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# NO. 2 AND 9B TELEGRAPH SERVICEBOARDS DIRECT-LEG ARRANGEMENTS

CONTENTS PAGE



## 1. GENERAL

1.01 This section describes the direct-leg features of the No. 2 and 9B telegraph serviceboards. It supplements Section E45.002 for the No. 2 telegraph serviceboard and E45.006 for the No. 9 telegraph serviceboard. These features have been made available to supplement the hub circuit arrangements which were originally provided for interconnecting the legs of networks at the serviceboard. Direct-leg arrangements require less equipment than hub circuits. This provides a more economical way of interconnecting these circuits but some loss in operating efficiency will be experienced due to the variety of interconnecting arrangements which must be considered when carrying out testing operations.

1.02 This section is reissued to revise the description of the direct-leg arrangements for the No. 2 and 9B serviceboards. Since this section covers a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 The over-all plan for the improved serviceboard provides for the termination of 2-leg networks on a direct-leg basis employing the conventional balanced loop or neutral principle of telegraph transmission. Direct-leg connections will apply to all TWX circuits requiring serviceboard terminations and to all full and half duplex private line terminal and through circuits with the exception of those requiring regeneration and through circuits employing 43A1 channel terminals. Two-leg networks requiring regeneration, through circuits involving 43A1 channel terminals and all networks which include three or more legs, will continue to be served on a hub circuit basis.

1.04 With the original hub circuit arrangements the legs of all line or loop facilities were terminated in the service position. The facility position of the serviceboard served primarily as a line board and included line and loop jacks which provided for patches between the line conductors and the line repeaters and between the loop conductors and the loop repeaters, respectively.

1.05 Direct-leg arrangements are administered entirely at a facility position. The associated line and loop repeaters have no appearances at service positions. All relay-type line repeaters terminate in jacks in the facility position where they are cross-connected or patched for either hub or direct-leg operation. For hub operation, the repeater is connected to a 144A1 coupling unit which is terminated in a service position. For direct-leg operation the repeater is connected to a relay-type conversion repeater which connects via loop and equipment jacks at the facility position to the loop conductors for terminal operation. When a break feature is not important, the conversion repeater is a 13H1 loop repeater which includes a polar relay and is suitable for half or full duplex operation.

When a break feature is desired, a 2-relay conversion repeater (90C1 loop repeater) is employed. Two relay-type line repeaters may be interconnected at a facility position for through operation on a direct-leg basis. In order to arrange relay-type line repeaters so that they will serve hub or direct-leg circuits, the full duplex repeater termination heretofore employed for hub-circuit operation has been retained.

**1.06** A new feature has been added to relay-type line repeaters terminated in the facility board. This feature causes a space to be transmitted outward whenever the repeater is disconnected from the associated 144A1 coupling unit or direct-leg circuit. The new feature causes a spacing current of about 1 milliampere to flow through the send relay windings at all times.

**1.07** Two types of channel terminals are available. For hub applications, 43A1 channel terminals per SD-70552-01 (Fig. W) are employed and for direct-leg service, the neutral arrangement per SD-70552-01 (Fig. A) is used. These channel terminals may not be converted from one type to the other. Therefore, the required number of each type must be provided with allowances for spares. The legs of 43A1 channel terminals which are arranged for hub operation terminate directly in a service position or via line and equipment jacks in a direct-leg facility position which provide means for making substitutions at a facility position. Those arranged for direct-leg operation terminate in a facility position. Whenever through operation or regeneration is required in conjunction with 43A1 legs, the network is established on a hub circuit basis at a service position.

**1.08** TWX trunk circuits and multisection toll subscriber lines have appearances only in the facility board. A ringdown intertoll trunk connects to a relay-type line repeater by means of a 10H1 loop repeater. In the case of automatic signaling line concentrating unit trunks, the loop repeaters in the trunk circuit are arranged for direct connection to the legs of relay-type line repeaters. In the case of 43A1 channel terminals servicing TWX circuits, the direct-leg (neutral) arrangement of the channel terminal is always used. Where connection of a 43A1 channel terminal is to a ringdown intertoll trunk or a HDX TLX in a 20-milliampere switchboard, a 10F1 loop repeater is required for conversion of 60-milliampere to 20-milliampere loops.

**1.09** An attendant at a facility position communicates or tests over lines or loops by means of a communication direct-leg teletypewriter cord circuit which is a cord-terminated circuit appearing in the keyself of the board and connects to the leg and equipment jacks. This cord circuit provides means for splitting the line and loop circuits, and terminates the side to which transmission is not directed. A monitoring lamp responds to signals from the terminated circuit. Access to the position teletypewriter and 118 TMS is provided. In addition to communication over the facility, the cord circuit provides means for the connection of a test signal cord circuit for transmitting test signals.

**1.10** A direct-leg monitoring circuit serves both private line and TWX direct-leg circuits. It is a cord-terminated circuit and connects to the leg and equipment jacks. In addition to its monitoring functions, it indicates the direction of transmission. Access to the 118 set for transmission measurements is provided.

## 2. DESCRIPTION OF CIRCUIT ARRANGEMENTS

**2.01** Fig. 1 to 20 show in schematic form the various ways in which line repeaters having relay-type outputs such as 40C1 channel terminals and those of the electronic type such as 43A1 channel terminals are terminated in a facility position for direct-leg service.

### A. Circuits Employing Relay-type Line Repeaters

#### Private Line Circuits

**2.02** Fig. 1 to 5 show the manner of terminating relay-type line repeaters for private line direct-leg service. The repeater legs are connected to leg and equipment jacks which may be assigned either to a 144A1 coupling unit for hub operation (see Fig. 11) or to a conversion repeater for private line service as indicated in Fig. 1 to 3, inclusive. The leg and equipment jacks provide access to the circuits for communication and testing in either direction. Connection of the direct-leg teletypewriter cord to these jacks splits the circuit. Fig. 5 shows a spare repeater termination and the method of patching it for a substitution. In Fig. 1, a 13H1 repeater is used as the conversion unit serving a half duplex loop circuit. This arrangement does not provide a break feature. If a break feature is required, the arrangement of Fig. 2 which in-

cludes a 90C1 loop repeater is employed. It should be noted that the loop-return battery is negative in Fig. 1 and positive in Fig. 2. All loops usually return to positive battery in accordance with Fig. 2. Since the line repeater in Fig. 1 furnishes positive battery for marking, it is necessary to return the loop to negative battery. By turning over the tip and ring conductors as in Fig. 1, the flow of the loop current is maintained in the proper direction at the station. In Fig. 3, a 13H1 repeater is used with a full duplex loop circuit. Here again it is desirable to turn over the connections to the receive loop jack circuit in order to maintain the proper direction of current flow at the station. The loop jack circuits shown between the loop conductors and the conversion repeaters in Fig. 1, 2, and 3 provide for repeater substitution and for flexibility in patching loop conductors either for direct-leg or hub circuit operation.

**2.03** Two line repeaters may be connected together back to back for through operation in the manner shown in Fig. 4. The polar operating current in each direction of transmission is approximately 15 milliamperes.

**2.04** Fig. 12 shows a relay-type line repeater associated with a 13G1 loop repeater for sending polar signals to a group of subscriber station loops connected in parallel. A maximum of ten such station loops may be connected to a repeater. Negative battery is used for mark and each leg draws approximately 10 milliamperes on a polar basis. Fig. 12B shows an individual current measuring circuit for parallel polar loops grounded at a subscriber station. The circuit may also be used for ground return station loops. In either case, the particular loop is split off from the group by a patch using a facility patch cord between the loop TGL jack and the PATCH jack. This terminates the loop in its equivalent marking battery via jack MEAS. CUR to which the meter cord is connected.

#### TWX Circuits

**2.05** TWX ringdown intertoll trunks require an intermediate loop repeater when they are connected to a relay-type line repeater. The loop repeater which is coded 10H1 or 10H2 is connected to the line repeater via leg and equipment jacks as shown in Fig. 6. The connection of the loop repeater to the various trunk circuits is as shown in Fig. 6A, 6B, 6C, 6D, and 6E. Fig. 6A and 6B apply to No. 1 and 1A TWX switchboards with and without No. 15 telegraph testboards, respectively. Fig. 6C applies to switchboard 3A and Fig. 6D applies to the No. 3C switchboard. Fig. 6E shows the connections required for a No. 5 TWX switchboard.

**2.06** TWX multisection toll subscriber line circuits employ line facilities to which they are connected on a direct-leg basis without separate loop repeaters as shown in Fig. 7, 8, and 9. The arrangement of Fig. 7 and 8 are associated with switchboards and that of Fig. 9 with a line concentrating unit.

**2.07** Interconnecting arrangements for line facilities and automatic signaling concentrating unit trunks are shown in Fig. 10, 10A, and 10B. Fig. 10 and 10A show the manner of interconnecting a concentrating unit trunk at a switchboard office. Fig. 10 and 10B show the equivalent arrangement for an operator office trunk circuit at a line concentrating unit office. As in the case of Fig. 7, 8, and 9, the loop repeaters are incorporated in the trunk circuits.

### B. Circuits Employing 43A1 Channel Terminals

#### Private Line Circuits

**2.08** All 43A1 channel terminals arranged for direct leg operation are terminated on a full duplex basis in facility position leg and equipment jacks. The manner in which 43A1 channel terminals and subscriber loops are interconnected for private line service is shown in Fig. 13 and 14. It should be noted that the full duplex arrangement of Fig. 14 employs separate loop and equipment jacks for each loop and a single leg and equipment jack. The resistors shown enclosed in the dashed rectangle in Fig. 14 provide the correct terminating resistance for the send loop and provide the correct value of signal voltages for driving the sending circuit of the channel terminal from the full duplex send loop. In the case of half duplex operation shown in Fig. 13, a single pair of leg and equipment and loop and equipment jacks is employed and the RL and SL leads are tied together. This causes the 43A1 channel terminal to function on a half duplex basis. No provision is made for interconnecting two neutral-type channel terminals for through operation as this is done on a hub circuit basis.

**2.09** Fig. 17 shows the manner in which a spare 43A1 channel terminal may be patched to serve a half duplex subscriber loop. Fig. 18 shows the manner in which a spare 43A1 channel terminal may be patched to serve full duplex subscriber loops.

**2.10** Fig. 19 shows a neutral-type 43A1 channel terminal assigned to a hub circuit via a neutral-to-hub conversion circuit. Two 13G1 loop repeaters interconnect the sending (SL) and receiving (RL) legs of the line repeater to a 144A1 coupling unit which connects to the hub of the concentration group. Fig. 20 shows a hub-type 43A1 channel terminal appearing in the direct-leg facility position and serving hub circuits in a hub service position. The RL and SL leads connect to a single pair of leg and equipment jacks and the TL lead is cross-connected to the legs jack or legs relay circuit. This situation is not normally encountered but is operationally feasible. Hub circuits usually appear in the service position only.

### TWX Circuits

**2.11** Fig. 15 shows the manner of interconnecting a 43A1 channel terminal and TWX ringdown intertoll trunks. Connection to the trunk circuit is via the B, T, or R designated lead from the channel terminal on a half duplex basis. In the case of switchboards arranged for 20-milliampere operation as shown in Fig. 15A, 15B, or 15C, connection is via a 10F1 loop repeater which provides the current conversion. Fig. 15B applies where the trunk terminates in a No. 1 or 1A switchboard and there is no No. 15 telegraph testboard. In the case of 60-milliampere boards, connection from the channel terminal is direct via the T or R designated lead as shown in Fig. 15D and 15E for the No. 3A or 5 switchboard, respectively.

**2.12** Multisection toll subscriber lines are connected to 43A1 channel terminals on a full duplex basis in accordance with Fig. 16, 16A, 16B, or 16C. Fig. 16A applies to toll subscriber line circuits terminating in No. 1 and 1A switchboards and Fig. 16B applies to No. 3A and 3C switchboards. Fig. 16C shows the interconnecting arrangements for multisection toll subscriber lines associated with 101A or 102A line concentrating unit.

**2.13** Automatic signaling concentrating unit trunks are connected to 43A1 channel terminals in the manner shown in Fig. 16, 16D, or 16E. Fig. 16D applies to the concentrating unit trunk circuit at a switchboard office and Fig. 16E is for an operator office trunk circuit at a 101A or 102A line concentrating unit office.

### C. Direct-leg Teletypewriter Cord Circuit for Communication and Testing

**2.14** *General:* Communication with direct-leg circuits is accomplished by the use of the direct-leg teletypewriter cord circuit at the facility position. The position teletypewriter normally associated with the teletypewriter cord circuit may be associated with this cord by operation of keys located in the keyshelf. A cord designated CONN. SIGS is provided for the connection of the test signals. Test signals may also be applied by the test signal cord circuit via a jack designated TST SIG CD. Access to the 118 set for transmission measurements is provided since the measuring circuit is normally associated with the position teletypewriter.

**2.15** ***Functions of Cords and Keys:*** Connection of the cord circuit is made at the TGL-TGEQ leg and equipment jack circuit adjacent to the associated line repeater. Two cords are provided. The cord designated COM.MON, is equipped with a double plug and is used for normal communication. The cord designated COM, is equipped with a single plug and is provided for access to circuits one jack of which may be patched so that it is possible to connect to either the TGEQ or the TGL jack but not to both. Connection of the cord circuit to an assigned facility terminates the facility in the cord circuit to permit communication or testing in either direction. A monitoring lamp (MON) circuit is associated with the use of the COM.MON (double plug) cord. This lamp will light in response to space signals from the terminated line or station loop of the circuit under test. Selection of the particular cord is made by the COM.MON-COM key. This key permits only one cord to be used at a time, thus avoiding the accidental interconnection to two independent circuits simultaneously. Access to the position teletypewriter, arrangement of the cord circuit for the particular type of line or loop to be tested, and splitting the circuit for testing toward the line or drop are accomplished by operating the SP LINE-SP

DROP and the RELAY REP-ELEC. REP keys. Both keys must be operated before communication or testing can be effected. Operation of the SP LINE-SP DROP key to either position provides termination of the sending and receiving circuit elements of the position teletypewriter set in a half duplex hub pot. The cord circuit is arranged for testing relay or electronic type circuits by the operation of the RELAY REP-ELEC. REP key. The CONN.SIG cord provides means for connecting test signals to the direct-leg teletypewriter cord for sending to the circuit under test. Jack TEST SIG.CD provides means for patching the LEG cord associated with the test signal cord circuit to provide a source of test signals. This releases the position teletypewriter from its association with the direct-leg teletypewriter cord circuit and permits connection of the test signal cord circuit elements for sending test signals when it is desirable to provide for the distant office to stop the test signals. The HDX-FDX key arranges the circuit for communication with a half or full duplex station, respectively.

2.16 ***Application to Direct-leg Circuits Using Relay-type Repeaters:*** Fig. 21 and 21B show a relay-type line repeater terminated in leg and equipment jack circuit. The loop side of the circuit may include a half duplex loop employing a 13H1 repeater (Fig. 21C), a half duplex loop employing a 90C1 repeater (Fig. 21D), or a full duplex loop circuit employing a 13H1 repeater (Fig. 21E). Fig. 21A shows a relay-type line repeater assigned to FDX or HDX loop circuits for connection to Fig. 21B, 22, or 25.

(a) ***Split to Line:*** Fig. 21 shows the direct-leg teletypewriter cord circuit arrangement for communicating and testing with a relay-type line repeater. A 144A1 coupling unit provides the necessary signal conversion between the position teletypewriter and the line repeater as shown in the line communicating part of the circuit. The split-off loop is terminated in an equivalent line resistance while the receiving circuit elements of the associated loop repeater connect to the MON lamp circuit.

(b) ***Split to Drop:*** Fig. 22 shows the cord circuit arrangement for communicating with relay-type repeater loops. Incoming signals from the station are impressed on the half duplex hub pot associated with the position teletypewriter via the REQ ring of the COM.MON cord and V1(A) and V4 tubes. Signals originating from the position teletypewriter are also impressed on the half duplex hub pot and transmitted to the station via V3 tube, contacts of K11 relay, the TEQ tip conductor of the COM.MON cord, and the sending circuit elements of the associated loop repeater. The split-off line repeater is terminated in an equivalent resistance and its receiving circuit elements connect to the MON lamp circuit.

2.17 ***Application to Direct-leg Circuits Using 43A1 Channel Terminals:*** Fig. 23A and 23B show a 43A1 channel terminal terminated in a leg and equipment jack circuit. The loop side of the circuit may include a half duplex loop circuit (Fig. 23C), a full duplex loop circuit (Fig. 23D), or the special case of a pair of 13G1 loop repeaters associated with a 144A1 coupling unit arranged as a neutral-to-hub conversion circuit (Fig. 23E).

(a) ***Split to Line:*** Fig. 23 shows the direct-leg teletypewriter cord circuit arrangement for communicating and testing with a 43A1 channel terminal line repeater. Incoming line signals from the receiving circuit elements of the channel terminal are impressed on the half duplex hub pot associated with the position teletypewriter via the TLN tip conductor of the COM.MON cord and V5 tube. Signals originating from the position teletypewriter are also impressed on the half duplex hub pot and transmitted to the sending circuit elements of the channel terminal via V8 tube and the RLN ring conductor of the COM.MON cord. The split-off loop is terminated in an equivalent line resistance circuit and the MON lamp circuit.

(b) ***Split to Loop:*** Fig. 24 shows the direct-leg teletypewriter cord circuit arrangement for communicating and testing with the loop circuit associated with a 43A1 channel terminal. In the case of a half duplex subscriber loop, a 96A1 loop repeater performs the necessary signal conversion to and from the position teletypewriter. In the case of full duplex circuits (Fig. 23D and 23E), incoming signals from the sending loop circuit or the 13G1 loop repeater (repeater B) are transmitted to the position teletypewriter via the

REQ ring conductor of the COM.MON cord, V1(A) and V4 tubes and the half duplex hub pot. The split-off line repeater is terminated on a half duplex basis in its equivalent loop resistance and the MON lamp circuit.

### D. Direct-leg Monitoring Circuit

**2.18** A direct-leg monitoring circuit is provided in the facility position for monitoring on private line and TWX direct-leg circuits. This circuit replaces the TWX legs monitoring circuit heretofore located in service positions of No. 2 and 9B serviceboards. It is arranged for connection to the position teletypewriter or the auxiliary teletypewriter circuit and has access to the 118 set for transmission measurements. The circuit appears in a cord equipped with a double plug. The plug is connected to the leg and equipment jack circuit adjacent to the line repeater. As in the case of the original TWX legs monitoring circuit, the new direct-leg monitoring circuit includes a "direction of transmission" feature which includes two lamps designated LINE and DROP.

**2.19** The monitoring circuit is designed to meet the following operating conditions.

(a) Monitor in direct-leg circuits served by either relay-type or 43A1 repeaters.

(b) Respond to signals from either the line or the drop.

(c) Monitor on TWX circuits.

(d) Monitor either full or half duplex transmission,

Four 2-position keys located in the keyshelf arrange the circuit to perform the functions outlined above.

**2.20** ***Monitoring Direct-leg Circuits Using Relay-type Repeaters:*** Fig. 25 shows the monitoring circuit arrangement when associated with relay-type repeaters. The presence of the ring-sleeve section of the cord in the TGL jack places the windings of polar relay (K3) in series with the sending side of the loop repeater. Thus, K3 relay will respond to signal current changes from the station. The resulting mark (+130V) and space (−130V) voltages on its contact are transmitted via V6 tube to the position teletypewriter and 118 set for transmission measurements or to the auxiliary teletypewriter. Signals originating from the line will be sampled on a voltage basis by the presence of the sleeve section of the cord in the TGEQ jack. The direction of transmission will be recognized by the flashing of the DROP or LINE lamp in the plate circuit of V1 and V2 tubes, respectively.

**2.21** ***Monitoring Direct-leg Circuits Using 43A1 Channel Terminal:*** Fig. 26 shows the monitoring circuit arrangement when associated with electronic direct-leg circuits. The presence of the ring-sleeve section of the cord in the TGL jack samples the signal voltages originated by the station while the sleeve section of the cord samples the signal voltages originated by the line. The particular type of operation is selected by relays under the control of keys as shown. Signal voltages from the line or drop are converted to suitable values and polarity by V4 and V5 tubes. The resulting signal voltages are transmitted to the position teletypewriter or auxiliary teletypewriter via V6 tube which provides the correct mark and space voltages. The direction of transmission will be recognized by the flashing of the DROP or LINE lamp in the plate circuit of V1 and V2 tubes, respectively.

### E. Keyshelf Circuits in Direct-leg Arranged Serviceboard

**2.22** Fig. 27 shows the communication and transmission measuring preference chain circuits associated with the cord circuits appearing in a facility or combined position of the No. 2 or 9 serviceboard. The direct-leg teletypewriter cord circuit and direct-leg monitoring circuit are shown in the chain of testing cord circuits and have access to the teletypewriter and 118-type telegraph transmission measuring set on a left to right order of priority as the cords appear in the cord shelf, except that the teletypewriter cord circuit has first preference in use of the position teletypewriter.

## 3. DESCRIPTION OF EQUIPMENT

### A. Direct-leg Monitoring Cord Circuit

**3.01** The bay equipment for the direct-leg monitoring circuit is mounted on 19-inch relay rack and occupies the space of three 1-3/4-inch mounting plates.

**3.02** At the serviceboard, the circuit appears in the keyshelf in the manner shown in Fig. 28A and 28B for the No. 2 and 9B serviceboards, respectively.

**3.03** Jacks and keys associated with the direct-leg monitoring circuit appear in the face of the serviceboard as shown in Fig. 29A and 29B for the No. 2 and 9B serviceboards, respectively. For the No. 2 serviceboard, this equipment is mounted directly above the piling rail in the center panel. For the No. 9B serviceboard, this equipment is mounted in a miscellaneous jack strip in the jackfield of the keyshelf bay.

### B. Direct-leg Teletypewriter Cord Circuit

**3.04** Mounted on 19-inch relay rack, the bay equipment for the direct-leg teletypewriter cord circuit occupies the space of six 1-3/4-inch mounting plates.

**3.05** At the serviceboard, the circuit appears in the keyshelf in the manner shown in Fig. 30 for both the No. 2 and 9B serviceboards. A jack (TST SIG CD) is located in the jackfield of the face equipment as part of the miscellaneous jack group.

## 4. LIST OF FIGURES

### 4.01 *Circuit Figures*

| FIG. NO. | TITLE |
|---|---|
| 1 | Interconnecting Arrangements for Relay-type Line Repeater and HDX Subscriber Loop Using 13H1 Loop Repeater |
| 2 | Interconnecting Arrangements for Relay-type Line Repeater and HDX Subscriber Loop Using 90C1 Loop Repeater |
| 3 | Interconnecting Arrangements for Relay-type Line Repeater and FDX Subscriber Loops Using a 13H1 Loop Repeater in the Send Leg |
| 4 | Relay-type Line Repeaters Interconnected for Through Operation |
| 5 | Spare Relay-type Line Repeater Termination in Facility Position |
| 6, 6A, B, C, D, and E | Relay-type Line Repeater Serving TWX Ringdown Intertoll Trunk |
| 7 | Relay-type Line Repeater Serving Multisection Toll Subscriber Line Circuit at Switchboard Office |
| 8 | Relay-type Line Repeater Serving Multisection Toll Subscriber Line Circuit at Switchboard Office |
| 9 | Relay-type Line Repeater Serving Multisection Toll Subscriber Line Circuit at Concentrating Unit Office |
| 10 | Relay-type Line Repeater Serving Concentrating Unit Trunk (Line Concentrating Units 101A and 102A) |
| 11 | Relay-type Line Repeater Serving a Hub Circuit |
| 12 | Relay-type Line Repeater and 13G1 Loop Repeater Serving Parallel Polar Loop Circuits |
| 12A | Terminating Circuit for Spare 13G1 Loop Repeater for Use in Fig. 12 |
| 12B | Current Measuring Circuit for Parallel Polar Loops Grounded at Subscriber Station |
| 13 | No. 43A1 Channel Terminal Serving HDX Private Line Subscriber Loop |
| 14 | No. 43A1 Channel Terminal Serving FDX Private Line Subscriber Loops |
| 15, 15A, B, C, D, and E | No. 43A1 Channel Terminal Serving TWX Ringdown Intertoll Trunk |
| 16 | No. 43A1 Channel Terminal Serving Multisection Toll Subscriber Line Circuit (TWX) |
| 16A | Multisection Toll Subscriber Line Circuit Switchboards, Numbers 1 and 1A, SD-70095-01 |
| 16B | Multisection Toll Subscriber Line Circuit Switchboards, No. 3A and 3C, SD-70391-01 |
| 16C | Multisection Toll Subscriber Line Circuit 101A and 102A Line Concentrating Units, SD-70316-01 |

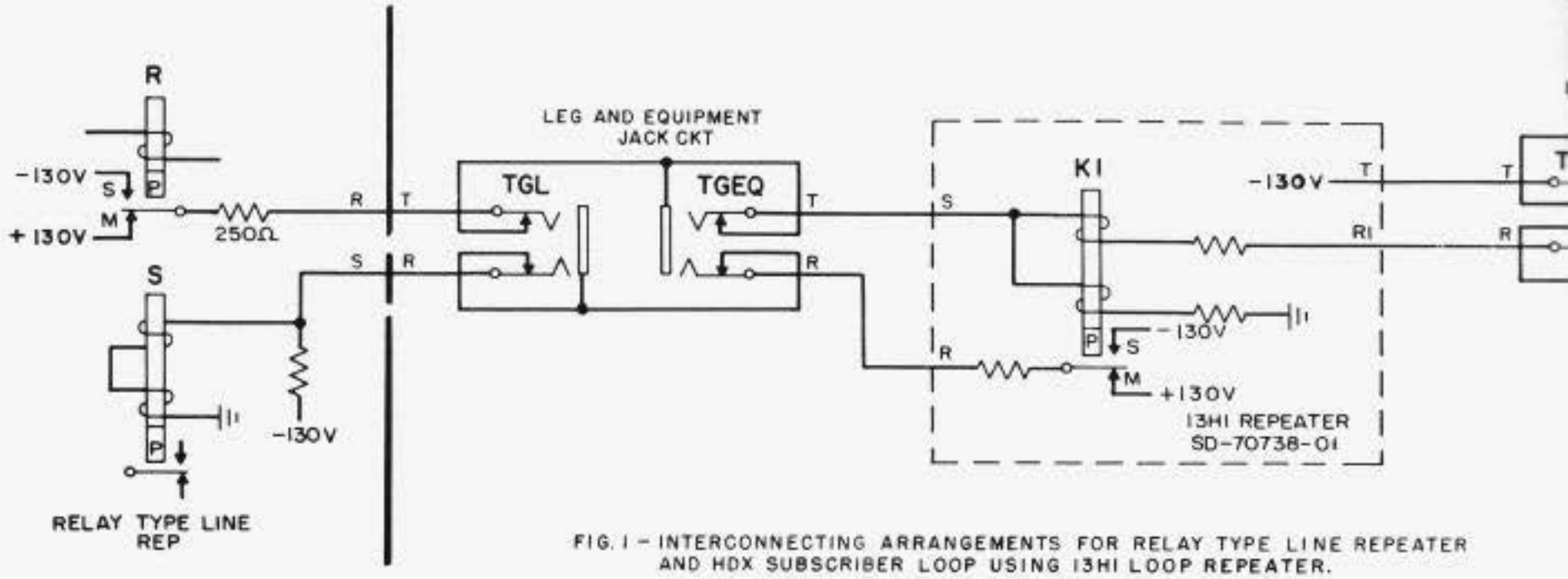



FIG. 1 – INTERCONNECTING ARRANGEMENTS FOR RELAY TYPE LINE REPEATER AND HDX SUBSCRIBER LOOP USING 13HI LOOP REPEATER.

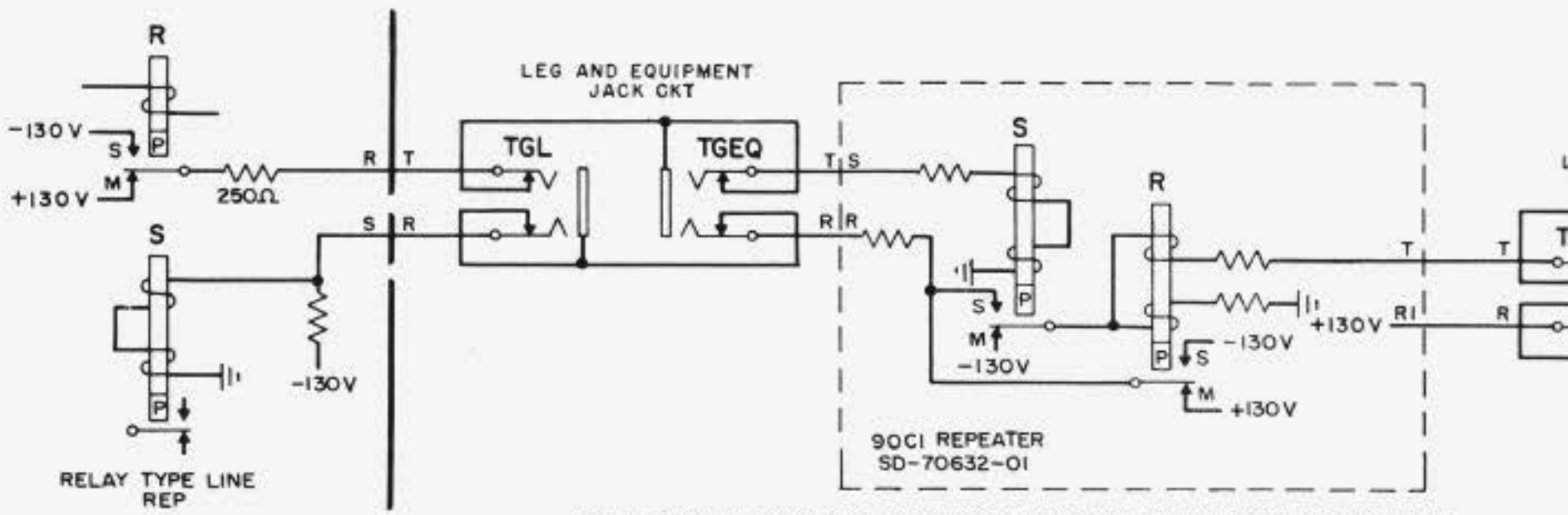



FIG. 2– INTERCONNECTING ARRANGEMENTS FOR RELAY TYPE LINE REPEATER AND HDX SUBSCRIBER LOOP USING 90CI LOOP REPEATER.

