50-KILOBIT WIDEBAND LOOP
1 THROUGH 50 KHZ
WLR-5 REPEATER
DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section describes the 50-kilobit wideband loop repeater which provides an equalized baseband customer loop for wideband data transmission. The loop uses WLR-5 repeaters to provide the necessary amplification over the group bandwidth. The repeaters provide amplification and continuously adjustable loss equalization to post-equalize the wideband loop over the 1-kHz through 50-kHz band. They also provide, on an optional basis, pilot-controlled twist regulation to compensate for attenuation changes in the cable facilities due to temperature variations.

1.02 This section is reissued to provide information on a low frequency compensated regulator (CP22) to be used in WLR-5 repeaters to correct for low-frequency phase distortion where required.

1.03 The WLR-5 repeaters of the 50-kilobit wideband loop may be located on the customer's premises at one end of the loop, at the central office terminal at the other end of the loop, or at intermediate locations. Therefore, the WLR-5 repeaters are referred to as customer repeaters, terminal repeaters, or intermediate repeaters, respectively. All repeaters provide amplification for both directions of transmission.

1.04 Each repeater consists of ten circuit-pack plug-in units, five for each direction of transmission. A typical terminal repeater is shown in Fig. 1.

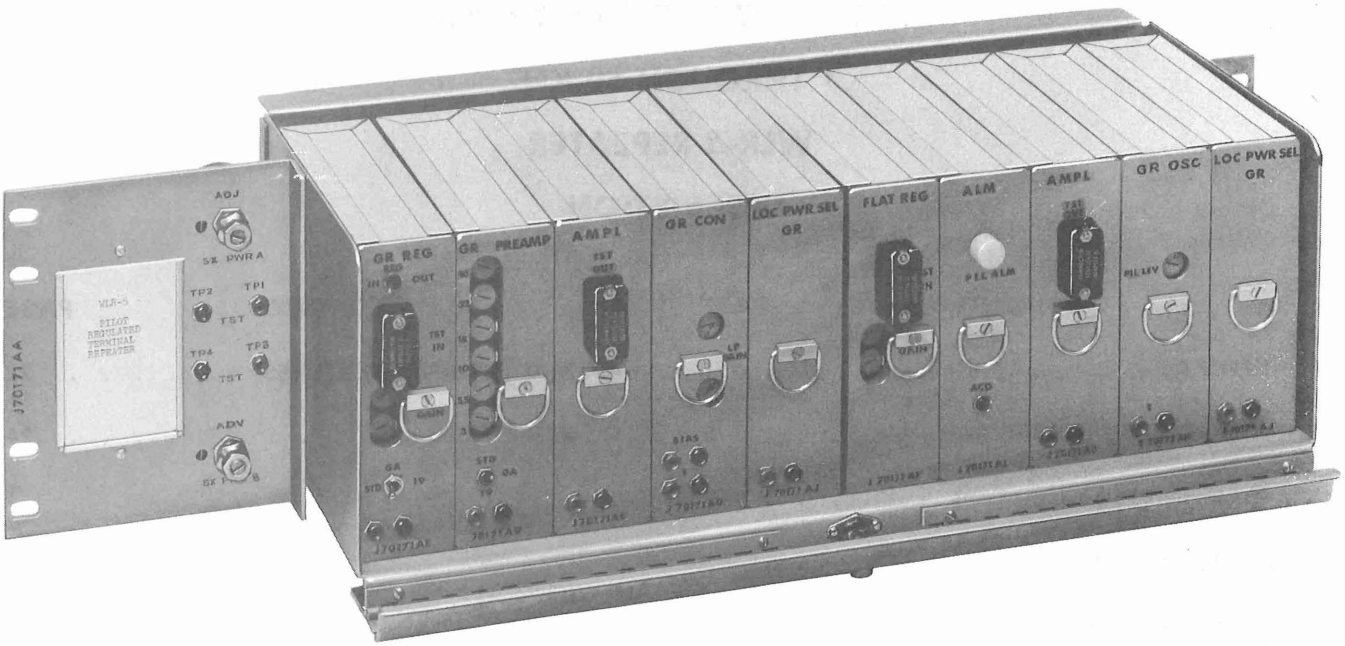

Fig. 1—WLR-5 Pilot-Regulated Terminal Repeater

1.05 The repeaters of the 50-kilobit wideband loop may be powered locally by a central office battery, or they may be powered remotely by sending simplex current over the cable pairs. Even if the simplex current is not required as a source of remote power, a minimum sealing current will be sent over the cable pairs to seal the loop in order to reduce possible noise from the use of solderless connections.

1.06 Three types of enclosures are used to house the repeaters: a J70171AA 2-way repeater shelf for office locations, a J70171A weathertight cabinet assembly for pole mounting, and a J70171B weathertight apparatus case for pole or manhole mounting. The 2-way repeater shelf is designed to be mounted on a 23-inch bay at central office and customer locations and is capable of holding the units for one 2-way repeater. The shelf may be equipped with potentiometers to adjust simplex current to power remote repeaters. The weathertight repeater cabinet is used exclusively for housing intermediate repeaters. Each repeater cabinet can hold seven 2-way repeaters. This is sufficient to provide repeater amplification and equalization at an intermediate point for seven 50-kilobit wideband loops. The weathertight apparatus case holds one 2-way intermediate repeater.

2. LOOP DESCRIPTION

A. General Considerations

2.01 All 50-kilobit wideband loops, except for very short loops (6-dB loss or less) which have only one 2-way repeater at the terminal, have at least two 2-way repeaters to provide amplification and equalization: a customer repeater and a terminal repeater. The customer repeater is located as close as possible to the customer data auxiliary set (DAS), and the terminal repeater is located in or adjacent to the wideband service bay (WSB) in the central office. These two repeaters can compensate for up to 30 dB of cable loss at 25 kHz for each direction of transmission.

2.02 If the loss encountered on a loop is greater than 30 dB, additional repeaters are specified for installation at intermediate points along the loop. Each intermediate repeater provides 2-way amplification. Normally not more than two intermediate repeaters are used to extend the maximum loop length of 90-dB overall cable loss.

2.03 Wideband data signals transmitted over the 50-kilobit wideband loops are extremely susceptible to both white noise and impulse noise.

To protect the wideband loop circuits from undue exposure to noise, a number of special precautions should be taken.

(a) All transmission pairs in the central offices and on the customer premises, as well as the cross-connecting jumpers on the main distributing frame, must be 761A or 762A special double-shielded cables with special attention paid to the grounding of shields.

(b) All the battery and ground pairs must be shielded 22BF cables when a miscellaneous fuse panel is used.

(c) The WLR-5 repeaters themselves should be mounted in the most quiet locations available. In central offices, the WLR-5 repeaters are always mounted in or adjacent to a WSB if one is available.

2.04 The frequency range of 1 through 50 kHz has been referred to a number of times only because the insertion loss of the cable (between 135-ohm terminations) is flat below 1 kHz. Therefore, the equalizer networks need only begin to have excess gain above 1 kHz. Actually, it is important for the loop to have a response down to very low frequencies. To provide this low-frequency response, transformers with very wide bands have been used with 3-dB points at 10 through 20 Hz and the number of transformers has been limited to two per active repeater. Because the frequency band extends to 50 kHz, well above the voiceband, special attention must be paid to the cable pairs selected. To ensure that the cable loss characteristic can be equalized by the WLR-5 repeater, all loading coils and bridge taps must be removed from the cable pairs.

2.05 The 50-kilobit wideband loop may be used in two ways: to interconnect two specific data sets without access to or involvement with other equipment and to serve as the connecting link between a data set and the WSB. From the WSB, the data set signals can be interconnected through other coordinated facilities to a remotely located data set.

B. Typical Loop

2.06 A typical nonregulated 50-kilobit wideband loop used to provide entrance to the WSB is shown in Fig. 2 and a regulated loop is shown in Fig. 3. Three repeaters are shown in each of these loops: one at each end of the loop plus one intermediate repeater. Total losses (cable plus wiring) of up to 60 dB at 25 kHz can be overcome with this arrangement. A very short nonregulated loop, utilizing only one repeater, is shown in Fig. 4.

2.07 The amplified outputs of the customer repeater and of the terminal repeater can be adjusted to compensate for the losses occurring between the repeaters and the terminating equipment. To maintain the end losses within reasonable limits, customer wiring loss and office wiring loss from the terminal repeater to the WSB should not exceed 1.88 dB at 25 kHz or 1000 feet of 761A cable. The loss should be accounted for as part of the 30-dB maximum repeatered span. However, to minimize exposure to noise, the terminal repeater should preferably be located in the WSB.

C. Equalization

2.08 The preamplifier unit of the repeater provides continuously adjustable post equalization of the loss characteristics of the cable used in the wideband loop. The equalization is attained by increasing the gain of the preamplifier at the higher frequencies to compensate for the greater losses incurred in the cable as frequency is increased.

2.09 The preamplifier contains six high-frequency boost networks, each adjustable by means of a potentiometer located on the face of the unit, as shown in Fig. 5. Each potentiometer is labeled according to the frequency at which it should be adjusted. Each high-frequency boost network is designed to produce gain at its adjusting frequency and above but to have only a small effect below this frequency.

2.10 The high-frequency boost controls are used to set the desired gain characteristics of the preamplifier and thereby accomplish the equalization. The flat gain of the repeater is set by means of a flat-gain control located in the regulator unit. The adjustment procedure requires that a 1-kHz tone be sent over the line to initially set the flat gain of the repeater. Then the test tone is set to each adjustment frequency in turn, starting at the low-frequency end of the spectrum and working up to 50 kHz. In this manner, each repeater section can be equalized to provide a flat response within $\pm$0.25 dB or 0.5 dB peak to peak.

