NAVELEX 0967-LP-616-7010

TECHNICAL MANUAL

OPERATION AND MAINTENANCE INSTRUCTIONS WITH PARTS LIST

KEYBOARD SEND-RECEIVE (KTR) AND RECEIVE-ONLY (ROTR) TYPING REPERFORATOR SETS

MODEL 28

VOLUME 1

Manufactured by
Teletype Corporation

Manual Prepared by
Western Technical Associates
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TABLE OF CONTENTS

TABLE OF CONTENTS - Continued

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TABLE OF CONTENTS - Continued

TABLE OF CONTENTS - Continued

TABLE OF CONTENTS - Continued

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TABLE OF CONTENTS - Continued

LIST OF ILLUSTRATIONS

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LIST OF TABLES

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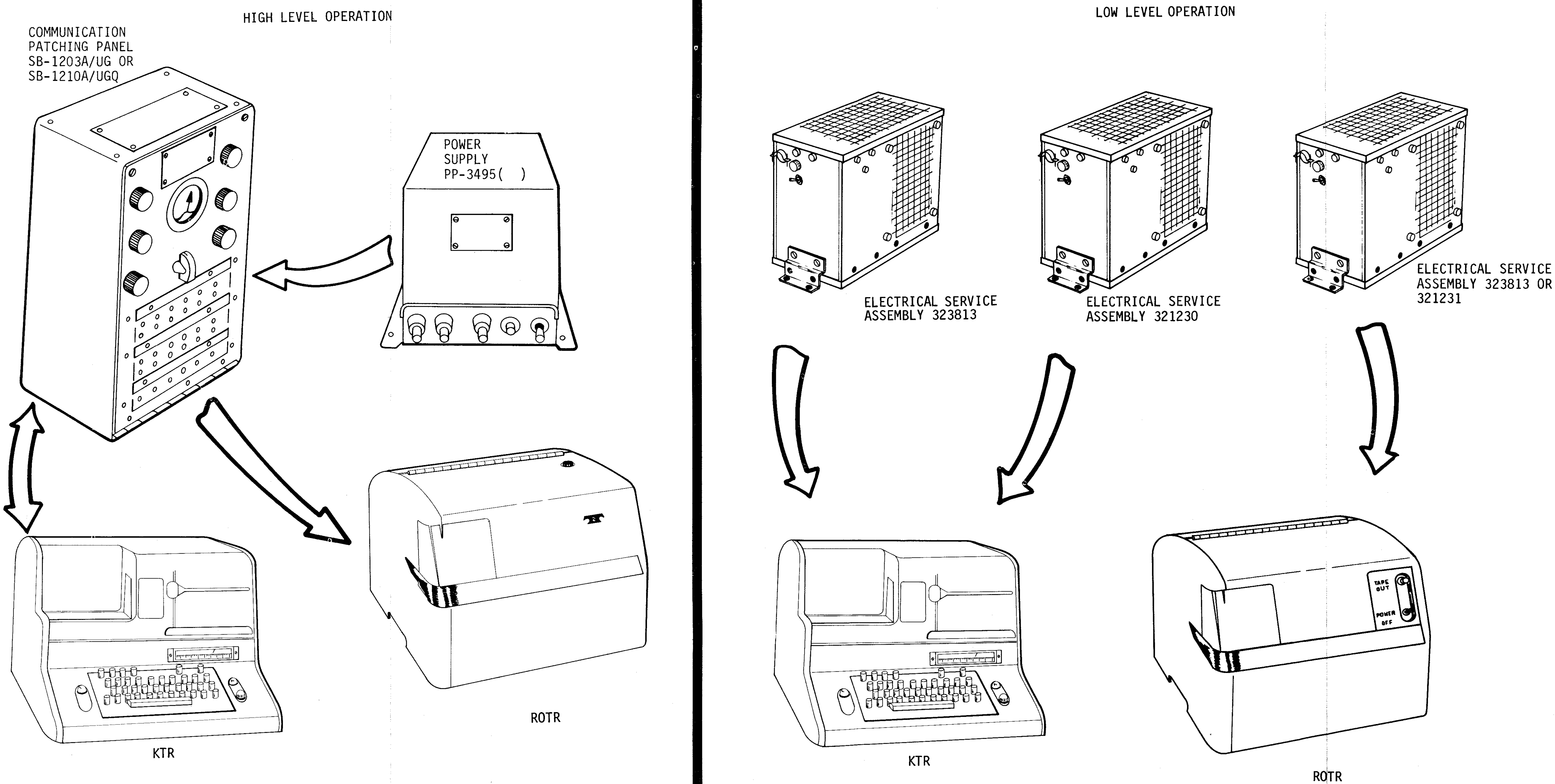


Figure 1-1. Keyboard Send-Receive Typing Reperforator Set (KTR) and Receive-Only Typing Reperforator (ROTR) Set Model 28

CHAPTER 1
GENERAL INFORMATION AND SAFETY PRECAUTIONS

1-1. SAFETY PRECAUTIONS. To stress the importance of employing proper safety techniques while performing maintenance procedures on the equipment involved, the user of this manual is directed to throughly familiarize himself with the safety precautions described in Chapter 4, paragraph 4-4.

1-2. INTRODUCTION. This manual provides information and instructions for installation, operation, and maintenance of the Keyboard Send-Receive (KTR) and Receive-Only (ROTR) Typing Reperforator Sets Model 28 (figure 1-1). Maintenance information includes instructions for testing, performing preventive maintenance and adjustments, troubleshooting, and repairing. A parts list is also included.

1-3. EQUIPMENT DESCRIPTION. The Typing Reperforator Sets Model 28 consist of two basic types, each of which is described in the following paragraphs. Figures 1-2 through 1-6 are three-fourths front views of configurations currently in use.

a. KTR Set. The KTR Typing Reperforator Set is an electromechanical apparatus that provides terminal facilities for exchanging messages over appropriate transmission facilities including telegraph lines, telephone networks, and radio channels. An operator sends the messages by typing them on a keyboard which translates the data to a serial start-stop (teletypewriter) code. The originating KTR set records the transmission on communications-type tape in the form of code hole perforations and printed characters. The distant stations record the transmission on tape, page-width copy paper, or continuous business forms, determined by the facilities of the station. The set operates at various speeds up tc 107 words per minute (wpm).

b. ROTR Set. The Receive-Only Typing Reperforator Set (ROTR) is similar to the KTR set, but has no keyboard sending facilities. The ROTR set is used in applications that require only the reception of messages and printing and punching them on tape. The ROTR sets can be regular size or miniaturized as shown in figures 1-3 and 1-4.

c. High- and Low-Level. This manual covers both high-level and low-level configurations of typing reperforator sets. High-level typing reperforator sets are used in applications wherein radio frequency interference (RFI) does not present a problem. Low-level typing reperforator sets have RFI suppression features incorporated. One of the RFI suppression features is the use of a low-level signaling code from which the term low-level is derived. The low-level signaling code are the +6-volt (mark) and -6-volt (space) polar code levels versus the 0.060-milliampere (mark) and 0-milliampere (space) neutral code levels used in the high-level sets. High-level typing reperforator equipment is

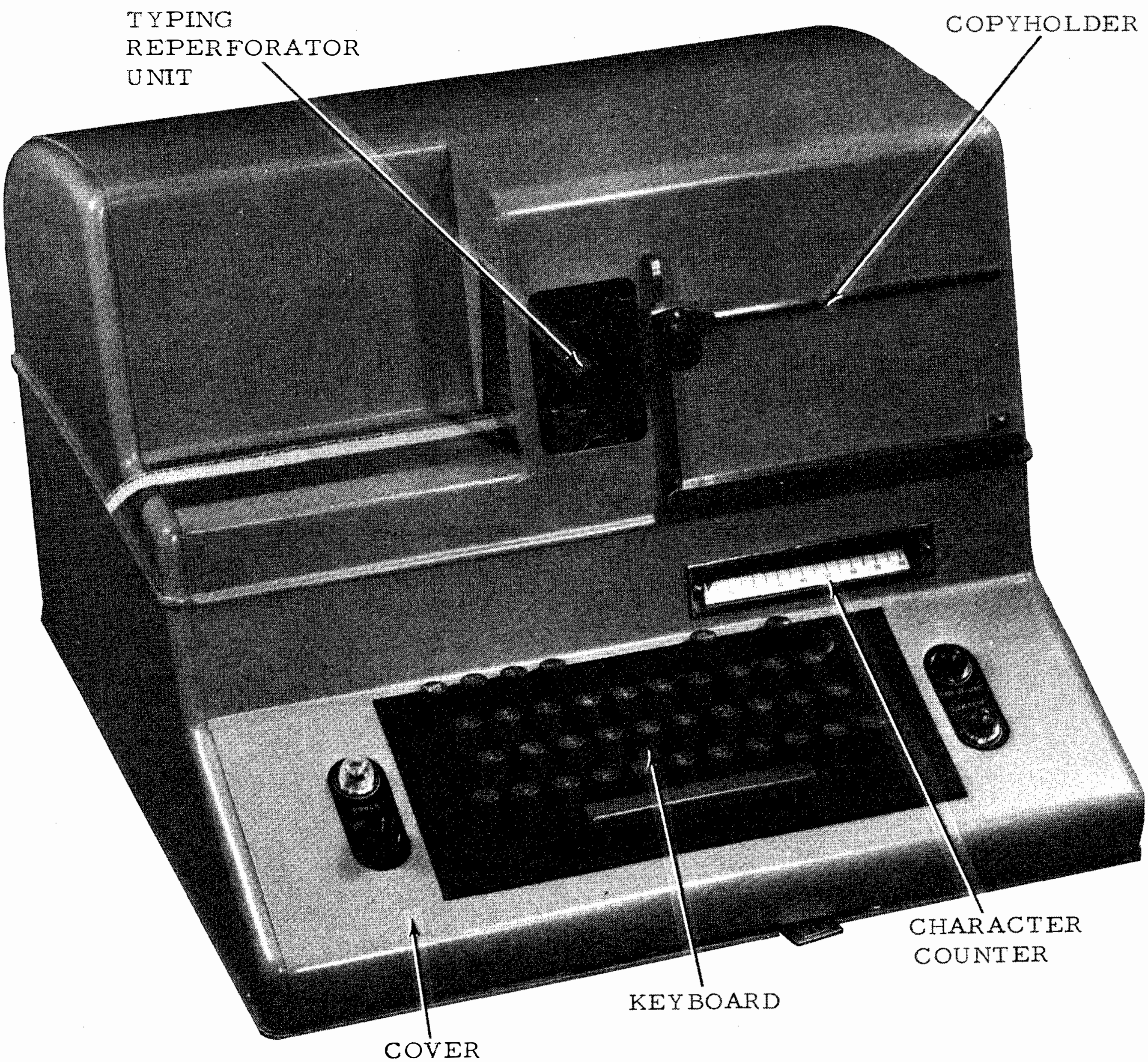


Figure 1-2. Keyboard Send-Receive Typing Reperforator Set Model 28

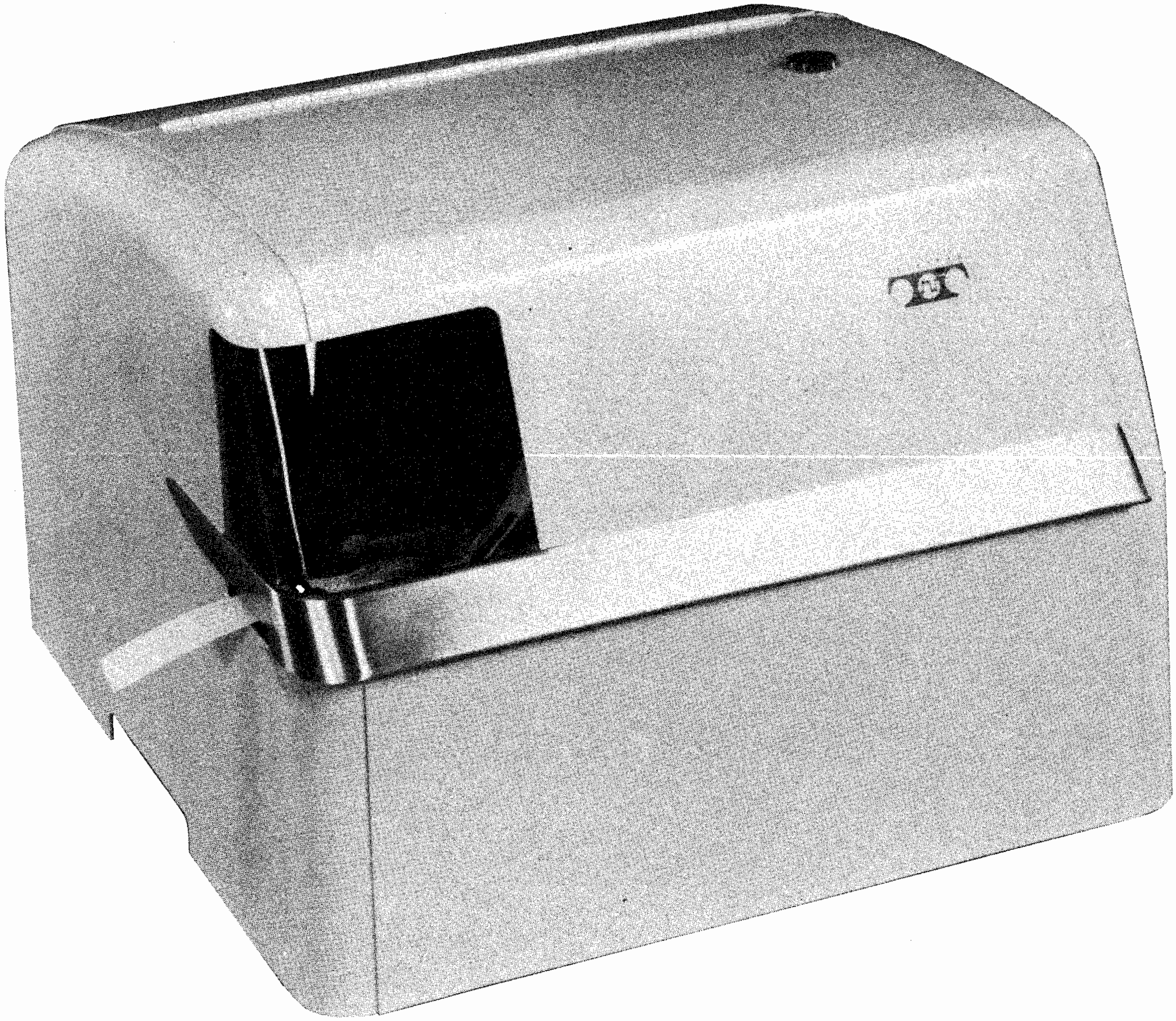


Figure 1-3. Receive-Only Typing Reperforator Set Model 28

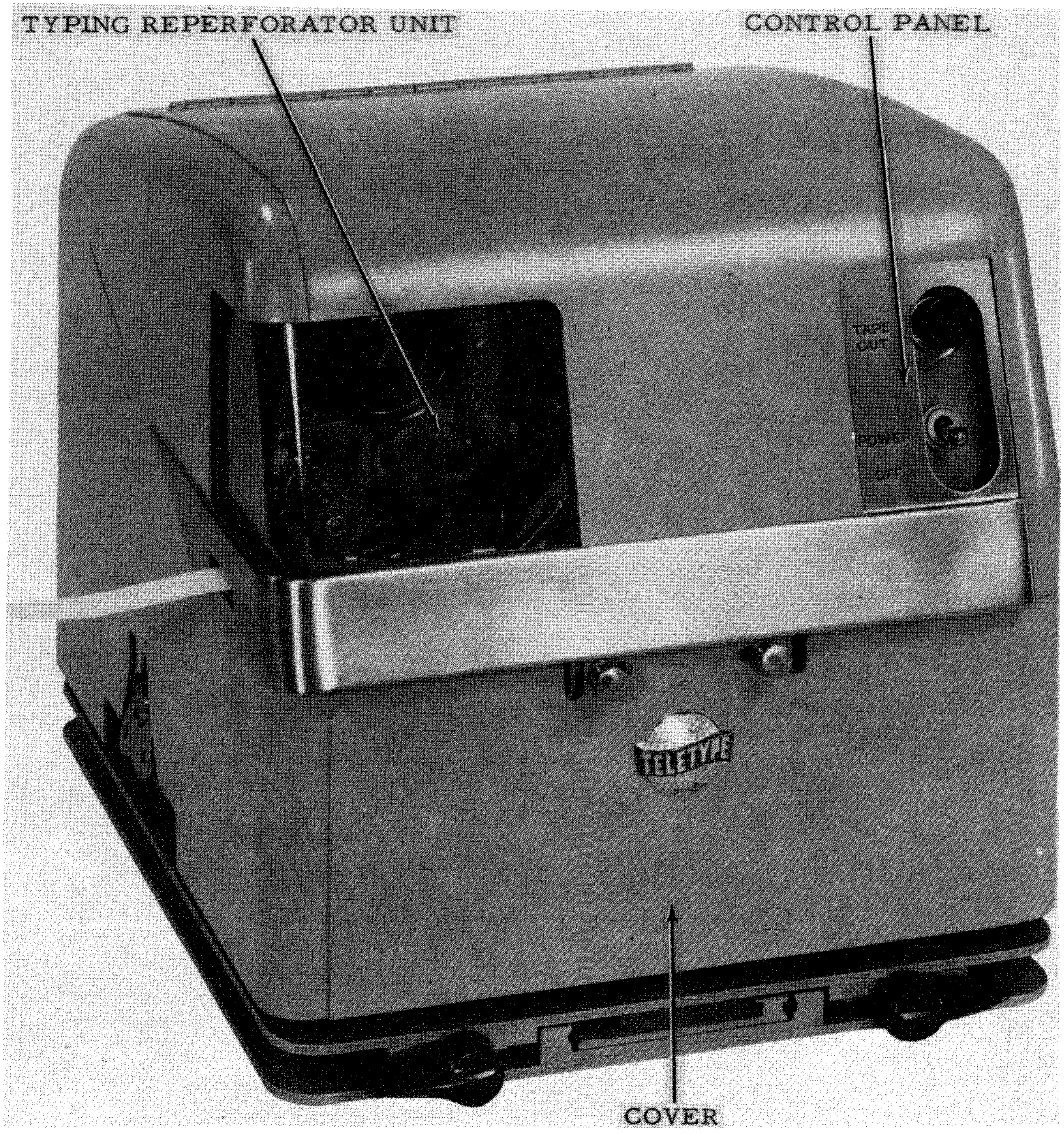


Figure 1-4. Miniaturized Receive-Only Typing Reperforator Set Model 28

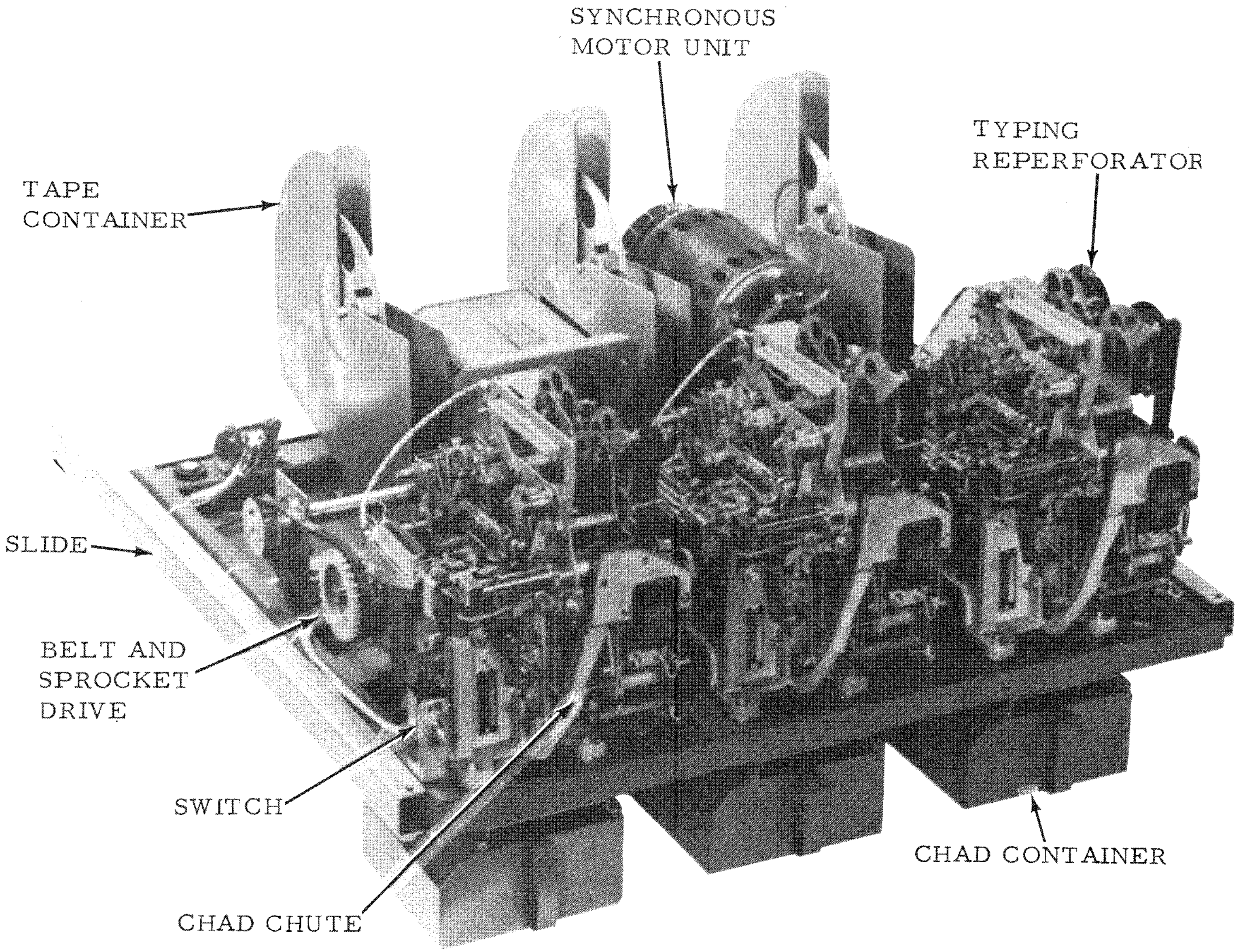


Figure 1-5. Multiple Typing Reperforator Set Model 28

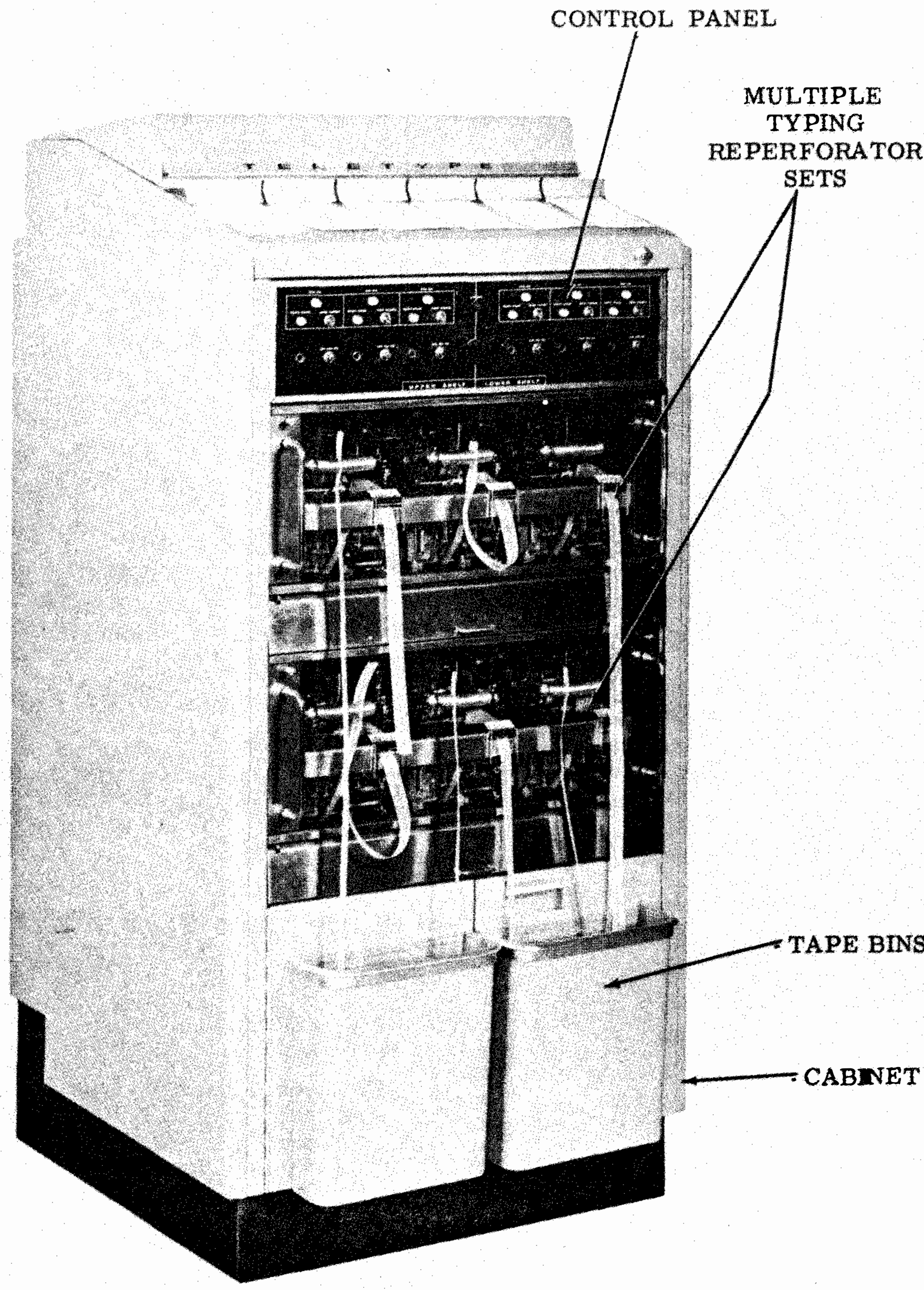


Figure 1-6. Typical Multiple Reperforator Set Model 28 Cabinet

described in paragraph 1-3.1 and low-level equipment is described in paragraph 1-3.2.

1-3.1 EQUIPMENT DESCRIPTION (HIGH-LEVEL). The component complement of the typing reperforator sets may vary from one installation to another, depending upon the operational requirements. In general, a KTR set consists of a typing reperforator unit, a keyboard base, a motor unit, and an enclosure as shown in figure 1-7. The receive-only base replaces the keyboard base in ROTR sets, and in the multiple ROTR sets, it accommodates three typing reperforator units. In KTR sets, the motor unit and typing reperforator unit are mounted on the base portion of the keyboard (figure 1-7). The motor unit supplies rotary motion, through a gear set, to the typing reperforator unit and the keyboard. Gear sets may be interchanged to obtain various operating speeds up to 107 wpm. The transfer of rotary motion from the motor unit to the typing reperforator unit in ROTR sets is achieved through interchangeable gear sets or, in certain sets, by an optional, variable speed gear mechanism (see figure 1-8). In the multiple ROTR sets, the typing reperforator units may operate at a common speed, or at independently varied speeds.

a. Typing Reperforator Unit. The typing reperforator unit contains the mechanisms necessary for translating electrical input signals into mechanical motions that perforate code holes and print the equivalent messages on tape. The unit may be equipped to provide either fully-perforated or partially-perforated (chadless) operation. A function box is included to provide special functions such as unshift-on-space and signal bell.

b. KTR and ROTR Bases. Both the KTR and the ROTR bases provide mounting facilities for the typing reperforator unit, motor, drive gears, and various mechanisms required for control of the set. Unlike the ROTR base, the KTR base is equipped with mechanisms for generating and transmitting a teletypewriter signal.

c. Motor Units. The motor units provide mechanical motion for KTR and ROTR sets. These units may be either of two basic types, ac synchronous or ac/dc series governed. The ac synchronous motor is used when the power source is regulated; the ac/dc series governed motor operates from either regulated or unregulated power. The latter is required where only unregulated power is available. The units operate at the same speed. They are available in standard and heavy-duty horsepower ratings, to accommodate varying load requirements.

d. Enclosures. The components of the KTR and ROTR sets may be housed in the following enclosures: The KTR cover, the ROTR cover, the miniaturized ROTR set cover, and the multiple reperforator set cabinets. In addition, tables are available for supporting the cover-enclosed sets.

e. Variable Features. A wide variety of optional features are available with the equipment. These features, which provide special operations or control facilities, or which serve as an aid in operation, are in most cases readily installed in the field. Some of

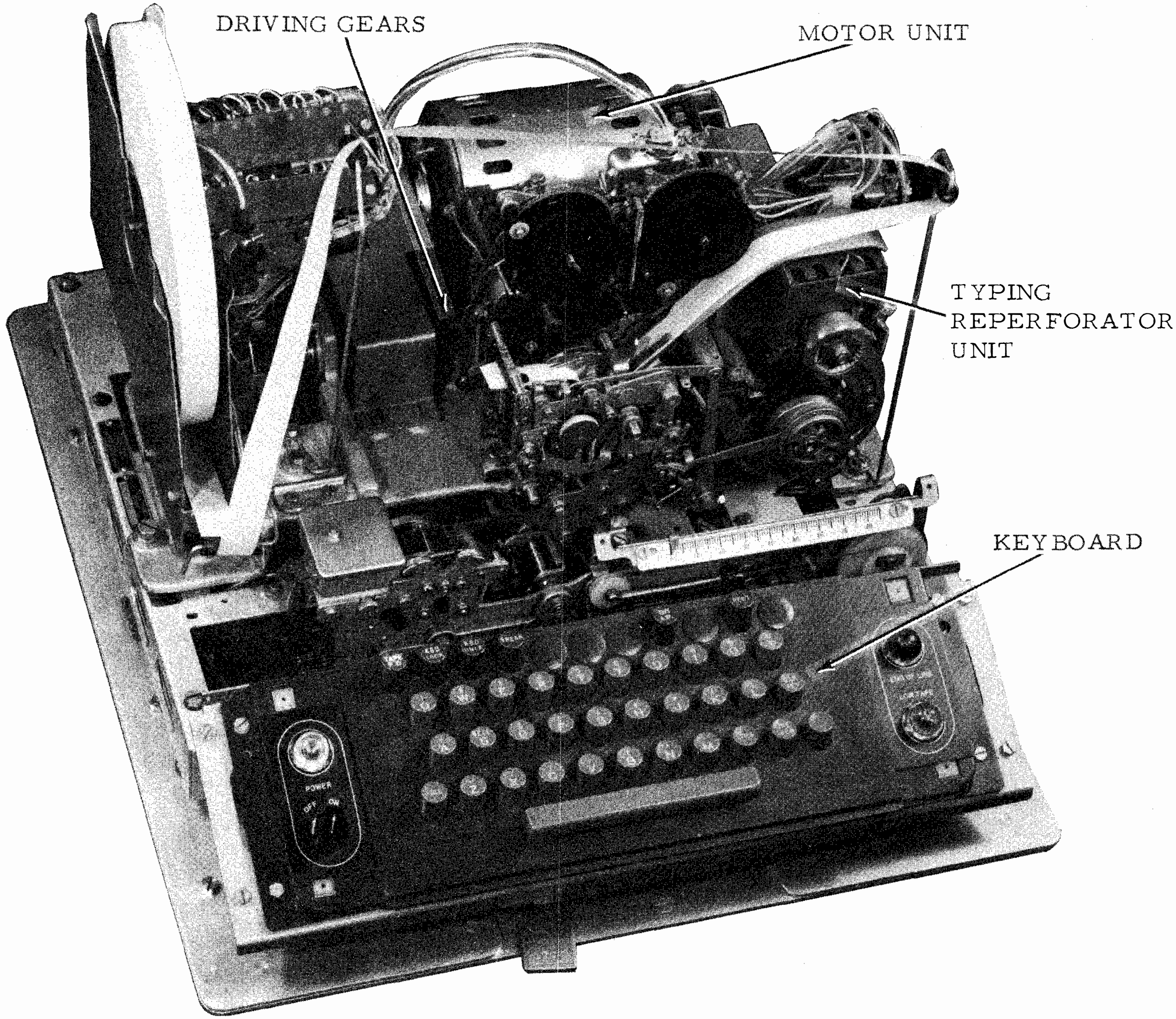


Figure 1-7. Keyboard Send-Receive Typing Reperforator Set Model 28 (Cover Removed)

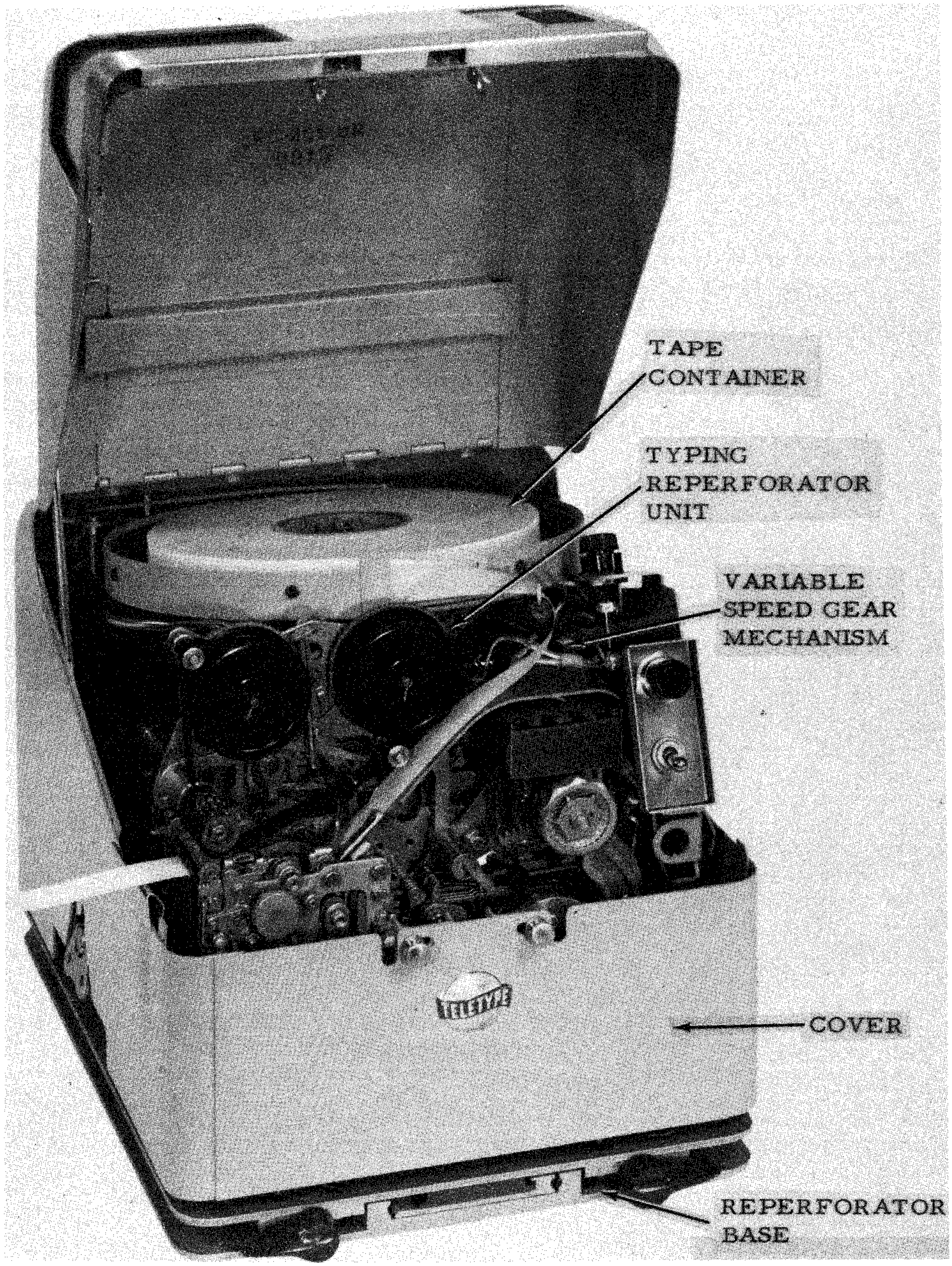


Figure 1-8. Miniaturized Receive-Only Typing Reperforator Set Model 28 (Cover Open)

these features are briefly described in the following paragraphs.

(1) Tape Feed-Out Mechanisms. These mechanisms operate automatically or manually to step-out a length of blank or LETTERS perforated tape for convenience in tape handling. Feed-out may be interfering or non-interfering.

(2) Backspace Mechanism. This mechanism may be operated manually or with power drive. The mechanism retracts tape back through the punch block to allow erroneously perforated data to be obliterated by replacement with the LETTERS code combination.

(3) Variable Speed Drive Mechanism. This mechanism is used in place of single-speed gear sets on certain ROTR sets. This feature permits the selection of operating speeds by means of a manually operated lever. Typically, speeds of 60, 75, and 100 wpm are available.

(4) Motor Control Mechanisms. This mechanism starts or stops the set's motor in response to predetermined signal line or separate line conditions.

(5) Contact Mechanisms. A number of electrical contact assemblies are available to provide control to external equipment or for other special applications. These include code-reading, timing, and LETTERS-FIGURES contact mechanisms.

(6) Accessories. Various accessories are available to facilitate tape processing and handling, including tape bins, low-tape and tape-out alarms, and tape winders.

1-3.2 EQUIPMENT DESCRIPTION (LOW-LEVEL). Low-level typing reperforator sets differ from high-level typing reperforator sets in that RFI suppression features have been incorporated in several of the low-level components. The following paragraphs describe these features and point out the areas of difference between high-level and low-level equipment.

a. RFI Suppression. RFI suppression as applied to typing reperforator sets is accomplished by means of shielding and wave-shaping a low-level electrical telegraph signal throughout the equipment. The installations vary with each set, but produce the same results of ensuring signal line privacy.

(1) Signaling. The code is transmitted by means of a $\pm$6-volt polar signal through a network of shielded cables to the shielded container of an electrical service assembly (ESA). A +6-volt signal is mark; a -6-volt signal is space.

(2) Electrical Service Assembly (ESA). The ESA is an electrically-shielded container in which shielded cables terminate. It also serves as a housing for certain components such as plug-in clutch magnet driver circuit cards, keyer circuit cards, and power supply circuit cards. Components and construction characteristics of ESAs are discussed in paragraph 1-3.3.

(3) Cabling. The shielded cabling varies with each set according to need. Each component unit of a set is equipped with sufficient

shielding, in the form of metallic enclosures and shielded cables, to suppress signal radiation. All signal generators and magnet assemblies in the signal circuitry are shielded by means of metal containers attached to their respective cables. Interconnecting cables join the component units to the ESA by means of metal connectors which screw together for a tight shielded connection.

b. KTR and ROTR Set RFI Components. A shielded RFI selector mechanism is used in the typing reperforator unit of KTR and ROTR sets. A shielded contact box assembly is used in the signal generator mechanism of the keyboard unit of KTR sets.

c. RFI Selector Mechanism. The RFI selector mechanism (figure 1-9) mounts on the main frame of the reperforator. The selector consists of a special three-pin electrical receptacle, double-shielded cable and metallic container. The three-pin electrical receptacle ensures a secure and shielded electrical connection to other associated apparatus. The double shielded cable electrically connects the three-pin electrical receptacle to the selector magnets. The shielded cable is composed of three electrical conductors encircled by braided inner and outer shields. The inner and outer braided shields are electrically separated from each other and the three electrical conductors by flexible solid dielectric. The metallic container functions as a shielded enclosure for the selector magnet assembly. Enclosed within the metallic container are the selector magnet coils, coil mounting bracket, and selector armature. Each selector magnet coil contains an electrostatic shield which surrounds the coil windings. The selector coil mounting bracket provides mounting facilities for the coils, armature, and biasing spring. The receptacle, shielded cable, metallic container, and selector coils provide RFI suppression when used with associated RFI equipment.

d. RFI Signal Generator Contact Box Assembly. The RFI signal generator contact box assembly (figure 1-10) consists of a double-shielded contact box, a contact assembly, a filter card assembly, and a double-shielded signal line cable with receptacle.

(1) Contact Box. The RFI signal generator contact box is composed of an inner metallic box completely enclosed by an outer metallic box. They are physically fastened together with insulating material to provide electrical isolation.

(2) Contact Assembly. The contact assembly is provided with gold-plated contacts to permit low voltage operation. It is electrically insulated from the inner box which encloses it.

(3) Filter Card Assembly. The filter card assembly is a network of three resistors and a capacitor mounted on a circuit board. It is mounted on the contact assembly within the inner box. When used in conjunction with associated shielded cables, power supplies, and keyer, the filter provides a low-level interface and RFI suppression.

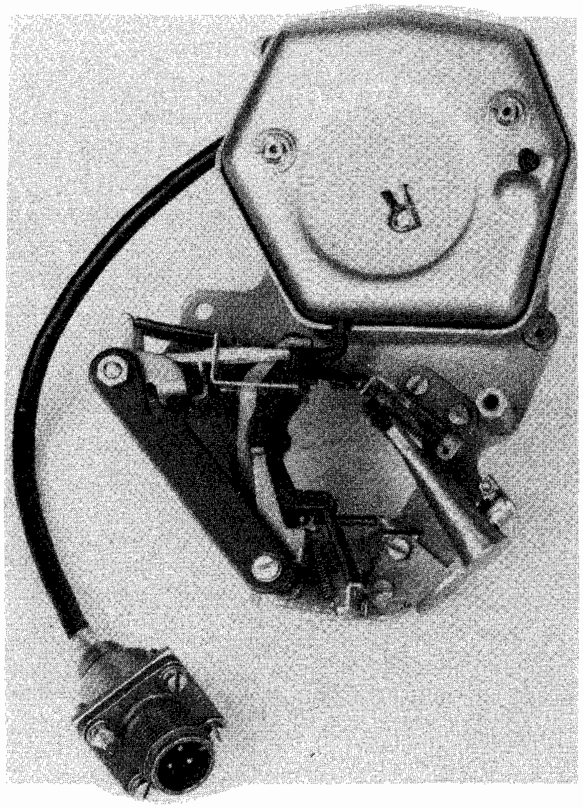


Figure 1-9. RFI Selector Mechanism

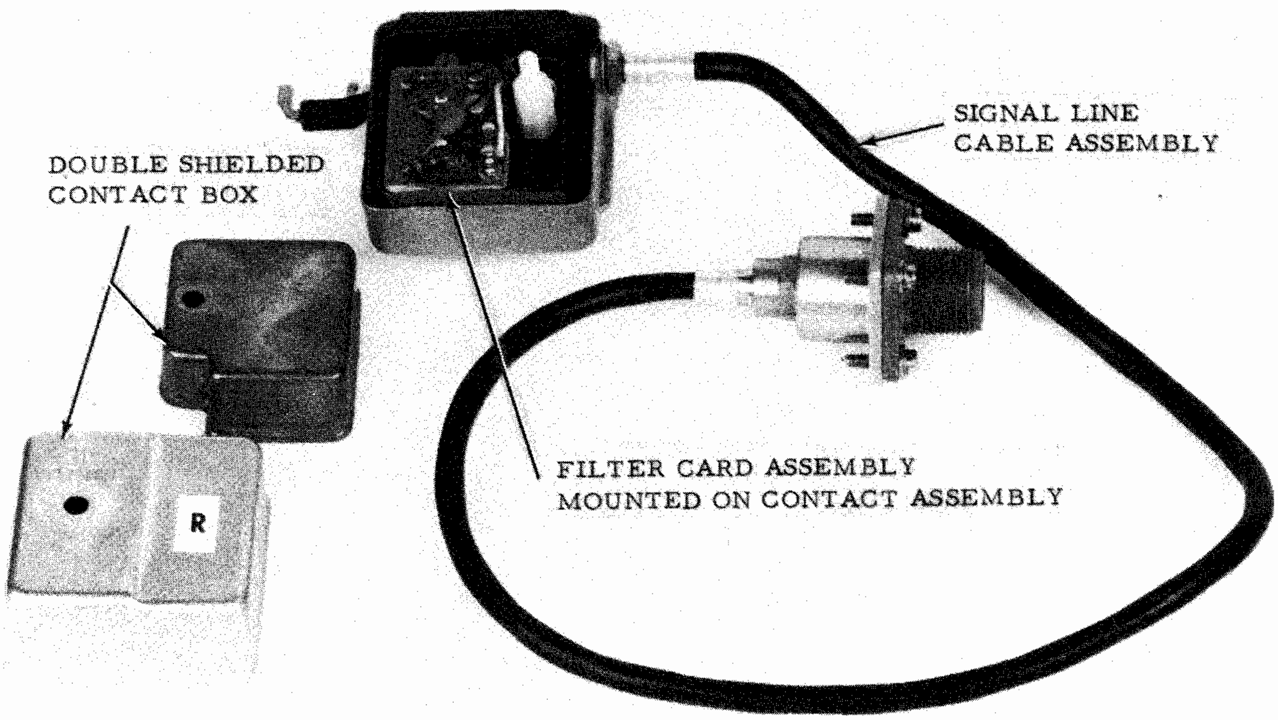


Figure 1-10. RFI Signal Generator Contact Box Assembly

(4) Signal Line Cable Assembly. A double-shielded cable assembly is provided to electrically connect the contact box to a three-pin electrical receptacle. The shielded cable is composed of three electrical conductors encircled by braided inner and outer shields. Two of the three internal wires are electrically insulated, and transfer the telegraphic signals to associated equipment. The remaining wire is bare and electrically connected to the inner contact box, inner braid shield, and cable receptacle. The inner and outer braided shields are electrically separated from each other and the wire by flexible solid dielectric. The inner braid is electrically connected to the inner contact box and the outer braid is electrically connected to the outer contact box. The cable assembly provides RFI suppression when used with associated RFI equipment.

1-3.3 ELECTRICAL SERVICE ASSEMBLY. In low-level configurations an electrical service assembly (ESA) is used instead of the load current power supply. The following paragraphs describe briefly the components comprising the ESA with their functions.

a. General Description. The ESA is an electrically-shielded container in which the shielded cables terminate. It also serves as a housing for certain components such as plug-in selector magnet driver circuit cards, clutch magnet driver circuit cards, keyer circuit cards, power supply circuit cards and relays. Figure 1-11 is a three-fourths front view of the Model 28 ROTR Set with the reperforator table, showing the front panels opened indicating the location of the ESA. In table models the ESA is connected to the reperforator by shielded cables.

b. ESA Designs. The ESAs are shielded metal containers which vary in configuration for different applications. They differ primarily because of the number of IRs (isolation relays) and circuit board connectors which are provided for the associated keyers and drivers, as well as whether they are designed to be table-mounted or installed in a cabinet. ESAs that house low-level keyer (LLK) or selector magnet drivers (SMD) require double-shielded box construction. An inner aluminum box functions as an electrostatic shield and is electrically isolated from an outer box which serves as a magnetic shield. Single-box construction is adequate for the clutch magnet driver (CMD) circuit cards which serves as a combined electrostatic-magnetic shield. The inner box contains a mounting plate with circuit board connectors to accommodate a power supply printed circuit board assembly and the required number of CMD, SMD, and LLK circuit cards. A screw terminal strip is provided for connecting the signal line. The outer box contains the inner box, a power supply transformer, power line filter, and a screw terminal block for ac power connections. A power switch and fuse are located on one side of the box. The rectifier filter capacitor is housed within the inner box. Figures 1-12 and 1-13 show single-box and double-box ESAs, respectively, designed to be table-mounted. Figure 1-14 shows relative positions of inner and outer boxes and covers and circuit card connectors in a double-shielded ESA.

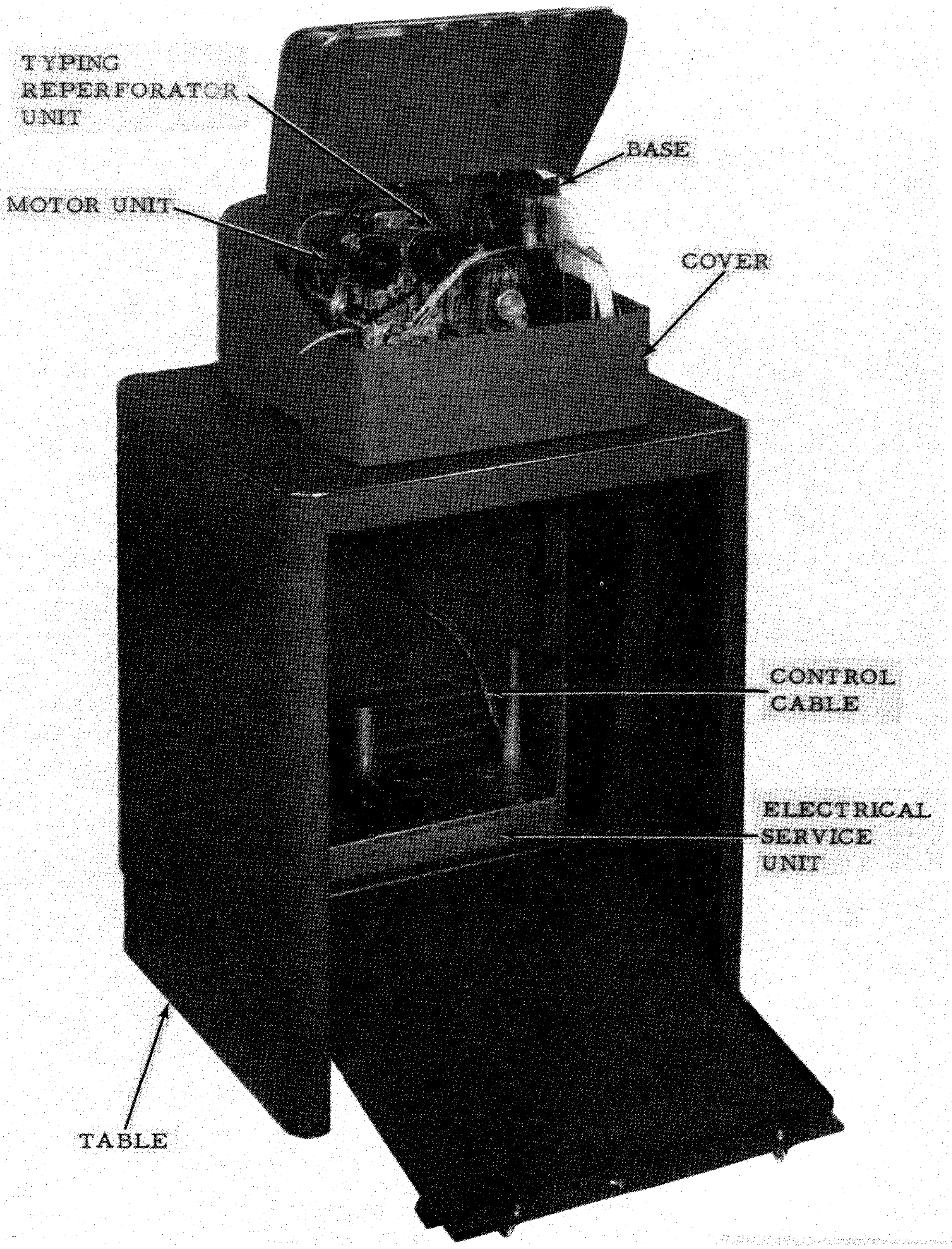


Figure 1-11. Receive-Only Typing Reperforator Set and Reperforator Table Model 28

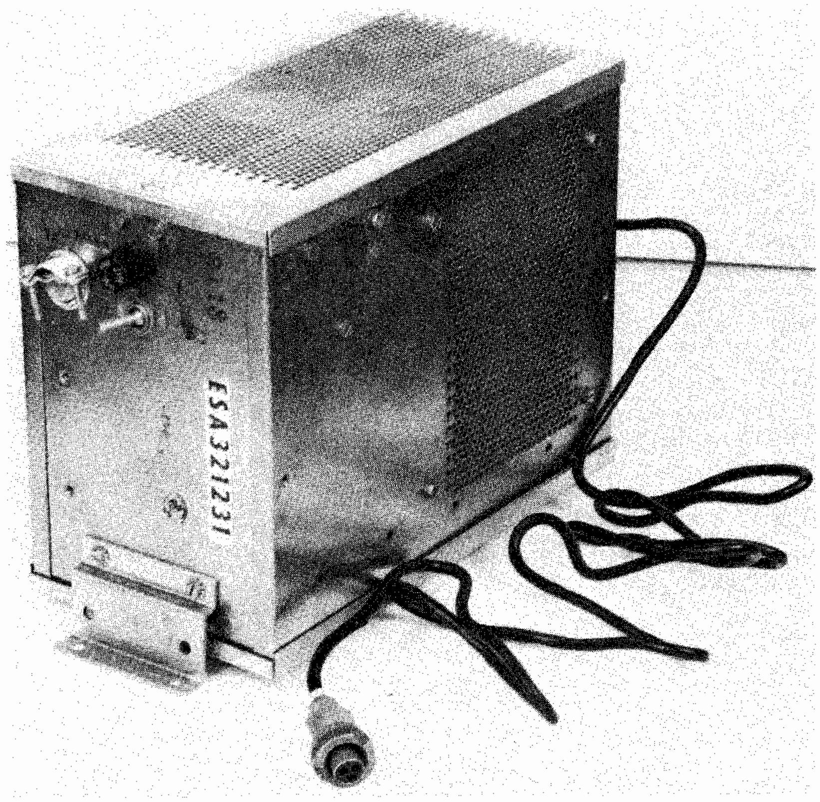


Figure 1-12. ESA for Table Mounting - Single Box Construction

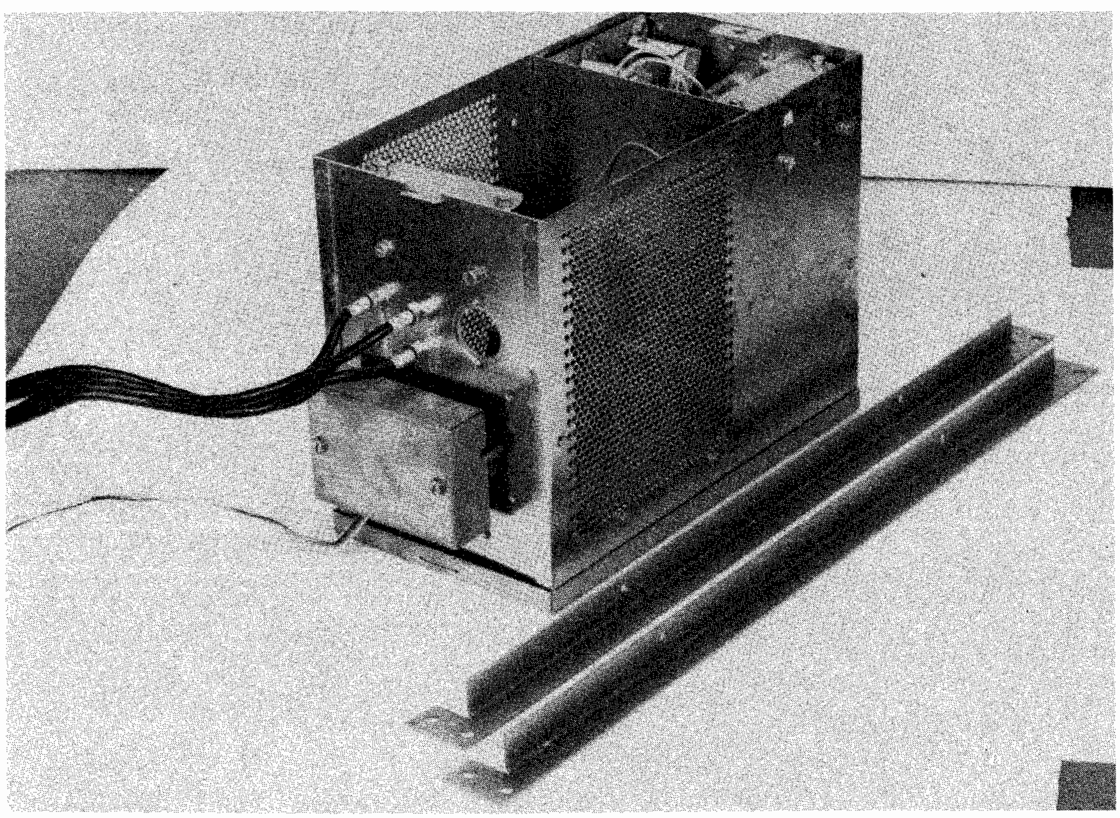


Figure 1-13. ESA for Table Mounting - Double Box Construction

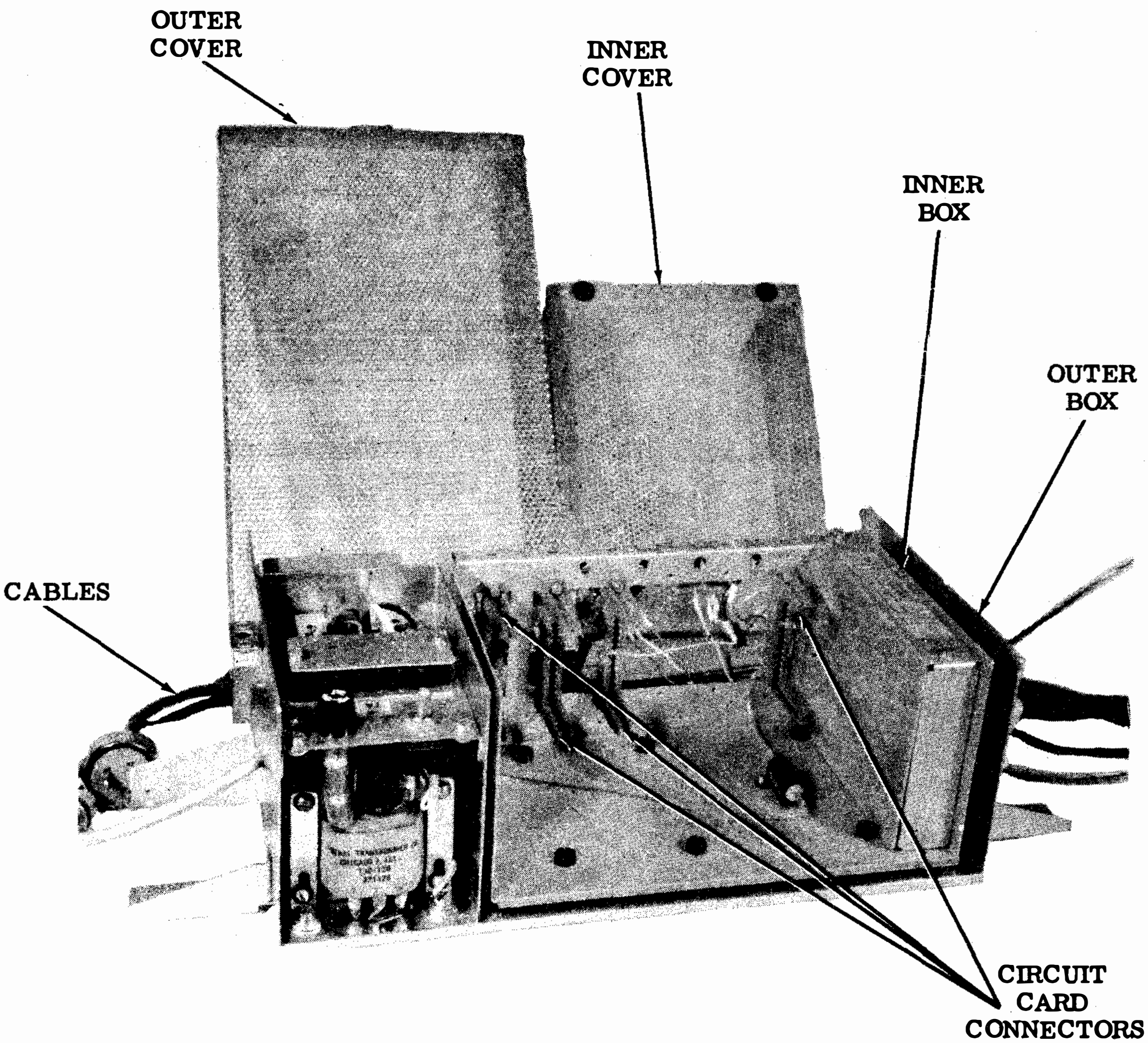


Figure 1-14. ESA Showing Circuit Card Connectors

c. ESA Components. Figure 1-15 is a top view and figure 1-16 is a bottom view of a double shielded ESA. Figure 1-17 is an exploded view of an ESA having single-box construction, showing typical components. Figure 1-18 shows locations of typical cards used in an ESA. Refer to the circuit discussions in Chapter 3 for a detailed discussion of the operation of each of these circuit cards. Abbreviations for the ESA components listed in table 1-2 are as follows:

ROTR	Receive-Only Typing Reperforator
SRTR	Send-Receive Typing Reperforator
ESA	Electrical Service Assembly
LLK	Low-Level Keyer
SMD	Selector Magnet Driver
CMD	Clutch Magnet Driver
PS	Power Supply
WDP	Wiring Diagram Package

d. ESA Circuit Cards. The following paragraphs include a basic descrption of the physical properties and operating characteristics of the circuit cards used in the ESA.

(1) Selector Magnet Driver (SMD). The TP323810 selector magnet driver is a 15-pin circuit card assembly designed to plug into an associated ESA as an integral part of its components. When used in conjunction with proper power supply and filter assemblies, it is intended for RFI suppression of receiving selector noise in systems requiring this suppression. Figure 3-55 is a front view of the circuit card. The SMD provides two inputs and makes possible reception from either one of two separate transmitters (single input operation) while the input line from the other transmitter is open. A spacing signal at either input will provide a spacing output. In order to function properly, the SMD should be installed in a double-shielded enclosure and used in conjunction with the appropriate ESAs where extreme RFI suppression is required. It is not intended for general use. The input current to the SMD is a low-level +6-volt input for a marking state, and a -6-volt for a spacing state. The output current of the SMD is 60 milliamperes ±10 percent during the marking state. The output is zero during the spacing state. The SMD assumes the marking state with positive input voltages not greater than +0.5 volt dc and the spacing state with negative voltages not greater than 0.5 volt dc. The marking and spacing switching levels are adjustable within 10 percent of each other. This requirement applies to either input. Each input of the SMD has a minimum input resistance of 50,000 ohms. The maximum input capacitance of either input is 2500 picofarads. Overall receiving margins of properly adjusted Model 28 selectors driven by this SMD (polar rectangular wave input) should exceed 70 points at either input. The SMD provides a marking output when both inputs are open. Both inputs cannot be in the marking condition simultaneously without producing a garbled output. The SMD operates at bit rates up to 75 baud. It operates in a free-

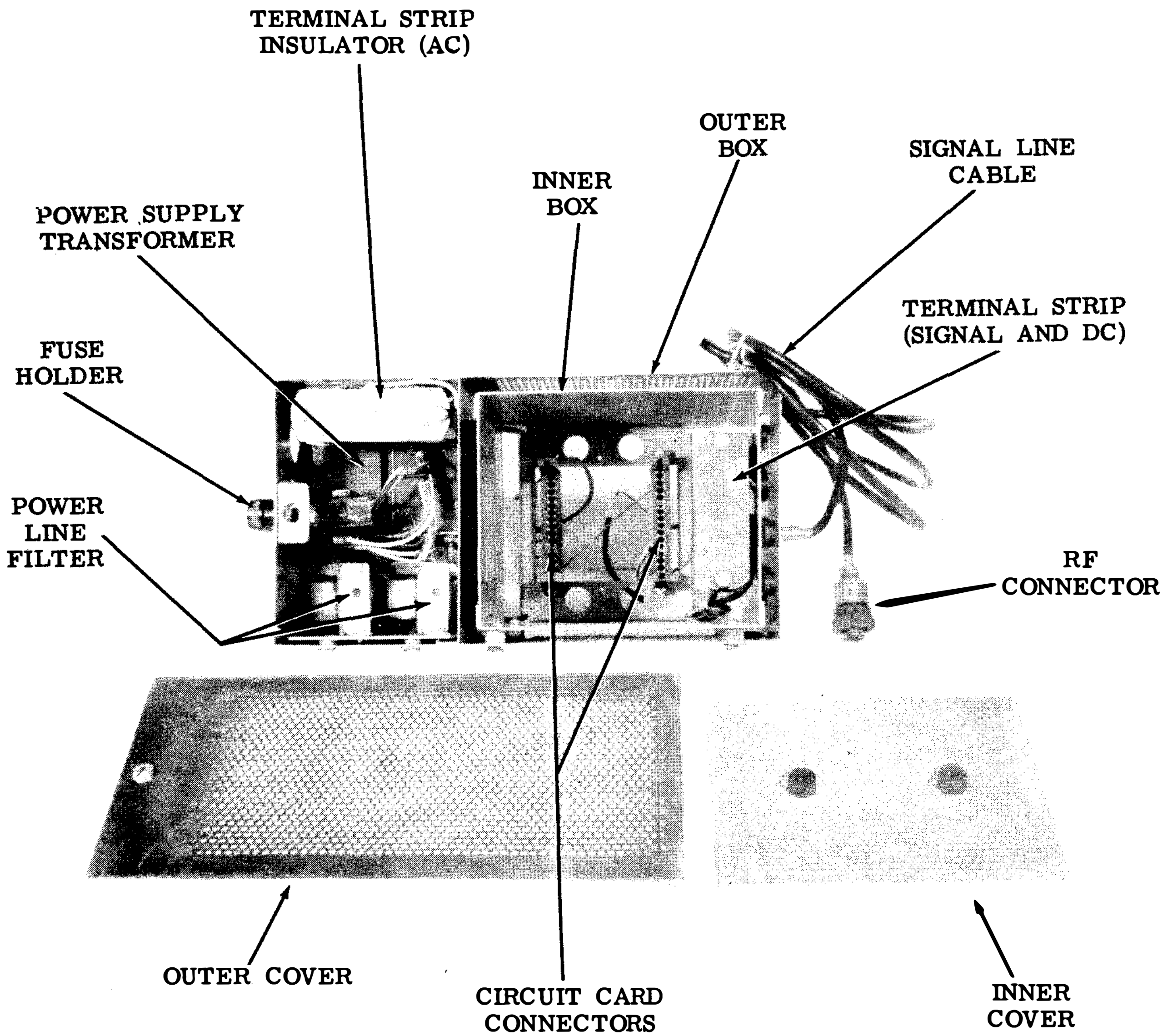


Figure 1-15. Typical Parts of an ESA - Double Box Construction (Top View)

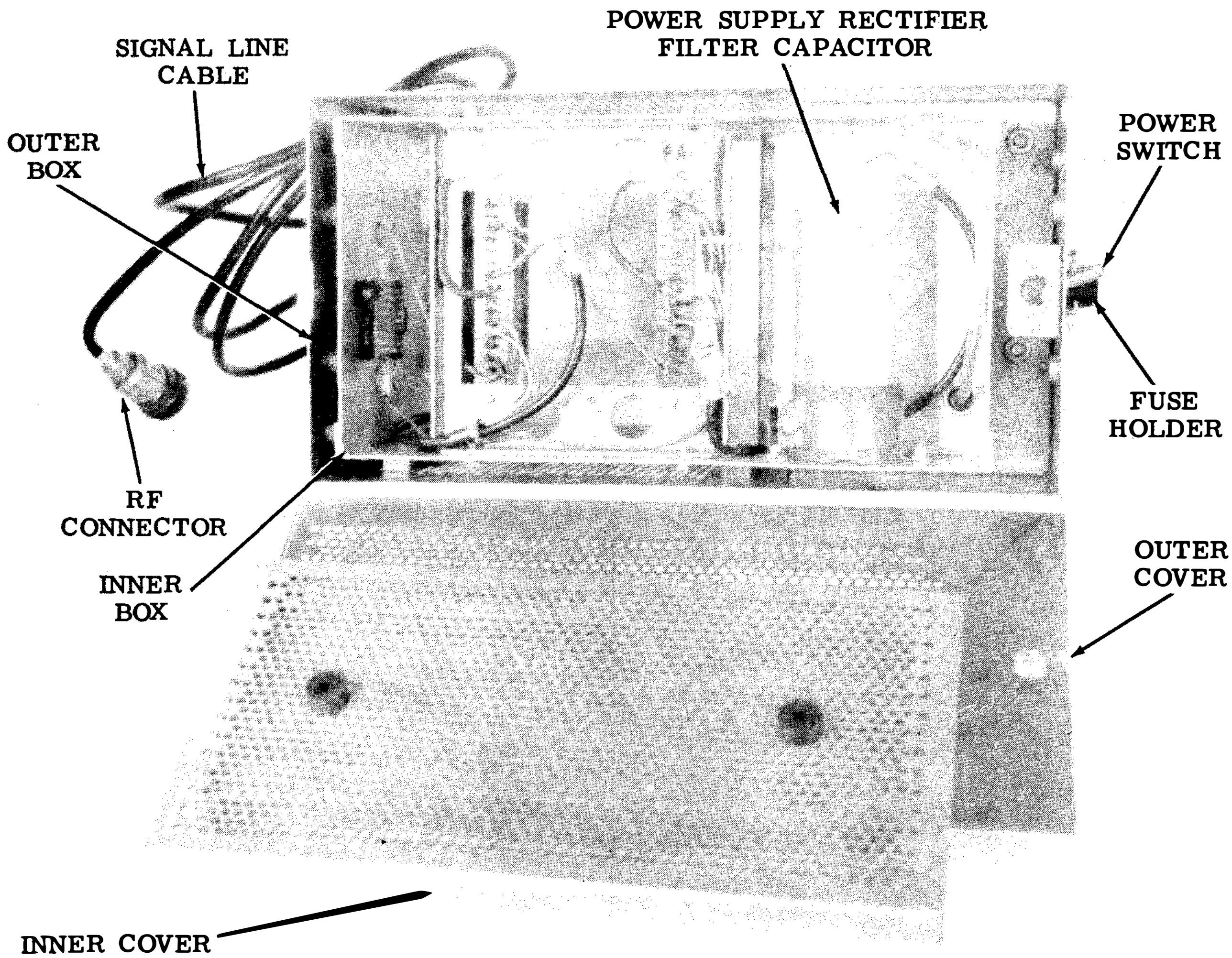


Figure 1-16. Typical Parts of an ESA - Double Box Construction (Bottom View)

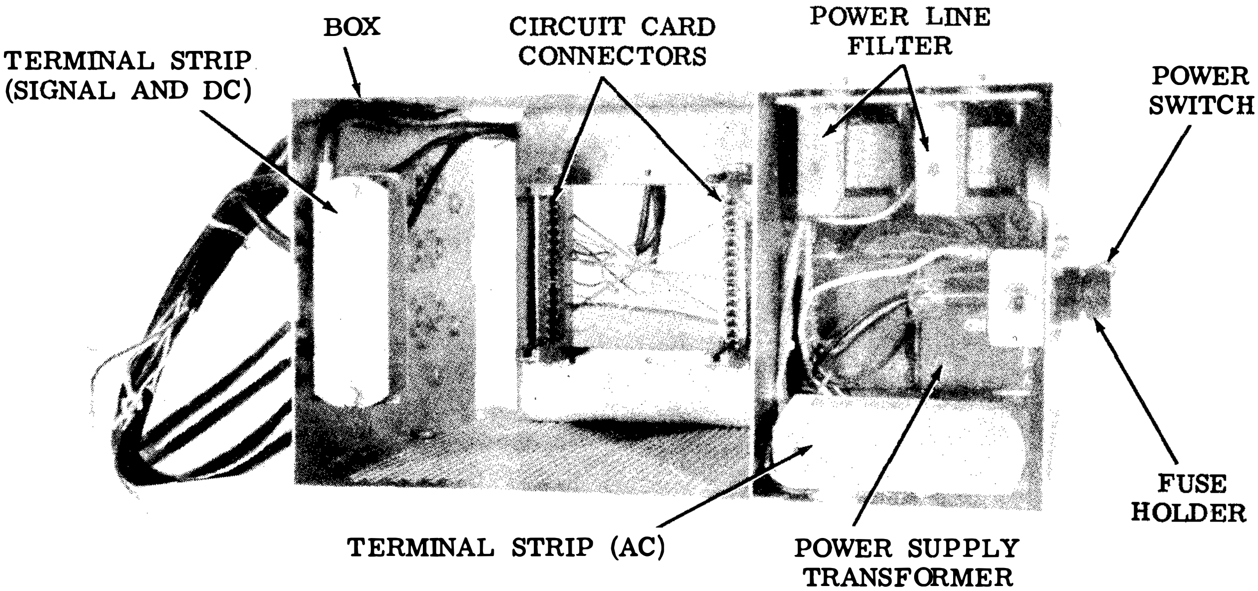


Figure 1-17. Typical Parts of an ESA - Single Box Construction (Cover Removed)

air ambient temperature of 70 degrees Centigrade (158 degrees Fahrenheit). Storage temperature should not exceed 85 degrees Centigrade (185 degrees Fahrenheit). The SMD operates from a power supply delivering 47 to 53 volts dc. The power consumption under any combination of power source, environmental, and component conditions is 8.5 watts maximum. The SMD, together with associated ESA and power supply. is intended for use with equipment requiring low-level RFI (polar-EMC) operation.

(2) Low-Level Keyer (TP303142). The low-level keyers (LLK) are circuit card assemblies approximately 2-1/4 and 4-1/2 inches. They are designed to plug into a 15-pin connector that is wired into the ESA where it becomes an integral components for the suppression of RFI. A front view of this circuit card is shown in figure 3-56. The TP303142 LLK, when used in conjunction with the TP321268 filter card assembly is intended for use with the TP323644 and TP323645 signal generator (one contact) assemblies. This LLK is adaptable to various types of Model 28-type equipment when used with the applicable ESA and is designed to operate from one set of contacts. However, two signal generator outputs (filter card outputs) may be paralleled to drive one signal line from either of two signal generators. Each keyer is designed to operate into a high-resistance load such as the TP323810 SMD. An external power source, mounted in the associated ESA, is required to operate the keyers. All low-level keyer features for the TP303142 given in the following paragraphs assume the use of the TP321268 filter card assembly. Maximum unloaded power consumption of each keyer is less than 50 milliwatts. The output of the TP303142 keyer is +6.0 volts dc ±1.0 volt corresponding to the marking state and -6.0 volts dc spacing state. The marking and spacing state. The marking and spacing output voltage should be balanced to within 10 percent of each other. The TP303142 keyer operates from the spacing contacts (mark contact open,

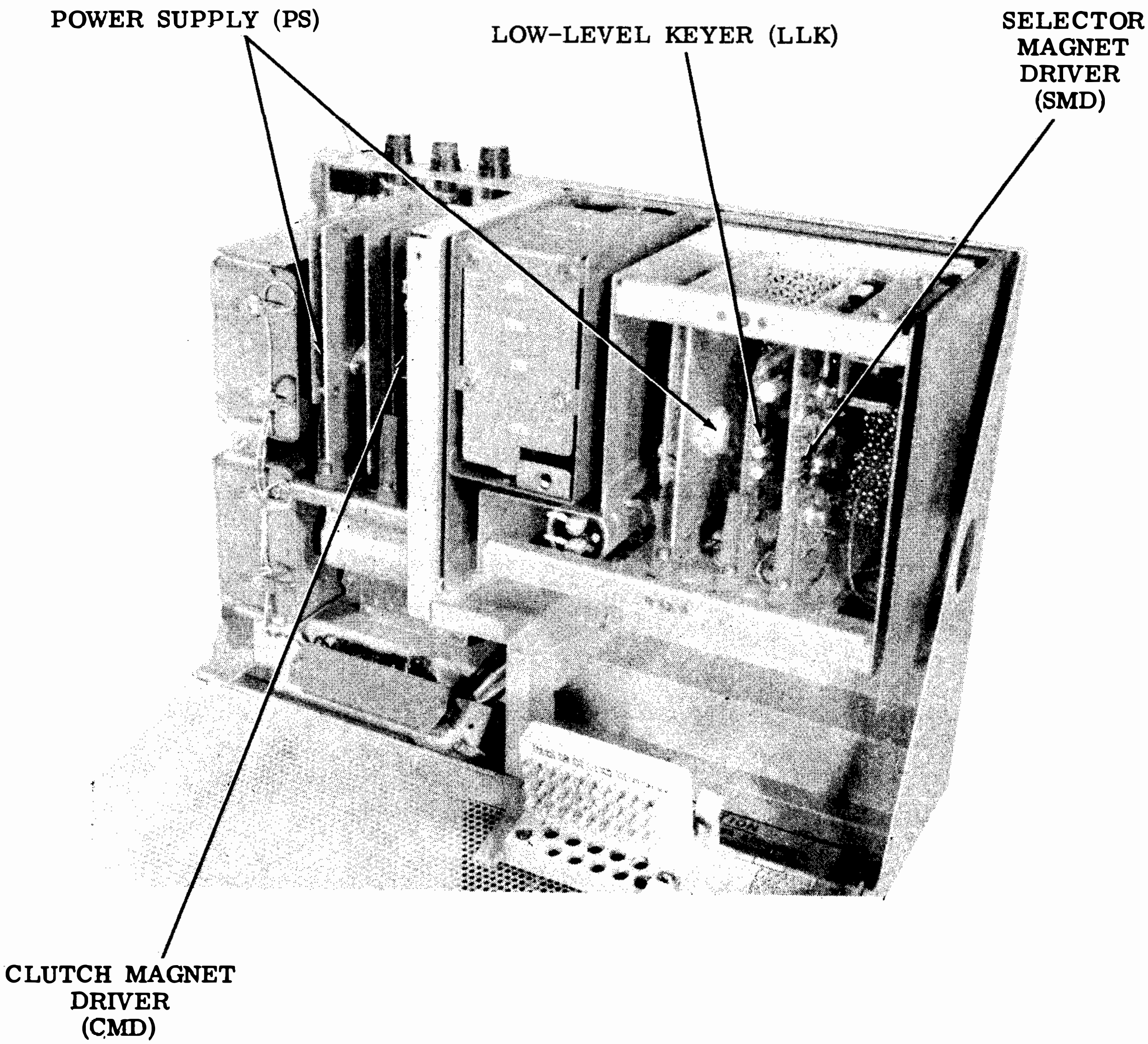


Figure 1-18. ESA Showing Typical Circuit Cards

space contact closed) of the TP323645 or TP323644 signal generator assembly. The outputs from two TP321268 filter card assemblies may be paralleled for parallel operation of either of two transmitters. The nominal output impendance is 100 ohms. The keyers operate at bit rates up to 75 baud. Maximum short circuit output current is 60 milliamperes. The TP303142 keyer operates into a load resistance of 5000 ohms minimum. The keyers and TP321268 filter card assembly operate in a maximum free-air ambient temperature of 70 degrees Centigrade (158 degrees Fahrenheit). Storage temperature should not exceed 85 degrees Centigrade (185 degrees Fahrenheit). The TP303142 keyer operates from a power source delivering $\pm$7.42 volts dc $\pm$6.0 volts. Maximum unloaded power consumption is less than 50 milliwatts. The mark and space symmetry at zero volt (output waveform) is adjustable by means of the signal generator position adjustment for the TP303142 keyer. The outputs may be adjusted within 10 percent of each other by the 5 megohm potentiometer on the keyer card. The keyer is intended for use on signal lines less than 1000 feet in length. However, operation is possible with line lengths up to 5000 feet.

(3) <u>Power Supply Card (General Description)</u>. Two power supply cards are used in the ESA, one generating 0.5-ampere and one generating a 1.5-ampere output. These two circuit cards, when installed in a shielded ESA containing the proper transformer and filter assembly, are intended as a radio interference power source in systems requiring low-level RFI. The required power supply should be plugged into the 15-pin TP148458 connector in the ESA that has a TP198650 polarizing key between pins M and N for the 0.5-ampere power supply and between pins K and L for the 1.5-ampere power supply. Refer to table 1-1 for information regarding the applicable power supply card to be used with the particular set and to the wiring diagram packages in Chapter 5 for the applicable wiring diagrams. See figure 3-54 for a typical card. The transformer and filter circuits for both power supplies are located in part of their associated ESA. The power transistor and heat sink for the 1.5-ampere power supply is also part of the ESA. The power transistor and heat sink for the 0.5-ampere power supply are included as part of the TP321290 circuit card assembly. The amperage rating and quantity of power supply circuit cards to be used (one per ESA) will depend upon the equipment used. Each power supply circuit card assembly is a part of some ESA. Each ESA is part of equipment used in low-level operation.

(4) <u>Power Supply (0.5-Ampere) Card</u>. The following technical data applies to 0.5-ampere power supplies when installed in an ESA that accommodates from one to three selector magnet drivers (SMD) or clutch magnet drivers (CMD).

(a) Input: 100 volts ac to 130 volts ac, 45 to 66 Hertz

(b) Output:

1. +47 volts dc to +53 volts dc at 0.5-ampere maximum

2. +6.6 volts dc to +7.8 volts dc at 0.018-ampere maximum

(c) Fusing:

1. AC: 0.8-ampere, slow-blowing (TP162360)

2. DC: 0.5-ampere, fast-blowing (TP131807)

(d) Operating Ambient Temperature: +40 degrees Fahrenheit to 120 degrees Fahrenheit with cooling fan.

(5) Power Supply (1.5-Ampere) Card. The following technical data applies to the 1.5-ampere power supply installed in an ESA that accommodates from one to six selector magnet drivers (SMD) or clutch magnet drivers (CMD).

(a) Input: 100 volts ac to 130 volts ac, 45 to 66 Hertz

(b) Output: +47 volts dc to +53 volts dc at 1.5-ampere maximum

(c) Fusing:

1. AC: 2-ampere slow-blowing

2. DC: 1.5-ampere fast-blowing

(d) Operating Ambient Temperature: +40 degrees Fahrenheit to 120 degrees Fahrenheit with cooling fan in a multiple-reperforator cabinet (LBAC).

(6) Clutch Magnet Driver. The following paragraphs describe the TP321991 clutch magnet driver (CMD) circuit card and outlines the electrical theory when installed (plugged into a shielded ESA containing the proper power supply and filter assemblies). Refer to figure 3-57 for a front view of this circuit card. The CMD is a solid-state, direct-coupled amplifier built as a plug-in circuit card assembly approximately 2-1/2 by 4-1/4 inches. It requires an external power source. All connnections are made through a 15-pin circuit card connector. The CMD output drives a Model 28 transmitting clutch upon receipt of a low-level input pulse. It is to be used with the proper associated equipment and is not for general use. These CMDs are adaptable to various Model 28 equipment sets through the use of associated modification kits. Each CMD (one or more) is part of, or associated with, some ESA. The number of CMDs used depends on the number of clutch magnets used in the set. The CMDs receive low-level signals (+6-volt clutch coil energized, -6-volt coil de-energized, nominal) and operate a Model 28 clutch. The TP321991 CMD is designed for use with 256M or 252M coils, depending on the type of transmitting equipment used. The output current during the energized state for the CMD is:

(a) 252M Coil (Single coil for LK/LAKs) 107 to 132 milliamperes

(b) 256M Coils (two coils in series for LXDs) 124 to 156 milliamperes

NOTE

When operating an LK or LAK at the maximum pulsing rate (minimum period), the machine may not respond to each synchronous pulse when in the REPEAT mode.

(c) Operation is considered satisfactory when the incoming synchronous pulse complies with the following requirements:

1. Minimum sync pulse duration = 20 milliseconds.

2. Maximum sync pulse duration = 40 milliseconds or 2 bit lengths, whichever is longer.

3. Minimum sync pulse period = 110 percent of transmitted character length.

Under the conditions of 1 through 3 above, start pulse delay should be between 15 and 35 milliseconds. (Delay is measured from zero volt of the positive-going input synchronous pulse signal to the beginning of the start pulse at the signal generator contacts.) If the TP321268 filter card assembly and TP303142 keyer are used, a nominal 6 milliseconds must be added to the delay to account for delay in the keyer. The TP321991 CMD assumes the energized state with positive input voltages not greater than +0.5-volt and the de-energized state with negative voltages not greater than -0.5-volt. The energized and de-energized switching levels as defined in the previous sentence are adjustable to within 10 percent of each other. The TP321991 CMD should have a minimum input resistance of 50,000 ohms. The maximum input capacitance is 2500 picofarads. The CMD provides a spacing (de-energized) output when the input line is open. The clutch magnet driver operates in a free air ambient temperature range of zero degree Centigrade (32 degrees Fahrenheit) to 65 degrees Centigrade (150 degrees Fahrenheit). Storage temperature should not exceed 85 degrees Centrigrade (185 degrees Fahrenheit). The TP321991 CMD operates from a power supply delivering +47 to +53 volts dc. Power consumption under any combination of power source, environmental, and component conditions is 13 watts maximum. The TP321991 CMD is intended for use on clock lines less than 1000 feet in length. However, operation is possible with line lengths up to 5000 feet. The TP321991 CMD, when used with associated power supplies, is intended for use with interfaces conforming to the following requirements:

Fed. Std. 22 Section 3102 b

MIL-STD-188B

1-4. RELATIONSHIP OF UNITS. Figure 1-1 shows the component relationship between a keyboard send-receive typing reperforator (KTR) set or a receive-only typing reperforator (ROTR) set.

1-5. REFERENCE DATA. Table 1-1 lists the physical properties and operating characteristics of the Model 28 Typing Reperforator and its components.

1-6. EQUIPMENT, ACCESSORIES, AND DOCUMENTS SUPPLIED. Table 1-2 is a matrix showing high-level and low-level teletype sets with covers, typing reperforator models, keyboards and bases, motors, etc., available. Both models and the equivalent Navy designation are included for each sets.

1-7. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED. Table 1-3 lists the test equipment and publications required but not supplied with the unit.

Table 1-1. Reference Data

Item	Property or Characteristic			
Nomenclature	Keyboard Send-Receive (KSR) and Receive-Only (ROTR) Sets Model 28 (Refer to Table 1-2 for official nomenclatures)			
Manufacturer	Teletype Corporation, Skokie, Illinois			
Weight and Dimensions	Height (Inches)	Width (Inches)	Depth (Inches)	Weight (Pounds)
Keyboard Send-Receive Set Typing Reperforator Set	13-3/4	17	18-3/4	119
Receive-Only Typing Reperforator Set	9-1/2	13	13-1/2	48
Receive-Only Miniaturized Typing Reperforator Set	9-1/4	10	12	40
Typical Model 28 Multiple Perforator Set Cabinet (Includes Multiple Typing Reperforator Sets)	57-1/2	25-/12	32-1/2	270
Table	35	20-1/2	18-1/2	50
Tape				
Type	Standard Communications			

Table 1-1. Reference Data - Continued

Item	Property or Characteristic
Width	11/16 in.
Code Perforations	Chadless or fully perforated
Characters spacing	10 per inch (or 10 feed holes per inch)
AC Synchronous Motor	Requires regulated power source for operation
Input Voltage	115 VAC ±10%
Phase	Single
Frequency	60 Hz ±5%
Input Current	
Starting	9.00 amps
Running	1.85 amps
Heat Dissipation	50 watts
Horsepower	0.50
Power Factor	
No Load	23.7%
Full Load	38.5%

Table 1-1. Reference Data - Continued

Item	Property or Characteristic
Miniaturized AC Synchronous Motor	Requires regulated power source for operation
Input Voltage	115 VAC ±10%
Phase	Single
Frequency	60 Hz ±0.5%
Input Current	
Starting	5.00 amps
Running (No Load)	1.05 amps
Running (Full Load)	1.25 amps
Horsepower	0.025
AC Governed Motor	Operates from regulated or unregulated power source
Input Voltage	115 VAC ±10%
Phase	Single
Frequency	50 to 60 Hz
Input Current	
Starting	1.75 amps
Running	1.00 amps
Heat Dissipation	75W

Table 1-1. Reference Data - Continued

Item	Property or Characteristic
Power Factor	
No Load Full Load	71.0% 66.8%
Horsepower	0.5
Ambient Temperature	-20°C (-4°F) to +50°C (+122°F) Temperature should not increase over +40°C (+72°F)
Signal Current	0.060 or 0.020 ampere off/on direct current applied to signal generator from external source
Code	5-level Baudot - sequential start/stop
Clutch Trip Magnet Control Circuit	Operates from following external sources: a. 115 VAC, ±10%, 60 Hz b. 120 VAC ±10%, with suitable external resistance c. 50 VAC ±10%, with suitable external resistance
Printed Characters, Chadless	
Height	0.120 in., standard 0.193 in., maximum
Width	0.075 in., standard

Table 1-1. Reference Data - Continued

Item	Property or Characteristic										
Printed Characters, Fully Perforated											
Height	0.100 in.										
Width	0.046 in.										
Operating Speeds	Unit Code										
	7.00	7.00	7.00	7.00	7.42	7.42	7.42	7.42	7.50	7.50	7.50
Operations Per Minute	390	428.6	636	643	368	404	460	600	364	400	600
Baud	45.5	50.0	74.2	75.0	45.5	50.0	56.9	74.2	45.5	50.0	75.0
Pulse Length	0.022	0.020	0.0135	0.0133	0.022	0.020	0.0175	0.0135	0.022	0.020	0.0133
Frequency (Hertz)	22.75	25.0	37.1	37.5	22.75	25.0	28.45	37.1	22.75	25.0	37.5
Characters/Second	6.5	7.1	10.6	10.7	6.0	6.7	7.7	10.0	6.1	6.7	10.1
Words/Minute	65	71.4	106	107	60	67.3	75	100	60.6	66.6	100
ESA Power Supplies	0.5 - Amp						1.5 - Amp				
AC Input	100 to 130 VAC						100 to 130 VAC				
Frequency	45 to 66 Hz						45 to 66 Hz				
Power	55W at 15 VAC for 25W output						100W at 115 VAC for 50W output				

Table 1-1. Reference Data - Continued

Item	Property or Characteristic	
Output	+47 to +53 VDC @ 0.5 amp +6.6 to +7.8 VDC @ 0.018 amp -6.6 to -7.8 VDC @ 0.018 amp	+47 to +53 VDC @ 1.0 amp
Operating Temperature	+40°F (4.4°C) to +110°F (43°C) with fan	+40°F (4.4°C) to +110°F (43°C) with fan
Fusing		
ac	0.8A slo-blow TP162360	2.0 slo-blow TP120166
dc	0.5A fast-blow TP131807	1.5A fast-blow TP115358

Table 1-2. Equipment Matrix, Model 28 Typing Reperforators and Tape Printer Keyboards

		NAVY DESIGNATION	COVERS				ENC		TYPING REPERFORATORS											KEYBOARDS					RŌ BASES					SLIDING BASE	ESA	ESA'S/PCB'S								MOTORS					GEAR SETS (BAUD) 50.0	45.5	74.2	45.5	56.8	74.2	50.0	75.0	45.5	50.0
		MANUFACTURER'S DESIGNATION	LRC202BR	LRC205BR	LPC200BR	LPC211BR	LPC202BR	LPC200BR	LSRC200BR	LRR9AWA	LPR35BRD	LPR40AWA	LPR53BRP	LPR62BRP*	LPR72BRP	LPR85BRP	LPR83BRP	LPR88AWA	LPR72AWABRP	LTRK1ARN	LTRK5ARN	LTRK8ARNBRS	LTRK11ARN	LTR11BRJ	LRB8	LRB31	LRB49	LRB57	LRB62*	TP174459		ESA321230	ESA321231	ESA323813	LLK303142	SMD323810	CMD321991	PS321290	PS321132	LMU3	LMU24	LMU38	LMU41	LMU56*	TP152766	TP159660	TP159700	TP161293	TP161294	TP161295	TP163504	TP163505	TP173795	TP194927
		FIGURE NUMBER							5-3	5-3	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-2 5-3	5-4 5-5	5-4 5-5	5-2	5-2	5-6	5-7	5-6	5-6	5-7		5-15 5-10	5-11	5-14	5-23	5-12	5-24	5-25	5-29	5-8	5-8	5-8	5-8	5-8											
		TELETYPE IDENTIFICATION NUMBER																																																				
HIGH-LEVEL	KTR	TT-253/UG						X		X										X																				X								X	X	X				
HIGH-LEVEL	KTR	TT-253A/UG						X					X								X																			X											X	X	X	
HIGH-LEVEL	KTR	TT-253B/UG						X					X							X																				X					X			X		X				
HIGH-LEVEL	KTR	TT-253C/UG						X					X									BRJ																			X					X			X		X				
HIGH-LEVEL	KTR	TT-253D/UG						X		X												X																			X					X			X		X				
HIGH-LEVEL	KTR	TT-292/UG						X		X										X																							X					X	X	X				
HIGH-LEVEL	KTR	TT-292A/UG						X					X									BRJ																					X				X	X							
HIGH-LEVEL	ROTR	AN/UGC-70**																																																			
HIGH-LEVEL	ROTR	AN/UGR-2		X								X														X				X												X													
HIGH-LEVEL	ROTR	TT-192/UG	X							X															X															X														
HIGH-LEVEL	ROTR	TT-192A/UG		X								X														X				X												X													
HIGH-LEVEL	ROTR	TT-192B/UG	X							X																	X													X														
HIGH-LEVEL	ROTR	TT-192C/UG				X								X															X															X										
HIGH-LEVEL	ROTR	TT-274/UG	X							X															X																		X											
HIGH-LEVEL	ROTR	TT-274A/UG	X							X																		X														X												
HIGH-LEVEL	ROTR	TT-274B/UG	X								X																X																X											
HIGH-LEVEL	ROTR	TT-274C/UG	X							X																		X														X												
LOW-LEVEL	KTR	AN/UGC-78‡			X				X								X							X								X		X	X	X	X	X	X	X								X		X				X
LOW-LEVEL	KTR	TT-253( )UG			X				X							X							X									X		X	X	X	X	X	X	X										X				
LOW-LEVEL	ROTR	AN/UGC-64	X																X						X								X			X		X	X				X											
LOW-LEVEL	ROTR	TT-571/UG	X				X								X										X								X							X														
LOW-LEVEL	ROTR	TT-605/UG				X		28RFC 600B/004/XXX/BR										X												X			X											X										

*PART OF VSL 50BR ***REFER TO VSL 50BR FOR COMPLETE BREAKDOWN AND PARTS (GEAR SHAFT ASSEMBLY FOR 60, 75, 100 WPM)

AN/UGC-70 CONSISTS OF VSL 569*WHICH INCLUDES VCL 561BR***, VCL562BR***, AND A COVER.

***VSL AND VCL ARE TELETYPE CODES USED FOR REFERENCE ONLY. BREAKDOWN OF VSL'S AND VCL'S MAY BE OBTAINED FROM TELETYPE CORP.

‡FROM NAVELEX 0967-588-010.

Table 1-3. Equipment and Publications Required But Not Supplied

Category	Recommended Equipment	Alternate	Equipment Test Parameters	Application
Telegraph Signal Analyzer	Test Set, Telegraph TS-2616/UGC	Equivalent	Measures timing distortion in start/stop and synchronous data telegraph signals. Refer to NAVSHIPS 0969-125-8010.	Maintenance, Trouble-shooting
Volt-ohm-milli-ammeter	Multimeter AN/USM-311	Equivalent	AC voltage - 115, 5.6 VAC DC voltages - 120, 7.5, 1.5 VDC Direct Current - 60 mA, 70 ua Resistance - Continuity measurements	Maintenance, Trouble-shooting
Tools	Teletype Repair Kit TK-188/U	Equivalent		Maintenance, Repair
Tuning Fork	TP104986	Equivalent	Checks motor unit motor speed	Maintenance Trouble-shooting

CHAPTER 2
OPERATION

2-1. INTRODUCTION. This chapter describes the operation of Keyboard Send-Receive (KTR) and Receive-Only (ROTR) Typing Reperforator Sets Model 28 from a maintenance standpoint. Operation of a KTR or ROTR teletypewriter set when installed as part of a system is covered in the appropriate system manual.

2-2. CONTROLS AND INDICATORS. KTR and ROTR set controls and indicators are shown in figures 2-1 and 2-2 and briefly described in table 2-1.

2-3. OPERATING PROCEDURES. Procedures for operating the KTR and ROTR sets are provided in table 2-2.

NOTE

If the set is a low-level configuration, the proper switch on the associated electrical service assembly (ESA) must be set to the appropriate position for turn-on and turn-off.

2-4. OPERATOR MAINTENANCE. Operator maintenance is limited to replacing tape and installing a new ribbon. Refer to figures 2-2 and 2-3.

a. Tape Installation. Threading is identical for all units within the typing reperforator mechanism but the path from the tape container is adapted to the particular unit. To install tape, proceed as follows:

(1) Refer to figure 2-3.

(2) Remove tape container hub and insert it through tape spool.

NOTE

On most units, tape feeds from right to left. However, in some RO units, tape feeds from left to right.

(3) Roll hub with tape into tape container so that tape feeds from bottom hole.

(4) Ensure that low tape switch lever rides on outer edge of tape roll when tape is installed in the container.

(5) Cut or tear the leading end of tape so it is square and feed it from base tape guide rollers or loop into tape chute.

(6) Push tape downward around die wheel to the point where it will be engaged by the feed wheel.

(7) Turn manual feed thumbscrew counterclockwise to thread tape between feed wheel and die wheel, under the tape shoe through the punch block.

(8) Extend tape beyond edge of cabinet or cover tape aperture, closing access door with tape protruding.

b. Ribbon Installation. Open the cabinet or cover access door. The ribbon mounts in a vertical position at top of reperforator and is held in place on each of the two spool shafts by a toggle lever.

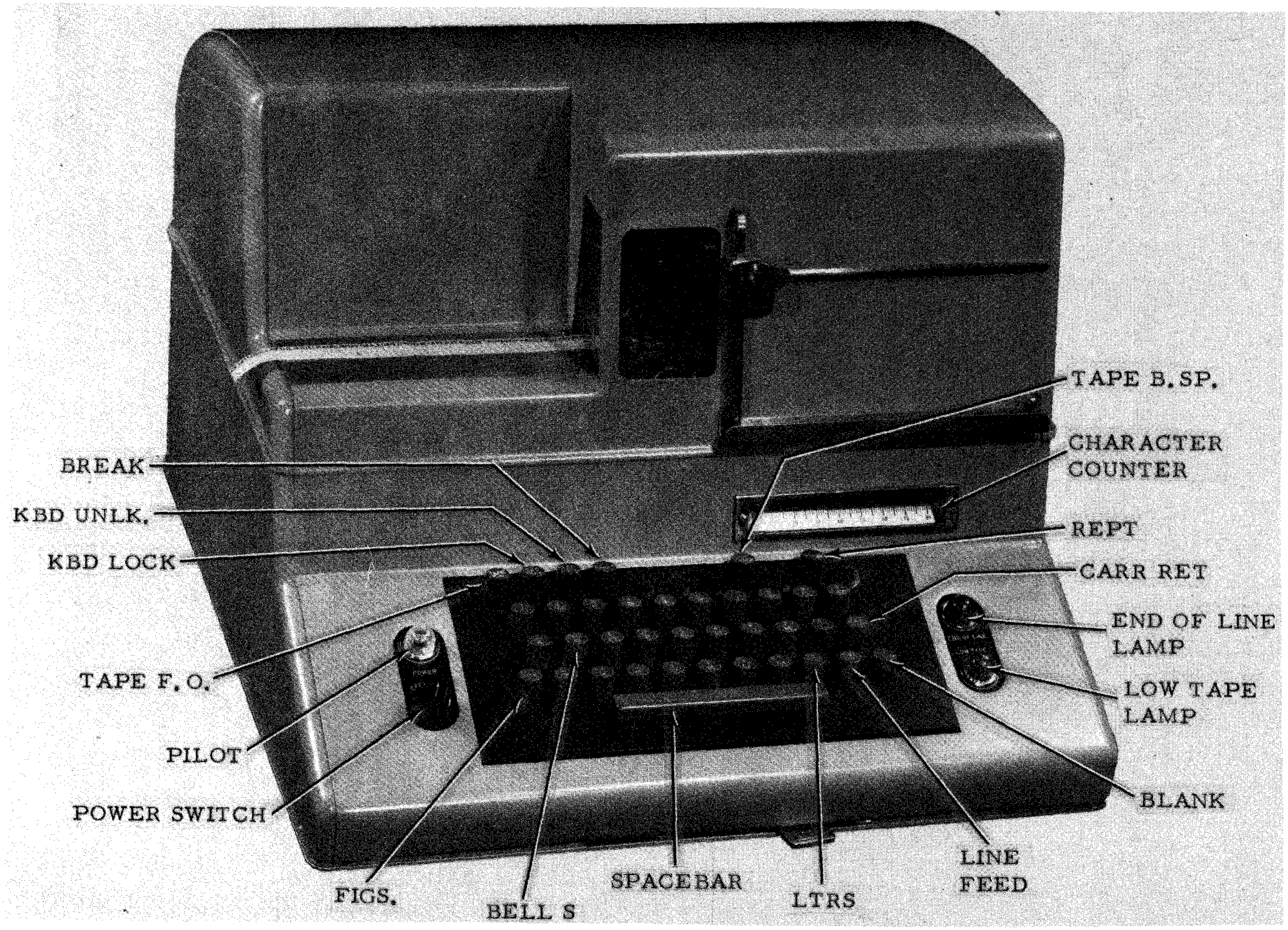


Figure 2-1. KTR Controls and Indicators

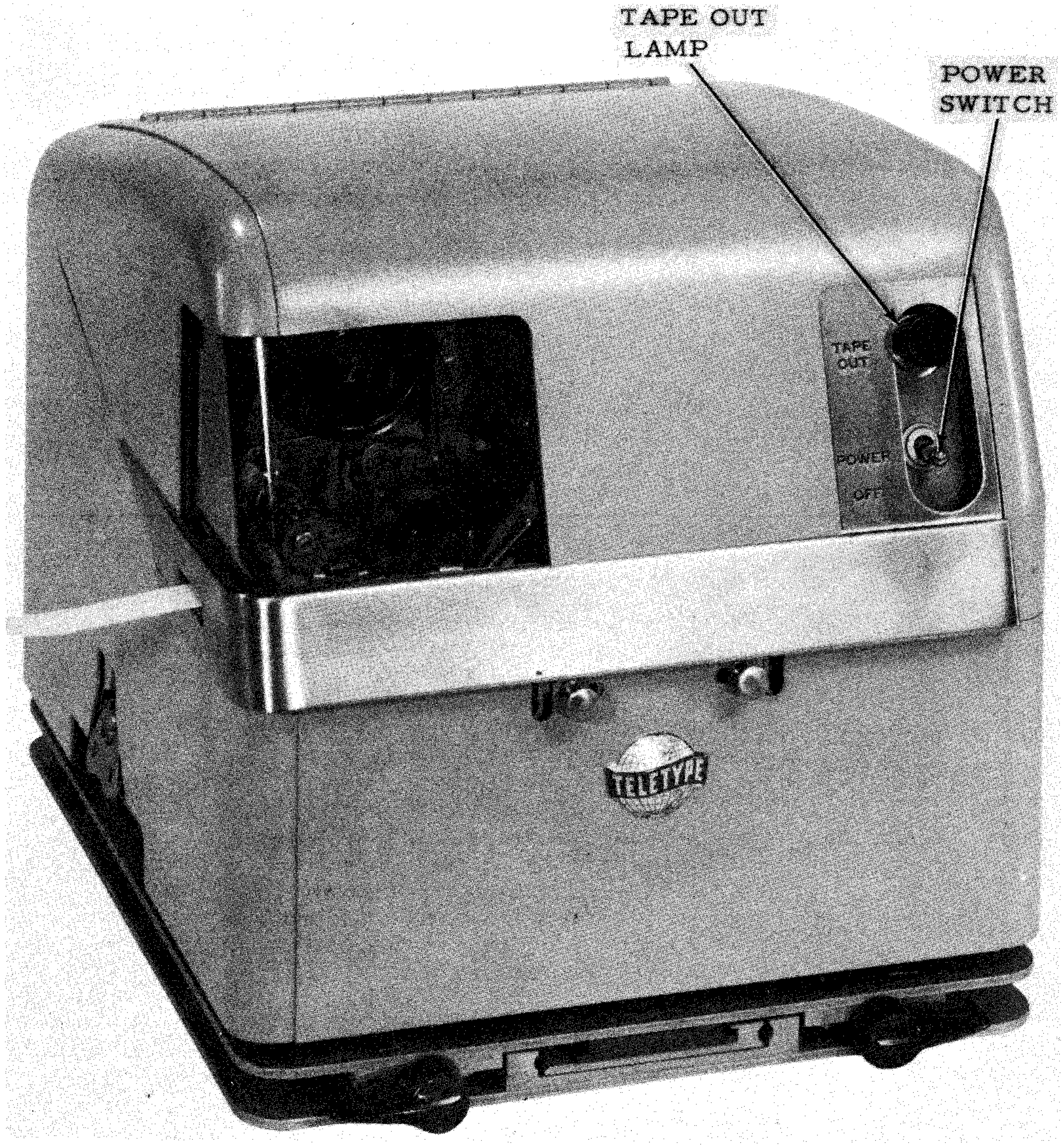


Figure 2-2. ROTR Controls and Indicators

Table 2-1. Control and Indicator Functions

Control/Indicator	Function
KTR Control and Indicator Functions (figure 2-1)	
4AMP-SL-BL fuse	Provides electrical circuit overload protection.
POWER switch	Applies primary ac power to motor unit and indicator circuits.
PILOT lamp	Illuminates at all times when POWER switch is in ON position.
END OF LINE indicator lamp	Illuminates when typed message reaches the 66th to 68th space from the beginning of a line and remains illuminated until carriage return key is pressed.
LOW TAPE lamp	Illuminates when low tape contacts close whenever the diameter of the tape is reduced to a predetermined dimension.
Character counter	Indicator advances one unit for each character. Returns to zero when carriage returns to left margin.
Function keys	When pressed, manually sets code bar mechanism to signal code combination for function selected. Signal code combination is distributed to signal line. Signal code is transmitted to local typing unit, for monitoring, and to remote typing unit. Signal code combination, received by typing units, activates mechanism corresponding to function selected.
FIGS key	Selects figures signal code combination. Figures shift function initiated at typing units. Results in positioning of type box, through related mechanisms, for printing of figures, punctuation marks, or other upper case symbols.
LTRS key	Selects letters signal code combination. Letters shift function initiated at typing units. Results in positioning of type box, through related mechanisms, for printing of letters.

Table 2-1. Control and Indicator Functions - Continued

Control/Indicator	Function
CARR RET key	Selects carriage return signal code combination. Carriage return function initiated at typing units. Results in returning printing type box carriage, through related mechanisms, toward left side of typing unit.
LINE FEED key	Selects line feed signal code combination. Line feed function initiated at typing units. Results in advancing platen, through related mechanisms, either one line or two lines, depending on position of single-double line feed lever.
KBD LOCK key	When pressed, causes signal generator to be shunted, preventing signal generation. Key remains depressed until released by pressing KBD UNLK key.
KBD UNLK key	When pressed, removes shunt from signal generator, allowing signals to be generated.
BLANK key	Pressing key twice in succession operates keyboard lock. KBD UNLK key must be pressed to resume operation. Pressing key alternately with other keys (except KBD LOCK and BREAK keys) will not lock keyboard.
REPT key	When pressed, together with any other key (except local function keys), causes repeated transmission of function or character selected.
BREAK key	When pressed for about two seconds interrupts signal line causing typing units to run "open". Since depressing the BREAK key operates the keyboard lock, it is necessary to depress the KBD UNLK key to resume transmission.
Upper Case S key	Pressing key causes bell to ring.

Table 2-1. Control and Indicator Functions - Continued

Control/Indicator	Function
Character keys	When pressed, manually sets codebar mechanism to code combination for character distributed to signal line. Signal mechanically distributed to signal code is transmitted to local typing unit, for monitoring, and to remote typing unit. Signal code combination, received by typing units, activates printing mechanism to print letter or figure character selected, depending on which shift function has been previously selected.
Space Bar	Manually sets code bar mechanism to space signal code combination. Signal code combination received by typing unit activates spacing mechanism.
TAPE F.O. key	Automatically feeds the tape out of the Reperforator Set to a predetermined length.
TAPE B. SP. key	Moves tape back one character to the right of the punch block.
ROTR Control and Indicator Functions (figure 2-2)	
TAPE OUT switch	Automatically feeds the tape out of the reperforator unit to a predetermined length.
POWER switch	Applies primary ac power to motor unit and indicator circuits.

Table 2-2. KTR and ROTR Operating Procedures

Step	Action	Normal Indication
1.	Turn-On. To turn on the teletypewriter set, proceed as follows:	

CAUTION

Ensure POWER switch is in OFF position before turning on the external power supply.

Step	Action	Normal Indication
*a	Ensure primary power cord is plugged in to ac outlet.	
*b	Before turning POWER switch to ON, ensure that the set gears are compatible with the speed of the sending equipment. Obtain desired speed by means of the selecting lever at the rear of the set.	

CAUTION

Operate speed selector lever only when POWER switch is in OFF position.

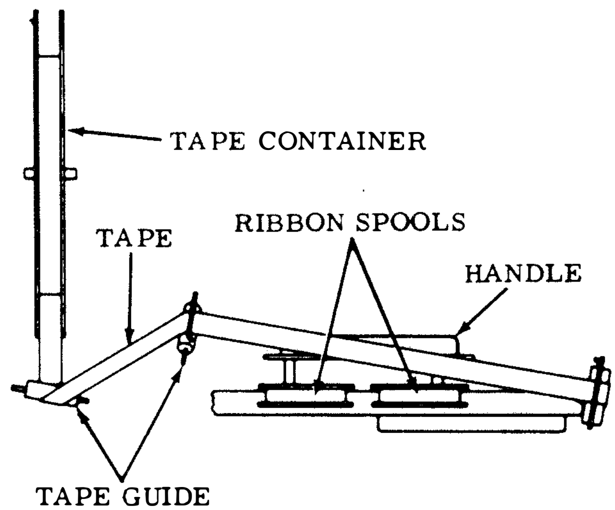
Step	Action	Normal Indication
*c	Set POWER switch to ON.	PILOT indicator illuminates and motor starts running.
2.	Operating Tests. Check for proper operation of teletypewriter set as follows:	
*a	Press TAPE FEED-OUT button (ROTR) or TAPE F.O. key (KTR).	Armature should be pulled down and set runs open.

*Applies to both KTR and ROTR

Table 2-2. KTR and ROTR Operating Procedures - Continued

Step	Action	Normal Indication
*b	Close external signal circuit.	Typing reperforator runs closed until incoming signal initiates perforating and typing functions.
*c	Check an incoming message by inspecting the typed tape and comparing the coded equivalent (six characters in advance of the typed character) with the typed character.	Typed character corresponds to coded equivalent.
d	Press KBD UNLK key and type any typical message.	Indicator on character counter advances one unit for each character. END OF LINE lamp illuminates when character counter reaches 66 to 68 units.
e	When END OF LINE lamp illuminates, press CARR RET key.	END OF LINE lamp goes out and character counter indicator returns to zero.
f	Press TAPE B. SP. key	Tape in typing reperforator moves one character to right of punch block.
g	Press TAPE F. O. key	Tape automatically feeds out to predetermined length.
h	Press REPT key simultaneously with any character key.	Transmission of character is continuous until character key is released.
i	Press BREAK key.	Typing reperforator runs open.
j	Press KBD LOCK key.	All keys on keyboard lock.
*k	Remove typing reperforator tape container from typing reperforator set.	LOW TAPE indicator lamp illuminates.

*Applies to both KTR and ROTR



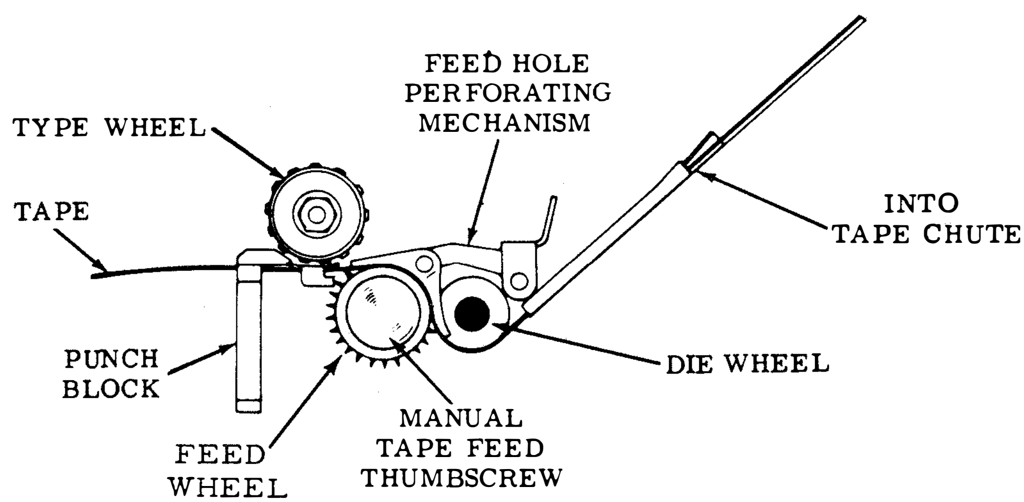


Figure 2-3. Path of Tape

To install ribbon, proceed as follows:

(1) Refer to figure 2-4.

(2) Engage hook on end of ribbon in the hub of an empty spool (retain one spool if replacing a used ribbon).

(3) Wind a few turns of the ribbon on to the empty spool to ensure that the reversing eyelet has been wound upon the spool. Wind the left spool clockwise and the right spool counterclockwise.

(4) Install empty spool over the open toggle of its spindle and turn the spool slightly until driving pins on shaft engage holes in rear of spool.

(5) Close the toggle and thread ribbon around the roller, through reversing pins (making sure eyelet is always above pins) for both spools, over the left roller (or under the right roller) and to the opposite spindle.

(6) Place spool on spindle.

(7) Rotate spool to take up slack in ribbon and latch the second toggle.

(8) When properly installed, the ribbon should feed from the outside of each spool and should reverse whenever an eyelet engages a set of reversing pins.

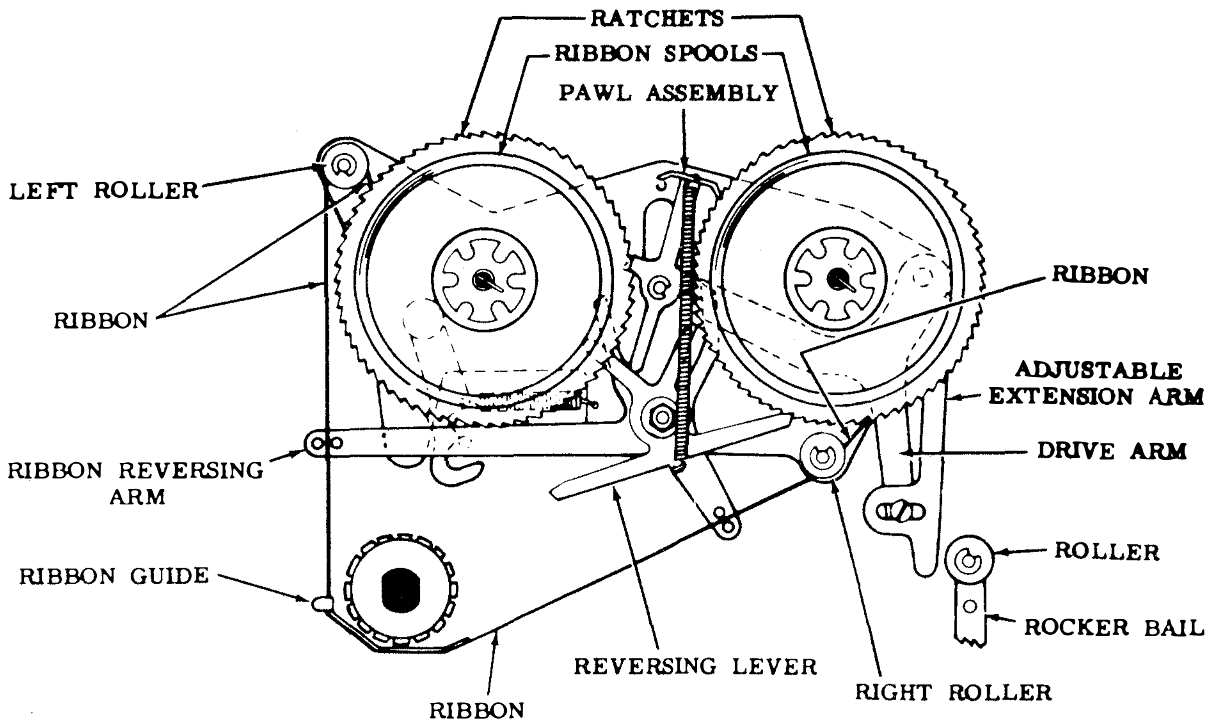


Figure 2-4. Path of Ribbon

CHAPTER 3
FUNCTIONAL DESCRIPTION

3-1. INTRODUCTION. This chapter provides a functional description of the Keyboard Send-Receive (KTR) and Receive-Only (ROTR) Typing Reperforator Sets Model 28. Views of both fully perforated and chadless units are included, with basic assemblies and location of components shown to clarify similarities and differences between these units. Descriptions are divided into a general system description keyed to a basic system diagram. A functional block diagram follows showing signal paths and the functional blocks comprising each of the blocks in the system block diagram. A brief description of the function performed by each of these blocks and the interaction between these blocks is keyed to the functional block diagram. The third level of circuit theory includes a detailed discussion of each assembly including illustrations of mechanical linkages and schematics where applicable. Refer to the schematics and wiring diagrams in Chapter 5 for a complete display of circuit paths and system wiring.

3-2. GENERAL DESCRIPTION OF SYSTEM OPERATION. Figure 3-1 is a right front view of the chadless type Typing Reperforator unit Model 28, showing the location of principal assemblies. Figures 3-2 and 3-3 show a right-rear view and a left-rear view, respectively, of the Typing Reperforator unit Model 28 for fully-perforated tape. The fully-perforated tape typing reperforator unit (figure 3-2) prepares fully punched tape and prints between the feed holes. The chadless-type typing reperforator unit prepares partially punched (hinged chad) tape and prints along the upper edge of the tape. Except for these differences, the two typing reperforator units are identical.

