TM 11-5815-281-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

FIELD AND DEPOT MAINTENANCE MANUAL

DISTRIBUTOR-TRANSMITTER SET, TELETYPEWRITER AN/GGC-9

This copy is a reprint which includes current pages from Change 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY
17 OCTOBER 1962

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 115-volt motor circuit, the signal line circuits, and 120-volt power supply circuit. Serious injury or death may result from contact with these circuits. Turn off the power before making any connections or replacing any parts inside the equipment.

DON'T TAKE CHANCES!

Technical Manual No. 11-5815-281-35

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *17 October 1962*

Direct Support, General Support, and Depot Maintenance Manual

DISTRIBUTOR-TRANSMITTER SET, TELETYPEWRITER AN/GGC-9

CHAPTER 1

INTRODUCTION

1. Scope

a. This manual covers direct support, general support, and depot maintenance of Distributor-Transmitter Set, Teletypewriter AN/BBC-9. Detailed equipment functioning is described in chapter 2.

b. The complete maintenance instructions for this equipment includes TM 11-5815-281-12.

2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

2.1. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33A/AFR 75-18/MCO P4610.19B, and DSAR 4500.15.

2.2. Reporting of Errors

The reporting of errors, omissions and recommendations for improving this manual by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-Q, Fort Monmouth, NJ 07703.

CHAPTER 2

THEORY

Section I. GENERAL FUNCTIONING OF DISTRIBUTOR-TRANSMITTER SET, TELETYPEWRITER AN/GGC-9 (HIGH-LEVEL OPERATION)

3. Distributor-Transmitter Set, Teletypewriter AN/GGC-9, Block Diagram, High-Level Operation
(fig. 1)

a. Distributor-Transmitter Set, Teletypewriter AN/GGC-9 consists of the following major components:

Quantity	Nomenclature	Common name
2	Distributor-Transmitter, Teletypewriter TT-322/GGC-9.	Transmitter
1	Numbering Unit, Teletypewriter, Message, MX-3650/GGC-9.	Numbering base
1	Control, Distributor-Transmitter, Teletypewriter C-3873/GGC-9.	Control base
1	Power Supply PP-3131/GGC-9.	48-volt power supply
1	Power Supply PP-1801/FG	120-volt power supply

b. Each transmitter sends messages in the form of stop-start, five-unit code impulses (para 4). The message identification information which precedes the tape message information is derived from the numbering base. The body of the message is derived from the code holes perforated in the message tape inserted by the operator. Each transmitter is connected to a separate signal line.

c. The equipment operates from a 105- to 125-volt, 60-cycle, single-phase, alternating current (ac) input supplied to the control base. The control base distributes the ac power to the 48-volt power supply, to the 120-volt power supply, and to the motors. The power supplies convert the ac to their respective direct-current (dc) outputs which are connected into the control base. The motors convert the ac electrical power to mechanical power to drive the transmitter mechanisms.

d. The control base uses 48-volt dc from the PP-3131/GGC-9 to operate its relays, to operate the clutch magnets of the transmitters, and to operate the stepping switches of the numbering base.

e. The PP-1801/FG supplies 120-volt dc for signal line current.

f. The numbering base consists of two functionally identical switch groups; one associated with each transmitter. Each switch group provides the selecting impulses for the message identification information for the beginning of each message transmitted by its associated transmitter (para 5).

4. Signaling Code, High-Level Operation

The signaling code used in teletypewriter communication systems consists of a sequence of marking and spacing impulses. Each code group includes five selecting impulses which may be either marking or spacing, depending on the code of the character or function to be transmitted. The five selecting impulses are preceded by a start impulse (spacing) and followed by a stop impulse (marking) to maintain synchronism between transmitting and receiving mechanisms. When the five selecting impulses are arranged in all possible combinations, they provide 32 different code combinations.

5. Transmission Sequence, High-Level Operation
(fig. 2)

The position of the message numbering reset switch in the associated portion of the numbering base determines whether a transmitter will transmit message identification information before transmitting a message from the message tape.

a. Message Numbering Reset Switch in Midposition. When transmission begins, the numbering base automatically transmits the *message identification information*

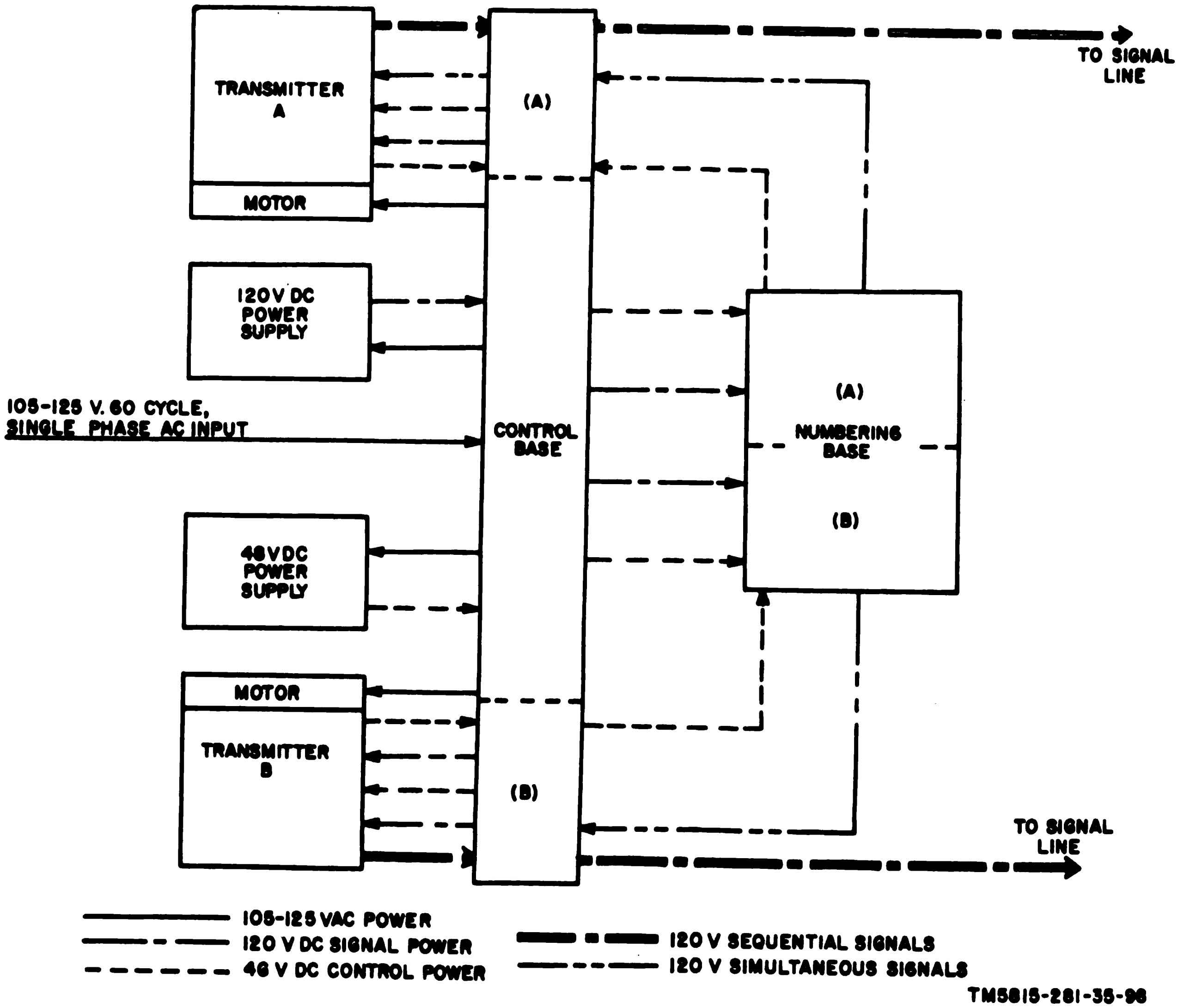


Figure 1. Distributor-Transmitter, Teletypewriter AN/GGC-9, block diagram, high-level operation.

The message identification information consists of a start-of-message indicator, three channel designating letters, the figures code group, a message number, and the letters code group. The start-of-message indicator is controlled by the CASE switch, located on the front of the control base. When the CASE switch is in position 1, the start-of-message indicator consists of five successive blank code groups (fig. 33). When the CASE switch is in position 2, the start-of-message indicator consists of one blank code group followed by the code groups for ZCZC. The channel designating letters are controlled by the wiring of the plugs into the control base for this purpose. The message numbers are controlled by the permanent wiring on the banks of the stepping switches in the numbering base. As the main stepping switch of the numbering base advances to the 13th step, a circuit is closed to energize tape-reader relay TRA, and transmission from the tape-sensing mechanism begins.

b. Message Numbering Reset Switch in OFF Position. When transmission begins, the tape-reader relay is immediately energized and transmission is directly from the tape. Message identification information is not furnished by the numbering base.

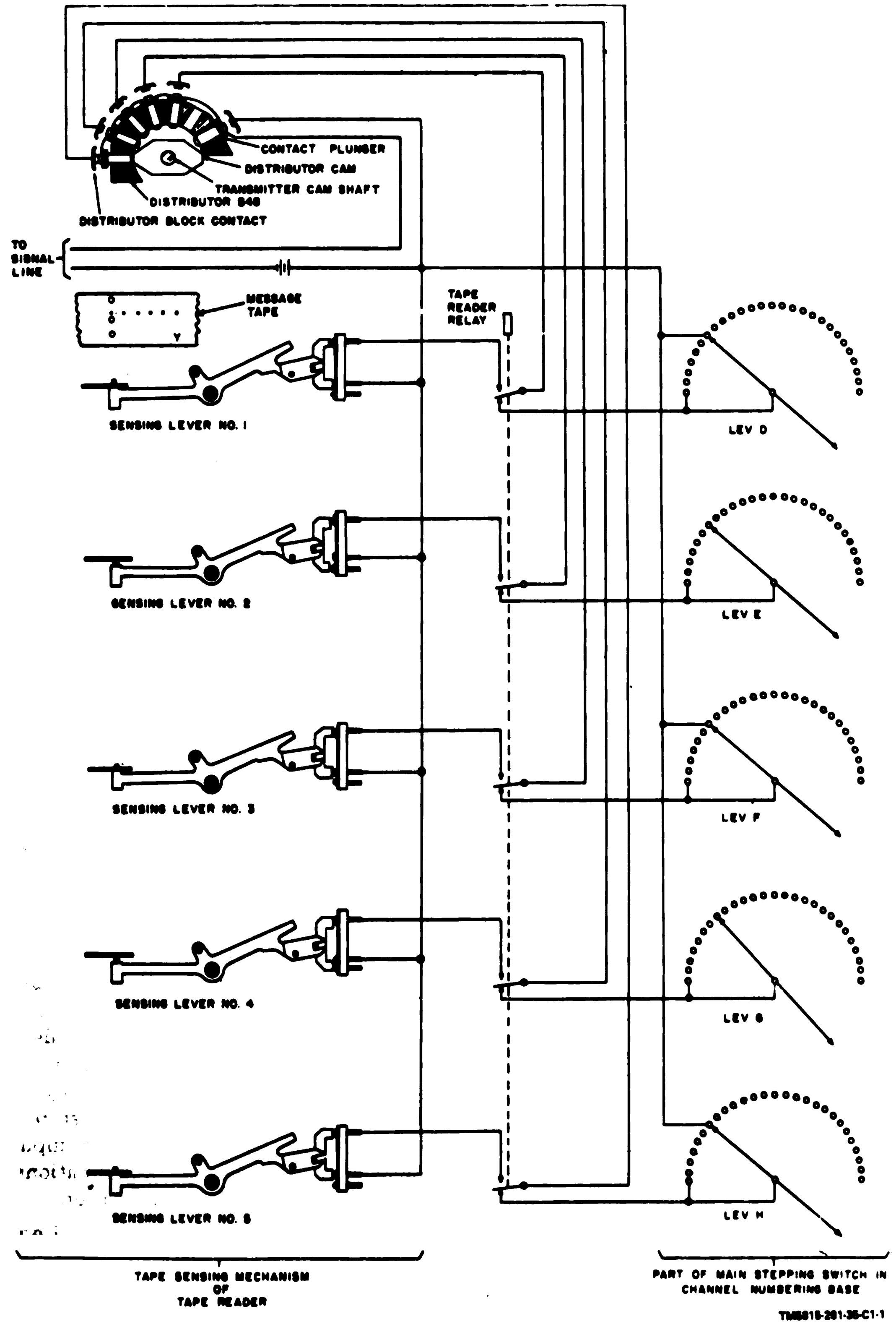


Figure 2. Simplified transmission circuit, high-level operation.

Section 1.1. GENERAL FUNCTIONING OF DISTRIBUTOR-TRANSMITTER SET, TELETYPEWRITER AN/GGC-9 (LOW-LEVEL OPERATION)

5.1. Distributor-Transmitter Set, Teletypewriter AN/GGC-9, Block Diagram, Low-Level Operation

(fig. 2.1)

a. When Distributor-Transmitter Set, Teletypewriter AN/GGC-9, is used for low-level operations, all components listed in paragraph 3*a* are required except the 120-volt power supply.

b. Each transmitter sends messages in the form of stop-start, five unit code impulses (para 5.2). The message identification information which precedes the tape message information is derived from the numbering base. The body of the message is derived from the code holes perforated in the message tape inserted by the operator and is read by a photo-reader assembly (A2) in each transmitter. Each transmitter is connected to a separate signal line.

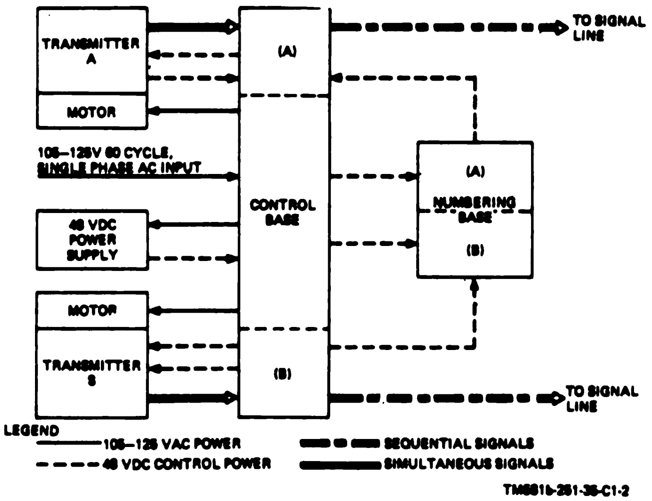


Figure 2.1. Distributor-Transmitter, Teletypewriter AN/GGC-9, block diagram, low-level operation.

c. The equipment operates from a 105- to 125-volt, 60 cycle, single-phase, alternating current (ac) input supplied to the control base. The control base distributes the ac power to the 48-volt power supply and to the motors. The power supply converts the ac to a 48-volt direct current (dc) output which is connected into the control base. The motors convert the ac electrical power to mechanical power to drive the transmitter mechanism.

d. The control base uses 48-volt dc from PP-3131/GGC-9 to operate its relays, to operate the clutch magnets of the transmitters, to operate the stepping switches of the numbering base, and to power the lamps of the photo-reader (A2). The control base contains a power supply circuit board (A1A4) that converts 115-volts, 60 cycle, to +5 volts and +40 volts. Plus 5 volts is used to power the circuits of clock circuit board A1A1, switching circuit board A1A2 and logic circuit board A1A3 in the control base. The +40-volts operates the photo-reader assembly in each of the transmitters and the photo-isolator on switching circuit board A1A2.

e. The numbering base consists of two functionally identical switch groups; one associated with each transmitter. Each switch group provides the selecting impulses for the message identification information for the beginning of each message transmitted by its associated transmitter (para 5.3).

5.2. Signaling Code, Low-Level Operation

The signaling code used in teletypewriter communication systems consists of a sequence of marking and spacing impulses read through the photo-reader (A2) in each transmitter and synchronized through the clock circuit board A1A1, switching circuit board A1A2 and logic circuit board A1A1, switching circuit board A1A2 and logic circuit board A1A3 in the control base. Each code group includes five selecting impulses which may be either marking or spacing, depending on the code of the character or function to be transmitted. The five selecting impulses are preceded by a start impulse (spacing) followed by a stop impulse (marking). When the five selecting impulses are arranged in all possible combinations, they provide 32 different code combinations.

5.3. Transmission Sequence, Low-Level Operation

(fig. 2.2)

The position of the message numbering reset switch in the associated portion of the numbering base determines whether a transmitter will transmit message identification information before transmitting a message from the message tape.

a. Message Numbering Reset Switch in Midposition. When transmission begins, the numbering base automatically transmits the message identification information. The message identification information consists of a start-of-message indicator, three channel designating letters, the figures code group, a message number, and the letters code group. The start-of-message indicator is controlled by the CASE switch, located on the front of the control base. When the CASE switch is in position 1, the start-of-message indicator consists of five successive blank code groups (fig. 33). When the CASE switch is in position 2, the start-of-message indicator consists of one blank code group followed by the code groups for ZCZC. The channel designating letters are controlled by the wiring of the plugs into the control base for this purpose. The message numbers are controlled by the permanent wiring on the banks of the stepping switches in the numbering base. As the main stepping switch on the numbering base advances to the 13th step, a circuit is closed to energize tape-reader relay TRA, and transmission from the tape-sensing mechanism, by means of the photo-reader (A2), begins.

b. Message Numbering Reset Switch in OFF Position. When transmission begins, the photo-reader (A2) is immediately energized and transmission is directly from the tape. Message identification information is not furnished by the numbering base.

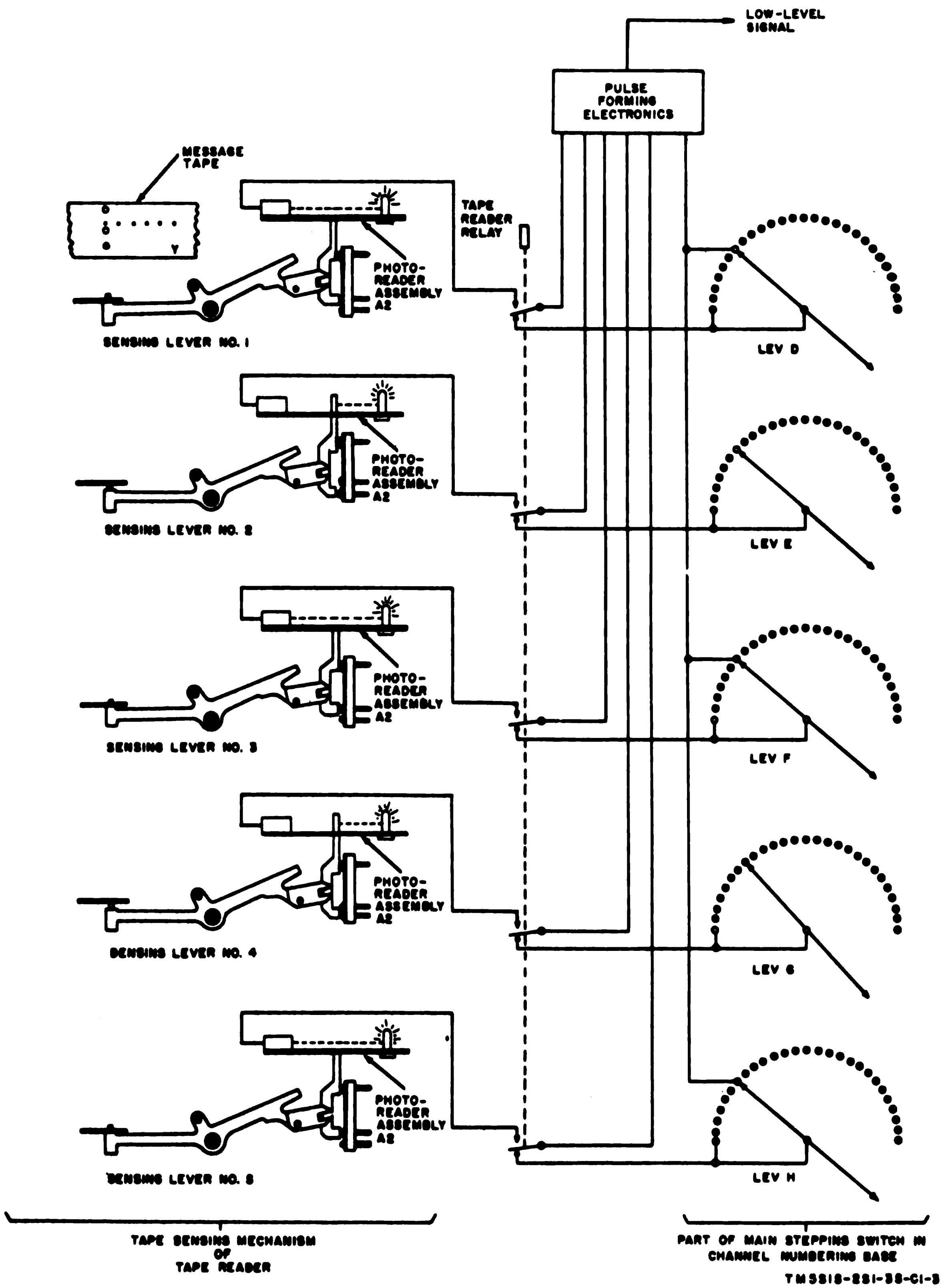


Figure 2.2. Simplified transmission circuit, low-level operation.

6. Distributor-Transmitter, Teletypewriter TT-322/GGC-9, Block Diagram (fig. 3)

a. The motor (para 7) receives ac power through the control base and converts it into mechanical power to operate the various mechanisms of the transmitter. The motor speed is held at precisely 3,600 revolutions per minute (rpm) by the motor governor assembly (para 8). Mechanical power is transferred to the transmitter drive shaft through a gearset, power shaft (para 9), and friction clutch (para 10) under the control of the distributor clutch magnet (para 12). The distributor clutch magnet is operated by 48-volt dc from the control base. The transmitter drive shaft operates the distributor (para 11) and the blank signal counter mechanism. It also operates the tape-reader mechanism under the control of the tape-reader clutch magnet (para 13), which is operated by 48-volt dc from the control base. The blank signal counter mechanism (para 17) has a mechanically operated switch and receives 48-volt dc from the control base to control the distributor clutch magnet under certain conditions.

b. The tape-reader mechanism senses the presence and absence of code holes in the message tapes (para 14), and produces corresponding simultaneous teletypewriter signals; using the 120-volt dc from the control base. These signals are provided to the distributor. Simultaneous teletypewriter signals are also provided to the distributor from the numbering base, through the control base. The simultaneous signals are converted to normal stop-start sequential signals that are transmitted to the signal line.

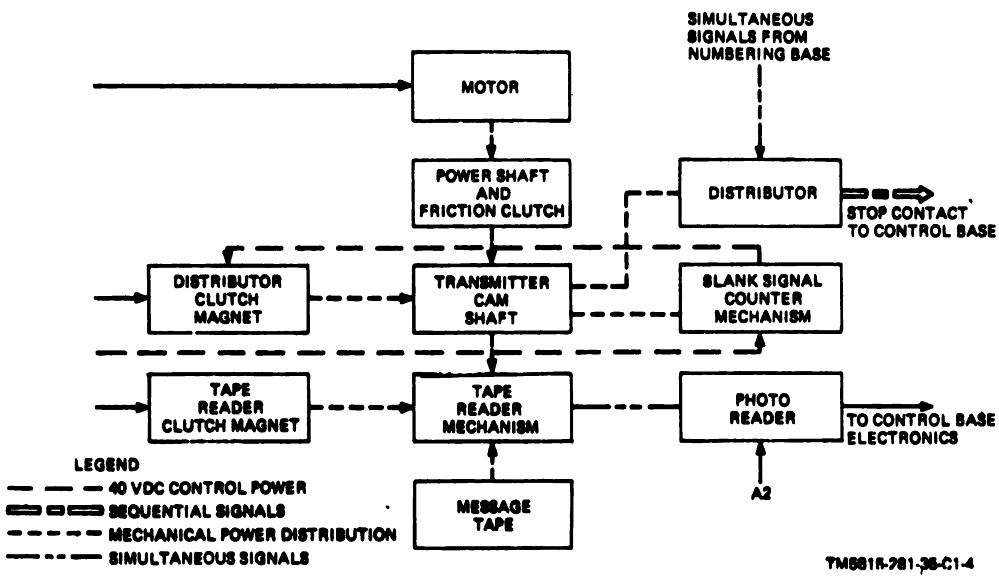


Figure 3. Transmitter block diagram, low-level operation.

7. Motor

Each transmitter includes a series-governed motor which requires 105- to 125-volt, 50- to 60-cycle, regulated or unregulated ac for operation. The motor develops 1/23 horsepower at 3,600 rpm. The speed is controlled by a mechanical governor assembly (para 8) mounted on the rotating motor shaft. The motor armature rotates clockwise when viewed from the target-wheel end.

8. Motor Governor Assembly
(fig. 4 and 5)

a. The motor governor assembly is adjustable to permit the motor speed to be maintained at precisely 3,600 rpm. The governor is mounted on, and rotates with, the motor shaft. The governor contacts are connected in series with the field coils and armature of the motor through two sliprings (located on the back of the motor speed governor base) which are contacted by two brushes in the motor housing. The movable electrical contact of the governor (fig. 4) is flexible and is held against the stationary electrical contact by a coil spring until the motor speed exceeds 3,600 rpm. When this occurs, the centrifugal force acting on the movable electrical contact is greater than the tension of the spring. The movable electrical contact then moves away from the stationary electrical contact. The speed at which the contacts will open depends on the tension applied to the spring by the governor adjusting lever. The tension on the spring may be increased or decreased by manipulating the shaft of the governor worm while the motor is running.

b. The governor worm has two integral threaded portions (fig. 5): one right hand and one left hand. Complete instructions for adjusting the motor speed are given in TM 11-5815-281-12.

9. Mechanical Power Distribution
(fig. 6)

Mechanical power is distributed to the mechanisms of the transmitter by the motor through a drive gearset. This drive geatset consists of a worm on the motor

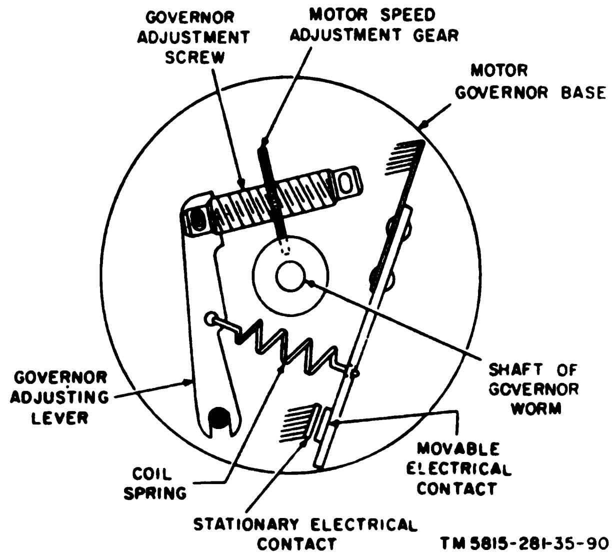


Figure 4. Motor governor assembly.

shaft and a fiber worm gear fastened to the motor end of the power shaft. The power shaft rotates continuously when the motor is operating and transfers power to the transmitter camshaft through the driving gear, the drive gear, and the friction clutch.

10. Friction Clutch
(fig. 7)

a. A felt-disk, gear-type friction clutch, mounted on the transmitter camshaft, permits rapid stopping and starting of shaft rotation while the motor runs continuously. The friction clutch consists of a driving

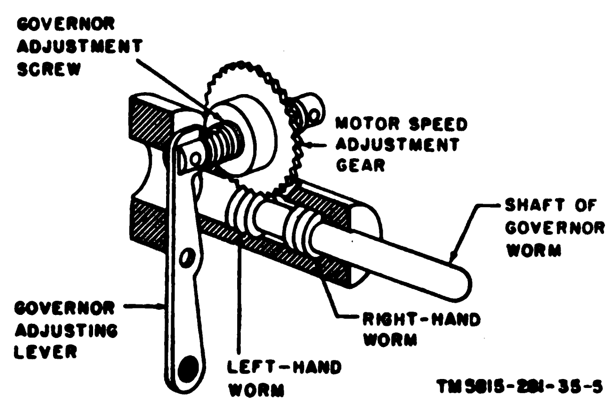


Figure 5. Cutaway view of governor housing, showing governor worm shaft.

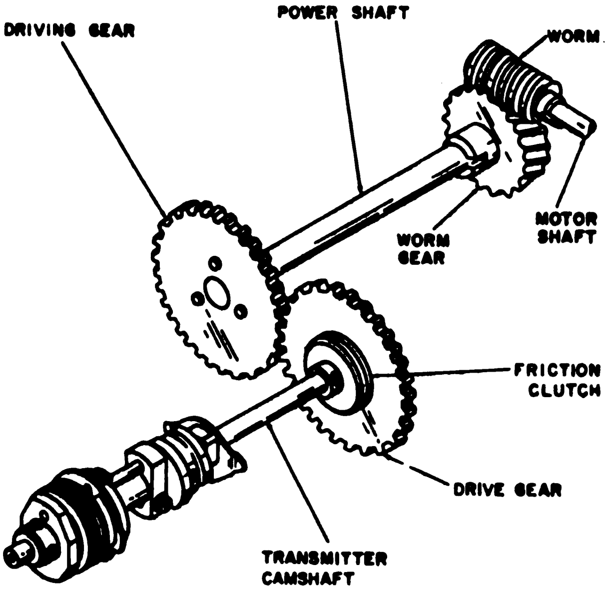


Figure 6. Transmitter mechanical power distribution.

portion and a driven portion. The driving portion consists of a drive gear and two felt friction plates. Projections on the sides of the driving gear engage perforations in the felt friction plates, forcing the plates to rotate with the gear. The driven portion of the friction clutch consists of two clutch disks, a friction clutch spring, a friction clutch adjusting collar, and a threaded collar. One clutch disk is secured to the transmitter camshaft with setscrews; the other clutch disk engages a threaded collar on the camshaft. The threaded collar is also secured to the transmitter camshaft with setscrews.

b. The clutch disks are held tightly against the friction plates by pressure of the friction clutch spring. Variation of the spring pressure permits adjustment of the friction between the clutch disks to insure sufficient friction to turn the camshaft during transmission of each code group. When rotation of the camshaft is mechanically blocked, the drive gear and the friction plates continue to rotate, driven by the driving gear on the power shaft. When the transmitter camshaft is released, the friction between the felt plates and the clutch disks again causes the parts to rotate together to transmit the code group.

c. The friction clutch spring pressure is adjusted by loosening the two screws that hold the friction adjusting collar to the threaded collar, and rotating the adjusting collar clockwise to increase or counterclockwise to decrease the pressure. As the spring pressure is increased, the force required to halt rotation of the transmitter camshaft is increased. As the spring pressure is decreased, the force required to halt the rotation of the transmitter camshaft is decreased.

11. Code Transmitting Mechanism, High-Level Operation

The impulses transmitted from the transmitter are derived from either the numbering base or the message tape. Transmission of impulses to the signal line is always controlled through distributor contacts S48 of the transmitter.

a. When the distributor clutch magnet is energized (para 29*c*(3)), the transmitter camshaft is driven by the friction clutch. One of the two high points of the distributor cam (fig. 8) moves counterclockwise, away from the contact plunger associated with the stop impulse. The flat spring, against which the plunger had been exerting an outward thrust, presses the stop contact plunger inward. The insulator and movable (inner) contact of the stop contact pair move away from the stationary (outer) contact, opening the stop contacts.

b. The distributor cam continues to rotate past the next plunger space. This space includes neither a contact plunger nor a set of contacts; all other contacts remain open, causing the transmission of a start

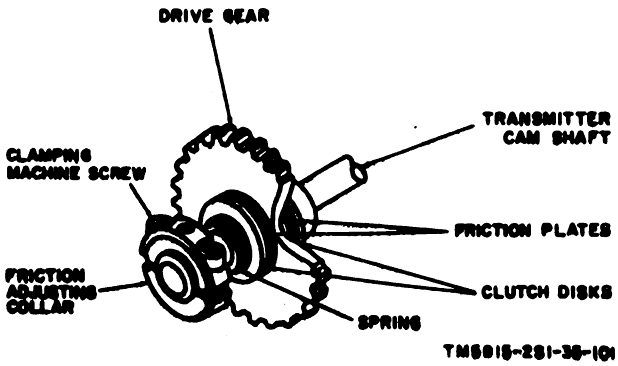


Figure 7. Gear-type friction clutch.

(no current) impulse to start the receiving units in synchronism.

c. The high part of the distributor cam now moves against the contact plunger associated with the first code impulse, camming the plunger outward. As it moves outward, the plunger moves against the flat spring mounted on the outer circumference of the distributor block, flexing the spring, insulator, and contact upward to move the movable contact against the stationary contact. As the distributor cam rotates past the plunger, the contact flat spring restores the plunger to its normal position and opens the contacts.

d. The distributor cam engages the remaining four contact plungers in succession. Each plunger and set of contacts are associated with one of the code impulses, and one 180° turn of the cam causes the sequential transmission of five code impulses to the signal line. The contact plungers are equally spaced in the distributor block, the diameters of the cam contact surface of these five plungers are identical, and the transmitter camshaft speed is constant, causing the five code impulses to be of equal time length.

e. After the fifth code impulse has been transmitted, the opposite lobe of the distributor cam moves against the stop contact plunger. The stop contact plunger has a diameter 1.42 times that of the other five plungers, giving a stop impulse duration 1.42 times that of the other impulses. This is necessary to maintain synchronism between transmitting and receiving units.

f. When the message identification information that originates at the numbering base is to be transmitted, the five stationary impulse contacts are controlled through the contacts of the main stepping switch (para 20). When tape is processed, impulse transmission is controlled through the tape-sensing mechanism. The operation of the distributor mechanism is the same, regardless of the origin of the signals.

g. The following sequence chart summarizes the operation of the distributor mechanism during transmission in high-level operation. The sequence starts with the distributor cam holding the stop contact closed, and the transmitter sending from a message tape.

Code transmitting sequence chart, high-level operation

Transmitter camshaft rotates distributor cam past stop contact plunger.	Stop contact flat spring pushes stop contact plunger to restored position, permitting stop contacts to open.
Start (no current) impulse sent while distributor cam moves past empty (start) position.	Sensing levers pivot to sense message tape.
Distributor cam strikes contact plunger associated with first code impulse, camming plunger outward.	Plunger strikes flat spring, flexing spring and insulator, and pressing movable contact against associated fixed contact, transmitting first code impulse to signal line.
Distributor cam moves out of engagement with contact plunger associated with first code impulse.	Flat spring moves plunger inward to restored position, permitting first code impulse contacts to open.
Distributor cam engages second, third, fourth, and fifth contact plungers in sequence, closing their associated contacts to send remaining four code impulses.	Second, third, fourth, and fifth code impulses sent to signal line.
Distributor cam moves against stop contact plunger, closing stop contacts.	Stop impulse of code group is transmitted.

11.1. Code Transmitting Mechanism, Low-Level Operation

a. The impulses transmitted from the transmitter are derived either from the numbering base or the message tape. Transmission impulses from the paper tape are generated by the photo-reader (A2). The photo-reader (A2) is actuated through the motion of the code-sensing pins in sensing holes in the paper tape. The code sensing lever actuates the five contact wipers which make and break the light beams in accordance with the paper tape data code being sensed (fig. 12).

b. The following sequence chart summarizes the operation of the code transmitting mechanism during transmission in low-level operation. The sequence starts with the distributor cam holding the stop contact closed, and the transmitter sending from a message tape.

Code Transmitting Mechanism Sequence Chart, Low Level Operation

Transmitter camshaft rotates distributor cam past stop contact plunger.	Stop contact flat spring pushes stop contact plunger to restored position, permitting stop contact to open.
Start (no current) impulse sent from control base electronics while distributor cam moves past empty (start) position.	Sensing levers pivot to sense message tape.
Sensing pin on sensing lever enters hole in message tape.	Contact wiper moves down permitting light beam from miniature lamp to be sensed by light sensing transistor.
Sensing lever and pins continue to read tape codes.	Second, third, fourth, and fifth code impulses are sensed by light sensing transmitter and transmitted to electronics and on to the low level signal line.

12. Transmitter Camshaft Control (fig. 9)

Rotation of the transmitter camshaft is controlled by the distributor clutch magnet armature. When the distributor clutch magnet is energized (para 29c(3)), the armature is attracted to the core of the magnet and pivots counterclockwise around the tape-reader clutch magnet armature shaft. As the distributor clutch magnet armature moves counterclockwise, the left extension of the armature moves downward, out of engagement with the stop plate of the transmitter camshaft. The camshaft immediately begins to turn as the result of friction clutch action (para 10). When the distributor clutch magent is deenergized, the left extension of the armature is

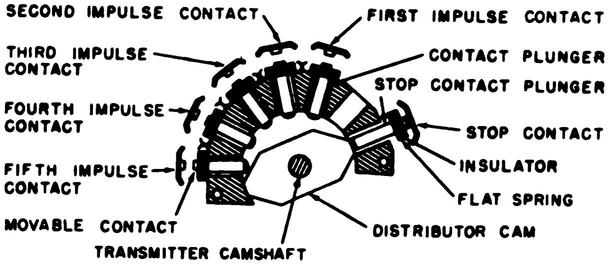


Figure 8. Distributor S48, contact arrangement.

raised to the blocking position under spring tension and the transmitter camshaft is stopped.

13. Tape-Reader Clutch Control (fig. 10)

a. Rotation of the tape-reader cam assembly is controlled by the tape-reader clutch magnet armature. When the tape-reader clutch magnet is energized (para 34e), the tape-reader clutch magnet armature is attracted to the magnet core and the armature extension moves downward, out of engagement with the kickout plate of the tape-reader clutch. The clutch pawl springs and the camming action of the kickout plate cause the projections of the clutch pawls to engage the aligned notches of the tape-reader clutch notched drum. The drum is securely fastened to the transmitter camshaft.

b. As the tape-reader clutch magnet armature moves toward the core, the armature shaft turns counterclockwise and imparts that motion to the unlatch actuating lever (fig. 9). The upward motion of the unlatch actuating lever performs two functions. First, the upward motion activates distributor magnet pulsing switch S44 to energize the distributor clutch magnet, and second, the upper extension releases the distributor armature latch so that it is free to move upward under the tension of its spring as soon as the upper extension of the distributor clutch magnet armature moves counterclockwise. This latter action locks the distributor clutch magnet armature in the operated position. As the transmitter camshaft begins to rotate, the tape-reader cam assembly turns with it due to the engagement of the tape-reader clutch.

c. During transmission from the message tape, the distributor clutch magnet remains energized under the control of the

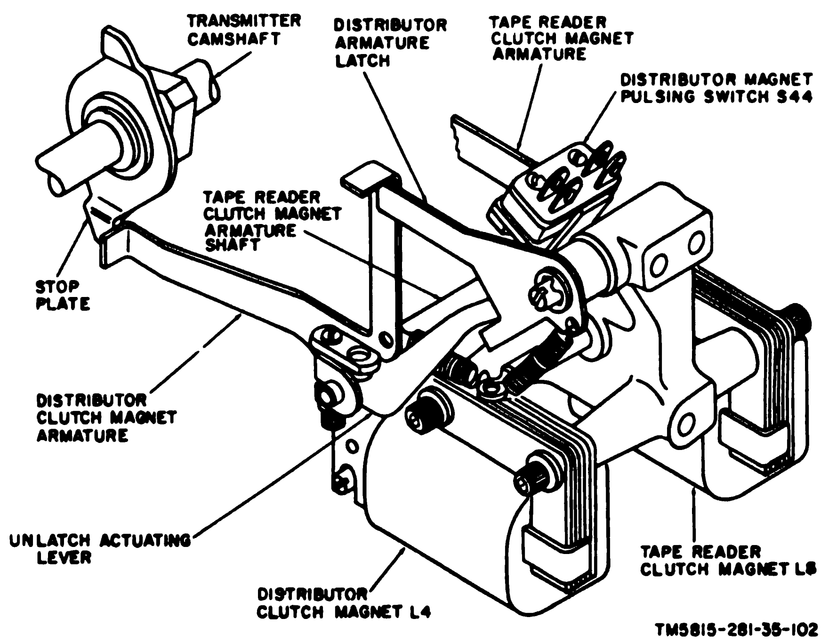


Figure 9. Transmitter camshaft control mechanism.

tape-reader clutch magnet. When transmission is ended by the operation of the stop-start lever, the tight-tape lever, or the tape-out lever, both magnets deenergize and the tape-reader clutch magnet armature extension raises to engage the kickout plate of the tape-reader clutch. If the armature extension travels the maximum possible distance upward, the unlatch actuating lever moves downward to cam the distributor armature latch out of the return path of the distributor clutch magnet armature. The stop tooth on the kickout plate is oriented to lead the stop plate of the transmitter camshaft by 18° to insure that the tape-reader clutch is cammed out of engagement before the camshaft stops. If the tape-reader clutch magnet armature extension comes into engagement just after the leading edge of the stop tooth on the kickout plate is past, the tape-reader clutch magnet armature will only raise slightly because it comes into contact with the raised portion of the kickout plate (a 20° cam dwell). Because the turning of the shaft of the tape-reader clutch magnet armature is limited, the unlatch actuating lever does not move far enough to cam the distributor armature latch out of the path of the distributor clutch magnet armature, and the armature latch remains momentarily in the latched position. However, as the kickout plate continues to turn, the tape-reader clutch magnet armature completes its maximum travel and the distributor clutch magnet armature is unlatched.

d. The following chart summarizes the sequence of events that occur during the operation of the tape-reader. Initially, tape is installed in the transmitter, the stop-start lever is in the START position, the transmitter camshaft is rotating, and the message identification information has been transmitted.

Tape-reader control mechanism sequence chart

Tape-reader clutch magnet L6 is energized	Tape-reader clutch magnet armature pivots, releasing kickout plate and causing tape-reader clutch to engage.
Tape-reader clutch magnet armature shaft pivots with armature, pivoting unlatch actuating lever mounted on other end of armature shaft.	Unlatch actuating lever operates distributor magnet pulsing switch S44 to close circuit to distributor clutch magnet.
Distributor clutch magnet energized, pivoting clutch magnet armature.	Transmitter camshaft stop plate unblocked by armature; upper extension of armature blocked in operated position.
Transmitter camshaft starts rotating, rotating tape-reader cam assembly.	
Distributor and tape-reader clutch magnets are deenergized.	
Tape-reader clutch magnet armature starts to pivot, moved by the tension of its spring.	Distributor clutch magnet armature temporarily blocked from pivoting by distributor armature latch.
Tape-reader clutch magnet armature continues to pivot, pivoting unlatch actuating lever.	Unlatch actuating lever pivots distributor armature latch, releasing distributor clutch magnet armature.
Abutment of kickout plate strikes tape-reader clutch magnet armature.	Projections on tape-reader clutch pawls cammed out of notches in the tape-reader clutch notched drum, extending clutch pawl springs.
Tape-reader cam assembly stops rotating.....	Stop plate on transmitter camshaft strikes armature of distributor clutch magnet, stopping camshaft rotation.

14. Tape-Sensing Mechanism

a. The tape sensing mechanism (fig. 11) consists of five similarly shaped code-sending levers, five code-sensing lever springs, five contact wipers that are part of the photo-reader assembly (A2), a restore lever and comb assembly, a sensing lever restoring cam that is part of the tape-reader cam assembly, and a photo-reader assembly (A2).

b. When the tape-reader cam assembly is in the latched position, the sensing lever restoring cam is stopped with its high portion against the cam follower of the restore lever and comb assembly. In this position, the restore lever and comb assembly is held pivoted to its clockwise position and the comb applies upward pressure against the left ends of the code-sensing levers, holding them in their clockwise position. In this position, the tops of the sensing pins at the right end of the levers are held below the surface of the message tape.

c. When the tape-reader clutch engages, the tape-reader cam assembly starts rotating with the transmitter camshaft. As the cams rotate, the cam follower portion of the restore lever and comb assembly moves off the high portion of the restoring cam. The tension of the restore lever spring pivots the restore lever and comb assembly counterclockwise, releasing the upward pressure applied against the code-sensing levers by the comb. When the code-sensing levers are released, the code-sensing lever springs tend to rotate the levers counterclockwise, raising the sensing pins at the right end of the sensing levers.

d. If a hole is present in the message tape directly above the sensing pin, the code-sensing lever continues to pivot until it is arrested by the comb of the restore lever and comb assembly (A, fig. 12). If no hole is present in the message tape above the sensing pin, the movement of the code-sensing lever is blocked by the message tape after a very slight counterclockwise movement (B, fig. 12).

e. For high-level operation, a contact wiper (part of tape-reader switch S5) is mounted on the left end of each code-sensing lever, opposite the sensing pins. The contact wiper is lowered to close a marking circuit to the distributor block if a code hole is present in the portion of the message tape associated with that sensing lever. If no code hole is present, the counterclockwise movement of the sensing lever is blocked before the associated contact wiper can move far enough to close the marking contacts to the distributor block.

*e.*1. For low-level operation, a contact wiper is mounted on the left end of each code-sensing lever, opposite the sensing pins. If a hole is present in the tape, the contact wiper is lowered allowing the light beam from the miniature lamp to be sensed by the photo-sensing diode (A, fig. 12) which in turn sends an impulse to the pulse forming electronics. If no hole is present, the counterclockwise movement of the sensing lever is blocked before the associated contact wiper can move far enough to allow the light beam to be sensed by the photo-sensing device (B, fig. 12).

f. In this manner, the five sensing levers position the contact wipers of tape-reader switch S5 in one of two positions, depending on the perforations in the message tape. The operation of the tape-sensing mechanism is summarized in the following sequence chart. Initially, the tape is installed in the transmitter and the sensing levers are held in their clockwise position by the restore lever and comb assembly.

for high-level operation.

Tape-Sensing Sequence Chart, High-Level Operation

Tape-reader clutch mechanism is latched by tape-reader clutch magnet armature; tape-reader cam assembly halted.	Cam follower of restore lever and comb assembly rides against high portion of its associated cam, holding restore lever and comb assembly and sensing levers clockwise against tension of their springs.
Tape-reader clutch armature releases kickout plate to engage tape-reader clutch.	Tape-reader cam assembly rotates, moving high portion of sensing lever restoring cam away from cam follower of restore lever and comb assembly.
Restore lever spring pivots, restore lever and comb assembly counterclockwise, releasing code-sensing levers.	Sensing lever springs tend to pivot sensing levers counterclockwise.
If code hole is present in message tape directly above sensing pin of sensing lever, sensing lever continues to pivot counterclockwise until stopped by restore lever and comb assembly.	If no code hole is present in message tape directly above sensing pin of a code-sensing lever, sensing lever is blocked by message tape and is held in clockwise position.
If code-sensing lever is pivoted counterclockwise, contact wiper associated with that sensing lever moves downward to close marking circuit to distributor block.	If code-sensing lever is blocked by message tape, contact wiper is held in its restored position.
Code transmitting sequence (para 11) takes place at this time.	
High portion of sensing lever restoring cam moves against cam follower portion of restore lever and comb assembly.	Restore lever and comb assembly pivots clockwise. Comb engages sensing levers which had moved to marking position, moving them toward restored position.
Comb engages remaining sensing levers, moving all levers to restored position.	Cam follower reaches high portion of sensing lever restoring cam.

f.1. The five sensing levers position the contact wipers in one of two positions, depending on the perforations in the message tape. The operation of the tape-sensing mechanism is summarized in the following sequence chart for low-level operation. Initially the tape is installed in the transmitter and the sensing levers are held in their clockwise position by the restore lever and comb assembly.

Tape-Sensing Sequence Chart, Low-Level Operation

Tape-reader clutch mechanism is latched by tape-reader clutch magnet armature; tape-reader cam assembly halted.	Cam follower of restore lever and comb assembly rides against high portion of its associated cam, holding restore lever and comb assembly and sensing levers clockwise against tension of their springs.
Tape-reader clutch armature releases kickout plate to engage tape-reader clutch.	Tape-reader cam assembly rotates, moving high portion of sensing lever restoring cam away from cam follower of restore lever and comb assembly.
Restore lever spring pivots restore lever comb assembly counterclockwise, releasing code-sensing levers.	Sensing lever springs tend to pivot sensing levers counterclockwise.
If code hole is present in message tape directly above sensing pin of sensing lever, sensing lever continues to pivot counterclockwise until stopped by restore lever and comb assembly.	If no code hole is present in message tape directly above sensing pin of a code-sensing lever, sensing lever is blocked by message tape and is held in clockwise position.
If code-sensing lever is pivoted counterclockwise, contact wiper associated with that sensing lever moves downward and allows light sensing beam to be sensed by photo-transistor and transmits signal to pulse forming electronics in the control base.	If code-sensing lever is blocked by message tape, contact wiper is held in its restore position and light beam is blocked, thus the photo-reader (A2) is inoperative.
Code transmitting sequence (para 11.1) takes place at this time.	
High portion of sensing lever restoring cam moves against cam follower portion of restore lever and comb assembly.	Restore lever and comb assembly pivots clockwise. Comb engages sensing levers which had moved to marking postion, moving them toward restore position.
Comb engages remaining sensing levers, moving all levers to restore position.	Cam follower reaches high portion of sensing lever restoring cam.

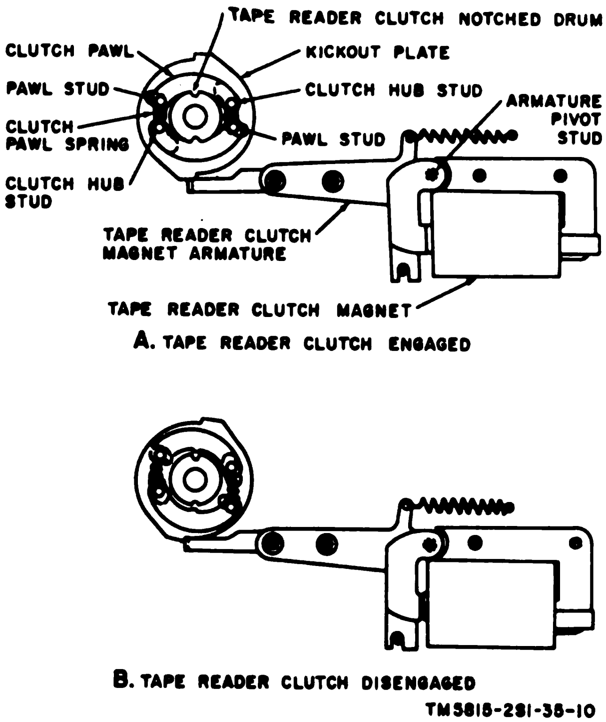


Figure 10. Tape-reader clutch control mechanism.

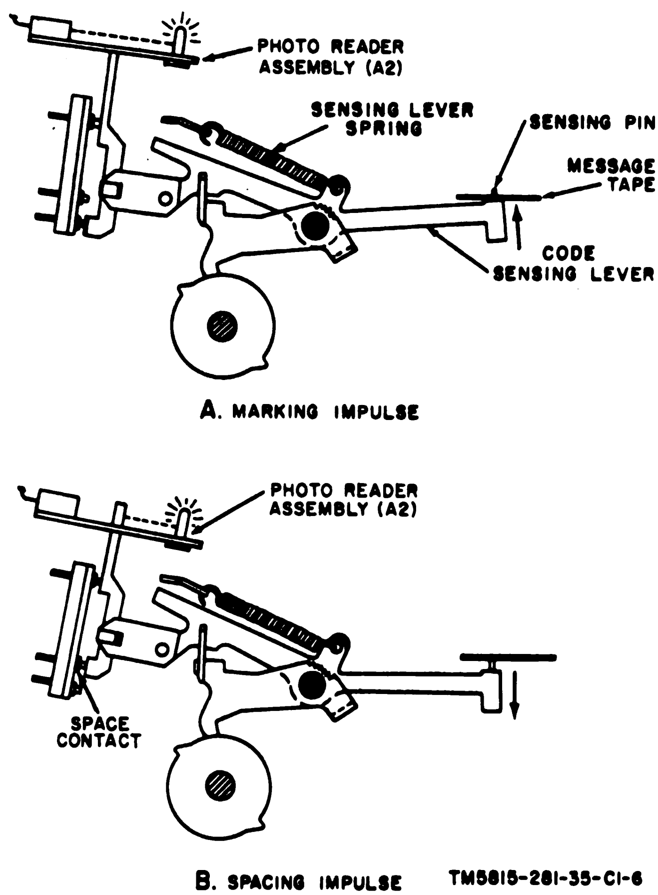


Figure 12. Sensing of marking and spacing impulses.

15. Tape-Feed Mechanism (fig. 13)

Tape feed occurs immediately after the transmission of each code group. The tape-feed mechanism consists of a tape-feed claw, tape-feed operating lever, tape-feed cam lever, and a tape-feed retracting lever. It also includes a tape-feed retracting lever cam and a tape-feed cam which are part of the tape-reader cam assembly. Tape feed occurs only when the tape-reader clutch is engaged (para 13). The tape-feed mechanism is driven by the tape-feed cam and the tape-feed retracting lever cam mounted on the tape-reader cam assembly. Tape feeding is accomplished by two distinct motions of the tape-feed claw: a horizontal movement (A, fig. 13) and a vertical movement (B, fig. 13).

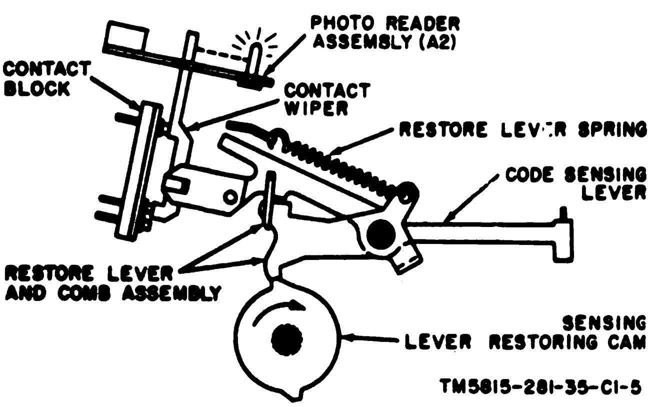


Figure 11. Code sensing levers in restored position.

a. The horizontal movement of the tape-feed claw makes the message tape feed forward through the interaction of the tape-feed operating lever, the tape-feed cam lever, and the tape-feed cam, which is part of the tape-reader cam assembly. When the tape-reader cam assembly is at rest, the cam lever is engaged with the notch in the tape-feed cam, and the tape-feed claw is in the left position. When the tape-reader cam assembly starts to rotate, the cam lever is cammed out of the notch in the tape-feed cam, pivoting the tape-feed cam lever clockwise. As the lever moves clockwise, a projection on the cam lever engages a lug on the tape-feed operating lever, pivoting the operating lever clockwise.

b. The top of the tape-feed operating lever rides in a notch in the tape-feed claw. As the tape-feed operating lever pivots, it permits the tape-feed claw to shift the tape-feed claw to the right (A, fig. 13) where the pins in the claw engage the feed holes in the message tape as described in *e* below. The tape-feed cam continues to rotate with the tape-feed cam lever riding on the high portion of the cam until the sharply sloping low portion of the cam moves into line with the tip of the cam lever. This makes the cam lever spring and the operating lever spring pivot both levers sharply counterclockwise.

c. As the tape-feed operating lever pivots, it moves sharply against the left side of the notch in the tape-feed claw, moving the claw abruptly to the left. As the tape-feed claw moves, it feeds the message tape one space to the left.

d. In addition to the horizontal movement of the tape-feed claw, it is also moved vertically through the combined action of the tape-feed retracting lever and the tape-feed retracting lever cam which is part of the tape-reader cam assembly. When the transmitter camshaft is in the at-rest position, the cam follower portion of the tape-feed retracting lever is on the low portion of the tape-feed retracting cam so that the retracting lever is pivoted to its counterclockwise position. In this position, the stud at the right end of the tape-feed retracting lever that engages the notch in the tape-feed claw holds the pin end of the tape-feed claw up into engagement with the tape-feed holes.

e. When transmission begins and the tape-reader cam assembly rotates, the high portion of the tape-feed retracting lever cam moves into engagement with the cam follower portion of the retracting lever. This pivots the tape-feed retracting lever clockwise, making the stud at the end of the retracting lever pull the feed pins at the end of the tape-feed claw down, out of engagement with the feed holes in the message tape. As the retracting lever cam continues to rotate, the high portion of the cam moves away from the cam follower of the retracting lever. This permits the retracting lever spring to pivot the retracting lever counterclockwise so that the stud which engages the tape-feed claw raises the feed pins of the tape-feed claw into engagement with the feed holes in the message tape.

f. The actual motion of the tape-feed claw under the control of the tape-feed operating lever, the tape-feed retracting lever, and their respective cams is rectangular. The tape-feed retracting lever makes the tape-feed claw engage the tape before feeding and withdraws it after feeding. The tape-feed operating lever makes the tape-feed cam lever move to the left (A, fig. 13) while the pins of the tape-feed claw are engaged with the feed holes in the message tape, and makes the tape-feed cam lever move to the right when the tape-feed claw is disengaged from the message tape.

g. The following chart summarizes the sequence of operations that occur during the tape feeding process. The cycle starts with the transmitter camshaft and the tape-feed cam assembly in the at-rest position.

Tape-feed sequence chart

Tape-feed cam lever is on low portion of tape-feed cam; tape-feed cam lever and tape-feed operating lever are counterclockwise, holding tape-feed claw to left.	Tape-feed retracting lever is at low portion of tape-feed retracting lever cam; retracting lever spring holds retracting lever and tape-feed claw in counterclockwise position pins are in engagement with message tape.
High portion of retracting lever cam moves into engagement with retracting lever, pivoting lever counterclockwise.	Stud at end of retracting lever moves tape-feed claw out of engagement with feed holes message tape.
High portion of tape-feed cam moves into engagement with tape-feed cam lever, pivoting cam lever and tape-feed operating lever (engaged by cam lever) clockwise.	Tape-feed operating lever releases tape-feed claw, permitting tape-feed claw spring to shift claw to right.
High portion of tape-feed retracting lever cam moves out of engagement with tape-feed re-	Stud at end of retracting lever lifts pin end of tape-feed claw upward; pins engage feed holes in message tape.

Tape-feed sequence chart

tracting lever, permitting retracting lever spring to pivot retracting lever spring to pivot retracting lever countercloskwise.	
Low portion of tape-feed cam moves opposite tape-feed cam lever.	Tape-feed cam lever spring pivots cam lever counterclockwise, releasing tape-feed operating lever.
Operating lever spring abruptly pivots tape-feed operating lever counterclockwise, causing it to strike tape-feed claw.	
Tape-feed claw is abruptly shifted by operating lever; pins in tape-feed claw move tape one space.	

16. Control Lever Mechanism

The operation of each transmitter is controlled by the control lever mechanism that operates switches to energize or deenergize the two clutch magnets. Three control levers are involved: the stop-start lever, the tape-out lever, and the tight-tape lever.

a. *Stop-Start Lever* (fig. 14).

(1) The stop-start lever is manually positioned by the operator to control the operation of the transmitter. Three lever positions are provided: the START position permits transmission to start; the STOP position stops transmission; the FEED RETRACT position holds the tape-feed claw and the tape-out lever retracted. Movement of the Stop-start lever from FEED RETRACT to START allows transmission of the message identification information to the signal line, followed by the message.

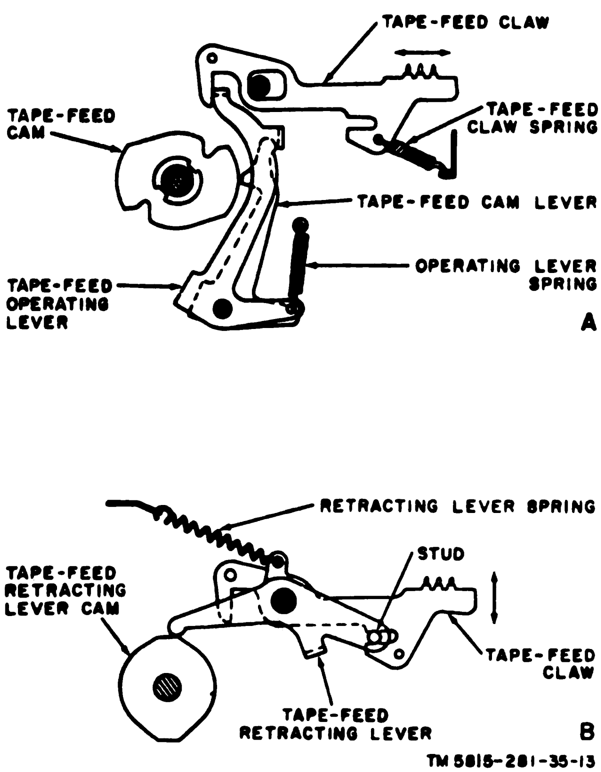


Figure 13. Tape-feed mechanism.

(2) Before starting the transmitter, when the tape is installed and the stop-start lever is held in the STOP position by the stop-start lever detent, the stop-start lever holds the stop-start switch cam against the switch operating lever of stop-start switch S42, so that the normally closed stop-start switch is held open. When the stop-start switch is open, distributor clutch magnet L4 is deenergized and the transmitter camshaft (fig. 9) is prevented from rotating by the distributor clutch magnet armature. The interoperation of the retracting arm (fig. 14) on the switch operating shaft and the lever arm assembly (fig. 15) on the tape-out lever holds the tape-out lever in its retracted position.

(3) Following is a chart summarizing the sequence of events that occur when the stop-start lever is operated with a message tape is installed and the tight-tape lever is in the slack position.

Stop-start lever sequence chart

Stop-start lever is in STOP position	Tape-out switch S30 is closed, stop-start switch cam holds stop-start switch S42 open, and distributor clutch magnet armature blocks stop plate on transmitter camshaft, preventing rotation of camshaft. Tape-out lever is held down and out of engagement with message tape.
Stop-start lever is raised to START position ...	Stop-start lever pivots stop-start switch cam counterclockwise to permit stop-start switch S42 to close. Retracting arm on switch operating shaft moves away from lever arm assembly on tape-out lever, permitting tape-out lever to pivot clockwise into engagement with bottom of message tape.
Stop-start switch S42 closes electrical contacts to energize distributor clutch magnet L4. Message identification information will be transmitted first. *Note: The actions described in the transmitter camshaft control sequence (para 12) start at this point in the overall sequence of equipment operation.*	
Stop-start lever moved to STOP position	Stop-start lever pivots stop-start switch cam clockwise toward switch operating lever to open normally closed stop-start switch S42. Retracting arm on switch operating shaft strikes lever arm assembly on tape-out lever to pivot tape-out lever counterclockwise out of contact with bottom of message tape.
Stop-start switch S42 opens circuit to distributor clutch magnet L4 making clutch magnet armature block rotation of transmitter camshaft to stop transmission.	
Stop-start lever moved to FEED RETRACT position.	Upper projection of stop-start lever engages stud on tape-feed retracting lever, pivoting tape-feed retracting lever clockwise.
Tape-feed retracting stud which engages tape-feed claw pulls tape-feed claw down, moving pins at ends of tape-feed claw out of engagement with feed holes in message tape.	
Stop-start lever continues to pivot switch operating shaft, rotating shaft.	Tape-out switch cam (at end of switch operating shaft) strikes tape-out switch actuating lever and moves it against tape-out switch operating lever to hold tape-out switch S30 open.

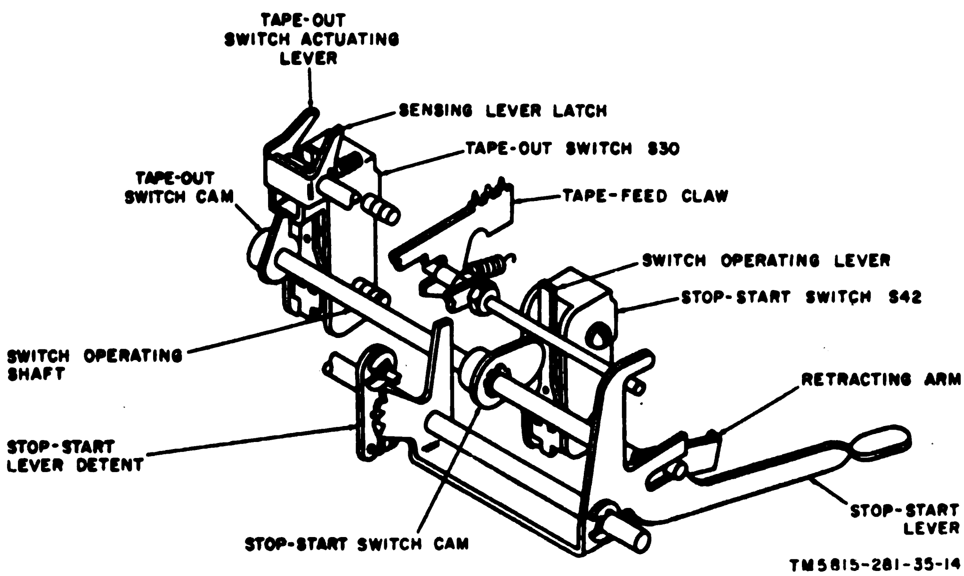


Figure 14. Stop-start lever operation.

b. Tape-Out Lever (fig. 15).

(1) The tape-out lever stops tape feeding when the end of the message tape passes under the tape cover. This is done by the interaction of the sensing finger, tape-out lever, tape-out lever spring, tape-out lever shaft, and tape-out switch lever. Tape feeding is stopped through the operation of tape-out switch S30 which deenergizes tape-reader clutch magnet L6.

(2) During transmission, while tape is being fed through the transmitter, the sensing finger on the tape-out lever is held against the underside of the message tape under the tape cover by the tape-out lever spring. When the end of the tape passes through the tape cover, the tape-out lever spring is free to pivot the tape-out lever and sensing finger, pivoting with it the tape-out lever shaft and the switch lever cam which is secured to the other end of the shaft with setscrews. The switch lever cam moves against the upper extension of the tape-out switch lever, and pivots it so that the lower end of the lever moves against the switch operating lever to open normally closed tape-out switch S30. Opening the switch deenergizes the tape-reader clutch magnet and stops tape feeding.

(3) Tape-out switch S30 is held open until the stop-start lever is moved to the FEED RETRACT position, a new message tape is inserted, and the stop-start lever is returned to the STOP position. Until the lever is moved to the FEED RETRACT position, tape-out switch S30 is held open by the sensing lever latch that holds the latch lever cam mounted on the tape-out lever shaft. When the cam is latched, the shaft cannot pivot and therefore the tape-out switch lever holds tape-out switch S30 open.

(4) When the stop-start lever is moved to the FEED RETRACT position, it cams the retracting arm clockwise to move the tape-out switch cam (fig. 14), at the opposite end of the switch operating shaft, into engagement with the tape-out switch lever and the sensing lever latch, camming both out of engagement with their associated cams and holding the tape-out switch lever against the switch operating lever to prevent tape-out switch S30 from closing. Immediately thereafter, the retracting arm strikes the lever arm (fig. 15) on the tape-out lever, pivoting the tape-out lever counterclockwise to cause the sensing finger to move downward, out of the path of the message tape. When the new message tape is installed and the stop-start lever is moved to START, the tape-out lever is released to permit the sensing finger to move upward against the underside of the tape.

(5) Following is a sequence chart that summarizes the actions that occur when the end of the tape feeds under the tape cover. Initially, the tape is installed and the transmitter is operating.

Tape-out lever sequence chart

Stop-start lever in START position; tape feeding into transmitter.	Sensing finger held against underside of tape by tension of the tape-out lever spring.
End of message tape passes sensing finger.....	Sensing finger moves upward and tape-out lever pivots clockwise, pivoting tape-out lever shaft and switch lever cam.
Switch lever cam strikes tape-out switch lever, pivoting lever counterclockwise.	Lower extension of tape-out switch lever strikes tape-out operating lever, opening tape-out switch S30.
Tape-reader clutch magnet L6 deenergizes as switch S30 opens and permits tape-reader clutch to disengage.	

Tape-out lever sequence chart

Sensing lever latch engages latch lever cam	Counterclockwise rotation of tape-out lever shaft is prevented by sensing lever latch.
Stop-start lever moved to FEED RETRACT position. Stop-start lever cams retracting arm and switch operating shaft clockwise, pivoting tape-out switch cam at other end of shaft.	Tape-out cam moves against tape-out switch operating lever and sensing lever latch, holding lower extensions against switch S30 to prevent closing of switch.
Upper extension of the sensing lever latch moves out of engagement with latch lever cam.	Tape-out lever shaft released; is free to pivot.
Retracting arm strikes lever arm, pivoting tape-out lever counterclockwise.	New message tape installed in transmitter; tape cover closed.
Stop-start lever moved to STOP position	Stop-start lever moves retracting arm out of engagement with lever arm, releasing tape-out lever.
Tape-out lever spring moves tape-out lever clockwise; sensing finger moves upward, against underside of message tape.	

c. *Tight-Tape Lever* (fig. 16).

(1) The tight-tape lever is located at the front of the transmitter. When the transmitter is operating, the message tape is fed through a slot in the tight-tape lever; the end of the lever moves upward when twisted or tangled tape approaches the feed mechanism of the transmitter. When the tight-tape lever is raised, stop-start switch S42 opens, halting further transmission.

(2) The tight-tape lever is mounted on the tight-tape lever shaft which extends through and pivots in a bearing in the transmitter frame. When the end of the lever is raised, the tight-tape lever shaft pivots and moves the stop-start switch lever on the opposite end of the shaft against the switch operating lever to open normally closed stop-start switch S42. Opening the switch deenergizes distributor clutch magnet L4 and moves the distributor clutch magnet armature into the path of the transmitter camshaft stop plate and stops transmission.

(3) When the tape is untangled and the end of the tight-tape lever is

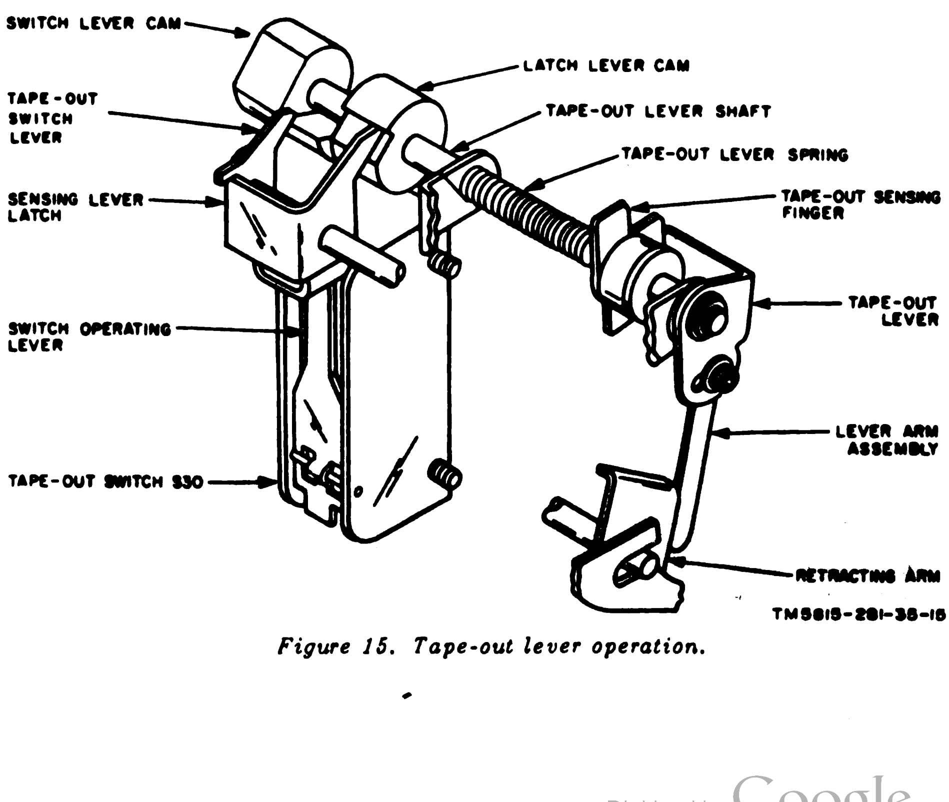


Figure 15. Tape-out lever operation.

lowered, the tight-tape lever shaft pivots the switch actuating lever away from the switch operating lever, allowing stop-start switch S42 to close. This closes the circuit to distributor clutch magnet L4 and the transmitter camshaft starts to rotate again.

(4) Following is a sequence chart that summarizes the actions that occur when the tight-tape lever operates.

Tight-tape lever sequence chart

Tangled tape moves toward the transmitter as tape feeds.	Tangle in tape strikes the tight-tape lever, raising the lever.
Tight-tape lever shaft pivots	Switch actuating lever at other end of tight-tape lever shaft moves against switch operating lever, opening stop-start switch S42.
Distributor clutch magnet L4 deenergized, halting rotation of transmitter cam-shaft.	Clutch magnet armature moves into path of transmitter camshaft stop plate; transmission stops.
Tape untangled and tight-tape lever lowered....	Tight-tape lever shaft pivots stop-start switch lever away from switch operating lever, closing stop-start switch S42.
Distributor clutch magnet L4 energized	Distributor clutch magnet armature moved from path of transmitter camshaft stop plate. Transmission resumes.

17. Blank Signal Counter (fig. 17 and 18)

The blank signal counter, mounted on the left rear of the transmitter, sends a predetermined number of blank signals to the signal line after the transmission of a message when the associated BLANK SIGNAL switch S1 (or S2) mounted on the front panel of the control base, is in the BLANK SIGNAL position. The blank signal counter is primarily a stepping mechanism that operates a set of contacts to open the circuit to distributor clutch magnet L4 after a predetermined number of blank signals have been transmitted. The number of blank signals transmitted is adjustable over the range from 10 to 80 and depends on the position of the counter indexing ratchet.

a. The blank signal counter is operated by the camming action of a cam pin on the tape-reader clutch notched drum and by the counterrestore cam, which is part of the tape-reader cam assembly. The cam pin on the tape-reader clutch notched drum rotates whenever the transmitter camshaft rotates and applies a camming action against the counter lever once for every revolution of the transmitter camshaft. The counterrestore cam is a two-lobed cam that rotates only when the tape-reader clutch assembly rotates, applying a camming action against the restore lever cam follower twice for every revolution of the counter restore cam. The distributor cam rotates independently of the tape-reader cam assembly during transmission of signals derived from the numbering base. During transmission of signals derived from the message tape, the tape-reader cam assembly and the distributor cam rotate together (para 13) through the tape-reader clutch.

b. As the distributor cam rotates, the tape-reader clutch notched drum and the

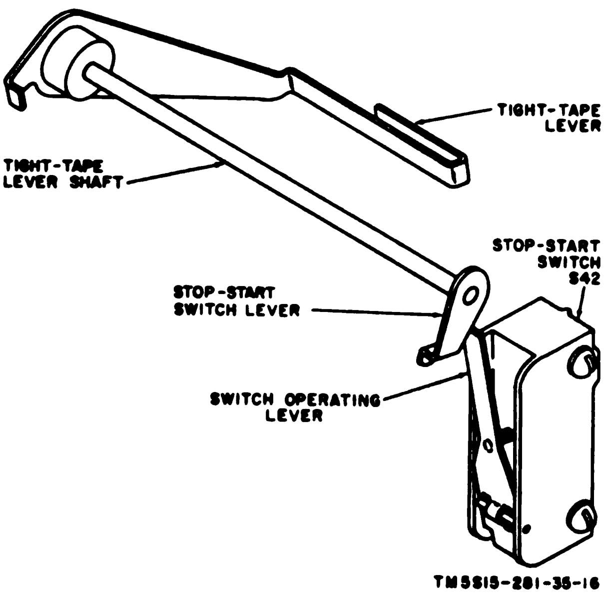


Figure 16. Tight-tape lever operation.

cam pin also rotate. With every revolution of the shaft, the cam pin applies a camming action against the lower end of the counter lever (fig. 18), pivoting the counter lever slightly clockwise. As the counterlever pivots, the counter pawl, mounted on the left end of the counter lever, moves upward, moving the lower projection of the counter pawl into engagement with the counterpawl kickout post, thus pivoting the counter pawl clockwise on its shaft. The operation after the counter pawl pivots depends on the condition of the counter mechanism just before the start of transmission. If blank signals have been sent from the transmitter following the last message sent, the counter contact cam ratchet has been stepped around, and held in position by the cam ratchet detent so that the blank area of the ratchet is adjacent to the counter pawl. In this condition, the pivoting of the counter pawl has no effect on the counter contact cam ratchet at this time. If the counter contact cam ratchet was in the restored position, the same as when blank signals were not sent from the transmitter following the last message, the point of the counter pawl that engages a tooth in the counter contact cam ratchet imparts a counterclockwise thrust against the ratchet as it moves upward with the counter lever. This rotates the ratchet the equivalent of one ratchet tooth for each rotation of the transmitter camshaft. The message identification information is made up of 13 code groups, and because two code groups are transmitted with every revolution of the transmitter camshaft, 6-1/2 revolutions of the camshaft are required to transmit the message identification information. During message identification information transmission, the counter contact cam ratchet is stepped six or seven notches, depending on the initial position of the cam pin at the start of transmission. Reverse rotation of the counter contact cam ratchet is prevented by the cam ratchet detent.

c. After transmission of the message identification information is completed, transmission begins from the message tape. A high portion of the counter restore cam (part of the tape-reader cam assembly) moves against the restore lever cam follower and slightly pivots the restore lever cam follower and the counter restore lever. As the restore lever cam follower pivots, it strikes the eccentric on the counter lever and pivots the counter lever clockwise far enough to cause the counter pawl to move out of engagement with the countercontact cam ratchet. As the counter restore lever pivots, it pulls the cam ratchet detent mounted on the upper end of the counterrestore lever out of engagement with the counter contact cam ratchet, releasing the ratchet. The first time the ratchet is released, the counter clock spring pinned to the counter contact cam ratchet rotates clockwise until the counter contact pin strikes the stud on the counter indexing ratchet, halting the rotation of the counter contact cam ratchet. This nullifies all previous stepping of the ratchet. The high portion of the counter restore cam then moves away from the restore lever cam follower, permitting the restore lever cam follower and the counter restore lever to be pivoted counterclockwise by the counter restore lever spring. As they pivot, the restore lever cam follower moves away from the eccentric on the counter lever and the counter lever spring also pivots the counter lever counterclockwise. When the low portion of the counter restore cam is opposite the restore lever cam follower, the levers have pivoted far enough to permit the counter indexing ratchet and the counter pawl to reengage the teeth on the counter contact cam ratchet.

d. The counter restore cam is a two-lobed cam; therefore, the restoration of the counter contact cam ratchet occurs twice for every rotation of the counter restore cam. The operation of the counter lever that tends to step the ratchet as described in *b* above is constantly counteracted by this restoring action as long as both the distributor cam and the tape-reader cam assembly rotate, so that the counter contact pin remains restored against the stud on the counter indexing ratchet.

e. During this time, normally closed blank tape switch S28 (fig. 18) at the rear of the counter mechanism remains closed, closing the holding circuits of relays STA (or STB). When these relays are energized, the relay contacts in the distributor clutch magnet circuit are closed and the distributor clutch magnet is energized. When transmission from the message tape is completed, the tape-reader clutch is disengaged (para 13c) and the tape-reader cam assembly, including the counter restore cam, ceases to rotate. The circuit to distributor clutch magnet L4 is held closed through the holding circuit of relay STA (or STB) by blank tape switch S28 and the distributor cam continues to rotate until the preset number of *blank* signals have been transmitted. At this time, switch S28 opens to deenergize relay STA (or STB), which opens the circuit to distributor clutch magnet L4 to stop the transmitter. The impulse contacts of distributor S48 are not energized from either the numbering base or through the wiper contacts on tape-reader switch S5. The stop impulse is the only current impulse transmitted; this causes a blank signal to be transmitted with each half revolution of the distributor cam as long as the camshaft continues to rotate. While the distributor cam rotates, the counter mechanism is stepped as described in *b* above. When the counter contact cam ratchet is rotated counterclockwise by the counter lever and pawl, the counter contact pin, mounted on the counter contact cam ratchet, approaches the projection on blank tape switch S28. As the counter contact pin moves against the projection on the switch, it cams the contacts of the switch open, opening the holding circuit to relay STA (or STB) and deenergizing distributor clutch magnet L4. The deenergizing of distributor clutch magnet L4 releases the clutch magnet armature to block the rotation of the distributor cam. When the counter contact pin opens blank tape switch S28, the counter contact cam ratchet has been rotated to such a position that any further rotation will cause the counter pawl to engage that portion of the ratchet from which the teeth have been removed. This prevents any additional stepping of the ratchet until the counter contact cam ratchet is restored as described previously in *c* above.

f. Following is a sequence chart that summarizes the operation of the blank signal counter mechanism. Transmission starts with the message identification information derived from the numbering base, followed by transmission from a message tape.

Blank signal counter sequence chart

Distributor cam rotates to transmit signals of message identification information originating at numbering base.	Cam pin on the tape-reader clutch notched drum pivots counter lever clockwise, causing counter pawl to turn counter contact cam ratchet counterclockwise one notch.
Distributor cam continues to rotate, transmitting two code groups with each revolution until transmission of message identification information is complete.	Counter lever and counter pawl continue to step counter contact cam ratchet one notch with each revolution of camshaft.
Tape-reader clutch engages, rotating tape-reader cam assembly.	One lobe of counterrestore cam on tape-reader cam assembly moves against restore lever cam follower, pivoting cam follower clockwise.
As restore lever cam follower pivots, it strikes eccentric on counter lever, pivoting counter lever clockwise.	Both counter pawl and cam ratchet detent move out of engagement with counter contact cam ratchet, permitting counter clock spring to rotate ratchet to restored position (counter contact pin against stud on counter indexing ratchet).
High portion of counter restore cam moves away from restore lever cam follower.	Restore lever cam follower and counter lever are pivoted counterclockwise by their springs, moving counter pawl and cam ratchet detent into engagement with counter contact cam ratchet.
Above process continues with feeding of counter contact cam ratchet nullified by operation of restore lever cam follower which restores ratchet twice with each revolution of camshaft. This prevents counter contact cam ratchet from moving counter contact pin more than one space away from stud on counter indexing ratchet as long as tape-reader clutch is engaged.	

Blank signal counter sequence chart

Tape reader clutch releases, stopping rotation of counter restore cam.	Normally closed blank tape switch S28 (at rear of counter mechanism) provides holding circuit for relay STA (STA (or STB). Contacts of relay STA (or STB) keep distributor clutch magnet L4 energized, permitting continued rotation of distributor cam on transmitter camshaft.
Cam pin operates counter lever once with each revolution of the distributor cam.	Counter lever operates counter pawl causing it to step ·counter contact cam ratched.
Blank signal is sent to signal line with each half revolution of distributor cam.	Counter contact cam ratchet continues to step once with each revolution of distributor cam.
Counter contact pin (on counter contact cam ratchet) moves against projection of blank tape switch S28 opnening circuit to relay STA (or STB) to deenergize distributor clutch magnet L4.	Distributor clutch magnet armature moves into path of stop plate on the transmitter camshaft, stopping transmission.

18. Pulsing Switches (fig. 19)

Two pulsing switches are mounted on each transmitter and are operated by cams on the transmitter camshaft. These switches are the numbering pulsing switch S32 and the latch pulsing switch S46.

a. Numbering Pulsing Switch S32. Numbering pulsing switch S32 is operated by the cam which adjoins the distributor cam on the transmitter camshaft. It controls

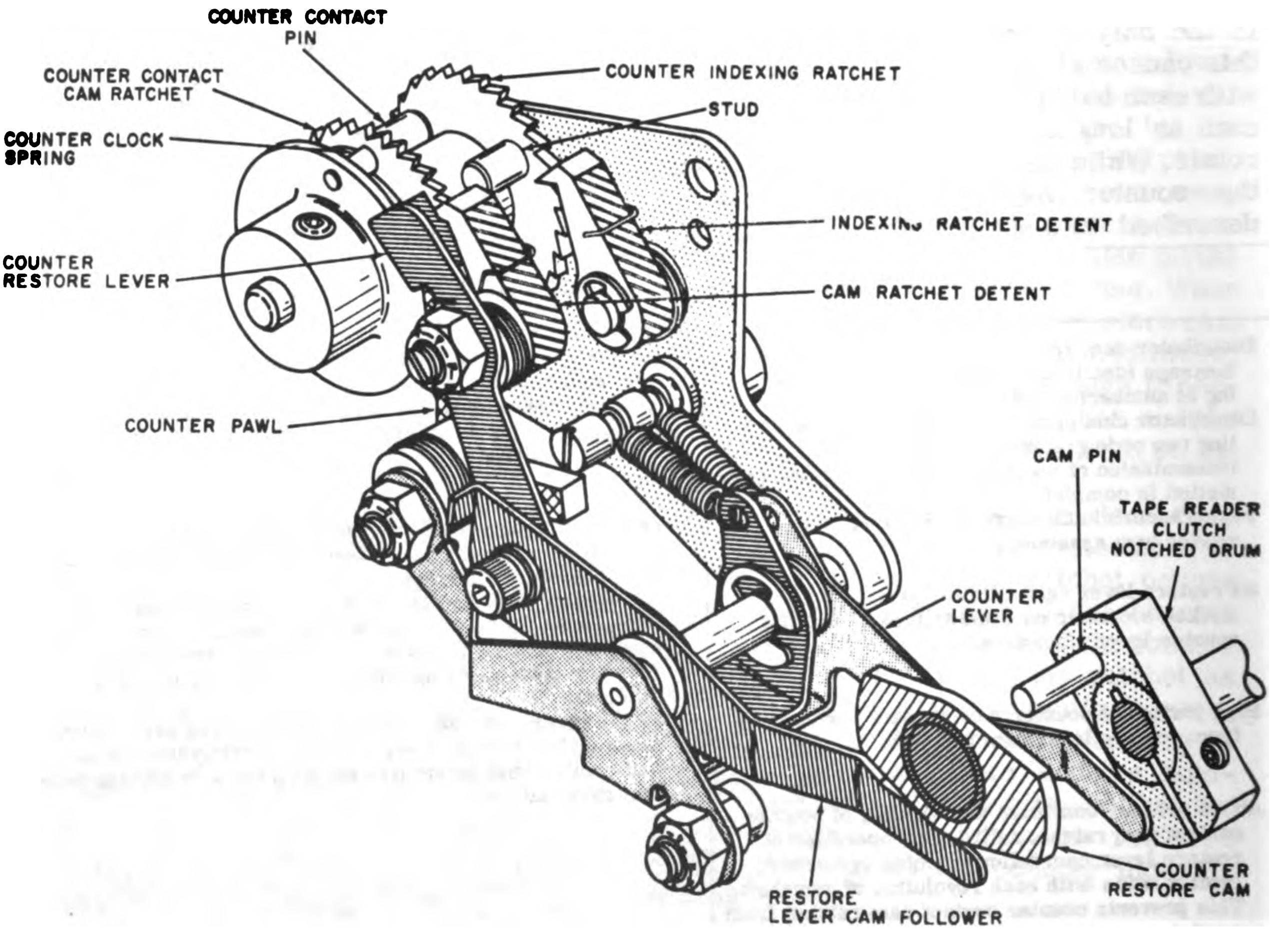


Figure 17. Blank signal counter mechanism.

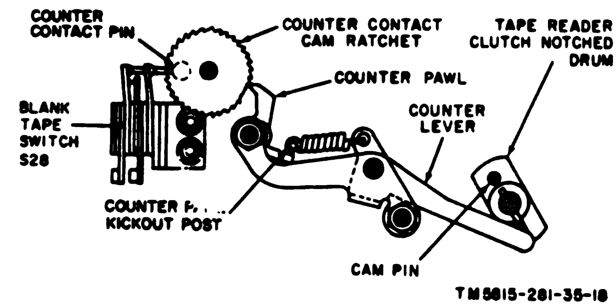


Figure 18. Blank tape switch S28 opened by pin on counter contact cam ratchet.

the main stepping switch NSA (or NSB) in the numbering base during the 13-character message identification information. Numbering pulsing switch S32 holds the circuit to the numbering base closed during the transmission of the five code impulses and opens the circuit during the transmission of the stop and start impulses. Refer to paragraph 19 for a description of the mechanical operation of the numbering base.

b. Latch Pulsing Switch S46. After end-of-tape is sensed, the latch pulsing switch is used to keep the tape-reader clutch magnet (L6) energized until the last character of a message tape has been sensed.

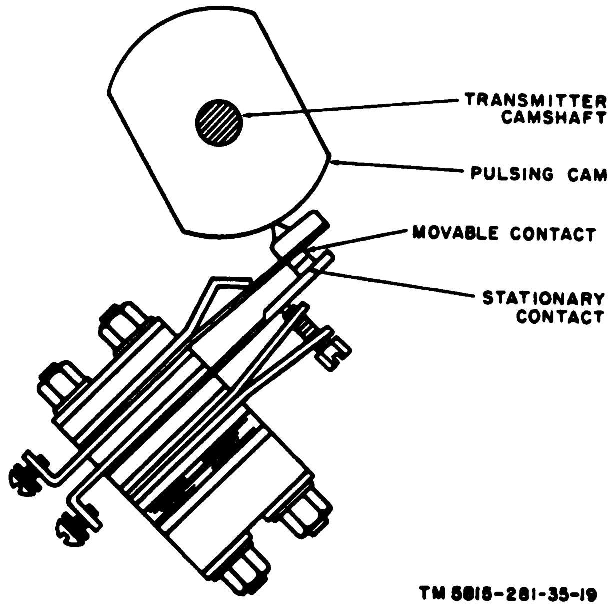


Figure 19. Typical cam-operated pulsing switch.

Section III. MECHANICAL THEORY OF NUMBERING UNIT, TELETYPEWRITER, MESSAGE MX-3650/GGC-9

19. Numbering Unit, Teletypewriter, Message MX-3650/GGC-9 Block Diagram, High-Level Operation

a. The numbering base is made up of two similar switch groups, each consisting of one main stepping switch and three numbering stepping switches. Each of these groups is associated with one of the two transmitters. The block diagram in figure 20 illustrates one of these switch groups.

b. The function of the numbering base is to provide the code impulses for the 13 characters that make up the message identification information. All of these characters are permanently wired on the contact banks of stepping switches with the exception of the three channel designating letters. The three channel designating letters are derived from the strapping of jack J7A (or J7B). The code groups formed by the stepping switches are simultaneously transferred to teletypewriter code associated contacts of distributor S48.

c. The operating coil of the main stepping switch is operated by 48-volt dc pulses that originate at numbering pulsing switch S32 of the associated transmitter (para 18a). Pulsing the operating coil from the transmitter keeps the numbering base synchronized with the transmitting mechanism.

d. 48-volt dc and 120-volt dc are routed through the numbering base. 48-volt dc is used to operate the relays and the stepping switch magnets; 120-volt dc is used on the signal line.

19.1. Numbering Unit, Teletypewriter, Message MX-3650/GGC-9 Block Diagram, Low-Level Operation

a. The numbering base is made up of two similar switch groups, each consisting of one main stepping switch and three numbering stepping switches. Each of these groups is associated with one of the two transmitters. The block diagram in figure 20 illustrates one of these switch groups.

b. The function of the numbering base is to provide the code impulses for the 13 characters that make up the message identification information. All of these characters are permanently wired on the contact banks of stepping switches with the exception of the three channel designating letters. The three channel designating letters are derived from the strapping of jack J7A (J7B). The code groups formed by the stepping switches are simultaneously transferred to the pulse forming electronics in the control base.

c. The operating coil of the main stepping switch is operated by 48 volt dc pulses that originate at numbering pulsing switch S32 of the associated transmitter (para 18*a*). Pulsing the operating coil from the transmitter keeps the numbering base synchronized with the transmitting mechanism.

20. Main Stepping Switches NSA and NSB (fig. 21)

a. Each of the main stepping switches consists of a magnet coil, an armature, a pawl, and a ratchet wheel that rotates the 8 contact wipers over the 27 stationary contacts of their respective levels. The contacts are arranged in a semicircular

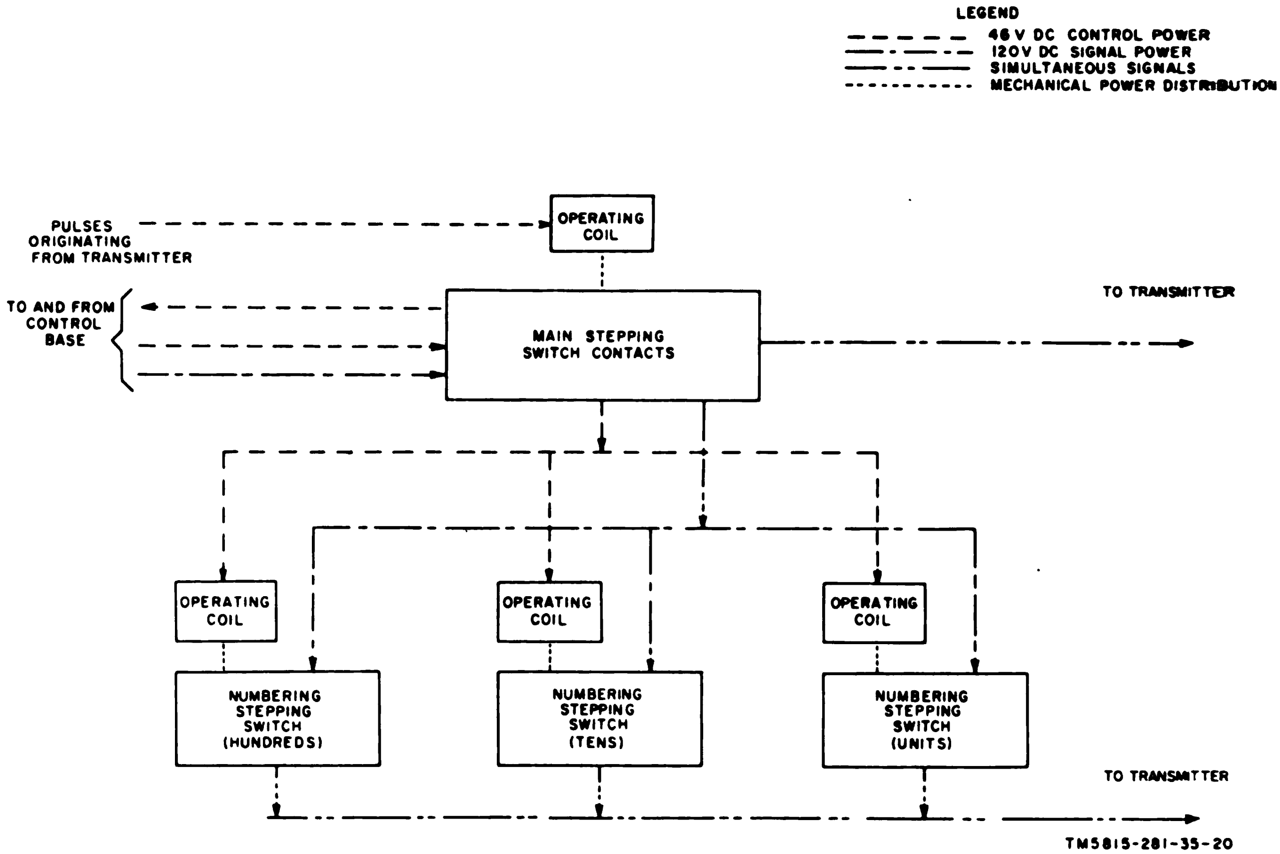


Figure 20. One of two switch groups in numbering base, block diagram.

arc on each level. The energizing and deenergizing of the magnet causes step-by-step progression of the wipers over each of the contact banks. In each complete cycle of the main stepping switch, the wipers are in contact with 13 contact points of the 27-contact-point switch. Parallel wiring between points 0, 13, and 26; 1 and 14; 2 and 15; 3 and 16; etc, produces identical results whether the wiper begins the 13 steps at 0 or at 13.

b. When the main stepping switch magnet coil is energized by numbering pulsing switch S32 on the transmitter (para 31*a*(2)), the armature of the stepping switch is pivoted clockwise. This pulls the pawl, mounted on the armature, out of the notch in the ratchet, and the pawl spring moves the pawl to engage the next counterclockwise ratchet tooth. At the same time, the pawl compresses the drive spring which is mounted between the bracket and a projection on the magnet armature. When the circuit to the magnet is broken (by the opening of S32 during the stop pulse) and the magnet is deenergized, the drive spring exerts a driving force against the armature, pivots the armature counterclockwise, and moves the pawl which has engaged a tooth in the ratchet, thereby stepping the ratchet one space clockwise. The teeth on the armature engage the ratchet to prevent any overthrow. The eight sets of contact wipers are mounted on the same shaft as the ratchet and are pivoted with the ratchet. Each of the contact wipers is thus moved to the next stationary contact on its associated level.

c. Each of the eight levels of the main stepping switch (A, fig. 64) is used for the control of specific circuits. The functional application of each level is listed in the following chart.

Level	Level designation	Function
1	A	Holds distributor clutch magnet energized during transmission of 13-character message identification information.
2	B	Holds relay STA (or STB) energized while message identification information is being transmitted.
3	C	Energized tape-reader relay FNA (or FNB) to start message tape transmission sequence.
4	D	1st impulse control.
5	E	2d impulse control.
6	F	3d impulse control.
7	G	4th impulse control.
8	H	5th impulse control.

21. Numbering Stepping Switches (fig. 22)

The operation of the numbering stepping switches is similar to that of the main stepping switches. Each consists of a magnet coil, an armature, a pawl, a drive spring, and a bank of stationary contacts, consisting of 1 level of 12 contacts and 5 levels of 11 contacts each, which are engaged by a set of contact wipers.

a. The magnet coil is normally deenergized. When it is energized by an impulse from level C of its associated main stepping switch (NSA or NSB), the armature pivots clockwise and pulls the pawl out of engagement with the ratchet. The pawl spring moves the pawl to engage the next clockwise notch of the ratchet. Simultaneously, the armature compresses the drive spring which is mounted between the armature and the bracket. When the magnet is deenergized, the armature is released. The tension of the drive spring pivots the armature counterclockwise, and the pawl moves the ratchet one step. The teeth on the armature engage the ratchet immediately to prevent any overthrow.

b. Each numbering stepping switch is equipped with an indicator wheel with numbers printed on the outer circumference. The indicator wheel is mounted on the same shaft as the ratchet wheel. Each indicator wheel is aligned with a window in the front panel of the channel numbering base. The three indicator wheels together indicate the number of the last message transmitted from the associated transmitter.

c. The numbering switches are mounted three to a numbering bank, with the right switch associated with the units column of the message number, the center switch associated with the tens column, and the left switch with the hundreds column. The units switch is equipped with cam-operated off-normal contacts that cause the tens switch to be energized just before the units switch steps beyond the ninth number. When the tens switch is deenergized, it will step to the next consecutive number. The tens switch is equipped with a similar arrangement that causes the hundreds switch to step just before the tens switch steps beyond the ninth number. This stepping system keeps the switches stepped in proper relation to each other.

d. Each stepping switch has a particular function. These functions are listed in the following table:

Numbering switch	Associated main stepping switch	Function
RUA	NSA	Provides code impulses for units code group transmitted by transmitter A (connected to jack J12).
RTA	NSA	Provides code impulses for tens code group transmitted by transmitter A.
RHA	NSA	Provides code impulses for hundreds code group transmitted by transmitter A.
RUB	NSB	Provides code impulses for units code group transmitted by transmitter B. (connected to jack J114).
RTB	NSB	Provides code impulses for tens code group transmitted by transmitter B.
RHB	NSB	Provides code impulses for hundreds code group transmitted by transmitter B.

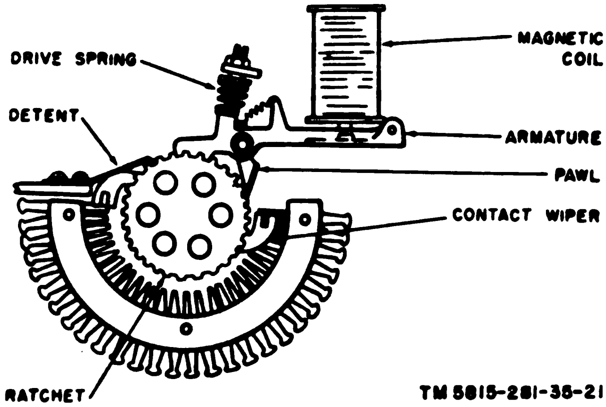


Figure 21. Main stepping switch.

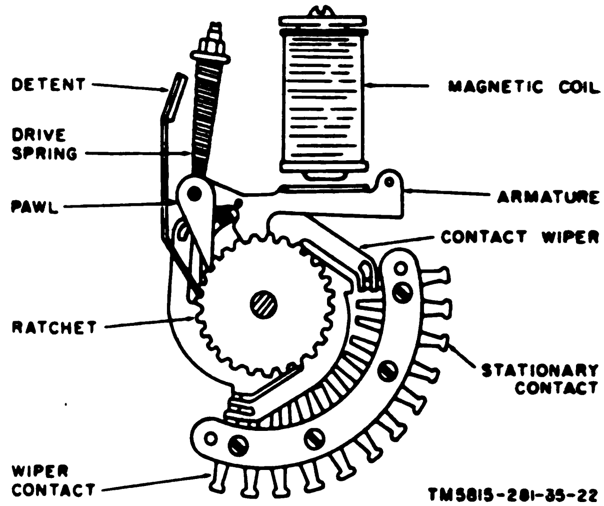


Figure 22. Numbering stepping switch.

Section IV. CIRCUIT DESCRIPTIONS FOR DISTRIBUTOR-TRANSMITTER SET, TELEYPEWRITER AN/GGC-9 (HIGH-LEVEL OPERATION)

22. General

a. This section describes the electrical theory for Distributor-Transmitter Set, Teletypewriter, AN/GGC-9 for high-level operation. Refer to figure 196 for a complete schematic diagram of the entire distributor set. All circuits are described for transmitter A (connected to jack J12 at rear of control base), the left side of the numbering base, and the left side of the control base. The circuit descriptions use the reference designations assigned to the electrical components associated with this portion of the equipment. The circuits for transmitter B (connected to jack J14) and its associated equipment are identical with those for transmitter A, except that the reference designations for some of the electrical components are different. These reference designations are shown in brackets on the simplified schematic diagrams. The chart in paragraph 23 provides a cross index of the reference designations for all switches. The chart in paragraph 24 provides a cross index of the reference designations for all relays.

b. Unless otherwise indicated, the circuits described are as established when the controls are set to the following positions:

Control	Reference designation	Position
POWER switch (on transmitter).	S8	ON
Message numbering reset switch.	S34 (S35)	Midposition
Stop-start lever........	none	FEED RETRACT
BLANK SIGNAL switch..	S1 (S2)	OFF
CASE switch	S10 (S11)	2
Power switch (on control base)	S13	PWR

23. Switch Functions and Reference Designation Cross Index

The following chart lists all switches used with Distributor-Transmitter Set, Teletypewriter AN/GGC-9 and gives the function of each. It also provides a cross index to convert each switch reference designation from that used with transmitter A, connected to jack J12, to its counterpart used with transmitter B, connected to jack J14 and its associated equipment.

Switch	Reference designation		Location	Function
	Transmitter A	Transmitter B		
BLANK SIGNAL	S1	S2	Control base	Controls generation of blank signals after transmission of message.
Tape-reader	S5	S5	Transmitter	Interprets code holes in tape and transfers information to contacts of distributor S48.
POWER	S8	S8	Transmitter	Controls ac power input.
CASE	S10	S11	Control base	Determines format of start-of-message indicator.
Power	S13	S13	Control base	Controls ac power input to power supplies.
Blank tape	S28	S28	Transmitter	Stops blank signal transmission after predetermined number of blanks have been transmitted.
Tape-out	S30	S30	Transmitter	Opens circuit to tape-reader clutch magnet L6 when end of tape is sensed.
Numbering pulsing	S32	S32	Transmitter	Controls stepping of stepping switches in numbering base.
Message numbering reset.	S34	S35	Numbering base.	Controls message numbering.
FORWARD STEP UNITS.	S36	S37	Numbering base.	Allows manual stepping of units column of message numbering indicators.
FORWARD STEP TENS..	S38	S39	Numbering base.	Allows manual stepping of tens column of message numbering indicators.
FORWARD STEP HUNDREDS.	S40	S41	Numbering base.	Allows manual stepping of hundreds column of message numbering indicators.
Stop-start	S42	S42	Transmitter	Stops or starts transmission.
Distributor magnet control.	S44	S44	Transmitter	Energizes distributor clutch magnet L4 (immediately after tape reader clutch magnet L6 energizes) to permit transmission from message tape.
Latch pulsing	S46	S46	Transmitter	Holds relay TSA (or TSB) energized until stop impulse of last character in message tape is transmitted.
Distributor.............	S48	S48	Transmitter	Controls transmission of signals to signal line.
LINE BREAK	S50	S51	Control base	Opens signal line.
Main stepping	NSA	NSB	Numbering base.	Controls transmission of message identification information.
Numbering stepping (units).	RUA	RUB	Numbering base.	Controls transmission of units digit of message number.
Numbering stepping (tens).	RTA	RTB	Numbering base.	Controls transmission of tens digit of message number.
Numbering stepping (hundreds).	RHA	RHB	Numbering base.	Controls transmission of hundreds digit of message number.

24. Relay Functions and Reference Designation Cross Index

The chart below lists all relays used with the Distributor-Transmitter Set, Teletypewriter AN/GGC-9 and gives the function of each. It also provides a cross index to convert each relay reference designation used with Transmitter A to the equivalent reference designation used with Transmitter B.

Reference designation		Function
Transmitter A	Transmitter B	
SDA	SDB	Greates delay to insure proper operation of unit when stop-start lever is moved from STOP to START position.
TSA	TSB	Prepares unit for transmission.
STA	STB	Starts transmission from unit.

Reference designation		Function
Transmitter A	Transmitter B	
FNA	FNG	Prepares unit for transmission from message tape after message identification information is completed.
KNA	KNB	Prevents coil of main stopping switch from being energize while transmission from tape is taking place.
TRA	TRB	Determines whether distributor S48 transmits from stepping switches in numbering base or from message tape.

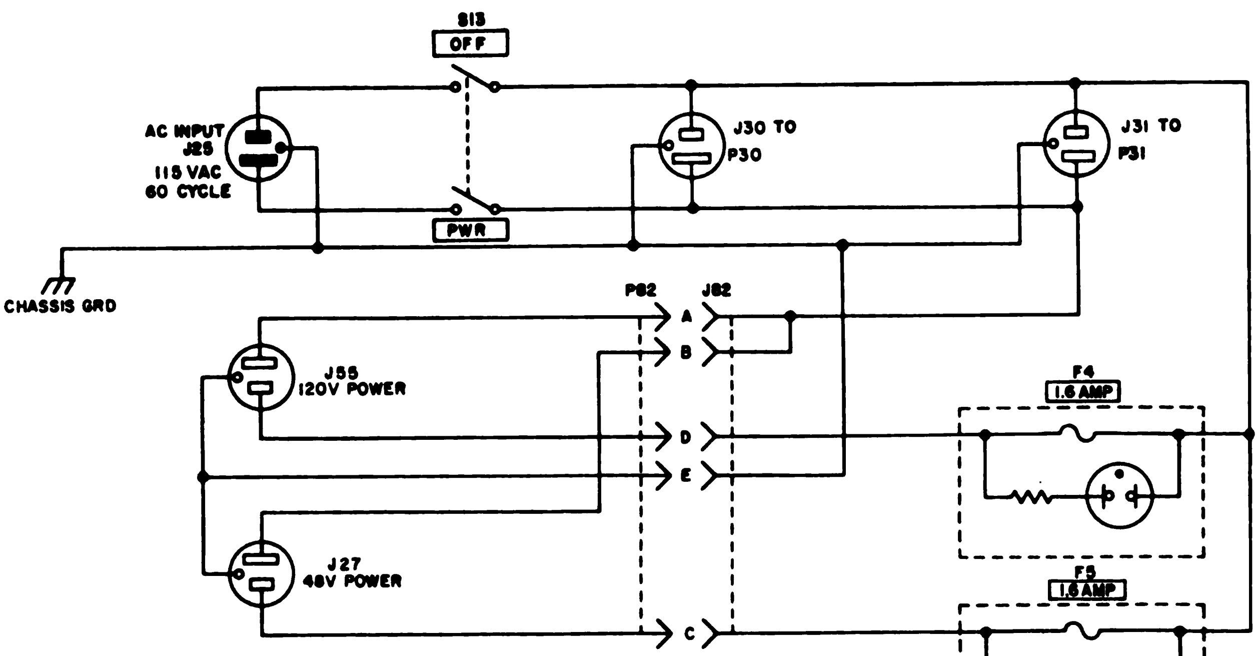
25. Ac Input Circuit (fig. 23)

a. The 105- to 125-volt alternating current is connected to the control base when plug P25 of the ac input cable is connected to jack J25 on the control base. When power switch S13 is in the PWR position, ac power is supplied to jacks J27, J30, J31, and J55 which connect ac to the transmitters, the 48-volt power supply, and the 120-volt power supply.

b. A branched cable terminated by plug P82 and jacks J27 and J55 is used to connect ac power to the power suppliec. One branch terminates at pins A and D of jack J82 and is fused by neon indicator fuse F4 to protect the 120-volt power supply from overload. The other branch terminates at pins B and C of jack J82 and is fused by neon indicator fuse F5 to protect the 48-volt power supply from overload.

26. Motor Circuit (fig. 24)

Power is applied to each motor through two 1.6-ampere fuses, F1 and F2, located one on either side of the line. When power switch S8 is in the ON position, current flows through filter FL2, the field coils, armature, and governor contacts, to operate the motor. The motor speed is controlled by the governor contacts which are



NOTE
See sheet 1, figure 196 for ac input line capacitor details.

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Figure 23. Ac input circuit, schematic diagram.

in parallel with 250-ohm resistor R1. When the motor speed is below 3,600 rpm, the governor contacts are closed and the resistor is shorted out. Maximum current flows through the field coils of the motor, and the motor speed increases. When the motor speed exceeds 3,600 rpm, centrifugal force opens the governor contacts. This removes the short across R1 and reduces the amount of current through the motor field coils. The speed of the mtoor decreases accordingly. Filter FL2 and capacitors C16 and C17 suppress radiofrequencies generated by the governor contacts and the motor commutator. Capacitor C2 and the 10-ohm portion of R1 suppress arcing at the governor contacts, and thus reduce interference with the associated electronic equipment.

27. Power Supply PP-3131/GGC-9 (48-Volts Dc) (fig. 25)

a. The 48-volt power supply provides a 48-volt unfiltered dc power source and a 48-volt filtered dc power source. This power supply can also provide 150 volts but this voltage is not required in this equipment. The unfiltered 48 volts operates the stepping switches; the filtered 48 volts operates the relays and clutch magnets. The 115-volt ac input to the power supply is applied to the primary winding of transformer T1.

b. Transformer T1 steps down the voltage to a secondary voltage of 58 to 79 volts, depending on the connections made at the adjustable taps. Full-wave rectifier CR1 changes the secondary ac to pulsating dc. The unfiltered 48-volt supply is obtained directly across the output terminals of rectifier CR1 and is connected to terminal board TB1 of the control base from which it is distributed.

c. The positive side of the unfiltered 48-volt dc circuit is traced from the output terminal of rectifier CR1, through 2-ampere indicator fuse F1, through the dc output cable, to terminal 2 of terminal board TB1. The positive side of the filtered 48-volt dc circuit is traced from the output terminal of rectifier CR1, through filter choke L1, through 2-ampere indicator fuse F2, through the dc output cable, to terminal 1 of terminal board TB1. The negative side of both the filtered and the unfiltered circuits are provided through a common circuit which is traced from the negative output terminal of rectifier CR1, through the dc output cable, to terminals 3, 4, and 5 of terminal board TB1. Choke L1 and capacitors C3 and C4 filter the dc output available at terminals G and F of plug P29. Resistor R4 maintains a constant load on the filtered output.

28. Power Supply PP-1801/FG (120-Volts Dc) (fig. 26)

a. The ac input voltage to plug P55 is furnished through the control relay base. The ac input is supplied to the primary of transformer T2. The number of primary turns used is determined by the position of the movable input lead on terminal board TB26. When the input lead is moved from the terminal marked 105 to terminal 115, or from terminal 115 to terminal 125, the number of turns in the primary winding is effectively increased and the voltage output of the transformer is decreased.

b. The output tap for transformer T2 is connected to terminal board TB26. Varying the position of the output lead shown connected to terminal 180 in figure 26 increases or decreases the number of turns in the secondary winding of the transformer, and increases or decreases the output of the transformer proportionately. When the lead is moved from the terminal marked 160 to the terminal marked 170, or from 170 to 180, the output of the transformer is increased by approximately 10 volts. Varying the position of the lead shown connected to terminal 2 of the secondary of transformer T2 from the terminal marked ± toward terminal 8, decreases the number of secondary turns used and decreases the output voltage of the power supply approximately 2 volts for each step. Varying the position of both adjustment leads can give the desired 120-volt output.

c. The ac output from the secondary winding of transformer T2 is rectified by selenium rectifier CR2. Choke coil L2 and

NOTES:

1. S28 BLANK TAPE SWITCH IS CAM OPERATED.
2. S5 TAPE-READER SWITCH CONTACT WIPER IS LEVER OPERATED.
3. S46 LATCH PULSING SWITCH IS CAM OPERATED.
4. S48 DISTRIBUTOR CONTACTS ARE CAM OPERATED.
5. S42 STOP-START SWITCH SHOWN IN START POSITION.
6. S30 TAPE-OUT SWITCH IS LEVER OPERATED (TAPE-IN POS.)
7. S44 DISTRIBUTOR MAGNET PULSING SWITCH IS LEVER OPERATED WHEN READER CLUTCH MAGNET L6 IS ENERGIZED.
8. S32 NUMBERING PULSING SWITCH IS CAM OPERATED.

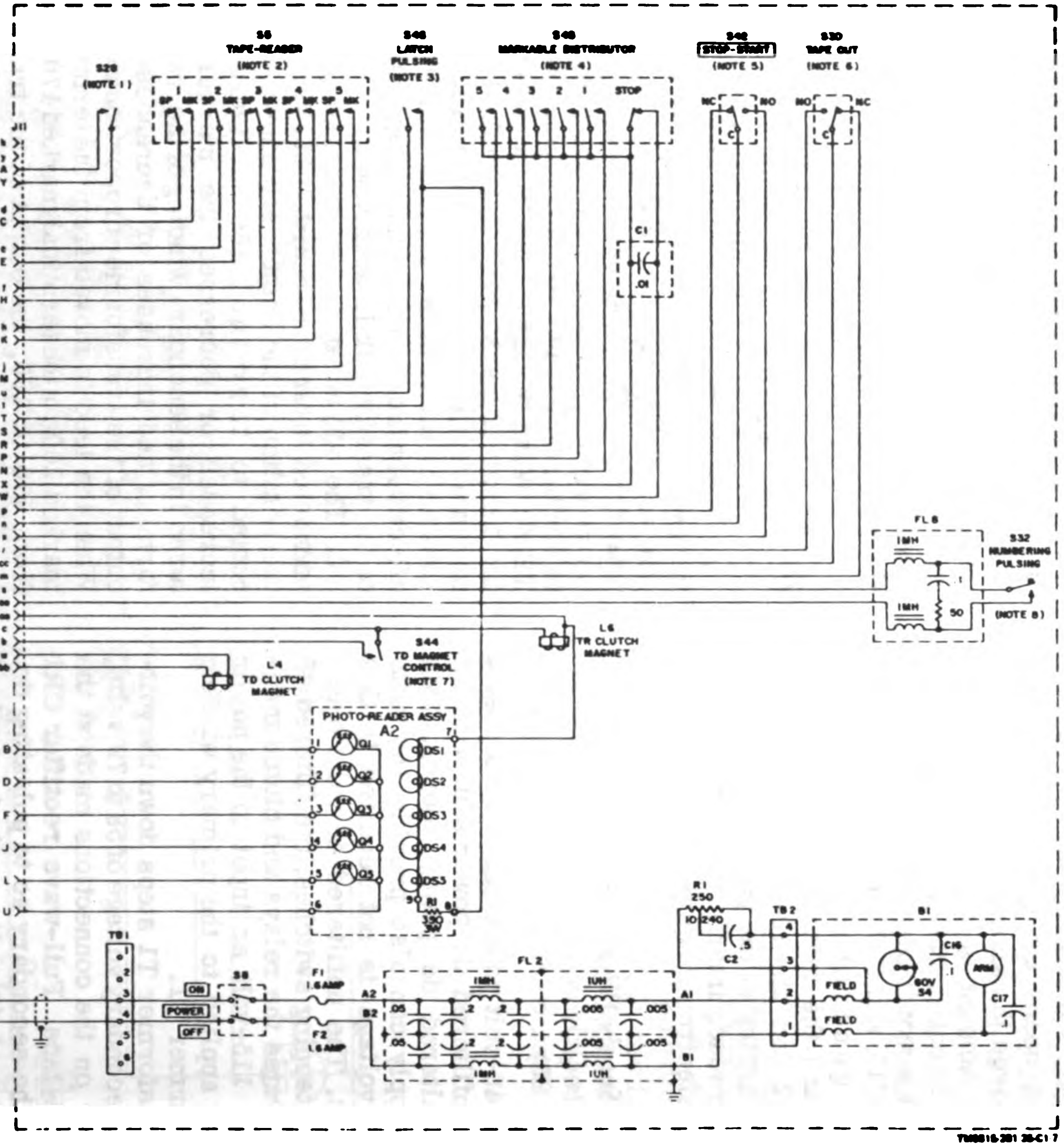
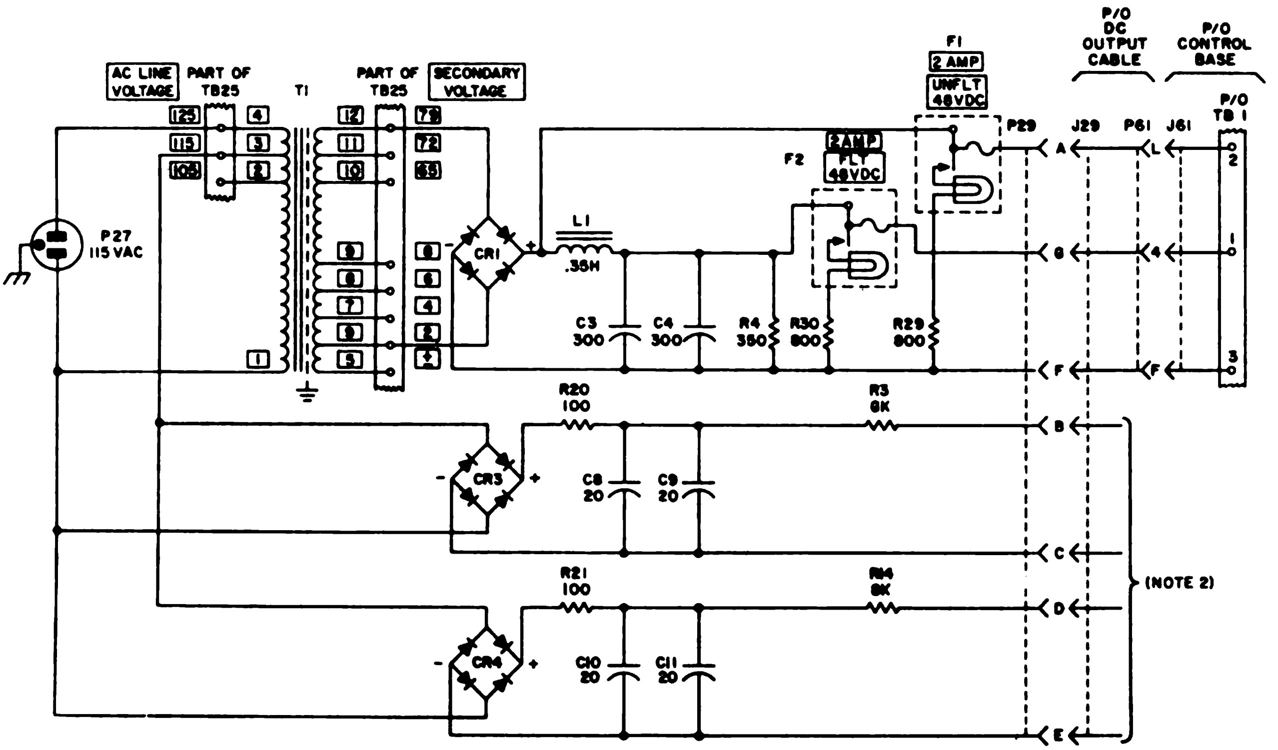


Figure 24. Transmitter, schematic diagram.