Delay equalization of the line is also accomplished as a result of the loss equalization.

2.11 The WLR-5 preamplifier is capable of equalizing 19-, 22-, 24-, and 26-gauge cables with losses of up to 30 dB at 25 kHz. A switch is available on the face of the unit that modifies the 3-kHz and 5.5-kHz networks to make it possible to equalize long lengths of 19-gauge cable. Mixed-gauge cables have inherent unpredictable ripples in their insertion loss characteristics that cannot be removed by this type of equalization. It is advisable, whenever possible, to avoid mixed gauges within a single repeater span. The existence of different gauges in ***different*** repeater spans could be beneficial since the buildup of systematic equalization errors would be avoided.

D. Pilot Regulation

2.12 To provide a measure of how far the loss of a loop has drifted due to changes in ambient temperature, a 60-kHz pilot is transmitted from the customer and terminal repeater over the cable pairs. The level of this pilot is monitored at each repeater and is compared with a reference voltage. Any difference between the pilot level and the reference voltage produces a dc control current, which controls the gain of the repeater. The pilot-regulated 50-kilobit wideband data loop is shown in Fig. 3.

2.13 The gain shape of the group regulator has been designed to approximate the temperature coefficient of the insertion loss of a large variety of cable types and cable lengths over the 1-kHz through 50-kHz band. One of two regulator circuits may be selected by using the switch mounted on the face of the group regulator. One position matches 22-, 24-, and 26-gauge cables, and the other position is used exclusively for 19-gauge cable.

E. DC Power

2.14 The power selectors provide a well-filtered power supply, plus filtering and means for distributing dc power sent out over the cable pairs. Two basic types of power selectors are available: the J70171AJ local power selectors for repeaters where a −48 volt battery is available and the J70171AK remote power selectors for repeaters receiving power over the cable pairs. For customer and terminal repeaters on pilot-regulated loops, a pilot rejection filter is necessary to block the 60-kHz noise at the input of the loop and to block the pilot frequency at the output of the loop. Group power selectors J70171AJ, L2 and J70171AK, L2 contain this filter.

2.15 A filtered power supply is provided for the active units associated with each direction of transmission by a voltage regulator in the power selector. The voltage regulator in locally powered repeaters is supplied directly from a −48 volt battery, while remotely powered repeaters are powered by sending simplex current over the cable pairs. The voltage across a remotely powered repeater is limited by a 27-volt regulating diode.

2.16 Office-mounted repeater shelves are equipped to send simplex current over the line in either direction to seal the cable pairs and, if required, to power remote repeaters. Remote power selectors are equipped to receive simplex current from either direction, to pass it on to other repeaters, or to loop the sealing current. One or more repeaters may be powered in series by using +130 volts, −48 and +130 volts, or −130 and +130 volts, as required. All should be obtained from quiet filtered supplies.

2.17 The polarity of the applied voltage is chosen so that simplex current flows in the direction of signal transmission. Therefore, a positive battery is always supplied to a transmitting pair and negative battery is supplied to a receiving pair. Power arrangements for a locally powered loop and a remotely powered loop are shown in Fig. 6 and 7, respectively. Sealing current is not transmitted over 761A cable at customer premises between the repeater and the DAS. If outside plant facilities are used for this short line section, all splices should be soldered.

2.18 The active circuitry, for one direction of transmission, on a nonregulated loop requires from 40 to 50 mA and on a regulated loop requires 50 to 90 mA. To assure that these currents, plus 10 mA to bias the breakdown diodes, are available on a hot day under emergency conditions, the simplex current is set at 75 mA and 110 mA under nominal conditions for nonregulated and pilot-regulated loops, respectively. To assure at least 10 mA per wire for sealing current under all conditions, the simplex current should be set at 30 mA. The office-mounted repeater shelves, equipped to send simplex current, provide a 1500-ohm potentiometer

