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ATTENDED DIAL PBX SYSTEMS

GENERAL

An attended dial PBX system consists of a single or multiple position manual switchboard associated with dial switching equipment. The manual switchboard is used by one or more attendants (1) for answering and distributing the incoming calls and (2) for assisting certain station users in originating calls. The dial switching equipment is used by the PBX station users for completing their own outgoing and intercommunicating calls without the assistance of the attendant. Dial service is practical for PBX systems where:

1. A large volume of intercommunicating service is involved (including cases where the customer owns or is contemplating the purchase of a dial intercommunicating system).

2. A considerable amount of outgoing central office and tie line traffic is involved.

3. Intercommunicating and outgoing PBX service is required during periods when a switchboard attendant is not on duty.

However, where the proportion of outgoing and intercommunicating traffic is relatively small, or where the customer desires close supervision by the PBX attendants over all types of calls, manual service may serve the customer's requirements better than dial.

An attended dial PBX system offers distinct advantages over an arrangement consisting of a manual PBX and a separate customer-owned dial intercommunicating system because:

1. It provides central office service as well as intercommunication without duplication of cabling, equipment, power facilities, and telephone instruments.

2. The charges for the dial system are reasonable in comparison with cost of manual PBX, plus annual interest, tax, insurance, depreciation, maintenance, and general overhead charges on customer-owned intercommunicating system.

OPERATION AND SUPERVISION

OPERATION—Attended dial PBX systems are designed primarily for use in common battery (manual or dial) central office areas but usually can be adapted for use in magneto central office areas.

The operation of the associated manual switchboard used by one or more attendants for answering and distributing incoming calls and for assisting certain station users in originating calls is covered in Part VI, Sections 3 and 4.

The dial switching equipment, which completes the calls dialed direct by PBX station users, is similar to that used in step-by-step dial central offices. From the standpoint of operation, there are two kinds of such calls:

1. "Trunk" calls to the manual switchboard attendants, to the central office, to other PBX's over tie lines, to dial code calling equipment, and to dial PBX conference equipment.

2. "Intercommunicating" calls to other PBX stations served by the dial PBX system.

"Trunk" Call Operation—When a station user lifts the receiver to dial a "trunk" call, a switch called a line finder (or line switch with some types of PBX's) seeks and connects to the calling station. At the same time a selector switch, which is directly connected to the line finder, returns the dial tone to indicate the equipment is ready for the call. In response to the first digit dialed, the selector selects a particular level of trunks (or tie lines, etc.) and connects the calling station to an idle trunk. For example, a station user of a dial system with a cord type manual switchboard obtains a trunk to the manual switchboard attendants by dialing "0." By dialing "9," the user obtains a central office trunk. Dialing "8" gives the user access to a tie line. Dialing other single digit codes, such as "7," for example, may give access to a dial code call system or to a dial PBX conference circuit, if such optional features are provided. (With a cordless type of switchboard, the station user makes an intercommunicating call to reach the PBX attendant instead of dialing "0").

"Intercommunicating" Call Operation—When a station user lifts the receiver to dial another station served by the same dial PBX system, an idle line finder switch seeks and connects to the calling station in the same manner as on a "trunk" call described above. The operation of the dial equipment from this point varies slightly for two, three, and four-digit systems as outlined below.

1. Three-Digit System—After an idle line finder seeks and selects the calling station, a selector switch permanently connected to the line finder returns a dial tone to the calling station. The selector switch then responds to first digit of the three-digit number dialed to connect the calling station to an idle connector switch. The connector switch in turn responds to the last two digits dialed to complete the call to the station desired. If the called station is not busy, the connector switch returns an audible ringing signal to the calling station. However, if the called station is busy, the connector switch returns a busy tone signal to the calling station. (Operation of a four-digit system is practically the same except that a second selector switch is employed which responds to the second digit of the four-digit number to connect the calling station to a connector switch).

2. Two-Digit System—The two-digit system employs selector-connector switches instead of separate selector and connector switches. The selector-connector switch performs both the function of a selector and a connector. It returns a dial tone and responds to the first digit dialed to connect the calling station to a trunk, tie line, or station level. It responds to the second digit dialed to complete a call to another PBX station served by the same dial PBX system.

Below is a summary of the type of switches involved in calls dialed by station users:

Type of Call	Switches Involved		
	2-Digit System	3-Digit System	4-Digit System
"Trunk"	LF-SC	LF-S	LF-S
"Intercommunicating"	LF-SC	LF-S-C	LF-S-S-C

Dial switches are illustrated and described in the exhibits following.

Incoming Dial Repeating Tie Line Calls—At the incoming end of the tie line, the call may be routed through either an incoming type of selector (or selector-connector) or through a regular selector (or selector-connector), depending on the service requirements, as explained below.

1. Where the tie line is terminated on an incoming type of selector (or selector-connector), the station user at the originating end of the tie line does not receive a dial tone after dialing the tie line code, and therefore can dial the number of the station desired immediately after dialing the tie line code.

2. Where the tie line is terminated on a regular selector (or selector-connector), the station user at the originating end of the tie line receives a dial tone after dialing the tie line code. There is a short delay between the time the user dials the tie line code number and the time the dial tone is heard. During the delay, the tie line may be seized by another station user. However, this disadvantage is offset to a degree by the saving in the expense of providing an incoming selector (or selector-connector) for each incoming dial repeating tie line, as explained in "1," above. Regular selectors (or selector-connectors) instead of incoming types for incoming dial repeating tie lines may be provided only with the 740-E type of dial PBX, described later in this section.

SUPERVISION—Dial PBX systems with associated cord type switchboards normally provide non-through supervision. However, through supervision may be provided where there is a particular requirement. The type of supervision required should be specified. The local and long distance calls dialed direct by station users are not routed through the manual switchboard and are therefore under the control of the calling station user.

Through supervision is usually provided with key switchboard type of dial systems which cannot readily be modified to provide non-through supervision. (See Part VI, Section 1, for explanation of through and non-through supervision.)

CAPACITIES

DIAL EQUIPMENT—The dial switching equipment part of a dial PBX system is installed on a two, three, and four-digit basis in accordance with the number of dial PBX stations required.

The station capacity of the dial switches in a two-digit system would appear to be 99 stations, but actually it is reduced by 10 for each selector-connector level used for attendant's trunks, central office trunks, and tie line trunks. The "0" level in most dial systems is used for attendant's trunks, the "9" level for central office trunks, and the "8" and "7" levels, if required, for tie line trunks.

In like manner, the nominal dial station capacity of the dial switches in a three-digit system is reduced by 100 for each selector level used for attendant, central office, and tie line trunks; and the capacity of a four-digit system is reduced by 1,000 for each level so used.

Other factors which reduce the nominal dial station capacities of dial PBX systems are:

1. The "1" level is usually the last level equipped with station lines, particularly on the three and four-digit systems, because of the possibility of inadvertent switchhook operation causing wrong numbers.

2. One or two station line terminals per connector or selector-connector group are usually reserved for Plant department test purposes.

MANUAL SWITCHBOARDS—The manual switchboard associated with an attended dial PBX system is arranged on either a one or two-position non-multiple basis or a multiple position basis in the same manner followed in the case of manual PBX systems.

The nominal station line capacities of the various cord switchboards associated with attended dial PBX systems are:

Non-Multiple Cord Types	Stations (Per Position)
552-A	300
556-A	180

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Multiple Cord Types	Stations
552-D (3-panel)	600
605-A (small 4-panel)	2,000
605-A (large 4-panel)	3,200
607-A (4, 6, or 8-panel)	5,600
607-B (4, 6, or 8-panel)	5,600
606-A (6 or 8-panel)	9,600

The station capacities of manual cord switchboards associated with dial PBX systems are larger than the capacities of switchboards associated with manual PBX systems because station line lamps are not required for dial stations. (However, line lamps are required for manual stations on dial PBX's.)

Switchboard capacities are reduced somewhat when designation strips are used over the jacks.

Capacities of manual cordless switchboards associated with 740-A-B-C systems are same as capacities of dial equipment since station lines do not appear on the attendant's switchboard (see Types of Systems described later).

TYPES OF TRUNKS

Manual Central Office Trunk

1. Provides two-way service between associated manual PBX switchboard and common battery or magneto central office.

2. Appears at associated manual switchboard only, but not in the dial switching equipment.

3. Each trunk terminates in a jack at the manual switchboard and has an associated line lamp and a designation strip space.

4. If trunk is multipled, a busy lamp or idle indicator lamp is provided for each trunk.

5. Manual trunks are provided as required on cord type switchboards, not on key switchboard types. The first number of the trunk group is listed in the telephone directory.

Direct Dial Central Office Trunk (Out-Dial)

1. Provides a one-way service from unrestricted dial PBX stations (outgoing calls dialed direct by station users without the assistance of the PBX attendant).

2. Ordinarily appears on "9" level of selectors or selector-connectors, but not on associated manual switchboard.

3. Direct dial trunks are provided as required with cord switchboard type dial systems but not with key

switchboard types. The direct dial trunk group, which is not listed in the telephone directory, is always used with manual or combination trunks, or both.

4. Where more than ten trunks are required for outgoing service, a graded multiple arrangement is employed. For example, certain direct dial trunks may be assigned as first choice outgoing from a particular group of stations. Other direct dial trunks may be assigned as first choice outgoing from another group of stations, and the remaining trunks made common to all stations (see exhibits).

5. Cannot be furnished in magneto central office area.

Combination Central Office Trunk

1. Combines the features of a manual and a direct dial trunk. (Provides two-way service between PBX switchboard and central office, and one-way service from unrestricted dial PBX stations to central office.)

2. Appears at associated manual switchboard and also on "9" level of selectors or selector-connectors.

3. Each trunk terminates in a jack at the manual switchboard and has an associated line lamp and a designation strip space.

4. On both non-multiple and multiple arrangements a busy lamp (or idle indicator lamp) is provided for each trunk to indicate to the PBX attendant when the trunk is in use on a call originated by a station user.

5. The maximum number of combination trunks provided on key and cord switchboard types of dial systems is ordinarily ten. (See Central Office Trunk arrangements below.)

6. When manual trunks are not associated with the combination group, the first number of the combination group is listed in the telephone directory.

7. Cannot be furnished in magneto central office area.

CENTRAL OFFICE TRUNK ARRANGEMENTS—The number and type of central office trunks provided with a dial PBX system depends on the volume and nature of the central office traffic. Trunk arrangements are determined by the Traffic department after study of the incoming and outgoing calls.

Ordinarily, combination trunks are the only type provided with the smaller dial PBX systems requiring not more than ten trunks. No provision is made for any but combination trunks for dial systems having the cordless or key type of associated manual switchboard.

Where the trunk requirements exceed ten, which is the maximum number of combination trunks usually pro-

vided, a number of manual or direct dial trunk groups, or both, may be provided in addition to a combination trunk group. Or, when a particularly large number of trunks is required, manual and direct dial trunks without associated combination trunks may be used. Typical trunk arrangements are:

1. Manual and Combination Trunk Arrangement—The manual trunks are first choice in the central office for incoming calls to the PBX. When all the manual trunks are busy, incoming calls will be received over the combination trunks. Outgoing calls dialed by station users are routed over the combination trunks. The selection of the combination trunks is in reverse consecutive order.

2. Manual, Combination, and Direct Dial Trunk Arrangement—The combination trunks receive incoming calls only when all manual trunks are busy. The combination trunks are selected by the dial equipment for an outgoing call only if all the direct dial trunks available to the particular calling station are busy.

3. Manual and Direct Dial Trunk Arrangement—When a particularly large number of trunks is required, manual and direct dial trunks, without associated combination trunks, may be used since there may be no particular advantage to the use of combination trunks under such conditions. The manual trunk group is used for incoming and outgoing calls handled by the switchboard attendant. The direct dial trunk group is used only for outgoing calls dialed by station users.

