

**NO. 300 SWITCHING SYSTEM**  
**STATION SYSTEMS**

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**1. GENERAL**

**A. Introduction**

**1.01** This section describes the No. 300 switching system which has been developed to replace the 102A key equipment used in FAA (formerly CAA) air route traffic control centers. This system was designed specifically to meet FAA requirements and provides operational features and position equipment to meet their particular needs.

**1.02** The purpose of this system is to provide voice communications facilities between personnel at ARTCC's and to other allied agencies over regular telephone lines and also to connecting customer-owned radio facilities.

**B. General Operation**

**1.03** Attendants at operating positions in an ARTCC may establish connections for outgoing service by one of two methods, direct access (DA) or indirect access (IA). For direct access, each position is equipped with a number of DA keys, there being one key per line. By depressing one of these nonlocking-type keys, the attendant is connected directly to another attendant or to the line which he desires. Appropriate lamp indications are provided for signaling purposes at both terminating and originating ends within a center as well as at other positions having direct access to the same line.

**1.04** The IA method enables a position attendant to be connected to any line or attendant in the No. 300 system even though he may not have DA capability. This is accomplished by depressing a single nonlocking-type button on the position which enables the attendant, by means of a push-button (PB) dial, to dial the

## SECTION 993.002.01

code address of the wanted line or attendant. The PB dial may be used with either access method if the line connected to is of the dial type requiring further dialing, such as CO and PBX lines or selective signaling lines.

**1.05** Incoming calls, with the exception of direct position intercommunication, are indicated by a flashing lamp. When answering calls, it is only necessary for the position attendant to depress the proper key associated with the line or feature being answered. Established connections which have been answered may be released by the operation of a release button, by the removal of the plug from the attendants telephone jack, or by the operation of another line or special function key.

### C. Objectives

**1.06** As indicated above, No. 300 switching system was designed to meet specific customer needs and requirements. To achieve this, a number of objectives were established as follows.

- (a) Simplify and reduce controller's work operations.
- (b) Decrease telephone equipment space requirements in the attendants console.
- (c) Increased flexibility in handling both long and short term traffic changes.
- (d) Simplify installation and maintenance effort.

### D. Principal Features

**1.07** The functions of this system include a number of features, the more important of which are as follows.

- (a) Enable a position attendant to have direct access to a number of most wanted lines or positions by merely operating a key (one per line).
- (b) Enable a position attendant to have indirect access to any position or line available to the center by the use of push-button dialing.
- (c) Permit incoming long line calls intended for a specific position in the ARTCC to be indicated in that position.

(d) Circuit arrangements to permit establishment of connections over either dial, manual, or selective signaling type lines.

(e) Incoming dial selection of attendants positions with call storage and sequence answering and with primary and secondary answering responsibility arrangement on certain lines.

(f) Position intercommunication on an override basis so that one position always has access to another even though it may be busy.

(g) Distinctive types of lamp indications at positions such as steady, flashing, fluttering, or winking to indicate status of line or call.

(h) Individual position control of lamp displays to eliminate any unnecessary flashing or steady lamp displays.

(i) Provisions for using the position telephone set with FAA-provided radio control features on an automatic transfer basis.

(j) A light load lamp panel to indicate all calls to a center during light traffic periods.

(k) An audible guard tone signal on dial lines while dialing is in progress.

(l) Arrangements to permit a multiplicity of line and position connections at the same time.

(m) Arrangements to prevent a position from establishing a connection to more than one line or position at the same time.

(n) Rapid service connections via push-button dialing.

## 2. EQUIPMENT UNITS (Fig. 1)

### A. Line and Position Connector

**2.01** The line and position connector consists of relay and crossbar switch equipment for connecting attendant telephone circuits to various types of lines and to other attendant telephone circuits. Connections to lines are established either for outgoing or incoming calls.

**2.02** Each line and position connector circuit is divided into two similar line connector frames with each frame having a group of com-

mon control relays known as a controller. For increased reliability, the controller consists of two parts, either of which will handle all traffic on the frame in the event of trouble. Normally, the controller parts are used alternately in serving the frame traffic.

**2.03** The frames consist of fields of 200-point crossbar line switches with the positions connected to the verticals and the lines connected to the horizontals. A field of 200-point crossbar switches, in columns corresponding to the columns of line switches, provides for connecting the push-button dial leads to the leads associated with a line that requires dialing. The line leads are wired from the dial switch horizontal to the register sender link.

#### **B. Indirect Access Control Circuit**

**2.04** The indirect access control circuit (IAC) with an associated register connector (RC) provides a means whereby any attendant may connect his telephone circuit to any one of the other line circuits or positions by the use of his indirect access key and the push-button dial.

**2.05** Two or more IAC and associated RC circuits are associated with each line and position connector frame, the number depending upon the traffic demand at the particular installation. The circuits are arranged to be used in order as they serve the requests for indirect access on the frame. If a request from one attendant position for an indirect line connection is in the process of being served by one of the IAC circuits at a time when a request is received from another position, the next idle IAC serves the second request. When a connection between an attendant position and a line is completed, the IAC is released and available for serving another request.

#### **C. Register Connector Circuit**

**2.06** The register connector circuit (RC) registers code signals from the push-button dial set of an attendant making an indirect access call and translates these signals into information which is used to operate a select magnet in the line and position connector circuit corresponding to the dialed code.

