NAVSHIPS 91781

INSTRUCTION BOOK

for

CODE TAPE RECORDER RD-112/U

McELROY MANUFACTURING CORPORATION
LITTLETON, MASSACHUSETTS

BUREAU OF SHIPS NAVY DEPARTMENT

Contract: NObsr 52163 *Approval by BuShips: 10 OCTOBER 1952*

LIST OF EFFECTIVE PAGES

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DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code 993-100
10 October 1952

From: Chief, Bureau of Ships
To: All Activities Concerned with the Installation, Operation and Maintenance of the Subject Equipment

Subj: Instruction Book for Code Tape Recorder RD-112/U NAVSHIPS 91781

1. This is the instruction book for the subject equipment and is in effect upon receipt.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense Publications.

4. All Navy requests for NAVSHIPS Electronics publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the Bureau of Ships Journal and in the Index of Bureau of Ships General and Electronics Publications, NAVSHIPS 250-020.

H. N. WALLIN
Chief of Bureau

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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GUARANTEE

The Contractor guarantees that at the time of delivery thereof the supplies provided for under this contract will be free from any defects in material or workmanship and will conform to the requirements of this contract. Notice of any such defect or non-conformance shall be given by the Government to the Contractor within one year of the delivery of the defective or non-conforming item, unless a different period of Guarantee is specified in the Schedule. If required by the Government within a reasonable time after such notice, the Contractor shall with all possible speed correct or replace the defective or non-conforming item or part thereof. When such correction or replacement requires transportation of the item or part thereof, shipping costs, not exceeding usual charges, from the delivery point to the Contractor's plant and return, shall be borne by the Contractor; the Government shall bear all other shipping costs. This Guarantee shall then continue as to corrected or replacing supplies or, if only parts of such supplies are corrected or replaced, to such corrected or replacing parts, until one year after the date of redelivery, unless a different period of Guarantee is specified in the Schedule. If the Government does not require correction or replacement of a defective or non-conforming item, the Contractor, if required by the Contracting Officer within a reasonable time after the notice of defect or non-conformance, shall repay such portion of the contract price of the item as is equitable in the circumstances.

INSTALLATION RECORD

Contract Number NObsr-52163 Date of Contract, 11 January 1951

Serial Number of Equipment.....

Date of acceptance by the Navy.....

Date of delivery to contract destination.....

Date of completion of installation.....

Date placed in service.....

Blank spaces on this page shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the date acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS 383 (revised). The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the *Bureau of Ships Manual* or superseding instructions.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Standard Navy stock number or when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the *Bureau of Ships Manual* or superseding instructions on the subject of radio-safety precautions to be observed.

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

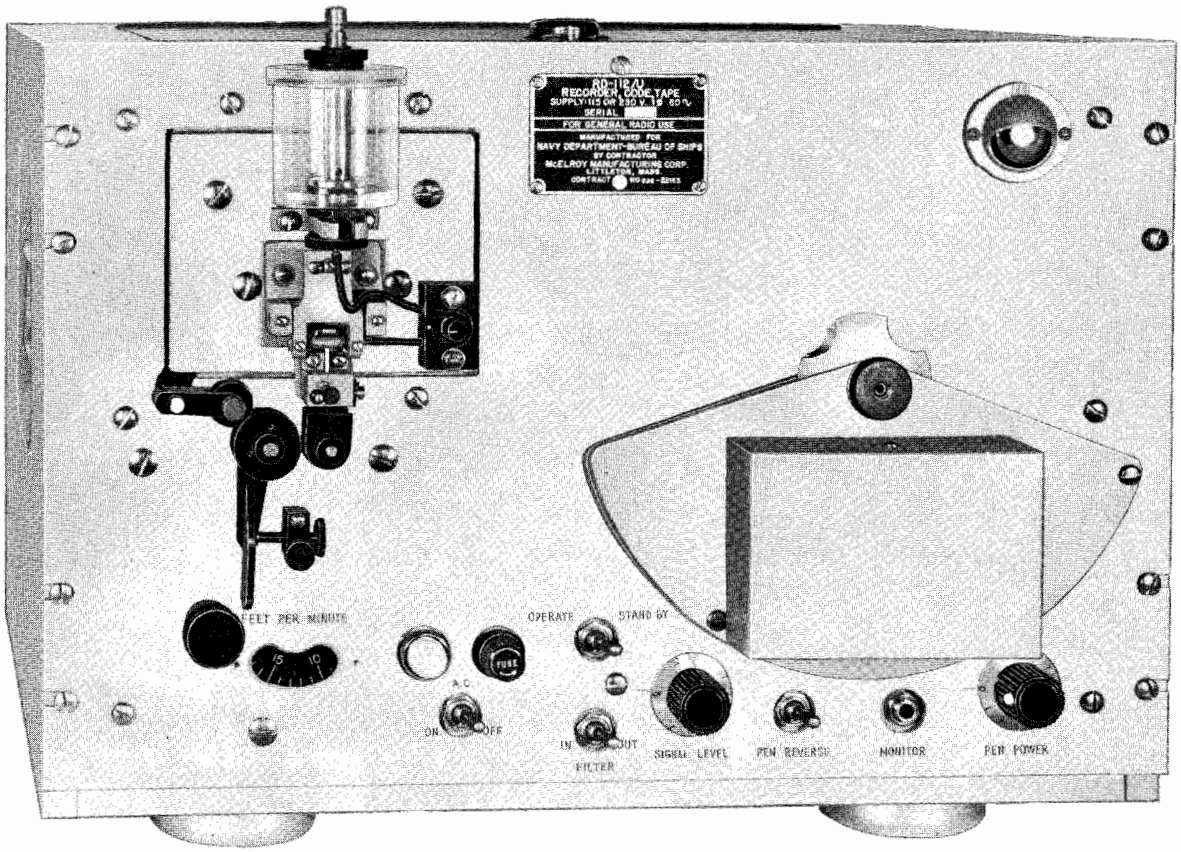


Figure 1-1. Recorder, Code, Tape, RD-112/U

SECTION 1.
GENERAL DESCRIPTION

1. GENERAL.

Code Tape Recorder RD-112/U is a self-contained, undulating type ink-slip recorder capable of converting radio telegraph code information from the normally transient, audible form to its visual equivalent in a permanently written form. The written information is recorded with ink on standard paper recording tape drawn through an electronically operated recording mechanism by a mechanically operated tape puller powered by a synchronous electric motor. Amplification of radio telegraph code information and conversion to its final form is accomplished by means of a specialized type of amplifier contained in the unit. Both amplifier and tape puller are designed to operate from a common source of 115 or 230 volts, 50/60 cycle alternating current.

Code Tape Recorder RD-112/U is capable of recording radio telegraph code signals through a continuously variable speed range of 0 to 350 words per minute when its input terminals are properly connected to the correct output terminals of any commercial or other type of radio receiver. It is also equally capable of recording the same type of signals when properly connected to an audio transmission line delivering signals from a radio receiving station. Similarly, it may be used to record signals from a local signal source, such as a code practice oscillator, when properly connected to its output terminals.

Code Tape Recorder RD-112/U is contained in a gray enameled steel case approximately 14 inches high by 19 inches wide by 13 1/2 inches deep. Its total uncrated weight is approximately 80 pounds and its cubic displacement approximately 2 1/2 cu. feet. A hinged lid, located on the case top, permits easy access to the interior of the unit. Defective vacuum tubes may be replaced through this opening without necessitating removal of the front panel and chassis. Recessed carrying handles are located on each side of the equipment case. The ink reservoir assembly, recording pen assembly, all controls, switches and indicators necessary for normal operation of the equipment are located on the front panel. The A.C. power receptacle and signal input terminals are located at the rear of the chassis. (J-102 and TB-101 respectively in Fig. 1-2 below.)

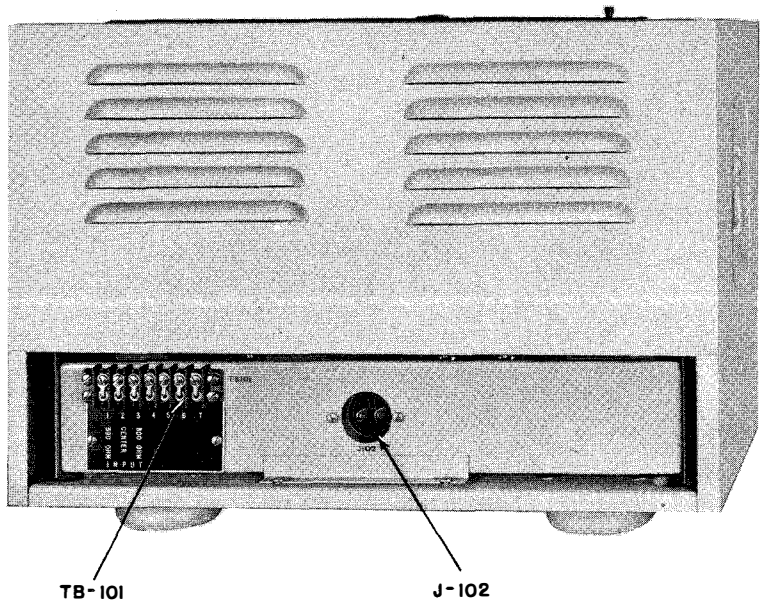


Figure 1-2. Code Recorder, Rear View

Code Tape Recorder RD-112/U is equipped with a Maintenance Kit located on the front panel of the instrument, attached by a hinge to the tape bin. The kit contains spare parts and special tools required for normal operational maintenance of the equipment. Three types of recording pens, each capable of producing a line of different width, are furnished with the instrument. The medium diameter pen is installed and properly adjusted at the manufacturer's plant prior to shipment. The narrow and wide line recording pens (O-114 and O-116 respectively) are contained in the Maintenance Kit. (See Fig. 1-3).

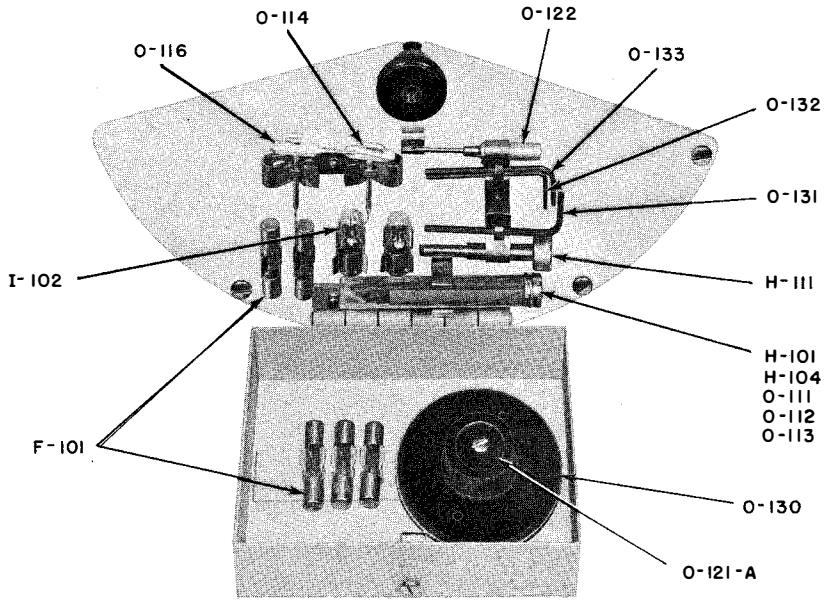


Figure 1-3. Maintenance Kit

Code Tape Recorder RD-112/U is shipped with all vacuum tubes and indicators installed in their proper sockets. The equipment is ready for immediate use following initial operational adjustments.

2. REFERENCE DATA

The following reference data is included as pertinent information:

a. Nomenclature. - Code Tape Recorder, RD-112/U.
b. Contract Number. - NObsr-52163 11 January 1951,
c. Contractor. - McElroy Manufacturing Corporation, Littleton, Mass.
d. Cognizant Naval Inspector. - Inspector of Naval Material, Boston, Mass.
e. Number of Packages Involved. - One (including equipment spares.)
f. Total Cubical Contents. - (including equipment spares)
Crated: 6.6 Cu. Ft.
Uncrated: 2.5 Cu. Ft.
g. Total Weight. - (including equipment spares)
Crated: 138 lbs.
Uncrated: 78 lbs.
h. Operating Frequency. - 500 to 5,000 cycles per second.
i. Input Impedance. - 300 ohm single; 600 ohm single; 600 ohm balanced line.
j. Input Sensitivity. - 0.075 volts.
k. Tape Speed. - 5 to 35 feet per minute.
l. Recording Speed. - 0 to 350 words per minute.

m. Tape Type. - Standard 3/8 inch wide recording tape.
n. Pen Stroke. - Adjustable 1/32 inch to 3/16 inch.
o. Input Power Requirements. - 115/230 volt, 50/60 cycle, single phase, A.C.
p. Power Consumption. - 95 volt/amperes.

