GENERAL DESCRIPTION
740C PBX

1. GENERAL:

1.1 This section describes the equipment, operation and maintenance features of the 740-C Private Branch Exchange for large residences in manual or dial system central office areas.

2. EQUIPMENT DESCRIPTION:

General:

2.1 The equipment for a 740-C P B X is arranged essentially in three main units consisting of the attendant's (receiving) cabinet, the switching equipment and the power plant. The attendant's (receiving) cabinet has been so designed that in appearance, it will harmonize with the surroundings of a large residence and is suitable for location on a table, in a niche in the wall or any other convenient place in a residence. Provision is made so that two of these cabinets can be furnished when desired, to provide for answering incoming trunk calls at either one or two locations, but both cabinets cannot be used at the same time. The switch frame equipment and power plant are so arranged that they can be conveniently located in a small room or any other suitable place in a residence.

Attendant's (Receiving) Cabinet:

2.2 The attendant's cabinet is semi-octagonal in shape as shown in Fig. 1, and is provided in two units. One unit consists of the shell or outer woodwork part of the cabinet. The other unit known as the tray consists of the woodwork base and back and a key and lamp panel in which is mounted the key and lamp apparatus, so that the shell of the cabinet can be easily removed to permit access to the apparatus for installation and maintenance purposes. The cabinet is provided with two finishes: one with woodwork finished in antique walnut and the key and lamp panel finished in old brass, and the other with the woodwork finished in mahogany and the key and lamp panel finished in statuary bronze.

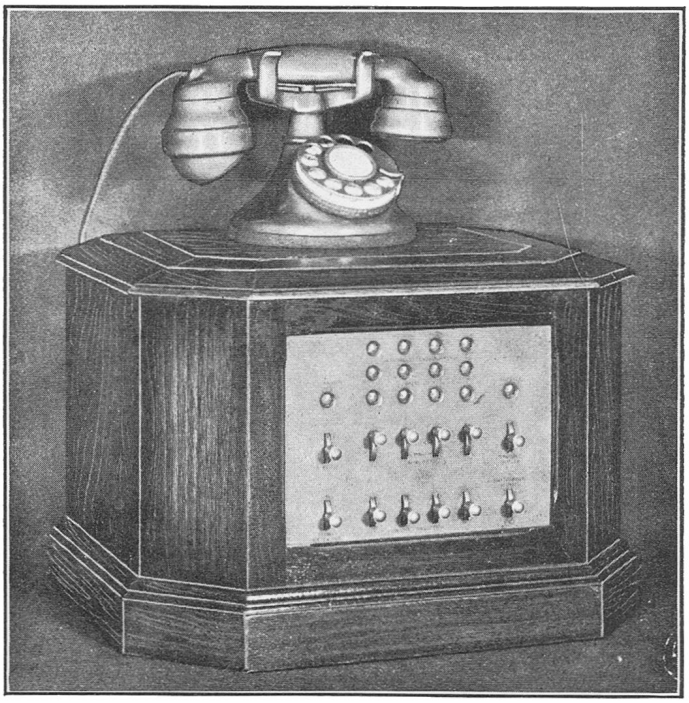

Fig. 1.

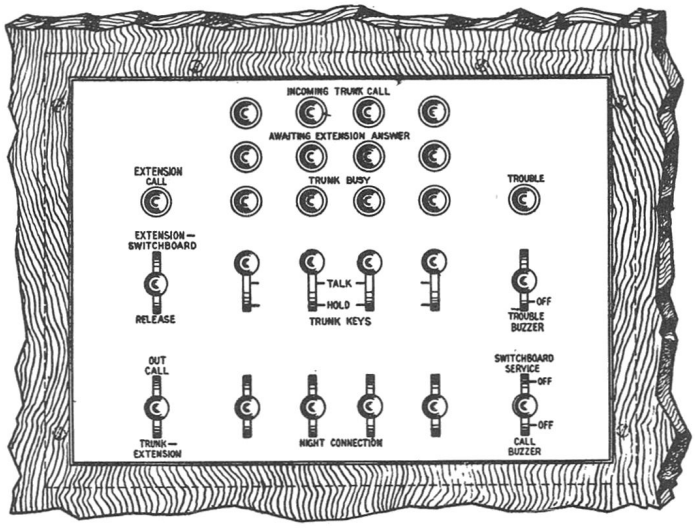

Fig. 2.

