10E1 TELEGRAPH SINGLE LINE REPEATER

CONTENTS PAGE

1. GENERAL 1

2. OPERATING PRINCIPLES 1

3. CIRCUIT ARRANGEMENTS 2

Elimination of Adjustable Biasing Feature 2

Use of 255A Relays 2

Ratio of Loop and Bias Currents 2

Effective Polar Transmission 3

4. DESCRIPTION OF EQUIPMENT 3

1. GENERAL

1.01 This section describes the 10E1 telegraph single line repeater. This repeater employs a circuit similar to the 10B type repeaters but has no bias adjusting feature to compensate for bias which may be introduced into the signals outside of the repeater. The 10E1 repeater employs four 255A relays and the equipment for two repeaters is arranged as a single unit for mounting on a standard 19-inch relay rack bay. The dimensions of the unit are such that it may be mounted in the space originally provided for the monitoring units of metallic and voice frequency telegraph repeaters.

1.02 This section is being reissued to include information on the 10E repeater manufactured in accordance with J70021 List 2. The List 2 repeater is arranged to send effective polar signals toward drop 2 of the TLT. The repeater as previously manufactured in accordance with J70021 List 1 was arranged to send effective polar signals toward drop 1. This issue also covers other improvements in the repeater.

2. OPERATING PRINCIPLES

2.01 Assume that the west and east loops are closed and that all relays are on their marking contacts. Referring to Fig. 1 transmission of a spacing signal from west to east takes place as follows: When a spacing signal originates in the west loop, the (HE) and (LW) relays are operated to spacing under the influence of the bias current in the 3-6 windings of these relays. The bias current is fixed at approximately one-half the value of the loop current. Opening of the marking contacts of the (LW) relay sends a spacing signal into the east loop. Opening of the marking contacts of the (HE) relay causes a hold current to be established through the 3-6 windings of the (LE) and (HW) relays which serves to hold these relays on their marking contacts. In order to prevent momentary opening of the (LE) relay contacts which might interfere with transmission, the 3-6 winding of the (LW) relay is shunted by an 1800-ohm resistance. This causes the (HE) relay to leave its marking contacts slightly before the (LW) relay and helps to establish the hold current in the 3-6 windings of the (LE) and (HW) relays before the loop current in the 2-7 windings decays.

2.02 Transmission of a marking signal from west to east takes place as follows: When a marking signal originates in the west loop a marking current of approximately twice the value of the bias current builds up in the 2-7 windings of the (LW) and (HE) relays and causes these relays to operate to their marking contacts. Closure of the contacts of the (LW) relay causes a marking signal to be sent into the east loop. Closure of the marking contacts of the (HE) relay produces a bias current in the 3-6 windings of the (LE) and (HW) relays. As this current has a spacing effect, it would cause the marking contacts of the (LE) and (HW) relays to be opened momentarily if it were allowed to build up faster than the east loop current. The circuit is designed to avoid this condition by shunting the 3-6 winding of the (LW) relay with 1800 ohms, as previously noted, and by providing a 207E or 307E retardation coil to delay the build-up of the bias current. The 1800-ohm shunt causes the (LW) relay to close its marking contacts slightly before the (HE) relay.

2.03 If, while the west loop is sending, the east loop station desires to break, a spacing signal originating from the east loop will operate the (LE) and (HW) relays to spacing as soon as the west loop is closed. This will cause the break signal to reach the west loop station. This description holds for transmission in the opposite direction except that conditions are reversed.

2.04 The bias and hold circuit is in the form of a bridge as shown on Fig. 1 and operates as follows: When the contacts of the (HW) relay are closed, the 3-6 windings of the (LW) and (HE) relays are connected across on unbalanced bridge circuit and current will flow in the direction indicated by the arrow marked bias. When the (HW) relay contacts are open, one arm of the bridge is open and a hold current flows through the 3-6 windings of the (LW) and (HE) relays in the opposite direction, as indicated by the arrow. In a similar manner the (HE) relay opens the other bridge circuit and causes bias and hold currents to flow through the 3-6 windings of the (LE) and (HW) relays.

