

GENERAL DESCRIPTION

605A PBX

1. GENERAL:

1.1 This section gives a general description of the No. 605-A private branch exchange and associated operating features.

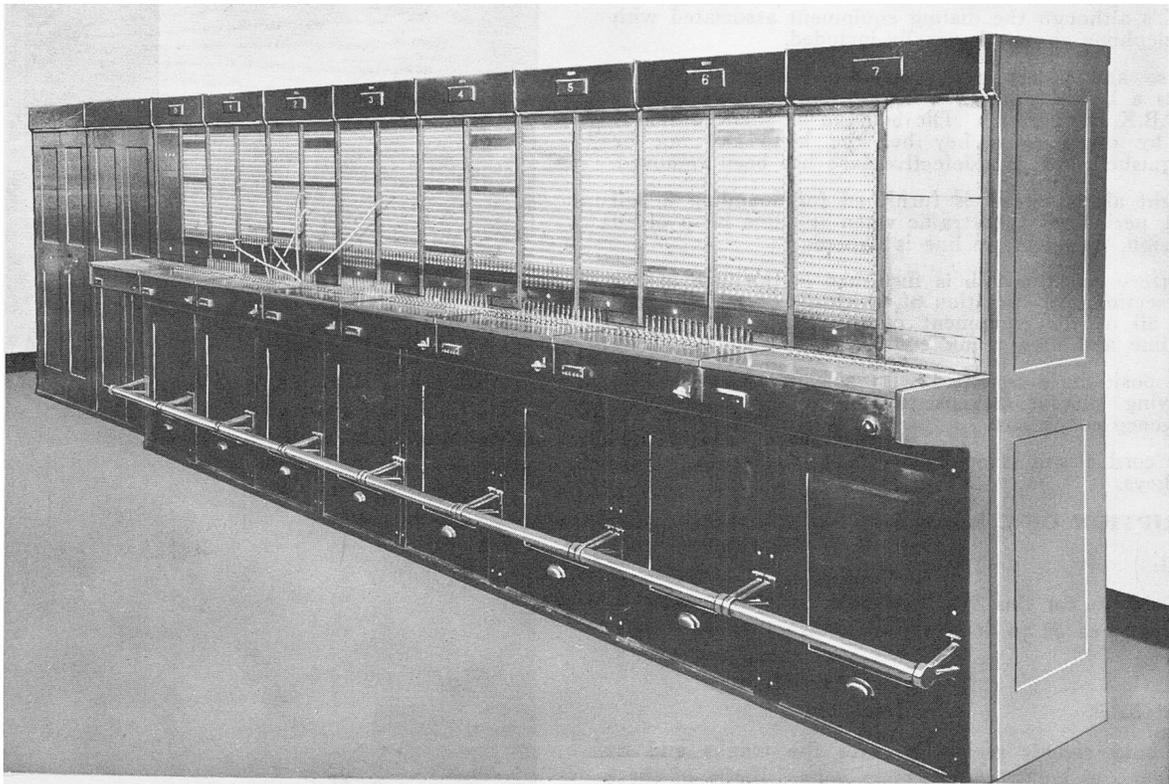
1.2 The No. 605-A private branch exchange is used as a manual multiple private branch exchange in either dial or manual central office districts, and also as the manual switchboard of the No. 701-A private branch exchange where multiple sections are required.

2. GENERAL DESCRIPTION:

2.1 The following photographs show a typical installation of the No. 605-A private branch exchange. The front of the switchboard, and a rear view with the doors removed are shown. In the front view photograph, positions 1 to 6 inclusive are regular sections, positions 0 and 7 are the head and foot sections respectively. An enclosed distributing frame is shown at the left of position 0. In addition to the units shown in the front view photograph, an installation may contain angle sections, a cable turning section, telautograph sections, a battery cabinet, one or more rectifiers or a motor generator set, an enclosed or an open relay rack and an open distributing frame instead of the enclosed distributing frame. The power plants and the open frame and rack are mounted on the floor separate from the switchboard line up.

