and L is now broken at No. 3 contact of relay TS. Relays MK and L therefore operate to their No. 5 contacts under control of their 2–7 windings. Capacitors A and B are again discharged as the discharge path is closed through 5 and 1 of relay MK. Relays FS and SL are reoperated to their No. 3 contacts, as the circuit through the 1–6 windings of the relays is again closed through 5 and 1 of relay MK Relays SP and TR reoperate to their No. 4 contacts as their 6–3 winding circuit is now open at No. 4 of relay SL, and 2–7 windings have control. When relay SP reoperates to its No. 4 contact, the selector magnet circuit is closed, thereby terminating the artificial start pulse. Capacitor C is discharged as the discharge path is again closed through 4 and 1 of relay TR. The synchronizer circuit is now completely restored to its original condition, and another closure of the clutch lever contacts will begin the operation over again.

(14) *Synchronizer circuit, time out feature.* Relay R operates to its marking contact after the end of a message. Capacitors E, F, G, and H charge again as described in (11) above. The grid of the tube is made more positive until the tube conducts current and reoperates relay P to its No. 3 contact. Relay N now reoperates, making the synchronizer circuit ineffective.

Section II. TELETYPEWRITER SET AN/TGC–1

142. General Introduction

Teletypewriter Set AN/TGC–1 is comprised of a metal console which houses the following: two receiving-only typing reperforators, a multiple transmitter distributor comprised of a number transmitter and two message transmitters, a motor-driven tape winder, a rectifier, a number tape reel, and circuit and control elements. These elements are arranged to operate on one circuit with both message transmitters arranged to permit continuous transmission without loss of line time and message numbers automatically inserted by the number transmitter. In this case the upper typing reperforator provides a continuous monitor copy of the outgoing message, while the lower typing reperforator receives the incoming messages. The set may also be arranged to operate on two circuits. In this case the No. 1 circuit uses the A (middle) transmitter for sending and the lower typing reperforator for receiving. The No. 2 circuit uses the B (right-hand) transmitter for sending and the upper typing reperforator for receiving. The number transmitter functions with the No. 1 circuit only. When the set is arranged to work on one circuit, only, operation is designated NORMAL. When the set is arranged to work on two circuits, operation is designated SPLIT. The typing reperforators and transmitter distributor used by Teletypewriter Set AN/TGC–1 are similar to the typing reperforator and transmitter distributor covered in paragraphs 37 through 65. The necessity for outlining their mechanical operations and adjustments is thereby eliminated. Teletypewriter Set AN/TGC–1 is shown in figure 252.

143. Description

At the bottom of Teletypewriter Set AN/TGC–1 an equipment drawer is mounted. This drawer contains the transmitting and receiving relays, control relays, resistors and spark killers, together with the necessary switches for adapting the set to different types of operation. The SPLIT-NORMAL switch, SA, makes all the necessary changes from one-circuit to two-circuit operation. The DUPLEX-SINGLE switch, SB, makes all the necessary changes from duplex to single (half-duplex) operation. The POLAR MAKE-AND-BREAK switches, S3 and S4, are for adapting the set to polar or neutral operation. The OP-NON-OP switches, S1 and S2, prevent interference with the operation of alarm or break features. When the set is operating SPLIT, if one of the two circuits should be disconnected, switch S1 or switch S2 is switched to its NON-OP position. Switch S1 is for circuit No. 1 and switch S2 is for circuit No. 2. The line terminal strip is mounted at the left of the equipment drawer. The terminal strip is in two sections, each section consisting of nine terminals. The first eight terminals in each case are used for line and line battery connections. The ninth terminal on the left section is bonded to the console, so that the entire console may be connected to ground. The ninth terminal on the right section provides ground for an alarm bell common to all sets if this feature is desired. The power cabinet is located at the right of the equipment drawer and contains a male plug base for the power input, a main power switch, fuses for all circuits, an AC-DC switch for adapting the set to a-c or d-c primary power supplies, series resistors for the motors for d-c operation, and switches for shortening out these resistors for a-c operation. Just above the equipment drawer is a compartment for set tapes. The compartment may be divided by a partition which is provided to separate the tapes belonging to the two circuits for split operation.

There is a separate narrow compartment for the number tape. The number tape reel is mounted in front of the tape compartment just below the number transmitter. The reel holds the number tape to be used by the number transmitter in the transmission of message numbers. The reel can hold a prepared number tape of about 750 numbers. Above the tape compartment is the multiple transmitter distributor mounted on roller slides so that it may be pulled out for inspection. The receiving typing reperforator is mounted in a closed compartment above the transmitter distributor. The typing reperforator is on roller slides so that it may be pulled forward. The rectifier unit is mounted behind the typing reperforator. Four monitor jacks, two for the transmitting and two for the receiving circuits, are mounted in the same compartment. Another closed-in compartment, which houses the monitor typing reperforator and the motor-driven tape winder; is just above the receiving typing reperforator compartment. Both the monitor typing reperforator and the tape winder are on roller slides. The tape winder consists of an ac-dc series motor, reduction gear, clutch, 10-inch reel, and illuminating lamp. The monitor copy tape from the monitor typing reperforator is wound on this tape winder. At the top of the console is the signal indicator: The signal indicator is comprised of alarm lamps, release, break, and feed-out keys and an alarm switch, housed in a demountable box which is connected to the con-