2.3 The key panel equipment is arranged as shown in Fig. 2, and consists of the necessary control keys and supervisory lamps. Each of the four central office trunks has associated with it three lamps and two keys. The three lamps are placed vertically; the uppermost is the INCOMING TRUNK CALL lamp; the middle one is the AWAITING EXTENSION ANSWER lamp and the lowest is the TRUNK BUSY lamp. These lamps are furnished with amber lamp caps when the face plate of the key and lamp panel is finished in old brass and with green lamp caps when the face plate is finished in statuary bronze. Under the lamps is a lever-type TRUNK KEY arranged for TALK and HOLD positions. The key is in the normal position when the key lever is perpendicular to the plane of the face of the cabinet. It is operated to the TALK position by partial downward movement and to the HOLD position by far downward movement. Under this key unit is another lever-type key which is used for night connections between station lines and central office trunks. These keys are designated NIGHT CONNECTION. On the left of the trunk keys is a common key unit with two keys, namely, EXTENSION SWITCHBOARD and RELEASE key and OUT CALL and TRUNK EXTENSION key. Directly above the common key unit is a lamp which is associated with the attendant's line which is designated EXTENSION CALL. On the right of the trunk keys is a key unit with two keys, namely, TROUBLE BUZZER, and SWITCHBOARD SERVICE and

CALL BUZZER keys. Above this key unit is a TROUBLE lamp. Inside the cabinet is mounted the necessary terminal strip for connecting the lamp and key equipments to the outside cable.

2.4 Two attendant's cabinets can be provided when desired. The cabinet which is in operation depends on the position of the SWITCHBOARD SERVICE key at the first cabinet. A similar key is provided in the second cabinet but serves only to "cut off" the battery supply to this cabinet in case the key at the first cabinet is operated and it is not desired to receive calls at either cabinet.

Switch Frame and Casing:

2.5 All the switching apparatus except that which is located in the attendant's cabinet is mounted on a double-sided frame. One side of the frame, called the line finder side as shown in Fig. 3, is arranged to mount seven line finders on one shelf; 43 line and cutoff relays and relays of the subgroup, group and alarm circuits and certain of the relays of the attendant's telephone and line circuit and trunk circuits on seven mounting plates, with the jack, key and lamp equipment of the line finder and the group and alarm circuits on a jack panel, a standard double row 46 capacity fuse panel and two 149-A terminal strips.

2.6 The other side of the frame, called the selector-connector side as shown in Fig. 4, mounts two shelves. The top shelf provides for one attendant's telephone and line circuit unit and four central office trunk circuit units and the bottom shelf is arranged to mount seven selector-connectors. A switch frame casing (finished with neutral green finish) as shown in Fig. 5 is provided to enclose the frame for appearance, protection and maintenance reasons.

Numbering Scheme:

2.7 All local calls are completed by two-digit operation. Each station is assigned an individual two-wire line with a call number corresponding to the number of the terminal in the selector-connector bank multiple to which the line is connected.

2.8 The selector-connector bank is arranged for forty lines and four central office trunks and the selector-connector is arranged to function on five levels. The fifth level is definitely assigned to central office trunks. The first to fourth levels inclusive are used for dial station, attendants and test lines. Vacant terminals of the selector-connector bank are made busy.

