701B AND 711B PRIVATE BRANCH EXCHANGES
GENERAL DESCRIPTIVE INFORMATION

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1. INTRODUCTION

A. General

1.01 This section describes the 701B and the 711B step-by-step dial private branch exchanges which have been developed and standardized to replace the 701A and the 711A PBX's, respectively.

B. 701B PBX

1.02 The 701B PBX consists of dial switching equipment mounted on frames, attendant facilities, trunk circuits mounted on relay racks, the necessary cross-connecting facilities, and an automatic power plant which furnishes battery and ringing current as well as the various tones required.

1.03 The new PBX, like the one it replaces, can be used for either 2-, 3-, or 4-digit systems. The dial equipment, controlled by dials at the station telephones, consists of an assembly of step-by-step switches which function to connect one station to another or to central office trunks or tie trunks.

1.04 The manual switchboard furnished with the 701B PBX may be of either the non-multiple or multiple type, depending upon the position and jack requirements at the installations.

1.05 Intercommunicating calls are completed directly by dialing. Calls outgoing to the central office or tie trunk calls are established either directly by dialing or via an attendant at the associated switchboard. Incoming calls from the central office are completed by the attendant directly to the station by means of jack appearances for each station line in the face of the switchboard, or in some cases, by direct dialing through the PBX switch train.

1.06 Where a PBX system is arranged for direct inward dialing, the PBX is assigned a central office code or may share an office code with other PBX's in a given area. The stations within the PBX are then assigned a 2L + 5N number by prefixing the office code to the station numbers. A typical 2L + 5N number is EXeter 3-4401. The office code is EX 3, and the last four digits the extension number.

1.07 In addition to establishing a direct connection to a PBX station, the incoming trunk circuit used for direct inward dialing has a transfer feature by which the called station can summon the attendant in on the connection in order to transfer the incoming call to another station within the PBX.

C. 711B PBX

1.08 When the step-by-step equipment is used without a manual switchboard and its associated circuits, it is known as a 711B PBX. These PBX's are designed for those cases where the majority of calls are intercommunicating or outgoing to the central office, and where the PBX serves as an auxiliary to a distant attended PBX.

1.09 Operator calls are handled by an attendant at a manual switchboard at a distant location over dial-repeating tie trunks. Incoming

calls from a central office are directed to the distant PBX and are completed over repeating tie trunks by the attendant to the 711B PBX stations.

1.10 By providing incoming tie trunks with access to outgoing tie trunks either through the switchboard or the switching equipment, the 701B and 711B PBX's may be made to function as tandem centers for tie trunk networks serving several PBX's.

2. DIAL EQUIPMENT

2.01 The basic element of these systems is the step-by-step switch and its bank. (See Fig. 1.) Each bank consists of ten rows of terminals in a partial circle. The switch steps upward to select the row and rotates to select the terminal. The banks are fastened to shelf frameworks; the switches are mounted opposite the banks.

A. Line Finders

2.02 The line finder switch (see Fig. 2) consists of three 200-point switch banks, each with an associated wiper, to care for the tip, ring, and sleeve terminals of 200 station lines. A vertical commutator and commutator wiper is added to provide the level hunting feature.

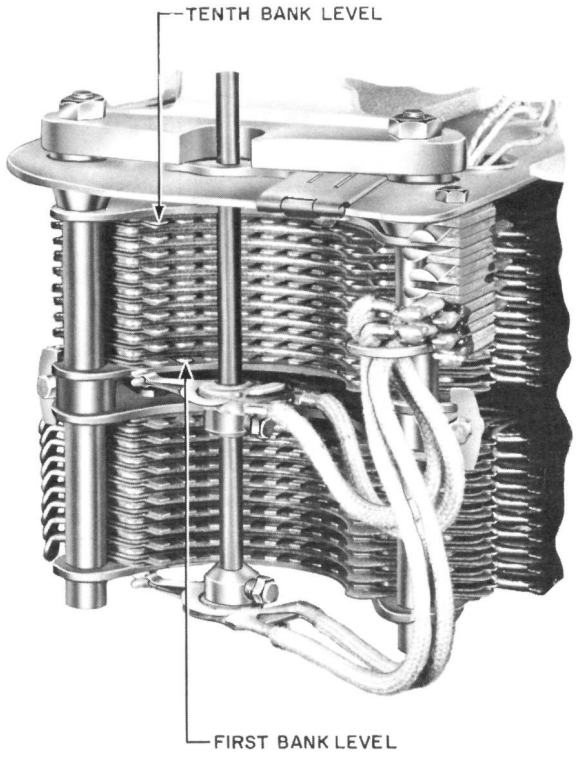


Fig. 1 – Step-by-Step Switch Bank Assembly and Mounting

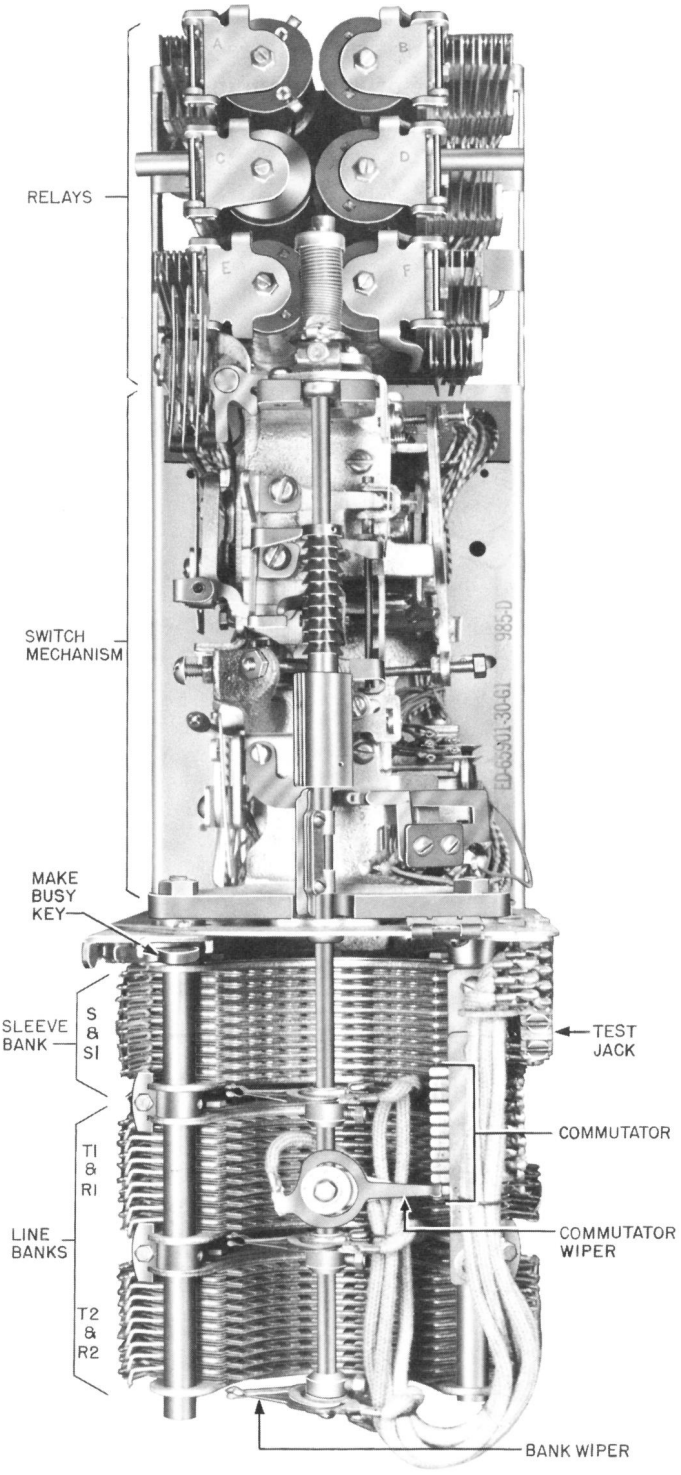


Fig. 2 – 200-Point Line Finder Switch

2.03 The tip and ring terminals (T and R) of the even hundreds stations appear in the lower switch bank, the tip and ring terminals (T1 and R1) of the odd hundreds group in the middle bank. In the top bank the sleeve leads of the even hundreds stations are wired to the S terminals and those of the odd hundreds stations are wired to the S1 terminals. (See Fig. 3.)

2.04 All of the line finders and their associated line relays common to a group of 200 station lines constitute a line finder group. The line finder group is divided into ten subgroups, each subgroup consisting of those switches having the same last digit in its number. For example, the first line finder subgroup may consist of switches 1, 11, 21, etc, the second subgroup of switches 2, 12, 22, etc.

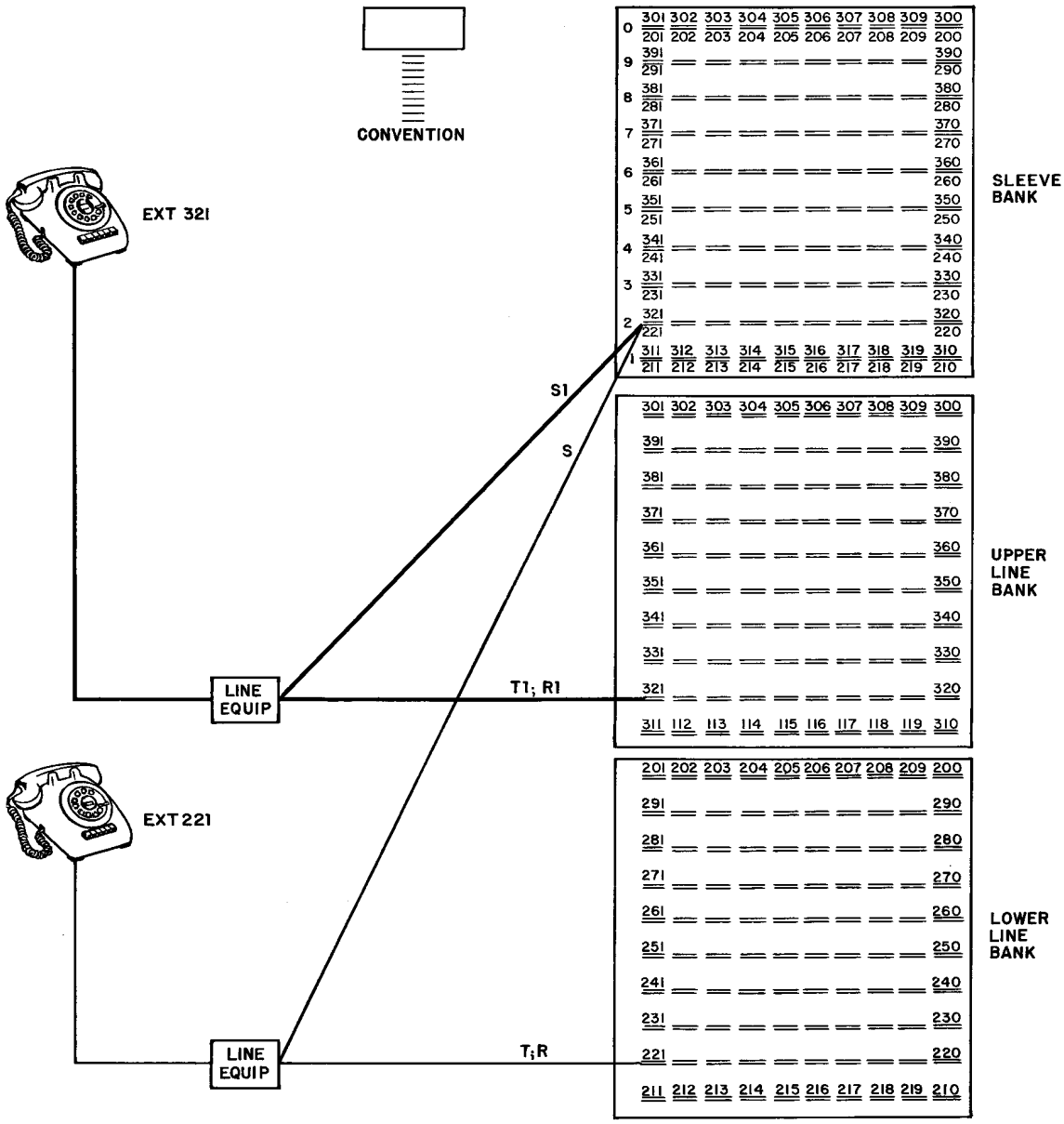


Fig. 3 – 200-Point Line Finder Switch Showing Bank Numbering at the Switch

2.05 The 200 station lines, referred to as a line group, are divided into subgroups of 20 lines each. The first subgroup of lines appears on the first level of line finders 1, 11, 21, etc, the second subgroup of lines on the first level of line finders 2, 12, 22, etc.