2.2 Provision is made for multiple appearances of the line lamps, and lamps are employed for the busy signals on trunks and tie lines. Non-through supervision is obtained on inward calls and also on outward calls to both manual and dial central offices, except when the night and through dial key is operated. The cord circuit is arranged to feed battery independently to the front and rear cords, this feature, in conjunction with the higher operating voltage, permitting greater extension line ranges than are obtainable with the No. 600-C private branch exchange. Other improved arrangements include provision for trunk, tie line and long line equipment mounted on a circuit unit basis, increased trunk capacity, provision for an enclosed type relay rack adapted for lining up with the switchboard sections, and substantial economy in the cable pair conductors required for battery supply.

2.3 The sections of the No. 605-A P B X are of steel construction with the upper units separate from the lower units and are designed so as to facilitate installation and improve maintenance conditions by permitting equipment arrangements which are readily accessible.



Typical Front View.

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2.4 The principal features of the 605-A PBX are as follows:

- (a) The line lamps of the extensions are associated with the multiple jacks, separate answering jacks not being provided. These line lamps may be multiplied under certain conditions. Because of the use of multiple lamps, pilot lamps are not furnished.
- (b) The busy signals for the trunks and tie lines are 6-volt tungsten lamps connected in groups of eight lamps in series or in groups of less than eight lamps in series with resistance.
- (c) Only one type of cord circuit is provided, there being no provision for toll cords. Toll grade of transmission on the long tie lines is obtained from the tie line circuits.
- (d) The cord circuit is arranged for double supervision, that is, it provides supervision from each extension independently on an extension-to-extension connection.
- (e) Non-through supervision from an extension to a central office trunk is obtained on both incoming and outgoing calls except when the night and through dial key in the cord circuit is operated.
- (f) On trunk connections the battery for the station transmitter is obtained from the trunk circuit except where long line circuits are furnished.
- (g) On extension-to-extension connections, the cord circuit is of the series condenser bridged impedance type, there being a condenser in series with each of the talking leads and an impedance with battery and ground connected in its middle, bridged across the talking leads on each side of these condensers.
- (h) The sections are arranged for operation with dial system central offices, and may also be operated with manual central offices, but in manual central office areas the dials are generally omitted from the keyshelves of the P.B.X.'s although the dialing equipment associated with the telephone circuits is usually included.
- (i) A fuse and power alarm circuit is furnished which sounds a bell and lights a lamp whenever any fuse at the P.B.X. is operated. The bell can be silenced at any time by operating a key but the lamp can not be extinguished until the defective fuse has been removed.
- (j) A night alarm circuit is furnished for sounding a bell during periods of light traffic when any line lamp of an extension, trunk, or tie line is lighted.
- (k) A battery cutoff switch is furnished in the face of the head section, the operation of which disconnects battery from all of the equipment of the PBX except the long line and long trunk equipment.
- (l) Each position is equipped with a hand generator for supplying ringing current to the cord circuits under emergency conditions.
- (m) Each cord circuit is equipped with two, two-way lever type keys.

3. DESCRIPTION OF CIRCUITS:

General:

3.1 The circuits for this PBX are designed to operate on a voltage range of 32 to 46 volts, which is obtained from a local battery.

Busy Signals:

3.2 The busy signals associated with the trunks and tie lines are tungsten lamps rated at six volts. Eight of these lamps are connected in series except where less than eight appearances of the busy signal are required in which case a

resistance is substituted in the circuit for each lamp less than eight. With eight lamps in series across 32 to 46 volts, each lamp receives less than its rated voltage but this produces sufficient illumination for busy signals.

Line Lamps:

3.3 The line lamps for the station lines, trunks and tie lines are of the carbon type rated at 40 volts.

Line Circuits:

3.4 **Line Circuits for Regular Station Lines:** The regular station line circuit is furnished for all lines except those to order turrets and 523-type subscriber sets. It contains cutoff jacks and provision for a line relay for long extensions, and for multiple line lamps, although under certain conditions, two lamps may be used without line relays. No panel pilot lamps are provided. The battery for the lamps is obtained through a relay, the operation of which sounds the night alarm bell when the night alarm key is properly operated. There is one night alarm relay for each group of 60 lines.