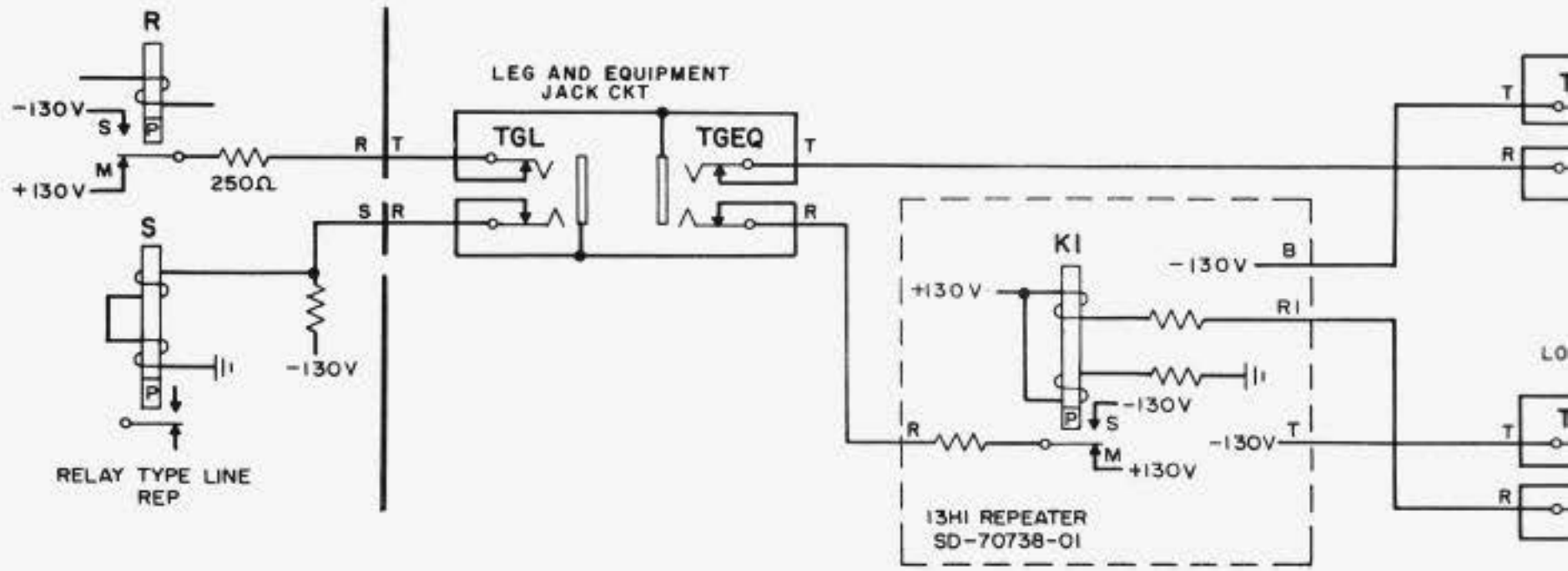
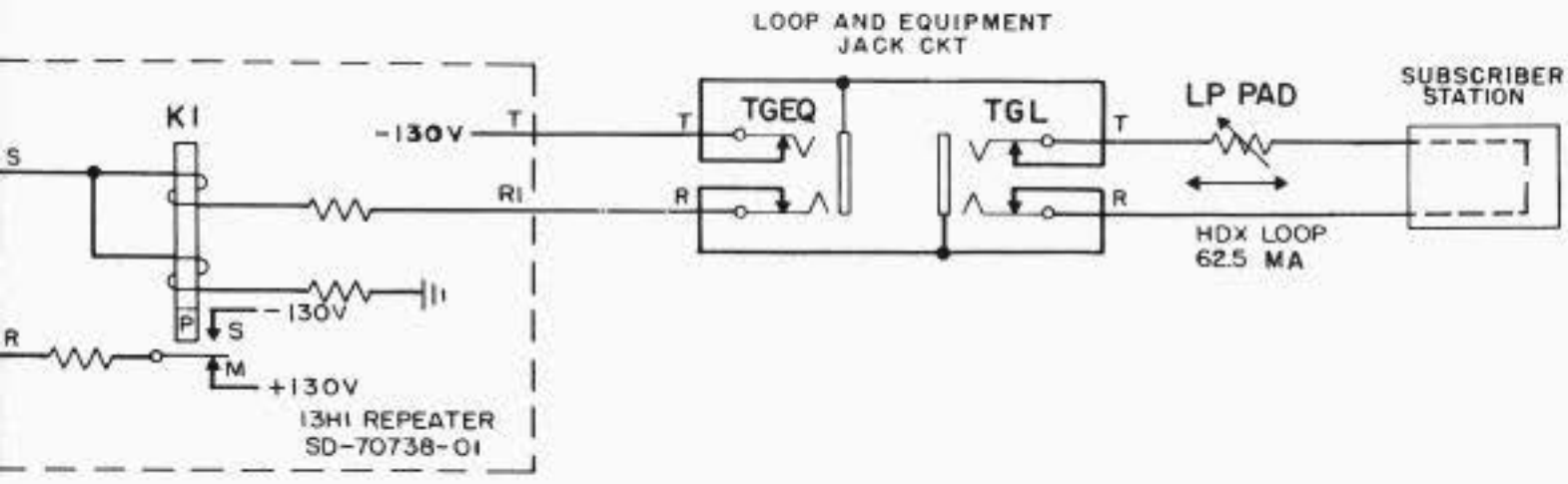
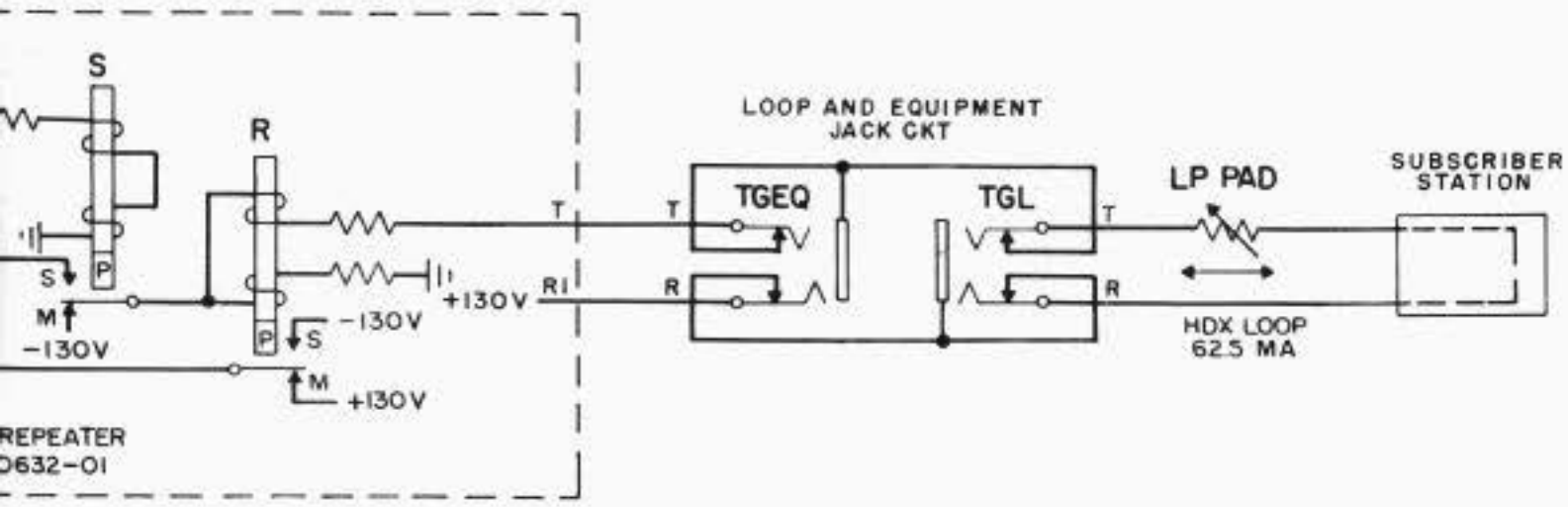


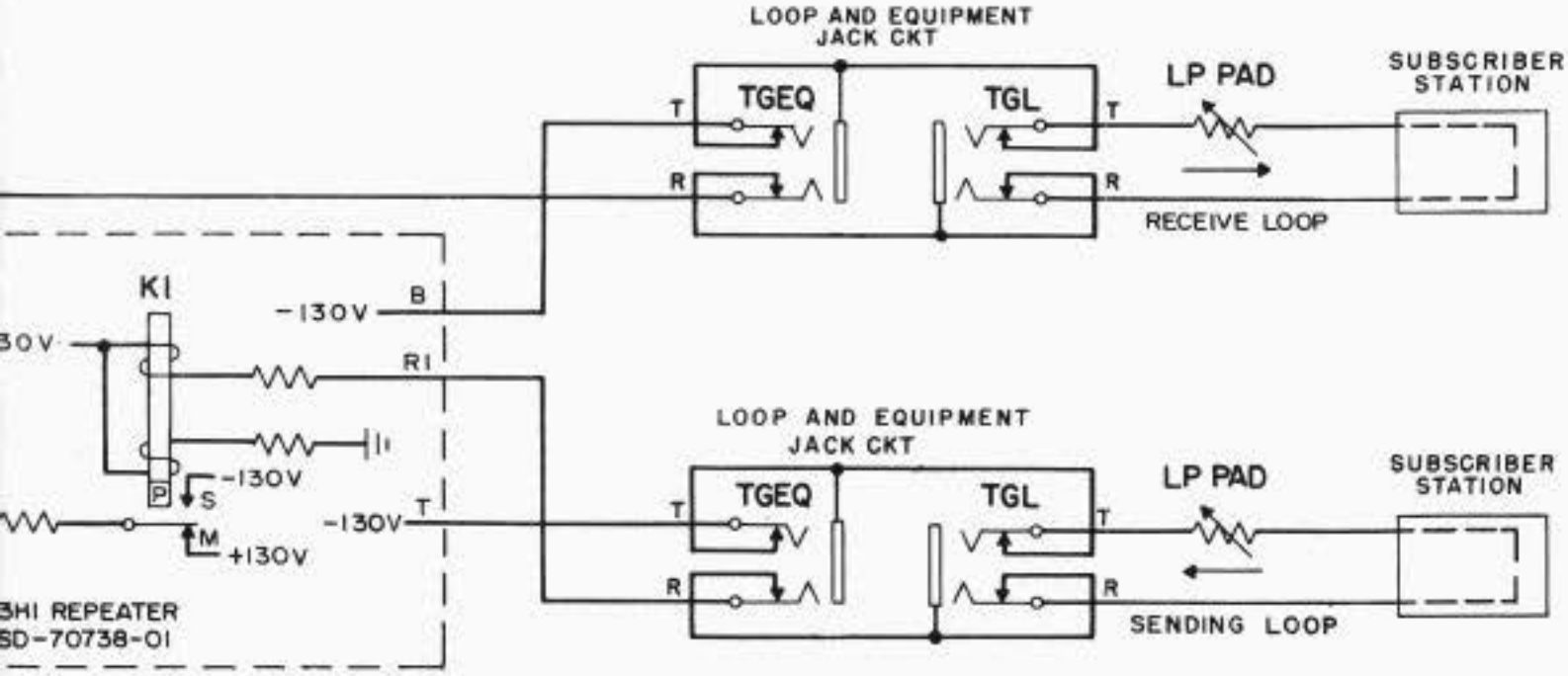

FIG. 3– INTERCONNECTING ARRANGEMENTS FOR RELAY TYPE LINE REPEATER AND FDX SUBSCRIBER LOOPS USING A 13HI LOOP REPEATER IN THE SEND LEG.



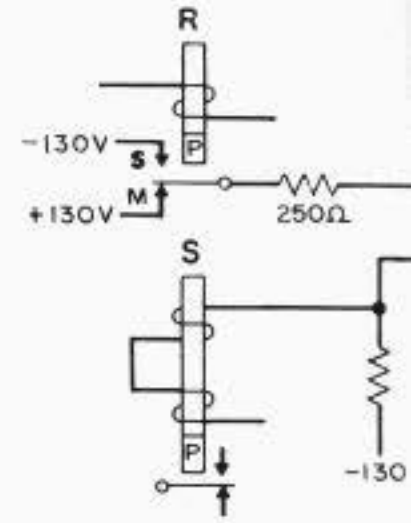

ANGEMENTS FOR RELAY TYPE LINE REPEATER
OOP USING 13HI LOOP REPEATER.

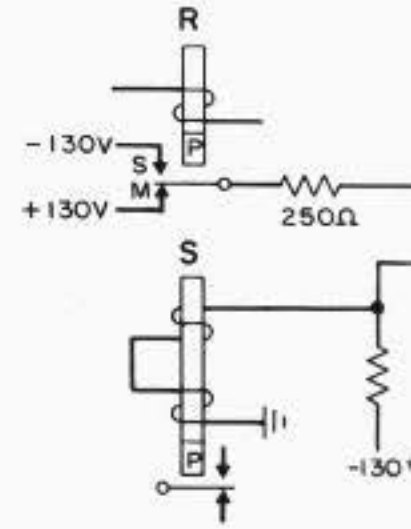



ANGEMENTS FOR RELAY TYPE LINE REPEATER
LOOP USING 90C1 LOOP REPEATER.

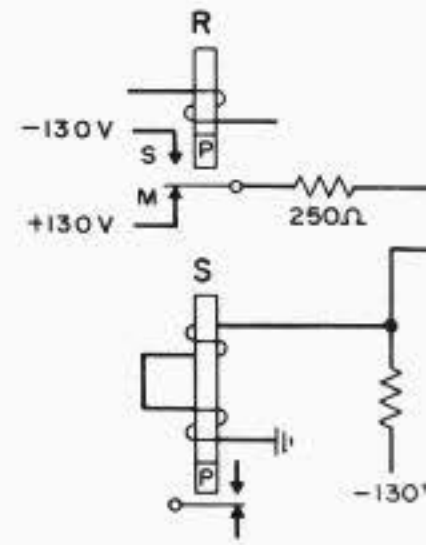



ANGEMENTS FOR RELAY TYPE LINE REPEATER AND
USING A 13HI LOOP REPEATER IN THE SEND LEG.




RELAY TYPE LINE
REPEATERS




RELAY TYPE LINE
REP

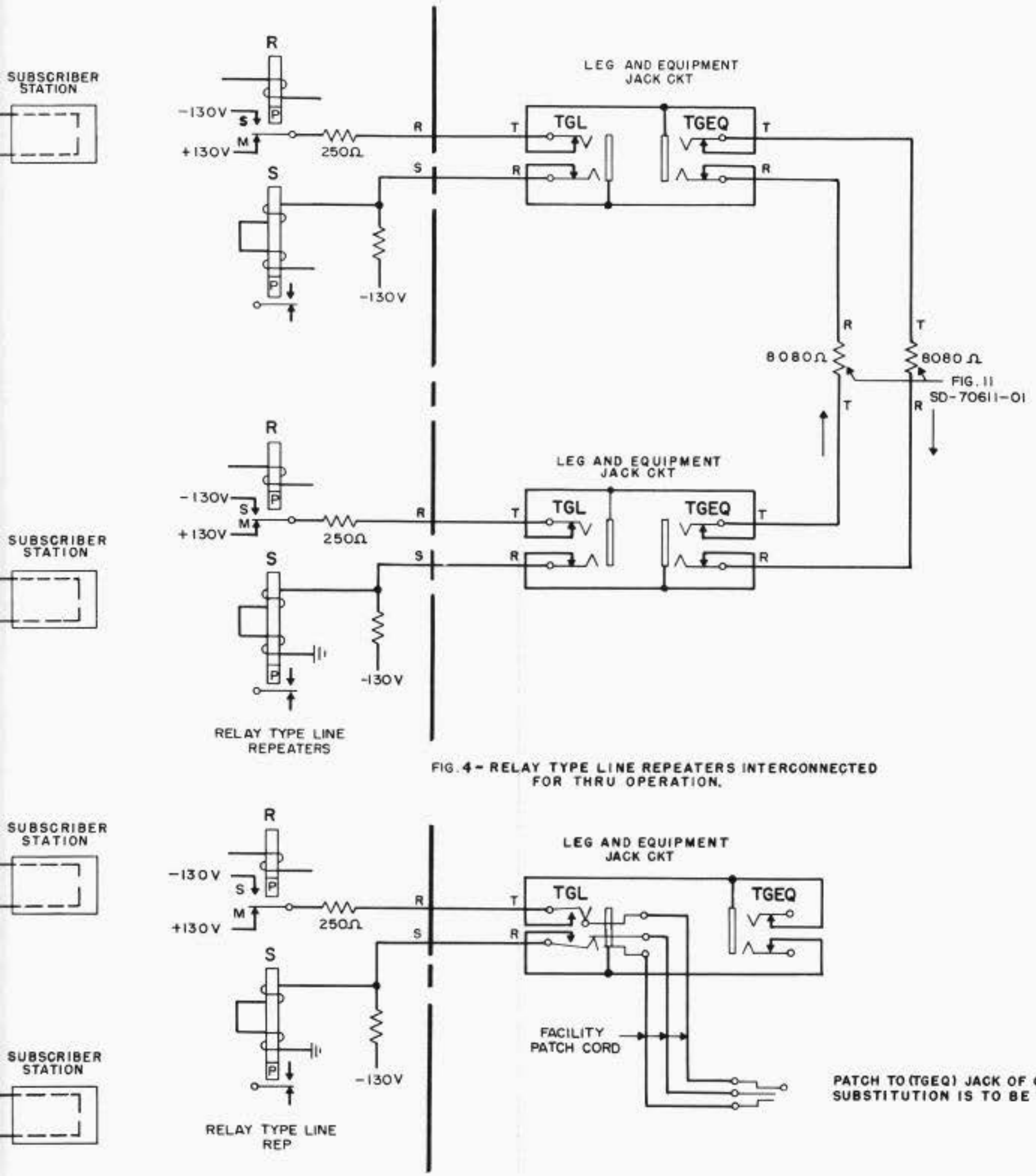



FIG. 4 - RELAY TYPE LINE REPEATERS INTERCONNECTED FOR THRU OPERATION.

FIG. 5 - SPARE RELAY TYPE LINE REPEATER TERMINATION IN FACILITY POSITION

Fig. 1, 2, 3, 4, and 5

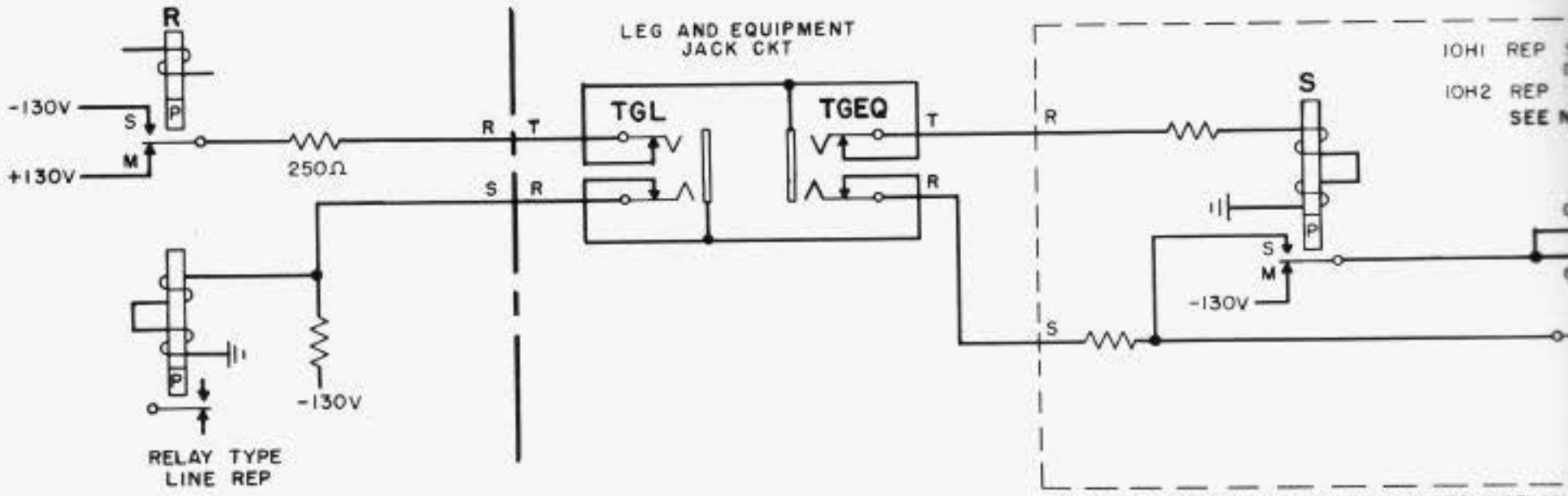



FIG. 6 - RELAY TYPE LINE REPEATER SERVIN

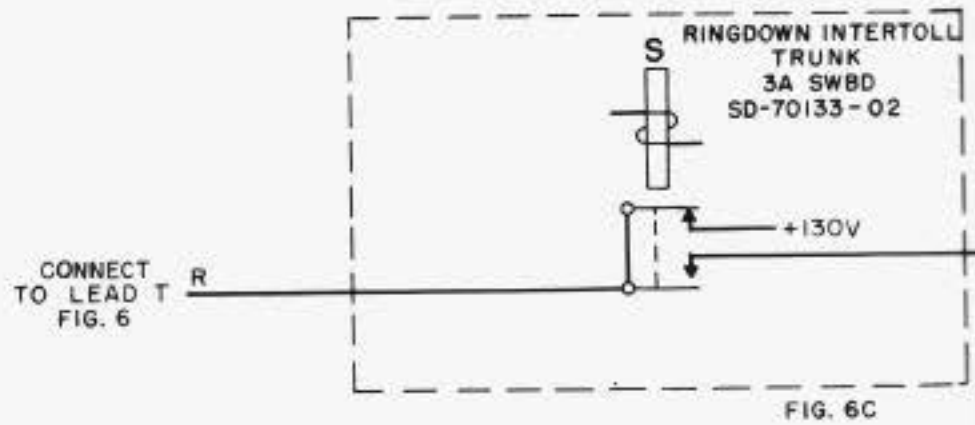



FIG. 6C

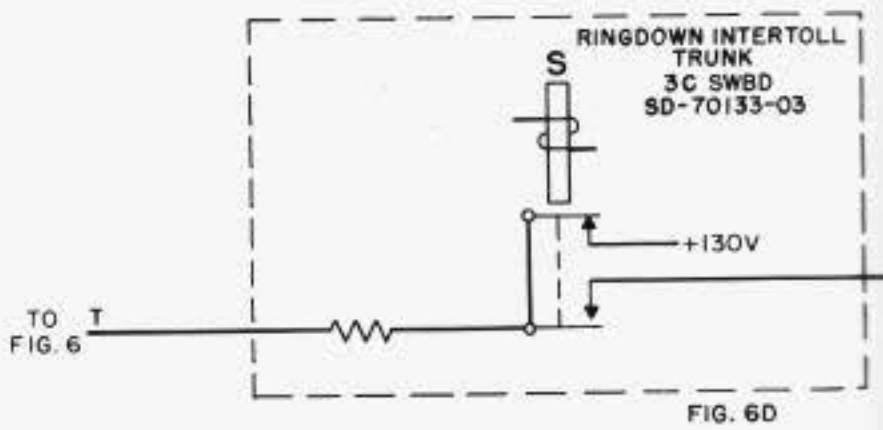



FIG. 6D

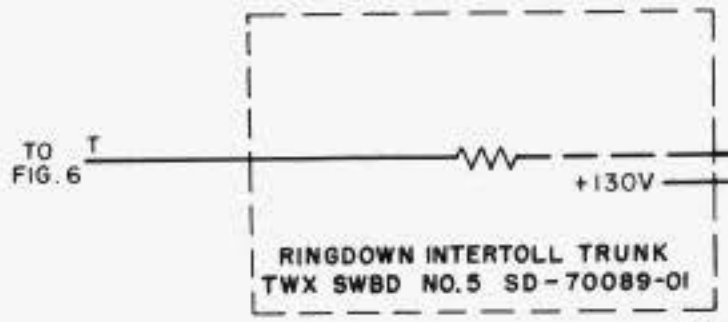



FIG. 6E

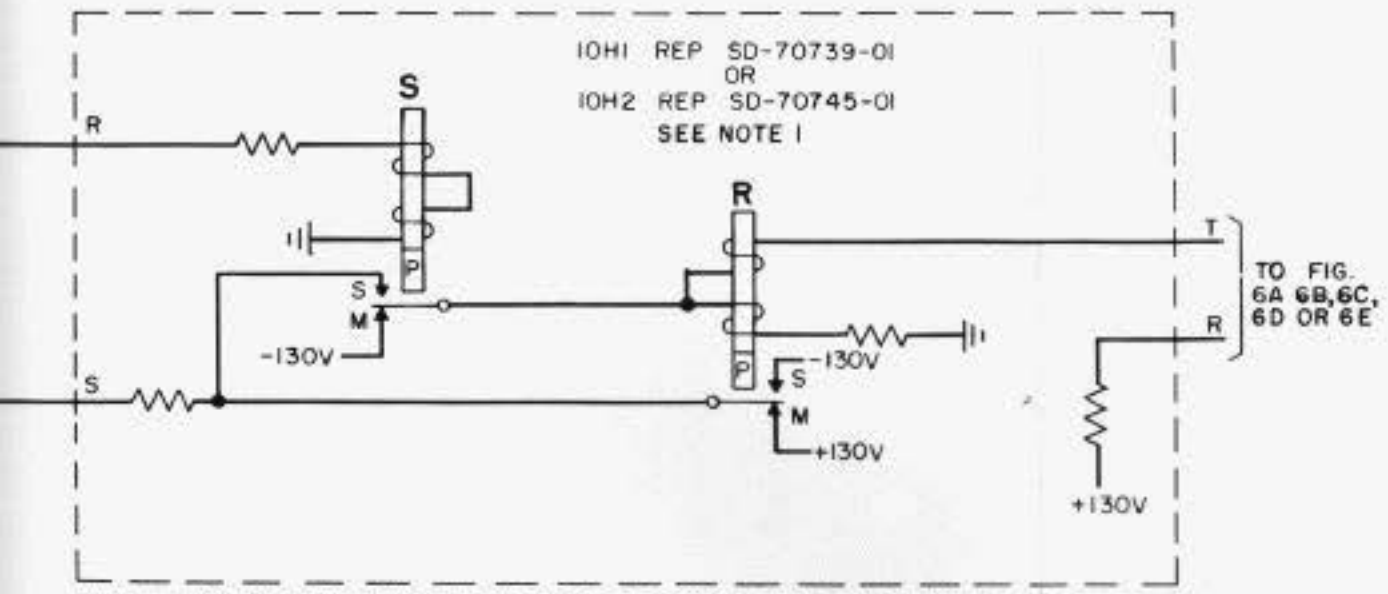
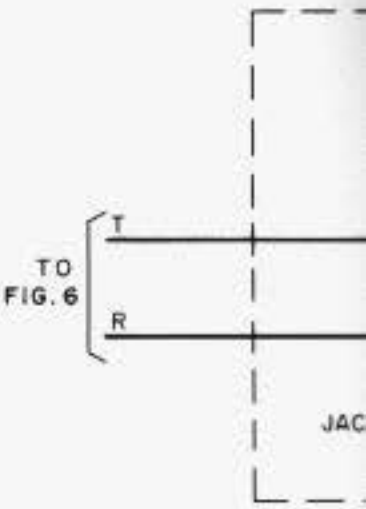
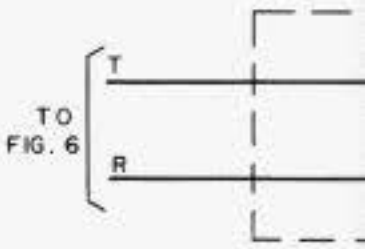



FIG. 6 - RELAY TYPE LINE REPEATER SERVING TWX RINGDOWN INTERTOLL TRUNK



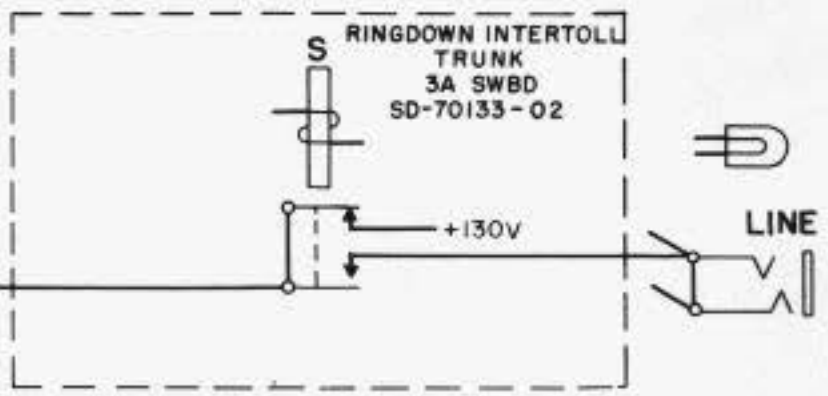




FIG. 6C

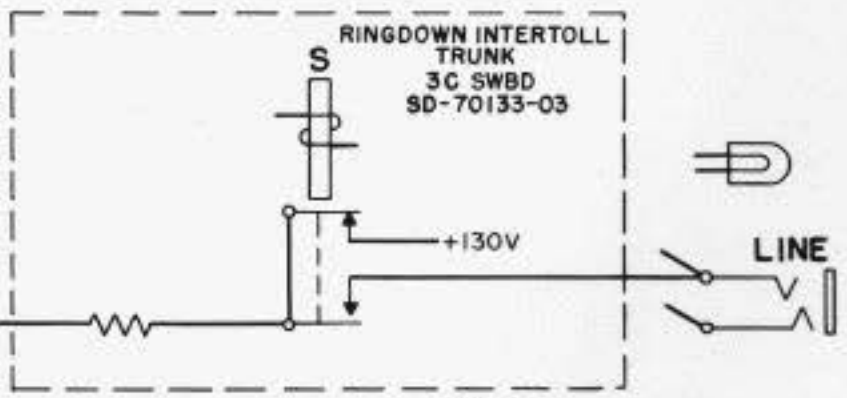



FIG. 6D

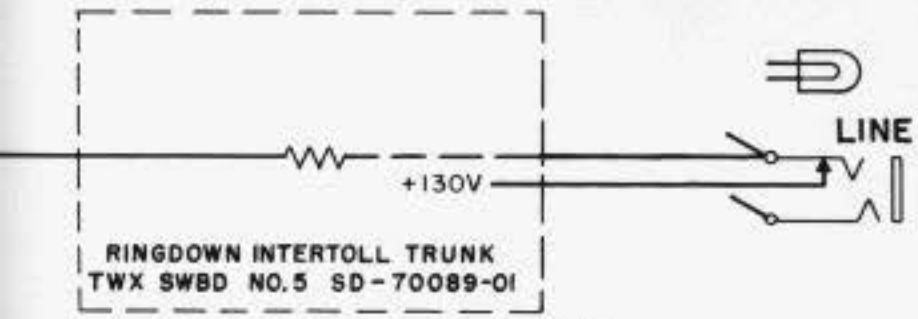
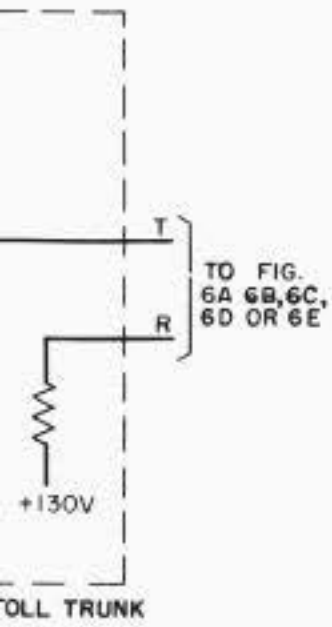
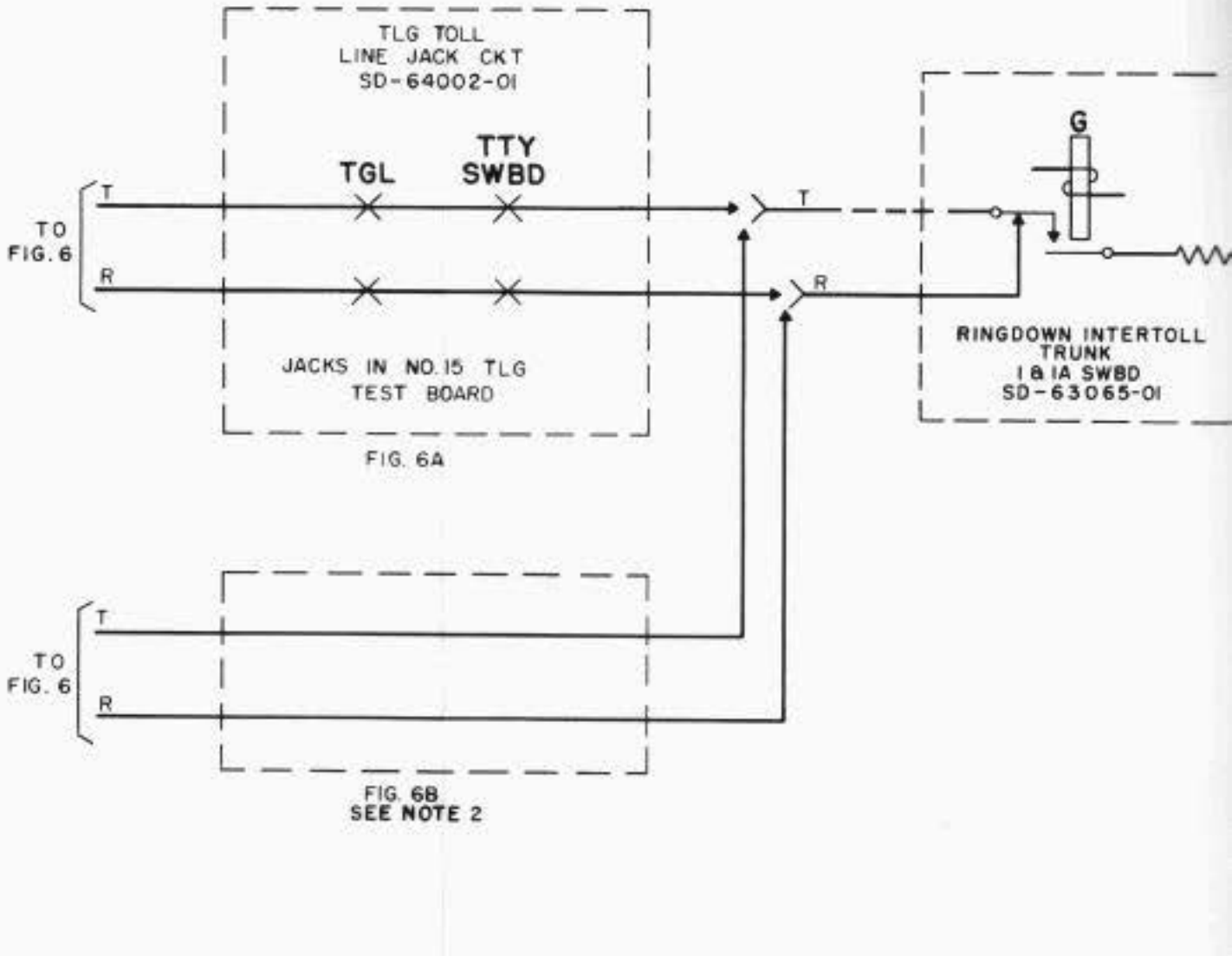



FIG. 6E

NOTES:

1. 10H2 REPEATER IS FIELD MO
2. FIGURE 6B IS PROVIDED WHE




NOTES:
1. 10H2 REPEATER IS FIELD MODIFIED 10GI REPEATER.
2. FIGURE 6B IS PROVIDED WHEN NO. 15 TEST BOARD IS NOT USED.

