T1 DIGITAL LINE
GENERAL DESCRIPTION
DIGITAL TRANSMISSION SYSTEMS

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1. GENERAL

1.01 This section contains a general description of the T1 digital line and associated equipment. It is confined to metropolitan T1 equipment and does not include modifications for special applications. The application schematics which give broad schematic coverage are SD-3C252-02 (T1C/T1 ORB), SD-97080-01 (201 ORB), and SD-97080-02 (206 ORB).

1.02 This section is being reissued for the following reasons:

(a) To recommend not using two-cable bidirectional line repeater operation because of the complexity of apparatus case splicing.

(b) To add the J98725H order-wire panel.

(c) To add the AA through AM active and passive type double letter fault-location filters.

Revision arrows are used to emphasize significant changes. Equipment Test Lists are not affected.

1.03 The T1 digital line is a zero-loss facility for digital transmission between digital terminal locations. The rate of bipolar digital transmission using time-division multiplex pulse code modulation on the T1 digital line is 1.544 megabits per second (Mb/s) which in the digital signal hierarchy is called DS1 rate or signal.

1.04 A T1 digital line uses 4-wire transmission; a separate cable pair is required for each direc-

tion of transmission. The T1 digital lines consist of office repeater bays, cross-connect bays, and line repeaters placed in cable pairs to regenerate the signal after it traverses a section of cable. T1 lines can be aerial, buried, or ducted, and repeater locations can be in manholes or above ground. Line repeaters and cables are arranged to form spans (paragraph 2.01). The office repeaters contain a single regenerator. Line repeaters contain two separate regenerators and a common power supply. Power is supplied to the repeaters over the cable pairs via a simplex circuit.

1.05 The different codes of repeaters used for T1 digital lines are shown in Table A. The repeaters are used as line repeaters, office repeaters, and bridging repeaters. They are described in Section 365-200-101.

1.06 The T1 digital line is designed for use on paired metropolitan area trunk (MAT®) trunk cable and intercity outstate trunk (ICOT*) cable. The repeater section loss used in engineering the T1 system is 31 dB and corresponds to the average value of insertion loss for a 6000-foot section of 22-gauge high capacitance cable at 772 kHz. Because the repeater sections adjacent to central offices (COs) are subjected to impulse noise originating in the central offices, these sections are usually shorter than a normal repeater section. The end sections may be of any length up to 4500 feet of 22-gauge cable and are built out to the nominal repeater section loss of 31 dB. Extensive details for engineering a T1 line are given in Section 855-351-101.

2. SPAN CONCEPT

2.01 The sum of all paralleled span lines between two CO buildings is called a ***span***. A ***span line*** is a string of regenerators in tandem from the digital cross-connect (DSX-1) bay or the office repeater bay (ORB) in one CO to the DSX-1 or ORB in another CO (Fig. 1). When the 201 ORB (Fig. 2) is used as a terminal, the span line begins at the span IN jacks on the bank terminating assembly at a terminal office or on the span terminating assembly at an intermediate office. It ends at the span OUT jacks on the span terminating assembly in another office. When the 206 ORB or the T1C/T1 ORB is used as a terminal, the span line connection is the same except the corresponding span line terminating jacks on the 206 ORB (Fig. 3) are located on some repeaters; and with the T1C/T1 ORB (Fig. 4), the jacks are located on a jack field. These jacks are designated L IN and R OUT, respectively.

2.02 The inputs and outputs of span lines and digital channel banks, data banks, or modems can be made accessible for patching at a common location with the digital system cross-connect bays (DSX-1, Fig. 5) (paragraph 4.04). When a DSX-1 is used as a terminal the span line begins at the IN jack on the DSX-1 span panel and ends at the OUT jack in the other office. Span lines may be in different cable sheaths and lie along different geographical routes (paragraph 3.02).

2.03 T1 span lines are connected in tandem to form T1 facilities. The T1 span lines may be rerouted and interchanged between terminals to respond to failures or changes in traffic requirements. Because the span line renders unilateral transmission only, two span lines are required to transmit and receive. In the event of failure, any span line from one office to another office may act as a temporary replacement line for any other span line having the same direction of transmission. It is recommended, however, that the maintenance line provided in the same cable be used.

3. MODES OF OPERATION

3.01 Line repeaters are plug-in units consisting of two separate regenerator circuits. The regenerators are factory-wired in the units so that they either provide regeneration for both directions of transmission (bidirectional) or one direction of transmission (unidirectional). Thus, line repeaters are classified as bidirectional or unidirectional.

3.02 The following four modes of cable-repeater operation are used for T1 digital lines:

(1) One cable using bidirectional line repeaters (Fig. 6)

(2) One cable using unidirectional line repeaters (Fig. 7)

(3) Two cables using bidirectional line repeaters (Fig. 8)

(4) Two cables using unidirectional line repeaters (Fig. 9).

Both directions of transmission are carried in a single cable sheath in modes (1) and (2). Each direction

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of transmission is carried in a separate cable sheath in modes (3) and (4). Modes (1) and (4) are used more widely than the others and were formerly called one-cable and two-cable operation, respectively.

3.03 The four modes of operation result from using either type of repeater with one cable or two cables to provide both directions of transmission. The line repeaters (Fig. 10, 11, and 12) are placed in the apparatus cases listed in Table A at repeater locations. Typical T1 apparatus cases are illustrated in Fig. 13, 14, 15, 16, and 17. Refer to Sections 631-005-101, 640-525-307, and 640-525-308 for additional information on T1 apparatus cases.

3.04 The one cable (screened) using bidirectional or unidirectional repeaters are described in paragraphs 3.05 and 3.06. The screened cable decreases the near-end crosstalk coupling in two transmission systems and hence the interference from other systems. Screened cable will permit the maximum number of T1 lines per sheath and full utilization of the cables for T1 carrier use. Because physical separation of the pairs is not required, the number of systems that may be installed in a screened cable is greater than that for nonscreened cable.

A. One Cable Using Bidirectional Line Repeaters

3.05 With this arrangement, bidirectional line repeaters are used with a single cable for both directions of transmission (Fig. 6). Both repeater inputs and outputs appear at the same point in a cable, making near-end crosstalk the limiting factor in digital line design unless a screened cable is used (paragraph 3.04). The number of facilities which can be installed in a single cable is largely controlled by the physical and electrical separation of the pairs used for the two directions of transmission. The number of facilities which can be installed in a single cable also depends on the cable section loss, since this determines the difference in the signal level between the input and the output. The two sides of a single repeater serve both directions of transmission for a single system; therefore, each repeater is associated with one particular system. The use of bidirectional repeaters determines the powering scheme (Part 5) and requires only one maintenance line of bidirectional line repeaters for span patching.

B. One Cable Using Unidirectional Line Repeaters

3.06 With this arrangement, unidirectional line repeaters are housed in two apparatus cases and spliced into only one cable so that a system is served by two regenerators in separate apparatus cases (Fig. 7). Each repeater in one apparatus case serves two T1 facilities in one direction of transmission, and each repeater in the other apparatus case serves two systems in the other direction of transmission. The use of unidirectional line repeaters determines the powering scheme (Part 5) and requires two maintenance lines in each direction to restore the two facilities associated with each repeater. If growth occurs, the apparatus cases can be spliced to two cables carrying the separate directions of transmission to obtain maximum cable pair usage.

C. Two Cables Using Bidirectional Line Repeaters

3.07 With this arrangement, the bidirectional line repeaters are associated with only one facility, but the two directions of transmission are carried in separate cable sheaths (Fig. 8). Maximum repeater spacing and cable pair usage are realized by separating the directions of transmissions into two cables. The use of bidirectional line repeaters determines the powering schemes (Part 5) and requires only one maintenance line of bidirectional line repeaters for span patching. ▶However, because of the complexity of apparatus case splicing two cable bidirectional operation is no longer recommended.◀

D. Two Cables Using Unidirectional Line Repeaters

3.08 With this arrangement, unidirectional line repeaters are used with a separate cable for each direction of transmission. The signal levels at every corresponding point in the cable are the same for all facilities thus, near-end crosstalk ceases to be a controlling factor and does not limit the number of facilities which can be installed on the cables. Figure 9 shows this cable-repeater arrangement. Since the two sides of a repeater are used for two span lines in the same direction of transmission, the two sides are always associated with two different facilities. One repeater cannot be associated with one particular facility. In this arrangement the two apparatus cases serving the two directions of transmission must be spliced into the cables differently. For example, if the inputs to side 1 of the repeaters in one apparatus case are connected to the office A side of the cable, then the inputs to side 1 of the repeaters in the other apparatus case must be connected to the office B side of the cable so that both directions of transmission are obtained. The use of unidirectional line repeaters determines the powering schemes (Part 5) and requires

two maintenance lines in each direction to restore the two facilities associated with each repeater.

4. OFFICE EQUIPMENT

4.01 The inputs and outputs of T1 span lines appear at jacks on the DSX-1 or ORB. The span lines are connected to other T1 lines at intermediate offices or to digital terminal or multiplex equipment at the end of the route. Bridging repeaters in the ORB or DSX bays are used to patch out a bad line and connect a spare maintenance line in its place, thereby applying the bipolar signal to the maintenance line. Office repeaters provide current regulation for powering the incoming and outgoing lines as well as for signal regeneration of the incoming line. The office repeater bays (Fig. 2, Fig. 3, and Fig. 4) for mounting office repeaters are described in detail in this section. Other office equipment is briefly described below.

4.02 For special applications, office repeaters can be mounted on a smaller scale in the J98711D and E combined bays or the J98713F line terminating unit (LTU). The combined bays, used mainly for traffic service position systems (TSPSs), are 7 feet high and contain a D1 or D3 channel bank (24 channels), one or two 206- or 236-type repeaters, an order-wire panel, a fault-locating panel, a power distribution panel, and a 231-type jack panel. The LTU (Section 365-200-103) is a miniature office repeater bay, containing two 206- or 236-type repeaters, power fuses, and jacks (fault-locating, order-wire, and −48 volt). It is used to provide office equipment for T1 lines connecting small installations, such as wideband data customers, with digital facilities.

4.03 The J98710U express office repeater panel (EORP) is functionally similar to an apparatus case. It is a 23-inch panel which can be mounted in a 7-foot, 9-foot, or 11-foot 6-inch bay for through connections of T1 facilities at intermediate offices. Each EORP is designed to house 25 repeaters, a fault-locating filter, and provide an optional order-wire appearance with provision for both the fault-locating and order-wire pairs. The EORP can be cabled directly to a cable vault, splice box, office distributing frame, or protector frame. Depending on the length of the line segment between the line repeater location and the EORP, either a 3-dB flat loss pad or a 7.5 dB artificial line network is used to provide for proper level coordination and end section buildout. The EORP has optional primary lightning protection, and both the 3-dB flat loss pad and 7.5-dB artificial line network have provision for secondary lightning protection. There are no powering connections to an EORP. For a detailed description of the EORP see Section 365-200-105.

4.04 The DSX-1 patch and cross-connect bay is composed of 17-inch or 23-inch jack panels rack-mounted in frames to provide a common location in the office for cross-connecting and patching. A typical bay arrangement is shown in Fig. 5. The inputs and outputs of T1 lines, digital channel banks, data banks, and modems connect to the DSX-1 with ABAM or 600-type cables. The required cross-connections are made between the DSX-1 jacks associated with these inputs and outputs. Patching at the DSX-1 is used to temporarily bypass faulty apparatus or initially transfer service that is to be permanently rerouted. The DSX-1 is equipped with a communication panel for the appearance of various voice communication circuits, and a maintenance panel which provides access to maintenance related circuits. For a detailed description of the DSX-1 see Section 365-301-101.

4.05 The J98710R-1 T1 quasi-random signal source (QRSS), shown in Fig. 18, is a bipolar bit generator capable of simultaneously supplying a nearly random bit stream for 1 through 25 T1 digital lines. It contains two plug-in units, a clock unit, and a word generator. The J98710R-1 T1 QRSS is described in Section 103-493-104.

4.06 The J98725AF T1C/T1 QRSS shown in Fig. 19, is a bipolar bit generator capable of simultaneously supplying a QRSS for 1 through 50 T1 or T1C digital lines. This QRSS contains two signal plug-in units, either T1C [ED-3C569-( ), G1] or T1 [ED-3C569-( ), G2], or a combination of the two for providing both T1C and T1 signals. It also contains a ED-3C568-01( ) power and alarm plug-in unit. The unit provides power for the signal plug-in units from −48 volt office battery and connections to the office minor alarms. The J98725AF T1C/T1 QRSS is described in Section 103-494-105.

4.07 The QRSS (J98710R-1 or J98725AF) is used for testing, troubleshooting, and as a signal source for supplying signals to maintenance and idle service lines. Each output of the QRSS to maintenance line interface circuit (see SD-99503) provides a standby signal for ten ***maintenance lines***. The QRSS is usually mounted in the ORB or DSX-1.

4.08 The J98710T T1 line monitor panel (Fig. 20) is a signal detector and a transmission switch. It

may be miscellaneously mounted or mounted in a DSX bay and is used to monitor digital transmission at office repeater points. The monitoring is done by logic circuitry contained in the plug-in violation detector. The logic circuits simultaneously detect bipolar violations and absence violations. Relays in the panel, when triggered by the plug-in pattern detector, perform alarm and control functions so that the T1 line monitor can operate unattended. The T1 line monitor panel is described in Section 103-493-107.

A. J98710A-( ) Office Repeater Bay (201 ORB) (A&M Only)

4.09 Span lines appearing at the 201 ORB enter the office through a distributing frame and terminate at the J98710A span terminating assembly (STA) shown in Fig. 21. Office wiring arrangements for the more common modes of repeater operation are shown in Fig. 22 and 23.

4.10 The 201 ORB is provided in 7-, 9-, and 11-1/2 foot heights. A fully equipped 7-foot bay mounts three bank terminating assemblies (BTAs) and three STAs. A fully equipped 9-foot bay mounts four BTAs and four STAs. A fully equipped 11-1/2 foot bay mounts six BTAs and six STAs. However, the 201 ORB may contain other combinations of BTAs and STAs.

4.11 Each STA accommodates six 201-type office repeaters or six 208-type repeaters with 215A adapters and six control units. Therefore, a 7-foot bay accommodates 18 through or 36 terminated 2-way facilities. A 9-foot bay accommodates 24 through or 48 terminated 2-way facilities. A 11-1/2 foot bay accommodates 36 through or 72 terminated 2-way facilities. Monitoring points and jacks are provided in the STA for each of the repeaters. The jacks provide access to the output of each repeater and to the input of each outgoing span line. Moreover, the jacks are used for patching maintenance lines and for other maintenance operations. A cross-connect field is also contained in the STA. The cross-connect field enables cross-connecting the STA to the distributing frame and to other units on the 201 ORB.

4.12 The 201- or 208-type repeater used in the 201 ORB provides PCM pulse regeneration for one direction of transmission for two span lines (span dedication) or for both directions of transmission for two span lines (facility dedication). An option provided in the 201-type and some 208-type repeaters must be selected for loop powering connections.

4.13 The 201-type bridging repeaters mount in any spare position in the STA. The required jacks and cross-connect points for the input and output of the bridging repeater are located on the STA. Power for the STA is supplied from −48 volt office battery through an associated control unit.

4.14 The distributing terminals strip (DTS) connects the 600-type or ABAM cable transmission pairs between the STA and the main distributing frame (MDF). The DTS is normally located at the top of the 201 ORB as shown in Fig. 2.

4.15 The J98710C BTA provides jack access between the 201 ORB and D-type channel banks at terminal offices or another ORB at intermediate offices. Each assembly (Fig. 24) provides connections to 12 D-type channel banks (24 channels). The DSX-1 eliminates the need for the BTA and provides patching access at a central location in the office. Some older installations have the equalizers mounted in the BTA, but present procedures call for mounting these equalizers in the D-type channel bank bay. In either case, the equalizers are used to build out the line between the transmitting side of the D-type channel bank and the ORB to a nominal flat loss of 6 dB. The output of the terminal is 6 dB higher than the level needed at the ORB to allow for cabling and equalization losses between the bank and the repeater bay. Selectable equalizers are provided to correct for approximately 0 through 150, 150 through 450, and 450 through 750 feet of 600-type or ABAM cable.

4.16 The J98710B control unit (Fig. 25) is used to distribute power from the bay fuse and alarm panel to the span line when power is supplied locally. When power is supplied from the opposite end of the span, power looping for the span line is provided by the control unit through the office repeater. Each of the six control units, when plugged into the STA provides power for two incoming and two outgoing span lines. Since two span lines in each direction are usually associated with one office repeater, each office repeater requires one control unit. A control unit distributes power for one facility when bidirectional line repeaters are used, and two facilities in one direction when unidirectional line repeaters are used. Five fuses are provided on each control unit: four are for four span lines, and the fifth is for the office repeater.

4.17 A J98710D fuse and alarm panel, shown in Fig. 26, distributes the required combination of

−48 volt, −130 volt, and +130 volt office battery and ground to the STAs and then to the control units when the local office is supplying power for the span lines and local office repeaters. When power is supplied from the opposite end of the span, the local office repeaters may be powered either separately or from the span lines. If powered separately, the local fuse and alarm panel supplies the required power. The fuse and alarm panel provides three fuses for each STA one each for the −48 volt, −130 volt, and +130 volt supplies. Alarm relays on the panel permit connections for audible and visible indications of fuse failure.

4.18 A J98710E order-wire panel, shown in Fig. 27, may be mounted in the ORB to provide talking facilities between the ORB and any apparatus case location along the span. Based on the length of the span, one order-wire panel (at one end of the span) or two order-wire panels (one at each end of the span) may be installed. See Section 855-350-107 for details. The order-wire panel provides talking and signaling battery for the order-wire pair and connections to the switching equipment in the office.

4.19 The J68769AJ telephone set panel is used with the order-wire circuits (paragraph 6.03). Power is supplied from the office power distribution fuse bank. This panel is shown in the 201 ORB in Fig. 2.

4.20 The fault-locating filter panel is used for mounting filters for fault-locating (Part 6) of the office repeaters. Jacks for terminating the filters are located on the ORB jack field. The fault-locating filter panel is shown in the 201 ORB in Fig. 2.

4.21 The jack mounting panel on the 201 ORB (Fig. 2) is equipped with jacks for the order-wire pair, fault-locating pair, QRSS outputs, and various maintenance related facilities. If the DSX-1 is part of the installation, these jacks are located on the DSX-1 communication or maintenance panels.

4.22 The interbay cable duct on the 201 ORB is used to channel the interbay span cross-connect cabling. It has a capacity for 500 through 600 pairs and is mounted at a convenient height as shown in Fig. 2.

B. J98710J, K, and L Office Repeater Bay (206 ORB)

4.23 Span lines appearing at the 206 ORB enter the office through a distributing frame and are terminated in the 206- or 236-type office repeaters (Fig. 28 and 29). Office wiring arrangements for the more common modes of repeater operation are shown in Fig. 30 and 31.

4.24 The 206 ORB is provided in 7-, 9-, and 11-1/2 foot heights. When fully equipped, the 7- and 9-foot bays contain 50 office repeaters (48 service-line and 2 maintenance-line), and 2 bridging repeaters. The 11-1/2 foot bay contains 75 office repeaters (72 service-line and 3 maintenance-line), and 3 bridging repeaters. All repeaters are plug-ins mounted in bay shelves, 13 in each shelf.

4.25 The 206 and 236 office repeaters provide most of the span terminating circuitry required in the 206 ORB. Each repeater provides PCM pulse regeneration for one incoming span line. Some repeaters contain jacks for access to the repeater output and to the input of the outgoing span line. Moreover, the jacks are used for patching maintenance lines and other maintenance facilities. Monitoring points are provided for each repeater. Jack access is provided at the DSX-1 when using repeaters which do not have jacks. The repeaters having power regulators supply regulated power to the T1 digital line.

4.26 A 206 or 236 bridging repeater is mounted in position 13 of even-numbered shelves, next to the repeater for the maintenance line. Power for the bridging repeaters is obtained locally from −48 volt battery through the power distribution panel in the ORB.

4.27 The 234D distributing terminal strip connects the 600-type or ABAM cable transmission pairs and fault-locating pairs between the 206 ORB and the distributing frame verticals. It is mounted near the top of the repeater bay as shown in Fig. 3.

4.28 An ED-97442-50 span cross-connect field (Fig. 32) is used for cross-connecting intraoffice transmission pairs between the office side of the 206- or 236-type repeaters and other units within the same bay or other bays. Its location on the repeater bay is shown in Fig. 3.

4.29 An optional feature, the bay cross-connect field (Fig. 3), is used in the 206 ORB for cabling intraoffice transmission pairs from the span cross-connect field to other repeater bays, DS1 terminals, central cross-connect fields, or DSX-1 cross-connects.