3-3. BASIC BLOCK DIAGRAM DESCRIPTION. Figure 3-4 is a basic block diagram showing in simplified format the functional blocks and basic signal paths comprising the unit. The diagram contains nine mechanisms, each of which is described briefly in the following paragraphs.

a. <u>Drive Mechanism</u>. The typing operation, which causes characters to be imprinted on tape, is caused by striking a print hammer against selected characters on a rotating bakelite type wheel. The type wheel is driven through a gear train and clutch arrangement by an ac motor mounted on the base of the unit. The main shaft rotates continuously as long as power is applied. The unit is referred to as being in the idling condition when the main shaft is turning and the signal circuit is closed, so that no signal is being received. The unit is referred to as running open when the main shaft is turning and no signal is applied to the selector magnets.

b. <u>Selecting Mechanism</u>. Selection of the character to be punched or printed is made by pressing a key in the keyboard or when a five-level code is received over the transmission line to the set. In either case this causes a series of electrical impulses representing

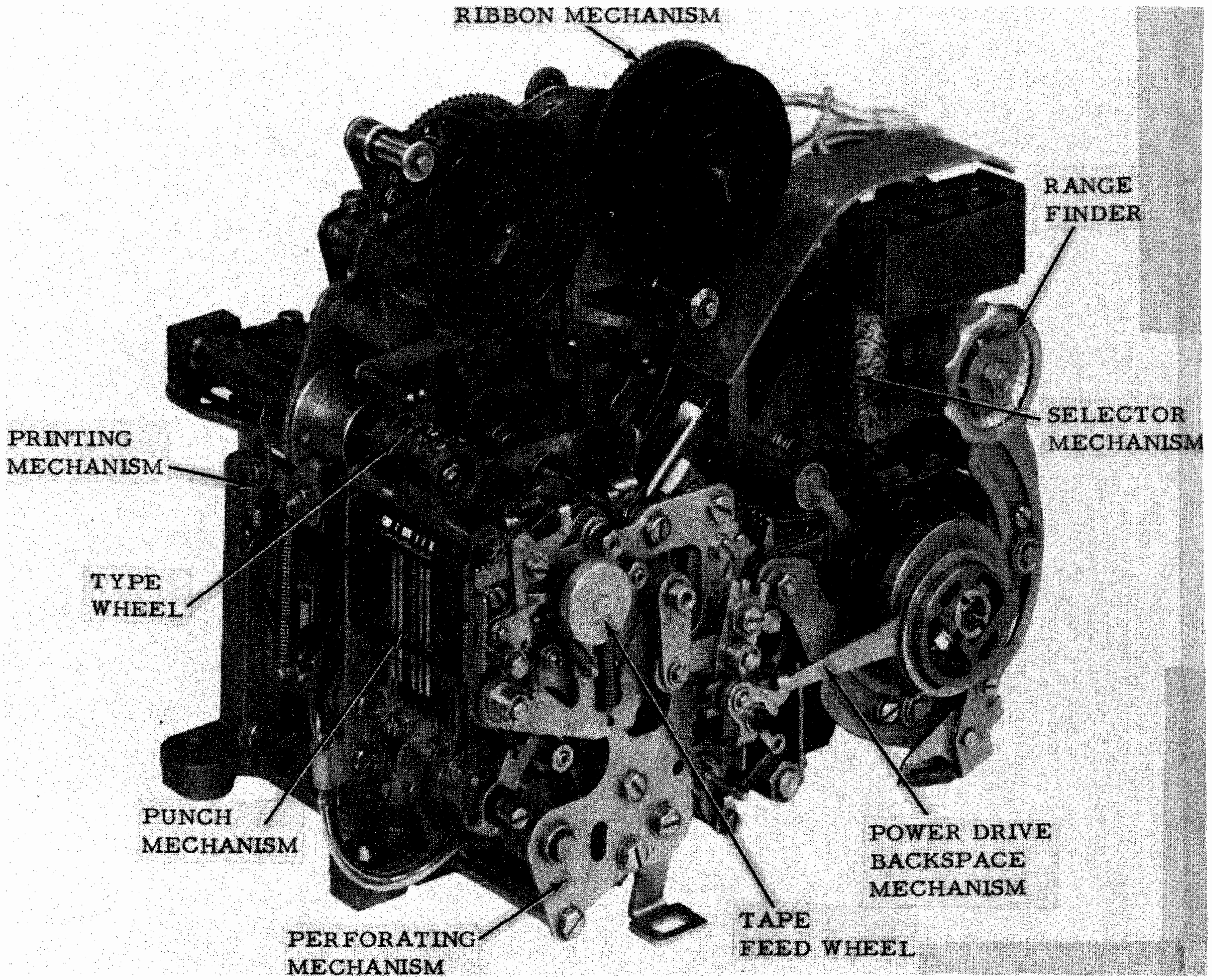


Figure 3-1. Typing Reperforator Unit Model 28, Chadless Tape, Right Front View

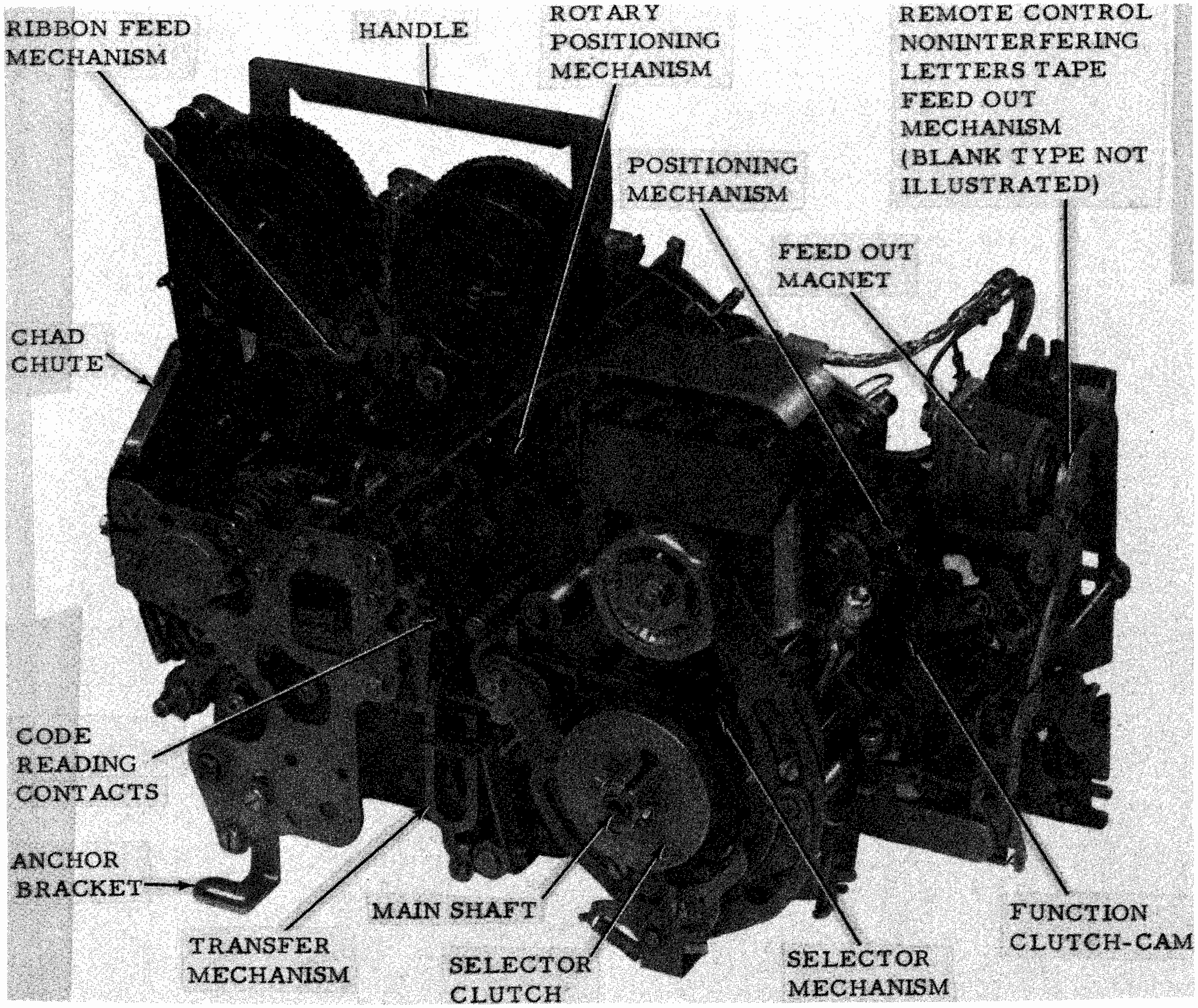


Figure 3-2. Typing Reperforator Unit Model 28, Fully-Perforated Tape, Right-Rear View

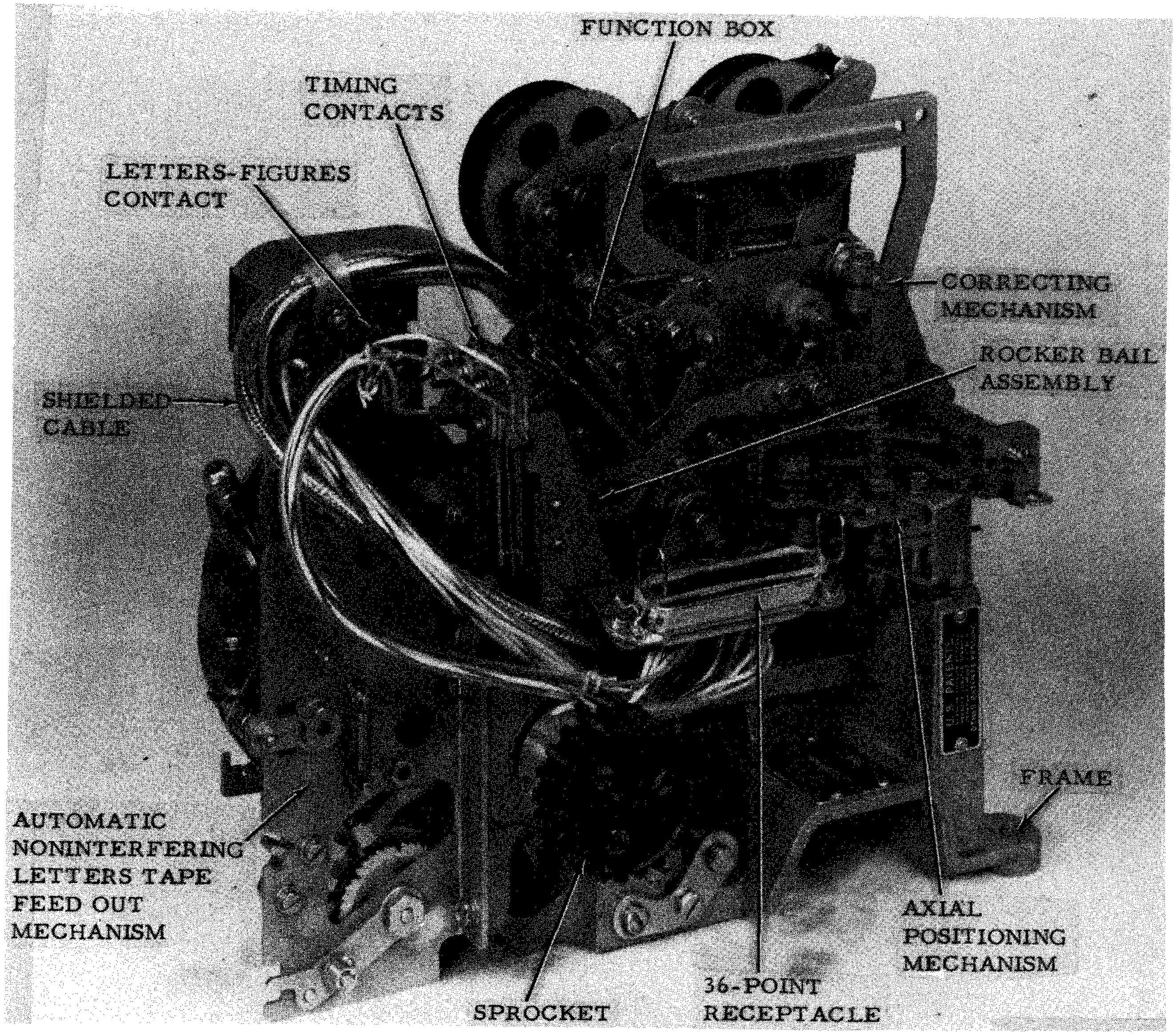


Figure 3-3. Typing Reperforator Unit Model 28, Fully-Perforated Tape, Left-Rear View

the desired character to be generated. The selector mechanism, made up of a selector, a clutch trip assembly, and a cam-clutch, translates the signaling code combinations into mechanical arrangements which govern tape printing and perforating. The electrical pulses comprising each code combination are applied to a magnet on the selector. An 0.020 or 0.060 ampere signal is applied externally to the selector magnet. External electrical signals are applied through a 36-pin connector at the rear of the unit, as shown in figure 3-4. The two-coil selector magnet may be wired in series for the 0.020-ampere signal or in parallel for 0.060-ampere operation. A range finder permits adjustment of the selector in relation to the signaling code.

c. Perforator Mechanism. This block contains the punch slides and components used to physically punch the code for the desired character in the tape. The mechanical arrangements are passed on through the transfer mechanism to control the position and printing mechanisms, and to the punch slides to control the punching operation.

d. Transfer Mechanism. Near the end of each selecting cycle, the transfer mechanism moves the intelligence in the form of a mechanical arrangement from the punch slides to the function box mechanism and to the positioning mechanisms. Five mechanical linkages are included in the transfer mechanism, each associated with a punch slide to produce the five-level code described in paragraph 3-5.

e. Function Box Mechanism. The function box mechanism enables the unit to perform various auxiliary functions including LETTERS-FIGURES shift, unshift-on-space, and signal bell, as described in the discussion of variable features. The function box conveys the motion of the main shaft to the mechanisms concerned with the actual typing and punching operations.

f. Positioning Mechanisms. This basic block is made up of three functional assemblies which operate independently to position the typewheel during the typing operation. The operation of each of these three mechanisms is described in the functional block diagram description.

g. Type Wheel. The character to be used to type the intelligence on tape, either figure, letter, or special symbol, is embossed on a cylindrical bakelite type wheel which is rotated by an ac motor through a mechanical gear train and clutch arrangement as previously stated. During the function cycle the rotary and axial positioning mechanisms, having received the intelligence from the transfer mechanism, position the type wheel so that the character generated by the depressed key or received on the transmission line is selected and accurately positioned for printing. A typical type wheel character arrangement is shown in figure 3-5, in which the wheel's cylindrical surface is shown rolled into a plane.

h. Printing Mechanism. After the type wheel has been positioned and corrected, the printing mechanism supplies the impact which drives the paper and inked ribbon against the

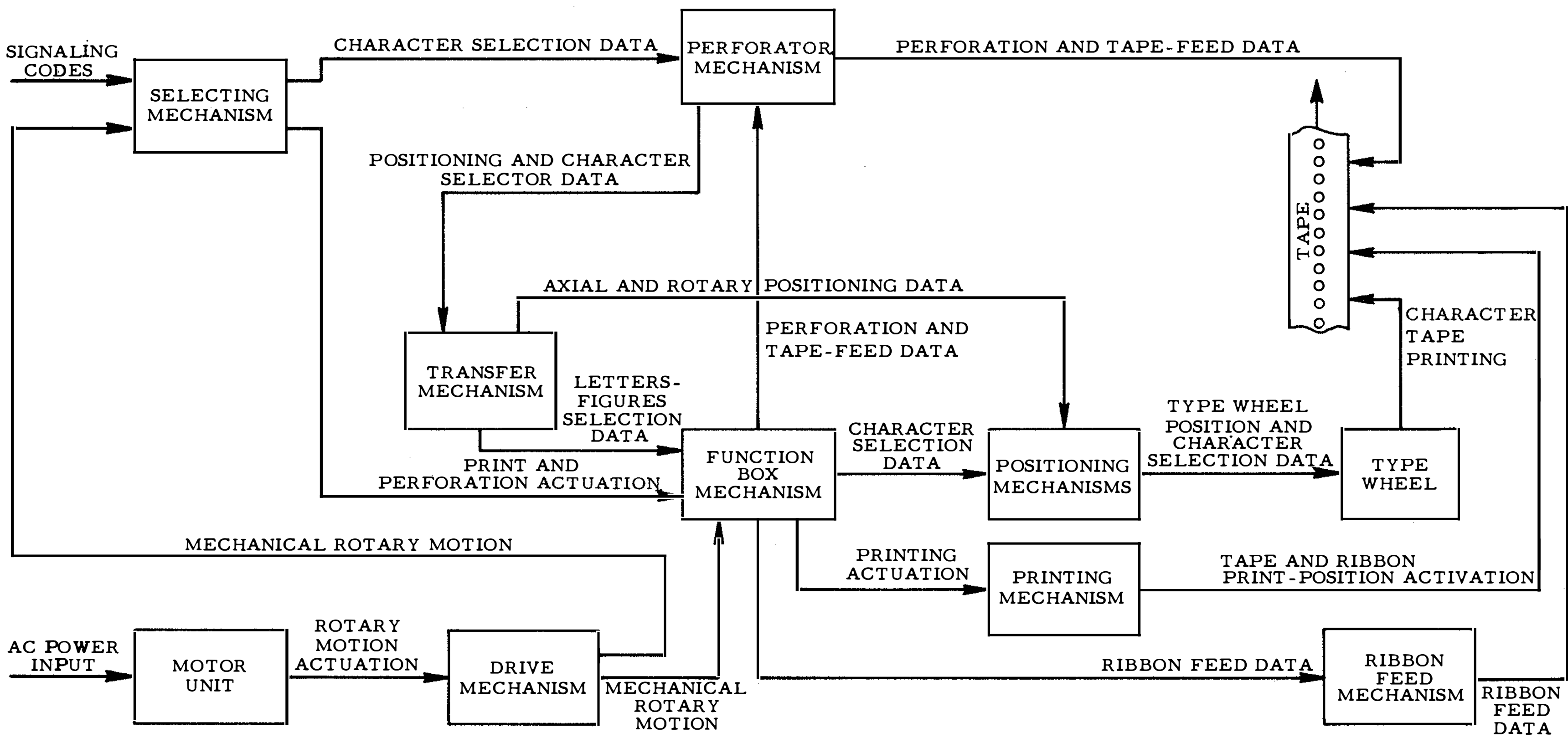


Figure 3-4. Basic System Block Diagram

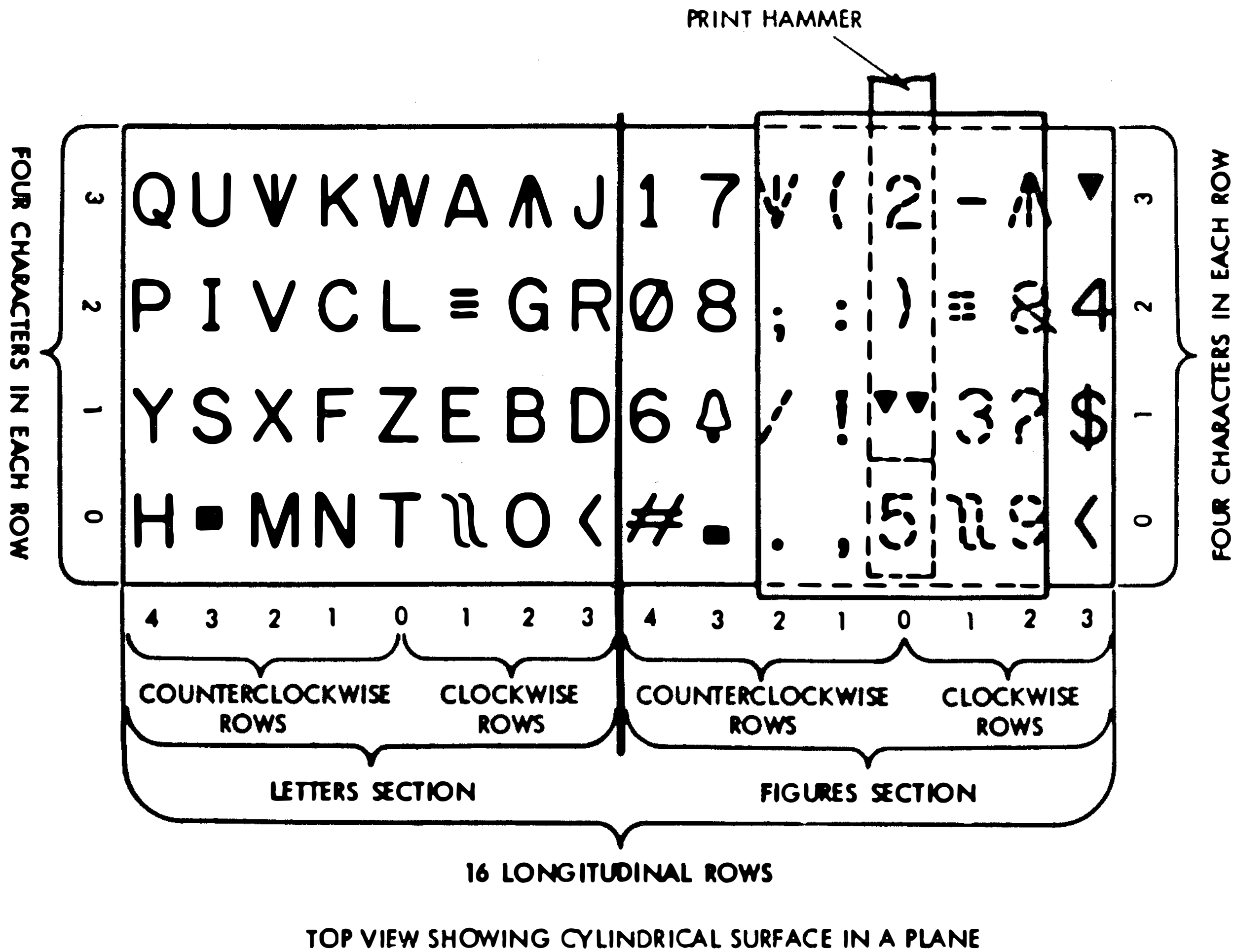


Figure 3-5. Typical Type Wheel Character Arrangement

selected character. It effects this operation by means of a shaft supported by a bracket attached to the type wheel bearing housing.

i. Ribbon Feed Mechanism. The characters are imprinted on the tape in ink supplied by an inked ribbon which is held between the tape and the type wheel by a guide. The inked ribbon is advanced after printing each character by a ribbon-feed mechanism. The path of the ribbon is down to the right off the top of a right spool, under a right follower, through right pins on the reversing arm, through the ribbon guide, up through left pins on the reversing arm, and to the right over the top of a left spool. A line drawing of the ribbon path is shown in figure 3-30.

j. Tape. The perforating mechanism steps the tape, punches feed holes, and perforates chadless (or fully-perforated) code holes received by the selecting mechanism. The tape is threaded by means of a handwheel. Printing and punching occur simultaneously at a punch block, both the characters are printed, 10 characters per inch, six spaces to the right of the corresponding code combinations. The type wheel is retracted at the end of each operation to make the last printed character visible.

3-4. VARIABLE FEATURES. A number of features not shown on the block diagram are available with the typing reperforator. Some of these features are described briefly in the following paragraphs and discussed in more detail later in the chapter.

a. Contact Mechanisms. These mechanisms furnish electrical pulses for remote use. They include timing, code reading, and audible and visible indicator actuating contacts.

b. Backspace Mechanisms. Two basic types are available, manual and power drive. They are used to retract the tape in order to erase (obliterate) an error.

c. Tape Feed-Out Mechanisms. Several different methods print the inclusion of a predetermined length of blank or LETTERS-perforated tape following a message. This operation facilitates handling. Normally, the interfering tape feed-out mechanism operates at the end of a message. A message can not be received during the feed-out period. The non-interfering tape feed-out mechanisms have provisions for operating messages that are received during the feed-out period. The mechanisms may be operated manually, automatically, or by remote control.

d. Print Suppression on Function. This feature inhibits printing of a predetermined character when this character or function is selected.

e. Motor Control Mechanisms. These devices start or stop the motor used to rotate the type wheel in response to a predetermined signal level or line condition.

f. Universal Sunction Blade. This blade contains removable tines so that it may be coded to accomodate any desired function box requirement.

g. Variable Speed Configuration. A variation of the reperforator unit is a configuration containing an additional shaft that enables its perforator and typing mechanisms to be operated at a different speed from that of its selecting mechanism.

3-5. SIGNALING CODE. The typing reperforator operates on the principle of electro-mechanical conversion of message characters in terms of a signal code. As shown in figure 3-6, five signal levels comprise the code for the character to be printed or punched. A start bit (always spacing) precedes the first bit in the coded character, with the fifth character bit followed by a stop bit (always marking).

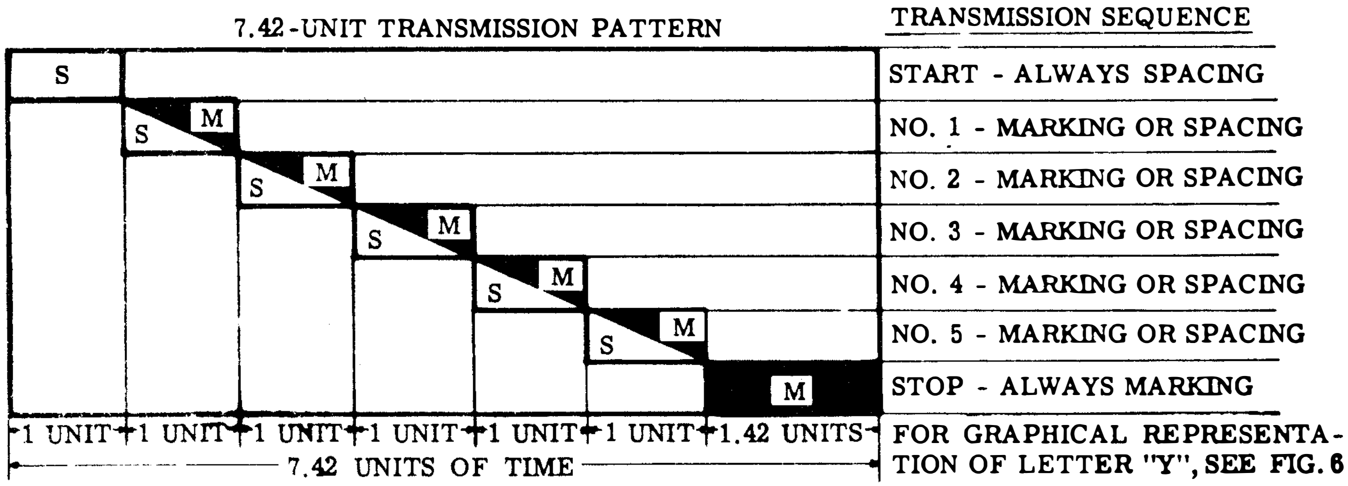
a. Baudot Code. Teletypewriter equipment uses the Baudot code, a five-level start-stop signaling code in which each character or function is represented by a combination of marking current and spacing current time intervals. In a polar signaling circuit, intervals during which current flows in a positive direction are referred to as marking elements, with intervals during which current flows in the opposite direction designated as spacing elements. In a neutral signal circuit, intervals during which current flows in the circuit are referred to as marking elements, and intervals during which no current flows as spacing elements.

b. Five-Level Configuration. Every code combination includes five elements that carry the intelligence, each of which may be either marking or spacing. The start and stop elements provide for mechanical synchronization between the transmitting and receiving equipment. All five elements are marked in the letters code. The blank code consists of five spacing elements.

c. Code Permutation. The total number of permutations of a five-unit code is two to the fifth power, or 32. In order to transmit more than 32 characters and functions, a LETTERS-FIGURES shift operation is designed into the equipment. This permits each permutation, excluding those used to shift and unshift the apparatus, to represent two characters or functions.

d. Typing Speeds. The typing reperforator may operate with a 7.00, 7.42, or 7.50 unit transmission pattern, as listed in Table 1-1. The signaling frequency is expressed in dot cycles-per-second, one cycle consisting of a positive current pulse followed by a negative current pulse. The equipment speed in baud is equal to twice the frequency (refer to Table 1-1). Speed in words per minute (wpm) is roughly equivalent to one-sixth the operations per minute (opm). Marking elements in the intelligence code are represented by holes, while spacing elements consist of an absence of holes. The row of smaller holes between the second and third levels are tape feed holes and do not enter into the code permutation.

3-6. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION. The following paragraphs comprise a brief description of each of the functional blocks on the functional block diagram in figure 3-7. The interaction between functional blocks and



a.

FIGUR S	-	?	:	$	3	!	&	#	8	'	(	)	.	,	9	Ø
LETTERS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	●	●		●	●	●				●	●					
2	●		●				●		●	●	●	●				●
FEED HOLES	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
3			●			●		●	●		●		●	●		●
4		●	●	●		●	●			●	●		●	●	●	
5		●					●	●				●	●		●	●

FIGUR S	1	4	🔔	5	7	;	2	/	6	"	ǁ	<	≡	■	∨	∧
LETTERS	Q	R	S	T	U	V	W	X	Y	Z	BLANK	C.R.	L.F.	SPACE	LTR	FIG.
1	●		●		●		●	●	●	●					●	●
2	●	●			●	●	●						●		●	●
FEED HOLES	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
3	●		●		●	●		●	●					●	●	
4		●				●		●				●			●	●
5	●			●		●	●	●	●	●					●	●

(TYPICAL CHARACTER ARRANGEMENT) b.

Figure 3-6. Signaling Code

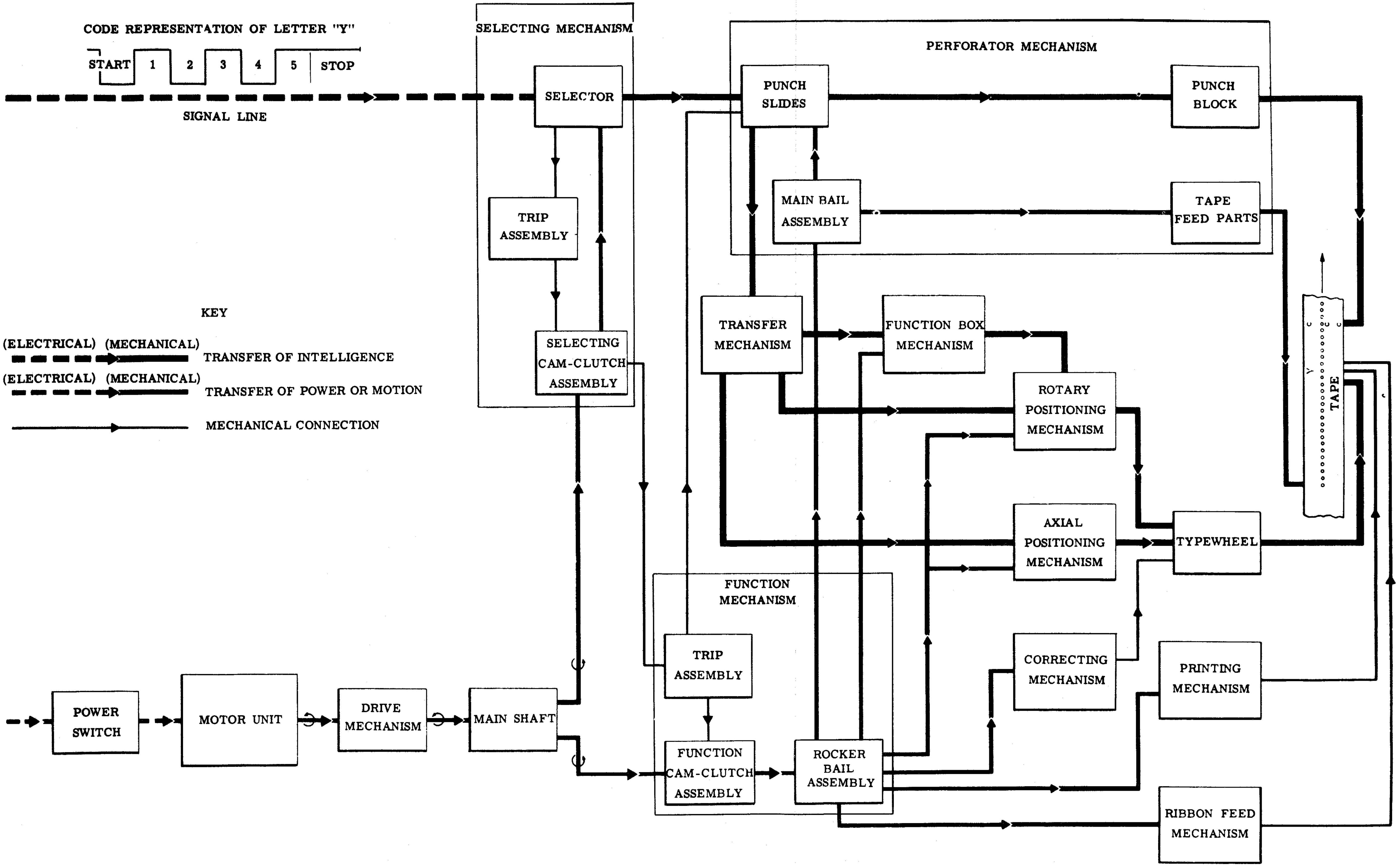


Figure 3-7. Typing Reperforator Unit Model 28, Block Diagram

assemblies also is briefly discussed.

a. Power Switch. The typing reperforator has a power switch electrically connected in the ungrounded leg of the ac power input path, as shown in the system schematic, figure 3-8. In low-level configurations, the ESA has its own power switch. An indicator lamp connected in parallel with the switch comes on when power is applied to the reperforator unit. The ac input is applied to the tape feed-out switch and the backspace switch, which require a 115-volt input, and to the ac motor used to rotate the main shaft. The type and location of the power switch used will vary according to the individual set configuration. Note on figure 3-8 that the 115-volt ac input is routed to the primary windings of a step-down transformer. The 5.5-volt ac output of the secondary winding is routed to indicator lamps and keyboard components that require the reduced voltage.

b. Motor Unit. A 1/2-horsepower ac motor is used to supply rotary motion, through a gear train and clutch assembly to the reperforator unit and the keyboard. The motor is physically mounted on the keyboard frame of the reperforator as shown in figures 1-5 and 1-7. Either of two basic types of motor, ac synchronous or ac/dc series governed, may be used. The ac synchronous motor is used when the power source is regulated, while the ac/dc series governed motor operates from either regulated or unregulated power sources. Both motors rotate at the same speed, and both may be standard or heavy-duty models according to their adaptations. Note on figure 3-8 that the motor contains both a starting winding, used to overcome inertial torque, and an operating winding. When power is first applied to the motor both windings are energized and the starting capacitor begins to charge. When the capacitor is fully charged the motor start relay drops and the starting winding is de-energized. A thermal cutout relay is included for overheat conditions, and closes automatically when excessive ambient temperature exists, bypassing the motor and shutting off the unit.

c. Drive Mechanism. The motor supplies rotary motion, through a gear set, to the typing reperforator unit and keyboard. Gear sets may be interchanged to obtain various operational speeds. This may also be accomplished by an optional variable-speed drive mechanism. In the multiple ROTR sets, a common speed may be used or each set may operate at its own prescribed operational speed.

d. Main Shaft. The main shaft and selecting cam-clutch assembly, shown from right to left in figure 3-9, includes the clutch, stop arm bail cam, fifth, fourth and third selector cams, cams for the spacing and marking locklevers, second and first selector cams, selector reset bail cam, and the function trip cam. The cam-clutch is controlled by the selector through the clutch trip assembly, as described in the detailed discussion of this assembly. During the time in which the signal circuit is closed (marking), the selector magnet coils are energized and hold the selector armature up against the magnet pole pieces. In this position, the armature blocks the lever, and the cam-

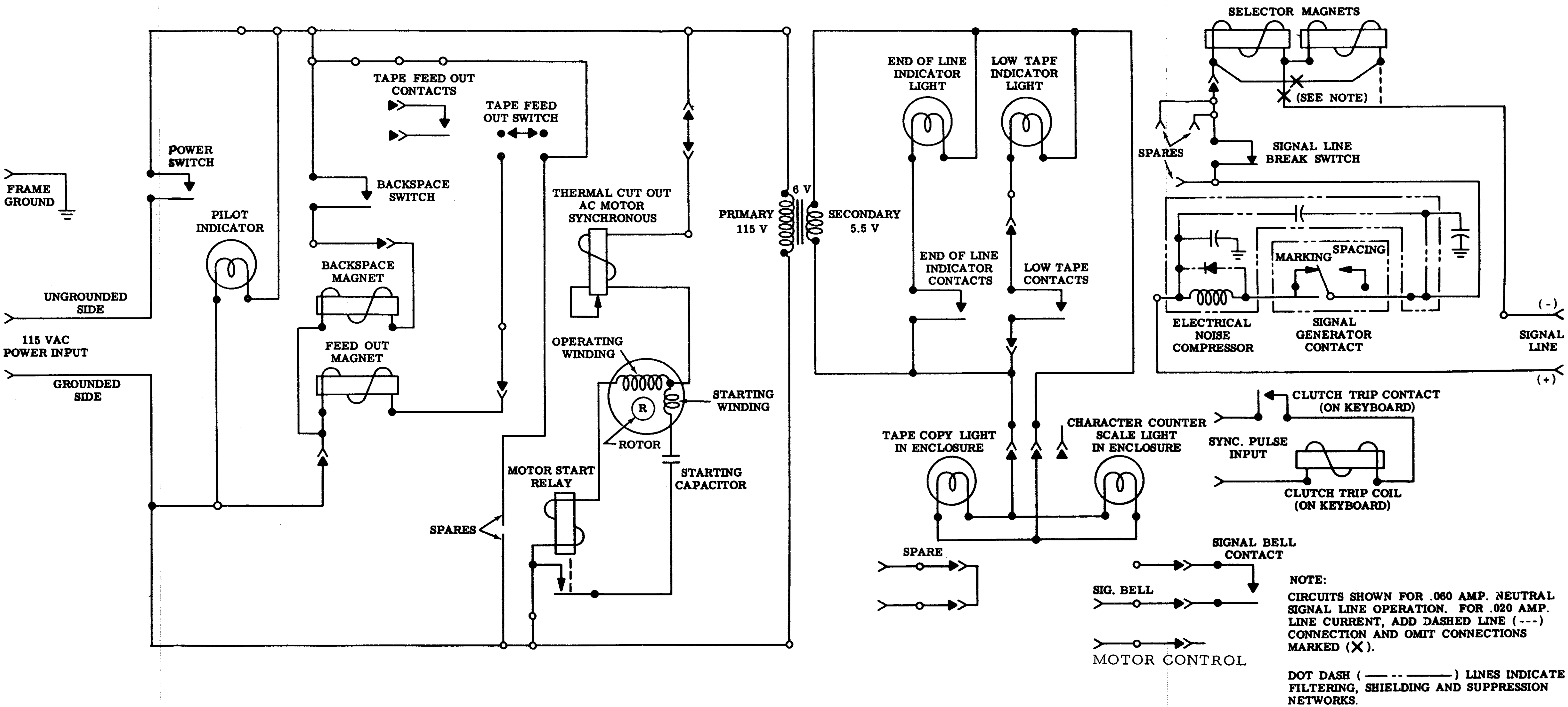


Figure 3-8. Typical Typing Reperforator Set Model 28, Schematic Diagram

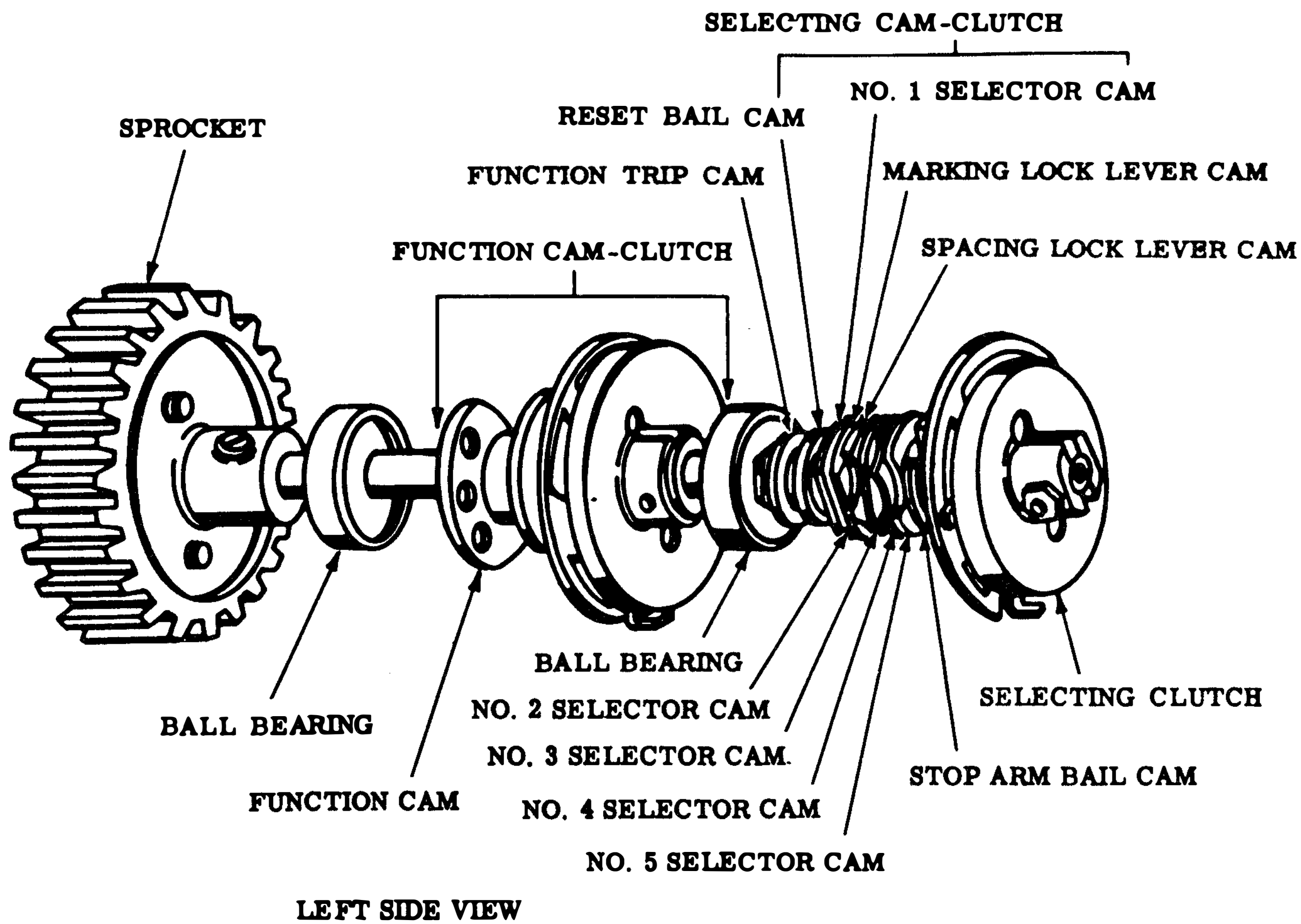


Figure 3-9. Main Shaft

clutch is held stationary between the stop arm and latch-lever. At the end of the function cycle the cam-clutch is disengaged from the ac motor.

e. Selector. The signaling code combination, such as the combination representing the character "Y", plotted in the upper left-hand corner of figure 3-7, is applied to the selecting mechanism. The start pulse of the character being received causes the selector, through a trip assembly, to trip the selecting cam-clutch, initiating the selection cycle.

f. Trip Assembly. Near the end of the selecting cycle, the cam-clutch actuates the function cam-clutch in the function mechanism to operate the printing and perforating actions. The selection cam-clutch is then de-energized and remains inoperative until the next code combination is received. The trip assembly is active during these functions.

g. Selecting Cam-Clutch Assembly. The selecting cam-clutch assembly participates in transferring timed motion of the code combination into a corresponding mechanical arrangement. The main shaft imparts motion to the selecting cam-clutch when the clutch is engaged at the start of the selecting cycle, and controls clutch operation throughout the selecting cycle until the clutch is disengaged at the end of the cycle.

h. Main Bail Assembly. The main bail assembly transfers the motion of the rocker bail assembly in the function box to align the punch slides in the perforator mechanism. This ensures that printing and punching operations are synchronized.

i. Punch Slides. The outputs of the function and transfer mechanisms are routed to both the positioning and printing mechanism and to the perforator mechanism, so that printing and punching of the selected character will be performed simultaneously. When the five punch slides are actuated by the selector, punches are aligned to perforate the tape in accordance with the hole positions for the character to be punched.

j. Punch Block. The punch block operates in conjunction with selected pins to perforate the tape at the same time the selected character is being typed by the printing mechanism.

k. Tape-Feed Parts. The tape-feed parts making up part of the perforator mechanism include a toggle bail, a slide post, toggle links, draglinks, and the punch slide reset bail. As the perforating mechanism punches the selected hole combination, motion of the main bail assembly causes the tape to be advanced one character space before the next code combination is received. Note that the selecting and punching/printing operations occur simultaneously. That is, while the perforating mechanism is punching the hole positions for the selected character and the printing mechanism is impressing the character on the tape, the selecting mechanism may be processing the next code combination.

l. Function Cam-Clutch and Trip Assemblies. The function cam-clutch, like the selector cam-clutch, is driven by the main shaft as shown in figure 3-9. This clutch is engaged throughout the function cycle in the same manner that the selection cam-clutch is controlled by the main shaft throughout the selection cycle, and is actuated by a similar trip assembly. The function cam-clutch and the rocker bail assembly translate the rotation of the main shaft into simple harmonic motion.

m. Rocker Bail Assembly. This assembly, in conjunction with the function cam-clutch, distributes rotary motion of the main shaft to the following mechanisms:

(1) Ribbon feed mechanism

(2) Perforator

(3) Correcting mechanism

(4) Function box

(5) Printing mechanism

(6) Oscillating assembly

(7) Pushbars of the axial and rotary positioning mechanisms. During the first part of each function cycle the cams bear against the roller, causing the bail assembly to rock to the right. During the latter part of the cycle, the bail assembly returns to the home position as the rotary motion of the cams is reversed.

n. Transfer Mechanism. Near the end of each selecting cycle, the transfer mechanism moves the intelligence in the form of a mechanical arrangement from the punch slides to the function box mechanism and to the positioning mechanisms. Five mechanical linkages are included in the transfer mechanism, each associated with a punch slide, to produce the five-level code described in paragraph 3-5.

o. Function Box Mechanism. The function box mechanism enables the unit to perform various auxiliary functions including LETTERS-FIGURES shift, unshift-on-space, and signal bell. The function box conveys the motion of the main shaft to the mechanisms concerned with the actual printing and punching.

p. Type Wheel. As shown on the expanded view of the type wheel in figure 3-10, there are 16 longitudinal rows, each of which is made up of four characters numbered from 0 through 4 from front to rear. The surface is divided into a letters section and a figures section, with each section consisting of eight longitudinal rows. The fifth row, in a counterclockwise direction from the division line, is numbered 0, with four rows in one direction. These are designated counterclockwise, while three rows in the other direction are designated clockwise rows, as shown in figure 3-10. It should be noted that the clockwise and counterclockwise modifiers refer to the direction of rotation of the wheel to select the rows, and not to their position of the wheel. The position of the print hammer relative to the type wheel is also shown.

q. Rotary Positioning Mechanism. The rotary positioning mechanism, which is controlled by the number 3, 4, and 5 selecting elements of the code, rotates the type wheel so that the row containing the

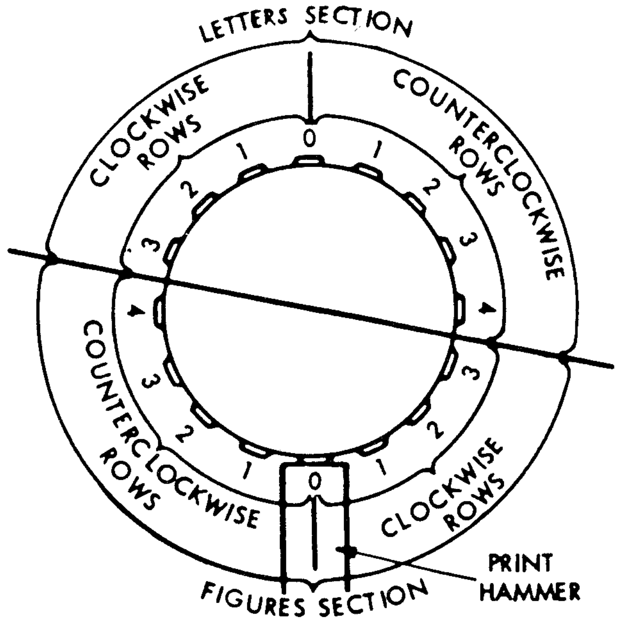


Figure 3-10. Type Wheel Showing 16 Logitudinal Rows, Front View

selected character to be printed is aligned with the print hammer at time of printing.

r. Axial Positioning Mechanism. The functions of the axial positioning mechanism are to position the type wheel to the front so that the proper character in the selected row is aligned with the print hammer at the time of printing and to retract the type wheel and ribbon guide at the end of the function cycle so that the last typed character is visible. It is controlled by pushbars actuated by numbers 1 and 2 of the code.

s. Correcting Mechanism. After the type wheel has been positioned by the rotary and axial positioning mechanisms, the selected character is more accurately aligned for printing by the corresponding mechanism which compensates for any play or backlash in the positioning linkages.

t. Printing Mechanism. Following type wheel positioning and final correction, the printing mechanism is activated. This assembly, by means of a hammer, drives the tape and inked ribbon forcibly against the type wheel, imprinting the selected character on the tape.

u. Ribbon Feed Mechanism. Immediately after the selected character has been typed, a ribbon-feed mechanism advances the inked ribbon one character space, and reverses its direction when one of two ribbon spools is depleted. Near the end of the function cycle the axial positioning mechanism retracts the type wheel and a ribbon guide so that the last printed character is visible. The LETTERS or the FIGURES code sets up an arrangement in the transfer mechanism which permits the function box to operate and to cause the rotary positioning mechanism to shift the type wheel 180 degrees of rotation.

3-7. KEYBOARD AND BASE ASSEMBLY BASIC OPERATION. Functional descriptions of these units are included in the following paragraphs.

3-7.1 KEYBOARD DESCRIPTION AND COMPONENT FUNCTIONS. The keyboard provides mounting and transmission facilities for the sets. The keyboard is a device for converting the mechanical action resulting from the depression of a key into electrical pulses that are transmitted over a transmission line. In addition, it provides mounting facilities for a typing reperforator and a motor unit, as well as for a variety of accessories.

a. General Description. Motive force for activating the keyboard is derived from the motor unit by means of an intermediate shaft assembly. Electrical wiring to and from the keyboard is terminated in a 16-pin connector and at three terminal boards. The keyboard is operable at 60, 75 or 100 wpm (368, 460, or 600 opm). Operating speeds are varied by interchanging sets of gears that are supplied as optional components. The signal generator contact box may be adapted to provide either polar or neutral signals. It also may be adapted for synchronous pulsed transmission. Views of the keyboard assemblies are shown in figures 3-11, 3-12, and 3-13.

b. Base Assembly. The base assembly provides mounting facilities for the keyboard and signal generator mechanisms, the intermediate gear shaft assembly, tape container, tape-out switch, a base casting for support of the typing reperforator, a character counter mechanism, and optional accessories.

(1) Gear Shaft. The intermediate gear shaft assembly includes three gears and a shaft. The assembly transfers motive power through a gear to the typing reperforator unit. Motive power is conveyed by a shaft connected through this gear assembly to a pair of helical gears which in turn drive the signal generator mechanism.

(2) Character Counter. The character counter mechanism contains a scale which records in increments of one character the length of the transmitted message up to the 72-character equivalent of a page-printed teletypewriter line. When 66 to 68 characters have been typed, an END-OF-LINE indicator lights. Pressing the CARR RET key returns the counter to zero and opens the lamp circuit.

c. Keyboard Mechanism. The keyboard mechanism contains the keytops, keylevers, code bars and levers and other code selecting parts that transform the intelligence contained in the manual selection of a keytop into a teletypewriter code combination, represented by code bar positions. The code combination for the selected character is transferred from the code bars through transfer levers to the signal generator mechanism. In addition, this mechanism contains a rotary-type main power switch as well as POWER, TAPE-OUT, and margin indicator lamps. The keytops are positioned in the conventional three-bank arrangement, with numerals, punctuation marks, and special symbols available in upper case positions. The space bar is

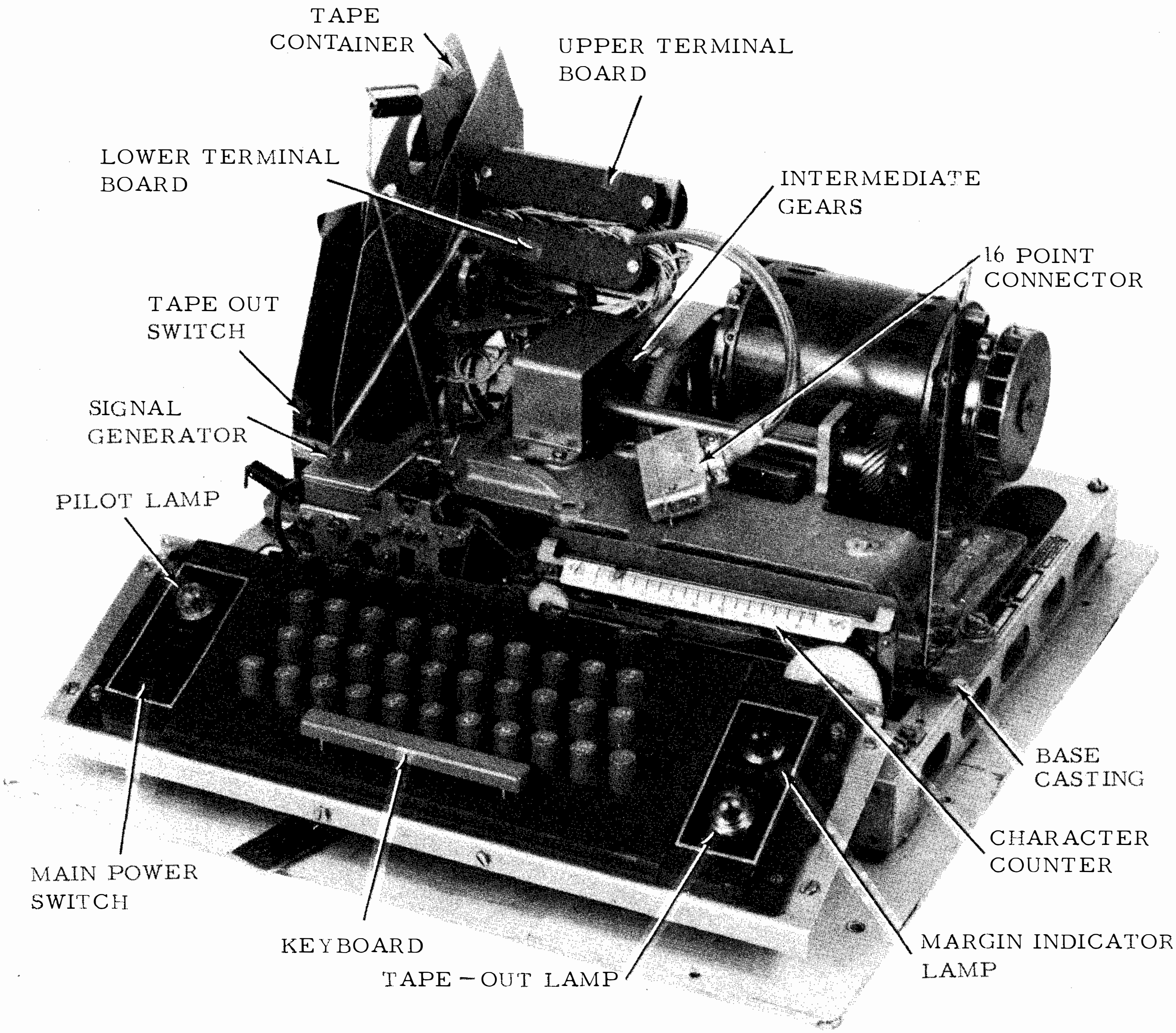


Figure 3-11. Send-Receive Typing Reperforator Keyboard Model 28, Front Right View

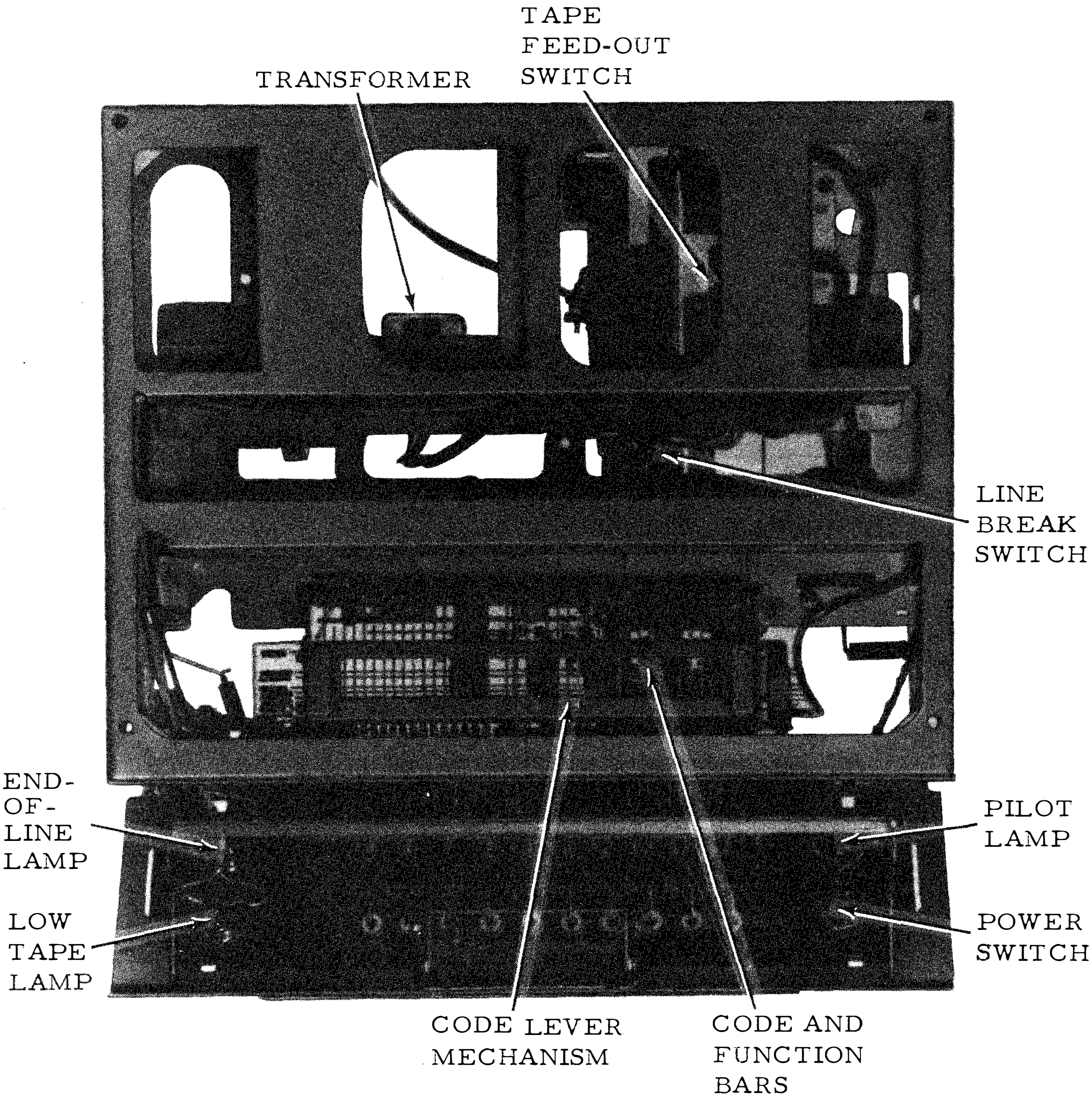


Figure 3-12. Send-Receive Typing Reperforator Keyboard Model 28, Bottom View

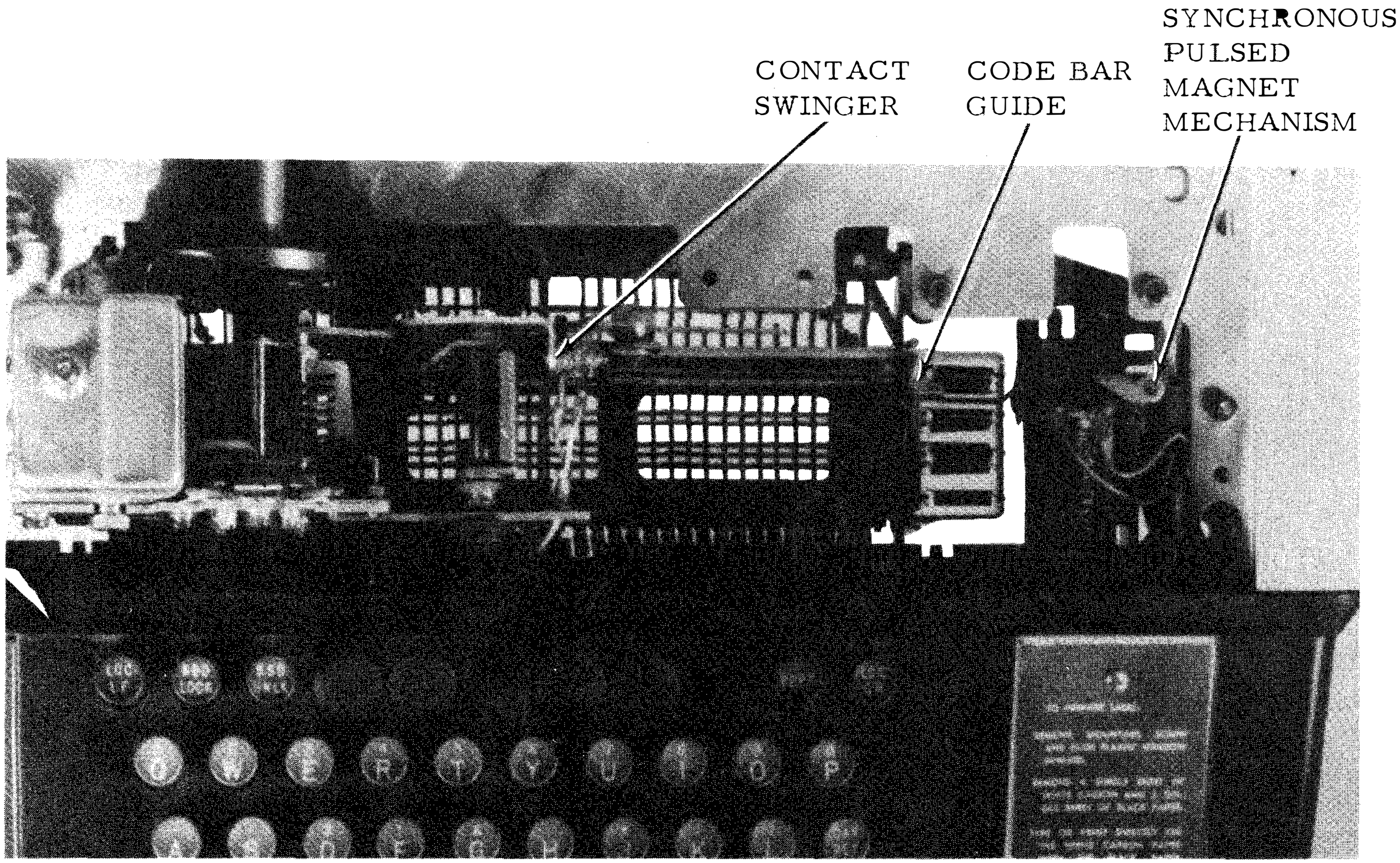


Figure 3-13. Send-Receive Typing Reperforator Keyboard Model 28, Top View

located centrally below these keys. Keytops for local operations are provided above the standard keytops for facility of operation. This row has provisions for 11 keys. A wedge lock assembly prevents the simultaneous depression of more than one keytop.

d. Signal Generator Mechanism. The signal generator mechanism generates the start-stop teletypewriter signal. Basically, it consists of an enclosed box containing a set of fulcrum-type transmitting contacts, a transfer bail used to control the opening and closing of the contacts, selector levers that engage the transfer bail in a sequence determined by the position of the code bars, and a multilobe cam which determines the pulse duration of the signal code elements. A shaft, on which a gear and clutch are mounted, receives motive power to drive the mechanism from a gear on the intermediate gear shaft assembly. The contact box may be equipped with an RF or arc suppression network.

3-7.2 BASE ASSEMBLIES BASIC DESCRIPTION AND TYPES. The typing reperforator bases are available in several variations. They provide a foundation for the motor unit and either one or three typing reperforator units. They also provide mounting facilities for electrical and mechanical operational devices and accesories. Four types of bases are described in the following paragraphs.

a. Single-Plate Base. This base contains a plate that rests on four metal feet and serves as a foundation for the other elements. Wiring, a power switch, a four-point terminal board, and a three-point power connector are part of the power circuits. All other wiring terminates in a 32-point connector mounted by a bracket at the rear of the plate. Three nine-point terminal boards provide intermediate connecting points for this wiring which includes two selector magnet leads. The typing reperforator unit is mounted by four tapped holes at the left front of the plate. The motor unit is supported by three posts and an adjusting plate. Motion is transferred from the motor unit to the typing reperforator unit by a single-speed drive mechanism (figure 3-14). Gear sets may be interchanged to obtain different operating speeds. A tape container with a roller, a wire guide and a wooden filler for a tape roll are attached to the extreme right of the plate. A low-tape mechanism incorporating two switches which may be connected to visual or audible alarms is located in the rear of the container. The base may be carried by a front handle with the connector mounting bracket serving as a rear handle.

b. Double-Plate Base. In this base, an upper plate is separated from a somewhat larger lower plate by rubber vibration mounts. The lower plate rests on four leather feet and has two handles and four slots for mounting a cover. Wiring, a power switch and a three-point connector are part of the power circuits. All other wiring terminates in a 16-point connector. Two nine-point terminal boards provide intermediate connecting points for all wiring except two selector magnet leads. The double-plate receive only base assembly is shown in figure 3-15. A clamp with keeper secures cables where they leave

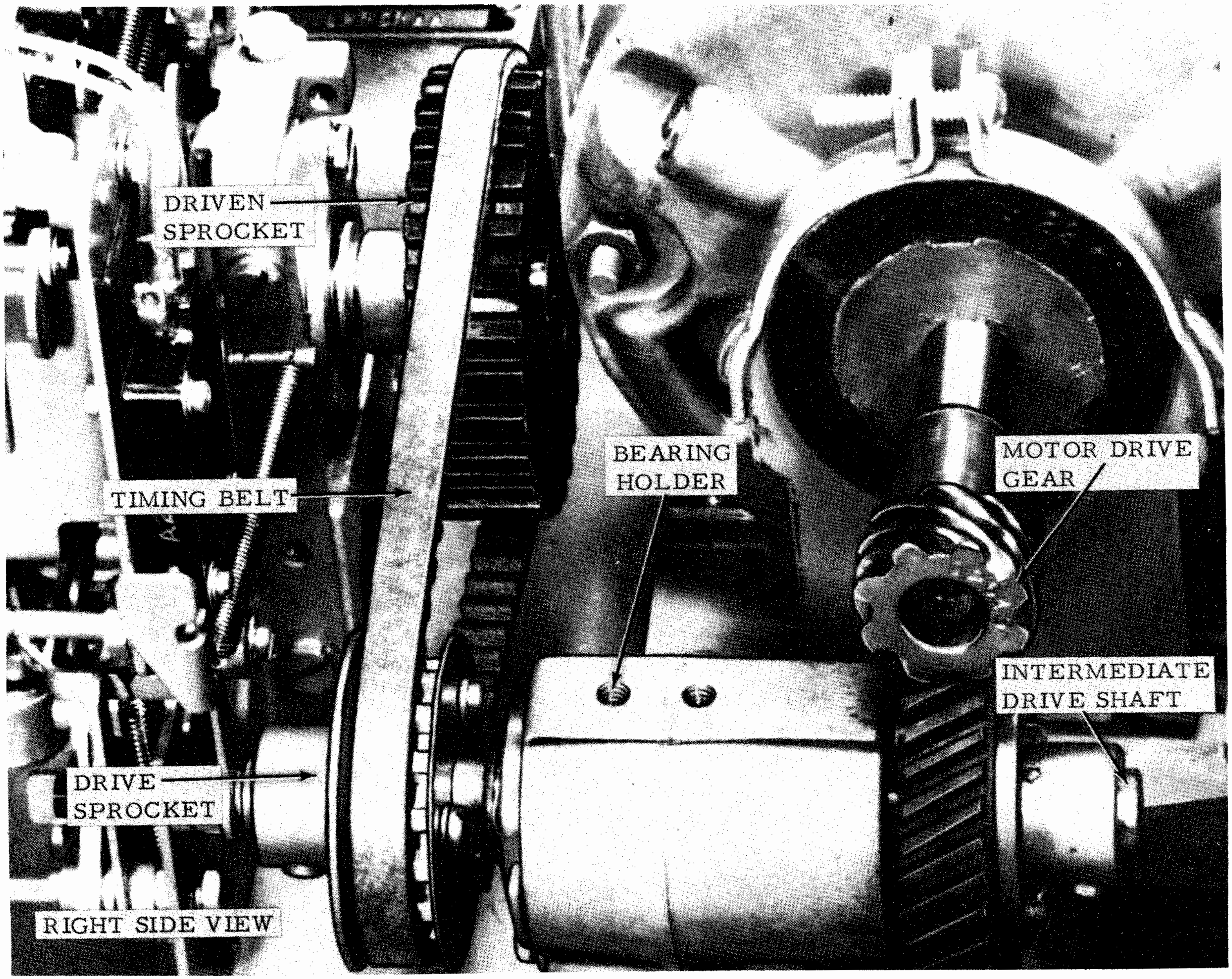


Figure 3-14. Single-Speed Drive Mechanism

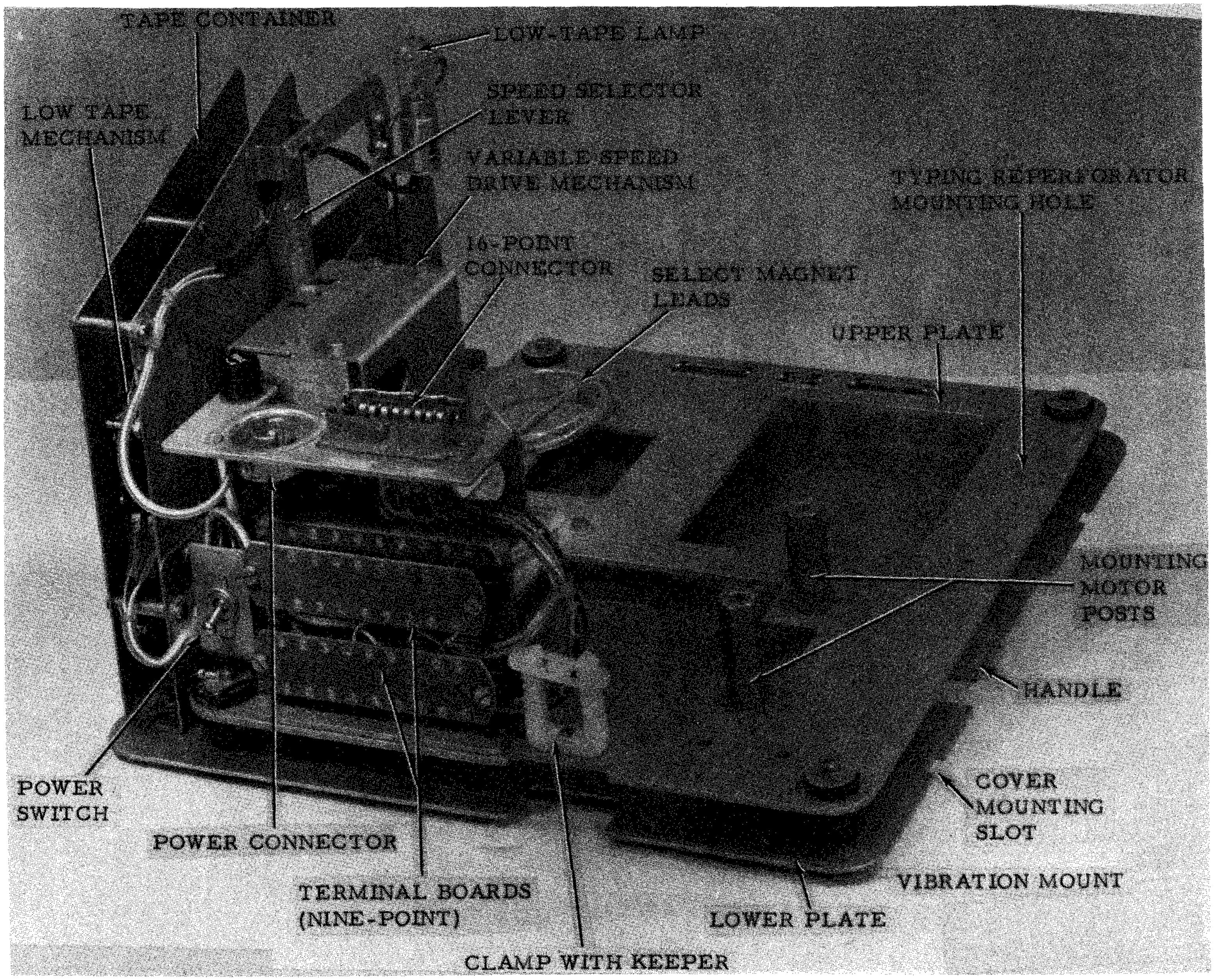


Figure 3-15. Double-Plate Receive-Only Base

the base. The tape container and the mounting facilities for the motor unit and the typing reperforator unit are identical to those of the single-plate base (see paragraph 3-7.2a). A LOW-TAPE lamp is mounted by a bracket on the tape container. Motion can be transferred from the motor unit to the typing reperforator unit through a single-speed drive mechanism (figure 3-14). Gearsets that may be interchanged to obtain different speeds, are available as an optional feature. A variable-speed drive mechanism, which permits manual selection of operating speeds (60, 75, or 100 wpm) by movement of a lever, may be used with this base as shown in figure 3-15.

c. Miniaturized Base. This base is similar to the base previously described in that it is of double-plate construction and contains essentially the same features. It is, however, lighter in weight and smaller in size, and the mechanisms are arranged differently to conserve space. The miniaturized base is shown in figure 3-16. The base contains two rectangularly shaped plates, separated by vibration isolators, and is equipped with four feet. A casting provides mounting facilities for a motor unit. A tape container, equipped with a TAPE-OUT switch, is supported by brackets above the motor unit mounting. A control panel contains a main POWER switch, a TAPE-OUT lamp, and provisions for a tape feed-out switch. Its mounting bracket also contains a fuse holder. Terminal boards, cable clamps, a reperforator connector, and the necessary electrical wiring are included. The base is normally equipped with a variable-speed drive mechanism, which permits manual selection of operating speeds (60, 75, or 100 wpm) by movement of a lever. A single-speed drive mechanism, with which speed changes are made by changing gears, may be used with this base.

d. Multiple Reperforator Base. This base provides mounting facilities for three typing reperforator units and one motor unit, and for the necessary auxiliary equipment. A plate upon which the components are installed is separated from an oil pan by resilient mountings. Side rails are provided for installation of the base in a cabinet. Posts on an adjustment plate are provided for mounting a motor unit. Three tape containers equipped with tape-out switches, a 14-point connector, terminal blocks, and a main POWER switch, are also included. Three chad containers are provided on bases accommodating a fully-perforated tape output typing reperforator unit. This base is shown in figure 3-17. The typing reperforator units, which are mounted near the front of the base, receive rotary motion from the motor unit through a cross-shaft assembly and timing belts. On some bases, intermediate gear assemblies transfer the motion from the cross-shaft to the typing reperforator units via timing belts. The units may operate at a common speed or at independently varied speeds. Speed changes are made by interchanging gears at the motor unit and cross-shaft assembly, by changing the sprocket and timing belt at the reperforator units; or on bases so equipped, by changing gears in the intermediate gear assemblies.

3-8. DETAILED FUNCTIONAL DESCRIPTION. The following paragraphs comprise a series of detailed discussions pertaining

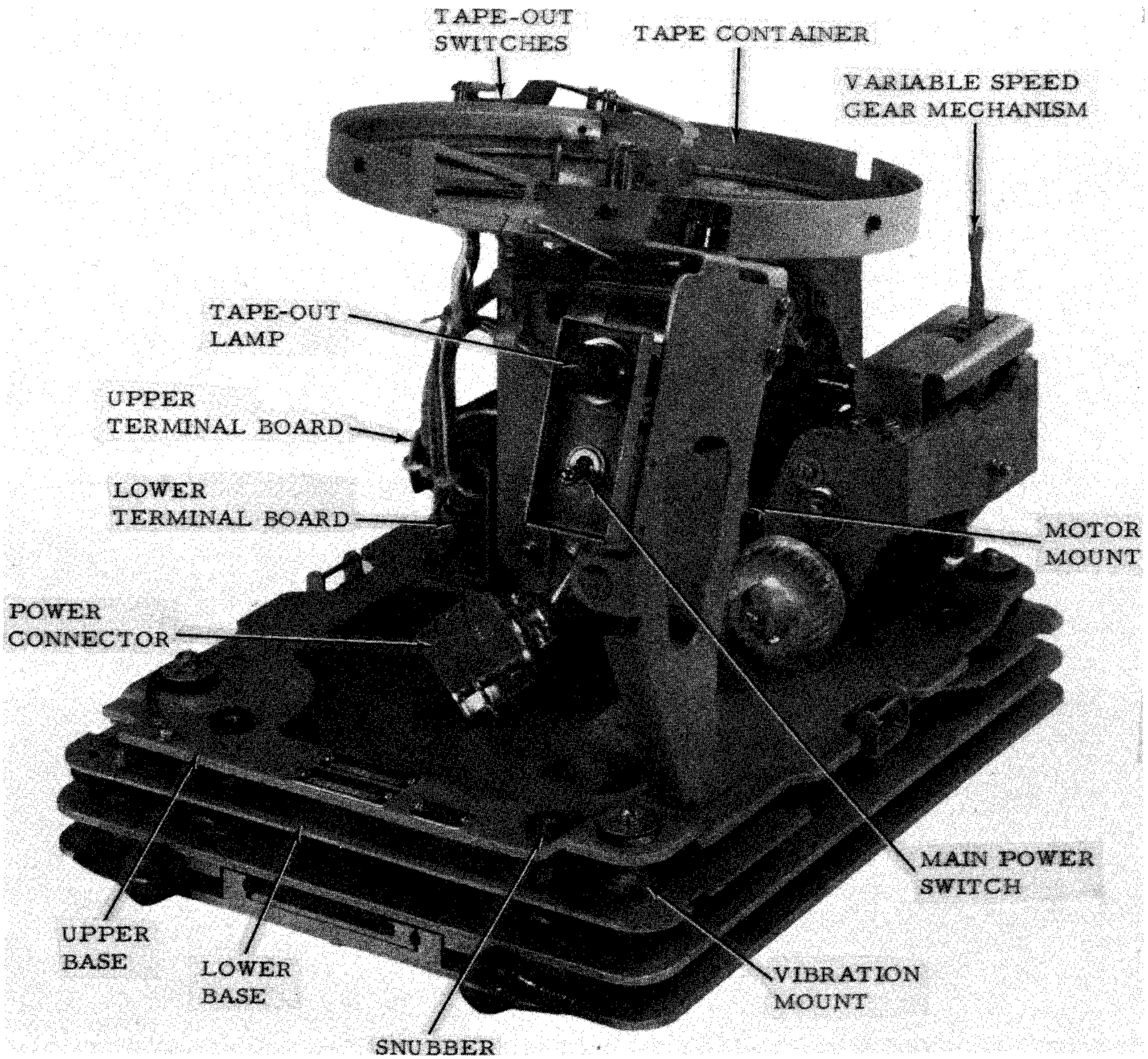


Figure 3-16. Miniaturized Base

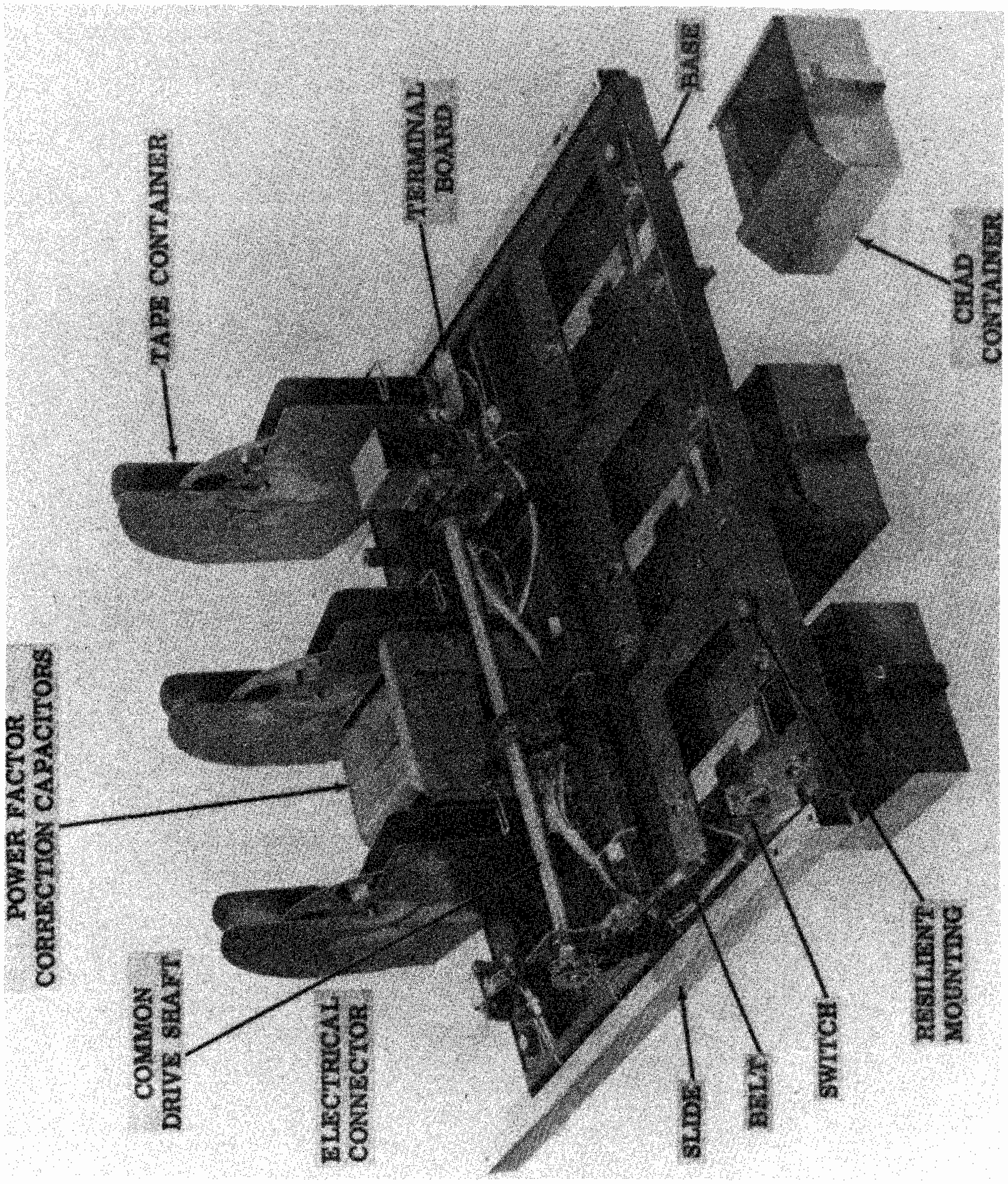


Figure 3-17. Multiple Reperforator Base

to the functional blocks and general descriptions in the previous paragraphs. Additional assemblies such as mechanisms used to perform variable feature functions are not described in the functional block discussion. The detailed theory of operation of each of these mechanisms also is discussed. Unless stated to the contrary, references in text to "left" or "right" indicate the operator's left or right, facing the front of the unit. The selector mechanism will be at the right and the punch mechanism at the left. In illustrations, unless specifically labeled otherwise, it is assumed that the equipment is being viewed from the front. Pivot points are solid black to indicate fixed points and cross hatched to indicate floating points.

3-8.1 RECEPTION AND TRANSLATION. The mechanisms associated with reception and translation functions are discussed and their operational theory described in the following paragraphs.

a. Selecting Cam-Clutch and Trip Assembly. The components comprising this assembly are shown in figure 3-18. When a code combination is received, the start element (spacing) de-energizes the magnet, and the selector armature under tension of its spring moves down out of the way of the start lever. The start lever turns clockwise under spring pressure and moves the stop arm bail into the indent of the start cam. As the stop arm bail rotates about its pivot point, the attached stop arm is moved out of engagement with the clutch shoe lever. The selecting cam-clutch engages and begins to rotate counterclockwise. The stop arm bail immediately rides to the high part of the cam, where it remains to hold the start lever away from the armature while the intelligence pulses of the code are received and processed by the selector. When the stop element at the end of the code combination is received, the armature is pulled up blocking the start lever. Thus the stop arm bail is prevented from dropping into the low part of its cam, and the attached stop arm is held in position to stop the clutch shoe lever. When the clutch shoe lever strikes the stop arm, the inertia of a cam disk causes it to continue to turn until its lug makes contact with the clutch shoe lever. At this point, a latchlever drops into a detent in the cam disk, and the clutch is held disengaged until the next code combination is received.

b. Clutch Operation. Clutch operation is described in the following paragraph:

(1) Engagement. The clutch drum is attached to and rotates in unison with the main shaft, as shown in figure 3-9. In the disengaged position, shown in figure 3-19, the clutch shoes do not contact the drum and the shoes and cam disk are held stationary. Engagement is accomplished by moving the stop arm, shown in figure 3-18, away from the clutch, thus releasing stop lug A and the lower end of shoe lever B. The upper end of lever B pivots around its ear C, which bears against the upper end of the secondary shoe. The ear D and the upper end of the primary shoe are moved left until the shoe makes contact with the notched inner surface of the rotating drum at point E. As the drum turns counterclockwise, it drives the primary shoe downward so that it

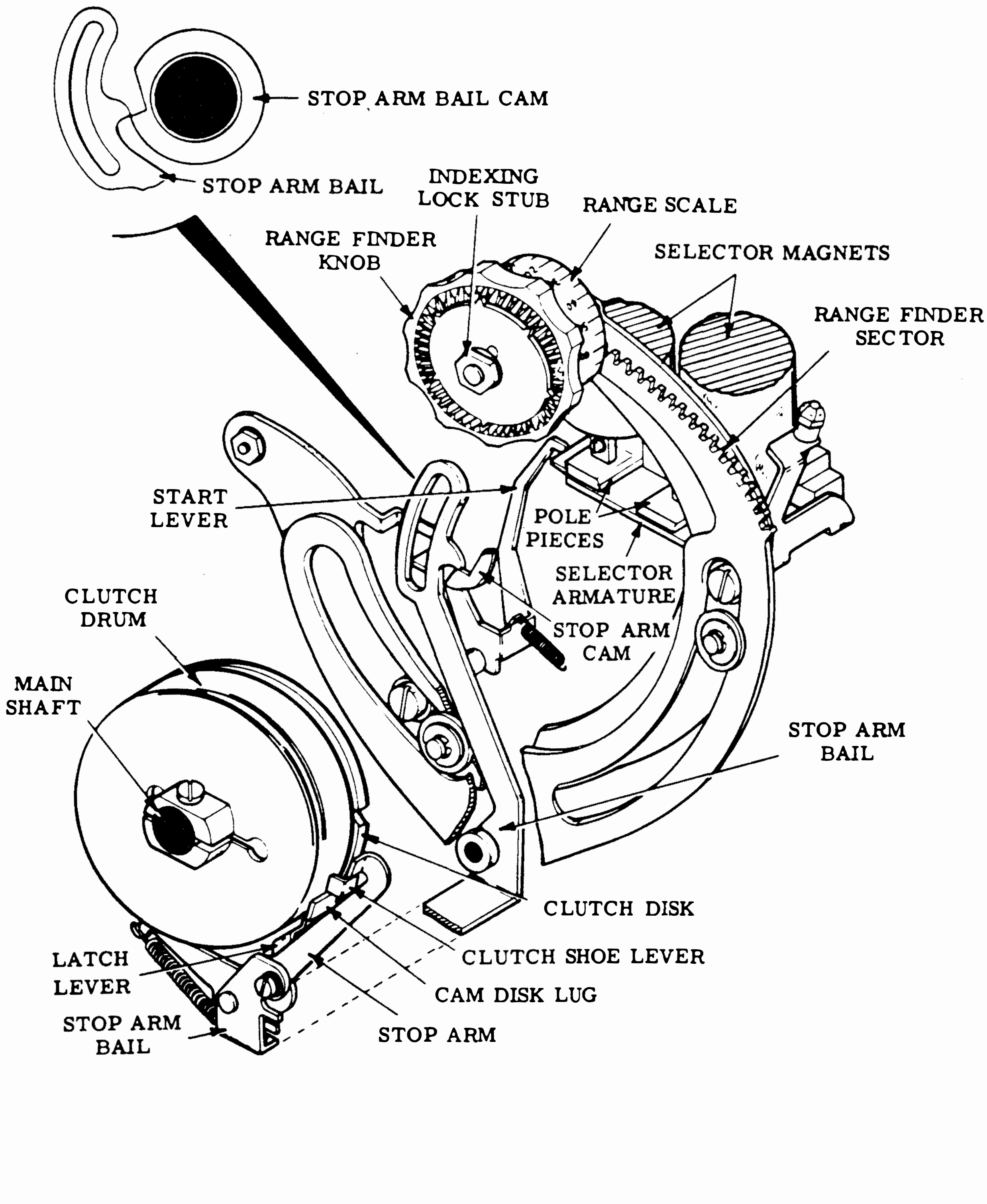


Figure 3-18. Range Finder and Selecting Cam-Clutch Assembly

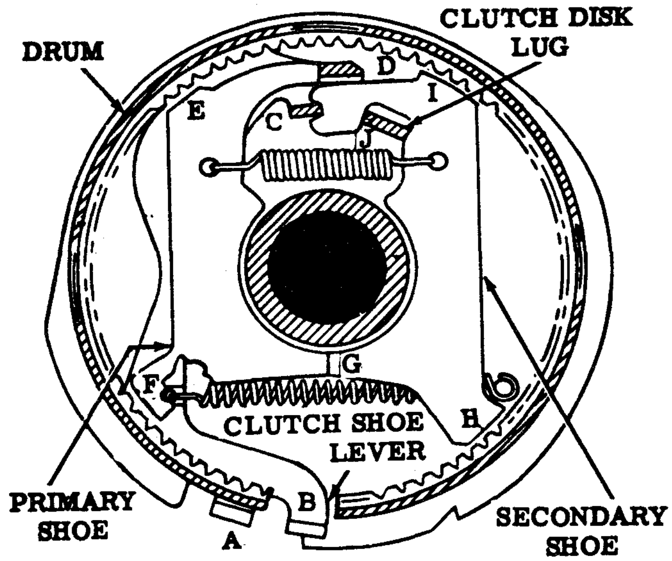


Figure 3-19. Clutch, Disengaged

again makes contact with the drum at point F. There, the combined forces acting on the primary shoe cause it to push against the secondary shoe at point G. The lever end of the secondary shoe then bears against the drum at point H. The drum drives this shoe upward so that it again makes contact with the drum at point I. Forces involved are multiplied at each of the preceding steps. The aggregate force is applied through the shoes to lug J on the clutch cam disk, and the disk and attached cam turn in unison with the drum.

(2) Disengagement. Clutch disengagement is effected when the lower end of shoe lever B strikes the stop arm shown in figure 3-18. Lug A and the lower end of the shoe lever are brought together as shown in figure 3-20 and the upper end of lever B pivots around its ear C. This allows its other ear D to move toward the right. The upper spring then pulls the shoes together and away from the drum. The latchlever seats in the detent in the cam disk and the cam is held in its stop position until the clutch is again engaged.

c. Selector Operation. The selector assembly consists primarily of two magnet coils (figure 3-18), an armature and associated bails, levers, and latches (figure 3-20). Five linkages, each of which consists of a selecting lever, a push lever and a punch slide latch, link the selector cam with the punch slides. Since the linkages are identical, only the number 4 is shown in its entirety in figure 3-21. As the selecting elements of the code combination are applied to the magnet, the cam actuates the selecting levers. When a spacing element is received, a marking locklever is blocked by the end of the armature, and a spacing locklever swings to the right above the armature and locks it in the spacing position

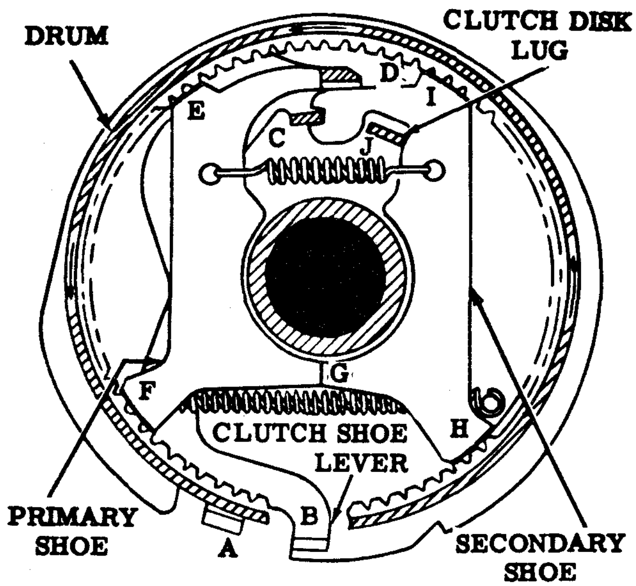


Figure 3-20. Clutch, Engaged

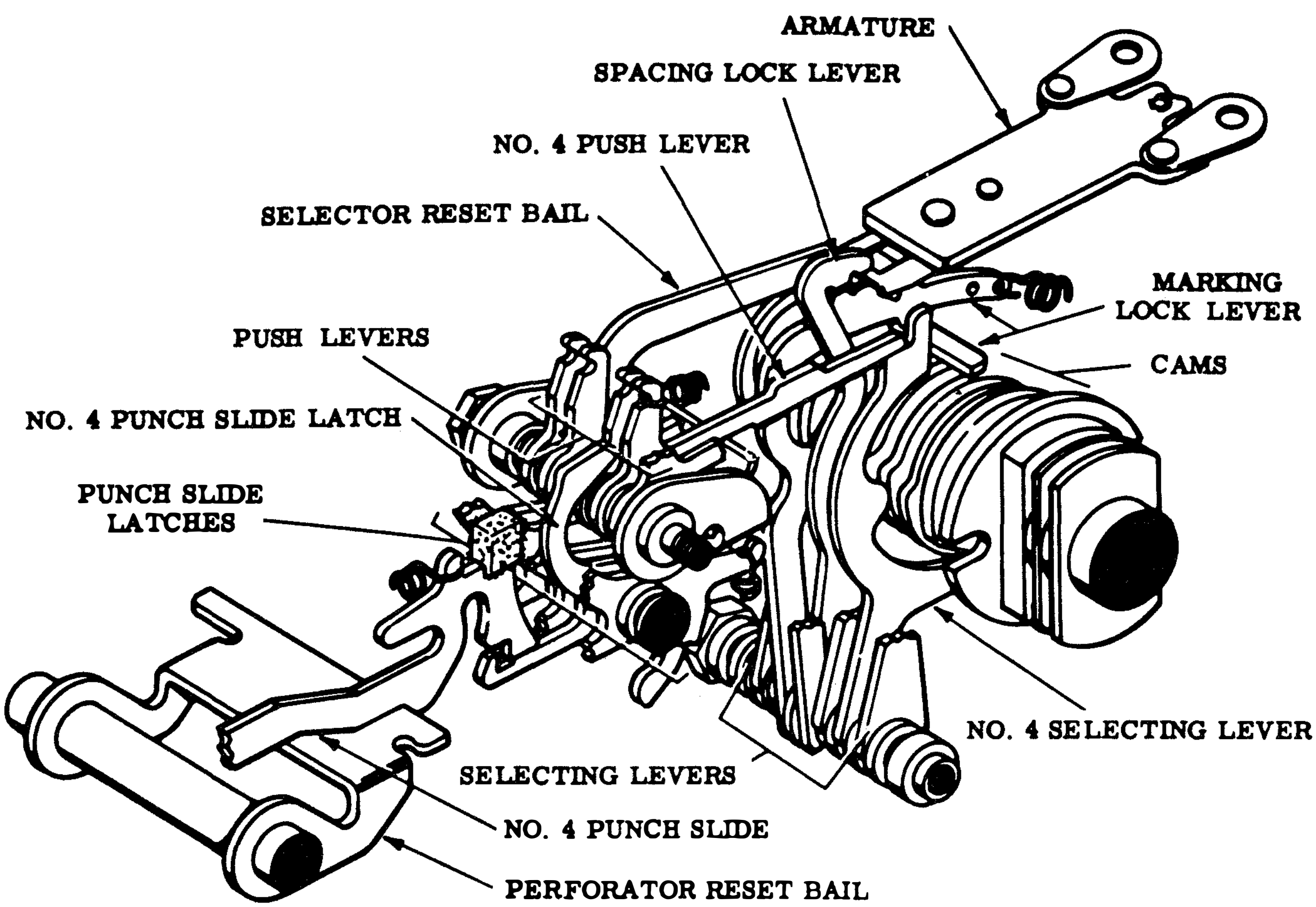


Figure 3-21. Selector

until the next signal transition occurs. Extensions on the marking locklever prevent the selecting levers from following their cams. When a marking element is received, the spacing locklever is blocked by the end of the armature, and the marking locklever swings to the right below the armature and locks it in the marking position until the next signal transition occurs. During this marking condition, the selecting levers are not blocked by the marking locklever extensions, but are permitted to move against their respective cams. The selecting lever that is opposite the detent in its cam, while the armature maintains a marking condition, swings to the right, or selected position, and the end of an associated pushlever falls off a step on the selecting lever. As the cam rotates, the selecting levers, together with any selected push-levers, are moved to the left by the high part of their respective cams, where they remain until the next code combination is received. The unselected pushlevers remain to the right. When the next code combination is received, a selector reset bail, lifted by its cam (figure 3-21), strips the selected pushlevers from the selecting levers, and the pushlevers are turned to the right by their springs. The selected pushlevers, in moving to the left, rotate associated punch slide latches counterclockwise (figure 3-21). Just before the fifth pushlever is selected the selecting cam acting through the function trip assembly, causes the perforator reset bail to release the punch slides. The unselected latches retain their associated slides to the right, while the selected latches permit their slides to move to the left under spring tension. During the latter part of the function cycle, the reset bail returns the punch slides to their unselected position. The latches under spring tension return to their unselected position when the pushlevers are repositioned at the beginning of the next selecting cycle.

d. Orientation. For optimum performance, the selecting mechanism should be adjusted to sample the signaling code elements at the most favorable time. To make this adjustment, the operating margins are established through the range finder, which provides a means of varying the time of sampling. The obtaining of this optimum setting is referred to as orientation. When the range finder knob (figure 3-18) is pushed inward and rotated, its attached range finder gear moves the range finder sector (which supports the stop arm bail, stop arm and latchlever) either clockwise or counterclockwise about the selector cam-clutch. This changes the angular position at which the selector cam-clutch stops with respect to the marking and spacing lock-levers. When an optimum setting is obtained, the range finder knob is released. Its inner teeth engage the teeth of the indexing lock stud and hold the range finder mechanism in position. The setting may be read on the range scale opposite a fixed index mark.

e. Transfer. Transfer of motion near the end of each selecting cycle is accomplished by five linkages in the transfer mechanism. A linkage, shown in figure 3-22, consists of a transfer lever, a pulse beam, and a bellcrank. Since the linkages are similar, only the number 4 linkage is shown in its entirety. The linkages

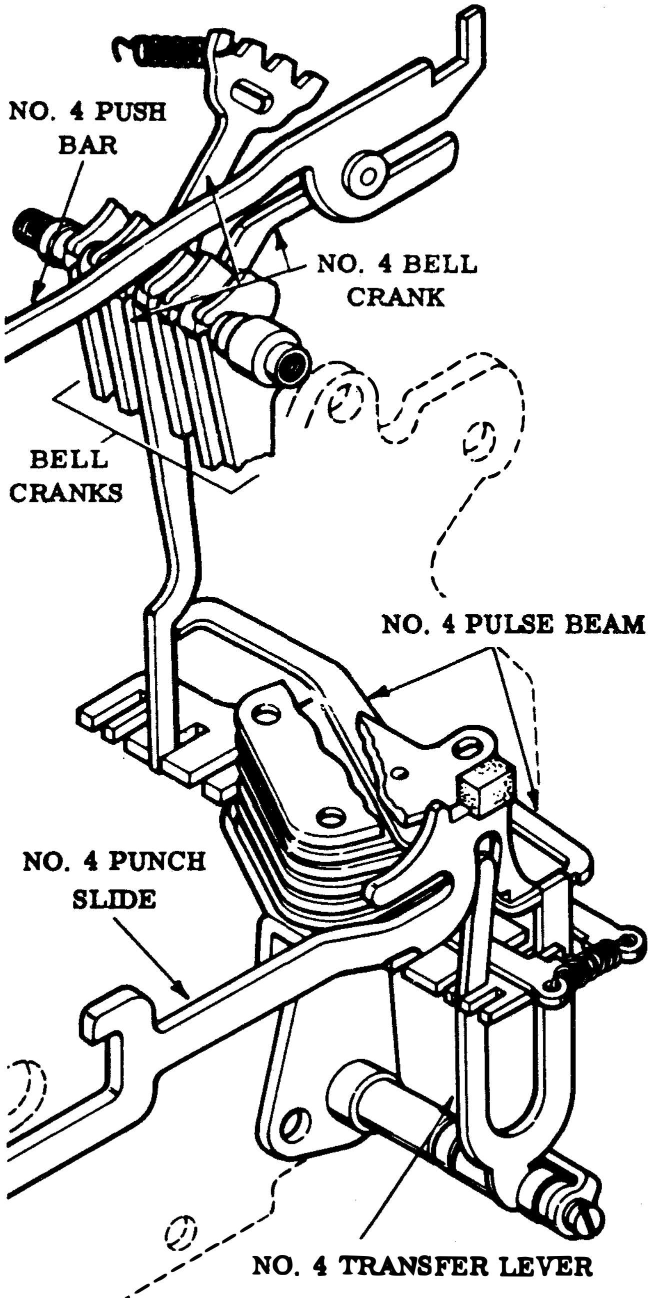


Figure 3-22. Transfer Mechanism

associated with the unselected punch slides, described in paragraph 3-8.1c, remain in their unselected position, as shown. However, the selected slides in moving to the left, pivot the associated transfer levers which, in turn, move corresponding pulse beams clockwise (as viewed from above). The selected beams allow associated bellcranks under spring tension to pivot counterclockwise and lift attached pushbars. The push-bars, in turn, control the positioning mechanisms. In the period of the last half of the function cycle, the selected slides are moved back to the right and return the linkages to their unselected postions. Slotted upper arms of the bellcranks extend up into the function box and control its operation as described in the discussion of positioning mechanisms. An additional bell crank, not associated with a transfer linkage, is specifically concerned with the LETTERS-FIGURES shift.

3-8.2 MOTION FOR TYPING AND PERFORATING. The motion of the main shaft is conveyed to the mechanisms concerned with typing and perforating by the function box mechanism, as described in the functional block diagram discussion. Functional descriptions of the three assemblies comprising this mechanism are included in the following paragraphs.

a. Function Cam-Clutch and Clutch Trip Assembly. The trip assembly is shown in its unoperated condition in figure 3-23. A follower lever rides on a function trip cam which is part of the selecting cam-clutch. Near the end of the selecting cycle, as the main shaft rotates counterclockwise, the high part of the cam pivots the follower lever which, through an attached adjusting arm, rotates a main trip lever counterclockwise. A reset bail trip lever attached to the main trip lever lowers the perforator reset bail and releases the punch slides, and an upper arm of the main trip lever moves out of the way of a clutch release, which falls against a down-stop and rotates a trip shaft counterclockwise. Immediately, the low part of the trip cam allows the follower lever to return to its unoperated position, and the upper arm of the main trip lever moves down against the release. When the trip shaft is rotated by the release, it moves an attached clutch trip lever out of engagement with the clutch shoe lever. The clutch engages, and the cam-clutch begins its cycle. The internal operation of the clutch is the same as that of the selector clutch, described in paragraph 3-8.1a. About midway through the function cycle, an eccentric pin on the function cam lifts a reset arm, which rotates the trip shaft clockwise. The release is moved up and allows the main trip lever to fall against the adjusting arm and raise the reset bail. The eccentric pin then moves out from under the reset arm, and the release is permitted to return to its unoperated position against the main trip lever. When the cam-clutch assembly completes its cycle, the clutch shoe lever strikes the trip lever, and the clutch is disengaged.

b. Rocker Bail Assembly. The bail is shown in its home position in figure 3-24. During each function cycle, the function cams bear against the rollers and cause the bail to rock to the right (as viewed

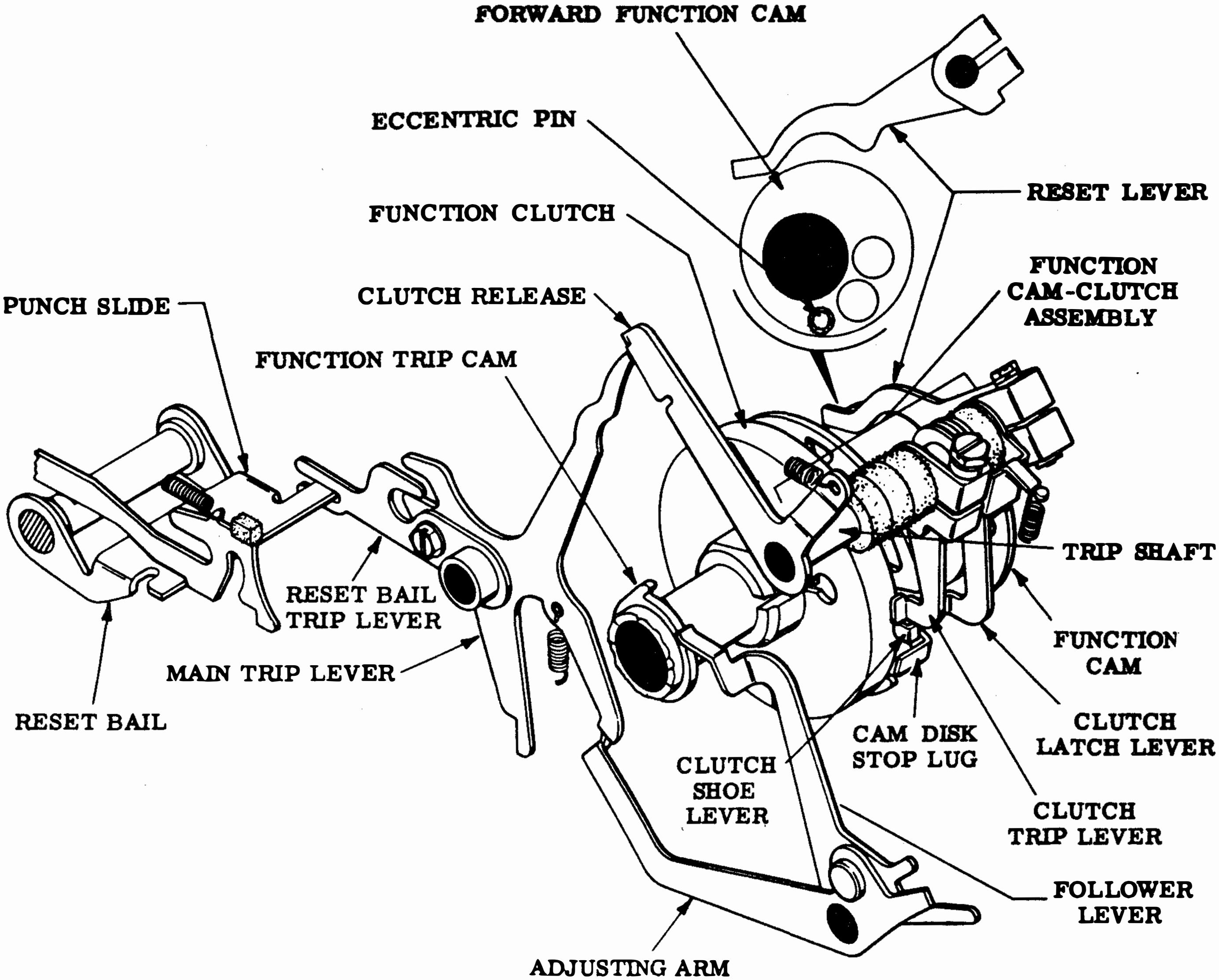


Figure 3-23. Function Cam-Clutch and Clutch Trip Assembly

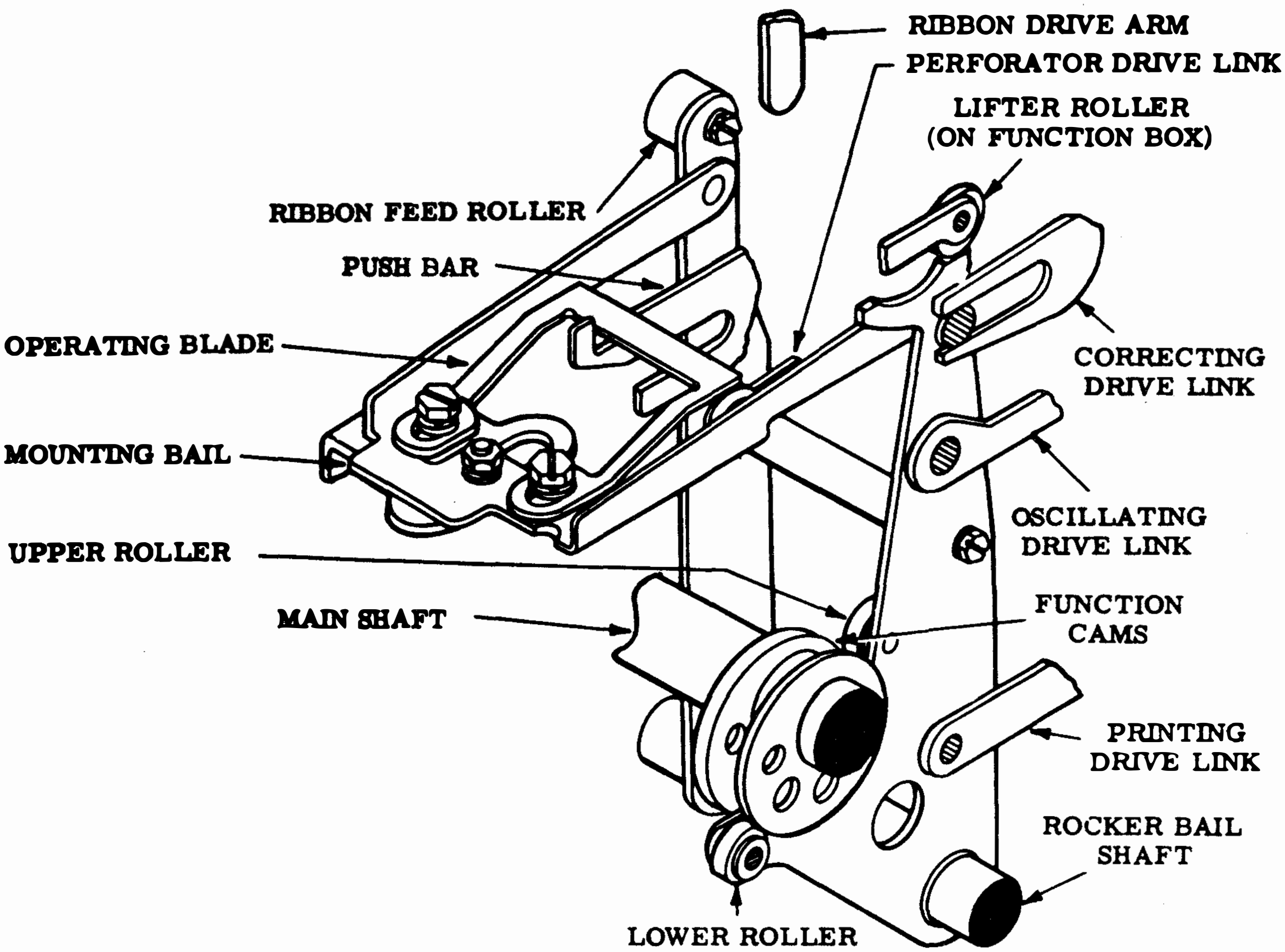


Figure 3-24. Rocker Bail Assembly

from the rear in figure 3-24) during the first part of the cycle. During the latter part of the cycle the rocker bail is moved back to its home position as the direction of cam rotation is reversed.