TABLE 1-1. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	OVER-ALL DIMENSIONS			VOLUME	WEIGHT
			HEIGHT	WIDTH	DEPTH		
1	CODE TAPE RECORDER	RD-112/U	14	19	$16\frac{1}{2}$	2.5	78
1	POWER INPUT CABLE (W-101)						2.0
1	SPARE PARTS BOX		$2\frac{1}{2}$	4	$1\frac{1}{2}$		0.3
2	INSTRUCTION BOOK		$11\frac{1}{2}$	$8\frac{3}{4}$			3.0

NOTE: DIMENSIONS LISTED ABOVE ARE IN INCHES; VOLUME IN CUBIC FEET; AND WEIGHT IN POUNDS.

TABLE 1-2. EQUIPMENT REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	REQUIRED USE	REQUIRED CHARACTERISTICS
1 ROLL (8" DIA.)	TAPE, $\frac{3}{8}$", PAPER RECORDER	G53-P-21164	WRITING SURFACE FOR RECORDING PEN	100% VIRGIN BLEACHED CHEMICAL WOOD PULP, FREE FROM GROUND WOOD
8 OZ.	INK, ETERNAL BLACK FOUNTAIN PEN QUALITY	G53-I-1732	WITH RECORDING PENS	INK MUST BE OPAQUE & OF THE SUSPENSION TYPE

TABLE 1-3. SHIPPING DATA

SHIPPING BOX NO.	CONTENTS		OVER-ALL DIMENSIONS			VOLUME	WEIGHT
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	CODE TAPE RECORDER	RD-112/U	$20\frac{1}{4}$	$24\frac{1}{4}$	$23\frac{1}{4}$	6.6	138
	POWER INPUT CABLE (W-101)						
	SPARE PARTS BOX						
	INSTRUCTION BOOK						4.0

NOTE: DIMENSIONS LISTED ABOVE ARE IN INCHES; VOLUME IN CUBIC FEET; AND WEIGHT IN POUNDS.

TUBE

TABLE 1-4. VACUUM/COMPLEMENT

TUBE TYPE	FUNCTION	NO. PER UNIT
6AG5	PUSH-PULL AMPLIFIER	2
6AL5	SIGNAL RECTIFIER	2
6AQ5	POWER AMPLIFIER	2
6BA6	SIGNAL AMPLIFIER	2
6E5	SIGNAL LEVEL INDICATOR	1
6X4	FULL WAVE RECTIFIER	1

SECTION 2.

THEORY OF OPERATION

1. GENERAL.

Code Recorder, RD-112/U responds to pulses of audio frequency tone, such as radio telegraph code signals, and records them on tape by means of an electronic amplifier, an electro-mechanical recording mechanism, and a mechanical tape puller. The electronic circuit consists of an amplifier and limiter coupled to a signal rectifier which, in turn, is coupled to a two stage, push-pull voltage and power amplifier. The output power actuates the recording mechanism which applies ink to the moving tape. The mechanically operated tape puller consists of a variable speed tape drive mechanism powered by a synchronous motor.

NOTE

FOR THE CONVENIENCE OF THE OPERATOR OR TECHNICIAN, THE SERVICING BLOCK DIAGRAM, PRACTICAL WIRING DIAGRAM AND SCHEMATIC WIRING DIAGRAM, FIGURES 5-7, 5-8, AND 5-9 RESPECTIVELY, ARE SO PRINTED THAT THEY MAY BE KEPT IN VIEW ALONG WITH THE TEXT PROPER. THESE DIAGRAMS WILL BE FOUND AT THE REAR OF SECTION 5.

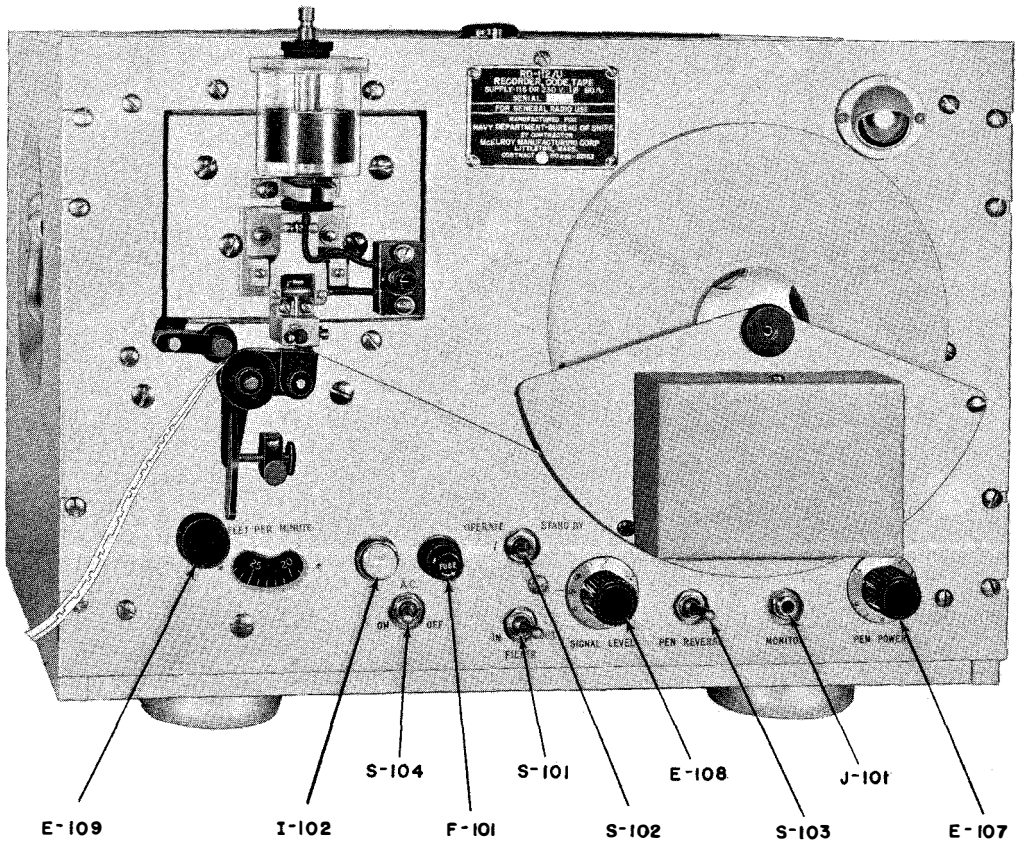


Figure 2-1. Code Recorder, Front View

2. CIRCUIT ANALYSIS.

a. INPUT STAGE. The input signal pulses are coupled through an isolation transformer T-101, to filter switch S-101. When S-101 is in the "IN" position, band pass filter Z-101 is connected between the secondary of T-101 and signal level control R-101. Band pass filter Z-101 offers a low impedance to signals of 1875 cycles per second with side bands of 150 c.p.s., and a higher impedance to signals outside of this total band width of 300 c.p.s. It is thus very useful in effecting a large reduction in response to spurious interfering signals and noise, such as might be present when recordings are being made directly from a radio receiver. When S-101 is in the "OUT" position, the secondary of T-101 is connected directly to signal level potentiometer R-101, and the recorder responds to signals over a wide range of audio frequencies. Coupling between R-101 and the control grid of V-101 is provided by C-101.

b. AMPLIFIER AND LIMITER. V-101 serves as signal voltage amplifier and limiter. In addition to a small self-bias provided by cathode resistor R-104, additional bias proportionate to signal strength is provided by means of a grid leak biasing system which maintains the plate voltage swing within fairly constant limits. Thus the output voltage is maintained at nearly the same level regardless of wide fluctuations of input voltage. The output signal is coupled to T-102 through C-104.

c. SIGNAL RECTIFIER. The secondary winding of T-102 is connected to the plates of V-102, a duo-diode, which performs the function of rectifying the signal voltage in a reasonably conventional full wave circuit. A negative pulse envelope appears at the secondary center tap of T-102 and a positive pulse envelope at the cathodes of V-102, which are connected together.

d. FIRST PUSH-PULL AMPLIFIER. Since the pulses appearing in the rectifier circuit are 180 degrees out of phase, they are applied directly to the control grids of the first push-pull amplifier tubes, V-103 and V-104. The negative pulse is applied to V-103 and the positive pulse to V-104. Since V-103 is operating at zero bias, it is normally conducting maximum current; V-104, operating at a fixed bias in its cathode circuit, is normally cut off.

e. SECOND PUSH-PULL AMPLIFIER AND OUTPUT STAGE. The plates of V-103 and V-104 are directly coupled through identical resistive networks to the control grids of the second push-pull amplifier tubes, V-105 and V-106 respectively. The grid bias of these tubes is therefore controlled by the plate voltage of the preceding tubes, V-103 and V-104. Since, during periods of quiescence, V-103 is conducting heavily due to zero bias and its plate voltage is low due to the IR drop across its load resistor R-114, a low positive voltage is present at the control grid of V-105, to which the plate of V-103 is directly coupled through R-116. During the same periods of quiescence, V-104 is cut off due to a fixed bias and its plate voltage is high as a result of no IR drop across its load resistor R-115. Thus, a high positive voltage is present at the control grid of V-106 to which the plate of V-104 is directly coupled through R-119. As a result of this high positive voltage, V-106 conducts heavily through cathode resistor R-120. Since R-120 is common to V-105 and V-106, the IR drop across it is sufficient to overcome the small positive voltage on the grid of V-105 and bias it to cut-off. Thus a signal pulse, appearing in the signal rectifier circuit, completely reverses this condition for the duration of the pulse. Output transformer T-103, with a center-tapped primary, provides the plate load for V-105 and V-106, and couples the signal to the recording coil. Since T-103 can only transfer energy while the primary current is changing, the signal pulse is differentiated and appears as two sharp pulses of opposite polarity. C-106 is connected across the primary of T-103 to suppress peak voltage surges caused by the interrupted nature of the current changes.

f. ELECTRO-MECHANICAL RECORDING MECHANISM. Reproduction of the original pulse envelope is accomplished by means of a magneto-mechanical-memory in the form of an armature mechanically coupled to the recording coil, and operating between two powerful magnetic poles. Its operation, in principle, is similar to that of the voice coil in a dynamic speaker. Mechanical motion of the coil is coupled to the pen through levers. When the first pulse arrives, the coil, armature and pen are driven to the limit of travel in one direction, and upon collapse of the pulse

are retained in position by the armature. The next pulse, being of opposite phase, drives the complete assembly back to its original position where it is held firmly until another signal pulse arrives.

g. SIGNAL LEVEL INDICATOR. Electron ray indicator I-101 (See Fig. 4-2 in Section 4), provides visual indication of the signal level and is used in conjunction with the selective input filter Z-101. The indicator responds to changes in signal level produced when the input signal frequency varies through the pass band of filter Z-101. When the input frequency is adjusted to 1875 c.p.s., (the design center frequency of the filter), indication is shown by maximum closure of the "eye" of electron ray indicator tube V-109. A portion of the filter output voltage is amplified by V-107 and rectified by V-108. The rectified voltage, which varies in accordance with the average signal level, is applied to the control grid of V-109.

3. TAPE DRIVE MECHANISM.

Code Recorder RD-112/U employs a variable speed tape drive mechanism to pull tape through the recording head. See Tape Drive Mechanism in Figure 5-4. The tape drive consists of a synchronous motor and cone assembly driving friction wheel O-130 which in turn operates tape friction wheel O-121. Rotation of tape speed control E-109 moves motor and cone assembly with respect to friction wheel O-130. With the tape speed control set for low speed operation, the relationship of the cone to the friction drive wheel will appear as shown in (A) of Fig. 2-2. With speed control set for high speed operation, the cone and disc will appear as in (B) of Fig. 2-2. Tape speed is dependent, therefore, upon the ratio of the effective diameter of the cone to the

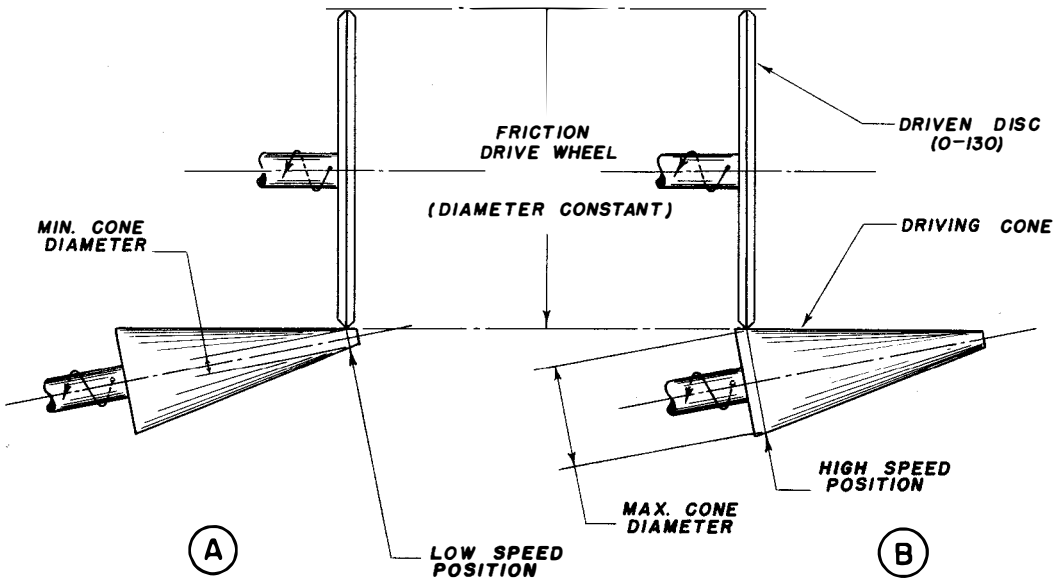


Figure 2-2. Principle of Speed Change Using Movable Cone Drive

fixed diameter of the friction drive wheel. Solenoid B-102 allows contact between the friction wheel O-130 and cone only when the recorder is in operation, thus preventing the development of flat spots on the rubber rim of this wheel. Direct current for operation of the solenoid is provided by selenium rectifier CR-101 and filter capacitor C-112.

