never there after he moved away, at the latter date. During this time he was much at Drawbaugh's shop, and assisted the latter a great deal in experimenting. He identifies a large number of instruments as having been seen by him at Drawbaugh's shop, to wit: "A," "B," "D," "E," "F," "I," and testifies that he had helped to experiment with all of them. He describes the experiments at length.

This witness was called by the complainants who proved by him that he had published a card for Drawbaugh, before June, 1874, containing a partial list of inventions and not mentioning the telephone. This card figures in many places in complainants' brief, and seems to have taken up considerable space in the opinion of the court, and here it is:

Daniel Drawbaugh.

INVENTOR, DESIGNER

and

SOLICITOR of PATENTS.

☞Also Models Neatly Made To Order.

Eberly's Mills,

Cumberland County, Pennsylvania.

[See Other Side.]

Dan'l Drawbaugh,
INVENTOR OF
THE FOLLOWING PATENTS.

Stave, Heading & Shingle Cutter.
Barrel Machinery.
STAVE JOINTING MACHINE, Many in use.
Tram & Red-staff for leveling face of Millstone.
Rine and Driver for running Millstone.
Nail Machinery for Feeding Nail Plates.
PUMPS, ROTARAY & OTHERS.
Hydraulic Ram.
THE DRAWBAUGH Rotary Measuring Faucet, very extensivly used.
CARPET RAG LOOPER.-- A little device by which rugs are looped quick and firm, without Needle or Thread.
ELECTRIC CLOCK.

MAGNETO ELECTRIC MACHINE,

For short line Telegraphing, Fire Alarm, and Propelling Electric Clocks. It can be applied to any form of Electric movement. Gives entire satisfaction USEING NO *GALVANIC BATTERY.*——
For SIMPLICITY it has NO RIVAL.

We say of it:

(1) It was prepared by Holsinger, without Drawbaugh's supervision, and as a sort of return for Drawbaugh's aid to him in getting him assistance to start a newspaper. It bears internal evidence of inaccuracy in describing inventions of Drawbaugh's, notably in its description of the electric clock.

(2) *It purports only to give a list of patented inventions.*—It omits the stamp canceller, the siphon pump, the machine for wrapping wire, the weather indicator, the gas governor, the automatic boiler feed, all proven by complainants as before that time. It inaccurately gives as patented some things not patented; but Holsinger knew well that the *telephone* was not.

(3) It purports to give a list of those things likely to bring money-earning business from the surrounding neighborhood, in practical every-day tools among the people where the card was issued. The only electrical machine mentioned is referred to with a special emphasis on its *simplicity* and the absence of a battery, thus giving assurance of a practical machine for practical uses among the country people.

(4) As a card issued to farmers, millmen, and housewives in Milltown, the advertisement for sale of a double machine for telephoning would have been absurd.

(5) It was early in 1874, and Drawbaugh had no telephone machines ready for sale, and the card purports to advertise only for sale to the class of people about there, and it omitted the gas governor and wire wrappers and the stamp canceller, for the same reason, *i.e.*, such people did not use them.

(6) As Drawbaugh was then experimenting to make it "talk out," and had not patented it, but was negotiating to get financial aid in the enterprise, he would not care to advertise to patent pirates the matter of his greatest work, to no good purpose.

(7) Drawbaugh was said to be a fool and insane at the same time on account of his devotion to his invention; his labors had come to be unremunerative, and his object was, as shown by his moving to Mechanicsville, the next year, to get every-day work, and let the people know he was doing it without calling marked attention in that community to his "hobby," and the subject of adverse criticism, which was notorious, among the people whose custom he sought by the card.

(8) Holsinger talked through the, to him, perfect, because finished, machines "D" and "E" (not finished until February, 1875), in the summer of 1875, a year after the card; and the "Experiments," as he calls them, of 1874, were with the rude and unclosed machines "F," "B" and "C."

Finally. — After this testimony, and after his memory was refreshed by the card, the witness distinctly and emphatically states to the complainants that his testimony for defendants, as just analyzed, is correct, and says his memory is unchanged.

Any one of the foregoing reasons is a more complete explanation of the card, than the assumption that this reputable and unimpeached citizen and the host of corroborative witnesses are perjurers, or that Drawbaugh did not advertise the telephone because he did not have it.

Dates.

Of the witnesses, all, with the exception of those where later dates are given (eight), give their testimony as to having seen or talked with the machines prior to June 2, 1875, the date of Bell's invention; and in every case the testimony shows that the date has been fixed accurately by collateral and convincing circumstances. To illustrate, the dates are as accurately fixed in a great majority of instances as in the case of ex-Congressman Haldeman, of Harrisburg. But to corroborate the dates we call a number of witnesses, who testify as to being told of the machines and of the common report of the machines at the dates which the foregoing witnesses have fixed as the time they saw them; and this latter class of witnesses as accurately fix the dates. There would seem to be no possible collusion here, as when a witness has testified to a collateral fact, we have in almost every instance called a stranger to the witness, giving the direct testimony, to establish the date of such collateral fact.

To illustrate the method of fixing these dates, Spafford and McHenry, and Bricker, were commissioners appointed under an act of the Pennsylvania Legislature, of April 3, 1869. Having filed their report of the complete adjustment in the Court of Common Pleas of Clinton County, November 1, 1869 — a certified copy is shown in this record. They never saw each other after this survey was completed until they met in Harrisburg to testify in this case — Bricker, Spafford, McHenry. Spafford and McHenry were persons of high standing in the community, and were personally named in the act of April 3, 1869, as commissioners for this important work. Spafford and McHenry were never in Milltown, but heard of Drawbaugh's talking machine from Bricker in October, 1869, while adjusting the Clinton County line, and it was talked of fully by the commissioners at the time. Bricker got his information with regard to it from Henry Drawbaugh at Newville.

Bolye, Brenziger, Goldsmith, Irwin, McGraffic, Stackpole, John H. Updegraff, Mrs. Fry, Mr. Hake, Mr. Young, Mr. Strouse, and Mr. Weaver fix the date of Dr. C. E. Updegraff's visit at May 1, 1875, and the dates are fixed by these witnesses conclusively by fixing the time of the visit and the place they started from in Harrisburg and the details of the visit, through the records of the Odd Fellows' lodge, of the places they were boarding in, and by the testimony of fellow-boarders, and of their talking of the talking machine on their return.

The witnesses for the defence who saw and talked through the machines, identify them as of dates in harmony with Drawbaugh's testimony as to making them; which, according to the latter's testimony, in the succession already shown, down to and including "D" and "E" (which are conceded by the other side to have been perfected machines), and all prior to March, 1875.

The New York and Philadelphia Tests of the Reproduced Tumbler Instrument "F" and the Tin Can Instrument "B," and the Magneto Instruments "C" and "I."

A number of the original parts of these instruments exist and are in evidence, and from the parts and from the testimony of Drawbaugh and other witnesses describing them, reproduced instruments were constructed, in order to show the court how they appeared and acted, when completed in all their parts. Of the reproductions, "F" was the only one of the four which was a carbon instrument. It is in evidence that they had been made some time before the New York tests, and had been very roughly handled, and their adjustments were in a loose and shaky condition. It is said that these instruments failed to operate successfully in the New York tests, although they all transmitted words, and even sentences. The court below lays great stress upon the failure of these instruments to do satisfactory work in these tests. The instruments were again reproduced and properly adjusted at Philadelphia, and worked perfectly. It was impossible for the complainants' experts to find any difference between the reconstructed and adjusted machines tested at Philadelphia and the description of them and of their parts and adjustment, as given by Daniel Drawbaugh in his testimony in 1882. It is difficult to see how the criticism could be justly made that the witnesses who testified that they talked through these old instruments, as they originally existed, must have falsified, because of any failure of the New York tests on the reproduced instruments, in the light of these considerations and in the light of the complainants' own testimony. In the original case, complainants' expert, Mr. Pope, testified, agreeing with the defendants' expert, Mr. Benjamin.

It is difficult to see wherein the essential parts of these machines differ, and it is perfectly plain that the New York tests failed of perfect action from the rough treatment the machines had had, and from having been shaken out of adjustment. Complainants' witness, Professor Wright, of Boston, in his notes of the tests of the instruments used in New York, states the results as follows: "'F,' reproduced as transmitter; Drawbaugh talking, Tisdale receiving — heard very well; understood very well, numerals counted, and conversation." Whatever instruments were used by complainants' experts, Pope, Cross and White, in their private tests, were not put in evidence, and they were unable to say they were reproductions of the instruments used at New York and Philadelphia, and they never tested the reproductions used by Professor Barker at Philadelphia.

Mr. George F. Edmunds for the People's Telephone Company, and for the Overland Telephone Company.

The court below was right in its theory in the treatment of this cause, and that theory was that either this method of transmitting speech through a wire, and by what are called electrical contrivances, actually existed at the time that the defendants' testimony in the court below said that it did, or the whole of the defendants' testimony is false.

After the utmost inquiry and the utmost contrivance and ingenuity that could be brought to bear, it was found by the court below, that these machines, which were said to have been used and practised by Drawbaugh, were in substance and fact the same sort of contrivances for transmitting articulate sounds through an iron or copper or any other metallic wire, as those of Mr. Bell, and therefore, as the court below held, there was only one way to get rid of this cause below, and that was to find that the story that was told by Mr. Drawbaugh, of himself and of his work, and the story that was told by his neighbors and visitors and the great mass and cloud of witnesses that came from that community, was untrue, and that, so far as this part of the case is concerned, is all there is to it; and that is exactly what you have got to do when you study this testimony—what Judge Wallace did.

You must adopt his theory, which I will state a little later on, and hold that the whole of this thing that was said to have existed on the face of the earth from 1868 or 1869 down to 1875 and 1876 and thereafter (I suppose poor Drawbaugh had a right to go on with what he had, although Bell had come on the scene) is a pure fabrication, a pure illusion. I don't mind about epithets; you can call it illusion, delusion, fabrication or anything else. The question is whether those things took place on the surface of the earth at that time. If they did, then, confessedly, according to the finding of Judge Wallace below, and according to the arguments of our learned friends on the other side, if those things took place that were said to have taken place prior to the date of this patent, as this testimony tends to show, with whatever of imperfection this witness or that witness may be found to have been guilty of, either purposely or otherwise, then Mr. Bell's case as a prior inventor and as entitled to prevent the use of these machines, that are said to have been invented by Drawbaugh, has no place in this court.

It is not the question that you are now to pronounce upon, whether Mr. Drawbaugh shall have a patent for a particular thing. It is the question of whether he or those who have taken up his cause shall have a right to use their instruments against the intervention that you are called upon to make because Bell is a favored and prior inventor; and therefore it is of no consequence whether Drawbaugh has an application for a patent now pending, or whether he ever made an application or thought of making an application for a patent.

The point is whether Mr. Bell is entitled to stand upon the law of Congress which says that if he is the first and prior inventor of a useful invention, and has made a proper application in a proper way for its exclusive possession and use, he shall have it. That is all. So that, what is to become of the Drawbaugh invention, or the Gray invention, or the whosoever invention as it regards a monopoly to be obtained through the Patent Office has nothing to do with this case at all.

Now, let us see if we can find out, according to the ordinary and universal principles, and practice and experience of mankind, whether we can believe anything in respect of an alleged historic event, that is said to have occurred, before fame had glorified some later discoverer. Let us see what a telephone is. It is a contrivance for transmitting speech. When the air is fair, as it is to-day, it is an amazingly good one. You and I talk to our grocer, or our doctor, or whatever, and it is extremely convenient. There comes around a sudden change of weather to-night, and to-morrow morning, I try to talk to my grocer and my butcher, and I tell him I want lamb, and he says, "Is it beef you want?" The thing is out of adjustment, and after trying and trying and hearing a roar in your ear—and somewhere in some of these books there is stated that in these earlier times (supposing it is not all a lie and an invented lie) that was just the thing that happened in one of these ancient Drawbaugh contrivances; that one witness who put his ear to a thing, instead of hearing a voice, heard a roar. Well, we have all heard a roar, and are inclined to tear the thing down and throw it out of the window, and send it down to whoever is chief of the performance here (and a very good fellow I believe he is), and ask him to refund our money. The thing won't go. You are in immeasurable wrath and indignation. But when you come to look at this telephone you find that, on the whole, it is an extremely useful, an extremely ingenious, an extremely valuable invention; but when you find it out are you to say *post hoc ergo propter hoc?*

Are you to say that nobody ever did anything of that kind before, for the simple reason that somebody who finally got force enough, with capital behind him, with science as his handmaid, with the stress and urgency of competition in telegraphy, like the Gold and Stock Board in New York and The Western Union Telegraph Company, struggling for the ascendancy in the best means of communication, hesitating for a year or two before they believed the thing was of the least possible consequence—are you therefore to say that every man who lived in this neighborhood in Pennsylvania, and that this old unlettered man, whose life had been pure from beginning to end, are liars?

There is nothing else, in my judgment, in this case, on the point I am now speaking of, except that we take up what has at least come to be a famous and accomplished fact, and say that everybody ought to have known it before, and that if anybody had known the fact before and could not make anybody else believe in it, it must be a lie. Now I deny that proposition. It is against human experience; it is against human morals; it is against every principle and test that we apply to the belief that we are called upon to express one way or the other in respect of human testimony.

Now, therefore, I want to ask your Honors, in the brief time that I have — and I shall not refer in detail to this testimony, but I wish to ask you to explore and to read this testimony both of the complainants and of the defendant, in this People's case and the Overland case, which brings in some later testimony — to read this evidence and see whether you can say as Judge Wallace did, that one single part of the evidence, namely, the statement of this poor old inventor himself, is a fabrication, and that other parts of it, as to events that they say took place on the earth before this patent of Mr. Bell was applied for, were pure delusions, and that the testimony of scores and scores of men and women having no common concert (unless it is brought about afterwards by a conspiracy that involved every one of them) was a fabrication or a delusion.

If we were to carry ourselves back, if you please, and to try this case as it might have been tried if the law of Congress had been a little changed, so that instead of having an appeal to the Supreme Court of the District of Columbia on a refusal of the Commissioner of Patents to grant a patent, we had an appeal to this court; if Drawbaugh, sorrowful and sick and miserable and harried by judgments and creditors and delusions and crazinesses (as some of these witnesses say about this very thing, which I shall come to presently again) had applied for a patent before Mr. Bell had appeared on the scene at all, and the Commissioner of Patents had said, "I won't grant you this patent, not because of anybody or anything else, Reis, or a string telephone, or whatever, or a harp of a thousand strings" — that my brother on the other side will delight your Honors' fancies with, if he does not convince your judgment,—"I will not grant you this telephone because it is of no practical use; it is not a useful invention. You have got a toy. You have got a demonstration of what is called a scientific fact. You have got a thing here which, when a person speaks into one hole, at one place, another person can hear it at another. Of what consequence is that? No possible consequence to humanity." Just as Orton thought; just as everybody but Pope—who had a vision of the future that none of the business men, who had money and who had enterprise and who had ambition and who had competitions, could be made to think, for a whole twelve months or more, of this very Bell apparatus, thought. The Commissioner of Patents says, "I won't grant you this patent." And now we appeal to this court, and not to the Supreme Court of the District of Columbia; and we come on here with this proof, and we show to your Honors, by this same set of testimony, and with all the counter testimony, that there are five per cent of that whole community, called as witnesses—and I think that is a fair statement; call it ten per cent if you please, or twenty—who say, "We were around Drawbaugh's shop all the time and never heard of such a thing;" but there is your ninety per cent or eighty per cent or seventy per cent or sixty per cent who say, "We saw and heard that thing go." Well, you say, "It must be proved, upon all human grounds of considering testimony, that that thing did happen—that you have got a contrivance that will do that thing."

Now you have got over that point. Now, if you had heard that testimony pro and con—taking it all, before fame had lit its lamp and flamed it over this world, could there be a doubt that you would say that that thing did exist, and that Drawbaugh did it? It is impossible to deny it. Then you would come to the second question: "Well, what of it?" That is just what these wise and prudent and urgent and ambitious and learned and critical men said—all but Pope—for a whole year after Bell had brought his operation of 1877 to public and commercial view, and was refused, because, although they admitted it would exist and did exist, yet it was of no consequence. And it would have been open to question; and if I were sitting in your place in 1875, when this testimony had been presented on appeal from the Commissioner of Patents to me, sitting where you are, I am very much afraid that I should have thought—as I believe you all would have thought, as Orton thought, and as the Stock Exchange thought at New York, and as everybody else thought at that period of time, "We cannot grant this patent, because it is a mere toy." It is like the gyroscope, which flies in the face of all natural ideas of gravitation, as we all know. What of it? Is the gyroscope a useful invention for the practical purposes of humanity? Everybody knows it is not. It is a very useful and ingenious thing, as illustrating a law, and nobody knows what that law is to this day; that is an unseen force or combination of forces that nobody can understand; that violates all our common sense about the laws of gravitation; and that is, that you put a wheel into motion, and although it may lean way over there [indicating], and may weigh five thousand pounds, it won't fall down. Well, what good is that to mankind in a practical sense? So I say, if we carry ourselves back, as I think most sincerely we are bound to do, when we are trying to find out the truth, to see what we should have said in 1875 if the whole of this evidence had been presented to us then as to what Drawbaugh had done, we should have said, "It is plain beyond all possible dispute that he has done that thing;" and we should have been most likely to say, sitting on an appeal from the Commissioner of Patents, "We will not grant you a patent because it is not a useful invention. It is a mere toy or a mere illustration of an interesting circumstance in the law of the vibration of the atmosphere; but as a useful invention that is to be applied to the common purposes of mankind (which is the theory of the patent laws) it has no place here."

Now the question, therefore, is whether this evidence proves, and proves to a demonstration, and proves more and more by the circumstance that there is counter evidence, that this witness is mistaken in his date, and that that witness is mistaken in the identity of the particular instrument that is called to his attention, proves more, and more from that circumstance,— that it is not this conspiracy which involves two hundred or more people, of all walks of life in this town in Pennsylvania. And as I think, the key to the whole of it is (the circumstance that I have been so shortly commenting upon) that at the time when this invention was being carried forward by this man, nobody believed it was otherwise than the idea of what is now called a crank. Some people — because people differ in their emotions and their sensibilities and their perceptibilities — said, "It is impossible. I won't go up and see it," as the Jews did, I believe. When sceptics scoffed and hooted all they could say in answer was, "These things we saw, we heard; we saw the sick healed; we saw the eyes of the blind opened," &c. Nobody believed it. That would dispose of one class of these witnesses, who said it was impossible. The other people said, "What of it? What good will it do that you can speak through this piece of wire and by this contrivance, whatever it may be?" I am not now on the question whether the contrivance of Drawbaugh was the same as the contrivance of Bell or not; that is another question. I am speaking on the question of whether there did exist in those years, beginning in 1863 and going down to 1875, (I will stop before the Bell application for the first patent was filed) the implements named, and whether those things did take place there. The other class of people say, "Oh, yes, we have heard of that sort of thing. We didn't take any interest in it. It was funny; it was queer;" — just as you say of thousands of devices for children and that sort of thing; the discovery of some new force of nature which the great mass of mankind believes cannot be applied to the positive and the efficient objects of human affairs. Now, when you come down to 1877, as I say, when Mr. Bell's final and real patent was obtained and had got through a year of struggle, the thing discovered, either by Gray (as I believe) and absorbed, to use a moderate expression, by some of the occult contrivances of the Patent Office, without the personal combination of Mr. Bell himself, so far as I at this present moment believe, but in some way absorbed out of the secret archives of the Patent Office into a remodelled specification—he has got his patent of 1877 that does describe a device that will do that thing. That having been done, it takes a year or more before he and all his coadjutors, he and they with millions of capital and enterprise and ambition behind to push it forward, and not an over amount of scruples before to retard it, can bring it to be believed in and invested in and operated by the public of the United States as a useful invention. It turns out to be useful.

Now they tell us that that staggers human experience; if I substitute Drawbaugh's name for Bell's my learned friends say it staggers human experience; you cannot do anything of that kind. If Drawbaugh had done the same thing that Bell had, in the same time, you would have believed the whole thing was a conspiracy and a lie and that the thing did not exist now. You would not have believed the evidence of your senses; yet in Bell's case it took a year or more to persuade anybody—people who, with money and with capital and with ambition and with competition to contest for the best means of monopolizing the interchange of communication across this continent and everywhere else, to think it was of the least possible consequence. Now, may it please your Honors, is not that a commentary of some weight upon the audacity (and I use that in its best possible sense) of the gentlemen on the other side and the learned Judge below, in the treatment of this subject. Judge Wallace was even wiser than they, under the impress of his considerations, in finding a means of getting rid of this proof of what had taken place. I am not now, you understand, on the question of whether Drawbaugh's contrivances, if they existed, were the same contrivances as Bell's. That you will come to understand, if you have not already. I don't suppose there is any question about that, but no matter for that. Judge Wallace's only way out, under whatever intellectual or other impression of this tide-wave of what had come to be a famous discovery, was this. It was, as he saw, impossible to get rid of this testimony on the ordinary principles, which, ever since jurisprudence was invented, have been applied to finding out the truth. Here he says—I will not quote his language, but that is the idea and scope of it, and I only refer to it because it is the best possible and the strongest presentation of any grounds upon which you can say these things did not exist and happen as they are related to have existed and happened — he says: Why, here is a whole community, a well-ordered, respectable, quiet body of people, engaged in every occupation of life that makes up a well-ordered and respectable community. Out of these, within the circuit of the geographical limits where an inconspicuous or crazy or inconsequential, not useful but interesting contrivance had been discovered, witnesses are called upon, one by one, to state what they remember. They say with endless iteration, — but not repetition of the same date and circumstances and event, which would give some ground to say, "Why, there must have been a convention to see this thing, or else the whole thing is in some way a delusion or fabrication," — but week by week and month by month, as the ordinary events of a social and respectable and well-ordered community made it happen that one or the other of its members should go to that place, they saw these things, which existed for some purpose or other — *if* they saw them; they heard these voices, and were able to hear and speak to a person in a distant room by applying their mouth to one and their ear to another, as the case might be (I am not going into the details), and therefore, as they say, they saw the thing and they heard the voice. How are you going to disbelieve it? Why, Judge Wallace says that the only way you can possibly disbelieve it is to believe that the man — now I state this strongly; I exaggerate, and logically exaggerate, merely to show you the absurdity of the proposition — Judge Wallace says, "You cannot believe anything of that kind, because there was not any such fellow as Drawbaugh; there was not any such shop."

Now, as I say, I have exaggerated that; but logically he says: "I cannot believe all that these people, of unquestioned respectability, and in every walk of life, say that they saw and heard before the great dividing line of fame and no fame (which is a great dividing line) had been drawn in 1877 or 1878, or whatever the time was; because, if I *take Drawbaugh alone* and there had been no other witness in the case, I should have said, it is absolutely incredible that Drawbaugh could have done that thing." Now, that is the honest logic, if your Honors will read that opinion, and the honest statement (although I have paraphrased it) of the judgment of the court below; and I repeat that it is the best ground on which the complainants' case below and the appellees here be put. Now it is, I confess, a little bit new, and I shall speak of it with reserve and modesty, that a judicial tribunal should so reason. To illustrate; as in a case of treason, for instance, where the Constitution requires that nobody shall be convicted unless upon the evidence of at least two witnesses, where the first witness to prove the treason who was *pars inter partes*, says, "I was a coadjutor in this treason of the respondent," and himself tells the story; the Judge charges the jury, "Why, this man's story, this coadjutor in the treason, this accomplice, I should not believe if he told this story alone. I don't believe he was there, if I took him alone, at all. The whole of his story standing alone would challenge my disbelief, on his own statement, instead of my belief. Therefore, gentlemen of the jury, although there are two hundred people who came together, a band of patriots, rushing to the scene of the *corpus delicti*, who swear that they saw this man engaged with the respondent in committing this act of treason, they are not to be believed; they are acting under a delusion, because if I had that fellow alone, I should think he was a liar and a scamp." Now, what kind of logic is that? What kind of morals is it? What kind of philosophy is it? What kind of persuasion is it to the constitution of the human mind to believe or disbelieve any evidence? I need not say that it is perfectly absurd, and yet I repeat with emphasis and deliberation that that is the ground, stated ground, upon which the court below held that the Drawbaugh contrivances, machines, instruments, operations, facts, never existed on the surface of this earth until after—never existed at all, because nobody contends that these events took place that are described by the witnesses after 1877 and 1878.

I beg, for the sake of human justice, that whatever may become of this cause, which, compared to the infinite measures of justice, is a small one, great as it is, that your Honors will not commit yourselves to any such theory of the weighing of human testimony as that. But that is what it is. I have not overstated it. Read his opinion. But now let us see how they treat Drawbaugh alone. Let us suppose now that this invention was not famous, and that the millions behind and the millions before, and the great light at night and the cloud by day to lead us did not exist, and we were to look at it as a simple fact; what would you believe then? Suppose it stood on the testimony of this old man alone? Because I don't mean to leave Mr. Drawbaugh in the category in which Mr. Justice Wallace left him.

It has generally been supposed, perhaps erroneously, that the whole life and conduct of a man, when he gives testimony about any event that he says he knew about and that he did himself and that was within the category of human possibilities, and not against a law of nature, — when you would say he was crazy, insane, and therefore, although perfectly honest, not to be believed, — would be considered, and, if his course of life had been such as to show him, as we are all shown, whether Judges or gentlemen at the bar, or bystanders or suitors or whatever, to be honest, he would be believed. Now, how are you going to tell whether a man is an honest man or not? How are you going to find that out? All that we can judge by, as we have not omniscience and do not know the secret hearts of men, is the life and conversation of the person in question. If a man is brought on the stand to testify, of whose career for twenty or thirty or forty years, the twelve men in the jury-box and the three or the five Judges on the bench, as the case may be, at a *nisi prius* trial, know without any proof what his reputation is in the community; that he has been a gambler; that he has been an immoral man; that he has been averse to everything that upholds the good order and morality of the community; in other words, that his color is bad, without referring to specific instances; if a man of that kind comes up to testify, and although he may say something within the ordinary course of human nature, if it is disputed, you doubt it. That is the law by which you measure men. Now, take it on the other hand. Suppose, respecting the same event, a fact that could exist, not a statement that showed that the man must be insane, poor fellow; whose life from his birth to the day of giving his testimony has been pure; has been upright; has been respected; and that in the whole forty years that he had lived in that community never a shade or a suspicion had touched it; and he tells you a tale of an event that he himself was the doer of, and which is within the range of sanity; would you believe him, although two years, five years, ten years after, a scientist, glorified by capital and by fame, had said, "I have done that thing, and therefore you could not have done it before." That is a statement of this case as applied to the testimony of Drawbaugh himself, if you take him alone. And you have refused to uphold many and many a patent in this court as you ought, upon testimony more slender than would be the testimony of this honest old man himself, if it stood alone. And yet he is surrounded and fortified by scores and scores of honest and respectable people, whose characters are not impeached any more than his is, who say that they saw and heard that thing done before this dividing line, about which there can be no mistake, between the glorified fame of Bell and his coadjutors, and what preceded it.

So that I submit, if your Honors please, you are to be governed in reading this testimony by this test; and that is the test to which I appeal; only read it with all its drawbacks — and there are drawbacks which my learned friend on the other side will present; drawbacks which I say, according to all human experience in finding out truth, fortify rather than diminish the force of the evidence in favor of this invention of Mr. Drawbaugh. Taking all that in, if you act upon the principles which have been common to intellectual operation for a thousand years and must always be, if you seek for the living truth, as you do, and unless you reverse all the principles of finding that have ever guided you before, you cannot fail to say that it is proved that this old man, in that obscure place, where the forces of nature are just the same as they are at Beacon Hill in Boston, that this old man in that obscure place, did do the thing that Mr. Bell did, at some time in 1876 or 1877, for this purpose I do not care which.

Something has been said about Gray's having applied for a telephone patent in 1876, the same day that Bell did; there is no claim that Gray stole it from Bell; he, therefore, as all agree, invented a telephone cotemporaneously with Bell; so it was not, after all, impossible that any mind save Bell's should have made this discovery. But I will not dwell on this line of argument, because I cannot take up your Honors' time. What I have said is, to my mind, the key to the whole thing on the question of priority. Perhaps something ought to be said for a single moment, about what the court below said in respect of the intrinsic impossibility of Drawbaugh's having done this thing. Perhaps it is not necessary, because the court below was obliged to find (to pursue his own logic) and refer only to the intrinsic, as he thought, impossibility of Drawbaugh's being capable of prophesying among prophets, or of good coming out of Nazareth, or whatever, upon the ground that Drawbaugh was a pure liar; that he was a perjured scoundrel, weak, feeble, but pernicious, to use a phrase which I hope will not offend this administration, pernicious in having sold himself to a band of adventurers who are trying to do exactly what Mr. Bell and his band of adventurers have been trying to do, and that is to make something out of an invention; because when you come to the question of adventurers and epithets, of course one invention is just as good as another, whether it be a new one or an old one; everybody goes into it who thinks he can make anything out of it. Now to fortify his notion, Judge Wallace, feeling evidently that the ice was a little thin that he stood on, in respect of these methods of weighing testimony and finding out truth that I have referred to, rather steadied himself as a man on stilts does with a long pole, to keep from falling over — on the idea that it is intrinsically impossible that Drawbaugh could have had such a conception. Why? Because it required what is called scientific training. It required costly and particular apparatus. It required scholasticism, and a long drawn-out and drawn-up consequence of study, from step to step, that should have at least brought him, as the Judge thought Mr. Bell had been brought, to the point where this crowning glory of discovery would have come. In other words, it was logic; step by step of a logical proposition; and nobody, therefore, could discover what was before an unseen force of nature, always existing — how many more there are that are yet to be discovered, if your Honors please — but not one of them, to this day, has ever been discovered by such logical steps as Judge Wallace thought were necessary a man should take to do. There is Mr. Bell himself, struggling and hoping, as people do, for the philosopher's stone, exhausting all the sources year in and year out of a trained and philosophical and scientific mind, with every adjunct that scholarship and research and history could give him ; and he finds the philosopher's stone, which is to turn everything into gold. He was struggling and struggling to do something which he could not reach. How did he get it at last? Accidentally — in the sense in which I use the word accident. A particular amount of tension in a particular set of mechanical contrivances happened to be such that, finally, struggling away, they heard a word; and then for weeks — I am not now stating this, you understand, with precision, to illustrate what I say — they had heard one sound and there was hope. Now, it was not logic that did that. It was not logic that led Franklin to put his kite up in the sky. It was not logic that has led anybody at least to discover anything. It is not training that does it, although training is useful; the man is better equipped. The soldier can fight better who has a multiple discharge gun than the man with equal courage and bravery who has only an old musket; but they are both true patriots, and they both have the same intrinisic force and capacity to do. One has better implements; that is all. Now, what is the history of this sort of thing? How many instances there are!. I might take all the time that is left to our side to tell you, and tell you rightfully, not speaking out of the record — because I believe you have decided after great consideration, that the court may be supposed to have some general knowledge of human events without its being printed and sent up to you by the clerk.

Suppose you take Columbus to begin with. His instance is so familiar that it is useless to refer to it. Suppose you take Arkwright, the great English inventor of the cotton spinning machinery; was he a student, a professor, a teacher, of any kind of science? Not a bit of it. He was a barber. Suppose you take Watt, another Englishman, who, I believe, is somewhat famous, and who, perhaps, may be referred to without violating the proprieties, although his name is not mentioned in the record. What was he about? He, like poor old Drawbaugh, was engaged in his youth, when he was fourteen, in inventing an electrical machine; for aught I know it may have been this electrical machine; because this telephone is an electrical machine, and nothing else. He was doing that very thing when he was a mere lad. Where was his scholasticism, his great accumulation of all the scientific knowledge and facts that had been discovered in natural history in the centuries before? I can run down, may it please your Honors, through Fulton, and Whitney, the cotton-gin man; and what was he? A man skilful in mechanics? No; he was a lawyer in an obscure country town in Georgia, living on a plantation, and I believe teaching the children — teaching the children of some planters, who were great people in those days; and it was suggested to him what a great thing it would be if you could only find out a way to get rid of the seeds in the cotton and separate the fibres from the seed. This lawyer invented the cotton gin. Up start my brothers on the other side and say, as Judge Wallace said below, "Why, it is utterly impossible. This man was bred to Blackstone and Coke; what does he know about the method of separating the seeds of cotton from the fibre?" Suppose somebody in a distant part of the country, three or four or five years afterwards, this obscure thing down there working well, should say, "It is impossible to believe this man Whitney who swears, and the men on his plantation who swear, that they had a cotton gin working there for five years before an application was made in Mississippi, by somebody, or in Louisiana, where a great syndicate had been gotten up to exploit a cotton gin that had been discovered." I could go through, of course, innumerable illustrations which demonstrate—and I am ashamed to take your Honors' time even in referring to it—that the history of human experience from the beginning of time that we have any record of, down to this day; from the time, as I believe, the Bible, or some other good book, tells us that Tubal Cain invented the art of playing the flute, the first musical instrument, it is said, that ever was made, down to this day—shows that the correlation between what we call scientific knowledge and education and the discovery of these important forces of nature, and their application, has no connection whatever; and that it is more often than otherwise that the obscure genius whom God made and whom the schools did not make, and the obscure mechanics, most of whom unhappily have never got the benefit of their inventions, have been men who have brought to the knowledge of mankind most of the things which we now consider to be the most useful to us. Therefore, I say, without going, as I said, in the time that must be left to my fellows—without going into the question of the identity of these machines; without going into the utmost gravity of that question about what happened between the time when the application of Mr. Bell as formulated and put into the hands of Mr. Brown, was filed in the Patent Office, and on the same day with Mr. Gray's caveat describing what he would do and what happened thereafter; and without going into the question of the effect of these claims, in respect to their validity and scope and so forth, I must say that in respect of the topic I have called your Honors' attention to, that it is the end of this case: If your Honors will take this testimony as to what took place in an honest and respectable community in Pennsylvania for years and years, year in and year out, proved by the whole body of the community, of every calling, in support of this honest old man whose career is not questioned as a man of purity of life, of uprightness of character, although poor and sorrowful, there is an end of it.

Mr. James J. Storrow for the American Bell Telephone Company in reply to the arguments about the Drawbaugh defence.

The story as told. — Drawbaugh's story and the recollections of his witnesses, if they are reliable, come up to this: That for eight years before the Bell patent he had electric speaking telephones at his machine shop at Eberly's Mills, three miles from Harrisburg, the capital of Pennsylvania, and with them transmitted speech so well that the common country farmers coming there could and did use them, speak into them, and understand all that was said; and that this was known to hundreds of persons, in Harrisburg and all that part of the country. If that is not true in the fullest sense, then the testimony of himself and his supporting witnesses tells a false story. Yet it is a part of his history, put into the answer, testified to by himself, agreed to by every one of his witnesses, that not one of his telephones was ever used for any useful purpose whatever. He never actually took one outside of his workshop until long after the Bell patent. He never offered a single one to a human being to use, and not a human being had ever asked for one to use, when this suit was brought in October, 1880, long after the Bell instruments had gone into extensive commercial use. He did not himself, even, apply them to any useful purpose. They were not arranged so that he could speak to his workmen from his office, nor call from his shop to his house. According to his own story, they were kept in a box, and all he ever did was to take them out from time to time and connect them to wires running from one part of his shop to another merely for the purposes of experiment, or to gratify curiosity. It is thus a part of the case which he asks the court to believe that these instruments, for eight years before the Bell patent, were known to hundreds of people, and were matters of common talk all over his county and in Harrisburg, the capital of a great state; yet it is another part of his story that this great invention, perfected, they say, in his shop and thus made known, never led to the use of a telephone by any human being; though it is also a part of their story that he recognized that the invention was of surpassing interest and enormous value — sure to bring fame and fortune to its makers. They say in their answer that nobody had ever transmitted speech, even up to the time their answer was filed in January, 1881, "by reason of any information derived from Drawbaugh," and that all the telephones which had been used in the world were the result of "independent inventions by other persons," and were not due to Drawbaugh.

It seemed to us impossible that a practical telephone, successfully operative, could have been known to that community, within three miles of Harrisburg, for eight years before the Bell patent, and left no mark. Mr. Bell's feeble instrument at the Centennial made him instantly famous all over the world. As soon as he offered his telephones to the public they went out by the thousands, and all men since have been trying to infringe his invention. Such an instrument, so easy to make when once it has been invented, so cheap, so simple, which everybody could use, so interesting in itself and of such obvious utility, could not help publishing itself if it existed. It is obvious that this must be so, and the experience of Mr. Bell shows that it was so. Judicial experience has taught the courts that there is no better test of the existence of such an invention.

To make out this story, its propounders rely upon absolutely nothing but the deposition of Drawbaugh himself and the mere bare recollections of ignorant countrymen, no one of whom had the least idea even of the mechanical structure of the instruments which they say they saw, and which none of them took any interest in. There is not a scrap of paper nor one of the events which would necessarily arise out of the existence of such instruments as he says he had, to confirm the story. Nothing but bare recollections are produced for Drawbaugh.

Advent of the Drawbaugh claim. — In July, 1880, when more than a hundred thousand Bell telephones were in use, a company of stockholders who had bought up Drawbaugh's pretensions — Marcus Marx, Simon Wolf, Moritz Loth, F. A. Klemm, Edgar Chellis, M. W. Jacobs, and Lysander Hill — filed an application in the Patent Office, and published in the newspapers a proclamation that they had a vast number of affidavits to support their claims, and a "cash" capital of five million dollars, and "within sixty days would drive out all the telephones in the market, save the one they held, or else compel the Gray, Bell, and Edison lines to pay the new company a munificent royalty." That was the first time the world at large had ever heard that Drawbaugh had a telephone, or that he claimed to be the inventor. The "cash" capital was a humbug — there was none. The sixty days was a humbug; for they were enjoined on their first telephone, and have put out none since. Was the rest of their story any better?

They were promptly sued (October 20, 1880), and a preliminary injunction granted. When they came into court, it appeared from their testimony that they had not used, and never proposed to use, Drawbaugh telephones. Marx, Wolf, Loth, and Klemm formed their association before they had heard of Drawbaugh, intending to use telephones of a form devised in 1879 by Klemm, one of their number, and those were the only telephones they had employed. They were early advised that they plainly infringed the Bell patents, and that they could not prosper unless they could find not only a telephone, but a "prior inventor." Whereupon a gentleman in Washington who had been counsel for Drawbaugh sent them to Harrisburg. They found that a few days before their visit, Chellis, keeper of a 99-cent store in Harrisburg, and Mr. Lysander Hill, and Mr. Jacobs, then counsel for Drawbaugh and Chellis in litigation about a molasses spigot invented by Drawbaugh and now counsel in this case, had acquired Drawbaugh's pretensions by a contract for which they paid him nothing; so the syndicate bought from them. The only contribution, therefore, the world has received from Drawbaugh consists in depositions furnished by him to help these infringers in a career of infringement they had embarked in before they heard of him.

The story told in their answer is that telephones made and used by Drawbaugh for communicating "between distant points" in and before the year 1874, are "still in existence, and capable of successful practical use." All of this is untrue. "Distant points" dwindles to fifty feet between one part of his workshop and another as the only use pretended, and the exhibits produced are so destitute of working parts that it is impossible to transmit any sound with any pair even alleged to have been made before 1875. To attempt to transmit any sounds whatever, therefore, with any instruments like those which he says he had before the close of 1874, "reproductions" must be made; and the essential working parts for those reproductions cannot be now constructed, nor their original character learned, except from Drawbaugh's own deposition. For not one of his witnesses knew, or had the intelligence and skill to know, how the instruments were constructed, still less the nature of the operation they performed.

Drawbaugh has taken in this case about four hundred depositions, and we have taken two hundred, scattered along through nearly four years of preparation of the case. The first testimony was taken, and his exhibits first produced, in April, 1881. Drawbaugh's own deposition was begun in December, 1881. The proofs were closed in June, 1884. The case was decided in favor of the Bell patent at the circuit, December 4, 1884. All the testimony had been stipulated into the *Overland* case, then pending, and as the proofs in that case were not closed, the Drawbaugh Company took in that case more testimony about Drawbaugh after the first decision. That was laid before Judge Wallace by consent, and argued to him in December, 1885, when he affirmed his former conclusions. Thus, the defendants not only had every opportunity to take testimony during the progress of the case, but after it had been decided, by the accident of another case pending, they were enabled to take more testimony. If proof existed, they could then have rebutted every conclusion drawn by the court. That they did not even attempt to do that, except in two particulars where they broke down in a manner which destroys the moral character of the defence, is conclusive that no fact or proof exists which can control that decision.

The Drawbaugh Company have made a show of a large number of witnesses, but the mere oral testimony alone, considering the character and standing of the witnesses, their relation to Drawbaugh and their means of knowledge, is much stronger against Drawbaugh than it is in his favor. But such a case as this does not turn on oral recollections. In *Atlantic Works* v. *Brady*, 107 U. S. 192, and many other decisions spread in our brief, the rule has been d down from the time of Whitney's cotton gin until now, that upon a claim made late, after a patent has gone into extensive use, when its profits offer a great temptation, when the invention itself is one which, whenever made, necessarily appeals to the curiosity, to the desire, to the convenience, to the wants of every one, mere oral recollections never yet established a case. The court looks at the probative effect of the man's acts. If the invention is one which in its nature publishes itself, then, if the marks of publication are not found; if the invention is one which goes into use of itself, and marks of use are not found; if it is one calculated to affect the action of the community, and indelible marks in the community are not found,—the courts do not believe the story. If they cannot read the telephone in the events of his life, they will not accept it from his deposition. *Atlantic Works* v. *Brady*, 107 U. S. 192, 203; *Wood* v. *Cleveland Rolling Mill Co.*, 4 Fish. Pat. Cas. 560 (Swayne, J.); *The Cotton Gin case*, quoted in *Motte* v. *Bennett*, 2 Fish. Pat. Cas. 642; *Howe* v. *Underwood*, 1 Fish. Pat. Cas. 162 (Sprague, J.); *Johnson* v. *Root*, 2 Fish. Pat. Cas. 292 (Clifford and Sprague, JJ.); *Cahoon* v. *Ring*, 1 Cliff. 592; *Hayden* v. *Suffolk Co.*, 4 Fish. Pat. Cas. 94 (Sprague, J.); *McCormick* v. *Seymour*, 3 Blatchford, 213 (Nelson, J.); *Seymour* v. *Osborne*, 11 Wall. 516; *Aultman* v. *Holley*, 11 Blatchford, 317 (Woodruff, J.); *Colt* v. *Mass. Arms Co.*, 1 Fish. Pat. Cas. 116 (Woodbury, J.); *Perham* v. *Am. Buttonhole Co.*, 4 Fish Pat. Cas. 468 (Strong and McKennan, JJ.); *Smith* v. *Fay*, 6 Fish. Pat. Cas. 542 (Emmons, J.); *Brown* v. *Guild*, 23 Wall. 181.

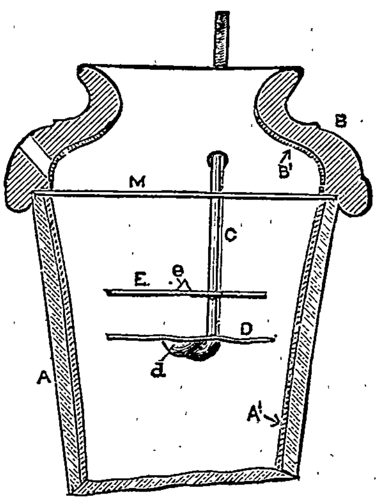
The rules of law go further. If the evidence which the enormous record of this defendant presents does not come up in quality as well as in quantity to what his story would afford if true, the record does not tend to prove that story, but disproves it. If the testimony taken as a whole substantially falls short of what the story, if true, would afford, it disproves the claim. Lord Mansfield said: "Evidence is to be weighed according to that which it is in the power of one party to produce, and of the other to contradict." Cowper, 65; approved in *Smith* v. *Whitman*, 6 Allen, 564. The same rule was enforced in *Clifton* v. *United States*, 4 How. 242; *Standard Measuring Machine Co.* v. *Teague*, 15 Fed. Rep. 390; *Commonwealth* v. *Webster*, 5 Cushing, 316: *S. C.* 52 Am. Dec. 711; *McDonough* v. *O'Neil*, 113 Mass. 92; *Cheney* v. *Gleason*, 125 Mass. 166; *Howe* v. *Underwood*, 1 Fish. Pat. Cas. 162.