2.05 Provision has been made for connecting battery to the spacing contact of one or both line relays. This provides improved transmission since it tends to improve the symmetry of the signal wave shape received from the single line repeater. This is particularly desirable in operating over cable loops of appreciable length. Since this form of transmission is essentially polar with a practically symmetrical current wave shape, it will be denoted as "effective polar" transmission. When this arrangement is used for sending into the loop circuit between two terminal repeaters, transmission towards one terminal repeater will be "effective polar" and that towards the other terminal repeater will be "neutral."

2.06 The 10E1 repeater was formerly arranged to send effective polar toward drop 1 of the TLT and had negative battery connected to the spacing contacts of the line relays. The repeater so arranged was covered by J70021 List 1. As at present manufactured the repeater is arranged to send effective polar toward drop 2 and therefore has positive battery connected to the spacing contacts of its line relays. The repeater arranged to send effective polar toward drop 2 is covered by J70021 List 2.

3. CIRCUIT ARRANGEMENTS

3.01 The fundamental circuit of the 10E1 repeater is similar to that of the 10B type repeaters. It differs, however, in several important respects which are discussed below. A complete circuit schematic of the repeater wired to send effective polar signals toward drop 2 is shown on Fig. 2.

Elimination of Adjustable Biasing Feature

3.02 The bias correcting feature heretofore provided with 10B type repeaters has been omitted. Therefore when the repeater is employed to work with loops of appreciable length they should be equipped with wave shaping networks and no adjustments will be required at the repeater since the bias will be reduced by the wave shaping.

Use of 255A Relays

3.03 The use of 255A relays results in a much smaller variation in the bias of outgoing signal due to differences in individual relays than would occur if 215 type relays were employed. This improvement is even more marked when compared with the 228A relays heretofore employed on 10B type repeaters. This smaller variation of bias is of importance in minimizing the possibilities for kick-off and permits more general interchangeability of the relays and repeaters.

Ratio of Loop and Bias Currents

3.04 In order to secure minimum signal distortion it is desirable that the bias and loop currents be fixed at a definite ratio. For 10B type repeaters there are certain factors which cause this ratio to vary in individual cases. These factors are listed below.

(1) Manufacturing variations in the resistance units in the bias and hold circuit.

(2) Manufacturing variations in the resistances of the relay windings.

(3) Variations in the average battery voltage in different offices.

(4) Differences in the voltages of the positive and negative telegraph batteries in the same office. (Variations from the average battery voltage do not affect the ratio of the loop and bias currents as long as the positive and negative battery voltages remain equal unless the loop current is readjusted to compensate for such variations.)

3.05 The effect on signal bias of the variations listed under Items (1), (2) and (3) of 3.04 is reduced by adjusting the bias current accurately at the time of installation with relays of average resistance inserted in the repeater, or with resistances equal to the average resistance of a relay winding substituted for the 3-6 windings of all relays. The repeater is equipped with a sufficient number of resistance units which can be strapped to obtain a close adjustment of the bias current.

.06 Those variations caused as described in Item (4), of 3.04 have been eliminated through redesign of the bias and hold circuit from a potentiometer to a bridge circuit. The bridge type of bias and hold circuit is shown on Fig. 1. With the potentiometer circuit heretofore employed, the positive and negative 130-volt batteries applied to the bias and hold circuit are opposed for the bias condition and any variations between these voltages will result in changes in the bias current. In the case of the bridge type bias and hold circuit the positive and negative 130-volt batteries are applied to the circuit in a series aiding manner for both bias and hold conditions and any voltage variation of one battery with respect to the other will have no effect on either the bias or hold currents as long as the combined voltage of both batteries remains the same. Variations in which the sum of the positive and negative battery voltages changes will cause the loop and bias currents to vary but will have no effect on the bias of the transmitted signals whether the two batteries vary equally or not, since these currents will remain in the same ratio.

