

## **GENERAL DESCRIPTION**

### **701A AND 711A PBX**

#### **1. GENERAL:**

1.1 This section gives a general description of the 701-A and 711-A private branch exchanges and associated operating features.

This section is reissued to convert it to letter size. Figs. 1, 2, 3, and 4 have been replaced by new Figs. 1, 2, and 3 which are more modern views of the equipment. In the process of conversion, marginal arrows have been omitted.

1.2 The 701-A and 711-A P B X 's are arranged for the completion of intercommunicating calls directly by dial with provision for completing calls outgoing to the central office over trunks, and to other P B X 's over tie lines directly by dial. These classes of calls can, however, be completed via the attendant in the case of a 701-A P B X. Incoming calls from the central office to a 701-A P B X are completed by the attendant of the associated manual switchboard. Where this class of call to a 711-A P B X is required, it is completed by the attendant at the manual switchboard of a connecting P B X over repeating tie lines. These P B X 's are designed to operate with a manual, panel or step-by-step central office.

1.3 The 701-A P B X consists of dial equipment mounted on switch frames, a manual switchboard of the cord type, with the trunk and tie line circuits mounted on relay racks, the necessary cross-connecting facilities, and a local power plant. The dial equipment embodies step-by-step switches, controlled by dials provided at the station telephones. The manual switchboard furnished with this P B X may be of either the non-multiple or multiple type. The manual non-multiple switchboard used is the 552-A and the manual multiple switchboard is the 605-A.

1.4 The 711-A P B X is not provided with a manual switchboard but employs all the other equipment used with the 701-A P B X, except the miscellaneous circuits associated with the switchboard. It is necessary to provide repeating tie lines from an attended P B X to receive calls incoming from the central office. Outgoing direct dial central office trunks can be furnished if desired. This type of P B X is designed for cases where a great majority of the calls are intercommunicating, outgoing to the central office and between the P B X and connecting P B X 's with little or no traffic incoming from the central office.

#### **2. GENERAL DESCRIPTION:**

2.1 A self-supporting type distributing frame is furnished with these P B X 's to provide the necessary cross-connection facilities, except in small installations where no protection is required where the cross-connection facilities on the line relay rack are used.

2.2 The dial equipment of these P B X 's consists of step-by-step type switches used for the completion of calls established without the aid of the P B X attendant, such as intercommunicating calls, calls outgoing to the central office and calls outgoing to, and incoming from, connecting P B X 's over tie

lines, as well as calls to the attendant. The station line and line finder group and subgroup circuits are mounted on bays of line relay rack. The apparatus for the trunk, tie line and miscellaneous circuits are mounted on bays of miscellaneous relay rack.

2.3 Incoming trunk calls are completed by the attendant directly to the station by means of a jack appearance of each station line in the face of the switchboard provided with the 701-A P B X. Facilities are also provided for handling calls from station lines that are on a manual basis, calls of an informational nature, calls outgoing to the central office (mostly outgoing toll calls), outgoing and incoming tie line calls and such other service as may be required of the attendant.

#### **3. DIAL EQUIPMENT:**

3.1 The dial equipment consists of line finders (with associated station line and group circuit apparatus), selectors, selector-connectors and connectors. For 2-digit P B X 's, selector-connectors are used in place of the selectors and connectors that are required for a 3-digit or combined 3 and 4-digit P B X

3.2 The station line and group circuit apparatus is arranged in groups of 200 station lines, each 200-line group being mounted on a bay of line relay rack.

3.3 Step-by-step line finders are used with these P B X 's to provide line equipment that is self-protecting. One or more unit-type mountings with capacities of 9 and 20 line finders are provided for the group of line finders arranged to serve a group of 200 dial station lines. Three 200-point banks, each with an associated wiper, are required to care for the tip, ring and sleeve of the 200 station lines. In each of the 100 positions of the switch the wipers are in contact with two station lines. A switching relay determines which one shall be cut through. The line finder is also provided with a commutator and commutator wiper to provide the level hunting feature. On the origination of a call at one of the dial stations, the line and group circuit apparatus functions to start a line finder and to mark the level on the vertical commutator and the particular station line on the sleeve terminal in the line finder bank, so that it will be selected when the line finder steps to it.

3.4 Directly connected to each line finder is a first selector or a selector-connector. After the line finder has found the calling station line and has cut through, dial tone is sent out from the selector or selector-connector. On the reception of the first digit dialed, the selector or selector-connector steps vertically to the level dialed. In a 3-digit or combined 3 and 4-digit P B X, where selectors are used, the selector rotates to an idle trunk in the chosen level and connects the calling party to either a second selector, connector, a trunk or a tie line. The second selector, required on 4-digit calls, functions from a single digit to step to the desired level, after which it rotates and picks an idle tie line or a trunk to an idle connector.

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3.5 Three types of selectors, all requiring 300-point banks, are employed with 3-digit and combined 3 and 4-digit 701-A and 711-A P B X 's; a local first selector which is directly connected to a line finder, a second selector which is connected to the bank terminals of first selectors, and an incoming selector which is required for P B X 's having tie lines so arranged that the station can be reached directly by dialing from the distant P B X .

3.6 The selector-connector functions, as the name implies, both as a selector and as a connector. When dialed to a level assigned to trunks or tie lines, the switch functions as a selector, requiring only one digit to connect to a trunk or tie line. When dialed to levels assigned to station lines, it functions as a connector and requires two digits to connect to a station line.

3.7 Two types of selector-connectors are provided: a regular selector-connector which functions to connect directly to the particular connector terminal dialed; and a rotary hunting selector-connector, which is arranged to hunt over a group of station lines in a level, for an idle line. The former requires 300-point banks and the latter 400-point banks.

3.8 The upper levels of selectors and selector-connectors are generally assigned to central office and attendant trunks and tie lines. The dialing of a single digit when trunks and tie lines are associated with first selectors and selector-connectors, or of two digits when the tie lines are associated with second selectors, operates the switches to connect the calling station to the trunk or tie line.

