PRIVATE LINE TELEPHONE SERVICE
SPECIAL MULTISTATION SYSTEMS
TESTS AND ADJUSTMENTS

CONTENTS PAGE

1. INTRODUCTION

1.01 This section covers the procedure for various tests, adjustments and maintenance of special one-way and two-way multistation circuits. It assumes the familiarity with and makes use of the circuit and equipment arrangements described in Section 310-400-100.

1.02 Communication is furnished between the center and outlying stations by the one-way speech multistation circuit. No signaling is involved and all stations are monitored. There is also radio transmitter and receiver equipment connected with this arrangement which serve as backup for the wire line facilities.

1.03 The two-way multistation circuit provides two-way speech and two-way signaling between the center and a maximum of six outlying stations on a 4-wire basis. Also, where more than one two-way multistation circuit terminates at the center a grouping arrangement is provided to connect all these two-way circuits together at the center so that the center can communicate with all stations simultaneously.

2. ONE-WAY SPEECH MULTISTATION CIRCUITS

(A) General

2.01 The maximum allowable 1000-cycle line losses are indicated on Fig. 1. If only one position is connected to the circuit at the center and only one telephone instrument is connected at each outlying station, the over-all effective transmission should be approximately -5 db. As shown by Fig. 1 it is possible for the other positions at the center to monitor on the line. Each monitoring position will cause approximately 1.5 db loss. As mentioned previously the line may be connected to a radio transmitter at the center. When the radio transmitter is not connected it is replaced by a 600-ohm resistor. The bridging loss of the radio transmitter or its idle termination on the line is approximately 3.5 db.

2.02 Each outlying station has two separate on-premise locations which are connected to the one-way speech multistation circuit. The first (Location A) has two sets of jacks wired in parallel and a two-position switch which is used to connect these jacks to either the incoming wire line or to the output of a local radio receiver. Location B is another on-premise multiple of the same equipment provided at Location A with the exception that a single jack is provided together with a 100-type loudspeaker, the latter being removed from the circuit when the 52-type operator's head set is plugged into the jack.

(B) Over-all Transmission Measurements

2.03 In setting the gains of the amplifiers of the one-way speech circuit a 1000 cps, -10 dbm test tone should be applied to the test jack at the center as shown in Fig. 2. With this tone applied the gains of the amplifiers at