The lines of proof which are possible, and which the story if true must furnish, contrast with the proof presented by the claimant.—There is much proof in our favor from the recollection of reliable witnesses. But the Bell Company can rest its case on Drawbaugh's history and the knowledge of his intimates as proved out of the defendants' own record, chiefly by his cross-examination, and by unassailed contemporaneous writings. Drawbaugh has not presented a single sketch, letter, memorandum or piece of paper of any kind to connect his name with the speaking telephone in any way, until the time when he was avowedly making improvements on the Bell telephone in 1878, after that instrument had got into extensive commercial use. From that time on, written and printed contemporaneous proof of what he was then doing is abundant. If he had had speaking telephones before that, it would have been equally abundant earlier. The Bell Company, however, have found considerable written and printed contemporaneous evidence directly and specifically showing what Drawbaugh was doing, and what he invented during the ten years before the Bell patent; and each one of these papers, all acknowledged by Drawbaugh to have emanated from him, are specifically inconsistent with his pretensions. Two of them are lists he published of his inventions, complete and inchoate, with no telephone among them. Against this, it is on such bare recollections as have been indicated that he relies to prove both the fact of a telephone and the date of the fact.

Remains of instruments.—They produce also certain remains of instruments, but all those alleged to have been made before the Bell patent are so far destroyed that, with the exception of a pair of magneto instruments, D and E, alleged to have been made in February and March, 1875, no sound of any kind can be transmitted by any set of them. The structure of the most essential working parts, and the capacity of all previous instruments, depend solely upon his memory. Not a single witness ever understood, or had the capacity to understand what their structure was, and, if they are to be restored, the restoration will depend upon the uncorroborated and unchecked testimony of Drawbaugh alone.

In the great sewing machine case, *Howe* v. *Underwood*, 1 Fish. Pat. Cas. 160, remains were produced, and from them the experts testified that they concluded that the originals must have contained certain other parts which no longer existed, and that from the indications given by the remains they could reconstruct the machines as Cuvier reconstructed an extinct animal from a few bones. Judge Sprague replied that Cuvier's conclusions were based on the rightful assumption that the extinct animal was the perfect work of a perfect creator; but to assume that about the destroyed machine was to assume, and not to prove the case.

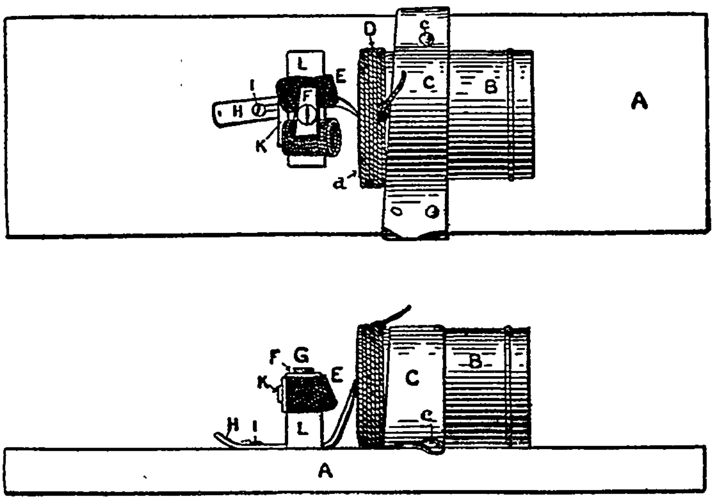
The Drawbaugh Exhibits. — The different remains are as follows:



Broken Tumbler F. ½ *size.*

The first one, Exhibit F, alleged to have been a carbon powder *transmitter*, and alleged to have been made in 1867, consists only of a broken tumbler A with a wooden mouthpiece B, and two pieces of zinc E, O, and a piece of wire, C. Drawbaugh says that he either made his instrument out of a broken tumbler or that it got broken very shortly afterwards. He attempts from memory to supply those parts which would constitute a carbon telephone transmitter, and to swear that he once had them inside this tumbler.

The instrument B, produced as a *receiver* to go with F, and alleged to have been made in 1867–8, consists of a small tin fruit can, apparently once used as a paint pot, held by a tin strap nailed to a rough board, with the remains of an electro-magnet in front of it. No diaphragm or armature exists.



Tin-can Receiver B. ¼ *size.*

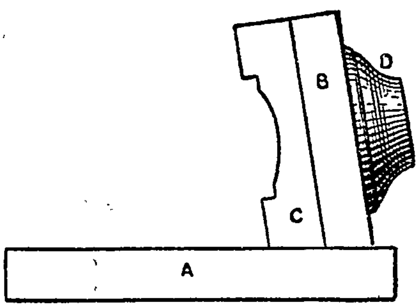


Exhibit C as it exists. ¼ *size.*

The next instrument, C, Drawbaugh's second form alleged to have been made in 1869–70, consists now merely of a board frame-work and a mouthpiece.

Drawbaugh testifies that it had a diaphragm and an armature and an electro-magnet. If made as he states, the instrument would be almost exactly, not only in substance but in mere form, a copy of the Bell telephone in commercial use during the first three months of 1877. This also was Bell's second form.

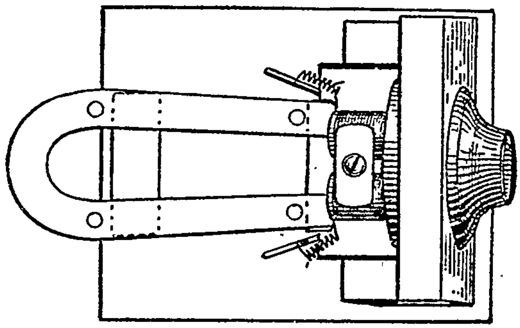
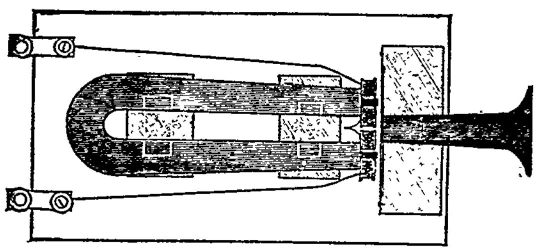
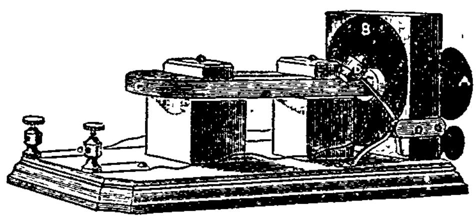


Exhibit C as Drawbaugh's Memory says it was. $\frac{1}{4}$ *size.*



Bell Telephone in Public Use in April, 1877. *Plan.* $\frac{1}{5}$ *size.*



Bell Telephone in Public Use in May, 1877. *View.*

The next instrument now consists of a mere cylindrical wooden box, I, said to have been made in 1870–1. After this mere shell was testified to in the case by a number of witnesses, Drawbaugh added a newly made diaphragm and an electro-magnet, and swore that either these or something like them were in the original.

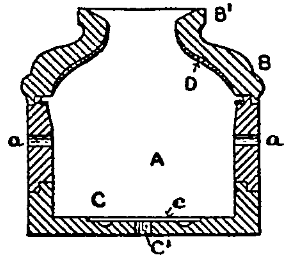
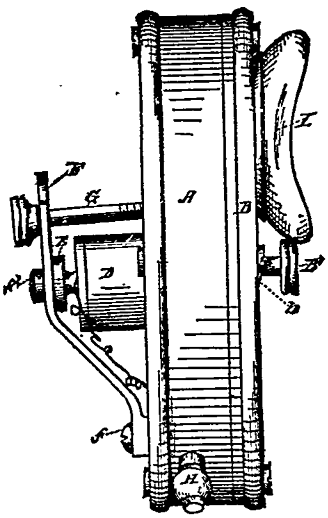


Exhibit I. ¼ *size.*

The next is Exhibit A, which is a rather highly organized *receiver* in working order, alleged to have been made in 1874. The case is of walnut and neatly finished. It is not a complete telephone apparatus, but only the receiving end of one. The diaphragm C is of black walnut veneering. In front of it is the thin air space and the small mouthpiece or earpiece of Bell's second patent. D is the electro-magnet with a soft iron core, adjustable by means of the screw G. His story is that he chiefly used it as a



A, side view. ½ *size.*

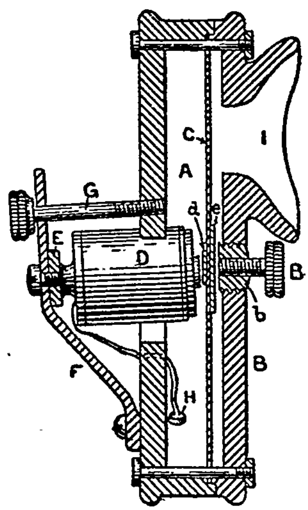
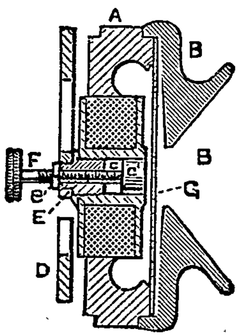


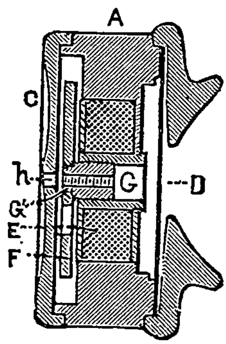
Exhibit A. ½ *size.*

receiver with the broken tumbler transmitter F. Only two or three witnesses, however, pretend to have seen this pair used together.

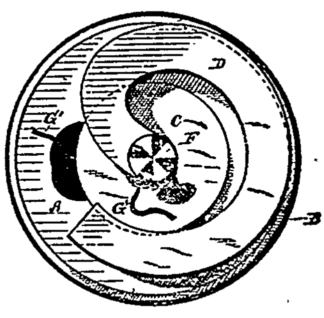
The next, a pair of magneto telephones, D and E, very highly organized, have the nice refinements of the best modern instruments; — the flaring mouthpiece; the thin air space; the short core and large coil; the adjusting screw; the permanent magnet of Mr. Bell's second patent; with all the refinements which Mr. Bell's subsequent experience added and put into the commercial instruments in 1877–8, and subsequently; these are good, practicable instruments, though their cores and magnets are so badly proportioned (and the instruments thereby so unnecessarily weak in tone) that it is difficult



Section of D.



Section of E.



Rear View of D.

to believe that they were made by a man who understood the true purpose and function of those elements and invented their combination. They are alleged to have been made in the first quarter of 1875. The cuts are one-half size.

All these instruments were first put in evidence in 1881. Their existence before that depends upon mere memory.

These are all that are said to have been made before the Bell patent.

Drawbaugh's story continues that at about the time of the Bell patent, or immediately after, in the spring of 1876, he made a pair of very highly organized hard carbon microphones, G and O, in black walnut cases, of a peculiarly neat and graceful shape, and provided with all the refinements of detail of

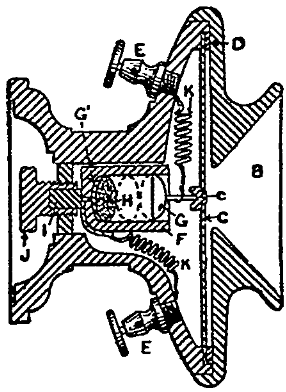
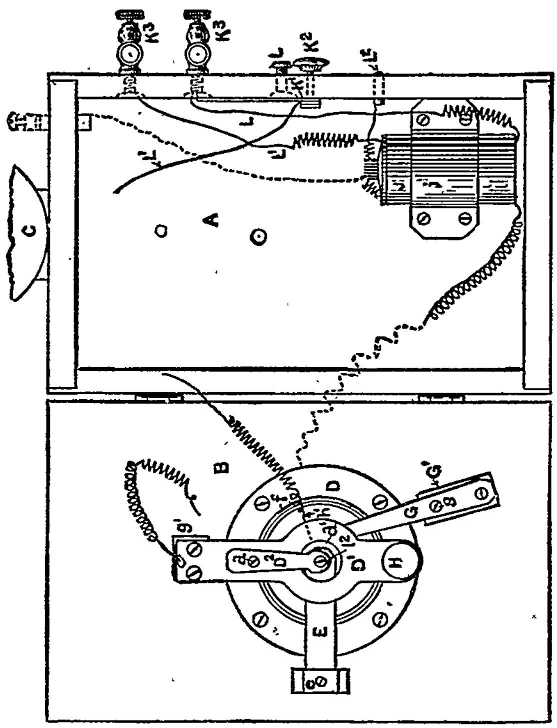


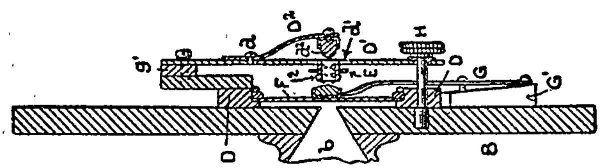
Exhibit G. ½ *size.*

the best modern instruments. C is an iron diaphragm in front of which is the thin air space and mouthpiece. H is a tube of wood (a non-conductor) in which he says he had three flat balls of hard gas carbon, of which one, H, now remains. The adjustment is by a screw, J, in the recess at the back, and this screw is faced with a soft rubber cushion, I. These instruments have, however, a radical defect in the manner of mounting the carbons, which makes them practically poor instruments. It is precisely the defect (too great rigidity in the supports, for the rubber does not practically yield) which appeared in Edison's early carbon telephones in the spring of 1878.

He says that he followed this pair by an instrument H, alleged to have been made in the summer and fall of 1876, which, *so far as ordinary observation goes,* appears to be an almost exact copy of the well-known and highly organized Blake transmitter in every detail of form, as well as in all its principles. This was followed by J, P, etc., none of which, according to his testimony, were as good as H. His story is that 1876 was his high water mark.



View of Inside with Door Open, Exhibit H. ¼ *size.*



Section.

The later instruments, D and E, G and O, H and the subsequent ones are of admirable mechanical construction. He made them himself. They show that he was a very fastidious workman, with ample facilities, which indeed he had in his own workshop. If any of his earlier instruments are rude, it is not because he lacked skill, materials or facilities for making good ones.

His story is, that he made his broken tumbler instrument F and tin can instrument B in 1867. According to his own witnesses, these were the instruments he habitually showed to visitors for nine years afterwards, and through which they say he transmitted perfectly intelligible speech without any trouble whatever during each of these years. His own testimony is that his rude broken tumbler F was believed by him to embody this great invention. But he never made another carbon telephone, nor attempted to make another carbon telephone, nor any other variable resistance telephone until 1876, nine years later. His story further is, that from the time he first made F, "his whole heart and soul were on the telephone," and all the time he could spare from supporting his family was devoted to work on it. That story is not true.

The exhibits themselves disprove it. It is impossible that such a workman as he is, with his facilities, would have kept for years, or even for a week, a broken tumbler and a rude tin paint-pot as his sole embodiment of this wonderful invention, if they embodied it to such an extent as even to promise success. The fact of the extreme rudeness of these instruments and all others that he is said to have made down to the time of the magnetos D and E, — a period of eight years, according to the dates alleged, — when compared with his skill and facilities as a mechanic, shows that up to the time he made better instruments, (whenever that was) he had not got beyond rude and unfruitful experiments which did not encourage him even to spend a day or two in remaking the instruments in a workmanlike shape. The remains prove more than that. They not only show that his enterprise remained in that experimental and unpromising condition (whatever be their date), but by their paucity and their rudeness they absolutely falsify the whole story told by himself and his witnesses, that during all those years he thought of nothing and worked at nothing but the speaking telephone. For all the instruments he attributes to that period (1867 to 1876) would not account for a week's work.

[Mr. Storrow then pointed out a number of details in these instruments which, he argued, showed that even if the working parts were what Drawbaugh described, still the structure and arrangement of the machines as a whole were so extremely bad and inconvenient that it was impossible to believe that a good mechanic like Drawbaugh would have kept a promising invention in such a shape without at once introducing the obvious modifications necessary to have fitted the instruments even for comfortable experimenting.]

Drawbaugh called fifty-one witnesses (and no more) who professed to have heard speech at his shop before the Bell patent, through the exhibits produced.

String telephones.—There is abundant proof from statements contained in questions put by Drawbaugh to one of the complainants' witnesses and the answers elicited, corroborated by pregnant circumstances, which shows explicitly that as early as 1872 or 1873 the string telephone was seen in use in the village, at least in the shop of Drawbaugh's brother, across the street from Drawbaugh's house; while several others of Drawbaugh's own witnesses distinctly and unequivocally state their recollection that the instruments they saw at Drawbaugh's shop, and styled his "talking machines," were string telephones. Judge Wallace decided in his opinion upon the first hearing that it was proved that there were string telephones in the village and at the shop at that time. Subsequently, Drawbaugh took more testimony in the Overland case, and submitted it to the court a year afterwards; but this later testimony, instead of attempting to rebut the existence of string telephones, only affirmed it. It must therefore be taken as a settled fact in the case that, at least as early as 1872, there were string telephones in the village and at his shop. It is a fact in the case that at least as early as 1869 string telephones were publicly known in this country.

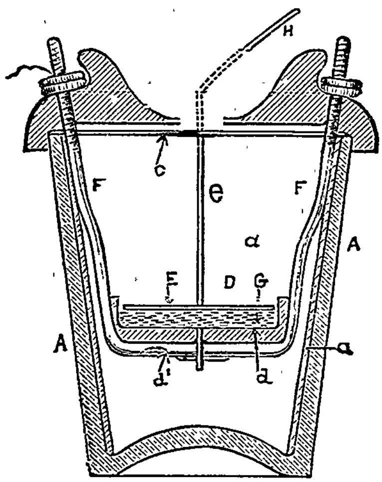
Tests of the Drawbaugh exhibits.—Drawbaugh had fifty-one witnesses who swore to speech through his instruments before Bell's patent. But, evidently doubtful about the value the court would attach to such witnesses as he produced, he undertook to prove by one expert witness, as an independent proposition, that telephones made as he swore his were made would to-day transmit speech. He so asserted in terms in the answer filed, and after the taking of testimony had begun in this case he made with his own hands, and with the assistance of his brother, at his own shop, what he said were "reproductions" of his alleged early instruments. He tested them and afterwards put them in evidence as correct reproductions. He then called a professional expert who testified that he had tested these reproductions with Drawbaugh and that they were "good, practical, operative speaking telephones," while Drawbaugh himself testifies that with the first and most imperfect of the alleged originals—the tumbler F and the tin can B—he and the neighboring farmers could without trouble transmit whole sentences, spoken, or read from a newspaper, as early as 1868, and that each subsequent set of instruments were better than the first. Believing the instruments, even as he described them, to be incapable of such results, we challenged his expert to repeat in the presence of witnesses the tests he said he had made with the "reproduced" or original instruments. Choosing their own time and place, three days were occupied in New York, in March, 1882, in testing them, the defendants selecting a skilled person to speak, and another skilled person to listen, the Bell company merely insisting that shorthand writers should take down what was said at one end, and what the listener thought he heard at the other.

It was specifically proved, and was not denied by any witness, that the instruments offered and tested by Drawbaugh as "reproductions" were much better in their details than the originals of which the remains were produced ever could have been (according to what remained), even assuming that Drawbaugh's statement was to be taken implicitly for the original structure of those alleged parts of the originals which do not exist. It was also proved that the circumstances under which the exhibits were tested in New York were vastly more favorable than anything that could have existed at Drawbaugh's workshop, where the instruments were said to have been used by unskilled farmers in the midst of moving machinery. The result with the alleged reproductions of the alleged early instruments (especially F and B) was, in the language of their own expert, that all they got was "a sound, and now and then a word." Sentence after sentence, of from ten to thirty words each, were spoken into the transmitter and nothing recognized. With all these aids hardly one word out of a hundred was recognized when the tumbler transmitter F and the tin can receiver B, in the "reproduced" and improved forms, were used. In fact, when words and irregular numbers were spoken into that instrument, out of the few words and numbers which the listener at B thought he recognized, more than half had not been spoken at all. Later instruments did somewhat better. But half the witnesses, including Drawbaugh, had sworn to perfectly intelligible speech through F and B, and the tests proved this pair, even in the improved form of 1882, and with the aid of improved conditions, to be absolute failures. The result of this test was, that if these instruments had existed at his shop exactly in the form in which Drawbaugh says they did, not a word could have been heard by his countrymen witnesses under the circumstances narrated by them. With the utmost allowance in their favor, the whole story told by him and his witnesses of the successful transmission of speech at his workshop during a series of years, is thus physically proved to be necessarily and absolutely false. In *Ely* v. *Monson Manufacturing Co.*, 4 Fish. Pat. Cas. 79, Judge Sprague, speaking of the sewing machine case, stated the result of such a test. He said: "The stubborn fact that Hunt's machine would not work, and that Howe's would, *made the oaths of the witnesses as inoperative as the machine.*"

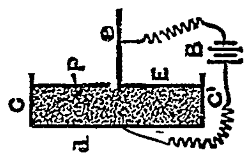
This result agrees with the conclusions drawn from Drawbaugh's history as discovered from his own deposition. His story, as he proffers it, is of admirable speaking telephones in 1867 or 1868, and nine years subsequent devotion to them, with no thought of anything else. His witnesses, as a class, swear to that. The fact turns out to be that his present so-called "reproductions" of what he says were his instruments show that if he had them he never could have got any even seriously encouraging results. The exhibits themselves, by their rudeness and fewness, show that he never got anything with them whatever which encouraged him to remake them in better form, as so skilful a workman would have done; while the history of his life, shown by his cross-examination, discloses that the years in question were chiefly occupied with experimental work of a totally different character, such as the construction of electric clocks and a large number of other contrivances. It shows that this other experimental work, which his witnesses do not remember, but which he narrated on cross-examination and which is abundantly proved, occupied necessarily so much of his time and attention as to totally disprove his carefully sworn story of absorption in the telephone. The appearance, therefore, of the exhibits themselves, the performance of his so-called "reproductions," and the proved and admitted occupations of his life, not only disprove the existence of successful telephones at his shop, but they absolutely destroy the picture of his life and work which he and his witnesses have sworn to, and therefore show them unworthy of credit. The truth is that they have now transferred to the telephone their memory of work which was really on these other contrivances.

The opinion filed by Judge Wallace in December, 1884, insisted very much upon the total failure of these New York tests. All the Drawbaugh testimony was also part of the record in the "Overland" case, and as that case did not come up for argument until a year later, Drawbaugh employed the interval in taking more testimony to rehabilitate his story. During that time he made great efforts to construct some more so-called "reproductions," and to find out some way to make them talk. A new set of instruments were offered as new "reproductions"; the expert who had made the former tests was discarded; a new one, entirely ignorant of the case, was employed; and with these new so-called "reproductions" the new expert had not the slightest trouble at Philadelphia, in February, 1885, in transmitting whole newspaper paragraphs without losing a word.

No attempt whatever was made in the testimony to explain why his "reproductions" tried in New York in 1882 were total failures, and his so-called "reproductions" tried at Philadelphia in 1885 were perfect successes. Drawbaugh did not himself go on the witness stand after his first deposition in January, 1882, nor permit his former expert to: nor did he attempt to explain how it was possible that his instruments of 1867–8 could have talked as perfectly as those of 1885, and yet never led to any practical use or to a patent.



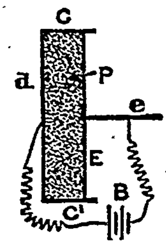
"*F. Reproduced.*"



Illustrative Diagram.

This second test at Philadelphia was simply a piece of fraud. His original story was that the electrical part of his tumbler instrument F consisted of a cell or box, E, G, *d*, (sufficiently illustrated by C *d* C in the illustrative diagram,) not far from the size of a half-dollar, holding carbon powder, (*d* in the tumbler, P in the illustrative diagram,) with a plate or plunger of metal E resting on the carbon, and connected by a rod *e* with the centre of a diaphragm. The theory is that as the plunger vibrates up and down under the influence of sound waves applied to the diaphragm, it will compress the carbon powder more or less, and thus vary the electrical current which passes through the powder. It is essential for this operation that the bottom of the plunger should touch very lightly on the top of the carbon powder, but should never part contact from it for an instant. The fatal defect of such an arrangement (whenever Drawbaugh made it) is that the up and down vibration of the plunger shakes and packs down the carbon, so that, if the touch be delicate enough at the outset, a number of vibrations less than those needed to make a single syllable (15 to 20) generally pushes away the powder, and the plunger parts contact with it at the top of the stroke, and articulation becomes impossible. This trouble was found in New York, and is practically inseparable from this contrivance, so arranged.

Some years after the Bell patent, Henry Hunnings, an English inventor, experimenting with the carbon powder telephones of Edison and others, found that if such a cell were tipped up so that it was perpendicular, as in this diagram, or at an angle say of 45 degrees, the action of gravity would make the powder, by its own weight, constantly keep against the vibrating plate or plunger, and there would be no break of contract. This effect would be aided by using powder which was granular and dry, like the sand in an hour-glass. If it becomes "packed" by accident, its proper condition is restored by tapping it. The Hunnings transmitter, so made, is one of the most powerful transmitters known. It is described in his patent No. 250,251, Nov. 29, 1881.



Drawbaugh made his tumbler talk at Philadelphia by putting the Hunnings invention inside of it.

His "reproduced F" is shown in the cut, with the cell horizontal, as it would be when the tumbler stood on its base. He testified in terms that he always so used it. That such was his chosen position for it is also shown by the fact that in the New York tests he so used it, placing it on a firm support where it could not receive the slightest jar. In the New York test the utmost care was taken to guard it from the slightest disturbance. To walk across the room threw it so out of condition that it would not yield a word, and Drawbaugh's expert declared that this test of it was "a constant struggle for adjustment."

But in Philadelphia the new "reproduced F" was held in the hand at an angle of 45 degrees. Not the least pains was taken to hold the instrument still. It was freely moved about, and the new expert, who had never read the testimony and was himself imposed upon, ingenuously said that its condition was improved by tapping it. The powder used at Philadelphia was granular, while that described by Drawbaugh and that used at New York (prepared by Drawbaugh himself for that test) was fine and unctuous like flour. The Hunnings conditions of use were thus provided at Philadelphia. They were not present, in New York, where Drawbaugh had only his own knowledge to guide him.

The Hunnings arrangement requires obviously that the plunger E should fit tightly enough to prevent the powder from seriously shaking out when tipped up, while in the Drawbaugh form, held horizontally, no fit is needed. In the Philadelphia "reproduced F" of 1885 it did so fit. In the "reproduced F" of 1881 it did not. The original tumbler had no cell when produced, and the remains showed that the cell Drawbaugh described never could have formed part of it. But whether it did or not, the rude alleged original plates produced are so uneven and irregular in their contour that they would have let the powder escape in a few moments.

Original plates of Drawbaugh's F. ½ size.

Our experts copied this Philadelphia tumbler, and found in repeated experiments that when held horizontal as Drawbaugh directed, hardly a word ever got through. When tipped as Hunnings directed, it talked well—just as it did in the Philadelphia tests. This we proved; and they took no evidence to refute it.

The success of the new tests at Philadelphia, therefore, was due to the fact that Drawbaugh stole the Hunnings invention and put it inside his tumbler. Where did he learn it?

The New York tests of the Drawbaugh instruments were made in March, 1882. The vast significance of their failure was at once recognized, and was pointed out by our experts. The defendants took testimony for two years after that, but they never attempted any more tests, nor introduced any more testimony to establish the capacity of the so-called "reproductions." The proofs were closed in June, 1884. During the oral argument before Judge Wallace in October, 1884, and after our opening argument had exposed the proved incapacity of these instruments, they offered for the first time to bring into court and publicly try new "reproductions" and to show that they would talk perfectly well. That offer was refused on the ground that it was an attempt to introduce new evidence during the hearing. Afterwards, in the "Overland" case, at Philadelphia, in February, 1885, they did produce those new so-called "reproductions" and tested them. They talked as the defendants said they would, and we discovered that they had then in effect concealed the Hunnings invention inside their tumbler. We found out how it got there. The Hunnings invention belonged to the Bell company, and they had, in 1882, carried on a long series of experiments with it. After the time when Drawbaugh closed his testimony in June, 1884, not attempting to repeat his tests with his alleged "reproductions," and before the time when he offered new "reproductions" before Judge Wallace in October, 1884, and tried them in Philadelphia in February, 1885, he had hired from the Bell company's employ one of the men who had elaborately experimented with the Hunnings invention in the Bell company's laboratory. That person was proved to have been one of those who brought the new "reproduced" instruments to the new expert to try. On this testimony, at the second hearing in November, 1885, Judge Wallace, as matter of fact, found that the success of the second or Philadelphia tests had been obtained by concealing the Hunnings invention inside the Drawbaugh exhibit. This disposes of the character of the instrument and of the moral character of the case.

Drawbaugh cannot complain of the original reproductions. He testified that he made them himself in the summer of 1881, and that he and his experts tried them in December, 1881, before they were put in evidence. Then he put them in evidence, as part of his own deposition, and swore to them as true reproductions in January, 1882. The tests in New York were at the end of March, 1882, three months after they were put in evidence. Liberty was given to him on the record to repair any accidental injuries that they might have suffered; and he did so before the tests. He never during the subsequent two years of testimony complained that he could have made better "reproductions," nor did he offer to present new ones and try them until after he had hired from the Bell company's laboratory their workman who was familiar with the Hunnings invention.

Ear-marks of copying. — Comparing the modern "Blake transmitter" with Drawbaugh's instrument H, alleged to have been made in the summer and fall of 1876, not only are the principles of the two identical, but the particular form and arrangements of the parts, even in immaterial matters, appear to be the same. But the most important feature in the Blake consisted in weighting a certain brass cup, carried on the end of a spring and holding a bit of carbon, bringing into play the element of a notable inertia.[1] The Drawbaugh instrument H had the same spring, with the same brass cup on the end of it,[2] and the same bit of carbon held in it in the same way; but while the two were thus the same, so far as the eye of an observer could notice, the fact was that *the unseen weight inside the cup, which made the soul of the invention in the "Blake," did not exist in the Drawbaugh.* It is a case of un-

[1] See the description and cut of the Blake, p. 279, *supra*.

[2] See cut on p. 402, *supra*.

intelligent copying by a man who did not even know what was the soul of the invention he now pretends he made.

Another important feature of the "Blake" consists in a spring which holds the diaphragm in place, for the purpose of getting rid of screw fastenings around the edge of the diaphragm, in order to leave it more free to vibrate. Drawbaugh has the iron framework to support the diaphragm, and the spring pressing on the latter, but has clamped the diaphragm at its edge, and thus the chief purpose and function for which the spring was introduced by Blake, is excluded by Drawbaugh, and the Drawbaugh instrument is just as good without it as with it; — another feature which proves the whole instrument to be the result of unintelligent copying and piracy.

Drawbaugh's instrument H was not produced in evidence until 1881, two years and a half after the Blake instrument had gone into commercial use all over the country.

It is also a significant fact that the order alleged for Drawbaugh's exhibits is an epitome of the order in which the several inventions were published by others. Bell's first instrument was described in the papers as made of a tin can and bladder; such was Drawbaugh's B. His next was the large horse-shoe magnet instrument; such was Drawbaugh's C. Then Bell introduced the short core and coil, the metal diaphragm, and thin air spaces; Drawbaugh's D and E have these. The first public notice of a carbon battery transmitter described it as made with powder. Then Edison and Berliner used hard carbon contacts; then springs, &c., were added, until the Blake transmitter was reached. Drawbaugh's F, G, O, and H repeat this order. In short, all this psychological proof is that he copied, and the character of his deposition (p. 415, *infra*) singularly confirms this. Bare memories of dates must overcome all this to make a case for him.

Drawbaugh's own testimony is that while his tumbler F, and tin can B, were the first ones, he, within a few years after, replaced them by somewhat better instruments, C, I, and having made the better ones, the tumbler and tin can were thrown aside, their bladder diaphragms eaten off by mice and never restored; and that if he ever showed them to any one after that, it was as mere wrecks and curiosities, and not as working instruments. It could not have been otherwise if there be any truth in his story of progressive improvement. Now it is abundantly proved by a number of the best of his own witnesses that the tumbler and tin can were exhibited by him, in working order, and used, at his best instruments at a considerable time after the Bell patent. Such exhibition and use of them at that time, necessarily, and according to his own story, disproves the existence at that time of the far better instruments which according to his pretences then existed.

Drawbaugh's occupations and the history of his life. — We have learned this from his cross-examination, from certain papers put in on his cross-examination, and from some record evidence. The story told in his answer and in his direct testimony is, that he made the invention and embodied it in a successful working form as early as 1867, (and large numbers of his witnesses alleged that it was looked upon as a great invention which would supersede the telegraph and make him the richest man in the country if he could complete it); but that it never got into use anywhere outside of his shop. The failure to get it into use, or to have it patented, or protected by caveat, is said to be solely because of his abject poverty and his "utter want" of proper tools and facilities for making telephones for use. He recognizes that the fact that the invention never went into use or was patented is fatal, unless explained, and he makes no other attempt to reconcile the fact and the story. The answer formulated that excuse, and he and others testified in support of it. His history destroys that pretence, and his whole story falls with it.

He has been all his life a professional inventor and patentee. He says that he has made over fifty inventions and patented a dozen. He never had any trouble in getting his neighbors to advance the money for experimental and Patent Office expenses. During the very years under inquiry, between the time when he alleges he first got speech in 1865 and the date of the Bell patent in 1876, he took out a number of patents, and his neighbors and friends contributed over $30,000 in actual money, chiefly to exploit certain of his inventions and to patent them; and in small part to exploit the inventions of others in his shop, under his direction.

In *O'Reilly* v. *Morse*, 15 How. 62, 111, this court said that no man could make an invention like the telegraph without an accurate knowledge of the scientific facts which were to be employed in it. That is still more true of the telephone. Yet Drawbaugh's story is that without education, indeed absolutely without that knowledge which is as necessary as tools and materials for the originator of these instruments, he made all the inventions embodied in the magneto telephone, in the carbon telephone, and in the microphone; that he made the discoveries of Helmholtz as to "quality" of sound, (though indeed his deposition shows that he has not the slightest knowledge on that subject,) and the discoveries of Faraday about magneto induction, as well as the invention of the speaking telephone itself. And yet when on the witness stand he is asked to state his knowledge of acoustics, all that he knows is that the pitch of a sound depends upon the number of vibrations. What constitutes "quality" or articulation, the very foundation of the speaking telephone, is something that he has not the remotest idea of. He further pretends to have made for himself, independently, some of the most striking inventions of modern times. He led his neighbors to believe that he invented Bain's electric clock, the automatic fire alarm, the Siemens and Halske magneto key, the Casali autograph telegraph, the Wheatstone alphabet telegraph, the Giffard injector, and other known things. In short, he pretends to be, and by these false pretences made his neighbors believe that he was, a genius far beyond any that the world has ever seen. All this was humbug and deception, and he knew it was.

Drawbaugh's deposition is a very extraordinary one. The invention he was to testify to is one which above all others never could have been arrived at by accident, but must have been the result of abstruse scientific reasoning and thought. Yet his deposition reads like that of a stranger. Instrument after instrument, already sworn to by others, (for he was the last witness called on their testimony in chief,) was put into his hand, and he was asked, generally by leading questions, when he made it. But from the beginning to the end of his deposition, which occupied thirty-two days, he never but once undertook to make any statement as to the origin or mental growth of his conception, or as to the principles involved. He was once asked how he came to employ the principle of variation of pressure in the carbon telephone, which he says was the first one he made, and he replied that he did not know whether he discovered that principle, or heard of it from some one else, or read of it. He testified: "I don't remember how I came to it; I had been experimenting in that direction; I don't remember of getting at it by accident, either—I don't remember of reading it; I don't remember of any one telling me of it; I don't suppose any one told me." He could not tell how any idea came to him, and the moment he was pushed as to the origin of anything, he resorted to the stereotyped answer of Queen Caroline's valet, "I do not remember." An inventor who had made so absorbing and thoughtful an invention could not have left out the heart of his story if he had tried to.

Laying aside the speaking telephone in dispute, it is proved that every one of these old inventions which he made his neighbors believe originated with him, was well-known and published in the books years before he pretended to have touched them. He got his chief reputation in his county by producing an electric clock, about 1872–5,—as if he were the first who had ever made one,—for the men to whom he sold the clock invention testified that they so believed. Just such clocks had been known for twenty years, and we found in his possession, and made him produce on cross-examination, an encyclopædia, published in 1852, with a full description of one, from which he had varied only in insignificant details of no importance. Upon the strength of these alleged inventions, he got his neighbors to advance their money to patent his clock, among other things. His whole life in his community was that of a charlatan and impostor, and he made all his neighbors believe that he was the first inventor of these various contrivances, as firmly as any of them pretend to believe that he was the first inventor of the telephone in dispute. So, when the present people, Chellis and others, asked him to let them set him up as a prior inventor of the telephone (for he never made such a claim for himself), their scheme did not startle him, for he did not realize how much more serious it was than the pretences which he had often put forward. So he became, at first a mere tool in their hands, and afterwards interested enough to work on his neighbors and talk up his case to make witnesses.

It is proved, chiefly by his own cross-examination and by some contemporaneous newspaper accounts of his work, that from 1865 to 1876 he spent more time and money on these various experimental gimcracks than would have been needed to have made a hundred telephones if he had known how to make them, or to patent them if he had had them to patent. Yet he swears that during all those years he could think of nothing but the telephone, and his compurgators all testify that they never saw him at work on anything else. The admitted facts show that that story is, on his part a fabrication, and on their part either a fabrication or the result of ignorance, stupidity, and forgetfulness, acted upon by his personal influence, village gossip, and local feeling. In *Wood* v. *Cleveland Rolling Mills*, 4 Fish. Pat. Cas. 550, Swayne, J., said: "The confidence of the attacking witnesses is often in proportion to the distances in time. Their imagination is wrought upon by the influences to which their minds are subjected, and beguiles their memory."

His only excuse for not patenting or making instruments is his "utter" want of tools and his "miserable poverty." This part of his story is a deliberate artifice. About 1865 he devised an alleged improvement in machinery for nail making. He had no trouble in getting partners to advance him money to experiment with it, and he took out two patents in 1865–7. His partners put in several thousand dollars. One of them was Governor Geary of Pennsylvania, and that partnership continued at least until Governor Geary died, in 1873. It is of course impossible that, with Governor Geary for a partner, this man could have had, for six years, within eight miles of the capital of Pennsylvania, practical speaking telephones which he was anxious to introduce to the world and to patent, and to do which he only wanted fifty dollars. Yet he does not pretend that he ever brought such an invention to Governor Geary's notice. If he had had them, the governor would have known of them, and the public history of the telephone would have then begun.

About 1865–6 he invented an improvement in molasses faucets and pumps. He had no trouble in getting his neighbors to raise over $20,000 in cash to enable him to experiment with that invention, to patent it (November, 1866), to fit up a machine shop to manufacture the articles, and to make him their master mechanic. That machine shop, stocked with from ten to fifteen thousand dollars' worth of tools and machinery, and run by water power, has been at his disposal, free of rent, for his own work, from 1867 to the present time.

It has been proved from his own deposition that during the ten years before the Bell patent he actually received in cash at different times more than $10,000, as his own money; yet the truth of his whole story rests on the assertion that he never could find fifty dollars to get a patent for the telephone, nor materials with which to make a few for sale. His partners in this faucet and pump company, which they afterwards (in 1869) turned into a regular corporation under the laws of Pennsylvania, with a capital of $20,000, and called the "Drawbaugh Manufacturing Company," not only made these faucets and pumps, but they made several other things that he had invented, and when they found that their work was slack they asked him to furnish any other inventions which he had, or to make some new ones, to enable them to employ their machinery and capital. They had a number of meetings for the purpose of examining into the various things he offered them, and after finding nothing which they thought worth taking up, they employed him to make some new inventions for that purpose. This appears from the corporation records, and his own proofs. This partnership and corporation lasted six years, until July, 1873. It is a part of his story that during all this time he had practical talking machines; that he believed the invention to be the most important of his generation and full of profit for its maker; that all he wanted was fifty dollars to patent it. Yet it is a proved and conceded fact that during all that time he never asked his company nor a single one of his partners to invest any money in the alleged telephone. He never showed it to any one of them, and not one of his partners during all those years ever heard of such an instrument. With the exception of a possible suggestion about some kind of undefined knowledge in one of them who is dead, it is not pretended that any of them even heard of it. More than half of them have been on the witness stand and have so testified, and the fact that Drawbaugh under these circumstances did not call the others, his friends and neighbors, is conclusive against him. He does not name them when asked to specify the persons to whom he applied for aid, and he does not testify that he ever showed it to any of them. The same is essentially true of all the workmen. Out of eighteen or twenty employed there he has found one or two who say they think they saw a broken tumbler on the bench in his shop while they worked there, but never tried it; and that is all.

The fact that an invention of so startling a nature, which according to his story he described and showed freely to every one and made the chief work of his life, never was known to a single one of his partners, and, without any pretence of exception except such as is found in the memories of one or two men, was never known to any of his fellow-workmen, working in the shop where he pretends he always kept and tried it, is absolutely conclusive against his story. In the case of his partners it is not merely a question of memory. They were men of means,—the poorest of them worth about $30,000, and the richest about $90,000. They were old personal friends of his, with sufficient confidence in him to embark their money on his inventive skill, and to ask him for more inventions when they had exploited those he had. It is impossible that he could have had this invention without their knowing it, and it is impossible that they could have known it and the invention remained unpatented and unused.

In 1873 to 1876 he was particularly experimenting with a telegraphic key, of a kind which he pretended was new, but which had in fact been known for a dozen years. He made two of them, costing him more labor and trouble than a dozen copies of his telephone would have cost him if he had had any to copy. He carried these telegraph keys to a telegraph office and got leave to try them, and carried one to Harrisburg and publicly exhibited it, and called in two of his personal friends — the telegraph superintendents of the Pennsylvania and the Northern Central Railroads — to see it, at a time when he says he had perfect speaking telephones and was anxious to try them on an actual line. Yet, with this opportunity, he confesses that he never exhibited his telephones nor sought to try them outside his shop, nor informed those to whom he showed his telegraph key that he had such a thing as a telephone.

The pump and faucet business of his company was bought out in the summer of 1873 by Hauck Bros. & Co., and David Hauck, an extremely clever master mechanic, carried on that business during parts of the next two years in Drawbaugh's shop, working generally in the same room with Drawbaugh. In the summer of 1879 Drawbaugh and this David Hauck got into an interference in the Patent Office, on the subject of another improvement in molasses faucets. They took testimony, Drawbaugh's financial backer (Mr. Chellis) and counsel (Mr. Jacobs) being one of his present backers and one of his present counsel. They conceived that it would be desirable to prove in that interference that Drawbaugh was a man intellectually capable of making an invention. So they asked David Hauck and his brother whether, while they worked in Drawbaugh's shop, Drawbaugh was not very friendly with them and very free in telling them about all his inventions; they replied that he was. They then asked David Hauck — these were Drawbaugh's own statements put into the form of questions by his counsel — whether Drawbaugh was not a great inventor, and David Hauck answered that according to his knowledge of Drawbaugh he was a copyist and an improver of details, but not a man who either originated anything or who carried any invention to successful completion. Nettled by this answer, Drawbaugh then interrogated Hauck seriatim, — Did not Drawbaugh invent the electric clock? &c., &c., naming a number of other things, to each of which Hauck replied that those were old inventions, and all that Drawbaugh did was to modify the details. Yet during this long examination they never once put to Hauck the question, which would have been decisive if they could have put it, — Did he not know that in 1873 and 1874 and 1875, when he worked in Drawbaugh's shop, Drawbaugh had electric speaking telephones which could be readily talked through? No speaking telephone was alluded to in the list of inventions that Drawbaugh then recited in his questions to Hauck. Yet this man worked during the three years before the Bell patent in the very room where Drawbaugh says he showed his telephones freely to every one; and Drawbaugh began by proving that he freely showed all his inventions to Hauck. This interrogation was in May, 1879.

When Drawbaugh himself testified a few weeks later, Hauck's counsel asked him in substance whether he was not a man who simply picked up and attempted to improve other men's ideas, but carried nothing to completion, and then pushed him to name everything he had ever done which resulted in any successful invention. Drawbaugh enumerated a number of things, but did not name the telephone. The same questions were put to Drawbaugh's brother, who is one of the principal witnesses on his behalf in this case; and he, in like manner, enumerating those things which he thought would conduce to his brother's glory, did not mention the telephone.

Here, then, we have Drawbaugh's solemn written statements, the year before this controversy began, as to the inventions on which he wishes his fame to rest. He made them, both in his questions to Hauck and in his own answers, and for the avowed purpose of making the best show he could. The telephone is not in his list.

There is also other contemporaneous written evidence of the same kind. In the summer of 1874, and again in the summer of 1876, he published an advertising card, the two sides of which are as follows:

Daniel Drawbaugh.

INVENTOR, DESIGNER

and

SOLICITOR of PATENTS.