Effective Polar Transmission

3.07 A resistance of 1500 ohms is provided in the battery tap which is connected to the spacing contacts of the line relays. This resistance will for practical purposes approximate the impedance of the marking contact battery lead under average operating conditions. The spacing contact battery can be utilized by connecting the "Y" or "Z" wiring or both. The "Y" wiring connects battery to the spacing contact of the (LW) relay and the "Z" wiring connects battery to the spacing contact of the (LE) relay. "Y" wiring is obtained by strapping terminals 14 and 15 of terminal strip A on the rear of the repeater. "Z" wiring is obtained by strapping terminals 15 and 16 of this terminal strip.

3.08 Effective polar transmission should prove advantageous for repeating into loops with or without wave shaping equipment. Since no means for bias correction are available in the 10E1 repeater, this form of transmission is particularly desirable as the signals will be relatively free from bias in so far as the nature of the loop circuit is concerned. If transmission into the loop is on a neutral basis, the bias received from the 10E1 repeater will depend somewhat on the characteristics of the loop. It is therefore desirable to use effective polar transmission to avoid bias in signals received directly from the 10E1 repeater. If the repeater is employed to send into a TLT circuit which interconnects the legs of two toll terminal repeaters, the signals will of necessity be neutral towards one of these repeaters. In this case if an inductive loop is included in this TLT circuit on the side of the 10E1 repeater which sends the neutral signals, the signals sent through this loop may be biased to spacing due to the loop inductance. If the inductive loop is on the side of the 10E1 repeater which sends polar signals, the signals sent through the inductive loop will be unbiased, but the signals sent in the neutral direction will be biased to spacing.

3.09 As mentioned in 2.05 the 10E1 repeaters may be found in the field wired in either one of two ways. The repeaters of earlier manufacture had provision for connecting negative battery to the spacing contacts of the line relays and were arranged to send effective polar signals toward drop 1 of the TLT and the repeaters of later manufacture had provision for connecting positive battery to the spacing contacts of the line relays and were arranged to send effective polar signals toward drop 2 of the TLT. In either case the repeater should be connected to the TLT so as to send effective polar signals through any loops which may be connected to the TLT. To send toward drop 1 of the TLT, the repeater should be connected to either the highest numbered loop jack of the No. 4 telegraph test board; the loop 1 jack of the No. 5 telegraph board; or the highest numbered loop jack of the No. 9 telegraph board. To send toward drop 2 the repeater should be connected to the loop 1 jack of the No. 4 telegraph board, to the highest numbered loop jack of the No. 5 telegraph board or to the loop 1 jack of the No. 9 telegraph board.

4. DESCRIPTION OF EQUIPMENT

4.01 The equipment arrangement for two 10E1 repeaters is shown on Fig. 3. This equipment occupies a space of seven 1-3/4" mounting plates or a total height of 12-1/4". The apparatus associated with one repeater is mounted on the left and that of the other repeater on the right of the equipment unit. Three 1-3/4" mounting plates located at the top of the unit accommodate the battery cutoff keys, resistances, condensers, coils and designation strips. The four 203 type terminal strips mounted on the rear of the top mounting plate are provided for connecting external leads to the repeater and to facilitate strapping changes. In repeaters of earlier manufacture a P-419712 designation strip was

employed and mounted by clamping beneath the heads of two adjacent mounting plate screws. These designation strips accommodated a card of 3" by 5" size. In repeaters of later manufacture, a 91D designation strip is employed which mounts flat on the mounting plate. The two lower mounting plates are of 3-1/4" height and accommodate the polar relays. No monitoring equipment is provided with this repeater, since all service adjustments and measurements are to be made elsewhere. Repeaters arranged to send effective polar signals toward drop 2 bear the following stamping: 10E1 REP DROP 2 SD-70161-02. On the older repeaters arranged to send effective polar toward drop 1 the stamping does not appear.

Attached:

Figs. 1, 2 and 3.

BELL TELEPHONE LABORATORIES, INC.

ES-536495
INFORMATION
L. NO. P25262
2-2-39
ISSUE: 1 M.R.P.