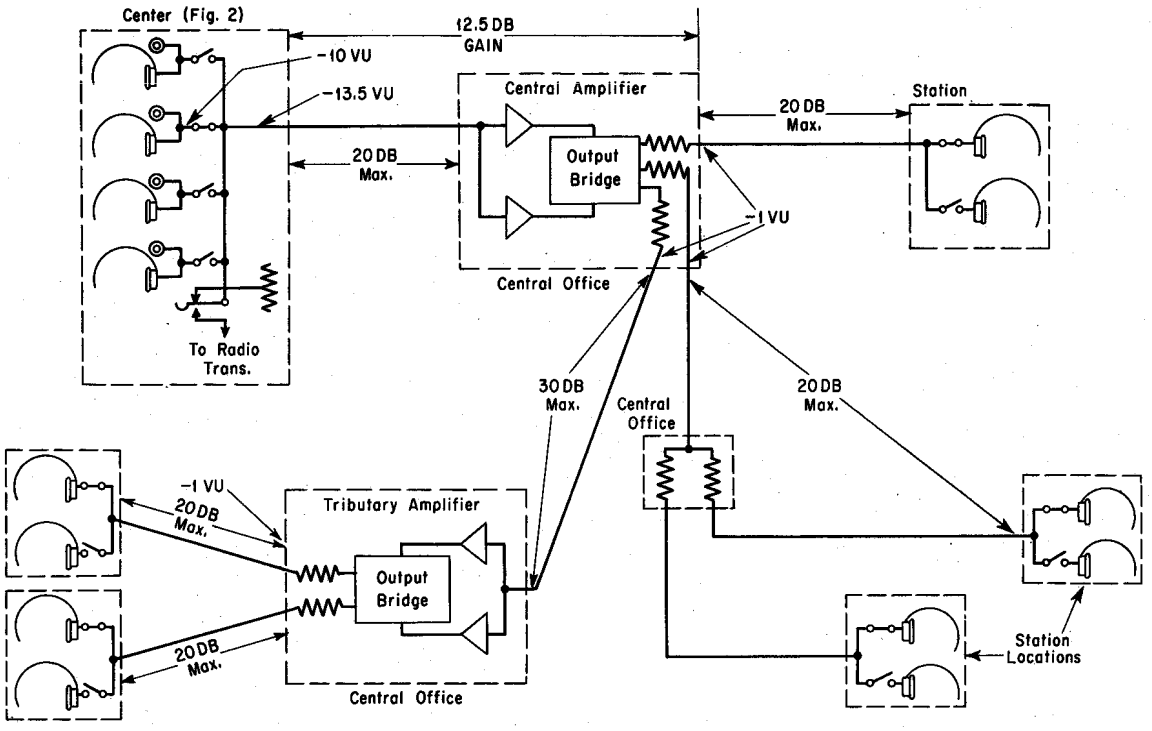
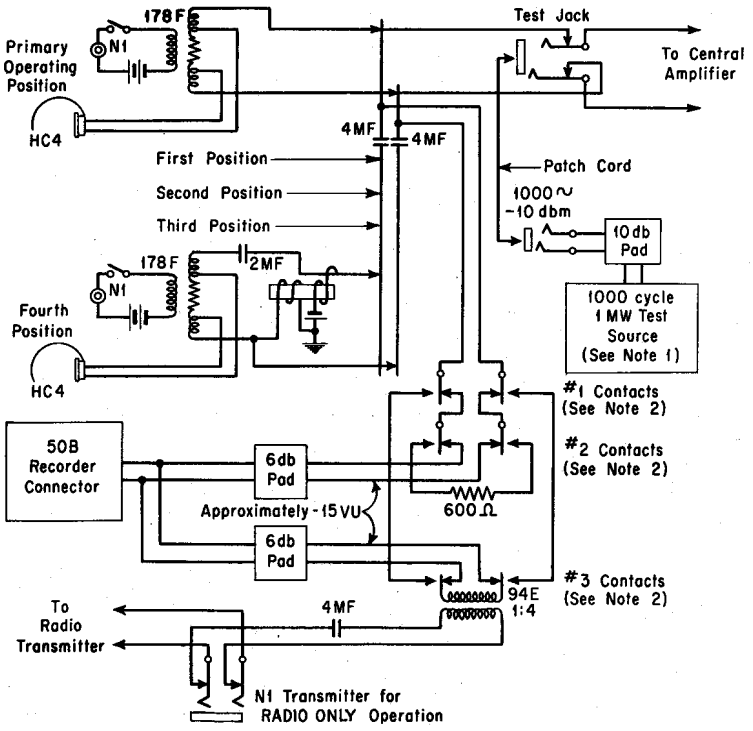


Fig. 1 - One-Way Speech Multistation Circuit



NOTES:

1. 1000 cycle 1MW Test Source may be supplied from either a local test oscillator or from the nearest Central Office over private pair.
2. Contacts #1, 2 & 3 are shown normal. The various methods of operation are as follows:
   a) WIRE LINE and RADIO #1 & 3 contacts operated, #2 contacts normal.
   b) WIRE LINE ONLY #1 & 3 contacts normal, #2 contacts operated.
   c) RADIO ONLY #1, 2 & 3 contacts normal. Headsets plugged into RADIO ONLY jacks and radio keys associated with these jacks operated.

Fig. 2 - Arrangement at Center
(One-Way Speech Multistation Circuit)

the central office as shown by Fig. 3 should be adjusted so that the volume indicator reads +1.5 when connected across the load and within a decibel of this when connected across the individual amplifiers. The same procedure should then be followed for the tributary amplifiers if there are any. With this adjustment a transmission measuring set connected at the end of each line in place of the outlying station should read approximately between -18 dbm and -10 dbm with the 1000 cps test tone applied at the center. With no bridge positions at the center and an average talker at the center, the volume indicator should swing in the range from -7 to +3 on speech peaks. These readings are not vu readings, but merely meter indications for testing purposes.

(C) Central Amplifier Test

2.04 If a 1000 cps tone is not available at the center, the following method for adjusting the gain of each amplifier unit of the one-way speech circuit may be used at the central office.

