PANEL DIAL TELEPHONE SYSTEM

TRAFFIC LAYOUTS

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PANEL DIAL TELEPHONE SYSTEM TRAFFIC LAYOUTS

This bulletin is issued to provide general information covering the traffic layouts in the Panel Dial Telephone System. Information contained herein is for educational purposes only.

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BIBLIOGRAPHY

Hawthorne Club Evening School Course TP-2 1937

Please Note:

Pages 22, 44, 52, 60, and 66 will not appear in this electronic document because the original document contained empty pages for those pages. Also, due to the complexity and hard to read small details of scanning 11" x 17" engineering drawings on a stndard scanner and splicing the sections together with proper alignment and resolution, the task was felt to be too time consuming for what few people would benefit from having these drawings of systems which are over 60 years old; therefore, these drawings are not include here (Figures 1 to 17). Sorry for having to leave them out of this electronic document but it just wasn't feasable.

PANEL DIAL TRAFFIC LAYOUTS

INTRODUCTION

The preceding course in Panel Dial Telephony presented a description of the apparatus and frames comprising the Panel Dial System and of the methods used in completing calls from Dial to Dial, from Dial to Manual and from Manual to Dial subscribers. In general, the description covered only that equipment involved in the completion of one call, little consideration being given to the fact that many calls of a varied nature must be in progress at the same time. It is the purpose of this course to describe the various practices in the arrangement of apparatus on the frames, the arrangement of frames in the central office and the grouping of lines and trunks necessary to satisfactorily meet a variety of traffic conditions. Not only will the various traffic possibilities of units of equipment be described, but an actual application of one or more methods to a recent panel office will be studied.

Many improvements have been made in Panel equipment since its original introduction into the Bell System and as a result the various existing offices may be grouped into several distinct types. Experience in the field with the final selector circuit used prior to 1929 had shown the desirability of improving the terminal hunting circuit and of obtaining greater margins for circuit operation. In redesigning the final selector circuit to accomplish this, it was found that the best results could be obtained by employing battery instead of ground on the sleeve lead through the winding of the cutoff relay in the subscriber line circuit.

In order to distinguish between the new arrangement and the arrangement previously used, equipment designed for battery on the sleeve became known as "Battery Cutoff Relay Equipment," and the earlier type as "Ground Cutoff Relay Equipment."

Co-incident with the development of Battery Cutoff Relay equipment, the panel "B" Switchboard was completely redesigned to provide for call distribution which increased the efficiency of the "B" operators by distributing evenly the incoming traffic over the occupied positions.

As there were also other changes made in panel equipment in addition to those outlined above, a distinctly new type of panel office resulted. In fact, the differences are so marked that it is not possible to furnish Battery Cutoff mechanical equipment to complete a partial 10,000 line ground cutoff unit. Ground cutoff equipment, frequently of a later type than the original, must be furnished.

TYPES OF PANEL DIAL OFFICES IN SERVICE

	Subs Line Conn to	Conn to Send thru	Max No of Send per Group	Type of Sender	Type of "B" Swbd	Year Intro	Appx No in Service
Ground on the Cutoff Relay	Line Switch	Rotary Send Sel	22	*Translator	Cordless	1920	13
	300 Pt Line Find Frm	" " "	22	"	"	1920	69
	400 Pt Line Find Frm	" " "	22	"	"	1924	15
	400 Pt Line Find Frm	Rotary Link	44	"	"	1926	18
	400 Pt Line Find Frm	Panel Link	100	"	"	1927	40
	400 Pt Line Find Frm	" "	100	#Decoder	"	1928	19
Battery on the Cutoff Relay	400 Pt Line Find Frm	Panel Link	100	#Decoder	Call Distb	1929	216

*Translator Senders are of 4 types:

1 - 2 Digit with Translator on Sender Frame (Office Codes of 2 Digits)

2 - 2-3 " " " " " " (" " " 2 & 3 ")

3 - 3-2 " " Separate Translator Frames & Pulse Machines (Office Codes of 2 & 3 Digits)

4 - 3 " " " " " " " " (" " all of 3 ")

#Decoder Senders are of 2 types:

1 - 3-2 Digit (Office Codes of 2 or 2 & 3 Digits)

2 - 3 " (" " "

While this text will cover only the present standard Battery on the Cutoff Relay equipment, many problems arise in connection with the introduction of the new equipment into buildings where units of the Ground Cutoff type equipment are now in service. For this reason, and because of the fact that Ground Cutoff type equipment is frequently ordered for additions to existing offices of this type, the outline on page 2 of the various types of panel dial equipment is included as a matter of general information.

This text has been issued as study material on the Panel System and should not be used for any other purpose. Revised issues of this text will appear when important changes in the system make revision necessary.

COURSE OUTLINE

MAIN & INTERMEDIATE DISTRIBUTING FRAMES AND SUBSCRIBERS LINES

Main Distributing Frame

The telephone lines from instruments at the subscriber's premises enter the central office in lead covered cables through a cable vault and terminate on protectors on the vertical side of the main distributing frame (VMDF). When a separate protector frame is not furnished, the entire vertical side of the MDF is used for mounting protectors, on which all subscribers lines and trunks terminate. Since interoffice trunks are usually run entirely underground and do not require the same protection as line circuits, they may terminate on dummy protectors.

On the horizontal side of the Main Distributing Frame (HMDF) are mounted terminal strips used for terminating switchboard cable from various equipment within the central office. Those circuits entering or leaving the office are cross connected by means of jumpers from the terminal strips to the proper protectors on the VMDF. There is thus provided a means of flexibility in connecting any outside cable pair to any circuit within the office.

As several central offices may be located in the same building and terminated, for flexibility of trunk assignments on one MDF, this frame frequently would attain a length greater than the building could accommodate. There are two methods in general use by means of which the length of any one MDF may be held within the limits of the building without loss in flexibility. The first method consisted of terminating the subscribers lines on one MDF (Subs MDF) and the trunks on another MDF (Trunk MDF) located adjacent and parallel to each other. This method entailed no loss of flexibility since there is no occasion to cross connect lines to trunks. The second and more recent method employed a separate protector frame located parallel to the MDF. This protector frame is equipped with protectors on both sides, each side presenting the same appearance as the vertical side of an MDF equipped with protectors. The MDF used with this protector frame is identical on the horizontal side with the older type MDF but the verticals on the vertical side are equipped with terminal strips, each vertical mounting terminal strips associated with two verticals of protectors. Since one of these MDF verticals is equivalent to two of the older type, and further, since the protector requirements usually determine the amount of MDF necessary, the effect was to reduce by one-half the length of the MDF. Some of this saving may be offset by subscriber terminal requirements on the horizontal side.

Subscriber numbers, or terminals, from 0 to 9999 of each central office unit in the building appear on groups of terminal strips on the horizontal side of the MDF. From these terminals jumper cross-connections are run to the protectors, thus making possible the connection of any number to any underground cable pair. This feature is necessary due to changes in underground cables and to permit a given subscriber to retain the same telephone number should he move to a different part of the area served by that building, in which case his line would come in on an entirely different underground cable. From these HMDF terminal strips, two conductors (Tip) and (Ring) are extended in

switchboard cable to the horizontal side of the Intermediate distributing frames serving each central office unit.

The foregoing description covers the usual practice with respect to the 10,000 numbers of each unit appearing on the HMDF but in recent years an alternate standard has been introduced for use in areas having a large percentage of party lines. This new method, which is used on the study job selected for this course, provides for cabling the HMDF terminal strips to terminal strips of the subscriber lines on the vertical intermediate distributing frame. In party line areas, the total number of subscriber lines may be appreciably less than the number of working terminals and, since it is only the subscriber line that leaves the building, a saving is realized on HMDF terminal strips and cable between the HMDF and the IDF.

INTERMEDIATE DISTRIBUTING FRAME

The intermediate distributing frame (IDF) may, or may not, be located on the same floor with the MDF. It should be located as near as possible to the mechanical equipment of the unit which it serves. On groups of terminal strips on the HIDF, will appear all equipped terminals of the units served by that IDF. From these terminals, jumper cross-connections are run to the subscriber line circuits terminating on the VIDF. Means are thus provided to assign any one or more terminals to any line circuit in a manner to balance the load on the line finders serving the various groups of lines, and to enable the segregation of various classes of traffic to the proper line groups. The IDF is also used as a terminating point and as a point of cross-connection for a variety of miscellaneous circuits required by the telephone company traffic and maintenance forces.

A number of arrangements are used at the IDF for connecting message registers to the message rate subscriber line and for connecting two or more terminals, or subscribers, to one line circuit. Fig. 4 will illustrate several typical methods.

Figure 4-A

This figure shows the line circuit terminating on the VMDF, cross-connected to the HMDF and cabled to the HIDF where it is extended thru a three or four wire jumper to the VIDF and cabled to the line circuit equipment on the line finder frame. The HIDF terminal strip, which is shown broken, is usually a 7 point terminal strip, the front three rows of which (not shown on this figure) are strapped to adjacent rows and to other terminal strips in order to provide a convenient means of connecting a large number of unassigned numbers, or terminals, to an intercepting answering jack at the "A" Board. The three leads, (T), (R) and (S), to Final Mult are cabled to the multiple banks of the final frames in groups of 500 numbers to each final choice. The second lead on the "S" terminal to Check Mult connects at the "A" Board to a checking multiple used by the "A" operator in checking subscriber numbers on Toll and Long Distance calls. The lead to MR rack connects to a message register located on the message register rack, one register directly con-

nected to each equipped terminal from 0 to 9999, the registers being numbered from 0 up, to agree with the equipped terminals. Figure 4-A covers the basic connections of subscriber line equipment at the IDF, other figures differing only with respect to the message register and party line arrangements.

Figure 4-B

The wiring arrangement shown by this figure is used where a number of lines in the office will be either coin or flat rate and will not be connected to message registers. Here, the "M" terminals are "bunched" on "M" terminal strips on the HIDF and the message rate terminals cross-connected to an "M" terminal on the VIDF from which cables are run to the message registers. In this case, since the register to terminal connection is variable, instead of fixed, as in Figure 4-A, the registers are numbered from 1 up. Since, in certain cases, some of the lines in message rate groups may operate on a flat rate basis, means must be provided to supply ground to the "M" lead, to replace the ground thru the message register winding and thus satisfy the message rate district selector circuit in the registration position. This ground is permanently connected to the "M" lead by strapping to a "G" punching on the front row of the "M" terminal strips.

Figure 4-C

Figure 4-C is essentially the same as Figure 4-B, except that two rows of terminals on the VIDF have been strapped together and connected to one set of subscriber line equipment. This method provides two rows on which to connect the jumpers from the terminals on the HIDF and thus avoid jumper congestion at the VIDF fanning strip. This figure illustrates the basic feature of a two party line, that is, two terminals, or numbers, served by a single line circuit.

Figure 5-A

This figure illustrates the further use of the bunching block principle as applied to a 4 party line, that is, four terminal numbers on one set of line circuit equipment. Since the panel dial system is not arranged to provide 4 party message rate service, this figure can be used only on flat rate, or coin lines, and the message register wiring is omitted.

Figure 4-D

Figure 4-D is essentially the same as Figure 4-C, except that it provides for the new alternate standard of cabling from the HMDF to the VIDF in offices having a high percentage of party lines.

Subscriber Line Circuits

The subscriber line circuit gives the subscriber access to panel dial central office selecting equipment for originating and terminating calls and provides a means for recording charges on message rate lines. The Line circuit consists of a line and cutoff relay

mounted on mounting plates of units on the line finder frame line relay bay. The message register, which is a part of a message rate line circuit, is mounted on a separate line message register rack. These registers are, in fact, message meters having several rows of numbered indicating discs, the numerals on which are visible from the front of the register. The registers are usually mounted behind glass doors thru which photographs of the register readings may be taken each month. A comparison of the readings from monthly photographs gives the total number of message rate calls during the month and, hence, determines the amount of the message rate subscriber's monthly bill. Another method of taking register readings monthly consists of using a 2-way talking line between a reader at the MR Rack and a recorder stationed at a desk where billing records are kept.

Subscriber line circuits are of the following types:

A - Flat rate--Individual--2 Party and 4 Party

A line for which the telephone company charges a fixed or flat rate per month, regardless of the number of calls made.

B - Coin Box--Individual, 2 Party and 4 Party

A line having a coin box at the subscriber's premises by means of which one or more coins are collected for each call made. Coin boxes are of two types, single slot for private use, and multi-slot for public pay station use.

C - Message Rate--Individual and 2 Party

A line having connected to it at all times one or two message registers which automatically record the completion of each call originated by the one or two subscribers on the line.

Party lines of the panel system operate on a terminal per station basis, that is, each party on the line has a different number. For example, the four subscribers on a four party line might have numbers such as 2112, 2655, 4205 and 4673. Two of these stations or subscribers are rung over the tip of the line and two over the ring with either semi-selective or full selective ringing, as will be explained later under incoming frames.

The number of line circuits of each class required to adequately serve a given central office area is determined by the telephone company from calling rate and holding time data. This data is obtained either from a count of the manual traffic in the area or based on commercial department forecasts for a future period.

LINE FINDER FRAMES

The line finder frame is one of a chain of frames required in a panel dial office for handling calls originating in the area served by the office. The circuit is designed to find the calling subscriber's line in the panel dial office so that a connection can be established between this line and other subscribers or an operator.

The 400 point line finder frame (i.e. capacity of 400 subscriber lines for any given line group) with line units equipped with eighty subscriber lines each is the type used for all new installations of panel link, battery on the cut off relay equipment. When adding equipment to existing offices it may be necessary to provide line units with a capacity of 40 lines each, 300 point line finder or line switch equipment. This text will cover only the 400 point line finder frame which is being manufactured on a standard basis.

Line Finder Frame Equipment

The line finder frame (Fig. 7) is commonly composed of a central bay and one or two line relay bays, depending on the grouping used. The central bay consists of multiple banks with the associated selector rods, commutators, clutches, friction roll drive, etc. All ten multiple banks are provided unless otherwise requested. The selector rods and associated apparatus are furnished in accordance with the traffic requirements for a particular line group as determined by the busy hour calling rate and holding time.

A line relay bay has a capacity of five line units each consisting of line and cut-off relays for eighty subscriber lines which terminate on two multiple banks, and the trip circuit apparatus for tripping the brushes of the associated multiple banks. The number of line units furnished in any line group is governed by the number of lines equipped in that group. One start circuit unit is required for each line relay bay, and is mounted at the bottom of the bay. On this unit is mounted the start circuit apparatus and a set of emergency start and emergency trip circuit apparatus for use in case the regular circuits are in trouble.

Line Finder Groups

Different numbers of line finders are required for various classes of service within an office or for offices serving different areas such as business or residential. To meet this condition line finder groups may be arranged with a capacity of 28, 40, 60 or 80 line finders per group. This is accomplished by using split multiple banks as shown in Figure 7. The capacities of the different arrangements are shown in the following table:

Line Finders per Group	28	40	60	80
Subscriber Lines per Group	400	400	400	400
Groups per Frame	2	1 1/2	1	3/4
Line Finders per Frame	56	60	60	60
Banks per Group	10	10	10	10
Lines per Bank	40	40	40	40

The line relay bays required for the various line group arrangements will be:

Line Finders per Group	Line Finder Frames	Line Relay Frames
28	1	2
40	2	3
60	1	1
80	4	3

A typical floor plan arrangement of line finder frames showing the location of line relay bays for 28 and 40 line capacities is shown in Figure 2. This layout illustrates the fact that the location of the line relay bay on 40 group line finder frames changes with the direction of growth of frames in a given row.

