

STROMBERG-CARLSON TELEPHONE MFG. CO.

**ROCHESTER, N.Y. CHICAGO, ILL.
KANSAS CITY, MO. TORONTO, ONT.**

BULLETIN NO. 1021

DECEMBER, 1918

Private Branch Exchange Switchboards



Standardized P. B. X. Switchboards

The manufacture of private branch exchange switchboards in the past has been handled in much the same way as the manufacture of large city exchange equipments in that each switchboard was designed, engineered and built to order. This not only increased the manufacturing cost of the finished product but also involved a delay in the delivery of the apparatus from three to eight weeks; the exact time depending upon the nature of the special features required by the purchaser and the number of orders having precedence in the factory.

A study of the specifications covering thousands of private branch exchange switchboards manufactured by us showed that the large majority of the orders could have been filled satisfactorily with one or two standard switchboards. In other words there was no great difference in the nature of the services to which these switchboards were to be put and that practically all of the local conditions could have been met with a standard type of equipment in one or two sizes of cabinet woodwork.

As a result of the convictions created by our study we have developed two standard private branch exchange switchboards which are manufactured and carried in stock in quantities ready for immediate delivery upon receipt of a customer's order. These switchboards, as a careful reading of this bulletin will show, have a greater capacity for equipment than previous types of the same size; utmost certainty and ease of operation; reliable circuits and apparatus, and a much greater flexibility of equipment to meet local service conditions.

These two standard switchboards are fully wired for ultimate equipment capacities as indicated in the following:

Stock Switchboards

No. 101 50 Line switchboard containing wiring for 50 local line equipments, 8 pairs of connecting cords and 5 trunk line equipments. See page 3.

No. 102 100 Line switchboard containing wiring for 100 local line equipments, 10 pairs of connecting cords and 7 trunk line equipments. See Page 5.

As all of the circuits and apparatus employed in our standard boards are designed for highest operating and transmission efficiency, we urge their purchase without modification. The equipment represents the highest development in switchboard engineering and the results of our 25 years of telephone and switchboard making experience are evident in every structural detail.

Stromberg-Carlson Telephone Manufacturing Co.

Rochester, N. Y.

Chicago, Ill.

Kansas City, Mo.

Toronto, Ont.

Southern Distributors—Scoville Mercantile Co., Atlanta, Ga.

Pacific Coast Distributors—Garnett Young and Company, San Francisco and Los Angeles, Cal., Portland, Ore., Seattle, Wash.

Standard 50 Line P. B. X. Switchboard No. 101 Type



Fig. 1—No. 101 P. B. X. Switchboard

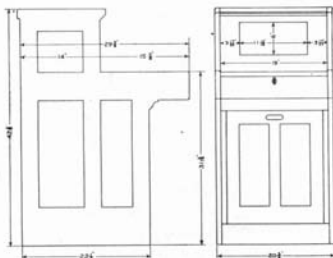
Equipment capacity considered, this private branch exchange switchboard is the smallest and most compact apparatus of its kind, yet its small size has not been gained through sacrifice of utility or accessibility. Because it occupies only $3\frac{1}{4}$ square feet of floor space it is particularly well suited to the needs of modern business offices where economy of space is most essential.

The cabinet of the No. 101 P. B. X. Switchboard stands $42\frac{3}{4}$ inches high and its extreme width is $20\frac{3}{4}$ inches. These dimensions are such that the operator may see over and to either side of the switchboard while seated at work in a chair of ordinary height; this is a desirable feature for installations where the operator serves as information clerk in addition to her regular duties. The cabinet is neatly panelled and made with flush sides so that a two-position switchboard can be formed by bolting two cabinets together side by side.

Dimension diagrams and specifications for standard equipments of switchboards of this type will be found on the following page. For detailed descriptions of the apparatus used in the various circuits see pages 7 to 21 inclusive.

P. B. X. Switchboards

Dimensions No. 101 Switchboard



Standard Equipments and Prices

In placing orders for any of the following switchboard equipments it is only necessary to specify the code number and letter and the kind of woodwork wanted. To order a dull golden oak finished No. 101 P. B. X. switchboard equipped with 20 lines, 4 cord pairs and 3 trunk lines it is only necessary to specify—"1 No. 101-B Switchboard No. 20 Finish".

Wired for	Code Number	No. of Lines Equipped	No. of Cord Pairs Equipped	No. of Trunks Equipped	Approx. Weight Packed	Price Golden Oak No. 20 Finish
	101-A*	10	4	2	300 Lbs.	\$337.50
50 Lines	101-B*	20	4	3	310 "	379.00
8 Cord Pairs	101-C*	30	5	3	320 "	415.00
5 Trunks	101-D	40	6	4	330 "	467.50
	101-E	50	8	4	340 "	514.50

*Equipments marked with this symbol are carried in stock—other equipments listed can be furnished subject to slight delay in delivery.

	Each
For more cord pairs equipped add	\$11.00
For less cord pairs equipped deduct	9.00
For more C. E. Trunks equipped add	16.00
For less C. E. Trunks equipped deduct	11.00
For night switching keys add	2.10

Changes may be made in the standard impedance coil trunk circuit as follows:

For repeating coil (for long trunks) add	\$3.00
For modifying trunk to connect with local battery main exchange add	4.75
For modifying trunk to connect with automatic main exchange, (customer to furnish dial), add	1.50

Prices are F. O. B. Rochester, N. Y. and Chicago, Ill.

Standard 100 Line P. B. X. Switchboard

No. 102 Type



Fig. 2—No. 102 P. B. X. Switchboard

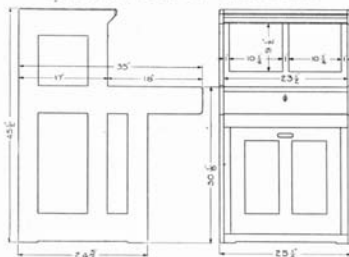
This switchboard which is only slightly larger than our No. 101 type has twice the capacity, viz. 100 local lines, and is recommended for use with large commercial P. B. X. installations in which rapid growth is anticipated. It is extremely compact for its equipment capacity and occupies only five square feet of floor space.

As in the case of our other floor type P. B. X. cabinets it is designed so that the operator may see over the top and to either side of the cabinet conveniently. Its height is $45\frac{1}{2}$ inches and extreme width $25\frac{1}{4}$ inches. The cabinet is free from all dust-catching ornamentations and may be easily kept clean and neat. The flush sides provide for convenient alignment of additional sections of this type of switchboard for installations wherein facilities beyond the capacity of a single section are required.

A diagram showing the principal dimensions of the No. 102 cabinet and tables showing standard equipments regularly furnished will be found on the following page. For detailed descriptions of the equipment see pages 7 to 21 inclusive.

P. B. X. Switchboards

Dimensions No. 102 Switchboard



Standard Equipments and Prices

In placing orders for any of the following standard equipments it is only necessary to specify the code number and letter and the kind of woodwork wanted. For example to order a dull golden oak finished No. 102 switchboard equipped with 40 lines, 6 cord pairs and 3 trunks it is only necessary to specify—"1 No. 102-D Switchboard No. 20 Finish."

Wired for	Code Number	No. of Lines Equipped	No. of Cord Pairs Equipped	No. of Trunks Equipped	Approx. Weight Packed	Price Golden Oak No. 20 Finish
	102-A	10	4	2	390 Lbs.	\$409.50
	102-B*	20	4	3	400 "	451.00
	102-C	30	5	3	410 "	487.00
100 Lines	102-D*	40	6	3	420 "	523.00
10 Cord Pairs.	102-E	50	8	3	430 "	570.50
7 Trunks	102-F	60	8	3	440 "	595.00
	102-G	70	8	4	450 "	636.00
	102-H	80	10	4	460 "	683.50
	102-I	90	10	4	470 "	708.50
	102-J	100	10	5	480 "	749.50

*Equipments marked with this symbol are carried in stock—other equipments listed can be furnished subject to slight delay in delivery.