4. Combination and Direct Dial Trunk Arrangement— The combination trunks are used for the incoming and outgoing calls handled by the switchboard attendant and for overflow calls from the direct dial trunks. The direct dial trunk group is used only for outgoing calls dialed by station users.

The addition or removal of trunks may involve rearrangement of the trunk groups, particularly in the case of the larger systems.

Attendant Trunk ("0" Level)

1. Provides one-way service from dial PBX stations to the manual switchboard attendant of a cord switchboard type of dial system, but not a key switchboard type of system.

2. Appears on "0" level of selectors or selector-connectors and on trunk jack in associated manual switchboard.

3. Each attendant trunk has associated line lamp.

4. A call from a dial station to attendant may be extended to the central office by the attendant without disconnecting from the trunk or recalling the station.

5. The number of attendant trunks required is determined by the Traffic department on the basis of the number of restricted stations (described later), number of assistance calls, etc.

Intercepting Trunk

1. Provides one-way call path from dial switching equipment to manual cord switchboard associated with dial PBX system in order to facilitate PBX attendant assistance when station users call a non-working selector level or connector terminal through error.

2. Ordinarily furnished only with the larger dial systems. (See Types of Systems described later).

3. Calls arriving on a non-working selector level or connector terminal are routed immediately to the attendant. (Where intercepting trunks are not provided, all calls to a vacant level or terminal receive busy signal.)

4. Each intercepting trunk appears at manual switchboard in a jack with associated line lamp.

5. The number of intercepting trunks required is specified by the Traffic department.

TYPES OF STATIONS

UNRESTRICTED DIAL STATION—User can dial direct to PBX attendant, central office, dial tie lines, dial code call system, dial conference system, other dial PBX stations, and manual PBX stations associated with the connector multiple. Incoming central office, manual tie line, and intercommunicating calls from manual stations are completed to the unrestricted dial station with the assistance of the PBX attendant. Incoming calls dialed by other dial PBX stations and incoming repeating tie line calls are completed without the assistance of the attendant. The unrestricted station line terminates at manual switchboard in a jack without associated line lamp as well as in the dial switching equipment.

RESTRICTED DIAL STATION—Two general types of restricted dial PBX station service may be provided:

1. Stations mechanically denied direct access to the central office trunks. These stations may make outgoing central office calls only with the assistance of the PBX attendant. When a restricted station user dials a restricted level, a busy tone signal is received.

2. Stations restricted to intercommunicating service only. Such stations are mechanically denied access to the PBX attendant as well as to the central office. These stations are not connected to a jack on the associated manual switchboard and cannot receive

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incoming central office calls. This type of restricted station service is available only with cord type switchboard systems.

Stations may also be denied access to other levels such as tie line and certain station levels, if required.

Only one type of restricted station service may be provided for stations served by the same line finder-selector group.

Since dial PBX service is most effective when all stations are arranged for complete dial service without restrictions, the use of restricted stations should generally be limited, especially where the operating load would be increased substantially by assistance calls from restricted station users.

MANUAL STATION—User can place outgoing and intercommunicating calls through the associated manual switchboard with the assistance of the attendant. Incoming calls are, of course, completed manually to the station by the attendant. Manual stations are not available with key switchboard type dial systems. The manual station line terminates at the manual switchboard in a jack with associated line lamp, and may be associated with the connector multiple, if desired, in order to receive intercommunicating calls dialed direct by dial station users. A manual station may be equipped with a dial in a dial central office area to enable the user to dial his own outgoing calls after the attendant has set up the cord connections.

FEATURES AND ARRANGEMENTS

CONSECUTIVE (ROTARY) STATION GROUPS—Consecutive (rotary) service for a maximum of ten dial stations may be provided in the same manner as central office trunks are operated as consecutive groups. Rotary hunting type connectors or selector-connectors are required to provide the feature. For example, if the fifth level of a rotary hunting type connector is used, 51 would be the first station in the group and 50 the last station (59 hunts into 50, not 60). Station line hunting is particularly effective where a group of station lines serves a number of persons who make common usage of the lines, such as order, purchasing, and service department personnel. Consecutive station groups are provided with some types of cord switchboard dial systems, but not with key switchboard types. (See Types of Systems described later).

TWO-PARTY LINE STATIONS—Two-party PBX station lines may be provided with some cord switchboard type dial systems if warranted for off-premises locations where considerable mileage is involved and there is little need for communication between the two stations. A special reverting feature can be provided by special arrangement, however, to enable two party-line stations to signal each other. Two jacks are provided at the manual switchboard and ringing is selective.

NIGHT SWITCHING ARRANGEMENT—With this arrangement one or more central office trunks can be answered at a station location and the incoming calls completed to other stations when the switchboard is unattended. More than one night answering station can be provided, each station being arranged for answering different trunks.

For each central office trunk answered at the night station location, two standard dial station line circuits and one auxiliary line circuit are required, as illustrated in the exhibits. Each trunk is connected at the switchboard to a standard station line circuit in the same manner as for ordinary night connections. This station line is associated with an auxiliary line circuit which terminates at the night answering location, usually in key equipment. An additional station line also terminates in the key equipment for use by the night station attendant to notify another station user that a call is waiting. A holding relay is provided in the auxiliary line circuit.

When an incoming call answered at the night station location is for another station, the night station attendand places a hold on the central office trunk, dials the station desired over another station line, and tells the person desired to dial a specified number (the connector terminal number of the second standard dial station line circuit) to obtain connection to the trunk on which a call is being held. When the person desired dials the specified number, his station is connected through the second standard dial station line circuit to the auxiliary line circuit and thence to the central office trunk on which the call is waiting.

Another feature of the night switching arrangement enables the night station attendant to set up outgoing central office calls for dial stations which are mechanically denied access to the central office trunk level. The restricted station user dials the station of the night attendant who sets up the call in a manner similar to that described above for incoming calls.

The night switching feature is provided with all types of dial PBX systems.

TOLL DIVERTING FEATURE—With this feature, one group or all PBX stations may be denied direct access to A-board and toll operators. Calls to the operator are diverted to the PBX attendant. Equipment is provided on each combination and direct dial trunk and at the central office so that calls for long distance will be routed back to the PBX attendant at cord type dial systems. On cordless type dial systems, the call is routed to a busy line circuit. This service feature is provided only in certain types of central offices:

1. Manual—Generally not provided.

2. Step-by-Step Dial—Since modification in the central office is usually very expensive, it may not be practical to offer the service.

3. Panel Dial—Where arrangements were made initially to provide the service, the necessary central office

modifications are relatively simple. Where the necessary provisions were not made during the initial installation of the central office equipment, the modifications are rather substantial.

4. Cross-Bar Dial—Equipment usually provided and modifications necessary to furnish the service are relatively simple.

SPACE REQUIREMENTS—In general, the space for the dial PBX system should be permanent, adequate, and large enough for growth. The dial switching equipment and power plant should be enclosed in a room readily accessible to telephone company personnel, but not to the customer's employees and patrons. The room should also be free from dirt, dust, moisture, and excessive heat. Other requirements such as ceiling height, electrical outlets, and lighting are considered by the Plant department for each installation.

The location of the associated manual switchboard should be, if at all possible, adjacent to the dial equipment room. With such an arrangement, short runs of cloth-covered cable may be used to connect the dial switching equipment and the switchboard together. If the two locations are not adjacent, higher installation costs are incurred in that lead-covered cable in conduit or on wall brackets is required.

In the case of the larger installations, the provision of an enclosed switchboard operating room, free of outside disturbances, is a distinct advantage. (The exhibits show typical floor plans for dial systems.)

TYPES OF DIAL SYSTEMS

740-A—Two-Digit System

1. Capacity—10 central office trunks and 88 stations.

2. Use—Limited to comparatively few cases where traffic is largely intercommunicating and incoming call volume is relatively small.

3. Dial Equipment—Line finders and selector-connectors.

4. Manual Switchboard—Non-multiple key type placed on desk or table.

5. Supervision (Part VI, Section 1)—Through.

6. C. O. Trunks—Combination type.

7. Field Lines (Part VI, Section 1)—Not provided.

8. Attendant trunks—Not provided. Attendant is reached over attendant station line.

9. Intercepting Trunks—Not provided.

10. Tie Lines (Part X, Section 1)—Two-way manual and incoming dial repeating types not provided.

11. Stations—All types provided except manual stations.

12. Optional Features

   a. Night switching arrangement

   b. Toll diverting (calls routed to busy tone circuit instead of to PBX attendant).

   c. Dial PBX conference service (Part VI, Section 1).

   d. Manual or dial code call service (Part III, Section 4).

13. Features Not Provided

   a. Consecutive station groups

   b. Two-party station lines

   c. Manual PBX conference service (Part VI, Section 1)

   d. Connection of loud speaker paging system to switchboard (Part III, Section 3).

   e. Recorder-connector (Part III, Section 1)

14. One of the main limitations of the 740-A is that distribution of incoming calls is comparatively slow because the attendant must dial the number of the station desired.

740-B—Two-Digit System

1. Capacity—10 central office trunks and 38 stations.

2. Use, dial equipment, switchboard, operation, and limitations are the same as 740-A.

740-C—Two-Digit System

1. Capacity—4 trunks and 38 stations.

2. Use—Large residences primarily.

3. Manual Switchboard—Smaller and more attractive than 740-A-B Switchboard.

4. Dial equipment, operation, and limitations are practically the same as 740-A-B except:

   a. 740-C has secrecy feature which prevents switchboard attendant from listening to conversations.

   b. No provision is made for tie lines.

740-AX—Two-Digit System

1. Capacity—9 combination central office trunks and 80 stations.

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a. Additional manual trunks and manual stations may be provided not to exceed the capacity of the associated manual switchboard.

2. Use—For installations under 80 stations where substantial growth cannot be foreseen. No longer manufactured. The 740-E type is used unless 740-AX equipment is available for reuse.

3. Dial Equipment—Line finders and selector-connectors.

4. Manual Switchboard—One or two-position non-multiple 552-A type.

5. Supervision (Part VI, Section 1)—Ordinarily non-through.

6. C. O. Trunks—Either two-way manual and combination types or combination types only, depending on the volume and type of traffic.

7. Field Lines (Part VI, Section 1)—May be terminated.

8. Attendant Trunks—Provided.

9. Intercepting Trunks—Not provided.

10. Tie Lines (Part X, Section 1)—All types available except incoming dial repeating tie lines.

11. Stations—All types.

12. Optional Features

   a. Night switching arrangement

   b. Toll diverting

   c. Manual or dial PBX conference service (Part VI, Section 1)

   d. Manual or dial code call service (Part III, Section 4)

   e. Connection of loud speaker paging system to switchboard (Part III, Section 3).

   f. Recorder-connector (Part III, Eection 1)

13. Features Not Provided

   a. Consecutive station groups

   b. Two-party station lines

740-E—Two and Three-Digit System

1. Capacity—80 stations in two-digit field; 300 stations in three-digit field.

2. Use—For installations under 80 stations where substantial growth cannot be foreseen. For initial installations between 80 and 300 stations, both the 740-E and 701-A are considered, the final choice depending on such factors as cost, expected growth, and availability of 701-A equipment for reuse.

3. Dial Equipment—Line finders and selector-connectors in two-digit systems; line finders, selectors and connectors in three-digit systems.

   a. Dial equipment is furnished in six basic packages of 40, 60, 80, 100, 120 and 160 station lines. Two or more packages may be combined to obtain the amount of equipment required.

   b. A two-digit 740-E can be expanded to a three-digit system on an in-service basis without replacement of any of the two-digit equipment (no provision is made for combined two and three-digit operation).

   c. The 740-E requires more line finder-selector switches than the 701-A in three-digit installations because the 740-E provides for 100 lines per group of switches whereas the 701-A provides for 200 lines per group. However, the customer is charged only for the number of switches required for an equivalent 701-A.

   d. Incoming dial repeating tie lines may be terminated on regular selectors or selector-connectors to avoid expense of individual incoming selector per tie line (see Incoming Dial Repeating Tie Line Calls described previously).