3-8.3 TYPE WHEEL POSITIONING. The operation of each mechanism used to position the type wheel is discussed in detail in the following paragraphs. The description of the type wheel as discussed in the functional block diagram description and shown in figures 3-5 and 3-10 should be reviewed to obtain a more complete understanding of the positioning function before attempting to analyze these discussions.

a. General Operation. Each printing operation (excluding those devoted to the LETTERS-FIGURES shift) begins and ends with the type wheel in the home position of the section containing the character to be printed. That is, the number 0 character of the number 0 row is at the point of contact of the print hammer. Actually, inasmuch as the wheel is retracted to show the last printed character, the number 0 character is slightly to the rear, but for this discussion it will be assumed that this is the point of contact. During the printing operation the axial and rotary positioning mechanisms, transferring separate but simultaneous motions to the wheel, position it so that the character represented by the received code combination is at the point of contact of the hammer at the time of printing. The rotary mechanism, which is controlled by the number 3, 4 and 5 selecting elements of the code, revolves the wheel so as to select the proper row; and the axial mechanism, which is governed by the number 1 and 2 elements, moves it forward and rearward along its axis so as to select the proper character in the row. Rotation of the type wheel to print in either the LETTERS or the FIGURES section is controlled by the number 7 element of the code. The LETTERS-FIGURES shift, which consists of rotating the wheel eight rows from the home position of one section to that of the other, requires a separate operation of the equipment and results in the printing of the LETTERS or FIGURES symbol. To illustrate the above, if the wheel is in the figures condition, as shown in figure 3-25, and the numeral "5" is to be printed, there is no movement of the wheel during the printing operation, because "5" is already at the point of contact of the hammer. However, if the letter "I" is to be printed, the signaling code for LETTERS must first be viewed to shift the type wheel eight rows to the LETTERS home position. Then during the next operation it is rotated three rows counterclockwise and moved forward two characters so that "I" is at the point of contact of the hammer. Printing takes place, and the wheel is then returned to the letters home position.

b. Rotary Positioning. This mechanism, mounted on the front plate of the typing reperforator, includes two eccentric assemblies shown in figures 3-25 and 3-26. Each assembly contains a primary shaft, a section of which is formed into a pinion. A secondary shaft, mounted in the primary and offset from its center, forms an eccentric, referred to as the rear eccentric. A portion of the secondary shaft is also a

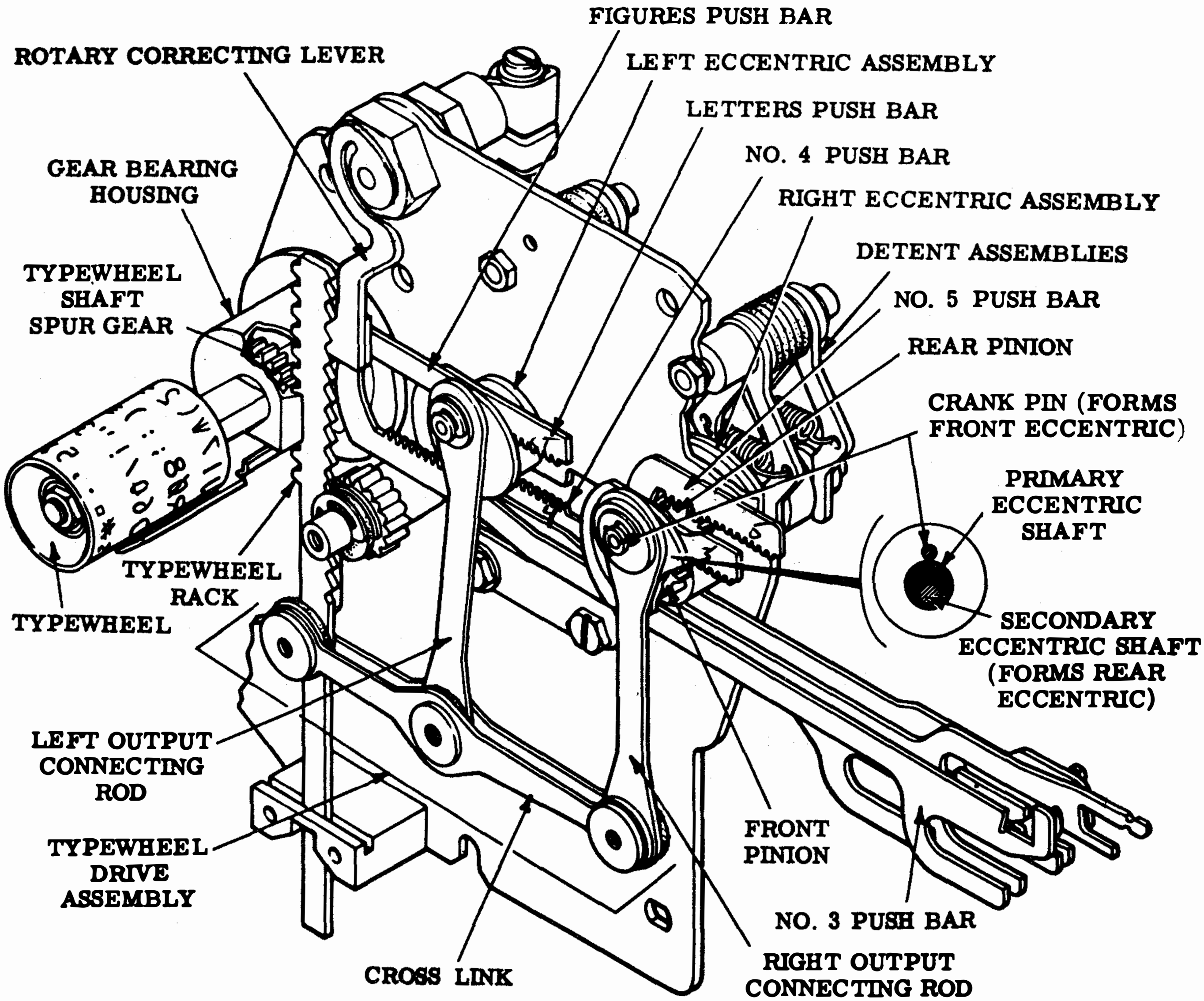


Figure 3-25. Rotary Positioning Mechanism

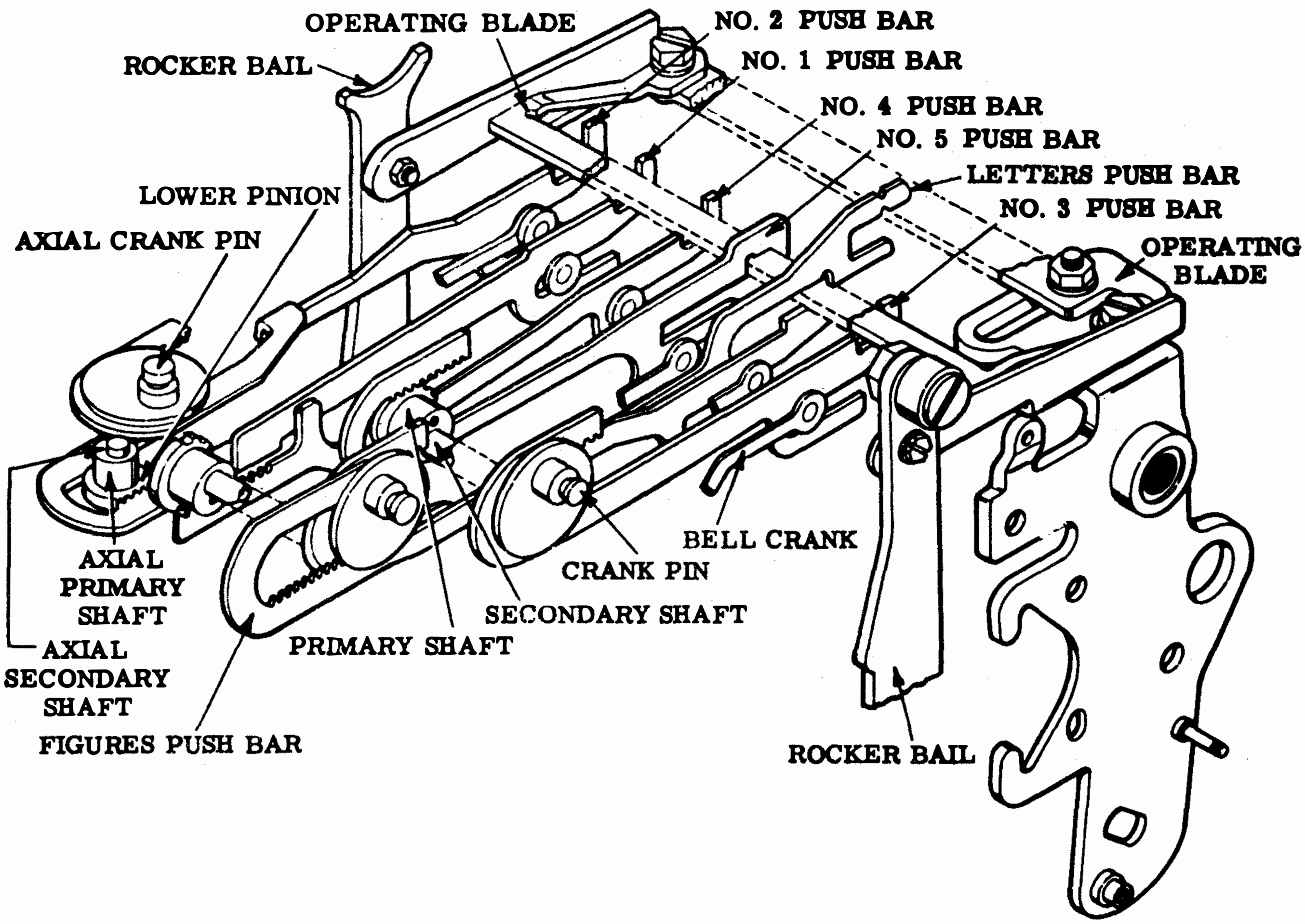


Figure 3-26. Pushbars and Eccentric Assemblies

pinion, and a crank pin mounted on its disk-like forward surface forms a secondary, or front, eccentric. Each of the four pinions of the two eccentric assemblies is engaged by the rack of a pushbar; the number 3 bar engages the rear pinion, and the number 5 engages the right pinion. The left front pinion is engaged by both the LETTERS and the FIGURES pushbar. The eccentric assemblies are linked to the type wheel shaft by a drive assembly as shown in figure 3-24. The type wheel is secured to the front of the shaft which is supported by a bearing housing mounted at the left rear of the front plate. A spur gear which meshes with a type wheel rack rides on the shaft in a bearing housing. The shaft is free to move axially in the housings and the spur gear, but has flats in its circumference which bear against flats in the gear to ensure that it rotates when the gear rotates. When a pushbar is lifted by its bellcrank, in response to a marking pulse as described in paragraph 3-8.1e, the rocker bail operating blade (see figures 3-24 and 3-26) engages a slot in the bar and moves it to the left during the first part of the function cycle. The bar, by means of its rack and the mating pinion, rotates the associated eccentric one-half revolution where it is locked in position by a detent assembly while printing takes place. When the bail rocks back to the right during the latter part of the cycle, it returns the bar and eccentric to their home position where the eccentric is again detented. The preceding does not apply to the number 5 pushbar which is designed so that it is selected (moved to the left) on spacing rather than on marking, nor to the left - front eccentric which affects the LETTERS-FIGURES shift. In both assemblies one-half revolution of the rear eccentric results in its maximum vertical displacement which is transferred through the front eccentric to a crank pin. Similarly, one-half revolution of the front eccentric results in its maximum displacement being transferred to the crank pin. If both eccentrics are rotated, the displacement of the crank pin is equal to the algebraic sum of the two displacements which may be in either the same or opposite directions. Both assemblies are so designed that, if the displacement of the rear eccentric is taken to be one unit, the displacement of the front eccentric is four units. Four permutations are thus available: zero (neither eccentric displaced), one unit (rear eccentric displaced), four units (front eccentric displaced) and five or three units depending on how the assembly is set up (both eccentrics displaced). In the right assembly the home position of the rear eccentric is down and the home position of front eccentric is up (figure 3-26). Thus their displacements are in opposite directions - up for the rear and down for the front - and their aggregate displacement is three units downward. Any displacement occurring in the right assembly is imparted to the type wheel rack in equal quantity but opposite direction. For example, if the number 5 pushbar is selected, it causes the right-rear eccentric to be displaced, and one unit of upward motion is transferred through a right output connecting rod to the right end of a cross link (figure 3-25). The cross link pivots about a left output connecting rod and at its left end imparts one unit of downward displacement to the type wheel rack. The rack rotates the spur gear, shaft, and type wheel one row of characters clockwise from the home position, and the number 1 clockwise row (figure 3-24) is presented to the print hammer at the time of printing. On its right stroke the number 5 pushbar returns the eccentric and the type wheel to their home positions. In a similar manner, selection of the number 3 pushbar results in a four-unit downward displacement of the right front eccentric and a four-row, counterclockwise rotation of the type wheel. Selection of both the three and five type bars results in a three-row, counterclockwise rotation of the type wheel. The home position of the left-rear eccentric is up, and any displacement appearing in the left assembly is transferred to the type wheel rack in double quantity in the same direction. When the number 5 pushbar is selected, the left-rear eccentric is displaced one unit downward. This movement is conveyed through the left output connecting rod to the approximate mid-point of the cross link. The cross link pivots about the right output connecting rod and its left end imparts two units of downward movement to the type wheel rack which rotates the type wheel two rows clockwise from its home position. When both eccentric assemblies are displaced, the motion occuring in the type wheel rack is equal to the algebraic sum of the motions resulting from each assembly. For example, if the number 3, 4 and 5 pushbars are all selected, three units of upward displacement from the right assembly and two units of downward displacement from the left assembly occur as one unit (3-2 = 1) of upward displacement in the rack and a counterclockwise rotation of one row in the type wheel. If neither the number 3, 4 nor number 5 pushbar is selected, the mechanism remains inactive and printing takes place in the number 0 row. Excluding the left-front eccentric, which is only used for the LETTERS-FIGURES shift, there are eight permutations available in the other three eccentrics, making it possible to select any of the eight rows in a given section (figure 3-5).

c. <u>Axial Positioning</u>. This mechanism mounts on an axial bracket supported by the frame and the front plate, as shown in figure 3-27, in a manner similar to the rotary positioning mechanism. Two eccentrics, a lower whose pinion is driven by the number 1 pushbar, and an upper whose pinion is driven by the number 2 pushbar, rotate in a horizontal plane in bearing housings attached to the bracket. The eccentric assembly is linked to the type wheel shaft by an axial output rack and sector as shown in figure 3-27. The selection of either the number 1 or number 2 pushbars results in the maximum displacement toward the rear of the associated eccentric, and the eccentrics are so designed that, if the displacement of the lower is taken to be one unit, that of the upper is two units. Again, four permutations are available at the crank pin; zero (neither eccentric displaced), one unit (lower eccentric displaced), two units (upper eccentric displaced) and three units (both eccentrics displaced). If during a function cycle neither pushbar is selected, no motion occurs in the axial positioning

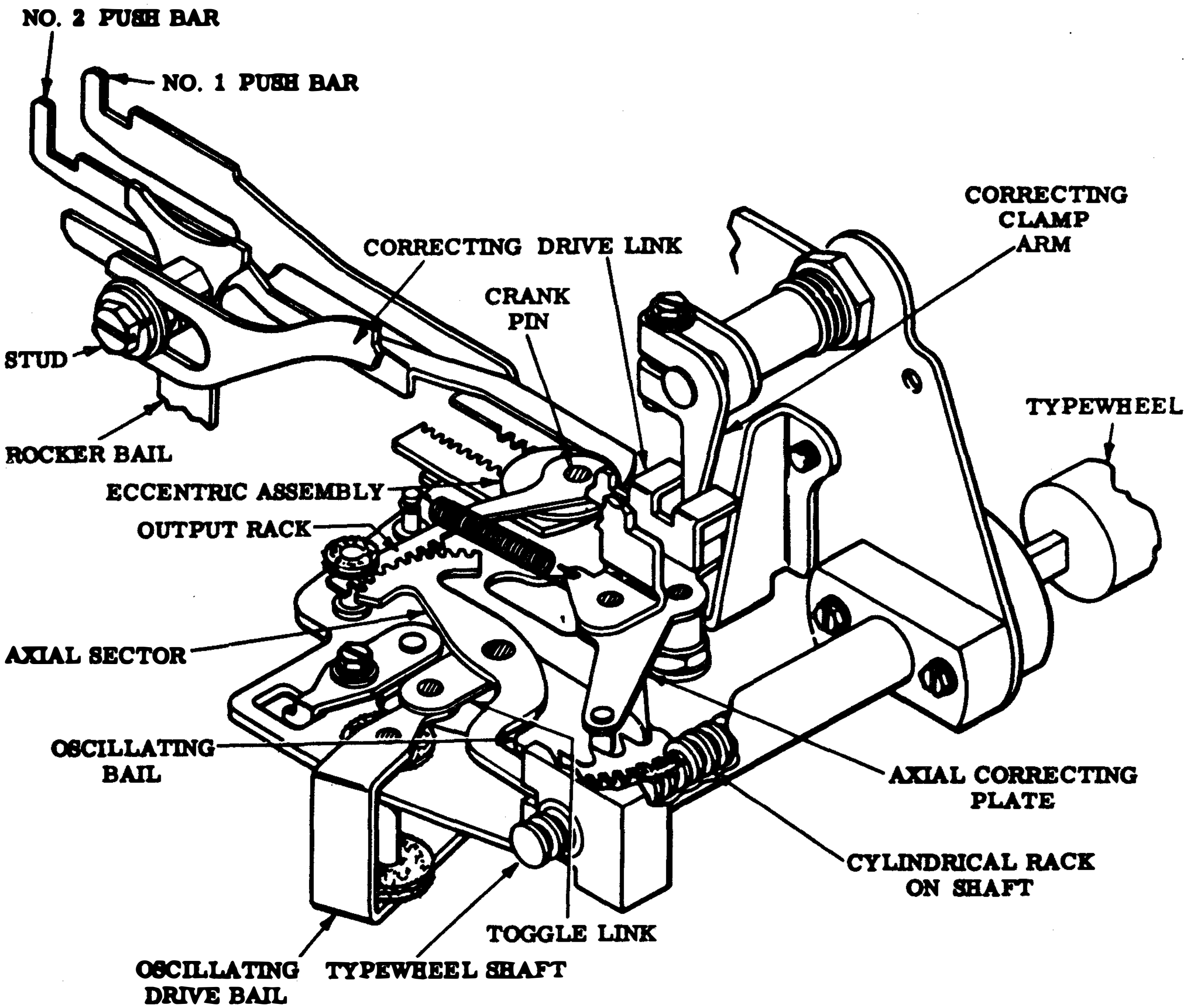


Figure 3-27. Axial Positioning Mechanism

mechanism with the exception of that resulting from the oscillating assembly, and the number 0 character of the selected row is aligned with the hammer at the time of printing (figure 3-5). On the other hand, if the number 1 pushbar is selected, it causes the lower eccentric to revolve, and one unit of displacement to be transferred by the crank pin to the axial output rack. The rack moves to the rear and passes the motion to the axial sector, which pivots counterclockwise (as viewed from above). The right end of the sector, by means of a cylindrical rack in the type wheel shaft, moves the type wheel one character forward from its home position. The number 1 character is printed, and when the pushbar reverts to its unselected position it returns the axial linkage and type wheel to their home position. If the number 2 pushbar is selected the number 2 character is printed, and if both pushbars are selected, the number 3 character is printed. The cylindrical rack has no lead, and the shaft can thus be rotated while being moved axially. With each cycle of the function clutch, an oscillating drive link transfers from the rocker bail an unselected motion to an oscillating drive bail (figures 3-27 and 3-28). This movement is passed by toggle links to an oscillating bail and the sector pivot. The effect of this action is to introduce a separate motion to the sector tending to cause it to pivot about the teeth on the output rack. During the fore part of the function cycle, if no axial pushbar is selected, the right end of the sector is moved forward slightly and positions the number 0 character for printing. At the end of any cycle the sector retracts the type wheel slightly so that the last printed character is visible. Concurrent with the above operation, a ribbon oscillating lever is made to pivot about its left end, and with each cycle project and to retract the ribbon guide which would obstruct the view of the character (figure 3-28).

d. <u>Correction</u>. During each function cycle the Rocker bail transfers motion through a correction drive link to a correcting clamp and shaft, as shown in figure 3-27. The shaft pivots a rotary correcting lever (see figure 3-25) which is equipped with an indentation that engages a tooth in a type wheel rack. There is a tooth in the rack for each row of characters (16 in all) and they are so correlated with the type wheel that when a tooth is engaged by the corrector its row is accurately aligned with the print hammer. Axial correction, which is accomplished simultaneously, is similar to rotary correction; the drive link rotates an axial correction plate counterclockwise (as viewed from the above), and a roller mounted on the plate engages a notch in the axial sector (figure 3-27). Thus the type wheel is accurately aligned in both fields of motion just before printing takes place. During the latter part of the function cycle, a correction drive link spring returns the correction mechanism to its home position. Since the rocker bail is the source of motion for both the pushbars and the positioning mechanism, correction must take place at a point near enough to the extreme travel of the bail so that it does not interfere with the movement of the type wheel rack or axial sector. In addition, because the rocker bail controls the tripping of

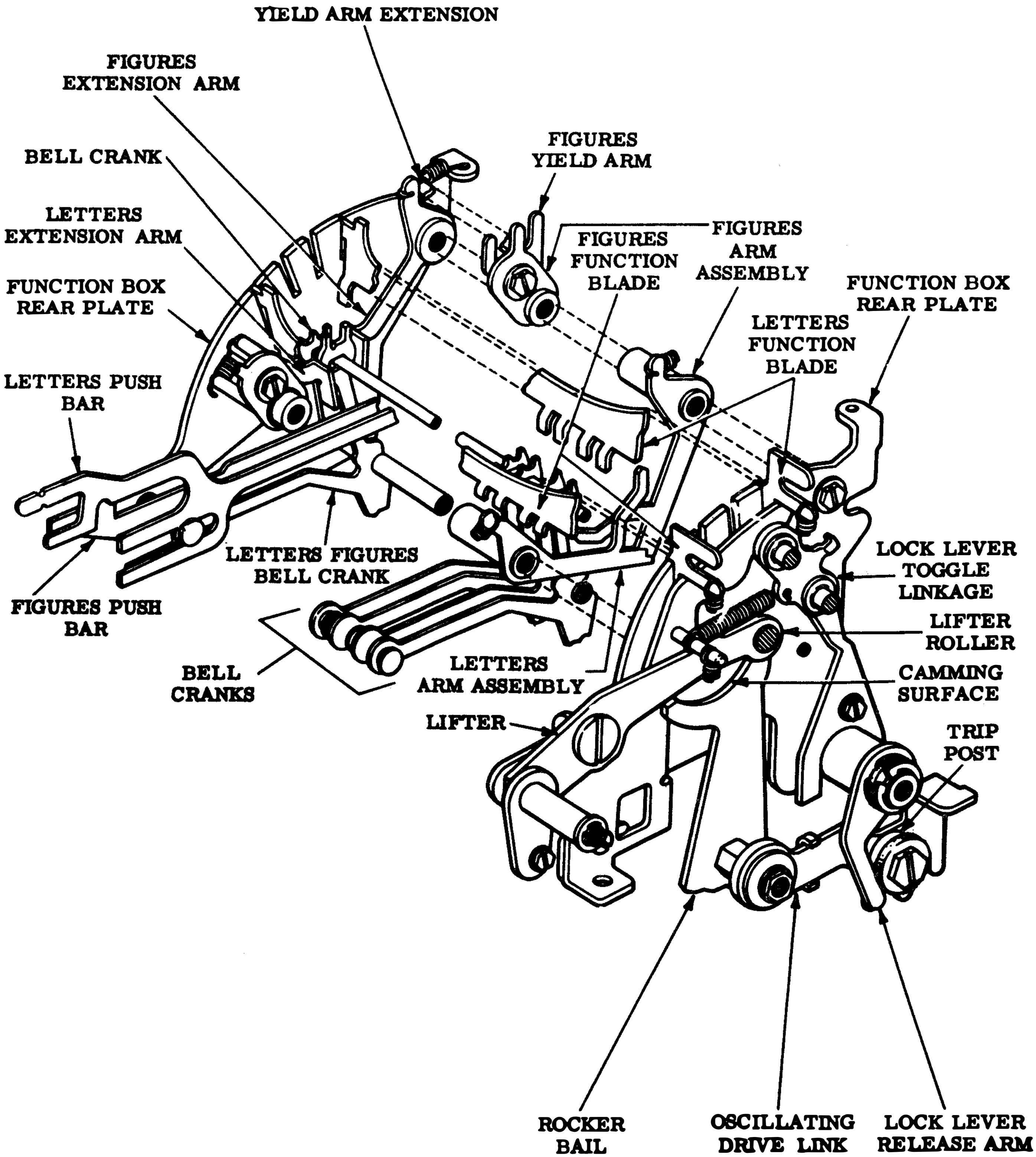


Figure 3-28. Function Box, Exploded View

the print hammer, which occurs very late in the bail's stroke, it becomes necessary to utilize the time between the tripping of the hammer and its striking the paper to accomplish correction. The delay in actuating the correcting mechanism is effected by allowing a drive stud on the rocker bail to slide in an elongated slot in the correcting drive link during the early part of the cycle.

e. LETTERS-FIGURES Shift. The purpose of the LETTERS-FIGURES shift is to rotate the type wheel from the home position of one section to that of the other (figure 3-10). It is effected by means of the function box mechanism which is made up of a number of assemblies mounted on two plates located at the upper rear of the typing reperforator (figure 3-28). When the unit is in the letters condition, as shown in figures 3-10 and 3-18, and the figures code combination (12-45) is received, the transfer mechanism sets up the FIGURES arrangement in the bellcranks during the selecting cycle. Then, as the rocker bail moves from its home position during the first part of the function cycle, a lifter roller under spring pressure follows a camming surface on the rear arm of the bail (figure 3-28), and the lifter allows LETTERS and FIGURES function blades to move down and, by means of tines on their lower surface, feel for an opening in the slotted upper arms of the bellcranks. The slot arrangement of the number 1, 2, 4 and 5 bellcranks are identical and permit the entry of both function blades when all are selected. However, on receipt of the FIGURES code combination the number 3 bellcrank permits entry of the FIGURES blade while blocking the LETTERS blade. In moving all the way down, the FIGURES blade encounters a projection of a FIGURES arm assembly and causes the arm assemblies to shift from their LETTERS to FIGURES position. A yield arm extension attached to the FIGURES arm assembly pivots a FIGURES extention arm away from the LETTERS-FIGURES bellcrank. A LETTERS extension arm under spring tension rotates the bellcrank clockwise (figure 3-28) and the bellcrank lifts the LETTERS and FIGURES push-bars. As the bail reaches its extreme position, the lifter is cammed up and raises the function blades. While the LETTERS-FIGURES bellcrank is being positioned by the function box, the number 1, 2 and 4 push bars are selected, the type wheel is moved two rows clockwise and three characters forward, and the FIGURES symbol is printed. On its return stroke, the rocker bail operating blade encounters a shoulder on the FIGURES push bar (which was lifted as described above) and moves the bar to the right as viewed from the front in figures 3-24 and 3-26. The common pinion moves the LETTERS pushbar to the left, and the left-front eccentric shifts from its up to down position. Since the type wheel has been displaced two rows clockwise during the first part of the cycle, it is rotated six more rows to the FIGURES home position. As the bail returns to its home position during the last half of the cycle, a locklever toggle linkage (figure 3-28) prevents the lifter roller from following its camming surface, and the lifter holds the function blades up so they do not drop onto the bellcranks. As the bail nears its home position, a trip post riding on the oscillating drive link strikes a lock release arm, buckling the toggle linkage and permitting the lifter roller to again fall on the bail camming surface. In a manner similar to that described above, when the LETTERS code combination (12345) is received, the function box causes the LETTERS-FIGURES bell-crank to lower the LETTERS and FIGURES pushbars. The wheel is rotated two rows counterclockwise during the first part of the cycle and six more rows to the LETTERS home position during the last part of the cycle, and the LETTERS bar is moved to the right. The preliminary two-row rotation of the type wheel, which is made possible by selecting the number 5 pushbar on spacing rather than marking, provides less throw and smoother operation than would be possible if the complete eight-row displacement were effected during the latter part of the cycle. During each operation the lifter permits the function blades to move down and feel for an opening, but except for the shift operations they are blocked by slotted arms of the bellcranks.

3-8.4 PRINTING. The printing mechanism effects the printing of the character on the tape by means of a print hammer which is actuated by the rocker bail assembly. Operation of these assemblies is described in the following paragraphs.

a. Print Hammer. The print hammer is mounted on a shaft supported by a bracket attached to the type wheel bearing housing. In its unoperated condition, as illustrated in figure 3-29, the hammer is held against an accelerator by a relatively weak spring. The accelerator is mounted on the hammer shaft, and in its upper position the hammer is retained by a printing latch against the tension of a relatively strong spring.

b. Rocker Bail Assembly. The rocker bail, during the initial part of the function cycle, moves a printing drive link to the right (as viewed from the rear in figure 3-29), causing a pivot arm to rotate clockwise. The arm lowers a trip link which slides in an elongated slot. Near the end of the rocker bail's travel, the trip link pivots the latch which releases the accelerator. Under the spring tension, the accelerator snaps down and impels the hammer upward. the face of the hammer drives the tape and inked ribbon up against the type wheel and imprints the selected character on the tape. The accelerator does not follow the hammer through the complete printing stroke. Near the end of its travel, the accelerator encounters a projection on a latch bracket, and inertia carries the hammer the rest of the way. As the rocker bail returns to its home position, it causes the trip link to move up, release the latch and return the accelerator to its latched position.

3-8.5 RIBBON FEEDING. Each function cycle, as the rocker bail nears the end of its left travel, a roller mounted on its forward arm pivots a drive arm clockwise. The drive arm lifts a feed pawl which advances the ribbon by rotating a ratchet on one of the ribbon spools one tooth. A retaining pawl under spring tension detents the ratchet while the feed pawl, during the latter part of the function cycle, is lowered so as to engage the next tooth. The ribbon is advanced in this manner during each operation until the ribbon feed mechanism

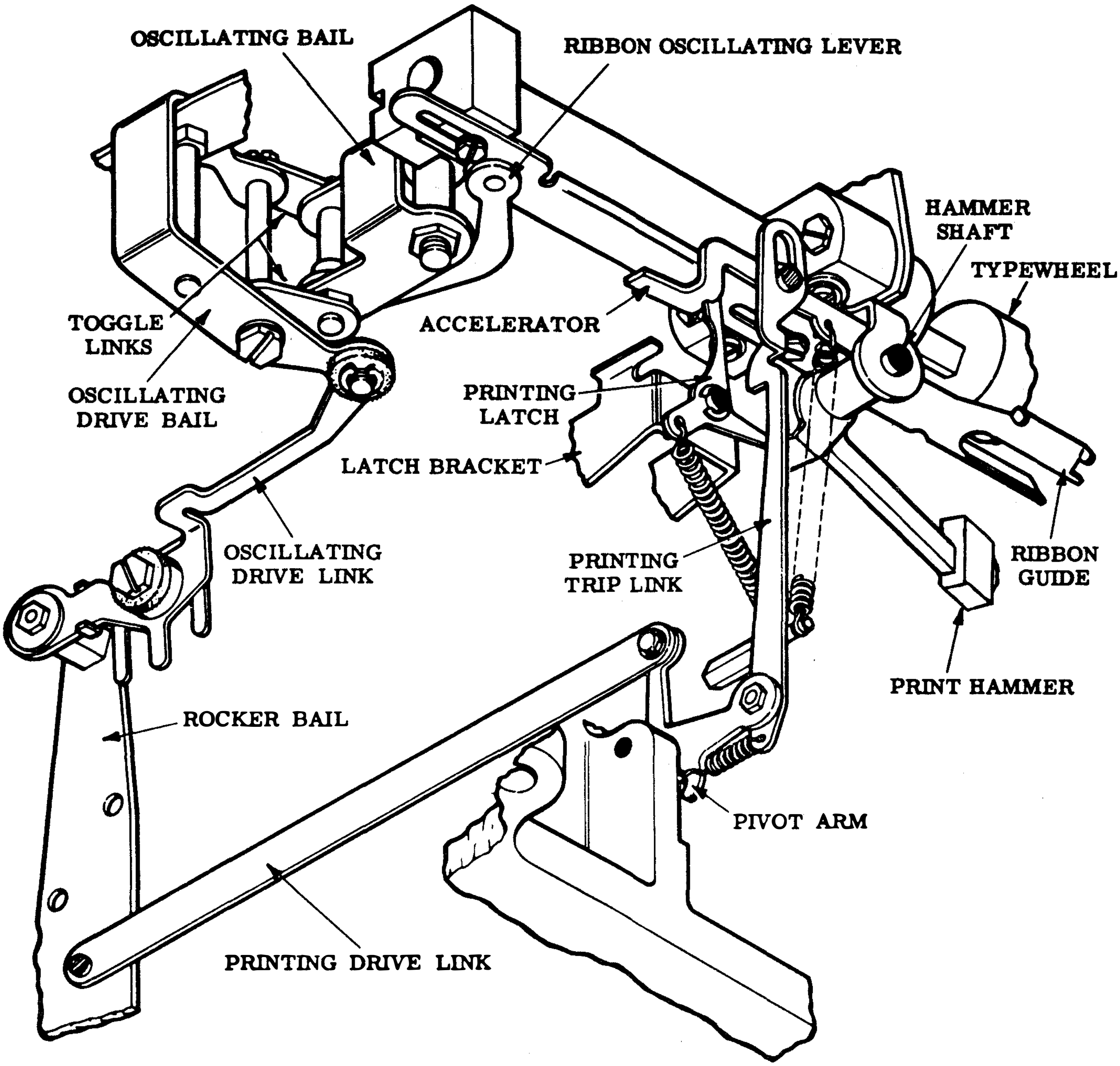


Figure 3-29. Printing Mechanism

is reversed. The ribbon-feed mechanism is shown in figure 3-30. When a spool is almost depleted, a rivet in the ribbon encounters pins on the reversing arm, and the stress applied through the ribbon as it is rolled on the other spool pivots the arm. As the pawl assembly is lowered at the end of the next operation, an extension strikes the reversing arm, and the pawl is shifted against the other ribbon spool ratchet. The pawl's rounded lower extension pivots a reversing lever which shifts the retaining pawl so that it engages the opposite ratchet. The ribbon will then feed in the opposite direction until again reversed. A detent holds the reversing arm in position until its next reversal.

3-8.6 PERFORATING. Either of two types of tape perforation may be performed, depending on whether fully perforated or chadless (hinged chad) type tape is to be used. Operation of both type mechanisms are described in the following paragraphs.

a. Perforating-Chadless Units. As described in paragraph 3-8.2a, the reset bail is lowered near the end of the selecting cycle and releases the five punch slides shown in figure 3-31. The selected slides move to the left and the unselected slides are held to the right side by their latches. In the selected position, a projection of each slide extends over the slide post. During the first part of the function cycle, the rocker bail moves to the left and, by means of a

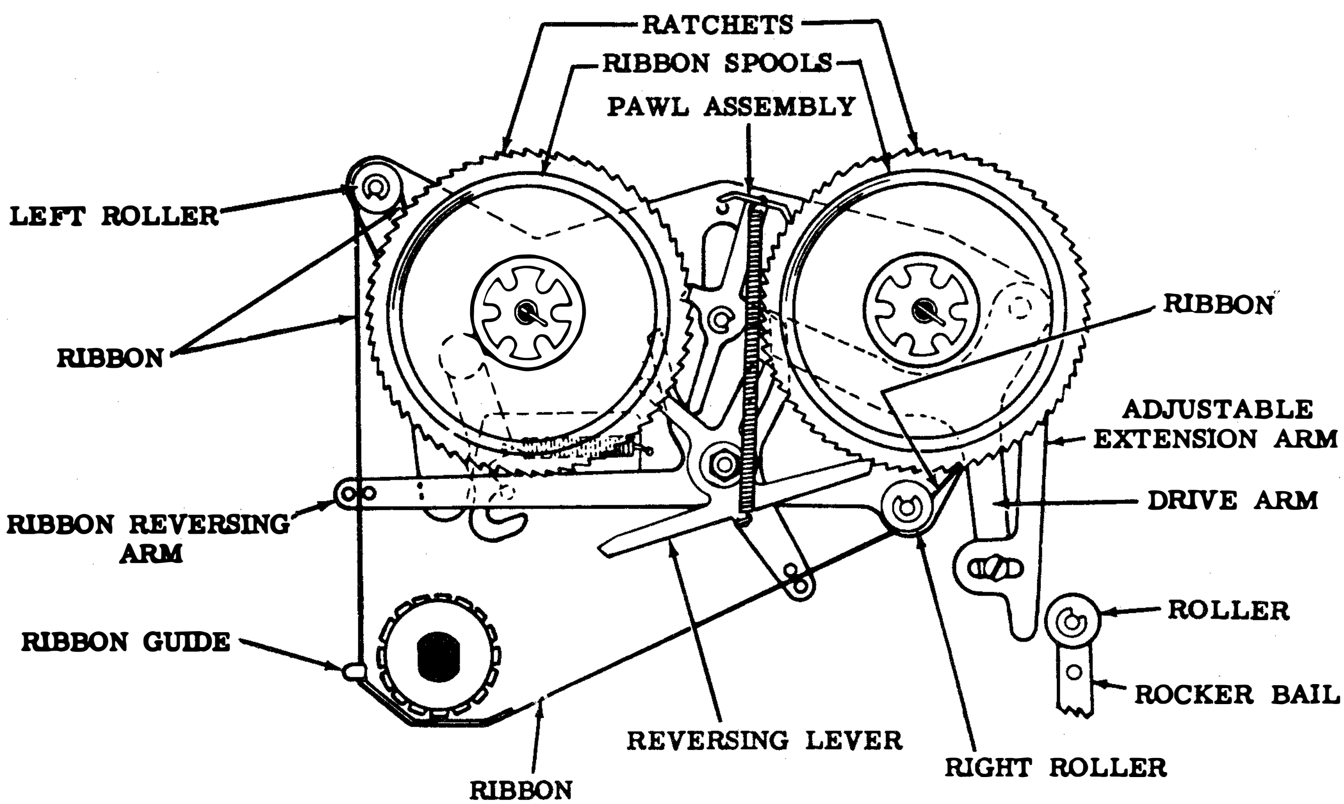


Figure 3-30. Ribbon Feed Mechanism, Front View

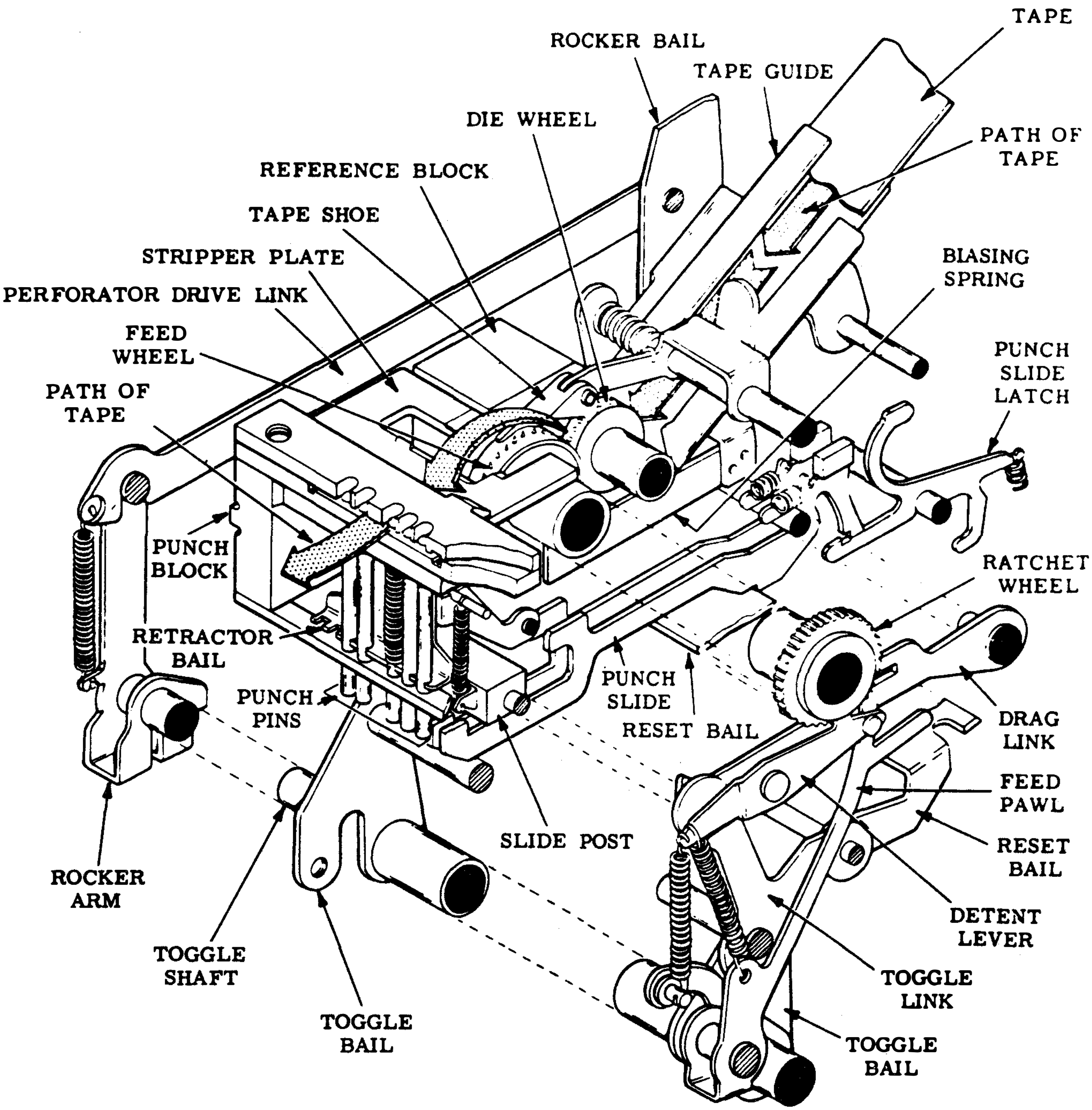


Figure 3-31. Perforating Mechanism - Chadless Tape Unit

drive link and rocker arm, rotates the toggle shaft and bail counterclockwise. Toggle links attached to the front and rear of the bail lift the slide post and move the reset bail to the left. The selected slides are carried upward by the post and force the associated pins through the tape. The slides pivot about the same point as the drag links, and thus become an integral part of the main bail assembly during the perforating stroke. A retractor bail, which engages notches in the punch pins, is pivoted clockwise as the pins move up through the tape. Approximately midway through the function cycle, the function trip assembly lifts the reset bail. During the last half of the cycle, the toggle bail is rotated clockwise and lowers the punch slides. The reset bail, moved to the right by the toggle links, drives the slides back to their unselected positions, where it holds them until the next operation. The retractor bail, under spring pressure, holds the punch pins down against the slides until the pins are retracted below the tape. The notches in the pins are long enough to allow the retractor bail to pivot its full amount without lifting the unselected pins against the tape, but are short enough to permit the bail to serve as a downstop for the pins, and thus hold them in the block. A compression spring is mounted on the number 3 punch pin, and four tension springs are hooked to the slide post and the retractor bail. The main bail assembly, the retractor bail, and the selected slides and punch pins move as a unit during the perforating stroke, and the retractor bail tension springs are not part of the load on the toggle shaft. The openings in the block above the tape, through which the selected pins protrude, are semi-circular, so that only the rear portion of the hole is severed.

b. Perforating-Fully Perforated Units. As previously stated, the reset bail is lowered near the end of the selecting cycle, releasing the five punch slides shown in figure 3-31. The selected slides move to the left, and the unselected slides are retained to the right by their latches. In the selected position, a projection of each slide extends over the slide post. Since a feed hole is perforated every operation, the punch slide associated with the feed-hole punch pin is designed so that it is always in a selected position. During the first part of the function cycle, the rocker bail moves to the left and, by means of a drive link and rocker arm, rotates the toggle shaft and bail counterclockwise. Toggle links attached to the front and rear of the bail lift the slide post and move the reset bail to the left. The selected slides are carried upward by the post and force the associated pins through the tape. The slides pivot about the same point as the drag links, and thus become an integral part of the main bail assembly during the perforating stroke. Approximately midway through the function cycle, the function trip assembly lifts the reset bail, as shown in figure 3-32. During the last half of the cycle, the toggle bail is rotated clockwise pulling the slide post down and lowering the selected punch slides. The punch slides, which engage notches in their respective punch pins, pull the punch pins down below the tape. the main

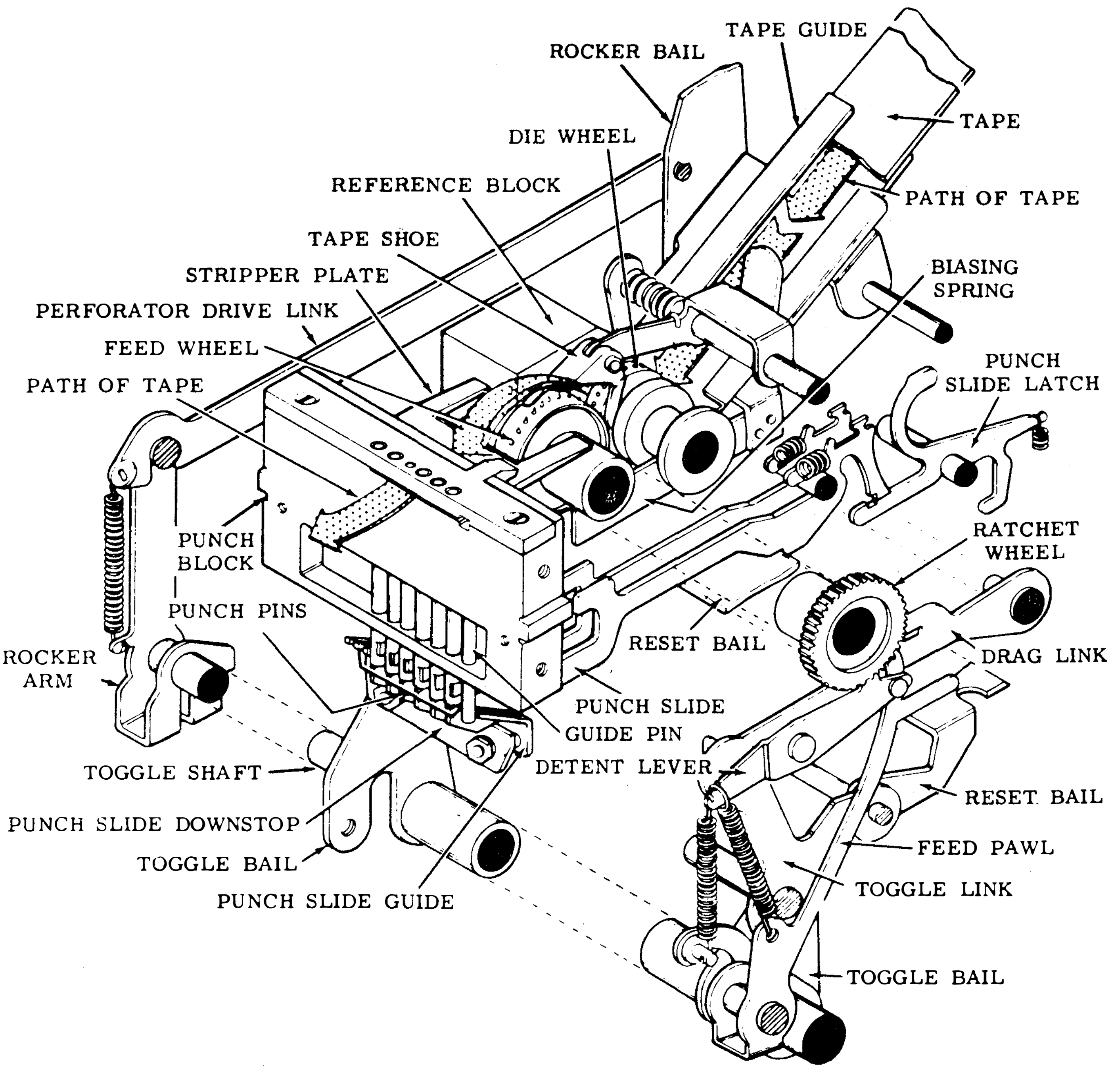


Figure 3-32. Perforating Mechanism - Fully-Perforated Unit

bail assembly and the selected punch slides and their associated punch pins move as a unit during the perforating stroke. The opening in the die block above the tape, through which the pins protrude, are circular so that the entire hole is punched. A chad chute, mounted on the reperforator punch block, mates with a chute on the base, and carries the chad punched from the tape into a chad container.

3-8.7 FEEDING - FULLY-PERFORATED AND CHADLESS UNITS. Tape feeding is accomplished after perforation during the last half of each function cycle. The tape is threaded down through a tape guide and then up between a feed wheel and die wheel (figures 3-31 and 3-32). A feed pawl driven by the toggle bail acts upon a ratchet and rotates the feed wheel which, by means of pins and a slot in the die wheel, advances the tape one character at a time. A detent with a roller that rides on the ratchet holds the feed wheel and tape in position during perforation. The detent and feed pawl springs are so positioned that the pressure of the detent of the ratchet is high during the first half of the cycle (to hold the tape in position during perforation), but is low during idling and the last half of the cycle, to facilitate tape threading and feeding. A tape shoe retains the tape on the feed wheel, and a guide spring holds it back against a reference block so that the feed holes are punched a uniform distance from the edge. The tape is stripped from the feed wheel by a stripper plate, passes into the punch block where it is printed and perforated, and finally emerges at the left. A guide spring, by holding the tape back against a reference surface on the block, maintains a uniform relationship between the code perforations and the edge of the tape.

3-9. DETAILED FUNCTIONAL DESCRIPTION, VARIABLE FEATURES. A number of variable features may be installed as part of the typing reperforator set. The following paragraphs describe in detail the theory of operation of these units.

3-9.1 CONTACT ASSEMBLIES. Contact assemblies which may be installed as part of the typing reperforator include the Selector Mechanism Timing Contacts, LETTERS-FIGURES Contacts, Signal Bell Contacts, End of Feed-Out Timing Contacts, Code-Reading Contacts, and Timing Contacts. The operation of each of these mechanisms is described in the following paragraphs.

a. <u>Selector Mechanism Timing Contacts</u>. Operating in conjunction with an additional cam mounted on the selector cam assembly, shown in figure 3-33, this timing contact set (break-make transfer) operates each cycle of selection. The actuating lever maintains a relationship with the rest position of the selector cam, because its pivot point is on the range scale selector rack. Therefore, the contact set is used to signal that the selector cam is in the rest postion.

b. <u>LETTERS-FIGURES Contacts</u>. The LETTERS-FIGURES contact assembly is mounted on the rear of the selector mechanism and is operated by the upper extension of the LETTERS pushbar. Its purpose is to give a remote signal to indicate whether the typing reperforator is in the LETTERS or the FIGURES condition. When the unit is in

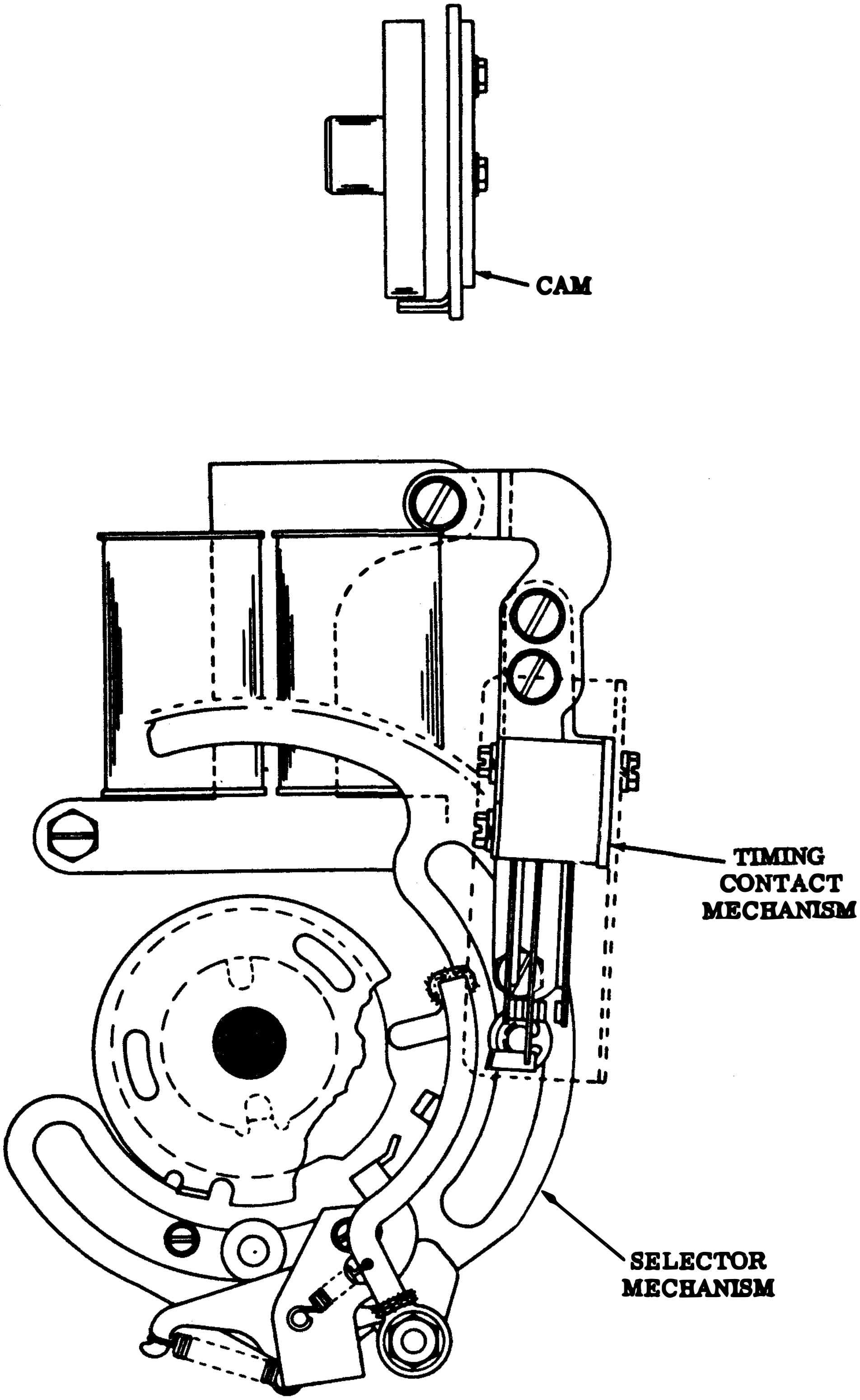


Figure 3-33. Selector Magnet Timing Contacts

the LETTERS condition, the LETTERS pushbar is positioned towards the right and in contact with the operating lever. In this position (rotated counterclockwise) the operation lever is not in contact with the center contact spring and the center and upper contact points are made. When the FIGURES code combination is received, the LETTERS pushbar is moved to the left and permits the operating lever to rotate clockwise and engage the center contact spring and break the contact between the center and upper contact points. As the operating lever rotates further, contact is made between the center and lower contact points.

c. Signal Bell Contacts. Mounted on and controlled by the function box, these contacts provide an electrical pulse to actuate an audible alarm when the typing reperforator receives the signal bell code combination. The contacts are shown in figure 3-34. With the unit in the FIGURES condition and the signal bell code combination (1-3--) received at the selector mechanism, the number 1 and 3 bellcranks rotate in response to the marking pulses, and the number 5 bellcrank rotates in response to a spacing pulse. In this position, the slotted arms at the top of the bellcrank permits the signal bell function blade to drop under spring tension. The normally-open signal bell contacts, fixed to the function blade, drops with the blade and the contacts close. In the LETTERS condition, the FIGURES bellcrank blocks the signal bell function blade.

d. End of Feed-Out Timing Contacts. This contact assembly, used in conjunction with the non-interfering LETTERS (or blank) tape feed-out mechanism, furnishes an electrical pulse to indicate the termination of feed-out. The contacts are actuated by a bail extension that receives its motion from the tape length adjusting plate. When the feed-out operation terminates, the plate engages and rotates the bail arm, causing the normally-open contact to close and the normally-closed contact to open. Refer to the discussion of the remote control tape feed-out for additional theory concerning this function.

e. Code-Reading Contacts. Five contacts, each of which is actuated by a punch slide, read the code combinations perforated by the typing reperforator and establish circuits corresponding to the five elements. Either transfer or make contacts are available. Applications include error checking and parallel code output.

f. Timing Contacts. When connected to external circuits, these contacts provide electrical pulses which may be synchronized with the code-reading contacts for circuit control purposes. Either single- or double-contact mechanisms are available. The contacts, which are of the transfer type, are actuated by bails which receive motion from the typing reperforator function cam.

3-9.2 UNIVERSAL FUNCTION BLADE. This function blade may be coded for any desired character or shift condition by removing tines. The function blade has removable tines in the marking and spacing positions for all levels. The universal function blade is shown in figure 3-35.

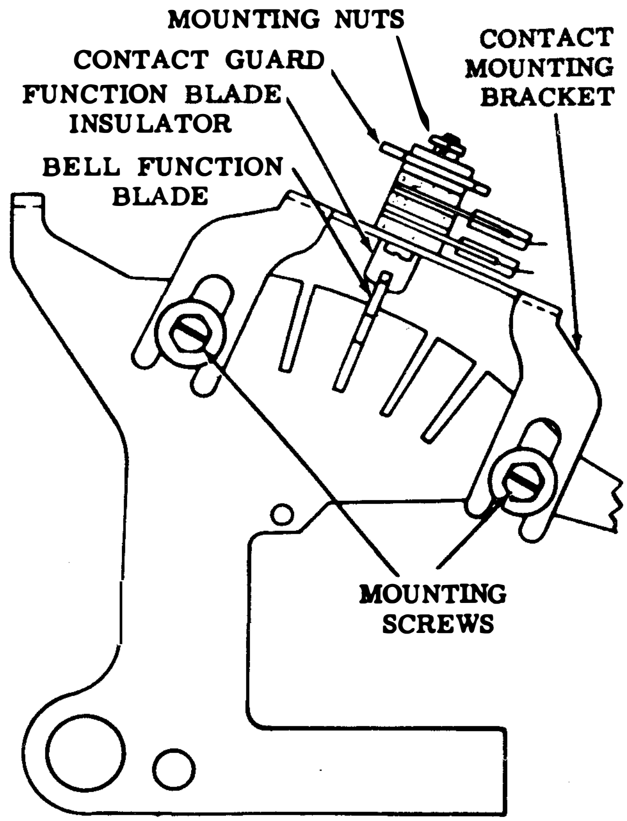


Figure 3-34. Signal Bell Contacts

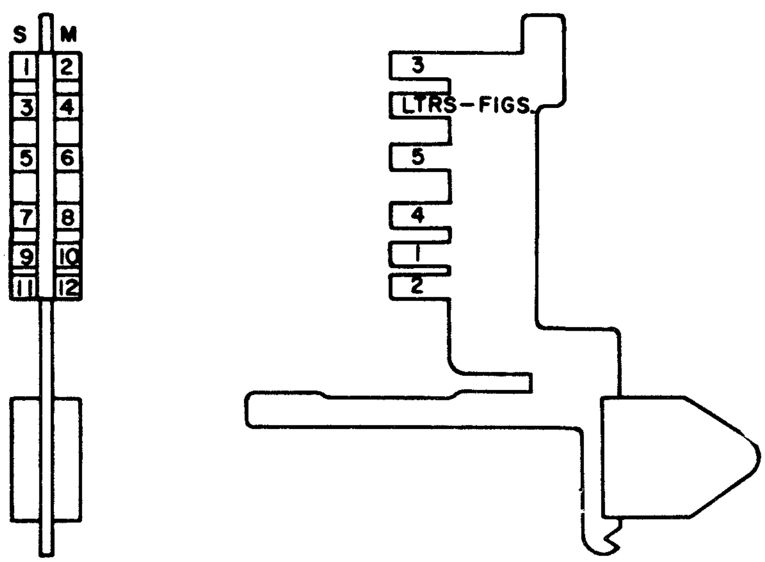


Figure 3-35. Universal Function Blade

3-9.3 PRINT SUPPRESSION-ON-FUNCTION. This feature utilizes a print hammer stop that permits the hammer to strike the top of the characters on the type wheel but not the base surface. Therefore, if a character or function symbol is relocated in the base surface, printing will not occur when this character or function is selected.

3-9.4 INTERFERING LETTERS TAPE FEED-OUTPUT. The theory of operation of this function is described in the following paragraphs.

a. General. This feature enables the typing reperforator to step out tape containing successive letters code combinations. The feed-out operation may be actuated locally by a hand lever or, with the addition of a separate set of parts, it may be controlled remotely by energizing a solenoid. Letters feed out will continue as long as the hand lever or solenoid is actuated. Since the mechanism's operation involves tripping the selector clutch while retaining the armature in its marking position, a message can not be received during the feed-out period. The mechanism is shown operated in figure 3-37.

b. Initiation. When the typing reperforator is in the idling condition, the selector magnet is energized and the start lever is blocked as shown in figure 3-36. Feed out is initiated by moving a hand lever to the left (figure 3-36). A drive shaft affixed to the hand lever rotates a trip lever which lifts the start lever. The latter clears the armature and under spring tension rotates clockwise. The selecting cam-clutch engages and the unit undergoes a complete cycle of operation. Since the selector remains energized, it is equivalent to all intelligence elements of the signaling code being marking. As a result, the LETTERS symbols is printed, the LETTERS code combination (12345) is perforated and the tape is advanced one feed hole. As long as the hand lever is retained to the left, the start lever will trip the selecting cam-clutch and feed out will continue.

c. Termination. Feed-out is terminated by releasing the hand lever. The driver shaft and trip lever rotate clockwise under spring tension and lower the start lever. When the stop arm bail and start lever are moved to the left by the stop arm bail cam, the start lever is blocked by the armature, the selecting cam-clutch is disengaged and the typing reperforator is returned to its idling condition. A message received during feed-out will be garbled.

d. Solenoid Operation. By the use of an additional set of parts, the LETTERS feed-out operation can be initiated by an electrical pulse from an external source. When the solenoid (figure 3-36) is energized by the pulse, it pulls a plunger to the left. The plunger, through a stop arm and the drive shaft, causes the trip lever to lift the start lever. and feed-out is effected as described in the description of the initiation operation. Feed-out will continue until the solenoid is de-energized, at which time the plunger moves back to the right, the start lever is lowered, and feed-out is terminated as described in the discussion of the termination operation.

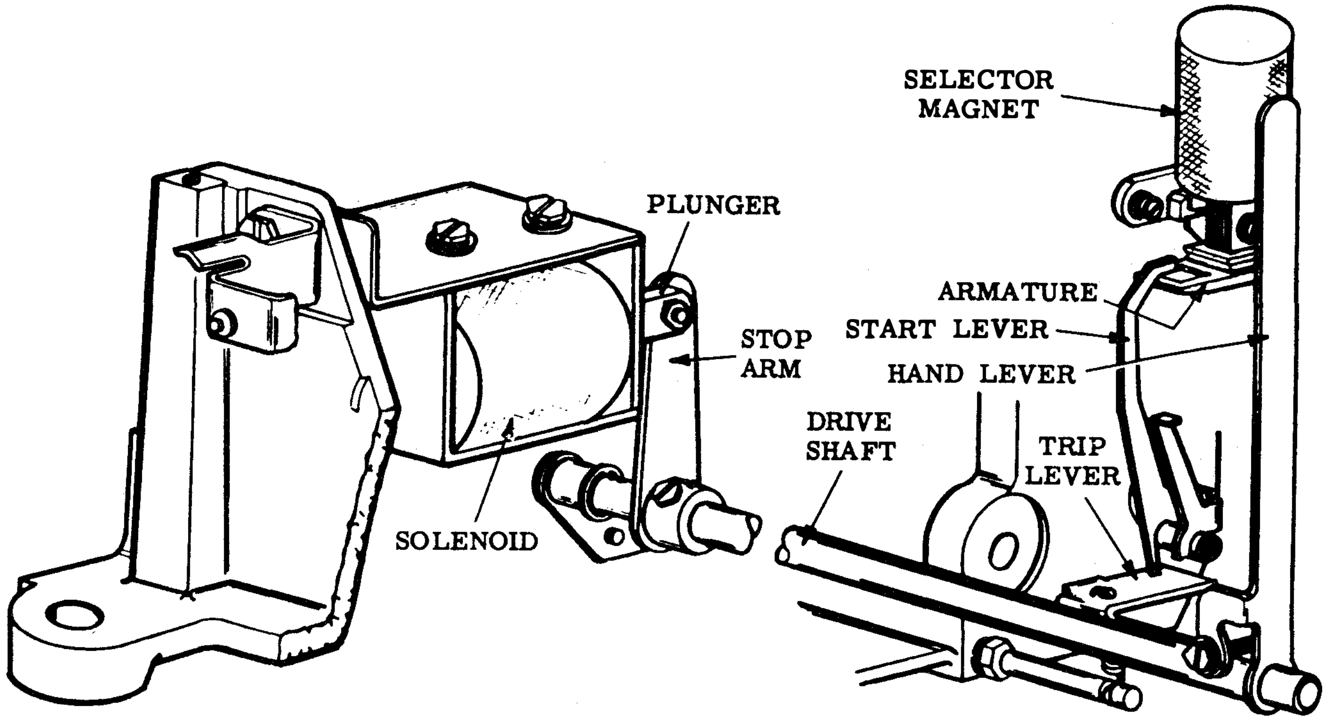


Figure 3-36. Manual Interfering Letters Tape Feed-Out Mechanism

3-9.5 REMOTE CONTROL NON-INTERFERING BLANK TAPE FEED-OUT. The following paragraphs describe this operation.

a. General. A predetermined length of blank (unperforated) tape may be stepped out at the end of each message by remote control. The operation is initiated by an electrical pulse from a remote source that is applied to a tape feed-out magnet. The feed-out is adjustable in steps of 0.6 inch, up to 18 inches. Messages received during any part of the feed out cycle will be processed without interference or loss of content. A non-repeat latch prevents successive tape feed-out operations from being initiated until the first feed-out sequence has been completed. At the end of the feed-out operation, the mechanism stops and remains inactive until another cycle is initiated. Feed-out initiation is described in the following paragraph.

b. Initiation. The feed-out operation is initiated when an electrical pulse is applied to the feed-out magnet with the typing reperforator in the idle condition. With the magnet energized, the armature bail moves the blocking bail out of engagement with the drive bail assembly. The spring-loaded drive bail falls into the detent of its cam and the connecting link positions the release lever on the lower step of the latchlever. The non-repeat latch is delayed one cycle by the spring loaded blocking latch on the drive bail. (If the start magnet is held energized longer than one cycle, the non-repeat latch prevents the drive bail from again falling into the detent of its cam.) As the drive bail reaches the detent of its cam, the blocking latch rides over the non-repeat latch. The drive bail then reaches the high part of its cam and the non-repeat latch falls into engagement with the drive bail. When the start magnet is de-energized, the spring-loaded blocking bail again engages the drive bail and, simultaneously, disengages the non-repeat latch.

c. Metering. When the drive bail positions the release levers on the lower step of the latchlever as described above, metering takes place. The release lever has now permitted the check pawl and feed pawl to engage two adjacent ratchets. One of the ratchets is fed continually by the feed pawl. This ratchet has a deeper notch at every sixth tooth, so that the pawl engages the second ratchet on every sixth cycle. After the second ratchet has rotated an amount equivalent to two teeth, a follower, riding a cam attached to the ratchet, drops off its peak and unblocks the tripping mechanism. After a predetermined length of tape has been fed (as measured by the second ratchet), the latchlever is actuated, as it would be by the selector cam on receipt of a message, and the tripping mechanism is blocked to prevent further feeding. Simultaneously, the feed pawls are lifted off the ratchets, and the ratchets return to their zero position.

d. Tripping and Punch Blocking. A bail that follows a cam attached to the main shaft engages the function clutch trip lever. When the cam follower enters the detent of its cam, an operating spring causes the bail to operate the clutch trip lever. The perforating and printing mechanisms are then allowed to punch and print the character stored in the selector. However, to ensure that only blank tape will be advanced, a blocking link is connected to the selector stripper cam follower shaft. When the magnet is energized, and the drive bail positions the release lever on the lower step of the latchlever as described in the previous paragraph, the left end of the blocking link moves to the left and under the punch slide reset bail. Now, when the function clutch is tripped, the marking punch slides are blocked by the punch slide reset bail. The slide post on the front toggle links clears the punch slide projection on its upward movement. The punch slide reset bail then falls off the blocking link, but the punch slides cannot move forward into the marking position because they are blocked by the slide post. Each time the main shaft rotates one revolution, a blank tape feed-out cycle is initiated, provided the function clutch trip lever bail is not blocked by the metering mechanism. Should an incoming message trip the metering mechanism, the tripping mechanism is immediately blocked from any further operation and the blocking link is pulled out of engagement with the punch slide reset bail.

e. Storage. The purpose of the storage mechanism is to hold the reset bail (perforating mechanism) in engagement with the punch slides until the slides are fully reset, so that they may recognize the first character set up in the punch slide latches by the selecting mechanism. This mechanism consists of a latch that is operated by a link attached to the punch slide reset bail toggle. During reception of an incoming message, the toggle mechanism pushes the latch out of the way of the reset bail prior to its being stripped by the clutch trip lever.

3-9.6 REMOTE CONTROL NON-INTERFERING LETTERS TAPE FEED-OUT. The operation of this mechanism is essentially the same as that of the remote-control non-interfering blank tape feed-out mechanism. This feature, however, does not contain a blocking link on the stripper cam follower shaft. Therefore, the tape output is perforated in the letters code combination (12345). This mechanism is shown in figure 3-37.

3-9.7 AUTOMATIC NON-INTERFERING LETTERS FEED-OUT. The following paragraphs describe the theory of this operation.

a. General. This feature automatically initiates the feed-out of a predetermined length of LETTERS perforated tape at the end of each message, following a fixed period of signal line idle time. The duration of delay between the termination of the message and the initiation of feed-out is determined by one of several available cams. (At 100-wpm operation, for example, delays of approximately 4 seconds and 16 seconds are available.) The length of tape feed-out is also variable in increments of

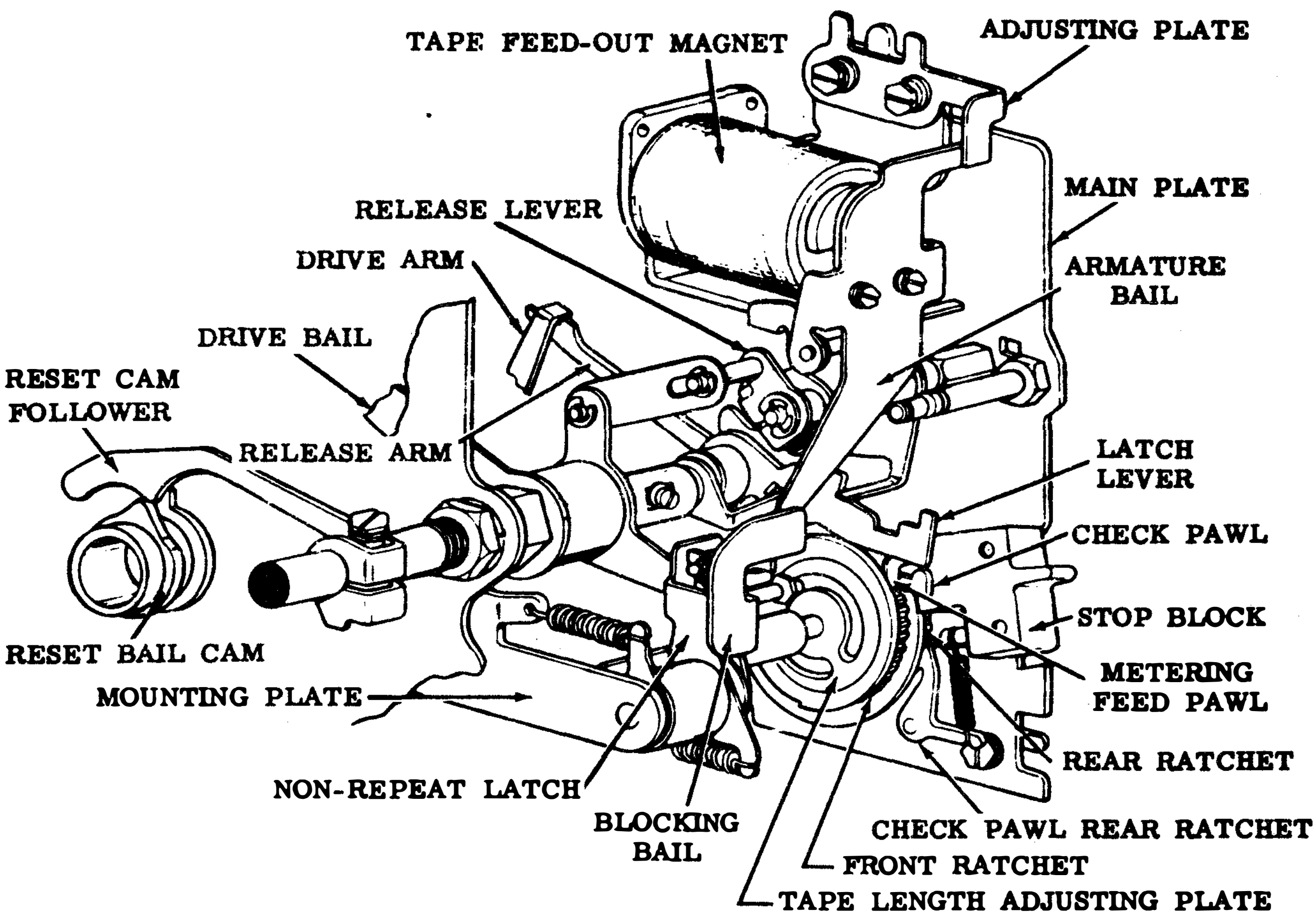


Figure 3-37. Remote Control Non-Interfering Letters Tape Feed-Out Mechanism

0.6 inch up to 3.6 inches or 18 inches. The mechanism may be controlled remotely with the addition of a separate set of parts. Messages received during any part of the feed-out cycle are processed without interference or loss of content. An exploded view of the mechanism is shown in figure 3-38.

b. Initiation. The feed-out operation is automatically initiated by a fixed period of idle signal line. Through the interaction of a drive link operated by the rocker bail and a follower activated by the reset bail cam in the selector, the mechanism recognizes the end of a message. The timing of the selector while receiving a message is such that the reset bail cam raises its follower during the first part of the selector cycle. The follower, through a linkage, lowers a latchlever which permits a release lever to rotate clockwise. When the release lever is in its clockwise position, the mechanism is in its unoperated condition as explained below. When the rocker bail goes to its extreme left position during the middle of the function cycle, the attached drive link rotates the release lever counterclockwise and places the mechanism in its operated condition. Each time a new character is received, the above sequence occurs. End-of-message recognition is obtained when the release lever is rotated counterclockwise by the rocker bail and is not permitted to rotate clockwise by the follower.

c. Metering and Feed-Out. When the release lever rotates counterclockwise, it lowers a front check pawl onto

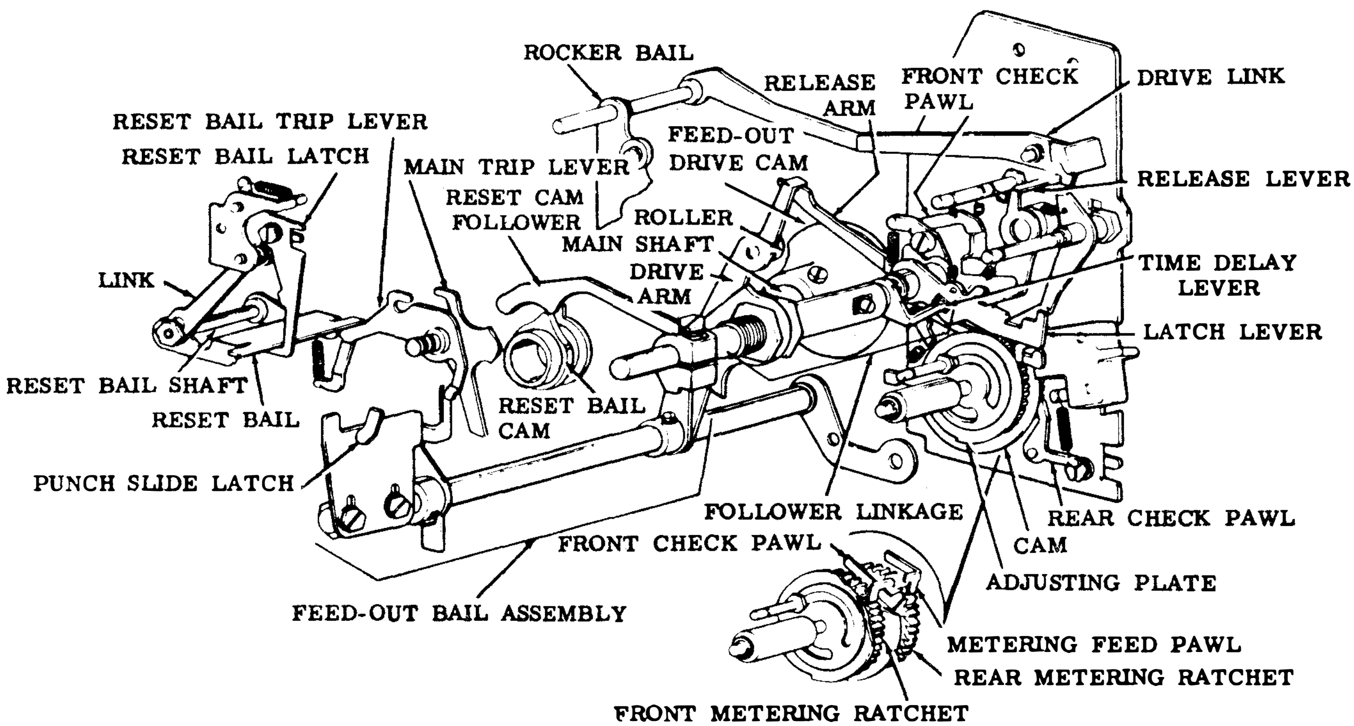


Figure 3-38. Automatic Noninterfering Letters Tape Feed-Out Mechanism

two metering ratchets. A time delay lever rides on a cam attached to the front ratchet. When the front ratchet rotates, the time delay lever rides to the low part of the cam and causes a release arm to release the drive arm of a feed-out bail assembly. A roller on the drive arm then rides, under spring pressure, on a feed-out drive cam on the main shaft. As the shaft rotates, each time the roller rides to the low part of the cam, the feed-out bail assembly rotates the main trip lever counterclockwise tripping the function clutch. The feed-out bail also rotates the punch slide latches counterclockwise setting up a LETTERS code combination. Thus, the reperforator feeds-out LETTERS tape in the same manner as if the function clutch and punch slides had been actuated by the selector. As the rachets are rotated as described above, an adjusting plate on the front ratchet reaches the position where it rotates the latchlever clockwise. The latchlever, in turn, through the time-delay lever, causes the release arm to latch the drive arm and terminates feed-out. The latchlever also permits the release lever to move to its clockwise position and lift the metering feed pawl and front check pawl off the ratchets. A spring returns the front ratchet to its start position. The mechanism remains in its unoperated condition until the next code combination is received. The adjusting plate is adjustable for varying lengths of tape feed-out.

d. Non-Interference. When the first character of an incoming message is received during feed-out, the selector clutch is tripped and the reset cam follower causes the release lever to rotate clockwise. Feed-out is terminated, as described in the discussion of the metering operation, and the message is perforated. When the first character is received during feed-out, the relationship between the selector cam and the function cam could be such that the reset bail would release the punch slides before the slides are fully reset. In this case, the first character of the incoming message would be lost. The purpose of the storage assembly is to prevent this. The storage assembly consists of a reset bail latch that is moved by a link attached to the reset bail shaft. During normal reception of messages, the link pushes the latch out of the way of the reset bail prior to the bail's being lowered by the main trip lever. Whenever the condition described above occurs, the latch holds the bail in engagement with the slides until they are fully reset, so that they may recognize the first character set up in the punch slide latches by the selector.

3-9.8 BACKSPACE MECHANISMS. These mechanisms are described in the following paragraphs.

a. General. The back-space mechanism steps the tape back through the punch block in order to delete perforated errors. The erroneously perforated code combination in the retracted tape is then obliterated by perforating the letters code combination in its place. The back space mechanism may be operated manually or it may include power drive. The mechanism used with chadless tape differs from that used with fully perforated tape in that it contains a tape rake for depressing the chad. The mechanisms are shown in figure 3-39.

b. Manual Backspace (Fully Perforated Tape). Depressing the handle of the backspacing bellcrank disengages the perforator feed pawl from the feed wheel ratchet. The backspacing feed pawl then engages the feed wheel ratchet and rotates the feed wheel clockwise, backspacing the tape to the next row of perforations.

c. Manual Backspace (Chadless Tape). Depressing the handle of the backspacing bellcrank disengages the perforator feed pawl from the speed wheel ratchet and simultaneously rotates the rake to depress the chads. The backspacing feed pawl then engages the feed wheel ratchet and rotates the feed wheel clockwise, backspacing the tape to the next row of perforations.

d. Power Drive Backspace. A start magnet in the power drive mechanism is energized by a remote source. When energized, the armature bail is pulled downward. An extension of the bail disengages the drive link latch, which drops and engages a notch in the eccentric arm. The eccentric arm, driven by the perforator main shaft, moves to the right. This action causes the bellcrank handle to be depressed through a system of linkages between the drive link latch and the bellcrank, after which operation is as previously described.

3-9.9 SEND-RECEIVE KEYBOARD, DETAILED FUNCTIONAL DESCRIPTION. The following paragraphs provide a detailed discussion of the sequence of operation, function keys, and character counter mechanism of the send-receive keyboard.

a. Sequence of Operation. The discussion is further broken down to the discussions of depression of keys, positioning of code bars, and resetting of the code bars, as described in the following paragraphs. The code bar and codelever universal bail mechanism is shown in figure 3-40.

(1) Depression of Keys. As a code-selecting keytop is depressed, the corresponding codelever rotates about its pivot point. The rear end of the codelever comes up and rotates the universal bail. The extension arm on the top of the universal bail moves out of engagement with the step at the rear end of the universal bail latch. This occurs when the key and corresponding codelever latch are about two-thirds of the way toward full stroke. The universal bail latchlever then moves downward under spring force developed by the latchlever spring. As this latch comes down, it strikes the code bar reset bail latchlever and carries it downward. The code bar mechanism is shown in figure 3-41. When the corner of the reset bail latch descends beyond the center line of the needle bearing (mounted on the reset bail), the various spring forces acting on the reset bail cause it to swing to the right. This in turn allows the various code bars to move to the right (in the direction of the spring forces acting on each code bar). During this time, the codelever is moved up to its full position. Therefore, the codelever may stop some of the code bars from moving to their extreme right hand position. The code bars have vertical

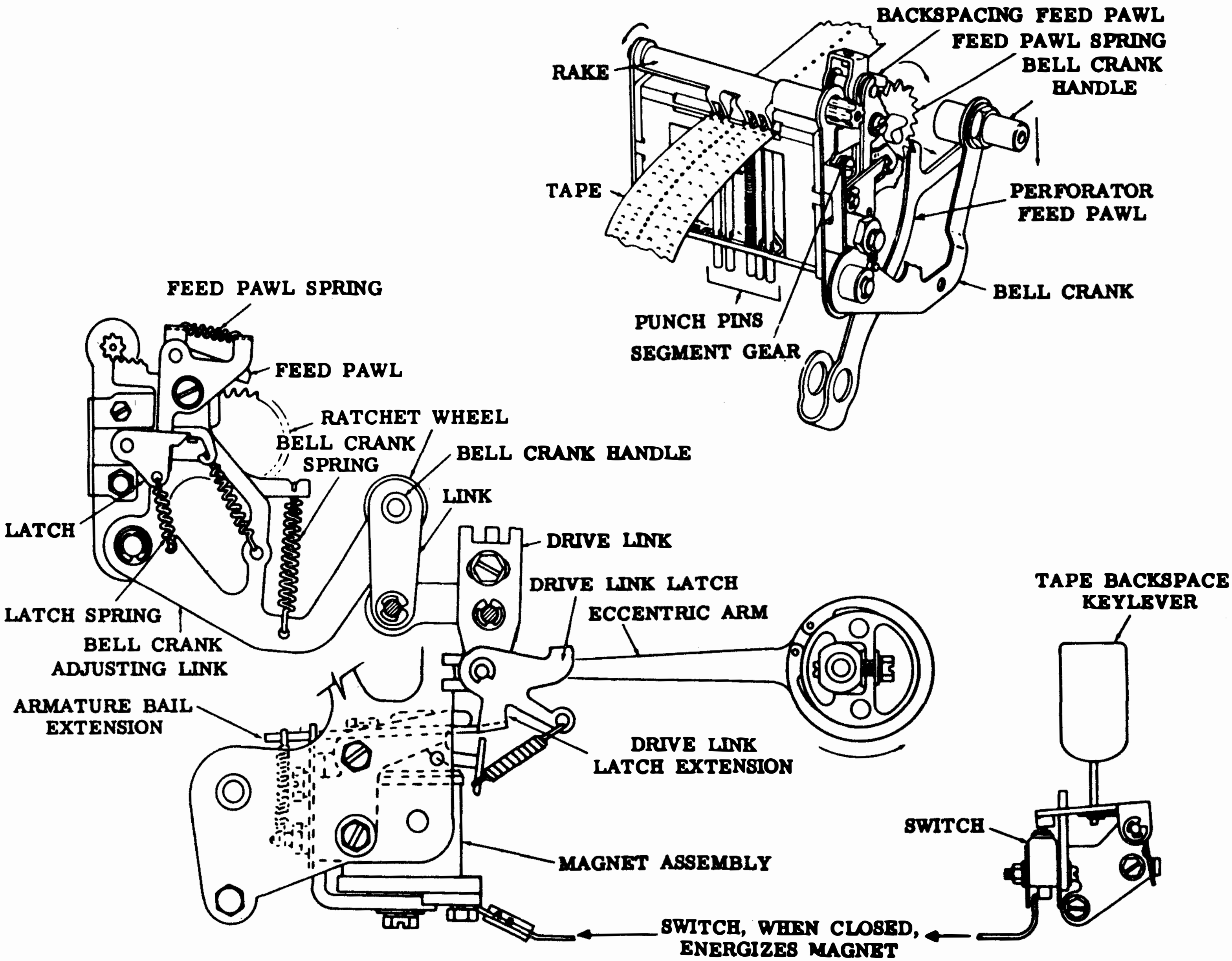


Figure 3-39. Backspace Mechanisms

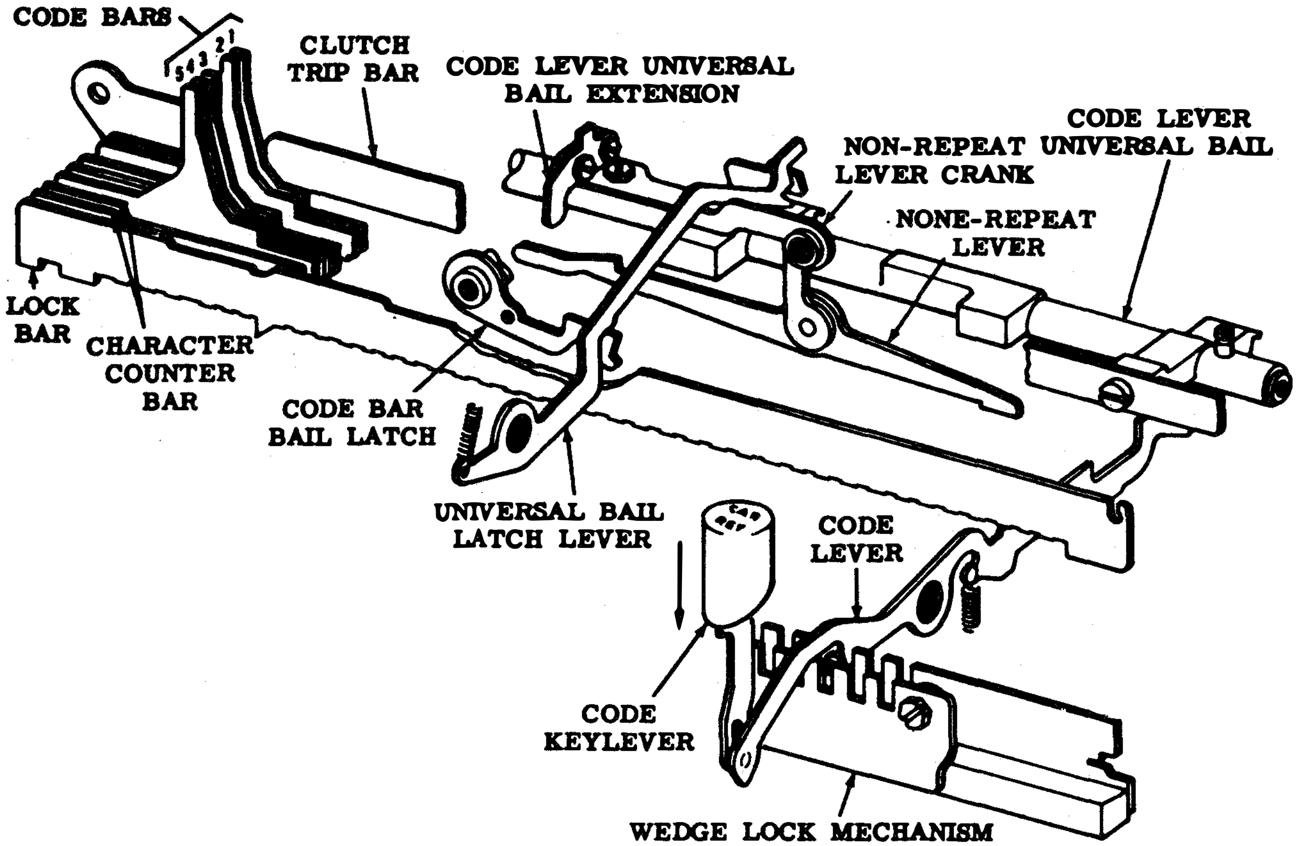


Figure 3-40. Code Bar and Codelever Universal Bail Mechanism

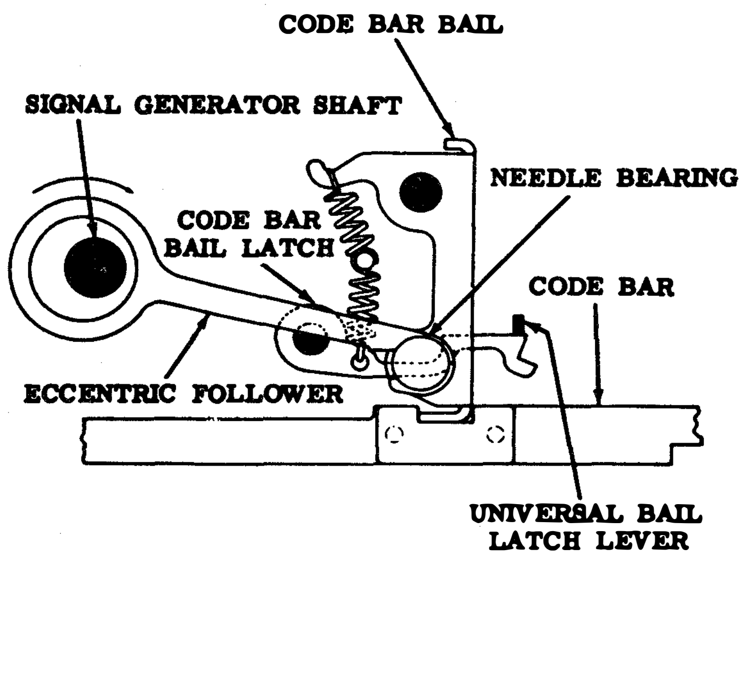


Figure 3-41. Code Bar Bail Mechanism

extensions that engage a curved part of the signal generator transfer levers. Those code bars that are permitted to move to the extreme right also move the corresponding transfer lever to the right. However, those code bars that are stopped, because their teeth engage the actuated codelever, do not quite touch or move their corresponding transfer levers. Therefore, these transfer levers remain in their normal left hand position as shown in figure 3-42. A locking wedge is mounted on the projection of the lower position of all code-levers and function levers as shown in figure 3-43. When the lever is operated, its locking wedge moves downward between the lock balls, in the lock ball channel, preventing the simultaneous operation of more than one keylever. Simultaneously with the trip-off of the reset bail and the movement of the code bars to the right, the clutch trip bar (located in the rear slots of the code bar guides) moves to the right as shown in figure 3-41. This clutch trip bar engages the clutch stop lever and moves it out of latch with the clutch stop lug. Up to this point, all of the action has been caused by manual operation of the keytop and its associated codelever as shown in figure 3-40. The motor unit supplies the mechanical power to drive the associated typing reperforator unit and the signal generator shaft. Refer to the appropriate section for description and principles of operation of the motor unit.

(2) Positioning of Code Bars. Once the clutch is tripped, it rotates continuously as long as the keyboard is turned on. Since the clutch shoes are mounted on a plate that is part of the cam assembly, the cam begins to rotate (clockwise when viewed from the front of the keyboard). The arrangement of the cam assembly shown in figure 3-44, is such that the third cam from the rear begins to push downward on its corresponding transfer lever. At almost the same time, the eighth cam from the rear begins to move the transfer lever locking bail upward. The blade portion of this locking bail goes up beside a downward projection on each transfer lever. The locking projection is left or right of the locking bail, depending upon the position of the transfer lever (as set up by the permutation action of the code bars). Thus, in the first few degrees of cam rotation, the permutated position of the transfer levers is locked into position and the code bars are free to be reset in their normal latched positions. The cams and their corresponding transfer levers are numbered from rear to front. The number 3 cam engages its transfer lever first, and moves it down. Since the start pulse is always spacing, no code bar is required to engage this lever and it is always held to the left by its spring. Therefore, as the third cam moves the lever down, the hook at the upper right side of the transfer lever engages the right side of the transfer (rocker) bail. This tips the transfer bail to the right and pulls the contact drive link to the right. The resulting action of the contact toggle is such that the left set of contacts acts as a pivot and the right hand contacts begin to open. The right-hand contacts control the signal current in single contact type operation. When these contacts are open, the result is no current in the signal circuit. Therefore, the

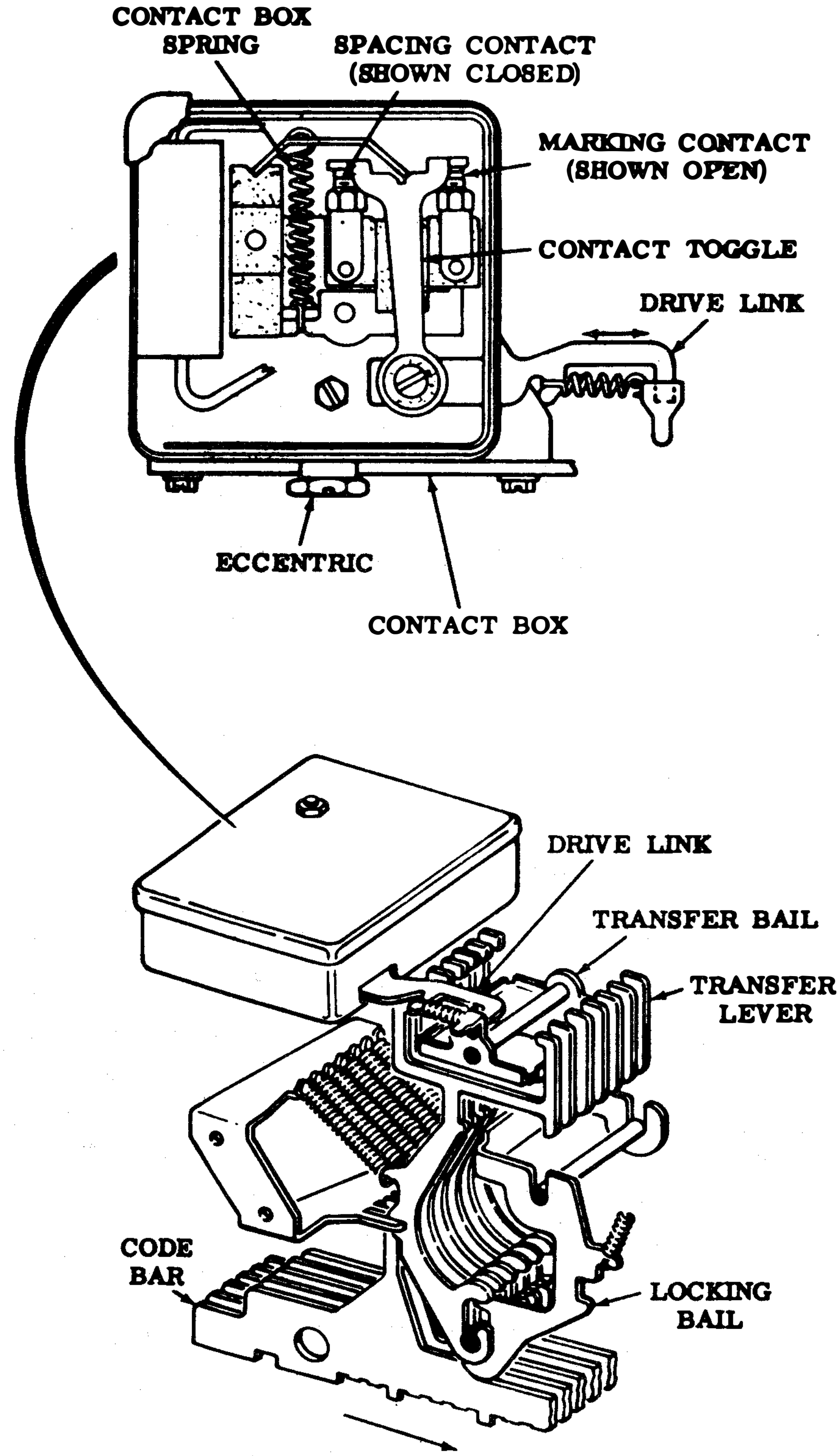


Figure 3-42. Transfer Lever Mechanism and Contact Box Mechanism

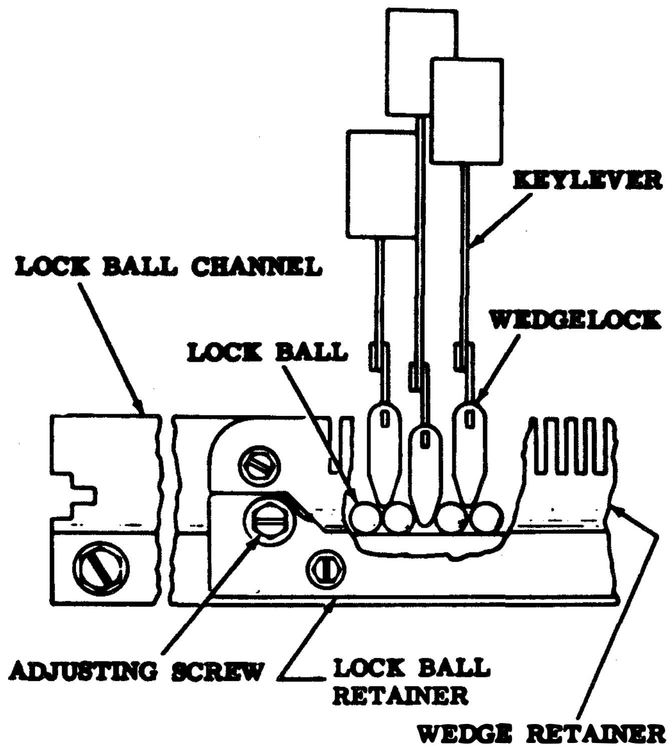


Figure 3-43. Wedge Lock Mechanism

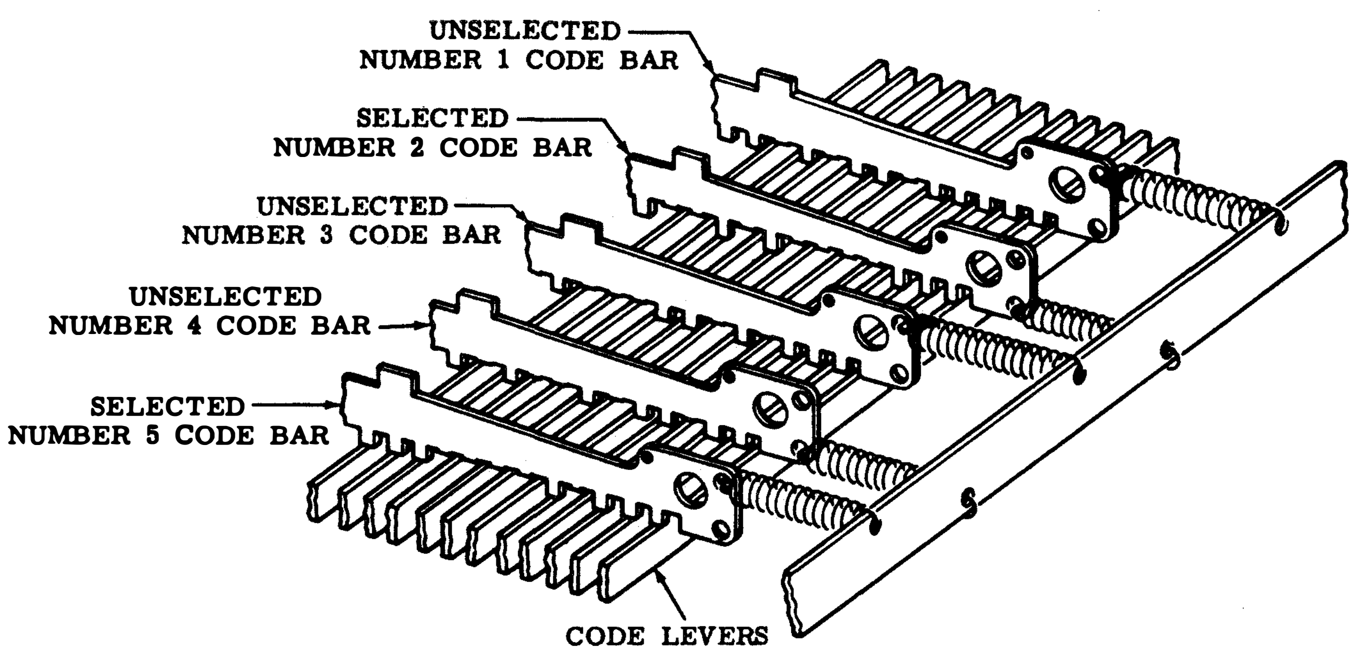
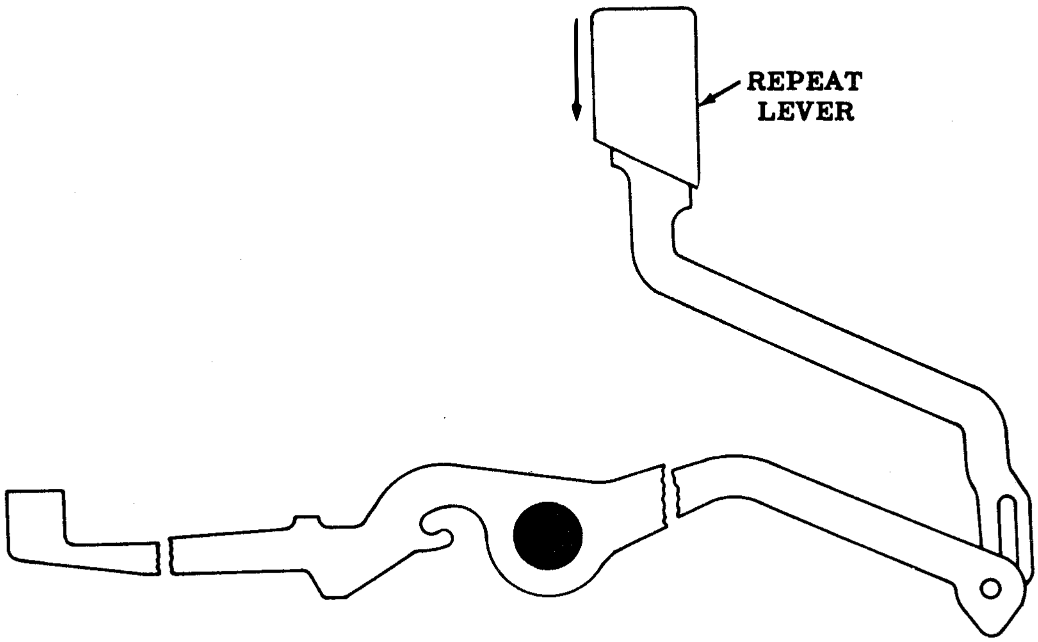


Figure 3-44. Code Bar Selection

first pulse, the start pulse of any character code is a spacing (no current) pulse. The number 1 cam and the transfer lever move downward next. In turn, the upper left hook of the associated transfer lever pulls down on the rocker bail (holding it to the right or tilting it back to the left). This pushes the drive link to the left (or right) and results in closing the right (or left) contacts and allowing a marking (or spacing) pulse to be transmitted. Similarly, the remaining transfer levers, numbers 2, 4, 5 and 6, are pulled downward by their respective cams. The resulting pulse is marking if the transfer lever is to the right, or spacing if it is to the left. The number 7 transfer lever is held to the right by a stop pin. Therefore, the last pulse (the stop pulse) is always marking (current on). The locking bail is actuated by the number 8 cam lobe. This cam begins to move the locking bail up into its locking position almost as soon as the cam starts to rotate, as shown in figure 3-42. Full lock position occurs approximately at the half-way point of the start pulse (48-1/2 degrees of rotation). The dwell on the eighth cam from the front holds the locking bail in its lock position until after the beginning of the number 5 pulse. Then the cam pulls the bail down out of lock, and all transfer levers are free to return to their initial positions at a point about halfway through the stop pulse.

(3) Resetting of the Code Bars. Reset of the code bars is accomplished by means of an eccentric on the front of the cam assembly, which drives an eccentric follower arm (figure 3-41). This arm engages a stud on the side of the reset bail and pulls the reset bail to the left as the cam rotates. At the peak position of the reset eccentric, the code bar reset bail latch is clear of the needle bearing stud. This permits the latch spring to pull the latch up into locking position, and the code bar reset bail is latched as the eccentric drives the follower arm back to its initial position. As the code bar reset bail is moved to the left (into reset), it engages projections on the permutation code bars, clutch trip bar, and a step on the non-repeat lever. Thus, all of these elements are moved to the left into latched reset position. The repeat mechanism is shown in figure 3-45. The reset eccentric is positioned in angular relationship to the remainder of the cam so that pick-up of the code bars and non-repeat lever begins. Just after the number 2 pulse begins, near the end of the start pulse, the code bars have been moved to the left a sufficient distance to permit the codelever (that determined the permutation) to drop down out of the universal bail. This permits the universal bail to rotate forward and move the non-repeat lever down and off the reset bail. At the same time, the extension of the universal bail moves in under its latchlever and holds this latchlever up almost in the same position that the pawl on the non-repeat lever had held it in the early reset movement. With the universal bail latch held up, the reset bail continues to move to the left. Full reset occurs at approximately 180 degrees of cam rotation (1/4 through the number 3 pulse). As soon as the universal bail is permitted to move forward, a second keytop can be depressed. However, from that point on, full time of cam



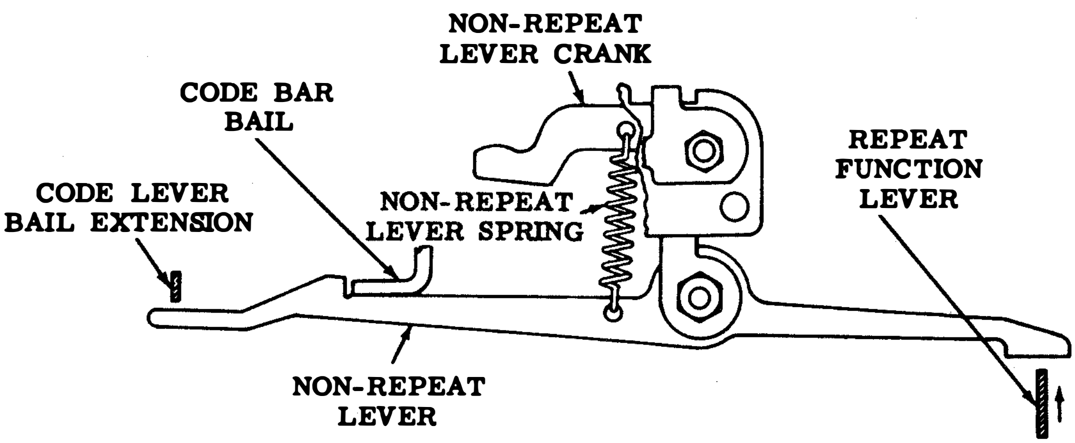


Figure 3-45. Repeat Mechanism

rotation must expire before a third and successive keytops can be operated.

b. Function Keys. The following paragraphs describe theory of operation of the function keys.

(1) Repeat Mechanism. Operation of the REPT keytop simultaneously with one of the keys in the three lower rows or the spacebar disables the non-repeat mechanism and causes the character or function selected to be repeated as long as the REPT keytop is held operated. The depressed REPT keytop causes its function lever to raise the right end of the non-repeat lever as shown in figure 3-45, and rotates it about its pivot point. In this position, the non-repeat lever cannot be engaged and operated by the code bar bail, therefore, the non-repeat lever crank will not reset the operated code bar bail latch. The code bar bail and universal bail latchlever are thus maintained in their operated positions, and the code bar bail follows the eccentric movement back and forth until the REPT keytop is released.

(2) Electrical Line-Break Mechanism. The electrical line-break mechanism, shown in figure 3-46, provides a means of interrupting signal circuits as an alerting signal for automatic equipment sometimes used in the teletypewriter system. Interruption of the line current is accomplished by depressing the BREAK keytop. When the BREAK keytop is depressed, its function lever pivots and raises the front end of the break lever. The rear portion of the break lever depresses the actuator pin of the sensitive switch, which opens the normally-closed contacts. This action breaks the continuity of the signal line, causing transmission of a break (no current) signal. When the BREAK keytop is released, the tension of the switch spring and the break lever spring cause the function lever to return the keytop to its normal position, and the switch contacts to their normal closed condition.

(3) Keyboard Lock-Unlock Mechanism. Operation of the (red) KYBD LOCK keytop causes its function lever to raise the keyboard lock bar pawl. In its upper position, the pawl releases the keyboard lock bar, and a spring pulls the bar to the right. In this position, projections on the lower side of the bar block the upward movement of any code lever and the repeat function lever. This mechanism is shown in figure 3-47. Operation of the (red) KYBD UNLK keytop causes its function lever to rise against a camming surface on the keyboard lock bar and drive the bar toward the left until the lock bar pawl drops into a notch in the lock bar. In this position, the projections on the lock bar lie between the codelevers and offer no interference with their operation. This mechanism is shown in figure 3-48.

(4) Tape Backspace. Depressing the TAPE B.SP. keytop directly activates a switch which controls the backspace function on the typing reperforator. The keytop is spring loaded to return to its unoperated position after each operation. There is no associated function lever for this keytop, and the code bar mechanism is not affected by its operation. The operation is isolated from the signal

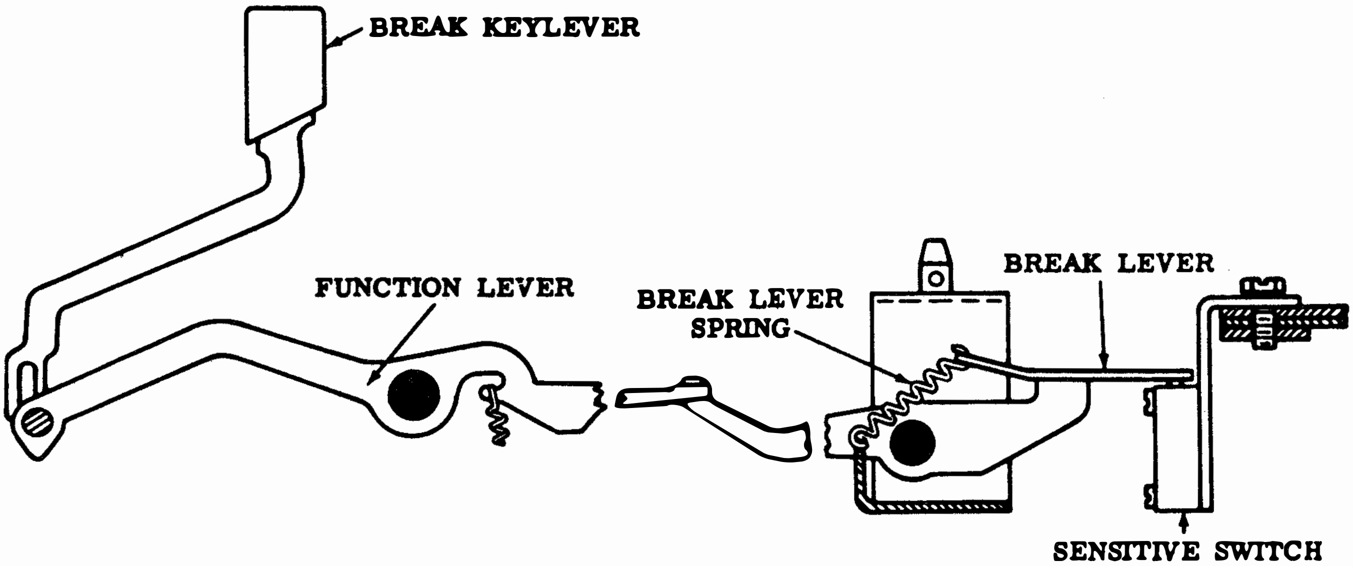


Figure 3-46. Electrical Line-Break Mechanism

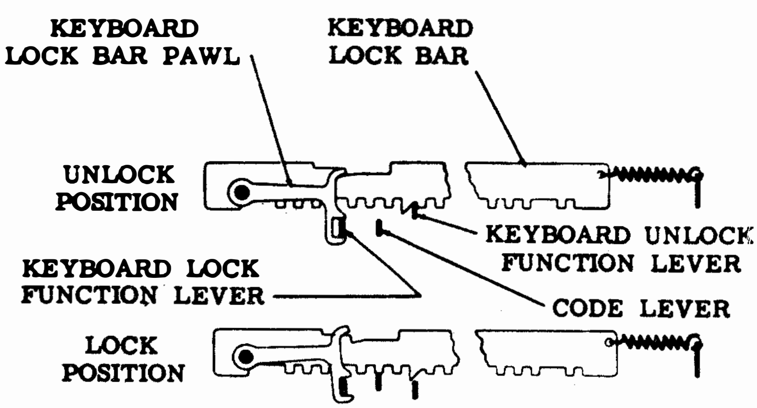


Figure 3-47. Keyboard Lock Mechanism

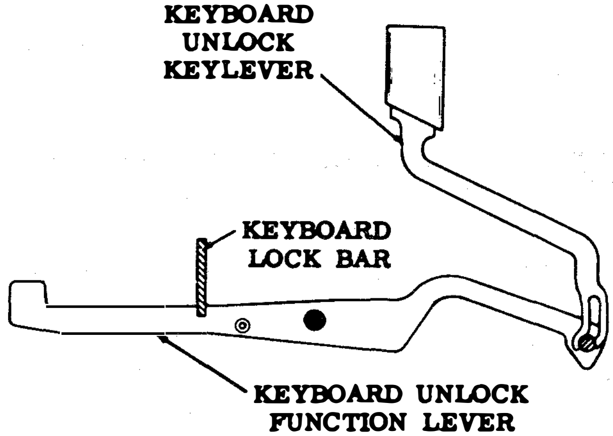


Figure 3-48. Keyboard Unlock Mechanism

generator mechanism and does not affect other units in the line circuit. The purpose of the back space function is to permit eradication of an erroneous character code, or codes, by reperforating such codes, using the five-hole perforated LETTERS code.

(5) Tape Feed-Out. The TAPE F.O. keytop operates a sensitive switch located at the rear of the base. Although the switch is actuated through a function lever, the use of this key is an off-line operation and has no effect on the code bars.

c. Character Counter Mechanism. Functional operation of this mechanism is described in the following paragraphs.

(1) General. The character counter is driven mechanically from the code bar mechanisms through the counter and counter reset code bars located in the second and third (from front) slots of the code bar basket. These code bars have drive projections which engage the forks of the feed and reset bails of the counter. As the code bars fall to the right when a key on the keyboard is struck, the counter mechanism is tripped. The mechanism is shown in figures 3-49 and 3-50. These functions may be divided into three distinct phases of operation of the counter mechanism, stepping, counter reset and restart.

(2) Stepping. Referring to sequence A (figure 3-51), as a key is struck the code bars fall to the right, carrying with them the feed bail (1). The drive bail, which is linked to the feed bail, moves to the left slightly more than one tooth. As the code bars are reset under power, the stepping bail (1) moves clockwise, causing the drive lever to advance the ratchet drum one tooth. The drive pawl prevents the ratchet drum from rotating counterclockwise until it is again tripped for the following character. When this occurs, the ratchet drum rotates slightly counterclockwise, coming to rest against the latchlever.

(3) Counter Reset. Sequence B (figure 3-51) illustrates the tripped position of the counter mechanism for a reset function. The reset bail (2) moves counterclockwise as its code bar falls to the right,

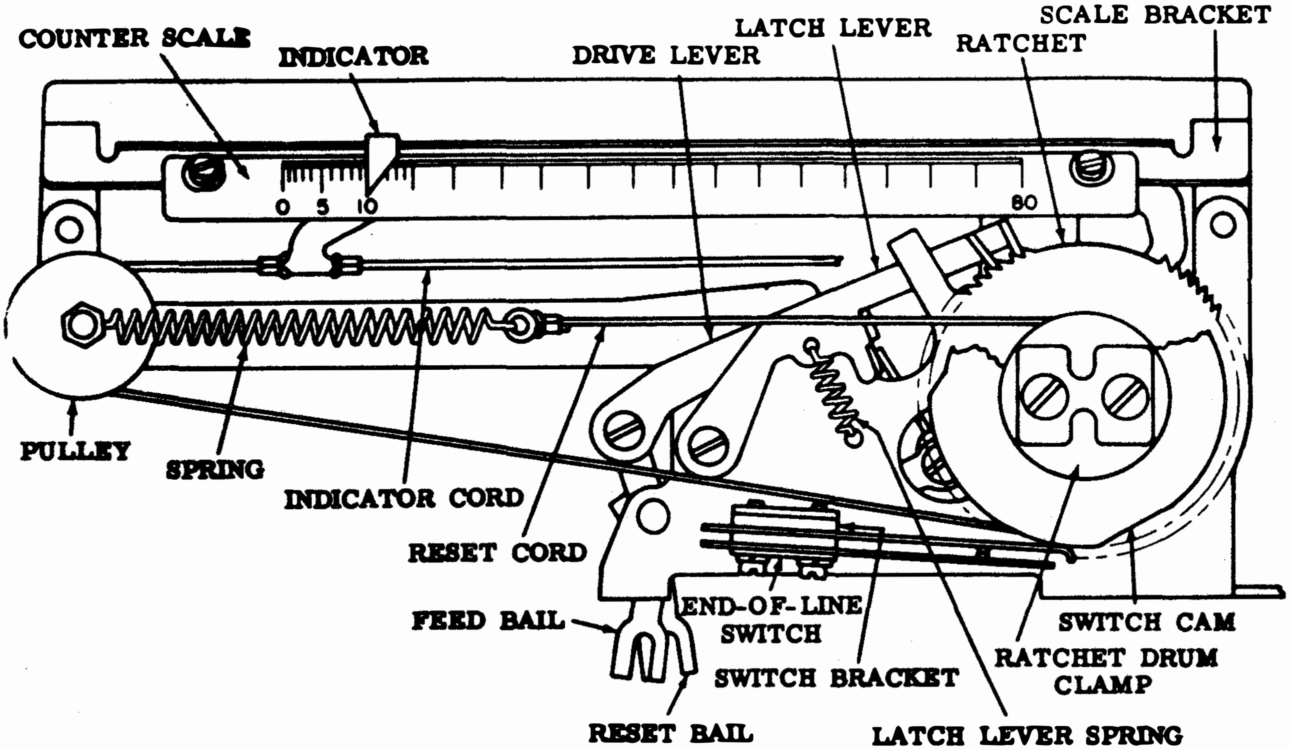


Figure 3-49. Character Counter Mechanism, Front View

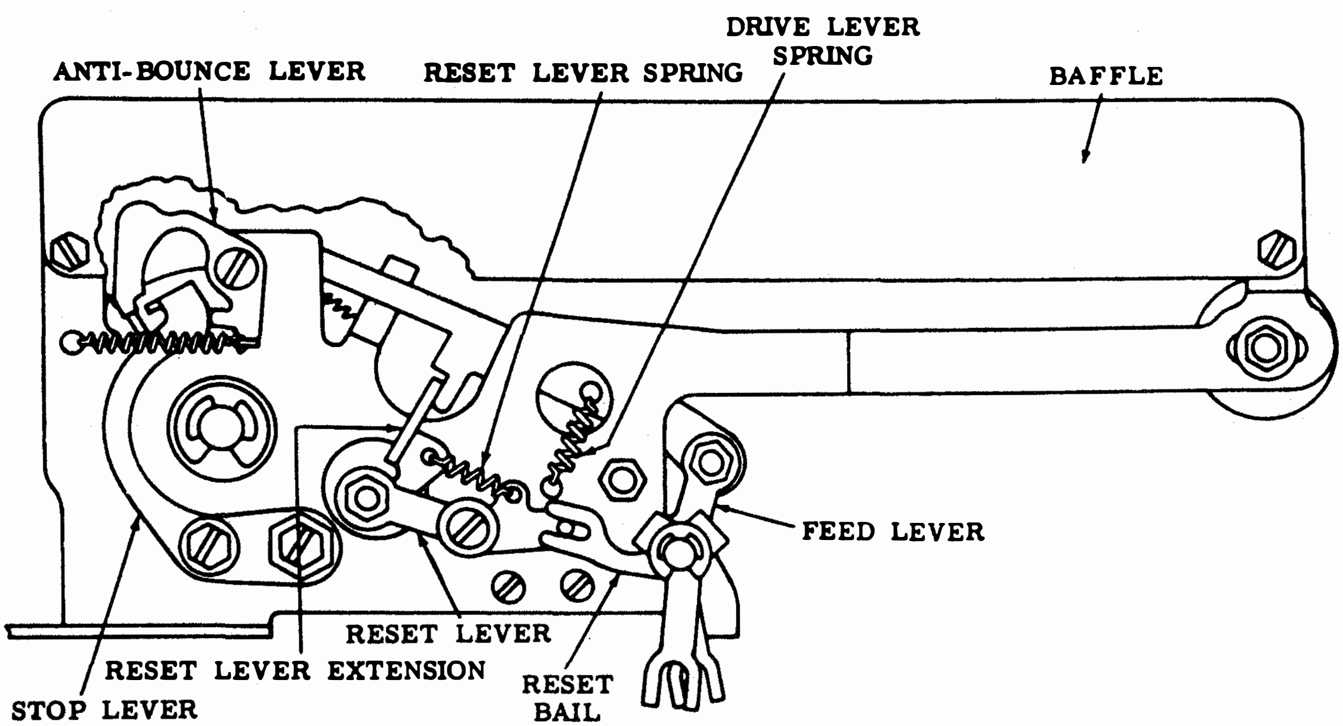


Figure 3-50. Character Counter Mechanism, Rear View

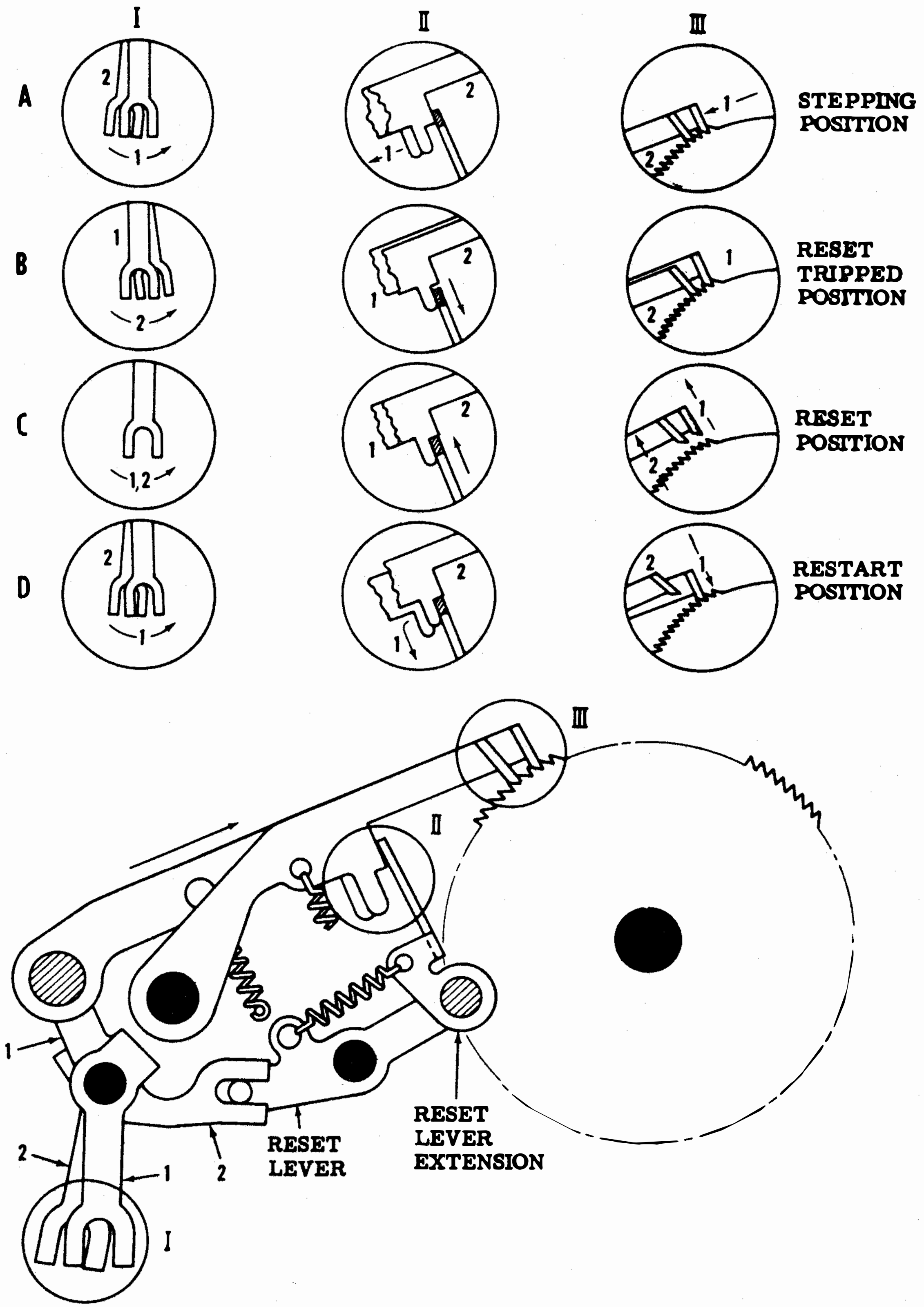


Figure 3-51. Operation of Character Counter Mechanism

causing the reset lever in turn to rotate clockwise. As the reset lever rotates clockwise, the reset lever extension moves downward until it falls under the shoulder of the projection on the drive and latchlevers under the action of its spring. When the counter bars are reset, as in C (figure 3-51), the reset bail is rotated clockwise to its original position, causing the reset lever to rotate counterclockwise, carrying both the drive and latchlevers out of engagement with the ratchet teeth. The mechanism remains in this condition, and the ratchet drum assembly rotates rapidly counterclockwise (under the action of its return spring) until it reaches its zero position. As the ratchet drum reaches its zero position, a stop on the ratchet strikes a stop lever fastened to the frame. The elastic impact is transmitted through the stop lever to the anti-bounce latch, whose lower end is normally in contact with the stop lever. The anti-bounce latch rotates counterclockwise, dropping in behind the ratchet stop. As the ratchet drum rebounds from the stop lever, its stop strikes the anti-bounce latch, preventing further motion and maintaining the anti-bounce latch in its actuated position. The ratchet continues to operate between the stop lever and anti-bounce latch until the energy in the system has been largely dissipated. The ratchet stop then remains in contact with the stop lever, permitting the anti-bounce latch to return to its normal position.

(4) Restart. Sequence D (figure 3-51) illustrates the restarting action of the counter mechanism for the character following a carriage return. As a key on the keyboard is depressed, the counter code bar falls to the right, the feed bail moves counterclockwise and the drive lever moves to the left. As the drive lever moves to the left, it is disengaged from the reset lever extension and falls into engagement with the ratchet tooth. As the code bars are reset under power, the feed bail rotates clockwise, and the feed lever begins to move to the right. As it does, its projection pushes the reset lever extension to the right and out of engagement with the latch-lever, which falls into engagement with the ratchet drum. As the drive lever completes its stroke, it steps the ratchet one tooth, as in the normal stepping operation.

d. End-of-Line Switch. Operation of the end-of-line switch is controlled by a switch cam. The switch cam rotates with the ratchet drum and can be adjusted to close the switch at any typed line length from 10 to 80 characters. The location of this switch is shown on figure 3-49.

e. Bases. The receive-only typing reperforator bases are composed basically of passive mechanisms. The variable-speed drive mechanism, used with certain bases and available as an optional feature, is described below.

3-9.10 VARIABLE FEATURES. The functional descriptions of these units are described in the following paragraphs.

a. Variable-Speed Drive Mechanism. This mechanism is used on certain receive-only bases and permits the manual selection of the typing reperforator operation speed to permit synchronization with the transmission speed of the incoming signal. Speed selections must be made with the motor unit inoperative. The mechanism is shown in figure 3-52. A motor pinion gear attached to the motor shaft drives the main driving gear on a hub at the front end of the lower of two of the variable speed intermediate gear mechanism shafts. Three gears, fastened to hubs which rotate with the lower shaft, are driving gears. From the front, the first gear drives at 75 wpm speed, the second, smallest gear at 60 wpm, and the largest gear, at the right, at 100 wpm. On the upper shaft, spaced so the gears will clear non-mating driving gears in the shifting operation, but will mate for the selected gear ratio, are three driven gears. The driven gears slide freely horizontally on a hub fastened to the shaft, but are keyed to rotate the shaft, regardless of which gear combination has been selected. From the front, the gears on the top shaft are first, the driven gear for 60 wpm operation, second, the largest gear, for 100 wpm, and third, the smallest gear, for 75 wpm. Between the second and third gear and separated from the gears by spacers is a gear block on which the shift lever slides. Manually positioning the gear-shift handle releases the three position detent in the top of the housing and permits the movement of the handle to the right or left, as required to select a gear ratio. The selected ratio is indicated by indexed detents in the grease retainer covering the mechanism. At the rear, the mechanism is in position for 75 wpm operation. The center position is for 100 wpm, and the front index is for 60 wpm. The gear ratio selected must be the same as that on the distant station transmitting equipment. The lower shaft drives a hub and driving sprocket at its front end. The sprocket is connected through a timing belt to operate the typing reperforator at the selected speed.

b. Synchronous Pulsed Transmission. The synchronous pulsed transmission mechanism provides a means of initiating signal transmission from the keyboard, at a predetermined rate, upon reception of an 0.050-ampere external clocking pulse of 20-millisecond duration. This mechanism is shown in figure 3-53. When any green key on the keyboard is depressed, the reset bail moves right and releases all selected code bars. Also released is the universal code bar which moves right and closes the clutch magnet conditioning contacts setting up the clutch trip magnet to receive the external clocking pulse. Upon reception of the external clocking pulse, the clutch trip magnet energizes and unlocks the clutch trip bar. As the clutch trip bar moves to the right it engages the clutch trip bail extension and trips the signal generator clutch, allowing the signal generator cam shaft to rotate and transmit the proper sequential signal. After one complete revolution of the signal generator cam shaft, the reset bail returns to the starting position resetting all code bars and the clutch trip bar.