**2.07** The register connector is used on all indirect access-type calls and its function is completed when the dial pulsed code is registered and the proper select magnet has been operated. If the line selected is one requiring further dialing, these additional digits are registered in the register sender described below. It might be noted here that calls may be answered or originated via indirect access.

**2.08** The circuit is designed to handle only 2- or 3-digit code numbers, the digits of which are dialed in sequence. The first digit of the dialed code determines whether the number is going to have two or three digits. If the first digit indicates a 3-digit number, the circuit waits until after three digits have been dialed before signaling the LPC to make the final connection. If the first digit indicates a 2-digit number, the circuit signals the LPC immediately after the second digit is registered and translated. A table on the circuit drawing indicates assignable code numbers with groups varying in size from a minimum of 90 assignable codes to a maximum of 900.

#### **D. Register Sender Circuit**

**2.09** The purpose of the register sender (RS) is to convert the push-button dial pulses into a regular ten pulses-per-second pulsing rate when connections are made via DA or IA to CO or dial PBX line circuits, PBX tie trunks, 600/1500-cycle, or SS1 selective signaling circuits. The register sender simply replaces the rotary dial in generating pulses at the standard rate.

**2.10** The RS will register a maximum of seven digits from the push-button dial and will recognize the class of call. When a dial line has been seized for an outgoing call either by DA or IA, it is connected to an idle RS by the operation of the register sender link circuit with a maximum of five senders served per link circuit. When the RS is ready to receive dial codes, the RL lamp is lit on the PB dial.

**2.11** The register sender checks for improper code information being received from the PB dial and indicates this by changing the RL lamp from steady to flashing. It makes abandoned call checks and releases when the asso-

ciated link circuit times-out because of delay in dialing by the attendant. In case an improper code is indicated, or at any time before dialing is completed, the stored information may be cleared by the attendant by the operation of the CLEAR button on the PB dial.

**E. Register Sender Link Circuit**

**2.12** The register sender link circuit serves as the connecting link between dial lines and the register senders. The heart of the circuit is a crossbar switch field where the actual connection between the senders and dial lines is made. Since eleven paths are necessary for each connection, the horizontal strapping is severed in the center of the 100-point crossbar switches.

**2.13** The register sender link permits a maximum of five simultaneous link connections, and at the same time prevents more than one register sender from being connected to a line simultaneously, or more than one line from being connected to a register sender. A register sender time-out feature is incorporated in the link circuit to recognize delayed dialing intervals.

**F. Local Dial Line Circuits**

**2.14** This circuit provides for 2-way service between the system and certain local dial stations. It is arranged for automatic ringing toward the dial station and enables the station to dial any one of 90 position attendants. It also provides a means for storing a maximum of three incoming calls at a position and for answering them in the order in which they are received.

**2.15** The local line circuits consist of individual step-by-step switches with banks that are wired in multiple. The primary answering circuit of each position is connected to a set of bank terminals on the switches according to the 2-digit number assigned each position. This permits a selection of a maximum of 90 positions by these local dial lines.

**G. Signal Circuit**

**2.16** A common signaling circuit is used to provide a means for flashing, winking, and fluttering the various indicating lamps at an

attendants position. The circuit consists of two sets of flashing relays designated REGULAR and ALTERNATE. Should the regular set fail, an automatic transfer to the alternate takes place and an alarm is given.

**H. Selective Signaling Circuits**

**2.17** Arrangements in the No. 300 switching system provide for connections to the 600/1500 cycle and SS1 selective signaling systems. These systems are described in other sections.

**2.18** With these arrangements, any position assigned a code may be selectively signaled on an incoming call and, by means of the register sender circuit, outgoing pulsing may be applied to the selective signaling circuits. Terminations for incoming calls will usually be to the long lines common answering equipment. Outgoing calls requiring use of the selective signal circuits may originate either by IA or DA.

**3. POSITION EQUIPMENT (Fig. 2)**

**A. Push-Button Dial**

**3.01** The push-button (PB) dialer is a set of nonlocking-type push-button keys at a position to take the place of a rotary dial. The PB dial includes three control buttons (START, END, and CLEAR), a ready (RL) lamp, and ten code buttons labeled in accordance with the conventional dial. The code buttons can be quickly depressed in a sequence corresponding to a given code in order to direct the system to perform an operation.

**3.02** When using the PB dialer, a tone is heard which is slightly higher in pitch than dial tone. This tone, which is called guard tone, indicates dialing is in progress and is heard by the position attendant using the dial as well as by any other attendant who may select the same line while dialing is taking place. The tone ceases when outpulsing of the dialed information is completed. The functions of the control buttons are as follows.

**3.03** The START button is used only when a second dialing sequence is required such as on selective signaling lines to call in additional stations or if more than seven digits are required.

**3.04** The END button is used only on CO or PBX lines to tell the system that dialing is completed. This must be depressed after the last digit of the code.

**3.05** The CLEAR button is used to clear out any information sent by an attendant during the dialing period. This permits the attendant to clear the register sender at any time before dialing is completed or if a flashing READY lamp indicates that an unassigned code has been registered or two keys have been depressed simultaneously. Use of the button will clear out the dialed information so that the attendant may dial again.