SECTION 3.
INSTALLATION

1. UNPACKING.

Code Recorder RD-112/U is packed for overseas shipment. The recorder, blocked and braced with a wooden assembly protecting the front panel, is padded with cellular cardboard on all surfaces and boxed in a fibre-board container. This inner, sealed fibre-board box, with desiccant inside, and a sealed moisture-vapor-proof barrier outside, is packed in a wooden shipping container bound with metal straps. Excelsior is used as padding between the wooden shipping container and the outer fibre-board box. A location for unpacking should be selected where the unit will not be unduly exposed to dust, dirt and excessive moisture. Extreme care should be exercised when unpacking to assure that no damage is done to the equipment, several components of which are mounted externally.

CAUTION: DO NOT POUND OR HAMMER THE SHIPPING CONTAINER. DO NOT THRUST TOOLS SUCH AS PRYING BARS INTO THE INTERIOR OF THE CONTAINER.

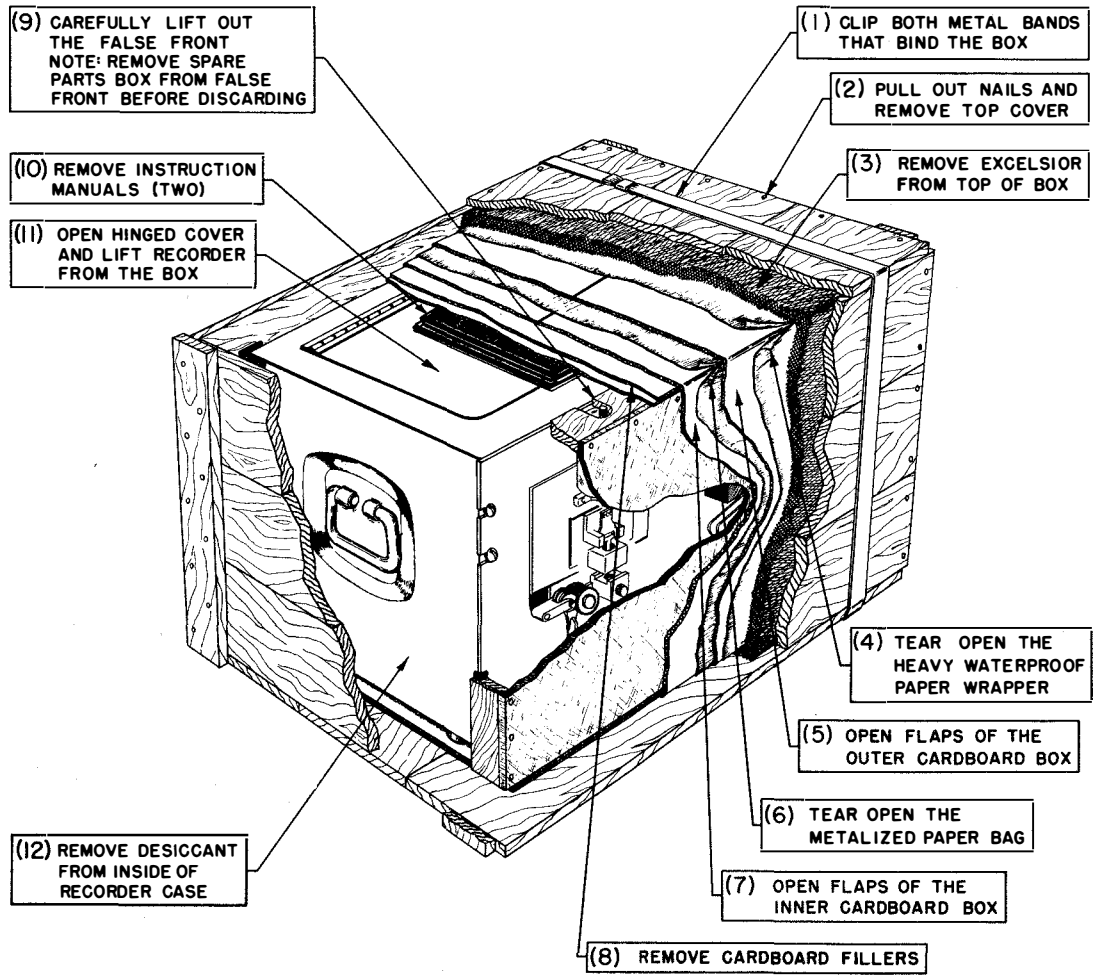


Figure 3-1. Code Recorder, RD-112/U Unpacking Procedure

2. LOCATING EQUIPMENT.

Code Recorder RD-112/U may be located on a table, bench or at a convenient height in a standard 19 inch Navy relay rack. It should be installed near a 115 or 230 volt, 50/60 cycle AC outlet. The operating location, however, need not necessarily be in close proximity to the signal source since the input terminals of the recorder may be connected to the signal source by any convenient length of cable. If it is anticipated, however, that one person may operate both signal source and recorder simultaneously, it may be desirable that the recorder be located near the signal source.

3. PRELIMINARY CAUTION.

Code Recorder RD-112/U operates with an input voltage of 115 volts or 230 volts, 50/60 cycles, alternating current. Rated line voltage and frequency must be correctly ascertained before attempting to operate the equipment. Toggle switch S-105, which adapts the recorder to either 115 or 230 volts input voltage, is located on top of the chassis directly behind power transformer T-104, and is accessible by lifting the hinged lid on top of the case. Switch S-105 is locked in the 115 volt position by clamp E-101 when it leaves the factory. (See Fig. 5-1). If the input voltage is known to be 115 volts, no adjustment will be necessary. If the input voltage is known to be 230 volts, remove clamp E-101 and move switch lever to the 230 volt position. Replace clamp E-101.

4. PRELIMINARY ADJUSTMENT OF OPERATING CONTROLS.

To facilitate the initial operation of the equipment, adjust front panel controls as indicated below. See Fig. 2-1 for identification of controls listed below.

(1) Speed control knob should be rotated counter-clockwise as far as possible. In this position, speed indicator should read approximately five feet per minute.

(2) AC power switch should be in the "OFF" position.

(3) OPERATE-STANDBY switch should be in the "STANDBY" position.

(4) FILTER switch should be in the "OUT" position.

(5) SIGNAL LEVEL control should be rotated counter-clockwise as far as possible. In this position, dial should read zero.

SECTION 4.
OPERATION

1. PRELIMINARY PROCEDURE.

Recorder RD-112/U is available for immediate operation as soon as power and signal input connections have been made and the ink reservoir has been filled with ink.

a. POWER CONNECTIONS. Power cable assembly W-101, packed with the equipment, is provided with a female receptacle on one end and a male plug on the other end. Plug the female receptacle into J-102, located at the rear of the chassis and insert male plug into previously selected AC outlet.

b. SIGNAL INPUT CONNECTIONS. Signal input connections are made to terminal board TB-101, located at the rear of the chassis. See Fig. 1-2. The recorder input impedance is 600 ohms, center tapped. With the center tap grounded, it may therefore be connected to match signal source output impedance of 600 ohms balanced to ground, 600 ohms single or 300 ohms single. Terminals 4, 5, 6 and 7 are unused, and are provided only for possible future use.

c. FILLING INK RESERVOIR.

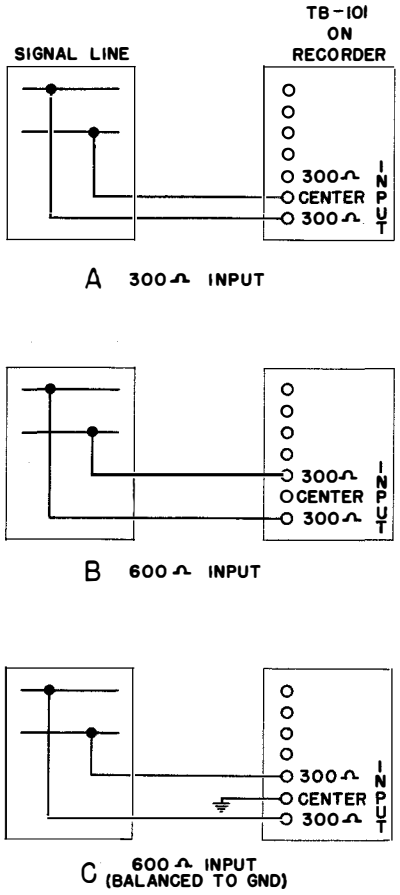


Figure 4-1. Recorder Input Connections

CAUTION

IRON SALT INKS AND CARBON BLACK DRAWING INK MAY CLOG THE INKING MECHANISM AND SHOULD BE USED ONLY WITH THE WIDELINE PEN, O-116.

NOTE

IF THE TAPE RECORDED IS TO BE USED LATER FOR RETRANSMISSION FROM A PHOTO-TUBE KEYER, INK-WELL SHOULD BE FILLED WITH GOOD QUALITY CARBON BLACK DRAWING INK. IF THE TAPE RECORDED IS ULTIMATELY TO BE USED FOR SIGHT READING, ANY GOOD QUALITY WRITING INK WILL BE ADEQUATE FOR USE WITH EITHER THE NARROW-LINE PEN O-114 OR WITH THE MEDIUM-LINE PEN O-115.

Before filling the inkwell, gently close needle valve O-135, (if not already closed), by rotating clockwise. See Fig. 4-3. As the taper of this valve is extremely shallow, very little pressure is required to stop the ink flow. Hose connections to the valve and pen should also be checked for tightness. Remove inkwell cover by first removing knurled thumbnut H-112 which holds cover in place, and half-fill inkwell with undiluted ink of fountain pen quality. Return inkwell cover and cover thumbnut H-112.

NOTE

A TINY VENT HOLE HAS BEEN PROVIDED IN THE COVER TO PREVENT THE BUILDING-UP OF A VACUUM WITHIN THE INK RESERVOIR. THE OPERATOR SHOULD TAKE CARE NOT TO BLOCK THIS HOLE WITH COVER THUMBNUT H-112.

2. STEP-BY-STEP OPERATING PROCEDURE.

(For identification of controls listed below, refer to Figures 2-1, 4-2, and 4-3.)

Step 1. Operate AC power switch S-104 to the "ON" position. Indicator light I-102, above and to the left of the power switch should now light. Allow approximately 45 seconds for the amplifier tubes to reach their normal operating temperature.

