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MACHINE TELEPHONE SWITCHING SYSTEM.

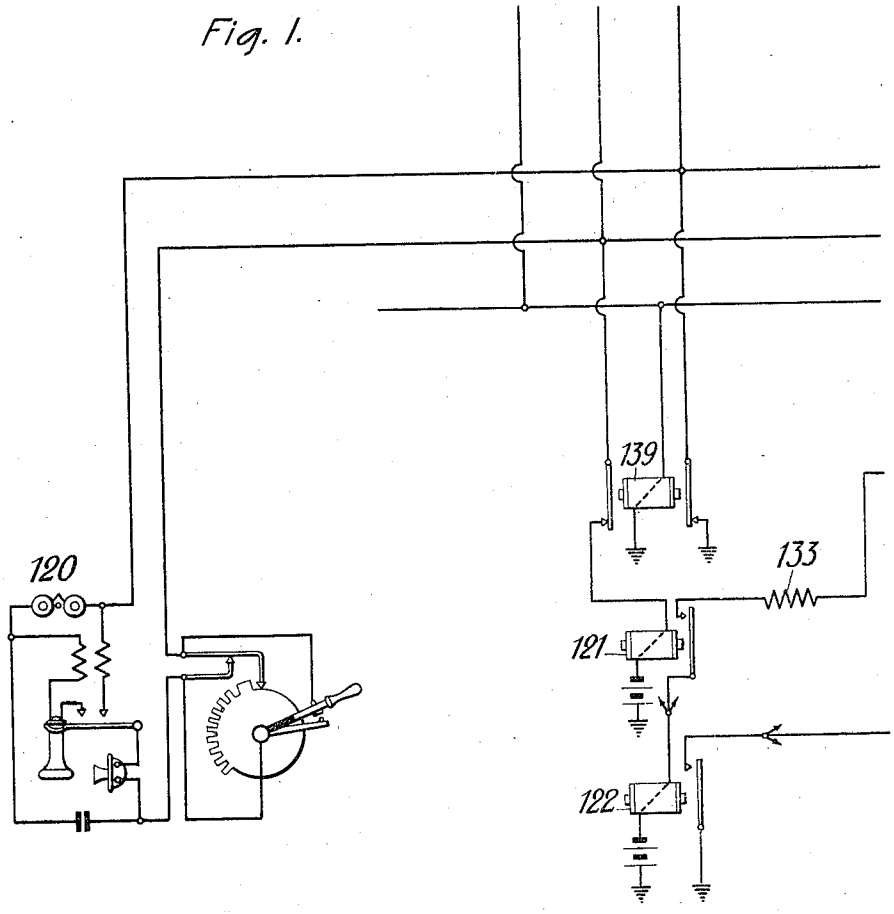
APPLICATION FILED MAR. 2, 1914.

1,137,223.

Patented Apr. 27, 1915.

9 SHEETS—SHEET 1.

Fig. 1.



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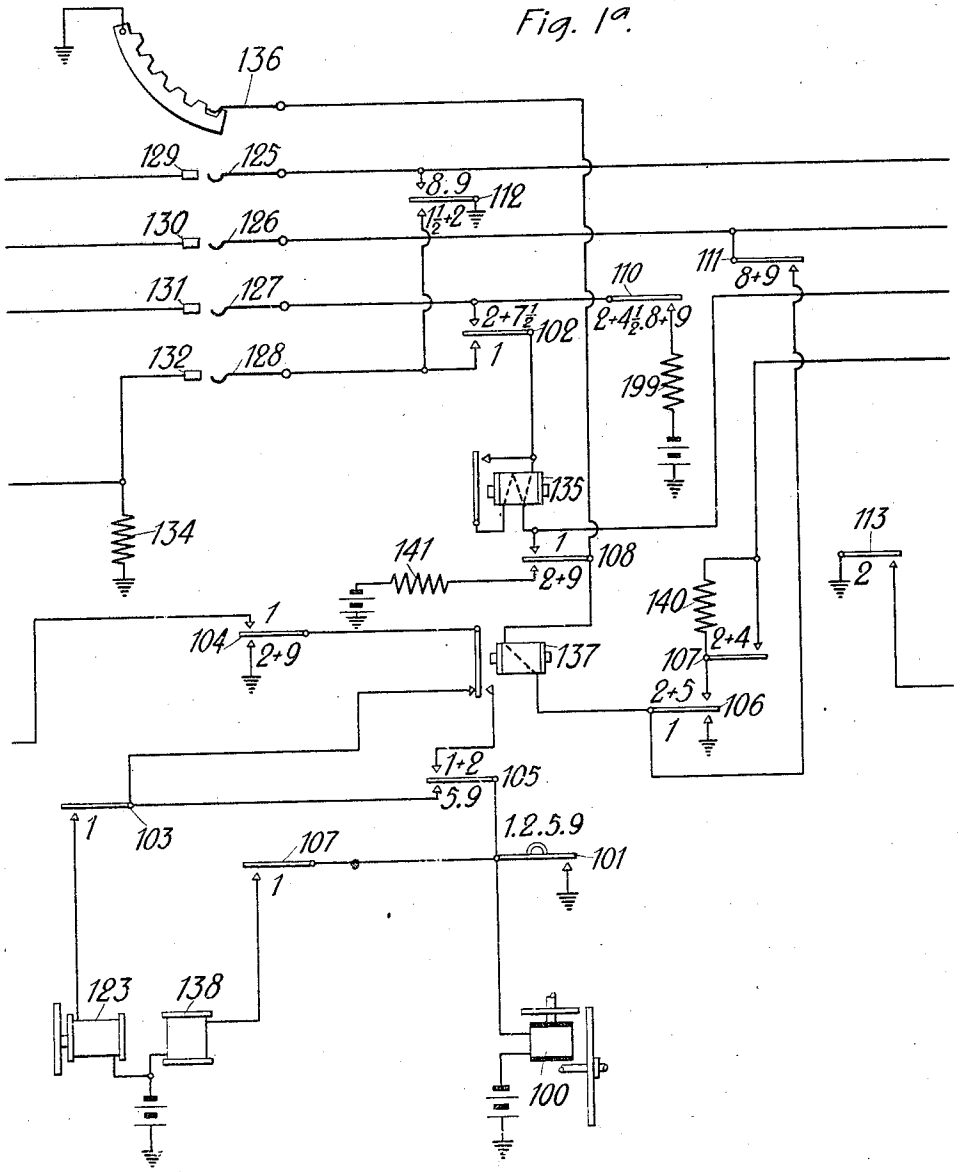
9 SHEETS—SHEET 2.

Fig. 1a.



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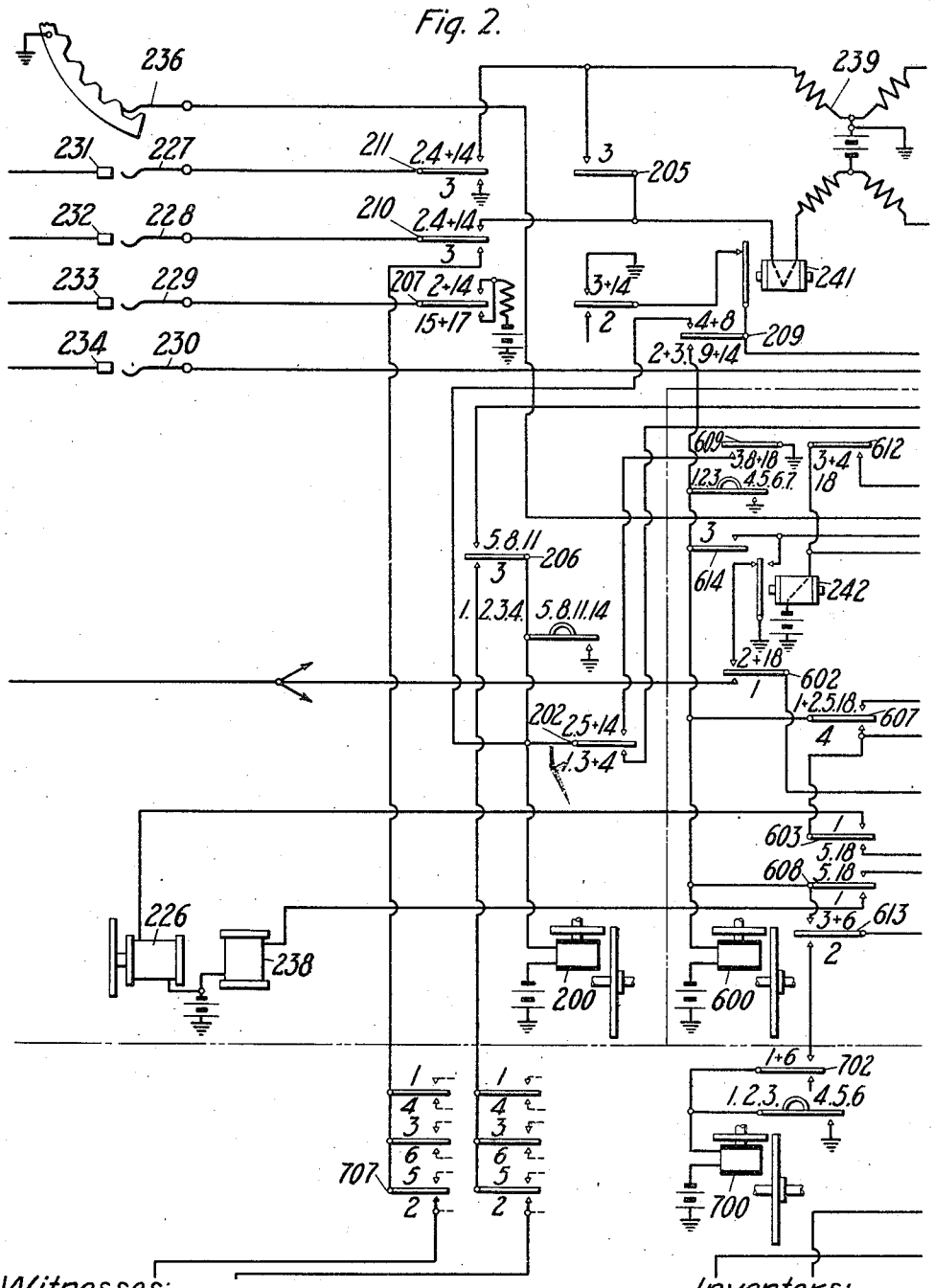
9 SHEETS—SHEET 3.

Fig. 2.



