

A. E. CO. TYPE 10A2 KEY TELEPHONE SYSTEM
DESCRIPTION AND OPERATION

CONTENTS	PAGE
1. GENERAL	1
Features and Services	3
2. SYSTEM COMPONENTS	4
Central Office or PABX Line	
Circuit Cards	4
Manual Intercom Line	
Circuit Cards	5
Dial Intercom Selector	
Circuit	5
Automatic Tie Line Circuit	6
Ringdown Tie Line Circuit	6
Station Line Circuit	6
Common Equipment	6
Power Equipment	7
Packaging	9
13- and 15-Line Panels	11
3. SYSTEM OPERATION	12
Outgoing Call to Central Office	
or PABX	12
Incoming Call	12
Manual Intercom Call	13
Dial Intercom Call	14

1. GENERAL

1.01 This Section presents a description of the Type 10A2 Key Telephone System. Information on system operation is also included. The following paragraphs present general information, features and services, and a description of associated station apparatus and system components. This information is followed by an explanation of system operation for different types of calls. This Section has been reissued to present information on additional Type 10A2 Key Telephone System equipment. Covered is new equipment which enables non-key telephones to have pushbutton access to a Type 10A2 system. Also included is information on greater line handling capacity power supplies, and a new Type 10A2 Key Service Unit. Because of extensive revisions, marginal arrows have been omitted. For information on installation, refer to the appropriate Section in the 484-401 series of General System Practices.

1.02 The Type 10A2 Key Telephone System is a private telephone system operated manually by the customer's use of a pushbutton type key telephone at each station. The Type 10A2 system provides line circuits which may



Figure 1a. Type 86.



Figure 1b. Type 860A.

Figure 1. Key Telephones.



Figure 2. Type 86A Key Adapter.

connect to a central office, PBX, PABX, or another key telephone system. Two types of line circuits are available, and may be furnished in various combinations to meet a customer's requirements. Operating services, including audible signaling, visual signaling, and supervision are provided as required by the line circuits. No attendant is required to serve a key telephone system.

1.03 A Type 10A2 system provides an intercommunication facility capable of serving nine key telephone stations on a dial selective basis. If a customer requires more than a nine-station intercommunication facility, a Type 16A Key Telephone System may be used as the additional intercommunication facility.

1.04 In general, a Type 10A2 Key Telephone System consists of relay equipment and power equipment in prewired "combination" type packages called key service units, plus associated station apparatus. A key service unit contains the relays and other circuit components to furnish and control line circuits, and operating services. The station apparatus consists of key telephones for accessing the line facilities. These key telephones contain lamps for visual signaling and supervision, and may contain bells and buzzers for audible signaling.

1.05 A Type 10A2 system uses circuits and prewired apparatus designed to reduce the size of bulk apparatus. Lighter weight equipment is used to perform system functions. Line circuits utilize both electromechanical components (miniature relays) and solid state components (transistors, diodes, etc.). Line circuits are built on plug-in printed circuit cards that are provided on a per line basis.

1.06 Type 86 and 860A key telephones (Figure 1) which were used as station apparatus with the Type 10A1 Key Telephone system may be used with the Type 10A2 Key Telephone System. Type 80, 90M, 182A and 183 telephones may be used to place and answer calls through a key telephone system, provided they are modified to accommodate A-lead control. Type 880 Speakerphones may be used without modification. If pushbutton access to the key telephone system is desired, a Type 86A Key Adapter (Figure 2), or Type AE6050 or Type AE6051 keys (Figure 3) must be used in conjunction with these single-line telephones.

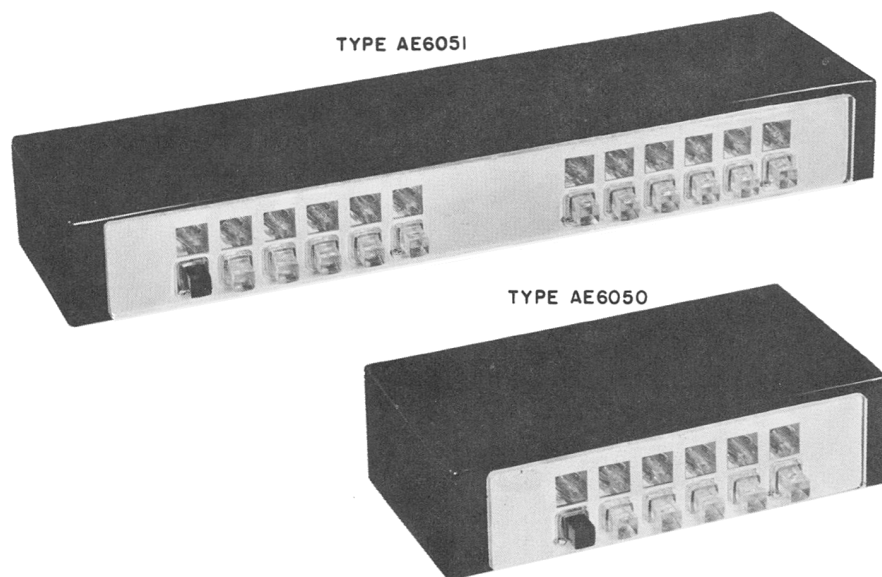


Figure 3. Types AE6050 and AE6051 Keys.

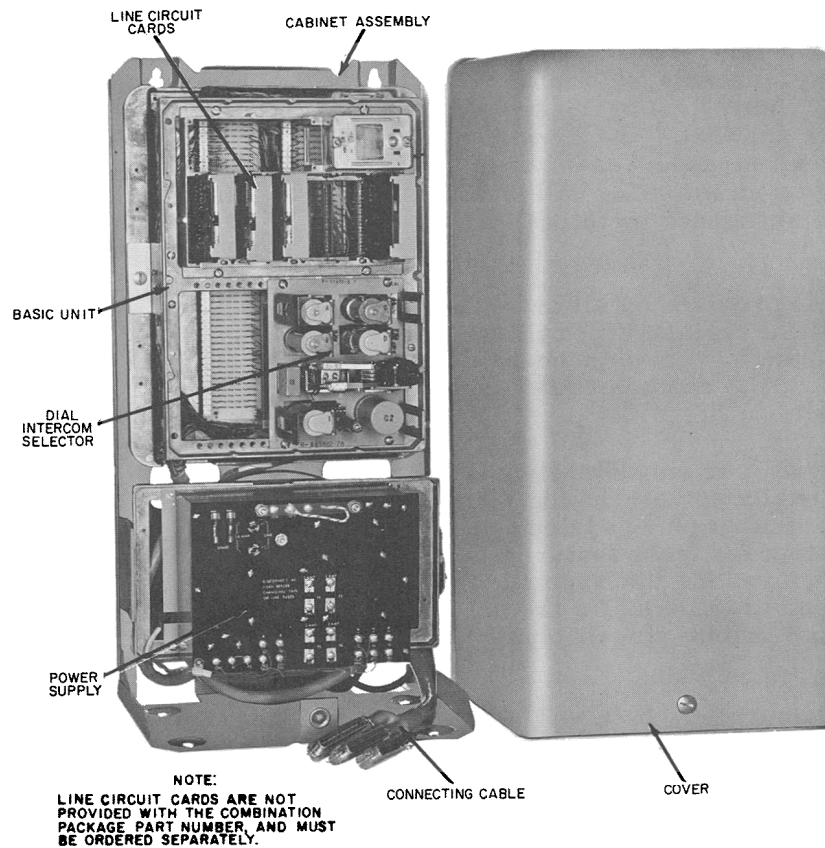


Figure 4. A Six-Line "Combination Package" Key Service Unit.