Step 2. Obtain a blank roll of standard 3/8 in. wide recorder tape and if warped, slam flat on a table top. Do not break the cemented seal securing the end of the tape to the roll. Loosen the

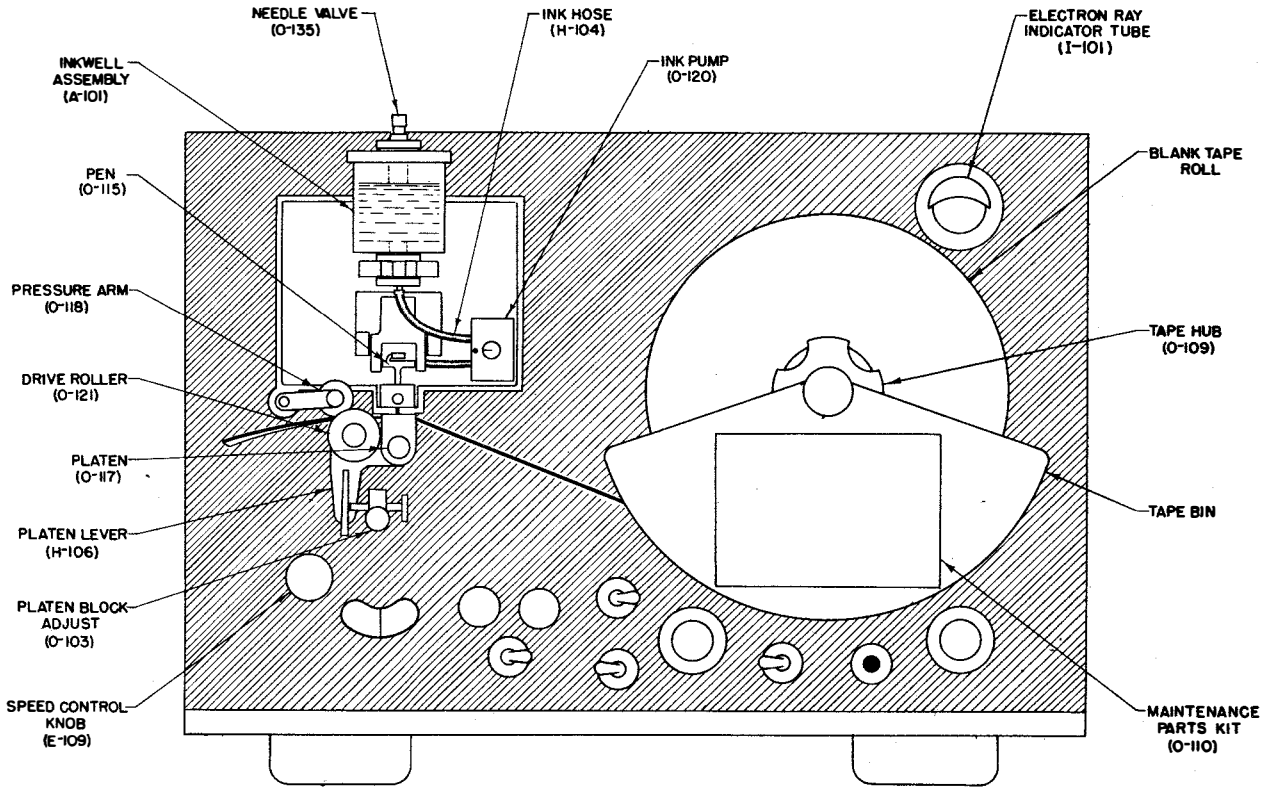


Figure 4-2. Recorder Front Panel Components

knurled thumbnut securing tape hub to the tape bin and remove the hub assembly. Press tape hub into the tape roll so that when tape is mounted, it will unwind in a clockwise direction. Place hub and tape roll in position in the tape bin and tighten hub thumbnut firmly. Correct tension has been built into the tape hub, making a fine adjustment of the thumbnut by the operator unnecessary.

Step 3. Throw OPERATE-STANDBY switch to the "OPERATE" position. The motion of the tape drive mechanism should now be audibly and visibly apparent.

Step 4. Break seal of tape roll and pull free several feet of tape to make certain that the tape unwinds readily. Tear off excess tape leaving approximately twelve inches of free blank tape for threading. Lift pressure arm O-118 from friction drive wheel O-121 moving it to its neutral position to the left. Rotate tape platen lever H-106 in a clockwise direction so as to lower tape platen O-117 away from the pen thereby providing an opening through which the tape can be threaded. Being careful not to engage the point of the recording pen, draw the tape over the tape platen lever and tape drive wheel. Gently return platen lever and pressure arm to their operating positions. As the pressure arm is spring-loaded, the tape will be forced against the rubber tire of the friction drive wheel by the pressure arm roller and consequently will be immediately pulled through the recording mechanism. Adjust tape speed as desired by operating tape speed control E-109.

Step 5. Open needle valve O-135 approximately two or three turns. If no obstruction exists in the ink supply network, and if the tape platen is correctly adjusted, an inked line should now appear on the tape. If no inked line appears and another turn of the valve does not remedy the condition, slowly rotate the ink pump control one complete revolution or until the white line on the control knob is aligned with the white dot visible through the plastic cover of ink pump O-120.

NOTE

OPERATOR SHOULD MAKE CERTAIN THAT THE ABOVE ALIGNMENT (SHOWN IN FIG. 4-3 BELOW) IS MAINTAINED DURING THE NORMAL OPERATION OF THE EQUIPMENT.

If the ink clog persists in spite of rotation of the ink pump control, clean the entire ink supply network as specified in paragraph 3 of this section.

Step 6. If there is evidence of ink flow, but the inked line is either too wet or scratchy, an adjustment of the tape platen lever is necessary. The tape platen adjustment is made by operating platen lever adjustment screw H-108, which is locked in position by locking screw H-107. Turn this adjustment screw in or out so as to produce the best possible record line, which under normal conditions will be when the point of the recording pen barely touches the tape.

Step 7. Advance the SIGNAL LEVEL control E-108 until the code signals are reliably recorded on the tape. If the SIGNAL LEVEL control is not advanced far enough, the pen may not faithfully follow the signal pulses. MONITOR jack J-101 is provided for use with high impedance headphones.

Step 8. Advance PEN POWER control E-107 only as far as is necessary to produce clear and accurate recordings. It may not be necessary to advance this control at all, as a minimum amount of pen power is provided even when the control is rotated fully in a counter-clockwise direction. If the pen power control is not advanced far enough, the force driving the pen will be insufficient to produce accurate recordings; if advanced too far, the pen will be driven with excessive force, thus subjecting the mechanism to unnecessary wear.

Step 9. If the coded characters appear on the tape upside-down as shown in (D) of Fig. 4-4, operate PEN REVERSE switch S-103 to its alternate position.

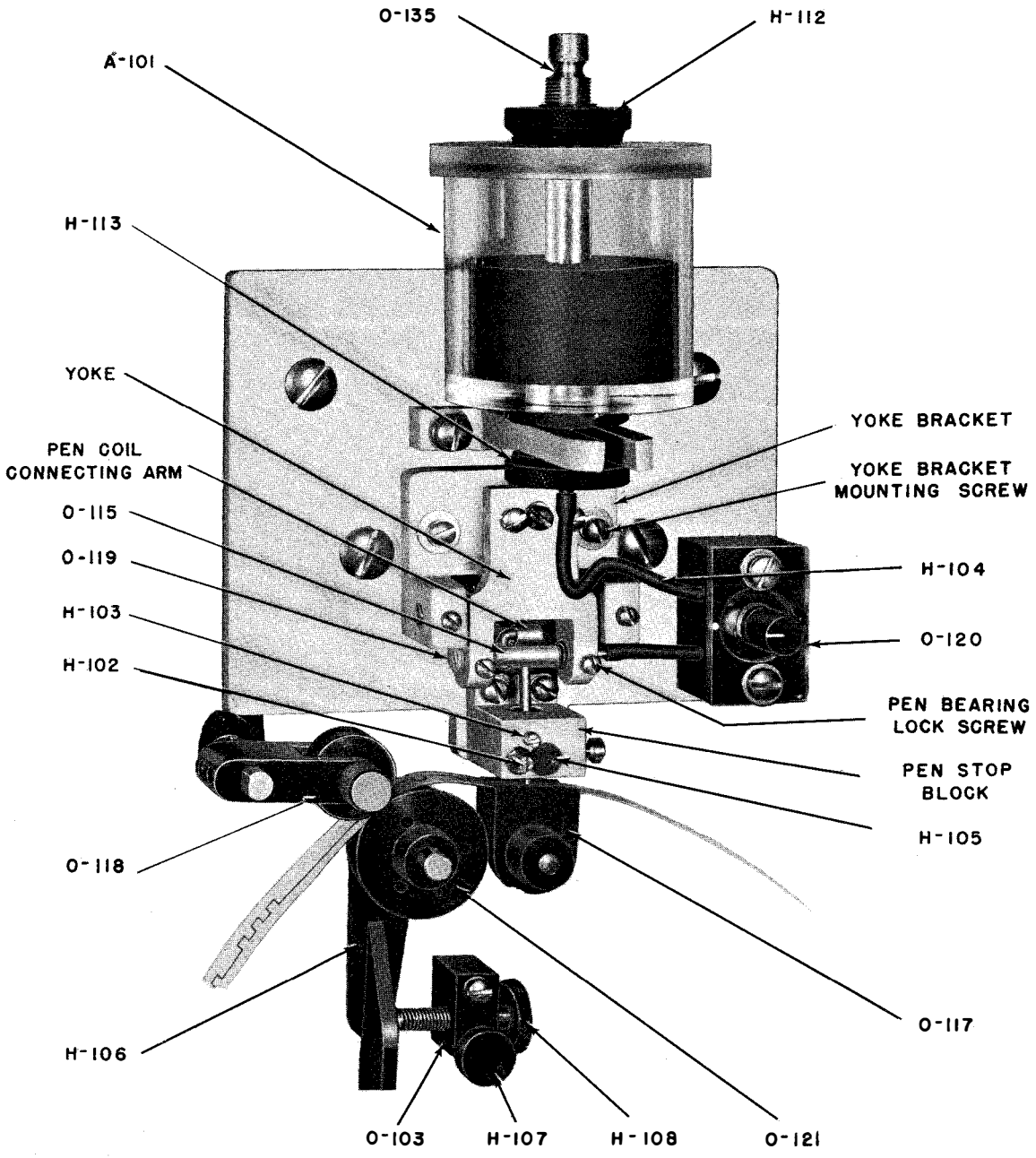


Figure 4-3. Recording Mechanism

Step 10. If the signal source is a radio receiver equipped with a Beat Frequency Oscillator and background noise causes undesirable distortion of the recorded signals, throw FILTER switch S-101 to the "IN" position. Tune receiver B.F.O. to give maximum closure of "magic eye" tube V-109 located at the upper right-hand corner of the RD-112/U front panel. Maximum closure of the "eye" indicates that the highest signal-to-noise ratio has been attained under the existing conditions of radio reception.

Step 11. Speed control knob E-109 is used to adjust tape travel to the speed of the signals being recorded. The recording speed should be so adjusted that the dot characters appear to be approximately square, which means that the horizontal and vertical lines representing a dot should be equal in length. If the recorder's tape speed is correctly synchronized with the input signal, the

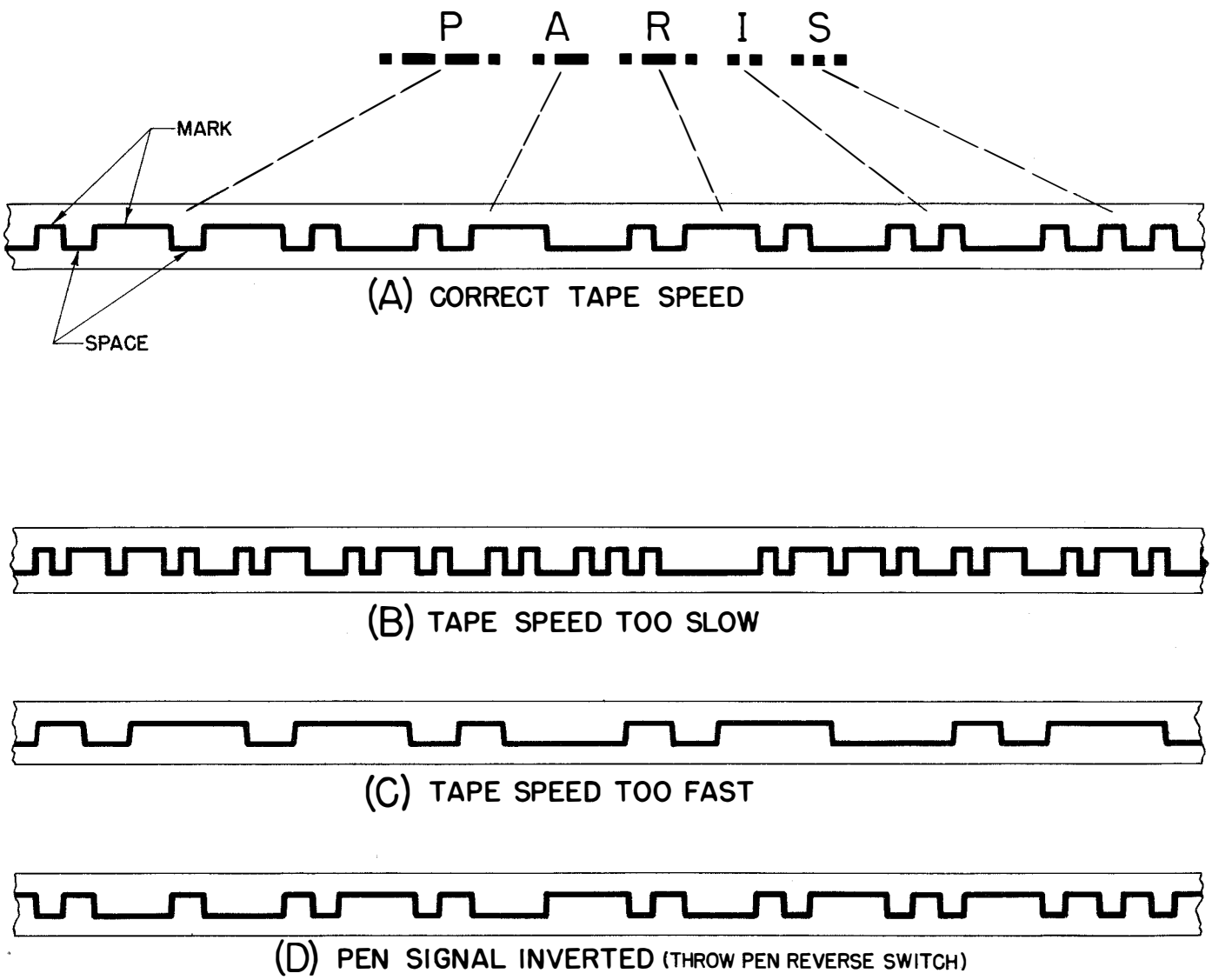


Figure 4-4. Recorded Signals

record line should appear as in (A) of Fig. 4-4 above. If the recording speed is either too slow or too fast with respect to the input signal, the transcription will appear as in (B) and (C) respectively of Fig. 4-4. A detent has been provided at a tape speed of 25 feet per minute and is easily detectable by the operator when the tape speed is varied through a speed of 25 feet per minute as indicated on the calibrated dial to the right of the speed control knob.