3-9.11 ELECTRICAL SERVICE ASSEMBLY COMPONENTS. The following paragraphs include detailed functional descriptions of the circuit cards used in the ESA units found in low-level typing reperforator sets. Refer to the paragraphs following the functional block diagram

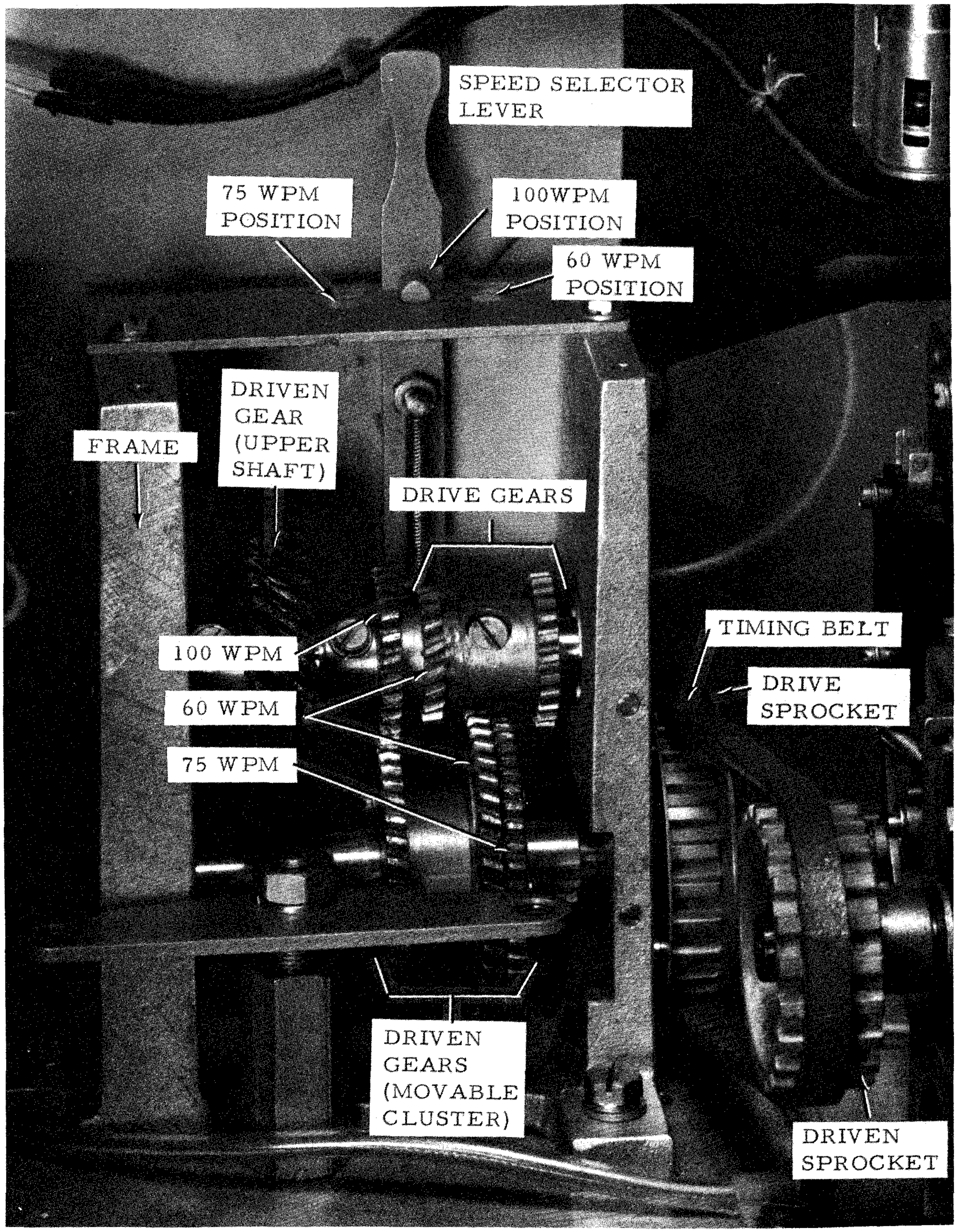


Figure 3-52. Variable-Speed Drive Mechanism

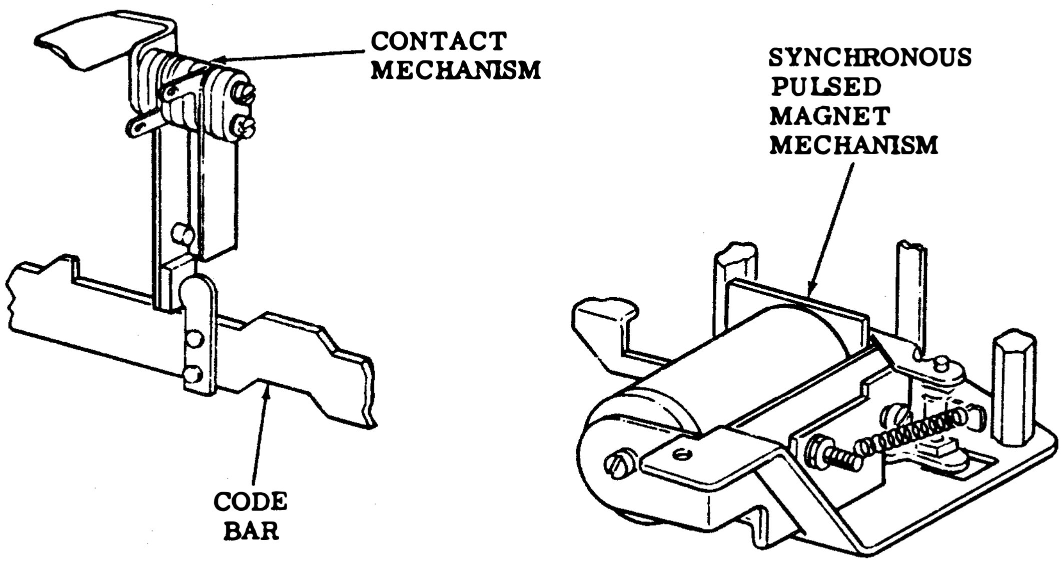
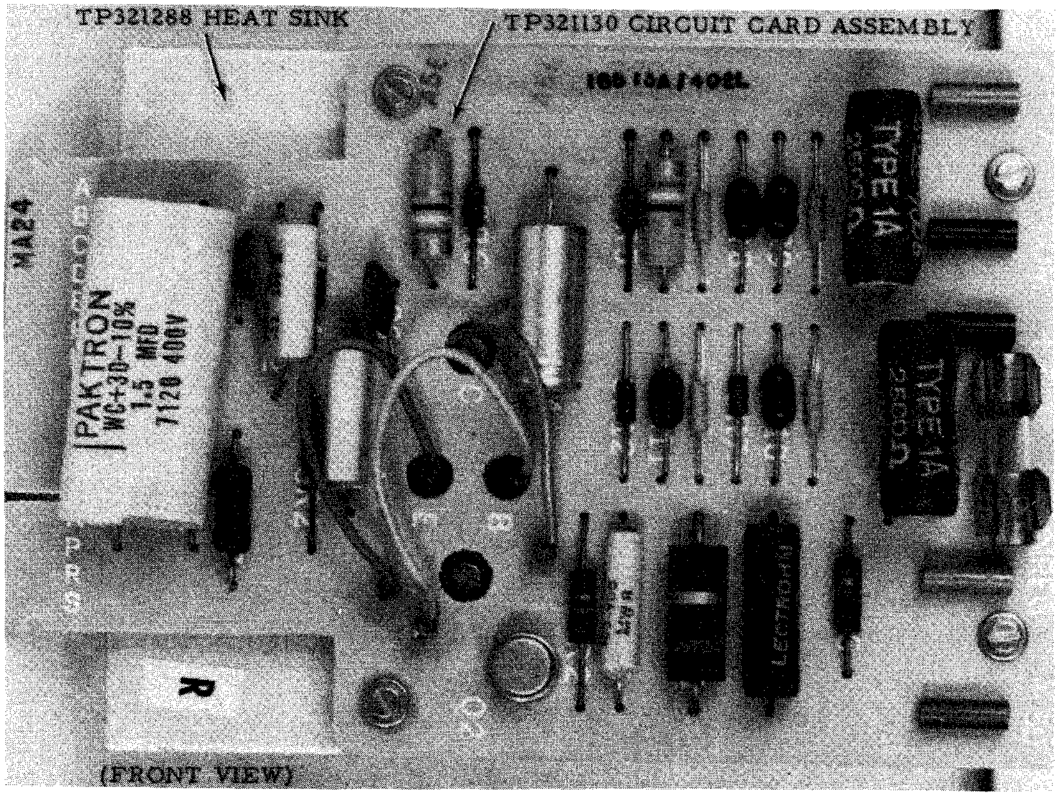


Figure 3-53. Synchronous Pulsed Transmission Mechanism

description for the operation of the ESA used in the set.

a. ESA Using 0.5-Ampere Power Supply Card. Refer to figure 5-26 for the power supply card schematic diagram. Power supply transformer T1, diodes CR1, CR3, and power supply rectifier filter capacitor C8 form a full-wave rectifier to obtain a minimum of 58 volts unregulated dc. Transistors Q1 and Q2 form a two-stage series voltage regulating element. Both transistors are always conducting, with the base-emitter drop of each transistor at approximately 0.7 volt. The voltage drop across R2 is negligible. (Resistor R2 is used in conjunction with capacitor C5 for RFI noise suppression.) In effect, the emitter of Q1 is clamped to the same potential as the reference diode combination CR7 through CR12, ie, the dc output of Q1 is nominally 47 volts. The difference between the Q1 dc output and the unregulated dc appears across the collector-emitter junction of Q1. Figure 3-54 shows both front and rear views of this circuit card. Transistor Q2 is a gain stage for Q1. Resistor R1 limits the current that divides between the CR7 through CR12 reference diodes and the base of Q2. The base current of Q1 or the collector current of Q2 is equal to the base current of Q2 multiplied by the dc current gain (HFE) of Q2. Resistor R7 acts as a bleeder and assures that Q1 and Q2 will conduct even when no load is connected across the output terminals. Without R7 and no load connected, the output would rise to the same value as the unregulated dc. However, a minimum load of 0.150-ampere must also be applied to maintain the +53 volt regulation limit. The +7-volt output is obtained by dropping the unregulated dc voltage across resistor R4 to supply the Zener reference diode CR6 which is connected across the output. Resistor R5 and Zener diode CR5



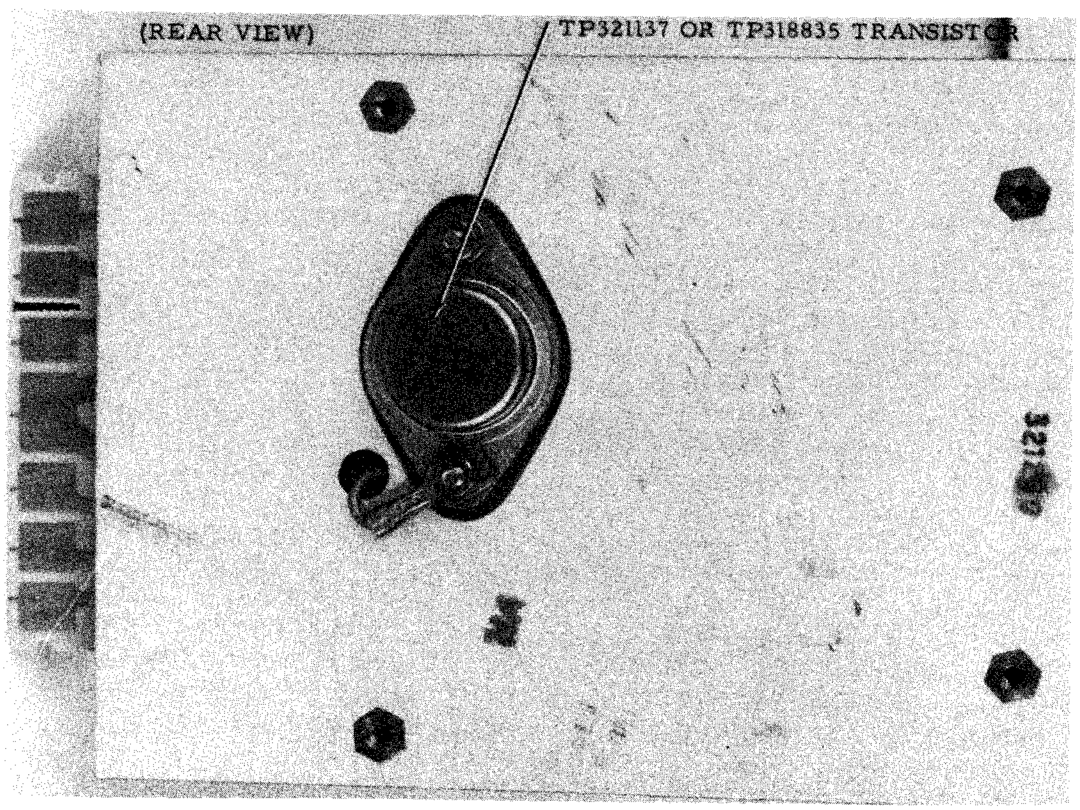


Figure 3-54. Power Supply, One-Half-Ampere, TP321290

provide a -7-volt output in the same manner previously described. However, a full-wave rectifier consisting of rectifier diodes CR2 and CR4 and capacitor C4 is required to obtain the negative unregulated potential with respect to the circuit common. Capacitors C1 through C3 suppress RFI noise transients which occur due to rectifier switching. Capacitors C6 and C7 and inductors L3 and L4 suppress Zener diode noise. The transformer shields and a low-pass filter consisting of L1, L2, and C9 through C12 provide noise isolation between power line and power supply. The ESAs are normally wired so that one 250-ohm (25-watt) resistor is connected across the collecter-emitter of Q1 when each associated SMD or CMD is inserted in its connector to reduce power dissipation in Q1. (This is equivalent to paralleling Q1 and 250 ohms for each, approximately 0.150-ampere of load current.) Fuse F102 limits the output current to a total of 0.5 ampere.

b. ESA Using 1.5-Ampere Power Supply Card. Refer to figure 5-30 for the power supply card schematic diagram. Power supply transformer T1, diodes CR1, CR2, and power supply rectifier filter capacitor C101 form a full-wave rectifier to obtain a minimum of 58 volts unregulated dc. Transistors Q1 and Q2 form a two-stage series voltage regulating element. Both transistors are always conducting, with the base-emitter drop of each transistor at approximately 0.7 volt. The voltage drop across R2 is negligible. (Resistor R2 is used in conjunction with capacitor C4 for RFI noise suppression.) In effect, the emitter of Q2 is clamped to the same potential as the reference diode combination CR3 through CR8, ie, the dc output of Q2 is nominally 47 volts. The difference between the Q2 dc output and the unregulated dc appears across the collector-emitter junction of Q2. Transistor Q1 is a gain stage for Q2. Resistor R1 limits the current that divides between CR3 through CR8 reference diodes and the base of Q1. The base current of Q2 or the collector current of Q1 is equal to the base current of Q1 multiplied by the dc current gain (HFE) of Q1. Resistor R4 acts as a bleeder and assures that Q1 and Q2 will conduct even when no load is connected across the output terminals. Without R4 and no load connected, the output would rise to the same value as the unregulated dc. Capacitor C1 through C3 suppress RFI noise transients which occur due to rectifier switching. The transformer shields and a low-pass filter consisting of L1, L2, and C102 through C105 provide noise isolation between power line and power supply. Fuse F102 limits the output current to a total of 1.5 ampere.

c. Selector Magnet Driver (SMD). The following electrical theory requires reference to figure 3-55 and the schematic diagram in figure 5-28. The TP323810 selector magnet driver (SMD) is basically a direct-coupled amplifier providing a current gain of approximately 80 db. The first two stages (Q1, Q6, or Q5, Q7) provide the necessary gain to drive a Schmitt trigger (Q8 and Q9). Transistors Q2 through Q4 comprise a power regulator stage which provides the power supply with a constant load. In the marking state with a positive voltage with respect to common applied to each input (or a

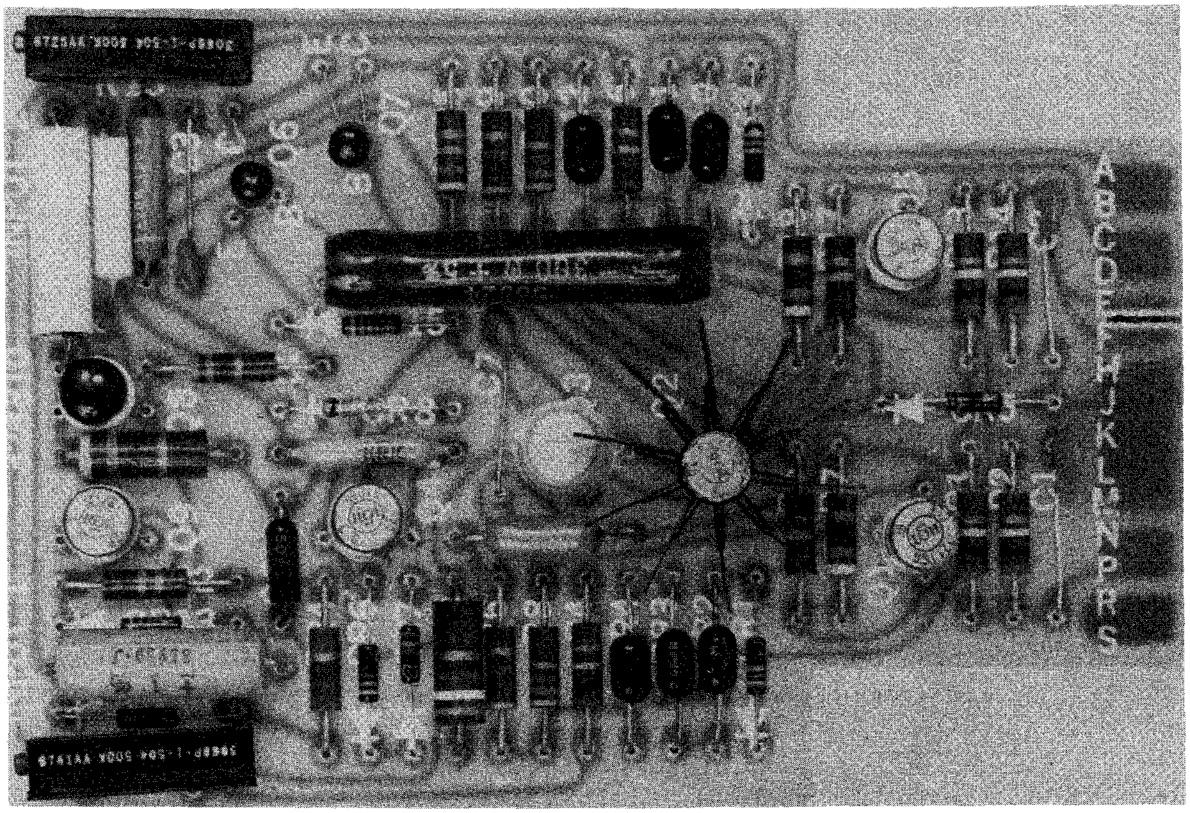


Figure 3-55. Selector Magnet Driver (SMD), TP323810

positive voltage on one input, the other open), Q1 and Q5 conduct, which in turn saturate Q6 and Q7. In this marking state, the voltage drop from the emitter of Q6 to the collector of Q7 is less than the voltage drop from the CR15 anode to the Q8 emitter. Under this condition, the base-emitter junction of Q8 is reverse-biased, thus turning Q8 off. With Q8 off, the Q9 base will conduct through R26 and thus energize the external selector magnet in the collector circuit. Transistor Q9 base current is sufficient to saturate the collector. In this condition, selector magnet current is determined primarily by the value of the limiting resistor R23 and the power regulator output voltage. In the spacing state, with a negative voltage on input 1, input 2, or both inputs, the respective input transistor or transistors (Q1, Q5) are off. In this condition Q6-Q7 collector current is cut off and the base of Q8 conducts. Transistor Q8 base current is sufficient to saturate the collector. The Q8 emitter-collector saturation voltage is less than the forward drop across CR13 thus reverse biasing the base emitter junction of Q9. With this junction reverse biased, Q9 collector current is cut off and the selector magnet is de-energized. Because of the difference in magnitude of Q8 and Q9 load currents, the drop across R21 will be greater in the marking state than in spacing. This means that the input voltage to the third state (Q6 VCE + Q7 VCE) necessary to change the state of Q8 will be different depending on the previous state. Specifically, a larger combined Q6 and Q7 collector-emitter voltage is required to turn on Q8 than to turn off Q8. This hysteresis, peculiar to Schmitt triggers, enables positive driver input signals to energize the selector coil and negative going input signals to de-energize the coil. Resistors R4, R16, and potentiometers R3 and R15 serve to bias Q1 and Q5 and set the center of the switching interval. Emitter resistors R7 and R18 assist in gain stabilization. Resistors R6, R8, R19, and R20 form voltage dividers to bias CR2 through CR4 and CR10 through CR12. These diodes exhibit temperature characteristics such that together with R7 and R18, effective temperature compensation is obtained to stabilize the switching level of the SMD. Diode CR5 establishes a voltage reference for the first stages to ensure switching level stability. When low-resistance transmitters (about 100 ohms) are used to key the driver, R1 and R13 have no significant effect of the operation of the circuit. However, when the line resistance is high (open line), R1 and R13 apply sufficient bias to drive Q1 and Q5 into conduction. This operation will maintain the terminal equipment in the idle state when input lines are open, or will allow single-line operation by simulating a marking signal on the other input. In the power regulator, CR8 and the base-emitter junction of Q4 establish a voltage reference for R11 which determines the current drain of the unit. Diode CR6, CR7 and the base-emitter junction of Q3 serve to clamp the Q4 collector at a low voltage so as to minimize power dissipation in Q4. As the power requirement of the circuitry following the regulator decreases, the output voltage of the regulator will begin to rise. This rise corresponds to a decrease in Q4 collector-base voltage. The effect is to increase the forward bias on the base-emitter junction of Q3 and cause increased collector conduction. This collector current increases the conduction of Q2 whereby Q2 and R10 absorb the excess power. Q2 functions as a variable resistance so as to maintain a constant resistance across the output of the regulator regardless of the state of the driver circuitry. As a consequence of this, the power supply sees a constant load, regardless of driver state. Capacitors C4 and C5 provide negative feedback to reduce transient generation in the driver. Capacitors C3 and C7 and C8 are radio-frequency bypass capacitors to eliminate any parasitic oscillations that may occur as a result of switching.

d. <u>Low-Level Keyer (LLK)</u>. The principles of operation of the TP303142 keyer circuit card are described in the following paragraphs. Refer to figure 3-56 for a front view of the TP303142 circuit card and figure 5-24 for a schematic diagram. The TP303142 low-level keyer is a neutral-to-polar converter which, by means of passive and active filtering, shapes the output waveform. In the marking state the signal generator contact is open and Q1 conducts to a level established by resistors R1, R2, and R11. Transistor Q1 conducts sufficient current to saturate the collector of Q2 which rises to slightly less than the positive supply voltage. With Q2 conducting, Q4 and Q6 also

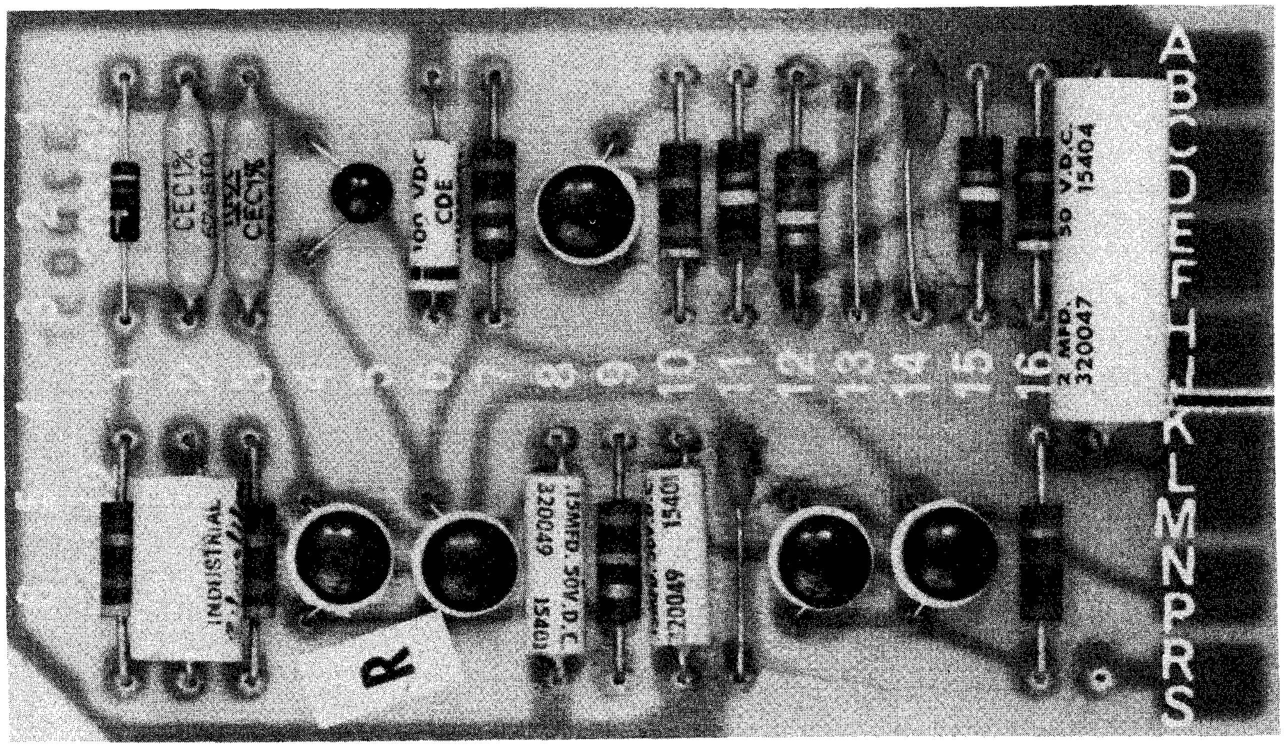


Figure 3-56. Low-Level Keyer, TP303142

conduct. Transistor Q4 base current (equal to the total output load current divided by the product of Q4 and Q6 gains) is small and consequently the voltage drops across R6, R10, and R7 are insignificant. Transitor Q6 base current (equal to total output load current divided by the gain of Q6) is also small resulting in an insignificant voltage drop across R8. Thus, the output voltage is the power supply voltage minus the sum of Q2 voltage with collector-emitter saturated, Q4 base-emitter voltage and Q6 base-emitter voltage. The drop across R9 for normal output loads is insignificant. In the spacing state the signal generator contact is closed. In this state R1 is shunted by the series combination of R13 through R15 thus reducing Q1 base voltage below the emitter voltage established by the voltage divider R3, R11. With the emitter being at a higher potential than the base, Q1 is turned off. With Q1 off, Q2 is off and its collector voltage approaches the negative supply voltage. In this state Q3 and Q5 conduct. For the same reasons as in the marking state, the output voltage is primarily a function of Q3 base-emitter voltage and Q5 base-emitter voltage. Diode CR1 is added to compensate the unsymmetrical properties associated with the second stage. During transitions, the nonsymmetric low-pass contact filter prefilters the input to the keyer. In addition, common mode effects due to the unbalanced strap capacitance of the contact assembly, are reduced. Capacitors C1 and C6 limit the high-frequency response of states 1 and 2, thus providing additional shaping. Stage 3 (Q4 and Q3) is a low-pass active filter. By means of C2 charging and discharaging through the feedback network, consisting of R6, R10, R7, and C2, the rise and fall times are lengthened to produce an acceptable spectrum (from RFI standpoint). Capacitors C3, C5, and C5 provide additional shaping by bypassing undesirable frequency components generated in Q3, Q4, Q5, and Q6. C7 is a radio frequency bypass capacitor to decouple the power supply.

e. Power Supply Card. Two power supply circuit cards are employed in the ESA used with model 28 type equipment: one a 0.5-ampere, and the other a 1.5-ampere. The 0.5-ampere and 1.5-ampere circuit cards, when installed in a shielded electrical service assembly (ESA) containing the proper transformer and filter assembly, are intended as radio frequency interference (RFI) suppression power sources in systems requiring low-level RFI. Refer to paragraph 3-9.11a and b for theory of operation of an ESA using both types and to figure 3-54 for a front and top view of the TP321290 power supply circuit card. The following paragraphs explain the general operation of each power supply circuit card assembly when it is installed in an electrical service assembly (ESA). The transformer, filter, and the 1.5-ampere power transistor with heat sink are included as part of the ESA. For more detailed information, refer to the wiring diagram package of the specific set that is used.

(1) Power Supply (0.5-Ampere) Card. Transformer T1, capacitor C8, filter components L1, L2, C9, and C10 through C12 are all located in the electrical service assembly, not on the circuit card assembly. (Refer to figure 3-54 and schematic diagram in figure 5-26.) Transformer T1, diodes CR1, CR3, and capacitor C8 form a full-wave rectifier to obtain a minimum 58 volts unregulated dc. Transistors Q1 and Q2 form a two-stage series voltage regulating element. Both transistors are always conducting with the base-emitter drop of each transistor at approximately 0.7 volt. The drop across R2 (used in conjunction with C5 for noise suppression) is negligible. In effect, the emitter of Q1 (dc output) is clamped to the same potential as the reference diode combination CR7-CR12 (nominally 47 volts). The difference between the dc output and unregulated dc appears across the collector-emitter junction of Q1. Resistor R1 limits the current that divides between the CR7-CR12 reference diodes and the base of Q2, which is a gain stage for Q1. The base current of Q1 (Q2 collector current) is the base current of Q2 multiplied by the dc current gain (HFE) of Q2. Resistor R7 across the output acts as a bleeder and also assures that Q1 and Q2 will conduct even when no load is connected across the output terminals. Without R6, and output would rise to the same value as the unregulated dc with no load connected. The +7-volt output is obtained by dropping the unregulated dc voltage through resistor R4 to supply the Zener reference diode CR6, which appears across the output. R5 and CR5 provide -7-volts in a similar manner; however, a full-wave rectifier

consisting of rectifier diodes CR2, CR4, and capacitor C4 is required to obtain the negative unregulated potential with respect to circuit common. Capacitors C1 through C3 are used to suppress noise transients which occur due to rectifier switching. Capacitors C6 and C7 and inductors L3, L4 suppress Zener diode noise. A low-pass filter consisting of L1 through C12, and transformer shielding are used to obtain noise isolation between power line and power supply.

(2) Power Supply (1.5-Ampere) Card. Transformer T1, capacitor C101 and low-pass filter components L1, L2, C102 through C105, transformer shielding, and power transistor with heat sink Q2 (Q1 of ESA) are located in and are parts of the associated electrical service assembly. (Refer to figure 3-54 and schematic diagram in figure 5-30.) Transformer T1, diodes CR1, CR2, and capacitor C101 form a full-wave rectifier to obtain a minimum +58-volt unregulated dc. Transistors Q1 and Q2 form a two-stage series voltage-regulating element. Both transistors are always conducting with the base-emitter drop of each transistor at approximately 0.7-volt. the drop across R2 (used in conjunction with C4 for noise suppression) is negligible. In effect, the emitter of Q2 (dc output) is clamped to the same potential as the reference diode combination CR3 and CR8 (nominally 47 volts). The difference between the dc output and unregulated dc appears across the collector emitter junction of Q2. Resistor R1 limits the current that divides between the CR3 and CR8 reference diodes and the base of Q1, which is a gain stage for Q2. The base current of Q2 (Q1 collector-emitter current) is the base current of Q1 multiplied by the dc current gain (HFE) of Q1. Resistor R4 across the output acts as a bleeder and also assures that Q1 and Q2 will conduct even when no load is connected across the output terminals. Without R4, the output would rise to the same value as the unregulated dc with no load connected. Capacitors C1 through C3 are used to supress noise transients which occur due to rectifier switching. A low-pass filter (in ESA), consisting of L1, L2, C102 through C105, and transformer shielding, is used to obtain noise isolation between power line and power supply. Fuse F102 limits current output to a total of 1.5 amperes.

f. Electrical Theory (TP321991 CMD). All circuit references in the following paragraphs are made with respect to figure 3-57, the circuit board assembly drawing, and schematic diagram in figure 5-25. The driver is basically a direct-coupled amplifier providing a current gain of approximately 80 decibel. The first two stages (Q1 and Q2) provide the necessary gain to drive a Schmitt trigger (Q3 and Q4). Q5 and CR2 comprise a power regulator stage which provides the power supply with a constant load. In the marking state, with a positive voltage with respect to common applied to the input side of the Q1 base resistor R5, Q1 conducts, which in turn saturates Q2. In this condition, the sum of the voltage drops around the loop R14, Q2 collector-emitter and Q3 base-emitter is in a condition to reverse bias the base-emitter junction of Q3 and thus cut off

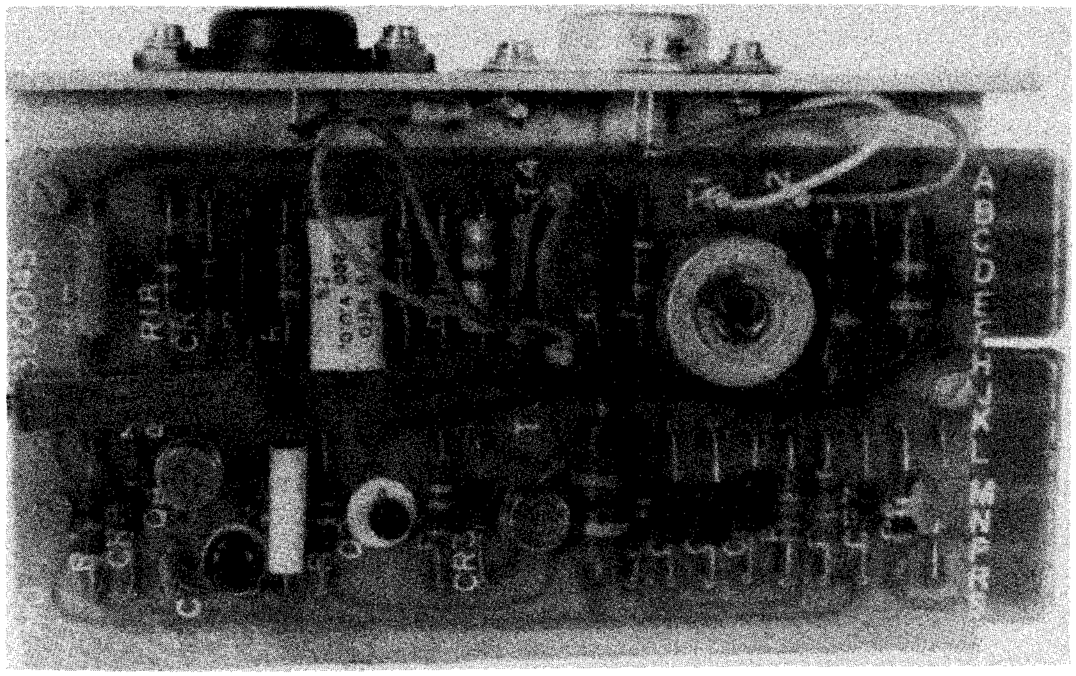


Figure 3-57. Clutch Magnet Driver (CMD) TP321991 for Low-Level Operation

Q3 collector current. The Q4 base current increases the voltage drop across R15 in order to satisfy loop conditions established by the power regulator voltage, R14, CR8, and Q4 base-emitter voltage. The Q4 base current is sufficient to saturate the collector. In this condition, load current is determined primarily by the load resistance, R17, and the power regulator output voltage. In the spacing state, with a negative input voltage, Q1 is cut off with reverse base-emitter bias established by the reverse transient protection diode CR3. With Q1 off, Q2 does not conduct. Consequently, to satisfy loop conditions established by R13, Q3 base-emitter, R14, and the regulator voltage, Q3 conducts to raise the voltage across R13. Base current is sufficient to saturate the Q3 collector. The Q3 collector-emitter voltage is less than CR8 voltage, which in turn reverse biases the base-emitter junction of Q4. With the latter junction reverse-biased, the Q4 collector is cut off. The collector circuit at Q2 has been interrupted and brought out to the connector contacts at the bottom of the card. This circuit must be completed externally or Q3 cannot be turned off and the magnet coils are held de-energized. The circuit thus affords a degree of local magnetic control. Because of the difference in magnitude of Q3 and Q4 load currents, the drop across R14 will be greater in the marking state than in spacing state. This means that input voltage to the third state

(Q2 VCE) necessary to change the state of Q3 will be different depending on the previous state. Specifically, a larger Q2 collector-emitter voltage is required to turn on Q3 than to turn off Q3. This hysteresis, peculiar to Schmitt triggers, enables positive driver input signals to energize and load coil and negative-going input signals to de-energize the load coil. Resistor R6 and potentiometer R7 serve to bias Q1 and set the center of the switching interval. Emitter resistor R8 assists in gain stabilization. R11 and R9 form a voltage divider to bias CR4 through CR6. These diodes exhibit temperature characteristics such that together with R8, effective temperature compensation is obtained to stabilize the switching level of the driver. CR7 establishes a voltage reference for the first stage to ensure switching level stability. When a low-resistance transmitter (about 100 ohms) is used to key the driver, R4 has little significance on the operation of the circuit. However, when the input resistance is extremely high, R4 applies sufficient bias to Q1 to cut it off. This operation will maintain the terminal equipment in the idle state when the input line is open-circuited. In the power regulator, CR1 and the base-emitter junction of Q5 establish a voltage reference for R1 and R2 which determines the current drain of the unit. As the driver demands less power from the regulator, such as being in the de-energized state, the excess current (excess over energized current) is shunted through Zener diode CR2. This operation maintains a relatively constant load for the external power supply. R2 is adjusted to set minimum CR2 current for voltage regulation. Coil L1 and capacitor C1 serve to reduce noise generated by Zener diode CR2. Capacitors C3 and C6 provide negative feedback to reduce transient generation in the driver. C5 and C7 are radio-frequency bypass capacitors to eliminate any parasitic oscillations that may occur during high-speed switching. Diode CR9, C4 and R16 form a transient-limiting network to protect Q4 from excessive reverse transient voltages present when switching inductive loads.

CHAPTER 4
SCHEDULED MAINTENANCE

4-1. INTRODUCTION. This chapter contains preventive maintenance and performance test procedures for the Keyboard Send-Receive (KTR) and Receive-Only (ROTR) Typing Reperforator Sets Model 28. The purpose of scheduled maintenance is to anticipate and eliminate potential trouble sources in an effort to minimize interruptions to service. Recommended preventive maintenance actions are tabulated in a scheduled maintenance action index along with suggested intervals of performance and references to paragraphs containing specific instructions for performing maintenance actions. The scheduled maintenance actions in this manual are cancelled when the Planned Maintenance System (PMS) is implemented for this equipment aboard your ship or station.

4-2. SCHEDULED MAINTENANCE ACTION INDEX. Table 4-1 lists scheduled maintenance action to be performed on KTR and ROTR sets. The Periodicity column indicates the interval and sequence of maintenance action performance. D denotes daily, W denotes weekly, M denotes monthly, Q denotes quarterly, and R denotes as required. The Maintenance Action column briefly describes the maintenance action to be performed. The Reference column lists the paragraph describing the maintenance action in further detail.

4-3. EQUIPMENT AND MATERIALS REQUIRED. The following equipment and materials are required to accomplish preventive maintenance and performance test procedures included in this chapter.

Clean, lint-free cloths.

Cleaning solvent: Trichloroethane O-T-620

Table 4-1. Scheduled Maintenance Action Index

Periodicity	Maintenance Action	Reference
M (Or after 150 hours of operation)	Inspect KTR and ROTR	4-5a
M (Or after 150 hours of operation)	Lubricate KTR and ROTR	4-5b
Q or R	Conduct performance tests	4-8

Lubricants: Oil, MIL-L-17672
Grease, MIL-G-23827

Test equipment and tools listed in table 1-3.

CAUTION

To clean gold contacts in units so equipped, pass a twill jean cloth between the closed contacts of the signal generator; avoid pulling the twill jean completely through the contacts. Open contacts to release the twill jean cloth. Use no other cleaning or burnishing methods. Avoid pitting or chipping the gold contact points. Do not touch the cleaned contact surfaces.

4-4. SAFETY PRECAUTIONS. The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

a. Keep Away From Live Circuits. Operating personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside the equipment with the primary power applied. Under certain conditions, dangerous potentials may exist when the power control is in the off position due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

b. Do Not Service Or Adjust Alone. Under no circumstances should any person reach into or enter the enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

c. Resuscitation. Personnel working with or near high voltage should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery.

4-5. PREVENTIVE MAINTENANCE PROCEDURES. The following paragraphs contain scheduled preventive maintenance procedures referenced in table 4-1.

a. Monthly Inspection. Inspect KTR or ROTR monthly or after 150 hours of operation as follows:

(1) Remove cover.

(2) Inspect all mechanisms for presence of a red, powdery substance which indicates lack of lubrication.

(3) Examine the KTR or ROTR for damaged parts and replace, if necessary.

b. Monthly Lubrication. If lack of lubrication is indicated, lubricate the typing reperforator and tape printer, base, and keyboard in accordance with instructions provided in paragraph 4-6.

NOTE

Typing reperforator and tape printer, base and keyboard should be lubricated every two days for a period of 12 days after cleaning solvent.

4-6. LUBRICATION. The following paragraphs provide lubrication instructions for Model 28 reperforator and tape printer units and associated reperforator and tape printer keyboards and bases. Lubricate intervals are specified in table 4-2. Intervals are based on speed of operation, and apply to keyboards and bases as well as the basic reperforator and tape printer units. Lubrication methods for typical units are presented in lubrication charts located at the end of this chapter. The lubrication charts consist of photographs and line drawings. Photographs show the general area to be lubricated. Callouts on the photographs refer to line drawings indicating each specific mechanism to be lubricated, and method of lubrication.

a. General Lubrication Instructions. Apply MIL-L-17672 oil wherever the use of oil is indicated. Apply MIL-G-23827 grease on all surfaces where indicated. If the function cam needle bearings are disassembled at any time, repack the bearings with TP195287 grease (Beacon 325 grease or its equivalent). The following symbols apply to the specific lubrication instructions indicated in the line drawings. All spring wicks and felt oilers should be saturated. The friction surfaces of all moving parts should be thoroughly lubricated. Over-lubrication, however, which will permit oil or grease to drip or be thrown on other parts, should be avoided. Take special care to prevent oil or grease from getting between armatures and pole faces or between electrical contact points. Apply a thick film of grease to all gears. Apply oil to all cams, including the camming surfaces of each clutch disc. Pull a piece of "BOND" paper between the armature and the pole pieces to remove any oil or foreign matter that may be present. Make certain that no lint or pieces of paper

Table 4-2. Lubrication Intervals - Typing Reperforator and Tape Printer Units, Typing Reperforator and Tape Printer Bases, and Typing Reperforator and Tape Printer Keyboards

Operating Speed (wpm)	Lubrication Interval
60	3000 hours or 1 year*
75	2400 hours or 9 months*
100 107	1500 hours or 6 months*

remain between the pole pieces and armature.

Symbol		Meaning
O	-	Apply MIL-L-17672 oil (O1 - apply drop of oil, O2 - apply two drops of oil, etc.)
G	-	Apply MIL-G-23837 grease
SAT	-	Saturate with MIL-L-17672 oil (felt washer, oilers, wicks, etc.)

WARNING

Disconnect or turn off power before applying any lubricant.

b. Lubrication Intervals. Lubricate the units just prior to placing them in service. After a few weeks in service, relubricate to make certain that all points receive lubrication. Thereafter, use the lubrication intervals specified in table 4-2.

c. Views. References to front, rear, left, right, etc., in the lubrication charts, apply to the units as viewed by the operator facing the unit. The photographs identify figure numbers referring to particular line drawings of mechanisms to show where these mechanisms are located on the unit. The line drawings indicate points to be lubricated and the kind and quantity of lubricant to be used. Parts in the line drawings are shown in an upright position unless otherwise specified.

d. Typing Reperforator Unit. Lubrication charts for a typical typing reperforator unit are in table 4-3 and presented in figures 4-1 through 4-47. Figures 4-21 through 4-24 show the basic units, figures 4-25 through 4-44 show variable features; figures 4-45 through 4-47 show the earlier design mechanisms.

e. Keyboards. Lubrication charts for typical typing reperforator and tape printer keyboards are indexed in table 4-4 and presented in figures4-48 through 4-76. Basic units are shown in figures 4-48 through 4-71. Variable features are shown in figures 4-72 through 4-76.

f. Bases. Lubrication charts for typical Model 28 reperforator and tape printer receive-only bases are indexed in table 4-5 and presented in figures 4-77 through 4-85 Specific lubrication procedures are provided as follows:

(1) Receive-only base (figures 4-77 through 4-81).

(2) Multiple-mounted receive-only base (figure 4-82).

(3) Auxiliary-mounted receive-only base (figure 4-82).

(4) Receive-only miniaturized reperforator base (figures 4-83 and 4-85).

(a) Sliding Subbase for receive-only miniaturized reperforator base (figure 4-85).

4-7. SCHEDULED PERFORMANCE TESTS. Scheduled performance tests consist of mechanical checks for high-level and low-

Table 4-3. Typing Reperforator and Tape Printer Lubrication Chart Index

Table 4-3. Typing Reperforator and Tape Printer Lubrication Chart Index - Continued

Table 4-3. Typing Reperforator and Tape Printer Lubrication Chart Index - Continued

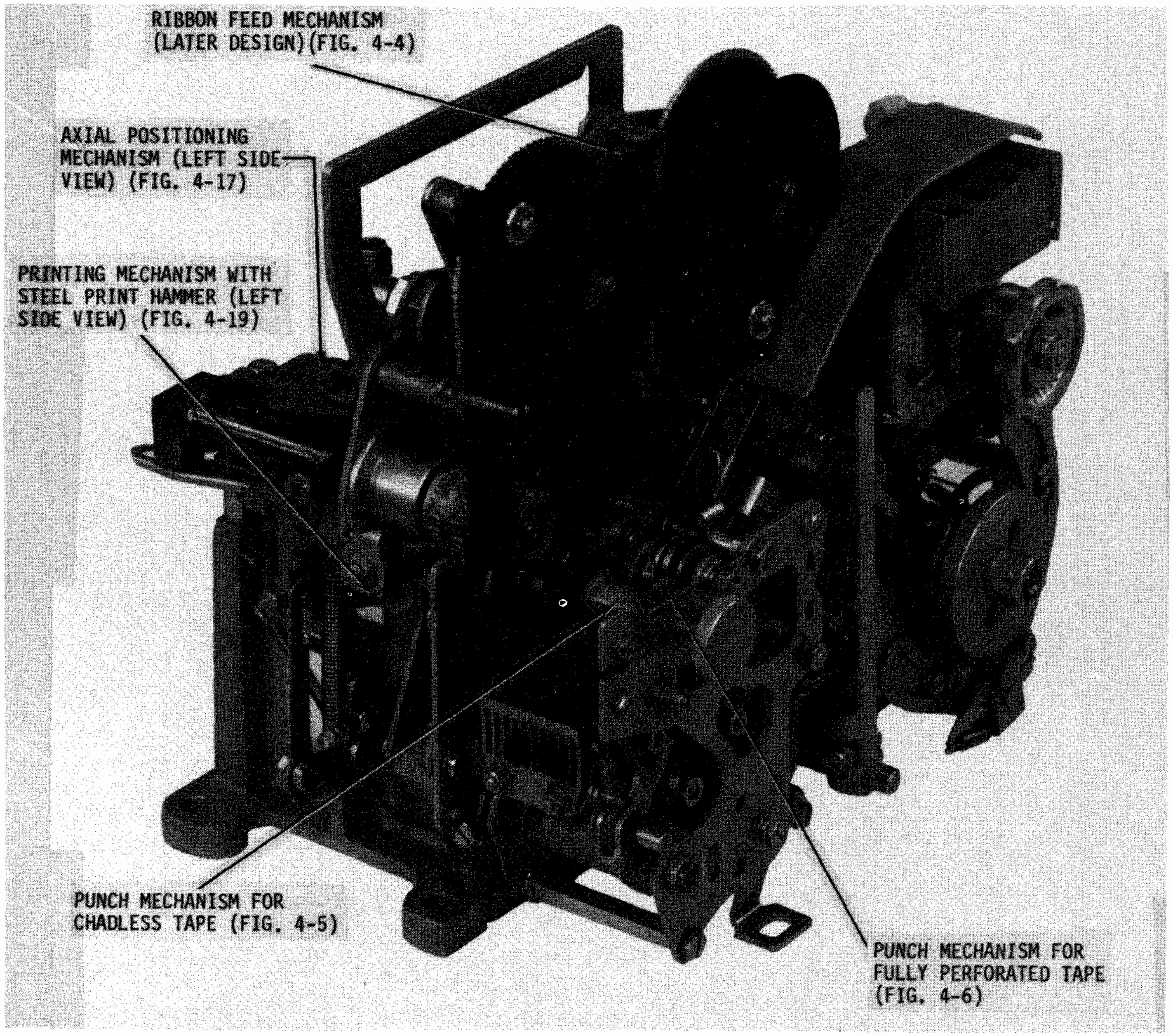
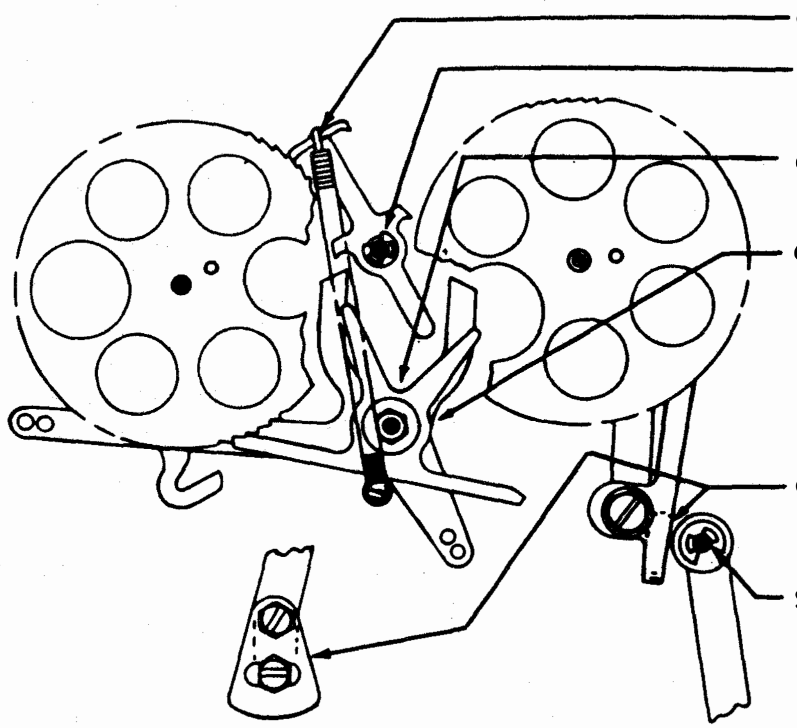
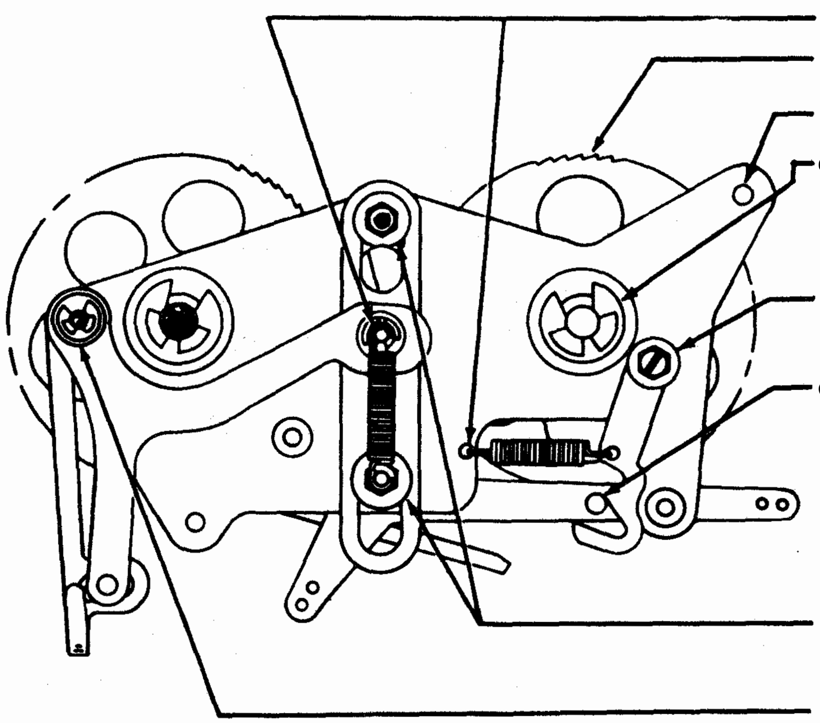


Figure 4-1. Typing Reperforator Unit, Front View



O1	HOOKS (2)	SPRING
O2	PIVOT POINT	FEED PAWL
O2	PIVOT	CHECK PAWL
O2	PIVOT POINTS (2)	REVERSING ARM
G	CONTACTING SURFACE	DRIVE ARM ADJUSTABLE EXTENSION
SAT	FELT WASHER	DRIVE ARM ROLLER

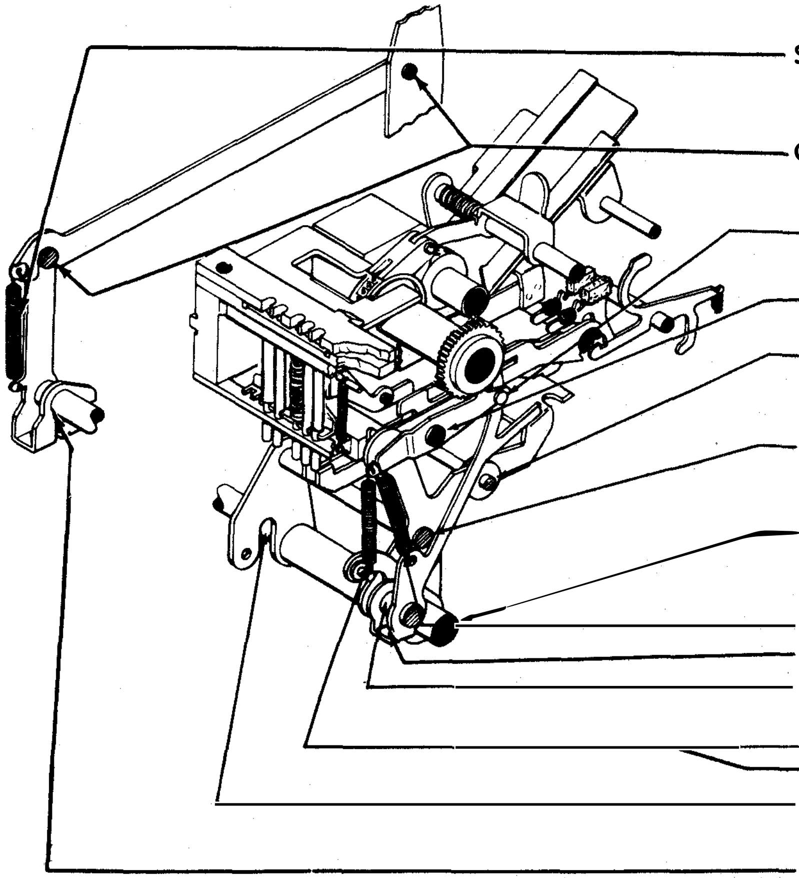
FRONT VIEW



O1	HOOKS (2)	SPRINGS (2)
G	TEETH	RATCHET WHEEL
O2	SHAFT	ROLLERS (2)
O2	SHAFT, FELT WASHERS	RATCHET WHEEL (2)
O2	PIVOT	DETENT
G	CONTACTING SURFACES	DETENT
O2	UPPER AND LOWER BUSHING	SLIDE LEVER
O2	PIVOT	DRIVE ARM

REAR VIEW

Figure 4-2. Ribbon Feed Mechanism, Later Design



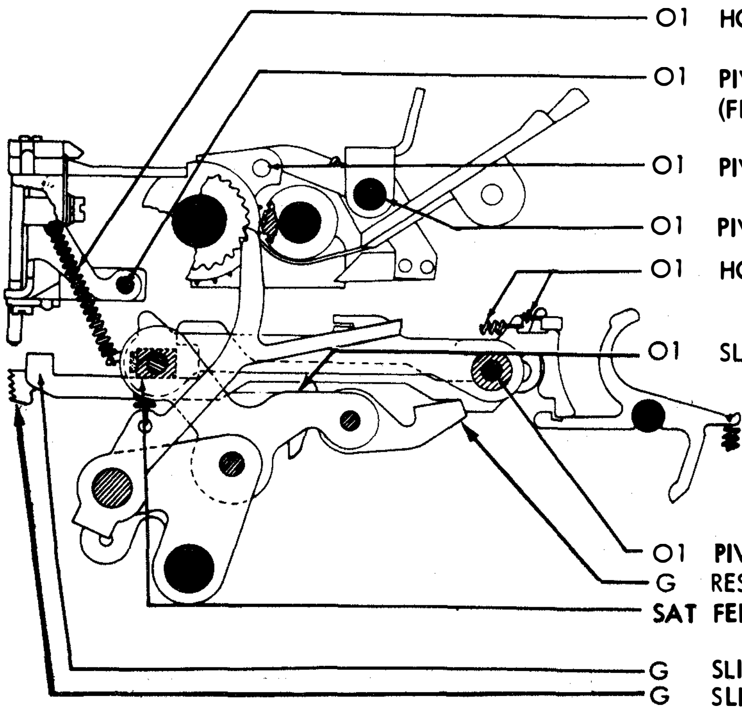
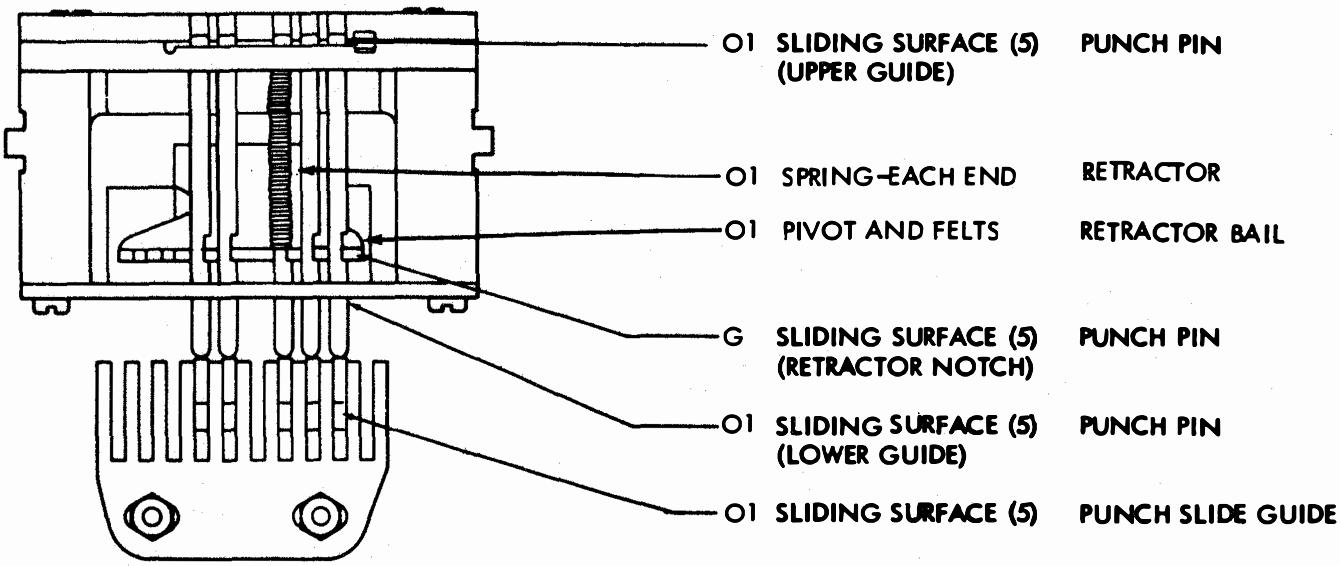


Figure 4-3. Punch Mechanism for Chadless Tape (Sheet 1 of 2)



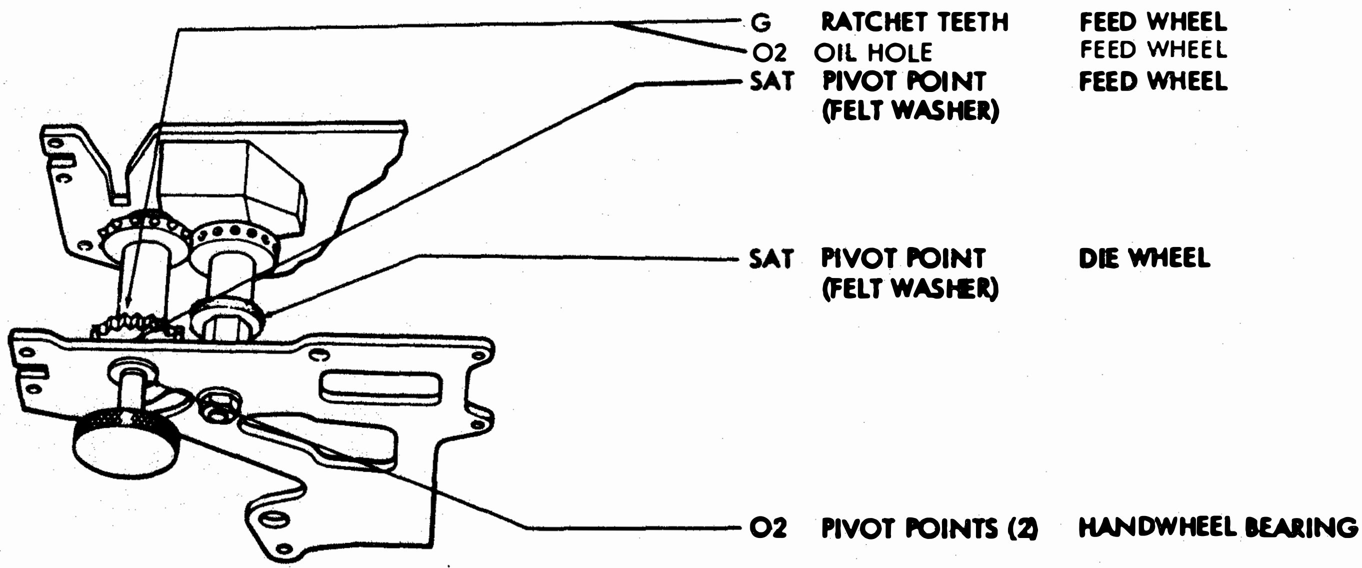
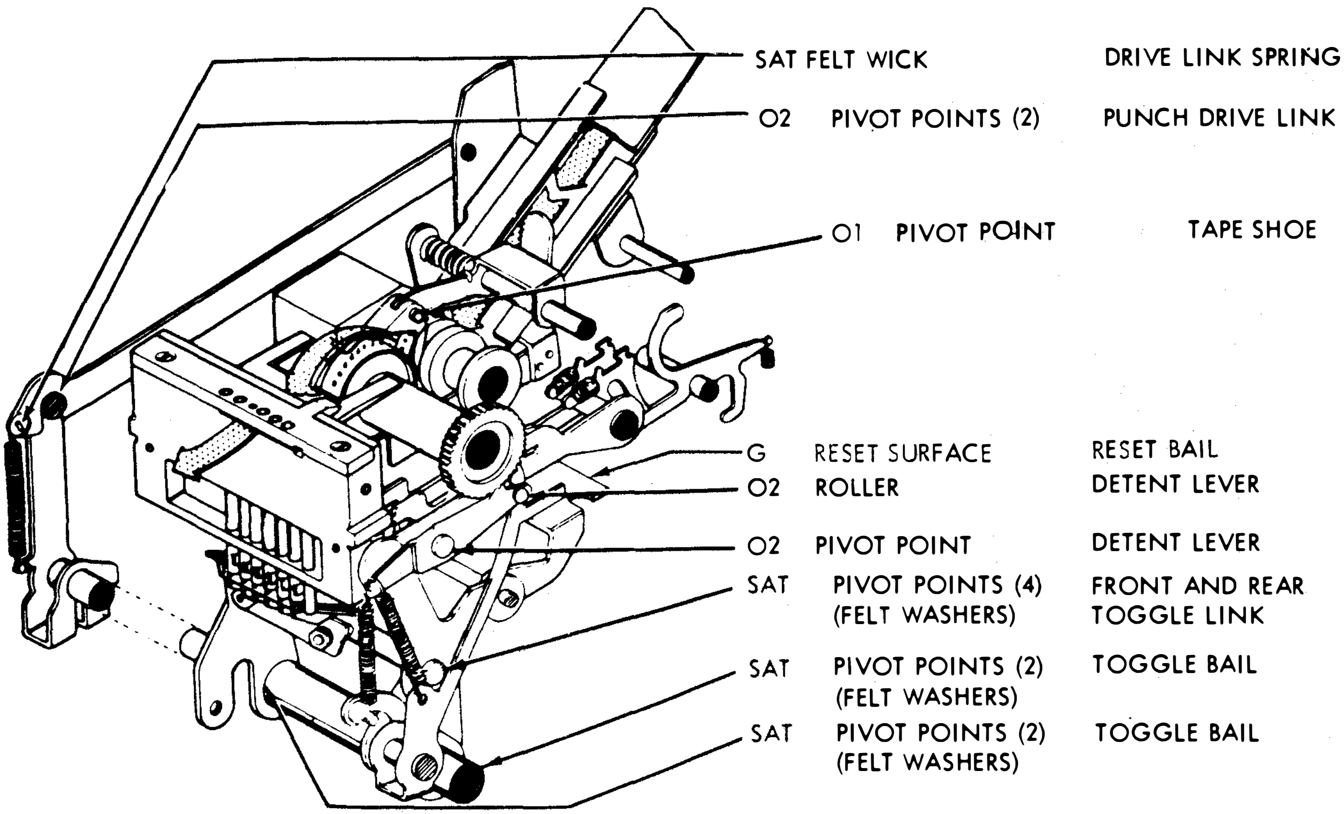


Figure 4-3. Punch Mechanism for Chadless Tape (Sheet 2 of 2)



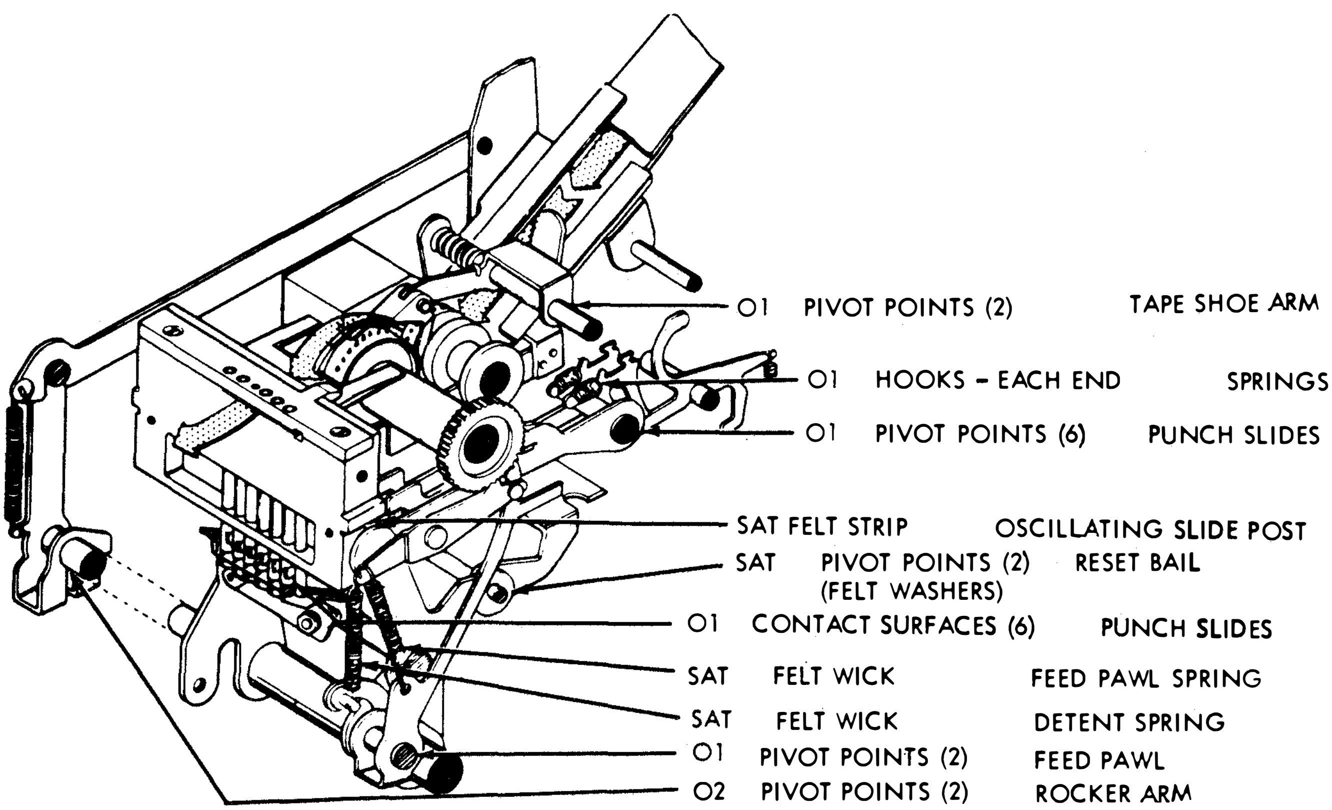
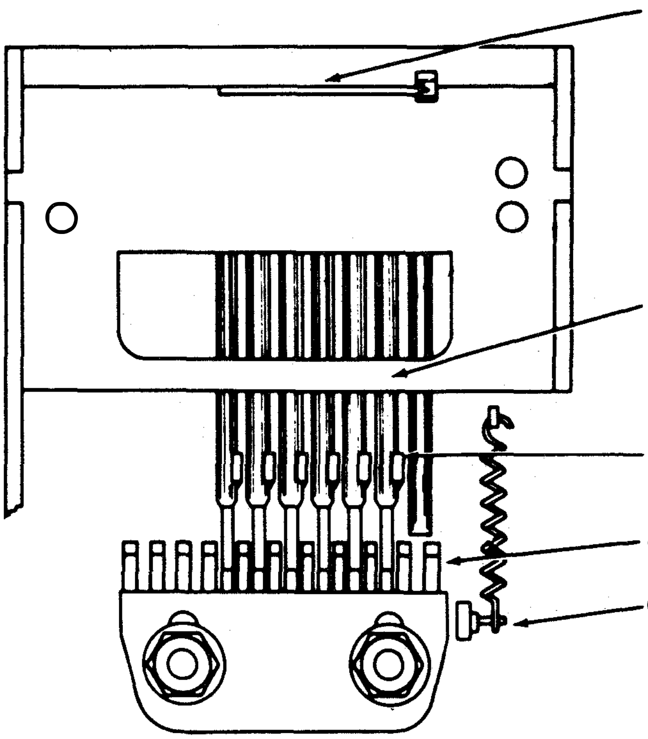


Figure 4-4. Punch Mechanism for Fully-Perforated Tape (Sheet 1 of 2)



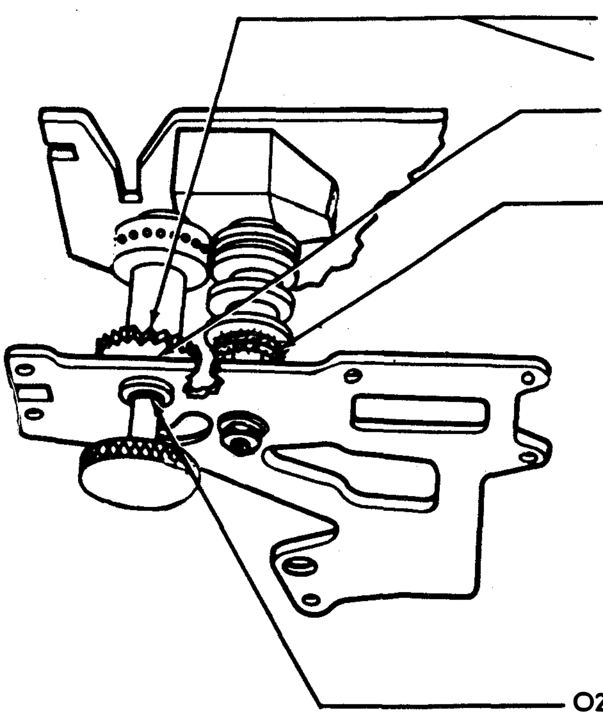


Figure 4-4. Punch Mechanism for Fully-Perforated Tape
(Sheet 2 of 2)

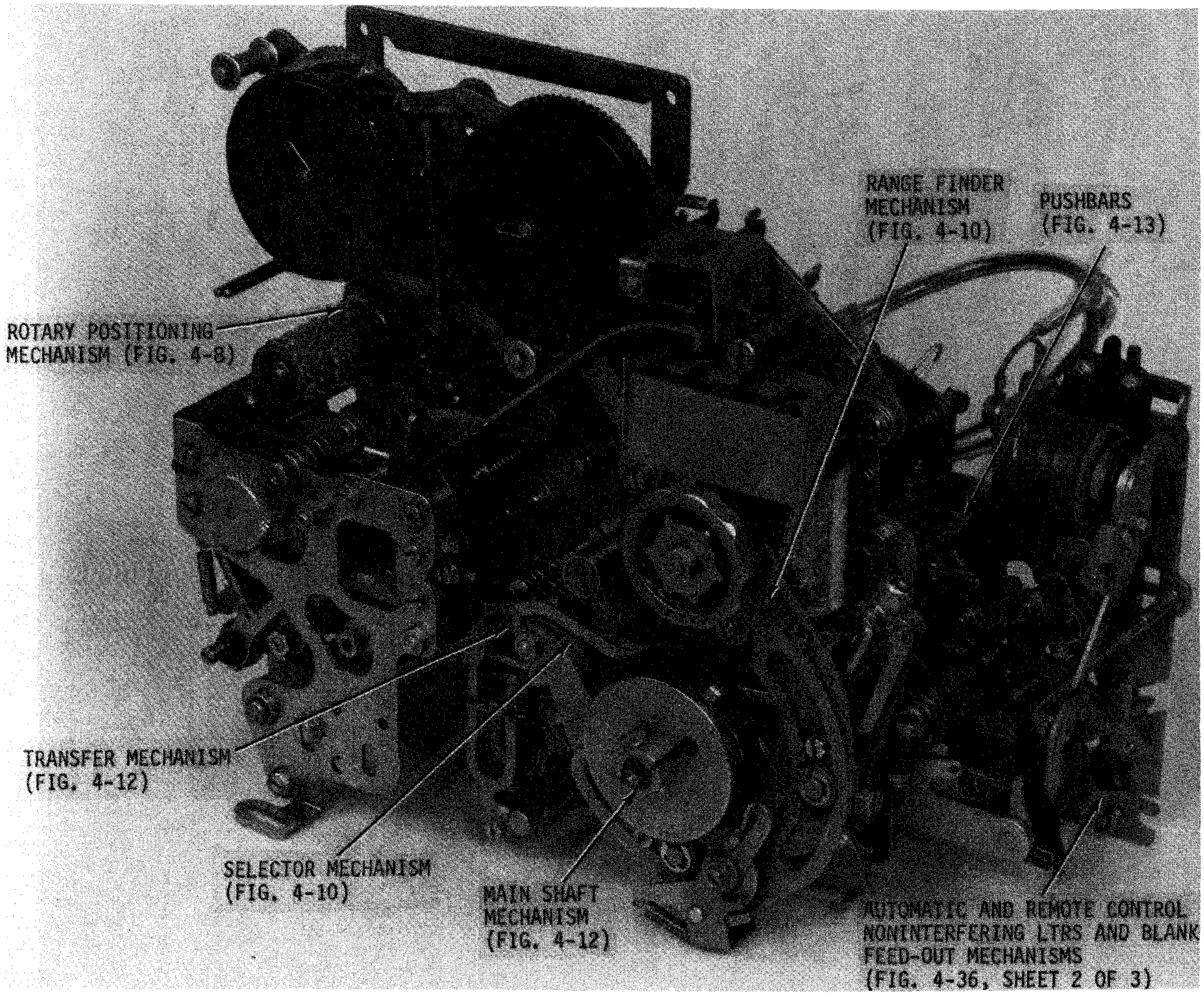


Figure 4-5. Typing Reperforator Unit

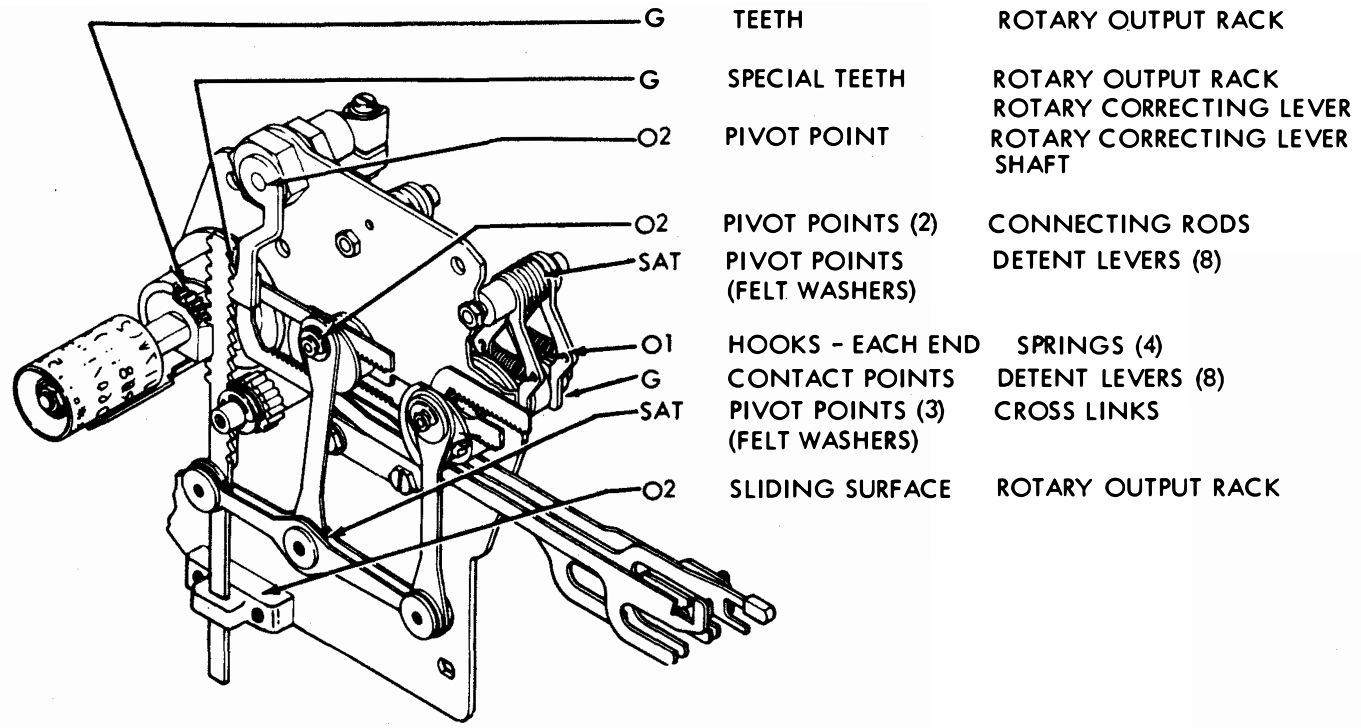


Figure 4-6. Rotary Positioning Mechanism

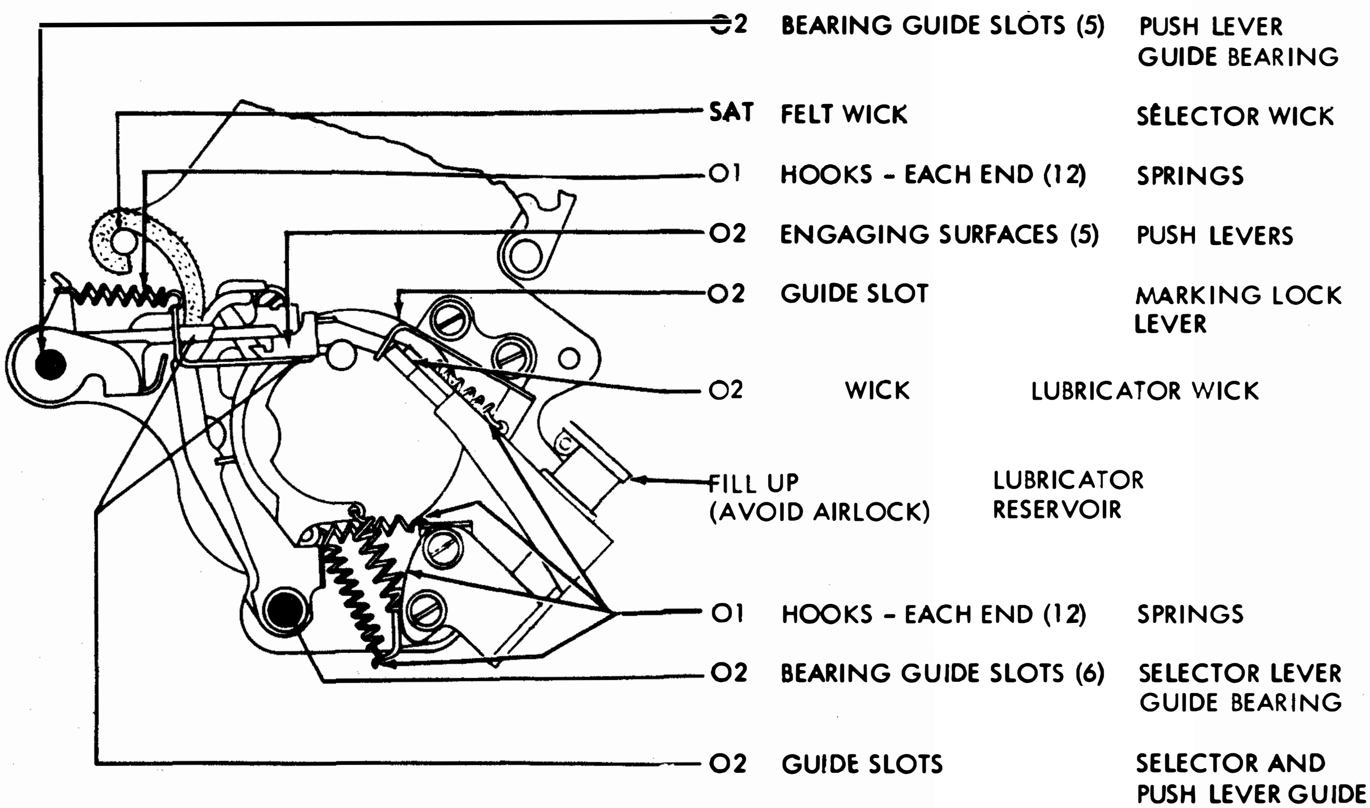


Figure 4-7. Selector Mechanism

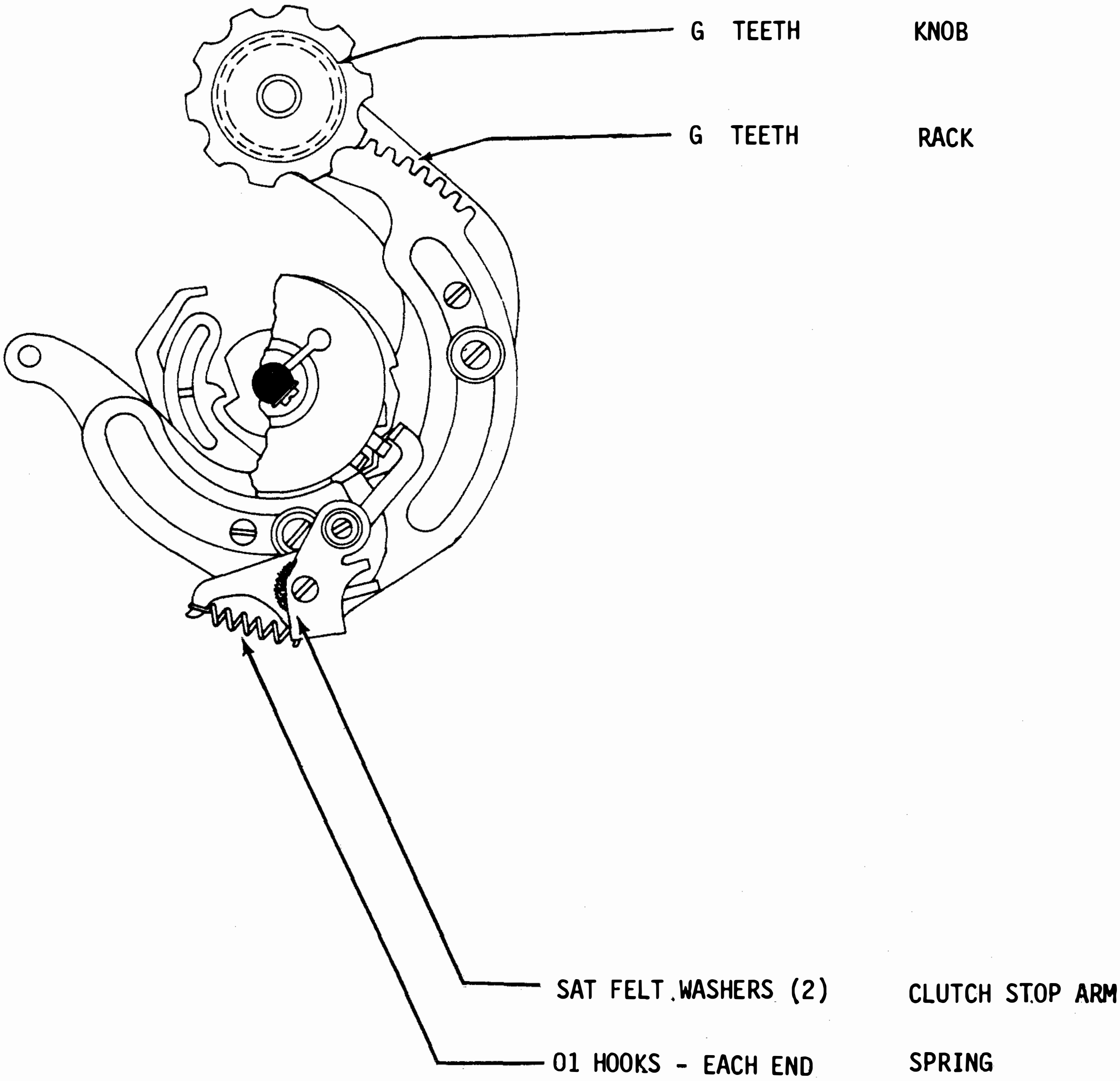
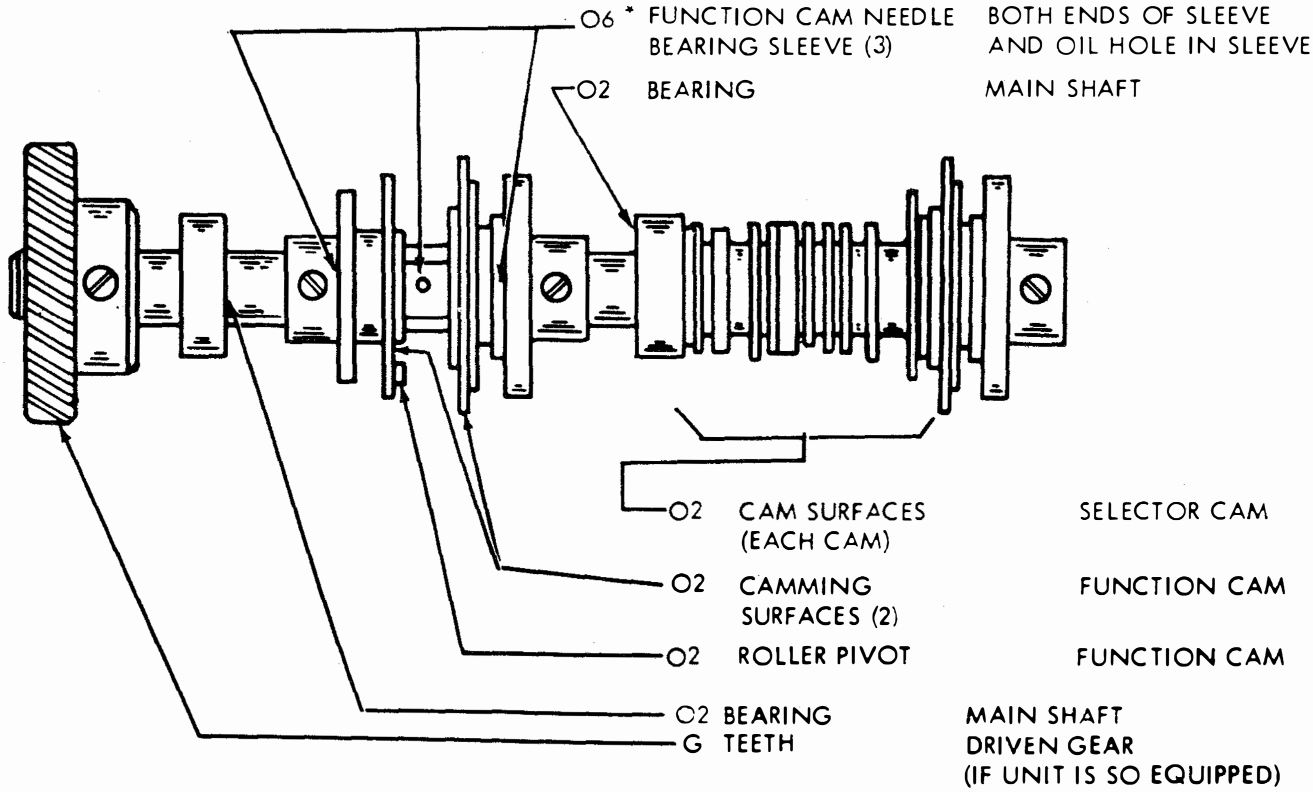


Figure 4-8. Range Finder Mechanism



*IF FUNCTION CAM NEEDLE BEARINGS ARE DISASSEMBLED AT ANY TIME, REPACK BEARINGS WITH GREASE (BEACON 325) (TP195298) OR ITS EQUIVALENT.

Figure 4-9. Main Shaft Mechanism

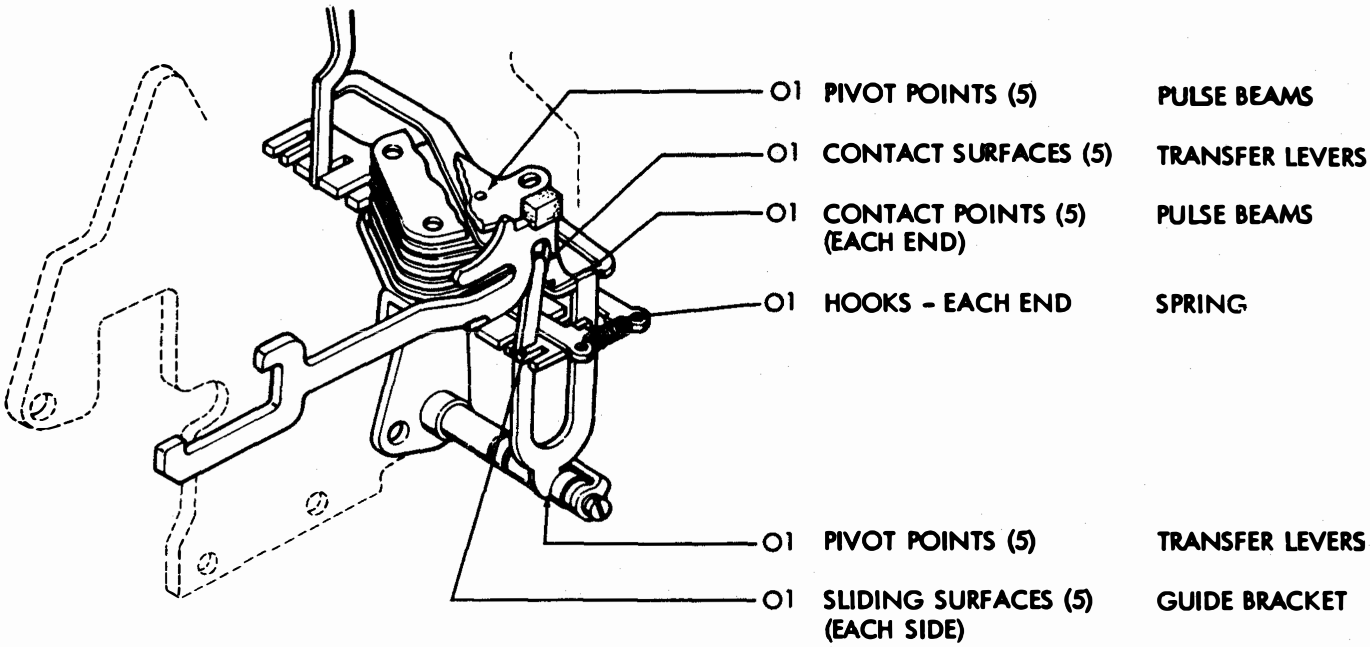


Figure 4-10. Transfer Mechanism

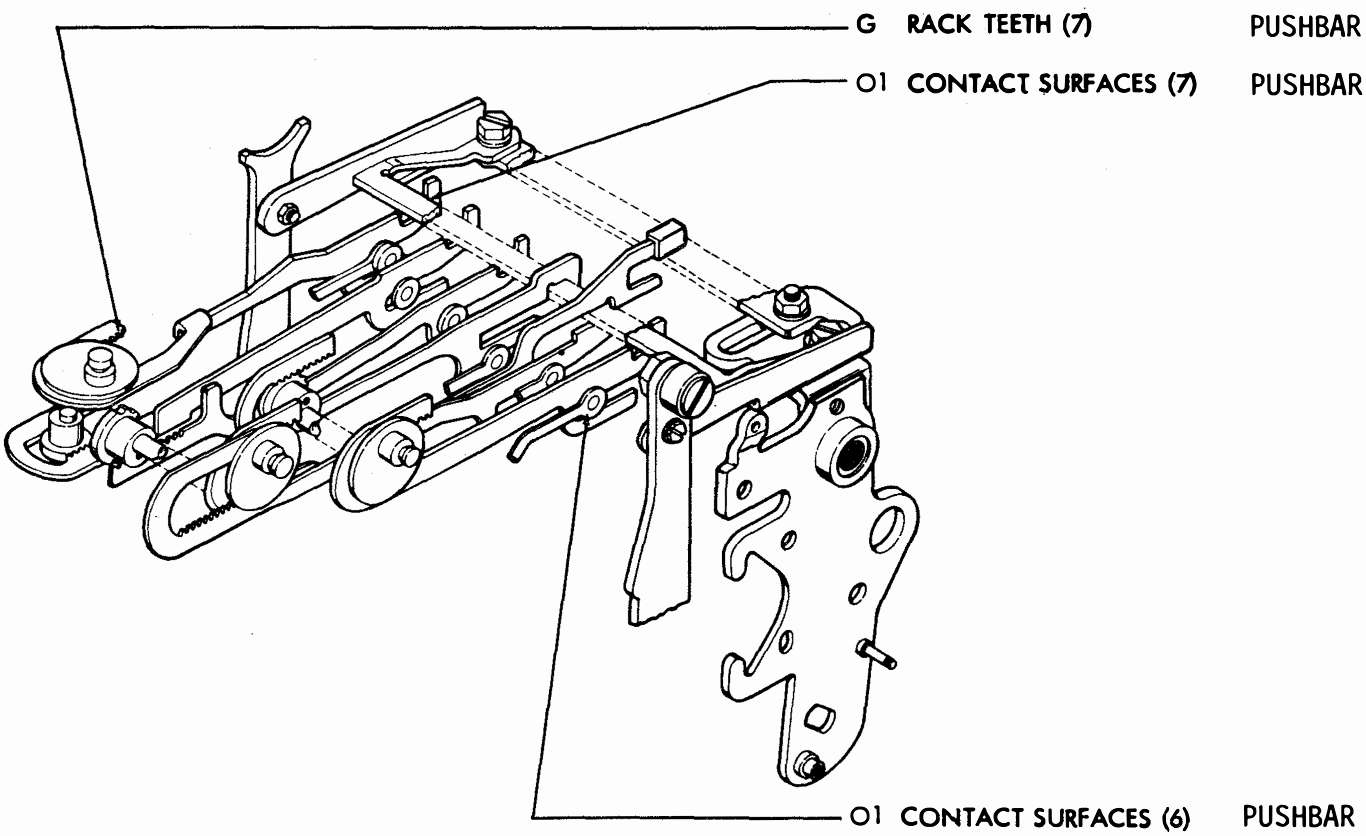


Figure 4-11. Pushbar

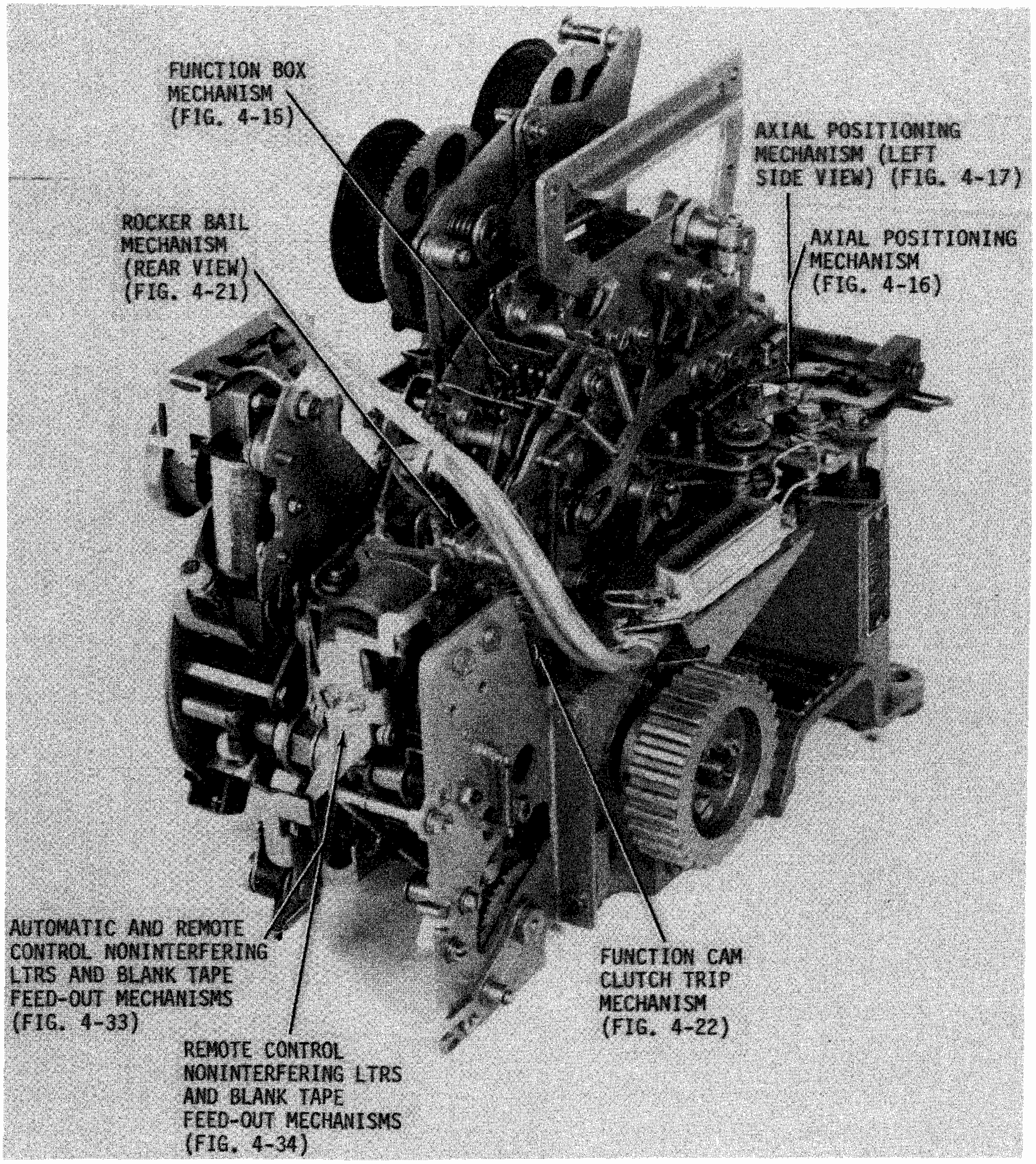


Figure 4-12. Typing Reperforator Unit, Right Rear View

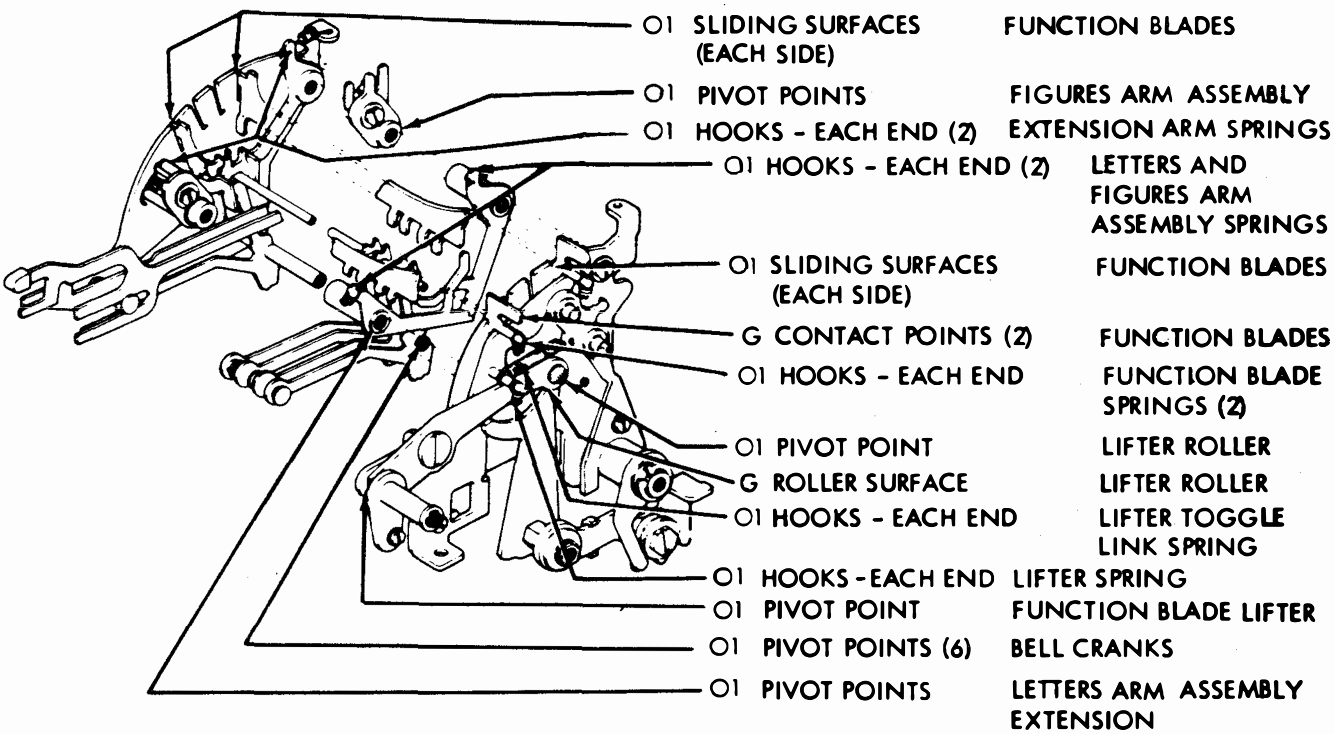


Figure 4-13. Function Box Mechanism

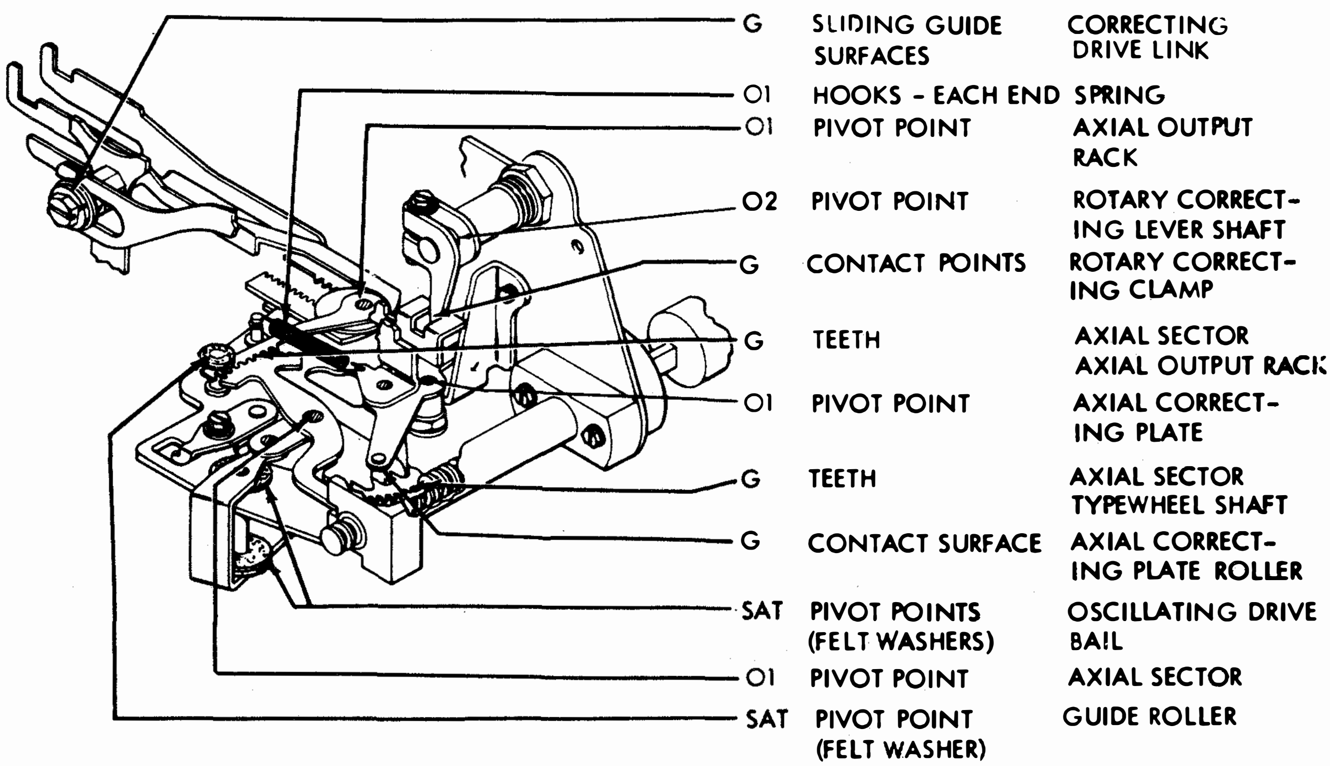


Figure 4-14. Axial Positioning Mechanism

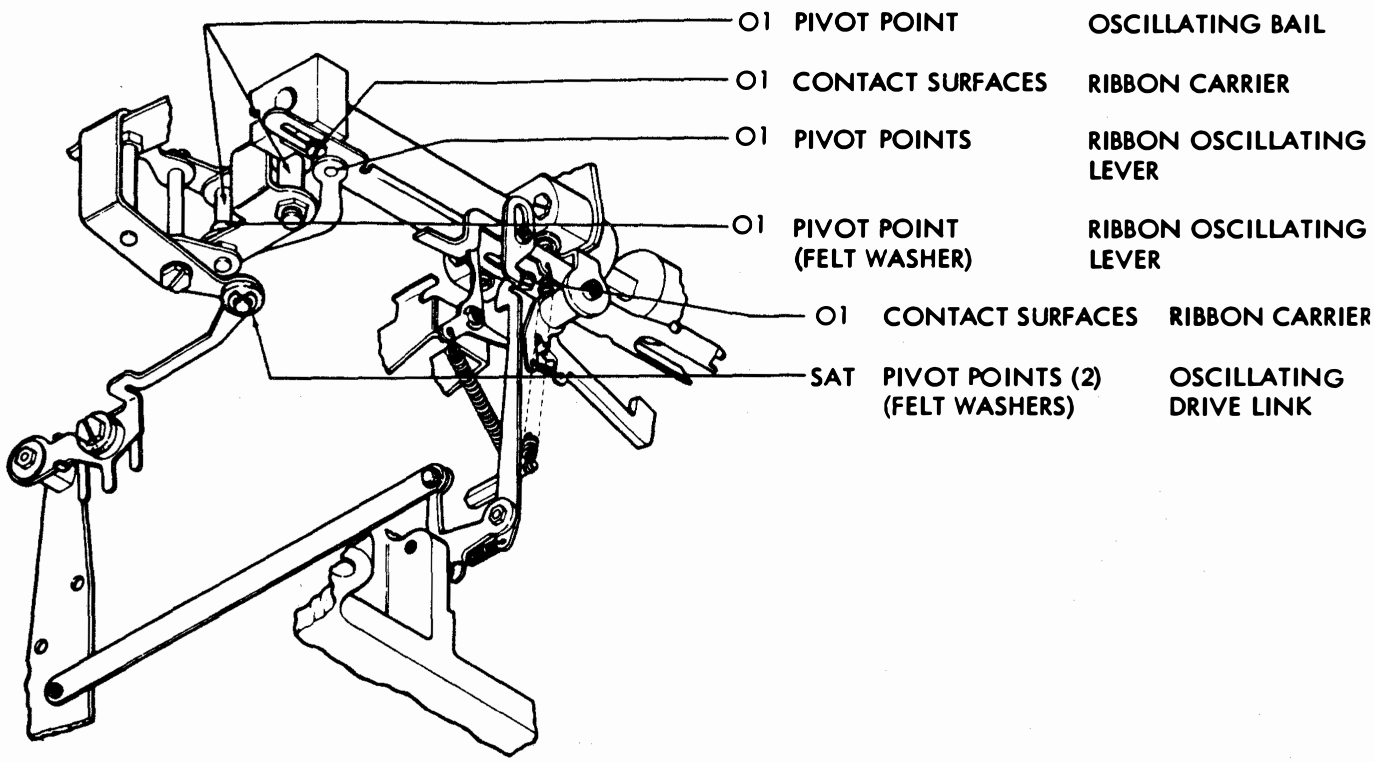


Figure 4-15. Axial Positioning Mechanism, Left Side View

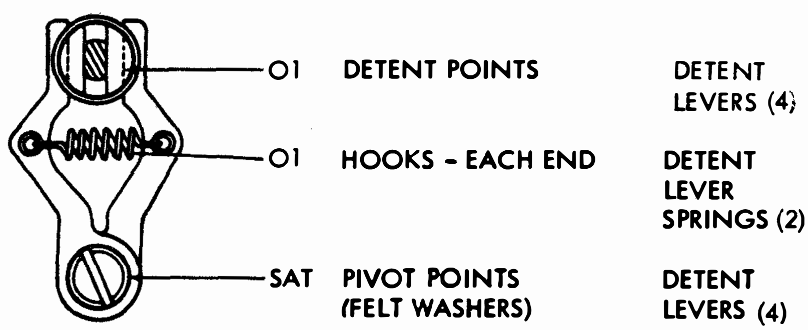


Figure 4-16. Detent Assemblies, Bottom View

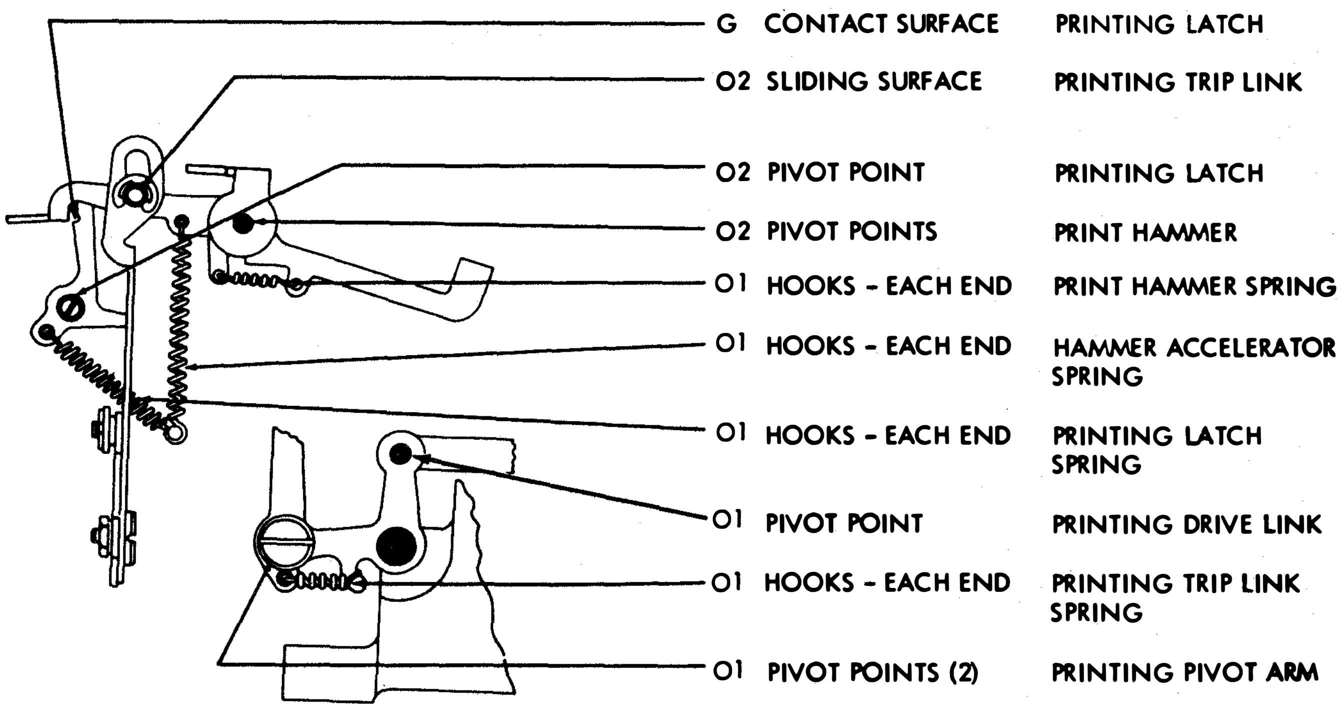
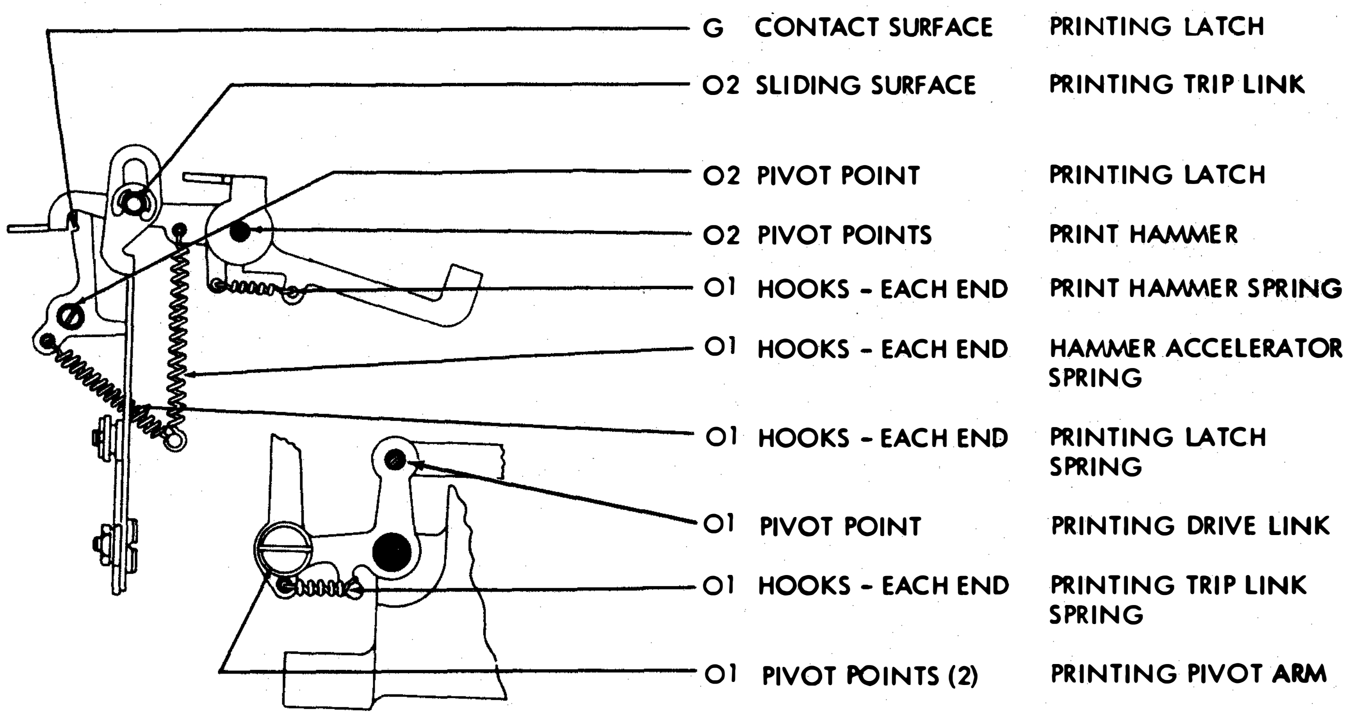


Figure 4-17. Printing Mechanism with Steel Print Hammer, Left Side View



NOTE

The printing mechanism with resilient print hammer (not illustrated) shall be lubricated in the same manner as the steel print hammer shown above but in addition, the felt washer between the resilient print hammer accelerator and the frame shall be saturated with oil in accordance with general lubrication procedures. Where a mechanism is equipped with print suppression parts, a thin film of grease shall be applied on print hammer stop at the point of contact with the point of contact with the print hammer lever.