4. Manual Switchboard—The 740-E dial equipment may be associated with:

   a. 552-A or 556-A one or two-position non-multiple cord switchboards

   b. 552-D or 605-A multiple cord switchboards

5. Supervision (Part VI, Section 1)—Ordinarily non-through.

6. C. O. Trunks—All types.

7. Field Lines (Part VI, Section 1)—May be terminated.

8. Attendant Trunks—Provided.

9. Intercepting Trunks—Provided.

10. Tie Lines (Part X, Section 1)—All types.

11. Stations—All types.

12. Optional Features

   a. Consecutive station groups.

   b. Two-party station lines (by special arrangement).

c. Night switching arrangement.

d. Toll diverting.

e. Manual or dial PBX conference service (Part VI, Section 1).

f. Manual or dial code call service (Part III, Section 4).

g. Connection of loud speaker paging system to switchboard (Part III, Section 3).

h. Recorder-connector (Part III, Section 1).

701-A—Two, Three or Four-Digit System

1. Approximate Capacity:

   a. 80 stations on two-digit basis.

   b. 800 stations on three-digit basis.

   c. 8,000 stations on four-digit basis.

2. Use—For installations of large station capacity, and also smaller installations where substantial and rapid growth is expected.

3. Dial Equipment—Line finders and selector-connectors for two-digit systems; line finders, selectors and connectors for three and four-digit systems.

   a. A two-digit system can be expanded to a three-digit system by replacement of two-digit equipment.

4. Manual Switchboard

   a. 552-A one or two-position non-multiple cord switchboard.

   b. 552-D, 605-A, 606-A, 607-A or 607-B multiple cord switchboards.

5. Supervision (Part VI, Section 1)—Non-through.

6. C. O. Trunks—All types.

7. Field Lines (Part VI, Section 1)—May be terminated.

8. Attendant Trunks—Provided.

9. Intercepting Trunks—Provided.

10. Tie Lines (Part X, Section 1)—All types.

11. Stations—All types.

12. Optional Features

    a. Consecutive station groups.

    b. Two-party station lines.

    c. Night switching arrangement.

    d. Toll diverting.

    e. Manual or dial PBX conference service (Part VI, Section 1).

    f. Manual or dial code call service (Part III, Section 4).

    g. Connection of loud speaker paging system to switchboard (Part III, Section 3).

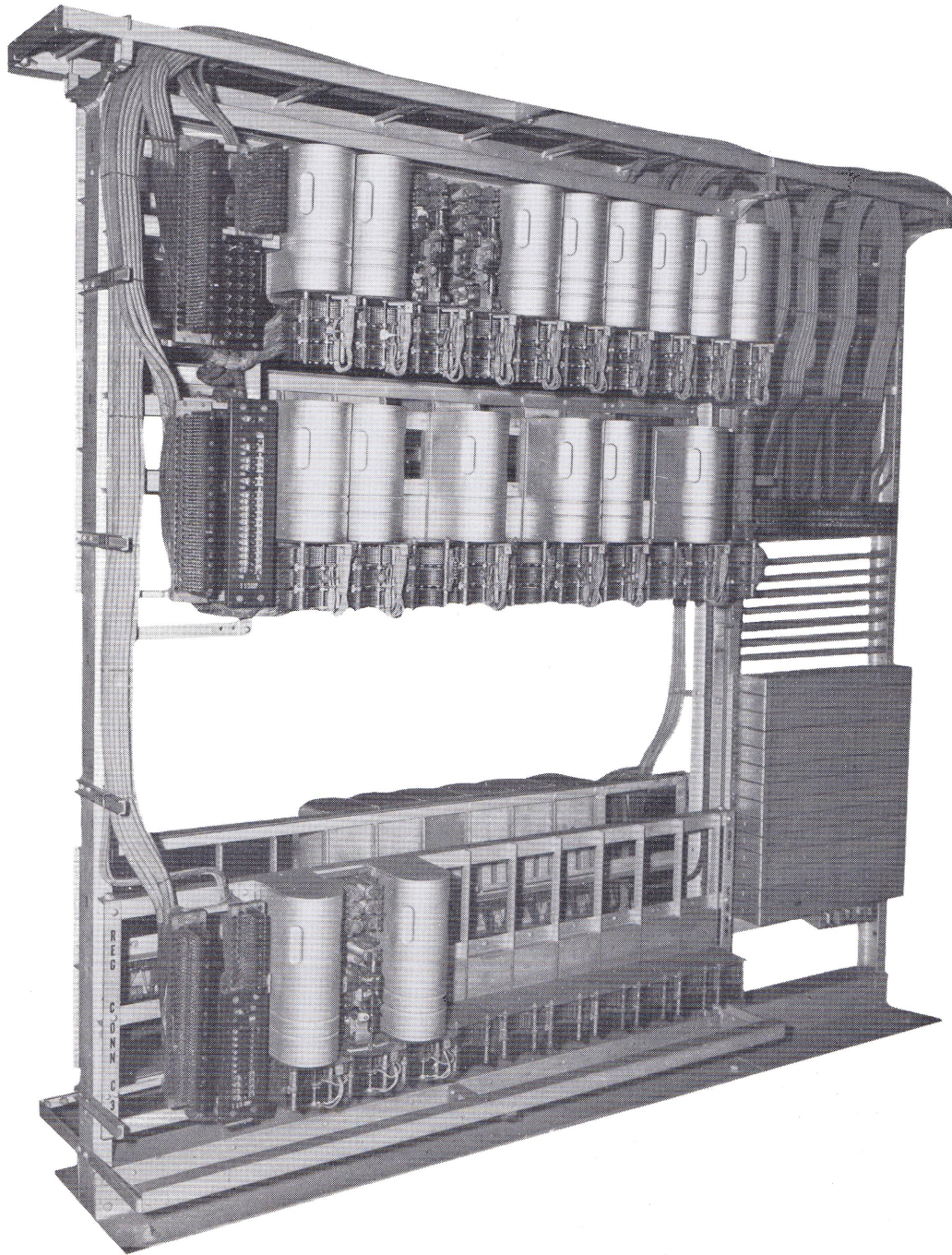   h. Recorder-connector (Part III, Section 1).

700-C—Two, Three or Four-Digit System

1. Capacity—Practically same as 701-A.

2. Use—Same as 701-A which supersedes 700-C.

3. Dial Equipment—Same as 701-A except line switches are used instead of line finders. The maximum capacity of a line switch is 100 stations, whereas the line finder maximum capacity is 200 stations. Furthermore, with the 700-C system, the number of selectors which any group of stations can have access to is limited to 10, while with the 701-A system larger groups of selectors may be provided. Since these limitations to 700-C equipment result in less efficient use of switches, a larger number of selectors are required for a 700-C than for a 701-A of the same capacity. However, the customer is charged only for the number of selectors required for an equivalent 701-A.

4. The associated manual switchboards are the same types used with 701-A.

702-A—Four-Digit System

(Similar to 701-A but of larger capacity and substantially higher cost. The capacity of the 701-A is sufficient for most customer requirements.)

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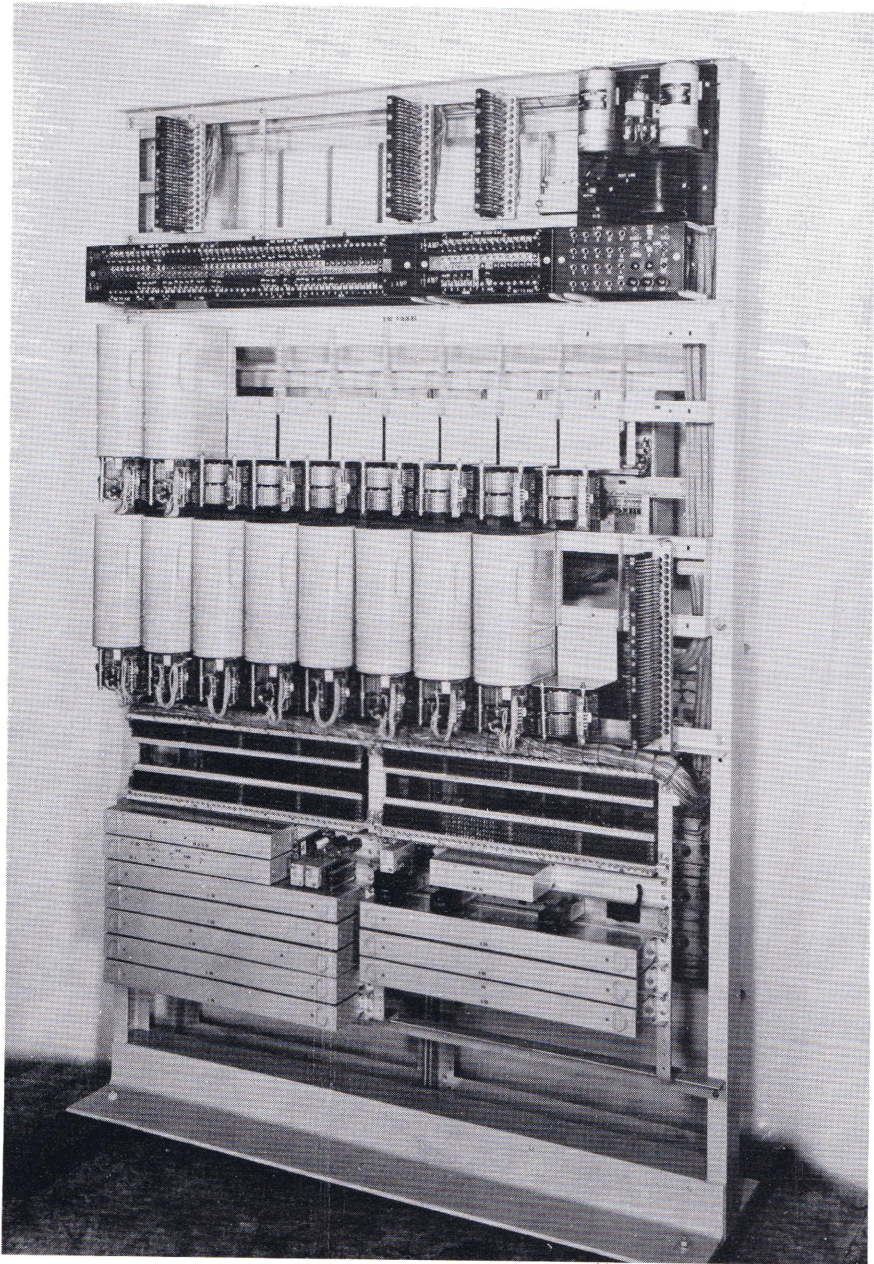Exhibit 1
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DIAL PBX SWITCHING EQUIPMENT

701-A Dial Equipment
Covers of Some Switches Removed to Show Detail of Apparatus

Dial PBX switching equipment consists of several types of electrically controlled switches mounted on a frame. The switches are grouped by types and interconnected by call-carrying paths. The number of switches required depends on the size of the PBX and the amount of traffic.

Exhibits 3 and 4 describe the various types of switches and explain their operation.

Associated with the dial equipment is a distributing frame, a power plant and the manual switchboard. Exhibits 17 and 18 show the amount of floor space required for the entire dial PBX system.

Exhibit 2

DIAL PBX SWITCHING EQUIPMENT

740-E Dial Equipment
7' High; 4½' Wide; 1¼' Deep

Line finders, selector-connectors, line and trunk relays, terminal equipment, etc., are mounted on one double-sided switch frame. Swing-out gates are provided for mounting trunk relays.

The two-digit dial equipment is packaged as follows:

Stations	Selector-Connectors
40	6
60	8
80	10

Where capacity of two-digit systems is exceeded, the PBX may be converted to three-digit operation by adding another switch frame for selectors and replacing or modifying existing selector-connectors to operate as connectors. Other switch frames can be added as required for growth.