#### **B. Primary and Secondary Answering**

**3.06** Each position may be provided with primary and secondary answering lamps and keys, each group of which consists of four lamps and a button. Three of the lamps are used to indicate incoming calls while the other lamp indicates when the position has answered a call as a result of depressing the button. The primary answering (PA) group provides terminations for calls which are directed to a particular position by means of local dial line circuits or PBX tie lines from locations outside the ARTCC. (See 3.10.) The secondary answering (SA) arrangement permits calls directed to one position to be displayed and answered at another position designated to provide back up or secondary answering service to the primary answering position. Operation of a locking-type turn button designated SEC LPS at any position will cause the PA display at that position to be duplicated as an SA display at a certain previously designated position.

#### **C. Long Lines Common Answering**

**3.07** A long lines common answering (LL COM) feature is provided at each position to permit the answering of a predetermined number of selective signaling-type private lines by depressing a common button. Each position is provided with two lamps and a button for this purpose. One lamp is used to indicate that one or more calls have been directed to the position and the other to indicate the LL COM button has been depressed to answer the call. In the event a position has direct access to a long line

circuit, the termination of an incoming call is directed to the DA equipment and not to the LL COM display.

#### **D. Lamp Displays**

**3.08** Certain lamp signals are provided to show line status indications. These are as follows.

- (a) An *unlit* lamp indicates the line is not in use at any position and is idle or feature is not in use at position in question.
- (b) A *steady* lamp indicates the line has been selected or is being used at another position and is busy.
- (c) A *flashing* lamp (1/2 second on, 1/2 second off) indicates an incoming call on a line to which no position is connected.
- (d) A *winking* lamp (60 ppm) is associated only with calls on CO or PBX lines and indicates the line is being held.
- (e) A *fluttering* lamp (12 pps) indicates the line or feature to which a position is connected.

**3.09** Other lamp indications provided are as follows.

- (a) Push-button dial *ready* lamp is on the push-button dial set. A steady lamp indicates that a dial path is established and that pulsing can begin. A flashing lamp indicates that a nonexistent code has been registered or a dialing error has been committed.
- (b) The position *override* lamp when lit (only steady) indicates that another position, or positions, has joined the position via the intercom feature.
- (c) The position *pilot* lamp when off indicates that there are no unanswered calls especially directed to that position. A flashing pilot lamp indicates there are unanswered incoming calls directed to the position. It does not flash when lamps are lit in the secondary answering display.

#### **E. Position Blanking**

**3.10** A position blanking feature is provided in each position which automatically extinguishes all other lamp displays at a position

upon receipt of an incoming call (or calls) for which the position has primary answering responsibility or which has been directed to the position by a selective signaling line, leaving only the flashing pilot lamp and the line or answering feature lamp (or lamps) involved. The blanking feature operates in conjunction with the position pilot which remains flashing until *all* of these calls have been answered. A fluttering lamp, which indicates an established talking connection at the position, is not extinguished.

#### F. Common Control Keys

3.11 All positions are equipped with common control keys to permit control of the following features.

- (a) The *hold* key is a nonlocking-type push button used to establish a hold condition on CO or PBX lines only. A winking line lamp indication is provided at all positions having DA to the line to indicate when a line is held. Should the connection have been originally established via IA, there is no indication at the position to show the line is being held unless it appears in the position's DA display.
- (b) The *short ring* (SR) key is a nonlocking-type push button used to provide a timed ringing signal on manual ringdown lines. (This is an optional feature.)
- (c) The *flash or ring* (FL-RING) key is a nonlocking-type push button used to take the place of a switchhook on CO or PBX type lines. It may also be used on automatic ringdown lines to provide additional ringing current on the line if desired.
- (d) The *chime cutoff* (CH) key is a locking-type turn button which permits the attendant to disable the position chime.
- (e) The *release* (RLS) key is a nonlocking-type push button used to disconnect the attendant from any feature or line.
- (f) The *signal restore* (SIG-RST) key is a locking-type turn button with an on and off position used to control the position blanking feature.
- (g) The *secondary lamps* (SEC LPS) key is a locking-type turn button used to control whether or not the PA display at that

position is duplicated in the SA display at the backup or supporting position.

- (h) The *headset-loudspeaker* (HS-LS) key (not shown on Fig. 2) is a nonlocking push button. It has an associated lamp located above it with both units mounted in the same line-up as the other keys and lamps. This key is used to control whether the loudspeaker or headset receiver is used at a position. When the lamp is lit, the loudspeaker is in use and when the lamp is out, the headset is being used.

#### G. Light Load Lamp Panel

3.12 This panel, which consists of a field of lamps provided at specific position locations external to the regular position equipment, indicates the status of incoming calls to the ARTCC. The lamp field is a multiple of some or all line lamps, as desired, so that the status of the lines can be observed at one or more locations. This permits incoming calls to be answered at these locations by indirect access. It is expected that it will be used only during light load periods and may be turned off or on by means of a lamp display cut-off (LD CO) key.

#### H. Position Recording

3.13 All positions are wired to customer owned recording equipment. Beep tone will be automatically provided on external lines where necessary.

#### I. Supervisors Position

3.14 The purpose of this position is to enable a supervisor to establish direct and immediate talking and dialing connections to any line circuit without dependence on the common switching circuits. This is accomplished by direct connections being made to any of the line circuits when the supervisor attendant operates the line key associated with a line. If the position is equipped with the indirect access feature, the common switching equipment is used the same as it would be for regular IA type calls. Provisions are made to have primary answering and long line common features at the position. In answering these types of calls, the regular circuit equipment is also used.