2.06 To reduce the line finder hunting time and to distribute the traffic load among the line finders, a so-called retrograde slip (from right to left) wiring method is used. (See Fig. 4.) The 20 lines of a subgroup are shifted from switch to switch, from the lowest bank level to the second lowest, and so on to the top level in the bank. If the first-choice switch is busy, a chain circuit arrangement advances the call through the subgroup to the first idle switch. If all of the line finders in the subgroup are busy, the call is directed to an idle switch in the next subgroup.

2.07 On the origination of a call at one of the dial stations, the line and group relays function to start a line finder and to mark the level on the vertical commutator and on the sleeve terminal in the line finder bank so that it will be selected, and then to connect that particular station line to a selector or selector-connector associated with the line finder.

B. Trunk Finders

2.08 The trunk finder unit is similar to the line finder unit. It may be used for combining groups of incoming trunks from distant PBX's into one common group so that the most economical use can be made of the trunking facilities between the point of concentration and the distant point.

2.09 A trunk finder unit can be arranged to serve intercepting trunks connected to nonworking lines, vacant selector levels, and unused connector levels. Each trunk finder terminates in a jack and lamp at the PBX switchboard.

2.10 A trunk finder unit may also be used at direct inward dialing installations to establish a connection between an incoming trunk circuit and an attendant trunk when the incoming call is to be transferred by the attendant.

C. Selectors

2.11 The selector switches (see Fig. 5) are designated both by type and by their position in the switching train, and are used to select trunks to other switches, to central office trunks, or to attendant and tie trunks. Unlike the line finder, the selector switch depends on subscriber dialing for its operation. The wipers step vertically to select a terminal level corresponding to the pulses generated by the pull of the dial, and on reaching the level, rotate automatically to select an idle trunk in the selector multiple.

2.12 Since the selector levels consist of ten terminals, only ten trunks may be assigned to any given level when the level is cabled common to all the shelves serving a group of selectors. When more than ten trunks are to be provided in a trunk group, a trunking arrangement known as a graded multiple is used. Where this is done, the terminals of a given selector level, instead of being wired to bank multiple strips mounted on each shelf unit, can be connected together by direct cable or cabled to the

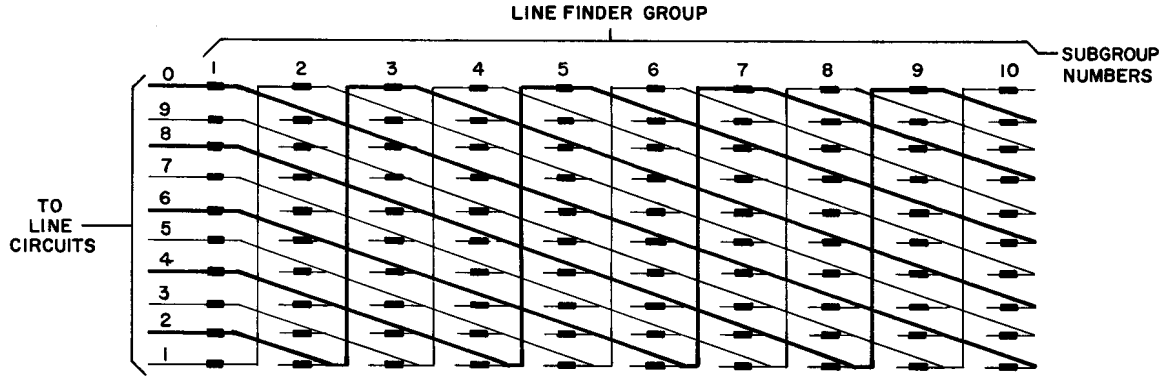


Fig. 4 – Line Finder Bank Slip

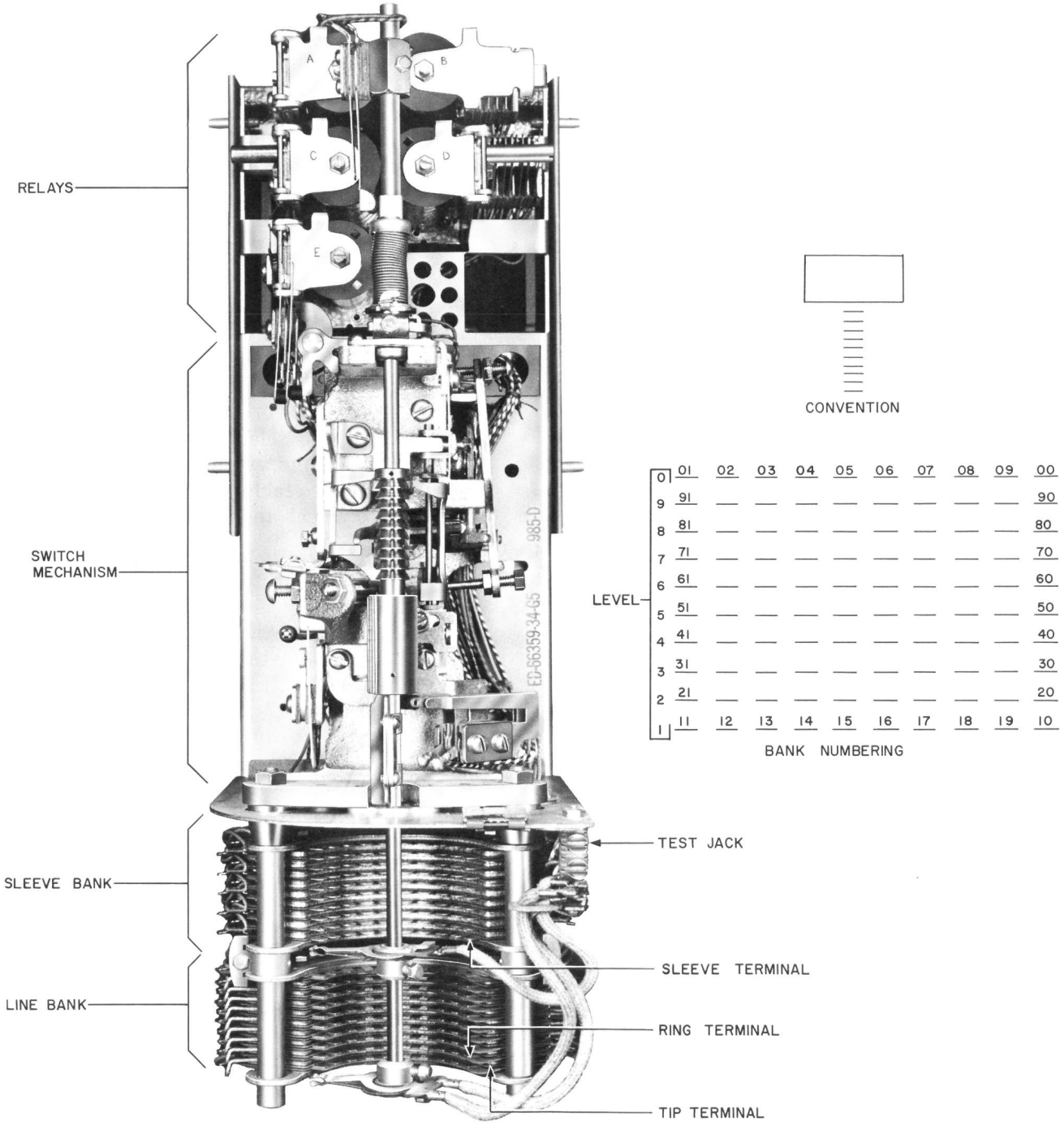


Fig. 5 – Selector Switch

distributing frame and cross-connected together. This permits certain trunks, called common trunks, to appear before all selectors in the group; others known as individual trunks are wired to separate selectors within the group.

2.13 The individual trunks, first choice to the selectors, are always the lower-numbered trunks. A reversal, used to reduce the selector hunting time, is usually placed at the middle of the subgroup. The tenth trunk, used for last trunk-busy registration, is always a straight multiple.

2.14 The graded multiple arrangements recommended for the 701B and 711B PBX's based on either 10 or 12 selectors per shelf are described in ***Traffic Engineering Notes for the 701B and 711B PBX*** dated September, 1959. One arrangement taken from these notes is illustrated in Fig. 6.

2.15 The ***first selectors*** are connected to their associated line finders by direct cabling. However, when local conditions warrant, provision is made for cabling these leads via the distributing frame to provide cross-connections. The switch is arranged to return dial tone to the calling station as soon as its line is seized by the line finder, and to respond to the first digit dialed.

2.16 Ordinarily the terminals of the top or zero level of the first selector multiple are connected to attendant trunks, and those of the ninth level are connected to central office trunks. The terminals of the lower levels may be extended to connectors (3-digit system) or to second selectors (3- and 4-digit systems). The first level is preferably unassigned to minimize the possibility of a preliminary pulse due to switchhook operation or similar action by the station user. However, where the numbering system requires its use, the first level may be used for access to service code groups, usually of the 11X type. Any remaining levels on the selector multiple may be used for tie trunks, foreign exchange trunks, etc.

2.17 Outgoing calls routed through the first selector may encounter an all-paths-busy condition, that is, all outgoing trunks on a particular level are busy. The first selector will then step to the eleventh rotary position and return an audible busy tone to the calling station.

2.18 The ***second selector*** responds to the pulses generated by the second pull of the dial. In 4-digit systems, the second selector provides direct access to the connectors. In 2- and 3-digit systems, second selectors may be used to provide additional levels for code calling, tie trunks, etc.

D. Connectors

2.19 The connector (see Fig. 7) is the last step in the train of selection. It differs from the selector in that it operates in response to the dial pulses in ***both*** the vertical and the rotary motion. The two digits of the called number which control the connector are the last two (tens and units digits). The tens digit determines the level selected and the units digit determines the particular terminal to which a connection is made.