A power plant and a distributing frame are associated with the dial equipment, besides the manual switchboard. Exhibits 19 and 20 show the amount of floor space required for the entire dial PBX system.

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DIAL SWITCHES

"0" LEVEL

"9" LEVEL

WIPERS

TOP BANK
(SLEEVE AND HUNTING
CONTACTS)

BOTTOM BANK
(TIP AND RING
CONTACTS)

Two-Bank Dial Switch

There are several types of dial switches, such as line finders, selectors, connectors, and selector-connectors; each of which performs a particular function in the progress of a dialed call. The various types are all similar in appearance and operation, each type having:

1. A number of movable contacts called wipers which step upward vertically and rotate horizontally to connect to certain non-movable contacts.

2. Tiers or banks of non-movable contacts. Each bank contains ten rows or levels of ten single or double contacts. There is one wiper for each bank of non-movable contacts. Three contacts in the switch banks are utilized to make the tip, ring and sleeve connections of a circuit. A fourth contact is utilized with rotary hunting type connector or selector-connector **switches.**

All dial switches, except line finders in 701-A 3 and 4-digit systems, are two-bank switches which provide for the termination of 100 lines. Line finders in 701-A 3 and 4-digit systems have three banks; two banks of tip and ring, and one bank of sleeve contacts which permits the termination of 200 station lines.

The line finder switches of a 3-digit 740-E system employs two-bank switches which permit the connection of only 100 station lines. This arrangement necessitates more switches with a 3-digit 740-E system than is required for a 701-A of the same size and capacity. However, the 740-E customer is charged only for the number of switches that would be required with a comparable 701-A system.

Exhibit 4

GROUPING OF STATIONS AND DIAL SWITCHES
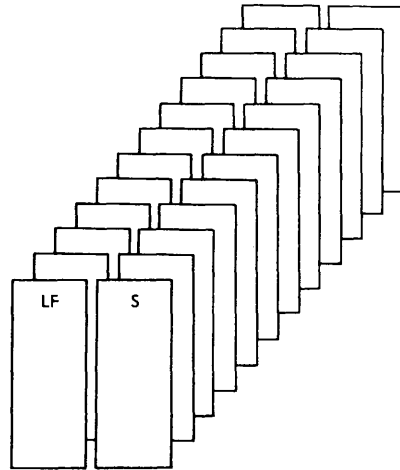# IN THREE-DIGIT DIAL PBX SYSTEMS
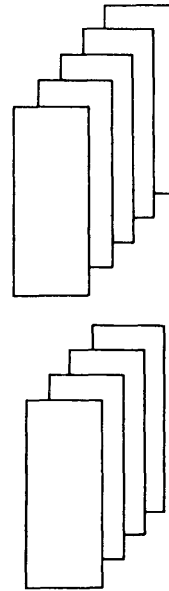
1. A Group of PBX Station Lines

2. A Group of Line Finders with Associated Selectors

3. Groups of Connectors

Maximum Number
of
Stations in Group

740-E—100
701-A—200

LF   S

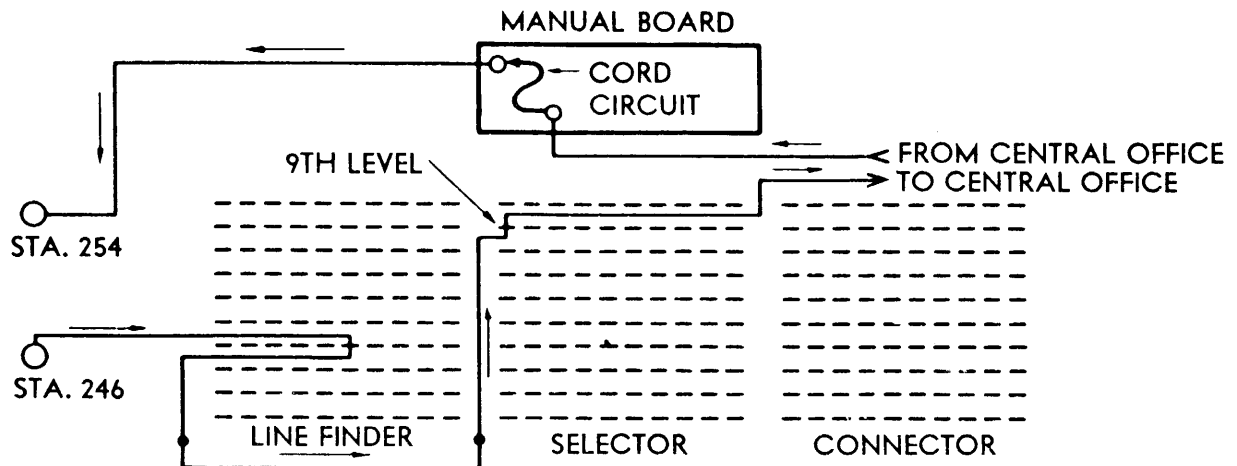Each station in a group has access to one group of several line finders with their associated selectors.

The number of line finder-selector switch groups is determined by the number of stations to be served. The number of line finder-selector switches provided in a group is based on the number of calls originated by the station group during the busy hour and the average holding time of the calls. Each line finder-selector switch has access to all connector groups.

For each selector level assigned to stations, there is a group of connectors. The number provided in a group is based on the number of incoming calls to the group during the busy hour and the average holding time of the calls. The maximum is ten connectors per group. Regular and rotary hunting type connectors are not provided in the same group.

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ROUTING OF CALLS

Through 3-Digit Dial PBX System

I. INCOMING CENTRAL OFFICE CALL

II. OUTGOING CENTRAL OFFICE CALL

INCOMING CENTRAL OFFICE CALL: Completed by PBX attendant who rings Station 254.
OUTGOING CENTRAL OFFICE CALL: Station 246 dials 9 to cause selector wiper contact to move up to 9th level and to move across the selector terminals to find an idle trunk. Note that connector is not used. Line finder and selector release when station originating outgoing call hangs up.

I. DIAL INTERCOMMUNICATING CALL

DIAL INTERCOMMUNICATING CALL: Intercommunicating calls are dialed by dial stations and restricted dial stations. In the above example, station 254 is dialing station 246. Station 254 removes receiver from hook causing line to be seized by a line finder. Each line finder has a directly associated selector which connects dial tone to line:
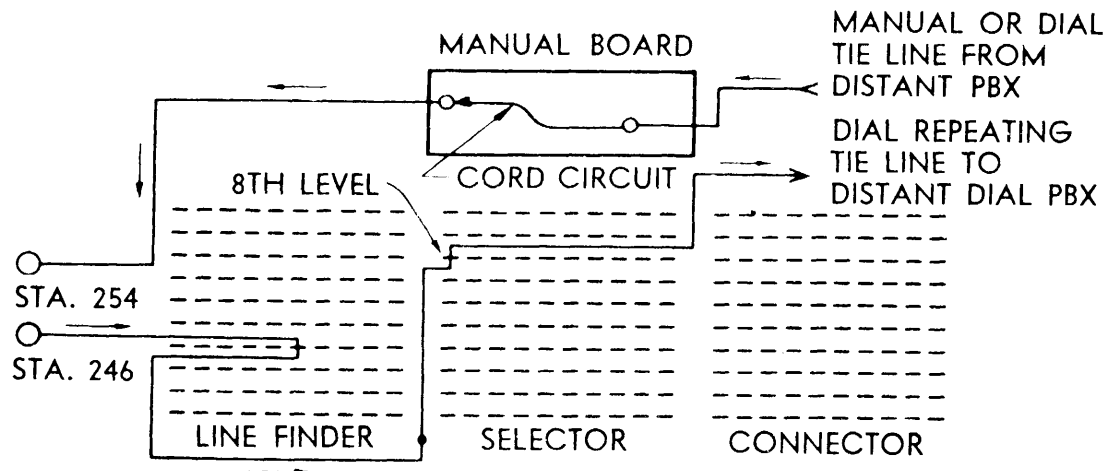The first digit dialed (2) causes selector wiper contact to move up to the desired hundred level (2) where it moves over terminals to select an idle connector.
The second digit dialed (4) causes the connector wiper contact to move up to the desired tens level (4).
The third digit dialed (6) causes the connector wiper contact to move over the connector level to terminal 6 where it makes final connection to the desired station (246) if not busy.

Exhibit 6

ROUTING OF CALLS
Through 3-Digit Dial PBX System (701A)

I. DIAL STATION TO MANUAL STATION

II. TIE LINE TO DIAL STATION

MANUAL BOARD

MANUAL STATION ─ CORD CIRCUIT

ZERO LEVEL   4TH LEVEL   DIAL REPEATING TIE LINE FROM DISTANT DIAL PBX

STA. 254

STA. 246

LINE FINDER   SELECTOR   CONNECTOR   INCOMING SELECTOR

DIAL STATION TO MANUAL STATION—In the example above, station 254 has dialed the attendant level (0) to obtain connection with a manual station not associated with connector multiple.

TIE LINE TO DIAL STATION—Tie line arranged to be selected and to select at both ends. A spearate incoming selector is provided for completing incoming tie line calls. In the above example, a dial station at the distant dial PBX has dialed the code for selecting this tie line and is now dialing station 246.

The first digit dialed (2) causes the incoming selector wiper contact to move up to the desired hundred level (2) where it moves over terminals to select an idle connector of the 200 group.

The second digit dialed (4) causes the connector wiper contact to move up to the desired tens level (4).

The third digit dialed (6) causes the connector wiper contact to move over the connector level to terminal 6 where it makes final connection to the desired station (246) if not busy.

I. MANUAL OR DIAL TIE LINE TO STATION

II. DIAL STATION TO REPEATING TIE LINE

MANUAL BOARD   MANUAL OR DIAL TIE LINE FROM DISTANT PBX

8TH LEVEL ─ CORD CIRCUIT   DIAL REPEATING TIE LINE TO DISTANT DIAL PBX

STA. 254

STA. 246

LINE FINDER   SELECTOR   CONNECTOR

MANUAL OR DIAL TIE LINE TO STATION—Completed by PBX operator who rings station 254.
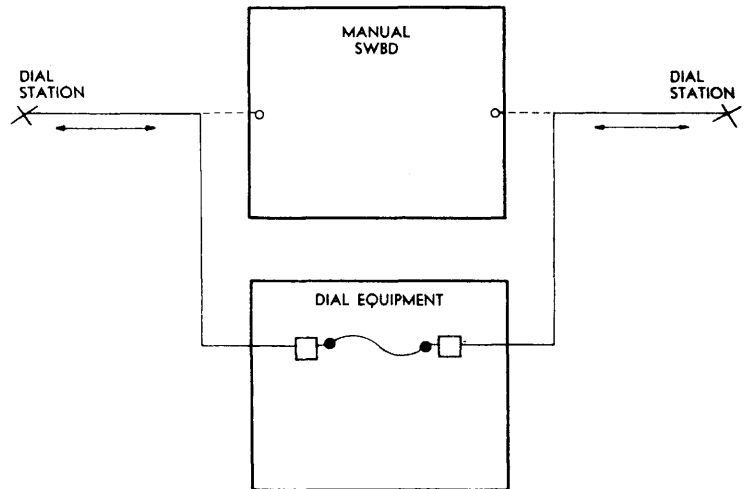
DIAL STATION TO REPEATING TIE LINE—In the example above, station 246 dials the dial tie line level (8) and is connected to the tie line. Then station 246 dials the station desired.