1.07 Where extension telephones are on a line, they may be excluded whenever it is desirable, if the key telephone serving the line is equipped with an exclusion feature.

Features and Services

1.08 Each key telephone station equipped with a Type 86 Key Telephone may access as many as five central office lines and hold each line. It is not necessary that each key telephone station in a system access all of the lines in the system, but only that each line be accessed by at least one key telephone.

1.09 A typical Type 10A2 Key Service Unit (KSU) (Figure 4) has provisions for mounting six line circuit cards (ordered separately). Any combination of central office or PABX line circuit cards, and manual intercom line circuit cards can be used. Any number of key service units may be used to make up a key telephone system.

1.10 Large capacity prewired 23-inch panels have provisions for mounting either 13- or 15-line circuit cards. Any combination of central office or PABX line circuit cards, and manual intercom line circuit cards can be used,

with the following exception: manual intercom line circuit cards cannot be used in receptacle 13 of either panel and require additional wiring if used in positions other than receptacles 7 and 8 on either panel. Any number of these panels may be used on a key telephone installation.

1.11 Automatic interrupted bell or buzzer signaling is standard on central office or PABX lines; however, steady signaling may also be furnished. Manual (coded) signaling is provided on manual intercom lines, and either manual or automatic signaling may be provided on tie lines. The equipment bells or buzzers may be connected to the individual lines on the premises, or grouped to a common ringer serving a number of stations. A bell, buzzer, or chime may be used as the common audible signal for each group of station equipment.

1.12 Visual signals are provided in the form of illuminated pushbuttons on the key telephone, Type 86A key adapter, and Type AE6050 or AE6051 keys. Lamps associated with the pushbuttons flash on an incoming call, wink to indicate a line on hold, and light steadily to indicate a busy line. An option is provided to obtain a steadily lit lamp during the hold condition, if desired.

1.13 All signaling on a central office or PABX line is on a locked-in basis. It is initiated by ringing current, controlled by locked-in relays, and ended by answering the incoming call. A time-out circuit stops locked-in visual and audible signaling on an incoming call when it is unanswered and abandoned by the calling party.

1.14 A hold feature is provided on all central office or PABX line circuits which allows both incoming and outgoing calls to be held while transferring a call to another station or answering another call.

1.15 Tie lines (automatic or ringdown signaling type) are available for linking key telephone systems with other private telephone systems. The equipment for these features is the same as that employed for the Type 10A1 Key Telephone System; tie line KTUs are not miniaturized and do not employ plug-in printed circuit cards.

1.16 For intercommunication between stations of the same key telephone system, or closely related key telephone systems, intercom lines may be supplied with manual (code) signaling or selective (dial) signaling.

2. SYSTEM COMPONENTS

Central Office or PABX Line Circuit Cards

2.01 A standard central office or PABX line circuit card (H-850345-A), WA-1400-A, used in the Type 10A2 Key Telephone System is shown in Figure 5. This line circuit card provides:

- (a) Flashing visual signal control on incoming calls.
- (b) Audible signal control on incoming calls.
- (c) Time-out on a per line basis.
- (d) Steady visual busy signal on a per line basis.
- (e) Holding facilities on a per line basis.
- (f) Visual wink (or optional steady if Type 10A2 equipment is accessed from a key telephone also accessing a Type 10A1 or 10A Key Telephone System for compatible lamp signals) signal to indicate a held line.
- (g) Hold removal when the line is re-seized.

- (h) Operation of central office or PABX lines under local power failure conditions.
- (i) An option to operate an audible signaling device once, for a period of one to three seconds, on each incoming call.

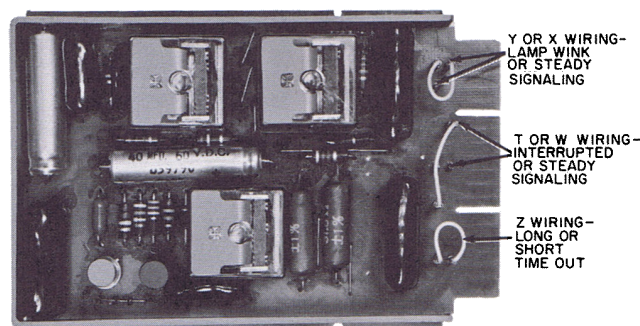


Figure 5. Central Office or PABX Line Circuit Card (WA-1400-A).

2.02 Each incoming line from a central office, PBX or PABX to a Type 10A2 Key Telephone System is provided with a separate central office or PABX line circuit in the Type 10A2 equipment. Line circuits are mounted on individual printed circuit cards.

2.03 Strapping options on each line circuit card (Figure 5) permit changes in the following circuit features:

- (a) The visual hold signal is factory wired to wink; by a change in strapping it may be made to light steady (same as busy).
- (b) Ringing signal control may be jumper strapped to provide interrupted ringing or steady ringing, or lines may be grouped to ring on a common audible signal basis. Factory wiring provides interrupted ringing.
- (c) The time-out delay period of visual and audible signal disconnect may be lengthened.

2.04 Line circuit cards are factory-wired for a short time-out delay on locked-in visual and audible signals. The short time-out delay allows 16 seconds to elapse if the call is abandoned after the first application of ringing current. If a second application of ringing current is sensed by the time-out circuit, it recycles to allow a nine-second time-out delay thereafter. If a ringing signal is not sensed by

the time-out circuit within the nine-second interval, release of the locked-in signals will be effected at the end of the timing interval.

2.05 A strapping option on each line circuit card allows the time-out duty cycle to be lengthened when the line served is not machine rung (Figure 5). By removing a strap, the time-out delay time is increased to an initial delay of 26 seconds after the first application of ringing current, and 15 seconds delay thereafter.

2.06 The Type 10A2 Key Telephone System line circuit has a high impedance ringing detection arrangement which permits an additional ringer to be placed ahead of the circuit (if required) without danger of pre-tip.

2.07 Maximum power drains exist whenever a line circuit is in the talking or hold condition. While in the talking condition, approximately 60 milliamperes at 24 volts dc is drawn per line; in the hold condition, approximately 30 milliamperes at 24 volts dc is drawn per line. The central office or PABX line circuit card is designed for optimum performance between 20 and 26 volts dc. If the potential drops below 20 volts dc, circuit failure may occur.

