

# TYPE 32-A P.A.B.X.

## (Modified For Selective Signaling)

### 1. APPLICATION

This system, employing local selective signaling, is designed to supply automatic, private-branch exchange service in connection with any type of central-battery automatic or manual public exchange without requiring any change in equipment at the central office. The trunk-lines can be connected to regular subscribers' line equipments, and since all the local telephones are equipped with dials, no changes in the P-A-B-X will be required in the event the public exchange is converted to dial operation at some future time.

### 2. CAPACITIES

This P-A-B-X provides for a maximum of two central-office trunks arranged for two-way operation, and ten stations, six of which have access to the two-way trunks and the other four being restricted to local inter-communication only. One of the stations may be provided with "secret-service" on trunk call conversations.

Facilities are included for three simultaneous calls, consisting of two trunk calls (either incoming or outgoing), and one local call. A common inter-communicating circuit is provided for the latter purpose.

### 3. TELEPHONES AND EQUIPMENT

The following sub-sections describe the equipment which is contained in the selective signaling Type 32-A P-A-B-X. Photographs of the various pieces of apparatus are also included.

#### 3.1 Telephones

Stations equipped to answer and originate public-exchange calls, and for transferring these calls to other similarly equipped telephones, are provided with monophone desk sets which are mounted on a sub-base. The sub-base contains two lever-type, locking keys (one for each central-office trunk), excepting at the station arranged to give secret service, where three keys are required. The third key is for disconnecting the engaged trunk from all other stations, thus assuring non-interference on toll and important trunk calls.

The keys are interlocked with the monophone switch, and are restored to normal when the handset is placed in its cradle at the completion of a call. It is, therefore, not necessary to check the position of the key levers before originating or answering a call.

The non-locking push button key in the top of the sub-base, and to the right of the lever keys, is used for "flashing" the central-office

operator, when the P-A-B-X is connected to a manual exchange; or for releasing an incompleting connection, when the trunk-lines terminate in an automatic central office.

Each station is equipped with a dial for calling the desired station; and for the trunk-connected stations to establish outgoing calls in the event the trunk-lines terminate in an automatic public exchange.

A regular dial telephone without sub-base is provided for the four local stations, when used.

#### 3.2 Trunk Signals

Conveniently located ringers associated with each trunk-line are regularly employed for indicating incoming trunk-line calls. Bells of different tones are generally used for the two trunks, in order to identify the trunk to be answered.

When desired, multiple lamp signals (operated by a relay associated with the trunk) may be employed for identifying the individual trunks. Colored lamps (or opals), corresponding with the color of the trunk key escutcheons, are preferable, i.e., red signals for the first trunk, and green for the second trunk.

#### 3.3 Local Signals

The local signaling system comprises one audible signal (bell, buzzer, etc.) located at each station. Any suitable design of direct-current bell or buzzer arranged for 12-volt operation, may be employed.

#### 3.4 The Switchboard

Fig. 1 is a view of the switchboard unit. Its dimensions are approximately 9-1/2" x 13-1/2" x 8-1/2". Fig. 2 shows the unit with the metal dust covers removed. The apparatus consists of two switch bases mounted side by side on cross angles, top and bottom. Two similar angles are attached to the units for fastening to a wall, and serve as hinges when it is desired to inspect the wiring in the rear.

The relays are mounted on the left-hand base. Each two-key station has an associated relay which serves to switch the telephone circuit from one trunk-line to the other. The three-key station has, in addition to the relay previously described, two other relays which serve to disconnect one or the other of the trunks from the remaining trunk-connected telephones. The local inter-communication circuit includes a relay which supplies transmission current to the telephone on local calls; and serves as a pulsing relay for the local selective signaling



system, which comprises four additional relays and a minor switch.

A terminal strip is mounted on the right-hand base. It provides termination for wiring of the trunk-lines, local stations, signal leads, and the current supply leads. The left-hand side of the terminal strip is wired to the relays, and the right-hand side is reserved for the wiring from the telephones and trunk lines. The wiring from the outside is brought in from the rear of the base and thru the lower spring

current of 1-1/2 amperes at 12 volts to the P-A-B-X. A filter, comprising a large choke coil and two 2,000 M.F. condensers, practically eliminate the A.C. ripple. As shown in the figure, the eliminator is housed in a metal cabinet. The dimensions of the cabinet are 10" x 10" x 4".