Step 12. The method of stopping the recorder is determined by the period of time that the recorder is expected to be out of service.

(1) If the recorder is being used to record intermittent transmissions with time intervals of less than one hour between transmissions, and it is desirable that the equipment be ready for immediate use the instant a new transmission begins, throw OPERATE-STANDBY switch to the "STANDBY" position at the termination of each recorded transmission. This removes power from the tape drive motor and the recording pen while allowing the amplifier tubes to maintain normal operating temperature. If the above procedure is used in shutting down the recorder, the unit will be ready for use as soon as the OPERATE-STANDBY switch is returned to the "OPERATE" position.

(2) If it is expected that the recorder will be out of service for a period of several hours, operate AC power switch to the "OFF" position. Gently close needle valve O-135. If this sequence of operations is followed, the ink hose and recording pen will remain filled with ink during the shutdown period. To resume normal operation, open needle valve and return AC power switch to the "ON" position. If an ink clot appears to have developed during the shutdown period, one complete turn of the ink pump knob should break the clotted seal and restore normal ink flow.

(3) If it is anticipated that the recorder will be out of service for a period of 24 hours or longer, close the needle valve at the termination of the final recorded transmission allowing the tape to continue running until the ink has been exhausted from the pen and hose. When the record line no longer appears on the tape, operate AC power switch to the "OFF" position and clean the recording mechanism as specified in paragraph 3 below.

3. CLEANING INKWELL ASSEMBLY AND INK HOSE.

As a clean ink supply network is essential for the maintenance of adequate ink flow, the inkwell, valve assembly and hose should be periodically washed in fresh lukewarm water.

CAUTION

DO NOT USE ALCOHOL, CARBON TETRACHLORIDE, GASOLINE, OR ANY OTHER SOLVENT FOR CLEANING THE INKWELL.

To remove the inkwell assembly; close needle valve O-135, pull ink hose from pen, (do not lose the small plastic bushing which insures a tight joint between hose and pen), pull hose through ink pump O-120 and remove inkwell assembly by loosening knurled mounting nut H-113. It is not necessary to clean the ink pump. Remove reservoir cover and pour out the ink. Disconnect hose from reservoir, disassemble valve (being careful not to lose valve spring), and wash hose, valve, and reservoir. Reassemble inkwell components, thread hose through ink pump starting at the bottom hole, and connect with valve.

4. CLEANING RECORDING PEN.

Two methods of cleaning the recording pens are available to the operator. (See a and b below). One is generally used when shutting-down the equipment; the other method being generally employed before the unit is to be put back into operation. Either method may, however, be substituted for the other or in addition to the other if considerable ink clotting is encountered.

a. PEN CLEANING ON SHUT-DOWN. Pull ink hose from pen, remove spare ink hose from plastic bottle in maintenance equipment kit (H-104 in Fig. 1-3), and connect to pen. After adequate precaution has been taken against ink spatter, blow out all ink from pen using spare ink hose as a mouth-piece. Return spare hose and connect old ink hose to pen.

b. PEN CLEANING PRIOR TO OPERATION. Pull ink hose from pen. If the medium diameter recording pen is being used, select the 0.008 inch diameter cleaning wire (O-111) which has been provided in the plastic bottle in the maintenance kit. Introduce this wire at the hose end of the pen and carefully draw the wire through the capillary tubing of the pen. Repeat the above procedure several times until wire runs through the pen smoothly. Return cleaning wire to parts kit and ink hose to pen.

5. PEN REPLACEMENT. STEP-BY-STEP PROCEDURE.

Step 1. Press platen lever to the left and remove platen by grasping the knurled finger grip and pulling forward. It is held in position by a spring-loaded ball detent which releases easily when pulled forward.

Step 2. Remove both screws securing the pen stop block assembly and with platen lever still pressed to the left, lower the block until clear of the pen.

Step 3. Exhaust ink from pen and hose by rotating the ink pump control knob several revolutions in a counter-clockwise direction. Close the needle valve.

Step 4. Remove the ink hose from the recording pen being careful not to lose the small plastic bushing. Place the bushing aside for use with the replacement pen.

Step 5. Remove both yoke bracket mounting screws and carefully slide the entire assembly to the left thereby disengaging the pen from the pen coil arm. See Fig. 4-3.

Step 6. Loosen the pen bearing locking screw securing the pen bearing at the hose end of the pen and with special bearing tool H-111, (shown in Fig. 1-3) remove pen bearing O-119.

NOTE

IT IS NOT NECESSARY TO REMOVE THE LEFT-HAND BEARING. SLIDE THE PEN TO THE RIGHT UNTIL IT IS CLEAR OF THE LEFT BEARING AND CAREFULLY LOWER THE LEFT END OF THE PEN UNTIL CLEAR OF THE YOKE.

Step 7. Before mounting the replacement pen, lubricate the pivoting surfaces of both pen bearings with a thin film of graphite grease or vaseline as specified in Fig. 5-4.

Step 8. Mount the replacement pen in position, replace the pen bearing, and adjust with the bearing tool until all end-play is eliminated without binding the pen in its normal travel. When this fine adjustment has been completed, tighten the locking screw previously loosened in Step 6.

Step 9. Mount the yoke bracket assembly, making certain to engage the pen coil connecting arm with the pen, and replace the yoke bracket mounting screws. Do not tighten the screws completely, however, as adjustment of the yoke bracket is usually necessary after the pen stop block has been mounted.

Step 10. Slide the pen stop block carefully over the pen point and upward into mounting position. Be sure that the block is horizontally and vertically positioned before tightening the mounting screws.

Step 11. While moving the pen through its normal travel, adjust the yoke bracket so as to reduce all binding to a minimum in the coil connecting arm linkage. The pen should be approximately centered in the pen stop block. When properly adjusted, tighten the yoke bracket mounting screws.

NOTE

IF DESIRED, THE YOKE BRACKET MAY BE ADJUSTED WHILE A SIGNAL IS BEING APPLIED, THUS ELIMINATING THE NECESSITY OF MOVING THE PEN MANUALLY.

Step 12. Press platen lever to the left and remount the platen, making certain that it is held in place by the spring-loaded ball detent.

Step 13. Thread the tape, start the ink flow, adjust the platen and record signals in accordance with the Step-By-Step Operating Procedure, paragraph 2 of this section.

Step 14. If the recorded signals are not centered on the tape and the vertical lines are shorter than before, adjustment is made while the recorder is operating by means of the three screws at the top of the pen yoke. See Tape Drive Mechanism in Fig. 5-4. Loosen the screws slightly, move the top of the yoke inward or outward until the recorded signals are centered, and gently tighten the three screws.

6. PEN STROKE ADJUSTMENT.

The stroke of the recording pen is adjustable to any value between 1/32 inch and 3/16 inch. Adjustable stops H-105, located in the pen stop block assembly, apply mechanical damping to the pen and limit its travel. Stroke adjustment is made while the recorder is operating. Loosen both locking screws located at the right side of the pen stop block and adjust the pen stops by turning adjusting bolts H-102 and H-103. See Fig. 4-3. When the adjustment has been made, secure the pen stops by tightening both locking screws.

SECTION 5.
MAINTENANCE

1. OPERATOR'S ROUTINE CHECK LIST.

At the beginning of each watch, prior to operation of the equipment the operator should make the following precautionary checks, and perform whatever correctional measures are necessary.

a. INKWELL SEDIMENT. If sediment has accumulated at the bottom of the inkwell, remove the inkwell, clean thoroughly as directed in paragraph 3 of Section 4, and refill with fresh ink.

b. CLOGGED PEN. If the pen appears to be clogged, remove the hose from the pen and clean in accordance with instructions given in paragraph 4 of Section 4.

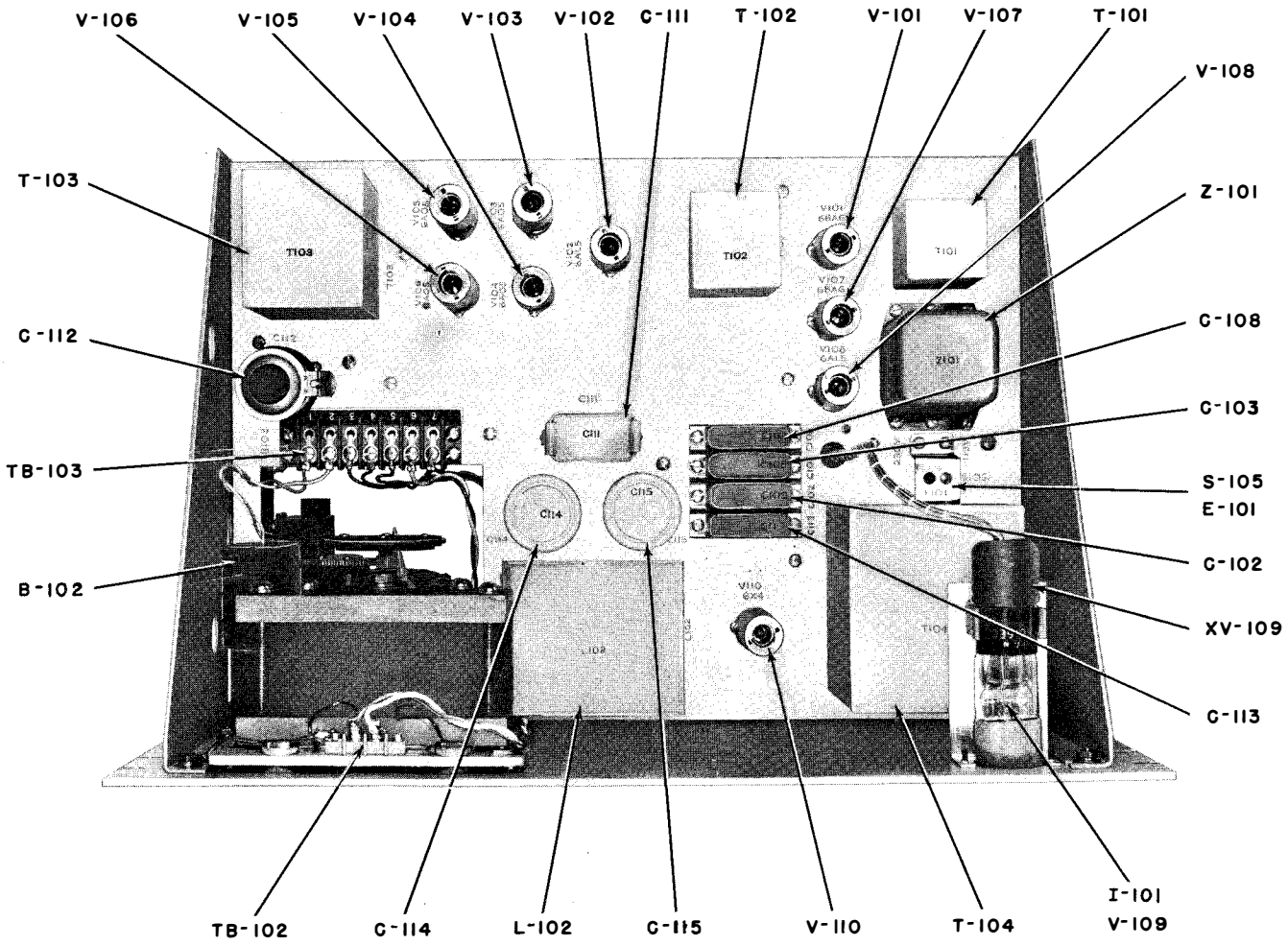


Figure 5-1. Recorder Top View, Cabinet Removed

NOTE

WHEN AN EMERGENCY EXISTS, AND THE PEN CANNOT BE READILY CLEANED, REPLACE IT IMMEDIATELY WITH THE LARGEST SIZE PEN.

c. EXCESSIVE PEN BEARING END-PLAY. While the pen should not bind in its normal travel, neither should it be so free that play between the pen and the bearings is noticeable. Using bearing tool H-111 found in maintenance kit, (See Fig. 1-3), tighten pen bearings until end-play is eliminated, making sure that the pen does not bind.

d. LOOSE CONTROLS. If any of the above components appear to be abnormally loose due to apparent slippage of locking screws, tighten with appropriate tool found in the maintenance kit.

e. BINDING CONTROLS. If binding or excessive tightness of a part is obviously caused by the part having moved due to a loose locking screw, readjust and tighten the locking screw. If, however, binding is due to any other cause, notify the technician.