Typical Rear Equipment.

3.5 Line Circuits for 523-B Subscriber Set: Lines equipped with 523-B subscriber sets require a line circuit somewhat different from that for the regular station line. The busy test feature is obtained by extending the sleeve of the line circuit to the 523-B subscriber set over a third wire to which ground is connected at the subscriber set by the operation of a key. The denied service feature used in telephone company commercial offices is obtained by providing two groups of multiple jacks for each line, one group with the tip and ring normal, and a second group with the tip and ring reversed.

3.6 Line Circuit for 523-C Subscriber Set: The line circuit for the 523-C subscriber set is the same as that for the 523-B subscriber set except that the additional multiple having the tip and ring reversed is omitted. It consists of a regular station line circuit with the sleeve lead extended over a third wire to the 523-C subscriber set to which ground is connected by the operation of a key.

3.7 Line Circuit for No. 1 Order Turret: The circuit for lines to No. 1 order turrets is like the regular station line circuit except that the sleeve lead is extended to the order turret over a third wire to which ground is connected when the busy key at the order turret is operated.

3.8 Line Circuit for No. 2 Order Turret: At No. 2 order turrets, no facilities are provided for making the lines test busy at the P B X when the turret is unattended, and no special line circuit is provided for this case. For lines to the No. 2 order turret, the regular station line circuit is furnished.

3.9 Line Circuit for No. 605-A P B X to be Converted to No. 701-A P B X: Where it is known that the No. 605-A P.B.X. will be replaced at some future time by a No. 701-A, a manual station line circuit which is different from the regular station line circuit is provided for the No. 605-A P B X. This circuit is the same as the dial station line circuit of the No. 701-A P B X except for a minor change in the wiring at the line relay and for the addition of the lamps in the subscriber's multiple of the manual positions. The line finder sleeve lead serves as a lamp lead while the circuit operates as a part of the No. 605-A P B X. When the conversion to the No. 701-A P B X is made, the line circuits are restored to normal.

Cord Circuit:

3.10 The cord circuit for the No. 605-A P B X is arranged for non-through supervision on both incoming and outgoing calls. On extension-to-extension connections, supervision is obtained independently from both extensions, and on extension-to-trunk connection the supervision from the extension is obtained on the rear cord lamp and rering supervision from toll operators is obtained on the front cord lamp. The rear cord is for extensions and the front cord for trunks or extensions. Either cord may be connected with tie lines but the front cord should be connected with the terminating tie line circuits to obtain the toll grade of battery supply for extension transmitters.

3.11 On an extension-to-extension connection the cord circuit is of the series condenser bridged impedance type. It contains condensers in series with the tip and ring leads, two windings of a retardation coil for supplying battery and ground to the rear cord and two windings on an H-type relay for supplying battery and ground to the front cord. In series with the talking leads between the bridging points of the retardation coil and the rear cord is a supervisory relay having

two pairs of windings each pair consisting of an inductive winding shunted by a non-inductive winding. One pair of windings is in series with the tip lead and the other is in series with the ring lead.

3.12 On an extension-to-trunk call, the condensers in series with the talking leads are removed from the circuit and the transmitter battery for the station is received from the trunk. Under this condition, the rear cord supervisory relay, having two pairs of inductive and non-inductive windings, is in series with the talking leads. When the front cord is connected with a trunk and the rear cord is free or connected with a station at which the receiver is on the hook, a winding of a retardation coil is connected across the talking leads of the cord circuit between the front cord and the supervisory relay, and when the station receiver is removed from the hook a non-inductive resistance is connected in series with the winding of the retardation coil, so that the major portion of the current from the trunk circuit will pass through the station transmitter. When the station receiver is restored to the hook, the resistance is short-circuited. A ringup relay in series with a condenser is connected across the talking leads of the cord circuit for the purpose of providing a rering signal from toll operators. When ringing current is applied to a trunk to which a cord circuit is connected, the cord circuit ringup relay operates and lights the front cord lamp and this lamp is extinguished when the ringing ceases.

