TYPE-3 LOW-VOLTAGE HUB
TEST PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This practice contains information on the type-3 low-voltage hub and its associated circuits. The type-3 low-voltage hub will be referred to in this practice as the hub.

1.02 This section is reissued to add more descriptive information on the test setup procedures.

1.03 Information on the 27B1 and 27C1 data mounting test features and instructions on using them are given in this section; however, tests to be performed are not specified. For information on the specific tests required at an outlying or remote station and on the test required to pinpoint or locate a trouble condition, refer to the applicable maintenance section (300) for the data set being used at the remote location.

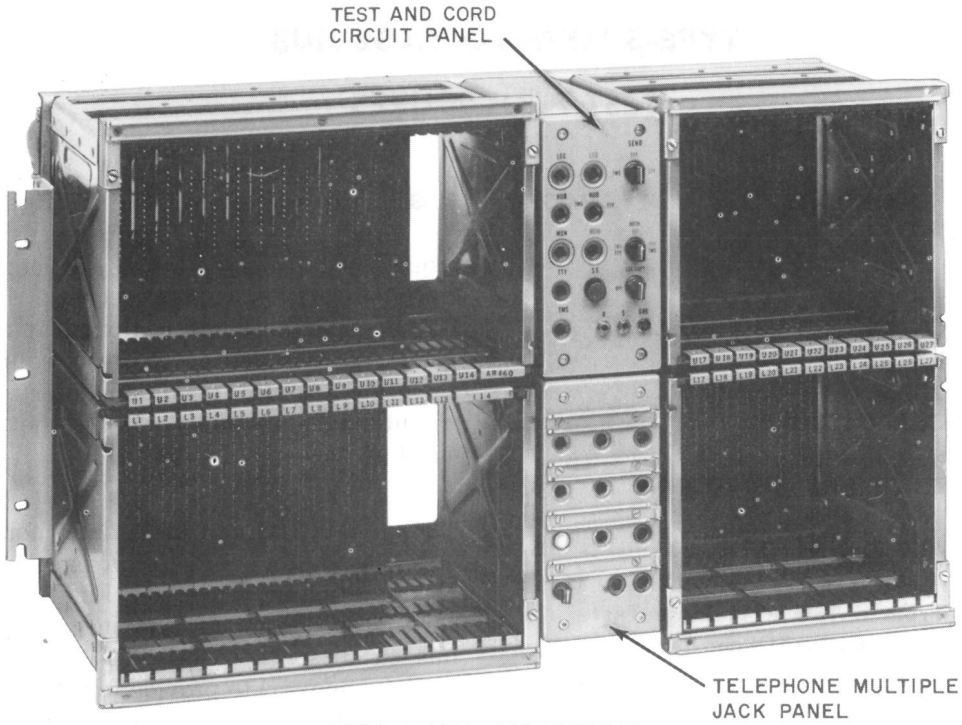
1.04 The 27B1 and 27C1 data mountings provide a test and cord circuit panel and a telephone jack multipling panel (see Fig. 1). This test and cord circuit panel is used in conjunction with the bus circuit pack (AR432 CP), P jack (patch), and M jack (monitor) to provide for in-service monitoring and out-of-service testing.

1.05 The jack and keys (see Fig. 1 and 2) of the test and cord circuit provide connections for a 911A data test set (DTS), teletypewriter (TTY), or a transmission measuring set (TMS). The keys are used to select the test set to be connected to the MON or LEG jacks.

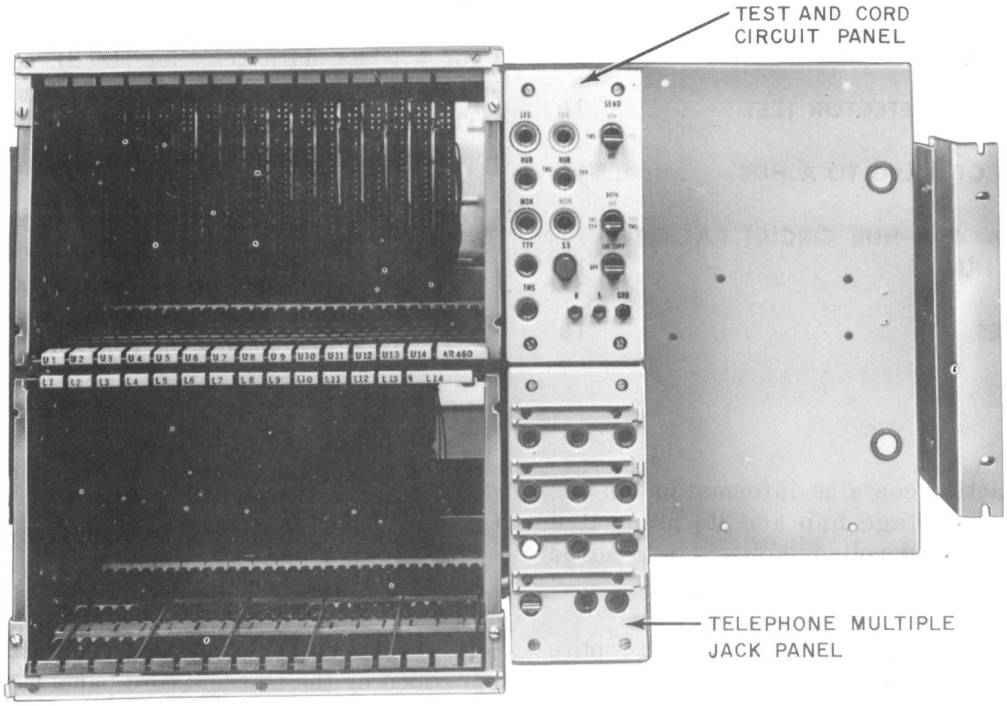
The test and cord circuit and the teletypewriter being used to monitor and test must be arranged for the same type interface, ie, both EIA or both 20 mA current interface.

1.06 The jacks and keys of the test and cord panel are shown in Fig. 2 and Table A. The key numbers shown in Fig. 2 correspond to the numbers shown in Table A which gives the designation and function of each key or jack.

1.07 A functional block diagram of the test and cord circuit shows the electrical connections provided by the test and cord panel (see Fig. 3).