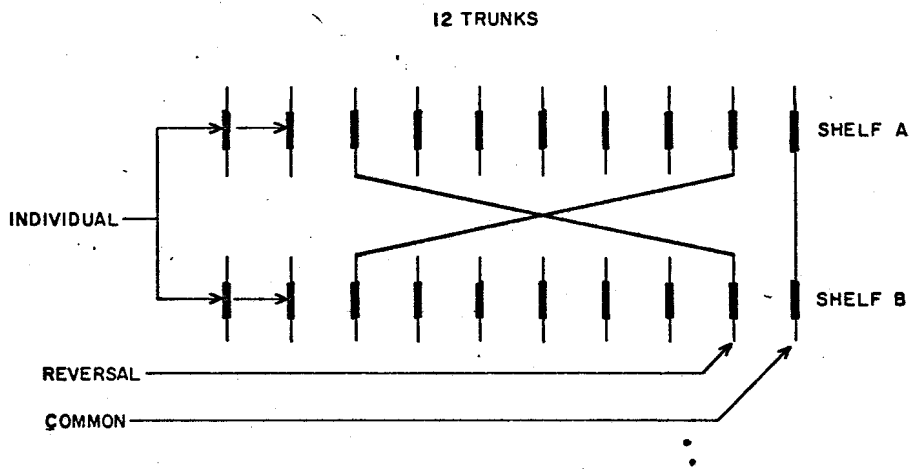
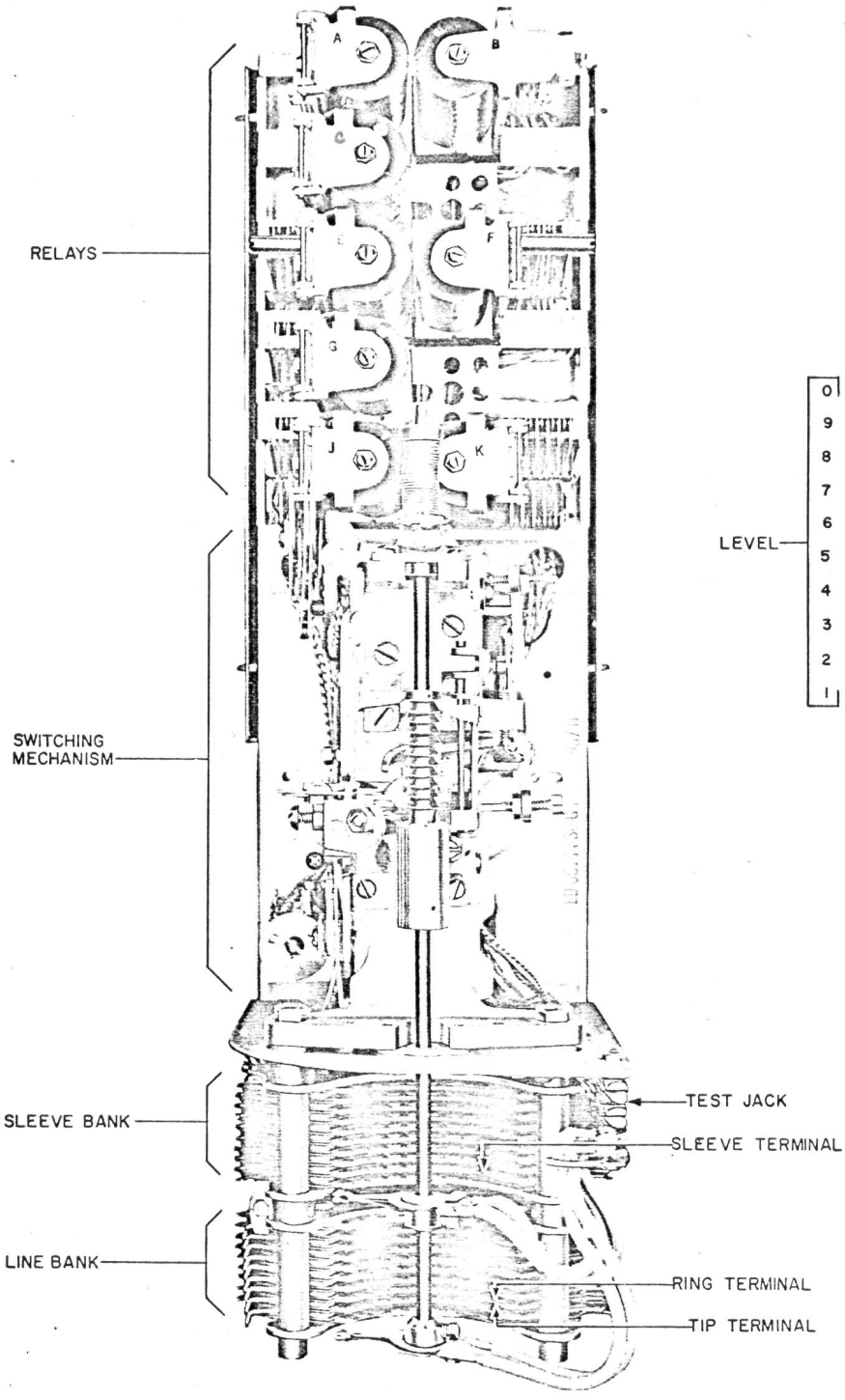
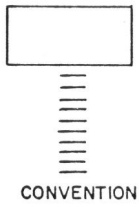


Fig. 6 – Graded Multiple Arrangement of Selector Trunks





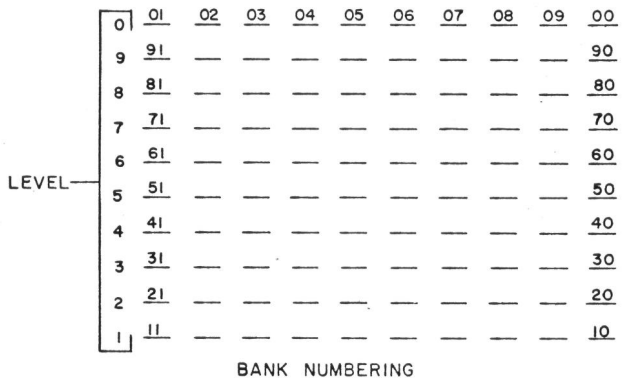


Fig. 7 – Connector Switch

2.20 Rotary hunting connectors are used where the PBX must serve groups of consecutive lines. This connector is capable of hunting over a predetermined group of terminals on the same level, and of seizing the first idle terminal assigned to the group. The rotary hunting connector responds to dial pulses of the last two digits. If all lines in the group are busy, a busy tone is returned to the calling party after the last terminal in the group has been tested.

2.21 The functions of the connector may be summarized as follows.

(a) Testing the called line for busy and returning busy tone if the line is in use.

(b) Extending the connection to the called line if it is idle.

(c) Ringing the called line and returning audible ringing to the calling party.

(d) Removing ringing current from the called line when the called party answers.

(e) Holding all preceding switches operated until the connection is released.

(f) Reversing polarity on the calling side of the line for supervisory purposes.

(g) Releasing when the calling party disconnects and causing the release of all other switches used in the connection.

E. Selector-Connectors

2.22 The selector-connector functions, as the name implies, both as a selector and as a connector. Ordinarily, the terminal levels of the selector-connector switch are assigned as follows.

LEVEL	ASSIGNMENT
0	Trunks to the Attendant
9	Trunks to the Central Office
8	Tie Trunks
1 through 7	Station Lines

2.23 The selector-connector responds to the first dial pulses in the same manner as the first selector when a trunk level is dialed (8, 9, or 0). The calling party then continues dialing or is connected to an attendant who completes the call.

2.24 When a station level is dialed (1 through 7), the switch reacts in the same fashion as a connector, that is, the switch steps vertically to the level corresponding to the first digit dialed, waits until the second digit is dialed, and then steps across the level to the position dialed. If the called line is in use, the selector-connector returns a busy tone to the calling line. The line finder and the selector-connector are held until the calling party restores his receiver to the switchhook.

2.25 Variations may be made in the assignment of levels. At some installations where tie trunks are not required, station lines can be connected, or two or more groups of tie trunks assigned, on level 8. When the latter option is selected, two digits must be dialed to determine which group of trunks is selected. When 2-digit rotary hunting is required for some trunks on the selector-connector, it must be used on all trunks, including the central office and attendant trunks.

F. Incoming Selectors and Connectors

2.26 Each incoming repeating tie trunk is associated with an incoming selector which is operated by the station or PBX attendant dial at the distant end. After reaching the incoming selector, the calling party may either continue to dial the station code of the called party or dial "0" and call in the PBX attendant.

2.27 If the station number is dialed, the call will be routed through the incoming selector or incoming selector-connector, depending on the size of the PBX.

2.28 If the attendant trunk level "0" is dialed from the distant end, the tie trunk will receive a signal over the "0" lead from the selector-connector causing the trunk to route the call to the manual switchboard, light the tie trunk lamp at the switchboard, and restore the incoming switch to normal.

G. Digit-Absorbing Selectors

2.29 When several PBX's are operating in a common numbering plan, digit-absorbing selectors are employed to absorb the digits that are not needed for switching, but which are desirable from the standpoint of the numbering plan.

2.30 In the 701B and 711B PBX systems, this switch may be used either as a regular selector, or as an incoming selector with tie trunks, and may be arranged to absorb the initial digit or a specific digit repeatedly on any level. However, the two types of absorption may not be mixed on the same switch.

2.31 If a level is arranged for repeated absorption, the switch drops back to normal each time it is stepped to that level. If a level is marked for once-only absorption, the switch drops back to normal the first time that level is dialed. After that, the switch is unlocked and will hunt when the next digit is dialed, even though that level had been marked for absorption.

2.32 The switch may also be arranged to provide restricted service on specified levels. When a level is marked for restricted service, any call from a restricted line reaching that level will receive a busy tone.

3. SWITCH FRAMES

A. Universal Switch Frame

3.01 The frame for mounting the line finder, selector, selector-connector, and connector units is of the floor-supported, double-sided type, approximately 7 feet 4 inches high, 6 feet long, and 1 foot 10 inches wide. The frame is universal in that it is arranged to mount shelf-type units of switching equipment on the front and rear. In addition, the equipment arrangements are such that the line relays are associated with the line-finder shelves, thus eliminating the need for separate line relay racks and associated cabling.

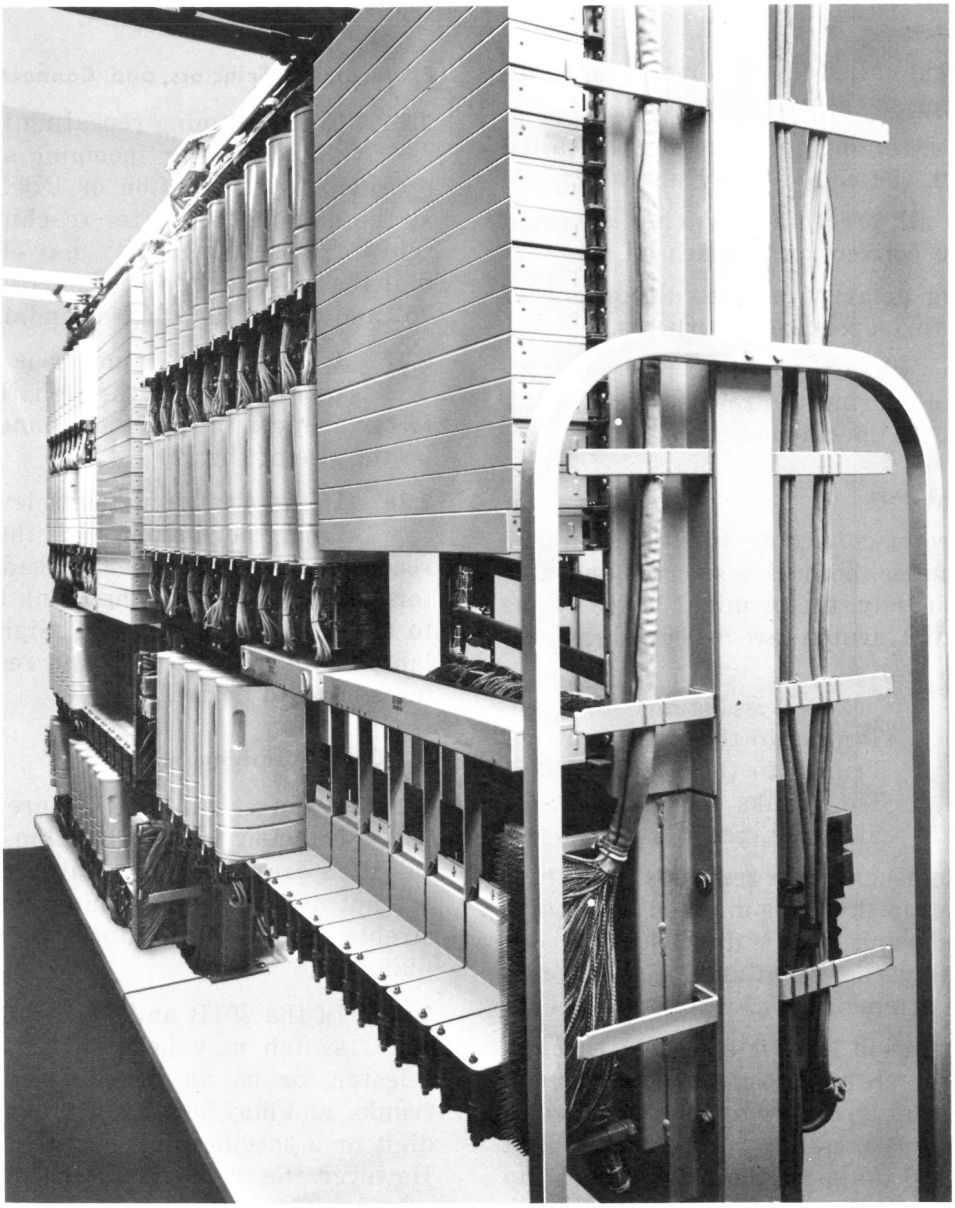


Fig. 8 – Front View of Typical Switch Frame (Line Finder and Line Finder Relay Side)

3.02 Mounted on the front of the switch frame are an initial line finder unit and associated line relays, a connector shelf for the first hundred group, and a supplementary line finder unit. (See Fig. 8.)

3.03 Mounted on the rear are an initial first selector unit, a connector shelf for the second hundreds group, and a supplementary first selector shelf. (See Fig. 9.)

3.04 For other equipment arrangements, a universal switch frame will accommodate ten selector shelves, five on each side. This equipment may consist of second selectors for 4-digit operation, operator selectors, or incoming selectors associated with tie trunks. Any unused mounting space may be reserved for future growth.