3.13 When the talk and dial key is operated, the tip and ring leads of the cord circuit are opened at points between the front cord and front supervisory relay or retardation coil but the talking circuit is maintained through the telephone set. In addition to connecting the T and R leads of the cord circuit to the telephone and dialing circuit, the operation of the talk and dial key closes the battery circuit of the attendant's transmitter and closes the attendant's receiver circuit in a sequence which prevents clicks. The receiver is wired through a contact on each talking key which closes after all other contacts when the key is operated, and opens before any other contacts are opened when the key is released, and thus the receiver circuit is opened before the electrical disturbances are originated which could produce clicks. The principal source of such disturbances is the retardation coil which is connected between the T and R leads of the telephone circuit. This retardation coil is provided to hold the central office connection after dialing and also to establish a current drain in the cord circuit to produce a potential other than ground on the tip of the cords so that busy tests can be heard. By having a potential on the tip of the cord between that of ground and battery a click is heard whenever the tip is touched to the sleeve of a line having either battery or ground connected to it. Lines and trunks which are not busy have their sleeve circuits open and free from either battery or ground.

3.14 In order that busy tests may be made with either the front or rear cord, a third cord circuit condition is provided. The first two conditions are those described above which are obtained (1) on extension-to-extension connections and (2) on trunk-to-extension connections. The third condition is obtained when both cords are free or when the front cord is connected with an extension and the rear cord is free. Under these conditions, the series condensers are out of the circuit and battery and ground are connected through the windings of the front cord supervisory relay to the tip and ring con-

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ductors of both front and rear cords. When the talk and dial key is operated a current flow is established through the windings of this supervisory relay and through the retardation coil in the telephone set and if there is not a station with the receiver off the hook connected with the front cord, a potential of about 8 to 13 volts, depending upon the battery voltage, will be established on the tips of the front and rear cords. If a station with the receiver off the hook is connected with the front cord, the potential on the tip of the rear cord will be greater because of the greater current flow through the tip winding of the supervisory relay.

3.15 A night and through dial key is provided in each cord circuit, the operation of which eliminates the series condensers and the bridged supervisory relay or retardation coil and which connects the talking leads from the front cord to the rear cord through rear cord series supervisory relay. The ringup relay in series with its condenser remains connected across the talking lead. The talk and dial key is ineffective when the night and through dial key is operated.

3.16 Where relays are connected to the sleeves of cord circuits, it has been found advisable to shunt the inductive windings of the relays with non-inductive resistances for the purpose of preventing a high instantaneous voltage on the sleeve when the plug is removed from the jack. The furnishing of the non-inductive shunt would ordinarily increase the current drain but to avoid this in the No. 605-A cord circuit, a condenser is provided in series with the non-inductive shunts around the windings of the sleeve relays.

Telephone and Dialing Circuit:

3.17 The telephone and dialing circuit for the No. 605-A P B X provides the same fundamental features as have been furnished in other P B X telephone and dialing circuits.

3.18 A dial and associated relay equipment are included in this circuit for use when the P B X is connected with a dial central office. When the P B X is connected with a manual office, this equipment is not used, but the relay equipment is usually furnished.

3.19 The relays in the dialing circuit are needed to prevent clicks to the attendant and to the calling station while dial pulses are being transmitted, and to permit the retardation coil in the telephone set to be connected across the circuit, after each train of dial pulses, without establishing false additional pulses. When the dial is pulled off normal, the retardation coil is short-circuited, the lead to the induction coil is opened, the receiver is short-circuited, the talking leads of the front cord are disconnected from those of the rear cord and battery and ground are connected through a double wound relay in the telephone set to the rear cord. This relay remains connected to the rear cord after the dial has been pulled off normal until the talk and dial key is restored. While this relay is operated and with the dial normal, the talking leads of the front cord are connected to those of the rear cord through condensers but while the dial is off normal these leads are open. After a train of dial pulses has been transmitted, the circuit through the retardation coil is established in two steps; first, the short circuit is removed from the coil leaving non-inductive resistance shunted around it and then after a fraction of a second the shunt is removed. This series of events is furnished so that the current through the pulsing relay at the central office will not decrease sufficiently to allow it to release while the current is building up in the retardation coil.