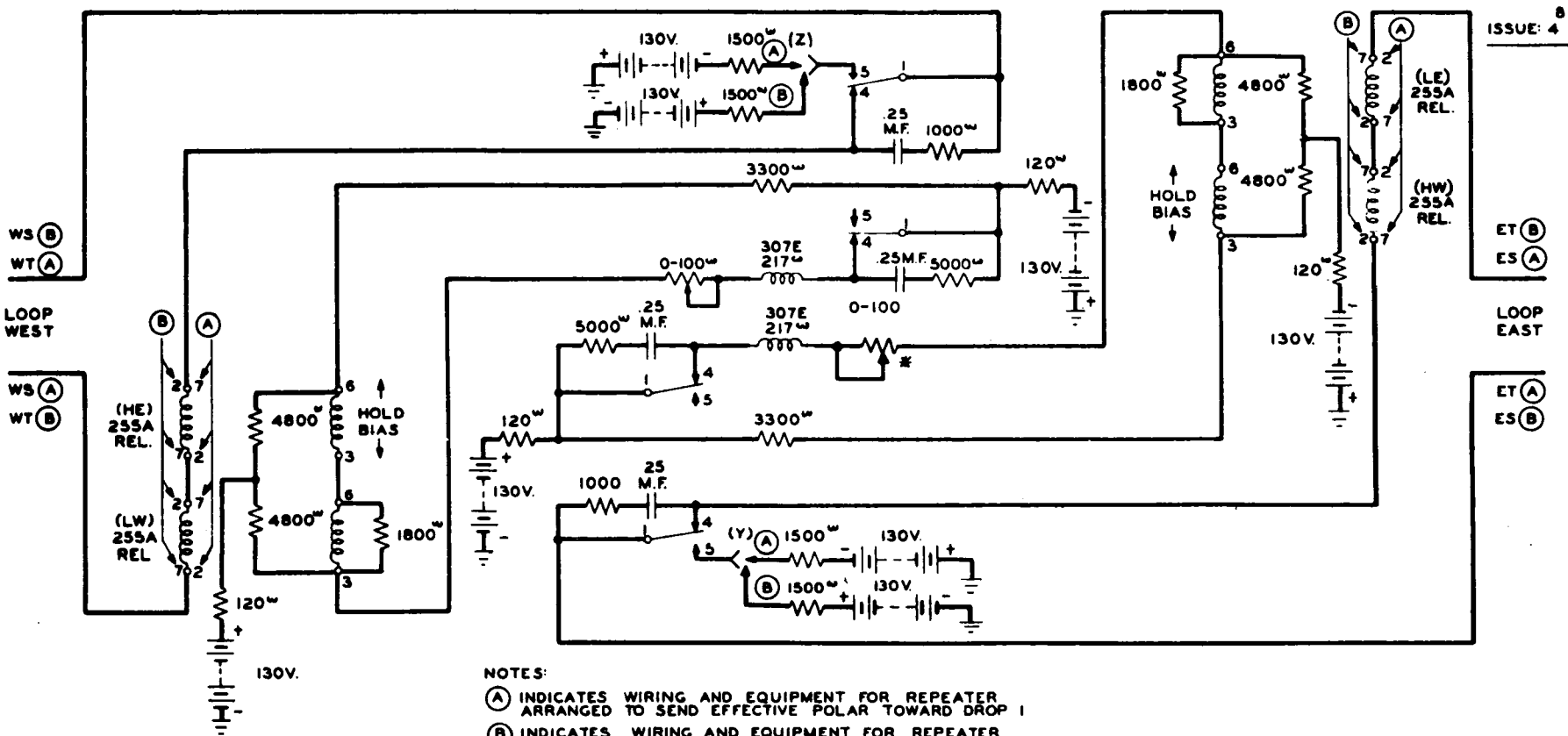
MINOR CHANGES
L. NO. P25288
3-23-39
ISSUE: 2 M.R.P.

MINOR CHANGES
L. NO. P25344
9-1-39
ISSUE: 3 M.R.P.

8-29-47
ISSUE: 4 L.C.R.

TELEGRAPH SYSTEMS
10EI TELEGRAPH REPEATER
SCHEMATIC

FIG. 1



NOTES:

(A) INDICATES WIRING AND EQUIPMENT FOR REPEATER ARRANGED TO SEND EFFECTIVE POLAR TOWARD DROP 1

(B) INDICATES WIRING AND EQUIPMENT FOR REPEATER ARRANGED TO SEND EFFECTIVE POLAR TOWARD DROP 2.