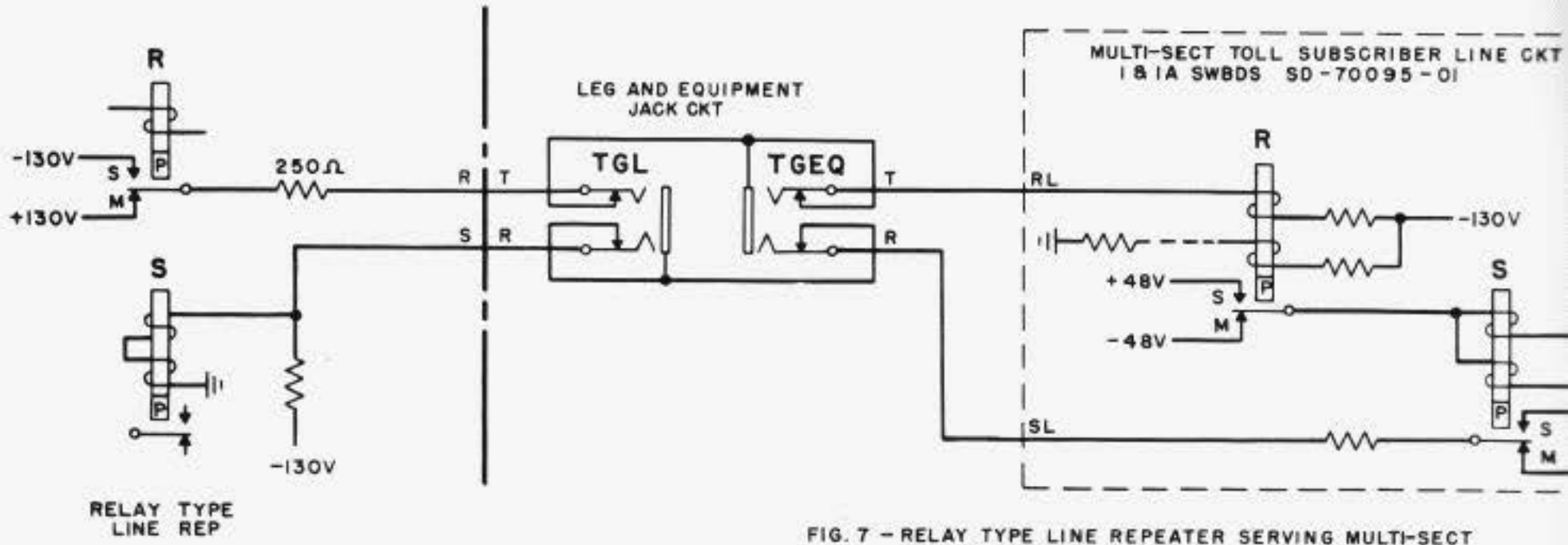



FIG. 7 – RELAY TYPE LINE REPEATER SERVING MULTI-SECT TOLL SUBSCRIBER LINE CKT AT SWBD OFFICE

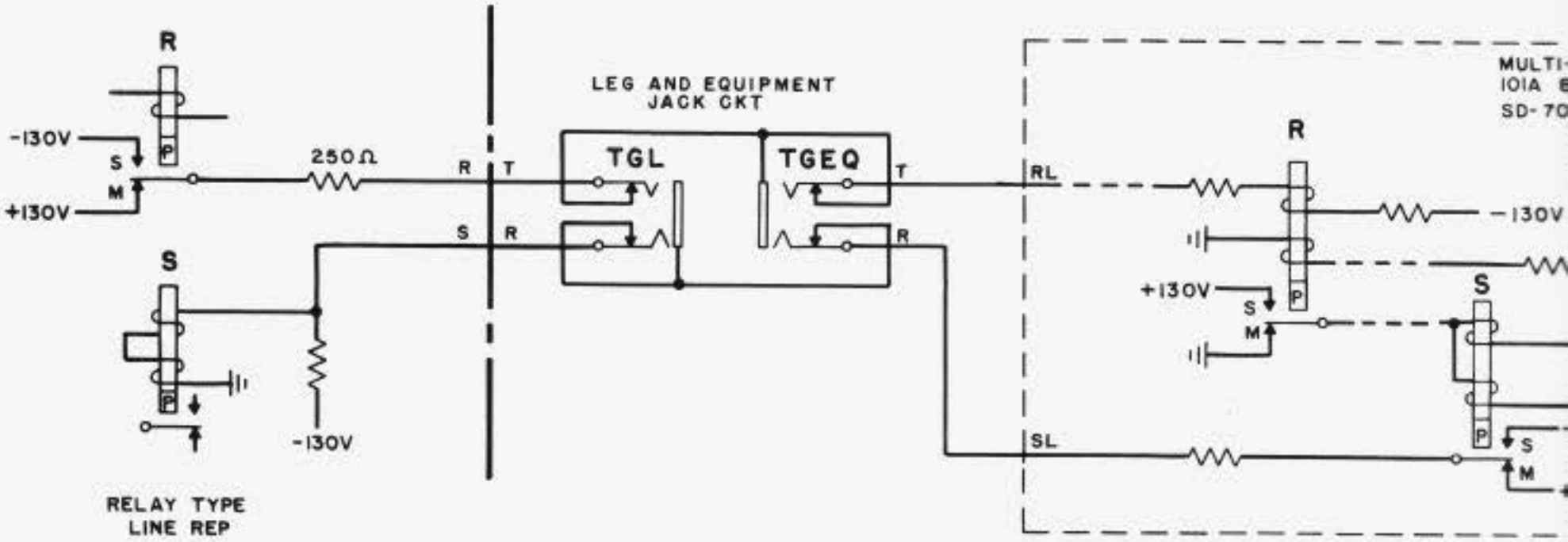
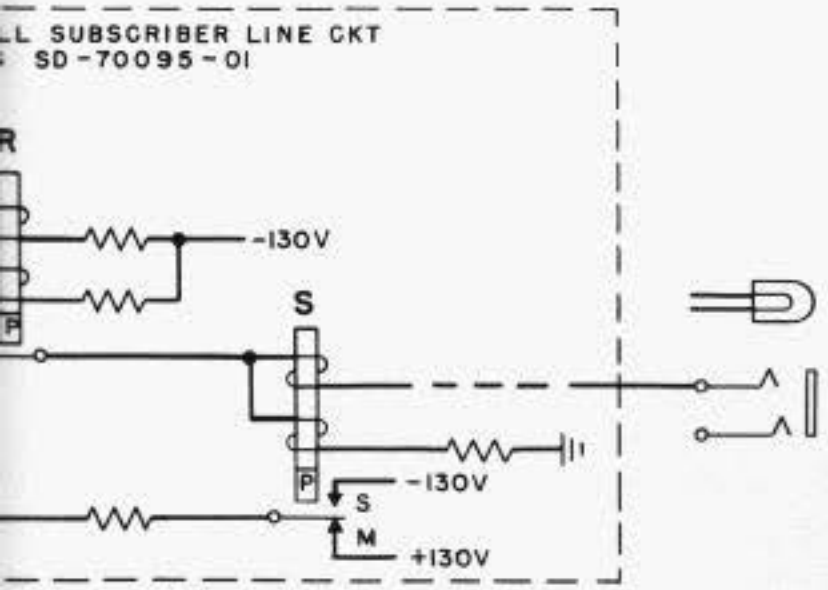



FIG. 9 – RELAY TYPE LINE REPEATER SERVING MULTI-SECT TOLL SUBSCRIBER LINE CKT AT CONC UNIT OFFICE

RELAY TYPE LINE REPEATER SERVING TWX AUTO. SIG TRUNKS




ERVING MULTI-SECT
T SWBD OFFICE

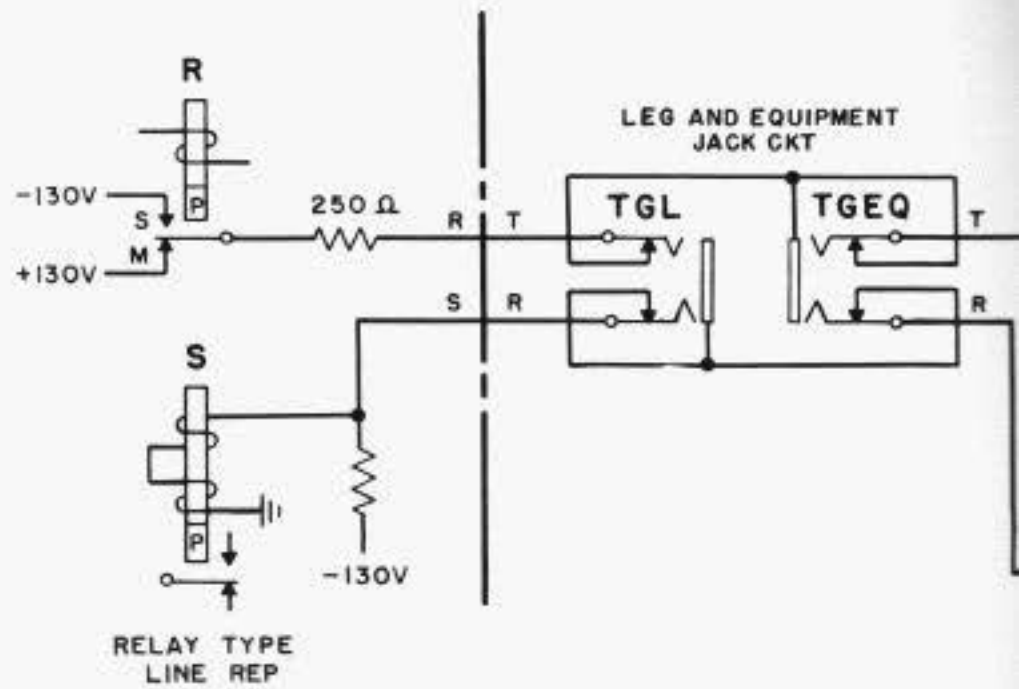
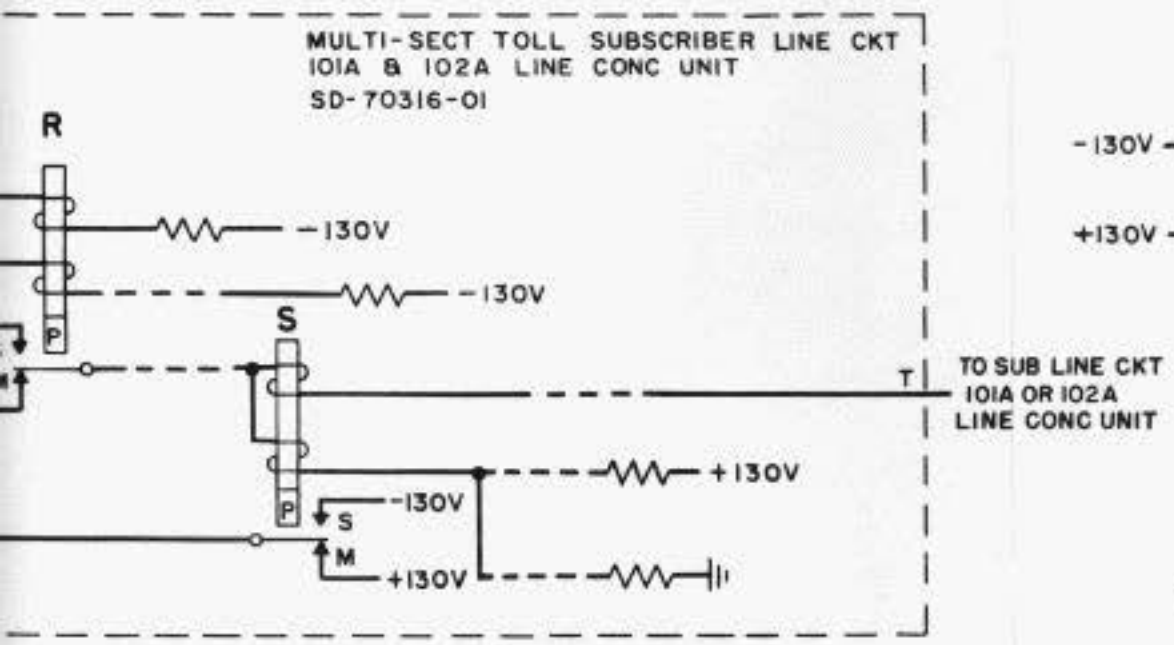



FIG. 8 - RELAY TYPE L
TOLL SUBSCRI




RVING MULTI-SECT
T CONC UNIT OFFICE

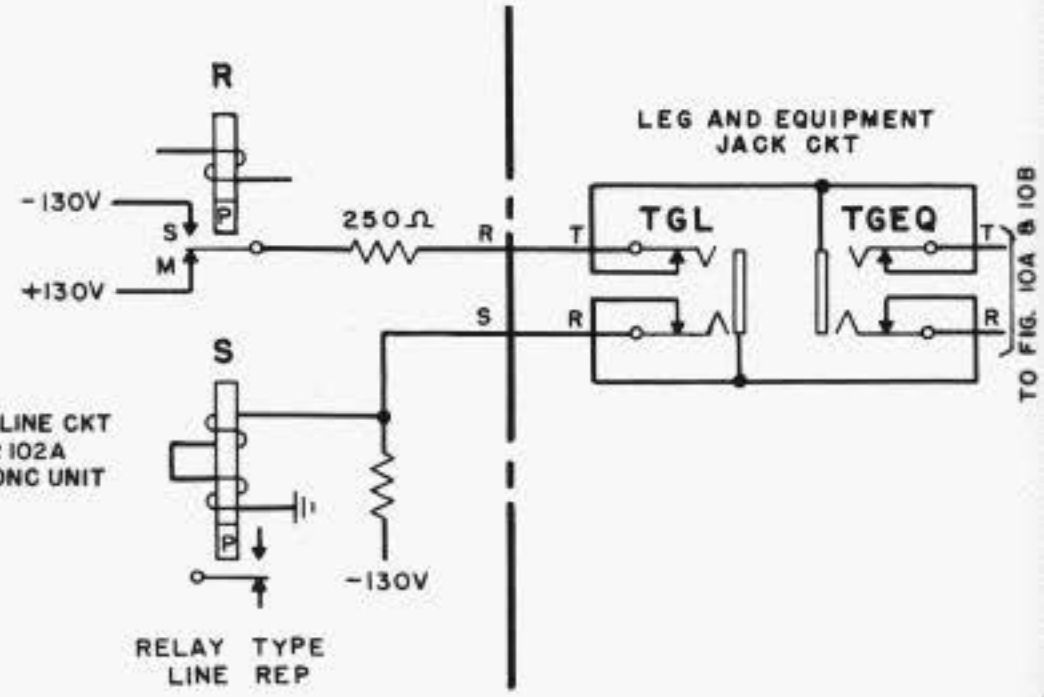



FIG. 10 - RELAY TYPE LINE REPEATER SERVING
CONC UNIT TRUNK (LINE CONC UNITS 101A & 102A)

TO
FIG.
10

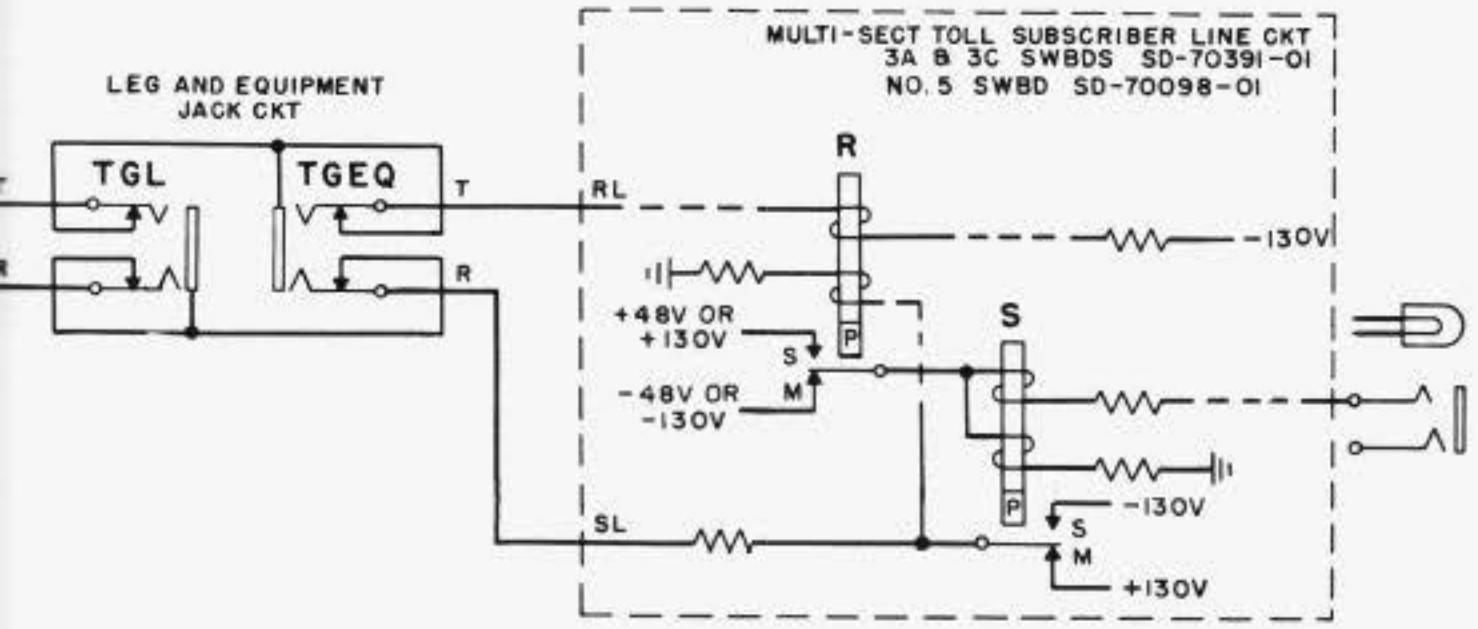



FIG. 8 - RELAY TYPE LINE REPEATER SERVING MULTI-SECT TOLL SUBSCRIBER LINE CKT AT SWBD OFFICE

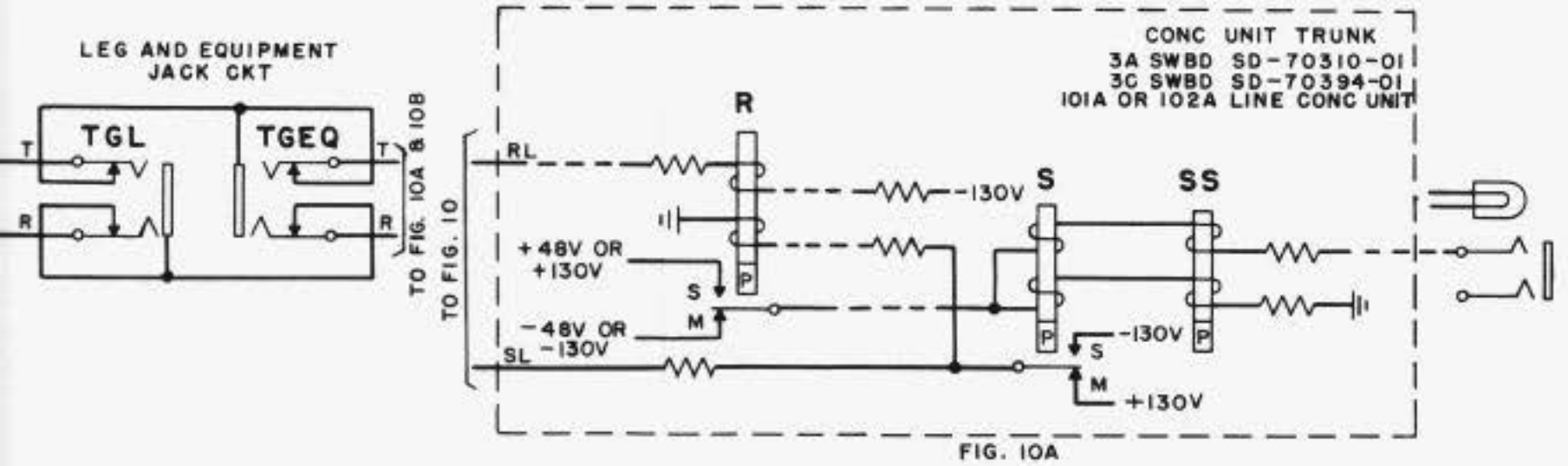



FIG. 10A

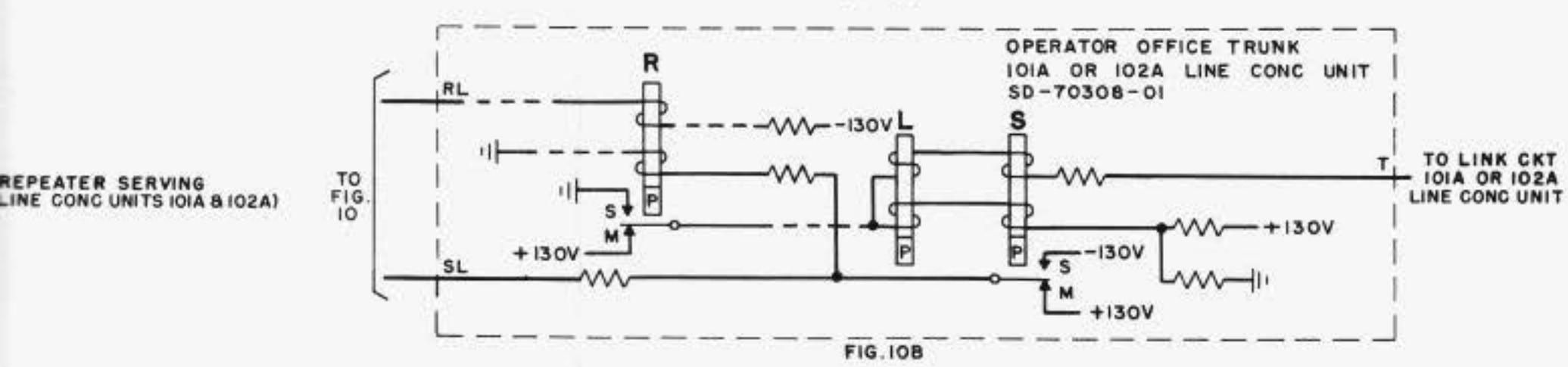



FIG. 10B

Fig. 7, 8, 9, 10, 10A, and 10B

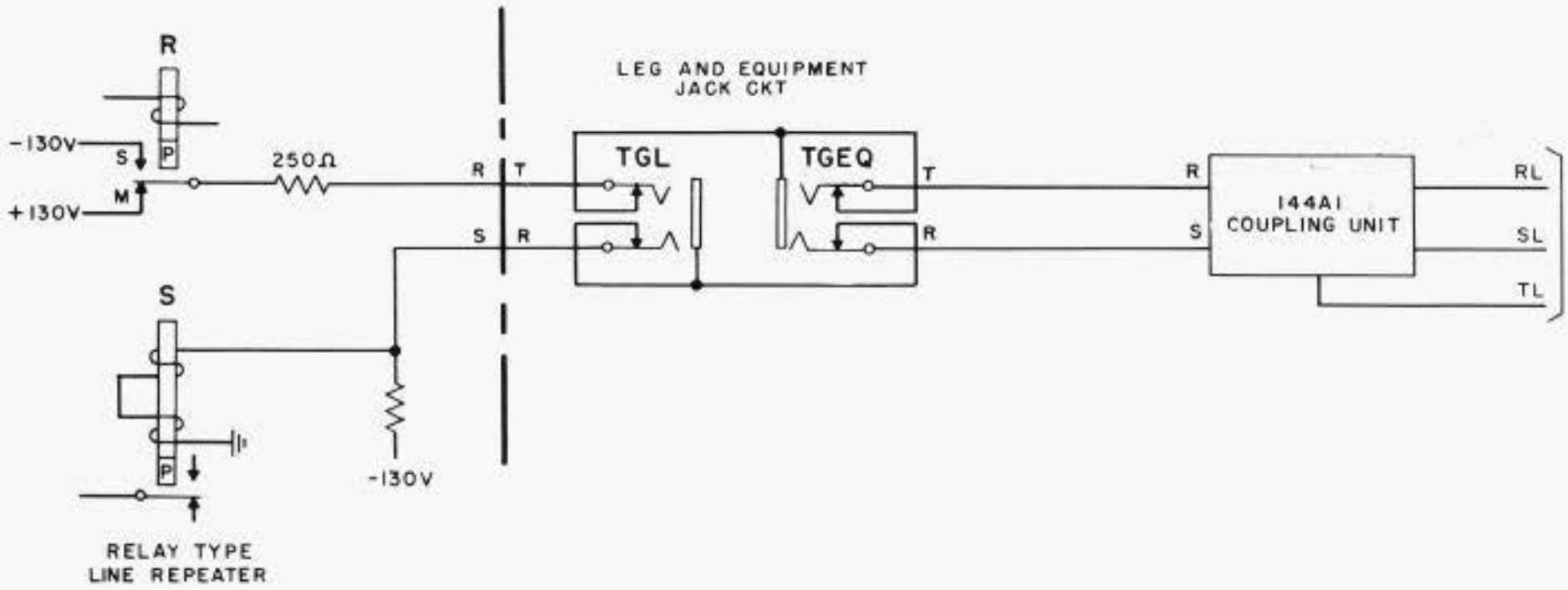



FIG. 11 – RELAY TYPE LINE REPEATER SERVING A HUB CKT

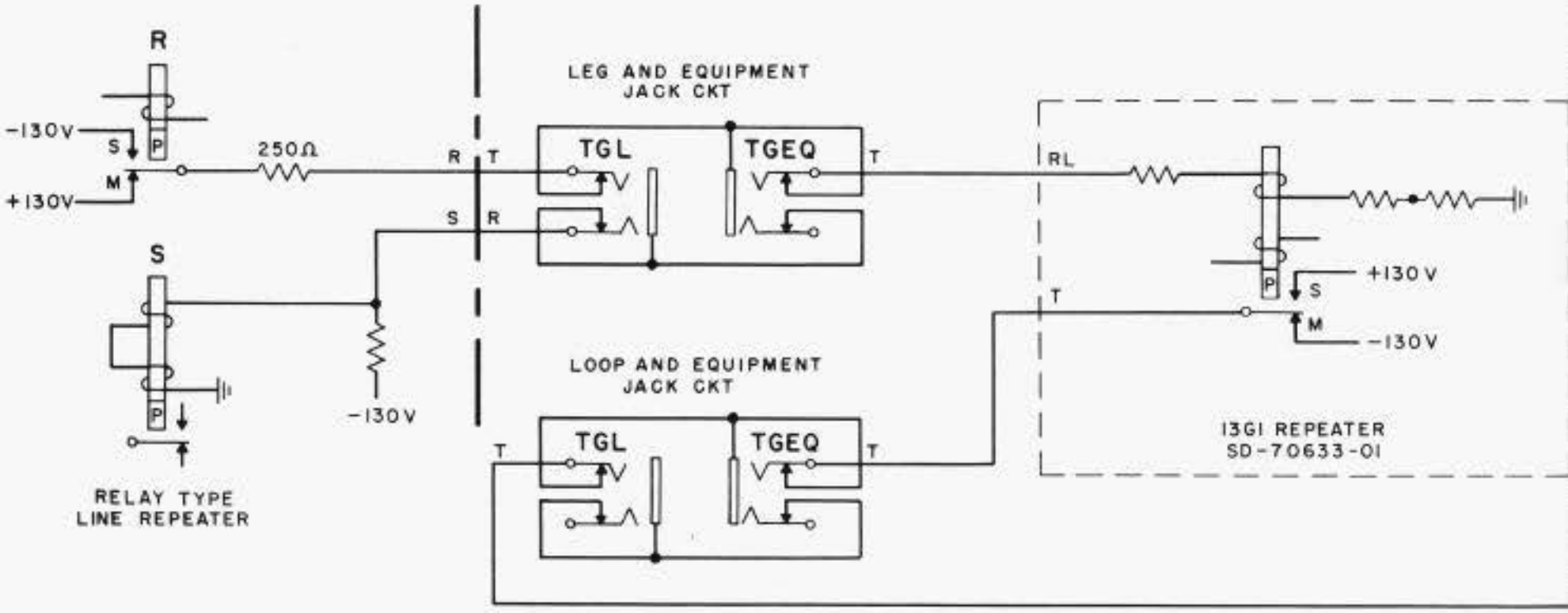
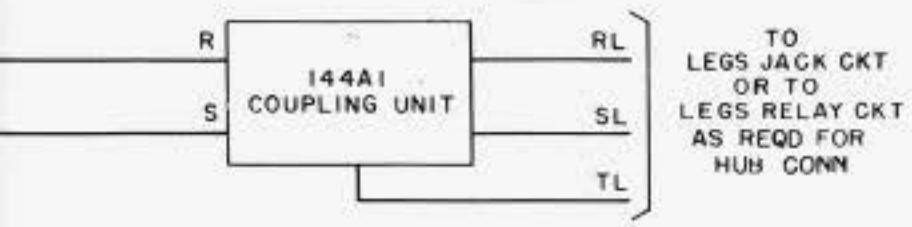
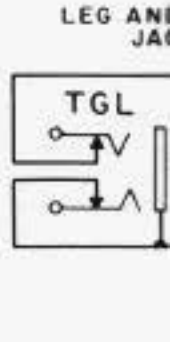