4.30 An ED-97443-30 fuse and alarm panel (Fig. 33) distributes the required combination of −48

volt, −130 volt, and +130 volt office battery and ground to the 206 or 236 repeaters with regulators via the power distribution unit when the local office is supplying power for the span lines and local office repeaters. When power is supplied from the opposite end of the span, the local office repeaters may be powered either separately or from the span lines. If powered separately, the local fuse and alarm panel supplies the required power. The fuse and alarm panel provides three fuses for each shelf in the ORB (one each for the −48, −130, and +130 volt supplies). Alarm relays on the panel permit connections for audible and visible alarm indications of fuse failure. In addition, the fuse and alarm panel supplies −48 volts to the order-wire panel, telephone set panel, and test set powering jacks.

4.31 An ED-3C009-30, G1 power distribution panel (Fig. 34) drops the −48 volt office battery to the level required for local powering of office repeaters, or the −130 volt battery to the level required for powering of the T1 digital line. One unit supplies power to one repeater shelf. The unit is mounted on the rear of the bay to minimize heating of other units in the bay.

4.32 The J98710M power dissipation unit (PDU) (Fig. 35) is mounted in a shelf at the top of the 206 ORB (Fig. 3). The PDUs house the power dissipation resistors. These resistors are associated with the 130-volt line current regulator in some 206 and 236 repeaters. Each PDU is dedicated to a shelf of repeaters, thus, there are six PDUs for the 206 ORB shown in Fig. 3. The PDUs are not required when powering low-powered lines (60 mA) with 236-type repeaters or when powering with −48 volts only. In their place 291A adapters are used or the M wiring strapping option (SD-97080-02) is applied to each repeater slot.

4.33 The J98710E order-wire panel (Fig. 27) may be mounted in the 206 ORB as shown in Fig. 3. This panel provides talking facilities between the ORB and any apparatus case location along the span. Based on the length of the span, one order-wire panel (at one end of the span) or two order-wire panels (one at each end of the span) may be installed. See Section 855-350-107 for details. The order-wire panel provides talking and signaling battery for the order-wire pair and connections to the switching equipment in the office.

4.34 The J68769AJ telephone set panel (Fig. 3) is used with the J98710E order-wire circuits. Power for it is supplied from the fuse and alarm panel.

4.35 ▶The J98725H order-wire panel (Fig. 36) may be mounted in the ORB in lieu of the J98710E order-wire panel and the J68769AJ telephone set panel (Fig. 3). The order wire is designed to furnish voice capability between repeater locations and any telephone within the associated exchange area, between repeater locations and the order-wire panel in the span terminal offices, and between two or more individual repeater locations. The panel provides flexibility of the order-wire system configuration by accepting interchangeable plug-in units to satisfy specific system requirements. The J98725H order-wire panel is also used in the J98725A, B, and C T1C/T1 DSX optional ORB as further described in paragraphs 4.55 through 4.57. Refer to Sections 365-325-100 and 855-350-107 for additional details.◀

4.36 The fault-locating filter panel (Fig. 3) is used for mounting filters for fault-locating (Part 6) in the office repeaters. Jacks for terminating the filters are located on the repeater bay jack field.

4.37 The 231-type jack mountings on the 206 ORB (Fig. 3) are equipped with jacks for the order-wire pair fault-locating pair QRSS outputs, and various maintenance related facilities. If the DSX-1 is part of the installation, these jacks are located on the DSX-1 communication and maintenance panels.

4.38 The interbay duct on the 206 ORB is used to channel the interbay span cross-connect cabling. It has a capacity for 500 through 600 pairs and is mounted in a convenient location just below the span and bay cross-connect fields as shown in Fig. 3.

C. J98725A, B, and C DSX Optional Office Repeater Bay (T1C/T1 DSX Optional ORB) and J98725D, E, and F DSX Dedicated Office Repeater Bay (T1C/T1 DSX-Dedicated ORB)

4.39 T1 spans may terminate at COs in T1C/T1 shop-wired 23-inch type bays (Fig. 4). Two types of 11-foot 6-inch and 9-foot bays are provided: the standard bay shown in Fig. 4 (T1C/T1 DSX Optional ORB) and the digital cross-connect dedicated bay (T1C/T1 DSX-DED ORB). These bays include shop-wired connectors and associated equipment which accommodates up to 104 repeaters (T1C/T1 ORB) or up to 156 repeaters (T1C/T1 DSX-DED ORB). Two other T1C/T1 ORB designs, a 9-foot and

a 7-foot bay, include similar hardware but have half the capacity of the 11-foot 6-inch bay. The 9-foot DSX-DED ORB will accommodate 104 repeaters.

4.40 A fully equipped 11-foot 6-inch T1C/T1 ORB contains eight repeater shelves; whereas a fully equipped 9- or 7-foot bay contains four repeater shelves. The T1C/T1 DSX-DED ORB contains 12 repeater shelves. Each shelf is front mounted, 8 inches in height, and provides connectorized slots (positions) for accepting thirteen 221- or 231-type repeaters (Fig. 37). All repeater slots labeled 25 (position 12 of even-numbered shelves) are dedicated to maintenance lines, those labeled 26 (position 13 of even-numbered shelves) are dedicated to bridging repeaters. The repeaters are described in Section 365-200-101.

4.41 Other circuits included in the T1C/T1 ORB are plug-in equalizers, power dissipation circuits, fuse and alarm circuits, fault-locating, order-wire, telephone set circuits, jack panels, and span and bay cross-connect panels. Jack panels and span and bay cross-connect panels are not provided if the ORB is to be used with a DSX-1. Interconnecting bay wiring is provided at the time of installation.

4.42 Associated with each office repeater connector position on the T1C/T1 ORB is a connector assembly for a discrete component, plug-in equalizer circuit card. Each regenerator output is dedicated to an equalizer connector input. In the T1C/T1 DSX-DED ORB, a single plug-in card containing 13 equalizers is associated with each shelf.

4.43 The equalizer connector will accept any of the codes of plug-in equalizers (Table B). The equalizers provide pulse equalization for up to 655 feet of intraoffice 600-type or ABAM cable. Also, the equalizers provide 0.8-dB steps to maintain the signal level difference due to equalization between −0.4 dB and +0.4 dB at the DSX-1.

4.44 When a DSX-1 bay is not provided and the ultimate growth is not expected to exceed four office repeater bays, jack appearances can be provided in the T1C/T1 ORB. In this case the equalizers are selected as if there were a DSX-1 located within the bay itself. That is, the equalizer code for 0- to 220-foot cross-connect distances would be used for every repeater in the ORB including bridging repeaters. This arrangement minimizes flat-loss mismatch when systems are looped and provides test set compatibility at the jacks on both bays.

4.45 The jack and cross-connect panels (Fig. 4 and Fig. 38) are mounted on a single shelf assembly in the T1C/T1 ORB ***when a DSX-1 is not provided.*** The jack field provides jack appearances for patching and testing office repeaters, fault-locating circuits, −48 volt test set power, and miscellaneous jacks. Order-wire jacks do not appear in the jack field but are on the self-contained order-wire panel. For small installations and locations requiring fewer than four ORBs, the jack and cross-connect facility is a panel on the ORB. However, if the ultimate T1 growth capacity in the central office exceeds four office repeater bays, a centralized DSX-1 cross-connect bay should be installed initially. Figure 39 shows a typical T1 cross-connect arrangement when using the T1C/T1 ORB.

4.46 In the 11-foot 6-inch T1C/T1 ORB, the jack panel contains jacks for eight shelves of office repeaters plus miscellaneous jacks. In the 9- and 7-foot ORB, the jack panel contains jacks for four shelves of office repeaters plus miscellaneous jacks. The jacks for each repeater provide a normally closed through connection at the regenerator output (R OUT to X IN). A similar connection is on the transmitting side (X OUT to L IN). Likewise, there is an arrangement for bridging jacks. Cross-connections within a bay and to nearby bays are made via the span cross-connect field. Cross-connections to more distant repeater bays and to D-type channel bank bays are made via the bay cross-connect field.

4.47 The jack field interface terminal strip (JTS) interfaces the repeater connectors with the jack and cross-connect panels. Regenerated (received) signals at the regenerator output are connected via the JTS to regenerator jacks (R OUT) which are normally closed through to the input jacks (X IN) and then to span cross-connect terminals. The R OUT jacks provide access to the regenerator output, while the X IN jacks provide access to the span cross-connect input (to D-type channel bank receiver). In-service signal monitoring for regenerated signals is provided at the MON jacks associated with the R OUT and X OUT jacks.

4.48 Transmitted signals (from D-type channel bank) are connected from the span cross-connect to the X OUT jacks which are normally closed through to the L IN jacks. From the L IN jacks, signals are connected to the repeaters via the JTS. The X OUT jacks provide access to the span cross-connect output (from D-type channel bank transmit-

ter), while the L IN jacks provide access to the outgoing line. In-service signal monitoring jacks for the transmit direction are also provided.

4.49 In addition, there are connections for bridging jacks. Jack field position 26 is always dedicated to the inputs and outputs of the bridging repeater. A signal from a QRSS or service line may be placed on a maintenance line by use of the bridging repeater and associated jacks. The circuit also provides a means for putting a signal source on a maintenance line or a line that is powered but not yet placed in service. The input of the bridging repeater is accessible at the BRDG IN jack. The output of the bridging repeater appears at the R OUT jack. The X IN jack provides access to the cross-connect input (to maintenance repeater). The R OUT jack and the X IN jacks are connected through normally closed contacts. The bridging repeater never interfaces directly with a span line but is always used in conjunction with the maintenance line repeater. Monitor jacks (MON) associated with the R OUT jack are provided for the bridging signals.

4.50 The jack field interface terminal strip (JTS) essentially serves as a hub for all connections between the office repeaters or equalizer connectors on one side and the jack and cross-connect panels on the other side. The terminal strip is divided into two sections: one for outgoing signals from the equalizer connector to the jack field and the other for incoming signals from the jack field to the passive side of a repeater. For example, a regenerated output signal at a repeater connector position is connected to its associated equalizer connector position. Then, this signal is connected to pins on the JTS where now the signal may be connected to a DSX-1 or the jack and cross-connect panels. The other part of the JTS provides tie points for the signals that are connected to the office repeater transmit direction. These signals are connected to the JTS from a DSX-1 or the jack and cross-connect panels. As is the case for regenerated signals (outgoing) connected to the JTS, pins are connected to its corresponding repeater connector position terminals. Also, on an optional basis, connections are provided for the T-Carrier Administration System (TCAS).

4.51 The fuse alarm and fault-locate filter panel (Fig. 40) distributes −48, −130, and +130 volt battery voltage to the office repeater shelves as required. The voltage delivered to each shelf is separately fused. Alarm relays are provided to indicate fuse failure. A shelf fuse failure causes a pair of relay contacts to operate and light the red (major alarm) lamp. A line fuse (located on repeater) failure causes another pair of relay contacts to operate and light the white (minor alarm) lamp. Eight separate fuse positions protect the order-wire circuit, connected test sets, or any other equipment used at the ORB that may require −48 volt battery. In addition, four connectors in the fuse and alarm panel accept plug-in fault-locating filters (Part 6). Also, four microswitches provide a short circuit when no fault-locating filter is installed. One plug-in fault-locating filter is shared by a maximum of 50 office repeaters for unidirectional operation. With bidirectional operation one filter is shared by a maximum of 25 office repeaters. Therefore, the 11-foot 6-inch ORB will be equipped with two filters for unidirectional operation and will be equipped with four filters for bidirectional operation. The 7- and 9-foot ORB is equipped with half the number of filters.

4.52 Alarm circuitry in the T1C/T1 ORB makes connection to the central office audible and visual alarms. Connections to the E2 remote alarms are available on an optional basis.

4.53 The fuse and alarm panel also distributes −48 volt power to the repeater shelves via the −48 volt power distribution circuit. Each repeater position has a 422-ohm series dropping resistor. This resistor supplies minus repeater power when the repeater is powered separately (not in tandem with the repeatered line). In addition, +130 volts is distributed to the repeater shelves via the ohm-per-volt circuit. Each repeater connector position has a 110-ohm resistor that is in series with the plus lead. This resistor and the line current regulator in the repeater provide current limiting. Also −48 volts is distributed to three 238AM jacks on the miscellaneous jack panel which are used for powering test equipment requiring −48 volts. These jacks are wired with −48 volts connected to the tip and ground connected to the sleeve.

4.54 The power dissipation unit (PDU) (Fig. 41) located at the top of the T1C/T1 ORB house the 1000-ohm power dissipation resistors. These resistors are associated with the line current regulator circuit in the office repeaters and prevent overload of the regulator transistor during high dissipation conditions. Each PDU is dedicated to a shelf of repeaters. Thus, there are eight PDUs on the T1C/T1 ORB shown in Fig. 4. The PDUs are not required when

powering low powered lines (60 mA) with 231-type repeaters or when powering with −48 volts and ground. In their place 292A plug-in adapters are used or the P wiring strapping option (SD-3C252-02) is applied to each repeater slot.

4.55 The J98725H order-wire (paragraph 6.03) and telephone set panel (Fig. 36) contains an OW TEL SET jack, a TEL SET IN jack, and an OW LINE jack. ACO and OW lamps and an ACO key are also located on the panel. The OW TEL SET jack is used to connect a 52-type headset for central office communication. The TEL SET IN jack and the OW LINE jack connect directly to the telephone set and the OW LINE to provide flexibility in patching between order-wire lines.

4.56 The OW lamp (white) indicates which order-wire line is activated. It lights during the quiet termination mode. Plugging into the OW TEL SET jacks lights the ACO lamp and turns off the audible office alarm. An ACO key is used to turn off the audible office alarm when the order-wire is placed in the quiet termination mode for field-to-field communications.

4.57 In order to meet the needs of various offices, there are four order-wire plug-in units available as options. However, the 23-inch by 2-inch order-wire panel provides connectors to accommodate only two of the four plug-in units. The four plug-in units are as follows:

(a) Order-wire and telephone set circuit which contains all the circuitry necessary to power and talk over the line, to connect to the CO dial system, and to provide timing and alarm circuitry to call the CO.

(b) Telephone set circuit which contains the circuitry necessary to talk over a given order-wire line powered from another location.

(c) Multiple circuit which enables additional appearances of the same order-wire within a CO.

(d) Bridging and coupling circuit which provides a means to ac couple two individually powered lines. It also provides a bridge connection that in connection with a telephone set circuit enables personnel to talk over the joined order-wire lines.

5. POWERING OF T1 DIGITAL LINES

5.01 Power from the CO battery is simplexed over the cable pairs from the office repeater bays. The battery potential applied to a span line results from combination of −48V, +130V, −130V, and ground and depends on the number of intervening repeaters before a power looping point. The office repeaters can be powered separately from the local office battery or in series with outgoing power or incoming power from the other end (see Note). When only one office supplies power for a span, the power is looped at the other office. When both offices supply power for a span, power is looped back toward both offices from one of the line repeaters. The line repeater at the looping point is powered from the office transmitting in the direction of side 1 of the looping repeater.

Note: When using 206- and 221-type EXCP repeaters for powering low powered lines (60 mA), they cannot be powered in series with the line because the regenerator circuits in these repeaters require 70 mA.

5.02 In the 201 ORB, the line current is manually set to 140 mA by means of resistors in the control units, but it must not be allowed to vary beyond 130 through 150 mA as the line temperature and office battery vary. In the 206 ORB and T1C/T1 ORB, the line current is held to approximately 140 mA (standard powered lines) or 60 mA (low powered lines) by means of an automatic line current regulator in the 206, 236, 221, or 231 repeater. This current for powering line repeaters also serves as a sealing current for unsoldered splices in the line.

5.03 The powering scheme for facilities using bidirectional line repeaters is shown in Fig. 42. The power loop consists of one office repeater and the bidirectional line repeaters which serve one facility. The office repeater is shown powered in series with the line (Fig. 42A) and powered separately (Fig. 42B), and the power is looped at a line repeater. Options on the 206 or 236 repeater could have been selected to power the 206 or 236 repeater from the other end. These arrangements are also provided at 201 ORBs with options on the control units (see Note). The battery potential applied to a power loop depends on the number of intervening repeaters before the looping point. Each power loop is uniquely related to one particular T1 facility.

Note: When powering the office repeater from the other end, all line repeaters must be through-powered.

5.04 The powering scheme for facilities using unidirectional line repeaters is shown in Fig. 43.

The power loops consist of two office repeaters and the unidirectional line repeaters which serve two facilities. The battery potential which depends on the number of repeaters to be powered is applied between the two office repeaters. The office repeaters shown in Fig. 43A are powered in series with the line whereas the office repeaters shown in Fig. 43B are powered separately. The power is looped at a line repeater. The power could have been looped from another CO by using office repeaters provided with looping arrangements. These arrangements are also provided at 201 ORBs with options on the control units. Removing any unidirectional line repeater, office repeater, or control unit (201 ORB) in a power loop disrupts powering on two facilities.

6. MAINTENANCE FACILITIES

A. Maintenance and Backbone Lines

6.01 A maintenance line is a span line which can be substituted for any in-service line by patching. Maintenance line repeaters must be provided in position 25 (slot 12 of even-numbered shelves in 206 and T1C/T1 ORB) and assigned on a span basis. Since all span lines in a given span are equivalent, it is not necessary to assign maintenance lines to a particular facility. If bidirectional line repeaters are used, one maintenance line providing both directions of transmission for one facility will be necessary. For unidirectional line repeaters, however, two maintenance lines will be necessary: one to provide one direction of transmission for two facilities, and the other to provide the other direction of transmission for two facilities.

6.02 A backbone line is a combination of span lines equipped with terminal bridging repeaters wired through intermediate offices. It is used for restoring of a failed facility. Since T1 carrier alarms only at the terminals, line sectionalization is required before a maintenance line patch can be established. Therefore, backbone lines are employed for quick restoration of service. After line sectionalization of the facility has been accomplished, service of the failed span is transferred from the backbone line to the maintenance line. The backbone line is then free for use with another facility. Use of backbone and maintenance lines on a network is directed by the T-Carrier Restoration Control Center (TRCC).

B. Order-Wire Pair

6.03 An order-wire pair renders communications between the various repeater locations within a span or between any repeater location within a span and the ORB or DSX-1 at either end of the span. This order-wire pair is a loaded pair which will appear, through a bridging arrangement, in every apparatus case in the span as well as on the ORB or DSX-1 at each end of the span. The order-wire pair may be loaded within the apparatus case. The order-wire terminals are accessible without opening the apparatus case, and normally only one order-wire pair is installed per route, regardless of the number of span lines making up the span.

6.04 Talking and signaling battery is provided to the order-wire pair from an order-wire panel at one of the span offices, making it possible to dial into switching equipment from the apparatus case locations. For long spans talking and signaling battery may be supplied from both ends. In this case, blocking capacitors are connected in series with the line at one of the apparatus cases near the center of the span to break dc continuity. When required, the capacitors are mounted inside the 466- or 468-type apparatus case where the order-wire conductors are normally strapped through. In the 475-, 809-, 818-, and 819-type cases order-wire continuity is maintained by a plug-in through connector. When capacitors are connected in series with the line, the through connector is removed and replaced by another plug-in connector which houses the capacitors. See Section 365-325-100 for a detailed description of the J98725H order-wire facility and Section 365-320-100 for the J98710E order-wire facility.

C. Fault-Locating System

6.05 When fault location is done a repeater or cable section is tested by applying an interrogation signal to the digital line and observing the level of the returned signal on the fault-locate line. The interrogation signal has bipolar violations added with the polarity inverted at an audio rate. When the violation density is varied, a low-frequency component will appear at the regenerator output. If this frequency corresponds to that of the tuned filter, it will be detected at the test location. The level of the detected signal is evaluated, and if it is not acceptable, repeater replacement or other span-line repair is required. See Section 365-800-002 (TOP) for detailed procedures on fault location.

6.06 The fault-locating system provides the means to remotely detect faulty repeater locations from the CO. It consists of a fault-locating test set

and an inductively loaded (VF) cable pair connecting a group of 12 fault-locating filters. The filters used in a fault-locate system for T1 are either passive or active. Both types are coded A through M for single letter filters, and ▶AA through AM for double letter filters, Table C shows the frequencies of the filters.◀ A single tuned filter is installed in each apparatus case and in each ORB at repeater locations included in the fault-locating plan. The regenerator outputs of all repeaters at a given location are coupled to the tuned filter whose resonant frequency is identified with that location. The output of the filter at each location is bridged to a fault-locating cable pair. This cable pair returns the selected frequency during the fault-locating procedures to the DSX-1 bay or ORB test jacks for evaluation.