☞Also Models Neatly Made To Order.

Eberly's Mills,

Cumberland County, Pennsylvania.

[See Other Side.]

Dan'l Drawbaugh,

Inventor of

THE FOLLOWING PATENTS.

Stave, Heading & Shingle Cutter.
Barrel Machinery.

STAVE JOINTING MACHINE, Many in use.
Tram & Red-staff for leveling face of Millstone.
Rine and Driver for running Millstone.
Nail Machinery for Feeding Nail Plates.

PUMPS, ROTARAY & OTHERS.

Hydraulic Ram.

THE DRAWBAUGH Rotary Measuring Faucet, very extensivly used.

CARPET RAG LOOPER.-- A little device by which rags are looped quick and firm, without Needle or Thread.

ELECTRIC CLOCK.

MAGNETO ELECTRIC MACHINE,

For short line Telegraphing, Fire Alarm, and Propelling Electric Clocks. It can be applied to any form of Electric movement. Gives entire satisfaction USEING NO *GALVANIC BATTERY.*——

☞For SIMPLICITY it has NO RIVAL.

That was not a list of things "patented," because half of them were not then and never have been patented. It was not a list of things that he was making for sale, because he was not making more than two or three of them for sale, and all the patents that he had taken out were sold. It was not even a list of inventions he had completed, for his clock was then in an inchoate state; he had one experimental working clock model; but his first finished clock was made in 1877. It was a list of the devices and inventions, complete or incomplete, on which he chose, in the summer of 1874 and the summer of 1876, to rest his claim to be an "inventor." He printed and distributed three hundred of these cards. There is no speaking telephone in that list. And yet, according to his story, he then had in his shop telephones perfectly fit for sale, and as highly refined and as perfect as those now in use, made no secret of them but publicly showed them, and believed them to be the most important invention of his time.

That card has another unpleasant effect on Drawbaugh. In the faucet interference testimony in 1879 he had qualified himself as an expert to testify upon a technical question. In order to so qualify himself he swore that he had acted as solicitor of patents for others and for himself, preparing specifications and claims for the Patent Office. In a printed billhead, printed for him between June, 1874, and the fall of 1876, he advertised himself as follows:

"Bought of Dan. Drawbaugh, Practical Machinist. Small Machinery, Patent Office Models, Electric Machines &c. a specialty."

A man believing himself so qualified as solicitor and model maker could not have had the speaking telephone for ten years in his shop, without at least filing a caveat on it or making a few for sale. Yet the answer said that he was absolutely unable to do even that, — and he must swear that he was. So, on his direct examination in this case, he testified that he was not a patent solicitor, and that he always knew that he was quite incapable of drawing a specification, though he admitted that he had done so in some cases. Afterwards, we found this card, by which he advertised himself as such. We introduced it by the deposition of the printer, one of his personal friends and witnesses. Drawbaugh never dared to go on the witness stand again, and no attempt was made to explain it by any witness. His whole testimony on that behalf, like the testimony about his poverty, was designedly introduced to meet what he knew was the turning point of his case.

An important part of this and other evidence — the production by him of a copy of the Patent Office rules, &c., was the proof it afforded of his familiarity with patents; — that he was familiar with the road to the Patent Office, and knew the importance of going there.

Between 1872 and 1876, two of his friends in Harrisburg were Mr. Kiefer, superintendent at Harrisburg of the telegraphs of the Pennsylvania Railroad, and Mr. Simon Cameron Wilson, then superintendent of the telegraphs of the Northern Central Railroad, and, at the time this case was tried, mayor of Harrisburg. Mr. Kiefer was also a member of a large electrical manufacturing firm — Hahl, Kiefer & Co. makers, among other things, of the signal service instruments for the Government. Drawbaugh during these years was in the habit of going to these two telegraph superintendents, obtaining small supplies of cast-off magnets, battery-plates, &c., from their condemned instruments, talking with them about his electrical experiments, and carrying to Harrisburg various electrical contrivances, such as his clock and his telegraph key, to show them. They were men who would have instantly taken his telephone and tried it if he had had any, and Mr. Kiefer testifies that he would have liked nothing better than to have patented and manufactured such things at his firm's factory. Yet during all those years Drawbaugh never showed them a telephone, and never hinted that he had ever thought of such a thing. These two gentlemen so testify in terms. Drawbaugh does not deny it. When asked to whom he applied for assistance about his telephone, he does not name them. This proof, again, does not rest on memory. If in 1873 or 1874 he had carried a speaking telephone to one of those men, the public history of the art would have begun that day, and not waited until Mr. Bell's appearance in 1876.

Another of his intimate friends was Mr. Theophilus Weaver, a patent solicitor of Harrisburg, himself an inventor. It is in evidence, and not contradicted, that Drawbaugh was in the habit of going to him from 1869 onward; that they had some business together; that some clients of Mr. Weaver's carried on business at Drawbaugh's shop, with Drawbaugh as superintendent, in 1875–6, and that Weaver had been there a number of times from 1867 to 1876. Yet Weaver testifies, without contradiction, that Drawbaugh, now pretending to be only too anxious to get his telephone patented, never spoke of the subject to Weaver, and Weaver never heard that Drawbaugh had a telephone until 1878, when Bell's telephones were in extensive commercial use and were in actual use in Harrisburg. Drawbaugh then said to Weaver, in May, 1878, that he had turned his attention somewhat to the subject a good many years back, but never got any results, and did not expect speech, but only musical tones, and had nothing to show for what he had done. These facts do not rest merely on Weaver's memory, though Drawbaugh does not contradict him. If Weaver, a patent solicitor, had known of a telephone in 1873, it would have been instantly patented.

Drawbaugh's relations in the community were such that if he had had a speaking telephone it would have been mentioned in the newspapers. He was known as an ingenious inventor of small things, and in that community attracted attention. He exhibited at the state fair in 1868 and 1869, and his exhibition (nail machinery and pumps) was mentioned in the newspapers. His witness Holsinger, at one time editor of a country newspaper, who says that in 1873–4–5–6 he was Drawbaugh's most intimate friend, next door neighbor and co-experimenter with the telephone, wrote some newspaper articles about Drawbaugh's inventions in 1875, and again in 1876. He mentioned his clock and praised it, and said that Drawbaugh was going to make one to exhibit at the Centennial; but never wrote a word about a telephone. It is proved by that article and otherwise, that Drawbaugh did contemplate exhibiting at the Centennial, but that what he proposed to do was to build an electric clock for that purpose; although he wants the court to believe that he then had in his shop speaking telephones as good as those now in use, and that he made no secret of them and was anxious to attract public attention to them.

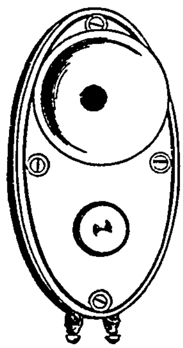
In 1878 he was visited by a number of newspaper writers, attracted by his electric clock, which during that spring was publicly exhibited for money in Harrisburg and some other towns. In that spring he became spoken of as a person connected with telephones; but in this way: Several paragraphs appeared saying that he was "then" inventing *improvements* in telephones, but not one of them attributed to him the original invention. It is not possible that the local newspaper writers could have visited him and got any inkling from him that he was the originator of that wonderful instrument without spreading his story at full length instantly in the papers.

Among other visitors, *Mr. Matthews*, an editor of the *Baltimore American*, went to his shop in April, 1878, to see his clock, and while there talked to him about the telephone, which was then attracting great attention. Drawbaugh's statement to Mr. Matthews was that he had experimented somewhat upon a telephone many years before Bell or Edison, but that he never got speech and never expected to; that his aim was to send telegraph messages by variations of tone and pitch. Mr. Matthews published this in his newspaper in 1878, and sent a copy to Drawbaugh, who never repudiated it. Mr. Matthews came upon the witness stand and repeated under oath his account of the visit. The article, after describing the clock at considerable length, and in a very laudatory manner, said of Drawbaugh's attempts about a telephone: "He never expected to send articulate sounds over a magnetized wire, but he believed that an alphabet could be arranged after the manner of a musical scale, and that messages could be transmitted and understood by the variations of tone and pitch."

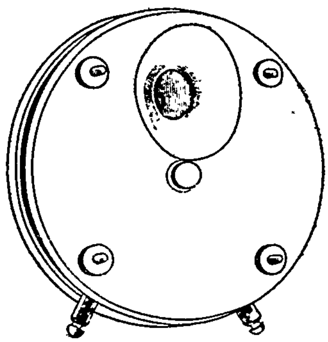
That such was Drawbaugh's purpose is curiously confirmed. It is proved as matter of fact in these cases that between 1860 and 1870 many persons were trying to construct telegraphs which should send ordinary telegraph messages by variations of tone and pitch, and that Drawbaugh knew of these attempts and was much interested in them. One of the most ingenious and extraordinary of these "phonic telegraphs," as they were often called, was described in the *Scientific American* in 1863. Drawbaugh got that paper, studied that description, thought a great deal of it, remembered it and some others on the witness stand, and finally produced the paper, which he had kept.

In the same spring as Mr. Matthews' visit — 1878 — a friend of his, *Mr. Stees*, a manufacturer at Harrisburg, now dead, took him to the telephone office in Harrisburg, introduced him, and said to the telephone people there that Drawbaugh was *then* engaged in making a telephone which he thought would be better than theirs, but never hinted that Drawbaugh was the originator of that great invention. Mr. Stees for many years had a private telegraph line connecting his office with one of his machine shops. He found such difficulty in working Morse instruments that he was the first man in Harrisburg to put in the Bell telephone, in March, 1878. Drawbaugh and he were intimate friends, and they had been partners in a little invention of Drawbaugh's ten or fifteen years before. Yet Drawbaugh does not pretend that he ever showed his telephones to Stees, or asked to try them on a line, or asked any aid from Stees until after Stees had the Bell telephone in use in 1878.

Drawbaugh called again at the telephone office a few days



Phelp's Snuff Box Magneto.



Drawbaugh's Magneto A.

later (May, 1878), examined the instrument the telephone company then had in use, known as the "Phelps Snuff Box," drew from his pocket his own instrument, A, and compared the two, asked if the Phelps was patented, and on being told that it was, said that his was too much like it, — without a hint that his was, as he now claims, four years old. Certainly their resemblance is wonderful. His story is that at that time he had had H (the Blake transmitter) for eighteen months, — an instrument far superior to anything then known in the country. Yet he never gave a hint of it. He borrowed a magneto telephone of an ingenious but rather inferior kind from the telephone company (the Phelps "Crown"), with curled magnets, and took it to his shop to study it and learn how it was made. He kept it several weeks. Yet, if his story be true, he had had for two years almost exactly that instrument (in L and M, the magnets of which were bent), and during all that time he also, according to his story, had telephones — the Blake transmitter H, and other microphones — which were so far ahead of it that it would have been thrown away the moment such instruments appeared.

In the fall of 1878, a history of Cumberland County, where he lived, was published. He subscribed $10 to it on condition that they would publish a biography of himself. He furnished the biography, and it was published essentially as he sent it. In it he enumerates a number of his inventions, and at the end of his enumeration, nowhere stating himself to be the originator of the telephone, he says that he has invented "several kinds" of telephones. Improvers are so spoken of; the originator never could so speak of himself. This vain-glorious autobiographist could not have failed to claim for himself what in 1878 was recognized as the greatest invention of our generation, if he had made it. This article was so printed, the book taken to him, this shown to him, and he, acquiescing in its correctness, paid his subscription.

These newspaper accounts — and there are a number of them in the first half of 1878 — speak of him repeatedly as *then* engaged in improving the telephone. That is a fact which his story must square with. Stees so informed the telephone company, in Drawbaugh's presence, in 1878. Yet, if the story of his deposition be true, he had at least a year before that completed the best telephones he ever made, and never, since the spring of 1877 down to the time when this suit began, constructed anything which was, or which according to his own account he thought was, an improvement on his alleged old ones of 1876.

The truth is that he made his telephones after the Bell patent came out. He at first copied what he had seen described in the *Scientific American* in September, 1876, as Bell's tin can instrument. It is in proof that he exhibited this to a number of persons in the fall of 1876 as the best thing he had. In the beginning of 1878, when telephones were attracting a great deal of attention in the community, and the microphone had become known but was not perfected enough for commercial use, he, like many others, seriously went to work to try and make modifications and improvements. That was his real work on the telephone, and we believe it was then that he did it, and made his first attempt at a carbon telephone. The contemporaneous newspapers and Stees' statement prove this part of his history.

Lloyd and *Worley*, two school teachers of Harrisburg, had long known him well, but had heard nothing about telephones. At the beginning of February, 1878, they went to see his clock, and presently published a very laudatory newspaper article about it. He told them that he had made telephones (not pretending that he had made them before Bell), but that the articulation was bad, and he was trying to improve it by giving a confined shape to the sound chamber. Plainly, he was *then* making D and E, his first telephones with the thin air chamber and other refinements which Bell patented and put into commercial use in 1877; for Drawbaugh never made any change in the sound chamber after D and E.

The mere fact, conclusively established, that at that time he was making improvements, is absolutely inconsistent with the story of himself and his witnesses that his most improved telephones were made some years before. On the other hand, it perfectly fits in with the fact that his work before that was in experiments on other contrivances, that no telephone was known to David Hauck or any of his partners, that no telephone was found in his advertising cards of 1874 and 1876, and that no telephones were shown to the telegraph superintendents Kiefer and Wilson.

His shop was full of electrical contrivances for many years. He undoubtedly had there as early as 1872 or 1873 string telephones. He had there in 1872 or 1873 modified telegraph instruments, such as the magneto key, and the alphabet instrument which would spell out words, and which he said were to supersede the existing telegraph instruments. His witnesses, many of them of exceptional stupidity, who undoubtedly saw electric speaking telephones at his shop in 1876–8, have mixed these things together, and, aided by their desire to help a friend, by his subtle insinuations of ideas into their heads, and by the gossip of the village grocery and cobbler's shop during the preparation of this case, have come to a condition of mind where they attribute to one time what they saw at another, in a shop full of contrivances all equally wonderful, and all equally incomprehensible to them.

Drawbaugh's witnesses and their value.—His case rests purely on oral recollections. Its whole strength lies in the fact that he has fifty-one such witnesses who testify that before the Bell patent they heard speech at his shop, through what they say they understood were electric speaking telephones.

Two questions lie at the foundation of this case. One is, what is the value of the mere oral recollections of the interested parties and their friends, of such a class, against the history of this man's life? and another is, what is the relative strength of the purely oral testimony on the two sides? for on Drawbaugh's side there is nothing else. We believe that the answer to each of these questions is against him.

When we first heard of the Drawbaugh claim and began to study the subject on the spot, we found that fair inquiry was impossible. The country people saw on one side a corporation of strangers; on the other, a neighbor whose success was a matter of local pride, and promised to bring into that little community, and into the pockets of an open-handed man, more money than the villagers had ever dreamed of. More potent than all was the intense local feeling of a narrow and rural community which made every member of it a partisan of one side and an enemy of the other. But this was not all. The Drawbaugh Company had diligently cultivated the ground, and had taken seventy-five *ex parte* affidavits, but not for use in any proceedings. They were simply anchors planted around to hold that community. The great case was the theme of gossip in the country grocery and cross-roads shoeshop, till the most ignorant were ashamed not to remember, and vied with each other in their stories. So we found, during the four years of taking testimony, that witnesses who remembered nothing in the first year, swore the most glibly for him in the last.

At the outset, we had to consider what classes of persons would be the crucial witnesses in such a case. The claimant had had nine partners and twenty-five workmen during the time in question. He had a number of close and intimate friends, near neighbors, men of substantial means, disposed to invest money in his inventions. He was in the habit of going to the two telegraph superintendents and other skilled and intelligent persons in Harrisburg and Mechanicsburg, and showing them his inventions. If his story be true, it is absolutely certain that to all those men the telephone would have been like a household word, and they would have been continually solicited to aid him in patenting, &c., if aid was needed, — for he was a professional inventor and patentee and says he always wanted to patent this invention. If the fact were clearly established that those men did not know of the invention, it would be certain that it did not exist. With that fact once established, the dim and strained recollections of the small farmers and farm laborers, testifying about an instrument they neither understood nor took interest in, their minds confused by the large number of contrivances they saw in his shop and the number of times they saw them, are of no value upon the question whether one particular unknown thing they saw was a speaking telephone, or at what period of their constant visits they saw it.

In this inquiry we were thoroughly successful. Indeed, the history of the case did not leave it in doubt; for most of these men were in such circumstances and of such disposition, shown by the aid they gave him about other inventions, that if they had known of a speaking telephone at his shop, the public history of the art would have begun at that instant. But the proof is even more specific. Drawbaugh's cross-examination and some other undisputed proofs developed the names of about seventy-five persons so situated. He was repeatedly asked whom he had applied to for aid, and what exhibitions of his instruments he had made; and no one of these men were named by him. Out of all these seventy-five men, only two or three (they were workmen employed about 1870) were called by the defendants to even pretend to any recollection about his instruments. Others were put on the stand for collateral matters, but not asked about telephones. Then we went to them, found in almost every case (including the case of the two telegraph superintendents) that Drawbaugh had applied to them before we had, and they had no recollection of any such machine until after the summer of 1876. We called a substantial number of them — enough to establish the proposition. That, under these circumstances, Drawbaugh, on whom the burden lay, and whose friends they were, did not call the others, is conclusive.

Against these stubborn facts the Drawbaugh party labored for four years, and called 400 witnesses, mostly for collateral and remote matters, but the crucial witnesses did not come. With all this scouring of the country, they could find only fifty-one persons who would pretend to fancy that they had heard speech during the ten years with anything which they could suppose to be the telephones he described — five a year — a number absurdly below what the story, if true, would have furnished. But hardly one of these was above the grade of a common farm laborer.

It is only the mere residuum of such conflicting oral testimony, if there be any residuum, which is to be set against the facts of his history, against his advertising card, against his own deposition and his questions to Hauck in the interference testimony in the summer of 1879, against the fact that all his partners and friends who would have advanced money for the telephone, if he had had one, never heard of it, against the fact that with one or possibly two exceptions no man of intelligence even pretends to have heard speech before the Bell patent. Besides that, an examination of the depositions themselves shows that they are thoroughly worthless, and that plainly a considerable number of them are the result of deliberate contrivance and conspiracy on Drawbaugh's part.

We begin with the fact that of these fifty-one witnesses more than half swear to thoroughly good speech through the tumbler F and tin can B. We know now from the New York tests that that is absolutely impossible. Several other witnesses swear that with a pair of magneto telephones, and several others swear that with instruments they cannot identify or describe, they heard perfectly good speech when the receiver was lying on the table, and they were several feet distant from it; or that they heard perfectly good speech without any trouble in the midst of the noise of the machinery of the shop. The best magneto telephones to-day, or the best instruments Drawbaugh pretends he had, cannot do anything of the sort. It is absolutely impossible. Moreover, the picture they give of his life for the ten years before the Bell patent—his "abject" poverty, his exclusive devotion to the telephone, that he worked on nothing else—we know is false. All this destroys an argument which rests on the assumption that what a large number of such witnesses say must be true. We know that what more than half of them swore to specifically about the telephone is false, and that their whole picture of his life gives nothing but false color. The circuit judge found that they were ignorant men who had been practised upon by Drawbaugh and first made to believe his story, and afterwards produced to swear to it. He declined to substitute their credulity for his own judgment.

Some specific instances are very instructive.

Henry Bayler, who appears on the surface to be one of the best half dozen of their witnesses, was one of the proprietors of a neighboring saw-mill and planing-mill from the spring of 1873 until the summer of 1877. He and Drawbaugh had dealings together, and Drawbaugh did repairs at the mill. Bayler says that at some time he went to Drawbaugh's shop and heard perfectly good speech through the tumbler F and tin can B. We know that is impossible. He says that it was when Drawbaugh was first repairing his saw-mill engine, which was fixed to be in June, 1873. His association of dates is hardly more than arbitrary; and if the occurrence, whatever it was, was not then, there is no way of fixing it any time short of the summer of 1877, when Bayler moved away. It certainly was not during the year named nor during the next year. For the partitions in the upper story of Drawbaugh's shop, where he says his telephones were usually kept and used, were changed from time to time, and we know from Drawbaugh's own testimony and the testimony of the different partnerships which occupied that shop and paid for the changes in the partitions, just when each change took place. Bayler testifies to the situation of the rooms, and exactly in which room each instrument was placed, and where the wires ran. The partitions and rooms which he so swears to as the place where he witnessed the tests of the instrument F and B, did not exist until 1875, two years after the time when he says he saw the instruments; they remained in that condition until 1878.

Bayler was also called to testify to Drawbaugh's extreme poverty. He puts his visit as at the end of June, 1873. He says that Drawbaugh importuned him to advance a little money to take a patent, and said that it was absolutely impossible for him to find any, and that if he could find money enough for a patent, his fortune would be made. He professes to have known that Drawbaugh was abjectly poor at that time. The truth is, as is shown by the books of the faucet company, produced by Drawbaugh, that at that time the company had just sold all its property for cash, and within two weeks from that time Drawbaugh received from that sale a dividend of $450 in actual cash, (July 15, 1873,) and had so little pressing call for the money that he used $300 of it to pay off the last instalment of the bottom mortgage on his own house; for he owned a double house at that time, and had for six years, with an old incumbrance of $300 on it. He lived in one half of this house, and rented the other half for $110 a year to a good paying tenant.

Bayler says that Drawbaugh's poverty was such that when he made repairs at the saw-mill he always required to be paid in cash at once; and that when he bought lumber from the saw-mill he always insisted that it should stand on credit; and when they settled their account finally he owed the saw-mill about $70, which they had to sue for and establish a lien for, in order to collect. Drawbaugh put Bayler on the stand to swear to that story. Yet the truth is that the saw-mill people never paid Drawbaugh a dollar of cash; that he got lumber from time to time only against his credit for work already done; that there never was a time during all these years when the saw-mill people did not owe him on settlement of account from $30 to $60, which he could have had by asking for it; and that at the very time alleged for this visit they owed him $50, sufficient to take out a patent, and he never asked them for it. These facts we afterwards proved by the production of Drawbaugh's accounts in his own handwriting, and by the saw-mill people's books, and they were not disputed. Moreover, the settlement of account had involved a suit between Drawbaugh and the saw-mill people, and in that suit Drawbaugh filed his own affidavit, stating this condition of the accounts, and showing that the last lumber he took from them ($70, in 1877) was intended to balance this account, and if it overran it, it was only about $10 or $15, which he was ready to pay. This affidavit, which we put into the case, was sworn to by Drawbaugh only fifteen months before he put Bayler on the stand to testify to the story which he knew was false.

Jacob Reneker says that at one time Drawbaugh was so poor that he sold to Reneker a part of his household furniture —a secretary and bedstead—to pay for provisions for his family. Drawbaugh on the witness stand repeats this story very pathetically. The fact is that at the time in question Drawbaugh was moving from one house to another: his household effects made eighteen horse-loads; he had more furniture than his family needed or than his new house could hold; among other things he had two secretaries (he had made one himself, and had afterwards bought a better one), and, in moving, he sent his old secretary and some bedsteads to his workshop as superfluities, varnished them up, and sold them to Reneker.

Urias R. Nichols testified that he had been in the signal service and assistant keeper of a lighthouse, and appeared to be an intelligent witness. He said that he went to Drawbaugh's shop and saw the tumbler F, and tin can B, and the wooden instrument A; that Drawbaugh said the wooden instrument was about two months old, and the tumbler and can three or four years old; and they talked through them. He testified that this was in January, 1875, and he fixed the date by saying that on the day of this his only visit to Drawbaugh's shop he bought some lime at a particular lime-kiln which he specified, and that a memorandum, which he said he had at home but forgot to bring and never produced, stated that the lime was delivered January 18, 1875. On cross-examination, he said that he went to the shop particularly to see Drawbaugh's electric clock, in consequence of having read an account of it in a newspaper, which he repeated. We found the newspaper with that account in it, and instead of being January, 1875, it was February, 1878, two years after the Bell patent. We produced the man who kept the lime-kiln up to April, 1876, the time of the Bell patent, with his books, and he proved that Nichols never bought any lime of him. Nichols testified on cross-examination that during the same season as this visit to Drawbaugh's shop he stated the occurrence to Colonel Maish, a lawyer in York, and a member of Congress. Colonel Maish, called as a witness by us, remembered the statement perfectly well, and knew Drawbaugh as one of his constituents; but he also remembered that when Nichols told him of it, the telephone was not new to him, because he had talked through a Bell telephone in Washington. The telephone he talked through we proved was put up by one of Mr. Bell's agents in the fall of 1877. Nichols never came back to explain his story, and there was no attempt to reinstate it. Yet he appeared to be one of their best witnesses.

But what becomes of Drawbaugh who puts a witness on the stand to detail an interview between them and to swear that at the time of the visit the telephone A was two months old, and that the first telephone with the tumbler and tin can was then a few years old, when it turns out that this visit was two years after the Bell patent? Either the whole occurrence is concocted, or it is fatal to his dates.

Samuel Nichols, another witness, says that he went to Drawbaugh's shop, listened to the tumbler and tin can, and heard two words, and his "son-in-law Bruce" was with him, and also heard two or three words. He thought the visit was in 1869. It turned out that Bruce did not become his son-in-law until June, 1876, four months after the Bell patent, and did not become acquainted with his family until after Bruce's first wife had died in 1875. Nichols' son, Edward Nichols, worked in Drawbaugh's shop in 1874 and swears that he never heard anything about telephones. Drawbaugh, who saw him before we did, tried to make him think he remembered them, but in vain.

Henry B. Musser, a farmer, went to Drawbaugh's shop several times to have his mowing machine repaired, between 1874 and 1878, inclusive, but each year in June, the mowing season. He fixes the dates of each of those visits by payments entered in his farm books. He says he saw the tumbler and tin can and once talked through them, and his recollection is that this was at his first visit, in June, 1874. On the witness stand he made a diagram of the arrangement of the rooms where the tumbler and tin can were at the only visit when he tried them, and where the wires ran; the partitions he so described did not exist until 1875 and remained until April, 1878. He undertook to describe the other things that he saw at the same time when he talked through the tumbler and tin can, and he testified to seeing at that time a number of electric clocks; in fact these did not exist before the summer of 1877. He has seen the later instruments there, but not in the same year when he tried F and B. This puts the tumbler and tin can as the best instruments after the Bell patent, and refutes the previous existence of better ones.

Several witnesses got into trouble in the same way by letting the fact be known that they saw at the same time the early telephones and some remarkable clocks which Drawbaugh admits did not exist until one or two years after the Bell patent.

Mrs. Darr testifies that she moved away from the village in 1870, and before she left she used to hear a great deal about Drawbaugh's telephones. That seemed to fix a date, but upon cross-examination she testified that at the same time, and while living there, she also heard a great deal about his electric clock, particularly about its being carried over to Harrisburg to be exhibited. That clock was not made until the fall of 1877, and was exhibited in Harrisburg in May, 1878.

Decker went there several times, and undertakes to fix one particular time, a year or two before the Bell patent, as the time when he particularly remembers hearing speech through the telephone. On direct examination he detailed the conversation between himself and Drawbaugh through the telephone; it was about the birth of the child of one of his neighbors. We called the neighbor, and his first child was born a year after the Bell patent.

George W. Drawbaugh, a nephew of Daniel, the claimant, said that he first knew of his uncle's speaking telephone at the time when he and his uncle, at his uncle's shop, were painting a certain wagon to be used by the firm of Drawbaugh Sadler, consisting of Daniel Drawbaugh, the claimant, and one Jacob Sadler, now dead. He does not exactly remember the date, but he got the lumber for the wagon from one Lee, and Lee's only charge against George Drawbaugh for lumber is in March, 1870. He then produced a witness *Ditlow*, who said that George Drawbaugh told him all about the exhibition at the time. Ditlow first testified as a witness for us that this was in 1877, a year after the Bell patent; but afterwards was prevailed upon by Drawbaugh to come back on the witness stand and swear that he did not well remember the date himself, but that in the spring of 1870 he went to the West to live (coming back generally for the winter), and told all this to people out there. A number of people from Indiana swore that he told it to them there in the spring of 1870, and could not have told it later because they knew him then and did not meet him afterwards. That story hung together extremely well, and seemed to fix 1870 as a date, until presently we got hold of the accounts of the firm of Drawbaugh & Sadler. That firm did not exist until 1871, and the wagon was not painted until 1871, so the whole labored chain of circumstances is pure delusion or fabrication.

These are only some out of a number of samples. More than a dozen out of his fifty speech-hearing witnesses were destroyed in this way. More than half are destroyed by the proved incapacity of F and B to talk. But it is not merely those specific witnesses who go by the board. There is no character left in a record of which they were the most important part. The court below found that his witnesses were mostly ignorant men whose memories were confused about what they saw or when they saw it, and whom Drawbaugh, with the aid of friendship and local feeling, had beguiled into believing untruths, and put them forward to swear to them.

The testimony furnishes some very curious proofs of this confusion of memories. We have already referred to the fact of a string telephone, in the village, at least. Other instances are more striking. *Captain Moore*, one of the most intelligent of his witnesses, carried on business at Drawbaugh's shop, with Drawbaugh for his superintendent, from March, 1875, to the fall of 1876. He never attempted to talk with any instrument, but saw some machines which he does not well remember, but thinks they were for speech. They had magnets, and were to be used without a battery; and he testified on direct examination that Drawbaugh said that they were to be used as a substitute for the fire-alarm telegraph. Now a speaking telephone could not well be so used. But Drawbaugh's magneto telegraph key, which he certainly had at that time, was intended by him for that use; he offered it for that purpose to the fire-alarm superintendent at Harrisburg, and his advertising cards of 1873–6 expressly stated its fitness for that purpose. *N. W. Kahney* testified that Drawbaugh told him that he had a Mechanicsburg man to go in with him on the telephone, and *Shopp* says that Drawbaugh was going to exhibit at the Centennial. We know from Drawbaugh that it was only his clock that any Mechanicsburg man thought of taking an interest in, and that it was only the clock that he thought of exhibiting at the Centennial. One of the most striking instruments produced was the tall H (the Blake transmitter), which most of the witnesses identify by the bell on top (only the lower edge of which is shown in the cut). We know as a matter of fact, from his own cross-examination, that he had in his shop from 1873, or thereabouts, to the present time, some alarm bells to be rung by electricity, for use in hotels. *Shettle*, one of his most conspicuous witnesses, swears that he saw in 1876 or 1877 an instrument which he recollects as H; that he recognizes it by the bell; that they did not talk through it; that Drawbaugh did not tell him it was a talking machine, but told him it was to be used for calling in hotels, and that all Drawbaugh did in showing it to the witness was to ring the bell.

We have already pointed out from Mr. Matthews' *Baltimore American* article, and Drawbaugh's preservation of the *Scientific American* article of 1863, his early attention to the "phonic telegraph." That was a plan of a machine which was to send words by sounds, and supersede the existing telegraph. With the class of men he called as witnesses, testifying in 1882–4 to ancient occurrences in a shop where they had seen telephones ever since 1876, and an abundance of electrical contrivance they did not understand before that, this was a sufficient basis for their confusion.

The absolute contrast and inconsistency between the story told by Drawbaugh and his witnesses and the actual facts of his life and his own repeated statements in writing before the controversy began, compel the conclusion reached by the Circuit Court that in its essential features, and the only feature which the law makes the turning point, to wit: on the question whether he had a practical speaking telephone before the Bell patent, the story is a fabrication, — an intentional fabrication by Drawbaugh, supported by witnesses in part dishonest, in larger part misled by him. These witnesses as a class are shown to be unreliable. Against them, or such of them as do not destroy themselves or are not destroyed by others we have the fact, established beyond controversy, and chiefly out of his own mouth, that neither his partners, nor the telegraph superintendents, nor his friend Weaver, the patent solicitor, nor his fellow-workman David Hauck, ever heard of the existence of such an instrument. Actual count shows on the one hand fifty-one witnesses who swear that they heard speech in the course of ten years, (mostly with F and B, proved to be incapable of speech,) and other witnesses who say they saw or heard of the instruments, but did not take interest enough to try them; and on the other hand seventy-five persons, intimate friends and intimates of his shop, who are proved, not by their own recollection alone, but by their history and conduct, and by Drawbaugh's testimony, to have had no knowledge of the existence of a telephone. These men are virtually his witnesses, for they are part of the class whom the law required him to call, and whose memory he in fact appealed to. The weight of the oral testimony, especially when judged by the rule laid down by Lord Mansfield, is on our side; but, in this conflict of testimony, the general history of the claimant, the confessed fact that this great invention never got into use by a single human being from his alleged work, coupled with his own history and his own declarations, with the proof of his habitual falsifications in the testimony, especially as to poverty, leave the case free from doubt. It would be enough that they left it in doubt, for the rule is settled that whoever atacks a long-established patent, as this man did for the first time in 1880, — a patent for an invention so startling that the moment it existed in the most rudimentary form it arrested universal attention, — and does that with the story that the invention in a perfected form in his hands never attracted attention enough to make anybody desire to use it, and who rests such a story on oral recollections of fact and of date, — must make out a case free from doubt. To raise a doubt is to resolve it against the claimant, said Judges Strong and McKennan in *Parham* v. *Button-Hole Machine Co.*, 4 Fish. Pat. Cas. 468, 482. To the same effect are *Wood* v. *Cleveland Rolling Mill Co.*, 4 Fish. Pat. Cas. 550; *Thayer* v. *Hart*, 20 Fed. Rep. 693; *Washburn* v. *Gould*, 3 Story, 122, 142; *Coffin* v. *Ogden*, 18 Wall. 120, 124; *Cantrell* v. *Wallick*, 117 U. S. 689, 696. The rule and a most substantial reason for it was well stated in *Thayer* v. *Hart*, 20 Fed. Rep. 693. "The evidence of prior invention is usually entirely within the control of the party asserting it; and so wide is the opportunity for deception, artifice or mistake, that the authorities are almost unanimous in holding that it must be established by proof, clear, positive and unequivocal."

Poverty is the only ground on which Drawbaugh attempted to reconcile the story alleged and the history proved. There is no suggestion in the record that the great gulf between his story and his life, — between the alleged existence of the invention and the proof that no marks or fruits of it are found, — can be bridged over by any lack of appreciation. On the contrary, it is a part of his story that he believed it to be of enormous importance and vast pecuniary value, and that for ten years he was so engrossed in it that he could think of nothing else. The answer says that nothing but his abject poverty prevented him from patenting it, and from manufacturing instruments for commercial use; that after he had first got good speech, he perceived that improvements would "increase its value to himself and the public," and therefore labored on it with great zeal and assiduity. He testifies that from 1867 for ten years he worked at it unceasingly, laying it aside only occasionally, and with reluctance, to earn bread for his family, whom he kept reduced (so he avers) to great poverty for this cause. The court below found that poverty was the only excuse offered, and that that excuse was false in fact.

He called forty witnesses (whose testimony to this point is collected in our brief) to swear that during the whole time he asserted the importance and the value of the invention. "He said it was the greatest invention ever known." "He said he could run it out for miles, and parties could talk the same as persons in a room together." It was "to supersede the telegraph." "My fortune lies in this." "He said it would be a fortune to him." "If I can accomplish it, it will be worth thousands to me." "Would be worth a great deal of money." "I have a talking machine that beats all the other of my inventions." "He said he could make a fortune out of it." "Would astonish the world." "If he would be able to get it accomplished, he would be a very rich man some day." "If he is successful in getting it finished, he will be the richest man in the valley." "It would surpass the telegraph." "When it was perfected, there would be no trouble to connect one point with another." "More wonderful and handier than the telegraph." "It will take the place of telegraphing, and be cheaper." "If he could get this accomplished, get it patented, he would be one of the richest men." "His whole heart and desire was on the telephone." They swore that they saw his shop usually lighted late at night, and always believed he was working on the talking machine, and that he habitually neglected his work to labor on the talking machine. "He appeared crazy on it. I often tried to get information from him on other subjects, and about half a minute's talk would turn him right on the talking machine—that is about his standing—the way he felt all the time I was there (1873–6)." Unfortunately for the credit of this witness (*Holsinger*), he, during that period, wrote two newspaper articles praising Drawbaugh's inventions. He described his clock, but did not mention the telephone among them.

His other occupations, his experiments on other and foolish contrivances, show this to be an absolutely false picture, and condemn all these witnesses. But the gossip, as they give it, during all the years down to a period as late as 1877, the year after the Bell patent, is that "*if* he gets it accomplished" he will be rich. Such gossip, whenever it was, together with the fact that he had sufficient means and tools, tells the history of a man who did *not* "accomplish." We believe, however, that these witnesses have entirely confused their memories of the many other things which he did before 1876 with the telephones which he made after 1876.

The burden is on him to show the truth of his history. Nor does the law find it essential to know just what he did, in order to decide against him. It puts one single inquiry: Did he have a practically successful speaking telephone before Bell's invention? Because, if he did not have that, it is not important to know whether he had nothing, or whether he had something that fell short of that. Therefore, if his history and surrounding circumstances are inconsistent with *that*, his case is disposed of, and the law does not seek whether there was some insufficient foundation for a false claim.

The history of the alleged maker of so startling an invention is not evidence which simply bears upon the probability of a story which may be true. It is the strongest legal proof against it or for it, as the facts may be. In *Atlantic Works* v. *Brady*, 107 U. S. 192, 203, this court declared that where this proof was all one way, no judicial action could be based on mere recollections to the contrary. In the sewing machine case (*Howe* v. *Underwood*, 1 Fish. Pat. Cas. 160, 165), Judge Sprague rehearsed the proof from recollections, and then stated the proof from the undisputed facts of the man's interest. These are two lines of positive proof, said he, so inconsistent that one or the other *must* yield, and that statement of the question answered it.

The argument of the value of a cloud of witnesses, which is the whole reliance of the other side, is all against Drawbaugh.

It is a well recognized fact that the illusions of memory are more common than the omissions of memory. That the partners and others — that these seventy-five men — would have known of and used the telephone if it had publicly existed, is certain. That such a cloud of intimates could have known of it, and forgotten it, is impossible. But that an unobservant set of men who have always seen and heard of much at his shop they did not understand or take interest in, and had seen and heard of telephones at his shop for five or six years before they testified, should now think they remember what in fact they did not then, but have seen and heard much of since, and should confuse their memories as to the subject they did see, and the time when they saw it, is consonant to daily experience, and to the observations of writers on the subject. The courts know this. "The confidence of the attacking witnesses is often in proportion to the distance in time that the one is removed from the other. Their imagination is wrought upon by the influences to which their minds are subjected, and beguiles their memory." Swayne, J., in *Wood* v. *Cleveland Rolling Mill Co.*, 4 Fish. Pat. Cas. 550. Of all causes for delusion in dates, none is so potent as the contrivance which Drawbaugh has generally induced his witnesses to resort to — the arbitrary association, by mere memory, of events which have no necessary relation to each other; as the attempt to fix the date of a particular visit to the shop by pretending to remember that it was while the witness lived in one house rather than another, and then casting a glamor of authenticity over the whole by producing a dated deed of the house selected. See *U. S. Stamping Co.* v. *Jewett*, 18 Blatch. 469.

The magneto instruments D and E. — Of all the instruments alleged to have been made before the Bell patent, the tests of the so-called reproductions show that none would physically suffice to overturn the patent except the magneto instruments D and E. The defence cannot be supported, therefore, except upon proof of the date of these two instruments. From the tests made at a comparatively early period in the case it was evident that it must turn on the dates of these. The defendants took four hundred depositions. Yet, out of this vast number, and from four years scouring of the whole country, they were able to find only seven men who even pretended to have heard a word through D and E before the Bell patent. The story is that these instruments existed a whole year before the Bell patent. Their perfection and clearness, in spite of some weakness, must have been such as to satisfy the most incredulous that when they were made the problem had been solved, and that whoever had them had instruments fit for commercial use. If they were made before telephones were in use in the world, they must have produced an enormous effect on Drawbaugh, on all his family and friends, and upon all of the many hundred people who are alleged to have known of his telephone. The fact that under these circumstances his utmost research can find only seven men who pretended to have got speech through them, is of itself decisive. These seven men, however, sift down upon the first critical examination of their testimony into almost nothing. They are as follows:

Decker swears that he heard speech through them in the fall of 1874. The claim made by Drawbaugh's counsel and sought to be supported by their proofs is that they first existed in the spring of 1875. Decker is the man who talked through a telephone about his neighbor's baby several years before it was born.

Jerry Fry was the storekeeper in the village from the spring of 1875 to the spring of 1880. At some time, which he says he fixes by mere memory as April, 1875, he heard *singing*, but no speech, through something which he thinks was D and E, and thereupon he told one of his neighbors, he says, that "it would be a very good thing if Drawbaugh gets it accomplished." Real speaking telephones like D and E never would produce that effect; nor has he any way of fixing a date.

Isaac Millard testified that he heard through them in 1874, which is before Drawbaugh pretends they were made; he afterwards was brought by leading questions to say he thought it was in 1875; but he had already sworn that in 1869 he plainly heard speech through the tumbler and tin can which we know cannot talk, and he also swore that in 1869 he heard speech over a certain out-door line which Drawbaugh himself testifies did not exist until 1878.

Fettrow, the blacksmith of the town, who hired half of Drawbaugh's house and lived under the same roof with him from 1868 to April, 1876, and has lived in the same house ever since, says that it was in 1875, according to his recollection, that Drawbaugh for the first time alluded to the subject to him. At some time, which he thinks was in 1875, he talked through something which he thinks was D and E. He has been at the shop from once a week to once a month ever since. He says that he has continually seen talking machines, but never tried to talk through one at any other time, and has no other definite recollection about them.

Holsinger is the witness who swore that Drawbaugh's whole heart and soul were on the telephone from the time he, the witness, first moved to Eberly's Mills in 1873 until he left in 1876, and that he hardly knew of Drawbaugh ever working on anything else, unless it might be his magneto telegraph key. Yet during that time Drawbaugh was absorbed in the various pieces of experimental work that have been mentioned. Holsinger was the printer who, in 1874 and again in 1786, printed the card enumerating eighteen other inventions but not the telephone; and Holsinger was the newspaper writer who in the fall of 1875, and again in the fall of 1876, wrote newspaper articles speaking of the clock as Drawbaugh's real work, and making no allusion to the telephone.

Harmon K. Drawbaugh is the claimant's nephew, and says that he did substantially all the work of making the instruments D and E, under his uncle's direction. Holsinger swears that with his own eyes, day after day, he saw Drawbaugh himself making them.

These six men were all the witnesses who pretended to have heard speech through D and E during the first taking of testimony for the defence. In the fourth year of the case, when they were completing their four hundred witnesses (called mostly to the most remote, trivial, and incompetent collateral matters), and after the incapacity of the instruments preceding D and E had been proved, Drawbaugh made great efforts to get some more witnesses to swear to this pair. He succeeded in getting only two, and they were such as would destroy any case for which they might be called.

John Simmons, an old inhabitant of the village, testified that he has worked in Drawbaugh's shop most of the time since 1880, and was in his employ at the time he testified; that during the taking of the testimony, and a few months before he himself testified, he stated to the complainant's representative that he knew nothing about the telephone. Afterwards, in 1884, he went on the witness stand and testified that it had suddenly come to him that he remembered all about it, and had talked through D and E, in November, 1875, but that he never mentioned that circumstance to any one until he told it to the defendants' counsel the day he testified. Yet during the whole of the time of taking testimony, and for three years preceding his deposition, he was employed by Drawbaugh as a workman in his shop, and talked with him about the case.

George May lived in Drawbaugh's village from 1874 to the day he testified in 1884. He is a farm laborer, and perhaps the stupidest among all the witnesses. He says that when testimony was first being taken in 1881–2 Drawbaugh asked him "whether I didn't mind the time he showed it to me in 1875." He had no recollection then, and was not called. But just at the end of the case, and after he had heard the matter talked over for four years in the little village, he suddenly remembered all about it, and testified in 1884 that Drawbaugh talked through D and E with him in March, 1875, and he knew that was the time because Drawbaugh sharpened a razor for him that year. When asked what else he saw and did on that occasion, he describes seeing the instrument H with as much certainty as D and E. Drawbaugh's own story is that the instrument H did not exist until the fall of 1876.

This testimony about D and E is the whole proof on which Drawbaugh's case must depend.