3.9 Regular connectors (with 300-point banks) and rotary hunting connectors (with 400-point banks) are used in 3-digit and combined 3 and 4-digit 701-A and 711-A P B X 's. They respond to the dialing of two digits, the first digit stepping the switch to the desired level and the second digit rotating the switch to the desired terminal. In the rotary hunting type, if this terminal is busy, the switch is arranged to hunt over the remaining terminals in the preassigned group. All connectors are of the reverse battery type and are arranged to handle both local and repeating tie line calls. In a 2-digit P B X incoming connectors are required if repeating tie lines are furnished. These connectors may be either of the regular or rotary hunting type.

### 4. MANUAL EQUIPMENT:

4.1 Dials are provided at the manual switchboard of the 701-A P B X if the P B X is located in a dial central office district or if repeating tie lines appearing at the switchboard are employed.

4.2 Only one type of cord circuit is provided which can be used for establishing connections between two station lines or between a station line and a central office trunk or a tie line (in either direction), as well as from one long through tie line to another long through tie line. On station-to-station connections the transmission battery is furnished from the cord circuit which is of the condenser bridged impedance type. On central office connections the transmission battery is fed from the central office so that on toll connections the advantages of toll grade battery can be obtained. On connections to tie lines the transmission battery may or may not be provided from the cord circuit, depending upon the type of tie line used and whether the station end or trunk end of the cord circuit is used with the tie line.

### 5. POWER PLANTS:

5.1 Two types of power plants are provided for the Nos. 701-A and 711-A private branch exchanges, one arranged for continuous operation of the charging equipment and the other arranged for automatic operation under control of an ampere-hour meter.

5.2 The plants arranged for continuous operation are the same as those employed in connection with the No. 740 type private branch exchange, and are furnished for either a-c. or d-c. service.

5.3 The power plants arranged for automatic operation consist essentially of a storage battery, charging equipment, voltage regulating apparatus and ringing and tone equipment. The storage battery, made up of active cells, together with counter e.m.f. cells, may be of radio type units housed in a metal cabinet for small P B X 's or of enclosed type glass jar batteries mounted in a battery rack for larger installations. The charging equipment consists of Tungar rectifiers for a-c. service or motor-generators for d-c. service arranged for automatic operation with a Sangamo ampere-hour meter and associated relay equipment for controlling the amount of charge and discharge. Voltage regulating apparatus consisting of a voltmeter relay with associated apparatus provides for a voltage range of 44 to 50 volts and functions in case the voltage should reach either of these extremes before the ampere-hour meter operates.

5.4 A ringing machine with the necessary relay and transformer apparatus provides dial and busy tones for all calls and ringing current on calls not involving the manual switchboard. On the latter calls ringing current is supplied over cable pairs from the central office.

5.5 The ampere-hour meter, voltage regulating apparatus, ringing machine and the necessary fuses, together with the miscellaneous apparatus, are mounted on a power board.

5.6 The power plant is so arranged that additional battery and charging equipment can be added as the P B X grows in size.

### 6. TRUNK, TIE LINE, MANUAL STATION LINE AND MISCELLANEOUS CIRCUITS:

6.1 Two types of intercepting trunks, terminated at the manual switchboard, are provided for the 701-A P B X for intercepting on vacant selector levels and unused connector terminals. No provision is made for intercepting trunks for the 711-A P B X and, therefore, the sleeve terminals of vacant selector levels and unused connector terminals in the 711-A P B X can be grounded so that the busy signal is given when a connection is completed to them.

6.2 Attendant trunks are provided from the zero level of first selectors or selector-connectors to the manual switchboard of the 701-A P B X so that the attendant can be reached from the P B X stations.

6.3 The following types of central office trunks are provided for these P B X 's:

1. An "attendant central office trunk" for the 701-A P B X with manual non-multiple switchboard which provides two-way service between the attendant and the central office.

2. An "attendant central office trunk" similar to the above, for the 701-A P B X with manual multiple switchboard.
3. A "direct dial central office trunk" for 701-A and 711-A P B X's outgoing to the central office from the multiple banks of selectors or selector-connectors to provide one-way service from a dial station to the central office by direct dialing.
4. A "combination central office trunk" for the 701-A P B X with either manual multiple or non-multiple switchboard which provides two-way service between the attendant and the central office and one-way direct dial service from a station to the central office.

6.4 All tie line circuits provided for these P B X's are of the two-way type which, however, can be used on a one-way basis where desirable. The two-way tie line circuits embody one or more of the following types of tie line service:

1. Manual tie line service between a 701-A P B X and a connecting attended P B X in which the tie line is selected manually by the attendant at the originating P B X and the call is completed manually by the attendant at the terminating P B X.
2. Dial tie line service between a 701-A P B X or 711-A P B X and a connecting attended P B X in which the tie line is dialed but no dial pulses are transmitted over the tie line and the call is completed manually by the attendant at the terminating P B X.
3. Repeating tie line service between a 701-A or 711-A P B X and a connecting P B X in which the dial station or the attendant at the originating P B X dials the station or attendant at the terminating P B X directly.

In addition, long manual tie line circuits for use with longer loops are provided for the 701-A P B X which can be arranged for termination of calls at the P B X with or without provision for connecting two long tie lines together for calls from one connecting P B X to another connecting P B X. This long

tie line service is handled at the manual switchboard of the 701-A P B X.