	Each
For more cord pairs equipped add.....	\$11.00
For less cord pairs equipped deduct.....	9.00
For more C. E. Trunks equipped add.....	16.00
For less C. E. Trunks equipped deduct.....	11.00
For night switching keys add.....	2.10
Changes may be made in the standard impedance coil trunk circuit as follows:	
For repeating coil (for long trunks) add.....	\$3.00
For modifying trunk to connect with local battery main exchange add.....	4.75
For modifying trunk to connect with automatic main exchange (customer to furnish dial), add.....	1.50
Prices are F. O. B. Rochester, N. Y. and Chicago, Ill.	

Construction Details of P. B. X. Switchboards

Nos. 101 and 102



Fig. 3—Rear View of No. 101 P. B. X. Switchboard with Relay Gate Closed

All private branch exchange switchboard cabinets described in this bulletin are made of oak with the individual pieces of ample thickness and weight to provide a substantial cabinet with plenty of strength to withstand the strains that are imposed during shipment from the factory to destination. The cabinets are well braced and form a rigid mounting for the apparatus that they contain.

We regularly finish cabinets with our dull golden oak No. 20 finish which is extremely durable for switchboard use because slight scratches and mars do not show on this kind of finish.

As shown in the illustration the lines of all of our standard switchboard cabinets are plain and simple so that the equipment will harmonize with office furnishings. Cabinets made in this way may be kept clean and neat appearing with but little attention since there are no fancy mouldings or other dust-catching ornaments. The sides of cabinets Nos. 101 and 102 are made flush so that two or more cabinets may be assembled alongside of one another and so that either side of the cabinet may be placed close against a wall or partition.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY

P. B. X. Switchboards

Convenient access may be had to all interior parts of standard cabinets by means of a removable rear panel which lifts out and exposes the interior apparatus as shown in Figures 3 and 5. A similar lift out panel is also provided in the front of the cabinet beneath the keyshelf to afford access to the cord compartment. The keyboard is hinged across its entire width with a strong piano hinge which will sustain the weight of the keyboard and equipment without danger of splitting the woodwork. When the keyboard is lifted the terminals of all the keys and the key cable wiring are exposed to view. The keyboard is fitted with a standard switchboard lock and key to prevent tampering with the equipment.



Fig. 4—Rear View of No. 101 P. B. X. Switchboard with Relay Gate Open

An excellent feature incorporated in our switchboard cabinets is our D. M. F. insulating material covering for the surfaces of the keyboard and plugboard. This material is tough and hard and will neither warp nor discolor. It has a pleasing finish like dull ebony which it retains under most adverse conditions. This covering protects the woodwork against injury, which might otherwise occur, due to the impact of falling or carelessly handled plugs. The top plates of the keys are also made of D. M. F. material so that the entire keyboard presents an unbroken dull black finish.

As shown in Figures 4 and 6 the relays and condensers used in the line, cord and trunk circuits are mounted on steel mounting plates which are in turn attached to an iron gate frame made of one piece of angle iron with oxy-acetylene welded corners. This

frame is mounted on pivots at the top and bottom so that it may be swung out of the cabinet to provide access to both sides of the equipment mounted on the frame. The convenience of this feature permits inspectors to work on the switchboard without disturbing the operator or interfering with the service.

All circuits leading out of the switchboard are terminated on a hard maple terminal board mounted at the top of the gate frame. The various terminals are neatly arranged and numbered to facilitate installation work and testing. The fuses for the different circuits are also located on the terminal board where they may be replaced quickly and easily when "blown".



Fig. 5—Rear View of No. 102 P. B. X. Switchboard with Relay Gate Closed

The interior wiring of the switchboard is laid up in laced cable forms made of No. 22 B. & S. Gauge tinned copper conductors insulated with two servings of silk and one serving of cotton. All wires are colored in accordance with a standard color code so that the circuits may be traced and tested easily. Leather straps hold the cable in place in the cabinet and prevent cutting the insulation of the wires at the points of attachment.

All standard private branch exchange switchboards made by us, unless otherwise specified, are wired and equipped for operation from an 11-cell storage battery located at

P. B. X. Switchboards

the private branch exchange or from battery current of equal voltage supplied over battery leads from the main exchange. The standard boards are arranged for trunk circuit operation in connection with "Central Energy" main exchanges but can be supplied without trunk equipments for isolated systems or with modified trunks for P. B. X. systems operated in connection with magneto or automatic main exchanges.

A detailed description of the equipments used in the various circuits and of their operation will be found in the following pages.



Fig. 6—Rear View of No. 102 P. B. X. Switchboard with Relay Gate Open

Standard Line Circuit Equipment

Each equipped line circuit in a standard No. 101 or No. 102 P. B. X. switchboard is equipped with a compact type line relay, line lamp with numbered lamp cap, and the associated double cut-off type line jack. The circuit used is shown in Figure 7, a type of line circuit which we have used successfully for many years. This circuit, since it contains a line relay, operates positively and displays a line signal of uniform brilliancy in connection with both long and short lines.

The relay used in this line circuit is our compact type relay which we regularly use in our standard Central Energy multiple switchboards for city exchange service. It is the most compact relay made. It occupies only one-third of the space usually taken up by other

kinds of relays designed for the same service and its weight is correspondingly less. Because of these features we are able to mount more relays in a given space than other manufacturers and consequently are able to produce switchboards of given size with a greater capacity for line equipments.

Notwithstanding the small size of the compact type relay it has a signalling efficiency equal to other so-called major relays of larger size and greater weight. For this reason the line equipments in our P. B. X. switchboards have the same efficiency and operating range as our large city exchange switchboards.

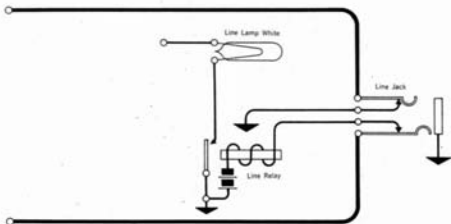


Fig. 7—Standard Line Circuit

Each line relay controls the action of a line lamp of approximately one-third candle power which is mounted behind a numbered and removable lamp cap in a steel lamp socket strip. The lamp sockets are mounted in the switchboard face above the corresponding line jacks and on the same centers. Each lamp socket on the strip is designed so that the light from the lamp is projected through its own lamp cap and is screened so that light cannot reflect through adjacent lamp caps and confuse the operator. The lamp socket strips are of all-metal construction so that the heat radiated from a permanent signal cannot warp or swell the mounting as often happens when mountings made of hard rubber are used.

Associated with and directly beneath each line lamp is the corresponding line jack. The jacks are mounted ten per strip and are of the double cut-off type which disconnects all signalling apparatus from the switchboard line circuit when a plug is inserted in the jack. This insures a clean circuit which gives maximum transmission efficiency.

The jacks are equipped with contact springs of ample length and thickness to provide the necessary permanent adjustment and positive action at all times.

All equipment used in the line circuits is assembled in the switchboard cabinet so that inspections and tests can be made with utmost ease and rapidity. The relays are assembled in groups of twenty under dust-proof group covers on steel mounting plates attached to the gate frame in the back of the switchboard so that both ends of the relays are accessible from the rear of the switchboard. The lamp socket and jack mountings can be unfastened and pulled back for inspection by turning the "butterfly" type fasteners which hold them in their places on the metal jack frame.

Standard Cord Circuit Equipment

The cord circuits used are of the double lamp type providing supervision over both of the lines connected by the cord circuit. The cord lamp signals are displayed when the subscribers served have hung up the receivers of their respective telephones. When both lamps are lighted it is a signal to the operator that both parties to the conversation have hung-up and that the connection may be taken down. When only one lamp is lighted it signifies that one party has finished and that the other is waiting to regain the operator's attention—generally this latter condition is accompanied by a periodic flashing of the lamp caused by the manipulation of the subscriber's telephone hookswitch.

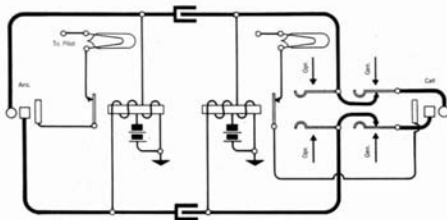


Fig 8—Standard Cord Circuit

Figure 8 shows the simplicity of the circuit wiring. It will be noted that the cord circuit relays have a triple function—first, in controlling the operation of the supervisory lamps through back contacts on the relays—second, to provide the necessary resistance between the main battery and the cord circuit to regulate the flow of a proper amount of current for talking and signalling purposes—third, to furnish impedance to prevent cross-talk or other inductive interference due to the use of a number of simultaneous connections to the common battery. The condensers interposed between the symmetrical halves of the circuit serve to isolate the two connected lines insofar as the supply of battery to these lines is concerned, thus insuring sufficient current to each line regardless of their respective lengths and resistances.