2. OPERATOR'S EMERGENCY MAINTENANCE.

NOTICE TO OPERATORS

IN THE EVENT OF AN EMERGENCY, OR WHEN PROPERLY AUTHORIZED TO DO SO IN THE ABSENCE OF A TECHNICIAN, THE FOLLOWING MAINTENANCE PROCEDURES MAY BE PERFORMED BY THE OPERATOR.

a. TUBE REPLACEMENT. Code Recorder RD-112/U has a tube complement of ten tubes, nine of which are mounted on top of the chassis under tube shields. They are accessible through the top of the case when the hinged lid is lifted. Before tubes can be replaced, the tube shields must be removed by pushing them downward, turning counter-clockwise and lifting. The most common tube defect is a burned-out filament. Any tube which does not exhibit a red or yellow glow, and does not feel warm to the touch, probably has a burned-out filament. Replace all of such tubes with one of the same type known to be good. Tubes may have other defects which cannot be detected by sight or touch by an inexperienced person. If a faulty tube is suspected and all tubes are lit, replace them all, one by one, with new ones of the same type known to be good.

NOTE

IF THE RECORDER IS BEING OPERATED WITH THE FILTER "OUT", V-107 MAY BE USED TO REPLACE V-101, AND V-108 MAY BE USED TO REPLACE V-102. SEE FIG. 5-1.

b. FUSE REPLACEMENT. A fuse is a protective device which burns out when equipment is subjected to a temporary or permanent condition of overload. Fuse F-101 protects the recorder against such overloads and is located in fuseholder XF-112 on the front panel to the right of the panel lamp. F-101 may be removed by turning the knurled knob of the fuseholder counter-clockwise and pulling forward. Replacement fuses of the same type are located in the maintenance kit mounted on the tape bin.

WARNING

NEVER REPLACE A FUSE WITH ONE OF HIGHER CURRENT RATING UNLESS CONTINUED OPERATION OF THE RECORDER IS MORE IMPORTANT THAN PROBABLE DAMAGE. IF A FUSE BURNS OUT IMMEDIATELY AFTER REPLACEMENT, DO NOT REPLACE A SECOND TIME UNTIL THE CAUSE HAS BEEN DETERMINED AND CORRECTED.

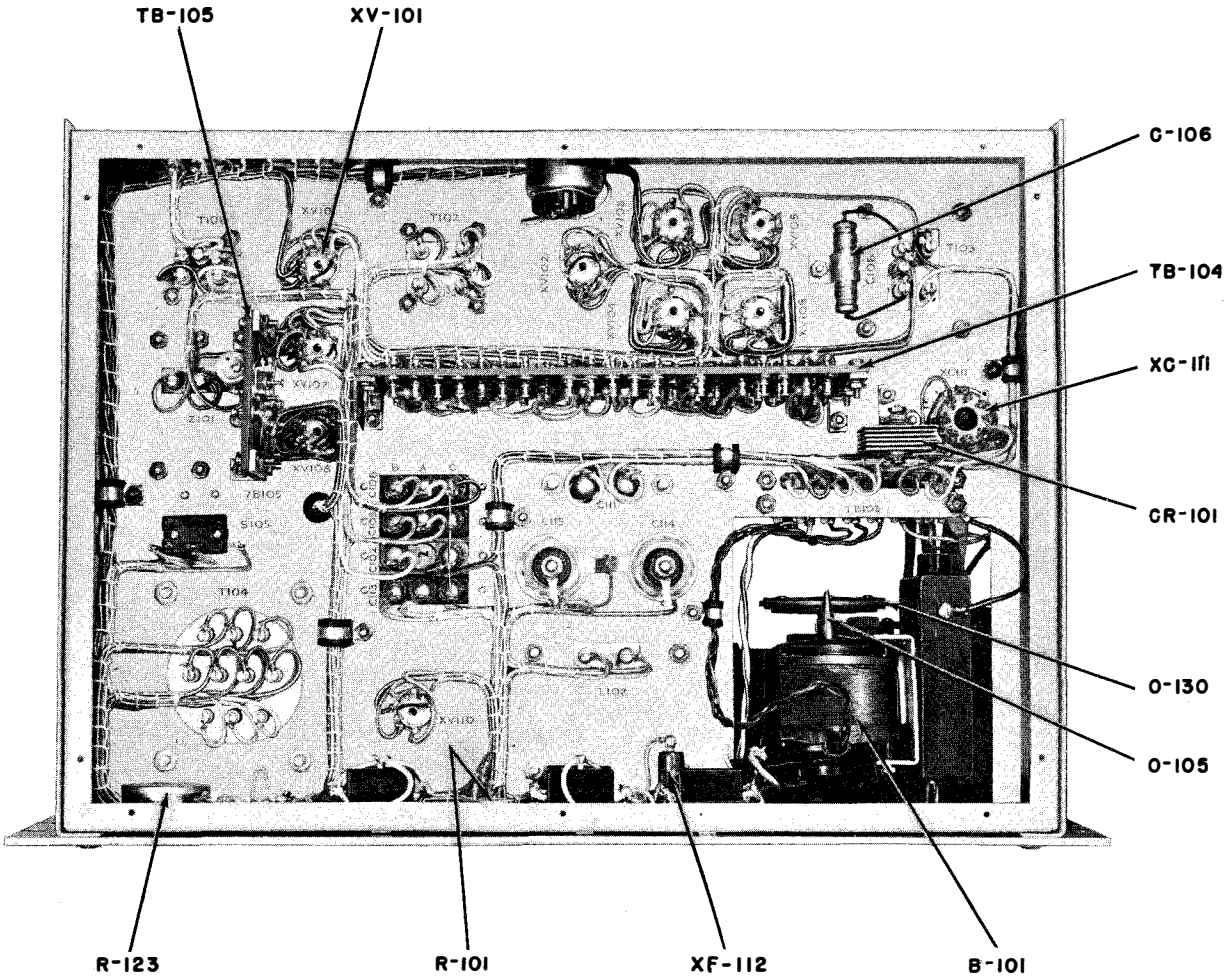


Figure 5-2. Recorder Bottom View, Cabinet & Base Plate Removed

3. PREVENTIVE MAINTENANCE.

NOTE

THE ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO THE REQUIREMENTS OF CHAPTER 67 OF THE *BUREAU OF SHIPS MANUAL*, OF THE LATEST ISSUE.

a. GENERAL. Preventive maintenance includes any and all procedures which tend to prevent failure of equipment during operation. It consists of visual inspection, testing of components, replacement of components when necessary, adjustments, lubrication and cleaning of the equipment.

TABLE 5-1. ROUTINE MAINTENANCE CHECK CHART. UNDERWAY - EACH WATCH

WHAT TO CHECK	HOW TO CHECK	PRECAUTIONS
1. Tape supply	a. Check amount of tape remaining. b. Check for warped tape roll. If this condition exists, remedy as specified in Section 4.	a. Be alert for colored tape section indicating end of roll. b. Irregular tape feed will prevent proper recording.
2. Ink supply	a. Check amount of ink remaining. b. Check for evidence of sediment. If this condition exists, remedy as specified in Section 4.	a. Ink level must be above feed hole in valve sleeve. b. Ink supply network may become clogged.
3. Ink pump control	Index line on pump control knob must point toward white dot on plastic front of pump.	Misalignment may impede or prevent ink flow.
4. Signal Level control	With normal signal input to the equipment and with the recorder amplifier in operating condition, pen should be actuated with less than maximum rotation of the Signal Level control.	If control setting is too low, recording may be intermittent.
5. Pen Power control	a. Vertical rise of recorded line may be rounded. b. Evidence of ink spatter on the tape.	a. Pen Power inadequate - rotate control clockwise. b. Pen Power excessive - rotate control counter clockwise.
6. Input Signal	Plug high-impedance headphones into Monitor jack. If excessive noise interference is present, move Filter switch to the "IN" position and tune receiver B.F.O. for maximum closure of "magic eye" tube, V-109.	If audio frequency of input signal does not correspond to pass band of filter Z-101, no recording will be possible.
7. Filter switch	If switch is in the "IN" position, tune receiver B.F.O. for maximum closure of V-109.	Interference may cause erratic or spurious recording. Receiver B.F.O. should be tuned for maximum closure of V-109.

b. STEP-BY-STEP PROCEDURE. The following step-by-step procedure should be carried out monthly:

Step 1. Check all electron tubes with a reliable, mutual conductance type tube tester. Replace any tube which indicates poor emission, low transconductance, heater to cathode leakage or shorts.

Step 2. Check the signal-level and pen-power potentiometers for roughness and worm spots. Replace if there is evidence of wear.

Step 3. Inspect all fixed resistors for evidence of overheating. Replace any which appear to be blistered.

Step 4. Inspect all molded tubular capacitors for cracks in the molded case. Replace any showing such cracks. See Fig. 5-3 for resistor, capacitor location.

Step 5. Examine all oil-filled capacitors for oil leaks. Replace any which are leaking oil.

Step 6. Examine C-112 for electrolyte leakage. Replace if there is evidence of leakage.

Step 7. Examine output and power transformers (T-103 and T-104 respectively) for evidence of overheating such as leaking wax. Replace if necessary.

Step 8. Check the drive motor mounting screws for tightness. Tighten if necessary.

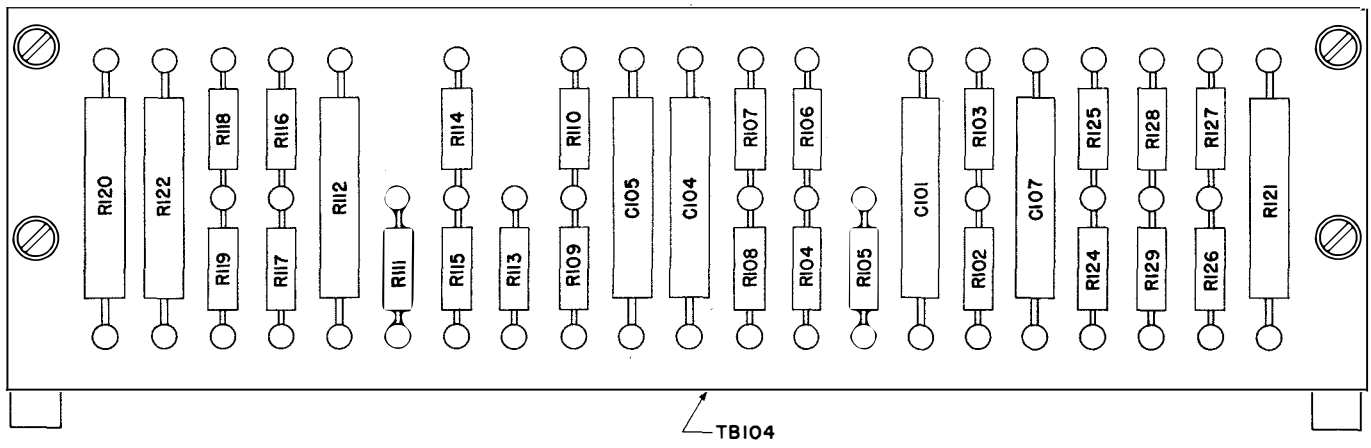
Step 9. Check cone O-105 and rim of the friction wheel O-130 for grease or oil film on the surface. See Fig. 5-2. Clean with carbon tetrachloride.

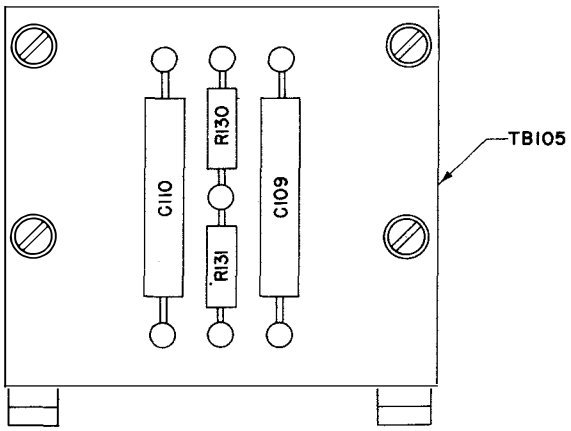
Step 10. Check both friction wheels, gears, shafts and bearings for excessive wear. If necessary, replace with a spare and if none is available, order a replacement.

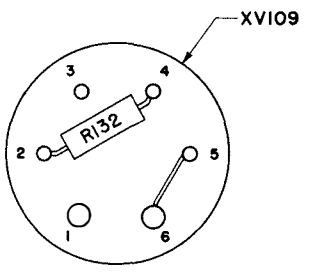
Step 11. Check the pen drive assembly for excessive tightness or looseness. Readjust if necessary.

Step 12. Clean the entire unit inside and out with compressed air and soft, dry, unused paint brush.