NOTES:

1. TERMINALS A AND F ARE UNFILTERED DC (TB1 TERMINALS 2 AND 3). TERMINALS G AND F ARE FILTERED DC (TB1 TERMINALS 1 AND 3).
2. TERMINALS B, C, D, AND E ARE NOT USED.
3. RESISTANCES ARE IN OHMS. CAPACITANCES ARE IN UF.
4. Two ac line filter capacitors (C102 and C103) are connected between ground and each side of ac input at P27.

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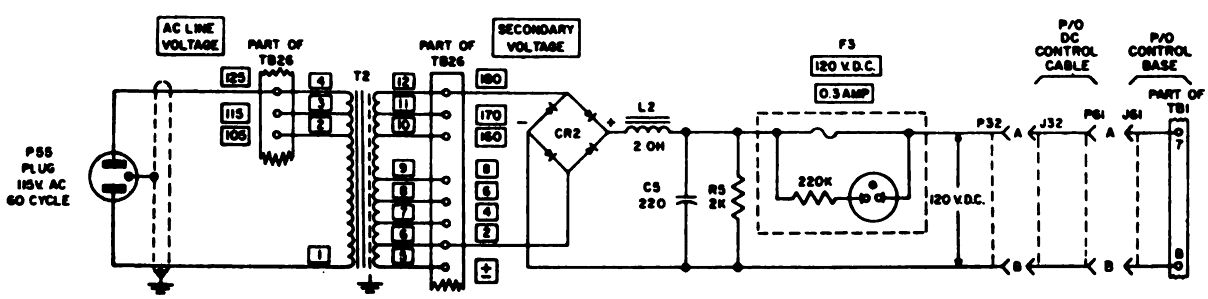
Figure 25. Power Supply PP-3131/GGC-9 (48-volts dc), schematic diagram.

capacitor C5 act as a filter for the output voltage. Resistor R5 is a constant load for the power supply and also provides a discharge path for the capacitor voltage when the power supply is disconnected from the power source. The output of the power supply is protected by 0.3-ampere neon indicator fuse F3.

d. The 120-volt dc output of the power supply is connected to terminal board TB1 in the control base through the dc output cable. The positive side of the circuit is connected to terminal 7 and the negative to terminal 6. The 120-volt dc output is available, if required, to provide current to the signal lines.



NOTES:
RESISTANCES ARE IN OHMS. CAPACITANCES ARE IN UF

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Figure 26. Power Supply PP-1801/FG (120-volts dc), schematic diagram.

29. Preparation for Transmission

a. When power switch S13 on the control base is in the PWR position, relay SDA (fig. 27) is energized through a circuit from battery, through the energizing coil of relay SDA, through CONTACTS R1-R2 of deenergized relay STA, through switch S42 (stop-start lever in FEED RETRACT position), to ground. When relay SDA is energized, contacts R1-R2 of relay SDA (fig. 29) open to prevent relay STA from energizing.

b. When a prepunched message tape is inserted into the transmitter and the stop-start lever is moved from the FEED RETRACT to the STOP position, contacts C and NC of tape-out switch S30 close (para 16*b*) the energizing circuit to relay TSA (fig. 28). This circuit is traced from battery, through the L-R winding of relay TSA, through switch S30 to ground. When relay TSA operates, it sets up the following conditions:

(1) Contacts R7-R8 in the energizing circuit for relay TRA (fig. 46) close.

(2) Contacts L7-L8 in the holding circuit of relay TSA (fig. 28) close.

(3) Contacts L3-L4 in the holding circuit of relay FNA (fig. 45) close.

(4) Contacts L5-L6 in the energizing circuit of relay STA (fig. 29) close.

c. When the stop-start lever is moved to the START position, the energizing circuit to relay SDA (*a* above) is opened and relay SDA deenergizes. As relay SDA deenergizes, it closes the energizing circuit to relay STA (fig. 29). This circuit is traced from battery, through the T-B winding of relay STA, through closed contacts R2-R1 of relay SDA, through closed contacts L5-L6 of relay TSA, and to ground. When relay STA energizes, it sets up the following conditions:

(1) Contacts R7-R8 of relay STA close to provide a holding circuit for relay STA during blank tape feedout (para 36*b*).

(2) Contacts L1-L2 of relay STA open to remove the short across the stop contacts of distributor S48 (fig. 30).

(3) Contacts L5-L6 of relay STA close to energize the distributor clutch magnet L4 of the transmitter to permit rotation of the transmitter camshaft (para 12). The energizing circuit (fig. 31) is traced from battery, through distributor clutch magnet L4, through contacts R1-R2 of relay FNA which is deenergized,

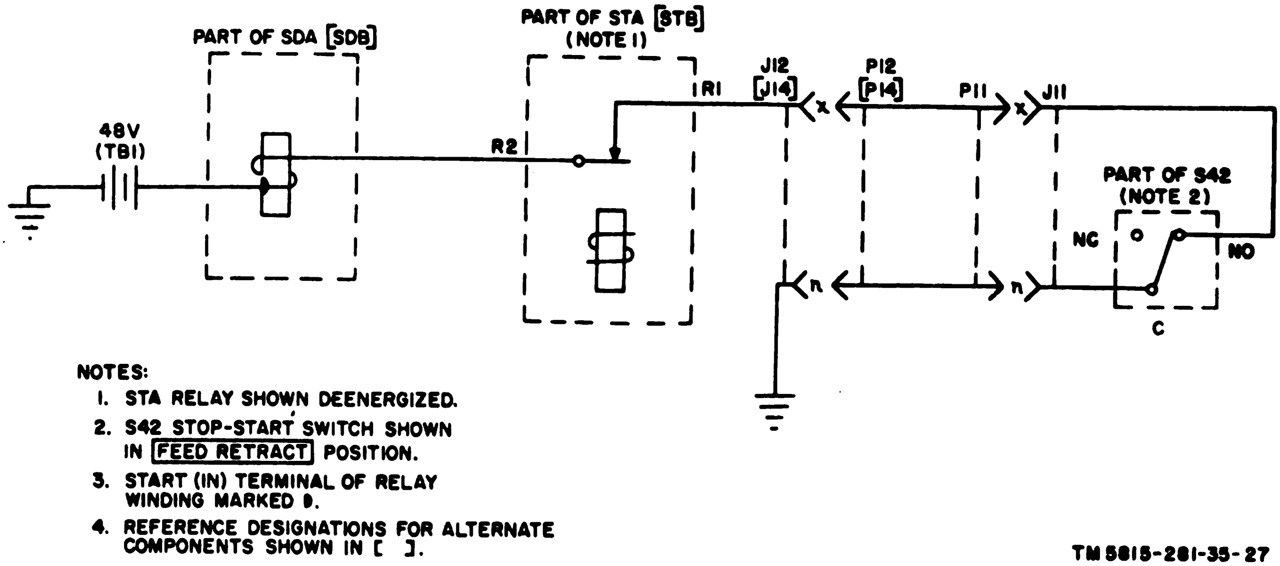


Figure 27. Relay SDA energizing circuit, simplified schematic diagram.

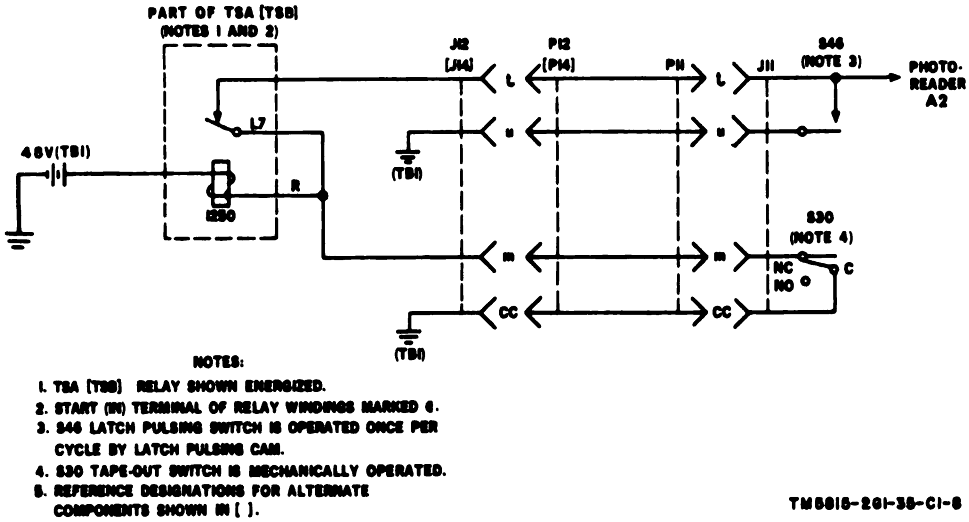


Figure 28. Relay TSA, energizing circuit, schematic diagram.

through contacts L5-L6 of relay STA, through the closed contacts of stop-start Switch S42 (START position), and to ground.

(4) Contacts R9-R10 of relay STA in the holding circuit of relay STA close to insure that the complete message identification information will be transmitted.

(5) Contacts L9 and L10 of relay STA close to provide a holding circuit for relay TRA after relay TRA is energized (fig. 46).

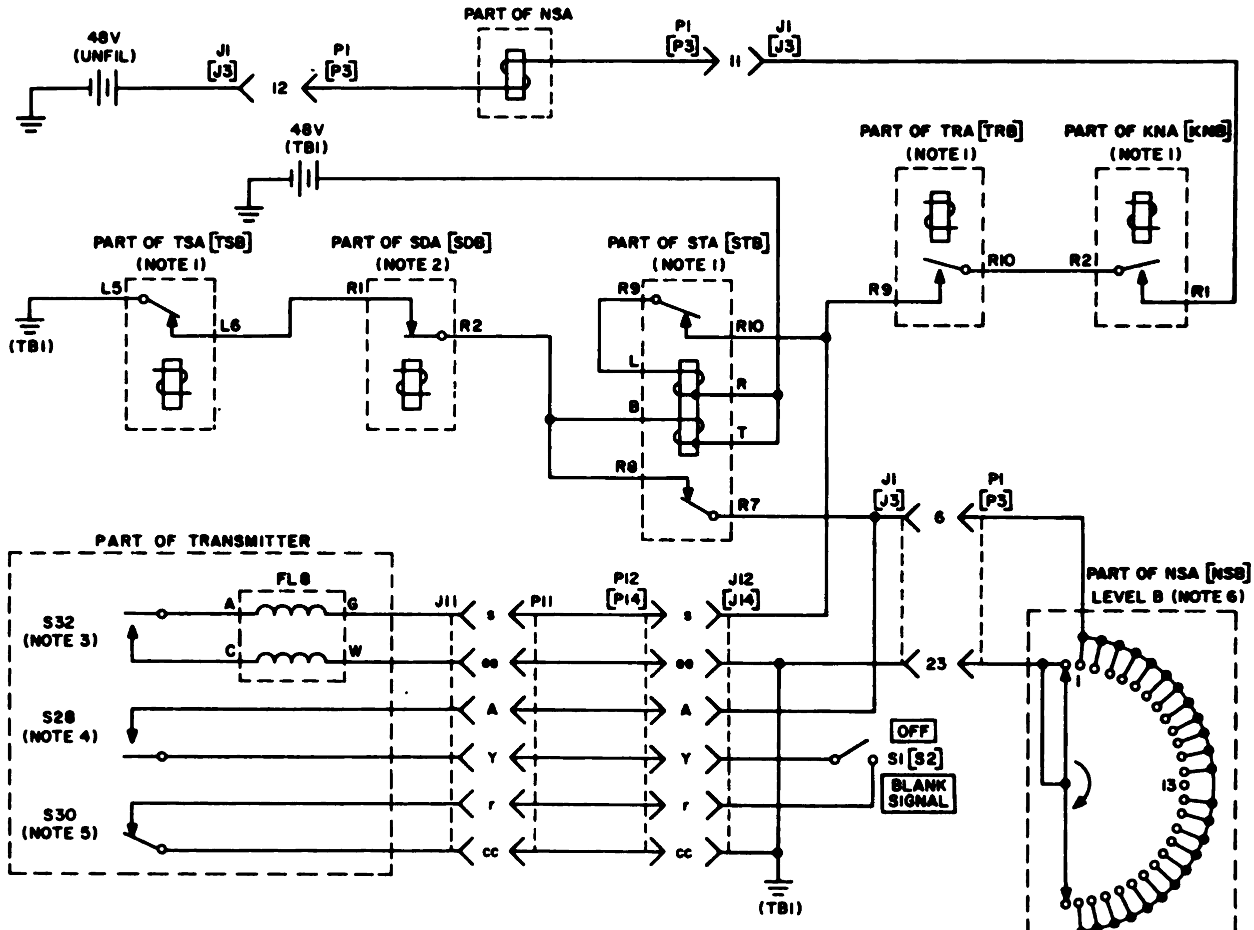
d. All circuits are now prepared for transmission of the message identification information. The signal line circuit (fig. 32) opens by rotation of the transmitter camshaft. The circuit is traced from the red signal line terminal, through filter FL1, through 120-volt dc power supply, switch A1S5 contacts B11 and B10, through SET JACK J18, through the stop contacts of distributor S48, through relay STA contacts L1-L2, through relay STA contacts R8-R7, through switch A1S5 contacts B2-B3, through LINE BREAK switch S50, through switch A1S5-B13 and B14, through contacts of each LOOP JACK J17 and J20, through resistor R10, through LINE CURRENT potentiometer R9, through filter FL1, to BLK terminal of the signal line. LINE CURRENT potentiometer R9 is provided in the circuit to adjust the line signal current.

30. Message Identification Information Transmission

a. When CASE switch S10 is in position 2, the message identification information (fig. 33) consists of one BLANK code group followed by code groups for Z, C, Z, C, three channel designating letters, the FIGS code group, the message numbering information, and the LTRS code group. When CASE switch S10 is in position 1, the message identification information differs only in that the start-of-message indicator changes to five successive BLANK code groups.

b. Each code group consists of five code impulses, preceded by a start impulse and followed by a stop impulse. Each of the five code impulses and the start impulse are all of equal time duration. The stop impulse is 1.42 times as long as the other impulses. Once distributor clutch magnet L4 is energized and the short is removed from the stop-impulse contact of distributor S48, information can be transmitted on the signal line.

c. A 27-point, 8-level main stepping switch (NSA) and three 12-point, 6-level numbering stepping switches (RUA, RTA, and RHA) store the 13-character message identification information. The complete code groups for all the message identification characters except the three digits of the message-numbering sequence are wired direct to levels D, E, F, G, and H, of main stepping switch NSA. The code groups for the numbers 0 through 9 are wired on levels B, C, D, E, and F of numbering stepping switches RUA, RTA, and RHA. A connection from the wipers of each level of the numbering stepping switches



NOTES:

1. RELAYS TSA [TSB], STA [STB], TRA [TRB], AND KNA [KNB] SHOWN ENERGIZED.
2. RELAY SDA [SDB] SHOWN DEENERGIZED.
3. S32 NUMBERING PULSING SWITCH IS OPERATED ONCE PER CYCLE BY NUMBERING PULSING CAM.
4. S28 BLANK TAPE SWITCH IS OPERATED BY COUNTER CONTACT CAM RATCHET.
5. S30 TAPE OUT SWITCH SHOWN IN END-OF-TAPE POSITION.
6. NSA [NSB] STEPPING SWITCH SHOWN IN HOME POSITION.
7. START (IN) TERMINAL OF RELAY WINDINGS MARKED ◀.
8. REFERENCE DESIGNATIONS FOR ALTERNATE COMPONENTS ARE SHOWN IN [ ].

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Figure 29. Relay STA, energizing circuit, simplified schematic diagram.

provides the code impulses for the particular number that is set up on the numbering stepping switches to positions 11 and 24 (units), 10 and 23 (tens), and 9 and 22 (hundreds) of levels D, E, F, G, and H of main stepping switch NSA. (See schematic diagram of numbering base, fig. 196.) During the transmission of message identification information, relay TRA is deenergized and its contacts connect the output of main stepping switch NSA (levels D through H) to distributor S48 as follows:

(1) Level D is connected to contact 1 of S48.

(2) Level E is connected to contact 2 of S48.

(3) Level F is connected to contact 3 of S48.

(4) Level G is connected to contact 4 of S48.

(5) Level H is connected to contact 5 of S48.

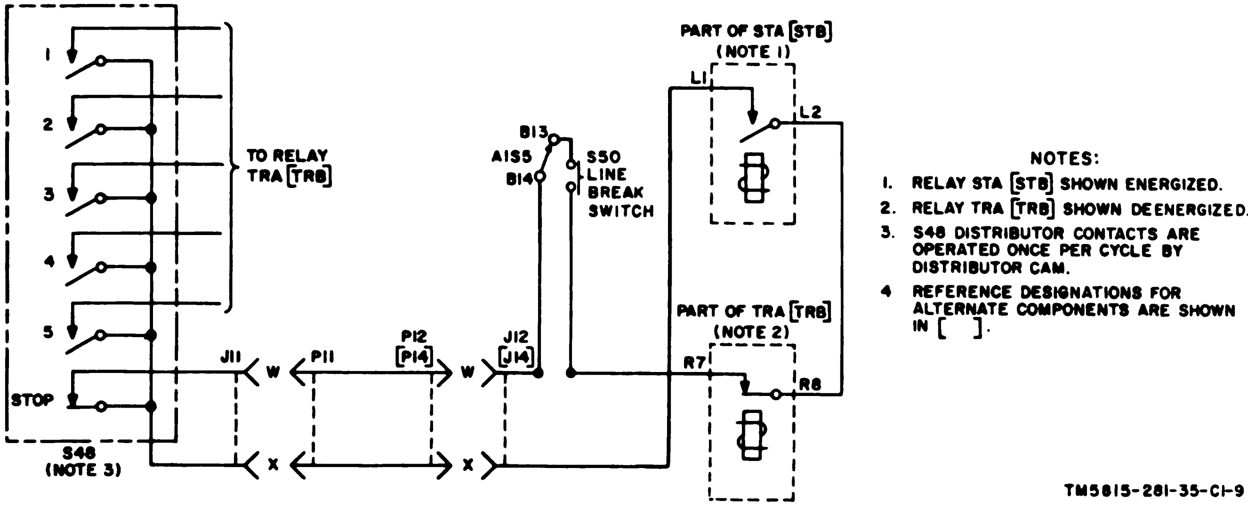


Figure 30. Removal of short across distributor S48, simplified schematic diagram.

31. Transmitting Start-of-Message Indicator

a. *CASE Switch S10 in Position 2.* The start-of-message indicator with CASE switch S10 in position 2 consists of the code groups for *blank, Z, C, Z, C* and is transmitted as follows:

(1) When distributor clutch magnet L4 is energized, the armature moves out of engagement with the transmitter camshaft, and the camshaft starts to rotate to open the stop contacts of the distributor switch S48 as described in paragraph 11a.

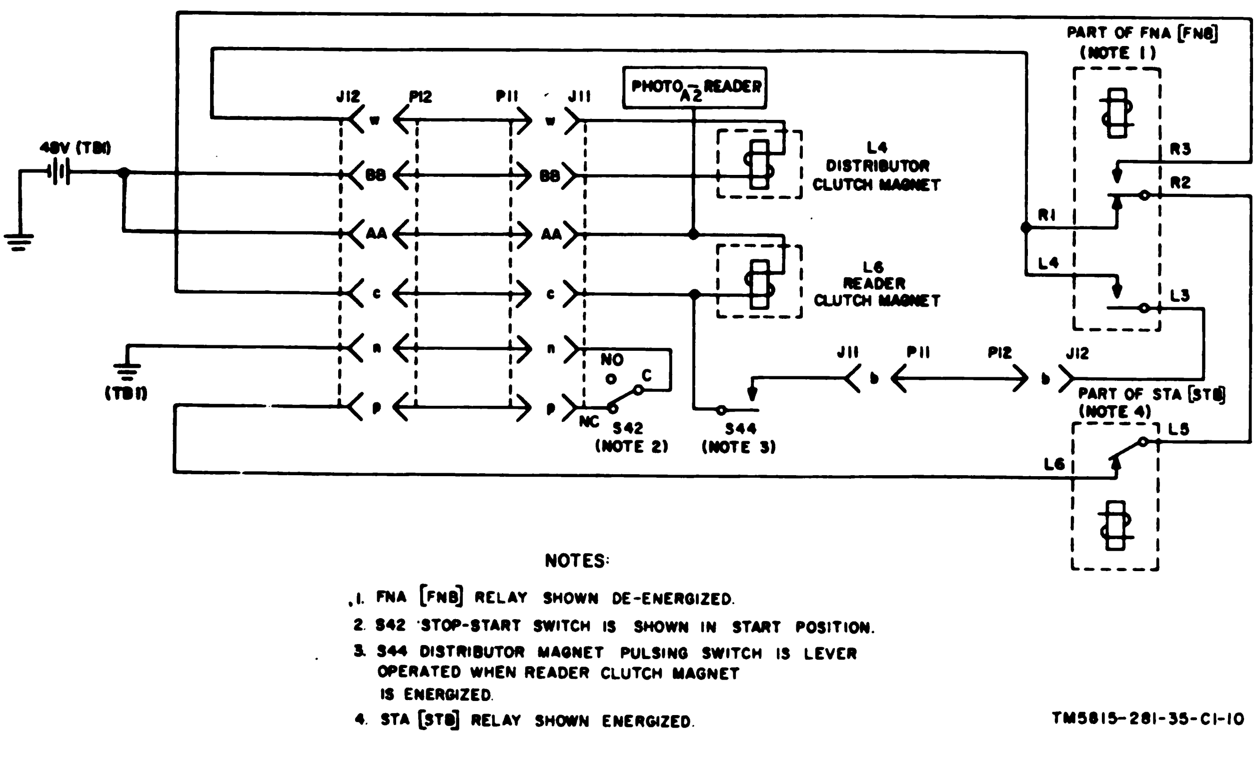


Figure 31. Clutch magnet energizing circuits, simplified schematic diagram.

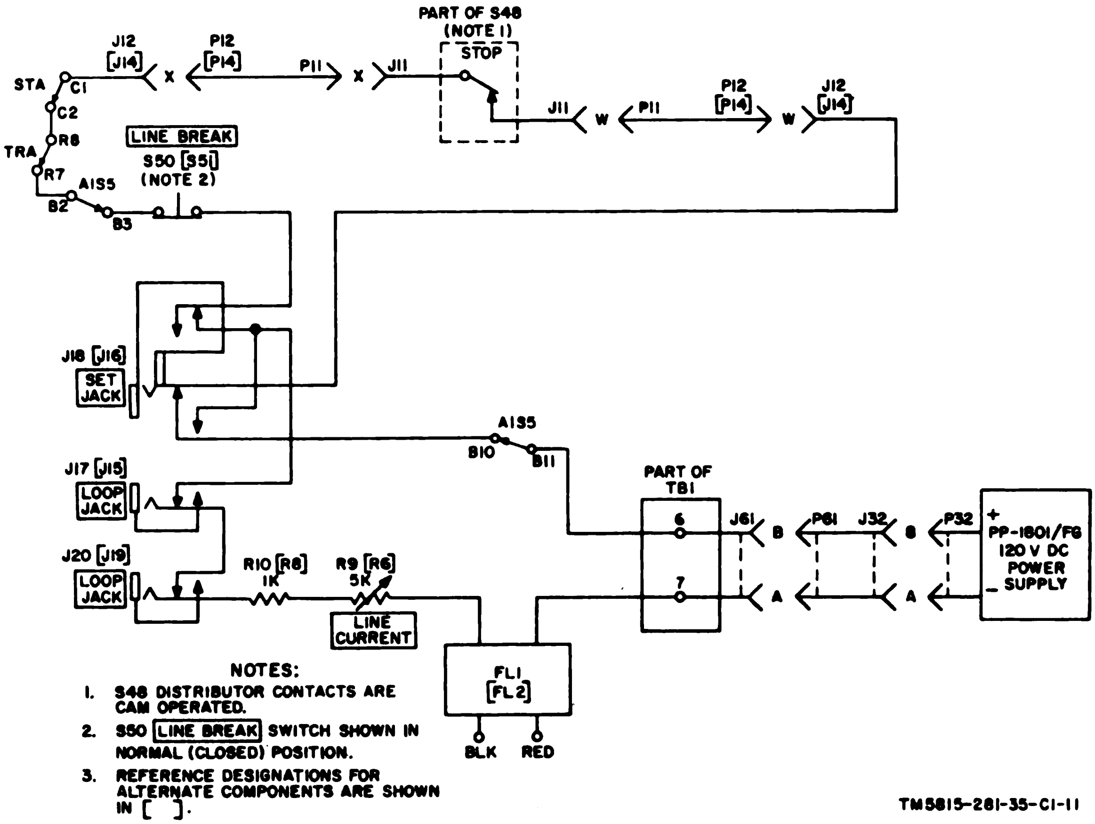


Figure 32. Signal line circuit closed through stop impulse contacts of S48, simplified schematic diagram.

This causes a start (spacing) impulse to be transmitted to the signal line, followed immediately by five intelligence impulses and a stop (marking) pulse. The circuit for the first intelligence impulse (fig. 34) is traced from the RED signal line terminal, through filter FL1, through the 120-volt dc power supply, through SET JACK J18, through CASE switch S10 in position 2, to level D of the contact bank of main stepping switch NSA, (in home position). Because the circuit is open at this point, a no-current impulse is transmitted to distributor S48 and to the signal line. The same condition is present at levels

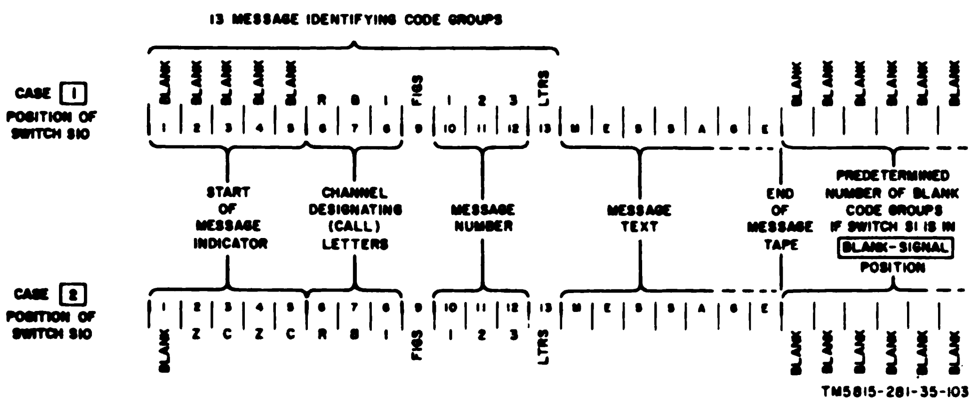


Figure 33. Message identification patterns.

E, F, G, and H; therefore five no-current intelligence impulses (a *blank* code group) are transmitted.

(2) As the transmitter camshaft rotates and while the code group is being transmitted, numbering pulsing switch S32 on the transmitter is closed by cam action to energize the coil of main stepping switch NSA. This circuit (fig. 35) is traced from battery through the operating coil of stepping switch NSA, through closed contacts R1-R2 of relay KNA which is deenergized, through closed contacts R10-R9 of relay TRA which is deenergized, through filter FL8, through numbering pulsing switch S32, through filter FL8, to ground. After the transmission of the fifth intelligence pulse, the numbering pulsing switch opens to deenergize the operating coil of stepping switch NSA, which causes the contact wipers to step (para 20). This sets up the intelligence impulses for the next code group to be transmitted.

(3) Because distributor clutch magnet L4 is held energized throughout the transmission, the transmitter camshaft continues to rotate and the stop impulse of the first code group is transmitted, followed immediately by the start impulse of the second code group. The intelligence impulses are derived from main stepping switch NSA, which has stepped, as described in paragraph 30*c*, so that the contact wipers now rest on the No. 1 (or No. 14) contacts of the contact banks. This sets up the code group for the letter Z on levels D through H of the switch. The signal line circuit (fig. 36) for the first impulse of the letter Z (a mark impulse) is traced from the RED signal line terminal, through filter FL1 through the 120-volt dc power supply, through switch A1S5-B11 and -B10, through SET JACK J18, through the closed contacts of switch S10, to contact 1, LEVEL D of switch NSA, through the switch wiper, through the closed R1-R2 contacts of relay TRA that is deenergized, through switch A1S5-C2 and C1, through the No. 1 pulsing contact of distributor S48, through switch A1S5-B4 and —B5, through the normally closed LINE BREAK switch S50, through switch A1S5-B14 and —B15, through the contacts of SET JACK J18, through the contacts of each LOOP JACK J17 and J20, through resistor R10 and potentiometer R9, through filter FL1, to the BLK signal line terminal. The next impulse (a space impulse) follows a similar path through contact 1 on level E of the main stepping switch except that the circuit is open because no connection exists between switch S10 and plug P1 (pin 23); therefore, a no-current impulse is transmitted. To complete the Z code group, two more space impulses and one mark impulse are transmitted to the signal line in this manner, followed by the stop impulse.

(4) As the last intelligence impulse of the code group for the letter Z is transmitted, the coil of the stepping switch which has been energized, as described in (2) above, again deenergizes and steps the switch so that the contact wipers are moved to contact No. 2 of the stepping switch contact bank. This sets up the intelligence impulses for the third code group, the letter C, on levels D through H of the stepping switch. The circuit for transmitting the first intelligence impulse of the third code group (fig. 37), a space impulse, is similar to that for the first code impulse of the second transmitted code group, except that the circuit is open between pin 18 of plug P1 and switch S10 so that a no-current impulse is transmitted. The circuit for the second intelligence impulse, (a marking impulse) is similar, except that the circuit between plug P1 (pin 14) and switch S10 is closed to cause a current impulse. In this manner, the second, third, fourth, and fifth code

groups of the start-of-message indicator are transmitted.

b. Switch S10 in Position 1. The start-of-message indicator (CASE switch S10 in position 1) consists of five successive *blank* code groups. The transmission circuits for these code groups are identical with those for position 2 except that, with switch S10 in position 1, all signal line circuit paths are open at S10 and only spacing code impulses are transmitted (when wipers of associated main stepping switch are on contacts 0 through 4 of levels D through H) to make five successive *blank* code groups.

32. Transmitting Channel Designating Letters

a. Channel designating letters (fig. 33) consist of any three letters of the alphabet and are derived by strapping the desired characters into plug P7A on the control base. This strapping determines the pattern of current and no-current impulses that will be transmitted for the sixth, seventh, and eighth code groups of the message identification information. The strapping instructions for plug P7A are given in paragraph 26, TM 11-5815-281-12.

b. The first channel designating letter is transmitted when wipers of the main stepping switch NSA are stepped to contact 5 (or 18) of the contact bank. A typical signal line circuit for transmitting a mark impulse (fig. 38) is traced from the RED signal line terminal, through filter FL1, through 120-volt dc power supply, through switch A1S5-B11 and —B10, through

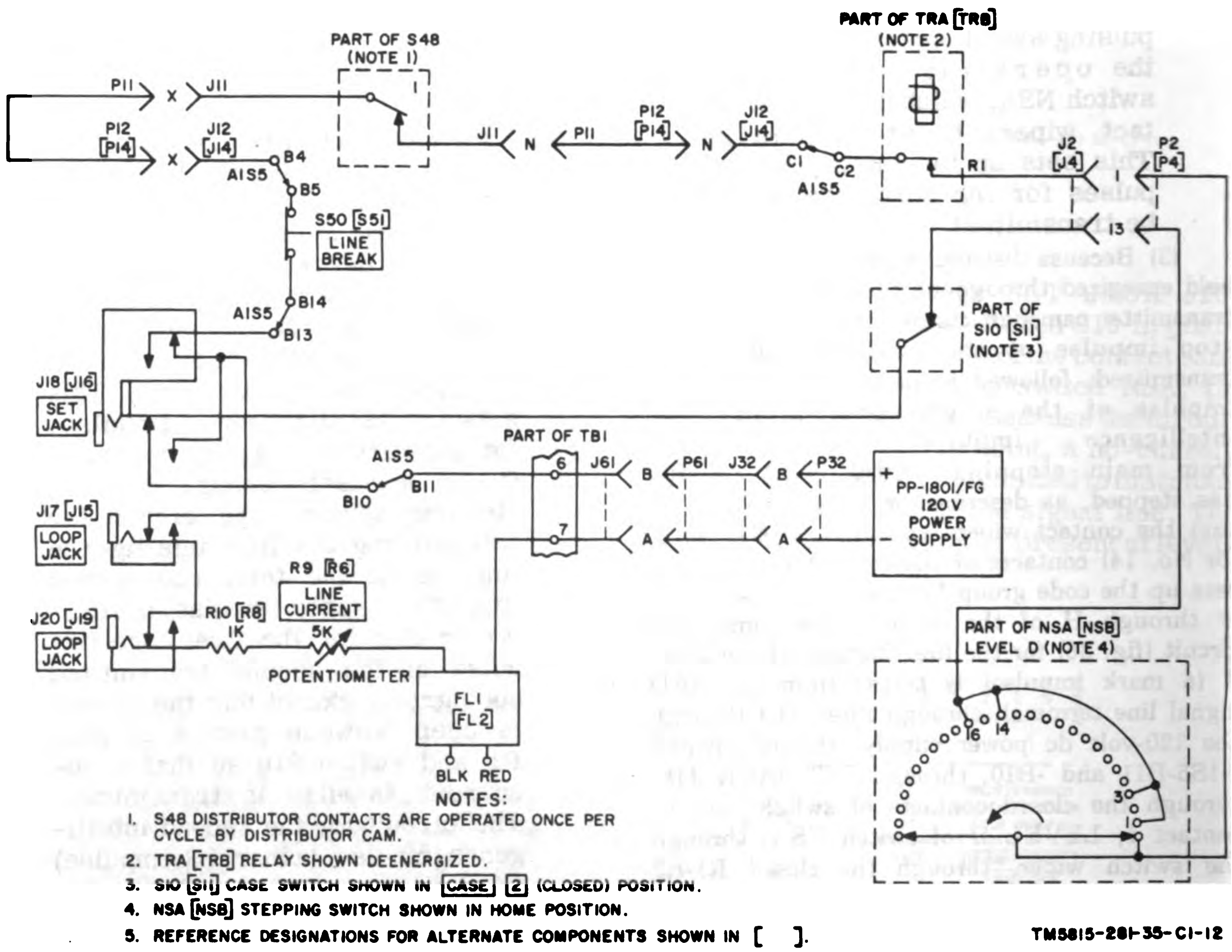


Figure 34. Transmission of first intelligence impulse (space) of first character (blank) of start-of-message indicator, simplified schematic diagram.

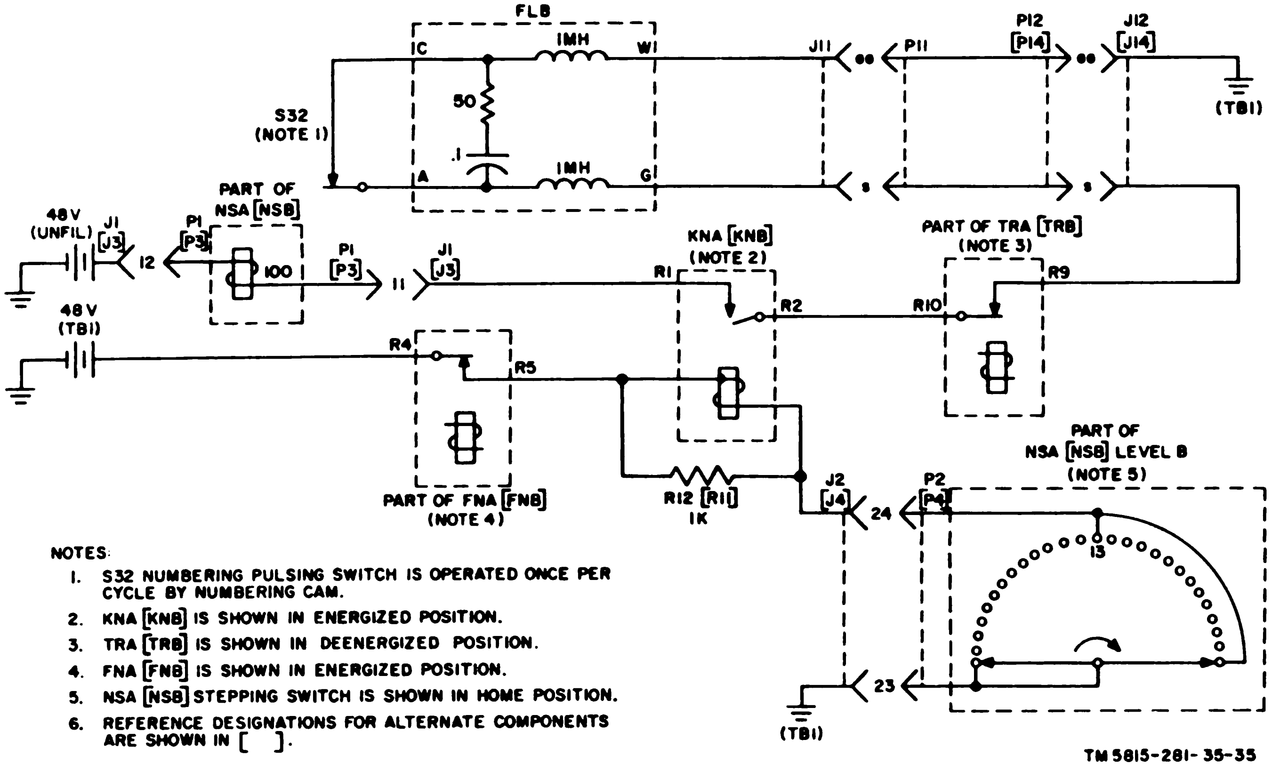


Figure 35. Energizing circuit of main stepping switch NSA and relay KNA, simplified schematic diagram.

the contacts of SET JACK J18, through the strapping that connects terminals 0 and 1 of plug P7A, through contact 5 of level D of switch NSA, through switch wiper, through the closed R1 and R2 contacts of relay TRA that is deenergized, through switch A1S5-C1 and -C2, through contact 1 of distributor S48, through switch A1S5-B4 and -B5, through LINE BREAK switch S50, through switch A1S5-B14 and -B13, through the contacts of SET JACK J18, through the contacts of LOOP JACK J17 and J20, through resistor R10 and potentiometer R9, through filter FL1, to the BLK signal line terminal.

c. A space impulse is transmitted in exactly the same manner, except that the associated terminals of plug P7A (terminals 0 and 1) are not strapped, so that the signal line circuit is open at this point to cause a no-current impulse.

d. The stepping of main stepping switch NSA occurs exactly as described in paragraph 31*a*(2) to step the switch to contact 6 (or 19) and contact 7 (or 20) of the switch contact bank to enable the transmitter to transmit the entire channel designating letter sequence.

33. Transmitting Message-Numbering Information

a. The message number (fig. 33) is transmitted as code groups 10, 11, and 12 of the message identification information, with the hundreds position as group 10, the tens position as group 11, and the units position as group 12. Before the number is transmitted, it is necessary to transmit a *figures* code group which is transmitted as code group 9 of the message identification information.

b. When the stepping switch wipers (fig. 39) are stepped to contact 8 (or 21) of the stepping switch NSA contact bank, the figures code group is transmitted from circuits permanently wired into the equipment. The circuit for transmitting the first impulse (mark) of the figures code group is traced from the RED signal line terminal, through filter FL1, through the 120-volt dc power supply, through switch A1S5-B11 and -B10, through the contacts of

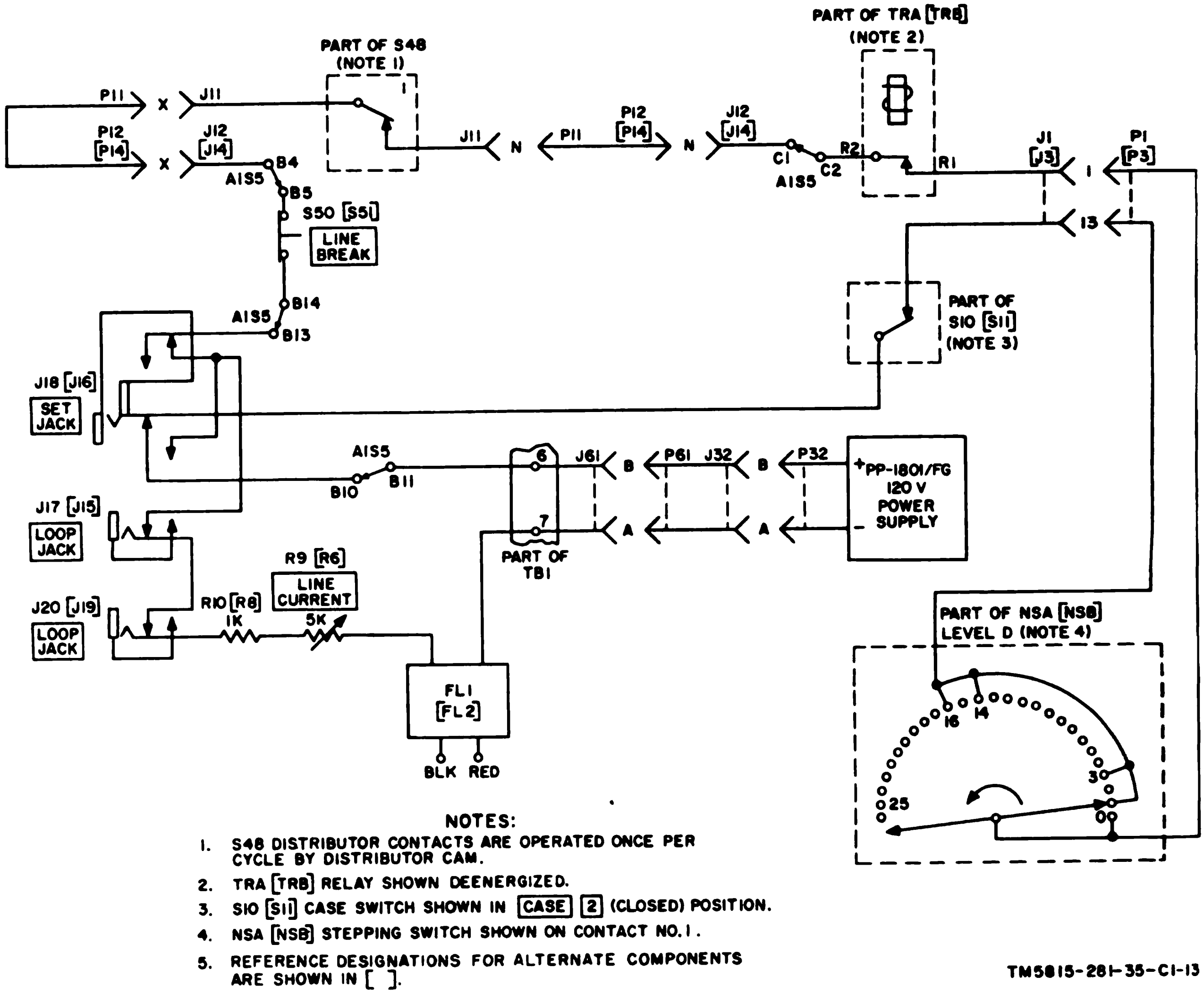


Figure 36. Transmission of first intelligence impulse (mark) of second character (Z) of message identification information, simplified schematic diagram.

SET JACK J18, to a junction point at pin 0 of jack J7A, to level D, contact 8 (or 21) of stepping switch NSA, through the switch wiper, through R1-R2 contacts of relay TRA which is deenergized, through switch A1S5-C2 and -C1, through pulsing contact 1 of distributor S48, through switch A1S5-B4 and B5, through normally closed LINE BREAK switch S50, through switch A1S5-B14 and -B15, through the contacts of the SET JACK J18, through the contacts of each LOOP JACK J17 and J20, through resistor R10 and potentiometer R9, through filter FL1 to BLK signal line terminal. The circuit for the second, fourth, and fifth impulses through contact 8 of levels E, G, and H respectively, are identical except that each circuit is routed through different terminals of J1 and P1. When the wiper of level F is on contact 8 (third impulse), the circuit is open between pin 4 of P2 and J7A and a space impulse is transmitted.

c. As the last intelligence impulse is transmitted to complete the figure code group, numbering pulsing switch S32 opens to deenergize the main stepping switch; this causes the wipers to step to contact 9 (or 22) on the stepping switch contact bank. From this position, the hundredths column number is transmitted. Five code impulses (and a start and stop impulse) are sent to the line for each message number. The code pulses for 0 through 9 are wired on levels B through F of each numbering stepping switch. Level B is wired for the

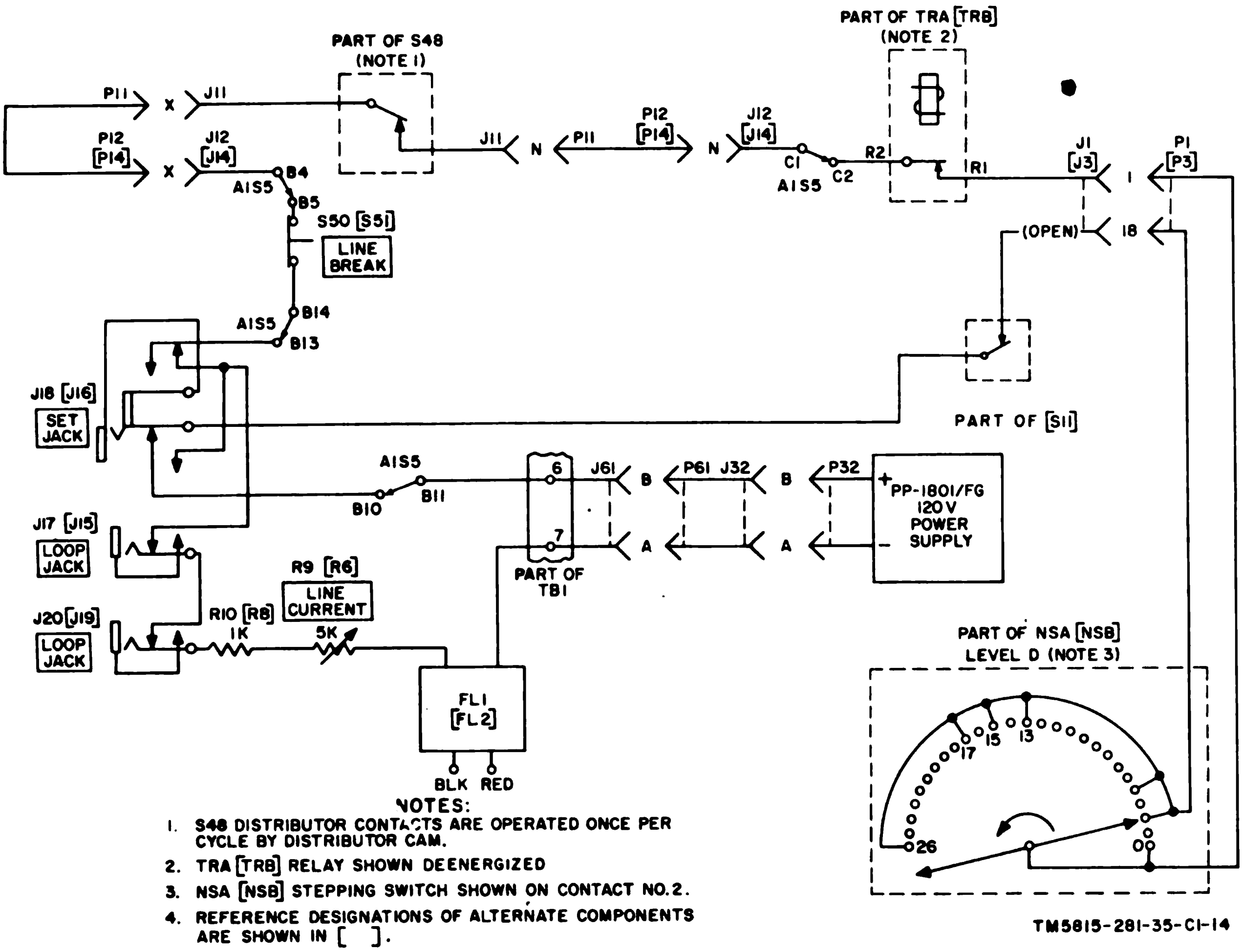


Figure 37. Transmission of first intelligence impulse (space) of third character (C) of message identification information, simplified schematic diagram.

first pulse, level C for the second pulse, and so on, through level F. The information from message numbering switch RHA is sent through position 9 (or 22) of main stepping switch NSA, to the distributor S48, and then to the signal line. Information from message numbering switch RTA is sent to distributor S48 and then to the signal line through position 10 (or 23) of main stepping switch NSA. Information from message numbering switch RUA is sent to distributor S48 and then to the signal line from position 11 (or 24) of main stepping switch NSA. Thus, the message numbering information from RHA is transmitted first, that from RTA next, and that from RUA last, transmitting a message number such as 001.

d. When the contact wipers of main stepping switch NSA move to position 5 (or 18) to set up the circuits to transmit the first character of the channel designating letters from levels D through H of stepping switch NSA, a circuit is also completed through position 5 of level C of main stepping switch NSA in order to energize the coil of numbering stepping switch RUA. Stepping switch RUA will not energize, however, until the operating coil of switch NSA is again energized, because the interrupter contacts of NSA, through which the circuit is routed, close only when the switch is energized. The circuit is traced from battery through the operating coil of switch RUA (fig. 40), through the contacts TL2-TL1 of the numbering reset

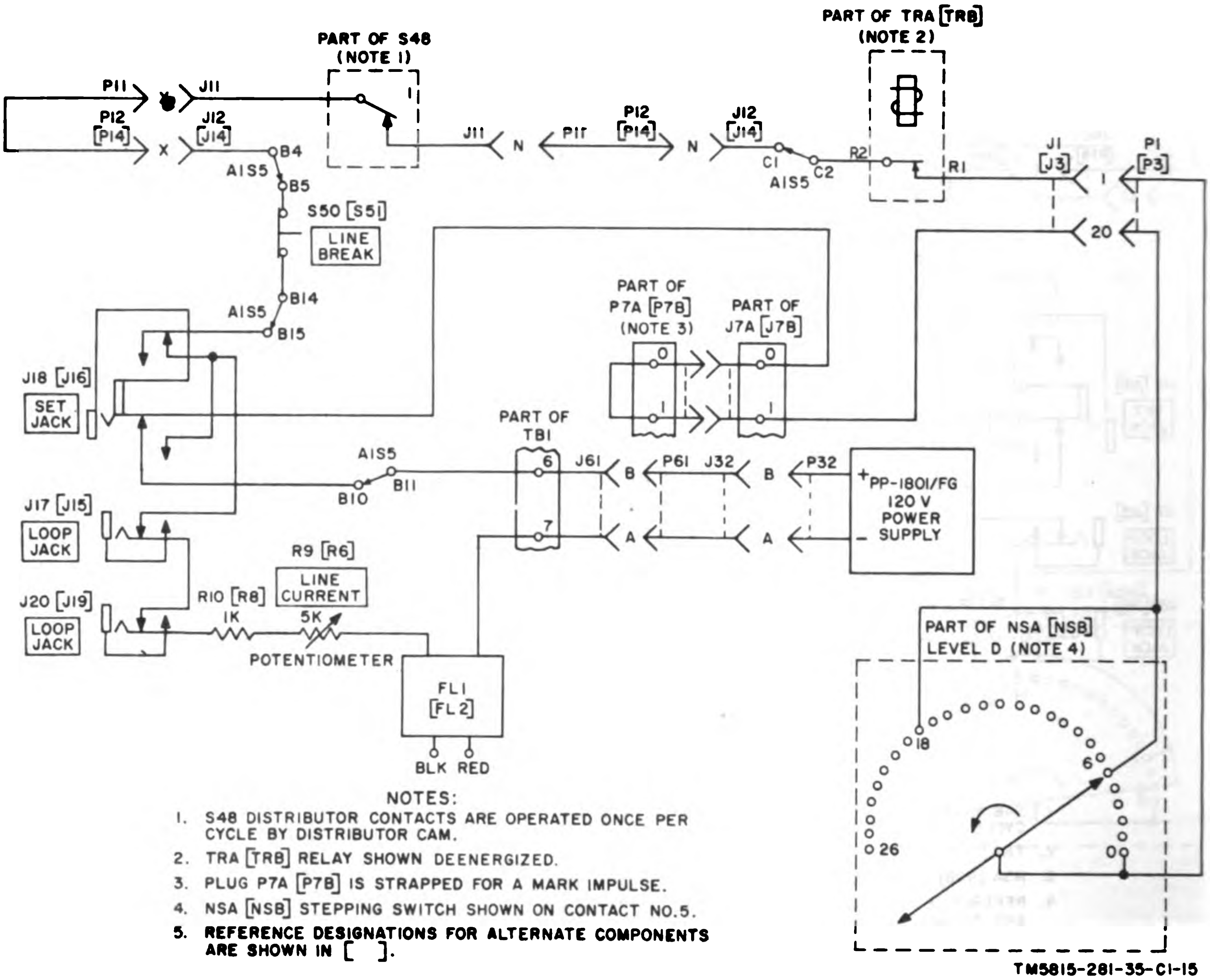


Figure 38. Transmission of first intelligence impulse of sixth character (first channel designating letter) of message identification information, simplified schematic diagram.

switch in the midposition, to contact 5 (or 18) on the contact bank of level C of main stepping switch NSA, through the wiper, through filter FL6, through the interrupter contact of switch NSA, through closed contacts BR1-BR2 of switch S34 (S35) to ground.

e. As soon as the main stepping switch has stepped to position 6 (or 19), numbering switch RUA will be deenergized, because the interrupter contacts of main stepping switch NSA close the circuit only when the coil of NSA is energized. As soon as numbering stepping switch RUA is deenergized, the spring will step its wipers to position 3, which corresponds to number 1 on the indicator wheel. As the wipers of numbering stepping switch RUA are stepped to a new position, the code pulse wired to that position on each level of RUA is transferred through the wipers of RUA to position 11 (or 24) of levels D through H of main stepping switch NSA. From NSA, the pulses are sent to distributor S48 and then, as the transmitter camshaft rotates, the signals are sent to the signal line. Although numbering stepping switch RUA steps to position 3 (corresponding to No. 1) when main stepping switch NSA steps to position 6 (or 19), the code pulses from RUA are not sent to distributor S48 until main stepping switch NSA is on position 11 (or 24).

f. When number stepping switch RUA

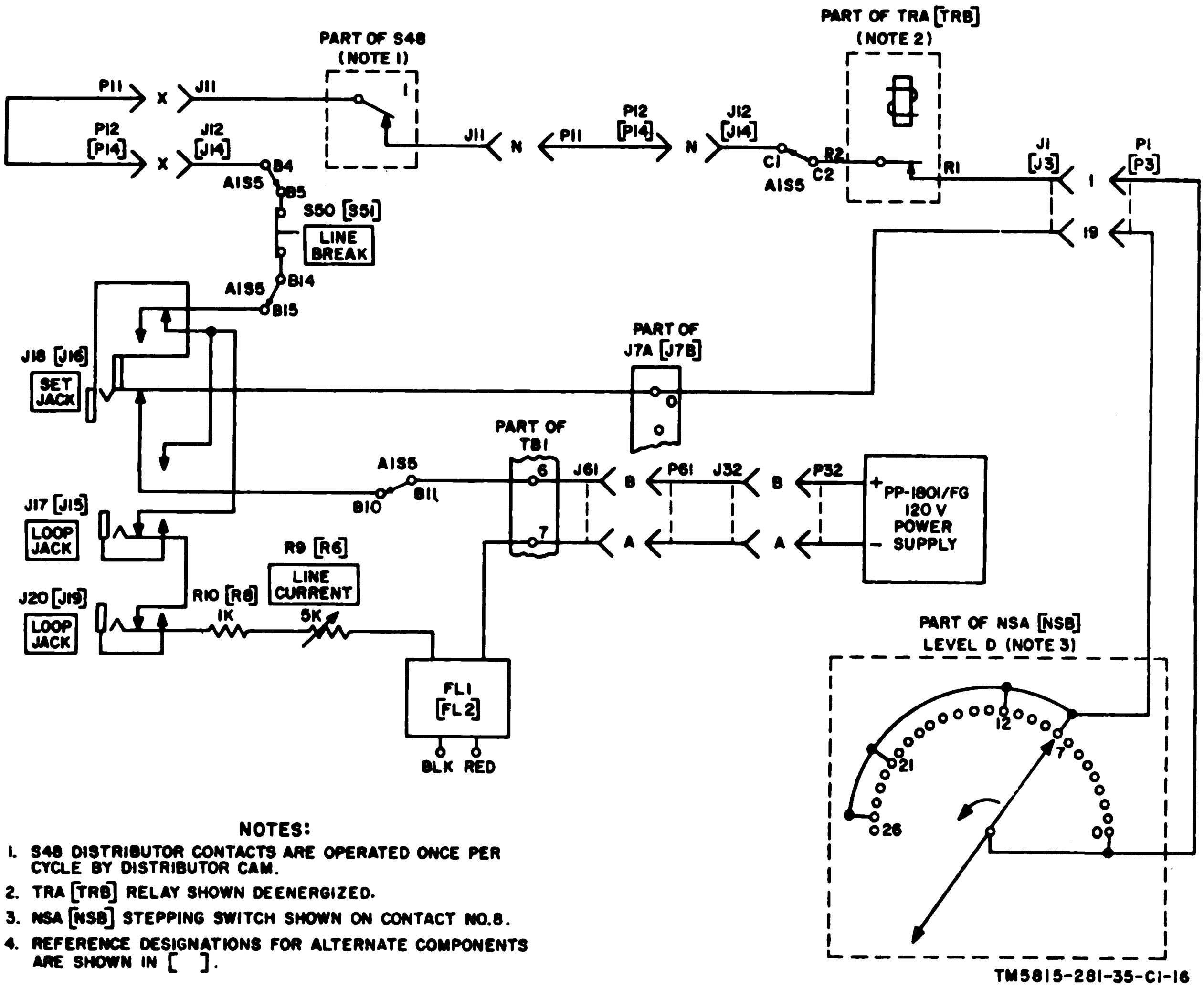


Figure 39. Transmission of first intelligence impulse of ninth character (figures) of message identification information, simplified schematic diagram.

has been stepped to the position at which the message-numbering indicators show number 009, a cam on the stepping switch assembly closes the off-normal contacts of stepping switch RUA. When the main stepping switch NSA next steps its wipers to position 3 (or 16), the coil of numbering switch RTA is energized through level C of main stepping switch NSA and the off-normal contacts of numbering stepping switch RUA. The circuit (fig. 41) is traced from battery, through the operating coil of numbering stepping switch RTA, through contacts TR1-TR2 of numbering reset switch S34 in the midposition, through the closed off-normal contacts of stepping switch RUA, to contact 3 (or 16) on level C on main stepping switch NSA. From here, the circuit continues through the contact wiper, through filter FL6, through the closed interrupter contacts of main stepping switch NSA (which is energized) through filter FL6, through contacts BR2-BR1 of switch S34, and to ground.

g. As switch NSA steps to position 4 (or 17), the circuit to switch RTA is broken, the coil of stepping switch RTA is deenergized, and the armature spring steps the wipers to position 3 (No. 1 on the indicator wheel). However, the code pulses for RTA are not sent to distributor S48 until main stepping switch NSA steps to position 10

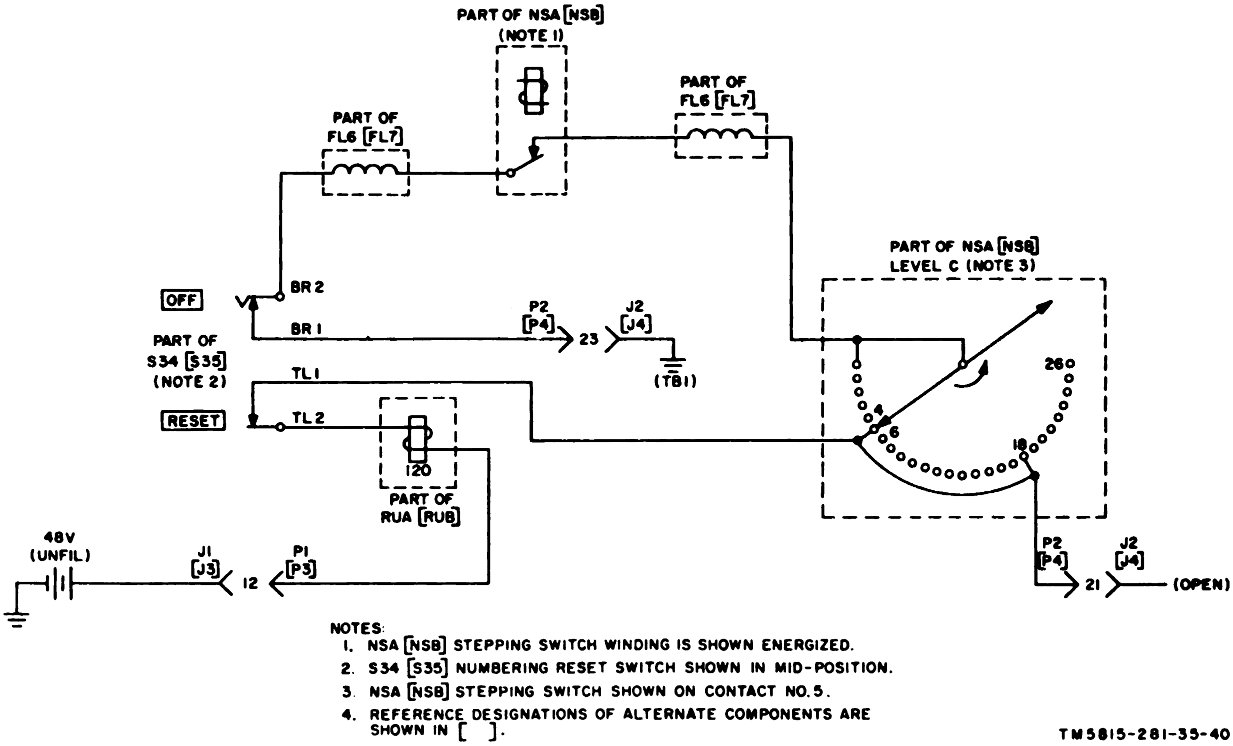


Figure 40. Energizing circuit for operating numbering stepping switch RUA, simplified schematic diagram.

(or 23) (c above). When main stepping switch NSA steps off position 5 (or 18), the circuit to numbering stepping switch RUA is broken, as described previously, and RUA will step its wipers. The circuit to numbering stepping switch RHA is still open and its wipers remain on position 2, which corresponds to 0 on the indicator wheel. Thus the number 010 will be displayed on the message-numbering indicators.

h. When numbering stepping switches RTA and RUA have stepped to the point that 099 is displayed on the message numbering indicators, a cam on each stepping switch assembly closes the off-normal contact associated with each switch. When main stepping switch NSA next steps its wipers to position 1 (or 14), a circuit is completed through level C of NSA, which will energize the coil of numbering stepping switch RHA. The circuit (fig. 42) is traced from battery, through the operating coil of numbering stepping switch RHA, through contacts TR5-TR4 of numbering reset switch S34, through the off-normal contacts of numbering stepping switches RTA and RUA, to contact 1 (or 14) on the level C of main stepping switch NSA. The circuit continues through the wiper of NSA, through filter FL6, through the closed interrupter contacts of switch NSA which is energized, through filter FL6, through contacts BR2-BR1 of switch S34, and to ground.

i. As the wipers of NSA step off position 1 (or 14) of level C, the circuit to the coil of numbering stepping switch RHA is broken and RHA is deenergized. The wipers of RHA are stepped to position 3, which corresponds to No. 1 on the associated indicator wheel. When the wipers of NSA step off position 3 (or 16), RTA will step its wipers to position 2, which corresponds to 0 on the indicator wheel. When the wipers of NSA step off position 5 (or 18), RUA will step its wipers to position 2, which corresponds to 0 on the indicator wheel. Thus, as main stepping switch NSA steps from position 1 to position 6, the message number displayed on the message-numbering indicators advances from 099 to 100.

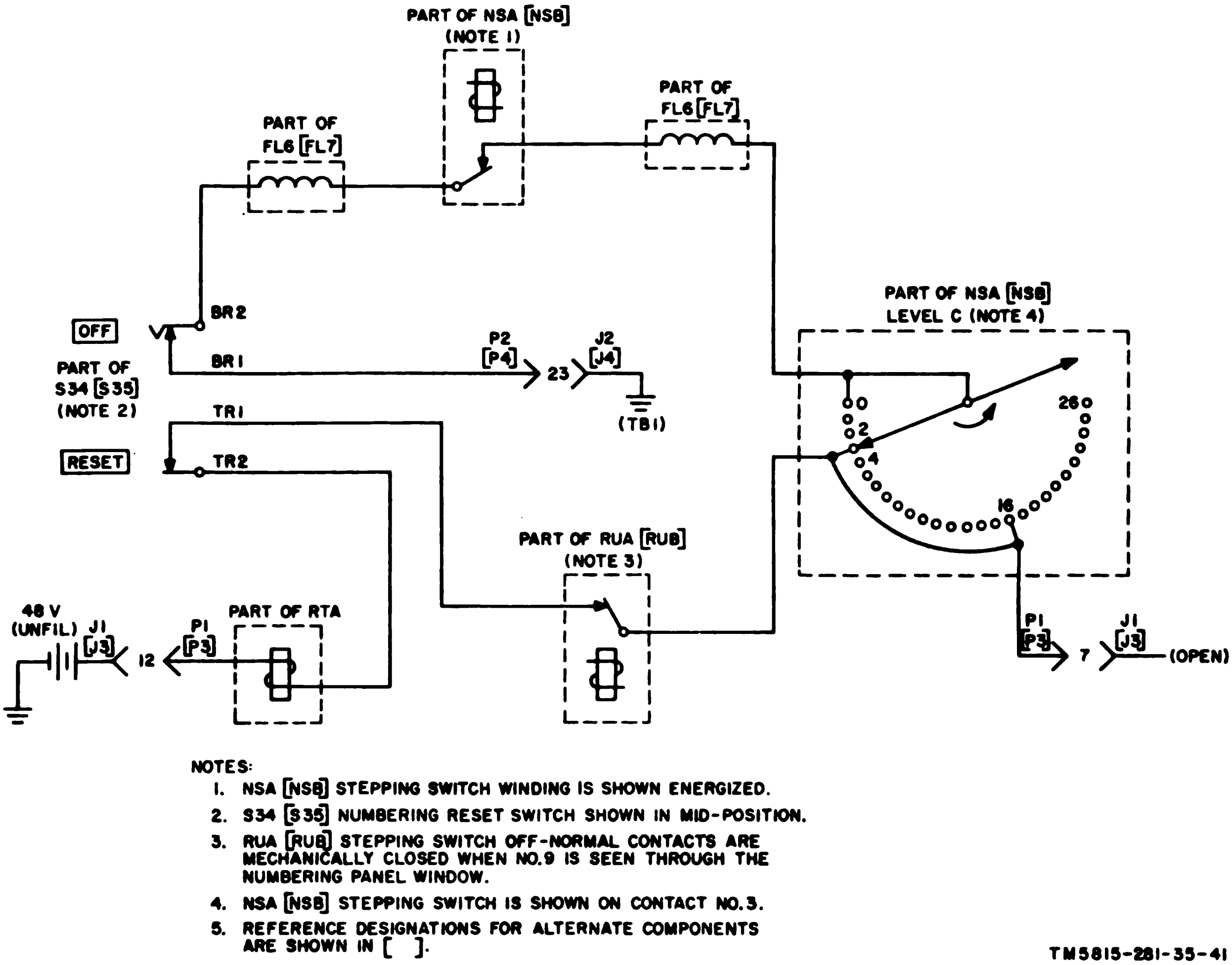


Figure 41. Energizing circuit for operating numbering stepping switch RTA, simplified schematic diagram.

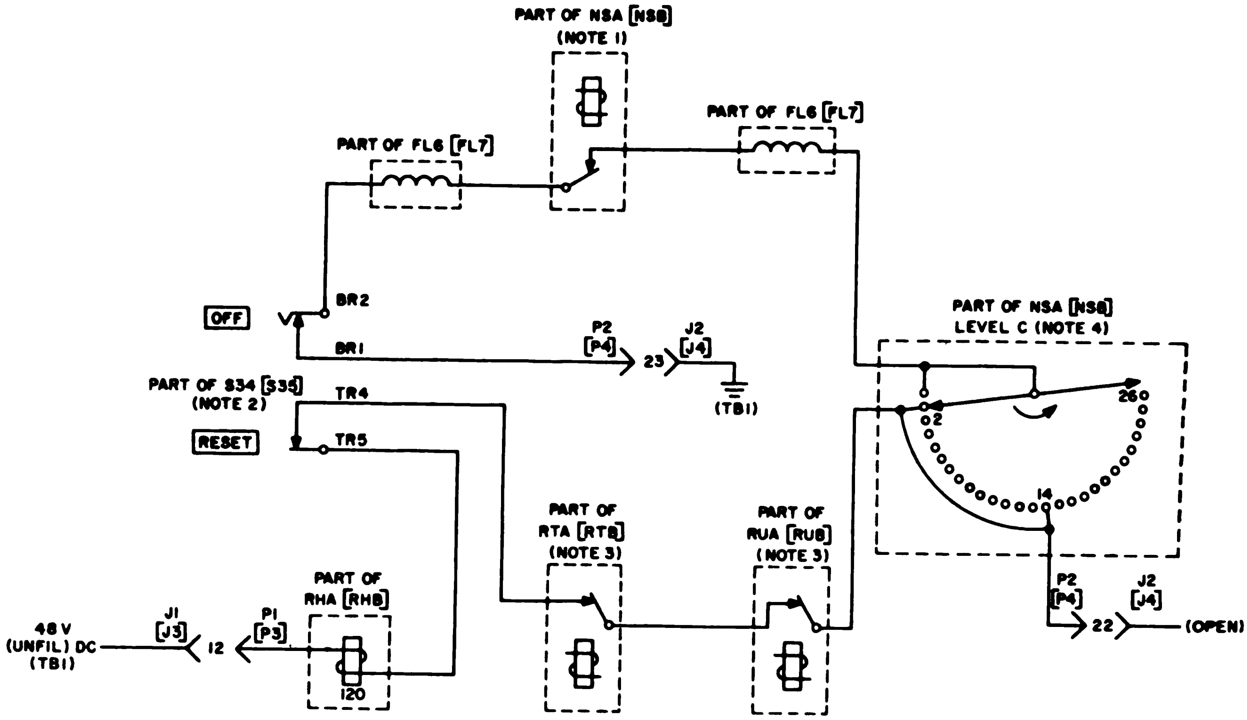
j. As described in *c* through *h* above, the signal circuits for transmitting the message numbering code groups are set up between the main stepping switch NSA and the numbering stepping switches RHA, RTA, and RUA, five code groups prior to the time that particular code group is to be transmitted. The various levels of the numbering stepping switches are connected to levels of main stepping switches as follows:

Numbering stepping switch level	Main stepping switch level	Associated code impulse
B	D	1
C	E	2
D	F	3
E	G	4
F	H	5

The various stepping switches are each connected to specific contacts so that the hundreds, tens, and units will be transmitted in their proper sequence. These connections are as follows:

Numbering stepping switch	Main stepping switch contact number	Associated number position
RHA	9,22	Hundreds
RTA	10,23	Tens
RUA	11,24	Units

k. A typical signal circuit for sending a marking impulse during transmission of the message numbering information (first impulse, transmitting No. 1 from units position) is shown in figure 43. The circuit is traced from RED signal line terminal, through filter FL1, through the 120-volt dc power supply, through switch A1S5-B11 and -B10, through the contacts of



NOTES:
1. NSA [NSB] STEPPING SWITCH WINDING IS SHOWN ENERGIZED.
2. S34 [S35] NUMBERING RESET SWITCH SHOWN IN MID-POSITION.
3. RTA [RTB] AND RUA [RUB] STEPPING SWITCH OFF-NORMAL CONTACTS ARE MECHANICALLY CLOSED WHEN NO. 9 IS SEEN THROUGH THE NUMBERING PANEL WINDOW.
4. NSA [NSB] STEPPING SWITCH IS SHOWN ON CONTACT NO. 1.
5. REFERENCE DESIGNATIONS FOR ALTERNATE COMPONENTS ARE SHOWN IN [ ].

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Figure 42. Energizing circuit for operating numbering stepping switch RHA, simplified schematic diagram.

SET JACK J18, to a junction at pin 0 of jack J7A, to contact 3, level B on numbering switch RUA. The circuit continues through the wiper of switch RUA, to contact 11 (or 24) of level D of the main stepping switch NSA, through the wiper of switch NSA, through contacts R1 and R2 of relay TRA which is deenergized, through switch A1S5-C2 and -C1, through the No. 1 pulsing contact of distributor S48, through switch A1S5-B4 and -B5, through the normally closed LINE BREAK switch S50, through switch A1S5-B14 and -B15, through the contacts of SET JACK J18, through the contacts of LOOP JACK J17 and J20, through resistor R10 and potentiometer R9, and through filter FL1 to the BLK signal line terminal.

l. A typical signal circuit for sending a spacing (no-current) impulse during transmission of the message-numbering information (fourth impulse, transmitting No. 1 from units position) is shown in figure 44. Note that it is similar to the circuit for transmitting a marking impulse described in *k* above, except that the circuit is broken between pin 9 of plug P2 and jack J7A. Since the circuit is interrupted here, a no-current impulse is transmitted.

m. After the transmission of the last numbering information, it is necessary to transmit a letters code group which is permanently wired into the equipment through contact 12 (or 25) on levels D through H of main stepping switch NSA. These circuits are similar to those described in *b* above, except that they are derived from contact 12 (or 25) instead of contact 8 (or 21) (fig. 39) of NSA.

n. After transmission of the last intelligence impulse of the last character of the

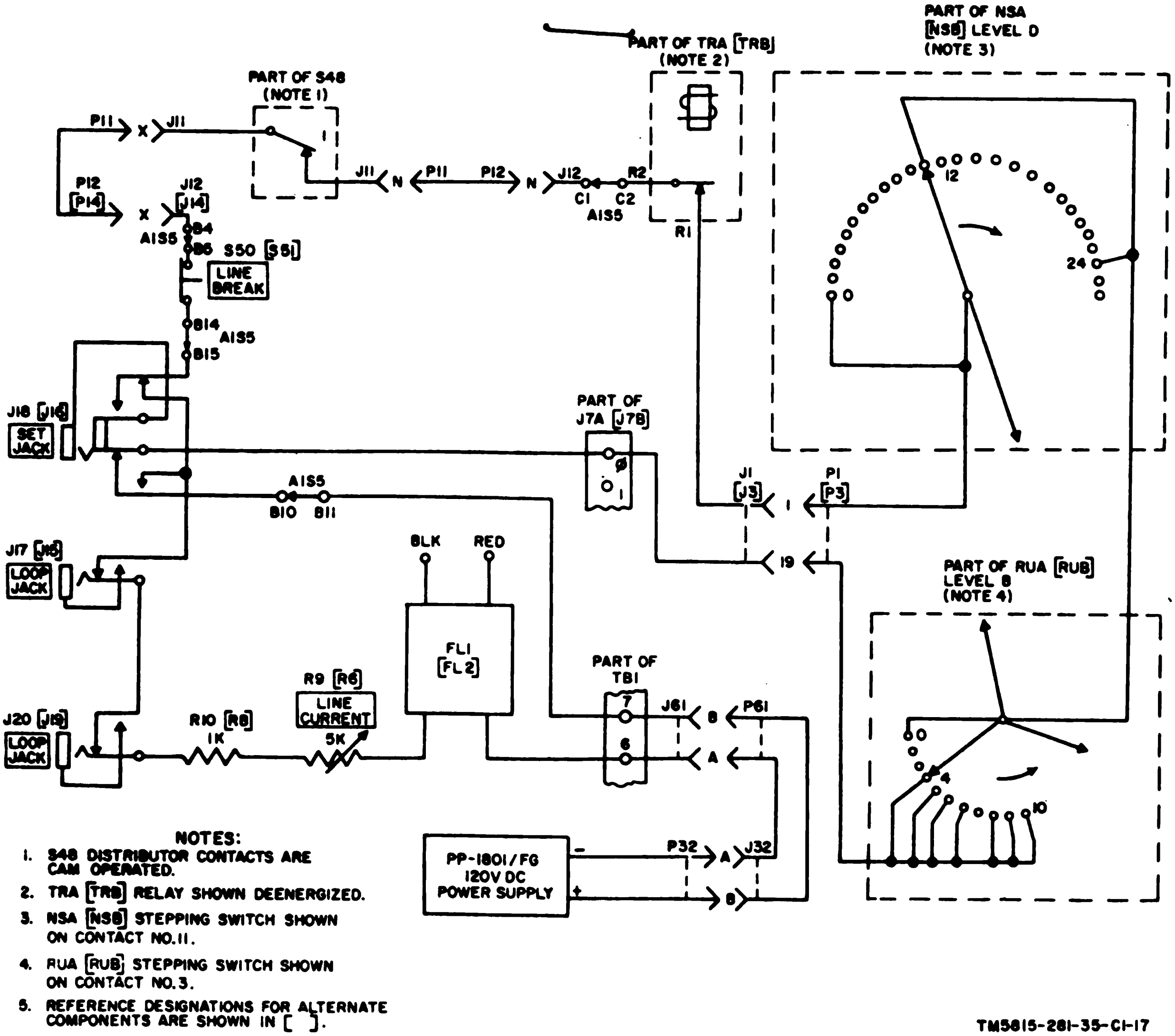


Figure 43. Typical signal circuit for sending marking impulse during transmission of message numbering information.

message identification information, cam-operated numbering pulsing switch S32 opens. This deenergizes main stepping switch NSA and causes it to step to contact 13 (or 0) on the contact bank. These are the home positions of the switch.

34. Preparation for Message Tape Transmission

a. The energizing of relay FNA (fig. 45) is the first step necessary to prepare the equipment to transmit from a message tape. Relay FNA energizes when the wiper of main stepping switch NSA has stepped to contact 12 (or 25) on level C of the contact bank. The interrupter contacts of the switch close as the operating coil is energized to prepare to step the switch to the home position. The energizing circuit for relay FNA is traced from battery, through the operating coil of relay FNA, to contact 12 (or 25) of main stepping switch NSA, through the contact wiper, through filter FL6, through the interrupter contacts of NSA, through filter FL6, through closed contacts BR2-BR1 of numbering reset switch S34 to ground. Relay FNA has a holding circuit that keeps the relay energized after its initial operation. This holding circuit is traced from battery, through the operating coil of relay FNA, through contacts L6-L5 of relay FNA, through contacts L4-L3 of relay TSA which is energized, to ground.

b. As relay FNA energizes, it closes the circuit to energize relay KNA as the

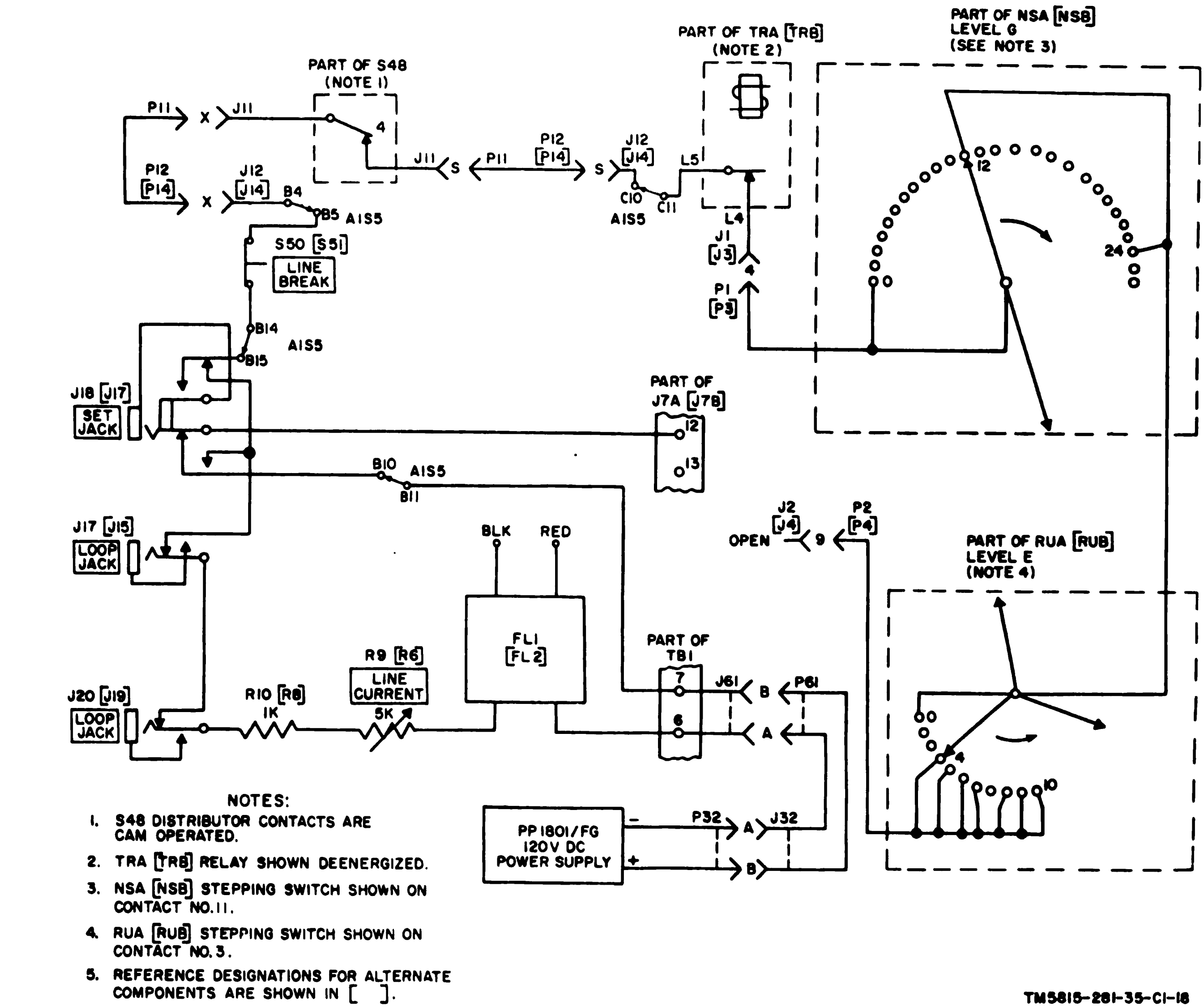
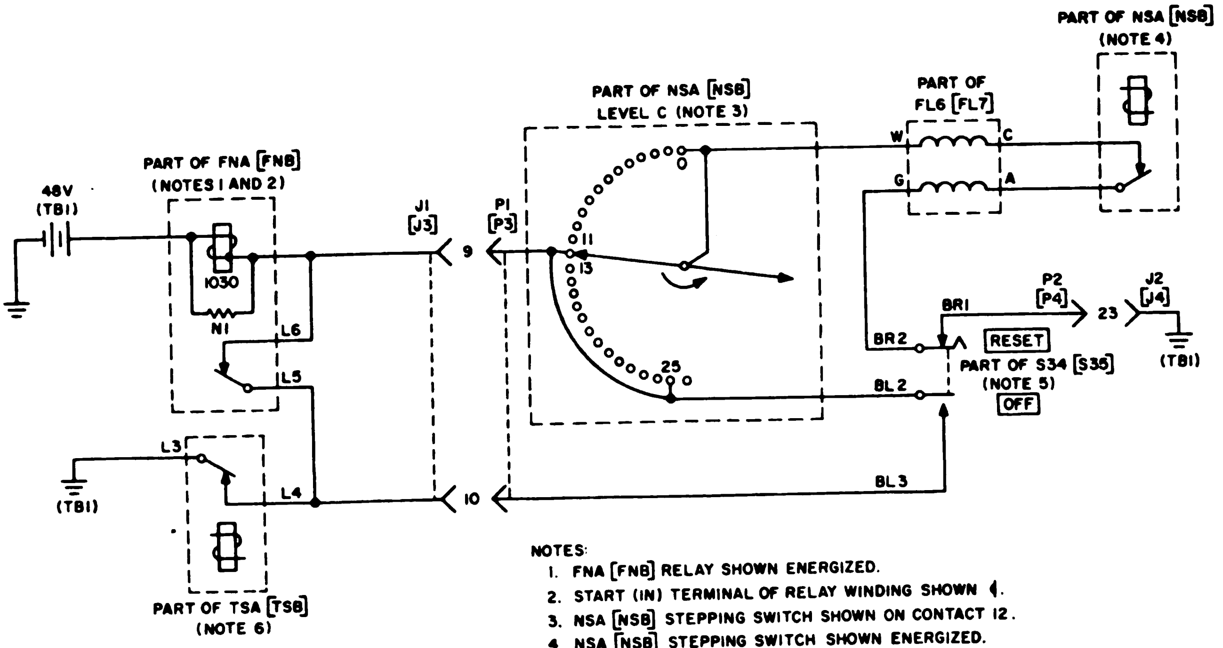


Figure 44. Typical signal circuit for sending spacing impulse during transmission of message numbering information.

main stepping switch NSA steps to the home position. As relay KNA energizes, it opens the energizing circuit to the operating coil of stepping switch NSA to prevent it from energizing as the numbering pulsing contacts close after the switch has stepped to the home position. The energizing circuit for relay KNA (fig. 35) is traced from battery, through contacts R4-R5 of relay FNA which is energized, through the operating coil of relay KNA, to contact 13 (or 26) on the contact bank of stepping switch NSA, through the switch wiper to ground.

c. As relay FNA energizes, it also closes the energizing circuit to relay TRA to operate the relay. When relay TRA operates, it breaks the circuits between the contact wipers of the main stepping switch NSA and the contacts of distributor S48, and closes the circuits to the photo-reader assembly and the stop contacts of distributor S48 (fig. 46). This shifts the transmission from the numbering base to the tape-reading section of the transmitter. The energizing circuit for relay TRA is traced from battery, through the B-T section of the operating coil of relay TRA, through contacts R8-R7 of relay TSA which is energized, through contacts R6-R7 of relay FNA which is energized, through the closed-off normal contacts of main stepping switch NSA which is deenergized, through filter FL6, through contacts BR2-BR1 of numbering reset switch S34 which is in mid-position, to ground. A holding circuit is provided that will prevent relay TRA from deenergizing after transmission has begun. This



NOTES:
1. FNA [FNB] RELAY SHOWN ENERGIZED.
2. START (IN) TERMINAL OF RELAY WINDING SHOWN ◂.
3. NSA [NSB] STEPPING SWITCH SHOWN ON CONTACT 12.
4. NSA [NSB] STEPPING SWITCH SHOWN ENERGIZED.
5. S34 [S35] NUMBERING RESET SWITCH SHOWN IN MID-POSITION.
6. TSA [TSB] RELAY SHOWN ENERGIZED.
7. REFERENCE DESIGNATIONS FOR ALTERNATE COMPONENTS ARE SHOWN IN [ ].

TM 5815-281-35-45

Figure 46. Relay FNA, energizing and holding circuits, simplified schematic diagram.

circuit is traced from battery, through L-R windings of relay TRA, through contacts R11-R12 of relay TRA, through contacts L9 and L10 of relay STA which is energized, to ground.

d. To keep the distributor clutch magnet L4 in step with the reader clutch, the circuit to the distributor clutch magnet during tape transmission is routed through switch S44 (para 13*b*). This change in the distributor clutch magnet circuit is made as relay FNA energizes. The original distributor clutch magnet circuit path is described in paragraph 29*c*(3). The new circuit (fig. 31) is traced from battery, through the windings of distributor clutch magnet L4, through the L4-L3 contacts of relay FNA which is energized, through lever-operated switch S44, through contacts R3-R2 of relay FNA, through contacts L5-L6 of relay STA which is energized, through stop-start switch S42 which is in the START position, to ground.

e. The tape-reader clutch magnet L6 is also energized as relay FNA energizes, starting the tape-sensing operation (para 14). The energizing circuit (fig. 31) for the reader clutch magnet is traced from battery, through the windings of distributor clutch magnet L6, through contacts R3-R2 of relay FNA, through contacts L5-L6 of relay STA, which is energized, through stop-start switch S42 which is in the START position, to ground.

35. Message Tape Transmission

a. Transmission occurs from the message tape as the code groups, sensed by the tape-sensing mechanism (para 14), are transferred to the distributor and transmitted to the signal line as sequential signals. The following circuit conditions are necessary for tape transmission to occur:

(1) Power switch S13 in PWR position.
(2) Switch S42 in START position.
(3) Distributor clutch magnet L4 energized.

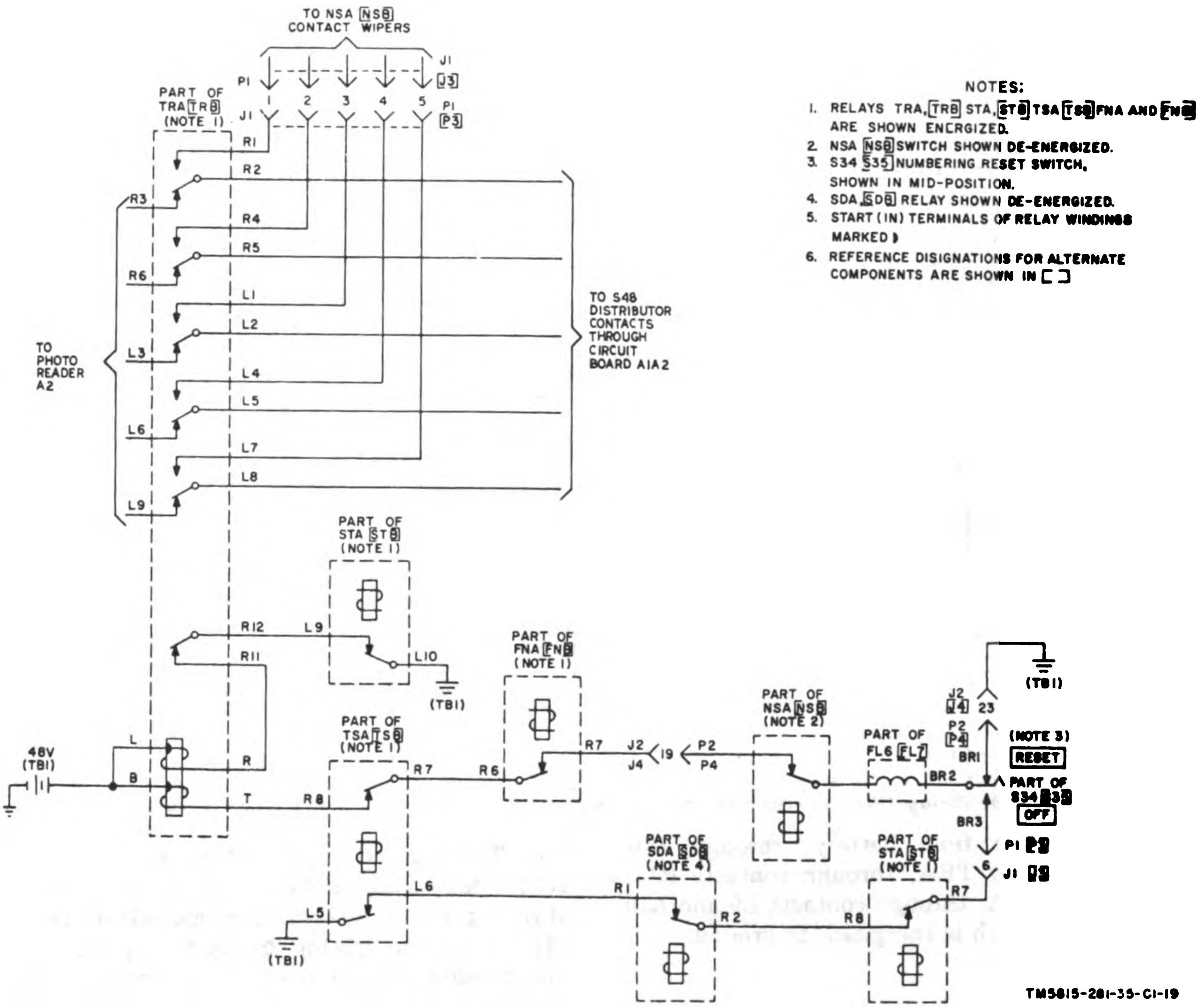


Figure 46. Relay TRA, energizing and holding circuit, simplified circuit, simplified schematic diagram.

(4) **Tape-reader clutch magnet L6 energized.**
(5) **Relays FNA, TSA, KNA, TRA, and STA energized.**
(6) **Relay SDA deenergized.**
(7) **Main stepping switch in home position.**

b. The circuit (fig. 47) for transmitting a mark signal for the first intelligence impulse of a message code group is traced from the RED signal line terminal, through filter FL1, through 120-volt dc power supply, through switch A1S5-B11 and -B10, through SET JACK J18, through the No. 1 mark contacts of tape-reader switch S5, through contacts R3-R2 of relay TRA, through switch A1S5-C2 and -C1, through the No. 1 pulsing contacts of distributor S48, through switch A1S5-B4 and -B5, through LINE BREAK switch S50, through switch A1S5-B14 and -B15, through SET JACK J18, through LOOP JACKS J17 and J20, through resistor R10 and potentiometer R9, through filter FL1 to the BLK signal line terminal.

c. When a sensing lever is positioned to transmit a space impulse, the circuit is as described in *b* above except that it is open at an SP contact of switch S5 and a no-current (space) impulse is transmitted to the signal line.

36. Stopping Transmission (End-of-Tape Condition)

a. Blank Signals Not Generated. When the BLANK SIGNAL switch S1 is in the OFF position to prevent the generation of blank signals at the end of the message, the following sequence occurs to stop tape transmission:

(1) Tape-out switch S30 is opened as the end of the tape passes through the sensing mechanism. As switch S30 opens, it breaks the original energizing circuit (para 29*b*) for relay TSA, and relay TSA is held through its holding circuit. This holding circuit (fig. 28) is traced from battery, through the operating coil of the relay, through contacts L7-L8 of relay TSA, through latch-pulsing switch S46 to ground. Switch S46 holds the circuit closed to insure complete message transmission.

(2) As the stop pulse of the last character is transmitted, cam-operated latch-pulsing switch S46 opens to deenergize relay TSA; this breaks the holding circuit.

(3) As relay TSA deenergizes, it breaks the holding circuit (fig. 45) for relay FNA and relay FNA deenergizes. As FNA relay contacts R2-R3 (fig. 31) open, this breaks the energizing circuit to

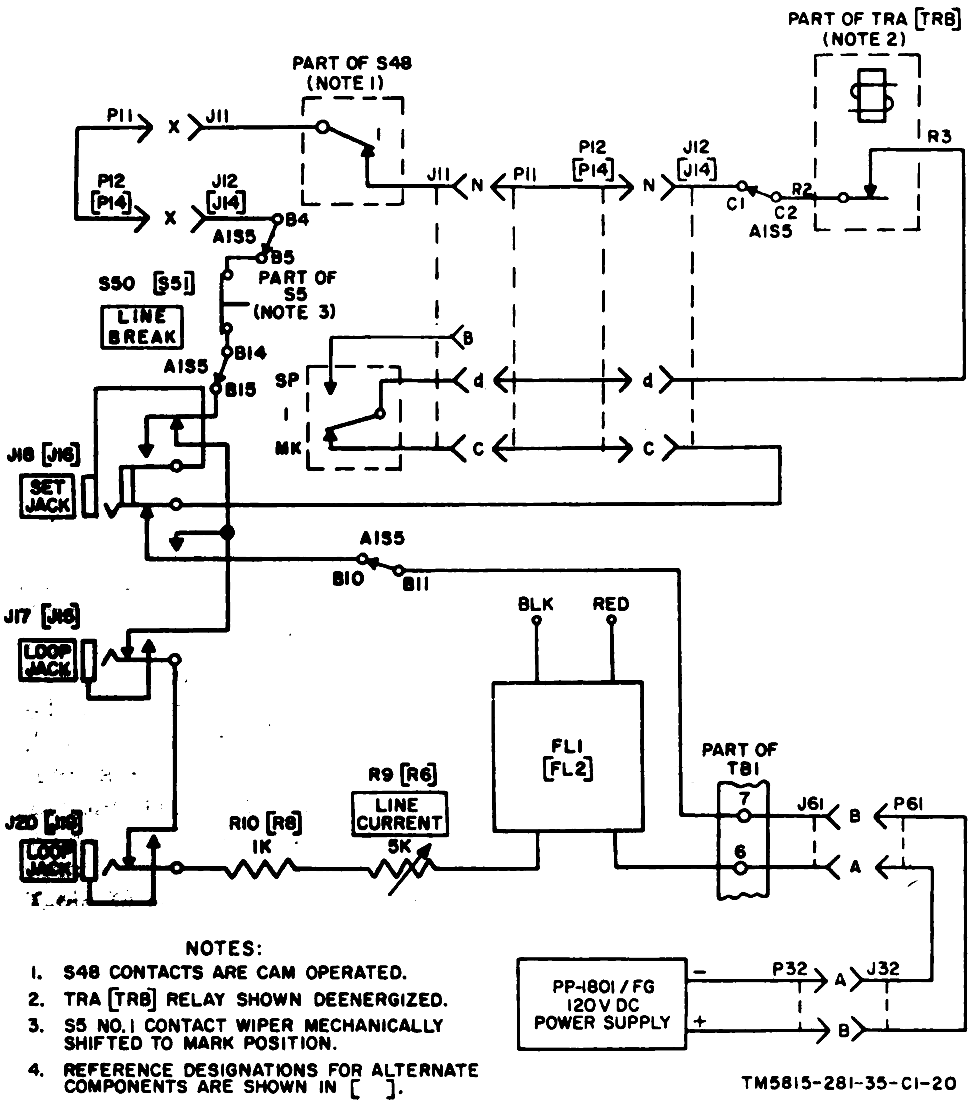


Figure 47. Transmitting mark impulse from message tape, simplified schematic diagram.

tape-reader clutch magnet L6. As contacts L4-L3 of relay FNA open, this breaks the energizing circuit of the distributor clutch magnet L4, but this circuit is immediately restored through the original energizing circuit as contacts R1-R2 of relay FNA close. When relay FNA deenergizes, it breaks the energizing circuit (fig 35) to relay KNA to prepare the energizing circuit of main stepping switch NSA for the transmission of the next message.

(4) As relay TSA deenergizes, it also opens the original energizing circuit (fig. 29) for relay STA. Relay STA is then held energized through a circuit that can be traced from battery, through contact R-L of the operating coil of relay STA, through contacts R9-R10 of relay STA, through filter FL8, through numbering pulsing switch S32 to ground.

(5) After the stop impulse of the last code group is transmitted, numbering pulsing switch S32 opens, which breaks the holding circuit of relay STA. Relay STA deenergizes to break the energizing circuit to distributor clutch magnet L4 (fig. 31). The distributor clutch magnet armature blocks further rotation of the transmitter camshaft as the magnet deenergizes.

(6) The deenergizing of relay STA breaks the holding circuit of relay TRA (fig. 46). This breaks all circuits between the tape-sensing mechanism and the distributor, and makes the connections between the numbering base and the distributor to prepare for transmission of the message identification information for the next message to be transmitted.

b. Blank Signals Generated. When BLANK SIGNAL switch S1 is in the BLANK SIGNAL position, it causes the generation and transmission of a predetermined number of blank signals at the end of the message, and the following sequence occurs to stop tape transmission.

(1) The start of the sequence is identical with that described in *a*(1) through (4) above.

(2) A second holding circuit (fig. 29) for relay STA is established through blank tape switch S28 on the transmitter and through BLANK SIGNAL switch S1 on the line control and relay base in the BLANK SIGNAL position. This circuit is traced from battery, through the B-T windings of the operating coil of relay STA, through contacts R8-R7 of relay STA, through normally closed blank tape switch S28, through BLANK SIGNAL switch S1 in the BLANK SIGNAL position, through the closed contacts of tape-out switch S30, to ground.

(3) With relay STA held energized, the energizing circuit to distributor clutch magnet L4 (fig. 31) remains closed and the transmitter camshaft continues to rotate. For every half turn of the camshaft, one blank code group is transmitted. Blank signal transmission continues until the energizing circuit to relay STA (fig. 29) is broken by the opening of blank tape switch S28. As relay STA deenergizes, it breaks the energizing circuit to the distributor clutch magnet to block rotation of the transmitter camshaft.

(4) The deenergizing of relay STA breaks the holding circuit of relay TRA (fig. 46). This breaks all circuits between the tape-sensing mechanism and the distributor, and makes the connections between the numbering base and the distributor to prepare for message identification of the next message to be transmitted.

37. Stopping Transmission (Tight-Tape Condition)

When the tight-tape lever moves upward because the message tape has become taut or tangled, the following sequence takes place:

a. The tight-tape lever opens stop-start switch S42 (contacts C-NC).

b. Stop-start switch S42 opens the circuit to distributor clutch magnet L4 (fig. 31) and tape-reader clutch magnet L6 to block rotation of the transmitter camshaft and stop transmission.

c. As the cause of the tight-tape condition is cleared up, switch S42 again closes (C-NC) to energize clutch magnets L4 and L6, and transmission resumes.

38. Stopping Transmission (Stop-Start Lever Operation)

a. *Operating Stop-Start Lever to STOP.* When the stop-start lever is moved to the STOP position during message transmission, the following sequence takes place:

(1) Operation of the stop-start lever to STOP opens stop-start switch S42 (C-NC).

(2) Stop-start switch S42 opens the distributor clutch magnet L4 circuit (fig. 31) and the tape-reader clutch magnet L6 circuit to block rotation of the transmitter camshaft and stop transmission.

(3) As the stop-start lever is again moved to the START position, switch S42 again closes (C-NC) to energize clutch magnets L4 and L6, and transmission resumes.

b. *Operating Stop-Start Lever to FEED RETRACT.* When the stop-start lever is moved from START to FEED RETRACT during transmission of a message, the circuits will react *as though the complete message had been transmitted in the normal manner*. Therefore, it the stop-start lever is subsequently moved to the START position, a new message identification sequence will be transmitted automatically, followed by the balance of the interrupted message. Normally a message should not be interrupted by moving the stop-start lever to FEED RETRACT during transmission from a message tape. If, after the tape begins feeding, it becomes necessary to stop transmission and then resume transmission *of the same message*, move move the stop-start lever to STOP to halt transmission and then to START to resume transmission. However, if another (higher priority) message must be transmitted immediately over a busy signal circuit, move the stop-start lever to FEED RETRACT, remove the tape of the interrupted message, insert the tape of the higher priority message, and move the stop-start lever to STOP; then to START.

(1) As the stop-start lever moves downward, past the STOP position, the conditions described in *a* (1) and (2) above occur.

(2) When contacts C-NC of switch S30 open, the circuit to relay TSA (fig. 28) opens, deenergizing TSA.

(3) When relay TSA deenergizes, it opens the holding circuit to relay STA (fig. 29) and relay FNA (fig. 45) to deenergize STA and FNA.

(4) As relay STA deenergizes, contacts L9-L10 (fig. 46) open to break the holding circuit for relay TRA, deenergizing TRA also. Contacts R1-R2 of relay STA close to energize relay SDA (fig. 27).

(5) The deenergizing of relays STA and TRA causes a short to be placed across distributor contacts S48 (fig. 30) (contacts L1-L2 of STA in series with contacts R7-R8 of TRA).

(6) When relay RNA deenergizes ((3) above), it opens the circuit to relay KNA, to deenergize KNA (fig. 35).

(7) All circuits are restored to their normal state, and the equipment is readied for transmission of the message identification information for the next message.

39. Message Numbering Reset Switch Operation

When message numbering RESET switch S34 is operated to the RESET position, numbering stepping switches RUA, RTA, and RHA are reset to 0. The numbering indicators then show 000. When message numbering RESET switch S34 is moved to the OFF position, the message identification information is not fed to distributor S48, and transmission is from the message tape only. These operations take place as follows:

a. *Message Numbering Reset Switch S34 in RESET Position.*

(1) The circuit to reset numbering

stepping switch RUA (fig. 48) is traced from battery through the operating coil of stepping switch RUA, to contact 11 on level A of the stepping switch, through contacts TL2-TL3 of numbering RESET switch S34 in the RESET position, to all contacts except contact 2 on level A of the stepping switch, through the contact wiper of the switch, through the interrupter contacts of the switch, to ground. This circuit energizes the operating coil of the switch, and, as the coil is energized, it opens the interrupter contacts to cause the switch to deenergize and step. The contact wiper steps to the next position on the contact bank and the circuit is again made and broken. The switch is stepped in this manner until the contact wiper reaches contact 2, at which time the number 0 is displayed in the associated message numbering indicator window.

(2) The circuits for resetting numbering stepping switches RTA and RHA are similar to those for RUA. In each case, the circuit is alternately closed and opened through level A of the contact bank until position 2 is reached and the number 0 shows through the window of the associated message numbering indicator.

b. Message Numbering Switch S34 in OFF Position. When message numbering switch S34 is in the OFF position, it prevents the transmission of the message identification information. Since the switch key is fitted with a stop to prevent its being moved to this position, the circumstances under which this feature would be used are very limited. If, for any reason, the stop is removed and the switch is operated to the OFF position, the following sequence of message tape transmission occurs:

(1) As the stop-start lever is moved from the FEED RETRACT position, relay SDA is deenergized (para 29c).

(2) As tape-out switch S30 is closed by the movement of the stop-start lever, relay TSA energizes (para 29*b*).

(3) Relay STA energizes as the contacts of relays TSA and SDA close (para 29c).

(4) The short is removed from across the stop contacts of distributor S48 (para 29*c*(2)).

(5) Relay FNA is energized through a circuit traced from battery (fig. 45), to the contact bank on level C of stepping switch NSA, through contacts BL2-BL3 of numbering RESET switch S34 in the OFF position, through contacts L4-L3 of relay TSA which is energized, to ground.

(6) As relay FNA energizes, relay TRA is energized through a circuit traced from battery (fig. 46), through the B-T windings of the operating coil of relay TRA, through contacts R8-R7 of relay TSA which is energized, through contacts R6-R7 of relay FNA which is energized, through the interrupter contacts of main stepping switch NSA which is deenergized through filter FL6, and through contacts BR2-BR3 of switch S34 in the OFF position. The circuit continues through contacts R7-R8 of relay STA which is energized, through contacts R1-R2 of deenergized relay SDA, through contacts L6-L5 of energized relay TSA, to ground. The holding circuit for relay TRA is traced from battery, through the L-R winding of relay TRA, through contacts R11-R12 of the relay, through contacts L9-L10 of relay STA which is energized, to ground.

(7) As relay TRA is energized, it closes the circuits connecting the contacts of tape-reader switch S5 with the contacts of distributor S48 to permit transmission from the message tape.

(8) With relays FNA and STA energized, the distributor clutch

magnet is energized as described in paragraph 34*d*. The tape-reader clutch magnet is energized as described in paragraph 34*e*.

(9) With these conditions established, the message derived from the message tape is transmitted from the transmitter.

40. FORWARD STEP Switch Operation (fig. 49)

A FORWARD STEP switch is provided for each numbering indicator. The FORWARD STEP switch is used when one numbering indicator is to be advanced independently of the others.

a. Operating FORWARD STEP UNITS Switch. When FORWARD STEP UNITS switch S36 is depressed, the circuit to numbering stepping switch RUA (fig. 49) is energized. When the FORWARD STEP UNITS switch is released, the coil of numbering stepping switch RUA is deenergized, and RUA steps one position. The circuit for stepping numbering stepping switch RUA is traced from battery, through the operating coil of stepping switch RUA, through FORWARD STEP UNITS switch S36 which is operated, to ground. The circuits for stepping switches RTA and RHA follow similar paths, with the circuit for RTA being routed through S38, and the circuit for RHA being routed through S40.

41. Message Numbering Indicators Stepped to Nine

a. Each numbering stepping switch has

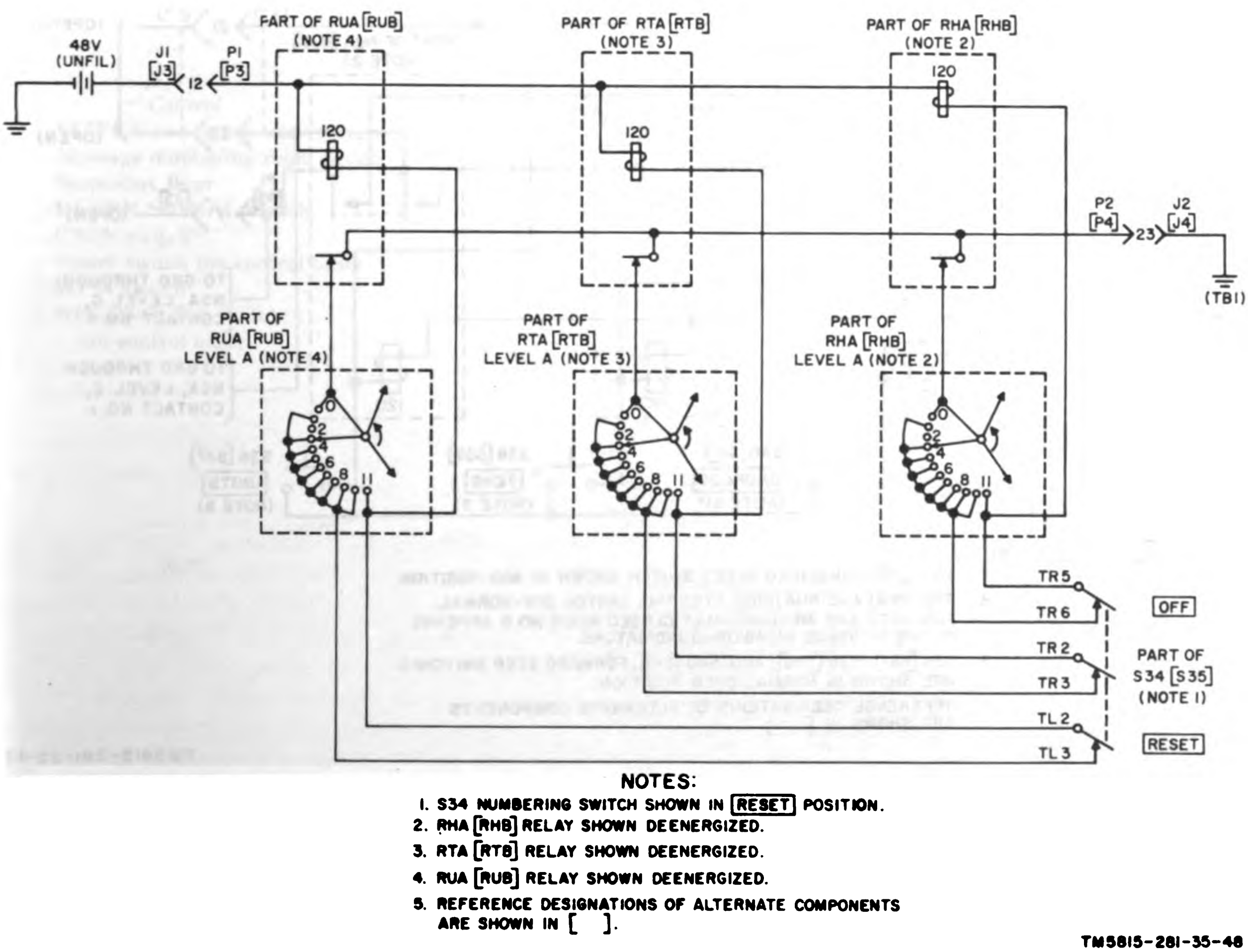


Figure 48. Message numbering RESET switch S34, simplified schematic diagram.

11 contacts between the home positions of the switch, but only 10 digits are required for each numbering cycle. Therefore, the switch is wired to step twice when the contact wiper moves from position 10 (where the digit 8 shows in the window of the message numbering indicator) to position 1 (where the digit 9 shows in the window of the message numbering indicator). When the numbering stepping switch deenergizes to step from position 10 to position 11, a circuit is closed on level A, which automatically energizes and deenergizes the numbering stepping switch. The switch thus steps twice in rapid succession and the contact wiper is moved to position 1.

b. The circuit (fig. 48) that automatically energizes and deenergizes numbering stepping switch RUA is traced from battery, through the coil of numbering stepping switch RUA, through contact 11 of level A of RUA, through the contact wiper which has stepped to contact 11, through the interrupter contacts of RUA, to ground. When the magnet energizes, the interrupter contacts open and deenergize the magnet. When the magnet deenergizes, it steps the wipers of RUA to position 1.

c. The circuits for numbering stepping switches RTA and RHA are energized and deenergized through the interrupter contacts and level A of the respective switches.

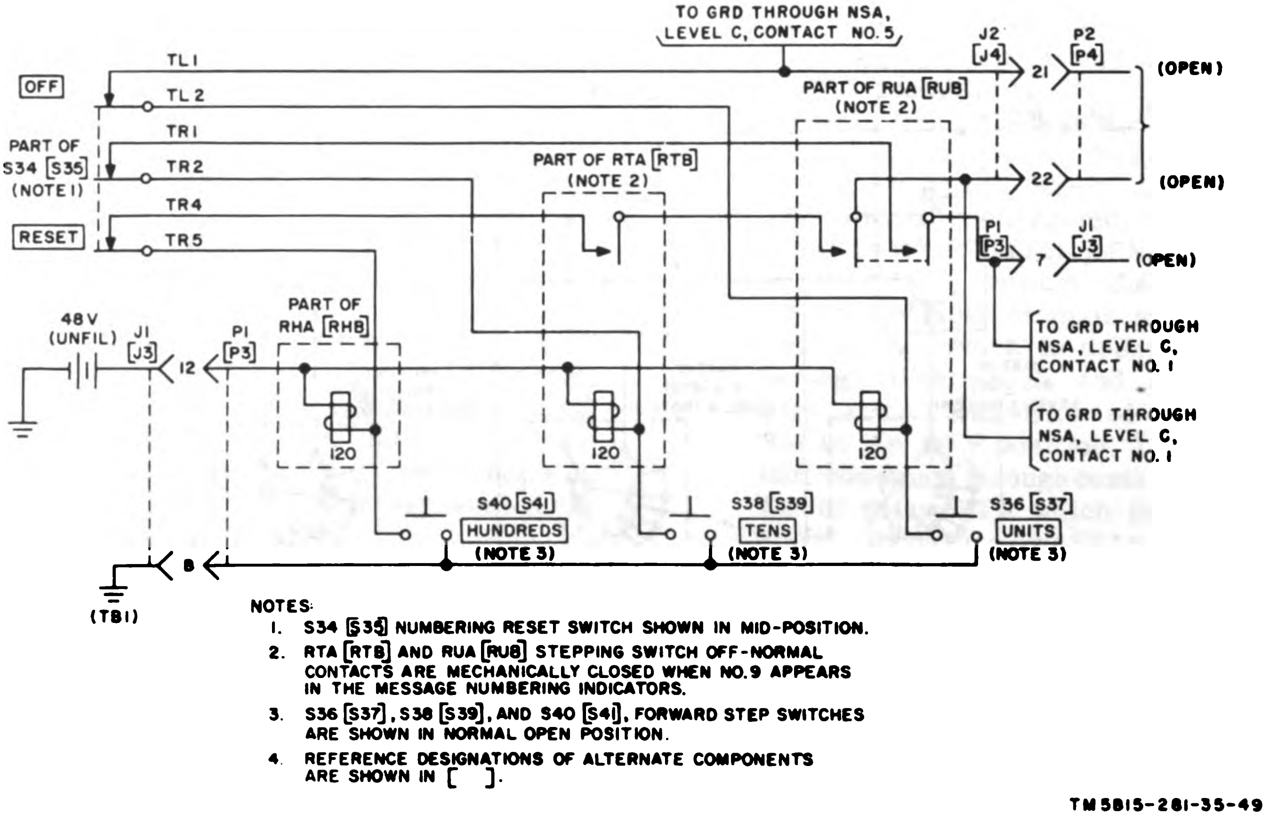


Figure 49. FORWARD STEP switch operation, simplified schematic diagram.