Drawbaugh himself is not among those who swear to the existence or use of those instruments before the Bell patent. After the first six enumerated witnesses had testified, Drawbaugh was called. His counsel did not dare to ask him when he made the instruments D and E, nor even if he made them before the Bell patent. They were put into his hands, and he was told, by a question objected to as leading and incompetent, that his nephew Harmon had testified that they were made in January or February, 1875, and he was asked by his own counsel, "Have you any recollection of the fact or not?" and he answered, "*I have no recollection of the time*, but I recollect of Harmon working on the machine. One of them was made before that time. What I mean is, that there was one of them made, and Harmon made, or helped to make, the other. *I cannot remember the year or the date of it.*"

Afterwards he was again asked which instruments he had made prior to the time when the Axle Company carried on business in the shop; their business began March, 1875, and ended in the fall of 1876. He says: "I won't positively say that D and E were prior to the Axle Company, but I know that at the time the Axle Company was running I had them there. It may have been prior to the starting of the Axle Company. It may be, but I do not want to be too positive."

The claimant himself, therefore, will not swear that those instruments were made before the Bell patent. The court must tell him, for he cannot tell the court. If he had had these perfect instruments eighteen months when he heard of

Bell's invention and Centennial exhibition in the summer of 1876, as he said he did, he could not have forgotten that fact. He knows that they did not then exist, and he does not dare to run the risk of a prosecution for perjury on that specific fact. When *he* will not swear that these instruments were made before the Bell patent, the court in such a case cannot, *as matter of law*, find that they were. Certainly it will not on such meagre testimony as he has produced, and in the face of the facts of his history. But though Drawbaugh did not even know in what year they were made, he personally tried to get May to swear to so definite a date as March, 1875, and persisted until he succeeded.

The defendant's witnesses who swear to D and E — both those who say they heard speech and those who say they casually saw them but never tried them — invariably profess to recognize them by the "curled" or snail-shaped steel magnet at the back of D (*vide* p. 400, *supra*). It is certain that they never saw it. This magnet in exhibit D is fastened very loosely by one end to one end of the sliding core of the electro-magnet. The rest of this curled magnet is entirely unsupported, and its mode of attachment is such that the least handling breaks it away and throws it out of place; so that as soon as the exhibit came to be used in evidence, a block of wood and a screw which are now present were put in after it had been filed, in order to preserve it from destruction. When the instrument was first made, the magnet was inclosed by a wooden cover, a duplicate of which now exists in E. Drawbaugh says that this cover became broken and lost off, and was not replaced. It is certain from the condition of the magnet and the mode of its attachment that the instrument never was used for many days without the cover, because it would have fallen to pieces. The loss of the cover, therefore, must have been, not at the very beginning of the life of the instrument, but at about the time when it ceased to be used and became superseded by later instruments. With that cover on, the curled magnet cannot be seen, and the arrangement of the adjusting screw is such that the cover, once put on, could not be taken off without breaking it to pieces or taking the instrument apart. Yet every one of the witnesses who testify to this instrument, including those who profess to have seen it before it was a month old, swear that they recognized it by "the curled magnet." It is obvious that they never could have seen that magnet, and that, as it is *now* a striking feature, their professed memory is the result of recent observation, and not of recollection.

Again, Drawbaugh's nephew, *Harmon Drawbaugh*, says that he finished and put together the metal work of these instruments. He swears that when they were first made, two sets of curled magnets were forged, and that one set was then made by Fettrow, the village blacksmith. The date when Fettrow made these magnets would therefore settle the date of the instruments. Now *Fettrow* produced at Drawbaugh's call all the accounts between himself and Drawbaugh from 1869 to April, 1876. He testified that they contained every item between himself and Drawbaugh; and in fact they did contain many items as low as ten cents for little pieces of iron and steel and forgings. Yet during the two years prior to April, 1876, there is no charge for magnets, and no charge for any piece of steel or metal whatever out of which those magnets could possibly have been made. It is certain from these accounts, therefore, that they were not made before April, 1876. All these pieces of testimony were commented upon at the first hearing before Judge Wallace, in October, 1884. The defendants afterwards took an additional volume of testimony, but made no attempt to meet these fatal pieces of proof then upon the record.

A number of witnesses called by Drawbaugh testify that the instruments which Drawbaugh showed as his best, at some time after the Bell patent, were the tumbler and tin can. *Urias Nichols*, for example, who went there at a date which we now have proved was in January, 1878, swears that the instruments he talked through were the tumbler and tin can, and he did not see D and E. So with *Samuel Nichols*. *Springer* testifies that he moved to the village in April, 1876, which was after the Bell patent, and lived there for nine months, and experimented with Drawbaugh almost every day.

He says that for several months when he first went there they used the tumbler and tin can exclusively, and that, after that, Drawbaugh said to him that he had now got some instruments which would talk both ways, and produced D and E as novelties, and the witness had never seen them before.

Testimony about 1875 and 1876, and later.—A number of witnesses called by us, personal friends of Drawbaugh, first heard of his having any telephone in October, 1876, and were then shown by Drawbaugh the *tin can* as all he had. The testimony of one set of these witnesses, *Shapley* and his brothers-in-law, is very convincing. Mr. Shapley was a jeweller and watchmaker at Mechanicsburg, a few miles from Drawbaugh's village. Indeed, Drawbaugh lived in Mechanicsburg from April, 1876, to April, 1877, while the Bell patent became famous. Mr. Shapley is a well-to-do, intelligent man, and he and Drawbaugh had been acquainted for many years. In 1876, Shapley had two thousand dollars lying idle which he was seeking employment for, and Drawbaugh, knowing of that, went to him to absorb the money. He offered to Shapley an interest in his electric clock invention, not then patented, and Shapley made with him a written conditional contract, dated November 8, 1878, to take it if on examination he liked it, and paid him $20 on account. In October, 1876, Shapley went to Drawbaugh's shop with his brother-in-law Landis, another watchmaker, and they examined the clock. A few weeks afterwards, Drawbaugh brought the clock to Shapley's store, set it up, arranged his earth batteries, and had it running: and Shapley paid about $20 more for the expenses of this. Then Shapley made another electric clock like it with his own hands, in order to better test the invention. Finally, discovering that that clock, like all others of its kind, could not possibly be a good timekeeper, owing to the variations in the strength of the electric current, he gave up the bargain.

Drawbaugh's story is that his utmost endeavors were directed to getting somebody to advance money enough to patent his telephones and manufacture them. Between June and October, 1876, Mr. Bell's Centennial exhibition had attracted the attention of every one to the telephone. Drawbaugh had read the accounts of it, and they had been published in the local papers. If he then had, not Bell's feeble membrane diaphragm instruments of the Centennial, but the excellent magnetos D and E, and the Blake transmitter H, it is not in human nature that, coming into contact with his friend Mr. Shapley, who was ready to invest several thousand dollars in his inventions, he would not have asked him to invest it in the telephone. It is not in human nature that he should not have told Shapley that he had these wonderful instruments if he had them, and shown them to Shapley when Shapley was at his shop in October, 1876. And when he wanted to create a sensation in the town by an exhibition in Shapley's shop, in November, 1876, after the newspaper accounts of Bell had excited the whole world about the electrical transmission of speech, it is impossible to believe that he would have got Shapley to spend $20 in carrying his clock there and setting it up, when the little magnetos which could be used without a battery or a moment's preparation would have far surpassed any possible clock in novelty and in interest. Yet it is the concurrent testimony of Mr. Shapley, of his brother-in-law Mr. Landis, and of Drawbaugh himself, that Drawbaugh never asked Shapley to invest any money in the telephone, nor pretended to them for one moment that he was the first inventor of it, nor made any reference to it beyond what Shapley testified as follows:

Mr. Shapley took the *Scientific American*, and Drawbaugh was in the habit of reading it at his shop and borrowing the papers. In September, 1876, the *Scientific American* described Bell's Centennial telephone as consisting of a tin can with a bladder across one end, carrying an iron armature, and an electro-magnet in front of that armature; and Drawbaugh testifies that about this time he read somewhere a description of Bell's instruments. In October, 1876, (the date is positively fixed,) Shapley and Landis were at Drawbaugh's shop. They both agree, and Drawbaugh does not contradict it, that he showed them the tin can instrument which corresponds to that description of Bell's apparatus, (and no other instrument,) and told them that that was an invention which was going to make a great stir in the world. Yet he did not hint to them that he was the originator of it; that he had had it for nine years; and that in that very room, twelve feet square, where they were, he had instruments — the magnetos D and E, the carbon microphones G, O, and the Blake transmitter H — which far surpassed anything that anybody dreamed of at that time. That was the time when he was first trying to interest Shapley in some invention, — he did not care what. And his story is that he thought the telephone the greatest thing ever made, and that he knew that $50 for a patent would insure fame and fortune, and he was in search of a partner.

A few days afterwards Drawbaugh was at Shapley's shop, and Shapley produced a copy of the *Scientific American* with a description of the Reis telephone, (issue of March 4, 1876,) and said to Drawbaugh that that was the kind of thing that he appeared to be working on, and gave him the paper. Drawbaugh agrees to all this. He kept the paper, and produced it on his cross-examination. But Drawbaugh never suggested to Shapley to join him in a telephone; never said that he invented it nine years before. He has never offered any explanation of how his story could be reconciled with these facts.

The evidence in his own record relating to 1875 and 1876 makes an equally strong case against him. The *Axle Company*, so-called, a partnership of four persons, employed Drawbaugh as their foreman, to make at his machine shop their patented axle. Their business began in March, 1875, and was not finally terminated until November, 1876 — eight months after the Bell patent. Drawbaugh called *Bear* and *Grove*, two of the four partners composing the Axle Company, and they, with an exhibition of great dulness and worthless memories, say that they think they probably saw telephones while they were there; Bear's chief reason for thinking so being, as he expresses it, "I have no doubt, as Mr. Drawbaugh explained to me often about his inventions, that he spoke of his talking machine." That is a good sample of the condition of mind of his neighbors who testified for him. They assume that he had them, and, ashamed to confess that they do not remember them, vie with each other in "recollection." Neither of these men pretend to any distinct recollection, and neither of them pretend ever to have talked through the instruments. *Kline*, the inventor of that patent axle, was at the shop a great deal, and must have known all about the telephones if they were there. The defendants drew from one of our witnesses on cross-examination the fact that while the taking of testimony was going on, Kline declared that he never knew of any telephone there; and in spite of that the defendants did not call him. The remaining member of the Axle Company was *Captain Moore*, a man of means, intelligence, and education; one of the three or four men of intelligence and education among all the defendants' witnesses. He says that during the time of his axle business, — which was until eight months after the Bell patent, — Drawbaugh spoke to him about his talking machine, and asked him to advance money to patent it, and that he (Moore) felt a good deal of interest in it. He was asked by Drawbaugh's counsel whether during that time Drawbaugh did not show him the tumbler F and tin can B, and he assented, and says that they then had the bladders on. He thinks that he also casually saw Drawbaugh at some time working on something which he says may or may not have been talking machines, but that is all. The inquiry thus put to him by Drawbaugh on the witness stand and his answer amount to a statement by Drawbaugh as well as by himself that the tumbler and tin can with the bladders on — that is not superseded — were the only telephone instruments specifically shown him during all the time he was there, down to the fall of 1876. If that be true, it is certain that the story that D and E were made before Captain Moore ever went there, and had long superseded F and B, which had consequently become dismantled, is false. Captain Moore thinks that this exhibition of F and B was in the early summer of 1875, but he has no possible way of fixing the date. There is no trace of the enthusiasm Drawbaugh would have shown if his story of eight years' anticipation of Bell were true. It is impossible, if D, E, and H existed, that Captain Moore could have been asked such questions by Drawbaugh or could have disclosed such a history.

Captain Moore's testimony shows that he has confused the tin can telephone B, which we have no doubt he saw in the fall of 1876, or later (after Drawbaugh had read of Bell's), with Drawbaugh's magneto key, which he undoubtedly saw in the early part of 1875 (p. 439, *supra*).

Summary.—In short, Drawbaugh's history is this. All his life he has been a professional inventor and patentee, and has made his living chiefly by selling his inventions. He was always able to find partners to join his enterprises. During the ten years before the Bell patent he himself received in actual cash $10,000; his friends and neighbors embarked $30,000 on his inventions, and offered to exploit other inventions if he had any to present. His story is that during all those years he had practical speaking telephones, fully realized that a fortune awaited him if he could patent them or make them for sale, and failed to do it solely from abject poverty himself and inability to obtain aid from others. Yet he spent more time and money experimenting on various gimcracks of no value than would have sufficed to make a hundred telephones and patent them a dozen times over, and not one of his partners or the intelligent men around him, or the telegraph superintendents to whom he showed his other electrical contrivances, ever heard that he had a telephone.

By the summer of 1876, if his story be true, he had then put into his own instruments nearly all the improvements which a hundred inventors have since labored to produce. Yet no one of these instruments, and no information derived from him, ever found its way to the public, ever led to any knowledge by others, ever made the slightest mark by which it can be traced. Just when he had thus (according to his story) reached high-water mark, he heard that Bell, by an instrument at the Centennial so rude and feeble that Drawbaugh's apparatus of ten years before—if his story be true—far surpassed it, had conquered the fame and fortune which he pretends was his own due, and which for ten years had been the spur that had urged him to privation and toil. Yet this did not wring from him an utterance of anguish or reclamation. He went to the Centennial with George Leonard, who for ten years had been his next door neighbor. But he did not carry any telephones. The subject was not mentioned to his companion, who had never heard that Drawbaugh had a telephone.

To his friend Shapley, who had a couple of thousand dollars ready to invest in some invention of Drawbaugh's, he showed in October, 1876, a tin can — just like the Bell telephone already described in the newspapers — and spoke of the importance of the invention, but did not hint that he had originated it, nor that he had perfected instruments which left it ten years behind; and, to use Shapley's money, he proposed an electric clock which he had copied out of an encyclopedia with some trivial changes, and never offered a telephone.

In 1874, and again in 1876, he printed and published a list of his inventions, and the telephone is not among them. In 1875, and again in 1876, his most intimate friend wrote about his inventions in the county newspaper, but did not mention the telephone. In the spring of 1878, several newspaper writers, attracted by large and very expensive electric clocks which his tools and resources enabled him to make, visited his shop. They spoke of him as *then* making improvements in the telephone, which, by that time, was in extensive use, and excited great attention, but to none of them did he say that he originated that great invention; yet his present story is that all those improvements had been completed eighteen months before. An autobiography published in 1878–9 substantially repeats this. To one writer only did he speak of past work, and those statements, made to so considerable a person as a friendly editor of the *Baltimore American*, and published in that year, were that he had tried to make a "telephone," but that it was for a musical telegraph, *with no expectation of speech.*

In the fall of 1878, he got partners to patent and make an improved molasses faucet he had invented eight or ten years before. He showed them his improved telephones (Mr. Blake's transmitter had just gone into commercial use within a few weeks), and their manufacture was discussed, but, after talking with him, they determined not to try it because Bell had the bottom patent, and they concluded that "Drawbaugh could not antedate him." Yet one of them had been his intimate friend and visitor for ten years. With the attention of these persons thus drawn to what he had done, and when he did it, came the episode of the Hauck interference testimony. All other of Drawbaugh's inventions did not go beyond improvements of detail in well-known machines. Neither the scope of his mind, nor the range of his knowledge, approached the regions of thought where this invention can be created. He was (the telephone apart) a charlatan and an impostor, for he made his neighbors believe that he was a great originator, by showing them his copies of other men's work. In this faucet testimony he raised the issue, and undertook by himself and his shopmate Hauck, to prove the scope of his genius. The testimony of both left it just where we have stated it. He named contrivance after contrivance which he had made, but he only repeated the list of his advertisements of 1874–6, and did not hint at the invention which would have established him at once. No claim to that invention was then thought of: he and the same men who now make the great claim for him could then find nothing better to spend time and money on than a molasses spigot. This was in May and June, 1879. Two months later, these same men called in their present principal counsel (Mr. Hill) to look at his Blake transmitter and his microphones, to study his story, and see whether it was worth while to file an application or do anything about it. But his and their determination was to drop the business. They did nothing.

A year later, in the summer of 1880, when the Bell patent was more than four years old and its profits held out a great temptation, Drawbaugh was first produced as a claimant, only to furnish a defence to some infringing speculators. One man who was his partner, and two who were his counsel, got three-quarters of his pretensions for nothing. Without spending or promising to spend a cent, they sold his story in a few days for $20,000 in money and an untold amount of stock. The infringing speculators who bought the claim did not want his telephones, and never used them. But they capitalized his story at five million dollars of "stock" and advertised that in a few weeks they would compel the Bell company to buy them out by paying a "magnificent royalty." Disappointed in that, and forced to fight (for the Bell Company refused to purchase and brought this suit at once), they told a story of invention and success which is falsified by every act of the claimant's life, by every piece of paper which helped to tell his history or enumerated the inventions he had made, and by every statement he has made in conversation and under oath, down to the time they bought and produced him. Their own action showed that they themselves disbelieved his story and only used him to speculate on.

They told of perfected telephones existing and well known for years in his shop,—but which never went outside its walls, never reproduced themselves, never were heard of at the Patent Office, never excited in any person the desire to have one, never imparted to any one the knowledge how to make one,—and yet the claimant was a professional inventor and patentee.

They acknowledged that such a story contradicted itself, and tried to reconcile it with his life by the plea of constraining poverty and by no other plea. But this, in its whole drift and substance and in all its important features of detail, is proved by Drawbaugh's own confession to be false. With it falls the case, the character of Drawbaugh who proffered it, and the value of the "memories" by which he sought to support it.

During all the years under inquiry he was surrounded by prominent and wealthy partners who advanced money for other inventions, but never heard of this. His partners and his friends the telegraph superintendents and others were such that if he had had the invention, they would have known of it; and if they had known of it, the public history of the telephone would have begun before Bell was heard of.

All this history consists of facts which are not capable of controversy, and does not depend upon fallible memories. Memories also are against him, for his partners and his shopmates do not know of the invention; and if they had known it, they would have remembered it now, and acted on it then.

In the face of this, he relies on the assertion that facts and dates which large numbers of witnesses have sworn to must be true. But this is destroyed by the fact that the instruments which he and half his witnesses have sworn to as perfect talkers are proved by his own public tests to be incapable of speech, by the fact that the picture of exclusive and unremitting devotion to the telephone which they tell is shown by his own account of his other occupations to be absolutely untrue, while witness after witness, tested in detail, is found to tell a story essentially false either as to the material fact or the material date. This destroys his argument from numbers. In such a case, moreover, the reason of the rule *falsus in uno falsus in omnibus* applies. That rule does not necessarily mean that the man who falsifies once is a liar; but it means that justice will not rest on testimony a substantial part of which is proved to be false. How much more so in a case which depends on mere oral recollections against every fact of his life, and which is generated under such circumstances as surrounded the origin of this defence. No balancing of depositions is needed. The law pronounces that it cannot rest such a claim on such a record.

Mr. E. N. Dickerson for the American Bell Telephone Company.

The incongruity of the several defences shows that to this great patent there is no one ground upon which any two of the numerous counsel against us can agree, and each finds the defences offered by the other to be so vain that he washes his hands of them. Nothing more is needed to show their thoroughly artificial and hollow character.

Dolbear says that Bell invented the only way in which it is possible to transmit speech, and he ought not to have a patent for that, because in that case Dolbear cannot use it, — and he says that he cannot make a telephone talk without it. And then he says that though Bell's patent is for a method, and not for a receiver at all, yet if Dolbear uses Bell's method by the employment of a different form of receiver for one end of his telephone, it would be hard indeed if he should not be permitted to do that. Then he says that, on the whole, Reis invented, or, at least, undertook to invent, another way of transmitting speech, and although that *way* will not transmit speech, and although he found on trial that the Reis apparatus would not transmit speech; yet, as Reis wanted to make a speaking telephone, and his only trouble was that he did not know how to, his ignorance ought not to prevent him from being reckoned the discoverer.

Dolbear personally gets into trouble, for in 1877 he held out Mr. Bell as the first inventor of any speaking telephone; then he wrote to Mr. Bell that he had modified the form, and perhaps made some invention himself, and he thought Mr. Bell ought to pay him some money. Next he wrote to Mr. Bell — for Mr. Bell did not pay him any money — that he would publish a book which would hurt Mr. Bell, adding, "I hope that there is nothing that I have said that would look to you like an immoral attempt." And next he appeared in the Dowd case as one who had sold his pretensions to that defendant, and was set up under oath as the first inventor of the whole speaking telephone. But when he got on the witness stand he had to back out of all that, and now being himself sued, he does not even set himself up in his own answer as a prior inventor.

The *Molecular* company says that Dolbear is mistaken, and that Reis invented the speaking telephone, and made first-rate speaking telephones. It is true that the Molecular experts all swear that Reis's plan for transmitting speech was entirely wrong, and that it is impossible to transmit a word by following the directions that he gave; and that it is only by changing the whole operation of the instrument, and making it work as Bell said for the first time in the world a telephone ought to be made to work, that you can get a word through it. But the Molecular counsel declines to be bound by the testimony of his own experts, and himself testifies that they must be wrong.

Then the Molecular company says: Never mind if Mr. Bell was the first to invent a competent method; we think that as matter of law his patent ought to be limited so as to give to him just enough of his invention to permit him to use the tin can and bladder instrument described in his patent, and let everybody else use all the other forms of telephone.

The Molecular company next sees that it must account for the fact that when Bell produced an instrument which they say was worthless, everybody wanted to use it; and that when Reis produced an instrument which they say was perfect, nobody wanted to use it. But, they say, the reason is that Reis offered it to the world freely, and so no one would take it; but Bell patented it, and then the community were drawn by the attraction of theft as well as the usefulness of the telephone. Finally they conclude that Bell never invented a telephone at all, and never thought he did, and never meant to, and never described one, and never intended to describe one.

The Overland and Drawbaugh combination avers that all that these gentlemen say is untrue. Reis did not invent the telephone at all, say they. Bell did invent it and described it; and they agree that a patent for the first inventor ought to be as broad as Mr. Bell says his is. But they say that Drawbaugh was the first inventor; that he both invented and perfected it. And they say that Gray was a first inventor; but Gray was a first inventor who came after Drawbaugh. At least, this is what they said up to a week ago. But now they have discovered that Mr. Bell was not so much an inventor as he was a thief and forger; that the "transcendent abilities" which they say he has, and which they recognize to be quite sufficient for the invention of the telephone, were perversely devoted by him to the perpetration of felonies.

The *Clay* company say that Varley invented the speaking telephone. And finally they say there is not, and never was, any such corporation as the American Bell Telephone Company, and that Bell never conveyed away his patents to any one.

Reis.—It used to be the law that the work of a foreigner, all done abroad, and described in publications by himself and others, must stand on those publications as a defence to a United States patent. But the fifty Reis publications all break down; for every expert on both sides in every case has had to swear that it is impossible to transmit speech if you follow those publications. Indeed, the experts have had to admit that the publications themselves said that Reis could not transmit speech, and that, in print, he acknowledged his own failure. But now they repudiate that. They sent a roving commission abroad to prove that all that Reis printed was wrong; that all his friends printed was wrong; and that he really did have a speaking telephone, and knew how to transmit speech, but wrote his publications to conceal his success. They produce as a witness Professor Sylvanus Thompson, of England. He wrote a book on electricity in 1880, and in that he said that Bell was the first inventor of the speaking telephone, and Reis was not. Afterwards he was employed by infringers to fight the Bell patent, and then he published another edition of his work, and said that he and his friend Mr. Dolbear, who is one of the infringers, were now ready to "admit" that Bell did not invent the speaking telephone, but that Reis did.

Then the Overland and Molecular companies sent to Germany in 1883, and took six depositions to prove that Reis invented a great deal more than he ever told of. The depositions are so absurd in themselves as to be beneath criticism; but the Circuit Court naturally ruled them all out as incompetent. Finally, Professor Sylvanus Thompson says the crowning point of Reis's career is found in his appearance at a certain scientific meeting at Giessen in 1864, and that he there established himself as the inventor of the speaking telephone. So they proceeded to take testimony of eye-witnesses and ear-witnesses to establish that particular assertion.

Just at this juncture the Department of Justice stepped in to aid them, and by a treaty signed by that department, and by the Bell company, and by one of the infringing companies, it was agreed that a commission might swiftly issue and be sent abroad, at the joint expense of the department and the infringers, and that the testimony it brought back should be put into one of the cases at the circuit, and in that way come before this court, under the sanction of the Department of Justice, and as its contribution. This was done, and those depositions are in the record.

So they proved, if mere swearing after twenty years could do it, that Reis had a first-rate speaking telephone at the Giessen exhibition in 1864, and that the particular person who experimented with him, and in whose laboratory the exhibition was held, was the celebrated Professor Buff, now dead. This unholy alliance had forgotten one circumstance. On that very day, and as a part of that exhibition, Professor Buff read a paper upon the sounds which could be produced by means of electricity; and in that paper he described the Reis instrument which he and Reis, within that hour, exhibited at that very meeting, and said that it was a circuit-breaker, and a very ingenious one, but instead of saying that speech was one of the sounds it could yield he said that "unfortunately it could only reproduce the pitch of musical sounds and not their quality." That paper was printed at the time. We put it into the case. It gives the verdict of the Giessen meeting, and is Reis's death blow.

They desired also to take the deposition of Professor Quincke, who was present at that meeting with Helmholtz and other well-known scientific gentlemen. Professor Quincke did not want to testify, but we consented that the other side might put in a certain letter recently written by him stating his recollection. Professor Quincke is dean of one of the faculties at Heidelberg, and so we introduced the honorary degree given last summer to Mr. Bell by the University of Heidelberg, on its 500th anniversary, as *the first inventor of the speaking telephone.*[1] That testimonial from the great

[1] In Virum Egregium ALEXANDRUM GR. BELL, Scotum, Qui ut Apparatu Telephonico Ingeniose Invento Societati Humanæ Magna Negotiorum Peragendorum Emolumenta Largitus est Atque in dies Crescentia ita Chronographo Perfecissime Excogitato Tam Physicen non Mediocriter Adjuvit Quam Physiologiæ Ipsique Arti Medicæ Instrumentum Rerum Sat Gravium Definiendarum Suppeditavit Jura et Privilegia Doctoris Medicinæ Honoris Causa.

German university within twenty miles of where Reis lived, did his work, and died, should put to shame the efforts of the Department of Justice to use the name of the United States to induce those Germans to swear that Bell was not the first inventor of the speaking telephone, and that their neighbor Reis was.

The Gray defence. — In 1877, the Western Union Telegraph Company determined to use Bell's telephone and test his patent. They bought up all the pretensions of all the "prior inventors" who had then been discovered. Many more have since appeared, because as fast as one "prior inventor" is spoiled, the next speculating company requires a new one. Among others they bought up Gray and Dolbear. When their agent Dowd was sued for infringing the Bell patent they defended the case, set up for him that Gray was the first inventor, and that he made his telephones under license from Gray. This was done in the name of the *American Speaking Telephone Company*, in which Gray and his partner owned a third of the stock and in which Gray was a director, while Gray was called as a witness to maintain that defence. The Dowd case, therefore, was Gray's case, defended by him and supported by his testimony. He there told his story.

Gray's own pretensions rested on a caveat which was based on a conception first made and communicated to others and put on paper by a sketch of February 11, 1876, then reduced to the form of a caveat which was sworn to and filed February 14, 1876, some hours after Bell had actually filed his application prepared long before. Gray took part in Bell's exhibition of his speaking telephone at the Centennial, June 24, 1876, and himself listened at Bell's instrument and heard the applause which greeted its performance. Some days afterwards he undertook to make an instrument as near like his own caveat as he conveniently could, and it would not talk a word. That was the first instrument he ever attempted to make for speech. He never attempted to make another until he made a Patent Office model in November, 1877, and there is no testimony that any instrument made like the Gray caveat ever did or ever can talk. As an inventor he is, therefore, necessarily out of the case, both because he never completed the invention, and because his mere conception, the earliest date of which is February 11, 1876, was after Bell had fully described his invention in his specification which was completed, signed, and sworn to on January 20, 1876, and filed February 14, 1876.

Gray made his first appearance in the controversy on October 29, 1877, when he filed an application in the Patent Office in the interest of the Western Union Company, and in it he described a magneto telephone and swore that he was the first inventor of it. In 1879, when he testified in the Dowd case, he swore that he had never conceived of the possibility of a *magneto* telephone until he listened at Bell's magneto telephone at the Centennial, and then did not believe that it could transmit until he had examined the wires and every detail of the apparatus and found by personal trial that it did talk. At that exhibition, he did not make the slightest claim that he had ever invented the speaking telephone. In the early part of 1877 he asserted, privately and publicly, in correspondence with Mr. Bell and in lectures which were reported in the newspapers, that Mr. Bell was the first inventor of the speaking telephone, and that what he, Gray, had invented was something quite different.

Thus Gray delivered a public lecture at Steinway Hall, New York, on April 2, 1877, about his harmonic, musical, multiple telegraph. The report in the *New York Tribune* of the next day, admitted to be true, said:

"After the first part of the programme had been executed, Mr. Elisha Gray came forward and addressed the audience. He was aware that great confusion existed in the public mind as to what *this* telephone could perform; in particular it had been confounded with *the speaking telephone invented by Prof. A. Graham Bell, of Boston.* Prof. Bell, Mr. Gray said, was present in the audience."

But when the Western Union Company were trying to acquire a "prior inventor" for use in their expected litigation, he appeared, in the fall of 1877 and in 1878, asserting that he was the sole and original inventor of the speaking telephone, and that Bell never invented it at all. And yet he is set up by counsel as an honest, simple-minded, guileless gentleman.

In the Dowd case, also, one defence was that the instruments of the Bell patent would not talk. But it turned out that while Mr. Edward Renwick, who is not an electrician, was able to make a pair that would not talk, our electricians, and afterwards Mr. Pope, the electrician of our opponents, had not the slightest difficulty in making telephones in exact conformity to the patent which talked perfectly well. That ended the defence that figure 7 of the Bell patent was not a talking telephone.

The Western Union Company had spent two years' time, with all its wealth and resources, hunting this country and Europe for a defence. But when this testimony was taken and printed, the late Mr. George Gifford advised them that the courts would always find that Bell was the inventor of the speaking telephone and that he had a good patent for it. They thereupon surrendered and submitted to a decree against them. The whole story is told by Mr. Gifford under oath, and is in the record. No judgment of a court could be more persuasive than the surrender of such a corporation, under the advice of such counsel, after such a preparation.

The defendants here were forced to meet this. They attempted to do it by asserting that the whole proceeding was a sham, and that it was the Bell Company, and not the Western Union that surrendered. To this one answer is that the record contains the whole story, told by Mr. Gifford himself under oath, and no man contradicts it; another is that the facts of the history are that the spoils of victory remained with the Bell Company and not with the Western Union Company. If the Gray pretensions had been well founded, the Western Union Company could have had a patent for the whole speaking telephone, and Bell would have nothing. The Western Union also owned the inventions of Edison, Page, and others in the nature of improvements or accessories of vast importance. Against this the Bell company had chiefly to rely on the Bell invention. The settlement between the two parties was that while it was recognized, both in language and by financial result, that the Bell patent was valid and controlled the profits of the business, yet that the subsidiary inventions of Edison, Page, and others owned by the Western Union were of some value; that they should be put into the hands of the Bell company to use; and that the Western Union should have such proportion of the total proceeds as might represent the value of these subsidiary patents. It was agreed that one-fifth of the proceeds corresponded to that value, and that was what they received.

The alleged fraud on Gray, and the proceedings at the Patent Office.—The files show the following state of facts: Mr. Bell's application was filed on February 14, 1876. On February 19, Wilber, the examiner, wrote to Pollok & Bailey, Bell's solicitors, a regular official letter, signed by the Commissioner, copied into the files, stating that the first, fourth, and fifth claims related to matters described in a pending caveat; that the caveator had been notified; and that Bell's application was suspended for ninety days, as required by law. To this Messrs. Pollok & Bailey replied, by an offical letter in the files, addressed to the Commissioner, requesting him to determine whether or not the application was filed prior to the caveat. They wrote: "We have inquired the date of filing the caveat, inasmuch as we are entitled to the knowledge, and find it to be February 14, 1876, the same day on which our application was filed. If our application was filed earlier in the day than was the caveat, then there is no warrant for the action taken by the office." They requested an examination into the facts, stating that the application was filed early in the day, and was signed and sworn to on the 20th of January. Examiner Wilber, before whom this letter first came, refused the request, insisting that if the two papers were filed on the same day they were to be considered as filed at the same time, and asserting that such was the practice of the office; and he refused to dissolve the interference. Yet it is charged that he was our tool and confederate and did everything we asked.

The matter was taken to the Commissioner in person, and he filed a written decision that the exact time of the filing of the papers must be ascertained, and the rights of the parties determined accordingly, citing legal authority for it. This court has since settled that such is the law. *Louisville* v. *Savings Bank*, 104 U. S. 469, 478. Thereupon Examiner Wilber officially decided and indorsed on the papers, that the Patent Office records showed that the application was filed in the clerk's office before the caveat, and that the application reached his room by noon of the 14th, and the caveat not until the next day. Everything that a hostile examiner could do against Mr. Bell, Wilber had done.

Turn now to the file of Gray's caveat, which is in the case. On February 19, 1876, the office sent a letter to him in the usual official form, saying that an application had been filed which appeared to interfere with his caveat; and he was invited to complete his specification as the law required. But in addition to that, Wilber wrote to Gray on the same day, another letter which is also in the files, stating the particulars in which the application conflicted with the caveat, and giving to Gray substantial copies of Mr. Bell's three most important claims, including the fifth claim for the speaking telephone. This was very wrong, for Gray had still three months in which to prepare and file his specification, and in that he could insert anything he pleased. To tell him beforehand the precise claims of Bell's application, which ought to have been kept secret, was not only a violation of the examiner's duty, but it was giving to Gray very unfair advantage, if he had been minded to make use of it. And yet they say that Wilber was our tool, working entirely in our interest. The letter turns out to be very valuable for us, for it shows that on that very day Wilber the examiner knew that Bell's specification was for a speaking telephone just as much as the caveat was. Gray personally received the notice, but chose not to proceed. He was wise, for he knew that his caveat was not written until Monday, February 14, while Bell's long specification, filed on that day, was necessarily written a good while previously. Indeed it was sworn to on January 20th.

The situation of these two men at that time offered a great contrast. Gray had for a partner Mr. Samuel S. White, of

Philadelphia, a wealthy manufacturer, devoted to patents; and Gray himself had the advantage of all the resources of the largest electrical machine shop in the country, of which he had until recently been superintendent. Mr. Bell, on the other hand, was absolutely destitute of means. Mr. Hubbard, who afterwards became his father-in-law, had agreed to help him about a multiple telegraph, but took no interest in the telephone, would advance no money about it, and objected to Bell's spending any time on it. That was not unnatural, for Mr. Bell had not constructed a practically useful speaking telephone, and Mr. Hubbard did not believe that he would make one. Thus all the attraction which wealthy surroundings could offer to a dishonest official were on the side of Gray, and the record of what Examiner Wilber did, showed that so far from aiding Mr. Bell he did everything he could to thwart him.

In 1879 came the Dowd case, which was Gray's case. Under his direction, his agent Dowd set up that Gray was the first inventor, and that Bell had "surreptitiously obtained a patent for that which Gray had first invented." That was the issue, and Gray went on the stand to support it. But that defence necessarily broke down, for Gray testified in that controversy that the first date he could assign rested on a sketch which he made on Friday, February 11, 1876, and which he turned into his caveat written on Monday, February 14, 1876. Now Mr. Bell's application showed on its face (and it was so proved) that it was completed, sent to Washington, copied in Washington by Mr. Pollok's clerk, got back to Boston, and there, in its finished condition, was signed and sworn to on January 20, 1876, and was again in Washington in the hands of Mr. Pollok to be filed, before Gray made his first sketch of February 11, 1876. When these facts were established, Mr. Gifford naturally knew that the Western Union Company and Gray could not prevail against Mr. Bell.

The question of Gray's standing against Bell again came up to trial in New Orleans in 1886, on new testimony from Mr. Gray and on testimony from Wilber, both offered by our opponents after the Department of Justice had begun its assaults on us. The court there decided that "the fact that Bell's invention certainly dates from January 20, 1876, and that it covers a speaking telephone, renders it unnecessary to pass upon the evidence relating to the tergiversations and claims of Gray; the alleged frauds of Bell in advancing his application for a patent; the illegal conduct and conflicting statements of Examiner Wilber; and many alleged vices and irregularities, the evidence of which forms the bulk of the record, and apparently the main defence in the case. At the same time it is proper to say that in all the evidence we have found nothing that shows that Bell has done or caused to be done anything inconsistent with his right to be called an honest man, with clean hands."

The papers themselves now on file in the office, show that anything that Wilber might swear to as to the transactions between himself and Mr. Bell, if he ever should swear to anything improper, would necessarily be as foolish in law as false in fact, because Mr. Bell could not have stolen anything from Gray and put it into his patent, inasmuch as the specification, as finally issued in the patent, is exactly the specification which Bell wrote and swore to three weeks before Gray's caveat existed, — with the exception of a mere formal explanatory amendment, which the courts have always decided was pure surplusage, and which did not change by a single letter any part of the application which described or claimed the speaking telephone. Therefore a new fraud theory had to be invented to get rid of these stubborn facts. It is this new theory which was started last week for the first time in the world. The charge which it makes is competent as a matter of evidence, for it is a charge that Bell did not make the invention, but stole it, or an important part of it, from Gray. That charge is set up in the answer of the Drawbaugh and Overland companies, and they have a right to argue in support of it. The new story is that Mr. Bell honestly and originally invented and described in his application the magneto speaking telephone, Fig. 7, and out of his own head drew the fifth claim, — which that description is sufficient to sustain, — all exactly as it now stands in the patent. But the specification also indicates that the particular transmitting member — the magneto transmitter — shown in Fig. 7, can be replaced by what is now called a variable resistance liquid transmitter, and that the apparatus thus modified will still transmit speech because as a whole it will still embody the novel principle described as the essential element in Fig. 7 and specified in the fifth claim, the only claim sued on. The charge is that this alternative form of the transmitting member was not invented by Mr. Bell; that Gray invented it and described it in his caveat of February 14, 1876; that Examiner Wilber of the Patent Office, who received the caveat on February 15, dishonestly and corruptly showed it to Bell's solicitors, and that the knowledge thus obtained was written into Bell's application after it was filed, by despoiling and altering the files by a species of forgery.

Their precise averment is that Bell's application as filed February 14, 1876, though it had Fig. 7 and the description of it, and claim 5, did not have the liquid transmitter part, nor claim 4 which specifically refers to that.

We know that on February 19 it did have them, because an official letter written on that day by the Patent Office to Mr. Bell, and another official letter written on the same day to Mr. Gray, state in terms that the application has them. Their hypothesis is that between February 15 and February 19, or thereabouts, Wilber delivered the Gray caveat, not to Mr. Bell, who was not in Washington, but to his solicitors Messrs. Pollok and Bailey; that Pollok and Bailey had to act instantly, because, say our opponents, while their tool Wilber insisted upon giving them the caveat, he would not delay that act twenty-four hours until Mr. Bell could be summoned from Boston to profit by it. So Pollok and Bailey, unable to wait for Bell, and having possession of the Gray caveat, stole Bell's application also, and cut out from it a number of sheets and forged new ones into which they wrote the liquid transmitter which they stole from Gray's caveat, and interpolated these into Bell's application, and then put those dishonest forged papers all back in the files. Nothing of this can touch Mr. Bell personally, because he was not in Washington at all in 1876 until February 26. That is the charge so far.

They say that the liquid transmitter must have got into Bell's specification by unintelligent copying, because Gray's caveat said that the liquid for a liquid transmitter must be water or some "*high* resistance" liquid, whereas Bell's patent specifies "mercury or some other liquid." Now, say our opponents, any one capable of making the invention, and, still more so accomplished an electrician as Mr. Bell, would not have written that, because he would have known that a liquid transmitter cannot work with mercury, which is a fluid of very *low* resistance. This, they say, proves that the description must have been interpolated by persons as ignorant as they say Messrs. Pollok and Bailey were; though why ignorant men, if copying, should have varied the liquid, no one explains.

But this whole argument rests upon a false basis of fact, and when the true scientific fact is known, it absolutely disproves the charge. With the particular form and arrangement described by Gray a high resistance fluid is essential, but with a different arrangement of the working parts of the liquid transmitter, mercury or some *low* resistance liquid not only can be used but makes a far better liquid transmitter than can be made with water, on Gray's plan. The tyro, stealing and copying from Gray's description and explanation, would have thought that water was the only available liquid; but Mr. Bell, being neither a tyro nor a thief, inventing the thing himself, perceived that a peculiar arrangement of parts with a low resistance fluid was the best plan. He made all his liquid transmitters in that way, — both his first, completed and successfully used on March 10, 1876, and his liquid transmitter exhibited at the Centennial in June, 1876, — employing mercury or acidulated water (low resistance liquids) in all. So it happens, not only that the liquid transmitter described in Bell's patent is very different from that of Gray, but it is so far different that nobody except an original inventor could have thought it out. It could not have been copied from Gray.

The two official letters of February 19 show that it was in the specification on that day. Bell, who was not in Washington until February 26, could not have written it in between February 15 and February 19; while the solicitors could not have done it, for it was necessarily the work of an original inventor of some brilliancy. It must therefore have been in the specification as originally written by Bell and filed February 14, before the caveat existed.

[Mr. Dickerson then explained what he insisted was a very grievous defect in the Gray plan of the liquid transmitter, but avoided by the Bell plan.]

The hypothesis of my opponents, as they state it, is based, and necessarily based, upon the theory that Wilber, the examiner, was the guilty confederate of Bell; yet it at once has to encounter the fact that instead of issuing the patent in the usual course, the first thing Wilber did was, on February 19, to suspend the application for three months, inform Gray of its contents, and invite Gray to raise an interference and contest Bell's claim. These letters are in the files, and Gray testified that he got the notice. When Bell's solicitors protested, and appealed to the Commissioner in writing, Wilber again resisted them, and only yielded when the Commissioner formally overruled him by a written opinion filed February 25.

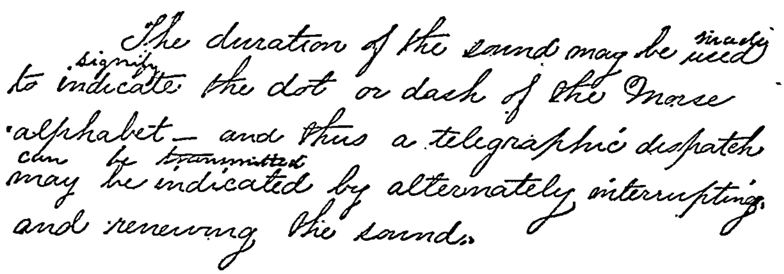
One or two days after February 25, Mr. Bell came to Washington, and my opponents give a very circumstantial hypothesis of what they say might have happened. As soon as he arrived, his solicitors told him, so the hypothesis runs, of the forgeries they had committed in his behalf, and he went into the office to admire what they had done. But he wanted an active part in the crime. So, finding the application all fair-written in ink, he, with his pencil, interpolated by pencil interlineation a number of words. Their hypothesis and line of argument, if sound at all, show exactly what was interlined. Upon examination, however, we are startled to find that each of those supposed changes would have injured the patent so far as it could have had any effect at all. He thus, according to their theory, mutilated his specification thirty-eight times. Their supposed proof of this is as follows:

Mr. Bell completed an early draft of his specification in November, 1875. There is in the record a copy or duplicate of that draft, made at that time to be given to Mr. George Brown, and known as the George Brown draft. This George Brown copy, the body of which is not in Mr. Bell's handwriting, shows very few emendations by him. Essentially it represents the proposed specification as it was when this early copy was made. The patent as issued differs from that copy of the early draft in thirty-eight passages. Obviously this may be because between November, 1875, when that duplicate was made, and the completion of the specification on January 20, 1876, Mr. Bell revised and improved his own copy of the draft. But the argument of my opponents is (and this is the essential basis of their hypothesis) that the actual specification filed February 14, 1876, written of course in ink, was exactly like the George Brown draft, and that the emendations were introduced by pencil cancellations and interlineations fraudulently made by Mr. Bell on that paper, in the Patent Office between February 27 and February 29, 1867.

If we could look at that very paper we could tell what was fair-written in ink, and whether there are any pencil interlineations, and if so what they are. My opponents say that there exists a fac-simile of that paper, with the fair-written ink words of the original regularly written in ink in the fac-simile, and the alleged pencil interlineations of the original written in pencil between the lines in the fac-simile. There was put in evidence and printed in the Dowd case in 1879 (finding its way thence into these cases by reprinting) a certified copy, certified April 10, 1879, and both sides agree that it is the usual habit of the Patent Office to make its copies of specifications in the manner of fac-similes. My opponents assume that that paper (on file in the Circuit Court in Boston, and now in the hands of the Chief Justice and known as the Boston exhibit) is such a fac-simile, and their argument about the interlineations is based on its present condition. Assuming their ground, that paper will test their hypothesis. If the fair-written ink words of that paper are the words of the Brown specification, and the pencil words are the new words which are in the patent but not in the Brown paper, their theory may be true, and the paper would give great support to it.