**3.15** It is not expected that all position attendants will have access to all types of facilities in the system. However, the supervisors position will be equipped with a number of access control keys. These keys, when operated, permit any attendant to gain access to the line controlled by the key via IA, after which the key is restored to normal. The purpose of these keys is to maintain supervisory control over the use of regular telephone lines accessible to the center.

#### **4. METHOD OF OPERATION**

##### **A. General**

**4.01** Each attendant's position has associated with it a group of relays which includes a relay per key for each of the position's line or special function keys. The operation of a key operates its associated relay which remains locked up until the end of this call when it is released by the attendant due to operation of his release key, by the operation of another line or special function key, or by the removal of the telephone set from its jack. In the following paragraphs, it is assumed that this action takes place.

##### **B. Direct Access (Fig. 3)**

**4.02** The operation of any one of the line keys causes the controller portion of the line and position connector to function. This action is sufficient to operate first the proper select magnet and then the proper hold magnet in the line and position connector which closes the crosspoints and establishes the connection as determined by appropriate wiring. After the closure of the crosspoints, the controller is released. At the calling position, a fluttering lamp signal is indicated, and a steady lamp signal at all other positions having direct access to the line. The entire operation to establish the connection takes approximately 0.2 second.

**4.03** If the line selected is a CO, PBX, or of the selective signaling type, dialing is required to complete the call. The seizure of the line by the line and position connector activates the register sender link which in turn seizes a register sender. Seizure of a sender by the link causes the READY lamp on the PB dial to light

steady. On CO and PBX lines, dial tone will be heard and nothing on the selective signaling lines. When the attendant sends the first digit of the code, "guard tone" will be heard and continue until all digits have been dialed and outpulsing is completed.

**4.04** If the line selected is of the manual type and signaling is not automatic, the attendant must know the appropriate type of signaling to use. This could be by use of the SR or FL-RING key or by voice through a loudspeaker at the distant end. When connected through a switchboard, the FL-RING key is used to flash or recall the operator.

##### **C. Indirect Access (Fig. 4)**

**4.05** Originating calls from a position via indirect access requires the operation of the IA button. Use of this button operates the appropriate relay in the group of position relays mentioned above, causing the controller to function which in turn activates the indirect access control circuit and its associated register connector. At the same time, the READY lamp is lit on the PB dial, since on IA type calls dialing is necessary. When the lamp is lit, the attendant may send either a 2- or 3-digit code to select the desired line. When the digits have been registered in the register connector, the RC causes the controller in the line and position connector to function again in a manner similar to that for a DA call. In this instance, the closure of the circuit to the proper select magnet is determined in the RC by translation of the digits that have been registered.

**4.06** Calls to CO, PBX, selective signaling, or manual-type lines require further action on the part of the attendant. This information has been outlined in preceding paragraphs.

##### **D. Override (Intercommunication)**

**4.07** With either IA or DA, when connections are being established from positions to lines or from position to position, there is no busy test. This means any call can override an existing connection. Each position is equipped with a loudspeaker and a key designated LS-HS which enables the position attendant to select hearing the overriding position on the speaker

(LS) or on the headset (HS). When an overridden position is connected to a land line and the key is in the HS position, the overriding position, the overridden position, and the distant end are all in communication with each other. If the key is in the LS position, the distant end cannot hear the overriding position. When the overridden position is connected to an air-ground radio line, the distant end does not hear the overriding positions regardless of the condition of the LS-HS key or the attendants push-to-talk switch.

**4.08** On all interposition calls, the override lamp at the called position is always immediately lit steady regardless of whether or not there is an existing conversation and no action is required on the part of the called attendant to complete a connection.

#### **E. Incoming Calls**

**4.09** Incoming calls are indicated and may be answered by means of the DA, PA, SA, and LL COM features. In all instances, the position pilot lamp will flash in conjunction with the incoming flashing lamps for any calls directed to that position.

**4.10** By the action of the signal circuit and the line circuit, a flashing lamp indication is provided in the proper lamp display in the called position. By operating the key associated with the flashing lamp, the attendant causes the line and position connector to select the line. When the connection is made, the flashing lamp becomes a fluttering lamp to indicate to the attendant which line has been answered. Positions having direct access to the line receive a steady busy lamp indication from the line circuit.

**4.11** On established CO and PBX line circuits, a winking lamp indication is provided at the calling position when a hold condition has been placed on the line except when connection has been made via IA.

**4.12** The primary and secondary answering features permit a storage of three calls at a position from certain local dial lines by means of the incoming dial selection circuit with a call storage and sequence answering arrangement. When an attendant sees a flashing lamp in his

PA display, he can answer the call by merely depressing his PA button. The call indicated on the first lamp will be connected to his headset, the lamp associated with the PA button will flutter, and the flashing lamp will go out. At the same time, any remaining stored calls will advance in the lamp display. Should he desire to have his remaining calls answered at the back-up position, he need only operate his SEC LPS key.

**4.13** The incoming dial selection circuit (Fig. 5) permits selection of a maximum of 90 positions by direct dialing from the dial outside of the center connected to it. Calls directed through this equipment are terminated in the primary answering display. Should the calling station appear as being available in any position via DA, the associated lamp in the DA group will flash or light steady as determined by the status of the call.