The keyboard equipment of each cord circuit consists of a pair of three-conductor plugs, three-conductor cords and a combined vertical roller-cam type ringing and listening key. The plugs are made with a depressed ring contact so as to avoid short circuiting the plug while inserting it in the jack and thereby causing an objectional click in the calling subscriber's receiver. All cords used are our "Duratex" moisture-proof type which are being used successfully in the largest exchanges with a minimum amount of trouble and maximum useful life.

It will be noted from the illustrations, Figures 1 and 2, that the ringing and listening keys are mounted flush with the surrounding keyboard so that there are no projecting edges to injure the operator's hands or clothing. The key tops are made of the same D. M. F. in-

sulating material as the covering on the keyshelf woodwork to present a pleasing and uniform finish which retains its lustre and resists wear. Each key is fastened to the steel key mounting frame independently of other adjoining keys to facilitate easy removal of the key unit by simply loosening two screws. All wires run to the keys in individual cables without cross strap wires so that a key can be pulled up and out of keyshelf for inspection.

The keys in themselves are positive acting and are designed so that continued use will not affect their operating qualities. The springs are long and heavy and will retain their adjustment in service indefinitely. As the springs are mounted vertically dust that might sift through the top of the keyshelf cannot settle on the springs nor lodge between the contact points.

Unequipped key and plug spaces are drilled and filled with apparatus blanks so that additional equipment may be installed at any time with a minimum amount of work.

Angle armature relays of the same type used in our main exchange switchboard and circuits are used exclusively in the cord circuits of our P. B. X. switchboards. These relays are extremely sensitive and efficient so that they have a wide range and are thoroughly reliable in their operation. The impedance of the windings and the shielding of the individual magnetic field of each pair of relays are designed to prevent the slightest cross-talk between the several cord circuits.

All relays and condensers used in the cord circuits are mounted in the back of the switchboard on steel mounting plates attached to the swinging gate frame to provide complete accessibility. All apparatus mounted in this way is stencilled with an identifying numbering and lettering to facilitate inspection and tests.

Standard Trunk Circuit Equipment

Plug-ended trunks of our standard types are preferred for P. B. X. service for the following reasons:

1. They permit through supervision from P. B. X. telephone to the main exchange and show simultaneous disconnect signals before both the Central and P. B. X. operators.
2. They eliminate trunk circuit complications from the local cord circuits that are required when jack-end trunks are required.
3. They increase the availability of local cords for strictly local connections.
4. They permit convenient connections of local lines to trunk lines for through night service.

The trunk circuit used in our P. B. X. switchboards is of the plug-ended type terminating at the P. B. X. switchboard in a three-conductor cord plug with the associated ringing and listening key, flash key and three control lamps; a white incoming call lamp, a green hold lamp and a red supervisory or disconnect lamp.

This trunk circuit will operate in connection with Central Energy main exchanges of all types and with slight modifications, may be used in connection with magneto and automatic exchange systems. The standard circuit which we regularly furnish is for use with short trunk lines in which battery is supplied to the trunk circuit from the main exchange only, but is convertible for use with long trunk lines in which the battery current is supplied to the trunk circuit from a storage battery at the private branch exchange.

The conversion of the circuit may be accomplished conveniently by changing the type of unit grouping of trunk apparatus mounting at the P. B. X. switchboard which will be described in greater detail in the following pages.

The white lamp of the group of three lamp signals used in this trunk circuit is the trunk line calling signal and is arranged to be lighted by the central office operator ringing out on the trunk line in the same way that an ordinary subscriber's line is rung. We use

P. B. X. Switchboards

in this trunk circuit our No. 300-X type ring-up relay which has an alternating current type of inertia armature. After being pulled up by the action of the ringing current it is mechanically latched in its operated position so that the lamp remains lighted until the P. B. X. operator answers the call by operating her listening key. This function is positive in its operation and the signal cannot be released by reverse current action in the relay as often happens when a magnetic locking action is used.

When the P. B. X. operator throws her listening key in answering an incoming call from central, the trunk is automatically "held" and the green lamp lights and remains lighted until the P. B. X. local station answers. The presence of this signal always indicates that the trunk is being held by some act of the operator and signifies an off-normal condition; for example, it relights when the P. B. X. party "hangs up" if the trunk listening key is accidentally left in its operated position. It will also flash under the same conditions if the P. B. X. party moves the hook on his telephone up and down.

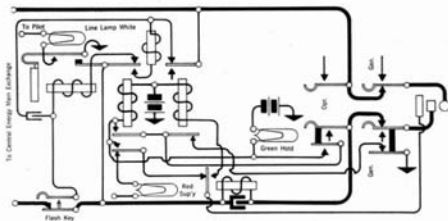


Fig. 9.—Standard Trunk Circuit, Impedance Coil Type

The green lamp does not light when the operator monitors a connection. When incoming trunk line calls are not completed through to a P. B. X. station the operator may restore the green signal by operating her trunk circuit ringing key.

The red lamp in the trunk circuit is a disconnect or supervisory signal which lights when the P. B. X. party hangs up his receiver after completing a conversation. This action also operates the supervisory lamp at the central office so that the trunk line is cleared quickly by both operators. The operation of the three trunk lamps are independent of one another so that a combination of red and white lamps lighted at the same time would indicate a disconnection to be made for some P. B. X. party and new incoming call from central. The circuit is so arranged that the lamps always signify the same operations regardless of the operating conditions that exist at the time. Further information regarding the sequence of operations in handling of trunk line calls will be found on page 30.

An entirely new feature of extraordinary value to telephone companies and other users of switchboards of this type is our method of grouping and mounting the relays, condensers, repeating coils, etc., used in each trunk circuit on a removable and interchangeable mounting plate which is, in turn, mounted on the gate frame in the rear of the switchboard. All of the apparatus on the mounting plate is wired together in accordance with the circuit requirements and terminated on a screw-connection terminal block on the end of the circuit plate. The P. B. X. switchboard cabinet is wired with a cable which provides

a trunk plate connecting arm for each of the several trunk equipments included in the ultimate capacity as specified for each type of cabinet. The connecting arm is fitted with spade clips which fit under the terminal screws of the trunk plate in their proper order so as to make a quick and secure connection without the use of a soldering tool. It is impossible to make a mistake in connecting a circuit plate and the work may be done by a person not skilled in telephony.



Fig. 10—Front View, No. 1-A Trunk Circuit Plate, Relay Covers Removed

Figures 10 and 11 show front and rear views of typical trunk circuit mounting plates as they appear ready for installation in the switchboard and Figure 6 shows the connecting arms that are provided on the switchboard cable form for making the connections with the circuit plates. Among the advantages that are gained by the method of switchboard construction are:

- (1) Each switchboard can be used for either long or short trunk line service by the use of one type or the other of our two standard trunk circuit plates which are interchangeable for use in the same switchboard.



Fig. 11—Rear View, No. 1-A Trunk Circuit Plate, Relay Covers in Place

- (2) P. B. X. switchboards of this type may be installed with the exact number of trunk circuit plates required for the active or leased trunks. This lessens the idle investment in unused equipment and reduces operating expenses.

- (3) It is possible to quickly substitute a complete trunk circuit plate so as to permit transfer of the replaced circuit plate back to the stock room or repair department for special adjustment or repair.

- (4) Obviates the use of trained men for making adjustment at P. B. X. switchboards, since it is possible to centralize the testing, adjustment and maintenance of trunk equipment at the main exchange repair department. See page 27.

Individual wooden packing boxes are provided for holding trunk circuit plates so that the shipping and handling of extra plates can be done without injury to the apparatus wiring. These packing boxes also allow the extra trunk circuit plates to be carried in stock under protection against injury or undue depreciation.

P. B. X. Switchboards

Figure 12 shows the schematic wiring of the trunk circuit plate as it is furnished for short line service wherein the trunk talking battery is furnished from the main exchange. Figure 13 shows the wiring of a similar circuit plate arranged for long line service in which the trunk talking battery is supplied to the circuit at the P. B. X. switchboard.