2.05 With the central amplifier set up for normal operation, apply a 1000 cps signal from a 600-ohm source by plugging it into the IN jack of the amplifier unit shown on Fig. 3. Adjust the level of the test signal and the gain of the amplifier unit according to one of the following:

(a) When the line loss between the center and the central amplifier is between 10 and 20 db, set the 1000 cps input level to -34 dbm and adjust the amplifier gain so that the volume indicator reading across the amplifier output will agree with the following formula:

Volume Indicator Reading = Line loss in db between center and central amplifier -19.5.

(b) When the line loss between the center and the central amplifier is between 0 and 10 db, set the 1000 cps input level to -24 dbm and adjust the amplifier gain so that the volume indicator reading across the amplifier output agrees with the following formula:

Volume Indicator Reading = Line loss in db between center and central amplifier -9.5.

2.06 Example: With a center to central amplifier line loss of 15 db, use (a) above. Then adjust gain so that the volume indicator

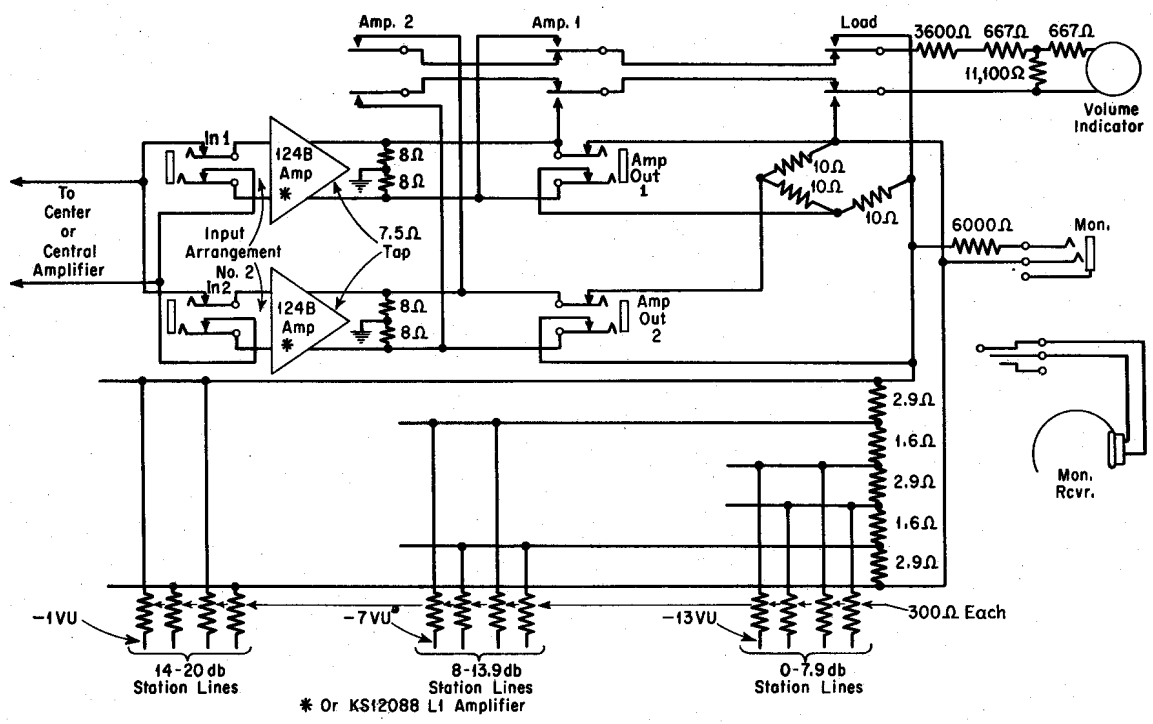


Fig. 3 - Central or Tributary Amplifier (One-Way Speech Multistation Circuits)

reads 15 - 19.5 = -4.5. With this VI reading, the gain from the center to the line side of the 300-ohm protective resistance will be 12.5 db.

Note: On the above calculations the center to central amplifier line loss should include terminal reflection losses based on a 600-ohm resistive termination at the center and a 300-ohm resistive termination at the central amplifier. The 3 db power division loss caused by the bridging of the two amplifier inputs is already taken into consideration in the above-mentioned formulas.

(D) Tone Device

2.07 An intermittent tone is connected to the line of the one-way multistation circuit at the center whenever the line is not in use. A 50B recorder-connector may be used for this purpose. This same recorder-connector is also used to supply tone to a local radio transmitter. This is discussed in more detail in Section 310-400-100.