**4.14** Each position may answer incoming long line calls terminated in the position by means of the long line common answering feature. Calls of this type are displayed by a flashing lamp indication designated LL. By depressing the associated key, the attendant causes the line and position connector circuit to select the incoming call and connect it to the position (Fig. 6). This extinguishes the flashing lamp and causes the busy lamp above the key to flutter. Long line calls may be stored but there is only the one lamp to indicate one or more calls waiting to be answered. Should an attendant answer one call with another waiting, the incoming LL lamp will continue to flash.

### **5. MAINTENANCE**

#### **A. Alarms**

**5.01** Certain troubles which occur in the signal circuit, register sender link circuit, line and position connector circuit, indirect access control circuit, or any of the local line circuits cause audible and visual alarms.

**5.02** In the line and position connector circuit, alarms are provided for troubles on the select magnet signaling leads, time-out of the controller, or if both controllers are made busy simultaneously by maintenance personnel.



**5.03** In the register sender link circuit, an alarm is sounded should the 100V power supply for the circuit become shorted or should there be a time-out in establishing a connection to a register sender.

**5.04** In the indirect access control circuit, an alarm is provided should the circuit fail to start or release within the proper time interval.

**5.05** In the local line circuit, an alarm is provided should the 197-type switch in the circuit fail to release within a timed interval because of mechanical trouble.

**5.06** In the signal circuit, an alarm is provided when, because of trouble, an automatic transfer from regular to alternate flashing circuit takes place or if trouble occurs on the alternate circuit while it is in service or being tested.

#### **B. Testing**

**5.07** A portable test box is provided to permit maintenance personnel to originate calls from the equipment room. This box consists of relays, the regular push-button dial, a hold key, short ring key, flash or ring key, indirect access key and lamp, and four test keys.

**5.08** Jacks are mounted on the frames to provide access to four designated position equipments. The test equipment may be connected to any jack by means of a cable having multipin-type plugs on each end. Any one of the four position relay equipments can be selected with the test keys on the box. When connections are established, the maintenance man is able to simulate position operation using regular position relay equipment and observe the progress of test calls through the various circuits. Lockout features cause the box to be ineffective should the position equipment selected be in use. When the test box is being used, the position attendant whose relay equipment is selected receives a steady pilot lamp.