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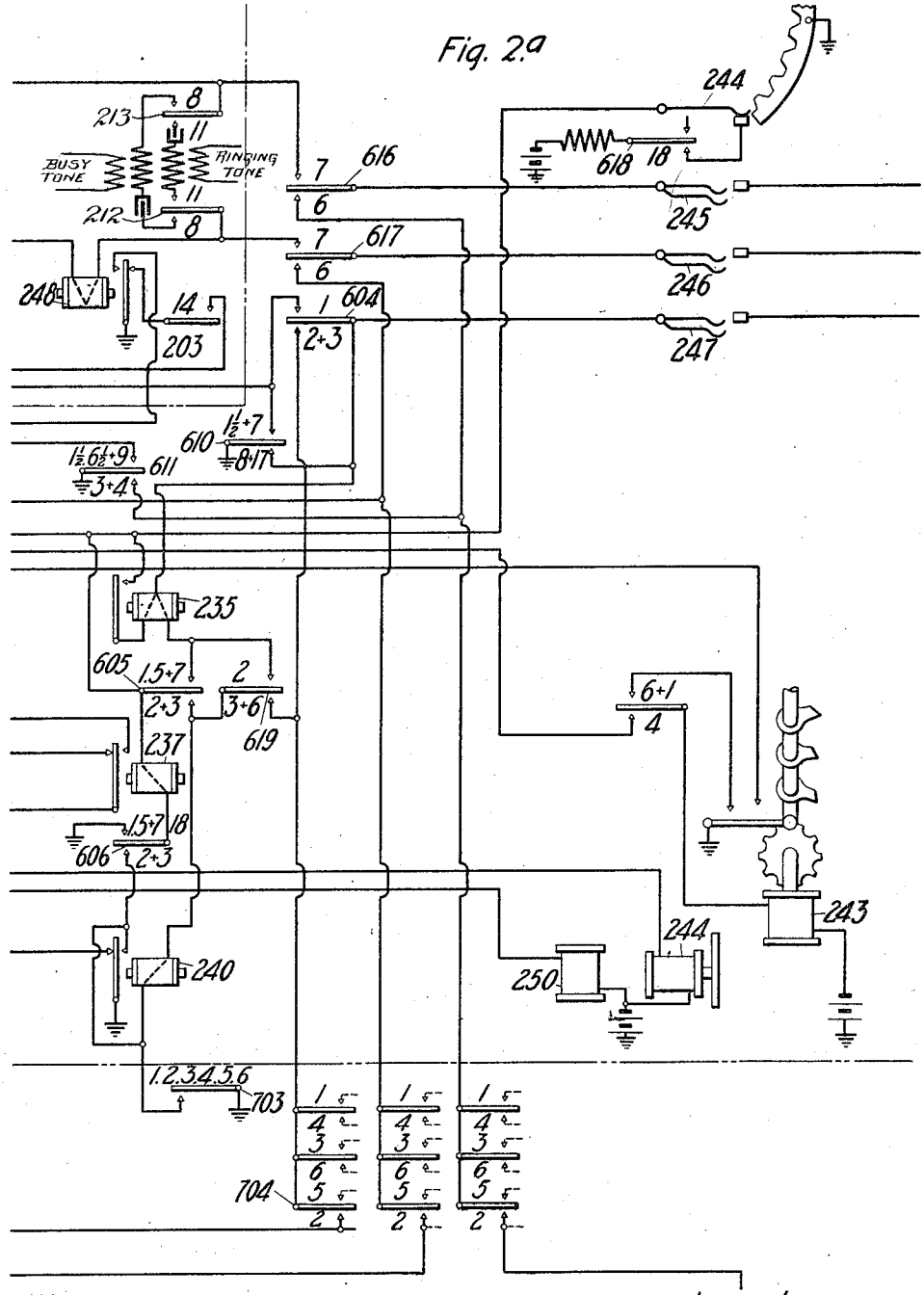
9 SHEETS—SHEET 4.

Fig. 2.a



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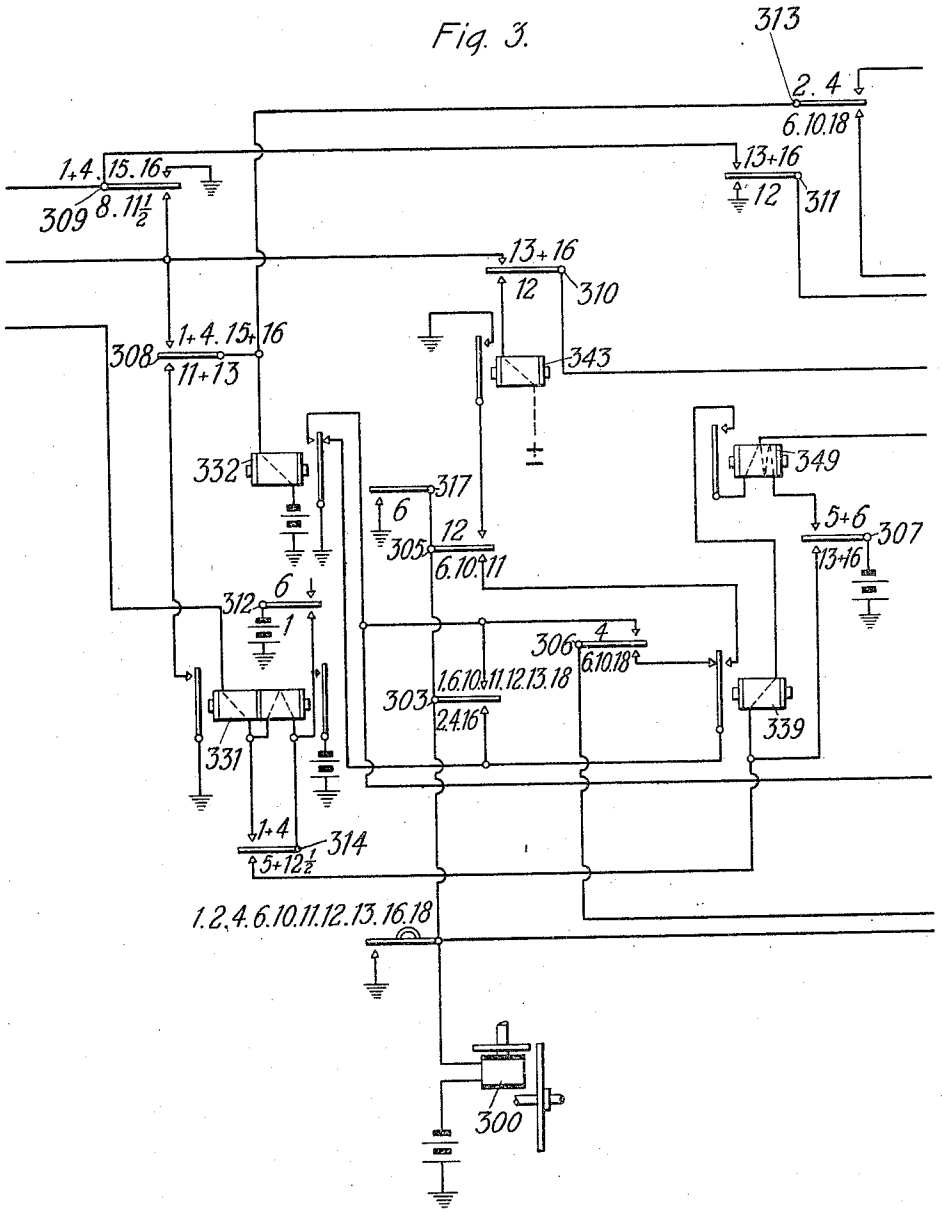
9 SHEETS—SHEET 5.

Fig. 3.



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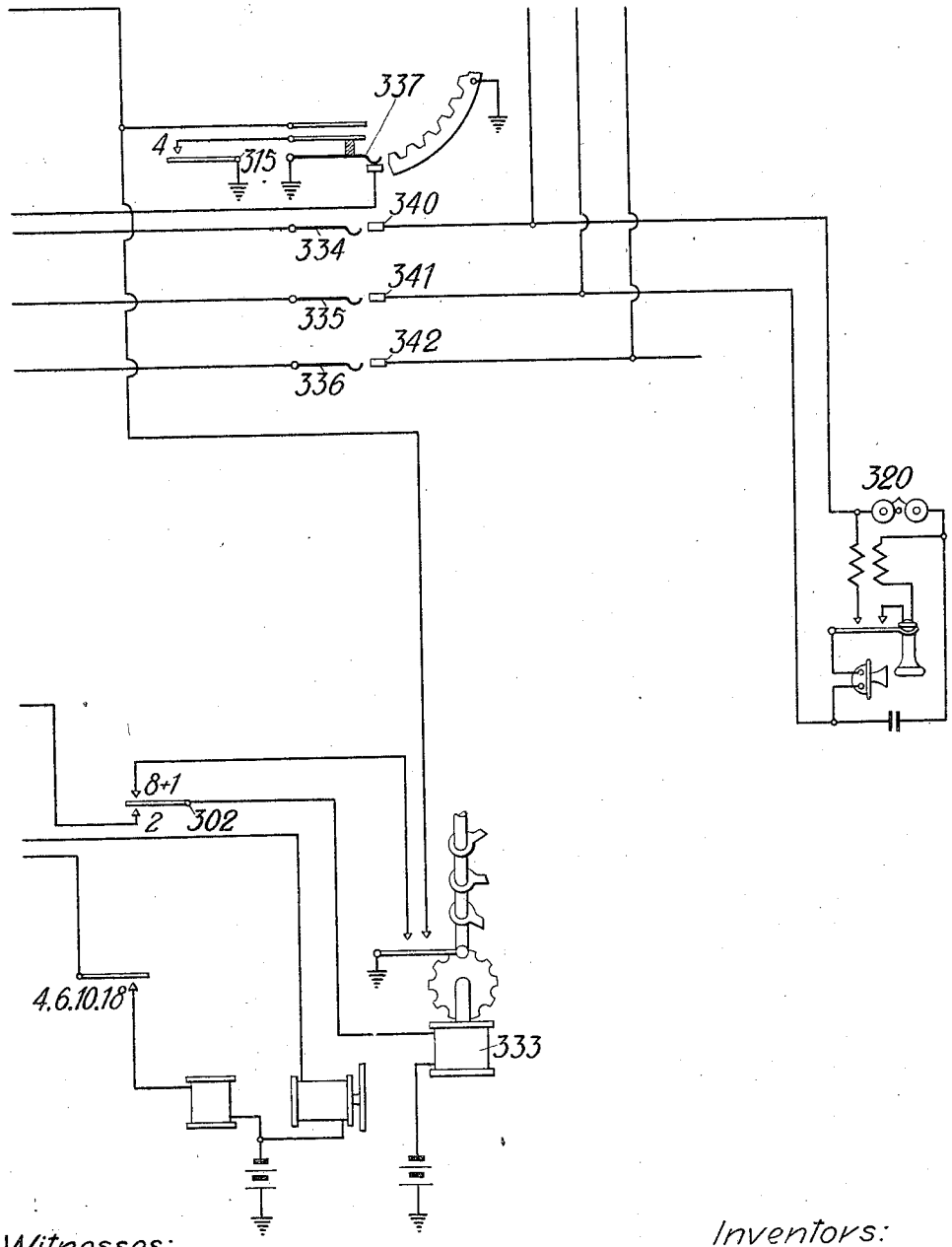
9 SHEETS—SHEET 6.