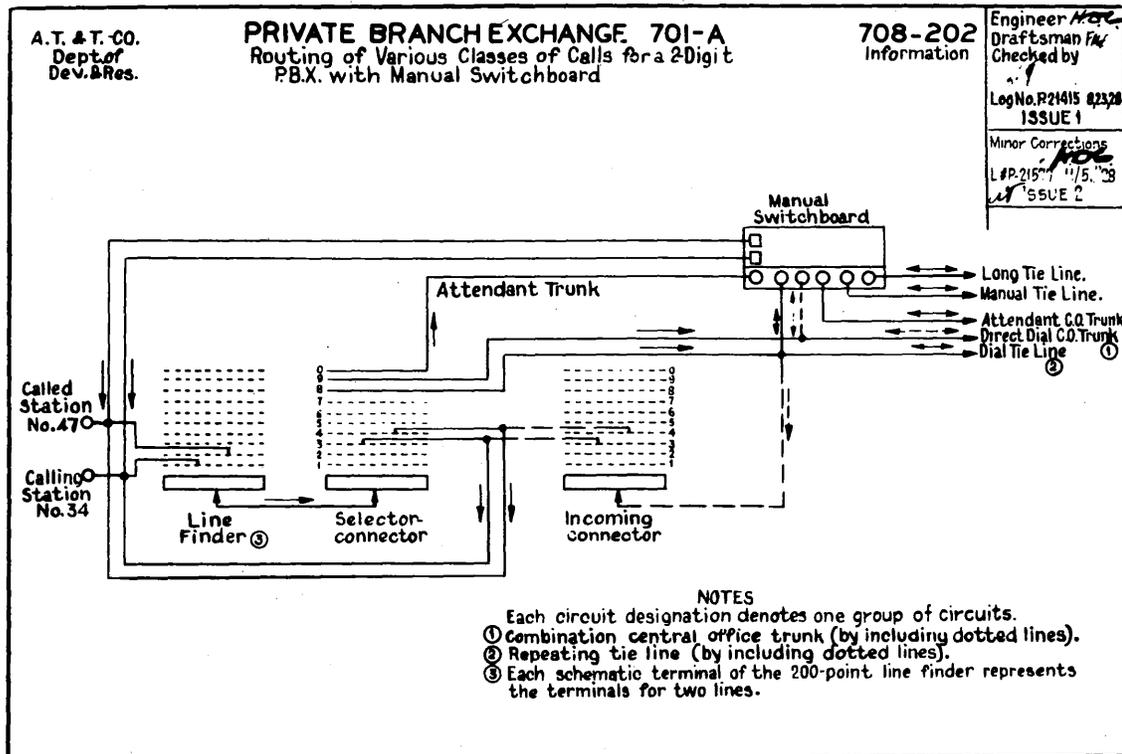
6.5 For cases where the external loop resistance of the station line or trunk exceeds the normal limits, long station line or trunk equipment is employed.

**7. LINE AND TRUNK OPERATING FEATURES:**

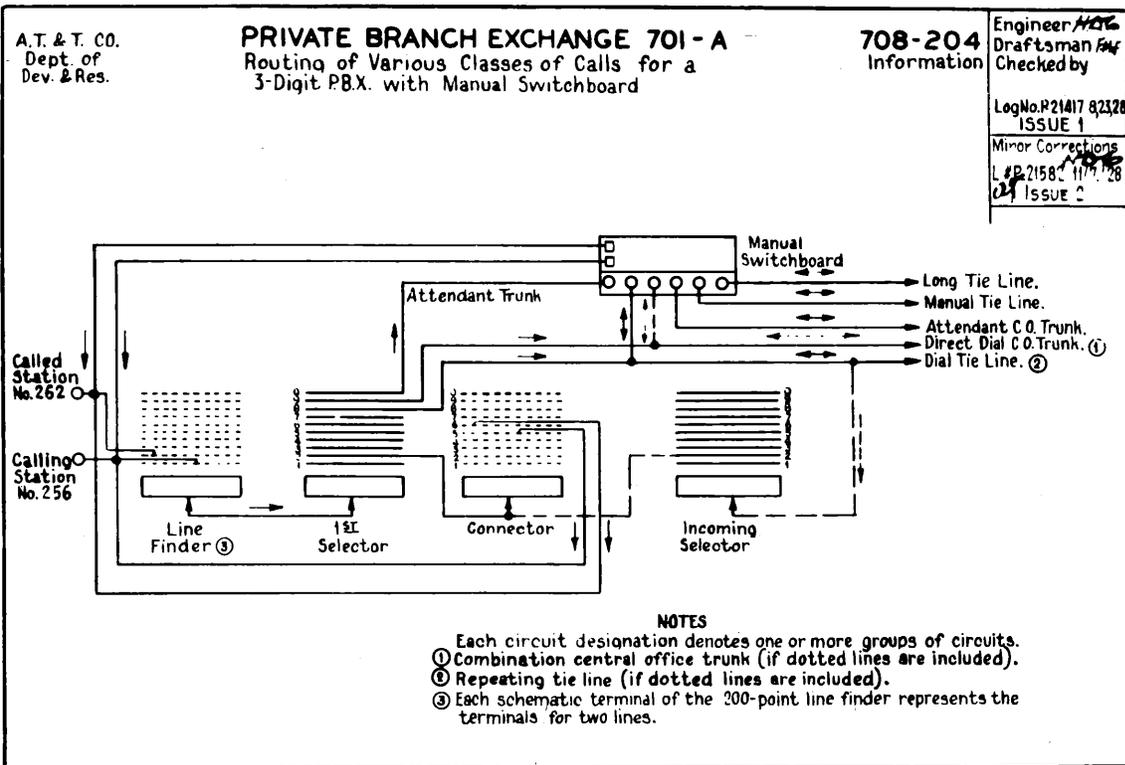
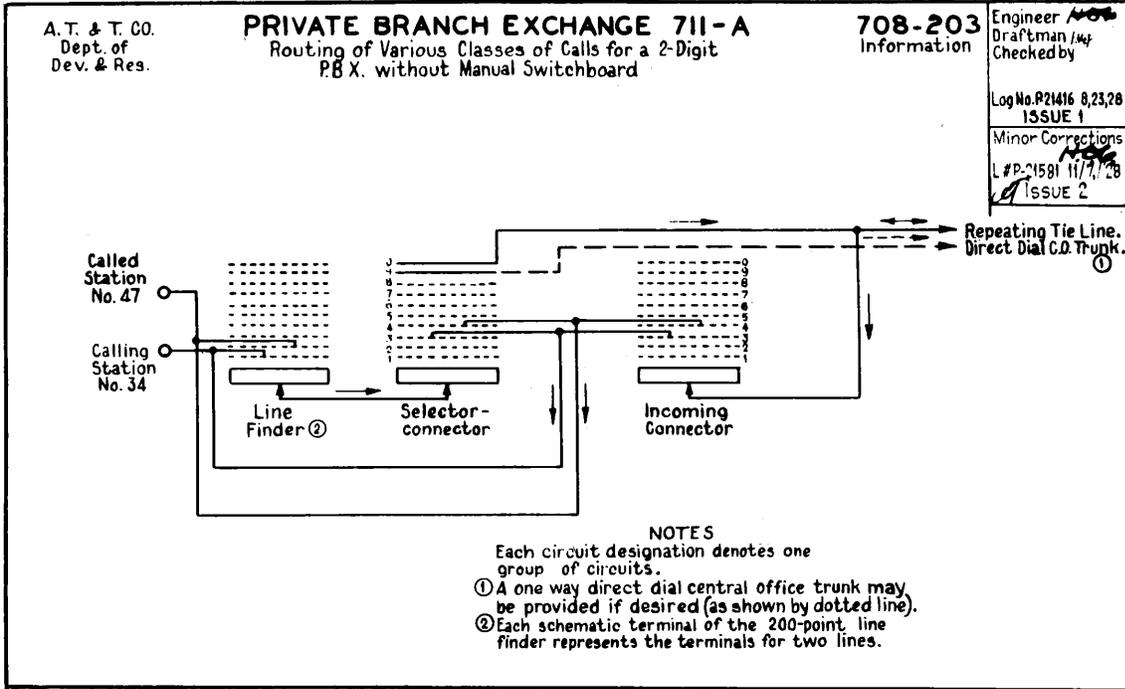
(a) **Numbering Scheme:**