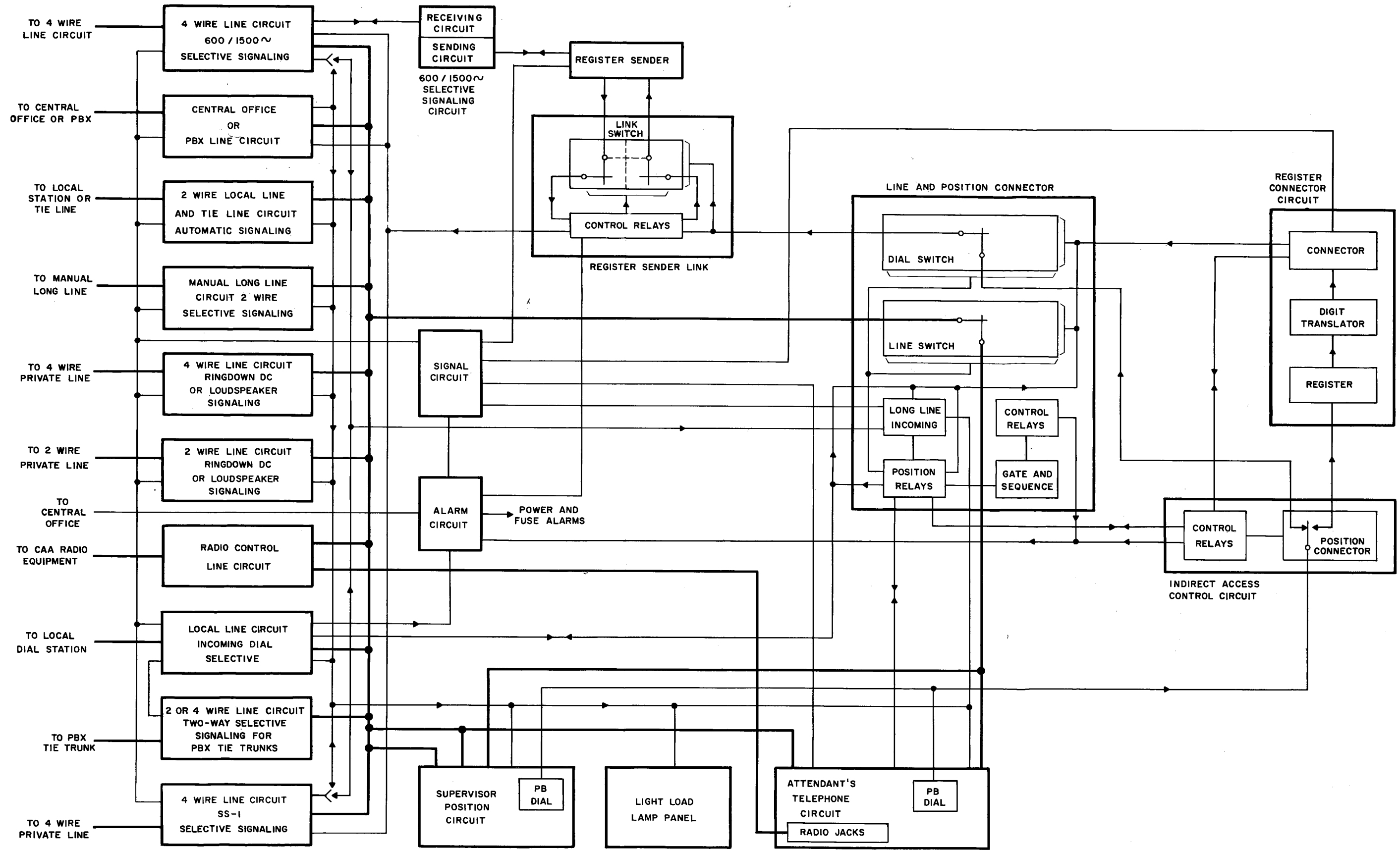


Fig. 1 - Equipment Units