Line Finder Sub-groups

The terminals in each line group on the line finder frame multiple banks are split vertically into two equal parts. The two parts are arranged in reverse order from top to bottom, the line on the bottom set of terminals in the first part being on the top set of terminals in the second part. The line finders serving each part are designated sub-groups A and B of their particular line finder group. This arrangement decreases the time required for a line finder to find a calling subscriber line since the line finder which starts hunting a subscriber line will be in the sub-group in which this subscriber line appears nearest the bottom of the bank. In the event all line finders in a sub-group are busy, one in the other sub-group will hunt the calling line. Reverses in the multiple bank are made by means of a small local cable and are indicated by the crosses between sub-groups on the banks as shown in Figure 7.

Viewed from the front of the frame, the line group numbering progresses in the same direction as the growth in a row of line finder frames with sub-group A always appearing at the left of sub-group B regardless of the direction of growth. This is illustrated in the line finder frame layout shown in Figure 6.

Line Finder Frame Cabling

Reference to the cabling schematic between line finder and district frames as shown in Figure 6 will show that all line finders on one side of a line finder frame which connect to one side of a district frame are cabled together: the clutch leads in one cable and the

commutator leads in another. These cables connect directly to clutches and commutators on the line finder frames and to terminal strips on the district frames.

The line circuits cable from terminal strips on the line units of the line relay bay in 40 circuit cables to the V.I.D.F. At the V.I.D.F. the cables from one line group terminate on one vertical or are split over adjacent verticals as required. The line groups start at the head end of the V.I.D.F. and are added in numerical order in the direction of growth of the I.D.F.

ORIGINATING TRAFFIC FRAMES

Sender Selector Type - Using Line Switches

On the first few panel dial jobs installed, each subscriber line circuit has associated with it a line relay, a cutoff relay and a rotary line switch (Magnet driven rotary 200 type selector). These line switches and associated relays are mounted on a unit framework consisting of three suitably shaped horizontal iron bars which are secured at each end to a short vertical "E" bar upright. Each of these units mounts 20 line switches in a horizontal row on the top half of the unit. Directly below the 20 switches are 20 short mounting plates each of which mount one line relay, one cutoff relay, one 18 type resistance and one condenser associated with that particular line circuit.

The banks of all the line switches on one unit are multipled together and connected to terminal strips on each end of the unit, using a slip arrangement to distribute the load evenly over the district selectors connected to the bank terminals. The wiring from the line and cutoff relays and the line switch rotor is wired in local cable to a third terminal strip located on the right end of the unit. This arrangement makes possible the mounting of the line switches and associated apparatus on the units in the shop. These equipped units are then shipped to the installer for mounting on the frames.

Nine units of line switches are mounted, one above the other on a line switch frame, giving this frame a capacity of 180 lines.

The line circuits are extended in 20 circuit cables from the line terminal strips on the right end of the units to the V.I.D.F.

From the bank multiple terminal strip on the left end of the unit, a 10 circuit cable is run for the even numbered bank terminals to 10 district selectors or is multipled to the left end of another line switch unit on the same or another line switch frame. The 10 odd bank terminals are cabled in a like manner from the bank multiple terminal strip on the right end of the unit.

The battery required for operating the line switches is fed through lavite resistances, which on account of the heat generated, are mounted on a separate framework called a "resistance rack". The resistances are mounted on 20 per strip mounting plates and each bay of rack has a capacity for mounting 54 mounting plates, a total of 1080 resistances serving 6 line switch frames. The leads between the resistances and the line switches are run in 16 BBE wire. The battery leads to the resistances are fused through alarm type fuses, located on unit type panels mounted at the bottom of the resistance rack.

Each group of 20 district selectors (in 2 sets of 10) is multipled to as many line switch units as required to properly load the selectors to capacity, as determined by the busy hour calling rate and holding times of the lines served. The sizes of the line switch groups that may be served by 20 district selectors range from 60 lines in business areas to over 400 lines in residence areas.

Assuming a theoretical office of 9000 lines, 50 line switch frames and 9 line resistance racks would be required. Since this is a relatively large amount of equipment for merely associating subscriber lines with idle district selectors, line finder equipment was perfected and introduced as soon as manufacturing conditions would permit.

Originating Traffic Frames

Sender Selector Type - Using Line Finders

300 Point Line Finder Frames

The 300 point line finder frame is arranged to mount 15 multiple banks each of which consists of 20 sets of terminals. These multiple banks may be split in three ways to provide either 28-28, 40-20 or 60 line finder selector groups. When the banks are split 28-28, the second of the two reversal cables on the bank uses the horizontal space of two selector circuits, thus reducing the capacity from 30 to 28 selectors on each side of the frame. On sender selector type line finder frames the line finder circuit relays are mounted on mounting plates in bays adjacent to the multiple bank bays in a manner similar to that used on regular panel selector frames.

Each equipped line finder selector circuit is wired in local cable to a terminal strip on the line finder frame and from there cabled to a terminal strip on a district frame where it is connected to a district selector circuit. The district selector circuit must, of course, be a type corresponding to the service required by the subscriber lines served by its associated line finder - that is flat rate and message rate individual, message rate two party or coin.

The 300 line circuits associated with a 60 group line finder frame are located on a separate frame called a line relay bay. This line relay bay is located adjacent and to the right of the line finder frame as viewed facing the front of the frames. Each 28-28 line finder frame and alternate 40-20 line finder frames would, of course, require a line relay bay adjacent to both right and left sides.

The 20 line and cutoff relays and the associated trip circuit for that bank are mounted on a unit on the line relay bay on the same horizontal level as the multiple bank to which it is connected. The 15 line and trip units are numbered like their associated multiple banks 0 to 14 from bottom up.

The subscriber line circuits are cabled from terminal strips on the right end of the unit to the VIDF.

The 300 point line finder frame is, except in unusual circumstances, completely replaced by the 400 point frame. 400 point line finder frames are used on additions to 300 point line finder jobs.

400 Point Line Finder Frames

The 400 point line finder frame is arranged to mount 10 multiple banks, each of which consists of 40 sets of terminals. These multiple banks may be split to provide 28-28, 40-20, 60 or 80 line finder selector groups. Adjacent to the multiple bank bays on each side are bays to accommodate the line finder relay circuit mounting plates. Wiring and cabling of the line finder selector circuits is arranged in the same manner as on 300 point line finder frames.

The 400 line circuits associated with a 60 group line finder frame are located on an additional bay. This line relay bay instead of being a separate assembly as in the 300 point type is a part of the line finder frame assembly. 28-28 and alternate 40-20 types of frames would have an additional line relay bay on the opposite end of the frame. This bay is also a part of the line finder frame assembly, which in this case will be 11'5" long and will consist of 2 bays for line relays, 2 bays for line finder relays and the center or multiple bank bay.

The 40 line and cutoff relays and the associated trip circuit for that bank are mounted on a unit on the same horizontal level as the multiple bank to which it is connected. The 10 line and trip units are numbered like their associated multiple banks from 0 to 9 bottom up.

With the above exceptions 400 point sender selector type line finder frames are wired and connected to outside apparatus and function in the same manner as 300 point line finder frames.

QUESTIONS

1. What is the function of line finder equipment?

2. How many subscriber lines constitute a line group?

3. What is the maximum number of subscriber lines which may be served by a line finder frame with a capacity of 28 line finders per group? With a capacity of 60 line finders per group?

4. What is a selector group? Sub-group?

5. How many selector groups would be required for two line finder frames fully equipped on the basis of 40 selectors per group?

6. How do line groups number with respect to direction of growth of line finder frames in a row? How do sub-groups number?

7. How many multiple banks would be necessary to equip a line group with 260 lines? How many line units would be required? How many start units?

8. Where is the reversal on line finder multiple banks located? Why is this used?

9. What is the line capacity of line finder multiple banks serving one sub-group?

10. Give cabling arrangement between line finder and district frames. Between line finder and I.D.F.

11. Make a sketch showing sub-grouping on line-up of four line finder frames fully equipped with 40 capacity line groups assuming right to left growth of frames.

DISTRICT SELECTOR FRAMES & TRUNK DISTRIBUTING FRAME

District Selector Frames

The subscriber district frame is one of a chain of frames in a panel dial office which is used exclusively for originating traffic. The district circuit is designed to close dialing leads from a subscriber's line through the link frame into the sender, select the proper trunking path to the called subscriber's office, furnish talking battery to calling subscriber, and operate line message register on message rate line. To do this, a district selector must be permanently connected to each line finder.

District selectors and frames arranged for operation with 400-point line finders having battery on cut-off relay and with panel links are generally used for all new installations.

Types of Frames

District frames are divided into three classifications depending on the type of service for which the circuit on the frame is designed. Each type district selector circuit requires a different amount of apparatus so that three sizes of frames are required. The types of frames are as follows:

Type Service	Mounting Plate Length	Frame Length
Regular (Flat Rate or Message Rate Individual)	16 1/2"	9'-1 5/8"
Two-Party Message Rate	23"	10'-2 5/8"
Coin	19"	11'-7 7/8"

Two types of district selector equipment are available for message rate service: one type arranged for multiple registration (additional registrations of line message register depending on zone called or length of conversation), and the other not arranged for multiple registration. Likewise two types of coin district selector equipment are available: one type arranged for coin overtime, (additional charge made when call lasts longer than a given time), and the other not arranged for coin overtime. The frame dimensions given in the above table do not include the framework required to mount the additional equipment required for zone and overtime operation.

The foregoing types of district selectors are used by subscribers in establishing calls. In addition to these, there is a small number of district selectors used by the special service operators at the dial system "A" board in handling calls for assistance in an emergency and in completing calls to stations which do not answer, or which are persistently

busy, service complaints, and "A" board toll calls. These district selectors are known as dialing districts, or key pulsing districts, depending on whether the dial system "A" board with which they operate, is equipped with dials, or key pulsing keysets. These selector circuits require no special frame, but are located on any district frame where space is available.

Frame Arrangement

The subscriber district frame, as shown in Fig. 8 A, is a double sided frame consisting of a central bay for mounting multiple banks, friction roll drives, clutches, commutators, selector rods, etc., and two adjoining bays, one facing front, and one the rear. Sequence switches, relays, repeating coils, and condensers in the district selector circuit, are mounted in these bays. In addition to the above, the coin district frame has two bays of coin control apparatus, one attached to the front and one to the rear relay bay. Each district frame has a capacity of 60 selectors numbered 1 to 59 odd on the front and 2 to 60 even on the rear.

From the standpoint of initial plant investment, it is desirable to equip the district frames as completely as possible. Therefore, the number of district frames required in an office is determined approximately by dividing the total number of district selectors cabled from the line finders, plus those the operators use, by the selector capacity of one frame.

The district selector circuit provides the repeating coil and quiet battery for the calling subscriber. At one time, these coils and associated condensers were mounted on a district coil rack which was located adjacent to the district coil rack fuse board that supplied the quiet battery for the talking circuit. A change in design of the coils and condensers made it possible to mount these on the selector frame and have them wired in the shop. A further change in the frame eliminated the necessity for a district fuse board in some cases. In offices where subscriber line loops are extended to 1500 ohms, instead of 750 ohms, signal battery is supplied directly to the frame and, by the use of a filter panel mounted above the commutators, the battery is made suitable for talking purposes.

District Multiple

Any district selector has access to all trunks appearing in the multiple bank on the frame. There are five of these banks on a district frame with 100 sets of terminals each, which constitute the outgoing path to the office selectors, or to incoming selectors in the same building or other exchanges. Each bank is divided from bottom up into 10 layers, 8 layers consisting of 11 sets of terminals and 2 layers of 6 sets. The top set of terminals in each layer is for registering "overflow" conditions when all trunks in a layer are busy. The layers are not mechanical divisions of the bank, but exist because of the wiring arrangement.

In some cases, the number of trunks outgoing to any one destination will exceed the 5 or 10 trunks in one layer. To meet this requirement, two or more adjacent layers in the same bank may be combined by grounding the sleeve of the intermediate overflow terminals so they will test busy. The district selector will hunt over the trunks in all the combined layers as though they were one large group. With this arrangement, the 450 trunks in the district multiple may be arranged in any desired combination from 40 groups of 10 trunks, and 10 groups of 5, to 5 groups of 90 trunks.

The multiple arrangement on one bank of the district frames for a typical office is shown in Fig. 9A. In this figure, each square labeled A, B, to T represents 5 trunks. The heavy horizontal lines indicate the boundaries of each trunk group. The first group on the bank consists of 30 trunks, and the next three groups have 20 trunks each, which is the trunk capacity of one bank. The other four banks on these frames would be arranged in a similar manner with the proper number of trunks in each group to handle the traffic.

The simplest plan to make the outgoing trunks accessible to all district selectors would be to run cable between the corresponding banks of the district frames, thereby connecting the trunks in multiple. Where this is done, the number of trunks is limited to the capacity of one frame, or 450 trunks. These may be divided into a maximum of 50 layers or, in other words, 50 offices, which could be served by trunk groups if they are connected to the district frame banks. However, the required number of trunks to an office is usually greater than the number in any one layer as illustrated by the typical case shown in Fig. 9 and often reaches 50 or more. In addition to the trunks required for regular service, groups must also be provided to special service operators, long distance, information, repair clerk, test desk, etc. Some modification of this plan is obviously required to meet the requirements of a multi-office area.

Sub-grouping District Multiple

By dividing a large group of trunks into two or more smaller groups, (sub-groups), and assigning each of these smaller groups to a group of district frames, more trunk groups can be placed on a bank and still have trunks to all terminations available to each district selector. The efficiency of the trunk group is decreased with this method, since one large group of trunks may be twenty-five per cent more efficient than when divided into two groups. In general, this plan must be resorted to, so in order to improve the efficiency of the trunk groups, a plan of grading the multiple is used.

Graded Multiple

A trunk group, when graded, is divided into two general divisions, namely: individual and common. Individual trunks are the lower numbered trunks of a group and are multipled through a sub-group or portion of the district frames. The common trunks are the higher numbered trunks in a group and are multipled to the district frames of more than

one sub-group. The quantity of trunks assigned to each of these classifications is such that, under normal traffic conditions, a district will not reach the common group of trunks unless all the individual trunks in the group test busy. Part of the individual and common trunks in a group are wired in such a manner that they may be converted from common to individual in order to obtain flexibility in assignment. Trunks wired in this manner are known as convertible trunks.

By referring to Fig. 9A, it will be seen that the trunk group on the bottom of the bank is wired for 10 individual, 15 convertible, and 5 common trunks. This makes it possible to vary the trunk assignment from 10 individual and 20 common to 25 individual and 5 common. Since this group of trunks is divided into seven sub-groups, (sub-group A, frames 201 & 202; sub-group B, frames 203 & 204, etc.), it is possible to vary the number of trunks outgoing from this group between a minimum of 90 and a maximum of 180. The other three groups on this bank have no trunks wired as individual, since the number of trunks which will be assigned for individual use is relatively small.