Fig. 3a.



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9 SHEETS—SHEET 7.

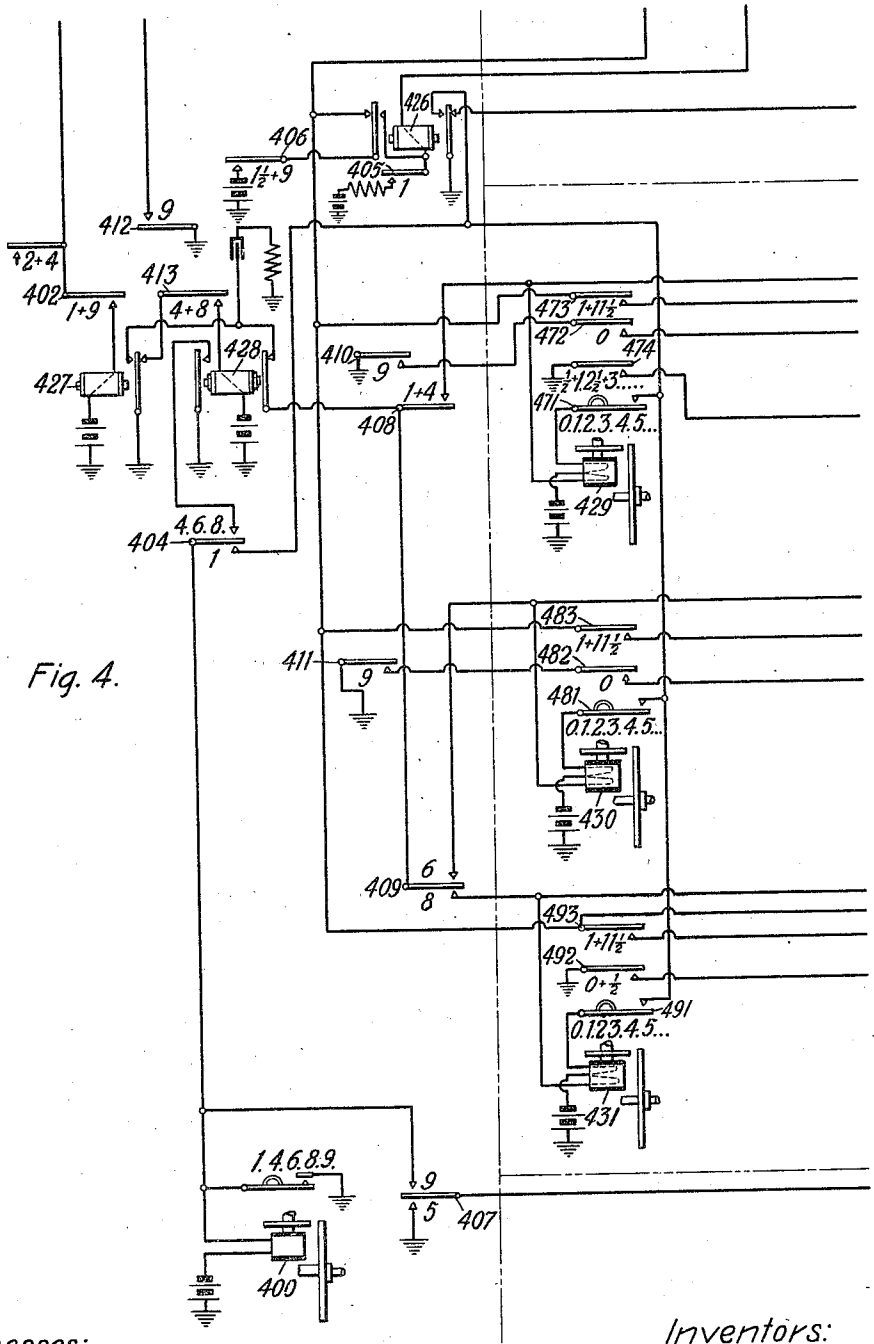

Fig. 4.

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9 SHEETS—SHEET 8.

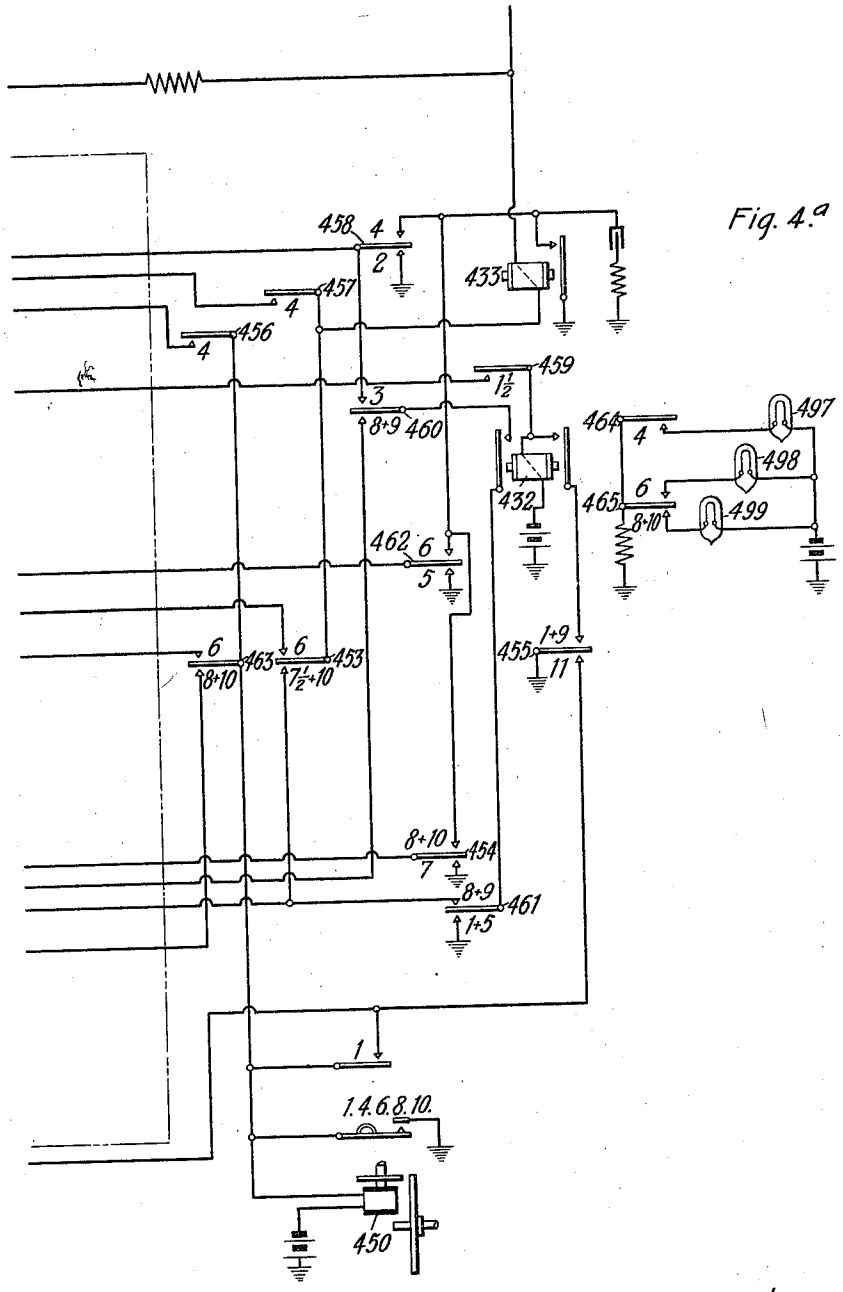

Fig. 4.ª

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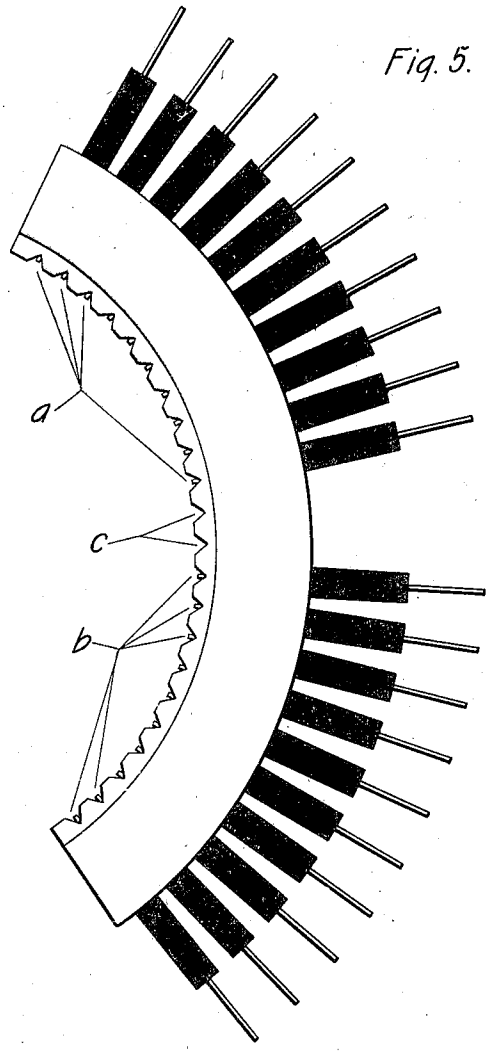
9 SHEETS—SHEET 9.

Fig. 5.



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UNITED STATES PATENT OFFICE.

FRANK ROBERT McBERTY, OF ANTWERP, AND LIPA POLINKOWSKY, OF BRUSSELS, BELGIUM, ASSIGNORS TO WESTERN ELECTRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF ILLINOIS.

MACHINE TELEPHONE SWITCHING SYSTEM.

1,137,223. Specification of Letters Patent. Patented Apr. 27, 1915.

Application filed March 2, 1914. Serial No. 821,374.

To all whom it may concern:

Be it known that we, FRANK ROBERT McBERTY, citizen of the United States of America, LIPA POLINKOWSKY, a subject of the Russian Emperor, residing at 49 Boulevard Leopold, Antwerp, Belgium, and 19 Rue Brialmont, Brussels, Belgium, respectively, have invented certain new and useful Improvements in Machine Telephone Switching Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to improvements in machine telephone switching systems, and has to do more particularly with systems in which the extension of the desired connection from a calling line to a called line is accomplished by automatic switching apparatus directly or indirectly under the control of a subscriber at the calling substation. Many of the features to be described, however, are not restricted to systems of this character, being also applicable, as will be apparent to those skilled in the art, to systems of widely varying character, as for example to semi-automatic telephone exchange systems, and also some of the features herein disclosed apply as well to manual telephone exchange systems.