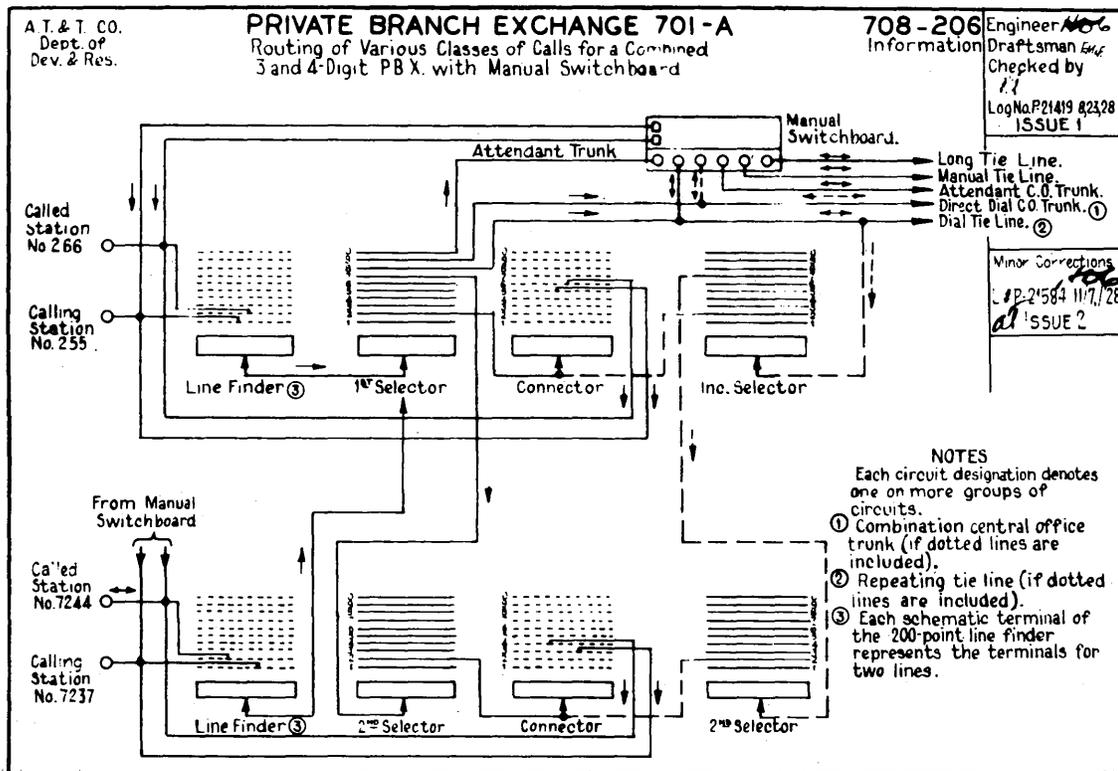
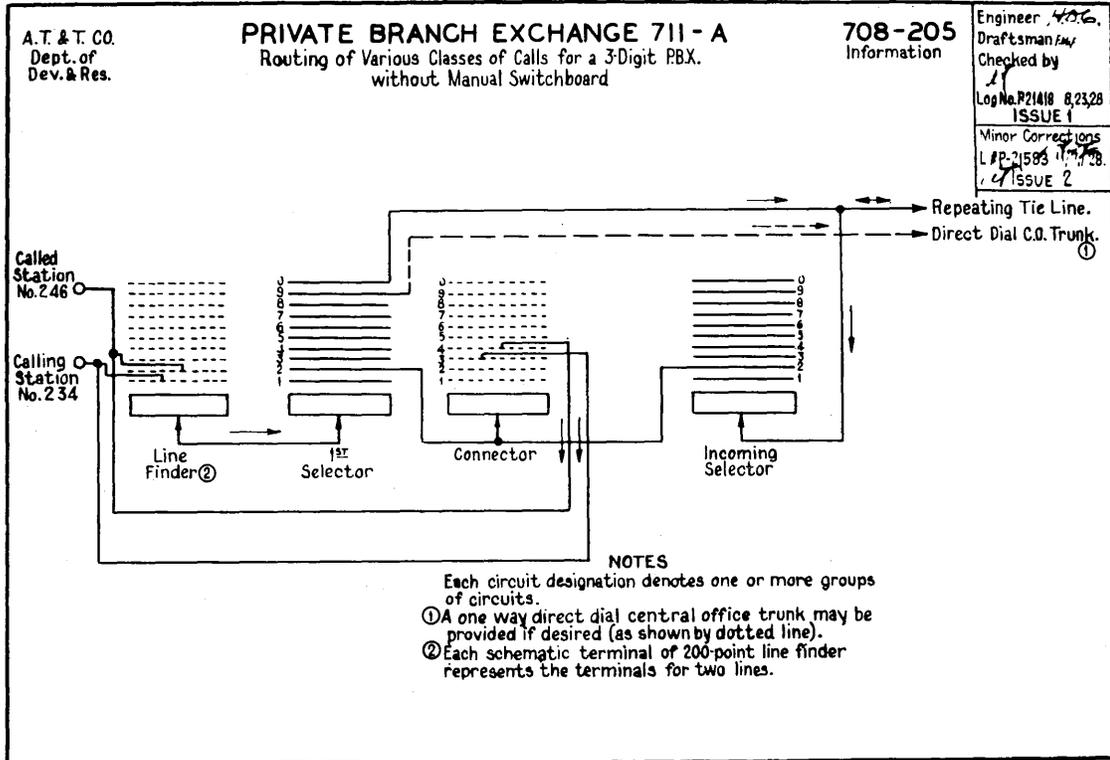
7.1 The 701-A and 711-A P B X's are arranged for individual station line service on a terminal-per-station basis. Extension stations can be provided, however, within the physical limitations for such an arrangement. Each dial station line or manual station line with connector multiple is assigned an individual call number and is connected to the corresponding terminal in the connector multiple for receiving incoming dialed calls. A multiple of each dial station line also appears on the banks of the line finders for originating service. In the 701-A P B X each station line is multiplied in the manual switchboard on a jack-per-station basis so that the attendant can complete calls to the station.