27BI DATA MOUNTING



27CI DATA MOUNTING

Fig. 1—27B1 and 27C1 Data Mountings Showing the Location of the Test and Cord Panel

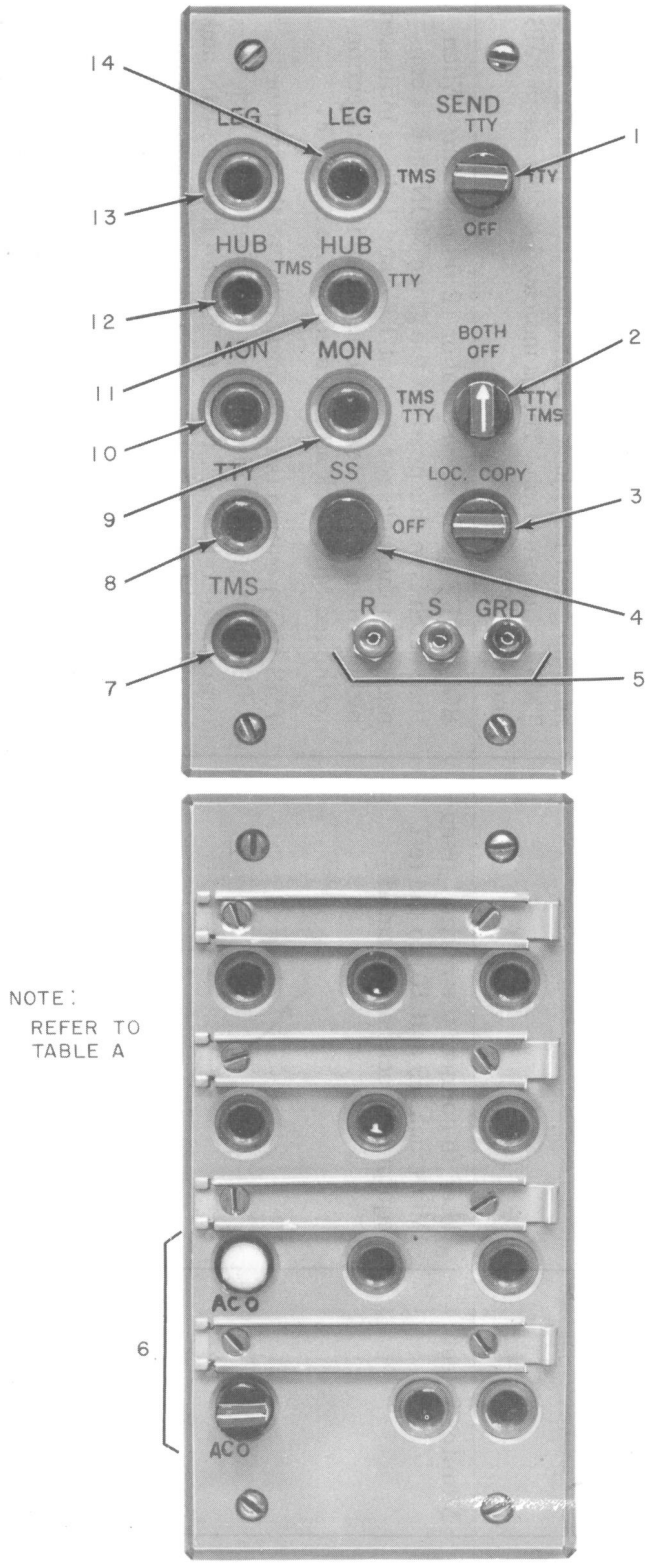


Fig. 2—Test and Cord Panel—Location and Designation of Jacks and Keys

TABLE A

TEST AND CORD PANEL CONTROLS – DESIGNATION AND FUNCTIONS

NO.	DESIGNATION	FUNCTION	SWITCH POSITIONS
1	SEND Select Key	Used to connect the red and green LEG jacks (13 and 14) to the test equipment jacks as indicated.	When this key is in the vertical position the green LEG jack is connected to the jack for the test TTY and there is no connection to the red LEG jack. This is indicated by the green TTY and red OFF panel markings at the top and bottom of the switch. When the key is in the horizontal position the red LEG jack is connected to the jack for the TTY test connection and the green LEG jack is connected to the jack for the TMS test connection. This is indicated by the green TMS and red TTY panel markings.
2	Monitor Select	Used to connect the red and green MON jacks (9 and 10) to the test equipment jacks as indicated.	BOTH-OFF position (vertical or 12:00 position) - When the switch is in this position the green MON jack is connected to the jacks for the test TTY and TMS as indicated by the green BOTH designation. There is no connection to the red MON jack as indicated by the red OFF. TMS-TTY position (switch positioned to the right or 3:00 position) - In this position the green MON jack is connected to the jack for test TMS and the red MON jack is connected to the jack for the test TTY. These connections are indicated by the green TMS and the red TTY panel markings. TTY-TMS position (switch positioned to the left or 9:00 position) - In this position the green MON jack is connected to the jack for the test TTY and the red MON jack is connected to the jack for the test TMS. These connections are indicated by the red TMS and the green TTY panel markings.
3	LOC COPY Key	Provides the necessary connections to cause the test TTY to print local copy.	When this key is in the vertical position the test TTY prints local copy as indicated by the LOC COPY panel marking. When this key is in the horizontal position the test TTY does not provide local copy as indicated by the OFF panel marking.

TABLE A

TEST AND CORD PANEL CONTROLS – DESIGNATION AND FUNCTIONS (Cont)

NO.	DESIGNATION	FUNCTION	SWITCH POSITIONS
4	SS Key	Superimposes a second spacing signal (double space) whenever a space signal is supplied from a TTY or TMS when this key is operated.	This pushbutton key is depressed in order to provide the double space signal to test the 500-ms break timer. When this key is depressed, the TL lamp should remain lighted for the duration of the break.
5	R, S, and GRD Jacks	Provides separate jacks for the R, S, and GRD lead connections for a TMS	Not Applicable
6	ACO Lamp and Key	Provides for acknowledgement of an alarm condition by cutting off the audible alarm and lighting the lamp to indicate that an alarm condition exists.	The ACO (alarm cutoff) key must be operated (turned clockwise) to silence the alarm and light the ACO lamp. After the alarm condition has been cleared, the light can be turned off by restoring the key.
7	TMS Jack	Provides for connecting the TMS through the test card circuit to the leg or hub being tested. Provides the same connection as the R, S, and GRD (5) except these are provided by one plug.	Not Applicable
8	TTY Jack	Provides for connecting the TTY through the test card circuit to the leg or hub jack being used for the test.	Not Applicable
9	MON Jack (Red) See Note	Associated with the Monitor Select Key (2) and is used to connect the leg or hub under test to the test equipment.	Not Applicable

TABLE A

TEST AND CORD PANEL CONTROLS -- DESIGNATION AND FUNCTIONS (Cont)

NO.	DESIGNATION	FUNCTION	SWITCH POSITIONS
10	MON Jack (Green) See Note	Associated with the Monitor Select Key (2) and is used to connect the leg or hub under test to the test equipment.	Not Applicable
11	HUB TTY	Used to connect a hub to the test TTY for test purposes.	Not Applicable
12	HUB TMS	Used to connect a hub to the TMS test equipment when testing is required.	Not Applicable
13	LEG Jack (Red) See Note	Used to connect a leg to test or monitoring equipment. The jack is used in conjunction with the SEND Select Key (1).	Not Applicable
14	LEG Jack (Green) See Note	Used to connect a leg to the test or monitoring equipment. The jack is used in conjunction with the SEND Select Key (1).	Not Applicable

Note: A jack or connector is designated "Red" or "Green" depending on the color of the circle around the jack or the lettering associated with the jack connections. The "Red" or "Green" panel marking indicates the connections that are made by the switch to the jack or connector of the same color.