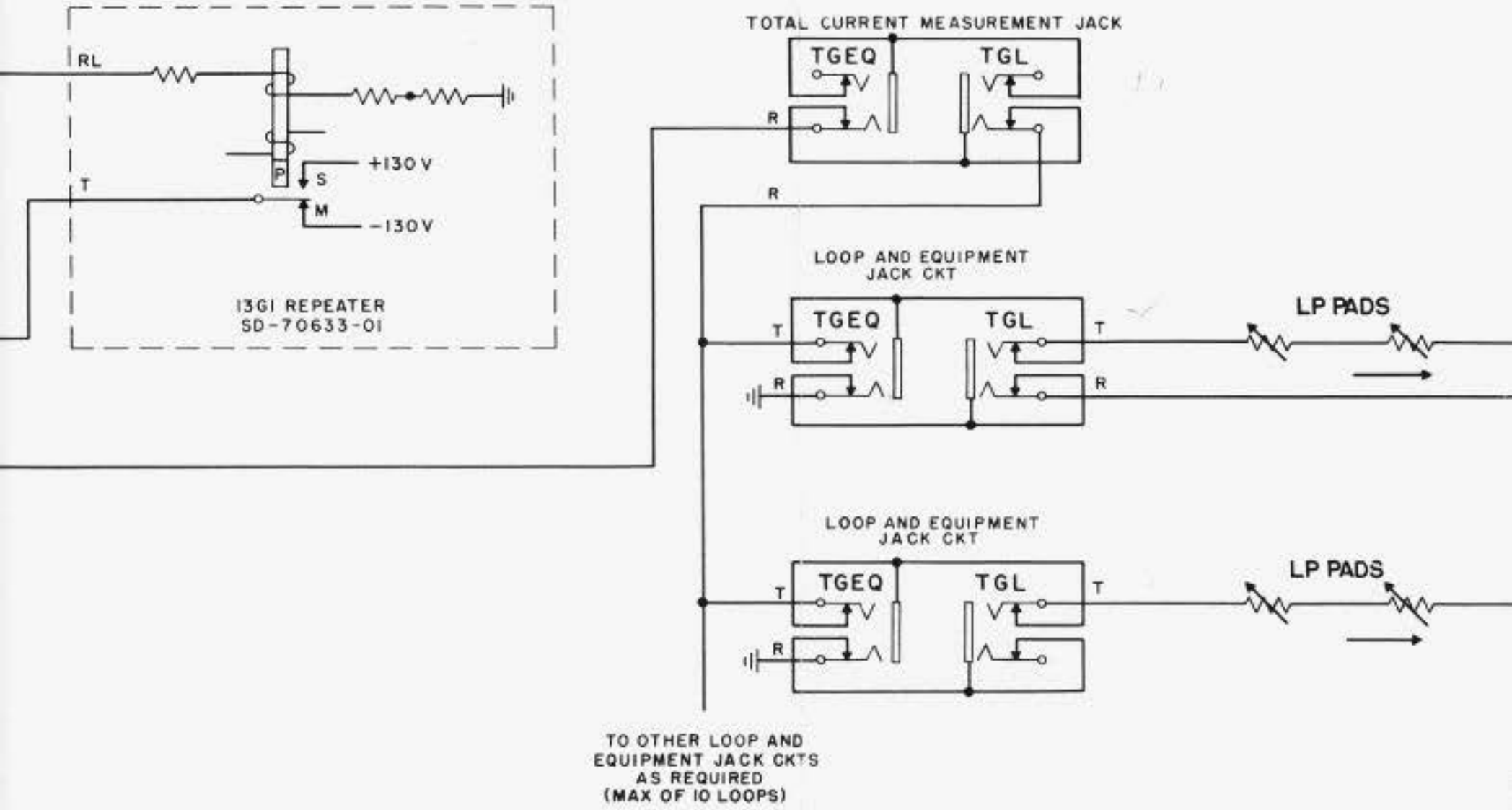

FIG. 12 – RELAY TYPE LINE REPEATER AND 13GI LOOP REPEATER
SERVING PARALLEL POLAR LOOP CKTS




ATER SERVING A HUB CKT




LINE REPEATER AND 131 LOOP REPEATER
RALLEL POLAR LOOP CKTS


FIG. 12A - TERMINATING CKT FOR SPARE 13GI LOOP REPEATER FOR USE IN FIG. 12

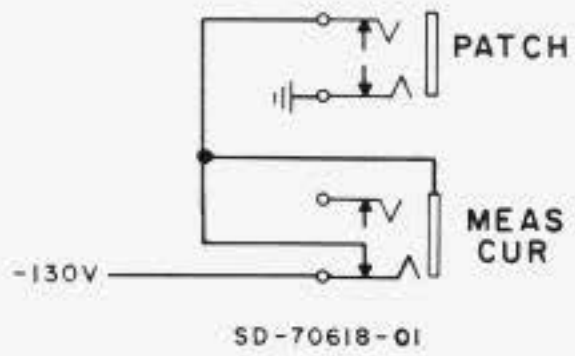



FIG. 12B - CURRENT MEASURING CKT FOR INDIVIDUAL PARALLEL POLAR LOOP

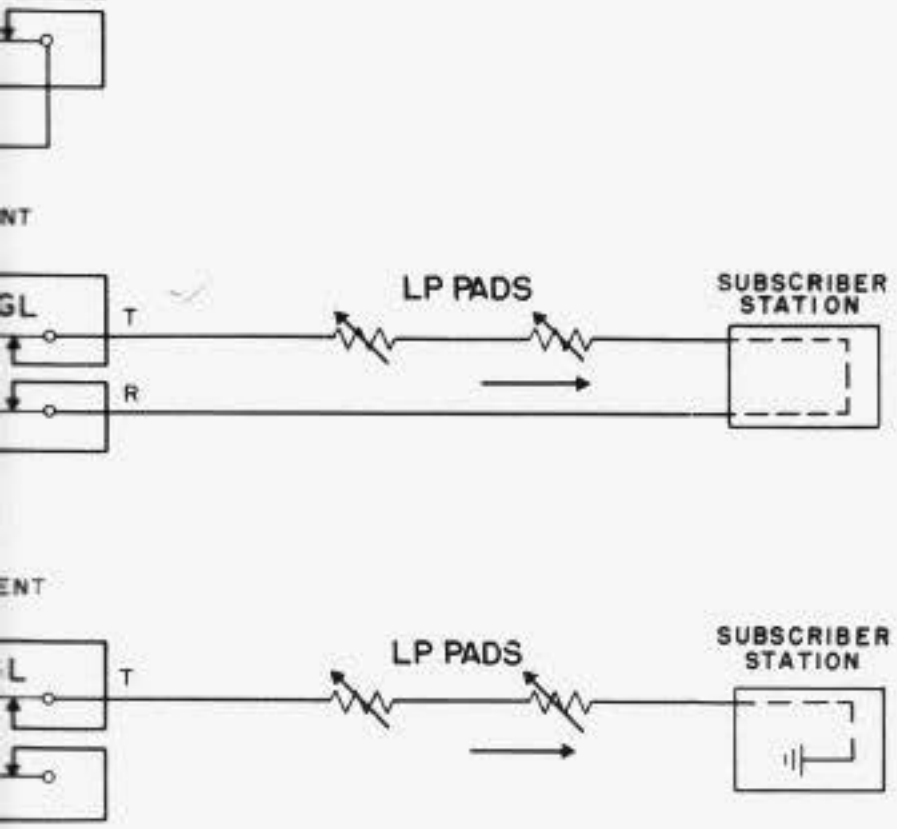



Fig. 11, 12, 12A, and 12B

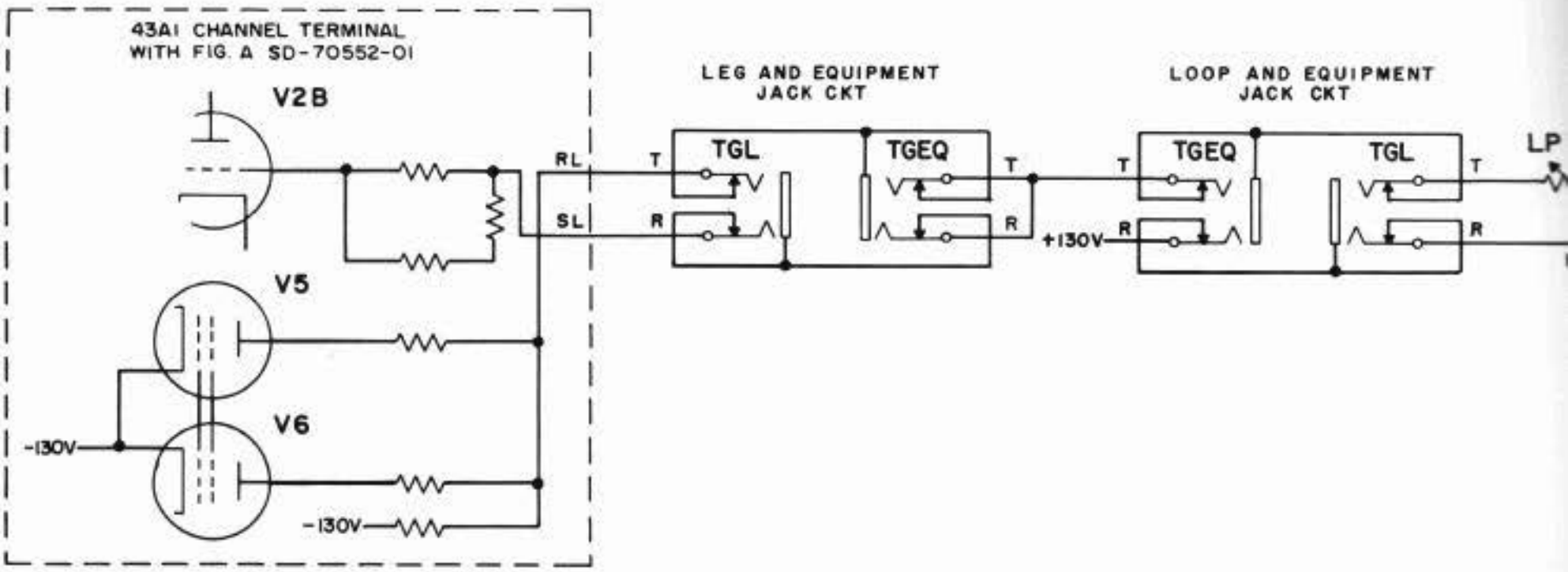



FIG. 13 – 43AI CHANNEL TERMINAL SERVING HDX P
LINE SUBSCRIBER LOOP

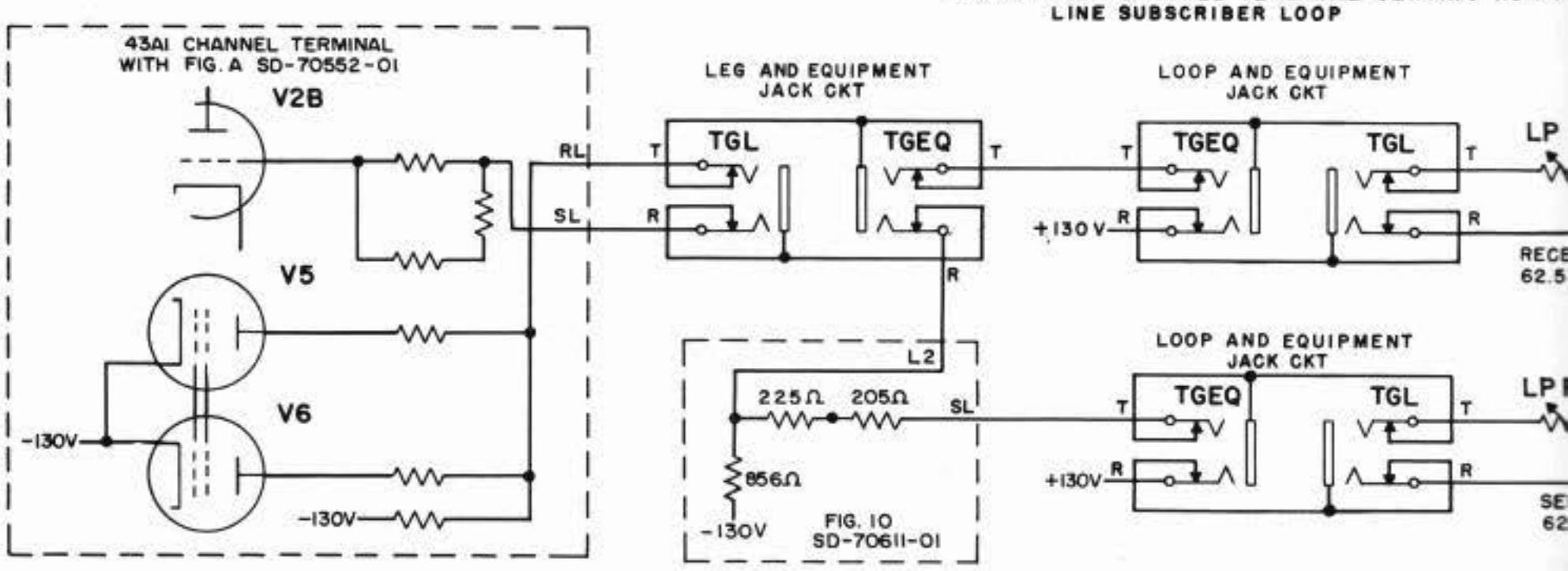



FIG. 14 – 43AI CHANNEL TERMINAL SERVING FDX
PRIVATE LINE SUBSCRIBER LOOPS

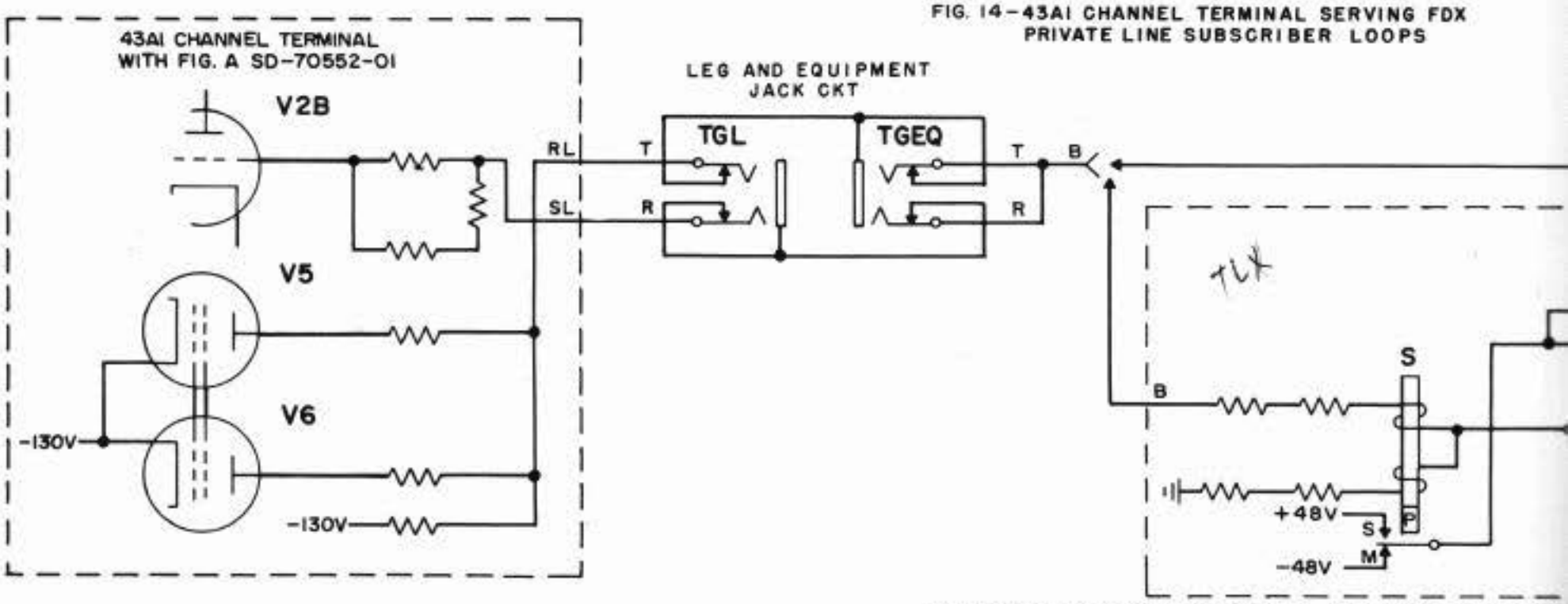



FIG. 15 – 43AI CHANNEL TERMINAL SERVING TWX RING

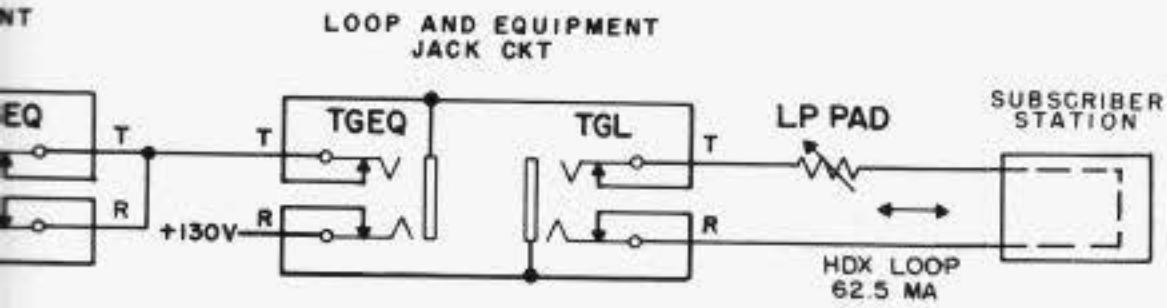



FIG. 13 – 43AI CHANNEL TERMINAL SERVING HDX PRIVATE LINE SUBSCRIBER LOOP

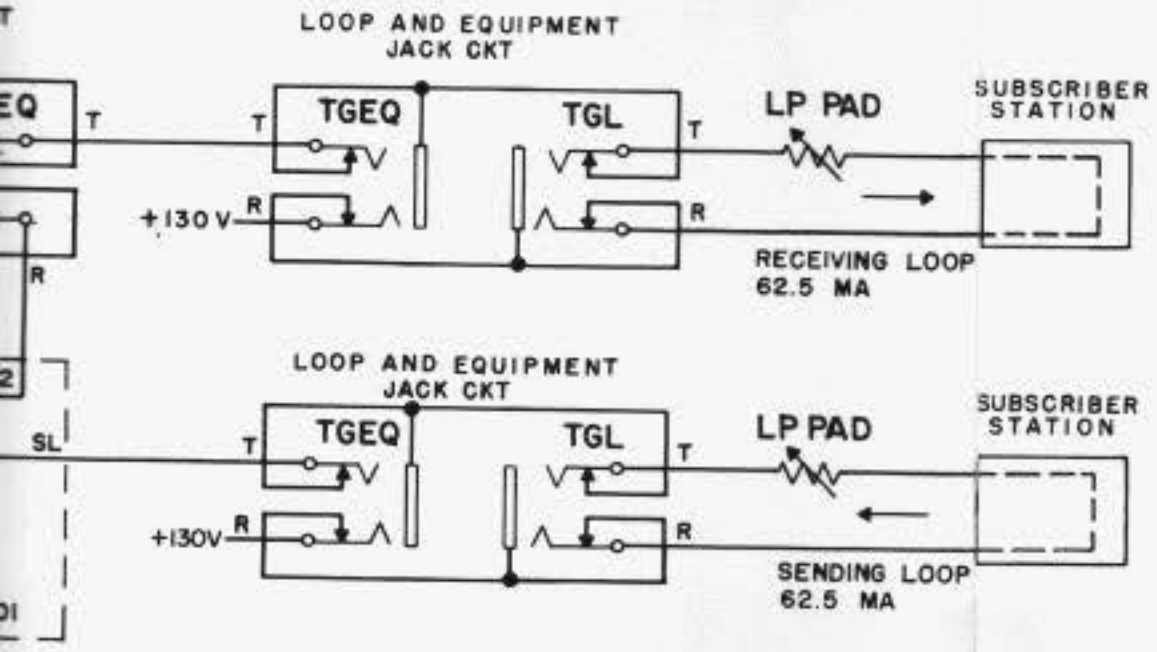



FIG. 14 – 43AI CHANNEL TERMINAL SERVING FDX PRIVATE LINE SUBSCRIBER LOOPS

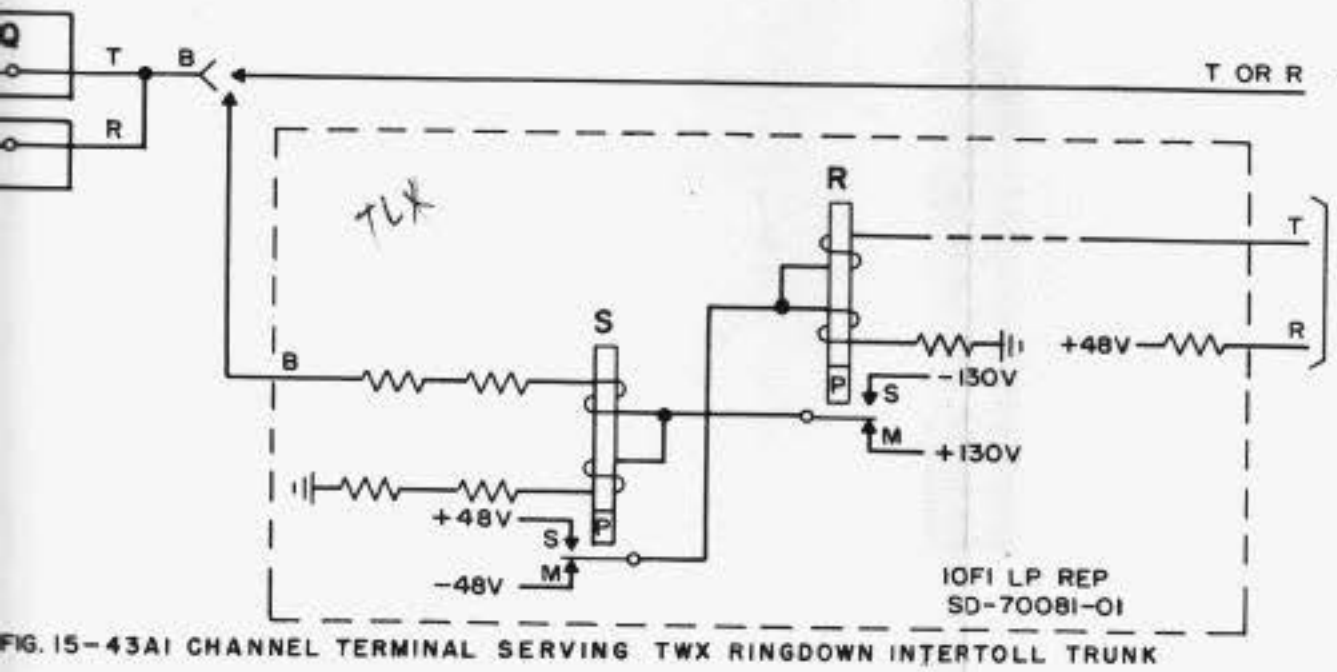
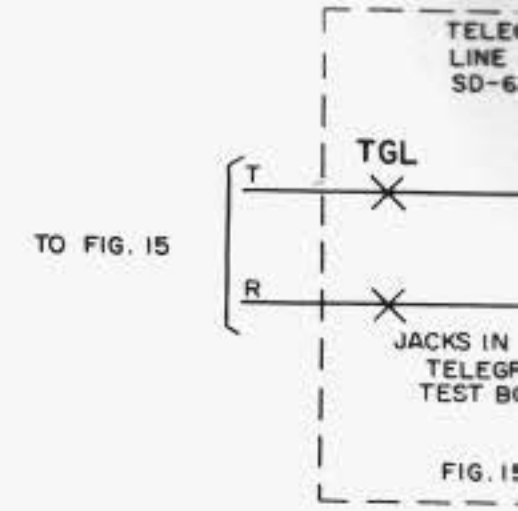
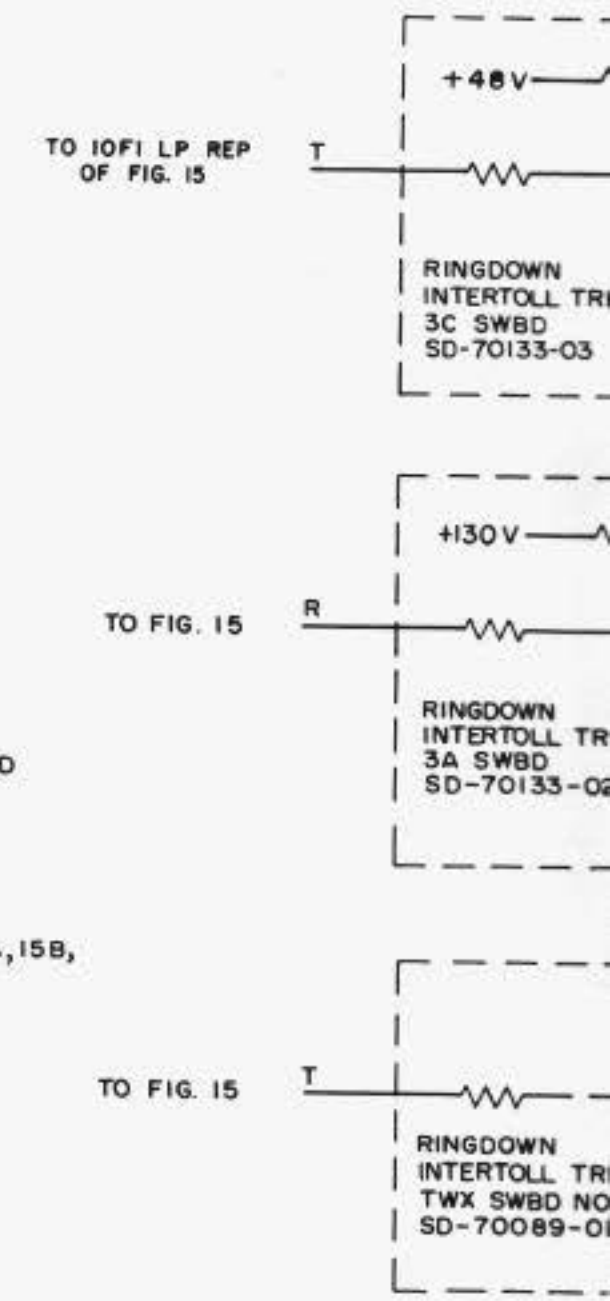


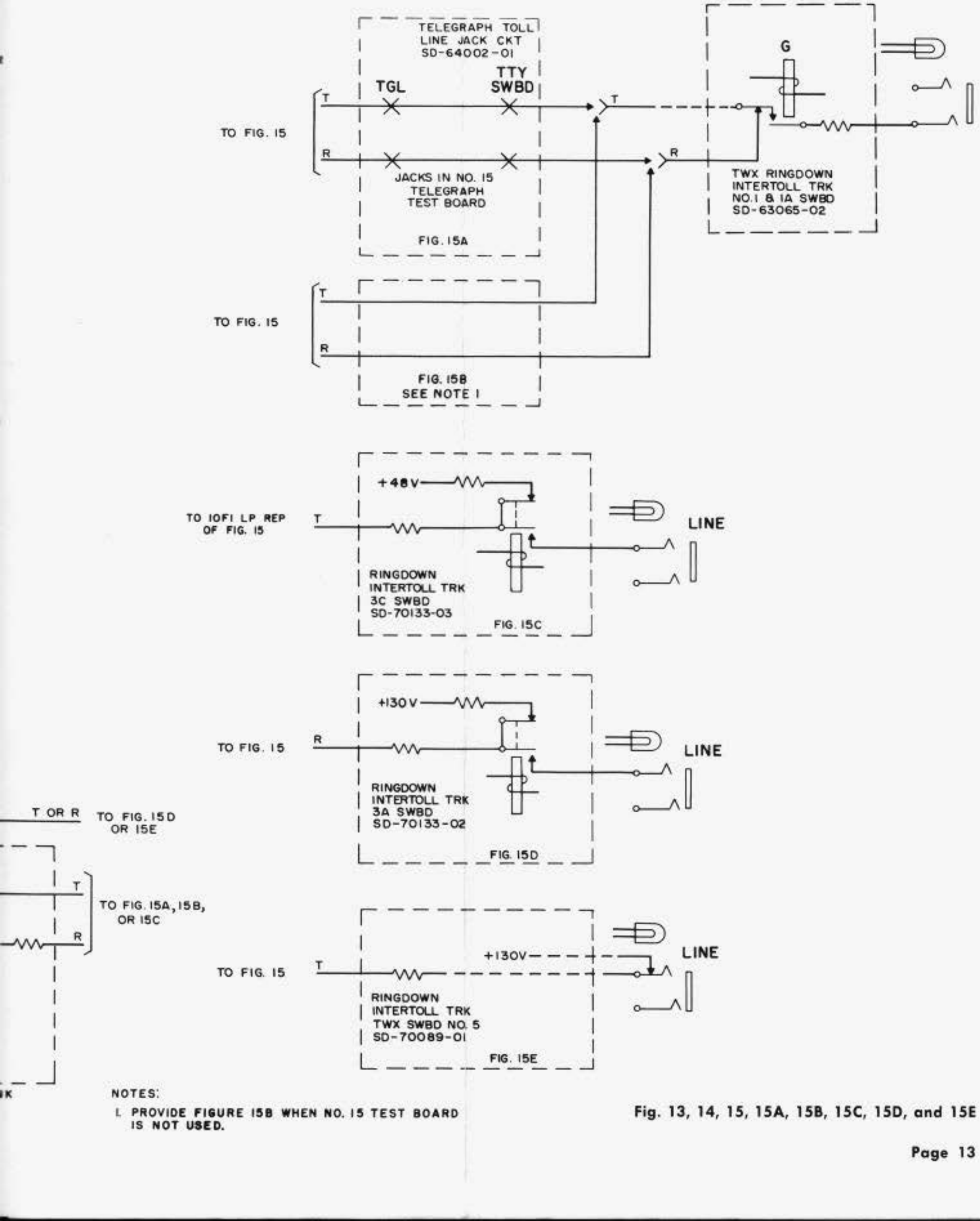

FIG. 15 – 43AI CHANNEL TERMINAL SERVING TWX RINGDOWN INTERTOLL TRUNK




NOTES:

1. PROVIDE FIGURE 15B WHEN NO. 15 TEST BOARD IS NOT USED.




NOTES:

1. PROVIDE FIGURE 15B WHEN NO. 15 TEST BOARD IS NOT USED.

Fig. 13, 14, 15, 15A, 15B, 15C, 15D, and 15E

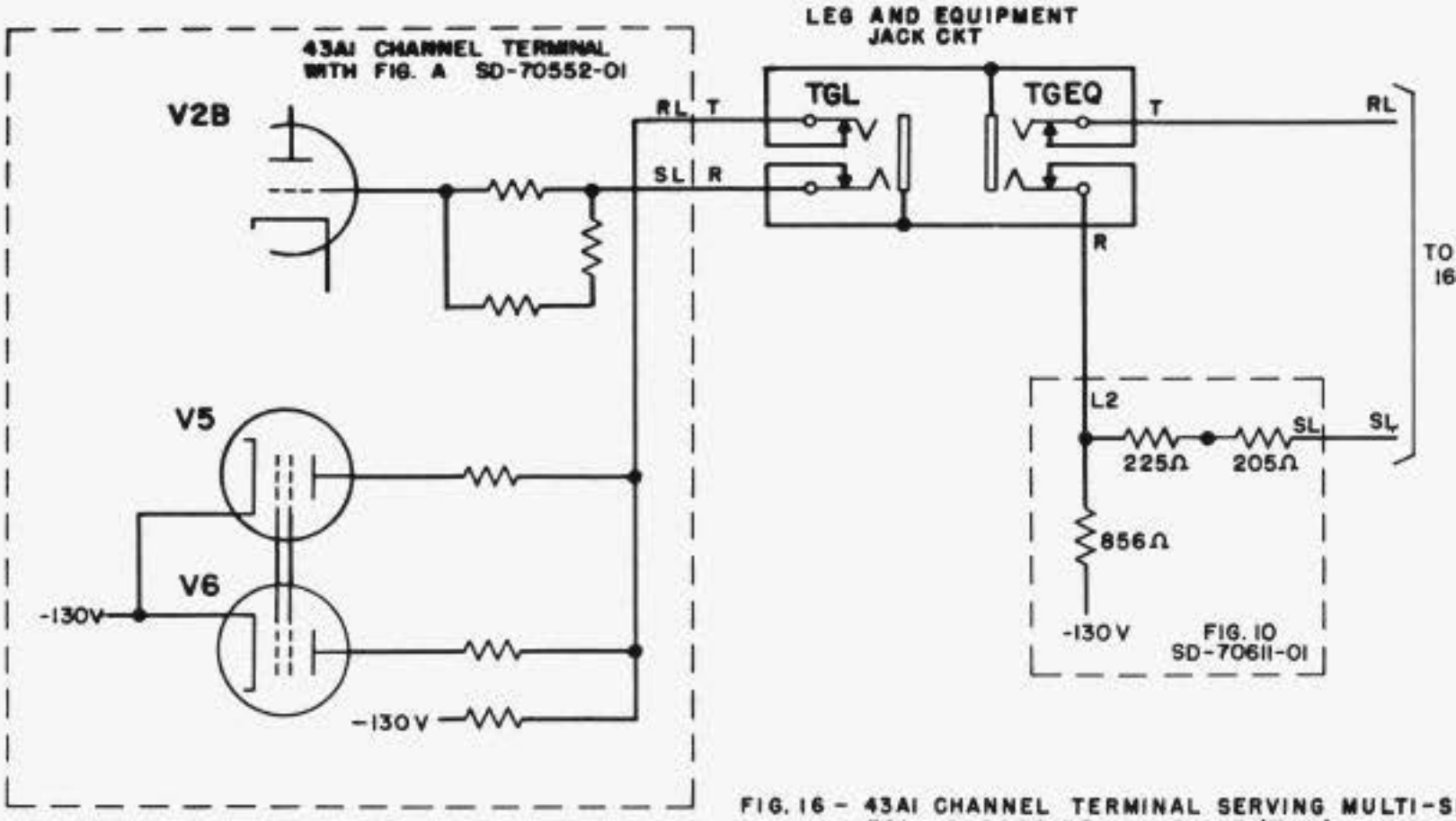



FIG. 16 - 43AI CHANNEL TERMINAL SERVING MULTI-SE
TOLL SUBSCRIBER LINE CKT (TWX)