2.08 Issue 5 of SD-69213-01 shows the arrangement for inserting the 50B recorder-connector in the circuit. The tone to the line is removed when the key at the center is operated for WIRE LINE ONLY or WIRE LINE and RADIO. The normal output tone of the 50B recorder-connector (-5 vu) is attenuated about 10 db by the two pad circuits before it is applied to the line. This is done in order to keep the vu meter on scale at the central office amplifier installation. With this pad arrangement the -15 vu tone applied at the center will cause the vu meter at the central office to read approximately -3.5. This reading can be used for a quick check of circuit performance.

(E) Over-all Talking Tests

2.09 After the foregoing circuit tests have been made on the one-way speech multistation circuits, the following tests should be made on the over-all circuits before they are furnished to the customer for service.

2.10 Make over-all talking tests to all outlying stations. In connection with this talking test, monitoring observations should be made at each outlying station to detect any undue noise or crosstalk. When there is a loudspeaker at an outlying station, the loudspeaker output should be checked during the talking test to determine whether satisfactory volume is obtained. The existing room noise conditions should be verified as typical and any necessary changes in the maximum gain of the loudspeaker circuit should be made.

2.11 Satisfactory transmission should be obtained on both the head set and the loudspeaker where provided. A generally uniform volume of transmission should be observed at each outlying station.

3. TWO-WAY SPEECH MULTISTATION CIRCUITS

(A) General

3.01 The maximum allowable 1000-cycle line losses are shown on Fig. 4. With this circuit arrangement the over-all effective

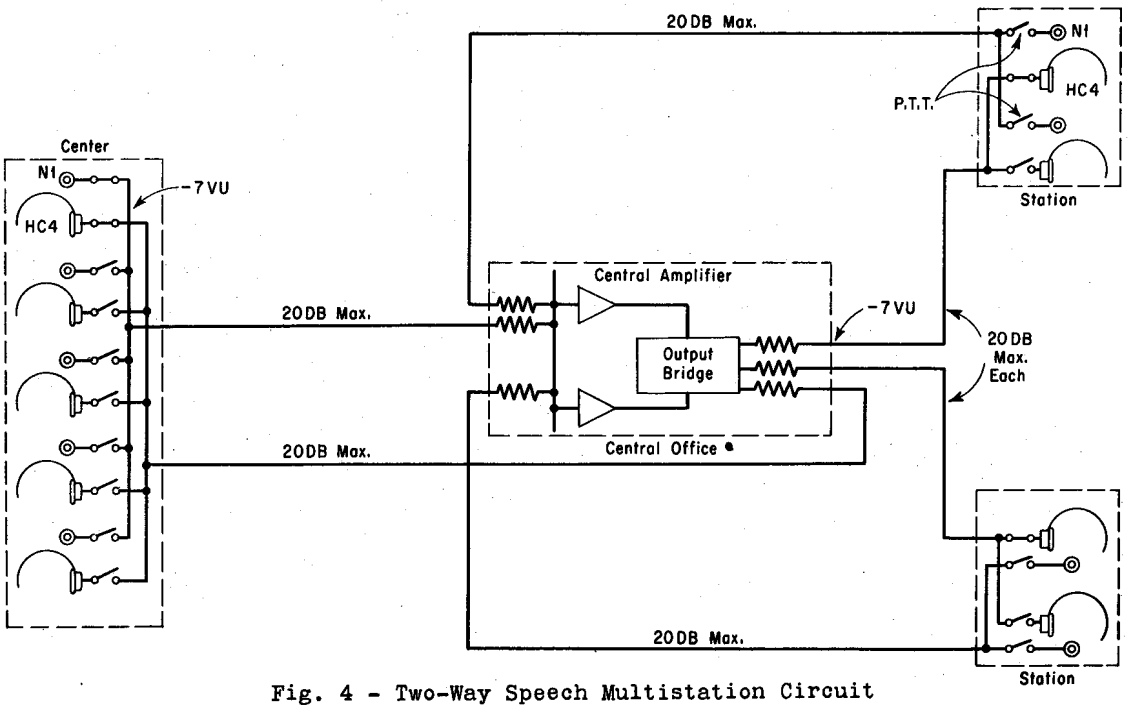


Fig. 4 - Two-Way Speech Multistation Circuit

transmission is approximately +1 db with one telephone set connected at the center and one at the outlying station. While five positions at the center have access to each two-way circuit, normally only one of these will be connected at any one time. However, one or two other positions may monitor on the line. A receiving loss of 3.5 db for one and 6 db for two monitoring stations will be incurred at the center.