7.2 In 2-digit 701-A and 711-A P B X's as shown on Sketches 708-202 and 708-203, the terminals on all except the upper levels of the selector-connector multiple bank are arranged for trunks to the P B X attendant or to repeating tie lines for 701-A and 711-A P B X's respectively; and level 9 is assigned to dial trunks to the central office. On calls to these levels the switch functions as a selector. The selector-connector can be arranged so that additional levels can be used on a selector basis for tie lines or other groups of trunks if desired. In a 2-digit system the dialing of one digit only is required to connect to a trunk or tie line. The connection to a local station line necessitates the dialing of two digits.



7.3 In 3-digit P B X's, as shown on Sketches 708-204 and 708-205, the upper levels of the first selector are assigned to trunks and tie lines, the zero level being ordinarily used for attendants' trunks, the ninth level for trunks to the central office and the eighth level for tie lines. Sketch 708-206 shows schematically the arrangements of a combined 3 or 4-digit 701-A P B X.





(b) **Miscellaneous Features:**

**7.5 Restricted Service:** Arrangements are provided with the 701-A and 711-A P B X's so that any line can be restricted from obtaining a direct dial connection to a central office trunk, to the attendant and to dial or repeating tie lines, and if the corresponding codes are dialed the station will receive a busy tone.

**7.6 Dial Tone:** Upon lifting the receiver from the switchhook at a dial station the line finder will function to extend the calling station line to a selector or selector-connector, which switch will apply dial tone to indicate that the circuits are in position to receive dial pulses. This dial tone is similar to that used in dial central offices.

**7.7 Busy Tone:** Upon dialing the assigned code or number of a trunk, tie line or station line which is busy, the calling station receives the busy tone, which is similar to the interrupted tone furnished for this purpose in central offices.

**7.8 Ringing and Ringing Tone:** After a connection has been made to a called station line through the dial equipment of 701-A and 711-A P B X's, machine ringing is supplied from the connector circuit. Ringing is arranged for a ringing period of one second and a silent period of two seconds. Ringing current is tripped when the called station receiver is removed from the switchhook. On calls through the manual switchboard of the 701-A P B X, manual ringing is applied by the operation of the ringing key associated with the cord circuit. During the time that machine ringing current is being applied on a call through the dial equipment, the calling station receives ringing induction tone, which indicates that the called station is being rung. Neither machine ringing nor ringing induction tone is obtained on calls through the manual switchboard.

**7.9 Station Line Hunting:** As previously described, selector-connectors and connectors of 701-A and 711-A P B X's can be provided with the station line hunting feature. Any number of station lines up to ten on a single level can be associated in a group, so that when the first station line is dialed the selector-connector or connector will connect to the first idle station line of the group.

**7.10 Night Service:** Connections can be established between trunks and station lines for night service by means of the cord circuits and night jacks in the trunks. A key is provided with each cord circuit, which when operated provides through supervision on these connections.

(c) **Supervisory Features:**

**7.11** 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. Should the called party still have the receiver off the hook, the line equipment associated with the called line will function as in the case of a new call. 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. 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 dial "A" board or to a toll operator, in which 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. 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. If a direct dial call is made over a combination trunk, the busy lamp in the multiple of the trunk at the P B X manual switchboard lights.

**7.12** If a connection is established to the central office by the attendant, switchhook supervision is obtained on the station end of the cord circuit and ringing signals are received from the central office on the trunk end of the cord circuit. Since the 701-A P B X cord circuits are arranged for non-through supervision, the disconnect signal will not be received at the central office until the attendant disconnects.

**7.13** Incoming trunk calls to the 701-A P B X are indicated by the lighting of the lamp associated with the jack appearance of the trunk. The attendant answers the call with the trunk cord, establishes a connection to the station line via the station line jack and rings the station manually by operating the ringing key associated with the station end of the cord. The same type of supervision is obtained as on an outgoing call.

**7.14** All tie line circuits, except ringdown manual tie line circuits which are arranged for ringdown signaling and supervision, are arranged to provide automatic signaling and supervision and the station or attendant at one P B X can flash the attendant at the other P B X. Tie line connections that are established directly by dialing from one P B X to a station at another P B X are under the control of the calling station.