On the other hand, if the ink words of that paper are the words of the patent, then it is certain that the emendations which converted the early draft of November, 1875, into the exact language of the patent in Mr. Bell's draft, were made before his solicitor's clerk, copying from that amended draft, made the paper which actually was filed. That is, those emendations were honestly made before the application was filed, and not dishonestly afterwards.

They did not produce the Boston exhibit. They read what purports to be a printed copy of it, printed in the Dowd case, and reprinted in the other cases from the Dowd print. That contains both sets of words printed regularly in the same line thus: "may be used to signify indicate,"[1] and does not tell which of the duplicate words, "used" or "made," "signify" or "indicate," are the words in ink and which are the words interlined in pencil in that exhibit. The clerk of the Circuit Court has produced the exhibit, which is examined by this court under a stipulation made a year ago, and that shows it. Here is a fac-simile of one paragraph of that original Boston exhibit.


made
The duration of the sound may be used
signify
to indicate the dot or dash of the Morse
alphabet — and thus a telegraphic dispatch
can be transmitted
may be indicated by alternately interrupting
and renewing the sound.

This tells the story. Now in every instance in that exhibit the fair-written ink words, as "used" and "indicate," "may be indicated" are the words of the patent, and the interlined words (which are in pencil) are the words of the older George Brown draft. The ink part is confessedly a copy of the ink part of the original application. The paper may have got into its present condition in consequence of some one, at some time,

[1] See p. 250, *supra*.

for some reason, interlining on that very paper (Boston exhibit) the George Brown words with a pencil; but neither it nor any paper of which it is a fac-simile (if in all parts it is a fac-simile) were produced by taking an ink copy of the George Brown draft and interlining the ultimate words of the patent. The very evidence they produce, when we look at the exhibit itself instead of the badly printed copy they rely on, destroys their whole charge.

As this charge was never made nor thought of until last week, it would be strange if the record showed how these interlineations got on to the Boston exhibit — whether they were put there by the Patent Office, as a copy of the original, or whether they were put there afterwards in pencil by some one who was comparing the application with the older George Brown draft, and got printed by mistake. It happens, however, that we know. A year ago, (February 18, 1886,) one of the counsel for the Bell company noticed this Dowd print and wrote to the counsel for the Drawbaugh company:

"The copy of the application is not printed correctly. I believe there are no errors in it which are of any importance, but there are some pencil marks on the copy that went to the printer in the Dowd case, with brackets, etc., and that got reproduced in your case."

This statement was accepted as correct, and by written stipulation the application was reprinted without those errors and the reprint put into the record. It was also agreed that this court "for greater certainty" might look at the original. On this correspondence and stipulation, those pencil marks must be taken as pencil marks accidentally made on that exhibit after it left the Patent Office.

My opponents did not refer to the Boston exhibit itself, but they found one other fact hard to encounter. The application in the Patent Office files to-day is fair-written in ink, exactly in the words of the patent, and without any trace of pencil interlineation. That record fact was fatal to the hypothesis of different ink words and pencil amendments in the original on file. They promptly met it by asserting that if their hypothesis and the official record were inconsistent, the record must have been forged. So, to support the hypothesis of one forgery they offer the hypothesis of another. Indeed, they assert that it is easier to believe two forgeries than one. They say in their brief:

"Crime breeds crime. A foul deed perpetrated in silence and secrecy draws around a man an invisible line that separates him from his fellows. He is thenceforth set apart as the especial victim of circumstances. He is arrayed in a never-ending but unequal conflict with the terrible Nemesis of retribution. The stern necessity is laid upon him of unceasing vigilance, of daring unscrupulousness, and of reckless effrontery in the commission of further offences; for only thus can he stave off the inevitable end. Mr. Bell, notwithstanding his transcendent intellectual abilities, proves no exception to the rule. There is evidence in this record, ample, complete and demonstrative, that subsequent to the 10th day of April, 1879, a crime of the most atrocious character was committed in the Patent Office of Washington; that this was done for the sole purpose of covering up and concealing the evidence existing in that office of crime previously perpetrated there in February, 1876, as already outlined."

So, say they, when the certified copy of April 10, 1879, produced in the Dowd case in 1879, informed Bell that the paper in the Patent Office exhibited the ink words and the supposed pencil interlineations, supposed proof of his supposed guilt, Nemesis told him that all trace of those alterations must be suppressed. So they say that Mr. Bell, having seen these interlineations in the Boston exhibit in 1879, went or sent to the Patent Office and stole the whole file in order to conceal the proof of his guilt furnished by the pencil interlineations, and substituted a new, clean one, in place of it, and that that is the one there now. The one there now, they say, is the result of this second forgery and substitution.

There are fatal difficulties even on the surface of this view. If Mr. Bell's object was to conceal the interlineations of the Boston copy, nobody can explain why he voluntarily, on the witness stand, as part of his own deposition, produced that very copy and put it into the Dowd case and had it printed and published.

Yet that is what he did. And nobody could explain how he could hope to take away the much marked and interlined file of that patent, which they say was one of the best known papers in the Patent Office, examined by a great many people from curiosity, and substitute a new, different and perfectly clean one, and expect that it would escape detection. Their hypothesis does not attempt to account for these facts.

Our opponents tried to bolster up this fraud charge, and the charge that Wilber, who in fact did everything he could to hinder and stop Bell from getting a patent, was nevertheless Bell's tool, by reading a letter written by Mr. Bell a year previously about another application he had in the Patent Office. In that letter, Mr. Bell, speaking of a harmonic multiple telegraph invention as to which he was about to come in conflict with Mr. Gray, wrote to his father and mother that he was just filing his application for it, and that his lawyers were doubtful whether the examiner would even declare an interference between him and Gray, "as Gray's apparatus had been there for so long a time." On that they argue that Wilber, the examiner, was even then their tool and showed them Gray's apparatus and told them it had been there a long time. The fact, however, turns out to be that Gray's *application* had not been there forty-eight hours, but that Gray's *apparatus* had been described in a number of newspapers for several months, and had been — not on file in the Patent Office but — on public exhibition in many places, including the public hall in the Patent Office. That was the fact which Mr. Bell referred to in his letter, by the phrase "as Gray's apparatus had been there for so long a time."

They next ask the court to judge Mr. Bell by his subsequent conduct. They say that if there was no fraud perpetrated on Mr. Gray in the Patent Office in 1876, Mr. Bell might be expected to honestly state to the world the subsequent history of his experiments and inventions, and that whether he did so or not would be a good test of his honesty at the outset. Thereupon they assert that he suppressed the fact that a few days after he got his patent he made his first liquid transmitter and got speech with it, and that this was only wrung from him years afterwards on cross-examination. I agree that his conduct is a good test, but it was exactly the contrary of what they aver. Instead of concealing the liquid transmitter, he within sixty days, in May, 1876, described it in a public lecture, printed the lecture at once, and sent a copy of it to Mr. Gray (whom he knew as an electrical inventor and his rival in harmonic telegraphy), and Mr. Gray testifies that he received it. He exhibited the instrument at the Centennial in the summer of 1876. Again, in his interference proceeding with Gray, in his preliminary statement, made in 1878 and printed in this record, he voluntarily told Gray, the Patent Office and the world that he made his first liquid transmitter in Boston on March 10, 1876, three days after his patent; and that statement has been before the community and before all the parties in all the cases for nine years.

In truth their own "Nemesis" seems to inspire the authors of this charge. They assert an infamous crime, and when every official record disproves it they reply that every record must have been forged. The Boston exhibit they rely on disproves the forgery, so they offer a misprinted copy of it, and they suppress or misstate the subsequent conduct which they say would prove or disprove the charge.

The George Brown specification. — Mr. Bell wished in 1875 to take out English patents at the same time as his American patents. He had no money, and Mr. Hubbard would not assist him in England. But the Hon. George Brown, of Toronto, a friend of his family, became interested in him, and chiefly as a matter of friendship agreed to take out English patents for him, and pay the expenses on certain terms. So he was to take all of Mr. Bell's specifications to England, which country he was about to visit. The inventions which he thus expected to patent were not the speaking telephone alone, but all Mr. Bell's electrical inventions, which were put into five long specifications, chiefly filled with the multiple telegraph. Mr. Bell was so much in need of means of subsistence that Mr. Brown agreed to allow him twenty-five dollars a month for his support for six months, while the patents were being taken out. As soon as Mr. Brown expressed his willingness to make this agreement, (September, 1875,) Mr. Bell went to work on his specifications, and his work resulted in one draft which he used for his American specification, and another draft which he gave to Mr. Brown to take abroad. The use which our opponents make of these drafts which are in the record, is this: They find — and such is the fact — that the liquid transmitter and the thirty-eight other words already referred to, are not in the George Brown specifications taken abroad. They say, *arguendo* (and this inference was never hinted at till a week ago) that the American specification as filed was probably the same as the George Brown specification; and therefore they conclude, *arguendo*, that the American specification as filed did not have a liquid transmitter in it. If that be the fact, then the liquid transmitter which is now in there must have been put in afterwards, — and, therefore, by forgery.

To begin with there are two answers which of themselves dispose of this. One is that the liquid transmitter part of the application and patent is not of importance. Figure 7 (the magneto speaking telephone) and the description of it which is in both papers, contains the whole broad invention and embodies the broad general principle. The broad fifth claim rests equally well on that instrument and description, whether the liquid transmitter be described in the application or not. The liquid transmitter is merely an alternative form in the nature of an improvement. It might be put in or left out of the patent without any legal consequences. Indeed, they argue that the description of the liquid transmitter in the patent is so vague and imperfect that the law cannot read it, and must treat the specification as if it were not there. Moreover, as an instrument, it is of a form which of itself is not of the slightest practical importance, for it is too inconvenient to be used. A second answer is that there is written proof that Mr. Bell invented the plan of producing his articulating current by variations of resistance, which is the particular subordinate principle employed in a liquid transmitter, ten months before he took his patent, and nine months before Gray began to think of the subject, for in a letter of May 4, 1875, printed in the record, he mentions the plan of varying the resistance as an improved means of transmitting speech by electricity. So this resort to the hypothesis of theft and forgery leads to the conclusion (and to no other conclusion) that Bell stole from Gray's caveat that which is of no legal or practical value, and the essential idea of which Bell in substance had and described in writing nine months before Gray's caveat was thought of.

The history of these papers is as follows: Mr. Bell made a draft of his specification in the fall of 1875, immediately after his first negotiations with Mr. Brown, in September, and he made at least two copies of it. On December 26, 1875, at Toronto, he made his final contract in writing with Mr. Brown, and immediately went back to Boston and sent a copy of all his specifications to Mr. Brown, including one of the two drafts of the speaking telephone specifications. He kept on working on the other draft which he had retained in order to send to his patent solicitor in Washington, and, during the month of January, 1876, the idea of the variable resistance transmitter again came into his mind, but now in the form of the liquid transmitter, which he then and there wrote into the draft of his American specification. This, we say, was after the George Brown specification had gone to Canada; and that is the reason why that feature is in the American specification and not in the George Brown specification.

That the paper for Washington was revised, and that the other was left untouched after the two copies were first made, is a fact proved in the case. The two papers probably were once identical, or nearly so. But the specification filed at Washington (as shown by the present file and by the copies already referred to) differs from the Brown specification in thirty-eight passages. Most of these differences are of no legal importance, and consist in the substitution of simpler and more concise or more happy words and phrases in the American specification, showing that in its present form it was the result of studious revision bestowed upon that particular paper after the time when the two were identical, and that, for some reason, these emendations were never transferred to the George Brown paper.

But, say they, Mr. Bell met Mr. Brown in New York on the 25th of January, 1876, the day before the latter sailed, and if he then had the liquid transmitter, in his American specification, why did he not write it into the copy that Mr. Brown had? It is not difficult to understand why. Mr. Brown, as a kind and friendly act, was going to take out patents on all the electrical inventions Bell had made—contained in five long specifications, with the speaking telephone tacked on to the last end of the last of them. That particular invention had not assumed importance in Mr. Brown's eyes, because Mr. Bell had told him that his practical success with that instrument was insignificant, and Mr. Brown, a busy man and a newspaper editor, without the knowledge to appreciate the scientific perfection of the invention, did not realize that anything would ever practically come of it. The multiple telegraph, which would send many messages at one time and was in a working form, was what he wanted. Any one not a man of high science, and not capable of appreciating the scientific perfection of Mr. Bell's ideas, would have said at once that he dismissed the muttering thing, as Mr. George Brown did, and paid no attention to it. So, when they met in New York, just as Mr. Brown was sailing, Mr. Bell did not attempt to correct the papers. Probably they were at the bottom of Mr. Brown's trunk, and Mr. Bell did not see them. We know that none of the thirty-eight emendations were transferred to them. Mr. Brown took the papers with him to Europe; never patented anything; brought them all back; and when the controversy began he returned them to Mr. Bell, and Mr. Bell himself voluntarily put them in evidence as part of his own deposition. Yet they want you to believe that those papers, voluntarily offered by Mr. Bell, contained, and that Mr. Bell knew they contained, positive proof of his forgery.

I said that Mr. Bell sent the specifications to Toronto to Mr. Brown in the first two or three days of January, 1876, and did not put the liquid transmitter in his American specification until a week or ten days later. Mr. Hill's brief, p. 217, says, "the American specification was completed between

January 1 and January 10, 1876," Mr. Bell having testified that it was about January 10 when he sent his draft to his solicitor in Washington. That that was the time when he put it into his American specification is sufficiently fixed by the testimony. That the papers went into Mr. Brown's hands in the first few days of January is not specifically sworn. Mr. Bell testifies that it was between the date of his contract, December 26, 1875, and the 25th of January, the day when Mr. Brown was in New York to sail. We had no occasion to verify the precise date when the papers went, or how they went to Mr. Brown — whether handed to him in person or put into his hands through the mail, — because no conflict ever arose in the case which made the precise fact important. But whatever I do or do not know outside the record, I am at least at liberty to suggest this explanation; and it is vastly more likely that Mr. Bell, having made the contract with Mr. Brown, and knowing that Mr. Brown was immediately to sail for Europe, rushing back himself to Boston, should at once have sent him the specification which he had prepared, than that he could have gone on committing forgery after forgery, and then should himself voluntarily, and in his own deposition, put into all the cases, and lay before all his adversaries, the very papers which they say he knew proved his fraud.

All the record proof is conclusive in our favor. All the positive testimony is conclusive in our favor. The sole argument on the other side is that if we do not fortify the record proof by the inferior proof from recollection on points which no one has ever questioned, the court must assume that we forged the record.

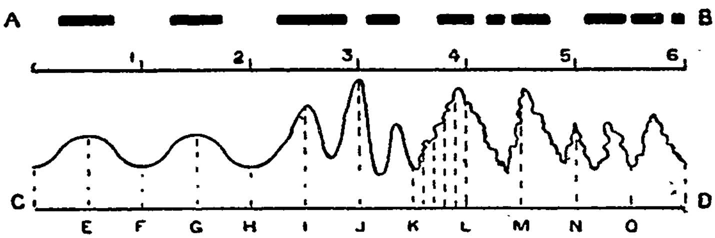
The McDonough defence. — McDonough read of the Reis apparatus. He copied it, making a simple form of Reis circuit-breaking transmitter, with a somewhat improved receiver. Six weeks after Mr. Bell had got his patent McDonough filed an application saying that speech could be transmitted by the simple make-and-break of Reis. Then he got up a company, not to use his instruments, of course, but to use the modern microphone which others had invented, and to use him as a "prior inventor." He has been enjoined. His case has been decided against him in the Patent Office, after a long litigation, and in the courts. He is a copyist of Reis; that is the end of his pretension.

The Varley patent.—Varley made a multiple harmonic telegraph, and patented it as such, in terms, in 1870. Nobody pretends that speech can be transmitted by that apparatus however operated, or by any instrument possessing the mode of operation which Varley describes. But he used the word "undulation" once in his patent, and Mr. Bell uses the word "undulation"; and the current produced by every dynamo machine since dynamo machines were made, may in a sense have the adjective "undulatory" applied to it. That is the resemblance, and the only resemblance, between these three contrivances. You might say that it proves that all of them were dynamo machines. The Clay company says that it proves that all of them were speaking telephones. That is the whole argument about Varley.

The *Holcomb* defence, and the *House patents* as defences are specifically abandoned by Mr. Lowrey, counsel for the Molecular company, in his brief, and no one insists on them. Holcomb made a Morse telegraph relay, and patented it as such in 1865. He tries to swear it into a speaking telephone, but the Circuit Court found his story false. House made an improved Morse telegraph relay, and patented it as such in one form in 1865 and in another form May 12, 1868, and both patents are in the case. But it can no more transmit speech when performing the kind of operation his patent describes than a Morse telegraph can.

The graphic representation of electrical currents.—I wish to explain the usual symbolical representations of electric currents. Here at AB is the ordinary representation of a "broken" current,—a succession of dashes or dots, as may be, separated by spaces. That total length from A to B does not represent a line wire, or symbolize a line wire with little fragments of electricity travelling along it one after another like successive drops. The length of line occupied by these dots and dashes represents time; not space or distance. This representation symbolizes the idea by the methods of analytical geometry.

It means, assuming that the whole distance AB represents a minute or any other unit of time, that for so much of that period of time as is represented by the length of one dash compared with the length of the whole distance, the current is flowing; not flowing over a little piece of the wire, but flowing over the whole wire for that short period of time. Then there comes a second period of time when there is no current anywhere on the line-wire, and the length of that period is represented by the length of the blank space. Then again a third period of time when there is a current over all parts of the wire, and so on.



We can go a little further than that. When we have Mr. Bell's undulatory current, which consists essentially of a current flowing continually (or without breaks unless they are so infinitely short that we consider it as flowing all the time), but varying in its strength, we can express it by a block with a level base and a curved upper edge.

CD, in the lower part of the foregoing diagram, represents such a current. The strength of the current at any one instant is represented by a line equal to the perpendicular height (the dotted line) from a particular part of the curve to the base line; at another instant the strength of the current is represented by the length of a line which extends from another part of the curve to the base line. This figure does not mean that the current is thrown into a succession of waves, ten, or twenty, or thirty, on a wire like the waves of the sea; it means, for all practical purposes, on any lines used in telephony, that the current through the whole wire is, in all parts of it, of a certain strength at one instant, and that at another successive instant, it is either weaker or stronger, as the case may be. For example, if the lengths C E, E F, F G, &c., represent seconds of time, then the strength of the current at the end of the first second would be represented by the length of the dotted line E; at the end of the second second by the length of the dotted line F, and so on. The parts at M, N, O indicate by the frequent changes in the curve that the current changes its strength very frequently, and in a very irregular manner. This diagram, therefore, is not a picture of anything that exists, but is a symbolical statement of an idea, or of a succession of measurements of the strength of the current taken at successive instants.

Thus time, and not space or distance, is symbolized by the lengths A B or C D in both cases, and the dimensions or shape of the blocks or of the curve express either that for a certain length of time there is a current and then none, as at A B, or there is always some current, but for one length of time stronger, and afterwards weaker, as at C D.

The "Spurious Brood" of decisions. — The defendants say that all the decisions of the circuit courts in the cases are a "spurious brood," resting on an "assumed decision" of Judge Lowell in Spencer's case, based, they say, upon an unwise, if not a dishonest admission. In Spencer's case Judge Lowell said that Bell "is admitted in this case to be the original and first inventor of any *mode* of transmitting speech electrically." That was "admitted" by Professor Henry Morton, the defendants' principal expert in that case, on the witness stand. Professor Henry Morton again comes on the stand as an expert witness for the Overland and Molecular companies, and repeats what he said in Spencer's case. Every other expert witness for the defence in any of these cases agrees that no *mode* for transmitting speech is described in any publication or any patent before Bell's patent (this is what Professor Morton and Judge Lowell were talking about), and all the judges have agreed with Judge Lowell. In the Molecular case, Judge Wallace said that the additional testimony of Professors

Young and Brackett, experts for the Molecular and Overland companies, only served to confirm Judge Lowell's opinion that Reis did not invent the speaking telephone. The attack they make on the decisions is therefore disproved by every expert who has ever testified on either side in any of these cases.

Breadth of the invention and of the patent. — The whole argument in this case can be shortly illustrated. Galileo made a telescope by combining two well-known forms of lenses with each other in a certain manner, by which the eye was enabled to see at unnatural distances, just as the ear is enabled to hear at unnatural distances by Bell's telephone. His telescope was not so good as you can now buy for twenty-five cents of a street pedlar; and the lenses of which he made it could be bought in shops at his time. But what he did was to fasten these two lenses in such relation to each other that, according to the law of God he discovered, they constituted a telescope. It distorted the things that he looked at, but for the first time it brought them near. If he had taken out a patent for it, he might have made for it this claim: "What I claim is a method of and apparatus for seeing telescopically, by causing the undulations of light to be converged upon the retina, substantially as described." That paraphrase of Mr. Bell's fifth claim would be a good claim for that telescope.

Then ingenious men made vast improvements which enabled their telescopes to do what Galileo's never could have done, and they have reached the great Lick telescope in California. If my opponents could examine that telescope to-day with Galileo, what would they tell him about it? They would acknowledge that it is a telescope because it has objective and eye-piece lenses put in that relation to each other which Galileo first thought out. But Dolbear would say that Galileo's patent discloses the only method possible for seeing telescopically, and that method, strange to say, does not defy the laws of nature, but conforms to them; and therefore the patent ought to be void. At any rate, says Dolbear, the objective of the Lick telescope is made out of two pieces of glass, — one of crown and one of flint glass, — instead of one, as Galileo's was, and therefore I ought to have leave to use Galileo's discovery if I will make my lens of two different kinds of glass instead of one.

Then comes the Molecular company, and they say that they are willing that Galileo should keep the bad telescope he made in his lifetime, and they will admit that he is the first inventor of that, or of any telescope, if he will only permit them and all other persons to "have access to the universal storehouse" through the door which he found and opened.

Then come the Overland and the Drawbaugh companies, and they say that Galileo never invented anything, but was only a thief and a forger. Indeed, they point to the fact that he was cast into prison; and a man who has done all that ought to have his patent taken away and be sent to the penitentiary.

And yet that great Lick telescope reveals the utmost secrets of the universe, because it follows that law of nature and that rule which Galileo laid down and embodied in the arrangement of his two bits of glass.

The Drawbaugh case. — The chief part of the appellant's argument on this is simply an assertion that the decision of the Circuit Court consists of astounding misstatements of proved facts. The first instance asserted is that Judge Wallace found that Drawbaugh wrote his own autobiography for the county history; whereas they say that Judge Wallace when he wrote that opinion had in his desk the original manuscript of that autobiography, in the handwriting of a certain Mr. Hull, now dead. It is true that he had that paper. But it is also true that Drawbaugh agreed to pay for the publication; that he agreed to furnish the autobiography; that he employed Mr. Hull to write it out for him; that the publisher of the history neither wrote it nor paid for one word of it, but received it in manuscript from Drawbaugh himself; and that very manuscript in question was produced by Drawbaugh on the cross-examination of one of our witnesses, without any attempt on his part to deny that he employed Hull to write it and that he furnished it himself to the publisher. All this is specifically testified to, and no witness denies it.

Then they charge that the circuit judge's statement as to

Drawbaugh's property was entirely wrong. They say the fact is that Drawbaugh owed vast sums of money; and they prove this by printing in a table how much he owed in 1869, and how much in 1870, and how much in 1871, and so on, making apparently a large total. The fact is that with a few unimportant changes it was the same debt that ran through all these years, and most of it was for indorsements which he never paid, and never was called upon to pay; so that the total which figures in their brief at about $14,000 represents an actual debt of about $500.

Then they attack Mr. Matthews's deposition, which Judge Wallace thought of considerable value, by asserting that Mr. Matthews wrote a letter (which was before the court) stating that no reliance ought to be placed on his recollection of the facts thus cited by the court. He made no such statement. The letter is in the record. It confirms Mr. Matthews's deposition explicitly. It repeats that he is sure from what Drawbaugh told him in 1878 that he is not the inventor of the speaking telephone. It also says, as to one little matter of detail, that he is not sure whether on that occasion Drawbaugh merely showed him the instrument lying on a bench, or took it up and placed it in his hands; and he does not want his testimony in that respect relied on if that matter is of any importance. It was not of the slightest importance, and had nothing to do with the very important matter for which he was called. Judge Wallace said that that letter only showed Mr. Matthews's scrupulous honesty, and added value to his deposition.

The Drawbaugh frauds. — There is no doubt that Drawbaugh at some time made all the exhibits put in evidence on his behalf, for he produced them himself in the case in 1881. But how long before 1881 he made them is another matter. A large number of his witnesses are specifically proved to be entirely mistaken about their dates. With nothing to fix them by except mere arbitrary association, one man thinks it was in 1875, because he sold a bushel of potatoes in that year, and so on with others. It is absolutely proved about many of them that the visits to Drawbaugh's shop when they first saw telephones were after the Bell patent instead of before. He made all these things, and had them with many other things at his shop before 1881. But whether the picture as given by the witness is in long perspective or is foreshortened, — whether they look at what they have seen through a true memory which would find them all between 1876 and 1881, or invert the opera glass and stretch out this history as far back as distortion can carry it, is the whole question. There are several of these witnesses who are specifically proved to have been debauched by Drawbaugh personally in the most infamous way; and that is enough to end his character. The Circuit Court below so found.

The great argument of the other side is: Here are fifty witnesses: suppose a pistol exploded in a man's ear: it is true that he might forget the date of the pistol explosion, and generally would, but he could not forget the explosion. Even that argument does not touch their case. An electric telephone, whenever they saw it, was not anything very startling to these witnesses. To a man of science it was. But these men had heard a string telephone in the village, and an electric telephone was no more astonishing to them. But no matter how startling it was, that is no reason why they should associate the true date with it. That they heard a pistol does not tell them when they heard it. I do not think that any man in this court room could tell me the year when he saw Donati's comet, the most startling celestial phenomenon of our generation; nor the date of the great transit of Venus, visible here within the last ten years. This man had his shop full of all sorts of contrivances which the country witnesses neither understood nor cared for, and they cannot for the life of them tell in what year they saw any of them, or give you a picture that you can rely on, with name and date of what they did see.

The evidence shows that Drawbaugh is a charlatan, surrounded by persons who have used him for dishonest purposes. The story is that in his shop, before he went to the Centennial, (for he made a visit there in the last half of October, 1876,) he had the most perfect collection of telephones that had ever existed in the world, even up to the time this suit began in 1881, — the perfected Bell transmitter and receiver, with all Bell's latest improvements in all their minute details; the Edison carbon-powder telephone; the carbon microphone, which has made Berliner, and Edison, and Hughes famous; and, finally, the Blake transmitter, with all its marvellous delicacy of detail, — except those parts which the eye does not see and which never got into Drawbaugh's instruments. He says that in that year he went up to the Centennial to see Mr. Bell's telephone, which he had read of, and spent five days there; that he went with his friend, Mr. Leonard, his neighbor for ten years, the richest man in the village, and he saw Bell exalted to the heavens for his feeble instruments, when he himself had then all the improved and perfected forms, which all the genius of the world spent the next five years in inventing; and yet he never opened his mouth to anybody at the Centennial, not even to Mr. Leonard, his neighbor who went with him. Mr. Leonard, his neighbor and fellow-traveller, did not know that Drawbaugh had a telephone at that time. Then he came back and laid a plot to sell to Shapley, his friend and neighbor, as his own invention, the right to patent the Bain electric clock, which he had copied out of Tomlinson's Encyclopedia, twenty years old; and he never told Mr. Shapley he had invented the telephone, or that he wanted money to exploit it.

Late in 1878 he formed a partnership between himself and one Chellis, who kept a ninety-nine cent store in Harrisburg, and Moffitt, an erratic dentist. He had then a plan for another improvement in an already improved molasses spigot; and, according to their present theory, he also had all these enormous inventions right there in the same room, where they had been perfected, as every one knew, if their story is true, before 1876. What he was really doing with the telephone at that time was trying to improve the telephones that Mr. Bell had invented. That part of his history — that he was then trying to improve the telephone — got into the local newspapers, and cannot be sworn away.

These two proposing partners looked over the contrivances he then had, in December, 1878, when Bell's telephones were in extensive use, — his improved telephones and his molasses spigot, — and they said they would rather take the molasses spigot. Why? Because, said they to him, "Bell has got a patent on the telephone, and you cannot anticipate him." And yet one of these men, Moffitt, had been Drawbaugh's bosom friend for ten years, a frequenter of his shop, had known all of his inventions, and now comes with the story that he knew Drawbaugh's telephones and talked through them years before Bell was ever heard of. The two partners talked with him a good deal about this in December, 1878, and early in 1879, and they said to him, "You cannot antedate Bell;" and Drawbaugh replied, "I don't know." They discussed the matter again — this old friend Moffitt and Chellis — and they said, "No, you cannot," and would not touch it, but took the molasses spigot. Now, in 1882, comes Chellis as the man who produced Drawbaugh to the world and sold him out for a defence to these infringers, and Moffitt as one of his chief supporting witnesses, and they say they know, and there is not a doubt about it, that he antedated Bell by ten years.

They had an interference controversy with Hauck about priority in the molasses spigot, and they went into that and had a fight in 1879. They had the same counsel they have got now, — Mr. Jacobs and Mr. Hill; and they beat Hauck and went into the business of making molasses spigots, at a great expense, when, according to the story they now tell, they had there in that room, and had had for ten years, this great invention, and everybody knew it. But they either did not know it then, or did not know it enough to put a dollar into it. Presently they thought they could make a speculation out of Drawbaugh's story. They now say that they found in 1879 that instead of working on this spigot he was spending all his time on the telephone. What was he doing? Why, if their story be true, he had made his most perfect instruments two or three years before that, and never added to them afterwards. If their story is true, his work was completed. But he was working on them then. The newspapers of the day said so. I have no doubt he was working on telephones in 1879, and that it was then, and not in 1876, that he was making the Blake transmitter. But Chellis then knew that he could not speculate on Drawbaugh's "prior invention" of the telephone, for he had talked with Drawbaugh, and he had talked (all this is in Chellis's deposition) with Drawbaugh's wife, and the result he came to was that he "could not antedate Bell," and it was not worth while putting a cent into the telephone.

By and by he met Shank, and asked him, and Shank said, — Why, Dan had been at work on it many years, perhaps as far back as 1870. That was news to Chellis; he had only been getting his information from Drawbaugh himself, and Drawbaugh's wife. The result was that when they took testimony they put on the stand Shank as their first witness, and then the witnesses whom Shank had hunted up, and they swore it back; and after they got through a crowd of such men they called Drawbaugh to the stand and asked him if what these men had sworn to was not true; and the best that can be said for him is that he would not deny it.

When they got Shank, and Chellis thought there was a chance of speculation, he sent for his counsel, Mr. Hill, and they looked it up together. It would have cost them thirty dollars to make two applications — fifteen dollars for the telephone, and fifteen more for the microphone. The two years statutory limitation had run against the telephone in 1879; but it had not run against the microphone; and if there is a word of truth in Drawbaugh's story, there would not have been the slightest difficulty of proving in 1879 when he had his microphone; and there could not have been the slightest difficulty in proving that he had had telephones before Mr. Bell, for Mr. Bell's telephone was only three years old, and the microphones of Berliner and Edison about two years old, and everybody knew this. Moreover, they all knew the great fight which was raging at that very time between the Western Union and the Bell companies. They had no occasion to spend any money. All they had to do was to take their story to either the Bell company or the Western Union, and they could have got a million dollars for it just as it stood, if they could have got either of those companies to believe it. But they knew too well to try that, for responsible companies do not buy stories until they have been sifted.

So this syndicate concluded that they would not spend thirty dollars, although the statute was running against them; and they would not offer their story to any corporation that might examine it; but they would make a partnership, and they would get Drawbaugh to give them three-fourths of his story for nothing, and then they would sell it to this People's Telephone Company, which paid them $20,000 cash and a lot of stock, without stopping to take the opinion of counsel or to spend so much as a half a day in investigating the story. All this was done. It is proved in the record by the deposition of Chellis himself.

It was a good speculation also for this company which purchased this falsehood. It at once issued five million dollars of stock on it, and with some of the money they got from selling that stock they for the first time applied for patents—on July 22, 1880. They published a proclamation, and we sued them, and they came before the Circuit Court in New York in October, 1881, with a bagful of affidavits, and we challenged them to produce them, and they said they would risk an injunction rather than produce them. They were wise, because the moment they put those affidavits before the court the affidavits and the story would have been spoiled, and no more stock could be sold on them. So they kept them back and sold stock on their "prospects."

That is the genesis and the history of this Drawbaugh speculation.

One of the frauds which illustrates their case is the water ram story. It became advantageous for them to prove, in order to fix a date, that the owner of a particular farm set up on it in 1875, for the use of a particular tenant, a water ram made by Drawbaugh. They got the owner, misled by a false association with the date of a lease, and forgetting a later lease of the farm to the same tenant, to swear that it was put in in 1875; and then they put more than thirty witnesses on the stand to swear to their own positive recollection of the same thing. The whole story was a falsehood. Mr. Draper, the owner, came back on the stand and admitted his mistake. The bills for the pipe for the ram, and the freight bills on the railroad, and the receipts on the railroad books, all dated in 1878, and correspondence between the owner and his farm agent, written in December, 1877, complaining that the ram was not in, were found by us and produced. Drawbaugh himself made the ram and put it up, and had all the accounts and dates of it, but would not come forward himself to swear to any dates about it. Finally they had to abandon the fiction and admit that it was put in in 1878. Yet Drawbaugh, with this knowledge, and after he and his partners had seen these papers, procured these men to swear it back to 1875.

Then the Hunnings transmitter fraud was of the same character. They attempted to deceive Judge Wallace in open court, and then attempted to deceive this court in the Philadelphia tests, by smuggling the Hunnings invention inside their broken tumbler instrument F. We detected the fraud and exposed it; and if there had ever been any moral character to the case before that, this would have destroyed it.

[In closing, *Mr. Dickerson* contrasted the united recognition of the value of Mr. Bell's inventions by the scientific world of Europe, with the attacks upon him in the defence of these suits.]

Mr. Causten Browne for Dolbear.

It has suited the convenience of our opponents, in the course of their argument, to speak of the several appellants whose cases are before the court, as having contributed each an ingredient, so to speak, of a certain mixture to be used for the common behoof against the health of the Bell patent. That is a figure of speech. It is also, if they will pardon me, a fiction. So far as I am aware, no one of the appellants in this case has any right to speak for any other. I certainly know that nobody has any right to say anything for the Dolbear interest, except Mr. Maynadier and myself. The court will remember that these cases were grouped together upon the docket, partly for the convenience of the court and partly for the convenience of counsel, that an end might be made of the whole matter. The counsel for the several appellants are companions, but not allies. Every man fights his own battle in his own way.

Now, as to the Dolbear Company, its defence to the Bell Company's suit is different in kind from the defence of any other appellant here. It is this: that the Dolbear method and apparatus do not infringe, even under the broadest construction of the Bell patent that the law will permit; that they are based upon a discovery of Mr. Dolbear as original and as fundamental as that of Mr. Bell; that he as well as Bell, although coming several years after him, started from first principles to deal with the problem of electrically transmitting speech; that Bell proceeded by one road, which lay open to him by virtue of the scientific knowledge of that date; while Dolbear proceeded by a road discovered by himself where scientific men had supposed a practical advance in the arts to be impossible; and that, except in reaching the result of electrically transmitting speech, stated in one form of words or another, there is no resemblance between the two methods or the apparatus employed by the two inventors, so far as regards any patent protection enjoyed by Mr. Bell. You will at once see that many issues which have been discussed before you during the last two weeks are of no materiality to the Dolbear defence. If any alleged anticipation of Mr. Bell's invention of the speaking telephone, or if any assumed narrow construction of his patent, shall prevail, so much the better for us, of course. Your labors in dealing with the Dolbear defence will, in that event, be lightened. But all of these defences may fail; all attempts to prove anticipation of Mr. Bell's invention may fail; all attempts made by other appellants to limit the construction of his patent may fail; and yet the defence of the Dolbear Company remain untouched.

No construction of this patent will cover the Dolbear method as an infringement, except a broad construction *for the use of electricity for the purpose of transmitting articulate speech.* That will do it. But that, in words or in substance, must be maintained as the prerogative and monopoly of Bell, or, I humbly venture to believe, I shall have no difficulty in satisfying you that the decree in the Dolbear case must be reversed. I suppose it was because no other construction than this would suffice to suppress the practice of the Dolbear method, that a theory of invention so dangerously broad, to say the least, was asserted by the counsel for the Bell Company. I shall in due time make it plain that no such dangerous — I was going to say wild — theory of patentable invention will be found suggested by Mr. Bell in the specification which he, as we have learned from the argument, drew with his own hand.

The fifth claim of the patent, in so far as it is a claim for a method, reads thus: "The method of . . . transmitting vocal or other sounds telegraphically, *as herein described*, by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, *substantially as set forth*." Here are two limiting expressions: "as herein described" and "substantially as set forth." Now, I suppose that one of these, no matter which, is intended to refer the reader to the description of what is meant by the term, "electrical undulations"; and I suppose that the other, no matter which, is intended to refer to the description of the way in which those undulations are produced and used. Rejecting certainly one of them, and as I believe both of them, the counsel have set up as the patented invention of Bell the transmission of speech *by means of "electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds,"* or, as they otherwise express it, "*electrical changes which correspond to the sonorous motions of the air.*" Causing the sonorous motions of the air, (that is, the vibrations produced by speech,) to bring about, no matter how, corresponding electrical changes of any sort, which electrical changes bring about, no matter how, sonorous motions of the air, like the first, — is the patented invention, as the appellees contend.

This was substantially the view taken by Mr. Justice Gray in the court below. I respectfully submit that this, while denying Mr. Bell a patent *in terms* for the use of electricity to transmit speech, gives it to him *in substance* by giving him a patent for that which is done necessarily, in the nature of things, *ex vi termini*, whenever speech is transmitted by electricity. Of course, if a man cannot have a good patent, as it is agreed he cannot, for the use of electricity to transmit speech, he cannot have a good patent for that in which the electrical transmission of speech *consists*. He has changed the words of his claim, but not the things claimed.

[Mr. Browne here quoted from several scientific witnesses in support of this position, and among others from Dolbear, taking occasion to defend him from some attacks that had been made against him.]

The court below dismissed this testimony, saying: "The evidence in this case clearly shows that Bell discovered that articulate sounds could be transmitted by undulatory vibrations of electricity, and invented the art or process of transmitting such sounds by means of such vibrations. If that art or process is (as the witnesses called by the defendant say it is) *the only way* by which speech can be transmitted by electricity, that fact does not lessen the merit of his invention, or the protection which the law will give to it."

The learned Justice misunderstood. It is not a question of *the only way* to transmit speech by electricity. Producing electrical changes upon the line corresponding to the sonorous air changes is not *a way* of transmitting speech by electricity. *It is doing it.* It is that in which the electrical transmission of speech consists. It is the alternative form of words for the same thing. Not only do we see *now* that the electrical transmission of speech implies that, and consists in the fact that, the sonorous motions of the air produced by speech shall in some way cause corresponding electrical changes of some kind in the line conductor, which electrical changes shall in some way cause sonorous motions of the air like the first; but it was a physical truth, known among scientific men, and practically applied, that the electrical transmission of *sound in general* implied, and consisted in, the production in the line conductor of electrical changes corresponding to whatever sonorous changes *were* made in the air by making the sounds, and the utilization of those electrical changes to produce sonorous changes in the air like the first.

Whether Reis did or did not successfully reduce to practice a speaking telephone, he certainly did transmit sonorous air vibrations made by human speech; and he certainly knew that if he would transmit speech, he must translate into electricity the vibrations of the air, in their relative duration, and that so far as he failed, his mistake was in supposing that he could do it with his apparatus.

The philosophy of the motion of air particles is this. The air is moved in speaking by way of vibration, the air particles moving to and fro in straight lines only. They can only move in straight lines. Nothing produces any result except the movement of the air particles to and fro in straight lines. Every movement of air particles to and fro is a vibration, relatively long or short. In speech, every air particle moves or vibrates in obedience to a *combination* of impulses, the chief being that which would, by itself, produce what is called the fundamental, and the others being such as would produce what are called overtones; and it is the mixture of these fundamental vibrations and overtone vibrations which gives what we call quality. But the whole is nothing and can be nothing but a *combination of vibrations of different pitches and amplitudes;* for every vibration has some pitch, and some amplitude; that is what vibration means; and there is nothing but vibrations of air particles to do the business. These various constituent vibrations do not separately exist in fact. Only the resultant of them exists in fact, and is felt by any one air particle; as only the resultant of several forces applied to a billiard ball appears in the direction and character of the motion it takes up. And what is it that acts upon the ear, or upon the diaphragm against which you talk in using the telephone? It is and can only be the condensation and rarefaction of the adjacent air, varied according to the resultant of the forces by which the air particles at the rear of the elastic column of air have been acted upon. I say "elastic column," for, when I talk to your Honor, Mr. Chief Justice, you may imagine a column of air reaching from my mouth to the drum of your ear. I press upon the end of that column next my mouth in a certain way. Your ear can perceive nothing but rarefactions and condensations, variations in degree, and in kind, if you please, of pressure upon the drum of your ear, due to impulses which I have given to my end of the column, and which have propagated themselves through to your ear. Condensation and rarefaction mean variations of pressure produced by movements of air particles to and fro. It can mean nothing else.

[*Mr. Browne* then read from the Gartenlaube Reis publication the passage commencing "Our ear" and ending "from each other," which will be found on page 65, *supra*, and contended that the whole problem was there stated, and that if what that writer says is necessary to be done, be done, the transmission of speech will follow.]

Mr. Bell undertook to solve this problem which, according to the appellees (and I have no occasion to dispute it) had baffled the scientific world, including, if you please, Mr. Reis. I have nothing to say against that. Mr. Bell came along and solved that problem; and that was, shall I say, *all* he did? Why, was it not a great thing to be the first man to solve that problem? Have I detracted a particle from his just renown as an inventor? Surely not. I am but protecting the right of another inventor to start also from first principles and, if he can, to find a method which is not that of Mr. Bell, in solving the same problem.

[After referring to *Tilghman* v. *Proctor*, 102 U. S. 707, as a correct and clear statement of the distinction in law between a patent for a process and a patent for a principle, *Mr. Browne* continued:]

We have now to inquire what was the method invented by Mr. Bell for solving the problem presented to *him*.

When he took his patent, there was but one agent that had ever been used for variably attracting any object so as to make it vibrate and beat the air and give out audible sound. That agent was *magnetism*. There was but one practical use to which electricity had ever been put for the purpose of so causing a body to vibrate and give out audible sounds; and that was as a *flowing current making an iron core an electro-magnet*, the variations of current strength causing like magnetic variations. Mr. Bell found a way to get electrical changes, corresponding in form to the sound waves, *in the current traversing the coils of an electro-magnet*, and so to produce corresponding variations in the magnet, and corresponding vibrations of a receiver armature. When I come to look at his patent, I shall give him the broadest construction that the actual fact of his invention can give any one; but I cannot, as I have been taught the law, include in his invention something which neither he nor any other man had then done or supposed could be done; that is to say, cause an armature to vibrate and give audible sounds by variations of *electrical attraction*, with no use of magnetism at all.

Dolbear, on the other hand, reduced to the service of mankind for the first time that property which Mr. Maynadier spoke of as the property of amber, or *elektron*, electricity, amberism. The power of a body charged with electricity to attract anything, though known for two thousand years to exist, had never been put to any practical use in the arts when Professor Dolbear made his invention; certainly it had never been supposed that variations of electrical attraction could cause corresponding vibrations of an armature. No instrument having any such operation ever existed before Mr. Dolbear's invention. Dolbear's receiving apparatus is properly enough *called* a condenser, because in structure it generally resembles the old condensers. That is to say, it has two plates electrically insulated and charged. But the operation is radically different from that of the old condensers. No operation of vibrating either plate by variations of electrical charge was contemplated or performed in the case of any of the old condensers. The arrangement of the parts or elements of the condenser did not admit of its being performed.

[After referring to and describing the Reis-Wright apparatus and the Varley patents, *Mr. Browne* continued:]

It is altogether a mistake to say that in any of these instruments there was any use whatever made of the power of electrical attraction, still less of varying electrical attraction, to control by way of vibration a diaphragm or any armature whatever set up in the electrical field. In all these old condensers the elements were placed close together, with a non-conductor (I do not mean air, but a solid non-conductor) interposed and closely fitted between them, so that the electricity might be condensed, which non-conductor prevented any practical vibration of either of the elements.