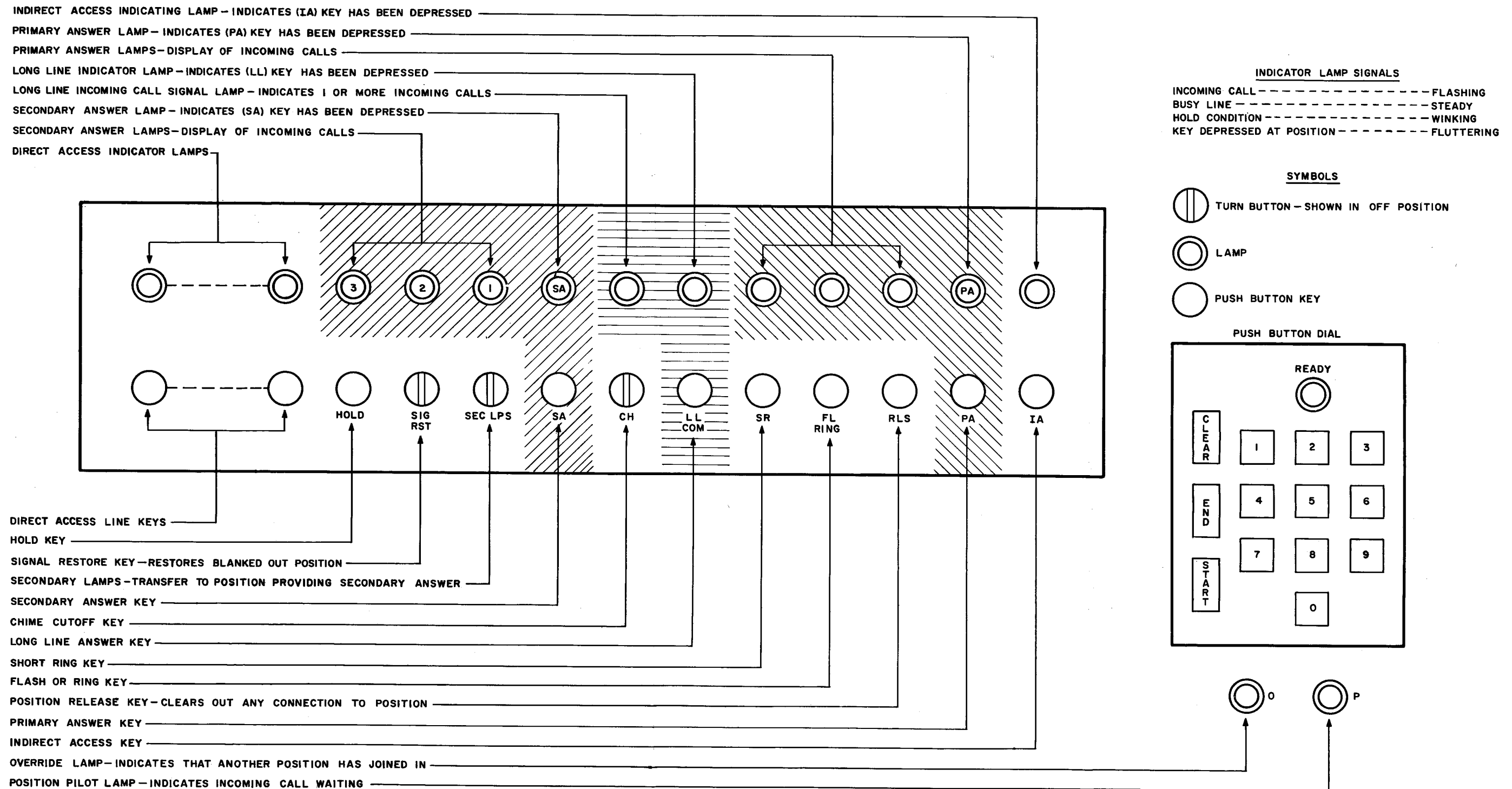
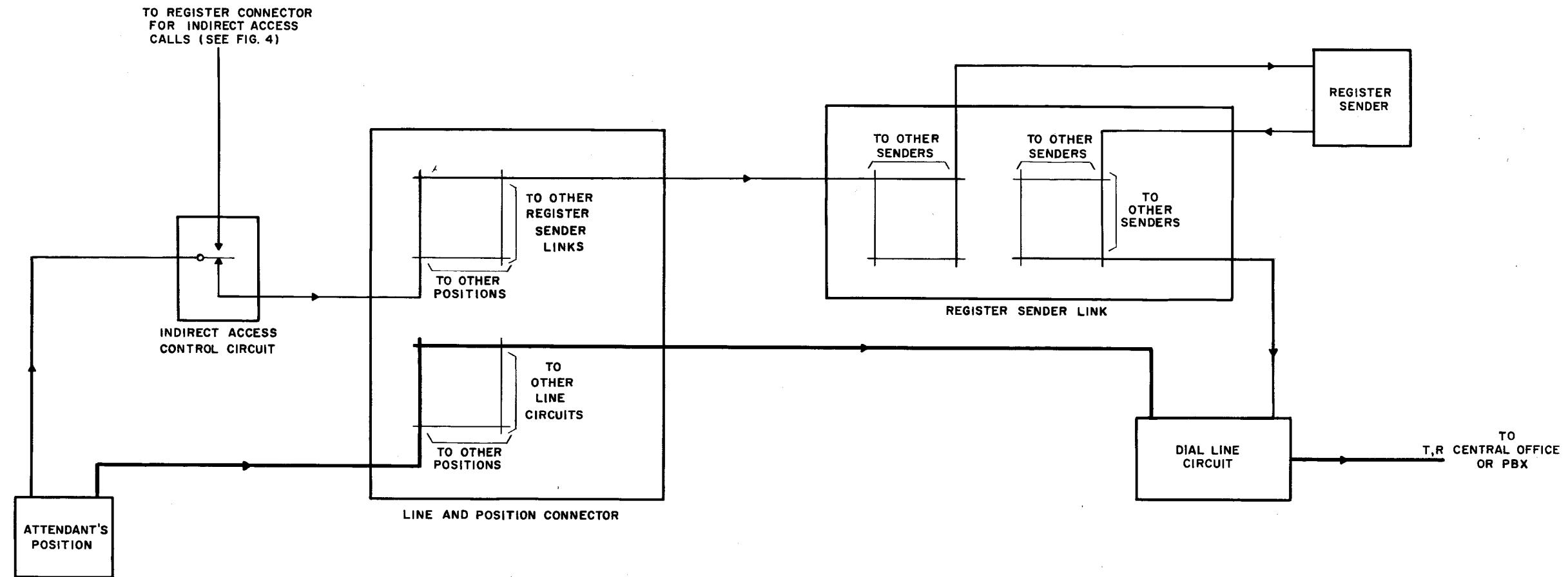


