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BELL SYSTEM PRACTICES
Teletypewriter and Manual
Telegraph Station and PBX
Installation and Maintenance

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Long Lines Department
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TELEGRAPH

13-Z-1 AND 13-Z-2 TELEGRAPH REPEATERS FOR ONE-WAY EXTENSION SERVICE

1. GENERAL

1.00 This issue supersedes Issue B. It is reissued to eliminate the need for two rectifiers at stations supplying loop current and to include installation information for the newer types of equipment.

1.01 This section covers the 13-Z-1 and also the 13-Z-2 telegraph repeaters. These two repeaters are electrically the same and are designed to give one-way extension service. The 13-Z-1 telegraph repeater is self-contained in a metal cabinet designed for wall mounting, while the 13-Z-2 telegraph repeater is mounted on an 884 type mounting plate for relay rack mounting.

1.02 These repeaters were designed for the purpose of furnishing one-way extension service from a circuit of one customer to other customers desiring this service in those cases where it is necessary or economical to make the connection to the main circuit on or near the premises of the first mentioned customer.

1.03 A specific feature of these repeaters is that the power supply required in connection with their operation need not necessarily be in the same location as the repeater itself but can, instead, be located in the office of one of the customers receiving the extension service.

2. THEORY OF OPERATION

2.01 The theory of operation of both of these telegraph repeaters for one-way extension service may be understood by referring to Figure 1. The figure assumes neutral operation in the main loop. It also assumes one extension loop containing two neutral receiving only stations. Note particularly that the rectifier supplying current to the extension loop also supplies bias current to the relay of the extension repeater. In the figure the rectifier is connected to the extension loop at a point indicated by "X" on the premises of the first extension station. The theory of operation would in no way be changed if the rectifier were instead connected to the extension loop at the point "Y" on premises of the main station. In case the main loop operates polar the bias circuit of the one-way extension repeater can be opened at the point indicated by "Z."

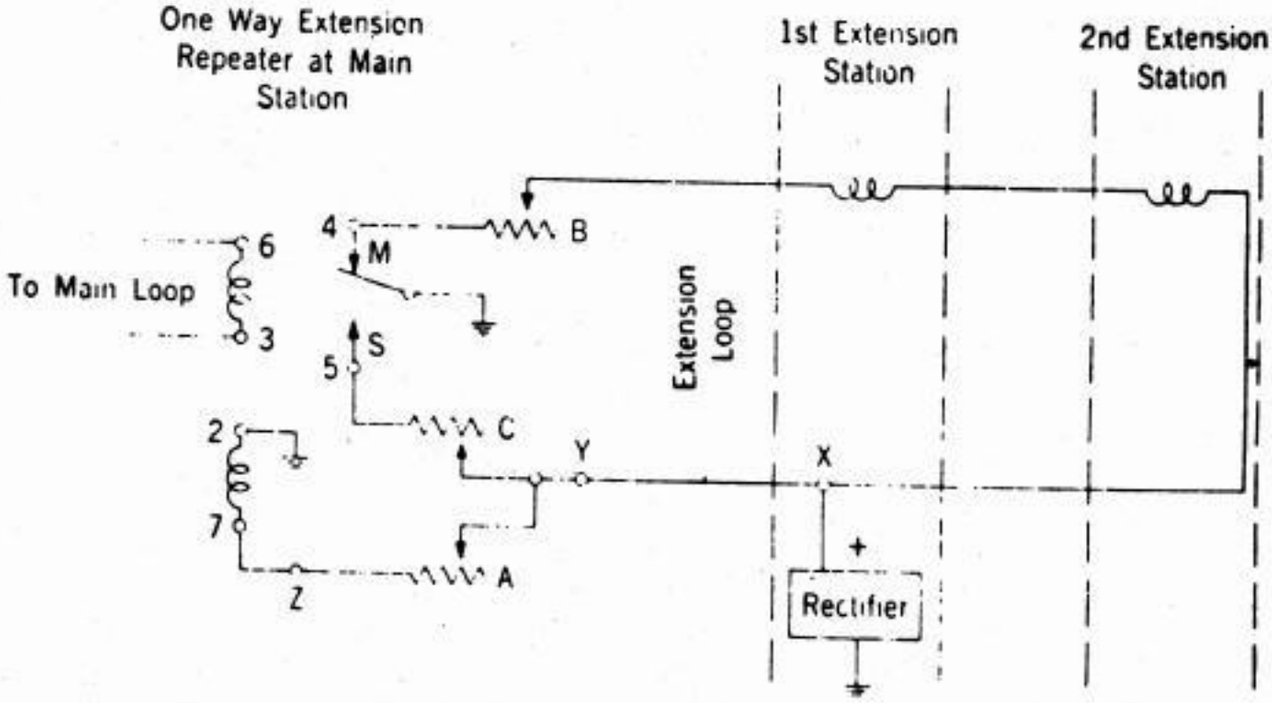


FIG. 1

2.02 When the main loop operates neutral the bias winding of the one-way extension repeater is used and the general lineup procedure is as follows:

(1) With the relay marking adjust resistance "B" to obtain the proper operating current in the extension loop.

(2) Now adjust resistance "A" to obtain the proper bias current through the relay bias winding.

(3) Adjustments (1) and (2) will affect each other because of the internal resistance of the rectifier so it will be necessary to repeat them both a few times in order to obtain the final values.

(4) With the relay spacing adjust resistance "C" until the bias current in the relay equals the final value of the bias current obtained above with the relay in the marking condition.

2.03 When the main loop operates polar the bias winding of the one-way extension repeater is not used and the general lineup procedure is as follows:

(1) With the relay marking adjust resistance "B" to obtain the proper operating current in the extension loop.

(2) With the relay spacing adjust resistance "C" so that the current flowing through this resistance equals the operating current obtained in (1). This procedure will balance the rectifier load for the marking and spacing condition.