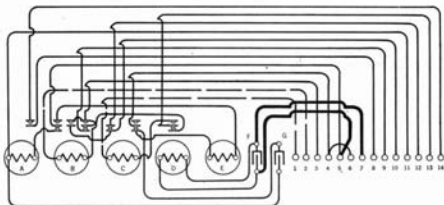


Fig. 12—Wiring of No. 1-A Trunk Circuit Plate

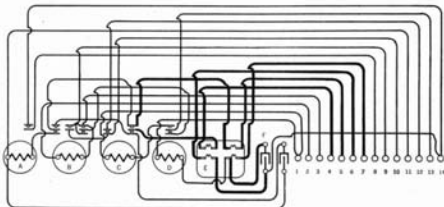


Fig. 13—Wiring of No. 2-A Trunk Circuit Plate

The two circuits have the same operating characteristics, the main difference being that the No. 1-A circuit plate for short line service is equipped with an impedance coil, whereas the No. 2-A circuit plate for long service is fitted with a repeating coil. In case of necessity No. 1-A circuit plates may be converted into the No. 2-A type or vice-versa with a few changes in the wiring and substitution of a repeating coil for an impedance coil or vice-versa.

The wiring of both types of this standard circuit is such that it is impossible to release the trunk at the central office by careless handling of the trunk plugs at the P. B. X. switchboard. This is a most important feature since many calls are "lost" because of improper operation in other types of switchboards wherein the necessary circuit safeguards are not provided.

Choosing the Proper Trunk Circuit Plate

The determining factor for deciding when to use the No. 1-A circuit plate and when to use the No. 2-A circuit plate is the signalling efficiency of the central office line and supervisory relay equipment with which the P. B. X. switchboard is to be used. For example: if the central office line and supervisory relays are adjusted to operate through a total resistance of 1000 ohms then with the No. 1-A circuit plate the resistance of the trunk line wires should not exceed 500 ohms as the holding coil in this trunk is of 500 ohms resistance. Under the above conditions the limiting resistance of the P. B. X. line wires, when the No. 1-A circuit plate is used, is about 250 ohms assuming that the resistance of the P. B. X. telephone is 150 ohms. If the central office relays will operate through more than 1000 ohms then the trunk line wires can have a correspondingly greater resistance.

The No. 2-A circuit plate should be specified in all cases where the resistance of the trunk line wires is greater than that allowable for the No. 1-A circuit plate. The upper limit in this case is practically the operating limit of the central office relays as the trunk is "held" through the 40 ohm winding of the repeating coil. The limiting resistance of the P. B. X. line wires with the No. 2-A circuit plate is about 1000 ohms as the battery for trunk line transmission is fed through a repeating coil at the P. B. X. switchboard.

To assist purchasers in choosing the proper circuit plate to meet any given local conditions our Engineering Department will furnish upon request recommendations and advice as to the most efficient equipment to be used.

Flashing Key

A flashing key is furnished as standard equipment in each trunk circuit. This key is used to flash the line or supervisory lamps at the central office to attract the attention of the main exchange operator for recalls or for other purposes wherein the assistance of the main exchange operator is required. The flashing key is non-locking and therefore cannot render the trunk inoperative through failure of the operator to restore the key handle to its proper position.

Night Switching Key

With the No. 1-A Circuit Plate night service can be given to any P. B. X. local line by merely inserting the trunk plug in the P. B. X. local line jack and switching off the P. B. X. battery supply. This extends the P. B. X. local line to the main exchange switchboard, so that signalling and other operating functions are direct—the same as for an ordinary subscriber's line.

When the No. 2-A Circuit Plate is used then it is advisable to have the P. B. X. switchboard equipped with a key for cutting the repeating coil and associated signalling apparatus in the P. B. X. trunk out of circuit for night service.

When this feature is added to the standard trunk circuit the unequipped side of the flash key is equipped with contact springs so that when this key is operated with its handle thrown toward the trunk plug the trunk line is connected through to the local line that is plugged-up for night service. When the key handle is in its normal upright position for day service the trunk circuit performs its normal functions. A lettered instruction card alongside of the trunk circuit keys explains the use of all keys.

All the P. B. X. switchboards are wired for night switching keys but they are furnished only on special order. An additional charge is made for this extra equipment.

Modifications of Standard Trunk Circuits

Trunk Line Equipment for Magneto Service

The standard trunk circuits employed in our switchboards can be converted for use with magneto exchanges by means of slight changes in the keys and key wiring. This is an important advantage to the telephone company as our P. B. X. switchboards can be adapted to the conditions which may exist in any portion of the exchange system.

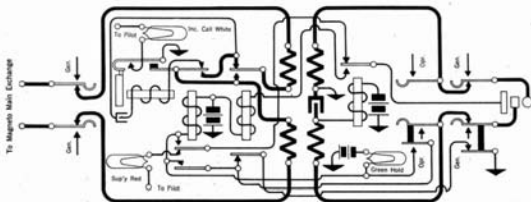


Fig. 14—Standard Trunk Circuit for Operation with Magneto Main Exchange

To modify the trunk circuit for operation with a magneto exchange it is only necessary to use the standard No. 2-A trunk circuit plate and replace the flashing key ordinarily provided in the keyboard equipment with a single ringing key so as to provide a means whereby the operator may ring down the drop at central. When these modifications have been made no battery current will be fed out from the P. B. X. switchboard over the trunk line, due to the use of the repeating coil, and there will be no interference with the operation of the main exchange switchboard and maximum transmission efficiency will be maintained.

It will be noted from the preceding paragraphs that the arrangement of this trunk circuit provides complete convertibility from central energy to magneto or magneto to central energy main exchange trunk operation. This advantage is of great importance to telephone companies that now operate magneto telephone systems that will eventually be converted into central energy systems. When this type of trunk circuit is used the cut-over to central energy operation can be made at the P. B. X. switchboard at minimum expenditure of time and money.

Complete information concerning the method of operating this trunk circuit in connection with magneto main exchanges will be found on pages 32 and 33 of this bulletin.

Trunk Line Equipment for Automatic Service

When the P. B. X. switchboard is to be used in connection with an automatic telephone exchange system (two-wire type) wherein the subscribers call one another by means of dials, only one simple change is required to adapt our standard trunk circuit to meet the operating conditions. The regular trunk ringing and listening keys are retained but the flashing key is replaced with a make-before-break key which is wired to the dial call-sending device that is common to all trunk line equipments in the switchboard.

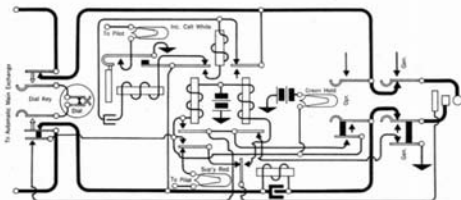


Fig. 15—Standard Trunk Circuit for Use with Automatic Main Exchange

Either the No. 1-A or No. 2-A trunk circuit plates can be used for this service so that the alternative methods of supplying trunk talking battery current to the trunk circuits are available as in operating the P. B. X. switchboard with a regular Central Energy system.

In this type of trunk circuit the natural operation of the keys and dial insure that the line and connection to the automatic main exchange will be held positively by the functioning of the P. B. X. trunk circuit equipment. This holding condition can not be accidentally disturbed or disconnected by the insertion of the trunk plug when extending a connection to a P. B. X. local line; furthermore, this condition is not dependent upon a separate holding key. Thus when the P. B. X. party responds, the holding condition is removed and the connection then acts as though made direct to the main exchange. When the P. B. X. party hangs-up his receiver an instantaneous disconnect signal is given to the P. B. X. operator and the disconnecting apparatus at the automatic main exchange is operated at the same time.

The lighting of the green hold lamp shows the operator when the trunk is being held by apparatus under her control. If the incoming call is not to be extended to a P. B. X. telephone, then the trunk may be released by throwing the lever of the trunk ringing key.

Complete information concerning the method of operating this trunk circuit in connection with automatic main exchange will be found on page 33.