Section V. CIRCUIT DESCRIPTIONS FOR DISTRIBUTOR-TRANSMITTER, TELETYPEWRITER AN/GGC-9 (LOW-LEVEL OPERATION)

41.1. General

a. This section describes the electrical functioning of Distributor-Transmitter Set, Teletypewriter, AN/GGC-9 for low-level operation. Refer to figure 196 for a complete schematic diagram of the entire set. All circuits are described for transmitter A (Connected to J12 at rear of control base). the left side of the numbering base, and the left side of the control base. The circuit descriptions include reference designations assigned to the electrical components associated with this portion of the equipment. Circuits for transmitter B (connected to jack J14) and its associated equipment are identical with those for transmitter A, except that the reference designations for some of the electrical components are different. These reference designations are shown in brackets on the simplified schematic diagrams. The chart in paragraph 41.2 provides a cross index of the reference designations for all switches. The chart in paragraph 41.3 provides a cross index of the reference designations for all relays.

b. Unless otherwise indicated, the circuits described are as established when the controls are set to the following positions:

Control	*Reference designation*	*Position*
POWER switch (on transmitter)	S8	ON
Message numbering reset switch	S34 (S35)	Midposition
Stop-start lever	none	FEED RETRACT
BLANK SIGNAL switch	S1 (S2)	OFF
CASE switch	S10 (S11)	2
Power switch (on control base)	S13	PWR
WPM switch	A1S4	60
NIK/20-60 MA switch (on control base)	A1S5 (S6)	NIK

41.2. Switch Functions and Reference Designation Cross Index

The following chart lists all switches used with Distributor-Transmitter Set, Teletypewriter AN/GGC-9 and gives the function of each. It also provides a cross index to convert each switch reference designation from that used with transmitter A, connected to J12, to its counterpart used with transmitter B, connected to jack J14 and its associated equipment.

Switch	Reference designation		Location	Function
	Trans A	Trans B		
BLANK SIGNAL	S1	S2	Control base	Controls generation of blank signals after transmission of message.
WPM (Words per minute)	A1S4	A1S4	Control base	Controls word per minute sending for NIK operation only.
Tape reader	S5	S5	Transmitter	Not used in low-level operations.
NIK/20-60 MA	A1S5	A1S6	Control base	Switches from high to low-level operations.
POWER	S8	S8	Transmitter	Controls ac power input.
CASE	S10	S11	Control base	Determines format of start-of-message indicator.
Power	S13	S13	Control base	Controls ac power input to power supplies.
Blank tape	S28	S28	Transmitter	Stops blank signal transmission after predetermined number of blanks have been transmitted.
Tape-out	S30	S30	Transmitter	Opens circuit to tape-reader clutch magnet L6 when end of tape is sensed.
Numbering pulsing	S32	S32	Transmitter	Controls stepping of stepping switches in numbering base.
Message numbering reset	S34	S35	Numbering base	Controls message numbering.
FORWARD STEP UNITS	S36	S37	Numbering base	Allows manual stepping of units column of message numbering indicators.
FORWARD STEP TENS	S38	S39	Numbering base	Allows manual stepping of tens column of message numbering indicators.
FORWARD STEP HUNDREDS	S40	S41	Numbering base	Allows manual stepping of hundreds column of message numbering indicators.
STOP-START	S42	S42	Transmitter	Stops or starts transmission.
Distributor magnet control	S44	S44	Transmitter	Energizes distributor clutch magnet L4 (Immediately after tape-reader clutch magnet L6 energizes) to permit transmission from message tape.

Switch	Reference designation		Location	Function
	Trans A	Trans B		
Latch pulsing	S46	S46	Transmitter	Holds relay TSA (or TSB) energized until stop impulse of last character in message tape is transmitted.
Distributor	S48	S48	Transmitter	Controls transmission of signals to signal line (stop switch only for internal timing).
LINE BREAK	S50	S51	Control base	Opens signal line.
Main Stepping	NSA	NSB	Numbering base	Controls transmission of message identification information.
Numbering stepping (units).	RUA	RUB	Numbering base	Controls transmission of units digit of message number.
Numbering stepping (tens)	RTA	RTB	Numbering base	Controls transmission of tens digit of message number.
Numbering stepping (hundreds).	RHA	RHB	Numbering base	Controls transmission of hundreds digit of message number.

41.3. Relay Functions and Reference Designation Cross Index

The chart below lists all relays used with the Distributor-Transmitter Set, Teletypewriter AN/GGC-9 and gives the function of each. It also provides a cross index to convert each reference designation used with Transmitter A to the equivalent reference designation used with Transmitter B.

Reference designation		Function
Trans A	Trans B	
SDA	SDB	Creates delay to insure proper operation of unit when stop-start lever is moved from STOP to START position.
TSA	TSB	Prepares unit for transmission.
STA	STB	Starts transmission from unit.
FNA	FNB	Prepares unit for transmission from message tape after message identification information is completed.
KNA	KNB	Prevents coil of main stepping switch from being energized while transmission from tape is taking place.
TRA	TRB	Determines whether distributor S48 transmits from stepping switches in numbering base or from message tape.

41.4. Ac Input Circuit
(fig. 49.1)

a. The 105- 125-volt alternating current (ac) is connected to the control base when plug P25 of the ac input cable is connected to jack J25 on the control base. When power switch S13 is in the PWR position, power is supplied to jacks J27, J30 and J31 which connect ac power to the transmitters and the 48-volt power supply.

b. A cable terminated by plug P82 and jack J267 is used to connect ac power to the 48-volt power supply. The cable terminates at pins B and C of J82 and is fused by neon indicator fuse F5 to protect the 48-volt power supply from overload.

41.5. Motor Circuit
(fig. 49.2)

Power is applied to each motor through two 1.6-ampere fuses, F1 and F2, located one on either side of the line. When power switch S8 is in the ON position, current flows through filter FL2, the field coils, armature, and governor contacts, to operate the motor. The motor speed is controlled by the governor contacts which are in parallel with 250-ohm resistor R1. When the motor speed is below 3,600 rpm, the governor contacts are closed and the resistor is shorted out. Maximum current flows through the field coils of the motor, and the motor speed increases. When the motor speed exceeds 3,600 rpm, centrifugal force opens the governor contacts. This removes the short across R1 and reduces the amount of current through the motor field coils. The speed of the motor decreases accordingly. Filter FL2 and capacitors C16 and C17 suppress radio frequencies generated by the governor contacts and motor commutator. Capacitor C2 and the 10-ohm portion of R1 suppress arcing at the governor contacts, and thus reduce interference with the associated electronic equipment.

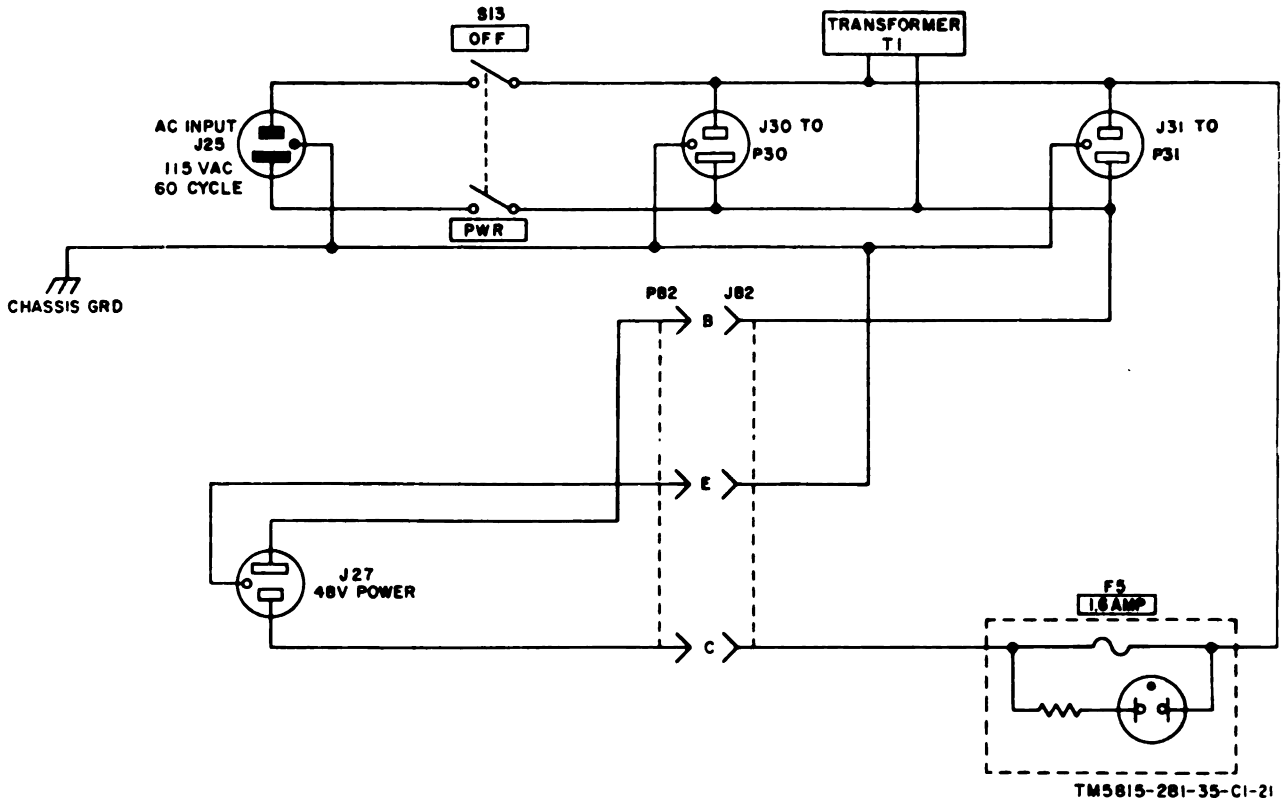


Figure 49.1. Ac input circuit, schematic diagram.

NOTES:

1. S28 BLANK TAPE SWITCH IS CAM OPERATED.
2. S5 TAPE-READER SWITCH CONTACT WIPER IS LEVER OPERATED.
3. S46 LATCH PULSING SWITCH IS CAM OPERATED.
4. S48 DISTRIBUTOR CONTACTS ARE CAM OPERATED.
5. S42 $\boxed{\text{STOP-START}}$ SWITCH SHOWN IN $\boxed{\text{START}}$ POSITION.
6. S30 TAPE-OUT SWITCH IS LEVER OPERATED (TAPE-IN POS).
7. S44 DISTRIBUTOR MAGNET PULSING SWITCH IS LEVER OPERATED WHEN READER CLUTCH MAGNET L6 IS ENERGIZED.
8. S32 NUMBERING PULSING SWITCH IS CAM OPERATED.

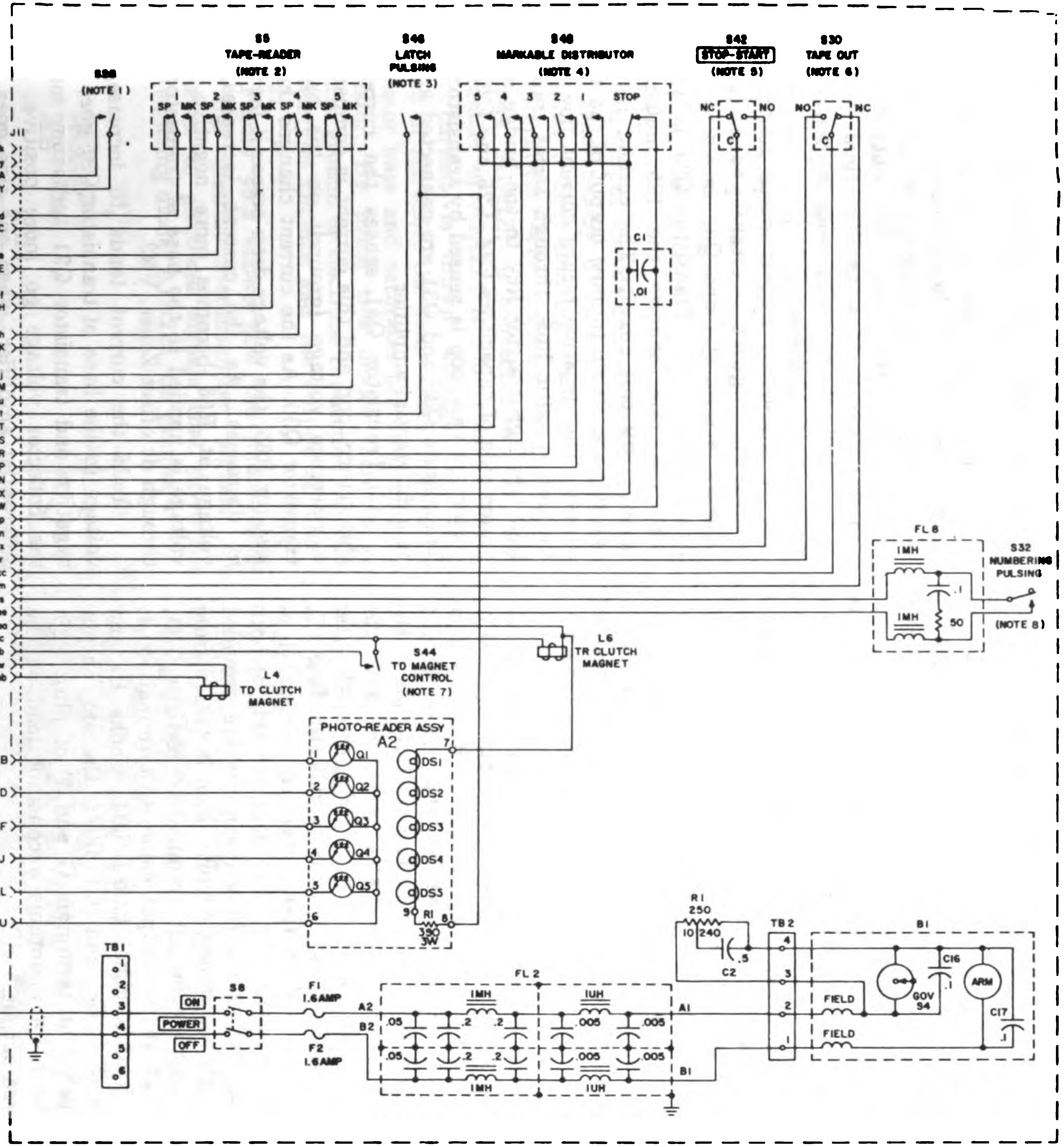


Figure 49.2. Transmitter, schematic diagram.

41.6. Power Supply PP-3131/GGC-9 (48-Volts Dc)

(fig. 25)

a. The 48-volt power supply provides a 48-unfiltered dc power source and a 48-volt filtered power source. This power supply can also provide 150 volts but this voltage is not required in this equipment. The unfiltered 48-volts operates the stepping switches; the filtered 48-volt operates the relays and clutch magnets. The 115-volt ac input to the power supply is applied to the primary winding of transformer T1.

b. Transformer T1 steps down the voltage to a secondary voltage of 58- to 79-volt, depending on the connections made at the adjustable taps. Full-wave rectifier CR1 changes the secondary ac to pulsating dc. The unfiltered 48-volt supply is obtained directly across the output terminals of rectifier CR1 and is connected to terminal board TB1 of the control base from which it is distributed.

c. The positive side of the unfiltered 48-volt dc circuit is traced from the output terminal of rectifier CR1, through 2-ampere indicator fuse F1, through the dc output cable, to terminal 2 of terminal board TB1. The positive side of the filtered 48-volt dc circuit is traced from the output terminal of rectifier CR1, through filter choke L1, through 2-ampere indicator fuse F2, through the dc output cable, to terminal 1 of terminal board TB1. The negative side of both the filtered and unfiltered circuits are provided through a common circuit which is traced from the negative output terminal of rectifier CR1, through the dc output cable, to terminals 3, 4, and 5 of terminal board TB1. Choke L1 and capacitors C3 and C4 filter the dc output available at terminals G and F of plug P29. Resistor R4 maintains a constant load on the filtered output.

41.7. Power Supply Circuit Board, A1A4 (48-volt dc)

(fig. 196)

a. The 115-volt, 60 Hz is applied through capacitors C1 and C2 to the power supply circuit board A1A4 across the primary of transformer T1. There are two separate secondary windings on transformer T1.

b. The first, secondary 3 and 4, is connected through connectors 2 and 3 to a bridge circuit comprised of diodes CR15, CR16, CR17, and CR18. The output of the bridge circuit is 7 volts and is filtered by capacitors C20 and C21. The output of capacitors C20 and C21 is connected to resistor R63 and shunt Zener diode VR1. Shunt zener diode VR1 is a 5.1-volt Zener and drops the output of capacitors C20 and C21 down to a regulated 5-volts.

c. The secondary winding on transformer T1, 5 and 6, is connected through terminals 9 and 10 to a bridge circuit comprised of diodes CR19, CR20, CR21, and CR22. The output of this bridge circuit is 55 volts. The final output of this circuit is 40 volts and is derived and maintained as follows:

(1) A constant current source, controlled by a current regulator circuit consisting of transistors Q30, Q31 and Q33, is fed to 39-volt Zener diode, VR2. Transistor Q33 is a series transistor that handles the 165 milliamperes required by this circuit. The current regulator controls the return (minus) output of the 40-volt supply. The negative return current flows back through resistor R65, through series transistor Q33, through resistor R67 to the bridge and to minus side of capacitors C24, C25 and C26. The current in this loop is sensed by transistor Q30. Transistors Q30 and Q31 are connected and act as a differential amplifier.

(2) Transistor Q31 senses the current in this return loop and this current is compared to a reference voltage (ground) on the base of transistor Q30. As the current changes through resistor R65, the voltage drop across it increases or decreases. As the current increases, the voltage at R65 becomes more negative, thus voltage is applied to the base of transistor Q31 through dc offset Zener, VR3.

(3) If the current tends to increase, the voltage to the base of transistor Q31 goes more negative and transistor Q31 turns on, making the collector voltage go more positive. In a differential amplifier, when one side goes more positive (Q31), the other side (Q30) goes more negative. As the collector voltage of transistor Q30 goes more negative, transistor Q32 conducts less which, in turn, causes transistor Q33 to conduct less and decreases the output current. In like manner, the opposite chain of events occurs if the constant current decreases.

(4) As the circuit load varies, most of the current variation is taken care of by shunt Zener diode VR3. Current variations not taken care of by VR3, since it has a limited impedance, are taken care of by the constant current source, transistor Q33.

(5) Zener diode VR3 maintains a constant output voltage of approximately 40-volts for all output conditions. As output current demands change, Zener diode VR3 acts as a shunt voltage regulator and absorbs all current delivered by the current regulator which is not used by the current load.

41.8. Circuit Boards A1A1, A1A2 and A1A3, Low-Level Operation (fig. 196)

a. With switch A1S5, in the control base, set to NIK, and WPM switch A1S4, in the control base, set to 60, oûtput of circuit boards A1A1, A1A2 and A1A3, channel 1, is delivered to TB3-1 and -2 and the output for channel 2 is delivered to TB3-4 and -5. Channel 1, low level operation, is covered in the following paragraphs.

b. The output signals delivered to TB-1 and 2 are generated by Z1, a photo isolator device containing a light-emitting diode and an NPN photo-transistor. The collector of the photo-transistor, A1A2Z1, is connected to TB3-1 and the emitter of A1A2Z1 is connected to TB3-2. When current is drawn through the diode portion of A1A2Z1, the diode emits light to the transistor base and saturates the output of the transistor. By using this device there is no physical ground or electrical connection between the teletype circuits and the output at TB3-1 and -2.

c. Figure 49.3 shows how the photo-reader and the distributor-transmitter signals are converted to electrical signals that drive the light-emitting diode, A1A2Z1, on channel 1.

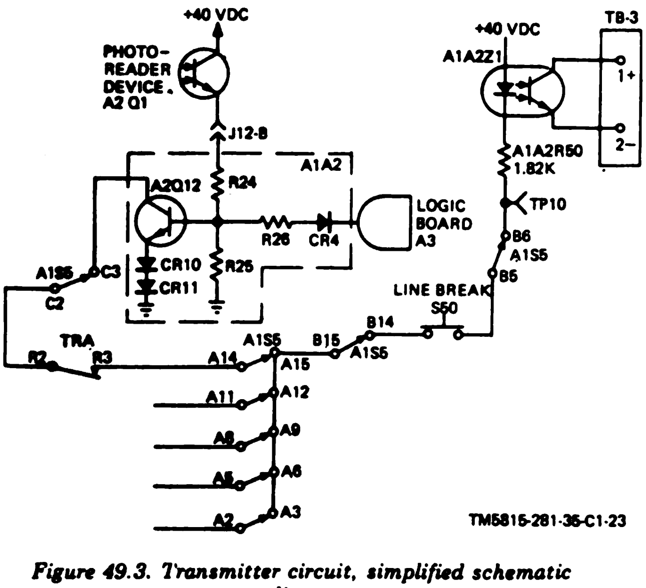


Figure 49.3. Transmitter circuit, simplified schematic diagram.

d. This circuit is traced as follows:

(1) The anode of diode A1A2Z1 is connected to 40-volt dc which is an internally supplied voltage from power supply board A1A4. The anode is connected to a series resistor A1A2R50. The circuit then leaves switching circuit board A1A2 and is connected to switch A1S5, pin B6. When in NIK position, B6 is connected to B5 of switch A1S5, then through LINE BREAK switch S50 which is normally closed, back to switch A1S5, contact B14, and then to B15. Contact A1S5B15 is also connected to contacts A15, A12, A9, A6, and A3 of switch A1S5. The circuit is traced through contacts A14, A11, A8, A5, and A2 to relay TRA. One signal is traced from A14 to relay contact TRA-R3. When relay TRA is energized, TRA-R3 is connected to TRA-R2, through switch A1S5C2 and A1S5C3, through terminal 39 on switching circuit board A1A2, to collector of transistor Q12 on switching circuit board A1A2. The other four connections through A11, A8, A5, and A2, are connected through relay TRA, switch A1S5, to switching circuit board A1A2 transistors Q14, A16, Q18, and Q20, respectively. The base circuits of these five transistors are connected to the photo-reader (A2) through jack J12. *For example:* the base of transistor Q12 is connected through resistor R24 to jack J12-B at the rear of the control base assembly. Pin J12-B is connected by cable through pin 1 of the photo-reader assembly (A2), to the emitter of photo transistor device A2Q1. The collector of A2Q1, in the photo-reader assembly (A2), is connected to +40 volts. When light, generated by one of the miniature lamps in the photo-reader assembly (A2), falls on the photo-transistor lens, the transistor saturates and +40 volts is connected back through jack J12 to switching board A1A2, through resistor R24, to the base of transistor Q12. Transistor Q12 is then turned on by this base current from the photo-reader (A2), and current flows through resistor R50 and the light emitting diode portion of A1A2Z1 and causes the output to photo-transistor to be saturated.

e. The photo-reader (A2) reads the tape codes and the data is sent to transistors A1A2Q12, Q14, Q16, Q18, and Q20 in parallel or simultaneous fashion. This parallel data must be converted to serial data as required by the communications system. This conversion from parallel to serial data is controlled by logic circuit board A1A3.

(1) Logic circuit board A1A3 consists basically of a BCD counter and a BCD to decimal converter with five outputs. Each of the outputs of the converter is connected to the base of one of the five driver transistors on switching circuit board A1A2 (Q12, Q14, Q16, Q18, and Q20). The emitters of these five transistors are biased at 1½-volts above ground by diodes CR10 and CR11 on switching circuit board A1A2. The bases of these five transistors are connected to logic gates through A1A3R83, R84, R85, R86, and R87 and through ten diodes, A1A3CR30 through CR39, on logic circuit board A1A3. These gates are normally at ground level. When they are at ground level, the base to emitter junctions of the five transistors, A1A2Q12, Q14, Q16, Q18, and Q20, are slightly reversed biased and these transistors are thus held in the off state. The transistors will be held off independently of the photo-reader signals.

(2) During normal operation, the logic circuits controlling the base of each of the transistors on switching circuit board A1A2 (Q12, Q14, Q16, Q18, and Q20) sequentially change from "zero" output to "one" output, which is 5 volts. When a logic output is 5 volts, the diodes, in series with the base of the transistor on switching circuit board A1A2, are reverse biased and control of the transistor is turned over to the photo-reader (A2). When light is sensed by the photo device in the photo-reader assembly (A2), the transistors are turned on. When light is not sensed by the photo device in the photo-reader assembly (A2), they remain off even though they are now enabled by the logic circuit. Transistors A1A2Q12, Q14, Q16, Q18, and Q20 are sequentially gated on so that a parallel input from the photo-reader (A2) is converted to a serial output. This output corresponds to the five data bits that are read from the tape.

f. In addition to the five data bits read from the tape, a start and stop pulse is generated and added to the waveform to complete the teletypewriter signals. Figure 49.4 shows how stop pulses are derived.

(1) Basic timing is generated by unijunction transistor Q5 on clock circuit board A1A1. A1A1Q5 is a complimentary unijunction transistor and is used because a complimentary type unijunction is more stable with temperature in terms of frequency of oscillation. The frequency of oscillation is determined by capacitor C3 on clock circuit board A1A1 and by one of three resistor combinations connected to ground. This circuit is traced on figure 196 from the emitter of transistor Q5 on clock circuit board A1A1 to WPM switch A1S4 and back to clock circuit board A1A1, through resistors A1A1R12, R14, or R16, in series with potentiometers R13, R15, or R17, respectively, to ground. By adjusting potentiometers A1A1R13, R15 or R17 and by changing WPM switch A1S4, the frequency of transistor A1A1Q5, and hence WPM switch A1S4, is changed. With WPM switch A1S4 set to pin 1, the electronics is set for 60 WPM, to pin 2-75 WPM and to pin 3-100 WPM.

(2) Base one of transistor A1A1Q5 (fig. 49.4) is connected through transistor A1A1Q4 which is developed across zener diode A1A1VR10. By turning transistor A1A1Q4 on or off, the clock output of A1A1Q5 is enabled or disabled. Zener diode A1A1VR10 is in series with resistor A1A4R64 (on power supply board A1A4) which is connected to the 40-volt output. Operation of transistor A1A1Q4 is controlled from a source in the teletypewriter mechanical operation so that the electronic circuits may be synchronized with the mechanical operation of the distributor-transmitter and the tape-reader. This is necessary so that at the same time the tape-reader is reading the paper tape codes, clock circuit board A1A1 is properly clocking out data.

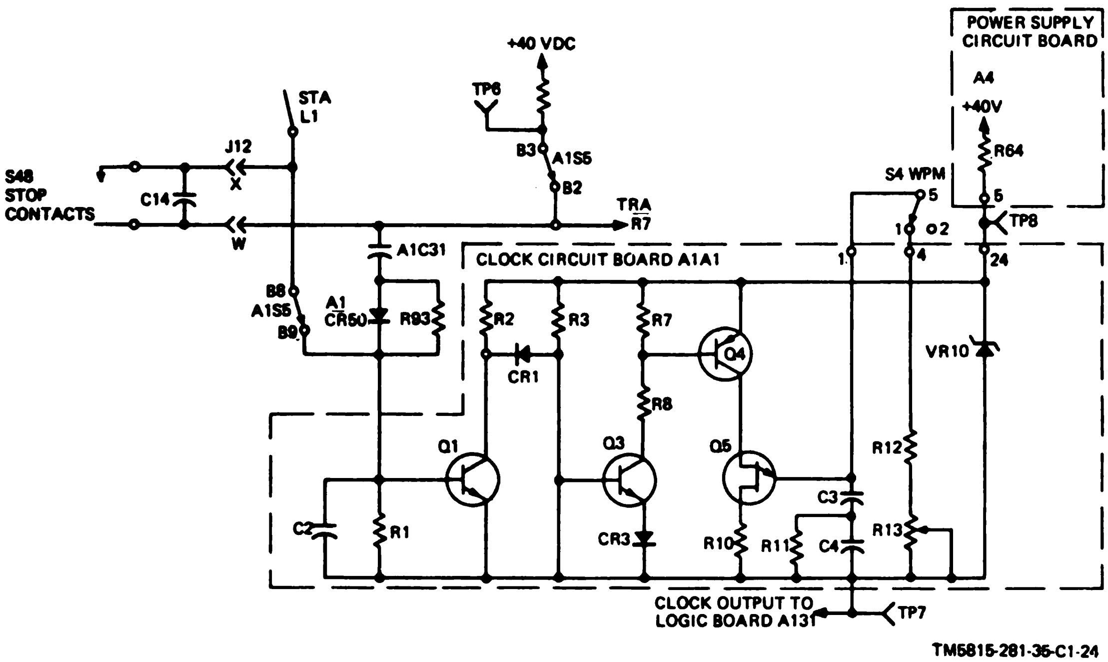


Figure 49.4. Stop pulse synchronizing, simplified schematic diagram.

(3) To synchronize these operations, stop contact switch S48, in the distributor-transmitter, is used. Transistor A1A2Q5, on switching circuit board A1A2, is gated on and off from the timing in the distributor-transmitter. This circuit, as traced on figure 49.4, shows resistor A1A2R49, on switching circuit board A1A2, connected to +40 volts. The other side of A1A2R49 leaves switching board A1A2 and is connected to contacts A1AS5-B3 and A1S5-B2, to jack J12-W, through a cable to one side of stop contact switch S48 in the distributor-transmitter. The other side of stop contact switch S48 is connected through jack J12-X to switch A1S5-B8, back to clock circuit board A1A1 at pin 19 and to the base of transistor A1A1Q1. Capacitor A1A1C2 and resistor A1A1R1 are also connected to the base of transistor A1A1Q1. When the stop contacts of switch S48 are open, resistor A1A1R1 holds transistor A1A1Q1 off. Capacitor A1A1C2 protects against waveform bounce. Transistor A1A1Q1 controls transistor A1A1Q3 through diode A1A1CR1 and transistor A1A1Q3 in turn, controls transistor A1A1Q4. Transistor A1A1Q4, as previously described, controls the application of voltage to the base of unijunction transistor A1A1Q5. When the distributor-transmitter is not operating, the stop contacts of switch S48 are closed and a completed current path can be traced from the +40 volts through A1A2R49, through the stop contacts of switch S48 to the base of transistor A1A1Q1. Transistor A1A1Q1 is now turned on which turns transistor A1A1Q3 off. Diode A1A1C3 provides bias in the emitter circuit of transistor A1A1Q3 so that transistor A1A1Q3 can be turned off by transistor A1A1Q1 through diode A1A1CR1. With transistor A1A1Q3 not conducting, the base of transistor A1A1Q4 is held off by resistor A1A1R8 and the clock circuit will not function.

(4) During normal operations, the stop contacts of switch S48 open when a character is read from the paper tape and close and remain closed until the next character is read. When the next character from the tape is being read, the stop contacts of switch S48 open, transistor A1A1Q1 will have an open circuit to its base and will turn off which will turn transistor A1A1Q3 on through resistor A1A1R3, and transistor A1A1Q4 will turn on and apply +10 volts to clock transistor A1A1Q5.

g. The above information explains the action of the photo-reader circuits and synchronization with the mechanical operations from the distributor transmitter. These circuits are further controlled by signals from logic circuit board A1A3 as follows:

(1) The clock output from clock circuit board A1A1 is coupled by capacitor A1A1C4 to logic circuit board A1A3 at test point 7. This clock signal is a very narrow, positive going pulse developed across resistor A1A1R11 as unijunction transistor A1A1Q5 quickly charges capacitor A1A1C3 to +10 volts. These narrow pulses are applied to logic circuit board A1A3 across 100-ohm resistor A1A3R82 and into the clock input of positive going edge trigger flip-flop A1A3Z5-1 at pin 3. The $\overline{Q}$ (Q-not) output of A1A3Z5-1 at pin 6 is applied to clock input of A1A3Z5-2 at pin 11. The $\overline{Q}$ output of A1A3Z5-2 at pin 8 is then applied to the clock input of trigger flip-flop A1A3Z4 at pin 3. These flip-flops are arranged as a BCD counter and count pulses as they come in from clock circuit board A1A1. The following truth chart provides a logic truth chart for operation of a basic three flip-flop counter.

The outputs of these three flip-flops are applied to positive NOR gates, A1A3Z8-2, Z8-3, Z9-1, Z9-2, Z9-3, Z9-4, Z10-1, Z10-2, Z10-3, and Z10-4. These NOR gates plus the five OR gates, formed by diode paris A1A3CR38-CR39, CR36-CR37, CR34-CR35, CR32-CR33, and CR30-CR31, are arranged to decode the BCD output of the counter flip-flops and provide a decimal count. The above truth chart shows logical operation of the positive NOR gates and OR gates and the overall operation of the BCD counter and decoder for each clock pulse.

Basic 8-Count BDC Counter, Truth Chart

Clock Count	Z2-1		Z2-2		Z4-1		Z10	Z10	Z10	Z10	Z9	Z8	Z8	Z9	Z8	Z8	OR GATE CR30-31	OR GATE CR32-33	OR GATE CR34-35	OR GATE CR36-37	OR GATE CR38-39
	Q	$\overline{Q}$	Q	$\overline{Q}$	Q	$\overline{Q}$	—2	—2	—1	—4	—2	—2	—1	—4	—3	—2					
0	0	1	0	1	0	1	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0
1	1	0	0	1	0	1	1	1	0	0	1	0	0	0	0	1	1	0	0	0	0
2	0	1	1	0	0	1	0	0	1	1	0	1	0	0	0	0	0	1	0	0	0
3	1	0	1	0	0	1	1	0	1	0	1	1	0	0	0	0	0	0	1	0	0
4	0	1	0	1	1	0	0	1	0	0	0	0	1	1	0	1	0	0	0	1	0
5	1	0	0	1	1	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	1

NOTES 1. Logic "0" is a ground level.

2. Logic "1" is a positive voltage output.

3. Flip-flops trigger on positive going signals only.

(2) The truth chart shows only a count of "5" clock pulses because when this count is reached the clock circuit is disabled. Since only five data bits must be read out in sequence, the clock pulses beyond a count of five are unnecessary. Disabling of the clock output is initiated by the output of positive NOR gate A1A3Z8-3. The output of this gate goes positive at the count of five (see the truth chart) and the positive signal (test point TP-9) is applied to the base of transistor A1A1Q2 on clock circuit board A1A1. Transistor A1A1Q2 is turned on by this pulse and damps the base of transistor A1A1Q3 to ground. Transistor A1A1Q3 then turns off and transistor A1A1Q4, without base drive, also turns off and removes —10-volt supply from clock transistor A1A1Q5. Thus at the count of five, the clock is inhibited and with clock pulses no longer being generated the logic circuit outputs remain in a count five condition. This condition prevails until the STOP contacts in the distributor-transmitter close, signifying completion of the reading operation for that character. Closing of the STOP contacts turns on transistor A1A1Q1 on clock circuit board A1A1. Transistor A1A1Q1 then inhibits the clock signal as described above, but in addition turns on transistor A1A1Q7. Transistor A1A1Q7 turns on transistor A1A1Q8 and the collector of A1A1Q8 goes to a ground or "0" level. This ground level is applied to the clear outputs of flip-flops A1A3Z5-1, Z5-2, and Z4-1 and resets all Q outputs of the flip-flops to "0." Thus the outputs of all the logic circuits will revert to the zero count condition (see truth chart). When the zero count condition is established, the output of positive NOR gate A1A3Z8-3 will return to "0" output. Thus transistor A1A1Q2 on clock circuit board A1A1 will turn off. This would allow the clock to operate again except for the fact that transistor A1A1Q1 has now turned on and will maintain the inhibit on the clock output until the stop contacts reopen. Either the count of five condition or the closure of the STOP contacts will inhibit the clock signals.

(3) The five decoded outputs of the logic circuits are applied through resistors A1A3R83 and A1A3R87 to the bases of the five data transfer amplifiers A1A2Q12, Q14, Q16, Q18 and Q20 on switching circuit board A1A2. When the logic outputs are at "0" or ground level, the five transistors are held off. As each decoded logic output sequentially goes to a "1" output, the particular transistor controlled by that logic output will now turn on or off according to the data signal from the photo-transistors in the photo-reader assembly (*d* above). Thus, for the duration of a clock period, each data transistor is sequentially enabled by the logic circuits and the character "bit" information, read by the photo-reader, is sequentially transferred to the signal line.

(4) Transistor A1A1Q7 on clock circuit board A1A1, which is driven by transistor A1A1Q1, is also connected to the base of transistor A1A1Q8. Transistor Q8 is used to enter the stop MARK at the end of each data character. When the stop contacts of switch S48 are closed, transistors A1A1Q1, A1A1Q7, and A1A1Q8 are on. The collector of transistor A1A1Q8, on clock circuit board A1A1, is connected to switch contact A1S5-B14, to LINE BREAK switch S50, to switch contacts A1S5-B5, through A1S5-B6, to switching circuit board A1A2, resistor A1A2R50. When the stop contacts of switch S48 are closed, transistor A1A1Q8 is turned around and current flows from the light-emitting diode portion of A1A2Z1 through resistor A1A1R50 to signal a MARK output. This STOP period will be 1.41 times the period of the data bits as described in the high level section and will be a function of the STOP contact adjustment in the distributor-transmitter.

(5) The start pulse of every character is a SPACE and is equivalent in length to the period of the five data bits. The start SPACE bit is generated automatically by the arrangements of the logic circuit outputs. When the STOP contacts open, signifying the start of a new character, transistor A1A1Q1 turns off and transistor A1A1Q4 reapplies +10 volts to clock transistor A1A1Q5. This rapid application of +10 volts to A1A1Q5 will cause A1A1Q5 to immediately trigger and "charge-up" capacitor A1A1C3. This initial clock pulse from A1A1Q5 will be ignored by flip-flop A1A3Z5-1 because the clear signal will still be present on pin 1. The clear signal will always take precedence over the clock input. This clear signal is, however, removed a few milliseconds after the first clock pulse has passed. Although both the clock enable signal and removal of the clear signal are generated by the opening of the STOP contacts and transistor A1A1Q1 turning off, circuit delays are such that A1A1Q5 is always enabled before transistor A1A1Q6 can remove the clear

signal from the logic flip-flops. Following this enabling of the clock, the logic circuits will remain in the zero count state until the clock again fires at the conclusion of the clock period. As can be seen from the truth chart, during the zero count period none of the data transistors is enabled, thus no current can be drawn through the output photo-isolator during this first clock period. Hence, for this first period the output will always be a space.

h. During this time a message heading is being entered into the system, a special circuit overrides the data signals from the photo-reader (A2). This circuit is traced on figure 196 as follows:

(1) Transistor A1A2Q21 on switching circuit board A1A2, is turned on through relay TRA-L12, through TRA-L13, to power supply board A1A4 pin 7, through resistor A1A4R80 to +5 volts. Transistor A1A2Q21 is turned on any time relay TRA is energized. Five diodes (A1A2C6, C8, C10, C12, and C14) and resistors (A1A2R25, R28, R31, R34, and R37) are connected to the bases of data transistors A1A2Q12, Q14, Q16, Q18, and Q20, respectively. When transistor A1A1Q21 is turned on, the anodes of these five diodes are pulled to ground. The diodes are reversed biased, hence they have no effect on operation of the data transistors A1A2 Q12, Q14, Q16, Q18, and Q20. This is the situation during normal operation when the tape is being read from the distributor-transmitter.

(2) During the time when the message identification information is being read, relay TRA is deenergized and transistor A1A2Q21 is turned off. With transistor A1A2Q21 turned off, current flows through resistor A1A2R47 and diodes A1A2CR6, CR8, CR10, CR12, and CR14 and turns on transistors A1A2Q12, Q14, Q16, Q18, and Q20. This circuit simulates a MARK signal from the photo-reader (A2).

(3) When the message identification is being read, the collectors of transistors A1A2Q12, Q14, Q16, Q18, and Q20 are routed through jack J12, to the numbering base and back through jack J12, to light-emitting diode A1A2Z1 and resistor A1A2R50 so that when the numbering base circuit is completed, current will flow from +40 volts through light-emitting diode A1A2Z1 and resistor A1A2R50, through the numbering base and back to switching circuit board A1A2 and into the appropriate transistor (A1A2Q12, Q14, Q16, Q18, or Q20) as they are sequentially enabled by the logic circuit.

(4) In summary, if the character impulse requires a MARK, the appropriate transistor (A1A2Q12, Q14, Q16, Q18, or Q20) will be connected to resistor A1A2R50 and light-emitting diode A1A2Z1. If the character impulse position requires a SPACE, the numbering base has an open circuit so that the collector of that particular data transistor would not be connected to A1A2R50 and A1A2Z1. When the message identification is completed, the appropriate relays close and the collectors of the transistors are again connected directly to A1A2R50 and A1A2Z1 through relay TRA. With relay TRA open, the only way the collectors of the transistors are connected back into the output circuit is through the numbering base wiring.

41.9. Low Level Parallel Operation

The preceding paragraphs describe the operation of the low-level electronics circuits which generate the low-level NIK output signals. The following paragraphs parallel the discussions presented in the high-level section and will discuss briefly the overall operation of the AN/GGC-9 system in a low-level configuration.

41.10. Preparation for Transmission

a. When power switch S13 on the control base is in PWR position, relay SDA (fig. 27) is energized through a circuit from battery, through the energizing coil of relay SDA, through CONTACTS R1-R2 of deenergized relay STA, through switch S42 (stop-start lever in FEED RETRACT position), to ground. When relay SDA is energized, contacts R1-R2 of relay SDA (fig. 29) open to prevent relay STA from energizing.

b. When a prepunched message tape is inserted into the transmitter and the stop-start lever is moved from FEED Retract to the STOP position, contacts C and NC of the tape-out switch S30 close (para 16b) the energizing circuit to relay TSA (fig. 28). This circuit is traced from battery, through the L-R winding of relay TSA, through switch S30 to ground. When relay TSA operates, it sets up the following conditions:

(1) Contacts R7-R8 in the enertizing circuit for relay TRA (fig 46) close.

(2) Contacts L7-L8 in the holding circuit of relay TSA (fig. 28) close.

(3) Contacts L3-L4 in the holding circuit of relay FNA (fig. 45) close.

(4) Contacts L5-L6 in the energizing circuit of relay STA (fig. 29) close.

c. When the stop-start lever is moved to the START position, the energizing circuit to relay SDA (*a* above) is opened and relay SDA deenergizes. As relay SDA deenergizes, it closes the energizing circuit to relay STA (fig. 29). This circuit is traced from battery, through the T-B winding of relay STA, through closed contacts R2-R1 of relay SDA, through closed contacts L5-L6 of relay TSA, and to ground. When relay STA energizes, it sets up the following conditions:

(1) Contacts R7-R8 of relay STA close to provide a holding circuit for relay STA during blank tape feedout (para 36*b*).

(2) Contacts L1-L2 of relay STA open to remove the short across the stop contacts of distributor S48 (fig. 30).

(3) Contacts L5-L6 of relay STA close to energize the distributor clutch magnet L4 of the transmitter to permit rotation of the transmitter camshaft (para 12). The energizing circuit (fig. 31) is traced from battery, through distributor clutch magnet L4, through contacts R1-R2 of relay FNA which is deenergized, through contacts L5-L6 of relay STA, through the closed contacts of stop-start Switch S42 (START position), and to ground.

(4) Contacts R9-R10 of relay STA in the holding circuit of relay STA close to insure that the complete message identification information will be transmitted.

(5) Contacts L9 and L10 of relay STA close to provide a holding circuit for relay TRA after relay TRA is energized (fig. 46).

d. All circuits are now prepared for transmission of the message identification information.

41.10. Message Identification Information Transmission

a. When CASE switch S10 is in position 2, the message identification information (fig. 33) consists of one BLANK code group followed by code groups for Z, C, Z, C, three channel designating letters, the FIGS code group, the message numbering information, and the LTRS code group. When CASE switch S10 is in position 1, the message identification information differs only in that the start-of-message indicator changes to five successive BLANK code groups.

b. Each code group consists of five code impulses, preceded by a start impulse and followed by a stop impulse. Each of the five code impulses and the start impulse are all of equal time duration. The stop impulse is 1.42 times as long as the other impulses. Once distributor clutch magnet L4 is energized and the short is removed from the stop-impulse contact of distributor S48, information can be transmitted on the signal line.

c. A 27-point, 8-level main stepping switch (NSA) and three 12-point, 6-level numbering stepping switches (RUA, RTA, and RHA) store the 13-character message identification information. The complete code groups for all the message identification characters except the three digits of the message-numbering sequence are wired direct to levels D, E, F, G, and H, of main stepping switch NSA. The code groups for the numbers 0 through 9 are wired on levels B, C, D, E, and F of numbering stepping switches RUA, RTA, and RHA. A connection from the wipers of each level of the numbering stepping switches provides the code impulses for the particular number that is set up on the numbering stepping switches to positions 11 and 24 (units), 10 and 23 (tens), and 9 and 22 (hundreds) of levels D, E, F, G, and H of main stepping switch NSA. (See schematic diagram of numbering base, fig. 196.) During the transmission of message identification information, relay TRA is deenergized and its contacts connect the output of main stepping switch NSA (levels D through H) to switching circuit board A1A2 as follows:

(1) Level D is connected through TRA-R1, TRA-R2 to transistor A1A2Q12 collector.

(2) Level E is connected through TRA-R4, TRA-R5 to transistor A1A2Q14 collector.

(3) Level F is connected through TRA-L1, TRA-L2 to transistor A1A2Q16 collector.

(4) Level G is connected through TRA-L4, TRA-L5 to transistor A1A2Q18 collector.

(5) Level H is connected through TRA-L7, TRA-L8 to transistor A1A2Q20 collector.

41.11. Transmitting Start-of-Message Indicator

a. CASE Switch S10 in Position 2. The start-of-message indicator with CASE switch S10 in position 2 consists of the code groups for blank, Z, C, Z, C and is transmitted as follows:

(1) When distributor clutch magnet L4 is energized, the armature moves out of engagement with the transmitter camshaft, and

the camshaft starts to rotate to open the stop contacts of the distributor switch S48. This causes the clock circuit on clock circuit board A1A1 to be enabled and removes the stop (MARK) signal being generated by transistor A1A1Q8. A start (SPACING) impulse is transmitted to the signal line as described previously in paragraph 41.8*f*, followed by five intelligence pulses and a stop (marking) pulse. The circuit for the first intelligence impulse (fig. 49.5) is traced from +40 volts supply through photo-reader device A1A2Z1, through A1A2R50, through contacts B5 and B6 of switch A1S5, through normally closed LINE BREAK switch S50, through contacts B14 and B15 of switch A1S5, to level D of main stepping switch NSA (in home position). The wiper of stepping switch NSA (level D) is connected back through contacts R1 and R2 of relay TRA, through contacts C2 and C3 of switch A1S5, to the collector of transistor A1A2Q12. During transmission of message heading information, transistor A1A2Q12 (as well as A1A2Q14, Q16, Q18, Q20) are biased in a marking condition by resistor A1A2R47 (transistor A1A2Q1 is off) as was described in paragraph 41.8*f*. Therefore if the circuit is completed through level D of stepping switch NSA, a marking pulse would be transmitted to the signal line when transistor A1A2Q12 was enabled by the logic circuits during the time period of first intelligence impulse. However, since the circuit is not completed through stepping switch NSA level D, a spacing impulse is transmitted as is required by the "blank" character. The same open circuit condition is presented by levels E through H of stepping switch NSA so that transistors A1A2Q14, Q16, Q18 and Q20 also transmit space impulses. Hence the "blank" code group is properly transmitted.

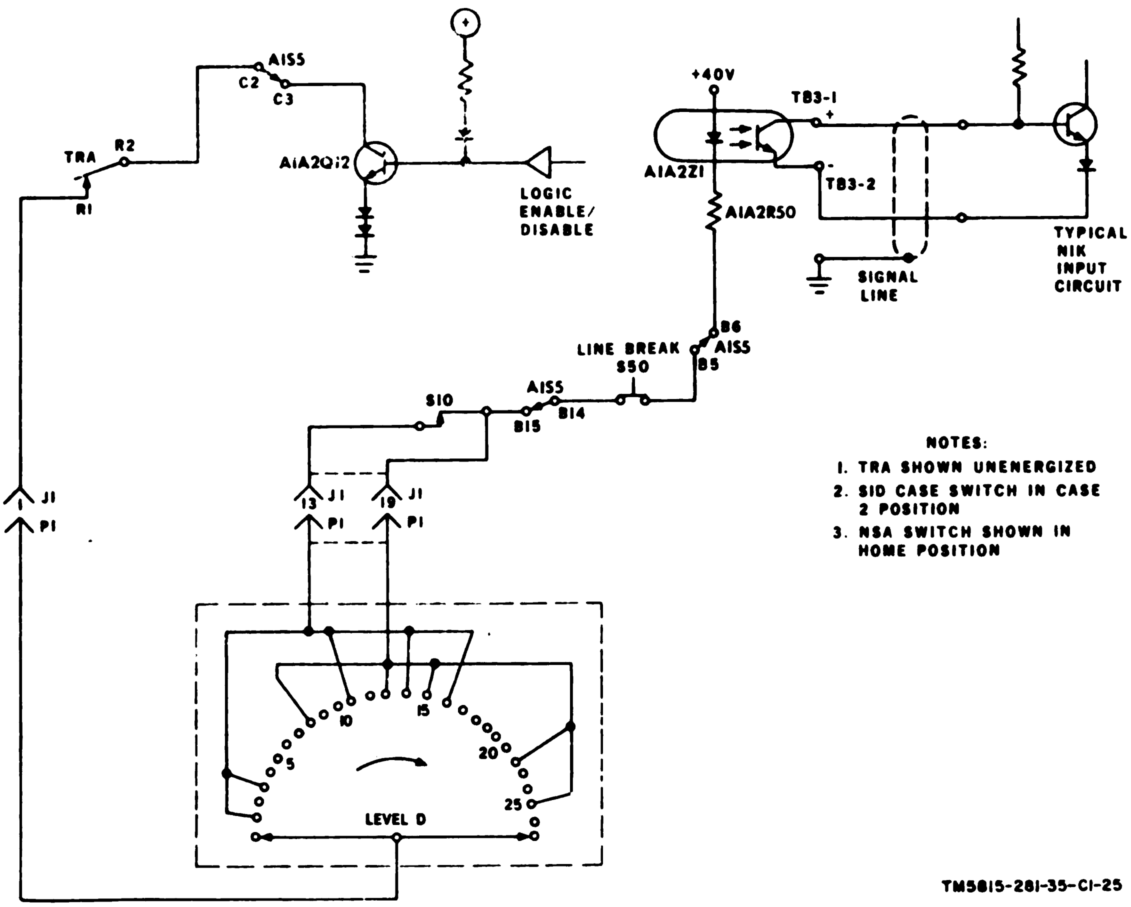


Figure 49.5. Transmission of first intelligence impulse (space) of first character (blank) of start-of-message indicator, low-level operations, simplified schematic diagram.

(2) As the transmitter camshaft rotates and while the code group is being transmitted, numbering pulsing switch S32 on the transmitter is closed by cam action to energize the coil of main stepping switch NSA. This circuit (fig. 35) is traced from battery through the operating coil of stepping switch NSA, through closed contacts R1-R2 of relay KNA which is deenergized, through closed contacts R10-R9 of relay TRA which is deenergized, through filter FL8, through numbering pulsing switch S32, through filter FL8, to ground. After the transmission of the fifth intelligence pulse, the numbering pulsing switch opens to deenergize the operating coil of stepping switch NSA, which causes the contact wipers to step. This sets up the intelligence impulses for the next code group to be transmitted.

(3) The contact wipers now rest on the number 1 (or number 14) contacts of the contact banks. This sets up the code group for the letter Z on levels Z through H of the switch. Refer to figure 49.5 to imagine the contact wiper in position 1. As can be seen from this figure, the circuit will be completed through the stepping switch and transistor A1A2Q12 (when enabled by the logic) will now draw current through A1A2Z1 and a MARK impulse will be transmitted as intelligence impulse number one. The circuit on level E is not completed and a space is transmitted for intelligence impulse number two. To complete the Z code group, levels F and G each are open circuits and so transmit spacing impulses while level H is completed and transmits a MARK impulse. The stop impulse is always added to the end of each code group by transistor A1A1Q8 as described previously in paragraph 41.8*g*.

(4) As the last intelligence impulse of the code group for the letter Z is transmitted, the coil of the stepping switch which has been energized, as described in (2) above, again deenergizes and steps the switch so that the contact wipers are moved to contact number 2 of the stepping switch contact bank. This sets up the intelligence impulses for the third code group, the letter C, on levels D through H of the stepping switch. In this manner, the second, third, and fifth code groups of the start-of-message indicator is transmitted.

b. Switch S10 in Position 1. The start-of-message indicator (CASE switch S10 in position 1) consists of five successive blank code groups. The transmission circuits for these code groups are identical with those for position 2 except that, with switch S10 in position 1, all signal line circuit paths are open at S10 and only spacing code impulses are transmitted (when wipers of associated main stepping switch are on contacts 0 through 4 of levels D through H) to make five successive blank code groups. Note on figure 49.5 that with switch S10 open, any MARK connections on contacts 0 through 4 will now be open circuits.

41.12. Transmitting Channel Designating Letters

a. Channel designating letters (fig. 33) consist of any three letters of the alphabet and are derived by strapping the desired characters into plug P7A on the control base. This strapping determines the pattern of current and no-current impulses that will be transmitted for the sixth, seventh, and eighth code groups of the message identification information. The strapping instructions for plug P7A are given in paragraph 26, TM 11-5815-281-12.

b. The first channel designating letter is transmitted when wipers of main stepping switch NSA are stepped to contact 5 (or 18) of the contact blank. A typical signal line circuit for transmitting a mark impulse is traced (fig. 49.6) from +40 volts through light emitting diode portion of A1A2Z1, through resistor A1A2R50, through contacts B5 and B6 of switch A1S5, through LINE BREAK switch S50, through contacts B14 and B15 of switch A1S5, through strapping that connects terminals 0 and 1 of plug P7A, through contact 5 of stepping switch NSA, through the switch wiper to contacts R1 and R2 of unenergized relay TRA, through contacts C2 and C3 of switch A1S5, to collector of transistor A1A2Q14. When transistor A1A2Q14 is enabled by the logic circuits, a marking impulse will be transmitted for impulse number 1 of that code group.

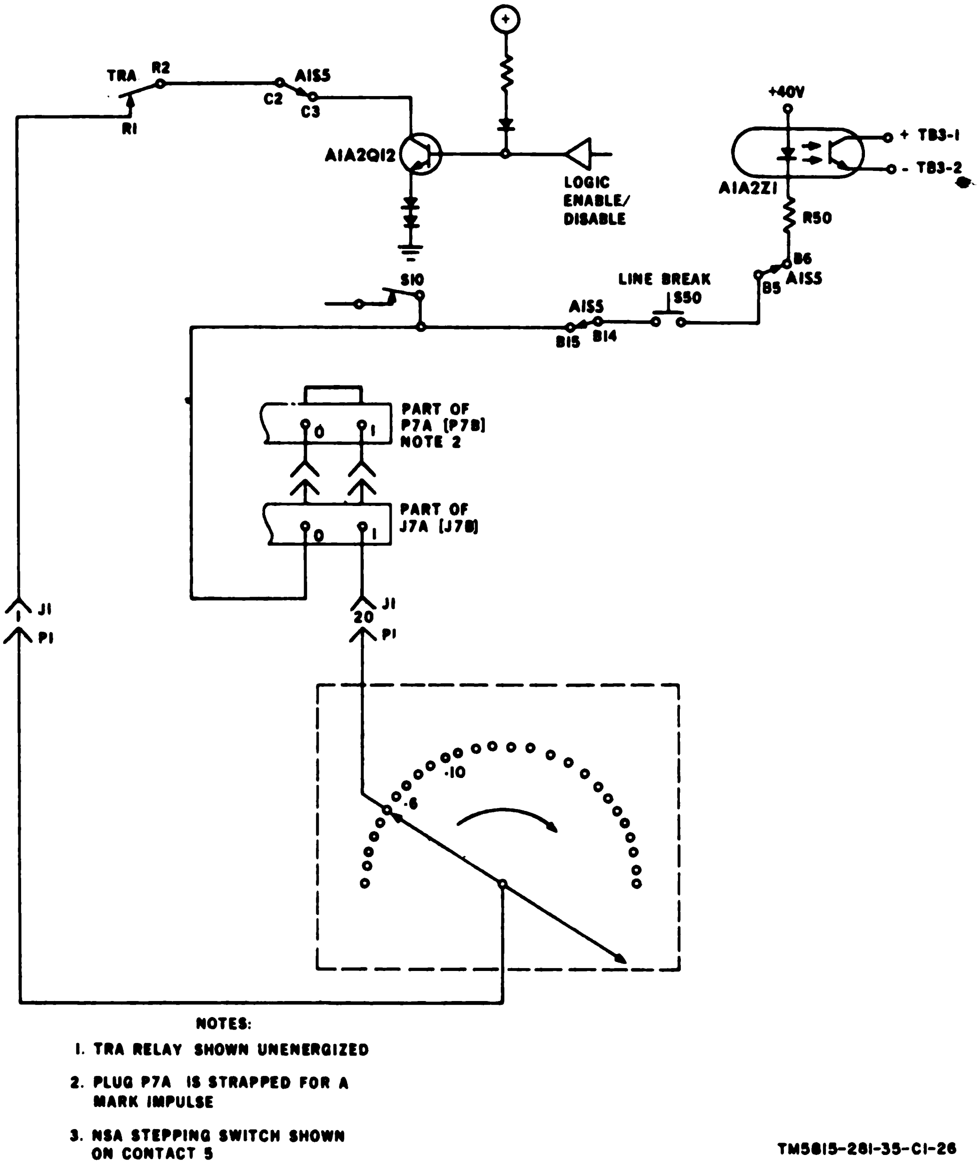


Figure 49.6. Transmission of first intelligence impulse of sixth character of message identification information, low-level operation, simplified schematic diagram.

c. A space impulse is transmitted in the same manner except the strapping on plug P7 is left open so that an open circuit exists between output isolator A1A2Z1 and transistor A1A2Q12. Therefore, the plug is wired to transmit the code group of marks and spaces for each of the switching transistors A1A2Q12, Q14, Q16, Q18, and Q20.

d. Switch NSA then steps to contact 6 (or 19) and contact (20) and in like manner the code information strapped on plug P7A is transmitted to complete the three channel designating letter codes.

41.13. Transmitting Message Numbering Information

a. The message number (fig. 33) is transmitted as code groups 10, 11, and 12 of the message identfication information, with the hundreds position as group 10, the tens position as group 11, and the units position as group 12. Before the number is transmitted, it is necessary to transmit a figures code group which is transmitted as code group 9 of the message identification information.

b. When the stepping switch wipers are stepped to contact 8, (or 21) of the stepping switch NSA contact bank, the figures code group is transmitted from circuits permanently wired into the equipment. This transmission occurs as shown in figure 49.5, where the wiper arm is now on contact 8 (or 21).

c. As the last intelligence impulse is transmitted to complete the figure code group, numbering pulse switch S32 opens to deenergize the main stepping switch; this causes the wipers to step to contact 9 (or 22) on the stepping switch contact bank. From this position, the hundredths column number is transmitted. Five code impulses (and a start and stop impulse) are sent to the line for each message number. The code pulses for 0 through 9 are wired on levels B through F of each numbering stepping switch. Level B is wired for the first pulse, level C for the second pulse, and so on, through level F. The information from message numbering switch RHA either completes or opens the circuit between output isolator A1A2Z1 and drives transistors A1A2Q12, Q14, Q16, Q18, and Q20 by means of the connections through contact 9 of the stepping switch. Message numbering switch opens or completes these circuits in stepping position 10 (or 23) and message numbering switch does the same in stepping position 11 (or 24). Thus the message numbering information from RHA is transmitted first, that from RTA next, and that from RUA last, transmitting a number such as 001.

d. When the contact wipers of main stepping switch NSA move to position 5 (or 18) to set up the circuits to transmit the first character of the channel designating letters from levels D through H of stepping switch NSA, a circuit is also completed through position 5 of level C of main stepping switch NSA in order to energize the coil of numbering stepping switch RUA. Stepping switch RUA will not energize, however, until the operating coil of switch NSA is again energized, because the interrupter contacts of NSA, through which the circuit is routed, close only when the switch is energized. The circuit is traced from battery through the operating coil of switch RUA (fig. 40), through the contacts TL2-TL1 of the numbering reset switch in the midposition, to contact 5 (or 18) on the contact bank of level C of main stepping switch NSA, through the wiper, through filter FL6, through the interrupter contact of switch NSA, through closed contacts BR1-BR2 of switch S34 (S35) to ground.

e. As soon as the main stepping switch has stepped to position 6 (or 19), numbering switch RUA will be deenergized, because the interrupter contacts of main stepping switch NSA close the circuit only when the coil of NSA is energized. As soon as numbering stepping switch RUA is deenergized, the spring will step its wipers to position 3, which corresponds to number 1 on the indicator wheel. As the wipers of numbering stepping switch RUA are stepped to a new position, the code pulse wired to that position on each level of RUA is transferred through the wipers of RUA to position 11 (or 24) of levels D through H of main stepping switch NSA. From NSA, the pulses are sent to distributor S48 and then, as the transmitter camshaft rotates, the signals are sent to the signal line. Although numbering stepping switch RUA steps to position 3 (corresponding to No. 1) when main stepping switch NSA steps to position 6 (or 19), the code pulses through RUA are not sent until main stepping switch NSA is on position 11 (or 24).

f. When number stepping switch RUA has been stepped to the position at which the message-numbering indicators show number 009, a cam on the stepping switch assembly closes the off-normal contacts of stepping switch RUA. When the main stepping switch NSA next steps its wipers to position 3 (or 16), the coil of numbering switch RTA is energized through level C of main stepping switch NSA and the off-normal contacts of numbering stepping switch RUA. The circuit (fig. 41) is traced from battery, through the operating coil of numbering stepping switch RTA, through contacts TR1-TR2 of numbering reset switch S34 in the midposition, through the closed off-normal contacts of stepping switch RUA, to contact 3 (or 16) on level C on main stepping switch NSA. From here, the circuit continues through the contact wiper, through filter FL6, through the closed interrupter contacts of main stepping switch NSA (which is energized) through filter FL6, through contacts BR2-BR1 of switch S34, and to ground.

g. As switch NSA steps to position 4 (or 17), the circuit to switch RTA is broken, the coil of stepping switch RTA is deenergized, and the armature spring steps the wipers to position 3 (No. 1 on the indicator wheel). However, the code pulses for RTA are not sent until main stepping switch NSA steps to position 10 (or 23) (*c* above). When main stepping switch NSA steps off position 5 (or 18), the circuit to numbering stepping switch RUA is broken, as described previously, and RUA will step its wipers. The circuit to numbering stepping switch RHA is still open and its wipers remain on position 2, which corresponds to 0 on the indicator wheel. Thus the number 010 will be displayed on the message-numbering indicators.

h. When numbering stepping switches RTA and RUA have stepped to the point that 099 is displayed on the message numbering indicators, a cam on each stepping switch assembly closes the off-normal contact associated with each switch. When main stepping switch NSA next steps its wipers to position 1 (or 14), a circuit is completed through level C of NSA, which will energize the coil of numbering stepping switch RHA. The circuit (fig. 42) is traced from battery, through the operating coil of numbering stepping switch RHA, through contacts TR5-TR4 of numbering reset switch S34, through the off-normal contacts of numbering stepping switches RTA and RUA, to contact 1 (or 14) on the level C of main stepping switch NSA. The circuit continues through the wiper of NSA, through filter FL6, through the closed interrupter contacts of switch NSA which is energized, through filter FL6, through contacts BR2-BR1 of switch S34, and to ground.

i. As the wipers of NSA step off position 1 (or 14) of level C, the circuit to the coil of numbering stepping switch RHA is broken and RHA is deenergized. The wipers of RHA are stepped to position 3, which corresponds to No. 1 on the associated indicator wheel. When the wipers of NSA step off position 3 (or 16), RTA will step its wipers to position 2, which corresponds to 0 on the indicator wheel. When the wipers of NSA step off position 5 (or 18), RUA will step its wipers to position 2, which corresponds to 0 on the indicator wheel. Thus, as main stepping switch NSA steps from position 1 to position 6, the message number displayed on the message-numbering indicators advances from 099 to 100.

j. As described in *c* through *h* above, the signal circuits for transmitting the message numbering code groups are set up between the main stepping switch NSA and the numbering stepping switches RHA, RTA, and RUA, five code groups prior to the time that particular code group is to be transmitted. The various levels of the numbering stepping switches are connected to levels of main stepping switches as follows:

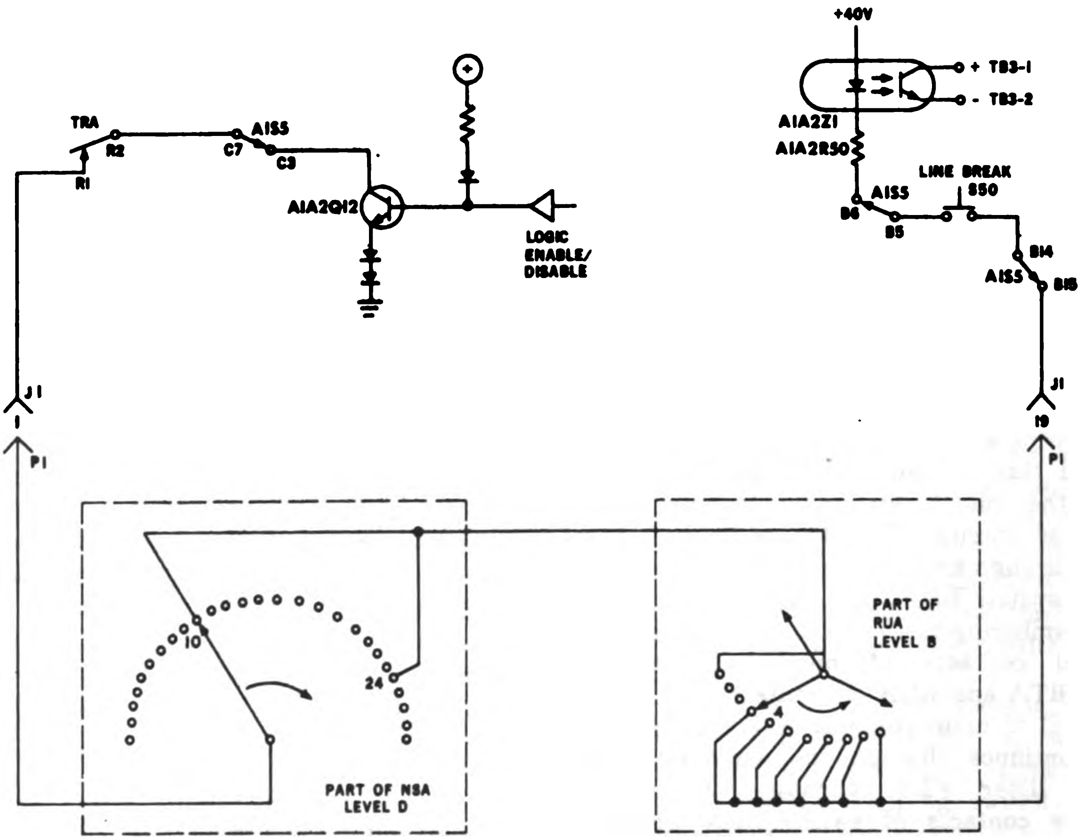
Numbering stepping switch level	*Main stepping switch level*	*Associated code impulse*
B	D	1
C	E	2
D	F	3
E	G	4
F	H	5

The various stepping switches are each connected to specific contacts so that the hundreds, tens, and units will be transmitted in their proper sequence. These connections are as follows:

Numbering stepping switch	*Main stepping switch contact number*	*Associated number position*
RHA	9,22	Hundreds
RTA	10,23	Tens
RUA	11,24	Units

k. A typical signal circuit for sending a marking impulse during transmission of the message-numbering information (first impulse, transmitting number 1 from units position) is shown in figure 49.7. The circuit is traced from +40 volts through isolator A1A2Z1 and resistor A1A2R50, through contacts B6 and B5 of switch A1S5, to contact 3 level B of numbering switch RUA, through the wiper of RUA to contact 11 (or 24) of level D on stepping switch NSA, through the wiper of NSA, through contacts R1 and R2 of unenergized relay TRA, through contacts C2 and C3 of switch A1S5 to the collector of transistor A1A2Q12.

l. A typical spacing impulse will be transmitted in the same way except that the circuit between isolator A1A2Z1 and transistor A1A2Q12 will be broken at numbering switch RUA as would be the case if this switch were in position 2 (fig. 49.7).



NOTES:
1. TRA RELAY SHOWN UNENERGIZED
2. NSA STEPPING SWITCH SHOWN ON CONTACT NO. 11
3. RUA STEPPING SWITCH SHOWN ON CONTACT NO. 3.

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Figure 49.7. Typical signal circuit for sending marking impulse during transmission of message numbering information, low-level operation.

m. After the transmission of the last numbering information, it is necessary to transmit a letters code group which is permanently wired into the equipment through contact 12 (or 25) on levels D through H of main stepping switch NSA. These circuits are similar to those described in *b* above, except that they are derived from contact 12 (or 25) instead of contact 8 (or 21) (fig. 39) of NSA.

n. After transmission of the last intelligence impulse of the last character of the message identification information, cam operated numbering pulsing switch S32 opens. This deenergizes main stepping switch NSA and causes it to step to contact 13 (or 0) on the contact bank. These are the home positions of the switch.

41.14. Preparation for Message Tape Transmission

a. The energizing of relay FNA (fig. 45) is the first step necessary to prepare the equipment to transmit from a message tape. Relay FNA energizes when the wiper of main stepping switch NSA has stepped to contact 12 (or 25) on level C of the contact bank. The interrupter contacts of the switch close as the operating coil is energized to prepare to step the switch to the home position. The energizing circuit for relay FNA is traced from battery, through the operating coil of relay FNA, to contact 12 (or 25) of main stepping switch NSA, through the contact wiper, through filter FL6, through the interrupter contacts of NSA, through filter FL6, through closed contacts BR2-BR1 of numbering reset switch S34 to ground. Relay FNA has a holding circuit that keeps the relay energized after its initial operation. This holding circuit is traced from battery, through the operating coil of relay FNA, through contacts L4-L3 of relay TSA which is energized, to ground.

b. As relay FNA energizes, it closes the circuit to energize relay KNA as the main stepping switch NSA steps to the home position. As relay KNA energizes, it opens the energizing circuit to the operating coil of stepping switch NSA to prevent it from energizing as the numbering pulsing contacts close after the switch has stepped to the home position. The energizing circuit for relay KNA (fig. 35) is traced from battery, through contacts R4-R5 of relay FNA which is energized, through the operating coil of relay KNA, to contact 13 (or 26) on the contact bank of stepping switch NSA, through the switch wiper to ground.

c. As relay FNA energizes, it also closes the energizing circuit to relay TRA to operate the relay. When relay TRA operates, it breaks the circuits between the contact wipers of the main stepping switch NSA and the collectors of transistors A1A2Q12, Q14, Q16, Q18, and Q20. These collectors are now connected directly to A1A2Z1 and A1A2R50 by means of switch A1S5 contacts A2-A3, A5-A6, A8-A9-, A11-A12, and A14-A15 and relay TRA contacts R3, R6, L3, L6, and L8 (see fig. 196 and simplified circuit in fig. 49.3). In addition, when relay TRA is energized transistor A1A2Q21 is turned on through contacts L12 and L13 and diodes A1A2CR4 through A1A2CR8 are reversed biased. This allows transistor A1A2Q12, Q14, Q16, Q18, and Q20 to be controlled by the photo-reader (A2) as described in paragraph 41.8*f*. The energizing circuit for relay TRA is traced from battery, through the B-T section of the operating coil of relay TRA, through contacts R8-R7 of relay TSA which is energized, through contacts R6-R7 of relay FNA which is energized, through the closed off-normal contacts of main stepping switch NSA which is deenergized, through filter FL6, through contacts BR2-BR1 of numbering reset switch S34 which is at midposition, to ground. A holding circuit is provided that will prevent relay TRA from deenergizing after transmission has begun. This circuit is traced from battery, through the L-R windings of relay TRA, through contacts R11-R12 of relay TRA, through contacts L9-L10 of relay STA which is energized, to ground.

d. To keep the distributor clutch magnet L4 in step with the reader clutch, the circuit to the distributor clutch magnet during tape transmission is routed through switch S44 (para 13*b*). This change in the distributor clutch magnet circuit is made as relay FNA energizes. The original distributor clutch magnet circuit path is described in paragraph 29*c* (3). The new circuit (fig. 31) is traced from battery, through the windings of distributor clutch magnet L4, through the L4-L3 contacts of relay FNA which is energized, through lever-operated switch S44, through contacts R3-R2 of relay FNA, through contacts L5-L6 of relay STA which is energized, through stop-start switch S42 which is in the START position, to ground.

e. The tape-reader clutch magnet L6 is also energized as relay FNA energizes, starting the tape-sensing operation (para 14). The energizing circuit (fig. 31) for the reader clutch magnet is traced from battery, through the windings of distributor clutch magnet L6, through contacts R3-R2 of relay FNA, through contacts L5-L6 of relay STA, which is energized, through stop-start switch S42 which is in the START position, to ground.

41.15. Message Tape Transmission

a. Transmission occurs from the message tape as the code groups, sensed by the tape-sensing mechanism (para 14), are transferred to switch board A1A2 and transmitted to the signal line as sequential signals. The following circuit conditions are necessary for tape transmission to occur:

(1) Power switch S13 in PWR position.

(2) Switch S42 in START position.

(3) Distributor clutch magnet L4 energized.

(4) Tape-reader clutch magnet L6 energized.

(5) Relays FNA, TSA, KNA, TRA, and STA energized.

(6) Relay SDA deenergized.

(7) Main stepping switch in home position.

b. The circuits for transmitting the information from the photo-reader to the signal line have been described in paragraph 41.8 Mark and space impulses are transmitted depending on the code levers blocking or not blocking the photo-reader (A2) light beam. The photo-signals are amplified and sequentially read out to the signal line at TB3-1 and TB3-2.

41.16. Stopping Transmission (End-of-Tape Condition)

a. Blank Signals Not Generated. When the BLANK SIGNAL switch S1 is in the OFF position to prevent the generation of blank signals at the end of the message, the following sequence occurs to stop tape transmission:

(1) Tape-out switch S30 is opened as the end of the tape passes through the sensing mechanism. As switch S30 opens, it breaks the original energizing circuit (para 29*b*) for relay TSA, and relay TSA is held through its holding circuit. This holding circuit (fig. 28) is traced from battery, through the operating coil of the relay, through contacts L7-L8 of relay TSA, through latch-pulsing switch S46 to ground. Switch S46 holds the circuit closed to insure complete message transmission.

(2) As the stop pulse of the last character is transmitted, cam-operated latch-pulsing switch S46 opens to deenergize relay TSA, this breaks the holding circuit.

(3) As relay TSA deenergizes, it breaks the holding circuit (fig. 45) for relay FNA and relay FNA deenergizes. As FNA relay contacts R2-R3 (fig. 31) open, this breaks the energizing circuit to tape-reader clutch magnet L6. As contacts L4-L3 of relay FNA open, this breaks the energizing circuit of the distributor clutch magnet L4, but this circuit is immediately restored through the original energizing circuit as contacts R1-R2 of relay FNA close. When relay FNA deenergizes, it breaks the energizing circuit (fig. 35) to relay KNA to prepare the energizing circuit of main stepping switch NSA for the transmission of the next message.

(4) As relay TSA deenergizes, it also opens the original energizing circuit (fig. 29) for relay STA. Relay STA is then held energized through a circuit that can be traced from battery, through contact R-L of the operating coil of relay STA, through contacts R9-R10 of relay STA, through filter FL8, through numbering pulsing switch S32 to ground.

(5) After the stop impulse of the last code group is transmitted, numbering pulses switch S32 opens, which breaks the holding circuit of relay STA. Relay STA deenergizes to break the energizing circuit to distributor clutch magnet L4 (fig. 31). The distributor clutch magnet armature blocks further rotation of the transmitter camshaft as the magnet deenergizes.

(6) The deenergizing of relay STA breaks the holding circuit of relay TRA (fig. 46). This reconnects the collectors of transistors A1A2Q12, Q14, Q16, Q18, and Q20 to the numbering base to prepare for transmission of the message identification information for the next message to be transmitted.

b. Blank Signals Generated. When BLANK SIGNAL switch S1 is in the BLANK SIGNAL position, it causes the generation and transmission of a predetermined number of blank signals at the end of the message, and the following sequence occurs to stop tape transmission.

(1) The start of the sequence is identical with that described in *a* (1) through (4) above.

(2) A second holding circuit (fig. 29) for relay STA is established through blank tape switch S28 on the transmitter and through BLANK SIGNAL switch S1 on the line control and relay base in the BLANK SIGNAL position. This circuit is traced from battery, through the B-T windings of the operating coil of relay STA, through contacts R8-R7 of relay STA, through normally closed blank tape switch S28, through BLANK SIGNAL switch S1 in the BLANK SIGNAL position, through the closed contacts of tape-out switch S30, to ground.

(3) With relay STA held energized, the energizing circuit to distributor clutch magnet L4 (fig. 31) remains closed and the transmitter camshaft continues to rotate. For every half turn of the cam shaft, one stop pulse will be generated by the stop contacts. Operating the stop contacts will cause the clock circuit to be enabled and the logic circuit will sequentially enable transistors A1A2Q12, Q14, Q16, Q18, and Q20. However, since the reader clutch is not energized, the tape reading levers will be blocking the light beams to the photoreader (A2) transistors. Thus the output character codes transmitted will be all spaces of a "blank" character. Blank signal transmission continues until the energizing circuit to relay STA (fig. 29) is broken by the opening of blank tape switch S28. As relay STA deenergizes, it breaks the energizing circuit to the distributor clutch magnet to block rotation of the transmitter camshaft.

(4) The deenergizing of relay STA breaks the holding circuit of relay TRA (fig. 46). This reconnects the circuits for transmission of the next message identification sequence.

41.17. Stopping Transmission (Tight-Tape Condition)

When the tight-tape lever moves upward because the message tape has become taut or tangled, the following sequence takes place:

a. The tight-tape lever opens stop-start switch S42 (contacts C-NC).

b. Stop-start switch S42 opens the circuit to distributor clutch magnet L4 (fig. 31) and tape-reader clutch magnet L6 to block rotation of the transmitter camshaft and stop transmission.

c. As the cause of the tight-tape condition is cleared up, switch S42 again closes (C-NC) to energize clutch magnets L4 and L6, and transmission resumes.

41.18. Stopping Transmission (Stop-Start Lever Operation)

a. Operating Stop-Start Lever to STOP. When the stop-start lever is moved to the STOP position during message transmission, the following sequence takes place:

(1) Operation of the stop-start lever to STOP opens stop-start switch S42 (C-NC).

(2) Stop-start switch S42 opens the distributor clutch magnet L4 circuit (fig. 31) and the tape-reader clutch magnet L6 circuit to block rotation of the transmitter camshaft and stop transmission.

(3) As the stop-start lever is again moved to the START position, switch S42 again closes (C-NC) to energize clutch magnets L4 and L6, and transmission resumes.

b. Operating Stop-Start Lever to FEED RETRACT. When the stop-start lever is moved from START to FEED RETRACT during transmission of a message, the circuits will react as though the complete message had been transmitted in the normal manner. Therefore, if the stop-start lever is subsequently moved to the START position, a new message identification sequence will be transmitted automatically, followed by the balance of the interrupted message. Normally a message should not be interrupted by moving the stop-start lever to FEED RETRACT during transmission from a message tape. If, after the tape begins feeding, it becomes necessary to stop transmission and then resume transmission of the same message, move the stop-start lever to STOP to halt transmission and then to START to resume transmission. However, if another (higher priority) message must be transmitted immediately over a busy signal circuit, move the stop-start lever to FEED RETRACT, remove the tape of the interrupted message, insert the tape of the higher priority message, and move the stop-start lever to STOP; then to START.

(1) As the stop-start lever moves downward, past the STOP position, the conditions described in *a* (1) and (2) above occur.

(2) When contacts C-NC of switch S30 open, the circuit to relay TSA (fig. 28) opens, deenergizing TSA.

(3) When relay TSA deenergizes, it opens the holding circuit to relay STA (fig. 29) and relay FNA (fig. 45) to deenergize STA and FNA.

(4) As relay STA deenergizes, contacts L9-L10 (fig. 46) open to break the holding circuit for relay TRA, deenergizing TRA also. Contacts R1-R2 of relay STA close to energize relay SDA (fig. 27).

(5) The deenergizing of relays STA and TRA causes a short to be placed across distributor stop contacts (contacts L1-L2 of STA in series with contacts R7-R8 of TRA).

(6) When relay RNA deenergizes ((3) above), it opens the circuit to relay KNA, to deenergize KNA (fig. 35).

(7) All circuits are restored to their normal state, and the equipment is readied for transmission of the message identification information for the next message.

41.19. Message Numbering Reset Switch Operation

When message numbering RESET switch S34 is operated to the RESET position, numbering stepping switches RUA, RTA, and RHA are reset to 0. The numbering indicators then show 000. When message numbering RESET switch S34 is moved to the OFF position, the message identification information is not fed to distributor S48, and transmission is from the message tape only. These operations take place as follows:

a. Message Numbering Reset Switch S34 in RESET Position.

(1) The circuit to reset numbering stepping switch RUA (fig. 48) is traced from battery through the operating coil of stepping switch RUA, to contact 11 on level A of the stepping switch, through contacts TL2-TL3 of numbering RESET switch S34 in the RESET position, to all contacts except contact 2 on level A of the

stepping switch, through the contact wiper of the switch, through the interrupter contacts of the switch, to ground. This circuit energizes the operating coil of the switch, and, as the coil is energized, it opens the interrupter contacts to cause the switch to deenergize and step. The contact wiper steps to the next position on the contact bank and the circuit is again made and broken. The switch is stepped in this manner until the contact wiper reaches contact 2, at which time the number 0 is displayed in the associated message numbering indicator window.

(2) The circuits for resetting numbering stepping switches RTA and RHA are similar to those for RUA. In each case, the circuit is alternately closed and opened through level A of the contact bank until position 2 is reached and the number 0 shows through the window of the associated message numbering indicator.

b. Message Numbering Switch S34 in OFF Position. When message numbering switch S34 is in the OFF position, it prevents the transmission of the message identification information. Since the switch key is fitted with a stop to prevent its being moved to this position, the circumstances under which this feature would be used are very limited. If, for any reason, the stop is removed and the switch is operated to the OFF position, the following sequence of message tape transmission occurs:

(1) As the stop-start lever is moved from the FEED RETRACT position, relay SDA is deenergized (para 29*c*).

(2) As tape-out switch S30 is closed by the movement of the stop-start lever, relay TSA energizes (para 29*b*).

(3) Relay STA energizes as the contacts of relays TSA and SDA close (para 29*c*).

(4) The short is removed from across the stop contacts of distributor S48 (para 29*c* (2)).

(5) Relay FNA is energized through a circuit traced from battery (fig. 45), to the contact bank on level C of stepping switch NSA, through contacts BL2-BL3 of numbering RESET switch S34 in the OFF position, through contacts L4-L3 of relay TSA which is energized, to ground.

(6) As relay FNA energizes, relay TRA is energized through a circuit traced from battery (fig. 46), through the B-T windings of the operating coil of relay TRA, through contacts R8-R7 of relay TSA which is energized, through contacts R6-R7 of relay FNA which is energized, through the interrupter contacts of main stepping switch NSA which is deenergized through filter FL6, and through contacts BR2-BR3 of switch S34 in the OFF position. The circuit continues through contacts R7-R8 of relay STA which is energized, throguh contacts R1-R2 of deenergized relay SDA, through contacts L6-L5 of energized relay TSA, to ground. The holding circuit for relay TRA is traced from battery, through the L-R winding of relay TRA, through contacts R11-R12 of the relay, through contacts L9-L10 of relay STA which is energized, to ground.

(7) As relay TRA is energized, the circuits from A1A2Z1 to the amplifier transistors A1A2Q14, Q16, Q18, and Q20, are closed to permit transmission from the message tape.

(8) With relays FNA and STA energized, the distributor clutch magnet is energized as described in paragraph 34*d*. The tape-reader clutch magnet is energized as described in paragraph 34*e*.

(9) With these conditions established, the message derived from the message tape is transmitted from the transmitter.

41.20. FORWARD STEP Switch Operation (fig. 49)

A FORWARD STEP switch is provided for each numbering indicator. The FORWARD STEP switch is used when one numbering indicator is to be advanced independently of the others.

a. Operating FORWARD STEP UNITS Switch. When FORWARD STEP UNITS switch S36 is depressed, the circuit to numbering stepping switch RUA (fig. 49) is energized. When the FORWARD STEP UNITS switch is released, the coil of numbering stepping switch RUA is deenergized, and RUA steps one position. The circuit for stepping numbering stepping switch RUA is traced from battery, through the operating coil of stepping switch RUA, through FORWARD STEP UNITS switch S36 which is operated, to ground. The circuits for stepping switches RTA and RHA follow similar paths, with the circuit for RTA being routed through S38, and the circuit for RHA being routed through S40.

41.21. Message Numbering Indicators Stepped to Nine

a. Each numbering stepping switch has 11 contacts between the home positions of the switch, but only 10 digits are required for each numbering cycle. Therefore, the switch is wired to step twice when the contact wiper moves from position 10 (where the digit 8 shows in the window of the message numbering indicator) to position 1 (where the digit 9 shows in the window of the message numbering indicator). When the numbering stepping switch deenergizes to step from position 10 to position 11, a circuit is closed on level A, which automatically energizes and deenergizes the numbering stepping switch. The switch thus steps twice in rapid succession and the contact wiper is moved to position 1.

b. The circuit (fig. 48) that automatically energizes and deenergizes numbering stepping switch RUA is traced from battery, through the coil of numbering stepping switch RUA, through contact 11 of level A of RUA, through the contact wiper which has stepped to contact 11, through the interrupter contacts of RUA, to ground. When the magnet energizes, the interrupter contacts open and deenergize the magnet. When the magnet deenergizes, it steps the wipers of RUA to position 1.

c. The circuits for numbering stepping switches RTA and RHA are energized and deenergized through the interrupter contacts and level A of the respective switches.

CHAPTER 3
THIRD ECHELON MAINTENANCE

Section I. GENERAL

42. Scope of Third Echelon Maintenance

Third echelon maintenance of the distributor set includes preventive maintenance and lubrication (para 46-56), troubleshooting (para 57-68), repair (para 69-97), and adjustment (para 98-193). Refer to TM 11-5815-281-12 for supplementary maintenance information.

43. Third Echelon Maintenance Tools

Tool Equipments TE-37, TE-50-B, and TE-111 include most of the tools required for the maintenance of the distributor set. The following additional tools are required:

a. A special insulated wrench (Kleinschmidt No. 58420A) is required to adjust the distributor contacts of the transmitters.

b. Three Brushes TL-72, or equal, are required for lubrication of the stepping switches in the numbering base.

c. A gage set, Signal Corps stock No. 6R41570, is required for the adjustment of relays.

44. Maintenance Materials

The maintenance materials in the TE-50-B and the items listed in the following chart are required for maintenance of the distributor set.

Item	Stock No.
Cleaning Compound, liquid form (1-pt can).	7930-395-9542 (Fed)
Dry Cleaning Solvent (SD-1) (5-gal can).	6850-264-9038 (Fed)
Anti-seize Compound (1/2-lb can).	52-2724.500.800 (CE)
Grease (KS7471) (1-lb can)...	6G650 (Sig C)
Oil (KS7470) (1-qt can)	6G1325 (Sig C)
Oil, General Purpose, Low Temperature Lubricating (OGP).	14-0-2564-200 (QMC)
Grease, Aircraft and Instrument (GL).	9150-261-8297 (Fed)
Lubricating Oil, Colloidal Graphite (LCG).	9150-261-7905 (Fed)
Lubricating Oil, Watch (OCW)	9150-270-0063 (Fed)

45. Third Echelon Test Equipment

The following chart lists the test equipment required for third echelon maintenance of the distributor set, the applicable technical manual for each item of test equipment, and the use of each item in the maintenance of the distributor set.

Test equipment	Technical manual	Use
Test Set I-181	TM 11-2036	Used to check operation of neutral-type relays.
Multimeter TS-352/U.	TM 11-5527	Used to measure voltage, current, and resistance.
Distortion Test Set TS-383A/GG.	TM 11-2217	Used to check bias and ends distortion tolerance of transmitted signals.

Section II. PREVENTIVE MAINTENANCE

46. Preventive Maintenance Chart

The maintenance and inspection procedures listed in the following chart should be performed by third echelon maintenance personnel at intervals as determined by the average daily number of hours of operation of the distributor set. Refer to the chart in paragraph 52 to determine the proper maintenance frequency. Refer to TM 38-750 for instructions in the maintenance of equipment records. Referenced paragraphs in the *Item* and *Normal condition or result* columns in the following chart provide additional maintenance and inspection details. Paragraphs referenced in the *References* column contain appropriate corrective maintenance instructions.

Item No.	Procedure		References
	Item	Normal condition or result	
1	VISUAL INSPECTION: Inspect the distributor set for completeness, cleanliness, and visible defects.	Distributor set is complete, clean, and ready for operation (para 5, 42, 46, and 47 of TM 11-5815-281-12; para 50 of this manual).	Paragraphs 2, 42, 46, and 47 of TM 11-5815-281-12; paragraph 50 of this manual.
2	LUBRICATION: Check all lubrication points (para 149-170).	Some lubrication points will require lubrication, other lubrication points will not.	Paragraphs 149-170.
3	MOTOR SPEED: Check speed of motors (para 23, TM 11-5815-281-12).	Motors are operating at correct speed (para 23, TM 11-5815-281-12).	Paragraph 23, TM 11-5815-281-12; paragraph 147 of this manual.
4	OPERATION CHECK: Check operation of distributor set (para 29, TM 11-5815-281-12).	See paragraph 29, TM 11-5815-281-12.	Paragraph 29 of TM 11-5815-281-12; paragraphs 171-194 of this manual.
5	TRANSMITTED SIGNAL BIAS: Check length of transmitted signals (para 133).	Signal bias does not exceed 5 percent (60-wpm opn); 7 percent (100-wpm opn).	Paragraph 133.

47. General Cleaning Instructions

Most preventive maintenance techniques pertain to specific areas of preventive maintenance, such as lubrication, and are covered in detail elsewhere in this chapter. When maintaining the distributor set;

a. Use No. 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for most cleaning purposes.

(1) When necessary, use a cloth moistened with solvent (SD-1) to clean metallic parts (except electrical contacts). Wipe solvent (SD-1) and dirt from the part with a clean, dry cloth.

Warning: **Cleaning compound is flammable and its fumes are toxic. Do not use near a flame; provide adequate ventilation.**

(2) A flushing action normally is best when cleaning electrical contacts. Dip an orangestick in cleaning compound and allow the liquid to drip from the stick through the contacts. Remove the cleaning compound carefully with a clean, dry cloth.

c. If available, vacuum cleaning equipment is suitable for removing loose dust, paper lint, and dirt from the distributor set. Compressed air may be used, but pressure must be kept below 60 pounds per square inch to prevent equipment damage.

48. Special Cleaning Instructions

a. Parko-Lubrized and Parkerized Parts. Do not keep parko-lubrized and parkerized parts (those with a black finish) in solvent (SD-1) for an extended period, because the protective impregnated oils and waxes will be removed. Clean all parko-lubrized and parkerized parts with an oil-soaked cloth.

b. Oil-Impregnated Bronze Parts. Do not immerse oil-impregnated bronze (oilite) bearings and other oil-impregnated parts in solvent (SD-1), because the impregnated oils will dissolve. To clean, use a stiff brush or wipe with an oil-soaked cloth.

c. Ball Bearings. The ball bearings used on the distributor set are sealed. Do not attempt to lubricate or clean them; wipe them with a clean, dry cloth. Replace any bearings that do not spin freely.

49. Preparation for Preventive Maintenance

Prepare for preventive maintenance as follows:

a. Disconnect the power cable from the ac power source.

b. Disconnect the cables that connect the component to be serviced to the control base.

c. Remove dust covers or panels as required to obtain access to interior of the component.

50. Preventive Maintenance Procedures

a. Dust Covers and Panels.

(1) Inspect the dust covers and panels. Look for dents, cracks, marred painted surfaces, or other damage.

(2) Clean the outer surfaces of the dust covers with a piece of cloth slightly dampened with water. Use a cloth moistened with solvent (SD-1) to remove oil, grease, or gummy deposits on the surface of the cover.

b. Bases.

(1) Clean the bases thoroughly with a cloth and sash brush. Wipe off all depositis of oil and grease that may have dropped from the mechanical assemblies.

(2) Check the wiring for cracked or deteriorated insulation and for kinks and strains caused by improper placement.

(3) Tighten loose fasteners, clamps, and connections.

(4) Wipe the outer insulation of cords and cables to remove oil and grease.

Caution: Never use solvent (SD-1) on rubber insulation; it is harmful to rubber.

c. Motors.

(1) The motor shaft should turn freely, smoothly, and quietly when turned by hand and when operated under power.

(2) Check the motor for evidence of overheating. This may be indicated by discoloration or by the odor of burned insulating material.

(3) Check to be sure that the screws that fasten the governor, the governor cover, and the target wheel are tight.

(4) Remove all dirt, dust, grease, and corrosion from the outside of the motor. Check to see that the wires leading to the motor are intact.

d. Transmitters.

(1) Check for loose, missing, or broken screws, bolts, fastenings, and electrical connections, frayed or broken wire insulation, and oil-soaked wiring and insulation.

(2) Inspect for worn or broken levers, pawls, latches, springs, bearings, and other mechanical parts. Be sure that all parts that should move freely do so without binding.

(3) Check for missing, broken, or distorted springs.

(4) Look for worn, dirty, or burned contacts on the transmitter pulsing contacts or the distributor contacts.

(5) Blow out or brush away any dirt, paper, or dust that may have accumulated in the transmitter mechanism, sensing levers, and feed mechanism.

(6) Clean the transmitter pulsing contacts and distributor contacts as described in *h*(2) below.

(7) Lubricate as described in paragraph 55.

e. Power Supplies.

(1) Inspect the power supplies for loose connections, damaged or broken parts, and defective or burned-out wiring. Look for evidence of overheating (discoloration of the transformer or rectifier stack).

(2) Tighten all loose screws, bolts, nuts, and cable clamps. Solder any loose or broken connections. Check the condition of the flexible transformer taps.

(3) Use a suitable brush, cheesecloth, and a vacuum cleaner to remove dust and dirt. Remove oily and gummy deposits with a cloth dampened with solvent (SD-1). Remove all rust spots. Repaint all chipped, scratched, or worn metal surfaces.

f. Cords, Cables, and Wiring.

Caution: **Do not allow oil or solvent (SD-1) to come in contact with rubber insulation. Oil or solvent (SD-1) causes deterioration of rubber.**

(1) Check all wiring for cracked or deteriorated insulation. Look for frayed or cut insulation at connecting or support points, kinks, or strain caused by improper placement.

(2) Tighten loose fasteners, clamps, and wiring connections. Repair loose or broken connections. Remove corrosion, rust, dirt, or dust from ground connections. Be sure that the outer insulation cover on cords and cables is wiped clean. Renew the weatherproof coating on any fabric-covered wires that require it.

(3) Where necessary, arrange the wiring to prevent it interference with the operation of mechanical parts. Resolder loose connections and replace worn or damaged wiring.

g. Terminal Boards.

(1) Inspect the terminal boards for cracks, breaks, and loose connections. Examine the connections for mechanical defects (broken or stripped screws and threads), dirt, grease, and corrosion. Tighten loose screws, lugs, and mounting bolts, Be careful not to strip the threads by exerting too much force. Solder loose or broken connections.

(2) Remove moisture with a dry cloth. Brush off dirt and dust. Remove oil or gummy deposits from terminal boards with a cloth moistened with cleaning compound.

h. Switches.

(1) Check the mechanical action of each switch. Operate each switch to see that it moves freely. Note the amount of spring tension and inspect for insufficient contact pressure where applicable. Tighten loose screws, lugs, or mounting bolts. Remove loose connections that are dirty or corroded and clean them before tightening or soldering.

(2) Wipe off any moisture present. Clean the exterior surfaces of the switches with a sash brush. Use cleaning compound to remove dirt from switch contacts (para 47*b*(2)). Polish the contacts with a contact burnisher. If the contacts are pitted or burned, use a contact file to restore the surfaces before polishing them with the burnisher.

Section III. LUBRICATION

51. Recommended Lubricants

a. Transmitter Mechanisms. Use the following to lubricate the operating mechanical parts:

(1) Oil, NSN 9150-00-223-4129 (1-qt can).

(2) Grease, NSN 9150-00-223-4003 (1-lb can).

b. Stepping Switches. Use the following to lubricate the stepping switches:

(1) Grease, Aircraft and Instrument (GL), Federal stock No. 9150-261-8297 (8-oz tube).

(2) Lubricating Oil, Collodial Graphite (LCG), Federal stock No. 9150-261-7905.

(3) Lubricating Oil, Watch (OCW), Federal stock No. 9150-270-0063 (1/2-oz bottle).

52. Lubricating Schedule

a. Transmitters. The following chart lists the recommended interval for *checking* the lubrication of the transmitters. Lubricate *only* those items that require lubrication. *Do not overlubricate.*

Operating speed (wpm)	Intervals between lubrication checks (days)			
	Operation up to 8 hours per day	Operation 8 to 12 hours per day	Operation 12 to 16 hours per day	Operation 16 to 24 hours per day
60	30	20	15	10
66	27	18	13	9
75	24	16	12	8
100	18	12	9	6

b. Stepping Switches. Lubricate the stepping switches in the numbering base after the first 3 months of operation and every 6 months thereafter.

53. Preparation for Lubrication

a. Transmitter Mechanisms. To lubricate the transmitter mechanisms, take the transmitter out of service and partially disassemble it as follows:

(1) Move the power switch on the control base to OFF. Disconnect the transmitter connecting cable that connects the transmitter to the control base. Disconnect the motor power cable from the control base.

(2) Remove the three shoulder screws (1, fig. 71) that secure the motor dust cover (6) to the base; remove the dust cover.

(3) Remove the transmitter covers (para 71*a*(3), 72*a*(2) and (4)).

b. Numbering Base. Prepare for lubrication of the stepping switches in the numbering base as follows:

(1) Move the power switch on the control base to OFF. Disconnect the cables that connect the numbering base to the control base. Remove the numbering base from its rack.

(2) Remove the machine screws (1, fig. 86), the lockwashers (2), and the flat washers (3) that secure the dust cover (4) to the numbering base; remove the dust cover.

(3) Remove the machine screws (5), the lockwashers (6), and the flat washers (7) that secure the front panel (23) to the numbering base; remove the front panel.

54. Methods of Applying Lubricants

a. Greasing. Use the grease gun supplied with Tool Equipment TE-50-B to apply grease. Hold the grease gun so that the nozzle forms an angle of 45° with the part to be lubricated. Operate the handle of the grease gun until grease is ejected; at the same time, rotate the gear to form a continuous ribbon of grease along the periphery of the part.

b. Oiling Transmitters. Lubricate the felt lubricating washers to the saturation point only. Use the pen-shaped oiler supplied in the TE-50-B or a piece of wire approximately 0.030 inch in diameter to apply oil to those parts that require only 1 or 2 drops of oil. If a wire is used, dip the wire approximately 1/2 inch into the oil to collect a small amount on the end of the wire; then touch the wire to the lubrication point. This method permits close control over the amount of oil applied to these points and prevents overlubrication. To lubricate other parts of the equipment, use the oiler supplied with the TE-50-B.

c. Oiling Stepping Switches. Use Brush TL-72 to measure and apply the specified oil and grease. Dip the brush into the lubricant to a depth of approximately 3/8 inch; scrape the brush lightly on the edge of the container to remove surplus lubricant. Touch the brush to the parts of the stepping switch to be lubricated and brush the area lightly. The amount of lubrication applied in this manner is referred to as a *dip*. In most cases, one dip is enough to lubricate several parts because only a thin film of lubricant is required.

Caution: **Use a different brush for each type of lubricant.**

55. Detailed Lubrication of Transmitters (fig. 50-57)

The points to be lubricated and the quantity to be applied are listed in the charts (*a* through *e* below). The charts are arranged according to the type of part to be lubricated so that the transmitter can be lubricated in a systematic manner. The item numbers listed in the charts correspond to the item numbers on the referenced figure.

Note: The ball bearings in the transmitters are sealed and do not require lubrication.

a. Gears.

Fig. No.	Item No.	Lubrication point	Method and quantity of grease (KS7471)
50	2	Drive gear	Apply sparingly around gear teeth.
50	3	Driving gear	Apply sparingly around gear teeth.

Fig. No.	Item No.	Lubrication point	Method and quantity of grease (KS7471)
50	4	Worm and worm gear	Apply liberally around gear teeth.
51	10	Counter cam ratchet	Apply sparingly around gear teeth.
51	12	Counter indexing ratchet	Apply sparingly around gear teeth.

b. Cams.

Fig. No.	Item No.	Lubrication point	Method and quantity of grease (KS7471)
51	9	Counter contact pin	Apply sparingly on working area of pin.
52	1	Channel numbering pulsing switch cam.	Apply sparingly on working area of cam.
52	2	Line break pulsing switch cam ...	Apply sparingly on working area of cam.
52	3	Counter pin	Thin film on pin.
52	6	Tape-feed cam	Thin film on working area of cam.
52	7	Counter restore cam	Apply sparingly on working area of cam.
52	8	Restore lever cam	Apply sparingly on working area of cam.
52	9	Tape-feed retracting lever cam ..	Apply sparingly on working area of cam.
52	10	Latch pulsing switch cam	Apply sparingly on working area of cam.
54	7	Switch lever cam	Apply sparingly on working area of cam.
54	9	Latch lever cam	Apply sparingly on working area of cam.

c. Friction Clutch.

Fig. No.	Item No.	Lubrication point	Method and quantity of oil (KS7470)
50	1	Friction clutch	10 to 15 drops along periphery of felt friction plates; apply sparingly to spring and collar.

Note: It is usually not necessary to release the spring tension of a friction clutch for routine lubrication. If the spring tension has been released as a result of another maintenance procedure, oil the friction clutch and adjust the clutch (para 140).

d. Lubricating Felt Washers.

Fig. No.	Item No.	Lubrication point	Method and quantity of oil (KS7470)
51	3	Latch cam felt washer	Saturate felt washer.
51	6	Pivot post felt washer	Saturate felt washer.
52	4	Clutch pawl felt washer	Saturate felt washer.
53	1	Cam lever felt washer	Saturate felt washer.
53	2	Detent lever felt washers	Saturate felt washer.
53	3	Stop-start lever felt washer	Saturate felt washer.
54	1	Lever arm felt washer	Saturate felt washer.
54	2	Driving dog felt washer	Saturate felt washer.
54	3	Tape-out lever felt washer	Saturate felt washer.
54	6	Lever latch felt washer	Saturate felt washer.
55	16	Counter felt washer	Saturate felt washer.

e. Miscellaneous Transmitter Lubrication Points.

Fig. No.	Item No.	Lubrication point	Method and quantity of oil (KS7470)
51	1	Distributor-armature latch pivot stud.	1 drop on working part; apply sparingly on rubbing surfaces.
51	2	Contact plungers	1 drop on each contact plunger.
51	4	Tape-out lever	1 drop at each pivot point; apply sparingly on working surfaces.
51	5	Sensing lever comb	1 drop at each sensing lever slot.
51	7	Indexing ratchet detent	1 drop at pivot point.
51	8	Counter ratchet detent	1 drop at pivot point.
51	11	Counter clock spring	2 drops on spring surface.
52	5	Kickout plate	Apply sparingly on all rubbing surfaces.

Fig. No.	Item No.	Lubrication point	Method and quantity of oil (KS7470)
52	11	Camshaft	Several drops on shaft at tape-reader cam assembly.
54	4	Sensing lever latch	1 drop at pivot points; apply sparingly on rubbing surfaces.
54	5	Switch actuating lever	1 drop at pivot points; apply sparingly on rubbing surfaces.
54	8	Tape-out lever shaft	Apply sparingly on rubbing surfaces.
55	1	Counter ratchet stud	2 drops all along stud.
55	2	Counter pawl	1 drop at pivot point; apply sparingly on working surfaces.
55	3	Counter lever	1 drop at each pivot point.
55	4	Restore lever cam follower	Apply sparingly to all bearing and rubbing surfaces.
55	5	Sensing lever comb	Apply sparingly to all rubbing surfaces of comb.
55	6	Restore lever	Apply sparingly to all contact surfaces.
55	7	Stop-start lever	Apply sparingly to all pivot and rubbing surfaces.
55	8	Tape-feed retracting lever stud	Apply sparingly to all rubbing surfaces of stud.
55	9	Switch cam	Apply sparingly on working surface.
55	10	Retracting arm stud	Apply sparingly on working surface.
55	11	Lever arm assembly	Apply sparingly on working surface.
55	12	Stop-start lever detent	1 drop at pivot points; apply sparingly on working surfaces.
55	13	Tape-feed operating lever	1 drop at pivot points; apply sparingly on working surfaces.
55	14	Tape-feed cam lever	1 drop at pivot points; apply sparingly on working surfaces.
55	15	Eccentric stud	Apply sparingly at contact point of stud.
55	17	Tape-reader clutch-magnet armature pivot stud.	2 drops on stud.
56	1	Tight-tape lever shaft	1 drop on each side of shaft bearing.
56	2	Distributor-armature latch	Apply sparingly on all working surfaces.
56	3	Distributor-armature unlatch actuating lever.	Apply sparingly on all working surfaces.
56	4	Distributor clutch-magnet armature.	1 drop at pivot point; apply sparingly on all working surfaces.
56	5	Switch actuating cam	Apply sparingly on working surfaces.
56	6	Switch operating shaft	1 drop at each side of shaft bearing.
57	1	Governor adjustment screw	Apply sparingly entire thread length.
57	2	Motor speed adjustment gear	Apply sparingly on gear teeth.
57	3	Governor worm	1 drop in governor hub opening.
57	4	Governor adjusting lever	1 drop at each end.

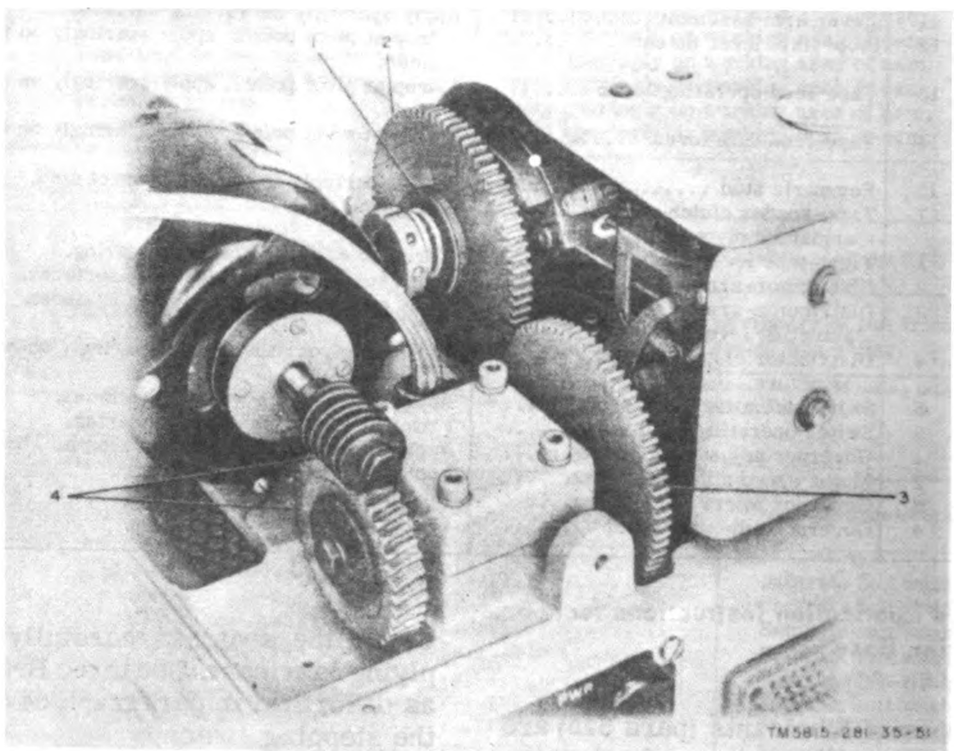
56. Detailed Lubrication Instructions for Numbering Base (fig. 58-60)

Three types of lubricants (para 51*b*) are required to lubricate the two main stepping switches and the six numbering stepping switches mounted in the numbering base. Clean the switches carefully before applying lubricant. Use three Brushes TL-72 as described in paragraph 54 to lubricate the stepping switches.

a. *Parts Requiring Grease, Aircraft and Instrument (GL).*

Fig. No.	Item No.	Lubrication point	Method and quantity
58	3	Main stepping switch shaft	1 dip at exposed end of shaft; 1 dip on shaft between ratchet and frame.
58	5	Main stepping switch armature pawl.	Divide 1 dip between pawl pivot pin and between pawl and armature.
58	6	Main stepping switch pawl spring.	Half dip divided between the holes at ends of the spring and the coils of the spring.
58	7	Main stepping switch drive spring.	Thin film on coils of the spring.
58	8	Main stepping switch armature	1 dip at each armature shaft pivot point and 1 dip divided between armature ends and frame.
58	9	Main stepping switch interrupter spring buffer.	Thin film between buffer pads (do not lubricate between contact points).

Fig. No.	Item No.	Lubrication point	Method and quantity
59	1	Numbering stepping switch drive spring.	Apply sparingly on coils of spring.
59	2	Numbering stepping switch interrupter spring buffer.	Thin film between buffer and armature.
59	3	Numbering stepping switch armature pawl.	Divide 1 dip between pawl pivot pin and rubbing surface between pawl and armature.
59	4	Numbering stepping switch pawl spring.	Apply sparingly on spring coils and in spring mounting holes.
59	5	Numbering stepping switch armature.	1 dip at each armature pivot point; apply sparingly between armature ends and frame.
59	6	Numbering stepping switch shaft..	1 dip at exposed end of shaft; 1 dip on shaft between frame and ratchet.
60	4	Off-normal cams	Thin film on each off-normal cam.



1 Friction clutch (felt washer)
2 Drive gear
3 Driving gear
4 Worm and worm gear

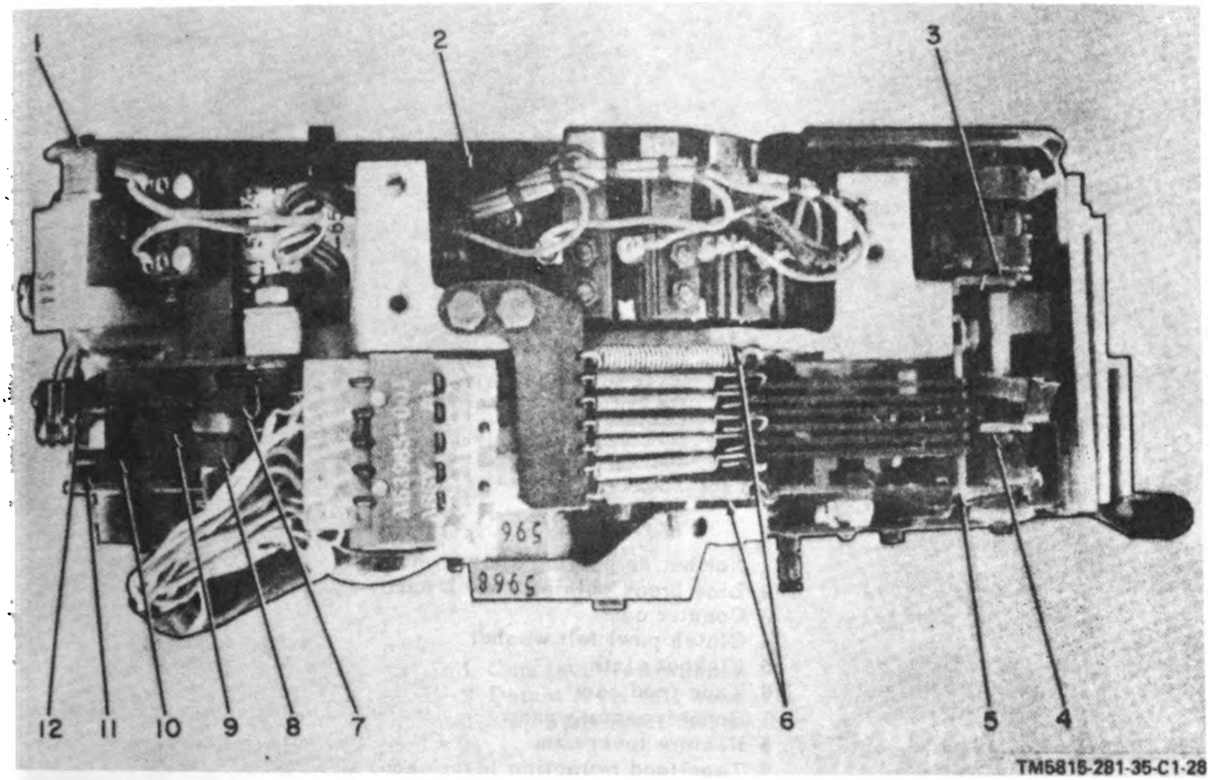
Figure 50. Transmitter, lubrication points, rear view.

b. Parts Requiring Lubricating Oil, Colloidal Graphite (LCG).

Fig. No.	Item No.	Lubrication point	Method and quantity
58	2	Main stepping switch ratchet......	Distribute 2 dips around entire outer circumference of ratchet; rotate switch while applying lubrication.
60	1	Numbering stepping switch ratchet.	Distribute 2 dips around entire outer circumference of ratchet; rotate switch while applying lubricant.

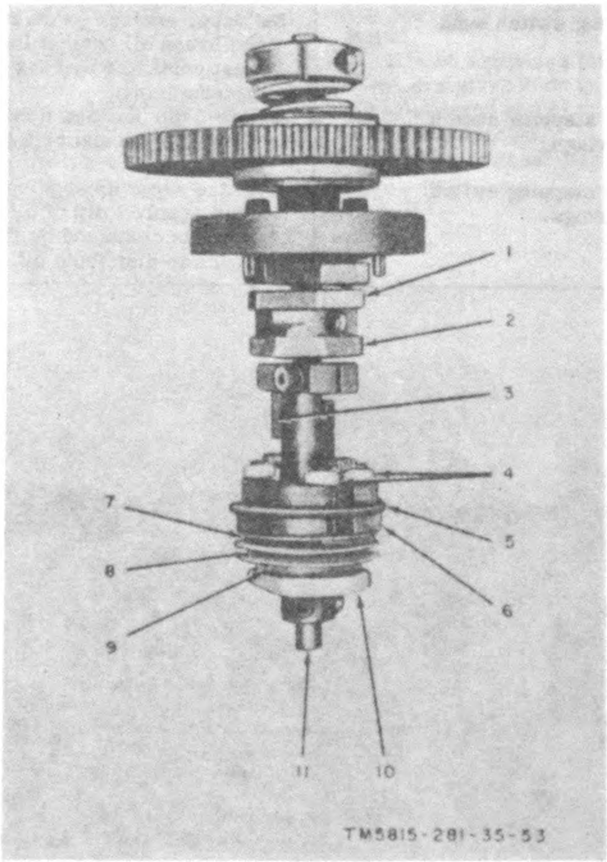
c. *Parts Requiring Lubricating Oil, Watch (OCW).*

Fig. No.	Item No.	Lubrication point	Method and quantity
58	1	Main stepping switch wiper springs.	Distribute 1 dip of oil between each three pairs of wiper spring tips when the wiper springs are standing off contact levels. Rotate switch 180° and lubricate other wiper springs. Rotate switch to distribute oil.
58	4	Main stepping switch bank contacts.	Set wiper springs on eighteenth set of bank contacts and brush oil against inside of wiper springs at point contacted by bank contacts. Rotate switch to distribute oil.
60	2	Numbering stepping switch wiper springs.	Divide 1 dip between tips of six pairs of wiper springs. Rotate switch and repeat until all wiper springs are lubricated.
60	3	Numbering stepping switch brush springs.	With the wiper springs resting on the first set of contacts, apply 1 dip of oil to each pair of wiper springs at points contacted by the brush springs. Rotate switch to distribute oil.



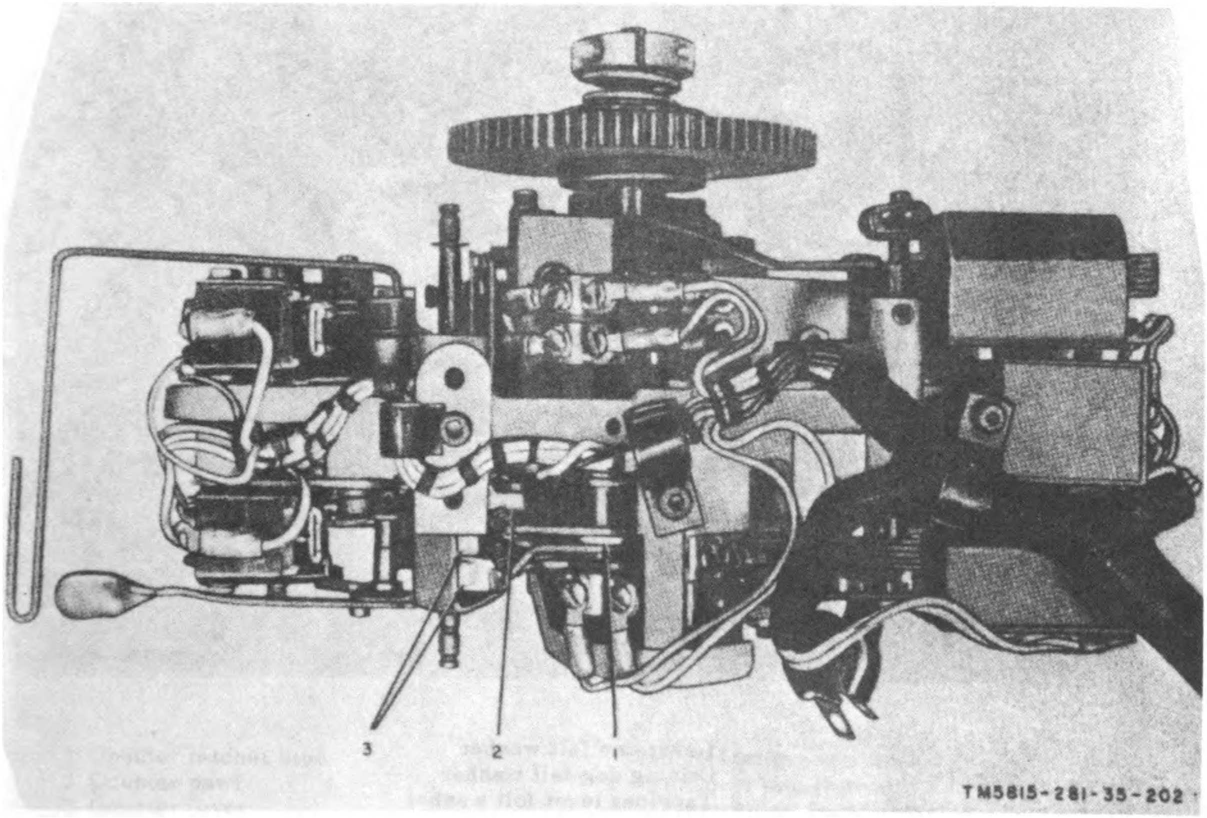
1 Distributor-armature latch pivot stud
2 Contact plungers
3 Latch cam felt washer
4 Tape-out lever
5 Sensing lever comb
6 Pivot post felt washer
7 Indexing ratchet detent
8 Counter ratchet detent
9 Counter contact pin
10 Counter cam ratchet
11 Counter clock spring
12 Counter indexing ratchet

Figure 51. Transmitter lubrication points, top view.