#### 4. INSTALLATION

The P-A-B-X and associated equipment should be installed in accordance with the following sub-

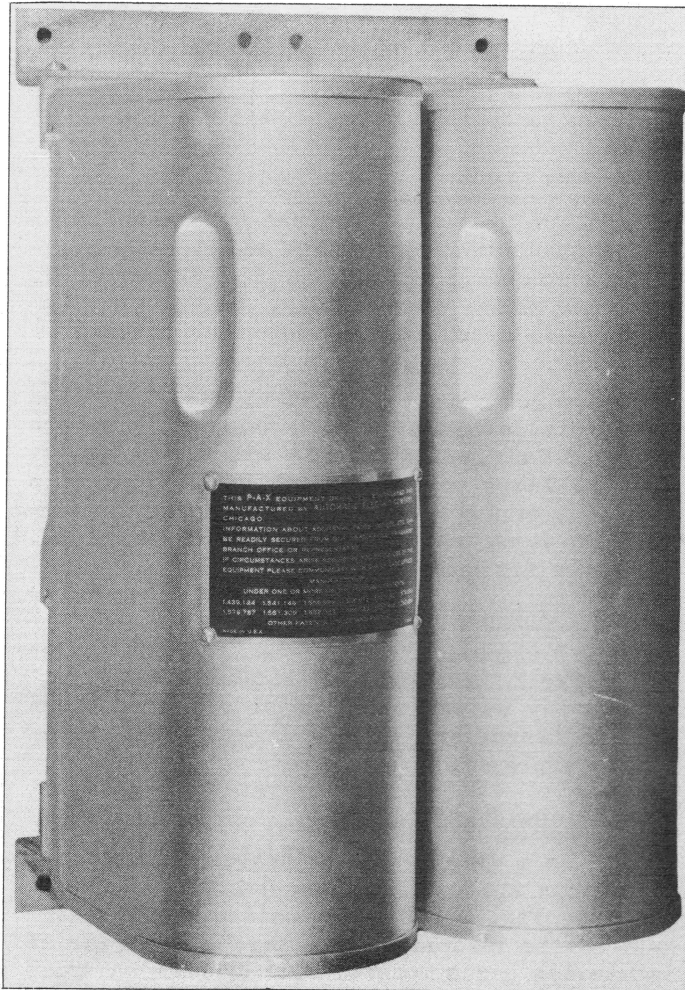


FIG. 1  
SWITCHBOARD UNIT

opening in the plate, and then distributed over the various terminals.

#### 3.5 Power Supply

The selective ringing Type 32-A P-A-B-X operates on 12 volts, direct current, supplied either by dry cells or by means of a telephone battery eliminator operating directly from the commercial power supply circuit. Fig. 3 shows this telephone battery eliminator which is arranged to rectify 105- to 125-volt, 60-cycle alternating current, and to deliver a direct