NOTE: DO NOT allow the potential to drop below 20 volts dc.

2.08 Local power is required for line circuit A-lead control and for hold as in other key telephone systems. If local power fails, all locally powered visual and auxiliary audible signals become inoperative. A local power failure will not affect the placing of central office calls from within the Type 10A2 system at any time, because the placing of such calls is not dependent upon local power. Notification of incoming calls can be obtained during local power failure conditions provided there are line signals connected at some points in the system or if there are supplementary switching arrangements to connect suitable audible signals to the lines for such periods.

Manual Intercom Line Circuit Cards

2.09 Manual intercom line circuit cards WA-1401-A, circuit number H-850345-A as shown in Figure 6 may be installed in any card position on the six-card key service unit. In the Type 10A2 system, manual intercom line circuit cards require that station apparatus have A-lead control to provide a ground for relay A, which controls the intercom line busy lamp. When A-lead control is provided, visual indication is given to all stations having access

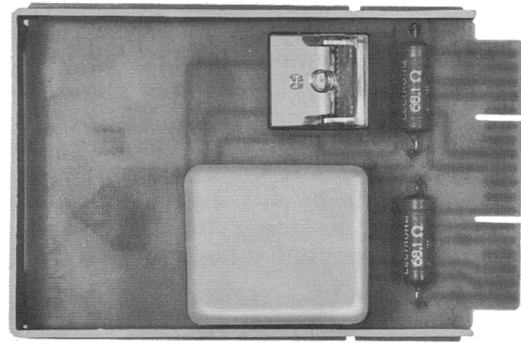


Figure 6. Manual Intercom Line Circuit Card (WA-1401-A).

to the manual intercom line, since all line lamps for this intercom line will be illuminated. Audible signaling is provided separately, usually by a signaling pushbutton and an external buzzer located at each station accessing the line.

Dial Intercom Selector Circuit

2.10 The dial intercom selector circuit (H-85973-1) consists of a rotary switch and a common control relay which furnish a common control relay which furnish a common talking intercommunication circuit with one common battery feed relay. It is usually furnished wired for single-digit selective dialing, accessing a maximum of nine intercom stations. A dial intercom selector circuit can serve more than nine stations, and can include various optional features when combined with units of the Type 16A Key Telephone System. For information on expanding the dial intercom selector to serve 18 stations, refer to the appropriate Section in the 484-401 series of General System Practices.

2.11 All stations associated with this circuit have equal unrestricted access to it; no privacy is afforded. The first station connecting to the circuit causes the associated intercom lamps at all of the intercom stations to light. Any station desiring to connect to the circuit and join the conversation, does so by operating the related pushbutton and lifting his handset.

2.12 The calling party, when connected to this circuit, dials the number corresponding to the desired station. This steps the wipers of the rotary switch to the signal lead of the called station. An audible signal then sounds at that station for a brief period of time. At the end of the signaling period, the rotary switch restores. No further signaling takes place unless the calling party chooses to redial the called station. The called station's number may be dialed for resignaling as often as desired.

(When the called number consists of two digits, only the last digit need be dialed for resignaling.)

2.13 Once the called station (or any other station) connects to the intercom, no further dialing is possible by any station, including the original calling station. No ring-back tone, busy tone, or intercept tone is furnished by this circuit.

Automatic Tie Line Circuit

2.14 The automatic tie line circuit, H-85781-2, (for additional information, refer to the appropriate section in the 484-400 series of General System Practices) consists of four relays. This circuit provides line facilities for linking a key telephone system directly to another telephone system. The other telephone system may be another key telephone system, a PBX or PABX as long as an automatic tie line circuit is provided at each end of the tie line. No hold feature is provided with this circuit.

2.15 Automatic tie line circuits may be accessed from any key telephone to which it is assigned. On incoming calls, all key telephone stations having access to the tie line circuit will be signaled audibly and visually, simultaneously. The station loop between systems linked by this tie line circuit should not exceed 1,000 ohms. To maintain adequate transmission level, not more than seven telephones should be connected to the tie line circuit.

2.16 When the tie line circuit is idle, the line lamps at all of the stations served by the tie line will be dark. The first station to seize this circuit causes the line lamps at local stations associated with the circuit to light steadily. Signaling the distant automatic tie line circuit is accomplished by operating the corresponding line pickup pushbutton and lifting the handset off-hook. On incoming calls, line lamps in key telephones accessing the corresponding line will flash. When the call is answered, the line lamps will light steadily to indicate a busy line.

Ringdown Tie Line Circuit

2.17 A ringdown tie line circuit, H-85781-3, (for additional information, refer to the appropriate Section in the 484-400 series of General System Practices) consist of four relays and provides line facilities for connecting a key telephone system directly to another private telephone system, local battery PBX, etc. A ringdown tie line circuit requires the use of two pushbuttons at each key telephone sta-

tion having access to it - a line pickup pushbutton and a signaling pushbutton. No hold feature is available. The station loop between key equipment locations linked by this circuit should not exceed 1,000 ohms.

2.18 All stations have equal access to the tie line. When the tie line circuit is idle, the line lamps at all of the stations served by the tie line are dark. The first station to seize the circuit causes the line lamps at all local stations associated with this circuit to light steadily. To signal the distant ringdown tie line circuit, depress the signal pushbutton; all stations connected to the distant ringdown tie line circuit will be signaled simultaneously. An incoming call is indicated by flashing lamps at all stations accessing the tie line and by individual or common audible signaling devices.

Station Line Circuit

2.19 A station line circuit, H-85781-4, (for additional information, refer to the appropriate Section in the 484-400 series of General System Practices) provides telephone service between a key telephone system and a distant station. Distant stations are generally non-key type telephones; therefore, the station line circuit is so designed that talking and signaling take place over the same pair of leads. This circuit requires only two wires to connect the key telephone system and the distant station. A battery feed relay in this circuit supplies battery and ground to the distant station. Since only one station is served by this battery feed relay, long loop circuits can be used without decreasing the quality of transmission. The loop circuit resistance should not exceed 1,000 ohms.

2.20 The distant station, by going off-hook, automatically signals the key system stations accessing the circuit. Any key system station accessing this circuit requires the assignment of two pushbuttons. One of the pushbuttons is used as a line pickup, and the other as a signal pushbutton. The first pushbutton key telephone station to seize this circuit causes the line lamps at all key telephone stations associated with this circuit to light steadily and indicate a line-busy condition.

Common Equipment

2.21 The only piece of common equipment used in a Type 10A2 Key Telephone System is an interrupter. This unit supplies the interrupted visual and locally derived audible signals. The interrupter uses a 10-volt a-c motor to drive a cam arrangement which operates a group of contacts at intervals to provide

the visual flash and wink signals to the lamps on the key telephones. One of the cams is used to provide interrupted ringing for audible signals. When a call is answered, the motor drives the cam back to its home position.