6.07 The T1 cable span requires an associated fault-locating cable pair for each set of repeater locations in tandem along the span. The repeater locations correspond to the fault-location system limit of 24 filters for repeater interrogation and fault detection per cable pair.

6.08 The 598- and 1068-type passive filters permit particular frequency assignments and fault identification of up to 12 repeater locations on the same fault-locating cable pair. When there are more than 12 repeater locations in a span, a separate fault-locating pair must be provided for each additional group of 12 locations. Thus, longer maintenance spans can be fault-located by repeating the series of filters along the line and sequentially reassigning the 12 interrogation signals (selected frequencies) to each additional pair. However, only one apparatus case per repeater location is bridged to the fault-locating pair. Very long spans will require using active filters.

6.09 The 1114- and 1115-type active filters improve signal-to-noise (S/N) performance of the FL lines, and permit separation of fault identification in opposite directions of bidirectional repeaters. The latter is made possible by the use of the 1115-type filters, split fault output repeaters and apparatus cases with split wiring. Selection of powering polarity to the FL line is determined by the polarity switch on the fault line powering module and ***the maintenance of T-R integrity to the filter locations.*** The polarity sensitive 1115-type dual-amplifier filters enable the return of FL signals from one or the other direction of digital transmission within the repeater. When this arrangement is combined with a loop-back capability in the APS or a manual loop-back, single-end fault location of both directions of transmission can be accomplished within a maintenance span for the bidirectional mode of operation.

6.10 The 1114-type single-amplifier filters are used in combination with the loop-back capability of an APS or manual loop-back to provide single-end fault location for the unidirectional mode of operation. Dual use of the twelve 1114-type filter codes may be obtained by placing a tip-ring turnover between two filter groups. Reversing the polarity of the power at the powering module activates one or the other group of filters and, in effect, provides a maximum of 24-filter configuration. The single-end FL techniques using the 1115-type filters can be extended by using additional FL lines. Also, it is general practice to use the 1114-type filter to serve the office repeaters in the terminating offices in both the bidirectional and unidirectional modes of operation.

6.11 The unique advantage of the FL technique described in paragraphs 6.09 and 6.10 is the provision of single-end testing capability. This capability provides for isolating faults in both directions of digital transmission from measurements made at one end of the maintenance span and utilizes a far-end loopback of the digital line. Both-end testing means that only one direction of transmission, the outgoing direction, can be tested from a given office, thus, the need to test a span from both ends. If unidirectional repeater operation is used, the FL system will be inherently directive because separate FL pairs are assigned to each direction of digital transmission.

6.12 Both-ends testing in T1 can be accomplished by using the 1114-type active filters or the 1068-type passive filters. The fault-locate jacks provide test equipment access to the output of any selected FL line. Logic circuitry in the J98725AJ fault-line powering module prevents dual access to the FL line. Integral to the fault line selection, the module provides power to the FL line for the active filters selected for interrogation and power for activating the logic circuitry of other offices on the unused part of the FL line when it appears in other span terminating offices.

7. TEST EQUIPMENT

7.01 The following test equipment is required for maintaining the T1 digital line. See Sections

365-020-301 and 365-800-002 (TOP) for maintenance procedures.

- ***J98725AA T1C/T1 Pair Loss Test Set (Section 103-494-104), 113A Test Set (Section 103-493-100), or 113B Test Set (Section 103-493-101):*** Used to determine dc integrity and pair loss between repeater locations.

- ***J98725AD T1C/T1 Fault-Locating Test Set (Section 103-494-106) or J98710F Fault-Locating Set (Section 103-491-100):*** Generates preset violation patterns which give rise to low-frequency tones at the repeater outputs. Used to determine the location of failed repeaters.

- ***J98725AC T1C/T1 Office Bipolar Violation Detector (See Section 103-494-100) or J98710G Error Detecting Set (Section 103-490-100):*** Used to detect bipolar violations and bipolar violation seconds (error rate) in the office.

- ***J98725AB T1C/T1 Manhole Bipolar Violation Detector (Section 103-494-101) or J98710P T1 Line Error Detector (Section 103-493-103):*** Used at line repeater locations to detect bipolar violations.

- ***J98710H Repeater Test Set (Section 103-492-100):*** Used to check the line repeater operability before installation.

- ***J98725AJ Fault Line Powering Module (Section 103-494-109):*** Provides −48 volts for powering the FLTS and 40 volts or 118 volts for the FL line.

- ***257A and 279A Adapters:*** Used in 206 ORB and T1C/T1 ORB repeater slots, respectively, to access cable pairs.

- ***KS-20775 L1 and L2 DS1 Error Rate Test Set (Section 103-493-109):*** Used to make reliable T1 error rate measurements.

- ***DS1/DS1C/DS2 Error Rate Test Set (KS-22331, L1 and KS-22332, L2) (Section 103-493-120):*** Used to make reliable T1, T2, T1C, and T1D error rate measurements.

8. REFERENCES

8.01 The following Bell System Practices and schematic diagrams are referenced in this section.

SECTION	TITLE
103-490-100	J98710G Error Detecting Set—Description, Operation, and Maintenance
103-491-100	J98710F, List 1 and J98710F, List 2 Fault Locating Sets—Description, Operation, and Maintenance
103-492-100	J98710H Repeater Test Set—Description and Maintenance
103-493-100	113A Test Set—Description, Operation, and Maintenance
103-493-101	113B Test Set—Description, Operation, and Maintenance
103-493-103	J98710P T1 Line Error Detector—Description, Operation, and Maintenance
103-493-104	J98710R T1 Carrier Quasi-Random Signal Source—Description
103-493-105	Biddle 110A Cable Test Set—Description, Calibration and Maintenance
103-493-107	T1 Line Monitor—Description and Tests
103-493-109	KS-20775, L1 and L2 Error Rate Test Set—Description and Operation
103-493-120	DS1/DS1C/DS2 Error Rate Test Set (KS-22331, L1 and KS-22332, L1)—Description, Operation and Maintenance
103-494-100	J98725AC Office Bipolar—Violation Detector—Description and Maintenance
103-494-101	J98725AB T1C/T1 Manhole Bipolar Violation Detector—Description and Maintenance

SECTION	TITLE
103-494-104	J98725AA Pair Loss Test Set—Description Operation and Maintenance
103-494-105	J98725AF T1C/T1 Quasi-Random Signal Source (QRSS)—Description, Operation, and Maintenance
103-494-106	J98725AD T1C/T1 Fault-Locating Test Set—Description and Maintenance
103-494-109	J98725AJ Fault Line Power Module—Description
365-010-100	Type T1 Carrier System—Overall System—General Description
365-020-301	T Carrier Central Office Restoration and Maintenance Responsibilities
365-200-101	Repeater Description
365-200-103	J98713F Line Terminating Unit and ED-3C570-( ) Line Powering Auxiliary Unit—Description
365-200-105	J98710U Express Office Repeater Panel—General Description
365-227-500	T1 Digital Line—Trouble Locating Procedures
365-301-101	DSX-1, DSX-1C, and DSX-2 Patch and Cross-Connect—General Description
365-320-100	T1 Order Wire—Description
365-325-100	J98725H Order-Wire Facility—Description
365-800-001	D1, D2, and D3 Channel Banks—Routine, Acceptance & Company Order Tasks (TOP)
365-800-002	T1 Line—Routine, Acceptance & Company Order Tasks (TOP)
365-800-003	D1, D2, and D3 Channel Banks/T1 Line—Trouble Clearing Tasks (TOP)
631-005-101	10-Type Cable Stubs—Description and Maintenance
640-525-307	800-Type Repeater Cases Description, Installation, Splicing and Maintenance
640-525-308	809-Type Repeater Cases Description, Installation, Splicing and Maintenance
855-350-107	T1, T1 Outstate and T1C—Engineering Design Order-Wire System Application
855-351-101	T1 Digital Line—Transmission and Outside Plant Design Procedures

DRAWING	TITLE
SD-3C252-02	T1 Applications Drawing for T1C/T1 Office Repeater Bay
SD-3C371-01	T1C/T1 Office Repeater Bay DSX Dedicated Application Schematic
SD-97080-01	Application Schematic (Span Terminating Assembly)
SD-97080-02	T1 Carrier Application Schematic
SD-99503	Patch and Cross-Connect Interconnection Circuit

TABLE A

T1 TYPE REPEATERS

TYPE AND REPEATER CODE	APPLICATION	MOUNTING
201A thru L*	Office, Line, and Bridging	466 App Case and STA
205A thru N†	Line	468 App Case
206A thru AB‡	Office and Bridging	206 ORB, STM, and LTU
208A thru F,§ AA and AB	Line	475, 818, 819 App Cases and EORP
209A thru F,§ AA and AB	Line	475, 818, 819 App Cases
221A thru C	Office and Bridging	T1C/T1 ORB
231A thru E	Office and Bridging	T1C/T1 ORB
236A thru P¶	Office and Bridging	206 ORB, STM, and LTU
238A thru D§	Line	475, 809 App Cases and EORP
239A thru D§	Line	475, 809 App Cases and EORP

* Repeater code letter I not used.

† Repeater code letters C, F, I, and L not used.

‡ Repeater code letters I, O, Q, V,X, and Z not used.

§ May be mounted in 479 App Case equipped with 245A or 253A adapter. (See Section 365-200-101.)

¶ Repeater code letters I, O, and Q through Z not used.

TABLE B

EQUALIZERS USED IN T1C/T1 ORB

ORB	*CABLE LENGTH	*EQUALIZER
T1C/T1 ORB (DSX optional) J98725A, B, C	0 to 220 Feet 220 to 440 Feet 440 to 655 Feet	ED-3C585-30, G1 ED-3C585-30, G2 ED-3C585-30, G3
T1C/T1 ORB (DSX dedicated ORB) J98725D, E, F	0 to 220 Feet 220 to 440 Feet 440 to 655 Feet	ED-3C744-30, G6 ED-3C744-30, G7 ED-3C744-30, G8

*At cable length transition point, use equalizer for the shorter length.

Do Not Overequalize.

TABLE C

FAULT LOCATE FILTER FREQUENCIES

FILTER CODE	CENTER FREQ (Hz)
A and AA	832
B and AB	928
C and AC	1049
D and AD	1206
E and AE	1340
F and AF	1508
G and AG	1722
H and AH	2008
J and AJ	2193
K and AK	2413
L and AL	2680
M and AM	3017

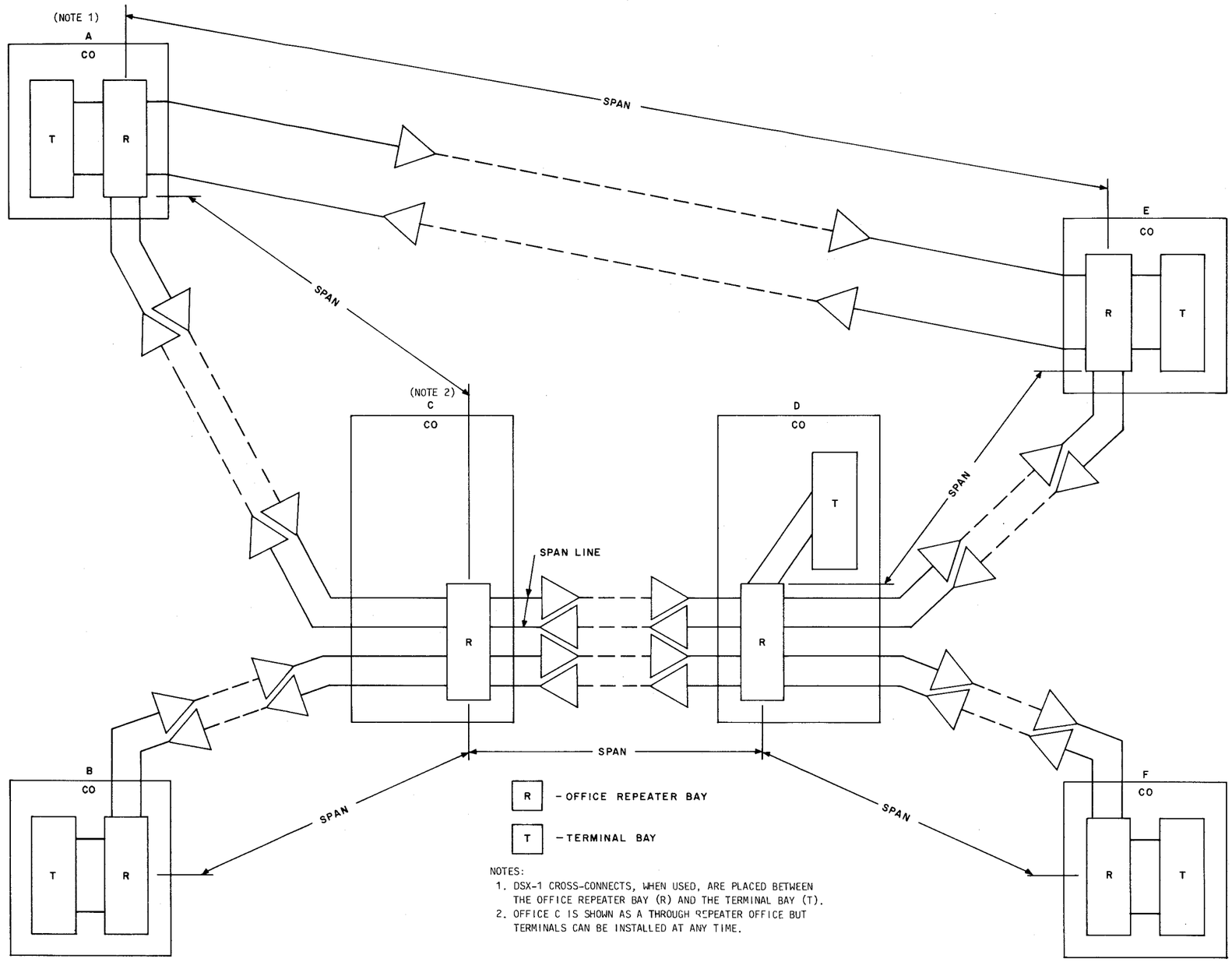
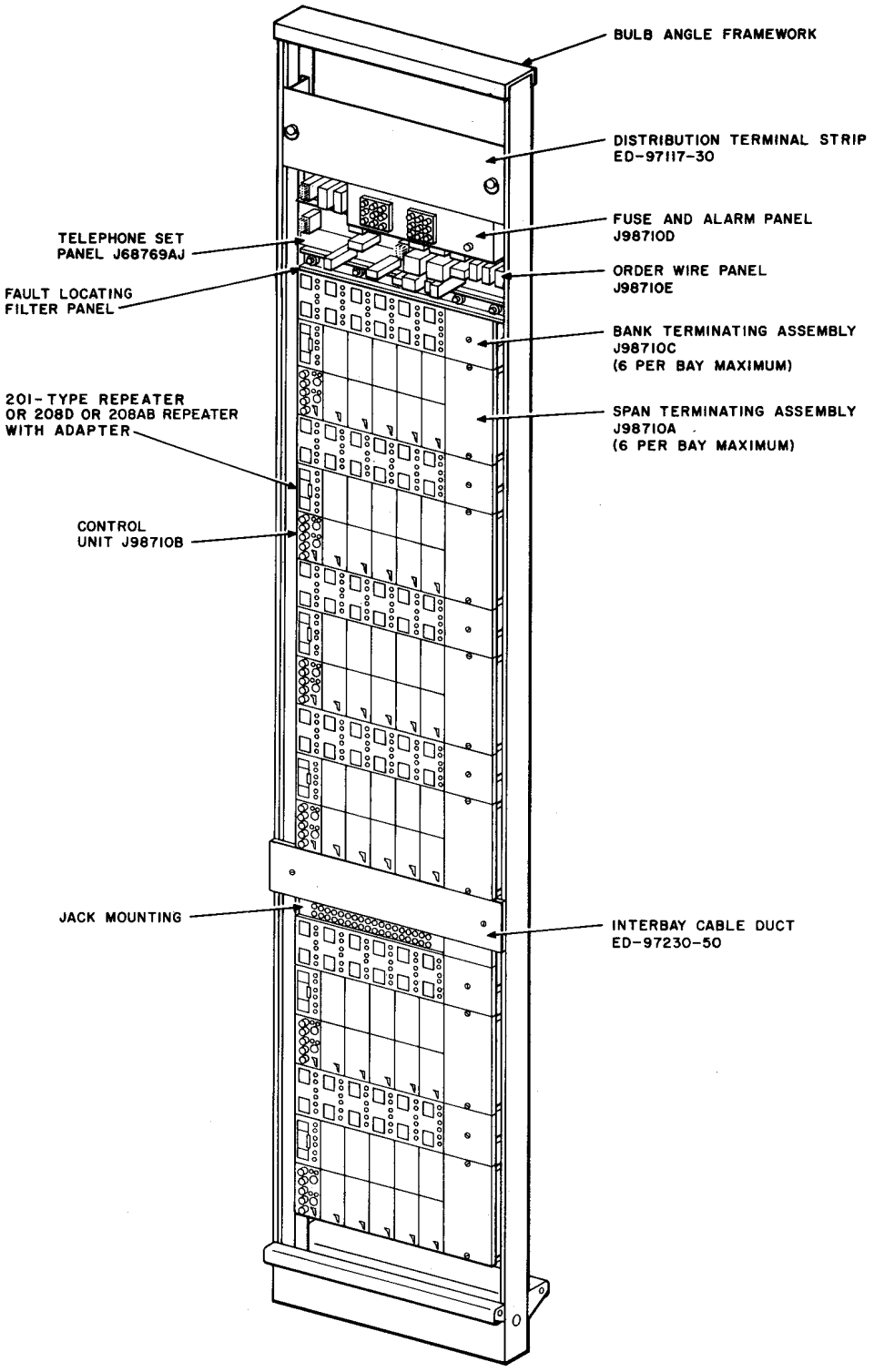


Fig. 1—Span Concept



FULLY EQUIPPED BAY AT TERMINAL OFFICE

Fig. 2—Typical 201 Office Repeater Bay (201 ORB)