In the Dolbear receiver, on the contrary, one of the plates is held firmly so that it cannot vibrate, and the other is held so as to be free to vibrate according to the variations of electrical charge, and beat the air and give an audible sound; the two plates being separated by a body of air, so that no current can pass. Here was a change in construction, designed to produce a new operation, for a new purpose, without which change that operation could not be performed nor that purpose answered. To hold one element of a condenser still, so that it shall not vibrate, and suspend the other so that it shall vibrate, and then make use of its vibration according to variations of electric charge, was wholly and absolutely new. No such instrument existed. No such use of any instrument had ever been proposed or supposed to be possible. It cannot be said with any show of reason that any equivalent for it was found in any of the old condensers.

Dolbear's discovery of the capacity of variations of electrical attraction to make an armature vibrate accordingly, was accidental. He says that when he showed it to scientific men, "without exception they expressed their astonishment at hearing that variations of the electric potential of a terminal plate could practically produce any sound vibrations of an opposed diaphragm comparable to those produced by the varying attractions of an electro-magnet."

It is, I submit then, the truth that Mr. Dolbear, like Mr. Bell, has made (in the language of the brief of the appellees) an application of the laws of nature which no one had ever made before, which no one had thought of before, by an instrument which did not exist before, *the result only* being the same — that is to say, the electrical transmission of speech; or, in other words, making speech bring about corresponding electrical changes on the line conductor which in turn bring about corresponding audible vibrations at the receiving station.

The appellees say that "the characteristic of Mr. Bell's current is form, not mere continuity. The invention of the speaking telephone *does not consist in the employment of a merely continuous as distinguished from a merely intermittent current.*"

But Professor Cross, their leading expert, says in his deposition:

"*In an electrical speaking telephone* the connection between the transmitter and receiver *must be* such that the latter shall not be acted upon merely at separate intervals, but the armature or other *moving portion of the receiver* must be constantly under the influence of and guided by the variations in the electrical current caused by the motions of the armature or other vibrating portion of the transmitter; and this vibrating portion of the transmitter itself must be able to substantially take up the complex motions of the air particles which act upon it. Only in this way can the quality, as well as the intensity of other sounds be reproduced, since not only the frequency of vibration but also the varying amplitude, and especially the varying form, must be reproduced in order to reproduce the quality called 'articulation.' *The electrical circuit of the instrument must always present an uninterrupted path by which the continually varying current may travel from the transmitter to the receiver; that is, the circuit containing the battery or other source of electrical power, the transmitter, line wire, receiver and earth or return wire must always be closed.*"

But the appellees say that *there are flowing currents* in Dolbear's method. In a sense this is true; but not in the sense of the Bell invention or of the Bell patent. The current in which the electrical changes corresponding to the sonorous air changes are produced, is the current *on the line conductor* extending, as Mr. Cross says, from the generator through the transmitter, through the receiver and back to the generator. This is plain from the Bell specification, for in the form of his apparatus shown in Fig. 7 and explained in the corresponding paragraph of the specification, there is *no other current* than that; the transmitter is an inductive diaphragm. In the commercial Bell telephone there is used a local circuit at the transmitting station for the purpose of producing the proper variations in the magnet at that same station; and so there is in the Dolbear apparatus. But this local circuit, including the magnet, is only for the purpose of inducing upon the line conductor, running from the transmitting station through the receiving station, the currents which are to do the work of transmitting the speech to the receiving station. These currents are in Bell the well-known circuit currents converted into magnetism by traversing the coils of an electro-magnet at the receiving station. In Dolbear, they are merely the currents which move to or from the receiving plate, which is thereby variably charged from instant to instant, so that it may exert its variable electrical attraction, *there being no magnetism at all.* The currents in the two are thus seen to be *essentially different in character, purpose, and result.*

The currents of Bell do their described work of transmitting the speech to the receiving station and there delivering it, by virtue of flowing, and only while they *are* flowing, through the coils of the receiving electro-magnet, whose corresponding magnetic variations vibrate the receiving diaphragm. All that vibrates the receiving diaphragm in Dolbear is the variations of charge of electricity in his attracting plate.

Mr. Bell employed, under the name of electrical undulations, variations of current strength producing like changes of magnetism, to receive and transmit air vibrations under the known law of the electrical transmission of sound, *i.e.*, that the electrical changes must correspond with the sonorous air changes. Dolbear employed variations of *electrical charge* to receive and transmit air vibrations under the same well-known law. Neither could patent the correspondence of the electrical changes with the sonorous air changes, because that was the known law of electrically transmitting sounds.

There is another way of putting this case. Mr. Reis tried, and, if you please (although that is disputed) failed, to transmit speech by variations of current strength in *an interrupted cir-*

cuit. Mr. Bell tried, and succeeded, in transmitting speech by variations of current strength in a *constantly closed circuit.* Mr. Dolbear transmits speech by variations of electrical attraction, using *no circuit*, and no flowing current for that purpose at all.

I have thus far refrained from any examination of the Bell specification on the question of the construction of his patent, and have confined myself to a comparison of *the things done* by the two men, Bell and Dolbear. If the things done are, as I trust I have satisfied you that they are, essentially different, no possible construction of the patent for the one can make it cover the other. I now ask your Honors to look at the Bell patent and see if you do not find the specification (written by Mr. Bell's own hand) to be drawn with the clearest recognition of the fact that his invention lay in transmitting speech electrically by producing on the line conductor running to the receiving station electrical changes (corresponding to the sonorous air changes) in currents of electricity traversing the coils of an electro-magnet at the receiving station, and in that way converted into magnetism of corresponding variations at that station, which magnetic variations perform the work of vibrating the receiving armature accordingly to give out audible sounds like those spoken at the transmitter.

The specification describes no circuit but a ring circuit, running from the positive pole around to the negative pole, and at the receiving station traversing the coils of an electro-magnet. It describes a way of getting multiple telegraphy; it describes a way of transmitting musical tones; and lastly it describes a way of transmitting speech. But everywhere, throughout the specification, there is this one constant and sole agent employed for transmitting the air vibrations produced in either case, and reproducing them to the ear, viz., *a constant circuit with a current converted into magnetism whose variations vibrate correspondingly the receiving armature.*

Take the paragraph where the method of and apparatus for transmitting speech are described. Strip away as immaterial everything which can, by the most liberal interpretation, be so regarded. Let it cover a vibrating metallic disk as well as the described membrane carrying an attached piece of metal. Let it cover a variable resistance transmitter instead of a magneto transmitter, because that substitution may be found suggested in another part of the specification. But if anything in the description of the method of and apparatus for transmitting speech is *characteristic of and essential to* Bell's invention, it is this, that *the current* from transmitting station to receiving station on which the required electrical changes are to be impressed, is a current traversing the coils of an electro-magnet, and that the operative power for vibrating the receiving diaphragm is the varying magnetism so produced in that electro-magnet.

No such current is employed by Dolbear for transmitting speech. No magnetism is used by him for reconverting the electrical changes into sonorous air changes. His method is new, because based upon a mode of using electricity not at the time of Bell's patent known to be practicable, and is substantially and fundamentally different from Bell's. His apparatus is new, and it is essentially different from Bell's for the same reason.

The only resemblance between Bell and Dolbear is in the fact that each produces, *somehow*, electrical changes in the line conductor corresponding with the sonorous air changes made by speaking, and reconverts those electrical changes, *somehow*, into sonorous air changes at the receiving station. But this cannot be validly patented by Bell (even if his specification would bear such a construction) because it is, under another form of words, patenting the use of electricity for transmitting speech, and this, it is agreed, cannot be done.

Mr. Wheeler H. Peckham for the Molecular Telephone Company.

It is, of course, apparent to the court at this time, that there is a very considerable difference in the position occupied by the several parties defendant to this litigation. My learned friend, who represents the Dolbear interest, has stated with considerable emphasis that he speaks alone for that interest.

That interest would be entirely subserved, possibly better subserved by such a decision as should find that the Bell patent was valid in its broadest construction, and that their defence alone that they did not infringe was valid, because there then would be left the Bell Telephone Company and the Dolbear Telephone Company as the sole possessors of the field. On the other hand, if the Drawbaugh defence should prevail alone and by itself, while, for the moment, the field is thrown open to all, very plausible applications could be made to Congress for a grant by a special patent to that inventor, of a privilege such as has been enjoyed by the Bell Company. On the other hand, the Molecular Company and all other companies which stand in similar position, depend solely upon the ground that this Bell patent must be limited to the sphere of a magneto telephone, and that, in so far as its claims are broader than that, it has been anticipated by an anticipation of general avail to all.

[*Mr. Peckham*, after controverting various positions taken by Mr. Dickerson and Mr. Storrow, and after analyzing the inventions of Reis and others prior to Bell, with the aid of plans and models, concluded as follows touching Bell's inventions and patents:]

All those things were before Mr. Bell came. Now, what did Mr. Bell do? Mr. Bell, adopting the magneto method of effecting electrical results, *took the apparatus of Reis and adapted it to that magneto method;* he did not do anything else. You have here substantially the equivalent of the Reis apparatus, with a little difference in shape; it is adapted to the magneto method; this, the Reis apparatus, is adapted to the variation of a constant current made by a battery; this, Fig. 7 of Bell patent, on the contrary, makes its current itself; when you speak there is a current, and when you do not speak there is none — or when you vibrate this diaphragm in whatever way you choose, there is a current, and when the diaphragm is still there is none.

Now, I will call your Honors' attention very briefly, I necessarily must, to things that have been done by Mr. Bell, and to some few clauses in his patent, and also to some few clauses in the specification prepared by him and sent abroad, and which has been alluded to in other arguments during this case for other purposes, in order to show that by the term "method" in the fifth claim of his patent, he, Mr. Bell, meant the magneto method and nothing else, and that the broader meaning was given to the word by his lawyer and not by him. Mr. Bell says that he first determined to devote himself to carry out to a practical result his conception as to multiple telegraphy, and when he came over to America he devoted himself constantly to the investigation of magneto electricity. He early had the idea, and he expressed it very soon in some letters, that magneto currents, the magneto method, if once the currents were strong enough, could be availed of for multiple telegraphy and also for the purposes of transmission of speech. The two things were in his mind together; but he was so strongly weighed down, as it were, with the mental conviction that the magneto currents would be insufficient to produce any practically useful result, that he never tried the experiment. His multiple telegraph instruments at first were of the same character as Varley's; that is, they were actuated by the making and breaking of a primary circuit which induced undulations in the secondary circuit, and in that way operated the receiving reed. Now, that was Mr. Bell's apparatus. That was his way that he had in mind. It was to develop this magneto system, wherein the work is done by varying the electromotive force, so that he might avail of it for purposes of multiple telegraphy, and at the same time for purposes of speech, if it should be carried out. Now, without reference to what went before that, I will call your Honors' attention to the first letter Mr. Bell writes upon this subject.

He had been, up to this time, experimenting or devising, as is the language he uses, devising multiple telegraph instruments. He had not carried them out in any concrete machine. "Devising" is his term for thinking of them. He then writes:

"Another experiment has occurred to me, which, if successful, will pave the way for still greater results than any yet obtained. The strings of a musical instrument in vibrating undergo great changes of *molecular tension*; in fact, the vibration represents the struggle between the tension of the string and the moving force impressed upon it. I have read somewhere that the resistance offered by a wire to the passage of an electrical current is affected by the *tension of the wire*. If this is so, *a continuous current of electricity* passed through a vibrating wire should meet with a varying resistance, and hence a pulsatory action should be induced in the current. If this turns out to be the case, the oscillations of the current should correspond in *amplitude*, as well as in the rate of movement, to the vibrations of the string. One consequence would be that the *timbre* of a sound should be transmitted. The *plan* for transmitting timbre that I explained to you before, viz., causing permanent magnets to vibrate in front of electro-magnets, is generally defective on account of the feebleness of the induced currents. If the *other plan* is successful, the strength of the current can be increased *ad libitum* without destroying the *relative intensities of the vibrations*."

He went on and tried that experiment and it failed. He did not try it with a vibrating diaphragm. He did not try it in any way to see whether *the voice* could have any effect in such work. He merely tried pulling the string or twisting the string, the wire; and it failed to give any sound whatever. No sound whatever was carried, and that experiment and that idea were dropped just then and there.

Now, your Honors will see what it is that Mr. Bell called his *method* at that early period. He draws, in that letter, a clear and plain distinction between the two methods, the one his magnet method, which he has not carried out to any practical result, because of his apprehension of the feebleness of the currents, and the other this method by varying the resistance, and in that way producing results at the receiving end, which he calls the other method. He speaks of them in that letter as "plans"; your Honors will see that when he is asked a question, immediately after giving the letter, and saying that he had made the experiments, he says on page 1606 (Comps. proof, Peop. Rec.), in speaking of that letter:

"When I speak in this letter of my '*plan* for transmitting timbre,' I mean *my method* of transmitting articulate speech."

So that, at that early period, we find Mr. Bell drawing this strong, plain, clear distinction between these *two methods*, these *two plans*, the one the magnet method, the other the varying resistance method.

On the second of June Mr. Bell made the discovery that these magneto currents, which he had before regarded as too feeble to carry out successfully to any practical purpose his plan to operate by the magneto method, were not so feeble as he supposed. He discovered and found that they might be used for some practical purpose, and then he immediately drops, and you never hear anything more of the plan or method which he had referred to in this letter of transmitting by varying the resistance, and the experiment which he tried, the experiment having completely failed. From that moment you never at any time, up to the issue of this patent, hear of any plan or the discussion of any plan for effecting the result by variable resistance. On the 2d of June he finds out by the accidental discovery that has been alluded to in the course of this argument that the magneto instruments are not so feeble as he supposed, and thereupon from that moment he goes on, in the course of experiments devoted to the perfection and carrying out of the magneto method, which, by that accidental discovery, he had found to be sufficient for his purposes. It is availed of principally for the purposes of multiple telegraphy. It perfects his system of multiple telegraphy. It is carried out in that.

I will now turn to the letter of Mr. Bell, or before I do that I will turn to his answer, and I want to read a few of these lines:

"At that time" — that is, in the summer of 1874 — "I proposed to take advantage of magneto-electric currents produced by the vibration of an armature actuated by the voice of a speaker, so that the electrical current employed would *be produced* by the action of the voice itself and not *independently of it;* hence the reproduced vibrations would necessarily be very much feebler than the originals, and it was questionable in my mind how far they would be of practical value. During the winter of 1874 and the spring of 1875 this feeling led me to seek *some method* by which the voice, instead of producing the electrical current used, should merely modify a current produced by other means. In May, 1875, I devised" — the word "devised" means that he thought out — "a *method* of varying the resistance of a galvanic circuit by the action of the voice in the hope that this would obviate the supposed insufficiency of the magneto-electric currents to produce practically operative effects. I was still carrying on experiments and researches regarding *this method* when the accidental discovery made on the 2d of June, 1875, already testified to, proved that the insufficiency of the magneto-electric current to produce audible effects was a mistake."

And then he goes on with his invention with regard to the magneto-electric currents.

On July 1, 1875, he writes Mr. Hubbard:

"The experiment to which I alluded when I saw you last promises to be a grand success. On singing this afternoon in front of a stretched membrane attached to the armature of an electro-magnet, the varying pitch of the voice was plainly perceptible at the other end of the line, no battery nor permanent magnet being employed."

"When the vibrations are received upon another stretched membrane in place of a steel spring, it is possible, nay, it is probable, that the 'timbre' of the sound will be perceived. I hope to try the experiment to-morrow afternoon."

That was written about a month after he had made this discovery, and it is the first time that there is anything in print or any letter written by him to indicate that he intended to make another stretched membrane, or two stretched membranes. The first he had made immediately after the discovery of June 2d was with but a single membrane, an instrument substantially like that. It had not any cone here and it was received on a reed, a vibrating reed, a steel reed alone.

After that we find Mr. Bell writing the letter of August 14th, on page 263 of our brief. What does he do here? It is the same thing. Mr. Storrow commented upon this letter as giving the idea to the world; it had not been put in a concrete form; there had been no directions given by which anybody could follow it out, but he said the great idea that was at the bottom of all telephony, that lay at the basis of this science, was given in this letter. I submit to your Honors, that this letter gave simply the idea of telephonic or telegraphic action, telegraphic work, *by means of the magneto current.*

"On glancing back over the line of electrical experiments, I recognize that the *discovery* of *the magneto electric current generated* by the vibration of the armature of an electro-magnet in front of one of the poles, *is the most important point* yet reached. I believe that it is the key to still greater things. The effects produced, though slight in themselves, appear to me so great, in proportion to their cause, that I feel sure that the future will discover means of utilizing *currents obtained* in this way on actual telegraph lines. So important does it seem to me to protect *the idea* that I think some steps should be taken immediately towards obtaining a caveat or patent, for the use of *a magneto-electric current,* whether obtained in the way stated above (by the vibration of permanent magnets in front of electro-magnets), or in any other way. I should wish to protect it specially as a means of transmitting, simultaneously, *musical notes* differing in *intensity* as well as in pitch. I can see clearly that the magneto-electric current will not only permit of an actual copying of *spoken utterances,* but of the simultaneous transmission of *any* number of musical notes, (hence messages) without confusion. The more I think of it the more I see that the method of making and breaking contact so many times per second is only the *first stage* in the development of the idea. When we can create a pulsatory action of a current, which is the *exact equivalent* of the aerial impulses, we shall certainly obtain exactly similar results." The making and breaking method, above referred to, he testifies, is that of his multiple telegraph system.

And your Honors will remember that he had spoken in the letters before, spoken in his testimony there, of the benefit, the desirable point, the essential element of this magneto current as being a current which was the creature of the voice, created by it.

Now I want your Honors to turn from that — he did nothing after that; he did nothing after this letter or after these experiments of June 2d, prior to the taking out of his patent, in the way of experiments, other than two or three experiments made in the early part of July, and which resulted in merely obtaining a sort of muttering effect; but I want you to look now, and it is all that I shall have time to call your Honors' attention to: first, to the draft specifications and claims of Mr. Bell, and, second, to his George Brown specification or copy application. The draft specifications are shown in our brief on pages 267 to 269. These are drafts made by him for his specification, and they show what was in the man's mind at the time, the idea that he had, or what he thought was really the invention which had come to him.

In the first one he speaks of his invention consisting in the employment of a vibratory or undulatory current and "of a method of and apparatus for producing electrical undulations." It *is the method for* producing. On the other side, there is a short paragraph in which he speaks about "inducing undulation in a continuous voltaic circuit *by the motion of bodies capable* of effecting a current." And on the next page a draft of a claim apparently is "*the method of inducing* (impressing) undulations in a continuous voltaic current." That is the method that was in his mind.

And then he has a third claim, which he puts in this place, and it would be a claim for a speaking telephone; but your Honors will see what kind of a claim it is that is here. This claim is:

"The phonautograph, whereby two or more vocal or other sounds, differing in pitch, loudness, and timbre, can be transmitted singly or simultaneously."

That did not come into his patent. That was left out. He says nothing of that character at all in the patent.

On the other side is:

"The *method of* and apparatus for transmitting simultaneously sounds differing in timbre as well as in pitch and loudness. The method of and apparatus for transmitting vocal utterances."

And the next claim is:

"In illustration of *the method* of creating a vibratory current of electricity. I shall show and describe one form of apparatus designed to produce undulations in a continuous voltaic current. But I wish to state here that the same effect may be produced in many other ways, all that is necessary being to influence the current *by the vibration or motion of bodies capable of affecting the current.*"

Now those are rough drafts or notes of drafts that he made in preparing it, drawing his specification of this patent furnished by Bell and presented by him when he was being examined as a witness in the case. I am going to refer now to the Brown paper. I am not referring to this paper as a branch of the argument made by Mr. Hill or for any such purpose as Mr. Hill used it. I am referring to it simply as showing the point that was in the mind of this man up to the time this specification was drafted, up to the time when this was delivered to Mr. Brown and carried away by him, and as helping us in the construction of the 5th claim of the patent itself as it now stands. He says:

"Undulatory currents of electricity may be produced in other ways than that described above, *but all the methods depend* for effect upon the vibration or motion of bodies capable of inductive action."

Now that is the statement in the George Brown paper. What is his claim? Claim 4 — "the method of and apparatus for transmitting vocal or other sounds telegraphically, by" — in brackets — "inducing in a continuous voltaic circuit" — that is the end of the brackets — "causing electrical undulations similar in form to the vibrations of the air accompanying said vocal or other sounds, the whole for operation substantially as herein shown and described."

Now, your Honors, the question is, What is the construction of that claim numbered here four, numbered five in the patent, as actually issued. Your Honors will see here that he had stated at this time, in the body of the specification, that all these methods for producing undulations depended upon the vibration or motion of bodies capable of inductive action; and then he says in his claim based upon that statement in his specification, that he claims "the method of and apparatus for transmitting vocal or other sounds telegraphically by causing electrical undulations," as therein described.

Now, how is it, by causing electrical undulations? Why, causing them in the only way and the only manner in which he had stated in the specification they could be caused or could be produced. That is the claim as he fixes it there.

Now, if we turn to the patent itself, we find that the fifth claim is substantially identical with the fourth claim in that George Brown specification. "It is the method of and apparatus for transmitting vocal or other sounds telegraphically," as therein described, "by causing electrical undulations similar in form."

This patent contains in the specification what was not contained in the George Brown copy. It contains a statement that

"Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit or by increasing and diminishing the power of the battery," &c.

But is it supposed, your Honors, that the patentee thought when he put those words or that feature into the specification, that he in any way affected or intended to affect the fifth claim, which was the fourth claim in the George Brown specification? By no means; because, when he puts this new matter of specification in this patent, he puts in another claim, to correspond to the new matter which he had put into the specification of the patent. This other claim which he has put in is the fourth claim of the patent of the method of producing undulations in a continuous volatile current by gradually increasing and diminishing the resistance of the circuit."

That is not put in as a claim having any connection with the production of sound, or having any connection with undulations which are produced by sound waves. It is put in as a simple claim, in and by itself, for the production of those undulations. It is not a claim upon which this suit is founded, and it is not a claim which has any validity, because that thing had been done in the year 1873 with precision by Mr.

Edison, in a patent which I have already alluded to, where he put his electrodes in water or glycerine or other liquid. So that we have here the specifications as prepared and taken by George Brown, speaking of a production of or causing electrical undulations, which, by the terms of the specification is necessarily confined to the magneto method, because the specification says that there is no other method; and then when we have by some means, whatever they may be, whether fair or unfair, fraudulent or honest, new thoughts from Gray or from himself, or whatever may be the reason, the idea suggested to him and put into his patent that electrical undulations can be caused by the variations of the resistance of the circuit, we find a claim put in to correspond to that; but we do not find any change or any variation whatever of the fifth claim.

Your Honors will see that there is not in that patent to be found anywhere from the beginning to the end any suggestion that there is any other method, or any other way of causing electrical undulations by sound waves than the one which is pointed out and illustrated by Fig. 7. All these prior methods of producing electrical undulations have reference to and are involved in the production of multiple telegraphy, or the production of telegraphy in some way, whether multiple or single. Some of them are ways that it is absolutely impossible to use in connection with the production of sound waves; as, for instance, the vibration of a wheel with magnets on the periphery before the poles of a magnet; that cannot possibly be used as a means of producing the undulations of the sound waves.

Mr. Charles P. Crosby for the Overland Company.

An action was brought by the Bell Telephone Company, in the month of November, 1884, against the Overland Telephone Company, a company incorporated under the laws of the State of New York; and very soon thereafter, or about that time, an action was brought in the Circuit Court of the United States, for the District of New Jersey, and one also in the Eastern District of Pennsylvania; the three actions being brought for the purpose of obtaining permanent injunctions, and a motion being made in each of the three actions for a preliminary injunction. By stipulation, the motion for injunction was argued in the three actions before the Circuit Court of the United States for the Eastern District of Pennsylvania, at Philadelphia, before a tribunal composed of Justices Butler, Nixon, and the presiding justice of the Pennsylvania Circuit. In the bill of complaint in that action, which was one of the papers upon which the motion for injunction was based, there were set forth some seventeen or eighteen instances where, as the Company claimed, there had been a prior adjudication in their favor at Circuit. Two days of the argument there was devoted to an endeavor upon the part of the Overland Company to show that there had been no real adjudications; and the history of those litigations, so far as we were able to give them in the limited time which was allowed to us to resist that motion, was shown upon that argument. At about that time, for the first time, what is called the Drawbaugh defence was called to the attention of the counsel of the Overland Telephone Company; and by the politeness and courtesy of counsel for the Drawbaugh, that defence so far as it existed at that time, and so far as the testimony had been taken in it up to 1884 (and which was necessarily but a partial defence at that time) was submitted to that tribunal. The element sought to be introduced here, and which is the basis, as I understand it, of the molecular defence, to wit, the Reis invention, was also partially before that tribunal, a portion of the Reis testimony having been taken. On the argument, Mr. Justice McKennon, without passing as I understand it, upon any of the defences — it appearing before him that the Drawbaugh case (what was called the Drawbaugh case) was in a position to be heard before Mr. Justice Wallace in the Circuit Court of the United States for the Southern District of New York — decided to refuse, at that point, the complainant's motion for a preliminary injunction, and to retain it until the decision of the Drawbaugh case in New York; holding as I believe, the Drawbaugh defence at that time to be a very serious and important defence to those who were engaged in contest with the Bell Telephone Company. At the close of that argument, Mr. Storrow, one of the counsel for the Bell Telephone Company, made an application to that tribunal for a restraining order pending the argument of the case before Mr. Justice Wallace which was refused; the judge holding that they might be entitled possibly thereafter to a final decree, but that they were not entitled to a restraining order in the meantime. I think that the question of former adjudications, which were made so salient and so prominent in that case up to that time, were successfully disposed of upon that argument. The Drawbaugh case was decided by Mr. Justice Wallace; and the Overland record which contained the record in the Drawbaugh case, and in the Spencer, the Dowd, and the Molecular, and all of the other defences, which, so far as counsel for the Overland Company were acquainted, were in existence up to the 15th of October, 1885, were incorporated in the Overland record; and when the Overland case came on for hearing, after the decision in the Drawbaugh case, it was not considered necessary upon the record then existing, and in the tribunal which had just decided the Drawbaugh case, to make any further argument; and so a decree *pro forma* substantially was entered, and the case came into this court.

I only call the attention of the court to that for a moment, so that it may understand (for I do not propose to go into the detail of any of the arguments that are made here) the position of the Overland Telephone Company in this tribunal. And with a single reference to the brief which was made in the Drawbaugh case I shall close what I have to say with reference to this case, all of the defences which are peculiar to the Overland, and out of which I suppose they may take any advantage, having been very ably presented by the various gentlemen who represent the various defendants here. Very much of the argument of Mr. Storrow and of Mr. Dickerson has been to the proposition that Daniel Drawbaugh, if he at any time prior to 1878 or 1879, had any invention of any sort or kind which had any value, that he would have communicated it to the outside world. I pass by the discussion as to Drawbaugh's poverty, I pass by the piteous story of his life which is detailed upon the record; I pass by the insinuations, the sneers, the gasconade, the buffoonery with which this man has been treated in this tribunal, as not germane to this discussion. They are not here, I will not notice them. One great central fact exists. At the least, Drawbaugh had some mechanical genius, at the least he had some inventive genius. It appears from their own record that he did invent something; that he knew something of electricity; and it appears incontrovertibly that some time prior to 1876 or 1877 by the testimony of over two hundred witnesses, that he had made, or was trying to make an instrument *that would talk* and that would *talk out loud.* The ingenuity of two of the subtlest brains of modern times, I believe, has not satisfied this tribunal of the falsity of that proposition. Every appliance known to great wealth, the use of detectives, the employment of the ablest counsel in America upon this question, have been brought substantially to dispose of Drawbaugh in this manner, and I submit to this tribunal that it has failed. The great central fact exists, and stands here like a column of light, that Daniel Drawbaugh was trying in the years 1875 and 1876 to make a machine that talked. The cardinal, the perhaps incomplete idea which has been worked out, existed in the mind of this poor mechanic at Milltown.

One word as to this portion of Mr. Dickinson's brief. It appears by the record in this case, and to that portion of the record which he cites, and which I beg to submit to the court, he in every instance cites correctly — this statement, which I beg leave to call to the attention of the court:

"Aside from the fact already shown, that he was at work on the magneto and carbon instruments at different times, there is a very simple answer which appears incidentally and naturally throughout the record. No effort was made to bring it out, and it appears in the testimony of witnesses, as in that of Drawbaugh, without consciousness on their part or his, that it was of any special importance. It is this: That the instrument in his view was not loud enough for practical purposes unless it would talk, without holding it to the ear, and convey the sound as far as ordinary speech. He wanted it to talk out as a man talks."

This testimony by Free is referred to in this connection: "He told me that he wanted to accomplish, and could do it, to make a machine that you could stay in one corner of the room, and putting the machine in the other corner, and hear as distinctly as putting it to the ear" — and that Drawbaugh told him that he had not done it yet, but "I am working at it and I am going to get it accomplished."

Now, in 1876, at the time of the Centennial, when it is claimed that Mr. Alexander Graham Bell laid the superstructure of his great reputation — at that time, this man supposed that a telephone had no commercial value unless it talked out loud. At that very time that he has detailed he was doing this, the *New York Tribune* thought that the only use of the telephone would be for "diplomats and lovers"; and the *Scientific American* summed up the public opinion of it as "a beautiful scientific toy"; and Gardner G. Hubbard, the partner and father-in-law of Mr. Bell — a telegraph manager and Mr. Bell's financial backer, "did not then believe the transmission of speech could be made commercially valuable." At the time that they had that estimation of it, Drawbaugh's idea of it was that it was of no value unless it talked out loud. And that was the solution of that branch of this question, which in my judgment these gentlemen have very quietly, carefully and scientifically avoided.

We rely, for the Overland Telegraph Company, upon all the defences that appear upon this record. We appreciate most heartily and thoroughly the presentation of what is called the Reis defence by my brethren Mr. Lowrey and Mr. Peckham; but we think the Drawbaugh defence is a very serious one here; and so far as the Overland Company is concerned, we rely upon the whole record.

Mr. Hill for the People's Company, and The Overland Company, in reply:

Before I enter upon the argument of the disputed propositions in this case, I beg leave to say a word or two in explanation of a matter which I have feared, perhaps unnecessarily feared, might not be thoroughly understood by the court; and that is as to what is really shown of the history of the case by a glance at a patent that is issued upon any day; as, for example, the patent to Alexander Graham Bell issued on March 7th, 1876. Several questions have been asked by the court with reference to that; and I fear that matter may not be perfectly clear.

When an application is filed in the Patent Office, the practice is to allow that application to be amended, formally or informally, sometimes in pencil marks, marked by the applicant, or by his attorney, upon the specification remaining in the Patent Office. When that is received, the examiner places it on file, goes to the specification, and marks around the passage that is amended red lines, striking it out and noting on it that the amendment marked A, B or C, or whatever it is, is substituted for that passage, and giving the date also. But when the patent finally issues, that document, with its amendments, is sent to the government printer, and the government printer prints it as finally corrected. The print that he makes is a clean, clear copy of the thing as finally amended; and that printed patent which comes from the government printing office does not show that any change whatever has been made in the document. The original is sent from the government printing office back to the Patent Office, and remains on file there, and is a part of what is called the "File wrapper and contents."

THE CHIEF JUSTICE: In that connection I want to ask a question. A paper was laid on my table this morning, called "Certified Copy of Exhibit," which appears to be a certified copy of a patent.

Mr. Storrow: Your Honor has had that paper for ten days.

THE CHIEF JUSTICE: That paper, as I understand it, is a certified copy of the file wrapper in Bell's case, showing the corrections.

Mr. Storrow: No, sir; that is the certified copy brought by Mr. Stetson, the clerk, from Boston, of exhibits which he produced. It shows the blue lines and pencil marks. I have already told that story.

Mr. Hill: When any party applies to the Commissioner of Patents, and asks for a certified copy of that file wrapper and contents, he gets a certified copy, among other things, of the document which was originally filed, with all the marks which were on it, whatever they may be, and however they may have been placed upon it. The rule in the office of the Commissioner is to very carefully place those marks on that certified copy exactly as they are on the original. Hence, in this case you can gather nothing from the patent — from the printed patent of March 7th, 1876 — as to the prior history of the application in the Patent Office. You will read in that patent only the final result of the whole. But, if you take the certified copy of April 10th, 1879, as printed in the Dowd record — which is a true copy, or is assumed to be, of the record as it then appeared, then if you look at that copy, that being a certified copy, you get not only the original document which was filed in the Patent Office, but you find noted on that copy the various changes which were made in it while it was there and before the patent issued.

The pencil memoranda and obliterations of words — the memoranda appearing in the 1879 copy, showing that words were originally in the document, as far as we can gather from the 1879 printed copy in the Dowd case — that words were originally in the document, which do not appear in the patent, show the state of the record, and show how those words appear on the document; but they do not appear there now. The patent, as it issued March 7th, 1876, does not show that; because the patent shows only the final form, the corrected form; it does not show how the corrections were made.

The Chief Justice: I understand you to say that the pencil memoranda upon the Boston paper are the corrections as finally made, and that, therefore, they should have made part of the specifications as put in the patent.

Mr. Hill: When I get along a little further in my argument I shall endeavor to show you that the paper brought here from Boston is a paper which has been doctored to explain this thing.

[*Mr. Hill* then reviewed the answers that had been made to his argument upon the paper known as the George Brown specification, contending that the facts which he regarded as very damaging had not been explained; and that it was impossible that Mr. Brown, a capitalist proceeding to Europe to invest his money in the invention, entering into a contract with Mr. Bell to give him so many dollars per month to further develop his invention, taking a half interest in the invention abroad, should be willing to go to Europe to patent the invention there, knowing, as he must have known when he left New York, that there was another current which would do the work equally well, if Mr. Storrow's theory was correct, and if that other current was in the American specification. He maintained that Brown desired to use the invention to prevent the lagging of cable signals; that the magneto currents caused by the induction of an armature, which were the only currents Bell had in his mind, were so light and feeble that it was impossible to use them for that purpose; that so far as Bell in May, 1875, had an idea of varying the resistance, it was limited to one form of apparatus — to vibrate a stretched rod or wire, varying the current, and that this was a failure and was abandoned; and that there was no explanation of the fact that Bell]

"Went home from his visit to Washington on February 25 or 26 to March 3, 1876, and immediately proceeded to construct a liquid transmitter like Gray's, got speech through it on March 10 and then kept still about it and concealed the fact — no explanation that the next step that he took was to construct two magneto devices just like Gray's receiver on or about the 1st of April, and then got speech through them; and that in his London lecture a year afterwards he tried to connect the experiment of 1875 directly with those two experiments of April, 1876, without giving the dates, but jumping over and keeping still about the intervening solution of the question of the transmission of speech on March 10."

Mr. Dickerson says that Bell's and Gray's instruments operate on exactly opposite principles. He says that Gray had the idea of varying the resistance of the liquid by varying the amount of liquid between the poles by bringing the poles nearer together. But he says that it was not Bell's idea to vary the resistance of the liquid. Let me read what Mr. Dickerson says. I find it in my copy of the arguments, on page 1114:

"Now you see the points of these two things. They are both supposed to be, they both are properly called, liquid transmitters. They work on directly opposite principles. One works upon the principle of approximating the two opposite poles and having a film of liquid between them, whose thickness is varied by the vibration; and the other operates upon the principle of dipping one of those poles in the water and thereby delivering more electricity or less." Dipping it in water, or in the liquid, thereby delivering more or less electricity.

Now what does the patent say? I appeal from Mr. Dickerson, Mr. Bell's counsel, arguing the case here and presenting a plausible theory to lead the court to his view of the case, to Mr. Bell, and I appeal to his decision of this question in the patent itself. Mr. Bell says: "The reciprocal vibration of the elements of a battery, therefore, occasions an undulatory action in the voltaic current. The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current." That is what Mr. Bell says, and he says: "Hence the vibration of the conducting wire" produces this effect. This description of Mr. Bell is exactly the description of Gray's caveat transmitter.

Then I come to another subject. There is another important matter which my friends have attempted to explain. I refer to the attempted explanation of how that certified copy of April 10, 1879, came to be printed and appear in the record as it does appear. Before I enter upon this explanation I wish to say that when my associate, Mr. Dixon, in his very careful, thorough, and able investigation of the facts in this case had developed the fact that there was an apparent and evident fraud indicated by the documents on file in the suit, we had no other evidence except those arguments to refer to, and they seemed to be absolutely conclusive of the whole subject as to the fraud, what it was, when it was perpetrated, and how it was perpetrated; absolutely conclusive of the fact that since the 10th of April, 1879, the Patent Office paper had been abstracted and another document filed in the file wrapper of the Bell application, appearing there now as the specification that was filed by Bell. It was immediately apparent that if that fraud had been committed in the Patent Office there was an absolute necessity imposed upon the party who committed it to commit the same fraud in the Circuit Court in Boston, because there was a certified copy of that document as it existed on April 10, 1879, known to be filed in that court in Boston. If they abstracted one of those copies and substituted a false copy in its place, it would be necessary to do the same thing with the other, or the other would give away the whole proceeding. It was liable at any time to expose the whole thing. Then came the question, But how could they do it? How could they make that alteration or that change in the record in Boston? Of course, it was easy enough to do it as a physical matter. The case was an old case that had been settled and disposed of. The obliging clerk would allow anybody who came in there and wanted to look at those papers to take the file wrapper, sit down at the table, open them and examine them, as is always allowed in those matters. He would not be particularly careful about it because it was an old case, an old file, years old, everything past and done.

[*Mr. Hill* then argued at length that these interlineations had been fraudulently made, and continued:]

Now, may it please your Honors, with but a very short time to spare, I must review a few points in connection with the Drawbaugh defence. My learned brothers have argued on the other side that in law oral evidence has never been allowed to overthrow a patent. It is hardly necessary for me to treat that question. If it were I would refer to *Gayler* v. *Wilder*, 10 How. 477; and *Coffin* v. *Ogden*, 18 Wall. 120.

It is said that the instrument marked I in the Drawbaugh exhibits had no magnet on it when found; that is true, that when the original model was put in evidence the magnet was not with it; but after it had been produced before the examiner, and put in evidence, Mr. Drawbaugh found among his various magnets at the shop a magnet which he recognized as the original used in that. He brought that magnet over and placed it on the instrument and it fitted its place exactly, both in its height, in the size of the poles which fitted the holes made for it, and in every respect it showed for itself at once that it was the magnet originally in the instrument.

It is said that the tumbler F could not be adjusted unless the bottom was out of it originally. They point to the fact that the bottom of the old tumbler is broken off, and that we have attempted to say it was closed up; and they state to the court that that is nonsense, because the instrument could not be adjusted in that case; and yet, your Honors, that is the exact fact, that the tumbler instrument F can be adjusted. The bottom was in there; they are adjusted by the screw rod at the top and not from the bottom. I mention that matter to show you what trifling things are brought before the court as evidence of importance, when they really have no importance at all, and they are answered by the condition of the instruments right in your presence.

It is said that a string telephone existed in Drawbaugh's shop in those early days: but there is not a word of evidence of the kind.

In regard to the tests made in New York and Philadelphia I want to be more particular in calling the attention of the court to the extraordinary misrepresentations that have been made regarding those tests. The history of the New York and Philadelphia tests is substantially this: When these Drawbaugh instruments were first put in evidence, the originals (the early ones) were dilapidated, — in some cases one or two of the parts gone, — and I directed Mr. Drawbaugh to make a set of instruments that would show exactly what the parts were, how they were related to the other, the other parts, if they were all there, and put them in as reproductions. The original instruments were offered in evidence just as they stood, and then I directed him to make reproductions to show the parts that were gone. For instance, in the tin can instrument the tin can remained there. The electro-magnet remained there, but the original diaphragm had been a membrane. The mice had eaten it off or something, and it had gone. I directed him to make another instrument, having the tin can and the electro-magnet just the same, and to put a diaphragm on it, and if there was anything on the diaphragm that would show, whatever it was. So he made one, which appears as the reproduced instrument. In the same way the tumbler instrument was reproduced and put in evidence; not for the purpose of testing; we never had any idea of testing those instruments, but merely to show the court what the relations of those parts were, so far as any of them were absent, what they were in the original machines. About the time Mr. Drawbaugh was testifying, the latter part of the taking of the testimony in the case, Mr. Benjamin, the expert, had the curiosity to try some of those instruments and see if they would operate: and he tested them and found that they would operate more or less as talking telephones — those instruments that are put in in that way merely show what the relations of the parts were. A test of those instruments was called for by my friends on the other side, and we made the test in New York at the end of Mr. Benjamin's testimony, or near the end of it. We had no time to make other instruments, to make other reproductions; in order to have the parts new and properly arranged and constructed, in operative condition, we had to take the old instruments that we had, the only set we had, the old reproduced instruments which had been in evidence for two or three years; which had been to Harrisburg, to Baltimore, to Philadelphia, to New York, to Washington, back and forth dozens of times; which had been taken apart and examined by counsel and by experts and by draftsmen, and had got in a very dilapidated condition; that is, the parts had got loose and out of position, many of them.

In the instrument A; if your Honors remember it — a little flat box with a hole near the centre — that instrument had been so badly handled and abused that the diaphragm inside of it had become broken in two, showing to what roughness of handling those instruments had been subjected. We had to take those instruments and adjust them the best we could and make the tests in New York, in order to accommodate these gentlemen, as we had no time to prepare new instruments; and they would have objected to them probably if we had, as not being in evidence. The tests were made in New York, and all the original instruments of Drawbaugh, the instrument H, the instrument A, the two instruments B and D, and the magneto instrument J, that handsome black walnut instrument about so square [indicating] — all those instruments operated perfectly well. They were the original instruments of Drawbaugh. The only instruments that did not operate perfectly satisfactorily were the reproduced instruments that we had made, not for testing, but simply to exhibit the arrangement of the parts. They did not operate perfectly satisfactorily; but they did operate as speaking telephones, and did transmit sentences, and were by no means conceded or claimed as failures, even those that were most dilapidated.

The Chief Justice: That was the tumbler?

Mr. Hill: Yes, your Honor; the tumbler operated. I will show you the testimony in a moment, Defendants' Vol. 2, Mr. Benjamin's testimony on pages 1278 and 1279. We will settle that matter at once. Mr. Benjamin testifies:

"Here are some sentences, which I read from the notes, which I heard distinctly through F and A."

F is the tumbler; A is the round box.

The Chief Justice: Is that the New York test?

Mr. Hill: That is the New York test. Mr. Benjamin testifying about the New York test and about the tumbler instruments which were used there, he says:

"Here are some sentences, which I read from the notes which I heard distinctly through F and A, and caused to be repeated back through the 'tell-tale' line to the room from which they were transmitted, and where the notes were taken by Mr. Marx."

The first sentence was: "What shall I do now? Shall I read to you something?" That was transmitted through the tumbler instrument at the New York test. Another: "I will read again." That was perfectly transmitted. Another: "Now, listen, while I talk. Do you hear that?" That was transmitted through the tumbler instrument at New York. Another: "How plainly can you hear me?" That was correctly transmitted. Again: "Is now almost at its height." That was transmitted perfectly well. Again: "For his action in the Lamson case." Those words were transmitted perfectly. Then he says:

"I have taken these sentences at random from the notes made in the back room, and I introduced them here merely to show the extent of the sentences that I clearly heard through F and A."

Then here is another. He put a Tisdel receiver on in place of A. He says:

"When F was used as a transmitter with a Tisdel magneto instrument as a receiver, sentences and words were received a little, though not much better. Here are some of the sentences heard and repeated by me, and taken down by the stenographer in the front room."

Here is one of them now, with the tumbler instrument, in New York:

"Have you heard of Judge Wallace's appointment? How do you like it?"

Again, "Shall I read an article to you now?"

Again, "How far can you understand what I say?"

Then Mr. Benjamin says:

"I was, and am still, of the opinion that the Tisdel hand instrument used was somewhat out of adjustment, owing to rough handling."

Then he says:

"I took the Tisdel instrument off the line, after using it for quite a short time with F as a transmitter, and substituted a Bell instrument, through which I received in the front room the following sentences, spoken into F in the back room."

The instrument F is the tumbler. He says:

"The following are some of the sentences heard:
'Dan Drawbaugh is standing by my side.'
'Do you like a Bell receiver better than a Tisdel?'
'Do you get it better now than before?'
'Do you think you can hear reading?'
'I will read something from the paper.'"