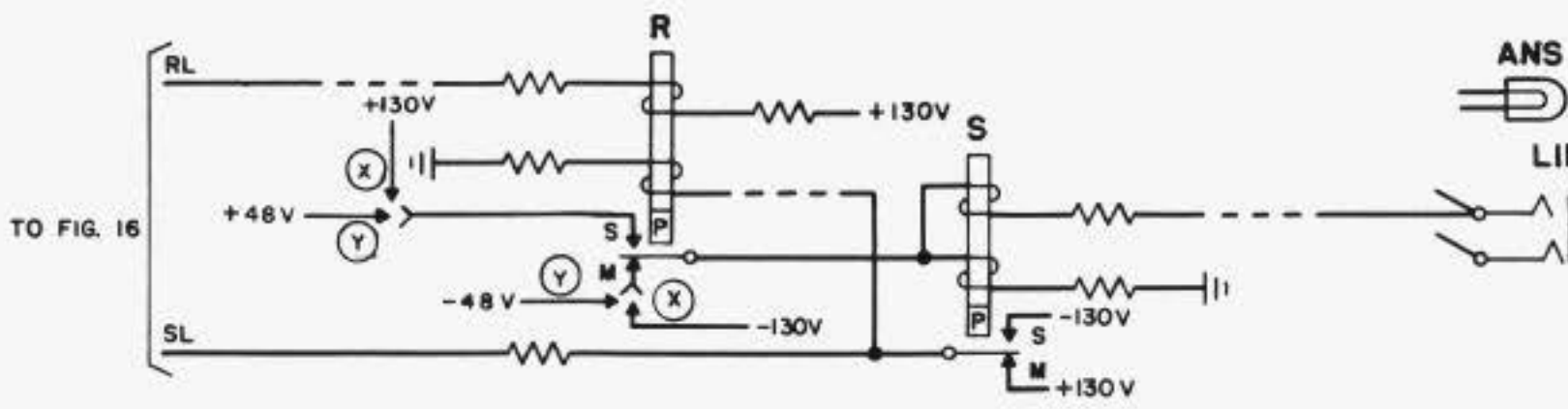



FIG. 16B - MULTI-SECTION TOLL SUBSCRIBER LINE CKT
SWBDS NUMBERS 3A (X OPTION) & 3C (Y OPTION)
SD-70391-01

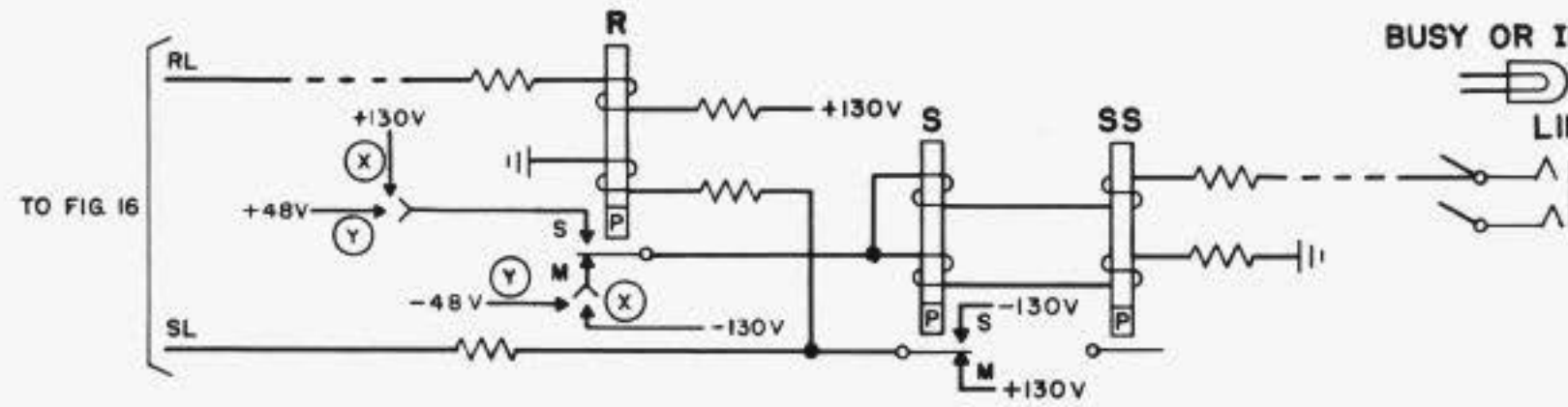



FIG. 16D - CONC UNIT TRUNK AT 3A SWBD (X OPTION)
SD-70310-01 3C SWBD (Y OPTION)
SD-70394-01

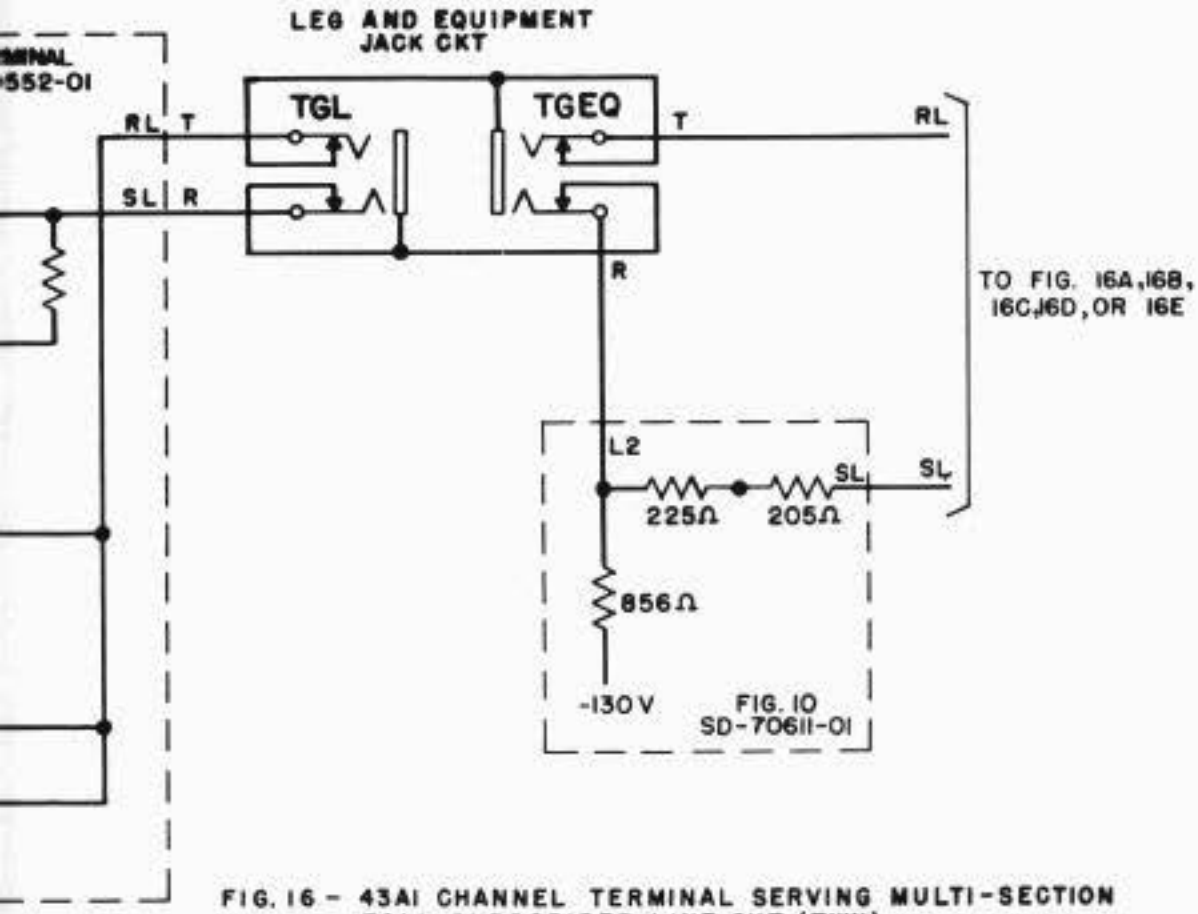



FIG. 16 - 43AI CHANNEL TERMINAL SERVING MULTI-SECTION TOLL SUBSCRIBER LINE CKT (TWX)

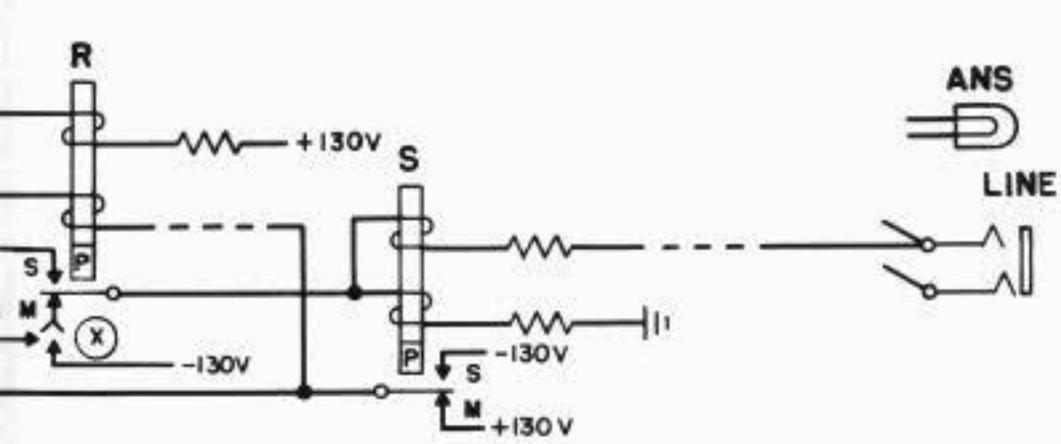



FIG. 16B - MULTI-SECTION TOLL SUBSCRIBER LINE CKT
SWBDS NUMBERS 3A (X OPTION) & 3C (Y OPTION)
SD-70391-01

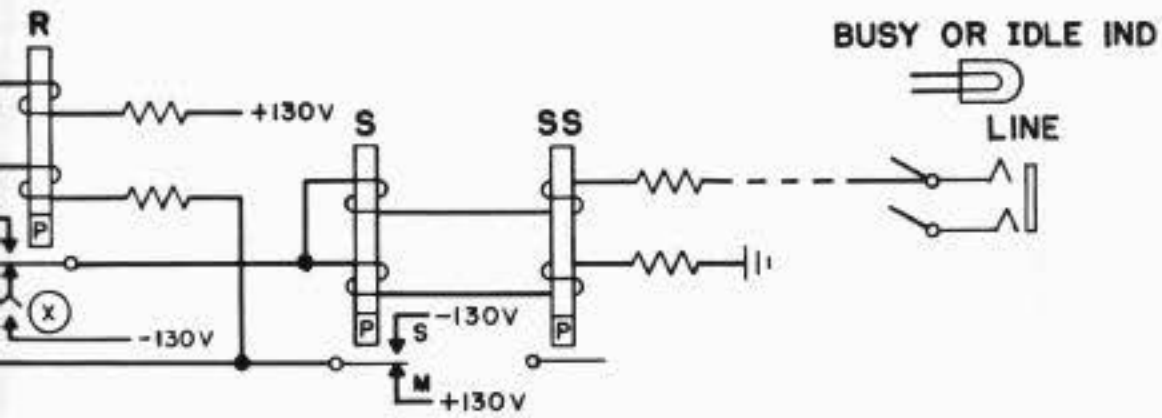
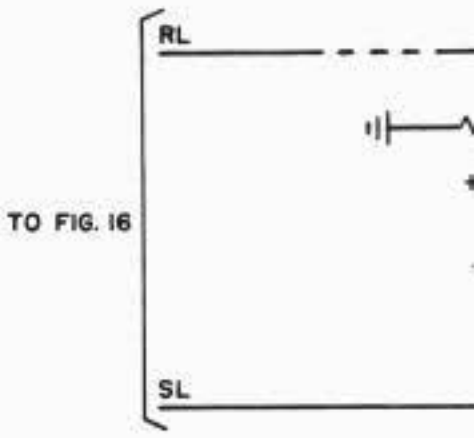
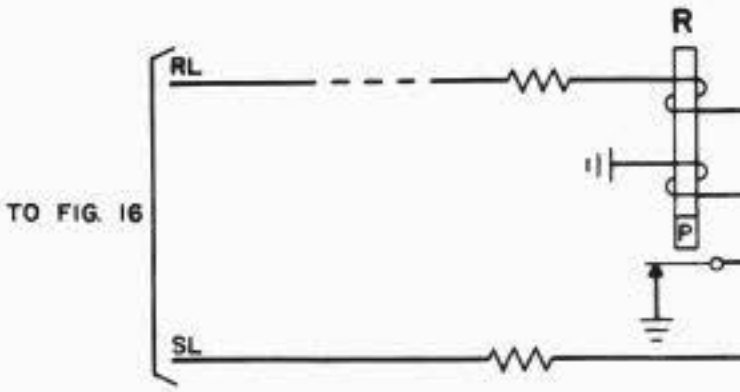
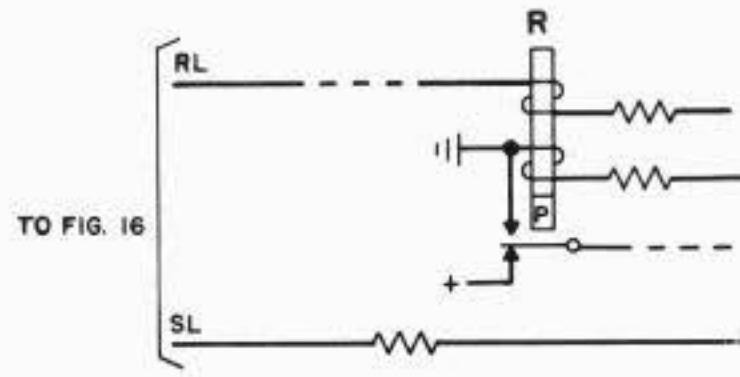



FIG. 16D - CONC UNIT TRUNK AT 3A SWBD (X OPTION)
SD-70310-01 3C SWBD (Y OPTION)
SD-70394-01



IG. 16A,16B,
6D,OR 16E

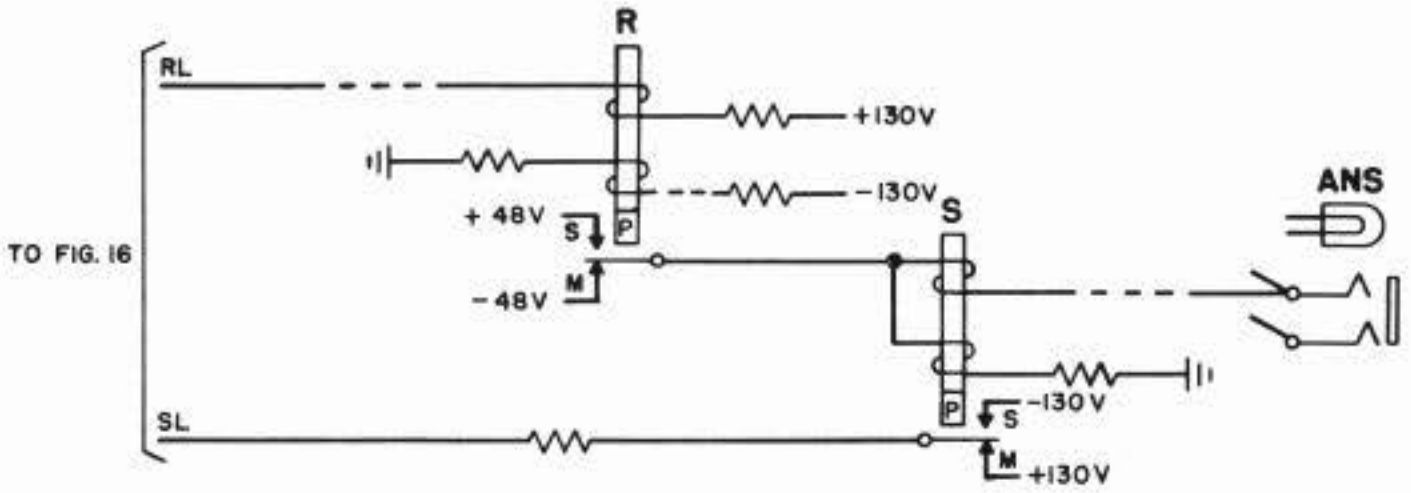



FIG. 16A – MULTI-SECTION TOLL SUBSCRIBER LINE CKT
SWBDS NUMBERS 1 & 1A
SD-70095-01

TION

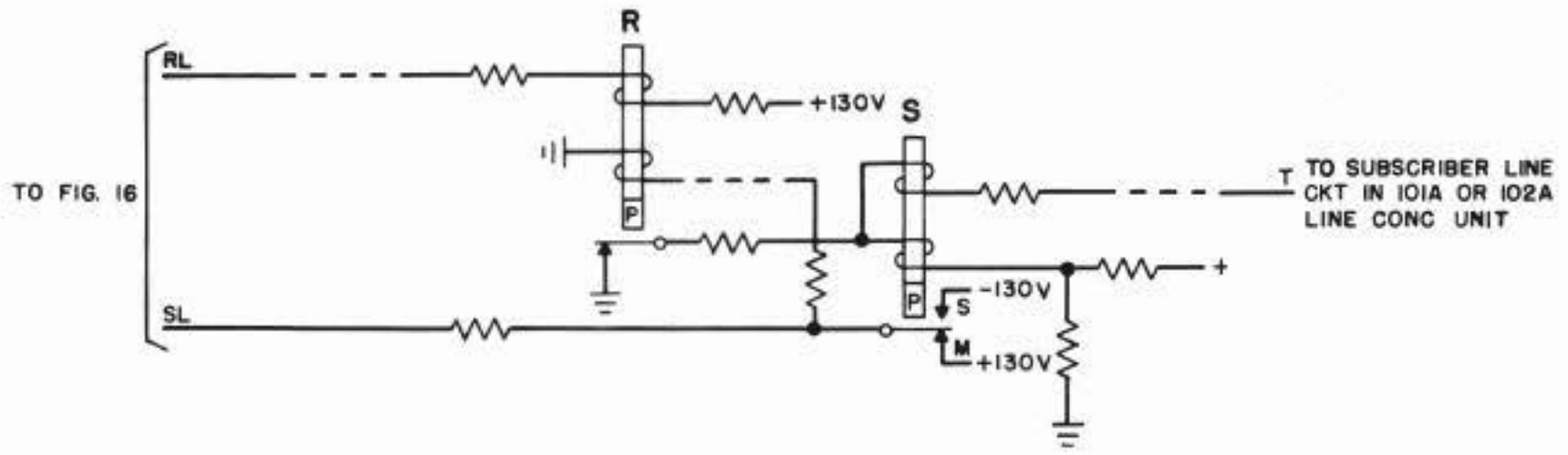



FIG. 16C – MULTI-SECTION TOLL SUBSCRIBER LINE CKT
101A & 102A LINE CONC UNITS
SD-70316-01

E IND

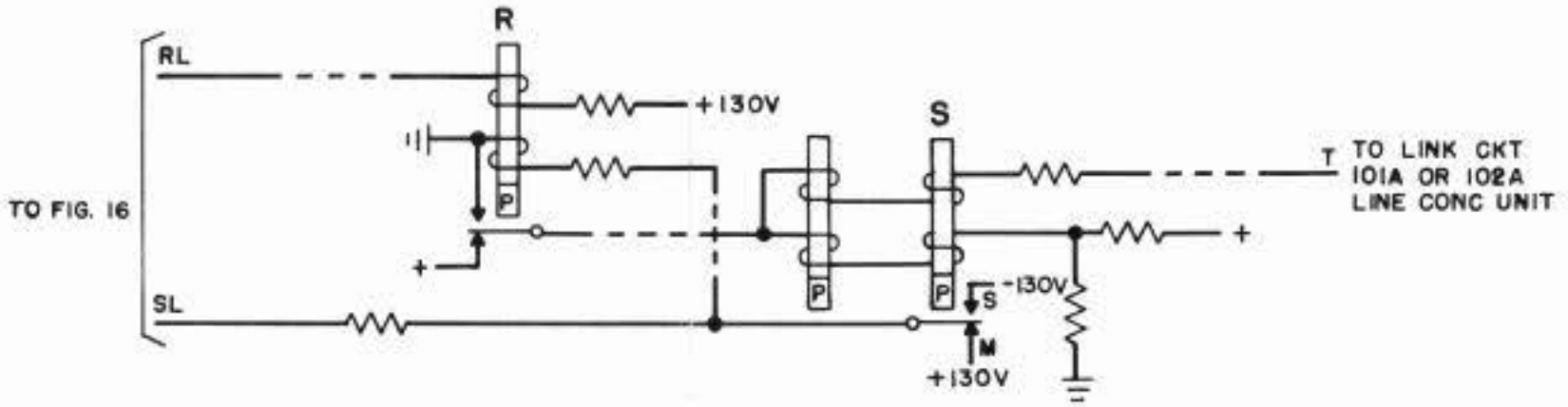



FIG. 16E – OPERATOR OFFICE TRUNK CKT AT LINE
CONC UNITS, 101A OR 102A

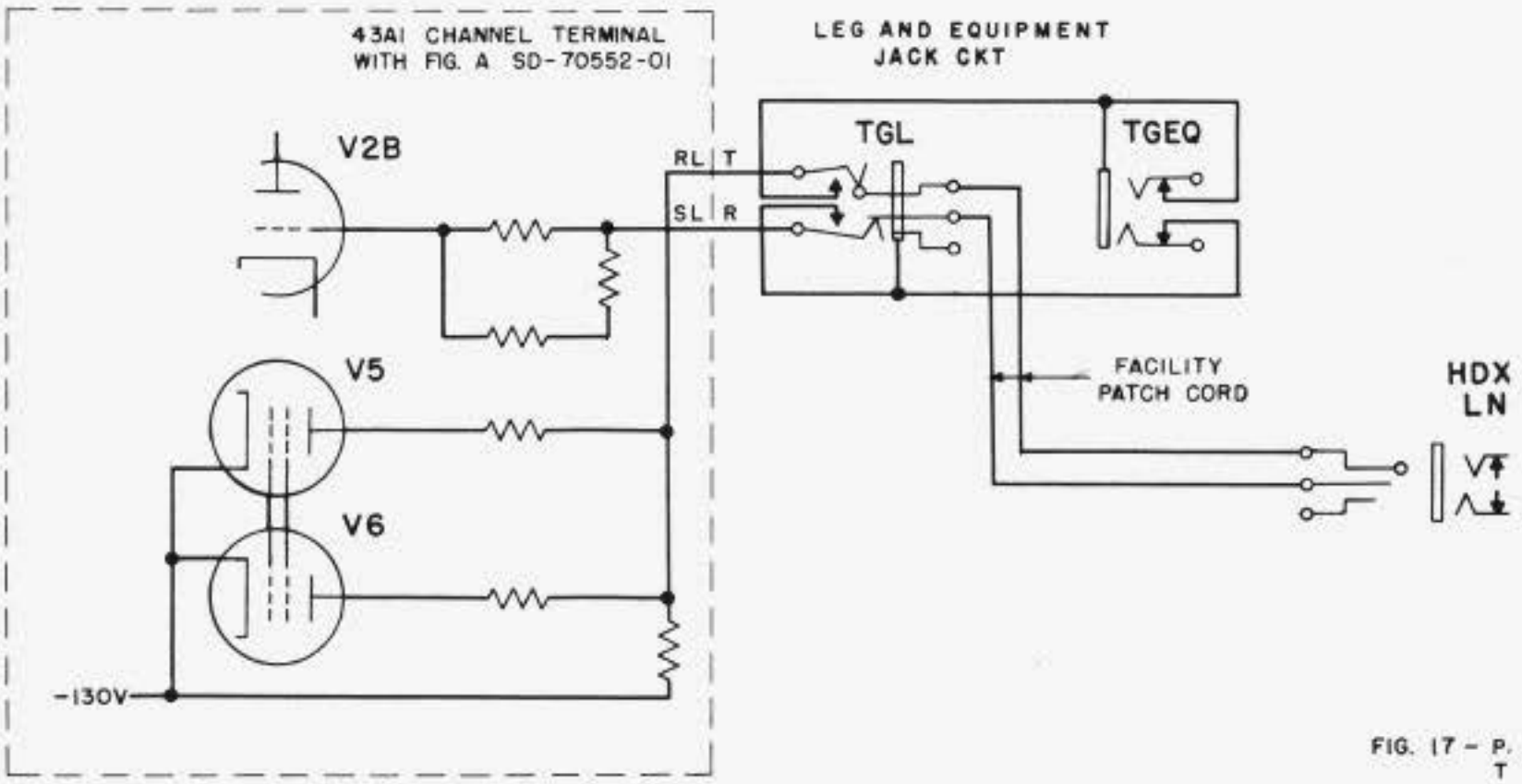



FIG. 17 - P.
T

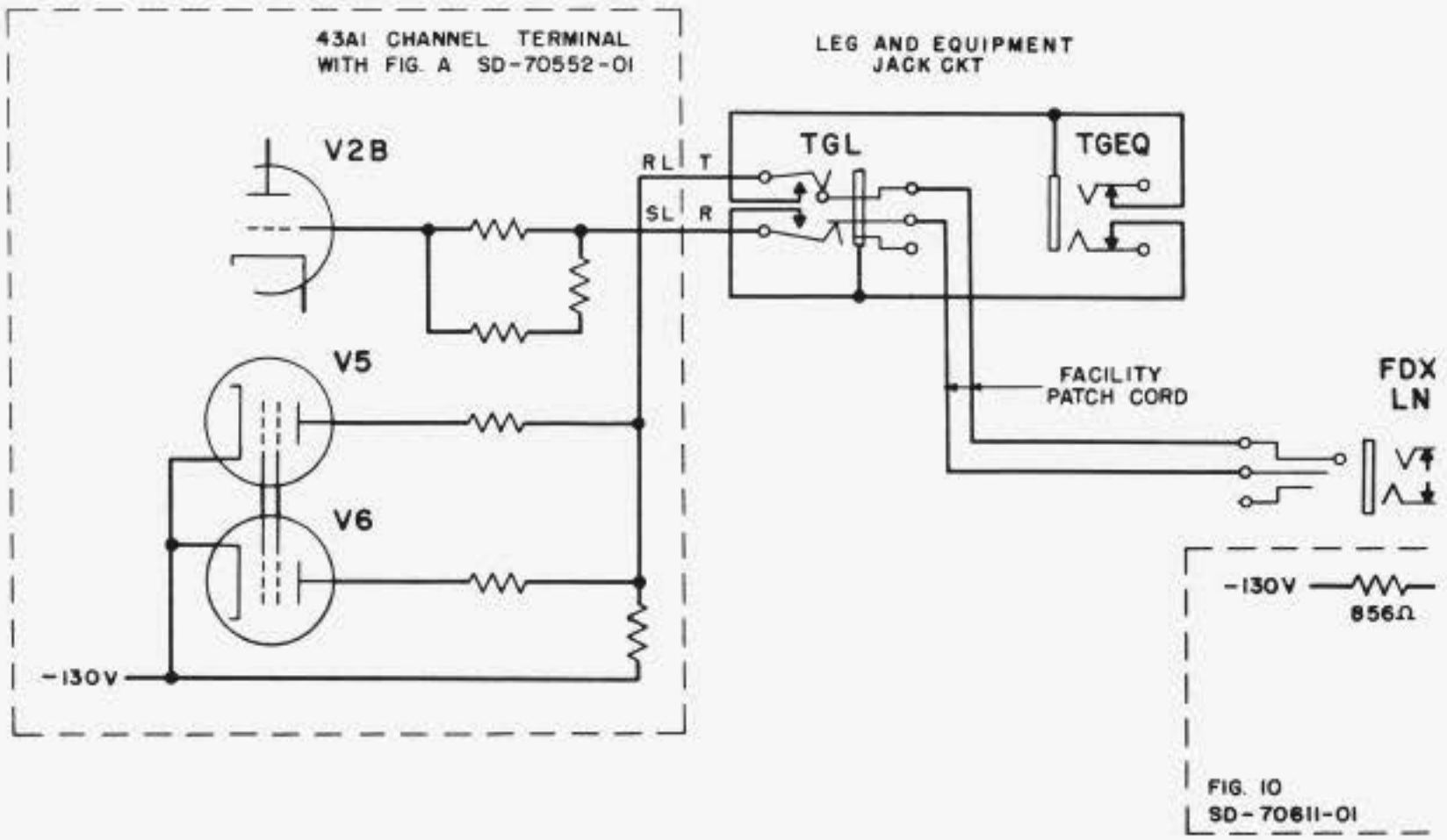
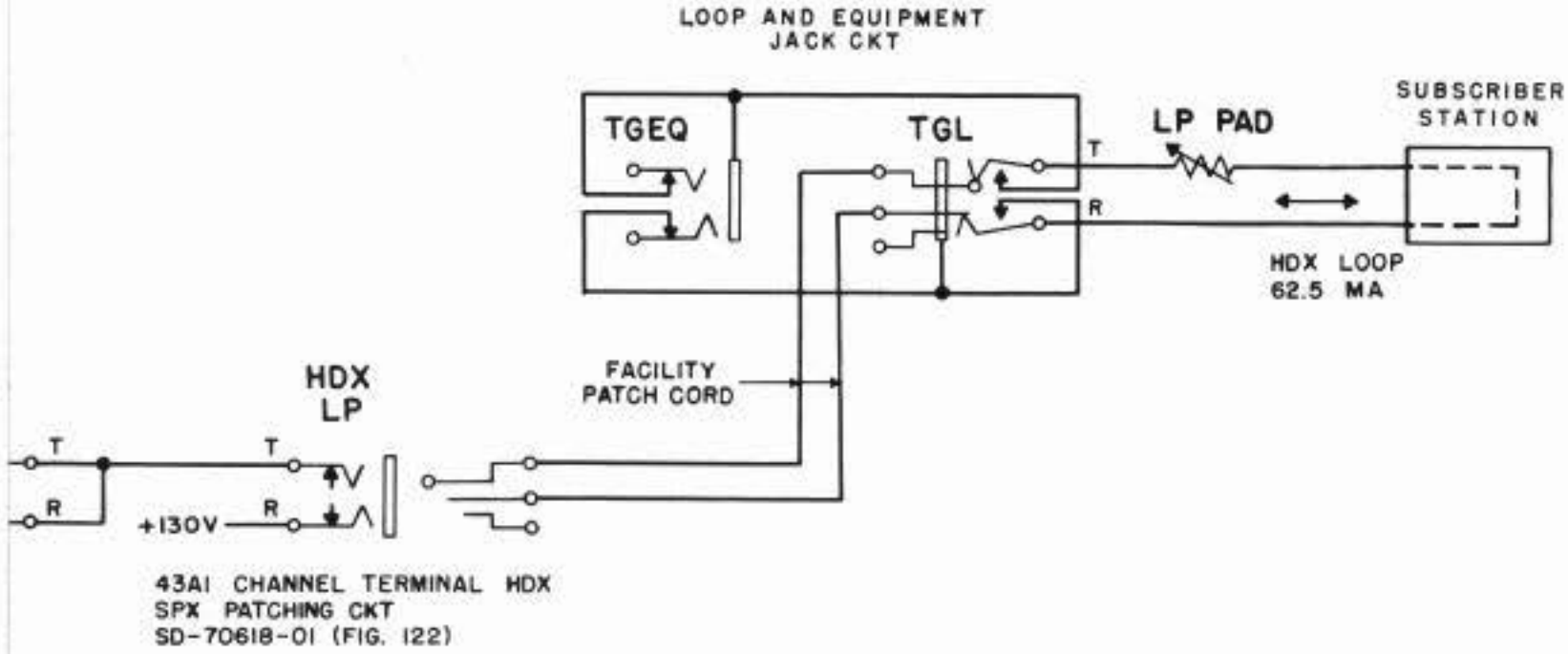
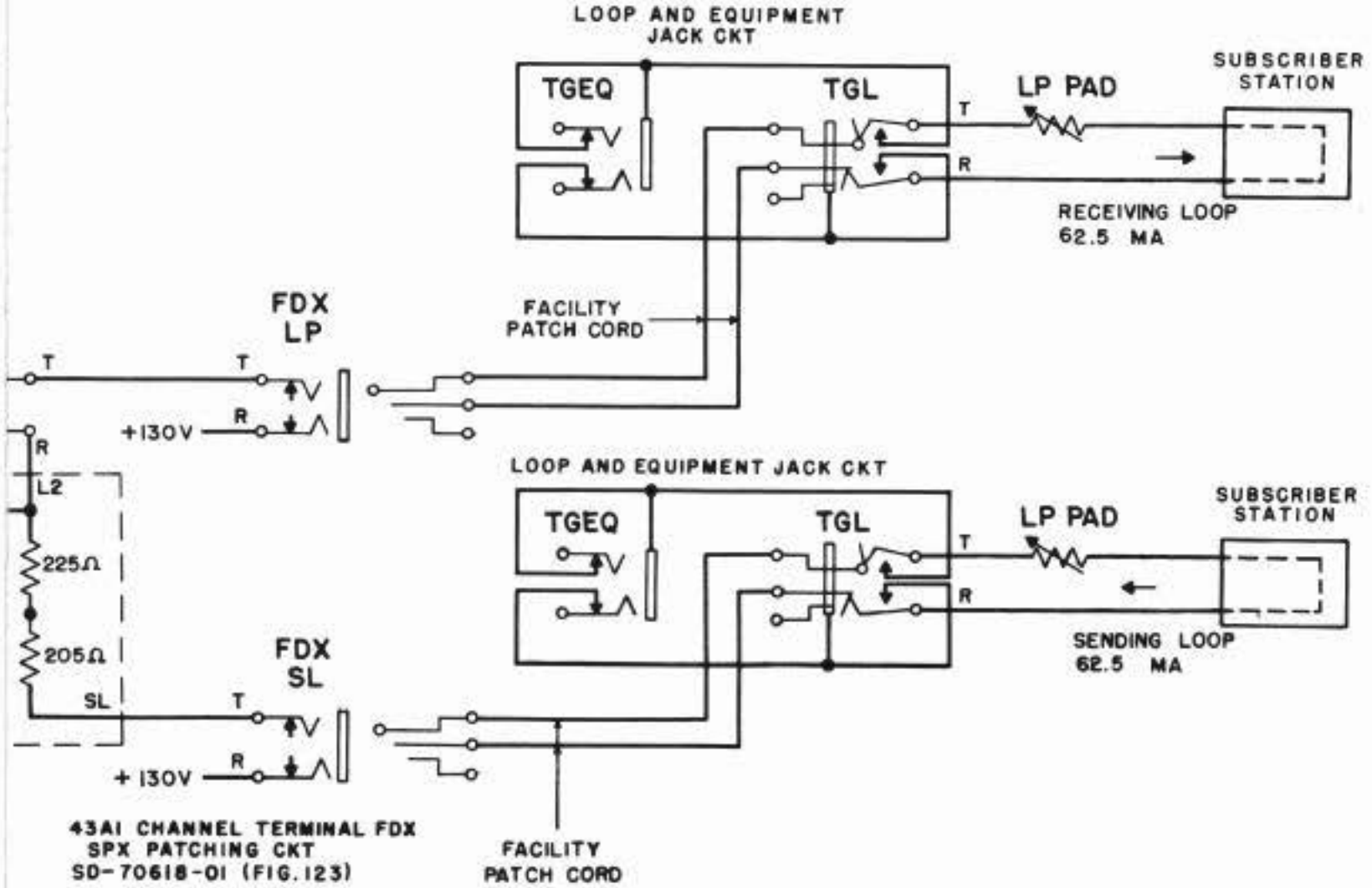