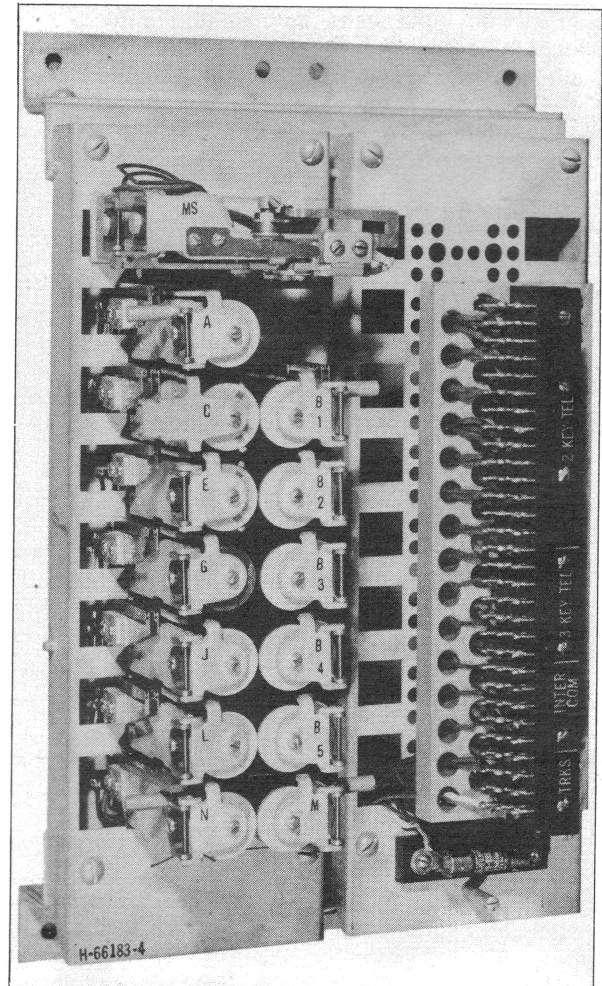


FIG. 2  
COVERS REMOVED

sections. To facilitate the wiring, a wiring plan and schematic circuit diagram are provided (Figs. 4 and 5).

#### 4.1 Switchboard Location

The P-A-B-X should be located as near as practicable to the center of the wire distribution system. It may be mounted on a wall or pillar, in an out-of-the-way or inconspicuous location. However, in selecting the location, a reasonably dry place, comparatively free from dust and fumes, is desirable.



#### 4.2 Power Equipment

The telephone battery eliminator (mounted in vertical position) or the dry cells, whichever is provided, may be located adjacent to the P-A-B-X; or at a distance not exceeding 25 feet from the P-A-B-X. A suitable battery box should be employed for housing the dry cells.

#### 4.3 Telephones

Each monophone set equipped with a sub-base is provided with a ringer box containing a ringer (or buzzer), an induction coil, a condenser, and two terminal strips. These boxes should be mounted in the wells of desks, or on adjacent walls not subjected to excessive dampness. The flexible cord from the monophone set should be connected to associated ringer box in accord-

ated condensers should not exceed 3 M.F. per trunk when the trunk-lines terminate in an automatic public exchange.

Conditions may exist where both audible and visual signals, such as lamps, are required. In such cases, a lamp per trunk may be installed at each telephone, or may be located so as to be visible at several or all stations. Any suitable style of lamp and lamp fixtures may be employed and, likewise, any available current supply (excepting the 12-volt P-A-B-X current) may be used to light these signal lamps. In order to avoid installing "Underwriters" wiring when commercial power supply is used, it is recommended that a small current transformer (such as is commonly employed for operating door bells) be utilized to step the commercial volt-