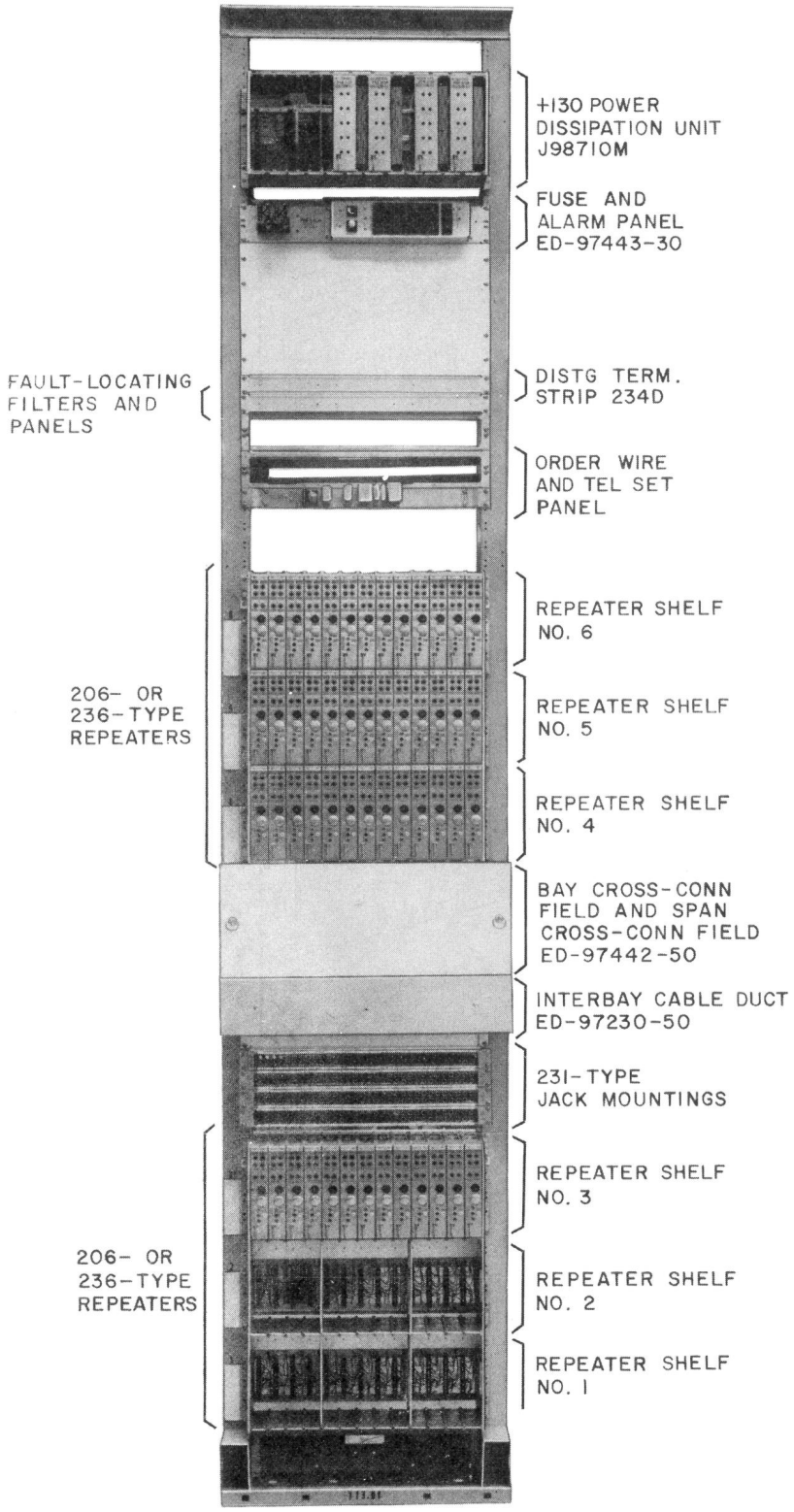
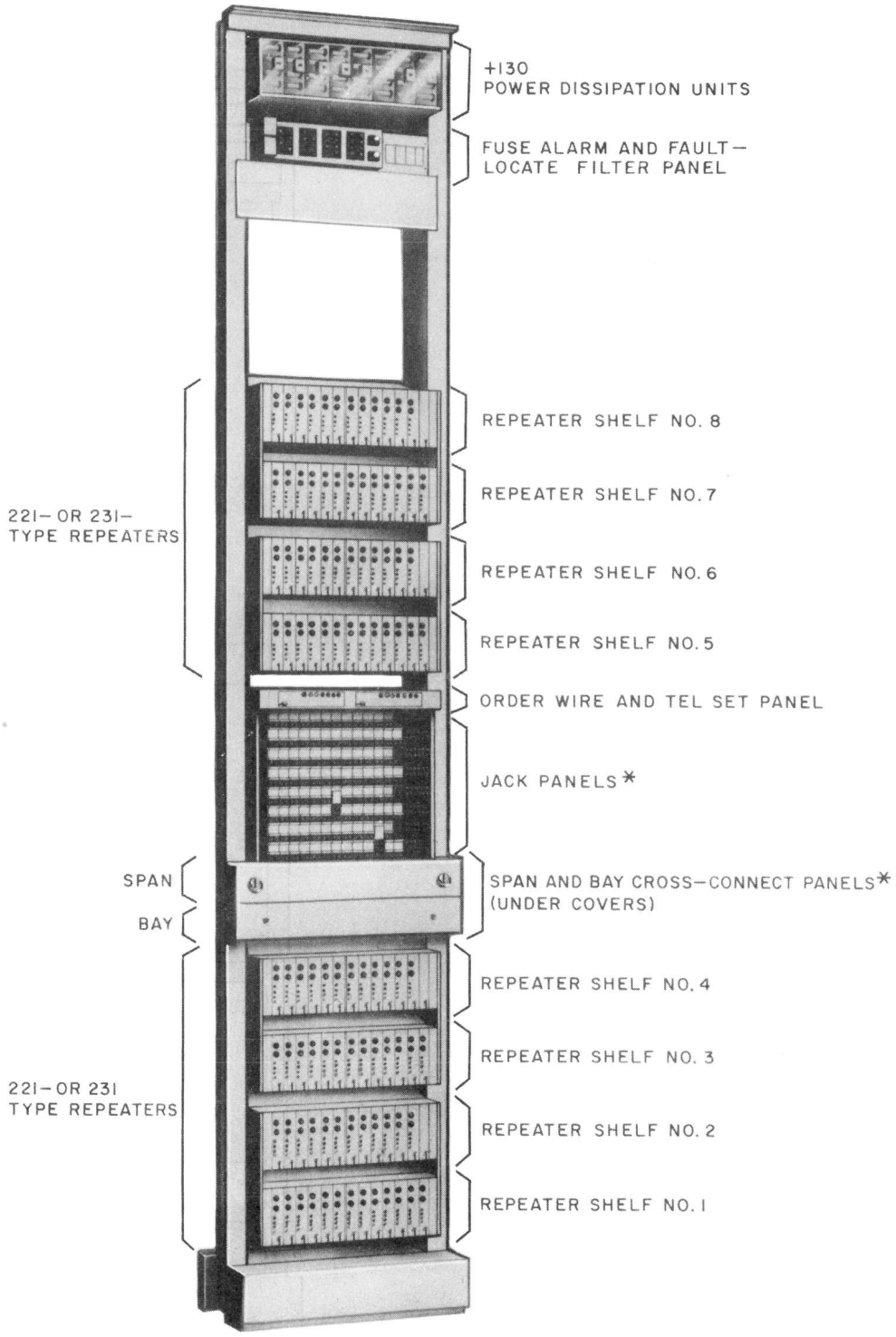


Fig. 3—Typical 206 Office Repeater (206 ORB)



* NOT PROVIDED IN THE T1C/T1 DSX–DED ORB. THE DEDICATED BAY IS PROVIDED WITH 12 REPEATER SHELVES.

Fig. 4—Typical T1C/T1 Office Repeater Bay (T1C/T1 ORB)

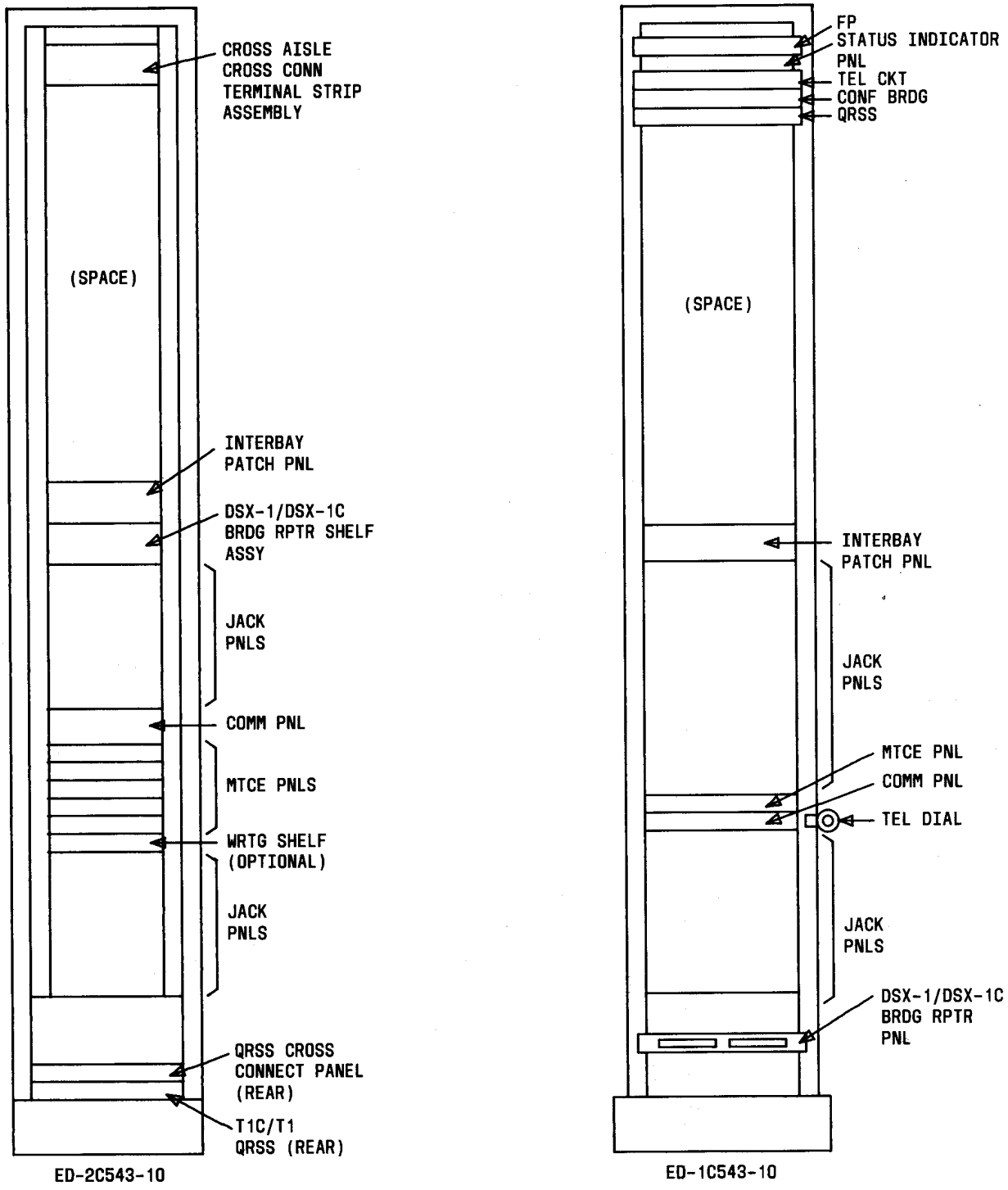


Fig. 5—Typical DSX-1 Bay Arrangement

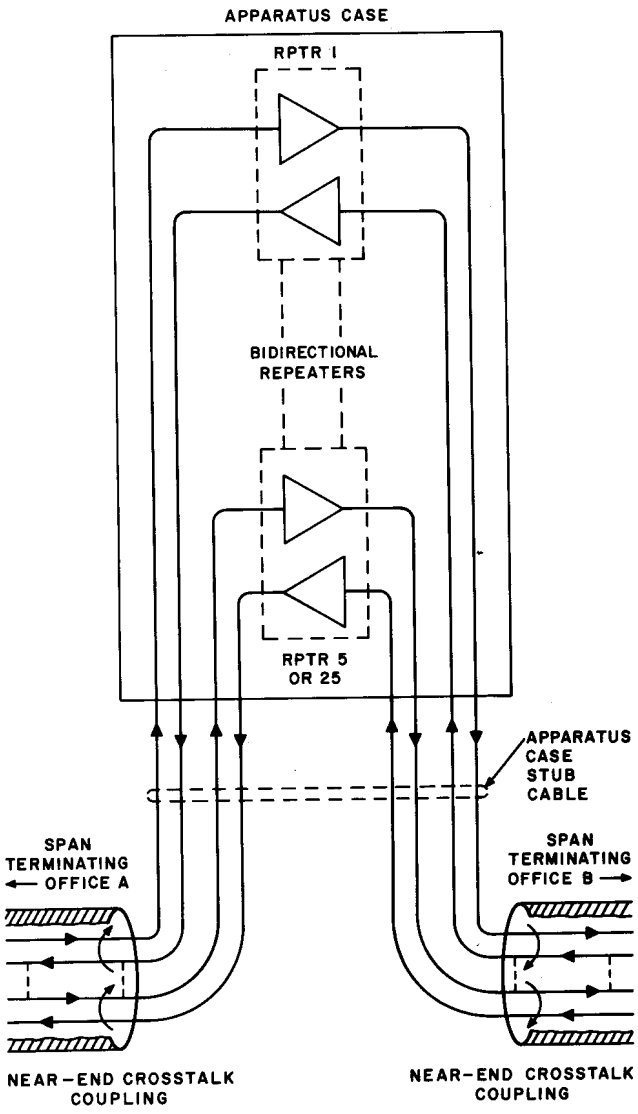


Fig. 6—One Cable Using Bidirectional Line Repeaters

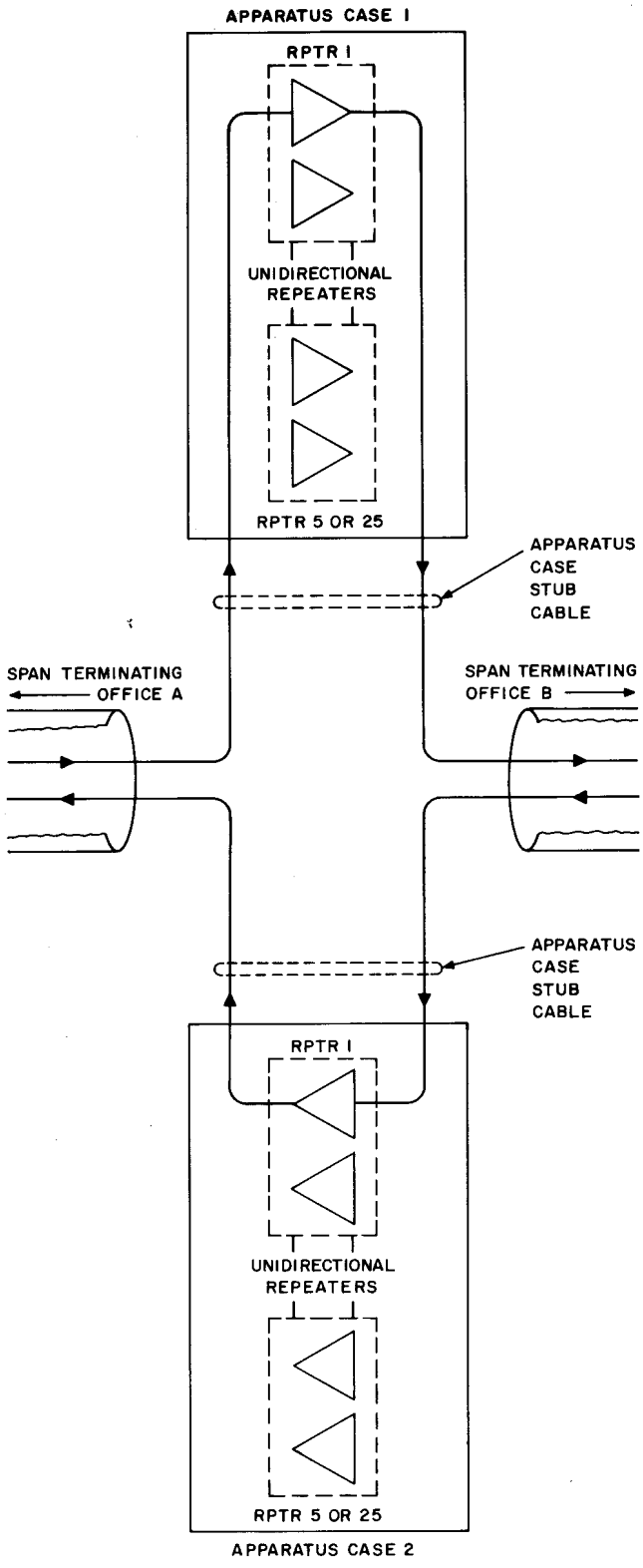
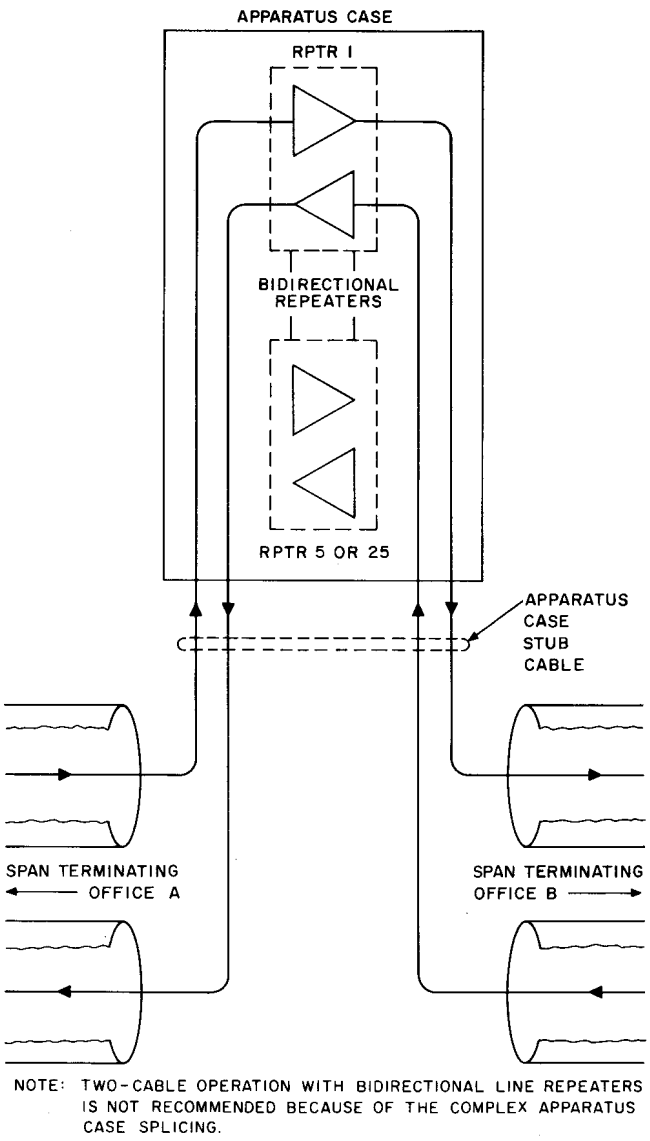


Fig. 7—One Cable Using Unidirectional Line Repeaters



NOTE: TWO-CABLE OPERATION WITH BIDIRECTIONAL LINE REPEATERS IS NOT RECOMMENDED BECAUSE OF THE COMPLEX APPARATUS CASE SPLICING.