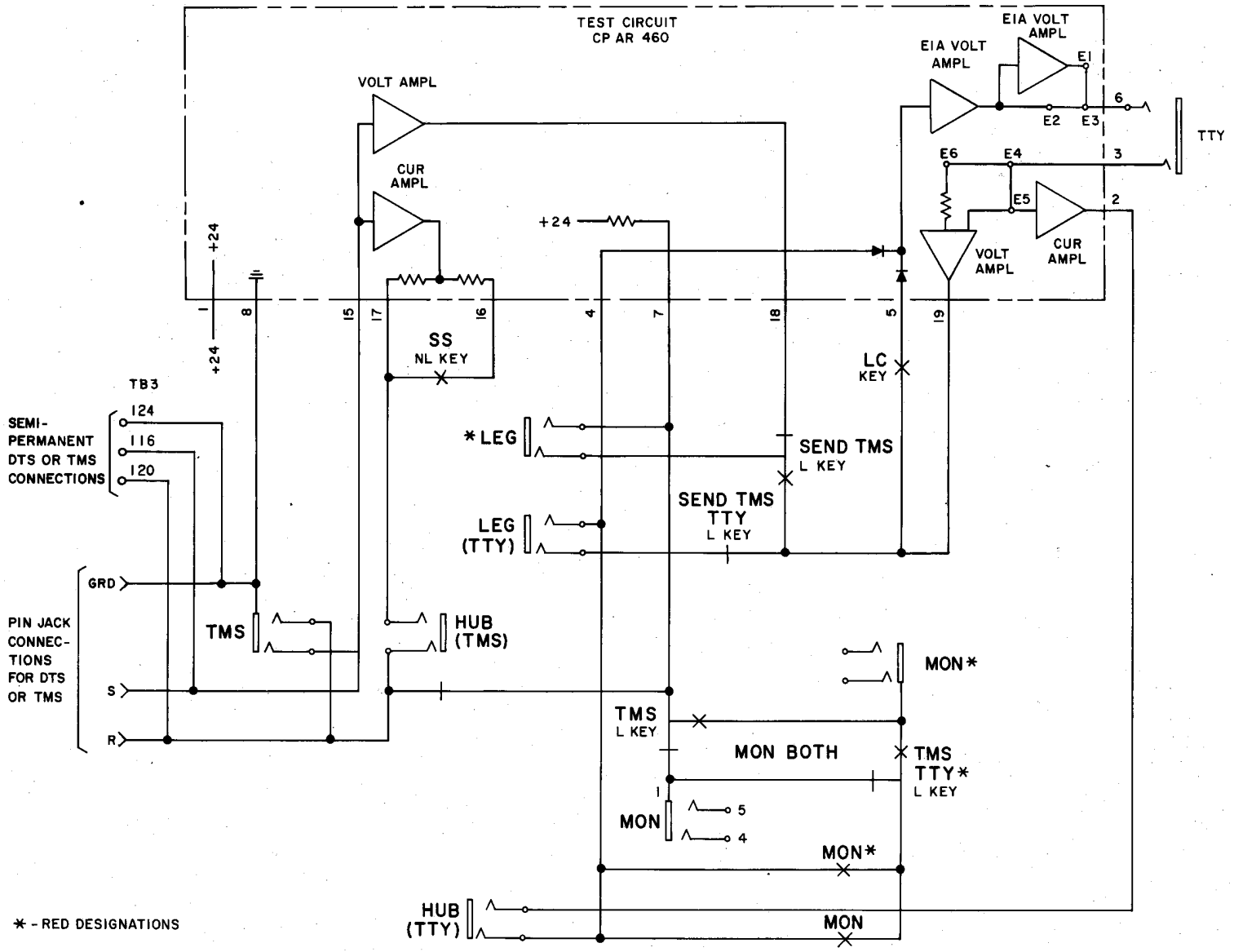


Fig. 3—Test and Cord Panel—Functional Block Diagram

2. MAINTENANCE AND TROUBLE CLEARING CONSIDERATIONS

2.01 When trouble is experienced with a hub circuit, the first consideration is the restoration of customer service. The legs and hub experiencing trouble can be monitored, as outlined in Part 3, to determine which circuits are in trouble or when the trouble is originating.

2.02 When spare legs and hubs are available, a known good unit can be patched in, ie, substituted to provide service until the trouble can be cleared and the equipment returned to service. When patching is not feasible, customer service will have to be disrupted while out-of-service testing.

2.03 When customer service cannot be restored by patching in a spare unit, the trouble condition will have to be located and cleared before service can be restored. A systematic approach to locating and clearing trouble is given in Fig. 4. This figure gives the test or checks that can be easily made in order to pinpoint the trouble and expedite the clearing of the trouble condition. When customer service has been returned by patching in spares, a different sequence of tests might be used. In this case, testing might start with the line facilities instead of the hub.

2.04 The equipment located at the remote station will determine the type testing required at this station. Refer to the applicable BSP for information on the data set and terminal equipment used at the remote station. Tests that are made on line facilities should also be made in accordance with the applicable practices for the equipment being used.

If the test circuit card is arranged for EIA operation, a cord without sleeve-to-sleeve continuity should be used to connect between the TTY jack on the test circuit card and the teletypewriter being used for testing.

3. MAINTENANCE PROCEDURES

3.01 A type-3 low-voltage hub does not require routine or periodic maintenance. Maintenance of this equipment consists of clearing trouble conditions by repairing or replacing defective or malfunctioning equipment.