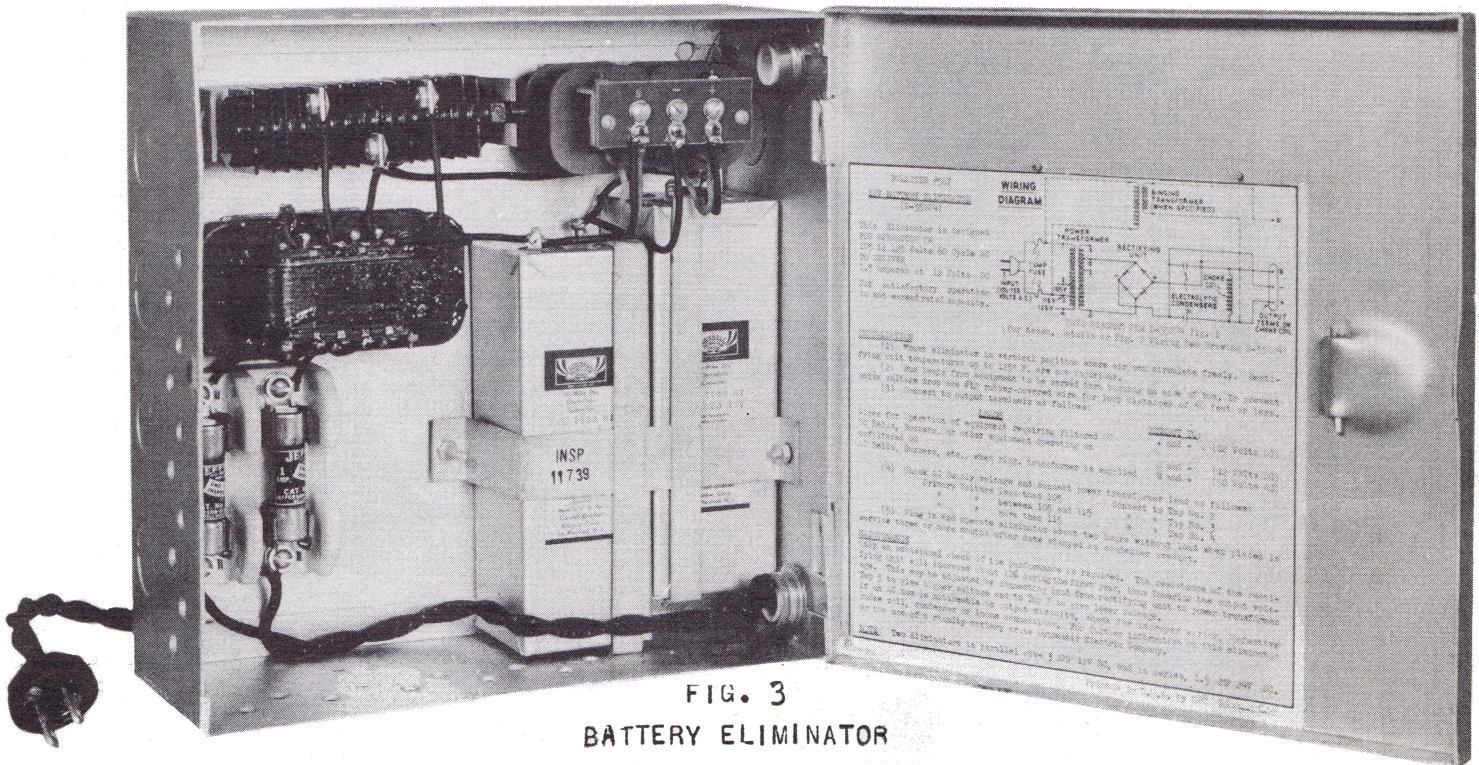


FIG. 3  
BATTERY ELIMINATOR

ance with the circuit labels attached to the base of the monophones and to the inside of the box cover.

#### 4.4 Trunk-Line Signals

Incoming trunk-line calls are signaled by means of alternating-current telephone ringers associated with each trunk. A condenser of 1 M.F. (or less) capacitance is connected in series with the ringer coils. These ringer boxes, not regularly furnished along with the P-A-B-X, should be suitably located so as to be audible at several or all stations. In case one signal will not suffice for all stations, additional ringers, connected in multiple, in series, or in series-multiple, as required, should be used. However, the combined capacitance of the associ-

age down to not more than 25 volts; and that lamps of a similar rating be used.

A suitable alternating current relay, or contactor, having a 1 M.F. condenser connected in series with its winding, is required per trunk when trunk identifying lamps are used. These relays and associated condensers may be located adjacent to the switchboard or at any location conveniently accessible for wiring to the trunk-lines.

#### 4.5 Wiring

Fig. 4 is a wiring plan showing the wiring between the P-A-B-X and associated equipment. As will be observed from the figure, each trunk-line requires one pair of wires between the