3.02 Each outlying station location has two sets of jacks wired in parallel. Under normal operation only one of these jacks will be used. However, when two sets are used a 3.5 db receiving bridging loss is added but since this is not normal operation this loss should not be included in the line loss calculations.

3.03 The length of the station wiring from the induction coil and battery supply retard coil to the head set jacks should be limited to a maximum of 20 ohms loop resistance as indicated by Note 103 on Drawing SD-69214-01. An impairment of one decibel for each 10 ohms should be included in the design calculation for these lines.

3.04 In some cases two stations may be served by two pairs (one receiving and one transmitting) from the central amplifier. When this is the case, 1 db loss should be added for the transmitting line loss and 3.5 db for the receiving line loss.

(B) Over-all Transmission Measurements

3.05 The central amplifier (Fig. 5) of the two-way speech circuit can be adjusted by use of the 1000 cps -10 dbm tone applied at the center. This tone should be connected to the associated transmitting line by means of the TEST T jack provided. With this tone applied the gain of each amplifier unit of the central amplifier should be adjusted so that the volume indicator associated with the central amplifier reads -8 across each amplifier output and within a db of this value across the load. As mentioned in Paragraph 2.03 this reading should not be interpreted as a vu reading.

Note: The above procedure will result in an over-all central amplifier gain (from transmitting LINE JACK to receiving LINE JACK which is equal to the line loss from the center to the central amplifier plus the center transmitting line pad loss. The over-all central amplifier gain obtained will be between 17 and 21 db since the pads are in 4 db steps.

3.06 If the two amplifiers are adjusted as discussed above with no bridged position at the center and an average talker at the center, the pointer of the volume indicator should swing between -10 and 0 on the meter scale on speech peaks measured across the output of the two amplifiers or across the load.

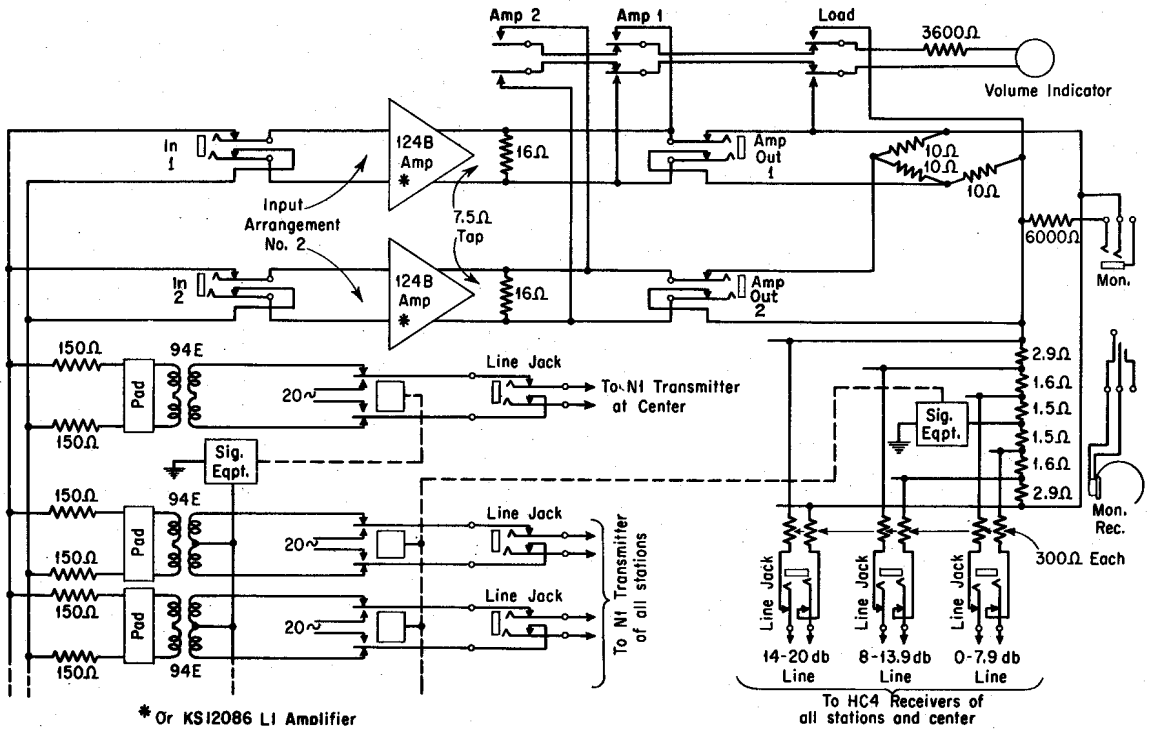


Fig. 5 - Central Amplifier
(Two-Way Speech Multistation Circuit)