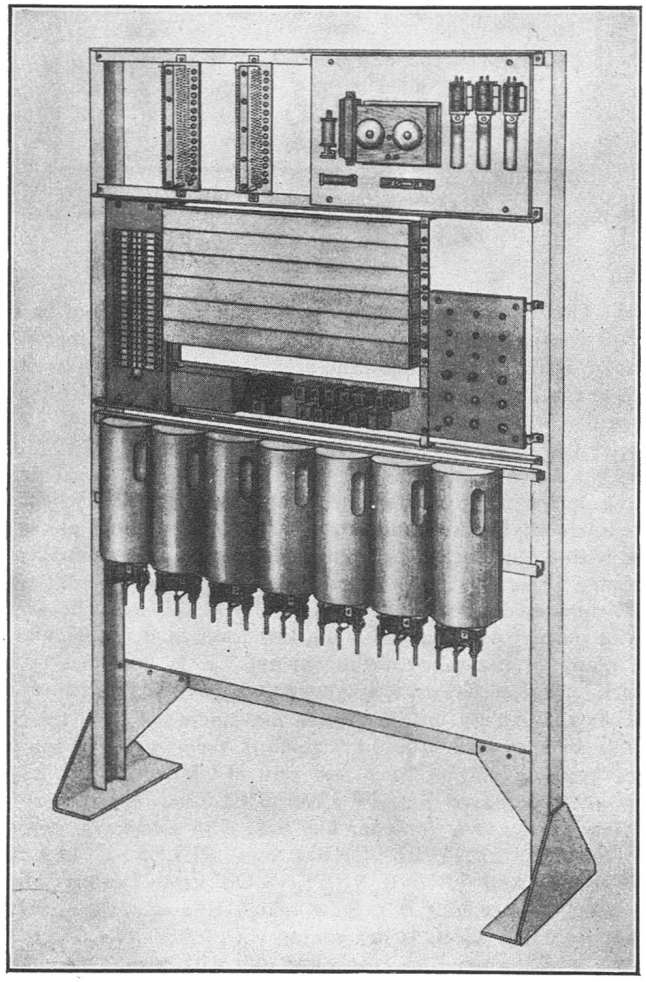

Fig. 3.

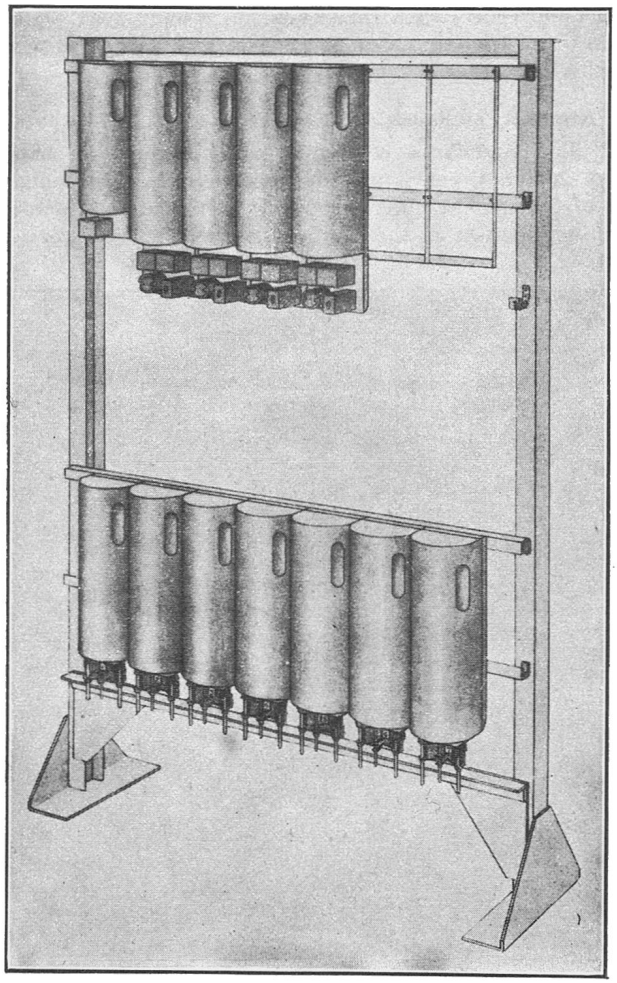

Fig. 4.