Figure 4-18. Printing Mechanism with Resilient Print Hammer, Left Side View

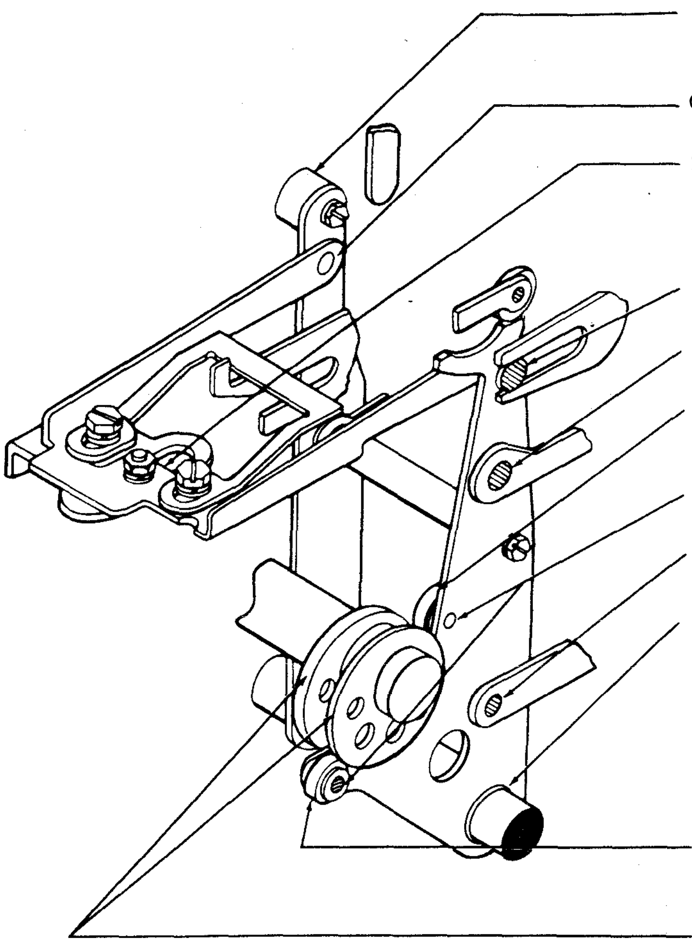


Figure 4-19. Rocker Bail Mechanism, Rear View

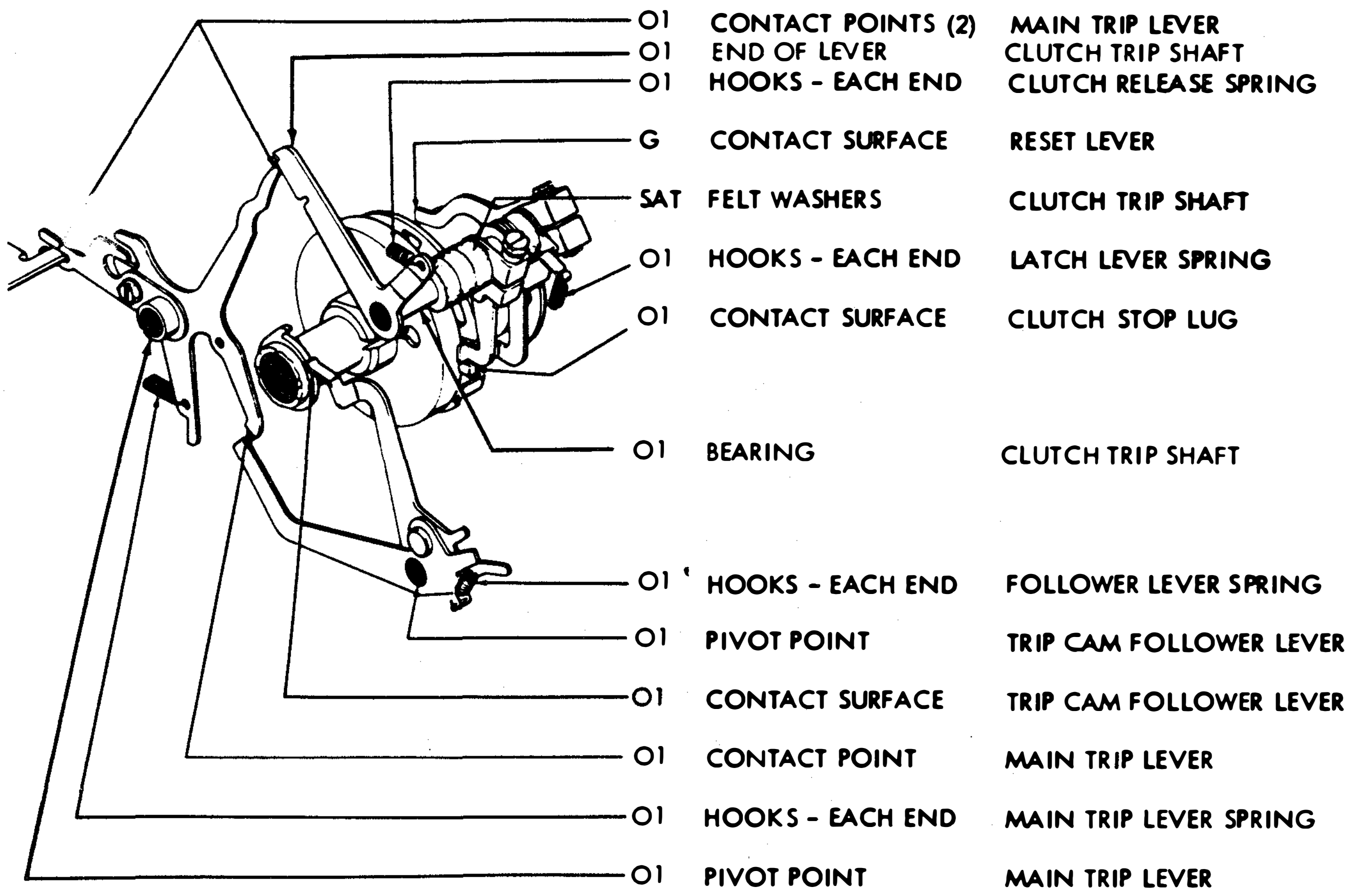


Figure 4-20. Function Cam Clutch Trip Mechanism

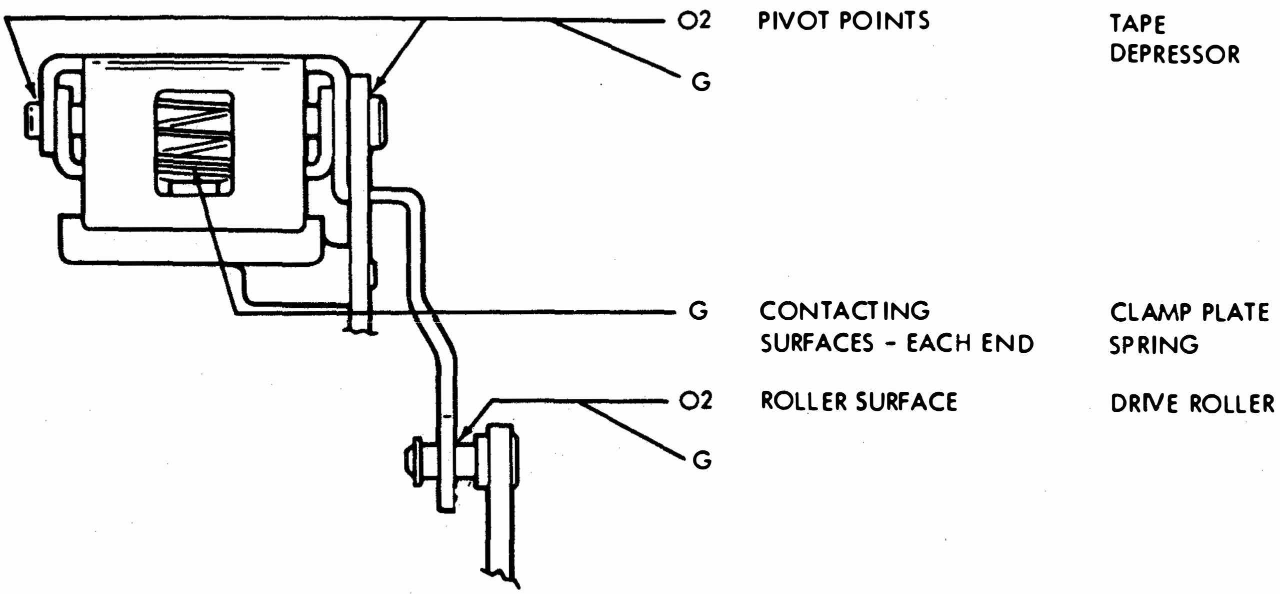


Figure 4-21. Slack Tape Mechanism

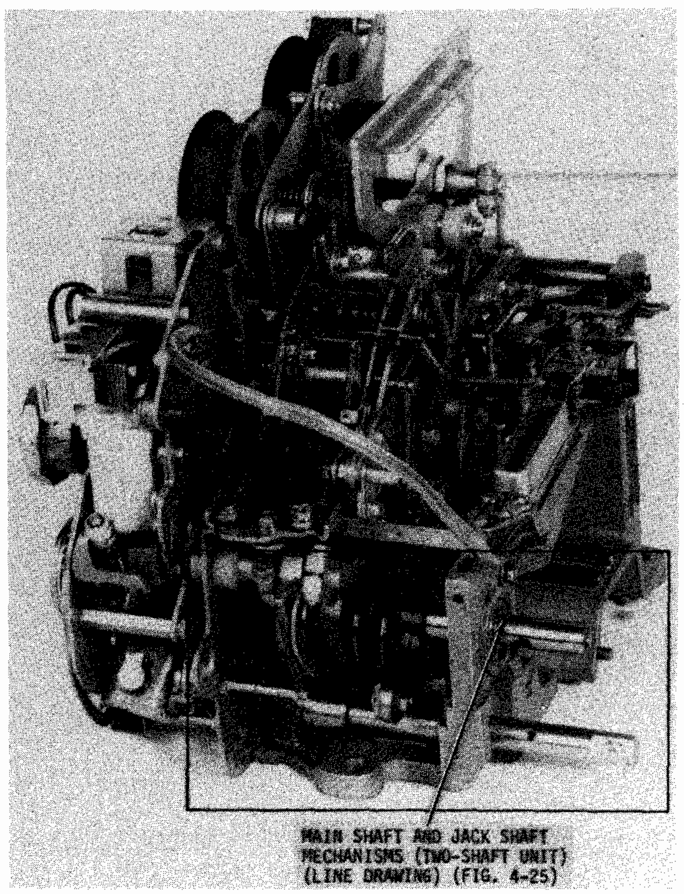


Figure 4-22. Main Shaft and Jack Shaft Mechanism, Two-Shaft Units

*IF FUNCTION CAM NEEDLE BEARINGS ARE DISASSEMBLED AT ANY TIME, REPACK BEARINGS WITH GREASE (BEACON 325) (TP195298) OR ITS EQUIVALENT.

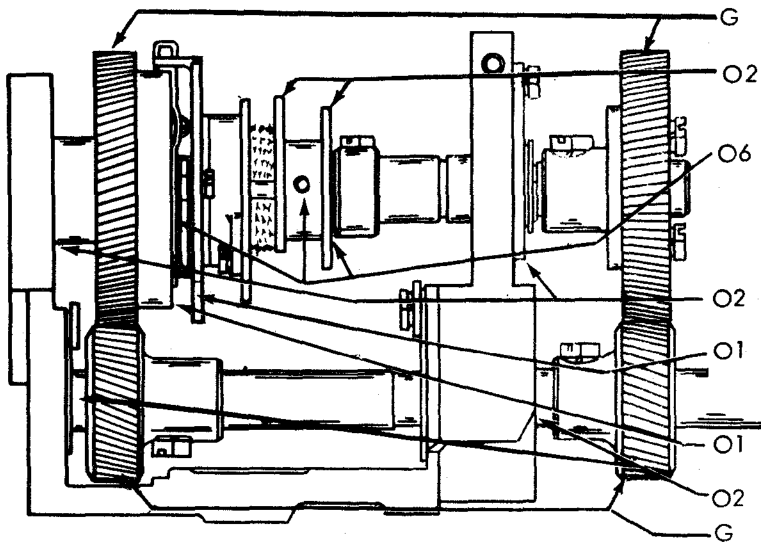


Figure 4-23. Main Shaft and Jack Shaft Mechanisms, Two-Shaft Units (Line Drawing)

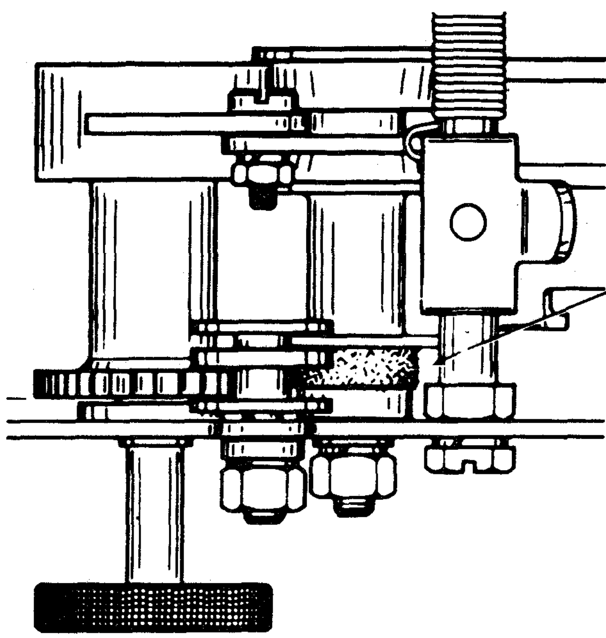


Figure 4-24. Tape Mechanism for Model 28 Tape Printer Unit

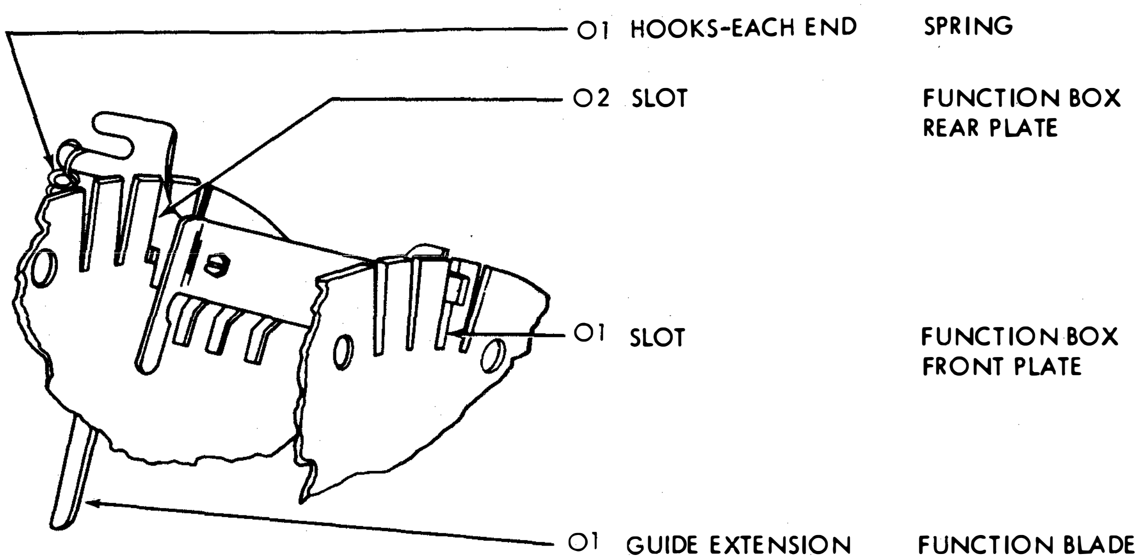


Figure 4-25. Unshift-On-Space Mechanism

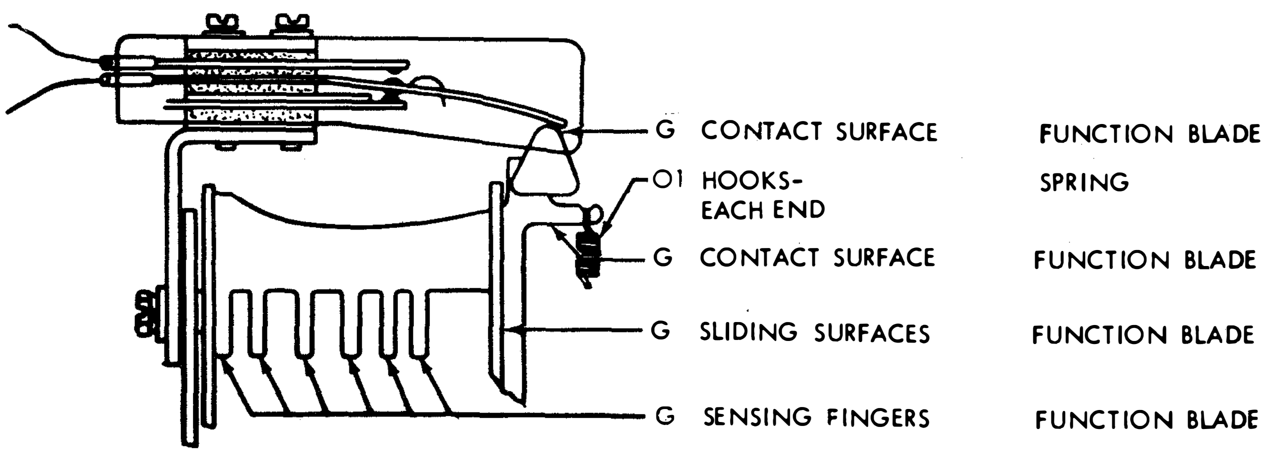


Figure 4-26. Signal Bell Contact Mechanism, Right Side View

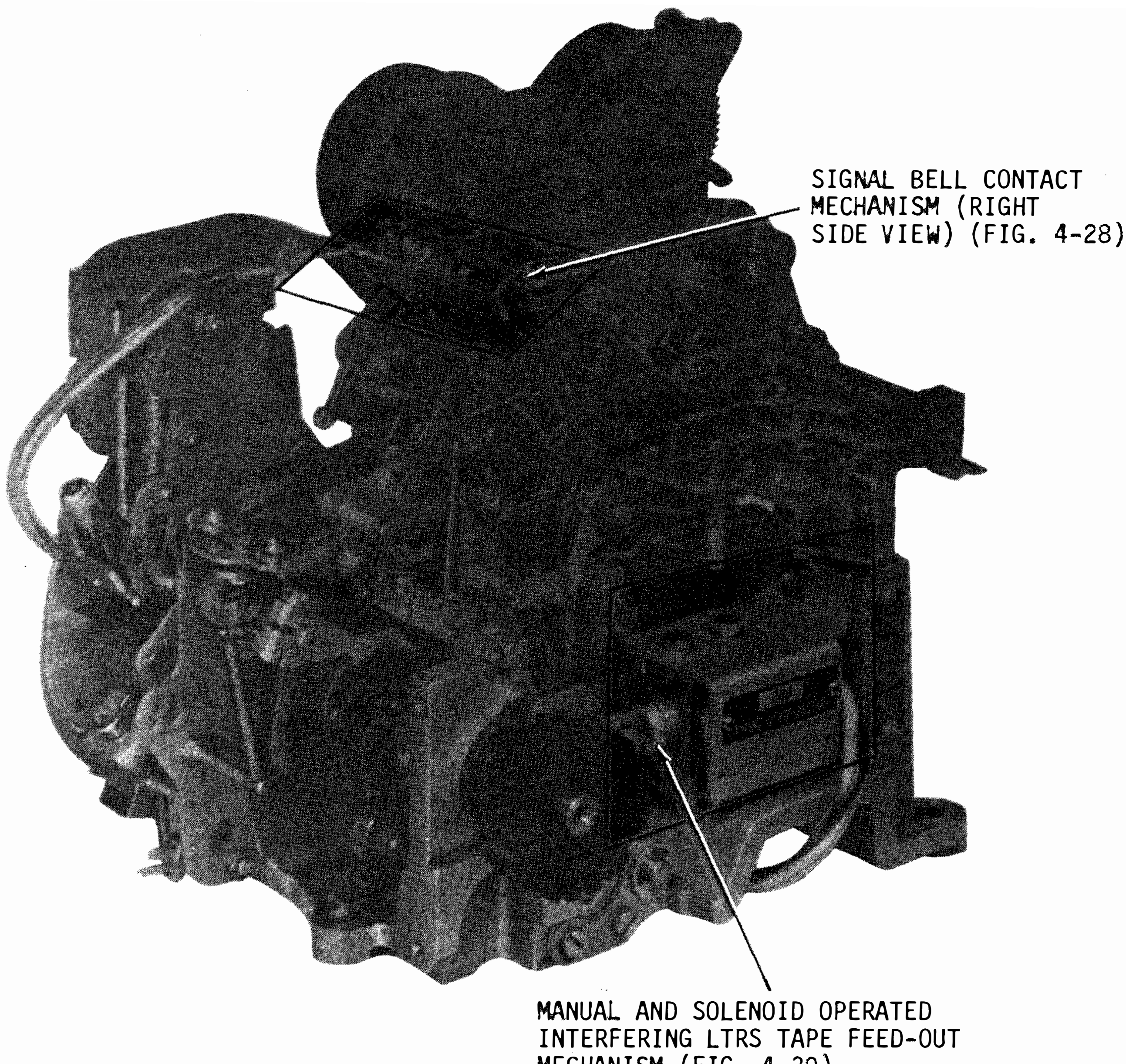


Figure 4-27. Manual and Solenoid Operated Interfering LTRS Tape Feed-Out Mechanism and Signal Bell Mechanism

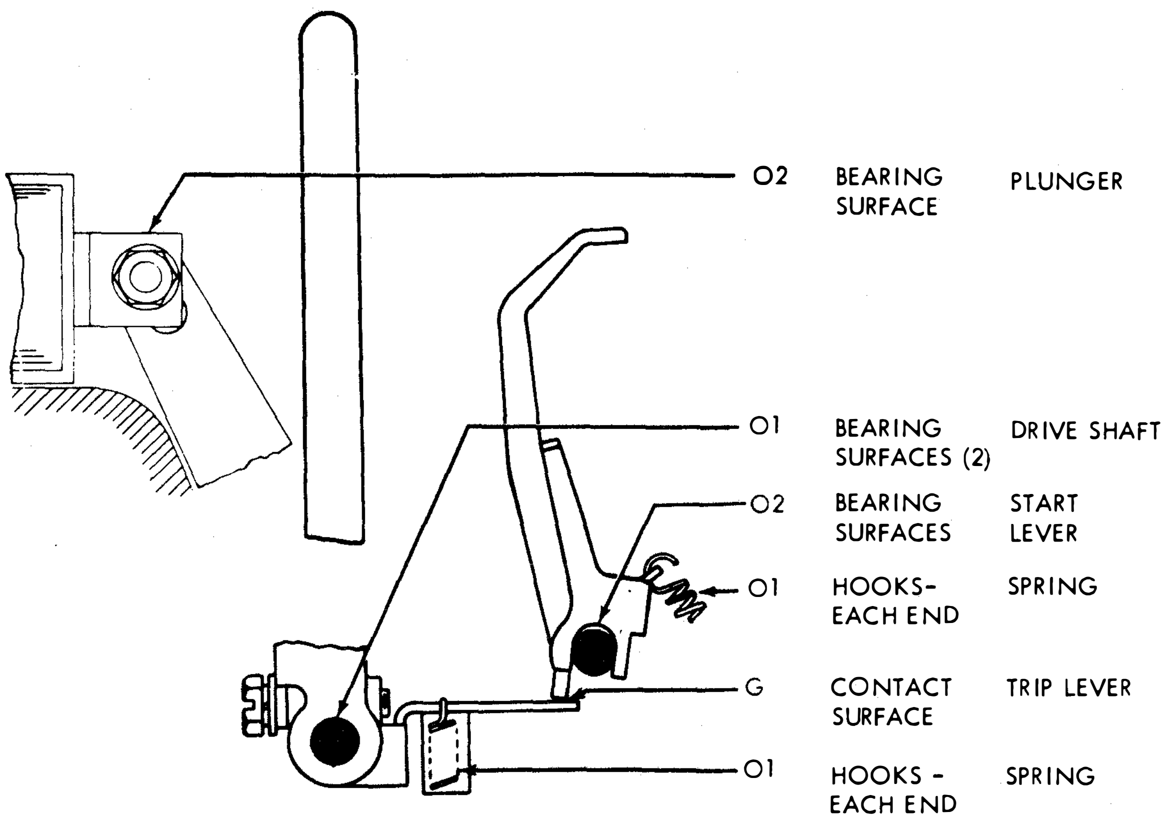


Figure 4-28. Manual and Solenoid Operated Interfering LTPS Tape Feed-Out Mechanism, Right Front View

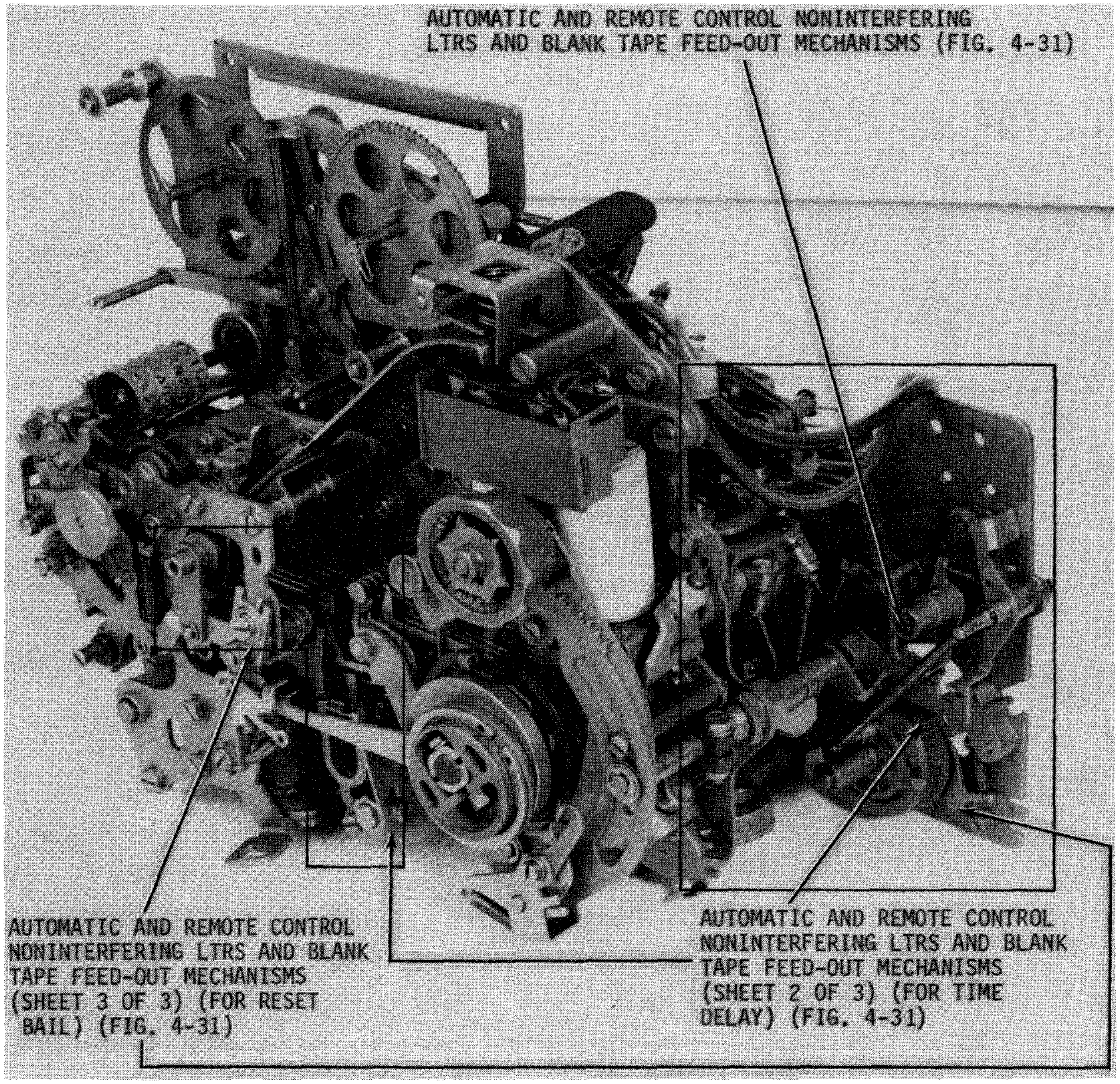
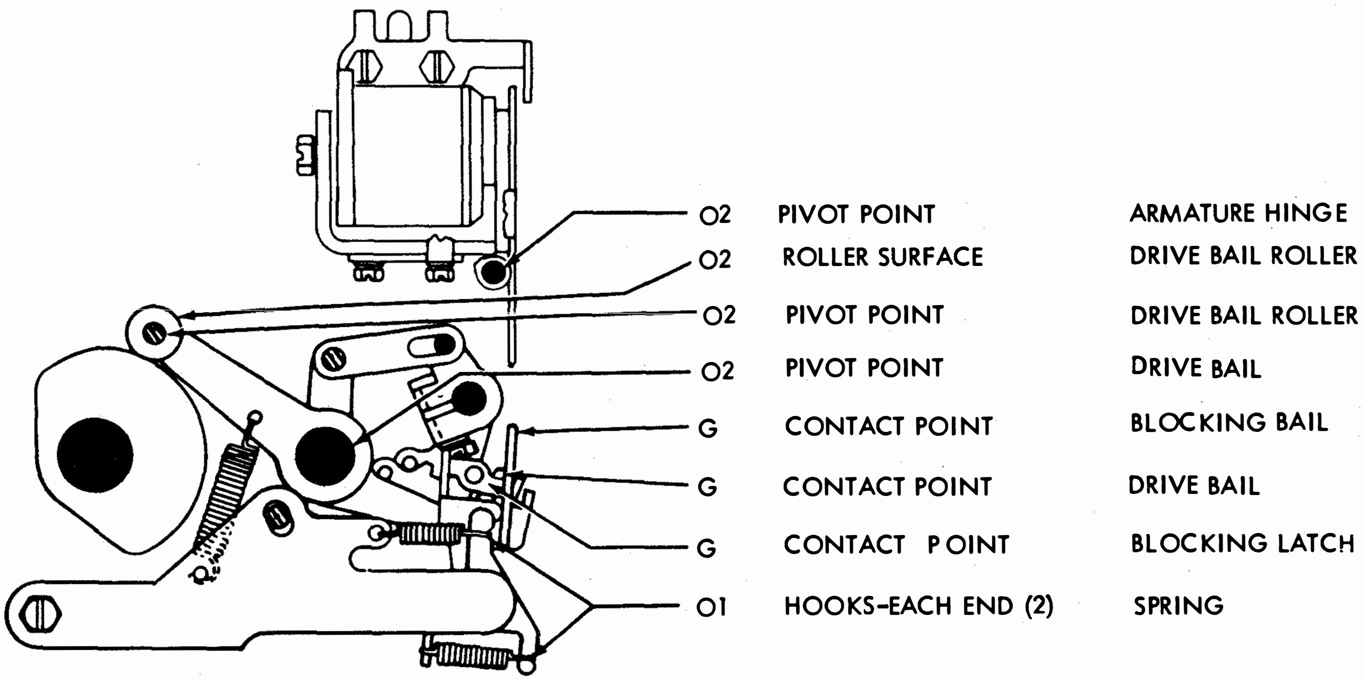


Figure 4-29. Automatic and Remote Control Noninterfering LTRS Tape Feed-Out Mechanisms, Right Front View



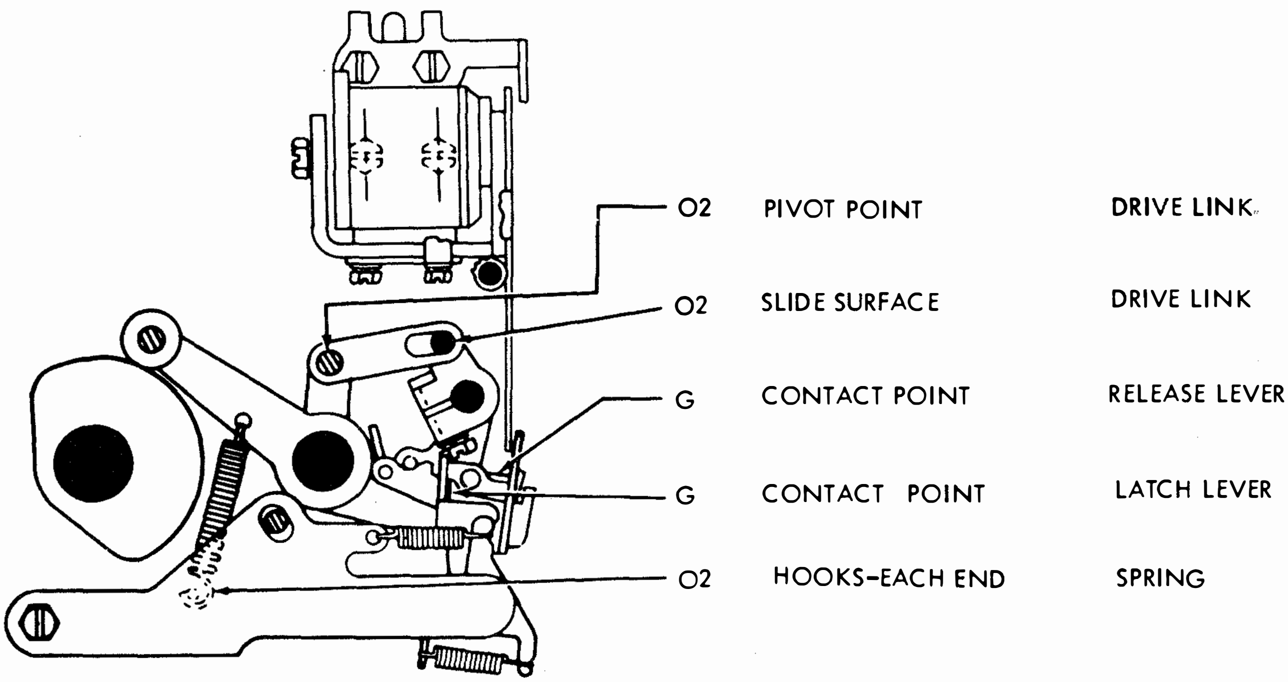


Figure 4-30. Remote Control Noninterfering LTRS and BLANK Tape Feed-Out Mechanism

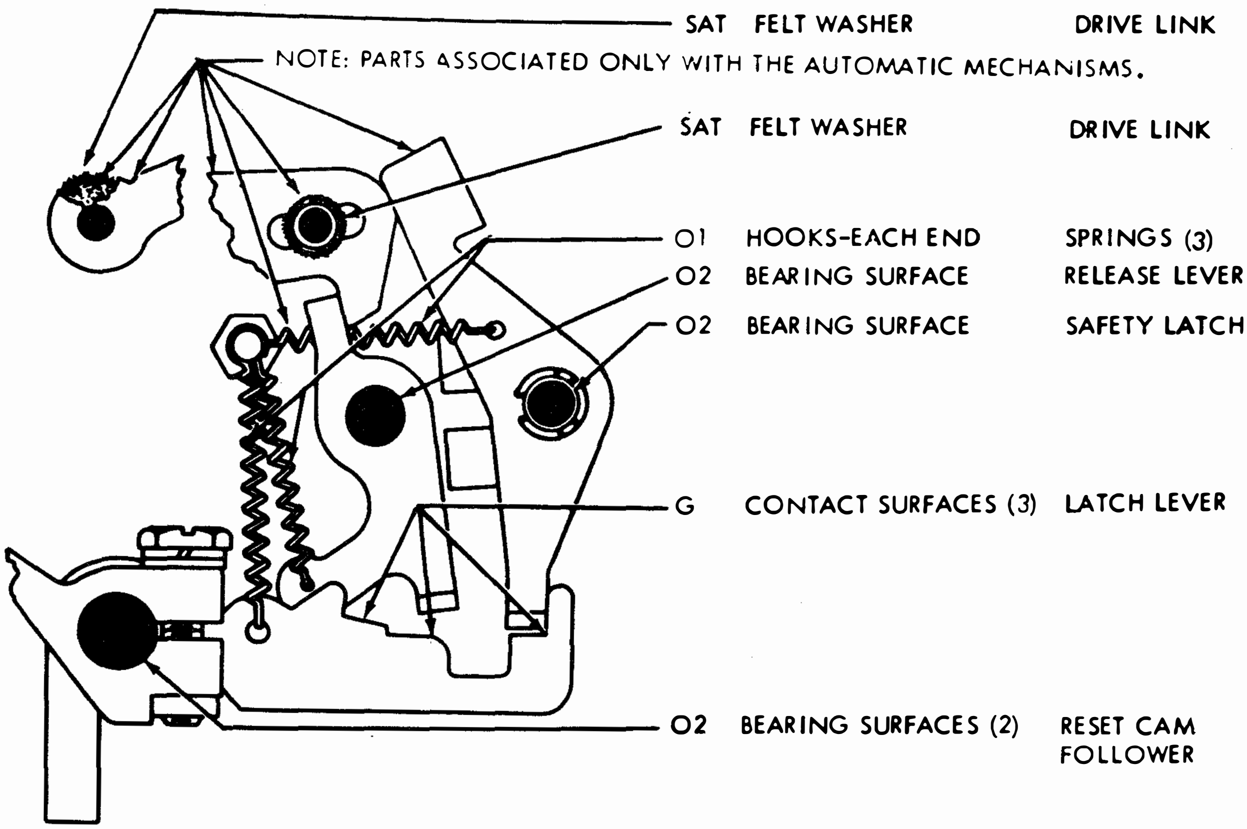


Figure 4-31. Automatic and Remote Control Noninterfering LTRS and BLANK Tape Feed-Out Mechanisms (Sheet 1 of 3)

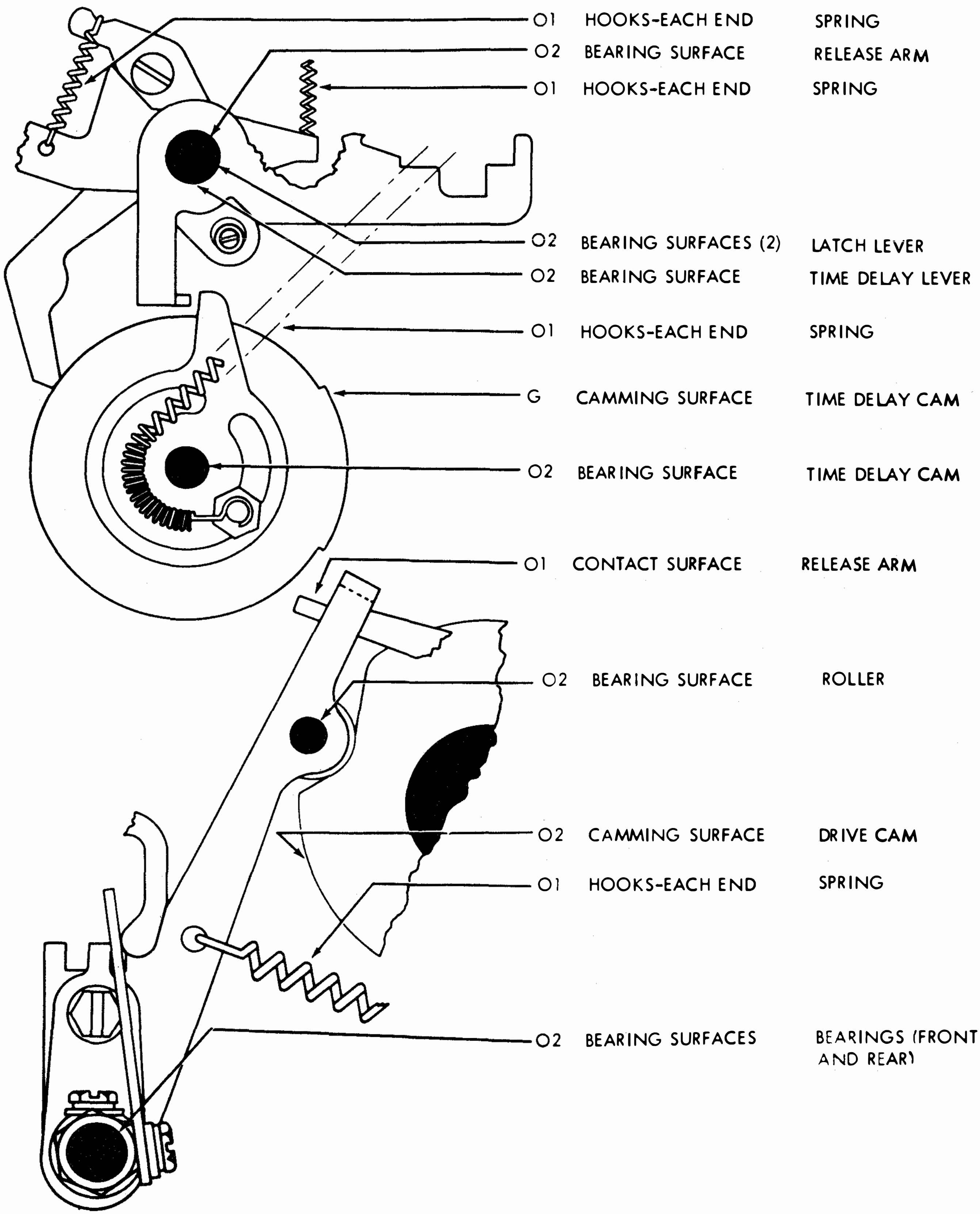


Figure 4-31. Automatic and Remote Control Noninterfering LTRS and BLANK Tape Feed-Out Mechanisms (Sheet 2 of 3)

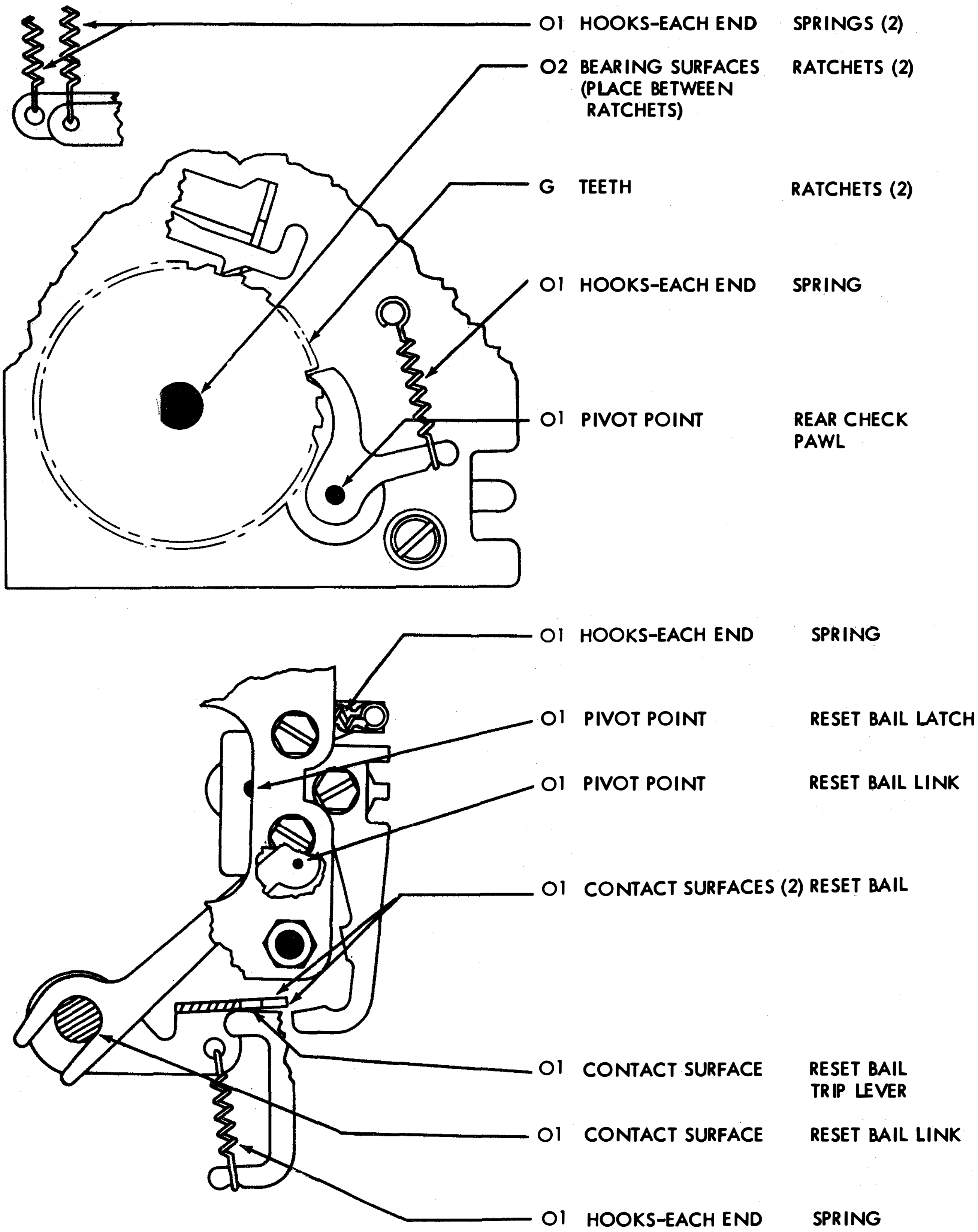
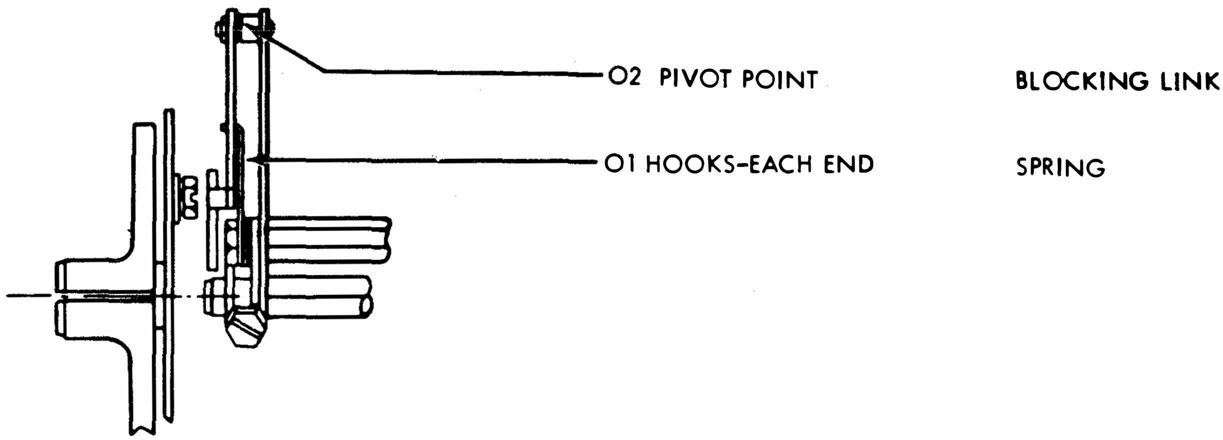


Figure 4-31. Automatic and Remote Control Noninterfering LTRS and BLANK Tape Feed-Out Mechanisms (Sheet 3 of 3)



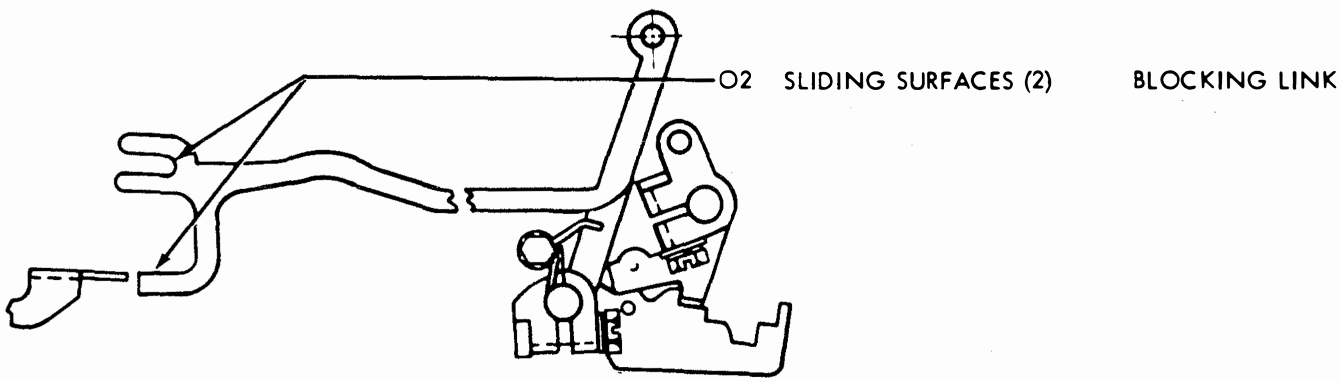


Figure 4-32. Automatic and Remote Control Noninterfering BLANK Tape Feed-Out Mechanisms

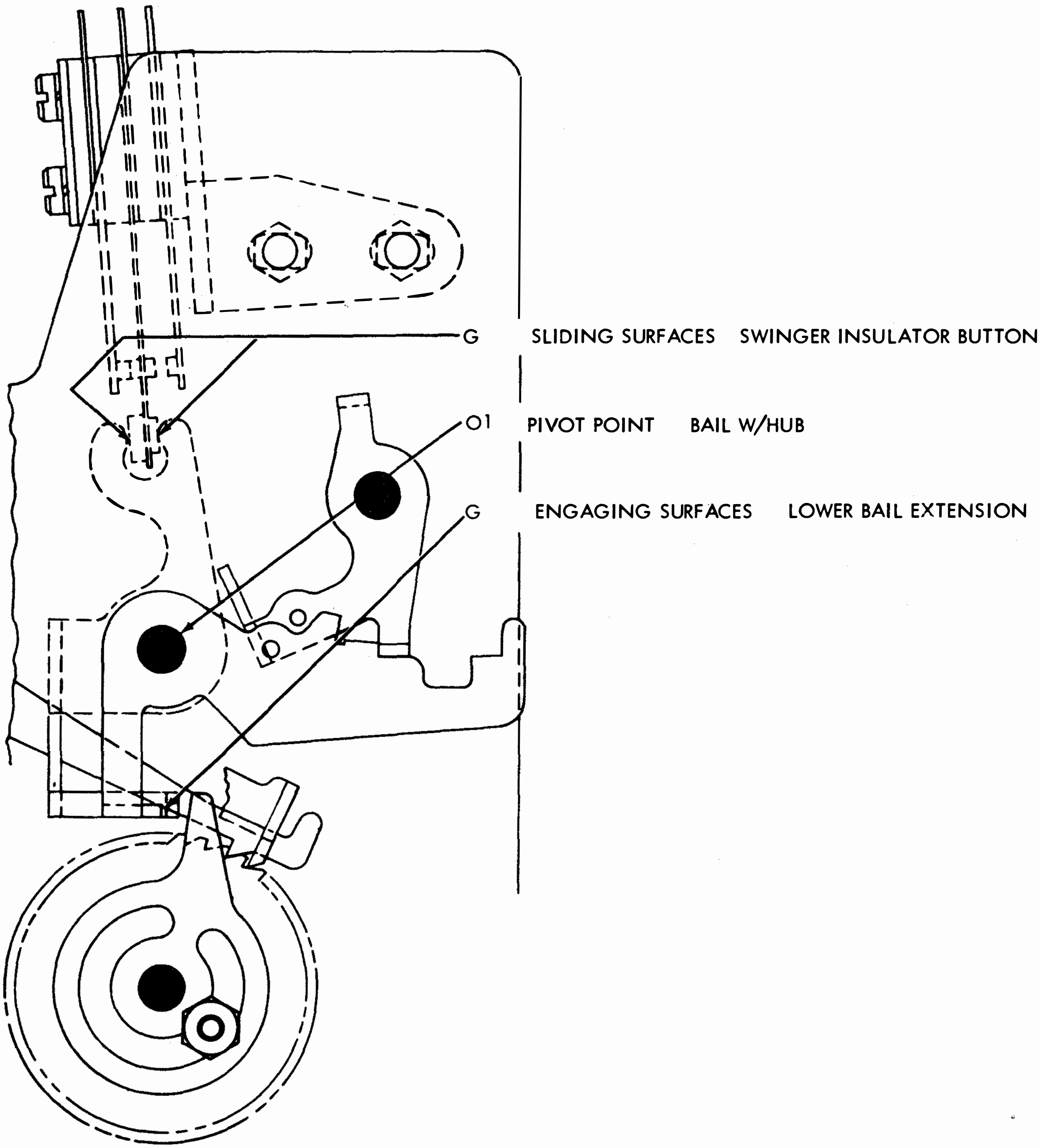
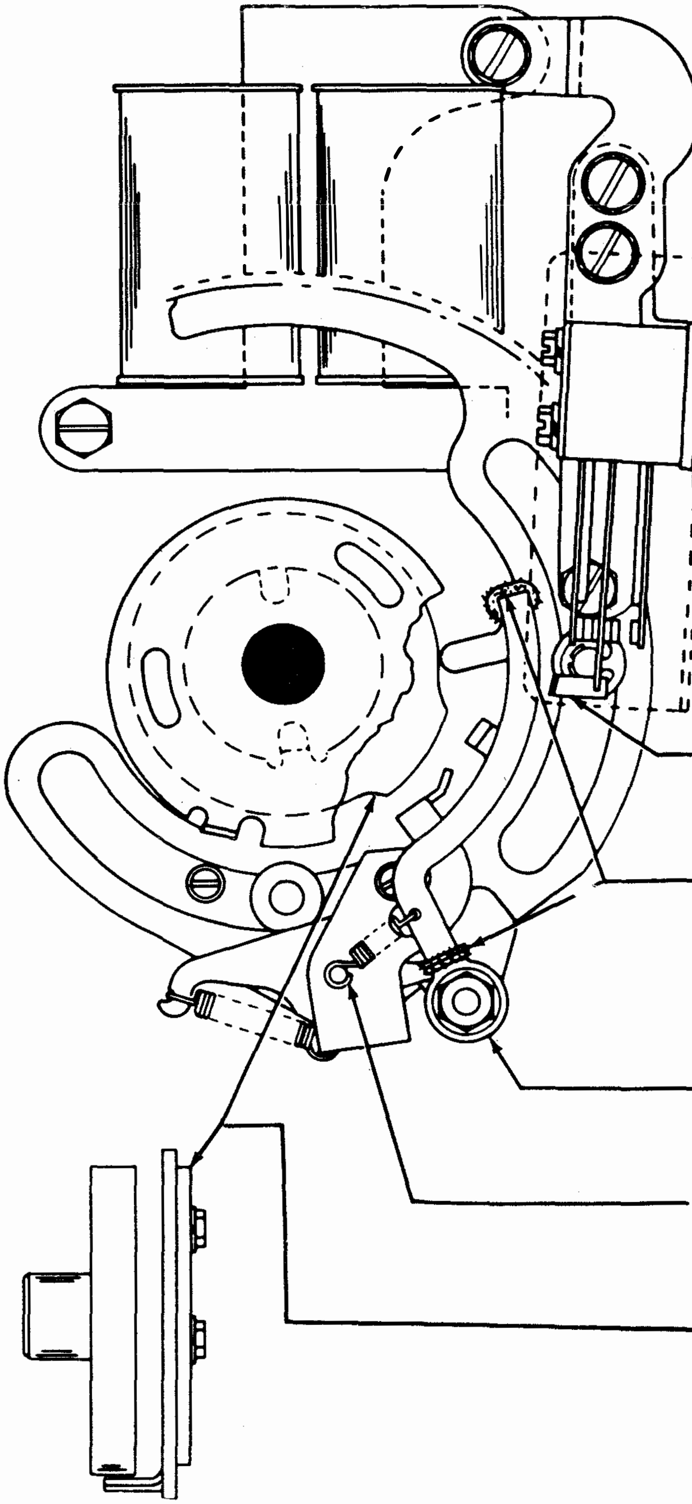


Figure 4-33. End of Tape Feed-Out Timing Contacts for Noninterfering LTRS and BLANK Tape Feed-Out Mechanisms



G	METAL FACE TOWARD OPERATING ARM	SWINGER SPRING INSULATOR
SAT	FELT WASHERS (3)	OPERATING LEVER
O2	BEARING-EACH END	OPERATING LEVER
O1	HOOKS-EACH END	OPERATING LEVER COILED SPRINGS
G	OPERATING SURFACE	CAM

Figure 4-34. Timing Contact Mechanism (Operated by Selector)

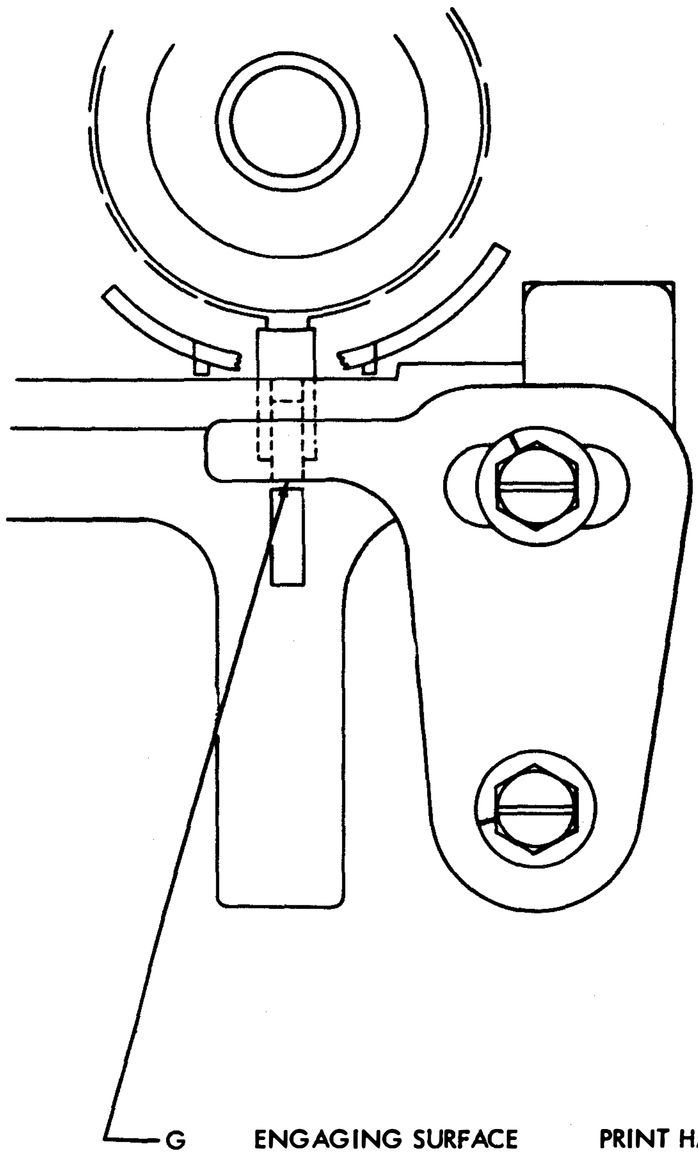


Figure 4-35. Print Suppression on Functions

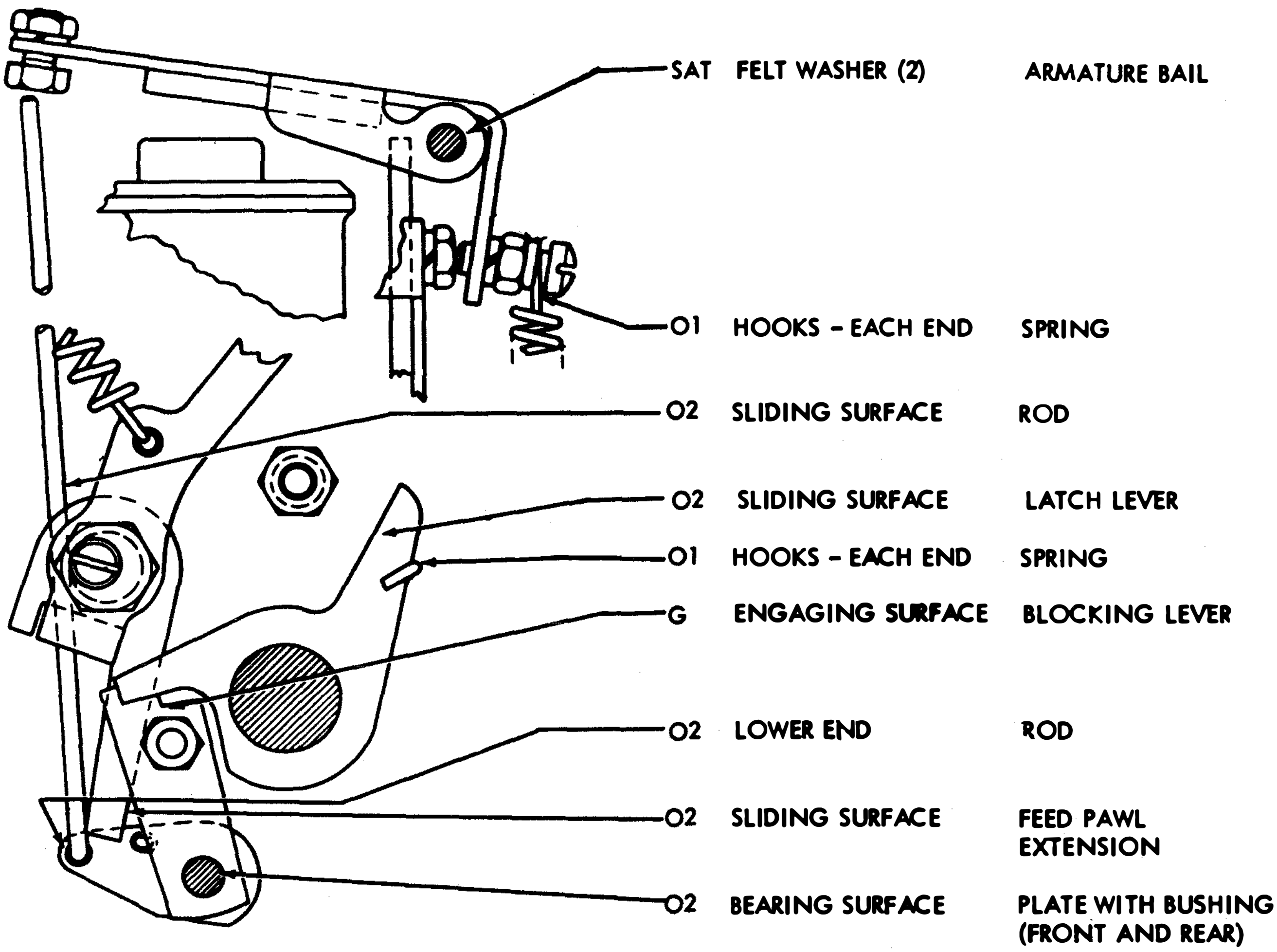
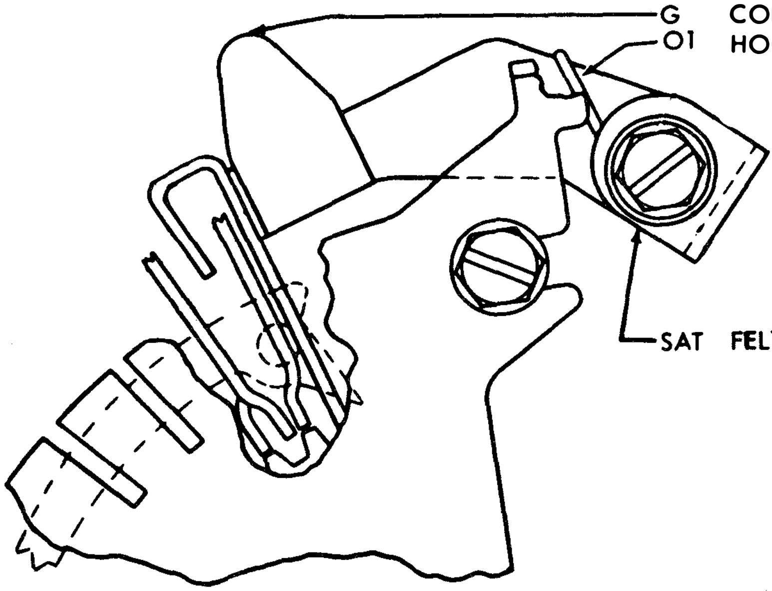


Figure 4-36. Blank Delete Mechanism (Sheet 1 of 2)



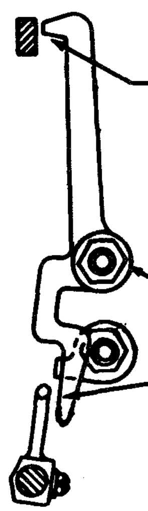


Figure 4-36. Blank Delete Mechanism (Sheet 2 of 2)

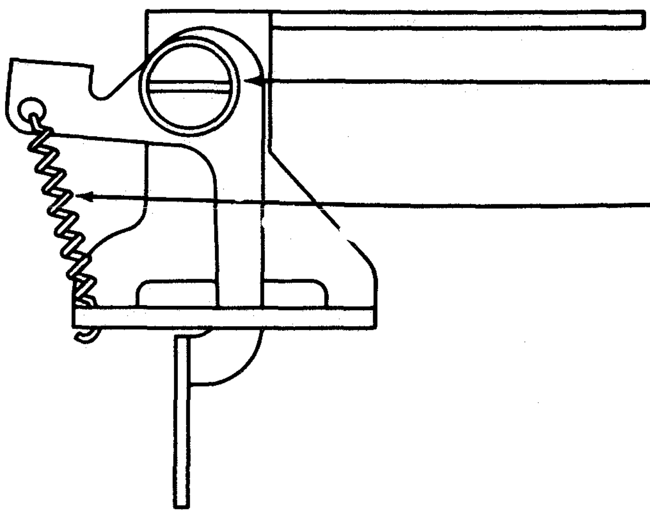


Figure 4-37. LETTERS-FIGURES Contact Mechanism, Later Design

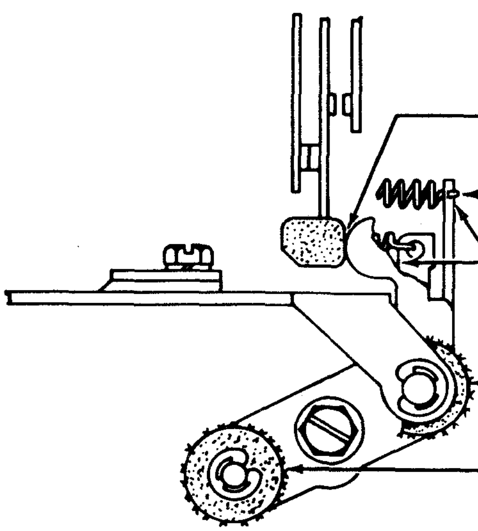


Figure 4-38. Timing Contacts

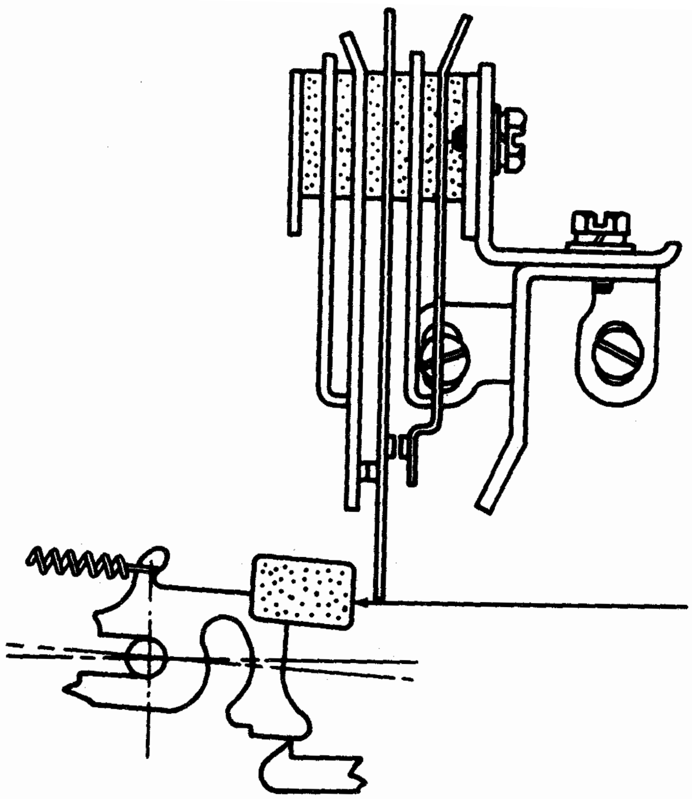


Figure 4-39. Code Reading Contacts

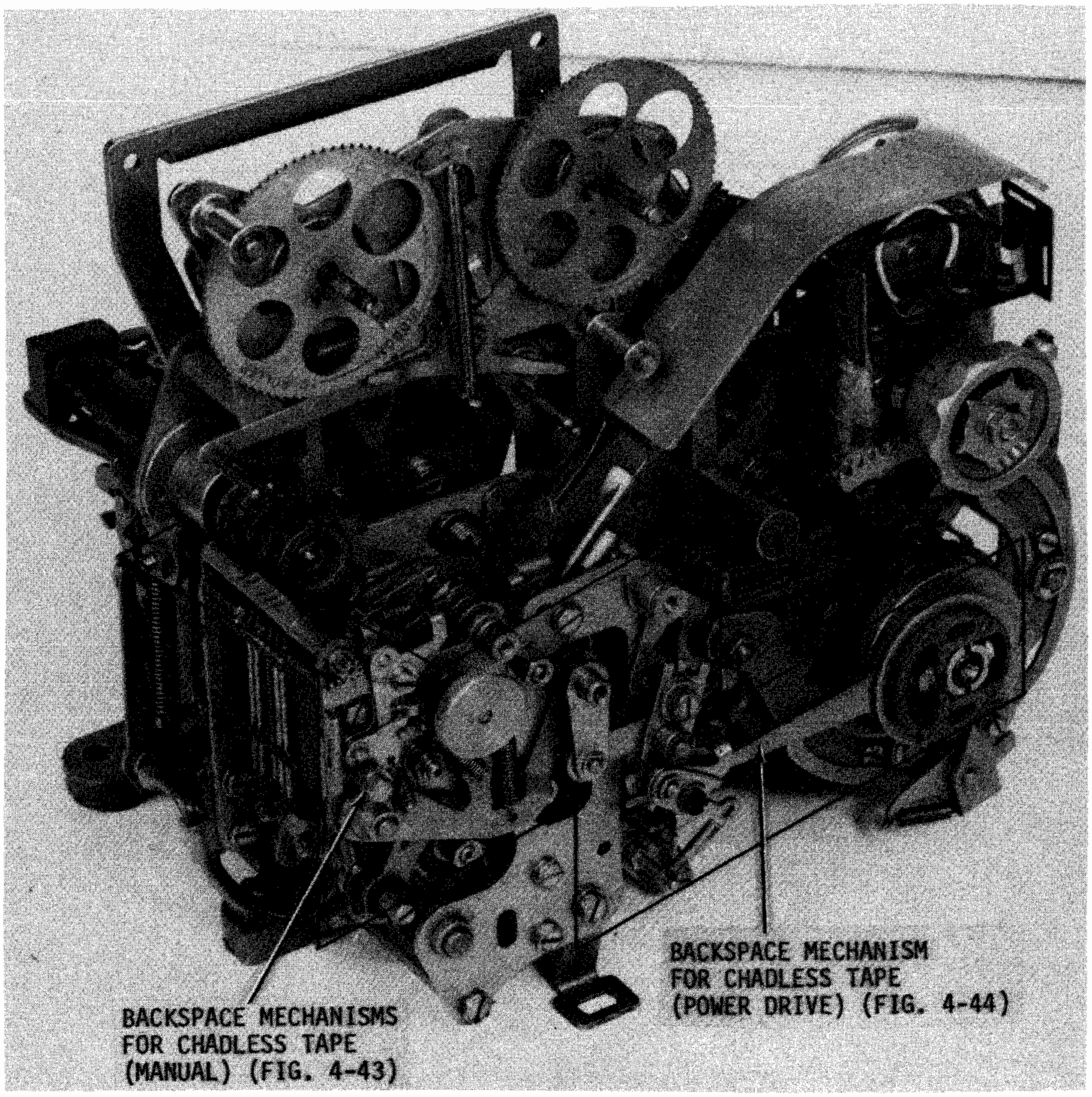


Figure 4-40. Manual and Power Drive Backspace Mechanisms (for Chadless Tape)

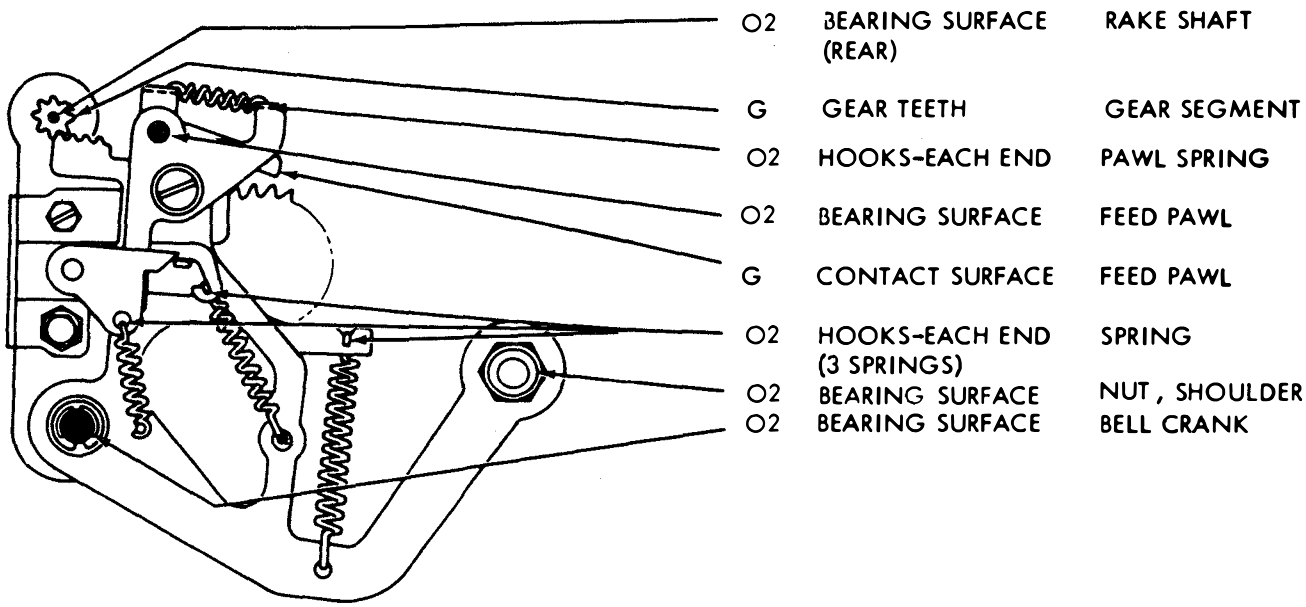


Figure 4-41. Backspace Mechanism for Chadless Tape (Manual)

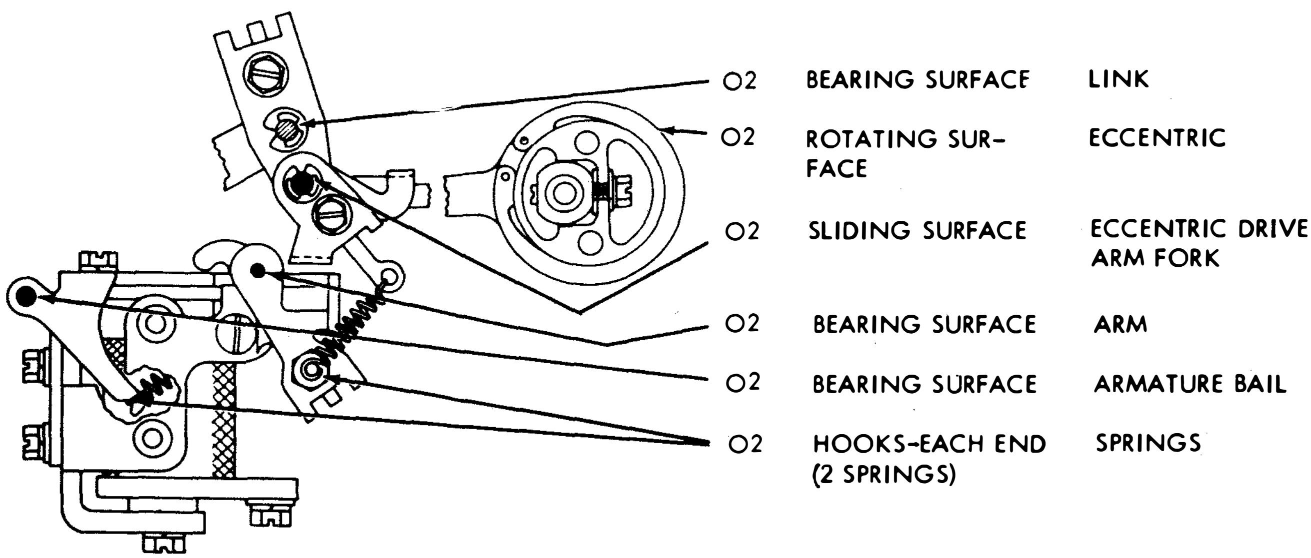
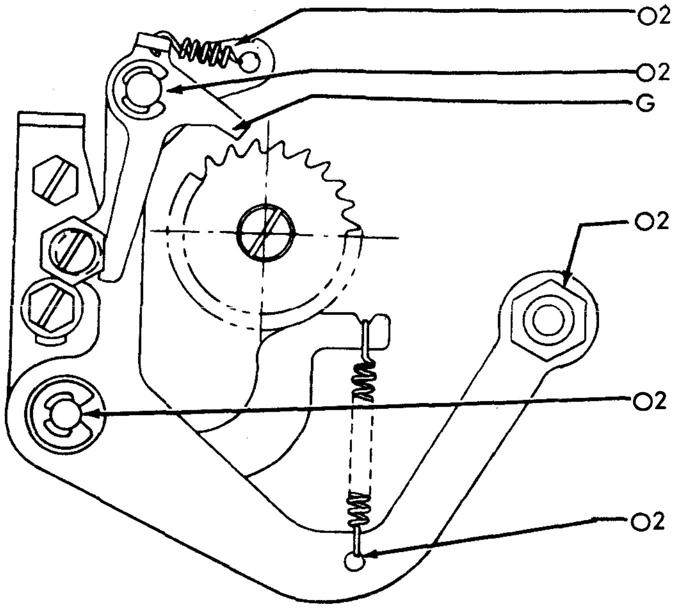
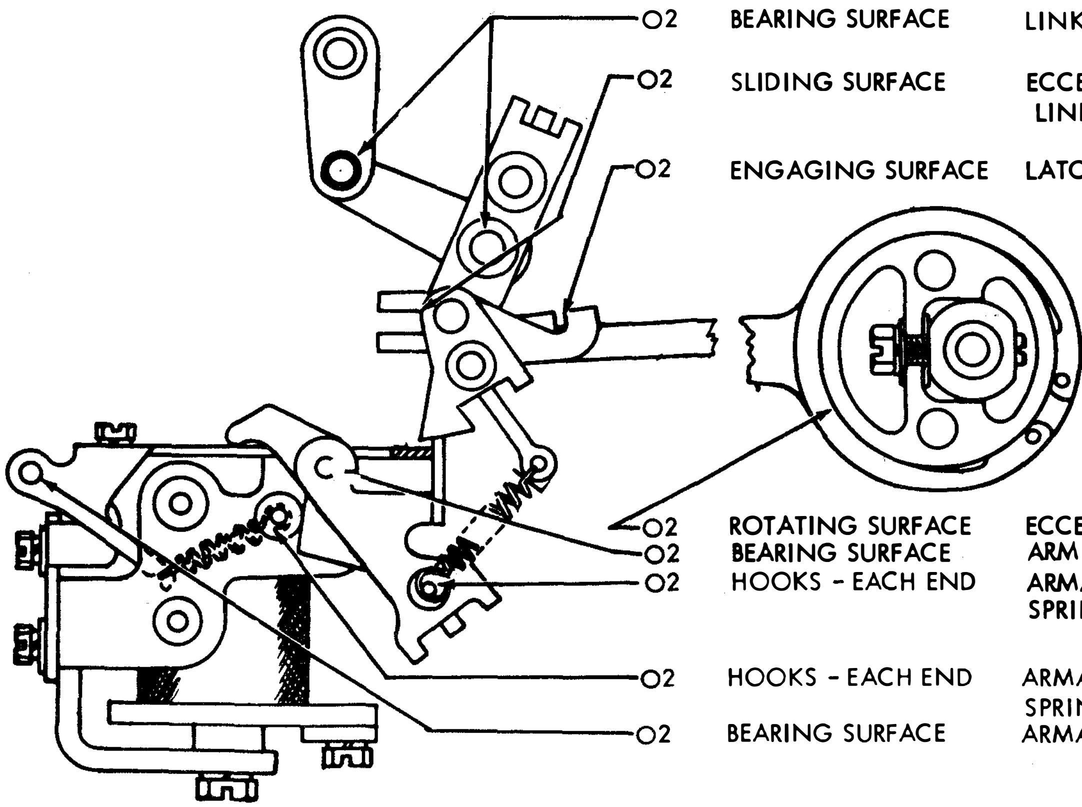


Figure 4-42. Backspace Mechanism for Chadless Tape, Power Drive

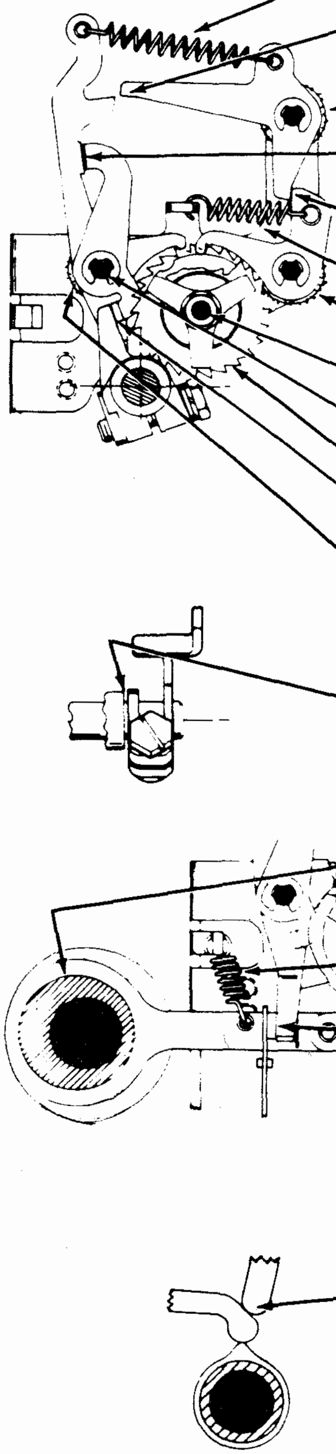


O2	HOOKS - EACH END	BACKSPACE PAWL SPRING
O2	BEARING SURFACE	BACKSPACE PAWL
G	FEEDING SURFACE	BACKSPACE PAWL
O2	BEARING SURFACE	NUT, SHOULDER
O2	BEARING SURFACE	BELL CRANK
O2	HOOKS - EACH END	BELL CRANK SPRING



O2	BEARING SURFACE	LINK
O2	SLIDING SURFACE	ECCENTRIC DRIVE LINK FORK
O2	ENGAGING SURFACE	LATCH
O2	ROTATING SURFACE	ECCENTRIC
O2	BEARING SURFACE	ARM
O2	HOOKS - EACH END	ARMATURE LATCH SPRING
O2	HOOKS - EACH END	ARMATURE BAIL SPRING
O2	BEARING SURFACE	ARMATURE BAIL

Figure 4-43. Backspace Mechanism for Fully-Perforated Tape, Power Drive



O1	HOOKS-EACH END	SPRING
O1	ENGAGING SURFACE	CONTACT OPERATING PAWL AND LATCH LEVER
SAT	FELT WASHERS	LATCH LEVER
O1	ENGAGING SURFACE	BELL CRANK AND CONTACT OPERATING PAWL
O1	ENGAGING SURFACE	LATCH PAWL AND LATCH LEVER
O1	HOOKS-EACH END	SPRING
SAT	FELT WASHERS	LATCH PAWL
O2	BEARING SURFACE EACH END	RATCHET WHEEL SHAFT
O1	BEARING SURFACE EACH END	BELLCRANK AND SUPPORTING STUD
G	TEETH AND FLANGES	RATCHET WHEELS
O1	ENGAGING SURFACE	CLAMP ARM AND BELLCRANK
SAT	FELT WASHERS	CONTACT PAWL
O2	BEARING SURFACE (2)	TIME DELAY RESET SHAFT BUSHING
O3	BEARING SURFACE	ECCENTRIC FOLLOWER DRIVE ARM AND ECCENTRIC
O1	HOOKS-EACH END	SPRING
G	ENGAGING SURFACE	DRIVE ARM
G	ENGAGING SURFACE	CONTACT OPERATING PAWL AND CONTACT INSULATOR
O1	ENGAGING SURFACE	SELECTOR RESET BAIL TIME DELAY RESET LEVER

Figure 4-44. Time Delay Motor Stop Mechanism

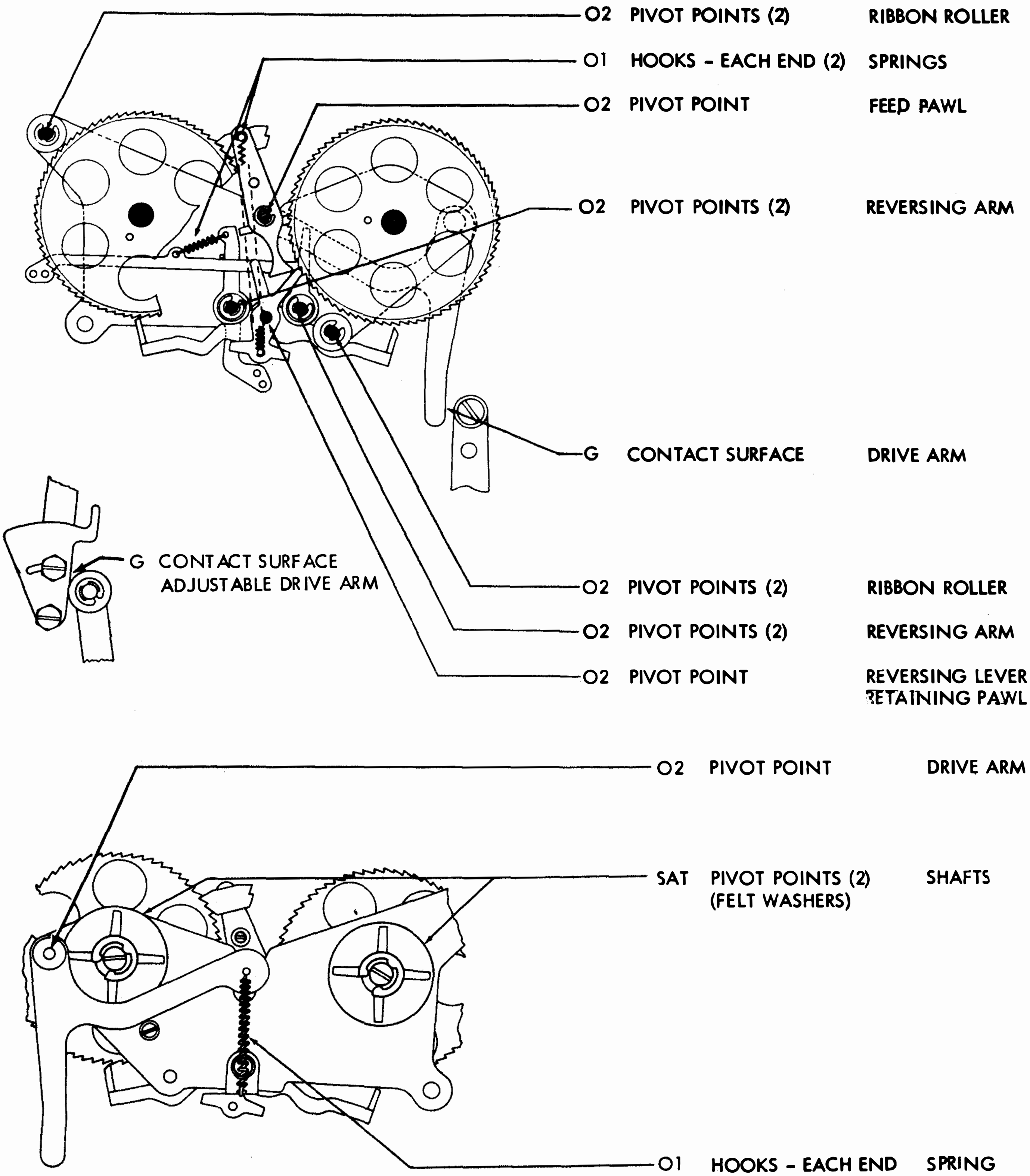


Figure 4-45. Ribbon Feed Mechanism, Early Design

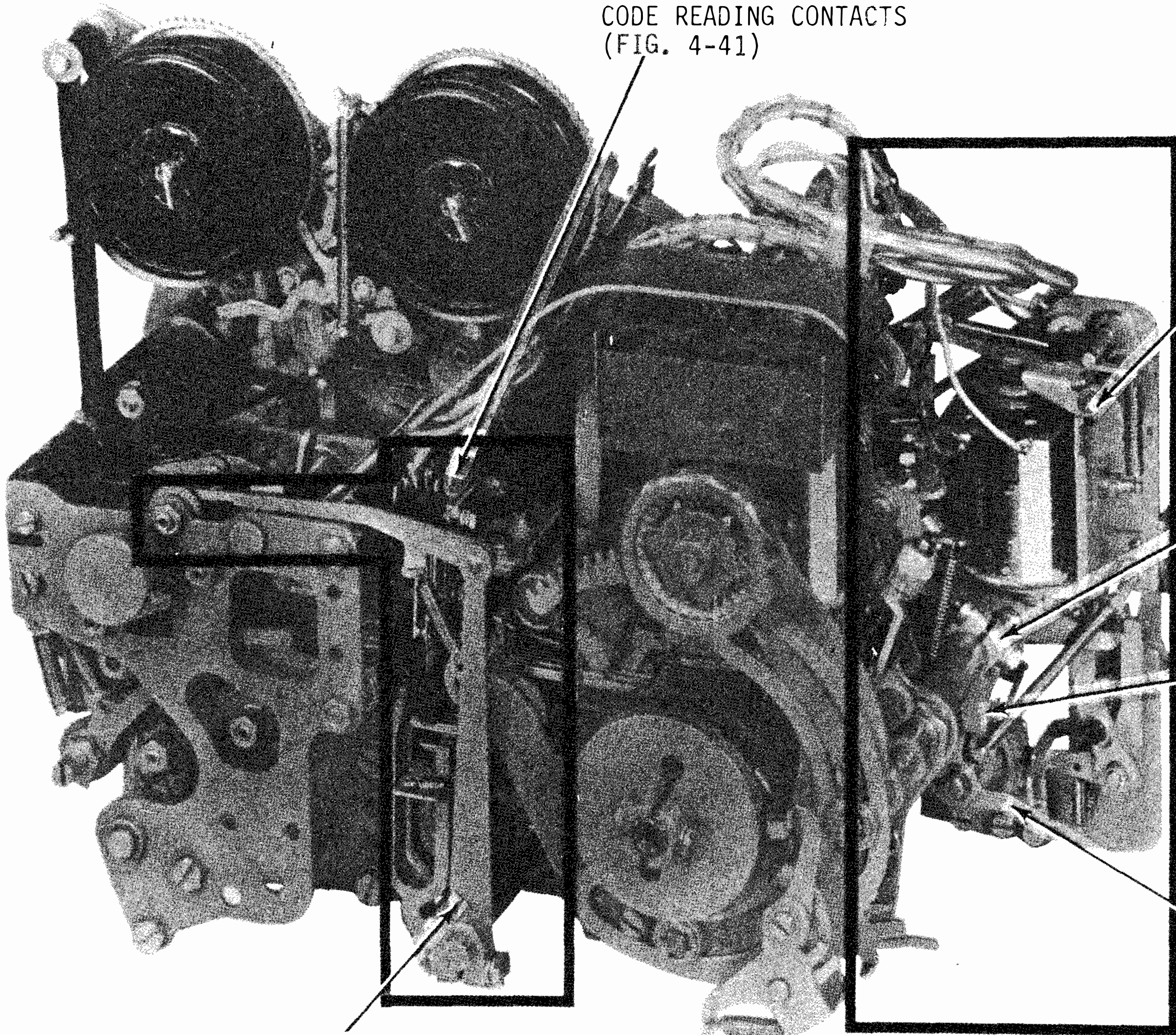
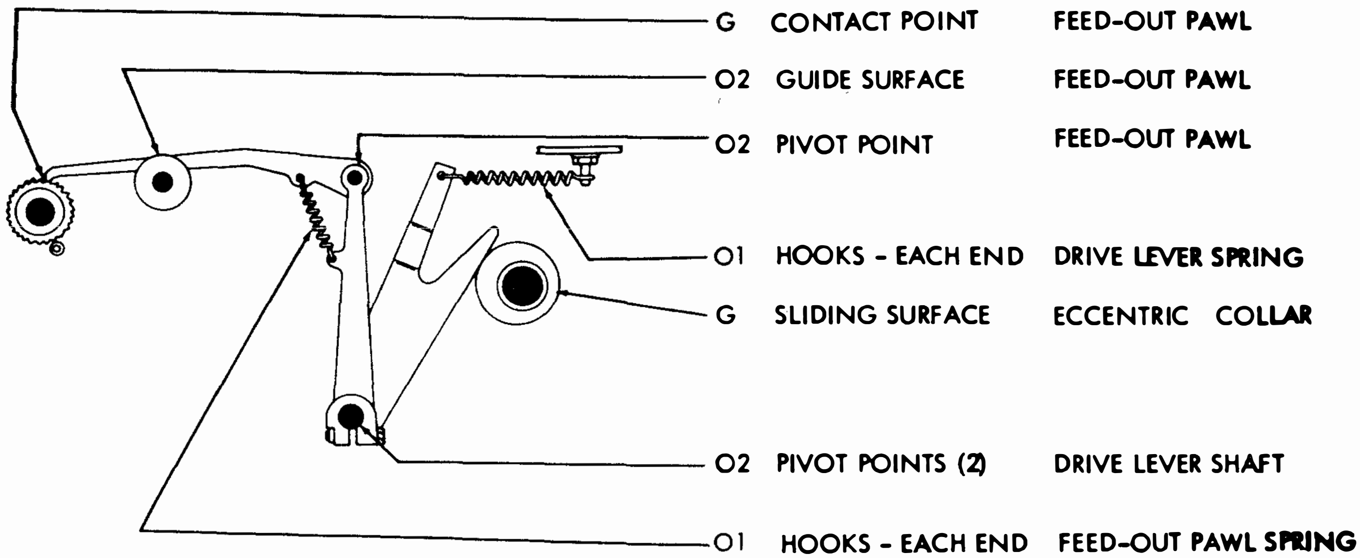


Figure 4-46. Remote Control Noninterfering BLANK Tape Feed-Out Mechanism (Sheet 1 of 5)



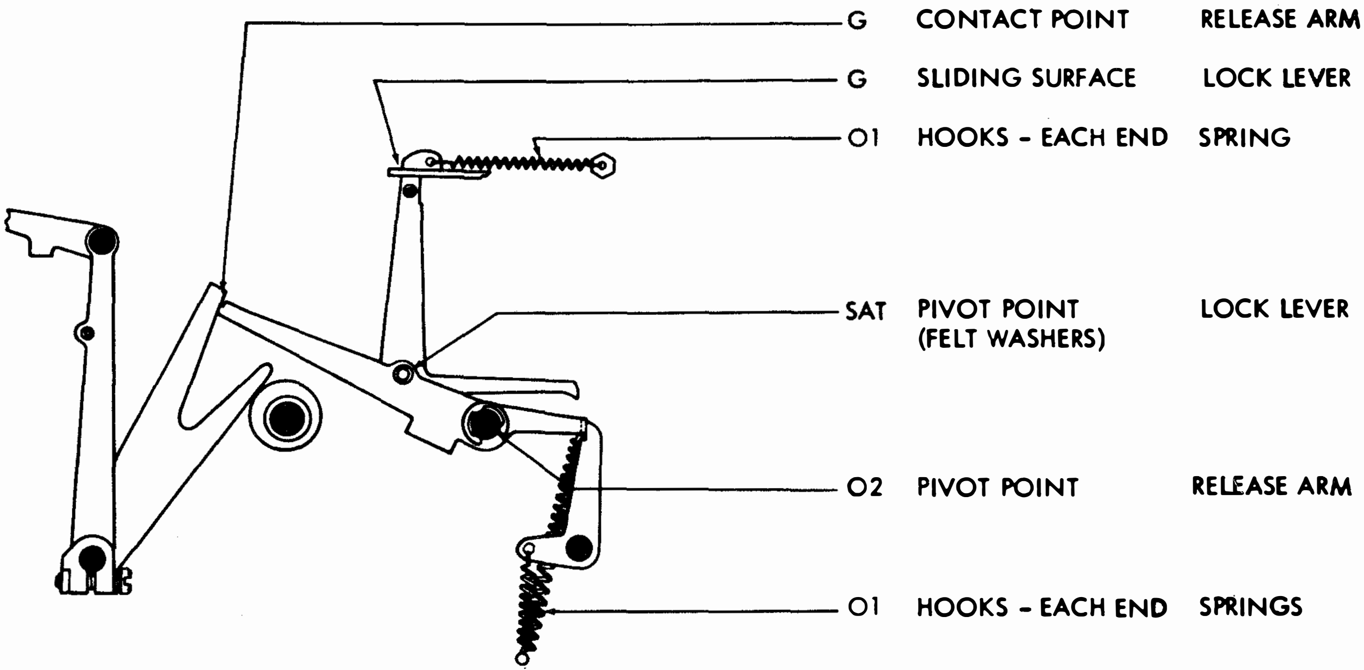
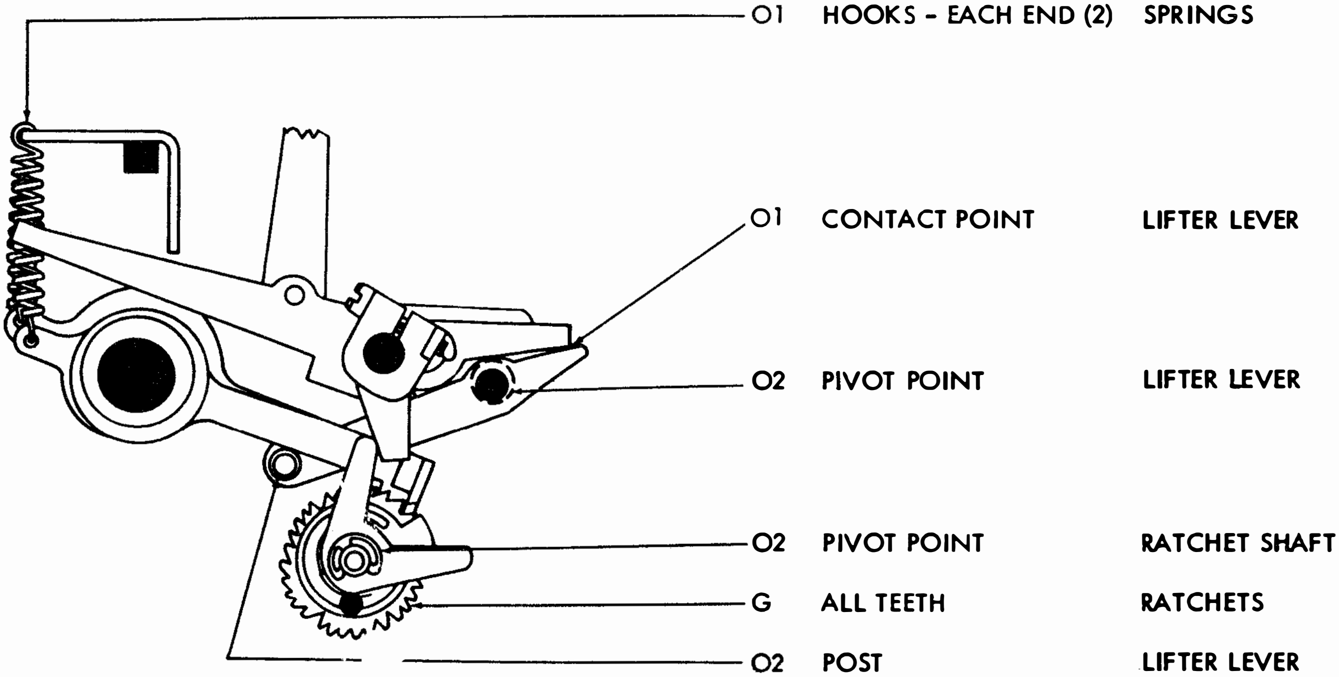


Figure 4-46. Remote Control Noninterfering BLANK Tape Feed-Out Mechanism (Sheet 2 of 5)



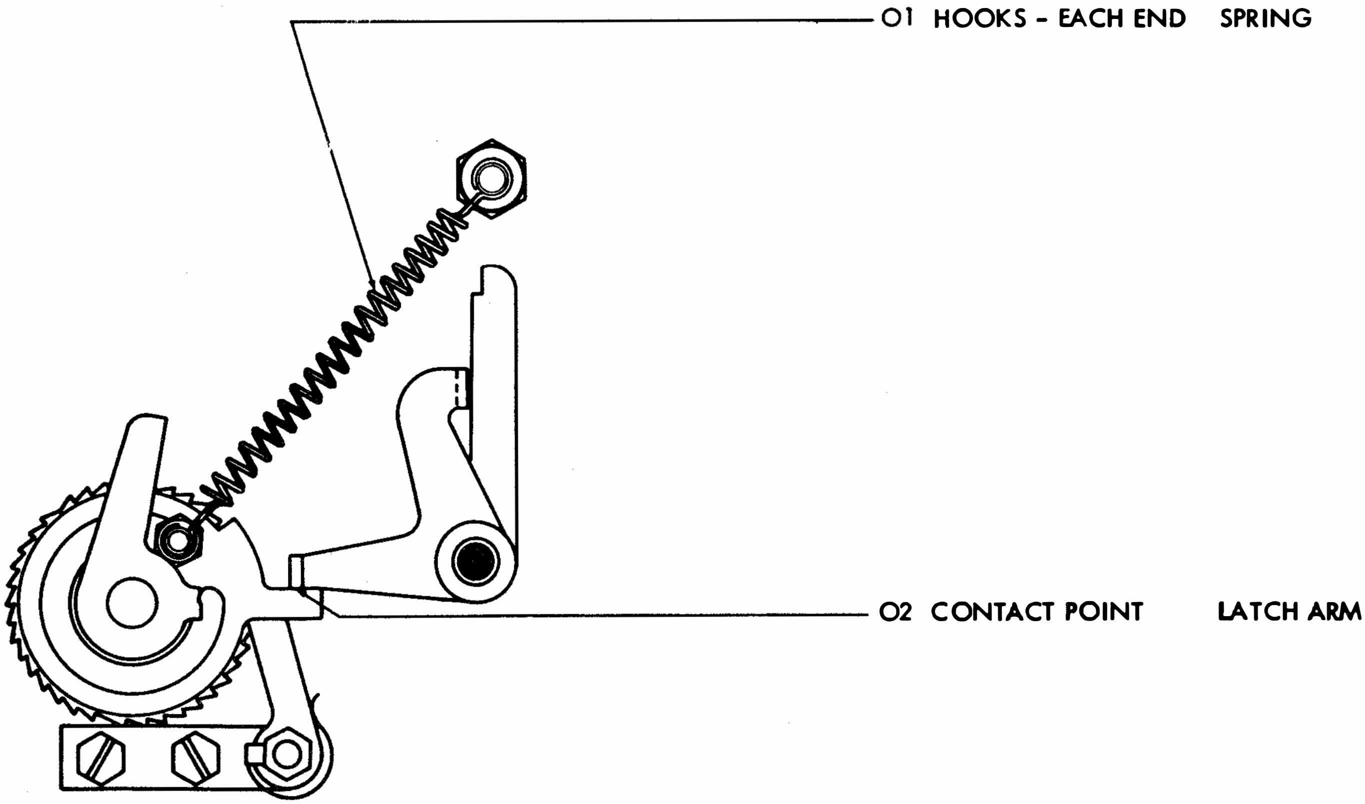
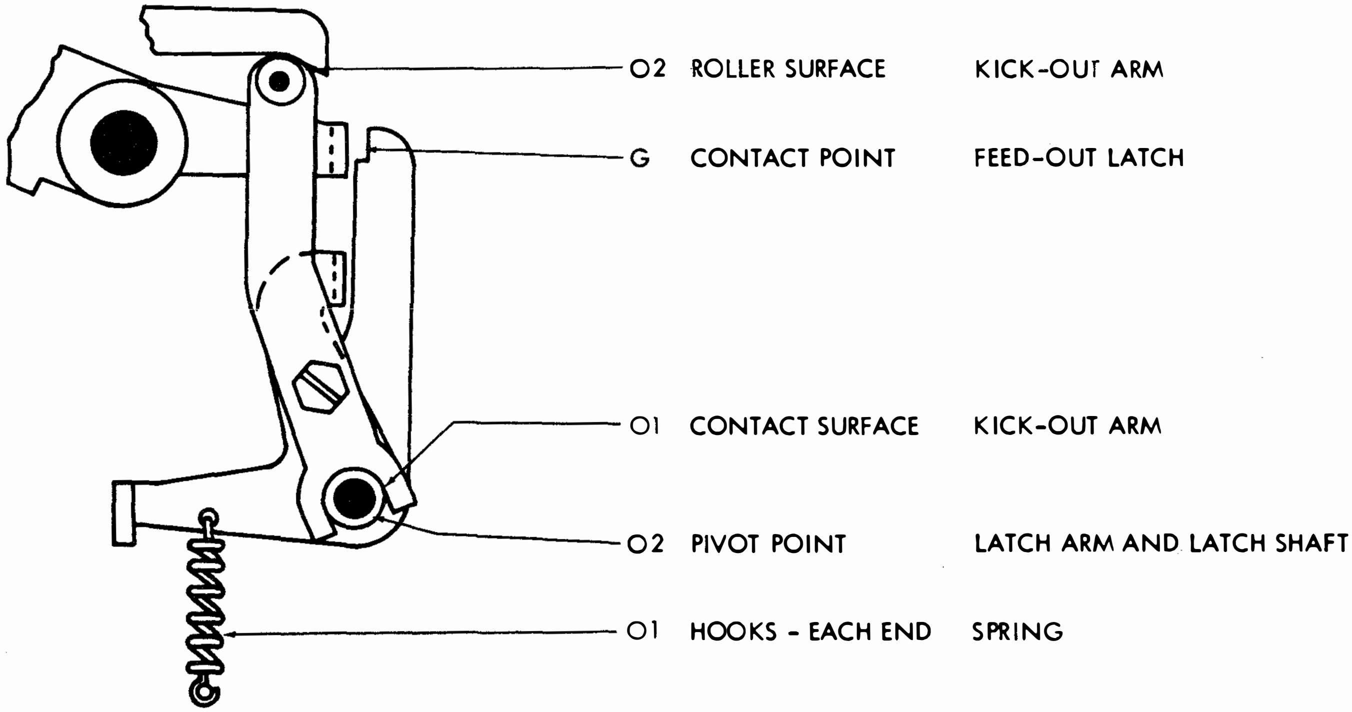
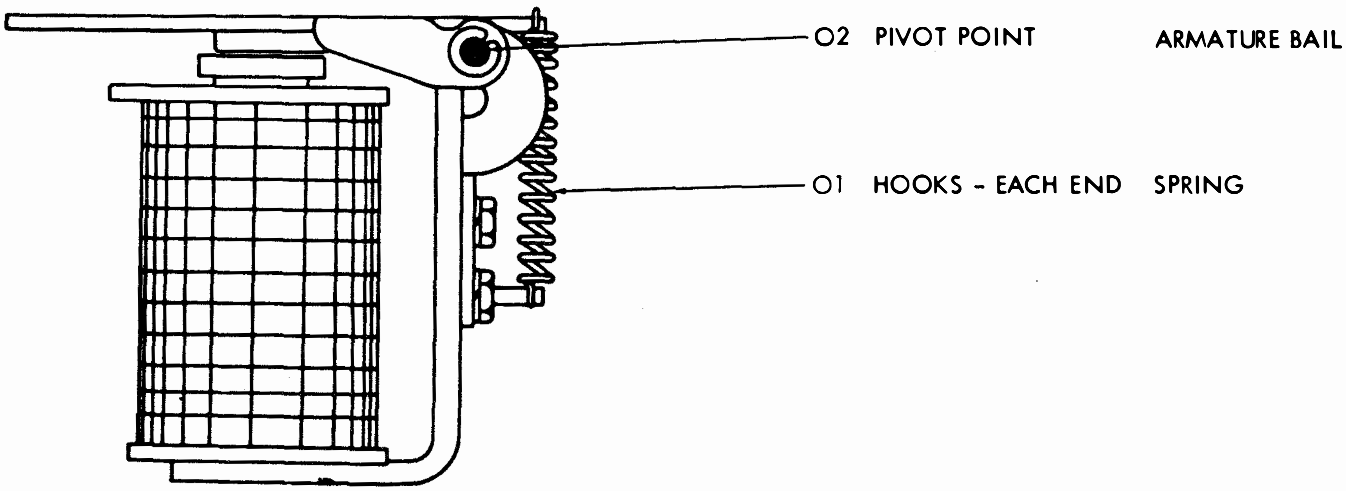


Figure 4-46. Remote Control Noninterfering BLANK Tape Feed-Out Mechanism (Sheet 3 of 5)





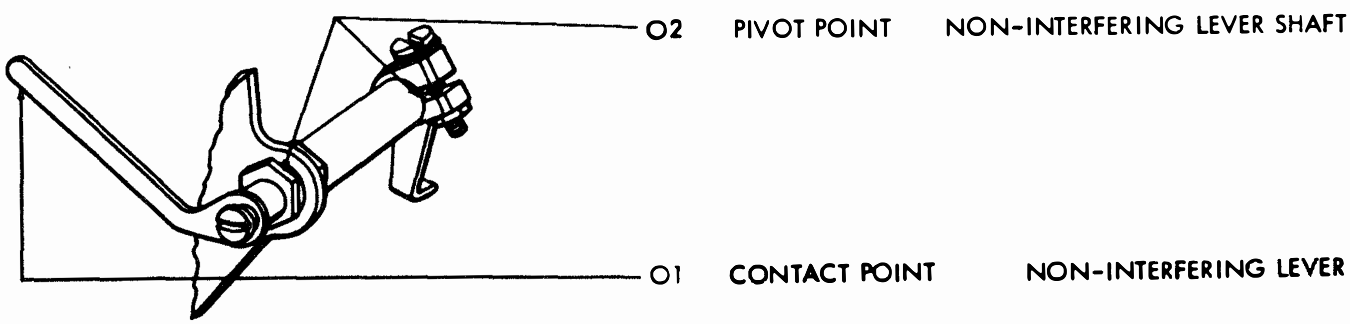


Figure 4-46. Remote Control Noninterfering BLANK Tape Feed-Out Mechanism (Sheet 4 of 5)

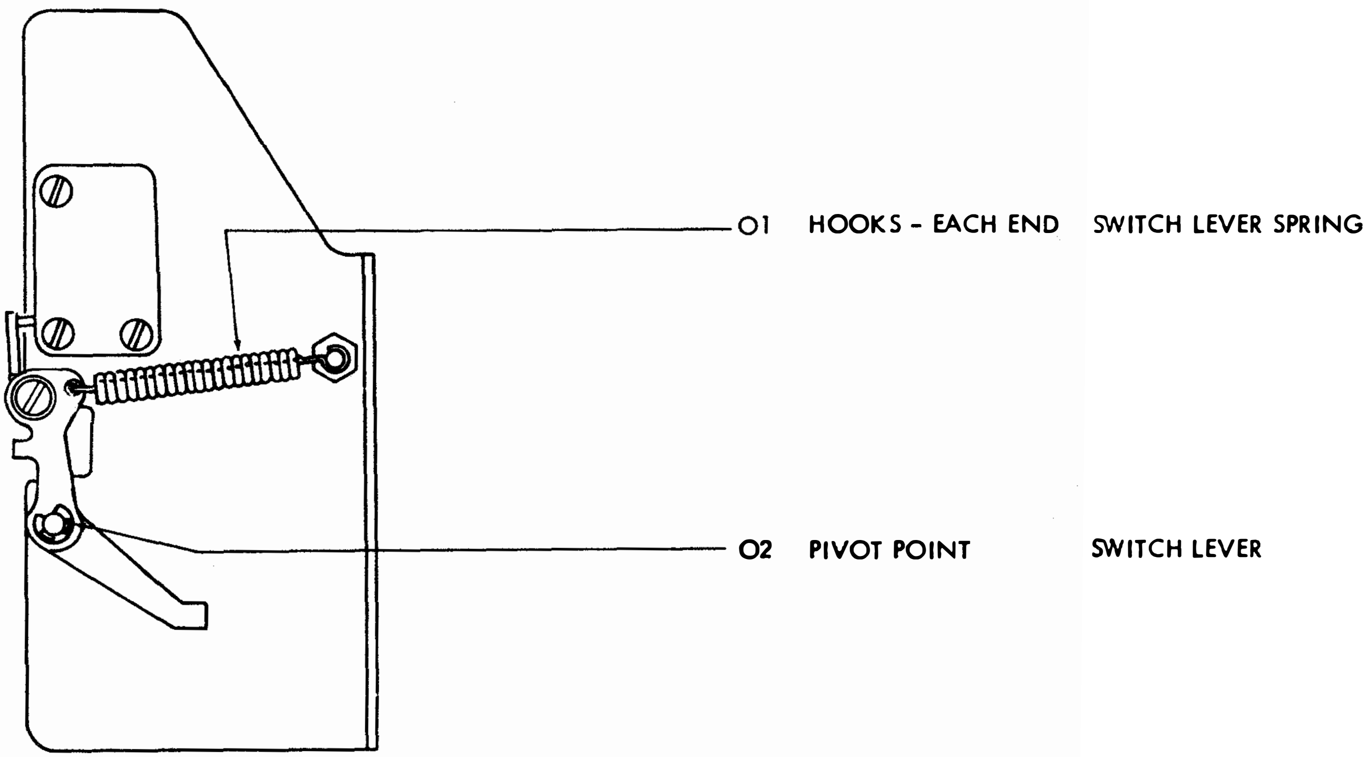


Figure 4-46. Remote Control Noninterfering BLANK Tape Feed-Out Mechanism (Sheet 5 of 5)

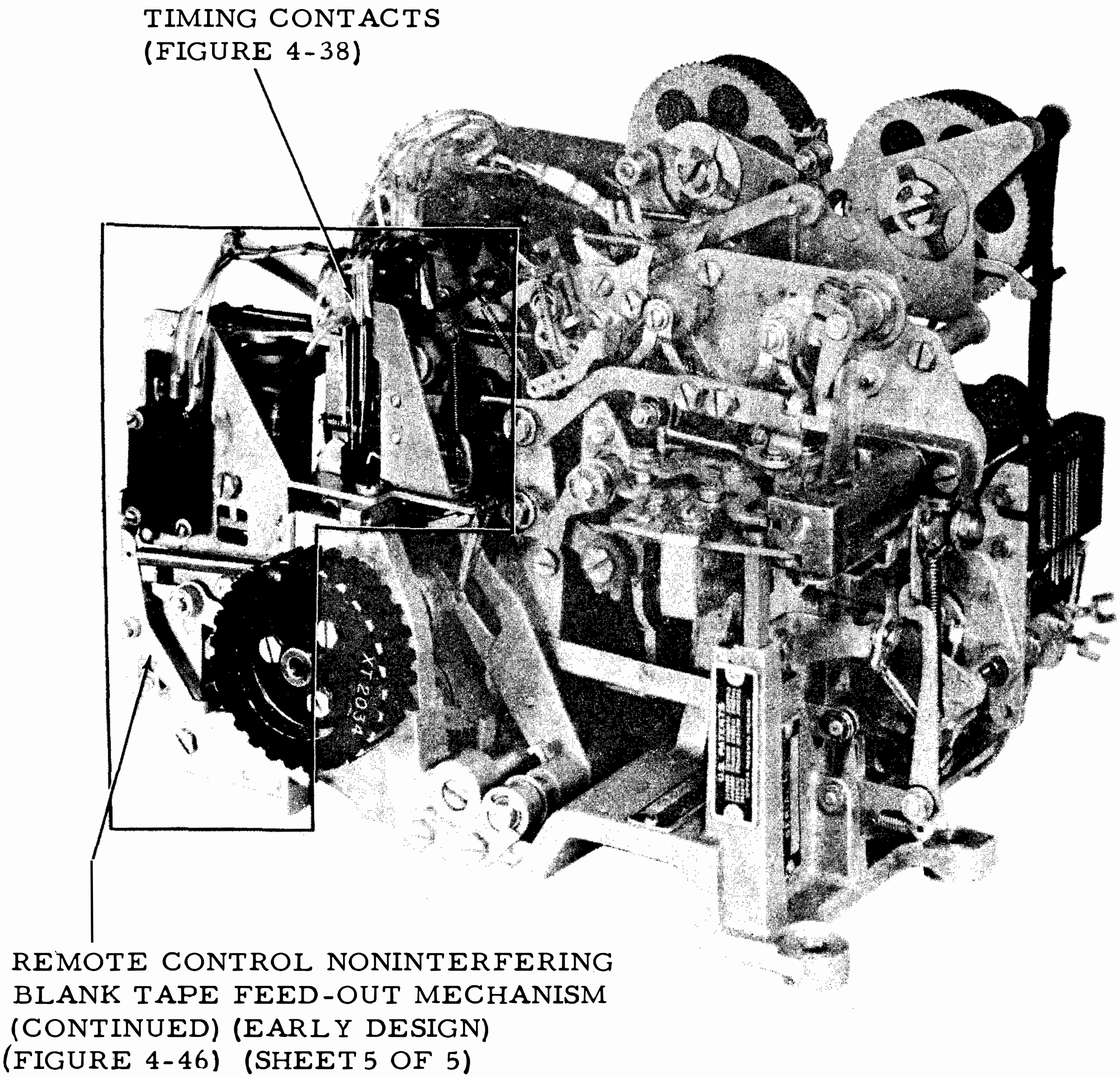


Figure 4-47. Remote Control Noninterfering Tape Feed-Out Mechanism and Timing Contacts

Table 4-4. Typing Reperforator and Tape-Printer Keyboard Lubrication Chart Index

Table 4-4. Typing Reperforator and Tape-Printer Keyboard Lubrication Chart Index - Continued

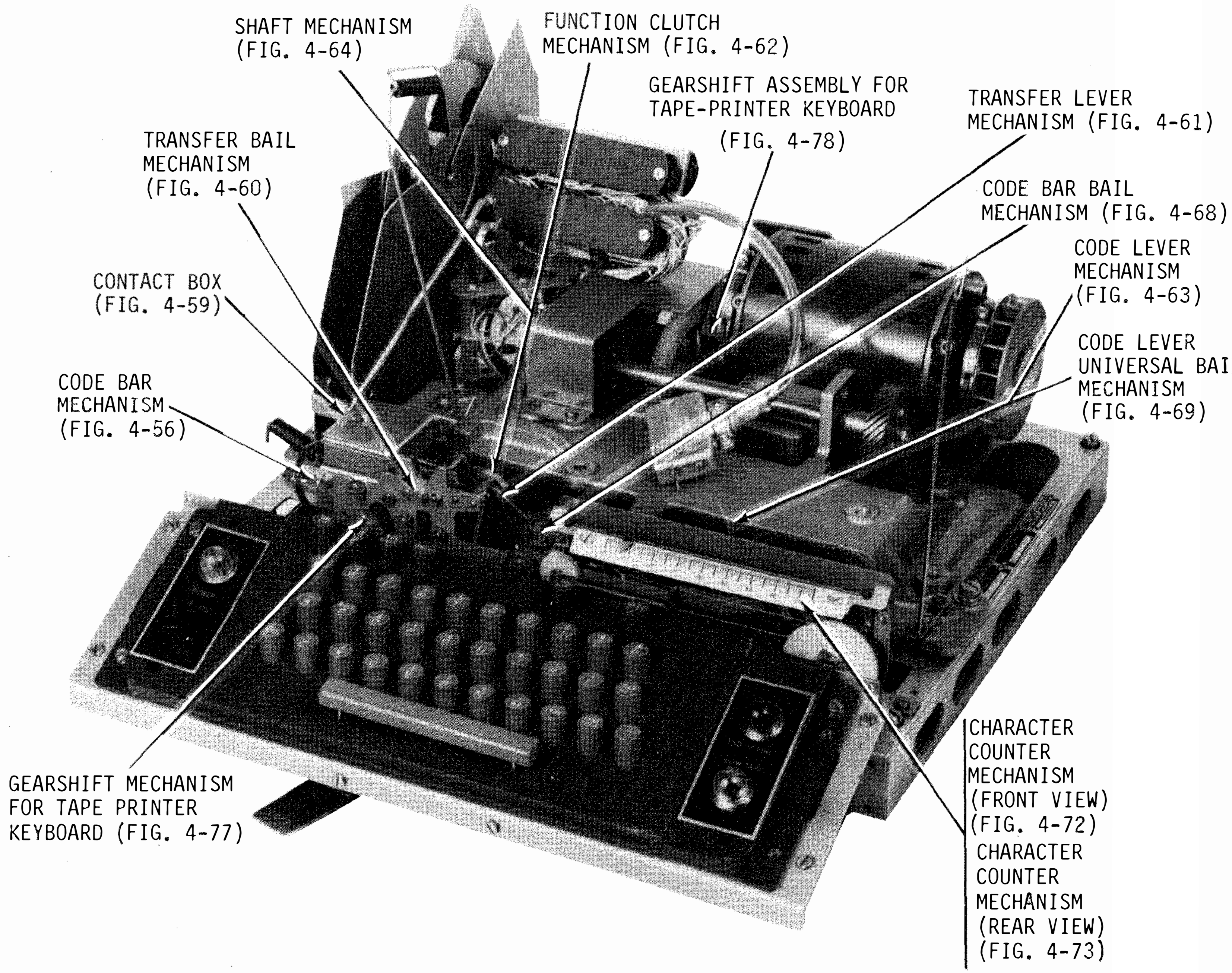


Figure 4-48. Typical Tape Printer Keyboard

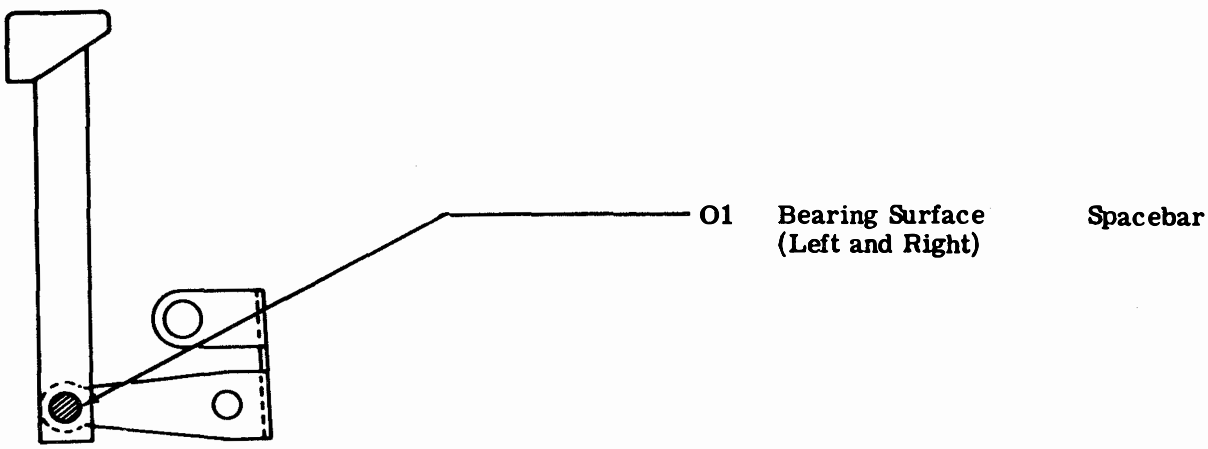


Figure 4-49. Spacebar Mechanism

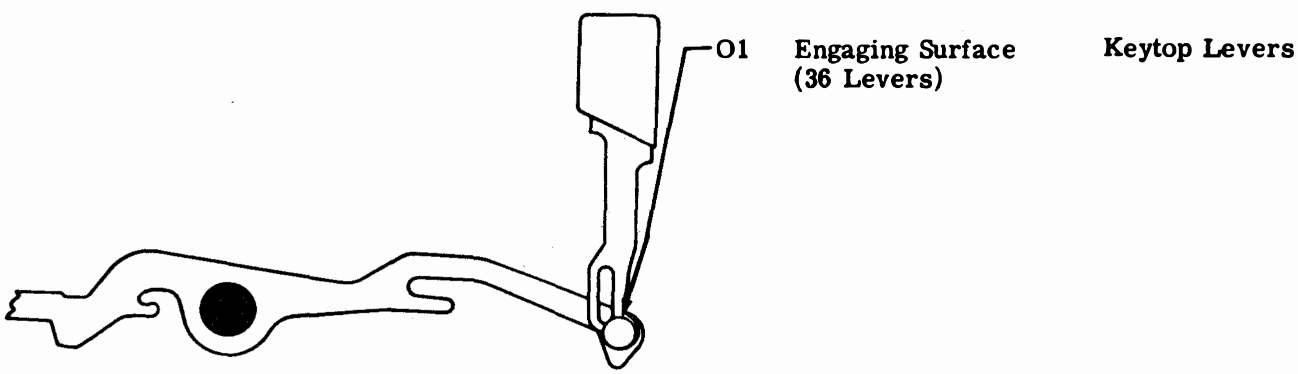


Figure 4-50. Keylever Mechanism

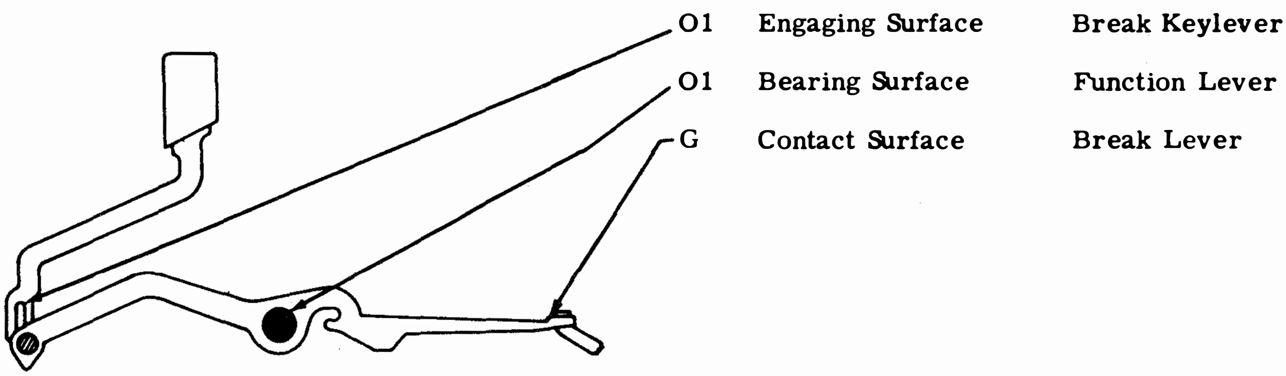


Figure 4-51. Break Lever Mechanism

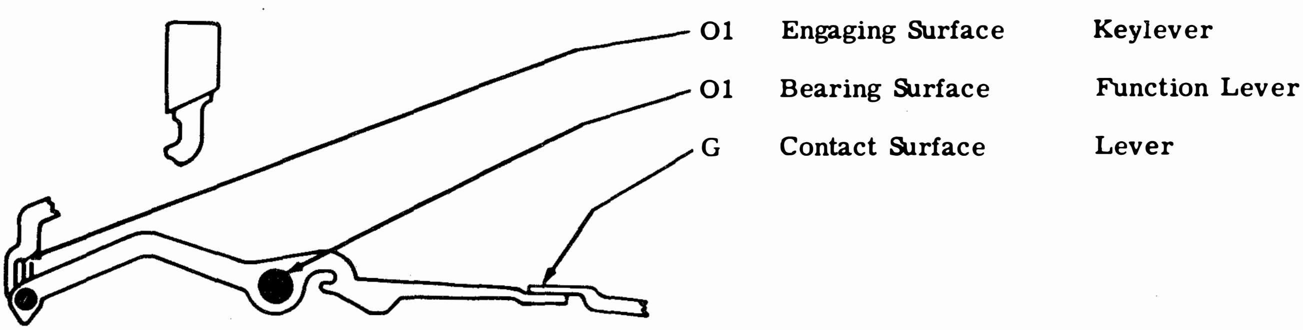
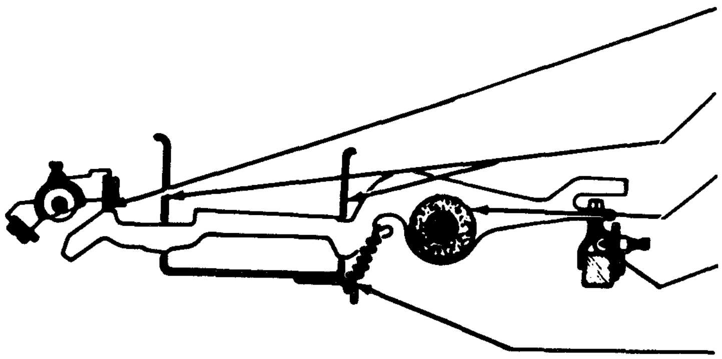
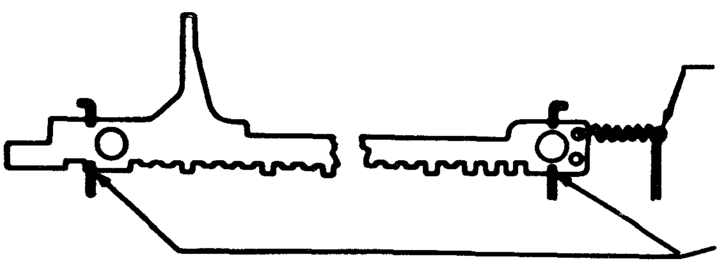


Figure 4-52. Function Lever Mechanism



G	Contacting Surface (32 Levers)	Codelever Universal Bail
O1	Guide Slots (32 Levers)	Codelevers
SAT	Felt Washers (6 Washers)	Codelever Shaft
O1	Bearing Surface (32 Wedges)	Lock Ball Track
O1	Hooks - Each End (40 Springs)	Spring

Figure 4-53. Code Lever Mechanism



O1	Hooks - Each End (7 Springs)	Spring
O1	Guide Slots (Left and Right - Top and Bottom)	Codebar Guides

Figure 4-54. Code Bar Mechanism

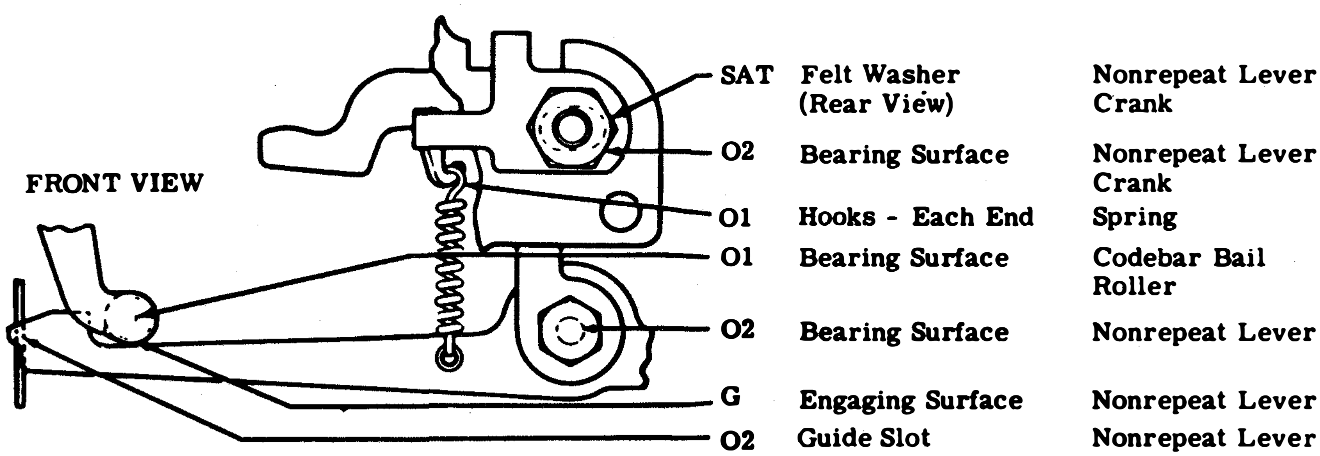


Figure 4-55. Nonrepeat Lever Mechanism

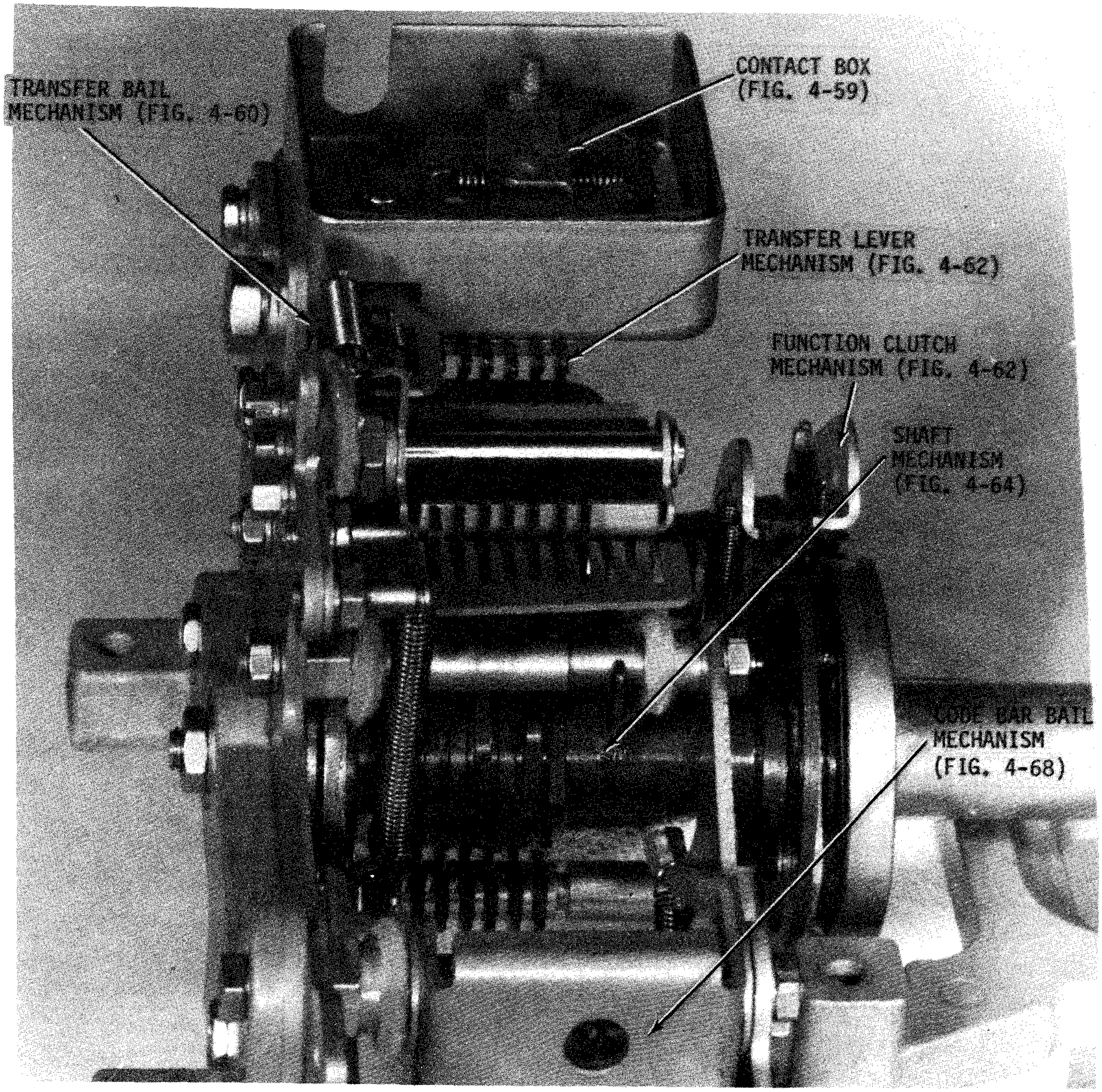
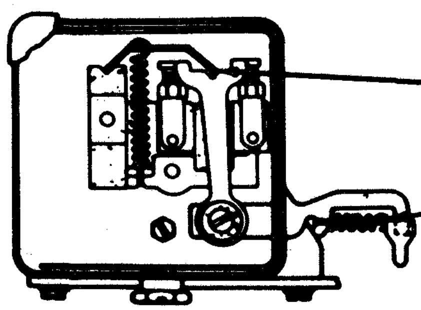


Figure 4-56. Signal Generator Mechanism



G	Engaging Surface	Contact Toggle
O1	Hooks - Each End	Spring

SPECIFIC NOTES

CAUTION

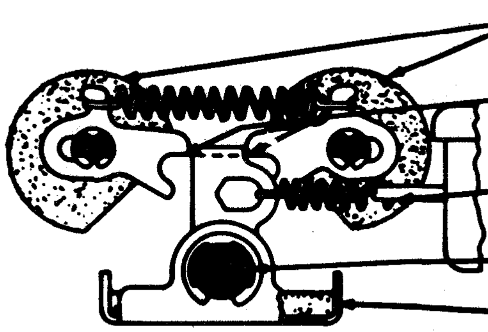
Note: The marking "DO NOT OIL" on the signal contact box cover should be interpreted literally. Portions of the mechanism should be greased as indicated, but no oil should be used.