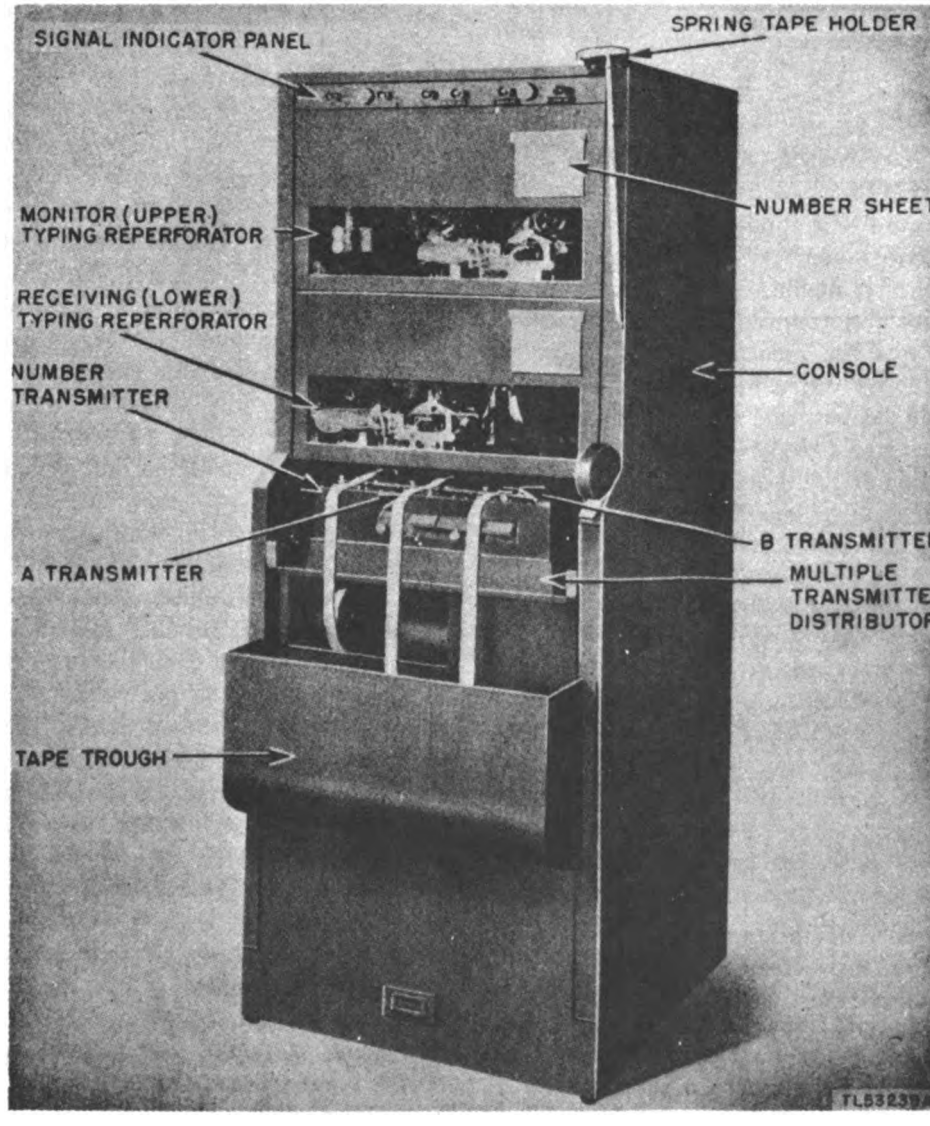

Figure 252. Teletypewriter Set AN/TGC-1 (view 1).

sole by means of a plug and socket. The NUMBER RELEASE key disables the automatic numbering feature. The two FEED-OUT keys, FO–1 and FO–2, are for the purpose of feeding tape out of the two typing reperforators when no messages are being received. The BREAK key is for the purpose of sending a break signal to the distant station. The BREAK lamp is a red lamp and lights when a break signal is received from the distant station. The lighting of this lamp indicates that the transmitters have been locked out and must be released for transmission. The RELEASE key releases the transmitters. The console is designed so that all power and signal line connections are accessible from the front, and the consoles may be set up side by side, back to back, or against the wall. Figures 253 and 254 show the various component parts of Teletypewriter Set AN/TGC–1.

144. Installation

a. General. The console should be placed in a well-lighted location that is convenient for operation. All signal, power, and ground wires should be run in a neat and secure manner, with no loose, dangling, or surplus wire that might be a safety hazard to personnel. In making connections to terminals be careful to see that the insulation is well cleaned from the wire and that the wire has not been nicked. The wire should be wrapped around the terminal screws in a clockwise direction with no excess bare wire on either side of the terminal screws. It is important that the terminal screws be tight. Insulated, twisted pair, inside wire of approximately 22 gage, such as used for telephone substation work, is suitable for signal line connections. The equipment ground wire should not be less than 14 gage and should be properly connected to a cold-water pipe or some other approved ground. The equipment drawer should be set in front of the console, and the 27-pin plug, the 30-pin plug, and the power plug should be plugged into their respective sockets. The equipment drawer can now be raised onto its slides and pushed back into position. The number tape reel is fastened in position below the transmitter shelf by means of the screws provided. The sliding transmitter shelf should be pulled out and the transmitter distributor unit placed on it. The 8-pin plug and the power plug are plugged into their respective sockets, and the sliding shelf pushed back. The tab number holder fastens on the right of the console by means of the screws provided. The rectifier unit is placed in the cradle behind the sliding shelf for the lower typing reperforator, and the input and output plugs of the rectifier are plugged into their respective sockets. The lower typing reperforator can now be placed on the sliding shelf. The tape chute should be positioned so that it will deflect the tape to the front. The motor and signal plugs of the typing reperforator plug into the power socket and signal jack respectively. The upper typing reperforator should now be placed on the upper sliding shelf, and the motor and signal plugs connected to their respective sockets. The tape chute in this case should be positioned so that it will allow the tape to pass straight through. The tape winder is fastened to the shelf by means of the bolts provided. The 27-pin plug attached to the signal indicator plugs into the socket at the top of the console. The signal indicator is fastened to the console by means of the screws provided. The spring tape holder fastens to the upper right-hand corner of the console by means of the screws provided.

b. Power and Ground Connections. The power supply for Teletypewriter Set AN/TGC–1 can be 110–120 volts and either alternating current or direct current. The frequencies that may be used for an a-c supply are 50–60 cycles. Both AC–DC switches in the power cabinet must be thrown to the correct position depending on whether the supply is alternating current or direct current. If the source is alternating current, the reperforator and transmitter distributor motors must have the 10- and 300-ohm governor resistors shorted out. When the source is direct current, the resistors must not be shorted out. The flexible lead on the rectifier unit should be connected to the primary tap of the input transformer which corresponds most nearly to the voltage of the power supply. Be sure that the grounded side of the power supply is connected to the ground side of the set (the wide pin in the plug base in the power cabinet). Terminal blocks LRS1 and LRS2, which are in the equipment drawer, must be cross-connected according to the type of power supply to be used. Figure 255 shows the various cross-connecting arrangements. If the supply is direct current and the live side is positive, strap block LRS1 straight across to block LRS2 as shown by the solid lines in figure 255. If, however, the live side is negative, the blocks are cross-connected *crossed* as shown by the dotted lines in figure 255. When the supply is alternating current and the rectifier is used, the blocks are cross-connected in the same manner as they were for direct current with the live side positive. A short length of flexible cord is