Restricted Service:

2.9 Any dial station can be restricted from outward direct dial central office service. This is accomplished by means of a fourth wire extended from the station line circuit through the intermediate circuits to the selector-connector so that when the trunk level is dialed by the restricted line (of which the RS terminals are strapped together and connected to ground) a busy indication is obtained.

Tones:

2.10 Dial tone and busy tone are provided to indicate that the equipment is in position to receive dial pulses and that a line or trunk is busy respectively. After a local connection has been established by the dialing of the necessary two digits, the called station bell is rung by machine ringing and ringing tone is furnished to the calling station.

Supervisory Features:

2.11 Local station-to-station connections are controlled by the calling party, and the replacement of the receiver on the hook at the calling station releases the connection.

2.12 Connections that are established over central office trunks to a dial system central office, where the called party is dialed directly, are controlled by the calling station so that when the receiver at the P B X station is hung up, the connection to the central office trunk at the P B X and at the central office is released. On calls made to a dial system "A" board, to a manual central office or to a toll operator, the connection is under joint control of the P B X station and the central office operator and the P B X station can flash the P.B.X. attendant and the central office operator. On calls that are dialed directly over a central office trunk as well as calls that are completed by the attendant, a lamp signal is lighted at the attendant's cabinet to indicate that the trunk is in use.

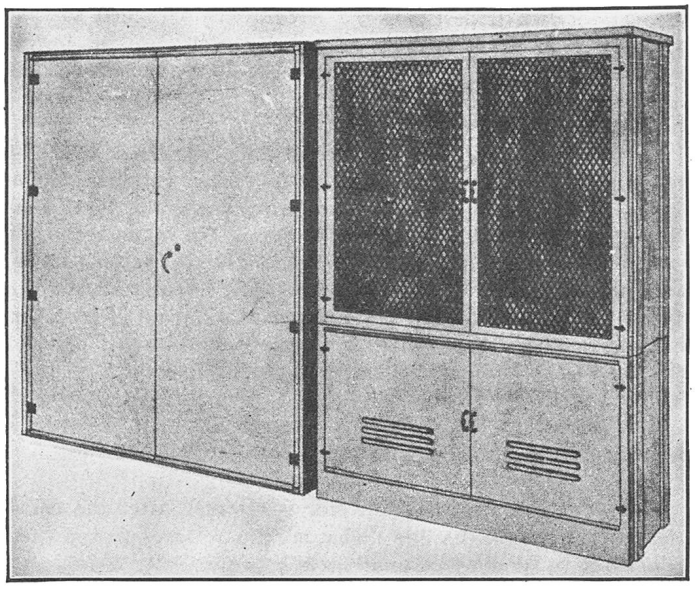

Fig. 5.

2.13 Incoming calls from the central office are indicated at the attendant's cabinet by a lamp signal and are there connected to the desired station by dialing. It is necessary for the attendant, however, to restore the keys associated with the call to normal in order to connect the central office trunk to the called station line. The keys associated with the trunk then become ineffective until a recall signal is obtained. A lamp signal is provided to indicate to the attendant when the call is answered by the station. The attendant receives a flashing lamp signal if the called station operates the receiver hook and can then connect to either the called station or the central office trunk by proper operation of the key equipment. In case the call is to be transferred, facilities are provided for releasing the first station line after which a connection may be established to the second station line. On an incoming central office call, if the called station is busy, the attendant has facilities for holding the central office trunk so that the cabinet may be operated to care for other calls.

Secrecy Features:

2.14 Complete secrecy is provided on all types of connections, on connections dialed directly to the central office and on connections established via the attendant between a central office trunk and a dial station line. Arrangements are provided, however, so that the attendant can be recalled but it is impossible to "bridge in" on a connection since the connection is "split" as soon as the keys are operated. The attendant can talk to the dial station by one key operation and to the central office by another key operation, but not to both at the same time.