In British Patents Nos. 26,079/10 and 21,259/11 there are described automatic telephone switching systems in which impulses transmitted from a calling station and representing the number of the wanted line are received at the central office by registering devices which thereupon act as controllers to govern the selecting operations necessary to extend the connection to the line represented by such registration. Furthermore, in British Patent No. 21,259/11 there is described a system and arrangement in which translation takes place in such registering and controlling devices whereby, although the controlling mechanism located at the substation may be constructed and operated according to one system of notation, the actual selection of the desired line and of the trunk lines over which it may be reached may take place in accordance with some other system of notation.

One of the principal features of this invention relates to systems of the character described in the patents referred to and relates more particularly to an improved and novel registering and controlling equipment and means for associating the same with the calling substation and the selectors to be controlled. Most specifically this feature of the invention involves the use of power-driven registering and controlling devices in such registering and controlling equipment and of improved and novel circuits and arrangements whereby such devices may be controlled and operated accurately and at high speed to positively and precisely control the operation of the automatic switching devices to be selectively and accurately set in response to the controlling operation at the called subscriber's substation.

Another feature of the invention relates to the connection of a connecting circuit taken for use by a calling line with a registering and controlling equipment of the type referred to and involves the use of switching mechanism adapted to quickly and accurately make such connection to permit under certain conditions the simultaneous control of such registering and controlling equipment by the calling subscriber's substation and the control by such equipment of the selective operations of a switch over which the call is to be extended.

Other novel features of the invention, such particularly as relate to operations of various sequence switches (steering switches) used therein and the inter-operation of such switches will more fully appear from the detailed description of the invention.

In the drawings, Figure 1 shows the circuits and apparatus of a subscriber's line and Fig. 1^a the first line finder adapted to extend the connection of such line when calling; Figs. 2 and 2^a illustrate diagrammatically the second line finder and the connecting circuit associated therewith, together with the group selector and other apparatus associated with such connecting circuit; Figs. 3 and 3^a illustrate the circuits and apparatus of a final selector; Figs. 4 and 4^a illustrate the circuits and apparatus of a registering and controlling equipment adapted to be associated with the connecting circuit shown in Figs. 2 and 2^a, to control the group selector and final selector shown. Fig. 5 is a detail of the structure of the final selector showing wherein the final selectors used in the system disclosed differ

from the final selectors disclosed in the British Patent No. 21,259/11 above referred to. Figs. 1, 1ª, 2, 2ª, 3, 3ª, 4 and 4ª taken together illustrate diagrammatically a system involving the invention. Fig. 1ª should be placed to the right of Fig. 1, Fig. 2 to the right of Fig. 1ª, Fig. 2ª to the right of Fig. 2, Fig. 3 to the right of Fig. 2ª, Fig. 3ª to the right of Fig. 3, Fig. 4 below Fig. 2, and Fig. 4ª below Fig. 2ª.

The line finders, group selectors and sequence switches are of types already known in the art as illustrated in the British patents above referred to, and need not be here in specifically described. Also the method of showing the sequence switch contacts is well understood, and mention need only be made that in Fig. 2 the sequence switch contacts of the three sequence switches shown thereon are associated with the sequence switch indicated in that portion of the figure separated from the remaining portions by dotted lines. The final selector switch differs from the final selector switches of this type previously known only by the addition of two extra notches in the interrupter plate of the top thereof, between the first 10 notches thereof and the second 10 notches thereof. It will be recalled that selector switches of this type have a capacity of two hundred lines, and the contacts of these lines are arranged in ten levels of twenty lines each. Between the bank of the one hundred lines individual to one hundred, and the bank of lines individual to another hundred, that is to say, between the first ten lines of each level and the second ten lines of each level there is a spacing plate. In selector switches of this type previously known the spacing between the two banks of line contacts was without effect, as the interrupter plate at the top of the selector was uncut over the portion thereof corresponding to the spacing plate. In the final selector switches as used herein, however, there are two notches cut in the portion of the interrupter plate corresponding to the spacing plate for purposes herein described. That is to say, in selecting a line in the first set of ten lines on a given level, the interrupter will operate a number of times corresponding to the number of lines passed over, whereas, in selecting a line in the second set of ten contacts on such given level, the interrupter will operate a number of times corresponding to the number of lines passed over plus two. This will be readily understood from an examination of Fig. 5 in which the notches *a* represent the notches of such interrupter plate corresponding to the first set of ten lines on the given level of the selector; the notches *b* represent the notches in such plate corresponding to the second set of ten lines on such level, and the two notches *c* represent the two extra or additional notches which have been added as above indicated for purposes hereinafter described.

The invention as disclosed herein will be best understood from a description of the operation of the system shown.

Assuming that the subscriber at the substation indicated at 120 desires connection with the subscriber indicated at 320, whose number is 307, he first removes his receiver from its switchhook, thereby closing a circuit for the line relay 121 which, on its energization, closes a circuit for and energizes the pilot relay 122 common to a group of incoming lines which appear multiplied upon a given group of first line finders such as the one shown in Fig. 1. Relay 122 closes a circuit over the sequence switch springs 104 and 103 for the power magnet 123 of all the first line finders of this group which are at this time in idle condition; that is, whose sequence switches 100 are in first or normal position. Such idle line finders will, therefore, start in motion, moving their brushes 125, 126, 127, 128 over the terminals 129, 130, 131, 132 of the lines appearing in such line finders, and testing such lines in the usual way. As one of them, however, brings its brushes into contact with the terminals of the calling line, it will find upon the terminal 132 of such line a selectable potential produced by the energization of the line relay 121 and determined by the resistance 133 and 134. Immediately that the brush 128 comes in contact with the terminal 132 upon which such selectable potential exists, the test relay 135 will be energized over the springs 102 bottom, 108 top and either the spring 106 or the interrupter brush 136. The energization of this relay 135 closes through its armature a low resistance holding winding for itself, the closure of such circuit through such winding so reducing the potential upon the terminal 132 that such potential is no longer selectable, and any other line finder whose brush 128 comes in contact with such terminal 132 will not be stopped. The carriage of the line finder which has thus seized the line, continues in motion, however, until its brushes are properly centered upon the terminals of the calling line, at which time the circuit through the interrupter brush 136 will be open, and the shunt being removed from around the power control test relay 137, such relay will be energized, opening the circuit of the power magnet 123 and closing the circuit of the holding magnet 138 over the springs 105 top and 107, thereby positively stopping the brush carriage in proper position. The energization of the relay 137 has also driven the sequence switch 100 out of its first into its second position. In this movement of the sequence switch a test guard is maintained upon the terminal 132 and the seized line

through the spring 112 bottom, the spring 102 bottom being opened as the sequence switch leaves its first position. In the second position the spring 110 being closed, the cut-off relay 139 of the calling line is energized, causing the deënergization of the line relay 121 and the consequent deënergization of the pilot relay 122, provided no other line of this group is at this time calling and not as yet been seized by a line finder. The deenergization of the relay 121 opens the battery circuit to the terminals 132, and the line now having been seized and being maintained busy, no selectable potential is possible upon its test terminal 132.

The sequence switch 100, on coming into its second position, has established a circuit over spring 113, the pilot wire, and the spring 602 bottom, back control of relay 237 and spring 603 top for the power magnets 226 of the idle second line finders in which the circuit connected to the first line finder shown appears in multiple. The brush carriages of such idle line finders, therefore, move the brushes 227, 228, 229, 230 over the contacts 231, 232, 233, 234 of the various lines appearing in such line finders.

The sequence switch 100, on coming into its second position, by closing the springs 108 bottom, 106 top and 107, has placed selectable potential on the terminal 234 of the trunk line or circuit connected to the first line finder associated with such sequence switch 100. When the brush 230 of one of such second line finders comes in contact with the terminal 234, upon which this selectable potential exists, the test relay 235 will be energized, the circuit for such relay including the springs 604 top, 605 top and either the interrupter brush 236 or the spring 606 top. Such relay 235 will, therefore, be energized, closing in parallel to its right-hand winding the low resistance holding winding, which will so reduce the potential upon the terminal 234 that no other second line finder can now seize the line to which such terminal is individual. The brushes of the seizing second line finder, however, will continue to move until when they are centered upon the terminals of the seized line the circuit over the interrupter brush is opened, and, the shunt being thereby removed from around the power-control test relay 237, such relay is energized to stop the switch in the usual manner by opening the circuit of the power magnet 226 and closing the circuit of the holding magnet 238, at the same time driving the sequence switch 600 out of its first into its second position by closing a circuit over the spring 607 top.

As the sequence switch 600 leaves its first position, and until it has passed through its seventh position, a busy test guard is maintained upon the terminal 234 by the closure of the spring 610, connecting ground to such terminal. As the sequence switch 600 was passing from its first into its second position, the spring 611 was closed sufficiently long to drive the sequence switch 200 out of its first position, the circuit for moving such sequence switch including the spring 202 bottom. This sequence switch comes to rest in its second position.

In position 2 of the sequence switch 600, and in position 2 of the sequence switch 200, the selection of an idle registering and controlling mechanism will take place. Before considering this operation, however, the various effects of the seizure of the circuit connected to the first line finder, and the movement of the sequence switch 200 into position 2 will be considered. When the test relay 235 was energized, the circuit therefor also included the relay 137, to maintain it energized, and relay 137 being energized the sequence switch 100 is moved from its second position to its fifth position.

In position 5 the circuit for relay 137 will include the resistance 140 as well as the resistance 141, but such relay will be maintained energized so long as the spring 610 top is closed.

In position 5 of the sequence switch 100, the spring 110 being open, the circuit for the cut-off relay 139 now includes the spring 102, the relay 135 and the spring 207; the sequence switch 200 now being in the second position. In this position also the spring 112 is open and the circuit of the calling line is extended over the springs 210 top and 211 top to the repeating coil 239.

As the sequence switch 600 came into its second position, the springs 604 bottom, 619 top, 605 bottom, 606 bottom and 613 bottom were closed. If at this time the sequence switch 700 individual to the connecting circuit shown is in such position that an idle registering and controlling equipment is connected by it to the leads shown, the relay 240 will be energized over a circuit including springs 703, 619 bottom, 704 bottom, relay 426 and spring 405 of the sequence switch 400 individual to such idle registering and controlling equipment. If, however, the equipment with which the leads are connected over such sequence switch 700 is already busy, the test circuit including the relay 240 of some other connecting circuit will already be energized over the circuit including the relay 426 and insufficient current will pass through the relay 240 shown, to energize it. A circuit will, therefore, be established over the back contact of such relay 240, spring 613 bottom and spring 702 to cause the sequence switch 700 to move and it will continue in motion until on closing the circuit from the leads of the connecting circuit to the leads of an idle equipment the relay 240 is energized, at which time the circuit over the sequence switch 700 will be

opened and the relay 237 being energized in parallel with the relay 240 the sequence switch 600 will be driven through sequence switch springs 602 top and 607 top from its second into its third position. In this position the relay 240 and the relay 237 are directly connected over the spring 619 bottom and over the spring 704 bottom, for example as shown, to the starting relay 426. This idle registering and controlling equipment is now seized and is inaccessible to any other connecting circuit having access thereto until it has performed its function or has been released by the hanging up of the receiver of the calling subscriber, as will be hereinafter described.