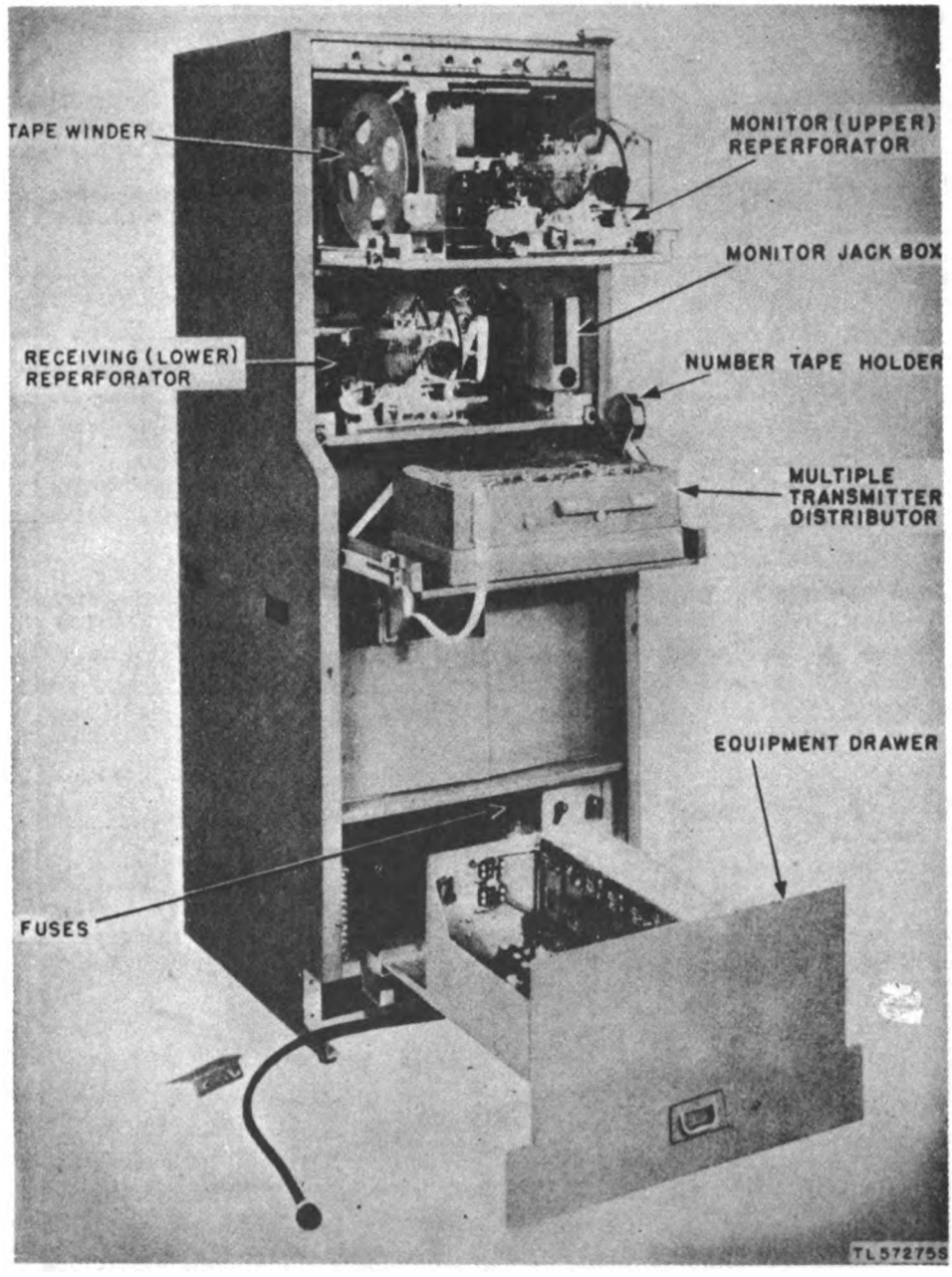

Figure 253. Teletypewriter Set AN/TGC-1 (view 2).

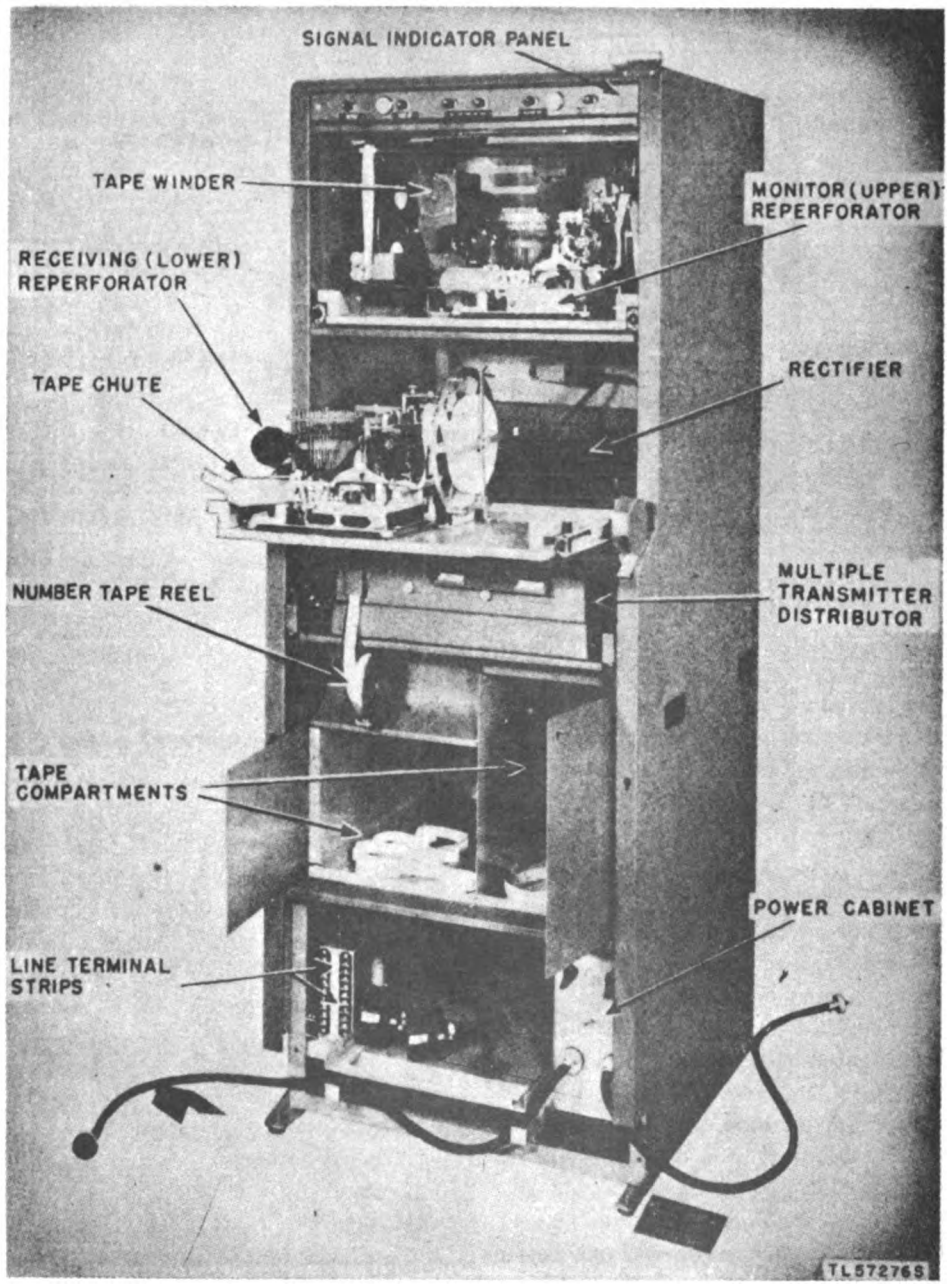

Figure 254. Teletypewriter Set AN/TGC-1 (view 3).

provided with each Teletypewriter Set AN/TGC–1. This cord is equipped with a plug on one end and a socket on the other end. The socket end plugs into the flush male base at the lower right-hand corner of the power cabinet. The plug end of the cord plugs into the room outlet for the power supply. With the power connected to the set and the main power switch in the power cabinet switched to ON, the transmitter distributor and the reperforator motors should run. When several sets are being set up side by side, they may be connected to power by means of the short cords provided. The cord provided with the second unit may be plugged into the flush male base of the second set and into the spare socket of the first set, and so on. By this means power may readily be connected to several sets. Since each set may draw up to 5 amperes, not more than three sets may be so connected. The equipment ground wire connects to terminal 9 of the left section of the line terminal strip.