Fig. 8—Two Cables Using Bidirectional Line Repeaters

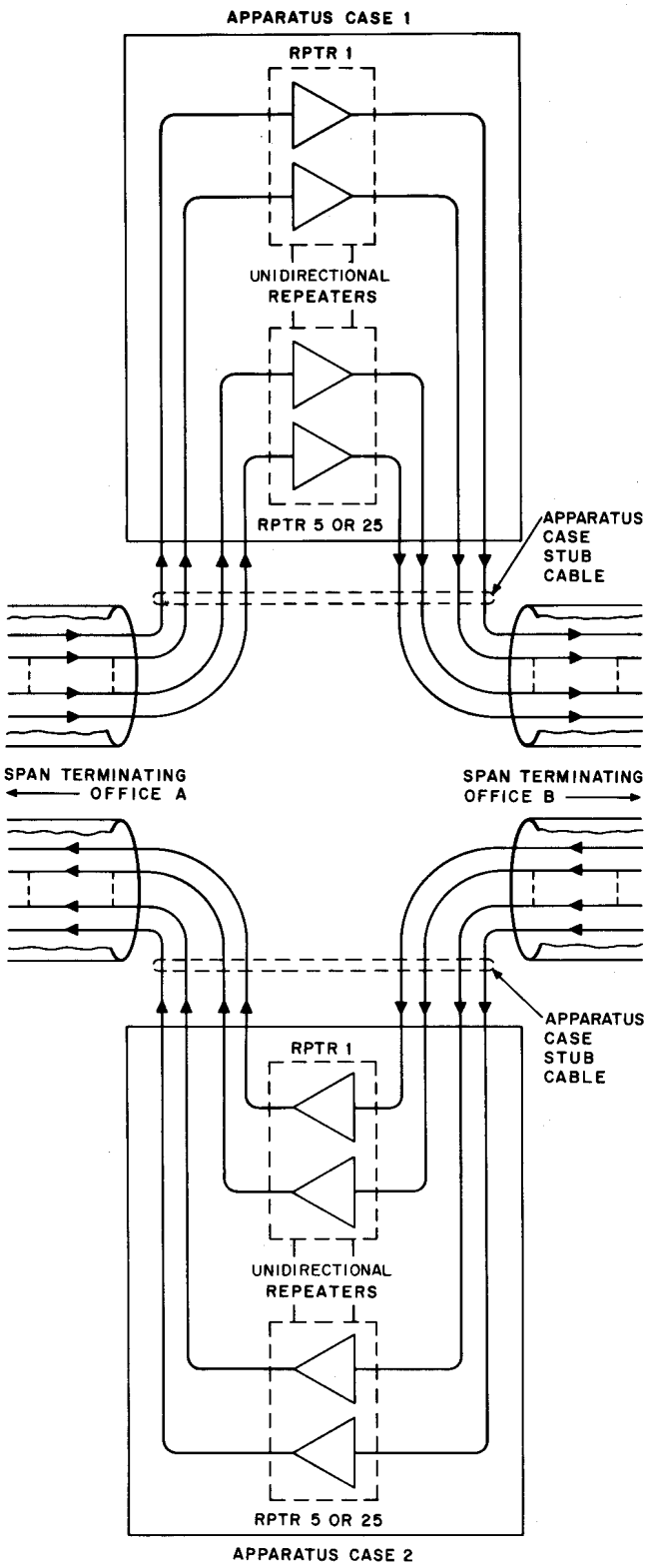


Fig. 9—Two Cables Using Unidirectional Line Repeaters

Fig. 10—Typical Nonintegrated Circuit 201-Type Repeater

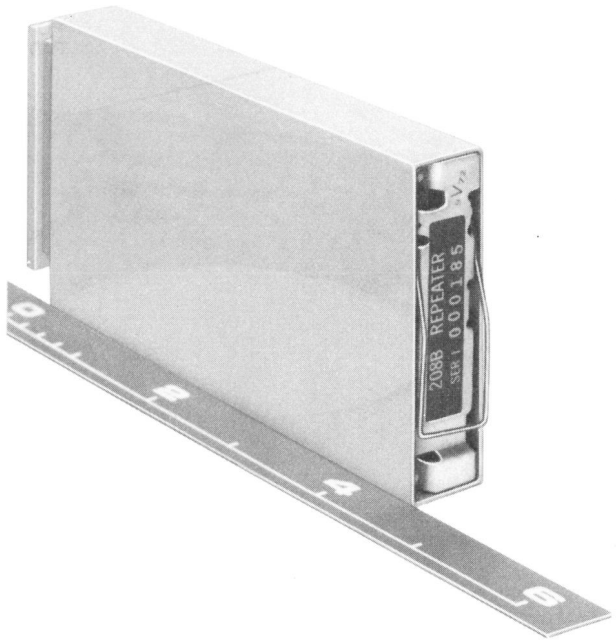


Fig. 11—Typical 208-Type Repeater

Fig. 12—Typical 238-Type Repeater

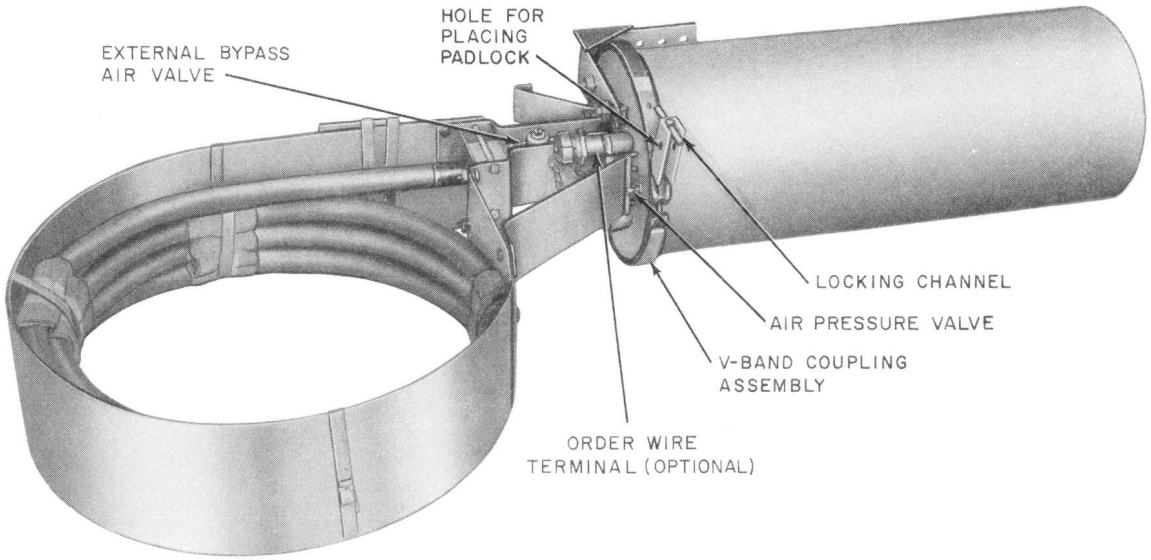


Fig. 13—466A Apparatus Case

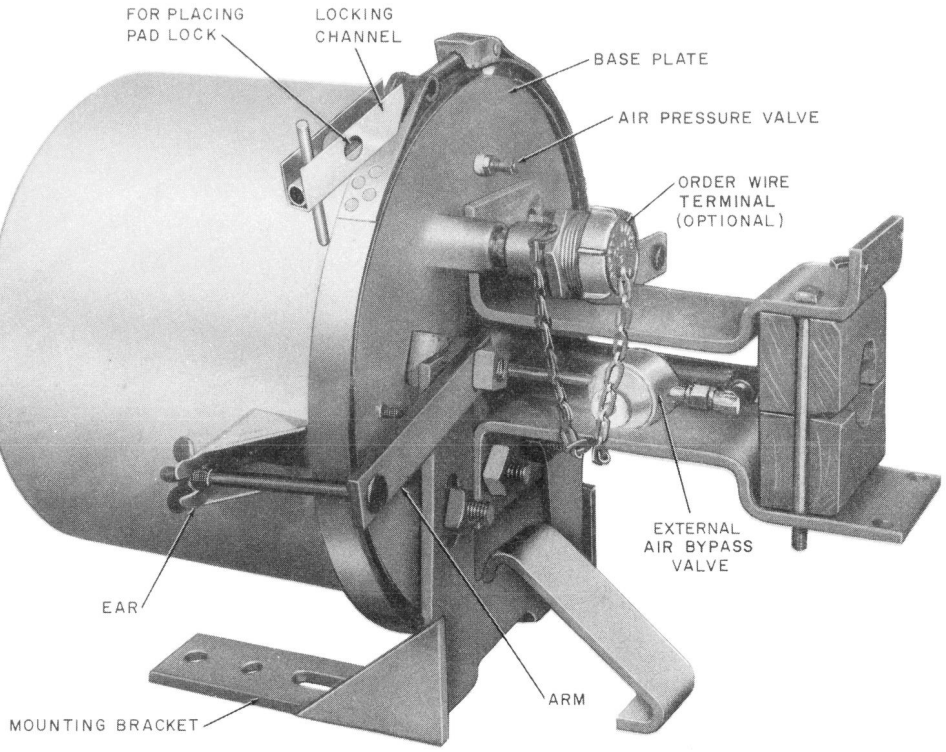


Fig. 14—468C Apparatus Case

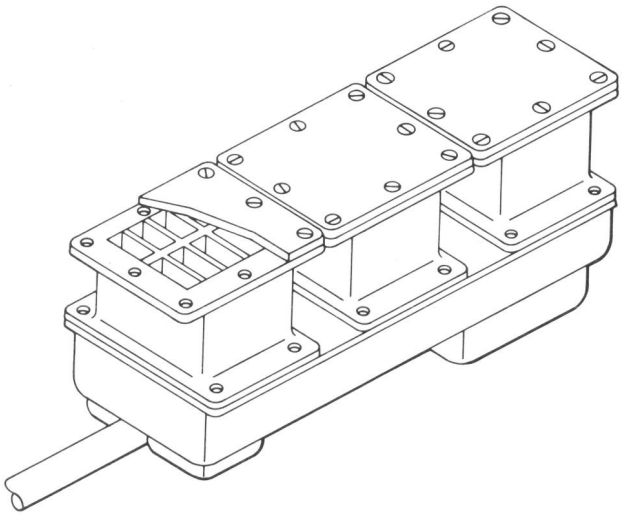


Fig. 15—475 Apparatus Case

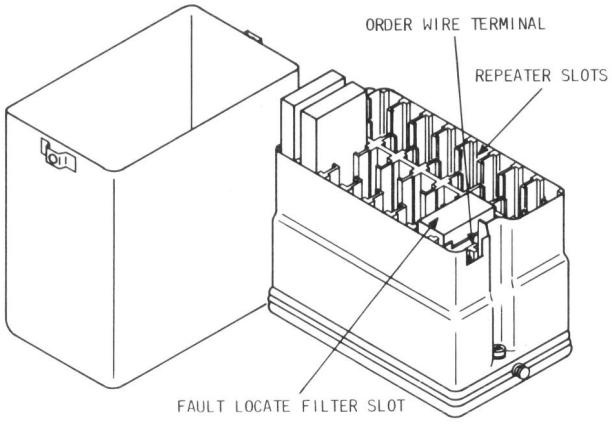


Fig. 16—809-Type Apparatus Case

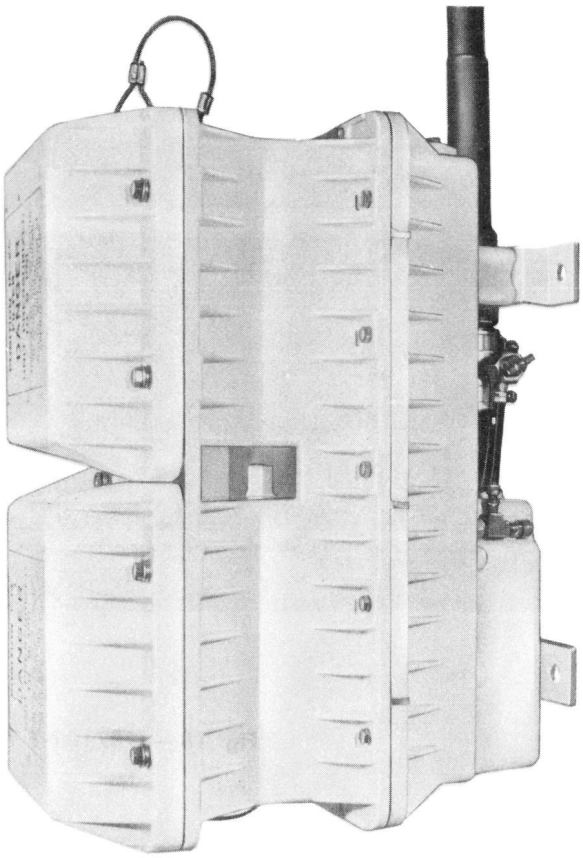


Fig. 17—818- or 819-Type Apparatus Case

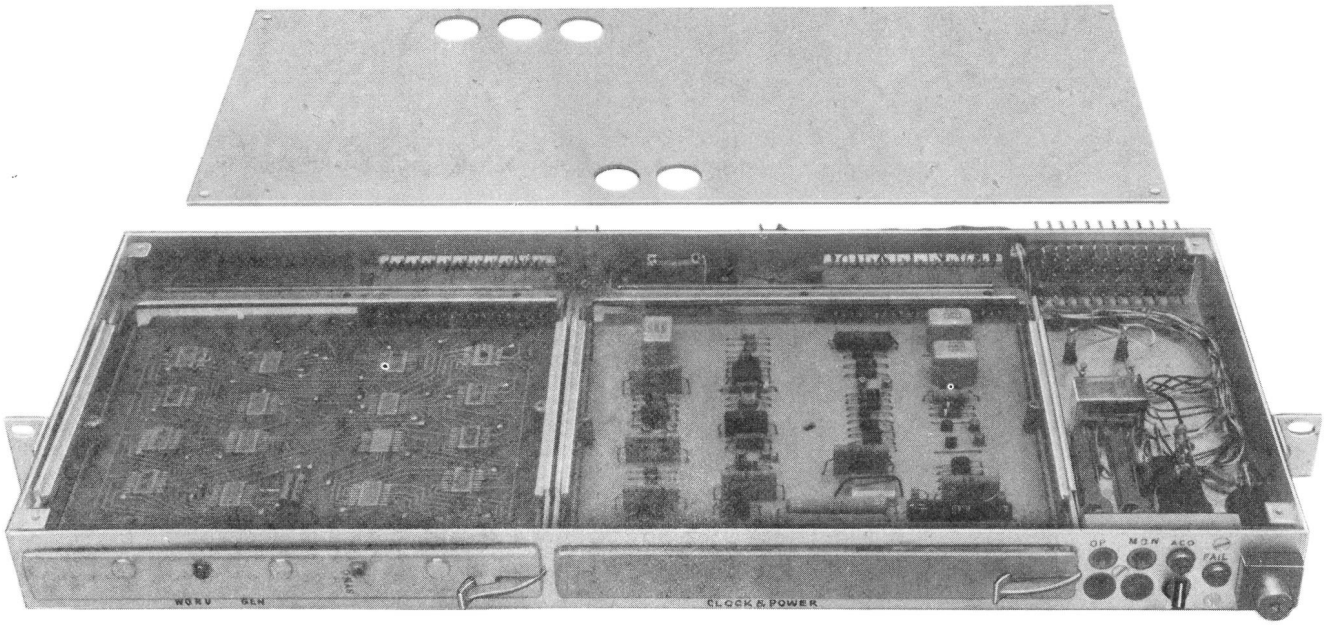


Fig. 18—J98710R-1 T1 Quasi-Random Signal Source

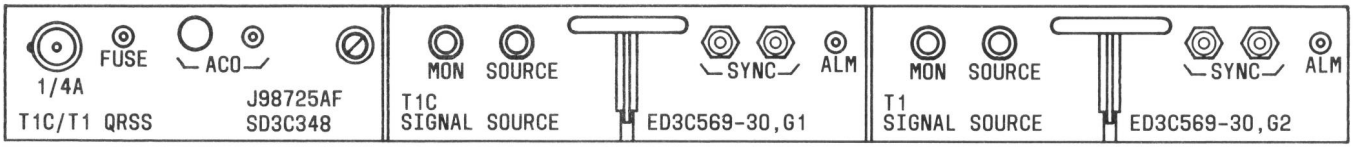
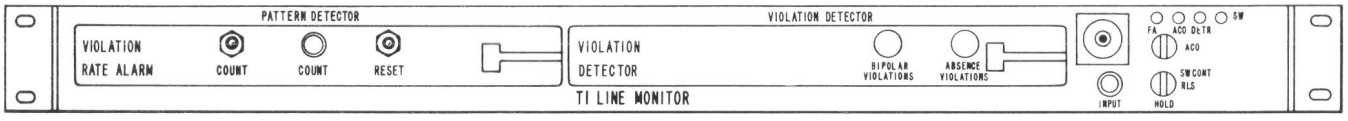


Fig. 19—J98725AF T1C/T1 Quasi-Random Signal Source



FRONT VIEW

Fig. 20—J98710T T1 Line Monitor

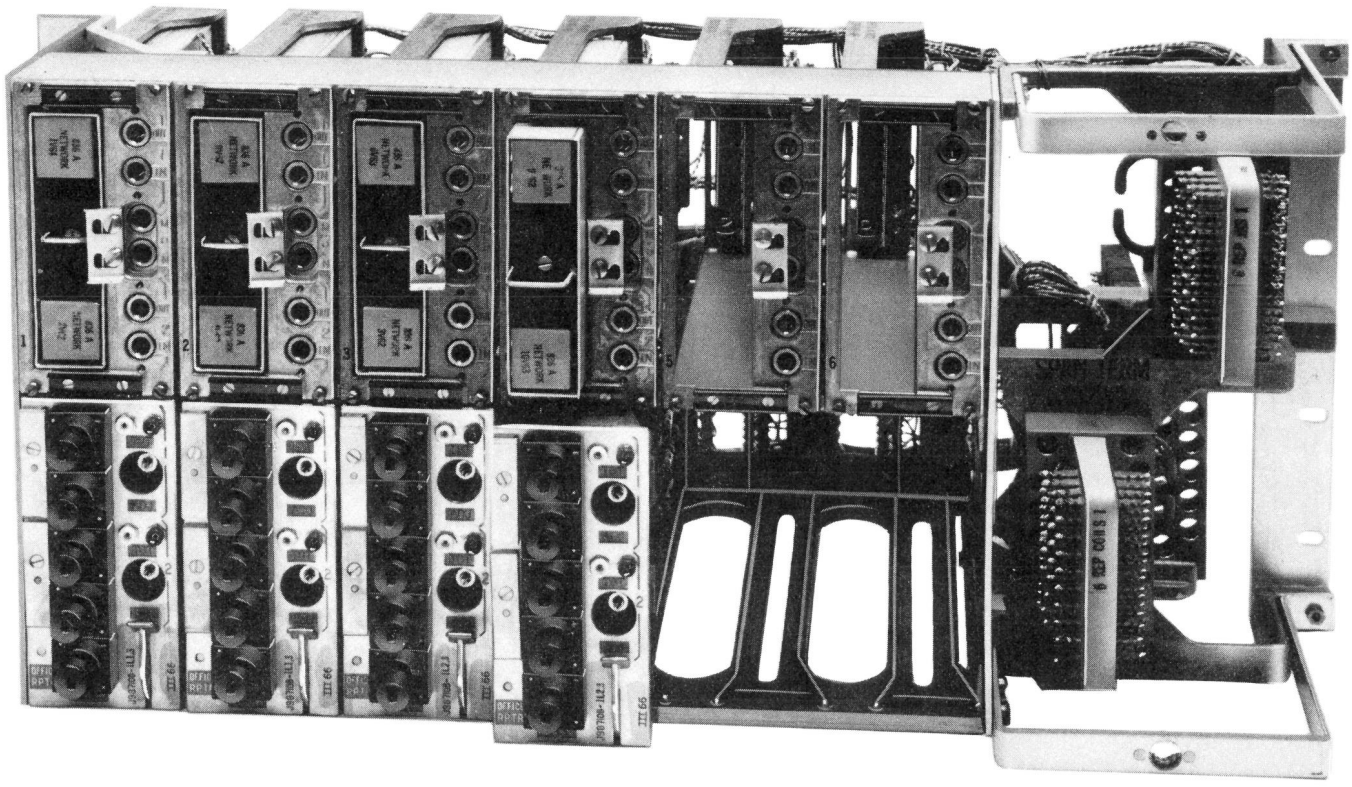


Fig. 21—J98710A Span Terminating Assembly

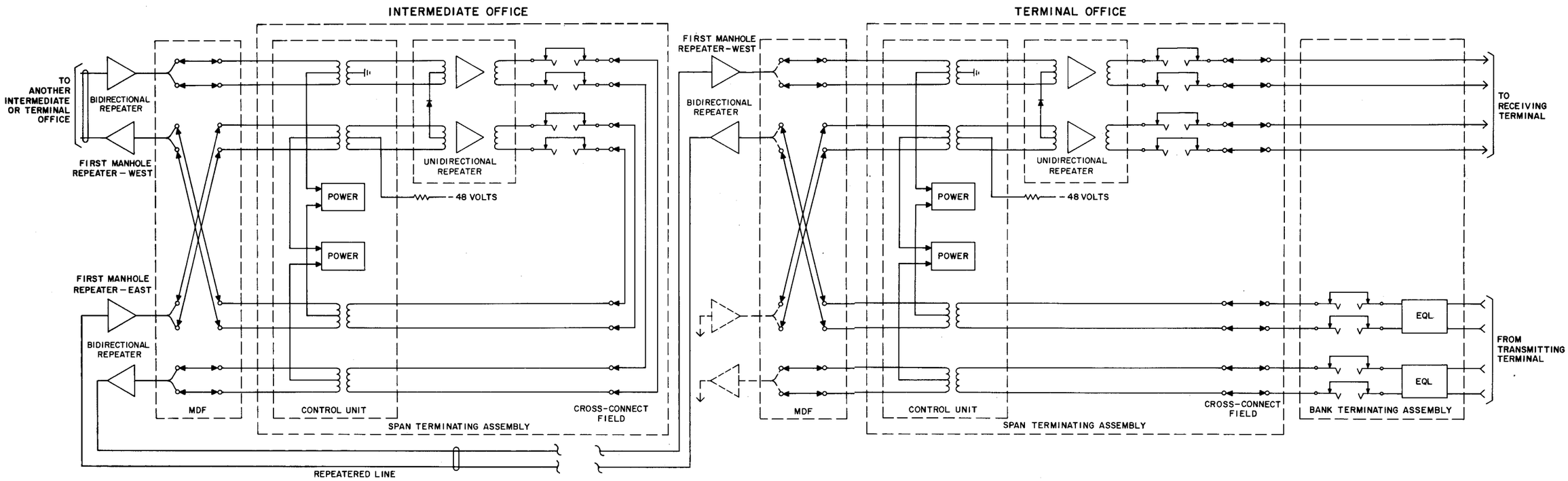


Fig. 22—Office Wiring for One Cable Using Bidirectional Repeaters (201 ORB)