3.20 To decrease the current drain through the attendant's transmitter, the circuit to this transmitter is closed only while a cord circuit talk and dial key is operated.

Trunk Circuits:

3.21 **Regular Central Office Trunk Circuit:** The regular central office trunk circuit for the No. 605-A P B X has four features which distinguish it from the central office trunk circuit of the No. 600-C P B X

- (a) Machine ringing from the central office is tripped by a momentary 100-ohm bridge in the trunk circuit which is connected across the talking leads when the incoming call is answered.
- (b) The ringup relay is of the pendulum J-type which has proved to be successful for reducing false trunk lamp signals when electrical surges are established on the trunk by the disconnecting of the central office or P B X equipment.
- (c) The busy signals consist of 6-volt tungsten lamps. Eight of these lamps are wired in series except where less than eight lamp sockets are available in which case resistance is substituted in the circuit for each lamp less than eight.
- (d) Night jacks in addition to the regular answering jacks are provided for establishing night connections.

3.22 **Miscellaneous Trunk Circuits:** The following types of miscellaneous trunk circuits may be employed with the No. 605-A P B X

- (a) Trunk Circuit in Multiple with No. 2 Order Turret.
- (b) Manual Long Line and Long Trunk Circuit located either at the P B X or at the Central Office.
- (c) Long Line and Long Trunk Circuit located either at the P.B.X. or at the Central Office and arranged to repeat dial pulses.

3.23 **Tie Line Circuits:** Five different types of tie line circuits are provided for the No. 605-A P B X Three of these are arranged for ringdown signaling and two for automatic signaling. Of the circuits with ringdown signaling, one is for short tie lines where transmission conditions are not severe, and the other two are for long tie lines with which it is considered necessary to furnish toll grade of battery supply for the transmitters of the P B X stations. Of the two ringdown tie line circuits with toll grade of battery supply, one is for tie lines which will not be connected with other tie lines and the other is for lines with which either through or terminating connections may be established. The latter tie line is equipped with a second jack, the use of which eliminates the repeating coil in the tie line circuit to improve transmission on through connections.

Fuse and Power Alarm Circuit:

3.24 All fuses of the 605-A P B X are associated with the alarm circuit so that when any fuse is operated an audible signal and a visual signal are given. A key is provided which will silence the audible signal, but the visual signal cannot be extinguished until the defective fuse has been removed. This key is of the turn-button type and is located in the head section near the battery cutoff key. An individual lamp is provided for each bus-bar associated with the P B X and consequently, the location of a defective fuse can be ascertained without removing the rear doors of the sections. In addition to this one lamp is provided for the fuses associated with the power charging circuit and another lamp is provided

for the ampere-hour meter circuit if such a circuit is installed. These lamps are located in one of the panels of the head section, and associated with the lamps is a designation strip for indicating the bus-bars with which they are associated.

Night Alarm Circuit:

3.25 A circuit is furnished with the No. 605-A P B X for sounding a bell or a buzzer while any line lamp of a station line, trunk or tie line is lighted. A key is furnished for silencing the bell in periods when the traffic is such that the bell would be ringing most of the time. This bell is sounded by the operation of a night alarm relay in series with the line lamps of the different circuits. For station lines, battery is connected through the night alarm relays and for trunks and tie lines, ground is connected through the night alarm relays. The night alarm key is of the same type as the fuse alarm key and is located adjacent to the latter key in the face of the head section.

Ringling Lead Circuit:

3.26 One pair of cable conductors from the central office generator and ground is provided for each group of 10 P B X positions or less. A resistance lamp is provided in the central office in series with the generator lead. A lamp is also provided at each P B X position. A hand generator is furnished in each P B X position so that service can be maintained under emergency conditions if trouble should develop on the generator leads from the central office. The hand generator is connected with the cord circuits by operating a turn button key which is located in the keyshelf to the left of the cord circuit keys. No provision is made for associating the hand generator with any circuits except the cord circuits.