**8. DESCRIPTION OF APPARATUS:**

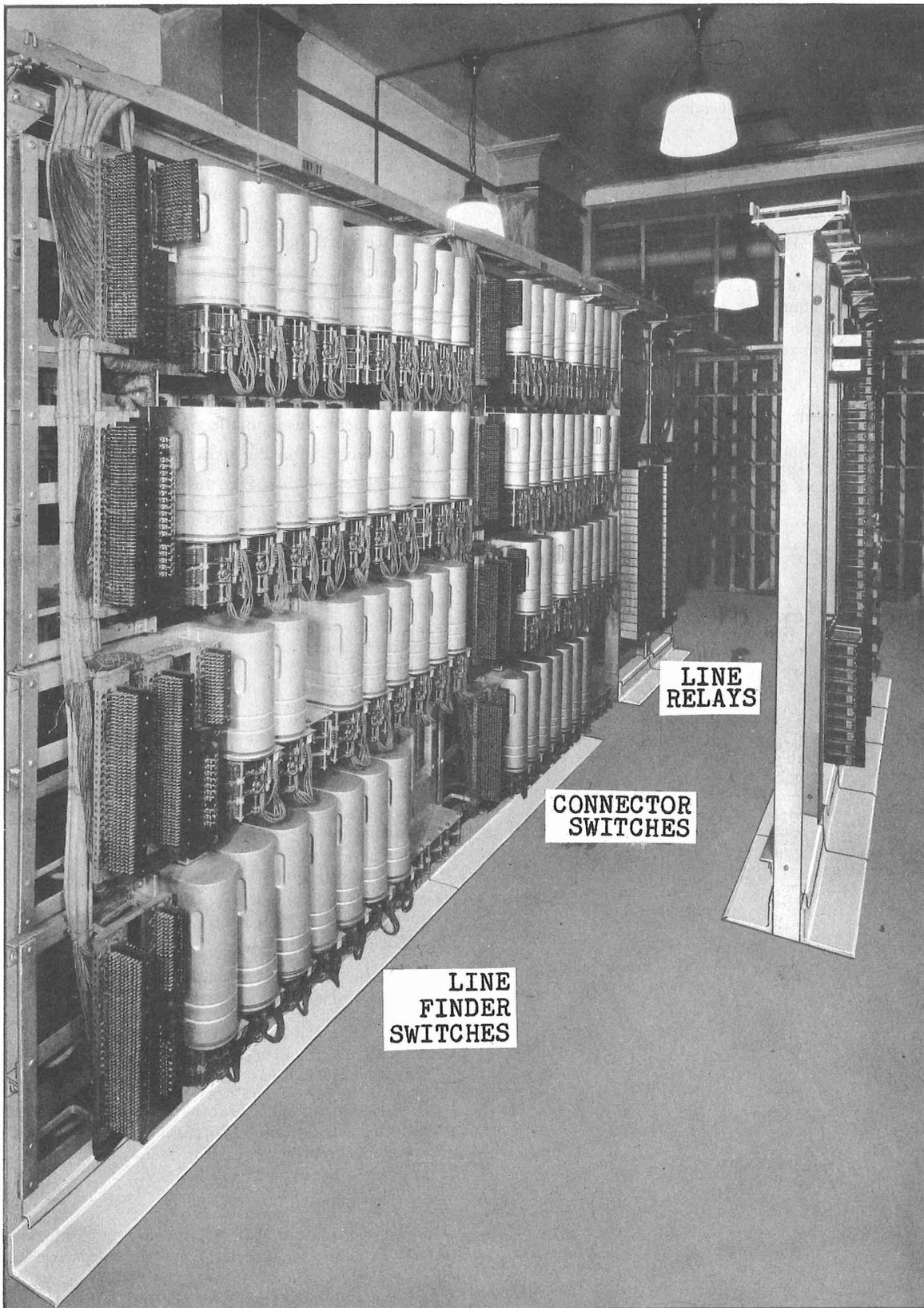
(a) **Dial Equipment:**

**8.1** Fig. 1 shows a general view of the dial equipment for the 701-A and 711-A P B X, the distributing frame being in the background.

**8.2** The frame is usually equipped with terminal strips on both sides, but where protectors are required on incoming cable pairs they can be mounted in place of the terminal strips on the vertical side.

**8.3** On small installations where protectors on incoming cable pairs are not required, 163-type terminal strips are mounted on the top on the rear of each bay of line relay rack to provide the necessary cross-connection facilities instead of a separate distributing frame.

**8.4** Fig. 1 shows the line finder and connector units. Line finder units are furnished in two sizes: a single-shelf unit mounting 9 line finders, and a double-shelf unit mounting 20 line finders. Each unit consists of a framework with the shelf cables, multiple banks and bank wiring with associated terminal strips and fuse and jack panels.



LINE  
FINDER  
SWITCHES

CONNECTOR  
SWITCHES

LINE  
RELAYS

Fig. 1.

8.5 Selector units are of the single shelf type. Selector-connector and connector units are of the single shelf or double shelf type. Selector, selector-connector and connector units are essentially the same as line finder units except that they have no jack panels, as only one terminal strip is required for the multiple bank.

8.6 The frame for mounting the line finder, selector, selector-connector and connector units is of the self-supporting, doubled-sided type. The frame is universal in that it will accommodate any combination of single or double-shelf switching units.

8.7 A switch designation card is provided on each selector, selector-connector and connector bearing the switch number, and a multiple designation card is provided on each selector shelf showing the termination of each trunk outgoing from the selector banks.

(b) **Manual Equipment:**

8.8 Fig. 2 shows a general view of a manual non-multiple switchboard for the 701A PBX and Fig. 3 shows a general view of a multiple switchboard for this PBX.