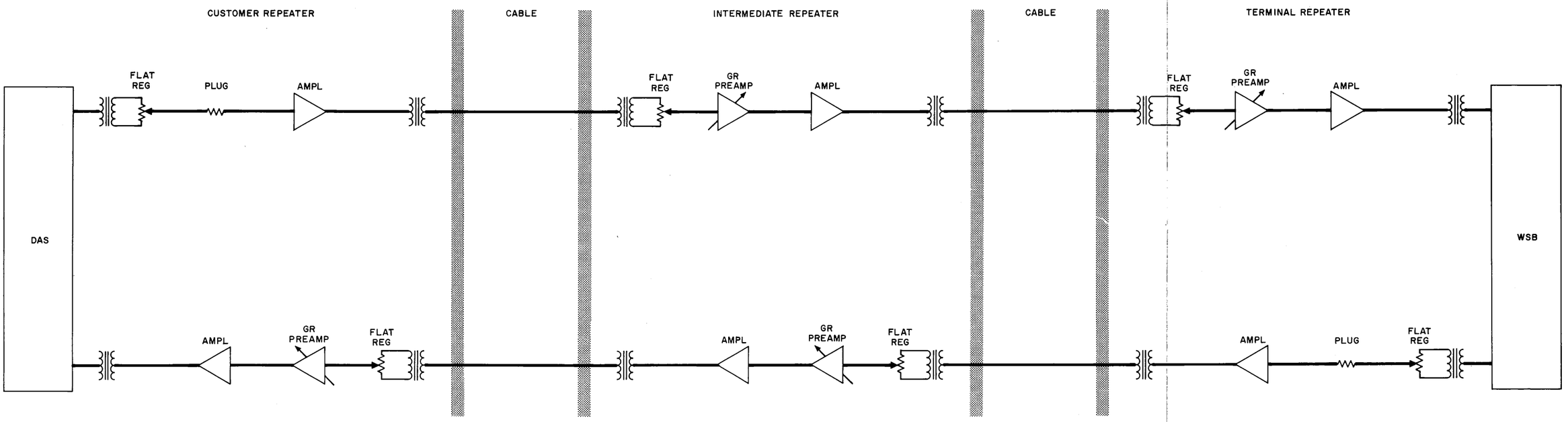

Fig. 2—Nonregulated 50-Kilobit Wideband Data Loop

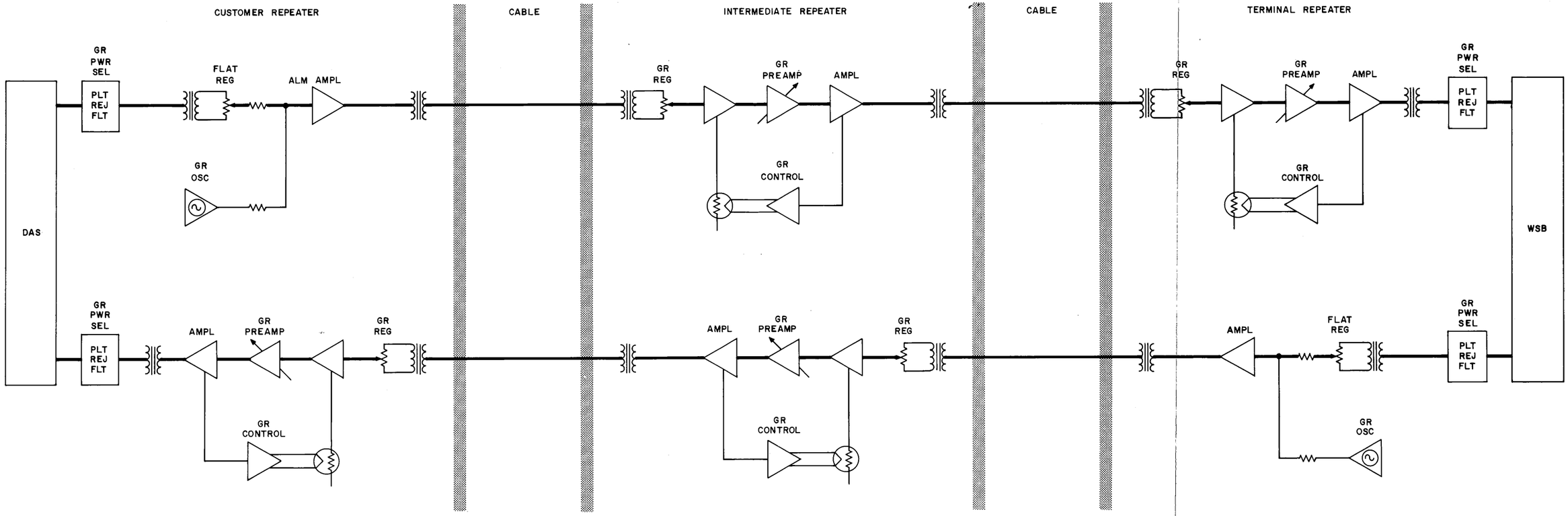

Fig. 3—Pilot-Regulated 50-Kilobit Wideband Data Loop

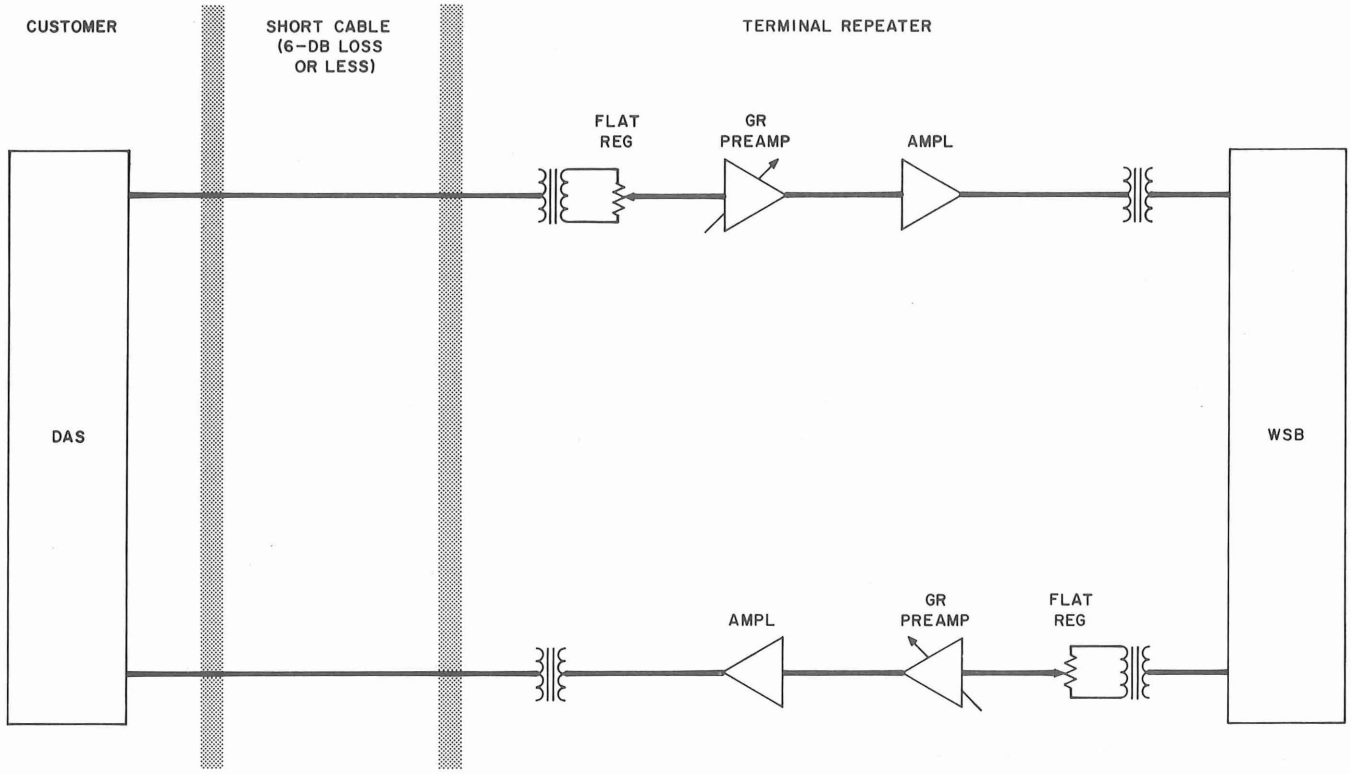

Fig. 4—Short 50-Kilobit Wideband Data Loop

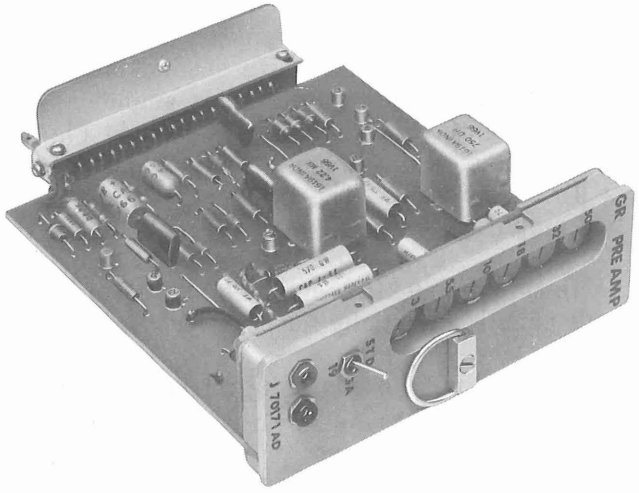

Fig. 5—Preamplifier

to adjust the current and test points where the current can be monitored by measuring the voltage across a 100-ohm resistor.

2.19 The supply or battery voltage required to remotely power one or two repeaters must be greater than the sum of the expected voltage drops around the loop with 75 mA or 110 mA of current flowing. The remaining voltage will appear across the adjusting potentiometer.

F. Alarms

2.20 A fuse and alarm panel J70171AN is available to provide battery and pilot alarms for a bay containing up to 20 repeaters. Contacts are provided to operate office major alarms when −48 volt, +130 volt, or −130 volt bay fuses are blown or to operate office minor alarms when individual circuit fuses are blown. For pilot-regulated repeaters, the fuse and alarm panel works in conjunction with the alarm plug-in unit to operate the office minor alarm upon loss of pilot. When any alarm is activated, an alarm light on the fuse and alarm panel identifies the bay. When the alarm indicates a loss of pilot frequency, a PIL ALM lamp is also lighted. In this case, a light on

the appropriate alarm plug-in unit identifies the loop that has lost the pilot frequency.

2.21 The alarm plug-in unit (J70171AL) is necessary at the customer and terminal repeater of each pilot-regulated loop. It senses the presence of the received pilot. When the pilot drops below its regulating range for 1 minute, the pilot alarm will be activated and the loop should be isolated from the other facilities by placing terminations at the WSB. Then the alarm features may be disabled by throwing the ACO switch on the front of the alarm plug-in unit. The lamp on the unit remains lighted to indicate that the trouble has not been cleared. The ACO switch is also used during line-up and maintenance testing.

3. REPEATER DESCRIPTION

3.01 Most components of each plug-in unit are mounted on a printed wiring board, which is fastened to a phenolic faceplate. A 20-pin plug is mounted at the rear of each unit to interconnect the units to other circuits of the repeater by means of wiring in the repeater shelf. An aluminum can surrounds each unit when it is fully assembled to provide both protection and shielding. There are 11 types of circuit packs which are inserted as required to meet the individual requirements of a repeater. These individual circuit packs are described below.

A. Amplifier CP1 (J70171AC)

3.02 The amplifier plug-in unit, shown in Fig. 8, provides 25 dB of flat gain between 1 and 250 kHz when driven from 1210 ohms. Two test jacks on the front panel provide a metering point for checking the bias of the amplifier output stage. In addition, test jack J1 and shorting plug P1 are provided for test purposes.

3.03 The amplifier consists of three direct-coupled stages with overall ac and dc feedback for bias and gain stabilization. Shunt- and bridge-type connections are employed by ac feedback at the input and output, respectively. The output transformer provides the means for sending simplex current over the cable pairs.

3.04 The three transistor stages are direct-coupled to conserve bias current. Therefore, a check on the output stage collector current is indicative of the biasing of all three stages. The face panel metering jacks have been provided for this purpose. In addition, jack J1 provides access to the output of the amplifier and the external circuit for test purposes. Figure 9 is a block diagram showing the configuration of the three transistor stages in tandem with the feedback from the output to the input. This figure also shows test jack J1 and associated shorting plug P1.

3.05 The amplifier provides the pilot pickoff for use in regulated loops. This signal is fed back to the control unit when required. The balanced output of the transformer is 135 ohms to approximately match the line impedance at 25 kHz. The maximum voltage output before clipping is 6 volts peak to peak or +19 dBm into 135 ohms.

B. Group Preamplifier CP2 (J70171AD)

3.06 The preamplifier, which provides the continuously adjustable equalization of the cable, is shown in Fig. 5. Miniature potentiometers are mounted on the front of the unit. These are screwdriver-adjusted equalizer controls. Two test jacks are also mounted on the face of the unit to provide a measurement point from which to check the bias of the output transistors.

3.07 The preamplifier consists of three similar 2-stage amplifiers connected in tandem. Each amplifier contains a high-frequency boost network in its feedback circuit and a second interstage network that couples it to the next amplifier. The first of the three amplifiers is shown in Fig. 10. The networks for this circuit provide gain adjustments at 3 and 5.5 kHz. The networks of the other two amplifiers provide gain adjustments at the 10-, 18-, 32-, and 50-kHz points of the overall 1-kHz through 50-kHz band. The insertion loss of cable pairs is essentially flat below 1 kHz.

3.08 Each network is a high-frequency boost network having unity gain at the lower frequencies and adjustable gain at the higher frequencies. The gain is adjusted by potentiometers. Each network produces gain at its adjusting frequency and above but has a negligible effect on frequencies below that of the adjustment point.