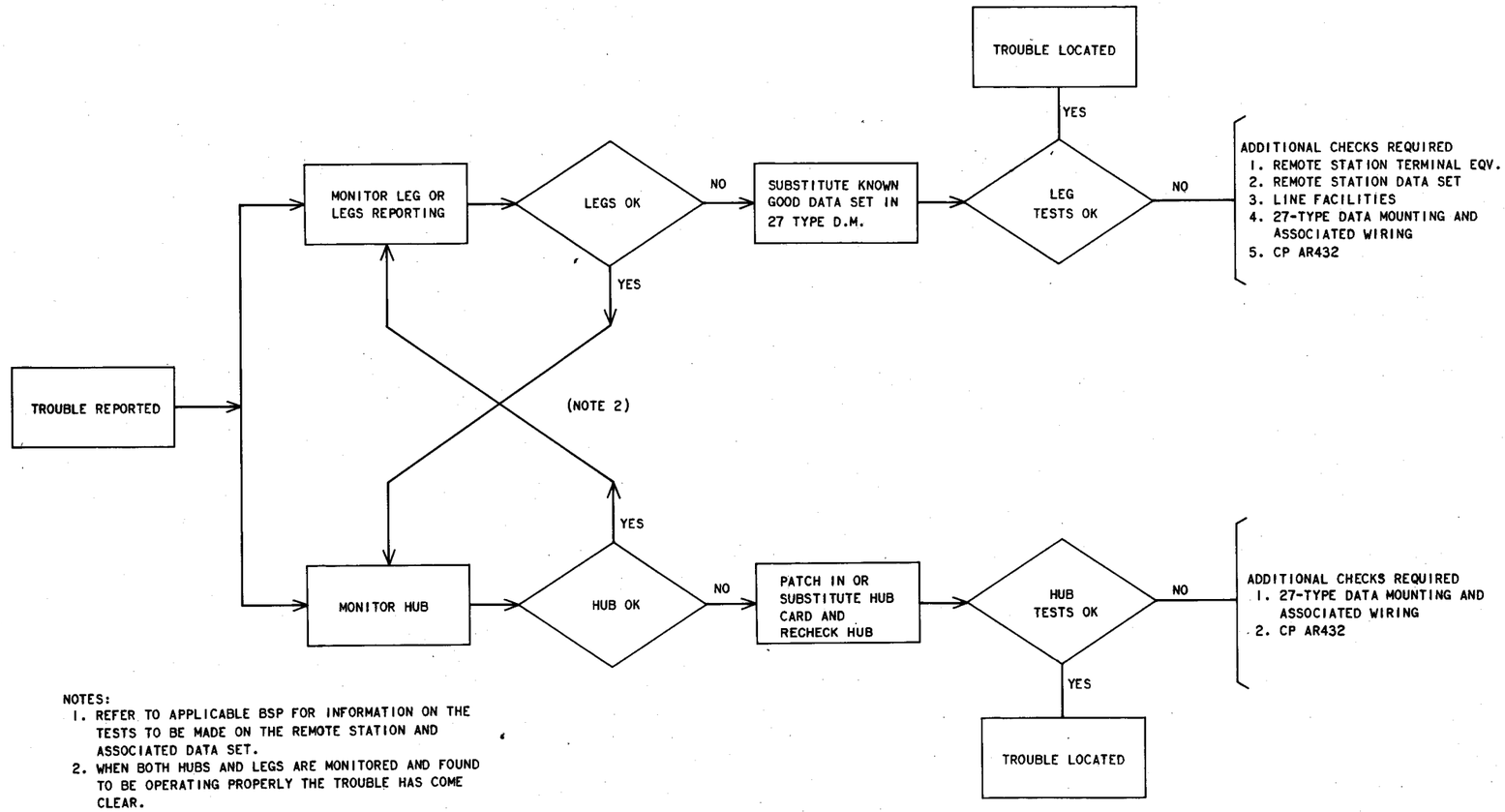
3.02 The tests or procedures required to locate or isolate a trouble condition fall into two categories. These categories are in-service monitoring where customer service is not disrupted and out-of-service testing that requires a disruption of customer service.

References made to the TMS designation in the following maintenance procedures refer to transmission measuring sets or a data test set such as the 911A data test set.

IN-SERVICE LEG OR HUB MONITORING

3.03 A leg or hub circuit may be monitored with a TTY or TMS to determine if it is operating properly. The jacks and keys that are used for connecting the test or monitoring equipment and connecting to the applicable hub or leg bus circuit card are shown in Fig. 5.

3.04 A cord with sleeve-to-sleeve continuity and equipped at both ends with 310 plugs (3W1A or equivalent) will be required to connect between the bus card circuit and the test and cord circuit. Connections from the test and cord circuit to the test sets or monitoring equipment depend on the test equipment being used and whether the test and cord circuit is arranged for EIA or 20 mA current interface. For example, the connection from the test and cord panel to the TTY is made via the TTY jack with the tip used for receiving, the ring for transmitting, and the sleeve for −24V battery return to complete the send and receive loops (3W1A cord or equivalent) if the circuit is arranged for 20 mA current interface. If the circuit is arranged for EIA interface, the cord must ***not*** have sleeve-to-sleeve continuity. The transmitter section of the 911A DTS is connected by either the TMS jack ring connection, pin jack S (P1N cord or equivalent), or terminal TB3-116 (refer to Fig. 3). The receive section of the 911A DTS is connected by either the TMS jack tip connection, pin jack R (P1N cord or equivalent) or terminal TB3-120 (refer to Fig. 3). Refer to Section 103-813-100 for information on the cords and connectors required when using a 911A DTS.



NOTES:
1. REFER TO APPLICABLE BSP FOR INFORMATION ON THE TESTS TO BE MADE ON THE REMOTE STATION AND ASSOCIATED DATA SET.
2. WHEN BOTH HUBS AND LEGS ARE MONITORED AND FOUND TO BE OPERATING PROPERLY THE TROUBLE HAS COME CLEAR.