GENERAL NOTES

Disassembly: Remove nut and lockwasher securing contact box cover and remove cover.

CAUTION: GREASE SPARINGLY - KEEP CONTACTS FREE OF OIL.

Figure 4-57. Contact Box



SAT	Felt Washers (2 Washers)	Latches
G	Engaging Surface	Transfer Bail
O1	Hooks - Each End (2 Springs)	Spring
O2	Bearing Surface	Transfer Bail
SAT	Oil Wick	Transfer Bail

Figure 4-58. Transfer Bail Mechanism

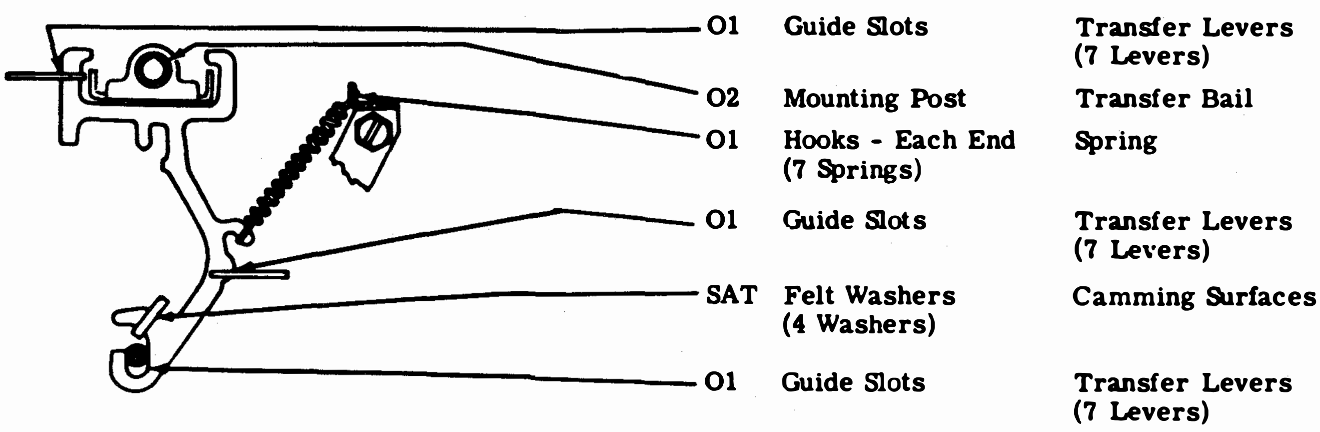


Figure 4-59. Transfer Lever Mechanism

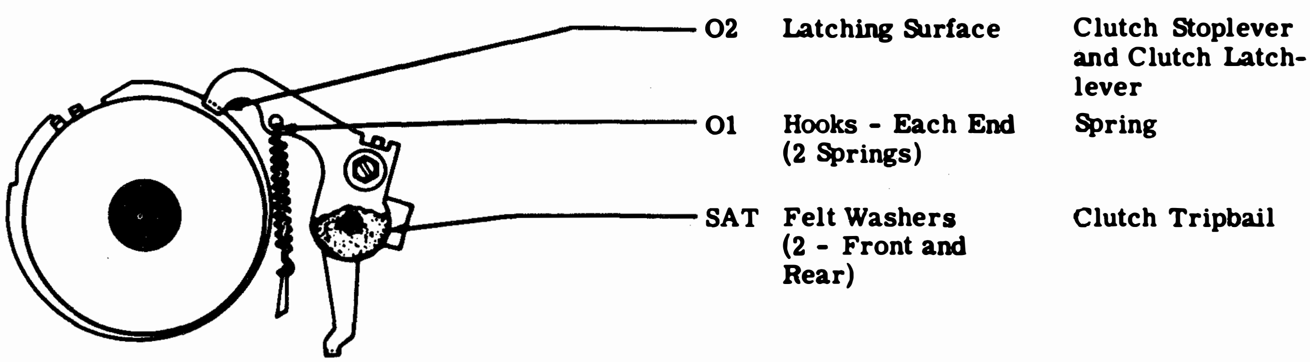


Figure 4-60. Function Clutch Mechanism

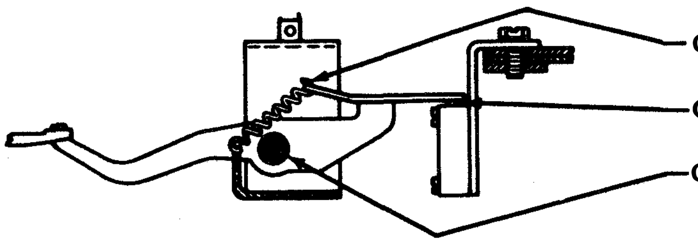


Figure 4-61. Electrical Line Break Mechanism

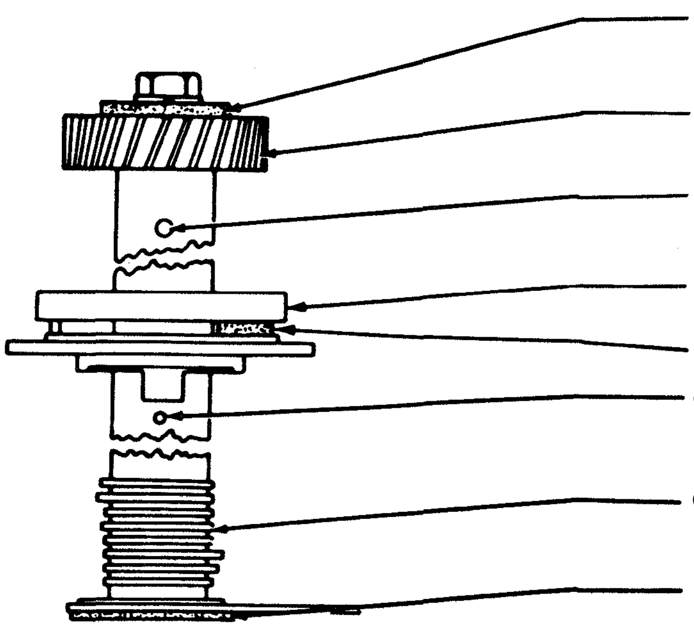


Figure 4-62. Shaft Mechanism

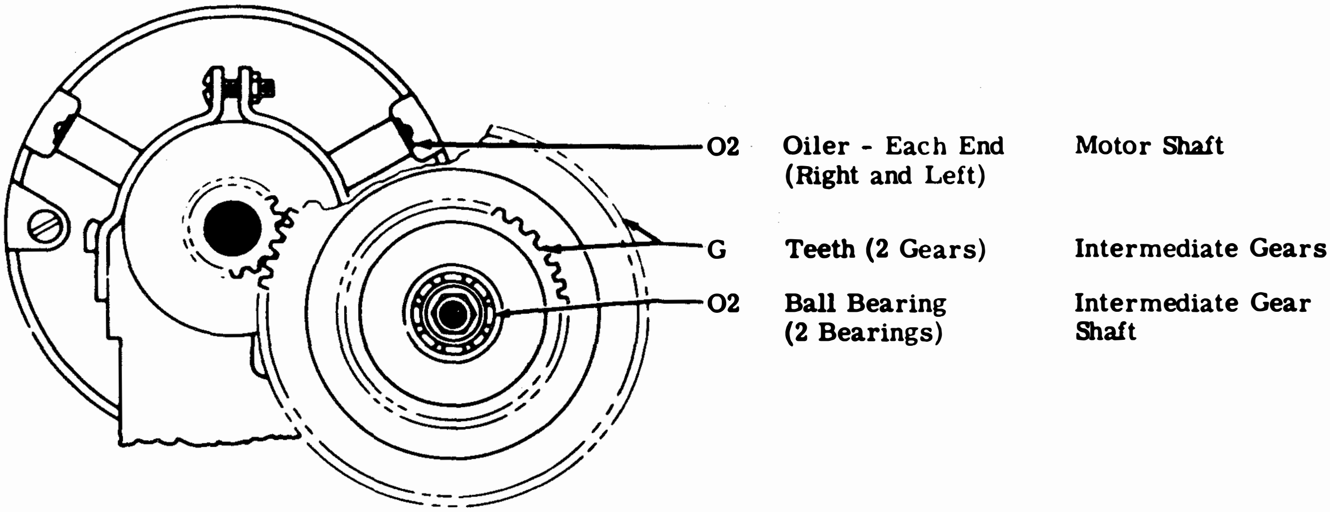


Figure 4-63. Intermediate Gear Mechanism

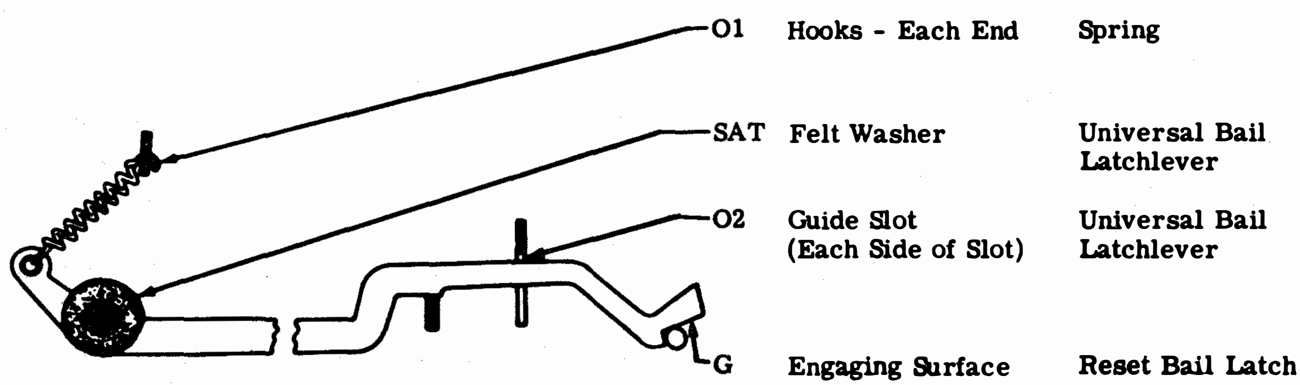


Figure 4-64. Universal Bail Latchlever, Right Side View

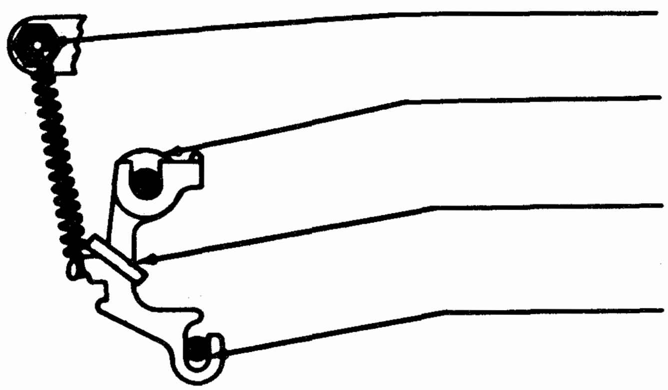


Figure 4-65. Locking Bail Mechanism

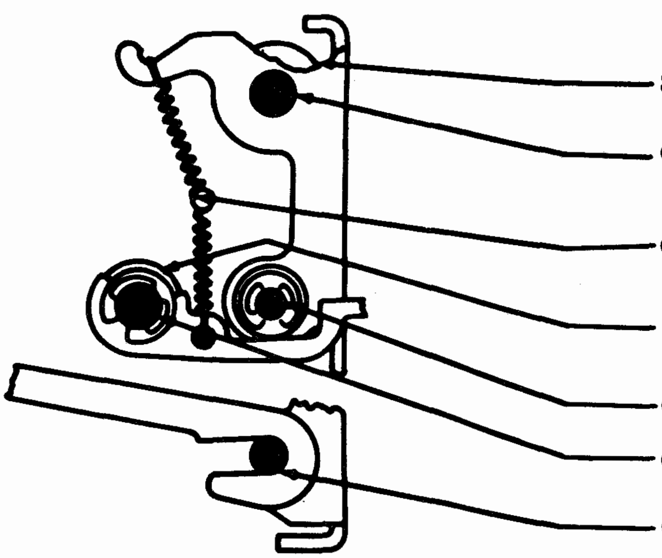
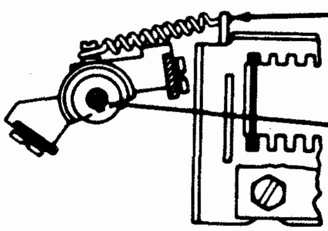
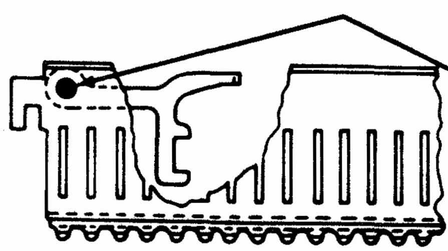


Figure 4-66. Code Bar Bail Mechanism



01	Hooks - Each End	Spring
02	Bearing Surface	Codelever Universal Bail

Figure 4-67. Code Lever Universal Bail Mechanism



01	Bearing Surface	Lockbar Latch

Figure 4-68. Lockbar Latch Mechanism

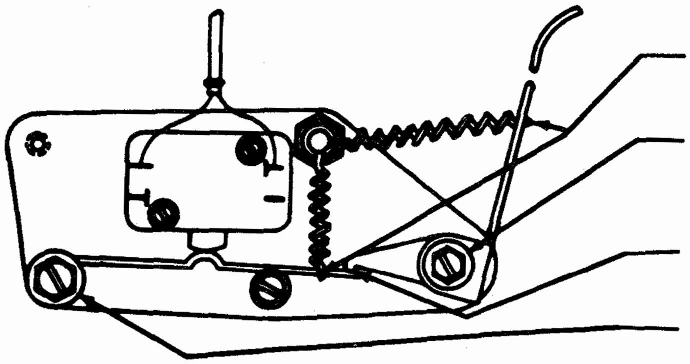


Figure 4-69. Tape-Out Switch Mechanism

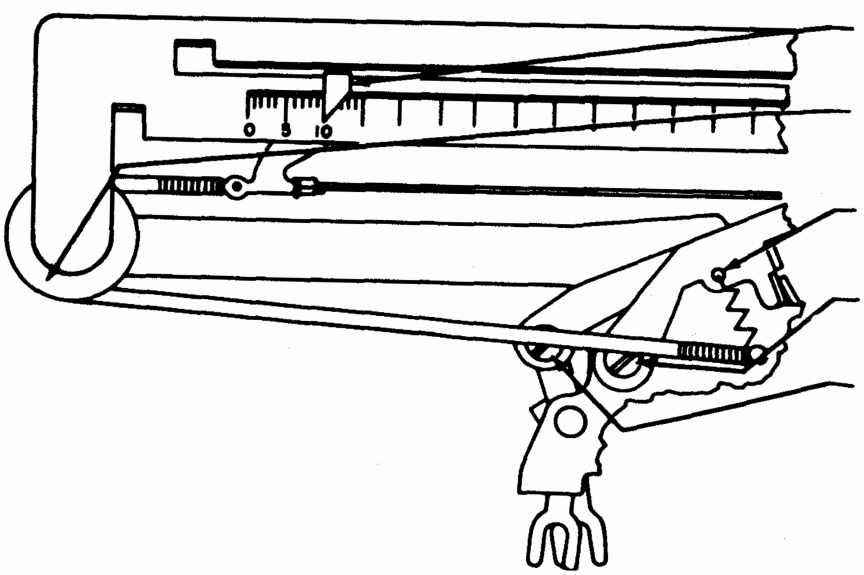


Figure 4-70. Character Counter Mechanism, Front View

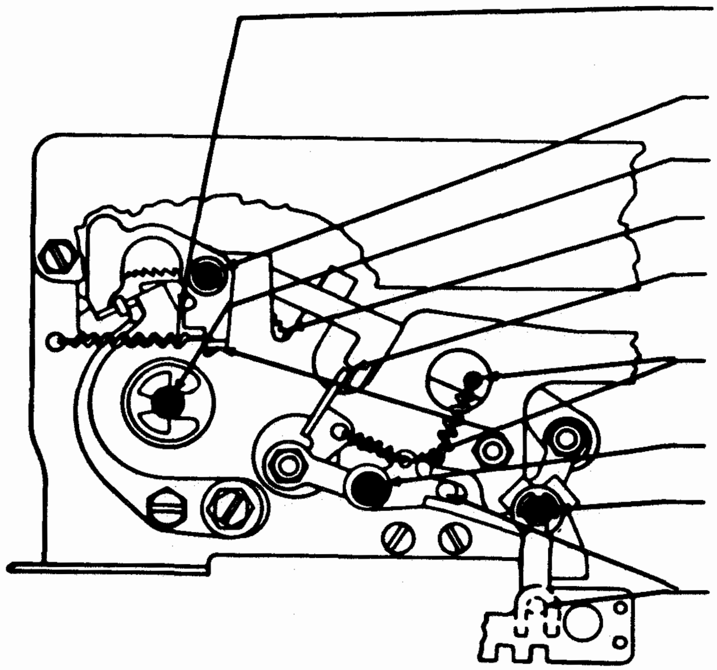


Figure 4-71. Character Counter Mechanism, Rear View

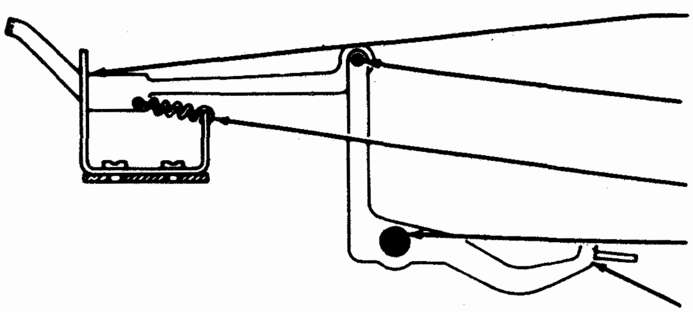


Figure 4-72. Local Tape Feed-Out Mechanism

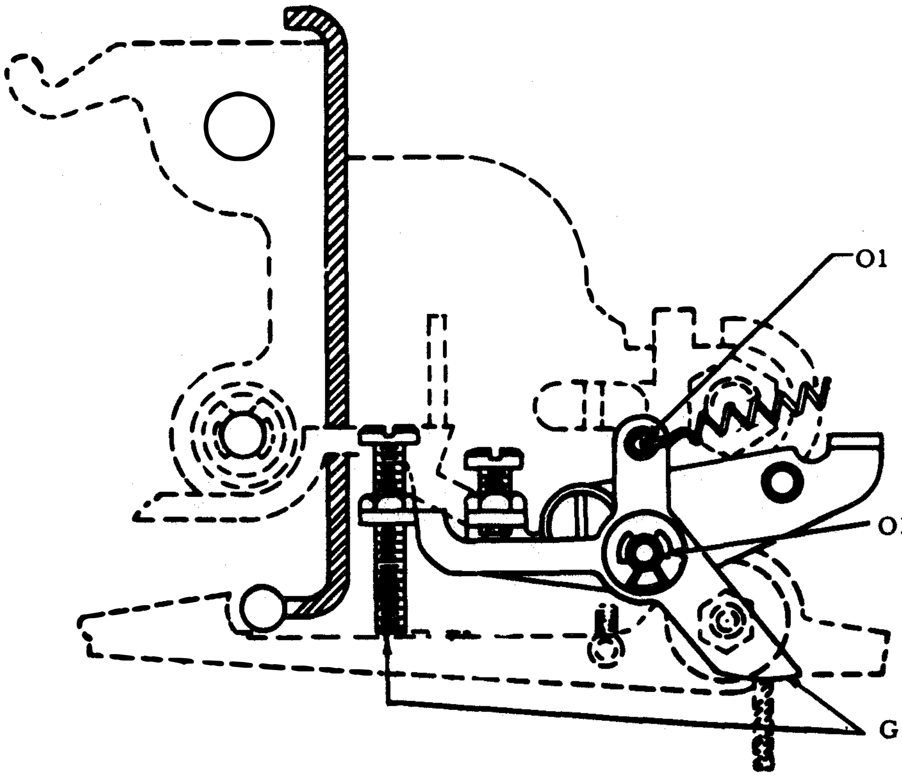
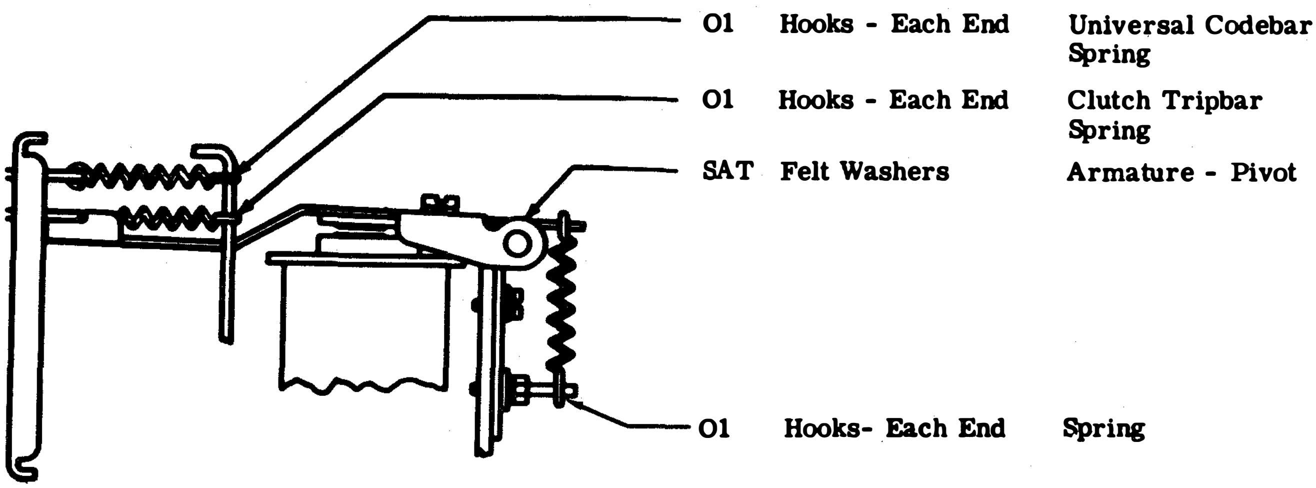


Figure 4-73. Repeat-On-Space Mechanism



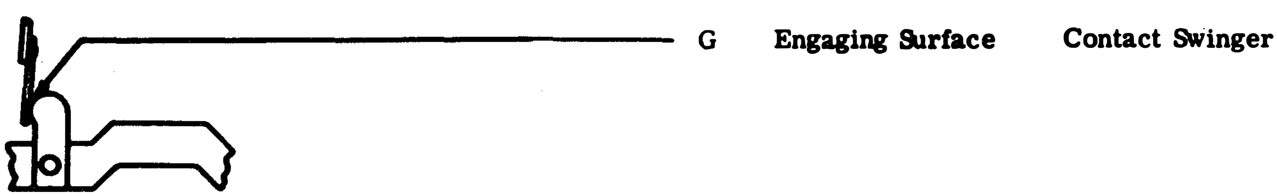


Figure 4-74. Synchronous Pulsed Magnet Mechanism

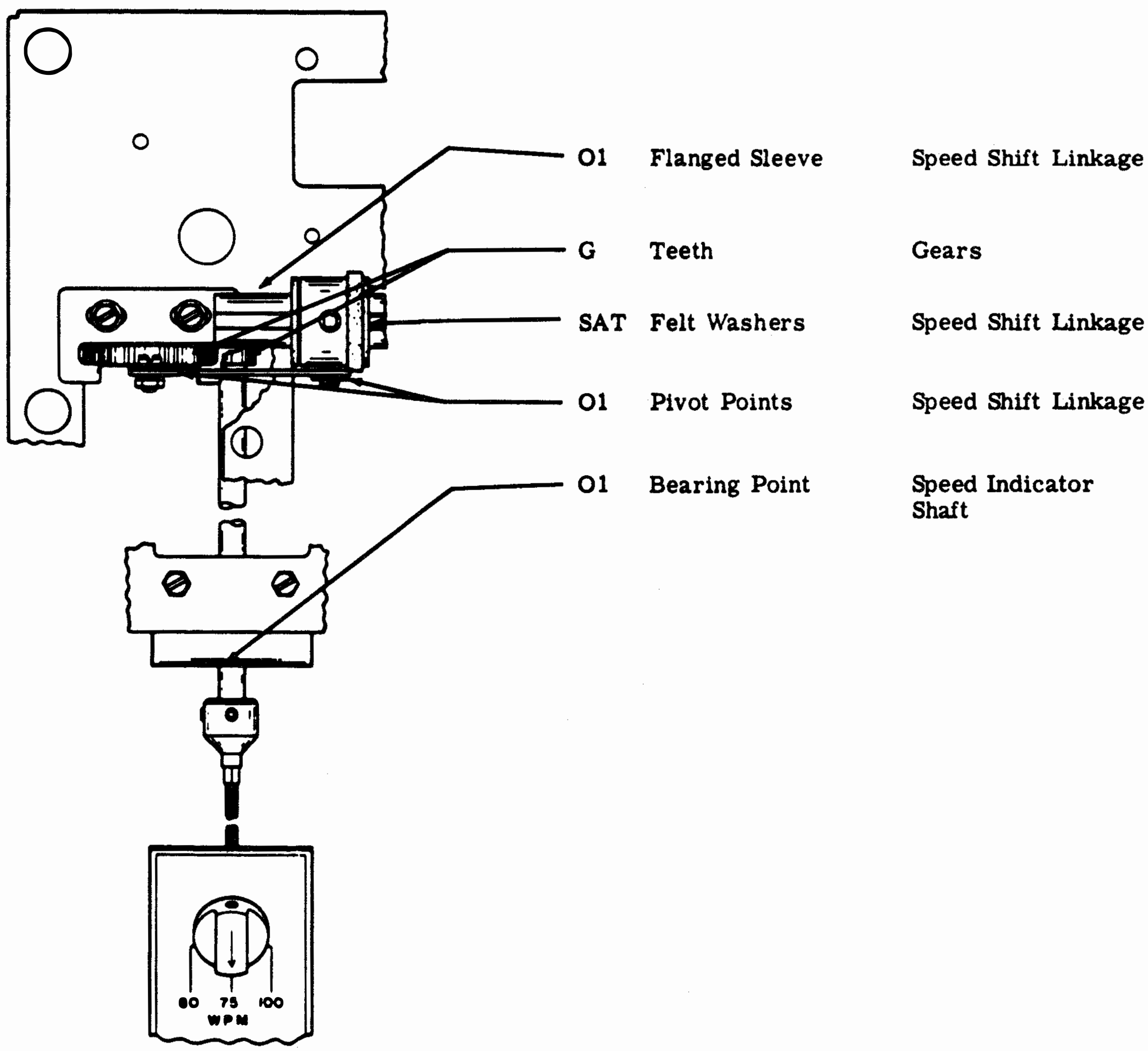


Figure 4-75. Gearshift Mechanism for Tape Printer Keyboard (Sheet 1 of 2)

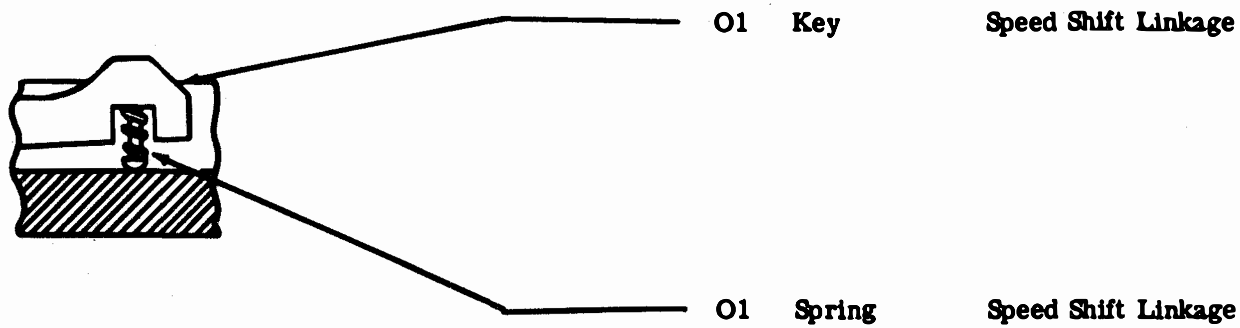


Figure 4-75. Gearshift Mechanism for Tape Printer Keyboard (Sheet 2 of 2)

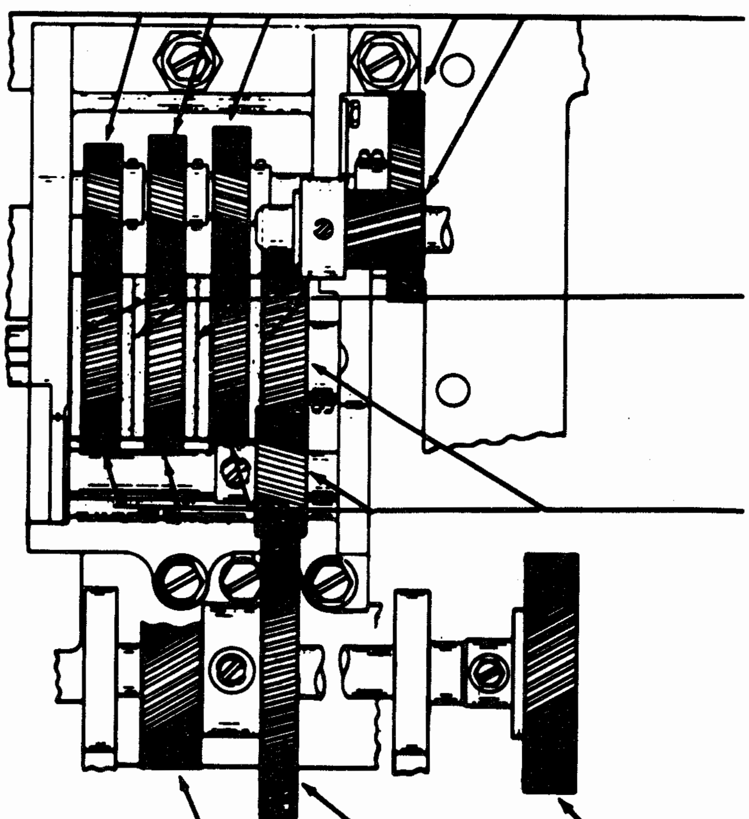


Figure 4-76. Gearshift Assembly for Tape Printer

Table 4-5. Typing Reperforator and Tape Printer Receive-Only Base Lubrication Index

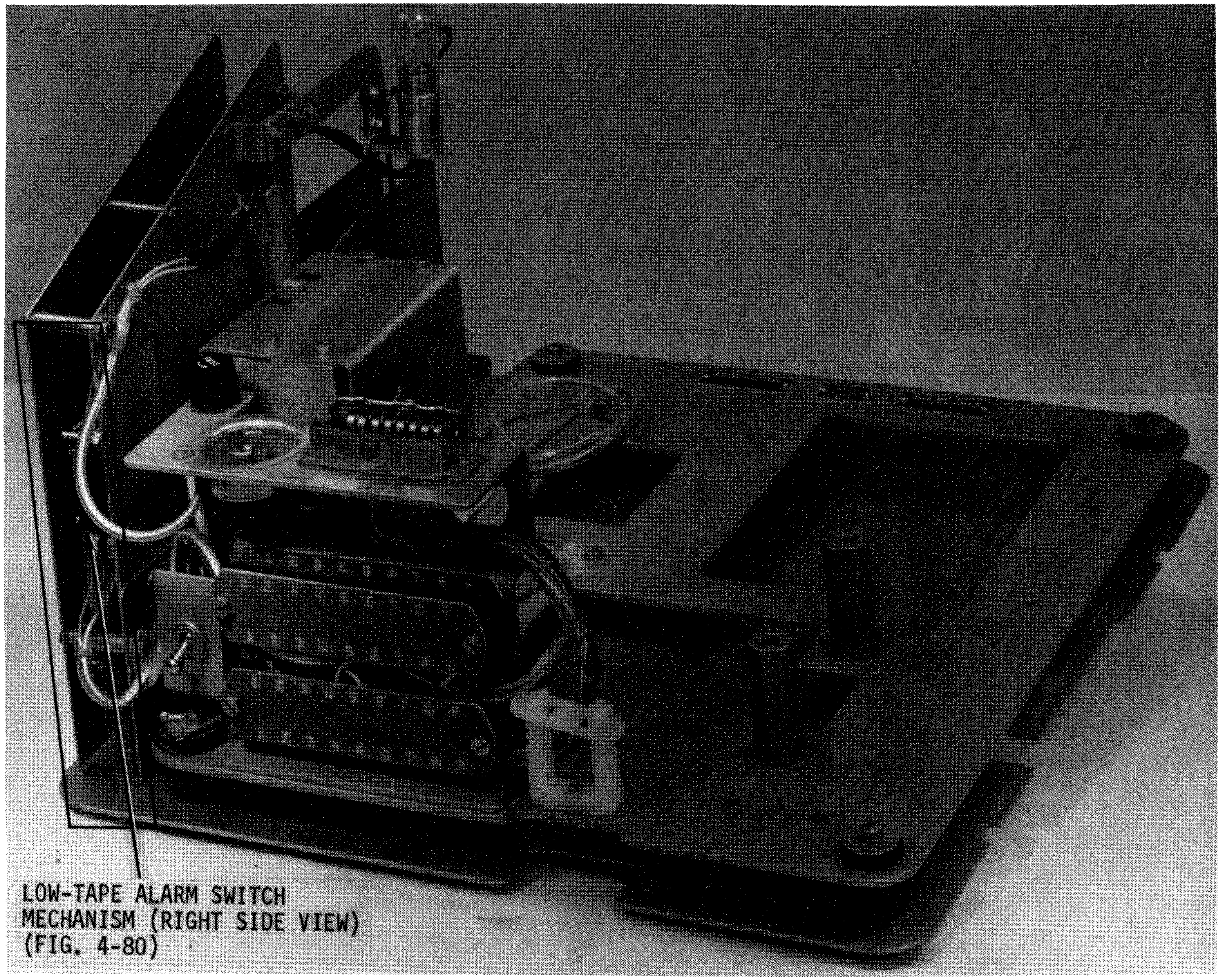


Figure 4-77. Receive-Only Base, Rear View

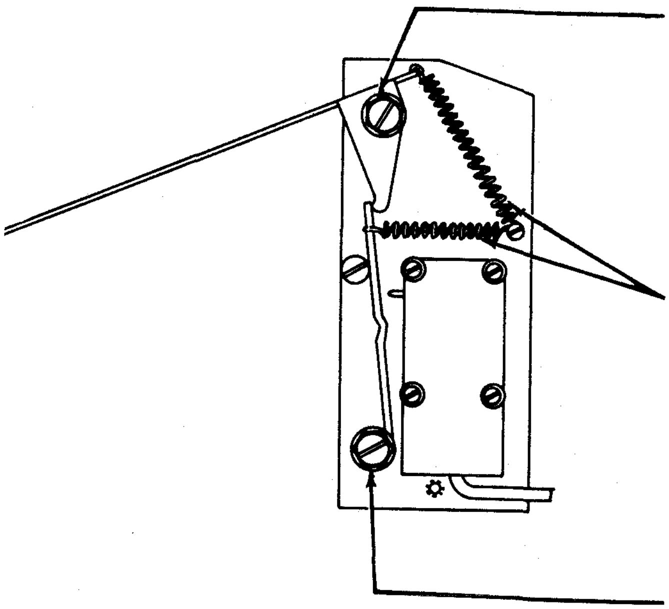


Figure 4-78. Low-Tape Alarm Switch Mechanism, Right Side View

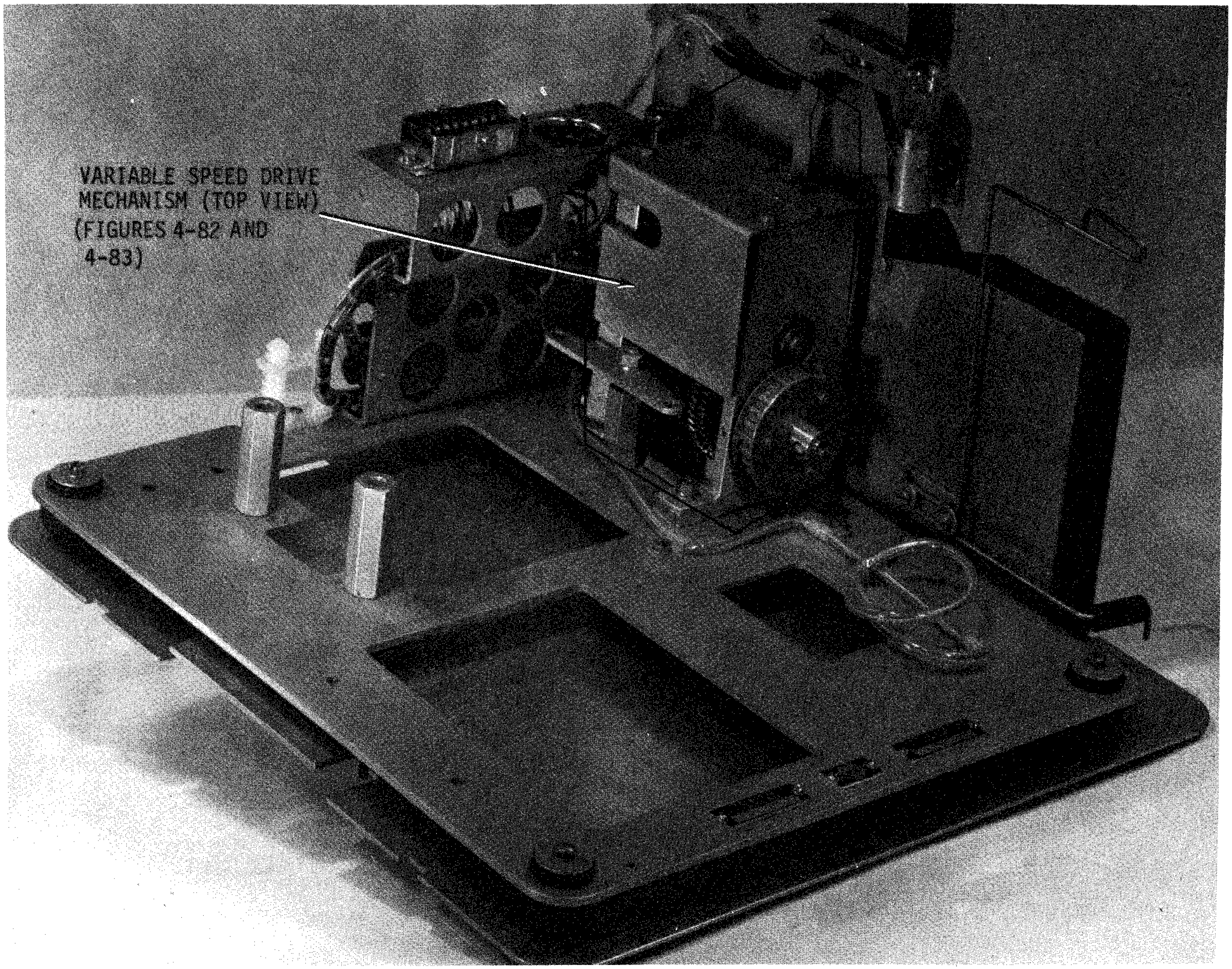


Figure 4-79. Receive-Only Base, Left Front View

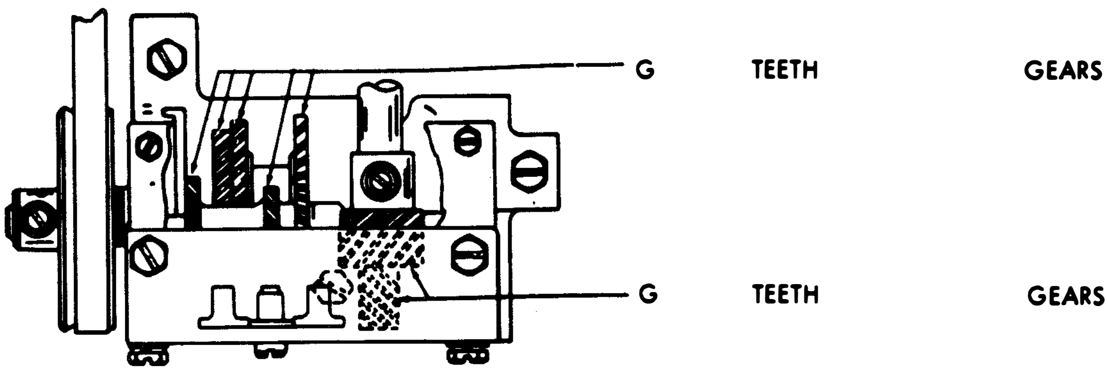


Figure 4-80. Variable Speed Drive Mechanism, Top View

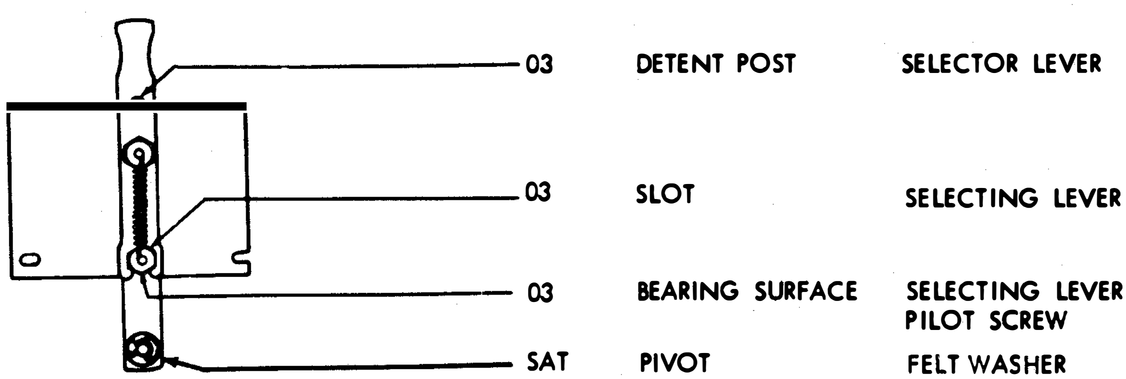


Figure 4-81. Variable Speed Drive Mechanism, Left Side View

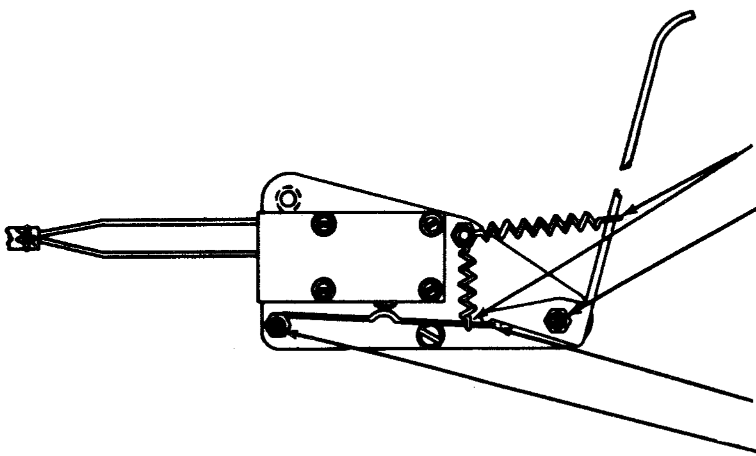


Figure 4-82. Low-Tape Alarm Switch Mechanism

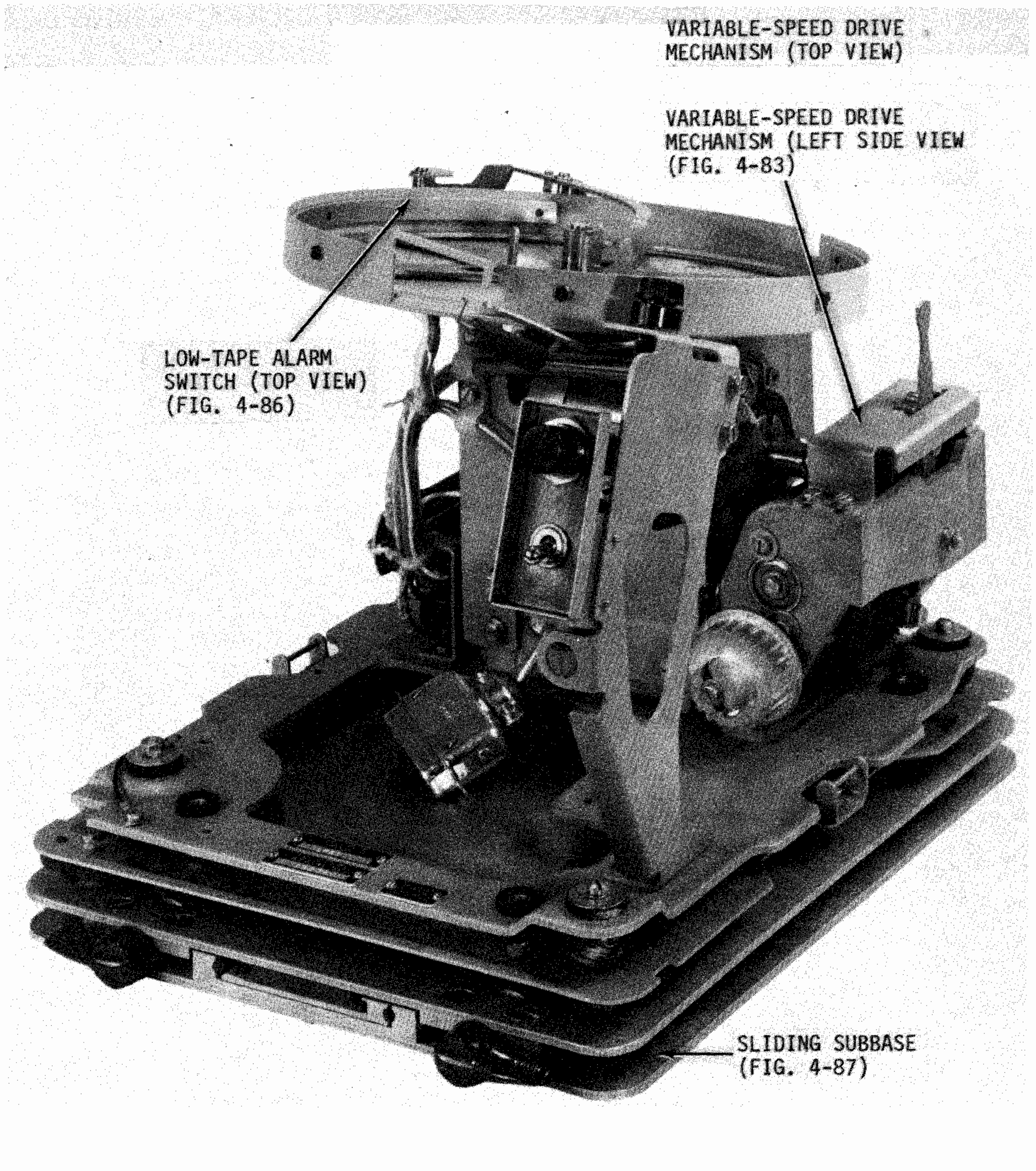


Figure 4-83. Receive-Only Base and Motor Unit Mounted on a Sliding Subbase

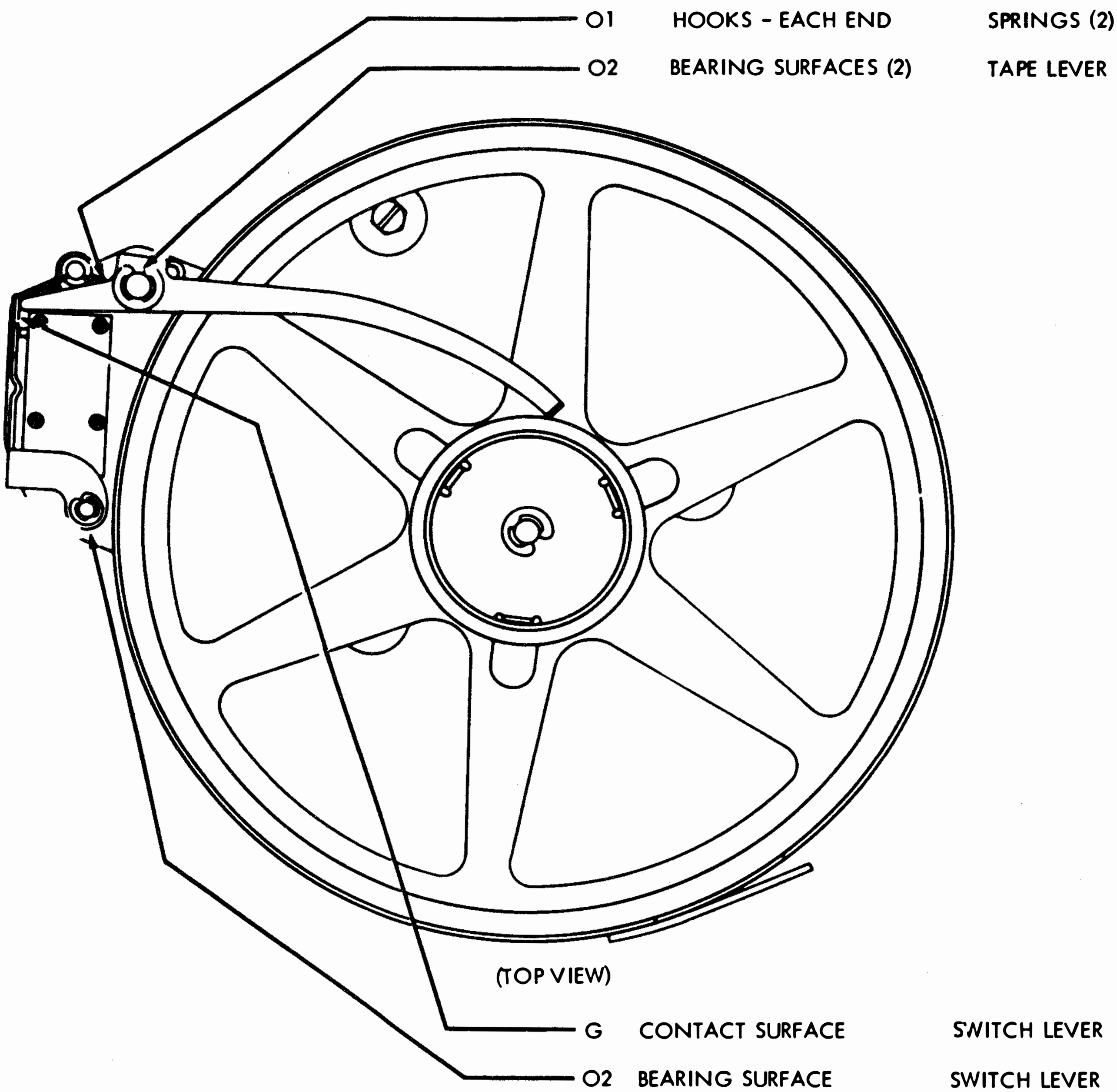
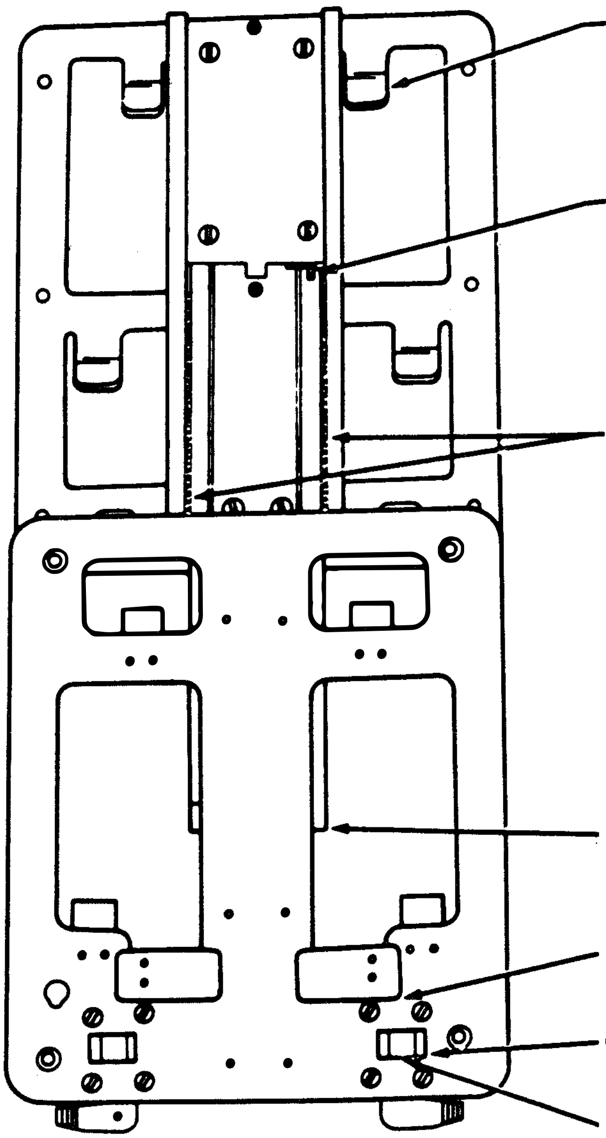


Figure 4-84. Low-Tape Alarm Switch, Top View



G	SLIDING SURFACES (8 PLACES)	STOPS
O1	SLIDING SURFACE	LOCKING LEVER
O2	BALL BEARINGS (2 PLACES)	SLIDE
G	BEARING AND SLIDING AREA (8 PLACES)	SLIDF
O2	TORSION SPRINGS (2)	LATCH
O3	BEARING POINTS (4)	LOCKING CYLINDER
G	FLAT SURFACES (2)	LOCKING CYLINDER

Figure 4-85. Sliding Subbase

level equipment in paragraph 4-7a and operational checks described in paragraph 4-7b.

a. Mechanical Checks. The following mechanical checks are to be performed quarterly or as required.

WARNING

Disconnect power from unit. Failure to comply can cause serious injury.

(1) Type Wheel. Check type wheel as follows:

(a) Refer to figure 6-97.

(b) Select SSMMM code combination.

(c) Place rocker bail to extreme left.

(d) Ensure correcting lever is firmly seated in type wheel lock.

(e) Type wheel should be aligned so that a full character is printed uniformly on paper. If character is not printed uniformmly, perform adjustment procedure described in paragraph 6-3.11(2) and (3).

(2) Tape Hole Spacing. Check tape hole spacing as follows:

(a) With a maximum tape supply load (full roll), power perforate six series of nine BLANK combinations followed by one LETTERS combination. Only LETTERS or BLANKS are acceptable.

(b) Place the the tape over smooth side of a 95960 tape gauge so that the first "2 code hole in tape is concentric with the first 0.072 inch hole of the tape gauge.

NOTE

The first five holes in the gauge are the same size as the code holes in the tape (0.072 inch diameter), but the sixth hole in the gauge is larger (0.086 inch diameter). This arrangement allows a ±0.007-inch variation in five inches. The next four 0.072-inch holes in the tape gauge should be visible through number 2 code holes in the tape, and the sixth number 2 code hole in the tape should be entirely within the 0.086-inch diameter hole of the tape gauge.

(3) Orientation and Range. Check orientation and range as follows:

(a) Refer to figure 6-62.

(b) Rotate the range finder knob in one direction until an error appears in typed copy, then retract range finder setting slowly until the error disappears.

(c) Note the number of points indicated at this position.

(d) Rotate the range finder knob in the opposite direction, until error appears in the typed copy, and retrace the range finder setting slowly until error disappears.

(e) Note the number of points indicated at this position.

(f) Rotate the range finder knob to a setting midway between the settings obtained in (c) and (e). This setting should be 72 points minimum. If not, perform the adjustment described in paragraph 6-3.1h(19).

(4) Printing Trip Link Clearance. Check printing trip link clearance as follows:

(a) Refer to figure 6-93.

(b) Trip the function clutch.

(c) Position the rocker bail to its extreme left.

(d) Manually lift the accelerator so that the latching surfaces of the printing latch and the accelerator are even.

(e) Measure the clearance between the accelerator and latch.

(f) There should be some to 0.015 inch clearance. If not, perform the adjustment described in paragraph 6-3.11(32).

(5) Signal Generator Contact. Check the signal generator contact as follows:

(a) Refer to figure 6-140.

(b) Remove the cover from the contact box.

(c) Place the detent toggle against its spacing stop and measure the marking contact gap (left side).

(d) Place the detent toggle against its marking stop and measure the spacing contact gap.

(e) The two gap measurement should be equal. If not, perform the adjustment procedure described in paragraph 6-4.2b(4).

(6) Clutch Shoe Lever Spring Tension. Check clutch shoe lever spring tension as follows:

(a) Refer to figure 6-138.

(b) Engage the clutch and hold cam disc to prevent turning.

(c) Attach a spring scale hook and pull at tangent to the clutch.

(d) The force required to move shoe lever in contact with the stop lug should be between 15 and 20 ounces. If not, perform adjustment procedure described in paragraph 6-4.2a(5).

(7) Clutch Shoe Lever Clearance. Check clutch shoe lever clearance as follows:

(a) Refer to figure 6-135.

(b) Disengage the clutch and measure the gap between the clutch shoe lever and clutch disc stop lug.

(c) Trip the clutch and rotate it until the clutch shoe lever is toward bottom of the unit.

(d) Align the head of the clutch drum mounting screw with the stop lug.

(e) Manually compress the shoe lever against the stop lug and allow them to snap apart, engaging the clutch.

(f) Again measure the gap between the clutch shoe lever and clutch disc stop lug.

(g) Subtract the measurement obtained in step (f) from that obtained in step (b) and record the difference.

(h) The difference should be between 0.055 and 0.085 inch. If not, perform the adjustment procedure described in paragraph 6-4.2a(1).

NOTE

At 100 wpm set the difference at 0.075 inch for proper operation.

b. Operational Tests. Operational tests for high-level KTR and ROTR sets are discussed below in paragraph 4-7b(1) and for low-level KTR and ROTR sets in paragraph 4-7b(2).

(1) Operational Tests (High-Level). Figure 4-86 shows the test setup required to perform high-level KTR and ROTR test procedures described in table 4-6. If abnormal indications are encountered during a test, refer to Troubleshooting Index Table 5-1 in Chapter 5. Prior to conducting the tests, perform the following initial control settings on the TS-2616/UGM test set shown in figure 4-86.

TS-2616/UGM

(a) AC POWER switch to OFF (down) position

(b) PEAK RESET switch to AUTO.

(c) RATE-BAUDS switch to 74.2.

(d) CODE LEVEL switch to 5.

(e) DISTORTION SELECT switch To PEAK-TOTAL.

(f) TRANSITION SELECT switch to ALL.

(g) INPUT POLARITY switch to either + or - to cause meter to deflect to right.

(h) INPUT SELECT switch to NEUTRAL 60.

(i) INPUT FILTER switch to IN.

(2) Operational Tests (Low-Level). Figure 4-87 shows test setup required to perform low-level test procedures described in table 4-7. If abnormal indications are encountered during a test, refer to Troubleshooting Index, table 5-1 in Chapter 5. Prior to conducting the tests, perform the initial control settings on the TS-2616/UGM test set as described in paragraph 4-7b(1).

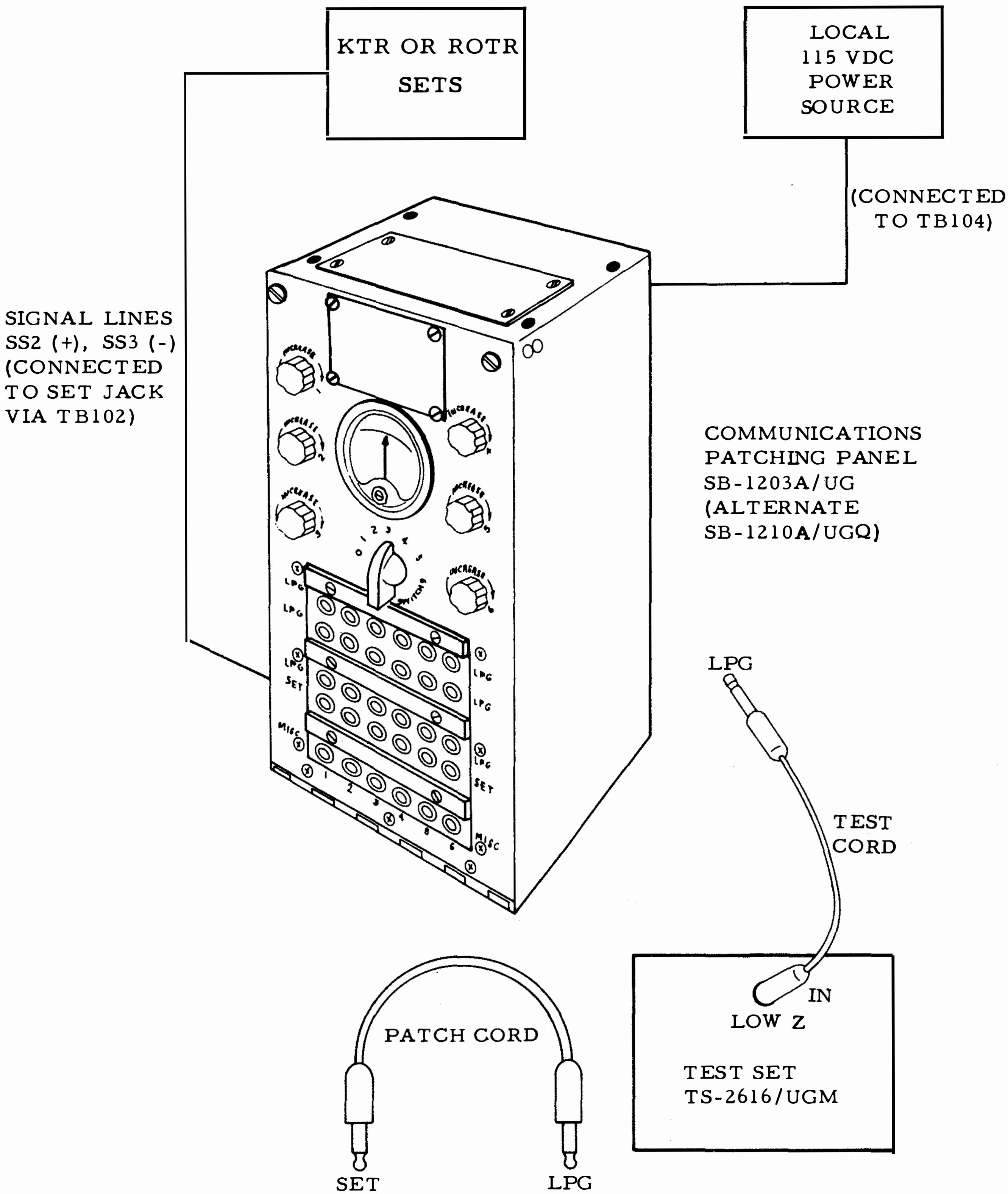


Figure 4-86. KTR and ROTR Test Setup (High-Level)

Table 4-6. KTR and ROTR Test Procedures (High-Level)

Step	Action	Normal Indication	Reference Table 5-1
1.	Preliminary.		
a.	Ensure TS-2616/UGM test set controls are set as indicated in paragraph 4-7b(1).		
b.	Ensure main power switch on KTR or ROTR is set to OFF (down) position.		
c.	Refer to figure 4-86.		
d.	Ensure KTR or ROTR are local 115 VAC power source are correctly connected to patching panel. (Refer to NAVSHIPS 0967-874-1010, formerly NAVSHIPS 95718.)		
e.	Plug KTR or ROTR test set, and local 115 VAC power source power cords into 115 VAC outlets.		
f.	Set power switches on test set and local 115 VAC power source to ON position.		
g.	Set KTR or ROTR main power switch to ON position.		

Table 4-6. KTR and ROTR Test Procedures (High-Level) - Continued

Step	Action	Normal Indication	Reference Table 5-1
2.	Lamp Checks. Check for proper operation of lamps as follows:		
a.	Observe pilot lamp.	Pilot lamp is lit.	Item 1
b.	Observe cabinet illumination lamp.	Illumination lamp is lit.	Item 2
3.	Motor Checks. Check for proper operation of motor as follows:		
a.	Observe motor starting.	Motor starts.	Item 3
b.	Determine that motor is not running too slow or too fast.	Motor runs at correct speed.	Item 4
4.	Main Shaft Drive Check. Check for proper main shaft drive as follows:		
a.	Observe main shaft rotation.	Main shaft rotates.	Item 5
b.	Observe gears.	Gears do not howl or chatter.	Item 6
5.	Signal Generator Shaft Drive Check. Observe signal generator shaft rotation.	Signal generator shaft rotates.	Item 7

Table 4-6. KTR and ROTR Test Procedures (High-Level) - Continued

Step	Action	Normal Indication	Reference Table 5-1
6.	<u>Typing Reperforator Checks</u>. Check typing Reperforator as follows:		
a.	Apply signal to set from signal line (external) or signal test set.	Typing reperforator opeates.	Item 8
b.	Apply alternate R and Y signal input.	R and Y are typed and perforated.	Item 9
c.	If distortion test set is used, apply FIGS and LTRS input.	Proper shift character is printed and corresponding code is perforated.	Item 10
d.	With signal line idle (marking) press TAPE F.O. key.	Tape is fed out to preset length.	Item 11
e.	While tape is feeding, interrupt feed-out with incoming signal.	Feed-out stops and first character of signal is typed and perforated.	Item 12
f.	Stop signal transmission.	Tape automatically feeds out to preset length, typed and perforated for letters.	Item 13
g.	Lift tape out of tape container.	TAPE OUT lamp lights.	Item 14

Table 4-6. KTR and ROTR Test Procedures (High-Level) - Continued

Step	Action	Normal Indication	Reference Table 5-1
h.	Replace tape roll (with at least one inch of tape on core).	TAPE OUT lamp extinguishes.	Item 15
i.	Press BREAK key.	Typing reperforator runs open.	Item 16
j.	Press KYBD LOCK key.	Keys in lower three rows will not operate.	Item 17
k.	Press KYBD UNLK key.	Tape is perforated according to input message.	Item 18
l.	Operate keyboard.	Character counter indicator advances one unit for each character or space typed and END-OF-LINE lamp lights between 66th and 68th space.	Item 19
m.	Depress CAR RET key.	Character counter indicator returns to zero and END-OF-LINE lamp is extinguished.	Item 20
n.	Press REPT key and one character key (or space bar) and hold.	Character (or space) is typed and perforated continuously until REPT key is released.	Item 21
o.	Press TAB B. SP. key.	Last perforated character is moved to right (in punch mechanism) in line with punch pins.	Item 22

Table 4-6. KTR and ROTR Test Procedures (High-Level) - Continued

Step	Action	Normal Indication	Reference Table 5-1
p.	Press LTRS key.	LETTERS code perforation obliterates previously punched (erroneous) code.	Item 23
q.	Turn KTR or ROTR main power switch to OFF position.	Motor stops.	Item 24

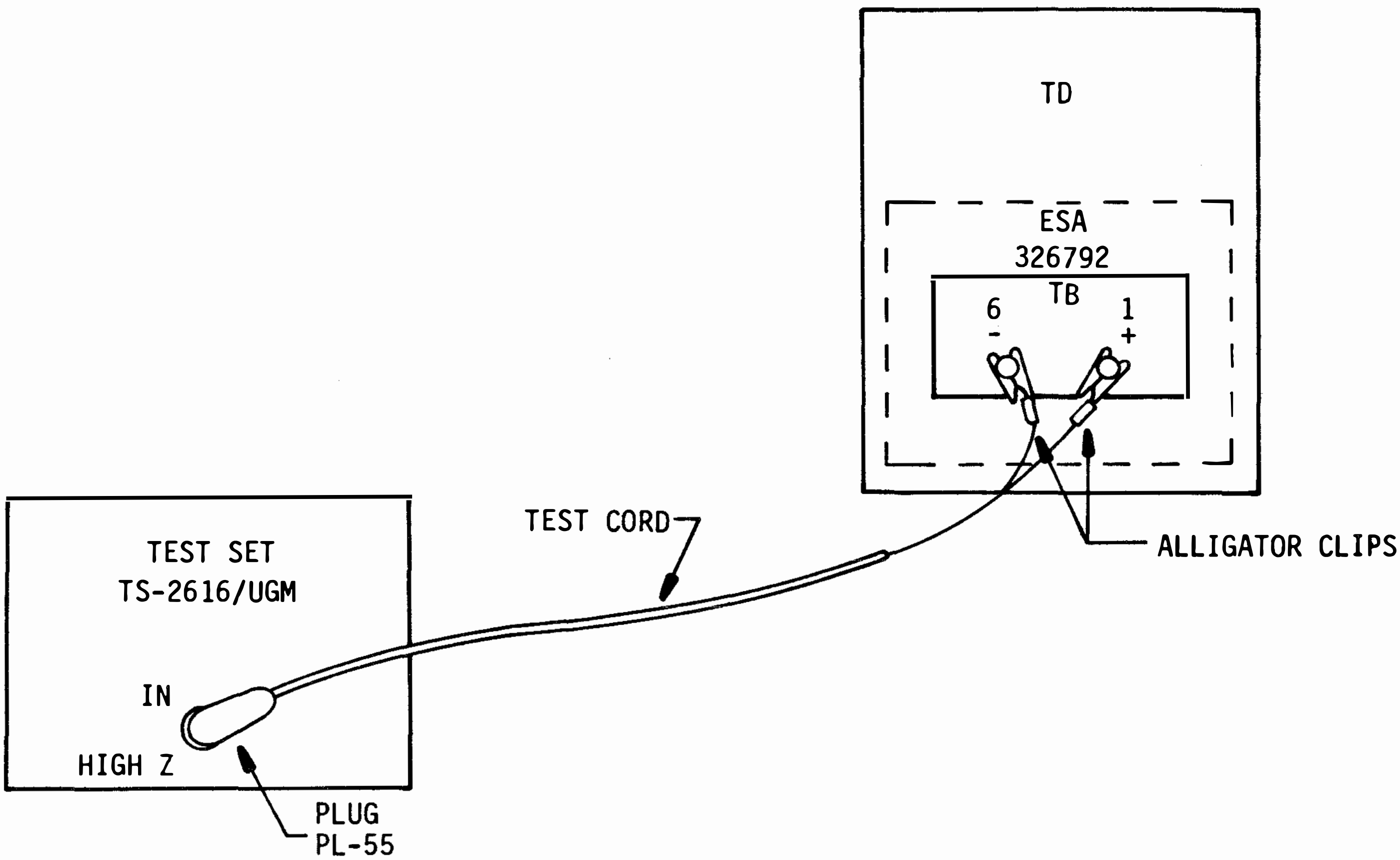


Figure 4-87. KTR and ROTR Test Setup (Low-Level)

Table 4-7. KTR and ROTR Test Procedures (Low-Level)

Step	Action	Normal Indication	Reference Table 5-1
1.	Preliminary.		
a.	Ensure TS-2616/UGM test set controls are set as indicated in paragraph 4-7b(1).		
b.	Ensure main power switch on KTR or ROTR is set to OFF (down) position.		
c.	Refer to figure 4-87.		
d.	Ensure KTR or ROTR and local 115 VAC power source are correctly connected to patching panel. (Refer to NAVSHIPS 0967-874-1010, formerly NAVSHIPS 95718.)		
e.	Plug KTR or ROTR test set, and local 115 VAC power source power cords into 115 VAC outlets.		
f.	Set power switches on test set and local 115 VAC power source to ON position.		
g.	Set KTR and ROTR main power switch to ON position.		

Table 4-7. KTR and ROTR Test Procedures (Low-Level) - Continued

Step	Action	Normal Indication	Reference Table 5-1
2.	Lamp Checks. Check for proper operation of lamps as follows:		
a.	Observe pilot lamp.	Pilot lamp is lit.	Item 1
b.	Observe cabinet illlumination lamp.	Illumination lamp is lit.	Item 2
3.	Motor Checks. Check for proper operation of motor as follows:		
a.	Observe motor starting.	Motor starts.	Item 3
b.	Determine that motor is not running too slow ot too fast.	Motor runs at correct speed.	Item 4
4.	Main Shaft Drive Check. Check for proper main shaft drive as follows:		
a.	Observe main shaft rotation.	Main shaft rotates.	Item 5
b.	Observe gears.	Gears do not howl or chatter.	Item 6
5.	Signal Generator Shaft Drive Check. Observe signal generator shaft rotation.	Signal generator shaft rotates.	Item 7

Table 4-7. KTR and ROTR Test Procedures (Low-Level) - Continued

Step	Action	Normal Indication	Reference Table 5-1
6.	Typing Reperforator Checks. Check typing reperforator as follows:		
a.	Apply signal to set from line (external) or signal test set.	Typing reperforator operates.	Item 8
b.	Apply alternate R and Y signal input.	R and Y are typed and perforated.	Item 9
c.	If distortion test set is used, apply FIGS and LTRS input.	Proper shift character is printed and corresponding code is perforated.	Item 10
d.	With signal line idle (marking) press TAPE F.O. key.	Tape is fed out to preset length.	Item 11
e.	While tape is feeding, interrupt feed-out with incoming signal.	Feed out stops and and first character of signal is typed and perforated.	Item 12
f.	Stop signal transmission.	Tape automatically feeds out to preset length, typed and perforated for letters.	Item 13
g.	Lift tape out of tape container.	TAPE OUT lamp lights.	Item 14

Table 4-7. KTR and ROTR Test Procedures (Low-Level) - Continued

Step	Action	Normal Indication	Reference Table 5-1
h.	Replace tape roll (with at least one inch of tape on core).	TAPE OUT lamp extinguishes.	Item 15
i.	Press BREAK key.	Typing reperforator runs open.	Item 16
j.	Press KYBD LOCK key.	Keys in lower three rows will not operate.	Item 17
k.	Press KYBD UNLK key.	Tape is perforated according to input message.	Item 18
l.	Operte keyboard.	Character counter indicator advances one unit for each character or space typed and END-OF-LINE lamp lights between 66th and 68th space.	Item 19
m.	Depress CAR RET key.	Character counter indicator returns to zero and END-OF-LINE lamp is extinguished.	Item 20
n.	Press REPT key and one character key (or space bar) and hold	Character (or space) is typed and perforated continuously until REPT key is released.	Item 21
o.	Press TAB B. SP key.	Last perforated character is moved to right (on punch mechanism) in line with punch pins.	Item 22

Table 4-7. KTR and ROTR Test Procedures (Low-Level) - Continued

Step	Action	Normal Indication	Reference Table 5-1
p.	Press LTRS key.	LETTERS code perforation obliterates previously punched (erroneous) code.	Item 23
q.	Turn KTR or ROTR main power switch to OFF position.	Motor stops.	Item 24

CHAPTER 5
TROUBLESHOOTING

5-1. INTRODUCTION. This chapter provides information required to isolate a malfunction in Send-Receive (KTR) and Receive-Only (ROTR) Typing Reperforator Sets Model 28 to a misadjusted mechanism or a defective component. Troubleshooting is based on the result of operational tests described in paragraph 4-7b of chapter 4. Wiring and schematic diagrams are presented at the end of this chapter for use in troubleshooting.

5-2. TROUBLESHOOTING PROCEDURES. Troubleshooting procedures for high and low-level KTR and ROTR teletypewriter equipment are provided in paragraphs 5-2.1 and 5-2.2. The high-level procedures contained in paragraph 5-2.1, are also applicable to low-level equipment. The procedures contained in paragraph 5-2.2 are applicable to low-level equipment only.

5-2.1 HIGH-LEVEL TROUBLESHOOTING PROCEDURES. The following paragraphs provide procedures for use in troubleshooting high-level KTR and ROTR teletypewriter equipment.

a. Troubleshooting Index. The troubleshooting index, table 5-1, contains the items referenced in tables 4-5 and 4-6, operational test procedures. If an abnormal indication is encountered, the technician is directed to a fault isolation paragraph.

b. Lamp, Fuse, and Semiconductor Index. Table 5-2 provide a list of lamps and fuses used in the high level KTR and ROTR sets. The above active components constitute the most probable cause of failure.

c. Fault Isolation Procedures. The following paragraphs provide fault isolation procedures referenced in table 5-1.

(1) If the motor does not start when main power switch is ON, proceed as follows:

(a) Check the external power supply to verify 115 volts ac is present on external connector pins 2 (grounded side) and 11 (ungrounded). When checking miniaturized sets, check at lower terminal board terminals 1 (ungrounded) and 7 (grounded).

(b) Check the solder connections to terminals of 16-point connector and receptacle. Check for loose or missing contacts within the case and for broken body moldings. Check the case for breaks or dents. Check the mating of the connector and receptacle and the operation of the latch locking the two in mated position.

(c) Check The solder connections to terminals of 36-point connector and receptacle. Terminals 35 and 36 of the connector (attached to the typing reperforator) must be strapped on the soldered end, and the connector must be mated with the base receptacle to complete the ac power distribution circuit in the set. Check for loose or missing contacts within the case and for broken body moldings. Check the

Table 5-1. Troubleshooting Index

Item	Text/Step	Symptom	Fault Isolation Paragraph
1	2a	Pilot lamp does not light	5-2.1c(2)(a),(b), (c), and (d)
2	2b	Cabinet illumination lamp does not light	5-2.1c(3)(a),(b), and (c)
3	3a	Motor does not start	5-2.1c(4)(a),(b) and (c)
4	3b	Motor runs at incorrect speed	5-2.1c(5)(a),(b) and (c)
5	4a	Main shaft does not rotate	5-2.1c(6)(a) and (b)
6	4b	Gears howl or chatter	5-2.1c(7)
7	5	Signal generator shaft does not rotate	5-2.1c(b)
8	6a	Typing reperforator runs open with signal input from signal line or signal test set. Typing reperforator runs closed on verifiable signal input from signal line or signal test set	5-2.1c(9)(a),(b), (c),(d),(e),(f),(g) (h), and (i) 5-2.1c(10)
9	6b	Typing and perforating failure when alternate R and Y signal is input	5-2.1c(11)
		Intermittent error	5-2.1c(12)(a),(b), and (c)
		Set gains or loses a pulse	5-2.1c(13)(a) and (b)
		Perforating failure	5-2.1c(14)(a) and (b) and 5-2.1c(21) (a),(b),(c), and (d)
		Punch fails to penetrate tape	5-2.1c(15)
		Tape does not feed	5-2.1c(16)(a) and (b)
		Feed holes are incorrectly spaced	5-2.1c(17)
		Printer does print	5-2.1c(18)
		Ribbon fails to feed or reverse	5-2.1c(19)(a) and (b)
		Set fails to type	5-2.1e(20)(a) and (b)

Table 5-1. Troubleshooting Index - Continued

Item	Text/Step	Symptom	Fault Isolation Paragraph
10	6c	LTRS or FIGS shift failure	5-2.1c(22)(a)
		Letters not positioned squarely for printing	5-2.1c(23)
		Only top or bottom of character prints	5-2.1c(24)(a) and (b)
		Characters too light or smudged	5-2.1c(27)
11	6d	Tape does not feed when TAPE F.O. key is pressed	5-2.1c(26)(a),(b),(c),(d)
		Incorrect length of tape is fed out	5-2.1c(27)a
12	6e	Tape continues to feed when signal interrupts feed-out	5-2.1c(28)(a),
		Loss of first character of incoming signal	5-2.1c(24)(a) and (b)
13	6f	Tape does not feed out	5-2.1c(30)(a) and (b)
		Tape feeds out to incorrect length	5-2.1c(31)
14	6g	TAPE-OUT lamp fails to light	5-2.1c(32)(a),(b),(c),(d), and (e)
15	6h	TAPE-OUT lamp remains lit	5-2.1c(33)
16	6i	Break signal transmission failure	5-2.1c(34)(a) and (b)
17	6j	KYDB LOCK key does not lock keyboard	5-2.1c(35)
18	6k	Keyboard transmission does not operate typing reperforator perfectly when KYBD UNLK key is pressed.	5-2.1e(36)(a),(b),(c),(d), and (e)
19	6l	Character counter failure when keyboard is in operation	5-2.1c(37)(a) and (b)
		END-OF-LINE lamp fails to light when character counter reaches 66th to 68th space	5-2.1c(37) (c), (d), (e) and (f)

Table 5-1. Troubleshooting Index - Continued

Item	Text/Step	Symptom	Fault Isolation Paragraph
20	6m	Character counter indicator fails to return to zero position	5-2.1c(38)(a) and (b)
		END-OF-LINE lamp remains lit	5-2.1c(39)(a) and (b)
21	6n	Repeat function fails	5-2.1c(40)(a) and (b)
22	6o	Tape fails to backspace	5-2.1c(41)(a),(b), (c), and (d)
23	6p	Back space correction fails	5-2.1c(42)(a),(b), and (c)
24	6q	Power remains on	5-2.1c(1)(e)

Table 5-2. Lamp, Fuse, and Semiconductor Index

Qty	Name, Type Part Number	Function Location	Energizing Voltage
1	Fuse, 4A, Slo-Blo 129919	Electrical circuit protection Keyboard Base	---
1	Pilot Lamp 115V Neon 161215	Power on indicator Keyboard	5.5 VAC
1	Lamp 6V Incandescent 161957	End of Line Indicator	5.5 VAC
1	Lamp 6V Incandescent 161957	Low Tape Indicator Keyboard	5.5 VAC
1	Lamp 6V Incandescent 161957	Tape Copy Light Cabinet	5.5 VAC
1	Lamp 6V Incandescent 161957	Character Counter Scale Cabinet	5.5 VAC

case for breaks or dents. Check the mating of the connector and receptacle and the operation of wire latches locking the two in mated position.

(d) Check motor connections. Leads are interchangeable. Refer to the wiring diagrams at the end of this chapter.

(e) Check the main power switch. Short the leads to the switch with an insulated screwdriver or an insulated jumper wire. Replace switch if shorting out the switch eliminates the power failure.

(2) If the pilot lamp does not illuminate when main power switch is ON, proceed as follows:

(a) Check the external power supply to verify that 115 volts ac is present on external connector pins 2 (grounded side) and 11 (ungrounded). When checking miniature sets, check at lower terminal board terminals 1 (ungrounded) and 7 (grounded).

(b) Check the solder connections to terminals of 16-point connector and receptacle. Check for loose or missing contacts within the case and for broken body moldings. Check the case for breaks or dents. Check the mating of the connector and receptacle and the operation of the latch locking the two in mated position.

(c) In KTR sets only, check the pilot lamp and socket.

NOTE

The pilot lamp socket contains a built-in lamp protecting resistance. Replace the socket if lamp replacement does not correct pilot lamp failure but subsequent steps indicate that power failure is not a problem.

(d) Check for loose connections on the terminal boards. Refer to the wiring diagrams at the end of this chapter for location of straps and jumpers on each set.

(3) If the cabinet lamps in KTR sets fail to illuminate, proceed as follows:

(a) Check the connector (attached to cabinet cable) and receptacle (on base-terminal board bracket) for good condition and proper mating in the event of cabinet illumination lamp failure.

(b) Check the cabinet illumination lamps (2) and sockets.

(c) Check for a burned out base-mounted transformer and loose transformer leads at the motor terminal block.

(4) If the motor does not start when main power switch is ON, proceed as follows:

(a) Check the fuse. If open, check mechanical linkage from motor through typing reperforator manually for excessive load before replacing fuse. If a fuse burns out immediately upon installation, check for shorted wiring in the motor or the tape-out circuit.

(b) Check for an open thermal cut-out switch at the rear of the motor mounting bracket. If the red switch button is raised, rotate the motor manually and check mechanical linkages to the motor shaft for an obstruction. Depress the switch button. If the cutout operates shortly after the motor switch has been reset, allow the motor to cool for five minutes and check further for the cause of overheating before resetting.

(c) Examine the motor brushes and replace a brush if its length is less than 3/8 of an inch. Wipe off and blow off accumulated carbon dust. Relationship of brush to slip rings should be maintained. Be sure brush springs are in place.

(5) If motor runs at incorrect speed, proceed as follows:

(a) If the synchronous motor operates at incorrect speed, check for 60 Hertz (plus or minus 0.5 Hertz) frequency in the external power supply.

(b) Check the governor adjustment. If the motor runs at incorrect speed, check for 115 volts ac power line supply. If line voltage is adequate and stable, use a 120-vps tuning fork to check the governor. Adjust if required.

(6) If the main shaft does not rotate when mechanical motion is transmitted to KTR main shaft, proceed as follows:

(a) Check the mechanical linkage through the intermediate gear mechanism. Adjust mesh of pinion and drive gear for barely perceptible backlash when the drive gear is centered vertically and horizontally beneath pinion.

(b) Check the mechanical linkage through variable speed drive mechanism. Note that the gears are properly installed and securely fastened to their shaft or sleeve. Check for sheared gear mounting screws. Check condition of the gears and remove any foreign objects in the gear mechanism. Visually inspect gear mesh when the gear change lever is in each of its three positions.

(c) Check the condition and tension of the timing belt. The belt should not be too tight. If belt appears too loose (yields more than 1/16-inch in response to slight pressure midway between the two sprockets), check for loosened screws attaching either the reperforator or the intermediate gear mechanism or both to the base.

(7) If the gears howl or chatter when mechanical motion is transmitted to KTR main shaft, check the mechanical linkage through the intermediate gear mechanism. Adjust mesh of the pinion and drive gear for barely perceptible backlash when the drive gear is centered vertically and horizontally beneath pinion.

(8) If the signal generator shaft does not rotate when mechanical motion is applied, check mechanical linkage through the intermediate gear mechanism. Adjust mesh of the pinion and drive gear for barely perceptible backlash when drive gear is centered vertically and horizontally beneath pinion.

(9) If the set runs open when external signal line

or signal test set signal is applied to the set, proceed as follows:

(a) Check for an open signal line external to the set. Check for 0.060-ampere 115 volts dc signal circuit (unless the selector magnets have been series wired for 0.020 or 0.030-ampere operation). If operating on 0.030-ampere circuit, check the external signal line relay.

(b) Check the solder connections to terminals of the 16-point connector and receptacle. Check for loose or missing contacts within the case and for broken body moldings. Check the case for breaks or dents. Check the mating of the connector and receptacle and the operation of the latch locking the two in mated position.

(c) Check the solder connections to terminals of the 36-point connector and receptacle. Terminals 35 and 36 of the connector (attached to the typing reperforator) must be strapped on the soldered end, and the connector must be mated with the base receptacle to complete the ac power distribution circuit in the set. Check for loose or missing contacts within the case and for broken body moldings. Check the case for breaks or dents. Check the mating of the connector and receptacle and the operation of wire latches locking the two in mated position.

(d) Check for loose connections on the terminal boards. Refer to the wiring diagrams at the end of this chapter for location of straps and jumpers on each set.

(e) Check for open selector magnets or faulty connections on the selector unit of the typing reperforator. Drag a thin piece of clean paper between the armature and the magnet cores to clean a dirty or oily armature. Be sure no lint is left beneath the magnet cores.

(f) Check for binding mechanisms in the selector unit. Check linkage for free operation. Check the clutch adjustment, (paragraphs 6-21b(1) and (3)), with particular attention to failure of the stop lever to latch or release.

(g) Check the selector mechanism adjustments, paragraphs 6-3.1h(9), (4), (6), (7), (8), (10), (15), (16), (17), and (20) in the order indicated.

(h) In KTR sets, check for an open signal break switch (normally closed) on the keyboard. Check signal break key linkage to the switch.

(i) In KTR sets, check the signal generator contacts and mechanical linkages.

(10) If the set runs closed on verifiable signal input, check for binding mechanisms in the selector unit. Check the linkage for free operation. Check the clutch adjustment (paragraphs 6-3.1b(1) and (2)) with particular attention to failure of stop lever to latch or release.

(11) If the typing reperforator fails to function when signal input is alternate R and Y, check operation and mechanical linkage of the function clutch. Note that the clutch is tripped near the end

of the operating cycle of the selector clutch.

(12) If an error in typing and reperforating is intermittent when signal input is alternate R and Y, proceed as follows:

(a) Check for an open signal line external to the set. Check for 0.060-ampere 115 volts dc signal circuit (unless the selector magnets have been series wired for 0.020 or 0.030-ampere operation). If operating on 0.030-ampere circuit, check the external signal line relay.

(b) Check the range finder knob phasing (paragraph 6-3.1h(18).

(c) Check the selector mechanism adjustments (paragraphs 6-3.1h(9) (12), (13), and (14).

(13) If the set gains or loses a pulse when signal input is alternate R and Y, proceed as follows:

(a) Check for binds in the selector and transfer mechanisms. Note in particular free operation of the linkage involved in the particular pulse gained or lost, as determined by analyzing errors for a common (1, 2, 3, 4, or 5 pulse) addition or omission.

(b) Check the selector mechanism adjustments (paragraphs 6-3.1h(9), (12), (13), and (14)).

(14) If the set fails to perforate when signal input is alternate R and Y, proceed as follows:

(a) Chec' function clutch and cam mechanisms and rocker bail operation. Check the punch mounting plate (preliminary adjustment) (paragraph 6-3.1c(1)).

(b) Check the rocker bail and guide bracket adjustments. Check the function clutch trip lever adjustment (paragraph 6-3.1b(6)). Check the reset arm (paragraph 6-3.1b(7)) punch position, toggle operating arm (paragraph 6-3.1c(4) and punch mounting plate (final) adjustments (paragraph 6-3.1c(2)).

(15) If the punch pins fail to penetrate tape when the signal input is alternate R and Y, check punch slide downstop plate (paragraph 6-3.1d(3)), punch pin penetration (paragraph 6-3.1d(1)), and punch slide guide (paragraph 6-3.1d(2)).

(16) If the tape does not feed when signal input is alternate R and Y, proceed as follows:

(a) Check for binds or obstructions in the tape container on path of tape.

(b) Check perforator adjustments.

(17) If feed holes are incorrectly spaced when the signal input is alternate R and Y, check perforator adjustments.

(18) If the printer does not print when signal input is alternate R and Y, check proper installation of the ribbon, particularly through ribbon carrier beneath typewheel.

(19) If the ribbon fails to feed or fails to reverse when signal input is alternate R and Y, proceed as follows:

(a) Check the position of the eyelets on the ribbon above the ribbon reverse arms at both spools.

(b) Check the ribbon feed mechanism and operating arm adjustment (paragraphs 6-3.1g(1), (2), and (3)).

(20) If the unit fails to type when the signal input is alternate R and Y, proceed as follows:

(a) Check the ribbom carrier (paragraph 6-3.11(1) or 6-3.1n(1))

(b) Check the print hammer (paragraph 6-3.11(4) or 6-3.1m(4))

(21) If the unit fails to perforate tape when the signal input is alternate R and Y, proceed as follows:

(a) Check the selector magnet bracket normaly operating conditions. (paragraph 6-3.1h(9)).

(b) Check the selector armature (paragraph 6-3.1h(4))

(c) Check selector spring tensions (paragraph 6-3.1h(6), 6-3.1h(8), and 6-3.1h(10)).

(d) Check selector clutch spring tensions (paragraph 6-3.1h(16) and (17)).

(22) If there is FIGS or LTRS shift failure when distortion test set is used to apply FIGS and LTRS input proceed as follows:

(a) Check the function mechanism (paragraphs 6-3.1e(1) and 6-3.1b(8)).

(b) Check the typewheel positioning mechanism.

(23) If the letters are not positioned squared for printing when the distortion test set is used to apply FIGS and LTRS input, check the axial and rotary positioning mechanism linkage and adjustments.

(24) If only top or bottom of a character prints when the distortion test set is used to apply FIGS and LTRS input, proceed as follows:

(a) Check and adjust the axial and rotary correcting mechanism for firm positioning of the correcting plate roller (axial) or correcting lever lobes (rotary) simultaneously with activation of printing hammer.

(b) Check the oscillating bail drive link (paragraph 6-3.lk(21)) and the oscillating bail pivot (paragraph 6-3.lk(22)).

(25) If characters are too light or are smudged, check print hammer adjustment (paragraph 6-3.11(4) for chadless tape or paragraph 6-3.1m(4) for fully perforated tape).

(26) If tape does not feed out when the TAPE F.O. key is pressed while signal the line is idle (marking), proceed as follows:

(a) Turn off the main power switch and press the TAPE F.O. key to discharge capacitor.

(b) Check for an open feed-out magnet winding or loose leads at the magnet. Check the power supply lead common to both feed-out and back space magnet at both terminal:

(c) Check the feed-out switch

(d) Check the mechanical linkage through feed-out mechanism.

(e) Check the tape feed-out adjustments.

(27) If an incorrect length of tape feeds out, when the TAPE F.O. key is pressed while the signal line is idle (marking) check the remote control tape feed-out mechanism.

(28) If tape continues to feed out when feed-out is interrupted with an incoming signal, check feed-out adjustments.

(29) If the first character of an incoming signal is lost when feed-out is interrupted with incoming signal, proceed as follows:

(a) Check the feed-out adjustments.

(b) Check the mechanical linkage with selector mechanism and perforator.

(30) If the tape does not feed out to preset length, typed and perforated for letters when signal transmission ends, proceed as follows.

(a) Check the mechanical linkage with selector mechanism.

(b) Check the feed-out adjustments.

(31) If an incorrect length of tape feeds out when signal transmission ends, check feed-out adjustments.

(32) If the TAPE OUT lamp fails to light when tape is lifted from tape container, proceed as follows:

(a) Check the mechanical linkage to the tape out switch for bent or broken components or missing springs.

(b) Check the TAPE OUT lamp and socket.

NOTE

If the TAPE OUT lamp socket contains a built-in lamp protecting resistance and lamp replacement does not correct pilot lamp failure but power failure is not a problem, replace the socket.

(c) Check the outer or lower tape-out switch.

(d) Check the connector and receptacle for connecting tape container to base terminal board mounting bracket. Ensure that the connector at the end of the tape container cable is properly mated with its receptacle

(e) Check for a burned out base transformer or for loosen transformer leads.

(33) If the TAPE OUT lamp does not extinguish when the tape roll is replaced, check the TAPE-OUT switch (paragraphs 6-5.1(2)(a) through (6)).

(34) If a BREAK signal transmission failure occurs when the BREAK key is pressed, proceed as follows:

(a) Check for a short in the normally closed BREAK switch.

(b) Check the mechanical linkage from the BREAK keylever to switch. Operation of the keylever should not affect the code bar mechanism.

(35) If the keyboard fails to lock when the KYBD LOCK key is pressed, check the mechanical linkage of the KYBD LOCK key through its code.

(36) If the keyboard transmission does not operate typing reperforator correctly when the KYBD UNLK key is pressed, proceed as follows:

(a) Perform fault isolation procedures 5-2.1c(9) through 5-2.1c(25).

(b) Check the signal generator contacts and mechanical linkages.

(c) Check the operation and adjustment of the signal generator clutch mechanism (paragraph 6-4.2a(1), through (5)).

(d) Check the signal generator and keyboard adjustments (paragraphs 6-4.2b(1) through (5) and 6-4.2c(2) through (4)).

(e) Check the synchronous pulse mechanism (paragraphs 6-6.2b(1) through (7)).

(37) If the character counter fails to advance one unit for each character or space typed when the keyboard is operating, proceed as follows:

(a) Check the mechanical linkage to the code bar mechanism. Ensure that the character counter operating forks are positioned over the pins on the right end of their respective code bars.

(b) Check the character counter adjustments (paragraphs 6-4.1b(1) through (8)).

(c) Check the END OF LINE lamp and socket.

(d) Check for maladjusted or dirty switch contacts in the character counter mechanism.

(e) Check for a burned out base mounted transformer or for loose transformer leads.

(f) Adjust the END OF LINE switch bracket and cam (paragraph 6-4.1b(2)).

(38) If the character counter fails to return to zero position when the CARR RET key is pressed, proceed as follows:

(a) Check the mechanical linkage to the code bar mechanism. Ensure that the character counter operating forks are positioned over the pins on the right end of their respective code bars.

(b) Check the mechanical linkage of the character counter reset mechanism.

(39) If the END OF LINE lamp remains lit when the CAR RET key is pressed, proceed as follows:

(a) Check for dirty or maladjusted switch contacts in the character counter mechanism.

(b) Adjust the character counter END OF LINE switch (paragraph 6-4.1b(2)).

(40) If a repeat function fails when the REPT keys and any of the character key or space bar is pressed, check freedom of the linkage and mating of the repeat keylever and code bar nonrepeat lever (paragraphs 6-4.1c(10) through (14).

(41) If tape fails to backspace when the TAPE B.SP. key is pressed, proceed as follows:

(a) Check for a defective backspace switch, located immediately beneath the TAPE B.SP. key. Check the switch at terminals 4 and 6 of the lower terminal board (orange lead and red lead).

(b) Check for an open magnet coil on the typing reperforator. Check for loose leads on the magnet and check both terminals of the common power supply lead between the backspace magnet and feed out magnet (for typing reperforator).

(c) Check the mechanical linages in the backspace mechanism (on typing reperforator). The mechanism should operate freely and without binding on downward movement of magnet armature. (paragraphs 6-6.1k(1), (3), 6-8.1d(2), 6-8.1b(2), 6-8.1b(3).

(42) If the back space correction fails when the LTRS key is depressed, proceed as follows:

(a) Check the mechanical linkages in the back space mechanism (in typing reperforator) (paragraph 6-6.1k(3), 6-8.1b(2), (3), and 6-8.1d(2)).

(b) Check the rake adjustment (paragraph 6-6.1k(1).

(c) Check the mechanical linkage through the intermediate gear mechanism. Adjust mesh of the pinion and drive gear for barely perceptible backlash when the drive gear is centered vertically and horizontally beneath pinion.

(43) If the motor continues to run when the main power switch is turned off, remove the main power source from the unit. Disconnect the lead from either terminal of the main power switch. Reapply main power. If the motor does not start, replace the main power switch.

d. Maintenance Schematic and Wiring Diagrams. Schematic and wiring diagrams are provided at the end of this chapter as aids to troubleshooting and maintenance of the typing reperforator sets. An index of the schematic and wiring diagrams for high level equipment is provided in table 5-3.

5-2.2 LOW-LEVEL TROUBLESHOOTING PROCEDURES. The following paragaphs provide troubleshooting procedures for checking some of the difficulties that may be encountered in the operation of electrical service assemblies (ESAs) and their associated components. For troubleshooting mechanical failures refer to the high-level equipment trouble-

Table 5-3. Index of High-Level Schematic and Wiring Diagrams for Troubleshooting

shooting procedures in paragraph 5-2.1, which are also applicable to low-level equipment.

a. Wiring and Schematic Diagrams. Wiring and schematic diagrams for use in trouble-shooting low-level equipment are shown in figures at the end of this chapter. An index of these diagrams is provided in table 5-4.

b. Lamp, Fuse, and Semiconductor Indexes. Refer to table 5-2 for a list of lamps and fuses used in both high-level and low-level TD sets. Additional fuses, and semiconductors found in low-level assemblies are listed in bills of materials which are included in figures at the end of this chapter. These active components are identified because they constitute the most probable cause of failure.

c. ESA General Troubleshooting Instructions. The following paragraphs provide general instructions for use when troubleshooting KRT and ROTR ESAs.

(1) Since the ESA encloses and is dependent on other component circuits for its operation, the field trouble-shooting and repair for these components also are included in the procedures. Refer to the applicable wiring diagrams at the end of this chapter which are referenced in table 5-4, for circuit tracing and identification of components. The diagrams are identified with their associated assemblies in the equipment matrix provided in table 1-2 of Chapter 1, which also indicates the figure number.

(2) Before attempting to repair a power supply fault, the technician should familiarize himself with the power supply card and ESA wiring. Refer to the circuit description in Chapter 3. Refer also to the wiring diagrams for each typing reperforator set as identified in table 1-2 of chapter 1. The wiring diagrams are those provided at the end of this chapter and indexed in table 5-4.

(3) Troubleshooting for an ESA is required only to repair the power supply or to correct wiring defects in case of loose, broken, or faulty wiring. Wiring can be checked by following the different circuits on the appropriate wiring diagram, point-to-point and comparing with the actual equipment wiring.

d. Power Supply Troubleshooting Procedures. If trouble should develop, it may be found by performing the checks outlined in the trouble-shooting procedures in tables 5-5 and 5-6 using a multimeter. The following instructions are applicable when troubleshooting power supply circuit cards.

(1) Colored test point jacks are provided on top of the power supply circuit card to accept standard meter probes.

(a) When a fault in the power supply is suspected but not obvious, disconnect all power from the ESA. Remove all keyer (LLK) and clutch magnet driver (CMD) circuit cards. Apply 100 to 130 volt ac power to the ESA and proceed with the troubleshooting procedure as outline in table 5-5 or 5-6.

Table 5-4. Index of Low-Level Schematic and Wiring Diagrams for Troubleshooting

Table 5-4. Index of Low-Level Schematic and Wiring Diagrams for Troubleshooting - Continued

Table 5-5. Power Supply Troubleshooting Procedures (0.5 Ampere Card)

Step	Action	Probe Position	Normal Response	Abnormal Response and Procedure
1	Check Voltage from -7 test jack.	COM-7	Meter reading should be: Min-6.6 volts Max-7.8 volts	RESPONSE: Meter reading of zero volt.
				PROBABLE CAUSE: CR5 shorted or R5 open.
			If normal, proceed to Step 2.	PROCEDURE: CR5 short-power supply card and repair or replace.
				Recheck Step 1.
				RESPONSE: Meter reading of +57 volts to +90 volts.
				PROBABLE CAUSE: CR5 open.
				PROCEDURE: Remove power supply card and repair or replace.
				Recheck Step 1.
2	Check voltage from +7 test jack.	COM +7	Meter reading should be: Min +6.6 volts Max +7.8 volts	RESPONSE: Meter reading of zero volt.
				PROBABLE CAUSE: CR6 shorted or R4 open.
			If normal, proceed to Step 3	PROCEDURE: Remove power supply card and repair or replace.
				Recheck Step 1.
				RESPONSE: Meter reading of +57 volts to +90 volts.
				PROBABLE CAUSE: CR6 open.

Table 5-5. Power Supply Troubleshooting Procedures (0.5 Ampere Card) - Continued

Step	Action	Probe Position	Normal Response	Abnormal Response and Procedure
				PROCEDURE: Remove power supply card and repair or replace.
				Recheck Step 1.
3	Check voltage from UNREG. test jack.	COM UNREG.	Meter reading should be: Min +57 volts Max +90 volts	RESPONSE: Meter reading of zero volt.
				PROBABLE CAUSE: Loose or blown fuse.
			If normal, proceed to Step 4.	PROCEDURE: Remove power supply card and replace fuse.
				Proceed to Step 5.
				RESPONSE: Meter reading indicates voltage which is too low.
				PROBABLE CAUSE: CR1 and/or CR4 open or shorted. C8 defective. T1 and power line filter defective.
				PROCEDURE: Remove power supply card or defective parts and repair or replace.
				Recheck Step 1.
4	Check voltage from +50 test Jack.	COM +50	Meter reading should be: Min +47 volts Max +53 volts	RESPONSE: Meter reading of zero volt.
				PROBABLE CAUSE: Q1 and/or Q2 open.
			If normal, end test.	PROCEDURE: Remove power supply card and repair or replace.

Table 5-5. Power Supply Troubleshooting Procedures (0.5 Ampere Card) - Continued

Step	Action	Probe Position	Normal Response	Abnormal Response and Procedure
				Recheck Step 1. RESPONSE: Meter reading of more than zero volt but less than +47 volts. PROBABLE CAUSE: Too many shorting straps across CR8, CR9, CR10, and CR11. PROCEDURE: Remove power supply card and remove straps, as necessary to increase voltage. Replace card. Recheck Step 1. RESPONSE: Meter reading of +57 volts to +90 volts. PROBABLE CAUSE: Q1 and/or Q2 shorted. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1.
5	Check voltage from UNREG. test jack.	COM UNREG.	Meter reading should be: Min +57 volts Max +90 volts	RESPONSE: Meter reading of zero volt. PROBABLE CAUSE: Repeated fuse blowing.

Table 5-5. Power Supply Troubleshooting Procedures (0.5 Ampere Card) - Continued

Step	Action	Probe Position	Normal Response	Abnormal Response and Procedure
			Return to Step 4.	PROCEDURE: Disconnect power and remove power supply card. Make continuity checks between card terminals B and N, N and H, B and H. A zero or near zero reading on the 1-ohm scale of a multimeter indicates a short. Check continuity between Q1 case and its heat sink (Q1 must be electrically isolated from heat sink with mica insulators). If the power supply card checks satisfactorily, check power line filter T1 and C8 for shorted condition. Repair or replace card. Recheck Step 1. RESPONSE: Meter reading indicates voltage which is too low. PROBABLE CAUSE: CR1 and/or CR4 open or shorted. C8 defective. T1 and power line filter defective. PROCEDURE: Remove power supply card or defective parts and repair or replace. Recheck Step 1.

Table 5-6. Power Supply Troubleshooting Procedures (1.0 Ampere Card)

Step	Action	Probe Position	Normal Response	Abnormal Response And Procedure
1	Check voltage from UNREG. test jack.	COM UNREG.	Meter reading should be: Min +57 volts Max +90 volts If normal, proceed to Step 2.	RESPONSE: Meter reading of zero volt. PROBABLE CAUSE: Loose or blown fuse. PROCEDURE: Remove power supply card and secure or replace fuse. Proceed to Step 3. RESPONSE: Meter reading indicates voltage which is too low. PROBABLE CAUSE: CR1 and/or CR2 open or shorted. C5 defective. T1 and power line filter defective. PROCEDURE: Remove power supply card or defective parts and repair or replace. Recheck Step 1.
2	Check voltage from +50 test jack.	COM +50	Meter reading should be: Min +47 volts Max +53 volts If normal, end test.	RESPONSE: Meter reading of zero volt. PROBABLE CAUSE: Q1 and/or Q2 open. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1. RESPONSE: Meter reading of more zero volt but less than +47 volts. PROBABLE CAUSE: Too many shorting straps across CR5, CR5, CR6, and CR7.

Table 5-6. Power Supply Troubleshooting Procedures (1.0 Ampere Card) - Continued

Step	Action	Probe Position	Normal Response	Abnormal Response And Procedure
				PROCEDURE: Remove power supply card and remove straps, as necessary, to increase voltage. Replace card. Recheck Step 1. RESPONSE: Meter reading of +57 to +90 volts. PROBABLE CAUSE: Q1 and/or Q2 shorted. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1.

Table 5-6. Power Supply Troubleshooting Procedures (1.0 Ampere Card) - Continued

Step	Action	Probe Position	Normal Response	Abnormal Response And Procedure
3	Check voltage from UNREG. test jack.	COM UNREG.	Meter reading should be: Min +57 volts Max +90 volts Return to Step 2.	RESPONSE: Meter reading of zero volt. PROBABLE CAUSE: Repeated fuse blowing. PROCEDURE: Disconnect power and remove power supply card. Make continuity checks between card terminals D and S, S and K, D and K. A zero or near zero reading on the one-ohm scale of a multimeter indicates a short. Check continuity between Q2 case and its heat sink (Q2 must be electrically isolated from heat sink with mica insulators). If the power supply card checks satisfactorily, check power line filter, T1 and C5 for shorted condition. Repair or replace card. Recheck Step 1.

Table 5-6. Power Supply Troubleshooting Procedures (1.0 Ampere Card)- Continued

Step	Action	Probe Position	Normal Response	Abnormal Response And Procedure
				RESPONSE: Meter reading indicates voltage which is too low. PROBABLE CAUSE: CR1 and/or CR2 open or shorted. C5 defective. T1 and power line filter defective. PROCEDURE: Remove power supply card or defective parts and repair or replace. Recheck Step 1.