Power Equipment

2.22 Eight power supplies are available for use with the Type 10A2 Key Telephone System. (For terminal layout, refer to the appropriate Section in the 484-401 series of General System Practices.) Two of the eight power supplies may be internally mounted on all wall-mounted key service units which do not include dial intercom selector circuits, or on all other units which have a cabinet assembly. The remaining six power supplies must be externally mounted. The capacity of the following power supplies is based on seven key telephone stations per line (central office, PABX, etc.).

NOTE: Ringing generator output and buzzer output can be provided simultaneously from a power supply, but not over the same lead. Simultaneous ringing and buzzer output is accomplished by the use of a transfer circuit (H-85973-2). For additional information, refer to the appropriate Section in the 484-401 series of General System Practices.

2.23 D-C supply for signaling and talking.

Three of the power supplies (FD-1040-FP, FD-1040-AM, and FD-1040-DA) available for use with Type 10A2 equipment do not provide a ringing frequency output; signaling is accomplished by buzzer operation. Filtered battery is provided for talking and unfiltered battery is used for circuit operation (except in the case of FD-1040-DA which uses filtered battery for both purposes). One of these units is standard equipment in the six-line "combination" type package; the others are used in supplying power to panel-mounted equipment.

(a) The d-c power supply (FD-1040-FP) used with the six-line "combination" type package will mount inside of the key service unit. One of these power supplies must be provided for each six-line "combination" type package. It provides:

- (1) 18-28 volts, 0.9 ampere, filtered dc;
- (2) 9-11 volts, 1.4 amperes, 60-cycle ac;
- (3) 8.75-11 volts, 2.8 amperes, 60-cycle ac (buzzer);

- (4) 16-20 volts, 1.4 amperes, 60-cycle ac (buzzer);
- (5) 20-28 volts, 0.6 ampere, unfiltered dc.

(b) The d-c power supply (FD-1040-AM) available for use with the 13- and 15-line panels can be mounted in any convenient location near the equipment. One unit or equivalent must be provided for each 30 lines (central office, PABX, etc.) to be served. It provides:

- (1) 21 volts, 1.0 ampere, filtered dc;
- (2) 10 volts, 8.0 amperes, 60-cycle ac;
- (3) 20 volts, 0.5 ampere, 60-cycle ac;
- (4) 23 volts, 2.0 amperes, unfiltered dc.

(c) When it becomes necessary to provide power for a maximum of 40 lines, power supply FD-1040-DA or equivalent is used. It provides:

- (1) 24 volts, 4.0 amperes, filtered dc;
- (2) 10 volts, 10.0 amperes, 60-cycle ac;
- (3) 20 volts, 0.5 amperes, 60-cycle ac.

2.24 D-C supply with 20-cycle ringing. When 20-cycle ringing is required on either the six-line "combination" type package or on panel-mounted equipment, the same power supply (S-7351 or equivalent) is used. It has the capability of serving 30 lines and, therefore, may be used to serve more than one "combination" type key service unit. When it becomes necessary to provide power for a maximum of 40 lines, power supply FD-1040-DC or equivalent is used. Both power supplies must be externally mounted in some convenient location.

(a) The S-7351 power supply provides;

- (1) 21 volts, 1.0 amperes, filtered dc;
- (2) 10 volts, 8.0 amperes, 60-cycle ac;

- (3) 20 volts, 0.5 ampere, 60-cycle ac;
 - (4) 23 volts, 2.0 amperes, unfiltered dc;
 - (5) 90 volts, 0.05 ampere, 20-cycle ac.
- (b) The FD-1040-DC power supply uses filtered dc for both talking and circuit operation. It provides:
- (1) 24 volts, 4.0 amperes, filtered dc;
 - (2) 10 volts, 10.0 amperes, 60-cycle ac;
 - (3) 20 volts, 0.5 ampere, 60-cycle ac;
 - (4) 90 volts, 0.05 ampere, 20-cycle ac.

FM, and FD-1040-DB) are available for use with Type 10A2 Key Telephone Systems which require 30-cycle ringing. One of these power supplies will mount inside the six-line "combination" type package; the others are designed for use with panel-mounted equipment.

- (a) One power supply (FD-1040-FM or equivalent) designed for mounting inside the six-line "combination" type package must be provided for each six-line "combination" type package in the system. It provides:

- (1) 18-28 volts, 0.9 ampere, filtered dc;
- (2) 9-11 volts, 1.4 amperes, 60-cycle ac;
- (3) 8.75-11 volts, 2.8 amperes, 60-cycle ac;
- (4) 16-20 volts, 1.4 amperes, 60-cycle ac;
- (5) 20-28 volts, 0.6 ampere, unfiltered dc;

2.25 D-C supply with 30-cycle ringing. Three power supplies (FD-1040-CP, FD-1040-

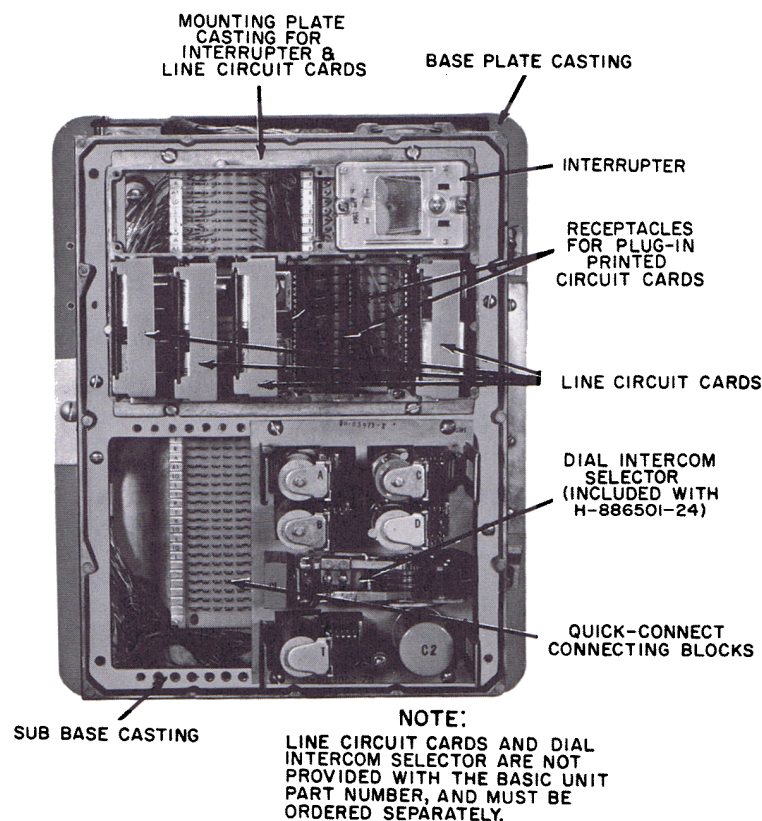


Figure 7. The Basic Key Service Unit Shown with a Dial Intercom Selector (Not Included with Basic Unit).