FIXED AT TIME OF INSTALLATION

ES-536495

CIRCUIT NOTES:

101. PROVIDE THREE LEADS FROM THE +130V TELEG. BAT. BUS BAR EACH EQUIPPED WITH A 74C OR 74E HEAT COIL PER CKT.

102. PROVIDE TWO LEADS FROM THE -130V. TELEG. BAT. BUS BAR EACH EQUIPPED WITH A 74C OR 74E HEAT COIL PER CKT.

103. OMIT "X" OPTION UNLESS CONNECTION TO HIT SUPPRESSOR CKT. IS REQUIRED. "X" AND "Z" OPTIONS SHALL NOT BE USED TOGETHER.

104. PROVIDE "Y" AND "Z" WIRING. "Y" WIRING PROVIDES EFFECTIVE POLAR TRANSMISSION FOR THE EAST LOOP AND "Z" WIRING FOR THE WEST LOOP. POLAR TRANSMISSION IS TOWARD DROP 2.

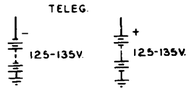
105. WITH 142Ω ± 1% RESISTANCES SUBSTITUTED FOR THE 3-6 WINDINGS OF ALL RELS. AND THE 1-4 TERMINALS OF THE CONNECTING BLOCKS FOR THE (HE) AND (HW) RELS. TEMPORARILY STRAPPED, THE STRAPPING OF THE (D),(E),(F),(U),(V), AND (W) RESISTANCES SHALL BE ADJUSTED TO GIVE A BIAS CURRENT IN ACCORDANCE WITH TABLE "A" THROUGH THE RESISTANCES SUBSTITUTED FOR THE (LE) AND (LW) REL. WINDINGS.

106. THE LOOP CURRENT SHALL BE ADJUSTED TO THE VALUE SHOWN IN TABLE "A".

107. THE (-BAT.) KEY SHALL BE A 552B KEY FOR NEW MANUFACTURE WHILE A 552A KEY MAY BE USED WHEN CONVERTING EXISTING REPEATERS.

TABLE A

TOTAL VOLTAGE	BIAS CURRENT	LOOP CURRENT
250V.	.030A.	.060A.
260V.	.03125A.	.0625A.
270V.	.0325A.	.065A.