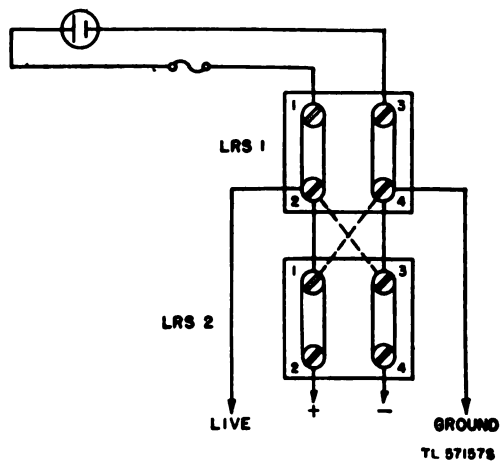

Figure 255. Cross connection diagram for terminal blocks LRS1 and LRS2.

c. LOCAL TEST. It is necessary to prepare a number tape. A master copy for the number tape is made up manually in one single long tape. The capacity of the tape will depend on the traffic need of the individual circuit, but 500 numbers will be ample for a day's work on even a heavy circuit. The form of the tape is as follows: Carriage return, line feed, office call, channel letter, figures, serial number, space, letters, blank, blank, blank, blank. This form is repeated for each consecutive number. It is important that there shall be no errors in the number tape. If errors are erased by means of the letters key, the erasures will be incorrectly interpreted by the number transmitter as indicating the termination of a number. Once the master tape is completed, multiple copies can be made for use on the set. One of these copies is reeled up backward on the number tape holder and the front end (number 1) inserted in the number transmitter. To make a local test it is necessary to strap terminals 15 to 16 and 7 to 17 on the line terminal strip. A resistance of about 1,000 ohms must be inserted between terminals 7 and 17 to govern the line current. With switch SA thrown to NORMAL, switch SB to DUPLEX, switches S1 and S2 to OP, and switches S3 and S4 to POLAR, the line terminal strip should be connected for NORMAL-DUPLEX-POLAR according to figure 256. Messages transmitted on the A (middle) and B (right-hand) transmitters will be received on both the monitor and receiving typing reperforators, with numbers interpolated by the number transmitter. With the set operating in this manner, provided the motor speeds are correct, the ranges of the typing reperforators can be measured and the range finders set.

d. LINE CONNECTIONS. Line connections for various types of operation are made according to figure 256. The terminal strip is in two sections, each of nine terminals. The left-hand section consists of terminals 1 to 9 and the right-hand section consists of terminals 10 to 18. In figure 256 the two sections are shown one above the other for convenience.

145. Circuit Operation

a. GENERAL. The various circuits can best be traced by referring to figures 257 through 262. In these figures all relays are shown in their normal condition, whether operated or not operated. Switch SA is shown in the NORMAL position. Switch SB is shown in the DUPLEX position. The letter L in the figures indicates the live side of the grounded battery and will be referred to as battery in tracing the circuits.

b. OPERATION OF RELAY RA OR RB. Relays RA and RB are for controlling operations of the transmitters. When a tape is placed in transmitter A and the transmitter start lever is depressed, there is a path from battery, through the 4–3 side of resistor R14, through contacts 5 and 6 of relay RNN, through contacts 24 and 23 of relay RB, through contacts 1 and 3 of switch SA3 in normal position, through the two windings of relay RA, through R23, through contacts 7 and 8 of relay RBK2, through the magnet of transmitter A, through the tape-out contacts, through the start lever contacts to ground. The current flowing in this circuit is sufficient to operate relay RA but is not great enough to oper-