C. Group Regulator CP3 (J70171AE)

3.09 The group regulator (Fig. 11) is similar in appearance to the amplifier and preamplifier and consists of an input coupling circuit, a preamplifier,

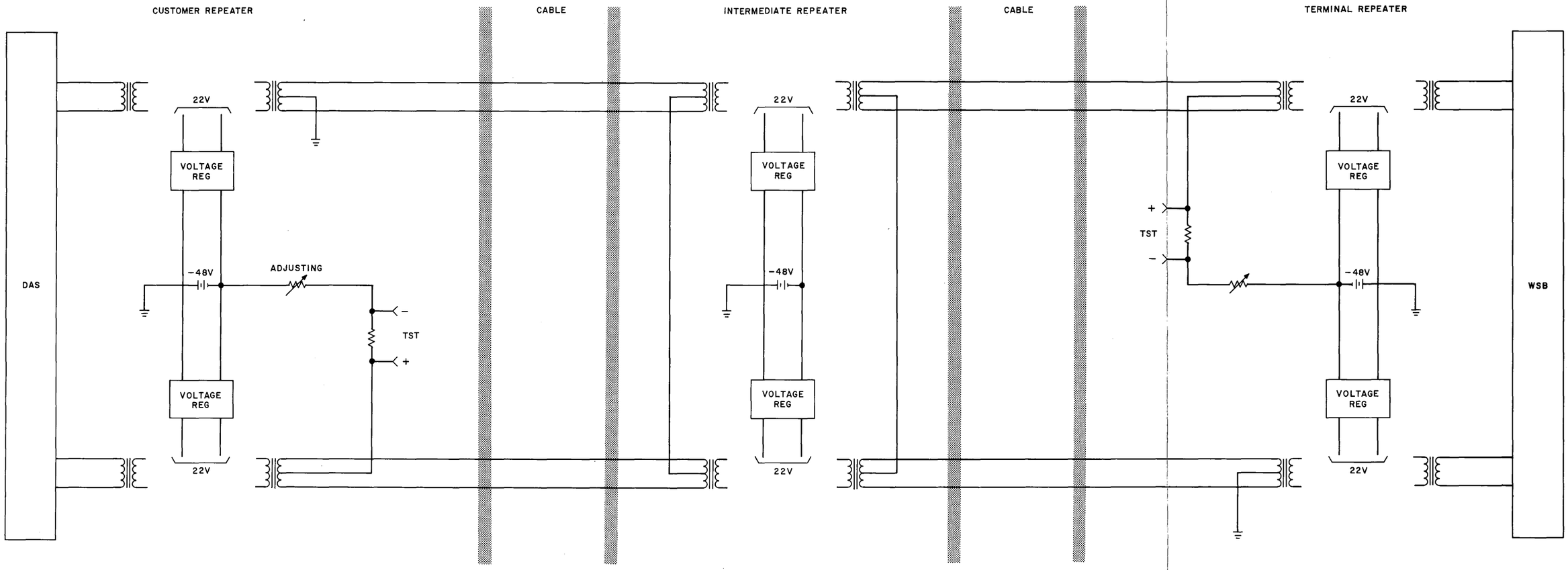

Fig. 6—Locally Powered Repeaters

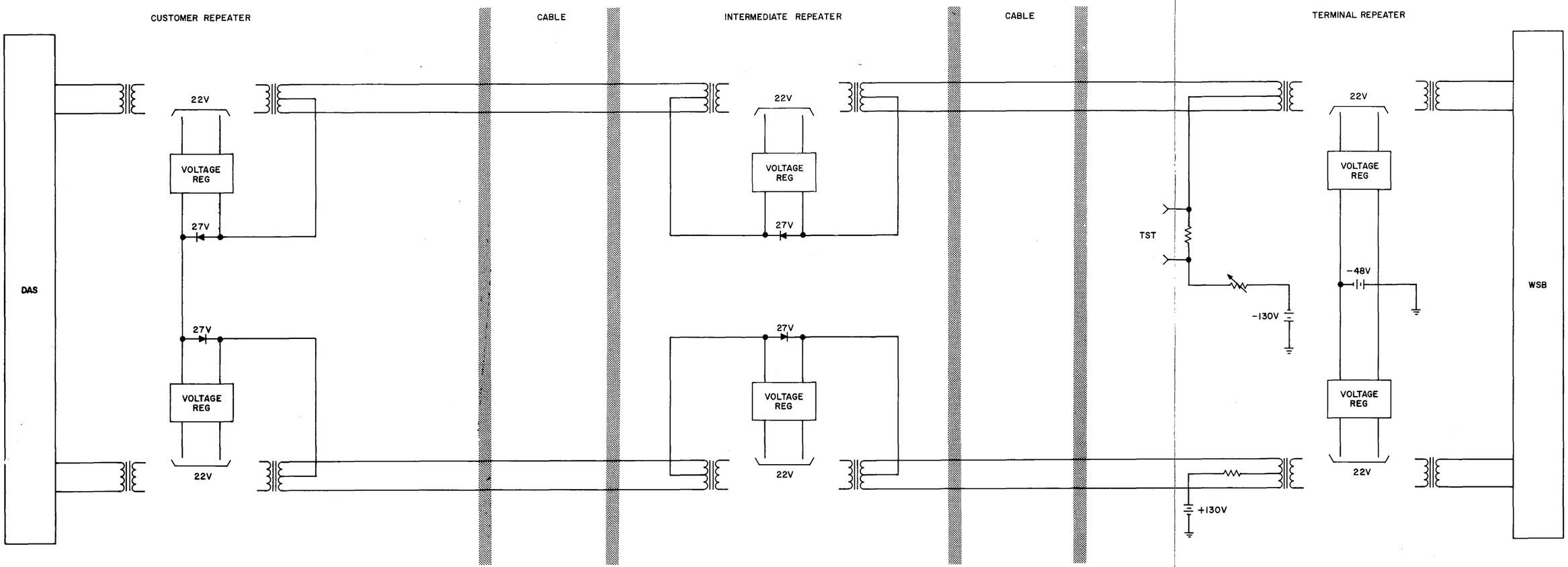

Fig. 7—Remotely Powered Repeaters

and a variable loss network. A block diagram of this unit is shown in Fig. 12.

3.10 The group regulator provides: (a) adjustment of the repeater flat gain over a 30-dB range, (b) a variable gain shape to compensate for cable changes due to temperature variations, (c) access to the input of the repeater and external circuit through test jacks, (d) removal of simplex current, and (e) a fixed flat-gain setting for line-up purposes.

3.11 The input coupling circuit consists of a transformer to match the balanced line to an unbalanced circuit and to remove the simplex current from the line. Jack J1, along with associated plug P1, is provided for access to the output of the line and the input of the repeater for test

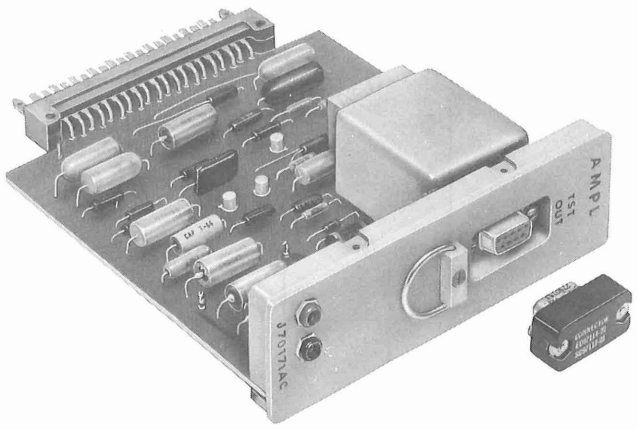

Fig. 8—Amplifier

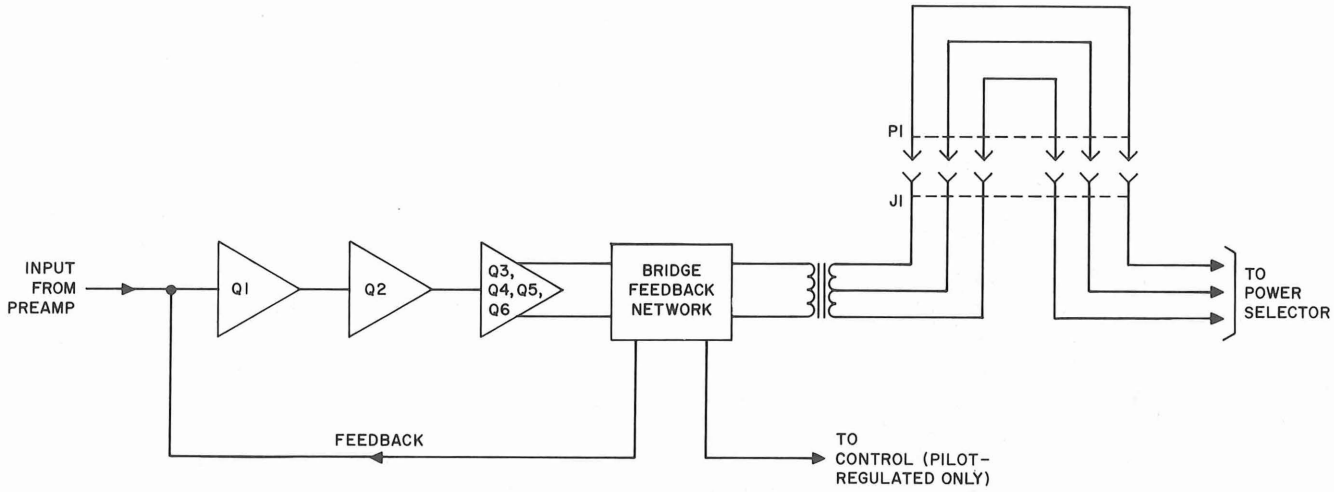

Fig. 9—Amplifier—Block Diagram

purposes. This circuit also provides lightning protection and maintains the input impedance at approximately 135 ohms. The flat-gain controls are provided by this circuit. Although two screwdriver-adjusted controls are on the front panel, either one or both controls may be used for gain adjustment.

3.12 The preamplifier circuit consists of a 2-stage, 3-transistor amplifier employing both ac and dc feedback for gain and bias stabilization. The test points for the bias checks are located in the output of this amplifier, and the measurements made here confirm the bias throughout the unit.