WARNING

Be extremely careful with capacitors; they may be charged. A severe electrical shock may be received from a capacitor or leads connected to the power supply while it is in operation.

In following the procedure outlined in table 5-5, perform step 1. If a normal response is received, proceed to step 2. If an abnormal response is received, repair or replace the card. After this procedure, return to step 1. Next, perform step 2 and on in the same manner.

(2) If this troubleshooting fails to reveal the difficulty, check for loose or cold solder connection or a broken or misplaced wire in the ESA. Recheck all wiring as indicated in paragraph 5-2.2c(1).

(3) Continually blowing fuses indicate a shorted component or components. Disconnect power, remove the circuit card assembly and make continuity checks between circuit card connector terminals B and N, N and H, and B and H. A zero or near zero reading on the one ohm scale of a multimeter indicates a short; disregard any other reading. Also check continuity between the power transistor case and its heat sink; the power transistor must be electrically isolated from the heat sink with mica insultors. If the board assembly checks satisfactorily, examine the power line filter, power transformer, and rectifier filter capacitor for a shorted condition. (These components are located within the ESA.)

(4) Failure to detect the fault using the methods described above normally indicates a loose or cold solder connection, broken or misplaced wire in the service assembly. Check all wiring according to appropriate wiring diagrams.

e. Low-Level Keyer (LLK) Troubleshooting Procedures. Table 5-7 provides information for use as a guide when troubleshooting the LLK. The following recommendations also are applicable when troubleshooting LLKs.

(1) It is recommended that any damaged keyer card be replaced in the field and maintained in a repair center. The repair center should have equipment capable of simulating normal operating conditions.

(2) It is also recommended that the keyer and asociated filter cards (if any) be radio frequency interference (RFI) suppression tested after servicing and prior to final installation. Failures from this standpoint are not necessarily recognized by monitoring a typical communications operation.

f. Clutch Magnet Driver (CMD) Troubleshooting Procedures. Table 5-8 provides information for use as a guide when troubleshooting the CMD. The following recommendations also are applicable when troubleshooting CMDs.

NOTE

The clutch magnet driver (CMD) is a circuit card assembly that needs only to be plugged into a properly keyed 15-pin receptacle which

Table 5-7. Low-Level Keyer Troubleshooting Guide

Symptom	Probable Cause
(a) Circuit always marking	Photocell in keyboard or distributor shorted
(b) Circuit always spacing	Photocell in keyboard or distributor open circuited
(c) Mark - space bits detectable but will not go positive on mark	Q3 open and/or Q2 shorted
(d) Mark - space bits detectable but will not go negative on space	Q4 open and/or Q1 shorted

is wired into an appropriate electrical service assembly (ESA).

(1) It is recommended that any damaged clutch magnet driver (CMD) unit be replaced in the field and maintained in a repair center. The repair center should have equipment capable of simulating

(2) It is also recommended that the CMD be radio frequency interference (RFI) suppression tested after installation. Failures from this standpoint are not necessarily recognized by monitoring a typical communications operation.

Table 5-8. Clutch Magnet Driver
Troubleshooting Guide

Symptom	Probable Cause
(a) Switching levels out of tolerance	(1) Improper adjustment of R7
	(2) Q1 low gain
	(3) CR7 defective or out of tolerance
(b) Circuit always marking	(1) Q3 open
	(2) Q1, Q2, or Q4 collector-emitter shorted
(c) Circuit always spacing	(1) Q1, Q2, or Q4 open
	(2) Q3 collector-emitter Shorted
	(3) CR8 open
(d) Output current too high	(1) CR2 open
	(2) R17 out of tolerance
(e) Output current too low	(1) R2 improperly adjusted or defective
	(2) R17 out of tolerance
(f) Transient suppressor network ineffective	(1) CR9 open
	(2) R16 open
	(3) C4 open

NO.	NOTES
1.	WIRING LEGEND: DISTANT TERMINATING AREA; DISTANT TERMINATING DESIGNATION; F-4-W-BL; WIRE COLOR CODE
2.	COLOR CODE: BK - BLACK, BR - BROWN, R - RED, O - ORANGE, Y - YELLOW, G - GREEN, BL - BLUE, P - PURPLE, S - SLATE, W - WHITE
3.	TERMINAL DESIGNATIONS ENCLOSED IN PARENTHESES ARE FOR REFERENCE AND ARE NOT MARKED ON COMPONENTS.
4.	TERMINALS ON CONNECTOR SHOWN AS VIEWED FROM SOLDER END.
5.	NORMALLY OPEN (NO) AND NORMALLY CLOSED (NC) CONTACTS ARE SHOWN WHEN THE REPERFORATOR IS IN THE STOP (IDLE) POSITION.
6.	THE SPACING (S) SIDE ON THE CODE READING CONTACTS ARE NORMALLY CLOSED. THE MARKING (M) SIDE OF THE CODE READING CONTACTS ARE NORMALLY OPEN.
7.	WHEN THE AUXILIARY CONTACTS ARE OPERATED FROM A SINGLE CYCLE FUNCTION CAM, THE CONTACTS NEAREST THE MOUNTING BRACKET ARE NORMALLY CLOSED. WHEN THE AUXILIARY CONTACTS ARE OPERATED FROM A DOUBLE CYCLE FUNCTION CAM, THE CONTACTS FARTHEST FROM THE MOUNTING BRACKET ARE NORMALLY CLOSED.
8.	GENERAL NOTE: WIRING OF INDIVIDUAL COMPONENTS IS DETERMINED BY REFERRING TO THE CABLE ASSEMBLIES SPECIFIED ON THE UNIT B/M.
9.	WHEN USING THE 162306 CABLE ASSEMBLY WITH THE LRPE8, CONNECT THE W-BL WIRE (NORMALLY CONNECTED TO G4) TO G6.
10.	
11.	WHEN COMMON CONNECTION IS USED, D.C. MUST BE PROVIDED FOR MAGNETS OTHER THAN 22MM WHICH OPERATES ON A.C. OR D.C.
12.	FOR WIRING OF BACKSPACE MAGNET ON LAK KEYBOARD MOUNTED PERFORATORS, REFER TO ASSOCIATED LAK WIRING DIAGRAM.
13.	SELECTOR MAGNETS MUST BE STRAPPED FOR 60 MILLIAMPERE OPERATION WHEN 179615 AND 179616 R.F. SUPPRESSION MODIFICATION KITS ARE USED WITH REPERFORATOR SET.
10	ON UNITS EQUIPPED WITH THE 173850 SHIELDED CABLE, THE STRAP BETWEEN TERMINALS C-35 AND C-36 IS OMITTED AND THE "G" WIRE OF THE CABLE IS CONNECTED TO TERMINAL C-35. IF THE UNIT EQUIPPED WITH THE 173850 SHIELDED CABLE IS USED ON A BASE NOT CONTAINING PROVISIONS FOR R F SUPPRESSION (INCLUDING BELL SYSTEM) REMOVE THE "G" WIRE FROM TERMINAL C-35 AND ADD STRAP BETWEEN TERMINALS C-35 AND C-36
14	THE LPR 66 SELECTOR MAGNET ASSEMBLY SHALL BE STRAPPED IN PARALLEL FOR 500 MA OPERATION

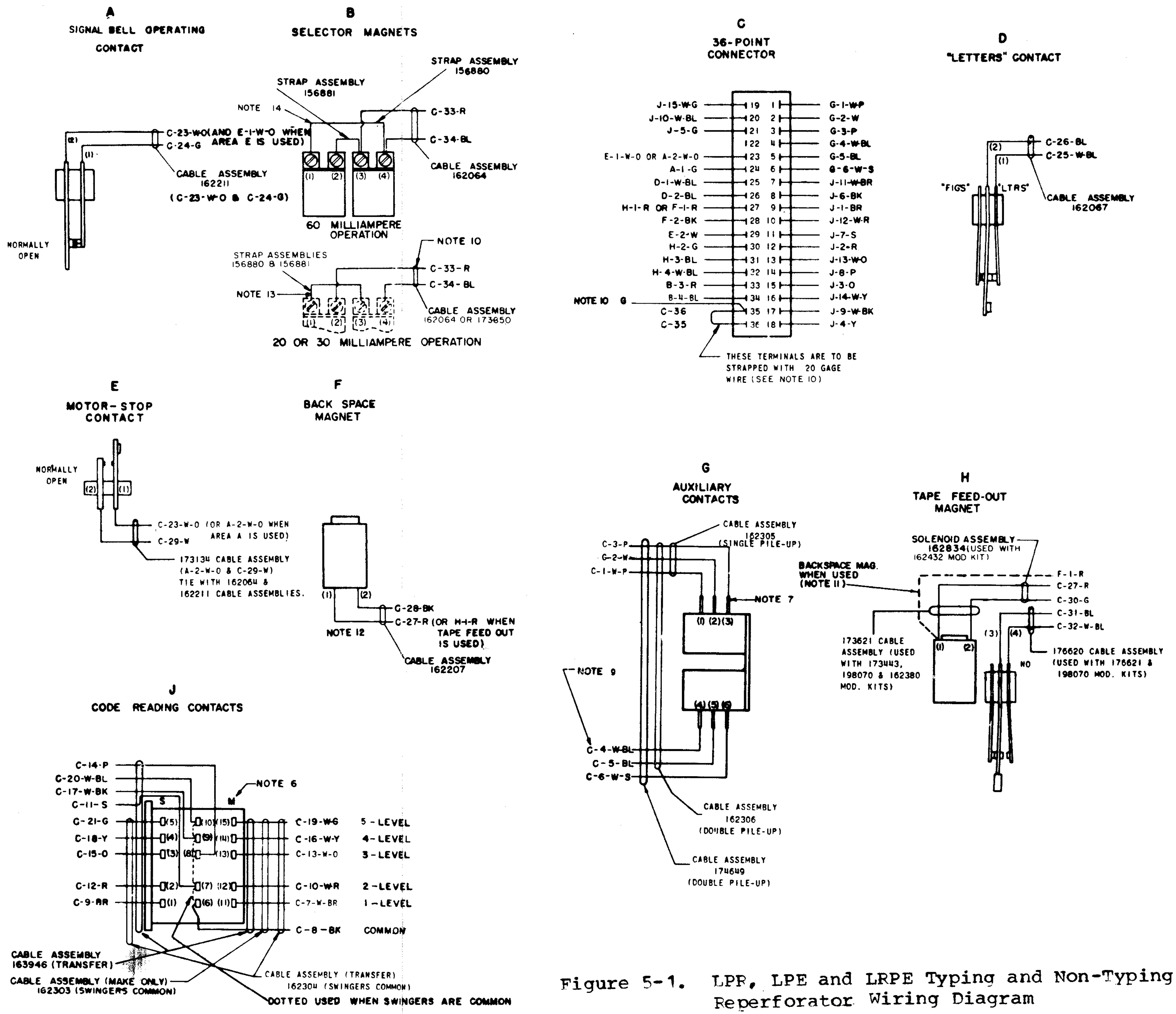
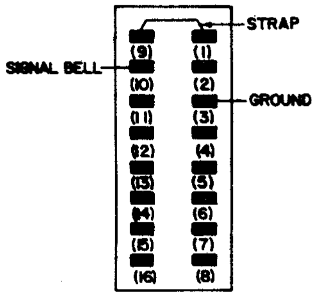


Figure 5-1. LPR, LPE and LRPE Typing and Non-Typing Reperforator Wiring Diagram

NO.	NOTES
1.	WIRING LEGEND: DISTANT TERMINATING AREA DISTANT TERMINATING DESIGNATION A-1-W-BL COLOR CODE
2.	COLOR CODE: BK - BLACK G - GREEN BL - BLUE Y - YELLOW BR - BROWN W - WHITE R - RED S - SLATE P - PURPLE O - ORANGE
3.	UNIT WIRED FOR 115V AC INPUT.
4.	CONNECTORS VIEWED FROM SOLDER TERMINAL ENDS.
5.	NUMBERS IN PARENTHESIS ARE FOR REFERENCE AND ARE NOT NECESSARILY SHOWN ON COMPONENTS.
6.	WHEN SOLDERING CABLE TO INDICATOR LIGHTS, BEND TERMINALS OUTWARD 90°.
7.	THESE SPARES ARE PART OF THE 161878 CABLE AND ARE TIED BACK AT THE F CONNECTOR.
8.	GROUND STRAP TO LEFT FRONT MTG. STUD ON BASE.
9.	TERMINAL NO.3 TO BE CONNECTED TO A GROUND SCREW ON THE BASE.
	MATING CONNECTOR 159541 
10.	UNITS INCLUDE MATING 16 PT. CONNECTOR FOR CUSTOMERS USE. CIRCUIT REFERENCES SHOWN ABOVE, FOR CIRCUITRY, REFER TO SET SCHEMATIC
11.	WIRING ON UNITS WITHOUT "Q" FUSE HOLDER.
12.	WIRING ON UNITS WITH "Q" FUSE HOLDER.
13.	FOR LTRK1 WITH 179615 MOD. KIT SEE 7220WD.
14.	FOR ASSOCIATED SCHEMATIC REFER TO: 8443WD
15.	REFERENCE SPEC. FOR TELETYPE CORP. EMPLOYEES ONLY: 6759S, 61338S.
16.	WHEN SYNCHRONOUS PULSE OPERATION IS REQUIRED CONNECT CMD LEADS AS SHOWN.

17.	LTRK1 KEYBOARDS INCLUDE THESE ITEMS. STRAPS 151818 AND 151819 ARE USED ON LTRK 5 AND LTRK 6 KEYBOARD.
18.	POWER INPUT MAY BE CONNECTED DIRECTLY TO THE "A" TERMINAL STRIP AS SHOWN. THE F2 AND F11 LEADS SHOULD BE TAPED AND TIED. POWER ALSO MAY BE CONNECTED THRU THE "F" MATING CONNECTOR AT "F2" AND "F11".
19.	"DR" INDICATES DRAIN WIRE
20.	INDICATES 18 AWG WIRE. (✱)

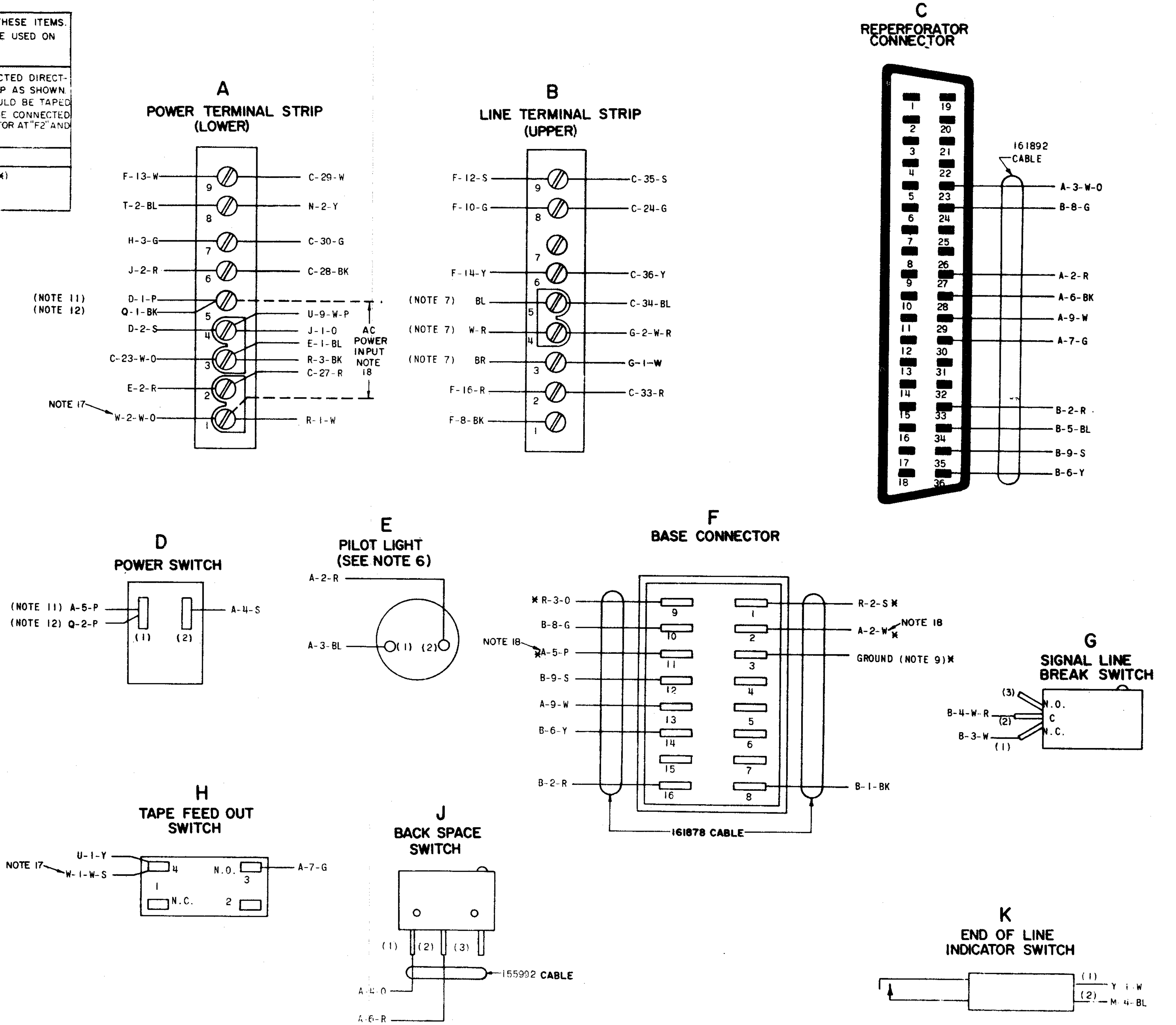


Figure 5-2. LTRK1, 2, and 10 Send-Receive Typing Reperforator Keyboard Wiring Diagram (Sheet 1 of 2)

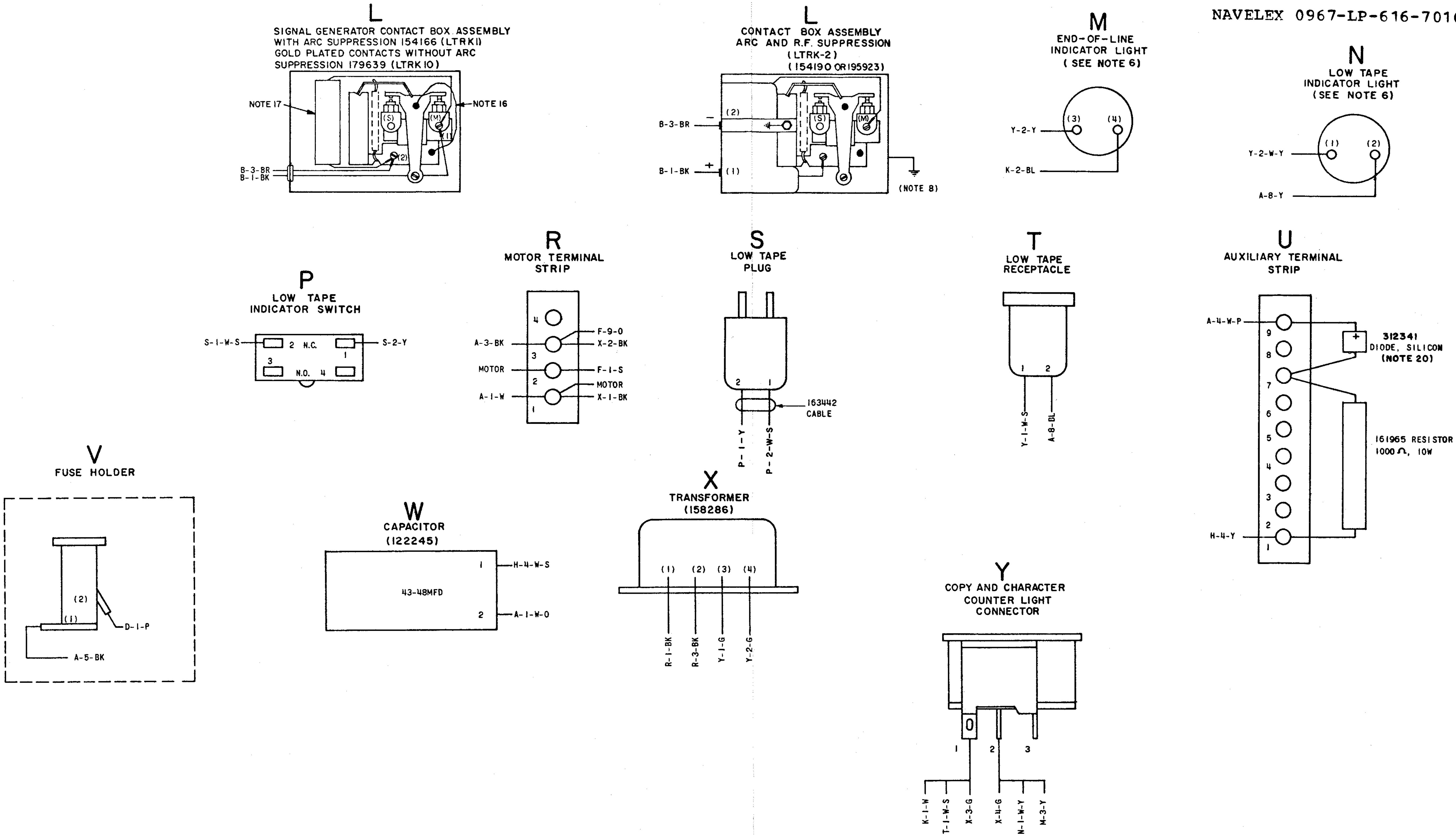


Figure 5-2. LTRK1, 2, and 10 Send-Receive Typing Reperforator Keyboard Wiring Diagram (Sheet 2 of 2)

NO.	NOTES
1.	FOR ACTUAL WIRING DIAGRAMS OF INDIVIDUAL UNITS. SEE WD NUMBERS OF COMPONENT UNITS. 3574WD - LTRK-1 2900WD - LMU3,4,6
2.	LEGEND: O A POWER TERM. STRIP ON LTRK (LOWER) O B LINE TERM. STRIP ON LTRK (UPPER) O U AUX. TERM. STRIP ON LTRK (REAR) O R MOTOR TERM. STRIP ON LTRK ← C 36 POINT CONN. ON LTRK ≻ F 16 POINT CONN. ON LTRK ← S LOW TAPE CONN. (PLUG) ≻ T LOW TAPE CONN. (RECEPTACLE) ← Y CHAR. COUNTER & COPY LAMP CONN. IN COVER
3.	ALL APPARATUS IS SHOWN IN UN-OPERATED OR DE-ENERGIZED POSITIONS.
4.	RESISTANCE VALUES IN OHMS CAPACITANCE VALUES IN MICROFARADS
5.	USE SYNCHRONOUS MOTOR ON REGULATED 60CPS(±.75%)AC POWER.
6.	OPTIONS: Ⓐ - WIRING WITH FUSE IN CIRCUIT Ⓑ - WIRING WITHOUT FUSE IN CIRCUIT Ⓒ - .060 AMP. SIGNAL LINE OPERATION Ⓓ - .020 AMP. SIGNAL LINE OPERATION
7.	NETWORK NO. 1 — TELETYPE NO. 153631 — 470 0.11
8.	SL-BL INDICATES SLOW BLOWING.
9	REFERENCE SPEC FOR TELETYPE CORP. EMPLOYEES ONLY. 61269S.

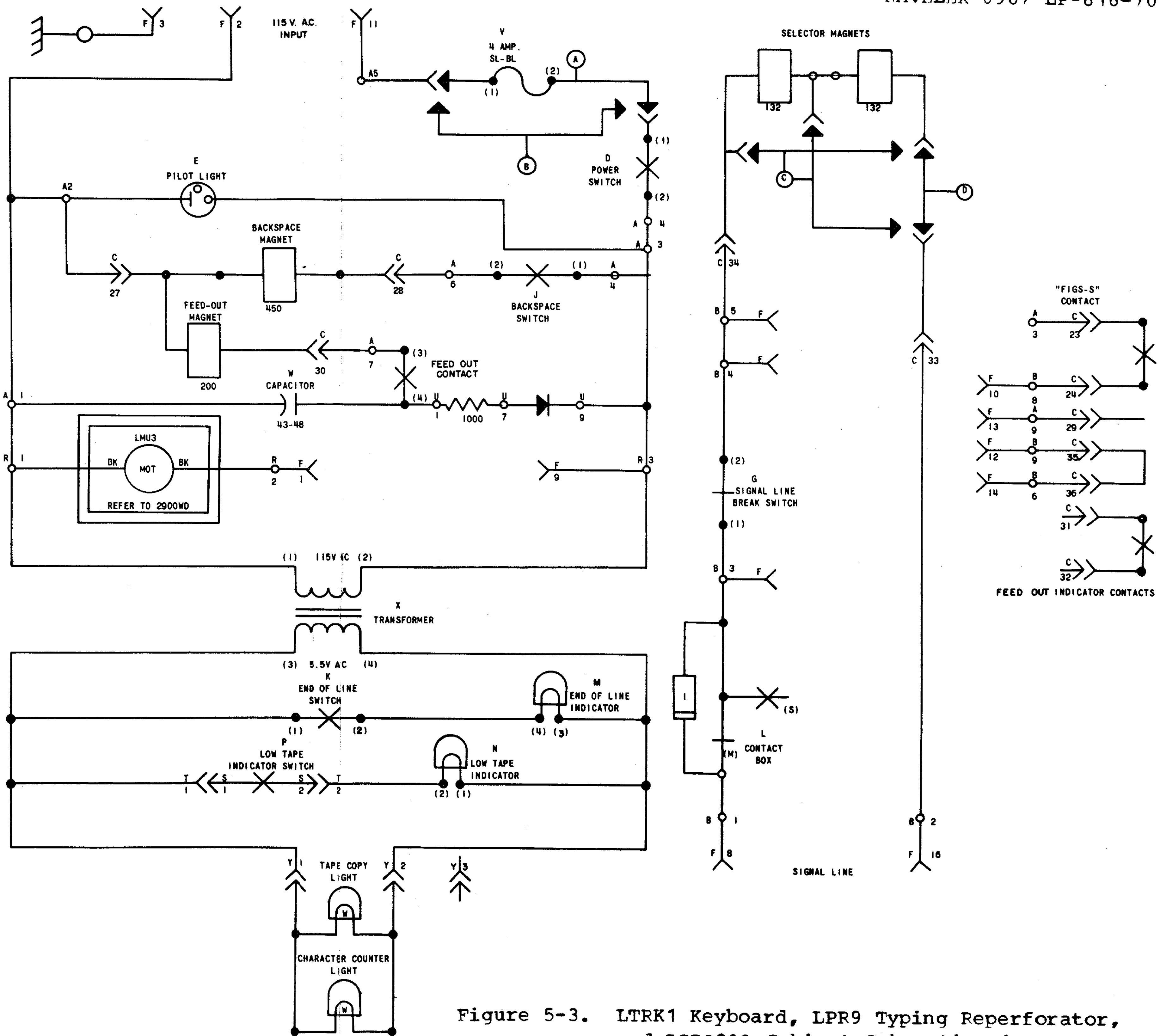


Figure 5-3. LTRK1 Keyboard, LPR9 Typing Reperforator, and LSRC200 Cabinet Schematic Diagram

NO.	NOTES
1.	WIRING LEGEND: DISTANT TERMINATING AREA; DISTANT TERMINATING DESIGNATION; A-1-W-BL; WIRE COLOR CODE
2.	COLOR CODE: BK - BLACK, BR - BROWN, R - RED, O - ORANGE, Y - YELLOW, G - GREEN, BL - BLUE, P - PURPLE, S - SLATE, W - WHITE
3.	UNIT WIRED FOR 115 VOLTS AC POWER INPUT.
4.	CONNECTORS VIEWED FROM SOLDER TERMINAL ENDS.
5.	WHEN SOLDERING CABLE TO INDICATOR LIGHTS, BEND TERMINALS OUTWARD 90°
6.	UNITS INCLUDE MATING 16 PT. CONNECTOR (159541) FOR CUSTOMERS USE.
7.	THESE SPARES ARE PART OF THE 161878 CABLE AND ARE TIED BACK AT THE F CONNECTOR.
8.	IN THE 16 PT. CONNECTOR, IT IS NECESSARY TO STRAP TERMINALS 1 AND 9.
9.	GROUND STRAP TO LEFT FRONT MOUNTING STUD ON BASE.
10.	TERMINAL 3 TO BE CONNECTED TO A GROUND SCREW ON BASE.
11.	ROUTE THE 164379 CABLE ALONG THE RIGHT AND INSIDE SURFACES OF THE KEYBOARD, AND SOLDER TO PINS 4 AND 5. TIE CABLE ASSEMBLY SECURELY TO BASE STRUCTURE.
12.	TAPED AND TIED BACK TO CABLE ASSEMBLY.
13.	POLARITY MUST BE MAINTAINED ONLY WHEN 154190 FILTER IS USED. POLARITY MAY BE DISREGARDED WHEN 195923 FILTER IS USED. COLOR CODING OF FILTER LEADS DOES NOT APPLY TO 195923 FILTER.
14.	FOR SCHEMATIC WIRING DIAGRAM, SEE 4953WD, SIMILAR TO 4797WD.
15	WIRING ON UNITS WITHOUT Q FUSE HOLDER.
16	WIRING ON UNITS WITH Q FUSE HOLDER.

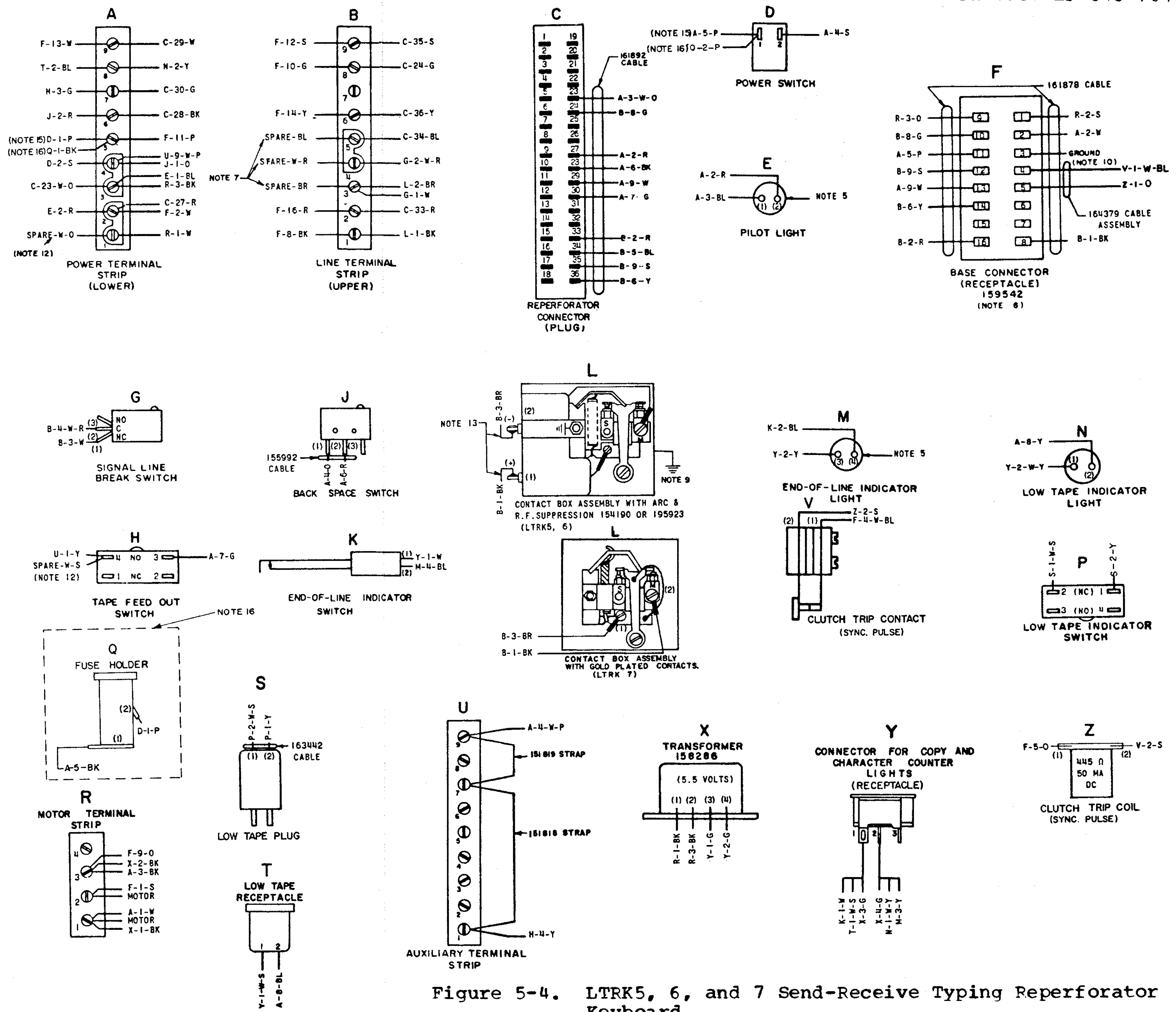


Figure 5-4. LTRK5, 6, and 7 Send-Receive Typing Reperforator Keyboard

NO	NOTES
1.	FOR ACTUAL WIRING DIAGRAMS OF INDIVIDUAL UNITS SEE WD NUMBERS OF COMPONENT UNITS. 4952WD MODEL 28 SEND-RECEIVE BASE LTRK5,6,7 2900WD MOTOR UNITS — LMU3, LMU38 3628WD TYPING REPERFORATOR LPR 53
2.	LEGEND ○ A POWER TERMINAL STRIP ON LTRK (LOWER) ○ B LINE TERMINAL STRIP ON LTRK (UPPER) ○ U AUXILIARY TERMINAL STRIP ON LTRK (REAR) ○ R MOTOR TERMINAL STRIP ON LTRK ≪ C 36 POINT CONNECTOR ≪ F 16 POINT CONNECTOR ◂ S LOW TAPE CONTACT (PLUG) < T LOW TAPE CONTACT (RECEPTACLE)
3.	ALL APPARATUS IS SHOWN IN UNOPERATED OR DE-ENERGIZED POSITIONS.
4.	RESISTANCE VALUES IN OHMS (Ω) CAPACITANCE VALUES IN MICROFARADS (MFD)
5.	CIRCUITS SHOWN FOR .060 AMP. NEUTRAL SIGNAL LINE OPERATION. FOR .020 AMP. LINE CURRENT, ADD DASHED LINE (---) CONNECTION AND OMIT CONNECTIONS MARKED (✱).
6.	USE SYNCHRONOUS MOTOR ON REGULATED 60 ∿ (±1%) AC POWER ONLY.
7.	COIL OPERATES ON DC, 50 MA. PULSE ONLY.
8.	DOT DASH ——-——-—— LINES INDICATE FILTERING, SHIELDING AND SUPPRESSION NETWORKS.
9.	CUSTOMER TO STRAP TERMINALS 1 AND 9 ON PLUG.
10.	3 SPARE WIRES TIED BACK AT F CONNECTOR
11.	TWO SPARE WIRES TAPED AND TIED BACK TO CABLE ASSEMBLY.

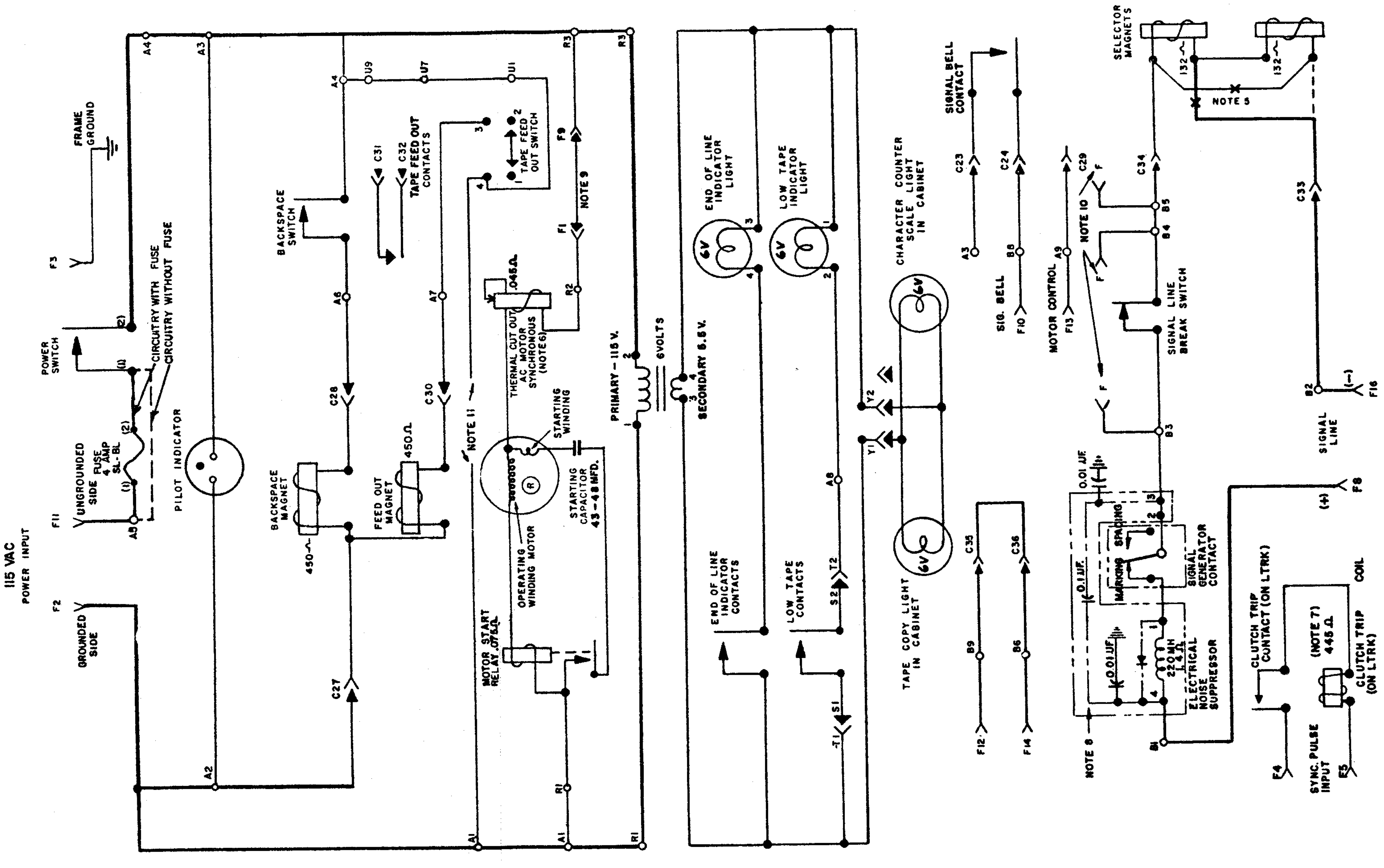


Figure 5-5. LTRK5, 6, and 7 Send-Receive Typing Reperforator Keyboard, and LPR53 and 9 Typing Reperforator Schematic Diagram

	NOTES
1	WIRING LEGEND DISTANT TERMINATING AREA DISTANT TERMINATING DESIGNATION WIRE COLOR CODE AB – 2 – W
2.	COLOR CODE BK BLACK BR BROWN R RED O ORANGE Y YELLOW G GREEN BL BLUE S SLATE W WHITE P PURPLE
3	ASSOCIATED CABLE ASSEMBLIES CABLE ASSEMBLY, CONTROL – 162574 CABLE ASSEMBLY – 156972 CABLE ASSEMBLY, LAMP HOLDER – 159592
4	16 AND 36 POINT CONNECTOR VIEWED FROM SOLDER END.
5.	TERMINAL DESIGNATIONS ENCLOSED IN PARENTHESIS ARE NOT MARKED ON COMPONENTS.
6.	FOR SCHEMATIC WIRING DIAGRAM SEE 3621 WD
7	156973 SWITCH SHOWN WITH TAPE OUT OF UNIT AND FROM SOLDERED END.
8	160307 WAS REPLACED FOR STANDARDIZATION.

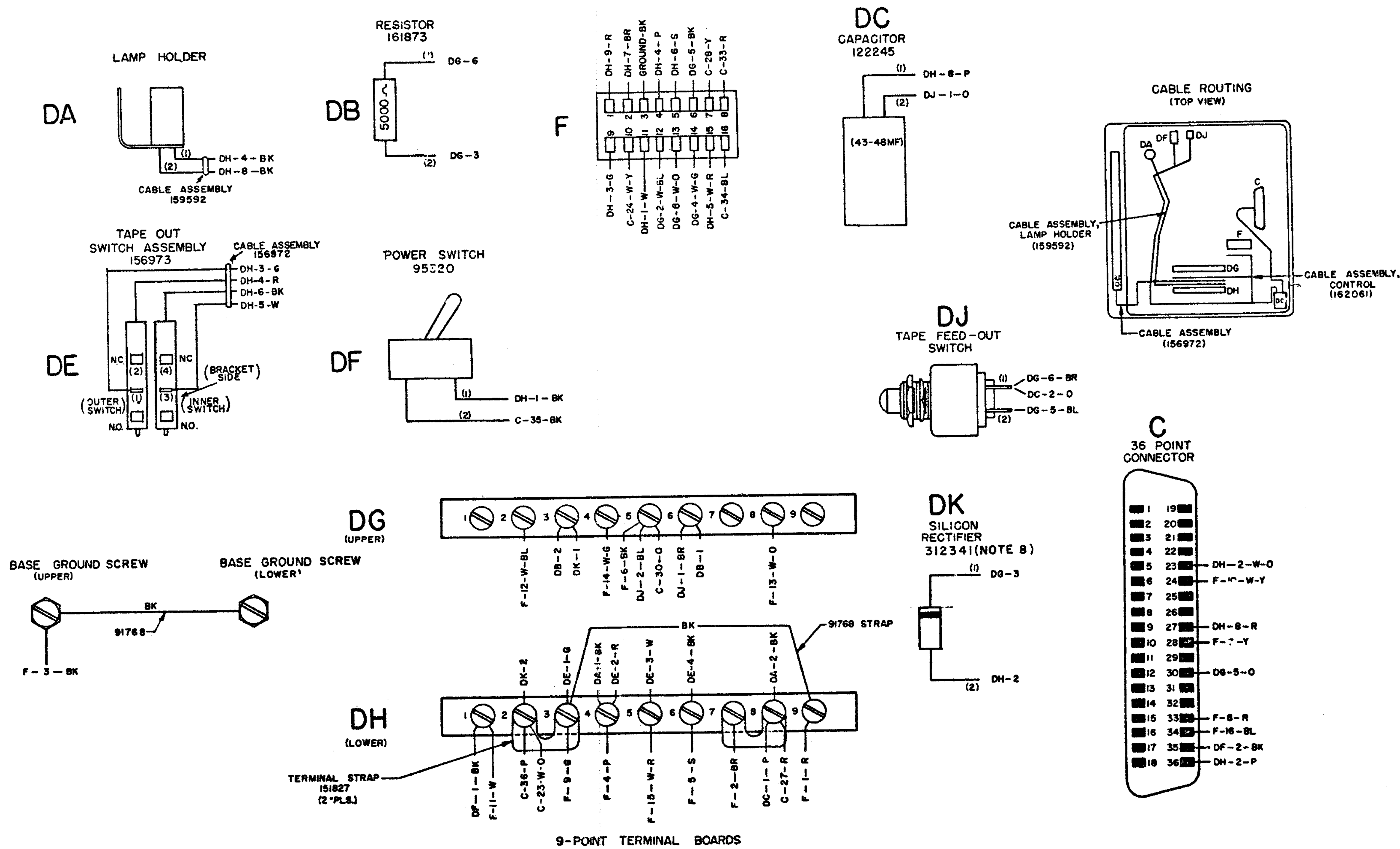


Figure 5-6. LRB8, 41, 49, and 57 Reperforator Base Wiring Diagram

	NOTES
1.	FOR ACTUAL WIRING DIAGRAMS OF INDIVIDUAL UNITS SEE BELOW: 3628 WD REPERFORATOR 2900 WD MOTOR UNITS – LMU24,56 4354 WD TYPING REPERFORATOR BASE LRB 31, 62
2.	LEGEND: DG TERMINAL BLOCK (ON BASE) DH TERMINAL BLOCK (ON BASE) C 36-POINT CONNECTOR
3.	ALL APPARATUS IS SHOWN IN UNOPERATED OR DE-ENERGIZED POSITIONS.
4.	(A) RESISTANCE VALUES IN OHMS (Ω) (B) CAPACITANCE VALUES IN MICROFARADS (MFD)
5.	CIRCUITS SHOWN FOR .020 AMP. NEUTRAL SIGNAL LINE OPERATION. FOR .060 AMP. LINE CURRENT, ADD DASH LINE (----) CONNECTION AND OMIT CONNECTION MARKED (—x—) ON SELECTOR MAGNETS.**(SEE 3628 WD LPR ACT. WD.)**
6.	USE SYNCHRONOUS MOTOR ON REGULATED 60∿ (±1%) A.C. POWER ONLY. GOVERNED MOTORS AND OTHER POWER CIRCUITS OPERABLE ON 50 TO 60∿ UNREGULATED A.C.
7	SL-BL INDICATES SLOW BLOWING.
8.	FAN USED ON LRB 62 ONLY.
9.	TOP TAPE OUT CONTACTS WIRING LEGEND. LRB 31 FROM DE 4 TO DH 6; FROM DE 3 TO DH 5 LRB 62 FROM DE 4 TO DG 6; FROM DE3 TO DG3

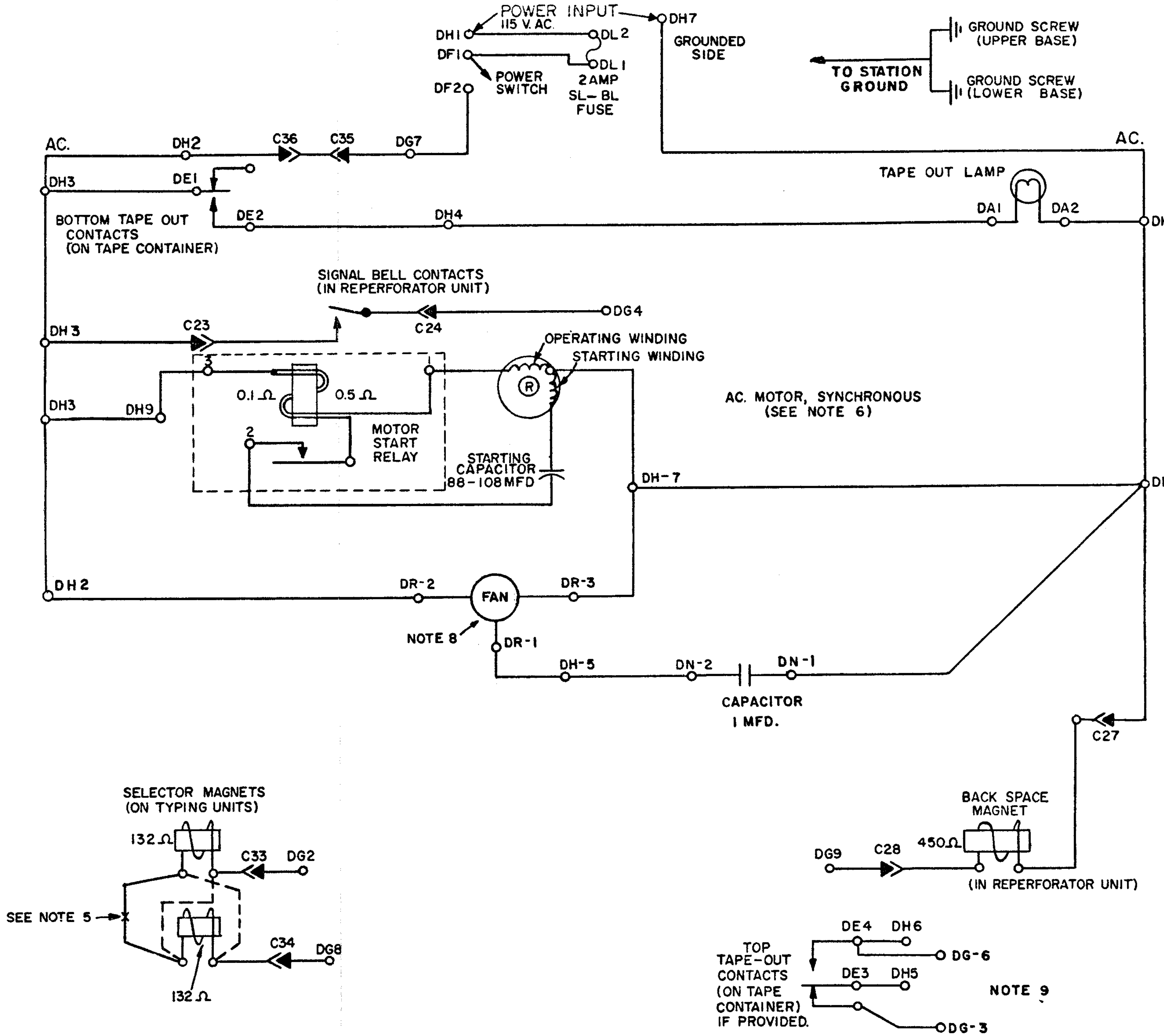
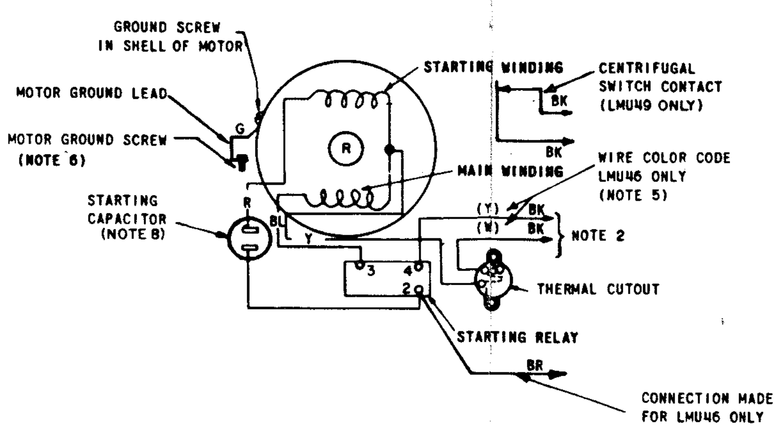


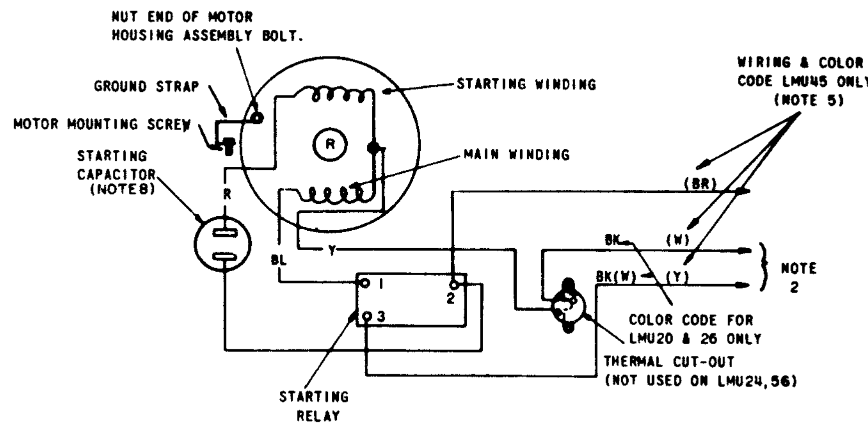
Figure 5-7. LRB31 and 62 Compact ROTR Reperforator Base and LPR40 Typing Reperforator Schematic Diagram

SYNCHRONOUS MOTOR UNITS

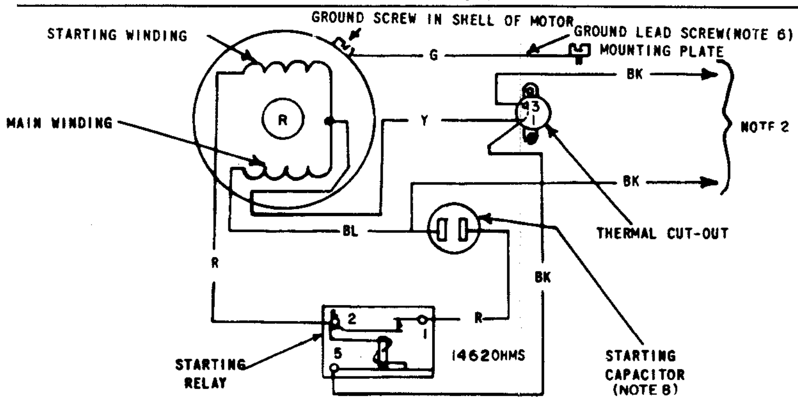
NO.	NOTES	
1.	SYNCHRONOUS MOTOR OPERATES ON REGULATED FREQUENCY (± 0.75%) MAXIMUM AC ONLY.	
2.	CONNECT EITHER WIRE TO DESIGNATED TERMINALS OF UNIT TERMINAL BLOCK, PER WIRING DIAGRAM OF ASSOCIATED UNIT	
3.	MOTOR LEADS OF SAME COLOR ARE INTER-CHANGEABLE.	
5.	EXTERNAL NOISE SUPPRESSION NETWORK CONSISTING OF 100 OHM, 1/2 WATT RESISTOR IN SERIES WITH 0.25 MFD 1K V CAPACITOR CONNECTED ACROSS YELLOW AND BROWN WIRES. (FOR LMU45,46)	
6.	MOTOR GROUND LEAD (GREEN) TERMINAL MUST BE FASTENED TO MOUNTING CRADLE OF MOTOR UNDER A SEPARATE GROUND SCREW ONLY. A SCREW USED FOR ANOTHER PURPOSE CANNOT BE USED FOR GROUNDING (UNDERWRITERS LABORATORIES REQUIREMENT).	
7	WIRE COLOR CODE: BK - BLACK BL - BLUE BR - BROWN P - PURPLE W - WHITE	R - RED O - ORANGE Y - YELLOW S - SLATE G - GREEN
8	LMU	STARTING CAPACITOR VALUE
	3,15,21,30,33, 36,37,38,42, 46,49,51,52	43 – 48 MFD
	11,12	170 – 226 MFD
	35	64 – 77 MFD
	55	15 – 18 MFD
	19,20,24,26, 31,45,56	88 – 108 MFD
	50,	161 – 193 MFD



LMU 3,11,12,15,21,30,37,42,46,49
FOR USE WITH 115V.A.C. 60~POWER SUPPLY
LMU 33, 36,38, 51,52
FOR 115V.A.C. 50~POWER SUPPLY.
LMU 55
FOR 230 V.A.C. 50~POWER SUPPLY

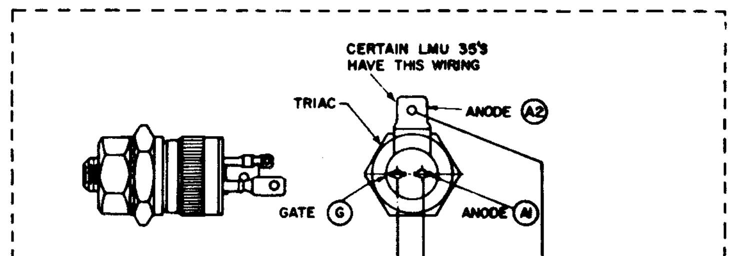


LMU 19,20,24,26,31,45,56
FOR USE WITH 115V AC 60~POWER SUPPLY ONLY



LMU 50,
FOR USE WITH 115V AC 50~POWER SUPPLY ONLY

LMU 35



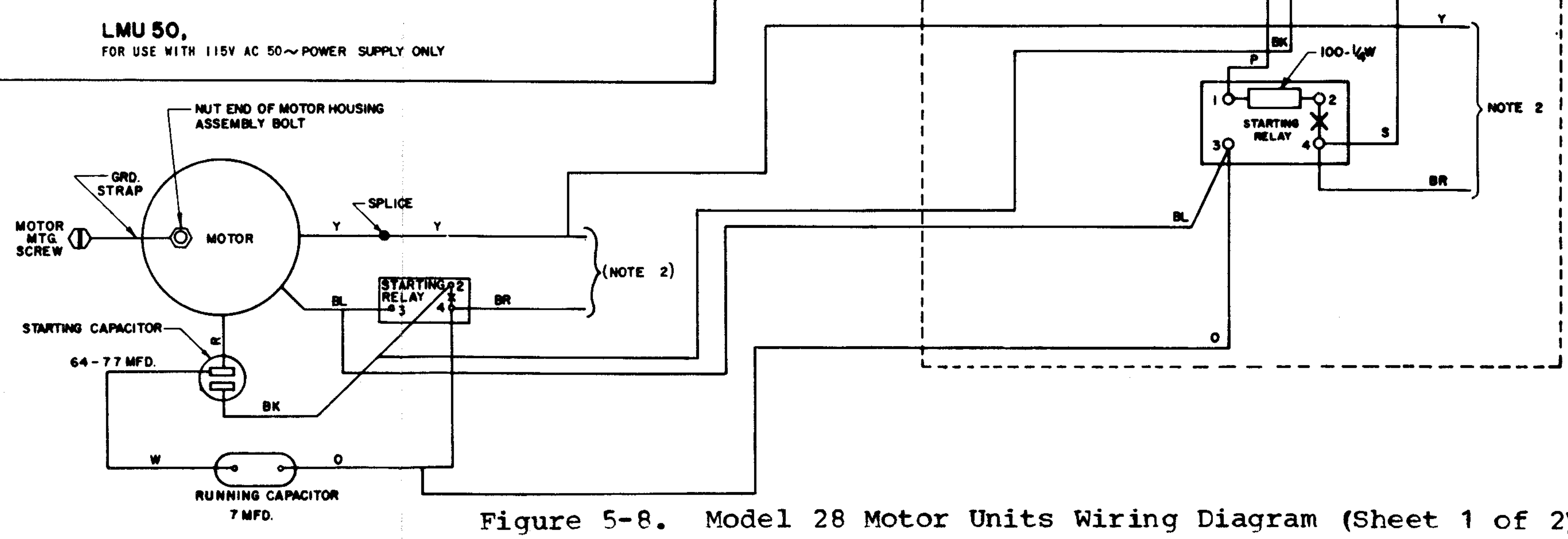
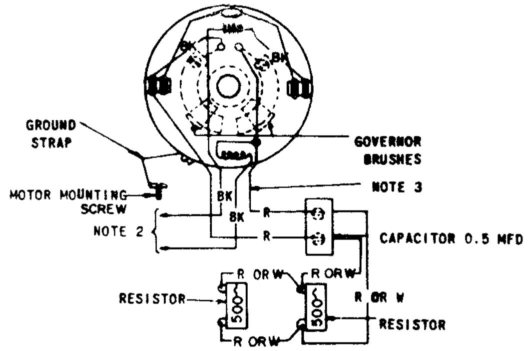


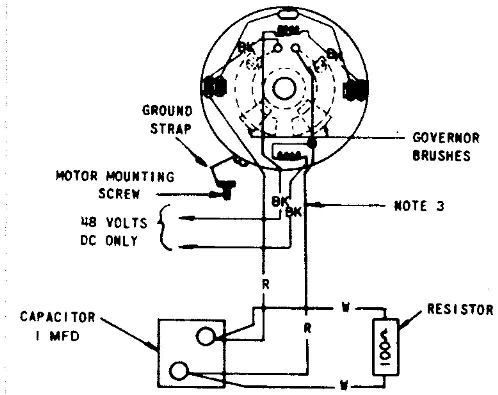
Figure 5-8. Model 28 Motor Units Wiring Diagram (Sheet 1 of 2)

SERIES GOVERNED MOTOR UNITS

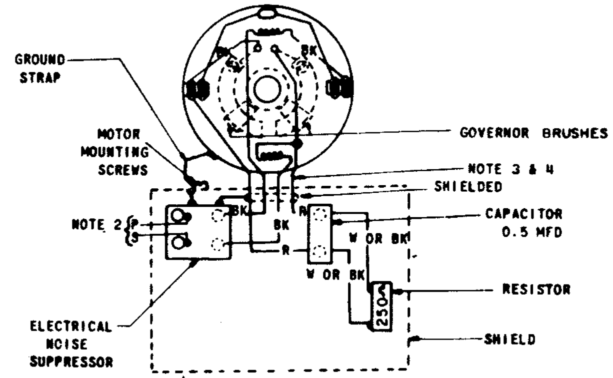
NO.	NOTES
1.	A. AC SERIES MOTOR UNITS OPERATE ON UN-REGULATED AC POWER. B. ASSOCIATED LESU MUST BE EQUIPPED WITH CAPACITOR-RESISTOR ASSEMBLY FOR DC OPERATION OF GOVERNED MOTORS.
2.	CONNECT EITHER WIRE TO DESIGNATED TERMINALS OF UNIT TERMINAL BLOCK, PER WIRING DIAGRAM OF ASSOCIATED UNIT.
3.	MOTOR LEADS OF SAME COLOR ARE INTER-CHANGEABLE.
4.	MOTOR LEADS ARE ENCLOSED IN APPROXIMATLY 10" LONG COPPER SHIELDING & FASTENED TO MOTOR AND CONTROL PARTS COMPARTMENT. (FOR LMU28).
5.	LMU4, 10, AND 14 MOTOR UNITS (UNIVERSAL SERIES GOVERNED) CONTAIN TWO 500 OHM RESISTORS WIRED IN PARALLEL EQUIVALENT TO 250 OHMS. LMU4 MOTOR UNIT SUPERSEDED BY LMU41 MOTOR UNIT. LMU10 MOTOR UNIT SUPERSEDED BY LMU47 MOTOR UNIT. LMU14 MOTOR UNIT SUPERSEDED BY LMU39 MOTOR UNIT.
6.	WIRE COLOR CODE: BK - BLACK R - RED BL - BLUE O - ORANGE BR - BROWN Y - YELLOW P - PURPLE S - SLATE W - WHITE G - GREEN



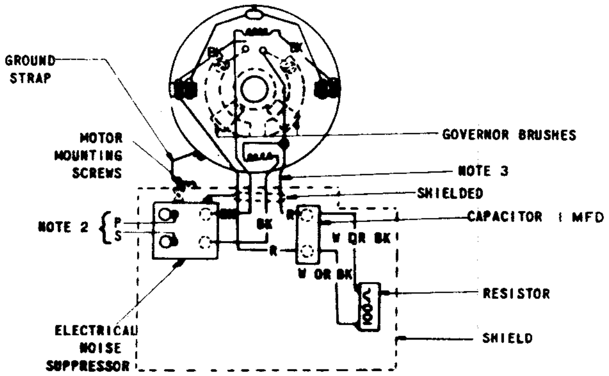
LMU 6,13 (UNIVERSAL)
WITHOUT RADIO FREQUENCY SUPPRESSORS
FOR USE WITH EITHER 115V AC 50-60~OR 115V DC POWER SUPPLY (NOTE 1B).



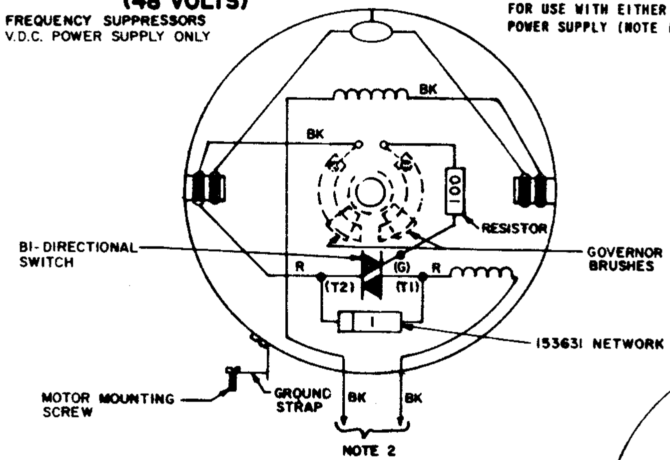
LMU 23 (48 VOLTS)
WITHOUT RADIO FREQUENCY SUPPRESSORS
FOR USE ON 48 V.D.C. POWER SUPPLY ONLY



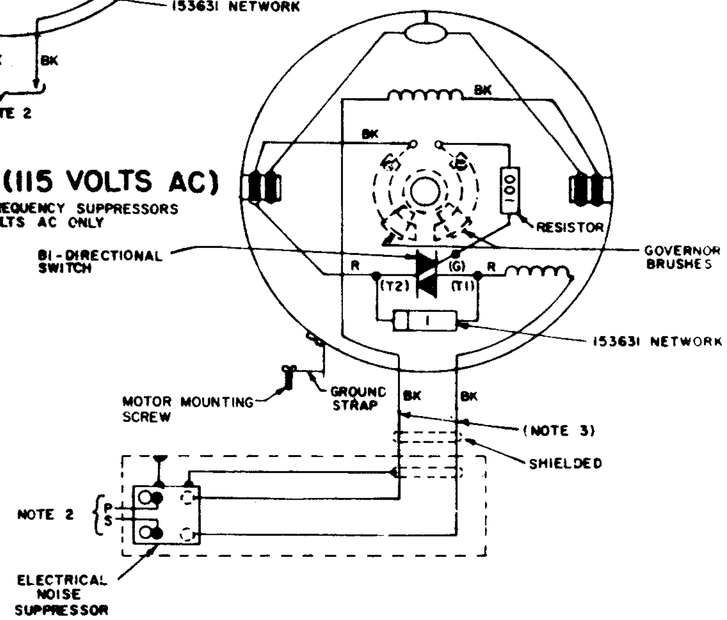
LMU 28,32,39,41,47 (UNIVERSAL)
WITH RADIO FREQUENCY SUPPRESSORS
FOR USE WITH EITHER 115V AC 50-60~115 V DC POWER SUPPLY (NOTE 1B)



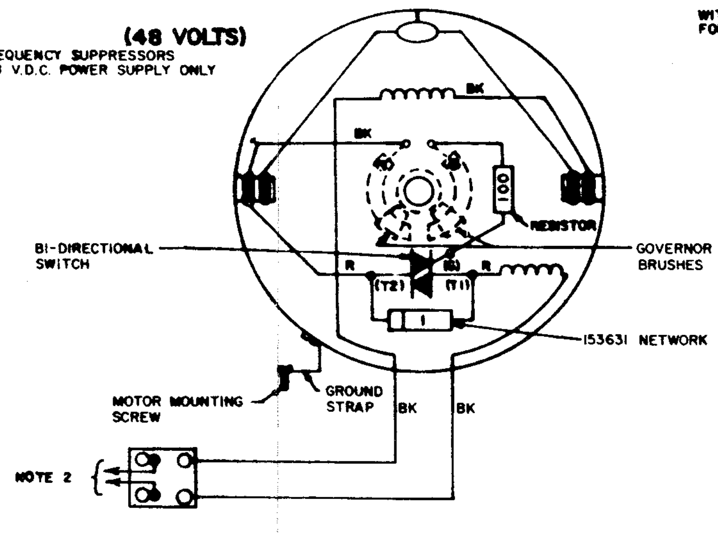
LMU 29 (48 VOLTS)
WITH RADIO FREQUENCY SUPPRESSORS
FOR USE ON 48 V.D.C. POWER SUPPLY ONLY



LMU 57, (115 VOLTS AC)
WITHOUT RADIO FREQUENCY SUPPRESSORS
FOR USE ON 115 VOLTS AC ONLY



LMU 63 (115 VOLTS A.C.)
WITH RADIO FREQUENCY SUPPRESSORS
FOR USE ON 115 VOLTS AC ONLY



LMU 60,61,64 (115 VOLTS AC)
WITH RADIO FREQUENCY SUPPRESSORS
FOR USE ON 115 VOLTS AC ONLY

Figure 5-8. Model 28 Motor Units Wiring Diagram (Sheet 2 of 2)

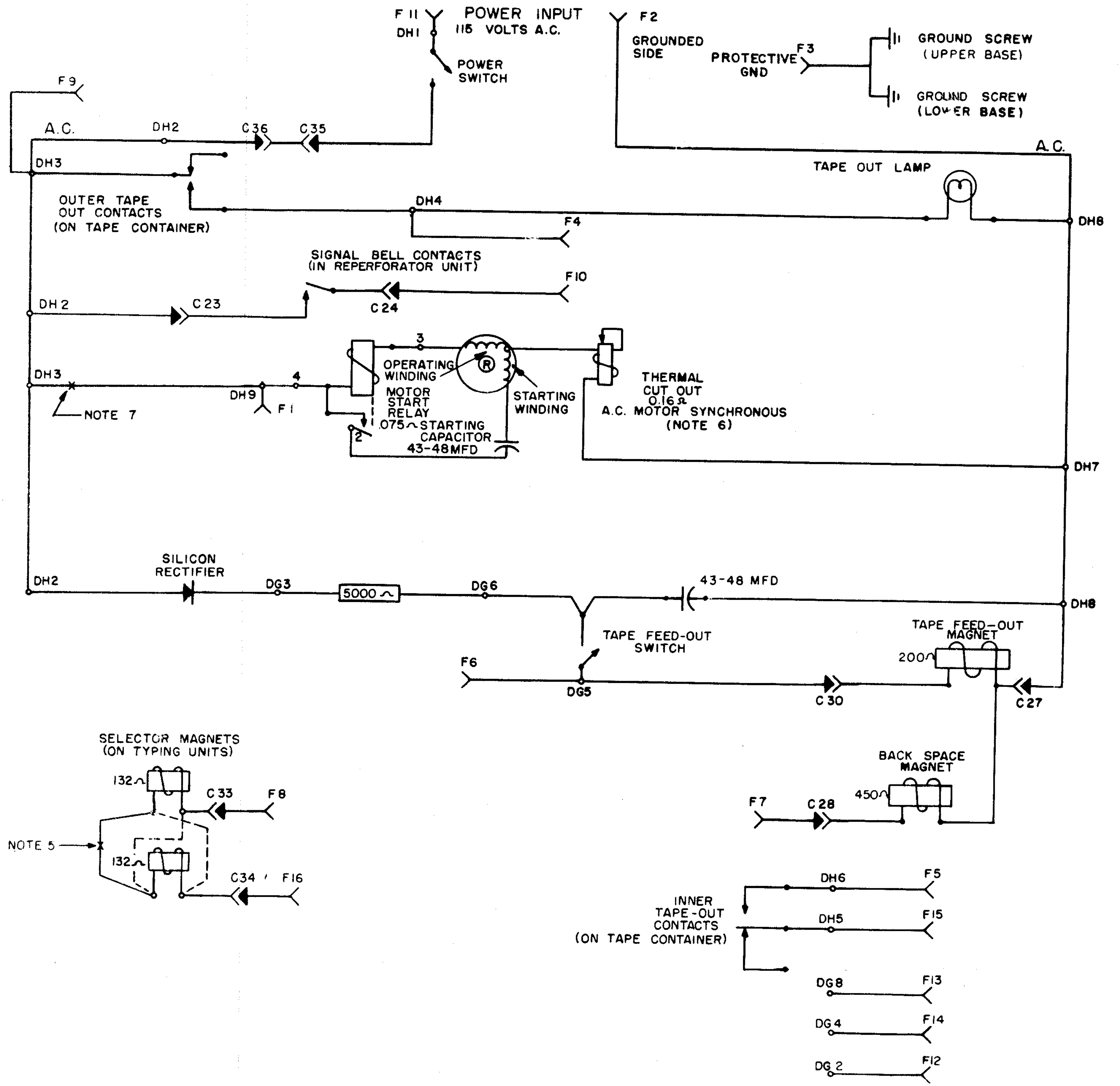
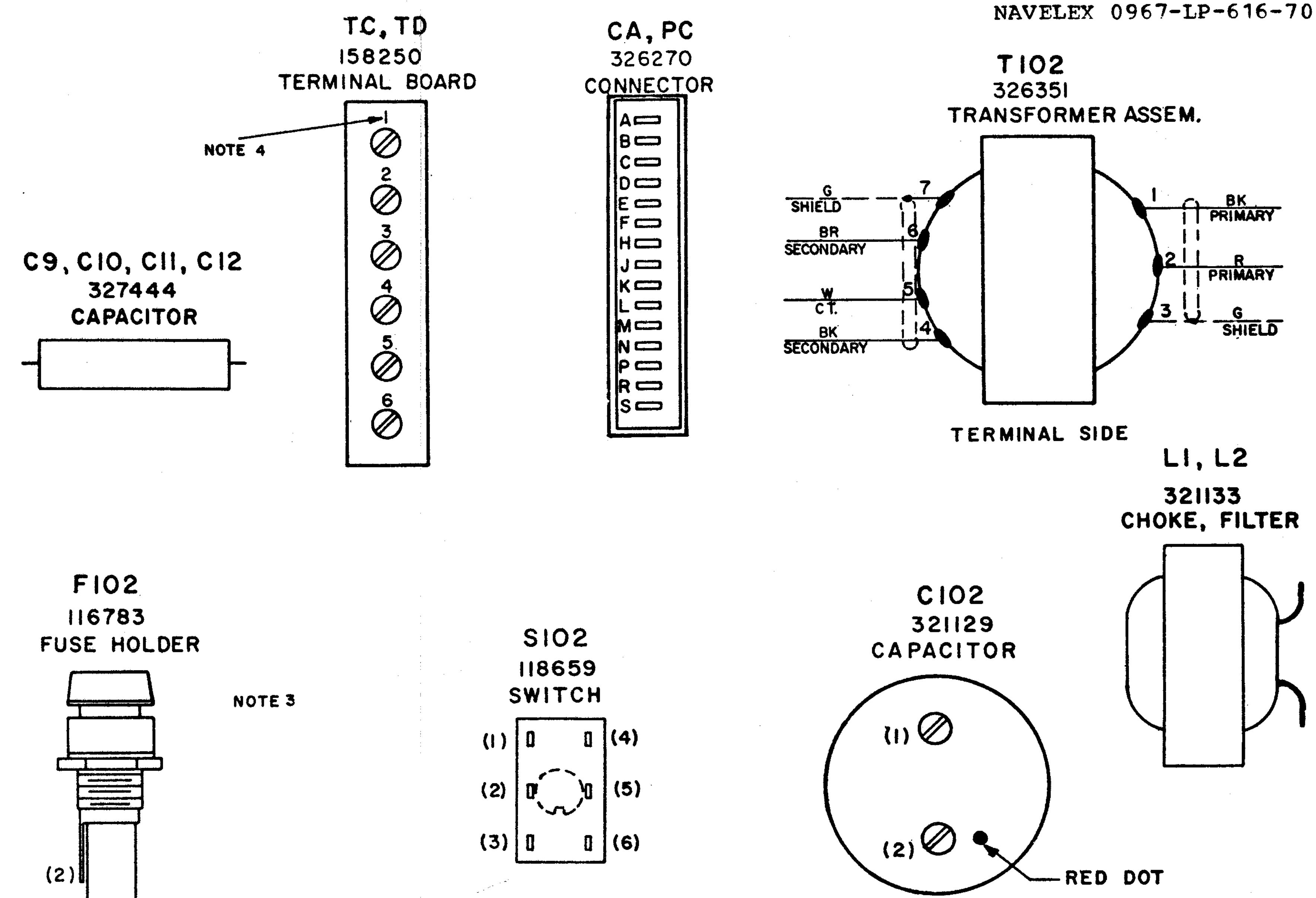


Figure 5-9. LRB8, 41, 49, and 57 Reperforator Base Wiring Diagram

NO.	NOTES
1.	ALL VOLTAGES DC UNLESS OTHERWISE SPECIFIED.
2.	TERMINAL DESIGNATION ENCLOSED IN PARENTHESIS ARE FOR REFERENCE AND ARE NOT MARKED ON COMPONENT.
3.	FUSE NUMBER-162360 8/10 AMP SLOW BLOWING
4.	TERMINAL NUMBERS APPEAR ON ASSOCIATED MARKING STRIP.
5.	INDICATES TO TAPE END TERMINATING POINT.
6.	INDICATES SINGLE SHIELDING
7.	INDICATES DOUBLE SHIELDING
8.	ALL STRAPPING WIRE 24 AWG BARE, 39603RM. USE SLEEVING WHERE REQUIRED. ① INDICATES 18 AWG STRANDED WIRE. ② INDICATES 24 AWG STRANDED WIRE. ③ INDICATES 24 AWG 2 LEAD SINGLE SHIELDED CABLE. ALL SURFACE WIRE 24 AWG GREEN, 31784 RM, UNLESS OTHERWISE SPECIFIED.
9.	REFER TO 8297WD FOR SCHEMATIC WIRING DIAGRAM
10.	COLOR CODE BK- BLACK G-GREEN BR- BROWN O-ORANGE BL- BLUE P-PURPLE R - RED Y-YELLOW S - SLATE W-WHITE
11.	OUTER SHIELD CONNECTED TO BOX AT CONNECTOR.



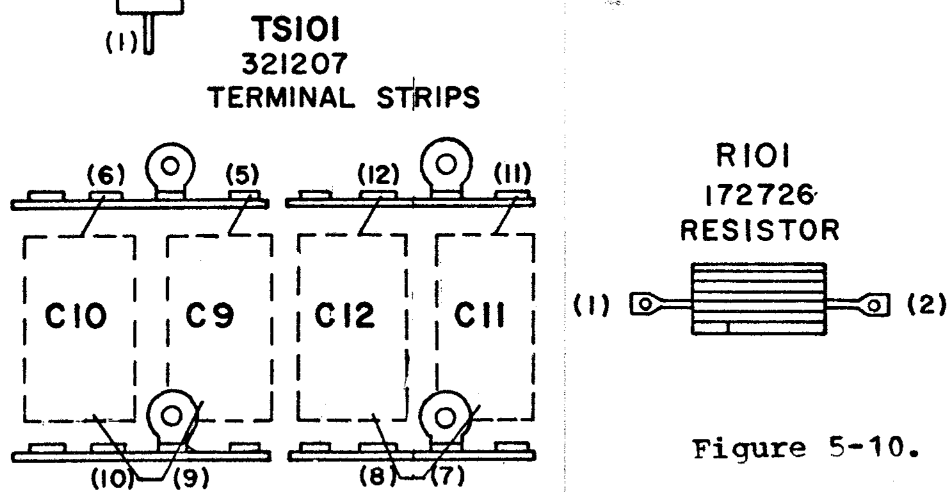
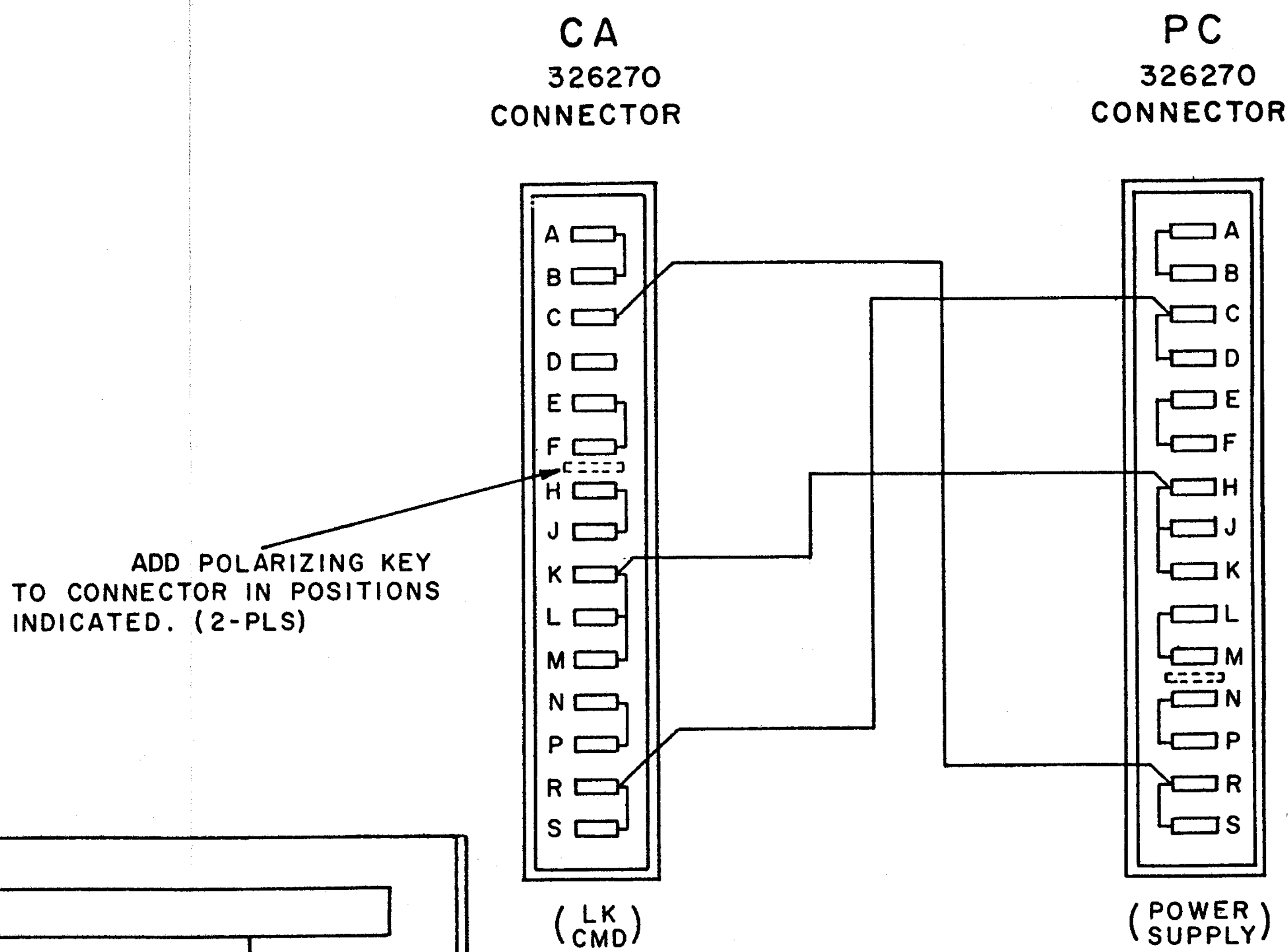


Figure 5-10. 321230 Electrical Service Assembly (Clutch) Wiring Diagram (Sheet 1 of 4)



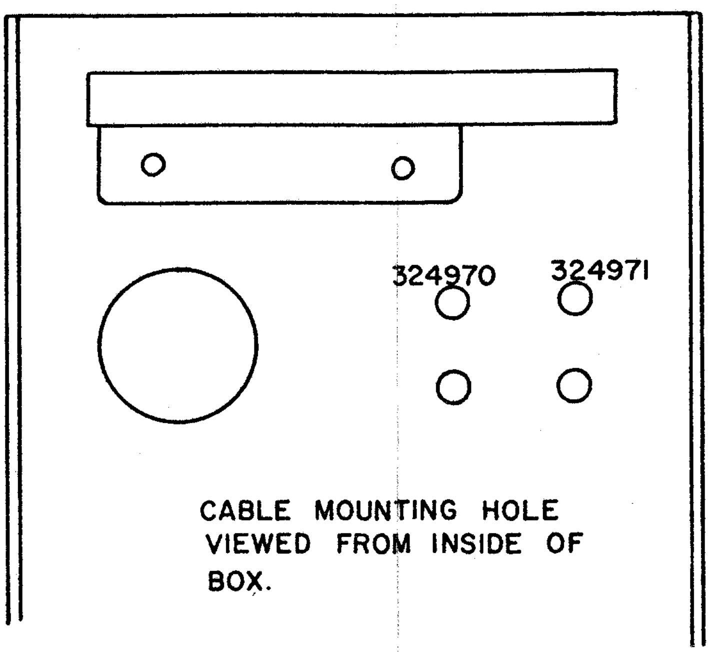


Figure 5-10. 321230 Electrical Service Assembly (Clutch) Wiring Diagram (Sheet 2 of 4)

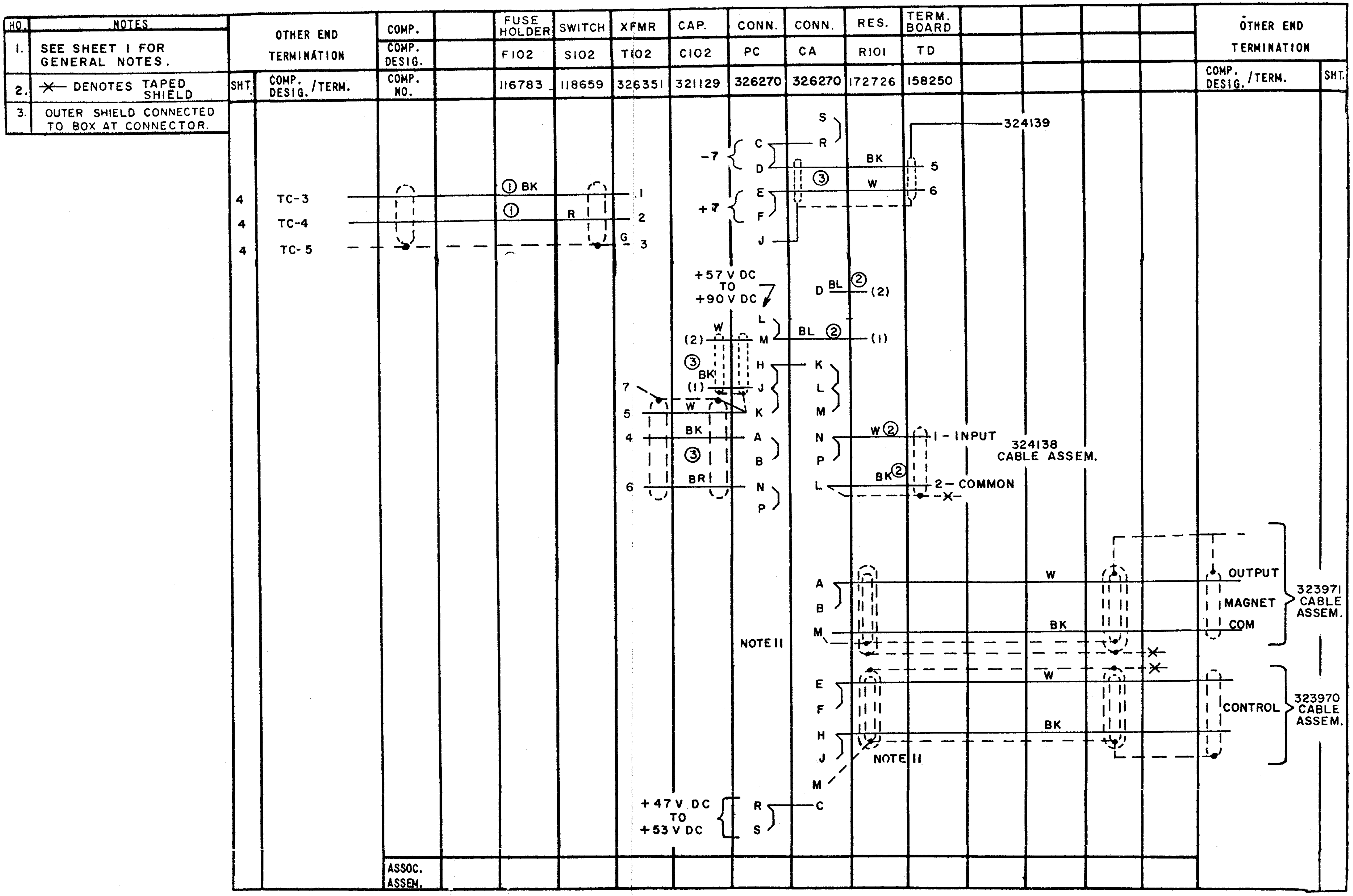


Figure 5-10. 321230 Electrical Service Assembly (Clutch) Wiring Diagram (Sheet 3 of 4)

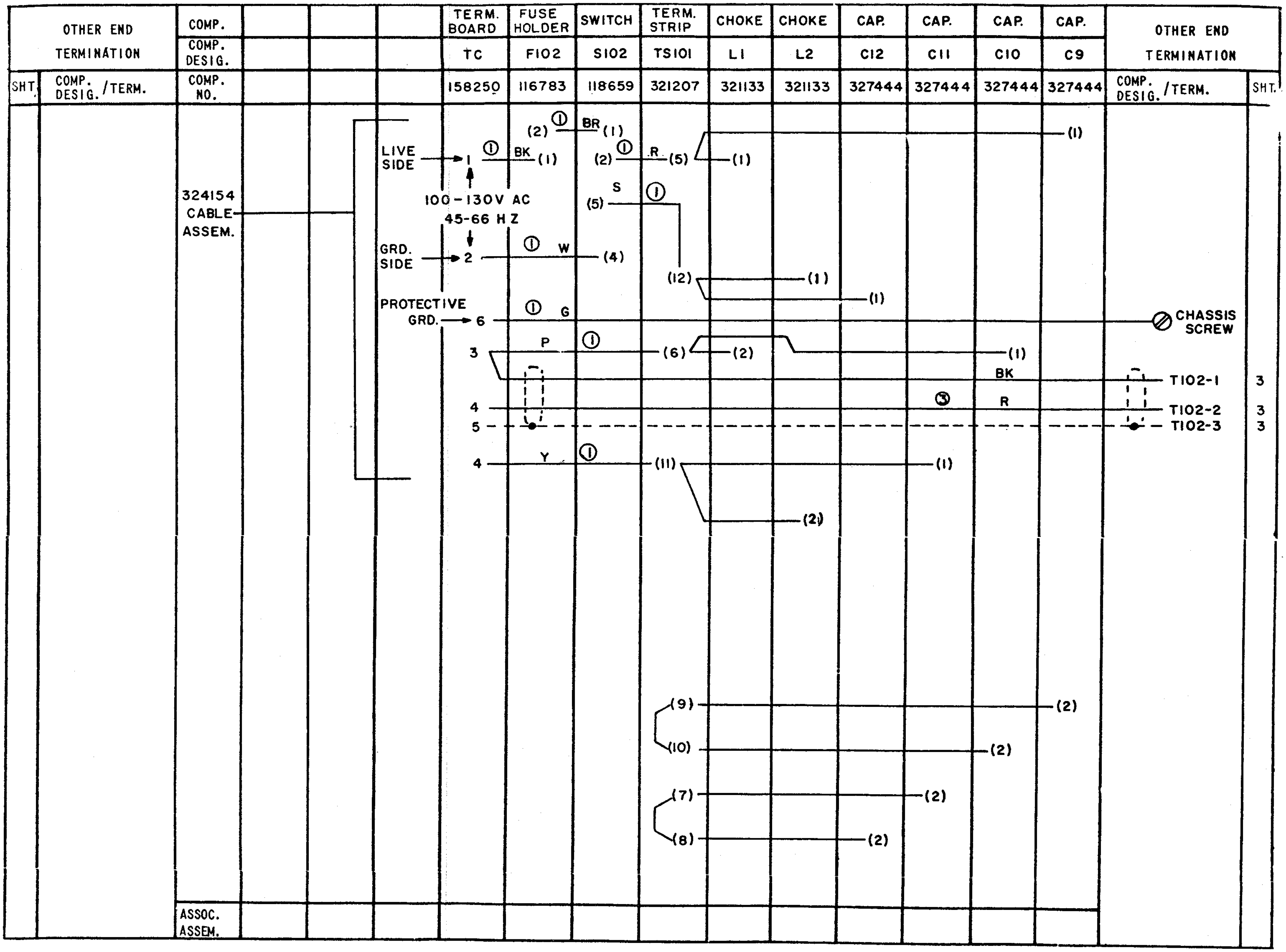


Figure 5-10. 321230 Electrical Service Assembly (Clutch) Wiring Diagram (Sheet 4 of 4)

NO.	NOTES
1.	ALL VOLTAGES DC UNLESS OTHERWISE SPECIFIED.
2.	TERMINAL DESIGNATION ENCLOSED IN PARENTHESIS ARE FOR REFERENCE AND ARE NOT MARKED ON COMPONENT.
3.	ALL SURFACE WIRE 24 AWG GREEN, 31784RM, UNLESS OTHERWISE SPECIFIED.
4.	ALL STRAPPING WIRE 24 AWG BARE, 39603RM. USE SLEEVING WHERE REQUIRED.
5.	✻ INDICATES TO TAPE END TERMINATING POINT.
6.	INDICATES SINGLE SHIELDING
7.	INDICATES DOUBLE SHIELDING
8.	THE PA CONNECTOR TAKES A 321290 CARD, THE SA TAKES A 323810 CARD.
9.	① INDICATES 18 AWG STRANDED WIRE.
10.	② INDICATES 24 AWG STRANDED WIRE.
11.	③ INDICATES 24 AWG 2 LEAD SINGLE SHIELDED CABLE.
12.	FUSE NUMBER: 162360 8/10AMP SLOW BLOWING
13.	SCHEMATIC DIAGRAM-8178WD
14.	REFERENCE SPEC. FOR TELETYPE CORPORATION EMPLOYEES ONLY 61352S
15.	COLOR CODE: BK-BLACK, BL-BLUE, W-WHITE, R-RED, Y-YELLOW, BR-BROWN, P-PURPLE, O-ORANGE, S-SLATE, G-GREEN
16.	321226 ASSEMBLY USES TERMINAL BOARDS TA, TB,TC,TD AS SHOWN. 321231 ASSEMBLY USES 158250 TERMINAL BOARD AS TA,TB ONLY.
17.	PLACE A POLARIZING KEY IN SA CONNECTOR BETWEEN E AND F, IN PA CONNECTOR BETWEEN M AND N.

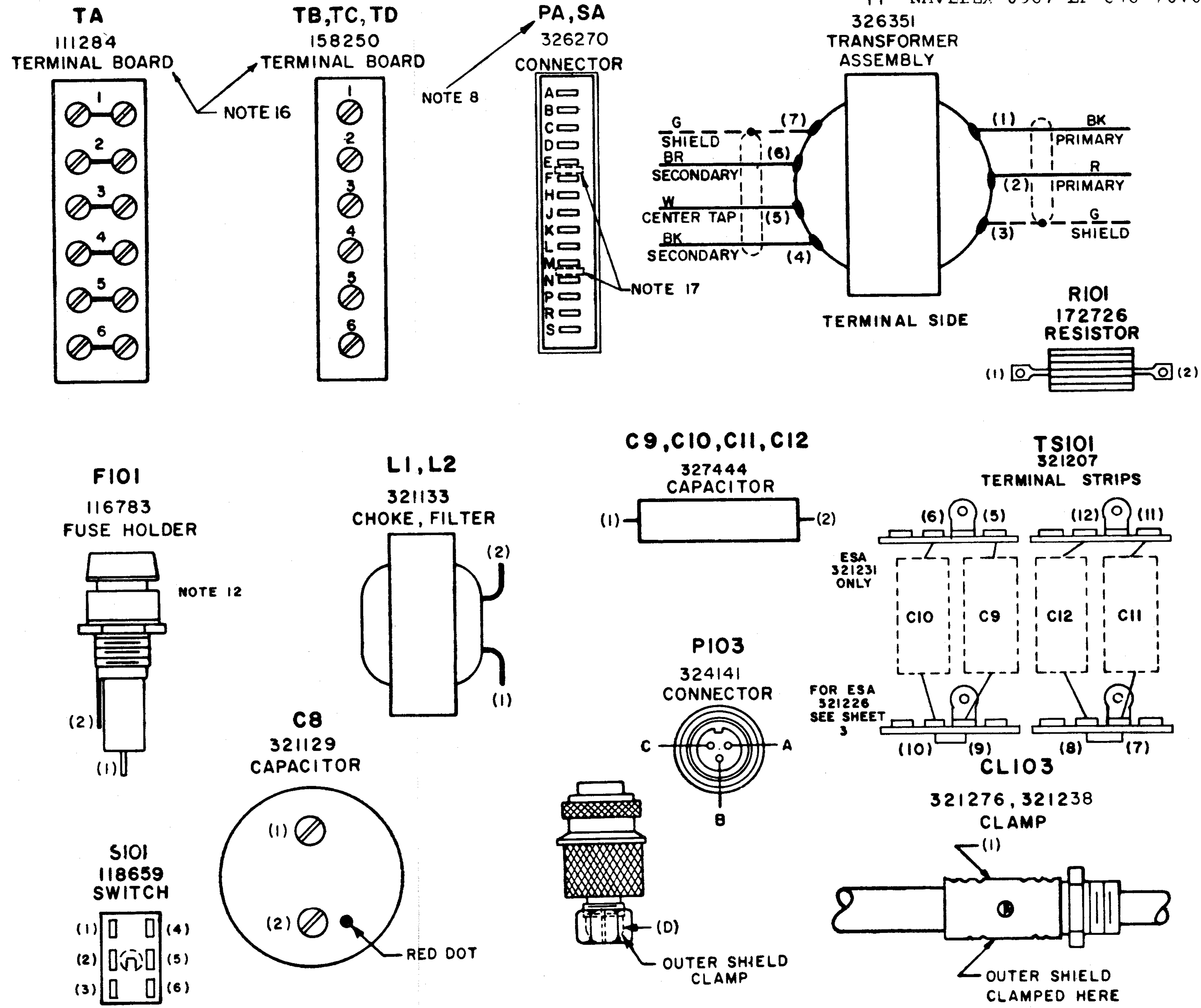


Figure 5-11. 321231 Electrical Service Assemblies Wiring Diagram (Sheet 1 of 3)

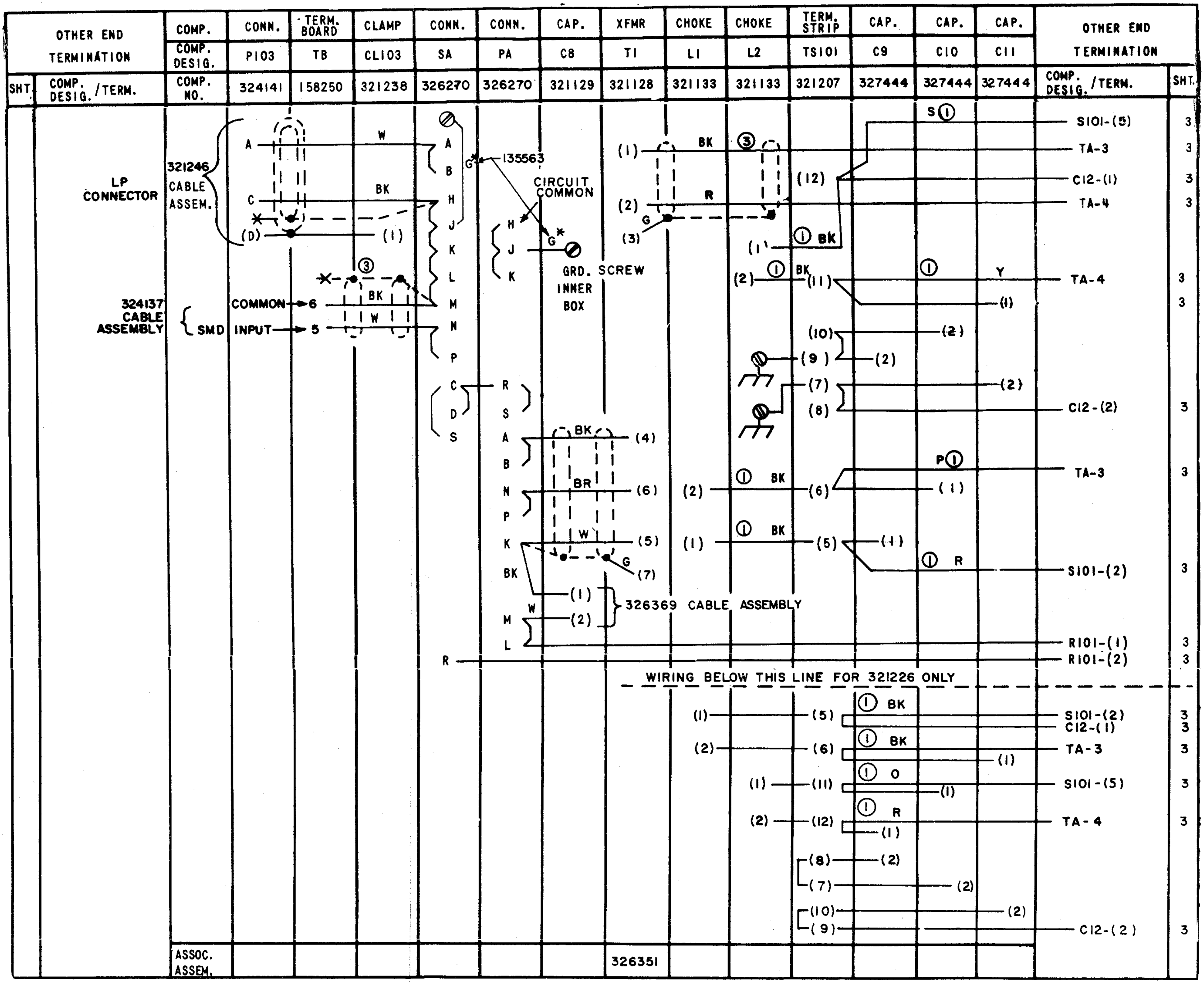


Figure 5-11. 321231 Electrical Service Assemblies Wiring Diagram (Sheet 2 of 3)

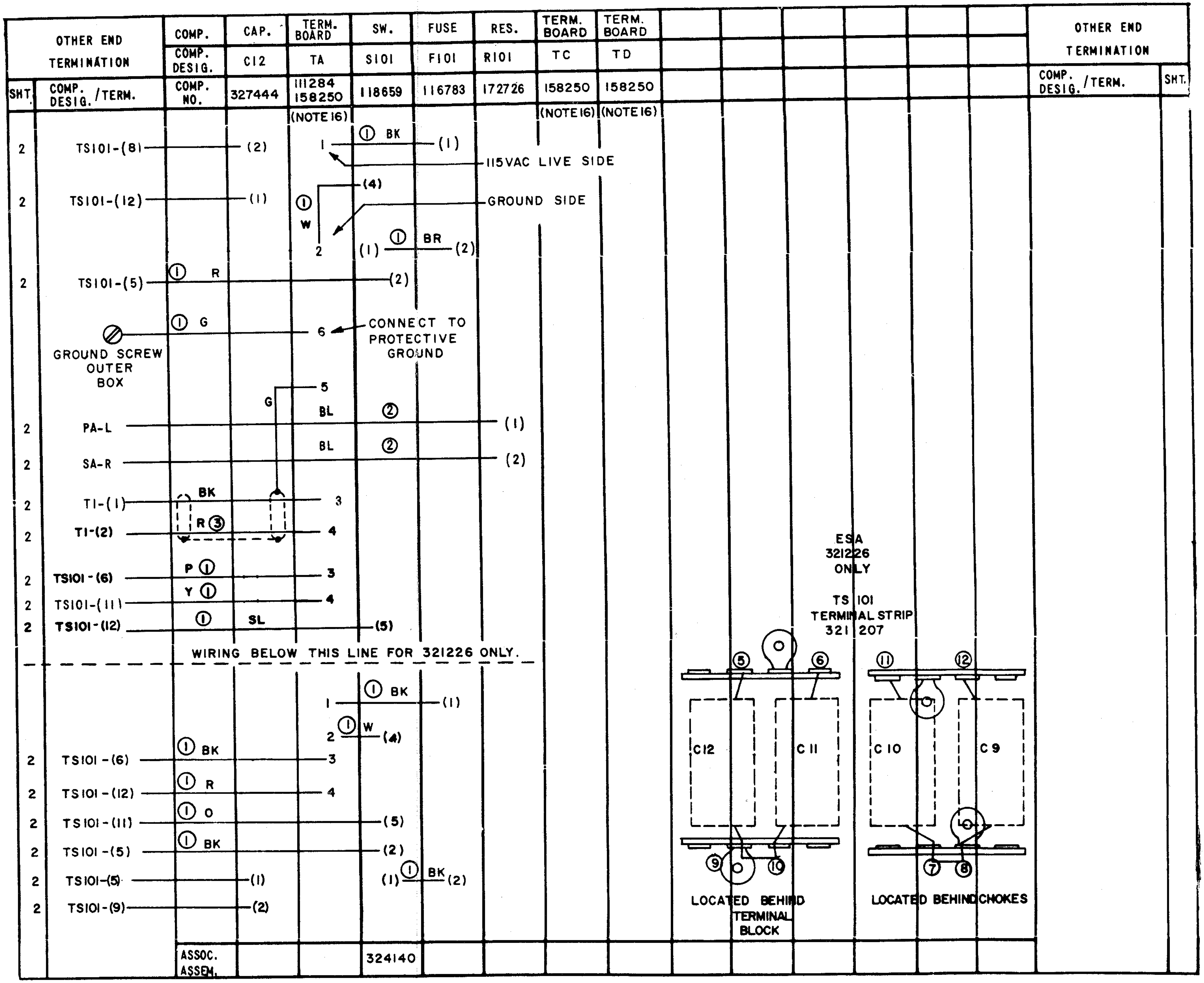


Figure 5-11. 321231 Electrical Service Assemblies Wiring Diagram (Sheet 3 of 3)

NO.	NOTES
1.	R3 AND R15 ARE ADJUSTED FOR SYMMETRICAL SWITCHING ABOUT ZERO VOLTS FOR INPUT 1 AND 2 RESPECTIVELY.
2.	PINS A,B - 60MA TO COILS PINS C,D - 47 TO 53V DC POWER INPUT PINS N,P - MS 188B SIGNAL INPUT 1 PINS E,F - MS 188B SIGNAL INPUT 2 PINS H,J,K,L,M, - CIRCUIT COMMON (ALL INPUTS AND OUTPUTS REFERRED TO CIRCUIT COMMON).
3.	REFERENCE SPEC. FOR TELETYPE CORP. EMPLOYEES ONLY: 61,264S.
4.	ALL RESISTORS ARE 5%, 1/2 WATT UNLESS OTHERWISE SPECIFIED.
5.	ALL CAPACITANCE VALUES IN PICOFARADS UNLESS OTHERWISE SPECIFIED.
6.	▽ DENOTES CIRCUIT COMMON.

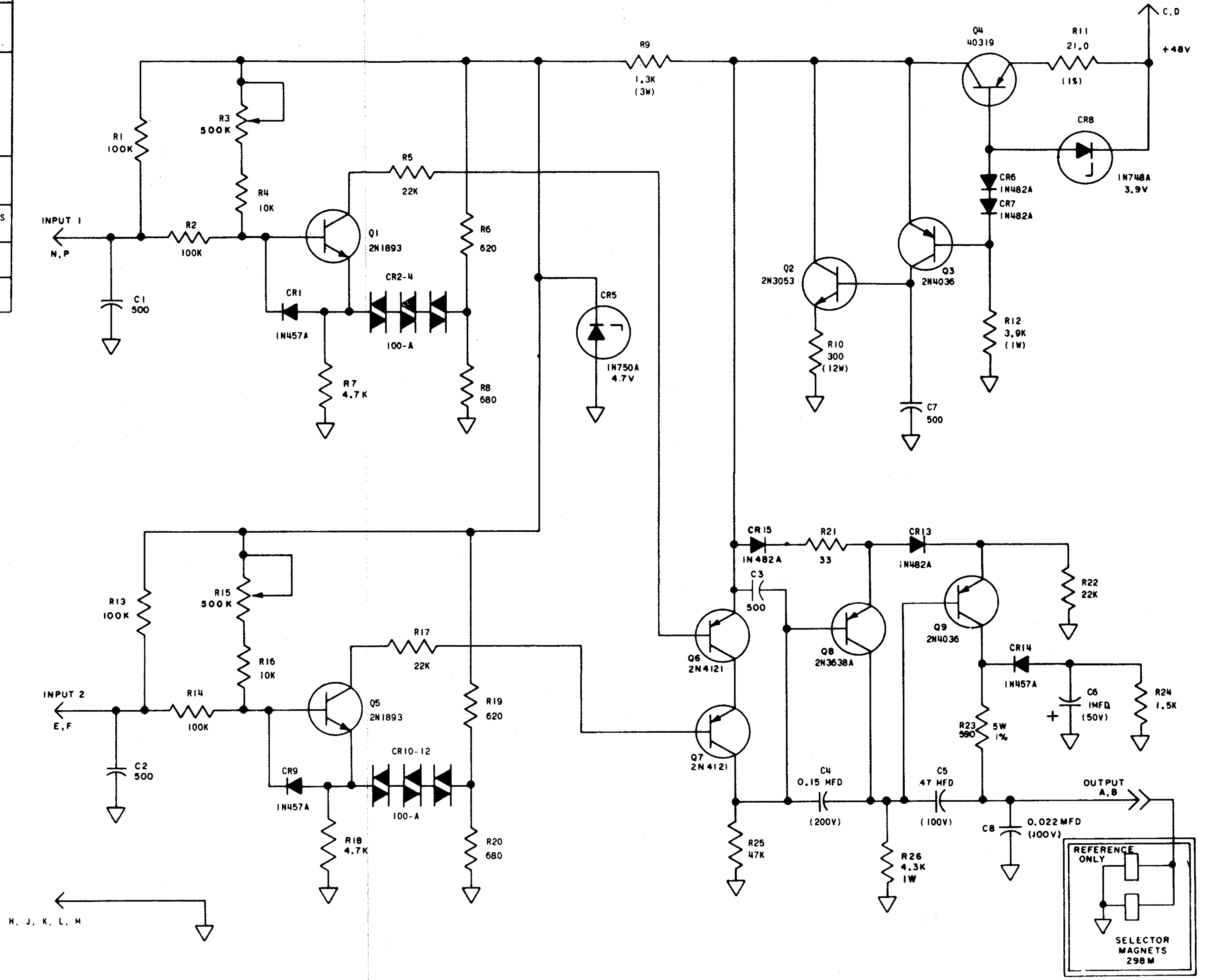


Figure 5-12. 323810 Selector Magnet Driver with Signal Combiner Schematic Diagram

NO.	NOTES
1.	———— INDICATES OUTER SHIELD AND - - - - - INDICATES INNER SHIELD
2.	CAPACITANCE VALUES IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
3.	>— INDICATES FEMALE AND —> INDICATES MALE TERMINALS ON CONNECTORS
4.	SL-BL INDICATES SLOW-BLOWING.
5.	( ) INDICATES SHIELDED WIRE.
6.	ALL VOLTAGES DC, UNLESS OTHERWISE SPECIFIED.
7.	TERMINAL DESIGNATIONS ENCLOSED IN PARENTHESES ARE FOR REFERENCE AND ARE NOT MARKED ON COMPONENT.
8.	WIRING DIAGRAM 8137WD
9.	RESISTANCE VALUES IN OHMS, UNLESS OTHERWISE SPECIFIED.
10	—C> DENOTES COMMON RETURN TO CIRCUIT GROUND.
11	REFERENCE SPEC FOR TELETYPE CORPORATION EMPLOYEES ONLY 61352 S
12	( ) INDICATES DOUBLE SHIELDED WIRE

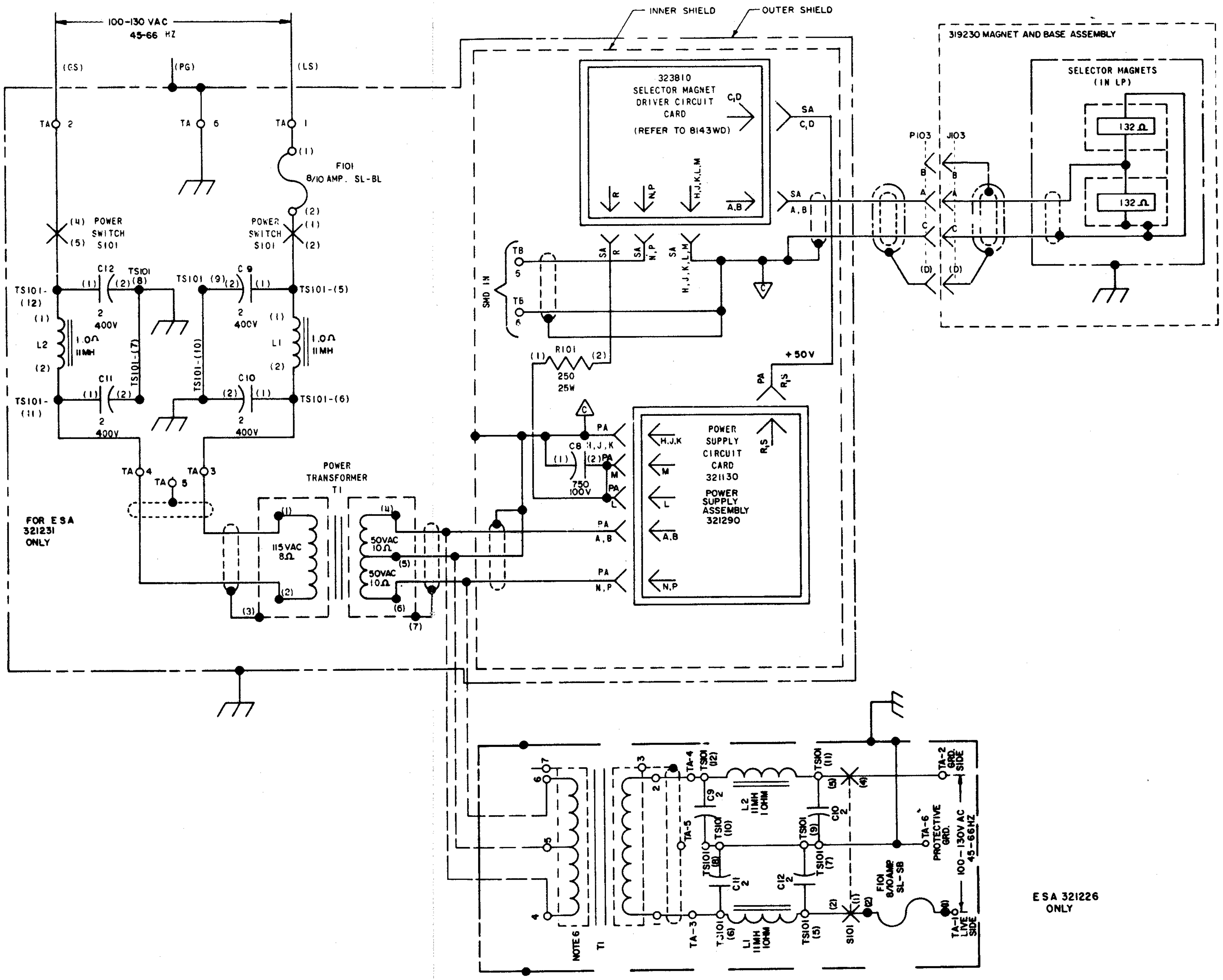


Figure 5-13. 321231 Electrical Service Assemblies

NO.	NOTES
1.	——— INDICATES OUTER SHIELD AND ----- INDICATES INNER SHIELD
2.	CAPACITANCE VALUES IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
3.	>—INDICATES FEMALE AND —>INDICATES MALE TERMINALS ON CONNECTORS
4.	SL-BL INDICATES SLOW-BLOWING.
5.	( ) INDICATES SHIELDED WIRE.
6.	ALL VOLTAGES DC, UNLESS OTHERWISE SPECIFIED.
7.	TERMINAL DESIGNATIONS ENCLOSED IN PARENTHESES ARE FOR REFERENCE AND ARE NOT MARKED ON COMPONENT.
8.	WIRING DIAGRAM - 8298 WD
9.	RESISTANCE VALUES IN OHMS UNLESS OTHERWISE SPECIFIED.
10.	FOR LOCAL COPY FROM KEYER, STRAP TB4 TO TB1.
11.	WHEN IT IS DESIRED TO PROVIDE AN EXTERNAL +6V AND -6V REMOVE THE +6V AND -6V LEADS FROM TB2 AND TB3. CONNECT COMMON OF EXTERNAL SUPPLY TO TB6
12.	SELECTOR MAGNETS 8299WD SIGNAL GENERATOR 8295WD
13.	REFERENCE SPEC. FOR TELETYPE CORPORATION EMPLOYEES ONLY 61267S

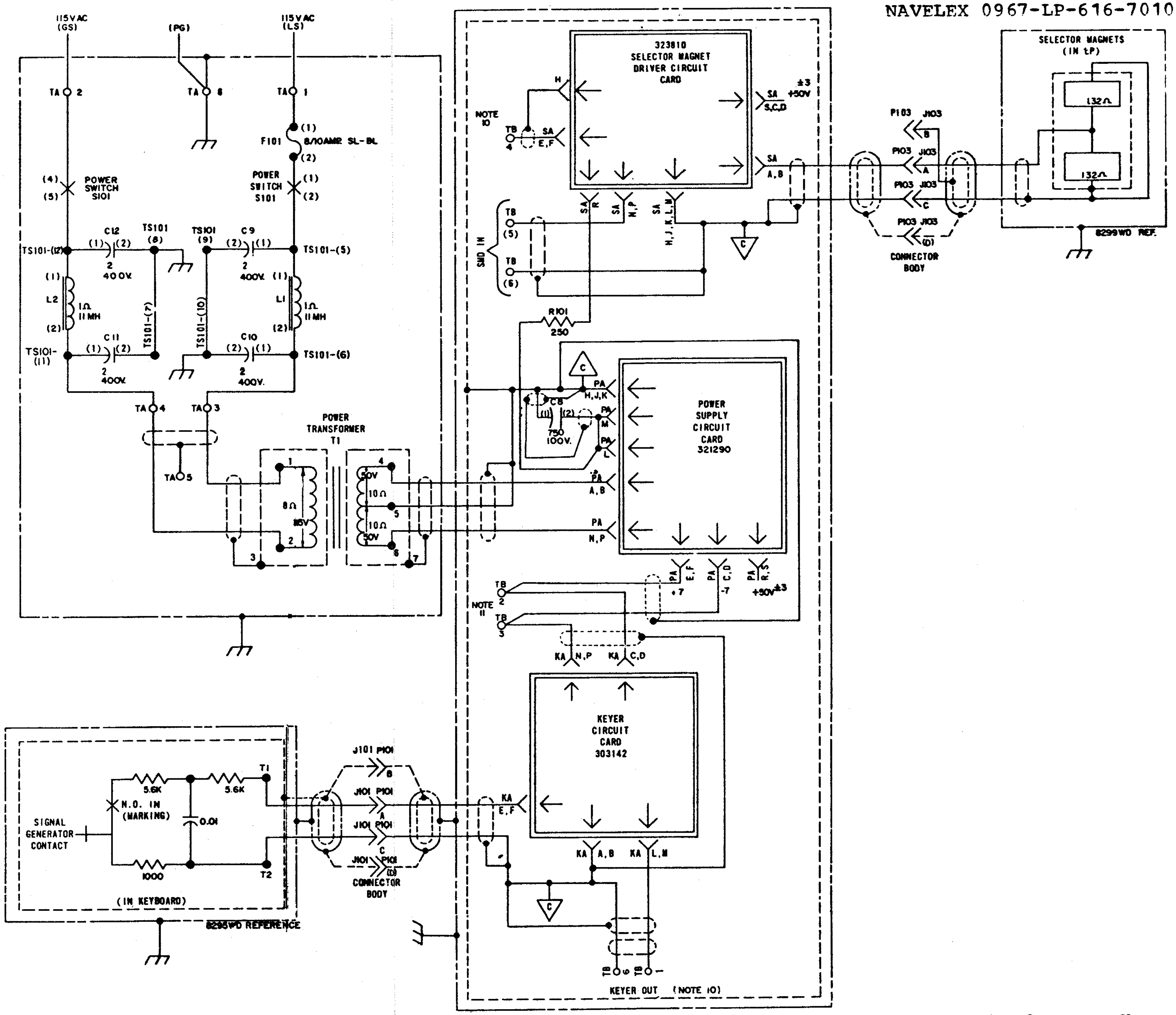


Figure 5-14. 323813 Electrical Service Assembly for One Keyer and One Driver, Schematic Diagram

NO.	NOTES
1	ALL RESISTORS 1/2 WATT, RESISTANCE VALUES IN OHMS, CAPACITANCE VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
2	INDICATES FEMALE TERMINAL INDICATES MALE TERMINAL
3.	INDICATES SINGLE SHIELDING INDICATES DOUBLE SHIELDING
4.	REFER TO 8132WD FOR ACTUAL WIRING DIAGRAM.
5.	SL-BL INDICATES SLOW-BLOWING.
6.	INDICATES CIRCUIT COMMON
7.	REFERENCE SPEC FOR TELETYPE CORPORATION EMPLOYEES ONLY 61267S
8.	TERMINAL DESIGNATIONS ENCLOSED IN PARENTHESIS ARE FOR REFERENCE AND ARE NOT MARKED ON COMPONENT.
9.	REFER TO RELATED SET SCHEMATIC FOR EXTERNAL CIRCUITS.
10.	8 OHMS (MAX.) PRIMARY RESISTANCE 10 OHMS (MAX.) SECONDARY RESISTANCE TO CENTER TAP.