- (6) 110-118 volts, 0.05 ampere, 30-cycle ac.
- (b) A larger capacity power supply (FD-1040-CP) is available for use with panel-mounted Type 10A2 Key Telephone Systems. It will serve up to 30 lines (central office, PABX, etc.) and may be mounted in any convenient location near the Type 10A2 equipment. It provides:
- (1) 21 volts, 1.0 ampere, filtered dc;
 - (2) 10 volts, 8.0 amperes, 60-cycle ac;
 - (3) 20 volts, 0.5 ampere, 60-cycle ac;
 - (4) 23 volts, 2.0 amperes, unfiltered dc;
 - (5) 110 volts, 0.05 ampere, 30-cycle ac.

- (3) When it becomes necessary to provide power for a maximum of 40 lines (central office, PABX, etc.), power supply FD-1040-DB or equivalent is used. This power supply uses filtered dc for both talking and circuit operation. It provides:
- (1) 24 volts, 4.0 amperes, filtered dc;
 - (2) 10 volts, 10.0 amperes, 60-cycle ac;
 - (3) 20 volts, 0.5 ampere, 60-cycle ac;
 - (4) 110 volts, 0.05 ampere, 30-cycle ac.

Packaging

2.26 The basic unit of the Type 10A2 Key Telephone System is the six-line Key Service Unit which is prewired to accommodate as many as six plug-in line circuit cards (ordered separately), plus additional panel-mounted units of the Type 10A1 and 16A systems, Figure 7.

2.27 The basic unit (Figure 7 with the exception of the dial intercom selector circuit) of any key service unit in the H-886501 and H-886502 series is composed of:

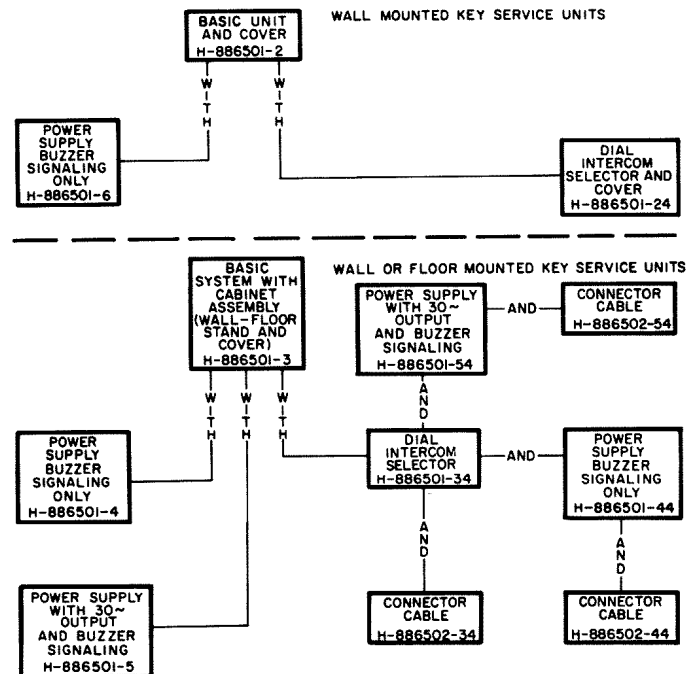


Figure 8. Available "Combination" Type Key Service Units.

- (a) A mounting plate casting to support interrupter and printed circuit card receptacles.
- (b) Two "quick-connect" connecting blocks, Type FD-1030-AN and FD-1030-AP (fanning strip included); fanning strip (as a loose item), FD-1030-AS.
- (c) A base plate casting.
- (d) An interrupter, Type FD-1058-AP.
- (e) A sub base for mounting Type 10A1 apparatus.
- (f) Six receptacles for plug-in printed circuit cards; Type WA-1400-A, and WA-1401-A.

2.28 Figure 8 shows 12 key service units which are presently available as "combination" type packages. Each of these units is available as a prewired assembly. Three of the units are for wall mounting only, while the remaining nine may be either wall- or floor-mounted. The three wall-mounted units are 16-3/4 inches high, 13-1/2 inches wide and 9-5/16 inches deep. The combination floor and/or wall mounted version is 28-1/2 inches high, 13-1/2 inches wide and 9-1/2 inches deep.

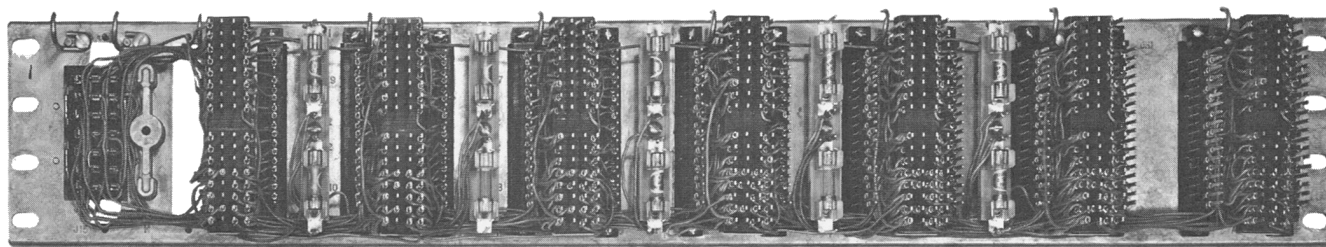


Figure 9a. H-886584-1 Panel (13-Line), Component Location.

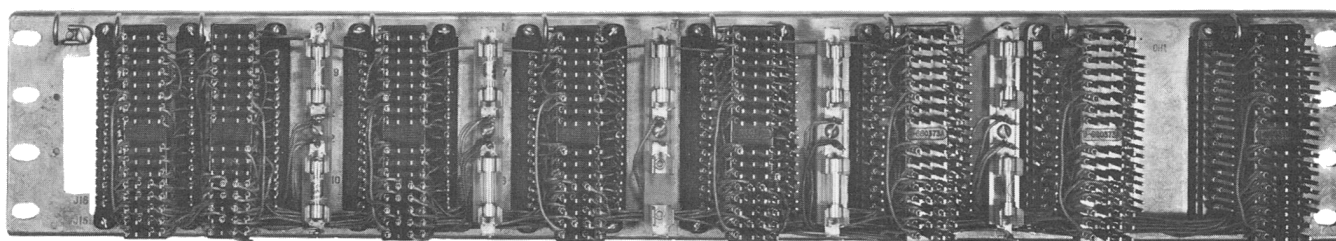


Figure 9b. H-886583-1 Panel (15-Line), Component Location.

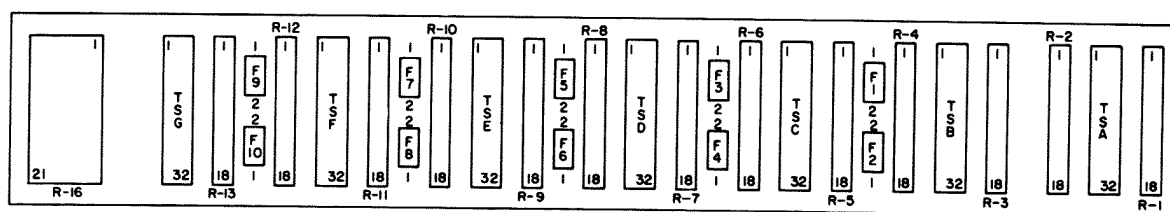


Figure 9c. H-886584-1 Panel (13-Line), Component Identification.