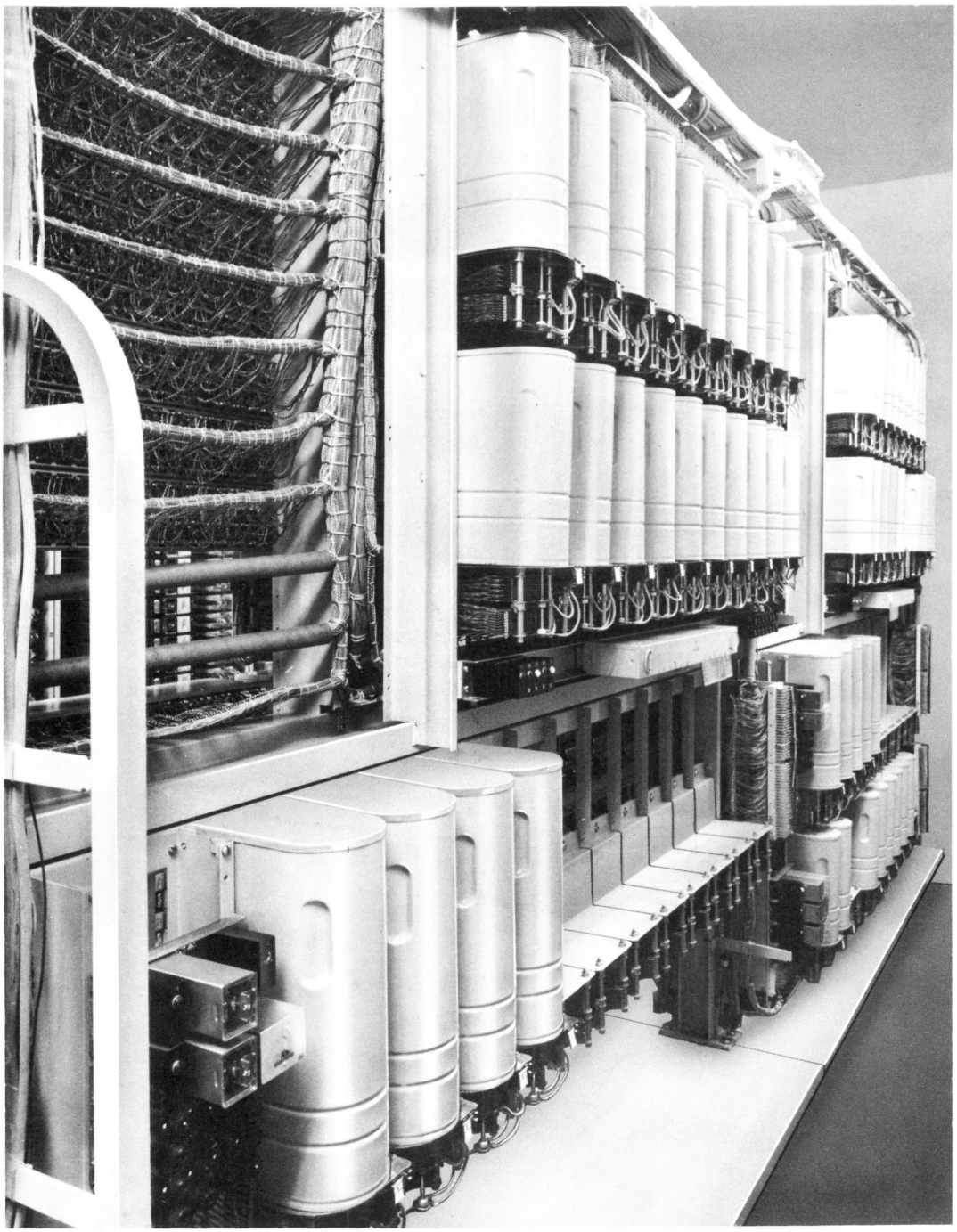


Fig. 9 – Rear View of Typical Switch Frame (Selector and Connector Side)

B. Relay Rack Switch Frame

3.05 A relay rack of comparable height, arranged to mount additional line finder and first selector units, is used to build out the switch frame groups when required. The relay rack frames may be aligned with the universal switch frames or installed in a separate line-up. (See Fig. 10.)

C. Distributing Frames

3.06 Cross-connecting facilities are provided by a distributing frame consisting of steel frameworks arranged to mount terminal strips and, where required, protector mountings.

3.07 Three distributing frames are available for use with the 701B and 711B PBXs, as follows.

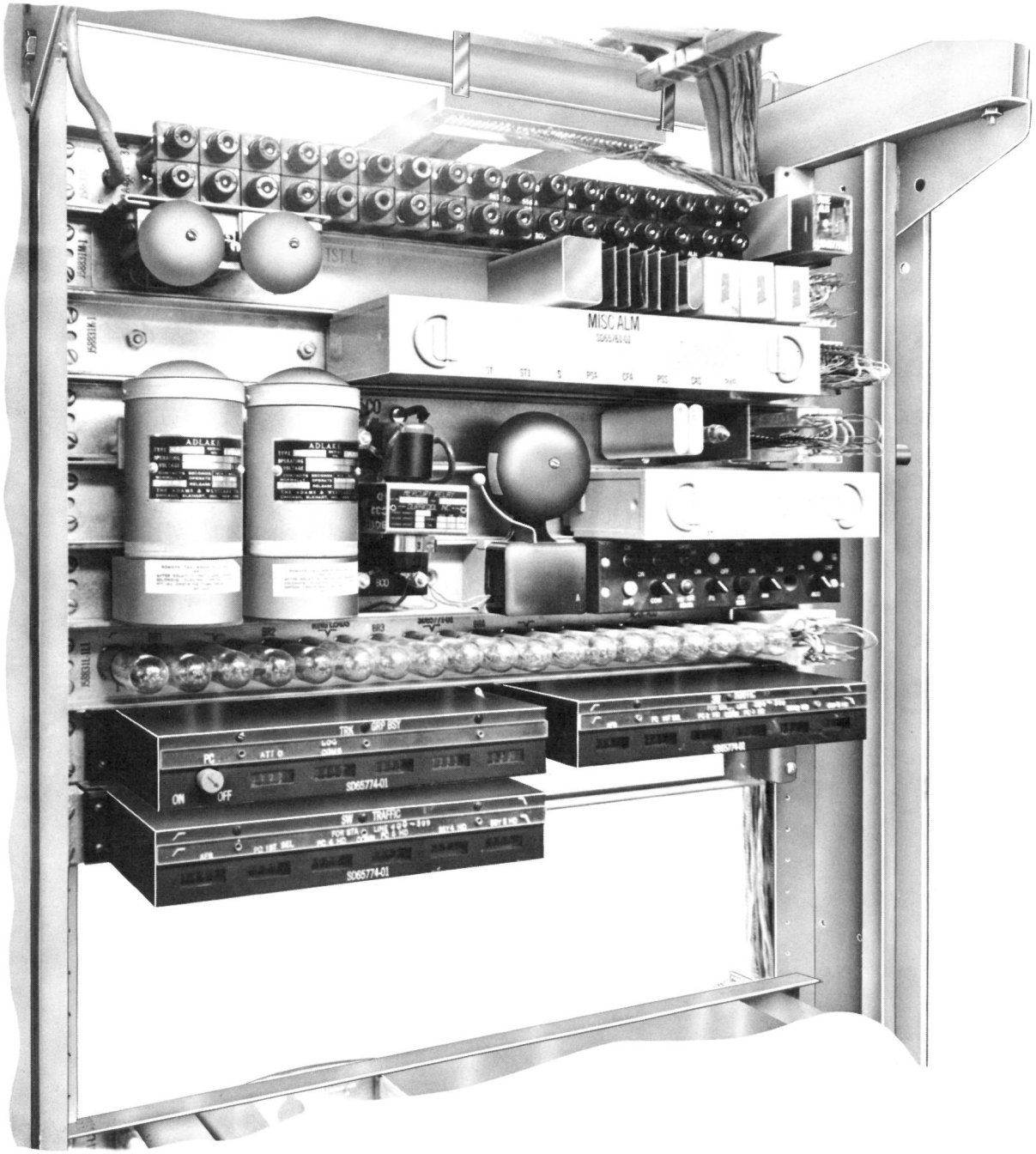


Fig. 10 – Typical Relay Rack Switch Frame (Showing Alarm Equipment and Traffic Registers)

(a) A single-sided frame for small installations where limited growth is expected consists of single verticals approximately 6 feet 11 inches high, with spacers to support a 12-inch cable rack at a height comparable to the switch frame. The verticals are spaced on 8-inch centers, and are available for mounting protectors or terminal strips.

(b) A double-sided frame which is limited in cable and jumper capacity to PBXs up to about 1000 lines is designed to line up with the universal switch frames to provide uniform aisle spacing. Jumper rings are provided to facilitate running the jumpers between the two sides of the frame. (See Fig. 11 and 12.)

(c) A central office type distributing frame for use with PBX installations over 1000 lines, or for smaller installations where the house and feeder cables enter from below, requires auxiliary framing to support it at the top at a height comparable to the universal switch frame. Vertical sections are available with protector mountings or for terminal strips on the vertical side. The horizontal side of the frame is arranged to mount terminal strips on 8-inch centers.

4. SHELF UNITS

4.01 The switch "shelves" consist of rectangular iron racks on which are mounted the switches, terminal strips, and the necessary fusing and alarm features, and which themselves are mounted on equipment frames.

A. Initial Line Finder Unit

4.02 The initial line finder unit consists of two shelves of ten line finder banks and switches each, and 200 dial station line and cut-off relays. One initial line finder unit is required to care for each group of 200 lines or a portion

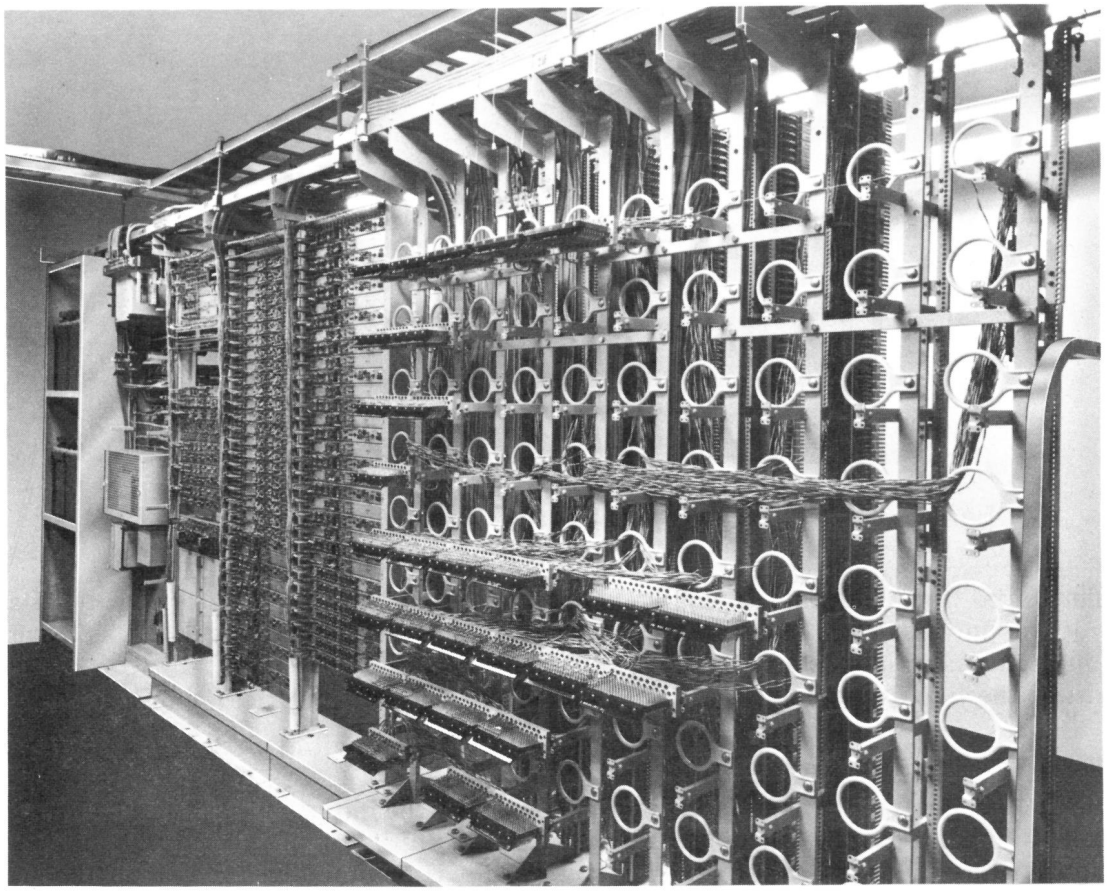


Fig. 11 – Horizontal Side of CDF (Showing Rear View of Miscellaneous Relay Rack and Power Plant)