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DIAL PBX STATIONS
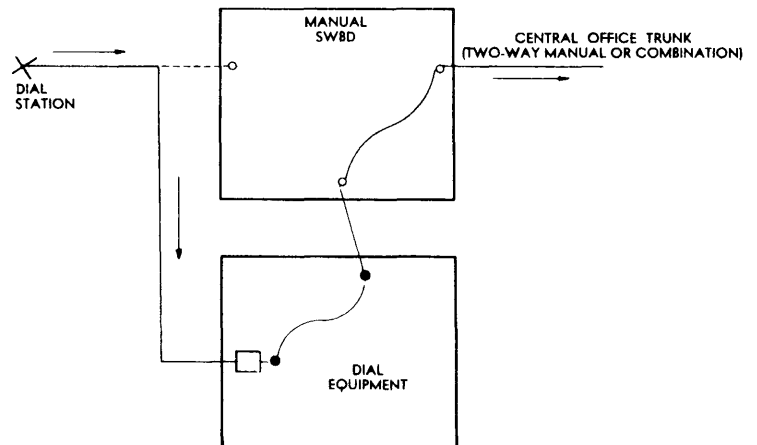
Operation of Dial and Manual Stations

DIAL STATION TO DIAL STATION

Dial stations dial each other without the assistance of the operator. When dial stations are in use the operator gets a small click in receiver when she tests the station for busy conditions by touching the tip of a cord to the sleeve of the station jack.
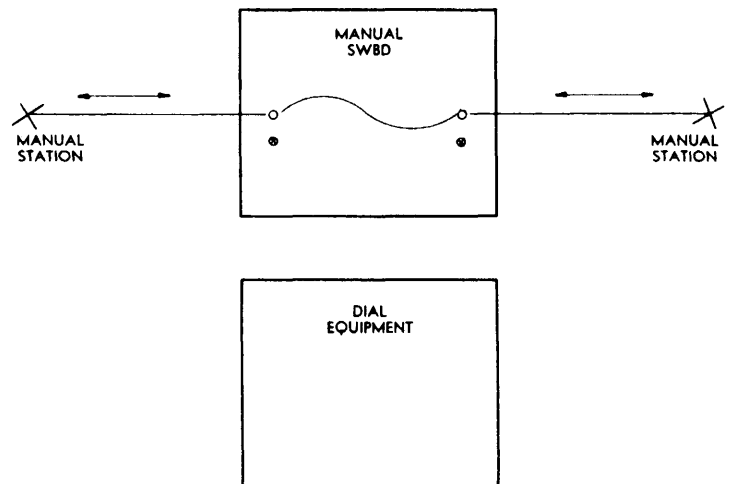
RESTRICTED DIAL STATION TO TRUNK

Restricted station receives a busy signal when the outside trunk level is dialed. An outside call can be completed by dialing the operator and requesting outside connection.

MANUAL STATION TO MANUAL STATION
(Not Associated with Connector Multiple)

Manual stations make and receive all calls through the manual switchboard. Stations are equipped with line lamps on the switchboard. Manual stations may be equipped with dials for use on night connections in dial exchanges.

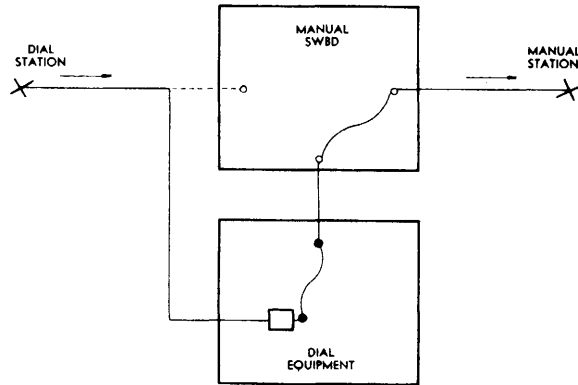⁓ —Cord circuit or dial equipment connection

▢ —Line equipment

⊗ —Station line lamp.

Exhibit 8

DIAL PBX STATIONS

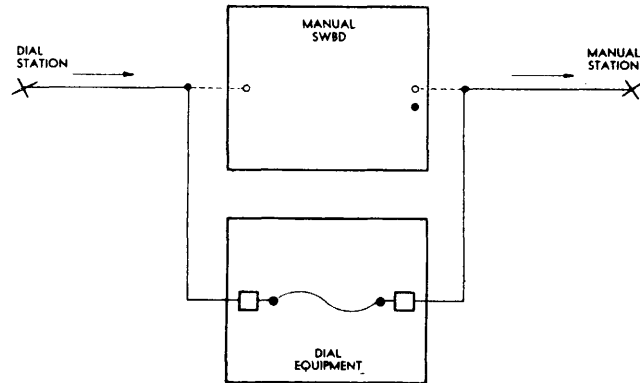## Operation of Dial and Manual Stations

DIAL STATION TO MANUAL STATION
(Not Associated With Connector Multiple)

A manual station not associated with connector multiple receives all calls through the manual board. Dial station must dial the operator and ask for the manual station.
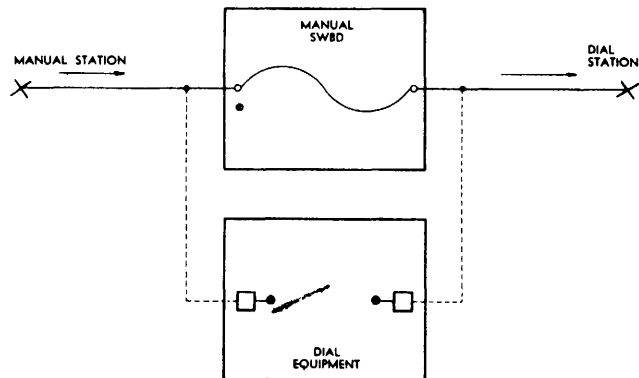
DIAL STATION TO MANUAL STATION
(Associated With Connector Multiple)

Manual stations may be associated with the connector multiple so that incoming intercommunicating calls from dial stations may be completed through the dial equipment.

MANUAL STATION ASSOCIATED WITH CONNECTOR MULTIPLE TO DIAL STATION

Manual stations associated with the connector multiple complete all originating calls with the aid of the operator.
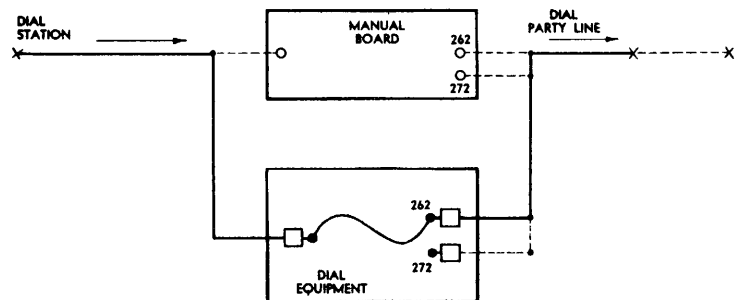
〰—Cord circuit or dial equipment connection

☐ —Line equipment

⊗ —Station line lamp.

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DIAL PBX STATIONS
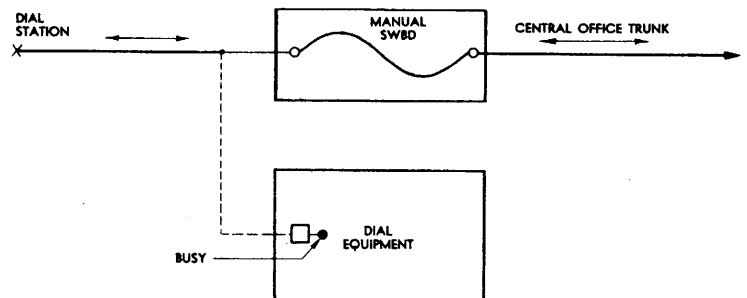## Operation of Dial and Manual Stations

DIAL STATION TO DIAL PARTY LINE

Used for off-premises stations to save mileage.
Separate station jacks and connector terminals
are required for each station.
Line equipment is required on each party line
station.

DIAL STATION USED FOR NIGHT CONNECTION TO CENTRAL OFFICE TRUNK (Two Way Manual or Combination)
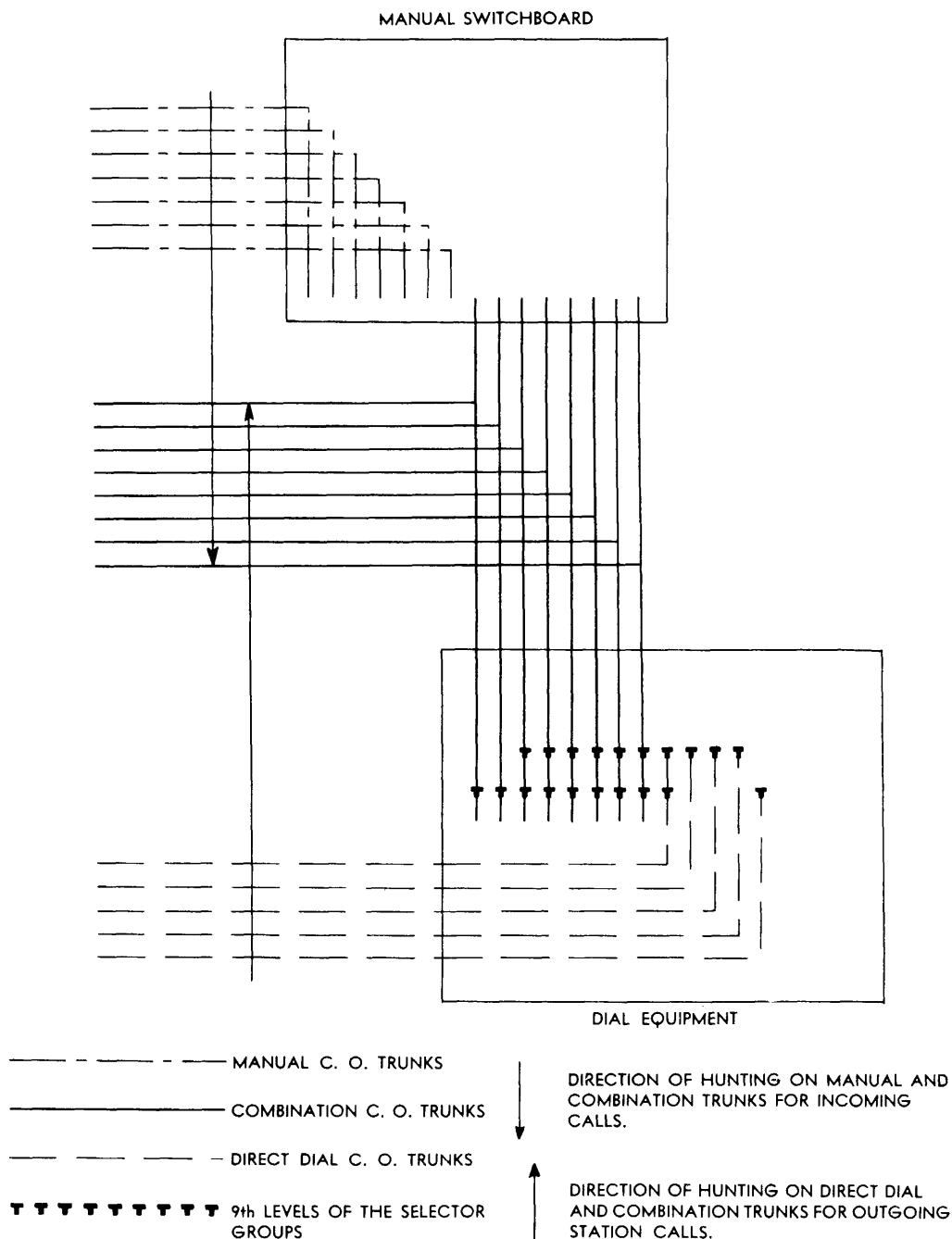
Dial stations set up for night connections are not
available for intercommunicating service. The
station will appear busy to other stations dialing
it. Where intercommunicating service is required
a separate station should be installed for night
connections.