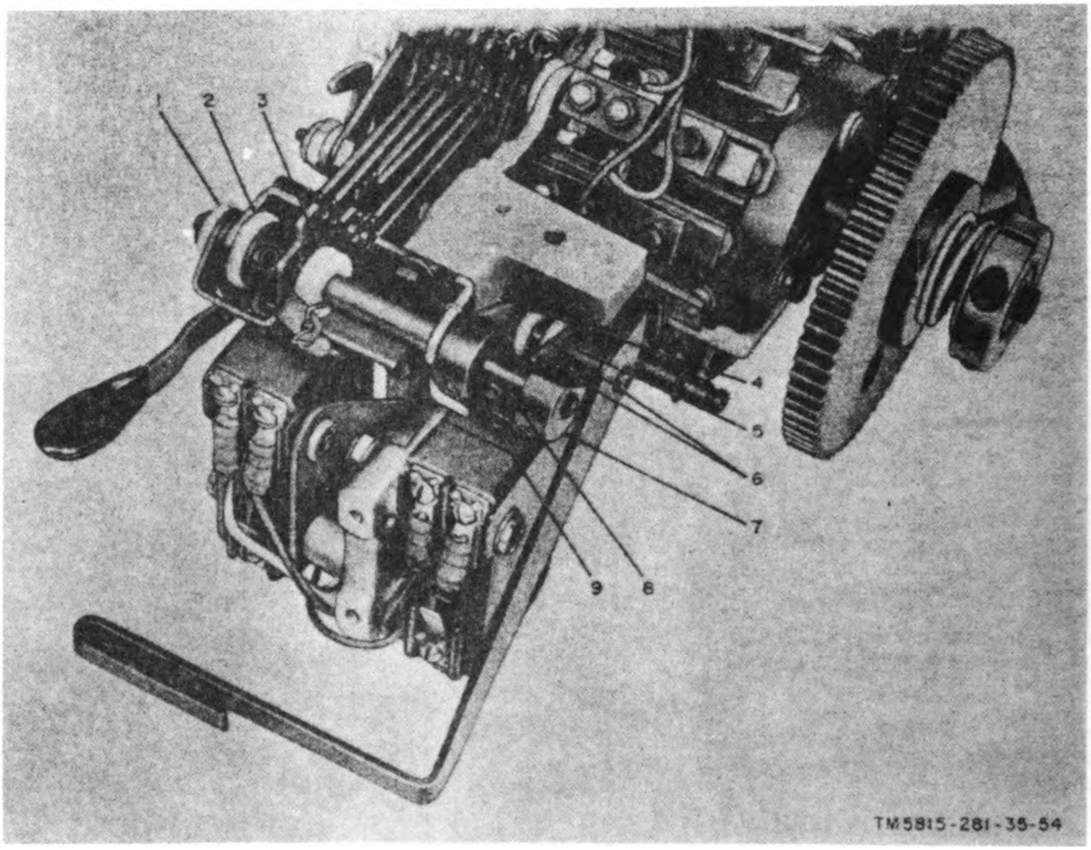
1 Numbering pulsing switch cam
2 Line break pulsing switch cam
3 Counter cam
4 Clutch pawl felt washer
5 Kickout plate
6 Tape-feed cam
7 Counter restore cam
8 Restore lever cam
9 Tape-feed retracting lever cam
10 Latch pulsing switch cam
11 Camshaft

Figure 52. Transmitter camshaft, lubrication points.



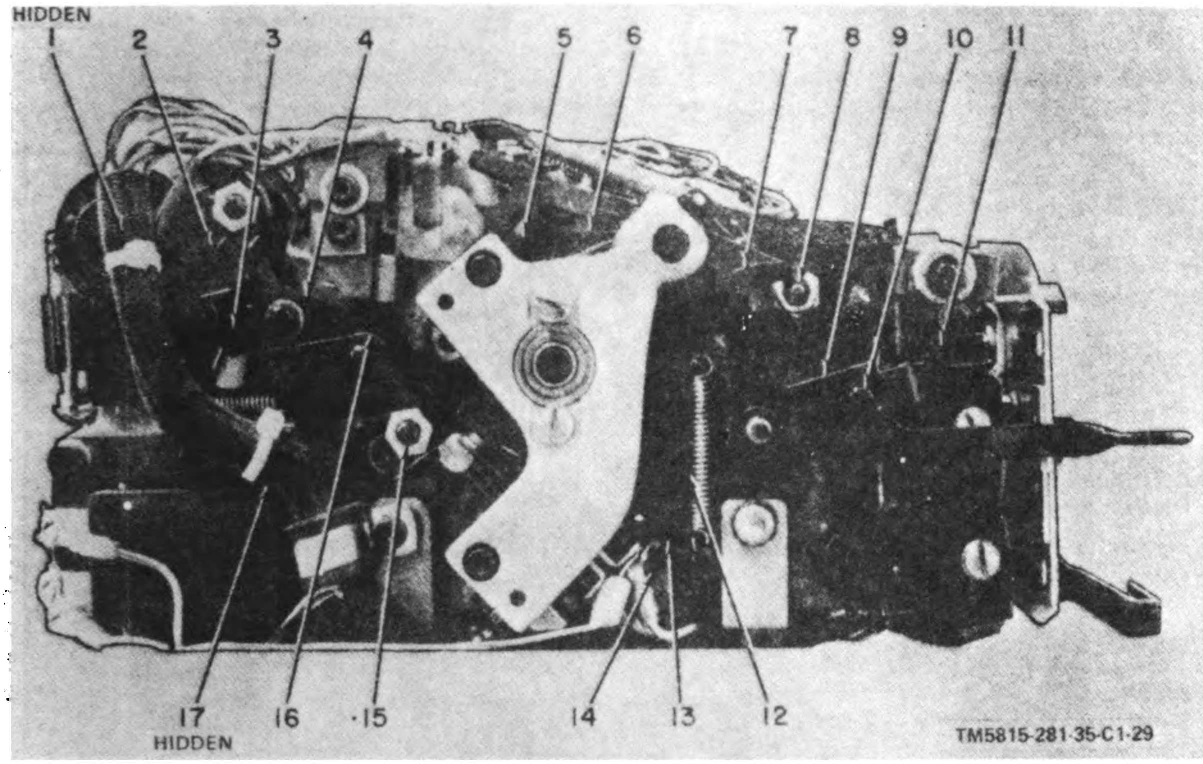
1 Cam lever felt washer
2 Detent lever felt washer
3 Stop-start lever felt washer

Figure 53. Transmitter, lubrication points, bottom view.



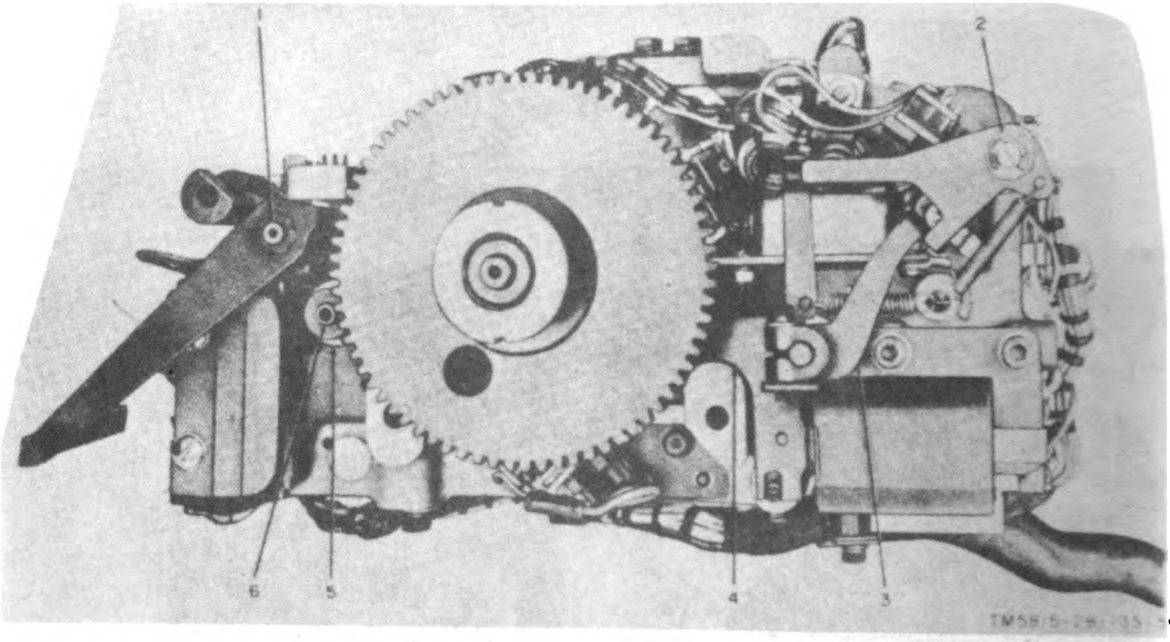
1 Lever arm felt washer
2 Driving dog felt washer
3 Tape-out lever felt washer
4 Sensing lever latch
5 Switch actuating lever
6 Lever latch felt washer
7 Switch lever cam
8 Tape-out lever shaft
9 Latch lever cam

Figure 54. Transmitter lubrication points, left-front view.



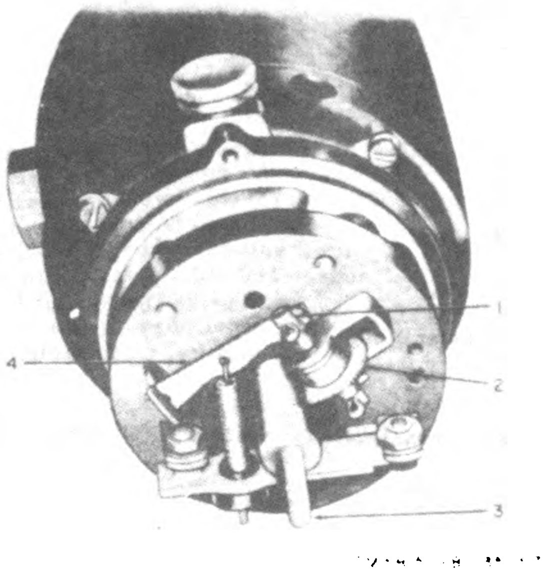
1 Counter ratchet stud
2 Counter pawl
3 Counter lever
4 Restore lever cam follower
5 Sensing lever comb
6 Restore lever
7 Stop-start lever
8 Tape-feed retracting lever stud
9 Switch cam
10 Retracting arm stud
11 Lever arm assembly
12 Stop-start lever detent
13 Tape-feed operating lever
14 Tape-feed cam lever
15 Eccentric stud
16 Counter felt washer
17 Tape-reader clutch-magnet armature pivot stud

Figure 66. Transmitter lubrication points, left-side view.



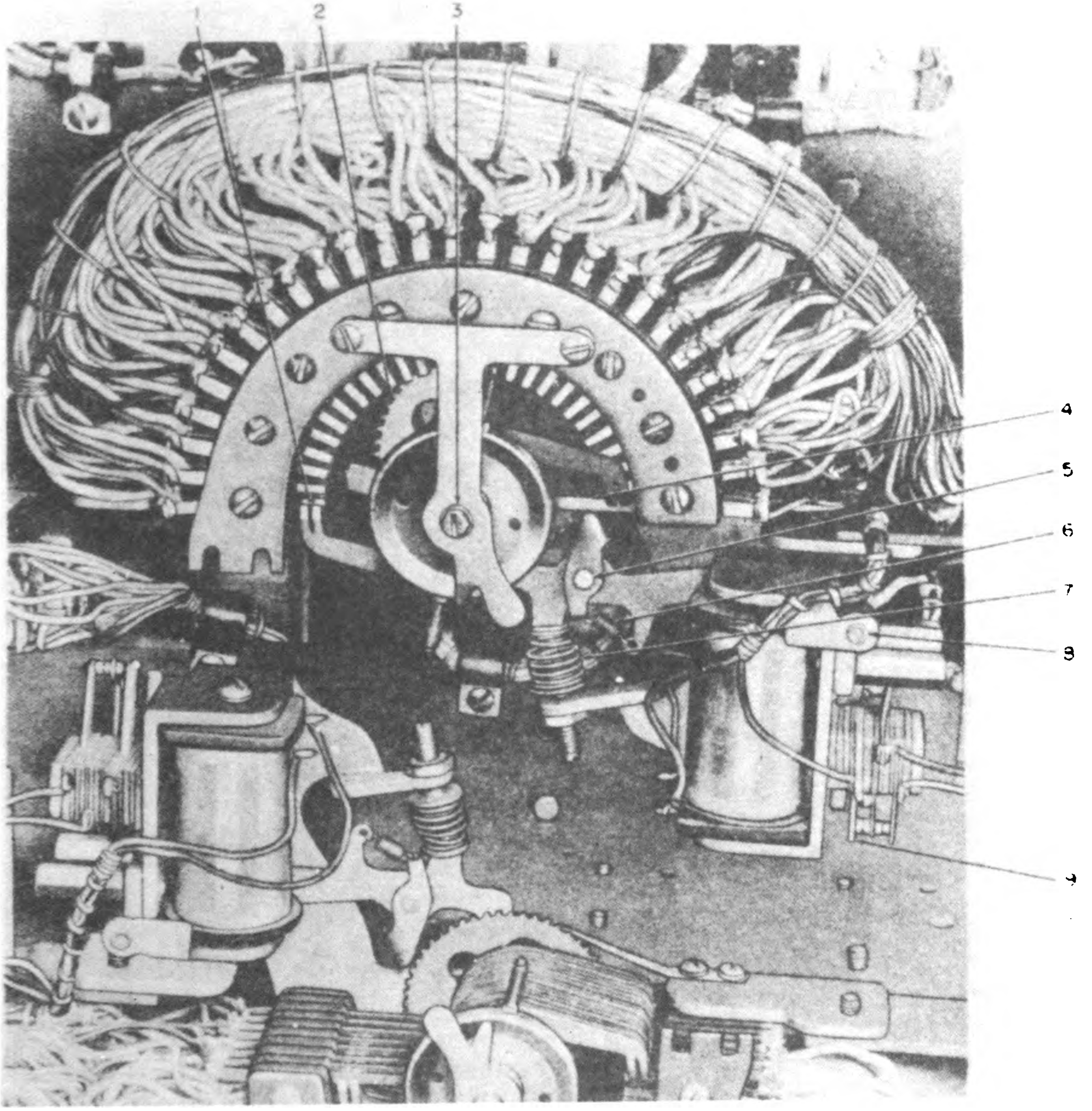
1 Tight-tape lever shaft
2 Distributor-armature latch
3 Distributor-armature unlatch actuating lever
4 Distributor clutch-magnet armature
5 Switch actuating cam
6 Switch operating shaft

Figure 56. Transmitter lubrication points, right side view.



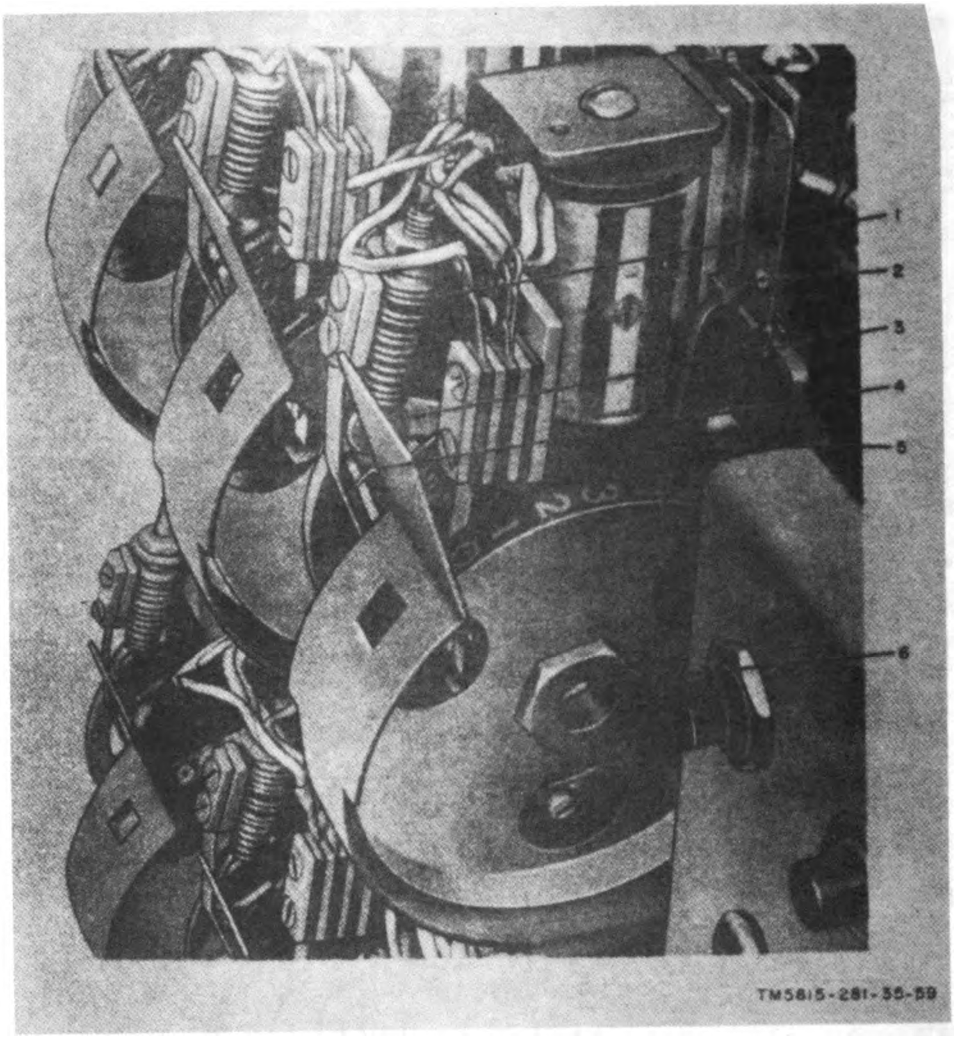
1 Governor adjustment screw
2 Motor speed adjustment gear
3 Governor worm
4 Governor adjusting lever

Figure 57. Motor governor, lubrication points.



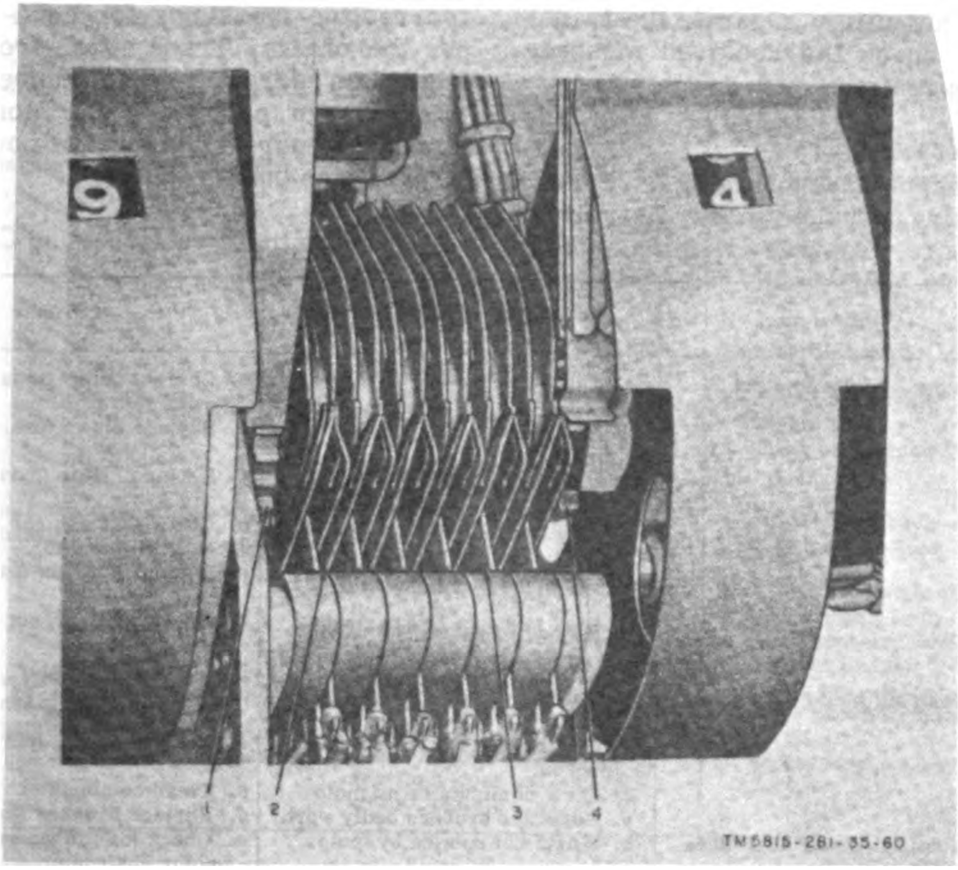
1 Main stepping switch wiper springs
2 Main stepping switch ratchet
3 Main stepping switch shaft
4 Main stepping switch bank contacts
5 Main stepping switch armature pawl
6 Main stepping switch pawl spring
7 Main stepping switch drive spring
8 Main stepping switch armature
9 Main stepping switch interrupter spring buffer

Figure 58. Main stepping switch, lubrication points.



1 Numbering stepping switch drive spring
2 Numbering stepping switch interrupter spring buffer
3 Numbering stepping switch armature pawl
4 Numbering stepping switch pawl spring
5 Numbering stepping switch armature
6 Numbering stepping switch shaft

Figure 59. Numbering stepping switch, right side view, lubrication points.



1 Numbering stepping switch ratchet
2 Numbering stepping switch wiper springs
3 Numbering stepping switch brush springs
4 Off-normal cams

Figure 60. Numbering stepping switch, front view, lubrication points.

Section IV. TROUBLESHOOTING, HIGH LEVEL OPERATION

57. General

The troubleshooting information presented in this section consists of a series of operational, mechanical, and electrical checks designed to lead maintenance personnel to the specific part, adjustment, or electrical component that is causing the trouble in the equipment. The procedures for sectionalizing, localizing, isolating, and correcting the most commonly occurring troubles of the distributor set are included in this section.

58. Sectionalizing and Localizing Troubles

When trouble occurs and the cause is not immediately apparent, proceed as follows:

a. Obtain as much information as possible from the operator about the equipment performance at the time the trouble occurred.

b. Make a visual inspection of the unit to determine if the trouble is caused by loose line or power connections, improperly set switches, or erratic motor speed. Check for blown fuses. If blown, correct the cause of the fuse overload and replace the fuse.

c. When localizing trouble to either of the transmitters use a teletypewriter receiver in good operating condition and fitted with a telephone-type plug for signal line connections. Insert the plug into the control base LOOP jack associated with the faulty transmitter. Operate the transmitter and check the received message to test its operation.

59. Troubleshooting Chart

Use the charts in the following paragraph when isolating troubles in the distributor set. The more probable troubles and the corrective measures for each are listed in the charts. Transmitter troubles are listed in paragraph 60; numbering base troubles in paragraph 61; control base trouble in paragraph 62; and power supply troubles in paragraph 63.

60. Transmitter Troubleshooting Charts

Item No.	Condition	Probable trouble	Correction
1	Motor stops or fails to start	*a.* Failure at power source	*a.* Correct defect or use another power source.
		b. Motor circuit fuse F1 or F2 blown.	*b.* Replace blown fuse.
		c. Open field or armature winding.	*c.* Replace motor (para 86).
		d. Governor contacts burned or pitted.	*d.* Clean, burnish, or replace contacts (para 86).
		e. Governor or motor brushes badly worn.	*e.* Replace brushes (para 86).
		f. Bind in shafts or bearings...	*f.* Locate and correct trouble in mechanism.
		g. Dirty commutator on motor	*g.* Clean commutator.
2	Motor runs but speed is erratic	*a.* Governor contacts dirty or pitted.	*a.* Clean, burnish, or replace contacts (para 86).
		b. Governor spring loose or broken.	*b.* Replace spring (para 86).
		c. Dirty commutator on motor .	*c.* Clean commutator.
		d. Governor brushes badly worn	*d.* Replace brushes (para 86).
3	Motor runs but power shaft does not turn.	*a.* Worm not rotated by motor..	*a.* Check for broken or missing motor shaft pin.
		b. Power shaft not rotated by motor-driven gear.	*b.* Check for missing or broken gear keys on power shaft.
4	Motor runs but transmitter camshaft does not rotate.	*a.* Friction clutch dry or improperly adjusted.	*a.* Lubricate or adjust friction clutch (para 140).
		b. Distributor clutch magnet L4 armature fails to clear stop plates.	*b.* Adjust distributor clutch magnet armature (para 13).
		c. Distributor clutch magnet not energized.	*c.* Check distributor clutch magnet circuit (fig. 31). Replace clutch magnet (para 78).
		d. Transmitter camshaft or shaft bearings binding.	*d.* Free bind; clear or lubricate as required.
5	Transmitter camshaft rotates when stop-start lever is at STOP.	Distributor clutch magnet L4 not functioning properly.	Check distributor clutch magnet and associated circuit (fig. 31). Adjust if necessary (para 113, 115, and 116).
6	Transmitter camshaft rotates but does not feed.	*a.* Tape-reader clutch magnet L6 armature does not clear kick-out plate.	*a.* Adjust tape-reader clutch magnet armature (para 112).
		b. Tape-reader clutch magnet L6 circuit fails to energize magnet.	*b.* Check tape-reader clutch magnet circuit (fig. 31).
		c. Tape-reader clutch notched drum loose on transmitter camshaft.	*c.* Tighten screw holding clutch notched drum to transmitter camshaft.
		d. Tape-feed claw spring or operating lever spring broken or missing.	*d.* Replace spring (para 77).
		e. Tape-feeding claw broken, bent, or binding.	*e.* Repair or replace tape-feed claw (para 77).
		f. Retracting lever spring broken or missing.	*f.* Replace spring (para 77).
7	Transmitter transmits only blank code combination.	*a.* Code-sensing levers or restore lever and comb assembly binding or sticking.	*a.* Free bind; clean and lubricate levers.

Item No.	Condition	Probable trouble	Correction
		b. Restore lever spring weak, broken, or missing.	*b.* Replace spring (para 77).
8	Transmitter transmits garbled copy.	*a.* One or more sensing levers sticking or binding.	*a.* Free bind; clean and lubricate sensing levers.
		b. One or more contact wipers sticking or binding.	*b.* Free bind; clean and adjust contact wipers.
		c. Friction clutch dry or out of adjustment.	*c.* Lubricate or adjust friction clutch (para 140).
		d. Tape-reader clutch notched drum not properly timed with stop plate on camshaft.	*d.* Adjust position of clutch notched drum on camshaft (para 110).
		e. One or more distributor contacts held open or closed.	*e.* Adjust distributor contacts (para 132 and 133).
		f. One or more sets of tape-reader switch contacts or wipers dirty or pitted.	*f.* Clean contacts and wipers.
9	Transmitter camshaft rotates continuously.	*a.* Distributor clutch magnet armature does not engage stop plate.	*a.* Adjust distributor clutch magnet armature (para 111).
		b. Stop-start lever linkage fails to open stop-start switch S42.	*b.* Adjust stop-start lever linkage (para 119 and 120).
		c. Counter mechanism fails to open blank signal switch S28.	*c.* Adjust counter mechanism (para 125 through 131).
10	Tape feeds during transmission of message identification information.	*a.* Tape-reader clutch magnet fails to deenergize.	*a.* Check tape-reader clutch magnet L6 and associated circuit (fig. 31).
		b. Tape-reader clutch magnet armature does not engage the kickout plate.	*b.* Adjust tape-reader clutch armature (para 112).

61. Numbering Base Troubleshooting Chart

Item No.	Condition	Probable trouble	Correction
1	Distributor set sends only a repeated letter, number, or function during message identification information transmission.	*a.* Pawl not engaging ratchet of main stepping switch NSA or NSB in numbering base.	*a.* Correct cause of trouble or replace switch NSA or NSB (para 89 or 90).
		b. Main stepping switch NSA or NSB binding, preventing rotation or switch shaft.	*b.* Free bind and correct cause of improper operation.
		c. Magnetic coil of main stepping switch NSA or NSB open.	*c.* Replace stepping switch (para 89 or 90).
		d. Switch drive spring broken or distorted.	*d.* Replace spring.
2	Numbering stepping switches fail to step beyond 000.	*a.* Magnetic coil of unit numbering stepping switch RUA or RUB open.	*a.* Check coil for continuity. If open, replace switch (para 89 and 90).
		b. Pawl not engaging ratchet on numbering stepping switch RUA or RUB.	*b.* Correct cause of trouble of replace switch RUA or RUB (para 89 or 90).
		c. Dirty contacts on main stepping switch NSA or NSB preventing pulsing of numbering stepping switch RUA or RUB.	*c.* Clean and burnish dirty contacts on main stepping switch NSA or NSB.
		d. Numbering stepping switch shaft binding, preventing shaft rotation.	*d.* Correct cause of trouble or replace switch RUA or RUB (para 89 or 90).
		e. Drive spring broken or distorted.	*e.* Replace spring.
3	Tens and hundreds numbering stepping switch RTA, RTB, RHA, or RHB fail to step.	*a.* Dirty off-normal switch contacts on numbering stepping switch of lower adjoining column.	*a.* Clean and burnish dirty contacts.

Item No.	Condition	Probable trouble	Correction
		b. Magnet coil of tens or hundreds numbering stepping switch RTA, RTB, RHA, or RHB open.	*b.* Replace switch.
		c. Drive spring broken or distorted.	*c.* Replace spring.
		d. Numbering stepping switch shaft binding, preventing shaft rotation.	*d.* Correct cause of trouble or replace switch RTA, RTB, RHA, or RHB (para 89 or 90).
4	One or more numbering stepping switches fail to return to zero when message numbering reset switch S34 or S35 is moved to RESET and back to midposition.	*a.* Interrupter contacts on numbering stepping switch dirty.	Check circuit through interrupter contacts; clean contacts if necessary.
		b. Message numbering reset switch S34 or S35 faulty.	Check circuit through message numbering reset switch S34 or S35 (fig. 49). Repair or replace switch if necessary (para 89 or 90).

62. Control Base Troubleshooting Chart

Item No.	Condition	Probable trouble	Correction
1	Transmitter clutch magnets fail to energize after motors have reached operating speed.	*a.* Relay SDA or SDB not functioning properly.	*a.* Check relay SDA or SDB and associated circuits (fig. 27).
		b. Relay STA or STB not functioning properly.	*b.* Check relay STA or STB and associated circuits (fig. 29).
2	Transmitter transmits repeated message identification information.	*a.* Relay TRA or TRB not functioning properly.	*a.* Check relay TRA or TRB and associated circuits (fig. 46).
		b. Relay TSA or TSB not functioning properly.	*b.* Check relay TSA or TSB and associated circuits (fig. 28).
3	Distributor set fails to send blanks for blank tape feedout.	*a.* Relay STA or STB not functioning properly.	*a.* Check relay STA or STB and associated circuits (fig. 29).
		b. Relay TRA or TRB not functioning properly.	*b.* Check relay TRA or TRB and associated circuits (fig. 46).
4	Distributor set fails to transmit with switch S34 or S35 in OFF position.	*a.* Relay STA or STB not functioning properly.	*a.* Check relay STA or STB and associated circuits (fig. 29).
		b. Relay TRA or TRB not functioning properly.	*b.* Check relay TRA or TRB and associated circuits (fig. 46).
5	Distributor set operates but no signal is sent to signal line.	*a.* Relay STA or STB not functioning properly.	*a.* Check relay STA or STB and associated circuits (fig. 29).
		b. Relay TRA or TRB not functioning properly.	*b.* Check relay TRA or TRB and associated circuits (fig. 46).
6	Tape does not feed and distributor set repeatedly transmits message identification information only.	Relay FNA or FNB not functioning properly.	Check relay FNA or FNB and associated circuits.
7	Message identification information sent when stop-start lever is moved from FEED-RETRACT to START (no tape in transmitter).	Relay SDA or SDB not functioning properly.	Check relay SDA or SDB and associated circuits (fig. 27).
8	Distributor set fails to transmit.	*a.* Ac power fuse F5 blown.	*a.* Replace blown fuse.
		b. Power switch S13 at OFF.	*b.* Set power switch to ON.
		c. Relay KNA or KNB not functioning properly.	*c.* Check relay KNA or KNB and associated circuits (fig. 35).
		d. Relay TRA or TRB not functioning properly.	*d.* Check relay TRA or TRB and associated circuits (fig. 46).
9	Main stepping switch NSA or NSB fails to step.	*a.* Power fuse F5 blown.	*a.* Replace blown fuse.
		b. Power switch S13 at OFF.	*b.* Set power switch to ON.
		c. Relay KNA or KNB not functioning properly.	*c.* Check relay KNA or KNB and associated circuits (fig. 35).
		d. Relay TRA or TRB not functioning properly.	*d.* Check relay TRA or TRB and associated circuits (fig. 46).

63. Power Supply Troubleshooting Chart

Item No.	Condition	Probable trouble	Correction
1	Distribution set fails to transmit or stepping switches in numbering base fail to step.	*a*. Fuse blown in 48-volt power supply. *b*. Faulty component in 48-volt power supply.	*a*. Replace blown fuse. *b*. Check power supply circuit (fig. 25); replace faulty part (para 97).
2	No line current on signal line.	*a*. Fuse blown in 120-volt power supply. *b*. Faulty component in 120-volt power supply.	*a*. Replace blown fuse. *b*. Check power supply circuit (fig. 26); replace faulty part (para 96).

Section IV.1. TROUBLESHOOTING, LOW LEVEL OPERATION

63.1. General

The troubleshooting information presented in this section consists of a series of operational, mechanical, and electrical checks designed to lead maintenance personnel to the specific part, adjustment, or electrical component that is causing the trouble in the equipment during low level operation. The procedures for sectionalizing, localizing, isolating and correcting the most commonly occuring troubles of the distributor are included in this section.

63.2. Sectionalizing and Localizing Troubles

When trouble occurs and the cause is not immediately apparent, proceed as follows:

a. Obtain as much information as possible from the operator about the equipment performance at the time the trouble occurred.

b. Make a visual inspection of the unit to determine if the trouble is caused by loose line or power connections, improperly set switches, or erratic motor speed. Check for blown fuses. If blown, correct the cause of the fuse overload and replace the fuse.

63.3. Troubleshooting Chart

Use the charts in the following paragraph when isolating troubles in the distributor set. The more probable troubles and the corrective measures for each are listed in the charts. Transmitter troubles are listed in paragraph 63.4; numbering base troubles in paragraph 63.5; control base trouble in paragraph 63.6; and power supply troubles in paragraph 63.7.

63.4. Transmitter Troubleshooting Charts.

Item No.	*Condition*	*Probable trouble*	*Correction*
1	Motor stops or fails to start	*a.* Failure at power source	*a.* Correct defect or use another power source.
		b. Motor circuit fuse F1 or F2 blown.	*b.* Replace blown fuse.
		c. Open field or armature winding.	*c.* Replace motor (para 86).
		d. Governor contacts burned or pitted.	*d.* Clean, burnish, or replace contacts (para 86).
		e. Governor or motor brushes badly worn.	*e.* Replace brushes (para 86).
		f. Bind in shafts or bearings	*f.* Locate and correct trouble in mechanism.
		g. Dirty commutator on motor	*g.* Clean commutator.
2	Motor runs but speed is erratic	*a.* Governor contacts dirty or pitted.	*a.* Clean, burnish, or replace contacts (para 86).
		b. Governor spring loose or broken.	*b.* Replace spring (para 86).
		c. Dirty commutator on motor	*c.* Clean commutator.
		d. Governor brushes badly worn	*d.* Replace brushes (para 86).
3	Motor runs but power shaft does not turn.	*a.* Worm not rotated by motor	*a.* Check for broken or missing motor shaft pin.
		b. Power shaft not rotated by motor-driven gear.	*b.* Check for missing or broken gear keys on power shaft.
4	Motor runs but transmitter camshaft does not rotate.	*a.* Friction clutch dry or improperly adjusted.	*a.* Lubricate or adjust friction clutch (para 140).
		b. Distributor clutch magnet L4 armature fails to clear stop plates.	*b.* Adjust distributor clutch magnet armature (para 13).
		c. Distributor clutch magnet not energized.	*c.* Check distributor clutch magnet circuit (fig. 31). Replace clutch magnet (para 78).
		d. Transmitter camshaft or shaft bearings binding.	*d.* Free bind; clear or lubricate as required.
5	Transmitter camshaft rotates when stop-start lever is at STOP.	Distributor clutch magnet L4 not functioning properly.	Check distributor clutch magnet and associated circuit (fig. 31). Adjust if necessary (para 113, 115, and 116).
6	Transmitter camshaft rotates but does not feed.	*a.* Tape-reader clutch magnet L6 armature does not clear kickout plate.	*a.* Adjust tape-reader clutch magnet armature (para 112).
		b. Tape-reader clutch magnet L6 circuit fails to energize magnet.	*b.* Check tape-reader clutch magnet circuit (fig. 31).
		c. Tape-reader clutch notched drum loose on transmitter camshaft.	*c.* Tighten screw holding clutch notched drum to transmitter camshaft.
		d. Tape-feed claw spring or operating lever spring broken or missing.	*d.* Replace spring (para 77).
		e. Tape-feeding claw broken, bent, or binding.	*e.* Repair or replace tape-feed claw (para 77).
		f. Retracting lever spring broken or missing.	*f.* Replace spring (para 77).

Item No.	Condition	Probable trouble	Correction
7	Transmitter camshaft rotates continuously.	*a.* Distributor clutch magnet armature does not engage stop plate.	*a.* Adjust distributor clutch magnet armature (para 111).
		b. Stop-start lever linkage fails to open stop-start switch S42.	*b.* Adjust stop-start lever linkage (para 119 and 120).
		c. Counter mechanism fails to open blank signal switch S28.	*c.* Adjust counter mechanism (para 125 through 131).
8	Tape feeds during transmission of message identification information.	*a.* Tape-reader clutch magnet fails to deenergize.	*a.* Check tape-reader clutch magnet L6 and associated circuit (fig. 31).
		b. Tape-reader clutch magnet armature does not engage the kickout plate.	*b.* Adjust tape-reader clutch armature (para 112).

63.5. Numbering Base Troubleshooting Chart

Item No.	Condition	Probable trouble	Correction
1	Distributor set sends only a repeated letter, number, or function during message identification information transmission.	*a.* Pawl not engaging ratchet of main stepping switch NSA or NSB in numbering base.	*a.* Correct cause of trouble or replace switch NSA or NSB (para 89 or 90).
		b. Main stepping switch NSA or NSB binding, preventing rotation or switch shaft.	*b.* Free bind and correct cause o improper operation.
		c. Magnetic coil of main stepping switch NSA or NSB open.	*c.* Replace stepping switch (para 89 or 90).
		d. Switch drive spring broken or distorted.	*d.* Replace spring.
2	Numbering stepping switches fail to step beyond 000.	*a.* Magnetic coil of unit numbering stepping switch RUA or RUB open.	*a.* Check coil for continuity. If open, replace switch (para 89 and 90).
		b. Pawl not engaging ratchet on numbering stepping switch RUA or RUB.	*b.* Correct cause of trouble of replace switch RUA or RUB (para 89 or 90).
		c. Dirty contacts on main stepping switch NSA or NSB preventing pulsing of numbering stepping switch RUA or RUB.	*c.* Clean and burnish dirty contacts on main stepping switch NSA or NSB.
		d. Numbering stepping switch shaft binding, preventing shaft rotation.	*d.* Correct cause of trouble or replace switch RUA or RUB (para 89 or 90).
		e. Drive spring broken or distorted.	*e.* Replace spring.
3	Tens and hundreds numbering stepping switch RTA, RTB, RHA, or RHB fail to step.	*a.* Dirty off-normal switch contacts on numbering stepping switch of lower adjoining column.	*a.* Clean and burnish dirty contacts.
		b. Magnet coil of tens or hundreds numbering stepping switch RTA, RTB, RHA, or RHB open.	*b.* Replace switch.
		c. Drive spring broken or distorted.	*c.* Replace spring.
		d. Numbering stepping switch shaft binding, preventing shaft rotation.	*d.* Correct cause of trouble or replace switch RTA, RTB, RHA, or RHB (para 89 or 90).
4	One or more numbering stepping switches fail to return to zero when message numbering reset switch S34 or S35 is moved to RESET and back to mid-position.	*a.* Interrupter contacts on numbering stepping switch dirty.	Check circuit through interrupter contacts; clean contacts if necessary.
		b. Message numbering reset switch S34 or S35 faulty.	Check circuit through message numbering reset switch S34 or S35 (fig. 49). Repair or replace switch if necessary (para 89 or 90).

63.6. Control Base Troubleshooting Chart

Item No.	Condition	Probable trouble	Correction
1	Transmitter clutch magnets fail to energize after motors have reached operating speed.	a. Relay SDA or SDB not functioning properly. b Relay STA or STB not functioning properly.	a. Check relay SDA or SDB and associated circuits (fig. 27). b. Check relay STA or STB and associated circuits (fig. 29).
2	Transmitter transmits repeated message identification information.	a. Relay TRA or TRB not functioning properly. b. Relay TSA or TSB not functioning properly.	a. Check relay TRA or TRB and associated circuits (fig. 46). b. Check relay TSA or TSB and associated circuits (fig. 28).
3	Distributor set fails to send blanks for blank tape feedout.	a. Relay STA or STB not functioning properly. b. Relay TRA or TRB not functioning properly.	a. Check relay STA or STB and associated circuits (fig. 29). b. Check relay TRA or TRB and associated circuits (fig. 46).
4	Distributor set fails to transmit with switch S34 or S35 in OFF position.	a. Relay STA or STB not functioning properly. b. Relay TRA or TRB not functioning properly.	a. Check relay STA or STB and associated circuits (fig. 29). b. Check relay TRA or TRB and associated circuits (fig. 46).
5	Distributor set operates but no signal is sent to signal line.	a. Relay STA or STB not functioning properly. b. Relay TRA or TRB not functioning properly.	a. Check relay STA or STB and associated circuits (fig. 29). b. Check relay TRA or TRB and associated circuits (fig. 46).
6	Tape does not feed and distributor set repeatedly transmits message identification information only.	Relay FNA or FNB not functioning properly.	Check relay FNA or FNB and associated circuits.
7	Message identification information sent when stop-start lever is moved from FEED-RETRACT to START (no tape in transmitter).	Relay SDA or SDB not functioning properly.	Check relay SDA or SDB and associated circuits (fig. 27).
8	Distributor set fails to transmit.	a. Ac power fuse F5 blown. b. Power switch S13 at OFF. c. Relay KNA or KNB not functioning properly. d. Relay TRA or TRB not functioning properly.	a. Replace blown fuse. b. Set power switch to ON. c. Check relay KNA or KNB and associated circuts (fig. 35). d. Check relay TRA or TRB and associated circuits (fig. 46).
9	Main stepping switch NSA or NSB fails to stop.	a. power fuse F5 blown. b. Power switch S13 at OFF. c. Relay KNA or KNB not functioning properly. d. Relay TRA or TRB not functioning properly.	a. Replace blown fuse. b. Set power switch to ON. c. Check relay KNA or KNB and associated circuits (fig. 35). d. Check relay TRA or TRB and associated circuits (fig. 46).

63.7. System Troubleshooting Chart

Item No.	Condition	Probable trouble	Correction
1	Transmitter transmits only blank code combination.	a. Code sensing levers or restore lever and comb assembly binding or sticking. b. Photo-reader (A2) assembly improperly adjusted, binding contact levers. c. Photo-reader (A2) lamps not illuminated because of no applied voltage.	a. Free bind; clean and lubricate levers. b. Adjust photo-reader (A2) mounting bracket (para 106). c. Check for broken or loose wires from photo-reader (A2) assembly. Check resistor A2R1.

Item No.	Condition	Probable trouble	Correction
1 (cont)		*d.* Photo-reader (A2) lamp burned out.	*d.* Check lamps with ohmmeter. Note: Lamps are wired in series so that a single open lamp will cause all lamps to go out. Replace bulbs as necessary (para 77).
		e. Photo-reader (A2) lamp holding springs loose or weak.	*e.* Replace or tighten as required (para 77).
2	Transmitter transmits garbled copy.	*a.* One or more sending levers binding.	*a.* Free bind; clean and lubricate sensing levers.
		b. Photo-reader (A2) mounting bracket not adjusted properly, binding contact wipers.	*b.* Adjust photo-reader (A2) mounting bracket (para 106).
		c. Friction clutch dry or out of adjustment.	*c.* Lubricate or adjust friction clutch (para 140).
		d. Tape-reader notched drum not properly timed with stop plate on camshaft.	*d.* Adjust position of clutch notched drum on camshaft.
		e. Improper motor speed.	*e.* Adjust motor speed (para 8).
		f. Switch A1S4, WPM, improperly set.	*f.* Set WPM switch A1S4 to 60, 75, or 100 WPM in accordance with gears installed in transmitter.
		g. Clock timing improperly adjusted.	*g.* Connect oscilloscope to TP7 (TP17) and observe waveform shown in A, figure 60.1. Adjust potentiometer corresponding to operating WPM for clock period indicated.
		h. Internal 40 V fluctuating due to misadjusted current source.	*h.* Check +40 volts at terminal A1A2-1 or A1A2-24 with oscilloscope. If 40 volts is being modulated during transmission, readjust A1A4R74 in clockwise direction until modulation disappears.
		i. Logic signals improperly sequencing output data transistors.	*i.* Check for proper logic signals at terminals A1A3-1 (A1A3-11), A1A3-2(A1A3-10), A1A3-3 (A1A3-9), A1A3-4 (A1A3-8), and A1A3-5(A1A3-7). Sync oscilloscope on TP9. Timing at logic outputs should appear as shown in B, figure 60.1. (Transmitter running.) If incorrect replace logic circuit board A1A3 or troubleshoot circuits using truth chart in paragraph 41.8*g* as a guide. Refer to figure 195③ for components of logic circuit board A1A3.
		j. Photo-transistor defective.	*j.* Check waveform (with transmitter running) at TP1, TP2, TP3, TP4, and TP5. These test points show the output of each of the five photo-transistors. With no tape being processed (e.g., all marks) the waveform at each test point should appear as shown in C, figure 60.1. If wave form

Item No.	Condition	Probable trouble	Correction
2 (Cont)			appears as a ground level or as +40 volts, replace appropriate transistor in photo-reader (A2) (fig. 78).
		k. Broken wire on switch A1S5(S6) or relay TRA (TRB).	*k*. If waveforms all appear correct, problem may be a broken wire on A1S5 or relay TRA that is causing loss of one impulse. Check wiring and repair as necessary.
		l. Data amplifier bias voltage inadequate.	*l*. Check voltage at anode of A1A2CR10 (A1A2CR110) for 1.5 ± 0.3 vdc. If improper voltage, check diodes A1A2CR10 and A1A2CR11 (A1A2CR110, A1A2CR111) and resistor A1A2R48 (A1A2R148) (fig. 195 ③).
		m. One or more data amplifiers defective.	*m*. Check resistors A1A2Q12, Q14, Q16, Q18, or Q20 (A1A2Q112, Q114, Q116, Q118, or Q120) for open circuit or base-emitter junction (fig. 195 ③).
3	No transmission output at TB3; constant space condition, e.g., receiver runs open.	*a*. No internal +40 volt supply.	*a*. Measure +40 volts at terminal A1A2-1 or A1A2-24. If not present, check for +40 volts short circuit. If not short circuit, check Zener diode A1A4VR1, transistors A1A4Q33, A1A4Q32. If voltage of 55 vdc is not present across capacitors A1A4C24, A1A4C25, and A1A4C26, check diodes CR19-CR22 and check transformer T1 for open circuit (fig. 195 ③).
		b. Output photo-isolator device defective.	*b*. Check for approximately 1.5 vdc level at TP10 (TP20). If level is correct, replace A1A2Z1 (fig. 195 ③).
		c. Stop contact sync circuit open.	*c*. Check voltage at TP6 (TP16) for approximately 0.7 vdc. If voltage is 0-volts or +40 vdc, stop-sync circuit is open. Check wiring from A1A2-23 (A1A2-46) through switch A1S5 (A1S6), through stop contact on transmitter, to terminal A1A1-19 (A1A1-10). Repair as necessary (fig. 196).
		d. Stop pulse amplifier circuit inoperative.	*d*. Check for open transistor A1A1Q8 (A1A1Q108). If transistor is good, check drive circuit transistors A1A1Q1 and A1A1Q7. Replace as necessary (fig. 195 ③).
4	Transmission from message tape is correct but message heading is transmitted as "blank" characters.	*a*. Numbering base circuit is open.	*a*. Check numbering base connectors and wiring.
		b. Relay contacts TRA-L12 and TRA-L13 shorted together.	*b*. Check contacts visually for proper make and break operation. Adjust as required.

Item No.	Condition	Probable trouble	Correction
4 (cont)		c. Photo-reader (A2) override circuit not engaging.	c. Check transistor A1A2Q21 (A1A2Q121) for collector to emitter short (fig. 196).
5	Transmission of message heading correct but message transmitted as all marks.	a. Relay contacts TRA-L12 (TRB-L12) and TRA-L13 (TRB-L13) not making contact when TRA (TRB) relay is energized.	a. Check visually for proper make and break operation. Adjust contacts as required.
		b. Photo-reader (A2) overcircuit not defeated.	b. Check transistor A1A2Q21 (A1A2Q121) and replace as necessary. If A1A2Q21 appears good, check base drive circuit from A1A2Q21 base through contacts L12 and L13 of relay TRA, through resistor A1A2R21 (A1A1R121) to +5 vdc. (When relay TRA is energized, transistor A1A2Q21 should saturate to ground level.) Repair the base drive as necessary.
6	Transmission of both message heading and message as all blanks.	a. Loss of operating voltage for clock circuit.	a. Check TP8 (TP18) for 10, ± 1 vdc. If no voltage appears, check Zener diode A1A2VR10 (A1A2VR110) for a short. Check supply current from A1A1-24 (A1A1-15) to resistor A1A4R64 (A1A4R66) to +40 vdc. Repair or replace as necessary (fig. 195 ① and 196).
		b. Clock unijunction transistor defective.	b. Check for clock waveform at TP7 (TP17) with transmitter running. If no clock waveform, check for dc voltage at A1A4-5 to be +10 volts. If present, check emitter voltage. If emitter voltage is at ground, replace A1A1Q5 (A1A1Q105) otherwise check wiring from A1A1-1 through switch A1S4 to appropriate resistors and potentiometers at terminals A1A1-4, A1A1-3, and A1A1-2 (A1A1-8, A1A1-7, and (A1A1-6) (fig. 196).
		c. Clock enable circuit defective.	c. If ten volts is not present on A1A4-5 (with transmitter running), check A1A1Q4 (A1A1Q104), A1A1Q3 (A1A1Q103), A1A1Q2 (A1A1Q102), and A1A1Q1 (A1A1Q101). Also check A1A1CR3 (A1A1CR103) for short circuit (fig. 196).
		e. Logic counter defective.	e. If clock signals are present at TP7, check for clock pulses across A1A3R82. Then check outputs of flip-flops A1A3Z5-1, A1A3Z5-2, and A1A3Z4-1 (A1A3Z3-1, A1A3Z3-2, and A1A3Z4-2). Replace as required (fig. 195 ① and 196).

Item No.	*Condition*	*Probable trouble*	*Correction*
6 (Cont)		*f*. Clear signal always present on counter flip-flops.	*f*. Check signal at A1A3-18 (A1A3-13). If signal remains at ground when transmitter is operating, check transistor A1A1Q6 (A1A1Q106) for short (fig. 196).
		g. Inhibit signal always outputted from logic circuit.	*g*. Check waveform at TP9. If it remains at +3 volts output while transmitter is operating, replace A1A3Z8 (A1A3Z18), assuming other logic circuits are correctly functioning (fig. 195 ③ and 196).

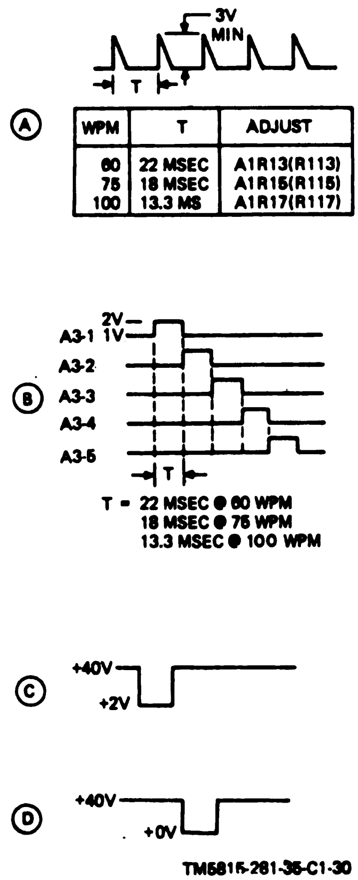


Figure 60.1. Waveforms.

63.8. Power Supply Troubleshooting Chart

Item No.	*Condition*	*Probable trouble*	*Correction*
1	Distribution set fails to transmit or stepping switches in numbering base fail to step.	*a.* Fuse blown in 48-volt power supply.	*a.* Replace blown fuse.
		b. Faulty component in 48-volt power supply.	*b.* Check power supply circuit (fig. 25); replace faulty part (para 97).
2	No line current on signal line.	*a.* Fuse blown in 120-volt power supply.	*a.* Replace blown fuse.
		b. Faulty component in 120-volt power supply.	*b.* Check power supply circuit (fig. 26); replace faulty part (para 96).

Section V. TROUBLESHOOTING DATA

64. General

This section provides data for use when troubleshooting, circuit checking, and component testing. Included are methods for identification of terminals of relays, switches, magnets, and jacks, and the proper resistance values for the windings of relays and clutch magnets.

65. Relay Terminal Identification and Winding Resistance Data

Figutes 61, 62, and 63 illustrate the three numbering patterns that identify the terminals of the relays mounted in the control base. To locate these relays, refer to figure 195. The following charts list the resistance values of the relay windings and the terminals of the windings. Where only one resistance value is given, only one resistance check is required. Where two values are given, two resistances must be checked.

Note: The dot next to the terminals of the relays in figures 61, 62, and 63 indicates the terminal to which the *inner* end of the winding is connected.

a. The winding resistances measured across the terminals of relays with the terminal identification pattern shown in figure 61 are as follows:

Relay	Winding resistances (ohms +10%)	
	Resistance across L and R	Resistance across T and B
TSA	1,250	-----
TSB	1,250	-----
TRA	980	1,000
TRB	980	1,000

b. The winding resistances measured across the terminals of relays with the terminal identification pattern shown in figure 62 are as follows:

Relay	Winding resistances (ohms +10%)	
	Resistance across L and R	Resistance across T and B
STA	980	1,000
STB	980	1,000
FNA	1,030	-----
FNB	1,030	-----

c. The winding resistances measured across the terminals of relays with the terminal identification pattern shown in figure 63 are as follows:

Relay	Winding resistance (ohms +10%) across L and R
SDA	2,250
SDB	2,250
KNA	615
KNB	615

66. Switch Terminal Identification Data

a. Stepping Switches. Two types of stepping switches are used in the numbering base. Figure 64 illustrates the pattern used to identify the terminals of main stepping switches NSA and NSB. Identification of terminals of numbering stepping switches RUA, RTA, RHA, RUB, RTB, and RHB is shown in figure 65. The resistance across the windings of the stepping switches are as follows:

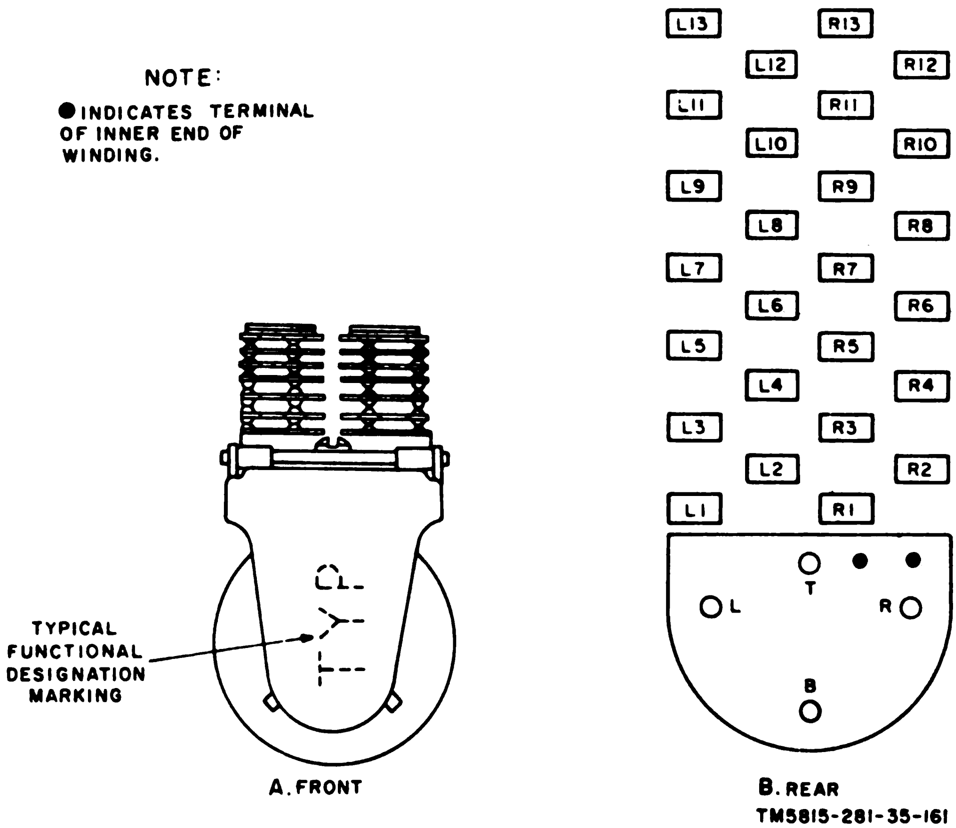


Figure 61. Terminals and contacts of relays TSA, TSB, TRA, and TRB.

Switch	Winding resistance (ohms +10%)
NSA	100
NSB	100
RUA	120
RTA	120
RHA	120
RUB	120
RTB	120
RHB	120

b. CASE Switches. The terminal identification and spring pileups of CASE switches S10 and S11 on the control base are shown in figure 66.

c. Message Numbering Reset Switches. The terminal identification pattern and individual spring pileups of lever-type switches S34 and S35 are illustrated in figure 67.

67. Jack Terminal Identification

a. LOOP JACKS. The terminals of the four LOOP JACKS on the front of the control base are shown in A, figure 68.

b. SET JACKS. The terminals of the two SET JACKS on the front of the line control and relay base are shown in B, figure 68.

68. Timing Chart

Figure 69 graphically illustrates the timing sequence during the transmission of the message identification information from the distributor set. Figure 70 illustrates the timing sequence during tape transmission and end-of-tape sensing. When troubleshooting, check the sequence of relay operation. An ascending slope in figures 69 and 70 indicates relay energizing time; a descending slope indicates relay deenergizing time. All relays listed are associated with transmitter A (external signal line 1). Refer to paragraph 24 for a cross-reference to convert the relay designations to their counterparts associated with transmitter B (external signal line 2).

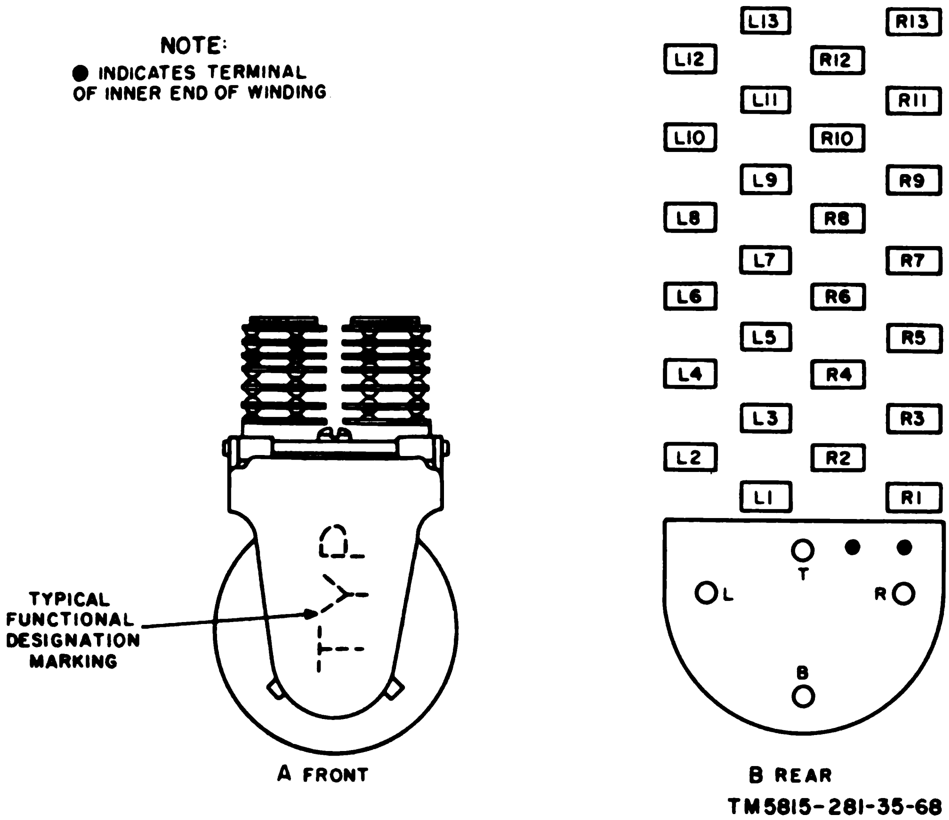


Figure 62. Terminals and contacts of relays STA, STB, FNA, and FNB.

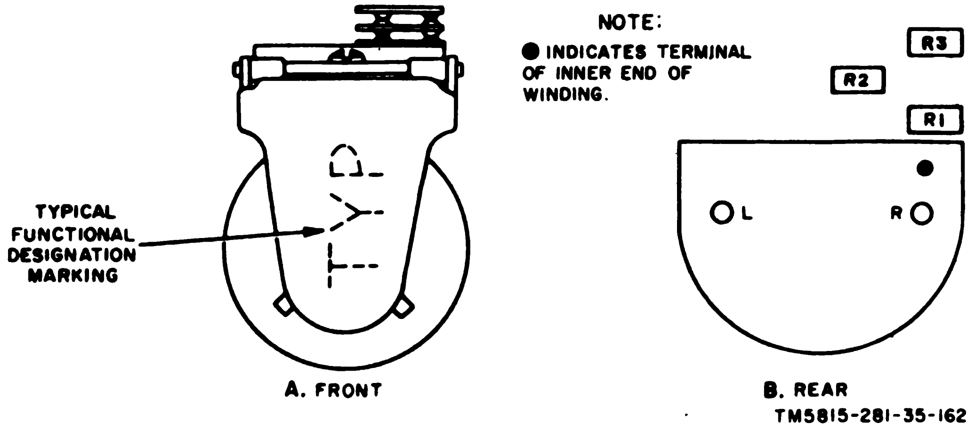


Figure 63. Terminals and contacts of relays SDA, SDB, KNA, and KNB.

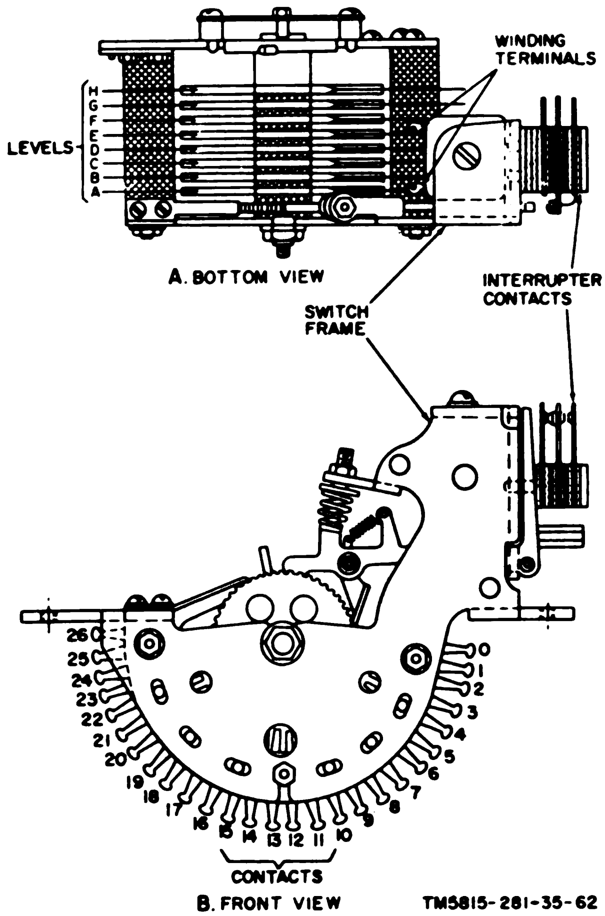


Figure 64. Terminals and contacts of main stepping switches NSA and NSB.

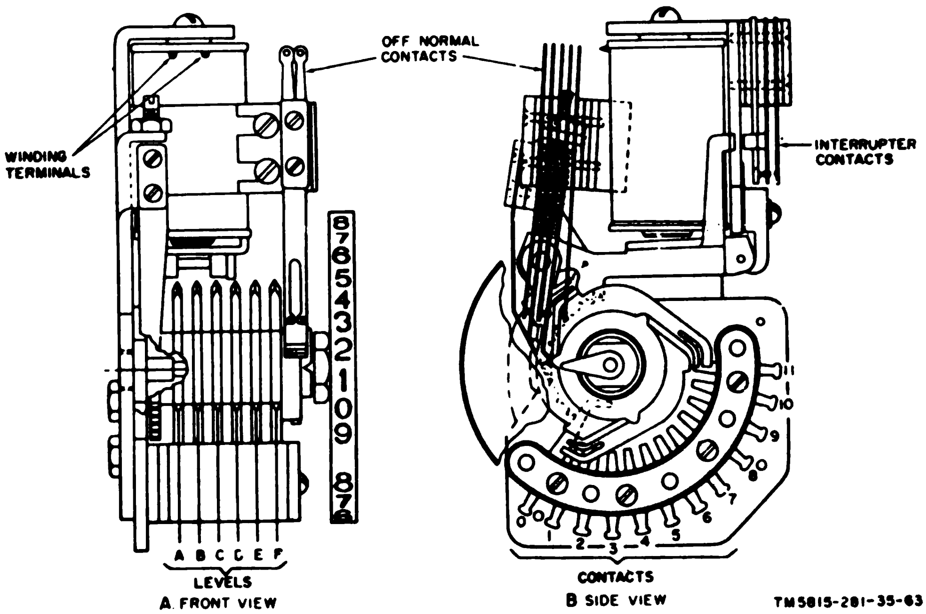


Figure 65. Terminals and contacts of numbering stepping switches RUA, RTA, RHA, RUB, RTB, and RHB.

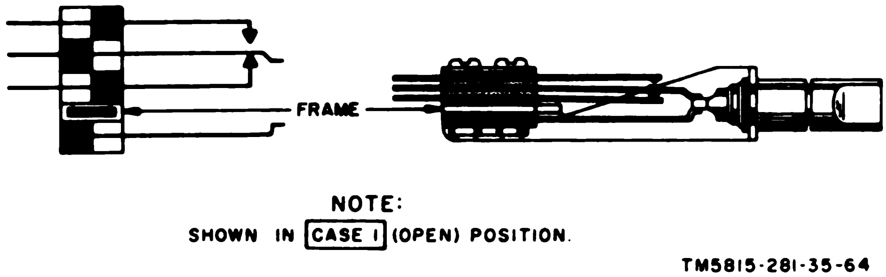


Figure 66. Terminal identification and spring pileups of CASE switches S10 and S11.

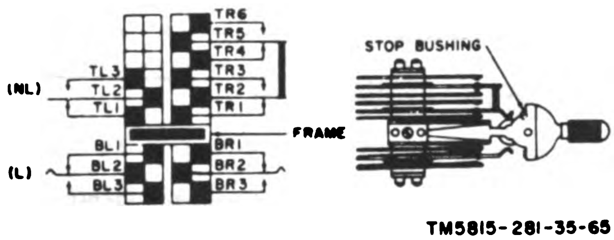


Figure 67. Terminal identification and spring pileups of message numbering reset switches S34 and S35.

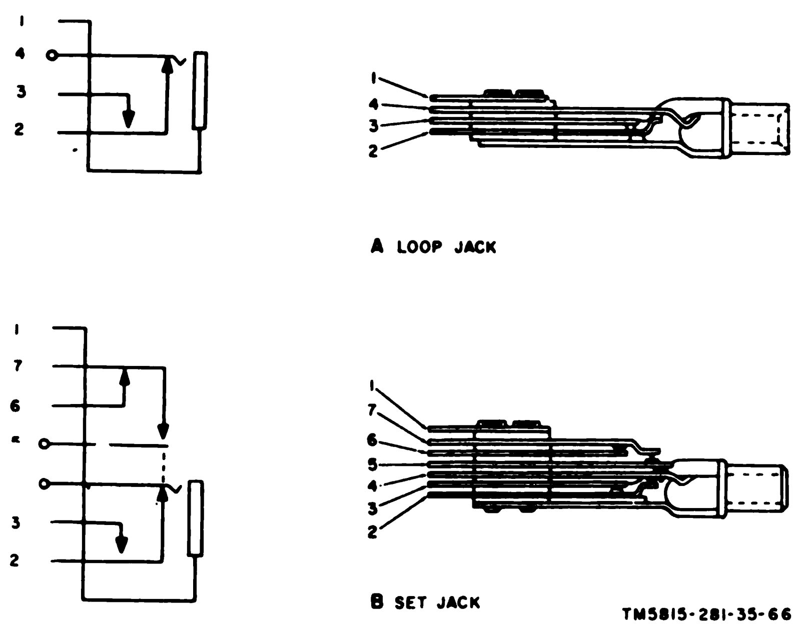


Figure 68. Terminal identification of LOOP JACK and SET JACK.

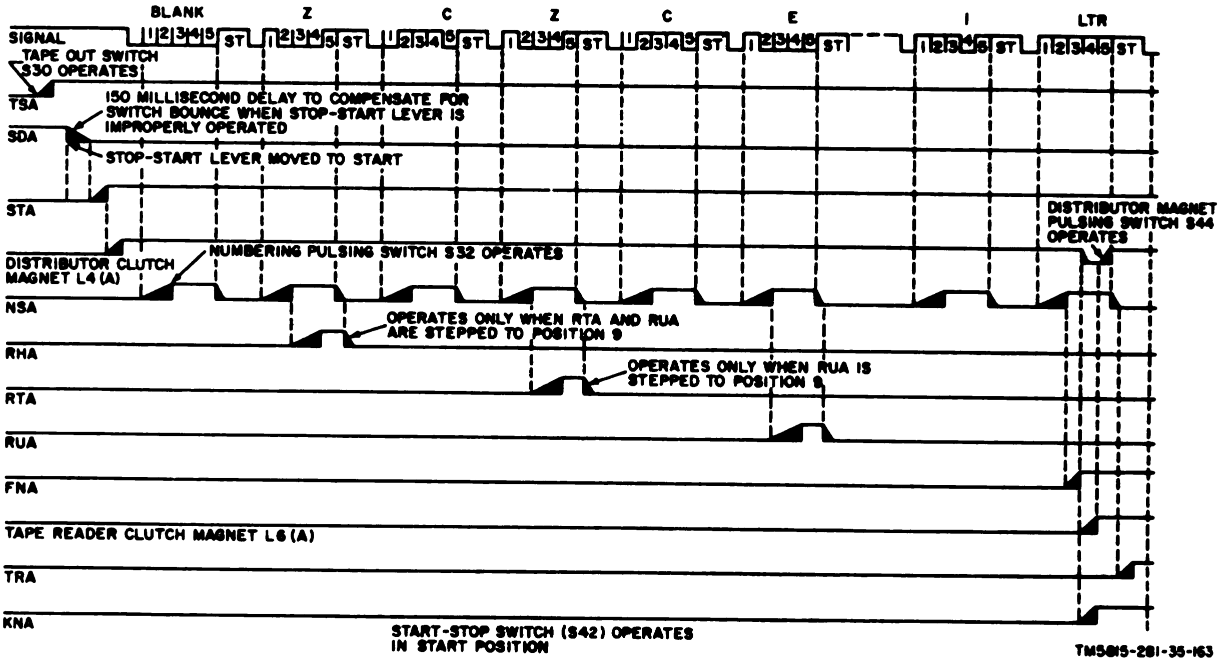


Figure 69. Sequence chart showing transmission of message identification information.

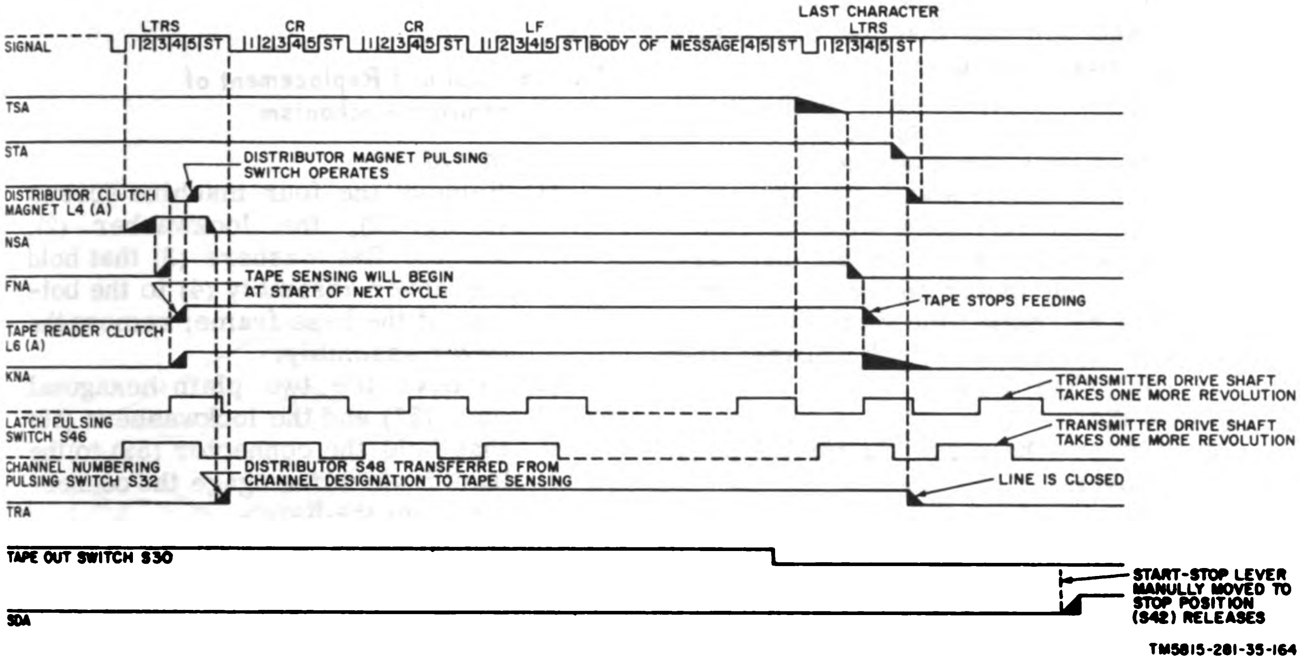


Figure 70. Sequence chart showing transmission from message tape and end-of-tape sensing.

Section VI. DISASSEMBLY AND REASSEMBLY OF TRANSMITTERS

69. General

This section and the following four sections describe the procedures required to completely overhaul the components of the distributor set. When disassembling the various parts and assemblies, disconnect the power and the signal lines. When reassembling the parts, make sure that mating gears, clutch assemblies, and mechanical linkages are in engagement before tightening the holding bolts or screws. Do not tighten screws, nuts, or bolts excessively. Apply a coat of anti-seize compound (para 44) to the steel screws before inserting them into magnesium or aluminum castings. After removing the springs, tag them for identification.

Warning: **Dangerous voltages exist in this equipment. Turn off power before making any connections or replacing any parts within the equipment.**

70. Removal and Replacement of Transmitter Motor

a. *Changing Motor Drive Gear Set.*

(1) Remove the three shoulder screws (1, fig. 71) that hold the motor dust cover (6) to the base frame (32); lift the cover upward and forward to remove it.

(2) Loosen the machine screw (1, fig. 85) that holds the worm (3) to the shaft of the motor armature (51). Loosen the machine screw (26, fig. 71) that holds the worm gear (28) to the power shaft (22). Hold the motor governor target wheel (19, fig. 85) on the armature shaft to prevent rotation of the shaft.

(3) Remove the machine screw (1, fig. 85) and the lockwasher (2) that hold the worm (3) to the shaft of the armature; pull the worm straight off the shaft.

(4) Remove the machine screw (26, fig. 71), the lockwasher (27), and the worm gear (28) from the power shaft (22).

(5) Remove the cotter pins (3) that hold the alternate gear set to the studs in the motor dust cover (6); remove the worm (4) and the worm gear (5). Install the alternate worm gear

on the power shaft; secure it in place with the machine screw and lockwasher (26 and 27).

(6) Install the alternate worm on the motor armature shaft; secure it in place with the machine screw and lockwasher (1 and 2, fig. 85).

(7) If necessary, loosen the four machine screws (4, fig. 85) that secure the motor to the base frame and reposition the motor to obtain the proper backlash between the gears (para 100).

b. Removal.

(1) Remove the motor dust cover (*a*(1) above).

(2) Remove the four machine screws (1, fig. 72), the lockwashers (2), and the flat washers (3) that hold the cover assembly (4) to the base frame; remove the cover assembly and the lockwashers (5).

(3) Disconnect the motor leads from terminal board TB2 in the base frame. Remove the machine screw (7, fig. 71), the lockwasher (8), and the flat washer (9) that hold the cable clamp (10) and the motor cable to the base frame.

(4) Remove the four machine screws (4, fig. 85), the lockwashers (5), and the flat washers (6) that hold the motor to the base frame and remove the motor from the frame.

c. Replacement.

(1) Position the motor on the base frame and secure it in place with the four machine screws (4, fig. 85), the lockwashers (5), and the flat washers (6).

(2) Connect the motor leads to terminal board TB2 as shown in figure 197. Secure the motor power cable to the base frame with machine screw (7, fig. 71), the lockwasher (8), the flat washer (9), and the cable clamp (10).

(3) Position the four lockwashers (5, fig. 72) and the cover assembly (4) on the base frame; secure them in place with the four machine screws (1), the lockwashers (2), and the flat washers (3).

(4) Install the motor dust cover.

71. Removal and Replacement of Transmitter Mechanism

a. Removal.

(1) Remove the four machine screws (1, fig. 72), the lockwasher (2), and the flat washers (3) that hold the cover assembly (4) to the bottom of the base frame; remove the cover assembly.

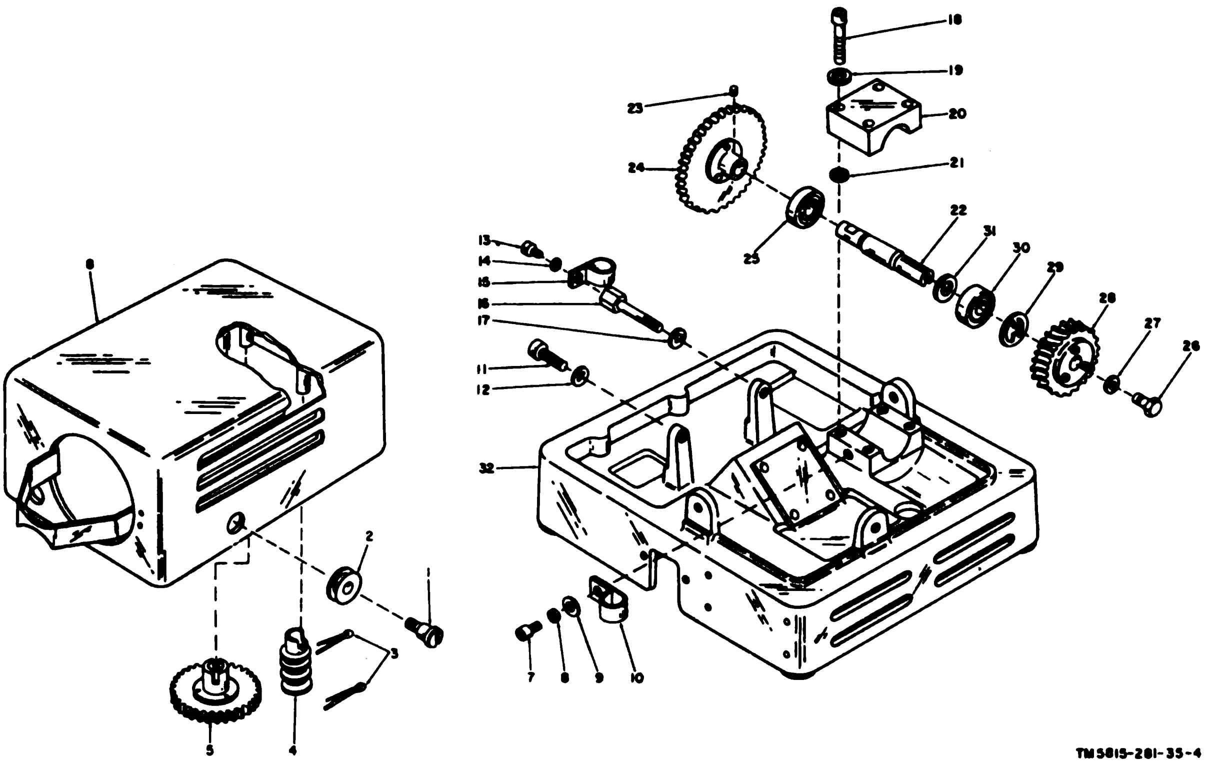
(2) Remove the two plain hexagonal nuts (57) and the lockwashers (58) that hold the connector (59) to the base frame; disengage the connector from the base.

(3) Remove the two machine screws (1, fig. 73), the lockwashers (2), the the flat washers (3) that hold the side cover assembly (8) to the front plate (16). Remove the two machine screws (4) and the lockwashers (5) that hold the side cover assembly to the rear of the transmitter frame; remove the side cover assembly.

(4) Remove the machine screw (13, fig. 71) and the lockwasher (14) that hold the cable clamp (15) to the standoff (16). Remove the standoff, the lockwasher (17), the machine screw (11), and the lockwasher (12) that hold the transmitter mechanism to the base frame (32); remove the transmitter mechanism carefully guiding the cable assembly (60, fig. 72) and the connector (59) through the hold in the base frame.

b. Replacement.

(1) Position the transmitter mechanism on the base frame carefully guiding the connector (59, fig. 72) and the cable assembly (60) through the hole in the base frame. Attach the transmitter mechanism to the base with a machine screw (11, fig. 71), the lockwasher (12), the standoff (16), and the lockwasher (17). Use the cable clamp (15), the machine screw (13), and the lockwasher (14) to attach the cable to the standoff.



1 Shoulder screw, 52701	17 Lockwasher, 10405
2 Grommet, 59713	18 Machine screw, 10030
3 Cotter pin, 10805	19 Lockwasher, 10438
4 Worm (100-wpm), 52108	20 Bearing block (part of item 32)
5 Worm gear (100-wpm), 52109A	21 Shim (0.003-in.), 57073
6 Dust cover, 60958A	22 Power shaft, 59684
7 Machine screw, 10003	23 Setscrew, 10209
8 Lockwasher, 10421	24 Driving gear, 59701A
9 Flat washer, 10472	25 Ball bearing, 10758
10 Cable clamp, 59189A	26 Machine screw, 56124
11 Machine screw, 11501	27 Lockwasher, 10438
12 Lockwasher, 10405	28 Worm gear (60-wpm), 52106A
13 Machine screw, 10003	29 Gear key, 54566
14 Lockwasher, 10429	30 Ball bearing, 10758
15 Cable clamp, 20516	31 Flat washer, 50746
16 Standoff, 59595	32 Base frame, 63914 (includes items 18 through 21.

Figure 71. Motor dust cover, base frame, and power shaft, exploded view.

(2) Position the side cover assembly (8, fig. 73) on the transmitter; attach it to the rear of the transmitter frame with the two machine screws (4) and the lockwashers (5) and to the front plate (16) with the two machine screws (1), the lockwasher (2), and the flat washers (3).

(3) Position the connector (59, fig. 72) on the base frame and secure it with the two plain hexagonal nuts (57) and the lockwashers (58).

(4) Position the lockwashers (5) and the cover assembly (4) on the bottom of the base frame; attach it in place with the four machine screws (1), the lockwashers (2), and the flat washers (3).

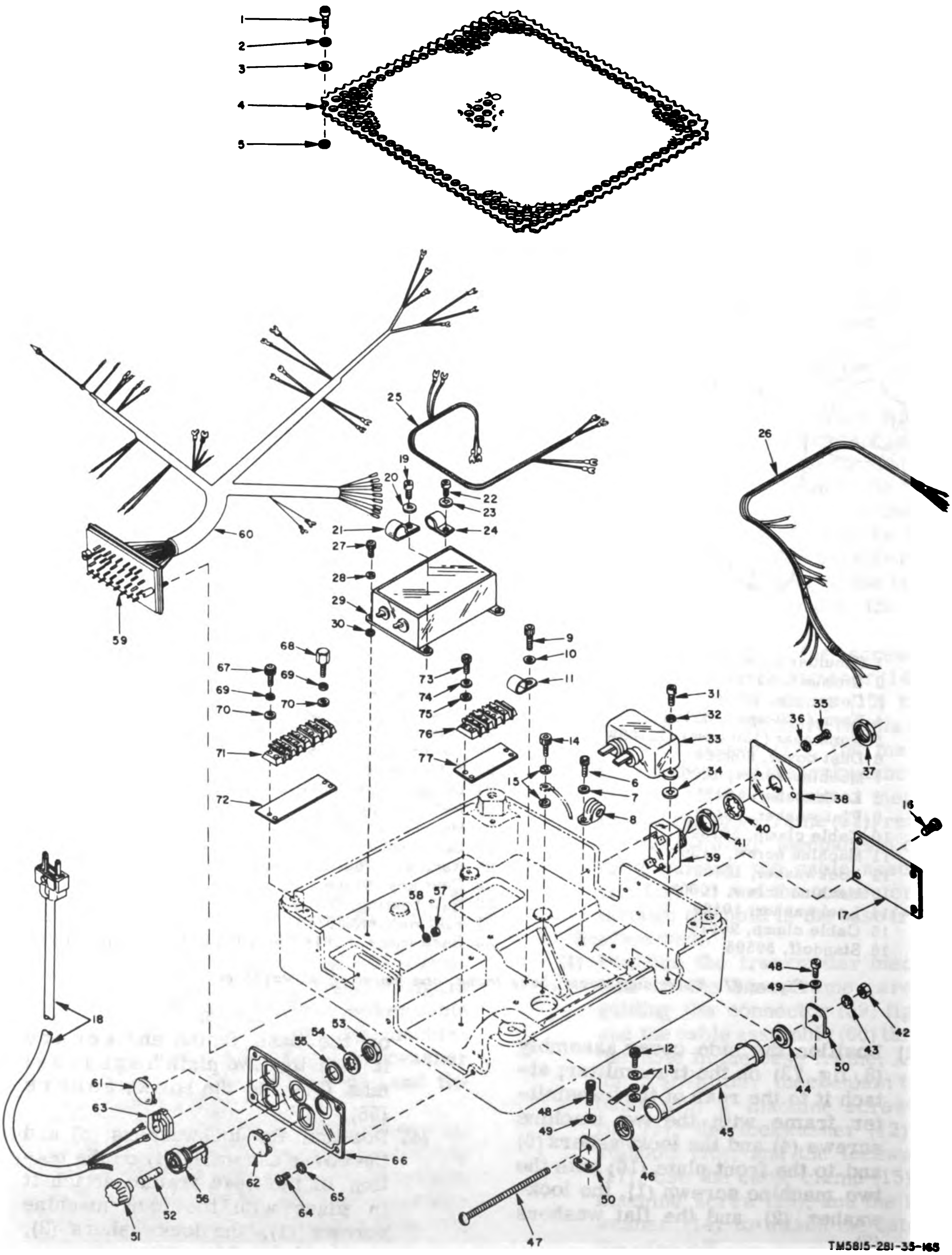


Figure 72. Transmitter base frame, internal components, exploded view.

1 Machine screw, 10055
2 Lockwasher, 10403
3 Flat washer, 10454
4 Cover assembly, 63915A
5 Lockwasher, 10403
6 Machine screw, 10003
7 Lockwasher, 10429
8 Cable clamp, 20516
9 Machine screw, 10003
10 Lockwasher, 10429
11 Cable clamp, 20519
12 Machine screw, 10055
13 Lockwasher, 10403
14 Machine screw, 10055
15 Lockwasher, 10403
16 Drive screw, 11032
17 Nameplate, 63917
18 Power cord, 63912A
19 Machine screw, 10055
20 Lockwasher, 10403
21 Cable clamp, 20519
22 Machine screw, 10003
23 Lockwasher, 10429
24 Cable clamp, 20510
25 Cable assembly, 60959A
26 Cable assembly, 59719A
27 Machine screw, 10055
28 Lockwasher, 10403
29 Filter (FL1 and FL2), 54581
30 Lockwasher, 10403
31 Machine screw, 10055
32 Lockwasher, 10403
33 Capacitor (C2), 20214
34 Lockwasher, 10403
35 Machine screw, 10393
36 Lockwasher, 10403
37 Plain hexagonal nut (part of item 36)
38 Switchplate, 59596
39 Toggle switch (S8), 20115
40 Plain hexagonal nut (part of item 36)
41 Lockwasher (part of item 36)
42 Plain hexagonal nut, 10516
43 Lockwasher, 10430
44 Centering washer, 10456
45 Resistor (R1), 59994
46 Centering washer, 10456
47 Screw, 11700
48 Machine screw, 10003
49 Lockwasher, 10429
50 Bracket, 59783
51 Fuseholder cap (part of item 56)
52 Fuse (F1 and F2), 20455
53 Plain hexagonal nut (part of item 56)
54 Lockwasher (part of item 56)
55 Flat washer (part of item 56)
56 Fuseholder, 20458
57 Plain hexagonal nut (part of item 59)
58 Lockwasher (part of item 59)
59 Connector (J11), 20484
60 Cable assembly, 63918A (includes item 59)
61 Plug button, 59792
62 Plug button, 59792
63 Strain relief, 20713
64 Machine screw, 10393
65 Lockwasher, 10403
66 Plate, 59683
67 Machine screw, 10006
68 Stud, 60013
69 Lockwasher, 10421
70 Flat washer, 10459
71 Terminal board (TB1), 21040
72 Marker strip, 21041
73 Machine screw, 10006
74 Lockwasher, 10421
75 Flat washer, 10459
76 Terminal board (TB2), 20368
77 Marker strip, 20388

Figure 72 – Continued

72. Disassembly and Reassembly of Transmitter Covers (fig. 73)

a. *Disassembly.*

(1) Remove the transmitter mechanism from the base frame (para 71*a*).

(2) Remove the two machine screws (9), the lockwashers (10), and the flat washers (11) that hold the front plate (16) to the right side cover (19). Remove the two machine screws (12) and the lockwashers (13) that hold the front plate to the front of the transmitter frame; remove the front cover.

(3) Remove the bushings (14) and the grommets (15) from the front plate. Remove the bushing (6) and the grommet (7) from the rear of the side cover assembly (8).

(4) Remove the retaining ring (17) that holds the right side cover (19) to the post on the transmitter frame; remove the right side cover. Remove the grommet (18) from the cover. Remove the second retaining ring (20).

(5) Remove the two machine screws (21), the lockwashers (22), the machine screws (23), and the lockwasher (24) that hold the top cover (52) to the transmitter frame; remove the top cover. Remove the two setscrews (25) from the top cover.

(6) Remove the two machine screws (26 and 28) and the flat washers

(27 and 29) from the tape shelf (33). Remove the tape guide (30), the steel ball (31), and the spring (32).

(7) Remove the two machine screws (34) and the lockwashers (35) that hold the tape shelf to the top cover; remove the tape shelf.

(8) Remove the setscrew (36) that holds the tape cover latch stud (37) to the tape cover bracket (49); remove the tape cover latch stud, the tape cover latch (38), and the tape cover latch spring (39)

(9) Remove the pin (40) that holds the tape cover (45) to the tape cover bracket (49); remove the tape cover spring (41), the assembled tape cover (45), and the tape guide (44).

(10) Remove the two machine screws (42) that hold the tape guide to the tape cover; remove the tape guide. Remove the two setscrews (43) from the tape cover.

(11) Remove the two machine screws (46), the lockwashers (47), and the flat washers (48) that hold the tape cover bracket (49) to the top cover (52); remove the tape cover bracket and shims (50 and 51).

b. Reassembly.

(1) Reassemble the transmitter covers as indicated in figure 73; the sequence for assembling the parts is the reverse of the disassembly sequence.

(2) Adjust the tape cover (para 142 through 145).

(3) Adjust the top cover (para 141 and 146).

(4) Replace the transmitter mechanism (para 71*b*).

73. Disassembly and Reassembly of Blank Signal Counter Mechanism

a. Disassembly.

(1) Remove the transmitter covers (para 72*a*).

(2) Unsolder the electrical leads from switch S28 (16, fig. 74). Remove the machine screw (1), the lockwasher (2), the flat washer (3), the plain hexagonal nut (1, fig. 84), the lockwasher (2), and the cable clamp (3) that hold the top of the counter mechanism to the transmitter frame. Remove the two machine screws (1, fig. 74), the lockwashers (2), and the flat washers (3) that hold the bottom of the counter mechanism to the transmitter frame; remove the counter mechanism.

(3) Remove the two setscrews (7) that hold the hub assembly (8) to the pivot post on the counter mounting plate (48); remove the assembled counter clock spring (10), the counter cam ratchet (11), and the counter indexing ratchet (12). Remove the drivescrew (9) that holds the counter clock spring to the counter cam ratchet; remove the counter clock spring.

(4) Remove the machine screw (13), the lockwasher (14), the plate (15) and blank tape switch S28 (16) from the counter mounting plate.

(5) Remove the retainer ring (17), the cam ratchet detent (18), and the detent spring (19) from the pivot post on the counter mounting plate.

(6) Remove the self-locking hexagonal nut (20) and the eccentric (21) from the counter lever (30).

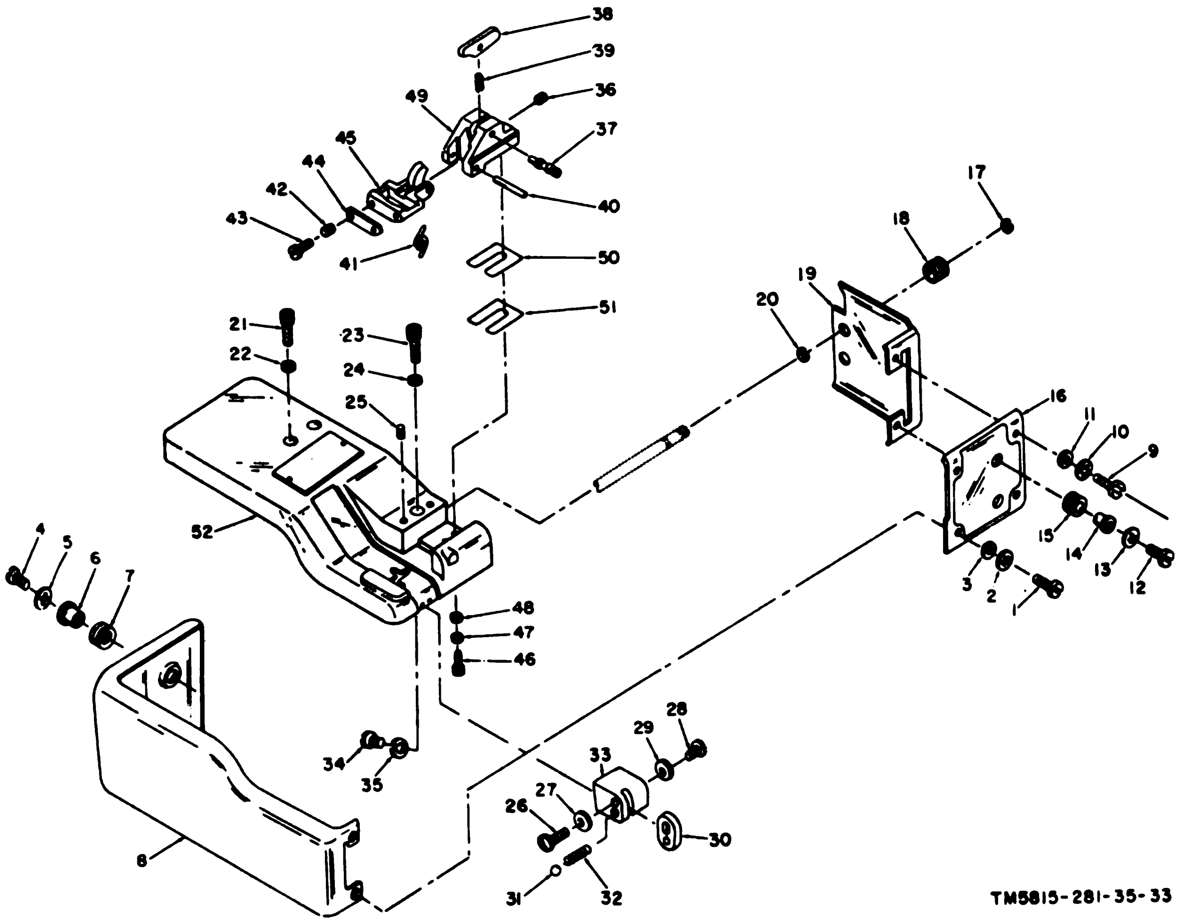
(7) Remove the counter lever spring (22) and the counter lever restore spring (23). Remove the three retainer rings (24) and the assembled levers (30), (40), and (41), from the pivot post on the counter mounting plate.

(8) Remove the retainer ring (25); the counter pawl (26) and the counter pawl spring (27) from the eccentric stud (29).

(9) Remove the self-locking hexagonal nut (28) and the eccentric stud (29) from the counter lever (30).

(10) Remove the bushing (31) from the assembled restore lever cam follower (40) and counter restore lever (41).

(11) Remove the retainer ring (32), the indexing ratchet detent (33), and the



1 Machine screw, 10106
2 Lockwasher, 10403
3 Flat washer, 10458
4 Machine screw, 10357
5 Lockwasher, 10403
6 Bushing, 52860
7 Grommet, 20725
8 Side cover assembly, 63916A
9 Machine screw, 10106
10 Lockwasher, 10403
11 Flat washer, 10458
12 Machine screw, 10357
13 Lockwasher, 10403
14 Bushing, 52860
15 Grommet, 20725
16 Front plate, 59711
17 Retaining ring, 10949
18 Grommet, 20725
19 Right side cover, 58737A
20 Retaining ring, 10949
21 Machine screw, 10003
22 Lockwasher, 10429
23 Machine screw, 10006
24 Lockwasher, 10429
25 Setscrew, 10224
26 Machine screw, 10252
27 Flat washer, 58859
28 Machine screw, 10252
29 Flat washer, 58859
30 Tape guide, 60522
31 Steel ball, 10924
32 Spring, 58797
33 Tape shelf, 58744
34 Machine screw, 10106
35 Lockwasher, 10429
36 Setscrew, 10203
37 Tape cover latch stud, 53952
38 Tape cover latch, 57204
39 Tape cover latch spring, 57203
40 Pin, 57214
41 Tape cover spring, 56324
42 Setscrew, 10221
43 Machine screw, 52884
44 Tape guide, 52809
45 Tape cover, 57209
46 Machine screw, 10004
47 Lockwasher, 10421
48 Flat washer, 10459
49 Tape cover bracket, 59414A
50 50 Shim (0.002-inch), 57201
51 Shim (0.005-inch), 57202
52 Top cover, 58742A

Figure 73. Transmitter covers, exploded view.

detent spring (34) from the eccentric stud (36). Remove the self-locking hexagonal nut (35) and the eccentric stud (36).

(12) Remove the machine screw (37), the lockwasher (38), the flat washer (39) and the restore lever cam follower (40) from the counter restore lever (41).

(13) Remove the setscrew (42) and the kickout post (43) from the counter mounting plate.

(14) Remove the two machine screws (44), the lockwashers (45), the nut plate (46) and distributor magnet pulsing switch S44 (47) from the counter mounting plate.

b. Reassembly.

(1) Reassemble the counter mechanism as indicated in figure 74; the sequence for assembly of the parts is the reverse of disassembly.

(2) Adjust the counter mechanism (para 125 through 131).

(3) Replace the transmitter covers (para 72*b*).

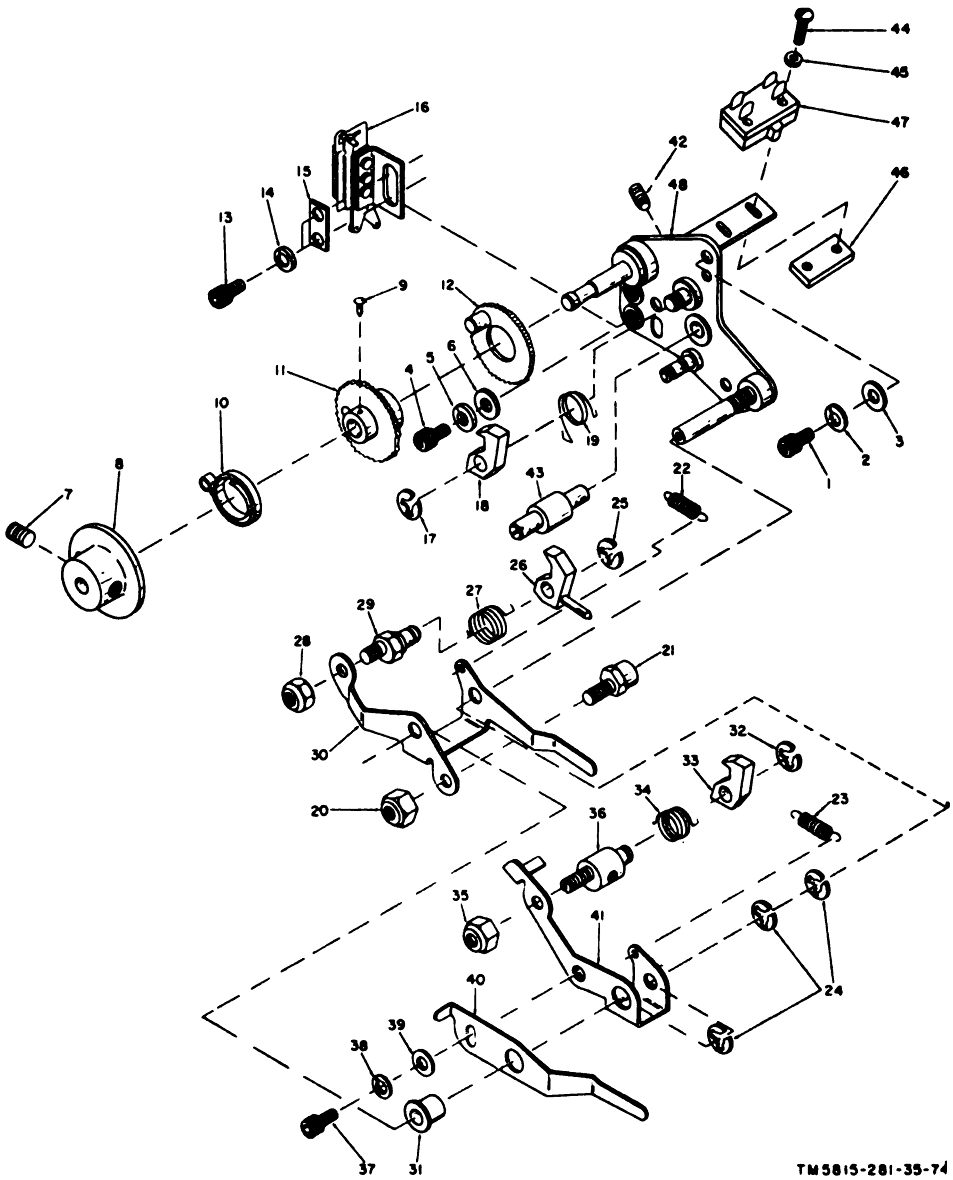


Figure 74. Counter mechanism, exploded view.

1 Machine screw, 10006
2 Lockwasher, 10429
3 Flat washer, 10458
4 Machine screw, 10004
5 Lockwasher, 10429
6 Flat washer, 10458
7 Setscrew, 10210
8 Hub assembly, 58632A
9 Drivescrew, 10348
10 Counter clock spring, 58741A
11 Counter cam ratchet, 58637A
12 Counter indexing ratchet, 58640A
13 Machine screw, 10001
14 Lockwasher, 10421
15 Plate, 60469
16 Blank tape switch (S28), 58651A
17 Retainer ring, 10949
18 Cam ratchet detent, 54803
19 Detent spring, 58788
20 Self-locking hexagonal nut, 10501
21 Eccentric, 58842
22 Counter lever spring, 58790
23 Counter lever restore spring, 58790
24 Retainer ring, 10949
25 Retainer ring, 10949
26 Counter pawl, 58645A
27 Counter pawl spring, 58789
28 Self-locking hexagonal nut, 10501
29 Eccentric stud, 58644
30 Counter lever, 58650
31 Bushing, 58647
32 Retainer ring, 10949
33 Indexing ratchet detent, 54803
34 Detent spring, 59660
35 Self-locking hexagonal nut, 10501
36 Eccentric stud, 58644
37 Machine screw, 10001
38 Lockwasher, 10429
39 Flat washer, 10458
40 Restore lever cam follower, 58649
41 Counter restore lever, 58656A
42 Setscrew, 10203
43 Kickout post, 58643
44 Machine screw, 10105
45 Lockwasher, 10433
46 Nut plate, 60298
47 Distributor magnet pulsing switch (S44), 20145
48 Counter mounting plate, 63922

Figure 74 – Continued.

74. Disassembly and Reassembly of Tape-Out Sensing Mechanism

a. *Disassembly.*

(1) Remove the transmitter covers (para 72*a*).

(2) Unhook the sensing lever latch spring (1, fig. 77) from the sensing lever comb (29, fig. 75). Unhook the tape-out lever spring (22) from the sensing lever comb. Unhook the tape-feed claw spring (38, fig. 78) from the sensing lever comb.

(3) Remove the two machine screws (1 and 4, fig. 75), the lockwashers (2 and 5), and the flat washers (3 and 6) that hold the sensing lever comb to the transmitter frame; remove the tape-out sensing mechanism.

(4) Remove the driving dog spring (7) from the driving dog (18) and the tape-out lever (20).

(5) Remove the setscrew (8) that holds the driving dog to the tape-out lever shaft (27). Remove the retainer ring (12) that holds the tape-out lever shaft to the sensing lever comb (29).

(6) Remove the machine screw (9), the lockwasher (10), and the flat washer (11) that hold the lever arm (15) to the tape-out lever; remove the bushing (13), the felt washer (14), and the lever arm from the tape-out lever shaft (27).

(7) Remove the retainer ring (16) from the lever shaft. Slide the assembled cams (24 and 25) and shaft to the right; catch the felt washer (17), the driving dog (18), the sensing finger assembly (19), the tape-out lever (20), the felt washer (21), and the tape-out lever spring (22) as they fall from the end of the shaft.

(8) Remove the two setscrews (23) that hold the switch lever cam (24) and the latch lever cam (25) to the lever shaft; remove the cams and felt washer (26).

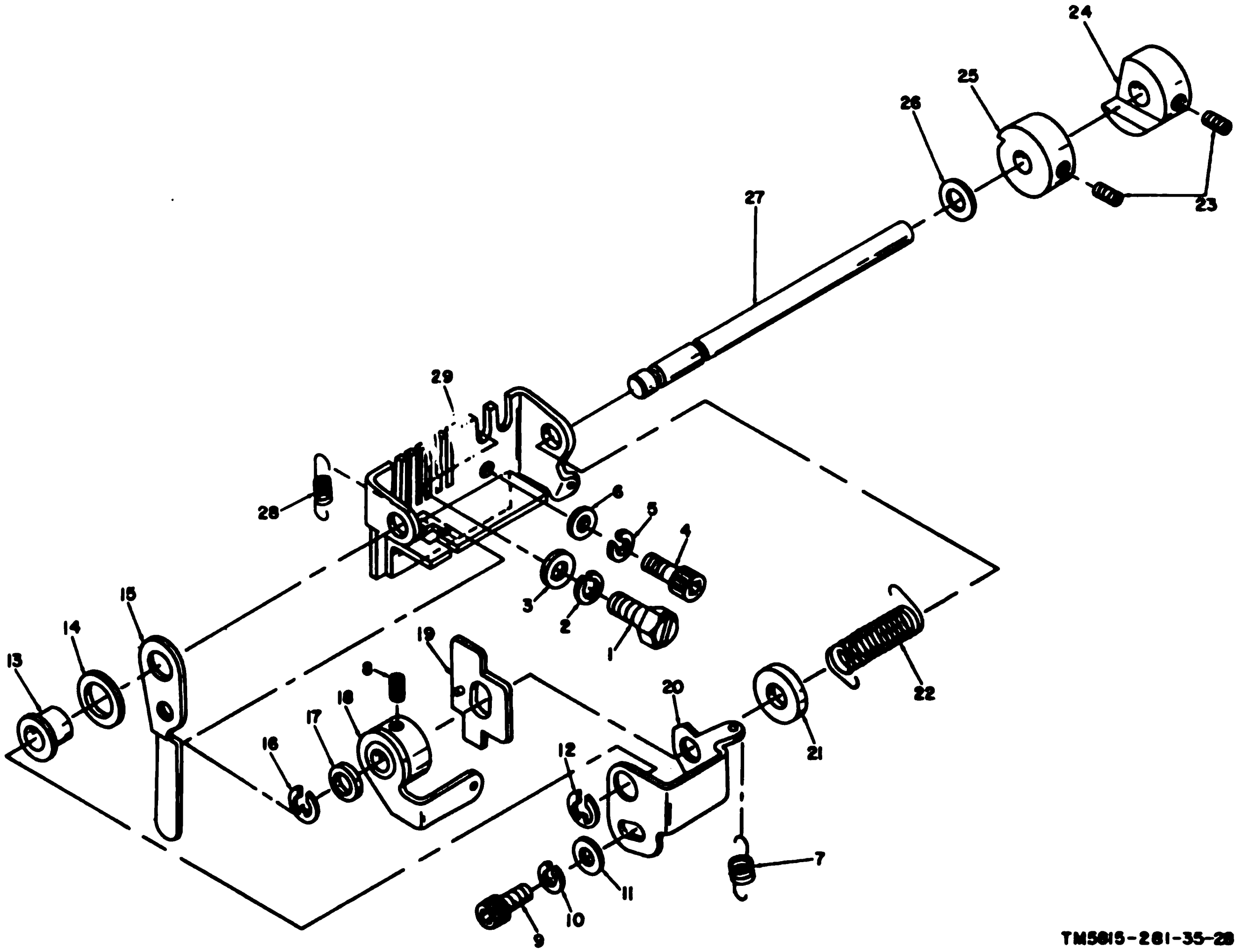
b. *Reassembly.*

(1) Reassemble the tape-out sensing mechanism as indicated in figure 75; the sequence for assembly the parts is the reverse of disassembly.

(2) Hook the tape-out lever spring (22), the tape-feed claw spring (38, fig. 78), and the sensing lever latch spring (1, fig. 77) to the sensing lever comb (29, fig. 75).

(3) Replace the transmitter covers (para 72*b*).

(4) Adjust the tape-out sensing mechanism (para 123 and 124).



1 Machine screw, 10398
2 Lockwasher, 10429
3 Flat washer, 10458
4 Machine screw, 10003
5 Lockwasher, 10429
6 Flat washer, 10458
7 Driving dog spring, 58792
8 Setscrew, 10201
9 Machine screw, 10058
10 Lockwasher, 10432
11 Flat washer, 50320
12 Retainer ring, 10960
13 Bushing, 58759
14 Felt washer, 61477
15 Lever arm, 60324A
16 Retainer ring, 10960
17 Felt washer, 61476
18 Driving dog, 58718A
19 Sensing finger assembly, 60582A
20 Tape-out lever, 60583
21 Felt washer, 61474
22 Tape-out lever spring, 58791
23 Setscrew, 10203
24 Switch lever cam, 58679
25 Latch lever cam, 58678
26 Felt washer, 61681
27 Tape-out lever shaft, 60578
28 Sensing lever comb spring, 58860
29 Sensing lever comb, 60579A

Figure 75. Tape-out sensing mechanism, exploded view.

75. Disassembly and Reassembly of Stop-Start Lever Assembly

a. *Disassembly.*

(1) Remove the transmitter covers (para 72*a*).

(2) Remove the retainer ring (1, fig. 76) that holds the stop-start lever (3) to the pivot shaft in the transmitter frame; move the stop-start lever detent (12, fig. 84) out of engagement with the stop-start lever and remove the stop-start lever and felt washers (2, fig. 76).

(3) Remove the setscrew (4) that holds the switch actuating cam (5) to the switch operating shaft and retracting arm (8); remove the switch actuating cam.

(4) Remove the assembled switch operating shaft and retracting arm (8) and the switch cam (7). Remove the setscrew (6) that holds the switch cam to the switch operating shaft and retracting arm; remove the switch cam.

b. *Reassembly.*

(1) Reassemble the stop-start levers as indicated in figure 76; the sequence for assembling the parts is the reverse of disassembly.

(2) Adjust the stop-start levers (para 118 through 120).

(3) Replace the transmitter covers (para 72*b*).

76. Disassembly and Reassembly of Tight-Tape Lever Assembly

a. *Disassembly.*

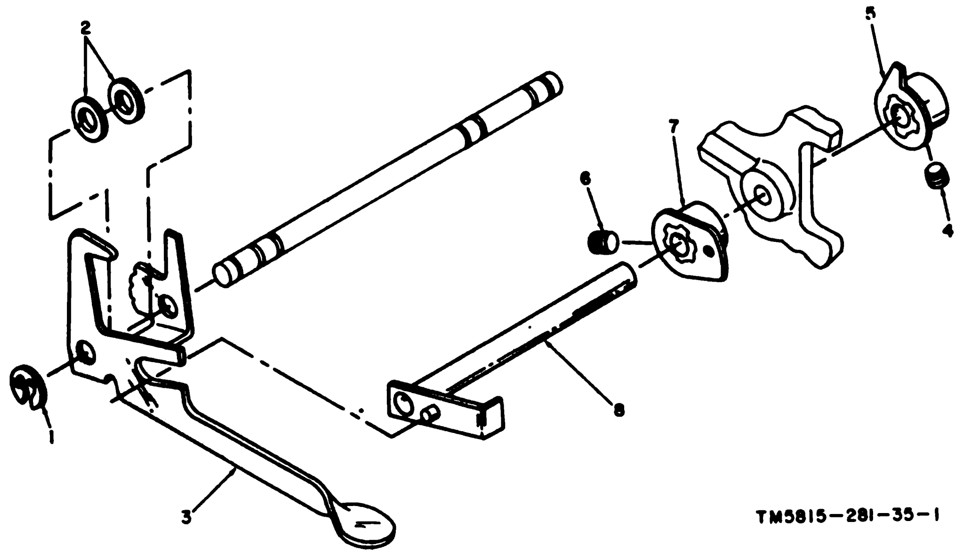
(1) Remove the transmitter covers (para 72*a*).

(2) Remove the sensing lever latch spring (1, fig. 77) from the sensing lever latch (4) and from the sensing lever comb (29, fig. 75).

(3) Remove the setscrew (2, fig. 77) that holds the tight-tape lever (3) to the tight-tape lever shaft (9); remove the tight-tape lever.

(4) Remove the sensing lever latch (4), the switch actuating lever (5), and the felt washers (6) from the tight-tape lever shaft.

(5) Remove the assembled tight-tape lever shaft and the collar (8) from the transmitter frame. Remove the setscrew (7) that holds the collar



1 Retainer ring, 10949
2 Felt washer, 61474
3 Stop-start lever, 58715
4 Setscrew, 10209
5 Switch actuating cam, 58729A
6 Setscrew, 10209
7 Switch cam, 58727A
8 Switch operating shaft and retracting arm, 58690A

Figure 76. Stop-start lever assembly, exploded view.

to the tight-tape lever shaft; remove the collar.

b. Reassembly.

(1) Reassemble the tight-tape lever assembly as indicated in figure 77; the sequence for assembling the parts is the reverse of disassembly.

(2) Adjust the tight-tape lever assembly (para 122).

(3) Replace the transmitter covers (para 72*b*).

77. Disassembly and Reassembly of Code Sensing Levers

a. Disassembly.

(1) Remove the transmitter covers (para 72*a*).