FIG. 18 - PATCHIN
TERMINA




ATCHING A SPARE 43AI CHANNEL
ERMINAL TO A HDX LOOP




G A SPARE 43AI CHANNEL
L TO FDX LOOPS

Fig. 17 and 18

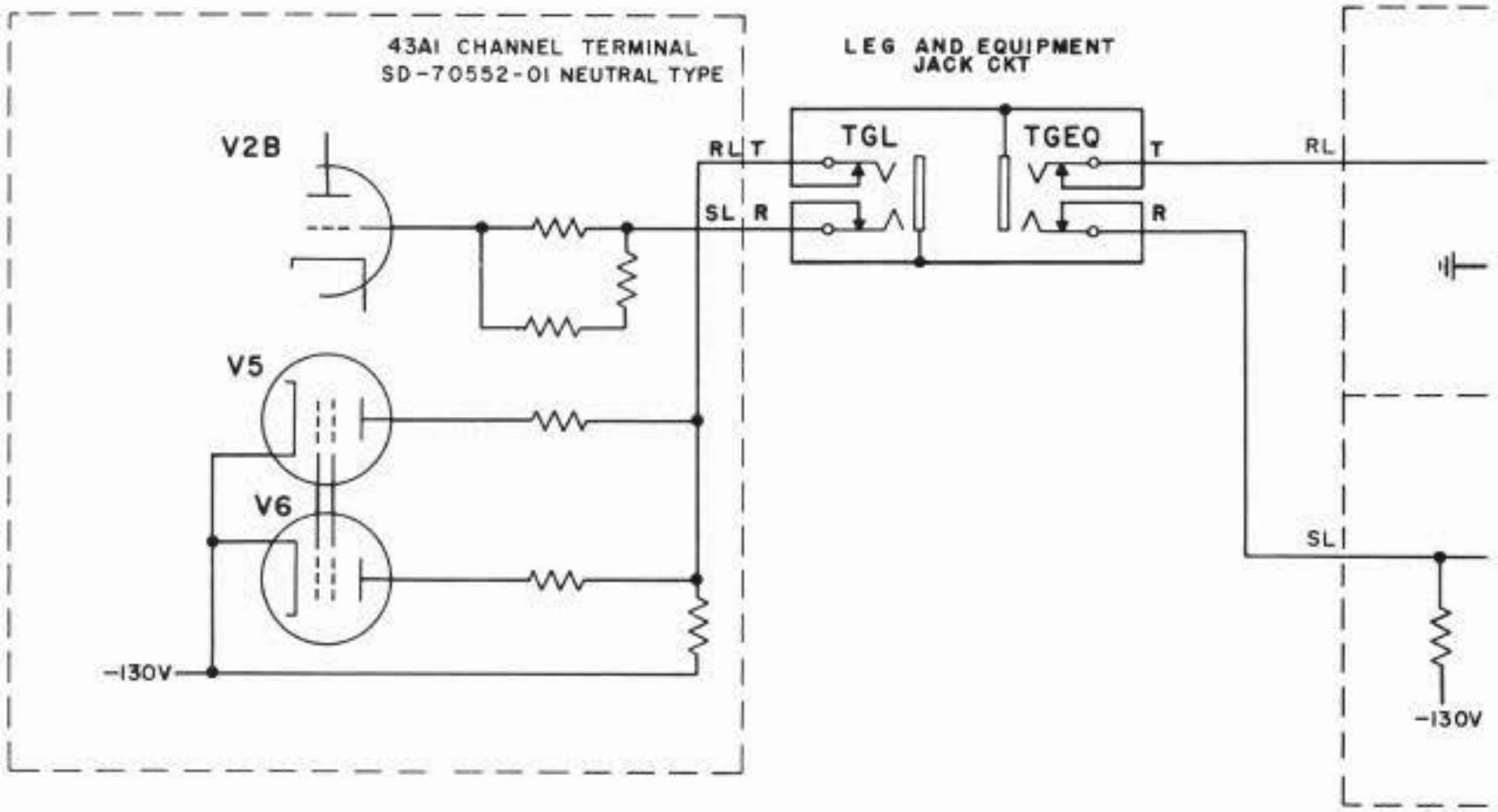



FIG. 19 - NEUTRAL TO HUB C
USING 2 13GI LOO
AND A 144AI COU

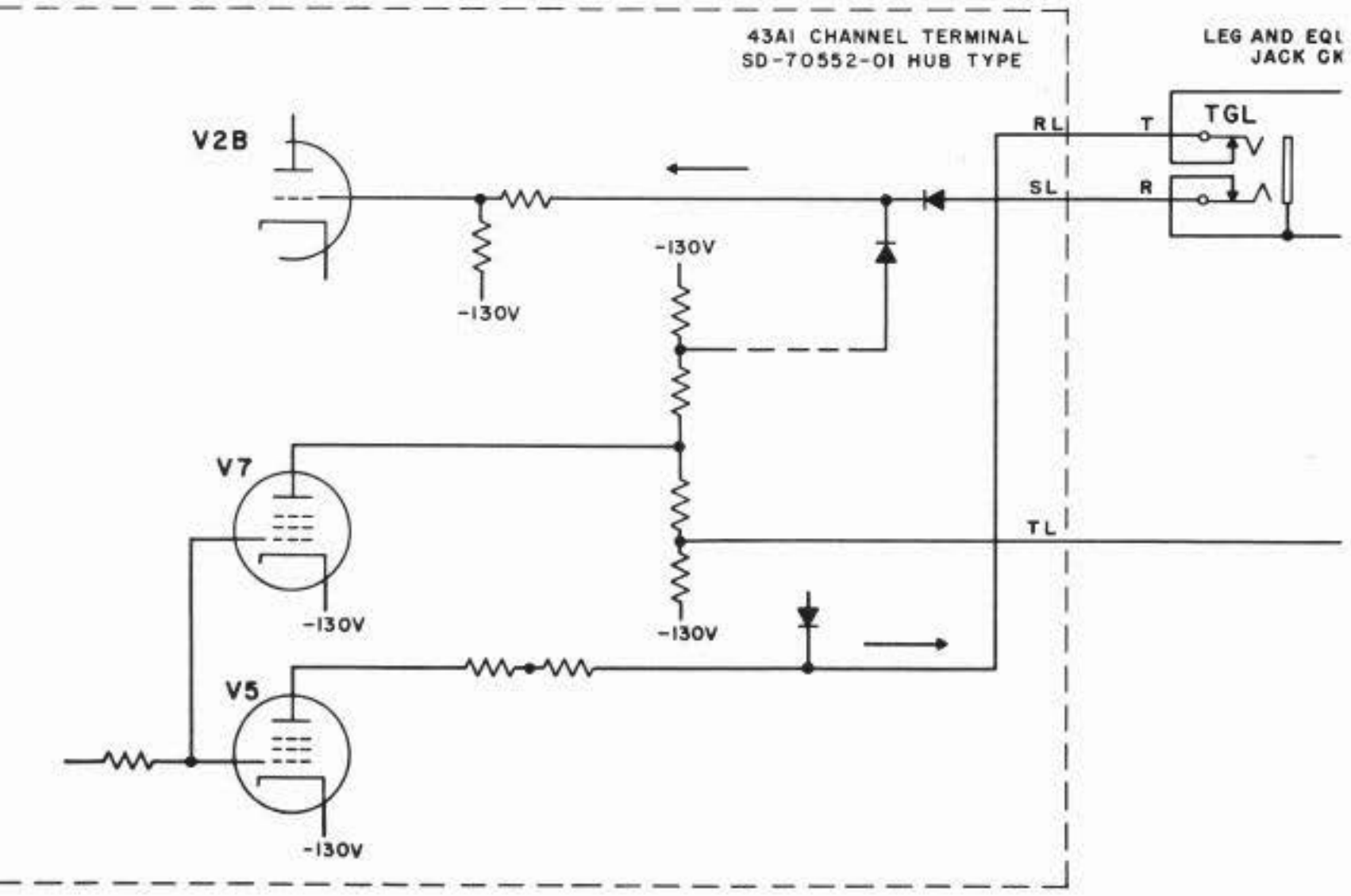
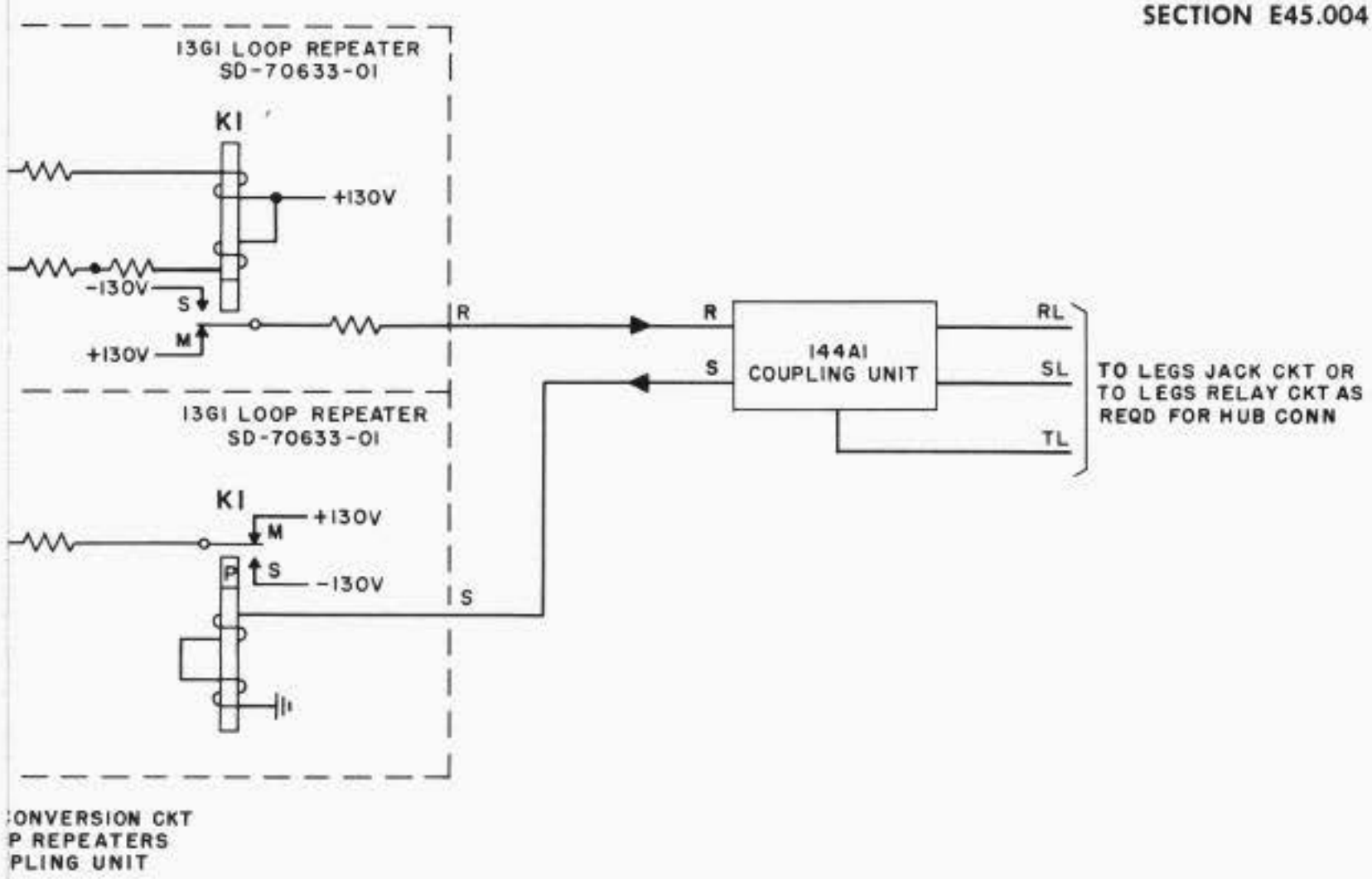



FIG. 20-HUB TYPE 43AI CHANNEL TERMINAL
APPEARING IN DIRECT LEG FACILITY
POSITION FOR HUB OPERATION AT A
HUB SERVICE POSITION




ONVERSION CKT
P REPEATERS
PLING UNIT

IPMENT
T

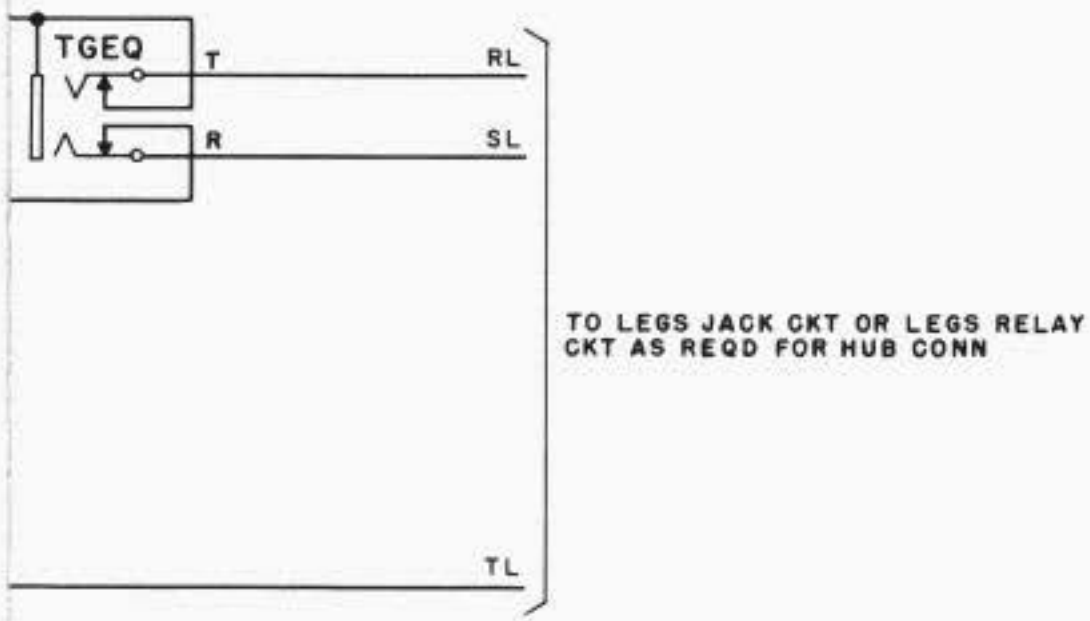



Fig. 19 and 20

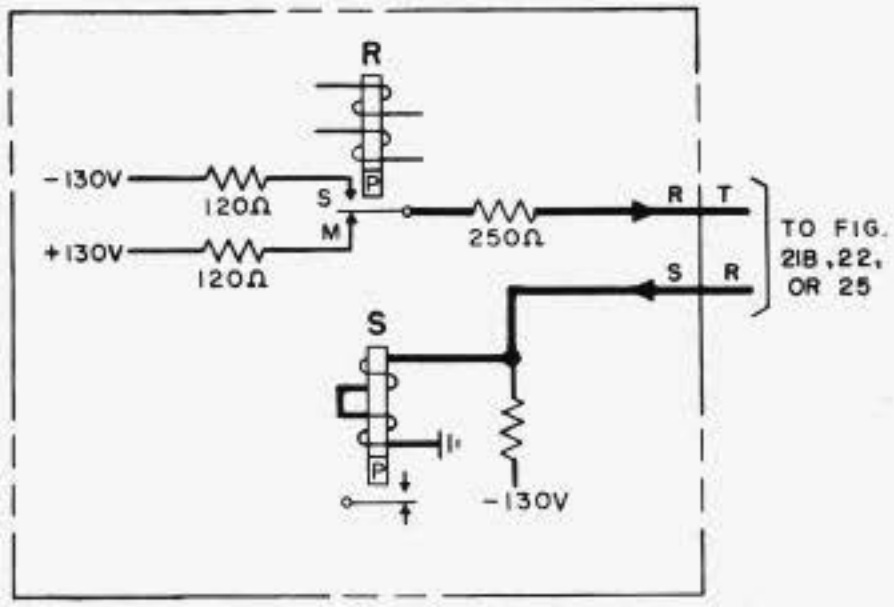
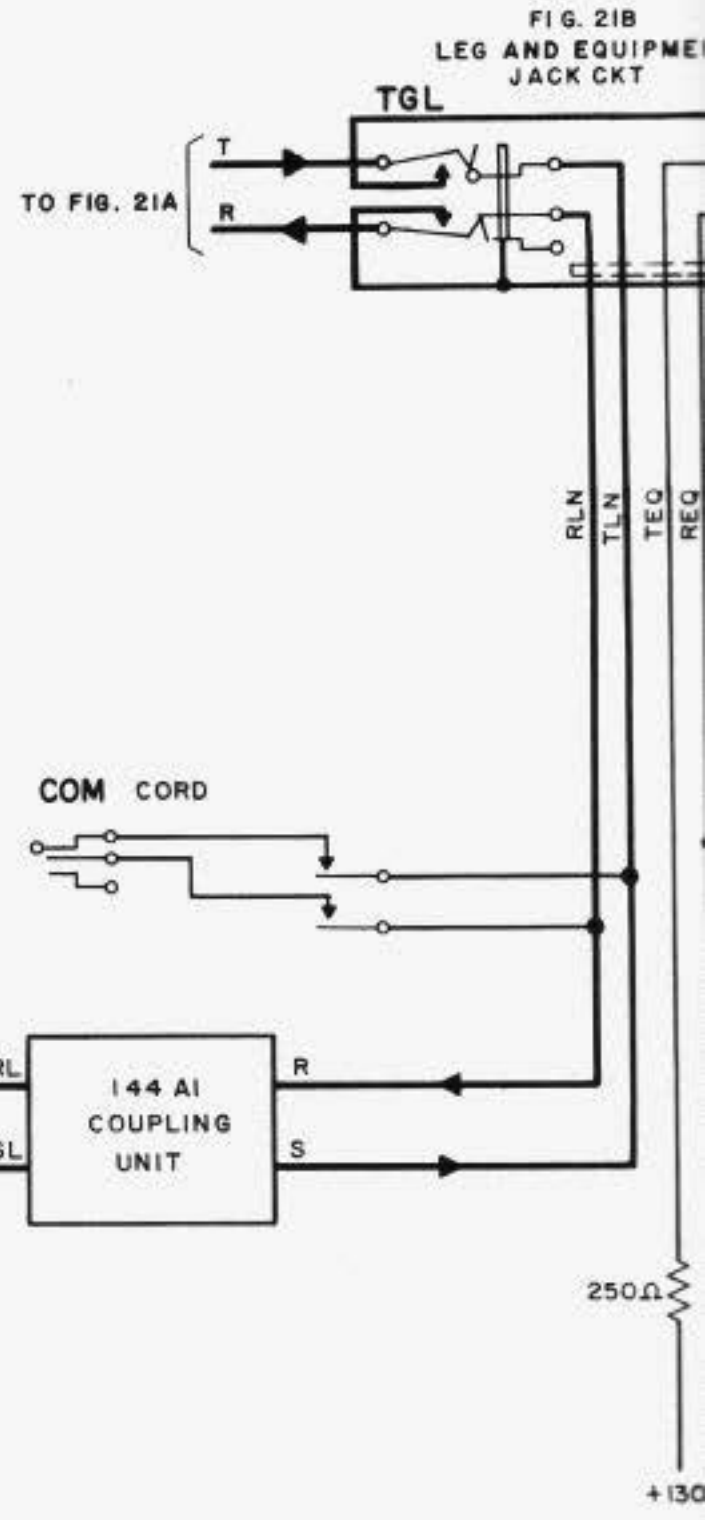



FIG. 21A - RELAY TYPE LINE REPEATER ASSIGNED TO FDX OR HDX LOOP CKTS



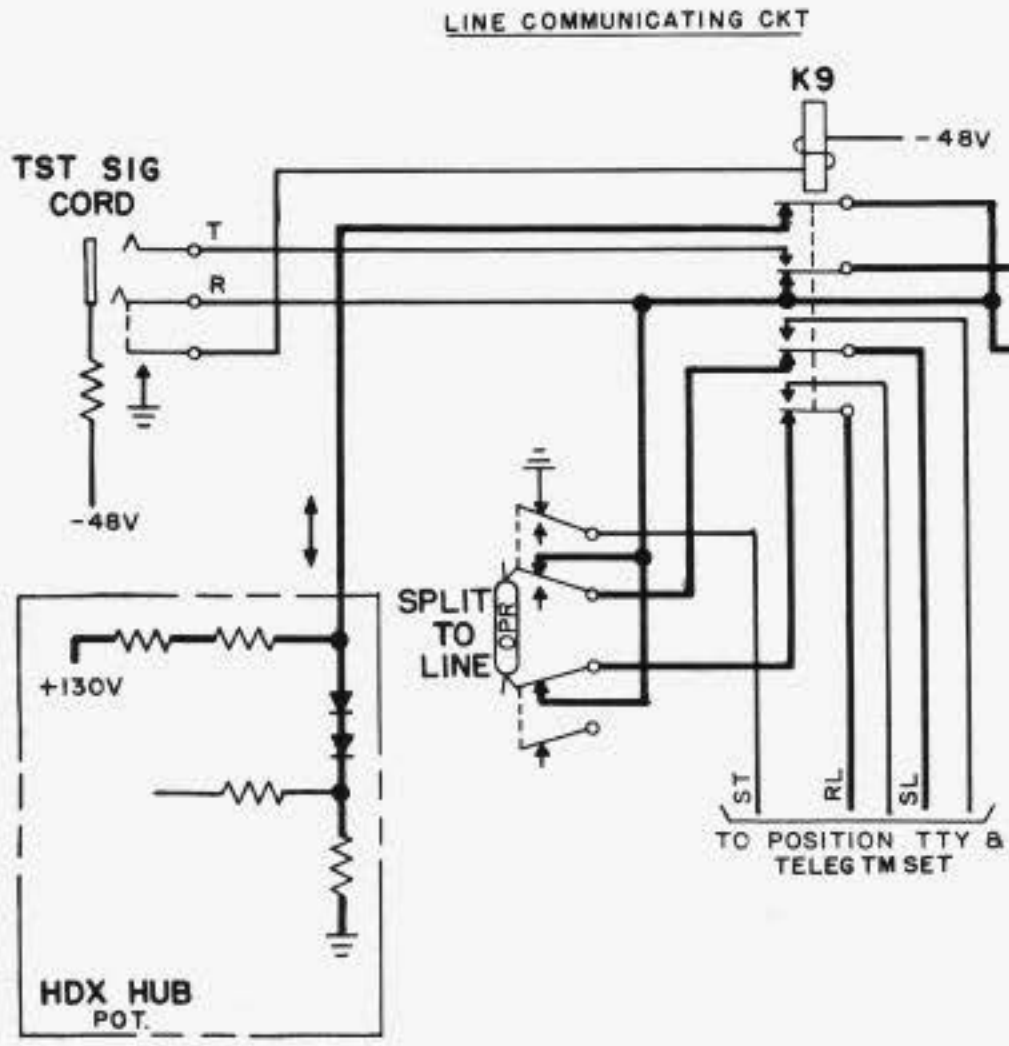




FIG. 21 — DL TTY CORD CKT ARRANG
TO LINE (RELAY TYPE REPE

FIG. 21B
LEG AND EQUIPMENT
JACK CKT

TGL

TGEQ

T

R

TO FIG. 21C,
21D,OR 21E

RLN

TLN

TEQ

REQ

COM MON
CORD

LOOP TERMINATING CKT

+130V

VIB

+130V

MON

V2

+130V

250Ω

-130V

+130V

TO FIG.
21B OR 25

T

R

S

TO FIG.
21B OR 25

T

R

S

TO FIG.
21B OR 25

T

R

L TTY CORD CKT ARRANGED FOR SPLIT
O LINE (RELAY TYPE REPEATER)

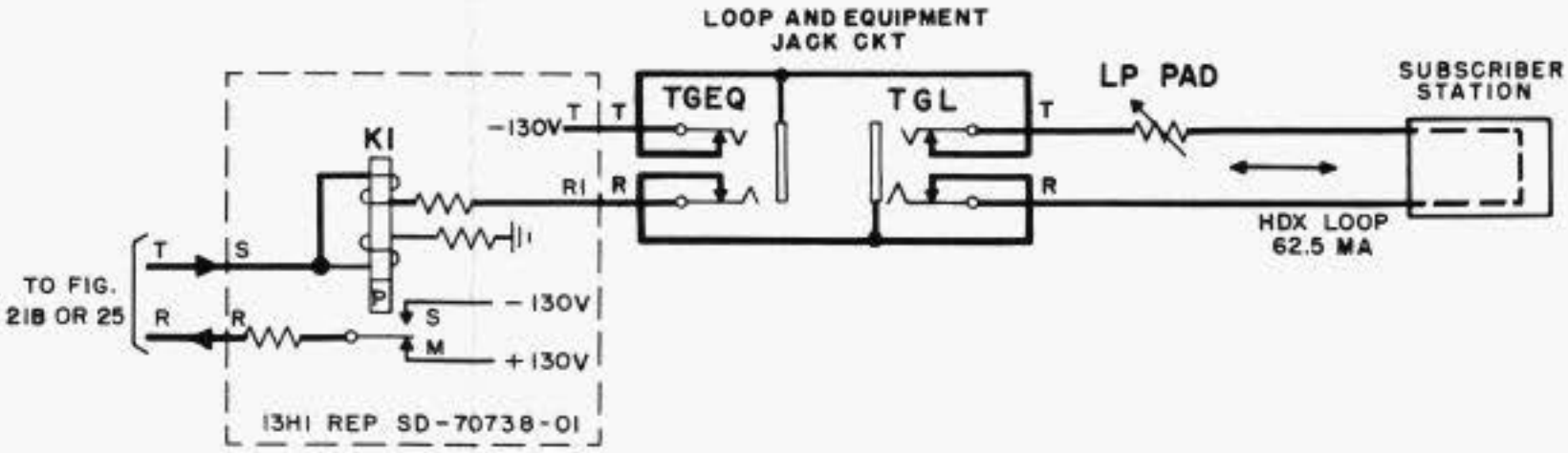
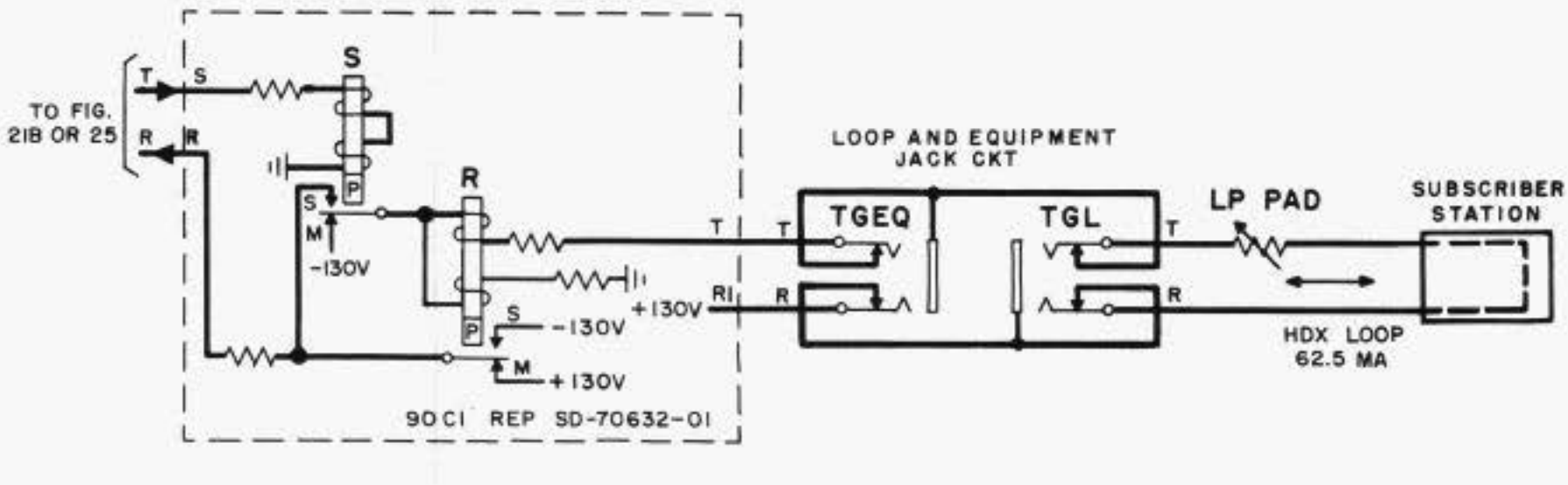