P. B. X. Switchboards

Standard Operator's Circuit Equipment

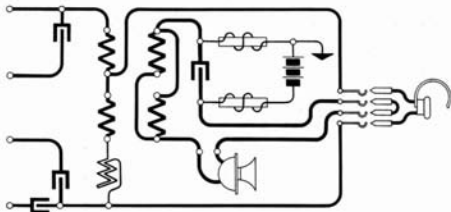


Fig. 16—Standard Operator's Equipment

The operator's equipment which we regularly furnish in standardized private branch exchange switchboards consists of a transmitter suspended from an adjustable arm, an operator's receiver with sanitary wire head-band, receiver cord and plug and all associated minor apparatus.

This apparatus is wired as shown in Figure 16 and is arranged to permit the use of a breast plate type operator's telephone set. This change may be made conveniently by short circuiting the cord terminals of the suspended type transmitter and then substituting one of our No. 2-C operator's telephone sets for the head receiver at the jack in the key shelf rail. The suspended type transmitter is generally preferred for P. B. X. service because it is easier to put on and take off a head receiver than a breast plate type telephone set, an act that is required frequently when the operator performs clerical work in addition to her regular duties at the switchboard.

Our operator's circuit equipment is unusually efficient in its operation not only because of the high individual efficiencies of the various parts but also because of the safeguards we have provided to avoid the introduction of outside noises in the circuit. To this end the transmitter is suspended by flexible cords so that vibrations in the cabinet caused by persons walking across the floor and by running machinery cannot reach the transmitter and effect its operation. We also use an operator's induction coil of the anti-side-tone type which is arranged in the circuit so that the P. B. X. operator hears but little of the outgoing transmission from her own transmitter and is therefore not disturbed by the usual side-tones.

The four terminals on the left side of the circuit diagram are the terminals of the operator's circuit equipment. The upper and lower terminals are connected with the listening keys of the local cord circuits and the two inner terminals are connected with the listening keys of the trunk circuits. The condensers in the trunk circuit listening key leads are installed to prevent crossing of the cord and trunk circuits should the operator happen to overlap the operation of a trunk listening key and a cord circuit listening key.

Generator Circuit Equipment

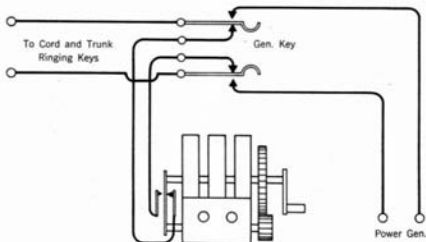


Fig. 17—Standard Generator Circuit

Provision has been made in the switchboards for supplying alternating ringing current to the ringing keys in the cord and trunk circuits from either the hand generator which is mounted in the switchboard cabinet or from a pole changer or other outside source of ringing current.

Each switchboard is equipped with a three-bar hand generator which is fitted with a detachable crank shaft and handle which extends out through the key-shelf rail on the right-hand side. This generator is wired in connection with a push-button type switching key, marked "GEN.," so that the hand generator is in circuit when the button is locked in the "out" position. When this push-button key is depressed so as to lock in the "in" position it disconnects the hand generator from the ringing circuit and connects it through to the power generator or pole changer terminals marked "POWER GEN." on the terminal board in the back of the switchboard.

Wiring is included in the cord and trunk circuits to provide for the automatic starting and stopping of a single unit ringing converter or pole changer such as our No. 5 Converter to economize the consumption of the operating battery. This wiring and the associated equipment is designed to start the ringing device through the use of a starting relay whenever the operator inserts a cord circuit calling plug in a line jack previous to ringing the connected station and whenever she operates her trunk line listening key to answer an incoming call from central which operation is generally succeeded by extending the trunk line through to a local line and ringing the local telephone. The terminals for the starting relay connections are brought out on terminal lugs on the terminal board in the rear of the cabinet.

Further detailed information concerning No. 5 P. B. X. Single Unit Converters will be found on page 28.

P. B. X. Switchboards

Pilot Lamp and Night Bell Equipment

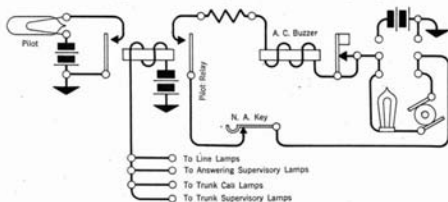


Fig. 18—Standard Night Alarm Circuit

To relieve the operator of the necessity of watching all of the signals we equip each standard switchboard with a pilot lamp which is mounted in the piling block beneath the line jacks and lamps.

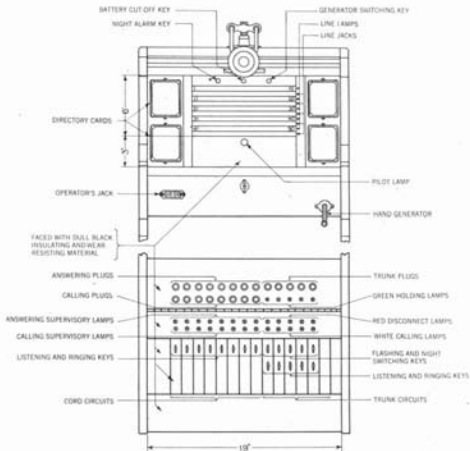
This pilot lamp is lighted whenever a call is indicated by a local or trunk line lamp or whenever a signal for a disconnection is indicated by a supervisory lamp in either a trunk or cord circuit. The lamp remains lighted as long as there is an unanswered signal on the switchboard.

The relay which operates the pilot lamp is equipped with an extra pair of contacts which are wired to close a night alarm buzzer circuit so as to give an audible as well as a visible signal to the operator for use at night or other times when there is no attendant seated at the switchboard. The action of the night alarm equipment is controlled by a switch marked "N. A." in a panel above the line jacks and lamps.

Unless otherwise specified switchboards will be supplied with the night alarm circuit designed to operate from alternating current taken from the power generator leads. The circuit is easily convertible for operation from direct current by substituting an impedance coil for the resistance coil and by adding a condenser. The same buzzer is used for both alternating and direct current night alarm, the only difference being that a strap is connected across the contact spring terminals of the buzzer when used with alternating current. The wires running from the noise-killer condenser are provided in the cabling of the switchboard cabinet so that this change can be made without disturbing the permanent wiring. This equipment is necessary to prevent the introduction of "noise" in the talking circuits when the buzzer operates from the storage battery current. Switching lugs are provided on the terminal board for connecting the night alarm circuit to alternating or direct current as required.

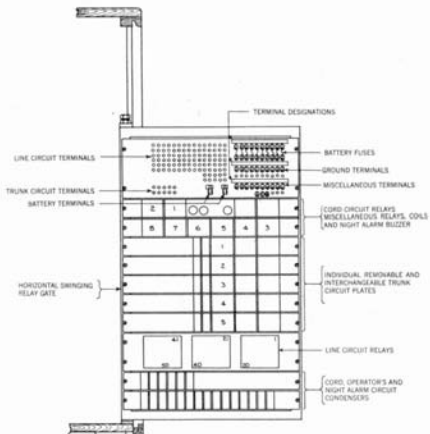
When the ringing current is supplied by a No. 5-B Converter (See Page 28), then the P. B. X. switchboard should be ordered equipped with a buzzer to operate from direct current. This is necessary as the converter runs only when the P. B. X. operator is extending a connection to a P. B. X. subscriber.