To equalize the average trunk hunting time, trunks cabled as individuals are slipped and reversed. Taken in layers of 5, the highest numbered individual trunks on the first frame of a sub-group are cabled to the next lower layer on the second frame of the sub-group, or in other words, slipped down one layer. When the layer reaches the bottom of the trunk group, the numbering is reversed. This is shown in Fig. 9, where layer B on frame 201 slips down one layer on frame 202, and, since on the second frame it is the lowest layer in the trunk group, the trunks are numbered from top downward, as indicated by the layer being marked B1. The common trunks are cabled straight between frames with a complete reversal between sub-groups. Convertible trunks are cabled straight between frames within a sub-group. Overflow terminals are not slipped or reversed.

Cabling

All trunks from the district multiple are usually cabled to the vertical side of a trunk distributing frame where they are cross connected by jumper wires to the office selectors, or to tie cable to the HMDF. At the MDF, part of the trunks are cross connected to incoming selectors in the same office and the remainder are connected by jumper wires to trunks to distant offices served directly from the district multiple. These connections are shown on Fig. 3. The entire district multiple usually cables from the first frame of the multiple, as shown in Fig. 9A, in 5 cables per bank with 20 circuits per cable. Individual and convertible trunks cable to the distributing frame from each sub-group. Frames within the same sub-group have their banks connected as required by means of short multiple cables run between corresponding banks.

District selectors cable from the selector terminal strips directly to the commutator and clutch terminals of the selectors on the line finder frames by sub-groups. These sub-groups are placed on the district frames in a regular order following the direction of growth of

the district frames in the row. District selectors also cable directly to the district finder multiple banks on the subscriber link frames.

Trunk Distributing Frame

The trunk distributing frame (TDF) is the same type frame as the IDF. It is located near the district frames for economy of cabling. As in the case of the district OGT, the office OGT cables to the vertical side of the frame. Since the OGT are concentrated on this frame, it serves as a doubling up point for the cables from the outgoing trunk test frame where a multiple of all outgoing trunks appear for testing purposes. The OGT are cabled to the VTDF as 3-conductor circuits where they are cross connected to the OGT test frame cables at the HTDF. Two conductor tie cables extend the tip and ring conductors of the OGT to the MDF.

Selectors on the office frames cable to the HTDF. This permits the trunks from each sub-group of district frames to be spread over several office frames, so that if one office frame should fail, the entire group of trunks from one district sub-group would not be put out of service.

Bunching blocks for convertible trunks shown in Fig. 9C are also located on the HTDF. By the use of these, trunks can be made common between sub-groups by jumper wires, or used as individual trunks as the traffic requirements change.

Tie cable, service observing equipment, and other circuits for the telephone companies use are also located on this frame.

QUESTIONS

1. What is the selector capacity of a district frame?
   What is the trunk capacity?

2. What is a group on a district frame multiple bank?
   What is a layer?

3. What is the purpose of slipping trunks?
   In what quantities are individual trunks slipped?

4. What is an individual trunk? A common trunk? A convertible trunk?

5. Where does the district outgoing trunk usually cable to?

6. Explain why a district multiple bank has 100 sets of terminals and only 90 trunks.

7. Why are overflow terminals not slipped?

8. Are there more district selectors than line finders in an office?

9. What is the purpose of a trunk distributing frame?

SUBSCRIBER LINK FRAMES & DISTRICT SELECTOR TEST FRAME

Subscriber Link Frames

The subscriber panel link frame (Fig. 10) is a double sided frame designed to mount thirty subscriber panel link circuits, fifteen circuits on each side of the frame. It is the function of this link circuit to associate a line finder-district selector circuit with a subscriber sender. The link circuit is made up of two parts--a district finder, (long elevator rod), with two brushes operating over two sets of 20 or 40 terminals on one district finder bank and a sender selector, (short elevator rod), operating over two 100 point sender banks. Two brushes per circuit are required, instead of the usual one, due to the fact that six leads are required between the district selector and the sender. The link circuit is thus able to establish connections between sub-groups of 14, 20, 30 or 40 district selectors and any one of a maximum of 100 subscriber senders.

The number of line finder and district selectors required to handle the traffic on one group of 400 or less subscriber lines is determined by the number of simultaneous calls that will be originated by that group at peak load periods. In contrast, the number of subscriber links that will be required to serve this group of line finder-district selectors is determined by the number of subscribers in this group that will simultaneously require the service of a sender. In an area where the holding time or length of conversation is long, a small number of links will suffice to provide sender connections. Where the holding times are short, a larger number of links will be required. Since the link circuit is required in the connection only for that period during which the sender performs its function, (from 16 to 24 seconds), it is obvious that a small number of links will serve a much larger number of line finder-district selectors.

To assure that a group of 400 subscribers is not completely deprived of service due to the failure of a link frame drive motor, multiple bank or friction roll drive, the links serving the "A" sub-group of line finder-district selectors are located on one link frame and those serving the "B" sub-group are located on the adjacent link frame. Until quite recently, the practice, as shown by Fig. 2, was to drive each link frame separately and to place the "A" sub-group links on odd numbered link frames and the "B" sub-group links in an identical manner on the even numbered link frames. Note on Fig. 6, that Link Frames 201 A & 201 B are identically equipped. The new practice is to drive a pair of link frames together, where floor plan arrangements permit, in the same manner as all other panel selector frames. The odd frames under this arrangement still mount the "A" Sub-group links and the even frames the "B" Sub-group links. In order to avoid service failure the "B" Sub-group links are placed on the opposite side of the adjacent frame of the pair and thus on a different drive motor than the "A" Sub-group links.

In assigning sub-groups to the link frames the standard practice is to locate the lowest numbered sub-group on the first link frame. Succeeding sub-groups are located in consecutive order building up in accordance with the growth of the link frame numbers.

District Finder Multiple Banks

The district finder multiple bank (15-4 Bank, Fig. 10 A) differs considerably from the usual multiple bank with respect to the type of strip terminals of which the bank is composed. In the first place, the strips extend only half way across the bank, appearing before the brushes of only 15 instead of 30 elevator rods on each side of the frame. The 15 sets of terminals on the front of the bank provide connections for the multiple brushes of district finder rods, 1 to 29 odd, located on the right half of the frame. Another set of 15 terminals will appear before district finder rods 2 to 30 even on the right hand side facing the rear of the frame. The left half of the bank is made up of 54 sets of terminals of the type shown on Fig. 10B, each set consisting of three terminals, (FT, FR, & SC in the bottom 27 sets and T, R & TR in the top 27 sets). These 54 sets present the contact terminals to the multiple brushes of the 15 district finder circuits on the rear of the frame. The right half of the bank is made up in the same way except that the strips are turned over to present the contact terminals to the multiple brushes of the 15 district finder circuits on the front of the frame. Only 20 of the 27 sets of terminals in each set are used for terminating district selectors, the other seven sets being used as guide terminals. To these two sets of 20 terminals are connected the six leads of the 14 or 20, or less, equipped district selectors of as many sub-groups as the 15 link circuits will serve. Should all 15 links be required for any one sub-group, none of the metal loops at the bottom of Fig. 10B would be cut. Since the number of links required per sub-group is always less than 15, the loops between pairs of terminals are cut as required. Referring to Fig. 6, Link Fr 201, G-204A, it will be noted that 5 links are required, hence, as denoted by "X", the loop is cut between the third and fourth pair of terminals. Each strip can be cut, if required, into seven pairs and one single terminal, the single terminal always being located so as to serve links 29 and 30. G-202A is served by link circuits 26, 28 & 30 on LK Fr #201. Cables numbered 99 and 102 carry the six leads per circuit from D-207 circuits 31, 33, 35, 37 and 30, 32 and 34 respectively to left sections of the district finder bank. In a similar manner, the association of all links and the district selectors they serve can be determined by locating the corresponding cable numbers at link and district frames. Cables from the district frames are connected to the sets of terminals on the district finder banks in accordance with a drawing known as the district locating chart which will be discussed in connection with the District Selector Test frame.

Since the district finder elevator does not return to normal after each connection, any spare terminals in the two sets of 20 are multipled to the equipped terminals by means of small multiple cable forms. Two of these small multiple forms are thus required for each sub-group having less than 20 equipped district selectors. This multiple

of equipped to unequipped terminals is made in accordance with standard tables that provide different arrangements for each number of equipped terminals.

In case it should become necessary to re-group the links due to traffic changes, the previously cut loop in the multiple strip can be reconnected by soldering, as the gap cut by the special cutting tool is only 1/32 of an inch wide.

The foregoing description covered only the 54 point multiple bank used for 14 or 20 sub-group districts, (28 or 40 per group). When 30 or 40 district selectors are required per sub-group, (60 or 80 per group), the 15-point bank is used. This bank consists of 94 sets of terminals and provides two sets of 40 terminals per sub-group.

Sender Banks

Referring to the chart on page 2 of Lesson 1, it will be noted that, prior to the introduction of the rotary link frame in 1926, the maximum number of subscriber senders in a group was 22. As pointed out in connection with graded multiple trunk groups in Lesson 3, a given number of trunks divided into several small groups will not handle as much traffic as the same number of trunks arranged in one large group. This principle applies to subscriber senders as well as to trunks and, therefore, a rotary link sender group of 44 senders would handle 2.37 times as many calls as two groups of 22 senders. Since the sender is a very expensive item of equipment, a further enlargement of the sender group would obviously result in appreciable savings. The panel link frame using two 100 point banks in parallel makes possible a sender group of 100 senders. Based on present standard sender capacity tables 100 senders in one group will handle as much traffic as 137 senders in 6.2 groups of 22 each.

The sender multiple consists of two panel banks each having 100 sets of three terminals and five sets of guide terminals. The bottom bank contains 100 sets of FT, FR and SC terminals and the top bank 100 sets of T, R and TR terminals; thus providing six leads to each of 100 senders. In general, when 100, or less, senders are required, the sender banks of all link frames are multipled together. When more than 100 senders are required, the link frames are multipled together in two or more groups in accordance with traffic requirements. To prevent excessive hunting time over these large banks, or repeat hunting over the lower terminals, the multiple between link frames is slipped. The present standard 90-10 arrangement consists of assigning 90% of the equipped senders to the lower 90 sets of terminals on the bank and multipling to other banks in the same group with a Latin square slip between banks. The other 10% of the equipped senders are assigned to the top set of ten terminals and multipled to other frames with a rotary slip.

The link circuits operate on a stay-put basis from any of the lower 90 terminals of the banks but are arranged to return to normal after completion of a connection to a sender on any of the top 10 terminals.

When less than 100 senders are equipped, the equipped terminals are multipled to the unequipped terminals in a standard manner by means of two small multiple cable forms connected one each, on the two sender banks of the lowest numbered link frame of the group.

To minimize possible service reactions, the cables from the sender banks to the sender frames are not all terminated at one link frame, but are spread as evenly as possible over all the link frames. Where the cables terminate at intermediate points in the multiple, they are connected at the lower numbered frame end of the short multiple cables as the other end will be slipped.

Dialing District Sender Selectors

In offices using a Dialing "A" Switchboard, the "A" operators obtain access to a sender by plugging the calling cord of the pair in use into an OGT jack connected to a Dialing District Selector. This district selector is permanently connected to a Dialing District Sender Selector on a panel link frame. Since this circuit performs only the operation of selecting a sender, only one elevator rod is required. Spare link positions are used for mounting these sender selectors, or, in rare cases, separate link frames completely equipped with these sender selectors are furnished.

With the above arrangement, the "A" operators, of course, use the same set of senders as the subscribers, hence the number of subscriber senders furnished must be sufficient to handle both classes of traffic. The study job used in connection with this course is provided with a Key Pulsing "A" Board and separate Key Pulsing senders are provided for the exclusive use of the "A" operators. These senders are connected to the key pulsing district selectors through a rotary sender selector and no equipment for this purpose is required at the subscriber link frames.

District Test Connectors

Subscriber link frames are arranged for 4 sub-groups of links per side of frame, which also means that both halves of the district finder bank may be split into 4 sections. On Fig. 6, link frames 207 & 208 have district finder banks split into four sections. A section of the district finder bank on one link frame may be multipled (without slip) to a district finder bank section on another link frame. Associated with each of a possible 4 equipped sub-groups on each side of a link frame are Test Connector Switches used by the District Selector Test frame in the test of district selectors. These test connector switches are 206 type selectors each associated with a 26 type bank. The terminals of these banks are arranged in 22 sets of 6 per row. From these banks, leads are extended in 4 local cables to 4 points adjacent to the district finder multiple banks. Referring to Fig. 10 A, these connector switches are shown in the upper right bay designated C1, C3, C5, & C7. The four groups of equipment associated with 4 sub-groups of links are numbered in a standard manner G1, G3, G5, & G7, front; G2, G4, G6 & G8, rear, regardless of the actual sub-group number used on a given

job. Test connector switches C1, C3, etc., are associated with their corresponding numbered sub-group equipment.

When less than 4 sub-groups are required on the side of a link frame, the sub-groups equipped depend on the location of the splits in the district finder bank.

One set of 6 leads from one test connector bank connects to the set of 6 district finder bank terminals associated with each equipped district selector circuit. The test connectors can thus connect successively to all equipped district selectors in that sub-group.

When a sub-group of links is split over two frames, the test connector is furnished only on one frame, usually at the opposite end of the multiple from the cables to the district selectors. On Fig. 6, Link Fr. 201, Sub-group 201 A is assigned to G7 and the Test Connector Switch (C7) is located on Fr. 201. Note that sub-group 201 A also appears on G7 of link frame 207, but that no associated test connector switch is furnished on Fr. 207. On Fig. 6, connector switches may be located by their designations C1 to C7, odd, and C2 to C8, even.

When 30 or 40 district selectors are equipped per sub-group, each Test Connector is made up of two switches, C1A, C1B, etc., in which case, 8 switches may be equipped per side of frame.

District Selector Test Frame

The function of the district selector test frame is to gain access to the subscriber district selectors and to test all of these selectors in rotation as a matter of periodic routine, or to reach any one selector, or any group of selectors, for making individual tests. The equipment for line finder exercise test is also located on the District Test frame, although this equipment has no connection with the selector test circuit.

A fully equipped district selector test frame will give access to 3200 district selectors. While this large number of district selectors could be tested by one frame, the time required to complete this cycle would be excessive. For this reason, and, further, to provide for more frequent testing and to have a test frame in reserve in case of failure, two test frames are furnished in many offices. Both frames are usually given access to all district selectors, but normally each frame makes routine tests only on half the total.

Access to the maximum of 3200 selectors is obtained as follows: The test circuit is connected to the brushes of a 206 type selector known as the Master Switch. To each one of 8 rows of terminals on the bank of the Master Switch are connected the brushes of a 206 type selector known as a Group Switch and numbered to correspond to the Master Switch row. From each one of 20 rows of terminals on the 8 group switches, leads are run to the brushes of the Test Connector Switches on the subscriber link frames.

Thus:

Master Sw. Rows		Group Sw. Rows		Test Conn. Sw. Rows	
8	x	20	x	20	= 3200

The district selector test circuit causes the line finder associated with the district selector under test to connect to line finder test line, (Line 0 - Bank 0), and through the six lead connection built up in accordance with the following table, causes the district selector to connect to a district selector test line in the district multiple. Over these test lines, the test circuit makes a test of all the regular functions of the line finder and district selector circuits.