FIG. 21C - HDX LOOP WITH 13HI REPEATER




MON

+130V

FIG. 21D - HDX LOOP WITH 90CI REPEATER

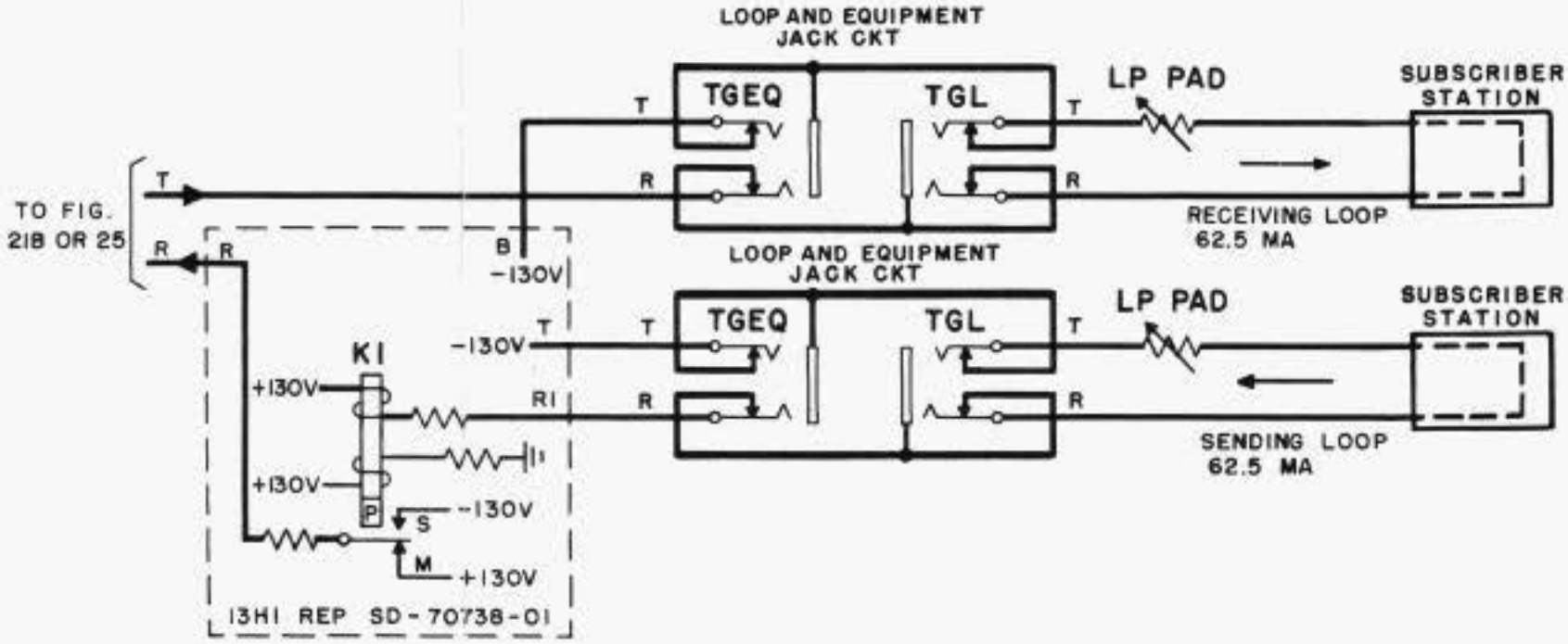



FIG. 21E - FDX LOOPS WITH 13HI LOOP REPEATER
IN THE SEND LEG

LEG AND EQUIPMENT
JACK CKT

TGL

TGEQ

TO FIG. 21A

T

R

T

R

TO
21D

COM MON
CORD

RLN

TLN

TEQ

REQ

COM
CORD

+130V

+130V

LINE TERMINATING CIRCUIT

MON

+130V

V2

VIB

-130V

+130V

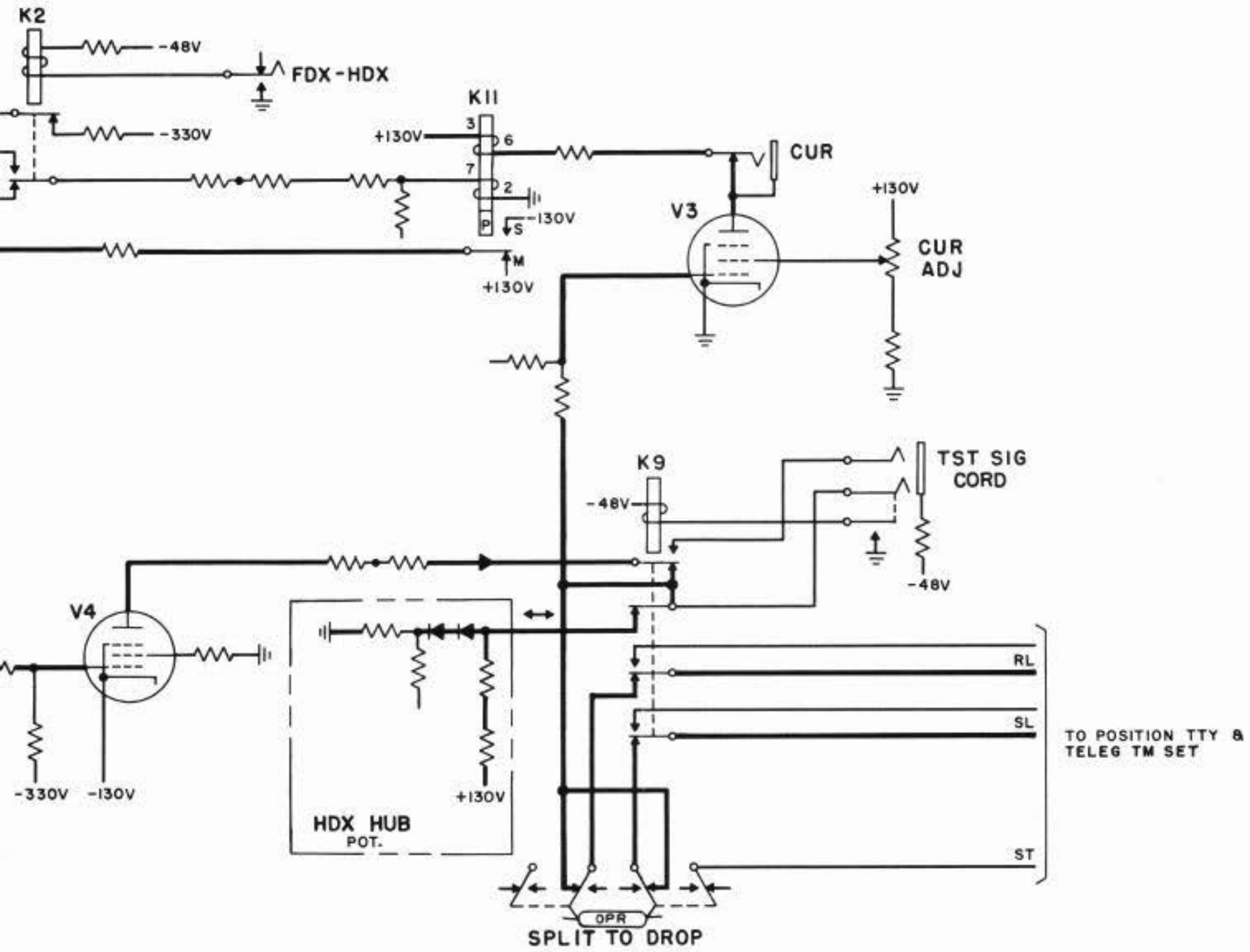
VIA

-130V

FI

3. 21C,
R 21E

LOOP COMMUNICATING CIRCUIT




22 - DL TTY CORD CKT ARRANGED FOR SPLIT TO DROP (RELAY TYPE REPEATER)

Fig. 22

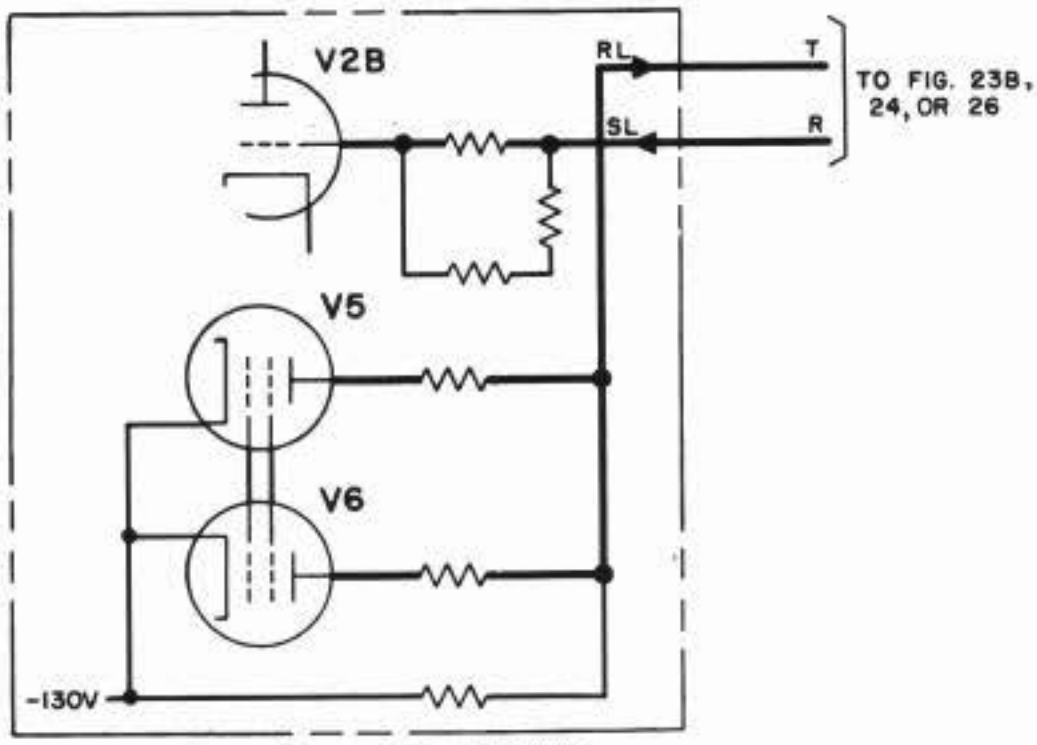
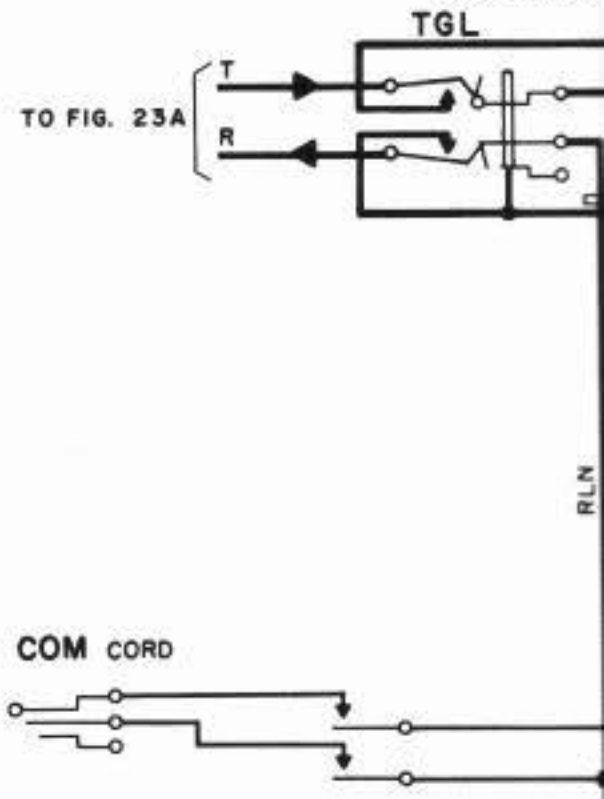
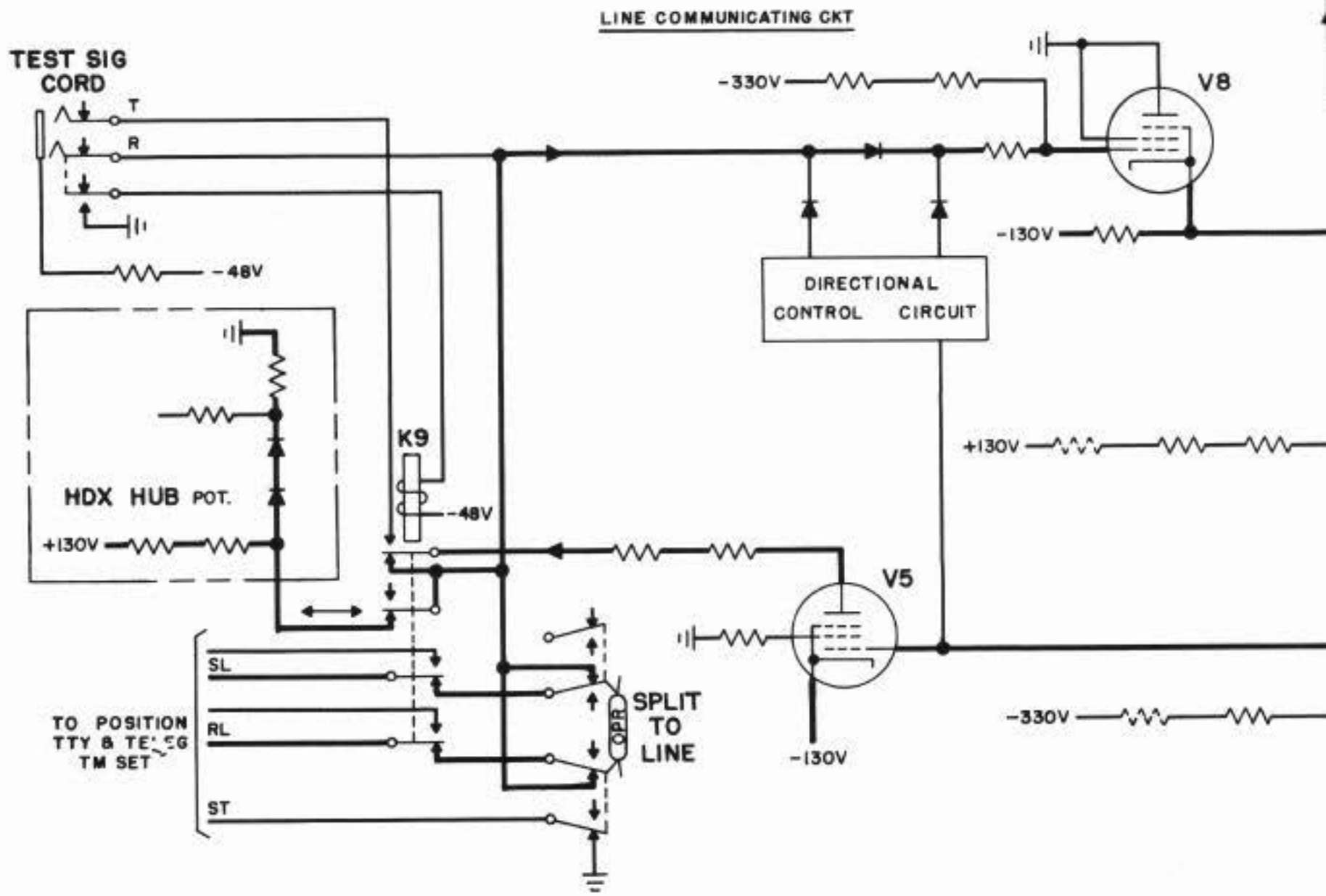



FIG. 23A - 43AI CHANNEL TERMINAL ASSIGNED TO FDX OR HDX LOOP CKTS



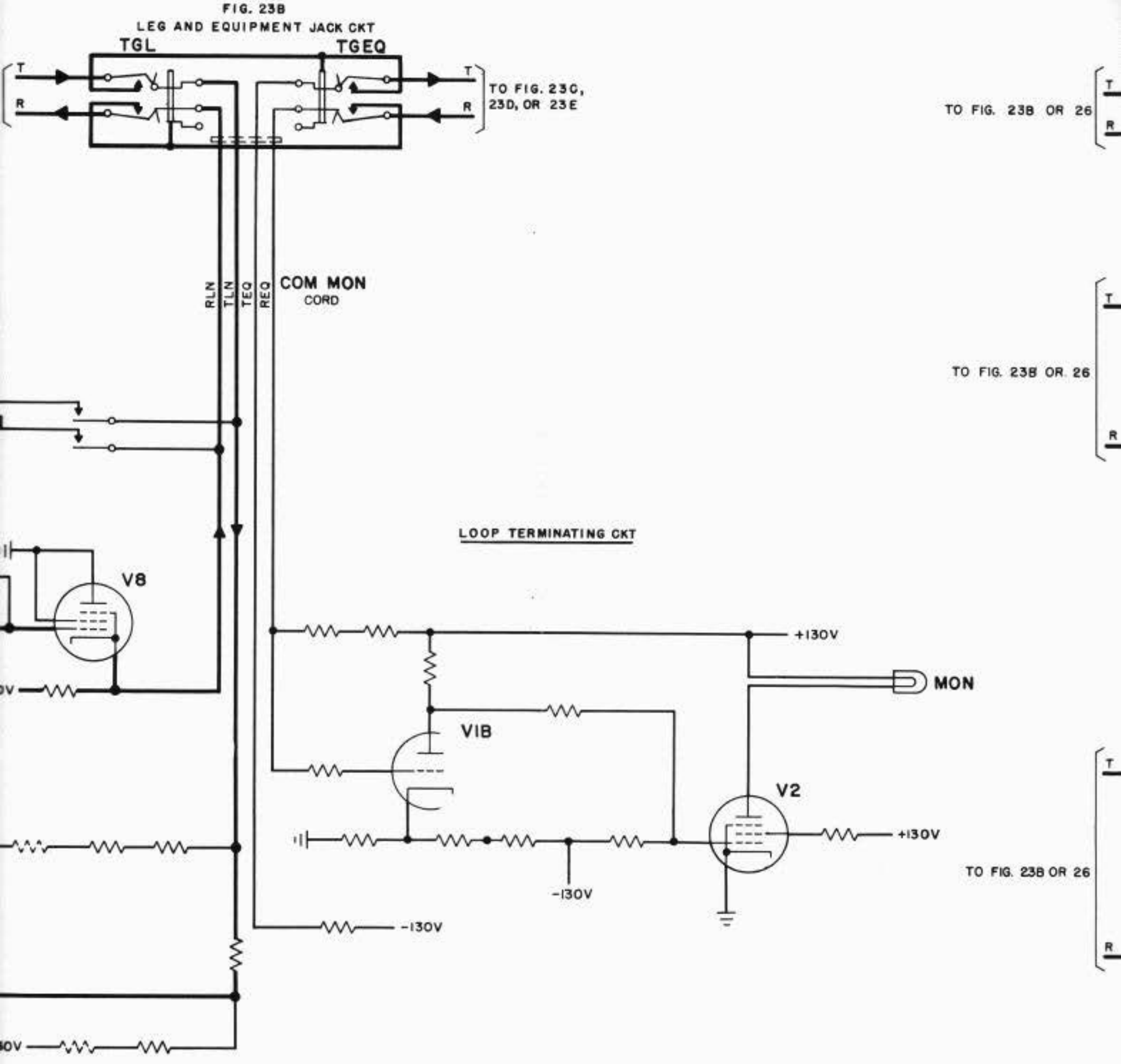



FIG. 23 – DL TTY CORD CKT ARRANGED FOR SPLIT TO LINE (ELECTRONIC TYPE LINE REPEATER)

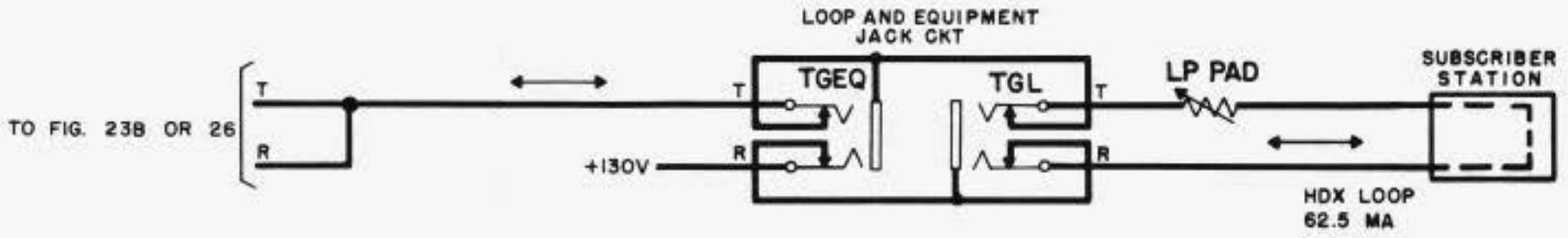



FIG. 23C - HDX LOOP

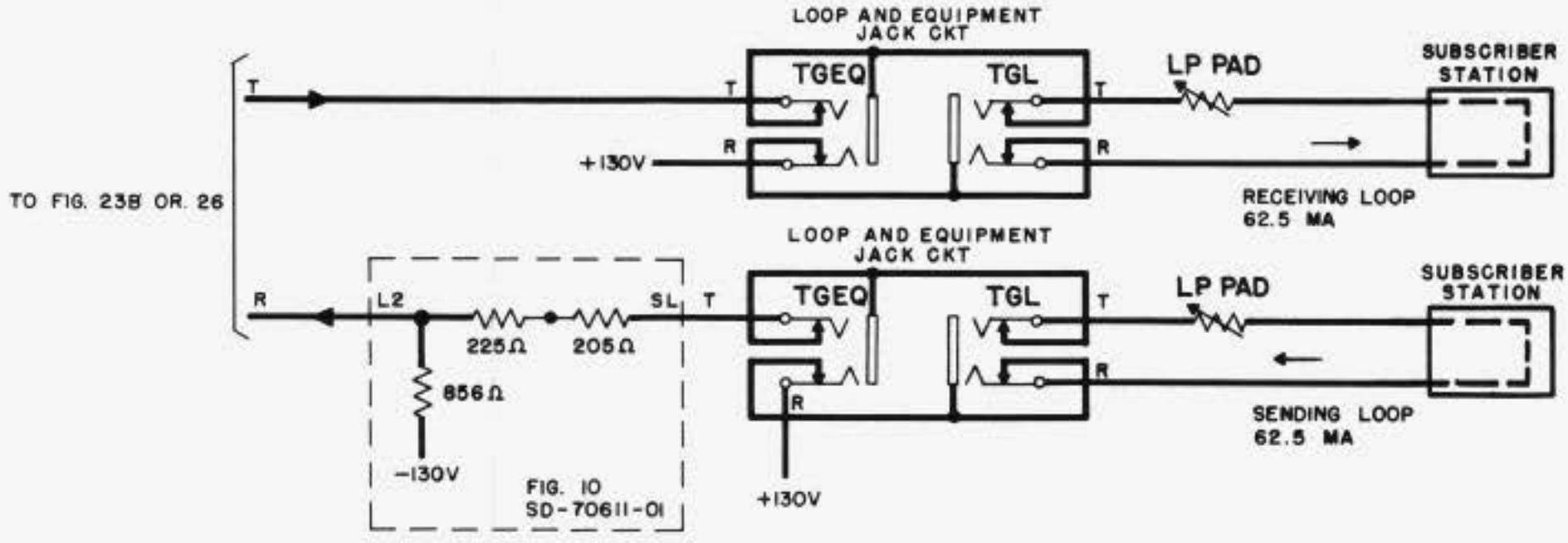



FIG. 23D - FDX LOOPS

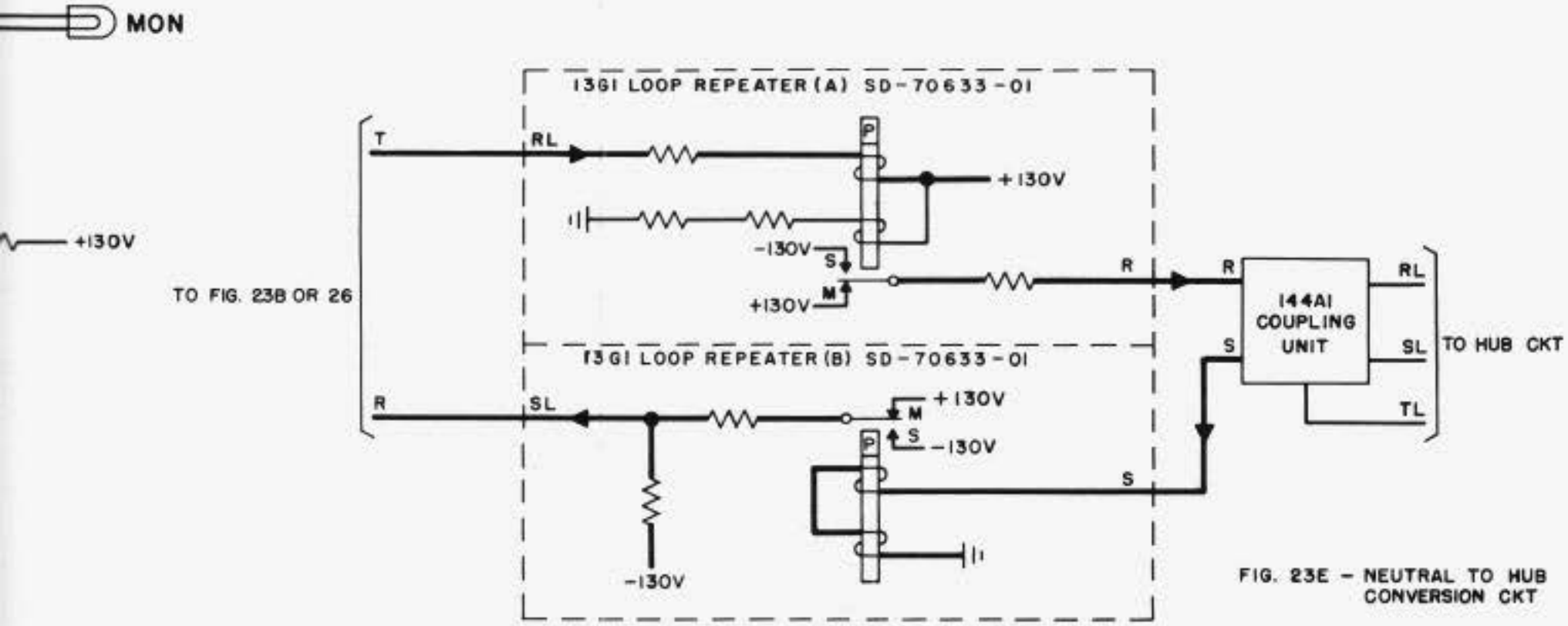



FIG. 23E - NEUTRAL TO HUB CONVERSION CKT

Fig. 23, 23A, 23B, 23C, 23D, and 23E

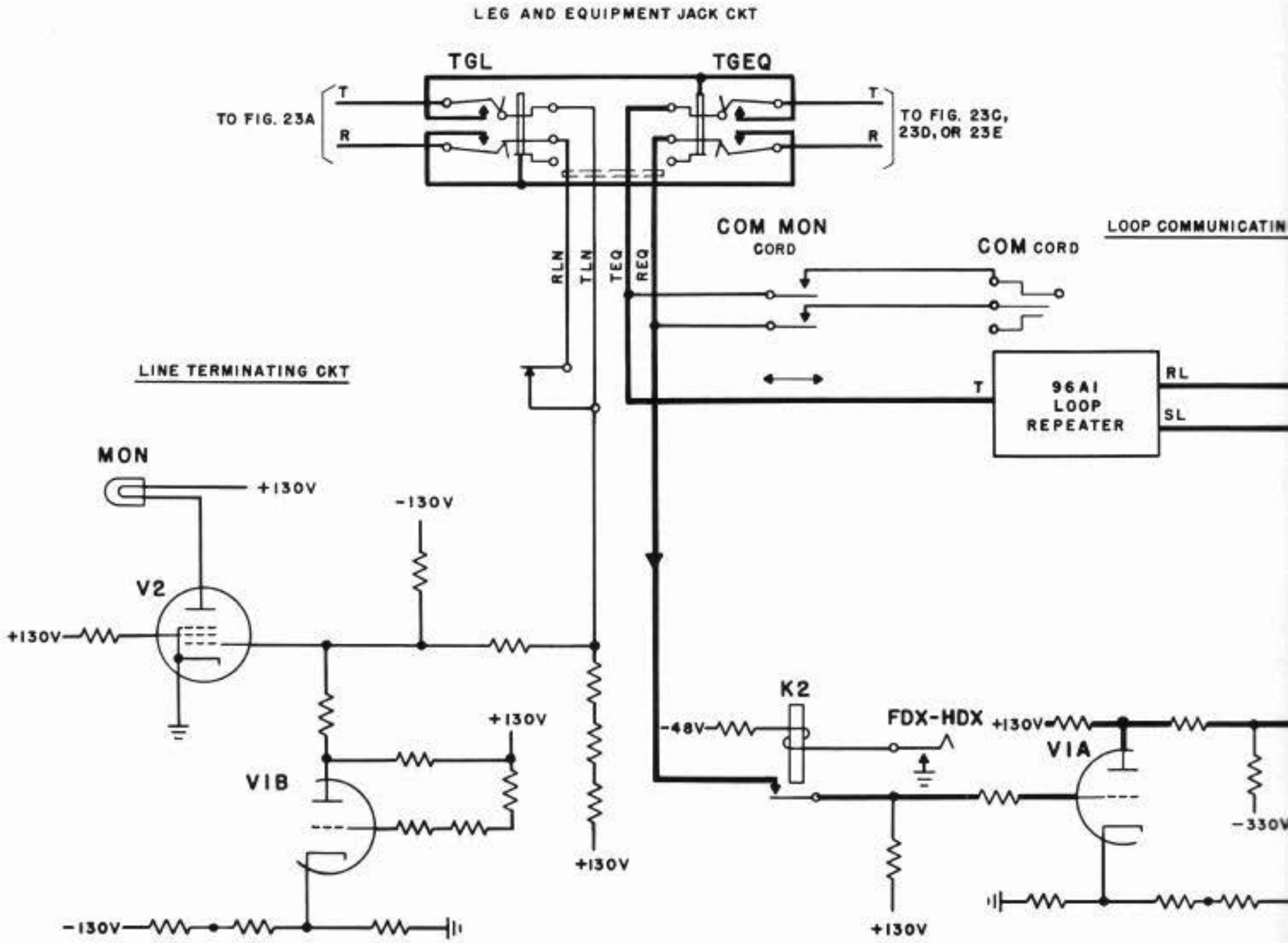



FIG. 24 DL TTY CORD CKT ARRANGED FOR SPLIT TO DROP (ELECTRIC TYPE LINE REPEATER)

T
R
TO FIG. 23C, 23D, OR 23E

LOOP COMMUNICATING CKT

COM CORD

TST SIG CORD

K9

T

R

-48V

-48V

T

96AI LOOP REPEATER

RL

SL

+130V

HDX HUB POT.

V4

FDX-HDX

+130V

VIA

-330V

-130V

-130

+130V

SPLIT TO DROP

TO POSITION TTY & TELE® TM SET

TTY CORD CKT ARRANGED FOR SPLIT DROP (ELECTRIC TYPE LINE REPEATER)

LOOP AND EQUIPMENT
JACK CKT

TGL

TGEQ

TO FIG. 21A

T

R

V

TO FIG. 21D, OR

+130V

$\frac{1}{2}$ V3

S R S

K3

3-

+6

7+

-2

-130V

S

+130V

M

TST SIG CORD

T

R

-48V

+130V

HDX HUB POT.