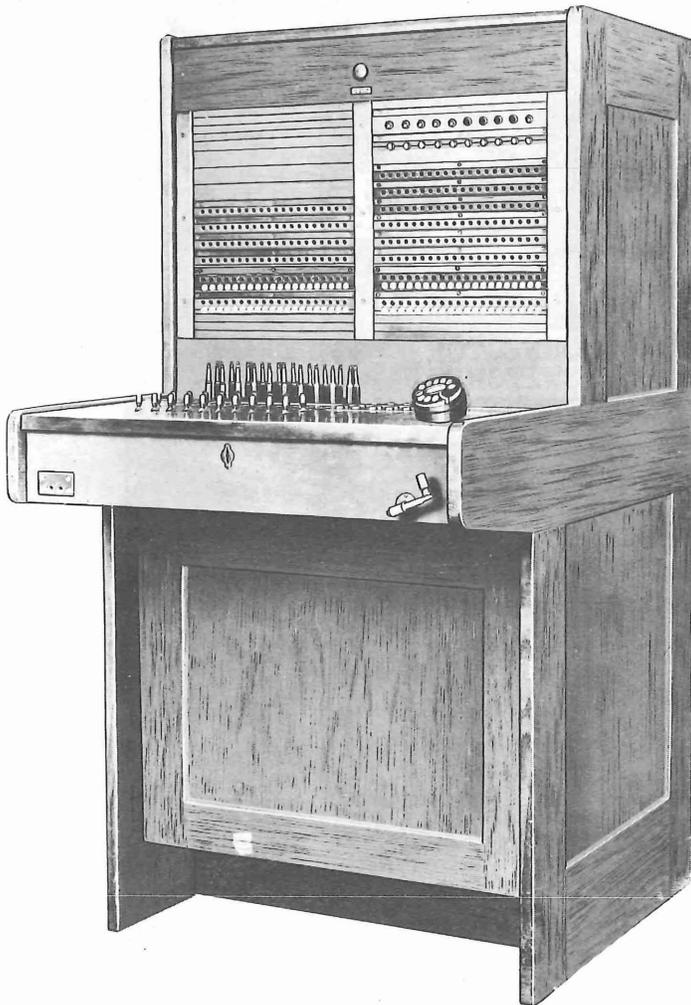


Fig. 2.

**9 MAINTENANCE EQUIPMENT:**

(a) **Alarm Circuits:**

9.1 The miscellaneous alarm circuit provides indications of the following irregularities:

1. Permanent short circuit of station line, ground on ring side of station line or receiver off hook.
2. Stuck release magnet on any switch.
3. Operation of any of the switch frame relay rack or switchboard fuses.
4. Failure of a line finder to find the calling station line (call blocked).
5. Ground on the line finder start lead or ground or short circuit on the chain circuit.
6. Failure of ringing current.
7. Discharge of the battery below 65 per cent. of capacity.
8. Blowing of fuses in the control circuit.
9. High voltage on the switching circuits.
10. Operation of discharge fuses.

9.2 Indications of irregularities are divided into "Class A" alarms (those requiring attention as soon as possible) and "Class B" alarms for minor irregularities. Class A alarms (for all irregularities except permanent signals) may operate an audible signal and a red lamp at the central office; Class B alarms (for permanent signals) may operate an audible signal and a white lamp at the central office. Both classes give an indication at the PBX by means of a vibrating bell and a red, white or green lamp, depending upon the type of irregularity.

(b) **Alarm Equipment Arrangements:**

9.3 The common alarm equipment is mounted on the miscellaneous relay rack, together with the test line, voltage regulation and ringing circuit equipment. This equipment consists of the dash-pot timing relays of the permanent signal, release magnet and call blocked alarms, a bell and keys (for the 711-A PBX only), fuse alarm protectors and the common alarm release. The equipment for alarms that is dependent on the layout of each particular installation is also mounted on the miscellaneous relay rack.

9.4 In the 701-A PBX, supervisory lamps and keys for the various alarm circuits are provided at the manual switchboard.

9.5 In both PBX's, lamps for the permanent signal, release magnet and call blocked alarms are provided on the miscellaneous relay rack as required.

9.6 A lamp annunciator cabinet is used for the larger installations. It contains pilot lamps in connection with the miscellaneous alarm circuit for indicating at a central point in the PBX the type of irregularity.

(c) **Test Lines:**

9.7 A test line is provided for use in conjunction with a test set in the routine testing of selector-connectors and connectors to test the busy, trip, pre-trip, ringing and talking conditions. The equipment for the test line is mounted on the common alarm unit. The circuit is wired to terminal No. 10 in each hundred of regular selector-connectors or connectors and terminals No. 19 and 10 in each hundred of hunting selector-connectors or connectors.

9.8 A test line used in conjunction with the same test set for testing line finders is also provided. This circuit is wired to terminal No. 10 in each hundred of the line finder multiple. As this terminal is arranged for test purposes and cannot be assigned to a station line, the line and cutoff relays are omitted in the line equipment unit.