Step 13. Inspect all soldered and screw-type electrical connections.



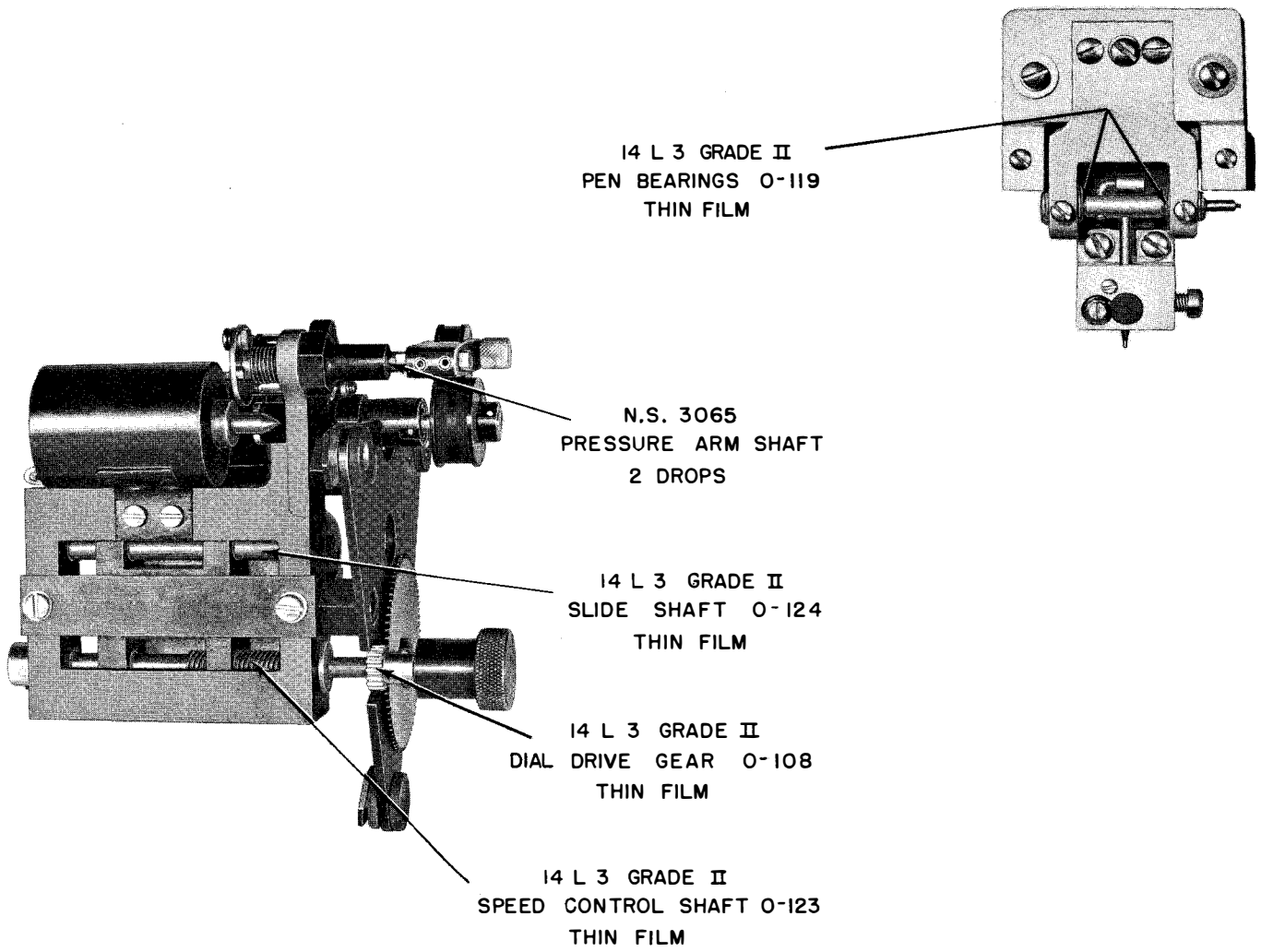




NOTE: R132 IS LOCATED IN BASE SOCKET OF ELECTRON RAY INDICATOR TUBE V109

Figure 5-3. Component Location Diagram

c. LUBRICATION. Lubricate all points as referenced in Fig. 5-4 below, semi-annually.



NAVY LUBRICANT		FEDERAL STANDARD STOCK CATALOG						NEAREST COMMERCIAL LUBRICANT
SPECIFICATION	TITLE	5-GAL.	55-GAL.	10-LB.	25-LB.	100-LB.	400-LB.	
N.S. 3065	LUBRICATING OIL	14-0-2663-8	14-0-2663-5					S.A.E. * 30 MOTOR OIL
14L3 GRADE II	LUBRICATING MINERAL GREASE							DOW-CORNING *44 MEDIUM SILICONE-GR.

Figure 5-4. Lubrication Data: Pen Mechanism; Tape Drive Mechanism

FAILURE REPORTS

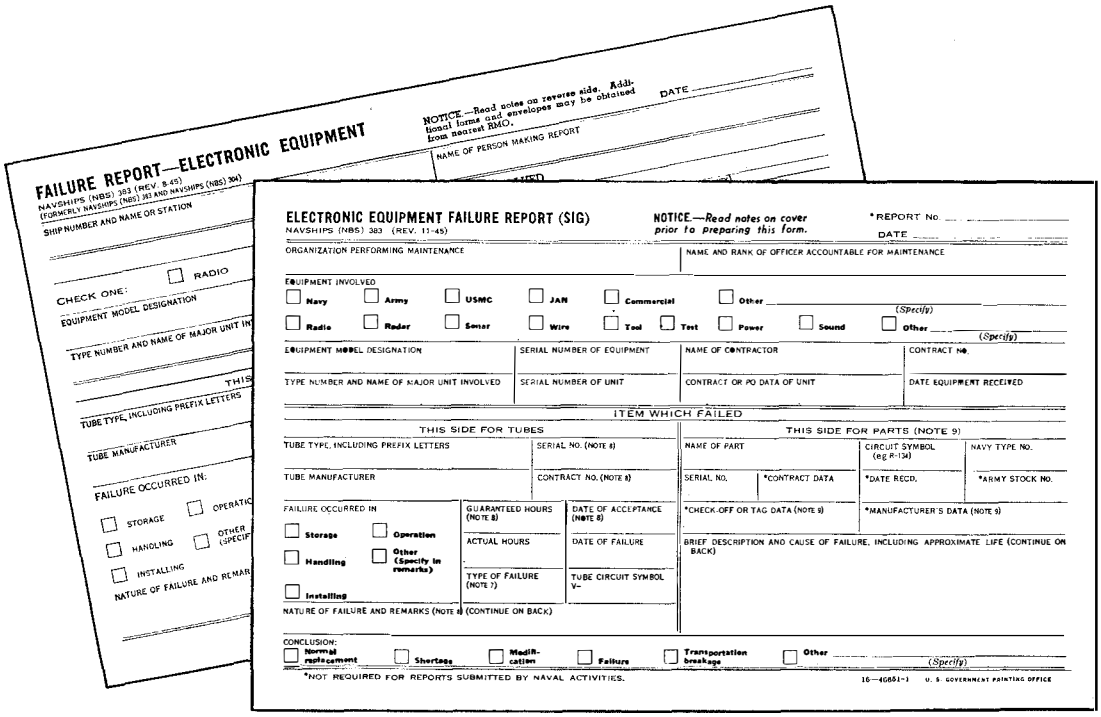
A failure report must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report form NAVSHIPS 383, which has been designed to simplify this requirement; The card must be filled out and forwarded to BUSHIPS. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-103, in the case of a transformer, or R-107, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from the nearest district printing or publications office.



FAILURE REPORT—ELECTRONIC EQUIPMENT
NAVSHIPS (NBS) 383 (REV. 8-45) (FORMERLY NAVSHIPS (NBS) 383 AND NAVSHIPS (NBS) 384)
SHIP NUMBER AND NAME OR STATION
CHECK ONE: RADIO
EQUIPMENT MODEL DESIGNATION
TYPE NUMBER AND NAME OF MAJOR UNIT IN
TUBE TYPE, INCLUDING PREFIX LETTERS
TUBE MANUFACTURER
FAILURE OCCURRED IN:
STORAGE OPERATIC
HANDLING OTHER (SPECIF
INSTALLING
NATURE OF FAILURE AND REMAR
NOTICE—Read notes on reverse side. Additional forms and envelopes may be obtained from nearest RMO.
DATE
NAME OF PERSON MAKING REPORT

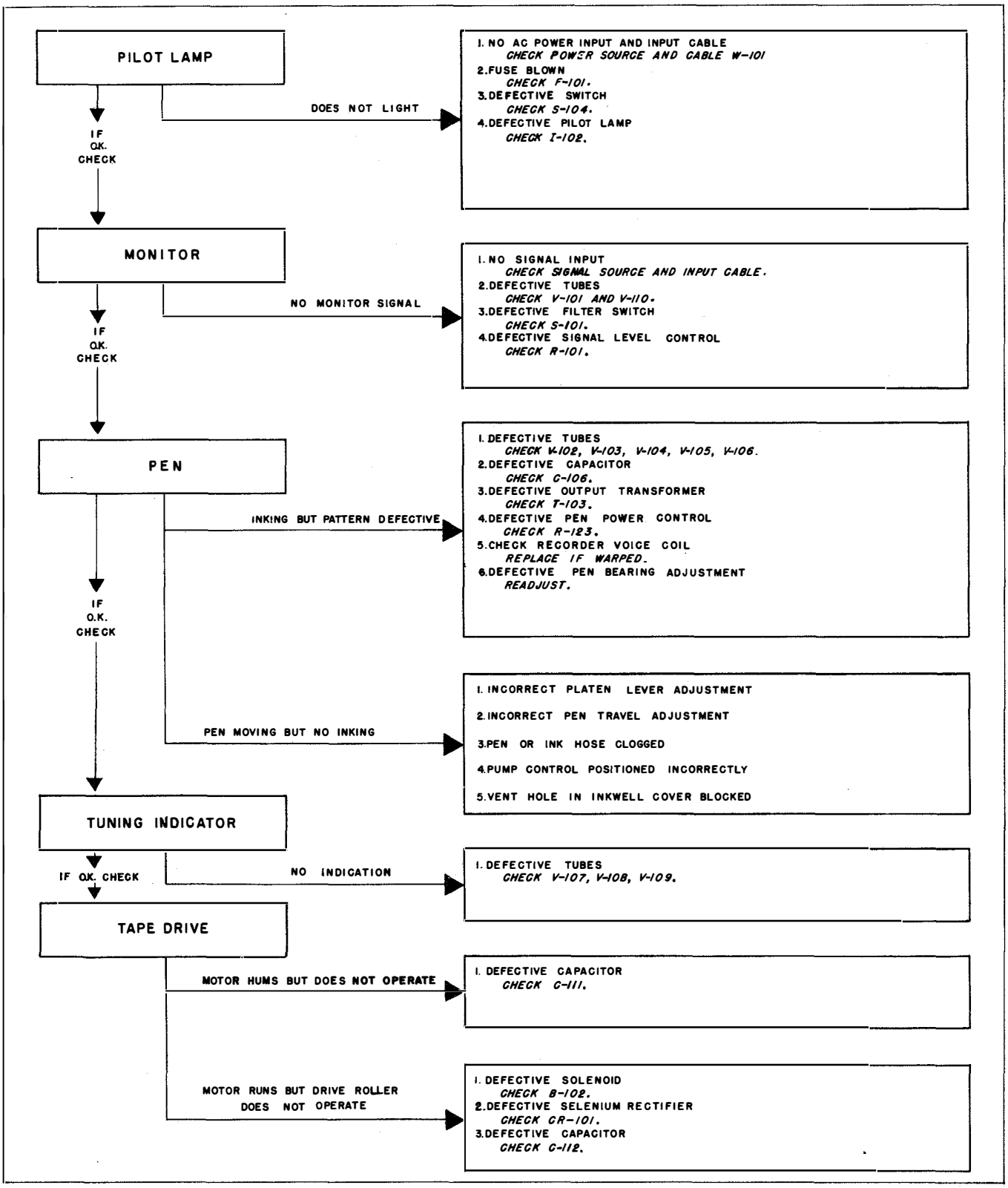
ELECTRONIC EQUIPMENT FAILURE REPORT (SIG)
NAVSHIPS (NBS) 383 (REV. 11-45)
NOTICE—Read notes on cover prior to preparing this form.
*REPORT NO.
DATE
ORGANIZATION PERFORMING MAINTENANCE
NAME AND RANK OF OFFICER ACCOUNTABLE FOR MAINTENANCE
EQUIPMENT INVOLVED
Navy Army USMC JAN Commercial Other (Specify)
Radio Radar Sonar Wire Tool Test Power Sound Other (Specify)
EQUIPMENT MODEL DESIGNATION | SERIAL NUMBER OF EQUIPMENT | NAME OF CONTRACTOR | CONTRACT NO.
TYPE NUMBER AND NAME OF MAJOR UNIT INVOLVED | SERIAL NUMBER OF UNIT | CONTRACT OR PO DATA OF UNIT | DATE EQUIPMENT RECEIVED
ITEM WHICH FAILED
THIS SIDE FOR TUBES
TUBE TYPE, INCLUDING PREFIX LETTERS | SERIAL NO. (NOTE 6)
TUBE MANUFACTURER | CONTRACT NO. (NOTE 8)
FAILURE OCCURRED IN: Storage Operation Handling Other (Specify in remarks) Installing
GUARANTEED HOURS (NOTE 8) | DATE OF ACCEPTANCE (NOTE 8)
ACTUAL HOURS | DATE OF FAILURE
TYPE OF FAILURE (NOTE 7) | TUBE CIRCUIT SYMBOL V-
NATURE OF FAILURE AND REMARKS (NOTE 8) (CONTINUE ON BACK)
THIS SIDE FOR PARTS (NOTE 9)
NAME OF PART | CIRCUIT SYMBOL (e.g. R-134) | NAVY TYPE NO.
SERIAL NO. | *CONTRACT DATA | *DATE RECD. | *ARMY STOCK NO.
*CHECK-OFF OR TAG DATA (NOTE 9) | *MANUFACTURER'S DATA (NOTE 9)
BRIEF DESCRIPTION AND CAUSE OF FAILURE, INCLUDING APPROXIMATE LIFE (CONTINUE ON BACK)
CONCLUSION: Normal replacement Shortage Modification Failure Transportation breakage Other (Specify)
*NOT REQUIRED FOR REPORTS SUBMITTED BY NAVAL ACTIVITIES.
16—40851-1 U. S. GOVERNMENT PRINTING OFFICE

Figure 5-5. Failure Report, Sample Forms

4. CORRECTIVE MAINTENANCE.

a. FAILURE REPORTS. Failure reports are required on the repair of this equipment. Complete information and instructions on this procedure is outlined in Figure 5-5.