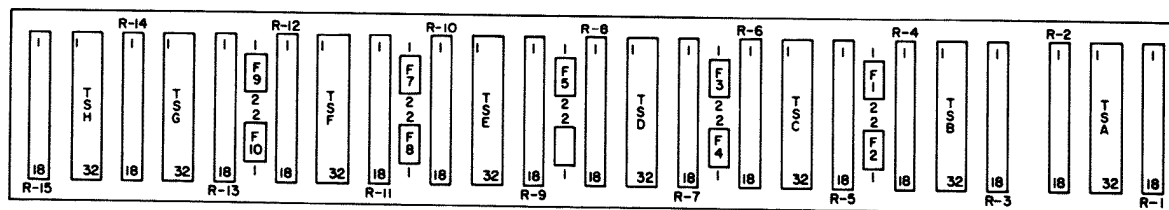


Figure 9d. H-886583-1 Panel (15-Line), Component Identification.

Figure 9. Type 10A2 13- and 15-Line Panels (Rear View).

13- and 15-Line Panels

2.29 The prewired panels, H-886583-1 and H-886584-1, (Figure 9) are four inches high and twenty-three inches wide, and can be mounted on any equipment rack 23 inches wide, or in housing units of the type used with Type 10A1 and 16A Key Telephone Systems. Some 23-inch racks may require the use of adapters to insure proper mounting hole alignment.

2.30 H-886583-1 panels have capacity for mounting 15 line circuit cards. Any combination of central office or PABX line circuit cards and manual intercom line circuit cards may be used, with one exception; manual intercom line circuit cards cannot be used in receptacle 13. Positions 7 and 8 are factory wired for manual intercom cards. These cards require filtered battery for transmission. If the manual intercom card is inserted in a position other than 7 or 8, the terminal supplying filtered battery to position 7 or 8 will have to be strapped to the position used.

2.31 H-886584-1 panels have a capacity for mounting 13 line circuit cards. Any combination of central office or PABX line circuit cards and manual intercom line circuit cards may be used, with the exception noted in Paragraph 2.30. This panel is equipped with a heavy duty interrupter to provide lamp wink, lamp flash, and interrupted ringing to the station equipment.

2.32 Each panel is arranged with small terminal strips for wire wrapping (Figure 8) that serve as connecting points for the common leads (LW, LF, LG, etc.) appearing on the panels. All common leads are factory wired between the line card receptacles and the terminal blocks. Each terminal block serves two printed circuit card receptacles.

2.33 Leads from the receptacle for each line, as well as the common leads, are terminated on the terminal strips for wire wrapping designated A through H on the H-886583-1 panels, and A through G on the H-886584-1 panels.

2.34 The common circuit leads are wired as two groups, and may be associated with separate common equipment or included as part of other grouped leads served by another panel of plug-in circuits. For additional information on the common circuit leads, refer to the appropriate Section in the 484-401 series of General System Practices. Panels may be interconnected to each other by means of common lead appearances associated with terminal block G on each panel. A 15-line panel must be connected to a 13-line panel so that the interrupter on the 13-line panel can be shared by both. Each of the eight interrupter contacts has sufficient current carrying capability to supply 50 lamps; therefore, each heavy duty interrupter can supply a maximum of 200 lamps in the lamp wink circuit, and 200 lamps in the lamp flashing circuit. Not more than 20 lamps should be connected to individual line circuit cards.

2.35 The 13-line panel can be equipped with a 22-conductor power cable, 22 feet long and a 7-1/2 foot connector cable (D-543295-F). The 15-line panel can be equipped with the 7-1/2 foot connector cable only. Either panel may be ordered without cables. The power cable is used to connect the panels to the local power source which serves them. When the panels are equipped with a connector cable, three Amphenol plugs are provided at terminations on the end of the cable. Panels ordered without the connecting cable require that all terminations be made to the terminal

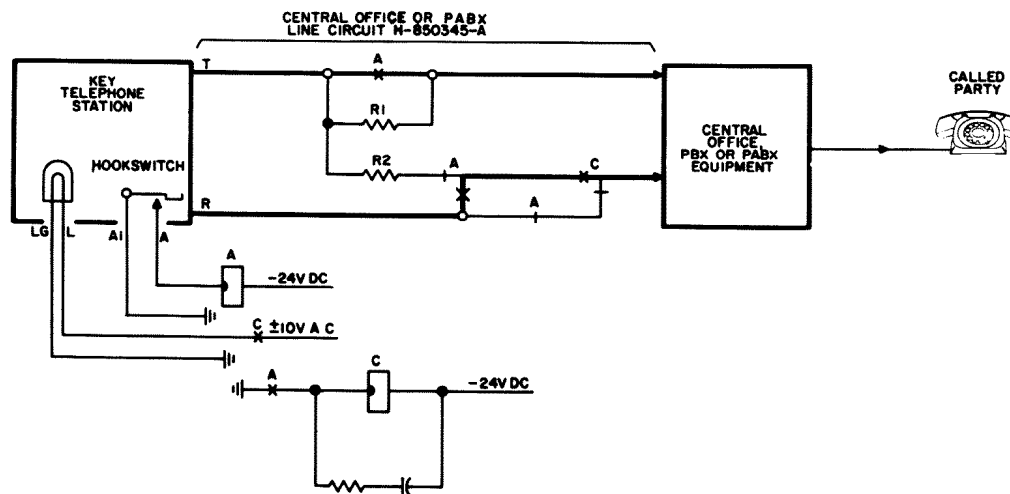


Figure 10. Outgoing Call.

blocks for wire wrapping on the rear of the panels.

2.36 The plug-in printed circuit cards (WA-1400-A, and WA-1401-A) are shown in Figures 5 and 6, respectively. These cards are 3-1/2 inches wide, and 5-1/4 inches long. The printed circuit cards mount all of the components necessary for the operation of the appropriate line circuits.

3. SYSTEM OPERATION

Outgoing Call to Central Office or PABX

3.01 When a call is placed from a key telephone station to a party served by central office, PBX, or PABX equipment (Figure 10), a central office or PABX line circuit card connects the key telephone station apparatus through the Type 10A2 Key Telephone System to the central office or other equipment that has access to the desired party.

3.02 An idle line is selected by operating one of the line pickup pushbuttons associated with a dark line lamp. Lifting the handset at the key telephone station then applies ground from lead A1 to the A lead of the selected line. This operates relay A on the printed circuit card in the key service unit to which the desired central office, PBX, or PABX line is connected. Relay A in turn operates relay C, which applies a 10-volt a-c potential to the line lamp lead. This lights a line lamp at each lamp-equipped station having access to the line, and the lamp glows steadily as a visual busy indication. Together, relays A and C complete a path from the key telephone station apparatus through the key telephone system to the central office, PBX, or PABX equipment. In the case of an automatic central office or PABX, this equipment will return dial tone to the calling party. In a manual office or at a PBX, it signals the operator or attendant.