As the sequence switch 600 moved into its third position it closed the circuit over the spring 609 to drive the sequence switch 200 also to its third position. In this position springs 210 bottom and 211 bottom are closed, and the impulse receiving circuit from the subscriber's substation to the registering and controlling equipment is now complete, such circuit being traceable from battery through the stepping relay 427, spring 402 of the sequence switch 400, spring 707 bottom of the sequence switch 700, spring 210 bottom of the sequence switch 200, brush 228 and terminal 232 of the second line finder switch, brush 126 and terminal 130 of the first line finder switch over the subscriber's line and through his substation, terminal 129 and brush 125 of the first line finder switch, terminal 231 and brush 227 of the second line finder switch, spring 211 bottom to ground and back to battery. This circuit being established, and the relay 426 being energized, as before described the sequence switch 400 is driven out of its first and into its fourth position.

It will be observed that the calling subscriber's supervisory relay 241, which at this time controls restoration and which in position 2 and position 4 and positions subsequent thereto is directly under the control of the calling subscriber, is energized by the closure of a spring 205.

The apparatus will now await the sending of impulses by the calling subscriber, such impulses being arranged in groups corresponding to the complement of the digits of the numerical designation of the called subscriber's station—that is to say, the called subscriber's number being assumed to be 307, the calling subscriber will transmit to the central station three series of impulses, the first series comprising seven impulses, the second series comprising ten impulses, and the third series comprising three impulses. In each of these series of impulses the last impulse sent will be relatively longer than the other impulses of the series, which other impulses are, in fact, quite short. The sender by which these impulses are sent may be of any desired structural character, provided that the impulses are sent in a complementary manner, and that the last of each of the groups of impulses sent by such device is relatively longer than the other impulses of such group. A sender is diagrammatically shown capable of accomplishing the necessary functions, and in which the setting of the sender produces no impulse in the circuit. The impulses as produced in the system as disclosed are interruptions of the circuit.

The system herein disclosed is for clearness shown only as a 1000 line system. In such a system there will be five groups of final selectors, each accessible to 200 lines thereof, and the group selectors used will have only five of the ten banks thereof utilized, one bank of contacts being connected to the trunk lines of the group of final selectors individual to one group of 200 lines, another connected to another group of final selectors individual to another 200 lines, and so on. In accordance with the translating system disclosed herein, the selection in the group selector of the trunk line leading to the group of lines having the proper hundreds digit is such that if the 100's digit of the desired line is zero or one, the tripping spindle of the group selector will be adjusted to release the proper set of brushes on the brush carriage by the movement of such spindle one step or stage. If the 100's digit of the desired line is two or three, such spindle will be moved three steps or stages. If the 100's digit is four or five, the spindle will be moved five steps or stages. If the 100's digit is six or seven, such spindle will be moved seven steps or stages, and finally if the 100's digit is eight or nine, such spindle will be moved nine steps or stages. Of course, it will be understood that if the system is for more than 1000 lines that the intermediate steps or stages, that is, second, fourth, sixth, eighth and tenth will be reserved for use when a trunk line is desired leading to the groups of selectors having access to the lines of such second thousand.

In a 1000 line system as herein disclosed, the trunk lines may be, and it will be assumed, are, connected to the alternate levels of contacts in such group selector. It will be further understood that by properly rearranging the tripping teeth upon the tripping spindle, the five levels and terminals which are used may be arranged, if desired, adjacently to each other, so that the first level will be selected by a single step of the tripping spindle, the second level by three steps of such spindle, the third level by five steps of such spindle, and so on. Furthermore, if preferred, the arrangement of the lines of the subscribers upon the final selectors may be so arranged that the trunk line leading to a corresponding group of 100 in each of the two thousand lines accessible

through a group selector will be selected in the same level of such group selector, such arrangement resulting in the selection of a line whose 100's digit is zero in either thousand by one step of the tripping spindle of the group selector, a line whose 100's digit is 1 by two steps of the tripping spindle, and so on. As shown, however, the arrangement of the lines and the selection in the group selector will take place as first above described. An operation, therefore, of the subscriber's sending mechanism to send the 100's digit 3 will produce seven breaks in the circuit, hereinbefore described, including the stepping relay 427, the last of such breaks being relatively longer than the others of the group. Upon the initial energization of the stepping relay 427 a circuit was closed by its armature over the spring 408 and the back contact of the changeover relay 428, including the lower winding of the 100's register 429. This causes the energization of the power magnet of such register and it moves until when midway between its zero or normal position and its first position, its local positioning or A spring 471 is closed. At this time a circuit is closed over the front contact of the relay 426 and such positioning spring through the upper winding of this register. The two windings of the register are differentially wound on the power magnet thereof, so that when a circuit is closed through both of said windings, or when there is a circuit through neither of said windings, such register will stop; whereas, when a circuit is closed through but one of said windings the register will move. The register 429, having therefore been brought to rest between its zero and first positions, will await the opening of the circuit through its lower winding at the front contact of the stepping relay 427 before moving farther. Therefore, as the result of the first impulse or interruption in the circuit in the operation of the subscriber's sending mechanism, and the consequent deënergization of the stepping relay 427, the register will move into its first position, the circuit of the upper winding thereof being closed through the positioning spring 471. Upon the cessation of the first impulse, the relay 427 is again energized, and the register 429 is driven to a position intermediate of its first and second positions, correspondingly in response to the second impulse it will be driven into its second position. Therefore, as seven impulses are being received, the seventh impulse will drive the register 429 into its seventh position. As this impulse is a longer one the stepping relay 427 will be deënergized sufficiently long for its armature to close at its back contact and spring 413 a circuit for the slow operating changeover relay 428 and energize the same. This changeover relay, opens the circuit of the register 429 at its right-hand armature, in order to prevent any false operation of such register, and closes at its left-hand armature a circuit over spring 404 for the sequence switch 400, driving such sequence switch into its 6th position. The 100's register has now been set, and it may proceed to control selection in the group selector. For this purpose the outgoing sequence switch 450 shown to the right of Fig. 4ª, and whose springs are all to the right of the dotted line, has been started by the closure of the spring 407 bottom as the incoming sequence switch 400 passes through its 5th position. Before, however, describing the selection controlling operation initiated by the movement of the outgoing sequence switch 450, further registering operations will be described.

Upon the reëstablishment of the transmitting circuit, and the consequent energization of the stepping relay 427, the circuit through the lower winding of the 10's register 430 will be energized in the 6th position of the sequence 400 over the spring 409 top. The group of impulses now being sent in, comprising ten impulses, (the zero digit being sent), the tens register will be moved to, and come to, a stop in its tenth position precisely in a similar manner as that in which the 100's register was set. The last impulse of this group being a relatively longer one, the changeover relay 428 was energized and the sequence switch 400 driven into its eighth position, the 10's register 430 thereby being removed from association with the stepping relay, and the units register 431 being placed under the control of such relay by the closure of the spring 409 bottom. The closure of the controlling circuit including the stepping relay 427 and its interruption three times to send the digit 7 will cause the units register 431 to move into its third position in the manner now well understood, and the final impulse being a long one, the sequence switch 400 will be driven out of its eighth position by the energization of the changeover relay 428. In its ninth position the incoming switch 400 will remain until at the conclusion of the selection controlling operation it is started in motion to its normal position by a circuit closed by the outgoing sequence switch 450 in returning to normal over the spring 407 top.

The registers have now been set to properly control the selection controlling operations in accordance with the numerical designation of the desired subscriber's line; the 100's register has been moved into its seventh position, the 10's register has been moved to its tenth position and the units register moved into its third position. As the incoming sequence switch 400 reached its ninth position a circuit was closed over the spring 412, and the spring 206 bottom, to drive the

sequence switch 200 out of its third into its fourth position, in which position the supervisory relay 241 is again placed under the control of the calling subscriber, and the sending circuit from the calling substation is open at the springs 210 bottom and 211 bottom.

The outgoing sequence switch 450 of the registering and controlling equipment, when it was moved from its first position as the incoming sequence switch 400 passed through its fifth position as above described, continued in motion until it reached its fourth position. In passing from its first to its second position a test was made by the spring 459 to determine whether the 100's digit of the number registered was odd or even; it having been found to be odd, the hundreds register is in its seventh position, seven impulses having been sent by the calling subscriber operating his sending mechanism for the digit 3, a circuit was closed for the translating relay 432. It will be observed that the spring 474 of the 100's register is closed in the following positions; only a few of which, for clearness, are indicated upon the drawings:

$\frac{1}{2}$ to 1
$2\frac{1}{2}$ " 3
$4\frac{1}{2}$ " 5
$6\frac{1}{2}$ " 7
$8\frac{1}{2}$ " 9
$10\frac{1}{2}$ "11

The relay 432 was therefore energized, closing by its right-hand armature a locking circuit for itself including the spring 455 top, and such relay will be maintained energized until the sequence switch leaves its ninth position.

As the sequence switch 450 passes through its second position the closure and subsequent opening of the circuit of the power magnet of the 100's register over the spring 458 bottom will drive such register one additional position that is in this case into its eighth position. Also as the sequence switch 450 passes through its third position the translating relay 432 being locked up a circuit will be established over the spring 460 top, left-hand armature of such relay and spring 461 bottom, to drive the 100's register 429 from its eighth into its ninth position.

On coming into its fourth position the sequence switch 600 being already in its third position, the fundamental circuit from the registering and controlling equipment is closed to the group selector shown on Fig. 2. This circuit includes the line relay 242 of the group selector, and the selection controlling stepping relay 433 of said equipment, both of which relays will be energized. This circuit also includes the springs 612, 473, 457 and 611 bottom.

The energization of the relay 242 drives the sequence switch 600 into its fourth position over the spring 614, in which position the circuit for the tripping spindle power magnet 243 is closed and the tripping spindle starts in motion. In moving from position 3 to position 4, sequence switch 600 makes no changes in the fundamental circuit.