Face and Keyboard Equipment No. 101 - 50 Line P. B. X. Switchboard

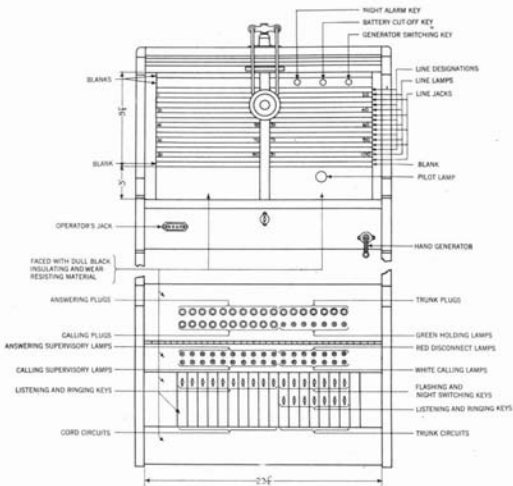


P. B. X. Switchboards

Rear Equipment No. 101 - 50 Line P. B. X. Switchboard

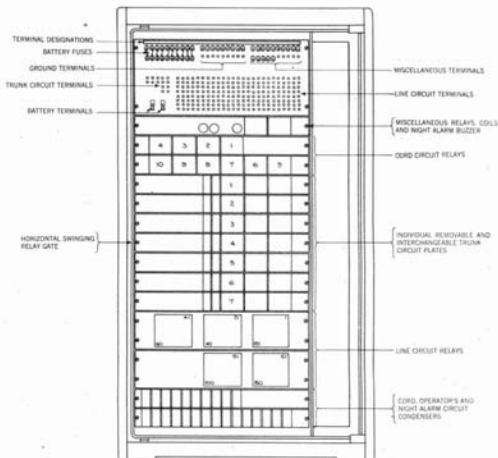


Face and Keyboard Equipment No. 102 - 100 Line P. B. X. Switchboard



P. B. X. Switchboards

Rear Equipment No. 102 - 100 Line P. B. X. Switchboard



No. 3-A Test Set for P. B. X. Circuit Plates

In order to obtain the greatest benefits to be derived from the use of our standardized P. B. X. switchboards, it is essential that each telephone company operating one or more switchboards of this type be also in possession of at least one of our No. 3-A Test Sets for P. B. X. Circuit Plates as illustrated on this page.

It is intended that this testing set be located in the telephone company's repair shop or wire chief's test room so that the testing inspection and adjustment of all P. B. X. trunk circuit plate equipment can be performed in the exchange building where proper facilities for the work are at hand. By having one or two extra trunk circuit plates at hand, it will be unnecessary to perform any work on the trunk circuits of the P. B. X. station other than the substitution of a new circuit plate for the old. This substitution of circuit plates can be performed by any employee so that trained P. B. X. inspectors are not required in clearing cases of trunk trouble.

The Circuit Plate Test Set contains all of the apparatus required to put a circuit plate through its proper sequence of operations and duplicates the operating conditions as they exist in actual trunk service. By operating the various keys the actions of the various operating elements can be observed under ideal

conditions and the necessary adjustments to relays can be made quickly, easily and at minimum cost. Detailed testing instructions are furnished with each test set.

The development of the trunk circuit plate and the circuit plate testing set by this company is one of the most progressive steps in P. B. X. switchboard equipment ever made. Through the use of our standardized P. B. X. switchboards and this associated apparatus, it is possible to produce economies in operation and maintenance that hitherto have been out of question.

Prices and further information concerning the No. 3-A Circuit Plate Test Set will be furnished upon application.

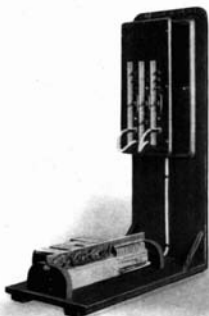


Fig. 23—No. 3-A Test Set for P. B. X. Circuit Plate

No. 5 Type P. B. X. Converters

This type of converter is equipped to transform direct current at a potential of 20-22 volts to an alternating current for ringing purposes at a frequency of 25 cycles per second. It consists of an oak cabinet measuring 9" x 11 $\frac{1}{4}$ " x 5 $\frac{1}{8}$ " in which all operating parts are enclosed. The equipment consists of a vibrator with pole-changing contacts, a step-up transformer and a condenser for suppressing sparking at the contacts. The wiring is brought out to four binding posts, two each for the input and output circuits.

The device is free from delicate parts and will operate continually without requiring adjustment or other attention. Its efficiency is very high and the potential of the ringing current stands up well under heavy loads. As many as forty bells bridged across one circuit have been operated with current from this converter and each bell rang sufficiently loud to give a good commercial signal. The converter consumes only .03 ampere when running without load, .09 ampere when ringing one bell, and .12 ampere when ringing eight bells.

Our P. B. X. switchboards are wired so that they can be used with the No. 5 Converter by merely adding a No. 201-A Starting Relay on the relay mounting plate beside the pilot relay. Complete wiring is provided in the cabinet for the control of the converter through this relay. It is arranged so that the converter will be set in operation in readiness for ringing when ever a calling plug of a P. B. X. cord circuit is inserted in the jack of a P. B. X. local line or whenever the operator answers a trunk call from the main exchange. In either

case the converter continues to operate until the called party responds or the operator abandons her attempts to obtain an answer and restores her calling equipment to normal condition.

It will be observed from the foregoing that the converter is vibrating only when required and that the starting and stopping of the converter is accomplished without effort on the part of the operator. Then too, the converter consumes battery current only during the period when ringing current may be required and that this consumed current is practically negligible except while the

operator is actually ringing a P. B. X. local subscriber.

The device is self-protecting, cannot be injured by ringing on short-circuited lines and requires no auxilliary lamps or other resistance elements in the ringing leads.

Standard Converters

No. 5-A Operates from 11 cells of storage battery or 20 volt battery of dry cells. To used only where two separate sets of storage battery are installed.

No. 5-B Same as No. 5-A Converter but equipped with noise-killing devices. To be used where but one battery is installed.



Fig. 24—Closed view No. 5 Type P. B. X. Converter



Fig. 25—Open View No. 5 Type P. B. X. Converter

Operation of Circuits

The following is a complete narrative of the functions and operations of the circuits of standardized P. B. X. Switchboards. The subjects are divided for convenience as follows:

- 1—Local P. B. X. Calls.
- 2—Trunk Calls, Outgoing from P. B. X. Switchboard.
- 3—Trunk Calls, Incoming to P. B. X. Switchboard.
- 4—Direct Line Night Service over trunk.

1—Local P. B. X. Calls:

(a) *P. B. X. Subscriber Calls:*

When a P. B. X. party desires another P. B. X. party the call is made in the usual way by removing the telephone receiver from the hookswitch, thereby lighting the line lamp of the P. B. X. switchboard.

(b) *P. B. X. Operator Answers Call:*

The act of plugging into the corresponding P. B. X. line jack, located directly under the lighted line lamp, with the answering (back) plug of a P. B. X. cord circuit, cuts off the line signalling apparatus in the jack and extends the talking circuit to the P. B. X. cord circuit. The operator listens by throwing the combined listening and ringing key handle of the P. B. X. circuit towards the plugs (locking position) so as to connect her talking equipment.

(c) *Ringing the Called P. B. X. Subscriber:*

If another P. B. X. party is desired then the calling plug (front) of the P. B. X. cord circuit is inserted into the jack of the desired P. B. X. line. This lights the calling (front) supervisory lamp of the P. B. X. cord circuit.

Throwing the combined listening and ringing key handle towards the operator (non-locking position) rings the desired party.

(d) *Ringing with Power Generator:*

When power generator current is available, then the generator switching key marked "GEN" should be depressed so that this current will be connected to the ringing key common wires. This allows the ringing to be done by the simple movement of the ringing key and without any other manual operations on the part of the operator.

(e) *Ringing with Hand Generator:*

If the power generator current is not available then the generator switching key, marked "GEN" should have its plunger in the "out" position, so that the ringing current provided by turning the crank of the hand generator will be connected to the ringing key common wires.

(f) *Two P. B. X. Parties Connected for Talking:*

The responding of the called P. B. X. party by the removing of the receiver from the hook of the called telephone, causes the calling (front) supervisory lamp of the P. B. X. cord circuit to be extinguished. The circuit now is completed and in the talking condition, all signal lamps associated with this particular connection being extinguished.

(g) *P. B. X. Parties Disconnect:*

When both P. B. X. parties hang up the receivers at the telephones, the corresponding two supervisory lamps in the connecting P. B. X. cord circuit will light. This notifies the operator that the conversation is completed and that the cord circuit used can be pulled down.

(h) *P. B. X. Party Recalls:*

If either P. B. X. party desires immediate attention of the operator when a conversation is completed, the moving of the hookswitch up and down slowly will flash the corresponding supervisory lamp in the P. B. X. cord circuit. This is the customary signal for the operator to listen-in on the cord circuit for further orders.

(i) *Common Pilot and Night Alarm:*

The line lamps and the answering supervisory lamps of this standard P. B. X. switchboard are connected to a common pilot lamp circuit, which lights in the usual way when any one or more of these connected line or supervisory lamps are lighted.