3.03 Upon receipt of dial tone, the calling party proceeds to dial the desired number, and the call progresses in the usual manner. If an operator or attendant is accessed, the calling party conveys necessary

information to her; she will either make connection to the called party or permit the calling party to dial the desired number. When the conversation is completed and the calling party hangs up, the A1 ground on the A lead to the A relay is removed. The A relay releases and removes ground from relay C. Relay C restores. The line busy lamp goes out, and the loop across the T and R leads is opened.

3.04 In the event of a local power failure, outgoing calls may still be placed. Now, however, a path is completed to the central office, PBX or PABX equipment as shown in Figure 11. The station is connected to the line by break contacts of relays A and C when the handset is removed from its cradle. Resistor R1 is in series with the station apparatus during power failure operation but does not affect the quality of transmission. The loop limit is determined by the central office or PABX to which the call is being placed. The normal loop limit is 1200 ohms, and remains essentially the same during both normal system operation and power failure.

Incoming Call

3.05 When a central office or PABX line circuit (Figure 12) is idle, the three relays in the line circuit are unoperated. Transistor Q2 is conducting as a result of negative potential appearing on its base. If a call is placed to the line, ringing current is applied to the T and R leads from the central office. The positive pulses of the ringing current are rectified by diode CR3 and applied to the base of transistor Q2. These positive pulses cause capacitor C5 to charge, which reduces negative bias to the base-emitter junction of transistor Q2 and causes transistor Q2 to cut off. A negative potential appears at the collector of transistor Q2 as it cuts off. Zener diode CR1 conducts due to the rise in voltage across it. Transistor Q1 senses this negative potential through zener diode CR1, and begins to conduct. In conducting, transistor Q1 completes the ground circuit to energize relay B. Relay B upon energizing, starts the interrupter, and completes the lamp flashing circuit to the key telephones accessing the seized line circuit.

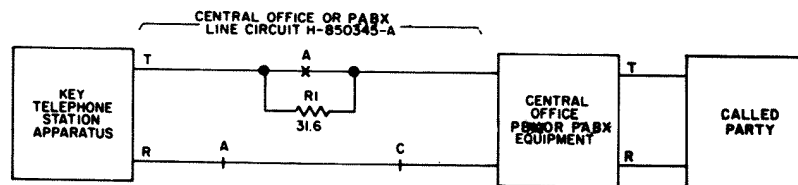


Figure 11. Outgoing Call During a Local Power Failure.

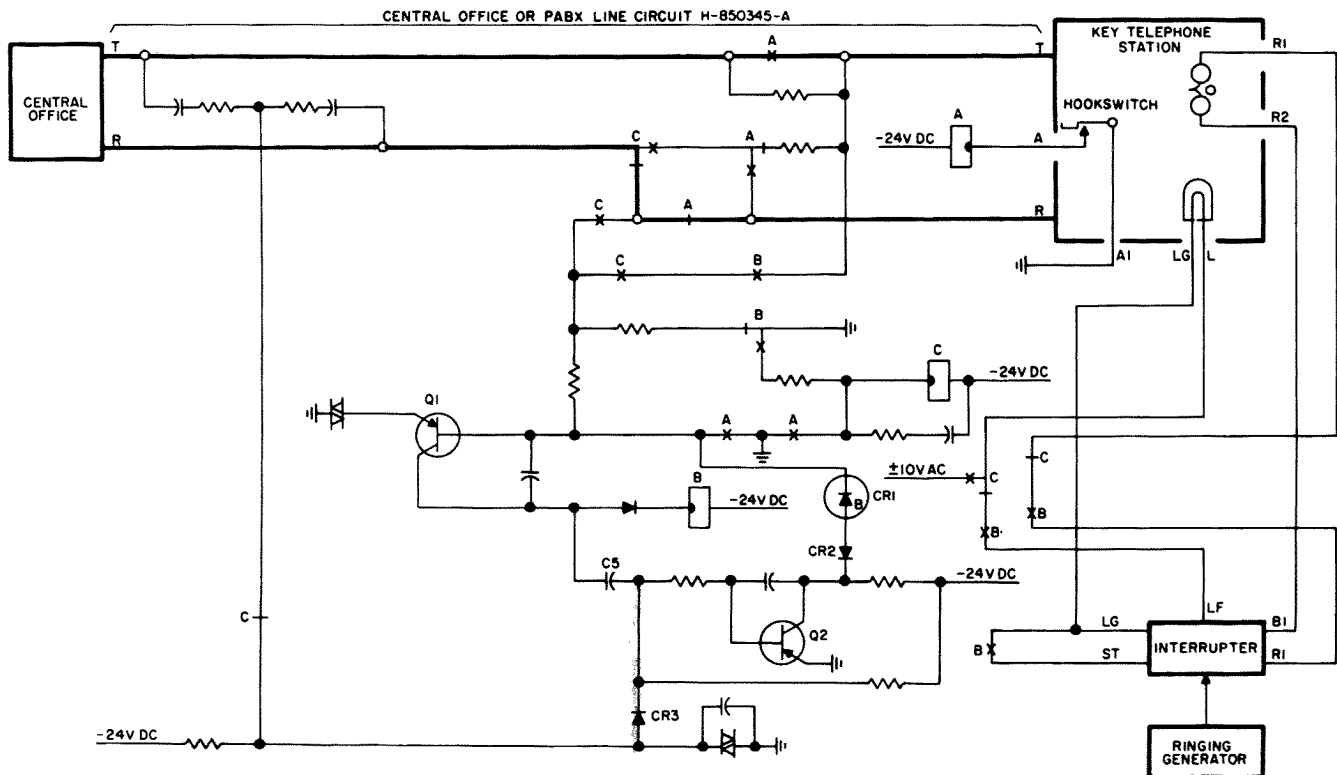


Figure 12. An Incoming Call Through a Central Office or PABX Line Circuit.

3.06 Starting the interrupter applies ringing current to the ringers of the key telephones, and an interrupted voltage to the associated lamp circuits. The ringers give an audible indication that there is an incoming call, and the line lamp at each key telephone associated with this line flashes at 60 IPM to provide a visual indication of the line on which the incoming call is appearing.

3.07 Depressing the line pickup pushbutton and lifting the handset of one of the key telephones causes ground to be applied to relay A. Relay A operates, energizes relay C, and applies a ground to the base of transistor Q1 which cuts off. Transistor Q1, cutting off, releases relay B, which stops audible signaling, changes the associated line lamp from a flashing to a steady condition, and allows transistor Q2 to again conduct. Conduction of transistor Q2 holds transistor Q1 cut off and thereby prevents the accidental restart of signaling when the parties disconnect.