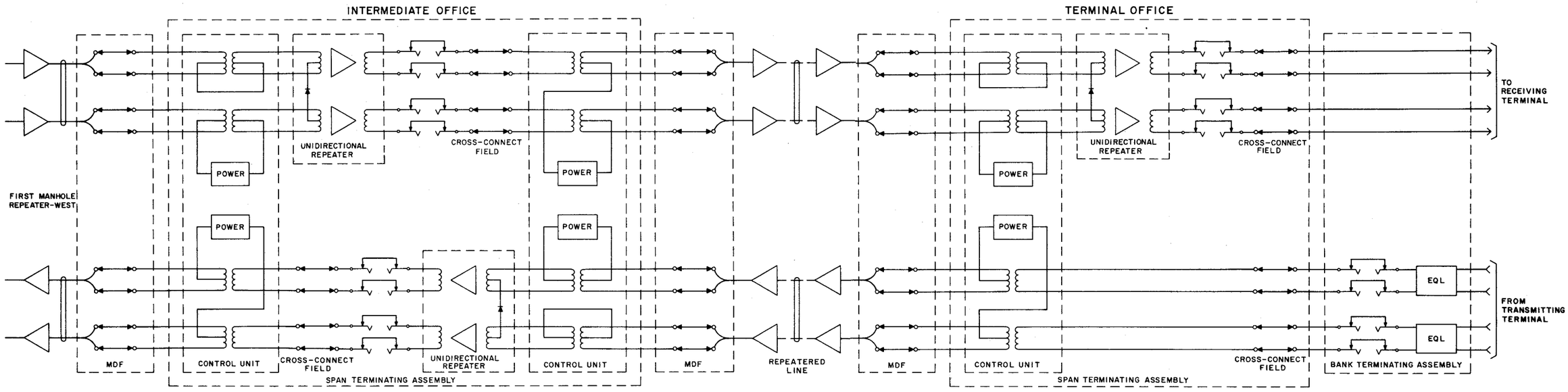


Fig. 23—Office Wiring for Two Cables Using Unidirectional Repeaters (201 ORB)

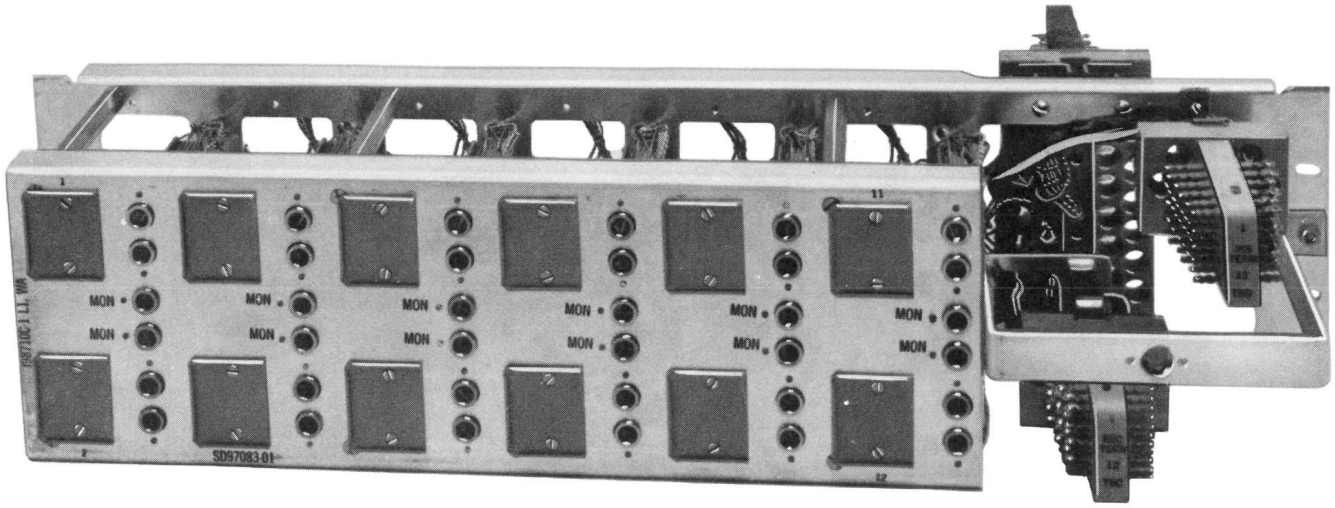


Fig. 24—J98710C Bank Terminating Assembly

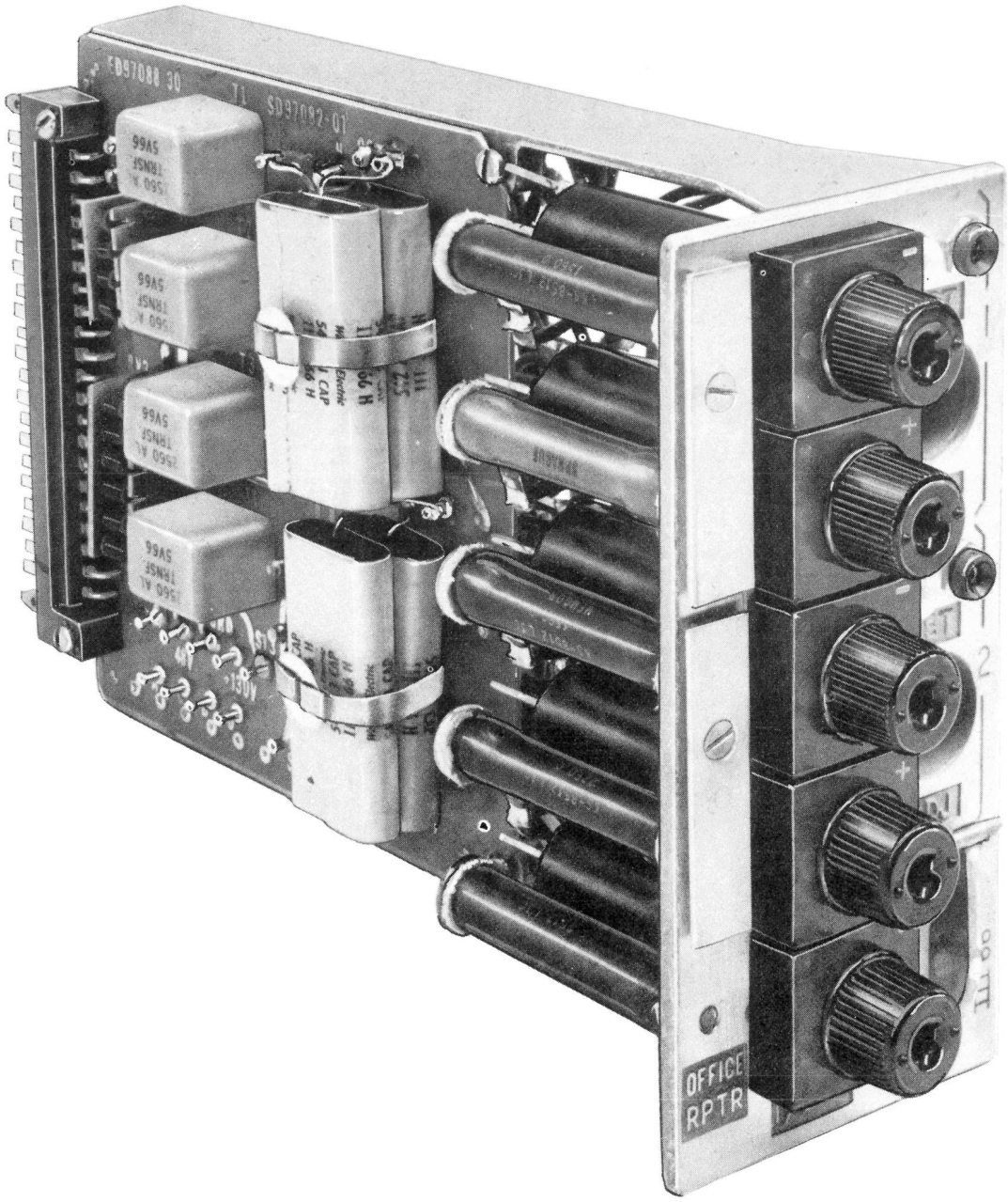


Fig. 25—J98710B Control Unit

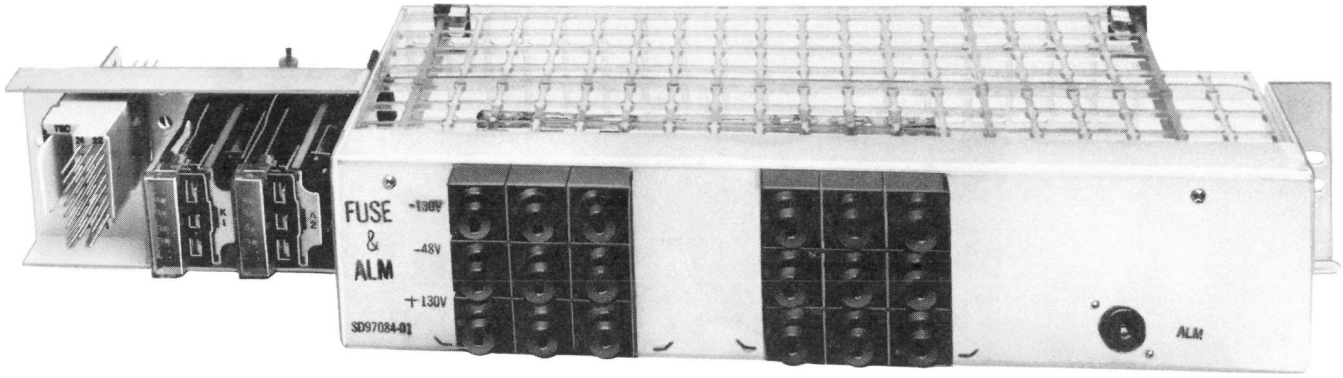


Fig. 26—J98710D Fuse and Alarm Panel

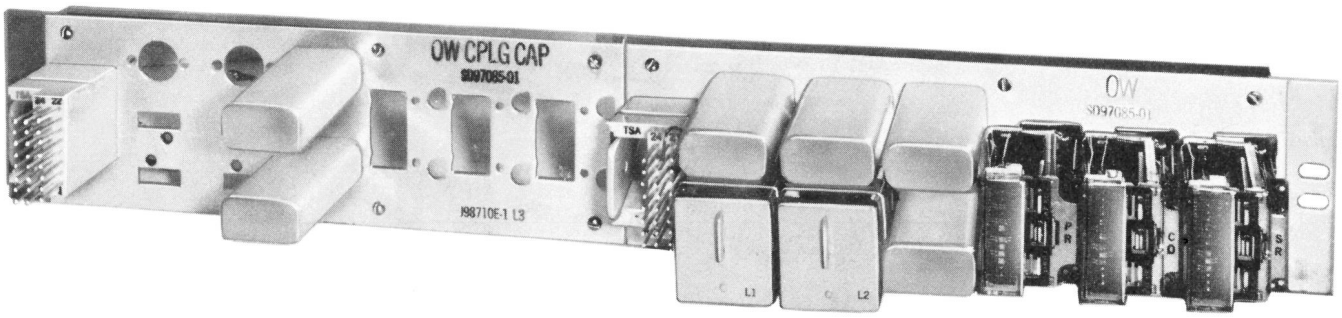


Fig. 27—J98710E Order-Wire Panel

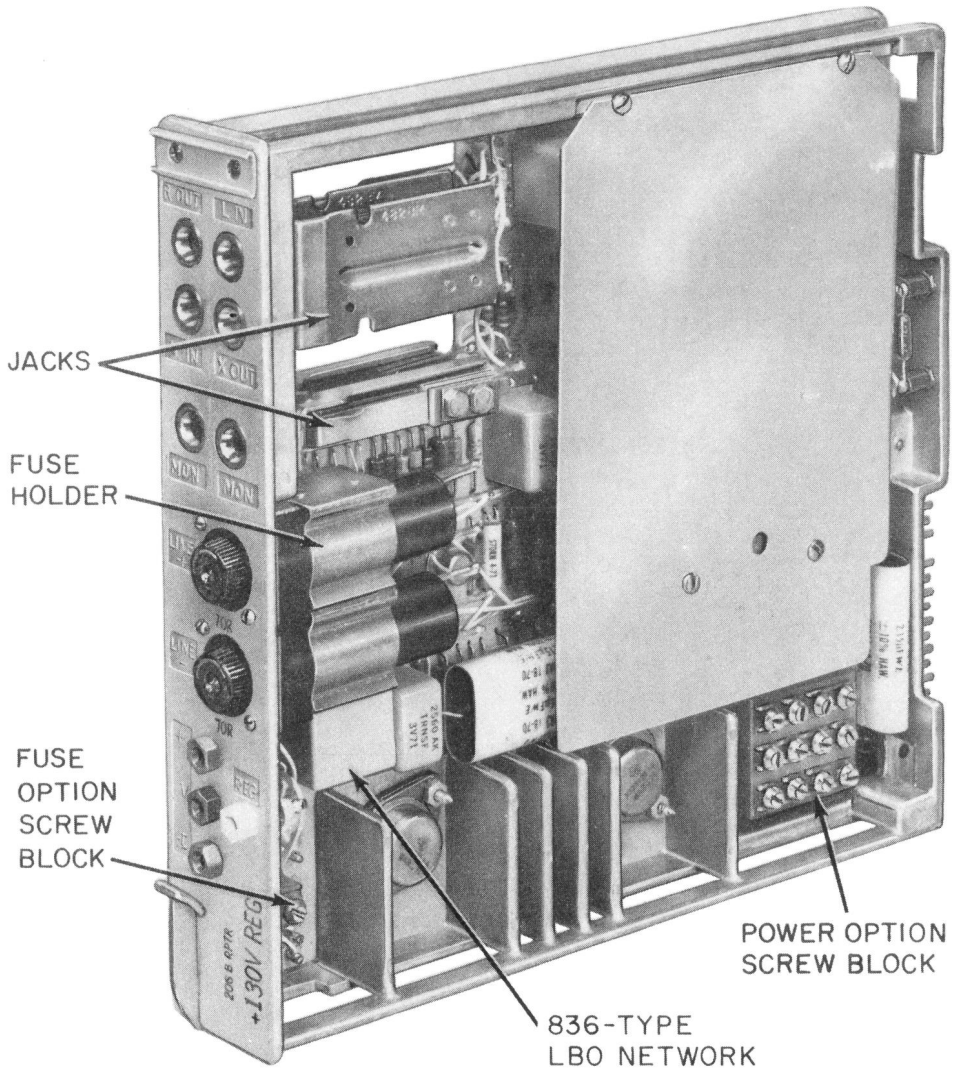


Fig. 28—Typical 206-Type Office Repeater

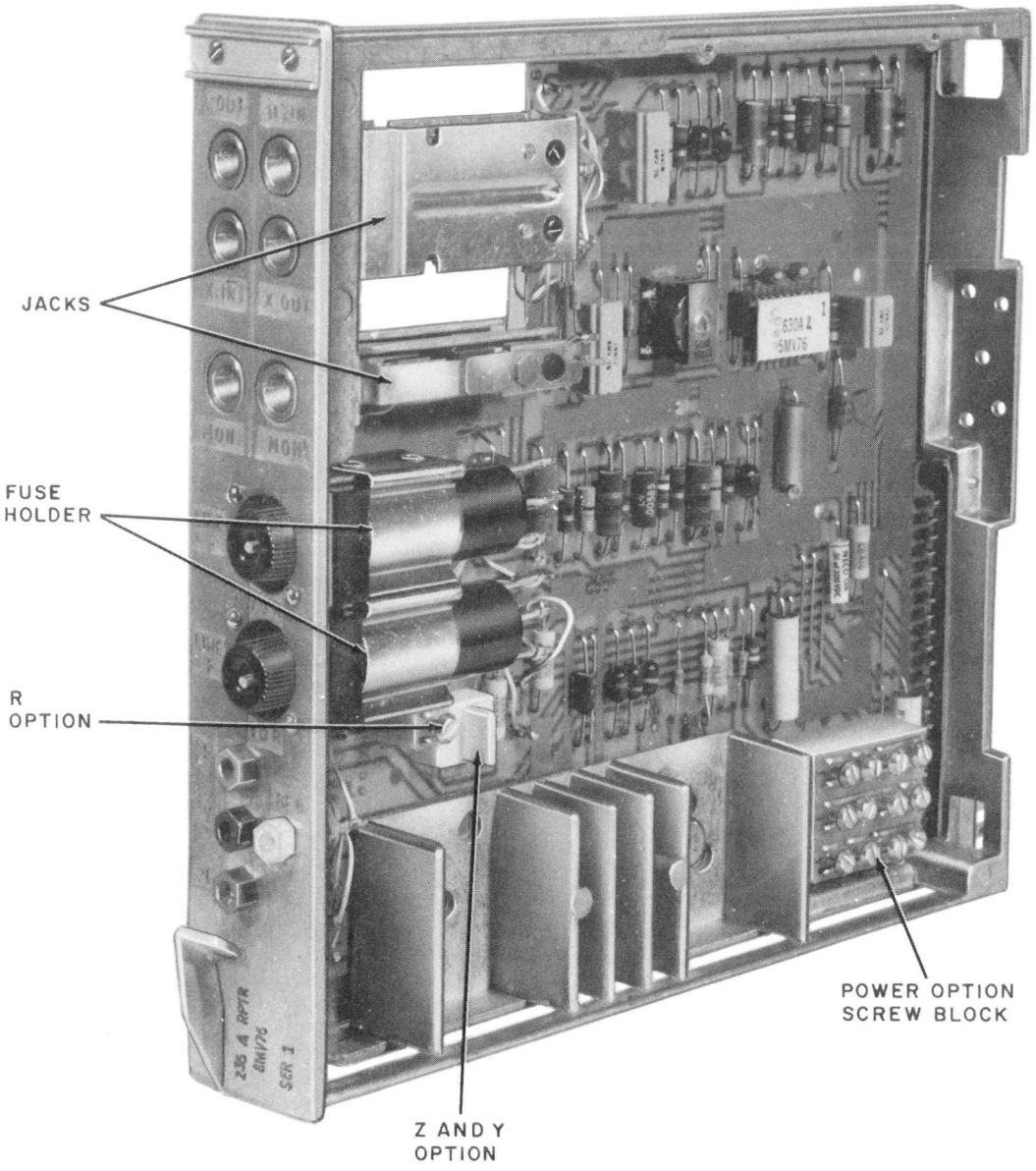


Fig. 29—Typical 236-Type Office Repeater

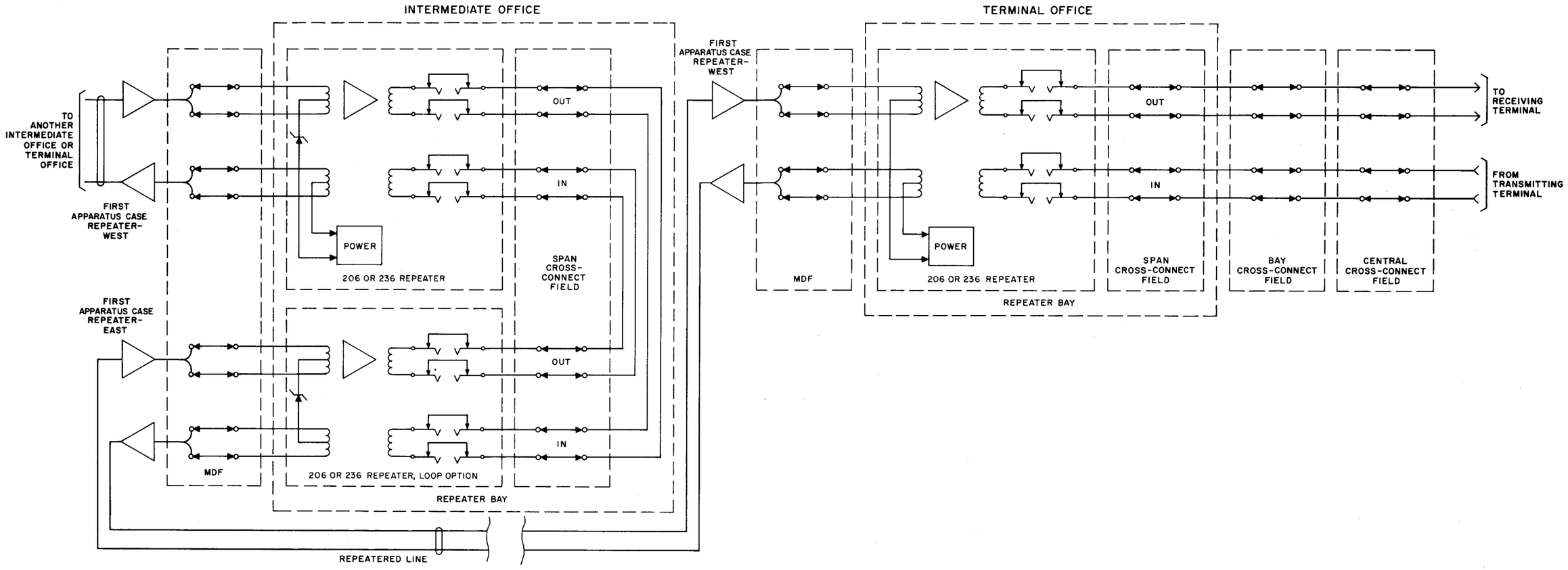


Fig. 30—Office Wiring for One Cable Using Bidirectional Repeaters (206 ORB)