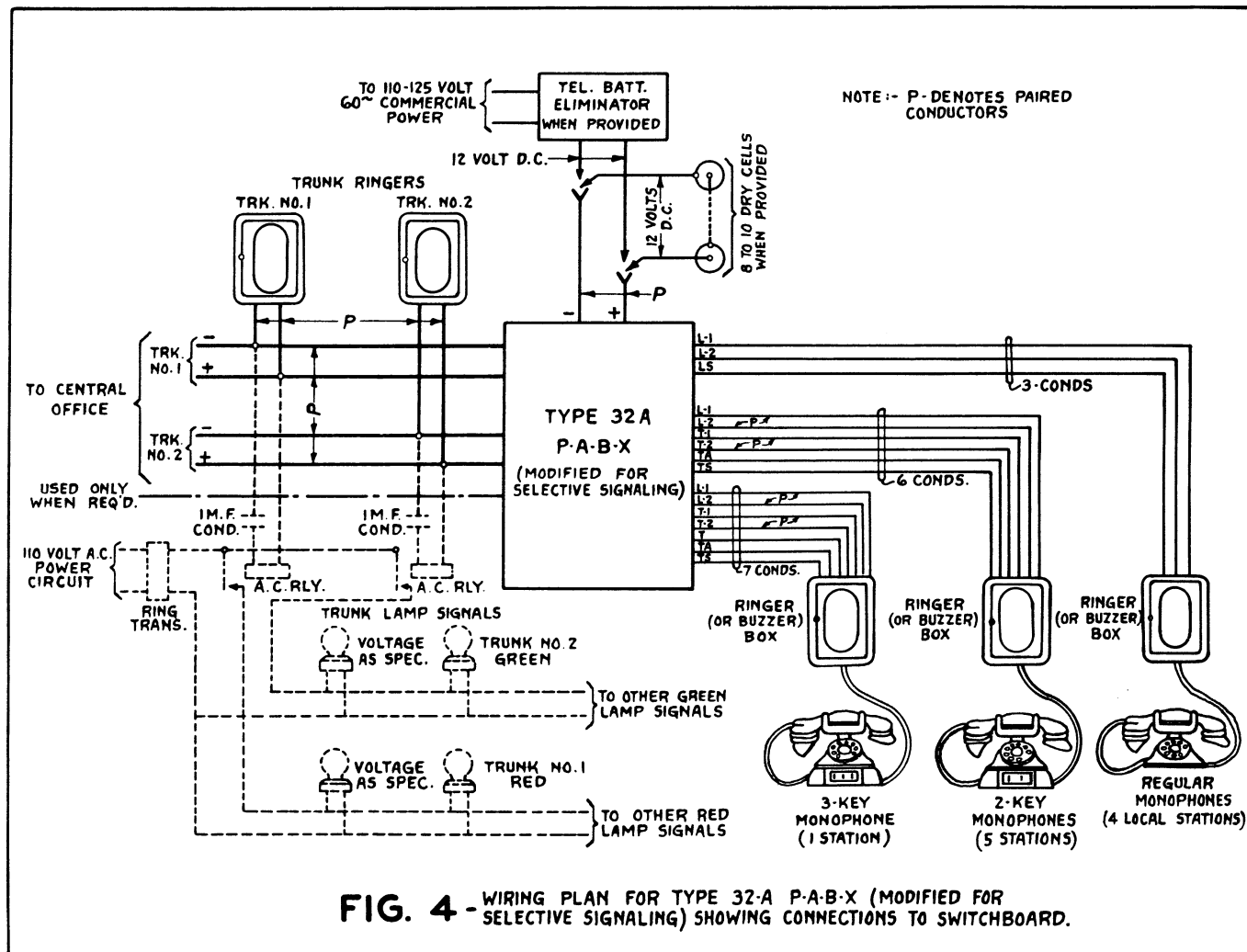
## TYPE 32-A P.A.B.X

P-A-B-X and the terminals at which the trunk-lines terminate, and one pair of wires to each trunk-line ringer, and each A.C. relay if used. Each two-key telephone requires six conductors between the switchboard and the telephone sub-set (2 pairs and 2 single conductors; or, 1 triplex, 1 pair, and 1 single conductor). The three-key telephone requires 7 conductors between the switchboard and the telephone sub-set (3 pairs and 1 single conductor; or, 2 triplex, and 1 single conductor). The stations restricted to local inter-communication require three

battery eliminator (or the dry cells when used). If a dry battery is employed, the cells should be connected in series. (For further details on "Building Wiring for Private Dial Systems" see Automatic Electric Company's Specification 5104.)

### 4.6 Connections at P-A-B-X

Fig. 1 shows the terminal strip at the P-A-B-X, and Fig. 5 shows the circuit of the P-A-B-X and associated equipment. All connections at the switchboard should be made in accordance



conductors between the switchboard and the telephone sub-set (1 pair and 1 single conductor). If desired, any of the buzzers or ringers may be mounted away from the ringer boxes. In this case, separate buzzers or ringers must be ordered.

Leads L-1 and L-2 may be multiplied from station to station, instead of from each station to the switchboard, if this is shorter distance.

Two No. 14 B. & S. gauge B.R.C. wires are required between the P A B X and the telephone

with the designation on the terminal strip and Fig. 5.

The "-" battery supply lead and the "+" supply lead should be connected to the proper terminals as indicated on the terminal strip. When a telephone battery eliminator is used, the third terminal (S) of this eliminator is not required, and, therefore, should not be wired to the switchboard terminal strip.