3. DESCRIPTION

3.01 Cabinet Type Repeater (13-Z-1)

(a) The repeater is self-contained in a black crinkle finished steel box 18 inches long by 12 inches high and 4 inches deep and is constructed in accordance with part lists, construction details and wiring information contained in the following Long Lines Department drawings, which may be ordered in the usual manner:

20295-SD-124;	Schematic
20295-T-124;	Wiring Equipment and Mounting Details

(b) Several knockouts are provided in the box; any one of these may be utilized for cabling the necessary external conductors to the terminal strip inside the box.

(c) This unit is designed for wall mounting. It may be mounted on a relay rack, however, by means of two steel bars shown on the "T" drawing.

(d) The 13-Z-1 repeater has been superseded by the 13-Z-2 type for new installations.

3.02 Relay Rack Type Repeater (13-Z-2)

(a) This repeater is provided on a mounting plate unit 3-13/32" wide for direct mounting on a standard relay rack. It is assembled on a 3-13/32" mounting plate in order to conserve space. Some of the parts employed differ from those employed in the 13-Z-1 repeater. It is constructed in accordance with part lists, construction details and wiring information contained in the following Long Lines Department drawings, which may be ordered in the usual manner:

20480-SD-124;	Schematic
20480-T-113;	Wiring, Equipment and Mounting Details

(b) This repeater is intended for installation on relay racks which are completely enclosed in a cabinet or casing such as used at Civil Aernautics Administration stations and described in Appendix 2 of Section P30.908.

4. INSTALLATION

4.01 Extension stations are ordinary neutral receiving only stations with the holding magnet or the operating windings of their receiving relays connected in series with the tip side of the loop. See Figure 2 for loop connections at stations which do not supply current to the loop or repeater.

4.02 When the rectifier for supplying current is located at an extension station then that station shall be the nearest one, electrically, to the repeater and shall be located on loop No. 1. The receiving only machine should be connected as in either Figure 3 or Figure 4, (which provide for continuous operation of the rectifier.) Any connections not shown should be normal for equipment used. New installations should be installed per Figure 4.

4.03 The rectifier should be adjusted in accordance with instructions in the "P" series of Bell System Practices.

4.04 Details concerning the required external connections for the 13-Z-1 and the 13-Z-2 repeaters are given in Figures 5 and 6, respectively, which are reproduced from 20295-SD-124 and 20480-SD-124. Care should be taken to ensure that a good ground connection is made to terminal 8 in the case of the cabinet repeater and to terminal 11 on terminal strip B in the case of the relay rack repeater. This is particularly important if the rectifier is not located at the main station.

4.05 The strapping and connections required to be made at the terminal block of the repeaters are shown in detail on Figures 5 and 6; information pertaining to the strapping and connections is contained in Notes 4, 5, 6, 7 and 8. In connecting extension loops to the repeater, care should be taken to see that tip conductors are connected to odd-numbered terminals on the block and ring conductors to even-numbered terminals.

5. LINEUP

5.01 Limiting conditions applying to extension loops and extension stations are given in Notes 1 and 3 of Figure 5 or 6. Another limiting condition is that not more than two repeater inputs shall be connected in series with any given main loop unless otherwise specifically authorized by circuit order.

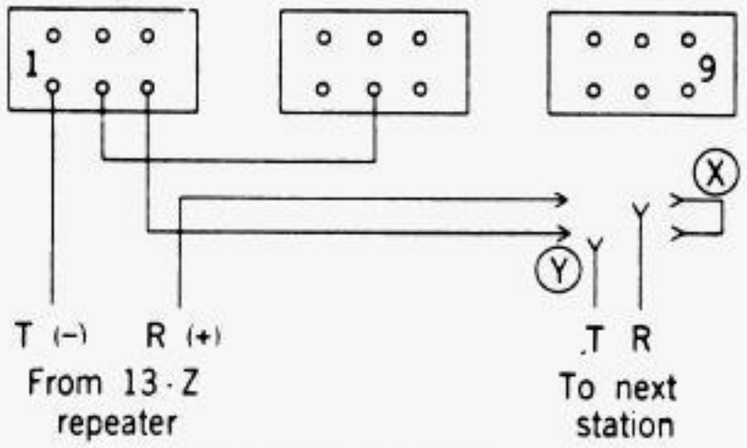
5.02 Detailed lineup instructions covering the extension repeater and extension stations are given in Note 7 of Figure 5 or 6.

5.03 In connection with the lineup the current in the main loop should be checked and if necessary it should be adjusted in the normal manner.

6. MAINTENANCE

6.01 The only normal maintenance required is routine checking and adjusting of the 215-type relay and the auxiliary rectifier output.

6.02 Before removing the 215-type relay from the repeater the (K) key, which is part of the repeater, should be operated. This will keep the main loop closed and will hold the extension loops in a marking condition. After the relay is reinserted the key should be restored to its normal position.