TABLE OF MASTER, GROUP & CONNECTOR SWITCH ASSOCIATION

Master Sw. Row No.	Group Sw. Row No.		District Sel. of 14 or 20 Sub-Group	District Sel. of 30 or 40 Sub-Group
1	1	Conn. Sw. #1	1 A	1 A
	2	" " 2	1 B	1 A
	3	" " 3	2 A	1 B
	4	" " 4	2 B	1 B
	19	" " 19	10 A	5 B
	20	" " 20	10 B	5 B
2	Group Sw. #2 Row No.			
	1	Conn. Sw. #1	11 A	6 A
	2	" " 2	11 B	6 A
	3	" " 3	12 A	6 B
	4	" " 4	12 B	6 B
	19	" " 19	20 A	10 B
	20	" " 20	20 B	10 B
3	Group Sw. #3 Row No.			
	1	Conn. Sw. #1	21 A	11 A
	2	" " 2	21 B	11 A
	3	" " 3	22 A	11 B
	4	" " 4	22 B	11 B
	19	" " 19	30 A	15 B
	20	" " 20	30 B	15 B
8	Group Sw. #8 Row No.			
	1	Conn. Sw. #1	71 A	36 A

District Selector Locating & Particular Circuit Chart

The district selectors of the various sub-groups as shown on the preceding table are connected to the district finder banks of the subscriber link frames and through these banks to the test connector switches in accordance with a locating chart made up for each particular job.

In the chart below:
Master Lamp No. = Master Sw. Row No. & Group Sw. No.
Group Lamp No. = Group Sw. Row No. & Conn. Sw. No.
Conn. Lamps = Conn. Sw. Row No.
207-49 = District Fr. 207 Sel. 49

MASTER LAMP NO. 1

Group Lamp No.

Conn. Lps.	1 G201A	2 G201B	3 G202A	4 G202B	5 G203A	6 G203B	7	8	9	10
1	207-49	207-39	207-31	207-21						
2	207-51	207-41	207-33	207-23						
3	207-53	207-43	207-35	207-25						
4	207-55	207-45	207-37	207-36						
5	207-57	207-47	207-30	207-38						
6	207-59	207-14	207-32	207-40						
7	207-2	207-16	207-34							
8	207-4	207-18								
9	207-6	207-20								
10	207-8	207-22								
11	207-10									

Only one half of Master Lamp No. 1 is shown. Group Lamps 11 to 20 continue in the same manner as 1 to 10 and serve sub-groups 206A, 206B to 210A & 210B. Succeeding sub-groups appear consecutively on group lamps associated with Master Lamp Nos. 2 & 3.

At the start of automatic routine test, the master switch steps to row #1, which causes group switch #1 to step to row #1, which in turn causes the first connector switch to step to row #1 and the test is begun on the district selector connected to that row. The connector switch steps in turn to succeeding rows until the first unequipped row is reached. This and succeeding unequipped rows are strapped in a manner to cause the connector to step to the last row. When this row is reached, the group switch steps to row #2 and the test proceeds.

Particular Circuit Test

It is frequently necessary to make special tests on one or more selectors that may appear at scattered locations on the banks of various connector switches. To gain access quickly to these particular circuits, use is made of the dial which is furnished on each district test frame. The first dial pull corresponds to the master switch row required, the second dial pull to the group switch row, and the third dial pull to the connector switch row. Referring to the table under master lamp #1, it will be noted that selector #2 on district frame 207 is located on group switch row #1 and connector switch row #7. Hence to reach this selector, the following code would be dialed: 1-1-7. The dashes between the numerals indicate the operation of a stepping key which transfers the

dial pulses from the master to the group and to the connector switches. In a like manner, to reach selector 8, on district frame 207, code 1-1-0 would be dialed. Selector 32 on district frame 207 would be reached by dialing 1-3-6.

QUESTIONS

1. How many multiple brushes are required per elevator rod on a panel link circuit? Why?

2. Would traffic requirements ever make necessary the furnishing of more links per sub-group than there were district selectors in the same sub-group?

3. How many sub-groups of links may be placed on the front of a panel link frame? On the rear?

4. Are district selector circuits slipped between link frames when a sub-group is split over the district finder banks of 2 link frames?

5. When are two test connector switches per sub-group required?

6. How many group switches would be required on the district selector test frame to provide access to all district selectors shown on cabling schematic Fig. 6?

SUBSCRIBER SENDER, DECODER CONNECTOR AND DECODER FRAMES

In the Panel Dial System, the pulses sent to the central office from the calling subscriber's dial do not control the operation of the mechanical selecting equipment as they do in the Step-by-Step System. Instead, the dial pulses are received and recorded by a device known as a subscriber sender, which thereafter controls the selecting equipment in finding an idle trunk to the called office and either selecting in that office the called subscriber's line or displaying the number to a manual "B" operator. The first two or three digits dialed in calling another subscriber constitute the office code which consists of the numerical equivalent of the first two or three letters of the called office name. These first two or three digits are arbitrarily designated the "A" and "B" or "A","B" & "C" digits respectively. The remaining digits dialed make up the called subscriber's number and are known as the thousands (TH), hundreds (H), tens (T), units (U), and, if required, station (ST) digits. In two digit areas, the office code consists only of the "A" and "B" digits, while in three digit areas, the "A", "B", & "C" digits are required. The numerical value of the office code bears no relation to the actual location on the district or office frame multiple banks of the trunks to the called office. To translate this code to values which can be used by the sender in controlling the selection of the proper group of trunks, a circuit known as a Decoder is brought into the connection through a Decoder Connector circuit.

Subscriber Sender Frames

The subscriber decoder type sender frame is a single sided frame arranged to mount five sender units and one interrupter unit. Each sender unit mounts the apparatus and wiring for two sender circuits. The sequence switches and terminal strip for the two senders on the unit are placed in the center of the unit with the relay equipment for one sender on the left and that for the other sender on the right, the mounting plate and relay portion of each sender being enclosed in a dustproof metal casing covering both apparatus and wiring. The senders on the bottom unit of the frame are designated A and B, left to right, with senders C to K located on the four units above in the same manner. The interrupter unit equipped with interrupters, resistances, miscellaneous relays and terminal strips is mounted above the top sender unit.

The senders mounted on these frames are of three types, as follows:

1- Subscriber Non-Coin Sender.
Used with non-coin subscriber's lines or coin subscriber lines operating on the "Coin First" or "Coin Deposit Before Dial Tone" basis.

2- Subscriber Coin Sender.
Required for use with Coin Subscriber's lines operating on the "Dial Tone First" basis in order to test for deposit of the coin before completing the call.

3- Key pulsing "A" Switchboard Sender
Required when DS "A" Board is of the Key Pulsing Type

The subscriber sender is arranged to serve subscribers' lines and DS "A" Board operators when the "A" Board is of the dialing type. It is selected by the sender selector portion of the subscriber panel link circuit automatically when the subscriber removes the receiver from the switchhook. Dial tone is sent back to the calling subscriber by the sender which then receives and records all pulses from the subscriber's dial. After the complete office code has been received, the sender immediately causes its associated decoder connector to establish a connection with an idle decoder. Over a set of 19 leads, the sender transfers to the decoder, the settings of the A & C, or A,B & C digit register relays and the class of service relays. The decoder translates, or decodes, this information and, over a set of 31 leads, transmits back to the sender the correct routing which is recorded in the sender on six groups of selection register relays. The sender then releases the decoder and decoder connector and proceeds with the call.

The information recorded on the sender selection register relays is used to set the counting relays in the sender, in order to control the movement of the district and office selectors in selecting a trunk to the called office. There are ten counting relays numbered from 0 to 9, hence the sender is able to receive, from the panel selector circuits, 1 to 10 pulses as the condition requires.

The explanation of the sender counting relay action which follows disregards the sender stepping relay and is considerably simplified in order to promote an understanding of the essential principle involved. Assume that the group of trunks to the called office is located on district bank 1, group 4. The selection register relays controlling district brush selection have accordingly been set by the decoder to allow the sender to receive two pulses. The sender now operates the (L) relay of the district selector handling the call which, in turn, causes the operation of the up-drive magnet on the selector clutch. The district selector elevator rod consequently moves upward, and as it enters the tripping zone for brush 0, a ground pulse is sent back to the sender from the district selector commutator. This ground pulse will be directed by the selection register relays to counting relay 1, which will operate and transfer the path for the next pulse to counting relay 0. Since the district up-drive magnet is still energized, the selector continues upward and, when it reaches the tripping zone for brush 1, another ground pulse is sent back to the sender operating counting relay 0. The operation of counting relay 0, releases the district selector (L) relay and the elevator rod stops in position for tripping brush 1. The district trip magnet is now caused to operate and hold operated. The sender counting relays are released and the sender advances to the next operation. The selection register relays controlling district group selection have been set by the decoder to receive 5 pulses from the district selector. The selector (L) relay is again operated, the up-drive operates and the elevator rod moves upward. As it does so, the trip lever of multiple brush 1 engages the trip finger and the brush

is tripped. When the tripped multiple brush has reached the bottom of trunk group 0, a ground pulse is sent back to the sender from the district selector commutator. This pulse will be directed by the selection register relays to counting relay 4. This relay operates and transfers the path for the next pulse to counting relay 3. The selector continues upward sending back to the sender ground pulses at trunk group levels 1, 2 and 3, these pulses operating counting relays 3, 2 and 1 respectively. The next pulse received will operate counting relay 0, which will release the district selector up-drive and stop the selector at the bottom of trunk group 4. At this time, the sender transfers control of the selector movement back to the district selector. The district selector then "trunk hunts" until an idle trunk is found.

The foregoing description of the method used in operating a predetermined number of counting relays is known as "revertive pulsing". This method is employed by the sender in controlling the movement, not only of the district selectors, but also office, incoming and final selectors.

Should the called subscriber be located in a manual office, the outgoing trunk from the district multiple bank will terminate on an incoming trunk on a Call Indicator position of a manual "B" board. In this case, the sender, through its impulser switch, causes a set of impulses to be sent out over the trunk, operating relays and lighting lamps in the call indicator. These lighted lamps display the called subscriber's number to the manual operator who then completes the call in the usual manner.

If office frames are used, certain groups of outgoing trunks will appear on the office frame multiple banks. In this case, the trunk on the district multiple bank will terminate on an office selector. The revertive pulse method is used by the sender to cause the office selector to reach the proper group of trunks.

Should the called subscriber be located in a panel dial office, the OGT from the district or office multiple, will terminate on an incoming selector in the called office. The sender controls the movement of the incoming and final selectors to cause the selection of the called line. The translation of the thousands and hundreds digits of the called subscriber's number into incoming brush, incoming group and final brush selections is done by the sender. A description of this translation will be covered under incoming and final frames.

The Key Pulsing "A" Switchboard sender operates in a manner similar to the subscriber sender, except that it is used exclusively by "A" Switchboard operators who are provided with a set of keys arranged to transmit pulses corresponding to those sent by a subscriber's dial. The key pulsing sender receives and registers these pulses, the first two or three of which correspond to the office code. After these are received, the key pulsing sender is connected through a decoder connector to a decoder and the call proceeds in the same manner as for a subscriber sender. Usually one key pulsing sender is mounted on a unit with a subscriber sender, because few key pulsing senders are required. This facilitates the distribution of

these senders over the sender frames in order that the failure of a drive motor will not put more than 25% of them out of service. If required, however, sender units equipped with two key pulsing senders may be furnished.

When the total number of subscriber senders is less than 70, each sender frame is driven by a separate motor to prevent motor failure from putting out of service a large percentage of senders. When more than 70 senders are furnished, two sender frames are driven by each motor wherever floor plan layouts permit. A minimum of four sender frames is always furnished.

Decoder Connector Frames

The decoder connector frame is a single sided frame 2'6 3/4" wide having a capacity of three decoder connector circuits, designated A, B and C, from bottom up. Each connector consists of 17 multi-contact relays and two mounting plates of miscellaneous relay equipment. In each connector the 6 upper multi-contact relays provide for connection to any one of a maximum of 6 decoders, while the 11 other multi-contact relays provide for connection to a maximum of 10 senders on one sender frame and to the decoder test frame. The 6 decoder multi-contact relays are multipled to a maximum of 17 decoder connector frames, since the decoder holding time is so short that 6 decoders are estimated to be able to adequately serve 510 senders. The average panel office requires but 3 decoder frames, in which case multi-contact relays for decoders 4, 5 and 6 are not furnished. The 10 sender multi-contact relays are individual to the 10 senders on the frame served by that connector. Sender multi-contact relays are furnished in accordance with the number of senders equipped on the associated sender frame.

Decoder connector frame 1, connector A, serves subscriber sender frame 1; connector B, sender frame 2; connector C, sender frame 3; etc.

In accordance with the above, the operation of 1 sender multi-contact relay and 1 decoder multi-contact relay serves to connect through between the sender and the decoder a set of 50 leads.

Decoder Frames

The decoder frame is a single sided frame 4' 8 3/8" wide arranged to mount the common relay equipment and the cross-connection facilities and relays for 300 routes. Provision is made for one or two supplementary bays, each having cross-connection facilities and relays for 300 additional routes. Supplementary bays are required only in areas where the number of offices to be served exceeds the capacity of the originating frame.

The deocder is arranged for 800 3 digit codes numbered from 200 to 999, inclusive. These include the 512 possible three letter codes and the 288 numerical codes obtained by dialing zero, or one, for the second or third digit, or both. One additional code "0" (Special Service Operator) is also

provided. These codes, together with PS (Permanent Signal), provide a total of 802 separate indications that the decoder may receive from the sender. Each such indication is represented in the decoder by a terminal punching called a "code point." The transmission, by the sender to the decoder, of any one of the 802 codes operates certain relays in the decoder, resulting in the grounding of the code point associated with that code. These code points are cross-connected to the winding of a route relay which will operate as a result of the grounding of its code point. The operation of a route relay causes its particular set of information to be sent to the selection register relays of the sender. As described under the sender, these selection register relays are set in the proper combination for selecting a group of trunks and completing all functions required over the route called for by the office code.

Cabling

The method of cabling between sender, connector and decoder frames is shown, for a typical job, by Fig. 3. The leads to the six decoders are multipled between the terminal strips of all connector frames in switchboard cable. In order to insure the maximum factor of safety, the cables to the odd decoder frames are run from the lowest numbered connector frame and the cables to the even numbered decoder frames are run from the highest numbered connector frame. This latter set of cables is run over a separate route and brought in to the opposite end of the connector frame multiple. The leads between the senders and the decoder connectors are corried in switchboard cables directly to the connector multicontact relays. The details of the above methods of cabling are shown on Fig. 11. Each sender frame is cabled to sender monitor distributing terminal strips located on the end of one or more rows of sender frames. Cables are also run from each sender frame to the sender test frame.

QUESTIONS

1 - Why are subscribers' senders furnished in Panel Dial Offices?

2 - How many sender frames would be required in an office having 56 subscriber senders and 6 key pulsing senders? How many drive motors would be required on these sender frames?

3 - What two conditions must exist to require that coin senders be furnished?

4 - What counting relay will operate first in directing a district selector to the 7th trunk group on a bank?

5 - Why are key pulsing senders furnished? Are key pulsing senders cabled to the subscriber panel link frames? Give reason.

6 - How many subscriber senders will one decoder connector frame serve?

7 - What decoders appear on the first decoder connector frame? The last decoder connector frame? What senders appear on each of these frames?

8 - How many decoder connector frames are required to serve the quantity of senders covered by question 2?

9 - What does the decoder do for the sender?

10 - What is the minimum number of decoder frames furnished?