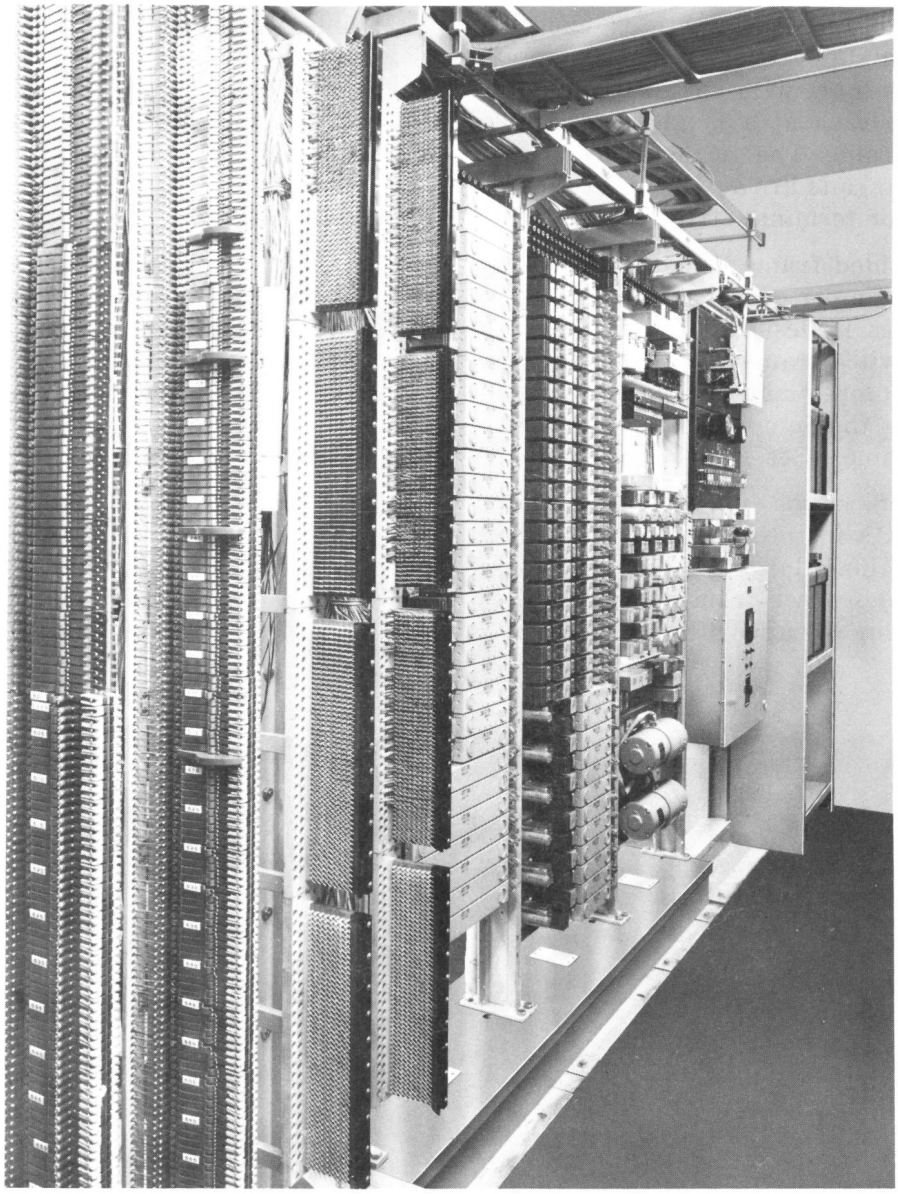


Fig. 12 – Partial View of Vertical Side of CDF and Miscellaneous Relay Rack

thereof. The initial line finder unit is mounted on the front of the universal switch frame. The associated line equipment is located alongside and to the right of the line finder banks.

B. Supplementary Line Finder Units

4.03 The supplementary line finder shelf units are used to build out the line finder groups which require more than 20 line finders. Two types of shelves are available, one accommodating 12 switches which may be mounted on the front of the universal switch frame, and the other accommodating 4 or 8 switches arranged to mount on the relay rack switch frame.

C. Initial First Selector Unit

4.04 The initial first selector unit consists of two shelves of ten first selector banks each. One initial first selector unit is required for each initial line finder unit. The first selector unit is mounted on the rear of the switch frame and is usually arranged so that its location on the shelves corresponds to the location of the line finder on its shelf.

D. Supplementary Selector Shelf Units

4.05 These shelf units may be used as second selectors or for incoming selectors exclusively, or they may be used to build out the first selectors associated with a line finder group which requires more than 20 switches. Two sizes are available: single units of 12 switches for mounting on the universal switch frame; or supplementary units with capacities of four or eight switches arranged to mount on the relay rack switch frame.

E. Connector Shelf Units

4.06 Connector shelves accommodating 12 switches for mounting on the same frame as the associated line finders and first selectors or relay rack type shelves of four or eight switches are available for these PBX's. These shelves may be used for mounting hunting connectors, selector-connectors, incoming connectors, or 2-digit rotary hunting selectors.

5. POWER SUPPLY

A. Power Plant

5.01 The power plant (see Fig. 13) provided for use with the 701B and 711B PBX's is available in capacities up to three rectifiers of 30 amperes each. This plant is enclosed in a cabinet assembly arranged for single-sided access and may be lined up with the switch frames or placed against a wall. The rectifiers are permanently connected to the batteries and are individually regulated by means of electronic devices incorporated in the power plant.

B. Ringing Power Plant

5.02 The ringing power plant consists of a control panel and two 1/4-ampere ringing machines. It is mounted on a relay rack bay with the common alarm unit, fuses, and the resistance lamps of the ringing lead circuit. This power plant is arranged for ac/dc ringing only, and provides for an automatic transfer from the first machine to the second in case of ringing circuit failure. (See Fig. 11 for typical view.)

5.03 The ringing machine is dc operated. It is a plug-in unit and furnishes 20-cycle ringing supply through interrupters, and dial and busy tones from a tone alternator. The interrupters and tone alternator are integral to the machine.

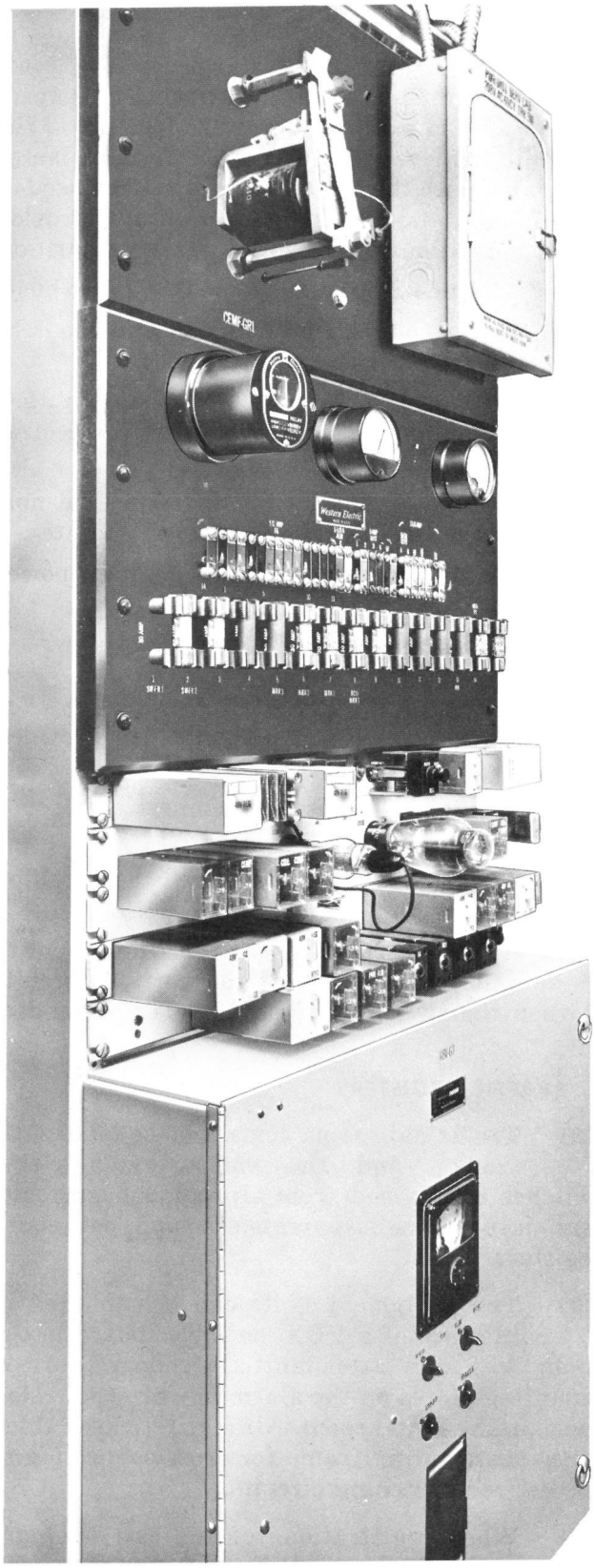


Fig. 13 – Typical Power Plant

6. ALARM CIRCUITS

6.01 The miscellaneous alarm circuit is arranged to care for all installations regardless of size. The alarm lamps are located on the individual shelves. In addition, aisle pilot lamps associated with the frame line-ups may be used at large installations. The alarm lamps provide visual indications of the following irregularities.

(a) All line finders in any one line group busy.

(b) Failure of the line finder to find the calling station line (call blocked).

(c) Permanent short circuit of station line, ground on ring side of station, or receiver off-hook.

(d) Failure of any switch to restore to normal when the release magnet operates.

(e) Blown fuse in switching gear or power failure.

(f) Blown fuse in switchboard position.

6.02 In the 701B PBX the following keys for the universal alarm circuit are provided at the switchboard.

(a) A ringing key used to connect emergency ringing facilities.

(b) A buzzer key to silence the position buzzer.

(c) A battery cutoff key for cutting off power and ringing supply for certain circuits when the switchboard position is unattended.

7. TRAFFIC REGISTERS

7.01 Traffic data from central office trunks, tie trunks, and the various step-by-step switches is obtained from all-trunks-busy registers, last-trunks-busy registers, and peg count registers.

7.02 The equipment units can be mounted in the face of a PBX, on a backboard in the room with the attendant switchboard, or on mounting plates on the alarm bay or other relay racks in the switchroom. All registers are cabled to the distributing frame for cross-connection to the desired switching circuits.

7.03 When registrations of the call load are not desired, a cutoff key associated with each register group is used to make the registers inoperative.

7.04 ***All-trunks-busy (ATB) registers*** for attendant trunks, dial central office trunks, or tie trunks are connected to all trunks in a group and operate each time all the trunks in the group become busy.

7.05 ***All-finders-busy (AFB) registers*** are connected to all line-finder switches in a group and operate each time all of the finders in the group become busy.

7.06 ***Last-trunk-busy (LTB) registers*** for connectors, selector-connectors, and second selectors are connected to the sleeve of the last-choice terminal and operate each time the last-choice connector, selector-connector, or second selector is seized. The last-trunk-busy register for a tie trunk group also functions in the manner described above.

7.07 ***Peg count (PC) registers*** used to measure originating, incoming, and outgoing traffic are connected to first selectors, incoming selectors, and other selectors, as required, and operate each time any of the switches in a group is restored to normal from an off-normal condition.

8. TRUNKS

A. Central Office Trunks

8.01 These trunks originate in the central office and terminate on the customer's premises in a manual switchboard or in the dial-operated switching equipment of the PBX.

8.02 The central office trunks available for the 701B and 711B PBX's are classified as follows.

(a) ***An attendant central office trunk*** terminates only in the manual switchboard associated with the PBX and provides 2-way service between the attendant and the central office.

(b) ***A direct dial central office trunk*** terminates in the dial-operated switching equipment and provides one-way service from a PBX extension to the central office by direct dialing.

(c) ***A combined central office trunk*** terminates in the manual switchboard for the attendant's use in receiving and originating central office calls ***and*** in the switching equipment for one-way direct dial service from an extension to the central office.

(d) ***Direct inward dialing trunks arranged for transfer*** are available for use in tandem or step-by-step central office areas only. These trunks are connected between the central office trunk and an incoming first selector, and provide a means for reaching a PBX extension or the PBX listed number by direct inward dialing (DID). The inward dialing trunks may also be connected to certain types of tie trunks where it is desirable for the called station to utilize the transfer feature provided in inward dialing trunks.