3.13 The variable loss network is shunted across the output of the preamplifier. This network controls the output of the group regulator by varying the amount of output signal shunted to ground. Two front panel switches are provided for this network. The switch marked GA STD/19 is used to select the proper network for use with either 19-gauge cable or 22-, 24-, or 26-gauge cable. The switch marked REG IN/OUT is used to switch the thermistor out of the circuit for initial line-up

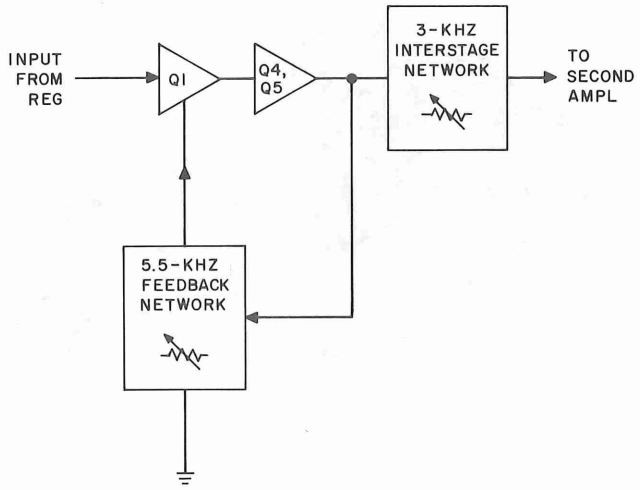

Fig. 10—Preamplifier—First of Three Amplifiers—Block Diagram

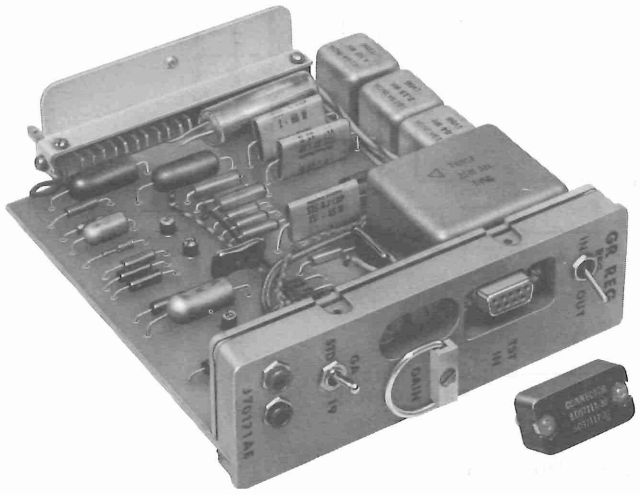

Fig. 11—Group Regulator

purposes. This switch is normally in the REG IN position. The control current for the thermistor is brought in from the group control unit CP5.

D. Flat Regulator CP4 (J70171AF)

3.14 The flat regulator (Fig. 13) is used in nonregulated loop repeaters to provide adjustment of the repeater gain over the 30-dB range. This unit also provides the means to remove simplex current from the cable and, by means of jack J1 and associated shorting plug P1, provides for access to the input of the repeater and the external circuit. A block diagram of the flat regulator is shown in Fig. 14.

E. Group Control CP5 (J70171AG)

3.15 The group control unit (Fig. 15) consists of a tuned preamplifier, a crystal filter, a detector, a comparator, and a dc amplifier mounted in a plug-in unit similar to the amplifier and preamplifier. A loop gain control is mounted on the front panel. A block diagram of this control is shown in Fig. 16.

3.16 The signal consisting of the pilot frequency (60 kHz) plus the signal frequency is brought from the amplifier into the tuned preamplifier, where it is amplified and partly filtered. The output of the tuned preamplifier is then fed into a crystal filter which passes only the pilot frequency. This output is fed into the detector where it is converted into a dc voltage. This dc voltage is then fed to the comparator, where it is compared with a reference voltage. Any difference between these voltages creates a change in the dc current which is fed to a dc amplifier, amplified, and sent to the thermistor heater in the group regulator. In addition, the presence of a voltage at the detector output is used as an indicator for alarm purposes.

3.17 Two test points are provided to check the control circuitry, and two additional test points are provided to check the bias of the preamplifier.

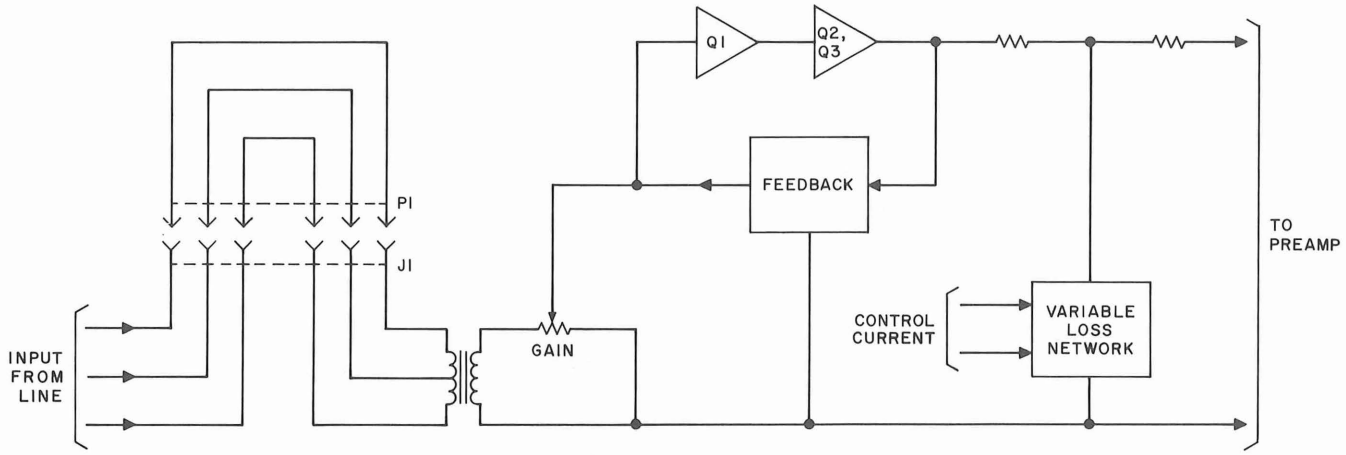

Fig. 12—Group Regulator—Block Diagram

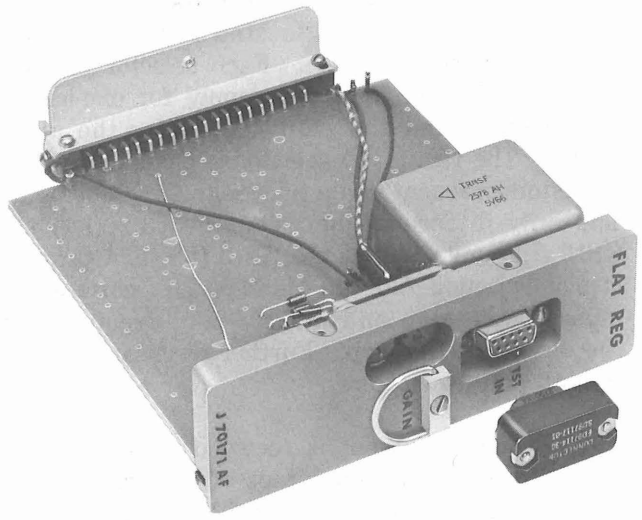

Fig. 13—Flat Regulator

F. Group Pilot Oscillator CP6 (J70171AH)

3.18 The group pilot oscillator (Fig. 17) is used in the transmitting portion of the terminal or customer repeater to generate the 60-kHz pilot signal. This unit consists of a single-stage oscillator, an amplifier, a detector, a comparator, and a dc amplifier. A block diagram of this unit is shown in Fig. 18.

3.19 The oscillator provides a crystal-controlled 60-kHz signal, which is fed into the amplifier, amplified, and fed to the line through an adjustable pilot level control. A portion of the signal is transformer-coupled to the control circuit and fed into the detector. The dc output of the detector is amplified by the dc amplifier and fed into the comparator, where the voltage is compared with a reference voltage. Any difference voltage will cause a current in the output of the comparator, which controls a thermistor in the input circuit of the oscillator amplifier, thereby controlling the gain of the amplifier to give a stabilized output. Two test points are provided on the front panel for setting the initial level of the oscillator.

G. Local Power Selectors CP7 and CP8 (J70171AJ)

3.20 Two local power selectors (Fig. 19) are available for terminal, intermediate, and customer repeaters where −48 volt dc power is available. The only difference between the CP7 (L1) and the CP8 (L2) power selectors is that the CP8 (L2) unit has a rejection filter added for use in customer or terminal repeaters of pilot-regulated loops. Further discussion of the selectors applies to both units.

3.21 Two power selectors are required for each repeater since each selector provides a filtered 22-volt supply for only one-half, or one direction, of a wideband repeater. In addition, both units provide a noise filter for applying simplex current to the cable and shunt capacitors to keep longitudinal office noise off the cable. Two test points are mounted on the front panel to check the output voltage, 22 volts ± 5 percent.