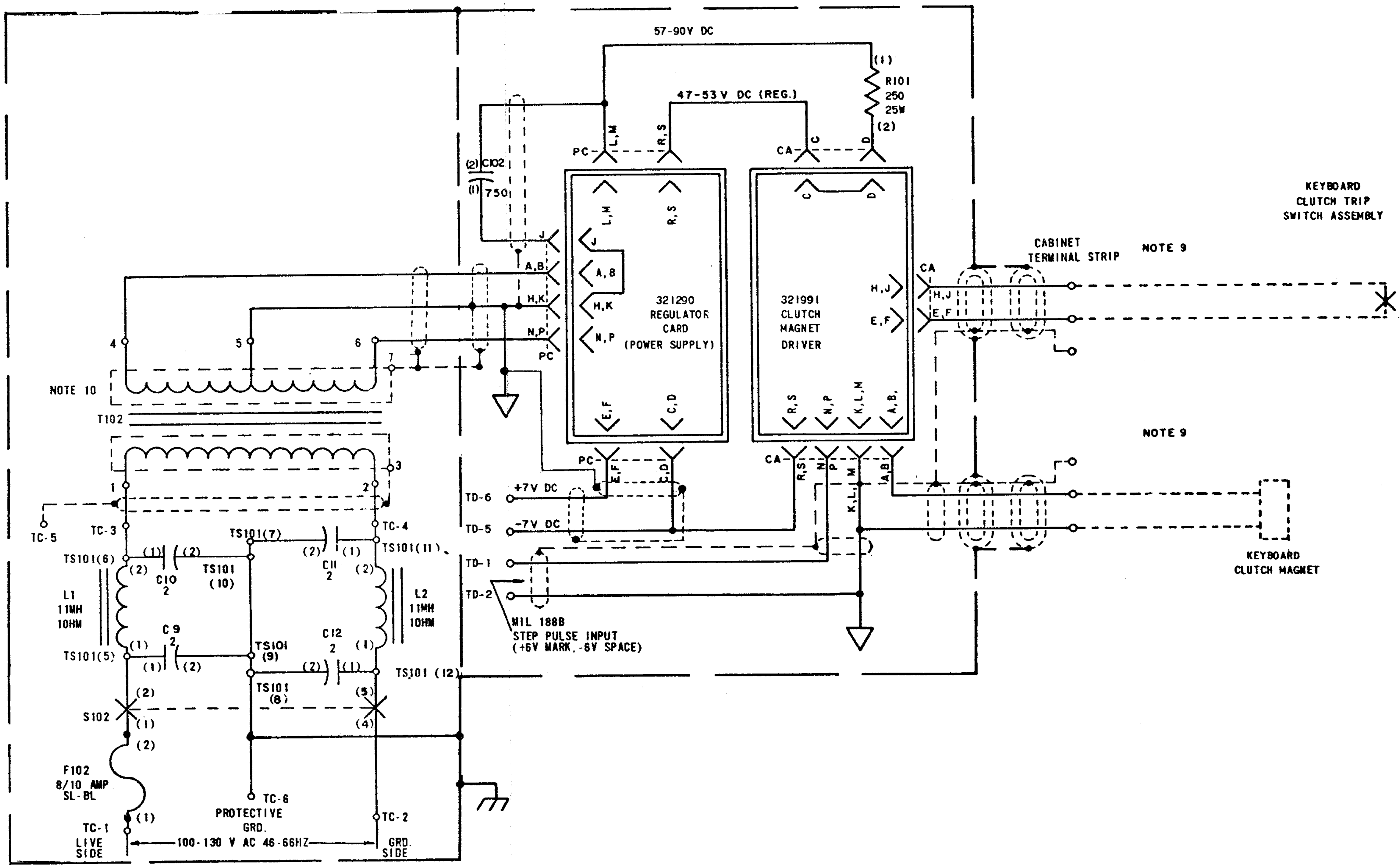


Figure 5-15. 321230 Electrical Service Assembly Schematic Diagram

NO.	NOTES
1.	ALL VOLTAGES DC UNLESS OTHERWISE SPECIFIED.
2.	TERMINAL DESIGNATIONS ENCLOSED IN PARENTHESIS ARE FOR REFERENCE AND ARE NOT MARKED ON COMPONENT.
3.	ALL SURFACE WIRE 24 AWG GREEN, 31784 RM, UNLESS OTHERWISE SPECIFIED. ALL STRAPPING WIRE 24 AWG BARE, 39603 RM. USE SLEEVING WHERE REQUIRED. (1) INDICATES 18 AWG STRANDED WIRE. (2) INDICATES 24 AWG STRANDED WIRE. (3) INDICATES 24 AWG 2 LEAD SINGLE SHIELDED CABLE. (4) INDICATES 24 AWG SINGLE SHIELDED WIRE.
4.	* INDICATES TO TAPE END TERMINATING POINT.
5.	INDICATES SINGLE SHIELDING. INDICATES DOUBLE SHIELDING.
6.	FUSE NUMBER: 162360 8/10 AMP SLOW BLOWING.
7.	ASSOCIATED CABLE ASSEMBLIES, 321246, 321248, 324154, 324136, 324137.
8.	TERMINALS 7 & 10 ARE GROUNDED THRU THE MOUNTING SCREW OF THE TERMINAL STRAPS.
9.	
10.	INNER SHIELD GROUND NUT ON CONNECTOR MOUNTING.
11.	COLOR CODE: BK-BLACK, R-RED, BL-BLUE, O-ORANGE, BR-BROWN, W-WHITE, S-SLATE, G-GREEN, Y-YELLOW, P-PURPLE
12.	ASSOCIATED WD 8296WD SCHEMATIC DIAGRAM.
	SEE SHEET 2 FOR OTHER NOTE

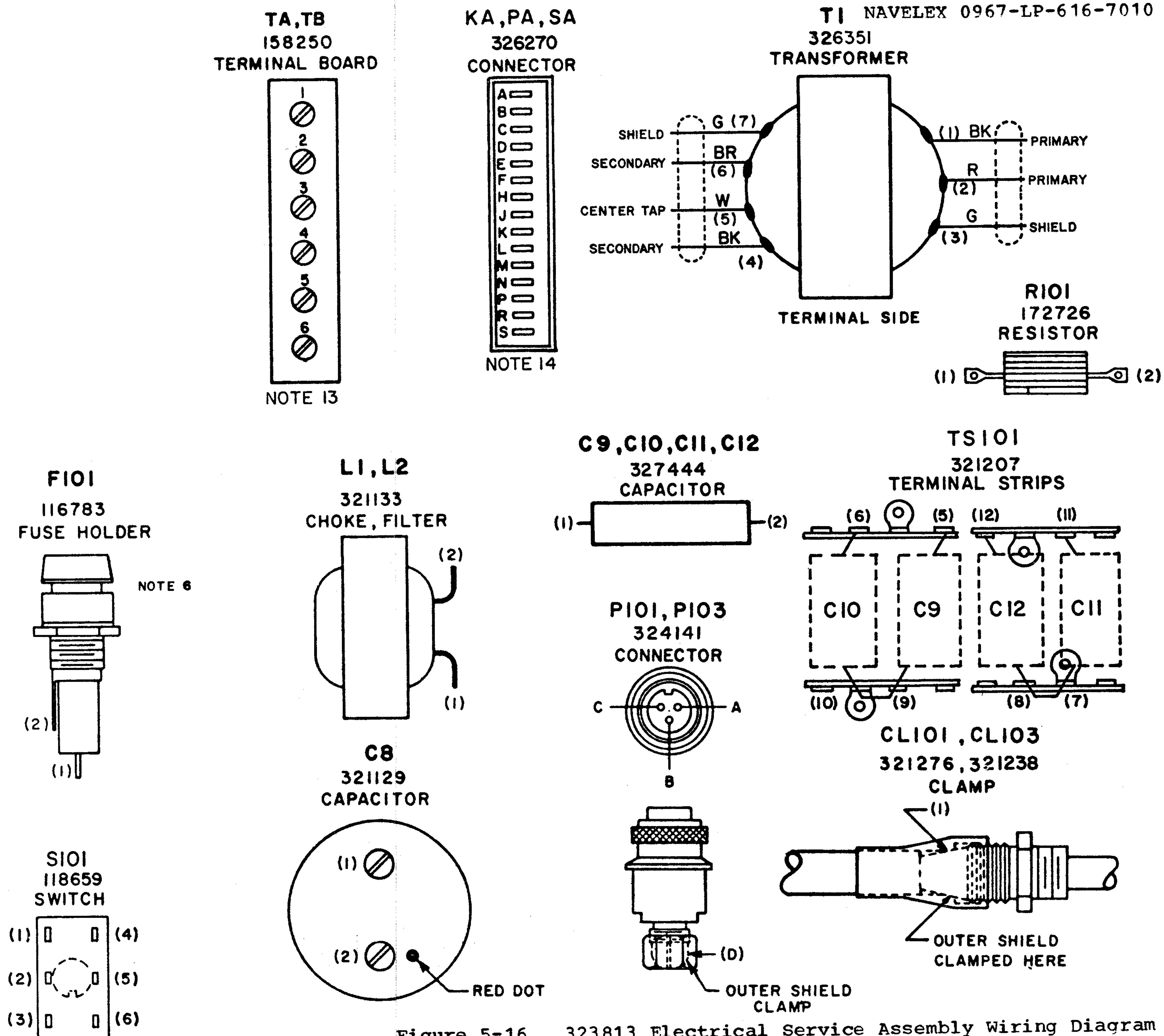


Figure 5-16. 323813 Electrical Service Assembly Wiring Diagram (Sheet 1 of 3)

NO.	NOTES
	REFER TO SHEET 1 FOR NOTES 1 TO 12
13.	"TA" BOARD IS MOUNTED WITH #6 CLOSEST TO FUSE. "TB" BOARD HAS #6 CLOSEST TO FILTER CHOKES.
14.	CONNECTOR SHOULD BE MOUNTED WITH "S" AT CAPACITOR MOUNTING SIDE. PA SHOULD BE MOUNTED CLOSE TO TRANSFORMER AND KA SHOULD BE MOUNTED IN THE CENTER. POLARIZING KEYS SHOULD BE INSERTED BETWEEN E AND F OF SA, BETWEEN J AND K OF KA AND BETEEN M AND N OF PA.
15.	WHEN IT IS DESIRED TO USE EXTERNAL BATTERY, REMOVE TAPE AND TIE THESE LEADS CONNECT + BATTERY (6.6 TO 7.8V) TO TERMINAL TB2 AND -BATTERY (6.6 TO 7.8V) TO TERMINAL TB3. CONNECT COMMON OF SUPPLY TO TB6 IF ± 6V IS SUPPLIED OUTPUT OF KEYER WILL DROP TO ± 4.5V.

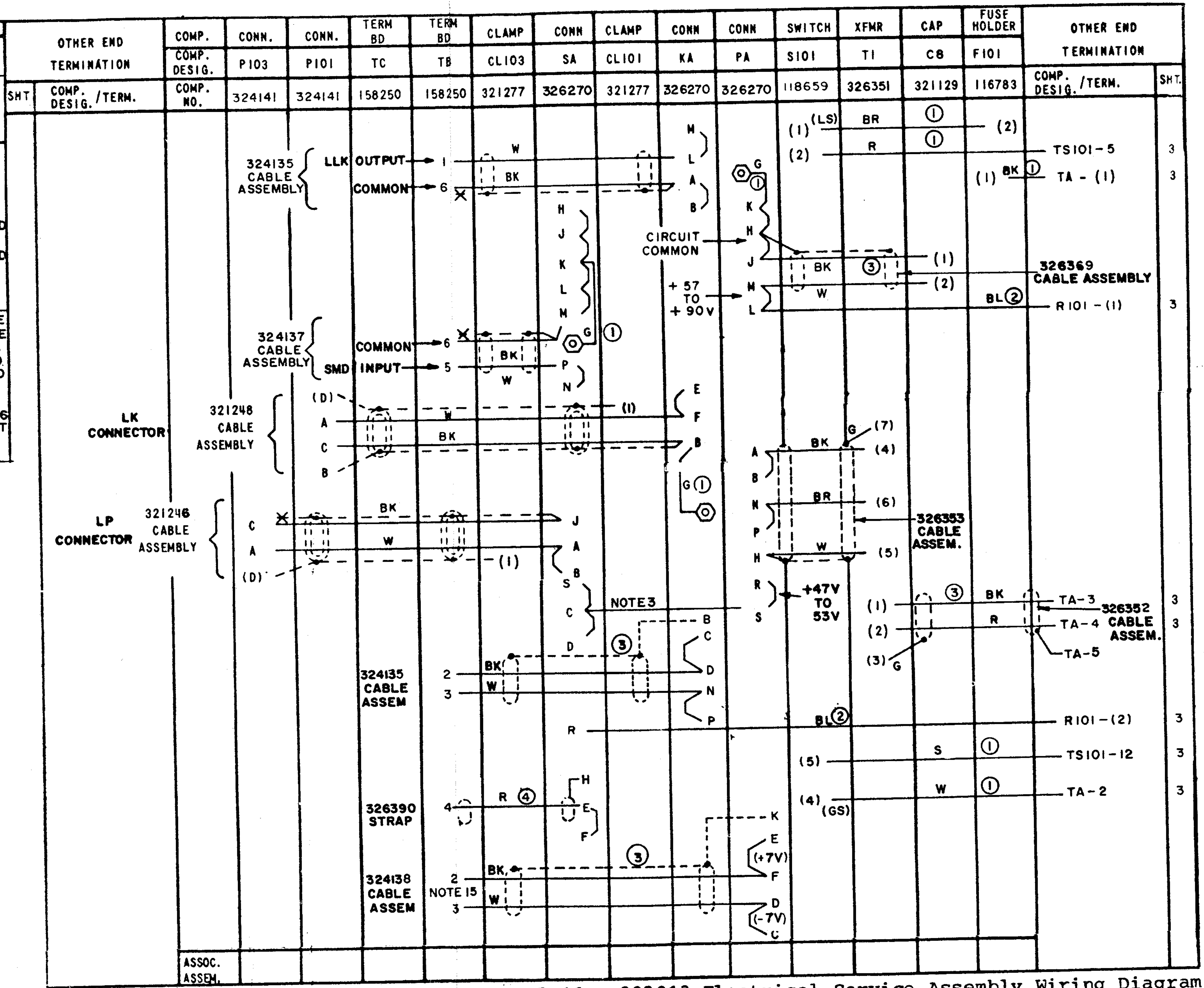


Figure 5-16. 323813 Electrical Service Assembly Wiring Diagram (Sheet 2 of 3)

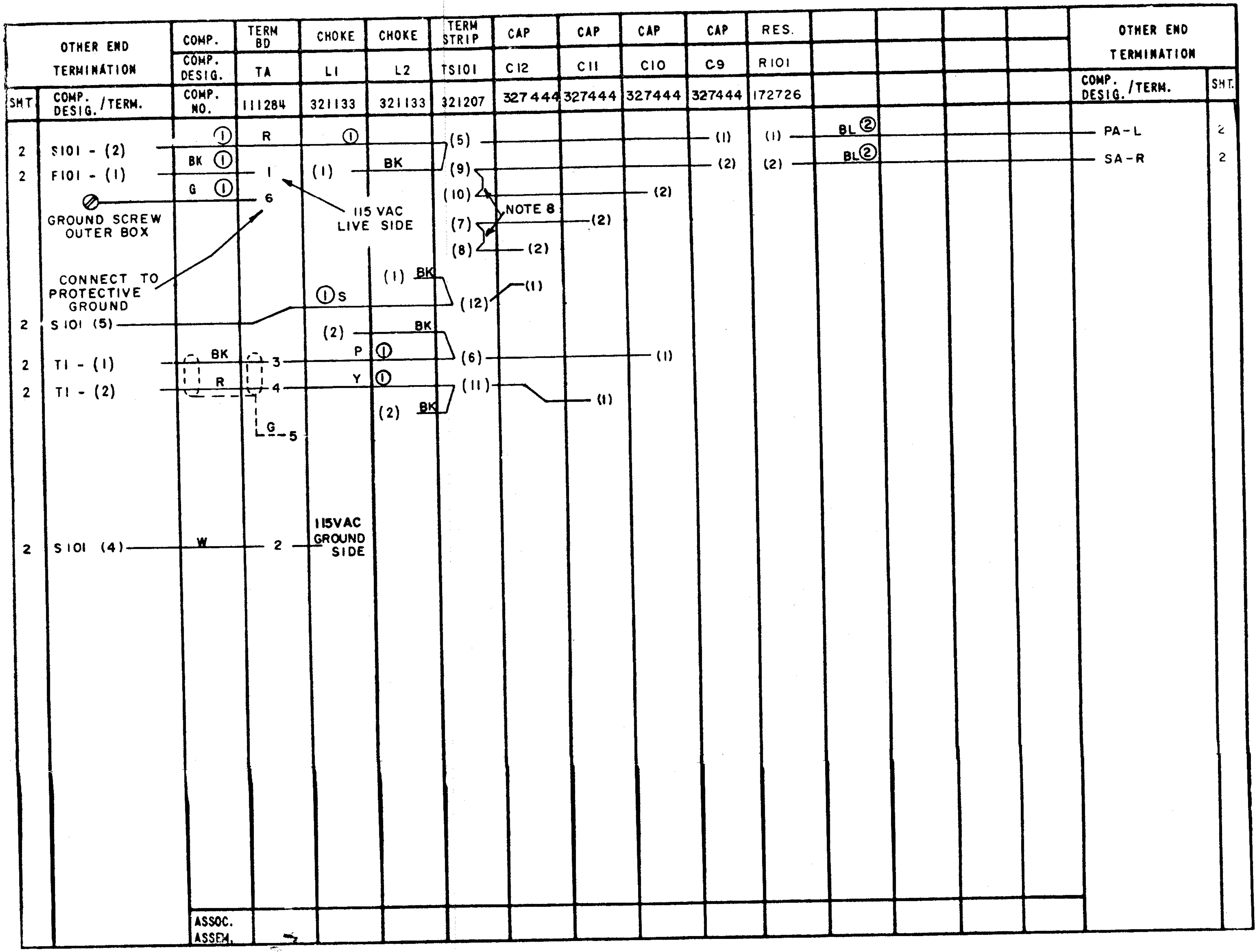


Figure 5-16. 323813 Electrical Service Assembly Wiring Diagram (Sheet 3 of 3)

NO.	NOTES
1	CONNECTOR VIEWED FROM SOLDER TERMINAL END.
2	SELECTOR MAGNETS ARE WIRED FOR .060 AMPERE OPERATION OR USE WITH 323810 SELECTOR MAGNET DRIVER.
3	COLOR CODE R- RED W- WHITE BK- BLACK
4	REFERENCE SPEC. FOR TELETYPE CORPORATION EMPLOYEES ONLY 61213S
5.	LEGEND: DR-DRAIN CL-CLEAR INSULATION
6.	REFER TO APPROPRIATE SET SCHEMATIC WIRING DIAGRAM FOR J CONNECTOR NUMBER.

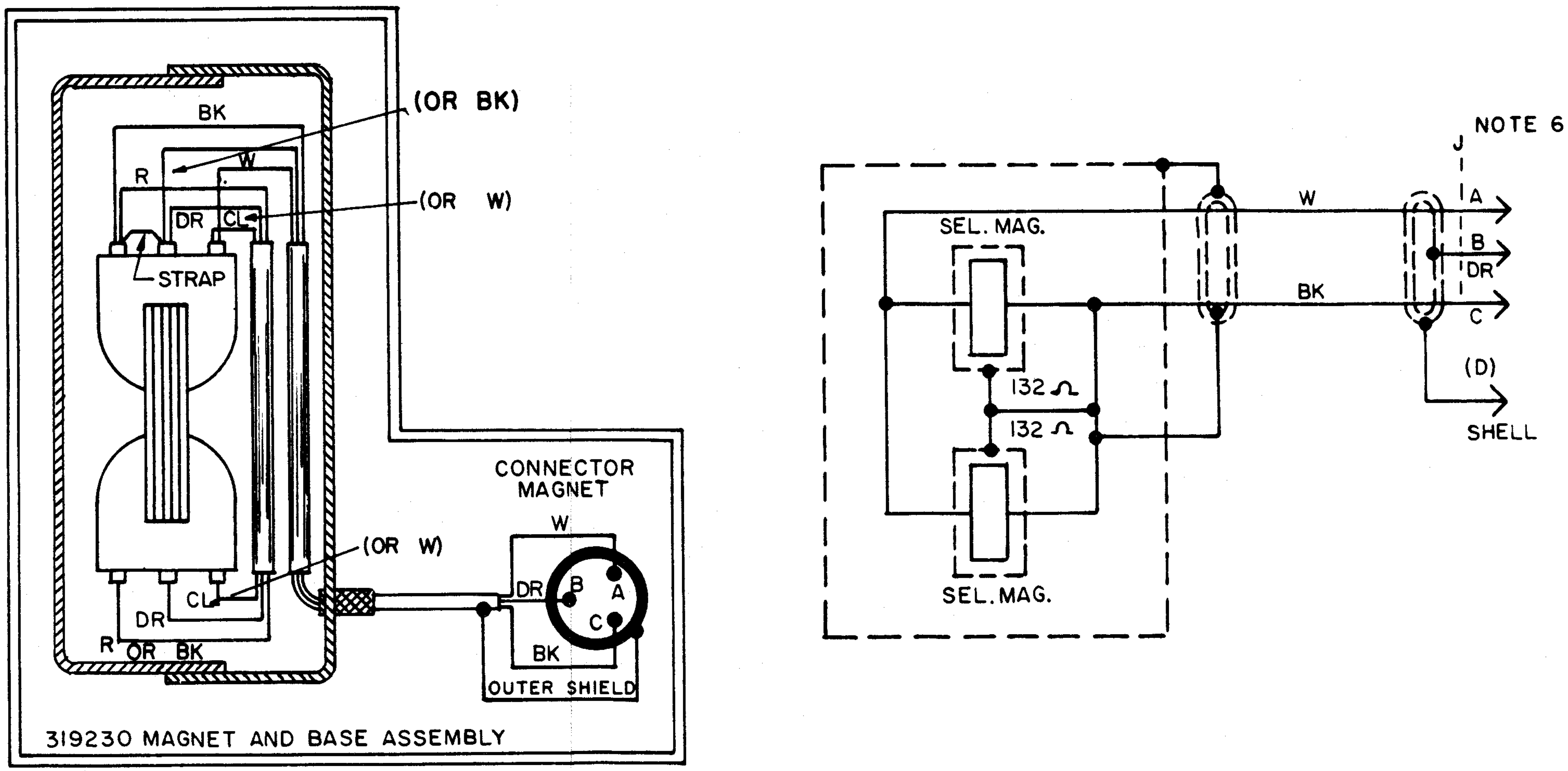


Figure 5-17. 319204 Selector Assembly Schematic Diagram and Wiring Diagram

NO.	NOTES
1.	WIRING LEGEND: DISTANT TERMINATING AREA; DISTANT TERMINAL DESIGNATION; A-1-W-BL; WIRE COLOR CODE
2.	COLOR CODE: BK - BLACK, BL - BLUE, BR - BROWN, R - RED, P - PURPLE, G - GREEN, Y - YELLOW, W - WHITE, S - SLATE, O - ORANGE
3.	UNIT WIRED FOR 115V AC INPUT.
4.	CONNECTORS VIEWED FROM SOLDER TERMINAL ENDS.
5.	NUMBERS IN PARENTHESIS ARE FOR REFERENCE AND ARE NOT NECESSARILY SHOWN ON COMPONENTS.
6.	WHEN SOLDERING CABLE TO INDICATOR LIGHTS, BEND TERMINALS OUTWARD 90°
7.	THESE SPARES ARE PART OF THE 161878 CABLE AND ARE TIED BACK AT THE F CONNECTOR.
8.	GROUND STRAP TO LEFT FRONT MTG. STUD ON BASE.
9.	
10.	UNITS INCLUDE MATING 16 PT. CONNECTOR FOR CUSTOMERS USE. CIRCUIT REFERENCES SHOWN BELOW. FOR CIRCUITRY, REFER TO SET SCHEMATIC. MATING CONNECTOR 159541: STRAP (9)–(1); FOR SIGNAL BELL (10); POWER INPUT (2); POWER INPUT UNGROUNDED (11); GROUND (3); CUSTOMER USE (12), (4); MOTOR CONT. RELAY (13), (5); CUSTOMER USE (14), (6); SIGNAL LINE LTRK10 (15); SIGNAL LINE LTRK10 (7); SIGNAL LINE (16); SIGNAL LINE (8). TERMINAL NO. 3 TO BE CONNECTED TO A GROUND SCREW ON THE BASE.
11.	WIRING ON UNITS WITHOUT "V" FUSE HOLDER.
12.	WIRING ON UNITS WITH "V" FUSE HOLDER.
13.	FOR LTRK-1 WITH 179615 MOD.KIT. SEE 7220WD.
14.	FOR ASSOCIATED SCHEMATICS REFER TO: 3575WD LTRK1; 4147WD LTRK2; 7221WD LTRK1 WITH 179615 MOD.KIT.; 8442WD LTRK10
15.	REFERENCE SPEC. FOR TELETYPE CORP. EMPLOYEES ONLY: 6759S.
16.	TOGGLE STRAP PRESENT ON LTRK10 ONLY.
17.	ARC SUPPRESSOR NOT PRESENT ON LTRK10.
18.	WIRE LTRK10 AS FOLLOWS: (1) REMOVE METAL STRAP BETWEEN B4 AND B5. (2) CONNECT W-R SPARE IN CONNECTOR F TO F7. CONNECT BL SPARE IN CONNECTOR F TO F15
19.	IF LTRK10 SIGNAL GENERATOR IS USED IN STANDARD 20 OR 60 MA DC LINE, IT SHOULD NOT BE TRANSFERRED TO LOW VOLTAGE SERVICE WITHOUT REPLACING SIGNAL GENERATING CONTACTS.
20.	160307 WAS REPLACED FOR STANDARDIZATION.

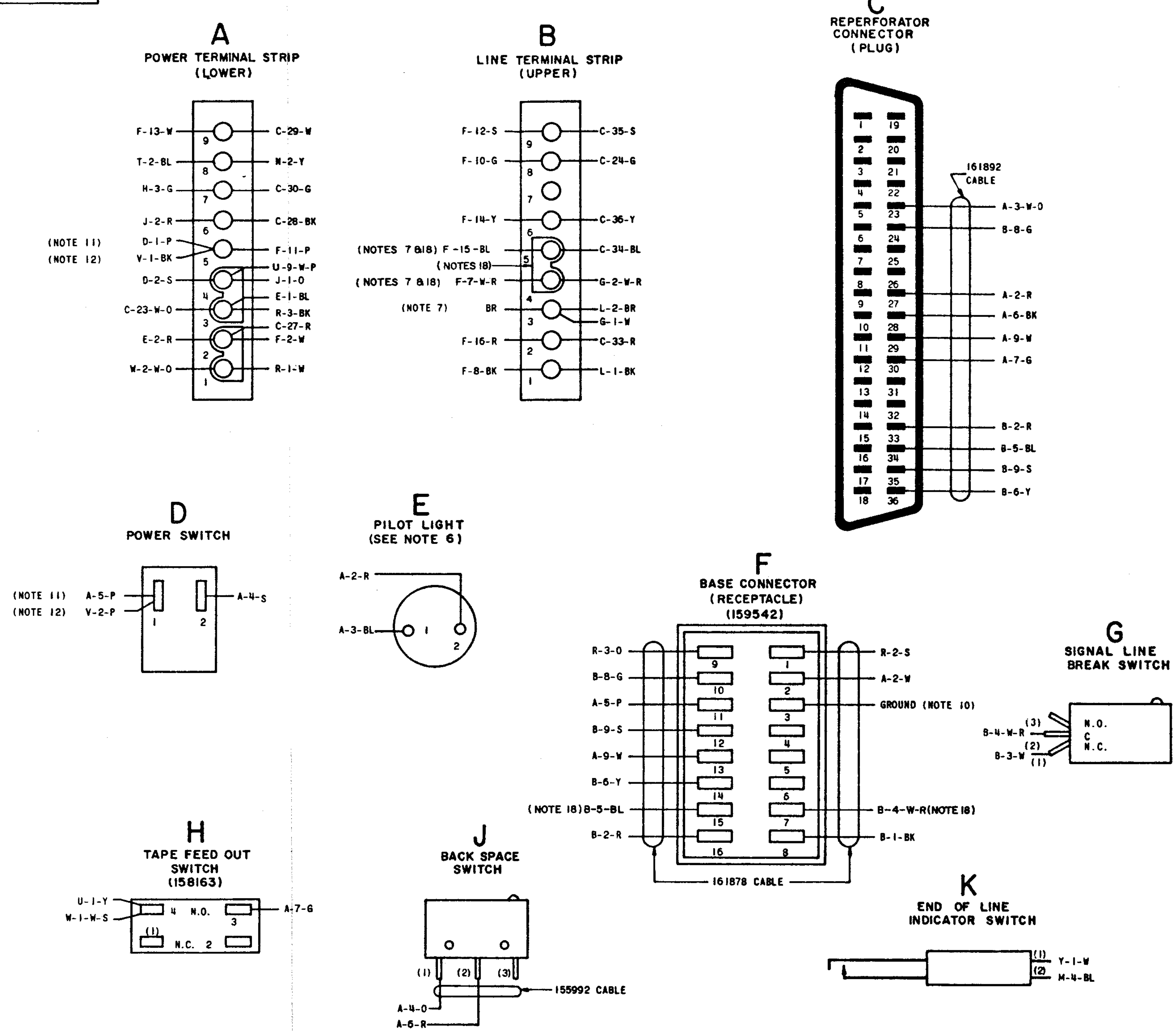


Figure 5-18. Send-Receive Typing Reperforator Keyboard Used with 323802 Modification Kit, Wiring Diagram (Sheet 1 of 2)

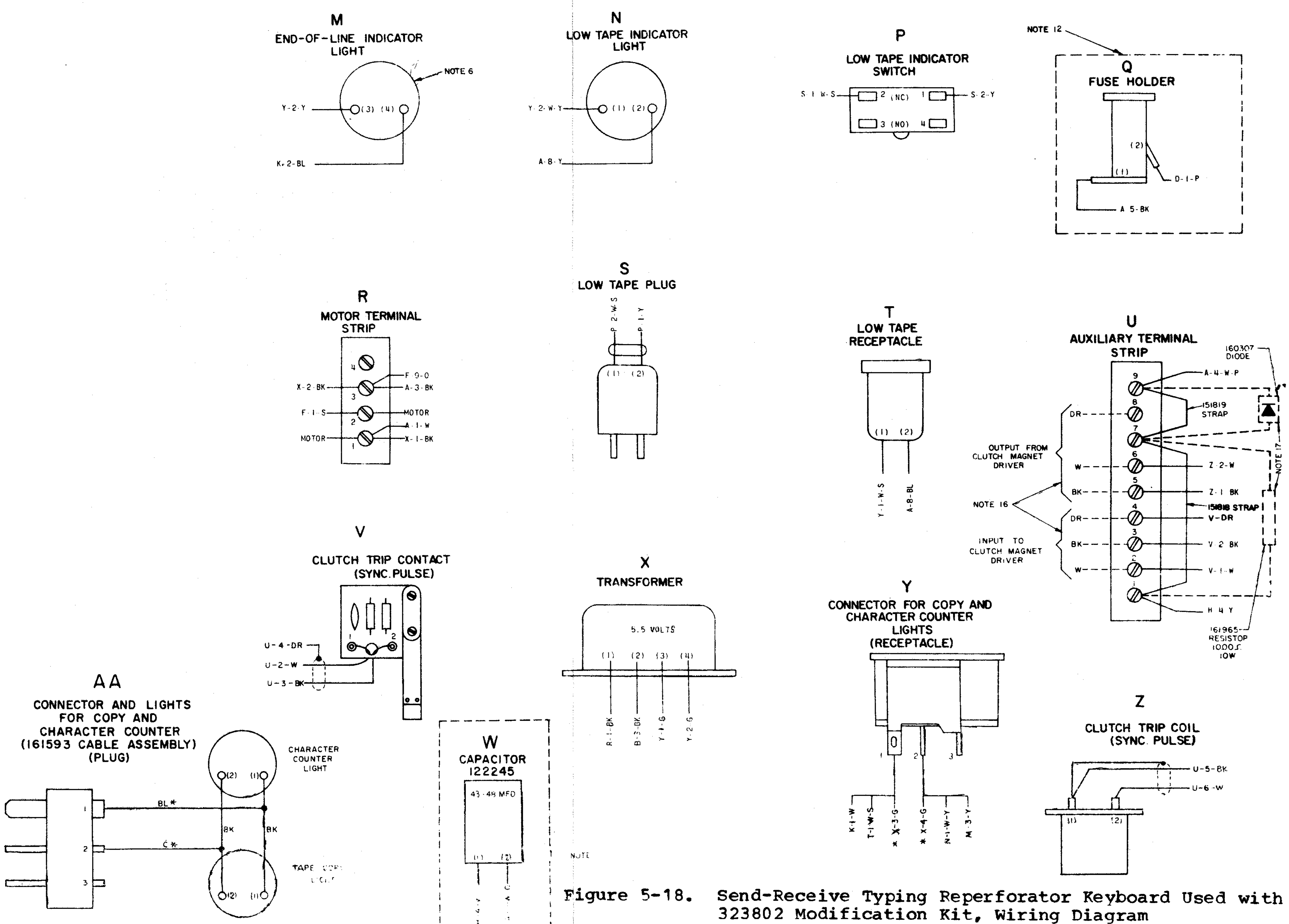


Figure 5-18. Send-Receive Typing Reperforator Keyboard Used with 323802 Modification Kit, Wiring Diagram (Sheet 2 of 2)

NO	NOTES
1	WIRING LEGEND. —DISTANT TERMINATING AREA —DISTANT TERMINATING DESIGANTION F-4-W-BL —WIRE COLOR CODE
2.	COLOR CODE BK - BLACK, BR - BROWN, R - RED, O - ORANGE, W - WHITE, G - GREEN, BL - BLUE, P - PURPLE, S - SLATE, Y - YELLOW
3.	TERMINAL DESIGNATIONS ENCLOSED IN PARENTHESES ARE FOR REFERENCE AND ARE NOT MARKED ON COMPONENTS.
4.	TERMINALS ON CONNECTOR SHOWN AS VIEWED FROM SOLDER END
5.	NORMALLY OPEN (NO) AND NORMALLY CLOSED (NC) CONTACTS ARE SHOWN WHEN THE REPERFORATOR IS IN THE STOP (IDLE) POSITION.
6.	GENERAL NOTE: WIRING OF INDIVIDUAL COMPONENTS IS DETERMINED BY REFERRING TO THE CABLE ASSEMBLIES SPECIFIED ON THE UNIT B/M.
7.	
8.	FOR WIRING OF BACKSPACE MAGNET ON LAK KEYBOARD MOUNTED PERFORATORS REFER TO ASSOCIATED LAK WIRING DIAGRAM.
9	ASSOCIATED SCHEMATIC DIAGRAMS 8443WD.

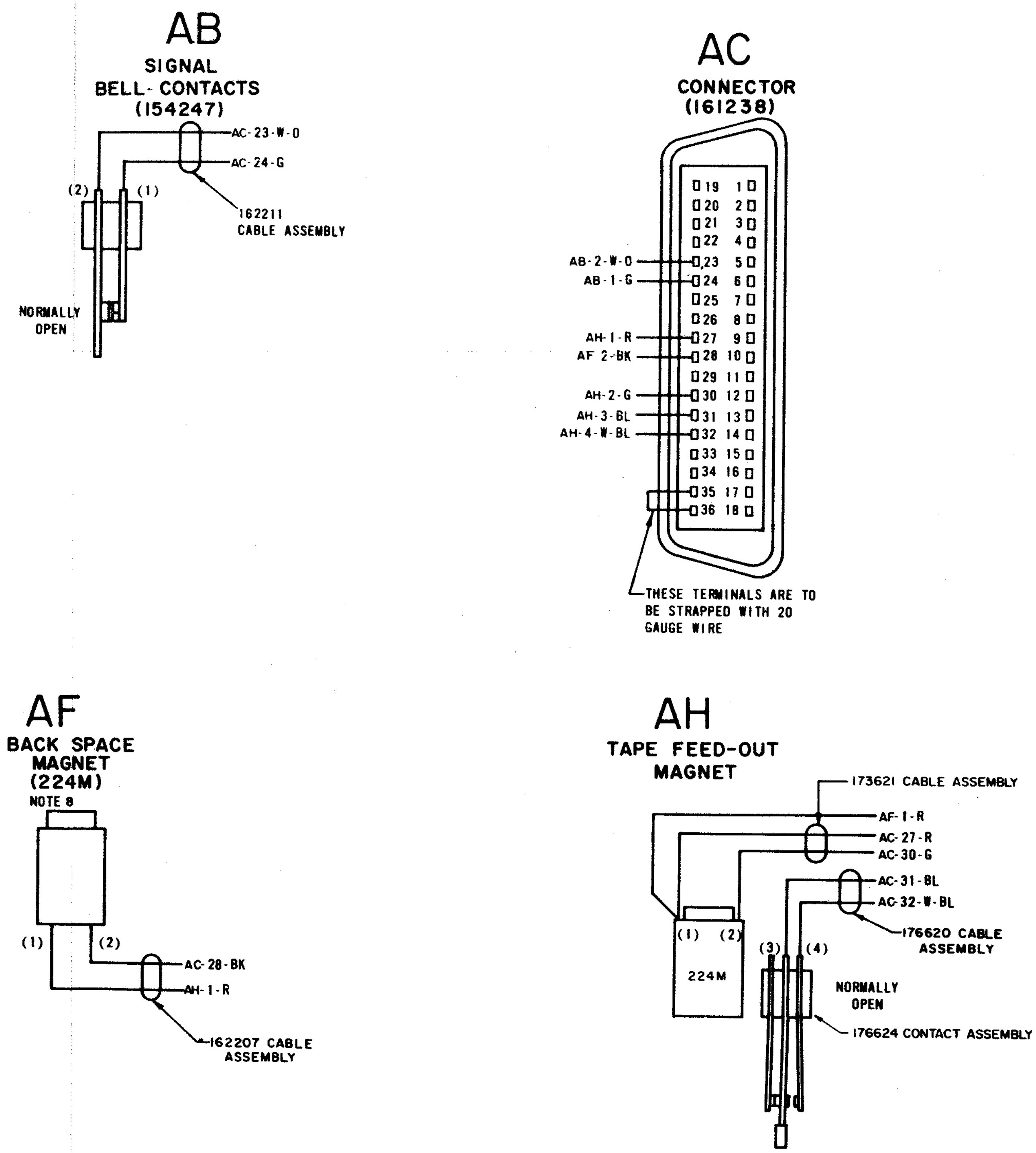


Figure 5-19. LPR Used with Modification Kit 323802 for Low-Level Operation, Wiring Diagram

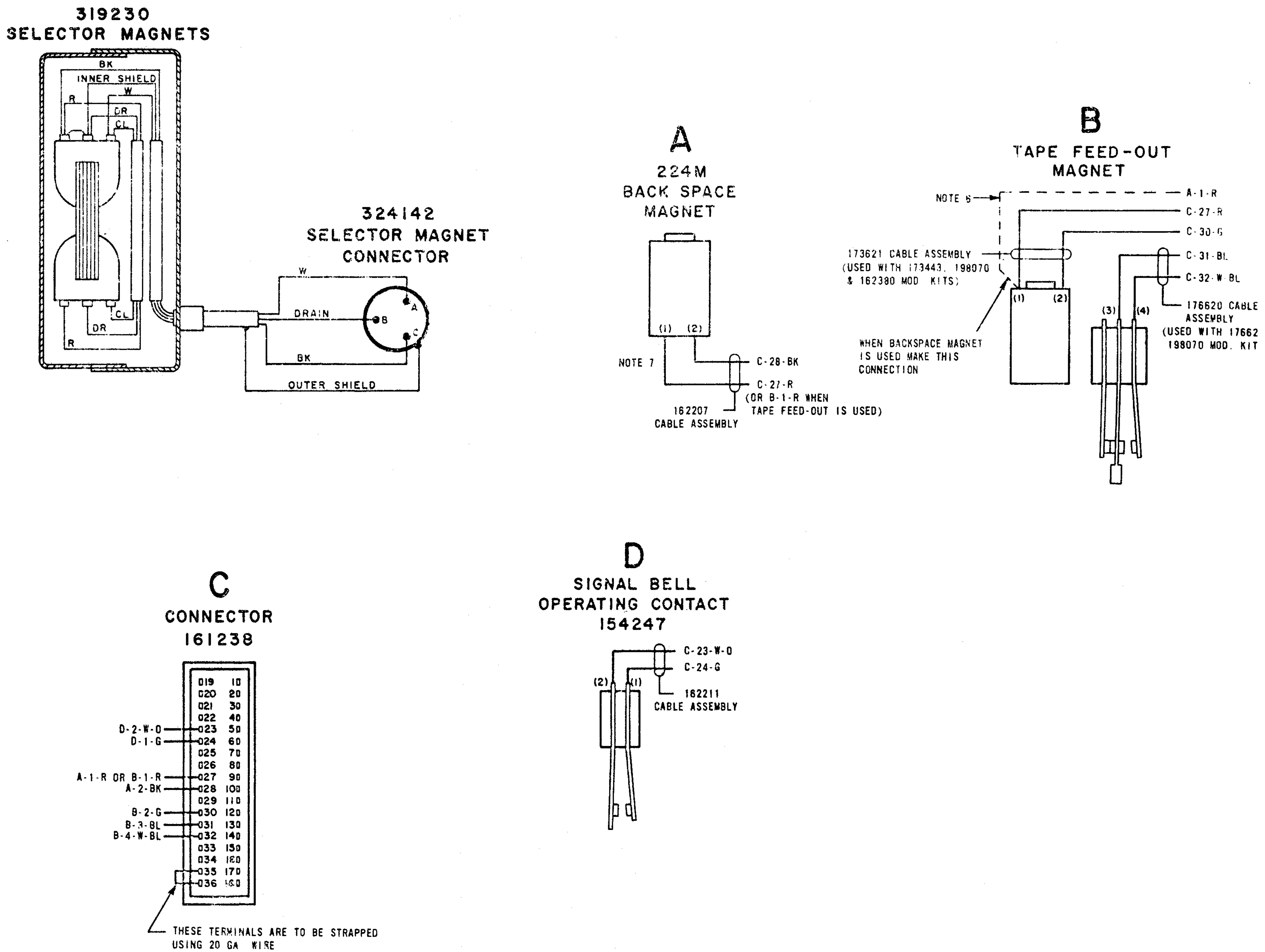


Figure 5-20. **LPR and LRPE Typing and Non-Typing Reperforator with Selector Assembly, Wiring Diagram**

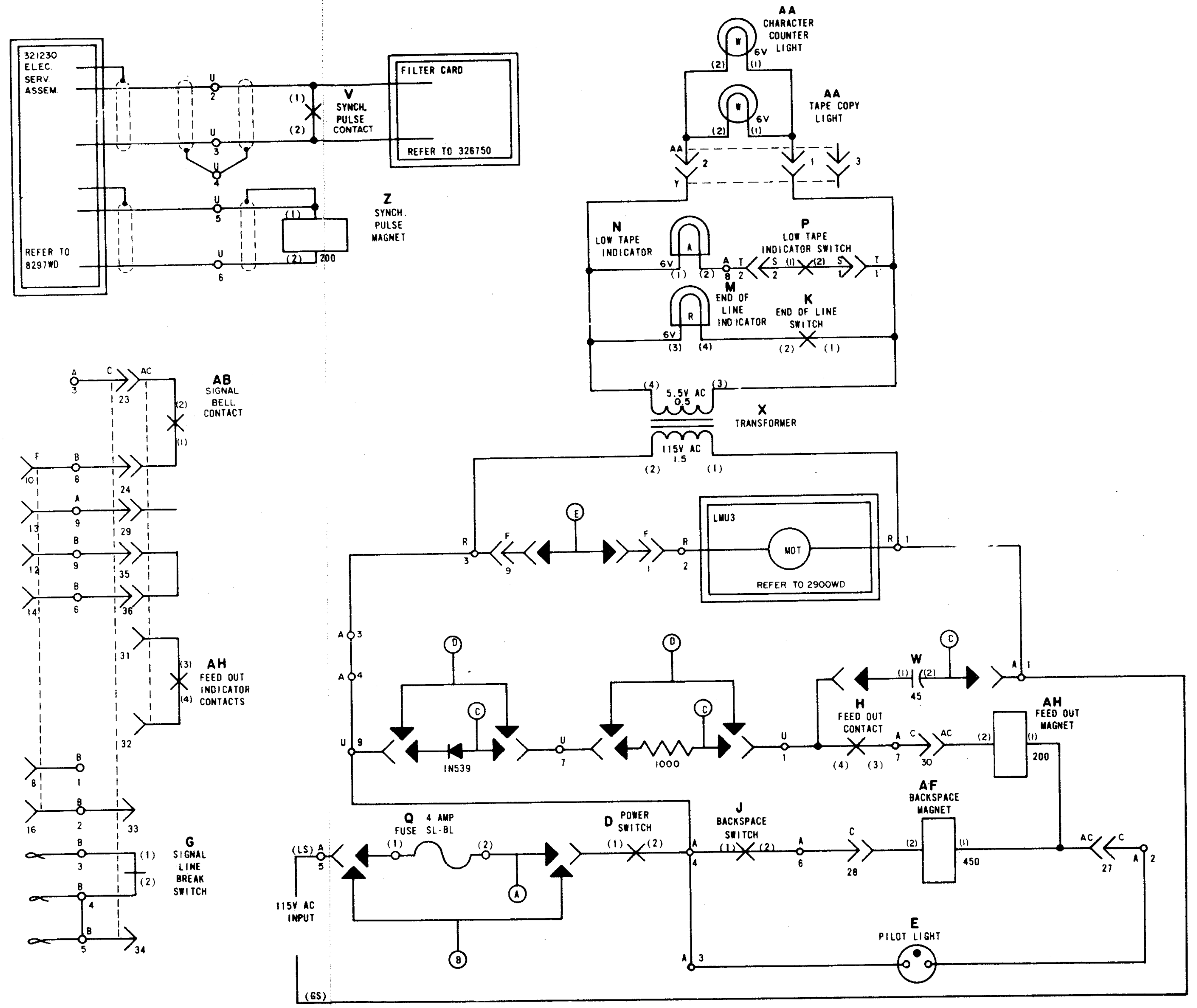


Figure 5-21. Send-Receive Typing Reperforator Set when Used with 323802 Modification Kit Schematic Diagram

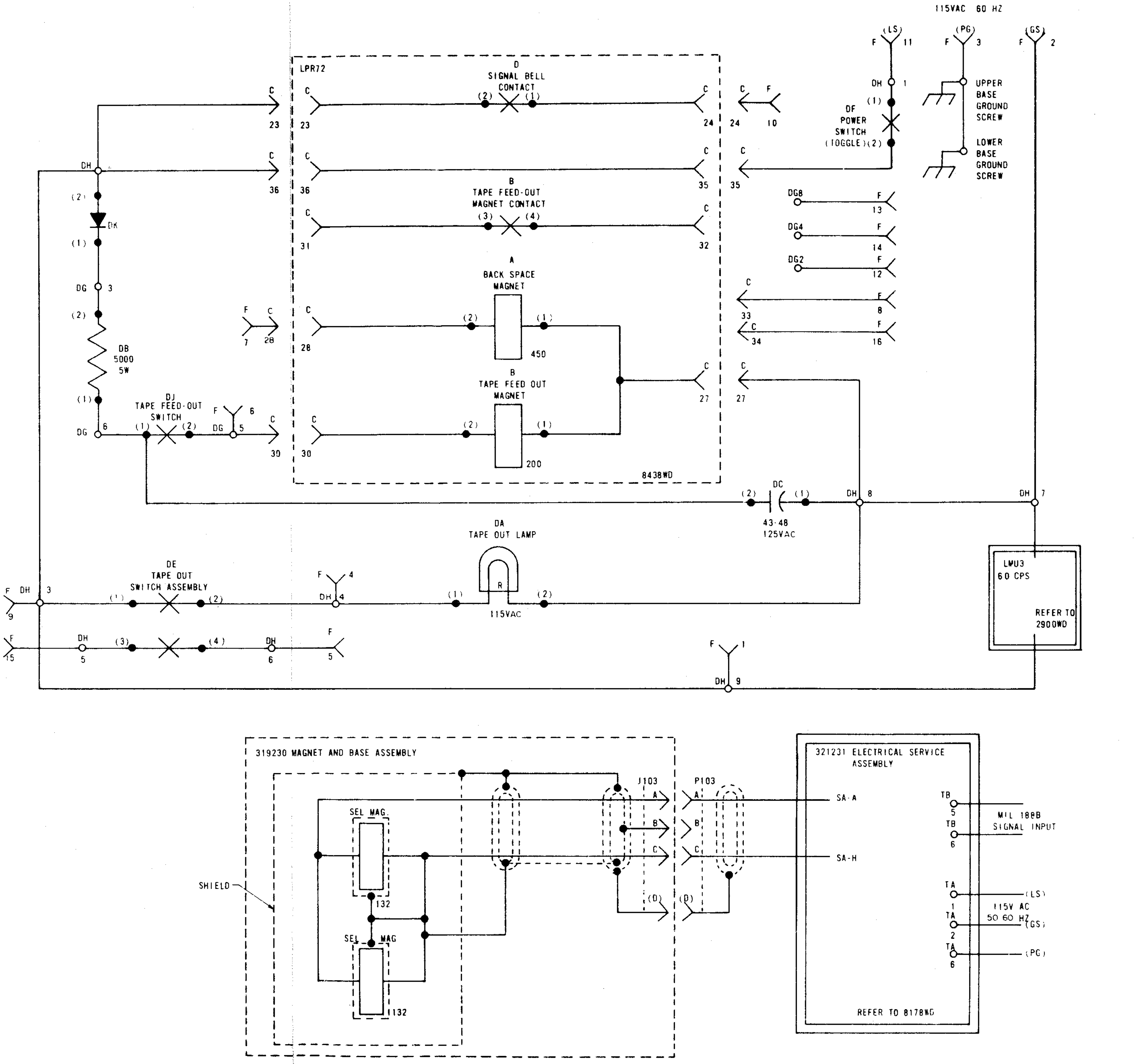
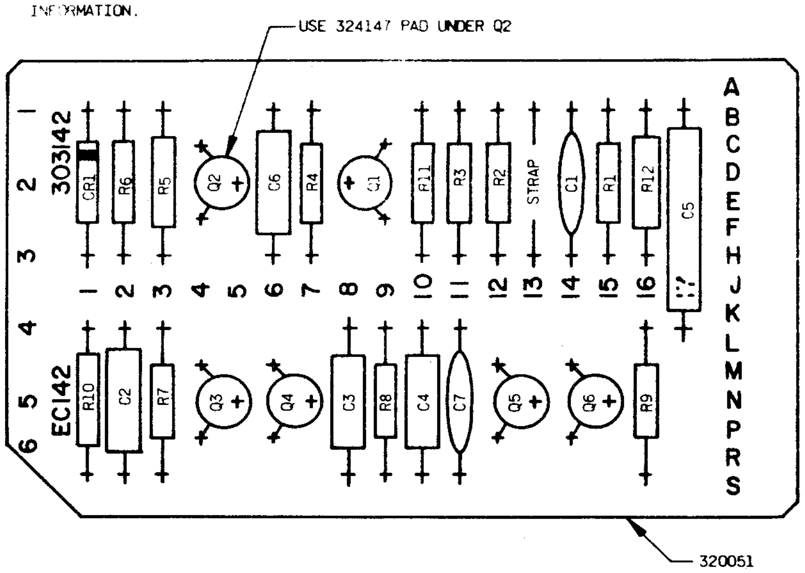


Figure 5-22. Receive-Only Typing Reperforator Set with Low-Level RFI Components Schematic Diagram

REF DESIG.	FAR. NO REQ	QTY	DESCRIPTION	FUNCTION
R1	118720	2	RESISTOR 100K 5% 1/2W	RC FILTER
R2	118178	1	RESISTOR 220K 5% 1/2W	Q1 BASE BIAS
R3			RESISTOR SAME AS R1	Q1 EMITTER BIAS
R4	129854	2	RESISTOR 10K 5% 1/2W	Q1 COLLECTOR BIAS
R5	321204	2	RESISTOR 13K 1% 1/2W	Q2 COLLECTOR BIAS
R6			RESISTOR SAME AS R5	RC BIAS EQUALIZER
R7	118147	2	RESISTOR 6.8K 5% 1/2W	Q3,4 BASE BIAS
R8			RESISTOR SAME AS R4	Q5,6 BASE BIAS
R9	137438	1	RESISTOR 100 Ω 5% 1/2W	RC FILTER
R10			RESISTOR SAME AS R7	Q3,4 BASE BIAS
R11	118146	2	RESISTOR 4.7K 5% 1/2W	Q1 EMITTER BIAS
R12			RESISTOR SAME AS R11	OUTPUT LOAD
CR1	181619	1	DIODE 1N482	R6 SHUNT SWITCH
C1	321157	2	CAPACITOR 500 PFD	INPUT FILTER
C2	320048	1	CAPACITOR .5 MFD.	ACTIVE FILTER FEEDBACK
C3	320049	2	CAPACITOR .15 MFD.	ACTIVE FILTER INTEGRATOR
C4			CAPACITOR SAME AS C3	RC FILTER INTEGRATOR
C5	320047	1	CAPACITOR 2 MFD	RC FILTER INTEGRATOR
Q1	315930	3	TRANSISTOR, 2N3568	1st AMPLIFIER
Q2	324144	1	TRANSISTOR 2N4121	2nd AMPLIFIER
Q3	315931	2	TRANSISTOR 2N3638	ACTIVE COMPLIMENTARY FILTER
Q4			TRANSISTOR SAME AS Q1	ACTIVE COMPLIMENTARY FILTER
Q5			TRANSISTOR SAME AS Q3	COMPLIMENTARY SYMMETRY EMITTER
Q6			TRANSISTOR SAME AS Q1	FOLLOWER AMPLIFIER
C6	181618	1	CAPACITOR .01MFD	RC FILTER
C7			CAPACITOR SAME AS C1	RF BY PASS
EC	320051	1	BOARD, ETCHED CIRCUIT	
		1	STRAP, BARE 24 AWG.	
	324147	1	PAD, TRANSISTOR	
	144495	5	PAD, TRANSISTOR	

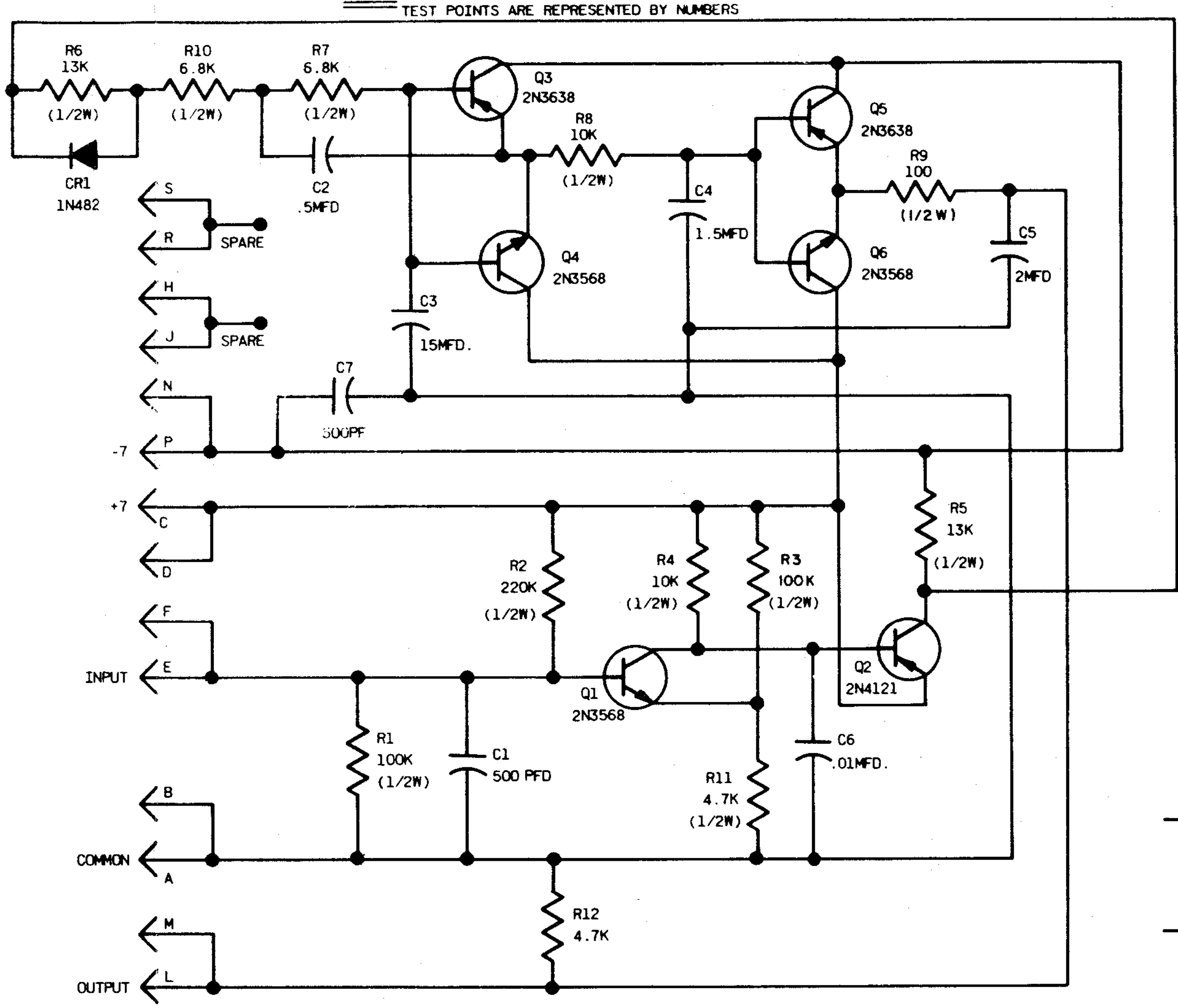
NOTE: MANUFACTURE PER MR200L
REFER TO 5016WD FOR MARKING INFORMATION.

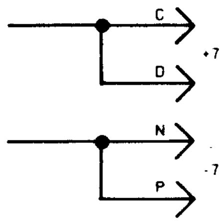


NAVELEX 0967-LP-616-7010

POLAR LINE KEYER ± 6V

NOTE: CARD CONNECTIONS ARE REPRESENTED BY LETTERS
TEST POINTS ARE REPRESENTED BY NUMBERS





ALPHA NUMERIC CONVERSION CHART		
STAMPING ON CIRCUIT BOARD	NUMERICAL CONVERSION FOR 15 PT. CARDS WHEN USED WITH 36 PT. CONNECTOR	
	WHEN INSERTED IN UPPER HALF OF CONNECTOR	WHEN INSERTED IN LOWER HALF OF CONNECTOR
A	1	22
B	2	23
C	3	24
D	4	25
E	5	26
F	6	27
H	7	28
J	8	29
K	9	30
L	10	31
M	11	32
N	12	33
P	13	34
R	14	35
S	15	36

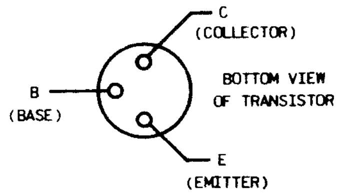


Figure 5-23. 303142 Polar Line Keyer ±6V Schematic Diagram

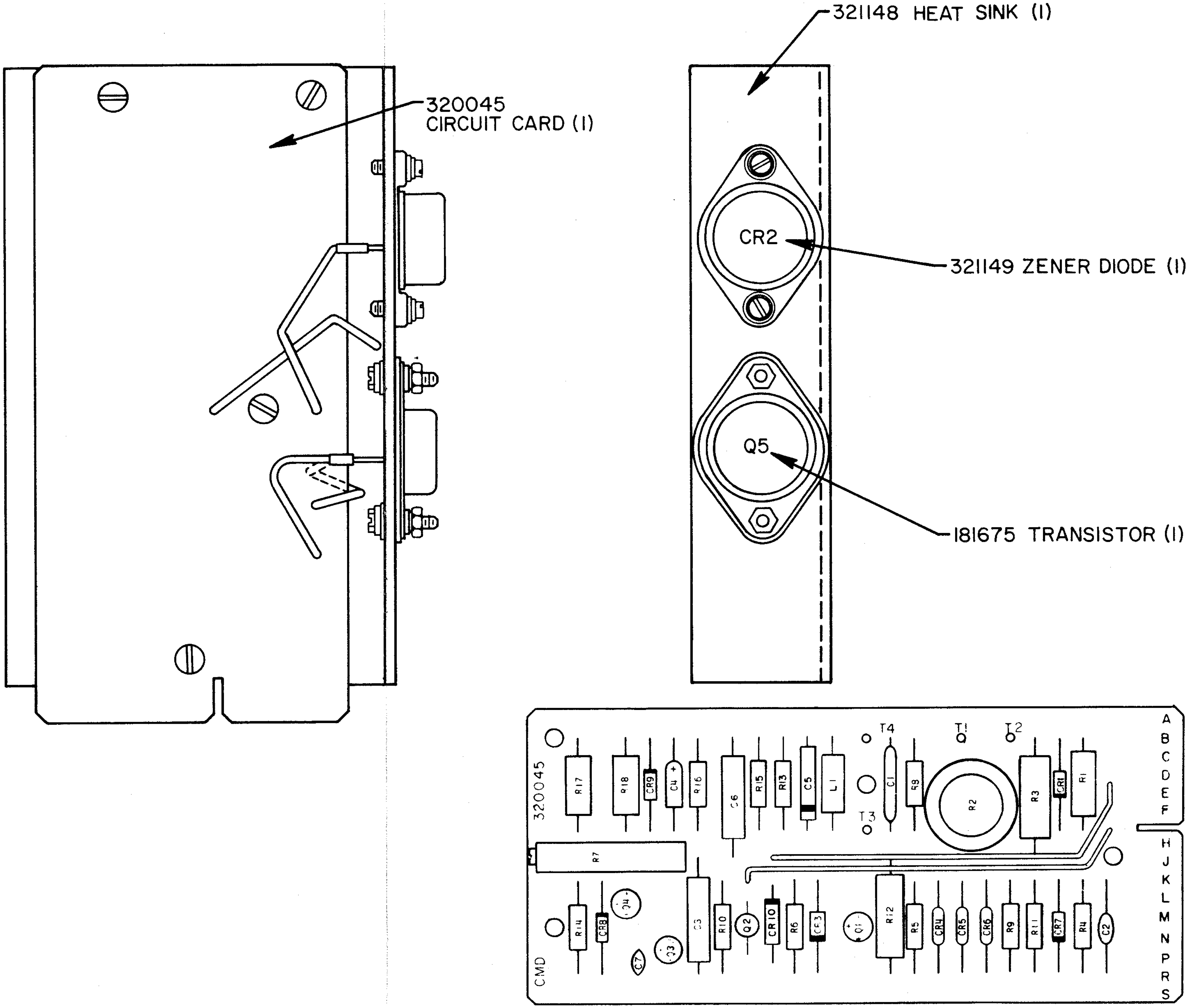


Figure 5-24. 321991 Circuit Card (CMD) Schematic Diagram (Sheet 1 of 2)

USED ON 321991

NO B/M

ASSEMBLY, CIRUIT CARD (CMD)				
REF. DESIG.	TELETYPE PART NO.	TOTAL QTY.	NAME AND DESCRIPTION	LOCATING FUNCTION
R1	327793	1	RESISTOR, 18 OHM 3 W. ±1%	REG CURRENT LIMITER
R2	182773	1	POTENTIOMETER, 3 OHM, 2.5W	REG CURRENT ADJ.
R3	321155	1	RESISTOR, 2K, 2W, 5%	CR1 CURRENT LIMITER
R4	118720	1	RESISTOR, 100K, 1/2 W, 5%	Q1 OPEN LINE BIAS
R5	118720	1	RESISTOR, 100K, 1/2W, 5%	INPUT RESISTOR
R6	129854	1	RESISTOR, 10K, 1/2W	Q1 BIAS
R7	321160	1	POTENTIOMETER, 5M	Q1 BIAS
R8	118146	1	RESISTOR, 4.7K, 1/2W, 5%	Q [illegible]MITTER RES
R9	129850	1	RESISTOR, 680 OHM, 1/2W, 5%	VOLTAGE DIVIDER
R10	321258	1	RESISTOR, 20K, 1/2W, 5%	[illegible] LOAD RES
R11	137604	1	RESISTOR, 620 OHM, 1/2W, 5%	VOLTAGE DIVIDER
R12	321292	1	RESISTOR, 1.3K, 2W, 5%	CR7 CURRENT LIMITE
R13	139143	1	RESISTOR, 43K, 1/2W, 5%	Q2 LOAD RES.
R14	321259	1	RESISTOR, 15 OHM, 1/2W, 5%	Q3 EMITTER RES
R15	165178	1	RESISTOR, 3.6K, 1 W, 5%	Q3 LOAD RES
R16	137442	1	RESISTOR, 1.5K, 1/2W, 5%	C4 BLEEDER RES
R17	321151	1	RESISTOR, 110 OHM, 3W, 1%	COIL CURRENT LIMITER
R18	321258	1	RESISTOR, 20K, 1/2W, 5%	CR8 BIAS RES.
C1	321158	1	CAPACITOR, .1 MFD.	R.F. BY-PASS CAP
C2	321157	1	CAPACITOR, 500 PFD.	R.F. BY-PASS CAP
C3	171829	1	CAPACITOR, .15 MFD.	Q3 FEEDBACK CAP
C4	321264	1	CAPACITOR, 50V, 2.7 MFD.	TRANSIENT SUPP.
C5	178860	1	CAPACITOR, 100V, .022 MFD	R.F. BY-PASS
C6	171587	1	CAPACITOR, 200V, .25 MFD.	Q4 FEEDBACK CAP.
C7	171583	1	CAPACITOR, .003 MFD	R.F. BY-PASS CAP.
L1	321159	1	CHOKE, 390μH	R.F. CHOKE
CR1	321161	1	DIODE, 1N748A, 3.9V ± 5%	REG. VOLT. REF.
CR3	321154	1	DIODE, 1N457A	Q1 BASE PROT.
CR4	178844	1	VARISTOR, 100-A	TEMP. COMP.
CR5	178844	1	VARISTOR, 100-A	TEMP. COMP.
CR6	178844	1	VARISTOR, 100-A	TEMP. COMP.
CR7	181667	1	DIODE, 1N750A, 4.7V ± 5%	TEMP. COMP. REF.
CR8	177611	1	DIODE, 1NC82	Q4 EMITTER DIODE
CR9	321154	1	DIODE, 1N457A	TRANSIENT SUPP.
NOTE 4 CR10	321154	1	DIODE, 1N457A	SHORT PROT.
Q1	321166	1	TRANSISTOR, 2N1893	D.C. AMP.
Q2	324144	1	TRANSISTOR, 2N4121	D.C. AMP.
Q3	321165	1	TRANSISTOR.	D.C. AMP.
Q4	321261	1	TRANSISTOR, 2N4036	D.C. AMP.
	324147	1	PAD, TRANSISTOR	Q2
	144495	3	PAD, TRANSISTOR	Q1, Q3, Q4
	321299	1	CIRCUIT BOARD, ETCHED	
	321171	2	LEAD (BK)	
T1-T4	137471	4	LUG, TERMINAL	

NO	NOTES
1	ALL RESISTORS 1/2 WATT, ALL RESISTANCE VALUES IN OHMS AND ALL CAPACITANCE VALUES IN MFD. UNLESS OTHERWISE SPECIFIED.
2	Q5 (181675) AND CR2 (321149) ARE MOUNTED TO 321148 HEAT SINK. SEE CMD ASSEMBLY 321991
3.	R2 IS ADJUSTED FOR 15 MA IN CR2 WITH INPUT MARKING (+6) AND OUTPUT CONNECTED TO A 150 OHM RESISTOR (5W)
4.	R7 IS ADJUSTED FOR SYMMETRICAL SWITCHING ABOUT ZERO.
5.	PINS A,B 140 MA TO COILS PINS R,S -6V DC PINS C,D +47 TO 53V DC POWER PINS E,F,H,J CONTROL CONTACT PROVISION. PINS N,P MS 1888 SIGNAL INPUT PINS K,L,M COMMON (ALL INPUTS AND OUTPUTS REFERRED TO COMMON)
6.	S-NUMBER 61,263 S

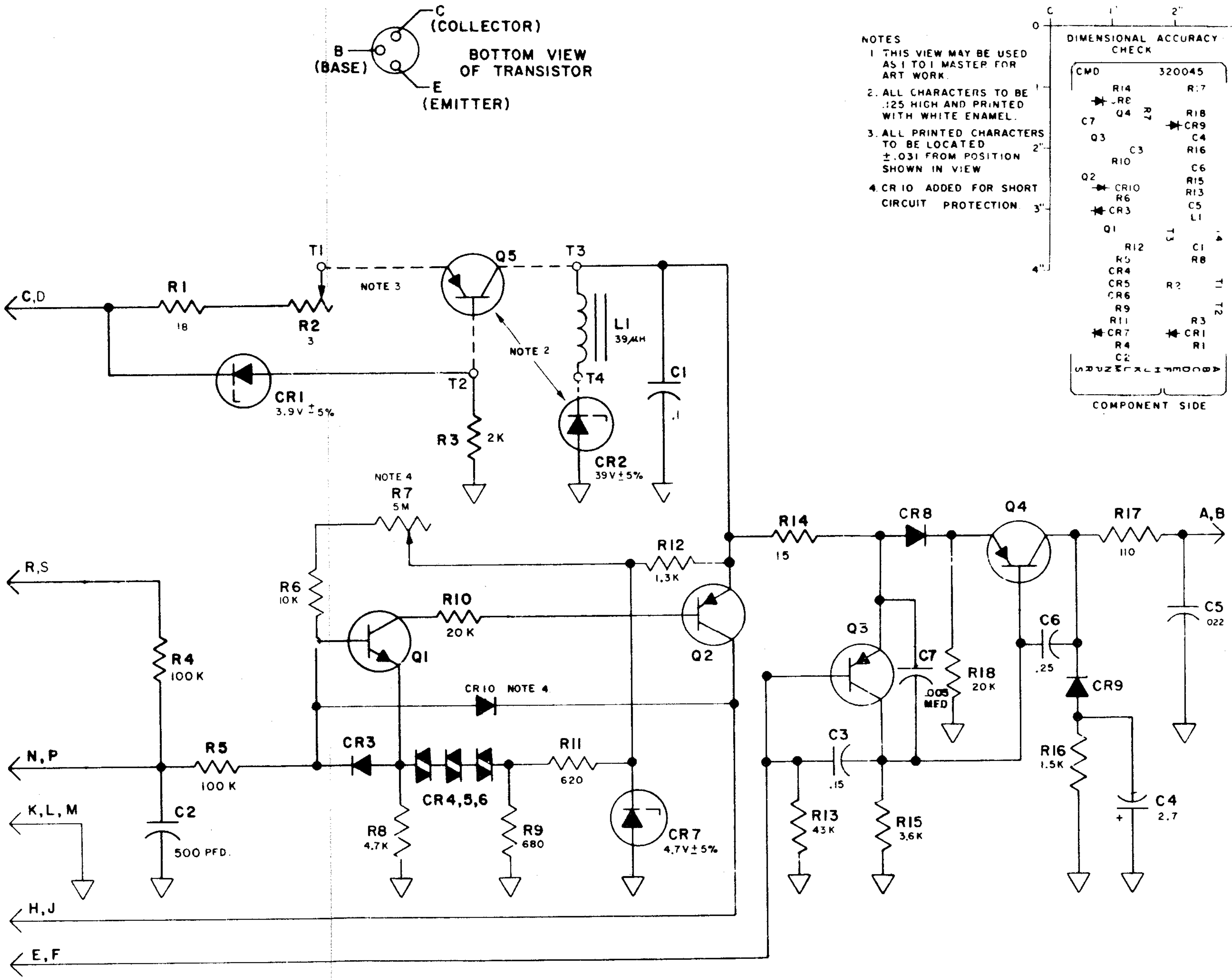
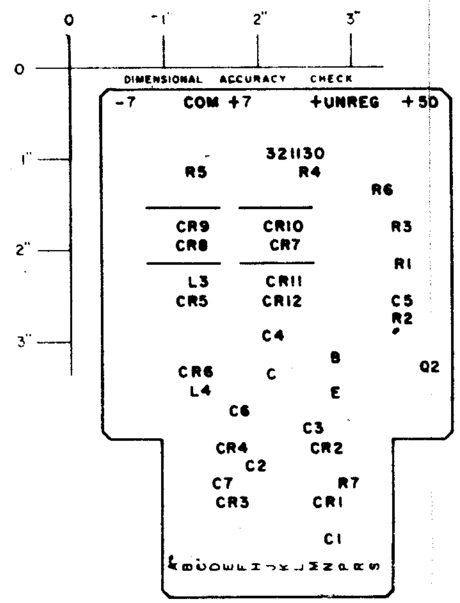


Figure 5-24. 321991 Circuit Card (CMD) Schematic Diagram (Sheet 2 of 2)

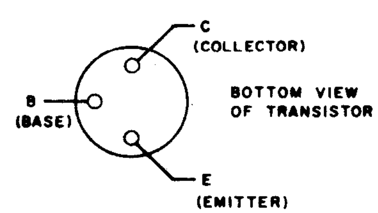
CIRCUIT BOARD ASSEMBLY, POWER SUPPLY (47-53V.D.C. .5AMP. MAX.)				
REF. DESIGN.	PART NO.	TOTAL QTY.	NAME AND DESCRIPTION	FUNCTION
C1	312284	1	CAPACITOR, 1.5 MFD 400V	RF FILTER
C2,3	171585	2	CAPACITOR, .22MFD 200V	RF FILTER
C4	171831	1	CAPACITOR, 10MFD 150V	RECTIFIER FILTER
C5	178860	1	CAPACITOR, .022MFD 100V	RF FILTER
C6,7	312385	2	CAPACITOR, .1MFD 10V	RF FILTER
R1	198937	1	RESISTOR, 2.7K 2W	
R2	182180	2	RESISTOR, 200 OHM 1/2W	
R3	171533	1	RESISTOR 4 OHM 5W	
R4,5	311664	2	RESISTOR, 2.5K 8W	DROPPING
R6			SAME AS R2	RF FILTER
R7	305298	1	RESISTOR, 3.3K 3W	BLEEDER
CR1-4	182520	4	DIODE (1N4383)	RECTIFIER
CR5,6	327794	2	DIODE, ZENER (7.2V)	REFERENCE
CR7	321286	2	DIODE, ZENER (1N4749A)	REFERENCE
CR8-11	178844	4	VARISTOR (W.E. 100A)	REFERENCE
CR12			SAME AS CR7	REFERENCE
L3,4	321159	2	INDUCTOR 39 uH	RF FILTER
Q2	321145	1	TRANSISTOR (2N2270)	GAIN
FC1,2	311068	2	FUSE CLIP	
F102	131807	1	FUSE .5 AMP.	
TP1	320042	1	JACK, TEST (SLATE)	
TP2	320041	1	JACK, TEST (GREEN)	
TP3	320039	1	JACK, TEST (BLACK)	
TP4	320040	1	JACK, TEST (ORANGE)	
TP5	320038	1	JACK, TEST (RED)	
P1-3	137471	3	TERMINAL POST	CONNECTOR
	321140	1	CIRCUIT CARD	
S1-S4	336470	4		
1	151637	2	SCREW 4-40	
2	151880	2	NUT 4-40	
3	110743	2	LOCK WASHER	
4	125011	2	FLAT WASHER	

CIRCUIT DESCRIPTION (SEE SHEET 2)

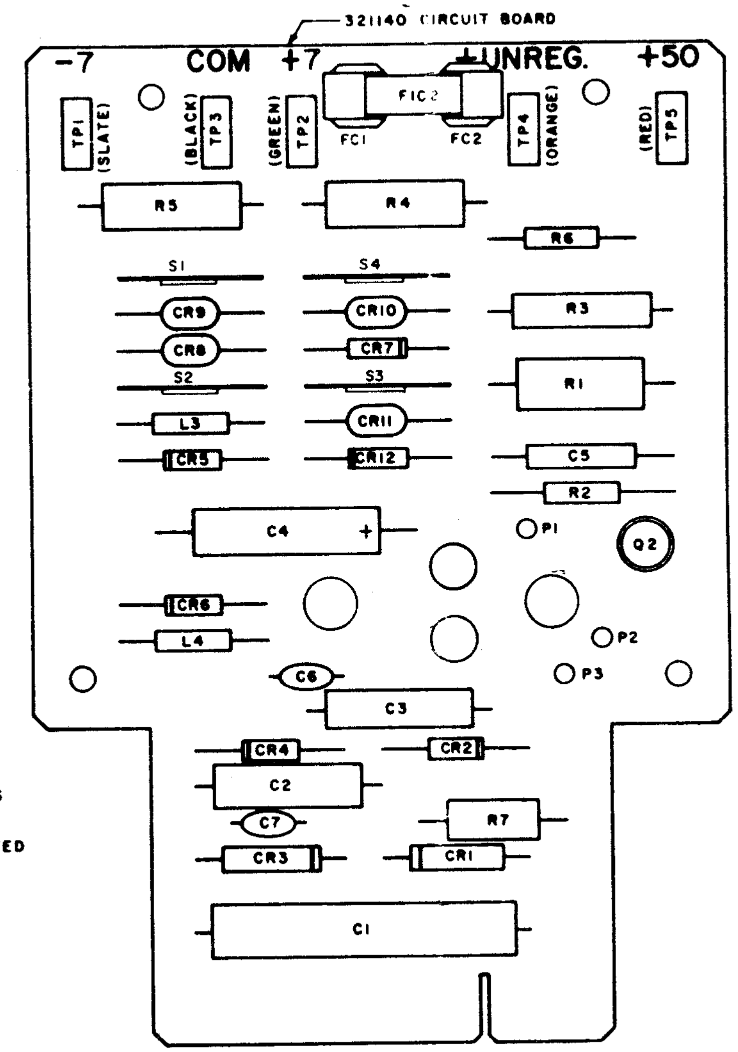
DIODES CR1 AND CR3 FORM A RECTIFIER WITH ASSOCIATED TRANSFORMER (321123) T1 AND CAPACITOR C8 (321129) TO OBTAIN A MINIMUM +58V DC UNREGULATED. Q1 IS AN EMITTER FOLLOWER VOLTAGE REGULATING ELEMENT WHICH ABSORBS THE VOLTAGE DIFFERENCE BETWEEN THE UNREGULATED DC AND THE CONSTANT +50V DC REFERENCE ESTABLISHED BY DIODES CR7-CR12. Q2 PROVIDES GAIN FOR Q1. DIODES CR3,CR4, TRANSFORMER T1 AND CAPACITOR C4 FORM A FULL WAVE RECTIFIER TO OBTAIN NEGATIVE UNREGULATED DC. R4 AND CR6, R5 AND CR5 FORM BASIC SHUNT REGULATORS TO OBTAIN +7 AND -7V DC.



SCALE 1/1



1) TELETYPE REFERENCE ONLY: SPECIFICATION 61,267S
2) SEE SHEET 2 FOR SCHEMATIC WIRING
3) ALL CHARACTERS TO BE .125 HIGH AND PRINTED WITH WHITE ENAMAL.
4) ALL PRINTED CHARACTERS TO BE LOCATED ±.031 FROM NOMINAL POSITION.



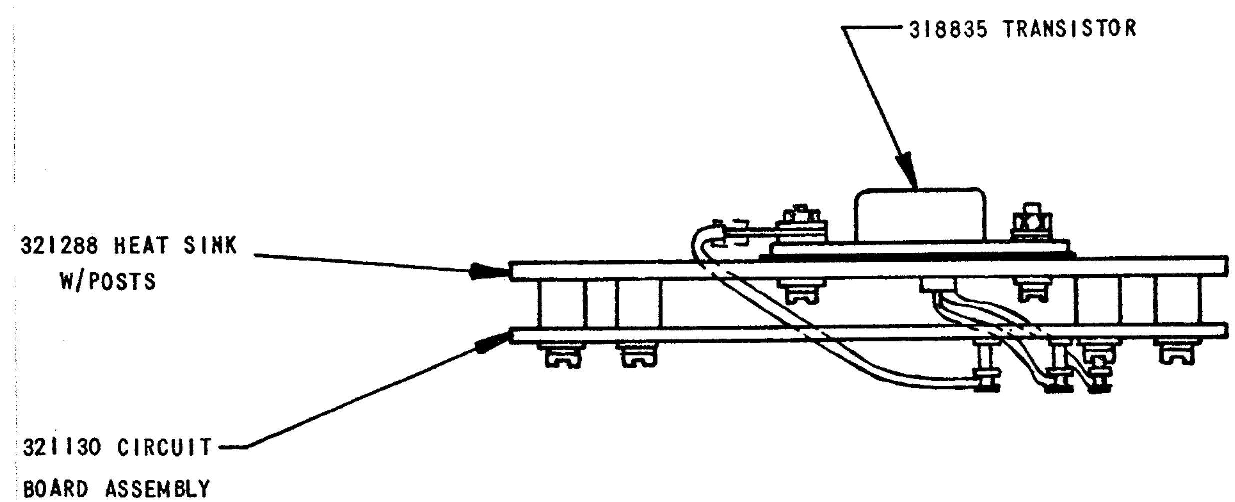


Figure 5-25. 321290 Circuit Card Schematic Diagram (Sheet 1 of 2)

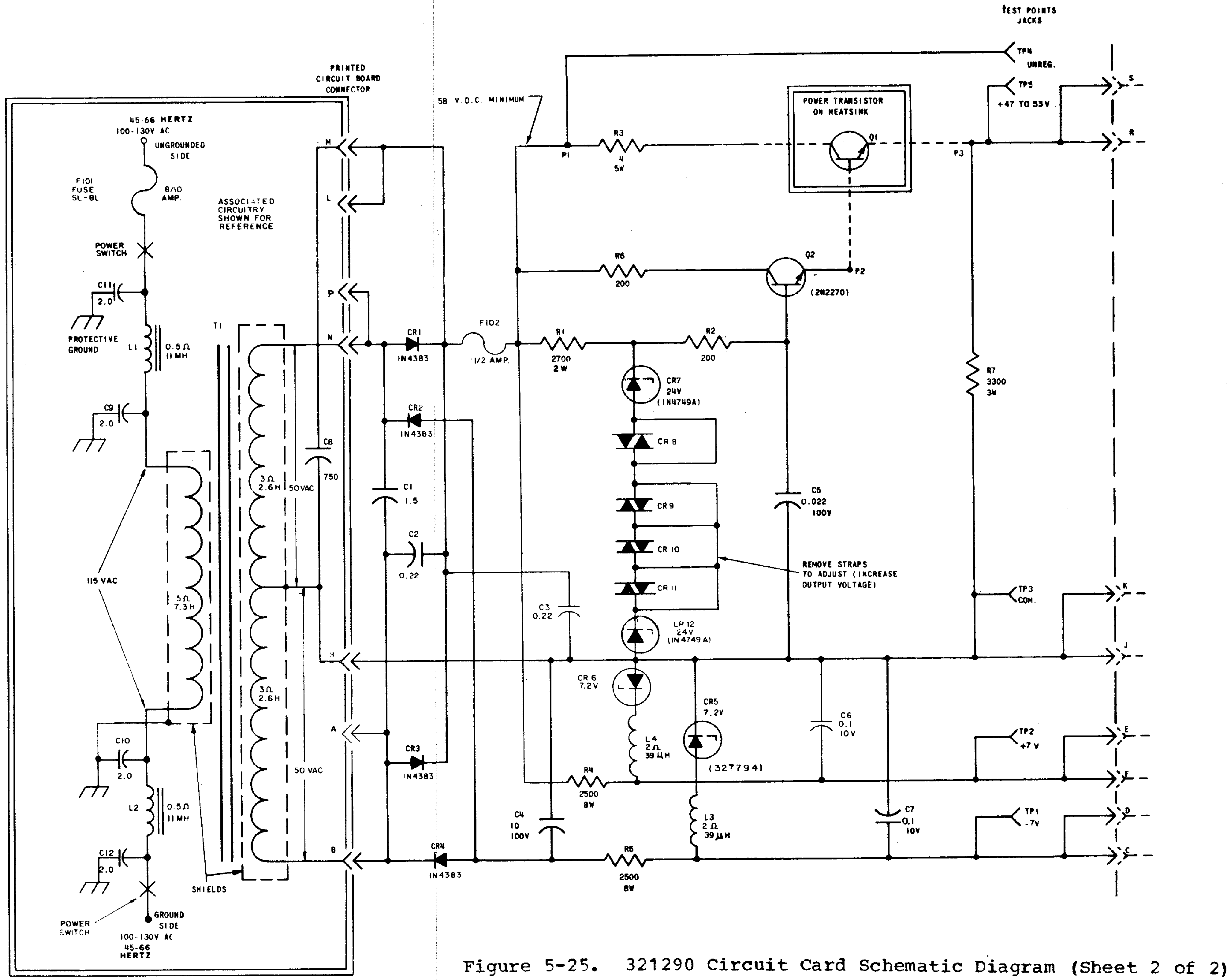
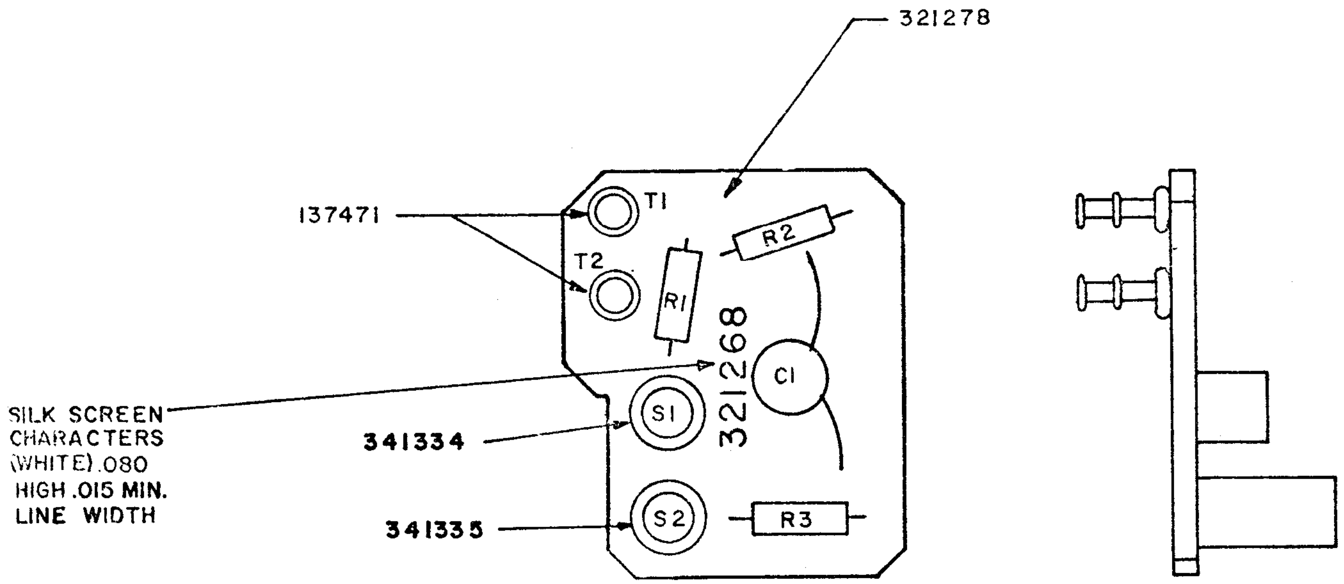
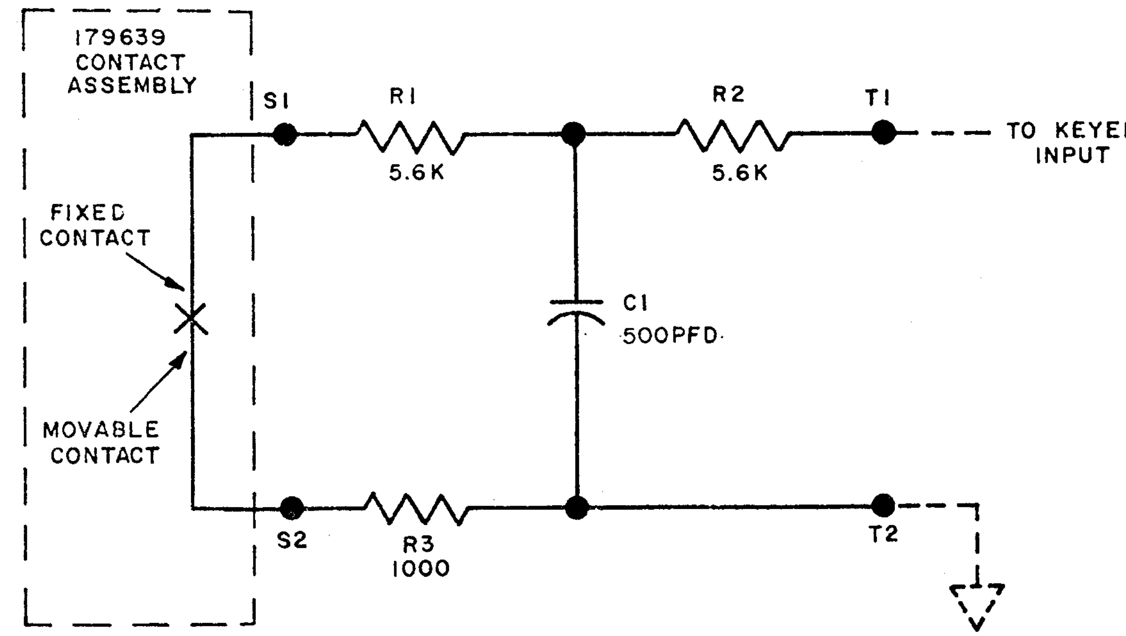


Figure 5-25. 321290 Circuit Card Schematic Diagram (Sheet 2 of 2)

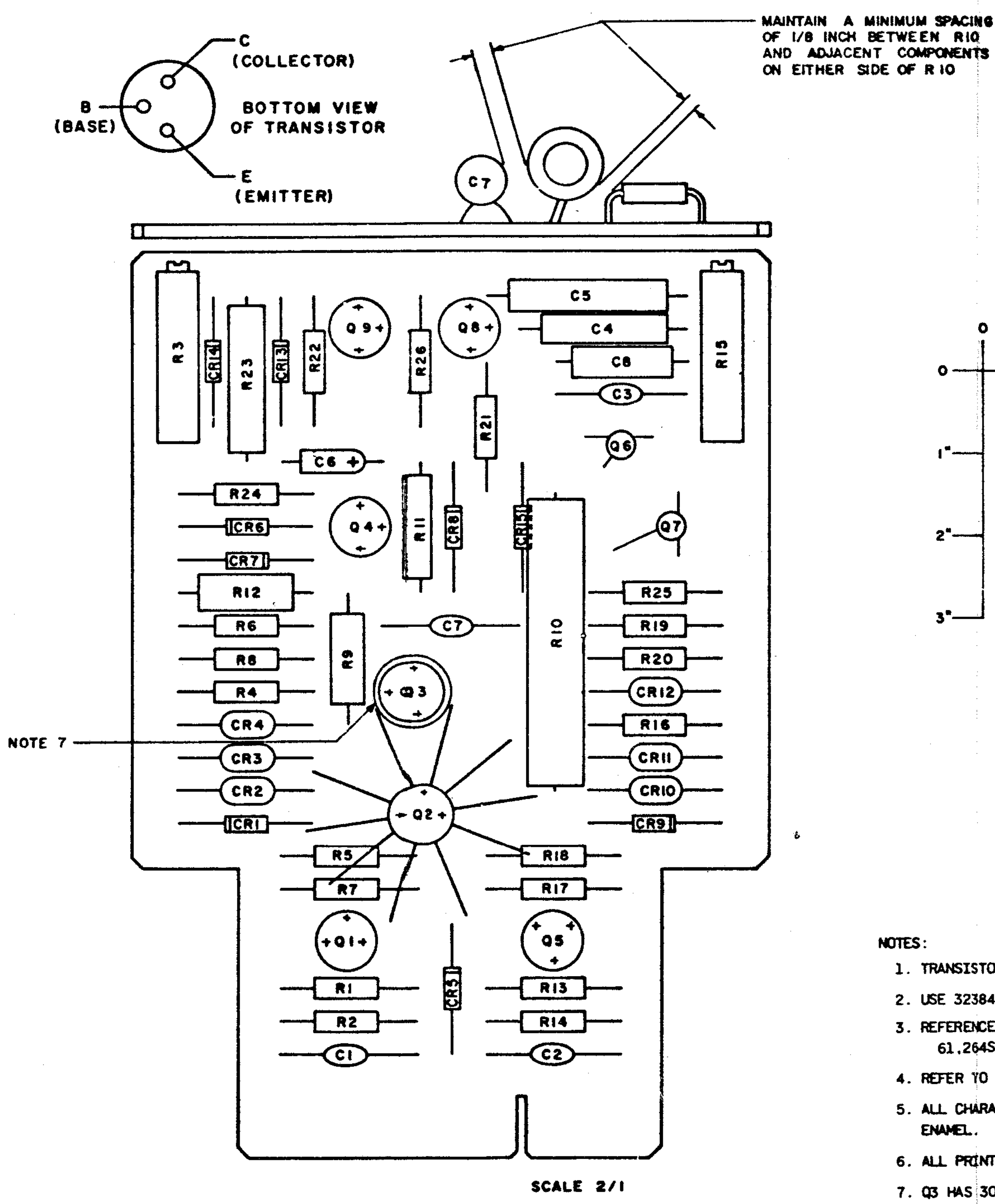


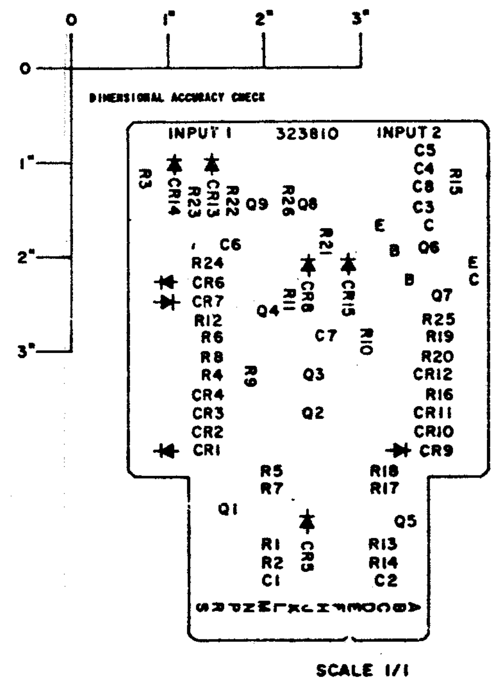


REF. DESIGN	TELETYPE PART NO.	TOTAL QTY.	NAME AND DESCRIPTION	LOCATING FUNCTION
R1	315960	2	RESISTOR, 5.6K 1/4 WATT	RC FILTER
R2	"		SAME AS R1	"
R3	321213	1	RESISTOR, 1000 Ω 1/4 WATT	"
C1	321157	1	CAPACITOR, 500 PFD	"
T1	137471	2	TERMINAL, SOLDER	
T2	"		"	
S1	341334	1	STUD, CONNECTOR	
S2	341335	1	"	
321278	321278	1	BOARD, ETCHED CIRCUIT	

NOTE:
DASHED LINES INDICATE EXTERNAL CIRCUITRY.

Figure 5-26. 321268 Filter Card Assembly Schematic Diagram





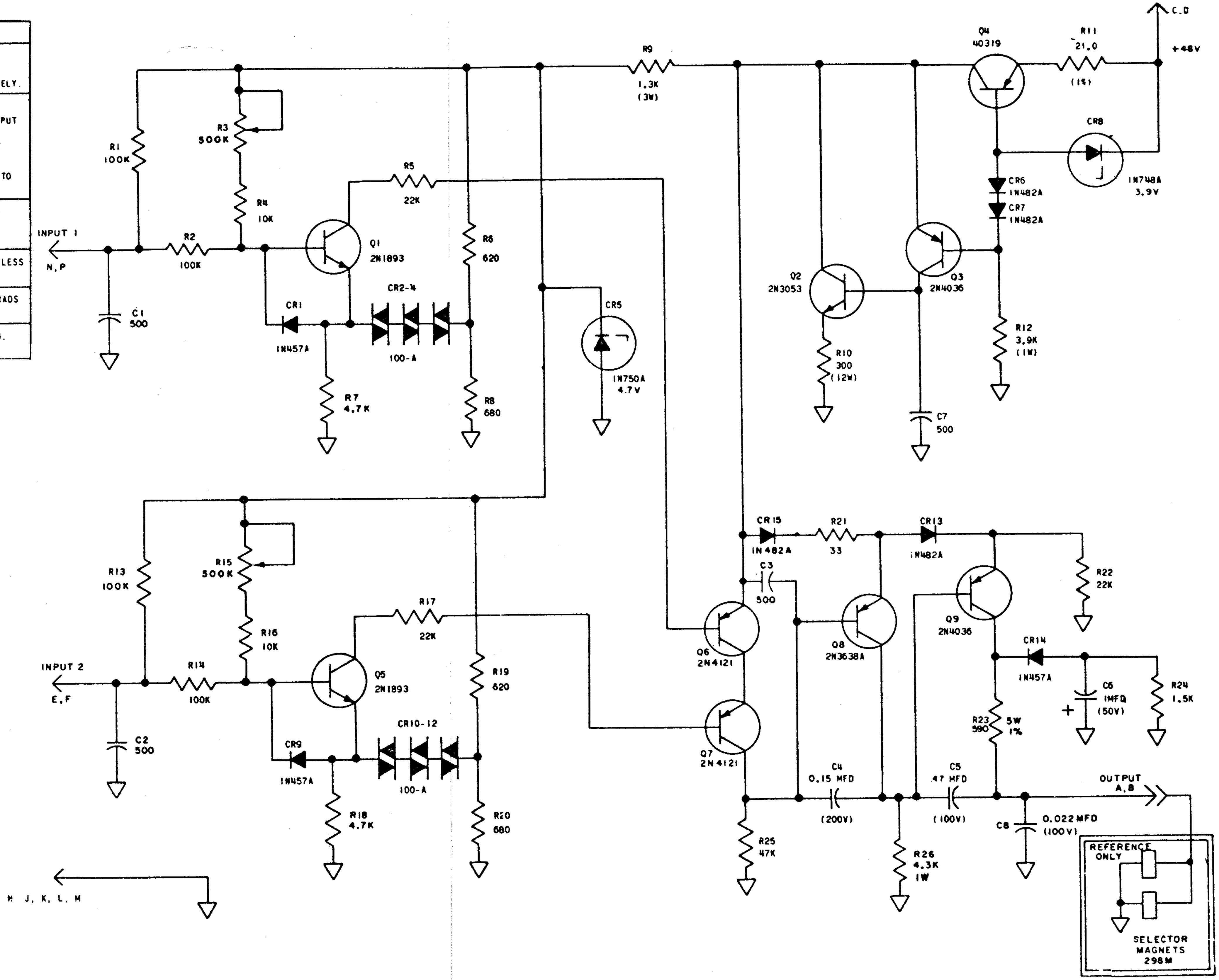
NOTES:

1. TRANSISTOR Q2 HAS 323847 HEAT SINK PRESSED ON.
2. USE 323846 TRANSISTOR PAD UNDER TRANSISTOR Q3.
3. REFERENCE SPECIFICATION FOR TELETYPE CORP. EMPLOYEES ONLY: 61,264S
4. REFER TO 8143WD FOR SCHEMATIC WIRING DIAGRAM.
5. ALL CHARACTERS TO BE .125 HIGH AND PRINTED WITH WHITE ENAMEL.
6. ALL PRINTED CHARACTERS TO BE LOCATED +.031 FROM NOMINAL.
7. Q3 HAS 300116 INSULATING COVER. POSITION Q3 (WITH COVER) SO THAT 323847 HEAT SINK MAY BE FULLY SEATED ON Q2.
8. 144495 TRANSISTOR PAD REQUIRED ON Q1, Q4, Q5, Q8 AND Q9, AND Q2.
9. PARTS CHANGED FOR STANDARDIZATION WERE FORMERLY AS FOLLOWS: CR1, CR9, CR14 — 321154 (1N457A) AND CR6, CR7, CR13, CR15 — 321156 (1N482A).

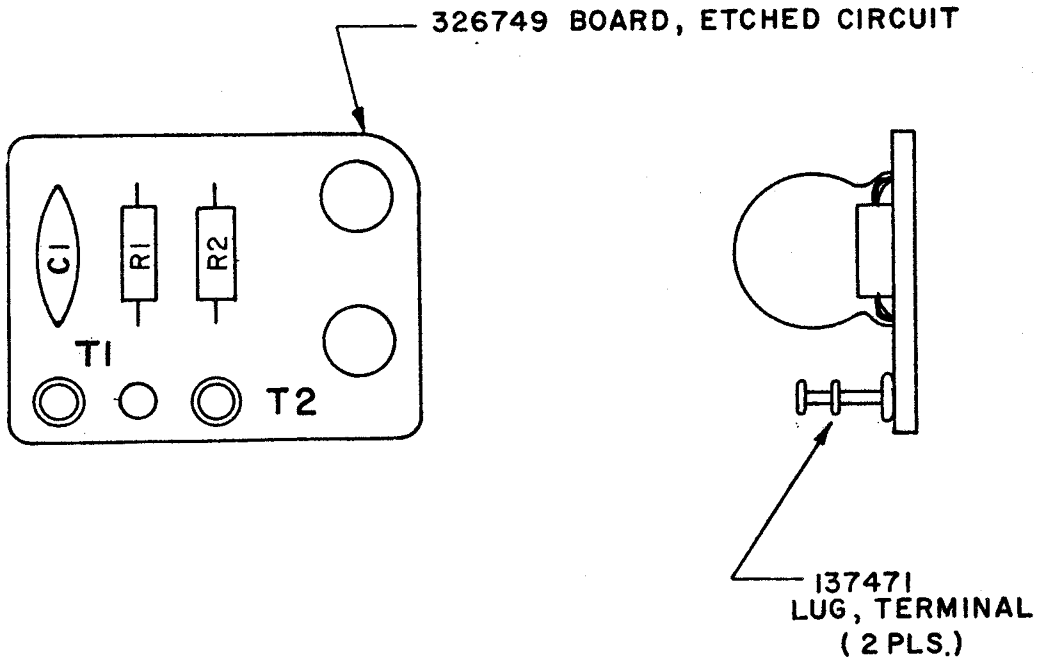
REF. DESIG.	TELETYPE PART NO.	TOTAL QTY.	NAME AND DESCRIPTION	LOCATING FUNCTION
C1	321157	1	CAPACITOR, 500 pf	R.F. BY-PASS CAP.
C2	321157	1	CAPACITOR, 500 pf	R.F. BY-PASS CAP.
C3	321157	1	CAPACITOR, 500 pf	R.F. BY-PASS CAP.
C4	171829	1	CAPACITOR, .15 MFD	Q8 FEEDBACK CAP.
C5	326776	1	CAPACITOR, .47 MFD	Q9 FEEDBACK CAP.
C6	321260	1	CAPACITOR, 1 MFD 50V	TRANSIENT SUPP.
C7	321157	1	CAPACITOR, 500 pf	R.F. BY-PASS CAP.
C8	178860	1	CAPACITOR, .022 MFD	R.F. BY-PASS CAP.
R1	118720	1	RESISTOR, 100K, 1/2W	Q1 OPEN LINE BIAS
R2	118720	1	RESISTOR, 100K, 1/2W	INPUT 1 RES
R3	323964	1	POTENTIOMETER 500K	Q1 BIAS
R4	129854	1	RESISTOR, 10K, 1/2W	Q1 BIAS
R5	118177	1	RESISTOR, 22K, 1/2W	Q1 LOAD RES.
R6	137604	1	RESISTOR, 620, 1/2W	VOLTAGE DIVIDER
R7	118146	1	RESISTOR, 4.7K, 1/2W	Q1 EMITTER RES.
R8	129850	1	RESISTOR, 680, 1/2W	VOLTAGE DIVIDER
R9	309468	1	RESISTOR, 1.3K, 3W	CR5 CURRENT LIMITER
R10	323841	1	RESISTOR, 300, 12 W	Q2 LOAD RES.
R11	323842	1	RESISTOR, 21, 1/2W, 1%	REG. CURRENT SET
R12	178864	1	RESISTOR, 3.9K, 1W	CR8 CURRENT LIMITER
R13	118720	1	RESISTOR, 100K 1/2W	Q5 OPENLINE BIAS
R14	118720	1	RESISTOR, 100K, 1/2W	INPUT 2 RES.
R15	323964	1	POTENTIOMETER 500K	Q5 BIAS
R16	129854	1	RESISTOR, 10K, 1/2W	Q5 BIAS
R17	118177	1	RESISTOR, 22K, 1/2W	Q5 LOAD RES.
R18	118146	1	RESISTOR, 4.7K, 1/2W	Q5 EMITTER RES.
R19	137604	1	RESISTOR, 620, 1/2W	VOLTAGE DIVIDER
R20	129850	1	RESISTOR, 680, 1/2W	VOLTAGE DIVIDER
R21	321975	1	RESISTOR, 33, 1/2W	Q8 EMITTER RES.
R22	118177	1	RESISTOR, 22K, 1/2W	CR13 BIAS RES.
R23	323843	1	RESISTOR, 590, 5W, 1%	COIL CURRENT LIMITER
R24	137442	1	RESISTOR, 1.5K, 1/2W	C6 BLEEDER RES.
R25	118154	1	RESISTOR 47K, 1/2W	Q6,Q7 LOAD RES.
R26	120424	1	RESISTOR 4.3K, 1W	Q8 LOAD RES.
CR1	197464	7	DIODE, NOTE 9	Q1 BASE PROT.
CR2	178844	1	VARISTOR, 100-A	TEMP. COMP.
CR3	178844	1	VARISTOR, 100-A	TEMP. COMP.
CR4	178844	1	VARISTOR, 100-A	TEMP COMP.
CR5	181667	1	DIODE, 1N750A	TEMP. COMP. REF.
CR6			SAME AS CR1	Q4 COLLECTOR CLAMP
CR7			" " "	Q4 COLLECTOR CLAMP
CR8	321161	1	DIODE, 1N748A	REG. VOLT REF.
CR9			SAME AS CR1	Q5 BASE PROT.
CR10	178844	1	VARISTOR, 100-A	TEMP. COMP.
CR11	178844	1	VARISTOR, 100-A	TEMP. COMP.
CR12	178844	1	VARISTOR, 100-A	TEMP. COMP.
CR13			SAME AS CR1	Q9 EMITTER DIODE
CR14			" " "	TRANSIENT SUPP.
CR15			" " "	Q8 EMITTER DIODE
Q1	321166	1	TRANSISTOR, 2N1893	DC AMP.
Q2	323844	1	TRANSISTOR, 2N3053	SHUNT REG
Q3	321261	1	TRANSISTOR, 2N4036	SHUNT REG. AMP.
Q4	323845	1	TRANSISTOR, 40319	SERIES REG.
Q5	321166	1	TRANSISTOR, 2N1893	DC AMP
Q6	324144	2	TRANSISTOR, 2N4121	DC AMP.
Q7			SAME AS Q6	
Q8	321165	1	TRANSISTOR, 2N3638A	DC AMP.
Q9	321261	1	TRANSISTOR, 2N4036	DC AMP.
	324197	2	PAD, TRANSISTOR	
	144495	6	PAD, TRANSISTOR	
	323846	1	PAD, TRANSISTOR	
	323847	1	HEAT SINK	
	323835	1	CIRCUIT BOARD, ETCHED	
	300116	1	COVER, INSULATING	

Figure 5-27. 323810 Circuit Assembly (SMD with Signal Combiner) (Sheet 1 of 2)

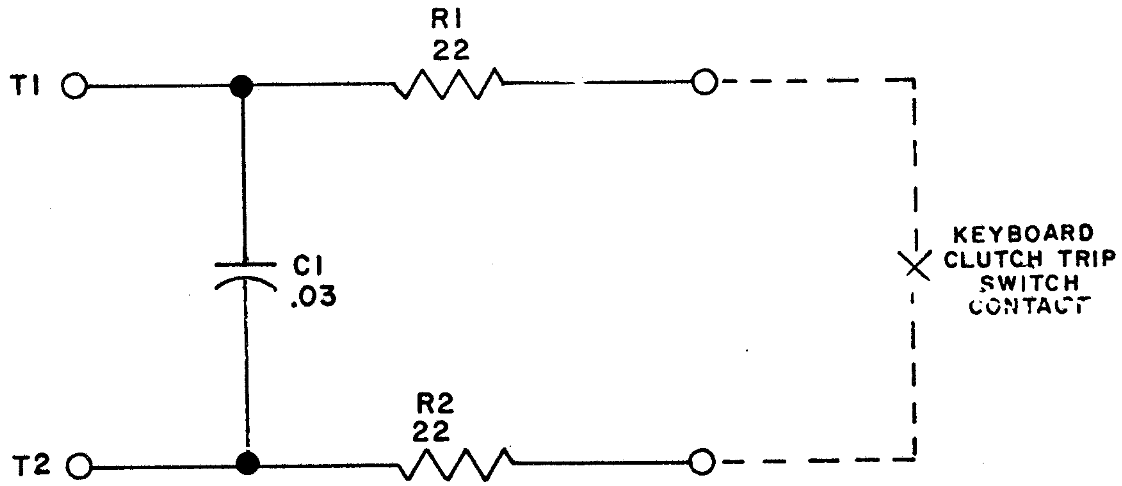
NO.	NOTES
1.	R3 AND R15 ARE ADJUSTED FOR SYMMETRICAL SWITCHING ABOUT ZERO VOLTS FOR INPUT 1 AND 2 RESPECTIVELY.
2.	PINS A,B - 60MA TO COILS PINS C,D - 47 TO 53V DC POWER INPUT PINS N,P - MS 188B SIGNAL INPUT 1 PINS E,F - MS 188B SIGNAL INPUT 2 PINS H,J,K,L,M, - CIRCUIT COMMON (ALL INPUTS AND OUTPUTS REFERRED TO CIRCUIT COMMON).
3.	REFERENCE SPEC. FOR TELETYPE CORP EMPLOYEES ONLY: 61,264S.
4.	ALL RESISTORS ARE 5%, 1/2 WATT UNLESS OTHERWISE SPECIFIED.
5.	ALL CAPACITANCE VALUES IN PICOFARADS UNLESS OTHERWISE SPECIFIED.
6.	DENOTES CIRCUIT COMMON.

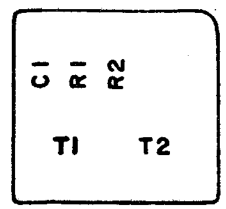


5-27 323810 Circuit Assembly (SMD with Signal Combiner) (Sheet 2 of 2)



REF. DESIGN	TELETYPE PART NO.	TOTAL QTY.	NAME AND DESCRIPTION	LOCATING FUNCTION
R1	326751	2	22 OHM, 1/4 WATT RESISTOR 10%	CURRENT LIMITER
R2			SAME AS R1	
C1	326752	1	.03 MFD., 50V CAPACITOR	RF BY-PASS
T1	137471	2	LUG, TERMINAL	
T2			SAME AS T1	
	326749	1	BOARD, ETCHED CIRCUIT	



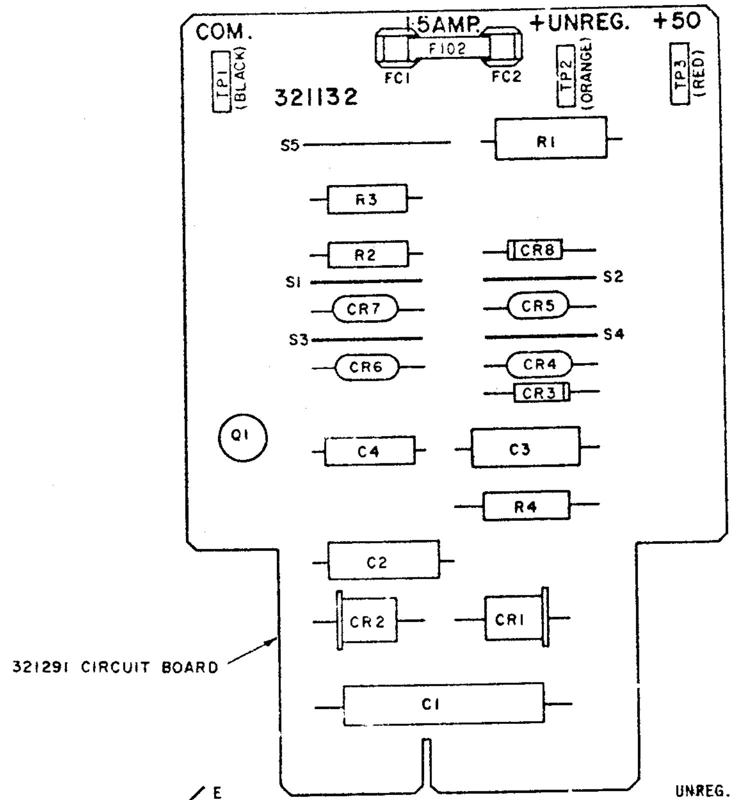


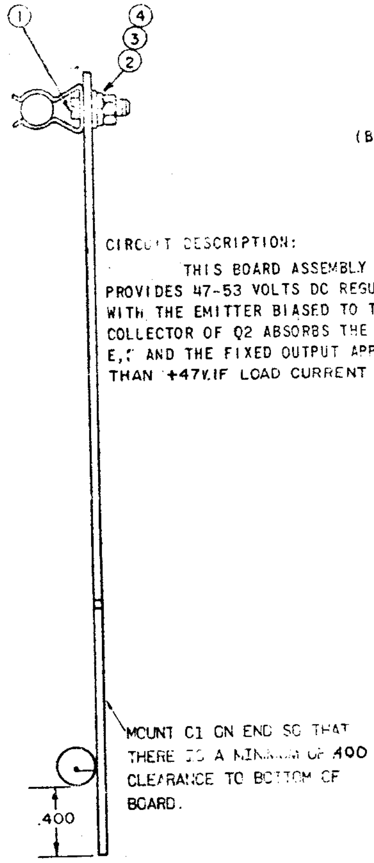
SCALE 1/1

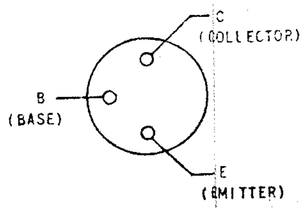
SILK SCREENING INFORMATION

NOTE:
ALL CHARACTERS TO BE .080 HIGH AND LOCATED ±.015 FROM NOMINAL POSITION. (WHITE ENAMEL)

Figure 5-28. 326750 Filter Card Assembly Schematic

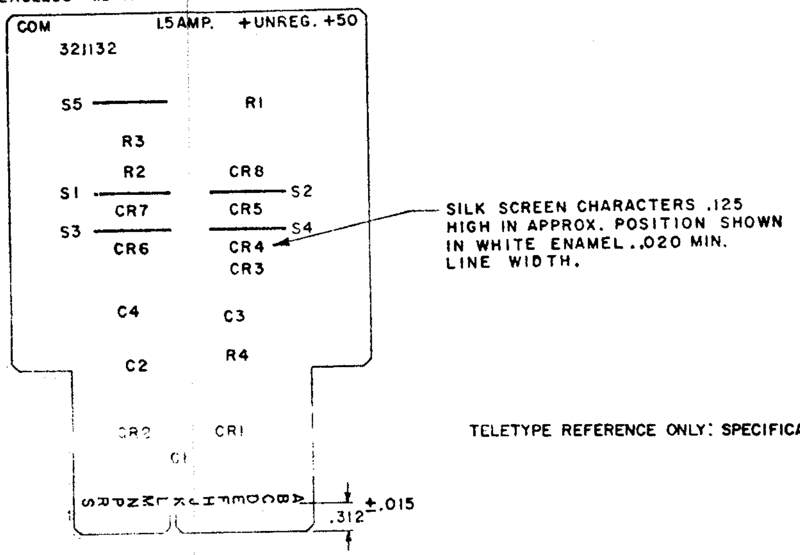






CIRCUIT DESCRIPTION:

THIS BOARD ASSEMBLY USED WITH ASSOCIATED TRANSFORMER (321214) AND CAPACITOR (321279) PROVIDES 47-53 VOLTS DC REGULATED OUTPUT AT 1 AMPERE MAXIMUM. Q2 IS THE SERIES REGULATING ELEMENT WITH THE EMITTER BIASED TO THE REFERENCE VOLTAGE SET BY REFERENCE DIODES CR3-CR8. THE BASE-COLLECTOR OF Q2 ABSORBS THE VOLTAGE DIFFERENCE BETWEEN THE UNREGULATED RECTIFIER VOLTAGE AT TERMINALS E,F AND THE FIXED OUTPUT APPEARING AT A,B. Q1 IS A GAIN STAGE FOR Q2. VOLTAGE OUTPUT MAY BE LESS THAN +47V. IF LOAD CURRENT EXCEEDS 1.0 AMPERE.



CIRCUIT BOARD ASSEMBLY, POWER SUPPLY (47-53 V.D.C. 1 AMP MAX.)				
REF. DESIGN.	PART NO.	TOTAL QTY.	NAME AND DESCRIPTION	LOCATING FUNCTION
C1	312284	1	CAPACITOR 1.5 MFD 400V	RF FILTER
C2	171595	2	CAP. .22 MFD 200V	RF FILTER
C3			SAME AS C2	RF FILTER
C4	178860	1	CAP. .022 MFD 100V	RF FILTER
CR1,2	321136	2	DIODE (1N4722)	RECTIFIER
CR3,8	321285	2	DIODE, ZENER (1N4749A)	OUTPUT REFERENCE
CR4,5	178844	4	VARISTOR (W.E. 100A)	VOLTAGE
CR6,7			SAME AS CR4,5	ADJUSTMENT
R1	198937	1	RESISTOR 2700 OHM, 2W	
R2,3	182180	2	RESISTOR 200 OHM 1/2W	
R4	305298	1	RESISTOR 3.3K 3W	BLEEDER
Q1	321145	1	TRANSISTOR (2N2270)	
S1-4	39603RM	.28FT	24 GA. WIRE, BARE (4 STRAPS)	
F102	330517	1	FUSE, 1.5 AMP.	
TP1	320039	1	JACK, TEST (BLACK)	TEST POINT
TP2	320040	1	JACK, TEST (ORANGE)	TEST POINT
TP3	320038	1	JACK, TEST (RED)	TEST POINT
FC1,2	311068	2	CLIP, FUSE	
1	151637	2	SCREW, FIL.	
2	125011	2	WASHER, FLAT	
3	110743	2	WASHER, LOCK	
4	3599	2	NUT	
	321291	1	BOARD, ETCHED CIRCUIT	
S5	39522RM	.1FT	20 GA. WIRE, BARE	

TELETYPE REFERENCE ONLY: SPECIFICATION 61,268S

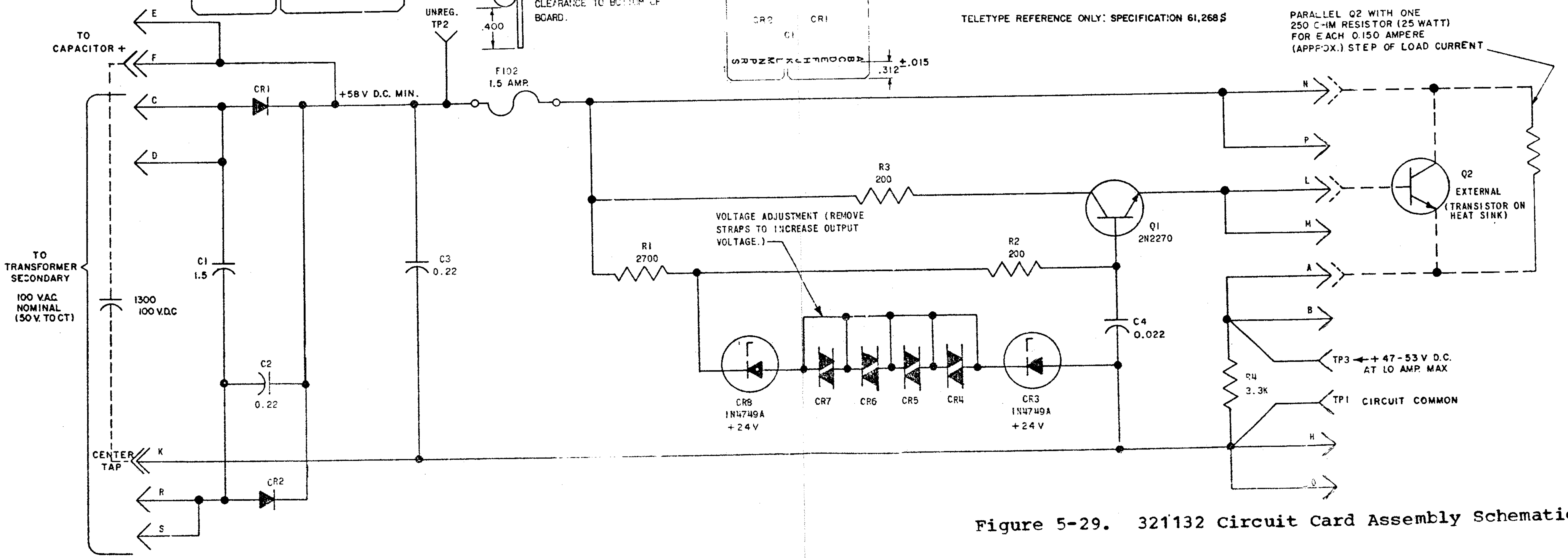


Figure 5-29. 321132 Circuit Card Assembly Schematic