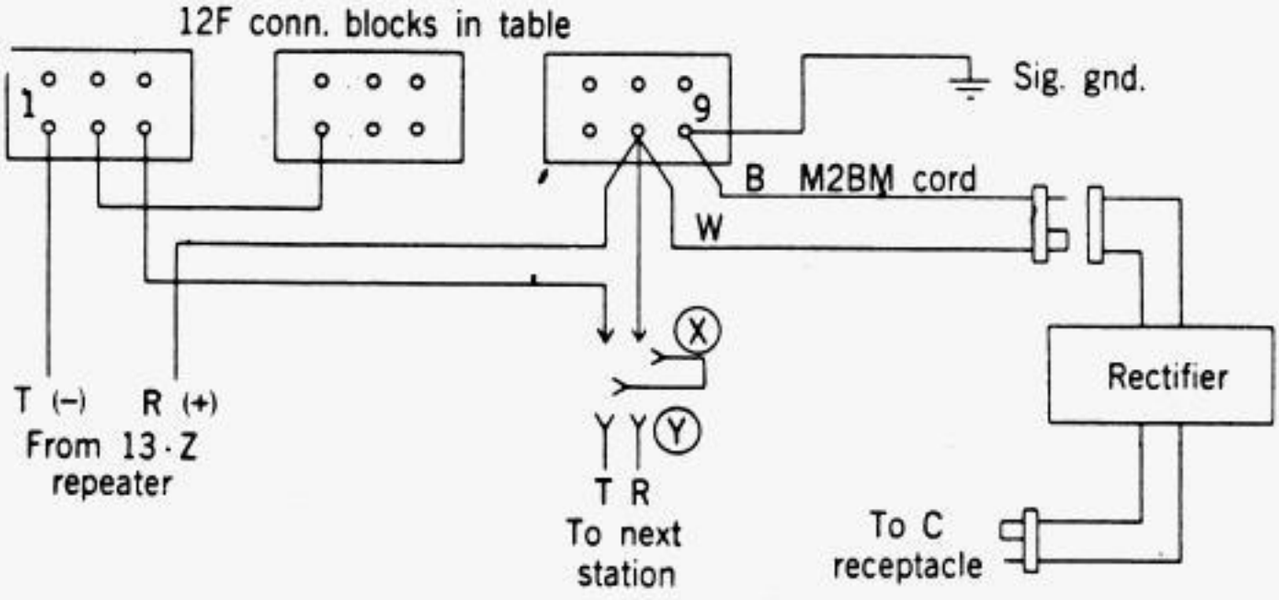


12F conn. blocks of 15N table or TP 117852 elec. svc. unit.

Use X wiring for single or last station. Use Y wiring for other stations.

Loop connections for stations not supplying loop current. 15N or XRT 200 table

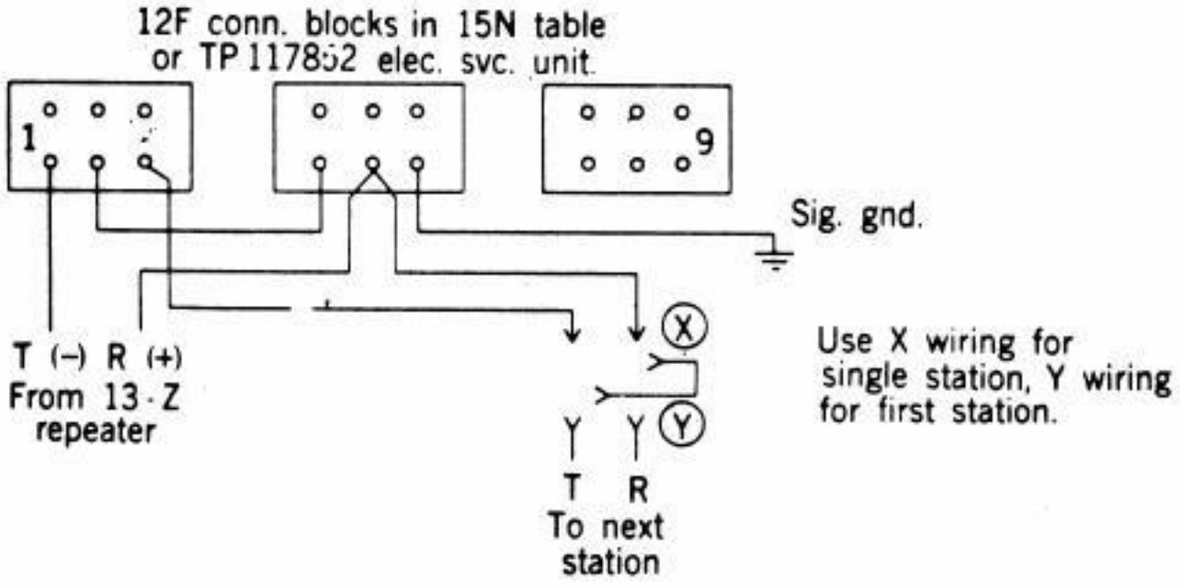
FIG. 2



Loop current supplied from station 15N table with separate J86205J rectifier (superseded)

Use X wiring for single station, Y wiring for first station.

FIG. 3



Loop current supplied from station 15N or XRT 200 table KS-5579 or KS-5663 (lists 1, 2, 3, 4 or 5) rectifier