3.07 If a 600-ohm transmission measuring set is connected to the receiving line in place of a station or at the center, the reading with the central amplifier adjusted as above and with an input level of -10 dbm (1000 cps) at the center as previously described should be approximately between -22 and -30 dbm. If this is not the case, changing the tap on the output circuit of the central amplifier to a different level for the receiving line may bring the measuring set reading within limits.

(C) Central Amplifier Tests

3.08 If a 1000 cps source is not available at the center, the following method for adjusting the gain of each amplifier unit may be used.

3.09 With a central amplifier set up in a normal operating condition, apply a 1000 cps -34 dbm signal from a 600-ohm source by plugging it into the IN jack of one of the amplifiers and adjust the gain of this amplifier using the following table:

Number of Lines connected in two-way speech circuit excluding line to center	Adjust single amplifier gain so that volume indicator across amplifier output reads:
6	+3.0
5	+2.1
4	+1.0
3	-0.1
2	-1.4
1	-3.0

After adjustment of this amplifier has been made, adjust the other amplifier in the same manner.

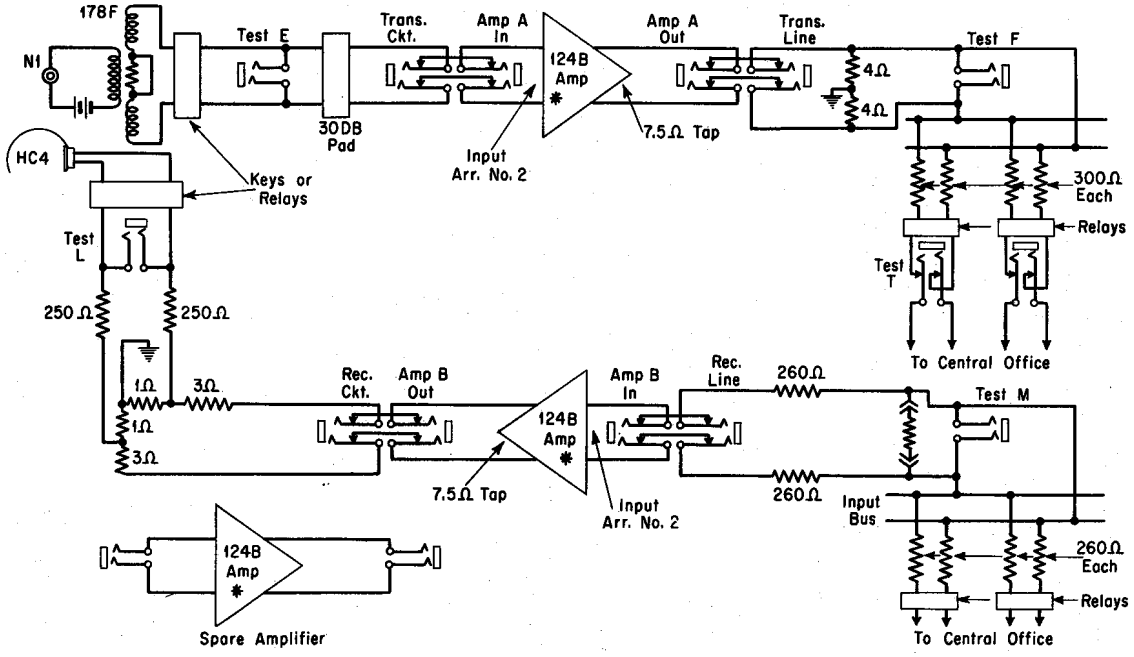
(D) Station Amplifier Test - Grouping Position

3.10 The amplifier arrangement for the grouping position at the center is shown schematically by Fig. 6. The transmitting amplifier gain should be adjusted so that the loss from the 178F induction coil of the grouping position to the line side of 300-ohm resistances is zero. This condition will be obtained with an amplifier gain setting of approximately 55 db (power gain). These adjustments are described in detail in Paragraph 3.12.