B. Tie Trunks

8.03 All of the tie trunks provided for the 701B and 711B PBX systems are of the 2-way type. However, by making one or more of its features inoperative, a tie trunk may be used on a one-way basis, where desirable. The 2-way tie trunks terminate on trunk jacks at the PBX switchboards, in the switching equipment, or both at the switchboard and in the dial equipment.

8.04 These trunks include one or more of the following types of service.

(a) ***Manual Tie Trunk Service*** (Between a 701B PBX and a Distant Attended PBX): Terminations are at the PBX switchboards for manual selection and answering by the attendants. If the tie trunk provides manual service only, either ringdown or automatic signaling may be used.

(1) ***Automatic Signaling:*** The line signal is automatic and operates when the attendant inserts a cord plug into the trunk jack.

(2) ***Ringdown Signaling:*** Signaling over a ringdown tie trunk is accomplished by operating the cord circuit ringing key after the tie trunk has been selected by the attendant.

(b) ***Dial-Selected Tie Trunk Service*** (Between a 701B or 711B PBX and a Distant Attended PBX): In addition to an appearance at the PBX switchboard, tie trunks providing dial-selected service are associated with terminals on selector levels for outgoing traffic. The tie trunk may be selected by the station dialing a designated code, after which the call is completed manually by the attendant at the distant PBX switchboard.

(c) ***Dial-Repeating Tie Trunk Service*** (Between a 701B or 711B PBX and a Distant PBX): The terminations for these trunks are as follows.

(1) Via jacks for incoming and outgoing service for the attendant.

(2) Via selector levels for outgoing dial-repeating service.

(3) Via incoming selectors for incoming dial-repeating service.

The dial-repeating feature permits the dial station or attendant at the local PBX to reach a station or attendant at the terminating PBX directly by dialing.

C. Trunks to Attendant

8.05 These trunks connect the dial-operated switching equipment of a 701B PBX system to its associated manual switchboard, and are used by the dial stations in reaching the PBX attendant. The connection may then be extended to a central office trunk, a tie trunk, or another extension by the attendant.

8.06 In the 711B PBX, a dial-selected or dial-repeating tie trunk to a distant attended PBX may be provided to perform the same function as an attendant trunk.

D. Direct Inward Dialing Trunks

8.07 In addition to establishing a direct connection to a PBX station as discussed in 8.02(d), the in-dialing trunks also provide facilities for subsequently transferring the call to another extension within the PBX system by the attendant.

8.08 Terminations are provided at the PBX switchboard either on a jack-per-trunk basis when only a few in-dialing trunks are provided, or via a trunk finder when a large number of these trunks are provided and it is advantageous to concentrate the traffic to save jack and lamp mounting space on the switchboard.

E. Incoming Trunks Arranged for Transfer Service

8.09 The transfer feature is actuated by the called party when he flashes the extension switchhook. The flashing action causes the trunk to light an associated lamp at the switchboard to summon the attendant in on the connection, and the transfer is completed by the attendant through a cord circuit at the switchboard.

8.10 The transfer feature is disabled when calls to the directory number are dialed over this trunk by the normal post springs on the incoming selector which open when the selector steps up to the level associated with this number.

F. Attendant Trunks for Reaching PBX Directory Number

8.11 These trunks are connected to the PBX incoming selector bank multiple and are used for reaching the attendant when the PBX directory number is dialed over an incoming trunk arranged for inward dialing.

8.12 The attendant trunks can be arranged to absorb none, one, two, or three digits before causing the trunk lamp at the associated switchboard to light.

G. Attendant (Transfer) Trunks Incoming From Trunk Finders

8.13 These trunks are connected to the trunk-finder multiple and terminate in a jack and lamp at the PBX switchboard. When the transfer relays in the incoming trunk circuit are actuated, a signal is sent to the trunk finder. The trunk finder will connect the inward dialing trunk to this trunk and then light the associated lamp at the PBX switchboard.

9. STANDARD DIAL SWITCHING EQUIPMENT ARRANGEMENTS

9.01 The dial switching equipment of the 701B and 711B PBX systems may be arranged to serve up to 10,000 stations. These arrangements may be on either a 2-digit, 3-digit, or 4-digit basis, depending upon the number of PBX extensions to be served at a given installation. The systems may also be arranged for combined 3- and 4-digit operation.

A. 2-Digit Systems

9.02 A 2-digit system (see Fig. 14) has a total capacity of 99 numbers. Generally, ten of these are used for central office trunks and ten for trunks to the PBX attendant (a selector level in each case). In addition, a selector level is also required for each single-digit tie trunk group thus reducing the capacity by ten additional numbers.

9.03 The switching equipment consists of a number of line finders and their associated selector-connectors, plus incoming selector-connectors for use with incoming dial-repeating tie trunks.

B. 3-Digit Systems

9.04 The switch train of a 3-digit dialing system (see Fig. 15) includes a number of groups of line finders, their associated first selectors, a number of groups of connectors, and incoming selectors. In a 3-digit system it is possible to have a maximum capacity of 999 numbers. However, when selector levels are used for attendant trunks, central office trunks, and tie trunks, the capacity is reduced by 100 numbers per level used.

9.05 Assuming an arrangement where the zero level is used for trunks to the attendant, the ninth level for trunks to the central office and the eight level for tie trunks, the maximum capacity would be 700 station lines.

C. 4-Digit Systems

9.06 The switch train of a 4-digit 701B and 711B PBX system (see Fig. 16) consists of line finders, first selectors, second selectors, connectors, and incoming selectors. The maximum capacity of a 4-digit 711B PBX is 10,000 station lines.

9.07 When a 701B PBX uses a 4-digit numbering plan, the station line capacity is dependent upon the capacity of the multiple of the type of manual switchboard associated with the system.

D. Combined 3- and 4-Digit Systems

9.08 In a combined 3- and 4-digit PBX, the 3-digit codes and the 4-digit codes are assigned to separate and distinct levels of the first-selector multiple. Second selectors are provided at the terminating end of the trunks from those levels of the first-selector multiple which are used for 4-digit calls.

9.09 For each group of second selectors added in this manner, the system is increased by 900 station lines. However, the maximum number of station lines per combined PBX is limited by the capacity of the switchboard associated with the system.