Now another long sentence.

"I said: 'Repeat what you read so that I can see whether you get it right or not.'"

That was sent through the F instrument. Then another sentence of a more emphatic nature, with reference to his not hearing correctly printed matter.

Mr. Justice Field: Those are the experiments at New York?

Mr. Hill: Those are the experiments at New York. Those are the performances of that F instrument at New York, where my brothers have told you in their argument that the thing was an utter total failure and that nothing could be done at all. Those are the representations that have been made to you about those tests; and yet that very instrument was doing those things there. It was not doing as well as it ought to have done; it was difficult to keep the adjustment. Mr. Benjamin says it was a perpetual struggle for adjustment. So that when the Overland case came we made further tests. We have been criticised for not making further tests in the New York case. Why, we made the tests at the very last end of our testimony. Our testimony was all in, Mr. Benjamin was the last witness we had. Then the other side put in their rebuttal and we could answer that but we had no right to any further evidence in the main case. In the Overland case, however, where the evidence was not completed, we subsequently made other tests. We had there made for the purpose of those tests correct copies of the instruments used in New York. We employed Professor Barker.

The Chief Justice: I want to ask you in that connection — I don't know whether I understood you — do I understand that these words which you say were transmitted and heard by Mr. Benjamin were sent through a tumbler instrument or were they sent through another instrument?

Mr. Hill: Sent through a tumbler instrument; that was used as a transmitter. They were sent through a tumbler instrument, through F, as a transmitter; and that tumbler instrument, your Honors will bear in mind, was used in a horizontal position, set just as this tumbler sets on the table, so that it transmitted these words in that position and not in any other position.

[*Mr. Hill* closed by reviewing the objections which had been made on the other side to these experiments.]

MR. CHIEF JUSTICE WAITE delivered the opinion of the court.

The important question which meets us at the outset in each of these cases is as to the scope of the fifth claim of the patent of March 7, 1876, which is as follows:

"The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth."

It is contended that this embraces the art of transferring to or impressing upon a current of electricity the vibrations of air produced by the human voice in articulate speech, in a way that the speech will be carried to and received by a listener at a distance on the line of the current. Articulate speech is not mentioned by name in the patent. The invention, as described, "consists in the employment of a vibratory or undulatory current of electricity, in contradistinction to a merely intermittent or pulsatory current, and of a method of, and apparatus for, producing electrical undulations upon the line wire." A "pulsatory current" is described as one "caused by sudden or instantaneous changes of intensity," and an "electrical undulation" as the result of "gradual changes of intensity exactly analogous to the changes in the density of air occasioned by simple pendulous vibrations."

Among the uses to which this art may be put is said to be the "telegraphic transmission of noises or sounds of any kind," and it is also said that the undulatory current, when created in the way pointed out, will produce through the receiver at the receiving end of the line "a similar sound to that uttered into" the transmitter at the transmitting end. One of the means of imparting the necessary vibrations through the transmitter, to produce the undulations, may be the human voice. Articulate speech is certainly included in this description, for it is an "uttered" "sound" produced by the "human voice."

It is contended, however, that "vocal sounds" and "articulate speech" are not convertible terms, either in acoustics or in telegraphy. It is unnecessary to determine whether this is so or not. Articulate speech necessarily implies a sound produced by the human voice, and, as the patent on its face is for the art of changing the intensity of a continuous current of electricity by the undulations of the air caused by sonorous vibrations, and speech can only be communicated by such vibrations, the transmission of speech in this way must be included in the art. The question is not whether "vocal sounds" and "articulate speech" are used synonymously as scientific terms, but whether the sound of articulate speech is one of the "vocal or other sounds" referred to in this claim of the patent. We have no hesitation in saying that it is, and that if the patent can be sustained to the full extent of what is now contended for, it gives to Bell, and those who claim under him, the exclusive use of his art for that purpose, until the expiration of the statutory term of his patented rights.

In this art — or, what is the same thing under the patent law, this process, this way of transmitting speech — electricity, one of the forces of nature, is employed; but electricity, left to itself, will not do what is wanted. The art consists in so controlling the force as to make it accomplish the purpose. It had long been believed that if the vibrations of air caused by the voice in speaking could be reproduced at a distance by means of electricity, the speech itself would be reproduced and understood. How to do it was the question.

Bell discovered that it could be done by gradually changing the intensity of a continuous electric current, so as to make it correspond exactly to the changes in the density of the air caused by the sound of the voice. This was his art. He then devised a way in which these changes of intensity could be made and speech actually transmitted. Thus his art was put in a condition for practical use.

In doing this, both discovery and invention, in the popular sense of those terms, were involved; discovery in finding the art, and invention in devising the means of making it useful. For such discoveries and such inventions the law has given the discoverer and inventor the right to a patent—as discoverer, for the useful art, process, method of doing a thing he has found; and as inventor, for the means he has devised to make his discovery one of actual value. Other inventors may compete with him for the ways of giving effect to the discovery, but the new art he has found will belong to him and those claiming under him during the life of his patent. If another discovers a different art or method of doing the same thing, reduces it to practical use, and gets a patent for his discovery, the new discovery will be the property of the new discoverer, and thereafter the two will be permitted to operate each in his own way without interference by the other. The only question between them will be whether the second discovery is in fact different from the first.

The patent for the art does not necessarily involve a patent for the particular means employed for using it. Indeed, the mention of any means, in the specification or descriptive portion of the patent, is only necessary to show that the art can be used; for it is only useful arts—arts which may be used to advantage—that can be made the subject of a patent. The language of the statute is, that "any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter," may obtain a patent therefor. Rev. Stat. § 4886. Thus, an art—a process—which is useful, is as much the subject of a patent, as a machine, manufacture, or composition of matter. Of this there can be no doubt, and it is abundantly supported by authority. *Corning* v. *Burden*, 15 How. 252, 267; *Cochrane* v. *Deener*, 94 U. S. 780, 787, 788; *Tilghman* v. *Proctor*, 102 U. S. 707, 722, 724, 725; *Fermentation Co.* v. *Maus*, 122 U. S. 413, 427, 428.

What Bell claims is the a· of creating changes of intensity in a continuous current of electricity, exactly corresponding to the changes of density in the air caused by the vibrations which accompany vocal or other sounds, and of using that electrical condition thus created for sending and receiving articulate speech telegraphically. For that, among other things, his patent of 1876 was in our opinion issued; and the point to be decided is, whether as such a patent it can be sustained.

In *O'Reilly* v. *Morse*, 15 How. 62, it was decided that a claim in broad terms (p. 86) for the use of the motive power of the electric or galvanic current called "electro-magnetism, however developed, for making or printing intelligible characters, letters, or signs, at any distances," although "a new application of that power" first made by Morse, was void, because (p. 120) it was a claim "for a patent for an effect produced by the use of electro-magnetism, distinct from the process or machinery necessary to produce it;" but a claim (p. 85) for "making use of the motive power of magnetism, when developed by the action of such current or currents, substantially as set forth in the foregoing description, . . . as means of operating or giving motion to machinery, which may be used to imprint signals upon paper or other suitable material, or to produce sounds in any desired manner, for the purpose of telegraphic communication at any distances," was sustained. The effect of that decision was, therefore, that the use of magnetism as a motive power, without regard to the particular process with which it was connected in the patent, could not be claimed, but that its use in that connection could.

In the present case the claim is not for the use of a current of electricity in its natural state as it comes from the battery, but for putting a continuous current in a closed circuit into a certain specified condition suited to the transmission of vocal and other sounds, and using it in that condition for that purpose. So far as at present known, without this peculiar change in its condition it will not serve as a medium for the transmission of speech, but with the change it will. Bell was the first to discover this fact, and how to put such a current in such a condition, and what he claims is its use in that condition for that purpose, just as Morse claimed his current in his condition for his purpose. We see nothing in Morse's case to defeat Bell's claim; on the contrary, it is in all respects sustained by that authority. It may be that electricity cannot be used at all for the transmission of speech except in the way Bell has discovered, and that therefore, practically, his patent gives him its exclusive use for that purpose, but that does not make his claim one for the use of electricity distinct from the particular process with which it is connected in his patent. It will, if true, show more clearly the great importance of his discovery, but it will not invalidate his patent.

But it is insisted that the claim cannot be sustained, because when the patent was issued Bell had not in fact completed his discovery. While it is conceded that he was acting on the right principle and had adopted the true theory, it is claimed that the discovery lacked that practical development which was necessary to make it patentable. In the language of counsel "there was still work to be done, and work calling for the exercise of the utmost ingenuity, and calling for the very highest degree of practical invention."

It is quite true that when Bell applied for his patent he had never actually transmitted telegraphically spoken words so that they could be distinctly heard and understood at the receiving end of his line, but in his specification he did describe accurately and with admirable clearness his process, that is to say, the exact electrical condition that must be created to accomplish his purpose, and he also described, with sufficient precision to enable one of ordinary skill in such matters to make it, a form of apparatus which, if used in the way pointed out, would produce the required effect, receive the words, and carry them to and deliver them at the appointed place. The particular instrument which he had and which he used in his experiments did not, under the circumstances in which it was tried, reproduce the words spoken, so that they could be clearly understood, but the proof is abundant and of the most convincing character, that other instruments, carefully constructed and made exactly in accordance with the specification, without any additions whatever, have operated and will operate successfully. A good mechanic of proper skill in matters of the kind can take the patent and, by following the specification strictly, can, without more, construct an apparatus which, when used in the way pointed out, will do all that it is claimed the method or process will do. Some witnesses have testified that they were unable to do it. This shows that they, with the particular apparatus they had and the skill they employed in its use, were not successful; not that others, with another apparatus, perhaps more carefully constructed or more skilfully applied, would necessarily fail. As was said in *Loom Co.* v. *Higgins*, 105 U. S. 580, 586, "when the question is, whether a thing can be done or not, it is always easy to find persons ready to show how not to do it." If one succeeds, that is enough, no matter how many others fail. The opposite results will show, that in the one case the apparatus used was properly made, carefully adjusted, with a knowledge of what was required, and skilfully used, and that in the others it was not.

The law does not require that a discoverer or inventor, in order to get a patent for a process, must have succeeded in bringing his art to the highest degree of perfection. It is enough if he describes his method with sufficient clearness and precision to enable those skilled in the matter to understand what the process is, and if he points out some practicable way of putting it into operation. This Bell did. He described clearly and distinctly his process of transmitting speech telegraphically, by creating changes in the intensity of a continuous current or flow of electricity in a closed circuit, exactly analogous to the changes of density in air occasioned by the undulatory motion given to it by the human voice in speaking. He then pointed out two ways in which this might be done: one by the "vibration or motion of bodies capable of inductive action, or by the vibration of the conducting wire itself in the neighborhood of such bodies;" and the other "by alternately increasing and diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery." He then said he preferred to employ for his purpose "an electro-magnet, . . . having a coil upon only one of its legs," and he described the construction of the particular apparatus shown in the patent as Fig. 7, in which the electro-magnet, or magneto method, was employed. This was the apparatus which he himself used without entirely satisfactory results, but which Prof. Cross, Mr. Watson, Dr. Blake, Prof. Pope, and others testify has done, and will do, what was claimed for it, and transmit speech successfully, but not so well indeed as another constructed upon the principle of the microphone or the variable resistance method.

An effort was made in argument to confine the patent to the magneto instrument, and such modes of creating electrical undulations as could be produced by that form of apparatus, the position being that such an apparatus necessarily implied "a closed circuit incapable of being opened, and a continuous current incapable of being intermittent." But this argument ignores the fact that the claim is, first, for the process, and, second, for the apparatus. It is to be read, 1, as a claim for "the method of transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth;" and, 2, as for "the apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, . . . substantially as set forth." The method, "as herein described," is to cause gradual changes in the intensity of the electric current used as the medium of transmission, which shall be exactly analogous to the changes in the density of the air, occasioned by the peculiarities in the shapes of the undulations produced in speech, in the manner "substantially as set forth;" that is to say, "by the vibration or motion of bodies capable of inductive action, or by the vibration of the conducting wire itself in the neighborhood of such bodies," which is the magneto method; or "by alternately increasing and diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery," which is the variable resistance method. This is the process which has been patented, and it may be operated in either of the ways set forth. The current must be kept closed to be used successfully, but this does not necessarily imply that it must be so produced or so operated upon, as to be incapable of being opened. If opened it will fail to act for the time being, and the process will be interrupted; but there is nothing in the patent which requires it to be operated by instruments which are incapable of making the break.

The apparatus, "as herein described," which is included in the claim, is undoubtedly one in which an electro-magnet is employed, and constructed "substantially as set forth" in the specification. One acting on the variable resistance mode is not described, further than to say that the vibration of the conducting wire in mercury or other liquid included in the circuit occasions undulations in the current, and no other special directions are given as to the manner in which it must be constructed. The patent is both for the magneto and variable resistance *methods*, and for the particular magneto *apparatus* which is described, or its equivalent. There is no patent for any variable resistance apparatus. It is undoubtedly true that when Bell got his patent he thought the magneto method was the best. Indeed, he said, in express terms, he preferred it, but that does not exclude the use of the other if it turns out to be the most desirable way of using the process under any circumstances. Both forms of apparatus operate on a closed circuit by gradual changes of intensity, and not by alternately making and breaking the circuit, or by sudden and instantaneous changes, and they each require to be so adjusted as to prevent interruptions. If they break it is a fault, and the process stops until the connection is restored.

It is again said, that the claim, if given this broad construction, is virtually "a claim for speech transmission by transmitting it; or, in other words, for all such doing of a thing as is provable by doing it." It is true that Bell transmits speech by transmitting it, and that long before he did so it was believed by scientists that it could be done by means of electricity, if the requisite electrical effect could be produced. Precisely how that subtle force operates under Bell's treatment, or what form it takes, no one can tell. All we know is that he found out that, by changing the intensity of a continuous current so as to make it correspond exactly with the changes in the density of air caused by sonorous vibrations, vocal and other sounds could be transmitted and heard at a distance. This was the thing to be done, and Bell discovered the way of doing it. He uses electricity as a medium for that purpose, just as air is used within speaking distance. In effect he prolongs the air vibrations by the use of electricity. No one before him had found out how to use electricity with the same effect. To use it with success it must be put in a certain condition. What that condition was he was the first to discover, and with his discovery he astonished the scientific world. Prof. Henry, one of the most eminent scientists of the present century, spoke of it as "the greatest marvel hitherto achieved by the telegraph." The thing done by Bell was "transmitting audible speech through long telegraphic lines," and Sir William Thomson, on returning to his home in England, in August or September, 1876, after seeing at the Centennial Exposition, in Philadelphia, what Bell had done and could do by his process, spoke in this way of it to his countrymen: "Who can but admire the hardihood of invention which devised such very slight means to realize the mathematical conception that, if electricity is to convey all the delicacies of quality which distinguish articulate speech, the strength of its current must vary continuously, as nearly as may be, in simple proportion to the velocity of a particle of air engaged in constituting the sounds." Surely a patent for such a discovery is not to be confined to the mere means he improvised to prove the reality of his conception.

We come now to consider the alleged anticipation of Philipp Reis. And here it is to be always kept in mind that the question is, not whether the apparatus devised by Reis to give effect to his theory can be made, with our present knowledge, to transmit speech, but whether Reis had in his time found out the way of using it successfully for that purpose; not as to the character of the apparatus, but as to the mode of treating the current of electricity on which the apparatus is to act, so as to make that current a medium for receiving the vibrations of air created by the human voice in articulate speech at one place, and in effect delivering them at the ear of a listener in another place. Bell's patent is not alone for the particular apparatus he describes, but for the process that apparatus was designed to bring into use. His patent would be quite as good if he had actually used Reis's apparatus in developing the process for which it was granted.

That Reis knew what had to be done in order to transmit speech by electricity is very apparent, for in his first paper he said: "As soon as it is possible to produce, any where and in any manner, vibrations whose curves shall be the same as those of any given tone or combination of tones, we shall receive the same impression as that tone or combination of tones would have produced on us." Bourseul also knew it before Reis, for, in a communication published in a Paris journal in 1854, he said: "Reproduce precisely these vibrations," to wit, the vibrations made by the human voice in uttering syllables, "and you will reproduce precisely these syllables."

Reis discovered how to reproduce musical tones; but he did no more. He could sing through his apparatus, but he could not talk. From the beginning to the end he has conceded this. In his first paper he said: "Hitherto it has not been possible to reproduce the tones of human speech with a distinctness sufficient for every one. The consonants are for the most part reproduced pretty distinctly, but the vowels as yet not in an equal degree. The cause of this I will attempt to explain. According to the experiments of Willis, Helmholtz, and others, vowel tones can be produced artificially, if the vibrations of one body are from time to time augmented by those of another, something as follows: An elastic spring is set in vibration by the blow of a tooth on a toothed wheel; the first vibration is the greatest, and each subsequent one is smaller than the preceding. If, after a few vibrations of this kind, (the spring not coming to a rest in the mean time,) the tooth wheel imparts a new stroke, the following vibration will be again a maximum, and so on. The pitch of the tone produced in this way depends upon the number of vibrations in a given time, but the character of the tone upon the number of swellings in the same time. . . . Our organs of speech probably produce the vowels in the same manner, through the combined action of the upper and lower vocal chords, or of these latter and the cavity of the mouth. My apparatus reproduces the number of vibrations, but with an intensity much less than that of the original ones; though, as I have reason to believe, to a certain degree proportional among themselves. But in the case of these generally small variations, the difference between large and small vibrations is more difficult to perceive than in the case of the original waves, and the vowel is therefore more or less indistinct." And again: "I have succeeded in constructing an apparatus with which I am enabled to reproduce the tones of various instruments, and even to a certain extent the human voice."

No one of the many writers whose papers are found in the records claim more than this for Reis or his discoveries. Although his first paper was published in 1861, and Bell did not appear as a worker in the same field of scientific research until nearly fifteen years afterwards, no advance had been made, by the use of what he had contrived or of his method, towards the great end to be accomplished. He caused his instruments to be put on the market for sale, and both he and those whom he employed for that purpose took occasion to call attention to them by prospectus, catalogue, and otherwise, and to describe what they were and what they would do. In his own prospectus, which was published in 1865 and attached to the apparatus, he says: "Every apparatus consists . . . of two parts, the telephone proper and the receiver. . . . These two parts are placed at such a distance from each other that singing or toning of a musical instrument can be heard in no other way from one station to the other except through the apparatus." And, "Besides the human voice there can be reproduced (according to my experience) just as well the tones of good organ-pipes from F — c, and those of the piano." Albert, the mechanician employed to make the instruments in his catalogue published in 1866, enumerates among the things he has for sale "Telephone of Reis for reproduction of tones by electricity." In a work on electricity by Robert M. Ferguson, published by William and Robert Chambers, London and Edinburgh, in 1867, it is said, in speaking of the telephone: "This is an instrument for telegraphing notes of the same pitch. Any noise producing a single vibration of the air, when repeated regularly a certain number of times in the second (not less than thirty-two), produces, as is well known, a musical sound. . . . A person when singing any note causes the air to vibrate so many times per second, the number varying with the pitch of the note he sings, the higher the note the greater being the number of vibrations. If we then by any means can get these vibrations to break a closed circuit, . . . the note sung at one station can be reproduced, at least so far as pitch is concerned, at another. Reis's telephone (invented 1861) accomplishes this in the following way," which is then described.

But it is needless to quote further from the evidence on this branch of the case. It is not contended that Reis had ever succeeded in actually transmitting speech, but only that his instrument was capable of it if he had known how. He did not know how, and all his experiments in that direction were failures. With the help of Bell's later discoveries in 1875 we now know why he failed.

As early as 1854 Bourseul, in his communication which has already been referred to, had said, substantially, that if the vibrations of air produced by the human voice in articulate speech could be reproduced by means of electricity at a distance, the speech itself would be reproduced and heard there. As a means of stimulating inquiry to that end he called attention to the principle on which the electric telegraph was based and suggested an application of that principle to such a purpose. He said: "The electric telegraph is based on the following principle: An electric current, passing through a metallic wire, circulates through a coil around a piece of soft iron, which it converts into a magnet. The moment the current stops, the piece of iron ceases to be a magnet. This magnet, which takes the name of electro-magnet, can thus in turn attract and then release a movable plate, which, by its to-and-fro movement, produces the conventional signals employed in telegraphy." Then, after referring to the mode in which speech is transmitted by the vibrations of the air, he said: "Suppose that a man speaks near a movable disk, sufficiently flexible to lose none of the vibrations of the voice; that this disk alternately makes and breaks the connection with a battery; you may have at a distance another disk which will simultaneously execute the same vibrations."

That Reis was working all the time, from the beginning to the end of his experiments, upon the principle of the telegraph as thus suggested by Bourseul, is abundantly proven. Thus, in his first paper, after describing his cubical block apparatus, he says: "If now tones or combinations of tones are produced in the neighborhood of the block, so that sufficiently powerful waves enter the opening *a*, then these sounds cause the membrane *b* to vibrate. At the first condensation the hammer-like wire *d* is pushed back; at the rarefaction it cannot follow the retreating membrane, and the current traversing the strips remains broken, until the membrane forced by a new condensation again presses the strip . . . against *d*. In this way each sound wave causes a breaking and closing of the current. At each closing of the circuit the atoms of the iron wire inside the distant spiral are moved away from each other; on breaking the circuit these atoms seek to regain their position of equilibrium. When this happens, in consequence of the reciprocal actions of elasticity and inertia, a number of vibrations are produced, and they give the longitudinal sound of the rod. This is the case if the making and breaking of the current occur with comparative slowness. If they occur more rapidly than the oscillations of the iron core, due to its elasticity, the atoms cannot complete their course. The paths described become shorter in proportion as the interruptions are more frequent, but then are just as numerous as these. The iron wire no longer gives its longitudinal normal tone, but a tone whose pitch corresponds to the number of interruptions in a given time; this is the same as saying that the rod reproduces the tone impressed upon the interrupter."

Such was the beginning, and it was maintained persistently to the end as well by Reis as by those who availed themselves of what he was doing. To this the Reis-Legat apparatus forms no exception, for in the paper describing it Legat says: "The operation of the apparatus described is as follows: When at rest the galvanic circuit is closed. When the air which is in the tube *a b* of the apparatus is alternately condensed and rarefied by speaking into it, (or by singing or introducing the tones of an instrument,) a movement of the membrane closing the smaller opening of the tube is produced, corresponding to such condensation or rarefaction. The lever *c d* follows the movements of the membrane, and opens and closes the galvanic circuit at *d g*, so that at each condensation of the air in the tube the circuit is opened, and at each rarefaction the circuit is closed. In consequence of this operation the electro-magnet of the apparatus, in accordance with the condensations and rarefactions of the column of air in the tube . . . is correspondingly demagnetized and magnetized, and the armature of the magnet is set into vibrations like those of the membrane in the transmitting apparatus." We have not had our attention called to a single item of evidence which tends in any way to show that Reis or any one who wrote about him had it in his mind that anything else than the intermittent current caused by the opening and closing of the circuit could be used to do what was wanted. No one seems to have thought that there could be another way. All recognized the fact that the "minor differences in the original vibrations" had not been satisfactorily reproduced, but they attributed it to the imperfect mechanism of the apparatus used, rather than to any fault in the principle on which the operation was made to depend.

It was left for Bell to discover that the failure was due not to workmanship but to the principle which was adopted as the basis of what had to be done. He found that what he called the intermittent current—one caused by alternately opening and closing the circuit—could not be made under any circumstances to reproduce the delicate forms of the air vibrations caused by the human voice in articulate speech, but that the true way was to operate on an unbroken current by increasing and diminishing its intensity. This he called a vibratory or undulatory current, not because the current was supposed to actually take that form, but because it expressed with sufficient accuracy his idea of a current which was subjected to gradual changes of intensity exactly analogous to the changes of density in the air occasioned by its vibrations. Such was his discovery, and it was new. Reis never thought of it, and he failed to transmit speech telegraphically. Bell did, and he succeeded. Under such circumstances it is impossible to hold that what Reis did was an anticipation of the discovery of Bell. To follow Reis is to fail, but to follow Bell is to succeed. The difference between the two is just the difference between failure and success. If Reis had kept on he might have found out the way to succeed, but he stopped and failed. Bell took up his work and carried it on to a successful result.

As to what is shown to have been written and done by Dr. Van der Weyde, it is only necessary to say that he copied Reis, and it was not until after Bell's success that he found out how to use a Reis instrument so as to make it transmit speech. Bell taught him what to do to accomplish that purpose.

So as to James W. McDonough. We presume that it will not be claimed that he is entitled to more than he asked for in his application for a patent, filed April 10, 1876, and there a "circuit breaker," so adjusted as to "break the connection by the vibrations of the membrane," is made one of the elements of his invention. The Patent Office was clearly right in holding that he had been anticipated by Reis.

The patents of Cromwell Fleetwood Varley, of London, England, granted on June 2, 1868, and the other October 8, 1870, were for "improvements in electric telegraphs." The objects of the invention covered by the first were "to cut off the disturbance arising from earth currents, to obtain a high speed of signalling through long circuits, and, should the conductor become partially exposed, to preserve it from being eaten away by electrolytic action;" and the object of the second was the "increase of the transmitting power of telegraph circuits, by enabling more than one operator to signal independent messages at the same time, upon one and the same wire, to and from independent stations." While this patentee in his specification says, "by my invention I superpose upon the currents used for working the ordinary telegraphs rapid undulations or waves, which do not practically alter the mechanical or chemical power of the ordinary signal currents," and that "these undulations are made to produce distinct and independent audible or other signals so long as these undulations are produced, whether ordinary signal currents be flowing or not," it is apparent that he uses the terms "undulations" and "waves" in an entirely different sense from Bell, for his patent implies operation on the principle of the electric telegraph; that is to say, by making and breaking the circuit. A Morse key, or something equivalent, is to be used; and besides, in the descriptive portion of the patent, it is said: "When the current is flowing through the coils of the electromagnet the horns of the fork *k* are drawn apart and the spring *l'* loses its contact; then, as the attraction of the magnet ceases, the horns of the fork spring back; this remakes the contact, and so a continual tremor is communicated to the tuning fork." In short, there is nothing in any part of the specification to indicate that the patentee had in his mind "undulations" resulting "from gradual changes of intensity exactly analogous to the changes in the density of air occasioned by simple pendulous vibrations," which was Bell's discovery, and on which his art rests. Varley's purpose was to superpose, that is to say, place upon the ordinary signal current another, which, by the action of the make and break principle of the telegraph, would do the work he wanted.

Another alleged anticipation is that of Daniel Drawbaugh.

Bell got his patent March 7, 1876, and the fortunate accident which led to his discovery occurred June 2, 1875. Active litigation to enforce his patented rights was begun by his Company on the 12th of September, 1878, with a suit in the Circuit Court of the United States for the District of Massachusetts, against Richard A. Dowd. This suit was defended by the Western Union Telegraph Company, and vigorously contested. The answer was filed November 4, 1878, setting up alleged anticipations by Gray, Edison, Dolbear and others. The record fills twelve hundred printed pages, but before a decision was reached the case was compromised and a decree entered by consent. The litigation ended at some time in the latter part of the year 1879. The last deposition was taken on the 19th of September in that year.

The next contested suit was brought in the same court on the 28th of July, 1880, against Albert Spencer and others. An answer was filed in this case September 6, 1880, and depositions afterwards taken, some of those in the Dowd suit being used in this by stipulation. On the 27th of June, 1881, a decision was announced by Judge Lowell sustaining the patent, upon which a decree was entered.

On the 14th of November, 1879, Abner G. Tisdel filed in the Patent Office an application for a patent for "a new and useful improvement in speaking-telephones," and on the 18th of November, 1879, Frank A. Klemm also filed an application for a patent for "a new and useful improvement in telephone-transmitters." These inventions were transferred by assignment to Ernest Marx and Frank A. Klemm of New York City, Moritz Loth of Cincinnati, and Simon Wolf of Washington. On the 6th of March, 1880, these parties entered into a mutual agreement to the effect that "each and all of their interests in said improvements and inventions, and the letters-patent to be issued therefor, shall be merged and consolidated as common stock in a corporate body, under the laws of either of the States of Ohio, New York, or the general laws of the United States, relating to the formation of incorporations in the District of Columbia, or of such other States or Territories as may be found necessary hereafter." This agreement was recorded in the Patent Office March 10, 1880.

On the 6th of May, 1880, Edgar W. Chellis, a merchant of Harrisburg, Pennsylvania, M. W. Jacobs, a lawyer at the same place, and Lysander Hill, a lawyer then residing in Washington, in the District of Columbia, made an arrangement with Daniel Drawbaugh by which they were to become jointly interested with him in his alleged telephone inventions, each to have a quarter interest. Nothing was paid for this, but each of the parties was to have one-fourth of anything that should be realized from the enterprise. On the 24th of May, 1880, Simon Wolf, one of the parties interested in the

Klemm and Tisdel inventions, visited Harrisburg on business with Chellis in reference to telephone matters. On the 18th of May, four days before this visit, a patent was issued to Wolf and his associates upon the invention of Tisdel. While Wolf was in Harrisburg negotiations were begun with Chellis for a transfer of the Drawbaugh inventions to the owners of those of Klemm and Tisdel. These negotiations resulted in a conditional contract of the 22d of June, by reason of which Chellis, Jacobs, Hill, and Drawbaugh went to Washington, and there on the 21st of July, 1880, Drawbaugh, claiming to "have invented certain new and useful improvements in the transmission of vocal speech, and the apparatus to be used for such purpose, for which I am about to make application for letters-patent of the United States," assigned to Klemm, Marx, Wolf, and Loth "the full and exclusive right to the said invention as fully set forth and described in the specification prepared and executed by me, dated the 21st day of July, 1880, preparatory to obtaining letters-patent of the United States therefor," and he, at the same time, and by the same instrument, authorized and requested the Commissioner of Patents to issue the patent to his assignees, "each as assignee of one-fourth part." The specification referred to in the assignment has not been put in evidence in any of the cases. In the course of taking the testimony it was called for by the Bell Company, but the counsel for the opposite party refused to produce either the original or a copy from the Patent Office. The assignment was recorded in the Patent Office July 22, 1880, and in the official digest of assignments the following notation appears: "About to make appl'n. Spe'n dated July 21, 1880."

On the morning of July 22, 1880, the following appeared in the *Cincinnati Commercial*, a newspaper printed at Cincinnati, Ohio:

"TELEPHONE COMBINATION.

"*Special to Cincinnati Commercial.*

"WASHINGTON, D. C., *July 21.* — An application for a patent was filed to-day that, in consequence of its vastness of interest, as well as wealth of prospect, renders it a subject of national interest. A company of leading business men has been formed, that has bought up all the telephone patents antedating those now in use, and known as the Bell, Gray, and Edison patents. The company is composed of leading business men from all parts of the country, Cincinnati being largely represented and interested. The cash capital of the company is $5,000,000, with headquarters in New York, and in about sixty days they will open up the telephone, which will certainly result in the driving out of all telephones in the market, save the ones they hold, or else the compelling the Gray, Bell, and Edison lines to pay the new company a munificent royalty. It appears from the testimony now on file and in the possession of the new company, which is conclusive and exhaustive, that the inventor of the telephone is a poor mechanic, living near Harrisburg, Pa., named Daniel Drawbaugh. Owing to his poverty, he was unable to push his patent on the market. The new company have secured and are sole possessors of this invention, antedating those now in use. They are also owners of four patents for telephones issued to Mr. Klemm, of New York. A large number of capitalists were here to-day to see the filing of the application, and they assert, with a positiveness that is almost convincing, that it will not be long till they have entire charge of the telephones, not only in this country but in the world, and that they will be able to establish lines by which messages can be transmitted for almost a song.

"Mr. Lipman Levy, of the law firm of Moulton, Johnson & Levy, of Cincinnati, was here to-day, in the interest of the Cincinnati parties, who, as already stated, are among the most prominent financial men of our city."

Afterwards, on the 23d of August, 1880, the following appeared in the *Journal of Commerce*, a newspaper printed in the city of New York:

"A New Telephone Company. — A company has recently been formed in this city with a capital of $5,000,000, for the purpose of manufacturing telephones. The company is to be known as The People's Telephone Company, and a number of leading capitalists in this city and Cincinnati are interested in it. The telephones are to be manufactured under the patents of Frank A. Klemm and Abner G. Tisdel, and the application for patents of Daniel Drawbaugh, of Eberly's Mills, Cumberland County, Pa., filed July 21, 1880. It is claimed by those interested in the new enterprise that Drawbaugh is really the inventor of the telephone, and had completed one years before Professor Bell or any one else had manufactured one. He was, however, in very humble circumstances, and his neighbors who knew of his experiments looked upon him as a harmless lunatic. He continued improving his original telephone, and it is claimed that the one which the new company proposes to furnish is superior to any now in use. The company has fitted up a factory in Brooklyn, and in three months will be prepared to supply 1000 of the new telephones. As soon as operations are actively commenced, it is expected that legal proceedings will be begun against the new company by the Gold and Stock Telegraph Company, which holds most of the existing patents, and a long and interesting legal fight is anticipated."

On the 30th of August, 1880, the People's Telephone Company was incorporated under the general laws of New York, with an authorized capital stock of $5,000,000, for "manufacturing, constructing, owning, furnishing, letting and selling telephones, and the apparatus used therewith, under the inventions and patents of Abner G. Tisdel, Frank A. Klemm, Daniel Drawbaugh, and other inventions and patents which may hereafter be assigned to said company," and on the 4th of September, 1880, Klemm, Loth, Marx, and Wolf, in consideration of $4,999,550, represented by 99,991 shares of stock, assigned and transferred to that company all their interest in the Klemm, Tisdel, and Drawbaugh inventions, those of Drawbaugh being described as "the inventions in telephones made by Daniel Drawbaugh of Eberly's Mills, Cumberland County, in the State of Pennsylvania, for which application for patents was made on or about the 21st day of July, 1880, and which was assigned to us on the [twenty-] first day of July, 1880, as more particularly appears in a deed of assignment recorded in the United States Patent Office in Liber W. 25, page 85, in the Book of Transfers of Patents."

For the assignment from Drawbaugh to Klemm, Marx, Loth, and Wolf $20,000 was paid in money to Chellis, Jacobs, Hill, and Drawbaugh, and they were also to have a certain amount of the stock of the proposed corporation when formed. What amount they actually got Chellis, who was sworn as a witness in the case, declined to tell, but he admitted it was large.

At this time, and in this way, the attention of the general public was called for the first time to the fact that Drawbaugh claimed to have anticipated Bell in the discovery of the telephone. Bell's success had been proclaimed more than four years before at the Centennial Exposition in Philadelphia. In the meantime inventions in aid of his discovery had been multiplied. According to the testimony of Park Benjamin, more than one hundred patents had been issued and indexed under the word "telephone." Numerous interferences had been declared and considered at the Patent Office. Gray, Edison, Dolbear, and others had either claimed for themselves, or others had claimed for them, priority of invention and discovery, and Bell had thus far been sustained as against them all. Blake had perfected his microphone apparatus, and Bell's patent had become a great commercial success.

The People's Company either began or threatened to begin operations under its charter, and on the 20th of October, 1880, the Bell Company brought suit against it in the Circuit Court of the United States for the Southern District of New York, to prevent any infringement of the Bell patents. In the bill it was alleged "that telephone exchanges now exist in more than two hundred and seventy-five towns and cities of the United States, and in every State thereof, and exist in substantially every city in the United States having more than 15,000 inhabitants, and in many smaller places;" "that there are now in use more than 100,000 electric speaking-telephones licensed by and paying royalty to" the Bell Company; "that the owners of said Bell patents, and those who now are or heretofore have been licensed by them, have devoted great time and attention and large sums of money to the development of the telephone and the introduction thereof into extensive use, and to the proper construction of the most suitable telephone lines and systems and telephonic appliances, and have constructed many thousand miles of telephone lines for use with telephones owned by" the Bell Company, "and licensed by it for such use, and that nothing which the defendants, or F. A. Klemm, A. G. Tisdel, and D. Drawbaugh . . . have done has contributed in any substantial way to the development of the telephone or the introduction thereof into use." The bill then avers that Klemm, Marx, Loth, and Wolf, having become the owners of the Klemm and Tisdel improvements, and having heard that Drawbaugh "claimed that he had made some experiments relating to electric speaking-telephones, (which experiments, if made, were incomplete, imperfect, unfruitful, and long before abandoned,) entered into an arrangement with him to set up and claim that he was the first inventor of the speaking-telephone, and to make application for a patent therefor; and thereafter, alleging and pretending that said Drawbaugh was the original and first inventor of the electric speaking-telephone, and that electric speaking-telephones had not before such application been in public use or on sale for more than two years, with the knowledge and consent of Drawbaugh, they did, on or about the 21st day of July, 1880, induce him to make and cause to be filed in the Patent Office of the United States an application for a patent to issue to them as assignees of the said Drawbaugh, as the first and original inventor of the electric speaking-telephone, the said defendants well knowing at the time that electric speaking-telephones had been in public use by" the Bell Company and its licensees "for more than two years before said application." It was then further alleged that if Drawbaugh had ever made his pretended inventions they "have not been by him, or any one claiming under him, introduced into public use, and that knowledge thereof has been withheld from your orators and the public, except so far as they have been disclosed within the three months last past by certain newspaper publications."

To this bill the People's Company filed an answer in December, 1880, or January, 1881. The record does not show the precise date. In this answer it was said that Drawbaugh was "the original and first inventor and discoverer of the art of communicating articulate speech between distant places by voltaic and magneto electricity," and that "long prior to the alleged inventions by" Bell, Gray, and Edison he, "then and now residing at Eberly's Mills, constructed and operated practical working electric speaking-telephones at said Eberly's Mills, and exhibited their successful operation to a great number of other persons resident in his vicinity and elsewhere;" that his telephones, as then constructed and operated, "contained all the material and substantial parts and inventions patented" in the patents of Bell, and "also other important and valuable inventions in electric and magneto telephony, and were fully capable of transmitting, and were actually used for transmitting, articulate vocal sounds and speech between distant points by means of electric currents; that some of the original machines and instruments, invented, made, used and exhibited to many others long prior to the said alleged inventions of Bell, or either of them, are still in existence, and capable of successful practical use, and are identified by a large number of persons who personally tested and used them, and knew of their practical operation and use, in the years 1870, 1871, 1872, 1873, 1874, and both prior and subsequently thereto; that certainly more than fifty, and probably not less than one hundred, persons, or even more, were cognizant of said Drawbaugh's invention and use of said telephones, and of his claim to be the original and first inventor thereof prior to the alleged inventions of said Bell, or either of them; that said Drawbaugh, for more than ten years prior to the year 1880, was miserably poor, in debt, with a large and helpless family dependent on his daily labor, and was from such cause alone utterly unable to patent his invention, or caveat it, or manufacture and introduce it on the market; that said Drawbaugh never abandoned his said invention, nor acknowledged the claims of any other person or persons thereto, but always persisted in his claims to it, and intended to patent it as soon as he could procure the necessary means therefor; that said Drawbaugh never acquiesced in the public use of said Bell, Gray, Edison, Blake or other telephones, nor in the claims of the alleged inventors thereof, nor gave his consent to such use." It is then said that Drawbaugh, after finding by experiment that his invention was capable of successful working, "conceived that its range and capacity for usefulness to the public might be very greatly enlarged; that many improvements of great value might be made and added to it, which, without departing from its principle, might increase its value to himself and to the public, and therefore set himself at work to discover and invent such improvements; that he discovered and invented some of said additional improvements prior to any alleged invention by Bell; and that notwithstanding his embarrassed and impoverished pecuniary condition, and his utter want of proper mechanical tools, materials, and appliances to conduct such work, he labored with all reasonable diligence to perfect and adapt his said improvements, and did finally, in due exercise of such reasonable diligence, perfect and adapt the same; and that in so far as the said Bell has incorporated such improvements in his said two patents, or either of them, he, the said Bell, has surreptitiously and unjustly obtained a patent or patents for that which was in fact first invented by Drawbaugh, who was using reasonable diligence in perfecting and adapting the same, and, therefore, the patent or patents of the said Bell therefor is or are invalid and void." It is then said that "the defendant in good faith, and relying upon its legal rights, . . . caused applications to be made and filed in the Patent Office for letters patent on the inventions of the said Daniel Drawbaugh, with the intention of procuring interference proceedings to be instituted, in accordance with the statute, against the patents of said Bell, and the pending applications of said Gray, Edison, and others, in order that said Drawbaugh may be adjudged by the Commissioner of Patents to be, as he rightfully is, the original and first inventor of the electric speaking-telephone, and may be adjudged entitled to receive a patent or patents therefor."

The People's Company began taking depositions on the 19th of April, 1881, but Drawbaugh himself did not appear as a witness until December 7, 1881. After that time others were examined, and when the proofs were closed between three and four hundred witnesses had been produced whose testimony was taken and put into the record to establish the priority of Drawbaugh's invention. This testimony, as is now claimed, shows the story of that invention to have been as follows:

"Early conception and experiments with the continuous current, 1862, 1866, and 1867.

"Tea-cup transmitter and receiver, 1866 and 1867.

"Tumbler and tin-cup and mustard can, ('F' and 'B,') 1867 and 1869.

"Improvement on 'B,' ('C,') 1869, 1870.

"Further improvement upon 'C,' and the more perfect magneto instrument 'I,' 1870, 1871.

"Mouthpiece changed to centre and adjusting screw inserted, (Exhibit 'A,') 1874.

"'D' and 'E,' perfectly adjusted and finished magneto instruments, January and February, 1875.

"'L,' 'M,' 'G,' and 'O,' from February, 1875, to August, 1876.

"'H,' August, 1876.

"'J,' 'N,' and 'P,' 1878."

This statement of the Drawbaugh claim we have quoted from the brief of counsel appearing in his behalf, and his success in the litigation has been placed, as we understand it, both in the answer and in the argument, on the truth or falsehood of what is thus set forth.

The letters "F," "B," etc., in the statement refer to exhibits in the cause, being certain instruments claimed to have been made and used by Drawbaugh in the progress of his work and preserved until now. The original tea-cup instrument was not produced, but Drawbaugh in his deposition gave what he said was a drawing, showing how it had been constructed. "F," "B," "C," "I," and "A" were neither of them in a condition for use when they were put in evidence, and no one of all the witnesses except Drawbaugh could tell how they were originally constructed, or what the process was by which sound was transmitted when they were used. All any of the witnesses could say on that subject was that they had used one or more of the different instruments at Drawbaugh's shop, had heard sounds and sometimes spoken words through them, and that Drawbaugh told them the sound was carried on the wire by electricity. There was nothing whatever produced in print or in writing on the subject; not even a memorandum or a drawing of any kind. And there is nothing in the testimony to show that Drawbaugh ever told any one how his earlier instruments were made, or what his process was, until he was called as a witness in December, 1881, and explained it in his testimony. This was nearly twenty years, according to the present claim, after he had begun his experiments, nearly seven after he had made and used "D" and "E," "perfectly adjusted and finished magneto instruments," and more than five after "L," "M," "G," "O," and "H" had been constructed and kept in his shop. It was also nearly six years after the date of Bell's patent, more than five years after the success of his discovery had been proclaimed at the Centennial Exposition in Philadelphia, four after his process had got into public use, three after it had become an established success, and two after he had brought his first suit for the establishment of his rights against Dowd, who represented the Western Union Telegraph Company, to a successful termination.

Under these circumstances it becomes important to consider the conduct of Drawbaugh in reference to his alleged invention during this twenty years of eventful history as connected with the discovery and use of telephones. If his present claim is true his experiments began almost as far back as those of Reis, and he had in his shop at Eberly's Mills, within three miles of Harrisburg, telephones that were substantially perfect months before Bell, on the 2d of June, 1875, got the clue to his subsequent discoveries. It is conceded that "D" and "E," made, as is claimed, in February, 1875, are substantially as good magneto instruments as any Bell had used before December, 1881, and "L," "M," "G," "O," and "H," all of which it is claimed were constructed by August, 1876, and some in February, 1875, are as good or nearly as good microphones as those of Blake, which were not invented until 1878. This is the theory of Drawbaugh's defence as it is set forth in the answer and in the argument, and by it his case must stand or fall. The claim is that the discovery of the process was complete, and that perfect telephones had been made and were in a condition for use a year and more before Bell got his patent.

Drawbaugh was, when he gave his deposition, fifty-four years of age, and had lived all his life at or near Eberly Mills, a small village near Harrisburg. He was a skilful and ingenious mechanic, and if he made "D" and "E," and the instruments which came after them, at the time it is said he did, he had good tools and good materials in 1875 and 1876, and was capable of doing the best of work. He was also somewhat of an inventor, and had some knowledge of electricity. According to the testimony he was an enthusiast on the subject of his "talking machine," and showed it freely to his neighbors and people from the country when they visited his shop.