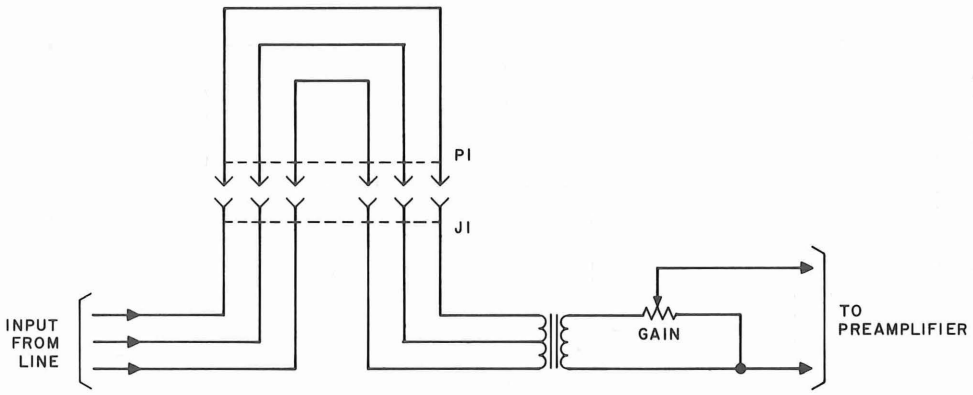

Fig. 14—Flat Regulator—Block Diagram

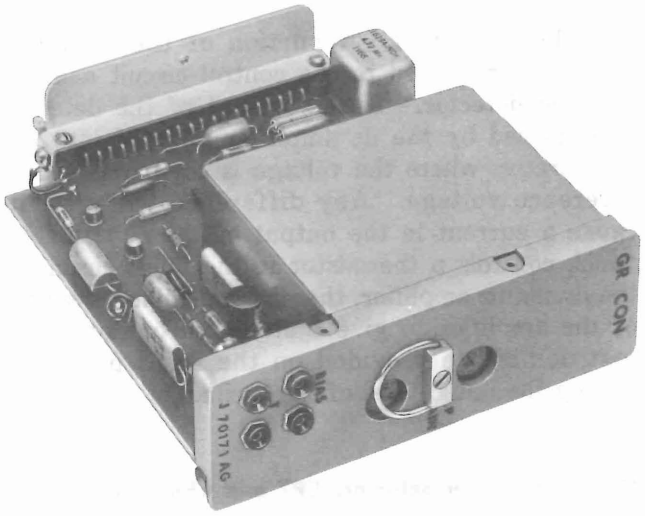

Fig. 15—Group Control

H. Remote Power Selectors CP9 and CP10 (J70171AK)

3.22 The remote power selectors (Fig. 20) are used in remotely located repeaters where dc power is not available. Each selector provides a regulated, filtered 22-volt supply for one-half of the repeater and a 27-volt supply for the alarm circuit. The CP10 (L2) selector is designed for use in customer repeaters on pilot-regulated loops only. The only difference between the CP9 (L1) and CP10 (L2) units is that the CP10 (L2) unit provides a pilot rejection filter to block 60-kHz noise at the input to the loop and 60-kHz pilot frequency at the output of the loop. Further discussion applies to both power selectors.

3.23 Simplex current is received from the cable through the center taps of the transformers in the two amplifier and regulator circuits. A block diagram of one-half (1-way transmission) of

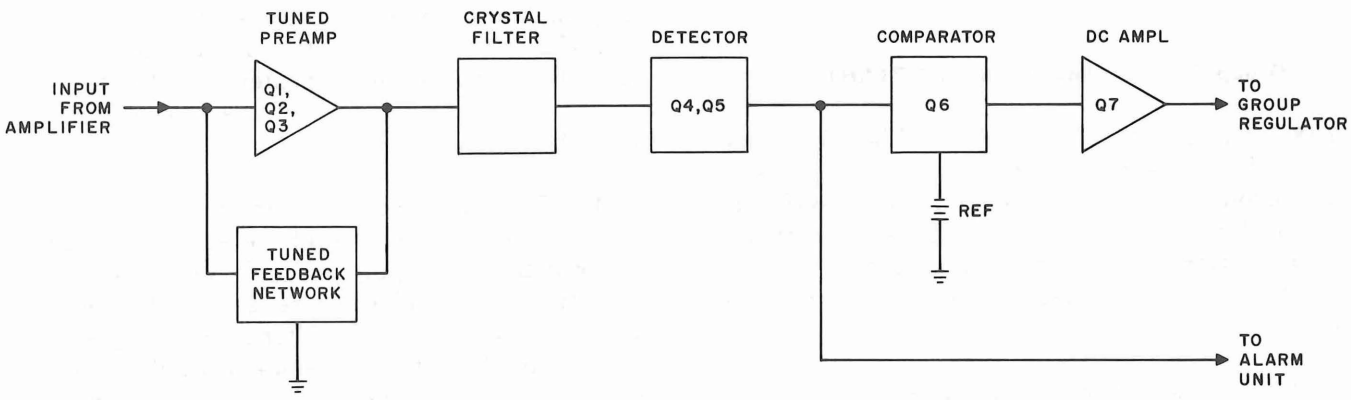

Fig. 16—Group Control—Block Diagram

the repeater is shown in Fig. 21. The current is then directed to two remote power selectors, one for each direction of transmission. The voltage across the repeater is set by the 27-volt diode and its surge-limiting resistor. This voltage is then filtered and regulated to give a stable 22-volt output. This output may be measured across the test points mounted on the front panel. In addition, a switch is provided on the front panel to select the method of powering, whether power is being received from side A or side B and whether it is looped or sent on to the next repeater. This unit also provides filtering to reduce longitudinal noise on the line and provides suppression of more than 60 dB at 60 Hz.

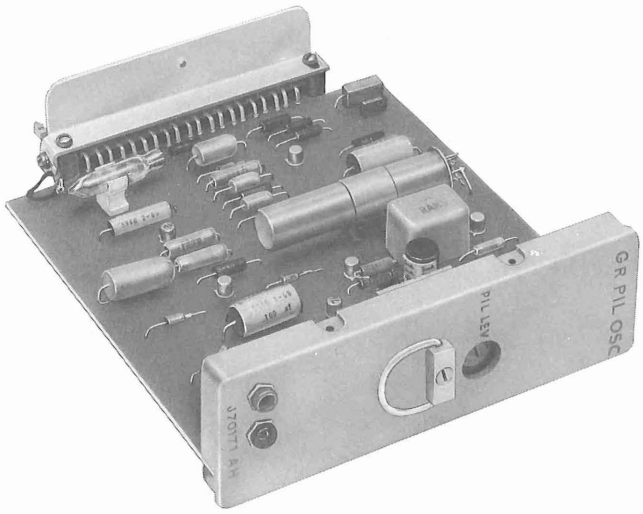

Fig. 17—Group Pilot Oscillator

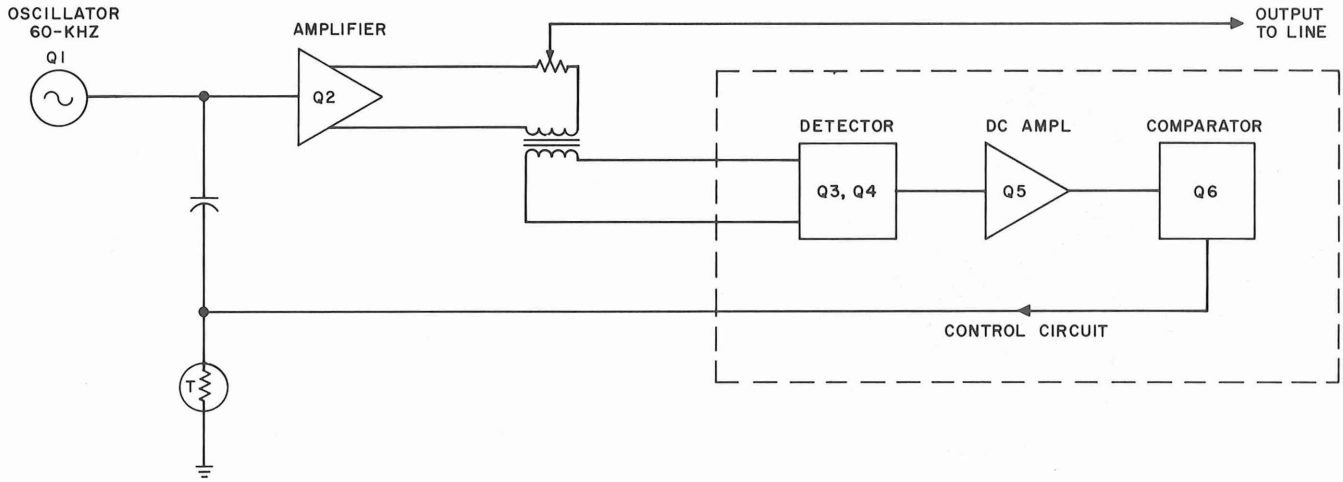

Fig. 18—Group Pilot Oscillator—Block Diagram

I. Alarm CP11 (J70171AL)

3.24 The alarm unit (Fig. 22) is used in terminal and customer repeaters on pilot-regulated loops. The function of this unit is to sense the presence of the received pilot. When the pilot drops below the regulating range for 1 minute, the alarm provides a pilot alarm light, disconnects the signal and pilot in the transmitting direction, and, in conjunction with the fuse and alarm panel, provides a bay pilot alarm light plus contacts to activate office minor alarms. The front panel controls provide an ACO switch and a pilot alarm light.

3.25 The transistorized logic circuit performs the logic statement. If the voltage on the alarm sense lead has been absent for 1 minute and the ACO switch is in its normal position, a relay will be operated. This relay operation then initiates the various alarm functions of the unit. The logic circuitry is designed to be powered either from 48 volts at locally powered locations or from 27 volts at remotely powered locations.