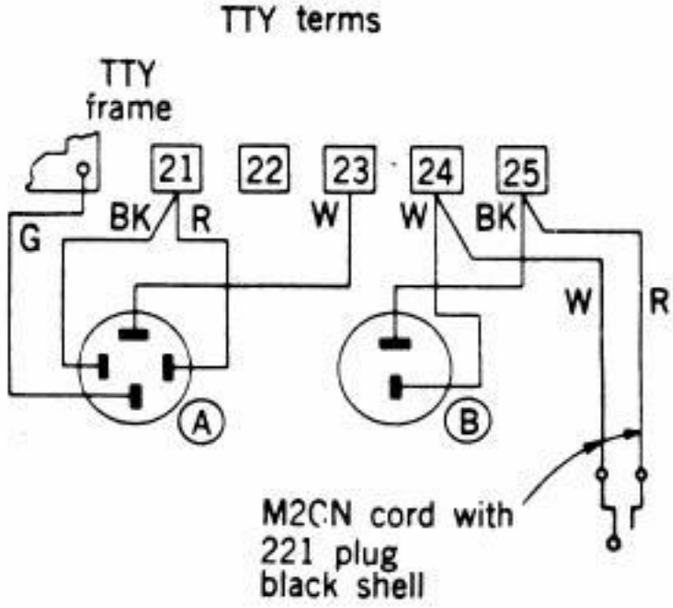
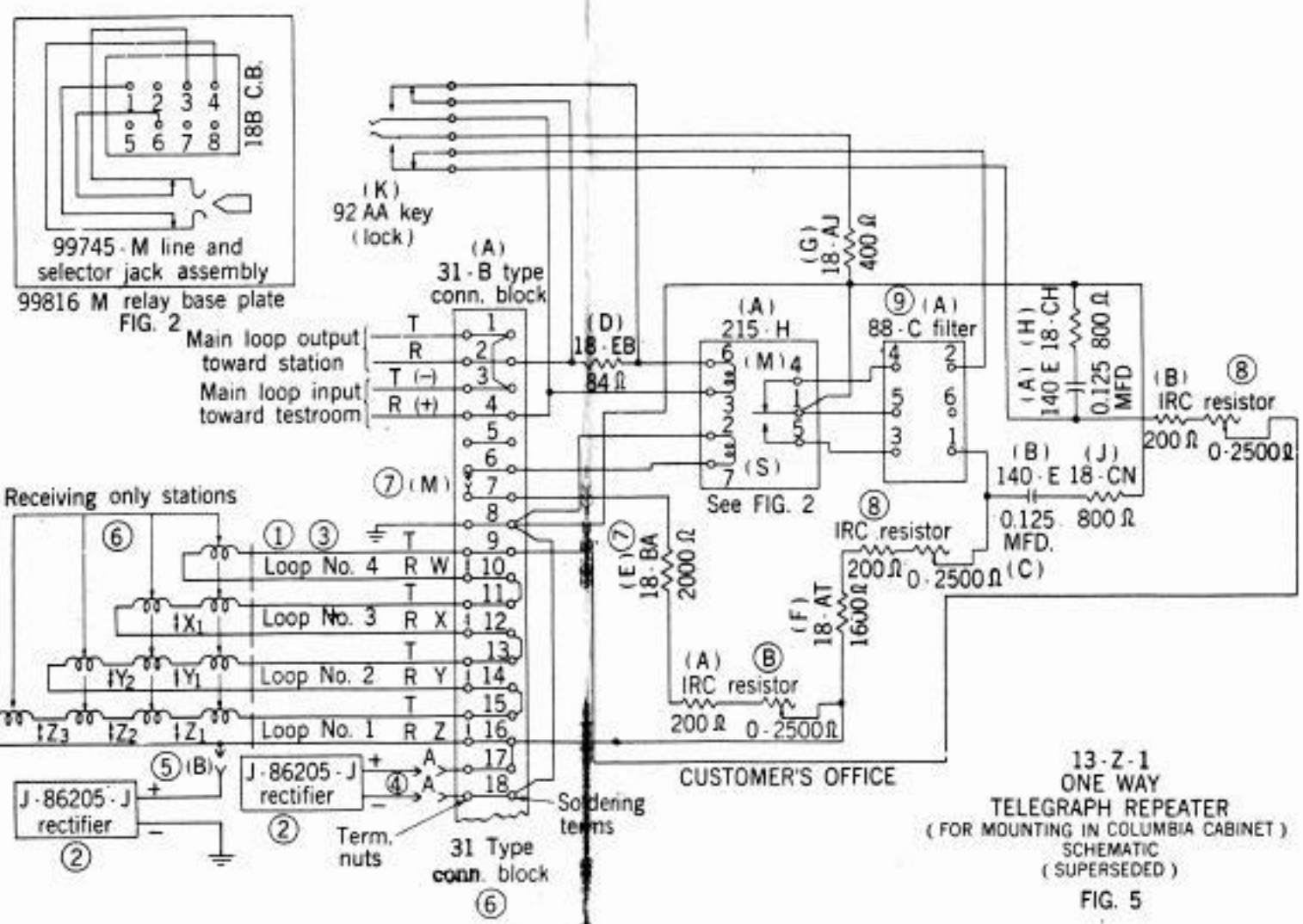


FIG. 4



13-Z-1
ONE WAY
TELEGRAPH REPEATER
(FOR MOUNTING IN COLUMBIA CABINET)
SCHEMATIC
(SUPERSEDED)

FIG. 5

1-17-52

- NOTES -

1. Not more than 4 output loops or 4 receiving only stations shall be associated with any one repeater.
2. Adjust rectifier in accordance with instructions in "F" series of B.S.P.
3. The total output loop length to be associated with any one repeater shall not exceed 10 miles.
4. If the rectifier is located on the premises with the repeater then use "A" wiring.
5. If rectifier is to be located at a receiving only station then use "B" wiring and locate it at the station nearest the repeater on loop No. 1. In this case the loop length between the repeater and the rectifier shall not exceed 5 miles.
6. Within limitations of Notes 1 to 5 straps W, X, Y and Z should be applied as required to obtain connections for 1, 2, 3, or 4 loops. Also connections Z_1, Z_2, Z_3, Y_1, Y_2, and X_1 should be applied as required so that not more than 4 receiving only stations are connected to any one repeater output.
7. Use "M" strap when main loop is operated neutral. Under this condition adjust the currents in the repeater as follows:
   1. With armature of (A) relay on mark adjust (B) res. to give output current of .060-.065 amps. Connect meter in series with subs. loop at lug 9 of conn. block.
   2. With armature of (A) relay on mark adjust (A) res. to give bias current of .030-.0325 amps. Connect meter in series with bias ckt. at "M" strap of conn. block.
   3. The adjustment of (A) res. changes the loop current so steps 1 and 2 may need to be repeated several times to arrive at final values.
   4. With armature of (A) relay on space adjust (C) res. to give a relay bias current equal to that obtained in 2 above. Do not change adjustment of (A) resistor. Connect meter in series with bias circuit at "M" strap of conn. block.
8. When main loop is operated polar omit "M" strap. Under this condition adjust the currents in the repeater as follows:
   1. With armature of (A) relay on mark adjust (B) res. to give .060-.065 amps. When "B" wiring is used connect meter in series with subs. loop at lug 9 of conn. block. When "A" wiring is used connect meter in series with rectifier at "A" strap.
   2. With armature of (A) relay on space adjust (C) res. to give .060-.065 amps. When "B" wiring is used connect meter in series with circuit at lug 16 of conn. block. When "A" wiring is used connect meter in series with rectifier at "A" strap.
9. Limit the length of the wires between the 88-C filter and the 18-B conn. block to 1-1/2 inches. Do not sew these wires in form and keep at least 1/4 inch from adjacent wiring.
10. Prior to Issue 6, Fig. 2 was not shown. The features shown in Fig. 2 may be incorporated in existing repeaters by providing the relay base plate and line and selector jack assembly shown in Fig. 2 in place of the 823-B mounting plate.