The Centennial Exposition was opened at Philadelphia in May, 1876, and Drawbaugh visited it on the 17th of October, 1876, remaining four or five days. Before he went he had heard, as he says, that some one besides himself had invented a speaking telephone, which he had the impression was on exhibition there. If what he now claims is true, he had then on hand in his shop Exhibits "D," "E," "L," "M," "G," "O," and "H," all of them good instruments of their kind, and capable of transmitting speech, and some of them but just finished. Bell's apparatus had been exhibited to the Board of Judges in June before, and had attracted marked attention. The matter was much discussed in the public press, and yet it never seems to have occurred to Drawbaugh to take any of his telephones with him when he went, although they were small in size, and some, or all of them, could have been carried without serious inconvenience.

When giving his testimony he was examined in chief as to that visit, and this is what he said on the subject of telephones:

"Q. 386. Did you attend the Centennial Exhibition, at Philadelphia, in the year 1876? A. Yes, sir; I did.

"Q. 387. Can you give the date on which you went there? A. I can by reference to a book. It was October 17, 1876. The 17th was a day on which I dated a letter from Philadelphia, while I was there on that visit.

"Q. 388. How long did your visit there last? A. About four or five days, to the best of my recollection.

"Q. 389. Who went with you on that visit? A. Mr. George Leonard.

"Q. 390. Was that the only visit to the Centennial Exhibition that you made? A. Yes, sir; it was.

"Q. 391. At the time that you went there, or before that time, had you heard that somebody else besides yourself had invented a speaking telephone — or a telephone? A. Yes, sir; some time before that, I don't remember how long, but not a great while.

"Q. 392. When you went there, did you suppose it would be on exhibition there? A. I don't remember whether I had heard that it was on exhibition or not; but I got the impression some way that it was on exhibition.

"Q. 393. While you were there at the Centennial, did you see any telephones, or make an effort to see any there? A. Yes, sir; I made an effort and seen an instrument called a telephone, and supposed it to be the instrument spoken of — the one of which I had heard. I was looking and had made some inquiry, and was directed or came to a portion of the building where I saw on a counter some man's telephone, the name I don't remember. At that time, or several times that I called, there was no one there to attend to it. I spoke to another party that had something else on exhibition — I don't recollect what it was — just near by, and I asked him whether there was any one there to attend, or to show the instruments. I was informed then, there was no one there to show them.

"Q. 394. If you remember, please state what kind of an instrument it was that you saw there, and state what information you were able to obtain there regarding it and its mode of operation. A. There was a number of instruments placed on to a raised portion — something like a shelf. That is, it resembled something like pigeon-holes, a box open in front, and each instrument at the back of it had an electro-magnet. The number of instruments I don't remember. I don't remember of counting them. If I am not mistaken, there may have been a dozen or more, perhaps; some were larger than others. I could not give you a much better description than that. I couldn't get any information about them. This attendant made some remarks about the instruments, but he didn't understand them, and couldn't explain them. I was several feet from where the instruments were. They were placed — it occurs to me — on a raised place like a shelf, just about high enough for a man to speak into; that is the way it looked to me. I did not go in behind the counter to examine them, although there was an opening to go in by, because I did not like to make too free, as there was no one there.

"Q. 395. Did you see any circulars lying around there referring to these instruments, or other advertisements of them? A. I don't remember about that; it may have been.

"Q. 396. What was your impression as to the character of the instruments, when you finally left them? A. I was impressed with the idea that they were instruments to telegraph by sounds. A certain sound to represent a certain letter of the alphabet. I am not certain how I got the idea, or whether any person told me that at the time, but that is the idea that I had. When I said certain sounds, I meant that sounds of a different pitch would represent different letters.

"Q. 397. Do you know whether that was 'Gray's Harmonic Telegraph' that you saw there or not? A. It didn't say 'telegraph;' I am confident it was called 'telephone.' I didn't see the working parts of the interior, except the electro-magnets. I took the name of the man and his address on a piece of paper, and put it in my pocket, but I don't know what became of it. I don't know whether it was 'Gray's Harmonic Telegraph,' or not.

"Q. 398. Did you see any tuning forks about it? A. I did not."

That was all he did during his entire visit to ascertain whether any one besides himself had actually entered upon this then new and interesting field of invention and discovery. He spoke to no one about what he had done himself, and he made no special effort to find out whether that which was on exhibition was in any respect like what he had at home. Neither did he when he got home, so far as the records show, say anything to his neighbors or visiting friends about what he had seen or heard. He had apparently lost all interest in "talking machines."

Not so, however, with his other inventions. The testimony shows that during the early part of 1876, he was much occupied in building an electric clock, which he thought of exhibiting at the Centennial. This he did not do, however, but either just before he went to Philadelphia, or soon after, Rufus E. Shapley, a jeweller of Mechanicsburg, went by his invitation, or on his suggestion, to Eberly's Mills to look at the clock which he had made. Soon afterwards the clock was taken to Shapley's store in Mechanicsburg, and on the 8th of November, 1876, Drawbaugh by an instrument in writing transferred to Shapley a half-interest in the "clock I am getting up, the said R. E. Shapley to pay for patenting the same." Shapley had then two thousand dollars in money which Drawbaugh was anxious to have him invest in that business, and the clock was taken by him to his shop so that it might be examined with that end in view if it should prove to be useful. Some time afterwards it was taken back to Eberly's Mills, where it remained until April 1, 1878, or thereabouts, when a clock company was formed, and that clock, or another one substantially like it, was taken about the country for exhibition. For this Drawbaugh was paid five hundred dollars, with an interest in the profits, and on the 20th of September, 1878, he applied for a patent for "improvement in earth batteries for electric clocks," which was issued January 14, 1879, to the members of the clock company. The enterprise does not seem to have been productive of any great success.

In November or December, 1878, while this clock was on exhibition at Harrisburg, Drawbaugh was introduced to Edgar W. Chellis. He had with him at the time a "wooden model of a faucet" that he wanted Chellis and another man to take each a third interest in. An arrangement was afterwards made by which Chellis got a two-thirds interest, he paying for it two hundred and fifty dollars, January 7, 1879. On the 14th of the same month Drawbaugh filed in the Patent Office an application for a patent for an "improvement in rotary measuring faucets," Chellis to have a two-thirds interest. After this application an interference was declared, March 29, 1879, between Drawbaugh and David A. Hauck, who had filed a conflicting application January 17. In his preliminary statement upon this interference Drawbaugh said that he had conceived the idea of his faucets and sketched them late in the fall of 1876; that he made a working model in the spring of 1877, and actually tested it then, but the Patent Office model was not completed until about the 1st of November, 1878. The case was closely contested, but finally decided in favor of Drawbaugh, January 15, 1880. The patent was granted to him and Chellis July 6 of the same year. In this contest Jacobs and Hill, who afterwards became interested in his telephone claims, appeared as the counsel of Drawbaugh.

On the 2d of July, 1879, Drawbaugh filed another application in the Patent Office for "improvement in water motors," Chellis to have in this also a two-thirds interest. Upon this application a patent was issued March 16, 1880.

It is impossible to believe, if Drawbaugh had in his shop, when he reached home from the Centennial, Exhibits "D," "E," "L," "M," "G," "O," and "H," or even "D" and "E" alone, that he would have set himself to work, in the first instance, at developing his clock enterprise, or perfecting his former conception of a measuring faucet, instead of making some effort to call the attention of his friends to his great discovery of the telephone, which he was in danger of losing by the patent which had been issued to another, and which he could not but have known was even then attracting the greatest attention. And in this connection it must be kept in mind that the theory of the defence is, as stated in the answer, that Drawbaugh had at that time fully perfected his invention, and that while at first he "conceived that its range and capacity for usefulness to the public might be very greatly enlarged," he had, before the date of Bell's patent, "notwithstanding his embarrassed and impoverished pecuniary condition, and his utter want of proper mechanical tools," finally perfected his work. His conduct afterwards, therefore, is to be judged, not as that of one who was still in the midst of his experiments, and doubtful of the results, but of one who had arrived at the end and had completed his success.

No man of his intelligence, with or without the enthusiasm upon the subject which it is said he possessed, could have remained silent under such circumstances. As we have read the testimony, it is not even pretended that he took any of his instruments outside of his own village until May, 1878, when, as is claimed, he showed one to his friend Stees, in Harrisburg, whom he had known for years, and who was the first to use, and, in fact, was then using, a Bell telephone, in that place, upon a private line of his own between his office and his shops. This produced no results, and when afterwards, in January, 1879, Chellis was told that Drawbaugh had "a phonograph and a telephone that he had invented," he gave it no attention, because, to use his own language, "I was interested in the faucet and motor business, and wished to push them, and I did not think we could do much with the telephone, as Bell had a patent, and I did not know that he could antedate them." And again, when speaking of a conversation he had with Drawbaugh, he said: "I advised him to drop it — the telephone — as he could not antedate Bell. He said he did not know about that; that he had been working on it a good while. It was his way of expressing himself; when I would say, 'You can't antedate Bell,' he would say, 'I don't know about that; I have been working at it a good while.'" This, it must be remembered, was in 1879, after the telephone had become a success, and after it had been a year or more in use in Harrisburg, where Chellis lived. It is impossible to believe that either Chellis or Drawbaugh was ignorant of the approximate time of Bell's invention, which had been the subject of frequent newspaper comment from the time of its exhibition at the Centennial. The subject was often referred to in the Harrisburg and Mechanicsburg papers, and it is not for a moment to be supposed that all of these various articles escaped their attention. Under such circumstances, if it were true that Drawbaugh had made his "D" and "E," as is now claimed, in February, 1875, he certainly would have said so, and would not have contented himself with so doubting an answer to Chellis's suggestion of his inability to antedate Bell as that which Chellis now says he gave.

Another important fact in this connection is one which is proved by the testimony of Andrew R. Kiefer, who, from 1863, had been division telegraph operator, having charge of the middle division of the Pennsylvania Railroad, and residing in Harrisburg. From 1867 to the winter of 1881–2 he was a member of a partnership firm in that place which was engaged in "the manufacture of burglar alarms, electric hotel annunciators, and fine electric work for the government — instruments for the Signal Bureau, patent models, &c." He had also, since 1876, kept a place for the sale of electrical supplies. He had known Drawbaugh certainly since 1876, and probably before. Drawbaugh met him on different occasions and talked upon electrical matters. In the course of their acquaintance Drawbaugh showed him an electrical fire-alarm apparatus and the works of his electric clock, but the subject of telephones was never alluded to between them until in the summer of 1881, when this occurred. We quote from Kiefer's deposition:

"In the summer of 1881 I took my wife out for a drive, and went over to see his [Drawbaugh's] works, never having seen them, and having promised to come and see him some time; my wife, not caring about going through the shop, remained in the carriage, and I went through alone with Mr. Drawbaugh. He showed me through the shops and introduced me to Mr. Chellis, and showed me parts of the water motor and some other things of his getting up. On account of my wife's being in the carriage alone I did not stay long. As I stepped into, or was just in the carriage, Mr. Drawbaugh said, 'I forgot to show you my telephone.' I did not get out again to go and see it, and I drove away without seeing it, expecting to see it again, but I have never got over to the shop since."

This was after the suit of the Bell Company against the People's Company was begun, and of course after the matter got into the hands of Chellis and his associates. It is no answer to the criticism of Drawbaugh's conduct in this particular to say, as was said in argument, that "one reason why he did not speak or apply to every man with whom he had personal acquaintance, was that he was ridiculed by his neighbors; that his invention was considered a humbug by them, and of no commercial value." Bell's success was proclaimed in the Harrisburg Patriot as early as February 26, 1877, and the days of ridicule were then past. If Drawbaugh had at that time in his shop the machines which it is now claimed were all complete as they now are by August, 1876, and most of them before, there cannot be a doubt that he would have taken them to some place where they could be tried, and show that they would do what he had all along claimed for them. All he had to do, at any time after he came back from the Centennial, was to take any pair of his little instruments to his friend Zeigler or his friend Stees at Harrisburg, attach them to a line wire, and show what he had. They were men who could appreciate his achievement, and help him if it was, as he now says it was, a success. It would certainly have been easier then, within two years of the time the first of them were made, and within a year of the date of Bell's patent, to show that he "antedated" Bell, than it was three years afterwards, when he was brought into the controversy through the instrumentality of his associates, not, as must be evident to all, to get a patent for himself, but to defeat that of Bell. And in this connection it is specially significant that the application which it is claimed was made for a patent on the 21st of July, 1880, and the specification of his invention which was then written out, have been purposely and designedly kept out of the case, although their production was demanded. They were written before this suit was begun, and it is impossible to believe that they would have been withheld, at least upon the call of the opposite party, if they were in all respects consistent with the subsequent developments of the case. The excuse given by counsel at the time, that they were "in the secret archives of the Patent Office," and "if produced and published in this cause would possibly invite the filing of contesting applications, and result in interference and additional litigation, besides unnecessarily prolonging the taking of testimony here and increasing the expenses," we cannot accept as satisfactory, especially as in the answer it was said that one object of filing the application was to procure "interference proceedings to be instituted against the patents of Bell, in order that Drawbaugh may be adjudged by the Commissioner to be, as he rightfully is, the original and first inventor."

We have not overlooked the depositions that have been taken in such large numbers to show that Drawbaugh was successful with "F," "B," "C," "I," and "A," before "D" and "E" were made. They have been studied with care, and if they contained all the testimony in the case it would be more difficult to reach the conclusion that Drawbaugh's claim was not sustained. But in our opinion their effect has been completely overcome by the conduct of Drawbaugh, about which there is no dispute, from the time of his visit to the Centennial until he was put forward by the promoters of the People's Company, nearly four years afterwards, to contest the claims of Bell. He was silent so far as the general public were concerned, when if he had really done what these witnesses now think he did he would most certainly have spoken. There is hardly a single act of his connected with his present claim, from the time he heard, before going to Philadelphia, that some one else had invented a telephone which was on exhibition at the Centennial, that is not entirely inconsistent with the idea even then of a complete discovery or invention by himself which could be put to any practical use. It is not pretended that what he did was done in private. He had influential friends with ample pecuniary resources, ready to help him in bringing out his inventions when they promised success. He easily got aid for his clock and for his faucet. The news of Bell's invention spread rapidly and at once, and it took but a few months to demonstrate to the world that he had achieved a brilliant success. If it were known at Eberly's

Mills alone that Drawbaugh had been doing the same thing for years in his shop there — and it certainly would have been known all through the little village if it had actually been done — no one can believe that the public would be kept in ignorance of it until four years afterwards, when a "special" from Washington "to the Cincinnati Commercial" announced a "Telephone Combination" to have entire charge of the telephones, not only in this country, but in the world," that could transmit messages "for almost a song."

But there is another fact in this case equally striking. As has already been seen, "F," "B," "C," and "I" were in no condition for use when they were produced and put in evidence. They were mere "remains," and no one but Drawbaugh himself could tell how they were made or how they were to be used. He undertook to reproduce some of them, especially "F" and "B." This was in the latter part of 1881, while the testimony was being taken. The Bell Company proposed that they should be tried to see if they would do what the witnesses said had been done with the originals, which the "remains" show must have been exceedingly primitive in their character. The testimony also shows that when they were originally used by or in the presence of the witnesses, no particular care was taken in their adjustment. They were lying around in the shop or standing upon shelves. Some say that when experiments were made they were held in the hand or allowed to stand on the table. Many testify to satisfactory results, and Drawbaugh himself said in his deposition: "I would have persons in the cellar reading printed matter — some advertisement or something — and I could hear the words that were read; and at other times I would go down into the cellar and read something, and coming up they would repeat the words to me that I had read."

The proposition of the Bell Company was accepted, and the reproductions were tried in March, 1882, under the most favorable circumstances. Three days were occupied in the test, and it is substantially conceded that it was a failure. Occasionally a sound was heard and sometimes a word, but "it would not transmit sentences." At the time of these experiments "F," which was the transmitter, was placed on a table, and used as Drawbaugh said it was originally. Two years afterwards other reproductions were presented, differently constructed and used in a different way, and these would "talk," but they were neither made nor used in the same way as the originals. To our minds the result of the second experiments conclusively showed that the original instruments could not have done what the witnesses supposed they did, and that what they saw and heard was produced by some other means than an electric speaking telephone. We do not doubt that Drawbaugh may have conceived the idea that speech could be transmitted to a distance by means of electricity and that he was experimenting upon that subject, but to hold that he had discovered the art of doing it before Bell did would be to construe testimony without regard to "the ordinary laws that govern human conduct." *Atlantic Works* v. *Brady*, 107 U. S. 192, 203. Without pursuing the subject further we decide that the Drawbaugh defence has not been made out.

Another objection to Bell's patent, put forth in the oral argument of Mr. Hill, and in the printed brief signed by him and in that signed by Mr. Dixon, is, that his application as originally filed in the Patent Office did not contain his present fourth claim, or any description of the variable resistance method, and that all which now appears in the specification on that subject, including the fourth claim, was surreptitiously interpolated afterwards.

Bell's application was filed February 14, 1876, and afterwards, during the same day, Elisha Gray filed a caveat, in which he claimed as his invention "the art of transmitting vocal sounds or conversations telegraphically through an electric circuit," and in his specification described the variable resistance method. The precise charge now made in the printed brief of Mr. Hill is, that "Mr. Bell's attorneys had an underground railroad in operation between their office and Examiner Wilbur's room in the Patent Office, by which they were enabled to have unlawful and guilty knowledge of Gray's papers as soon as they were filed in the Patent-Office," and "that an important invention, and a claim therefor, were bodily interpolated into Bell's specification, between February 14, 1876, and February 19, 1876, by Pollok, in consequence of the guilty knowledge which the latter already had of the contents of Gray's caveat before the declaration of interference with Gray on February 19th."

So grave a charge, made in so formal a manner, is entitled to careful consideration. It involves the professional integrity and moral character of eminent attorneys, and requires us to find from the evidence that after Bell swore to his application on the 20th of January, 1876, and after the application thus sworn to had been formally filed in the Patent Office, an examiner, who got knowledge of the Gray caveat put in afterwards, disclosed its contents to Bell's attorneys; that they were then allowed to withdraw the application, change it so as to include Gray's variable resistance method over Bell's signature, and over the *jurat*, and then restore it to the files, thus materially altered, as if it were the original; and all this between February 14 and February 19.

Although much stress was laid in argument on the fact that what purported to be a certified copy of the specification of Bell, as found in the file wrapper and contents printed in the Dowd case, differed materially from the patent, the cause of these differences has been explained in the most satisfactory manner, and we entertain no doubt whatever that the specification as now found in the patent is precisely the same as that on which the order to issue was made. If any alterations were made it was all done before February 19, and the fair copy which is now found on the files of the Office is precisely as it was when the order for the patent was granted. Not a shadow of suspicion can rest on any one growing out of the misprint of the specification in the Dowd case.

All that remains, therefore, on which to rest this serious charge is, that in a paper handed by Bell to George Brown, of Toronto, describing his invention, and which was intended to be used in England to secure a British patent, what is now claimed to be an interpolation in the American application is not to be found. It is but right to say that during the whole course of the protracted litigation upon the Bell patent, no argument was ever presented based on this discrepancy until the brief of Mr. Hill was filed in this court on the 18th of January, 1887, six days before the argument in these appeals was begun. So far as we are advised nothing had ever before occurred in the cases that seemed to make it necessary to prove when the variable resistance method or the fourth claim was put into the American application, or why it was left out of the paper handed to Brown. It seems always to have been assumed until the cases got here, that because it was in the American patent it was rightfully there. Certainly there is nothing in the pleadings in any of the cases to direct attention to the materiality of this fact.

A comparison of the paper handed Brown with the American application shows that they differ in more than thirty different places besides those which relate to the variable resistance method and the fourth claim. The differences are generally in forms of expression, thus indicating that one was written after the other and evidently for the purpose of securing greater accuracy. The paper handed Brown was clearly a rough draft and not a fair copy, for the record shows that it bore on its face the evidence of many erasures and interlineations. Bell says in his testimony that he began writing his specification in September or October, 1875, and wrote and rewrote it a number of times, finally adopting that mode of expression which seemed to him the best to explain his invention and the relation which one portion bore to another. He visited Brown in Canada in September and again in December, 1875. The arrangement was made between them on the 29th of December, at this last interview, by which Brown was to interest himself in getting out British patents. Other inventions besides the telephone were included in the contract entered into for that purpose.

Bell returned to Boston on the 1st of January, and immediately set himself to work to complete his specification. He had it done so that it was taken to Washington by Mr. Hubbard about the 10th of that month, and delivered to Pollok and Bailey, the attorneys. It was then examined by the attorneys, found correct, and a fair copy made and returned on the 18th to Bell in Boston for his signature and oath. It was signed and sworn to in Suffolk County, Massachusetts, January 20, and immediately returned to the attorneys. Afterwards Pollok met Bell in New York, and it was again gone over with care by the two together. No change whatever was made in it at that time, and Pollok took it back with him to Washington.

On the 25th of January, 1876, Bell met Brown, who was then on the way to England, in New York. It is now assumed that the paper which Brown took to England was handed to him then, and because the variable resistance method and the fourth claim were not in that, it is argued that they could not have been in the American specification at that time. But no one has said when the paper was actually handed to Brown. Bell says he cannot tell, but that it must have been after he made his contract with Brown on the 29th of December. As the American specification was signed and sworn to five days before the interview with Brown on the 25th of January, and the paper of Brown differs from it in so many particulars besides that now in question, it would seem to be clear that the paper was a copy of some former draft which Bell had made — possibly one taken to Canada in December — and not of that which was perfected afterwards. As the specification which had been prepared and sworn to was a fair copy, without erasures or interlineations, the fact that the paper handed Brown was not a fair copy would imply that it was not intended to be an exact transcript of the other. At any rate, the bare fact that the difference exists under such circumstances is not sufficient to brand Bell and his attorneys and the officers of the Patent Office with that infamy which the charges made against them imply. We therefore have no hesitation in rejecting the argument. The variable resistance method is introduced only as showing another mode of creating electrical undulations. That Bell had had his mind upon the effect of such a method is conclusively established by a letter which he addressed to Mr. Hubbard on the 4th of May, 1875, and which is found in the Dowd record, introduced into the Overland case by stipulation. Its insertion in his final draft of his specification is another proof of the care with which his work had been done.

In the case of the Clay Commercial Company objection was made to the sufficiency of the proof of the incorporation of the American Bell Telephone Company and of its title to the Bell patents. Upon the first point the proof was, 1, a special act of the general court of Massachusetts, entitled "An act to incorporate the American Bell Telephone Company," which authorized certain persons therein named and their associates to organize themselves under the provisions of c. 224 of the acts of 1870, and the acts in amendment thereof, for telephone purposes; and, 2, a certificate of the Secretary of the Commonwealth in the form required by § 11 of c. 224, that certain persons, among whom were the most of those mentioned in the special act, were legally organized and established as an existing corporation under the name of the American Bell Telephone Company. This section made such a certificate "conclusive evidence of the existence of a corporation" organized under that chapter. The authority granted by the special act to the persons named to organize as a corporation in this way, gave them the authority to select a corporate name, and also made the statutory certificate conclusive evidence of their corporate existence.

The objections to the proof of title are not, in our opinion, well taken. We do not deem it necessary to add to the length of this opinion by referring particularly to the testimony on that point.

This disposes of all the cases so far as the patent of March 7, 1876, is concerned. It remains only to consider the patent of January 30, 1877, about which but little has been said either in the oral or printed arguments. Apparently it received but little attention by counsel or the court in either of the cases below. In the Dolbear case, it was by consent excluded from the decree, and of course is not presented by that record in this court. In all the other cases the patent was sustained, and the Clay Commercial Company was adjudged to have infringed the third, fifth, sixth, seventh, and eighth claims; the Molecular Company the sixth, seventh, and eighth, but not the fifth; the People's Company the fifth, sixth, and eighth; and the Overland Company the third, fifth, sixth, seventh, and eighth. From the decree in favor of the Molecular Company as to the fifth claim the Bell Company has appealed.

In the case of the Clay Commercial Company it was alleged in the answer that the substantial and material parts of the things described and claimed were described and claimed in a prior British patent taken out by or for Bell, dated December 9, 1876, and that, inasmuch as the American patent does not bear the same date with the foreign patent, and is not limited to expire therewith, it is void. This point has not been pressed in the argument here, and in our opinion it has been settled by the decision of this court in *O'Reilly* v. *Morse*, 15 How. 62, 112, and impliedly by that in *Siemens* v. *Sellers*, 123 U. S. 276, at the present term, that the effect of § 4887 of the Revised Statutes is not to render invalid an American patent which does not bear the same date as a foreign patent for the same invention, but only to limit its term.

The patent itself is for the mechanical structure of an electric telephone to be used to produce the electrical action on which the first patent rests. The third claim is for the use in such instruments of a diaphragm, made of a plate of iron or steel, or other material capable of inductive action; the fifth of a permanent magnet constructed as described with a coil upon the end or ends nearest the plate; the sixth of a sounding box as described; the seventh of a speaking or hearing tube as described for conveying the sounds; and the eighth of a permanent magnet and plate combined. The claim is not for these several things in and of themselves, but for an electric telephone in the construction of which these things or any of them are used. Hence the fifth claim is not anticipated by the Schellen magnet, as was decided in the Molecular case below. The patent is not for the magnet, but for the telephone of which it forms but part. To that extent the decree in that case was erroneous.

It follows that the decree in each of the cases, so far as it is in favor of the Bell Company and those claiming under it, must be affirmed, and that the decree in the Molecular case, so far as it is against that company on the fifth claim of the patent of January 30, 1877, must be reversed and a decree directed to that extent in its favor. It is consequently so ordered.

MR. JUSTICE BRADLEY, with whom concurred JUSTICES FIELD and HARLAN, dissenting.

Mr. Justice Field, Mr. Justice Harlan and myself are not able to concur with the other members of the court, sitting in these cases, in the result which has been reached by them. Without expressing an opinion on other issues, the point on which we dissent relates to the defence made on the alleged invention of Daniel Drawbaugh, and applies to all the cases in which that invention is set up. We think that Drawbaugh anticipated the invention of Mr. Bell, who, at most, is not claimed to have invented the speaking telephone prior to June 10th, 1875. We think that the evidence on this point is so overwhelming, with regard both to the number and character of the witnesses, that it cannot be overcome. As this is a question of fact, depending upon the weight of the evidence, and involves no question of law, it does not require an extended discussion on the part of those who dissent from the opinion of the majority, — which is very ably drawn, and presents the case with great clearness and force. On the point mentioned, however, we cannot concur in the views expressed.

The essence of the invention claimed by Mr. Bell is, the transmission of articulate speech to a distance, by means of an electrical current subjected to undulations produced by the air vibrations of the voice. There are two modes (as yet discovered) by which these undulations may be thus produced. In one they are produced by interposing in the circuit a substance whose electrical conductivity may be varied by the concussions, or vibrations of the air produced by the voice. This is called the variable resistance process, because the electrical current is subjected to the variable resistance (or conductivity) of the substance thus interposed. By the other mode, the undulations are produced by the inductive effect of an armature (or small, flat piece of iron), attached to the membrane spoken against, and placed near to the poles of an electro-magnet situated in the circuit. In both cases, the undulations impart the vibrations which caused them to another diaphragm at a distance (called the receiver) by means of an electro-magnet in the circuit, placed near to an armature affixed to such diaphragm. These vibrations, thus reproduced, are detected by the ear, and the spoken words are heard.

We are satisfied from a very great preponderance of evidence, that Drawbaugh produced, and exhibited in his shop, as early as 1869, an electrical instrument by which he transmitted speech, so as to be distinctly heard and understood, by means of a wire and the employment of variable resistance to the electrical current. This variable resistance was produced by causing the electrical current to pass through pulverized charcoal, carbon and other substances, acted upon by the vibrations of the voice in speaking. This was the whole invention so far as the principle of variable resistance is concerned.

We are also satisfied that as early as 1871 he reproduced articulate speech, at a distance, by means of a current of electricity, subjected by electrical induction to undulations corresponding to the vibrations of the voice in speaking, — a process substantially the same as that which is claimed in Mr. Bell's patent.

In regard to the instrument in which the principle of variable resistance was used, more than seventy witnesses were examined, who either testified to having seen it and heard it, or established such facts and circumstances in relation to it as to put its existence and date beyond a question. With regard to the instrument in which electrical induction was employed to produce the requisite undulations, some forty or fifty witnesses were produced, many of whom saw it and heard speech through it, and others either saw it, or heard it talked about in such a manner as to fix the time when it was in existence. On the questions of time and result, there is such a cloud of witnesses in both cases, that it seems almost impossible not to give credence to them. The evidence of some of them may have been shaken with regard to the time they had in mind; but that of the great majority was not shaken at all, but corroborated by circumstances which rendered the proof irrefragable. Many of them, it is true, were plain country people; but they heard the words through the instrument; and that is a matter about which they could not be mistaken. It did not require science nor learning to understand that. But the witnesses were not confined to this class. A number of them were people of position in society, official, professional, and literary, — all, however, like the inventor, regarding the matter more as one of curiosity than of public importance.

As it would serve no useful purpose to repeat the testimony of these witnesses, we shall refrain from doing so. We will only add that nearly all the original instruments used by Drawbaugh were produced on the trial, and identified by the witnesses. Some of them were broken and in a dilapidated condition, but sufficiently perfect to be accurately reproduced. Their very form and principle of construction showed that they were intended for speaking telephones, and nothing else. Drawbaugh certainly had the principle, and accomplished the result. Perhaps without the aid of Mr. Bell, the speaking telephone would not have been brought into public use to this day; but that Drawbaugh produced it, there can hardly be a reasonable doubt.

We do not question Mr. Bell's merits. He appreciated the importance of the invention, and brought it before the public in such a manner as to attract to it the attention of the scientific world. His professional experience and attainments enabled him to see, at a glance, that it was one of the great discoveries of the century. Drawbaugh was a different sort of man. He did not see it in this halo of light. Had he done so, he would have taken measures to interest other persons with him in it, and to have brought it out to public admiration and use. He was only a plain mechanic; somewhat better instructed than most ordinary mechanics; a man of more reading, of better intelligence. But he looked upon what he had made more as a curiosity than as a matter of financial, scientific, or public importance. This explains why he did not take more pains to bring it forward to public notice. Another cause of his delay in bringing his invention to public notice was, that he was ever indulging the hope of producing speech, at the receiving end of the line, loud and distinct enough to be heard across a room, like the voice of a person speaking in an ordinary tone.

It is perfectly natural for the world to take the part of the man who has already achieved eminence. No patriotic Briton could believe that anybody but Watt could produce an improvement in the steam engine. This principle of human nature may well explain the relative feeling towards Bell and Drawbaugh in reference to the invention of the telephone. It is regarded as incredible that so great a discovery should have been made by the plain mechanic, and not by the eminent scientist and inventor. Yet the proof amounts to demonstration, from the testimony of Mr. Bell himself, and his assistant, Watson, that he never transmitted an intelligible word through an electrical instrument, nor produced any such instrument that would transmit an intelligible word, until after his patent had been issued; whilst, for years before, Drawbaugh had talked through his, so that words and sentences had again and again been distinctly heard. We do not wish to say a word depreciatory of Mr. Bell. He was original, if not first. He preconceived the principle on which the result must be obtained, by that forecast which is acquired from scientific knowledge, as Leverrier did the place of the unknown planet; but in this as in the actual production of the thing, he was, according to the great preponderance of the evidence, anticipated by a man of far humbler pretensions. A common astronomer, by carefully sweeping the sky, might have been first in discovering the planet Neptune; whilst no one but a Leverrier, or an Adams, could have ascertained its existence and position by calculation. So it was with Bell and Drawbaugh. The latter invented the telephone without appreciating the importance and completeness of his invention. Bell subsequently projected it on the basis of scientific inference, and took out a patent for it. But, as our laws do not award a patent to one who was not the first to make an invention, we think that Bell's patent is void by the anticipation of Drawbaugh.

MR. JUSTICE GRAY was not present at the argument, and took no part in the decision of these cases.

MR. JUSTICE LAMAR, not being a member of the court when these cases were argued, took no part in their decision.

PETITION FOR REHEARING.

On behalf of the People's Telephone Company and the Overland Telephone Company, the following petition for rehearing was filed May 7, 1888 :

"TO THE HONORABLE JUSTICES OF SAID COURT :

"The appellants in the above-entitled cases hereby humbly pray that the court will rehear and reconsider the matters decided March 19, 1888, so far as the same involve the question of priority of invention of the electric speaking telephone between Alexander Graham Bell and Daniel Drawbaugh; and that an order or orders be entered reversing the decisions below and dismissing the appellees' bills, with costs to the appellants in said cases respectively.

"The grounds of this application are, first, that the court, in its said decision, as evidenced by its written opinion, filed on said 19th day of March, giving its reasons therefor, inadvertently erred in respect to certain matters of fact and of law material to, and decisive of, said question, and therefore of these cases; and, secondly, that in consequence of said errors, the decision of the court was against the weight of the evidence.

"The opinion of the court treats three portions of the evidence as controlling, viz. : (1) The evidence of a great cloud of witnesses as to what Drawbaugh, prior to the fall of 1876, had accomplished in the matter of an electric speaking telephone; (2) His conduct from that time to the year 1880, when the appellants became interested in his inventions; (3) The New York and Philadelphia tests.

I. *Proofs of Drawbaugh's Priority.*

"Mr. Storrow, complainant's counsel, admitted in his oral argument that 'forty-nine witnesses testified that they had heard speech in Drawbaugh's shop before the date of the Bell patent' (Oral Argument of Storrow, p. 149).

"Seventy witnesses heard talk through the Drawbaugh telephones, or were present when others successfully talked through them prior to Bell's alleged conception of the telephone June 2, 1875.

"One hundred and forty-nine witnesses actually saw the instruments, and two hundred and twenty testified to having heard of or seen them prior to that time.

"Many of the witnesses testified to such circumstances, facts, and records corroborative of their evidence as to make it impossible that they could have erred, and either their testimony is true or they committed wilful perjury. No attempt has been made to impeach them. The dates they positively aver are all prior to June, 1875, the year when Bell claimed to have first conceived the idea of the telephone. Of this class of witnesses are the following:

"*Wilson H. Strickler:* Never was at Milltown but once. Had made an invention for insulating telegraph wires. Visited Drawbaugh for information and advice concerning that invention. Had not then filed his application for a patent. He and Drawbaugh talked to each other through the telephone at that time, and Drawbaugh explained to him how electricity operated it. Subsequently filed his application and obtained a patent for his invention. Produced the specifications and drawings as filed, and the patent as issued. Date of filing, August 22, 1874; date of patent, April 20, 1875 (Additional Proofs, p. 233).

"*George W. Bowman:* Resides at Mechanicsburg. Drove to Eberly's Mills with his wife to attend a baptism. After the baptism drove to Drawbaugh's shop. This was during the lifetime of his wife's mother, who died in 1871. He then and there heard Drawbaugh talk through the telephone (Additional Proofs, p. 173).

"*Mrs. Maggie E. Bowman*, wife of the above, corroborates his testimony. Her mother died March 14, 1871. Knows the baptism was before her mother's death, because it was upon her mother's persuasion that they went to attend it (Additional Proofs, p. 177).

"*Emanuel K. Gregory:* Resided at Milltown from March to October, 1870. Then removed to Massachusetts. Has never been in Pennsylvania since until he testified. At Milltown worked at Drawbaugh's shop for faucet company. The company's books corroborate this. Assisted Drawbaugh in his experiments, and heard him talk through his telephone a number of times. Identifies B and F as the instruments (Additional Proofs, p. 185).

"*William H. Zearing:* Had a pair of steelyards relettered by Daniel Drawbaugh. Entered the date and charge therefor in a book, November 23, 1873, as shown by book produced. Never had any steelyards relettered at any other time. When he went for them Drawbaugh talked to him through a telephone, saying among other things, "The steelyards are finished." Zeering was the secretary of the school board of his township (Def. Sur. Reb. Testimony, p. 122).

"Other witnesses of the same class are: Goodyear (Def. Sur. Reb. Tes., p. 1011); David Stevenson, Jr. (Def. Add. Proofs, p. 141); his two daughters (Def. Add. Proofs, pp. 166, 169); William H. Martin (Def. Sur. Reb. Tes., p. 827); John Keefauver (Def. Sur. Reb. Tes., p. 837). See accompanying brief for many others.

"II. *Drawbaugh's Conduct.*

"Of the above proofs the court say: 'If they contained all the testimony in the case it would be more difficult to reach the conclusion that Drawbaugh's claim was not sustained. But in our opinion their effect has been completely overcome by the conduct of Drawbaugh, about which there is no dispute, from the time of his visit to the Centennial until he was put forward by the promoters of the People's Company, nearly four years afterwards, to contest the claims of Bell.' p. 565.

"This conduct, concerning which the court say there is no dispute, relates solely to his incapacity as a business man. It is true that there is no dispute as to his incapacity to use, to the best advantage, the opportunity his invention gave him; but the court has evidently overlooked much testimony to show the constant efforts he did make to secure capital from 1876 to 1880 to enter upon the contention which would be sure to follow an application for a patent. Among the witnesses on this point are: Moffitt (Def. Record, Vol. 1, p. 497); Chellis (Same, p. 526), and Shettel (Same, p. 214). The accompanying brief cites many other witnesses to Drawbaugh's constant and earnest seeking of assistance to push his telephone inventions.

"III. *Drawbaugh's Ignorance of the Date of Bell's Invention.*

"Drawbaugh swore that he did not know the alleged date of Bell's invention until 1880 (Def. Record, Vol. 2, p. 870). The court must have overlooked this testimony, for they say that he must have known of the approximate time of Bell's invention, because the subject of the invention itself was often referred to in the Harrisburgh and Mechanicsburgh papers. He did not know but Bell had been at work on it as he himself had been for many years. The date of the patent was no guide to the date of the invention.

"IV. *Drawbaugh's Visit to the Centennial.*

"The failure of Drawbaugh to ascertain, when visiting the Centennial Exhibition, whether the telephone instruments there exhibited by Bell were similar to his own, seems to have been regarded by the court as strong evidence against his claim. But the court, after citing questions and answers from 386 to 398, inclusive, overlook the answer to the very next question, in which Drawbaugh testifies that none of the instruments he saw at Philadelphia were the instruments represented in the cuts of Bell's instruments as given in the record in this case.

"The testimony of Prof. Barker (Add. Proofs, p. 7) says that the Bell instruments were not easily accessible in the building at that time. They seem to have been merely exhibited to invited individuals at times of private tests. A fair inference from Drawbaugh's answers cited in the opinion of the court, and the one omitted is that he saw the instruments he supposed to be the subject of comment, and they were not telephones at all, but were harmonic telegraphic instruments, which his answers fairly describe.

"V. *Drawbaugh's Pursuit of his Invention.*

"The court say that he had apparently lost all interest in talking machines from 1876 to 1880. Such a conclusion could only be reached by overlooking the evidence of many witnesses. Among these are Stees and Johnson, who operated his carbon transmitter J at Harrisburg in May, 1878, months before the Blake transmitter was invented (Add. Proofs, pp. 209 and 198). He was constantly exhibiting his telephones during the whole of those four years to numerous witnesses, as will readily be seen by citations in the accompanying brief, but what is absolutely conclusive on this point is the fact that he made the most effective and finished telephones from 1876 to 1880.

"VI. *Drawbaugh's Neglect to Apply for a Patent.*

"The cost of an application for a patent being small, the failure of Drawbaugh to make such application is taken by the court as evidence that he had no invention. But this view leaves out of consideration the certainty of interference proceedings, the cost of which he was advised would be enormous, which advice has since been abundantly justified.

"VII. *The Tests at New York and Philadelphia.*

"Successful tests of Drawbaugh's instruments, both original and reproduced, were made in New York in 1882 and in Philadelphia in 1885.

"The court say that: 'It is substantially conceded that the test in New York was a failure'; that 'Occasionally sound was heard, and sometimes a word, but it would not transmit sentences.' That this was a very material error is shown by the testimony of Mr. Benjamin, at page 1278 of Def. Vol. 2, and by other witnesses. So far from it being conceded that the test at New York was a failure, it was conceded by complainants' counsel, Mr. Storrow, that it was a success. Concerning the single instrument F, he said: 'There were one hundred and thirty-seven phrases uttered into it on the second day, seven of those were understood, and some words of seven more, and that is all. The third day they got better. They uttered one hundred and seventy-five phrases into the transmitter; thirty-five of those were heard.' (Oral argument in Circuit Court, p. 92, filed here.)

"The court was of the opinion that the instruments afterwards reproduced and tested at Philadelphia were 'not the same,' but 'differently constructed'; but the Bell Company's expert, Pope, swore that they differed only in being constructed more carefully, and with better workmanship (Complainant's Reply, p. 176).

"In the opinion of the court in this very case, it is said of Bell's original instrument: 'The particular instrument which he had, and which he used in his experiments did not under the circumstances in which it was tried reproduce the words spoken so that they could be clearly understood, but the proof is abundant and of the most convincing character that other instruments carefully constructed and made exactly in accordance with the specifications, without any additions whatever, have operated and will operate successfully.'"

"The court said the instruments were used in a different way at Philadelphia than at New York; that is to say, that at New York they rested on a table, while at Philadelphia they were held in the hand. But Prof. Barker testified that he used them both ways at Philadelphia, and that they worked best when standing on the table as they did at New York. (Barker, Ans. 81 and 84 Def. Add. Proofs, p. 28). This evidence is more fully treated in the accompanying brief.

"VIII. *The Construction of the Instruments.*

"The court said that nobody knew the actual construction of the original machines except Drawbaugh himself. But there is much evidence beside that of Drawbaugh as to their construction, as will be seen by reference to the testimony cited in the accompanying brief, for example, H. K. Drawbaugh could reproduce the machines from memory. (Def., Vol. 1, pp. 566–7, Ans. 129, 130). Steinberger described one from memory. (Def., Vol. 1, pp. 344–6), and so did Schrader (Def. Sur. Reb., pp. 470–1, and see ten others cited in brief).

"*Finally.*

"The court says, in its opinion: 'We do not doubt that Drawbaugh may have conceived the idea that speech could be transmitted to a distance by means of electricity, and that he was experimenting upon that subject,' meaning, as is clear from the context, that he did this before Bell's invention.

"*The Drawbaugh story, then, is no afterthought growing out of Bell's discoveries*, but is based upon the admitted facts of a prior conception of the possibility of electric speech-transmission and prior experiments actually made to accomplish it. The same witnesses who satisfy the judgment of the court as to these facts, identify the machines and testify to their successful working, and are neither impeached nor contradicted as to these additional facts. At another point, referring to Drawbaugh, the court says: 'He was a skilful and ingenious mechanic. . . . He was also somewhat of an inventor, and had some knowledge of electricity. According to the testimony he was an enthusiast on the subject of his 'talking-machine,' and showed it freely to his neighbors and people from the country when they visited his shop.' p. 557 *supra.*

"Taking these admitted facts together, his prior conception of the possibility of electric speech transmission; his experiments to accomplish it; and, during his experiments his enthusiasm about the talking-machine—how can his *enthusiasm* be accounted for? Is it conceivable that enthusiasm resulted from constant failure? Can it be explained on any other reasonable theory than that his machines were producing the successful results about which the corroborating witnesses so abundantly testify? And why should he exhibit the invention so freely to the surrounding public, if it constantly failed to work when thus exhibited? Did he exhibit it as a failure or as a success? Can his conduct at the time, especially when taken in connection with his contemporary declarations that he had achieved the result, and was going to patent the invention, and wanted financial aid to secure the patents, be reconciled with any other theory than that of success? And is it not clear that the court has erred as to the evidential force of the facts which it admits to have been established?

"On account of the errors above referred to, which will be made more apparent by reference to the accompanying brief, and to the end, therefore, that equity may be done, and that this court may, upon fuller consideration and with the advantage of oral argument, revise its former opinion (if revision be right and proper), your petitioners pray that the court may be pleased to take their suggestions under a careful consideration and grant a rehearing upon the points upon which said decision was based, and grant such other relief and order as in equity and good conscience may be proper.

"New York, May 1st, 1888.

"Lysander Hill,
"George F. Edmunds,
"Don M. Dickinson,
"Charles P. Crosby,
"Henry C. Andrews,
"Of Counsel with Appellants."

There was also filed with this petition a full brief, signed by the same counsel, with many references to the evidence.

Mr. Justice Miller, May 14, 1888, delivered the opinion of the court.

No Justice who united in the opinion of the court having asked for a rehearing, the application is denied.