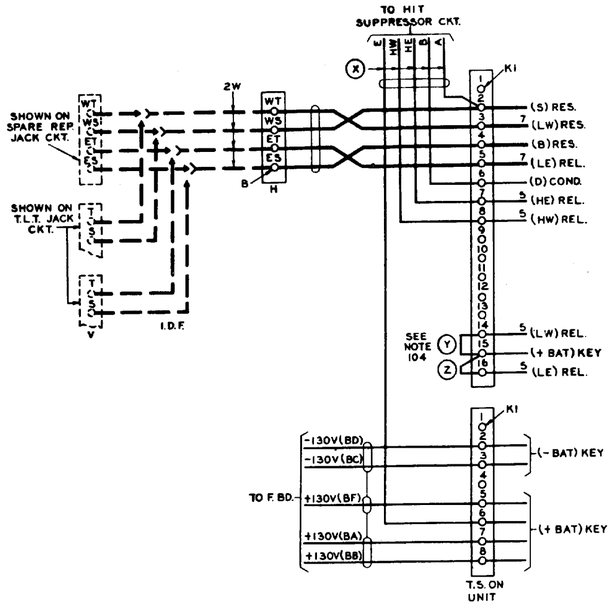
WORKING LIMITS

(A) 12 MI. NO. 19GA CABLE - LOADED AT SUBS. END

(B) 3 MI. NO. 19GA CABLE - NOT LOADED AT SUBS. END

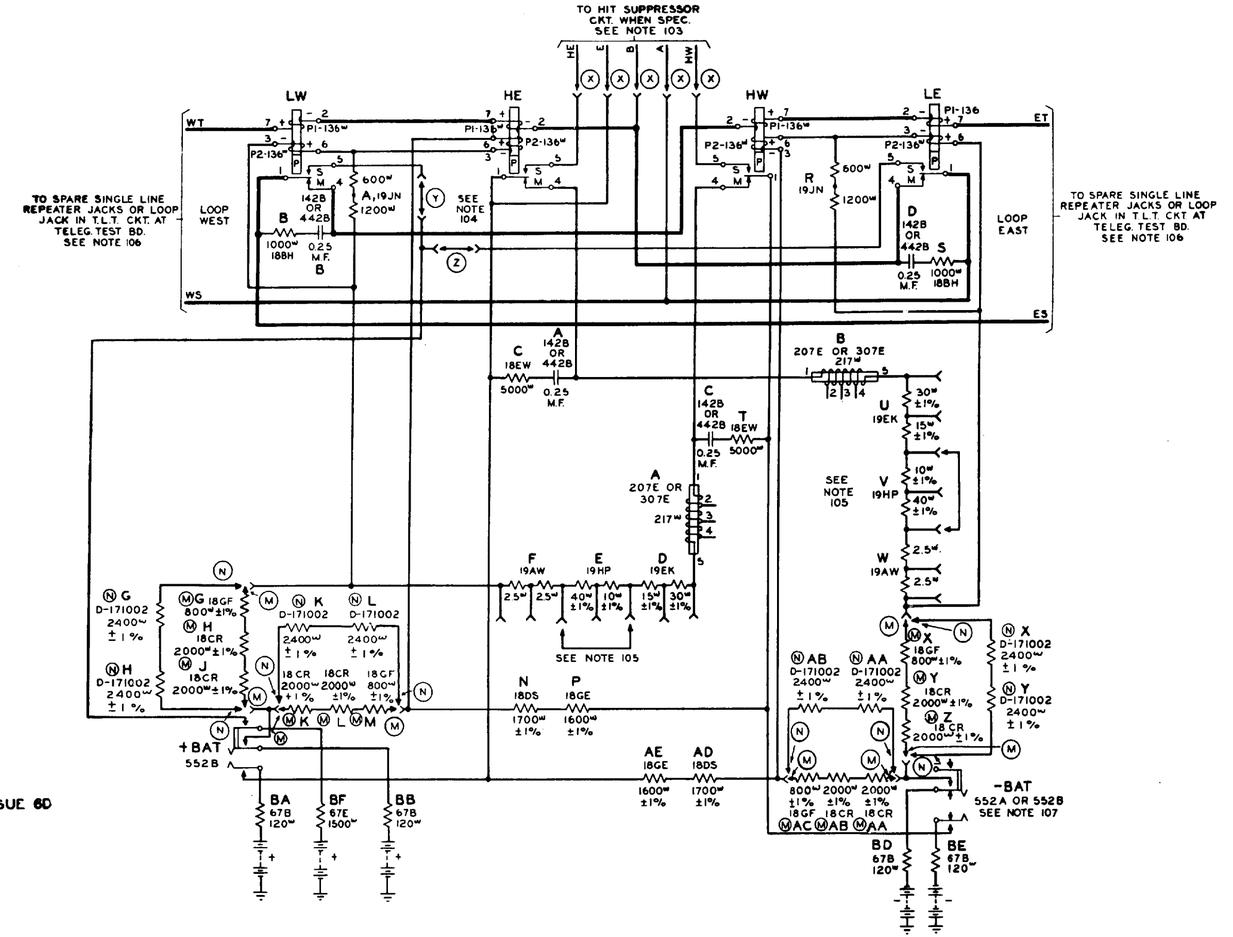
(C) FOR MORSE SERVICE THE INDUCTANCE OF THE LOOP SHALL NOT EXCEED THE EQUIVALENT OF SIX 3C SOUNDERS.