Fig. 4—Trouble Locating Procedure—Block Diagram

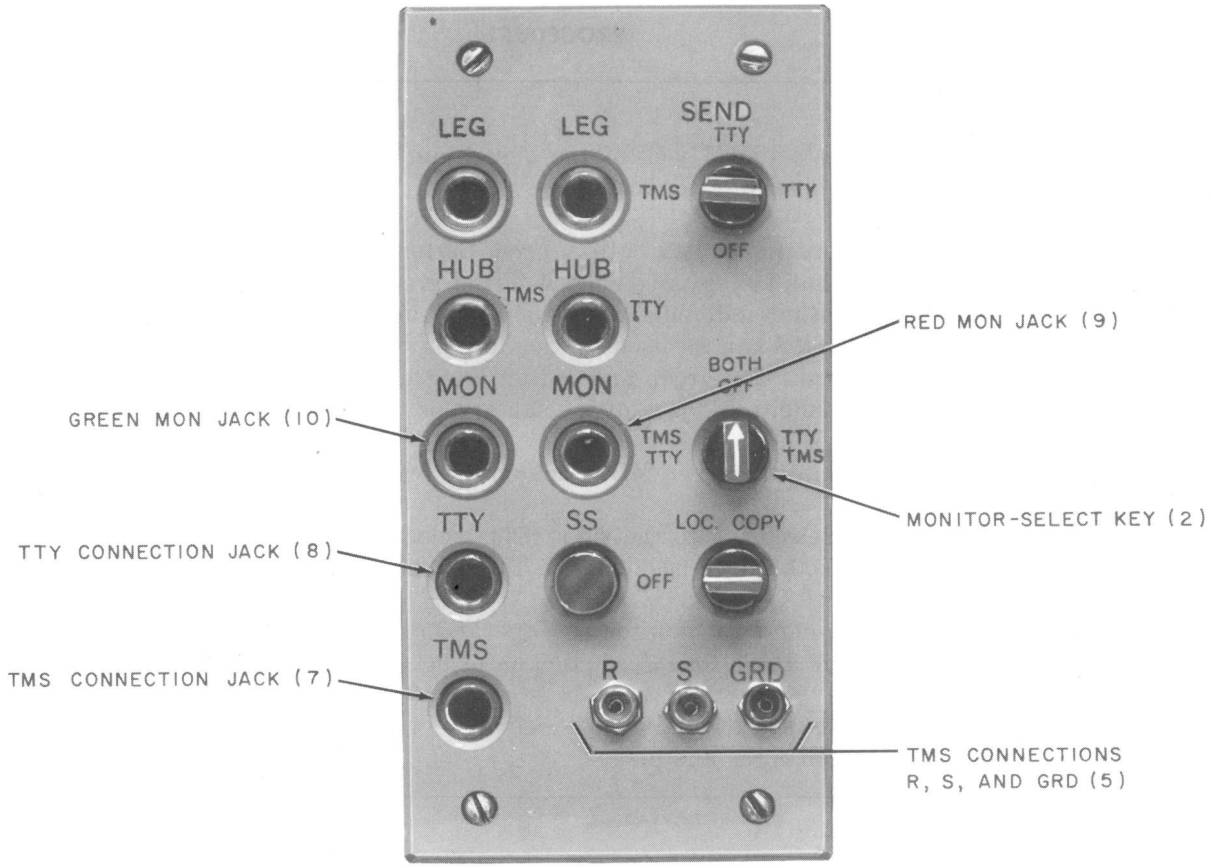


Fig. 5—Test and Cord Panel—Jacks and Keys Used for In-Service Monitoring

3.05 Perform the following procedure to monitor a hub or leg while it is in service. (Refer to Fig. 5.)

STEP	PROCEDURE
1	Connect the TMS and/or TTY to the test and cord panel in accordance with Fig. ▶6 or 7 and the following procedure.◀ ***Note:*** It is possible to monitor two hubs or legs at the same time by using a TMS and a TTY simultaneously. This is accomplished by connecting one hub or leg to the green MON jack and the other leg to the red MON jack. The Monitor Select key is then set to ▶TMS-TTY or TTY-TMS. Refer to Table A to determine which leg jacks the TTY and TMS are monitoring.◀

STEP	PROCEDURE
2	Insert the patch cord into the M jack of the bus circuit pack (AR432 CP) associated with the hub or leg to be monitored (refer to Fig. 8). ***Note:*** The test and cord panel has both a green lettered MON jack and a red lettered MON jack. When the hub or leg is connected to the green MON jack, it can be monitored by a TTY and TMS, either individually or simultaneously. When the red MON jack is used, either a TTY or TMS can be used to monitor the circuit, however, both units cannot be used at the same time. The green and red lettering on the Monitor Select key indicates the connection that is made to the jack of the same color.
3	Insert the ▶patch cord into the green MON jack on the test cord panel.◀
4	▶Operate the Monitor Select key to the right (3:00 o'clock position) if a TMS is being used for test or to the left (9:00 o'clock position) if a TTY is being used.◀
5	Operate the test equipment to monitor the operation of the leg or hub. Refer to the applicable test equipment BSPs for information on using the test equipment.
6	When no additional tests are to be made, the equipment can be returned to normal service by removing all the patch cords and plugs.

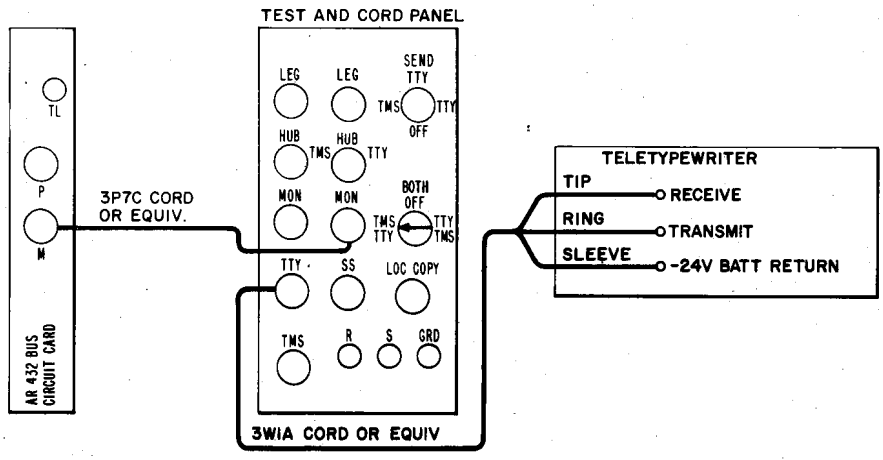


Fig. 6—▶Monitoring Hub or Leg with Teletype (20 mA Current Interface)◀

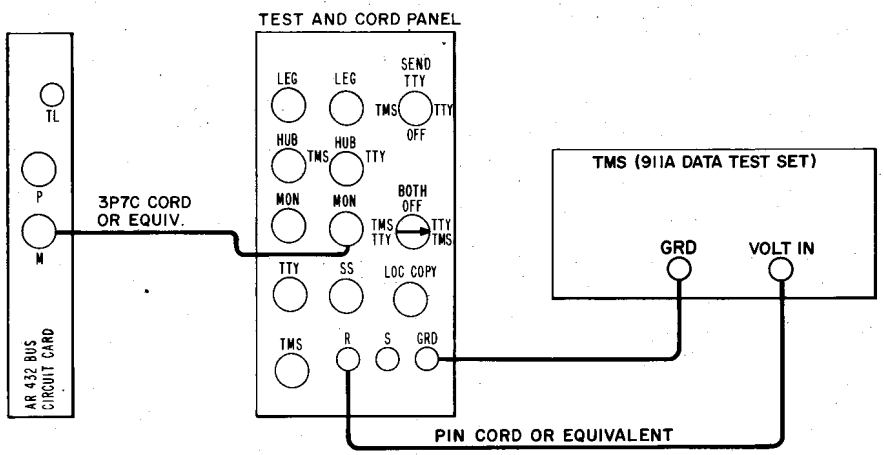


Fig. 7—Monitoring Hub or Leg with Transmission Measuring Set

OUT-OF-SERVICE TESTING OF A LEG

Before performing the following test, a release of the circuit must be obtained from the customer.

3.05 When a leg of the hub is to be tested using a TMS or TTY, the leg must first be removed from service. This avoids interrupting the service on the other legs associated with the hub. The following procedure uses the test and cord circuit to remove a leg from service and make the required test connections.

Note: The following test may require that a telephone craft employee be dispatched to the terminal equipment to make the distortion measurements indicated. If the station is arranged for loop-back testing, tests of the transmission facility can be made from the hub on a loop-back basis provided the terminal equipment at the station can be placed in the test mode.