〜 —Cord circuit or dial equipment connection

▢ —Line equipment
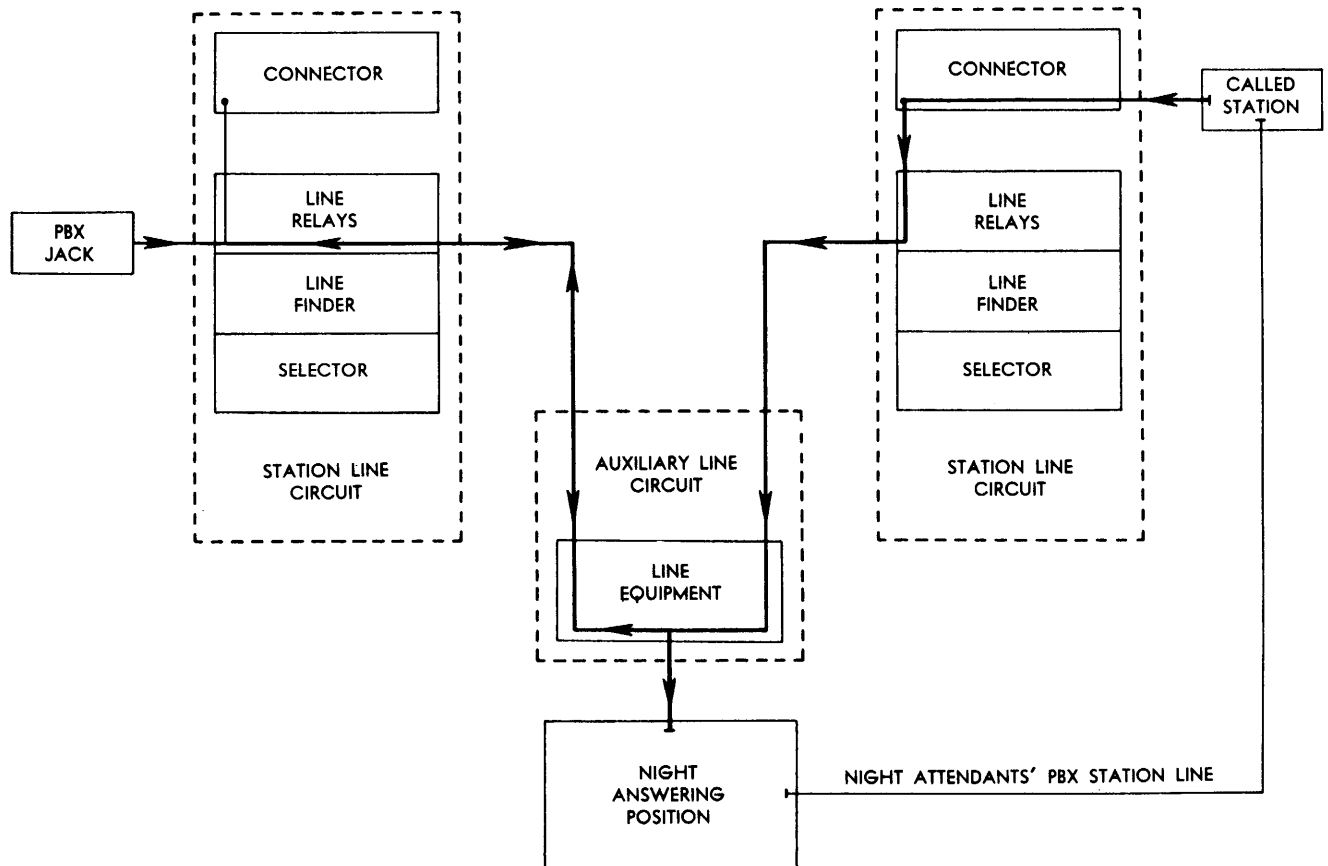
Exhibit 10

CENTRAL OFFICE TRUNK ARRANGEMENTS

MANUAL SWITCHBOARD

DIAL EQUIPMENT

————— ── ───── ─ ──— MANUAL C. O. TRUNKS

──────────────────── COMBINATION C. O. TRUNKS

——— ——— ——— ─ DIRECT DIAL C. O. TRUNKS

T T T T T T T T 9th LEVELS OF THE SELECTOR
GROUPS

DIRECTION OF HUNTING ON MANUAL AND
COMBINATION TRUNKS FOR INCOMING
CALLS.

DIRECTION OF HUNTING ON DIRECT DIAL
AND COMBINATION TRUNKS FOR OUTGOING
STATION CALLS.

Manual central office trunks are used primarily for incoming calls but are also available to the PBX attendant for outgoing calls.

Combination trunks are used primarily for incoming and dialed outgoing calls from stations but are available to the PBX attendant for outgoing calls. A maximum of ten combinations trunks may be provided.

Direct dial trunks are used only for dialed outgoing calls. They are not available to the PBX attendant.

Where more than ten direct dial and combination trunks are required for outgoing calls, certain trunks may be assigned as first choice outgoing from a group of stations, others may be assigned as first choice outgoing from another group of stations and the remaining trunks common to all stations.

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NIGHT SWITCHING ARRANGEMENT

Arrangement Illustrated Is For One Central Office Trunk Set Up To Receive Incoming Calls At Night.

When trunk is set up for night service, the line relays of the first station line circuit operate to put "busy" on associated connector terminal, cut off line finder and extend station line circuit through to the main frame where it is bridged to the auxiliary line circuit. (Line finder and connector operations are not required.)
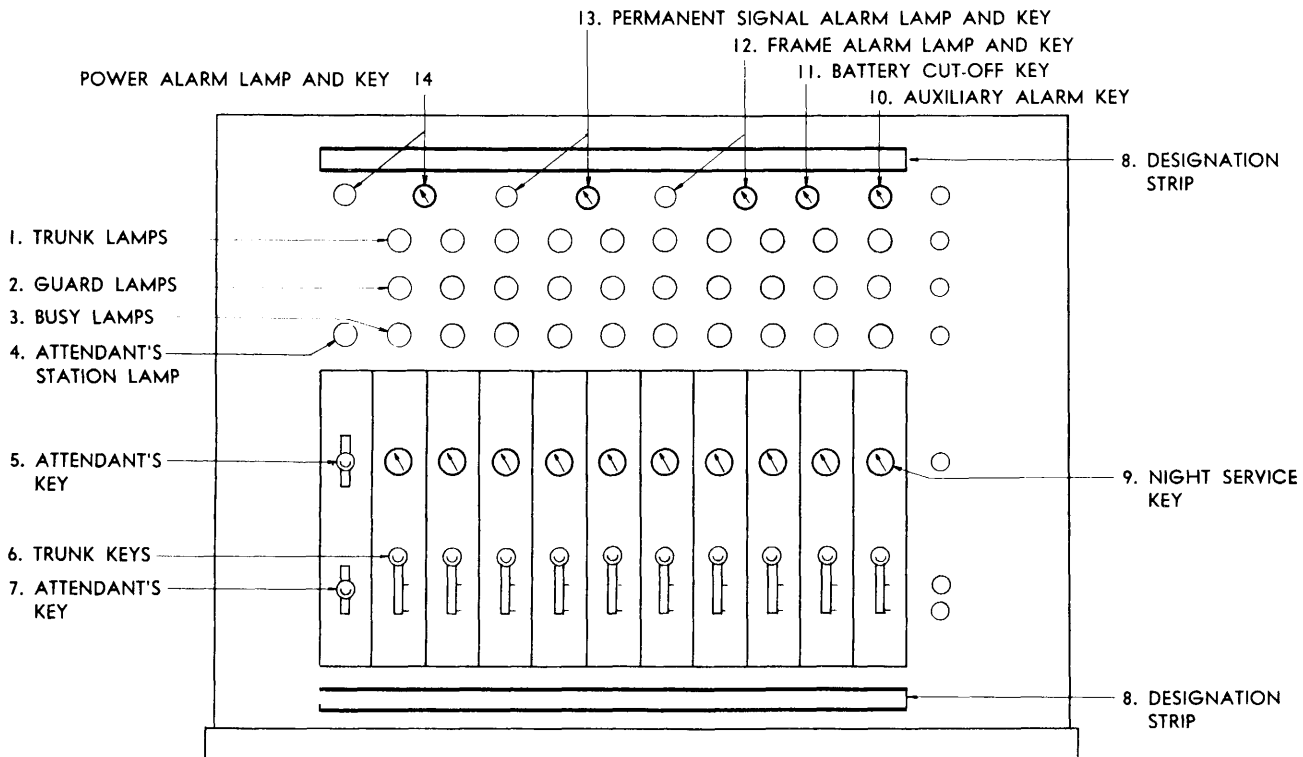
Auxiliary line circuit has termination on night attendant's answering equipment. Incoming trunk call is answered by night attendant who determines the station wanted. Trunk call is held and the station wanted is dialed over regular PBX station. Night attendant tells station user that call is waiting and the number (as-

signed to connector terminal of second station line circuit) that should be dialed, then hangs up.

Station user dials number and is connected through the second station line circuit to the auxiliary line circuit where the hold feature is released and central office call is picked up. (Line relay and connector operations required. Line finder operations not required.)

The first station line circuit may be used as station line for instrument of night answering equipment when not used for night service, if required.
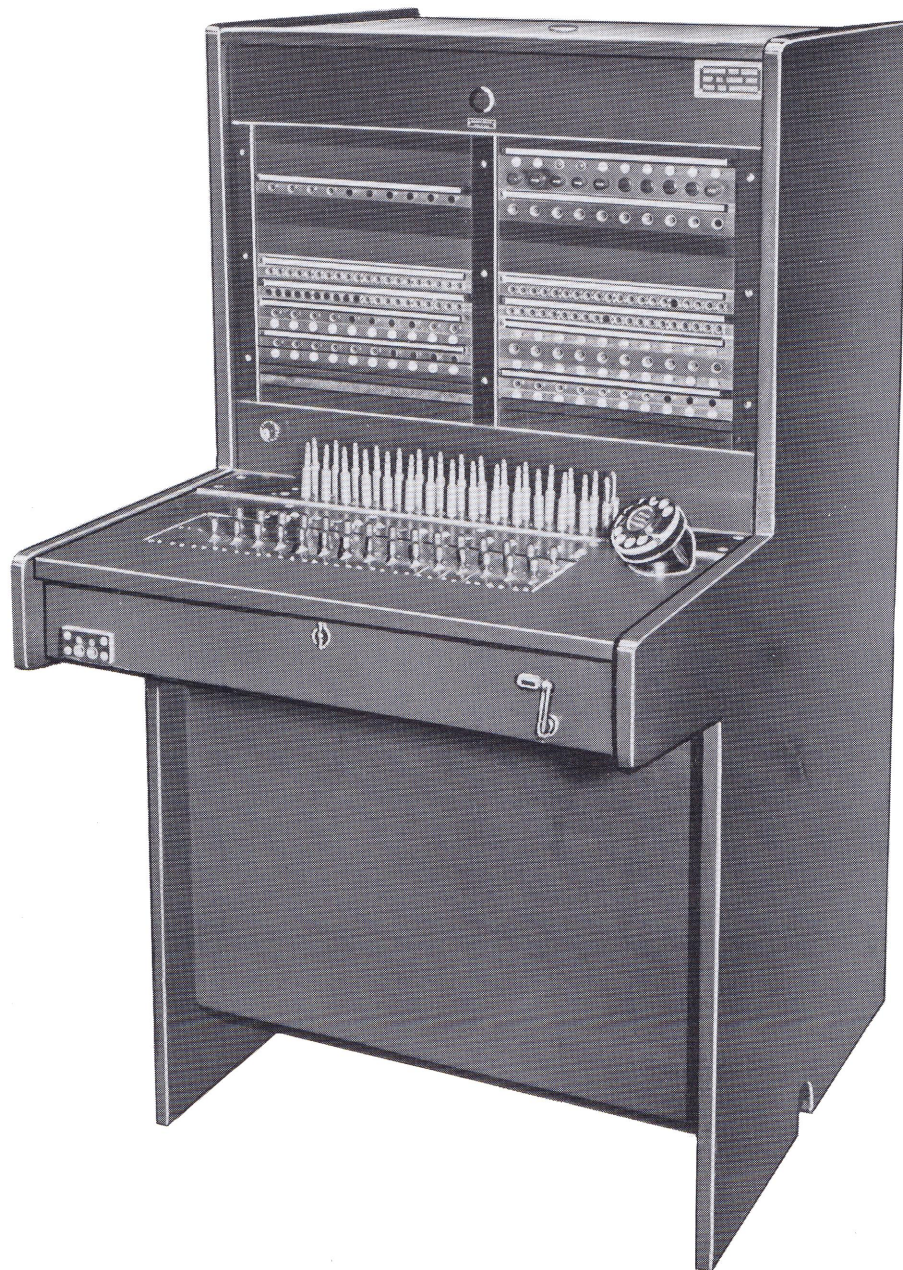
Exhibit 12

OPERATION OF 740-A DIAL PBX

1. Trunk lamp (white) lights to indicate incoming call from central office trunk or tie line. Operation of station switchhook causes lamp to flash indicating call is to be transferred to another station.