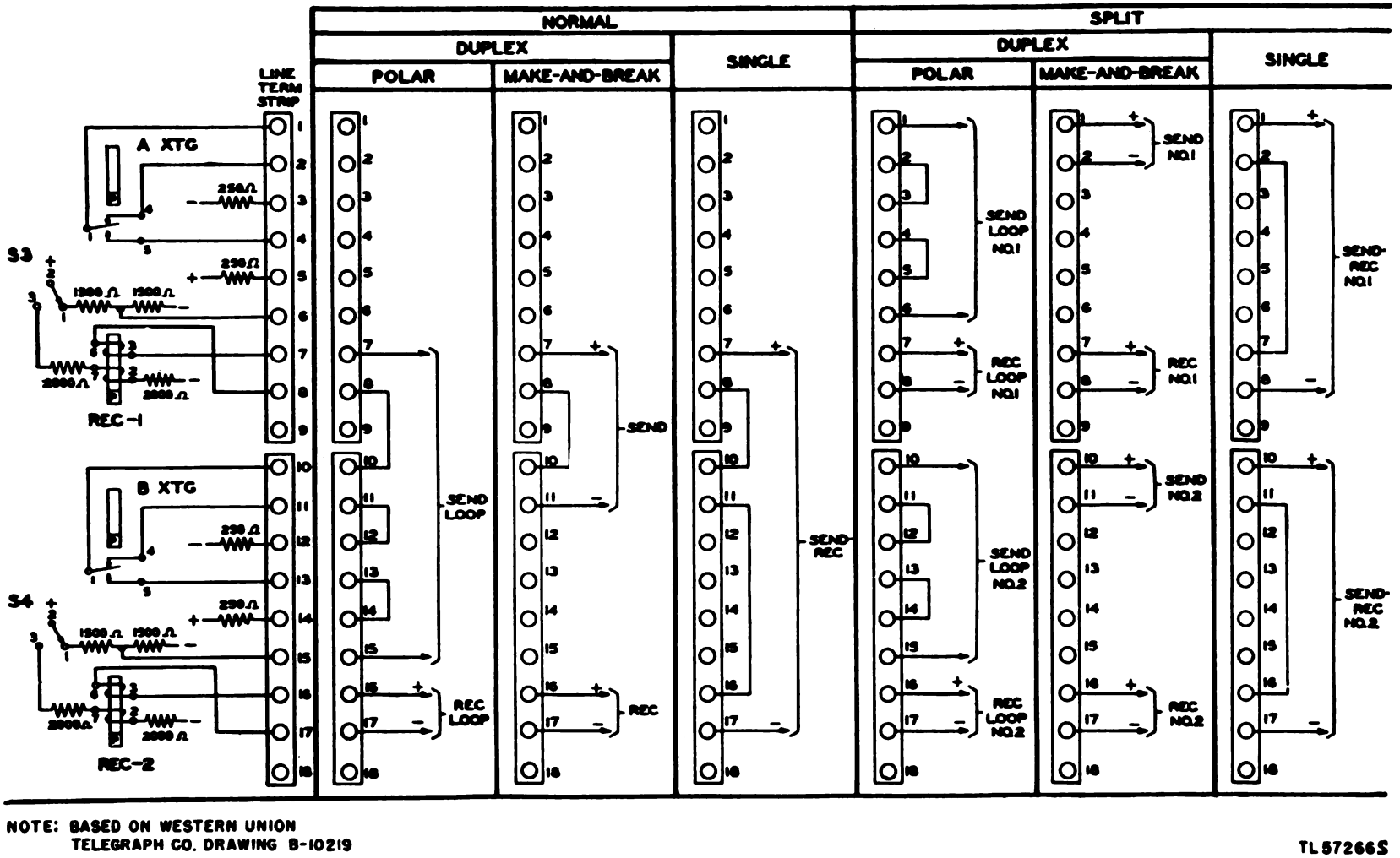

Figure 256. Terminal strip connections for Teletypewriter Set AN/TGC-1.

ate the A transmitter magnet. A similar circuit may be traced for relay RB. The operation of relay RA, however, opens the operating path for relay RB at contacts 23 and 24 of relay RA. Therefore, if a second tape is inserted in transmitter B, no action can take place until after the release of relay RA. With switch SA thrown to its SPLIT position, there is a path from battery through the 4-3 section of resistor R14, through contacts 2 and 3 of switch SA3, through the windings of relay RA, and then to ground through the same path as described above. There is also a path from battery through the 2–3 section of resistor R11, through contacts 21 and 22 of relay RR2, through contacts 5 and 6 of switch SA3, through the windings of relay RB to ground through the path previously described. Relays RA and RB can now operate independently for SPLIT operation. With switch SB thrown to its SINGLE position, the short is removed from contacts 21 and 22 of relay RR2. Thus, if switches SA and SB are in the SPLIT and SINGLE positions respectively, relay RB cannot be energized while relay RR2 remains operated.

c. Operation Of Number Transmitter. The operating path for the number transmitter magnet is from battery through the 2–3 side of resistor R11, through contacts 21 and 22 of relay RR2 or contacts 3 and 1 of switch SB, through resistor R24, through contacts 7 and 9 of switch SA5 in the NORMAL position, through contacts 2 and 1 of relay RN, through the closed contacts of the NUMBER RELEASE key, through the magnet of the number transmitter, through the tape-out contacts, through the start lever contacts to ground. The winding of relay RN is connected in parallel with the number transmitter magnet, but the resistances of the two branches of the circuit are so proportioned that sufficient current flows to operate the magnet but not relay RN. The operation of the magnet causes the transmitter to send out the next number. At the end of the number a letters character is sent which causes the letters operating lever on the transmitter to open momentarily the tape-out contacts. This opens the magnet circuit and stops the transmitter. The opening of the magnet circuit also causes the current in the parallel RN relay branch to rise high enough to operate relay RN. Relay RN operates and therefore opens contacts 1 and 2 preventing reoperation of the transmitter magnet even though the tape-out contacts close again. When switch SA is thrown to the SPLIT position, contacts 6 and 7 of relay RB are removed from the number transmitter magnet circuit, so that the number transmitter does not function under control of B transmitter. When switch SB is thrown to SINGLE, it removes the short from across contacts 21 and 22 of relay RR2. Thus if switches SA and SB are in NORMAL and SINGLE positions, respectively, the number transmitter cannot be operated while relay RR2 remains operated.

d. Operation Of NUMBER RELEASE Key. As described previously, when battery is applied to relay RN and the number transmitter magnet in parallel, the magnet is operated; but as soon as the magnet circuit is broken, relay RN operates. Depressing the NUMBER RELEASE key opens the number transmitter magnet circuit. If, therefore, the NUMBER RELEASE key is depressed when a tape is in the A or B transmitter, and is held depressed until after the transmitter start lever contacts are closed, relay RN will operate after relay RA or RB operates and no number will be transmitted.

e. Operation Of A or B Transmitter With relay RN released, there is a path from battery through the 2–1 side resistor R16, through contacts 4 and 3 of relay RN, through the winding of relay RNN to ground, thereby operating relay RNN. Therefore after a number has been transmitted by the number transmitter and relay RN operates, relay RNN is released. If a tape is in transmitter A and relay RA has been operated, the contacts 1 and 2 of relay RNN shorts out the high-resistance with winding of relay RA together with the 2,000-ohm series resistor R23. This raises the current in the circuit to a value sufficient to operate the A transmitter magnet and at the same time the high value of current through the low resistance winding of relay RA holds the relay operated. The operation of the A transmitter magnet causes the A transmitter to send out the message. A similar circuit may be traced for the B transmitter magnet. In this case the high resistance winding of relay RB is shorted out by contacts 3 and 4 of relay RNN. At the end of the message, as the tape runs out, the tape-out contacts open causing the release of both the transmitter magnet and the relay RA (or RB). The release of the relay opens the operating circuit of relay RN. The released RN relay completes a path through its contacts 3 and 4 to reoperate relay RNN. This restores the set to normal in readiness for the transmission of a second message. If a tape has already been placed in the idle transmitter, the reoperation of relay RNN will immediately complete

a path to operate the associated RA (or RB) relay, thereby starting a new cycle of operation. When switch SA is thrown to the SPLIT position, contacts 3 and 4 of relay RNN are no longer in the shorting path for the high-resistance winding of relay RB. Therefore, relay RB is no longer associated with relay RN. Relay RB can now operate independently as described in *b* above. Therefore the number 2 circuit using transmitter B will have no automatic message numbering with SPLIT operation.