As the relay 433 was energized coincidently with the energization of the line relay 242, it closed the circuit over the spring 458 top for the lower winding of the 100's register 429; the register, therefore, moved a half of a position, that is, until the closure of the circuit through its upper winding and the positioning spring 471 thereof is closed. As the tripping spindle of the group selector began to move it intermittently closed a circuit to ground, such circuit being so connected to the fundamental circuit that when it is closed the relay 433 will be shunted and deënergized, though the line relay 242 is maintained energized. This deënergization of the relay 433 will take place once for each movement of the tripping spindle one step or stage. Upon the deënergization of the relay 433 the 100's register again moves until it comes into its tenth position, from which position it will be moved to a position intermediate between its tenth and eleventh positions, when the relay 433 is again energized as the tripping spindle comes into its set position to trip the first set of brushes of the group selector; in the continued motion of the tripping spindle a second deënergization of the relay 433 takes place and the 100's register is moved into its 11th position, to be moved again into a position intermediate between its eleventh and zero positions, when the shunt is again removed at the tripping spindle.

The next closure of the earth connection at the tripping spindle, and the consequent third deënergization of the relay 433 drives the 100's register into its zero or normal position. In this position the spring 473 is open and, consequently, not only will the relay 433 remain deënergized when the connection to earth is broken at the tripping spindle, but also the line relay 242 will be deënergized, both the fundamental circuit and the branch circuit to ground being now open. As soon as this occurs, the circuit for the tripping spindle power magnet 243 is open at the front contact of the line relay 242, and the tripping spindle is brought to rest. Such tripping spindle, having moved three steps or stages, is now in position to release the third set of brushes on the brush carriage of the group selector, as it will be recalled that a trunk line leading to the group of final selectors in which the desired line appears is to be found in the third bank or level of such group selector.

As the 100's register came into its zero or

normal position, if the incoming sequence switch 400 is in its 9th position—that is, if 10's and units registration is complete—a circuit will be closed including the springs 456, 472 and 410 to drive the outgoing sequence switch 450 into its 6th position, in which it is ready to control tens selection as soon as an idle trunk line to a proper final selector has been found and seized in the group selector, as will be described. If the incoming sequence switch 400 is not as yet in its 9th position, the outgoing sequence switch 450 will remain in its 4th position, moving into its 6th position as soon as the sequence switch 400 reaches its 9th position.

When the line relay 242 stopped the movement of the tripping spindle of the group selector, it also closed a circuit over its back contact and the spring 602 top, back contact and armature of the relay 237, which is deënergized after the sequence switch 600 left its 3rd position, and spring 607 bottom, to drive the sequence switch 600 into its 5th position.

In the 5th position a circuit will be established for the group selector power magnet 244, including the spring 603 bottom the back contact and armature of relay 237, sequence switch spring 602 top and the back contact and armature of the line relay 242. The brush carriage of the group selector, therefore, will begin to move in its first movement, causing the proper set of brushes to be released in the movement past the said tripping spindle and then causing such released brushes 245, 246 and 247 to make contact with the various sets of contacts in the selected level. So long as the test brush 247 makes contact with the test terminals of trunk lines which are already engaged, insufficient potential will be found thereon to energize the relay 235 due to the fact that the low resistance winding of a relay corresponding to the relay 235 of some other group selector is already connected to the terminal multiplied to such test terminal. As soon, however, as the brushes come in contact with a set of terminals individual to an idle trunk line, full potential will be found on the test terminal thereof, and a circuit will be established for the test relay 235 extending from battery at final selector over the spring 312 bottom, spring 314 top, the left winding of the relay 331, test conductor of the seized trunk line, test brush 247 of the group selector, right-hand high resistance winding of the test relay 235, spring 605 top, power control test relay 237 and spring 606 top to ground. The test relay 235 will be energized, but the relay 237 will not be energized owing to the shunt there-around existing over the interrupter brush 244.

The energization of the relay 235 closes a low resistance circuit through its left-hand winding parallel to its right-hand winding, which so reduces the potential upon the test terminal of the trunk line that the test relay 235 of no other group selector, the brushes of which come in contact with the terminals of such line, will be energized. As soon as the brush carriage, which is continued in motion, properly centers the brushes upon the terminals of the seized line, the shunt circuit through the interrupter brush will be open and the relay 237 will be energized. The energization of this relay will open the circuit for the power magnet 244 and close the circuit for the holding magnet 250 over the springs 608 top and 607 top, so that the brush carriage of the group selector will be properly and accurately stopped in the well-known manner. The energization of the relay 237 has also closed a circuit for the sequence switch 600 to drive such sequence switch into its 6th position. In this position of the sequence switch 600 the fundamental circuit is connected through from the final selector to the registering and controlling equipment, and the closure of this circuit at this time depends upon whether the outgoing sequence switch 450 has reached its 6th position.

When the sequence switch 450 was driven out of its fourth position upon the completion of the hundreds selection controlling operation it moved directly into its sixth position but in passing through its fifth position the momentary closure of the spring 462 bottom has driven the tens register into its eleventh position in the now well-understood manner. When now the fundamental circuit is again closed in the sixth position of the sequence switch 450 including the line relay 332 at the final selector, spring 308 top, brush 246 of the group selector, spring 617 bottom, spring 483 of the 10's register, spring 453 top, relay 433, spring 616 bottom, brush 245 of the group selector, and spring 309 top to ground, the relays 332 and 433 are both energized. The energization of the relay 332 drives the sequence switch 300 into its second position by the closure of the circuit over the spring 303 top, in which position the circuit for the tripping spindle power magnet 333 is closed over the spring 302 bottom and the front contact of the relay 332. The tripping spindle will thereupon begin to move. The energization at this time of the relay 433 has closed a circuit over the spring 462 top to move the tens register one-half of a position from the position in which it was set as described.

It will be recalled that the 10's digit of the desired line is zero and, therefore, such line is to be found in the first bank or level of the final selector. It will therefore be necessary that the selection controlling operation of the final selector should be ter-

minated when the tripping spindle has moved one step or stage and is in position to release the set of brushes corresponding to the first bank set or level of contacts. It will also be recalled that the tens register was set by the subscriber in its 10th position and subsequently moved to its eleventh position. When, therefore, the tripping spindle at the final selector moves its first step or stage, the shunting of the relay 433 in the well-known manner drives the tens register into its zero or normal position. This movement of the tens register immediately opens the fundamental circuit at the spring 483 of such register, so that when the shunt circuit through the tripping spindle is opened both the relay 433 and the relay 332 are deënergized. At the same time the closing of the spring 482 of the tens register closed a circuit including the springs 411, 482 and 463 top to drive the out-going sequence switch 450 into its 8th position ready to control units selection, and the fundamental circuit which has been maintained open between the 6th and 8th positions of such sequence switch will there await its second closure at the final selector.

Immediately upon the deënergization of the line relay 332 as just described the movement of the tripping spindle is stopped, it being now in position to trip the first set of brushes on the brush carriage, and the sequence switch 300 is driven from its second position to come to rest in its 4th position.

As the outgoing sequence switch 450 of the registering and controlling equipment moved through its seventh position upon the termination of tens selection the momentary closure of the spring 454 moves the units register one additional position so that when the sequence switch stops in its eighth position and again closes the fundamental circuit the units register is in its fourth position. The closure at this time of the fundamental circuit again energizes the relays 332 and 433, but this time in the 4th position of the sequence switch 300 and the 8th position of the sequence switch 450. In the 4th position of the sequence switch 300 the energization of the relay 332 closes a circuit over the spring 306 top from the brush carriage power magnet of the final selector, and such brush carriage begins to move. In the initial movement of the brush carriage, the proper set of brushes (in this case the first set) is tripped as the carriage passes the tripping spindle.

In the subsequent movement of the brush carriage the brushes 334, 335, 336 sweep over the sets of terminals individual to the lines multipled to this bank or level of contacts. For each movement of such brushes to a set of terminals the interrupter device 337 closes a circuit to ground from the fundamental circuit over the springs 313 top and 315 in the well-known manner, such circuit to ground as is well understood shunting the relay 433 while maintaining the relay 332 energized.

Upon the energization of the relay 433 and its subsequent intermittent deënergization due to the shunting action of the contacts of the interrupter 337 at the final selector, the units register will be stepped in the well understood manner, one full position for each energization and subsequent deënergization of the relay 433. At the end of eight of such operations of the relay 433 the units register will again be in its normal position, the selected brushes of the final selector at this time being about to make contact with the 8th or No. 7 set of contacts of the bank or level to which they are individual. It will be recalled, however, that since the desired line is located in an odd hundred, the particular line desired is to be found in the second half of the final selector, and it is therefore necessary that the selecting operation should not terminate at this time. For this reason the fundamental circuit is not opened at this time at the spring 493 as would be otherwise the case, a shunt being maintained about such spring, such shunt including the spring 460 bottom, left hand armature of the translating relay 432 and the spring 461 top.

It will be recalled that the relay 432 was locked up when the sequence switch 450, in passing from its first to its second position, tested the condition of the 100's: register 429, and on finding it in a position corresponding to an odd hundred, completed the circuit for the translating relay 432. The fundamental circuit not being open at this time, the brush carriage at the final selector will continue to move until the units register 431 has made a complete revolution as a result of such movement. This means that the units register will take twelve additional steps. It will now be seen for what purpose the two additional notches in the interrupter plate of the final selector are provided, as hereinbefore described. To reach the contacts of the desired line after the units register has first reached its normal position would otherwise produce only ten deënergizations of the stepping relay 433, and, consequently, only ten steps by the units register.

Since it is necessary that the units register should come into its zero or normal position in order to cause the cessation of selection, it is necessary that two additional steps be provided for and, consequently, two additional notches are cut in the interrupter plate of the final selector to produce such steps. Therefore, after the stepping relay 433 has been operated twelve additional times, and as the selected brushes of the

final selector are coming into contact with the 7th set of terminals in the second half or range of the selected bank or level of the final selector, the units register will again be in its normal position.

As the units register passed its normal position without stopping, as above described, circuit was closed by the spring 492 over the spring 463 bottom to drive the sequence switch 450 out of its 8th and into its 10th position, this circuit being only maintained momentarily by the spring 492. The sequence switch stopped in its 10th position. When now the units register 431 comes a second time into its normal position the shunt around the spring 493 thereof being opened at the springs 460 bottom and 461 top, the fundamental circuit is immediately opened, producing the deënergization, in the manner well understood, of the relays 332 and 433 to terminate selection in the final selector. The units register 431 coming into its normal position again closes the spring 492, and the sequence switch 450 returns to its normal position, in which movement in passing through position 11 it closes a circuit at spring 455 bottom to return the sequence switch 400 to its normal position. It should be also noted that the sequence switch 450, on leaving its 9th position, opened the locking circuit of the translating relay 432. The desired line now having been selected, the services of the registering and controlling equipment are no longer required for this connection, and, therefore, as the sequence switch 400 left its 9th position the spring 406 opened the circuit for the relays 426 and 240, which circuit had been substituted for the one originally established over the spring 405 as the sequence switch 400 left its first position. The relays 426 and 240 are therefore deënergized.