**(d) Test Set:**

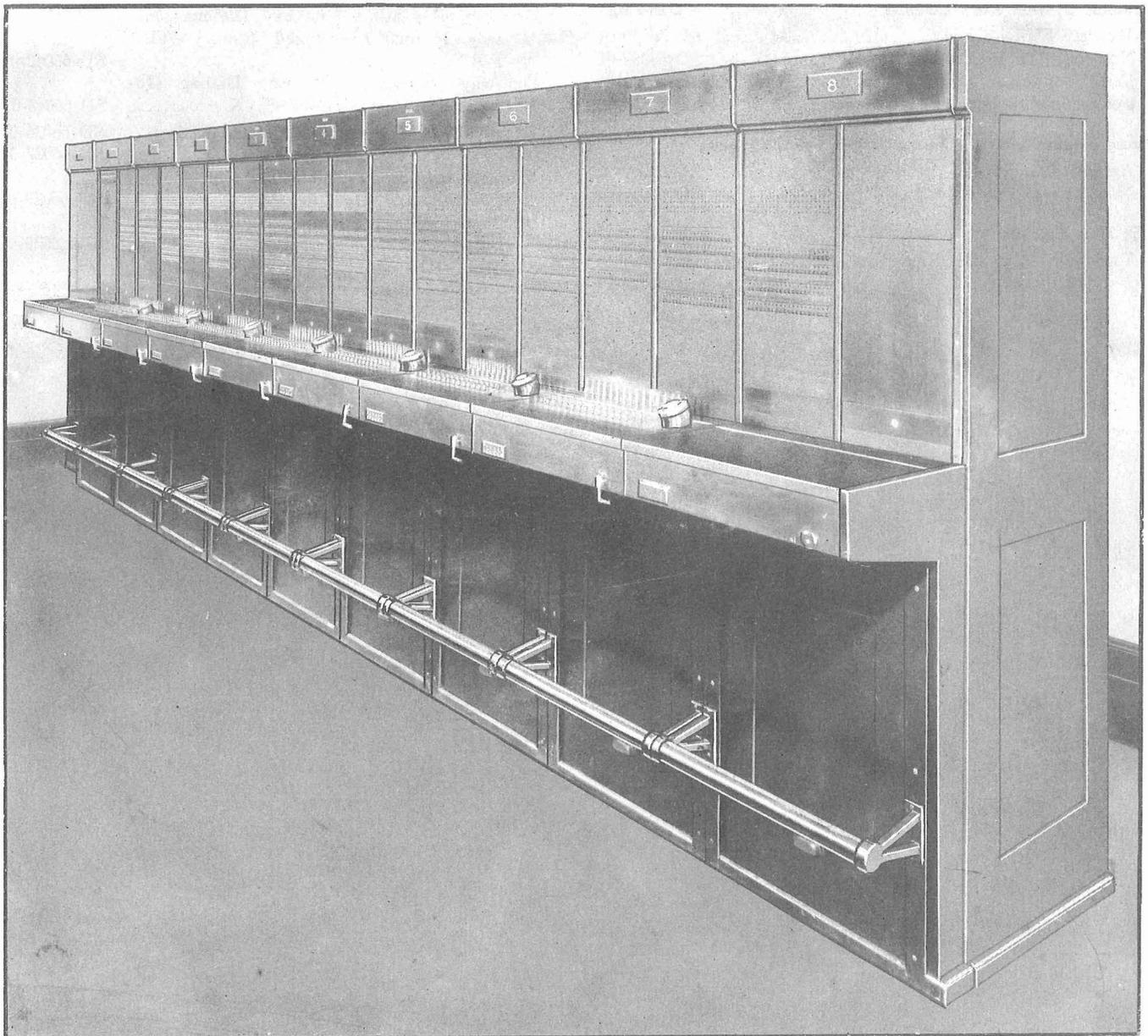
9.9 The test set for use in the testing of line finders, selectors, selector-connectors and connectors is mounted in a portable test box. A No. 35-C test set is used for current flow tests.

**10. CIRCUITS AND CIRCUIT DESCRIPTIONS:**

10.1 The following is a list of drawings pertaining to the 701-A and 711-A P B X's. Detailed circuit descriptions will be found in the associated CD sheets,

**Switching Circuits**

|   | <b>Circuit<br/>Drawing</b> |
|---|----------------------------|
| Line Finder Circuit (including Station Line,<br>Group and Subgroup Circuits)..... | SD-66138-011<br>012        |
| Selector-connector Circuit, Regular.....  | SD-66005-01                |
| Selector-connector Circuit, Rot. Hunt.....  | SD-66002-01                |
| First Selector Circuit—Local.....   | SD-66139-01                |
| First Selector Circuit—Incoming.....  | SD-66140-01                |
| Second Selector Circuit—Loc. or Inc.....  | SD-66010-01                |
| Connector Circuit—Regular.....  | SD-66143-01                |
| Connector Circuit—Rot. Hunt.....  | SD-66144-01                |
| Connector Circuit—Inc. Regular.....   | SD-66049-01                |
| Connector Circuit—Inc. Rot. Hunt.....   | SD-66050-01                |



**Fig. 3.**

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**Manual Switchboard Circuits**

Cord Circuit..... SD-66198-01  
 Attendant's Telephone and Dial Circuit..... SD-66129-01

**Trunk Circuits**

Attendant's Trunk Circuit..... SD-66035-01  
 Central Office Trunk Circuit—Multiple Switchboard ..... SD-66013-01  
 Central Office Trunk Circuit—Non-Multiple Switchboard ..... SD-66032-01  
 Central Office Trunk Circuit—One-way Direct Dialing—Two-way Attendant ..... SD-66052-01  
 Central Office Trunk Circuit—One-way Direct Dialing ..... SD-66051-01

**Manual Station Line Circuits**

Multiple Switchboard ..... SD-66020-01  
 Non-multiple Switchboard ..... SD-66082-01  
 With Connector Multiple ..... SD-66021-01  
 Convertible to Dial..... SD-66138-02

**Long Station Line or Central Office Trunk Circuits**

Arranged to Repeat Dial Pulses..... SD-66060-01  
 Not Arranged to Repeat Dial Pulses..... SD-66057-01

**Tie Line Circuits**

Two-way Manual Ringdown—Non-multiple Switchboard ..... SD-66024-01

Two-way Manual Ringdown—Multiple Switchboard ..... SD-66025-01  
 Two-way Manual, One or Two-way Dialing.. SD-66066-01  
 Two-way Repeating (Average Range) 701-A P B X ..... SD-66053-01  
 Two-way Repeating (Average Range) 711-A P B X ..... SD-66055-01  
 Two-way Repeating (Increased Range) 701-A P B X ..... SD-66054-01  
 Two-way Repeating (Increased Range) 711-A P B X ..... SD-66056-01  
 One-way Repeating, One-way Dialing, One-way Manual (Average Range) 701-A P B X ..... SD-66041-01  
 One-way Repeating, One-way Dialing (Average Range)—711-A P B X ..... SD-66044-01  
 One-way Repeating, One-way Dialing, One-way Manual (Increased Range)—701-A P B X ..... SD-66042-01  
 One-way Repeating, One-way Dialing (Increased Range)—711-A P B X ..... SD-66043-01  
 Terminating—Non-multiple Switchboard ..... SD-66026-01  
 Terminating—Multiple Switchboard ..... SD-66027-01  
 Through and Terminating—Non-multiple Switchboard ..... SD-66028-01  
 Through and Terminating—Multiple Switchboard ..... SD-66029-01