ION TTY &
TM SET

V6

-130V

FIG. 25 DL MON
RELAY

LOOP AND EQUIPMENT
JACK CKT

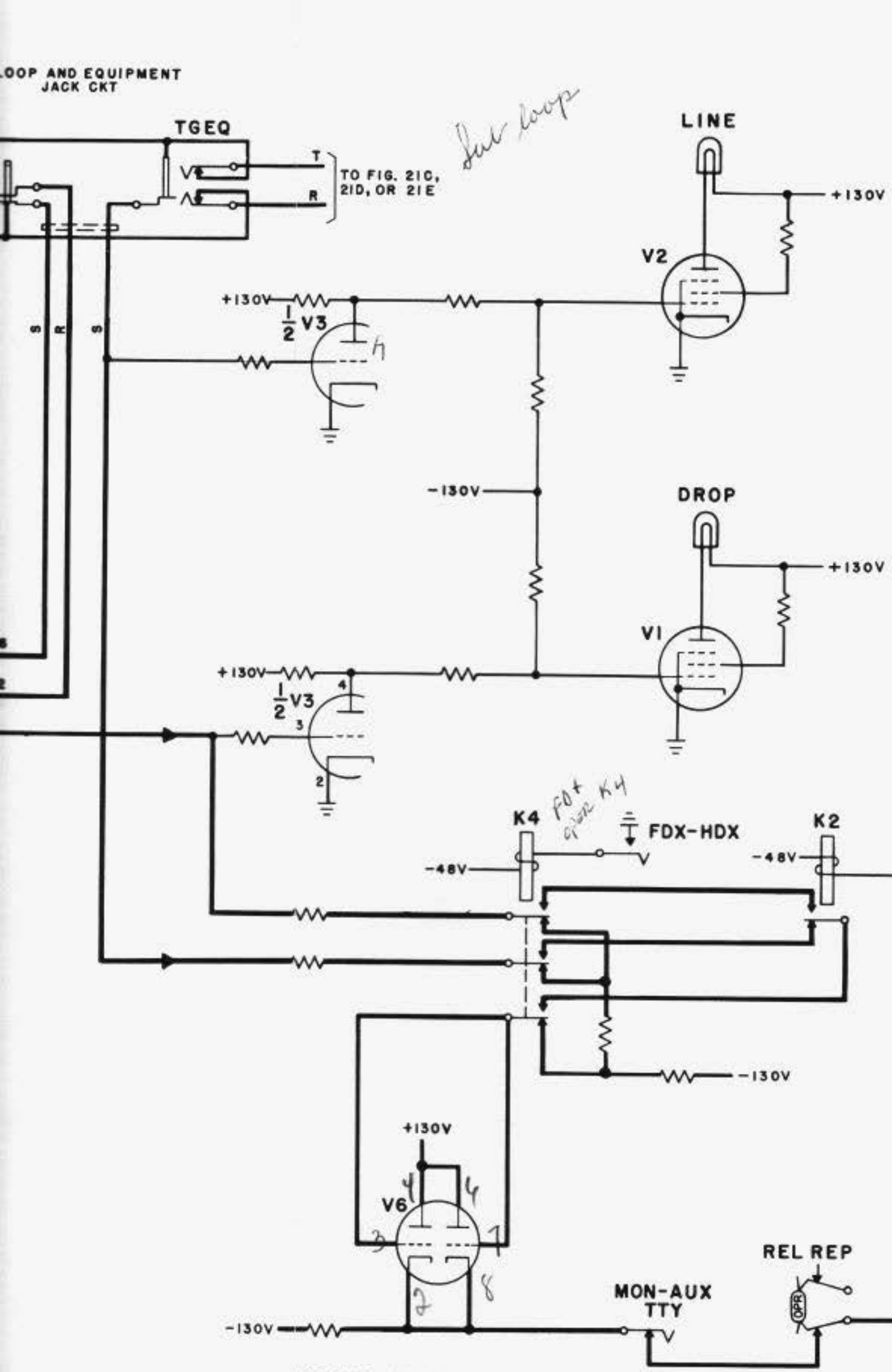



FIG. 25 DL MONITORING CKT ARRANGED FOR RELAY TYPE REPEATER MONTORING

LEG AND EQUIPMENT JACK CKT

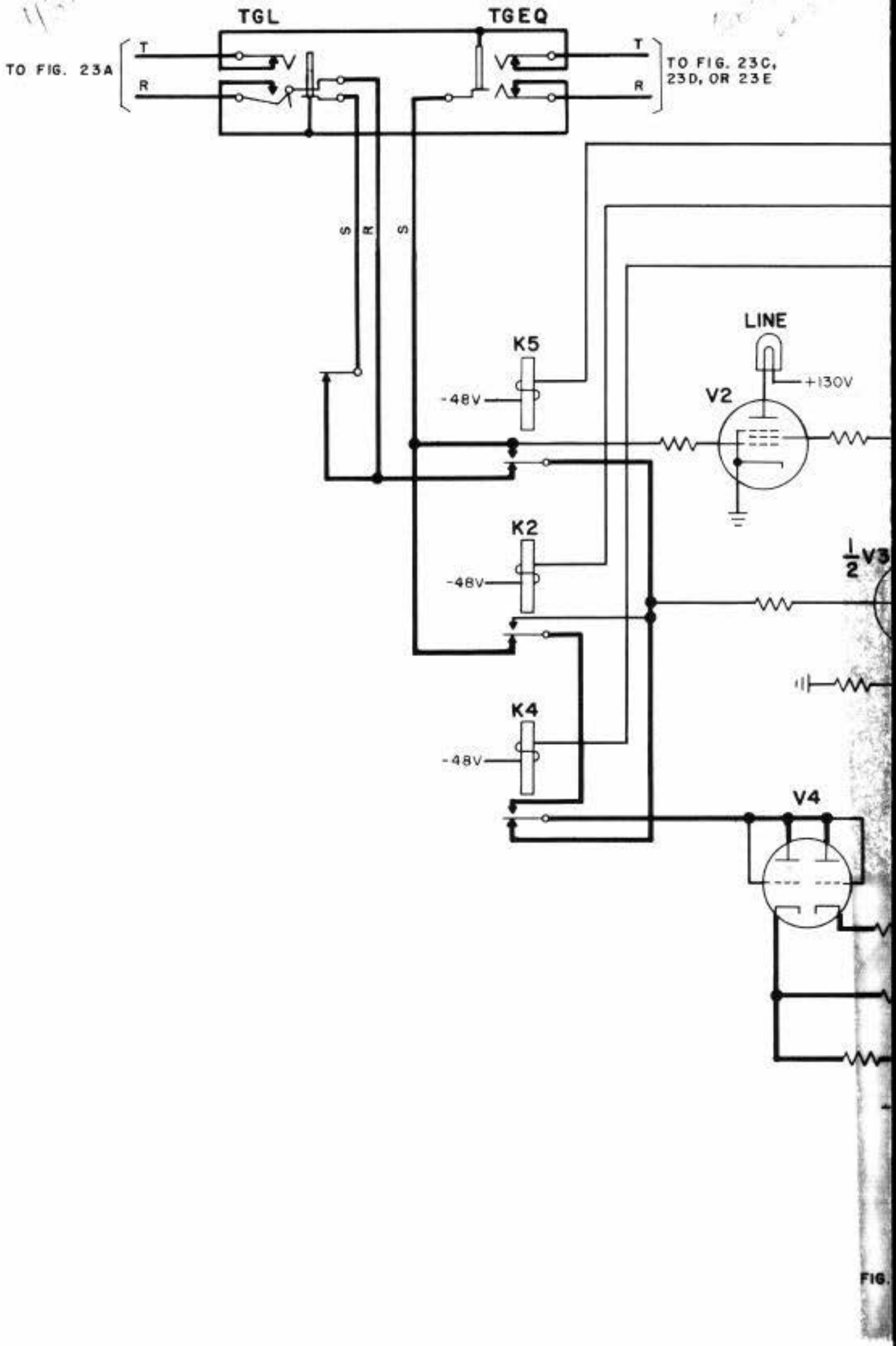
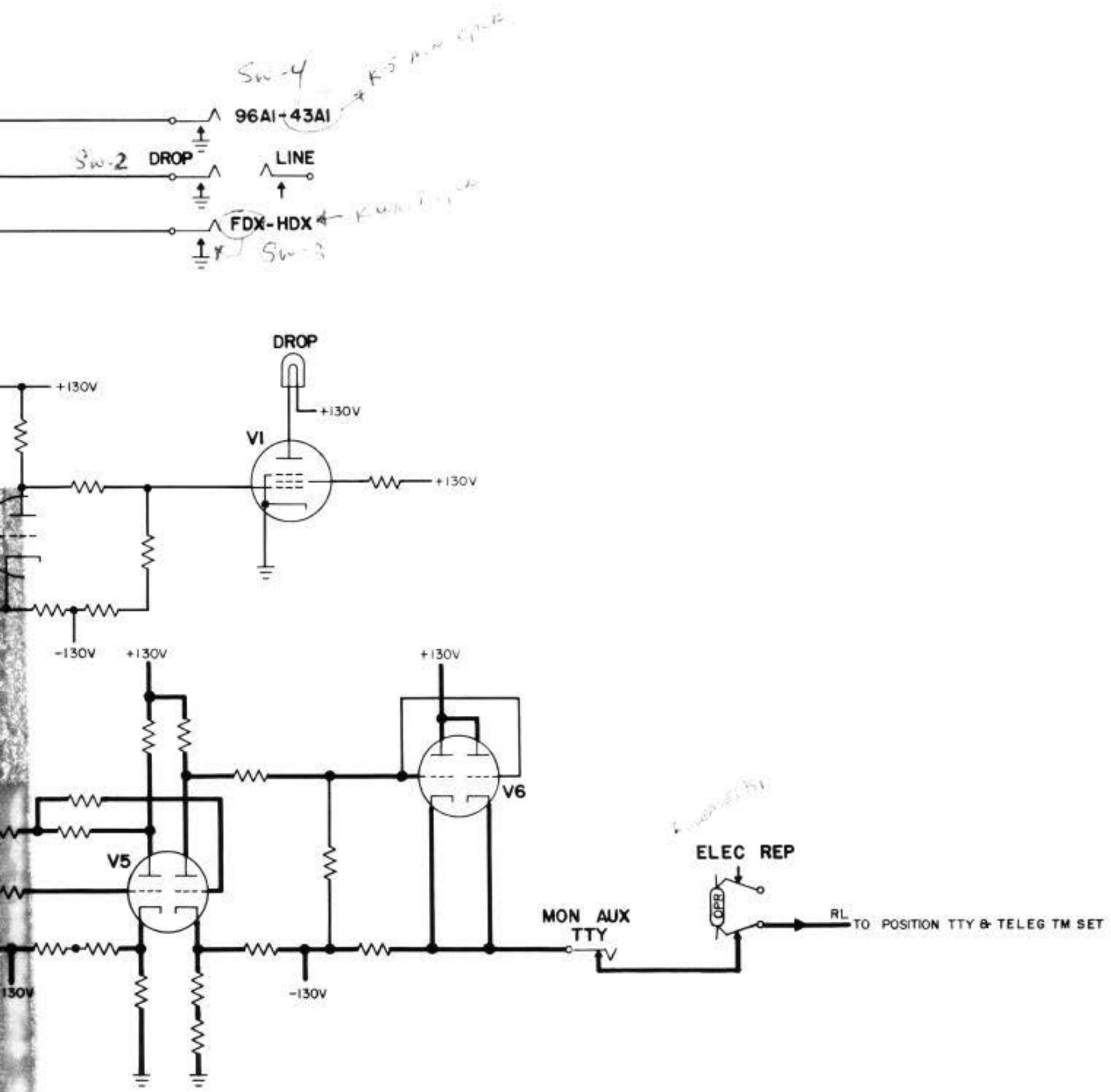



FIG.

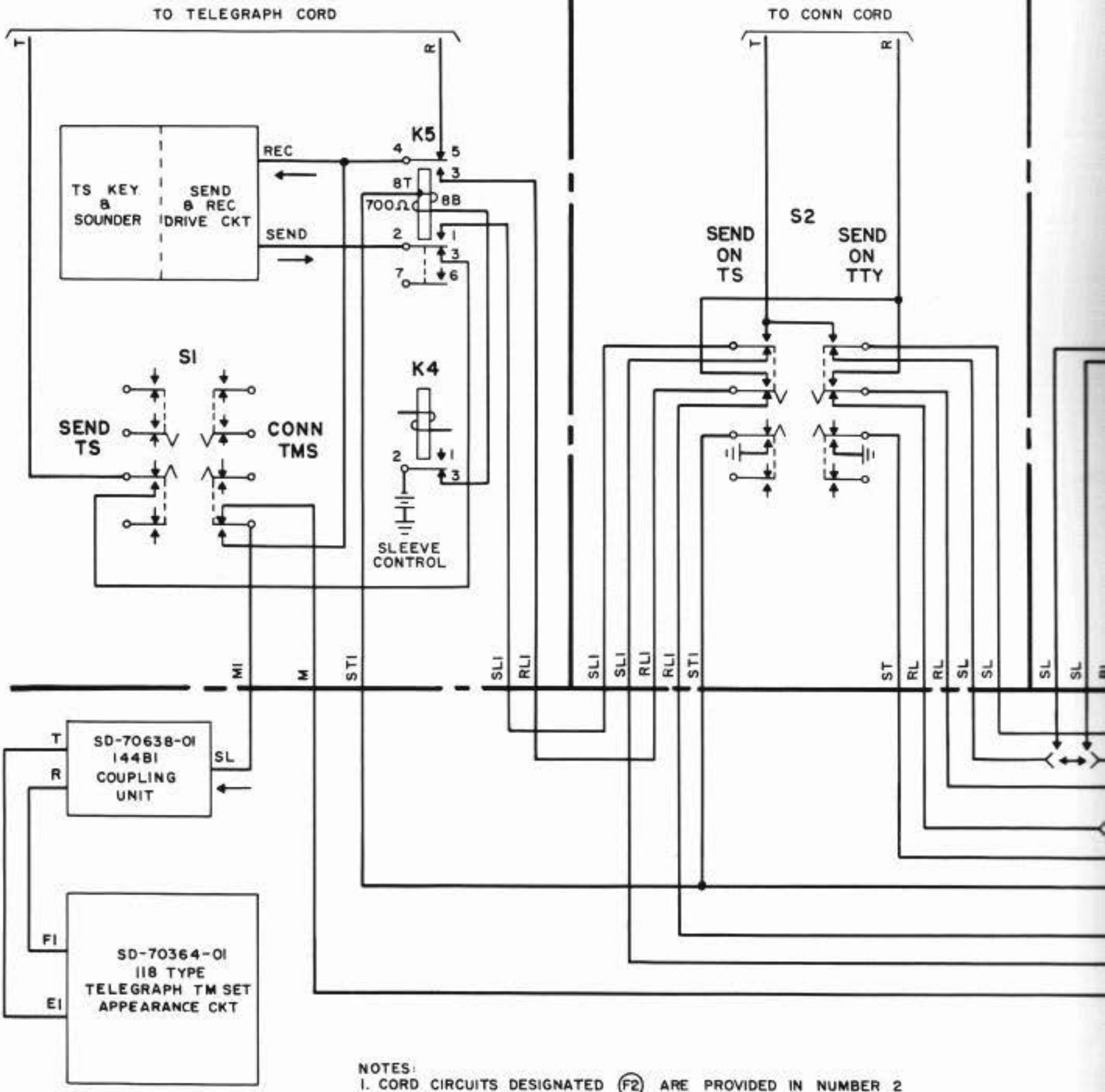



26 - DL MONITORING CKT ARRANGED FOR ELECTRONIC LINE REPEATER MONITORING

Fig. 26

TELEGRAPH CORD & SET CKT
SD-70562-01
(F2), (F9), & (C)

CONN CORD NO. 1
SD-70560-01
(F2), (F9), & (C)




NOTES:
1. CORD CIRCUITS DESIGNATED (F2) ARE PROVIDED IN NUMBER 2 SERVICE BOARD FACILITY POSITION.
   CORD CIRCUITS DESIGNATED (F9) ARE PROVIDED IN NUMBER 98 SERVICE BOARD FACILITY POSITION.
   CORD CIRCUITS DESIGNATED (C) ARE PROVIDED IN NUMBER 98 SERVICE BOARD COMBINED POSITION.

CONN CORD NO. 2
SD-70560-01
(F2)

TTY CORD CKT NO. 1
SD-70559-01
(F2), (F9), & (C)

TO CONN CORD

TO TTY CORD

T

R

S2

SEND ON TTY

SEND ON TS

MON INPUT OF RGEN

SEND TTY

TTY SET

SEND & REC DRIVE CKT

TC

RL

SL

K5

K4 SLEEVE

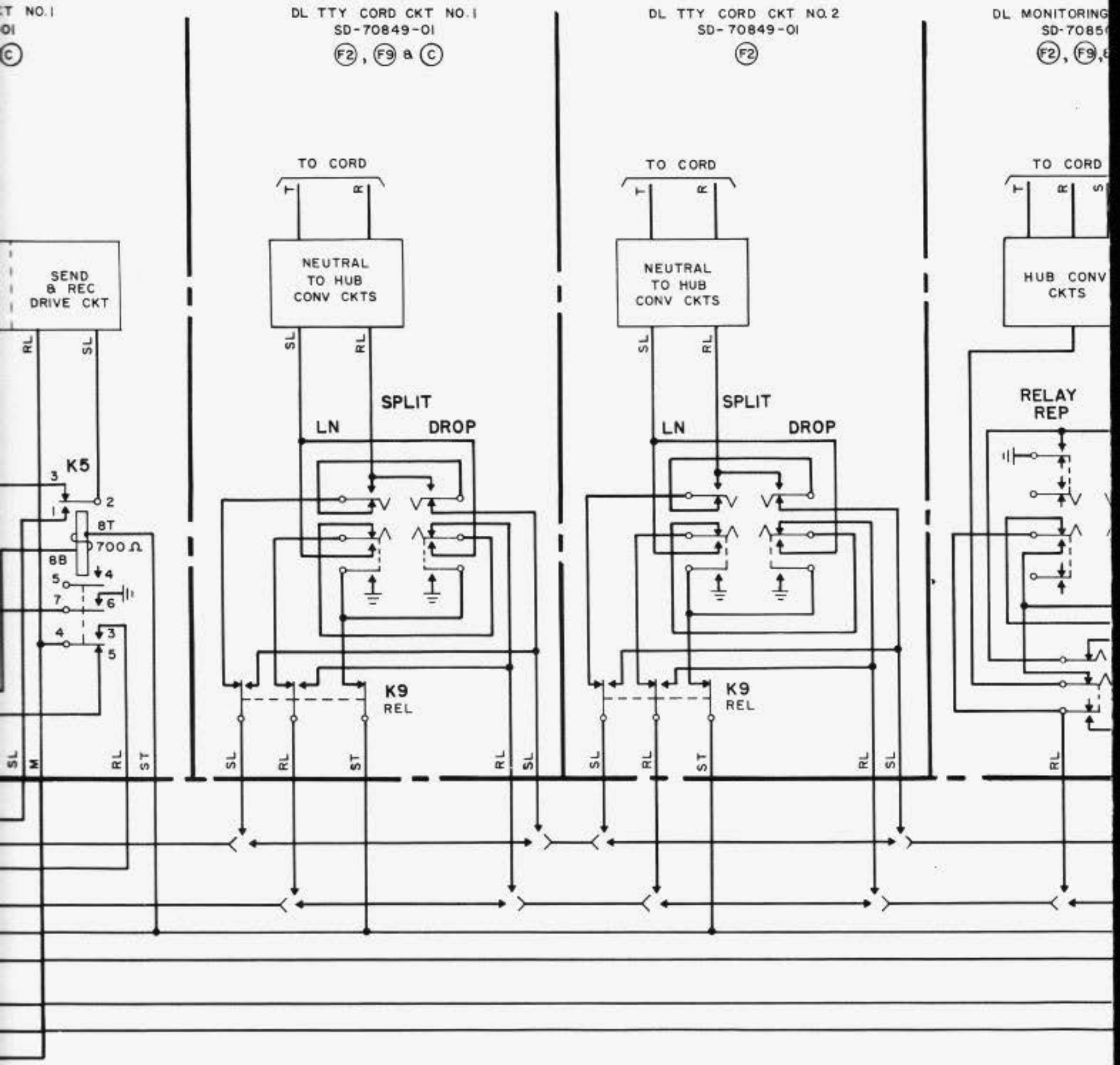
8T

700Ω

8B

SL SL SL SL RL RL ST STI RLI RLI SLI SLI SL M RL ST SL RL

FIG. 27 - COMMUNICATION AND TRANSMISSIO
PREFERENCE CHAIN CIRCUITS (S




27-COMMUNICATION AND TRANSMISSION MEASURING
PREFERENCE CHAIN CIRCUITS (SD-70860-01)

DL MONITORING CKT NO.1
SD-70850-01
(F2), (F9), & (C)

TO CORD
T R S
HUB CONV CKTS
RELAY REP
ELEC REP
MON AUX TTY
RL ST RL

DL MONITORING CKT NO. 2
SD-70850-01
(F2)

TO CORD
T R S
HUB CONV CKTS
RELAY REP
ELEC REP
MON AUX TTY
RL ST RL

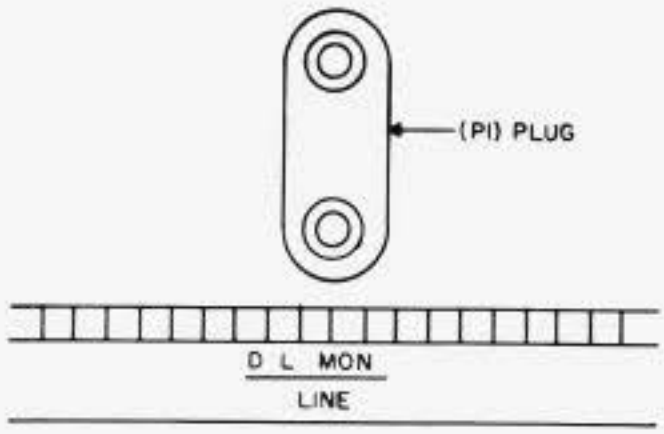
TEST SIG CORD CKT
SD-70550-01
(F2), (F9), & (C)

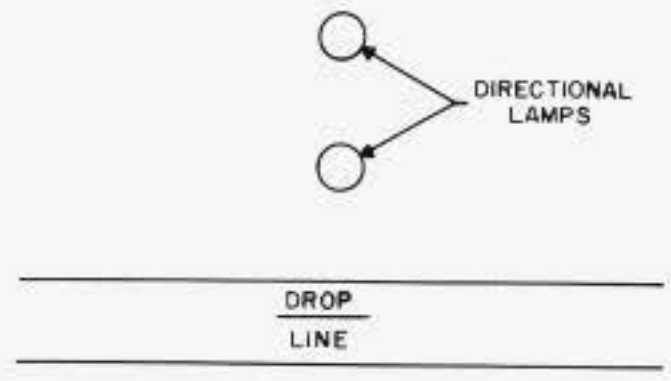
TO CONN LEG CORD
TO CONN SIGS CORD
RELAY CKTS
AI RL SL
SEND TTY
ST SL RL SL RL

NEUTRAL CORD CKT
SD-70558-01
(F2), (F9), & (C)

TO NEUTRAL CORD
R T
NEUTRAL TO HUB CONV CKTS
RL SL
S2
SEND ON TS
SEND ON TTY
RLI SLI STI
ST SL RL

Fig. 27



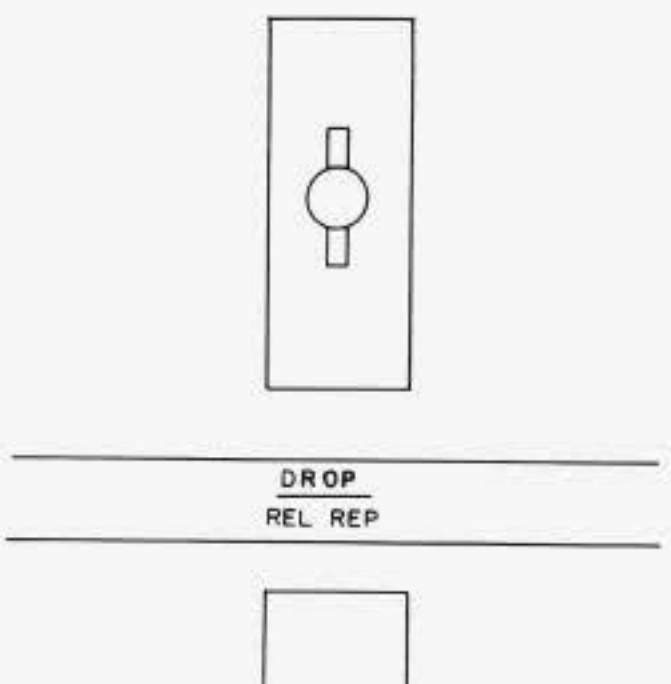
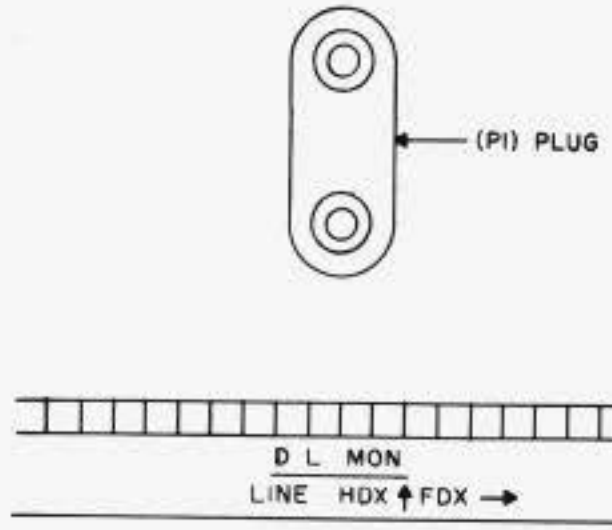




FIG. 28A - KEYSHELF ARRANGEMENT OF DIRECT LEG MONITORING CIRCUIT AT NO. 2 SERVICE BOARD FACILITY POSITION



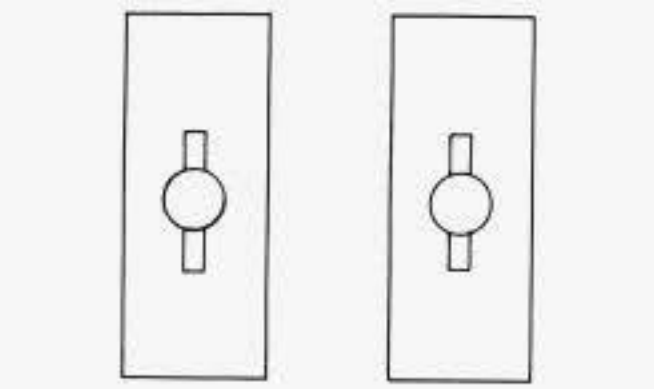




FIG. 28B - KEYSHELF ARRANGEMENT OF DIRECT LEG MONITORING CIRCUIT AT NO. 98 SERVICE BOARD FACILITY POSITION

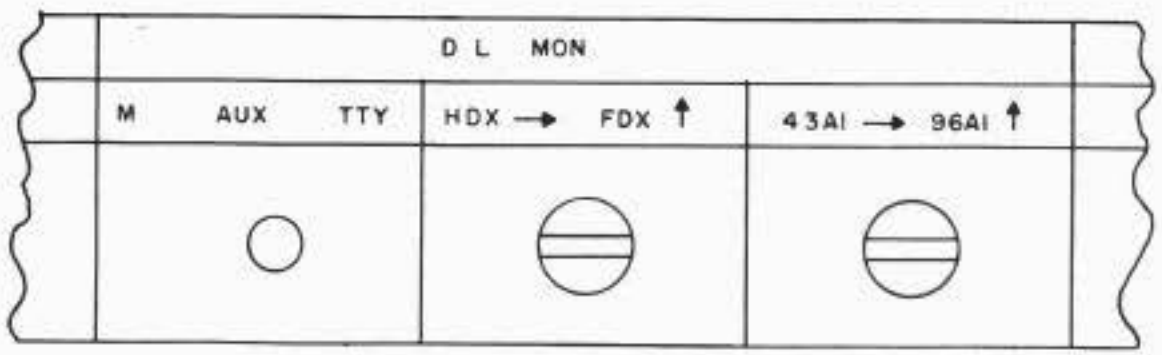



FIG. 29A - FACE EQUIPMENT FOR DIRECT LEG MONITORING CIRCUIT AT NO. 2 SERVICE BOARD FACILITY POSITION

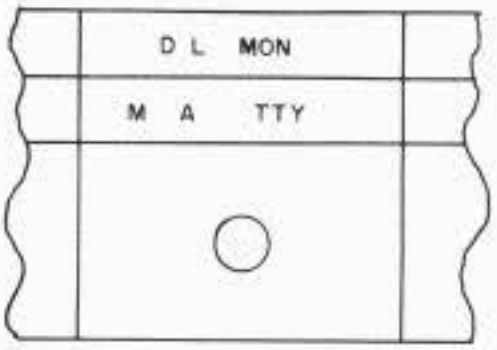
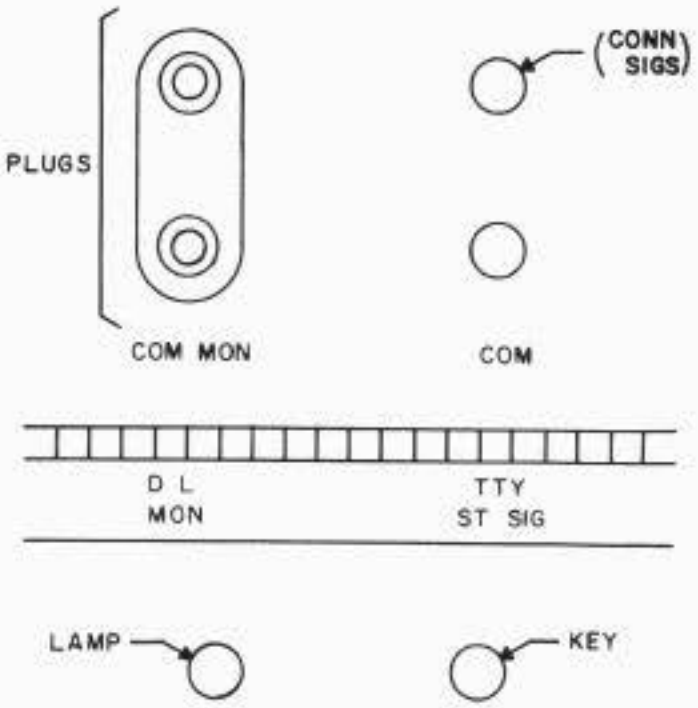



FIG. 29B - FACE EQUIPMENT FOR DIRECT LEG MONITORING CIRCUIT AT NO. 9B SERVICE BOARD KEY-SHELF BAY FACILITY POSITION



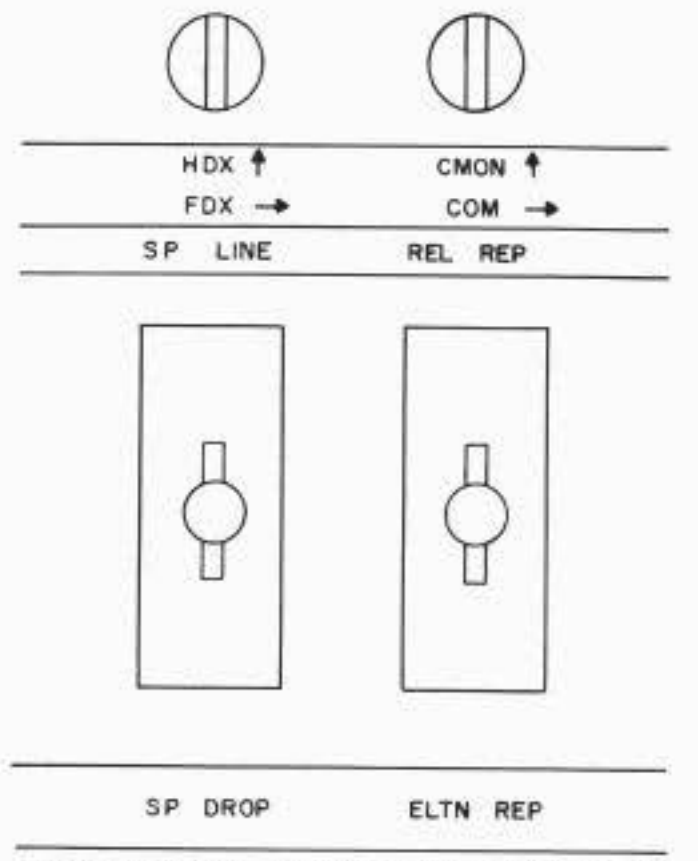




FIG. 30 - KEYSHELF ARRANGEMENT OF DIRECT LEG TELETYPEWRITER CORD CIRCUIT AT NO. 2 SERVICE BOARD FACILITY POSITION OR NO. 9B SERVICE BOARD KEYSHELF BAY FACILITY POSITION

**Fig. 28A, 28B, 29A, 29B, and 30**