A. Sending From a TSG (911-Type Test Sentence Generator) or TTY and Receiving With a TMS

STEP	PROCEDURE
1	Insert a dummy plug (165-type) into the P (patch) jack of the bus circuit pack (AR432 CP) associated with the leg to be tested. This removes the leg from the hub and avoids disrupting service on the other legs of the hub (refer to Fig. 8).
2	Insert a patch cord into the green lettered LEG jack on the test and cord circuit panel (refer to Fig. 9).
3	Connect the other end of the patch cord to the M (monitor) jack on the bus circuit pack for the leg being tested.
4	Connect the TSG and TTY to the test and cord panel in accordance with the applicable BSP for the test equipment being used. ***Note:*** The previous connections provide for out-of-service testing of a leg with a TTY and TSG. Coordination of the following test procedure may require that a telephone connection be established between the hub and terminal equipment.

STEP	PROCEDURE
5	If the leg is to be tested with a TSG, position the SEND key to the green TMS position (horizontal position). When the leg is tested with a TTY, the SEND key is set to the green lettered TTY (vertical or 12:00 noon position). The leg can now be tested by sending to the remote terminal where distortion measurements can be made. Distortion measurements of the data being transmitted to the hub from the remote terminal are made simultaneously and displayed by the TMS when testing an FDX facility. For a remote terminal that is arranged for loop-back testing (test mode), the facility can be tested completely from the hub location on a loop-back basis. Test signals sent from a TSG or TTY are transmitted to the remote terminal and looped back to the hub where the distortion reading is displayed by a TMS.
6	If no additional tests are required, the leg can be restored to normal by removing all patch cords and plugs.

B. Sending From a TTY and Receiving With a TTY

STEP	PROCEDURE
1	Insert a dummy plug (165-type) into the P (patch) jack of the bus circuit pack (AR432 CP) associated with the leg to be tested. This removes the leg from the hub and avoids disrupting service on the other legs of the hub (refer to Fig. 8).
2	Insert a patch cord into the red lettered LEG jack on the test and cord circuit panel (refer to Fig. 9).
3	Connect the other end of the patch to the M (monitor) jack on the bus circuit pack for the leg being tested.
4	Connect the TTY to the test and cord panel using TTY connector (see Fig. 9).
5	The leg can now be tested by sending from the keyboard to the remote terminal, and if the remote terminal is arranged for loop-back testing (test mode), the transmitted data is received by the TTY printer at the hub.
6	If no additional tests are required, the leg can be restored to normal by removing all patch cords and plugs.

OUT-OF-SERVICE HUB TESTING

Before performing the following test, a release of the circuit must be obtained from the customer.

3.06 When a hub is to be tested using either a DTS, TTY, or TMS, it will first have to be removed from service. The following procedure uses the test and cord circuit to remove a hub from service and make the required test connections.

STEP	PROCEDURE
1	If a test of the hub circuit pack without the legs of the concentrator group connected to it is required, insert a dummy plug (165-type) into the P (patch) jack of the bus circuit pack (AR432 CP) associated with the hub to be tested. ***Note:*** If the hub is to be tested with all legs connected to it, no dummy plug need be inserted into the P jack (refer to Fig. 8).
2	Connect one end of a patch cord to the M (monitor) jack on the bus circuit pack for the hub being tested (refer to Fig. 8).
3	If the hub is to be tested with a TMS or DTS, connect the other end of the patch cord to the HUB TMS jack on the test and cord circuit panel (refer to Fig. 10).
4	Connect the data test set equipment to the test and cord panel in accordance with the applicable BSP for the equipment being used (see Fig. 3).
5	Operate the data test set equipment to drive the hub and measure the distortion. ***Note:*** Distortion readings should not exceed 1 percent when the hub cord is tested in this way.
6	When the hub is to be tested with a TTY, the patch cord from the hub bus circuit pack is inserted into the jack marked HUB TTY (refer to Fig. 10) and the TTY is used to transmit test signals from the keyboard. ***Note:*** Information sent from the TTY keyboard should cause the hub to drive the TTY print mechanism without error.
7	When no additional tests are to be made, the hub can be restored to service by removing all patched cords and plugs.

DOUBLE-SPACE DETECTOR TEST

Before performing the following test, a release of the circuit must be obtained from the customer.

3.07 The double-space detector and break transmitter of the hub circuit pack can be tested in the following manner. Switch S3 of the hub circuit pack should be in position A to operate the break transmitter. The following procedure uses the test and cord circuit to remove a hub from service and make the required test connection.

STEP	PROCEDURE
1	Insert a dummy plug (165-type) into the P (patch) jack of the bus circuit pack (AR432 CP) associated with the leg to be tested. This removes the leg from service (refer to Fig. 8).
2	Connect one end of a patch cord to the M (monitor) jack on the bus circuit pack for the hub being tested (refer to Fig. 8).
3	Connect the other end of the patch cord to the HUB TMS jack on the test and cord circuit panel (refer to Fig. 10).
4	Connect the data test set equipment to the test and cord panel in accordance with the applicable BSP for the distortion measuring equipment being used.
5	Operate the data test set equipment to drive the hub.
6	Observe the TL lamp associated with the hub circuit being tested. The lamp should go on and off in step with the data signals coming in. Operate key SS. The TL lamp should remain lighted for one-half second and then continue to flicker with the data rate.
7	The hub can be restored to service by removing all patched cords and plugs.

PATCHING OF A LEG TO A HUB

3.08 When performing a trouble clearing routine or making a test, it may be advantageous to patch a leg to another hub for testing or add an additional leg to a concentrated group on a temporary basis. This is accomplished as indicated by the following procedure.

STEP	PROCEDURE
1	Insert a dummy plug into the P (patch) jack of the bus circuit pack (AR432 CP) for the leg to be transferred. This will lift the leg from the bus without disturbing the other legs in service. ***Note:*** The patch cord used in the following procedure must not have sleeve-to-sleeve continuity (sleeves tied together) to prevent connecting the TL lead of the leg to the SH lead of the hub, thereby causing hits into the hub circuit.
2	A patch cord (equipped with 310 plugs on both ends and having tip-to-tip and ring-to-ring continuity only) is inserted in the M (monitor) jack of the bus circuit pack (AR432 CP) of the leg to be transferred.

STEP	PROCEDURE
3	If it is necessary to perform monitoring tests on the leg to be transferred, continue with Step 5, otherwise Step 4.
4	Connect the other end of the patch cord to the M (monitor) jack of the bus circuit pack (AR432 CP) associated with the hub circuit pack receiving the transferred line. ***Note:*** This patch arrangement ties the SL and RL leads of the leg to the respective SL and RL bus lines for the hub.
5	Connect the other end of the patch cord to any of the three jacks of the TRK1 or TRK2 multiple groups. One end of a second patch cord (equipped with 310 plugs on both ends and having tip-to-tip and ring-to-ring continuity only) is inserted in the second of the three TRK jacks. The other end of the cord is inserted into the M (monitor) jack of the bus circuit pack (AR432 CP) associated with the hub circuit pack receiving the transferred line. The third jack of the TRK group can now be used to perform monitoring functions. ***Note:*** The TRK1 and TRK2 multiple jacks are also multipled to all other hub equipment bays. If it is necessary to transfer a leg from one bay to a hub concentration group on another bay, the TRK multiple jacks should be used according to Steps 1, 2, and 5.