The energization of the relay 426, and the restoration of the sequence switch 400 to normal will cause the registering and controlling equipment shown on Fig. 4 to test idle and accessible to any connecting circuit taken for use which has access to it. At the same time that the relay 426 is deënergized the relay 240 was deënergized and by the retraction of its armature closed a circuit to drive the sequence switch 600 from its sixth into its seventh position. This is the through or talking position of this sequence switch. In this movement, however, the contact 611 top is closed and the sequence switch 200 is driven from its fourth into its fifth position. In these positions the sequence switches 600 and 200 await the further operations of the final selector apparatus shown on Fig. 3.

Upon the deënergization of the relay 332 at the completion of the units selecting operation, the sequence switch 300 is driven from its fourth position, and it will move to its sixth position. When the trunk line to this final selector was first seized, it will be recalled that the seizing circuit included one of the windings of the relay 331 and the spring 314 top. This relay was therefore energized, and closed for itself a circuit to take the place of the circuit through the spring 312 bottom, which is opened as the sequence switch 300 leaves its first position. As the sequence switch moves from its fourth to its fifth position, the spring 314 top is opened and 314 bottom is closed. The relay 331 is maintained energized, both of its windings now being included in the circuit and the battery is connected over the spring 314 bottom to the power control test relay 339. At the same time the spring 307 top is closed, connecting battery with a high resistance winding of the test relay 349. The fifth position of the sequence switch 300 is the testing position thereof. If in this position full potential is found upon the test terminal 342 of the desired line, indicating that the line is idle, the test relay 349 will be energized over its right hand high resistance winding.

If on the other hand the normal potential upon such test terminal 342 is reduced by such line being busy, either as a calling line or a called line, as will occur in the well-known manner, the test relay 349 will not be energized. Assuming first that the line is idle and that such relay is consequently energized, it closes over its armature a circuit, through its low resistance left hand winding and the test relay 339, in parallel to its right hand winding, which will so reduce the potential of the test terminal of such seized line that it will test busy in all other final selectors in which it appears. Such circuit will also energize the relay 339 and when the sequence switch 300 comes into the sixth position, it will find circuits closed, one over the spring 317 and the other over the spring 305 bottom, and the front contact of relay 339 and the back contact of relay 332, to move it into its tenth position, in which position, and also in the eleventh position a circuit will be found closed to move it into its twelfth position.

The sixth position of this sequence switch is provided for hunting an idle line to a private branch exchange, in case the particular line selected is found busy. The apparatus for performing this operation is not shown, however, and in order to drive the sequence switch through its sixth position, which is, as shown, an idle position, whether the desired line is found idle or busy, the spring 317 is provided.

The twelfth position of the sequence switch 300 is the ringing position. In this position ringing current is projected over the called line by the closure of the springs 310 bottom and 311 bottom.

As the sequence switch 300 passed through its eighth position, the trunk line leading to its final selector was shortcircuited by the closure of the spring 309 bottom. This causes the momentary energization of the supervisory relay 248, which by the attraction of its armature drives the sequence switch 200 into its eighth position. This would cause the subscriber to receive the busy tone by the closure of the springs 212 bottom and 213 top, except for the fact that almost immediately after as the sequence switch 300 passes from its eleventh into its twelfth position, the spring 309 bottom is again closed energizing the relay 248 to drive the sequence switch 200 into its eleventh position. In this position of the sequence switch 200, the springs 212 top and 213 bottom being closed, the subscriber receives the distinctive ringing tone, and will continue to receive such tone so long as the sequence switch 300 remains in its twelfth position.

So long as the called subscriber does not respond, insufficient current will pass over the ringing relay 343 to energize it. As soon, however, as the path for direct current is closed at the subscriber's substation, by the removal of his receiver from its switchhook, the relay 343 will be energized and drive the sequence switch 300 into its thirteenth position. In this position the circuit is closed through from the battery and repeating coil shown in Fig. 2 to the called subscriber's substation, and the relay 248 is therefore energized, driving the sequence switch 200 out of its eleventh and into its fourteenth position.

The sequence switch 100 being in its fifth position, the sequence switch 200 being in its fourteenth position, the sequence switch 600 being in its seventh position, and the sequence switch 300 being in its thirteenth position, the calling subscriber and the called subscriber are now connected, each subscriber being supplied with transmitter current from the battery shown in connection with the repeating coil 239. Conversation may now take place.

Disconnection.—Upon the termination of conversation, one or both subscribers return their receivers to their respective switchhooks, thereby opening a circuit over which the supervisory relays 241 and 248 are maintained energized. Assuming that the called subscriber first restored his receiver to its switchhook, the deënergization of the relay 248 closes a circuit over the spring 203 and 209 bottom, to drive the sequence switch 600 out of its seventh position and into its eighteenth position. In this movement the sequence switch 600 closed in its 8th position a circuit over the springs 609 and 202 top, to drive the sequence switch 200 back to its normal position. On coming into its 18th position the sequence switch 600 established the usual restoring circuit for the brush carriage of the group selector, and such brush carriage moves until the brush 244 of the interrupter comes in contact with the normal segment, at which time circuit is closed over the spring 618 to energize the relay 237 which stops the movement of the brush carriage in the usual manner and drive the sequence switch 600 into its normal position.

As the sequence switch 600 left its 7th position, it opened at the spring 610 top the circuit of the relay 137 at the first line finder. This relay thereupon, being deënergized, drives the sequence switch 100 from its 5th into its 9th position. In the 8th and 9th positions of this sequence switch a circuit for this relay is again established, provided the calling subscriber has not restored his receiver to its switch hook, which includes the spring 108 bottom, the spring 111. The substation circuit and the spring 112 top. The sequence switch 100 will therefore stop in its 9th position and remain there until the subscriber opens the circuit to direct current at his substation by replacing his receiver upon its switch hook. As soon as this occurs, the relay 137 will again be deenergized and drive the sequence switch 100 back to its first or normal position. It will be observed that the cut-off relay 139 is controlled through the 7th position by a circuit including the spring 102 top, and in the 8th or 9th position by a circuit including the resistance 199 and the spring 110. This transfer of control is accomplished before the circuit of the cut-off relay 139 was opened at the spring 207.

As the sequence switch 600 left its 7th position, it opened at the springs 605 top and 606 top the circuit for the relay 331 at the final selector. This relay therefore immediately allowed its armatures to retract, its left-hand armature closing a circuit over the spring 308 bottom to energize the line relay 332. The energization of this relay drives the sequence switch 300 out of its 13th position into its 16th position. On coming into its 16th position, the circuit at the called subscriber's substation being already opened, the relay 332 is without current and therefore is deënergized, driving the sequence switch 300 into its 18th position. In this position of the sequence switch 300 the usual circuits are established to restore the switch carriage of the final selector to normal. When, however, the brush of the interrupter 337 comes in contact with the normal segment, circuit is again established to energize the relay 332 which, by the attraction of its armature, drives the sequence switch into its normal position. The entire apparatus is now in its normal position. It will be observed, however, that although the relay 331 at the final selector is deënergized

immediately that the sequence switch 600 leaves its 7th position, it is not again energized by the closure of the spring 610 bottom, as such relay 331 controls through its right-hand armature the energizing current for itself in all positions, except position 1, of the sequence switch 300. However, in positions 8 to 17 a test guard is maintained on the terminal of the trunk line by the closure of the spring 610 bottom.

Assuming that the calling subscriber first restored his receiver to its switch hook, the restoration to normal of the group selector apparatus, the sequence switch 600, sequence switch 200 and the first line finder apparatus, will take place precisely as has been hereinbefore described, except that these operations are initiated by the deënergization of the supervisory relay 241 instead of by the deënergization of the supervisory relay 248, as has been described, with the further exception that the sequence switch 100 will not stop in its 9th position as the circuit for the relay 137 over the calling subscriber's line will not be established. At the final selector, however, when the sequence switch 300 comes into its 15th and 16th positions the called subscriber not as yet having restored his receiver to its switch hook, a circuit will be established for the relay 332, including the springs 308 top, 310 top, subscriber's line, 311 top and 309 top. Therefore, when the sequence switch 300 comes into its 16th position it will there stop and await the restoration of the called subscriber's receiver to its switch hook, which, when it occurs, will open the circuit to the relay 332, allowing such relay to deënergize, to drive the sequence switch 300 out of its 16th position, after which the restoration of the final selector apparatus will take place as has been hereinbefore described.

Attempted connection to a busy line.—If after the final selector switch has been moved to bring its brushes 334, 335, 336 into contact with the terminals of the desired line, and the sequence switch 300 is moving through its 5th and 6th positions, such line should be found busy, insufficient potential will exist upon the test terminal 342 to accomplish the energization of the relay 349, consequently, no energization of the relay 339 will take place and when the sequence switch 300 comes into its 10th position it will stop, and the restoration of the brush carriage of the selector will take place over a circuit including the armature and back contact of the relay 332, armature and back contact of the relay 339, and spring 306 bottom.

As the sequence switch 300 passed through its 8th position, it will be recalled that the closure of the spring 309 bottom caused the energization of the supervisory relay 248 to drive the sequence switch 200 into its 8th position. In this position the busy tone is applied to the trunk line and the calling subscriber is thus notified of the busy condition of the desired line. When the brush carriage of the final selector reaches its normal position the relay 332 will be energized by circuit including the normal segment of the interrupter 337, and the sequence switch 300 will be driven into its 11th position. The circuit for such relay 332 being opened at the spring 313 as the sequence switch leaves its 10th position, the sequence switch 300 will stop in its 11th position. This sequence switch will remain in this position and the sequence switches 600 and 200 will remain in their 7th and 8th positions respectively (the called subscriber's line being entirely unaffected) until the calling subscriber restores his receiver to its switch hook when in response to the deënergization of the supervisory relay 241 the sequence switch 200 will be driven from its 8th into its 11th position. As it comes into its 9th position circuit will be established over the back contact of the supervisory relay, and the spring 209 bottom, to drive the sequence switch 600 out of its 7th position, from which position the restoration of the group selector switch, the sequence switch 600, the sequence switch 200 and the apparatus of the first finder will take place precisely as has been hereinbefore described. Furthermore, the restoration of the final selector apparatus will also take place as hereinbefore described immediately that the relay 331 is deënergized as the sequence switch 600 leaves its 7th position.

Premature disconnection.—If the calling subscriber should restore his receiver to its switch hook in the third position of the sequence switch 200, the deënergization of the stepping relay will cause the energization of the change-over relay 428, and the relay 427 remaining deënergized and the relay 428 energized, the incoming sequence switch 400 will be driven directly into its ninth position, from whatever position it may be at the time. When sequence switch 400 reaches its ninth position, the sequence switch 200 will be driven from its third into its fourth position, as has been hereinbefore described. The sequence switch 200 will then be further driven into its eleventh position by the closure of a circuit over the back contact of the supervisory relay 241, and from such position the group selector apparatus, the sequence switch 600, the sequence switch 200, the first line finder apparatus and the final selector apparatus, if it has been seized and moved from normal will be restored to normal condition, as has been hereinbefore described.