A common night alarm buzzer is also provided in this switchboard and so wired as to operate when the pilot relay pulls up, providing that the night alarm switching key, marked "NA" is in its operated position (plunger pulled out). When this key is fully depressed (locking position) the night alarm is disconnected from the pilot relay circuit.

P. B. X. Switchboards

2—Trunk Calls, Outgoing from P. B. X. Switchboard:

The trunk circuit used with this standardized P. B. X. Switchboard is designed to be connected to any regular subscriber's line circuit at the central office, so that the central office answering and calling functions will be the same as those of a regular telephone.

(a) Ordering of Central Connection by P. B. X. Party:

When the P. B. X. operator answers a local call from a P. B. X. line by means of a regular P. B. X. cord circuit and finds that the P. B. X. party desires a "city" line, then the answering plug of this local cord circuit is removed from the P. B. X. line jack and the plug of a non-busy trunk line inserted in its place. This allows the P. B. X. party to call any desired central office number direct. Also it allows the P. B. X. party to recall the central office operator in the customary manner for subsequent numbers by moving the telephone hook-switch up and down, and without disturbing the P. B. X. operator.

The P. B. X. operator must be cautioned to always answer each local call P. B. X. line lamp signal by means of a P. B. X. cord circuit rather than through a trunk plug, so as to avoid a false calling signal at the central office. This instruction is given on a designation plate, located at the right hand side of the key shelf.

(b) Ordering of Central Connection by P. B. X. Operator:

If the P. B. X. party desires that the P. B. X. operator do the calling of the central office subscriber, then the P. B. X. operator throws the combined listening and ringing key lever of a non-busy trunk into the listening position, which is towards the plugs (locking). It is not necessary that the corresponding trunk plug be inserted in the jack of the P. B. X. line until the P. B. X. operator knows whether the desired central office subscriber can be reached.

The operation of this trunk listening key causes a holding circuit to be locked across the trunk line and at the same time lights the line lamp at the central office. The P. B. X. operator gives the desired number to the central operator and if the called party responds, then the latter is told that a P. B. X. party wishes to speak and is requested to hold the line until the P. B. X. party is located. Now the trunk plug of this particular trunk line is inserted in the line jack of the P. B. X. party who originated the call, and the P. B. X. line rung in the usual way by throwing the combined listening and ringing key of the trunk circuit towards the operator (non-locking position).

(c) Holding of Trunk Indicated by Green Lamp:

The trunk holding lamp "green" lights when the trunk listening key is first thrown and remains lighted until the P. B. X. party responds. This lamp serves as a positive indication that the trunk is being held by the operator as it lights and remains lighted only as long as the holding circuit is connected across a trunk line. This green lamp is used for no other purpose, so as to avoid confusion of signals.

(d) Trunk Holding Connection Cannot be Accidentally Released:

When the trunk holding circuit is established and the green lamp is lighted, this condition is securely locked against accidental release through crossing of plug and jack or through condenser kicks, by several new safeguards which make this trunk practically fool-proof.

(e) Trunk Disconnect:

When the P. B. X. party is through talking and hangs up the telephone receiver, the central office disconnect signal is immediately operated; also a disconnect "red" signal is lighted in the trunk circuit at the P. B. X. switchboard. Either the central office operator or P. B. X. operator can pull down the connection first, without causing any difference in the disconnect functions of the P. B. X. or central office switchboard.

(f) Trunk Disconnect Pilot and Night Alarm Circuits:

The red disconnect lamp in the P. B. X. trunk circuit is connected to the common pilot circuit and night bell circuit the same as for the local line lamps and local cord circuit answering supervisory lamp.

(g) Trunk Cleared of Useless Bridged Apparatus During Talking:

This trunk circuit is so designed that when the P. B. X. battery is connected for talking the trunk calling relay and holding coil (if the trunk is arranged for holding coil) are removed from across the circuit so as to avoid high frequency transmission losses.

(h) Trunk Instantly Available for Incoming Calls from Central when P. B. X. Party Hangs Up:

The instant the P. B. X. party hangs up, after a conversation, the trunk line calling signal circuit is re-established at the P. B. X. switchboard so that the central office can call-in on a trunk, even before the P. B. X. operator has pulled down the trunk connection. Thus it is possible to have a calling (white) lamp and a disconnect lamp (red) light on a trunk at one time. This condition is not confusing as the P. B. X. operator knows that the only way a calling signal (white lamp) can be lighted is by the central office operator ringing on the trunk line, also that the presence of a disconnect signal (red lamp) on this same trunk indicates that the P. B. X. party is through talking and has hung up. In such a case the P. B. X. operator will pull down the trunk plug and answer the trunk line the same as for any incoming trunk call, subsequently described.

(i) Trunk Flashing Key:

If for any reason the P. B. X. operator wishes to flash the supervisory lamp at the central office, when a P. B. X. party is on the connected line, this can be done by simply throwing the combined flashing and night switching key handle towards the operator (non-locking position). This opens the trunk circuit as long as the key is held in the operated position, or the circuit can be intermittently opened and closed by the corresponding operating of this key handle. As a result of this opening and closing of the trunk line circuit at the P. B. X. switchboard, the central office supervisory lamp will be flashed, which is the customary indication for a recall or for immediate attention from the central office operator.

The P. B. X. trunk listening key handle can be thrown to listening position when "flashing back" so that the P. B. X. operator's telephone set will be on the circuit in readiness and the P. B. X. operator can respond immediately when the central operator comes in on the circuit.

This flash circuit is so arranged as to do away with disagreeable clicks which would otherwise be introduced in the connected P. B. X. subscriber's telephone as well as in the operator's head telephone, when working this key.

3—Trunk Calls, Incoming to P. B. X. Switchboard:**(a) Central Office Rings on Trunk Line to Call P. B. X. Switchboard:**

As previously stated, these trunk circuits are designed to terminate in the central office on regular subscriber's line circuits. Thus the central office operator calls a P. B. X. switchboard by ringing on the trunk line the same as for calling a local subscriber's telephone.

This ringing current operates a mechanically latching type of alternating current relay in the P. B. X. end of the trunk, positively lighting a calling lamp with white cap, which is located in line with the trunk plug.

(b) Trunk Calling Pilot and Night Alarm Circuit:

This trunk calling lamp (white) is connected to the common pilot and night bell circuit of the P. B. X. switchboard the same as for the local line trunks, etc.

(c) Answering a Trunk Call:

The P. B. X. operator answers a call coming in over the trunk line from central office, by throwing the lever of the associated combined listening and ringing key towards the trunk plug (locking position) so as to connect her telephone set.

(d) Trunk Automatically Held:

The act of throwing the trunk listening key lever by the P. B. X. operator provides and locks up a holding condition for the trunk and also lights a green lamp which stays lighted as long as this holding condition exists.

When the trunk is arranged for "short line" service this condition is established by means of a retardation coil connected across the trunk, while for "long line" service, with a repeating coil in the trunk, the holding condition is maintained by the closing of the circuit through the middle of the line half of the repeating coil.

This holding condition in the trunk is necessary to keep the supervisory signals of the central office cord and trunk circuits extinguished, so that the central office portion of the connection will not be pulled down prematurely.

When the holding condition is established and the green holding lamp is lighted, then this condition is locked from further interference so that the P. B. X. operator can return the trunk listening key to normal without releasing the trunk. This allows several calls to be answered in quick succession, holding such calls as require connection to P. B. X. lines, until the operator has time to complete these calls.

(e) Releasing the Trunk:

If a trunk call is not to be extended to a P. B. X. line then the operator can release the trunk without plugging into a line jack, by simply throwing the combined listening and ringing key handle into the ringing position, towards the operator (non-locking) before letting go of the key handle. This releases the lock on the holding condition and indicates that the trunk is no longer held, by extinguishing of the green holding lamp.

(f) Extending a Trunk Call to a P. B. X. Line:

If the incoming trunk call is to be extended to a P. B. X. line, the P. B. X. operator simply inserts the corresponding trunk plug into the jack of the desired line and throws the combined listening and ringing key handle towards herself, as in ringing with a local P. B. X. cord circuit previously described. The trunk holding lamp (green) remains lighted until the P. B. X. party responds, when it is extinguished and the trunk is cleared from all bridged apparatus which is not required for talking purposes.