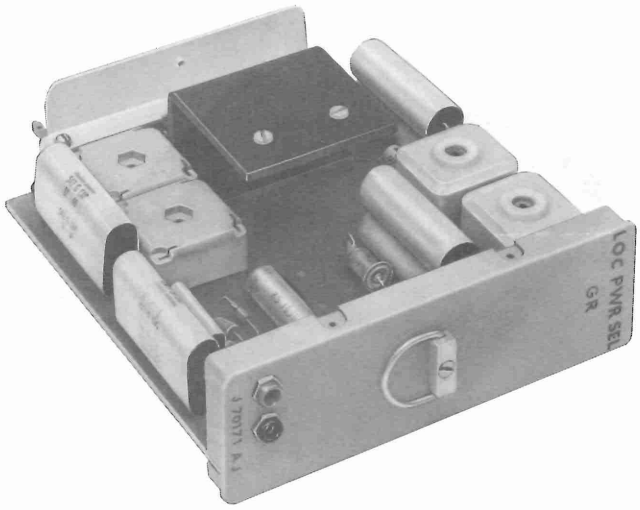

Fig. 19—Local Power Selectors

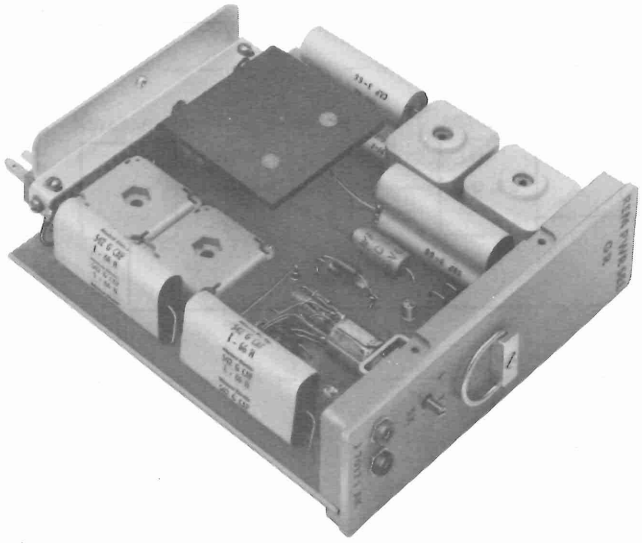

Fig. 20—Remote Power Selector

J. Plug CP12 (J70171AM)

3.26 This unit (Fig. 23) is used in shelf locations J2 and J7 to provide a connection from the regulator to the amplifier when neither a preamplifier nor an alarm circuit is required. It is also used to fill an empty space in shelf locations J4 and J9 when neither a control nor an oscillator circuit is required.

K. ▶Low Frequency Compensated Regulator CP22 (J70171BC)

3.27 The low frequency envelope delay requirement is the most critical transmission parameter. Most WLR-5 repeatered loops, engineered according to standard design, can be expected to meet the point-to-point requirements; however, low-frequency phase distortion can sometimes be a problem. This problem arises particularly when more than three repeatered sections are being utilized or when the wideband loop is being used for 50 kilobit per second secure speech. The low frequency compensated regulator (J70171BC) corrects for low-frequency phase distortion. When required, this plug-in board replaces the flat regulator (J70171AF). One low frequency compensated regulator is used in each direction of transmission at the transmitting terminal repeater only. This regulator can be used to extend point-to-point service to four repeatered sections and, if necessary, can be used to upgrade the 3-section lines which may not meet the low-frequency delay requirements.

3.28 The low frequency compensated regulator (Fig. 24) is used in nonregulated loop repeaters to provide the following:

- Adjustment of the repeater gain over a 30-dB range
- Removal of simplex current from the cable
- A means for access to the input of the repeater and the external circuit through test jacks
- Fixed flat gain setting for line-up purposes.

3.29 The low frequency compensated regulator (Fig. 25) consists of an input-coupling circuit and a preamplifier. Resistors R5 and R6 provide the means of adjusting the flat loss through the unit. This loss is limited to 30 dB.

3.30 Transformer T1 is used to connect the balanced input signal to the unbalanced circuit and provides a means of removing simplex current from the cable.

3.31 The preamplifier consists of a 2-stage, 3-transistor amplifier employing ac and dc feedback for gain and bias stabilization. The gain

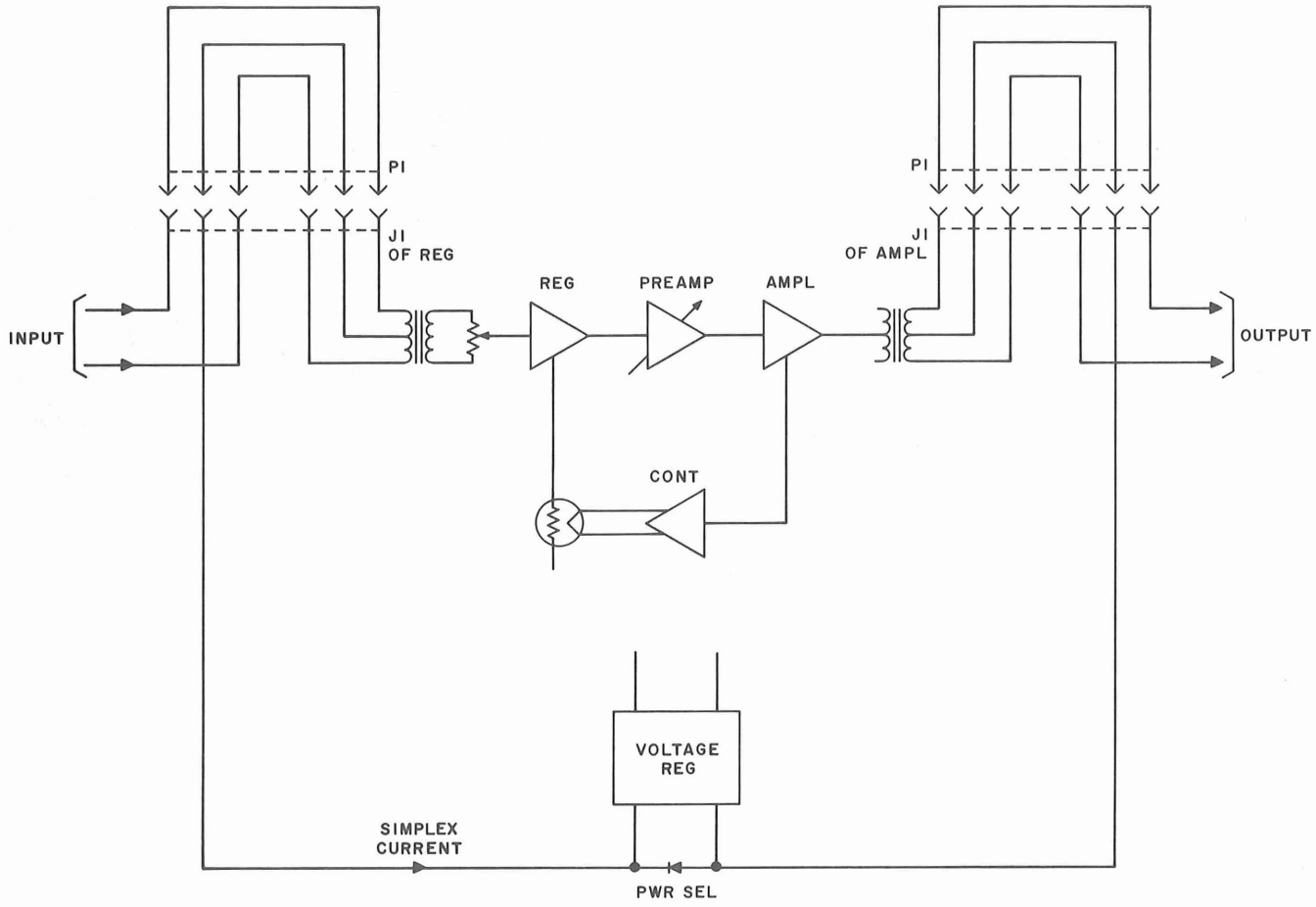

Fig. 21—Remotely Powered Pilot - Regulated Intermediate Repeater (One Direction)—Block Diagram

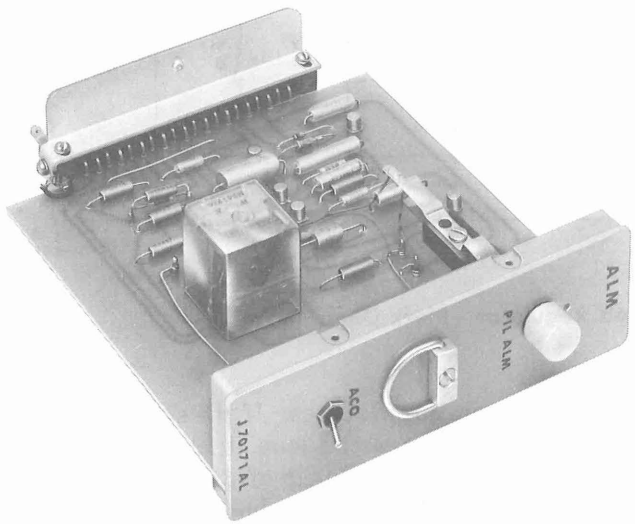

Fig. 22—Alarm

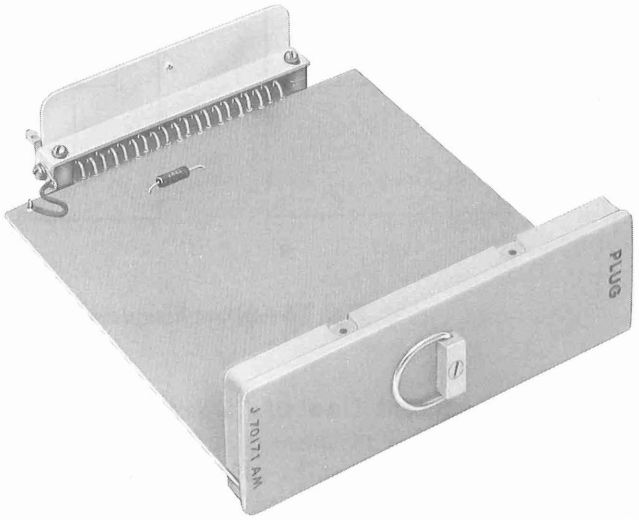

Fig. 23—Plug

of the amplifier is fixed by an internal voltage divider. Low-frequency response is changed by operating switches S1 and S2.