Capacity:

2.15 The equipment is arranged for a maximum of four central office trunks. Since one selector-connector level is used for the central office trunks, four levels remain that can be used for 40 lines. One of these lines is assigned to the attendant and another is used for testing purposes so that the dial station line capacity is limited to a maximum of 38.

Vacant Terminals:

2.16 The sleeves of all unused station lines are busied by connecting them to the ground leads at the positions of the associated line relays. The sleeve leads of unused trunks are busied by contacts of the sleeve jack spring with the ground jack spring at vacant trunk unit positions.

Power Plant:

2.17 The power plant is arranged as shown in Fig. 6 and comprises a self-contained equipment consisting of a 23-cell storage battery, continuously operated generating equipment and voltage control equipment consisting of four counter e.m.f. cells controlled by voltmeter relay. This equipment is housed in a steel cabinet (which is finished with neutral green lacquer finish) as shown in Fig. 5. The generating equipment is arranged for operation from a.c. building power supply, a tungar rectifier being used. A flexible cord with plug is used to connect to the building power supply and a ground lead is run to a water pipe ground.

2.18 Ringing supply may be obtained from the central office over cable pairs or from a ringing machine furnished with the power equipment. Provision is also made for providing the interrupted dial and busy tones from the ringing machine when it is provided. When a ringing machine is not provided these tones are furnished by a relay circuit.

Station Equipment:

2.19 Each dial station line including the attendant's line is equipped with two wires. The station equipment for the dial station lines and the attendant's cabinet consists of standard dial station telephone sets as covered in Bell System Practices.

Terminal Equipment:

2.20 The station line and central office trunks are terminated in a terminal box placed at a convenient location (preferably near the switch frame) for the purpose of cross-connection to the P B X equipment.

2.21 A terminal assembly employing Western Electric type terminal strips is mounted in the switch frame for making connection between local frame and outside cables.

2.22 The attendant's cabinet is furnished with a terminal strip for connections between the key and lamp apparatus and outside cable.

Cabling and Power Wiring:

2.23 A lead covered cable is used to make the connections between the terminal box and the terminal strips provided in the switch frame. One or two lead covered cables are used to make the necessary connections between the terminal strip in the switch frame and the terminal strip in the attendant's cabinet. It is preferable to run these lead covered cables through the floor of the switch frame, but they can be run through the roof of the casing if desired.

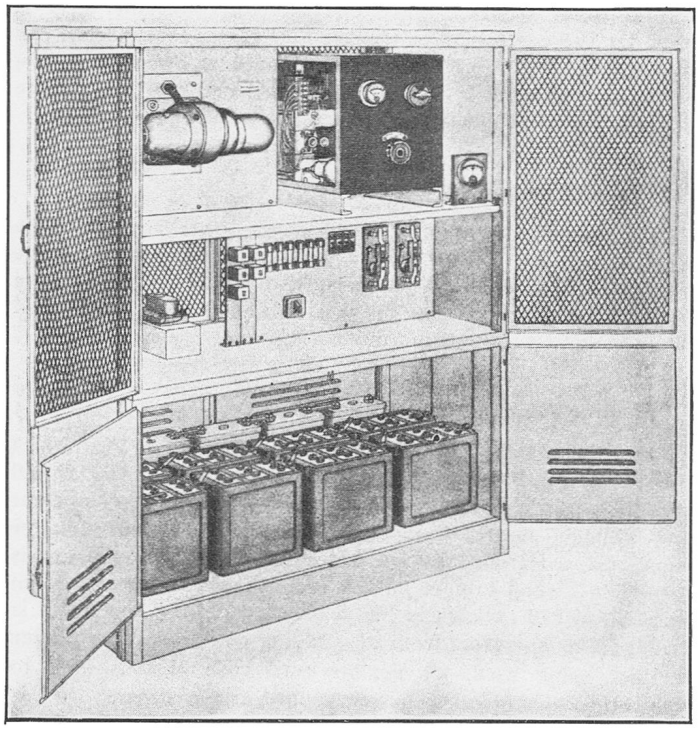

Fig. 6.