At each monophone ringer box, a ground strap should be provided between terminals 6A and 2B, as shown in Fig. 5.



## 5. METHOD OF OPERATION

The method of operation of the selective signaling Type 32-A P-A-B-X is very simple. The proper procedure is outlined in the subsequent sub-sections.

### 5.1 Local Calls

To make a local call, remove the handset from the cradle and, providing the system is not in use, dial the desired station's number. The one digit dialing will select and ring the called station for a short period of time. The ring may be repeated by simply re-dialing the number. The called station answers by merely lifting the handset. Disconnection is accomplished by restoring both handsets to their respective cradles.

### 5.2 Outgoing Calls (Trunk-Line)

To originate a call to a public-exchange subscriber, lift the handset from its cradle and then operate one of the trunk keys (the red key is associated with the first trunk and the green key with the second trunk). Listen on this trunk to determine whether it is idle or in use, before proceeding with the call. If the trunk is engaged, restore that trunk key and operate the other trunk key.

In the event the trunk-line terminates in a manual central office, transmit the calling number in the usual manner when the operator answers. Should the operator make an error in establishing the connection, slowly depress the push button a few times (without restoring the handset or the trunk key) to "flash" the operator.

If the trunk-line terminates in an automatic central-office, wait until "dial-tone" is heard, then proceed with the call by dialing the directory number of the desired public-exchange subscriber. In case an error is made in dialing the called subscriber's number, fully depress the push button once, without restoring the handset or the trunk key, to release the established connection, and then correctly dial the desired number.

Disconnection is accomplished in either case by simply restoring the handset to its cradle, which also restores the lever keys to normal.

### 5.3 Incoming Calls (Trunk-Line)

On incoming calls from the public-exchange, the individual trunk is identified either by the tone of the trunk-line bell, or by the color of the associated trunk signal lamp, if used. To answer an incoming call, first lift the handset of any station equipped to answer the trunks. Next operate the lever key associated with the trunk-line over which the call is received; that is, operate the red key if the call is on the first trunk, and the green key if the call is over the second trunk.

### 5.4 Transferring Incoming Call

In the event the incoming call is for another station, restore the trunk key, without replacing the handset. Then dial the number of the station wanted. The station called answers over the local communicating circuit by lifting the handset without operating any keys. The person transferring the call then instructs the station wanted to operate the trunk key (red or green) associated with the trunk over which the call was received. After the station wanted has been instructed, the person extending the call reoperates the trunk key to determine that the station wanted has answered the trunk call, and then retires from the connection by restoring the handset to the cradle. In this manner, an incoming call can be successively transferred from one station to another; or, if desired, two or more stations may engage the same call, provided the person at the 3-key station, if involved, does not operate the third (orange) key.

### 5.5 Secret Service

To secure secret service on either outgoing or incoming trunk-line calls, the orange key at the 3-key station is operated. This may be done at any time either before or during conversation. However, on incoming calls which have been transferred to the 3-key station, it is preferable not to operate the orange key until after conversation has started, in order to permit the person extending the call to check the transfer.

## 6. CIRCUIT EXPLANATION

A schematic circuit diagram of the selective signaling Type 32-A P-A-B-X is shown in Fig. 5. The circuit explanation of this system is given here.

### 6.1 Establishing a Local Connection

When a local intercommunicating call is initiated by removing the handset from the cradle (or when an incoming call is to be transferred by restoring the trunk key with the handset lifted), a circuit is established from ground, over lead L-1, through the telephone (with key springs A and D at normal), back over lead L-2, and through the winding of relay A to negative (-) battery, causing relay A to operate, and supplying transmission battery to the calling telephone. Relay A operating, completes a circuit to relay C, and opens part of an incomplete circuit to relay E, and the ROT magnet. Upon operating, relay C prepares a circuit to relay E and the ROT magnet; and also prepares N and the signaling circuit.

When the calling person dials the number of the desired party, relay A follows the dial impulses and when at normal, closes relay E and the ROT magnet. Relay E, being slow to release, will remain operated throughout the series of

pulses, thus holding open the starting circuit to relay N and also the circuit to the wiper of the minor switch. The ROT magnet, however, follows the impulses of relay A and rotates the wiper of the minor switch to the contact corresponding to the digit dialed.