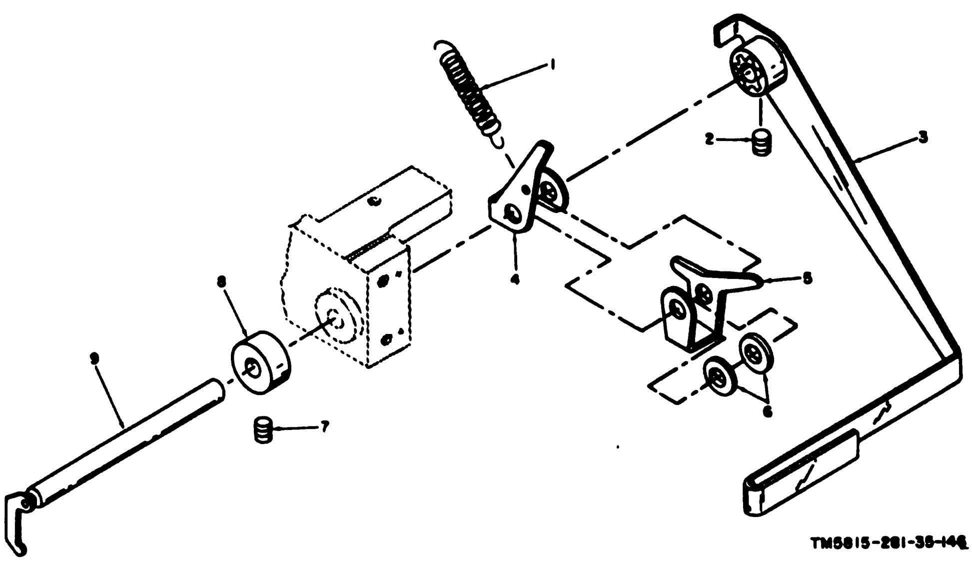
(2) Unhook the tape-feed claw spring (38, fig. 78) from the sensing lever comb (29, fig. 75).

(3) Remove the tape-feed retracting lever spring (1, fig. 78) from the sensing lever spring plate (8) and from the tape-feed retracting lever (47). Remove the five sensing lever springs (2) from the sensing lever spring plate and from the five sensing levers. Remove the restore lever and comb assembly spring (3) from the sensing lever spring plate and from the restore lever and comb assembly (43).

(4) Remove the tape-feed cam lever spring (4) from the tape-feed cam lever (17) and from the spring post on the transmitter frame. Remove the tape-feed operating lever spring (5) from the tape-feed operating lever (16) and from the spring post on the transmitter frame.

(5) Remove the two machine screws (6) and the lockwashers (7) that hold the sensing lever spring plate (8) to the transmitter frame; remove the sensing lever spring plate.

(6) Disconnect electrical leads from contact posts of contact block (12) and unsolder leads from terminals (56) of photo devices (50); tag all leads carefully.



1. Sensing lever latch spring, 52193
2. Setscrew, 10209
3. Tight-tape lever, 58724A
4. Sensing lever latch, 58716
5. Switch actuating lever, 55721
6. Felt washer, 61681
7. Setscrew, 10203
8. Collar, 50531
9. Tight-tape lever shaft, 56696A

Figure 77. Tight-tape lever assembly, exploded view.

(6.1) Remove two machine screws (9), two washers (10), and two square washers (11) that hold the contact block (12) and the bracket (55) to the transmitter frame.

(6.2) Remove bracket (55), contact block (12), tape reader switch contact wipers (13), and contact wiper springs (14).

(6.3) Remove three nuts (51) and three screws (52) that hold the three lamp retaining springs (53) in place. Remove the lamp retaining springs (53) and five miniature lamps (54).

(6.4) Unsolder and disconnect five photo devices A2Q1 through A2Q5 (50) from terminals (56); remove photo devices (50).

(6.5) Unsolder and disconnect leads (64) and resistor A2R1 (57) from contacts (58) on PC board A2A1 (59); remove resistor A2R1 (57).

(6.6) Unsolder and remove spacer (60). PC board A2A1 (59) is riveted to bracket (55). Contact guides (62) and (63) are cemented to contact block (12).

switch contact wipers (13), and the contact wiper springs (14).

(7) Remove the retainer ring (15) that holds the tape-feed operating lever (16) and the tape-feed cam lever (17) to the eccentric post (22); remove the felt washer (18), the tape-feed cam lever, and the tape-feed operating lever.

(8) Remove the setscrew (19) that holds the eccentric post to the transmitter frame; remove the eccentric post, the flet washer (20), and the flat washer (21). If the shims (26 and 27) are used, remove the machine screw (23), the lockwasher (24), and the flat washer (25) that hold the shims to the transmitter frame; remove the shims.

(9) Loosen the plain hexagonal nuts (29) on the two adjusting screws (28) and remove the hexagonal nuts and adjusting screws from the transmitter frame.

(10) Remove the felt washer (30) and the five retainer rings (31, 32, 33, 34, and 35) that hold the sensing levers to the pivot post (49); remove the five code-sensing levers (36, 37, 40, 41, and 42), the tape-feed claw (39), the restore lever and comb assembly (43), and the tape-feed retracting lever (47). Remove the tape-feed claw spring (38) from the tape-feed claw.

(11) Remove the self-locking hexagonal nut (44), the flat washer (45), and the eccentric post (46) from the tape-feed retracting lever.

(12) Remove the felt washer (48) and the pivot post (49) from the transmitter frame.

b. Reassembly.

(1) Reassemble the code sensing levers and associated parts as indicated in figure 78; the sequence of assembly is the reverse of disassembly.

(2) Reconnect the leads to the contact posts of contact block (12). Resolder the photo-devices (50) and leads to terminals (56). Resolder resistor A2R1 (57) to contacts (58) on PC board A2A1 (59).

(3) Adjust code sensing levers and associated parts (para 103, 104, 106, and 107).

(4) Adjust photo-reader bracket (55) (para 108).

(5) Replace transmitter covers (para 72*b*).

78. Disassembly and Reassembly of Distributor Clutch Magnet, Armature, and Latching Levers

a. Disassembly.

(1) Remove the transmitter covers (para 72*a*).

(2) Disconnect the electrical leads from the distributor clutch magnet (18, fig. 79).

(3) Remove the machine screw (1), the flat washer (2), and the nut plate (3) that hold the unlatch actuating lever (4) to the shaft of the tape-reader clutch magnet armature (14, fig. 80); remove the unlatch actuating lever.

(4) Remove the distributor armature spring (5, fig. 79) from the distributor clutch magnet armature (7) and from the spring post on the transmitting frame.

(5) Remove the retainer ring (6) that holds the distributor clutch magnet armature (7) to the shaft of the tape reader clutch magnet armature (14, fig. 80); remove the distributor clutch magnet armature, the laminated washer (8, fig. 79), and the flat washer (9).

(6) Remove the armature latch spring (10) from the distributor armature latch (12) and from the spring post on the transmitter frame. Remove the retainer ring (11) that holds the distributor armature latch to the eccentric stud (14); remove the distributor armature latch.

(7) Remove the setscrew (13) that holds the eccentric stud (14) to the transmitter frame; remove the eccentric stud.

(8) Remove the machine screws (15), the lockwashers (16), and the flat washers (17) that hold the distributor clutch magnet (18) to the transmitter frame; remove the distributor clutch magnet.

(9) Remove the setscrew (19) that

holds eccentric stud (20) to the transmitter frame; remove the eccentric stud.

b. Reassembly.

(1) Reassemble the distributor clutch magnet, the armature, and the latching levers as indicated in figure 79; the sequence for assembling the parts is the reverse of disassembly.

(2) Connect the electrical leads to the distributor clutch magnet.

(3) Adjust the distributor clutch magnet (para 111 and 113).

(4) Adjust the latching levers (para 115 through 117).

(5) Replace the transmitter covers (para 72*b*).

79. Disassembly and Reassembly of Tape-Reader Clutch Magnet and Armature (fig. 80)

a. Disassembly.

(1) Remove the transmitter covers (para 72*a*).

(2) Disconnect the electrical leads from the tape-reader clutch magnet (4). Remove the two machine

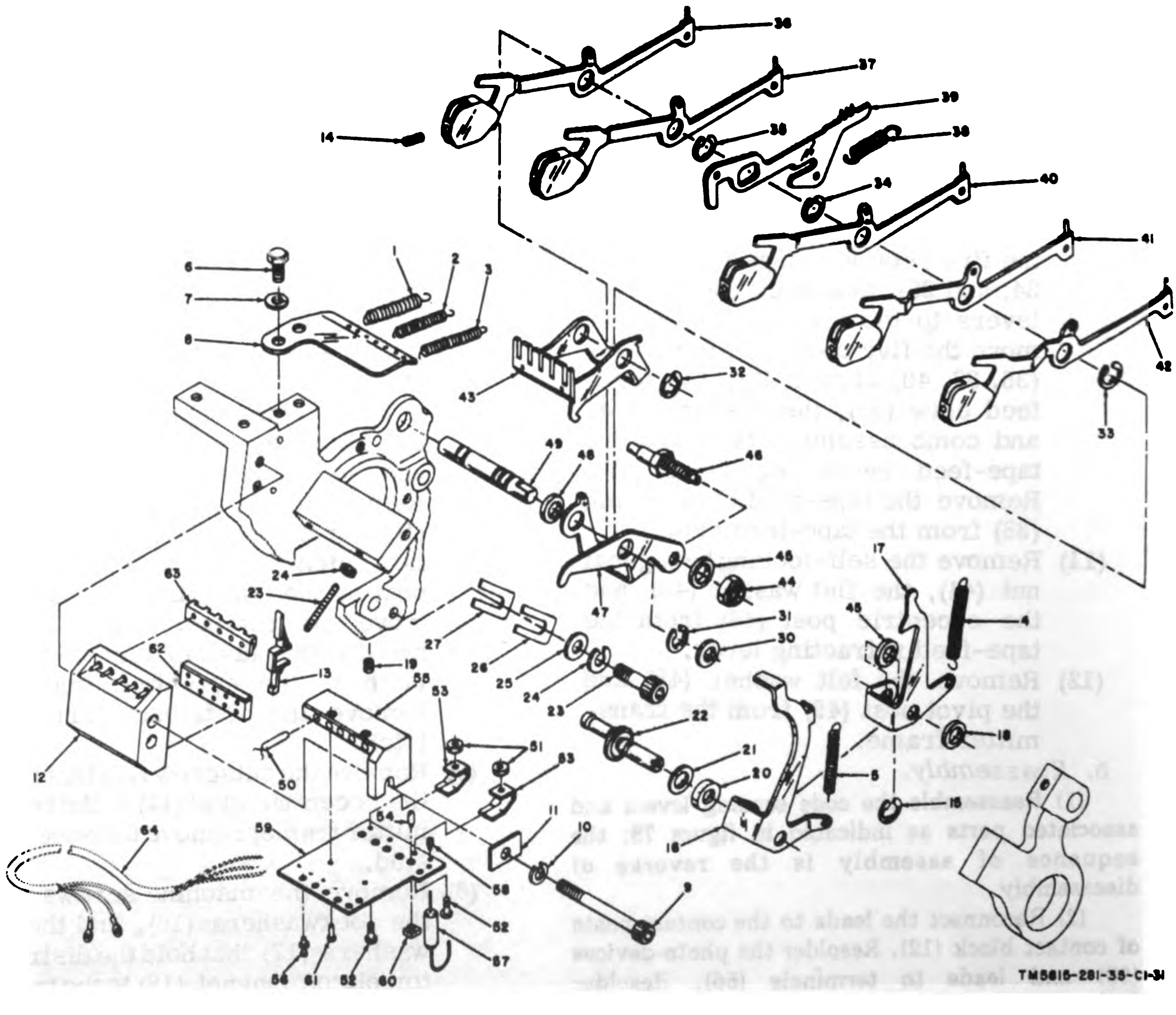


Figure 78. Photo-reader (A2), code sensing levers and associated parts, exploded view.

1 Tape-feed retracting lever spring, 58800
2 Sensing lever spring, 58802
3 Restore lever and comb assembly spring, 58801
4 Tape feed cam lever spring, 58799
5 Tape-feed operating lever spring, 58798
6 Machine screw, 10398
7 Lockwasher, 10429
8 Sensing lever spring plate, 58665
9 Machine screw, 10033
10 Lockwasher, 10429
11 Washer, A63379-001
12 Contact block, 58772A
13 Tape-reader switch contact wiper, 58677
14 Contact wiper spring, 58797
15 Retainer ring, 10949
16 Tape-feed operating lever, 58657
17 Tape-feed cam lever, 58658
18 Felt washer, 61681
19 Setscrew, 10204
20 Felt washer, 61480
21 Flat washer, 50827
22 Eccentric post, 58659
23 Machine screw, 10001
24 Lockwasher, 10429
25 Flat washer, 10458
26 Shim (0.002 inch) 57201
27 Shim (0.005-inch) 57202
28 Adjusting screw, 10239
29 Plain hexagonal nut, 10513
30 Felt washer, 61477
31 Retainer ring, 10957
32 Retainer ring, 10957
33 Retainer ring, 10957
34 Retainer ring, 10957
35 Retainer ring, 10957
36 No. 1 code sensing lever, 58672A
37 No. 2 code sensing lever, 58673A
38 Tape-feed claw spring, 53153
39 Tape-feed claw, 58686
40 No. 3 code-sensing lever, 58674A
41 No. 4 code-sensing lever, 58675A
42 No. 5 code-sensing lever, 58676A
43 Restore lever and comb assembly, 58672A
44 Self-locking hexagonal nut, 10501
45 Flat washer, 50827
46 Eccentric post, 58681
47 Tape-feed retracting lever, 58684
48 Felt washer, 61477
49 Pivot post, 58685
50 Photo device, LS400
51 Nut, MS35649-224
52 Screw, 540487-154
53 Spring, A63982-002, A63981-001
54 Lamp, 8828AS15
55 Bracket, A63983-001
56 Terminal A63977-002
57 Resistor A2R1, RW69V391
58 Terminal, 540015-502
59 PC board A2A1, A63977-001
60 Spacer, A63987-001
61 Rivet, MS16535-14
62 Contact guide, 2100436-001
63 Contact guide, 2100435-001
64 Leads to resistor A2R1

Figure 78 – Continued.

screws (1), the lockwashers (2), and the flat washers (3) that hold the tape-reader clutch magnet to the transmitter frame; remove the tape-reader clutch magnet.

(3) Remove the unlatch actuating lever and the distributor clutch magnet armature (para 78*a*(3) through (5)).

(4) Remove the tape-reader armature spring (5) from the tape-reader clutch magnet armature and from the spring post on the transmitter frame.

(5) Remove the machine screw (6), the lockwasher (7), the flat washer (8), the machine screw (9), the adjusting arm spring (10), the lockwasher (11), and the flat washer (12) that hold the armature adjusting arm (13) to the tape-reader clutch magnet armature (14); remove the armature adjusting arm.

(6) Remove the tape-reader clutch magnet armature and washer (15) from the transmitter frame.

b. Reassembly.

(1) Reassemble the tape-reader clutch magnet and armature as indicated in figure 80; the sequence for assembling the parts is the reverse of disassembly.

(2) Replace the distributor arm unlatch actuating lever and the distributor clutch magnet armature (para 78*b*).

(3) Adjust the tape-reader clutch magnet and armature (para 109, 112, and 114).

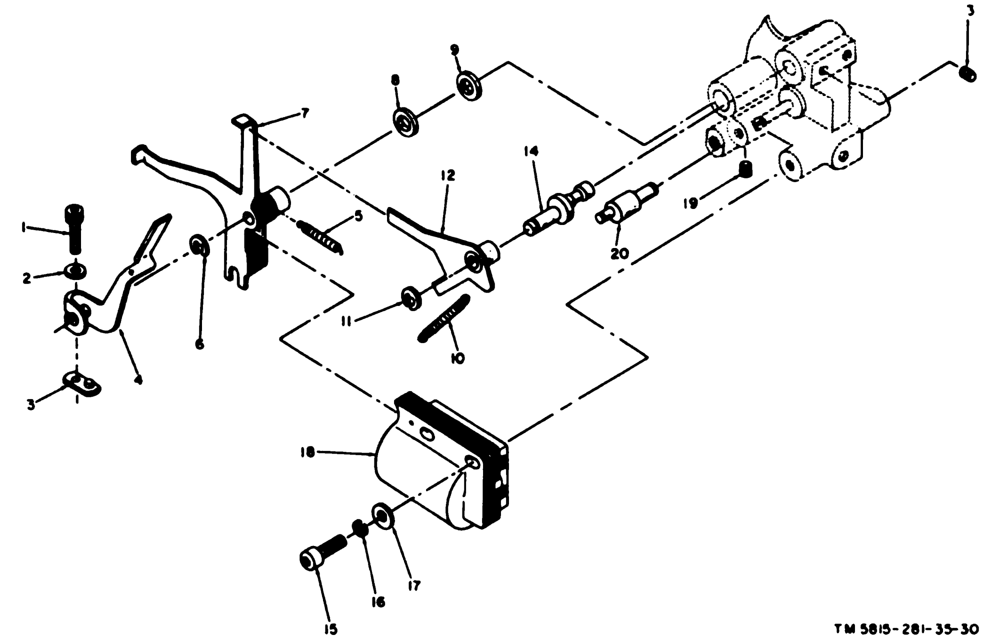
(4) Replace the transmitter covers (para 72*b*).

80. Disassembly and Reassembly of Transmitter Pulsing Switches

a. Disassembly.

(1) Disconnect all electrical leads from the numbering and latch pulsing switches.

(2) Remove the two machine screws (1, fig. 81) and the lockwashers (2)



1 Machine screw, 10006
2 Flat washer, 10459
3 Nut plate, 50174
4 Unlatch actuating lever, 60093
5 Distributor armature spring, 60007
6 Retainer ring, 10949
7 Distributor clutch magnet armature, 58705A
8 Laminated washer, 50831
9 Flat washer, 51408
10 Armature latch spring, 58795
11 Retainer ring, 10949
12 Distributor armature latch, 58700A
13 Setscrew, 10204
14 Eccentric stud, 52318
15 Machine screw, 10010
16 Lockwasher, 10426
17. Flat washer, 10467
18 Distributor clutch magnet (L4), 54384A
19 Setscrew, 10209
20 Eccentric stud, 58775

Figure 79. Distributor clutch magnet, armature, and latching levers, exploded view.

that hold the switch bracket (3) to the transmitter frame; remove the assembled switch bracket and numbering pulsing switch (15-32).

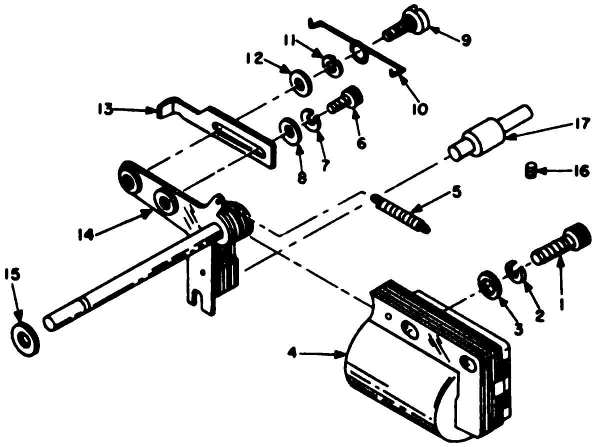
(3) Remove the two plain hexagonal nuts (4), the lockwashers (5), and the retainer plates (6) that hold the numbering switch (15-32) to the switch bracket (3); remove the assembled numbering pulsing switch and the shims (33).

(4) Remove the two machine screws (7) and the lockwashers (8) that hold the switch guide (9) to the transmitter frame; remove the switch guide and retainer plate (12).

(5) Remove the two machine screws (5, fig. 84), the lockwashers (6), and the setscrew (4) that hold the bearing support (8) to the transmitter; remove the bearing support.

(6) Remove the two plain hexagonal nuts (10, fig. 81), the lockwashers (11), and the retainer plates (12) that hold the latch pulsing switch (13) to the transmitter frame; remove the latch pulsing switch and shims (14).

(7) Disassemble each pulsing switch as shown in figure 81. The numbering pulsing switch is shown exploded (items (15) through (32)). The procedure for disassembling the latch pulsing switch (13) is



1 Machine screw, 10010
2 Lockwasher, 10426
3 Flat washer, 10467
4 Tape-reader clutch magnet (L6), 54384A
5 Tape-reader armature spring, 60007
6 Machine screw, 10003
7 Lockwasher, 10429
8 Flat washer, 10458
9 Machine screw, 51568
10 Adjusting arm spring, 58733
11 Lockwasher, 10429
12 Flat washer, 10458
13 Armature extension, 58709
14 Tape-reader clutch magnet armature, 58707A
15 Washer, 52430
16 Setscrew, 10209
17 Eccentric stud, 58775

Figure 80. Tape-reader clutch magnet and armature, exploded view.

identical with that shown for the numbering pulsing switch.

Note: Do not disassemble the individual pulsing switches unless it is absolutely necessary.

b. *Reassembly.*

(1) If the individual pulsing switches are disassembled, reassemble the pulsing switches as indicated in figure 81; the sequence for assembling the parts is the reverse of disassembly.

(2) Position the bearing support (8, fig. 84) on the transmitter frame; secure it in place with the machine screws (5), the lockwashers (6), and the setscrew (4).

(3) Adjust the pulsing switch contacts (para 134 through 139).

(4) Reconnect all electrical leads to the transmitter pulsing switches.

81. Disassembly and Reassembly of Transmitter Camshaft Assembly

a. *Disassembly.*

(1) Remove the transmitter covers (para 72*a*).

(2) Remove the tape-reader clutch magnet armature (para 79*a*(3) through (6)).

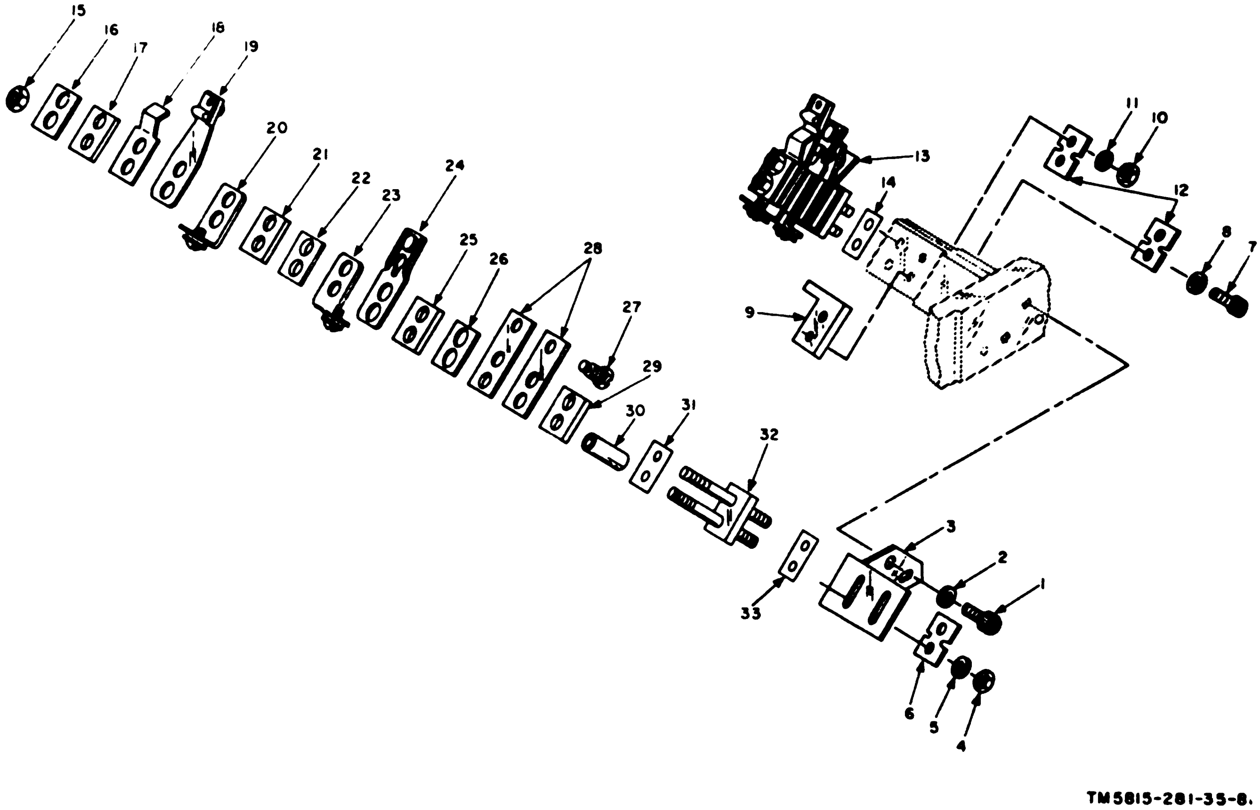
(3) Remove the counter mechanism (para 73*a*(2)).

(4) Remove the two machine screws (1, fig. 82) that hold both halves of the friction adjusting collar (2) to the drive shaft collar (5); remove the friction adjusting collar (2) and the friction clutch spring (3).

(5) Remove the two setscrews (4) that hold the drive shaft collar (5) to the transmitter camshaft (45); remove the drive shaft collar, the friction clutch disk (6), the friction plate (7); the bearing (8), the drive gear (9), and the friction plate (10).

(6) Remove the two setscrews (11) that hold the friction clutch disk (12) to the transmitter camshaft; remove the friction clutch disk.

(7) Remove the machine screw (13), the lockwasher (14), the flat washer (15), the two machine screws (16), the lockwashers (17), and the flat washers (18) that hold the bearing



1 Machine screw, 10004
2 Lockwasher, 10429
3 Switch bracket, 58745
4 Plain hexagonal nut, 56182
5 Lockwasher, 10432
6 Retainer plate, 55376
7 Machine screw, 10109
8 Lockwasher, 10432
9 Switch guide, 58732
10 Plain hexagonal nut, 56182
11 Lockwasher, 10432
12 Retainer plate, 55376
13 Latch pulsing switch (S46), 54325A
14 Shim, 59495 (0.015-in.), 59496 (0.059-in.), 59497 (0.0100-in.) (as required)
15 Plain hexagonal nut, 56183
16 Spacer, 54334
17 Spacer, 54336
18 Contact spring, 54333
19 Follower assembly, 60601A
20 Terminal assembly, 54318A
21 Spacer, 54336 (0.005-in) (0.010-in)
22 Shim, 60055 (0.005-in), 60056 (0.010-in.), or 60057 (0.015-in.) (as required)
23 Terminal assembly 54318A
24 Contact assembly, 60601A
25 Spacer, 54336
26 Spacer, 54324
27 Adjusting screw, 54338
28 Adjusting screwholder, 54341
29 Spacer, 54324
30 Sleeve, 54340
31 Same as item 14
32 Stud assembly, 54358A
33 Same as item 14

Note: Items 15 through 31 are part of numbering pulsing switch (S32), 54325A. The latch pulsing switch (13) is identical with the numbering pulsing switch.

Figure 81. Transmitter pulsing switches, exploded view.

support plate (23) to the distributor block; remove the assembled bearing (22) and the bearing support plate (23).

(8) Remove the two machine screws (19), the lockwashers (20), and the flat washers (21) that hold the bearing (22) in the bearing support plate; remove the bearing.

(9) Disconnect all electrical leads

from the distributor contacts; tag the leads. Remove the machine screw (1, fig. 83), the two lockwashers (2 and 4), and the plain hexagonal nut (5) that hold the grounding bond (3) to the capacitor mounting plate (15). Remove the two machine screws (6) and the lockwashers (7) that hold the distributor block (73) to the transmitter frame; remove the assembled distributor.

(10) Remove the latch pulsing switch (para 80*a*(5) and (6)).

(11) Remove the two machine screws (24, fig. 82), the lockwashers (25), and the flat washers (26) that hold the bearing (27) in the bearing support; remove the bearing.

(12) Remove the transmitter camshaft and assembled items 28 through 44.

(13) Remove the two setscrews (28) that hold the latch pulsing switch cam (29) to the transmitter camshaft; remove the latch pulsing switch cam, the feed-retracting lever cam (30), the spacer (31), the sensing lever restoring cam (32), the spacer (33), the counter restore cam (34), and the spacer (35).

(14) Remove the two clutch pawl springs (36) from the clutch pawls (40). Remove the retainer rings (37) that hold the clutch pawls (40) to the tape-feed cam (38); remove the tape-feed cam, the kickout plate (39), and the two clutch pawls (40) from the transmitter camshaft.

(15) Remove the machine screw (41) that clamps the tape-reader clutch notched drum (42) to the transmitter camshaft; remove the tape-reader clutch notched drum.

(16) Remove the two setscrews (43) that hold the pulsing switch cam (44) to the transmitter camshaft; remove the pulsing switch cam.

b. Reassembly.

(1) Reassemble items 45 through 24 (fig. 82); the sequence for assembling the parts is the reverse of disassembly.

(2) Position the assembled transmitter camshaft in the transmitter; make certain that each of the cams engages the proper lever. Replace the latch pulsing switch (14, fig. 81). Position the bearing support (8, fig. 84) on the transmitter frame; secure it with the machine screws (5), lockwashers (6), and setscrew (4).

(3) Position the distributor block (73, fig. 83) on the transmitter frame; secure it with the two machine screws (6) and the lockwashers (7). Position the grounding bond (3) on the capacitor mounting plate (14); secure the grounding bond with the machine screw (1), the two lockwashers (2), and a plain hexagonal nut (5). Connect the electrical leads to the distributor contacts.

(4) Reassemble items 23 through 1 (fig. 82); the sequence for assembling the parts is the reverse of disassembly.

(5) Replace the counter mechanism (para 73*b*).

(6) Replace the tape-reader clutch magnet armature (para 79*b*).

(7) Adjust the transmitter (para 99 through 146).

(8) Replace the transmitter covers (para 72*b*).

82. Disassembly and Reassembly of Distributor Switch S48 (fig. 83)

a. Disassembly.

(1) Remove the distributor block from the transmitter (para 81*a*(1), (4) through (7), and (9)).

(2) Remove the two machine screws (8) and the lockwashers (9) that hold the capacitor mounting plate (15) to the distributor block (73); remove the assembled capacitor mounting plate and capacitor (14).

(3) Remove the plain hexagonal nut

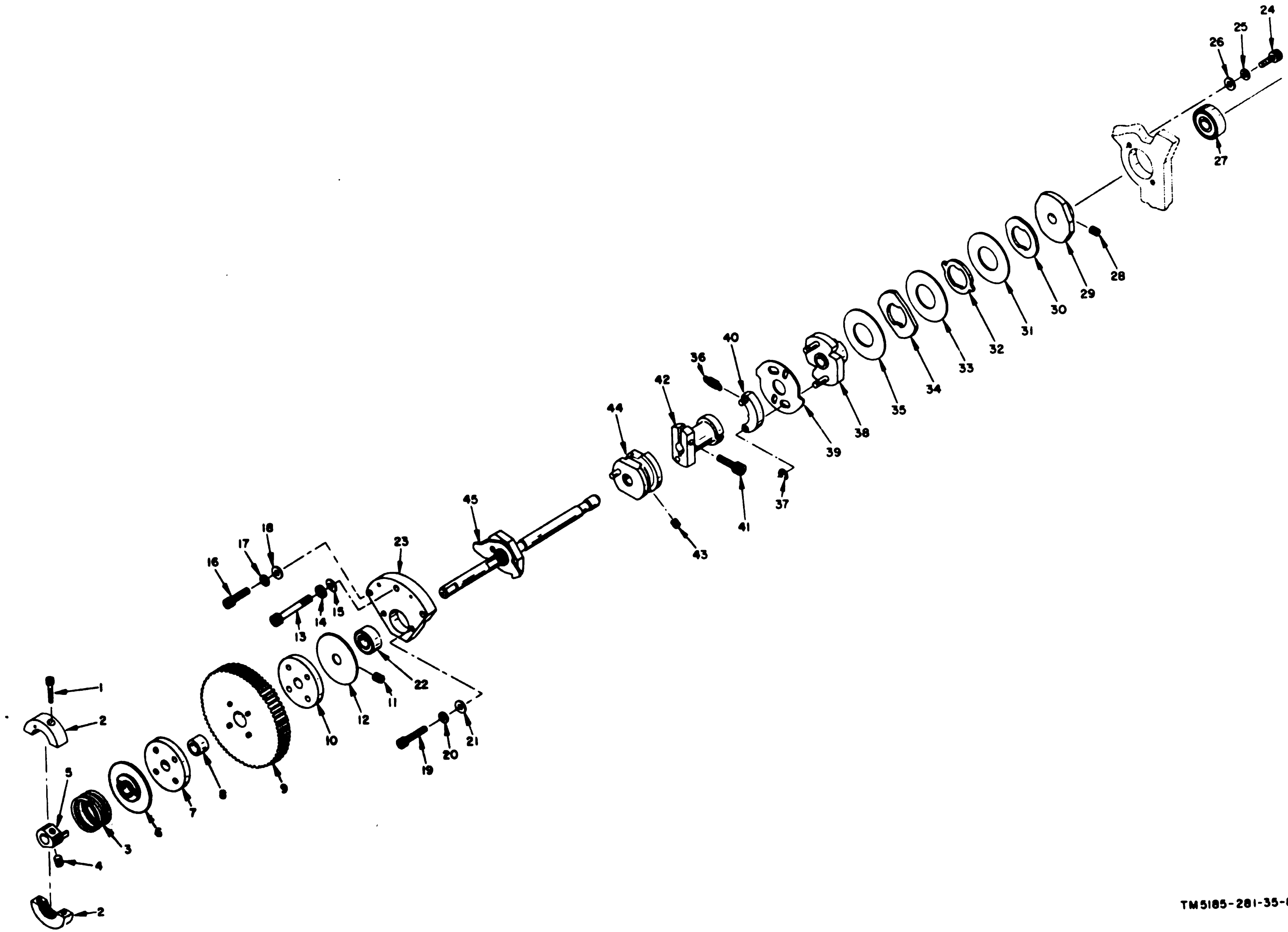


Figure 82. Transmitter camshaft assembly exploded view.

1 Machine screw, 10043	25 Lockwasher, 10429
2 Friction adjusting collar, 56832A	26 Flat washer, 10458
3 Friction clutch spring, 54933	27 Bearing, 10753
4 Setscrew, 10208	28 Setscrew, 10209
5 Drive shaft collar, 54928	29 Latch pulsing switch cam, 58755
6 Friction clutch disk, 54931A	30 Feed-retracting lever cam, 58765
7 Friction plate, 50013	31 Spacer, 58756
8 Bearing, 58836	32 Sensing lever restoring cam, 58768
9 Driving gear, 58283A (includes item 8)	33 Spacer, 58756
10 Friction plate, 50013	34 Counter restore cam, 58766
11 Setscrew, 10209	35 Spacer, 58756
12 Friction clutch disk, 50200	36 Clutch pawl spring, 58806
13 Machine screw, 10053	37 Retainer ring, 11103
14 Lockwasher, 10426	38 Tape-feed cam, 58760A
15 Flat washer, 10467	39 Kickout plate, 58767
16 Machine screw, 10006	40 Clutch pawl, 58750A
17 Lockwasher, 10429	41 Machine screw, 10009
18 Flat washer, 10458	42 Tape-reader clutch notched drum, 58757
19 Machine screw, 10001	43 Setscrew, 10210
20 Lockwasher, 10429	44 Pulsing switch cam, 60587A
21 Flat washer, 10458	45 Transmitter camshaft, 60573A
22 Bearing, 10753	
23 Bearing support plate, 58604A	
24 Machine screw, 10004	

Figure 82 – Continued

(10), the lockwasher (11), the flat washer (12), and the machine screw (13) that hold the capacitor (14) to the capacitor mounting bracket; remove the capacitor.

(4) Remove the two retainer rings (16) that hold the felt pad (17) to the distributor block; remove the felt pad.

(5) Unsolder the six solder connections between the conductors on each of the seven distributor contacts.

(6) Remove the plain hexagonal nuts (18) and the lockwashers (19) that hold each of the contacts to the distributor block; remove the distributor contacts and shims (72). Disassemble the distributor contacts as shown in figure 83.

Note: Disassemble the distributor contacts only when absolutely necessary.

(7) Remove the retainer rings (68 and 70) that hold the plungers (69 and 71) to the distributor block; remove the plungers.

b. Reassembly.

(1) If the contacts are disassembled, reassemble the distributor contacts as shown in figure 83; the sequence for assembling the parts is the reverse of disassembly.

(2) Resolder the connections between the conductors of each of the seven distributor contacts.

(3) Replace the distributor (para 81*b* (3) and (8)).

(4) Reconnect the electrical leads to the distributor contacts and to the capacitor.

(5) Adjust the distributor contacts (para 132 and 133).

83. Disassembly and Reassembly of Miscellaneous Transmitter Components (fig. 84)

a. Disassembly.

(1) Remove the transmitter camshaft assembly (para 81*a*).

(2) Remove the tape-out sensing mechanism (para 74*a*).

(3) Remove the stop-start levers (para 75*a*).

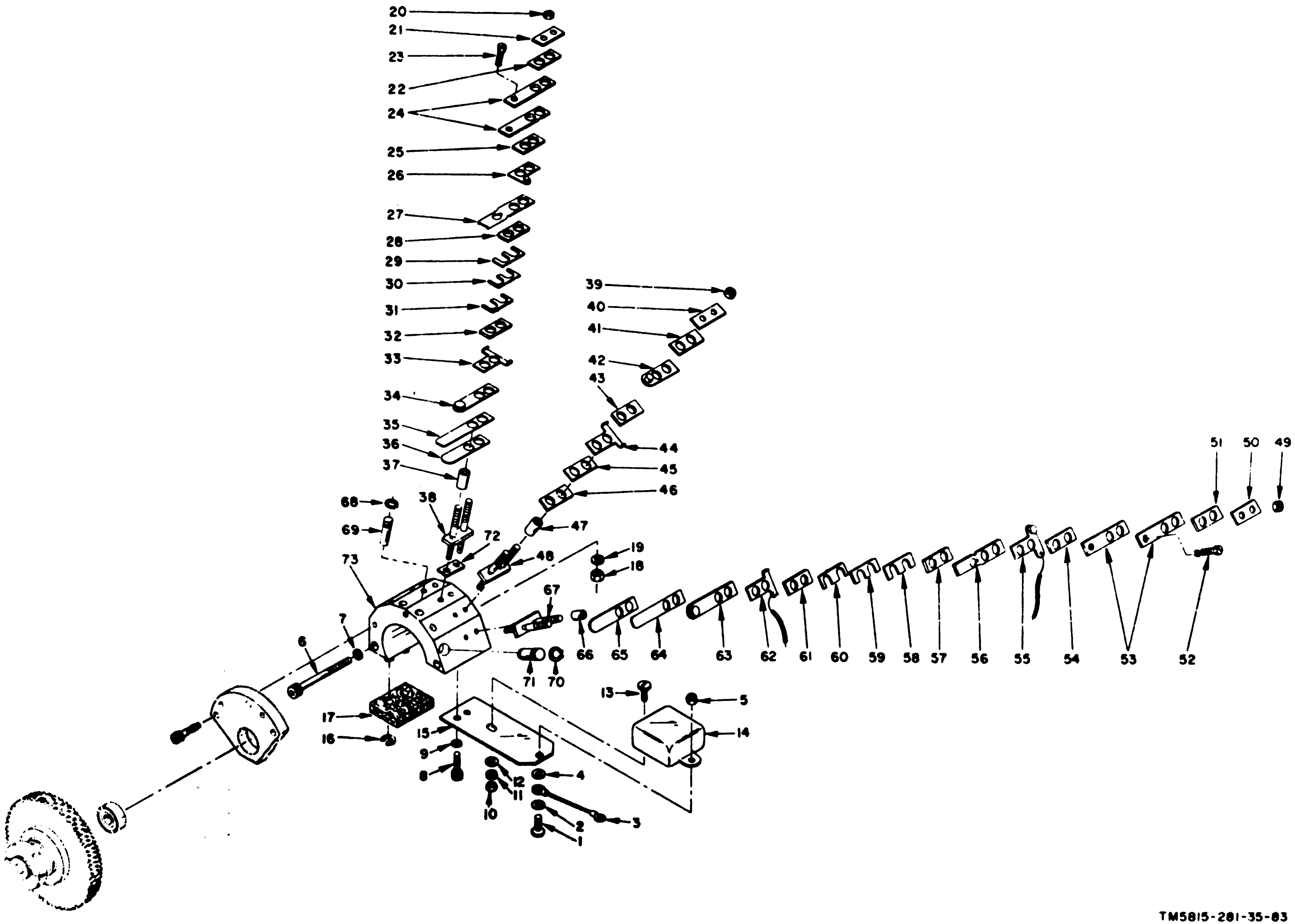


Figure 83. Distributor switch S48, exploded view.

1 Machine screw, 10335
2 Lockwasher, 10408
3 Grounding bond, 58660A
4 Lockwasher, 10408
5 Plain hexagonal nut, 10517
6 Machine screw, 10014
7 Lockwasher, 10426
8 Machine screw, 10001-01
9 Lockwasher, 10403
10 Plain hexagonal nut, 10517
11 Lockwasher, 10408
12 Flat washer, 10490
13 Machine screw, 10335
14 Capacitor (C14), 58124
15 Capacitor mounting plate, 58615
16 Retainer ring, 10949
17 Felt pad, 58614
18 Plain hexagonal nut, 56182
19 Lockwasher, 10432
20 Plain hexagonal nut, 56183
21 Spacer, 54334
22 Spacer, 54336
23 Adjusting acrew, 54338
24 Adjusting screwholder, 54341
25 Spacer, 54336
26 Terminal assembly, 58621A
27 Contact assembly, 60601A
28 Spacer, 54336
29 Shim (0.005-in.), 60055 (as required)
30 Shim (0.010-in.), 60056 (as required)
31 Shim (0.015-in.), 60057 (as required)
32 Spacer, 54336
33 Conductor, 58616
34 Contact assembly, 54769A
35 Spacer, 54781
36 Spacer, 54768
37 Sleeve, 58623
38 Stud assembly, 54358A
39 Plain hexagonal nut, 56183
40 Spacer, 54334
41 Spacer, 54336
42 Terminal assembly, 59472A
43 Spacer, 58620
44 Conductor, 58616
45 Spacer, 58617
46 Spacer, 54324
47 Sleeve, 59474
48 Stud assembly, 54358A
49 Plain hexagonal nut, 56183
50 Spacer, 54334
51 Spacer, 54336
52 Adjusting screw, 54338
53 Adjusting screwholder, 54341
54 Spacer, 54336
55 Terminal assembly, 58622A
56 Contact assembly, 60601A
57 Spacer, 54336
58 Shim (0.005-in), 60055
59 Shim (0.010-in.), 60056
60 Shim (0.015-in.), 60057
61 Spacer, 54336
62 Conductor, 58616
63 Contact assembly, 54769A
64 Spacer, 54781
65 Spacer, 54768
66 Sleeve, 58623
67 Stud assembly, 54358A
68 Retainer ring, 11011
69 Plunger, 58611
70 Retainer ring, 10971
71 Plunger, 58612
72 Shim, 59495 (0.015-in.), 59496 (0.050-in.), or 59497 (0.100-in.) (as required).
73 Distributor block, 58695

Notes:

1. Items 20 through 38 are part of distributor contact (No. 1), 58784A. Distributor contacts 2, 3, 4, and 5 are identical with No. 1.
2. Items 39 through 48 are part of distributor start contact 58786A.
3. Items 49 through 67 are part of distributor stop contact 58785A.

Figure 83 – Continued.

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(4) Remove the tight-tape levers (para 76*a*).

(5) Remove the tape-reader clutch magnet (para 79*a*).

(6) Remove the distributor clutch magnet armature, and latching levers (para 78*a*).

(7) Remove the code-sensing levers (para 77*a*).

(8) Remove the detent lever spring (9) from the detent lever (12) and from the spring post on the transmitter frame (52). Remove the felt washer (10) and the retainer ring (11) that hold the detent lever to the post in the transmitter frame; remove the detent lever.

(9) Disconnect the electrical leads from the transmitter cable.

(10) Remove the two machine screws (13 and 16), the lockwashers (14 and 17), and the flat washers (15 and 18) that hold the stop-start switch (19) to the switch mounting plate; remove the stop-start switch.

(11) Remove the machine screw (20), the lockwasher (21), and the flat

washer (22) that hold the switch mounting plate (23) to the transmitter frame; remove the switch mounting plate.

(12) Remove the self-locking hexagonal nut (26), the flat washer (27), the machine screw (24), the flat washer (25), the machine screw (28), the lockwasher (29), and the flat washer (30) that hold the tape-out switch (31) to the transmitter frame; remove the tape-out switch.

(13) Remove the machine screws (32 and 39) and the lockwashers (33 and 40) that hold the cable clamps (34 and 41) to the transmitter as indicated in figure 84; remove the cable clamps. Remove the transmitter cable from the cable clamps.

(14) Remove the machine screw (35) and the lockwasher (36) that hold the grounding straps (37) to the transmitter frame; remove the grounding strap and the lockwasher (38).

(15) Remove the machine screw (45) and the lockwasher (46) that hold the cable clamp (47) to the stud (48); remove the cable clamp. Remove the stud, the lockwasher (49), and the flat washer (50) and the machine screw (42), the lockwasher (43), and the flat washer (44) that hold the filter (51) to the transmitter frame; remove the filter.

b. Reassembly.

Note: If any of the spring posts, pins, or studs are loose or damaged, they must be replaced. Support the transmitter frame near the post to be removed to prevent damage to the frame. Press the new posts in at right angles to the plane of the frame. Replace a frame that has worn threads, enlarged holes, or is otherwise damaged.

(1) Reassemble the components as indicated in figure 84; the sequence for assembling the parts is the reverse of disassembly.

(2) Replace the code sensing levers (para 77*b*).

(3) Replace the distributor clutch magnet, the armature, and the latching levers (para 78*b*).

(4) Replace the tape-reader clutch magnet (para 79*b*).

(5) Replace the tight-tape levers (para 76*b*).

(6) Replace the stop-start levers (para 75*b*).

(7) Replace the tape-out sensing mechanism (para 74*b*).

(8) Replace the transmitter camshaft assembly (para 81*b*).

(9) Connect to the proper connection points all electrical leads from the transmitter cable.

84. Disassembly and Reassembly of Transmitter Base Frame and Power Shaft Assembly (fig. 71)

a. Disassembly.

(1) Remove the transmitter motor (para 70*b*).

(2) Remove the transmitter (para 71*a*).

(3) Remove the four machine screws (18) and the lockwashers (19) that hold the bearing block (20) to the base frame; remove the bearing block and shims (21).

(4) Remove the assembled power shaft and gears (items 22 through 31) from the base frame.

(5) Remove the two setscrews (23) that hold the driving gear (24) to the power shaft (22); remove the driving gear and ball bearing (25).

(6) Remove the machine screw (26) and the lockwasher (27) that hold the worm gear (28) to the power shaft; remove the gear, the five gear keys (29), the ball bearing (30), and the flat washer (31).

b. Reassembly.

(1) Reassemble the components as indicated in figure 71; the sequence for assembling the parts is the reverse of disassembly.

(2) Replace the transmitter motor (para 70*c*).

(3) Replace the transmitter (para 71*b*).

85. Disassembly and Reassembly of Base Frame Electrical Parts (fig. 72)

a. Disassembly.

(1) Remove the four machine screws (1), the lockwashers (2), and the

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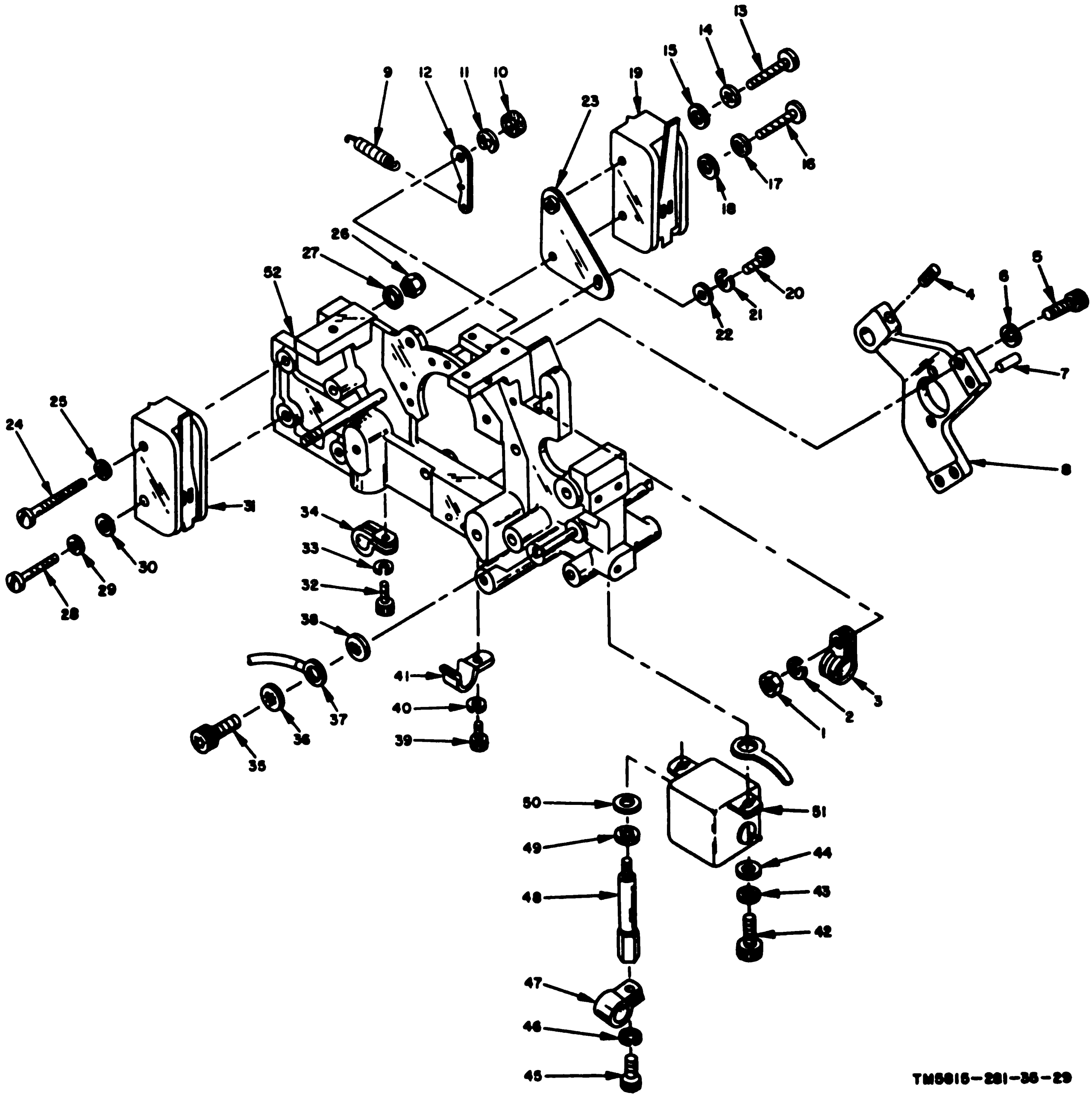


Figure 84. Miscellaneous transmitter components, exploded view.

1 Plain hexagonal nut, 10513
2 Lockwasher, 10429
3 Cable clamp, 20516
4 Setscrew, 10209
5 Machine screw, 10004
6 Lockwasher, 10429
7 Dowel, 10917
8 Bearing support, 58713
9 Detent lever spring, 53149
10 Felt washer, 61474
11 Retainer ring, 10949
12 Detent lever, 57206A
13 Machine screw, 10110
14 Lockwasher, 10403
15 Flat washer, 10458
16 Machine screw, 10110
17 Lockwasher, 10403
18 Washer, 10458
19 Stop-start switch (S42), 20108
20 Machine screw, 10003
21 Lockwasher, 10429
22 Flat washer, 10458
23 Switch mounting plate, 58722A
24 Machine screw, 10385
25 Flat washer, 10458
26 Self-locking hexagonal nut, 10500
27 Flat washer, 10450
28 Machine screw, 10110
29 Lockwasher, 10403
30 Flat washer, 10458
31 Tape-out switch (S30), 20108
32 Machine screw, 10008
33 Lockwasher, 10426
34 Cable clamp, 20519
35 Machine screw, 10001-01
36 Lockwasher, 10403
37 Grounding strap, 58660A
38 Lockwasher, 10426
39 Machine screw, 10008
40 Lockwasher, 10426
41 Cable clamp, 20521
42 Machine screw, 10001-01
43 Lockwasher, 10403
44 Flat washer, 10457
45 Machine screw, 10004
46 Lockwasher, 10429
47 Cable clamp, 20888
48 Stud, 58839
49 Lockwasher, 10403
50 Flat washer, 10457
51 Filter (FL8), 58440
52 Transmitter frame, 58687A

Figure 84 – Continued.

flat washers (3) that hold the cover assembly (4) to the base; remove the cover assembly and the four lockwashers (5).

(2) Unfasten all electrical connections within the unit. Loosen the holding screws on all terminal-type connections; unsolder all soldered connections.

(3) Remove the machine screws (6 and 9) and the lockwashers (7 and 10) that hold the two cable clamps (8 and 11); remove the cable clamps.

(4) Remove the machine screws (12 and 14) and the lockwashers (13 and 15) that hold the two ground leads; remove the ground leads.

(5) Remove the four drivescrews (16) that hold the nameplate (17) to the base; remove the nameplate.

(6) Remove the power cord (18) from its strain relief (63).

(7) Remove the two machine screws (19 and 22) and the lockwashers (20 and 23) that hold the two cable clamps (21 and 24); remove the cable clamps and cable assemblies (25 and 26).

(8) Remove the remaining two machine screws (27), the lockwashers (28), the filter (29), and the lockwashers (30).

(9) Remove the machine screws (31) and the lockwashers (32) that hold the capacitor (33) to the base; remove the capacitor and the lockwashers (34).

(10) Remove the machine screws (35) and the lockwashers (36) that hold the switchplate (38). Make certain that the soldered connections to the toggle switch (39) have been disconnected. Remove the assembled switchplate and switch. Remove the plain hexagonal nut (37), the lockwasher (41) and the plain hexagonal nut (40) that hold the toggle switch (39) to the switchplate; remove the switch.

(11) Remove the plain hexagonal nut (42) and the lockwasher (43) that hold the resistor (45) to the screw (47); remove the centering washer (44), the resistor, the centering washer (46), and the screws.o

(12) Remove the four machine screws

(48), the flat washers (49), and the two brackets (50).

(13) Remove the fuseholder cap (51) that holds the fuse (52) in the fuseholder (56); remove the fuse. Remove the plain hexagonal nut (53), the lockwasher (54), and the flat washer (55) that hold the fuseholder to the plate (66); remove the fuseholder.

(14) Remove the two plain hexagonal nuts (57), and the lockwashers (58), the connector (59), and the cable assembly (60).

(15) Remove the two plug buttons (61 and 62) and the strain relief (63) from the plate (66). Remove the four machine screws (64), the lockwashers (65), and the plate (66).

(16) Remove the machine screw (67), the stud (68), the two lockwashers (69), and the flat washers (70) that hold the terminal board (71); remove the terminal board and the marker strip (72).

(17) Remove the two machine screws (73), the lockwashers (74), and the flat washers (75) that hold the terminal board (76); remove the terminal board and the marker strip (77).

b. Reassembly.

(1) Reassemble the components as indicated in figure 72; the sequence for assembling the parts is the reverse of disassembly.

(2) Carefully tighten all electrical connections using screw type terminals; solder all soldered connections before installing the cover assembly (4).

86. Disassembly and Reassembly of Series-Governed Motor

(fig. 85)

a. Disassembly.

(1) Remove the motor (para 70*b*).

(2) Remove the machine screw (1) and the lockwasher (2) that hold the worm (3) to the armature shaft; remove the worm.

(3) Remove the pin (7) from the motor armature shaft; remove the grease seals (8) from the motor armature shaft.

(4) Remove the four machine screws (9) that hold the end plate (10) to the endbell (16); remove the end plate, the spring washer (11), the shim washer (12), and the flat washer (13).

(5) Remove the four machine screws (14) and the lockwashers (15) that hold the endbell to the motor housing and field (67); remove the endbell and the ball bearing (17).

(6) Remove the setscrew (18) that holds the motor governor target (19) to the shaft of the motor governor base assembly (44); remove the motor governor target.

(7) Remove the two machine screws (20), the lockwashers (21), and the motor governor cover (22).

(8) Remove the two setscrews (23) that hold the motor governor base assembly (44) to the motor armature shaft; remove the assembled motor governor.

(9) Remove the governor worm spring (24) and the governor worm (25) from the motor governor.

(10) Remove the electrical contact brush (36) from the motor governor.

(11) Remove the two electrical contact brushes (27).

(12) Remove the adjustment lever spring (28) and the grooved pin (29).

(13) Remove the self-locking hexagonal nut (30), the machine screw (31), and the flat washer (32) that hold the electrical contact arm (33) to the motor governor base assembly (44); remove the electrical contact arm and the insulator bushing (34).

(14) Remove the hexagonal nut (35) and the lockwasher (36) that hold the electrical contact (37) to the motor governor base assembly; remove the electrical contact.

(15) Remove the cotter pin (38) that holds the governor adjustment lever to the governor adjustment screw (41); remove the lever.

(16) Remove the second cotter pin (40) from the governor adjustment screw (41). Turn out the adjustment screw to release the laminated washer (42) and the motor governor adjustment gear (43).

(17) Remove the two brush shields (45) and the brush caps (46) that hold the brushes (47) in the motor; remove the brushes.

(18) Remove the armature (51) from the motor assembly. Remove the spring washer (48), the shim washer (49), and the ball bearing (50) from the armature.

(19) Remove the four machine screws (52) that hold the end plate (53) to the endbell (60); remove the end plate.

(20) Remove the four machine screws (54) and the lockwashers (55) that hold the endbell (60) to the motor housing and field (67); separate the endbell as far as permitted by the field leads.

(21) Remove the spring clip (56) that connects the lead to the endbell. Remove the two machine screws (57) and the lockwashers (58) that hold the lead and the capacitors (59) to the endbell; remove the capacitors.

(22) Remove the terminal lugs (61) from the motor leads. Remove the cap (62) and the eyelet (63) that hold the shielding (65) to the nipple (66) on the motor housing and field; remove the shielding and the terminal lug (64). Remove the terminal lug from the shielding.

(23) Remove the nipple from the motor housing and field.

b. Reassembly.

(1) Check the motor brushes (26, 27, and 47). Clean them if they are dirty or glazed; replace them if they are worn, chipped, or saturated with oil.

(2) Reassemble the motor as indicated in figure 85; the sequence for assembling the part is the reverse of disassembly.

(3) Install the motor (para 70c).

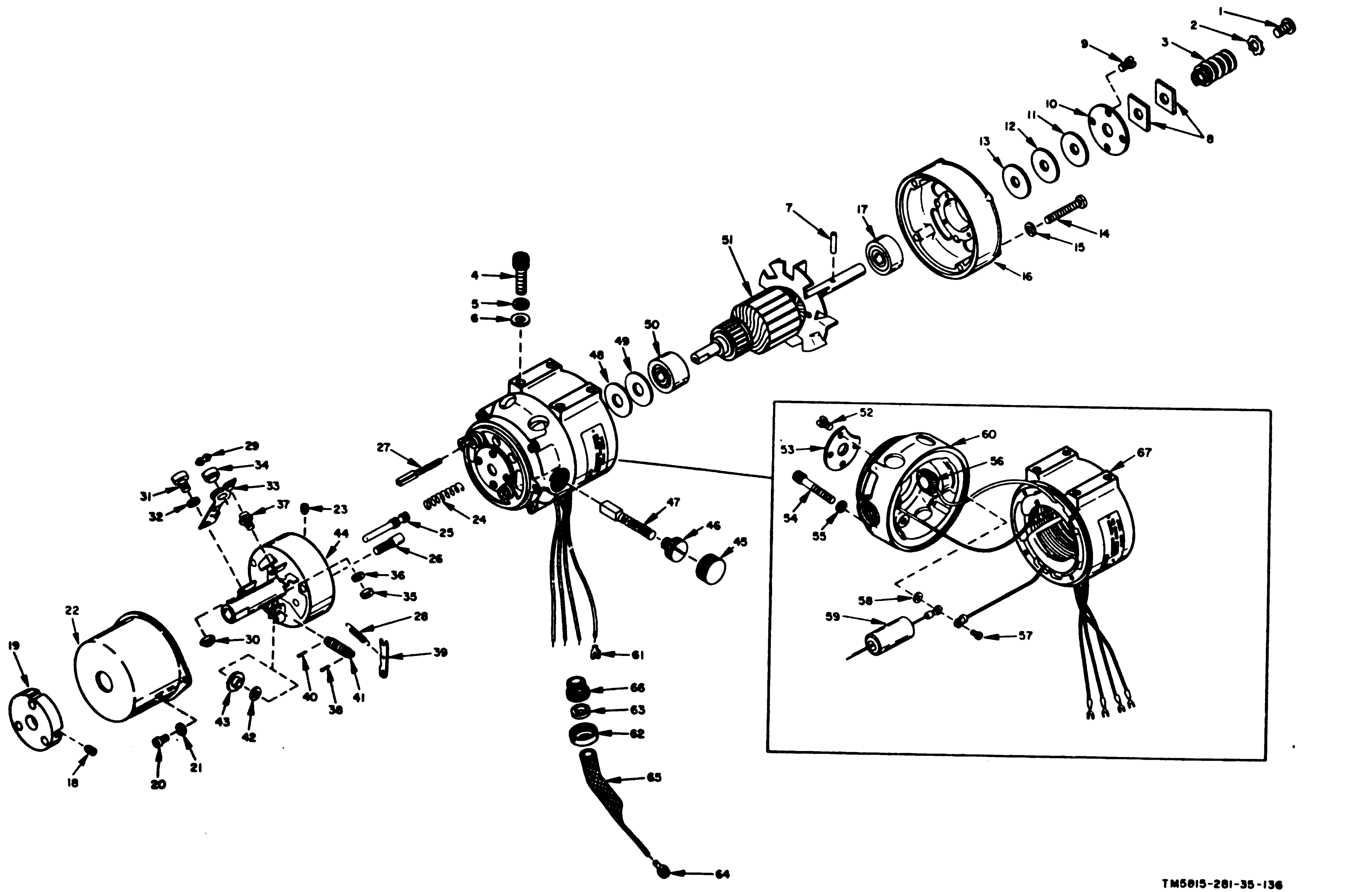


Figure 85 Transmitter motor, exploded view.

1 Machine screw, 50207
2 Lockwasher, 10406
3 Worm, 52105
4 Machine screw, 10024-01
5 Lockwasher, 10405
6 Flat washer, 10481
7 Pin, 50359
8 Grease seal, 50949
9 Machine screw, 60494
10 End plate, 60500
11 Spring washer, 60501
12 Shim washer (0.005-in.), 60506
13 Washer, 60493
14 Machine screw, 10172
15 Lockwasher, 10444
16 Endbell, 60505
17 Ball bearing, 10760
18 Setscrew, 10204
19 Motor governor target wheel, 50303A
20 Machine screw, 10321
21 Lockwasher, 10412
22 Motor governor cover, 50311
23 Setscrew, 10204
24 Governor worm spring, 51855
25 Governor worm, 56555A
26 Electrical contact brush, 51154A
27 Electrical contact brush, 51543A
28 Adjustment lever spring, 50334
29 Grooved pin, 50302
30 Self-locking hexagonal nut, 10840
31 Machine screw, 10055
32 Flat washer, 10459
33 Electrical contact arm, 50281A
34 Insulator bushing, 50293
35 Hexagonal nut, 10507
36 Lockwasher, 10404
37 Electrical contact, 50338
38 Cotter pin, 10800
39 Governor adjustment lever, 50301
40 Cotter pin, 10800
41 Governor adjustment screw, 50299
42 Laminated washer, 61413
43 Motor governor adjustment gear, 50278A
44 Motor governor base assembly, 51249A
45 Brush shield, 60495
46 Brush cap, 60496
47 Brush, 60503
48 Spring washer, 60501
49 Shim washer, 60493 or 60506
50 Ball bearing, 10765
51 Armature, 60492A
52 Machine screw, 60494
53 End plate, 60491
54 Machine screw, 10172
55 Lockwasher, 10444
56 Spring clip, 11033
57 Machine screw
58 Lockwasher
59 Capacitor, 20212
60 Endbell, 60490
61 Terminal lug, 20706
62 Cap, 51171
63 Eyelet
64 Terminal lug, 20708
65 Shielding, 20703-03.60
66 Nipple, 51172
67 Motor housing and field, 60499

Note: Items 7 through 17 and 50 through 67 are part of motor assembly 61109A.

Figure 85 – Continued.

Section VII. DISASSEMBLY AND REASSEMBLY OF NUMBERING BASE

87. Disassembly and Reassembly of Numbering Base Dust Cover and Front Panel (fig. 86)

a. *Disassembly.*

(1) Loosen the four thumbscrews that hold the front panel (23) to the rack; slide the numbering base out of the rack.

(2) Remove the seven machine screws (1), lockwashers (2), and the flat washers (3) that hold the dust cover (4) to the numbering base; remove the dust cover.

(3) Remove the four machine screws (5), lockwashers (6), and the flat washers (7) that hold the two handles (8) to the numbering base and to the front panel (23); remove the two handles and the front panel.

(4) Remove the two windows (13), doorknob (15), clamp (18), door (19), and the hinge (22) as indicated in figure 86.

b. *Reassembly.*

(1) Reassemble the numbering base dust cover and front panel as indicated in figure 86; the sequence for assembling the parts is the reverse of disassembly.

(2) Position the rollers of the numbering base on the roller guides of the rack. Slide the numbering base to the rear of the rack; tighten the thumbscrews.

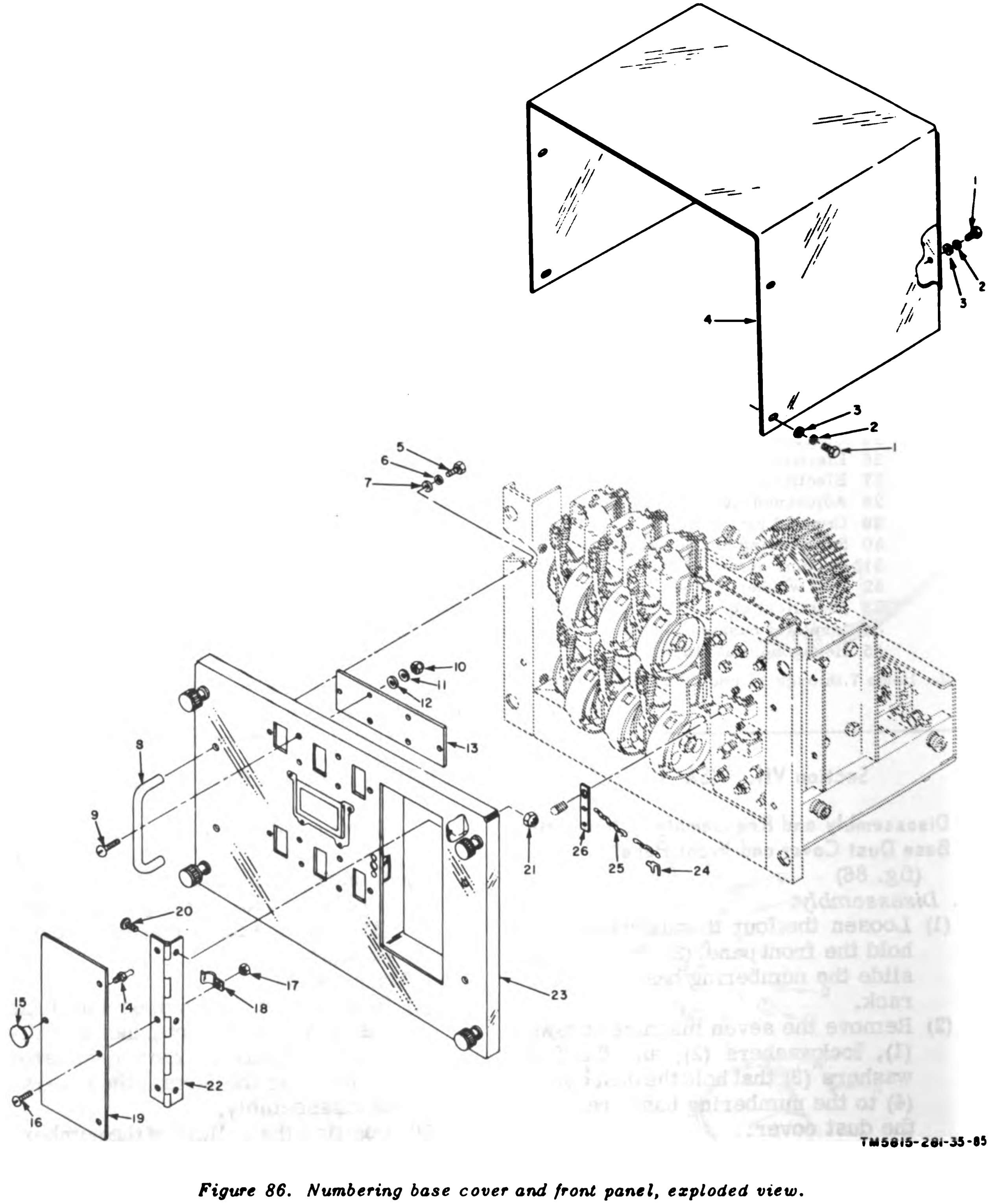


Figure 86. Numbering base cover and front panel, exploded view.

1 Machine screw, 10399	15 Knob, 11086
2 Lockwasher, 10430	16 Machine screw, 10393
3 Flat washer, 10454	17 Self-locking hexagonal nut, 10500
4 Dust cover, 58412A	18 Clamp, 20521
5 Machine screw, 10397	19 Door, 58421
6 Lockwasher, 10431	20 Machine screw, 10122
7 Flat washer, 10464	21 Self-locking hexagonal nut, 10525
8 Handle, 58370	22 Hinge, 58422
9 Machine screw, 10109	23 Front panel, 58417A
10 Self-locking hexagonal nut, 10540	24 Terminal, 20594
11 Flat washer, 50320	25 Chain, 11031
12 Felt washer, 55986	26 Strap, 60009
13 Window, 58416	
14 Stud, 58299	

Figure 86 – Continued.

88. Removal and Replacement of Numbering Base Major Assemblies

a. *Removal.*

(1) Remove the numbering base covers (para 87*a*(1) through (3)).

(2) Loosen the machine screw (6, fig. 91) that holds the terminal (24, fig. 86) to the lower subpanel. Remove the two knobs (1, fig. 90 and 91) that hold the strap (26, fig. 86) to the message numbering reset switches (5, fig. 90 and 91).

(3) Unsolder and disconnect all electrical leads from the components to be removed from the numbering base; tag the leads.

(4) Remove the machine screw (1, fig. 87) and the lockwasher (2) that hold the upper numbering assembly (8) to the cross brace (11).

(5) Remove the two machine screws (5) and the lockwashers (6) that hold the numbering base (34) to each of the brackets (7). Remove the upper numbering assembly.

(6) Remove the two machine screws (3) and the lockwashers (4) that hold each of the brackets (7) to the numbering base (34); remove the two brackets.

(7) Remove the machine screw (9) and lockwasher (10) that hold the cross brace (11) to the lower numbering assembly (20); remove the cross brace.

(8) Remove the machine screws (12) and lockwashers (13) that hold the bottom plate (14) to the numbering base (34); remove the bottom plate.

(9) Remove the two machine screws (15) and lockwashers (16) that hold each of the brackets (19) to the numbering base (34); remove the assembled brackets and the lower numbering assembly (20).

(10) Remove the two machine screws (17) and lockwashers (18) that hold each of the brackets (19) to the lower numbering assembly (20); remove the two brackets.

(11) Remove the self-locking hexagonal nut (21) and machine screw (22) that hold each of the four rollers (23) to the numbering base (34); remove the four rollers (23), sleeves (24), and the spacers (25) from the numbering base (34).

(12) Remove the self-locking hexagonal nuts (26) that hold the locating pins (27) to the numbering base (34); remove the two locating pins.

(13) Remove the machine screws (28) and lockwashers (29) that hold the cable clamps (30) to the numbering base (34); remove the cable clamps.

(14) Remove the two machine screws (31) and the lockwashers (32) that hold each of the connectors (33) to the numbering base (34); remove the four connectors.

b. *Replacement.*

(1) Replace the major assemblies of the numbering base as indicated in figure 87; the sequence for replacement is the reverse of the removal procedure.

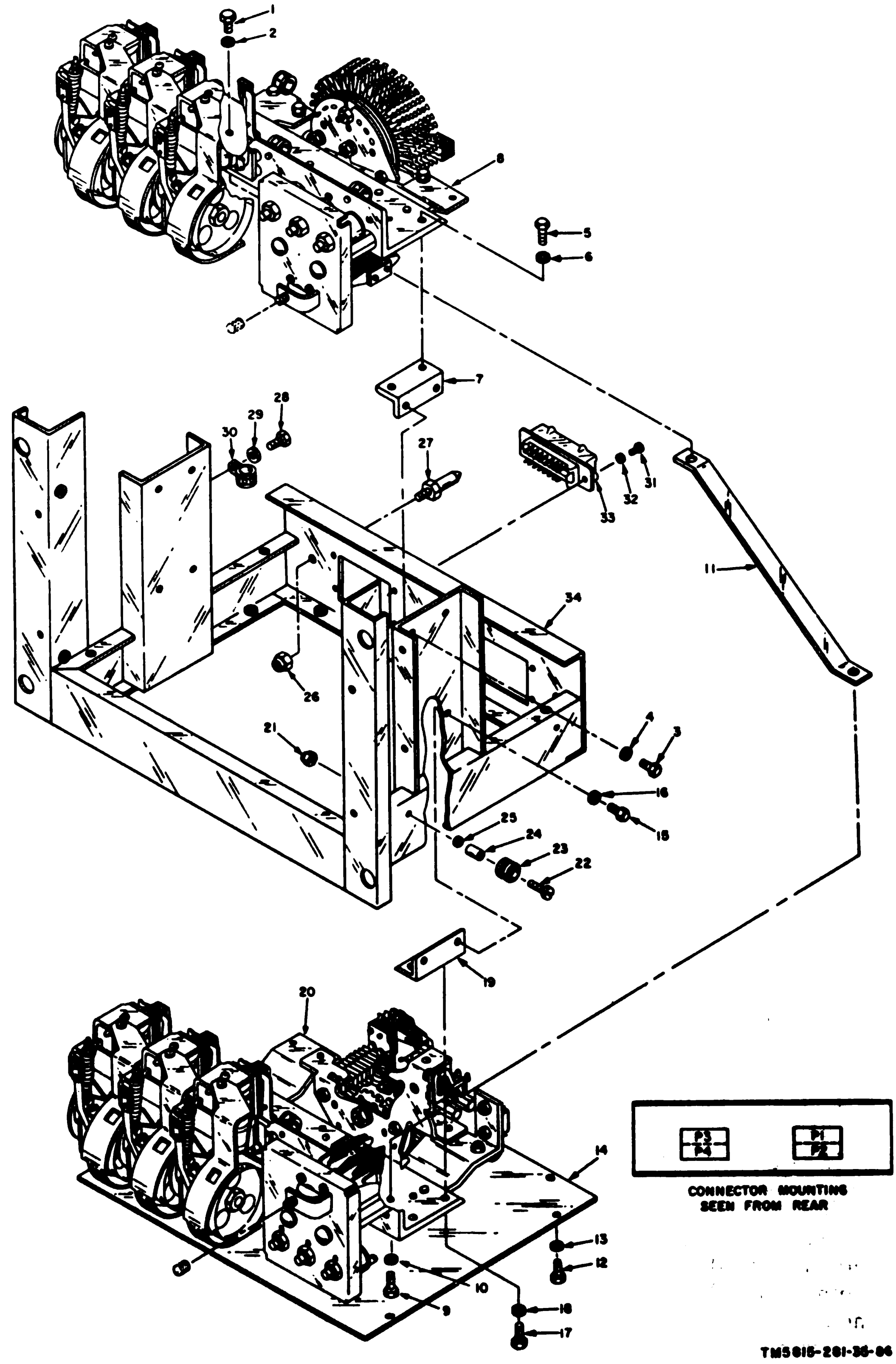


Figure 87. Numbering base, exploded view.

1 Machine screw, 10397	19 Bracket, 58429
2 Lockwasher, 10431	20 Lower numbering assembly, 58448A
3 Machine screw, 11200	21 Self-locking hexagonal nut, 10525
4 Lockwasher, 10431	22 Machine screw, 10275
5 Machine screw, 11200	23 Roller, 58372
6 Lockwasher, 10431	24 Sleeve, 58373
7 Bracket, 58429	25 Spacer, 58456
8 Upper numbering assembly, 58431A	26 Self-locking hexagonal nut, 10534
9 Machine screw, 10397	27 Locating pin, 58375
10 Lockwasher, 10431	28 Machine screw, 10008
11 Cross brace, 58430	29 Lockwasher, 10430
12 Machine screw, 10399	30 Cable clamp, 20530
13 Lockwasher, 10430	31 Machine screw, 10056
14 Bottom plate, 58411	32 Lockwasher, 10432
15 Machine screw, 11200	33 Connector (P1-P4), 20448
16 Lockwasher, 10431	34 Numbering base, 58428A
17 Machine screw, 11200	
18 Lockwasher, 10431	

Figure 87 – Continued.

(2) Position the strap (26, fig. 86) on the studs of the two message numbering reset switches (5, fig. 90 and 91); secure it in place with the two knobs (1). Position the terminal (24, fig. 86) under the machine screw (6, fig. 91) and the lockwasher (8) and tighten the machine screw.

(3) Replace the numbering base as described in paragraph 87*b*.

89. Disassembly and Reassembly of Upper Numbering Assembly
(fig. 88)

a. Disassembly.

(1) Remove the upper numbering assembly from the numbering base (para 88*a*(1) through (6)).

(2) Disconnect all electrical leads from the parts to be removed from the upper numbering assembly.

(3) Remove the two machine screws (1) and lockwashers (2) that hold the stepping switch mounting bracket (7) to the stepping switch mounting plate (52). Remove the two machine screws (3) and the lockwashers (4) that hold the filter mounting bracket (17) to the stepping switch mounting plate; remove the assembled stepping switch mounting bracket (7), the filter mounting bracket (17), and the main stepping switch (10).

(4) Remove the two machine screws (5) and lockwashers (6) that hold the stepping switch mounting bracket (7) to the main stepping switch NSA (10); remove the stepping switch mounting bracket.

(5) Remove the machine screw (8) and lockwasher (9) that hold the main stepping switch NSA (10) to the filter mounting bracket (17); remove the main stepping switch.

(6) Remove the machine screw (11) and lockwasher (12) that hold the cable clamp (13) to the filter mounting bracket (17); remove the cable clamp.

(7) Remove the two machine screws (14) and lockwashers (15) that hold the filter (16) to the filter mounting bracket (17); remove the filter.

(8) Remove the two machine screws (18), lockwashers (19), and the flat washers (20) that hold the upper subpanel assembly (21) to the stepping switch mounting plate (52); remove the upper subpanel assembly.

(9) Remove the six machine screws (22, 27, and 32), lockwashers (23, 28, and 33), and the flat washers (24, 29, and 34) that hold the numbering stepping switches RHA,

RTA, and RUA (25, 30, and 35) to the stepping switch mounting plate (52); remove the three numbering stepping switches and the six spacers (26, 31, and 36).

(10) Remove the two machine screws (37) and lockwashers (38) that hold the spark suppression filter (39) to the stepping switch mounting plate; remove the spark suppression filter.

(11) Remove the machine screws (40 and 43) and lockwashers (41 and 44) that hold the cable clamps (42

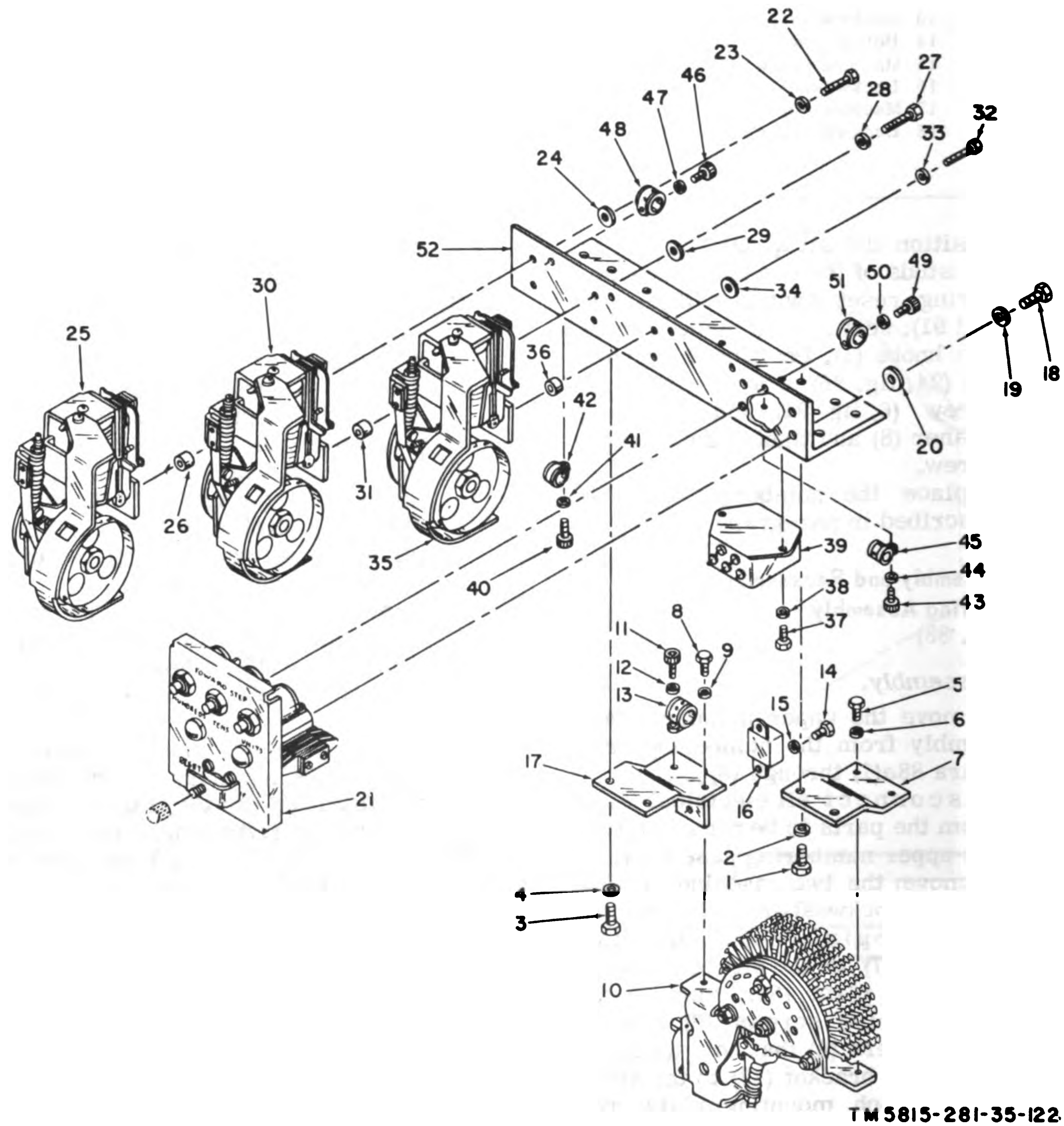


Figure 88. Upper numbering assembly, exploded view.

1 Machine screw, 11200
2 Lockwasher, 10431
3 Machine screw, 11200
4 Lockwasher, 10431
5 Machine screw, 10399
6 Lockwasher, 10430
7 Stepping switch mounting bracket, 58436
8 Machine screw, 10399
9 Lockwasher, 10430
10 Main stepping switch (NSA), 58439
11 Machine screw, 10003
12 Lockwasher, 10429
13 Cable clamp, 20530
14 Machine screw, 10001-01
15 Lockwasher, 10403
16 Filter (FL6), 58440
17 Filter mounting bracket, 58434A
18 Machine screw, 10397
19 Lockwasher, 10431
20 Flat washer, 10464
21 Upper subpanel assembly, 58442A
22 Machine screw, 10093
23 Lockwasher, 10430
24 Flat washer, 10467
25 Numbering stepping switch (RHA), 58437A
26 Spacer, 52157
27 Machine screw, 10093
28 Lockwasher, 10430
29 Flat washer, 10467
30 Numbering stepping switch (RTA), 58437A
31 Spacer, 52157
32 Machine screw, 10093
33 Lockwasher, 10430
34 Flat washer, 10467
35 Numbering stepping switch (RUA), 58437A
36 Spacer, 52157
37 Machine screw, 10001-01
38 Lockwasher, 10403
39 Spark suppression filter (FL10), 58447
40 Machine screw, 10003
41 Lockwasher, 10429
42 Cable clamp, 20526
43 Machine screw, 10003
44 Lockwasher, 10429
45 Cable clamp, 20514
46 Machine screw, 10003
47 Lockwasher, 10429
48 Cable clamp, 20518
49 Machine screw, 10003
50 Lockwasher, 10429
51 Cable clamp, 20518
52 Stepping switch mounting plate, 58432A

Figure 88 – Continued.

and 45) to the stepping switch mounting plate; remove the cable clamps.

(12) Remove the machine screws (46 and 49) and lockwashers (47 and 50) that hold the cable clamps (48 and 51) to the stepping switch mounting plate (52); remove the cable clamps.

b. Reassembly.

(1) Reassemble the components of the upper numbering assembly as indicated in figure 88; the sequence for assembling the parts is the reverse of disassembly.

(2) Replace the upper numbering assembly by reversing the removal sequence in paragraph 88*a*(1) through (6).

90. Disassembly and Reassembly of Lower Numbering Assembly
(fig. 89)

a. Disassembly.

(1) Remove the lower numbering assembly from the numbering base (para 88*a*(1) through (3) and (7) through (9)).

(2) Disconnect all electrical leads from the parts to be removed from the lower numbering assembly.

(3) Remove the two machine screws (1) and lockwashers (2) that hold the stepping switch mounting bracket (7) to the stepping switch mounting plate (55). Remove the two machine screws (3) and lockwashers (4) that hold the filter mounting bracket (17) to the stepping switch mounting plate; remove the assembled stepping switch mounting bracket (7), the filter mounting bracket (17), and the main stepping switch NSB (10).

(4) Remove the two machine screws (5) and lockwashers (6) that hold the stepping switch mounting bracket (7) to the main stepping switch; remove the stepping switch mounting bracket (7).

(5) Remove the machine screw (8) and lockwasher (9) that hold the main stepping switch NSB (10) to the filter mounting bracket (17); remove the main stepping switch.

(6) Remove the machine screw (11) and lockwasher (12) that hold the

cable clamp (13) to the filter mounting bracket (17); remove the cable clamp (13).

(7) Remove the two machine screws (14) and lockwashers (15) that hold the filter (16) to the filter mounting bracket (17); remove the filter (16).

(8) Remove the two machine screws (18), the lockwashers (19), and the flat washers (20) that hold the lower subpanel assembly (21) to the stepping switch mounting plate; remove the lower subpanel assembly (21).

(9) Remove the six machine screws (22, 27, and 32), the lockwashers (23, 28, and 33) and the flat washers (24, 29, and 34) that hold the numbering stepping switches RHB, RTB, and RUB (25, 30, and 35) to the stepping switch mounting plate (55); remove the three numbering stepping switches and the six spacers (26, 31, and 36).

(10) Remove the two machine screws (37) and lockwashers (38) that hold the spark suppression filter (39) to the stepping switch mounting plate; remove the spark suppression filter.

(11) Remove the machine screws (40 and 43) and the lockwashers (41 and 44) that hold the cable clamps

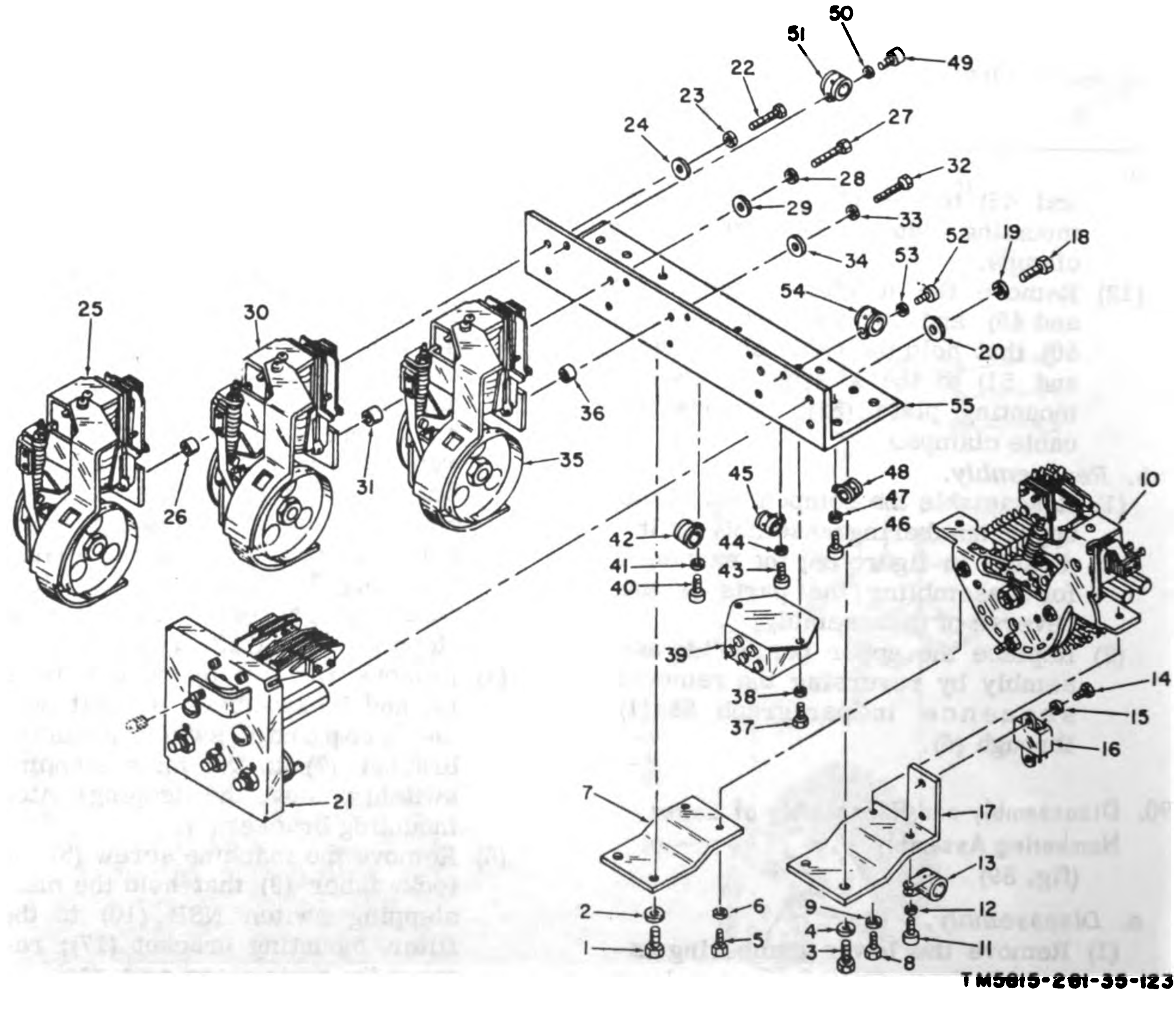


Figure 89. Lower numbering assembly, exploded view.

1 Machine screw, 11200
2 Lockwasher, 10431
3 Machine screw, 11200
4 Lockwasher, 10431
5 Machine screw, 10399
6 Lockwasher, 10430
7 Stepping switch mounting bracket, 55436
8 Machine screw, 10399
9 Lockwasher, 10430
10 Main stepping switch (NSB), 55439
11 Machine screw, 10003
12 Lockwasher, 10429
13 Cable clamp, 20530
14 Machine screw, 10001-01
15 Lockwasher, 10403
16 Filter (FL7), 55440
17 Filter mounting bracket, 55450A
18 Machine screw, 10397
19 Lockwasher, 10431
20 Flat washer, 10464
21 Lower subpanel assembly, 55452A
22 Machine screw, 10093
23 Lockwasher, 10430
24 Flat washer, 10467
25 Numbering stepping switch (RHB), 55437A
26 Spacer, 52157
27 Machine screw, 10093
28 Lockwasher, 10430
29 Flat washer, 10467
30 Numbering stepping switch (RTB), 55437A
31 Spacer, 52157
32 Machine screw, 10093
33 Lockwasher, 10430
34 Flat washer, 10467
35 Numbering stepping switch (RUB), 55437A
36 Spacer, 52157
37 Machine screw, 10001-01
38 Lockwasher, 10403
39 Spark suppression filter (FL11), 55447
40 Machine screw, 10003
41 Lockwasher, 10429
42 Cable clamp, 20516
43 Machine screw, 10003
44 Lockwasher, 10429
45 Cable clamp, 20526
46 Machine screw, 10003
47 Lockwasher, 10429
48 Cable clamp, 20526
49 Machine screw, 10003
50 Lockwasher, 10429
51 Cable clamp, 20518
52 Machine screw, 10003
53 Lockwasher, 10429
54 Cable clamp, 20514
55 Stepping switch mounting plate, 55449A

Figure 89 – Continued.

(42 and 45) to the stepping switch mounting plate; remove the cable clamps.

(12) Remove the machine screws (46, 49, and 52) and lockwashers (47, 50, and 53) that hold the cable clamps (48, 51, and 54) to the stepping switch mounting plate; remove the cable clamps.

b. Reassembly.

(1) Reassemble the components of the lower numbering assembly as indicated in figure 89; the sequence for assembling the parts is the reverse of disassembly.

(2) Replace the lower numbering assembly by reversing the removal sequence in paragraph 88*a*(1) through (3) and (7) through (10).

91. Disassembly and Reassembly of Upper Subpanel Assembly (fig. 90)

a. Disassembly.

(1) Remove the numbering base dust cover and front panel (para 87*a*).

(2) Remove the upper subpanel assembly from the numbering assembly (para 89*a*(8)).

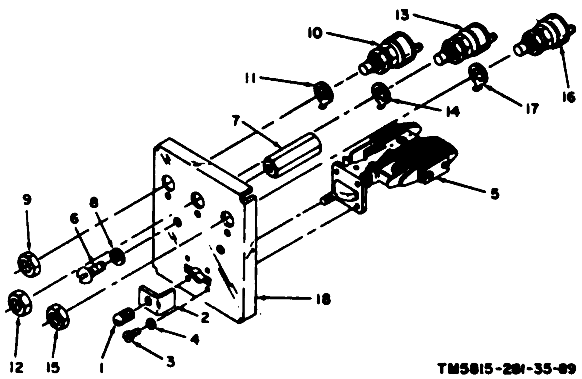
(3) Remove the knob (1) and the key lever stop (2) from message numbering reset switch S34 (5). Remove the four machine screws (3) and the lockwashers (4) that hold the message numbering reset switch to the subpanel (18); remove the message numbering reset switch.

(4) Remove the two machine screws (6), the subpanel mounting studs (7), and the lockwashers (8) from the subpanel (18).

(5) Remove the plain hexagonal nuts (9, 12, and 15) that hold FORWARD STEP switches S36, S38, and S40 (10, 13, and 16) to the subpanel (18); remove the FORWARD STEP switches and the keys (11, 14, and 17).

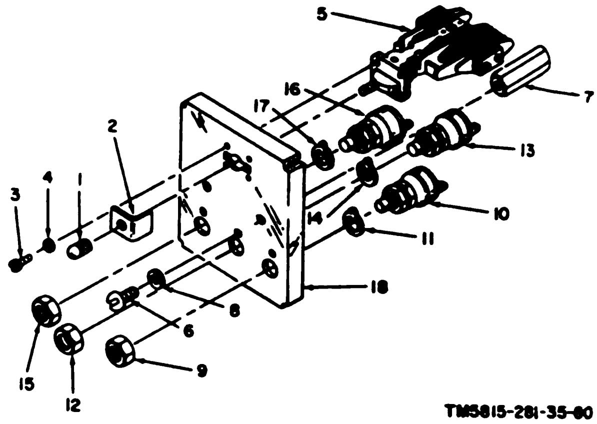
b. Reassembly.

(1) Reassemble the components of the upper subpanel assembly as indicated in figure 90; the sequence for



1 Knob
2 Key lever stop, 58032
3 Machine screw, 10124
4 Lockwasher, 10435
5 Message numbeiing reset switch (S34), 58445 (includes items 1 and 3)
6 Machine screw, 10122
7 Subpanel mounting stud, 58446
8 Lockwasher, 10431
9 Plain hexagonal nut
10 FORWARD STEP (HUNDREDS) switch (S40), 20132 (includes items 9 and 11)
11 Key
12 Plain hexagonal nut
13 FORWARD STEP (TENS) switch (S38), 20132 (includes items 12 and 14)
14 Key
15 Plain hexagonal nut
16 FORWARD STEP (UNITS) switch (S36), 20132 (includes items 15 and 17)
17 Key
18 Subpanel, 58443A

Figure 90. Upper subpanel assembly, exploded view.



1 Knob
2 Key lever stop, 58032
3 Machine screw, 10124
4 Lockwasher, 10435
5 Message numbering reset switch (S35), 58445 (includes items 1 and 3)
6 Machine screw, 10122
7 Subpanel mounting stud, 58446
8 Lockwasher, 10431
9 Plain hexagonal nut
10 FORWARD STEP UNITS switch (S37), 20132 (includes items 9 and 11)
11 Key
12 Plain hexagonal nut
13 FORWARD STEP TENS switch (S39), 20132 (includes items 12 and 14)
14 Key
15 Plain hexagonal nut
16 FORWARD STEP HUNDREDS switch (S41), 20132 (includes items 15 and 17)
17 Key
18 Subpanel, 58453A

Figure 91. Lower subpanel assembly, exploded view.

assembling the parts is the reverse of disassembly.

(2) Replace the upper subpanel assembly (para 89*b*).

(3) Replace the numbering base (para 87*b*).

92. Disassembly and Reassembly of Lower Subpanel Assembly
(fig. 91)

a. Disassembly.

(1) Remove the numbering base dust cover and front panel (para 87*a*).

(2) Remove the lower subpanel assembly from the numbering assembly (para 90*a*(8)).

(3) Remove the knob (1) and the key lever stop (2) from message numbering reset switch S35 (5). Remove the four machine screws (3) and the lockwashers (4) that hold the message numbering reset switch to the subpanel (18); remove the message numbering reset switch.

(4) Remove the two machine screws (6), the subpanel mounting studs (7), and the lockwashers (8) from the subpanel (18).

(5) Remove the plain hexagonal nuts (9, 12, and 15) that hold FORWARD STEP switches S37, S39, and S41 (10, 13, and 16) to the subpanel (18); remove the FORWARD STEP

switches and the keys (11, 14, and 17).

b. Reassembly.

(1) Reassemble the components of the lower subpanel assembly as indicated in figure 91; the sequence for assembling the parts is the reverse of disassembly.

(2) Replace lower subpanel assembly (para 90*b*).

(3) Replace the numbering base cover and front panel (para 87*b*).

Section VIII. DISASSEMBLY AND REASSEMBLY OF CONTROL BASE

93. Disassembly and Reassembly of Internal Assembly (fig. 195)

a. Disassembly.

(1) Remove the nine machine screws (1) that hold the cover plate (2) to the top of the control base; remove the cover plate. Remove the nine machine screws (3) that hold the cover plate (4) to the bottom of the control base; remove the cover plate.

(2) Remove the four plain hexagonal nuts (5), the lockwashers (6), and the machine screws (7), that hold the left bracket (23) to the front and rear brackets.

(3) Remove the two machine screws (8) and lockwashers (9) that hold the assembled cable connector (122) and standoffs (121) to the left bracket.

(4) Remove the two plain hexagonal nuts (10), the lockwashers (11), and the machine screws (12) that hold the left bracket to the relay mounting bracket; remove the left bracket (23), the assembled roller (22), and the terminal board (16).

(5) Remove the jumper wire (13) from terminal board TB1A (16). Remove the machine screw (14) and lockwasher (15) that secure the terminal board to the left bracket (23); remove the terminal board and the marker strip (17).

(6) Remove the self-locking hexagonal nut (18) and the machine screw (19) from the left bracket to remove the spacer (20), the sleeve (21), and the roller (22).

(7) Remove the four plain hexagonal nuts (24), the lockwashers (25), and the machine screws (26) that hold the right bracket (42) to the front and rear brackets.

(8) Remove the two machine screws (27) and lockwashers (28) that hold the assembled cable connector (126) and the standoffs (125) to the right bracket.

(9) Remove the two plain hexagonal nuts (29), the lockwashers (30), and the machine screws (31) that hold the right bracket to the relay mounting bracket.

(10) Remove the jumper wire (32) from terminal board TB1B (35). Remove the machine screw (33) and the lockwasher (34) that hold the terminal board to the right bracket (42); remove the terminal board and the marker strip (36).

(11) Remove the self-locking hexagonal nut (37) and machine screw (38) that hold the roller (41) to the right bracket; remove the spacer (39), the sleeve (40), and the roller (41).

(12) Unsolder and remove all leads from the components of the front panel assembly; tag the leads carefully.

(13) Remove the plain hexagonal nut (43), the flat washer (44), the lockwasher (45), and LINE BREAK switch S50 (46) from the front panel.

(14) Remove the capnut (47), the flat washer (48), and LINE CURRENT potentiometer R9 (49) from the front panel.

(15) Remove the plain hexagonal nut (50), the flat washer (51), and the lockwasher (52) that hold BLANK SIGNAL switch S1 (53) to the front panel; remove the BLANK SIGNAL switch.

(16) Remove the plain hexagonal nut (54), the flat washer (55), and the lockwasher (56) that hold power switch S12 (57) to the front panel; remove the power switch.

(17) Remove the plain hexagonal nut (58), the flat washer (59), and the lockwasher (60) that hold LINE BREAK switch S51 (61) to the front panel; remove the LINE BREAK switch.

(18) Remove the capnut (62), the flat washer (63), and LINE CURRENT potentiometer R6 (64) from the front panel.

(19) Remove the plain hexagonal nut (65), the flat washer (66) and the lockwasher (67) that hold BLANK SIGNAL switch S2 (68) to the front panel; remove the BLANK SIGNAL switch.

(20) Disconnect and remove resistors R8 and R10 (69 and 70) from the LOOP jacks.

(21) Remove the machine screws (72, 77, 82, and 87), the flat washers (73, 78, 83, and 88), the lockwashers (74, 79, 84, and 89), and the terminals (75, 80, 85, and 90) from connectors J1-J4 (76, 81, 86, and 91); remove the connectors from their respective cables.

(22) Unsolder and disconnect all leads from the components of the rear bracket assembly; tag leads carefully. Remove the two wiring harnesses from the cable support brackets on the rear bracket.

(23) Remove any damaged terminals (92, 93, or 94) from the wiring harness assemblies.

(24) Remove the two machine screws (95) and the lockwashers (96 and 97) that hold connector J25 (98) to the rear bracket assembly; remove the connector.

(25) Remove the four plain hexagonal nuts (99), the machine screws (100), and the lockwashers (101) that hold connector J61 (102) to the rear bracket assembly; remove the connector.

(26) Remove the two machine screws (103) and lockwashers (104 and 105) that hold connector J31 (106) to the rear bracket assembly; remove the connector.

(27) Remove the rear bracket assembly (107); pull the two wiring harnesses through the grommet holes.

(28) Disconnect all leads at terminal board TB1 (111) and remove the harness assembly (113) and the tubing (112). Tag all leads. Remove the plain hexagonal nuts (108), the lockwashers (109), and the machine screws (110) that hold the terminal board to the relay mounting rack; remove the terminal board.

(29) Unsolder and disconnect all leads from the components of the relay mounting rack assembly; tag all leads.

(30) Remove the two self-locking hexagonal nuts (114), the machine screws (115), the cable clamps (116), the lockwashers (117), and the flat washers (118) that hold the two harness assemblies to the relay mounting rack.

(31) Remove the connectors P7A and P7B (119 and 123) from mating connectors J7A and J7B (122 and 126). Unsolder and disconnect all leads at connectors J7A and J7B. Tag all leads.

(32) Remove the special screws (120 and 124) and the standoffs (121 and 125) from connectors J7A and J7B (122 and 126); remove the connectors.

(33) Remove the harness assemblies (127, 128, and 131).

(34) Remove the two plain hexagonal nuts (132 and 136), the lockwashers (133 and 137), and the machine screws (134 and 138) that hold filters FL14 and FL15 (135 and 139) to the relay mounting rack; remove the filters.

(35) Remove resistors R11 and R12 (140) from relays KNA and KNB (143). Remove the two machine screws (141) and the fiber washers (142) that hold relay KNB to the relay mounting rack; remove relay KNB and the insulator (144). Follow this same procedure to remove the 11 other relays.

93.1 Disassembly and Reassembly of Control Base Electronics

(fig. 195)

a. Disassembly.

(1) Perform disassembly of control base internal assembly (para 93*a*).

(2) Remove two machine screws (15), two washers (151), and two clamps (152) holding bracket (155) to relay mounting rack (145).

(3) Remove two machine screws (149), two lock washers (148), and two flat washers (147) holding bracket (146) to bracket (155) and to relay mounting rack (145).

(4) Raise bracket (155) and attached parts and slide cover plate (2) under the assembly.

(5) Remove two machine screws (157) and two washers (158) holding power supply circuit board A1A4 bracket (159) to bracket (155).

(6) Remove four machine screws (161), four spacers (162), four flat washers (163), four lock washers (164), and four nuts (165) holding power supply circuit board A1A4 (160) to brackets (159); remove brackets (159).

(7) Unsolder and disconnect all leads to power supply circuit board A1A4 (160); tag leads carefully; remove power supply circuit board A1A4 (160). Components of power supply circuit board A1A4 are shown in figure 195③.

(8) Remove two screws (157) and two washers (158) holding brackets (166) to bracket (155).

(9) Remove four machine screws (167), four flat washers (168), four lock washers (169), four nuts (170), one washer (171), and one clamp (172), holding logic circuit board A1A3 (173) to brackets (166); remove brackets (166).

(10) Unsolder and disconnect all leads to logic circuit board A1A3 (173); tag leads carefully; remove logic circuit board A1A3 (173). Components of logic circuit board A1A3 are shown in figure 195 ③.

(11) Remove two machine screws (175), two lock washers (176), and two flat washers (177) holding bracket (178) to transformer A1T1 (208).

(12) Move bracket (178) away from the assembly and remove two set screws (179) holding WPM switch A1S4 knob (180) to WPM switch A1S4 shaft. Remove WPM switch A1S4 knob.

(13) Remove nut (182) and lock washer (183) that hold WPM switch A1S4 (181) to bracket (178); remove WPM switch A1S4 (181).

(14) Unsolder and disconnect all leads to WPM switch A1S4 (181); tag leads carefully.

(15) Remove two screws (184), two lock washers (185), and two flat washers (186), that hold terminal block assembly A1TB3 (187) and marker strip (188) to test point panel (189).

(16) Disconnect and carefully tag all leads to terminal board A1TB3 (187) and marker strip (188).

(17) Unsolder and disconnect all leads to terminal board A1TB4 (190); tag leads carefully.

(18) Remove two machine screws (194), two lock washers (195), two flat washers (196), and two spacers (197) that hold terminal board A1TB4 (190) to test point panel (189).

(19) Unsolder and disconnect two resistors (191), two diodes (192), and two capacitors (193), from terminal board A1TB4 (190).

(20) Raise test point panel (189), unsolder and disconnect all leads to test points 1 through 20; tag all leads carefully.

(21) Remove two machine screws (199), two lock washers (200), two flat washers (201), and two cable clamps (202) that fasten cables to the bottom of bracket (155).

(22) Raise the remaining assembly and lay it on its side to expose the bottom of bracket (155). Remove four nuts (204), four lock washers (205), four flat washers (206), and one ground lug (207), that hold transformer A1T1 (208) to bracket (155). Remove transformer A1T1. Two of the four nuts (204) and washers that hold transformer A1T1 (208) in place, also hold bracket (209) on which FL1 and FL2 (210) are mounted.

(23) Unsolder and disconnect all leads to capacitors FL1 and FL2 (210); tag leads carefully.

(24) Remove two nuts (211) and two washers (212) that hold capacitors FL1 and FL2 (210) to bracket (209).

(25) Return the remaining assembly to an upright position.

(26) Remove two machine screws (212) and two washers (213) that attach circuit board A1A1 brackets (215) to bracket (155). Raise the terminal board assembly for access to terminal board brackets (215).

(27) Remove four screws (216), four washers (217), eight spacers (218), and four nuts (220); remove terminal board A1A1 brackets (215).

(28) Remove one screw (219), two washers (217), two clamps (221), one lock washer (214), and one nut (220).

(29) Raise clock circuit board A1A1 (222) and unsolder and disconnect all leads; tag all leads carefully. Remove clock circuit board A1A1 (222). Components of clock circuit board A1A1 are shown in figure 195 ③.

(30) Raise switching circuit board A1A2 (223) and unsolder and disconnect all leads; tag all leads carefully. Remove switching circuit board A1A2 (223). Components of switching circuit board A1A2 are shown in figure 195 ③.

(31) Remove two set screws (224) from each switch knob (225) of switches A1S5 (226) and A1S6 (229). Remove switch knobs (225).

(32) Remove nut (227) and lock washer (228) from the shafts of switches A1S5 (226) and A1S6 (229).

(33) Unsolder and disconnect all leads to switches A1S5 (226) and A1S6 (229); tag all leads carefully.

(34) Unsolder and remove resistors R95—R99 (230) from switch A1S5 (226) and resistors R151—R155 (231) from switch A1S6 (229). Remove switches A1S5 and A1S6.

(35) Lay the remaining assembly on its side and remove six machine screws (233), six lock washers (234), and six flat washers (235), holding switch support bracket (236) and heat sink assembly (237) to bracket (155). Remove switch support bracket (236).

(36) Unsolder and disconnect leads to transistor Q33 (245); tag all leads carefully.

(37) Separate heat sink assembly (237) from bracket (155). Remove two machine screws (238), two insulating washers (239), two flat washers (240), two lock washers (241), two nuts (242), one clamp (243), one insulator (244), and transistor Q33 (245) from heat sink assembly (237).

(38) Unsolder and disconnect the leads to diode A1VR2 (247) and to ground terminal (248); tag leads carefully.

(39) Remove nut (252), lock washer (251), flat washer (250), bushing (249), and terminal (248). Remove diode A1VR2 (247).

(40) Two nut plates (246) remain attached to heat sink (237).

b. Reassembly.

(1) Reassemble the components of the control base electronics as indicated in figure 195. The sequence of assembling the parts is the reverse of disassembly.

(2) Position the rollers of the control base on the roller guides and slide the assembly into place. Tighten thumbscrews firmly and reconnect the cables.

43) that hold SET JACK J16 and SET JACK J18 (32 and 44) to the bracket assembly; remove both jacks.

(9) Remove the machine screws (33 and 45) and flat washers (34 and 46) that hold CASE switches S10 and S11 (35 and 47) to the bracket assembly; remove the CASE switches.

(10) Remove the six machine screws (48 and 50) that hold the plates (49 and 51) to the bracket assembly; remove the plates.

b. Reassembly.

(1) Reassemble the components of the front panel assembly as indicated in figure (92); the sequence for assembling the parts is the reverse of disassembly.

(2) Install the front panel assembly on the control base by reversing the disassembly sequence described in paragraph 93*a*(1) through (4), (7) through (10), and (12) through (20).

94. Disassembly and Reassembly of Control Base Front Panel Assembly (fig. 92)

a. Disassembly.

(1) Remove and partially disassemble the control base front panel assembly (para 93*a*(1) through (4), (7) through (10), and (12) through (20)).

(2) Remove the fuse caps (1 and 6) and fuses F4 and F5 (2 and 7).

(3) Remove the plain hexagonal nuts (3 and 8) and the lockwashers (4 and 9) that hold the fuseholders (5 and 10) to the front panel assembly; remove the fuseholders. Remove the front panel assembly from the bracket assembly.

(4) Remove the four machine screws (11), the lockwashers (12), and the flat washers (13) that hold the two handles (14) to the front panel assembly; remove the two handles.

(5) Remove the two retainer rings (15) that hold the two thumbscrews (16) to the front panel assembly; remove the two thumbscrews.

(6) Unsolder and remove the six jumper wires (18, 19, 20, 21, 22, and 23).

(7) Remove the machine screws (24, 27, 36, and 39) and the flat washers (25, 28, 37, and 40) that hold LOOP JACKs J15, J17, J19, and J20 (26, 29, 38, and 41) to the bracket assembly; remove the LOOP JACKs.

(8) Remove the machine screws (30 and 42) and flat washers (31 and

95. Disassembly and Reassembly of Rear Bracket Assembly (fig. 93)

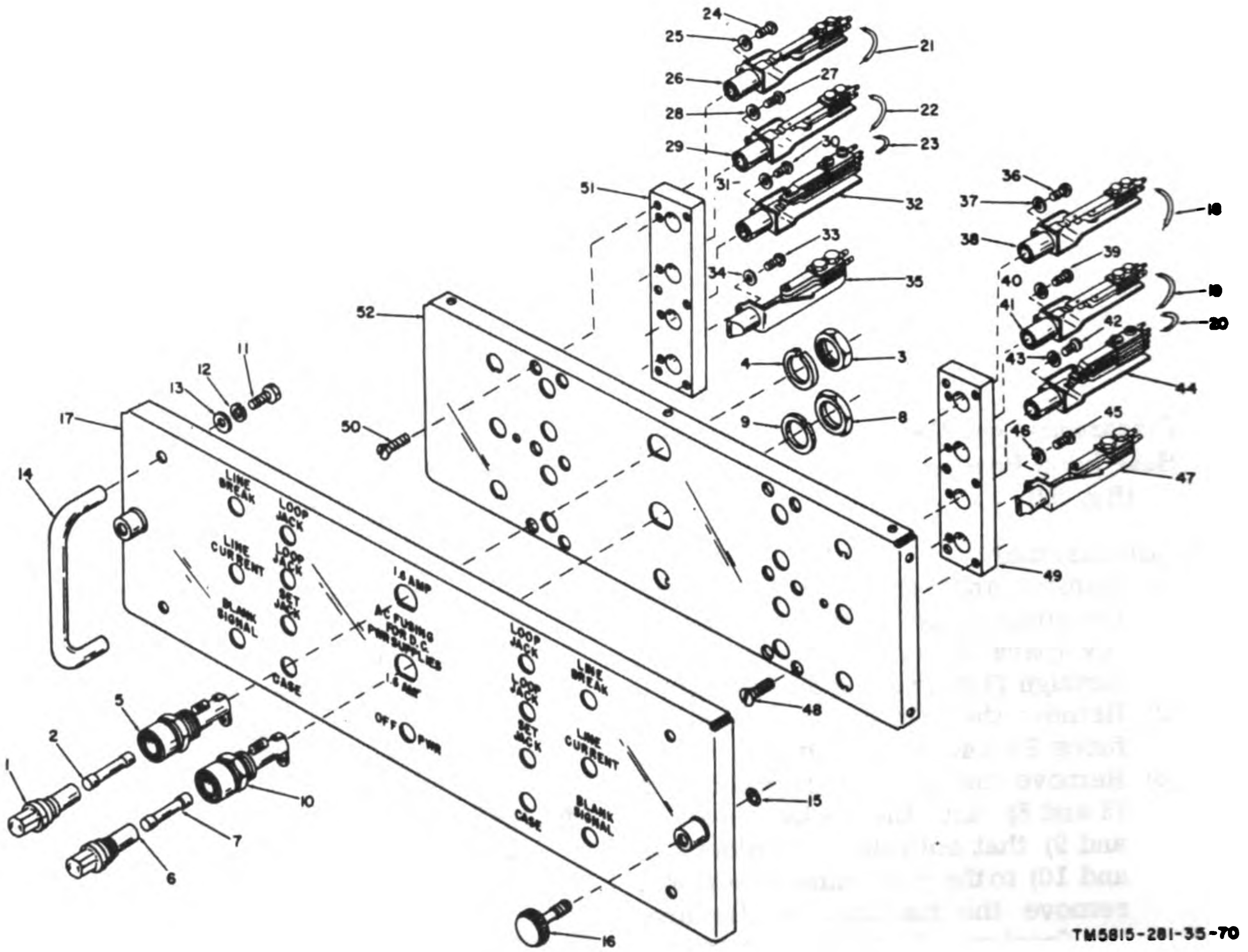
a. Disassembly.

(1) Remove and partially disassemble the rear bracket assembly (para 93*a*(1), (2), (7), and (21) through (27)).

(2) Remove the three self-locking hexagonal nuts (1 and 4) and the lockwashers (2 and 5) that hold filters FL1 and FL2 (3 and 6) to the rear bracket assembly; remove the filters.

(3) Remove the four plain hexagonal nuts (7), the lockwashers (8) and the machine screws (9) that hold the two cable support brackets (10) to the rear bracket assembly; remove the two cable support brackets.