Office Selector Frames, Office Selector Test Frame, Incoming Selector Test Frame and Outgoing Trunk Test Frame

Office Selector Frames

Office frames are used in conjunction with the district frames as a means of selecting the proper trunking path to the called subscribers office. They are required in areas where it is not possible to provide the required number of trunks or trunk groups from the district multiple directly to the various local offices within the area.

Where the office selectors are located in the same building as the district selectors, the office selectors will, in general be of the local office (3-wire, T, R & S) type. In large cities it may be desirable to have trunks from the district or office multiple in several local offices terminate as selectors before a multiple on an office frame located in some distant panel building which can, with a common group of outgoing trunks serve an area more economically than individual trunks from the various offices. In this case the office selectors will be of the distant office (2-wire) type. Establishing a distant office center of this type may result in substantial economies in the outside trunk plant.

The 3-wire office selector frame is the one used most extensively. It is a double sided frame of the same general design as the district frame. Because of the small amount of apparatus required for the circuit, the relays are mounted on vertical mounting plates in the same bay with and to the right of the sequence switches. On the front of the frame 30 odd numbered selectors appear before the 5 multiple banks; on the rear there are 30 even numbered selectors. The office multiple is comprised of 450 trunks arranged in the same manner as the district multiple.

In the study of district selector frames, it was found that the number of trunks outgoing to other offices could be increased by subgrouping the multiple. The number of outgoing trunk paths may be increased further by assigning a group of trunks on the district multiple as trunks to office frames. Each of these district trunks will be connected with an office selector which has access to all trunks on the office frame. As an illustration of this method of increasing the outgoing trunk paths, assume a group of 30 trunks on a district multiple bank assigned as trunks to office frames. These would be connected to 30 selectors on the office frame, each of these having access to the 450 trunks on the frame. In this way the number of outgoing trunk paths from this group of district trunks has been multiplied 15 times.

Multiple Arrangements

In metropolitan areas several groups of district trunks may be assigned for use with office frames to provide the necessary paths to all offices having direct trunks from the local office. Referring to the district multiple arrangement in Figure 12, it may be seen that 30 trunks in each of banks 1, 2 and 3 of the district frames are assigned to office frames. The trunks from district frame bank 1 serve one group of office frames or office zone No. 1. The trunks from district frame banks 2 and 3 serve other office zones. As indicated by the number of trunks cabled, the district trunk groups assigned to office frames have the greatest number of calls of any group on these banks. These groups are placed at the bottom of the district frame banks since this leads to a slightly quicker district group selection. Trunks from any one group on the district multiple vary from a total of 30 to 160, whereas groups on the office frames consist of 10 or 20 trunks. This is typical of multiple assignments since the smaller groups for which no space is available on the district multiple are assigned to the office multiple. Some spare multiple space is available on the office frames as shown in Figure 12, whereas all of the multiple is assigned on the district frames. By thus utilizing all of the district multiple and by properly grading the groups appearing on it, the number of office frames and selectors is reduced to an economical point. The spare trunks on the office multiple are made busy at the distributing frame.

The office multiple is wired between banks of office frames within the same zone in either local or switchboard cable depending on whether the frames are adjacent in a row or the multiple extends over aisles. Each trunk group is slipped in layers of 10 similar to the arrangement covered under District Selector Frames. The slip arrangement reduces the average hunting time of the office selector, provides a more uniform distribution of load and wear on the apparatus, and decreases the danger of simultaneous seizure of trunks by the selectors.

Grading may be applied to the office multiple, although, it is generally resorted to only in special cases, such as, where it is necessary to care for a large trunk group on the office multiple or where considerable growth in a trunk group is expected. The office multiple in Figure 12 has certain layers for special use in addition to those assigned as regular outgoing trunks to local offices. One group (bank 0 layer 8) is used in connection with the office selector test frame for the routine test of office selectors. The test trunks are multipled without slip throughout all frames in one zone. Where there is more than one zone, the test lines in each zone may be multipled together at the distributing frame instead of between adjacent banks.

Office Frame Cabling

In addition to the multiple cable between banks which was mentioned above, the outgoing trunks cable from the multiple banks to the vertical side of the trunk distributing frame. From this point they are

cross connected by means of jumper wires to the 2-wire tie cable which carries the outgoing trunks to the main distributing frame. This is shown in figure 3.

The selector circuits are cabled from a terminal strip on the front and rear of the office frame to the horizontal side of the trunk distributing frame where they are cross connected to the proper district outgoing trunks appearing on the vertical side of the distributing frame.

Office Selector Test Frame

The office selector test frame is a single sided frame designed to mount the apparatus required for testing the 3-wire office selectors in a panel dial office. The circuit is used to exercise all 3-wire office selectors in rotation as a matter of periodic routine, or to reach a particular selector or group of selectors for making individual tests. While one test frame can test a maximum of 3000 office selectors, the time required to complete a cycle of testing this large a group might prove excessive. In this event two test frames are furnished, each arranged to test all office selectors. When there are less than 300 3-wire office selectors in an office, a test frame is not usually provided and the office selectors are tested by means of manually operated test sets. Distant office selectors are tested by means of a wagon type test set.

Access to the 3-wire office selectors is obtained through the district selectors under control of the office test circuit, which are made to select any or all terminals in the district multiple bank assigned to the office frame and, in this manner reach the office selectors associated with this district trunk group. When these district test selectors are assigned on the various district frames so that all sub-groups of the district multiple can be reached, the test circuit will have access to all trunks terminating as office selectors. Selector No. 1 on the front and selector No. 2 on the rear of district frames are wired so that they may be equipped for testing as required. When associated with the office test frame these test selectors are known as "office test selectors". Separate office test selectors are required for each office test frame since the test circuit is not arranged to permit the use of the same test selector by two test frames. The test selectors are so arranged that they are available for regular service when not actually engaged in testing. The number of test selectors required for each office test frame is equivalent to the greatest number of sub-groups in a district multiple group assigned to office frames. The test selector is generally assigned on a district frame at the opposite end of the sub-group from the termination of the outgoing trunk cables. This is for the purpose of making a continuity test of as much of the associated district multiple as possible.

An office selector test frame is arranged for an ultimate of 24 office test selectors. There are connected to the test circuit through connecting switches (sequence switches) with three test selectors assigned to a connecting switch or an ultimate of 8 connecting switches. Through

6 pairs of directing switches (206 type selectors) the frame is capable of making tests on 120 various groups of trunks on the district multiple banks (one pair of directing switches for each 20 tests). A test is a cycle the test circuit makes in raising a test selector and returning it again to normal. A new test is performed when the test selector has selected all the trunks in one bank and enters another bank, since it is necessary to return the test selector to normal and trip another brush before selection of trunks can be made in the second bank. The test circuit can operate the test selector over consecutive groups of trunks within one bank. When two groups within a bank are separated by a group which is not to be tested, the test selector must be returned to normal and a new group selection made within the bank, thus establishing another test. Directing and connecting switches are provided as required to meet the needs of the local office.

The district multiple arrangement shown by Fig. 12 provides 6 sub-groups of trunks to Office Zone 1. To gain access to all of these trunks, an office test selector must be assigned on one of the district frames in each sub-group for each office test frame equipped. Assume that one office test frame is required and that the cables to the VTDF are run from the lowest numbered district frame in each sub-group. In order to provide continuity testing of the trunk multiple, the 6 test selectors would be assigned, one each, on the highest numbered district frame in each sub-group. The district multiple sub-grouping of trunks to Office Zones 2 and 3 is identical with that of Zone 1, therefore, the same 6 test selectors may be used to gain access to trunks to Zones 2 & 3. As the trunks of each Office Zone are on different banks of the district frames, the test selectors must make three separate brush and group selections (tests), or a total of 18 tests. One connector switch provides for 3 test selectors and one directing switch provides for 20 tests. The office selector test frame will therefore be equipped with two connector switches and one directing switch. The path of the test from the test selectors, through the multiple, to the VTDF, through the jumper to the HTDF and to all the office selectors is shown by Fig. 12.

The directing switches govern the connecting switches in their selection of the test selectors and also the manipulation of the test selectors in their selection of the various groups of trunks in the multiple banks. This control is made flexibel by wiring the arcs of the directing switches to terminal strips so that cross-connections can be made to meet the local requirements.

To assist the test man in making a test on a particular office selector, a locating chart is made similar to that used with the district test frame. This indicates the test selector which must be used to reach the group and directing switch and terminal number assigned to test the group. Since these assignments are affected by multiple rearrangements which are frequently made, it is not practicable to make these charts until the multiple is cut into service. The locating charts for the office

and incoming test frames are, therefore, made on the job instead of at the time the frame is engineered.

Incoming Selector Test Frame

In its design, operation and function the incoming selector test frame closely parallels the office selector test frame. The test circuit, through the use of test selectors on district and office frames, gains access to all the terminals on the district and office multiple banks which terminate as panel incoming selectors in the same or in distant offices. It is then possible to routine all of these incoming selectors in rotation or to test individually any one selector or group of selectors. A greater number of tests will be made over outgoing trunks appearing as incoming selectors in distant offices than over trunks to incomings within the same office. An incoming test frame does not test all of the incoming selectors in the office in which it is located. The panel interoffice incoming selectors originating on the district or office frame multiple in some distant office are tested by the incoming test frame within that distant office. The incoming selectors from dial system "B" boards are not tested by the incoming test frame, but are tested by manually operated test sets.

Test selectors for use with the incoming test frame are assigned on district and office selector frames in the same manner as described under the office test frame, and are known as "incoming test selectors". When two incoming test frames or an incoming test frame and office test frame are provided in the same office, a separate test selector is required for each test circuit.

Referring to Fig. 12, trunks to Victory (District Bank 0) and to Calumet (District Bank 4) are the only trunks which terminate on incoming selectors in the same building in which the equipment shown by Fig. 12 is located. The following offices shown on the district multiple of Fig. 12 are panel dial office: Victory, Haymarket, Harrison, Randolph, Central, Franklin, Superior, Monroe, State, Seeley, Wabash, Dearborn, Calumet & Canal. Incoming test selectors must accordingly be assigned in a manner to gain access to each sub-group of trunks to all of these offices. Assuming that only one test frame is used and that the cables to the VTDF are run from the lowest numbered district frame of each sub-group, the number of incoming test selectors to be assigned on the district frames should be determined. The number of tests required by each test selector should also be determined.

The following offices assigned to the office multiple are panel dial offices: Delaware, Andover, Webster & Longbeach. Incoming test selectors must be assigned on the office frames in a manner to gain access to trunks to these offices.

After the total number of test selectors and associated tests required on both the district and office frames is known, the number of connector switches and directing switches to be equipped on the incoming test frame should be determined.

One incoming test frame is generally provided for 1200 outgoing trunks to panel incoming selectors. The frame has a capacity of 8 connecting switches and 8 pairs of directing switches which will accommodate 24 test selectors and 160 tests. This equipment is furnished as required for each job. Flexibility in the selection of test selectors and their selection of various trunk groups in the multiple banks is obtained by cross-connecting at a terminal strip on the frame as in the case of the office test frame. A locating chart made at the completion of the installation is used to assist the test man in making tests on particular incoming selectors.

Outgoing Trunk Test Frame

As the name implies, the outgoing trunk test frame is designed for making tests on outgoing trunks and is not in any way used in the completion of subscriber calls. It is used by the plant department of the telephone company to make busy and finally clear trouble on trunks which the maintenance people have reported as inoperative or troublesome. This frame is also used as a terminating point for various trunks and tie lines to other frames and desks throughout the office which are used by the maintenance people.

The frame is single sided and consists of a test bay and one or more jack bays. The test bay mounts the equipment for a voltmeter test circuit and the relay equipment for a sender. This sender is used to control the proper brush and group selection of a selector when seizing a particular trunk for test. The sequence switches required with this sender are mounted on the miscellaneous interrupter frame since there is no motor or drive equipment on the outgoing trunk test frame. The key and lamp equipment for the various tie lines is also located on this bay.

The jack bay is arranged to mount the test and make busy jacks associated with each outgoing trunk. The trunks terminate in groups of 100 with 5 strips of "test" and 5 strips of "make busy" jacks in each group. The groups are mounted two across and ten high giving each jack bay a capacity of 2000 outgoing trunks. Switchboard cables of 100 circuits (T, R & S) terminate on the jacks of each group of trunks. The other end of these cables terminate on the HTDF in the majority of cases as shown in Fig. 3. On the HTDF, the T & MB jack leads (T, R & S) are terminated on 3 point terminal strips, 20 circuits per strip. A group of 100 jack circuits (0 to 99) thus appears on 5 terminal strips designated by hundreds to agree with the hundred numbering used at the jack bay. Two wire tie lines (T & R) are connected to the T & R punchings of each row on the HTDF and cabled from there to the HMDF in hundred circuit cables. At the HMDF, the tie lines are designated in hundreds, TL-0 (0 to 99), TL-1 (0 to 99) etc., to agree with hundred numbering at the jack bay and HTDF. It will thus be seen that a trunk from the district or office multiple outgoing to some other office, will be connected at the HTDF to a Test & Make Busy jack and to a 2 W tie line to the MDF. Since interoffice trunks of this type are 2 wire, the sleeve lead is not carried beyond the TDF. On Fig. 12, the leads from HTDF to the MDF are the above mentioned 2 wire tie lines.

Make busy jacks for permanent signal holding trunks and local incoming selectors are usually located in the position of a spare group of test and make busy jacks. Test circuits for use with the trunks are terminated at jacks in jack mountings located at the side of the jack bay uprights. The jack mountings also provide for the termination of the test circuit for making continuity and reversal tests and for test lines from the local test desk. Jacks for use when making transmission tests may also be added if requested. Patching cords are used to connect the test circuit to an individual trunk jack.

QUESTIONS

1. When is it necessary to use office selector frames?

2. What are the types of office selector circuits and the purpose of each ?

3. How many outgoing trunks appear on each office selector frame multiple bank? What is the trunk capacity of one frame?

4. How many selectors may be equipped on an office selector frame?

5. Is the office multiple graded? Is it slipped?

6. On what distributing frame and on which side of this frame does the office multiple generally terminate? Where are the office selectors cabled?

7. What equipment is used to test distant office frame selectors?

8. How is the office selector reached for testing? How is the incoming selector reached for testing?

9. What is a "test bay" as the term is used in determining the equipment required on a test frame?

10. What is the controling factor in determining the number of connecting switches required on an office or incoming test frame? In determining the number of directing switches?

11. What circuits appear on the OGT test frame?

12. How and by whom is the OGT test frame used?

INCOMING SELECTOR FRAMES AND FINAL SELECTOR TEST FRAME

Terminating Equipment

The panel dial frames covered in lessons 2 to 6, inclusive, make up what is known as the originating equipment. This designation is used because of the fact that all of these frames are located in the office which serves the subscriber originating the call, and, with the exception of dialing, perform all operations in connection with the origination of a call and the selection of an outgoing trunk to the office in which the called subscriber is located. The selected outgoing trunk terminates on an incoming trunk or selector in the same, or in a distant office. The equipment used in completing the selections in the called office is known as terminating equipment. In panel dial offices, this comprises the incoming and final frames and, where required, the "B" switchboard and associated "B" link and "B" sender frames. In a few cases, Dial Incoming or Terminating Senders are provided, instead of "B" equipment.