If the calling subscriber restores the receiver to its switchhook at any time after the sequence switch 200 has left its third

position and before it comes into its eighth position, the deënergization of the supervisory relay 241 will drive the sequence switch 200 into its eleventh position from which the restoration of all the apparatus will take place as hereinbefore described.

On any occasion of premature disconnection which takes place when the registering controlling apparatus is in an off-normal condition, the deënergization of the starting relay 426 will insure the restoration to normal of the various registers of the registering and controlling equipment.

The deënergization for a prolonged period of the stepping relay 427 causes the change over relay 428 to be energized sufficiently long to drive the sequence switch 400 into its ninth position.

In passing through its fifth position, the sequence switch 450 is started in motion as hereinbefore described. On coming into its fourth position, if it is not already in this position, the starting relay 426 being now deënergized, a circuit is established for the stepping relay 433 which includes the back contact and left hand armature of the starting relay, spring 473 of the hundreds register, spring 457 and back contact and right armature of the starting relay 426. The stepping relay 433 being energized a circuit is closed through the lower winding of the power magnet of the hundreds register and the register will start in motion. It will be observed that the circuit through the spring 471 and the upper winding of the power magnet of the hundreds register is opened at the right armature of the starting relay 426. The hundreds register will therefore move continuously until on coming into its normal position spring 473 is opened, when it will stop, the stepping relay 433 being then deënergized and the circuit of the lower winding of the power magnet of the hundreds register being thereby opened. The closure of the spring 472 in the normal position of the hundreds register drives the sequence switch 450 into its sixth position in the usual manner. In this position if the tens register is out of its normal position a circuit will be established over the springs 483 and 453 for the stepping relay 433 and the circuit which would otherwise be established over the spring 481, being maintained open at the front contact of the starting relay 426 the tens register will return to its normal position in which position it will stop, and by the closure of the spring 482 drive the sequence switch 450 into its eighth position in the usual manner. In the eighth position the units register 431 will be restored to its normal position in precisely the same way. On coming into its normal position the closure of the spring 492 will drive the sequence switch 450 out of its eighth position, and also out of its tenth position, and such sequence switch will return to its normal position. On passing through its eleventh position, the closure of the spring 455 will return the sequence switch 400 to its normal position in the manner hereinbefore described. Of course, if at the time premature disconnection took place, the hundreds register was in its normal position, no circuit would be established in the fourth position of the sequence switch 450 for the stepping relay 433, but a circuit would be immediately established to drive the sequence switch 450 into its sixth position. Correspondingly if when the sequence switch 450 came into its eighth position, the units register 431 was already in its normal position, the sequence switch 450 would be moved directly into its normal position.

Register controller mechanism supervisory signals.—Associated with the registering controlling mechanism are the signals 497, 498, 499. The spring 464 being closed in the fourth position of the sequence switch 450 causes the lamp 497 to light, indicating that the hundreds selecting controlling operation is taking place. Correspondingly the closure of the spring 465 top in the sixth position lights the lamp 498 to show that the tens selection controlling operation is taking place, and also correspondingly its closure at its bottom contact in the eighth and tenth positions and the consequent lighting of the lamp 499 indicates that the units selection controlling operation is taking place. These lamps serve to indicate to an attendant at what stage of its operation the registering controlling mechanism may be, and the prolonged lighting of one of these lamps will indicate some trouble which has held up the connection in the particular stage indicated by the lamp.

Establishing untranslated connection.—In the establishment of the connection hereinbefore described, it has been assumed that the number of the desired line was 307, in which case it was necessary that the desired line be selected in the second half or range of the final selector, and further that it was necessary that a second additional movement of the 100's register 429 be produced by the closure of the spring 460 top.

To illustrate how a call will be selected in the first half or range of the final selector it will be assumed that the desired line is designated 207. In this case obviously the tens register 430 and the units register 431 are set as hereinbefore described, in their 10th and 3rd positions respectively and by the subsequent steps produced by the springs 462 bottom and 454 bottom, control the selection controlling operations from the 11th and 4th positions respectively as hereinbefore described. The 100's register, however, will be set by the subscriber's sender in its eighth position, eight impulses having

been received from the substation sender to indicate the 100's digit 2.

When the sequence switch 450 moved from its first to its fourth position, preparatory to the initiation of the 100's selection controlling operation as it passed between its first and second position, the spring 459 was closed, but as the 100's register 429 was in an even position—in this case its 8th position—no circuit was established for the translating relay 432, and such relay is therefore not energized, and cannot be energized subsequently in the establishment of the desired connection. As the sequence switch 450 passed through its second position, the additional movement of the 100's register 429 one step or position is produced by the closure and subsequent opening of the spring 458 bottom. In passing through its third position no second movement of the 100's register 429 takes place, even though the spring 460 top is closed, for the reason that the translating relay 432 is not energized, and the circuit including the spring 460 top and the 100's register is therefore not closed. The 100's selection therefore will be controlled by the 100's register 429 from its ninth position and the group selector will be operated to select an idle trunk to a final selector in its third row of contacts as hereinbefore described, it being recalled that the trunk lines leading to the panel selectors having access to lines whose 100's digit is 2 and also whose 100's digit is 3 are in the third row of contacts of the group selector. Tens selection will take place in the present instance precisely as has been hereinbefore described. Units selection, however, will be terminated in the present instance when the units register 431 first returns to its normal position—that is after such units register has been moved eight steps to control the selection of the eight or No. 7 set of terminals in the first range of contacts in the selected level of the final selector. This result is produced by reason of the fact that no circuit to maintain the fundamental circuit closed exists in the 8th and 9th position of the sequence switch 450 as hereinbefore described through the spring 460 bottom, left armature of the translating relay 432 and spring 461 top. The fundamental circuit will therefore be opened at this time, causing the cessation of selection at the final selector and the sequence switch 450 will be driven continuously through its 9th and 10th positions by the closure of the spring 463 bottom, coming to rest only when it reaches its normal position.

It will therefore be seen that the translating relay 432, which tests the condition of the 100's register 429 as set by the subscriber, determines whether it is necessary that the 100's register be given the additional movement of one position, and also determines whether the desired line is to be found in the first half or second half of the selected level in the final selector.

It will be obvious from this description that for any number desired by the calling subscriber the impulses received from the substation when the substation sender is operated in accordance with the designation of the desired line will so set the registers at the central office that connection with the desired line will be accurately and positively accomplished.

I claim:

1. Registering and controlling equipment for machine switching telephone systems comprising a plurality of register-controllers, a sequence switch controlling the circuits by which said register controllers are set one after another and a second sequence switch controlling the circuits by which said register controllers one after another exercise their selection controlling operations.

2. Registering and controlling equipment for machine switching telephone systems comprising a plurality of register-controllers adapted to register the numerical designation of the desired line, and to produce selection controlling operations in accordance therewith, an incoming circuit under the control of which such register-controllers are one after another set, and an outgoing or selection controlling circuit over which said register-controllers one after another perform their selection controlling operations, and two sequence switches one controlling the association of such register-controllers with said incoming circuit and the other controlling the association of such register-controllers with said outgoing circuit.

3. Registering and controlling equipment for machine switching telephone systems comprising a plurality of register-controllers, an incoming circuit under the control of which said register-controllers are adapted to be set to register the numerical designation of the desired line, an outgoing circuit over which said register-controllers perform their respective controlling operations, a sequence switch associated with said register-controllers and said incoming circuit adapted to associate said register controllers one after another with said incoming circuit in response to changeover impulses in said circuit, a second sequence switch associated with said register-controllers and said outgoing circuit, a circuit controlled by said first sequence switch for operating said second sequence switch to associate a register-controller with said outgoing circuit, and a circuit controlled by said register-controller in the position taken by it at the termination of its selection controlling operation to operate said second sequence switch to remove such register-controller from association with

said outgoing circuit and associate a second register-controller therewith.

4. A registering and controlling equipment for machine switching telephone systems comprising a plurality of register-controllers, an incoming circuit under the control of which said register-controllers are set to register the numerical designation of the desired line, an outgoing circuit over which the said register-controllers perform their selection controlling operations, a sequence switch associated with said incoming circuit and said register-controllers to associate said register-controllers one after another with said incoming circuit in response to the changeover impulse in said incoming circuit, a second sequence switch associated with said register-controllers and said outgoing circuit for associating said register-controllers one after another therewith, a circuit controlled by said first sequence switch the closure of which causes said second sequence switch to operate to associate a first register-controller with said outgoing circuit, and a circuit jointly controlled by said first register-controller and said first sequence switch, the closure of which causes said second sequence switch to remove such first register-controller from association with said outgoing circuit and associate a second register-controller therewith.

5. A registering and controlling equipment for machine switching telephone systems comprising a plurality of register-controllers, an incoming circuit by which the setting of said register-controllers is controlled when they are one after another associated therewith, a slow operating relay coöperating with said incoming circuit and adapted to respond only to a prolonged impulse in said circuit, a sequence switch associated with said slow acting relay and said register-controllers responsibe to the operation of the slow acting relay to cause the association of said register-controllers with said incoming circuit one after another, an outgoing circuit over which such register-controllers perform their selection controlling operations when one after another associated therewith, a second sequence switch associated with said register-controllers, and said outgoing circuit controlling the association of said register-controllers one after another with said outgoing circuit, and a plurality of controlling circuits for said sequence switch each jointly controlled by one of said register-controllers and said first sequence switch.

6. A registering and controlling equipment for machine switching telephone systems comprising a plurality of register-controllers, an incoming circuit controlling the setting of said register-controllers when they are one after another associated therewith, a sequence switch associated with said incoming circuit and said register-controllers associating said register-controllers with said incoming circuit in response to changeover impulses in said circuit, an outgoing circuit over which said register-controllers perform their selection controlling operations when one after another associated therewith a second sequence switch associated with said register-controllers and said outgoing circuit to associate said register-controllers one after another therewith, and a circuit controlled by one of such register-controllers in the position assumed by it at the termination of the selection controlling operation and by said first sequence switch in the position assumed by it at the termination of the setting operation of a subsequent register-controller causing, when closed, the operation of said second sequence switch to remove this register-controller which has finished its selection controlling operation from association with such outgoing circuit and to associate another register with such outgoing circuit.

In witness whereof, we hereunto subscribe our names this 31st day of January A. D., 1914.

FRANK ROBERT McBERTY.
LIPA POLINKOWSKY.

Witnesses:
F. T. WOODWARD,
H. TUCK SHERMAN.