f. Operation Of A and B Transmitting Relays. With switch SA thrown to the NORMAL position, the line winding of the B transmitting relay is connected in series with the transmitting contacts of both message transmitters and the number transmitter. The path is from negative battery through the 2–1 half of resistor R6, through the transmitting contacts of the number transmitter through the transmitting contacts of the A transmitter, through the monitor jack MJ–3, through contacts 3 and 1 and 4 and 6 of switch SA1, through the transmitting contacts of the message transmitter B, through the monitor jack MJ–4, through the made contacts of the BREAK key, through the 6–3 winding of the B transmitting relay, through the 6–5 section of resistor R19 to positive battery. The bias circuit for the B transmitting relay is from positive battery through the 2–3 section of resistor R19, through the 7–2 winding of the B transmitting relay, through the 3–2 section of resistor R5 to negative battery. The B transmitting relay therefore follows the neutral signals of any one of the three transmitters. A spare transmitter or keyboard plugged into monitor jack MJ–3 or MJ–4 can also operate the B transmitting relay. When the switch SA is thrown to the SPLIT position, the B transmitting relay is under control of the B transmitter alone, and the A transmitting relay is under control of the A and the number transmitters. The circuit for operating the B transmitting relay is from positive battery through the 5–6 section of resistor R19, through the 3–6 winding of the B transmitting relay, through the made contacts of the BREAK key, through the monitor jack MJ–4, through the transmitting contacts of the B transmitter, through contacts 6 and 5 of switch SA1, through the 3–2 section of resistor R6 to negative battery. The operating circuit for the A transmitting relay is from positive battery through the 5–4 section of resistor R19, through the 3–6 winding of the A transmitting relay, through contacts 2 and 3 of switch SA1, through the monitor jack MJ–3, through the transmitting contacts of the A transmitter, through the transmitting contacts of the number transmitter, through the 1–2 section of resistor R6 to negative battery.

g. Polar Send Circuit. If NORMAL, POLAR operation is desired, throw switch SA to its NORMAL position and switch S4 to the POLAR position. Polar signals are now sent out on one send circuit from the contacts of the B transmitting relay. When the B transmitting relay is operated to its marking position by one of the transmitters, it sends a marking signal on a polar basis out on the send loop. The path is from negative battery through the 1–2 section of resistor R4, to terminal 12 of line terminal strip, through the strap to terminal 11 of line terminal strip, through contacts 4 and 1 of the B transmitting relay, to terminal 10 of the line terminal strip, through the strap to terminal 8 of the line terminal strip, through the 6–3 winding of the monitor receiving relay REC–1, to terminal 7 of the line terminal strip, through one side of the send loop, back through the other side of the send loop, to terminal 15 of the line terminal strip, through the 2–3 half of resistor R2 to positive battery. When the B transmitting relay is spacing, a spacing signal is sent on the send loop on a polar basis. The path is the same as it was for marking except that the armature of the B transmitting relay picks up positive battery from the No. 5 contact and the path is completed through the 2–1 half of resistor R2 to negative battery. If SPLIT, POLAR operation is desired, switch SA is thrown to its SPLIT position and switches S3 and S4 are thrown to their POLAR positions. The B transmitting relay now sends polar signals over send loop No. 2, which is connected to terminals 10 and 15 of the line terminal strip. The path is similar to that described above for the B transmitting relay, and, therefore, it is not necessary to trace it again. The A transmitting relay sends polar signals in a similar manner on send loop No. 1, which is connected to terminals 1 and 6 of the line terminal strip. It should be noted that the monitoring receiving relay REC–1 is no longer connected in series with a send loop as it was for NORMAL operation.

h. Neutral Send Circuits. The send loops for this type of operation must have battery connected externally and the proper resistance connected in series to adjust the line current to 60 ma. For NORMAL, NEUTRAL operation, switch SA is thrown to its NORMAL position, and switch S3 is thrown

to its MAKE AND BREAK position. The B transmitting relay sends neutral (make and break) signals on one send loop. The path is from positive externally supplied battery over one side of the send loop to terminal 7 of the line terminal strip, through the 3–6 winding of the monitor receiving relay REC–1, to terminal 8 of the line terminal strip, through the strap to terminal 10 of the line terminal strip, through contacts 1 and 4 of the B transmitting relay, to terminal 11 of the line terminal strip, over the other side of the send loop to negative battery. The bias circuit for the monitoring receiving relay REC–1 is from positive battery through contacts 2 and 3 of switch S3, through the 1–2 section of resistor R22, through the 7–2 winding of relay REC–1, through the 4–5 section of resistor R5 to negative battery. When operation is SPLIT, the A transmitting relay sends neutral signals on send loop No. 1 which is connected to terminals 1 and 2 of the line terminal strip. The B transmitting relay sends neutral signals on send loop No. 2 which is connected to terminals 10 and 11 of the line terminal strip. Both of these send loops must have external battery and the proper resistance to adjust the line current at 60 ma.

i. Operation of BREAK Key. The BREAK key contacts are in series with the 3–6 winding of the B transmitting relay and therefore when operated will cause the B transmitting relay to operate to its spacing contact. This causes a spacing signal to be sent on the send loop for as long as the key is held operated. Since the BREAK key is not associated with the A transmitting relay, it is not possible to send a break signal on send loop No. 1 when the set is operating SPLIT.

j. Polar Receive Circuits. There is only one receive loop connected to the set for NORMAL operation. The battery for supplying the polar receive loop is at the sending end. When marking signal is received, negative battery is applied over one side of the loop to terminal 17 of the line terminal strip, through the 6–3 winding of the receiving relay REC–2 to terminal 16 of the line terminal strip, over the other side of the receive loop to positive battery. When receiving a spacing signal, the polarities of battery applied to terminals 16 and 17 are reversed, thereby operating the receiving relay REC–2 to its spacing contact. The bias winding of the receiving relay is not energized because the bias circuit is open at the No. 3 contact of switch S4. The receiving (lower) typing reperforator selector magnet is operated under control of the receiving relay REC–2. When the receiving relay is operated to its marking contact, there is a path from battery through the 2–1 section of resistor R9, through contacts 3 and 1 of switch SA2, through jack MJ–2, through the winding of the selector magnet which is connected by means of a cord and plug to jack PJ–2, through contacts 4 and 6 of switch SA2, through contacts 4 and 1 of relay REC–2. through contacts 1 and 2 of switch S2 to ground. When operation is SPLIT, and additional receive loop is connected to terminals 7 and 8 of the line terminal strip. The 3–6 winding of the monitor receiving relay REC–1 is connected to this receive loop and operates on the polar signals received from the loop. It will be noted that receiving relay REC–2, which still operates on signals received from the loop that is connected to terminals 16 and 17, now controls the upper typing reperforator selector magnet, and the lower typing reperforator is under control of the receiving relay REC–1. This is because switch SA is now in its SPLIT position.

k. Neutral Receive Circuits. When the set is prepared for neutral (make and break) operation, switches S3 and S4 are thrown to their MAKE AND BREAK positions. With the switches in these positions the bias windings of the receiving relays REC–1 and REC–2 are energized and the relays, therefore, can receive neutral signals. For NORMAL operation there is one receive loop which is connected to terminals 16 and 17 of the line terminal strip. The 3–6 winding of the receiving relay REC–2 is connected across terminals 16 and 17 and operates on the received neutral signals as it has its bias winding energized. The selector magnet of the lower typing reperforator is operated under control of the receiving relay REC–2. An additional receive loop is connected to terminals 7 and 8 of the line terminal strip for SPLIT operation and operates the monitor receiving relay REC–1. As described in *j* above for SPLIT operation; relay REC–1 controls the selector magnet of the lower typing reperforator and relay REC–2 controls the selector magnet of the upper typing reperforator.