3.11 The loss from any receiving line to the receiver at the grouping position is compensated for by proper gain adjustment of the conference receiving amplifier which is approximately 60 db (power gain). No tone measurement is required for this gain adjustment. The amplifier is adjusted to give ample volume in the receiver of the grouping position when the grouping key is operated. A check of this gain adjustment may be made as outlined in Paragraph 3.12.

3.12 If a check of the zero loss conditions mentioned in connection with the conference amplifiers is desired, the following procedure may be used:

(1) With the grouping key not operated, temporarily ground the A1 lead of the conference line circuit (by strapping terminals 2



* Or KS12086 L1 Amplifier

Fig. 6 - Grouping Arrangement at Center (Two-Way Speech Multistation Circuit)

and 6 of Equipment Unit ED-91929-01 G29 of SD-69213-01). This operates all the T relays and connects all two-way speech circuit lines to the two conference amplifiers without connecting the grouping position telephone circuit to these amplifiers.

(2) Apply a 1000 cps -10 dbm test tone from a 600-ohm source to TEST E jack (SD-69213-01 Fig. 2).

(3) Adjust the gain of the transmitting amplifier so that the volume indicator associated with one of the two-way speech circuits reads approximately the same as when the -10 dbm tone is applied to this individual line by means of its TEST T jack (SD-69213-01 Fig. 3) as mentioned in Paragraph 3.05.

(4) Still following Steps 1 and 2, a 600-ohm measuring set plugged into TEST L jack (SD-69213-01 Fig. 2) of the conference line circuit should read between -22 and -30 dbm. If the measuring set reads below -30 dbm, the receiving amplifier gain should be increased so that the reading is within the above limits.

3.13 In order to facilitate checking and maintenance of the amplifiers it may be found desirable to provide some local means to record the proper amplifier gain control settings. Fig. 7 shows a card form used by one of the Telephone Companies to record pertinent maintenance data locally. Such a card may be mounted on the front of the amplifier or at any other location convenient to the maintenance personnel.

Two-Way Speech Multistation Circuit

SD-96465-01

Gain Control Setting

Amp. 1_____
Amp. 2_____

Note 1: Above settings give -8 meter reading with -10 dbm, 1000-cycle signal applied at center.

Note 2: A dead amp. will cause a loss of 6 db. To disconnect amp. from circuit insert plug into IN and AMP OUT jacks for this amp.

Fig. 7 - Line-Up Maintenance Card

(E) Over-all Talking Test

3.14 After the tests have been completed on the component parts of the two-way speech multistation circuits, the following tests should be made on the over-all circuit before it is furnished to the customer for service.

3.15 Make over-all talking tests between the center and all outlying stations for each individual line as well as the grouping position. Monitoring observations should be made at each outlying station and at the center to detect any undue noise and crosstalk. The existing room noise conditions should be verified as typical. Uniform volume of transmission should be observed at each outlying station on transmission from the center and at the center on transmission from the outlying stations.

(F) Over-all Signaling Test

3.16 Signaling tests should be made at each outlying station and at the center to meet the requirements of Section 310-400-100, Paragraph 3.08. Check the three methods of signaling so that the center can signal all six outlying stations simultaneously, each outlying station is able to signal each other outlying station without signaling the center and each outlying station can signal the center without signaling each other outlying station.

4. AMPLIFIER MAINTENANCE

4.01 The following discussion applies to both one-way and two-way speech circuits. If the output of speech or tone from one amplifier as measured with the meter provided with the associated equipment can not be made about equal to the output of the other amplifier by adjusting the proper gain control potentiometer, the amplifier with the low output volume should be removed by inserting dummy plugs into the AMP OUT and AMP IN jacks and should be checked or replaced. With the two dummy plugs in place, the other amplifier unit will continue to supply the multi-speech circuits with an over-all gain that is approximately 2.5 db below normal. The 124B Amplifier used with these lines should be connected for the normal audio frequency output of approximately 11.5 watts using standard 616-type vacuum tubes.

4.02 Testing and adjusting of the 124B amplifier are covered in Section 024-104-500. When the Langevin Amplifier (KS-12086 L1) is used, the manufacturer's installation and service manual with an addendum covering modifications may be used.