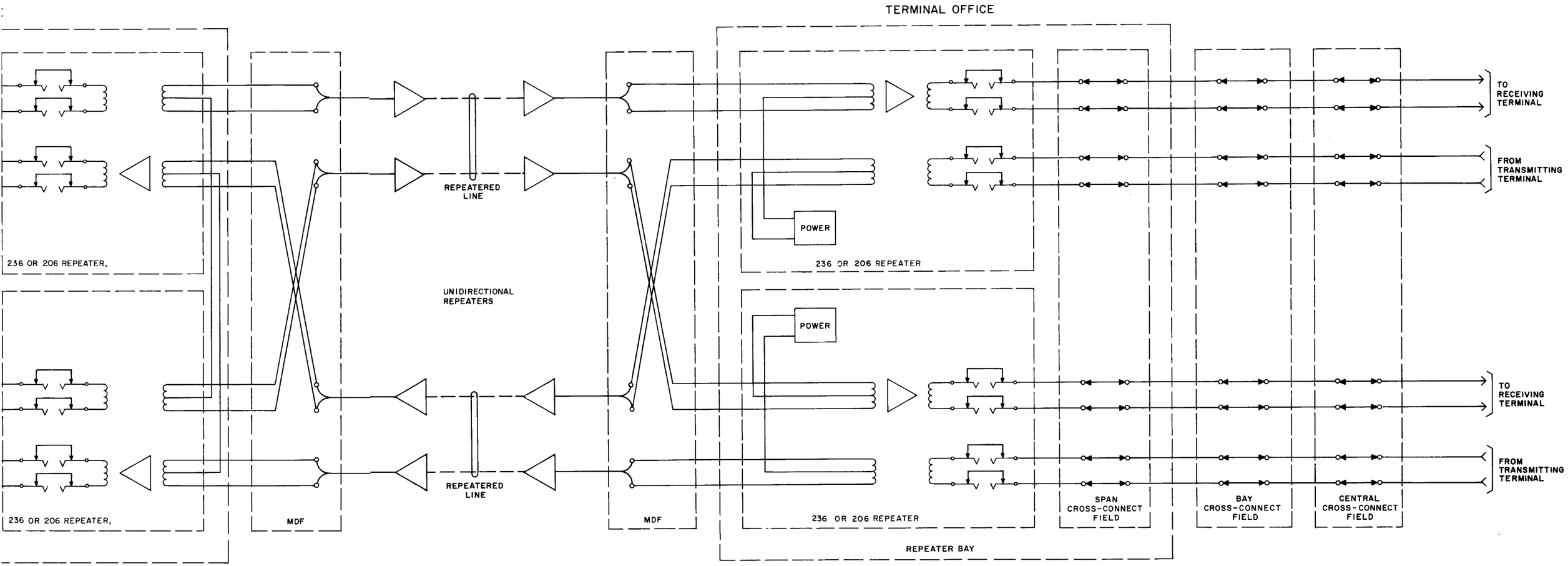
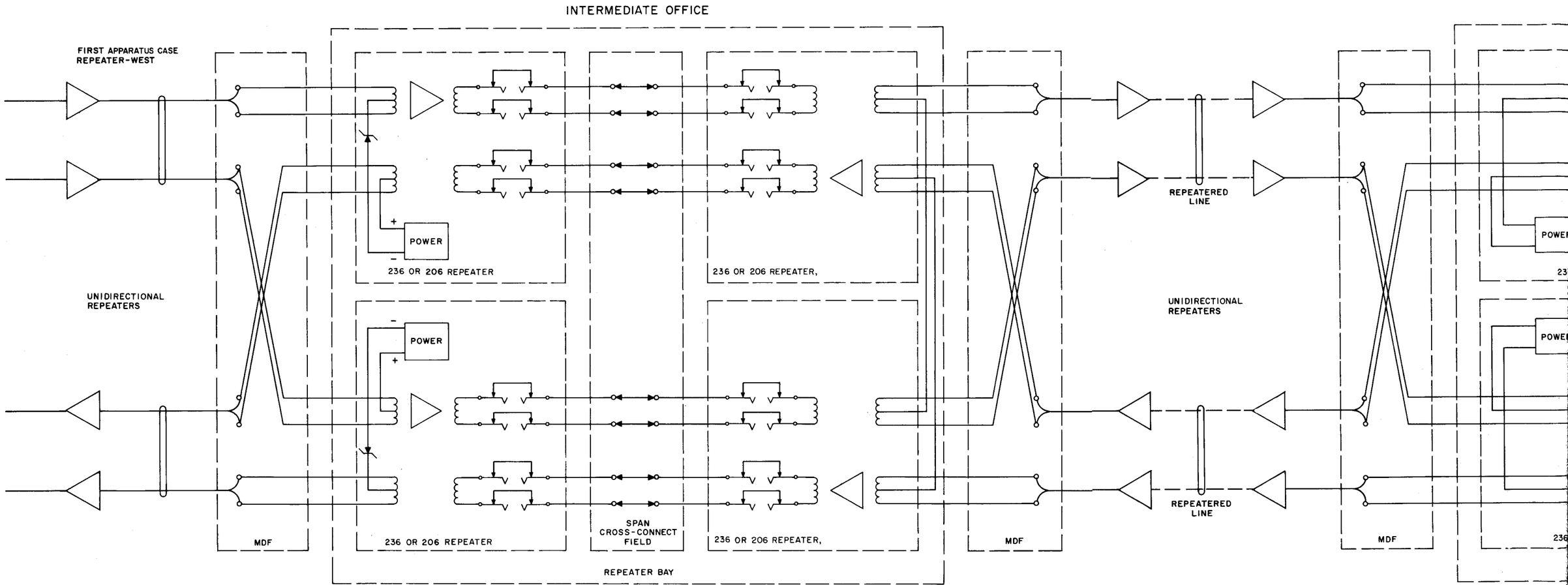


Fig. 31—Office Wiring for Two Cables Using Unidirectional Repeaters (206 ORB)


INTERMEDIATE OFFICE
FIRST APPARATUS CASE
REPEATER-WEST
UNIDIRECTIONAL
REPEATERS
POWER
236 OR 206 REPEATER
236 OR 206 REPEATER,
REPEATERED
LINE
UNIDIRECTIONAL
REPEATERS
POWER
MDF
236 OR 206 REPEATER
SPAN
CROSS-CONNECT
FIELD
236 OR 206 REPEATER,
MDF
REPEATERED
LINE
MDF
REPEATER BAY

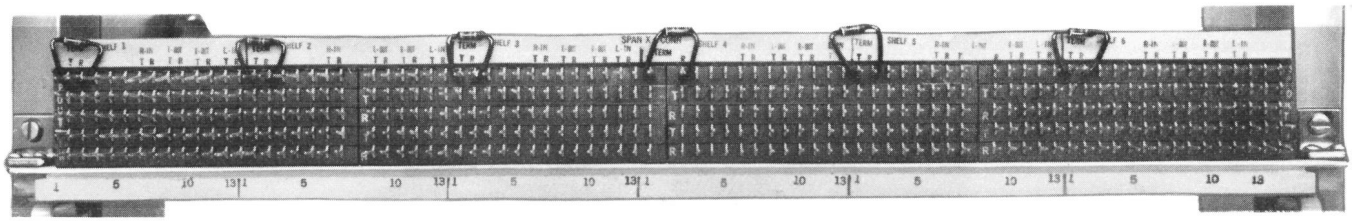


Fig. 32—ED-97442-50 Span Cross-Connect Field

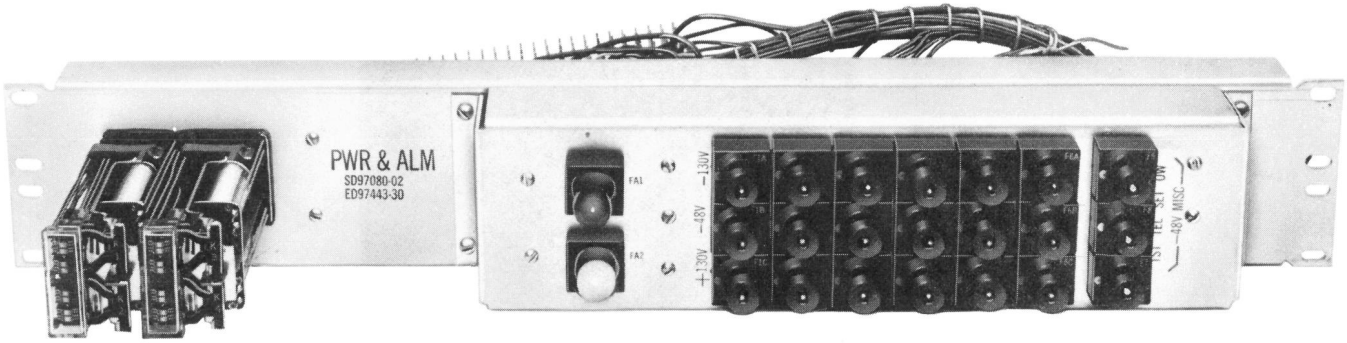


Fig. 33—ED-97443-30 Fuse and Alarm Panel

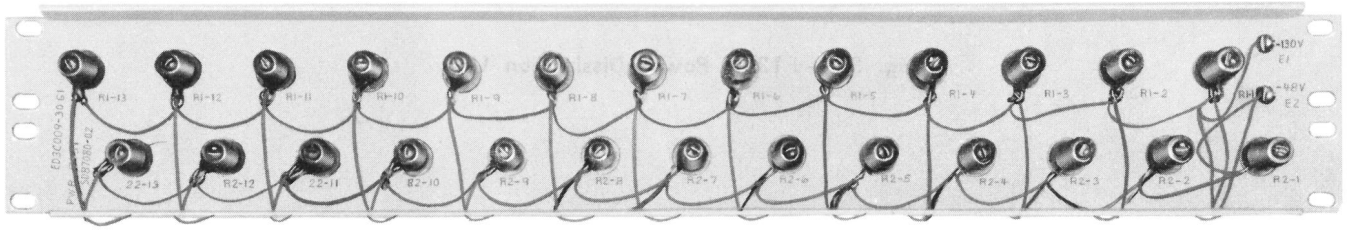


Fig. 34—ED-3C009-( ) Power Distribution Circuit Panel

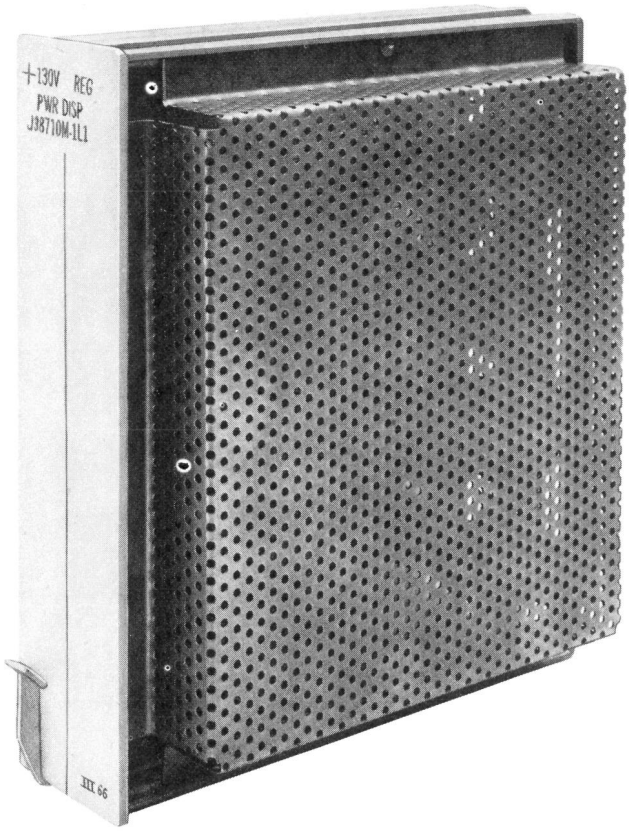


Fig. 35—+130V Power Dissipation Unit

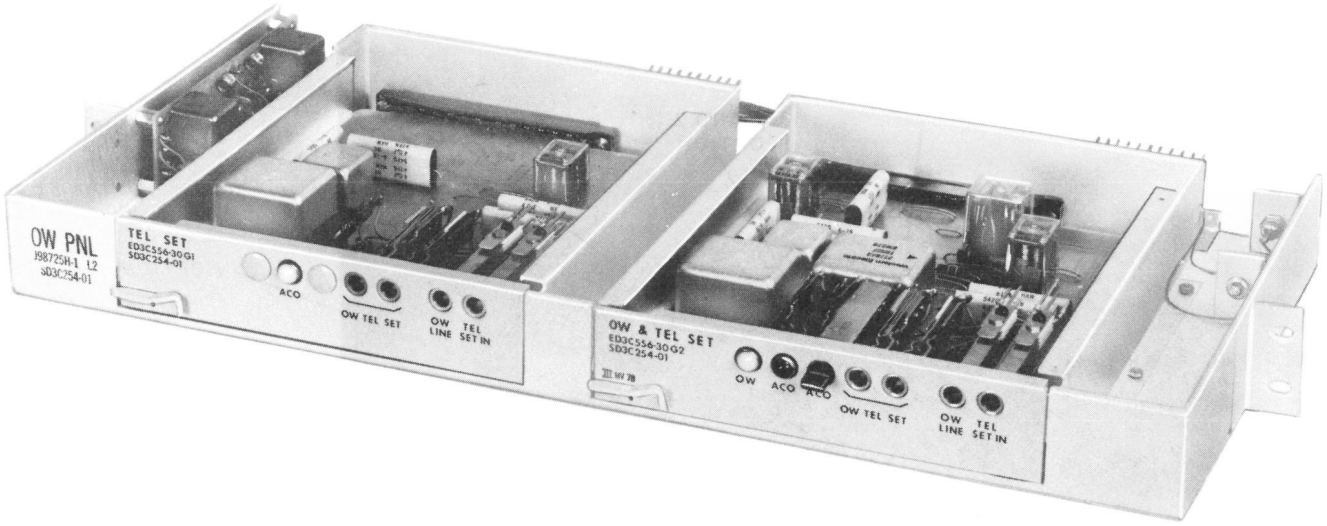


Fig. 36 — J98725H Digital Line Order-Wire Panel

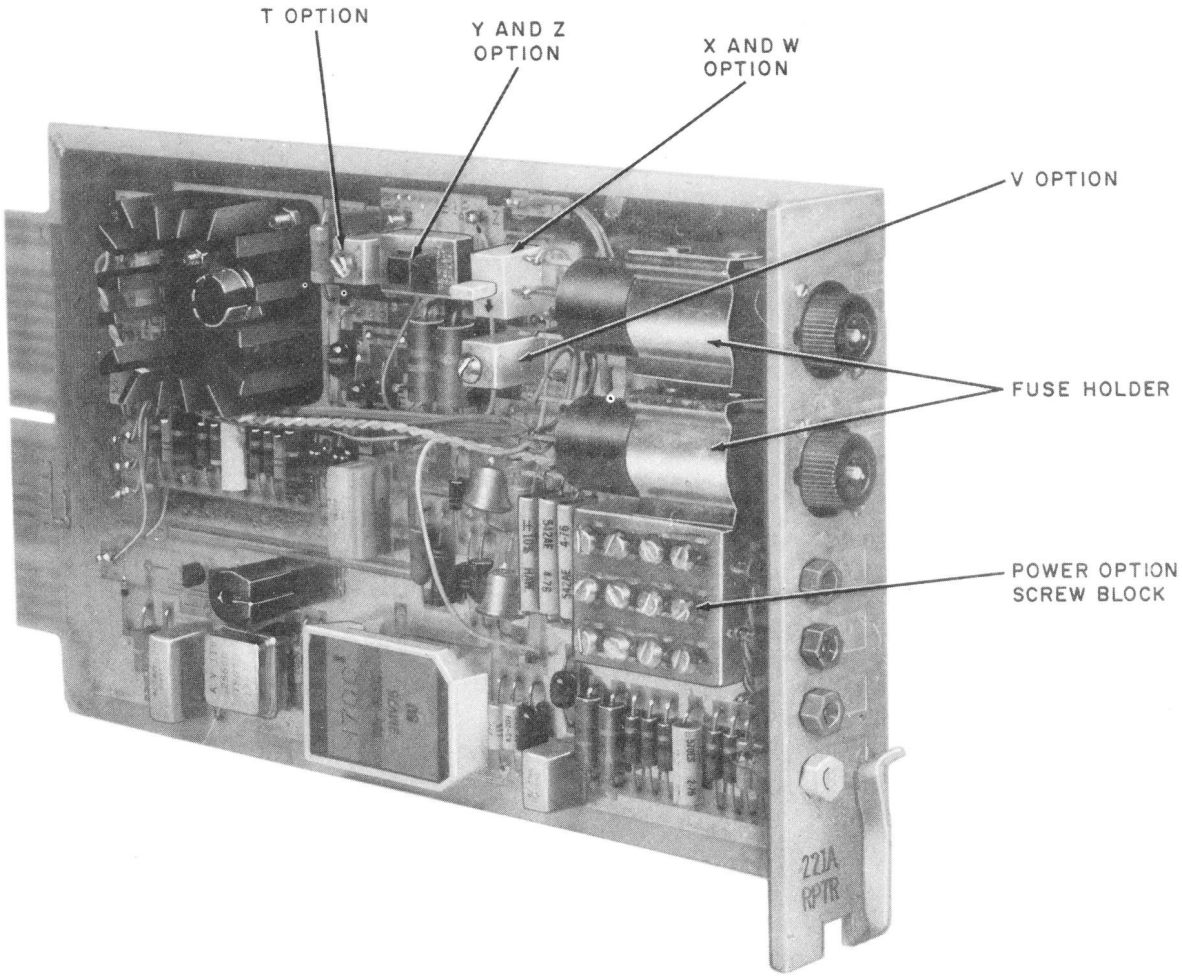
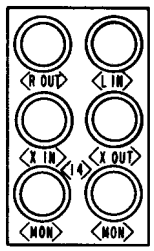
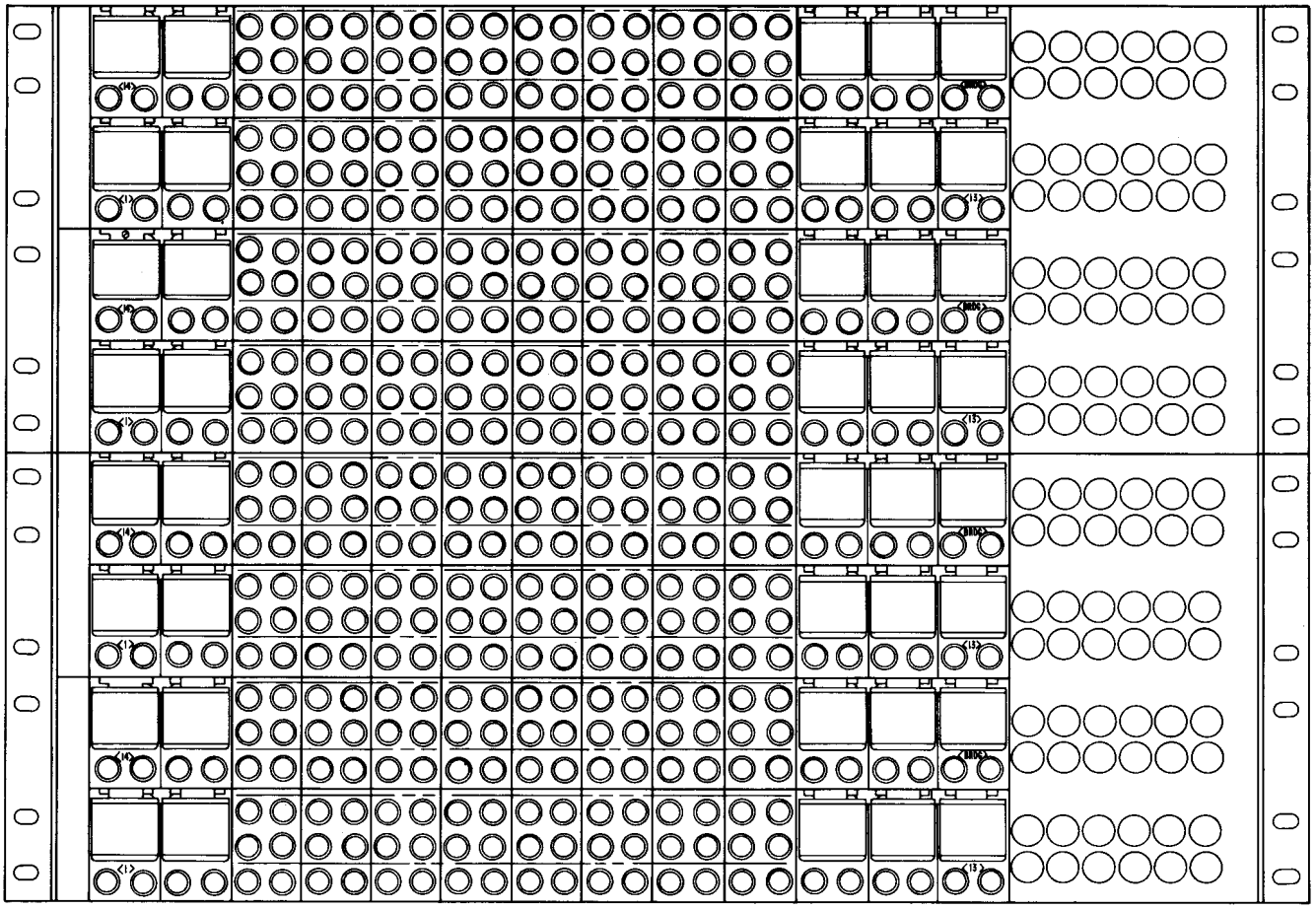