After the dial pulses cease, relay E will release and close relay N to negative battery at the minor switch. In releasing, relay E also closes the signaling circuit. The signaling circuit is from battery at the minor switch, through the minor switch off-normal springs (numbered 1 and 2 in Fig. 5), through the make contacts of relay C (operated at this time), break contacts of relays E and G, wiper of the minor switch, and thence out over the signal lead to the respective grounded buzzer or ringer at the station dialed.

The buzzer or ringer will operate for a definite interval of time determined by the period of vibration of the weighted spring on relay N in the following manner. When relay N operates, its weighted spring will vibrate and close an intermittent circuit to relay G. Relay G is slow to operate and will not operate on the intermittent circuit. However, when the weighted spring comes nearly to rest, relay G will operate, open the signal circuit, and thus cut off the signaling current.

When G operates it also closes the release (RLS) magnet circuit. The release magnet operates, returns the minor switch to normal, which opens relay N, which in turn opens relay G. When relay G restores it opens the release magnet and prepares the signal circuit for further use if necessary.

If the called party does not answer and the calling party wishes to signal again, it is only necessary to repeat the dialing. Each time the called party's number is dialed, the station will be signaled.

Transmission battery is supplied both the calling and called parties through the winding of relay A. Returning both handsets to their respective cradles, when the conversation is finished, restores the local talking and signaling circuits to normal.

## 6.2 Answering an Incoming Trunk-Line Call

On incoming calls, a path for the ringing current impressed on the trunk-line at the central office, is completed through the windings of the ringer (in series with a 1 M.F. condenser) associated with that trunk, causing it to ring; thus indicating by an audible signal of a distinctive tone that a trunk call is waiting to be answered.

In the event that trunk lamp signals are used to indicate incoming calls, ringing current from the central office will cause the alternating current relay associated with that trunk

to operate and close the circuit to the signal lamp or lamps. When ringing current is cut off from the trunk, the A.C. relay restores; thus opening the circuit to the signal lamps.

Should the incoming call be on the first trunk, key No. 1 of the telephone at which the call is answered is operated downward. This disconnects the telephone set from the common inter-communicating circuit and connects it to the first trunk; thus completing the connection. If the call is answered at a two-key station, the connection from trunk-line to telephone is through break contacts of relay L and break contacts of the B relay associated with that telephone. When an incoming call is answered at the three-key station, the first trunk is connected to that telephone through break contacts of relay M.

An incoming call over the second trunk is answered similarly by operating key No. 2 (green) of the telephone at which the call is answered. In this case, the second trunk-line is connected to the answering telephone set, through make contacts of relay M, which operates when trunk key No. 2 is operated, if the call is answered at the three-key telephone; or through break contacts of relay J and make contacts of the B relay associated with the answering telephone, which operates when the call is answered at a two-key station.

## 6.3 Transferring an Incoming Trunk-Line Call

In case the incoming call is for some other station or person, the person answering the call restores the operated trunk key manually, and then dials the number of the desired person. If relay B or M is operated (call being on trk. No. 2) it remains so until the handset is restored to the cradle. When the desired person answers the local call, the person who first answered the incoming call advises the desired person (over the local inter-communicating circuit) that he is wanted on a central-office call on trunk No. 1 or No. 2, as the case may be. The desired person then operates the proper trunk key and answers the trunk call. The person originally answering the incoming call reoperates the trunk key to determine that the call has been picked up by the desired person, and if this is the case, restores the handset to its cradle; thus releasing relay M or B and disconnecting that telephone from the trunk.

During the time that the person initially answering the call is calling the desired person and conversing with that person, a holding bridge is connected across the trunk, through break contacts of springs D and H, and the make contact of springs B, to hold the connection at the central office. On incoming calls, transmission current is supplied to the answering telephone (or telephones) over the trunk-line from the central office.



#### 6.4 Outgoing Trunk-Line Call

To initiate a call to the public exchange, the handset is first lifted from its cradle and then trunk key No. 1 or No. 2, depending on which trunk is idle, is operated downward. This disconnects the telephone set from the common inter-communicating circuit and connects it to the trunk-line. If trunk key No. 1 is operated, the connection is completed through break contacts of the associated B relay and break contacts of relay L, when the call is originated at a two-key station; or through break contacts of relay M, when the call is from the three-key station. If trunk key No. 2 is operated, the associated B relay (or the M relay if the call is placed from the three-key telephone) operates from ground (+ battery), through a make contact of key springs C, and the 200-ohm winding of the associated relay to negative (-) battery. The telephone is accordingly connected to the trunk-line, through make contacts of the operated relay.