FIG. 51



RECORD OF FIGURES, WIRING, AND APPARATUS CHANGES							
CHANGED ON ISS	IF JOB RECORDS DO NOT SPECIFY	THIS OPTION WAS FURN.	SEE NOTE	USE IN CIRCUIT			
				STD.	A & M	M.D.	
1				307 E		207 E	
4-D	M OR N	M		N		M	

FIG 2
BASED ON SD 70161-02, ISSUE 6D



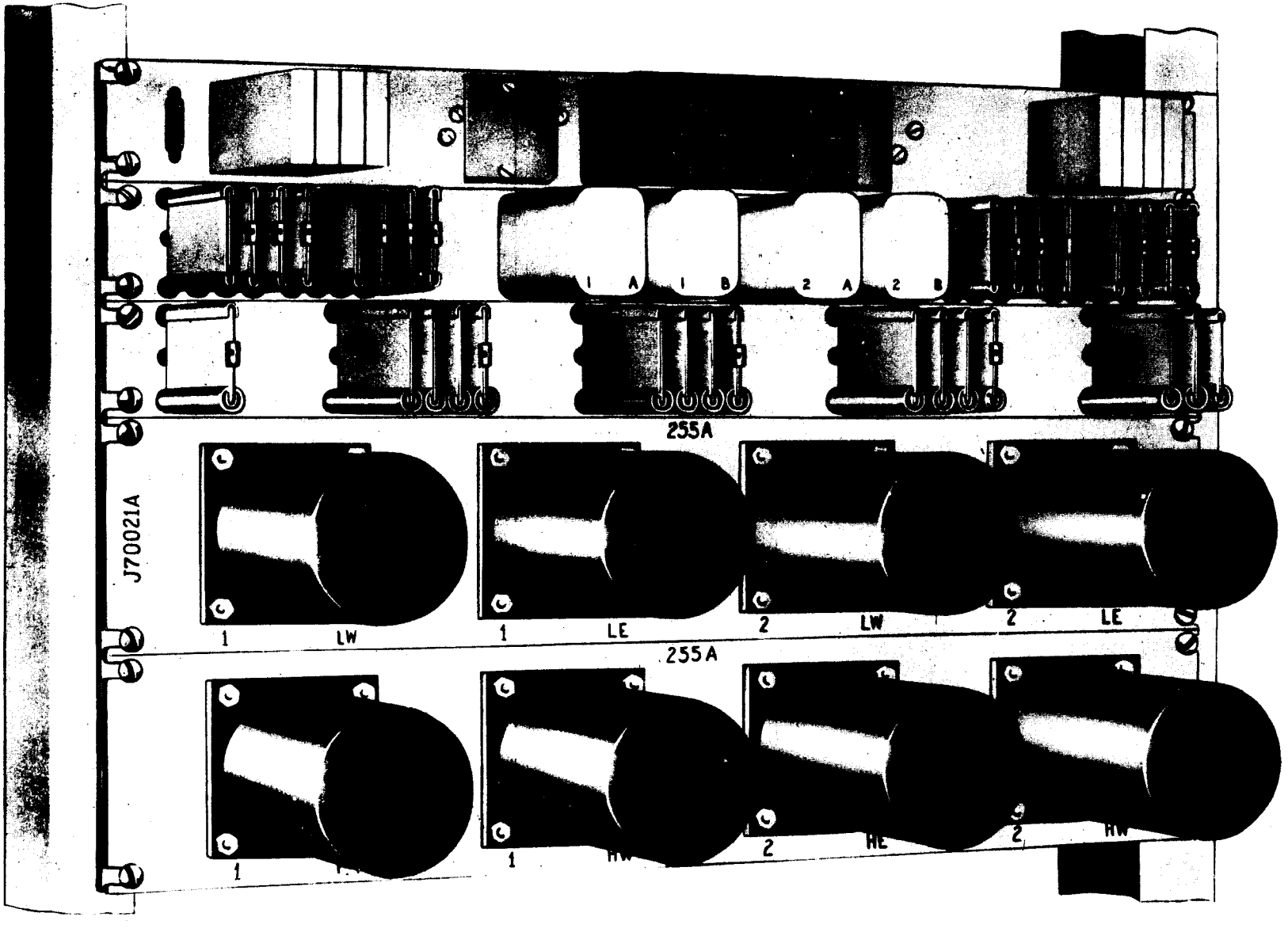


FIG. 3