2. Guard lamp (green) lights to indicate that a connection to a trunk or tie line has been set up but a call is not in progress. Used to check trunks before taking down night service connections.

3. Trunk busy lamp (red) lights when central office trunk is in use.

4. Attendant's station line lamp (white) lights to indicate incoming call from station.

5. Attendant's station key in up position connects attendant's telephone set and station line to calling station or trunk. In down position releases station line from trunk line when trunk call is to be transferred to another station or when station lines, connected for night service, are released from trunk lines.

6. Trunk keys provided to answer or make central office or tie line calls. Lower position provides holding on central office trunks (not on tie lines). In middle or "talk" position connects attendant's telephone set to central office trunk or tie line.

7. Key in up position is used for out trunk calls. In down position key is used for station calls.

8. Telephone numbers are shown on designation strips.

9. To set up night service conections, attendant operates night service key and associated trunk key to talk position and dials desired station number after operating station dial key. The trunk key and the station dial key are then restored to normal.

10. Auxiliary alarm key cuts off buzzer connection with the trunk signals.

11. Battery cut off key cuts off battery supply from attendant's cabinet.

12. Frame alarm lamp and key—Lamp indicates that a line or switch fuse has blown. The key cuts the alarm buzzer out of the circuit.

13. Permanent signal alarm lamp and key—Lamp indicates that a switch has become inoperative. The key cuts the alarm buzzer out of the circuit.

14. Power alarm lamp and key—Lamp indicates that a power circuit fuse has blown. The key cuts the alarm buzzer out of the circuit.
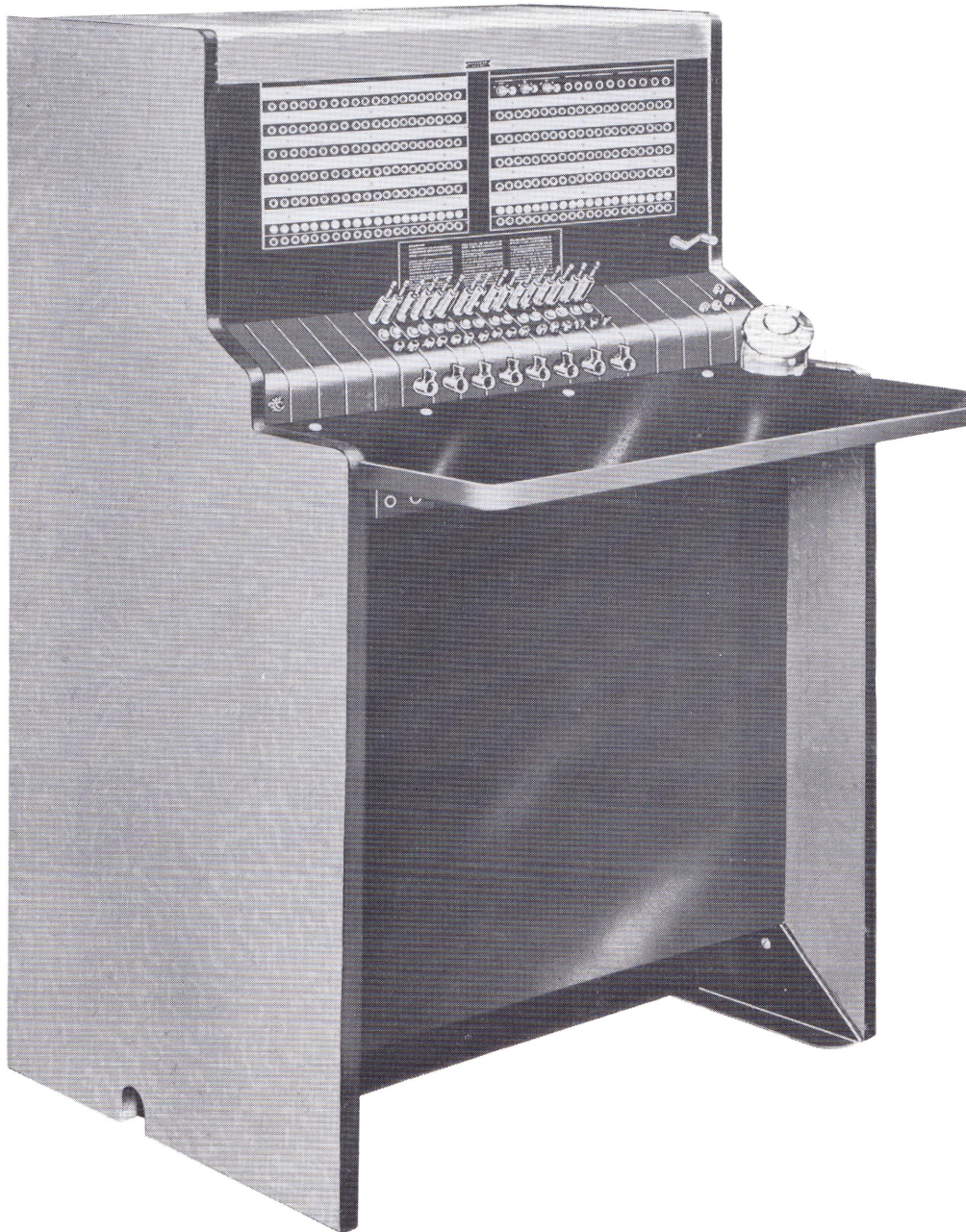
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552-A NON-MULTIPLE CORD SWITCHBOARD

Dimensions: 2'2⅞" Wide; 4'3 3/16" High; 2'10½" Deep
Capacity: 60 Trunks; 300 Stations; 15 Cord Pairs
Standard Finishes: Oak and Mahogany-Walnut
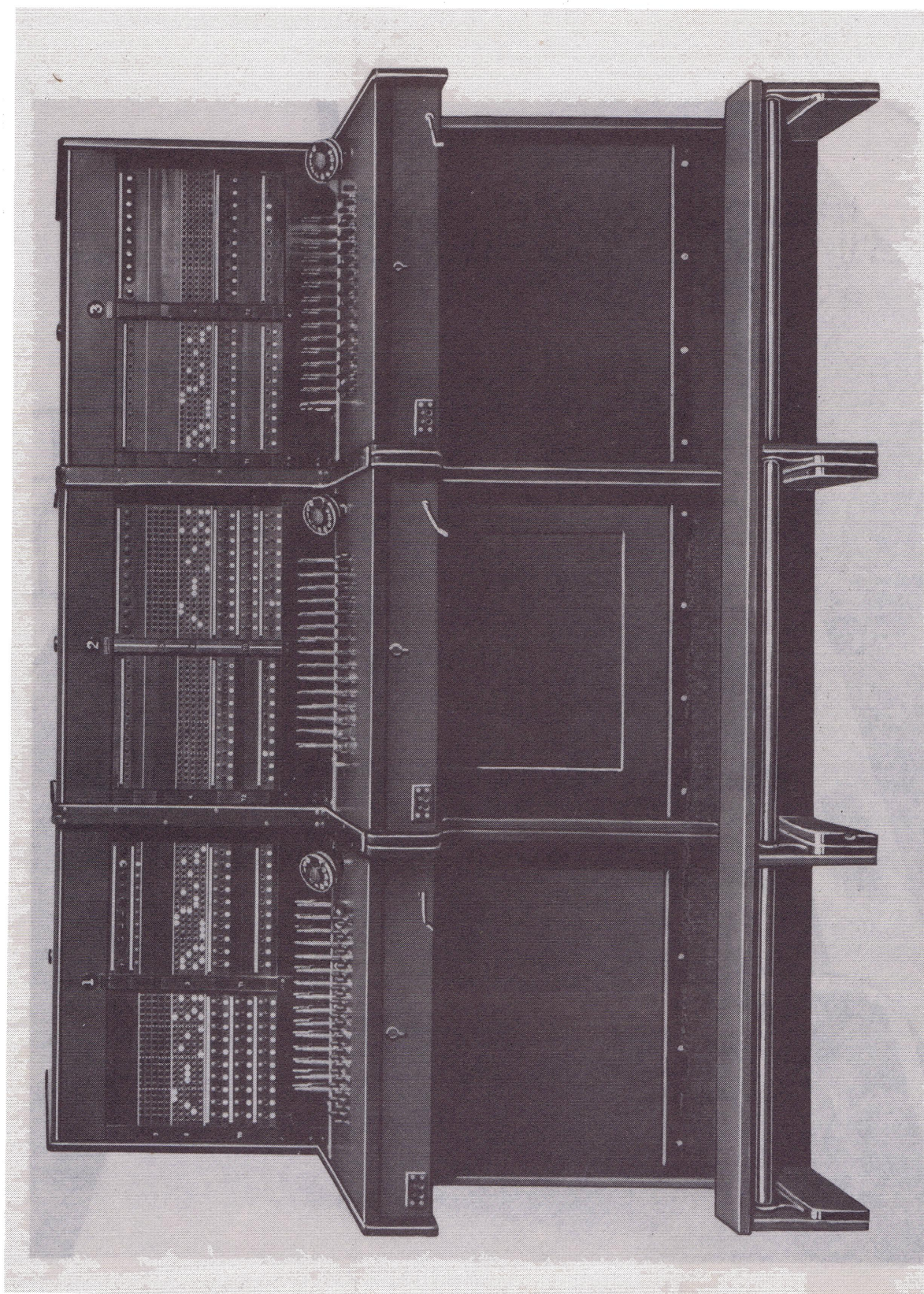
Exhibit 14

556-A NON-MULTIPLE CORD SWITCHBOARD
Used Only With 740-E Dial PBX Systems

Dimensions: 2'5⅜" Wide; 3'10" High; 2'5⅞" Deep
Capacity: 40 Trunks; 180 Stations; 15 Cord Pairs
Standard Finishes: Oak and Mahogany-Walnut