2.24 The power leads are run from the power equipment to the switch frame in conduit. The switch frame is grounded by extending the ground feeder lead to the ground lug on the frame.

3. OPERATING FEATURES:

General:

3.1 The circuits for the 740-C P B X are designed to operate on a voltage range of 44 to 50 volts.

Station Circuits:

3.2 The station sets for the dial stations and for the attendant's cabinet should be connected as indicated in the Bell System Practices. Each station line is limited to two ringing bridges. The allowable condenser capacity and the arrangement thereof are covered in the specifications.

Line, Line Finder and Associated Group Circuits:

3.3 The step-by-step line finders are used on all calls originating from dial station lines and on incoming calls from central office trunks that are dialed to dial station lines by the attendant.

3.4 These line finders are arranged to function with multiple banks having 50 sets of terminals to which are connected both central office trunks and station lines. A multiple slip is provided between the banks to shorten the time interval required for a line finder to connect to a line as well as to minimize the "stealing" of the line finder by a call originated subsequent to the call that started the line finder. A vertical commutator is provided with each line finder so that when a call is originated from a station line or central office trunk and attendant's line, the associated level can be indicated to a line finder. The wiring to this vertical commutator is also wired with a multiple slip. This arrangement places each subgroup of 10 lines and the central office trunks on different levels of the various line finders and the circuits are arranged so that the line finder used on any call is one requiring the fewest number of vertical steps to reach the level containing the station line.

3.5 When the receiver is removed from the hook at a dial station, the line circuit apparatus functions to start a line finder, to indicate on the vertical commutator the level containing the line, and to indicate the line in the set of terminals in the particular level. The line finder steps automatically, vertically to the particular level, and then horizontally to the calling line terminals. The line circuit and line finder then function to "cut through" to a selector-connector. Each set of terminals in the line finder bank provides for "tip," "ring," "sleeve," and "restricted service" leads. The "restricted service" lead is used to indicate to the selector-connector a line that is restricted from outgoing direct dial central office service.

3.6 When the selector-connector is released after the completion of the call, the line finder in turn releases and is then in position to function on another call.

Selector-Connector Circuit:

3.7 The selector-connector is directly connected to a line finder and is arranged to function from dial pulses to connect to station lines or central office trunks. Like the line finders, the selector-connectors are arranged to function with multiple banks having 50 sets of terminals. The switch operates over five levels; the fifth level being assigned to central office trunks, and the other four levels being assigned to station lines. On levels assigned to station lines, the circuit functions as a connector and on the level assigned to central office trunks, the circuit functions as a selector. No provision is made for hunting over a group of dial station lines.

3.8 When a line finder connects the calling line to the associated selector-connector, dial tone is furnished to the calling station. The first series of dial pulses steps the switch to the desired level. If this level is a connector level, it is necessary to dial another series of pulses to pick the called station line. If the called station line is busy, an audible busy signal is furnished to the calling station. If the called station line is idle, machine ringing current is applied and an audible ringing tone is furnished to the calling station. When the called station answers, the ringing is tripped and the circuit then functions to supply transmission battery to both the calling and called stations. If the level picked is the selector level, the switch functions after the first series of dial pulses to automatically hunt an idle central office trunk and to cut through, except in the case of a call to the central office from a restricted line, when the switch rotates to the 11th rotary step and busy tone is returned to the calling station. Busy tone is also returned to a non-restricted calling station if all central office trunks are busy.

3.9 When the calling station replaces the receiver or the central office trunk is released, the selector-connector is restored to normal.