3.08 Energizing relay A and relay C completes a metallic path from the central office to the key telephone which terminates the incoming C.O. ringing signal. When conversation is complete, and the called party hangs up, ground is removed from the A lead

and relay A. Relay A restores, and removes ground from relay C. Relay C restores, causing the line busy lamp at all of the stations accessing the line to go dark and indicate the line has returned to idle.

Manual Intercom Call

3.09 A manual intercom line circuit (Figure 13) provides the means for connecting two or more key telephones to a common talking circuit over which the parties at those stations may converse. Signaling on a manual intercom line is accomplished by means of a signaling key and a bell or buzzer at each station. Whenever a call is placed, all stations served by the intercom line will be signaled. Signaling may be coded to alert a particular station to an incoming call, or noncoded to call all of the stations.

3.10 Two pushbuttons must be provided at each key telephone served by a manual intercom line. One pushbutton is a non-locking signaling pushbutton key; the other is a locking line pickup pushbutton to seize the line.

3.11 To place a call, the calling party depresses the line pickup pushbutton associated with the manual intercom line circuit and lifts the handset from the cradle or hanger

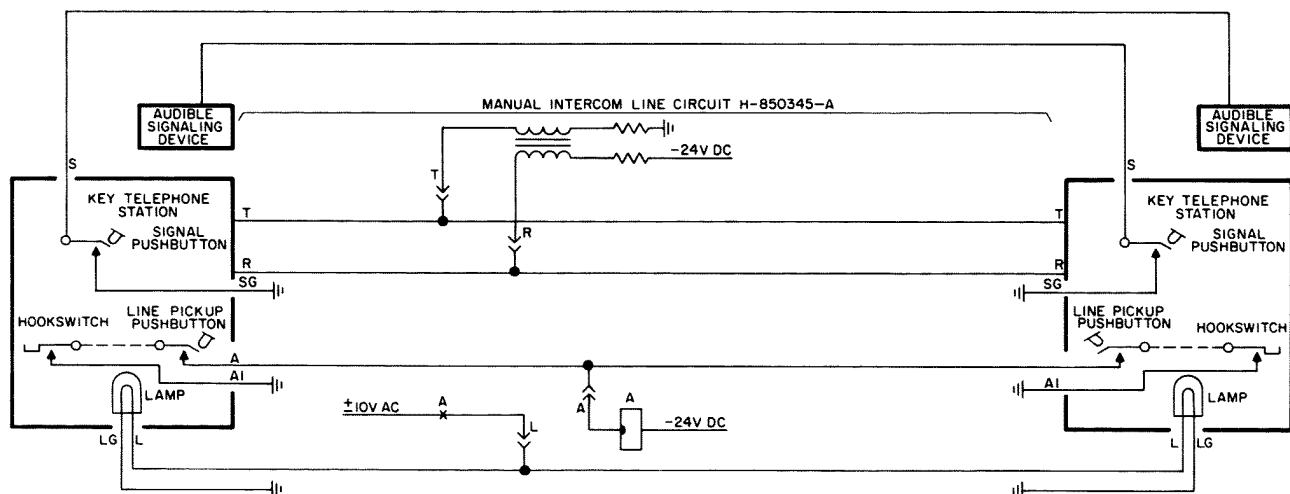


Figure 13. A Typical Manual Intercom Line Circuit.

at the key telephone station. The signaling pushbutton is then operated in the prescribed sequence to alert the called party. The bell or buzzers at all the stations served by this circuit will sound. The called party depresses the pickup pushbutton associated with the manual intercom line circuit, and lifts the handset of the telephone. Depressing the pickup pushbutton and lifting the handset at the calling station closes ground from lead A1 to lead A which energizes relay A in the manual intercom line circuit. Relay A energizing, lights the busy lamps at all of the stations accessing the manual intercom line circuit. When the called party answers, conversation can take place. Battery and ground is sup-

plied through the resistors and coil of the manual line circuit to the calling and the called parties.

3.12 When the conversation is completed, both parties hang up and remove ground from the A lead. The A relay restores and extinguishes the busy lamps at all of the stations to mark the intercom line idle.

Dial Intercom Call

3.13 To place a call using a dial intercom selector circuit, the calling party operates the corresponding pickup pushbutton on the key

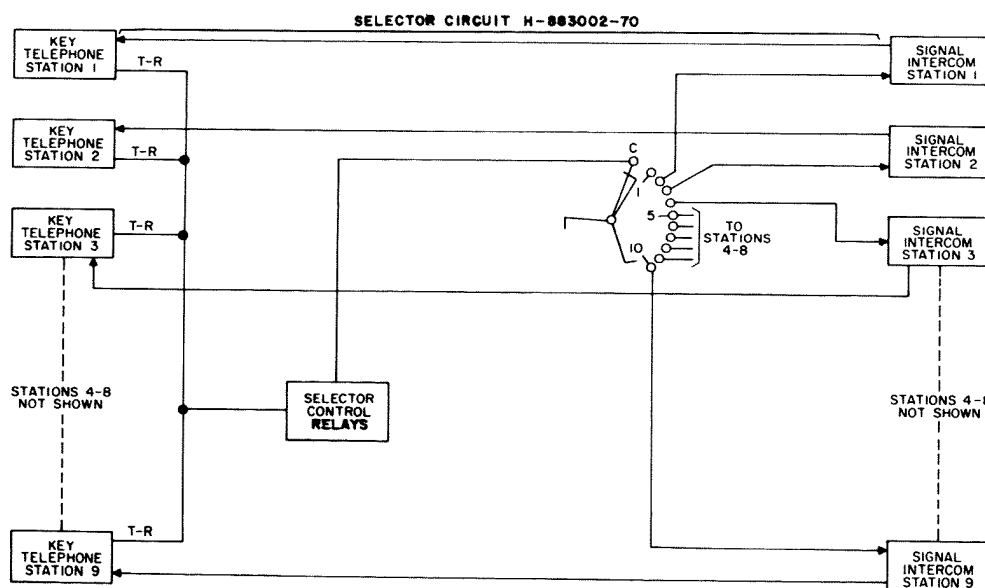


Figure 14. Dial Intercom Call.

telephone and lifts the handset. The busy lamps at all of the stations served by the intercom will light. The calling party now dials a digit (2-9) which corresponds to the desired party. See Figure 14. The control circuit in the intercom selector steps the rotary switch to the signaling lead of the called station. The wipers of the rotary switch remain in the position for one to three seconds, during which period the audible signal at the called station sounds. After 1 to 3 seconds, signaling ceases, and the rotary switch homes. If the called party answers, conversation may take place; if not, the calling

party may redial the digit corresponding to the called party. (When the called number consists of two digits, only the last digit need be dialed for resignaling.)

3.14 The calling party may dial the called party's number again each time he desires. The audible signaling device at the station will sound for 1 to 3 seconds; however, once the called party or any party served by the dial intercom selector circuit answers the intercom call, no further dialing can take place from any station until the circuit is released.