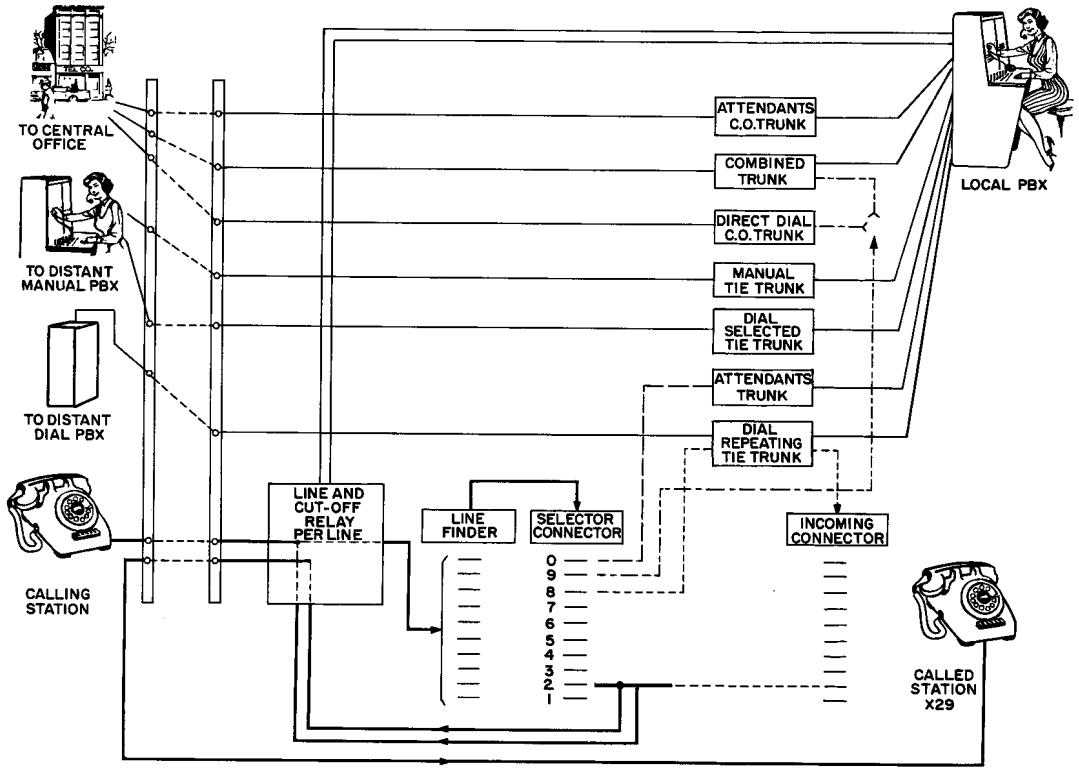


Fig. 14 – Trunking Arrangements for 2-Digit Systems

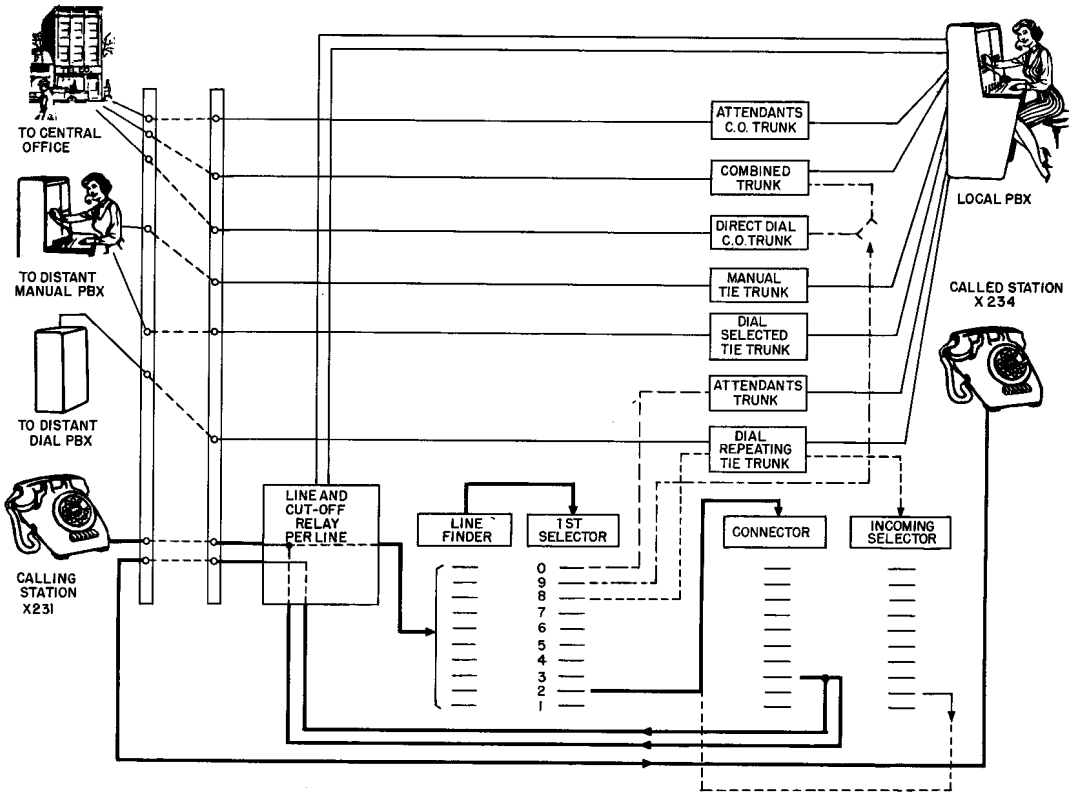


Fig. 15 – Trunking Arrangements for 3-Digit Systems

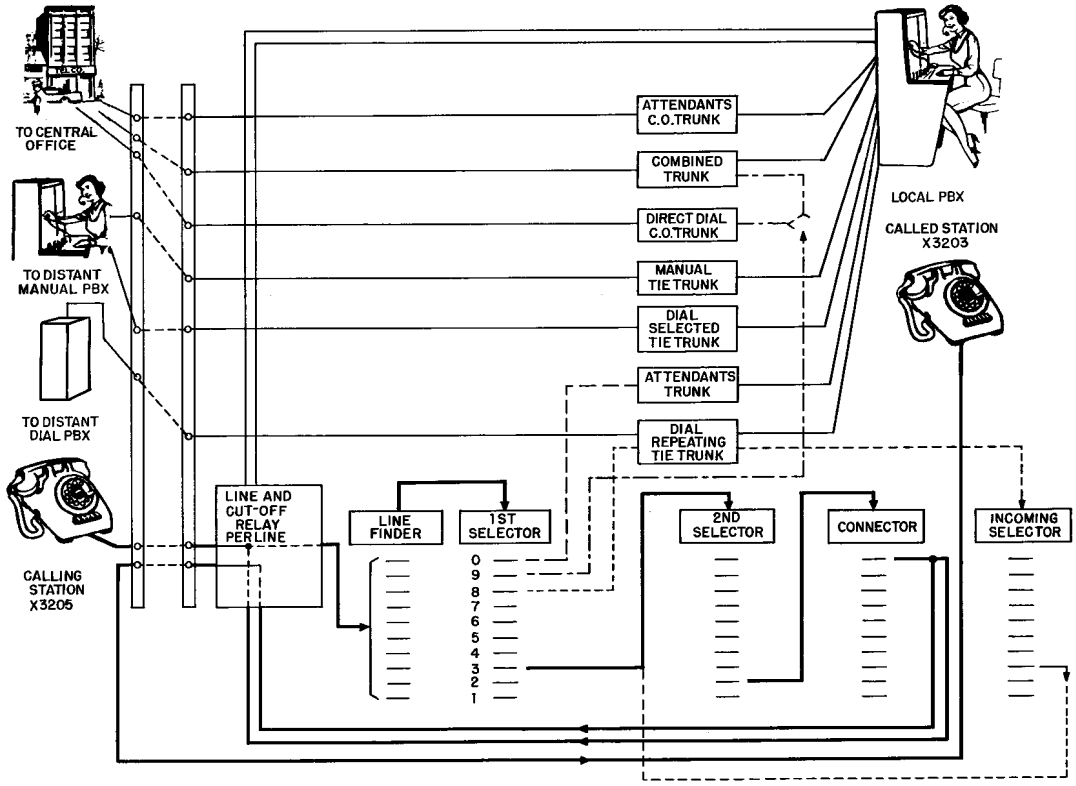


Fig. 16 – Trunking Arrangements for 4-Digit Systems

10. ROUTING OF CALLS ORIGINATING AT PBX DIAL STATIONS

10.01 Outgoing local calls are either dialed directly by the station user or handled by the attendant.

10.02 When the station receiver is removed from the switchhook, the first idle line finder in the associated subgroup will hunt the calling line. The line finder then cuts through to a first selector or selector-connector, and dial tone is furnished to the calling station indicating that the circuits are ready to receive dial pulses.

A. Station-to-Station Calls

10.03 Dial stations may complete station-to-station calls directly, or they may place the call through the PBX attendant by dialing "0".

10.04 In a 2-digit system, a selector-connector is directly connected with each line finder and functions as a connector on calls to levels assigned to station lines. On a station-to-station connection, the first digit dialed steps the selector-connector vertically to the desired level, and the second digit steps it horizontally to the connector terminals of the desired line.

10.05 When three digits are required to establish a station-to-station call, the line finder extends the call to a first selector. Upon the reception of the first digit, the selector steps vertically to the level dialed, and then rotates in that level until an idle trunk to a connector is found. The connector responds to the last two digits dialed, the intermediate digit stepping the switch vertically to the desired level, and the third digit rotating the switch to the desired connector terminal.

10.06 In a combined 3- and 4-digit system, the routing of 3-digit station-to-station calls is the same as that described above. When a 4-digit code is dialed, the first selector extends the call to a second selector which extends the call to a connector.

10.07 In a PBX using a 4-digit numbering plan, station-to-station calls are routed through the switch train in the same manner as the 4-digit

calls in the combined systems. For example, assume that the calling party wishes to call extension 3864. Having received dial tone, the extension user dials the digit 3. This causes the wipers of the first selector to step vertically to the third level and then to rotate until a trunk to an ***idle second selector*** is found. When the digit 8 is dialed, the wipers of the second selector step vertically to the eighth level and rotate until a trunk to an ***idle connector*** is found. Dialing the third digit (6) causes the wipers of the connector to step vertically to the sixth level, and dialing the last digit (4) causes them to rotate to the fourth terminal on the sixth level. The connector tests the called line and if it is idle, ringing begins. When the call is completed, the replacement of the receiver at the calling station releases the switch train.

B. Station-to-Attendant Calls

10.08 Where attendant trunks are provided, an extension user may reach the PBX attendant by dialing "0". In response to the dial pulses, the first selector or selector-connector brushes will step to the tenth or "0" level in the selector multiple and then rotate and hunt over the level for an idle trunk. When the trunk is seized, the selector extends the call over an attendant trunk to the associated switchboard and causes the line lamp of the corresponding trunk jack at the cord switchboard to light.

10.09 The attendant answers the call by inserting a cord plug into the trunk jack, and the desired connection can be established through the cord circuit at the manual switchboard.

10.10 When the extension user replaces the handset, the attendant will receive a disconnect signal (supervisory signal on cord). Removal of the cord plug from the jack will restore the circuits to normal.

10.11 At a 711B PBX installation, the zero levels of the first selectors or selector-connectors may be assigned to a group of the tie trunks over which the PBX stations may obtain the services of the attendant at the associated distant PBX.

C. Station-to-Central Office Calls

10.12 Central office calls may be completed by unrestricted stations without the assistance of the local PBX attendant. The calling party must first dial the digit corresponding to the selector level to which central office trunks have been assigned. The local selector or selector-connector then extends the call through a central office trunk to the dial central office. From there a second dial tone is returned. The calling party may then proceed to dial the desired number in the usual manner.

D. Station to Dial-Repeating Tie Trunk Calls

10.13 Calls over dial-repeating tie trunks may be completed directly by dialing the tie trunk code and the extension, or via the distant attendant by dialing "0" after the tie trunk has been seized.

10.14 When the tie trunk code is dialed, the switches on the first selector or selector-connector step up to the corresponding selector level and rotate in the level until an idle trunk is found.

10.15 The call is extended to an incoming selector or selector-connector at the distant end, and the desired extension can be reached directly by dialing the appropriate code without waiting for second dial tone.

10.16 If the distant PBX is operated as a tandem point to other PBXs, the incoming selector or selector-connector at the far end will, on tandem calls, connect a dial-repeating tie trunk to the PBX beyond tandem. This tie trunk terminates either at an attendant position or in an incoming selector or selector-connector for reaching extensions by dialing additional digits. The repeating tie trunk is arranged to provide suitable transmission terminations at the tandem PBX and at the PBX beyond tandem.

E. Station to Dial-Selected Tie Trunk Calls

10.17 Calls over dial-selected tie trunks are completed by the attendant at the terminating PBX. When the tie trunk code is dialed, the local selector or selector-connector extends the call to a terminating jack at the distant PBX. The tie trunk lamp associated with the jack lights, and the distant attendant completes the connection via the station jack by means of the cord circuit.

F. Station to Ringdown Tie Trunk Calls

10.18 Calls over a ringdown tie trunk to a distant attended PBX are placed through the local PBX attendant. The tie trunk is selected manually by the local attendant, and it is necessary for her to operate the associated cord circuit ringing key to light the tie trunk lamp at the connecting PBX. If the cord is arranged for flashing recall, the attendant must remain on the connection or return to the connection after ringing to avoid false operation of the flashing recall. The call is completed manually by the attendant at the distant PBX.

G. THRU Connections on Tie Trunks Via Attendant Position

10.19 When the attendant answers a tie trunk call and it is determined that the call will be completed via another tie trunk, the THRU jacks of both the incoming and outgoing tie trunks are connected by a pair of cords.

10.20 The attendant then inserts another dial cord into the dial or answer jack of the outgoing jack and dials the connection. Upon completion of dialing, the attendant removes the dial cord and the first answering cord from the jacks. The cords in the THRU jacks hold the equipment and provide supervision and the transmission conditions required for this type of call.

11. ROUTING OF CALLS TERMINATING AT PBX STATIONS

A. Over Central Office Trunks

11.01 An incoming call to a PBX not arranged for inward dialing, whether from a dial or manual central office, appears as a lighted trunk lamp in the face of the switchboard. The attendant answers the call with the trunk cord and establishes a connection to the called station via the station line jack.

11.02 Where machine ringing is provided, the ringing will start automatically and the calling party will hear the audible ring until the called station answers. If machine ringing is not provided, the attendant signals the called station manually by operating the ringing key associated with the station end of the cord.

B. Over Dial-Repeating Tie Trunks

11.03 Incoming calls over dial-repeating tie trunks are routed to an incoming selector or connector in the terminating PBX. If operator assistance is desired, the calling party dials "0" and is connected to the terminating switchboard via the attendant trunk.

11.04 If the terminating PBX uses a 2-digit code, the tie trunk terminates on an incoming connector. If a 3- or 4-digit numbering plan is used, the tie trunk terminates on an incoming selector. In the 3-digit scheme, the call is routed to a connector. With 4-digit dialing, it is extended to a second selector and then on to a connector for completion.

C. Over Dial-Selected Tie Trunks

11.05 An incoming call over a dial-selected tie trunk terminates on a trunk jack at the auxiliary switchboard. The lamp associated with the trunk jack will light to signal the attendant. The attendant answers the call by plugging the proper cord of a pair into the jack, and completes the connection via the station jack by means of the cord circuit.

D. To PBX Arranged for Inward Dialing

11.06 Incoming calls to a station within a PBX arranged for inward dialing can be made directly to the station by dialing the 2L + 5N number assigned to the extension, or if the calling party does not know the extension number, the call can be placed to the PBX directory number and completed by the attendant at the PBX switchboard.

11.07 The directory number traffic is routed through an incoming trunk circuit arranged for inward dialing into an incoming selector. In response to the dial pulses, the selector will step up to the level associated with the directory number and hunt over the level for an idle trunk.

11.08 When the trunk is seized, the incoming selector extends the call over an attendant trunk to the associated switchboard.

11.09 Incoming calls directed to a PBX extension are routed through the in-dialing trunk to the incoming selector, and on through the regular PBX switch train for completion.

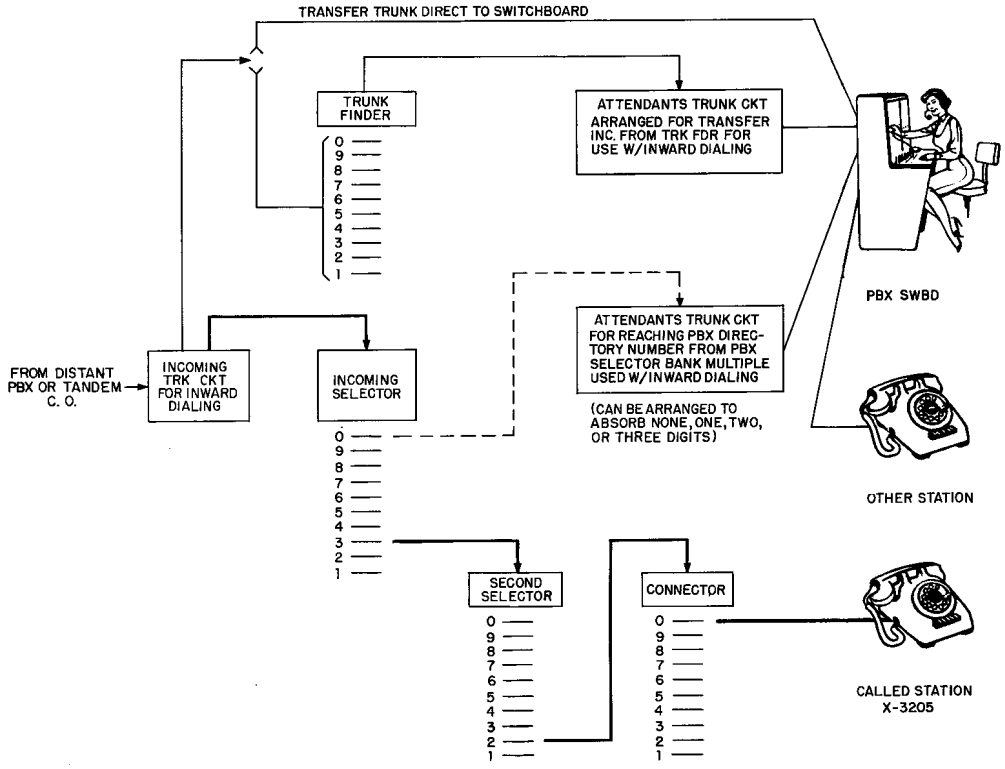


Fig. 17 – Trunking Arrangements for Inward Dialing

E. Transfer on Calls Originated Over Inward Dialing Trunks

11.10 An incoming call previously dialed directly to an extension from a central office or distant PBX over an in-dialing trunk may be transferred to another extension within the PBX by the ***called*** party. (See Fig. 17.)