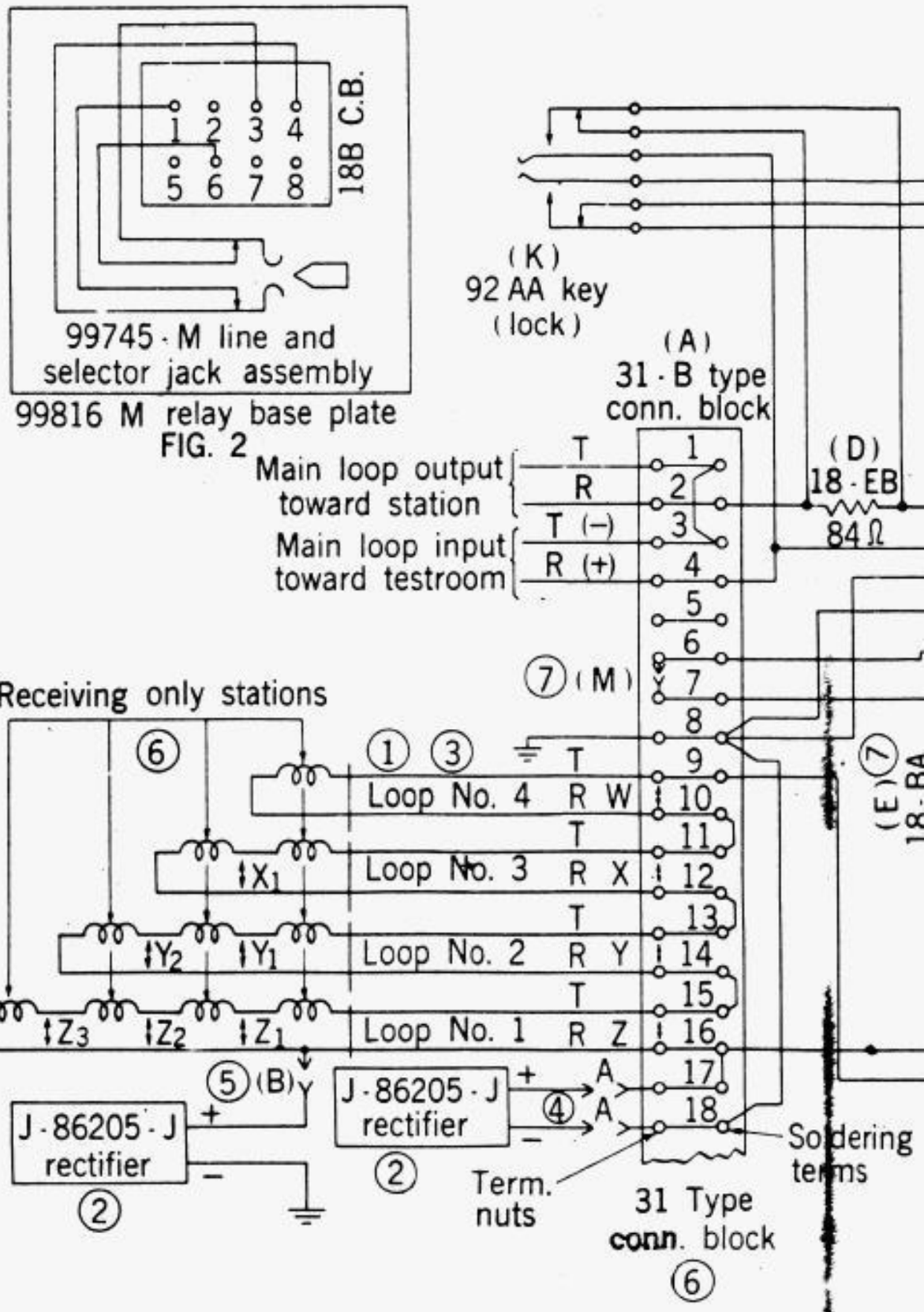
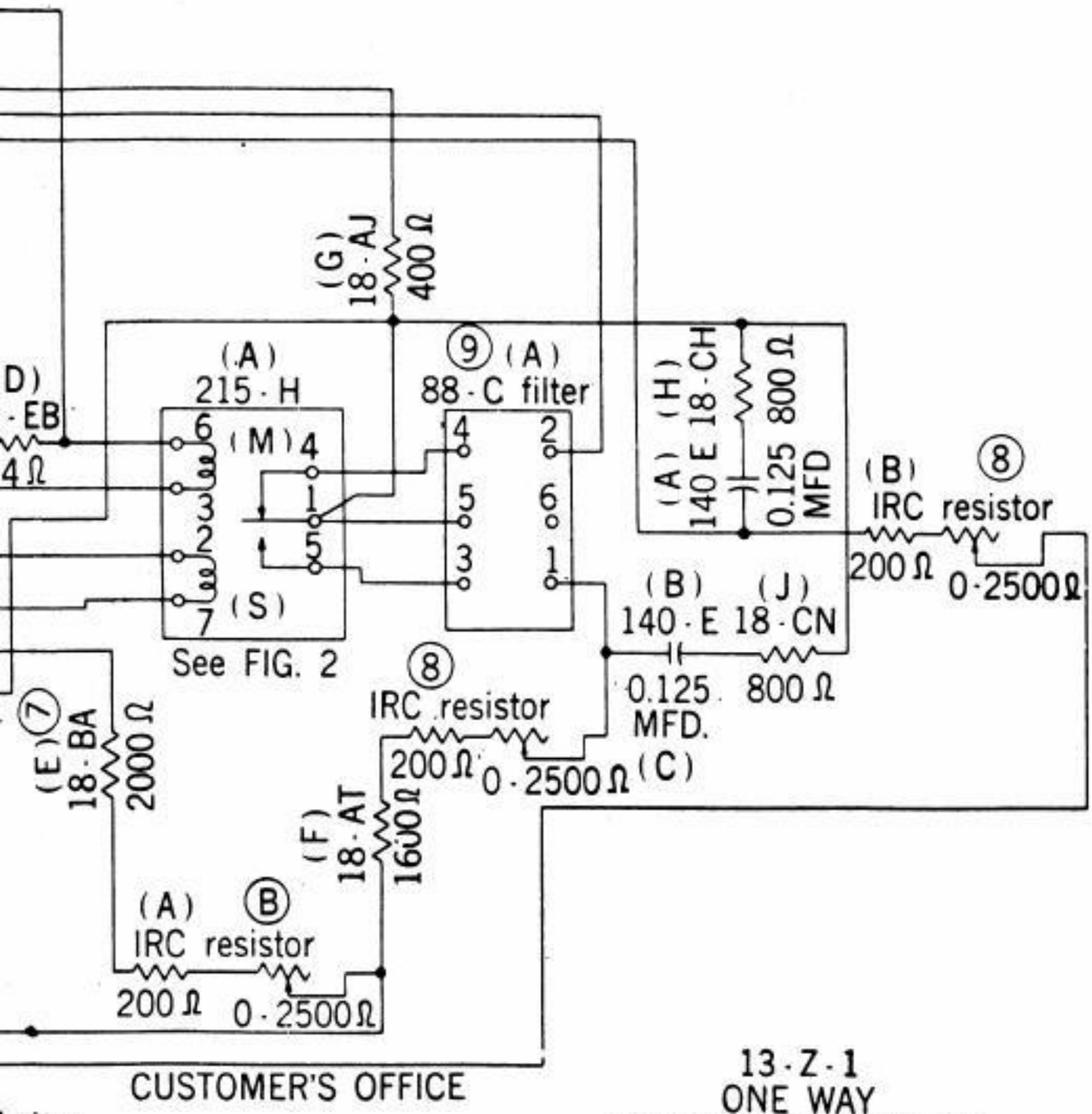