Incoming Selector Frames

The incoming selector frame is the first frame of a chain of frames used exclusively for terminating traffic. The frame is similar to other panel type selector frames illustrated by Fig. 8, mounting 5 one hundred point multiple banks and equipment for 60 selector circuits, 30 on the front and 30 on the rear. The number of incoming frames to be furnished for a given office is approximately equal to the total number of incoming trunks divided by 60.

The incoming selector circuit is designed to select a trunk to an idle final selector, ring the called subscriber's bell on completion of selection, transmit audible ringing tone to the calling subscriber, furnish talking battery to the called subscriber and transmit line busy tone to the calling subscriber in case the called line is busy. Since the incoming selector circuits originate as outgoing trunks in manual, toll and panel offices, several types of circuits must be provided.

TYPES OF INCOMING SELECTOR CIRCUITS	MOUNTING PLATE LENGTH		
	Ringing - 1 & 2 Pty.	4 Pty Full Sel	4 Pty Semi-Sel
FROM MANUAL OFFICES			
"B" Swbd - Local	16½"	16½"	19"
" " Tandem	16½	19	19
" " Toll	23	23	23
Key Ind - Local	16½	16½	16½
" " Toll	23	23	23
Key Pulsing - Toll	23	23	23
Dialing - Local (D.I.S.)	16½	16½	16½
" " (T.S.)	23	23	23
FROM PANEL DIAL OFFICES			
Local	16½	16½	16½
Tandem	16½	16½	19
"B" Swbd. - DS "A" Bd.	23	23	23
Key Pul - DS "A" Bd.	23	23	23
Dial - DS "A" Bd.	23	23	23

(16½" Mounting Plates require Frames 9' 1 5/8" long)
(19 " " " " 9' 6 5/8" ")
(23 " " " " 10' 2 5/8" ")

Incoming Multiple

Every incoming trunk or incoming selector must be able to establish connection to any one of a possible 10,000 subscribers in a unit of panel dial equipment. To meet this requirement, each incoming selector is given access on the multiple banks of the incoming frame to a set of 24 trunks to each group of 500 subscribers or to each final choice. Four groups of 24 trunks appear on each of the five multiple banks and are arranged in accordance with Fig. 13, SK "A". It will be noted that the trunks are numbered from 0 to 23 in each choice and that an overflow terminal appears above each set of 24 trunks. The 96 trunks and 4 overflows thus occupy all the terminals on a 100 point bank. Since more than 24 trunks are usually required to handle the traffic to each group of 500 subscribers, the incoming multiple is sub-grouped to double, treble, or further increase the number of trunk paths available. It will be noted that the 18 incoming frames shown on Fig. 13 are arranged in three sub-groups of 6 frames each. The three sub-groups result in three times 24, or a total of 72 paths from the incoming frames to each final choice. While the traffic to each choice would require more than 24 or 48 trunks, only one choice requires as many as 72 trunks. To enable a minimum number of equipped trunks to care for all calls to each final choice while, at the same time, providing sufficient trunks to handle peak loads in the several sub-groups, a plan of grading the incoming multiple is used. A typical method of grading is shown by Fig. 13 SK "B", this being the grading applied to Choice 0 of all three sub-groups. It will be noted that the individual trunks are slipped between frames in groups of 4, while convertible and common trunks are multipled

straight between frameswithout slip.

The 12 odd trunks from 1 to 23 of each choice are cabled from the end frame of each sub-group in a 12 circuit cable to an incoming multiple terminal strip located on the front of the final frame serving that choice. The 12 even trunks from 0 to 22 of each choice are cabled in a similar manner to the rear of the final frames. These incoming multiple terminal strips are shown on Fig. 14. Convertible trunks are made individual or common as required, and common trunks are multipled between the three sub-groups by wiring at the incoming multiple terminal strips. The method of making this multiple and the connection of the trunks to the equipped final selectors will be covered in Lesson 8.

Party Line Ringing

As mentioned in Lesson 1, each subscriber on a party line is assigned a different number. In a unit serving 4 party lines exclusively, the 10,000 subscribers would be assigned, four each, to 2500 four party lines.

On a two party line, the ringer in the subset of one subscriber is rung over the ring of the line to ground. The ringer of the second subscriber on the line is rung over the tip of the line to ground. After the final selector has made connection to the called final terminal, the incoming selector connects machine ringing to the ring of the trunk. Ringing current is extended to the ring of the called subscriber's terminal at the HIDF. In the case of the "Ring" party on the line, ringing is carried thru the jumper at the IDF or MDF to the ring of the line. In the case of the "TIP" party on the line, the T & R jumpers are reversed at the IDF or MDF. This causes the ringing applied to the ring of the final terminal to be applied to the tip of the line.

In offices arranged for four party full selective ringing, the ringers of two of the subscribers on a four party line are rung over the ring of the line, one ringer being biased to respond only to negative ringing current and the other only to positive ringing current. The ringers of the other two subscribers on the line are rung over the tip of the line in a similar manner. The reversal between the Tip & Ring of the two pairs of subscribers on the line is made thru the IDF or MDF jumpers. The four party full selective ringing incoming selector used in this type of office is arranged to apply negative superimposed ringing to the ring of the final terminals of all even numbered choices from 0 to 18, and thru the operation of the party ringing relay, apply positive superimposed ringing to the ring of the final terminals of all odd numbered choices from 1 to 19. The four subscribers on a party line might be assigned numbers and rung as follows:

PARTY	NUMBER	RUNG OVER	RING CURRENT
1	0499	Ring	-Superimposed
2	0999	Ring	+ "
3	1499	Tip	- "
4	1999	Tip	+ "

In offices arranged for four party semi-selective ringing, two parties are rung over the ring of the line, one with a 1 ring code, the other with a 2 ring code. The two subscribers rung over the tip of the line are rung in the same manner. This plan does not require the use of biased ringers. The four party semi-selective ringing incoming selector is arranged to apply the one ring code to the ring of the final terminals of even numbered choices and the 2 ring code to the ring of the terminals of odd numbered choices.

PARTY	NUMBER	RUNG OVER	RING CODE
1	0499	Ring	1 Ring
2	0999	Ring	2 Rings
3	1499	Tip	1 Ring
4	1999	Tip	2 Rings

Numerical Translation

An incoming selector has access to all of the 10,000 final terminals of each unit. Each incoming brush, therefore, has access to one-fifth of the total, or 2,000 terminals. The brushes are numbered from 0 to 4, corresponding to banks 0 to 4. Brush 0 has access to trunks to terminals from 0 to 1999, Brush 1 to terminals 2000 to 3999, etc. Since each final choice has 500 terminals and 2000 terminals are reached through each incoming brush, each incoming brush has access to 4 groups or final choices. These four groups per incoming frame bank are designated incoming groups 0 to 3.

The sender makes the translation of the thousands and hundreds digits of the dialed number to determine what counting relays will be used to control incoming brush, incoming group and final brush selection. A short rule for determining these selections is as follows:

Divide the number dialed by 2000 which will give the incoming brush selection.

Divide the remainder by 500 which will give the incoming group selection.

Divide the remainder by 100 which will give the final brush selection.

Final group (or tens) and units selections are obtained directly from the tens and units of the dialed number, no translation being necessary.

Example:

Number dialed——4945

2000 (4945 (2 Incoming Brush
4000

500 (945 (1 Incoming Group
500

100 (445 (4 Final Brush

Fictitious Numbers

In offices having less than 20 equipped final choices initially, the telephone company frequently desires to assign numbers falling in the unequipped choices. For example: Official lines are nearly always assigned in the block of 500 numbers from 9500 to 9999. To avoid installing initially the final frame that will ultimately serve this choice, the choice is multipled at the incoming frame banks to an equipped choice. Number 9500 would be translated by the sender to require incoming brush selection 4 and group selection 3. Since the incoming selector must be allowed to make these selections, the spare trunks located at this point on the incoming frame banks are multipled to an equipped choice at a lower level on the frame. Equipped final selectors will be connected to these trunks and the selection may proceed to its temporary termination on some other set of final terminals.

Final Selector Test Frame

The final selector test frame is a single sided frame designed to mount the apparatus required to gain access to all terminals on the incoming frame multiple banks that terminate as final selectors. It is then possible to exercise all these selectors in rotation as a matter of periodic routine, or to reach any one selector, or any group of selectors, for making individual tests. One final selector test frame is usually furnished for each panel dial unit having 300, or more, final selectors. In offices having less than 300 final selectors, the final selectors are tested by a manually operated test wagon.

Access to the final selectors to be tested is obtained through incoming selectors under the control of the test circuit. These incoming selectors are known as final test selectors and, when connected to the test circuit, can be made to select any or all of the terminals on the multiple banks of the incoming frames on which they are located, reaching, in this manner, all the final selectors in the office.

The test frame has a capacity of 7 connector switches, (21 Test Selectors) and six directing switches, (120 Tests). The principle of control of the test selector by the test circuit is the same as that used by the office and incoming selector test frames. An additional feature has been included in the final test circuit which permits a control by the test circuit of the number of trunks tested in each trunk group, instead of allowing the selector to test all trunks up to the overflow terminal. This control is accomplished through a 206 type selector known as a locating switch which steps in synchronism with the test selector in use. By means of cross-connections on the terminal strips associated with the arcs of the directing switches, the number of steps the locating switch is allowed to make on each test can be controlled. When the pre-determined number of steps have been taken by the locating switch (and the test selector) the test is stopped and the test selector is returned to normal. This feature thus provides a method by which the test selectors on all but the last sub-group are permitted to test only the trunks equipped as individual. The individual trunks of the last sub-group and the commons

are tested only by the test selector operating on the last sub-group. Repeat testing of the commons is avoided and considerable reduction is made in the time required to complete one cycle of tests.

Test selectors are assigned in a manner to reach all sub-groups of all choices on the incoming multiple. Selector #1 on each incoming frame is wired for use as a test selector. Where panel incoming selectors are assigned as test selectors, they may be used for regular service when not in use by the test frame, provided they originate as trunks on the district or office frame in the same building. In this case, the test frame, while using the selector, puts a busy condition on the sleeve terminals of the trunk at the multiple banks through a connection at the VTDF. If any other selector than a local panel incoming selector is assigned as a test selector, it must be assigned for testing purposes exclusively.

Cross connection charts showing the wiring necessary to control the test selectors and locating and particular circuit charts are made up during the engineering of the job. Complete information is then available as to the permanent assignment of the incoming multiple trunks to final selectors.

The incoming multiple arrangement shown by Fig. 13 would require the assignment of 3 test selectors. To obtain continuity testing of the multiple between incoming frames, the test selectors should be assigned on incoming frames 1, 7 and 13. Since the common trunks are to be tested from the last sub-group only, (sub-group C), the test selectors on frames 1 and 7 will each require 20 tests. This is due to the fact that only the individuals are tested in each choice, after which the test selector is returned to normal and another brush and group selection made before starting test of the individuals of the next higher choice. The test selector assigned to sub-group C will require only 5 tests since all trunks will be tested in each bank before the selector is returned to normal for another brush selection.

The conditions covered by Fig. 13 will, therefore, require 1 connector switch, (3 Test Selectors), and 3 directing switches, (45 Tests Used).

QUESTIONS

1. What frames are included in the originating equipment?
   In the terminating equipment?

2. Give three functions of the incoming selector circuit.

3. What is the trunk capacity of one incoming frame multiple bank?
   How many groups of trunks, (Choices), appear on each bank?

4. What choices are rung with a 1 ring code?

5. What choices are rung with plus superimposed ringing?

6. What type of ringing requires the use of superimposed ringing current?

7. Give a set of typical numbers of the 4 subscribers on a 4 party line.

8. What incoming brush, incoming group and final brush selection are required by the number 7631?

9. Why are one or more unequipped choices multipled to equipped choices?
   What choice is most frequently multipled in this manner?

10. What important difference is found in the method of operation of the final selector test frame as compared to the incoming selector test frame?

FINAL SELECTOR FRAMES & LOCAL TEST DESK TEST SELECTOR FRAME

Final Selector Frames

The final selector frame is one of a chain of panel dial frames which is used exclusively for terminating traffic. The final selector circuit originates as a trunk on the incoming frame multiple bank and, through a selector rod and multiple brushes, may make connection to a maximum of 500 subscribers for terminating calls.

The final frame is similar to the other panel type frames illustrated by Fig. 8, having a capacity of 60 selector circuits, 30 on the front and 30 on the rear. The frame mounts 5 one hundred point multiple banks to which are connected the 500 subscriber terminals of the associated choice or choices.

One final choice must be provided for each group of 500 final terminals corresponding to one choice at the incoming multiple. Depending upon the calling rate to the various choices, capacities of 30, 40, 60, or more, final selectors per choice are provided. The 30 & 40 capacity arrangements require the provision of multiple banks split 30-30 and 40-20, respectively. The capacities of several typical arrangements are shown by the following;

Sel. Cap. Per Choice	No. of Final Frms. Per Choice	Type of Mult. Bank	No. of Final Term.
30	1/2	30-30	1000 Per Frm.
40	2/3	40-20	1500 " 2 Frms.
60	1	60	500 " Frm.
90	1 1/2	30-30	1000 " 3 Frms.
120	2	60	500 " 2 "
180	3	60	500 " 3 "

The final frame multiple bank is divided into ten groups, each group consisting of ten lines. No overflow terminals are required, as the final selector does not trunk hunt, but is directed to a definite line in each group of ten by the sender. An exception to this arrangement occurs on PBX groups where from 5 to a maximum of 100 lines may be connected as a PBX group. In this case, the final selector is directed to the first line of the group by the sender and then hunts over the lines of the PBX group until an idle line is found. The final multiple is cabled from the multiple banks in 100 circuit cable to the HIDF where it appears as subscriber terminals. When the number of final selectors per choice is such as to require a multiple between the banks of two or more frames, this multiple is also run in 100 circuit cable.

In order to test subscriber lines, final selector circuits 1, 2, 59 and 60 are wired for use with the #14 Local Test Desk through the Local Test Desk Selector Frame. These selectors are wired and equipped for regular service, but are equipped for test desk testing only when required.

Selector circuits 1 and 2 are also provided with test jacks to permit them to be used in testing subscriber lines with the subscriber line test set.

The 24 trunks per sub-group per choice are cabled from the incoming multiple banks in two 12 circuit cables which terminate, one each, on incoming multiple terminal strips on the front and rear of the final frame serving the respective choice. Referring to Fig. 13, the connections from choice 0 on Incoming frames 6, 12 and 18 to final frame 1, represent, in each case, the two above 12 circuit cables. In the same manner, two cables are run from these frames for each of the 19 remaining choices, to the fronts and rears of the proper final frames from 2 to 21.

The incoming multiple terminal strips at the final frames are arranged to provide terminations for the trunks of from 4 to 12 sub-groups depending upon the sub-grouping required at the incoming frame multiple banks.

The incoming frames shown on Fig. 13, are arranged in 3 sub-groups, choice 0 of each sub-group being graded in accordance with SK "B". The incoming multiple terminal strips for the termination of the trunks of choice 0 on Final frame 1 are shown on Fig. 14. It will be noted that one incoming multiple terminal strip is provided on both the front and rear of the frame and that these terminal strips are arranged for 4 sub-groups. Odd numbered trunks from 1 to 23 of each sub-group are terminated on their respective portion of the incoming multiple terminal strip on the front of the frame. Likewise, even numbered trunks from 0 to 22 are terminated on an incoming multiple terminal strip on the rear of the frame.