(g) Listening-In on Trunk Conversation does not Re-Connect the Holding Coil:

If, for any reason, the P. B. X. operator listens-in on the trunk conversation, the holding coil (used on a short line trunk) will not be re-connected across the line and the green holding lamp will not be re-lighted. In this case the trunk is held by the presence of the P. B. X. telephone talking circuit apparatus, which is then across the circuit. By not having this holding coil across the circuit, bridged transmission losses, due to listening-in on a conversation are correspondingly reduced.

P. B. X. Switchboards**(h) P. B. X. Party can Flash P. B. X. Operator if Trunk Listening Key is Accidentally Left In Its Operated Position:**

The holding portion of the trunk circuit is so designed that the accidental leaving of the trunk listening key in its operated position (possible when the operator's head telephone is not in use) will not tie up the trunk circuit. The hanging up of the receiver at the connected P. B. X. telephone will cause the holding lamp (green) to give a steady light. Then if the P. B. X. party wishes immediate attention the working of the hookswitch slowly up and down will cause this green lamp to flash and thereby attract the operator's attention for immediate service.

The green lamp is intended solely to indicate to the operator that the trunk is being "held" by the mechanism of the P. B. X. switchboard which is under her control. Thus any lighting of this green lamp demands the P. B. X. operator's immediate attention.

4—Direct Line Night Service Over Trunk:

This standard P. B. X. switchboard is designed to give night service by inserting the trunk plugs into the jacks of a corresponding number of P. B. X. lines, upon which it is desired to give night service. Several important safeguards are provided to avoid interference with this night service.

When the P. B. X. is arranged for "short line" trunk service, without repeating coil (No. 1-A Circuit Plate), then night service can be given without the use of special trunk switching keys. All that is necessary is to see that the battery cut-off key is depressed as described under the following heading "d".

When the P. B. X. is arranged for "long line" trunk service with a repeating coil to feed talking and signaling battery from the P. B. X. switchboard to the P. B. X. subscriber (through a No. 2-A Circuit Plate), then night service can be given direct or with the aid of a night switching key. The wiring for this switching key is provided in each switchboard but the key is furnished only on special order. The operation of this key is as follows:

(a) Night Switching Key Clears Trunk Circuit from all Series and Bridged Apparatus:

A night switching key when desired for the "long line" trunk of the repeating coil type, is provided on special order. When this switching key handle is in its vertical position, the trunk is connected for "day service" with the signaling apparatus in circuit. With the handle of this key thrown towards the trunk plug, then the trunk is connected through direct (for night service) without any bridged or series apparatus or coils in the circuit.

This same key lever is used as previously described for flashing purposes, by throwing the lever handle towards the operator, which is non-locking position.

The plugging up of one of these standard trunks into any P. B. X. line, with the switching key set for night service gives the same condition for that particular connected P. B. X. telephone instrument as for a regular central office subscriber's line and telephone, with the same transmission conditions for local and toll service.

(b) Night Service Assured Even When the Night Key is Not Thrown:

This standardized P. B. X. switchboard is provided with the usual battery cut-off switch, so that all current for operating the P. B. X. lamps and relays, with the exception of the supervisory relays, can be disconnected when the operator leaves the switchboard at night.

This battery cut-off switch is a No. 119 Key, with top stamped "BAT", wired so as to connect battery when plunger is pulled out and disconnect battery when plunger is locked "in".

The retaining of battery current for these supervisory relays in the repeating coil trunk, makes it possible to signal the central office from the connected P. B. X. telephone whether the night switching key is in its correct position or not. This is a valuable safeguard because night service lines are usually employed for night watchmen or emergency purposes where reliable outgoing trunk service is vital.

Operation of Trunks From Magneto Main Exchange

When these standardized P. B. X. switchboards are equipped with ring-back keys in the trunks for use in connection with a magneto central office, these trunks will operate as follows:

(a) Trunk Calls from Magneto Central:

Calls from a magneto central office light the white calling lamp in the P. B. X. trunk, the same as calls from a Central Energy office. The P. B. X. operator answers these calls by throwing the handle of the trunk listening key, which is in line with a lighted trunk lamp, towards the trunk plug. This act extinguishes the white calling lamp and lights the green holding lamp. The green lamp remains lighted to remind the operator that she has a central office call, until the trunk is released, either by the operator throwing the listening key in the opposite direction or by the extending of the call as described in the next paragraph.

(b) Extending a Trunk Call from Magneto Central:

If the incoming call is to be extended to a P. B. X. telephone, then the P. B. X. operator inserts the trunk plug into the jack of the desired P. B. X. line and rings by throwing the handle of the trunk listening key towards herself. When the P. B. X. party responds the green lamp will be extinguished, showing the P. B. X. operator that the central office trunk call has been disposed of.

(c) *Disconnecting Magneto Trunk:*

Now when the P. B. X. party hangs up, the red lamp, which is located in line with the trunk cord, will light to show disconnection. This red lamp can be flashed for a re-call by the P. B. X. party working the hook-switch of the telephone up and down in the customary manner for such re-calls.

The P. B. X. operator finishes the disconnection by pulling down the trunk plug and then ringing off the central office by throwing towards herself the handle of the key located next to the trunk plug.

(d) *Trunk Calls to Magneto Central:*

Calls from a P. B. X. party which are intended for the magneto central office are extended by the P. B. X. operator removing the local cord circuit plug, used in answering the call, and substituting a trunk plug. The P. B. X. operator now rings the magneto central office by throwing the handle of the key, located nearest to the trunk plug, towards herself, listening-in to supervise the connection as is customary on magneto switchboards.

Operation of Trunks From Automatic Main Exchange:

When these standardized P. B. X. switchboards are equipped with dial keys in the trunk circuits and with automatic dials, then the operation of the trunks will be as follows:

(a) *Trunk Calls from Automatic Central:*

Calls from the central office to a P. B. X. party are handled exactly as from Central Energy main exchanges as described on page 31 of this bulletin.

(b) *Disconnecting the Automatic Trunks:*

The disconnecting of these trunk calls is made direct to the central office when the P. B. X. party hangs up, leaving the trunk in readiness for immediate incoming calls, even before the P. B. X. operator has pulled down the connection, as described in paragraph "h" on page 30.

The red trunk lamp lights for this disconnection at the P. B. X. switchboard and can be flashed for a re-call in the usual manner by working the telephone hook up and down.

(c) *Trunk Calls to Automatic Central:*

Calls from the P. B. X. telephones to the automatic office are made by the P. B. X. operator as follows:

First, the dial switching key handle (key nearest to trunk plug) is thrown towards the operator so as to connect the dial to the trunk and at the same time establishes the holding connection across the trunk circuit as described in paragraphs "b" and "c" on page 30 of this bulletin.

Second, the operator dials the number wanted in the automatic central office by working the dial in the regular way.

The green lamp of this particular trunk lights to show that the holding condition is existing on the trunk and remains lighted until either the P. B. X. operator releases the same by hand or until the trunk is connected to a P. B. X. line and answered by a P. B. X. party. The releasing by hand is described in paragraph "e" on page 31.

(d) *Trunk Automatically Held After Dialing:*

After the P. B. X. operator dials the number wanted in the automatic central office, then the circuit is held by the holding condition just described, even after the trunk dial switching key is restored and until the call has been answered by the P. B. X. line or released by the P. B. X. operator as described in paragraph "e" on page 31.

(e) *Trunk Night Service to Automatic Central:*

Night service from some of the P. B. X. telephones to the automatic central office can be provided as described on page 17 of this bulletin by furnishing the particular P. B. X. telephones with dials, and in the case of the No. 2-A Circuit Plate (repeating coil type of trunk) throwing the night switching key so that its handle will be towards the trunk plug. The No. 1-A Circuit Plate type trunk circuit will allow the dialing through to the central office without using the night switching key. In all cases the battery cut-off switch should be thrown so as to prevent the accidental lighting of lamps in the P. B. X. switchboard during the night.

(f) *Special Advantages of Automatic Trunk:*

The advantages described in paragraphs "d", "g" and "h" on page 30, and "g" and "h" on pages 31 and 32 apply also for this standardized trunk when used in connection with an automatic central office.