Fig. 37—Typical 221- and 231-Type Office Repeater



(HINGE AND DESIGNATION CARD HOLDER REMOVED)
(TYPICAL)



JACK FIELD

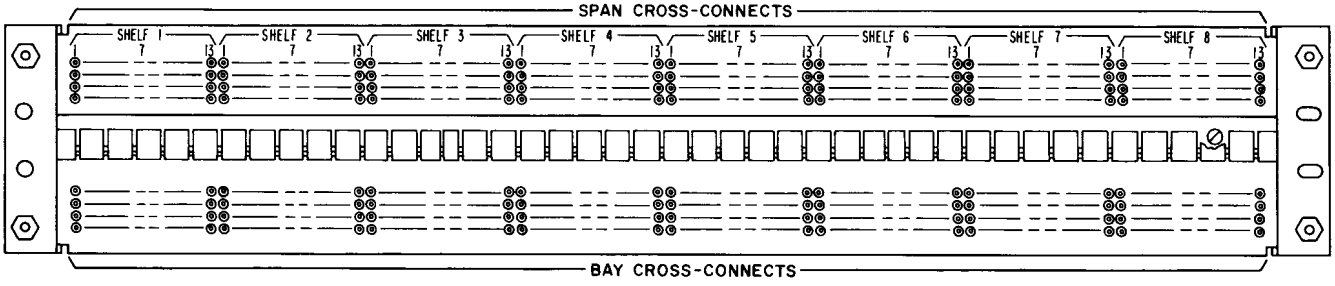


Fig. 38—Jack Field and Span and Bay Cross-Connect Panels (T1C/T1 ORB)

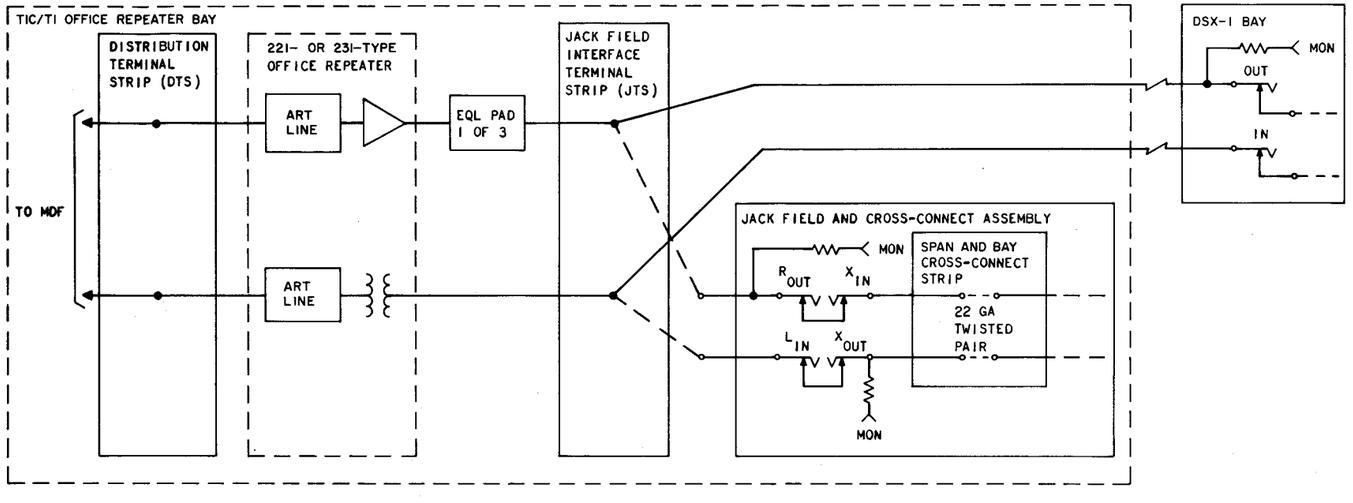


Fig. 39—Cross-Connect Arrangements With T1C/T1 ORB

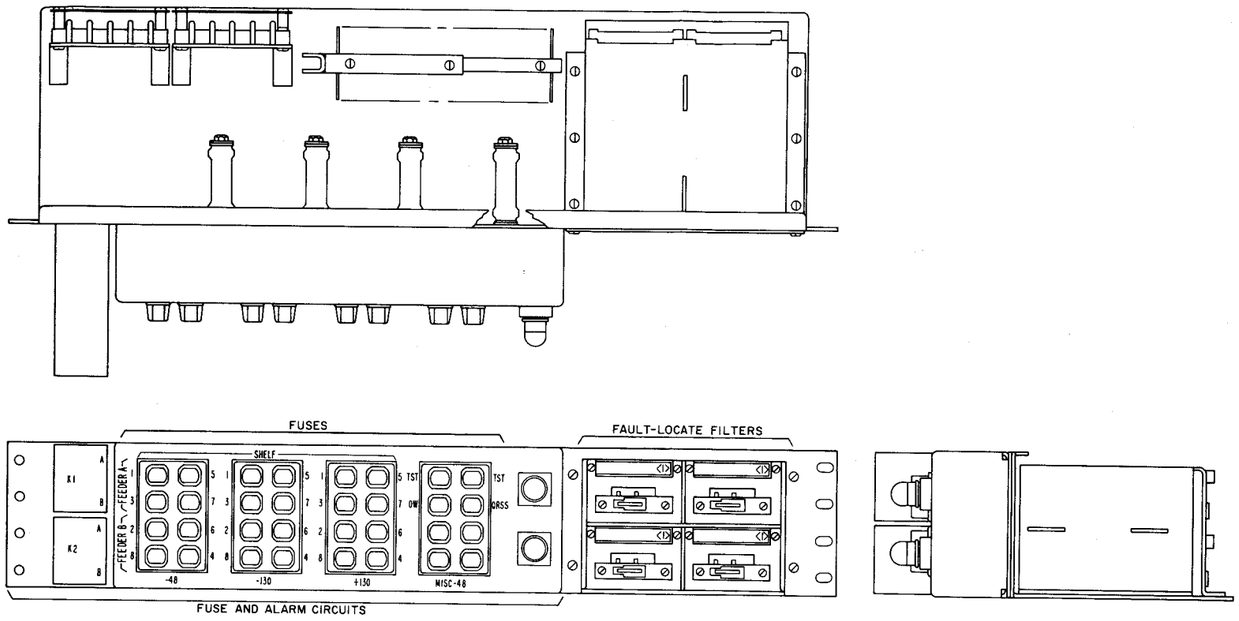


Fig. 40— Fuse Alarm and Fault-Locate Filter Panel (T1C/T1 ORB)

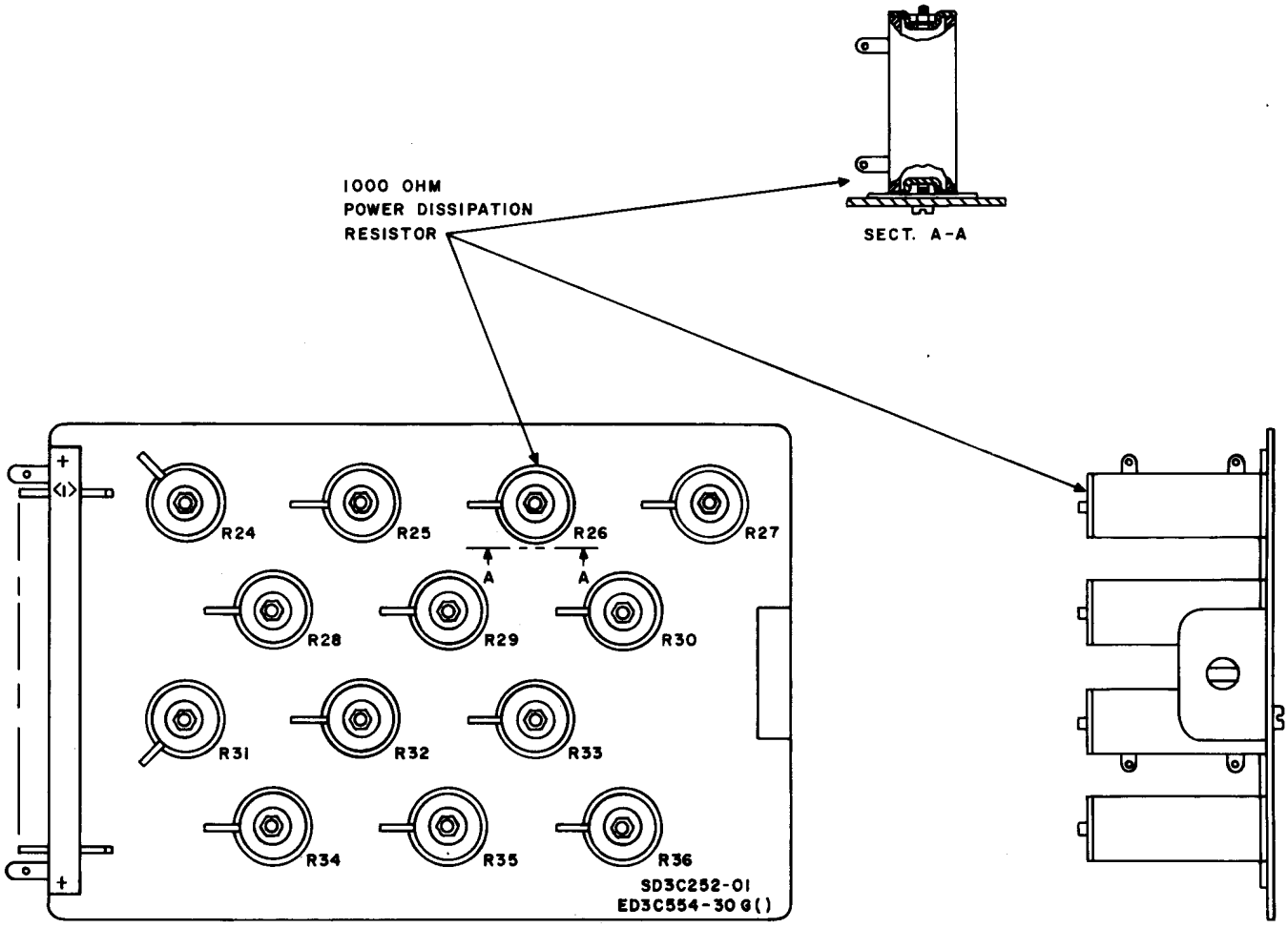
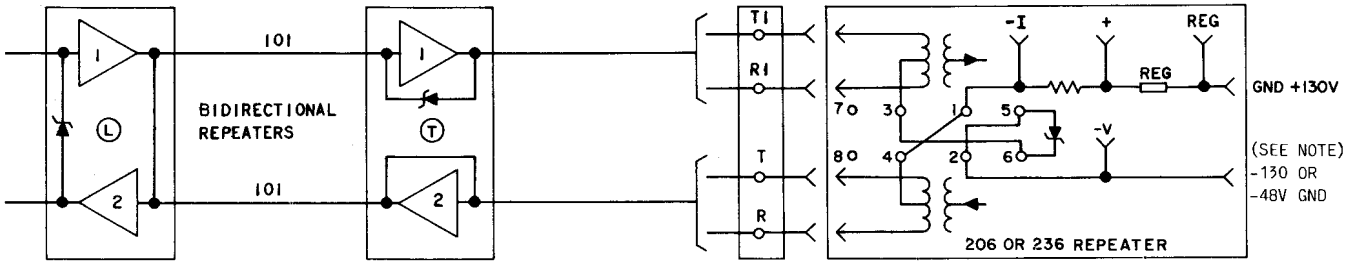
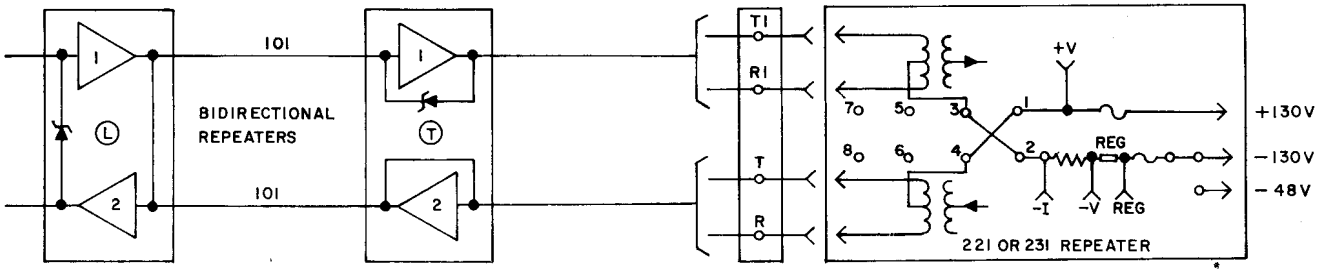


Fig. 41— ED-3C554-30 Power Dissipation Plug-In Unit



A - USING 206- AND 236-TYPE OFFICE REPEATERS

NOTE:
206-TYPE REPEATERS MAY HAVE EITHER A 48-VOLT OR A 130-VOLT REGULATOR DEPENDING ON REPEATER CODE.

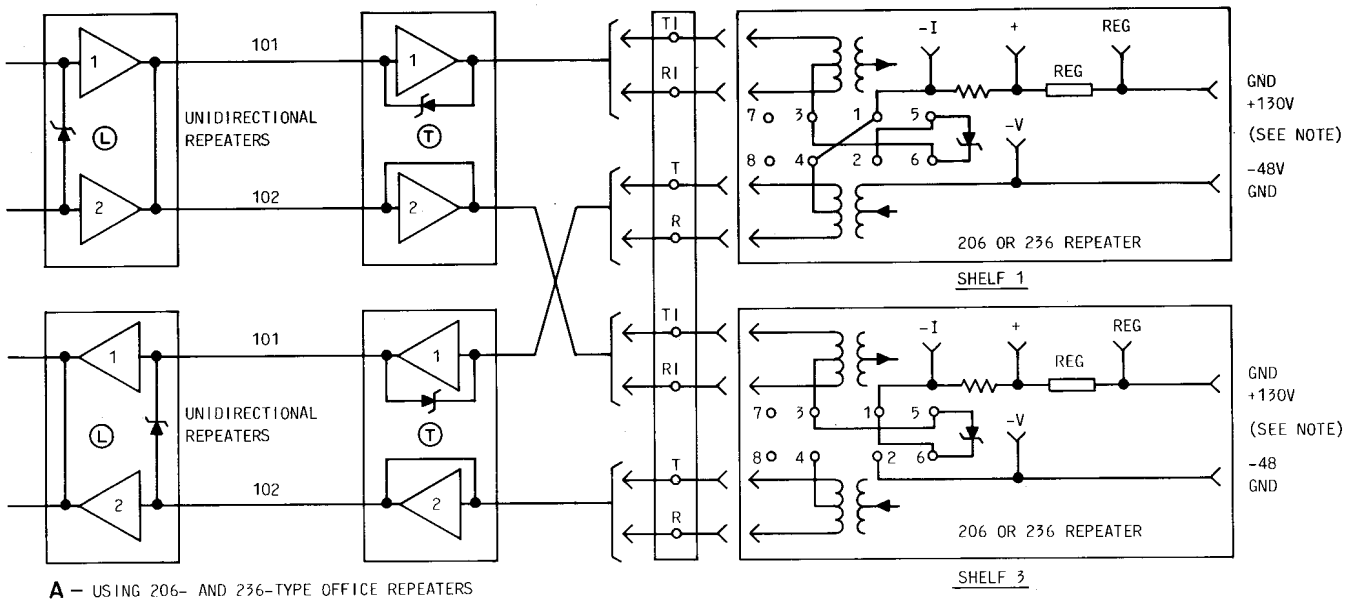


B - USING 221- AND 231-TYPE OFFICE REPEATERS

(L) INDICATES POWER IS LOOPED BY PROVIDING THE CORRECT CODE OF REPEATERS OR THE CORRECT OPTIONS SELECTED.

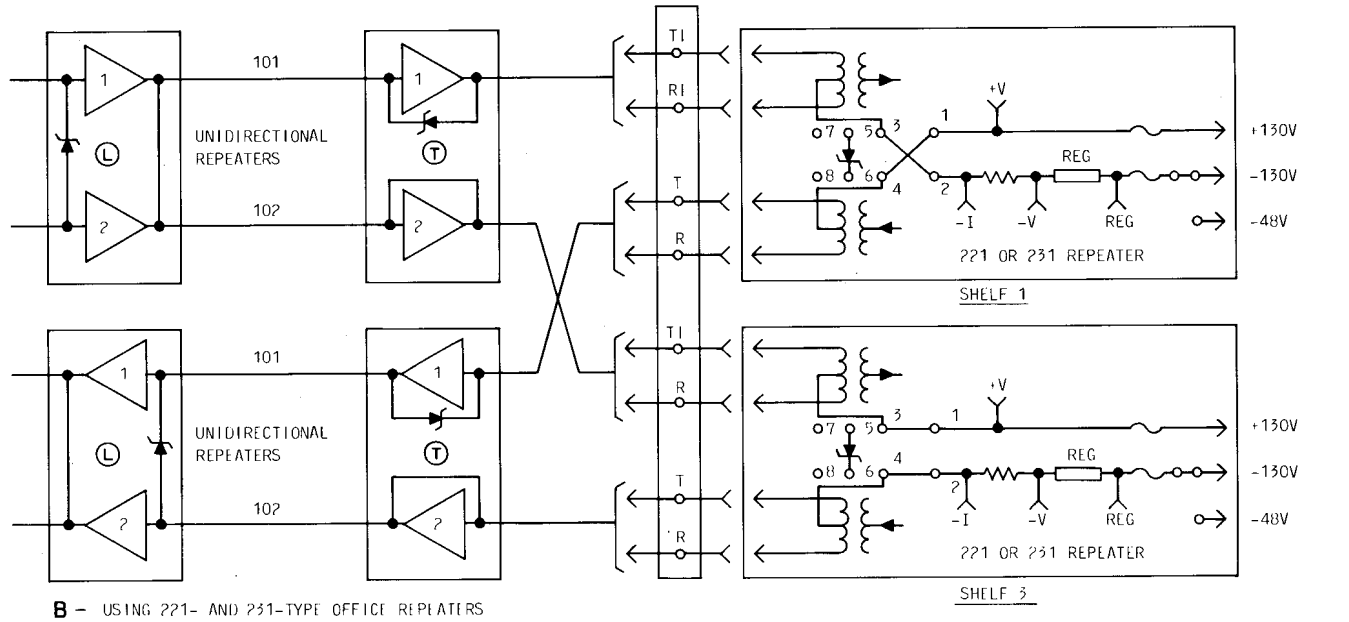
(T) INDICATES POWER IS FED THROUGH BY PROVIDING THE CORRECT CODE OF REPEATERS OR THE CORRECT OPTIONS SELECTED.

Fig. 42—Powering Scheme for Bidirectional Line Repeaters



A – USING 206- AND 236-TYPE OFFICE REPEATERS

NOTE:
206-TYPE REPEATERS MAY HAVE EITHER A 48-VOLT OR A 130-VOLT REGULATOR DEPENDING ON REPEATER CODE.



B – USING 221- AND 231-TYPE OFFICE REPEATERS

(L) INDICATES POWER IS LOOPED BY PROVIDING THE CORRECT CODE OF REPEATERS OR THE CORRECT OPTIONS SELECTED.

(T) INDICATES POWER IS FED THROUGH BY PROVIDING THE CORRECT CODE OF REPEATERS OR THE CORRECT OPTIONS SELECTED.

Fig. 43—Powering Scheme for Unidirectional Line Repeaters