Assume that 50 final selectors are necessary to care for the terminating calls to the 500 terminals appearing on the multiple banks of final frame 1. The 24 trunks of each of incoming sub-groups A, B and C, make a total of 72 trunks. Since only 50 final selectors are to be equipped, a certain number of trunks must be made common to all sub-groups and additional individual trunks assigned in each sub-group to obtain the total of 50.

Let X = Number of Trunks common to all sub-groups.
Let Y = Number of Individual trunks in each sub-group.

Then the three sets of individual plus the one set of common must equal 50; or $3Y + X = 50$.

Also, in any one sub-group, the sum of the individual and common must equal 24: or $Y + X = 24$

Subtracting the second equation from the first:

$$\begin{array}{rl} 3Y + X = & 50 \\ \underline{Y + X = } & \underline{24} \\ 2Y \quad = & 26 \end{array} \qquad Y = 13$$

Substituting to obtain X:

$$13 + X = 24$$
$$X = 11$$

The number of individual equipped trunks per sub-group may also be obtained as follows:

Let Y = number of individual equipped trunks per sub-group.
Let N = number of sub-groups.
Let Z = total number of equipped trunks per choice.

Then: $Y = \frac{Z-24}{N-1}$

Substituting quantities given for choice 1:

$$Y = \frac{50-24}{3-1} = \frac{26}{2} = 13$$

The incoming multiple (SK B, Fig. 13) is cabled to provide 4 individual, 12 convertible, and 8 common trunks. Table A, Fig. 14, indicates that 13 trunks equipped as individual are made up of 4 trunks cabled as individual and 9 trunks cabled as convertible. The 11 trunks equipped as common are made up of 8 trunks cabled as common and 3 trunks cabled as convertible. In each sub-group the trunks are numbered from 0 to 23. Even trunks, 0 to 22, are cabled to the rear of the final frames and odd trunks, 1 to 23, are cabled to the front of the frames.

It is the present standard practice to connect odd numbered trunks to odd numbered selectors and even numbered trunks to even numbered selectors. In each case the highest numbered trunks are connected to the lowest numbered selectors. Since other methods have been used in the past, it is the practice, on additions, to continue the method in use on the original portion of the job.

The 11 common trunks are made up of 6 odd trunks numbering down, 23, 21, 19, 17, 15 & 13, and 5 even trunks numbering down, 22, 20, 18, 16 & 14. The 13 individual trunks are made up of 6 odd trunks numbering down from 11 to 1, and 7 even trunks numbering down from 10 to 0. The trunks are connected to the selectors to be equipped by a short length of switchboard cable between the incoming multiple terminal strips and the final selector terminal strips. This cable is formed and connected as may be required to meet the various job conditions. The trunks to be equipped as common are connected from the first sub-group to the final selector terminal strip. In this case odd trunks 23 to 13 are connected to odd final selectors 1 to 11, and even trunks 22 to 14 are connected to even selectors 2 to 10. The common trunks are then multipled from the first to succeeding sub-groups with a reversal between sub-groups by means of loop wires run thru the fanning strip of the incoming multiple terminal strip. When a #14 Local Test Desk is used, the trunks used as test, in this case 23 & 22 (selectors 1 & 2), are not reversed between sub-groups, but are run straight in order to keep them at the top of the common group. The association of common trunks 13 to 23 with the final selectors and the details of multiple and reversal between sub-groups is shown by the Table of Trunk Multiple—Incoming Multiple Terminal Strips. Trunks which are equipped as common, but cabled on the incoming multiple as convertible, are multipled and reversed between sub-groups independent of the commons but in a similar manner.

The multiple of convertible trunks 13, 14, & 15 is shown by the trunk multiple table.

The trunks equipped as individual are connected from each sub-group to the final selector terminal strips and thence to the selectors. Individual trunks odd, 11 to 1 and even, 12 to 0 for each sub-group are connected to a set of final selectors which are available only to the incoming selectors of one sub-group. The assignment of individual trunks of the three sub-groups to final selectors is also shown by the trunk multiple table.

Final brush selection is determined by the sender as a part of the translation of the thousands and hundreds digits of the called number. After the final selector has made brush selection, the tens digit of the called number determines the sender counting relay to be used in selecting the proper group of ten lines. In making units selection, that is, connection to the called line, a slow speed up-drive is brought into use due to the fact that the revertive pulse method of control by the sender would not be fast enough to prevent overstepping of the final selector, if operated at the normal up-drive speed.

INCOMING MULTIPLE TERMINAL STRIPS

TABLE OF TRUNK MULTIPLE

FINAL FRAME 1 (CHOICE 0)

Rear of Frame (Even Trunks)

SUB-GROUP A (Inc. Fr. 1-6) Fin. Sel.	Trk.	SUB-GROUP B (Inc. Fr. 7-12) Fin. Sel.	Trk.	SUB-GROUP C (Inc. Fr. 13-18) Fin. Sel.	Trk.	
2	22		22		22	COM
4	20		16		20	
6	18		18		18	
8	16		20		16	
10	14		14		14	CONV
12	12	26	12	40	12	IND
14	10	28	10	42	10	
16	8	30	8	44	8	
18	6	32	6	46	6	
20	4	34	4	48	4	
22	2	36	2	50	2	
24	0	38	0	52	0	

Front of Frame (Odd Trunks)

Fin. Sel.	Trk.	Fin. Sel.	Trk.	Fin. Sel.	Trk.	
1	23		23		23	COM
3	21		17		21	
5	19		19		19	
7	17		21		17	
9	15		13		15	CONV
11	13		15		13	
13	11	25	11	37	11	IND
15	9	27	9	39	9	
17	7	29	7	41	7	
19	5	31	5	43	5	
21	3	33	3	45	3	
23	1	35	1	47	1	

Local Test Desk Test Selector Frame

One Local Test Desk Test Selector frame is furnished with each panel dial unit that is tested from a #14 Local Test Desk. The test desk may be located in the same building, or in some distant building. The frame is a single sided frame arranged to mount the sequence switch and relay equipment of test desk test selector circuits. Provision is made for 6 first selector circuits and 15 second selector circuits which together function in a manner similar to an incoming selector circuit.

The first selectors are connected to test jacks at the local test desk. The testman at the desk plugs a test cord into a test jack circuit and obtains a connection through the selecting equipment to any subscriber line in that unit, after which, tests on that line may be made as required. There are two methods in use for setting up the connection to the line to be tested.

In the first method, the test jack at the desk and the first selector circuits appear on the banks of a Call Distributing "B" Link Frame. The plugging of a test cord into the test jack causes a "B" link circuit to connect to the test selector and complete the connection through to a Call Distributing "B" operator and a "B" Sender. The number of the line to be tested is passed from the testman to the "B" operator who sets up the number on the position key set. This setting is then transferred to, and recorded in, the "B" sender which directs the selecting equipment to the called line.

In the second method, which is used in offices having no "B" board equipment, the local test desk is equipped with dials. The testmen plug the test cords into the test jacks, operate a key to connect the dial to the test cord, and dial the number of the line to be tested. The pulses from the test desk dials are received and recorded by a Terminating sender which then controls the selecting equipment in the same manner as a "B" sender.

The 6 first selectors are all connected through sequence switches to 15 second selectors arranged in 5 groups of 3. On the first selector sequence switch positions 1, 4, 7, 10, and 13 correspond to incoming brush selections 0, 1, 2, 3, and 4, respectively. The switch, in revolving into these positions, sends back to the sender ground pulses, in the same manner as a regular incoming selector in making brush selection. Assume the called number to be 3620. This number would be located in final choice 7, which originates on incoming bank 1. The first selector switch would, therefore, revolve to position 4, (Brush 1), in which position it would be connected to the first of the 3 second selectors serving that group of 2000 lines. Should this second selector be busy, the switch would revolve under its own control to position 5 or 6. If the second selectors connected to both of these positions were busy, a busy tone would be sent back to the test desk.

Assume the selector connected to switch position 5 to be idle. This would be the second selector in the second of the five groups. These three second selectors have access to a maximum of 4 final selectors in each of choices 4, 5, 6, and 7. Positions 1, 5, 9, and 13 of this switch

correspond to incoming group 0, 1, 2, & 3, respectively. Since the called number is located in choice 7, incoming group selection #3 must be made. The second selector switch is directed by the sender to switch position 13, at which time, it is connected to the first test final selector on the final frame serving choice 7. If this final selector is busy, the switch steps under its own control to the next position. The selected final selector is then directed by the sender in the regular manner to make brush, tens, and units selection and connect to terminal #3620.

Second selectors have access to final selectors serving the various choices as follows:

2nd SEL. NO.	CHOICES	FINAL TERM NO'S.
1, 2 & 3	0 to 3	0 to 1999
4, 5 & 6	4 to 7	2000 to 3999
7, 8 & 9	8 to 11	4000 to 5999
10, 11 & 12	12 to 15	6000 to 7999
13, 14 & 15	16 to 19	8000 to 9999

Regular incoming selectors could, of course, be used to obtain access to any final terminal number for test purposes, but, in that case, the first idle final selector would be brought into the connection. Since only certain final selectors, (1, 2, 59 & 60), are arranged for this special testing, the local test desk test selector circuits provide the means of selecting these circuits and excluding all regular final selectors.

QUESTIONS

1. How many final selector frames would be required to serve 6 choices, each of which is arranged for a capacity of 40 selectors?
2. Why are overflow terminals <u>not</u> required on final frame banks?
3. Why are incoming multiple terminal strips furnished at the final frames?
4. On which side of the final frame do the even numbered trunks terminate?
5. Assume 4 sub-groups of incoming frames and 54 final selectors required per choice:-
   How many individual selectors per sub-group?
   How many selectors common to the 4 sub-groups?
6. Give the reason for slow speed up-drive of the final selector in making units selection.
7. When is the Local Test Desk Test Selector frame provided?
   How many frames are provided for each panel unit?
8. State the reason for not using regular incoming selectors in connection with testing from the #14 Local Test Desk.

CALL DISTRIBUTING "B" SWITCHBOARD "B" SENDER FRAMES AND "B" LINK FRAMES

In some of the smaller cities partially converted to Panel Dial operation, the toll office and the remaining manual offices have been modified by the addition of key indicator equipment through which calls are completed to the panel offices. In the large cities, the provision of key indicator equipment in a large number of manual offices would be very expensive. Instead, it has been found more economical to furnish "B" switchboards and associated equipment in each panel office. For Ground-cutoff offices, the cordless "B" board type of equipment has been furnished, and in a few cases later modified for position distributing. Call distributing "B" equipment is provided in connection with all Battery-Cutoff offices requiring "B" boards.

Call distributing "B" equipment may be of the Local type serving only one or more panel dial units in the same building, or of the Central type serving panel dial units of several buildings. Only the Local "B" board type of equipment will be described herein.

The distant manual, toll, or tandem operator selects a straightforward trunk to the called panel dial office and inserts the plug of a cord pair into the trunk jack. The trunk terminates in the panel office on an incoming selector which has a multiple appearance on the trunk finder bank of a call distributing "B" link frame. The "B" link is a three way link, its function being to hunt for and connect together the selected trunk (or selector), an idle "B" sender, and an idle "B" board position. The insertion of the calling operators plug in the trunk jack causes the "B" link to perform these functions. After the "B" position is connected to the trunk, order tone is sent to the originating operator and the called number is passed to the "B" operator. When an idle "B" sender is associated with the trunk and position, a lamp indication is given the "B" operator who then registers the called number on the position key set. This number is registered and recorded by the "B" sender, after which the "B" position is immediately released and available to receive another call. The "B" sender translates the called number to determine incoming brush, incoming group and final brush selections and controls the incoming and final selectors in finding the called subscriber's line. After final selections have been completed, the link is disconnected, having been in the connection only for a period of about 11 seconds. A schematic of the call distributing "B" link, position and sender connection is shown by Fig. 15.

"B" Switchboard

The section for the call distributing "B" switchboard consists of a two position shop wired switchboard framework supported on legs. Each section is equipped with slanting key shelves for each position and is arranged to mount position and supervisor operating equipment, which for transmission reasons, cannot be located on the relay rack. Additional position and supervisor equipment is located on units on the relay rack.

A cable turning section is furnished at the originating end of each line-up of "B" board. "Calls waiting" lamps with associated keys and relays and the night alarm equipment are located in the cable turning section. The capacity of this equipment is such that a maximum of 40 "B" positions can

be placed in a single lineup.

Since a call distributing "B" operator is able to handle approximately 800 calls per hour, the number of positions required will be determined by dividing the busy hour "B" load by 800. The removal of the operators telephone set automatically makes the position test busy to the link circuits and, therefore, the light load and night traffic can be concentrated on a minimum number of occupied positions.

"B" Link Frames

The call distributing "B" link frame, (Fig. 16) is a double sided frame consisting of a center bay for mounting the trunk finder banks, the "B" sender banks, the friction roll drive, clutches, commutators, brush rods, etc., and two end bays, (1 front and 1 rear), on which are mounted the link circuit relays, sequence switches, etc., and the position selector switches. The link circuit is made up of three parts:- (1) a trunk finder, (long elevator rod), a 4 conductor circuit arranged to hunt over 120 trunks on two 60 point 4 conductor panel banks; (2) a sender selector, (short elevator rod), a six conductor panel selector arranged to hunt over two 100 point 3 conductor banks; (3) a position selector, (206 type selector), arranged to hunt over one 20 point rotary bank. The link circuit can thus establish connections between any one of 120 trunks, 100 senders and 20 "B" positions.

Two independent groups of 14 links each may be mounted on the frame, being divided evenly between the front and the rear of the frame. Each group is further sub-divided into sub-groups A & B consisting of 7 links. Of the 7 links of a group on the front of the frame, 4 are in the A sub-group and 3 in the B. On the rear, 3 are in the A sub-group and 4 in the B. The details of this arrangement are shown by the selector designation bar numbering of Fig. 16. Link circuits are equipped as required by traffic conditions, the lower numbered links on each side of the frame for each sub-group being equipped first.

There are two control trip and start circuits per frame, (1 per link group), and each of these contains separate relay and trip magnet equipment for the A & B sub-groups. When all link circuits of a sub-group are busy, a chain circuit through the busy links extends the calls that would normally be served by that sub-group to the other sub-group of the same link group. Provision is also made in the control equipment to transfer service from all the links on one side of a frame to those on the other side in case of drive motor stoppage.

Due to the different terminal arrangements on the trunk and sender banks, and, because in general the sender selector has a short up-travel to find an idle sender, a two speed up-drive is used on the "B" link frame. The trunk finder selector moves upward at the rate of 40 terminals per second and the sender selector at a rate of 30 terminals per second.

Sender Multiple Banks

The two 100 point sender banks are mounted directly above the friction roll drive, the two banks in parallel providing the necessary 6

conductors to each sender. The arrangement of the senders on the sender banks and the multiple between link frames is identical with that described for the subscriber panel link frame on pages 3 & 4 of Lesson 4.

To provide a means of connecting the "B" sender test circuit to each "B" sender, a test sender selector is equipped in the middle sender selector position on the front or rear of one link frame for each sender group.