3.27 Ringing current for tie line circuits and alarm circuits is obtained from the regular central office feeders supplying the P B X. A resistance lamp is furnished in the generator lead to both the fuse alarm circuit and the night alarm circuit.

Position Grouping Circuit:

3.28 A position grouping circuit is available for the purpose of connecting all the cord circuits on two positions to the telephone set of one of the positions. The circuit contains a key located to the left of the cord circuit keys in line with the front row of these keys and in front of the turn button key associated with the hand generator. The operation of the grouping key disconnects the telephone set from the cord circuits of the position containing this key and groups these cord circuits to those of an adjacent position. Thus, an operator can talk and dial on the cords on the position of the grouping key by connecting her telephone set with an adjacent position. This adjacent position may be located either at the right or at the left of the grouped position.

4. POWER PLANTS:

4.1 Ordinarily the storage battery for the No. 605-A switchboard will be charged over cable pairs from the central office 48 volt battery. The power equipment will usually consist of a cabinet, together with the necessary control equipment and an enclosed type battery.

4.2 A locally charged power plant may be used where charging over cable pairs is not feasible or economical. This plant

is arranged for continuous operation of the charging equipment. The charging equipment consists of either one or two Tungar rectifiers for a-c commercial service or a motor-generator set for d-c service. The same type of battery is used as for the cable pair charged power plant.

4.3 In addition, a larger capacity locally charged power plant may be used in cases where exceptionally large boards are installed. This plant is arranged for automatic operation with ampere-hour meter control. Tungar rectifiers are employed for a-c. service and motor-generator sets for d-c. service.

5. CIRCUIT DESCRIPTIONS:

5.1 The following is a list of the circuits pertaining to the No. 605-A P B X. Detailed circuit descriptions will be found in the associated CD sheets.

Line Circuits

Regular Station Line Circuit.....	SD-66020-01
Line Circuit for 523-Type Subscriber Sets.....	SD-66077-01
Line Circuit for No. 1 Order Turret.....	SD-66076-01
Line Circuit for 605-A P B X to be Converted to 701-A P B X	SD-66138-02

Cord Circuit	SD-66198-01
Telephone and Dialing Circuits	SD-66129-01

Trunk Circuits

Regular Central Office Trunk Circuit.....	SD-66013-01
Trunk Circuit at P B X 605-A in Multiple with No. 2 Order Turret.....	SD-66076-01

Long Line and Long Trunk Circuits

Manual Long Line and Long Trunk Circuit Located at P B X	SD-66057-01
Manual Long Line and Long Trunk Circuit Located at Central Office 20-28 Volt Bat- tery Supply	SD-66058-01
Manual Long Line and Long Trunk Circuit Located at Central Office 31-43 or 40-56- Volt Battery Supply.....	SD-66059-01
Long Line and Long Trunk Circuit Arranged to Repeat Dial Pulses Located at P B X	SD-66060-01
Long Line and Long Trunk Circuit Arranged to repeat Dial Pulses Located at Cen- tral Office	SD-66061-01

Tie Line Circuits

Two-Way Manual Ringdown Tie Line Circuit	SD-66025-01
Two-Way Manual Automatic or One-Way Dialing, Two-Way Manual Tie Line Circuit	SD-66065-01
One-Way Repeating, One-Way Dialing, One- Way Manual Tie Line Circuit.....	SD-66040-01
Terminating Tie Line Circuit.....	SD-66027-01
Through and Terminating Tie Line Circuit...	SD-66029-01

Miscellaneous Circuits

Battery Cutoff Circuit.....	SD-66036-01
Fuse and Power Alarm Circuit.....	SD-66019-01
Night Alarm Circuit.....	SD-66018-01
Ringling Leads Circuit.....	SD-66016-01
Position Grouping Circuit.....	SD-66273-01