1 2 3 4
5 6 7 8
18B C.B.
99745 - M line and
selector jack assembly
99816 M relay base plate
(K)
92 AA key
(lock)
(A)
31 - B type
conn. block
Main loop output
toward station
Main loop input
toward testroom
T
R
T (−)
R (+)
(D)
18 - EB
84 Ω
Receiving only stations
⑦ (M)
(E) ⑦
18 - RA
⑥
① ③
Loop No. 4 R W
Loop No. 3 R X
Loop No. 2 R Y
Loop No. 1 R Z
X1
Y2 Y1
Z3 Z2 Z1
⑤ (B)
J - 86205 - J
rectifier
②
④
A
Term.
nuts
Soldering
terms
31 Type
conn. block
⑥

FIG. 2



13-Z-1
ONE WAY
TELEGRAPH REPEATER
(FOR MOUNTING IN COLUMBIA CABINET)
SCHEMATIC
(SUPERSEDED)

FIG. 5

1-17-52

- NOTES -

(1) Not more than 4 output loops or 4 receiving only stations shall be associated with any one repeater.

(2) Adjust rectifier in accordance with instructions in "P" series of B.S.P.

(3) The total output loop length to be associated with any one repeater shall not exceed 10 miles.

(4) If the rectifier is located on the premises with the repeater then use "A" wiring.

(5) If rectifier is to be located at a receiving only station then use "B" wiring and locate it at the station nearest the repeater on loop No. 1. In this case the loop length between the repeater and the rectifier shall not exceed 5 miles.

(6) Within limitations of Notes 1 to 5 straps W, X, Y and Z should be applied as required to obtain connections for 1, 2, 3, or 4 loops. Also connections Z_1, Z_2, Z_3, Y_1, Y_2, and X_1 should be applied as required so that not more than 4 receiving only stations are connected to any one repeater output.

(7) Use "M" strap when main loop is operated neutral. Under this condition adjust the currents in the repeater as follows:

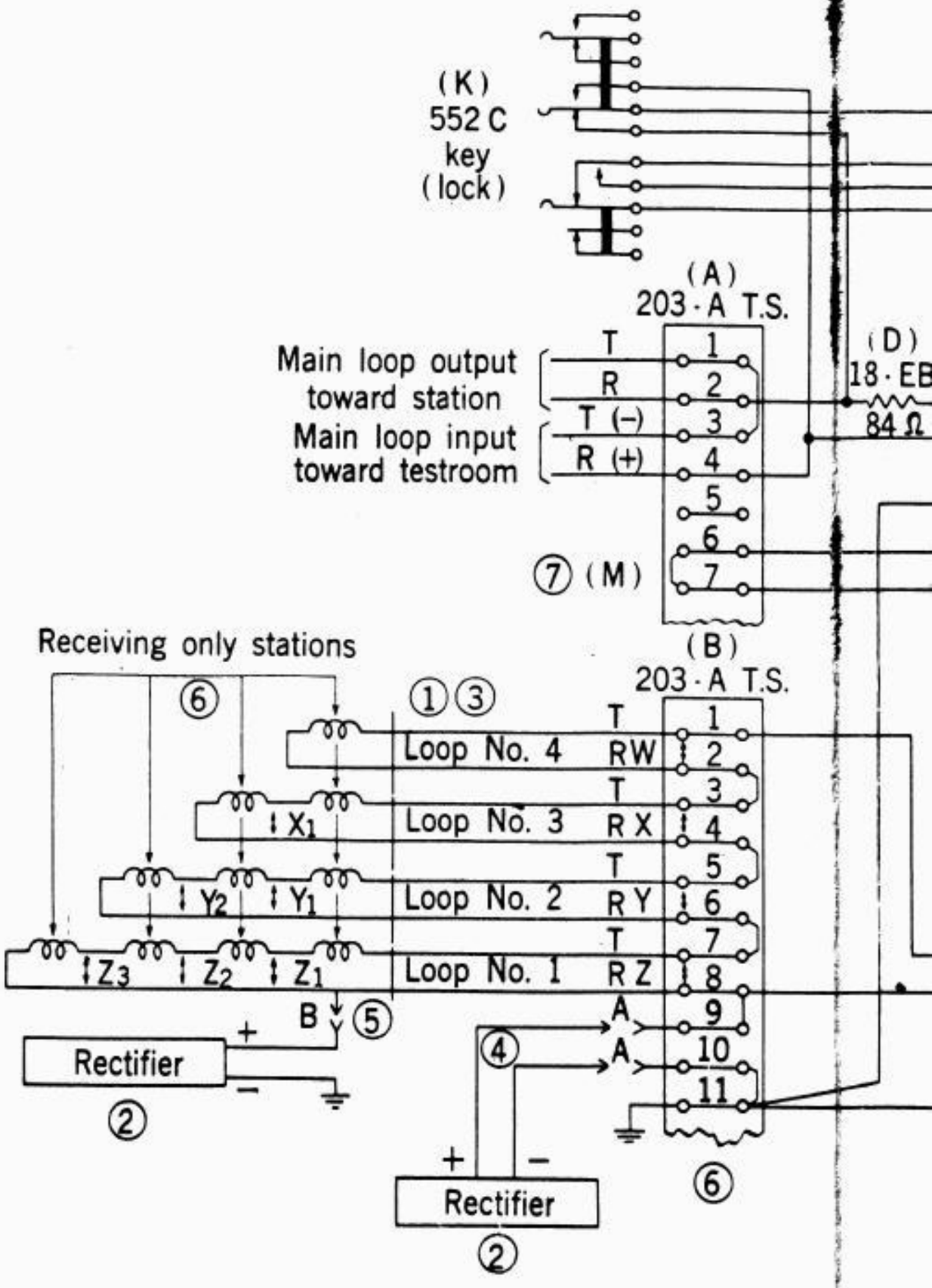
1. With armature of (A) relay on mark adjust (B) res. to give output current of .060-.065 amps. Connect meter in series with subs. loop at lug 9 of conn. block.
2. With armature of (A) relay on mark adjust (A) res. to give bias current of .030-.0325 amps. Connect meter in series with bias ckt. at "M" strap of conn. block.
3. The adjustment of (A) res. changes the loop current so steps 1 and 2 may need to be repeated several times to arrive at final values.
4. With armature of (A) relay on space adjust (C) res. to give a relay bias current equal to that obtained in 2 above. Do not change adjustment of (A) resistor. Connect meter in series with bias circuit at "M" strap of conn. block.

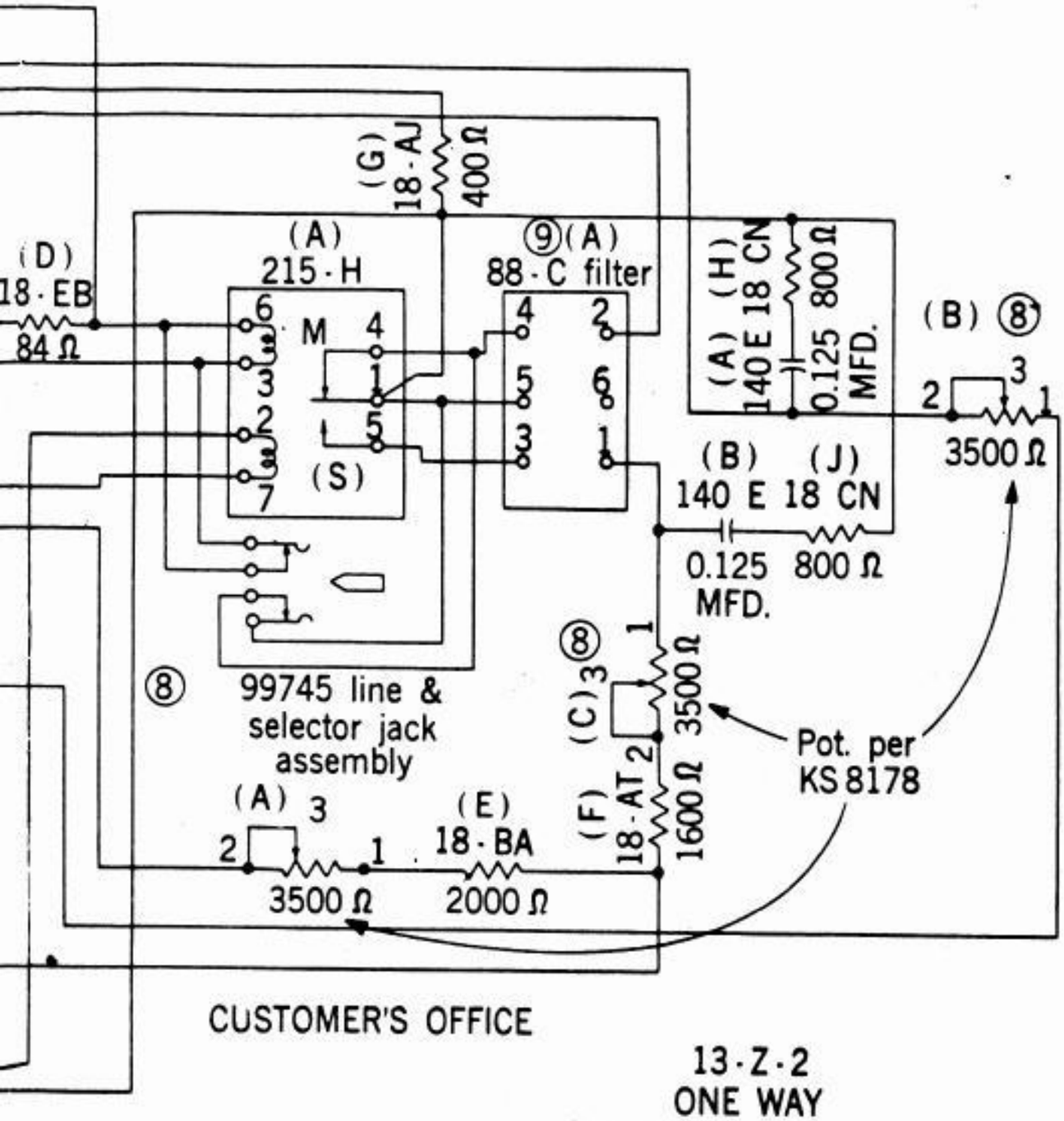
(8) When main loop is operated polar omit "M" strap. Under this condition adjust the currents in the repeater as follows:

1. With armature of (A) relay on mark adjust (B) res. to give .060-.065 amps. When "B" wiring is used connect meter in series with subs. loop at lug 9 of conn. block. When "A" wiring is used connect meter in series with rectifier at "A" strap.
2. With armature of (A) relay on space adjust (C) res. to give .060-.065 amps. When "B" wiring is used connect meter in series with circuit at lug 16 of conn. block. When "A" wiring is used connect meter in series with rectifier at "A" strap.

(9) Limit the length of the wires between the 88-C filter and the 18-B conn. block to 1-1/2 inches. Do not sew these wires in form and keep at least 1/4 inch from adjacent wiring.

(10) Prior to Issue 6, Fig. 2 was not shown. The features shown in Fig. 2 may be incorporated in existing repeaters by providing the relay base plate and line and selector jack assembly shown in Fig. 2 in place of the 823-B mounting plate.


(K)
552 C
key
(lock)
(A)
203 - A T.S.
Main loop output
toward station
Main loop input
toward testroom
T
R
T (–)
R (+)
1
2
3
4
5
6
7
⑦ (M)
(D)
18 - EB
84 Ω
Receiving only stations
⑥
①③
(B)
203 - A T.S.
Loop No. 4
Loop No. 3
Loop No. 2
Loop No. 1
RW
RX
RY
RZ
X1
Y2
Y1
Z3
Z2
Z1
B
⑤
A
A
④
Rectifier
②
+
–
Rectifier
②
⑥



13-Z-2
ONE WAY
TELEGRAPH REPEATER
SCHEMATIC
(FOR RELAY RACK MOUNTING)

FIG. 6

1-17-52

NOTES

① Not more than 4 output loops or 4 receiving only stations shall be associated with any one repeater.

② Adjust rectifier in accordance with instructions in P series of B.S.P.

③ The total output loop length to be associated with any one repeater shall not exceed 10 miles.

④ If the rectifier is located on the premises with the repeater then use "A" wiring.

⑤ If rectifier is to be located at a receiving only station then use "B" wiring and locate it at the station nearest the repeater on loop No. 1. In this case the loop length between the repeater and the rectifier shall not exceed 5 miles.

⑥ Within limitations of notes 1 to 5 straps W, X, Y, and Z should be applied as required to obtain connections for 1, 2, 3 or 4 loops. Also connections Z_1, Z_2, Z_3, Y_1, Y_2, and X_1 should be applied as required so that not more than 4 receiving only stations are connected to any one repeater output.

⑦ Use "M" strap when main loop is operated neutral under this condition adjust the currents in the repeater as follows.

1. With armature of (A) relay on mark adjust (B) Res. To give output current of .060-.065 amps. Connect meter in series with Subs. loop at Lug 1 of conn. block B.

2. With armature of (A) relay on mark adjust (A) res. To give bias current of .030-.0325 amps. connect meter in series with bias ckt. at M strap of the (A) conn. block.

3. The adjustment of (A) Res. changes the loop current so Steps 1 and 2 may need to be repeated several times to arrive at final values.

4. With armature of (A) relay on space adjust (C) Res. to give a relay bias current equal to that obtained in 2 above. Do not change adjustment of (A) resistor. Connect meter in series with bias circuit at "M" strap of conn. block.

⑧ When main loop is operated polar omit "M" strap under this condition adjust the currents in the repeater as follows:

1. With armature of (A) relay on mark adjust (B) res. to give .060-.065 amps. When "B" wiring is used connect meter in series with subs. loop at Lug 1 of the (B) conn. block. When "A" wiring is used connect meter in series with rectifier at Lug 9 of the conn. block B.

2. With armature of (A) relay on space adjust (C) res. to give .060-.065 amps. When "B" wiring is used connect meter in series with circuit at Lug 8 of conn. block B when "A" wiring is used connect meter in series with rectifier at Lug 9 of the conn. block B.

⑨ Limit the length of the wires between the 88-C filter and the 18-B conn. block to 1 1/2 inches do not sew these wires in form and keep at least 1/4 inch from adjacent wiring. "D1" wiring.