PATCHING OF A HUB CIRCUIT PACK TO ANOTHER HUB

3.09 It may become necessary to patch a spare hub circuit pack to a hub concentration group for trouble clearing. This is accomplished by the following procedure.

STEP	PROCEDURE
1	Insert a dummy plug into the P (patch) jack of the bus circuit pack (AR432 CP) for the hub circuit pack to be transferred. This will lift the hub circuit pack from the buses. ***Note:*** The patch cord used in the following procedure must not have sleeve-to-sleeve continuity (sleeve tied together) to prevent connecting the TL lead of the leg to the SH lead of the hub, thereby causing hits into the hub circuit.
2	A patch cord (equipped with 310 plugs on both ends and having tip-to-tip and ring-to-ring continuity only) is inserted into the M (monitor) jack of the bus circuit pack (AR432 CP) of the hub circuit pack to be transferred.
3	Connect the other end of the patch cord to the P (patch) jack of the bus circuit pack (AR432 CP) for the hub receiving the transferred hub circuit pack. ***Note:*** This patch arrangement ties the SL and RL leads of the hub circuit pack to the respective SL and RL bus lines for the hub.

4. REFERENCES

4.01 For additional detailed information on the type-3 low-voltage hub and the associated equipment, refer to the following documents.

NUMBER	TITLE
SD- & CD-1D172-01	Data Set 109G-L1
SD- & CD-73059-01	Data Systems Central Office Type-3 Low-Voltage Hub Circuit
SD & CD-73060-01	Data Set 108D-L1

SECTION	TITLE
103-813-100	911A, B, and C Data Test Sets—Description, Operation, and Maintenance
312-805-100	Data Set 108D-Type Used With Type-3 Low-Voltage Hub Arrangement—Description
312-808-100	Data Set 109G-11
807-401-153	Type-3 Low-Voltage Hub Equipment Design Requirements