3.32 The components of the basic repeaters are listed in Tables A, B, and C.

4. MAINTENANCE FEATURES

4.01 The J70171AA, L2 office-mounted repeater shelves, equipped to send simplex current, provide a 1500-ohm potentiometer to adjust the simplex current plus test points where the current may be monitored by measuring the voltage across a 100-ohm resistor. To supply power to a remote repeater, the simplex current is adjusted until a reading of 7.5 volts for a nonregulated loop or 11.0 volts for a regulated loop appears on a dc voltmeter connected to the test points. This

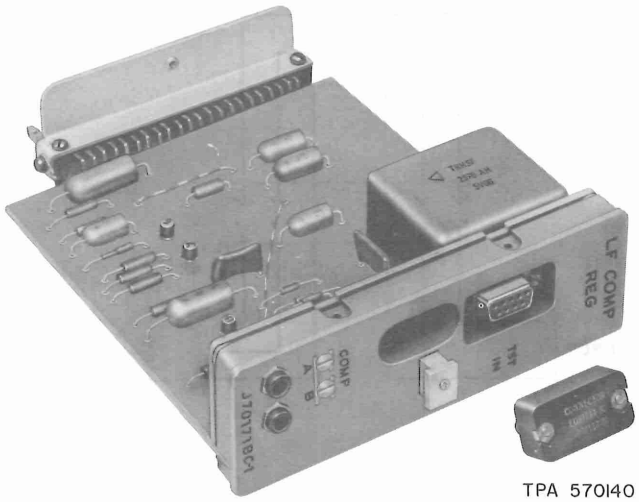

Fig. 24—Low Frequency Compensated Regulator

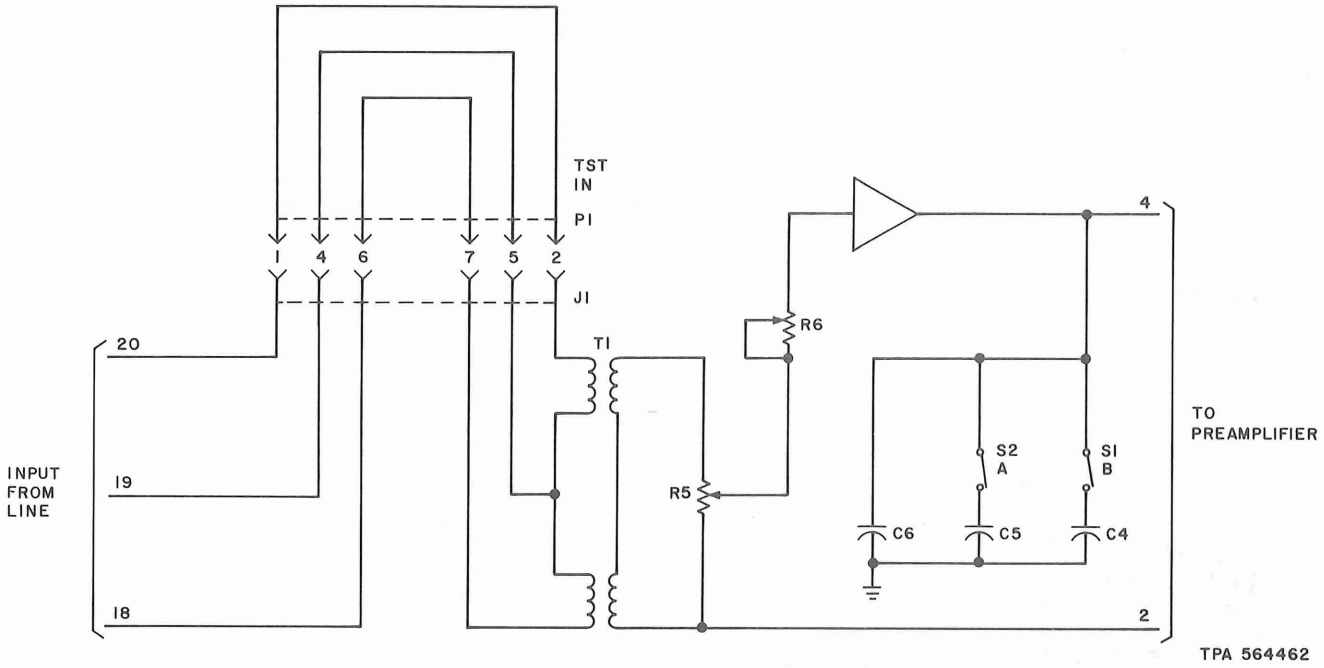

Fig. 25—Low Frequency Compensated Regulator—Block Diagram

indicates a current flow of 75 mA or 110 mA, respectively. Either of these is sufficient to supply power to the active units of the repeaters, to provide a bias current of approximately 10 mA for the breakdown diode, and to establish a 20-mA margin under nominal conditions to guard against erratic performance as the loop parameters vary due to temperature changes. If the simplex current is used only to seal the loop, the current should be adjusted until a reading of 3 volts is indicated on the meter. This reading shows that the current flow is 30 mA, which is sufficient for loop-sealing purposes and still provides a 10-mA margin over the minimum requirement.

TABLE A

CUSTOMER OR TERMINAL REPEATER
TRANSMITTING DIRECTION

PILOT-REGULATED	NONREGULATED
J70171AF Flat Regulator J70171AL Alarm J70171AC Amplifier J70171AH Group Oscillator J70171AJ, L2 or J70171AK, L2 Power Selector	J70171AF Flat Regulator J70171AM Plug J70171AC Amplifier J70171AM Plug J70171AJ, L1 or J70171AK, L1 Power Selector

TABLE B

CUSTOMER OR TERMINAL REPEATER
RECEIVING DIRECTION

PILOT-REGULATED	NONREGULATED
J70171AE Group Regulator J70171AD Group Preamplifier J70171AC Amplifier J70171AG Group Control J70171AJ, L2 or J70171AK, L2 Power Selector	J70171AF Flat Regulator J70171AD Group Preamplifier J70171AC Amplifier J70171AM Plug J70171AJ, L1 or J70171AK, L1 Power Selector

TABLE C

INTERMEDIATE REPEATER
IDENTICAL DIRECTIONS OF TRANSMISSION

PILOT-REGULATED	NONREGULATED
J70171AE Group Regulator J70171AD Group Preamplifier J70171AC Amplifier J70171AG Group Control J70171AJ, L1 or J70171AK, L1 Power Selector	J70171AF Flat Regulator J70171AD Group Preamplifier J70171AC Amplifier J70171AM Plug J70171AJ, L1 or J70171AK, L1 Power Selector

4.02 Bias measurement test points are provided on the face panel of the amplifier, preamplifier, group regulator, and group control units to measure the bias of the output transistors of the units. Since each unit consists of a series of direct-coupled transistor stages, a bias check on the output stage will verify that the entire circuit is properly biased. The measured bias voltages of the units are shown in Table D. If the measurements at the test points indicate that the voltage is out of limits, the defective unit should be replaced. No field adjustments of dc bias voltages are provided for these units.

4.03 Test access jacks, provided on the face panel of the flat or group regulator and on the amplifier plug-in unit, can be connected to an ED-73285 test connector (Fig. 26 and 27) for line-up and maintenance purposes. Plug P2 is connected to the jack in the flat or group regulator, which connects the test connector to the output of the incoming line and to the input of the repeater. Plug P1 is connected to the jack in the amplifier unit, which connects the test connector to the output of the repeater and to the input of the outgoing line. The ED-73285 test connector provides four jacks, EQPT 1, LINE 1, EQPT 2, and LINE 2,

TABLE D

CIRCUIT PACK BIAS VOLTAGE MEASUREMENTS

UNIT	BIAS VOLTAGE (DC)
Amplifier	11 - 14 Volts
Preamplifier	7 - 14 Volts
Group Regulator	9 - 12 Volts
Group Control	11 - 15 Volts

by which an ac voltmeter, signal generator, noise measuring set, or other appropriate test instrument can be connected to the circuit under test. The test connector also provides a pilot rejection filter when plug P1 is used for testing on regulated loops. This filter can be switched out of the circuit by means of a rejection filter switch mounted on the face panel of the test set. When the switch is in the group (GR) position, the filter is in the circuit. When the test connector is not connected to the repeater, a shorting plug interconnects the terminals of the test jacks; when the test connector is connected, the transmission path is broken and the repeater and line are terminated in 135-ohm resistors. Simplex current is maintained through the test connector transformers. This test connector can only be used for out-of-service tests.

Fig. 26—Test Connector

5. REFERENCES

5.01 The following CDs and SDs are related to this section:

SD-73051-01	WLR-5 Wideband Loop Repeater—Schematic Diagram
CD-73051-01	WLR-5 Wideband Loop Repeater—Circuit Description
SD-73035-01	Wideband Service Bay—Application Schematic
SD-1D100-01	Data Set 303-Type—Application Schematic