Fig. 2 - Attendants Position Equipment



NOTE:  
 I. IN ESTABLISHING CONNECTIONS TO LINE CIRCUITS NOT REQUIRING DIALING, OR TO OTHER POSITIONS, THE DIALING PATH SHOWN IS NOT USED.

Fig. 3 - Typical Connections - Direct Access

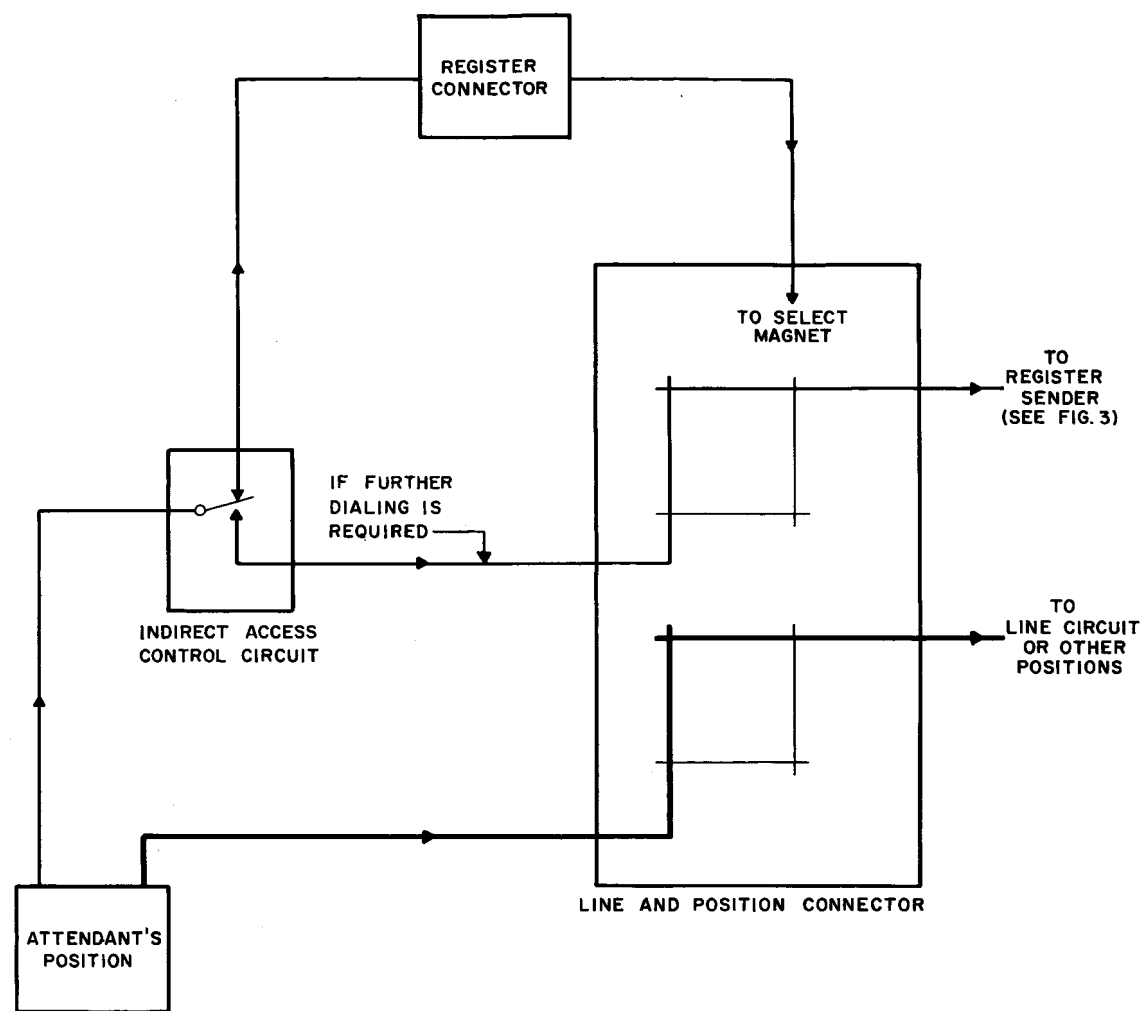


Fig. 4 - Typical Connections - Indirect Access

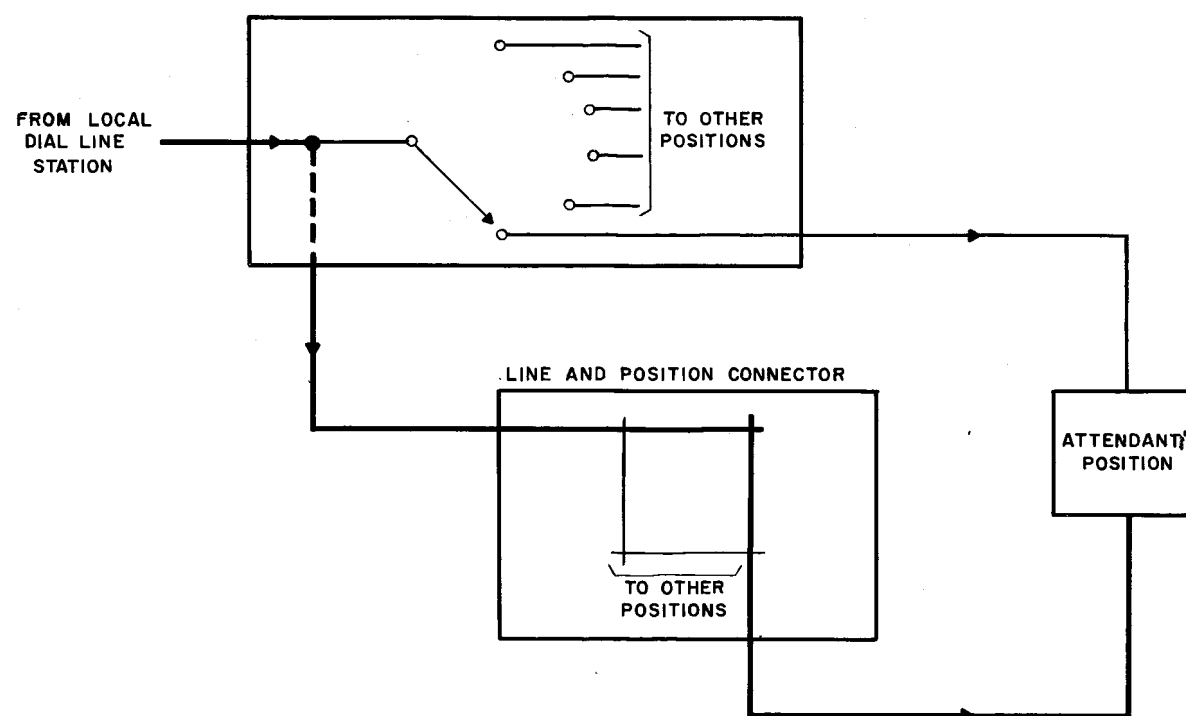


Fig. 5 - Incoming Dial Selection - Primary Answering

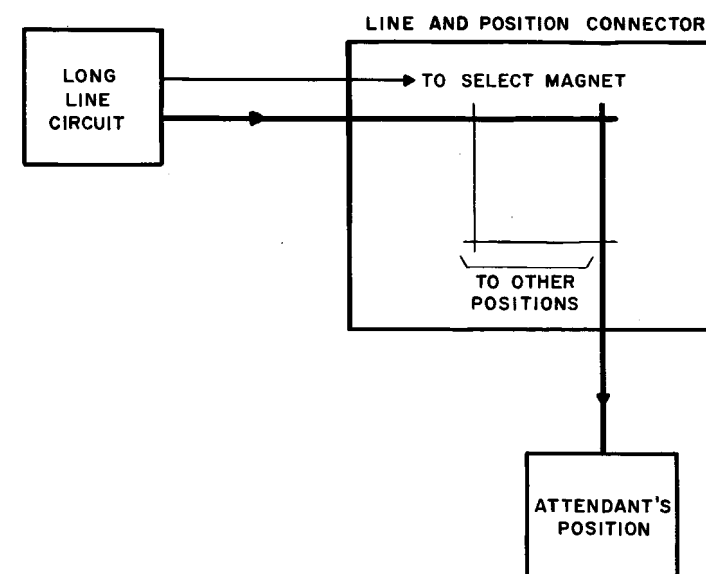


Fig. 6 - Incoming Call - Long Line

Fig. 4, 5 and 6