(4) Remove the four plain hexagonal nuts (11), the lockwashers (12), and the machine screws (13) that hold connector J82 (14) to the rear

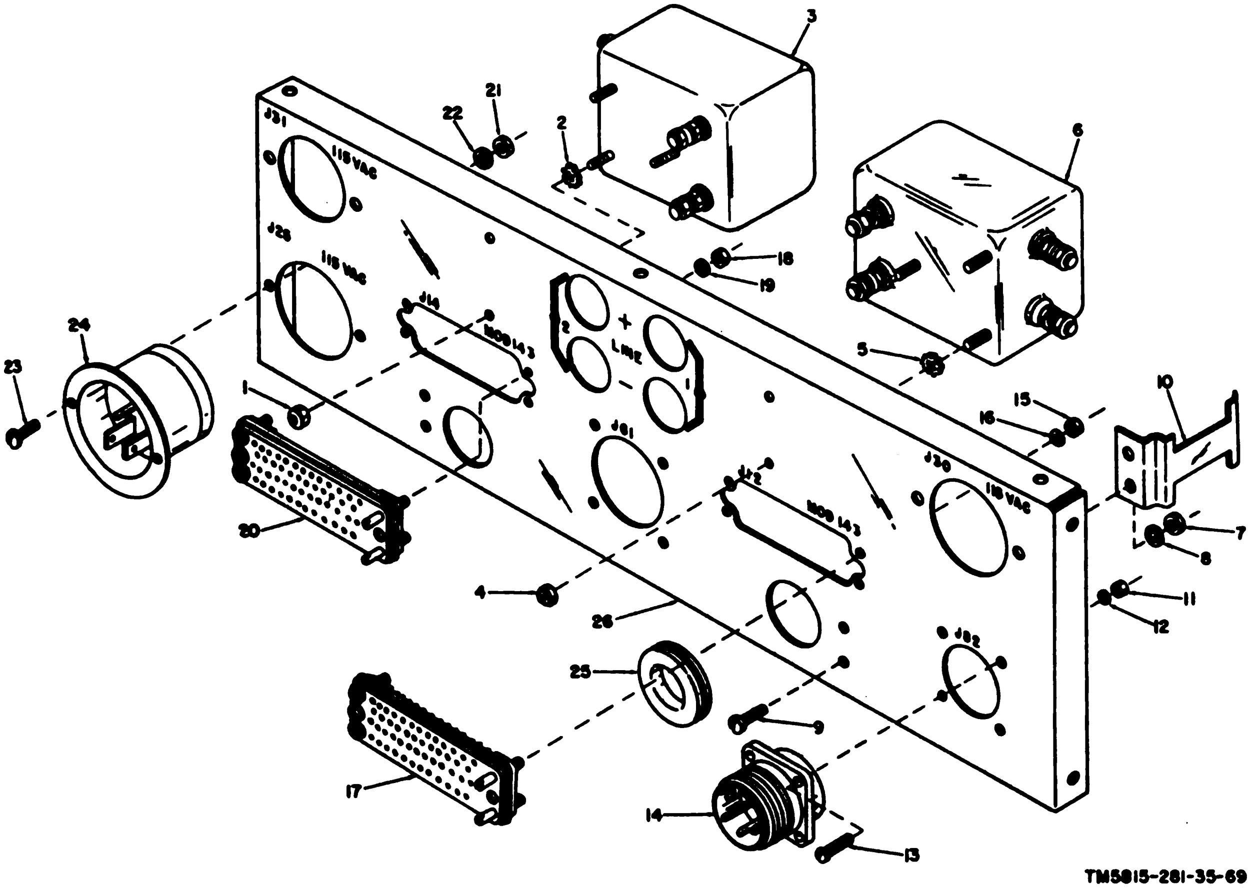


1 Fuse cap
2 Fuse F4, 20455
3 Plain hexagonal nut
4 Lockwasher
5 Fuseholder, 20471 (includes items 1, 3, and 4)
6 Fuse cap
7 Fuse F5, 20455
8 Plain hexagonal nut
9 Lockwasher
10 Fuseholder, 20471 (includes items 6, 8, and 9)
11 Machine screw, 10397
12 Lockwasher, 10431
13 Flat washer, 10464
14 Handle, 63944
15 Retainer ring, 11080
16 Thumbscrew, 11081
17 Panel, 63946A
18 Jumper wire, 22299-01.43
19 Jumper wire, 22299-01.43
20 Jumper wire, 22299-01.43
21 Jumper wire, 22299-01.43
22 Jumper wire, 22299-01.43
23 Jumper wire, 22299-01.43
24 Machine screw, 10304
25 Flat washer, 10459
26 LOOP JACK (J20), 20788
27 Machine screw, 10304
28 Flat washer, 10304
29 LOOP JACK (J17), 20788
30 Machine screw, 10304
31 Flat washer, 10459
32 SET JACK (J18), 20906
33 Machine screw, 10304
34 Flat washer, 10459
35 CASE switch (S10), 20499
36 Machine screw, 10304
37 Flat washer, 10459
38 LOOP JACK (J19), 20788
39 Machine screw, 10304
40 Flat washer, 10459
41 LOOP JACK (J15), 20788
42 Machine screw, 10304
43 Flat washer, 10459
44 SET JACK (J16), 20906
45 Machine screw, 10304
46 Flat washer, 10459
47 CASE switch (S11), 20499
48 Machine screw, 10306
49 Plate 63945
50 Machine screw, 10306
51 Plate, 63945
52 Bracket, 63949A

Figure 98. Control base front panel assembly, exploded view.

bracket assembly; remove the connector.

(5) Remove the eight plain hexagonal nuts (15 and 18) and the lockwashers (16 and 19) that hold connectors J12 and J14 (17 and 20) to the rear bracket assembly; remove the connectors.



1 Self-locking hexagonal nut, 10501
2 Lockwasher, 10406
3 Filter (FL2), 63957
4 Self-locking hexagonal nut, 10501
5 Lockwasher, 10406
6 Filter (FL1), 63957
7 Plain hexagonal nut, 10513
8 Lockwasher, 10403
9 Machine screw, 10393
10 Cable support bracket, 63958
11 Plain hexagonal nut, 10517
12 Lockwasher, 10408
13 Machine screw, 10109
14 Connector J82, 20487
15 Plain hexagonal nut
16 Lockwasher
17 Connector (J12), 20497 (includes items 15 and 16)
18 Plain hexagonal nut
19 Lockwasher
20 Connector (J14), 20497 (includes items 18 and 19)
21 Plain hexagonal nut, 10513
22 Lockwasher, 10403
23 Machine screw, 10393
24 Connector (J25), 20918
25 Grommet, 21001
26 Bracket, 63955A

Figure 93. Control base rear bracket assembly, exploded view.

(6) Remove the two plain hexagonal nuts (21), the four lockwashers (22), and the two machine screws (23) that hold connector J25 (24) to the rear bracket assembly; remove the connector.

(7) Remove the two grommets (25) from the rear bracket (26).

b. Reassembly.

(1) Reassemble the components of the rear bracket assembly as indicated in figure 93; the sequence for assembling the parts is the reverse of disassembly.

(2) Replace the rear bracket assembly by reversing the disassembly sequence (para 93*a*(1), (2), (7), and (21) through (27)).

96. Disassembly and Reassembly of Power Supply PP-1801/FG

a. Disassembly.

(1) Remove the two plain hexagonal nuts (23, fig. 95) and the lockwashers (24) that hold the terminal cover (25) to the mounting studs (27); remove the terminal cover.

(2) Unsolder and disconnect the electrical leads of the power supply harness (9, fig. 94), output cable (11), and the input cable (13) from the electrical components of the power supply.

(3) Remove the machine screw (1) and lockwashers (2) that hold the grounding lugs of the input and output cables to the chassis (32, fig. 95). Remove the machine screws (3 and 6, fig. 94) and the lockwashers (4 and 7) that hold the cable clamps (5 and 8) to the chassis; remove the harness (9).

(4) Remove the strain reliefs (10 and 12), the output cable (11), and the input cable (13) from the chassis.

(5) Remove the two mounting studs (14) and the lockwashers (15).

(6) Remove the two machine screws (16) and the lockwashers (17) that hold resistor R5 (18) to the chassis; remove the resistor.

(7) Remove the four plain hexagonal nuts (3, fig. 95) and lockwashers (4) that hold inductor L2 (5) to the chassis; remove the inductor.

(8) Remove the four plain hexagonal nuts (6) and lockwashers (7) that hold transformer T2 (8) to the chassis; remove the transformer.

(9) Remove the four machine screws (9), the lockwashers (10), and the flat washers (11) that hold rectifier CR2 (12) to the chassis; remove the rectifier.

(10) Remove the plain hexagonal nut (13) and the lockwasher (14) that hold capacitor C5 (15) to the chassis; remove the capacitor and the fiber washer (16).

(11) Remove the fuse cap (17) and fuse F3 (18) from the fuseholder (21). Remove the plain hexagonal nut (19) and lockwasher (20) that hold the fuseholder to the chassis; remove the fuseholder and the rubber washer (22).

(12) Remove the two self-locking hexagonal nuts (26) and mounting studs (27) that hold terminal board TB26 (28) to the chassis; remove the terminal board and the terminal marker strip (29).

(13) Remove the grommets (30 and 31) from the chassis.

b. Reassembly.

(1) Reassemble the PP-1801/FG as indicated in figures 94 and 95; the sequence for assembling the parts is the reverse of disassembly.

(2) Install the PP-1801/FG in its rack. Connect plug P55 to jack J55. Connect plug P32 to jack J32.

97. Disassembly and Reassembly of Power Supply PP-3131/GGC-9

Warning: **Short across capacitors C8, C9, C10, and C11 (fig. 97) before removing any components of the 48-volt power supply.**

a. Disassembly.

(1) Remove the two self-locking hexagonal nuts (28, fig. 96) and the flat washers (29) that hold the terminal cover (30) to the mounting studs (32); remove the terminal cover.

(2) Disconnect the electrical leads of the power supply cable (1), (fig. 97), the ac power cord (6, fig. 96), and the dc power cord (7) from the electrical components of the 48-volt power supply.

(3) Remove the machine screw (1) and the lockwashers (2 and 5) that hold the grounding lugs (3 and 4) of the ac and dc power cords to the chassis (52); remove the ac power cord (6) and the dc power cord (7).

(4) Remove the machine screws (33 and 36, fig. 97) and the lockwashers

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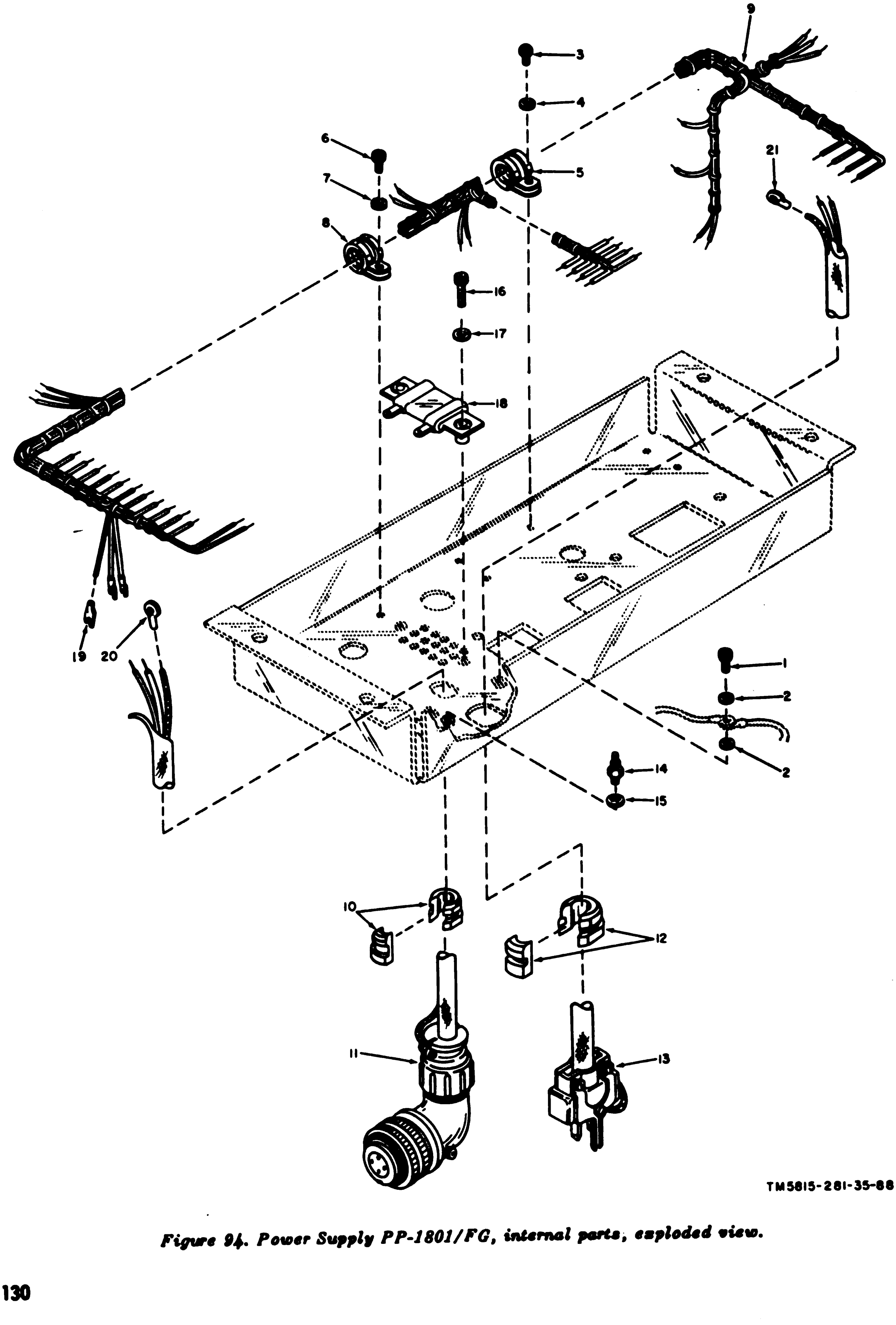


Figure 94. Power Supply PP-1801/FG, internal parts, exploded view.

1 Machine screw, 10032-01
2 Lockwasher, 10404
3 Machine screw, 10001
4 Lockwasher, 10429
5 Cable clamp, 20514
6 Machine screw, 10001
7 Lockwasher, 10429
8 Cable clamp, 20516
9 Harness, 58009A
10 Strain relief, 20713
11 Output cable, 58008A
12 Strain relief, 20835
13 Input cable, 58017A
14 Mounting stud, 20357
15 Lockwasher, 10403
16 Machine screw, 10093
17 Lockwasher, 10430
18 Resistor (R5), 20027
19 Terminal lug, 20706
20 Terminal lug, 20709
21 Terminal lug, 20709

Figure 94 – Continued.

(34 and 37) that secure the cable clamps (35 and 38); remove the cable clamps and cable. Remove the power supply cable (1) from the cable clamps. Remove the grounding leads of the power supply cable from the terminal mounting posts (12); remove the power supply cable.

(5) Remove the plain hexagonal nuts (8 and 12, fig. 96) and lockwashers (9 and 13) that hold capacitors C3 and C4 (10 and 14); remove the capacitors and flat washers (11 and 15).

(6) Remove the fuse caps (16 and 22) and fuses F1 and F3 (17 and 23). Remove the plain hexagonal nuts (18 and 24) and the lockwashers (19 and 25) that hold the fuseholders (20 and 26); remove the fuseholders and flat washers (21 and 27).

(7) Remove the two self-locking hexagonal nuts (31) and mounting studs (32) that hold terminal board TB25 (33) to the chassis (52); remove the terminal board and the terminal marker strip (34).

(8) Remove the four plain hexagonal nuts (35) and lockwashers (36) that hold choke L1 (37) to the chassis; remove the choke.

(9) Remove the four plain hexagonal nuts (38) and lockwashers (39) that hold transformer T1 (40); remove the transformer.

(10) Remove the four machine screws (41), the flat washers (42), and the lockwashers (43) that hold rectifier CR1 (44); remove the rectifier.

(11) Remove resistors R20 and R21 (2, fig. 97) from capacitors C9 and C11. Remove the machine screws (3 and 6) and the lockwashers (4 and 7) that hold capacitors C8 through C11; remove the capacitors.

(12) Remove the two machine screws (9) and lockwashers (10) that hold resistor R4 (11); remove the resistor.

(13) Remove the four terminal mounting posts (12) from the chassis.

(14) Remove the self-locking hexagonal nut (13) that holds resistors R3 and R14 (17 and 19) to the machine screw (22); remove the flat washers (14 and 15), the centering washers (16), the resistor (17), the flat washer (18), the resistor (19), the centering washer (20), the flat washer (21), and the machine screw (22). Remove items 23 through 32 in the same sequence of disassembly as followed for items 13 through 22.

(15) Remove the four machine screws (45 and 48, fig. 96) and the lockwashers (46 and 49) that hold rectifiers CR3 and CR4 (47 and 50); remove the two rectifiers.

(16) Remove the grommet (51) from the chassis (52).

b. Reassembly.

(1) Reassemble the PP-3131/GGC-9 as indicated in figures 96 and 97. The sequence for assembling the parts is the reverse of disassembly.

(2) Install the PP-3131/GGC-9 in its rack. Connect plug P27 to jack J27. Connect plug P29 to jack J29.

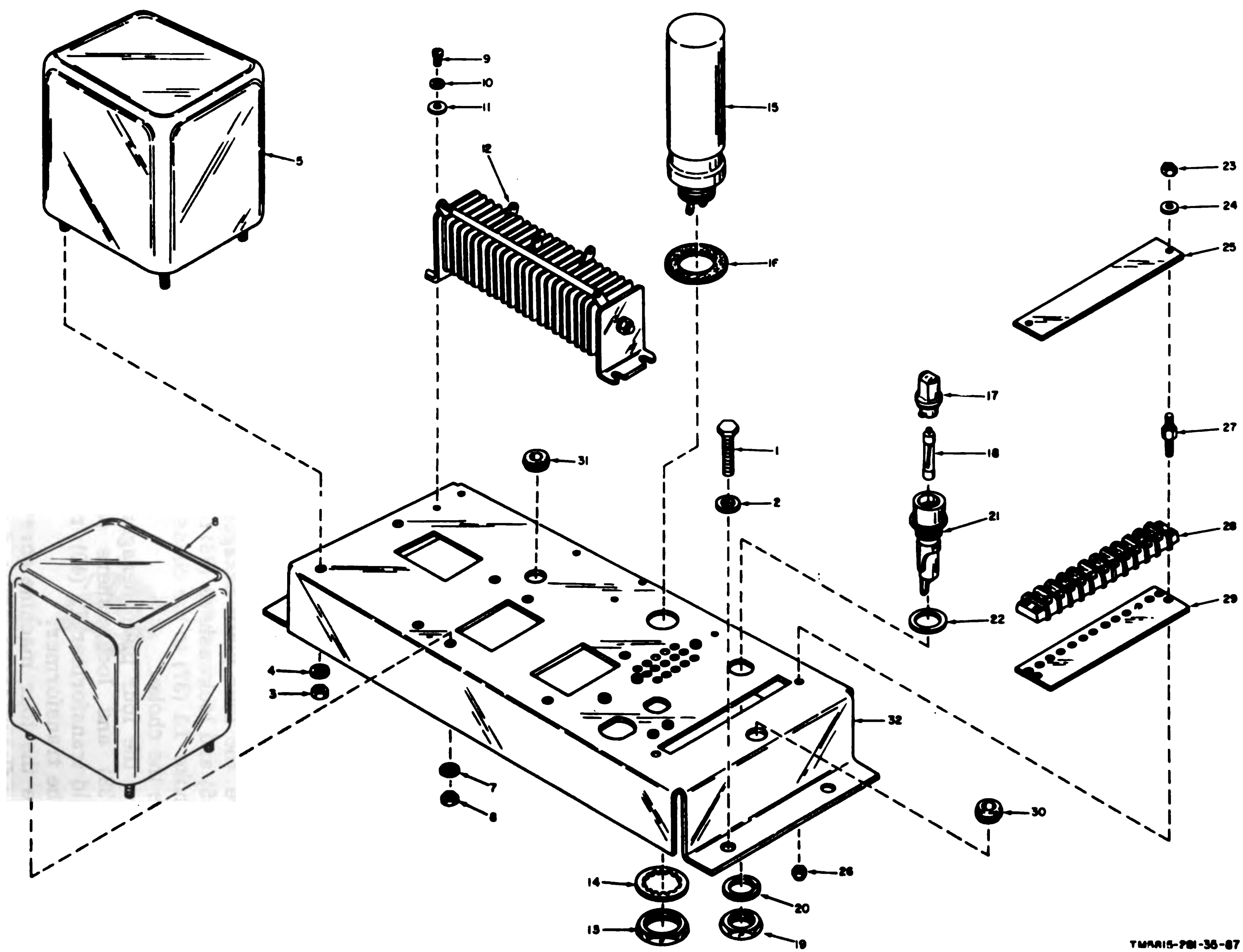


Figure 95. Power Supply PP-1801/FG, external parts, exploded view.

1 Mounting screw
2 Lockwasher
3 Plain hexagonal nut, 10509
4 Lockwasher, 10405
5 Inductor (L2), 58005
6 Plain hexagonal nut, 10509
7 Lockwasher, 10405
8 Transformer (T2), 58004
9 Machine screw, 10106
10 Lockwasher, 10429
11 Flat washer, 10458
12 Rectifier (CR2), 58006
13 Plain hexagonal nut
14 Lockwasher
15 Capacitor (C5), 20220 (includes items 13 and 14)
16 Fiber washer
17 Fuse cap
18 Fuse (F3), 20472
19 Plain hexagonal nut
20 Lockwasher
21 Fuse holder, 20471 (includes items 17, 19, and 20)
22 Rubber washer
23 Plain hexagonal nut, 10511
24 Lockwasher, 10450
25 Terminal cover, 58010
26 Self-locking hexagonal nut, 10500
27 Mounting stud, 51660
28 Terminal board (TB26), 20331
29 Terminal marker strip, 20332
30 Grommet, 20726
31 Grommet, 20726
32 Chassis, 58002A

Figure 95 – Continued.

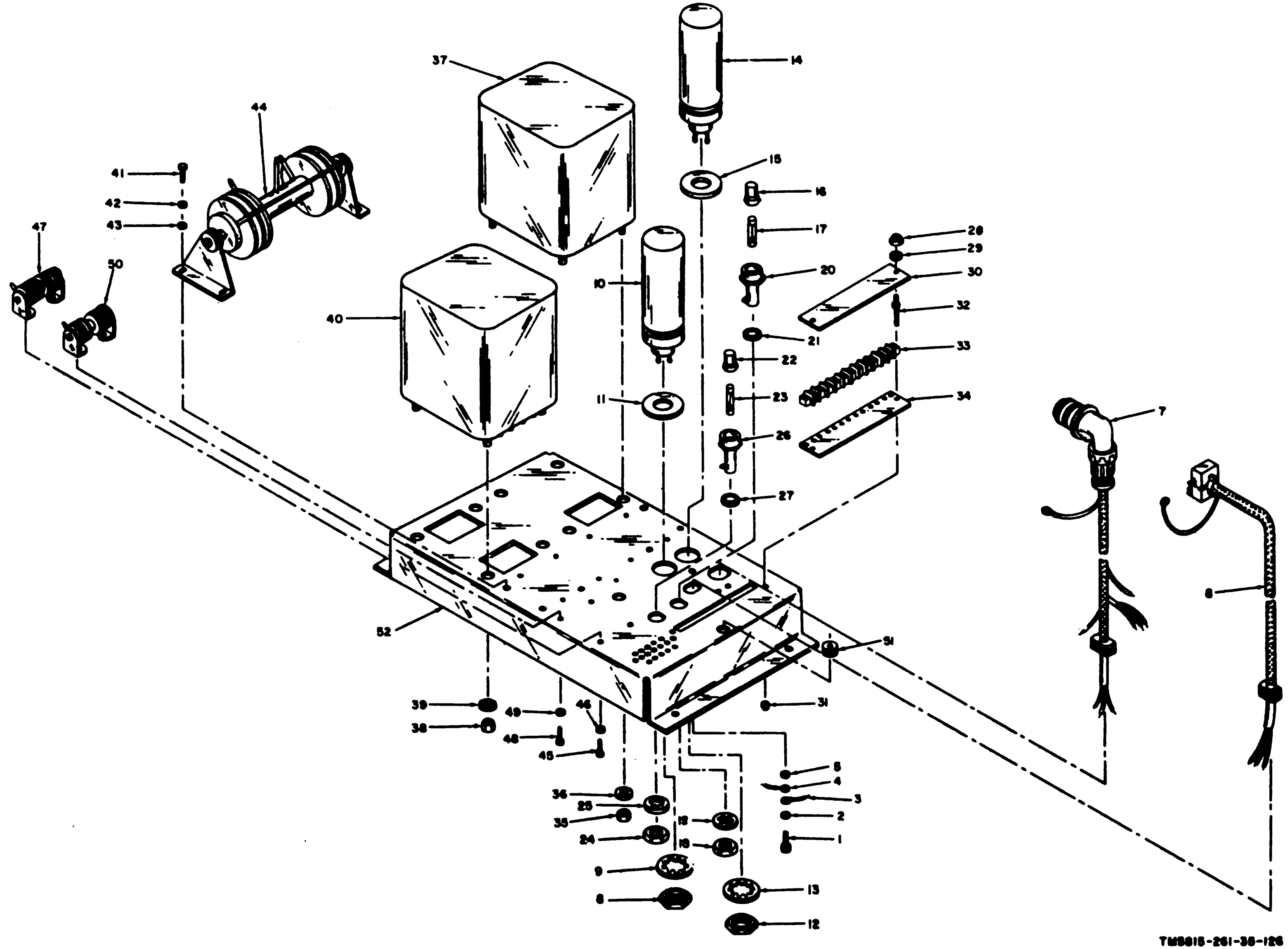
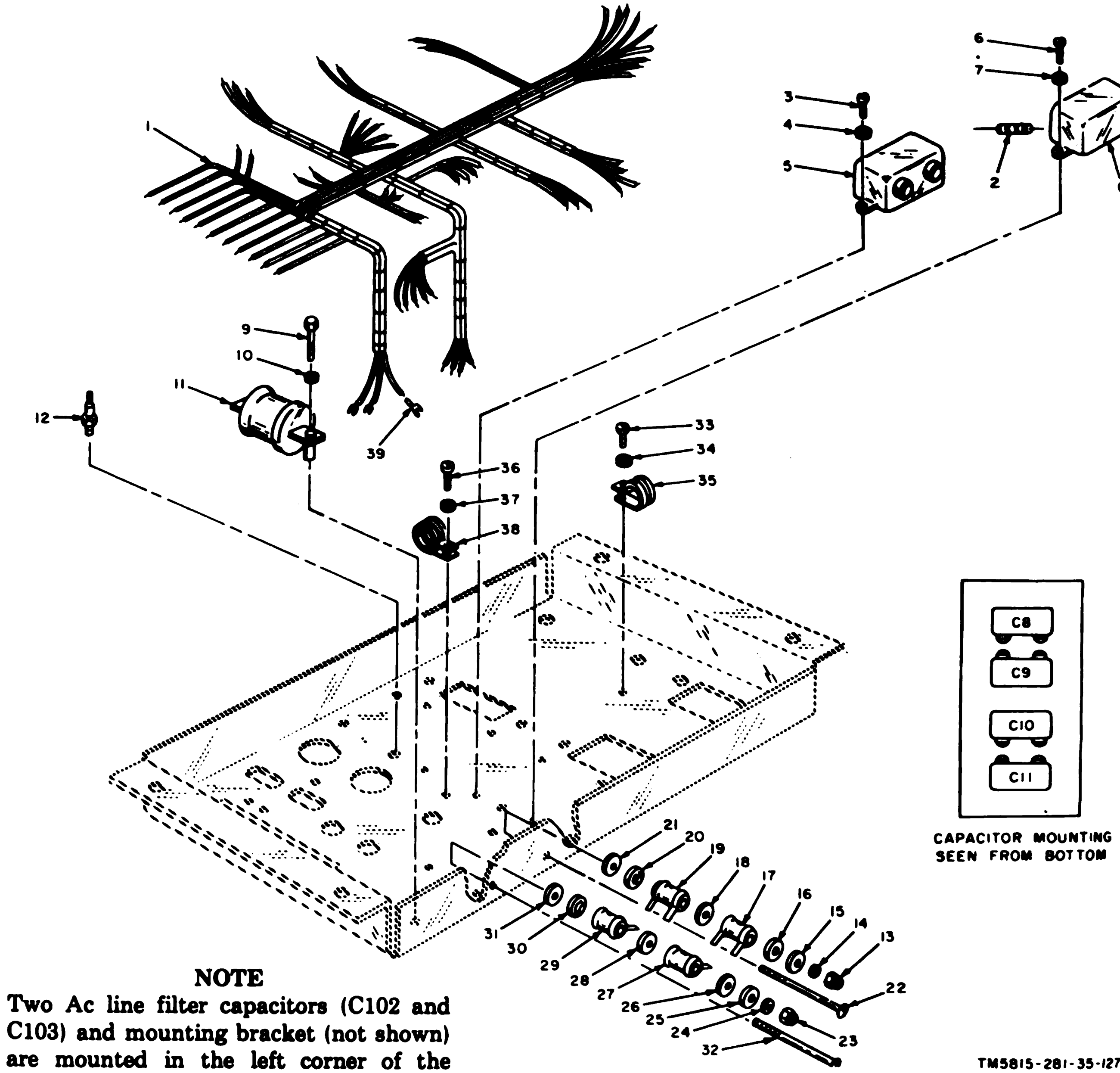


Figure 96. Removal of top components from 48-volt power supply.

1 Machine screw, 10032-01
2 Lockwasher, 10404
3 Grounding lug, 20709
4 Grounding lug, 20379
5 Lockwasher, 10404
6 Ac power cord, 58017A
7 Dc power cord, 58018A
8 Plain hexagonal nut
9 Lockwasher
10 Capacitor (C3), 20828 (includes items 8, 9, and 11)
11 Flat washer
12 Plain hexagonal nut
13 Lockwasher
14 Capacitor (C4) 20828 (includes items 12, 13, and 15)
15 Flat washer
16 Fuse cap, 58010
17 Fuse (F1), 20470
18 Plain hexagonal nut
19 Lockwasher
20 Fuseholder (XF1), 20469 (includes items 16, 18, 19, and 21)
21 Flat washer
22 Fuse cap
23 Fuse (F2), 20470
24 Plain hexagonal nut
25 Lockwasher
26 Fuseholder (XF2), 20469 (includes items 22, 24, 25, and 27)
27 Flat washer
28 Self-locking hexagonal nut, 10503
29 Flat washer, 10450
30 Terminal cover, 58010
31 Self-locking hexagonal nut, 10500
32 Mounting stud, 51660
33 Terminal board (TB25), 20331
34 Terminal marker strip, 20330
35 Plain hexagonal nut, 10593
36 Lockwasher, 10400
37 Choke (L1), 58015
38 Plain hexagonal nut, 10593
39 Lockwasher, 10400
40 Transformer (T1), 58014
41 Machine screw, 10103
42 Flat washer, 10467
43 Lockwasher, 10430
44 Rectifier (CR1), 58016
45 Machine screw, 10301
46 Lockwasher, 10429
47 Rectifier (CR4), 54356
48 Machine screw, 10301
49 Lockwasher, 10429
50 Rectifier (CR3), 54356
51 Grommet, 20726
52 Chassis, 58012A

Figure 96 – Continued.



NOTE

Two Ac line filter capacitors (C102 and C103) and mounting bracket (not shown) are mounted in the left corner of the chassis.

1 Power supply cable, 58019A
2 Resistor, (R20 and R21), 20010
3 Machine screw, 10106
4 Lockwasher, 10429
5 Capacitor (C8), 20213
6 Machine screw, 10106
7 Lockwasher, 10429
8 Capacitor (C9), 20213
9 Machine screw, 10093
10 Lockwasher, 10430
11 Resistor (R4), 20051
12 Terminal mounting post, 20357
13 Self-locking hexagonal nut, 10501
14 Flat washer, 10467
15 Flat washer, 51481
16 Centering washer, 57311
17 Resistor (R3), 20052
18 Flat washer, 51481
19 Resistor (R14), 20052
20 Centering washer, 57311
21 Flat washer, 51481
22 Machine screw, 10164
23 Self-locking hexagonal nut, 10501
24 Flat washer, 10467
25 Flat washer, 51481
26 Centering washer, 57311
27 Resistor (R29), 20039
28 Flat washer, 51481
29 Resistor (R30), 20039
30 Centering washer, 57311
31 Flat washer, 51481
32 Machine screw, 10164
33 Machine screw, 10106
34 Lockwasher, 10429
35 Cable clamp, 20514
36 Machine screw, 10106
37 Lockwasher, 10429
38 Cable clamp, 20888
39 Terminal, 20706

Figure 97. Disassembly of internal components of 48-volt power supply.

98. General

This section contains the requirements, methods of checking, and adjustment procedures for the two transmitters of the distributor set. Check the individual requirements and, if necessary, make the proper adjustments. The adjustments are arranged in sequence for a complete readjustment of a transmitter. When making individual adjustments, check all related adjustments. When parts or subassemblies must be removed to make an adjustment, refer to paragraphs 70 through 85 for removal and replacement instructions.

99. Transmitter Camshaft End Play Adjustment (fig. 98)

a. *Requirement.* There should be no clearance between the friction clutch disk and the ball bearing when the transmitter camshaft is pulled in the direction shown in figure 98.

b. *Method of Checking.* Pull the friction clutch disk away from the ball bearing. Check the clearance visually or by attempting to insert a feeler gage.

c. *Adjustment.*

(1) Loosen the two setscrews in the hub of the friction clutch disk.

Note: In some cases, it may be necessary to loosen the entire friction clutch assembly by loosening the two clamping screws in the friction clutch adjusting collar.

(2) Hold the transmitter camshaft toward the friction clutch and slide the friction clutch disk against the ball bearing. Tighten the setscrews.

(3) Realign the friction clutch assembly if it has been previously loosened. Make the friction clutch adjustment (para 140).

(4) Check the related adjustment (para 101).

100. Drive Gear Set Adjustment (fig. 99)

a. *Requirement.* There should be minimum backlash without binding between the worm and worm gear.

b. *Adjustment.* Loosen the four machine screws on the bearing block (A, fig. 99)

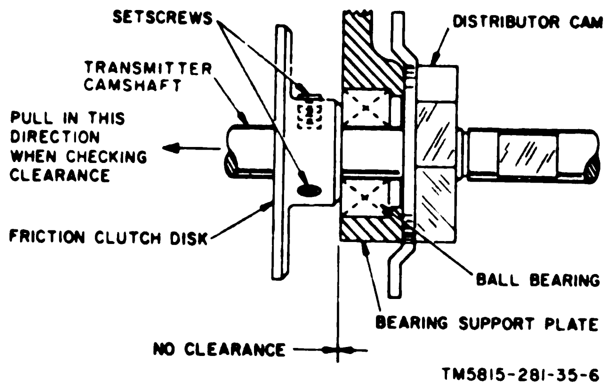


Figure 98. Transmitter camshaft end play require

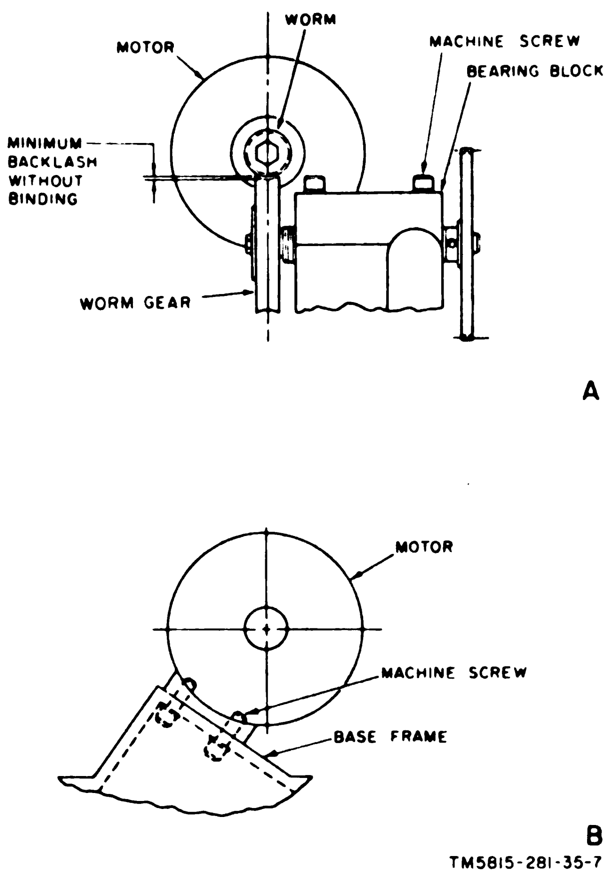


Figure 99. Drive gear set adjustment requirements.

and the four machine screws that hold the motor to the base frame (B, fig. 99). Slide the motor up or down and the worm gear back and forth until the requirement is met. Make sure that the centerlines of the worm and worm gear are in line. Tighten the four machine mounting screws and the four bearing block machine screws. Recheck the requirement.

101. Driving Gear and Drive Gear Alignment (fig. 100)

a. Requirement. The faces of the driving gear should be parallel and at least 1/64-inch inward from the faces of the drive gear.

b. Alignment. Loosen the two setscrews in the hub of the driving gear. Move the driving gear until the requirement is met. Tighten the setscrews and recheck the requirement.

102. Driving Gear and Drive Gear Backlash Adjustment (fig. 101)

a. Requirement. There should be minimum backlash without binding between the driving gear and drive gear.

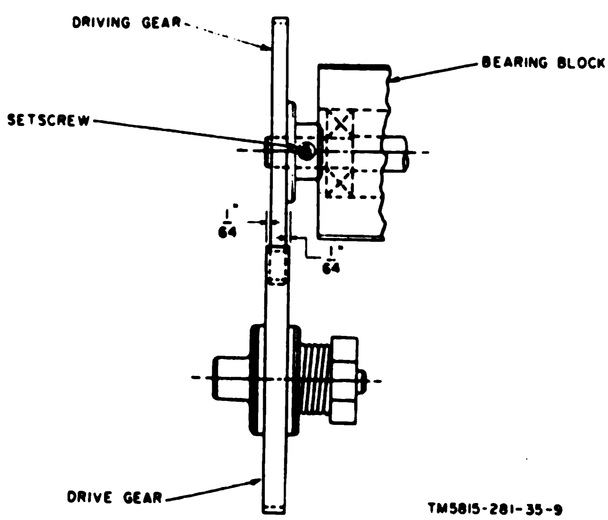


Figure 100. Driving gear and drive gear alignment.

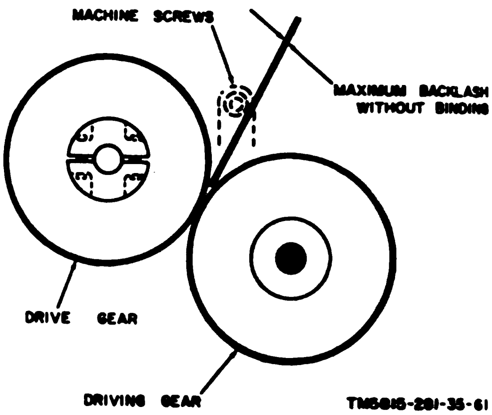


Figure 101. Driving gear and drive gear backlash requirement.

b. Adjustment. Remove the left side cover. Loosen the two socket-head machine screws that hold the transmitter assembly to the base frame. Move the entire transmitter assembly toward the front or rear until the requirement is met. Tighten the two socket-head machine screws and recheck the requirement. Replace the sidecover.

103. Code-Sensing Lever Alignment

a. Requirements.

(1) The code-sensing levers should be free in the sensing lever comb (fig. 102).

(2) The contact wipers should line up with their respective contacts on the contact block.

b. Alignment. Loosen the setscrews on the latch pulsing switch cam, the clamping machine screws in the tape-reader clutch notched drum, and the setscrews in the pulsing switch cam assembly (fig. 103). Loosen the setscrew to release the sensing lever pivot post (fig. 102). Position the code-sensing lever group to meet the requirements. Tighten the setscrew in the sensing lever pivot post and check the releated adjustment (para 104).

Note: The clamping machine screw in the tape-reader clutch notched drum, the setscrews in the latch pulsing switch cam, and the pulsing switch cam assembly are tightened when the related adjustment (para 104) is made.

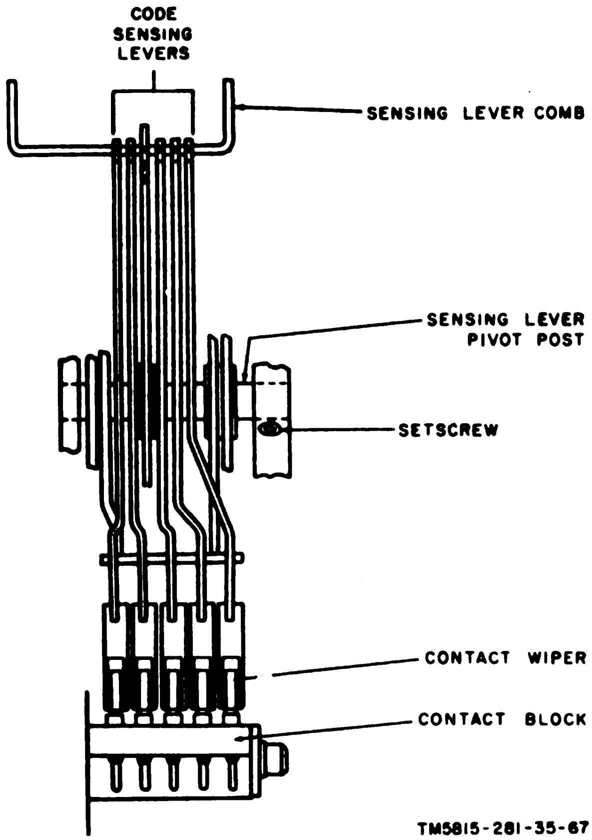


Figure 102. Code-sensing lever alignment.

104. Transmitter Camshaft Cams Adjustment (fig. 103)

Note: Be sure that the code-sensing levers are in alignment (para 103) before making this adjustment.

a. *Requirements.*

(1) The tape-feed retracting lever and the restore lever should be centered against the cam surface of their respective cams.

(2) There should be 0.0002- to 0.010-inch clearance between the hub of the tape-feed cam and the latch pulsing switch cam (B, fig. 103).

b. *Adjustments.*

(1) Disconnect the clutch pawl spring (A, fig. 103) and the tape-feed operating lever spring (fig. 104). Move the entire camshaft cam assembly and the latch pulsing switch cam to meet the requirement given in *a*(1) above. Tighten the clamping machine screw in the tape-reader clutch notched drum.

(2) Insert a feeler gage between the hub of the tape-feed retracting lever cam and the latch pulsing switch cam. Tighten the setscrews on the latch pulsing switch cam. Move the pulsing switch cam assembly against the tape-reader clutch notched drum and tighten the setscrews of the pulsing switch cam assembly against the flats of the transmitter camshaft.

105. Tape-Feed Cam Lever Adjustment

Note: Make the transmitter camshaft cams adjustment (para 104) before making this adjustment.

a. *Requirement.* The tape-feed cam lever should be centered on the tape-feed cam (A, fig. 104).

b. *Adjustment.* Remove the tape-feed cam lever spring. Loosen the machine screw (B, fig. 104). Add, or remove, the shims under the eccentric post to meet the requirement. Tighten the machine screw and replace the tape-feed cam lever spring.

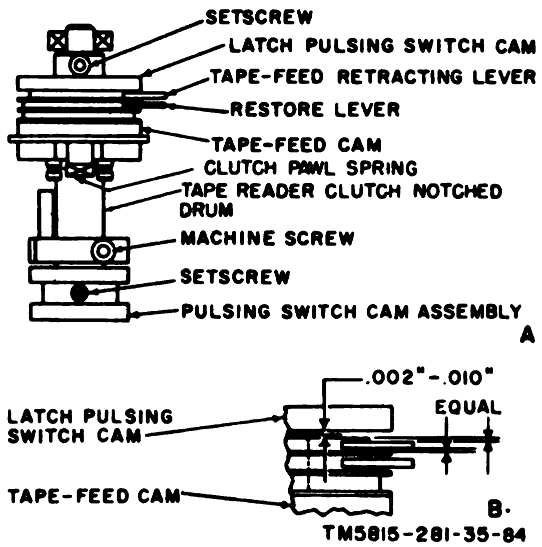


Figure 103. Transmitter camshaft cams adjustment requirement.

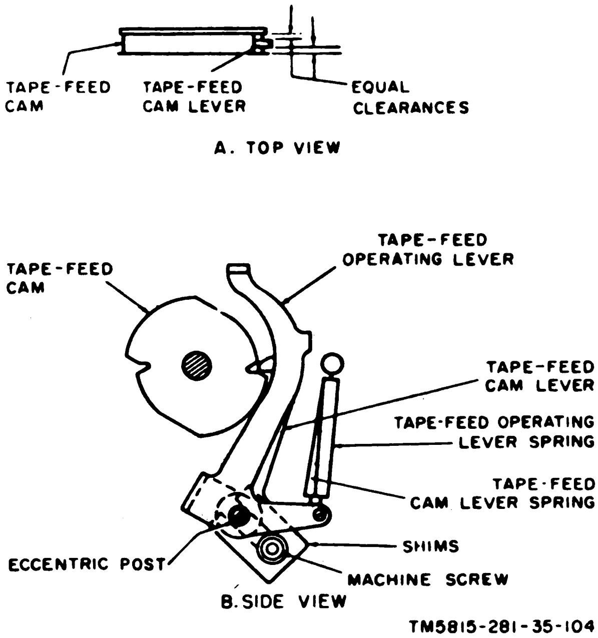


Figure 104. Tape-feed cam lever adjustment requirement.

106. Contact Block and Photo-Reader Assembly Adjustment

a. Requirement. The contact block should be positioned so that each contact wiper on the code sensing lever is in contact with the middle and top rows of contacts on the contact block when the opposite end of each code-sensing lever is manually pressed down into the bottom of the slot in the sensing lever comb assembly and play of the contact wipers is taken up in an upward direction.

b. Method of Checking. Manually depress each code-sensing lever pin until the lever is against the bottom of its slot in the sensing lever comb. Take up the play of the contact wiper in an upward direction. Check each contact wiper to make sure that all meet the requirement.

c. Adjustment. Adjust the bottom of the contact block (12, fig. 78), to a minimum clearance of 0.005 inches between the contact block and the counter lever (30, fig. 74) and the restore lever cam follower (41, fig. 74). Adjust the photo-reader bracket assembly (55, fig. 78), front to rear, so the contact wipers (13, fig. 78), are approximately centered in the opening of the printed circuit board A2A1 (59, fig. 78).

d. Perform the vertical photo reader assembly adjustment as follows: Position the photo-reader bracket assembly (55, fig. 78) so the contact wipers are approximately flush with the top of the assembly when the contact wipers (13, fig. 78) are in the high or mark position. Check the clearance between the code sensing levers (36, 37, 39, 40, 41, and 42, fig. 78) and the springs (53, fig. 78) holding the miniature lamps (54, fig. 78) on the photo-reader bracket assembly (55, fig. 78). There should be a minimum of 0.005 inches clearance. Tighten the machine screws (9, fig. 78).

e. Check the related adjustment (*c* above).

f. Connect all leads to contact block and photo-reader assembly.

g. Use Multimeter TS-352/U or equivalent, (fig. 181) and the following chart to check adjustment of the contact block (12, fig. 78) and photo-reader bracket assembly (55) for normal operation.

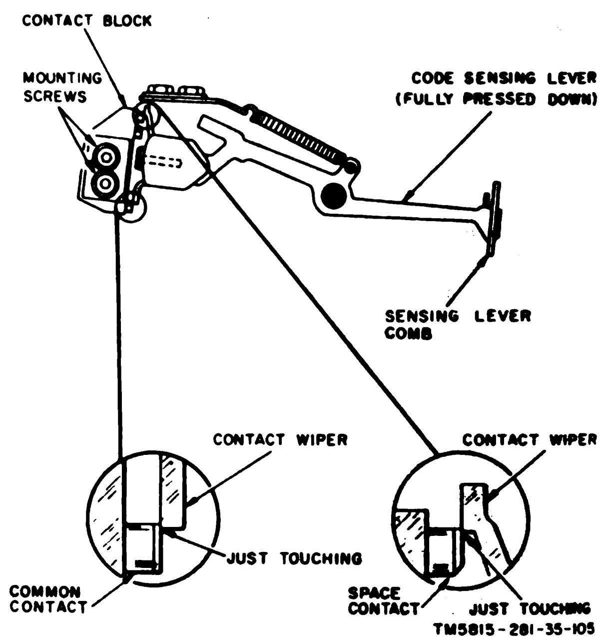


Figure 105. Contact block adjustment requirement.

Bit No.	Terminals of connector J11	Position of Sensing Levers	
		MARK	SPACE
Bit 1	C and d	Continuity	Open
Bit 2	E and e	Continuity	Open
Bit 3	H and f	Continuity	Open
Bit 4	K and h	Continuity	Open
Bit 5	M and j	Continuity	Open

h. If the above readings cannot be obtained, loosen the locknuts on the two restore levers and comb assembly stop screws (fig. 106) and position the code-sensing levers for mark impulses. Adjust the outside stop screw until the proper clearances are made. Adjust the inside stop screw until it just touches the restore lever and comb assembly. Tighten the locknuts and recheck measurements.

i. Dress all wires from photo-reader bracket assembly (55, fig. 78) and contact block (12, fig. 78) so they will not be struck by the lever (40, fig. 74) or counter restore lever (41, fig. 74) when the tape reader is in operation.

107. Restore Lever and Comb Assembly Adjustment

a. Requirement. There should be a 0.020- to 0.030-inch clearance between the top of the lowest contact wiper and the bottom of its associated space contact when the code-sensing levers are positioned for sensing mark impulses (A, fig. 106).

b. Method of Checking. Position the code-sensing levers for mark impulses. Check the requirement with feeler gages and note that the top of the contact wipers do not break the light beam from the miniature lamps (54, fig. 78) to the photo device (50, fig. 78).

c. Adjustment. Loosen the locknuts on the two restore lever and comb assembly stop screws. Position the code-sensing levers for mark impulses. Adjust the outside stop screw until the requirement is met. Adjust the inside stop screw until it just touches the restore lever and comb assembly. Tighten the locknuts and recheck the requirement. The top of the contact wiper will not break the light beam from the miniature lamps (54, fig. 78) to the photo device (50, fig. 78). Due to spring tension, in some cases the restore lever and comb assembly (fig. 106) can be distorted when only the outside stop screw has been adjusted. If this happens, the distortion can be corrected by adjusting the inside stop screw. Recheck the requirement. Variation of the required clearance can be partially corrected with the inside stop screw if this correction does not bind the code-sensing levers in the restore lever and comb assembly.

NOTE

After the requirement has been met, check for 0.015-inch minimum clearance between the heel of the upper end of each contact wiper and the top of its associated mark contact (B, fig. 106), when the code sensing lever is in the space impulse position. If the clearance is less than 0.015-inch, recheck the top cover adjustment (para 146), recheck the tape cover clearance adjustment (para 144), or if necessary, replace the contact wiper on the code-sensing lever.

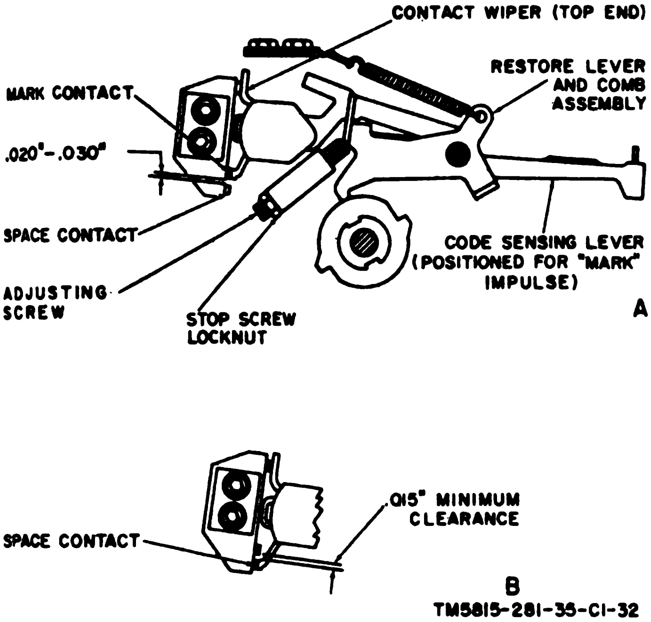


Figure 106. Restore lever and comb assembly adjustment requirement.

levers in the restore lever and comb assembly.

Note: After the requirement has been met, check for 0.015-inch minimum clearance between the *heel* of the upper end of each contact wiper and the top of its associated mark contact (B, fig. 106), when the code-sensing lever is in the space impulse position. If the clearance is less than 0.015-inch, recheck the top cover adjustment (para 146), recheck the tape cover adjustment (para 144), or if necessary, replace the contact wiper on the code-sensing lever.

108. Tape-Feed Retracting Lever Eccentric Post Adjustment (fig. 107)

Note: Set the stop-start lever to START before making this adjustment.

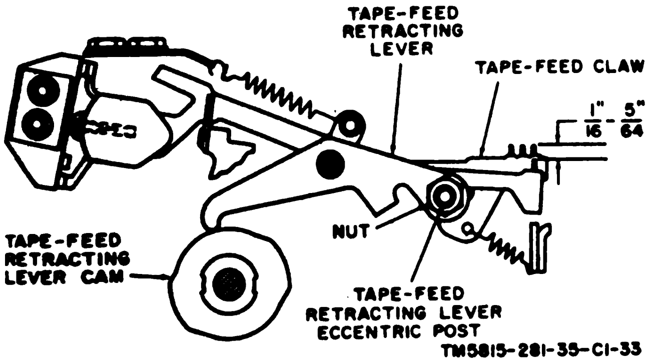


Figure 107. Tape-feed retracting lever eccentric post adjustment requirement.

a. Requirement. There should be 1/16- to 5/64-inch clearance between the top of the tape-feed claw pins and the top of the sensing lever pins when the tape-feed retracting lever cam is in the stop position.

b. Adjustment. Loosen the nut on the tape-feed retracting lever eccentric post. Position the eccentric post to meet the requirement. Tighten the nut and recheck the requirement.

109. Tape-Reader Clutch Magnet Armature Shaft End Play Adjustment (fig. 108)

a. Requirement. When the tape-reader clutch magnet armature is against the frame, there should be 0.001- to 0.010-inch clearance between the distributor clutch magnet armature and the frame.

b. Adjustment. Remove the retainer ring and the distributor clutch magnet armature. Add or remove the laminated washers until the requirement is met. Replace the distributor clutch magnet armature and the retainer ring.

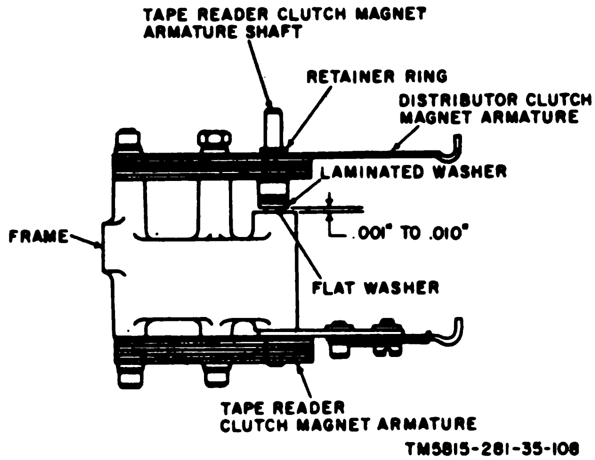


Figure 108. Tape-reader clutch magnet armature shaft end play requirement.

110. Tape-Reader Clutch Notched Drum, Tape-Feed Cam Lever Eccentric Post, and Armature Adjusting Arm Adjustments

Note: Remove the line break and numbering pulsing switches (A, fig. 134) before performing this adjustment.

a. *Requirements.*

(1) The tape-feed cam lever eccentric post (A, fig. 109) should be positioned approximately to its normal direction of maximum eccentricity.

(2) When the stop plate and the kickout plate are blocked by their armatures, the tooth of each clutch pawl (B, fig. 109) should clear the adjacent circumference of the tape-reader clutch notched drum, and the trailing edge of the tooth should be in alignment with the trailing edge of its associated notch in the drum.

(3) When the kickout plate is held away from the armature adjusting arm and the stop plate on the camshaft is blocked by the distributor clutch magnet armature, there should be 0.005- to 0.025-inch clearance between the kickout plate and the armature adjusting arm. When the kickout plate is released and allowed to rotate against the armature adjusting arm, the tooth on the clutch pawl must clear the notch of the tape-reader clutch notched drum.

b. *Method of Checking.* Set the transmitter to the stopped position and move the tape-reader clutch magnet armature to the operated (magnet energized) position. The teeth of the clutch pawl should move halfway into engagement with the notches of the tape-reader clutch notched drum. Move the distributor clutch magnet armature to the operated position. The teeth on the clutch pawl should fully engage the notches of the tape-reader clutch notched drum.

c. *Adjustments.*

(1) Loosen the setscrew to release the tape-feed cam lever eccentric post. Position the eccentric posts to the proper direction of maximum eccentricity. Tighten the setscrew.

(2) Turn the transmitter camshaft until the machine screw in the tape-reader clutch notched drum is accessible (fig. 103). Loosen the machine screw with an Allen wrench; keep the wrench inserted in the head of the screw. Turn the camshaft until the kickout plate and the stop plate are stopped by their respective armatures. Hold the camshaft and position the tape-reader clutch notched drum until the requirement given in *a*(2) above is met. Tighten the machine screw with the wrench.

Note: Only in extreme cases will it be necessary to readjust the tape-feed cam lever eccentric post to obtain a precise adjustment of the tape-reader clutch notched drum.

(3) Turn the transmitter camshaft until the stop plate is stopped by the distributor clutch magnet armature (B, fig. 109). Manually move the kickout plate away from the tape-reader clutch magnet armature adjusting arm to check the requirement given in *a*(3) above. Loosen the machine screws on the armature adjusting arm until the rerequirement given in *a*(3) above is met. Tighten the machine screws. Recheck the requirement. Replace

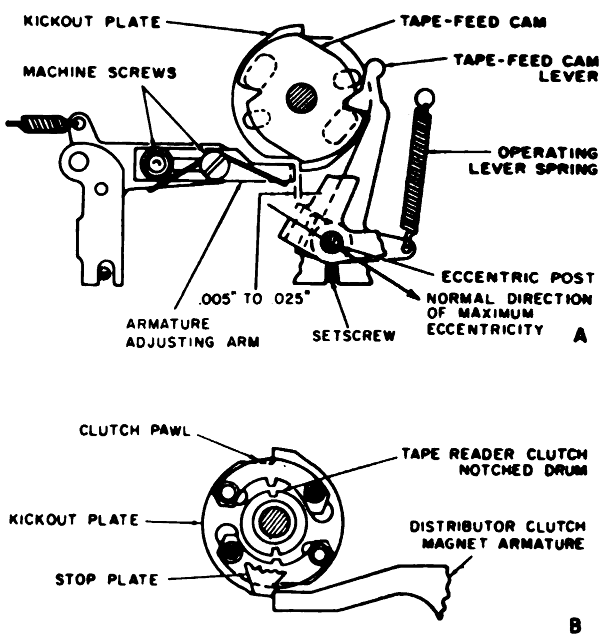


Figure 109. Tape-reader clutch notched drum tape-feed cam lever eccentric post and tape-reader clutch magnet armature adjusting arm adjustment requirements.

and readjust the line break and numbering pulsing switches (para 134, 135, and 139).

111. Distributor Clutch Magnet Armature Eccentric Stud Adjustment (fig. 110)

a. *Requirement*. When the distributor clutch magnet is energized, the distributor clutch magnet armature should clear the leading edge of the stop plate by 0.005 to 0.015 inch.

b. *Adjustment*. Loosen the setscrew that holds the eccentric stud. Position the eccentric stud to meet the requirement. Tighten the setscrew. Recheck the requirement on both sides of the stop plate. Check all related adjustments (para 115, 116, and 117).

112. Tape-Reader Clutch Magnet Armature Eccentric Stud Adjustment (fig. 111)

a. *Requirement*. When the tape-reader clutch magnet is energized, there should be 0.005- to 0.020-inch clearance between the tape-reader clutch magnet armature adjusting arm and the kickout plate.

b. *Adjustment*. Loosen the setscrew that holds the eccentric stud. Position the eccentric stud until the requirement is met. Tighten the setscrew. Recheck the requirement on both sides of the kickout plate. Check all related adjustments (para 114, 115, and 116).

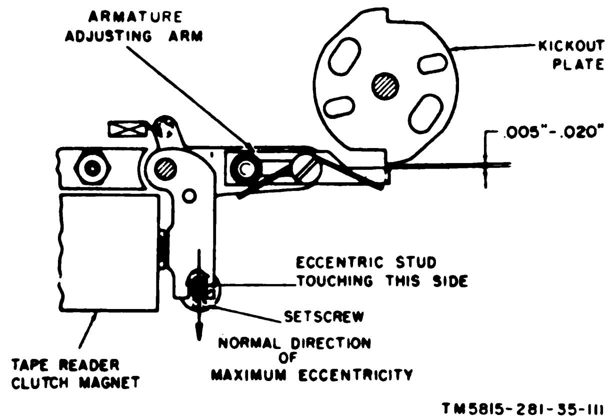


Figure 111. Tape-reader clutch magnet armature eccentric stud adjustment.

113. Distributor Clutch Magnet Adjustment (fig. 112)

a. *Requirement*. When the distributor clutch magnet is energized and the armature is against the eccentric stud, the clearance between both pole faces of the magnet and the armature should be 0.003 to 0.005 inch.

b. *Method of Checking*. Use either a piece of message tape or nonmagnetic shim stock to check the requirements.

c. *Adjustment*. Loosen the two machine screws that hold the distributor clutch magnet. Position the distributor clutch magnet to meet the requirement at both pole faces. Tighten the machine screws. Recheck the requirement.

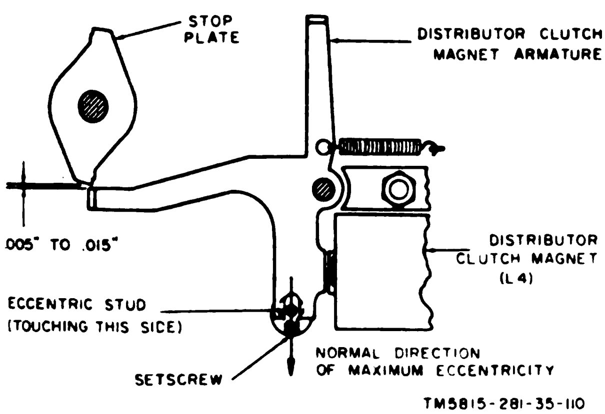


Figure 110. Distributor clutch magnet armature eccentric stud adjustment requirement.

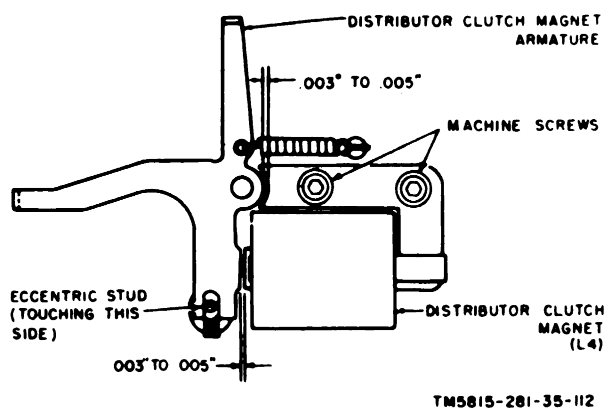


Figure 112. Distributor clutch magnet adjustment requirements.

114. Tape-Reader Clutch Magnet Adjustment
(fig. 113)

a. *Requirement*. When the tape-reader clutch magnet is energized, the clearance betweeen both pole faces of the tape-reader clutch magnet and the tape-reader clutch magnet armature should be 0.003 to 0.005 inch.

b. *Method of Checking*. Use either a piece of message tape or nonmagnetic shim stock to check the requirements.

c. *Adjustment*. Loosen the two machine screws that hold the tape-reader clutch magnet to the frame. Position the tape-reader clutch magnet to meet the requirement at both pole faces. Tighten the machine screws. Recheck the requirement.

115. Distributor Clutch Magnet Armature Latch Eccentric Stud Adjustment
(fig. 114)

a. *Requirement*. When both the distributor clutch magnet armature and the tape-reader clutch magnet armature are pulled against their eccentric studs, the distributor armature latch should clear the distributor clutch magnet armature by 0.004 to 0.008 inch.

b. *Adjustment*. Energize both magnet assemblies. Loosen the setscrew that holds the distributor armature latch eccentric stud. Turn the stud to position the distributor armature latch to meet the requirement. Tighten the setscrew. Recheck the requirement.

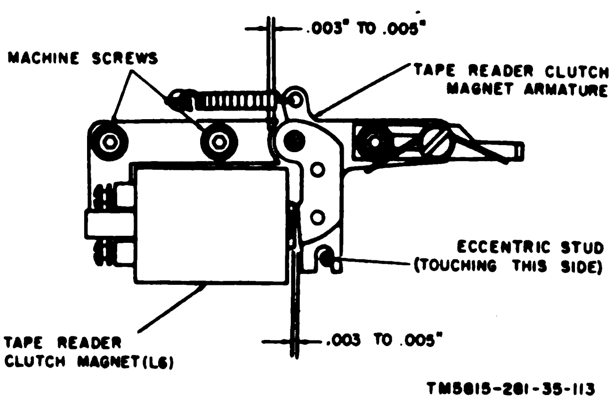


Figure 113. Tape-reader clutch magnet adjustment requirements.

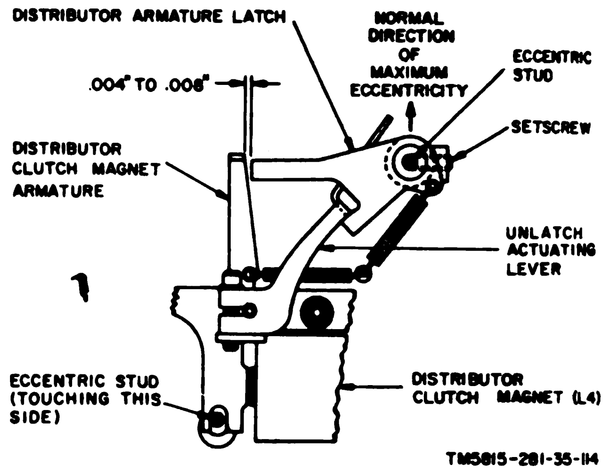


Figure 114. Distributor clutch magnet armature latch eccentric stud adjustment requirement.

116. Unlatch Actuating Lever Adjustment

a. *Requirements*.

(1) There should be a clearance of 0.010 to 0.025 inch between the distributor clutch magnet armature and the distributor armature latch (B, fig. 115) when both the tape-reader and distributor clutch magnets are deenergized.

(2) There should be a clearance of 3/16 to 1/4 inch between the distributor clutch magnet and the nut plate that holds the unlatch actuating lever (A, fig. 115).

b. *Adjustment*. Loosen the machine screw on the unlatch actuating lever. Position the lever to meet both requirements. Tighten the machine screw. Recheck both requirements.

117. Distributor Magnet Pulsing Switch Adjustment
(fig. 116)

a. *Requirements*.

(1) Distributor magnet pulsing switch S44 should be actuated when the latch actuating lever has moved to its midtravel position.

(2) When the tape-reader armature assembly is in the energized position, the unlatch actuating lever should not bottom the switch button of distributor magnet pulsing switch S44.

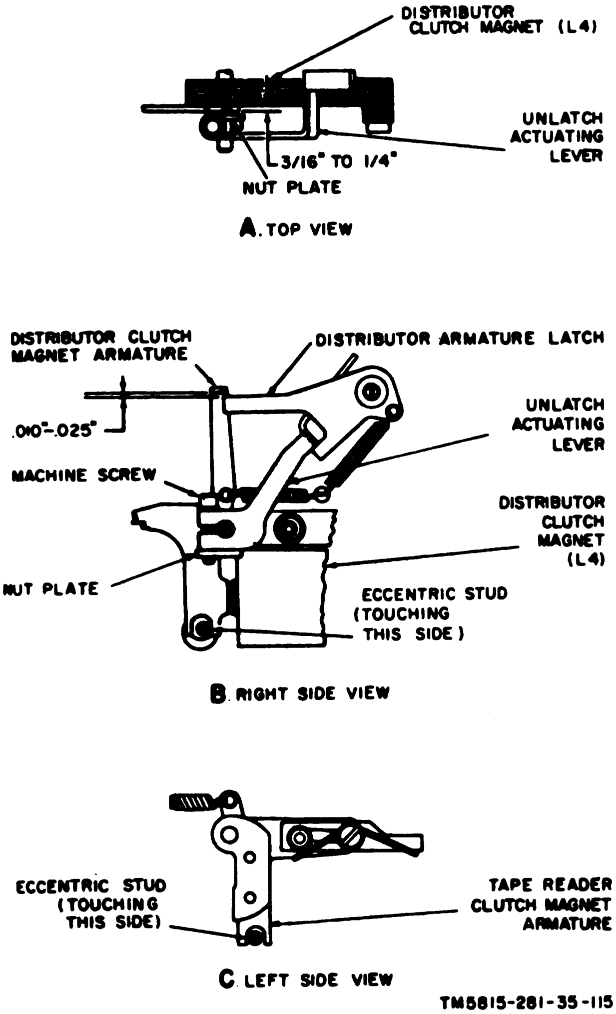


Figure 115. Unlatch actuating lever adjustment requirements.

b. *Adjustment.* Loosen the machine screws that hold the distributor magnet pulsing switch. Position the switch until both requirements are met, and tighten the two machine screws. Recheck the requirements.

118. Retracting Arm Adjustment

a. Requirement. There should be 0.015- to 0.035-inch clearance between the stop-start lever and the retracting arm (A, fig. 117).

b. Adjustment. Move the stop-start lever against the stop-start lever detent (B, fig. 117). Loosen the setscrews in the hubs of both the tape-out switch cam and

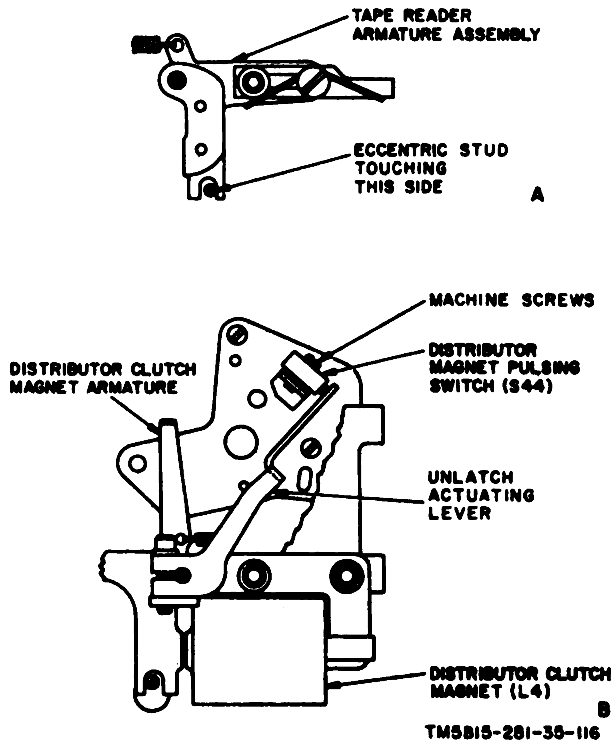


Figure 116. Distributor magnet pulsing switch adjustment.

the stop-start switch cam (A, fig. 117). Hold the stop-start lever against the stop-start lever detent. Move the retracting arm to meet the requirement. Align the stop-start switch cam vertically from the bottom of the unit; position the cam against the frame and tighten both setscrews. Recheck the requirement. Make the related adjustment (para 119).

119. Stop-Start Switch Adjustment (fig. 118)

Note: Adjust the retracting arm (para 118) before making this adjustment.

a. Requirements. The stop-start switch (S42) should be actuated just before the detent lever engages the start (upper) notch on the stop-start lever.

b. Method of Checking. Set the stop-start lever to the STOP position and connect a multimeter (arranged to indicate resistance) across the lower (common) and upper right (normally closed) terminals of the stop-start switch. Move the

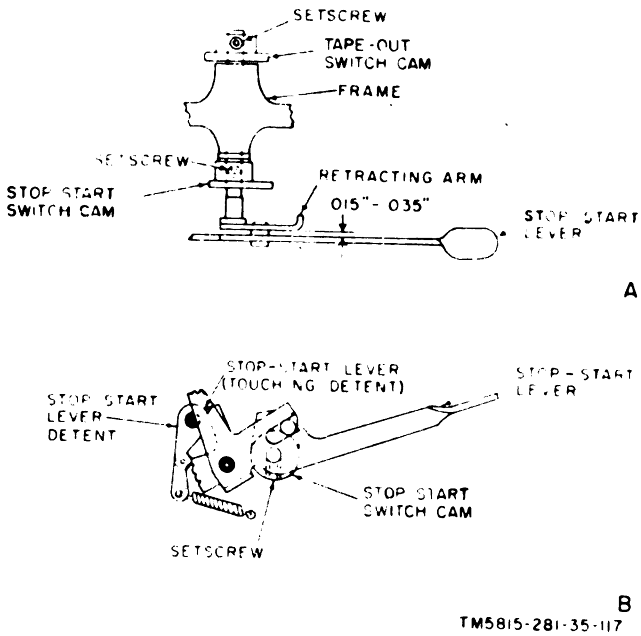


Figure 117. Retracting arm adjustment requirements

stop-start lever slowly from the STOP position to START position. Note the position of the stop-start lever when the switch is actuated as indicated by the change in the multimeter indication from zero resistance to infinity.

c. Adjustment. Loosen the two machine screws that hold the switch mounting plate to the frame. Position the stop-start switch to meet the requirement. Tighten the two machine screws. Recheck the requirement.

120. Tape-Out Switch Cam Adjustment

a. Requirements.

(1) With the stop-start lever in the FEED RETRACT position, there should be 0.020- to 0.035-inch

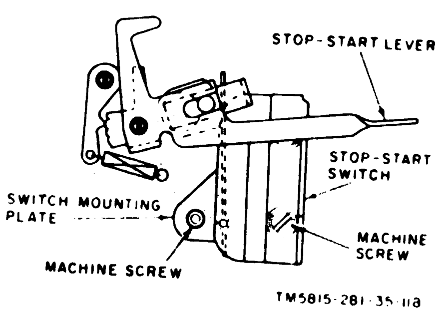


Figure 118. Stop-start switch adjustment

clearance between the sensing lever latch and the latch lever cam (B, fig. 119).

(2) There should be a maximum of 0.005-inch end play between the tape-out switch cam and the frame (A, fig. 119).

b. Adjustment. Move the stop-start lever to the FEED RETRACT position. Loosen the setscrew in the hub of the tape-out switch cam. Position the cam until the requirement is met. Tighten the setscrew. Recheck the requirement.

121. Tape-Out Switch Adjustment (fig. 120)

a. Requirement. Tape-out switch S30 should be actuated when the stop-start lever is midway between the STOP and FEED RETRACT positions.

b. Method of Checking. With the stop-start lever in the FEED-RETRACT position, connect a multimeter (arranged to indicate resistance) across the lower (common) and upper right (normally closed) terminals of the tape-out switch. Move the stop-start lever slowly from the FEED RETRACT position to the STOP position. Note the position of the stop-start lever when the tape-out switch is actuated, as indicated by a change in the multimeter indication from zero resistance to infinity.

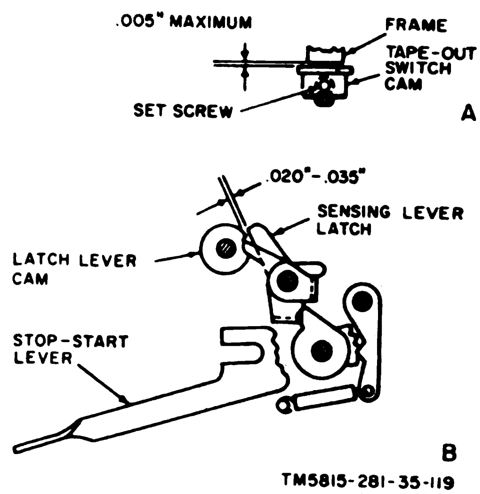


Figure 119. Tape-out switch cam adjustment requirements.

c. Adjustment. Loosen the two machine screws that hold the tape-out switch to the frame. Move the upper end of the tape-out switch to meet the requirement. Recheck the setting of the switch. Tighten the two machine screws. Recheck the requirement.

122. Tight-Tape Switch Actuating Lever Adjustment

a. Requirements.

(1) When the stop-start lever is in the START position, there should be a clearance of 0.015 to 0.050 inch between the stop-start switch cam and the tight-tape switch actuating lever (B, fig. 121).

(2) There should be a 0.001- to 0.005-inch clearance between the tight-tape lever and the sensing lever latch (B, fig. 121).

(3) The stop-start switch (C, fig. 121) should operate when a 0.015-inch feeler gage is inserted between the tight-tape lever and the frame, but should not operate when a 0.008-inch feeler gage is inserted between the tight-tape lever and the frame (A, fig. 121).

b. Adjustments.

(1) Set the stop-start lever to the START position, and loosen the setscrew in the collar on the tight-tape lever shaft. Press the collar against the frame, position the shaft to meet the requirement given in *a*(1) above, and tighten the setscrew. Recheck the requirement.

(2) Loosen the setscrew in the hub of the tight-tape lever. Establish an end play to meet the requirement given in *a*(2) above. Tighten the setscrew friction tight. Make the following adjustment; then tighten the setscrew firmly against the shaft.

(3) Position the tight-tape lever to meet the requirement given in *a*(3) above. Tighten the setscrew in the tight-tape lever. Recheck the requirements.

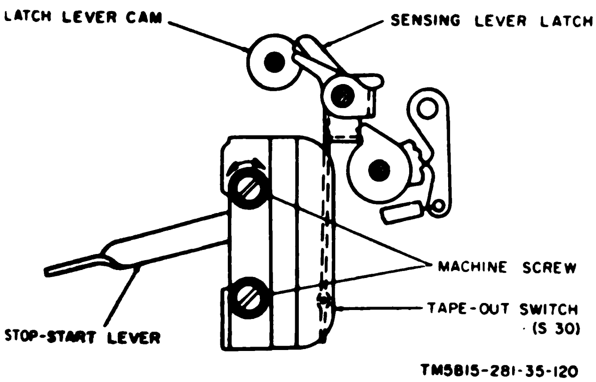


Figure 120. Tape-out switch adjustment.

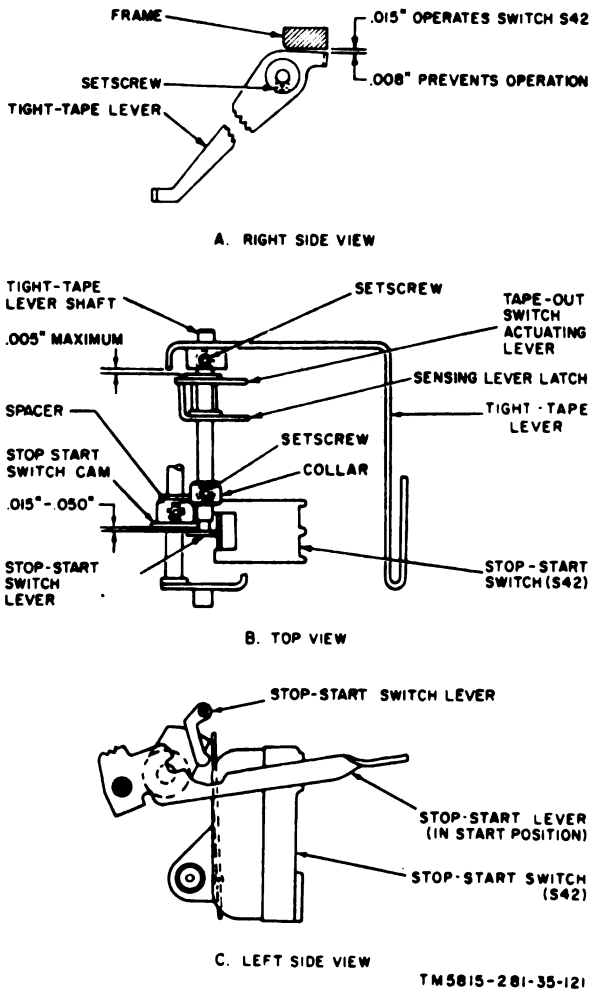


Figure 121. Tight-tape switch actuating lever adjustment requirements.

123. Tape-Out Sensing Finger Clearance and Height Adjustment (fig. 122)

Note : For easier and more accurate adjustments, install the transmitter top cover to provide a flat surface for checking the requirements and making the adjustments.

a. *Requirements.*

(1) There should be a maximum clearance of 0.005 inch at the closest point between the tape-out sensing finger and the driving dog, when the sensing finger is at maximum height.

(2) The top of the tape-out sensing finger should be level (visual check) with the top of the highest code-sensing lever pin when the finger and pins are fully retracted.

b. *Adjustments.*

(1) Move the stop-start lever to the START position. Loosen the setscrew in the driving dog. The tape-out sensing finger should be at the upper limit of its travel. Position the driving dog assembly to meet the requirement given in *a*(1) above; have the arm of the driving dog just touching the tape-out lever. Tighten the setscrew.

(2) Move the stop-start lever to the STOP position. Manually move the distributor clutch magnet armature to the energized position. Turn the transmitter camshaft by hand until the code-sensing lever pins are fully retracted and the tape-reader clutch is in the stop position. Loosen the machine screw to release the lever arm. Move the lever arm to meet the requirement given in *a*(2) above. Tighten the machine screw. Recheck the requirement.

124. Latch and Switch Lever Cams Adjustment

a. *Requirement.* When the stop-start lever is in the START position, the sensing lever latch should lock the tape-out lever shaft in position (A, fig. 123) against downward pressure on the tape-out sensing finger (fig. 122) while the tape-out switch actuating lever closed tape-out switch S30 (B, fig. 123).

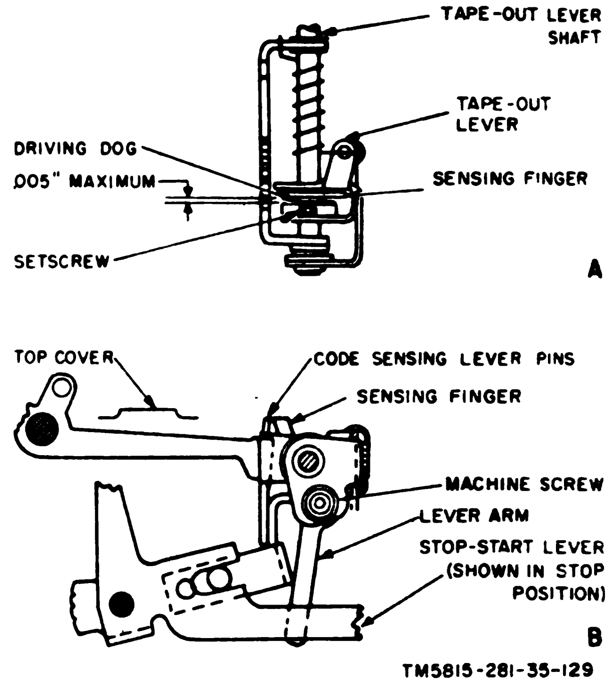


Figure 122. Tape-out sensing finger clearance and height adjustment requirements.

b. *Adjustment.*

(1) Move the stop-start lever to the START position. Loosen the setscrews in the latch lever cam and switch lever cam. Turn the latch lever cam until it locks against the point of the sensing lever latch and tighten the setscrew in the cam. Check the latching action by pressing down on the tape-out sensing finger. The tape-out lever shaft should not move. Turn the switch lever cam until the tape-out switch just closes. Turn the cam a few degrees further to insure switch overtravel and tighten the setscrew in the switch lever cam. Move the stop-start lever to FEED RETRACT.

(2) Recheck this adjustment by holding the tape-out sensing finger down. Move the stop-start lever to the START position. Slowly release the tape-out sensing finger. The tape-out switch should actuate just before the shaft is locked in position by the sensing lever latch.

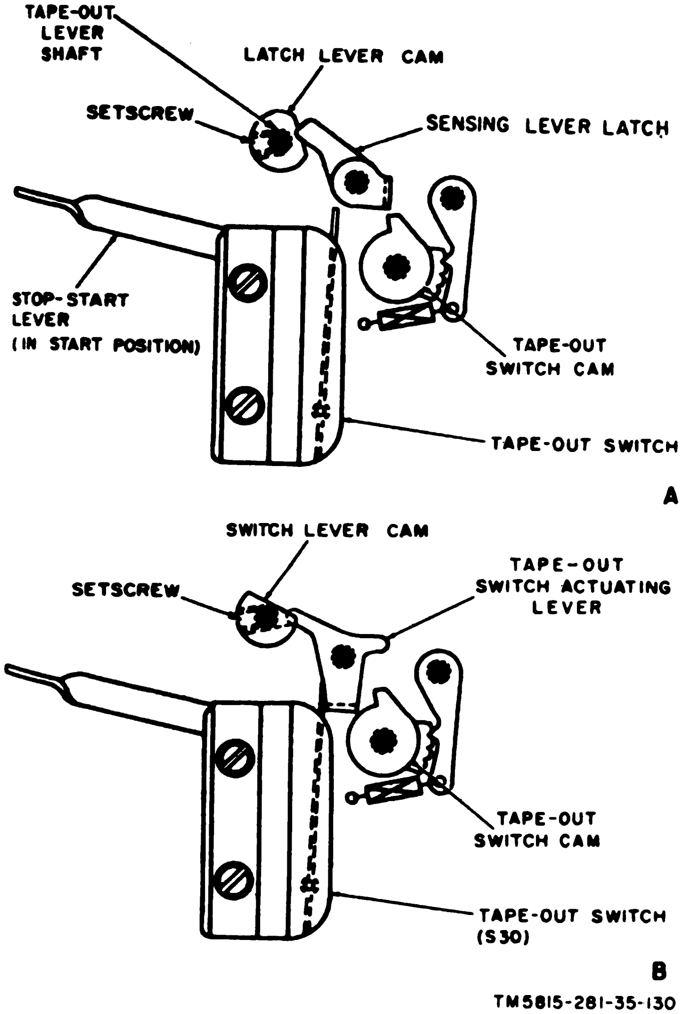


Figure 123. Latch and switch lever cams adjustment.

125. Counter Indexing Ratchet Adjustment (fig. 124)

a. *Requirement.* The number of blank characters sent from the transmitter after a message or after the end-of-tape is sensed should be set as desired. This predetermined value can vary from 10 to 80 characters (in steps of two), depending on the number desired.

b. *Method of Checking.* The indexing ratchet detent should engage the counter indexing ratchet at the count desired. The counter indexing ratchet has nine white enameled teeth with four teeth between each painted tooth. Each tooth represents two blank characters.

c. *Adjustment.* Rotate the oounter indexing ratchet counterclockwise to decrease the count. Move the indexing ratchet detent away from the counter indexing ratchet and rotate the counter indexing ratchet clockwise to increase count. Check the related adjustment (para 126).

126. Counter Hub Adjustment

a. *Requirements.*

(1) There should be 0.005- to 0.010-inch end play between the counter contact cam ratchet and the counter hub (A, fig. 125).

(2) When the counter indexing ratchet is set at the maximum 80-character count, the pins on the counter indexing ratchet and the counter contact cam ratchet are touching each other, and both pawls are held away from the counter contact cam ratchet; it should require a 1- to 2-ounce pull (B, fig. 125) to start the counter contact cam ratchet moving.

b. *Adjustment.* Loosen the setscrews in the counter hub. Turn the hub to obtain the required tension. Place a feeler gage between the counter hub and the counter contact cam ratchet to obtain the 0.005- to 0.010-inch end play. Tighten the setscrews. Recheck the requirements.

Note: After setting the spring tension, turn the counter contact cam -atchet a full turn to make sure that there is enough total movement in the ratchet to close the contacts.

127. Restore Lever Cam Follower Adjustment (fig. 126)

a. *Requirement.* When the tip of the

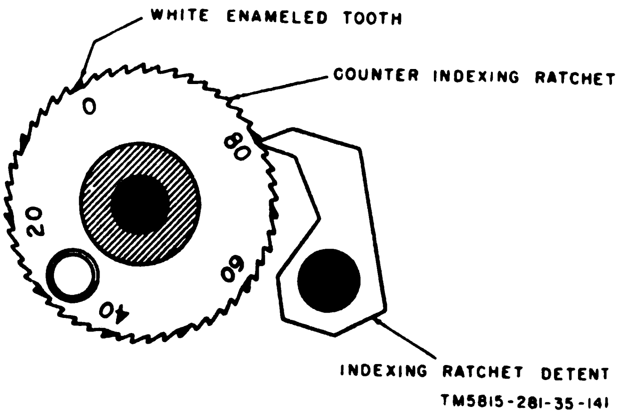


Figure 124. Counter indexing ratchet adjustment.

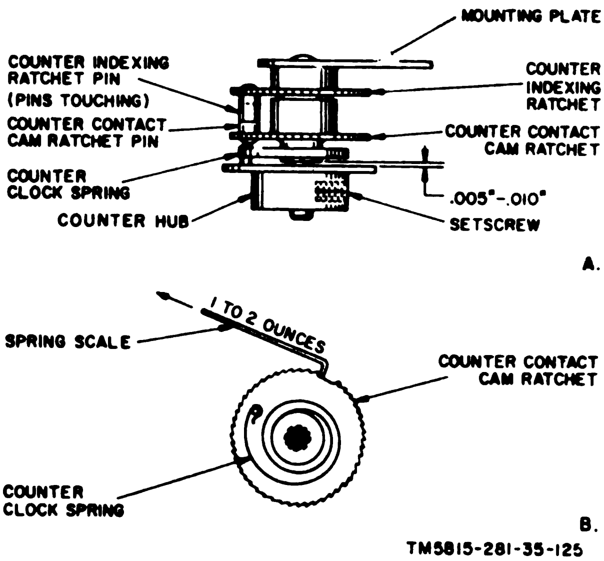


Figure 125. Counter hub adjustment requirements.

counter restore lever is against the counter hub, the restore lever cam follower should be against a low portion of the counter restore cam.

b. Adjustment. Loosen the machine screw that holds the restore lever cam follower to the oounter restore lever. Hold the counter restore lever against the counter hub and the restore lever cam follower against a low portion of the counter restore cam. Tighten the machine screw.

128. Cam Ratchet Detent Adjustment (fig. 127)

a. Requirement. When the counter indexing ratchet is set at the 80-character count, the counter indexing ratchet pin touches the counter contact cam ratchet pin; and the tip of the counter restore lever is resting against the counter hub, the cam ratchet detent should engage the first tooth clockwise following the blank space of the counter oontact cam ratchet.

b. Adjustment. Loosen the hexagonal nut on the eccentric stud. Turn the eccentric stud to the normal direction of maximum eccentricity as shown in figure 127. Position the eccentric stud to meet the requirement and tighten the hexagonal nut.

Note: The cam ratchet detent does not have to engage the tooth fully. The feeding of one tooth and any portion of another on the first step is permissible.

129. Counter Pawl Final Adjustment (fig. 128)

a. Requirement. One-half revolution of the tape-reader clutch notched drum should cause the counter pawl to feed the counter contact cam ratchet at least one tooth. When the unit is in the stop position and a tooth of the counter contact cam ratchet is engaged by a tooth of the cam ratchet detent, there should be a 0.005- to 0.015-inch clearance (visual check) between the counter pawl and the ratchet tooth.

b. Method of Checking. Move only the distributor clutch magnet armature to the operated position and turn the transmitter camshaft until the counter lever is on the

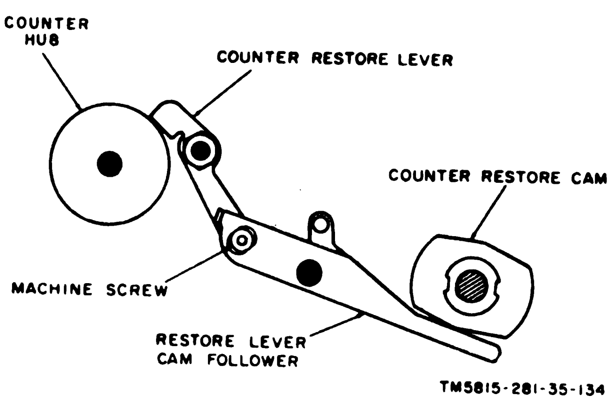


Figure 126. Restore lever cam follower adjustment

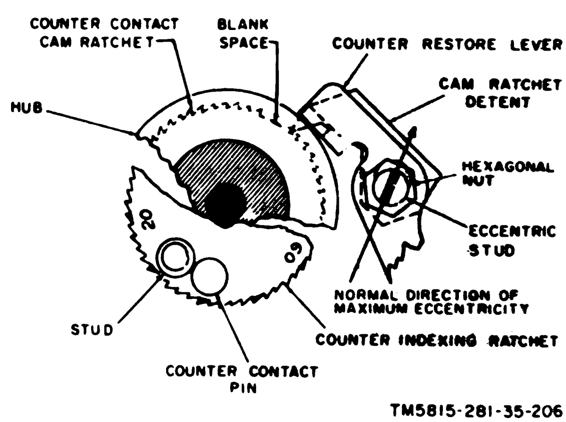


Figure 127. Cam ratchet detent adjustment.

high part of the pin in the tape-reader clutch notched drum. Check to see if the counter contact cam ratchet has been fed at least one tooth beyond the cam ratchet detent.

c. *Adjustment.*

(1) Loosen the setscrew to release the kickout post and position the post so that the counter pawl does *not* contact the kickout post at any point during the pawl's travel.

(2) Position the counter lever eccentric to set the maximum eccentricity in the direction shown in figure 128. Operate the restore lever cam follower to insure complete restoring of the counter contact cam ratchet. Set the transmitter camshaft to the stop position and the cam ratchet detent in engagement with a tooth of the counter contact cam ratchet, turn the counter lever eccentric until the counter pawl starts moving the counter contact cam ratchet. Turn the counter lever eccentric in the opposite direction until there is a 0.005- to 0.015-inch clearance between the counter pawl and a tooth of the counter contact cam ratchet. Tighten the hexagonal nut on the counter lever eccentric and recheck the requirement. Recheck the related adjustment (para 128).

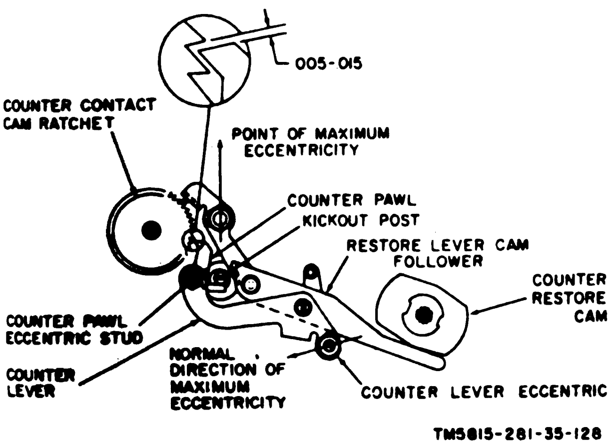


Figure 128. Counter pawl final adjustment requirement.

130. Counter Pawl Kickout Post Adjustment (fig. 129)

a. *Requirement.* When the counter pawl has fed the counter contact cam ratchet one tooth, there should be 0.005-inch minimum to one-half tooth overtravel of the cam past the cam ratchet detent.

b. *Method of Checking.* Operate the counter restore lever to return the counter contact cam ratchet to zero. Operate only the distributor clutch magnet armature (fig. 112), turn the transmitter camshaft by hand, and check the requirement visually.

c. *Adjustment.* Manually operate only the distributor clutch magnet armature and turn the transmitter camshaft by hand until the counter pawl has rotated the counter contact cam ratchet one tooth. Loosen the setscrew to release the kickout post. Turn the kickout post until it just touches the counter pawl. Tighten the setscrew. Recheck the requirement.

Note: When the tape-reader section of the transmitter camshaft is turned, the above adjustment procedure should provide a 0.010-inch minimum clearance between the counter pawl and the counter contact cam ratchet when the restore lever cam follower is on a high part of the counter restore cam.

131. Blank Tape Switch Adjustment

a. *Requirements.*

(1) When the contacts of blank tape switch S28 are closed, a pull of 15 to 25 grams, applied as shown in A, figure 130, should be required to open the switch contacts.

(2) When the counter pawl has fed the last tooth of the counter contact cam ratchet, there should be an 0.008- to 0.015-inch clearance between the switch contacts (C, fig. 130).

b. *Method of Checking.*

(1) Set the counter contact cam ratchet to the restored position, remove the contact cover, and check the requirement given in *a*(1) above with a spring scale.

(2) Operate the distributor section of the transmitter camshaft until the counter pawl has engaged and

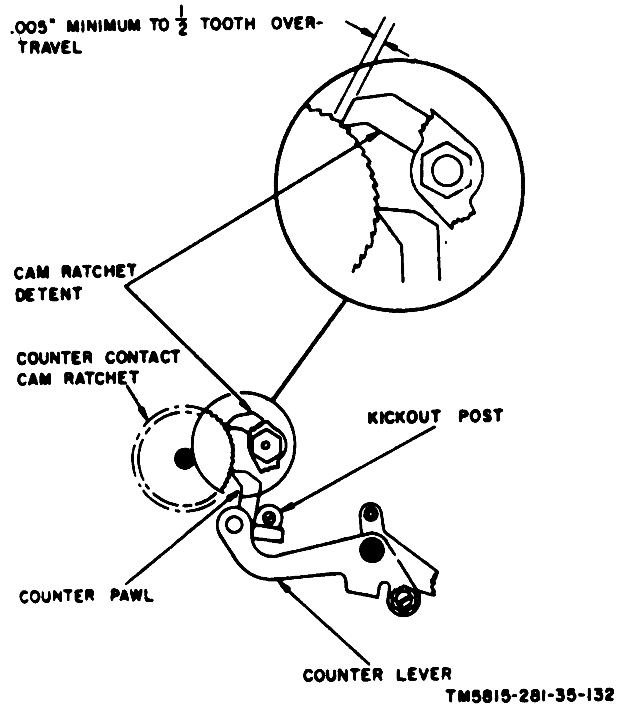


Figure 129. Counter pawl kickout post adjustment requirement.

rotated the last tooth of the counter contact cam ratchet. Check for the requirement given in *a*(2) above with the feeler gages.

c. Adjustments.

(1) To change the amount of spring tension for the requirement given in *a*(1) above, it is necessary to curl the movable contact of the blank tape switch. To curl the contact, insert a pair of long-nosed pliers (smooth jaws if possible) at the base of the movable contact. Do not clamp the contact tightly, but leave the pliers loose. Twist the pliers slightly and draw the pliers toward the tip of the contact. The direction of plier twisting is determined by the tension required. Twist toward the stationary contact to increase the tension; twist away, to decrease the tension. Repeat as necessary to obtain the required tension. Curling of the switch contact by this method provides a gradual bend which allows the tension to be distributed over the entire contact leaf rather than at a single point.

(2) To obtain the requirement given in *a*(2) above, turn only the distributor section of the transmitter camshaft until the counter pawl has engaged and rotated the last tooth of the counter contact cam ratchet. Loosen the switch mounting screws and position the switch to meet the requirement. Tighten the mounting screws. Recheck the requirement.

Note: After the 0.008- to 0.015-inch clearance is obtained, further operation of the distributor section of the camshaft should not rotate the counter contact cam ratchet since the counter pawl should be in the blank section of the ratchet and the cam ratchet detent should prevent the ratchet from returning to zero.

132. Distributor Contact Preliminary Adjustments

Note: This adjustment should be made only when reassembling the contact block after repair. It applies to all contacts of the distributor (A, fig. 131).

a. Requirements.

(1) When the bottom contact leaf is against the unoperated plunger and the adjusting screw is *not* in contact with the top contact leaf, there should be a 0.002- to 0.012-inch clearance between the contacts.

(2) When the bottom contact leaf is against the unoperated plunger, a force of 1 to 3 ounces should be required to move the bottom contact leaf away from the plunger (B, fig. 131).

(3) There should be a 0.020- to 0.030-inch clearance between the contacts when its associated plunger is in the unoperated (innermost) position, and the distributor block and the bottom contact leaf is against the plunger (B, fig. 131).

b. Adjustments.

(1) When the bottom contact leaf is against the unoperated plunger, position the adjusting screw so that it does not touch the top contact leaf. Loosen the hexagonal nuts on top of the contact assembly. Add or

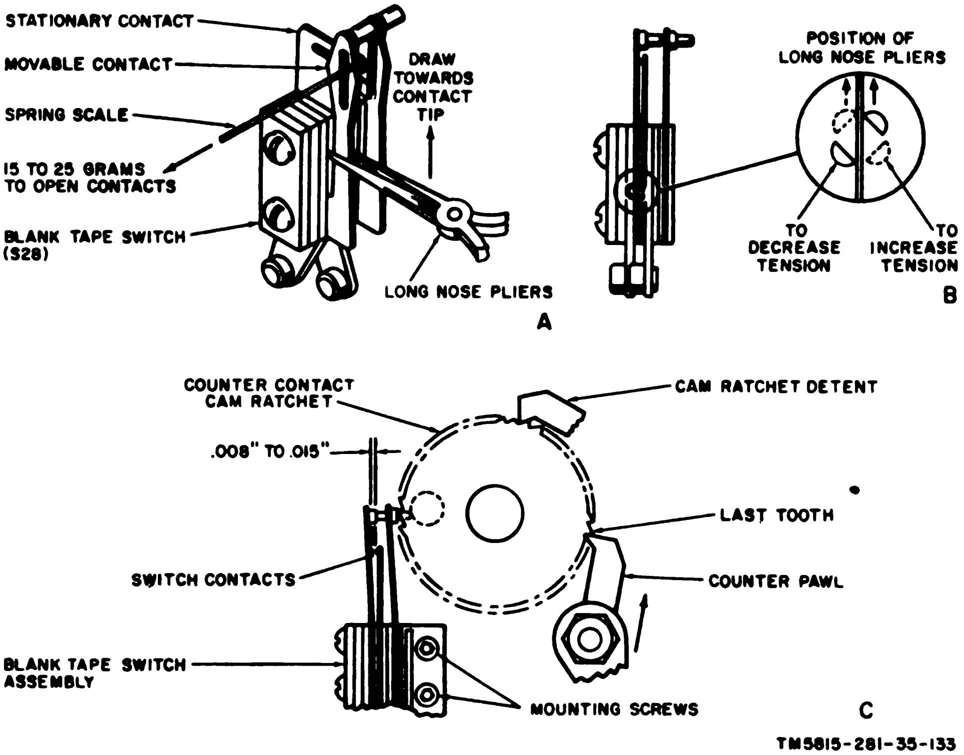


Figure 130. Blank tape switch adjustment requirement.

remove the shims between the insulators that separate the contacts (fig. 83) until the requirement is met. Tighten the hexagonal nuts. Recheck the requirement.

(2) To adjust contact leaf tension, loosen the hexagonal nuts inside the distributor block. To decrease tension, add the shims (72, fig. 83) between the distributor block and the switch assembly. To increase tension, remove shims. Tighten the hexagonal nuts. Recheck the requirement.

(3) To obtain the requirement given in a(1) above, make sure that the bottom contact leaf is against the unoperated plunger; then turn adjusting screw to meet the requirement. Check the related adjustment (para 133).

133. Distributor Contacts Final Adjustment

Note: Connect Distortion Test Set TS-383A/GG (or equal) to one of the two LOOP jacks associated with the transmitter to be adjusted.

a. *Requirements.*

(1) *Impulse length* (B, fig. 132). When the transmitted signals are viewed on the distortion test set:

(a) The start impulse and number 1, 2, 3, 4, and 5 code impulses should each be 100 divisions in length.

(b) The stop impulse should be 142 divisions in length.

(c) The tolerance for all impulses is ±5 divisions for 60-word per minute (wpm) operation and ±7 divisions for 100-wpm operation.

(d) Each impulse should begin within 5 divisions (60 wpm) or 7 divisions (100 wpm) of the zero marking on the measuring scale of the TS-383A/GG and end within 5 divisions (60 wpm) or 7 divisions (100 wpm) of the zero marking for the following impulse.

(2) *Contact gap* (A, fig. 132). After the pulse length has been set, there should be 0.015- to 0.040-inch clearance between the contacts

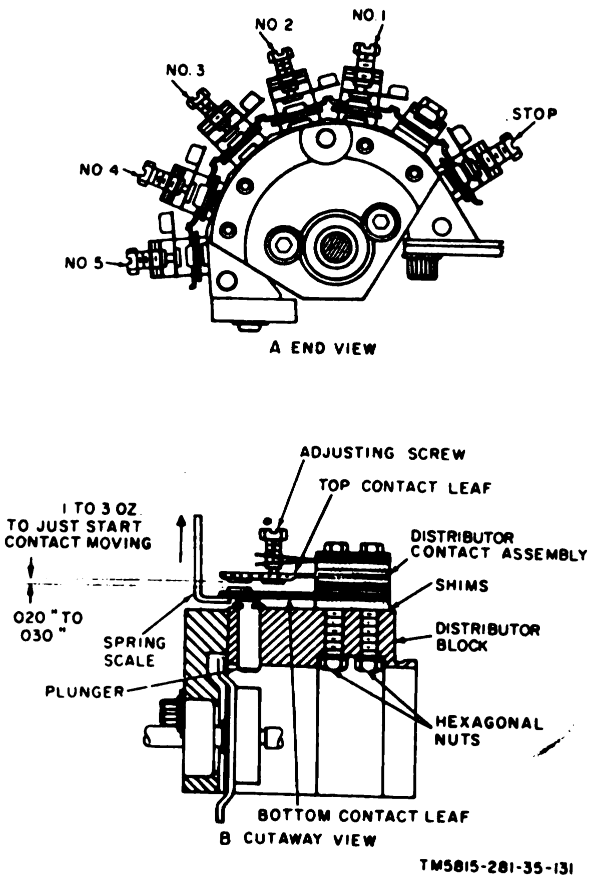


Figure 131. Distributor contact preliminary adjustment requirements.

when the plunger is off the high part of the cam.

(3) *Contact travel.* The travel of the contact closer to the adjusting screw should be a minimum of 0.015 inch. At the maximum travel point, the *contact should not strike the outer shoulder of the groove in the contact adjusting screw when the plunger is against a high part of the distributor cam.*

b. Method of Checking. Turn on both the TS-383A/GG and the transmitter. Turn the measuring scale of the TS-383A/GG to align the viewed impulses with their respective segments on the measuring scale and check the requirements.

c. Adjustments.

(1) Insert a message tape perforated with repeated R-code groups in the transmitter and check the No. 2, 4, and stop impulses. Turn the appropriate adjusting screw in or out to meet the requirements given in *a*(1) above for the No. 2, 4, and stop impulses. Remove the message tape and insert another tape perforated with repeated Y-code groups. Turn the appropriate adjusting screw in or out to meet the

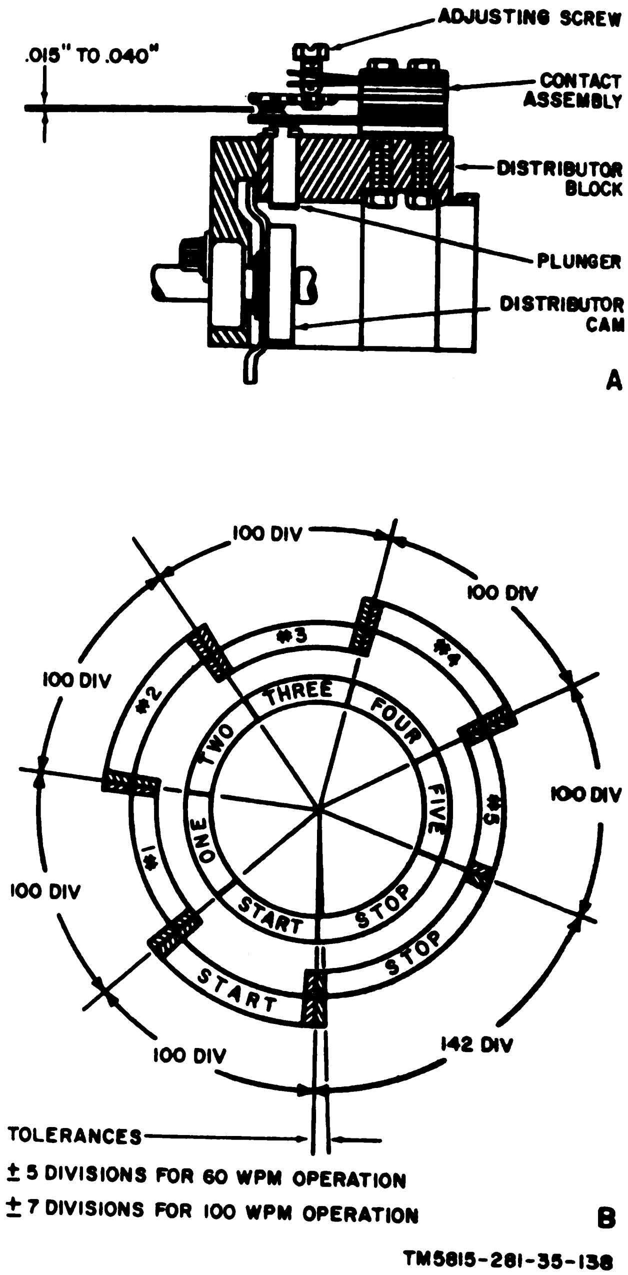


Figure 132. Distributor contacts final adjustment.

requirement for the No. 1, 3, and 5 impulses.

(2) Check the requirements given in a(2) and (3) above. If either of these requirements is not met, it may be necessary to readjust the signal pulse length to the lower end of the tolerance. Recheck the preliminary adjustment in paragraph 132. If the adjustment is not possible, replace the defective contact assemblies.

134. Numbering Pulsing Switch Preliminary Adjustment
(fig. 133)

Note: Perform this adjustment *only* when reassembling the numbering pulsing switch after repair, or if the requirements in paragraph 135 cannot be met.

a. *Requirement.* When a low portion of the numbering plusing switch cam is adjacent to (but not touching) the numbering pulsing switch, there should be a gap of 0.040 inch between the contacts of the numbering pulsing switch. The contacts should close when operated by a high portion of the numbering pulsing switch cam.

b. *Adjustments.*

(1) Turn the adjusting screw to get 0.040-inch clearance between the contacts of the numbering pulsing switch.

(2) Remove the hexagonal nuts and lockwashers that hold the numbering pulsing switch to the mounting bracket. Add or remove the shims to make proper closure of the switch when it is operated by the numbering pulsing switch cam. Replace the lockwashers and hexagonal nuts.

(3) Position the cam to have the contacts adjacent to a low part of the cam. Turn the adjusting screw 1/4-turn clockwise. Check the releated adjustment (para 135).

135. Numbering Pulsing Switch Final Adjustment
(fig. 134 and 135)

Note: The distributor contact final adjustment in paragraph 133 should be made before making this adjustment to determine the setting of the measuring scale of the TS-383A/GG. This setting must be left as established in paragraph 133 to obtain proper placement of the numbering pulse in relation to the transmitted code impulses.

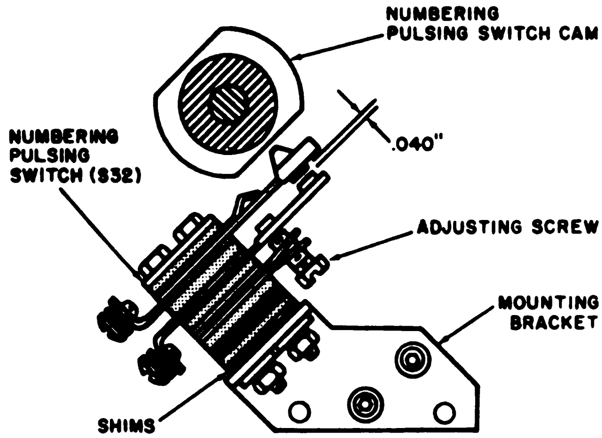


Figure 133. Numbering pulsing switch preliminary adjustment requirement.

a. *Requirements.*

(1) The numbering pulse should begin with the start of code impulse No. 1 and should end with the end of code impulse No. 5. The numbering pulse must begin no more than 15 divisions before the start of code impulse No. 1 and end no more than 5 divisions before or after the end of code impulse No. 5.

(2) When the cam follower is off the cam, there must be 0.020- to 0.040-inch clearance between the contacts of the numbering pulsing switch.

b. *Adjustments.*

(1) Leave the measuring scale of the TS-383A/GG at the setting established in paragraph 133. Connect the transmitter (note, para 133). Slightly loosen the hexagonal nuts (fig. 134) that hold the numbering pulsing switch to the mounting bracket. Insert a screwdriver between the notches of the retainer plates. Position the numbering pulsing switch by twisting the screwdriver until the numbering pulse is centered between the start of code impulse No. 1 and the end of code impulse No. 5. Disregard

the length of the pulse. Tighten the hexagonal nuts.

(2) Turn the adjusting screw clockwise or counterclockwise until the numbering pulse is the proper length (fig. 135). If this adjustment cannot be made, check the related adjustment (para 134). All contacts must be checked for clearance after adjusting. If the clearance requirement is not met, bend the contact stop to obtain the required clearance. Recheck the requirements after bending.

Note: After the signal lengths has been adjusted, *the contact leaf must not touch the shoulder of the groove in the adjusting screw when the contact cam follower is on a high portion of the cam.* If the contact leaf does contact the shoulder of the adjusting screw, readjust the numbering pulse to the lower end of the tolerance. Recheck the related adjustment (para 134) or, if necessary, replace the contact assembly.

136. Latch Pulsing Switch Preliminary Adjustment (fig. 136)

Note: Perform this adjustment *only* when reassembling the switch after repair, or when the requirement of the final adjustment (para 137) cannot be met.

a. Requirement. When a low portion of the latch pulsing switch cam is adjacent to (but not touching) the latch pulsing

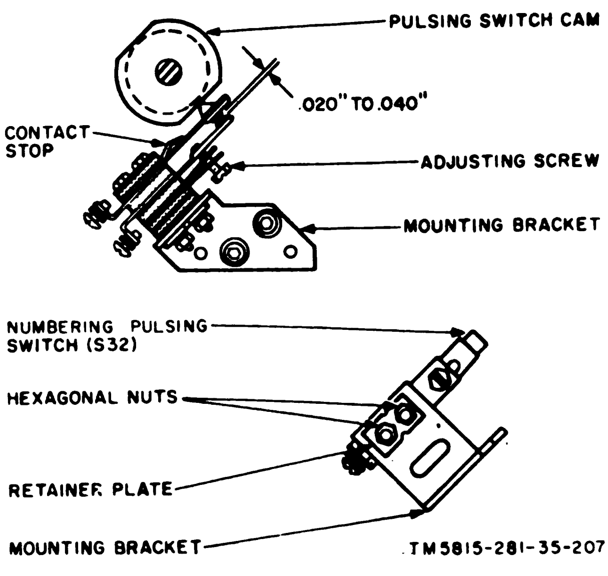


Figure 134. Numbering pulsing switch contact adjustment requirement.

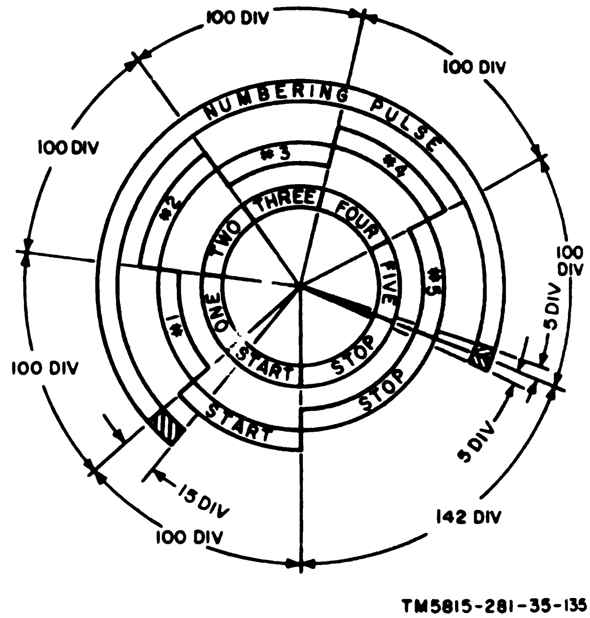


Figure 135. Numbering pulse timing requirements.

switch, there should be a gap of 0.040 inch between the contacts of the switch. The contacts should close when operated by a high portion of the latch pulsing switch cam.

b. Adjustments.

(1) Turn the adjusting screw to obtain the 0.040-inch clearance between the contacts of the latch pulsing switch.

(2) Remove the hexagonal nuts and lockwashers that hold latch pulsing switch S46 to the frame. Add or remove the shims to meet the closed-contact requirement. Replace the lockwashers and hexagonal nuts.

(3) Position the cam to have the contacts adjacent to a low part of the latch pulsing switch cam and rotate the adjusting screw 1/4-turn clockwise. Make the related adjustments (para 137 and 138).

137. Latch Pulse Timing Adjustment

Note: The distributor contacts final adjustment in paragraph 133 should be made before making this adjustment to determine the setting of the measuring scale of the TS-383A/GG. This setting must be left as established in paragraph 133 to obtain proper placement of the latch pulse in relation to the transmitted code impulses.

a. Requirement. The latch pulse should begin with the start of code impulse No. 4

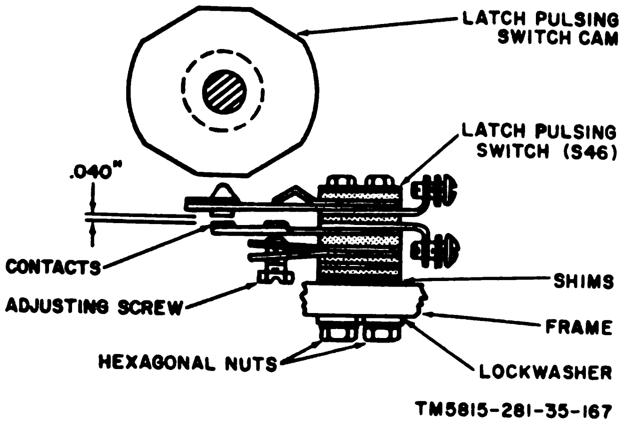


Figure 136. Latch pulsing switch, preliminary adjustment requirement.

and end with the 98th division of the stop impulse (B, fig. 137). The latch should begin *no more* than 5 divisions before or 20 divisions after the start of code impulse No. 4 and should end no more than 5 divisions before or after the 98th division of the stop impulse.

b. Adjustment. Center the latch pulse as follows:

(1) Be sure that the measuring scale of the TS-383A/GG is oriented as described in paragraph 133. Turn the adjusting screw (A, fig. 137) to obtain a preliminary latch pulse length of approximately 300 divisions.

(2) If necessary, loosen the hexagonal nuts and move the latch pulsing switch to the approximate center of the holes in the transmitter frame. Set the transmitter camshaft to the stopped position, loosen the latch pulsing switch cam setscrews, and reposition the cam as shown in figure 136.

(3) Slightly loosen the hexagonal nuts. Insert a screwdriver into the slots of the switchplate and, with the transmitter and TS-383A/GG running, adjust the position of the switch to achieve the final pulse centering. Tighten the hexagonal nuts and recheck the pulse centering. If the adjustment cannot be made, stop the transmitter and readjust the cam position as described in (2) above.

(4) When the latch pulse is centered, turn the adjusting screw on the latching pulsing switch to obtain the required pulse length.

138. Latch Pulse Switch Contact Adjustment (fig. 137)

a. Requirements.

(1) After the proper latch pulse length has been obtained (para 137), there must be 0.020- to 0.040-inch clearance between the contacts of the latch pulsing switch when it is adjacent to a low portion of its cam.

(2) The travel of the contact closer to the adjusting screw should be a minimum of 0.015 inch. At the maximum travel position, the contact should not touch the outer shoulder of the groove in the adjusting screw when the cam follower is against a high part of the cam.

b. Adjustments.

(1) Turn the latch pulsing cam to have the cam follower opposite a low part of the cam and bend the contact stop to meet the requirement given in *a*(1) above.