l. Half-duplex Operation. In all of the foregoing subparagraphs on circuit operation, it has been assumed that the set was operating on a full-duplex basis; that is, separate send and receive loops. It is possible to have the set operate on a half-duplex (single) basis using only one loop for both sending and receiving. This type of operation can be used with the set working either NORMAL or SPLIT. For half-duplex operation, however

only neutral signals can be used. When NORMAL, HALF-DUPLEX operation is desired, switch SA is thrown to its NORMAL position and switch SB is thrown to its SINGLE position. The send-receive loop must have battery supplied externally and the current adjusted to 60 ma. A path may be traced from positive battery over one side of the loop to terminal 7 of the line terminal strip, through the 3–6 winding of the monitor receiving relay REC–1 to terminal 8 of the line terminal strip, through the strap to terminal 10 of the line terminal strip, through 1 and 4 of the B transmitting relay to terminal 11 of the line terminal strip, through the strap to terminal 16 of the line terminal strip, through the 3–6 winding of the receiving relay REC–2 to terminal 17 of the line terminal strip, over the other side of the loop to negative battery. From this circuit it can be seen that when the B transmitting relay is sending, both of the receiving relays follow the signals. With the B transmitting relay in a steady marking condition, neutral signals which are sent by the distant end can be received on both receiving relays. If SPLIT, HALF-DUPLEX operation is desired, two send-receive loops are used, and switch SA is thrown to its SPLIT position. Send-receive loop No. 1 is connected to terminals 1 and 8 of the line terminal strip, and send-receive loop No. 2 is connected to terminals 10 and 17 of the line terminal strip. The path for circuit No. 1 is from positive battery over one side of the loop to terminal 1 of the line terminal strip, through 1 and 4 of the A transmitting relay to terminal 2 of the line terminal strip, through the strap to terminal 7 of the line terminal strip, through the 3–6 winding of the relay REC–1 to terminal 8 of the line terminal strip, over the other side of the loop to negative battery. When the A transmitting relay is sending, a monitor copy of the message is received from relay REC–1 and incoming messages are received on the same relay while the A transmitting relay is in a steady marking condition. A similar path can be traced for circuit No. 2 which uses the B transmitting relay and receiving relay REC–2.

m. Operation of Feed-out Key FO–1. If it is desired to cause the typing reperforator, which is under control of relay REC–1, to feed out tape while the relay is idle on its marking contact, key FO–1 is pressed. If the switch SA is in its NORMAL position, the upper monitor typing reperforator is under control of the relay REC–1. In this case pressing the key FO–1 closes a path from ground through contacts 2 and 1 of relay RR1, through the made contacts of key FO–1, through contacts 9 and 7 of switch SA1 to one side of the upper typing reperforator selector magnet. Ground is also applied to the other side of the winding through contacts 2 and 1 of switch S1, contacts 1 and 4 of relay REC–1, and contacts 12 and 10 of switch SA1. With ground applied to both sides of the selector magnet winding, the winding is shorted out and therefore the magnet is released. This causes the typing reperforator to feed out blanks. If, while key FO–1 is held depressed, relay REC–1 operates to its spacing contact, there is a path completed to operate relay RR1. The path is from battery through the 2–1 section of resistor R15, through the made contacts of the key FO–1, through the winding of relay RR1, through contacts 5 and 4 of relay RR1, through contacts 5 and 1 of relay REC–1, through contacts 1 and 2 of switch S1 to ground. The operation of relay RR1 opens the path from ground at contact 1 of the relay, thereby placing the typing reperforator magnet back under control of relay REC–1. When relay RR1 operates, a locking path is provided through its own contacts to keep the relay operated when relay REC–1 is not on its spacing contact. The path is from battery through the 2–1 section of resistor R15, through the made contacts of key FO–1, through the winding of relay RR1, through contacts 5 and 3 of the relay to ground. The release of key FO–1 will restore the circuit to normal. When switch SA is in its SPLIT position, the lower typing reperforator magnet is under control of relay REC–1. The operation of the key FO–1 causes the conditions just described for the upper typing reperforator magnet to be applied to the lower typing reperforator magnet.

n. Operation of Feed-out Key FO–2. When switch SA is in its NORMAL position and switch SB is in its DUPLEX position, relay REC–2 is the receiving relay and controls the receiving (lower) typing reperforator. To cause the lower typing reperforator to feed out tape, key FO–2 is pressed. Ground is applied to one side of the lower typing reperforator magnet winding through contacts 24 and 23 of relay RR2, through the made contacts of key FO–2, and through contacts 3 and 1 of switch SA2. Ground is also applied to the other side of the magnet winding through contacts 4 and 1 of relay REC–2; the magnet winding, therefore, is shorted out and the magnet is released, causing the typing reperforator to feed out blanks. If relay

REC–2 operates to its spacing contact, there is a path from battery through the 2–3 section of resistor R15, through the made contacts of key FO–2, through contacts 7 and 9 of switch SB1, through the winding of relay RR2, through the made contacts 28 and 27 of the relay, through contacts 12 and 10 of switch SB1, through 5 and 1 of relay REC–2, through contacts 1 and 2 of switch S2 to ground. Relay RR2 is therefore operated, and the typing reperforator magnet is back under control of relay REC–2. There is a locking path provided for relay RR2 through its own contacts 28 and 26, through contacts 3 and 4 of the RELEASE key to ground. This path will keep the relay operated if relay REC–2 should operate to its marking contact. Release of the key FO–2 restores the circuit to normal. If, while switch SA is in its NORMAL position, switch SB is thrown to its SINGLE position, there is a permanent path from battery through the 2–3 section of resistor R15, through contacts 8 and 9 of switch SB1, through the winding of relay RR2, through the made contacts 28 and 27 of the relay, through contacts 12 and 11 of switch SB1, through contacts 2 and 1 of relay RB, through contacts 1 and 2 of relay RA, through contacts 5 and 1 of relay REC–2 to ground. Thus if relays RA and RB are not operated (transmitters idle) and regardless of whether key FO–2 is depressed or not, relay RR2 will be operated as soon as relay REC–2 operates to its spacing contact That is, the first start pulse received will cause relay RR2 to operate, disabling the feed-out circuit. The locking path for relay RR2 is through the RELEASE key as it was before. The operation of relay RR2 causes the BREAK lamp to light and, as described in *b* and *c* above, blocks all transmitters. Relay RR2 remains locked, stopping all transmission and the lamp remains lighted until the RELEASE key is depressed and relay RR2 is released. It is not possible, therefore, when operation is NORMAL, HALF-DUPLEX (SINGLE) to operate any of the transmitters while a message is being received from the distant end. When switch SA is in its SPLIT position, the monitor typing reperforator is placed under control of relay REC–2 and becomes the receiving typing reperforator for circuit No. 2. Switch SA4 also shorts out contacts 2 and 1 of relay RA, so that the operation of relay RR2 (circuit No. 2) is independent of the operation of relay RA (circuit No. 1).