Central Office Trunk Circuit:

3.10 The central office trunk circuit is arranged for one-way outward direct dial service from a dial station and two-way service via the attendant's cabinet. To provide this service, the trunk circuit is connected to a selector level of the selector-connectors and to lamp and key equipment in the attendant's cabinet. Each trunk circuit is in addition connected to a line finder terminal so that the attendant can complete connections to dial stations on incoming calls and calls outgoing to the central office made via the attendant.

3.11 An outward direct dial call is routed via a line finder to a selector-connector where a trunk is picked after the dialing of the trunk code. As soon as the trunk is seized a TRUNK BUSY lamp associated with the trunk at the attendant's cabinet lights. If the central office is manual, the central office operator is signaled directly; if the central office is dial, it is necessary for the station to dial the desired number after dial tone is heard. When a central office operator is reached the circuit is arranged for joint control, therefore, the station can flash the local central office or toll operator and the P B X attendant. The trunk circuit is released when the calling party hangs up, if the call is dialed directly to a dial system subscriber. When the call is made via a local central office operator or a toll operator, the connection is held until the calling station hangs up and the operator releases the cord circuit.

3.12 Outward calls made via the attendant are placed with the attendant over the attendant's line. After the details of the call are given to the attendant it is necessary for the station to hang up. The attendant can either place the call to the central office and then dial the station over the trunk or vice versa. The connection is made to the central office by operating a TRUNK KEY associated with the trunk to the TALK position and by operating a common key associated with the attendant's telephone and line circuit to the OUT CALL position. The connection is completed inward to the dial station in the same manner as described below for incoming central office calls. After the connection has been established, the keys at the attendant's cabinet previously operated to set up the connection are restored to normal and the circuits function as regards supervision and disconnect in the same manner as on an outward direct dial call.

3.13 An incoming call from the central office is indicated by the lighting of the INCOMING TRUNK CALL lamp associated with the trunk at the attendant's cabinet. As soon as the trunk is seized at the central office, the TRUNK BUSY lamp in the attendant's cabinet also lights. The call is answered by operation of the TRUNK KEY to the TALK position extinguishing the INCOMING TRUNK CALL lamp. After receiving the details of the call, the attendant completes the connection by the operation of a common key in the attendant's telephone and line circuit to the TRUNK EXTENSION position with the TRUNK KEY in the TALK position and by dialing the station number. When the common key is operated to the TRUNK EXTENSION position, the lamp associated with the trunk, designated AWAITING EXTENSION ANSWER lights. The attendant waits to determine whether the line is busy and if busy, a busy tone will be heard. If idle, a machine ringing tone will be heard to indicate that the station bells are being rung, and the attendant may release all keys. The AWAITING EXTENSION ANSWER lamp is extinguished when the station answers. It is necessary in any event for the attendant to restore the keys associated with the call to normal before the connection can be established. The connection is completed when the called station answers, after which the associated keys are ineffective unless the attendant is recalled. The connection is released after the connection at the central office has released and the dial station has hung up.

3.14 The attendant may be recalled on all incoming calls and on outgoing calls to a D.S. "A," local, manual or toll operator. The recall signal is indicated by flashing of the INCOMING TRUNK CALL lamp. The attendant can then connect to the trunk by the operation of the TRUNK KEY to the TALK position or to the dial station by operation of the TRUNK KEY to the TALK position and the common key to the TRUNK EXTENSION position. These key operations split the trunk so that the attendant cannot hear the conversation of both parties. If the call is to be transferred, the attendant releases the first station by the operation of a common RELEASE key with the TRUNK KEY in the TALK position; however, the TRUNK EXTENSION key should be in the normal position. The attendant can then establish a connection to another station line in the same manner as previously covered for an incoming call.

3.15 The RELEASE position of the common key in addition to being used to release a connection to the first station on the transfer of a call, is also used to release a station line to which an incoming central office call has been dialed but cannot be completed due to a busy or don't answer condition.