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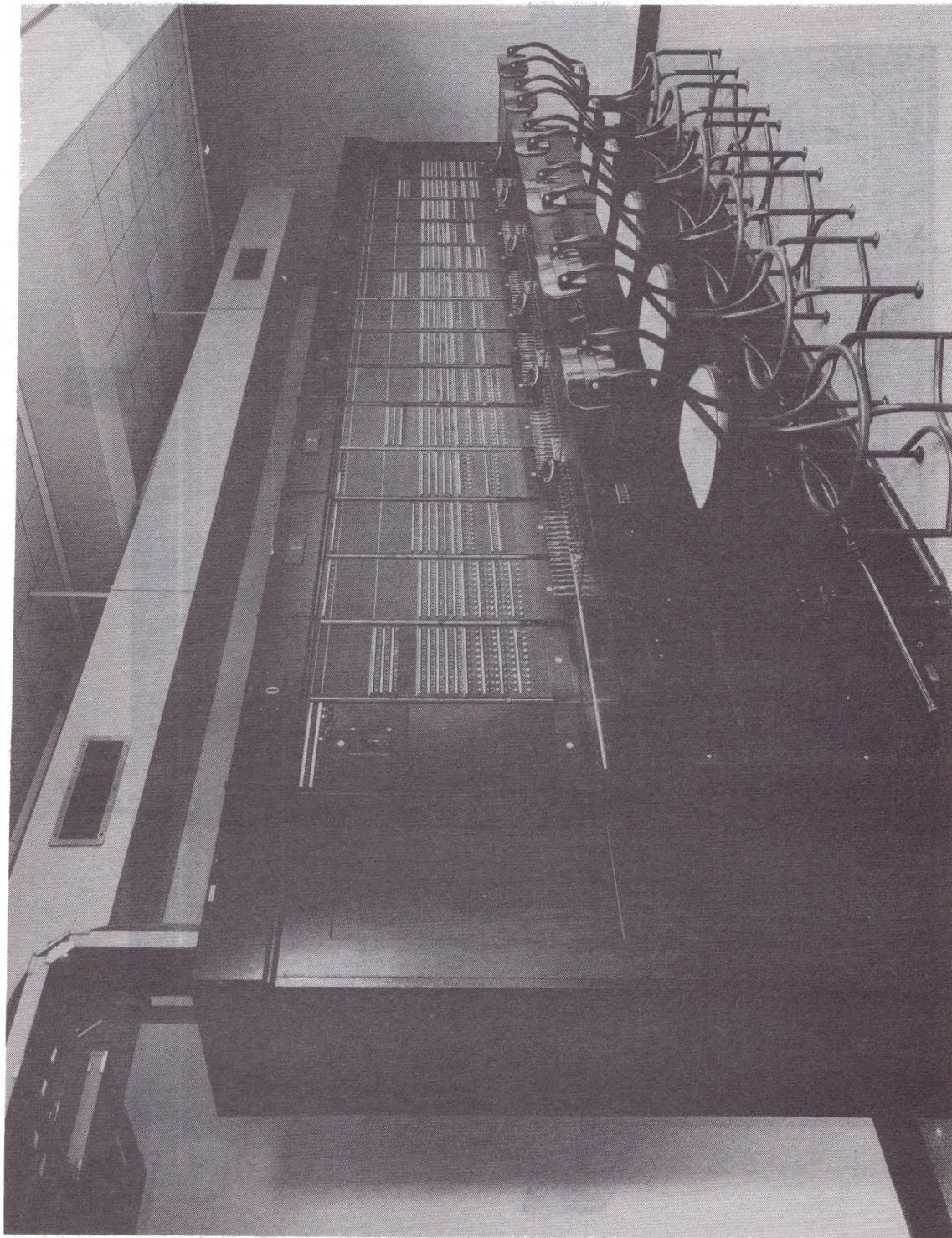Commercial Department
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552-D MULTIPLE CORD SWITCHBOARD

Dimensions for Each Position: 2'2⅞" Wide; 4'9 11/16" High; 2'10½" Deep
Capacity: 180 Trunks; 600 Stations; 15 Cord Pairs
Standard Finishes: Oak and Mahogany-Walnut

Exhibit 16

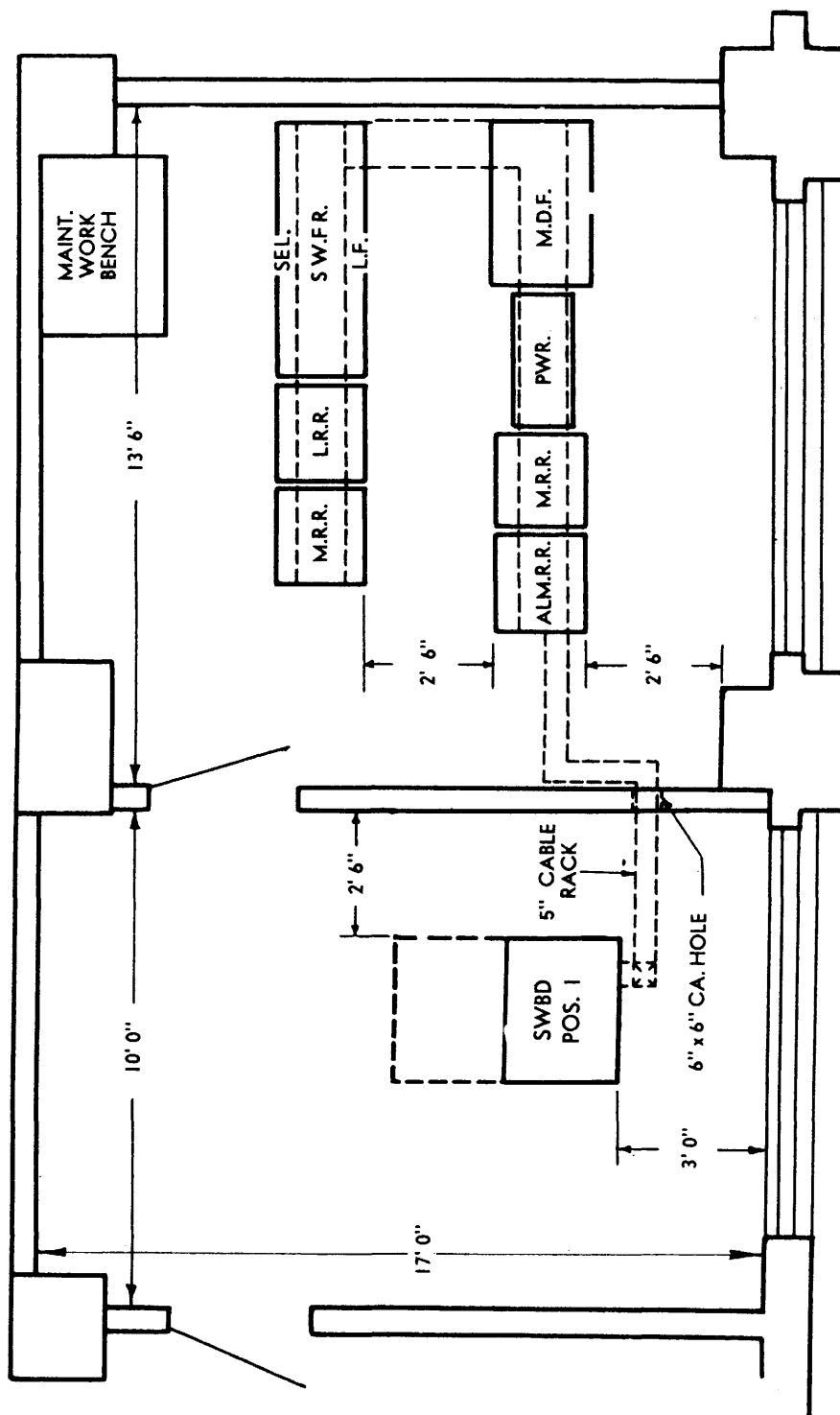# 605-A MULTIPLE CORD SWITCHBOARD
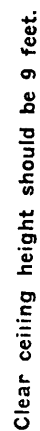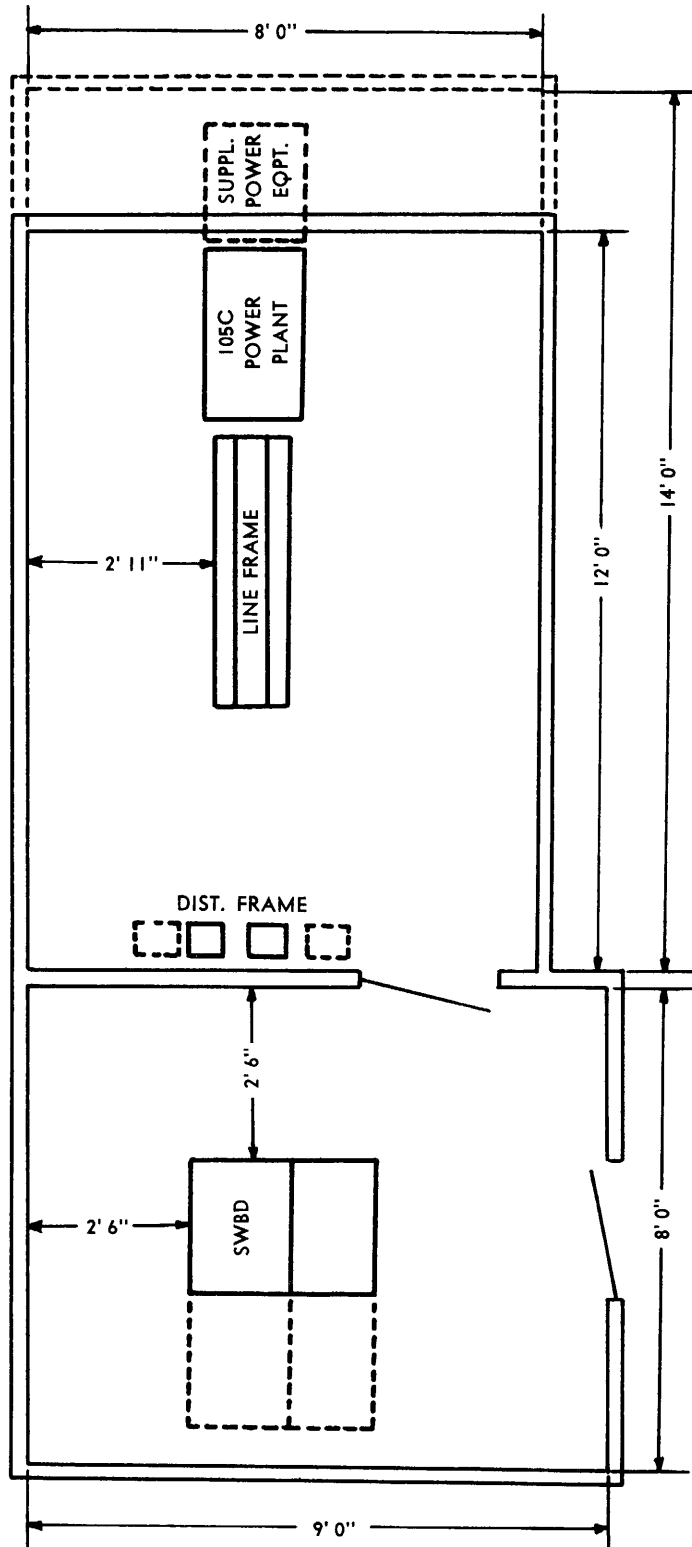

Standard Finish:
Mahogany-Walnut

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TYPICAL FLOOR PLAN FOR 701-A DIAL PBX—100 to 200 Lines

Clear ceiling height should be 9 feet.

Exhibit 18

TYPICAL FLOOR PLAN FOR 701-A DIAL PBX—300 to 400 Lines

10' 10"

FUTURE

FUTURE

FUTURE

FOOT SECTION

3

2

1

HEAD SECTION

C.T.S.

2' 6"

FACE OF JACKS

16' 3"

2' 6"

M.D.F.

M.R.R.

M.R.R.1

M.R.2

L.R.R.1

SW.FR.+1

FUT.BAD RING MACH.

FUT.1-2-A PWR PLT

701-A PWR PLT

BATT. RACK

L.R.R.1

SW.FR.+1

WORK BENCH OR FILE

2' 10"

2' 6"

2' 6"

2' 8"

3' 6"

2' 4"

27' 0"

Clear ceiling height should be 9 feet.

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TYPICAL FLOOR PLAN FOR 740-E DIAL PBX—80 Lines

SUPPL. POWER EQPT.

105C POWER PLANT

LINE FRAME

DIST. FRAME

SWBD

8' 0"

2' 11"

2' 6"

2' 6"

14' 0"

12' 0"

8' 0"

9' 0"

Clear ceiling height should be 9 feet.

Exhibit 20

TYPICAL FLOOR PLAN FOR 740-E DIAL PBX—100 to 300 Lines

Clear ceiling height should be 9 feet.