11.11 To achieve the transfer, the assistance of an attendant operating a switchboard is required.

11.12 The ***called*** party initiates the transfer by flashing his switchhook.

11.13 If the in-dialing trunk terminations are on a per-jack basis, the flashing action causes certain relays to operate, setting up a path through the incoming selector, the incoming trunk circuit, and the jack and lamp circuit, which in turn lights the trunk lamp at the attendant position.

11.14 If the in-dialing trunk is connected to a trunk finder, the flashing action sets up the path through the incoming selector and the incoming trunk circuit, and then routes it to the trunk finder. The trunk finder connects the incoming trunk to an attendant trunk and lights the associated lamp at the switchboard.

11.15 Ringing tone is provided to the calling and ***called*** party as an audible signal indicating that the attendant is being called.

11.16 When the attendant plugs in on the call, a 3-way connection is established between the calling party, the called party, and the attendant. After giving the request for transfer, the ***called*** party hangs up, disassociating himself from the connection. The connection between the ***calling*** party and the attendant is maintained, and the attendant can complete the call to the other extension through the cord circuit via the line multiple or a dialing trunk and the local switch train.

11.17 Where an incoming toll call is completed by DID, it is possible to call the toll operator in on the connection. The called party signals his attendant as previously described. The attendant then recalls the toll operator by re-

peatedly removing the cord plug from, and reinserting it into, the associated trunk jack. This causes battery and ground reversals to the connected trunk circuit which in turn will cause the supervisory lamp at the toll switchboard to flash.

12. MANUAL EXTENSIONS

12.01 Some of the extensions at a 701B PBX may not be equipped with dials. Such lines are equipped with jack and lamp appearances at the switchboard, and outgoing calls from these stations are handled by the attendant. When the handset at the calling station is removed from the switchhook, a line lamp associated with the line jack termination at the switchboard is lighted. The attendant answers the call with the proper cord and establishes the desired connection through a cord pair.

12.02 Incoming calls to these stations are completed by the attendant via the station line jack. In addition, these extensions may be assigned to connector or selector-connector terminals so that incoming dial calls can be completed directly.

13. SUPERVISORY FEATURES

13.01 A station-to-station call that is dialed directly is under the control of the ***calling*** party, and the replacement of the receiver at the ***calling*** station releases the switch train.

13.02 On a station-to-station connection that is established through the manual switchboard, switchhook supervision is obtained on both ends of the cord. The connection is held until the cord circuit is released.

13.03 On a call from a station to distant attendant via a dial-selected tie trunk, the originating end is under calling party control and the terminating end is under control of the distant attendant.

13.04 On a station-to-attendant call made locally or via a repeating tie trunk, the connection is under joint control of the station and the attendant.

13.05 A station-to-station call over a dial-repeating tie trunk is under joint control of the calling and called parties.

13.06 In a dial central office district, a call from a station to the central office that is dialed directly is under the control of the calling station, except in the case of a call to the central office operator or to a toll operator. In this case, the connection is under the joint control of the station and the central office operator, and the station can flash the central office operator.

13.07 If a call is made to a manual central office, the connection is under the joint control of the station and the central office operator.

14. SUPPLEMENTARY FACILITIES

A. Restricted Service

14.01 Any individual line can be restricted from obtaining a direct dial connection to a central office trunk simply by removing a red plastic sleeve from a contact on the line relay of the associated line circuit. If the central office level is dialed, the calling station will receive busy tone.

B. Intercepting Service

14.02 Vacant selector levels and unused connector terminals of a 701B PBX are connected to intercepting trunks and terminated in jacks and lamps at the attendant position.

14.03 When these levels are dialed, the intercepting trunk is seized by the incoming call and the line lamp associated with the trunk jack lights. Ringing tone is supplied to the calling party until the attendant answers. The attendant answers the call by inserting the plug of a PBX cord into the jack. The line lamp is extinguished and ringing is tripped. When the calling station disconnects, the attendant will receive a disconnect signal. When the attendant disconnects, the circuit will restore to normal.

14.04 Where attendant intercept is provided on inward dialing trunks, charge supervision is returned when the attendant answers a call that has been improperly dialed or directed to an unassigned station code.

14.05 In some cases, intercepting trunks may not be provided for the 711B PBX. In these cases, calls directed to a vacant selector level or to an unused connector terminal will receive busy tone.

C. Toll Diversion

14.06 Ordinarily, unrestricted PBX stations or tie trunks can dial the central office code and utilize whatever services are available, such as local, toll, and direct distance dialing. However, these stations can be denied direct access to toll in those cases where the central office trunks can be arranged for toll diversion.

14.07 When an unauthorized station or tie trunk dials a code which provides for toll service, the toll-diverting feature transfers the station from the central office trunk to a toll-diverting trunk or toll-diverting tone circuit, and the central office connection is released.

14.08 When used with the 701B PBX, the toll-diverting trunk routes the call to an answering jack at the PBX switchboard. When associated with the 711B PBX, the toll-diverting trunk will route the call to a busy tone circuit and it will be necessary for the extension user to hang up and originate a new call through the switchboard at the distant PBX.

D. Long Line and Long Trunk Circuits

14.09 When the conductor resistance of a PBX trunk or a PBX off-premise extension exceeds the normal operating range, supplementary signaling circuits are required for extending these ranges.

14.10 The ranges obtainable with these supplementary circuits vary with the type of PBX and the particular conditions encountered. In general, however, the long line, long trunk circuits, and repeater equipment provide a means for extending the ranges for transmitting switchhook, ringing, and dial pulse signals. Various combinations of these facilities are required to satisfy the unique condition of the individual line, and through their use, the distance between the terminating points may be increased.

E. Recorded Telephone Dictation Trunks

14.11 These trunks appear on selector or selector-connector levels in the PBX switch train, and are extended to either dial-controlled or voice-controlled dictating machines. One trunk circuit is associated with each dictating machine. A dial station user may reach a dictating machine by dialing the selector level code. Automatic selection of an idle trunk is accomplished in the normal trunk-hunting manner for the PBX. Tone is returned from the dictation trunk to indicate that the machine is available.

14.12 A dial controlled machine releases and reoperates in response to dial pulsed instructions as follows.

DIGIT	INSTRUCTION
"1"	Start or Stop
"2"	Correction
"3"	Playback
"4"	End of Message
"0"	Call in Attendant

14.13 With voice operation, the dictation is connected through to the dictating machine which gives a spurt of tone indicating that the machine is ready to record. The dictator has to dial the following functions.

DIGIT	INSTRUCTION
"2"	Connection
"3"	Playback
"1"	Cancellation of Remainder of Playback
"4"	End of Dictation
"0"	Assistance

F. Auxiliary Trunk Circuit for Completing Incoming Night Calls

14.14 An auxiliary trunk circuit associated with a PBX central office trunk provides an arrangement whereby incoming calls may be answered at a designated station and transferred to any other station in the PBX system.

14.15 The night attendant's equipment consists of either a key telephone set or 101-type key equipment and key telephone set, and may be used as a regular attendant's position or for night service at a dial PBX equipped with a switchboard.

14.16 At a 701B PBX, a night connection between the station and a central office trunk must be established at the associated switchboard to make the auxiliary trunk circuit effective. At a 711B PBX, connection to a central office trunk must be made in place of a connection to a line circuit for the night station.

14.17 When an incoming call appears on the central office trunk, ringing current from the central office operates the ringers at the night station. When the attendant determines the PBX station desired, the night attendant operates the hold key or button momentarily. This operation holds the transmission path closed to the central office and transfers the attendant's talking circuit to the PBX line circuit. When the PBX circuit returns dial tone, the attendant dials the called PBX station through the PBX switch train. When the called station answers, the attendant and the station can talk without the central office being able to hear.

14.18 When the attendant disconnects, certain relays in the auxiliary trunk circuit operate to remove the "hold" circuit from across the central office "T" and "R" leads, and to establish a transmission path between the PBX station and the central office.

15. DIAL AUXILIARY SWITCHBOARDS

15.01 A manual cord switchboard consists of one or more sections of framework containing a jack field in which are terminated station lines, central office trunks, and tie trunks. Double-ended cord circuits are provided for connecting the jacks together. In addition there are a telephone and dial circuit, which connects the attendant to the cord circuits by means of keys, and miscellaneous common auxiliary and alarm circuits. The switchboards available for the 701B PBX may be of either the nonmultiple (where the dial station line jacks and trunks have only one appearance) or multiple type (where there are two or more appearances of the same line or trunk jack).

15.02 Night connections between a station requiring night service and a central office trunk are established by the attendant through a cord circuit on the associated switchboard. The attendant plugs the back cord of an idle cord pair into the station jack, and the front cord into a central office trunk jack, then operates the night and through-dial key. The station is then connected directly to the central office trunk. Incoming calls from the central office are terminated at the station, and outgoing calls to the central office may be made without the assistance of the attendant.

A. 552-Type PBX Switchboard

15.03 ***Nonmultiple:*** These switchboards are intended to serve at installations where one or two positions are required. They are furnished in a capacity for 300 dial station lines (one position) or 400 station lines (two positions), 80 trunks, tie trunks, or manual station lines, and 15 cord pairs per position.

15.04 ***Multiple Type:*** The 552 multiple switchboard, used for three or more positions, has a standard capacity of 540 station lines and 120 trunk circuits multipled on a 3-panel basis. Both the multiple and nonmultiple 552-type switchboards utilize the same section assembly and keyshelf equipment, and may be used in either manual or dial step-by-step central office areas. Ringing current may be supplied over cable pairs from the central office or from the dial equipment ringing machine, while the battery supply is obtained from the power plant provided with the 701B dial equipment.

B. 605 PBX Switchboard

15.05 The 605A PBX is a multiple-type switchboard which may be used as the manual board associated with the dial switching equipment of the 701B private branch exchange. The standard capacity of the board, available in two sizes, is 2000 station lines and 480 trunk circuits (small) or 3200 station lines and 480 trunk circuits (large). These capacities are based on an equipment arrangement where both the trunks and jacks are multipled on a 4-panel basis. This capacity is variable in that the trunk capacity may be decreased to increase the number of station lines, or vice versa, depending upon operating conditions. A dial, provided for the attendant when connections are to be established over dialing tie trunks or to dial central offices, can be cut in on any cord circuit in the position by operating the associated TALK AND DIAL key. Power for the switchboard is obtained from the power plant provided with the 701B dial switching equipment. Ringing current may be supplied from the central office over cable pairs, or from the dial equipment ringing machine.

C. 607-Type PBX Switchboard

15.06 This PBX switchboard is a multiple-type board designed for use at large installations where the capacities of the 605-type PBX

are not sufficient to meet the customer's requirements. The 607 has a nominal capacity of 5600 station lines, 240 outgoing trunks, and 480 incoming central office or tie trunks. The station and trunk capacities are approximate, and either may be increased by decreasing the other. It differs from the 605-type switchboard in that a 92-type jack panel is used, and the cord circuits operate differently from those of the usual type PBX. The use of the 92-type jack makes possible a larger station line multiple, and the cord circuit is so designed that the rear cord is used for answering all types of calls and the front cord for calling all types of trunk and line circuits. These cord circuits feature machine ringing and automatic flashing recall. The power for the switchboard is obtained from the power plant provided with the 701B dial switching equipment, and an additional 6-volt battery is required to provide the features incorporated in the cord circuit.

D. 608-Type PBX Switchboard

15.07 This PBX may be used as a nonmultiple switchboard at installations where one or two positions are required, or it may be used as a multiple switchboard on a 3- or 4-panel basis. The capacity of this switchboard varies with the installation. A single section used on a nonmultiple basis may contain 300 station lines and 80 trunks. When used as a multiple board, the capacities may vary from 900 to 2400 station lines and from 180 to 480 trunks. The high capacities are obtained through the use of combined line lamp and designation strips and newly designed small jack and jack mounting. The 608 PBX features all nonlocking pushbutton key operation, distinctive supervisory lamp signals to indicate the status of a call, and plug-in type circuit equipments. The cord circuit enables the attendant to answer all calls on the back cord, and features automatic machine ringing on the front cord, manual ringing on both cords, and audible flashing recall on both the front and rear cords. Power is supplied from the 701B dial equipment. In addition, a relay circuit mounted in an auxiliary cabinet is required to convert the dc pulses used for the visual wink signal from 120 to 30 ipm.