o. Locking of Typing Reperforators. When switch SA is in its NORMAL position and switch SB is in its SINGLE position, the signals on the send-receive loop, whether sent or received, will operate both relays REC–1 and REC–2 as described in paragraph 142. To prevent the received copy from being recorded on the monitor typing reperforator, the typing reperforator is held idle during reception. With the send-receive loop in an idle condition there is a path from battery through the 2–1 section of resistor R10, through contacts 9 and 7 of switch SA1 through jack MJ–1, through jack PJ–1 and the selector magnet of the monitor typing reperforator, through contacts 10 and 12 of switch SA1, through contacts 5 and 6 of switch SB1, through contacts 3 and 4 of relay RA, through contacts 10 and 12 of switch SA3, through contacts 3 and 4 of relay RB, through contacts 5 and 6 of relay RR2 to ground. This path holds the monitor typing reperforator in a steady marking condition. As soon as reception begins and relay REC–2 operates to its spacing contact, relay RR2 operates as described in *n* above. The holding path for the selector magnet is maintained, however, because the ground side of the path is now connected through contacts 6 and 4 of relay RR2, contacts 9 and 7 of switch SA1, and contacts 6 and 5 of switch SB1. Therefore, the monitor typing reperforator cannot follow relay REC–1 and record the received message. When transmision is in progress, relay RR2 is not operated and the holding path for the monitor typing reperforator selector magnet is broken at relay RA or relay RB, whichever is operated. Therefore the monitor typing reperforator is free to record the sent message. A similar circuit is provided to prevent the sent copy from being received on the receiving typing reperforator. The path is from battery through the 2–1 section of resistor R9, through contacts 3 and 1 of switch SA2, through jack MJ–2, through jack PJ–2, and the magnet of the receiving typing reperforator, through contacts 4 and 6 of switch SA2, through contacts 5 and 6 of switch SB2, through contacts 5 and 4 of relay RB (assuming relay RB as the relay operated), through contacts 5 and 6 of relay RR2 to ground. The circuit is broken upon the release of relay RB (or RA), leaving the receiving typing reperforator free to record the received copy. When switch SA is thrown to its SPLIT position, it interchanges the monitor and receiving typing reperforators as already shown. The holding path for the receiving typing reperforator magnet is broken at contact No. 7 of switch SA2 and also

at contact No. 10 of switch SA3. The receiving typing reperforator, therefore, records both the sent and received copy on circuit No. 1, under control of relay REC–1. Control of the monitor typing reperforator magnet holding circuit by relay RA (circuit No. 1) is disabled at contact No. 10 of switch SA3. This leaves relay RB controlling the holding circuit. Relay RB is associated with circuit No. 2; therefore, the monitor typing reperforator, acting as the receiving typing reperforator for circuit No. 2, records only the received copy.

p. CALL-IN CIRCUIT. Should the circuit be left unattended, the ALARM switch may be thrown on and the ALARM lamp will light and an alarm bell will ring if signals are received from the distant end. When switch SA is in its NORMAL position, the ALARM switch is operated and a spacing signal is being received on relay REC–2; relay RC will operate. The path is from battery through the 4–5 section of resistor R15, through the made contacts of the ALARM switch, through the winding of relay RC, through contacts 9 and 8 of relay RC through contacts 5 and 1 of relay REC–2, through contacts 1 and 2 of switch S2 to ground. Relay RC locks itself operated through contacts 9 and 7 to ground, so that it will remain operated after relay REC–2 leaves its spacing contact. The circuit to operate the ALARM lamp is closed through contacts 5, 4, and 3 of relay RC. The circuit to operate the bell is closed through contacts 2 and 1 of relay RC. To release relay RC, the ALARM switch must be thrown off. When switch SA is in its SPLIT position, the circuit just described which is under control of the spacing contact of relay REC–2 remains the same, and the other winding of relay RC is connected to the spacing contact of relay REC–1. This makes the alarm feature responsive to received signals on either circuit No. 1 or No. 2. When relay RC is operated there is also a path from ground at terminal 9 of the line terminal strip closed through contacts 5 and 6 of relay RC, to terminal 18 of the line terminal strip. This path is for an external common alarm circuit if used.

q. BREAK CIRCUIT. Relay RBK1 is normally held operated by a path from battery through 2–3 section of resistor R9, through the winding of relay RBK1 to ground. Each time that relay REC–2 spaces, ground is applied to the No. 5 contact of the relay, thereby shorting out the winding of relay RBK1. Relay RBK1 is, however, a slow release relay and does not release on the normal operation of relay REC–2. If a sustained spacing impulse is received, as when the distant station sends a break, relay RBK1 will release. Relay RBK2, which is normally held operated through contacts 2 and 1 of relay RBK1, will release. The release of relay RBK2 closes through a path to light the BREAK lamp and also opens the magnet circuits of transmitters A and B, thereby stopping the A and B transmitter. When relay RBK2 has once been released, it breaks its own operating circuit at contact No. 4 and therefore cannot be reoperated by relay RBK1. Only the depression of the RELEASE key, which applies ground directly to the winding of relay RBK2, can reoperate relay RBK2. Since the break feature is not required in duplex operation, switch SB, when thrown to its DUPLEX position, applies ground to contact No. 4. This holds relay

Table II. Switch positions for various types of operation.

Type of operation	Switch positions					
	Switch SA	Switch SB	Switch S3	Switch S4	Switch S1	Switch S2
Normal-duplex-polar	Normal	Duplex	Polar	Polar	OP	OP
Normal-half-neutral	Normal	Duplex	Make and break	Make and break	OP	OP
Normal-half-duplex	Normal	Single	Make and break	Make and break	OP	OP
Split-duplex-polar	Split	Duplex	Polar	Polar	OP	OP
Split-duplex-neutral	Split	Duplex	Make and break	Make and break	OP	OP
Split-half-duplex	Split	Single	Make and break	Make and break	OP	OP

RBK2 operated regardless of the release of relay RBK1. When switch SA is in its SPLIT position, it shorts out contacts 7 and 8 of relay RBK2; relay RBK2, therefore, when released opens the magnet circuit of the B transmitter only.

146. Preparation of Set for Operation

Figure 256 shows the proper line terminal strip connections for the various types of operation. Table II shows the proper positions of the switches for the various types of operation.