In event the trunk line is associated with an automatic central office, connecting the telephone to the trunk closes this loop and, if switching equipment is available at the central-office, dial tone will be heard. The person calling then completes the connection by dialing the desired subscriber's number in the same manner as from a public-exchange telephone.

If the trunk-line connects to a manual exchange, closing the trunk loop at the telephone signals the operator. When the operator answers, the person calling passes the number to the operator who completes the desired connection. Restoring the handset to the cradle releases the trunk key, and disconnects the trunk-line from the telephone.

#### 6.5 Secret Service on Trunk-Line Calls

When desired, a conversation between the person at the three-key station and a public-exchange subscriber can be made secret by operating key S downward, after the trunk key has been operated.

In case trunk key No. 1 has been operated, when key S is operated, a circuit is completed from ground (+ battery) at the telephone, through a make contact of springs "E", a break contact of relay M, and the 200-ohm winding of relay L to negative (-) battery. Relay L operating, disconnects the first trunk-line from all two-key telephones, so that no other telephone can establish connection with trunk No. 1 as long as key S remains operated.

When the trunk-line call is over the second trunk, relay M is operated when key No. 2 is thrown. Accordingly, when secret service key S is operated, a circuit is completed from ground (+ battery) at the telephone, through a make contact of springs "E", a make contact of relay

M, and the 200-ohm winding of relay J to negative (-) battery, causing relay J to operate. Relay J operating, disconnects the second trunk line from all the other telephones, thus assuring secret conversation.

If key S at the three-key station is not operated as described, conversation on public-exchange calls is not secret. Operating key S and one of the trunk keys at the three-key station only disconnects that trunk from the other telephones. It is apparent, therefore, that the other trunk is available to the rest of the stations. Attention is again called to the fact that the system has a capacity of three simultaneous calls, consisting of two trunk calls (either incoming or outgoing) and one local call.

Restoring the handset to the cradle, or restoring key S manually, releases relay J or L whichever is operated; thus reconnecting the trunk to the succeeding equipment.

### 7. OPERATING INSTRUCTIONS

In order to forestall interruptions in telephone service due to unstandard conditions that may develop, it is advisable to make periodical checks of the equipment to determine whether it is functioning properly. The necessary tests and inspections can be performed most effectively if a system of routines is followed. The routines recommended and the periods of their performance are contained herein.

#### 7.1 Checking Battery Voltage - Monthly

(a) Test the dry cell battery (when used) for proper voltage. The combined voltage of the dry cells should be twelve volts. Dry cells should be replaced as required.

(b) The battery eliminator (when used) should be tested for proper output voltage---twelve volts. See instructions in eliminator cover.

#### 7.2 Checking Adjustment of Relays - Yearly

Check all relays for proper adjustment. All adjustments should be made in accordance with the values shown on the standard adjustment sheets.

#### 7.3 Inspection of Telephones - Yearly

The following procedure should be followed when making an inspection of the telephones:

(a) Test the speed of the dial by dialing the digit "0"; approximately one second of time should be required for the return of the dial to normal. Standard Adjustment Sheet A-805 outlines the proper adjustment of the dial.

(b) The lubrication of the dial should be checked so as to conform with Standard Adjustment Sheet A-805.

(c) Broken mouthpieces and earpieces should be replaced; loose mouthpieces and earpieces should

be tightened.

(d) Frayed and worn telephone cords should be replaced.

(e) A transmission test should be made over each telephone by talking with another person, noting how well his voice is heard, and inquiring how well he hears the voice of the person making the test. In case difficulty is encountered with either the receiver or transmitter assembly, a new assembly should be in-

serted in its place, and the defective assembly returned for repairs.

(f) Test the central-office trunks from each trunk-connected telephone, checking transmission and proper operation of the trunk keys. Have test made from central office over each trunk, and check for proper operation of the trunk signals and trunk keys.

(g) When testing each telephone, note whether the local signal operates properly.

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