Trunk Finder Multiple Banks

Both trunk finder multiple banks are split in the middle, the left half of each bank providing terminals for 60 trunks, or a total of 120 trunks for G-1. The right halves of the two banks likewise provide a capacity of 120 trunks for G-2. In order to reduce trunk finder hunting time, each half of both banks is further sub-divided into A and B portions with a complete reversal of the trunks between the two portions. The space required for these transpositions resulted in the placing of the sender selector rods of a group in the center with trunk finder rods on each side of them. Trip magnets are provided to trip the proper trunk finder brush.

The call distributing "B" incoming selector circuits are cabled from the incoming frames directly to the trunk finder banks. The odd numbered selectors of an incoming frame are cabled to the lower set of 30 terminals of each bank and the even numbered circuits to the upper 30 set of terminals. Due to the reversal between portions of the bank, this gives the odd numbered incoming selectors first choice to the "A" sub-group of links and the even numbered incoming selectors first choice to the "B" sub-group of links.

Incoming frames are assigned to the various sub-groups of links in accordance with traffic requirements of the various groups of selectors. The arrangement desired will usually be specified by the telephone company.

When a #14 Local Test Desk Selector frame is to be served by the "B" equipment, the first selector circuits of that frame are assigned to terminals on the trunk finder banks that are not assigned to incoming selectors.

"B" Position Selector Banks

Associated with each of the 14 link circuits on both the front and rear of the frame is a 206 type rotary selector operating over 20 sets of terminals on a 26 type bank. The 14 banks on each side of the frame are multipled together, without slip, by local cable. The 14 banks on the front of the frame are then multipled in a 20 circuit cable to the banks on the rear of the frame. This multiple is extended to all other link frames in switchboard cable with a Latin square slip between frames.

When more than 20 "B" positions are equipped a system of grading is used with the positions at the head end of the "B" lineup common to all link frames, the higher numbered positions being assigned as individuals.

"B" Sender Frame

The call distributing "B" sender frame is a single sided frame arranged to mount five "B" sender units. Each sender unit accommodates equipment for 2 senders, the equipment for one sender being placed above that for the other. Both circuits are enclosed in a dust proof metal casing covering both wiring and equipment. The senders are designated from A to K, bottom up, on each sender frame.

The "B" sender receives and records only the thousands, hundreds, tens, and units digits of the called subscribers number, hence requires no connection to a decoder. Translation of the TH & H digits of the called number is made by the "B" sender in the same manner as by a subscriber sender. Counting relays are also employed by the "B" sender to control the incoming and final selectors by the revertive pulse method.

QUESTIONS

1. What are the 2 most important methods of routing calls from manual or toll offices to panel dial offices?

2. Describe the progress of a call from a manual "A" operator through Call Distributing equipment in a panel office.

3. What determines the number of "B" positions required?

4. Name the 3 parts of a Call Distributing "B" Link circuit.

5. How many incoming selectors may be connected to one "B" link frame?

6. Give the capacity of link sub-groups per link frame and the maximum number of links that may be equipped in each.

7. Describe the sender multiple arrangement used between the sender banks of several "B" link frames.

8. On what link frames do the cables from the "B" sender frames terminate?

9. Why is 20 the maximum number of "B" positions that may be assigned to a set of link frames without grading the "B" position multiple?

10. What is the sender capacity of a "B" Sender unit?
    Of a "B" Sender frame?

SPECIAL "A" SWITCHBOARD

While the majority of calls originated by subscribers in a panel dial office will be completed immediately by the mechanical equipment in accordance with the number dialed, certain types of calls will, for various reasons, require the assistance of an operator. Accordingly, one or more sections of Special "A" Switchboard are provided and arranged to furnish several types of assistance to calling subscribers or to operators in other offices.

Three types of Special "A" board have been provided for the panel dial offices now in service. The first, or "Semi-Mechanical", was furnished on only a few of the earlier offices in the larger cities. The cost of the mechanical equipment required with this type proved to be greater than the operating savings would justify and, accordingly, the second, or "Dialing", type was furnished on all subsequent jobs until the development of the present standard "Key Pulsing" type. On this type, the 10 button key set, which replaces the dial of the dialing type, permits much faster registration of the digits set up by the operator and thus enables each operator to handle more traffic.

The special "A" board is similar in appearance to the manual "A" board, being a three position, 8 panel, high type section. The upper portion of the new section is furnished in one unit for the entire 8 panels of the section, but the lower portion is furnished as three separate single position units. Each position is equipped with one or more of several types of cord circuits, depending on the type of traffic served by the position.

Calls incoming to the "A" operators terminate on answering jacks located directly above the piling rail of the section and distributed over the panels before the several types of positions. Incoming calls are answered by the operators plugging the answering cord of a pair into the jack associated with the lighted line lamp. After the talking key of the cord is thrown, the operator is able to talk to the subscriber. If the call is to be completed, the calling cord of the pair in use is plugged into the proper outgoing trunk jack. These jacks are located immediately above the answering jacks in strips of 20 and are usually multipled through all panels of the board on a six panel basis.

To facilitate the handling of the various types of assistance calls, traffic is segregated into classes with each class routed to positions arranged to serve, or complete, that class of call. The types of positions and the classes of traffic served by each are as follows:

Sender Monitor Positions

Calls on sender supervisory trunks
Calls on coin control supervisory trunks
Calls on permanent signal holding trunks
Calls to and from lines in trouble
Calls received over the incoming call circuit from test desk
Calls for repair service when this service is transferred to the "A" board for night service.

The principal function of the sender monitor operator is to care for stuck sender conditions indicated by the lamps of the sender supervisory circuits. The sender supervisory circuit consists of a talking and a priming jack and a green lamp on non-coin senders, and the same equipment with the addition of a red coin lamp on coin senders. In case a sender is selected and no dialing is done, or where dialing is incomplete and a delay occurs, or where dialing is complete, but for some reason, the sender is not released from the connection within the delay period, a flashing signal appears on the green lamp. In these cases, the operator plugs into the talking jack with the plug of a cord circuit and challenges on the line. If a reply is received, the subscriber will be instructed to hang up and re-dial the call. If no reply is received, it is essential that the sender be released and restored to regular service as soon as possible. The operator will, therefore, remove the plug from the talking jack and plug into the priming jack. This operation of priming the sender causes the sender to route the district selector associated with the calling line to a permanent signal trunk, after which the sender is released and restored to regular service.

The coin sender acts similarly except that the red lamp will indicate any irregularity in collecting or refunding the coin. In that event, the operator plugs into the talking jack and offers assistance to the subscriber.

In link type senders, in case of no dialing, the sender, after the delay period, automatically routes the district to permanent signal and releases itself from the call.

The permanent signal lines on the district multiple are cross-connected at the T.D.F. to the permanent signal holding line circuits in the sender monitor position. When the district selector reaches a permanent signal holding line, the lamp will flash in the "A" Board. The sender monitor operator plugs into the associated jack and challenges the subscriber in a manner similar to that described above. If no reply is received, the operator may apply the howler, before reporting the trouble to the test desk. It should be noted that only a line finder and district selector are being held up as the sender was released shortly after the trouble was discovered.

When a line has been found to be in trouble, a "shoe" is placed on the line at the VMDF. This "shoe" separates the originating equipment for the line from the terminating equipment and by means of a plugging-up line jack box, the two sides of the equipment are terminated at the sender monitor position as trouble observation and test trunks and trouble intercepting trunks respectively. If the subscriber whose line is in trouble attempts to make a call, a signal will come in on the observation and test trunk. The operator will challenge with the idea of determining if the trouble was caused by the receiver being off of the hook. In any case, the subscriber will be instructed to call later. In the meantime, the maintenance man will have an opportunity to restore the line to normal operation.

During the trouble period, should someone call the line in trouble, a signal will come in on the trouble intercepting trunk. The operator will advise the calling party that the line is out of order.

Intercepting Positions

Calls to unassigned final terminals
Calls to changed and discontinued numbers
Calls to numbers denied service for non-payment of bills
Calls to numbers in unequipped final choices
Requests for verification of busy and don't answer reports
Requests for collection of coins on toll switching trunks received over the call circuit from the toll board

The principal function of the intercepting operator is to intercept calls incorrectly dialed or destined for points where telephone service is no longer furnished. It is the duty of this operator to inform the calling subscriber that a mistake has been made and furnish instructions as to the proper method of procedure. The intercepting operator will at times complete certain calls when the "A" board is arranged to furnish that type of service.

Special Service Positions

Calls over "Dial 0" or special service trunks
Calls to outgoing "AB" toll points
Calls to toll board if handled by the "A" operator
Calls from desks and supervisors
Calls originated by lines handled on a manual basis, such as rural lines, multi-slot coin lines, lines not equipped with dials, etc.

The special service operators will be principally engaged in completing calls from subscribers to toll or A-B toll points. Subscribers desiring to make an extra charge call or desiring help in dialing will dial the digit zero. The decoder translates this code and causes the sender to route the district or office selector to a group of "dial 0" or "special service" trunks. These trunks terminate on the TDF the same as any other district or office multiple trunks and are there cross-connected to the special service trunks in the "A" board. The "A" operator answers the call with an answering cord and terminates it with a calling cord. If the call is completed by the key pulsing method, the calling plug is inserted in a key-pulsing district outgoing trunk jack and the number is set up on the position key set. If the call is to a suburb which does not have panel equipment, the suburban office is reached via one of the regular O.G.T.'s.

Some telephone companies equip their "A" boards with checking multiple. This is a multiple similar in character to the subscriber's multiple in a manual "B" board, except that the line terminates at the special "A" board only as a small brass point connected to the sleeve of the line. The space consumed is very small, since 200 are placed in one inch of panel space. On answering an extra charge call, the operator requests the calling party's number for ticket purposes. The correctness of the number may be determined by placing the tip of the calling cord on the brass point corresponding to the number. If the number is correct, the operator will receive a distinctive tone. (If checking multiple is not provided, the operator may set up a call to the calling subscriber's number to determine if the line is busy.)

QUESTIONS

1. Why are "A" operators required in panel dial offices?

2. Name the 3 types of "A" boards now in service.

3. Describe briefly the answering and completing of a "Dial 0" call.

4. Name the 3 types of "A" positions.

5. What is the purpose of the checking multiple?

TRUNKING TO TRAFFIC AND MAINTENANCE DESKS

In addition to the assistance rendered to panel dial subscribers by the "A" operators, other desks, or bureaus, in the same or a distant building, provide further specialized services. The toll office and the traffic desks and bureaus furnish services in connection with regular subscribers traffic and are consequently operated by the telephone company Traffic Department. Other desks or bureaus that handle repair or maintenance activities are operated by the telephone company Plant Department.

Calls are routed to Traffic and Maintenance desks and bureaus over special groups of trunks on the district or office frame multiple banks as follows:

Calls to Toll Offices and Traffic Bureaus

Toll Offices

To place a toll call, panel dial subscribers usually dial the code 211. The registration of this code causes the operation of a route relay in the decoder, the same as for a regular office code. The operation of this route relay results in routing information being sent back to the sender for use in controlling the district and office selectors in selecting the proper group of trunks to the toll office.

Referring to Fig. 12, it will be noted that there are two separate groups of trunks to Long Distance Recording. The group of trunks on district bank 4 layers 7, 8 and 9 is used by non-coin subscribers. The group of trunks on Office Zone 3, Bank 1, layers 7,8 & 9 is used by coin subscribers. Separate groups of trunks are used for the two classes of subscribers in order that the toll operators may know the class of subscriber making the call.

While both classes of subscribers dial code 211, the links serving non-coin line finder district groups furnish class of service indications to the senders over the FT or FR leads that differ from those furnished by links serving coin groups. This difference in class of service indications will result in the operation of different service relays in the decoder. The operated service relays alter the information transmitted to the sender from the route relays and thus result in separate routings for the two classes of subscribers.

This principle may be used up to a maximum of 4 separate classes of service in one sender group, and is frequently applied to special service or "Dial 0" routings. For example, Fig. 12 shows 3 separate routes to special service for 3 classes of subscribers, namely:

Non-Coin	District Bank 0, Layer 0 & 1
Coin-Multi-Slot	Office Zone 1, Bank 0, Layer 7
Coin-Single Slot	Office Zone 3, Bank 0, Layer 2 & 3

Time Announcement Bureaus

Subscribers desiring to know the time of day dial a code listed in their local telephone directory. Trunks to the Time Announcement Bureau are usually located on the district or office multiple and are connected to by the district or office selector handling the call under control of the sender. The trunks are extended from the multiple through the TDF and MDF to announcement bureau. At certain intervals, usually every 15 seconds, time announcements are sent out over all trunks. These announcements will, of course, be heard simultaneously by all subscribers connected to announcement trunks.

In Chicago, time of day service is obtained by dialing CAThedral-8000, and consequently the routing of the call is somewhat different than the standard method described above.

Information Bureaus

Connection to a trunk to the central information bureau is usually obtained by dialing code 411. Trunks to "Information" are shown on Fig. 12, Office Zone 1, Bank 3, layers 5 & 6. Dialing code 411 will result in selections as follows:

District Brush	1
" Group	0
Office Brush	3
" Group	5

The selection by the office selector of an idle trunk in this group of 20 trunks connects the calling subscriber to a trunk at the centralized information desk where an operator will answer the call and furnish the information requested by the subscriber.

Calls to Maintenance Desks

Repair Service

To report trouble conditions, subscribers are instructed to dial code 611. The registration of this code results in the selection of a group of trunks on the district or office multiple. These trunks terminate as key ended talking lines on either a local or central repair service desk. At the repair desk, card records are kept for every subscriber in every central office unit served by that desk or bureau. An incoming call on any of the key ended trunks will be indicated by a buzzer or sounder and a flashing lamp associated with the calling trunk. The operator answers the call by throwing the trunk key to the talking position and saying "Repair Service". The subscribers complaint is recorded on a trouble ticket which, together with the record card, is referred to a test man at the test desk for action in clearing the trouble condition on the line.

The relay equipment associated with each code 611 trunk to the repair desk is arranged to cancel the charge on message rate lines, or return the coin on coin lines, as the subscriber should obviously not be charged for a call of this type.

Code 611, trunks are shown on Fig. 12, Office Zone 1, Bank 0, layer 9.

Test Desks

On Fig. 12, Office Zone 2, Bank 4, layer 9, is shown a group of code 511 trunks. These trunks are used by the repair men to obtain connection from the subscriber's premises to a trunk at the test desk. Over this connection, the repair man may confer with the man at the test desk, and by means of the test cords, the test man may make numerous tests on the line.

It is possible for the repair man at the subscriber's premises to make tests of the subscriber's station dial and ringer without the assistance of the test man. To do this, the repair man dials a code such as 711 which will cause the selectors serving the line under test to connect to a set of trunks (in this case Office Zone 2, Bank 0, layer 9) connected to ringer test lines, these in turn having access to one or more 51 type automatic dial testers.

Codes such as 511, 711, 388, 389 and 489 are not listed in the directory for use by subscribers but are known only to the repair and maintenance forces and are used exclusively by them.

Lines from Final Multiple

Nearly all Traffic or maintenance desks located in the same building with a panel office have one or more lines from the final multiple. Each line is assigned a final terminal number and may be reached by dialing that number. While any subscriber could dial these numbers and reach the desk on which the lines terminate, the assigned numbers are usually in the 9900 series and are known only to the telephone company employees. When the line is connected only to the final multiple, incoming one way service only can be given. Since these lines will usually be required to furnish two way service, each line is connected to a line finder bank terminal as well as a final bank terminal. Calls may then be originated over the lines by dialing the called code or number in the same manner as a subscriber.