(2) Turn the adjusting screw as required to obtain the requirements given in *a* above. If the contact touches the shoulder of the adjusting screw, readjust the signal to the lower end of the tolerance, recheck the preliminary adjustment, or replace the contact assembly.

139. Latch Pulsing Switch Guide Adjustment (fig. 138)

Note: The latch pulsing switch adjustments (para 137 and 138) should be made before making this adjustment.

a. Requirement. The switch guide should be positioned tightly against the front side of the latch pulsing switch. If the latch pulsing switch is removed for maintenance, it can be replaced in its correct position

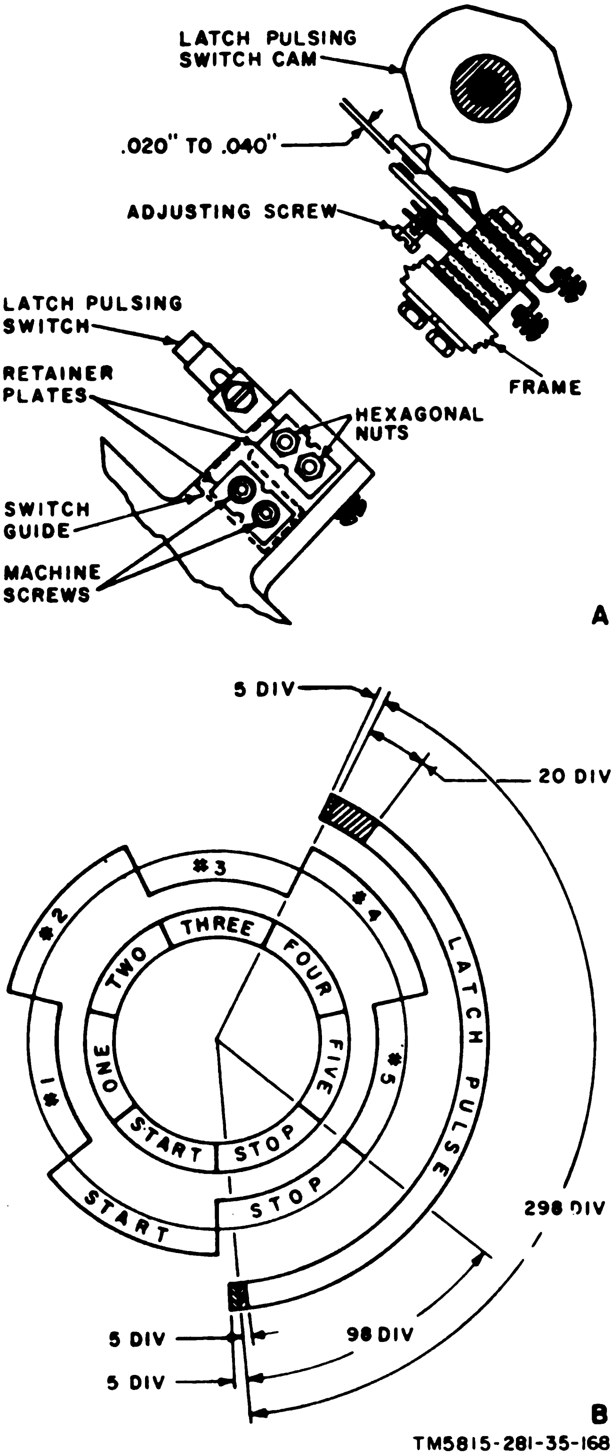


Figure 137. Latch pulsing switch, timing and contact adjustment requirements.

without readjusting the latch pulse length.

b. Adjustment. Loosen the machine

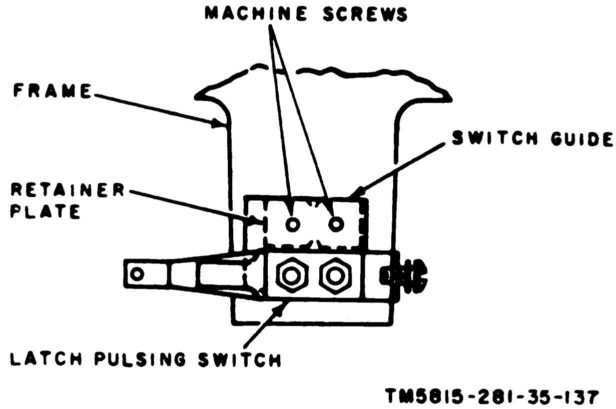


Figure 138. Latch pulsing switch guide adjustment.

screws that hold the switch guide to the transmitter frame. Position the switch guide tightly against the front and side of the latch pulsing switch and tighten the machine screws.

140. Friction Clutch Adjustment (fig. 139)

a. Requirement. Sufficient tension should be applied by the friction clutch to insure complete and proper rotation of the transmitter camshaft.

b. Method of Checking. Insert a message tape in the transmitter. Operate the stop-start lever from STOP to START and then back to STOP. Repeat this procedure a number of times to check the requirement; then allow the transmitter to operate continuously and check the requirement.

c. Adjustment. Loosen the machine screws in the friction adjusting collar. Turn the collar to decrease the tension of the friction clutch spring until the transmitter camshaft does not rotate properly. Turn the collar to increase tension of the spring until the camshaft does operate properly. Turn the collar another 1/2 to 3/4 turn, tighten the machine screws, and recheck the requirement.

141. Top Cover and Code-Sensing Levers Alignment

a. Requirement. When the restore lever and comb assembly is against a high

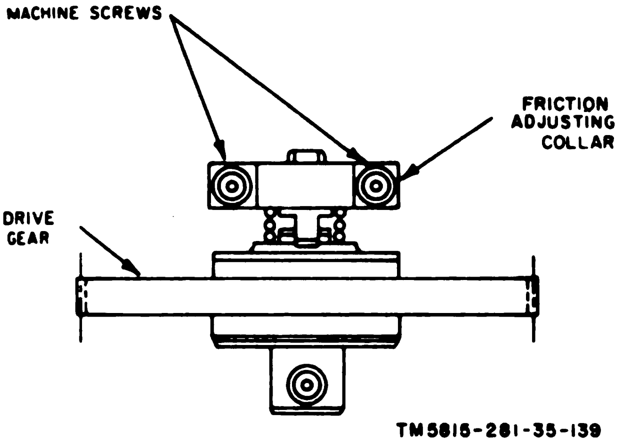


Figure 139. Friction clutch adjustment.

part of the sensing lever restoring cam, the top of the pins on the code-sensing levers should be flush with or below the top cover (B, fig. 140).

b. Adjustment. Loosen the machine screws that hold the top cover to the frame. Rotate the setscrews in the top cover (A, fig. 140) to meet the requirement. Tighten the machine screws, and recheck the requirement.

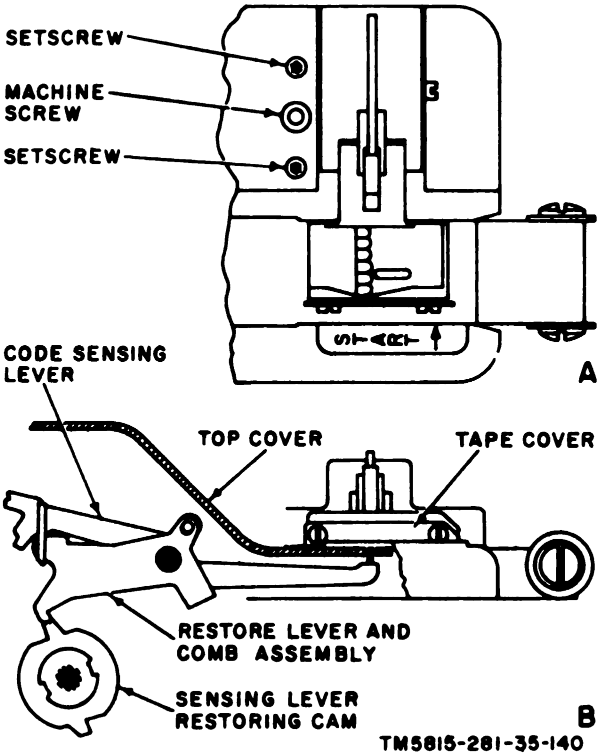


Figure 140. Top cover and code-sensing levers alignment.

142. Tape Guide Adjustment (fig. 141)

a. Requirement. There should be some (0.003-inch max) clearance between the tape guide and the tape cover.

b. Adjustment. Remove the tape cover from the transmitter. Back the setscrews away from the machine screws in the tape cover. Adjust the machine screws to meet the requirement when the tape guide is held against the heads of the machine screws. Tighten the setscrews against the machine screws, and check the related adjustment (para 145).

143. Tape Cover Preliminary Adjustment (fig. 142)

a. Requirement. The bottom surface of the tape cover should be parallel with the bottom of the tape guide groove in the top cover.

b. Adjustment. Remove the top cover from the transmitter. Loosen the setscrew and turn the eccentric screw clockwise or counterclockwise until the requirement is met. Check the related adjustment (para 144).

144. Tape Cover Clearance Adjustment (fig. 143)

a. Requirement. There should be 0.012- to 0.015-inch clearance between the tape cover and the top cover of the transmitter.

b. Adjustment. Remove the top cover from the transmitter. Loosen the machine screws. Add or remove the shims to meet the requirement. Tighten the machine screws, recheck the clearance, and check the related adjustment (para 145).

145. Tape Cover Bracket Adjustment

a. Requirement. When the code holes of a message tape (perforated with the letters code combination) are centered with the holes in the tape cover, there should be 0.002- to 0.005-inch clearance between the

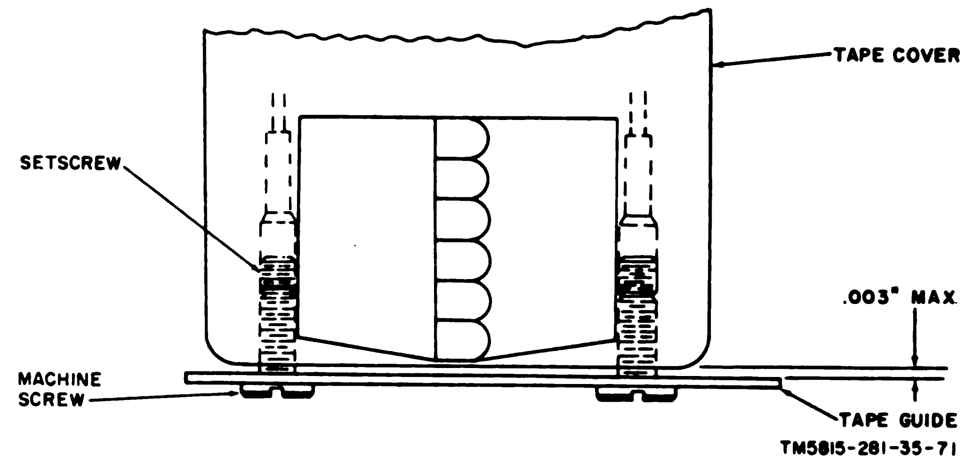


Figure 141. Tape guide adjustment requirement.

message tape and the edge of the tape guide groove in the top cover (A, fig. 144).

b. Method of Checking. Position the message tape (perforated with the letters code combination) 0.002 to 0.005 inch away from the tape guide. The holes of the tape cover should be centered over the holes in the message tape.

c. Adjustment. Loosen the two machine screws in the tape cover bracket (B, fig. 144). Move the bracket until the requirement is met, and tighten the machine screws.

146. Tape Cover Adjustment (fig. 145)

a. Requirement. When the tape-feed claw teeth engage the feed holes of the message tape, the edge of the message tape should be 0.002 to 0.005 inch away from the tape guide in the top cover.

b. Adjustments. Loosen the three machine screws that hold the top cover. Position the top cover to meet the requirement. Tighten the machine screw. Recheck the requirement.

147. Motor Governor Contacts Adjustments (fig. 146)

a. Requirements.

(1) The contacts should be aligned for maximum surface engagement.

(2) There should be a 0.001- to 0.008-inch clearance between the governor adjustment gear and the governor adjustment screw bracket.

(3) A maximum force of 10 ounces

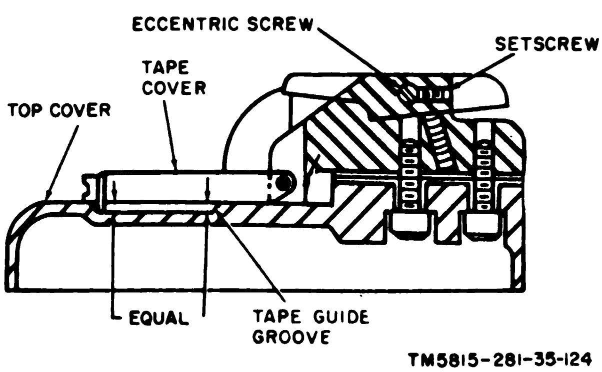


Figure 142. Tape cover preliminary adjustment requirement.

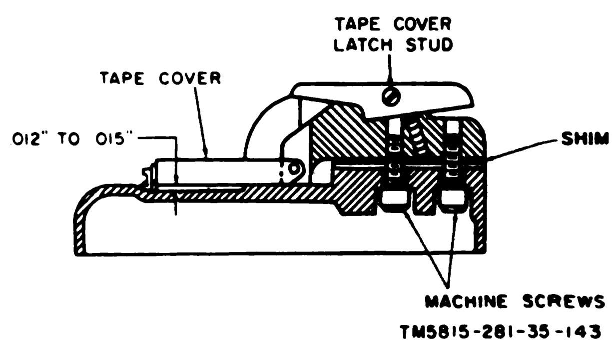


Figure 143. Tape cover clearance requirement.

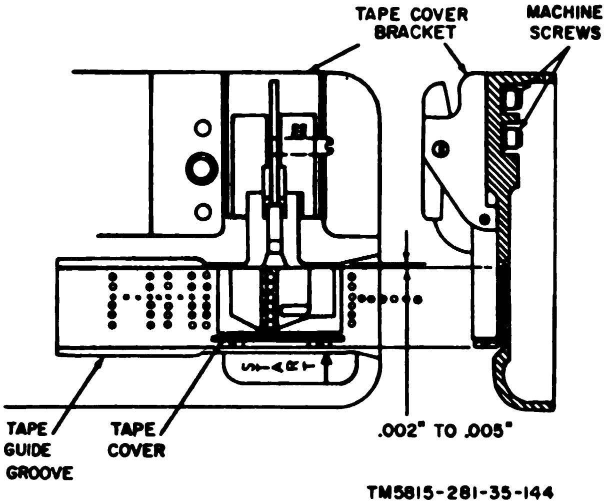


Figure 144. Tape cover bracket adjustment requirement.

should be required to push or pull the governor worm shaft to turn the gear assembly at any point within the operating range of the motor.

b. Adjustments.

(1) Loosen the contact arm spring mounting screw. Position the contact arm assembly to meet the requirement given in *a*(1) above.

(2) Peel the laminated washer to obtain the clearance required between the governor adjustment gear and the governor adjustment screw bracket.

(3) Check for dirt or bind between the motor governor adjusting gear and the governor adjustment screw bracket.

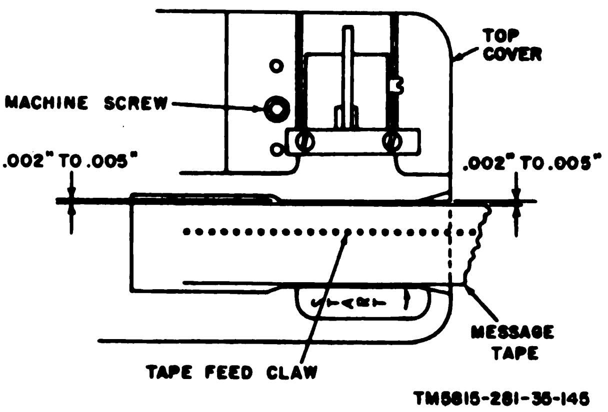


Figure 145. Top cover adjustment requirement.

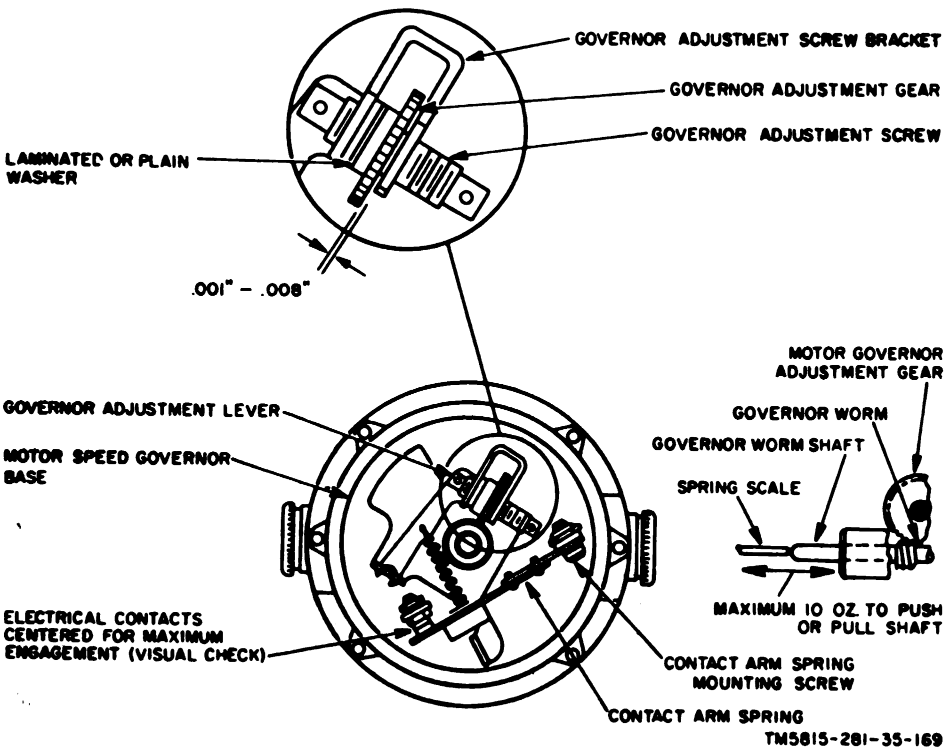


Figure 146. Motor governor contacts adjustment.

Note: Motor governors, when shipped from factory, are not equipped with a laminated washer. When adjustment is necessary to meet the requirement, use laminated washer (61413) as a replacement part for the original plain washer. Do not insert a laminated washer less than 0.005-inch thick because it may bind the governor adjustment screw.

148. Governor Assembly Locating Adjustment (fig. 147)

Note: This adjustment should be made only when mounting the governor assembly on the motor.

a. *Requirement.* There should be clearance of 1/16 (±1/32) inch between the slipring on the governor assembly and the brushholder on the motor.

b. *Adjustment.* Position the governor assembly to meet the requirement and tighten one setscrew frictiontight. Tighten the other setscrew firmly and then tighten the first setscrew firmly. This procedure will insure that the governor assembly remains properly in line with the motor shaft.

Note: The governor slip rings must be clean and smooth to insure proper brush contact. The area between the slip rings must be clean and free of foreign material.

149. Governor Target Assembly Adjustment (fig. 148)

a. *Requirement.* There should be a 0.001- to 0.020-inch clearance between the governor target and the motor governor cover.

b. *Adjustment.* Loosen the setscrew and position the governor target to meet the requirement. Tighten the setscrew.

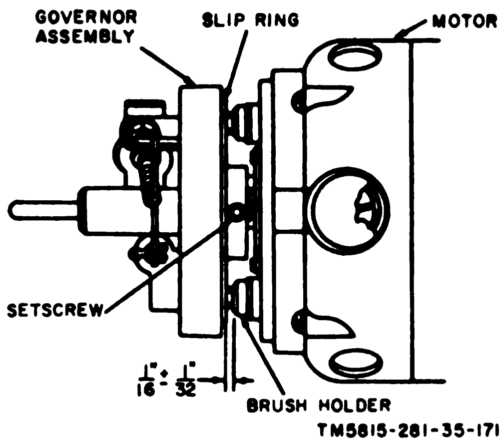


Figure 147. Governor assembly locating adjustment.

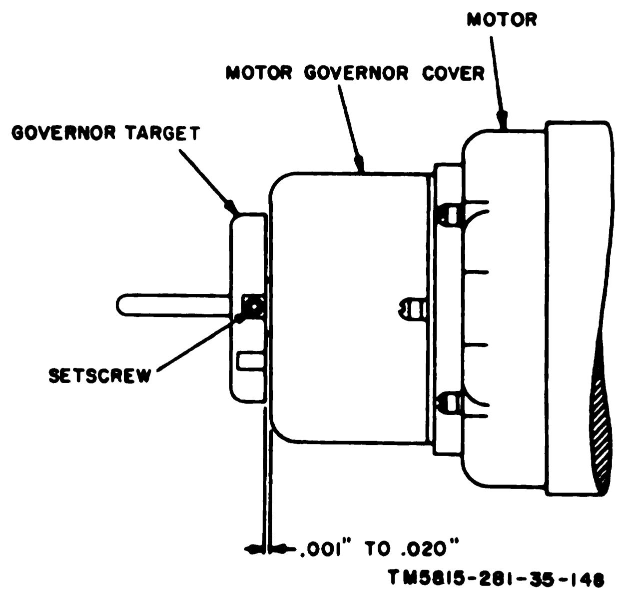


Figure 148. Governor target adjustment requirement.

Section XI. STEPPING SWITCH AND RELAY ADJUSTMENT PROCEDURES

150. General

This section describes the mechanical and electrical adjustment of the stepping switches and the relays used in the distributor set. The adjustments can be made while the stepping switches or relays are mounted in the equipment.

151. Numbering Stepping Switch Wiper Spring Tension Adjustment (fig. 149)

a. *Requirement.* There should be from 1/8 to 5/32-inch follow of each wiper spring when the pressure of its mating wiper spring is removed.

b. *Method of Checking.* Turn the wiper

assembly until number 7 is visible through the window of the associated numbering indicator (one set of contact wipers on position 5). Hold a 1-inch scale, with 1/32-inch graduations, at the tip of the wiper spring to be checked and note the scale reading. Use an orangestick to move the mating wiper spring until the two wiper springs are no longer in contact and read the amount of spring follow on the scale. Check the follow of each wiper spring in the group. Turn the wiper assembly 120° to the next group of wiper springs, and check the follow of each spring. Repeat the procedure for the third group of wiper springs.

c. Adjustment. Grasp the base of the wiper spring with duckbill pliers and bend it to meet the requirement. Check the wiper spring alignment (para 152).

152. Numbering Stepping Switch Wiper Spring Alignment (fig. 149)

a. Requirements.

(1) When the wiper assembly is slowly turned to the zero (home) position, both tips of each pair of wiper springs must touch the brush spring at the same instant and the tips must not be deflected more than 1/64 inch as the wiper springs pass over the brush springs.

(2) There should be a minimum of 1/32 inch between the adjacent wiper spring pairs as the wiper assembly is stepped to the zero (home) position.

b. Methods of Checking.

(1) Turn the wiper assembly until number 9 is visible through the window of the numbering indicator (one set of wipers resting on the first position). Slowly turn the wiper assembly until zero is visible through the window of the numbering indicator (home position) and note the amount of deflection (horizontal movement of the tip of each wiper spring) as the wiper springs pass over the brush springs. Repeat the procedure to check the other two sets of wiper springs.

(2) Turn the wiper assembly to the home position and check the clearance between each set of adjacent wiper springs. Repeat the procedure to check the other two sets of wiper springs.

c. Adjustment. Grasp the base of the wiper spring carefully with a pair of duckbill pliers and bend the spring carefully to meet the requirements. Check the wiper spring tension (para 151).

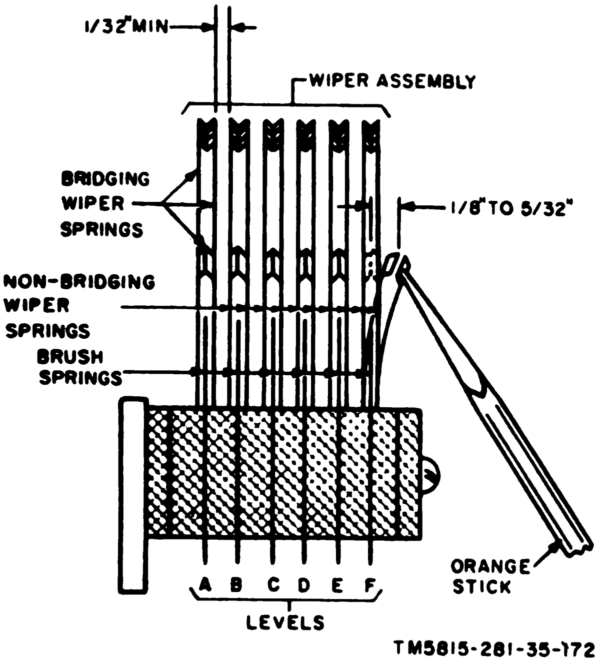


Figure 149. Numbering stepping switch wiper tension requirements.

153. Numbering Stepping Switch Armature Heelpiece Clearance Adjustment (fig. 150)

a. Requirement. When the armature is in the operated position, there should be a 0.0015- to 0.003-inch clearance between the armature and the heelpiece.

b. Method of Checking. Insert a 0.003-inch feeler gage between the armature and the heelpiece; press the associated FORWARD STEP switch to energize the windings of the numbering stepping switch under test. The feeler gage should be held tightly. Insert a 0.0015-inch feeler gage between the armature and the heelpiece and energize the winding of the numbering stepping switch. The feeler gage should be loose.

c. Adjustment. Loosen the mounting screws that hold the armature mounting bracket to the heelpiece and adjust the position of the bracket to meet the requirement. Check the related adjustments (para 155 and 156).

154. Numbering Stepping Switch Pawl Tip Tension Adjustment (fig. 151)

a. Requirement. A pull of 130 to 175 grams should be required to move the tip of the pawl from the ratchet wheel.

b. Method of Checking. Hook a spring scale under the tip of the pawl; pull on the scale until the pawl moves out of contact with the ratchet wheel and note the scale reading as the pawl leaves the ratchet wheel.

c. Adjustment. Bend the pawl spring until the requirement is met. If the proper tension cannot be obtained by bending the spring, install a new spring.

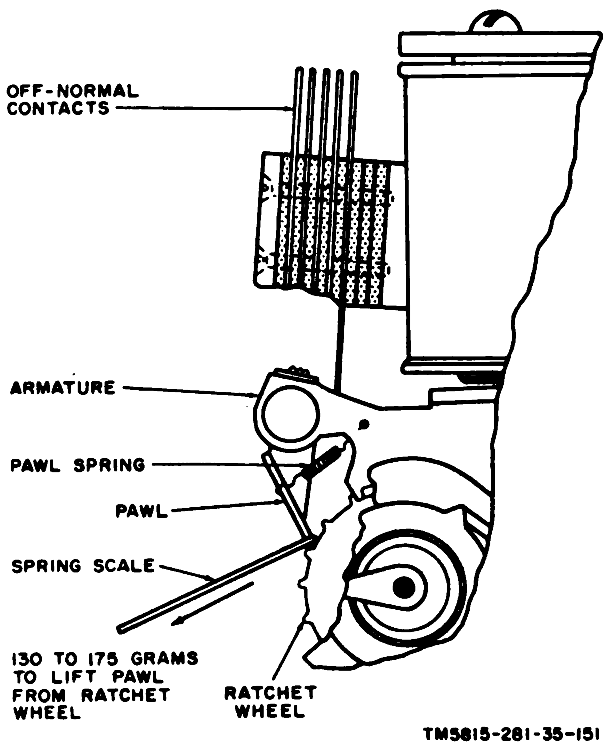


Figure 151. Numbering stepping switch pawl tip tension requirement.

155. Numbering Stepping Switch Pawl Alignment (fig. 150 and 152)

a. Requirement. The sides of the pawl (A, fig. 152) should be parallel with the sides of the ratchet wheel and the tip of the pawl must engage the ratchet wheel teeth squarely.

b. Method of Checking. Check the alignment of the parts visually when the magnet winding is deenergized.

c. Adjustment. Loosen the screws that hold the armature mounting bracket to the heelpiece (fig. 150) and readjust the position of the armature and mounting bracket to meet the requirement. Check the related adjustment (para 156).

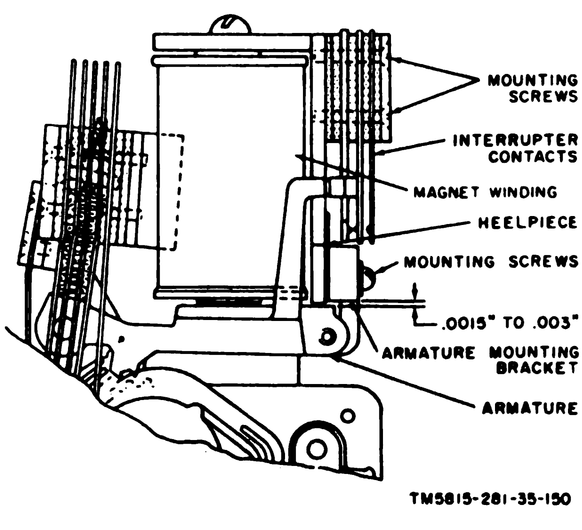


Figure 150. Numbering stepping switch armature heelpiece clearance requirement.

156. Numbering Stepping Switch Armature Alignment (fig. 150 and 152)

a. Requirements.

(1) The armature (B, fig. 152) should not extend more than 0.010 inch beyond the edge of the ratchet wheel when the play in the armature bearings is taken up in the direction of the overlap.

(2) The pawl (A, fig. 152) should extend between 1/64 and 3/64 inch

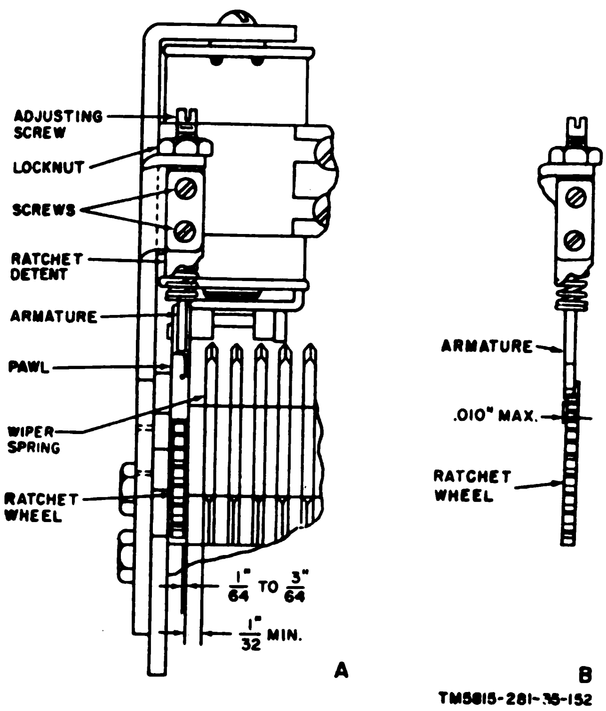


Figure 152. Numbering stepping switch pawl and armature alignment requirements.

beyond the side of the ratchet wheel adjacent to the wiper springs when the armature is moved in its bearings to both extreme positions.

b. Methods of Checking. Shift the armature from side to side and check the requirements in the extreme left and right positions.

c. Adjustment. Loosen the screws that hold the armature mounting bracket (fig. 150) to the heelpiece. Position the mounting bracket and the armature to meet the requirements. Tighten the mounting screws. Check the related adjustment (para 155).

157. Numbering Stepping Switch Wiper Spring Clearance Adjustment (fig. 152)

a. Requirement. There should be a clearance of 1/32 inch minimum between the first wiper spring and the adjacent armature and pawl.

b. Method of Checking. Turn the wiper assembly 1 full revolution and note the clearance between the first wiper spring and the armature and pawl.

Note: Failure of a stepping switch to meet the requirement is normally the result of a bent wiper spring.

c. Adjustment. Straighten the wiper spring to meet the requirement. Check the related adjustments (para 151 and 152).

158. Numbering Stepping Switch Ratchet Detent Tension Adjustment (fig. 153)

a. Requirement. The pressure required to move the ratchet detent from the ratchet wheel should be between 75 and 125 grams.

b. Method of Checking. Hook a spring scale under the tip of the ratchet detent where it engages the tooth of the ratchet wheel and pull the ratchet detent away from the ratchet wheel. Read the spring scale as the ratchet detent leaves the ratchet wheel.

c. Adjustment. Bend the ratchet detent to meet the requirement.

159. Numbering Stepping Switch Ratchet Detent Position Adjustment (fig. 152 and 153)

a. Requirements.

(1) When the armature is in the unoperated position, there should be a minimum of 1/32-inch clearance between the ratchet detent and the armature and pawl (fig. 153).

(2) When all the play between the pawl and the ratchet wheel is taken up in the direction opposite to normal switch rotation, there should be a maximum clearance of 0.003 inch between the ratchet detent and the engaged tooth of the ratchet.

(3) The tip of the ratchet detent should extend a minimum of 1/64 inch (A, fig. 152) beyond the wiper side of the ratchet wheel and the ratchet detent should be mounted parallel to the side of the ratchet wheel.

b. Adjustment. Loosen the two screws (fig. 152) that hold the ratchet detent to the switch frame. Adjust the position of the detent to meet the requirements. Tighten the screws. If necessary, bend the detent slightly to meet the requirement given in *a*(1) above.

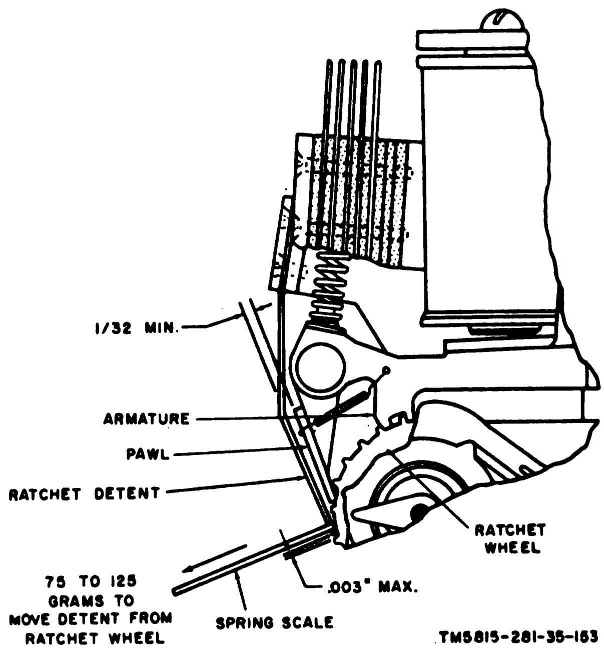


Figure 153. Numbering stepping switch ratchet detent adjustment requirements.

160. Numbering Stepping Switch Armature Drive Spring Compression Adjustment (fig. 154)

a. *Requirements.*

(1) A tension of 17 to 22 ounces should be required to lift the armature and pawl out of engagement with the ratchet wheel when the armature is in the unoperated position.

(2) When the wiper assembly is retarded manually and permitted to rotate slowly during a stepping operation, pressure of the armature drive spring must be sufficient to restore the armature fully to its normal unoperated position, and the wiper assembly must move a full step to the next set of bank contacts.

b. Methods of Checking.

(1) Hook a spring scale under the spring washer of the drive spring. Pull upward on the spring scale and read the scale when the stepping teeth of the armature and the pawl are separated from the ratchet wheel.

(2) Manually lift the armature until the pawl engages the next tooth on the ratchet wheel. Hold the wiper assembly and permit it to be turned slowly by the pressure of the drive spring. Be sure that the spring pressure steps the switch fully.

c. Adjustment. Loosen the locknut on the adjusting screw of the armature drive spring. Turn the adjusting screw clockwise to increase the spring compression and counterclockwise to decrease the compression. Adjust the position of the screw until the requirement in *a*(1) above is met and check the requirement given in *a*(2) above. If the requirement given in *a*(2) is not met, check for binding of the armature and wiper assembly. Correct the cause of the binding and recheck the equipment.

161. Numbering Stepping Switch Contact Bank Position Adjustment (fig. 155)

a. *Requirements.*

(1) The full width of the tips of each

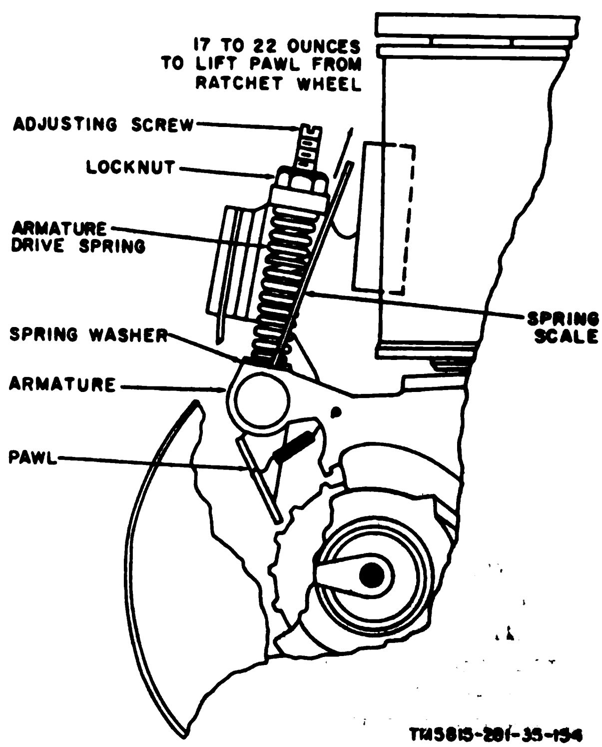


Figure 154. Numbering stepping switch armature drive spring compression requirement.

pair of wiper springs must be in contact with its associated bank contact.

(2) When the wiper assembly is stepped to any position of the switch, the flat contact portion of the level A bridging wiper springs should be centered on the associated contacts (B, fig. 155) and the nonbridging wiper springs of all levels except A should rest with the tip of the wiper springs at any point on the center third of the associated contact (A, fig. 155).

b. Method of Checking.

(1) Turn the wiper assembly 1 full revolution and examine both tips of each wiper spring for full-width contact.

(2) Step the wiper assembly to several positions on the contact bank and check the points at which the tips of the wiper springs come to rest.

c. Adjustment. Loosen the two machine screws that hold the contact bank to the frame. Adjust the position of the contact bank to meet the requirement.

162. Numbering Stepping Switch Interrupter Contacts Position Adjustment (fig. 156)

a. Requirements.

(1) The spring buffer should not extend above the top of the armature arm more than 0.005 inch.

(2) The contacts must not be out of alignment by more than 40 percent of their base diameter.

b. Adjustment. Loosen the two mounting screws that hold the interrupter contacts to the switch frame. Adjust the position of the moving contact spring to meet the requirement given in *a*(1) above; then adjust the position of the contacts to meet the requirement given in *a*(2) above. Tighten the mounting screws and recheck the requirements.

163. Numbering Stepping Switch Interrupter Contact Spring Tension Adjustment (fig. 157)

a. Requirement. When the armature is in the unoperated position, a force of 275

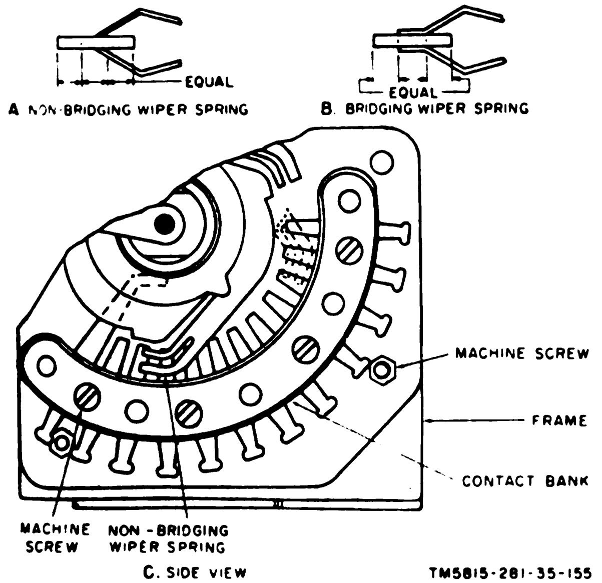


Figure 155. Numbering stepping switch contact bank position adjustment requirements.

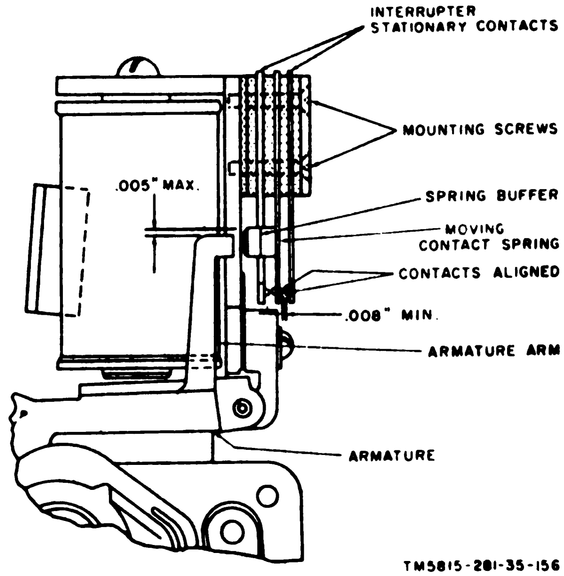


Figure 156. Numbering stepping switch interrupter contacts position adjustment requirements.

to 400 grams should be required to open the interrupter contacts.

b. Method of Checking. Block a spring scale under the end of the moving contact spring and pull the spring scale until the contacts open. Check the scale reading as the contacts open.

c. Adjustment. Use a pair of duckbill pliers to bend the moving contact spring carefully until the requirement is met. Start bending the spring at a point where it is mounted on the frame.

164. Numbering Stepping Switch Interrupter Contact Gap Adjustment (fig. 156)

a. Requirements.

(1) When the armature is in the unoperated position, the gap between the contacts on the moving contact spring and its mating contacts should be a minimum of 0.008 inch.

(2) Both contact pairs should open and close within 0.002 inch of each other.

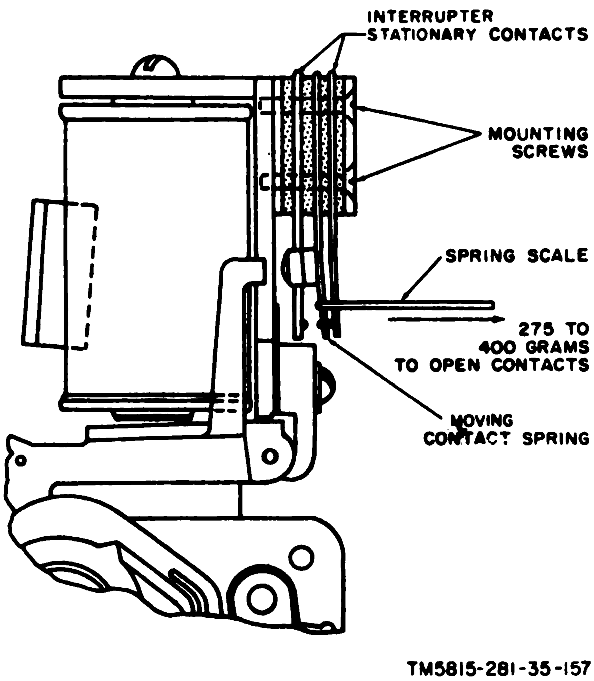


Figure 157. Numbering stepping switch interrupter contact spring adjustment requirements.

b. Methods of Checking.

(1) Insert a 0.008-inch feeler gage between the open interrupter contacts to check the clearance of the requirement given in *a*(1) above.

(2) Operate the armature manually until one pair of the interrupter contacts just touch. Check the second pair to be sure that they are also touching or are within 0.002 inch of touching their mating contact.

c. Adjustment. Use a pair of duckbill pliers to bend the contact to meet the requirements given in *a*(1) and (2) above.

165. Numbering Stepping Switch Self-Interrupted Speed Test

a. Requirement. When each numbering switch is self-interrupted through its interrupter contacts, the switch must operate at the maximum uniform speed obtainable by adjustment.

b. Method of Testing. Install a jumper between the appropriate terminals of the switch as indicated in the chart below. The chart identifies each terminal by listing the color of the wire already connected to the terminal. To test any of the upper stepping switches (RUA, RTA, or RHA), connect the positive lead from a 48-volt power supply to terminal 12 of plug P1 and connect the negative lead to terminal 23 of plug P2. To test any of the lower stepping switches (RUB, RTB, or RHB), connect the positive lead from a 48-volt power supply to terminal 12 of plug P3 and connect the negative lead to terminal 23 of plug P4.

Numbering stepping switch to be tested	Switch terminals	
	Winding terminal	Interrupter contact terminal
RUA	Brn-orn	Blk-yel
RTA	Yel	Blk-yel
RHA	Brn-yel	Blk-yel
RUB	Brn-orn	Blk-yel
RTB	Blk-orn	Blk-yel
RHB	Brn-yel	Blk-yel

c. Adjustment. Adjust the interrupter contacts as described in paragraphs 162 through 164 until maximum uniform self-interrupted speed is attained.

166. Numbering Stepping Switch Off-Normal Contact Position Adjustment (fig. 158)

a. *Requirements.*

(1) The off-normal contact assembly should be mounted parallel (A, fig. 158) to the frame on which the wiper assembly shaft is mounted, and the apex of the V-portion of the actuator spring should be in alignment with the center of the switch shaft.

(2) The V-portion of the off-normal contact spring should line up with the center of the off-normal actuating lobe on the indicator wheel when the switch is stepped to the 11th position (A, fig. 158).

(3) There should be a minimum clearance of 0.010 inch between the V of the off-normal contact spring (A, fig. 158) and the off-normal actuating lobe of the indicator wheel when the switch is stepped to either the first position or the tenth position.

(4) There should be a 1/32-inch clearance between the off-normal contact assembly and the nearest point of the adjacent wiper spring (B, fig. 158).

b. *Adjustment.* Loosen the mounting screws (B, fig. 158) that hold the off-normal contact assembly to the frame of the switch. Adjust the position of the switch until the requirements are met.

167. Numbering Stepping Switch Off-Normal Contact Spring Tension Adjustment (fig. 158)

a. *Requirements.*

(1) When the numbering stepping switch in in any position other than position 11, a force of 35 to 50 grams should be required (C, fig. 158) to open the inner break contacts.

(2) When the switch is in position 11 (D, fig. 158), a total force of 30 grams should be required to open both make contacts (15 grams for each contact of the pair).

(3) When ths switch is in position 11 (E, fig. 158), a force of 25 to 35 grams should be required to pull the buffer spring away from the actuator spring.

b. *Method of Checking.*

(1) To check the requirement given in *a*(1) above, turn the wiper assembly to any position other than position 11 and engage the hook end of a spring scale just above the V-shaped portion of the actuator spring (C, fig. 158). Hold the buffer spring out of engagement with the innter contact spring and pull outward on the spring scale; read the spring scale as the break contacts open.

(2) Set the wiper assembly to position 11, hook the spring scale under the outer set of make contacts, and pull outward on the contact until the contact points open. Check the spring scale as the contacts open.

(3) Set the wiper assembly to any position other than 11, insert the hook of a spring scale under the outer contact spring, immediately above the spring buffer, and pull outward until the buffer leaves the inner contact spring. Check the spring scale as the parts separate.

c. *Adjustment.* Bend the contacts and contact springs as necessary to meet the requirements. Use a pair of duckbill pliers and carefully make the adjustment; start at the upper portion of the contact.

168. Numbering Stepping Switch Off-Normal Contact Opening Adjustment (fig. 159)

a. *Requirements.*

(1) There should be perceptible clearance between the apex of the V of the off-normal contact spring and the indicator wheel when the switch is in positions 1 through 10.

(2) The make and break contacts should have a minimum contact separation of 0.008 inch.

(3) Both contacts of a contact pair should make or break within 0.002 inch of each other.

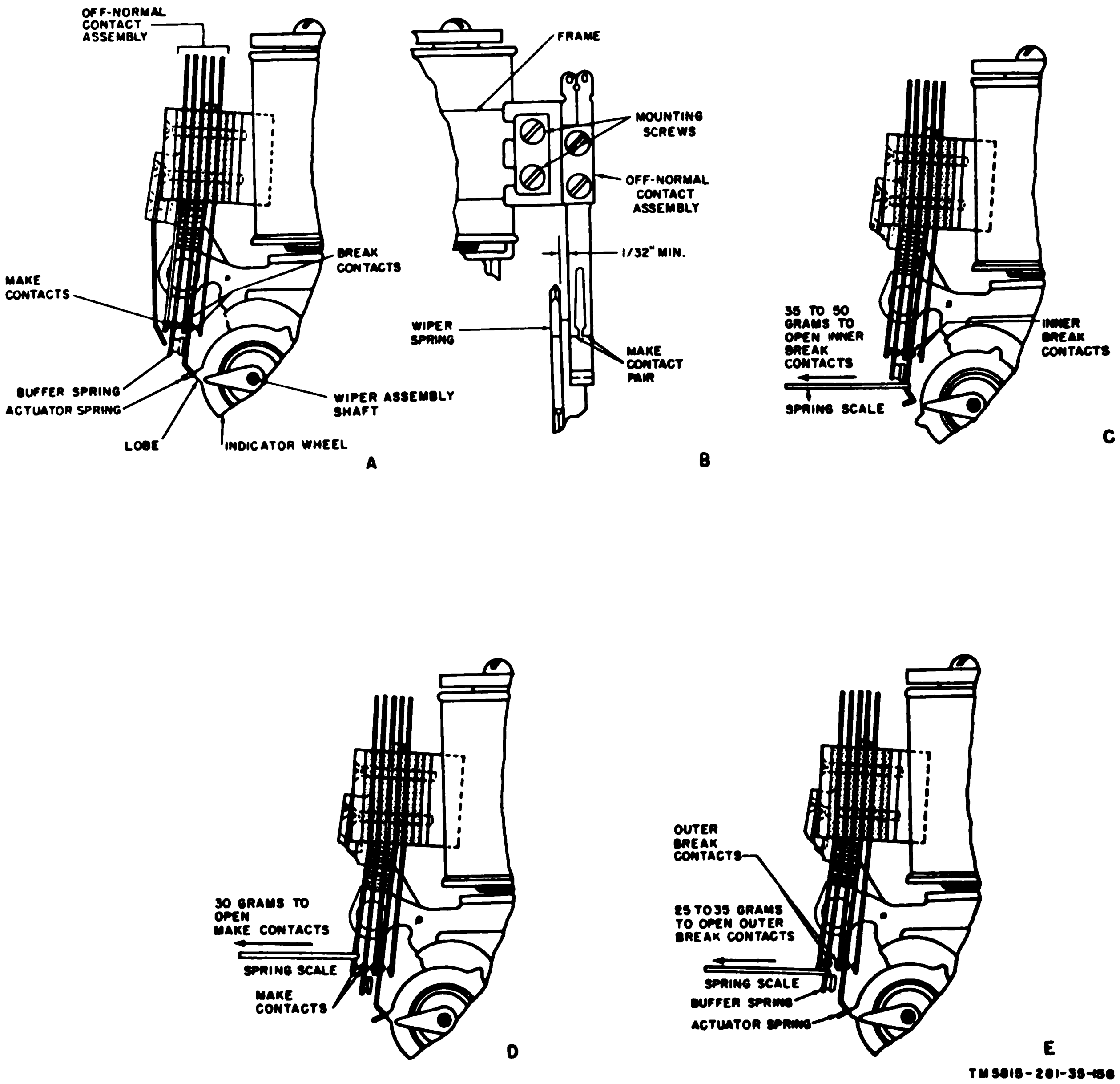


Figure 158. Off-normal contact assembly position and spring tension requirements.

b. Methods of Checking.

(1) Set the wiper assembly to any position other than 11, check to make sure that perceptible clearance exists between the indicator wheel and the apex of the V of the off-normal contact spring.

(2) Set the wiper assembly set to any position other than 11, check the space between the points on the contact springs and the mating make contacts by inserting a 0.008-inch feeler gage between the points. Move the wiper to position 11 and insert the 0.008-inch feeler gage between the break contacts. The gage should enter the gap without moving the contacts.

(3) Set the wiper assembly to position 10. Slowly rotate the wiper assembly to position 11; carefully observe each set of contacts. When the first break contact opens, its mating contact should open simultaneously

or within 0.002 inch of the first contact. When the first make contact opens, its mating contact should close simultaneously or within 0.002 inch of the first contact.

c. *Adjustment.* Use a pair of duckbill pliers to adjust the contact separation until the requirements are met. Check the related adjustment (para 167).

169. Main Stepping Switch Wiper Tension Adjustment
(fig. 160)

a. *Requirements.*

(1) There should be approximately 1/8-inch follow of each bridging wiper spring of levels A and B when the pressure of its mating wiper spring is removed.

(2) There should be approximately 3/32-inch follow of each nonbridging wiper spring of levels C through H when the pressure of its mating spring is removed.

b. *Method of Checking.* Turn the wiper assembly until one set of wiper contacts is in contact with position 13. Place a 1-inch scale at the tips of the wiper opposite those that engage the contact bank. Use an orangestick to deflect each wiper spring in turn and visually check the total horizontal movement of the opposite wiper. Turn the wiper assembly 180° and check the opposite group of wiper springs.

c. *Adjustment.* Grasp the base of the wiper spring with a pair of duckbill pliers and bend the wiper carefully to meet the requirements.

170. Main Stepping Switch Wiper Spring Alignment
(fig. 160)

a. *Requirements.*

(1) When the wiper assembly is stepped, and the wiper springs engage and pass the bases of the brush springs on the contact bank, the wiper springs must not be deflected more than 1/64 inch.

(2) When the wiper springs are resting on the bank contacts, there must be a minimum clearance of 1/16 inch between the adjacent pairs of wipers.

b. *Methods of Checking.*

(1) To check the requirement given in *a*(1) above, turn the wiper assembly until the wiper springs are on position 25. Place scale adjacent to the tips of the opposite set of wipers and step the wiper assembly one

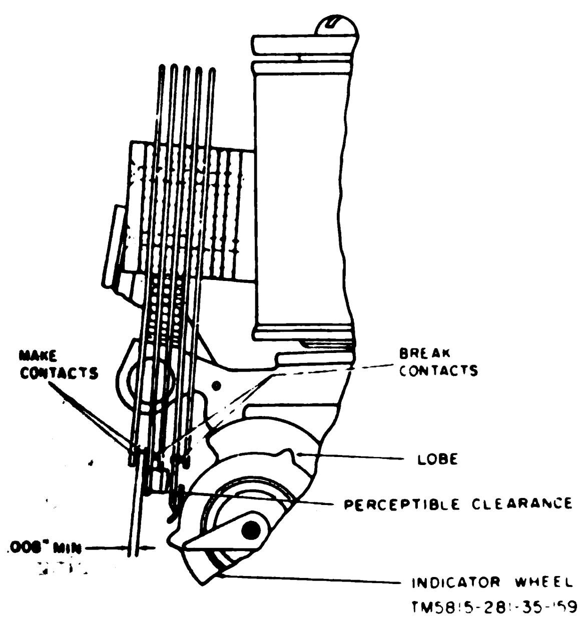


Figure 159. Off-normal contact opening requirement.

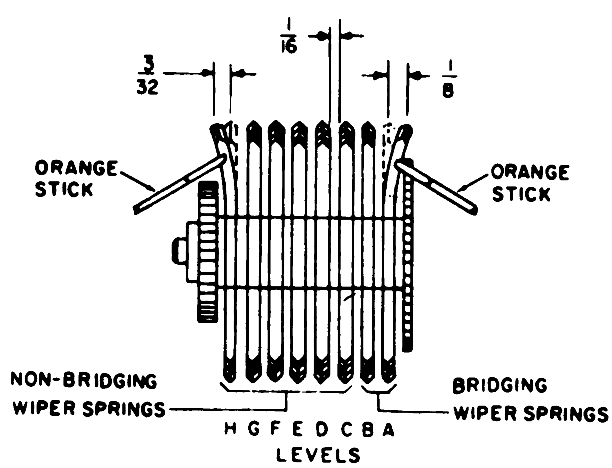


Figure 160. Main stepping switch wiper spring tension requirement.

space. As the wiper assembly is stepped, visually check the horizontal movement of the tip of each wiper spring. Repeat the check for the opposite set of wiper springs.

(2) To check the requirement given in *a*(2) above, turn the wiper assembly until the wiper springs are on position 26 and check the clearance between the adjacent pairs of wipers. Turn the wiper assembly 180° and check the opposite set of the wipers.

c. Adjustment. Grasp the base of a wiper spring with duckbill pliers and carefully bend the contact wipers as required. Check the related adjustment (para 169).

171. Main Stepping Switch Pawl Position Adjustment (fig. 161)

a. Requirement. The edge of the pawl along its length must be parallel to the side of the ratchet wheel and the tip of the pawl must be parallel to the ratchet tooth it engages.

b. Method of Checking. Check the requirement visually when the armature is in the unoperated position.

c. Adjustment. Loosen the standoffs that hold the armature mounting bracket to the heelpiece. Adjust the position of the armature mounting bracket and armature until the requirement is met. Check the related adjustment (para 172).

172. Main Stepping Switch Armature Heelpiece Clearance Adjustment (fig. 161)

a. Requirement. When the armature is in the operated position, there should be a clearance of 0.002- to 0.003-inch between the armature and the heelpiece.

b. Method of Checking. Insert a 0.003-inch feeler gage between the armature and the heelpiece and move the armature to the operated position. The feeler gage must be held tightly. Remove the 0.003-inch gage; insert a 0.0015-inch feeler gage between the armature and the heelpiece and move the armature to the operated position. The 0.015-inch feeler gage must not be held tightly by the armature.

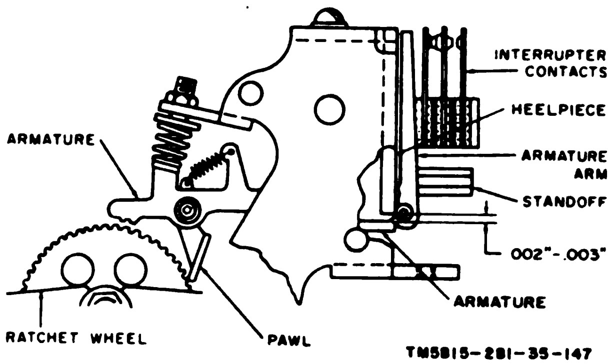


Figure 161. Main stepping switch pawl position adjustment requirement.

c. Adjustment. Loosen the standoffs that hold the armature mounting bracket to the heelpiece and adjust the position of the armature and bracket to meet the requirement. Check the related adjustments (para 171 and 173).

173. Main Stepping Switch Armature Alignment (fig. 161)

a. Requirement. The stepping teeth of the armature and the pawl tip should be centered with respect to the width of the teeth in the ratchet wheel.

b. Adjustment. Loosen the standoffs that hold the armature bracket to the heelpiece and adjust the position of the bracket and armature to meet the requirement. Check the related adjustments (para 171 and 172).

174. Main Stepping Switch Pawl Tip Tension Adjustment (fig. 162)

a. Requirement. A force of 130 to 150 grams should be required to move the tip of the pawl from the ratchet wheel.

b. Method of Checking. Hook a spring scale under the tip of the pawl and pull on the scale until the pawl moves out of engagement with the ratchet wheel. Note the scale reading as the pawl leaves the ratchet wheel.

c. Adjustment. Bend the pawl spring until the requirement is met. If the proper tension cannot be obtained by bending the spring, install a new spring.

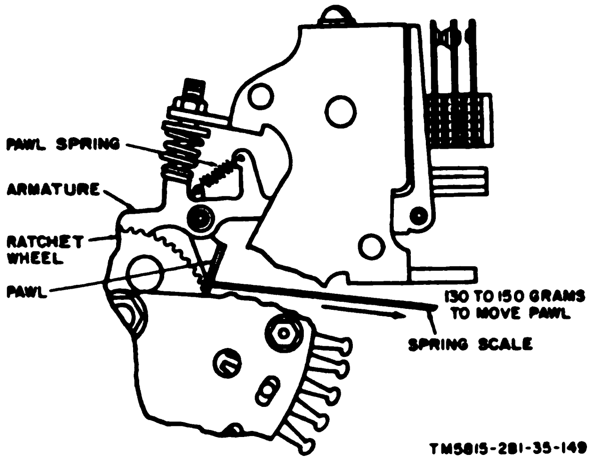


Figure 162. Pawl tip tension requirement.

175. Main Stepping Switch Ratchet Detent Tension Adjustment (fig. 163)

a. Requirement. A force of between 75 and 125 grams should be required to move the ratchet detent from the ratchet wheel.

b. Method of Checking. Hook a spring scale under the curve near the end of the ratchet detent and pull outward; read the scale as the tip of the ratchet detent leaves the ratchet wheel.

c. Adjustment. Bend the ratchet detent as needed to meet the requirement.

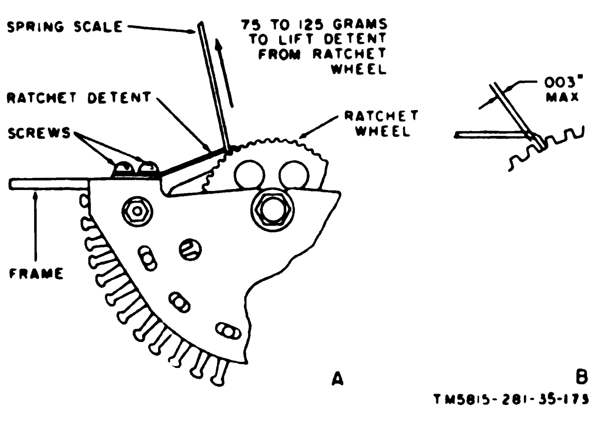


Figure 163. Ratchet detent requirements.

176. Main Stepping Switch Ratchet Detent Position Adjustment (fig. 163)

a. Requirement. When the play between the pawl and the ratchet wheel is taken up in the direction opposite the wiper rotation and the armature is in the unoperated position, the clearance between the end of the ratchet detent and the engaged tooth on the ratchet wheel must not exceed 0.003 inch.

b. Adjustment. Loosen the two screws that hold the ratchet detent to the frame of the switch. Position the ratchet detent to meet the requirement and tighten the screws.

177. Main Stepping Switch Contact Bank Position Adjustment (fig. 164)

a. Requirements.

(1) The full width of the tips of each wiper spring must be in contact with its associated contact.

(2) When the wiper assembly is stepped to any position of the switch, the tips of each bridging wiper spring must be in approximate alignment with the front edge of the associated bank contact and the tips of each nonbridging wiper must rest on the center third of its associated bank contact.

b. Methods of Checking.

(1) Turn the wiper assembly 1 full revolution and examine both tips of each wiper spring for full-width contact.

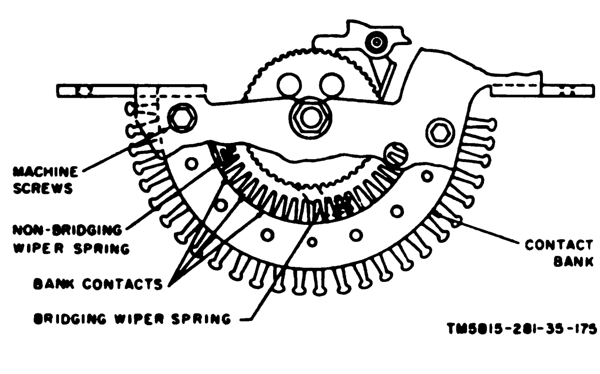


Figure 164. Contact bank position adjustment.

(2) Step the wiper assembly to several random positions on the contact bank and examine the points at which the tip of each wiper spring comes to rest.

c. *Adjustment.* Loosen the machine screws that hold the contact bank to the switch frame. Adjust the position of the contact bank to meet the requirements. Tighten the machine screws.

178. Main Stepping Switch Armature Drive Spring Compression Adjustment (fig. 165)

a. *Requirements.*

(1) A force of 17 to 22 ounces should be required to lift the armature and pawl out of engagement with the ratchet wheel when the armature is in the unoperated position.

(2) When rotation of the wiper assembly is retarded manually so that the assembly rotates slowly during a stepping operation, pressure of the armature drive spring must be sufficient to restore the armature fully to its normal unoperated position and the wiper assembly must move a full step to the next set of bank contacts.

b. *Methods of Checking.*

(1) Insert the hook of a spring scale under the armature at the point shown in figure 165. Pull the spring scale in the direction shown and note the scale reading as the armature and pawl leave the ratchet wheel.

(2) Manually lift the armature until the pawl engages the next tooth on the ratchet wheel. Hold the wiper assembly and permit it to be turned slowly by the pressure of the armature drive spring. Make certain that the spring pressure fully steps the switch.

c. *Adjustment.* Loosen the locknut on the adjusting screw. Turn the adjusting screw clockwise to increase the spring compression or counterclockwise to decrease the spring compression to meet the requirement given in *a*(1) above. Check the requirement given in *a*(2) above. If the requirement given in *a*(2) above is not met, check for binding of the armature and wiper assembly. Correct the cause of the binding and recheck the requirements.

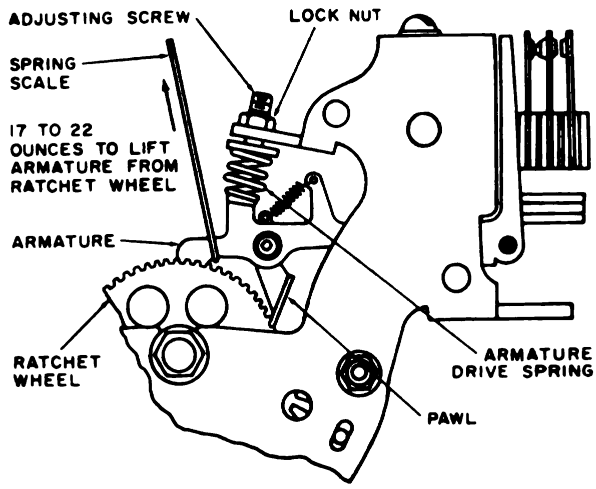


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Figure 165. Armature drive spring compression requirement.

179. Main Stepping Switch Interrupter Contacts Position Adjustment (fig. 166)

a. *Requirements.*

(1) When the armature is moved to the

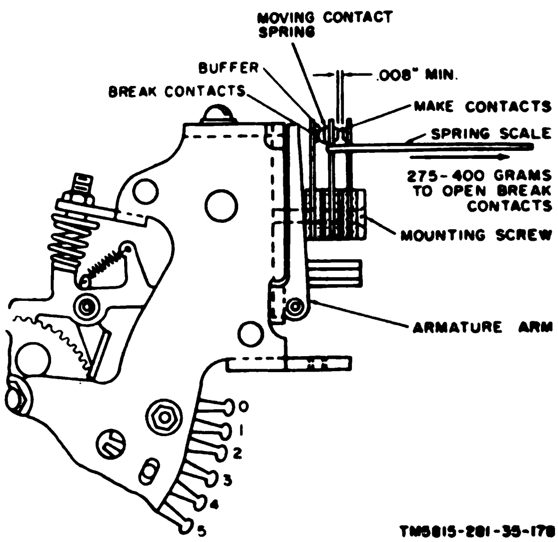

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Figure 166. Interrupter contacts spring tension and contact gap requirements.

operated position, the armature arm should be centered against the buffer of the contact spring.

(2) The interrupter contacts should not be out of alignment by more than one-fifth their face diameter and must make contact at approximately the center of the contact faces.

b. Method of Checking. Manually move the armature to the operated position and check the requirement.

c. Adjustment. Loosen the mounting screws that hold the interrupter contacts to the switch frame. Position the contacts to meet the requirements and tighten the mounting screws.

180. Main Stepping Switch Interrupter Contacts Spring Tension Adjustment (fig. 166)

a. Requirement. When the armature is in the unoperated position, a force of 275 to 400 grams should be required to open the break contacts.

b. Method of Checking. Insert the hook end of a spring scale under the buffer on the moving contact spring. Pull outward on the spring scale and note the tension of the spring scale as the contacts separate.

c. Adjustment. Bend the moving contact spring with a pair of duckbill pliers to meet the requirement.

181. Main Stepping Switch Interrupter Contacts Gap Adjustment (fig. 166)

a. Requirements.

(1) The contact gap of the break and make contacts should be at least 0.008 inch.

(2) The difference between the make contact gap and the break contact gap must not exceed 0.001 inch.

b. Method of Checking. Check the contact gap of the make contacts when the armature is in the unoperated position. Move the armature to the operated position and check the contact gap of the break contacts.

c. Adjustment. Bend the stationary (outer) contact springs with a pair of duckbill pliers until the requirements are met.

182. Main Stepping Switch Self-Interrupted Speed Test

a. Requirement. When each of the main stepping switches is self-interrupted through its interrupter contacts, the stepping switch must operate at the maximum uniform speed obtainable by adjustment.

b. Method of Testing. To observe the speed and smoothness of operation, connect each main stepping switch as outlined below:

(1) *Testing upper main stepping switch (NSA).*

(a) Connect a jumper between the winding terminal to which a blue wire is already connected and the interrupter contact terminal to which a green wire is attached.

(b) Connect the positive lead from a 48-volt power supply to terminal 12 of plug P1 and the negative lead to terminal 23 of plug P2.

(2) *Testing lower main stepping switch (NSB).*

(a) Connect a jumper between the winding terminal to which a black-yellow wire is attached and the interrupter contact terminal to which a violet-white wire is attached.

(b) Connect the positive lead of a 48-volt power supply to terminal 12 of plug P3 and the negative lead to terminal 23 of plug P4.

c. Adjustment. Adjust the interrupter contacts as described in paragraphs 179 through 181 until the maximum uniform self-interrupted speed is attained.

183. Relay Residual Gap Check (Relays TSA, TSB, STA, STB, FNA, FNB, KNA, KNB, SDA, and SDB) (fig. 167)

a. Requirement. The residual gap of relays TSA, TSB, STA, STB, FNA, FNB, KNA, KNB, SDA, and SDB should be 0.006 inch.

b. Method of Checking. Insert a 0.005-inch feeler gage between the armature and the core of the coil. Adjust the position of the gage until the residual disk on the armature is engaged in the hole in the gage. Move the armature to the operated position and gently push and pull on the gage to be sure that it slides between the armature and core. Repeat the test; use a 0.007-inch gage. The 0.007-inch gage should be held snugly between the armature and the core.

c. Adjustment. These relays have fixed residual gaps that can be checked but cannot be adjusted. If the relay does not meet the residual gap requirement, replace the relay.

184. Relay Residual Gap Adjustment (Relays TRA and TRB) (fig. 168)

a. Requirement. When the armature is in the operated position, there should be up to 0.004-inch clearance between the armature and the core of relays TRA and TRB.

b. Adjustment. Move the armature to the operated position and check visually for clearance between the armature and the core. If no clearance is present, loosen the locknut and turn the residual screw until there is just perceptible clearance between the core and the armature. Tighten the locknut. Insert the end of a 0.004-inch feeler gage between the armature and the core and adjust the position of the gage until the hole in the gage engages the end of the residual screw. Move the armature to the operated position and check to be sure that the feeler gage is held snugly between the core and the armature.

185. Relay Stroke Adjustment (fig. 169)

a. Requirement. When the armature is in the unoperated position (armature arms against the heelpiece residuals), the clearance between the core and either the residual screw or disk on the armature must be a 0.002-inch minimum and 0.025-inch maximum.

b. Methods of Checking.

(1) When the armature is in the unoperated position, check to see if a 0.025-inch gage (or combination of gages totaling 0.025 inch) can be inserted between the core and the residual screw or disk. The clearance must be sufficiently small either to prevent insertion of the gage, or, if insertion is possible, the gage must be held tightly in place by the armature and each

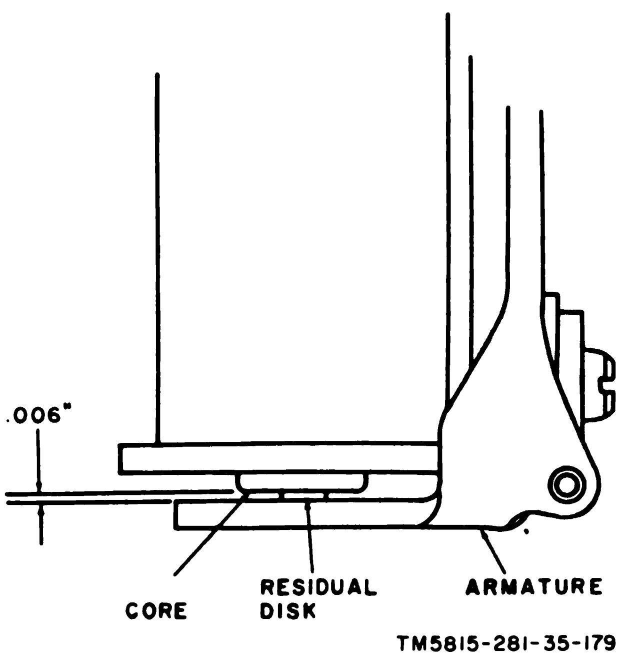


Figure 167. Residual gap requirement of fixed residual relays.

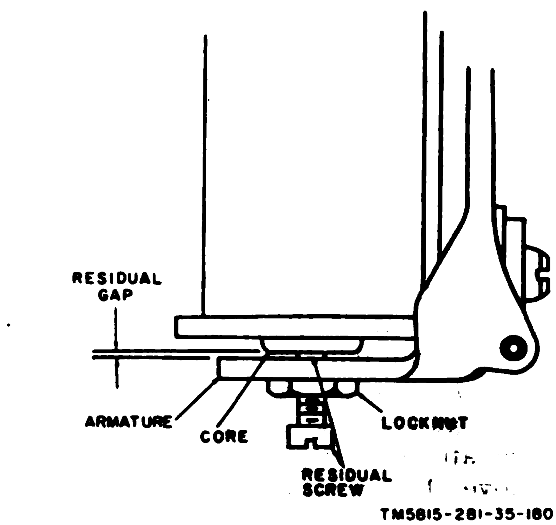


Figure 168. Residual gap requirement for adjustable residual relays.

armature arm must be against its heelpiece residual.

Note: Relays with a single contact spring pileup (fig. 163) include one armature arm; relays with two contact spring pileups (fig. 161 and 162) include two armature arms.

(2) Repeat the procedure in (1) above with a 0.020-inch gage. The gage should fit between the core and the residual screw or disk with no bind. Press the armature to hold the gage tightly against the core and check to be sure that some clearance is present between each armature arm and its heelpiece residual.

c. *Adjustments.*

(1) If the 0.025 gage fits loosely when making the check in *b*(1) above, remove the gage, hold the armature tightly against the core, and use an armature bender to bend either one or both armature arms (as required) slightly away from the contact springs. Repeat the checks given in *b*(1) and (2) above.

(2) If the 0.020-inch gage cannot be inserted when making the check in *b*(2) above, or if it can be inserted but is held tightly in place by the armature, hold the armature tightly against the core and use an armature bender to bend the armature arms slightly toward the contact springs. Repeat the checks given in *b*(1) and (2) above.

186. Relay Contact Spring Gaging Adjustment (fig. 170 and 171)

a. *Preliminary Check.* Check the contact springs for kinks, sharp bends, or bows that exceed 0.025 inch. Straighten any malformed contact springs before proceeding with the spring gaging adjustment. Use a pair of duckbill pliers with smooth gripping surfaces or a spring adjuster to straighten the springs (fig. 170). Position the tool at the base of the contact spring; twist the tool toward the contact to straighten the spring.

b. *Requirements.*

(1) *Maximum gaging.*

(a) With the relay energized, the make contacts should not close when a 0.010-inch feeler gage is held flush on the face of the core of the relay coil between the core and the armature.

(b) With the relay energized, the break contacts should not open when a 0.014-inch feeler gage is held flush on the face of the coil core.

(2) *Minimum gaging.*

(a) With the relay energized, the make contacts should close when a 0.006-inch feeler gage is held flush on the face of the core of the relay coil between the core and the armature.

(b) With the relay energized, the break contacts should open when a 0.010-inch feeler gage is held flush on the face of the coil core.

c. *Method of Checking.* Insert a feeler gage of the specific size for each of the requirements and energize the relay. Visually check to make sure that the make and break contacts open and close. Refer to figure 171 to determine which sets of contacts of each relay are make contacts and which are break contacts.

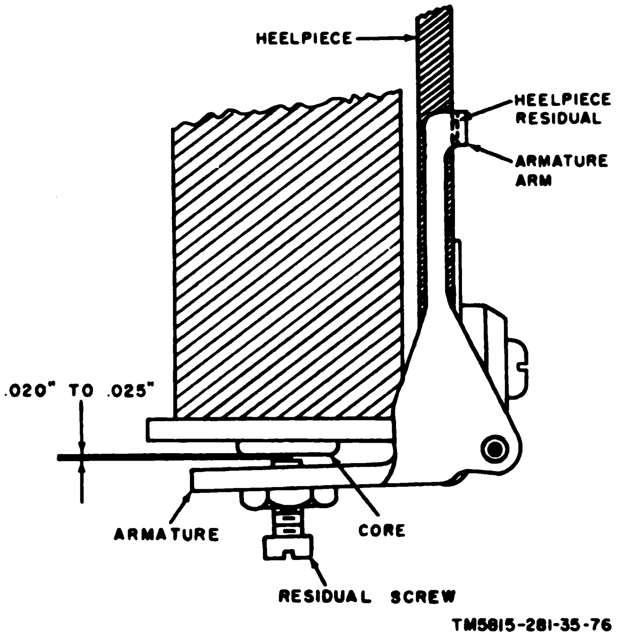


Figure 169. Relay stroke requirement.

d. Adjustments.

(1) If the requirements given in *a*(1) above are not met, bend the stationary spring slightly toward the armature springs for adjustment of the make contacts, or slightly away from the armature for adjustment of the break contacts. Adjust the stationary spring until the make contacts remain open when a 0.009-inch feeler gage is inserted between the core and the armature, and the break contacts remain closed when a 0.013-inch gage is inserted.

(2) If the requirements given in *a*(2) above are not met, bend the stationary spring slightly away from the armature spring for adjustment of the make contacts, or slightly toward the armature spring for adjustment of the break contacts. Adjust the stationary spring until the make contacts are closed when a 0.007-inch feeler gage is inserted between the core and the armature, and the break contacts are open when a 0.011-inch feeler gage is inserted.

(3) After all spring combinations are adjusted, completely recheck the requirements.

187. Relay Contact Adjustment (fig. 171)

a. Requirement. Each pair of contacts should make or break within 0.003 inch of the mating contact pair.

b. Method of Checking. Slowly operate the relay by hand, and as the contact pairs make or break, visually check to be sure that each pair opens or closes within the specified space limit of the other.

c. Adjustment. Bend the armature springs until both pairs of contacts make or break within 0.003 inch of each other.

188. Relay Electrical Tests and Adjustments

a. Requirement. Each relay must operate when the test value of the operate

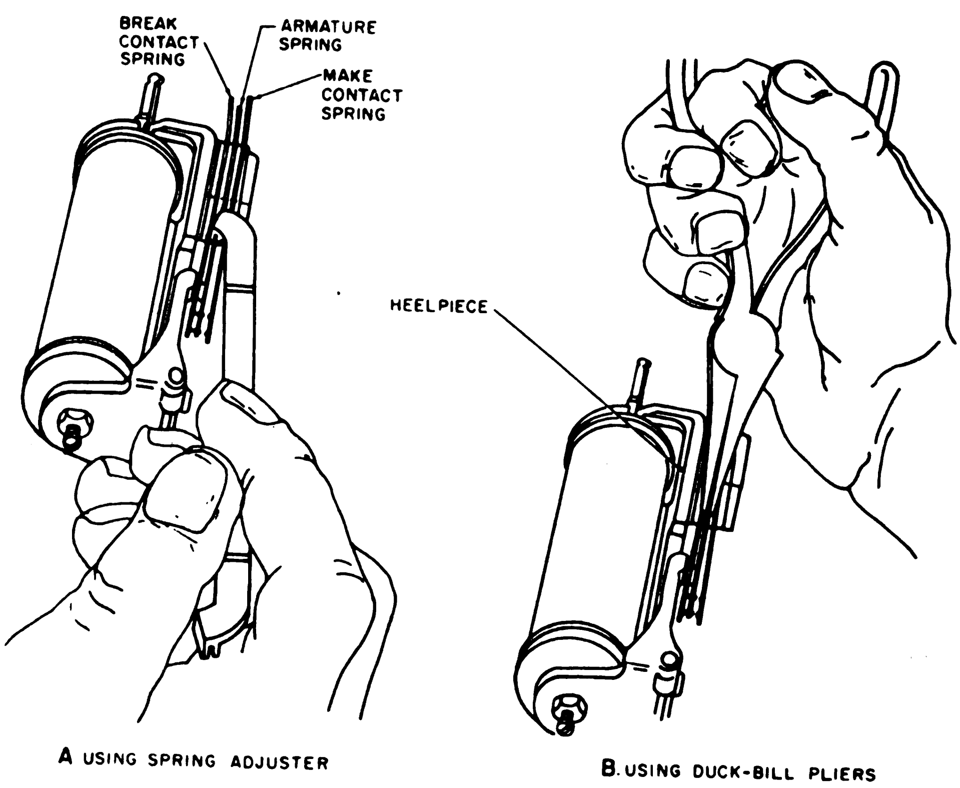


Figure 170. Contact spring adjustment.

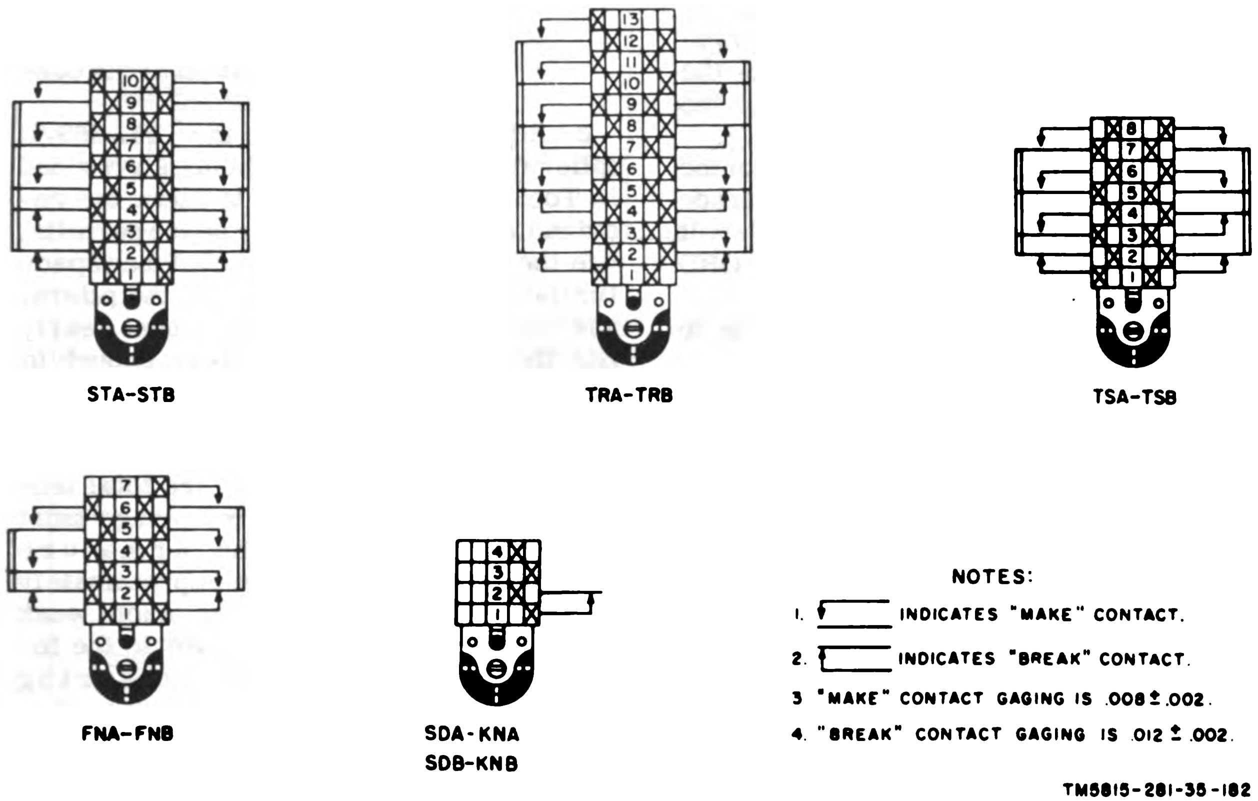


Figure 171. Relay spring contact arrangements.

current listed in the chart below is applied to the indicated winding of the relay. The relay must not operate when the test value of the nonoperate current is applied across the indicated winding of the relay.

Relay	Relay winding terminals	Operate current (ma)		Nonoperate current (ma)		Terminal to be connected to T-binding post of Test Set I-181 (negative battery)	Terminal to be connected to R-binding post of Test Set I-181 (positive battery)
		Test value	Readjust value	Test value	Readjust value		
STA	T-B	24.1	23.8	15.3	20.0	B	T
STB	T-B	24.1	23.8	15.3	20.0	B	T
FNA	R-L	13.1	12.6	10.5	11.0	L	R
FNB	R-L	13.1	12.6	10.5	11.0	L	R
TRA	T-B	17.2	16.9	13.5	14.2	B	T
TRB	T-B	17.2	16.9	13.5	14.2	B	T
TSA	R-L	25.6	24.3	15.0	15.6	L	R
TSB	R-L	25.6	24.3	15.0	15.6	L	R
KNA	R-L	19.0	18.5	16.0	16.5	L	R
KNB	R-L	19.0	18.5	16.0	16.5	L	R
SDA	R-L	7.5	7.0	5.0	5.5	L	R
SDB	R-L	7.5	7.0	5.0	5.5	L	R

Note: Use only the operate and nonoperate current *test* values listed in the chart to determine if the relay requires adjustment. If readjustment is necessary, also use the operate and nonoperate current *readjust* values in the chart.

b. Method of Checking. Use Test Set I-181 to test the relays for operate and nonoperate current requirements (fig. 172). The relays can be checked by connecting the test leads directly across the terminals of the relays (fig. 172). Remove the bottom cover from the control base to make connections. Remove the top cover from the control base to permit observation of the relays during tests. Check the operate and release current values of the relays as follows:

(1) Turn all resistance controls of the I-181 to the maximum resistance position and connect a 50 ±1-volt dc power supply the BAT and GRD terminals of the I-181.

(2) Connect a pair of test leads to binding posts T and R.

(3) Apply the test leads to the appropriate relay terminals as indicated in the chart.

(4) Adjust the current output to operate at the current value listed in the chart. Refer to TM 11-6625-202-10 for details of operation of the I-181.

(5) Operate the path 1 control key to SOAK for 1 second and apply the operate current to the relay as described in TM 11-6625-202-10.

(6) When the operate current is applied to the relay, the armature (or residual screw) must touch the core of the coil. Check to see that all make contacts are closed and that all break contacts are open. Refer to figure 171 to determine the make and break contact arrangement for the particular relay under test.

(7) Operate the controls of the I-181 to deenergize the relay winding and adjust the current to the nonoperate current value listed in the chart. Apply this current to the relay. The relay armature must remain in the unoperated position. Check to see that all make contacts remain open and that all break contacts remain closed.

c. *Adjustments*. Use the TL-369/U (pliers) or the spring adjusters provided in Tool Equipment TE-37 to make the required adjustments. Where space permits, use the pliers for adjustment. When space limitations prohibit the use of the pliers, use the spring adjuster that most nearly fits the spring but is still loose enough to slide along the spring freely.

(1) If the relay (A, fig. 173) operates when the nonoperate current was applied (*b*(7) above), the total tension of the armature springs must be increased. The armature springs should have approximately equal tension. Grasp each weak spring at a point close to the insulators and bend the spring slightly toward the heelpiece (fig. 170). Repeat the nonoperate test to check the adjustment. If the tension is still insufficient, grasp the spring close to the insulators and pull toward the contacts. Allow the pliers or spring adjuster to slide along the length of the spring, while twisting the hand and wrist to cause the spring to bow slightly away from the heelpiece (B, C, D, and E, fig. 173). Grasp the bowed spring close to the insulators and bend the spring against the break contact until it forms a straight line (F, fig. 173). Straighten any kinks in the relay

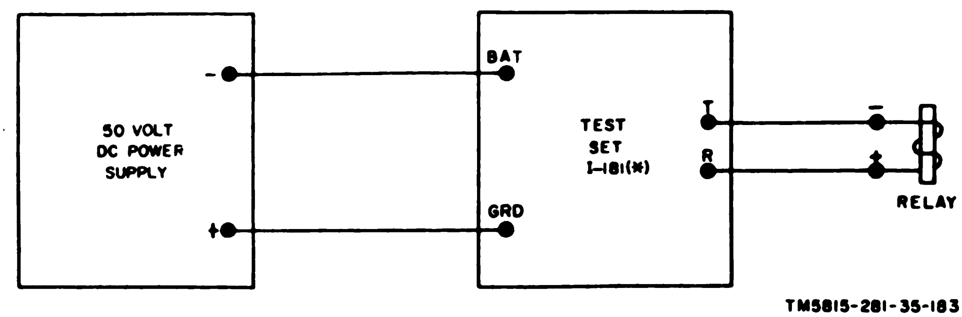


Figure 172. Relay test arrangement, block diagram.

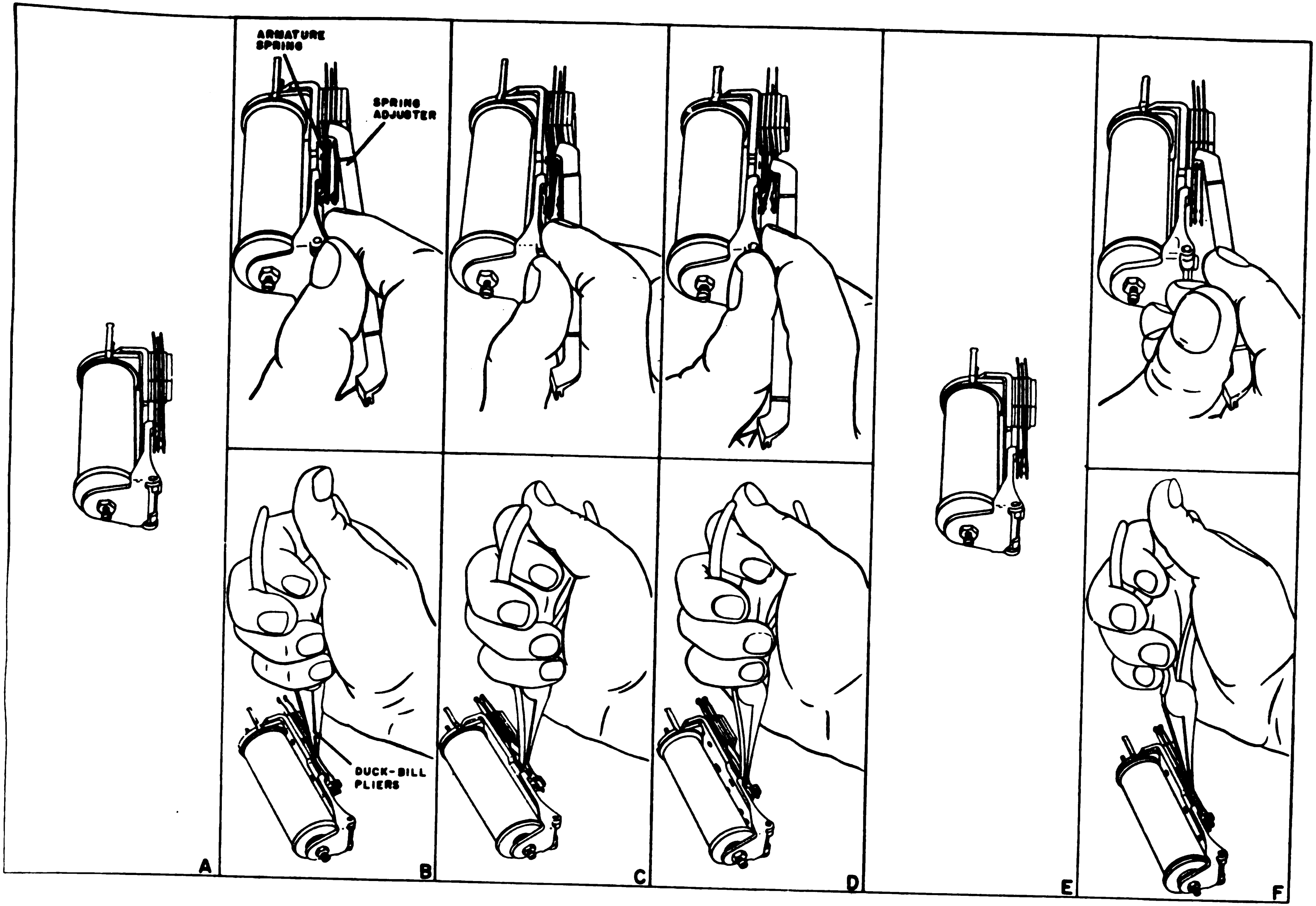


Figure 173. Technique of adjustment of relay contact spring tension.

and repeat the nonoperate tests listed in the chart in *a* above.

(2) If the relay did not operate during the operate test (*b*(5) and (6) above), the spring tension of the armature spring must be decreased. Grasp the armature spring to be adjusted at a point close to the insulators and bend the spring slightly away from the heelpiece. Repeat the operate test to check the adjustment. If the tension of the armature spring is still too great, grasp the armature spring at a point close to the insulators and pull the tool toward the contacts. Allow the pliers or spring adjuster to slide the length of the spring, while twisting the hand and wrist to cause the spring to bow slightly toward the heelpiece. Carefully straighten the spring. Adjust the spring tension until the relay meets the readjust operate current value listed in the value requirements chart in *a* above.

Section XII. SPRING DATA

189. General

This section contains data on the coil springs used in the distributor set. Use this data to determine whether a spring meets the tension requirement and also as a means of identifying springs. Replace all springs that do not meet the tension or compression requirements.

190. Crossed-End Spring Data (A, fig. 174)

Reference No.	Name	A Free length (in.)	B Extended length (in.)	Required tension, extended length (oz)	C Wire thickness (in.)	D No. of coils	E Outside diameter (in.)
58790	Counter lever spring..	21/32 ±1/32	1-1/16	20 ±2	0.020 ±0.0003	16-1/4	0.200
58795	Armature latch spring	39/64 ±1/32	1-1/16	1-1/2 ±1.5	0.009 ±0.0003	41-3/4	0.130
58796	Detent spring.........	5/8 ±1/32	15/16	30 ±3	0.020 ±0.0003	18-1/4	0.160
58798	Tape feed cam lever spring.	29/32 ±1/64	1-3/8	33 ±3	0.022 ±0.0003	28-3/4	0.172
58799	Tape feed operating lever spring.	13/16 ±1/64	1-3/16	32 ±3	0.022 ±0.0003	24-1/4	0.172
58801	Restore lever and comb assembly spring.	21/32 ±3/64	1-5/16	4-1/2 ±1/2	0.011 ±0.0003	40-1/4	0.127
60007	Armature spring	11/16 ±1/64	1	32 ±3	0.022 ±0.0003	18-3/4	0.174

191. Parallel-End Spring Data (B, fig. 174)

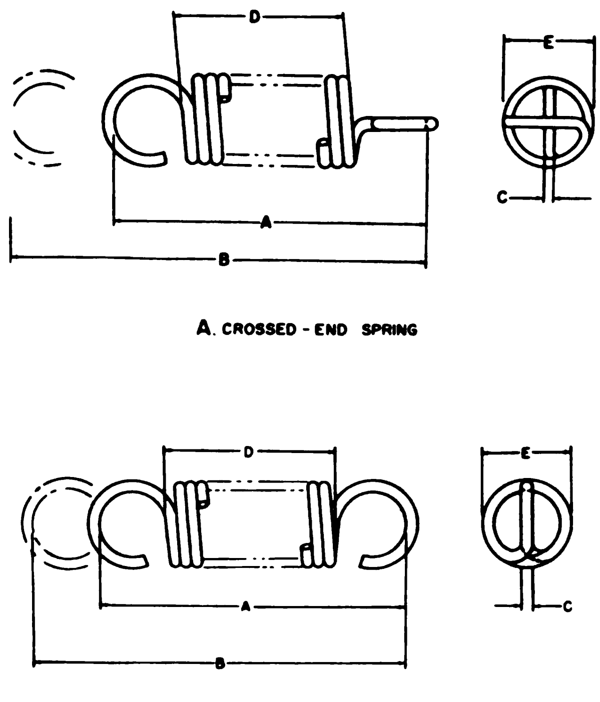
Reference No.	Name	A Free length (in.)	B Extended length (in.)	Required tension, extended length (oz)	C Wire thickness (in.)	D No. of coils	E Outside diameter (in.)
52193	Sensing lever latch spring.	15/32	9/16	10 ±1	0.016 ±0.0003	11-1/4	0.156
58792	Driving dog spring ...	3/8 ±1/32	1/2	6 ±0.6	0.013 ±0.0003	11	0.136
58799	Tape feed operating lever spring.	31/32 ±1/32	1-3/8	50 ±5	0.022 ±0.0003	27-1/2	0.175
58806	Clutch pawl spring....	27/64 ±1/32	5/8	4 ±0.4	0.012 ±0.0003	13-1/2	0.148

192. Compression Spring Data (fig. 175)

Reference No.	Name	A Free length (in.)	B Compressed length (in.)	Required tension, extended length (oz)	C Wire thickness (in.)	D No. of coils	E Outside diameter (in.)
54933	Friction clutch spring.	1/2 ±3/64	9/32	168 ±12	0.067 ±0.001	3-1/2	0.6875 ID
57203	Tape cover latch spring.	15/32 ±1/32	9/32	20 ±3	0.013 ±0.0003	18	0.086 OD
58797	Contact wiper spring	5/8 ±1/32	17/32	2-3/4 ±0.5	0.010 ±0.0003	27	0.078 OD

193. Special Spring Data

Fig. No.	Reference No.	Name	A Free length (in.)	B Extended length (in.)	Required tension, extended length (oz)	C Wire thickness	D No. of coils	E Diameter (in.)
A, fig. 176	56324	Tape cover spring.	......	......	......	0.016 ± 0.0003	7	0.114 ID
A, fig. 177	58733	Adjusting arm spring.	......	......	......	0.020 ± 0.0003	1	3/64 ID
Fig. 179	58788	Cam ratchet detent spring.	......	......	......	0.044 ± 0.0005	2¼	0.468 ID
Fig. 178	58789	Counter pawl spring.	......	......	....	0.015 ± 0.0003	5-1/8	0.310 ID
B, fig. 177	58791	Tape-out lever spring.	¾ ± 1/32	.....	......	0.022 ± 0.0003	32-7/8	0.156 ID
B, fig. 176	58802	Sensing lever spring.	1 ± 1/32	1-5/16	10 ± 1	0.015 ± 0.0003	44	0.120 OD
B, fig. 176	58860	Sensing lever comb spring.	½ ± 1/32	5/8	2¾ ± 0.3	0.011 ± 0.0003	18¼	0.123 OD
Fig. 178	59660	Indexing ratchet detent spring.	......	......	......	0.022 ± 0.0003	3-1/8	0.295 ID
Fig. 179.1	A63981	Miniature bulb holding springs, silver plated beryllium copper.	......	......	......	0.007 inch	—	0.24 inch
	A63982					0.007 inch	—	0.20 inch



B. PARALLEL-END SPRING
TM5815-281-35-174

Figure 174. Crossed-end and parallel-end springs.

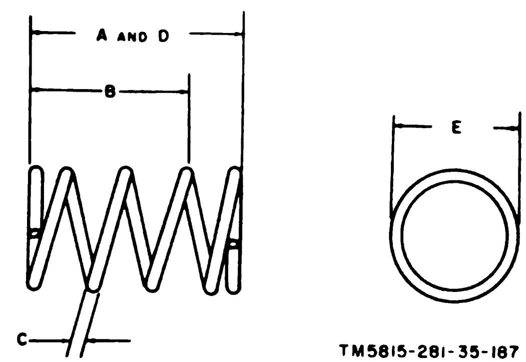


Figure 175. Compression spring.

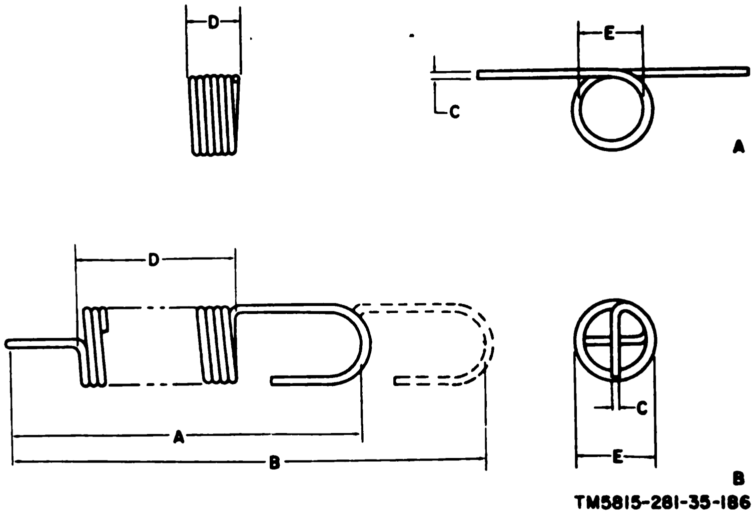


Figure 176. Tape cover spring, sensing lever spring, and sensing lever comb spring.

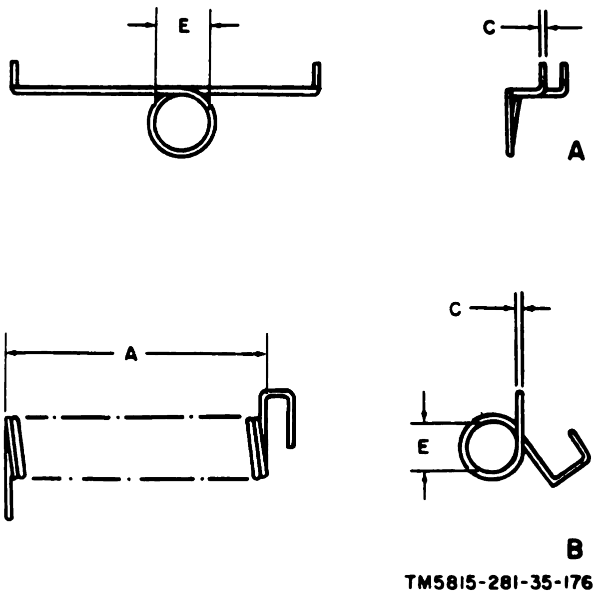


Figure 177. Adjusting arm spring and tape-out lever spring.

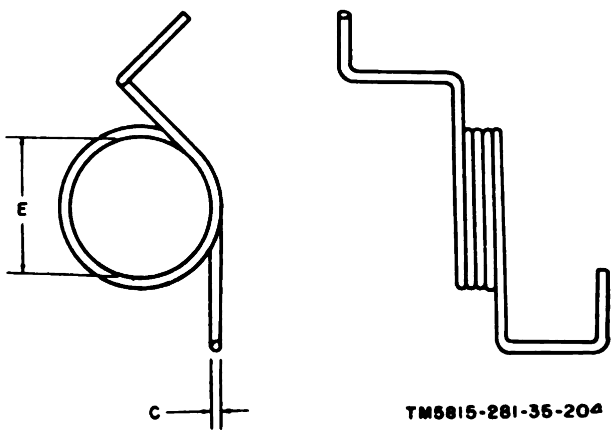


Figure 178. Indexing ratchet detent spring and counter pawl spring.

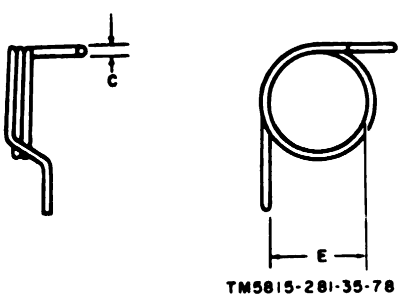


Figure 179. Cam ratchet detent spring.

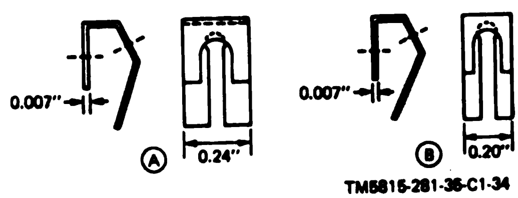


Figure 179.1. Photo-reader bulb holding spring.

CHAPTER 4

FOURTH AND FIFTH ECHELON MAINTENANCE AND TESTING PROCEDURES

Section I. GENERAL

194. Scope of Fourth and Fifth Echelon Maintenance and Testing Procedures

a. *Maintenance Procedures.*

(1) *Fourth echelon.* Fourth echelon maintenance of the distributor set includes all lower echelon maintenance procedures plus the replacement of parts not authorized for replacement at lower echelons.

(2) *Fifth echelon.* Fifth echelon maintenance of the distributor set includes all lower echelon maintenance procedures plus the repair and part fabrication operations made possible by the availability of metal-working tools and equipment such as lathes and welding equipment.

b. *Testing Procedures.*

(1) *Fourth echelon.* The testing procedures described in paragraphs 197 through 214 of this chapter are prepared for use by Signal Field Maintenance Shops and Signal Service Organizations responsible for fourth echelon maintenance of the distributor set. These procedures describe specific performance requirements that a repaired distributor set *must* meet before it is returned to a using organization. The testing procedures may also be used as a guide for testing the distributor set at a third echelon maintenance site if the proper tools and test equipment are available. When using the testing procedures, be sure to perform each test in the sequence presented. Comply with the instructions preceeding each chart before performing the first step in the chart. Perform each step in sequence. For each step, perform all actions listed in the *Control settings* columns; then perform each specific test procedure and verify it against the performance standards.

(2) *Fifth echelon.* Fifth echelon testing procedures are the same as the testing procedures used at fourth echelon shops.

195. Test Equipment, Tools, and Materials Required for Testing

All test equipment, tools, materials, and other equipment required to perform the testing procedures in this chapter are listed in the following charts and are authorized under TA 11-17 and TA 11-100 (11-17).

a. *Test Equipment.*

Nomenclature	Federal stock No.	Technical manual
Test Set I-181	6625-229-1042	TM 11-6625-202-10
Voltmeter, Meter ME-30A/U.	6625-669-0742	TM 11-6625-320-12
Multimeter TS-352/U.	6625-242-5023	TM 11-5527
Ohmmeter ZM-21/U.	6625-246-5880	TM 11-2050A
Distortion Test Set TS-383A/GG.	6625-322-1714	TM 11-2217
Variable Power Transformer CN-16(*)/U (or equal).	5950-235-2086	None

b. *Tools.* Tool Equipment TE-50-B, Federal stock No. 5180-356-4602 is required for final testing procedures.

c. **Materials.**

Qty	Material	NSN
3	Toggle switch, double pole, double throw, JAN type ST52K.	5930-00-060-2704
3	Toggle switch, single pole, single throw, JAN type ST52N.	5930-00-060-2707
1	Connector, electrical, 50-pin female.	
1	Terminal board, 20-position.	
1	Terminal board, 6-position.	
2	Fuseholder	5920-00-285-0755
1	Jack, telephone, JAN type JJ-089 (normally closed, 2-conductor).	5935-00-192-4789
2	Plug, male polarized.	
1	Milliammeter, dc, center zero, 0-100 ma range.	6625-00-196-6587
1	Resistor, variable, 0-5,000 ohms, 25 watts.	5905-00-108-6308
1	Resistor, fixed, 1,000 ohms, 25 watts.	5905-00-100-6855
1	Resistor, variable, 0-8,000 ohms, 4 watts.	
1	Resistor, variable, 0-50 ohms, 150 watts.	
1	Resistor, variable, 0-20,000 ohms, 10 watts.	
As reqd	Wire, copper, insulated, No. 20 hookup.	
5	Resistor, fixed, 39K, ¼ watt.	
1	Terminal board, 6-position.	
1	Jack, tip, red.	
1	Jack, tip, black.	
7	Connector, receptacle, electrical.	

d. Other Equipment.

(1) Ac ammeter, 0- to 10-ampere range.
(2) Source of 48-volt and 120-volt dc.
(3) Source of 40-volt dc.

196. Fabrication of Transmitter Test Circuit

High- and low-level test of the transmitter requires a test circuit (fig. 180). Use the materials listed in paragraph 195*c* to build the test circuit. Refer to figure 184 for a suitable front panel arrangement of the test circuit. Test points TP1 through TP7 and 40-volt supply jacks are mounted on the rear of the test circuit.

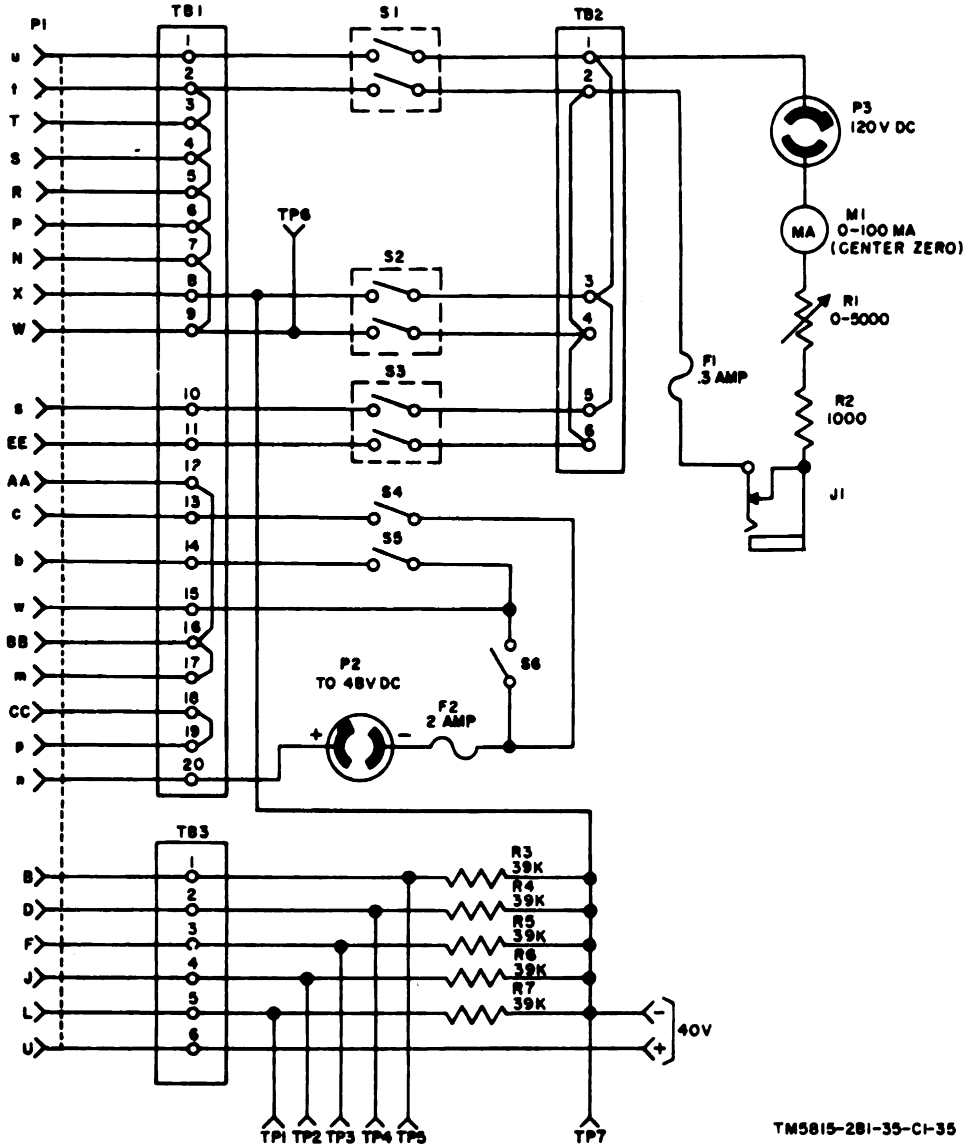


Figure 180. Transmitter test circuit.

Section II. TRANSMITTER TESTS

197. Transmitter Physical Tests and Inspection

a. Test Equipment and Materials. None required.

b. Test Connections and Conditions. Remove the motor dust cover.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	N/A	N/A	*a.* Inspect transmitter for loose or missing screws. *b.* Inspect all cords, plugs, and connectors, for wear, damage, and cleaniness. *c.* Inspect power switch for binding, freedom of movement, and positive action. *d.* Check movement of stop-start lever and tight-tape lever.	*a.* All screws are tight. None missing. *b.* Cords, plugs, and connectors are not worn, bent, or damaged and are free from dirt and corrosion. *c.* Switch moves freely. *d.* Levers move freely without binding.
2	N/A	N/A	*a.* Inspect motor and transmitter dust covers for dents, cracks, and chipped paint. *b.* Inspect base frame for chipped or worn paint. *Note:* Touchup painting is recommended in lieu of refinishing whenever practicable. Screwheads, binding posts, receptacles, and plated fastener parts will not be painted or polished with abrasives.	*a.* Motor and transmitter dust covers are free from dents, cracks, or chipped paint. *b.* Base frame is properly painted.
3	N/A	Move stop-start lever to start.	*a.* Turn motor target wheel by hand. *b.* Manually operate distributor clutch magnet armature and turn motor target wheel by hand. *c.* Manually operate distributor and reader clutch magnet armatures and turn motor target wheel by hand.	*a.* Motor should turn freely. *b.* Motor should turn freely with camshaft turning. *c.* Motor should turn freely while transmitter camshaft and tape-reader mechanism are operating.

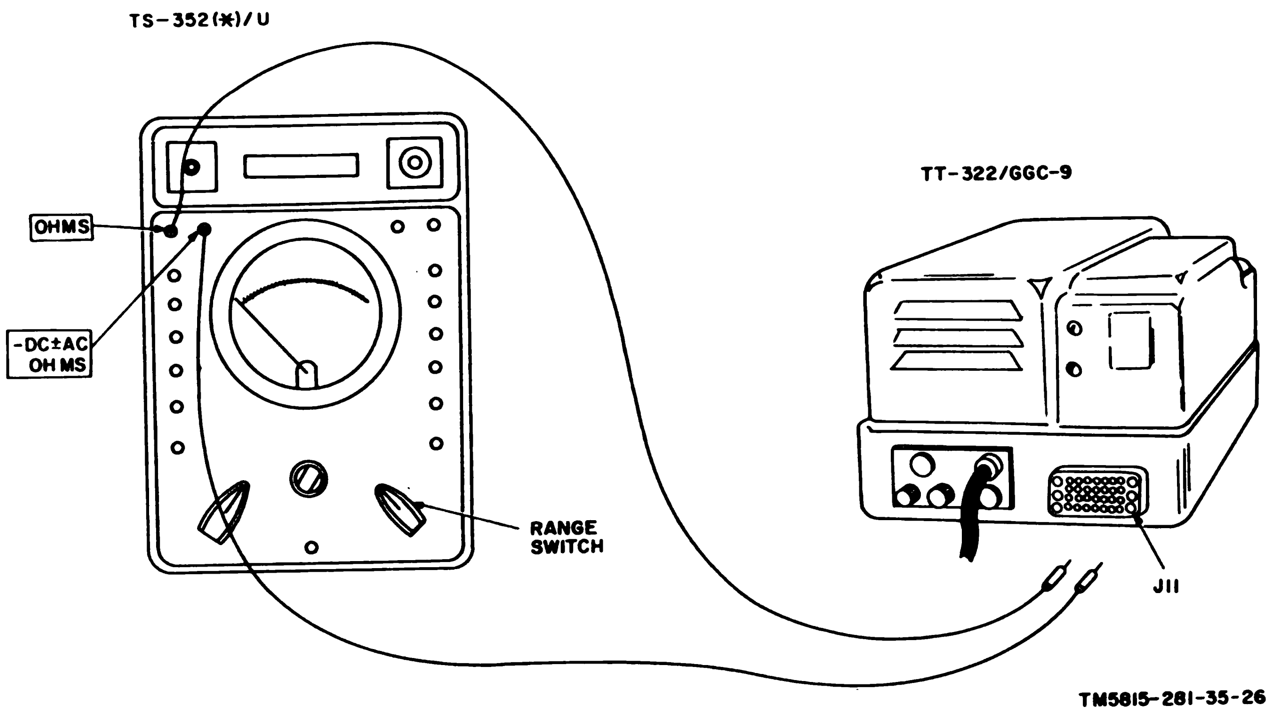


Figure 181. Transmitter continuity and resistance test setup.

		b. No. 2. *c.* No. 3. *d.* No. 4. *e.* No. 5.	*b.* P and X. *c.* R and X. *d.* S and X. *e.* t and X.	
4	Same as step 1 above.	Perform following actions: *a.* Manually close blank tape switch. *b.* Move STOP-START lever to STOP. *c.* Move the STOP-START lever to START. *d.* Depress tape-out sensing finger. *e.* Release tape-out sensing finger. *f.* Turn transmitter camshaft to close numbering pulsing switch.	Apply meter test probes across following terminals of jack J11: *a.* Y and A. *b.* x and n. *c.* p and n. *d.* m and cc. *e.* r and cc. *f.* ee and s.	Same as step 1 above.
5	TS-352/U: Range switch: RX1000 FUNCTION switch: OHMS	N/A *a.* NA. *b.* NA. *c.* Manually operate reader clutch magnet armature.	Apply meter test probes across followin terminals of jack J11 and read resistance: *a.* w and bb. *b.* aa and c. *c.* aa and b.	Between 548 and 709 ohms. Between 548 and 709 ohms. Between 548 and 709 ohms.

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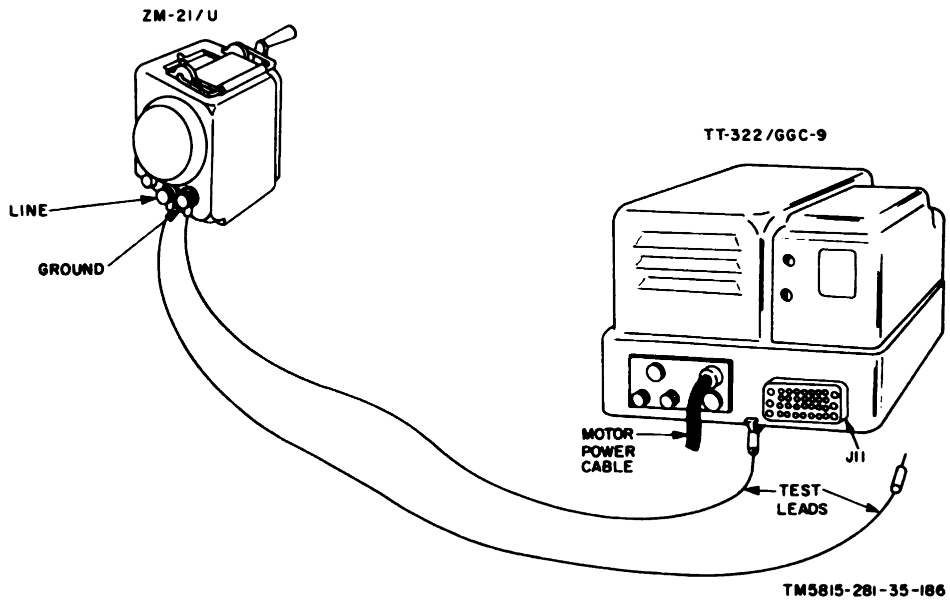

Figure 182. Transmitter insulation resistance test setup.