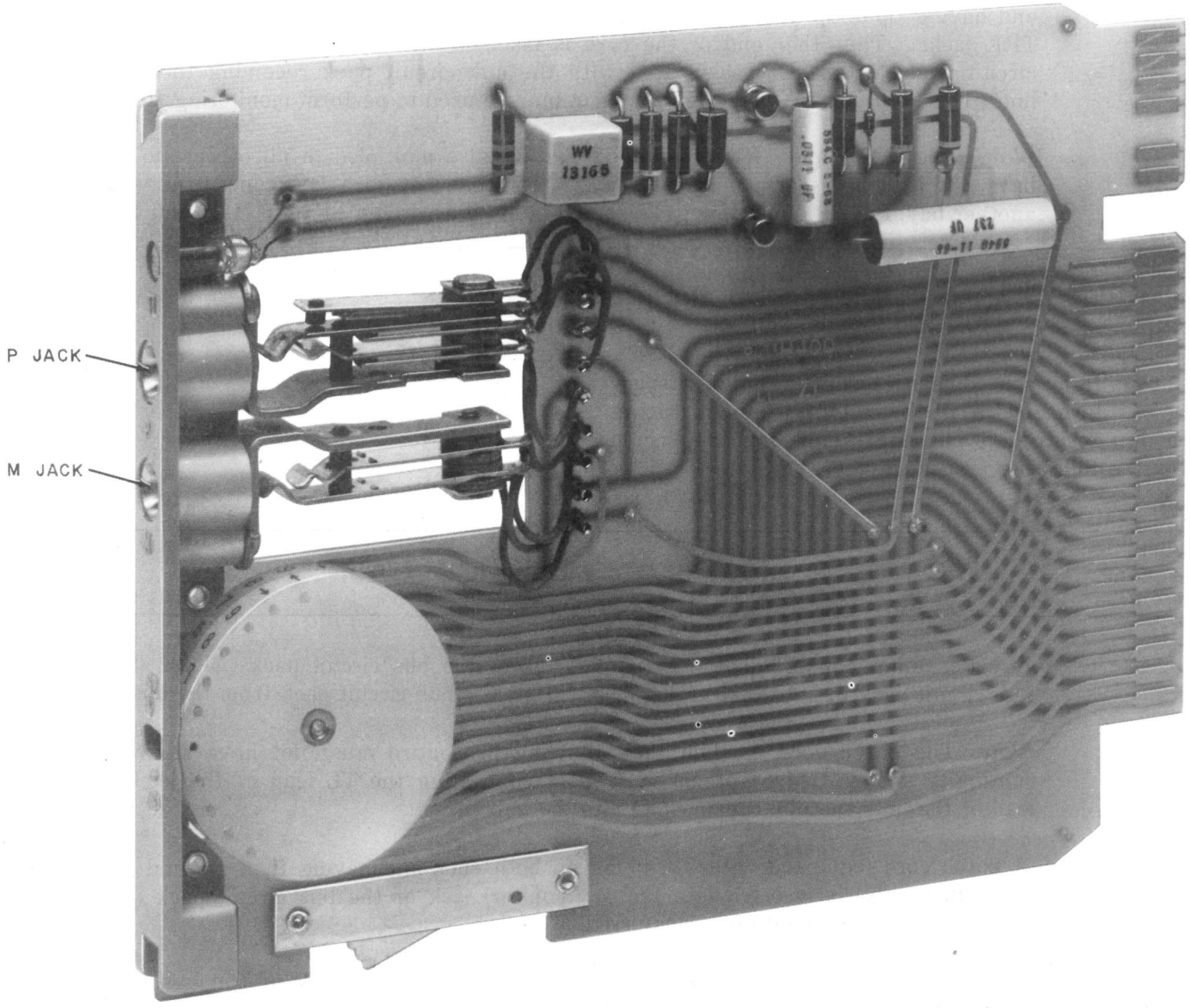
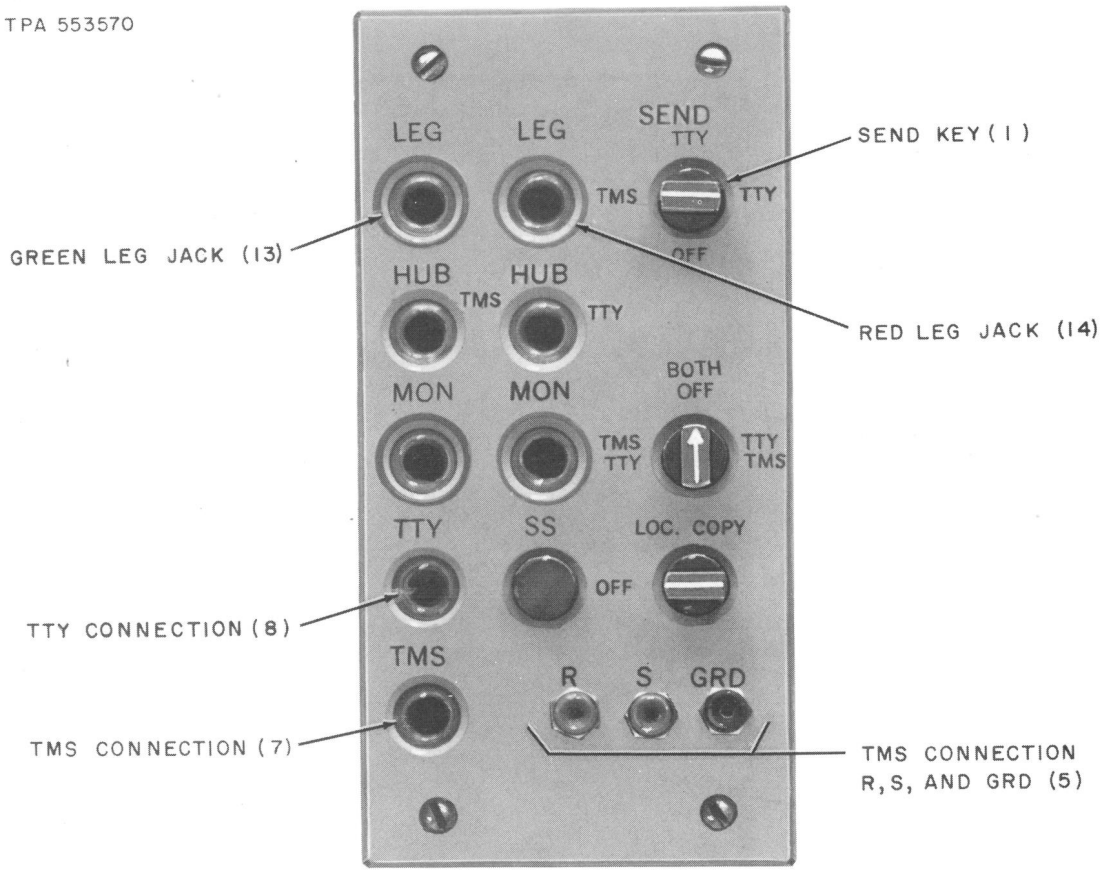
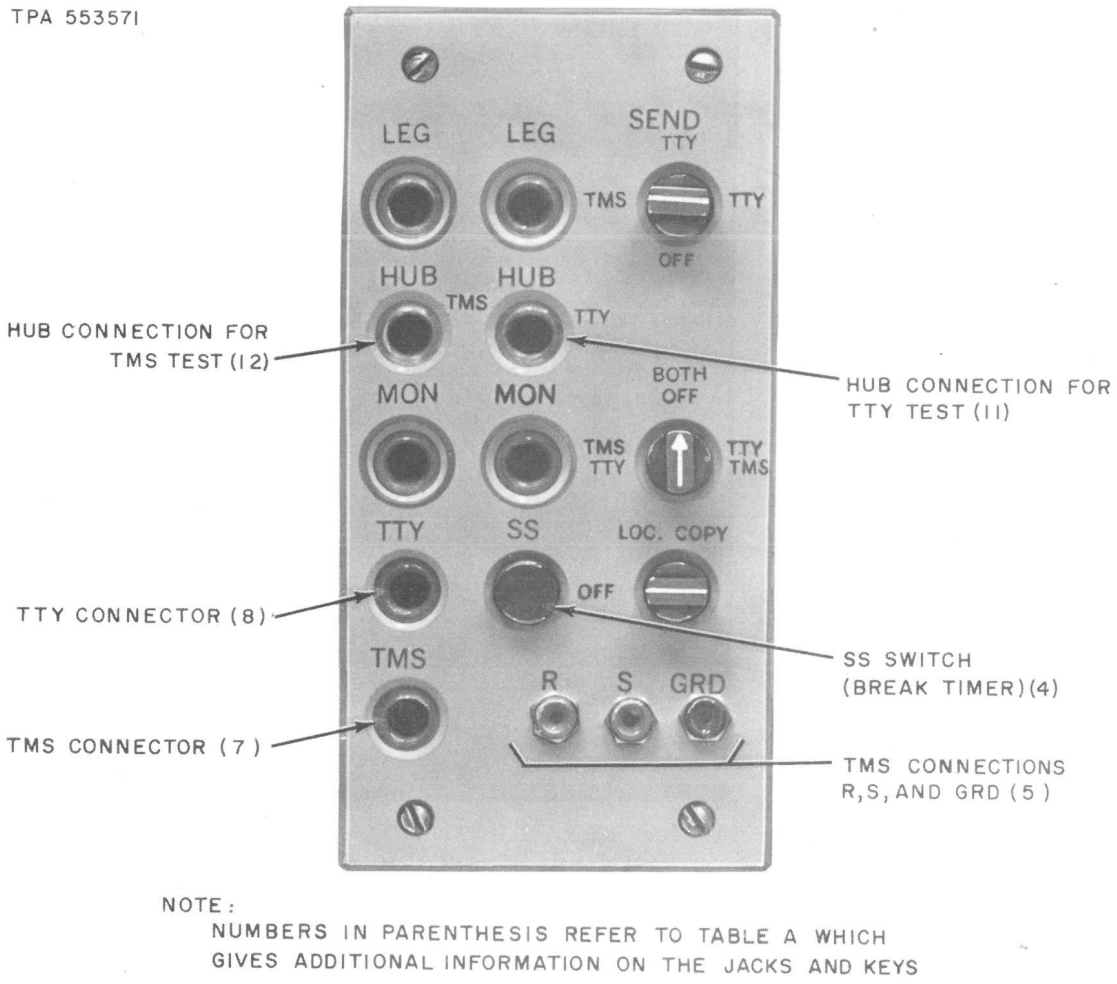


Fig. 8—Bus Card Circuit Pack (AR432 CP) Showing the Location of the M and P Jacks



NOTE:
NUMBERS IN PARENTHESIS REFER TO TABLE A WHICH GIVES ADDITIONAL INFORMATION ON THE JACKS AND KEYS.

Fig. 9—Test and Cord Panel—Jacks and Keys Used for Out-of-Service Leg Testing



NOTE:
NUMBERS IN PARENTHESIS REFER TO TABLE A WHICH GIVES ADDITIONAL INFORMATION ON THE JACKS AND KEYS

Fig. 10—Test and Cord Panel—Jacks and Keys Used for Out-of-Service Hub Testing