3.16 In order to provide for joint control of incoming calls and outward calls to a D.S. "A," local, manual or toll operator and to provide for immediate busying of the selector-connector multiple of the trunk circuit on incoming calls, it is necessary to provide a high-resistance bridge relay across the trunk circuit when in its normal position. With the use of this relay, it is necessary to signal the central office on the origination of a call, by ground from the P B X Therefore, the ground side of the line relay at the central office is opened.

Attendant's Telephone and Line Circuit:

3.17 The attendant's telephone and line circuit provides the necessary arrangements for establishing incoming and outgoing central office trunk connections in conjunction with a central office trunk. It also provides arrangements for the termination of a dial station line at the attendant's cabinet. A standard dial telephone set is used by the attendant which functions in conjunction with the lamp and key apparatus.

3.18 The dial station line provided for the attendant terminates at the cabinet in a standard subscriber's set and on the lamp and key. Calls from stations are indicated by the lamp designated EXTENSION CALL and are answered by a common key operated to the EXTENSION SWITCHBOARD position. Calls can be made to dial stations over this line by operation of the common key to the EXTENSION SWITCHBOARD position and by the dialing of the dial station code.

Tone, Ringing and Alarm Circuit:

3.19 The tone circuit functions to furnish dial tone to a selector-connector during the time interval between seizure of the selector-connector and the reception of the first series of pulses. The busy tone circuit functions during the interval between finding of a busy line or trunk by a selector-connector and the release of the selector-connector by the calling station or the attendant. The dial and busy tones are furnished from the ringing machine when one is provided. When a ringing machine is not provided dial tone is generated by a relay and busy tone is provided by means of a relay timing circuit which interrupts dial tone.

3.20 The ringing circuit is arranged to function with machine ringing furnished over a cable pair from the central office or when the distance to the central office is too great to economically furnish ringing current in this manner, to function with ringing current furnished from a local ringing machine. When the ringing current is furnished from the central office, a ring-up relay is bridged across the ringing mains, which operates during the ringing interval to close the ringing circuit to a selector-connector. The relay falls back during the silent interval to provide local tripping battery and ground. When ringing machine is provided, battery is superimposed on the alternating current for tripping purposes.

Note: The alarm circuit is described in paragraph 4.2.

4. MAINTENANCE FEATURES:

Alarm:

4.1 The alarm circuit provides visual and audible alarms to indicate the following conditions:

Permanent signal.
Call blocked.
Fuse operated.
Line finder start lead trouble.
Stuck release magnet.
Power trouble.

4.2 In the case of a trouble, the buzzer in the attendant's cabinet sounds and lamps on the frame and the TROUBLE lamp in the cabinet light. At the same time the P B X alarm at the central office operates.

Test Line:

4.3 A test line for use in the routine testing of selector-connectors is provided and the apparatus mounted on the switch frame. A selector-connector can be dialed to the test terminal and tested for ringing, pretripping, tripping and busy testing.

Test Set:

4.4 With the circuit arrangements in the test set, tests may be made of line finder and selector-connector operating features, particular line and restricted service features.

Test Key:

4.5 The line finder test key TST, located on the line finder test jack panel, is arranged to routine test the line finders or to start a line finder to hunt for the line connected to test jack "A."

5. CIRCUIT DESCRIPTIONS:

5.1 The following is a list of the circuit drawings applying to the No. 740-C P B X Detailed circuit descriptions will be found on the associated CD sheets.

Circuit	Drawing
Line, Line Finder and Group Circuits	SD-66126-011
	-012
	-013
Selector-Connector Circuit	SD-66142-011
	-012
Central Office Trunk Circuit	SD-66134-011
	-012
Attendant's Telephone and Line Circuit	SD-66136-01
Tone, Ringing and Alarm Circuits	SD-61135-01
Power	SD-80221-01
Test Line Circuit	SD-66128-01
Test Set Circuit	SD-66073-01