199. Transmitter Insulation Resistance Test

a. *Test Equipment and Materials.* Use Ohmmeter ZM-21/U to make the insulation resistance checks described below.

b. *Test Connections and Conditions.*

(1) Remove the motor dust cover.
(2) Disconnect all power and signal lines.
(3) Conduct the tests at normal room temperature (65°-80° F).
(4) Connect the test leads to the LINE and GROUND binding posts on the ohmmeter.
(5) Connect the equipment as shown in figure 182.

c. *Procedure.*

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	ZM-21/U: None	Power switch: ON	Connect ground lead of ohmmeter to an unpainted portion of transmitter base frame. Connect line lead, in turn, to each *ungrounded* terminal of plug at end of motor power cable. Operate ohmmeter crank.	Ohmmeter indicates not less than 8 megohms.
2	Same as step 1.	Stop-start lever: START. Transmitter camshaft at stop position.	Connect ground lead of ohmmeter to unpainted portion of transmitter base frame. Connect line lead to each pin (in turn), of jack J11. Operate ohmmeter crank.	Same as step 1.

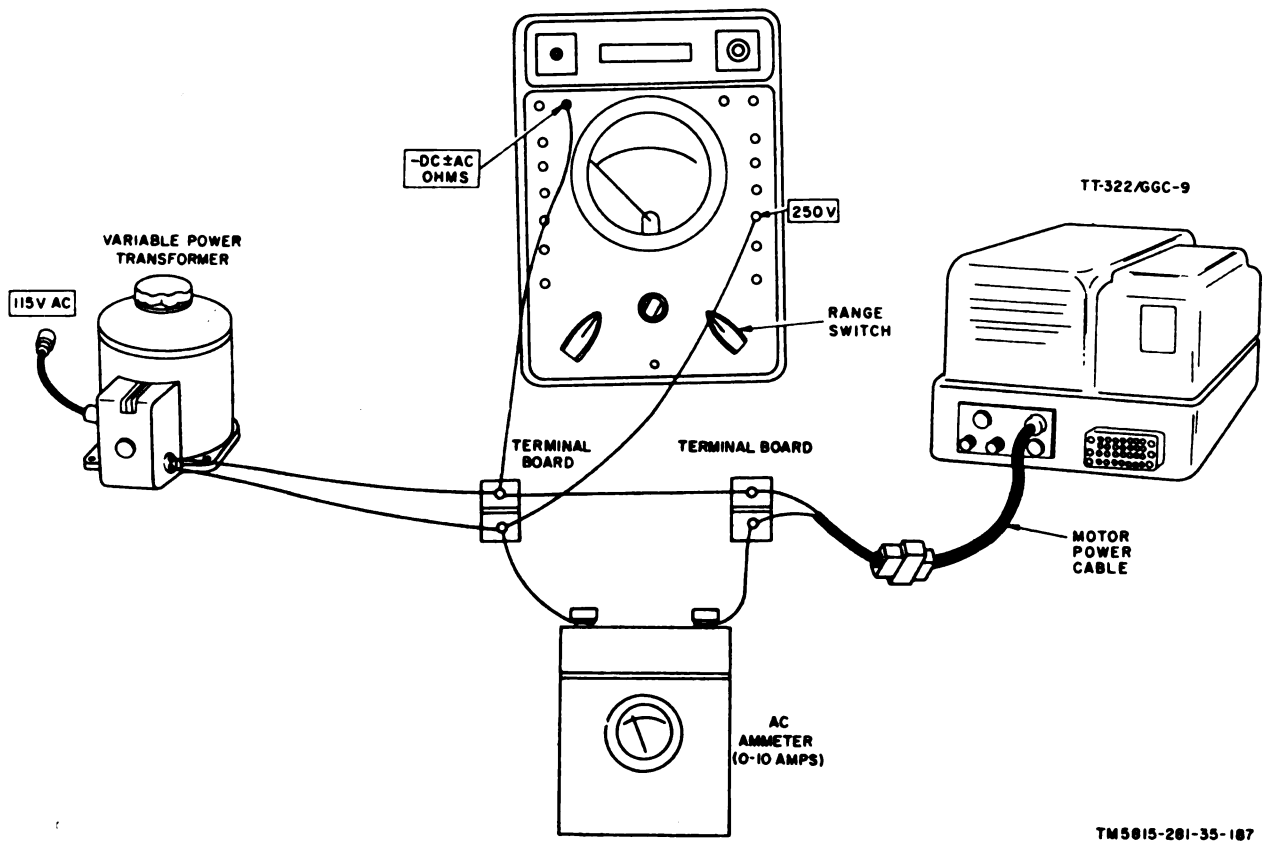

Figure 183. Transmitter motor test setup.

200. Motor Test

a. Test Equipment and Materials.

(1) Variable power transformer, 115-volt ac input, 0-140-volt output.

(2) Multimeter TS-352/U.

(3) Ac ammeter, 0-10 amperes.

(4) 180 vibrations per second (vps) tuning fork equipped with shutters.

b. Test Connections and Conditions (fig. 183).

(1) Connect a multimeter adjusted to indicate ac voltage across the output of the variable power transformer, in parallel with the power plug of the transmitter motor power cable.

(2) Connect a 0-10 ampere ac ammeter in series with one side of the transmitter motor power cable.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	TS-352/U FUNCTION switch: AC VOLTS. Variable power transformer: Adjust to 105-volt output.	POWER switch: ON	Use tuning fork to check and adjust speed of motor.	Correct motor speed can be obtained (target spots appear stationary) with 105-volt input.
2	TS-352/U: FUNCTION switch: AC VOLTS. Variable power transformer: Adjust to 125-volt output.	POWER switch: ON	Use tuning fork to check and adjust motor speed.	Correct motor speed can be obtained with 125-volt input.
3	TS-352/U: FUNCTION switch: AC VOLTS. Variable power transformer: Adjust to 115-volt output.	POWER switch: ON	*a.* Use tuning fork to check and adjust motor speed. *b.* Check ac ammeter current indication.	*a.* Correct motor speed can be obtained. *b.* Current drawn does not exceed 1.4 amperes.
4	N/A	POWER switch: OFF, and then to ON.	*a.* Check ac ammeter for maximum starting current indication. *b.* Operate motor for minimum of 30 minutes; check operating speed and current indication every 10 minutes.	*a.* Current does not exceed 2.5 amperes. *b.* Motor speed remains constant and current does not exceed that originally observed in step 3*b* above by more than 0.2 amperes.

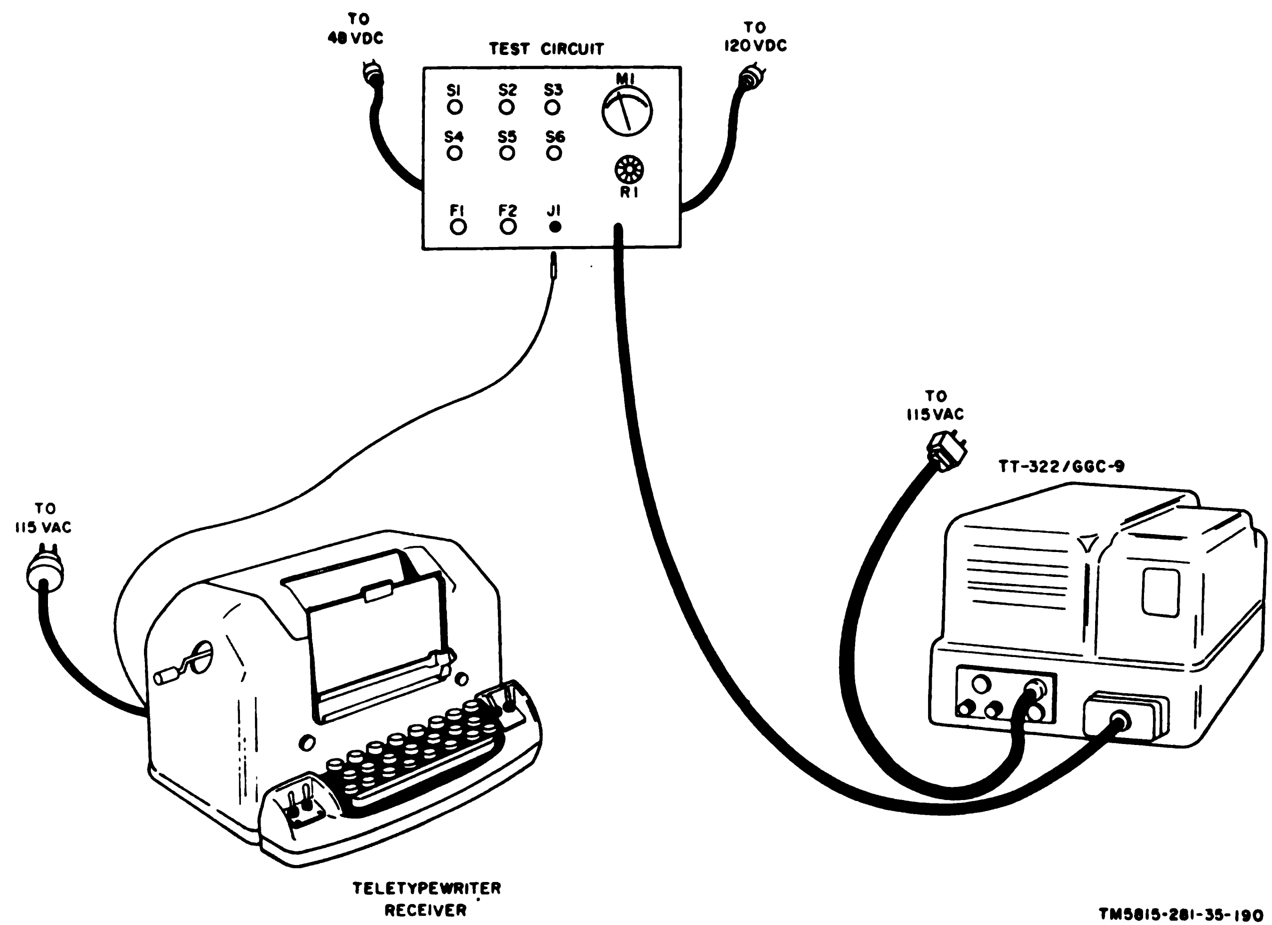

Figure 184. Transmitter operational test setup.

201. Operational Test

a. *Test Equipment and Materials.*

(1) Teletypewriter receiver (preferably page printer) in good operating condition and having a signal line connection terminating in a telephone type plug.

(2) Test circuit (para 196).

(3) Message tape containing repeated test message.

b. *Test Connections and Conditions.*

(1) *Teletypewriter receiver.* Motor switch: ON.

(2) *Test circuit.* All switches to OFF and 0-5000 ohm resistor in the extreme counterclockwise position.

(3) *Connections.* Interconnect the equipment as shown in figure 184.

c. *Procedure.*

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	Test Circuit: Adjust variable resistor to obtain 60 ma indication on meter M1.	Power switch: ON Stop-start lever: FEED RETRACT	*a.* Observe motor. *b.* Observe transmitter. *c.* Observe receiver.	*a.* Motor operates. *b.* Transmitter camshaft does not turn. *c.* Receiver runs closed.
2	Test circuit: Switch S6: ON.	Insert test message tape in transmitter.	*a.* Move stop-start lever to STOP. *b.* Move stop-start lever to START.	*a.* Transmitter camshaft does not turn. *b.* Transmitter camshaft turns but tape does not feed.
3	Test circuit: Switch S4: ON.	N/A	*a.* Observe transmitter. *b.* Observe receiver.	*a.* Tape feeds through transmitter. *b.* Receiver receives test message.
4	Test circuit: Switch S5: ON Switch S6: OFF	N/A	*a.* Observe transmitter. *b.* Move STOP-START lever to STOP. *c.* Move STOP-START lever to START.	*a.* Tape continues to feed through transmitter. *b.* Transmitter camshaft stops. *c.* Transmitter camshaft remains stopped.
5	Test circuit: Switch S6: ON (momentarily).	N/A	*a.* Observe transmitter. *b.* Allow transmitter to transmit repeated test messages. *c.* Check received copy.	*a.* Transmitter starts and continues to run. *b.* Test messages received properly by teletypewriter receiver. *c.* Received copy is identical with transmitted message.
6	Test circuit: All switches: OFF.	N/A	Check message tape transmitted.	Feed holes and code holes are free from distortion and elongation.

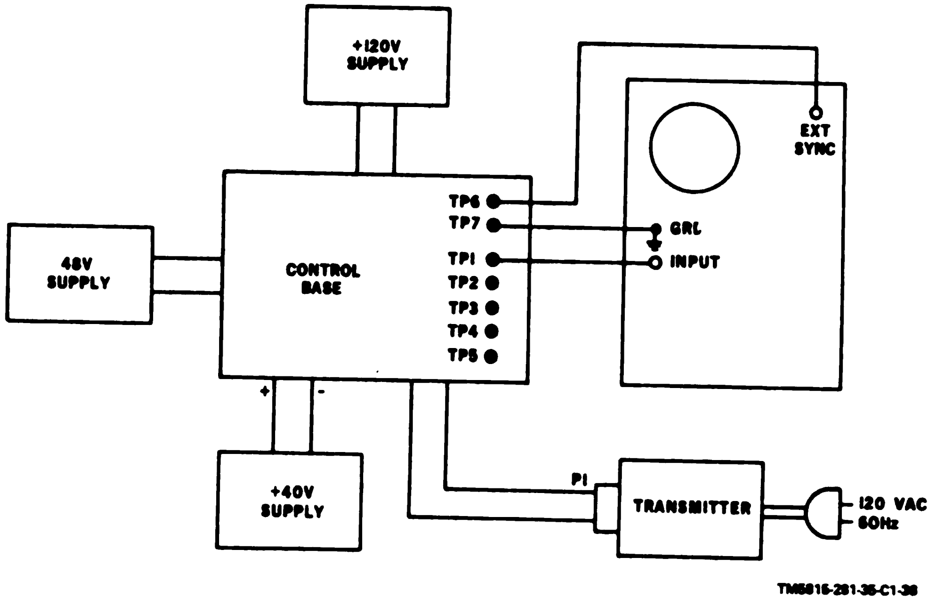

Figure 184.1. Transmitter operational test setup for photo-reader assembly (A2)

201.1 Operational Test for Photo-Reader (A2)

a. *Test Equipment and Materials.*

(1) Test circuit (para 196).

(2) Message tape. Punch tape with 20 to 30 characters of "blank" (use tape feed advance) followed by 20 to 30 characters of "LETTERS" (all 5-holes punched).

(3) Oscilloscope.

b. *Test Connections and Conditions.*

(1) Test circuit: all switches off.

(2) Oscilloscope: power switch to ON.

(3) Connections: Interconnect the equipment as shown in figure 184.1.

c. *Procedure.*

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	Test Circuit: Power switch to ON	Power switch: ON Stop-start lever: FEED RETRACT	*a.* Observe motor *b.* Observe transmitter	*a.* Motor operates. *b.* Transmitter camshaft does not turn.
2	Test circuit: Switch S6: ON Switch S2: ON Oscilloscope: Horizontal to external sync on "+" edge at 20 sec/cm vertical to 10 V/cm	Insert test message tape on transmitter	*a.* Move stop-start lever to STOP. *b.* Move stop-start lever to START.	*a.* Transmitter camshaft does not turn. *b.* Transmitter camshaft turns but tape does not feed. Oscilloscope on stop contact opening. Waveform should appear as a ground level dc signal.
3	Test circuit switch S4: ON	N/A .	*a.* Observe transmitter *b.* Observe oscilloscope.	*a.* Tape feeds through transmitter. *b.* Waveform remains at ground level while "blank" portion of tape is being read and then changes to waveform shown in D figure 60.1 when "letters" code passes through reader.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
4	N/A	N/A	Move stop-start lever to FEED RETRACT	Transmitter camshaft stops and oscilloscope no longer triggers.
5	Move oscilloscope probe to TP2	Reinsert test tape at beginning.	Move STOP-START lever to START	Transmitter camshaft starts and oscilloscope waveform changes as described in step 3*b*.
6	Oscilloscope: Move probe to TP3, TP4, and TP5	Reconnect test tape at beginning of each test.	Repeat steps 3 and 4 for each test point.	Observe oscilloscope as described in step 3*b*.
7	Test Circuit: all switches: OFF	N/A	Check message tape transmitted.	Feed holes and code holes are free from distortion and elongation.

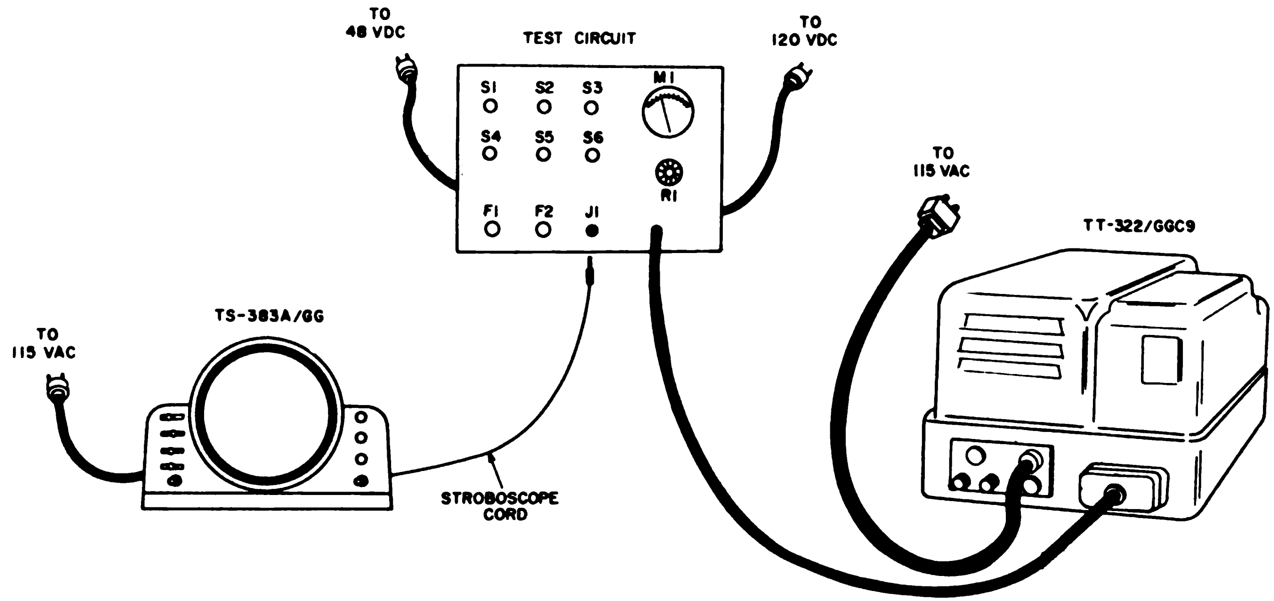

Figure 186. Signal bias and pulsing test setup.

2	Test circuit: Switch S4: ON.	Stop-Start lever: START.	Observe transmitter.	Tape feeds through transmitter.
3	Test circuit: Switch S5: ON. Switch S6: OFF.	N/A	*a.* Observe transmitter. *b.* Observe TS-383/GG.	*a.* Tape continues to feed through transmitter. *b.* Test set displays stop impulse 142 ±5 divisions long at 60 wpm (±7 divisions at 100 wpm). Orient test set scale to *stop impulse.*
4	Test circuit: Switch S2: OFF. Switch S1: ON.	N/A	Observe TS-382A/GG.	Test set displays latch pulse which starts between 5 divisions before and 20 divisions after start of No. 4 code impulse and ends 98 ±5 divisions after beginning of stop impulse.
5	Test circuit: Switch S1: OFF. Switch S3: ON.	N/A	Observe TS-383A/GG.	Test set displays numbering pulse which begins 0 to 15 divisions before end of start impulse and ends ±5 divisions within end of No. 5 code impulse.
6	Test circuit: Switch S4: OFF.	Stop-start lever: FEED RETRACT	Observe TS-382A/GG.	Test set displays steady 360° trace.
7	Test circuit: Switches S1, S3, and S6: OFF. Switches S2, S4, and S5: ON.	N/A	Insert test tape containing repeated Y signals in transmitter. Move stop-start lever to START. Move test circuit switch S6 to ON, then back to OFF.	Test set displays code impulses No. 1, 3, and 5 which begin and end within ±5 divisions of test set scale markings at 60 wpm (±7 divisions at 100 wpm) when scale is oriented with stop impulse.
8	Same as step 7 above.	N/A	Insert test tape containing repeated R signals in transmitter. Move stop-start lever to start.	Test set displays code impulses No. 2, 4, and stop which begin and end within ±5 divisions of test set scale markings at 60 wpm (±7 divisions at 100 wpm) when scale is oriented with stop impulse.

203. Summary of Transmitter Performance Standards

Personnel may find it convenient to arrange the checklist in a manner similar to that shown below:

Distributor-Transmitter, Teletypewriter TT-388/GGC-9

Test	*Performance standard*
1. INSULATION RESISTANCE	
a. Resistance between transmitter base frame and each pin of ac input plug.	*a*. Not less than 8 megohms.
b. Resistance between transmitter base frame and each pin of jack J11 (transmitter camshaft at stop position).	*b*. Not less than 8 megohms.
2. MOTOR TEST	
a. Acceptable motor input voltage range.	*a*. Motor speed can be adjusted to 3,600 rpm with input voltage of any value between 105 and 125 volts.
b. Current required to start motor.	*b*. Not more than 2.5 amperes.
c. Motor speed adjustment.	*c*. Not more than two white target spots pass any given point in either direction within 10 seconds.
d. Current drain while motor is operating at normal speed.	*d*. Not more than 1.4 amperes.
3. OPERATIONAL TEST	
a. Only distributor clutch magnet energized.	*a*. Transmitter camshaft turns, but tape does not feed.
b. Both distributor clutch magnet and tape-reader clutch magnet energized.	*b*. Tape feeds through transmitter.
c. Distributor clutch magnet circuit energized through distributor magnet pulsing switch S44; direct distributor clutch magnet circuit open.	*c*. Transmitter continues to operate, feeding tape.
d. Check received test message.	*d*. Test message correctly received.
e. Check transmitted message tape.	*e*. Code holes and feed holes are free from elongation and distortion.
4. SIGNAL BIAS AND PULSING TESTS	
a. Transmitter in stop condition.	*a*. Steady 360° trace on distortion test set.
b. Stop impulse length (blank code group transmission).	*b*. Stop impulse is 142 ±5 divisions long at 60 wpm (±7 divisions long at 100 wpm).
c. Latch pulse position and length.	*c*. Latch pulse starts between 5 divisions before and 20 divisions after start of No. 4 impulse, and ends 98 ±5 divisions after beginning of stop impulse.
d. Numbering pulse position and length.	*d*. Numbering pulse begins 0 to 15 divisions before end of start impulse and ends ±5 divisions of end of No. 5 impulse.
e. Position and length of code impulses No. 1, 3, and 5 (Y code group transmission).	*e*. Code impulses No. 1, 3, and 5 begin and end within ±5 divisions of test set scale markings at 60 wpm (±7 divisions at 100 wpm).
f. Position and length of code impulses No. 2 and 4 and stop impulse (R code group transmission).	*f*. Code impulses No. 2, 4, and stop impulse begin and end within ±5 divisions of test set scale markings at 60 wpm (±7 scale markings at 100 wpm).

Section III. NUMBERING BASE TESTS

204. Numbering Base Physical Tests and Inspection

a. Test Equipment and Materials. None required.
b. Test Condition. Remove the cover from the numbering base.
c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	N/A	N/A	*a.* Inspect the numbering base for loose or missing screws. *b.* Inspect all cables, plugs, and connectors for wear, damage, and cleanliness. *c.* Inspect all switches for binding, freedom of movement and positive action.	*a.* All screws must be tight, none missing. *b.* Cables, plugs, and connectors are not worn or damaged and are free from dirt and corrosion. *c.* Switches move freely.
2	N/A	N/A	*a.* Inspect cover and external panels for dents or cracks. *b.* Inspect switch mounting brackets for cracks or distortion. *Note:* Touchup painting is recommended in lieu of refinishing whenever practical. Screwheads, binding posts, receptacles, and plated fastener parts will not be painted or polished with abrasives.	*a.* Case and cover are free from dents and cracks. *b.* Brackets must be free from cracks or bends.
3	N/A	N/A	*a.* Manually operate main stepping switches NSA and NSB. *b.* Manually operate numbering stepping switches RUA, RUB, RTA, RTB, RHA, and RHB.	*a.* Main stepping switches step freely without binding or sticking. *b.* Numbering stepping switches step freely without binding.

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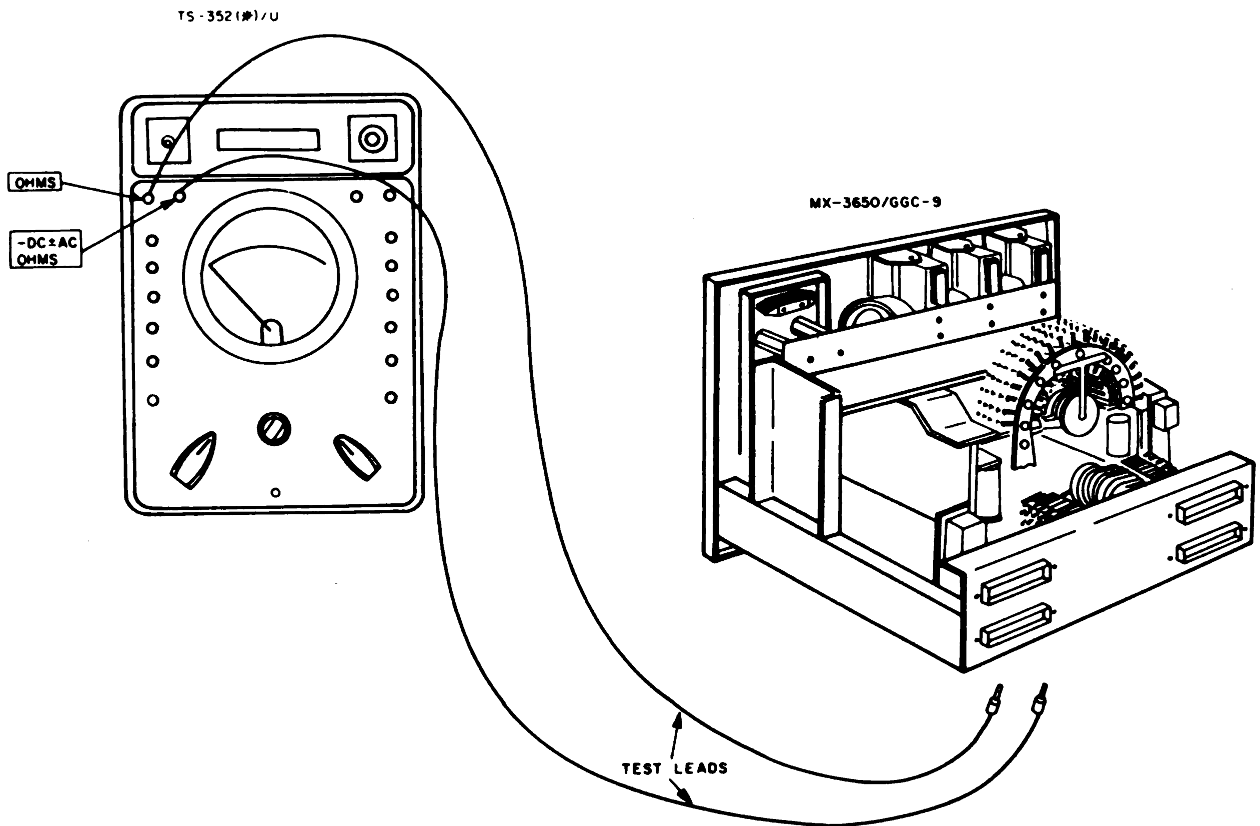

TM5815-281-35-192

Figure 186. Numbering base continuity test setup.

			P1-4 and RTA-level E wiper; and P1-5 and RTA-level F wiper. *g*. Manually step switch NSA to position No. 24 and apply test probes to following test points: P1-1 and RUA-level B wiper; P1-2 and RUA-level C wiper; P1-3 and RUA-level D wiper; P1-4 and RUA-level E wiper; and P1-5 and RUA-level F wiper.	*g*. Continuity exists between test points.
			h. Manually step switch NSB to position No. 1 and apply test probes to following terminals: P4-23 and P4-20; P4-23 and P4-19; P4-23 and P3-6; and P4-22 and FL7-W.	*h*. Continuity exists between terminals.
			i. Manually step switch NSB to position No. 3 and apply test probes to following terminals: P3-7 and FL7-W.	*i*. Continuity exists between terminals.
			j. Manually step switch NSB to position No. 5 and apply test probes to following terminals: P4-21 and FL7-W.	*j*. Continuity exists between terminals.
			k. Manually step switch NSB to position No. 22 and apply test probes to following test points: P3-1 and RHB-level B wiper; P3-2 and RHB-level C wiper; P3-3 and RHB-level D wiper; P3-4 and RHB-level E wiper; and P3-5 and RHB-level F wiper.	*k*. Continuity exists between test points.
			l. Manually step switch NSB to position No. 23 and apply test probes to following test points: P3-1 and RTB-level B wiper; P3-2 and RTB-level C wiper; P3-3 and RTB-level D wiper; P3-4 and RTB-level E wiper; and P3-5 and RTB-level F wiper.	*l*. Continuity exists between test points.
			m. Manually step switch NSB to position No. 24 and apply test probes to following test points: P3-1 and RUB-level B wiper; P3-2 and RUB-level C wiper; P3-3 and RUB-level D wiper; P3-4 and RUB-level E wiper; and P3-5 and RUB-level F wiper.	*m*. Continuity exists between test points.
2	Same as step 1 above.	RESET switches: OFF.	Apply test probes to following test points: P1-6 and P2-19; P1-9 and P1-10; P3-6 and P4-19; and P3-9 and P3-10.	Continuity exists between test points.

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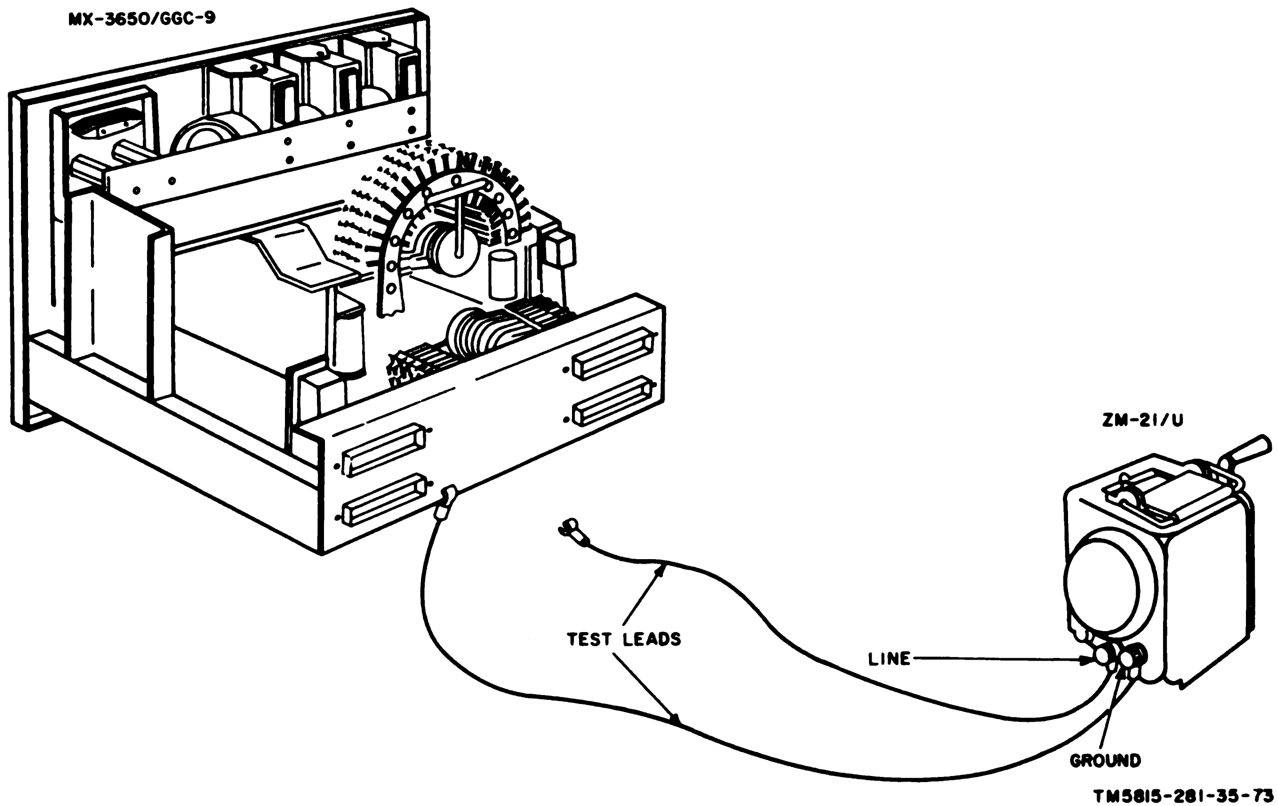

Figure 187. Numbering base insulation resistance test setup.

206. Numbering Base Insulation Resistance Test

a. *Test Equipment and Materials.* Use Ohmmeter ZM-21/U to make the insulation resistance test.

b. *Test Connections and Conditions.*

(1) Remove the numbering base dust cover.

(2) Connect the test leads to the LINE and GROUND binding posts of the ohmmeter.

(3) Conduct the tests at normal room temperature (65°–80° F).

(4) Connect the equipment as shown in figure 187.

c. *Procedure.*

Note: See note (para 205*c*).

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	ZM-21/U: None.	RESET switches: Midposition.	Connect ground lead of ohmmeter to unpainted portion of numbering base frame. Connect line lead of ohmmeter to each terminal, in turn, of plugs P1, P2, P3, and P4 and operate crank of ohmmeter.	Ohmmeter indicates at least 8 megohms.
2	Same as step 1 above.	FORWARD STEP switches: Alternately depress *upper* HUNDREDS, TENS, and UNITS switches.	Connect ground lead of ohmmeter to unpainted portion of numbering base frame. Connect line lead to terminal 8 of plug P1 and operate the ohmmeter crank.	Ohmmeter indicates at least 8 megohms.
3	Same as step 1 above.	FORWARD STEP switches: Alternately depress *lower* HUNDREDS, TENS, and UNITS switches.	Connect ground lead of ohmmeter to unpainted portion of numbering base frame. Connect line lead to terminal 8 of plug P3 and operate ohmmeter crank.	Ohmmeter indicates at least 8 megohms.
4	Same as step 1 above.	All switches: normal positions.	Connect ground lead of ohmmeter to unpainted portion of numbering base frame. Connect line lead to each of following test points, in turn: FL6-C; FL7-C; switch S34 - contact BL1; switch S35 - contact BL1; Each spare contact on switches RUA, RTA, RHA, RUB, RTB, and RHB; 2 spare contacts on levels A of NSA and NSB; and 17 spare contacts on level C of NSA and NSB.	Ohmmeter indicates at least 8 megohms.

207. Stepping Switch Self-Interrupted Speed Tests

a. *Test Equipment.* None.

b. *Test Connections and Conditions.*

(1) Remove the cover from the numbering base.

(2) Position the RESET switches to the midpositions.

c. *Procedure.*

Note: See note (para 205c).

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	N/A	RESET switches: Midposition.	Connect jumper between NSA winding terminal (terminal to which blue wire is connected) and to interrupter contact terminal (terminal to which green wire is connected). Connect positive lead from 48-volt power supply to P1-12. Connect negative lead to P2-23.	Stepping switch NSA operates continuously at uniform rate of speed.
2	N/A	Same as step 1 above.	Connect jumper between NSB winding terminal (terminal to which yellow-black wire is connected) and interrupter contact terminal (terminal to which violet-white wire is connected). Connect positive lead from 48-volt power supply to P3-12. Connect negative lead to P4-23.	Stepping switch NSB operates continuously at uniform rate of speed.
3	N/A	Same as step 1 above.	Connect jumper between winding terminal of RUA (terminal to which brown-red lead is connected) and to interrupter contact terminal (terminal to which black-yellow lead is connected). Connect positive lead of 48-volt dc power supply to P1-12. Connect negative lead to P2-23.	Stepping switch RUA operates continuously at uniform rate of speed.
4	N/A	Same as step 1 above.	Connect jumper between winding terminal of RTA (terminal to which yellow lead is connected) and to interrupter contact (contact to which black-yellow lead is connected). Connect positive lead from 48-volt dc power supply to P1-12. Connect negative lead to P2-23.	Stepping switch RTA operates continuously at uniform rate of speed.
5	N/A	Same as step 1 above.	Connect jumper between winding terminal of RHA (terminal to which brown-yellow lead is connected) and to interrupter contact terminal (terminal to which black-yellow lead is connected). Connect positive lead from 48-volt dc power supply to P1-12. Connect negative lead to P2-23.	Stepping switch RHA operates continuously at uniform rate of speed.

6	N/A	Same as step 1 above.	Connect jumper between winding terminal of RUB (terminal to which brown-orange lead is connected) and to interrupter contact terminal (terminal to which black-yellow lead is connected). Connect positive lead from 48-volt dc power supply to P3-12. Connect negative lead to P4-23.	Stepping switch RUB operates continuously at uniform rate of speed.
7	N/A	Same as step 1 above.	Connect jumper between winding terminal of RTB (terminal to which black-orange lead is connected) and to interrupter contact terminal (terminal to which black-yellow lead is connected). Connect positive lead from 48-volt dc power supply to P3-12. Connect negative lead to P4-23.	Stepping switch RTB operates continuously at uniform rate of speed.
8	N/A	Same as step 1 above.	Connect jumper between winding terminal of RHB (terminal to which brown-yellow lead is connected) and to the interrupter contact terminal (terminal to which black-yellow lead is connected). Connect positive lead from 48-volt dc power supply to P3-12. Connect negative lead to P4-23.	Stepping switch RHB operates continuously at uniform rate of speed.

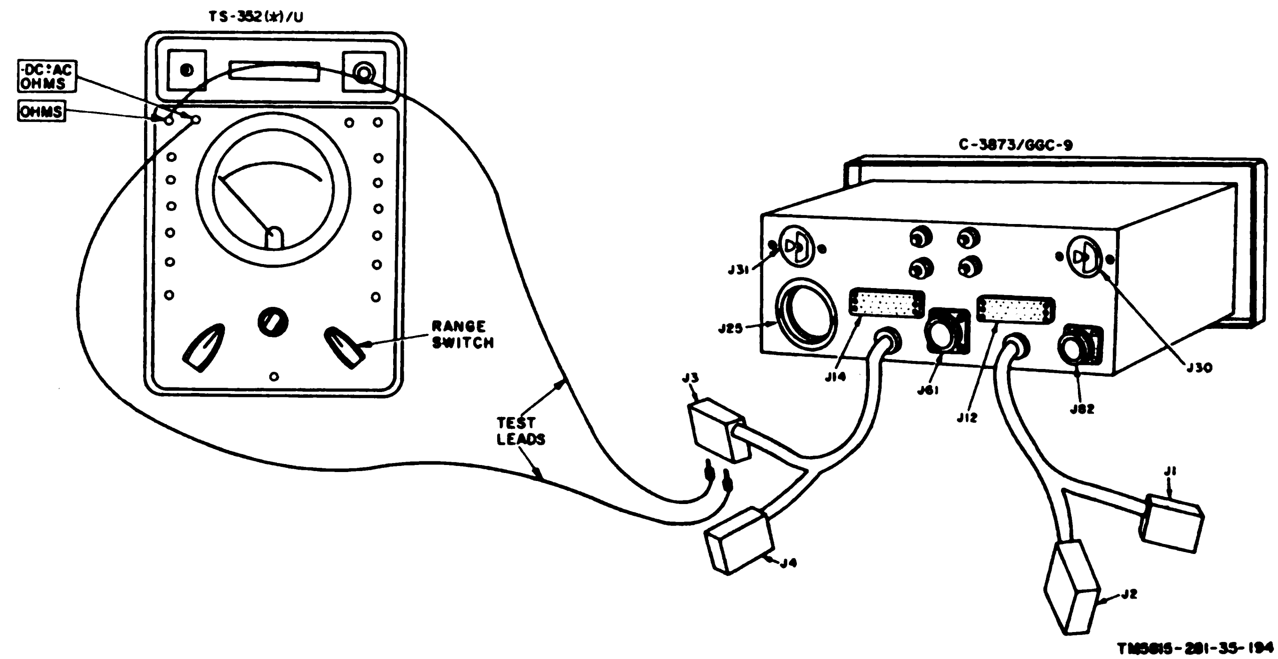

Figure 188. Control base continuity and resistance test setup.

			J3-1 and J14-N.	
3	Same as step 1 above.	BLANK SIGNAL switches: BLANK SIGNAL.	Apply test meter probes to following terminals: J12-r and J12-Y; and J14-r and J14-Y.	Continuity exists between each pair of terminals.
4	Same as step 1 above.	Power switch: PWR.	Apply test meter probes to following terminals: J25-small terminal and J82-D; J25-small terminal and J82-C; J25-large terminal and J82-A; and J25-large terminal and J82-B.	
5	TS-352/U: Range switch: RX1000. FUNCTION switch: OHMS.	N/A	Apply test meter probes to following terminals: *a*. J12-AA and J2-24 (with relay FNA operated). *b*. J12-BB and J12-CC (with relay TSA operated). *c*. J12-BB and J12-s (with relay STA operated). *d*. J12-BB and J12-A (with relay STA operated). *e*. J12-BB and J12-x. *f*. J12-BB and J1-9. *g*. J12-BB and J12-m. *h*. J12-BB and J2-19 (with relays TSA and FNA operated). *i*. J12-BB and J12-CC (with relavs TRA and STA operated). *j*. LINE 1 (black) and J20-tip. *k*. J14-AA and J4-24 (with relay FNB operated). *l*. J14-BB and J14-CC (with relay TSB operated). *m*. J14-BB and J14-s (with relay STB operated). *n*. J14-BB and J14-A (with relay STB operated). *o*. J14-BB and J14-x. *p*. J14-BB and J3-9. *q*. J14-BB and J14-m. *r*. J14-BB and J4-19 (with relays TSB and FNB operated). *s*. J14-BB and J14-CC (with relays TRB and STB operated). *t*. LINE 2 (black) and J19-tip.	Test meter should indicate following resistance: *a*. 615 ohms (relay KNA winding circuit). *b*. 980 ohms (relay STA L-R winding circuit). *c*. 980 ohms (relay STA L-R winding circuit). *d*. 1000 ohms (relay STA T-B winding circuit). *e*. 2250 ohms (relay SDA winding circuit). *f*. 1030 ohms (relay FNA winding circuit). *g*. 1250 ohms (relay TSA winding circuit). *h*. 980 ohms (relay TRA L-R winding circuit). *i*. 1000 ohms (relay TRA T-B winding circuit). *j*. 1000 to 6000 ohms (R9 and R10). *k*. 615 ohms (relay KNB winding circuit). *l*. 980 ohms (relay STD L-R winding circuit). *m*. 980 ohms (relay STB L-R winding circuit). *n*. 1000 ohms (relay STB T-B winding circuit). *o*. 2250 ohms (relay SDB winding circuit). *p*. 1030 ohms (relay FNB winding circuit). *q*. 1250 ohms (relay TSB winding circuit). *r*. 980 ohms (relay TRB L-R winding circuit). *s*. 1000 ohms (relay TRB T-B winding circuit). *t*. 1000 to 6000 ohms (R 6 and R8).

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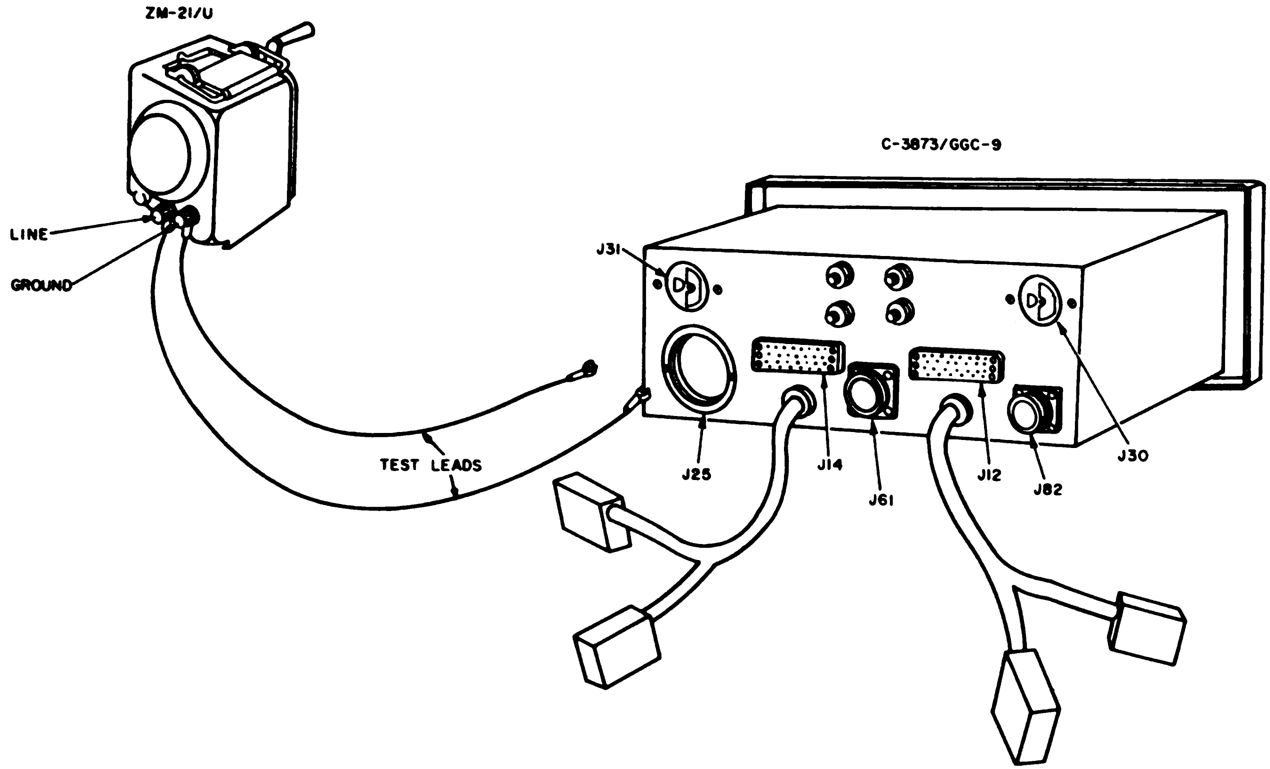

Figure 189. Control base insulation resistance test setup.

209. Control Base Insulation Resistance Tests

a. *Test Equipment and Materials.* Use Ohmmeter ZM-21/U to test the insulation resistance of the control base.

b. *Test Connections and Conditions.*

(1) Remove the top and bottom covers from the control base.

(2) Conduct the tests at normal room temperature (65°-80° F).

(3) Connect one test lead to the GROUND binding post of the ZM-21/U. Connect another lead to the LINE binding post.

(4) Connect the equipment as shown in figure 189.

c. *Procedure.*

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	ZM-21/U: none.	BLANK SIGNAL switch: BLANK SIGNAL CASE switch: 2 Power switch: PWR	Connect ground lead of ohmmeter to unpainted portion of the control base frame. Connect line lead of ohmmeter, in turn, to ungrounded terminal of plugs J25, J30, J31, and J82 (only terminal E of J82 is grounded). Operate the ohmmeter.	Ohmmeter indicates not less than 8 megohms.
2	Same as step 1 above.	Same as step 1 above.	Connect ground lead of ohmmeter to unpainted portion of control base frame. Connect line lead of ohmmeter, in turn, to each contact of jacks J12, J14, and J61.	Same as step 1 above.

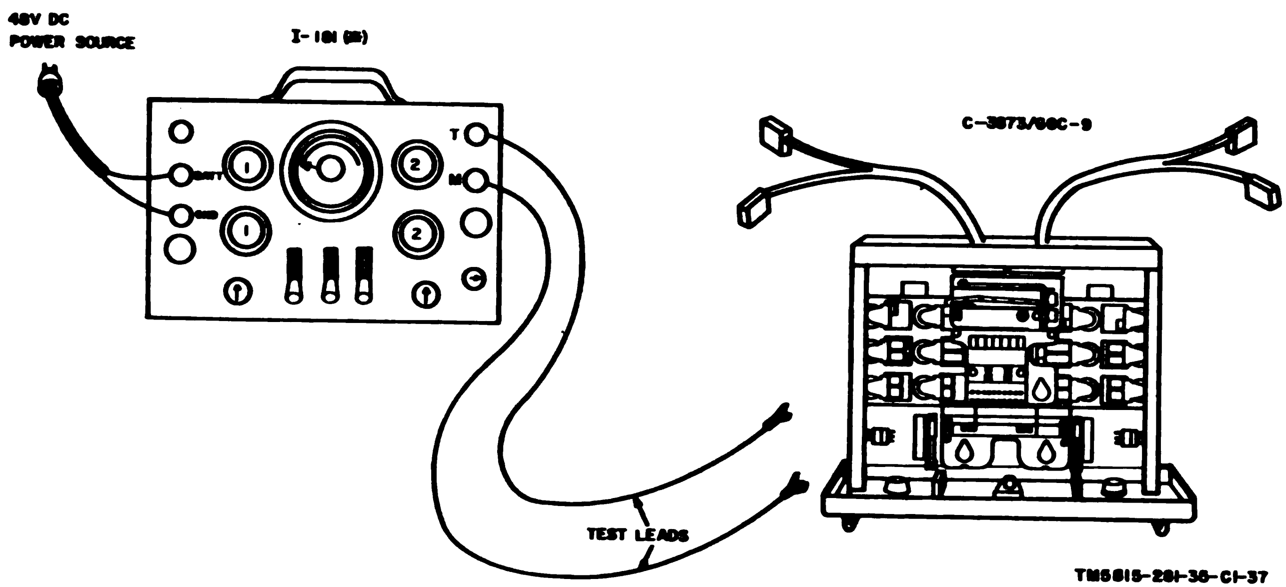

Figure 190. Relay operate and nonoperate test setup.

1	I-181: 75 MA-150MA-15MA switch: 150MA. (Readjust during test procedure)	N/A	*a.* Relay STA. Connect test leads to B and T coil terminals of relay STA. (1) Adjust current to 15.3 ma. (2) Adjust current to 24.1 ma. *b.* Relay STB. Same as *a* above.	*a.* Relay STA. (1) Relay does not operate. (2) Relay operates. *b.* Relay STB. Same as *a* above.
2	Same as step 1 above.	N/A	*a.* Relay FNA. Connect test leads to L and R coil terminals of relay FNA. (1) Adjust current to 10.5 ma. (2) Adjust current to 13.1 ma. *b.* Relay FNB. Same as *a* above.	*a.* Relay FNA. (1) Relay does not operate. (2) Relay operates. *b.* Relay FNB. Same as *a* above.
3	Same as step 1 above.	N/A	*a.* Relay TRA. Connect test leads to B and T coil terminals of relay. (1) Adjust current to 13.5 ma. (2) Adjust current to 17.2 ma. *b.* Relay TRB. Same as *a* above.	*a.* Relay TRA. (1) Relay does not operate. (2) Relay operates. *b.* Relay TRB. Same as *a* above.
4	Same as step 1 above.	N/A	*a.* Relay TSA. Connect test leads to L and R coil terminals of relay. (1) Adjust current to 15.0 ma. (2) Adjust current to 25.6 ma.	*a.* Relay TSA. (1) Relay does not operate. (2) Relay operates.
5	Same as step 1 above.	N/A	*a.* Relay KNA. Connect test leads to L and R coil terminals of relay. (1) Adjust current to 16.0 ma. (2) Adjust current to 19.0 ma. *b.* Relay KNB. Same as *a* above.	*a.* Relay KNA. (1) Relay does not operate. (2) Relay operates. *b.* Relay KNB. Same as *a* above.
6	Same as step 1 above.	N/A	*a.* Relay SDA. Connect test leads to L and R coil terminals of relay. (1) Adjust current to 5.0 ma. (2) Adjust current to 7.5 ma. *b.* Relay SDB. Same as *a* above.	*a.* Relay SDA. (1) Relay does not operate. (2) Relay operates. *b.* Relay SDB. Same as *a* above.

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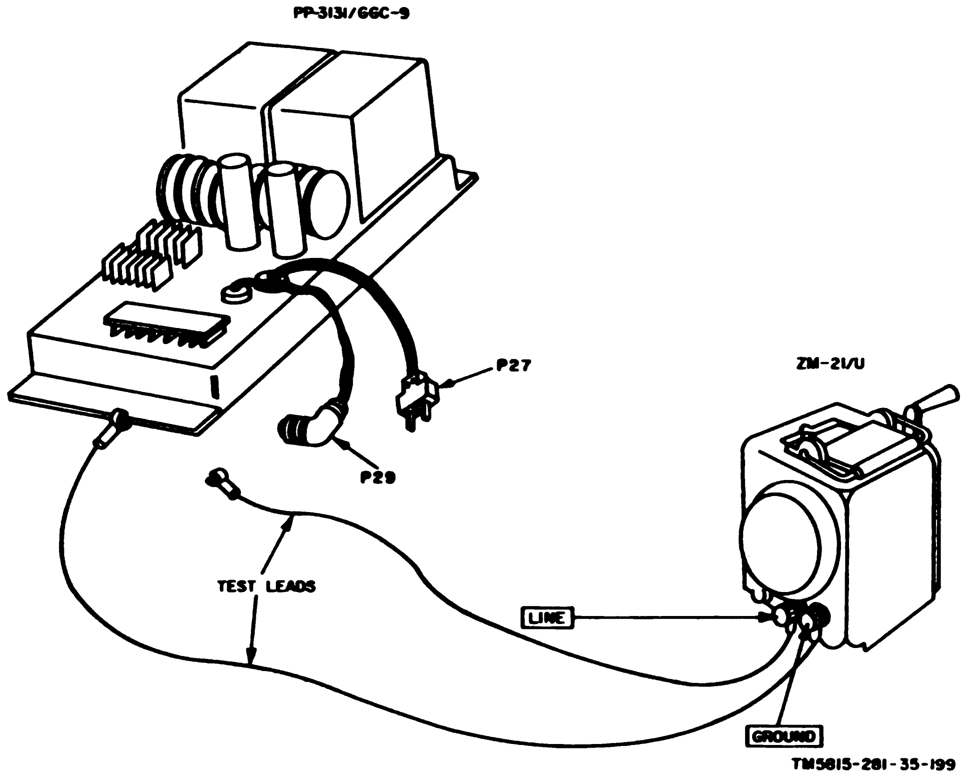

Figure 191. Power Supply PP-3131/GGC-9 insulation resistance test setup.

Section V. POWER SUPPLY PP-3131/GGC-9

211. Power Supply PP-3131/GGC-9 Insulation Resistance Test

a. *Test Equipment and Materials*. Use Ohmmeter ZM-21/U to test the insulation resistance of the PP-3131/GGC-9.

b. *Test Connections and Conditions*.

(1) Conduct the tests at normal room temperature (65°-80° F).

(2) Connect the test leads to the GROUND and LINE binding posts of the ohmmeter.

(3) Connect the equipment as shown in figure 191.

c. *Procedure*.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	ZM-21/U: none.	N/A	Connect ground lead of ohmmeter to unpainted portion of power supply base. Connect line lead of ohmmeter to each ungrounded terminal in turn of plug P27. Operate ohmmeter crank.	Ohmmeter should indicate at least 8 megohms.
2	Same as step 1 above.	N/A	Connect ground lead ohmmeter to unpainted portion of power supply base. Connect line lead of ohmmeter to each terminal, in turn, of plug P29. Operate ohmmeter crank.	Ohmmeter should indicate at least 8 megohms.

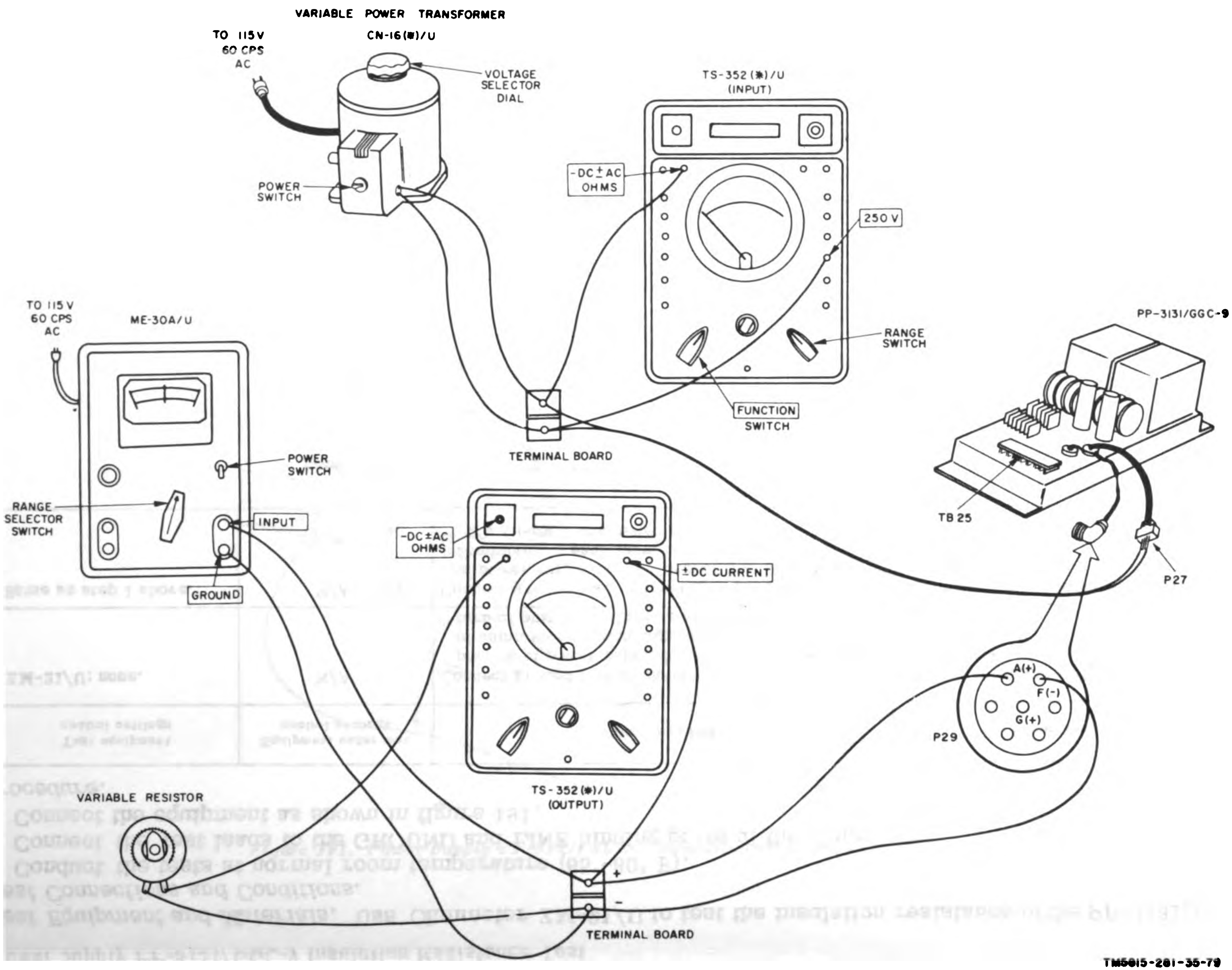

Figure 192. Power Supply PP-3131/GGC-9 output test setup.

			(2) ± and 4. (3) ± and 6. (4) ± and 8. (5) 65 and 72. (6) 72 and 79. *c*. Set CN-16/U power switch to OFF. Disconnect variable resistor and associated TS-352/U from circuit. Set CN-16/U power switch to ON.	(2) 3.6 to 4.4 volts. (3) 5.7 to 6.3 volts. (4) 7.6 to 8.4 volts. (5) 6.3 to 7.7 volts. (6) 6.3 to 7.7 volts. *c*. Voltage indication of TS-352/U should not exceed 58 volts.
3	N/A	N/A	*a*. Set CN-16/U power switch to OFF. Disconnect lead from pin A of plug P29 and connect it to pin G (places output test circuit across the filtered output terminals G(+) and F(-) of P29). Set CN-16/U power switch to ON. Adjust variable resistor until output TS-352/U indicates 1.5 amperes. Readjust variable power supply to obtain 48-volts dc output. *b*. Set CN-16/U power switch to OFF. Disconnect variable resistor and associated TS-352/U from circuit. Set CN-16/U power switch to ON.	*a*. Output should hold steady at 48 volts with 1.5 ampere drain. *b*. Voltage indication on output multimeter should not exceed 58 volts.
4	ME-30A/U: Range selector switch: 1 VOLTS. Power switch: ON.	N/A	Connect ME-30A/U as shown in figure 192. Check ripple voltage indicated by ME-30A/U.	Ripple present in 48-vdc output does not exceed 0.75 volts root mean square (rms).
5	N/A	N/A	*a*. Set power switch of CN-16/U to OFF. Connect output TS-352/U (arranged to indicate dc current), and 0-20,000-ohm variable resistor across pins B and C of plug P29. Connect other TS-352/U (arranged to indicate dc voltage) across output from pins B(+) and C(-). Set power switch of CN-16/U to ON and adjust variable resistor until output TS-352/U indicates 15 ma. Readjust the variable power supply to obtain 135-150 volt dc output indication on other TS-352/U. *b*. Disconnect variable resistor load from output circuit. *c*. Same as step *a* above except use pins D(+) and E(-) of plug P29 instead of pins B and C. *d*. Disconnect variable resistor load from output circuit.	*a*. Output voltage should hold steady with 15 ma drain. *b*. Output voltage indicated by TS-352/U should not increase by more than 20 *c*. Output voltage should hold steady with 15-ma drain. *d*. Output voltage indicated by TS-352/U should not increase by more than 20 volts.
6	ME-30A/U: Range selector switch: 3 VOLTS. Power switch: ON.	N/A	*a*. Connect ME-30A/U as shown in figure 192. Check ripple voltage across pins B and C of plug P29. *b*. Check ripple voltage across pins D and E of plug P29.	*a*. Ripple voltage does not exceed 1.7 volts rms. *b*. Ripple voltage does not exceed 1.7 volts rms.

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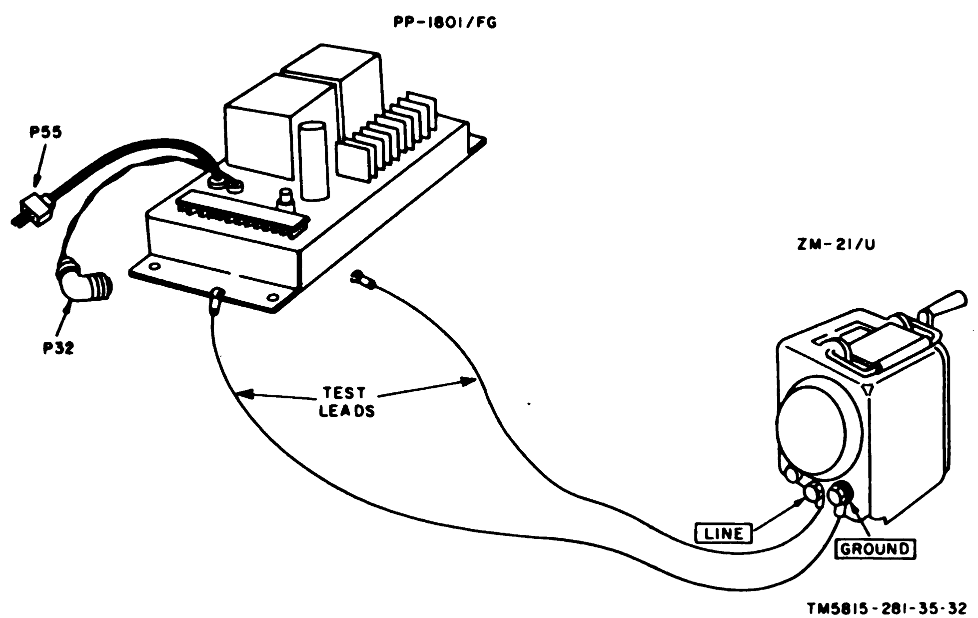

Figure 193. Power Supply PP-1801/FG insulation resistance test setup.

Section VI. POWER SUPPLY PP-1801/FG TESTS

213. Power Supply PP-1801/FG Insulation Resistance Test

a. Test Equipment and Materials. Use Ohmmeter ZM-21/U to test the insulation resistance of the PP-1801/FG.

b. Test Connections and Conditions.

(1) Conduct tests at normal room temperature (65°-80° F).

(2) Connect the equipment as shown in figure 193.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	ZM-21/U: none.	N/A	Connect ground lead of ohmmeter to unpainted portion of power supply base. Connect line lead of ohmmeter to each ungrounded terminal, in turn, of plug P55. Operate ohmmeter crank.	Ohmmeter should indicate at least 8 megohms.
2	Same as step 1 above.	N/A	Connect ground lead of ohmmeter to unpainted portion of power supply base. Connect line lead of ohmmeter to each terminal of plug P32, in turn. Operate ohmmeter crank.	Ohmmeter should indicate at least 8 megohms.

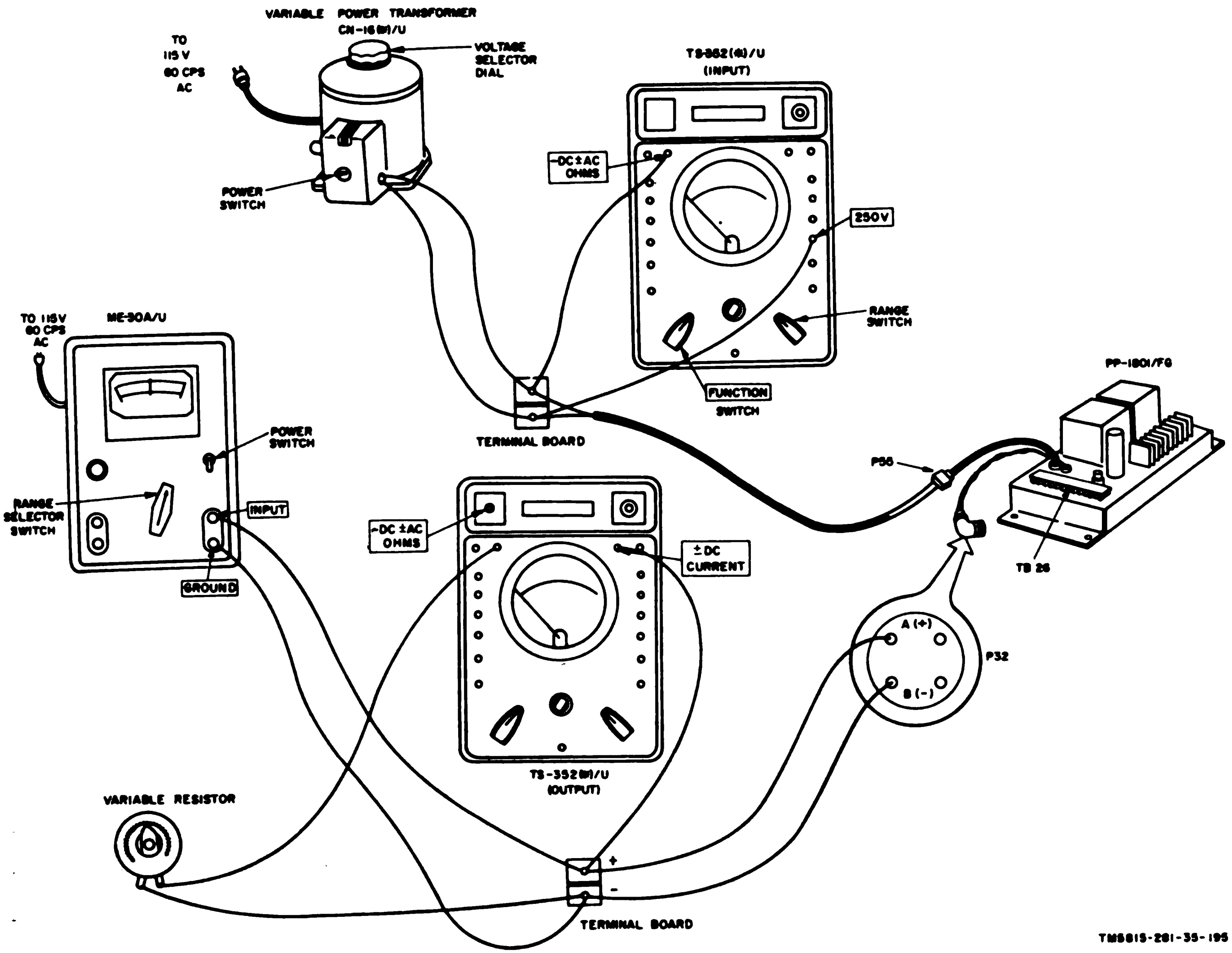

Figure 194. Power Supply PP-1801/FG output test setup.

2	N/A	N/A	*a.* Set power switch of CN-16/U to OFF. Move lead from 250-volt jack to ±DC CURRENT jack of output TS-352/U. Series-connect output TS-352/U and 0-8,000-ohm 4-watt variable resistor across power supply output (terminals A(+) and (-) of P32). Adjust output TS-352/U to indicate dc current. Adjust second TS-352/U to indicate dc volts and connect it across power supply output terminals also. Set power switch of CN-16/U to ON. Adjust variable resistor until output TS-352/U indicates 240 ma. Readjust variable power transformer if necessary to obtain 120-volt dc output indication on second TS-352/U. *b.* Disconnect input TS-352/U and use it to check ac voltage across following points on terminal board TB26: (1) ± and 2 (2) 2 and 4 (3) 4 and 6 (4) 6 and 8 (5) 160 and 170 (6) 170 and 180 *c.* Set CN-16/U power switch to OFF. Disconnect variable resistor and associated TS-352/U from circuit. Set CN-16/U power switch to ON.	*a.* Output voltage should remain steady at 120 volts with 240-ma drain. *b.* Transformer ac output is within following ranges: (1) 1.9 to 2.1 volts (2) 1.9 to 2.1 volts (3) 1.9 to 2.1 volts (4) 1.9 to 2.1 volts (5) 9 to 11 volts (6) 9 to 11 volts *c.* Voltage indicated by TS-352/U does not exceed 132 volts.
3	ME-30A/U: Range selector switch: 1 VOLTS. Power switch: ON.		Connect ME-30A/U as shown in figure 195. Check ripple voltage indication by ME-30A/U.	Ripple present in 120-v dc output does not exceed 0.75 volts rms.

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1 Machine screw, 10372
2 Cover plate, 63943
3 Machine screw, 10372
4 Cover plate, 63943
5 Plain hexagonal nut, 10504
6 Lockwasher, 10405
7 Machine screw, 10122
8 Machine screw, 19335
9. Lockwasher, 10432
10 Plain hexagonal nut, 10504
11 Lockwasher, 10405
12 Machine screw, 10122
13 Jumper wire, 22182-02.43
14 Machine screw
15 Lockwasher, 10434
16 Terminal board (TB1A), 21080 (includes item 14)
17 Marker strip, 20179
18 Self-locking hexagonal nut, 10573
19 Machine screw, 10275
20 Spacer, 58456
21 Sleeve, 58373
22 Roller, 58372
23 Bracket, 63936
24 Plain hexagonal nut, 10504
25 Lockwasher, 10504
26 Machine screw, 10122
27 Machine screw, 10335
28 Lockwasher, 10432
29 Plain hexagonal nut 10504
30 Lockwasher, 10405
31 Machine screw, 10122
32 Jumper wire, 22182-02.43
33 Machine screw
34 Lockwasher, 10434
35 Terminal board (TB1B), 21080
36 Marker strip, 20179
37 Self-locking hexagonal nut 10573
38 Machine screw, 10275
39 Spacer, 58456
40 Sleeve, 58373
41 Roller, 58372
42 Bracket, 63937
43 Plain hexagonal nut
44 Flat washer, 10494
45 Lockwasher
46 LINE BREAK switch (S50), 20476 (includes items 43 and 45)
47 Capnut
48 Flat washer, 10494
49 LINE CURRENT potentiometer (R9), 20015 (includes item 47)
50 Plain hexagonal nut
51 Flat washer, 10494
52 Lockwasher
53 BLANK SIGNAL switch (S1), 20119 (includes items 50 and 52)
54 Plain hexagonal nut
55 Flat washer, 10494
56 Lockwasher
57 Power switch (S12), 20499 (includes items 54 and 56)
58 Plain hexagonal nut
59 Flat washer, 10494
60 Lockwasher
61 LINE BREAK switch (S51) 20476 (includes items 58 and 60)
62 Capnut
63 Flat washer, 10494
64 LINE CURRENT potentiometer (R6), 20015 (includes item 62)
65 Plain hexagonal nut
66 Flat washer, 10494
67 Lockwasher
68 BLANK SIGNAL switch (S2), 20119 (includes items 65 and 67)
69 Resistor (R8), 20092
70 Resistor (R10), 20092
71 Front panel assembly, 63942A
72 Machine screw, 10376
73 Flat washer, 10467
74 Lockwasher, 10404
75 Terminal, 20709
76 Connector, 20493 (includes item 62)
77 Machine screw, 10376
78 Flat washer, 10467
79 Lockwasher, 10404
80 Terminal, 20709
81 Connector, 20493 (includes item 67)
82 Machine screw, 10376
83 Flat washer, 10467
84 Lockwasher, 10494
85 Terminal, 20709
86 Connector, 20493 (includes item 72)
87 Machine screw
88 Flat washer, 10467
89 Lockwasher, 10404
90 Terminal, 20709
91 Connector, 20493 (includes item 77)
92 Terminal, 20708
93 Terminal, 20169
94 Terminal, 20165
95 Machine screw, 10376
96 Lockwasher, 10404
97 Lockwasher. 10406
98 Connector (J25), 20449
99 Plain hexagonal nut, 10517
100 Machine screw, 10109
101 Lockwasher, 10408
102 Connector (J61), 20495
103 Machine screw, 10376
104 Lockwasher, 10404
105 Lockwasher, 10494
106 Connector (J31), 20449
107 Rear bracket assembly, 63935A
108 Plain hexagonal nut
109 Lockwasher
110 Machine screw
111 Terminal board (TB1), 21070
112 Tubing, 20754
113 Harness assembly, 63941A
114 Self-locking hexagonal nut, 10840
115 Machine screw, 10003
116 Clamp, 20516
117 Lockwasher, 10421
118 Flat washer, 10458
119 Connector (P7A), 20276
120 Special screw, 10148
121 Standoff, 63934
122 Connector (J7A), 20430
123 Connector (P7B), 20276
124 Special screw, 10148
125 Standoff, 63934
126 Connector (J7B), 20430
127 Harness assembly, 63939A
128 Harness assembly, 63939A
129 Terminal, 20708
130 Terminal, 23073
131 Harness assembly, 63940A
132 Plain hexagonal nut, 10521
133 Lockwasher, 10412
134 Machine screw, 10301
135 Filter (FL14), 54582A
136 Plain hexagonal nut, 10521
137 Lockwasher, 10412
138 Machine screw, 10301
139 Filter (FL15), 54582A
140 Resistor (R11 and R12), 20081
141 Machine screws
142 Fiber washer
143 Relay (KNB), 20159
Note: Relay shown is relay KNB. See chart on illustration for positions and part numbers of other relays on panel.
144 Insulator
145 Relay mounting rack, 63938A

52 Lockwasher
53 BLANK SIGNAL switch (S1), 20119 (includes items 50 and 52)
54 Plain hexagonal nut
55 Flat washer, 10494
56 Lockwasher
57 Power switch (S12), 20499 (includes items 54 and 56)
58 Plain hexagonal nut
59 Flat washer, 10494
60 Lockwasher
61 LINE BREAK switch (S51) 20476 (includes items 58 and 60)
62 Capnut
63 Flat washer, 10494
64 LINE CURRENT potentiometer (R6), 20015 (includes item 62)
65 Plain hexagonal nut
66 Flat washer, 10494
67 Lockwasher
68 BLANK SIGNAL switch (S2), 20119 (includes items 65 and 67)
69 Resistor (R8), 20092
70 Resistor (R10), 20092
71 Front panel assembly, 63942A
72 Machine screw, 10376
73 Flat washer, 10467
74 Lockwasher, 10404
75 Terminal, 20709
76 Connector, 20493 (includes item 62)
77 Machine screw, 10376
78 Flat washer, 10467
79 Lockwasher, 10404
80 Terminal, 20709
81 Connector, 20493 (includes item 67)
82 Machine screw, 10376
83 Flat washer, 10467
84 Lockwasher, 10494
85 Terminal, 20709
86 Connector, 24093 (includes item 72)
87 Machine screw
88 Flat washer, 10467
89 Lockwasher, 10404
90 Terminal, 20709
91 Connector, 20493 (includes item 77)
92 Terminal, 20708
93 Terminal, [illegible]169
94 Terminal, 20165
95 Machine screw, 10376
96 Lockwasher, 10404
97 Lockwasher, 10406
98 Connector (J25), 20449
99 Plain hexagonal nut, 10517
100 Machine screw, 1010?
101 Lockwasher, 10408
102 Connector (J61), 20495
103 Machine screw, 13076
104 Lockwasher, 10404
105 Lockwasher, 10494
106 Connector (J31), 20449
107 Rear bracket assembly, 63935A
108 Plain hexagonal nut
109 Lockwasher
110 Machine screw
111 Terminal board (TB1), 21070
112 Tubing, 20754
113 Harness assembly, 63941A
114 Self-locking hexagonal nut, 10840
115 Machine screw, 10003
116 Clamp, 20516
117 Lockwasher, 10421
118 Flat washer, 10458
119 Connector (P7A), 20276
120 Special screw, 10148
121 Standoff, 63934
122 Connector (J7A), 20430
123 Connector (P7B), 20276
124 Special screw, 10148
125 Standoff, 63934
126 Connector (J7B), 20430
127 Harness assembly, 63939A
128 Harness assembly, 63939A
129 Terminal, 20708
130 Terminal, 23073
131 Harness assembly, 63940A
132 Plain hexagonal nut, 10521
133 Lockwasher, 10412
134 Machine screw, 10301
135 Filter (FL14), 54582A
136 Plain hexagonal nut, 10521
137 Lockwasher, 10412
138 Machine screw, 10301
139 Filter (FL15), 54582A
140 Resistor (R11 and R12), 20081
141 Machine screws
142 Fiber washer
143 Relay (KNB), 20159
Note: Relay shown is relay KNB. See chart on illustration for positions and part numbers of other relays on panel.
144 Insulator
145 Relay mounting rack, 63938A
145.1 Capacitor C100, C101

5 ①. *Control base, exploded view (sheet 1 of 3).*

I A4,

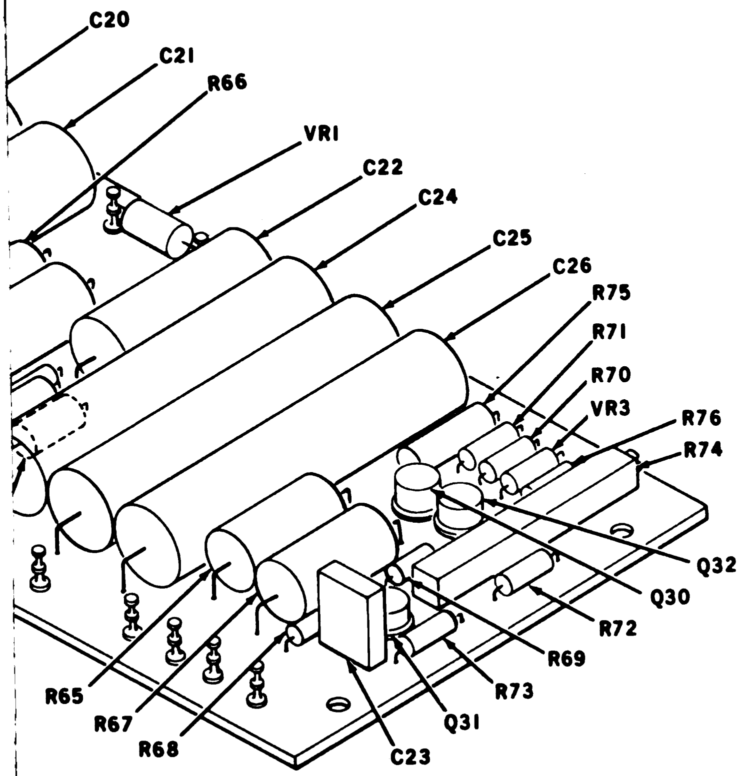
I A3,

7203-

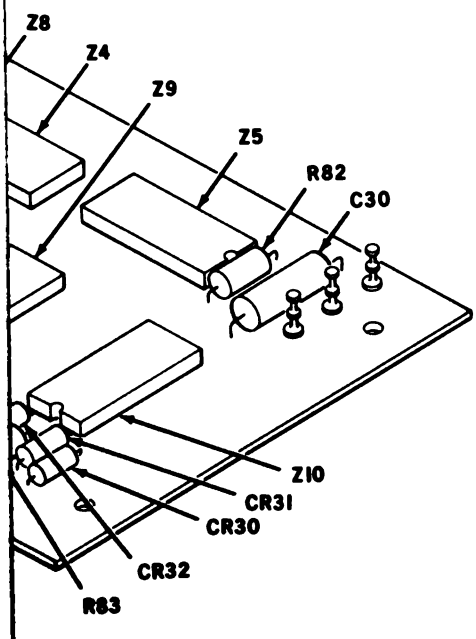
4)

183 Washer (Supplied with switch S4)
184 Screw, MS51957-31
185 Lock washer, MS35338-136
186 Flat washer, NAS62066
187 Terminal block TB3, 599-5
188 Marker strip, MS599-5-XP
189 Test point panel, 2100422-001
190 Terminal board assembly TB4, 2100446-001
191 Resistors, RCR07G102JS
192 Resistors, JAN 1N4454
193 Capacitors, M39014102-0240
194 Screw, MS51957-28
195 Lock washer, MS35338-136
196 Flat washer, NAS62066
197 Washer, MS15795-806
198 Jacks, SKT-14-P20-9, SKT-14-P20-1
199 Screw, MS15957-13
200 Lock washer, MS35338-135
201 Washer, 639300-907
202 Clamp, SM-C-546211-4
203 Screw, MS51957-26
204 Nut, MS35649-264
205 Lock washer, MS35338-136
206 Flat washer, MS15795-806
207 Terminal lug, MS25036-145
208 Transformer T1, 2100429-001
209 Bracket, 2100428-001
210 Capacitors FL1 and FL2, CZ24BKE224
211 Nut (Supplied with FL1 and FL2)
212 Washer (Supplied with FL1 and FL2)
213 Screw, MS51957-28
214 Washer, MS15795-806
215 Bracket, 2100416-001
216 Screw, MS51957-16
217 Washer, MS35338-135
218 Spacer, NAS43DDO-8
219 Screw, MS51957-17
220 Nut, MS35649-244
221 Clamp, SM-C-546211-6
222 Clock circuit board A1, 2100410-001
223 Switching circuit board A2, 2100411-001
224 Set screw, 4-40UNC-3A
225 Knob, MS91528-1P2B
226 Switch S5, X5P3301
227 Nut (Supplied with switch S5-S6)
228 Washer (Supplied with switch S5-S6)
229 Switch S6, X5P3301
230 Resistors R95-R99, RC20GF103J
231 Resistors R151-R155, RC20GF103J
232 Screw, MS51957-26
233 Screw, MS51958-61
234 Lock washer, MS35338-138
235 Flat washer, NAS620C10
236 Bracket, 2100414-001
237 Heat sink, 2100421-001
238 Screw, MS51957-29
239 Washer, MS15795-806
240 Washer, MS35338-136
241 Washer, MS35338-138
242 Nut, MS53649-264
243 Clamp, DF13B
244 Insulator, DF14A
245 Transistor Q33, JAN2N1485
246 Nut plate, MS21075-06
247 Diode VR2, JAN1N2992B
248 Terminal, NR59B
249 Bushing DF3D
250 Washer, insulating, 43-02-10
251 Lock washer, MS35338-138
252 Nut, MS35650-304

Figure 195 ②. Control base, exploded view (sheet 2 of 3).

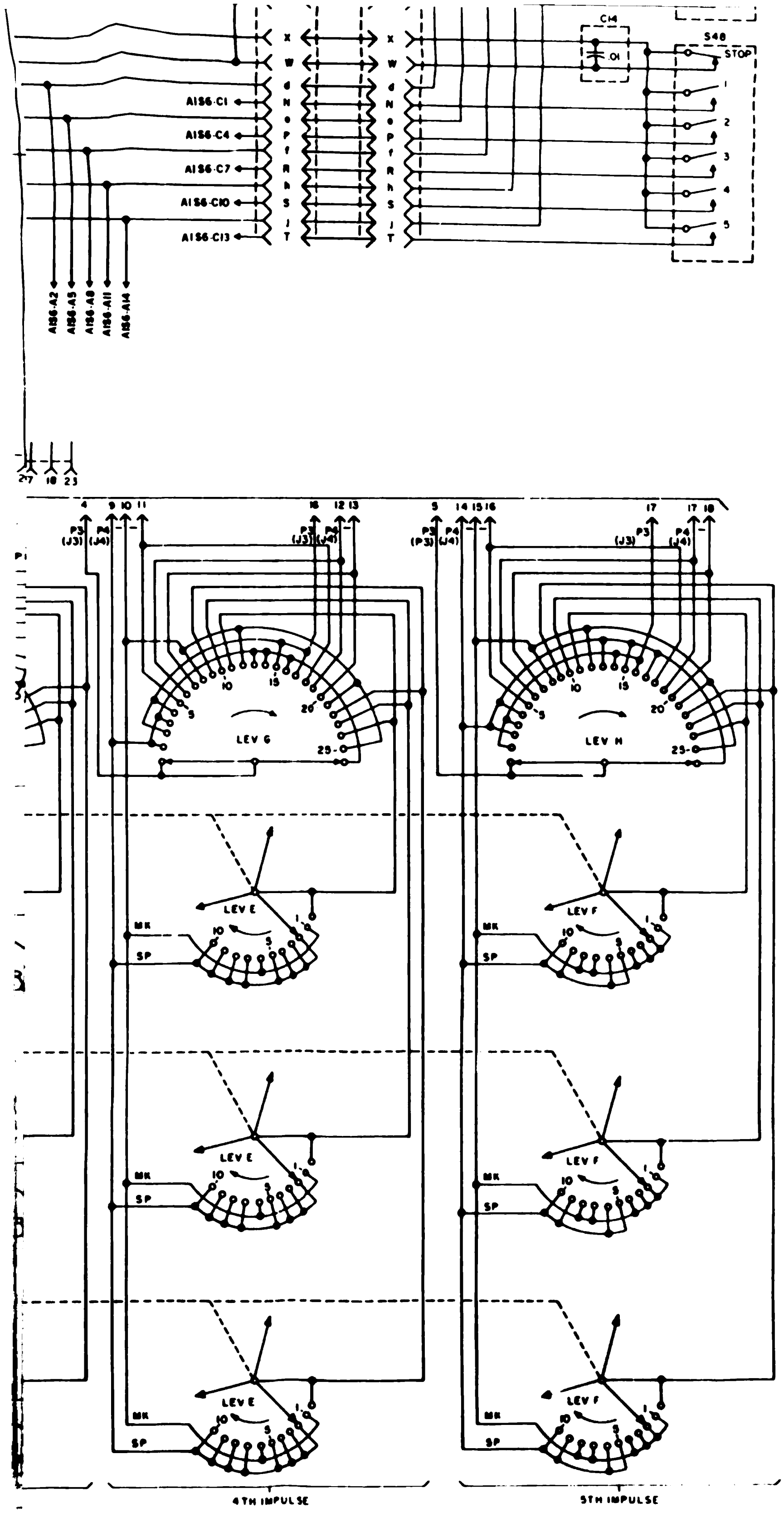


DETAIL D
POWER SUPPLY CIRCUIT BOARD A1A4



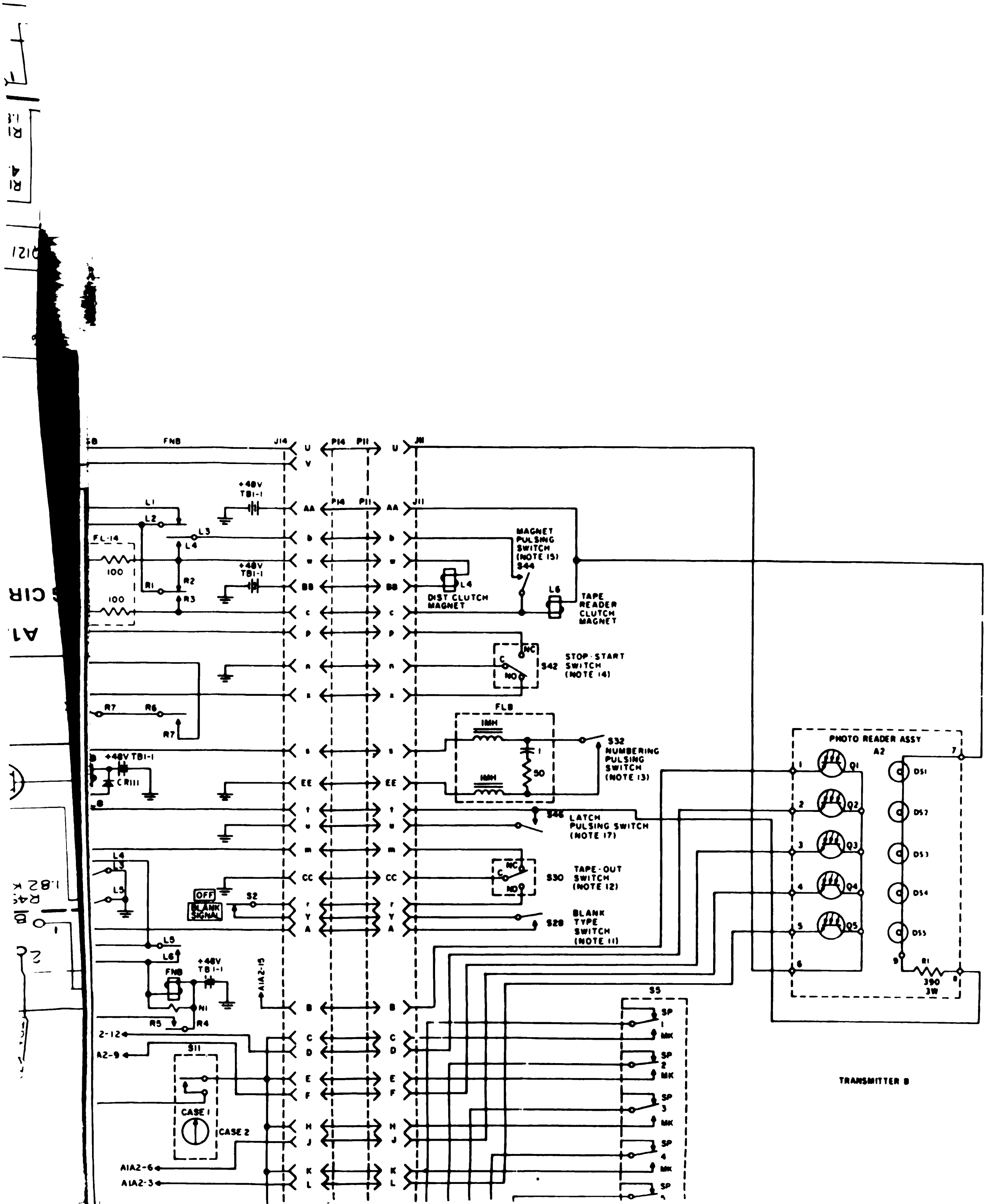
TM5815-281-36-C1-38 (3)

...base, exploded view (sheet 3 of 3).



TM5815-281-35-C1-39 (1)

Figure 196 (1). Distributor set, schematic diagram (sheet 1 of 3).



TRANSMITTER B
PHOTO READER ASSY
A2
390
3W
R1
DS1
DS2
DS3
DS4
DS5
Q1
Q2
Q3
Q4
Q5
S5
SP
MK
FNB
J14
P14
P11
J11
+48V
TB1-1
MAGNET PULSING SWITCH (NOTE 15)
S44
DIST CLUTCH MAGNET
L4
L6
TAPE READER CLUTCH MAGNET
STOP-START SWITCH (NOTE 14)
S42
FL8
1MH
S32
NUMBERING PULSING SWITCH (NOTE 13)
S46
LATCH PULSING SWITCH (NOTE 17)
S30
TAPE-OUT SWITCH (NOTE 12)
S28
BLANK TYPE SWITCH (NOTE 11)
OFF
BLANK SIGNAL
S2
A1A2-15
FL-14
100
CR111
S11
CASE 1
CASE 2
2-12
A2-9
A1A2-6
A1A2-3
R4
R5
N1

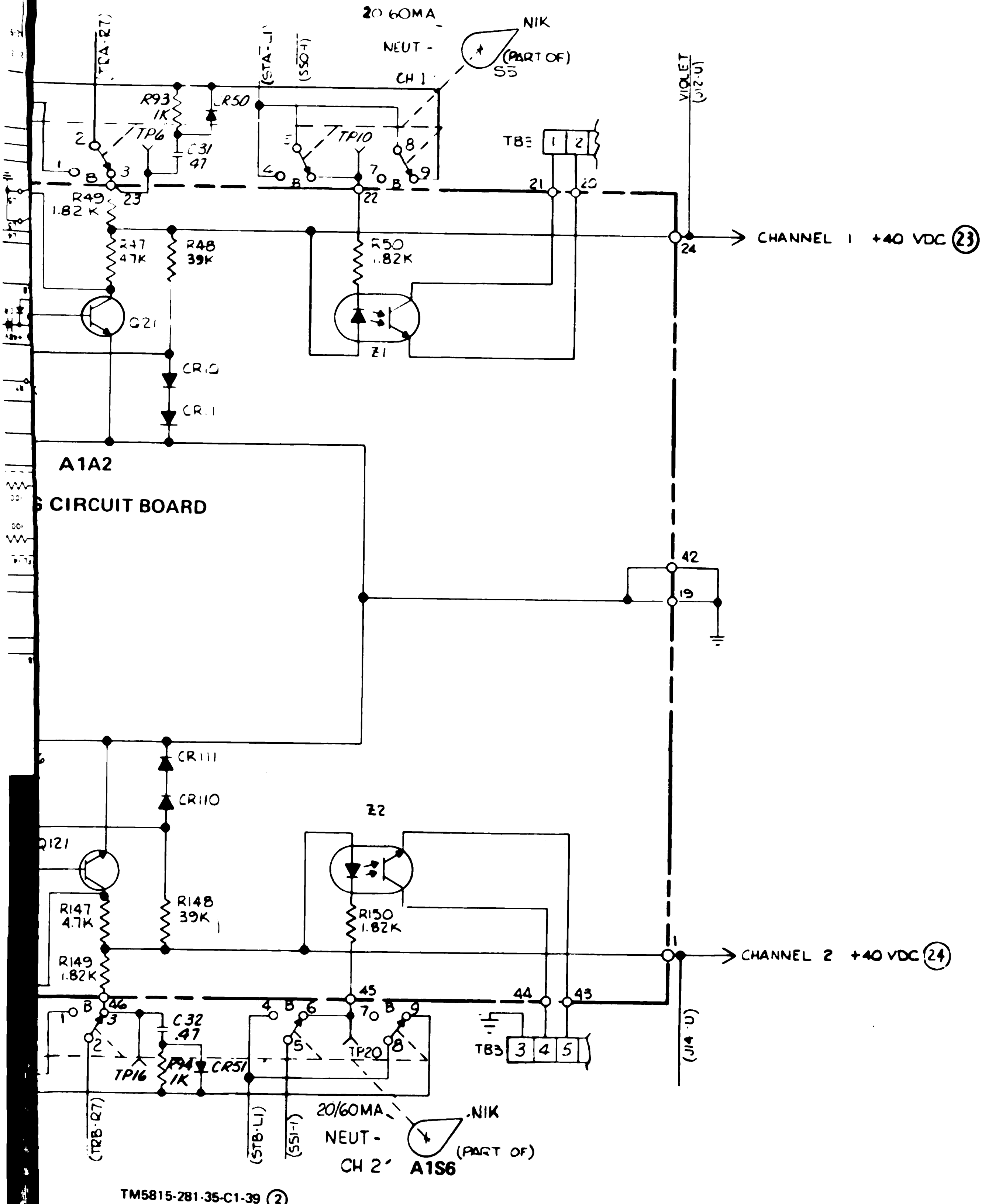


Figure 196 ②. Distributor set, schematic diagram (sheet 2 of 3).

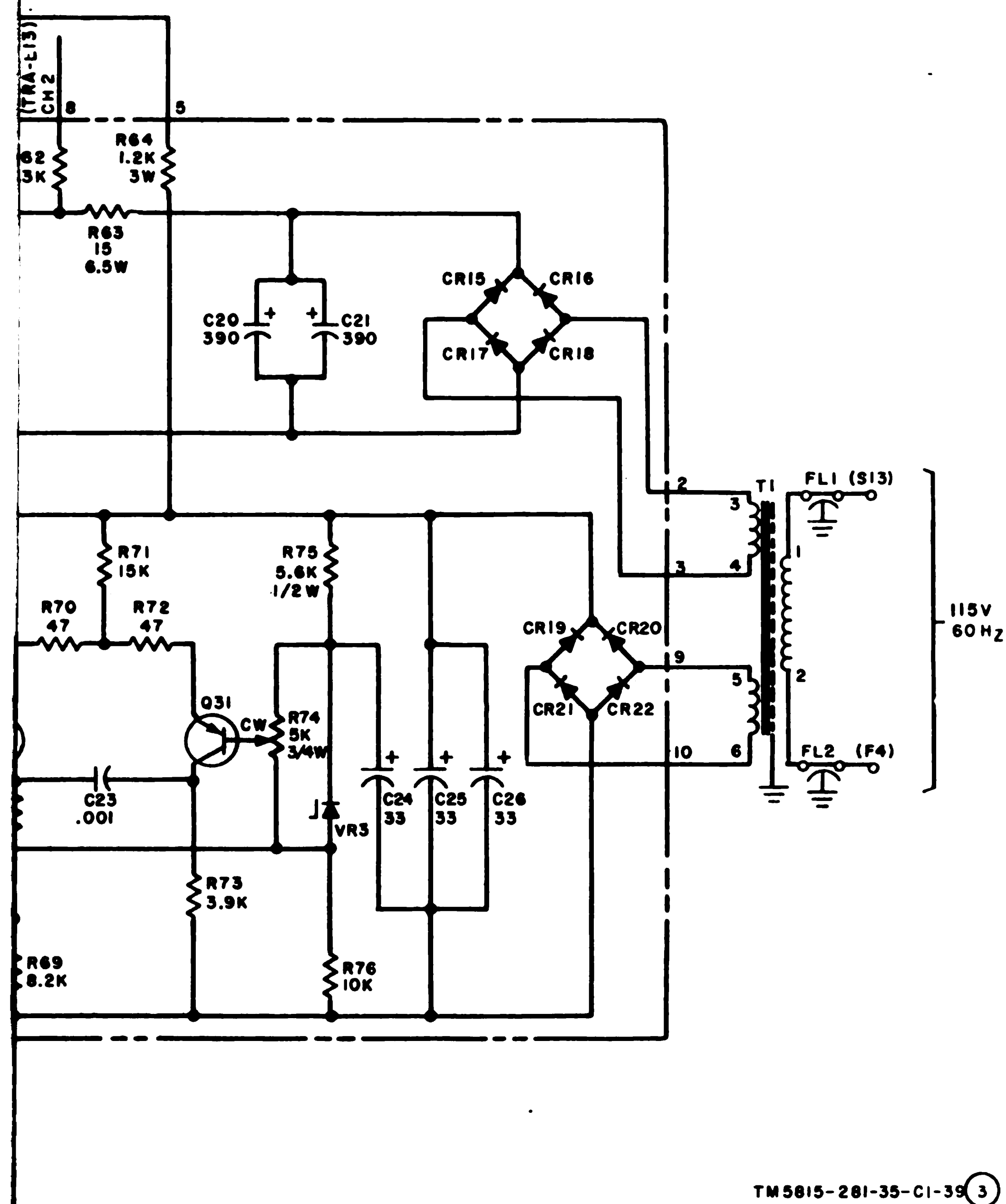


Figure 196 (3). Distributor set, schematic diagram (sheet 3 of 3).

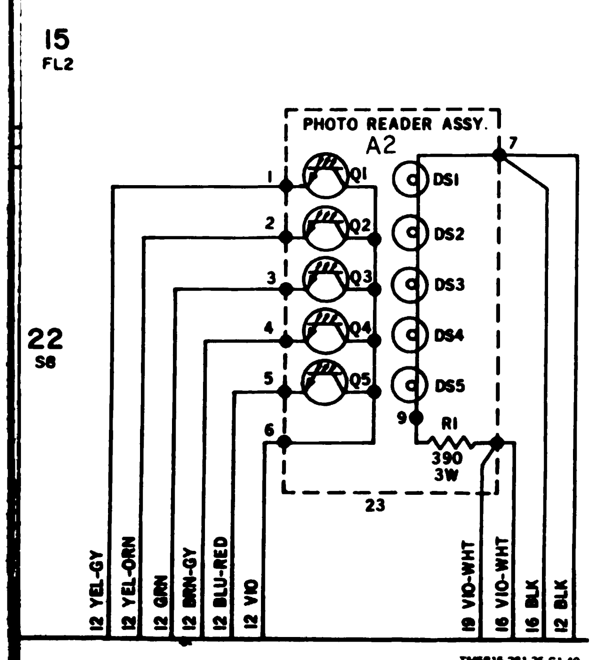
NOTES:

1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS.

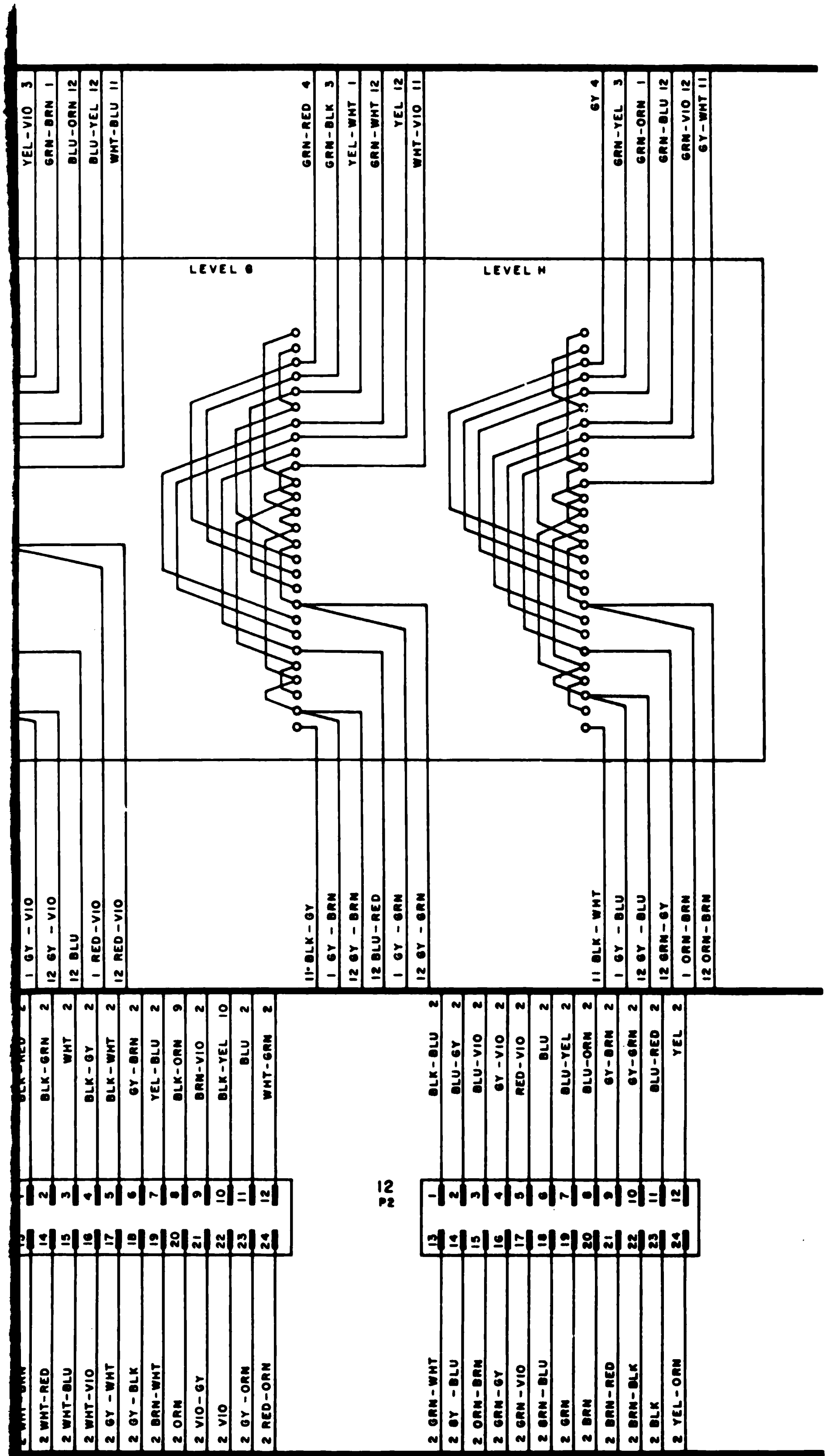
2. ALL SWITCHES ARE VIEWED FROM THE REAR.

3. REFERENCE DESIGNATIONS FOR ALTERNATE COMPONENTS ARE SHOWN IN [ ]

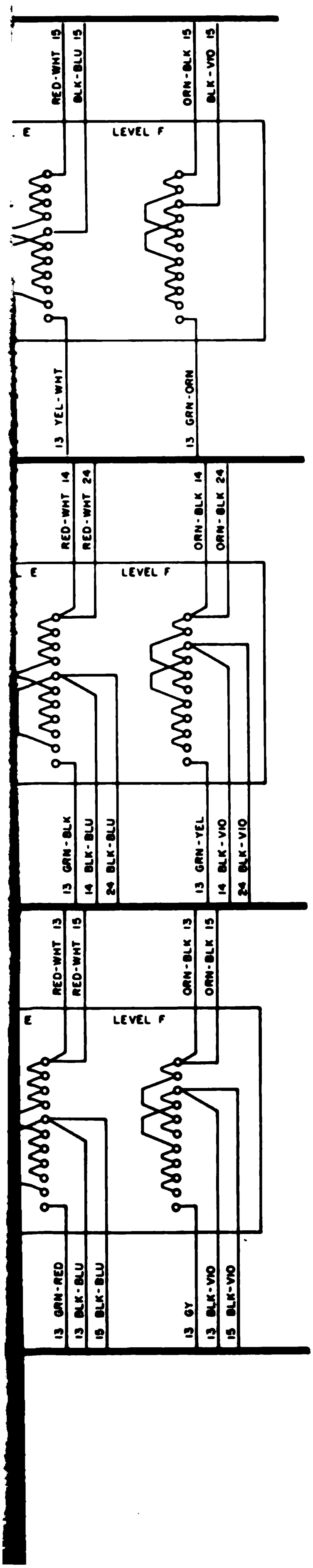
4. Some units include only white wires with a number code for cross-reference to original unit wire colors as follows: 0-Black; 1-Brown; 2-Red; 3-Orange; 4-Yellow; 5-Green; 6-Blue; 7-Violet and 8-Gray.



...itter, wiring diagram.



TM5815-281-35-190 (1)



NOTES:

1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS.
2. BS DENOTES BARE STRAP.
3. ALL PLUGS CONNECT TO CORRESPONDING JACKS ON CONTROL BASE WIRING DIAGRAM.
4. ADJACENT CONTACTS ON LEVELS OF STEPPING SWITCH ARE STRAPPED WITH BARE WIRE. STRAPPING BETWEEN CONTACTS SEPARATED BY ONE OR MORE CONTACTS USE BROWN WIRE.
5. Some units include only white wires with a number code for cross-reference to original unit wire colors as follows: 0-Black; 1-Brown; 2-Red; 3-Orange; 4-Yellow; 5-Green; 6-Blue; 7-Violet and 8-Gray.

TM5815-281-35-190 (2)

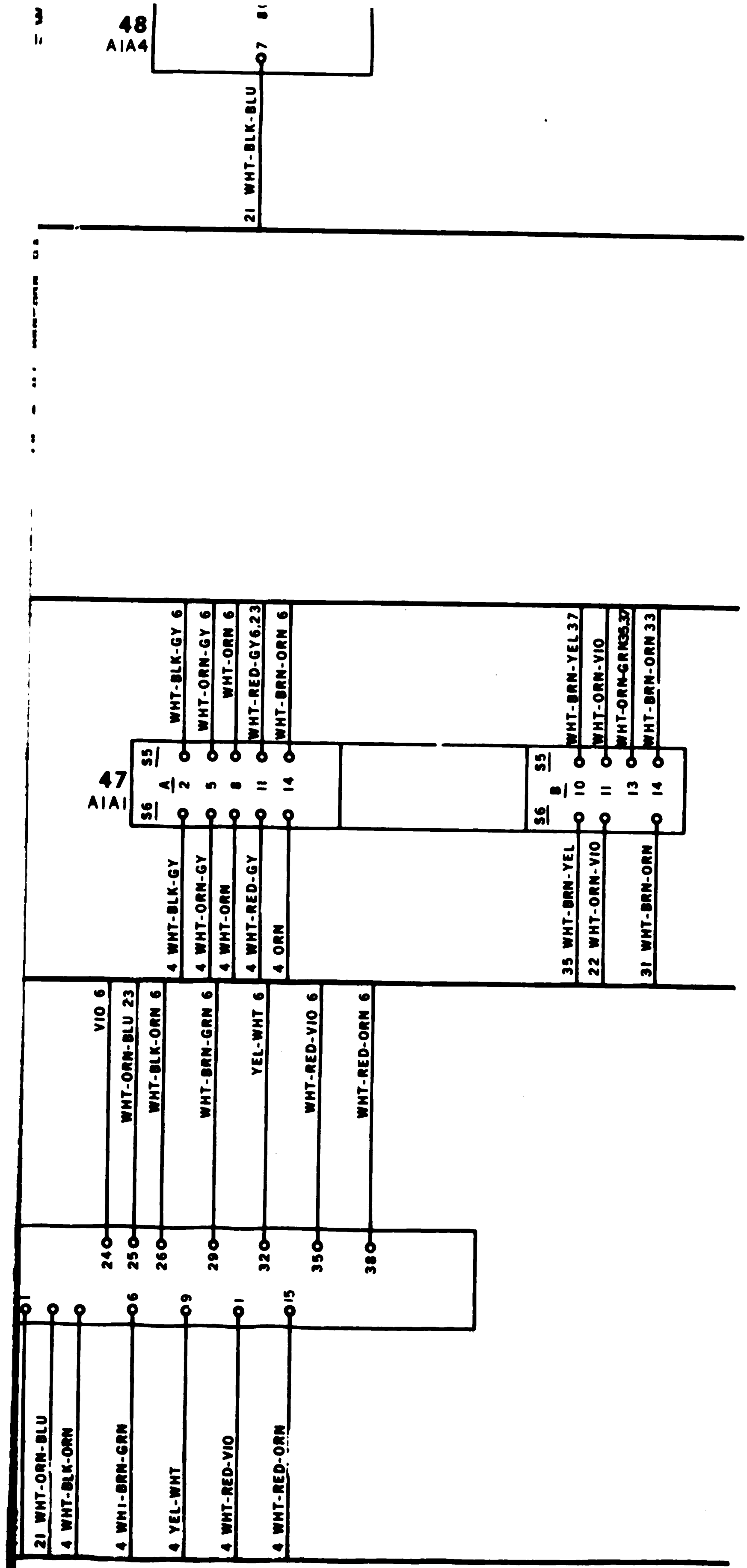
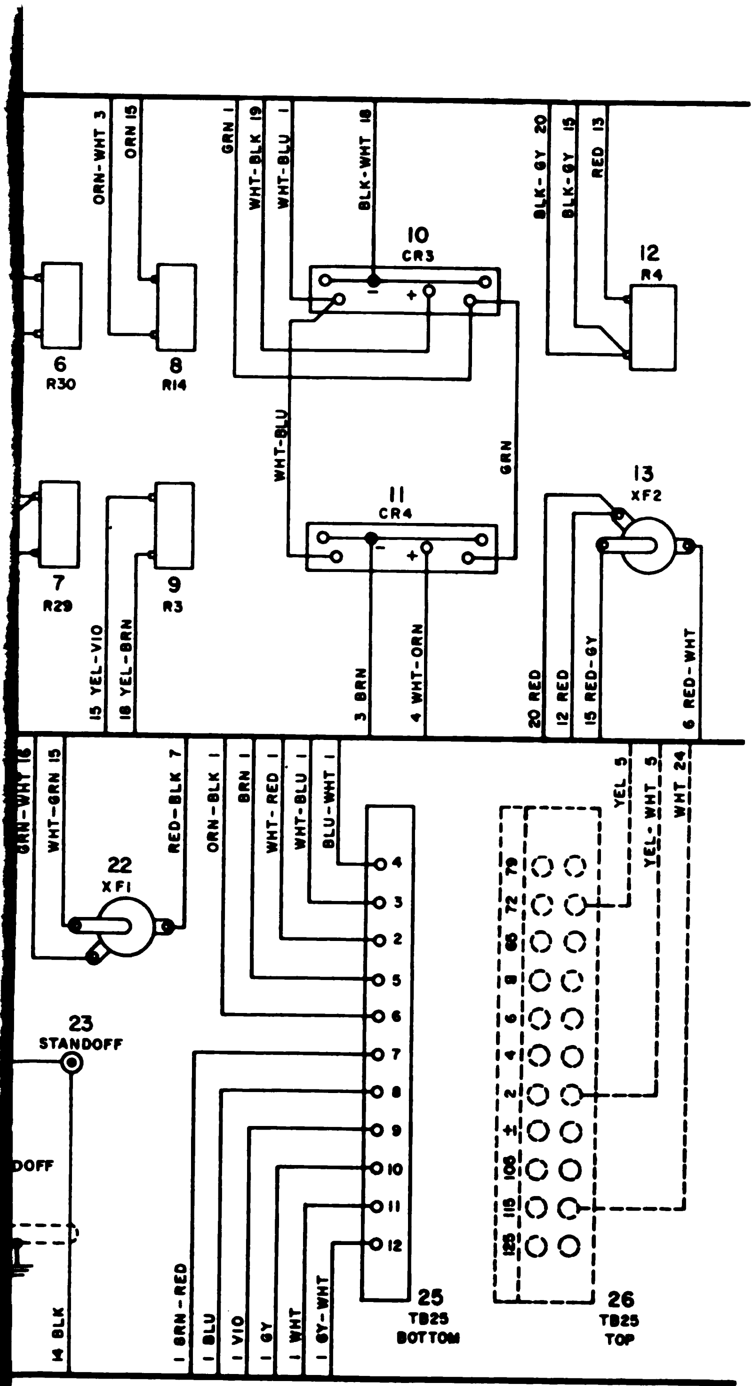


Figure 199. Control base, wiring diagram.



NOTES:

1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS.
2. BS DENOTES BARE STRAP.
3. DENOTES SHIELDED CONNECTIONS.
4. P27 (STATION 14) IS CONNECTED TO J27 OF AC INPUT BRANCHED CABLE
5. P29 (STATION 15) IS CONNECTED TO J29 OF DC OUTPUT BRANCHED CABLE

6. Some units include only white wires with a number code for cross-reference to original unit wire colors as follows: 0-Black; 1-Brown; 2-Red; 3-Orange; 4-Yellow; 5-Green; 6-Blue; 7-Violet and 8-Gray.

1 — 5815-281-35-200

ply PP-3131/GGC-9, wiring diagram.

NOTES:

1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO STATION TO WHICH THE WIRE RUNS.
2. DENOTES SHIELDED CONNECTIONS.
3. P55 (STATION 4) IS CONNECTED TO J55 OF AC INPUT BRANCHED CABLE.
4. P32 (STATION 12) IS CONNECTED TO J32 OF DC OUTPUT BRANCHED CABLE.
5. Some units include only white wires with a number code for cross-reference to original unit wire colors as follows: 0-Black; 1-Brown; 2-Red; 3-Orange; 4-Yellow; 5-Green; 6-Blue; 7-Violet and 8-Gray.

APPENDIX

REFERENCES

The following publications are applicable to field and depot maintenance of Distributor-Transmitter Set, Teletypewriter AN/GGC-9:

DA Pamphlet 310-4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TA 11-17	Signal Field Maintenance Shops.
TA 11-100 (11-17)	Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shops.
TM 11-2050A	Ohmmeter ZM-21/U.
TM 11-2217	Distortion Test Sets TS-383/GG, TS-383A/GG, and TS-383B/GG.
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-5815-281-12	Operator and Organizational Maintenance Manual; Distributor-Transmitter Set, Teletypewriter AN/GGC-9.
TM 11-5815-281-20P	Organizational Maintenance Repair Parts and Special Tools List; Distributor-Transmitter Set, Teletypewriter AN/GGC-9.
TM 11-6625-202-10	Operator's Manual; Test Sets I-181, I-181A, and I-181B.
TM 11-6625-320-12	Operator's and Organizational Maintenance Manual; Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U and ME-30C/U.
TM 38-750	The Army Equipment Record System and Procedures.

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Units org under fol TOE:
(1 copy each unit)
11-85
11-86
11-95
11-97
11-98
11-117
11-127
11-302
11-500(AA-AC)
29-134
29-136

NG: None

USAR: None

For explanation of abbreviations used, see AR 310-50.

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