Table 5-2 Trouble Shooting Chart

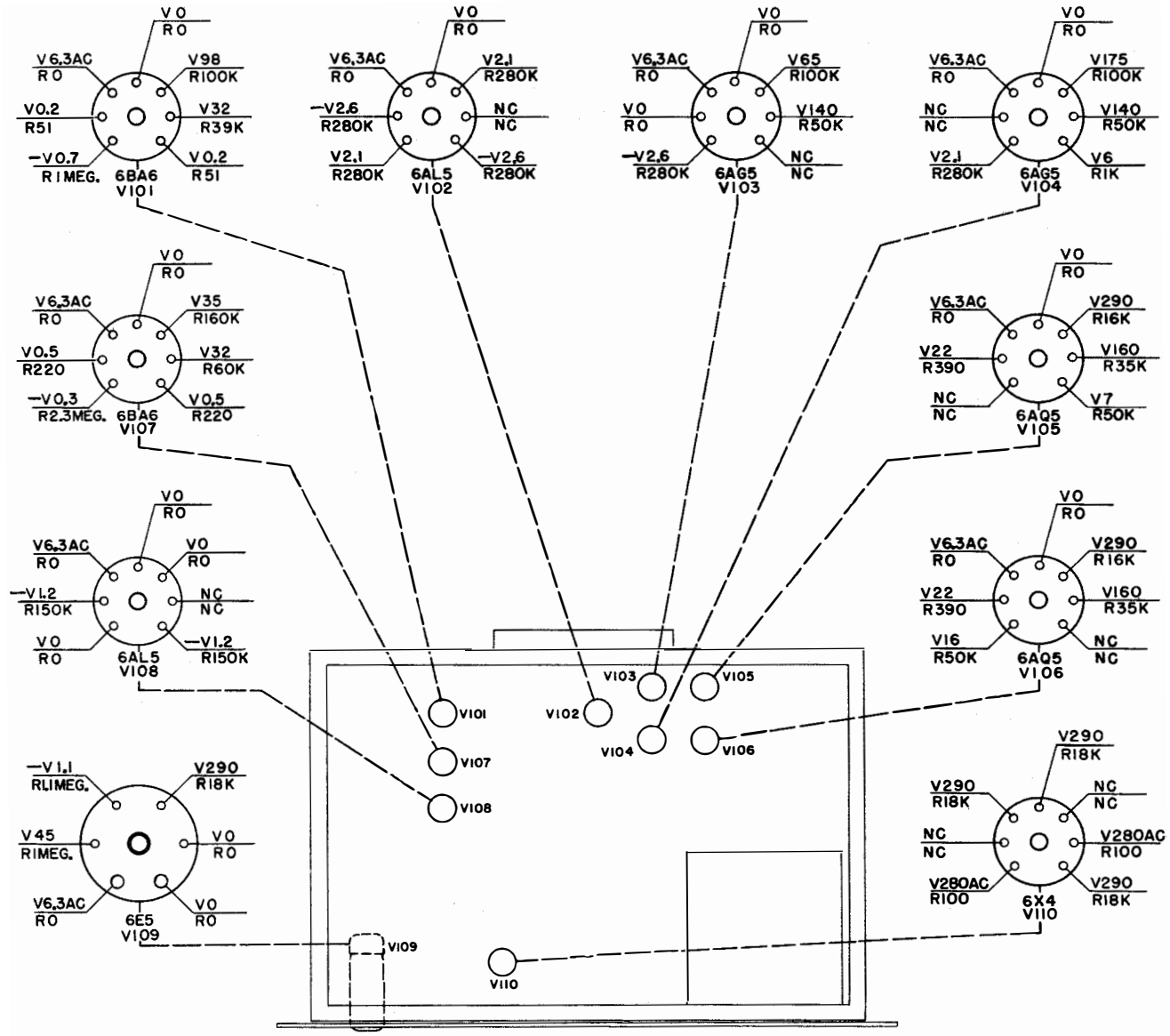


b. GENERAL. Corrective maintenance consists of isolating and correcting the cause of equipment failure. Isolating the defect is generally the more time-consuming of the two and requires the greater application of knowledge. A visual inspection often discloses such defects as loose connections, poorly soldered joints, burned resistors, loose screws or nuts, etc. Many faults can be located by the sense of smell, hearing, or touch and the application of common sense. Other faults, however, have to be located by means of appropriate testing devices. Occassionally a piece of equipment has a chronic defect. Records of previous troubles and correctional measures are therefore helpful in such cases. Sometimes troubles are of an intermittent nature and must be found during the period of intermittent operation. Most intermittent failures of components are due to thermal effects which cause parts of a previously damaged material to make contact when hot and separate when cool or vice versa depending upon the mechanical structure. Such a condition occurs in devices such as electron tubes, resistors, transformers, and other types of inductors. In some cases such defects can only be isolated by proving all other components to be good. When a piece of equipment is operating, but with diminished performance, it is usually caused by the gradual deterioration of a part or parts, such as loss of emission in electron tubes or the development of low leakage resistance in a capacitor. Defects of this kind are easily isolated. Total failure of a piece of equipment is usually the result of the sudden complete failure of one or more components which can be readily located by a technician with a good general knowledge and specific understanding of the equipment which has failed. The technician should therefore have a thorough knowledge of Section 2, THEORY OF OPERATION, before trouble shooting the RD-112/U.

c. TROUBLE SHOOTING. When either visual inspection of the electrical components or a thorough examination of mechanical adjustments fails to disclose the possible cause of trouble, it is necessary to localize the defective stage and part by other means. The most efficient method of localizing the defective stage is by signal tracing with a standard cathode ray oscillograph. If a repetitive audio signal of the correct amplitude and frequency is applied to the input terminals, and the wave form at the various stages observed and compared with those shown on the Servicing Block Diagram, Fig. 5-7, the defective stage can be readily located. The defective part or parts can then be located by making voltage and resistance measurements in the faulty stage, and comparing them with those given in Fig. 5-6, Voltage and Resistance Diagram.

Before proceeding with wave form observation and routine component testing in an inoperative recorder, it is very important to ascertain whether or not an open circuit exists in the load circuit which consists of the recording coil. An open coil places a severe strain upon the windings of the output transformer due to the fact that high voltage peaks are present in the output circuit which, when operated with no load, might puncture the insulation between windings. The recording coil should therefore be checked first with an ohmmeter. Its DC resistance should be approximately 3 ohms.

If the recording coil is providing the proper load, apply a repetitive audio signal and observe the wave form with an oscillograph as indicated above. Comparison with standard wave forms, (See Fig. 5-7), will indicate the stage where deviation from normal originates, and conventional methods of component testing will locate the defective component. Trouble Shooting Chart, Table 5-2, provides a further means of quickly locating the source of trouble.



VOLTAGE MEASUREMENTS TAKEN WITH V.T.V.M. UNDER THE FOLLOWING CONDITIONS:

(1) CONTINUOUS DOT SIGNAL INPUT
(2) SIGNAL VOLTAGE LEVEL OF .075 V.
(3) A.C. POWER SWITCH---"ON"
(4) FILTER SWITCH---"OUT"
(5) OPERATE-STANDBY SWITCH---"OPERATE"
(6) SIGNAL LEVEL CONTROL---"TEN"(OR MAX.)
(7) PEN POWER CONTROL---"TEN"(OR MAX.)

RESISTANCE MEASUREMENTS TAKEN WITH SIMPSON MODEL 260 OHMMETER WITH RECORDER CONTROLS SET AS FOLLOWS:

(1) A.C. POWER SWITCH---"OFF"
(2) FILTER SWITCH---"OUT"
(3) OPERATE-STANDBY SWITCH---"OPERATE"
(4) SIGNAL LEVEL CONTROL---"ZERO"
(5) PEN POWER CONTROL---"ZERO"

ANY "0" RESISTANCE (R0) EQUALS 1 Ω OR LESS.
ALL MEASUREMENTS ARE WITH RESPECT TO CHASSIS.

Figure 5-6
Voltage and Resistance Diagram

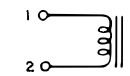
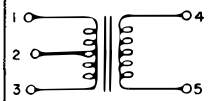
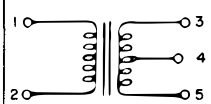
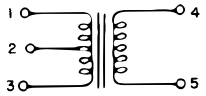
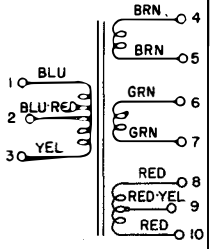
TABLE 5-3. TUBE OPERATING VOLTAGES

TUBE TYPE	FUNCTION	PIN NUMBER						
		1	2	3	4	5	6	7
6BA6	AMPLIFIER & LIMITER	−0.7	0.2	6.3 A.C.	0	98	32	0.2
6AL5	SIGNAL RECTIFIER	2.1	−2.6	6.3 A.C.	0	2.1	NC	−2.6
6AG5	VOLTAGE AMPLIFIER	−2.6	0	6.3 A.C.	0	65	140	NC
6AG5	VOLTAGE AMPLIFIER	2.1	NC	6.3 A.C.	0	175	140	6
6AQ5	OUTPUT AMPLIFIER	NC	22	6.3 A.C.	0	290	160	7
6AQ5	OUTPUT AMPLIFIER	16	22	6.3 A.C.	0	290	160	NC
6BA6	VOLTAGE AMPLIFIER	−0.3	0.5	6.3 A.C.	0	35	32	0.5
6AL6	INDICATOR RECTIFIER	0	−1.2	6.3 A.C.	0	0	NC	−1.2
6E5	ELECTRON RAY INDICATOR	6.3 A.C.	45	−1.1	290	0	0	
6X4	RECTIFIER	280 A.C.	NC	290	290	NC	280 A.C.	290

TABLE 5-4. TUBE CHARACTERISTICS

TUBE TYPE	FILAMENT VOLTAGE (VOLTS)	FILAMENT CURRENT (AMPS)	PLATE VOLTAGE (VOLTS)	GRID BIAS (VOLTS)	SCREEN VOLTAGE (VOLTS)	PLATE CURRENT (MA)	SCREEN CURRENT (MA)	A.C. PLATE RESISTANCE (OHMS)	TRANSCONDUCTANCE (MICROMHOS)
6AG5	6.3	0.30	250	−8	150	7	2	800,000	5000
6AL5	6.3	0.30	117			9		300	
6AQ5	6.3	0.45	250	−15	250	79	13	60,000	3750
6BA6	6.3	0.30	250	−20	100	11	4.2	10 MEG.	4400
6E5	6.3	0.30	250	−8	250	0.24		10 MEG.	
6X4	6.3	0.60	A.C. VOLTAGE PER PLATE - - - - - - - - 325 VOLTS (MAX) D.C. OUTPUT CURRENT - - - - - - - - 225 MA (MAX)						

TABLE 5-5. WINDING DATA

DESIG-NATION SYMBOL	STANCOR PART NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D.C. Ω	REMARKS
L102	811C3		SINGLE	NO. 29 E	3300	200 MAX.	INDUCTANCE: 10 HY. MIN 120 MA DC@10V 60CY. TEST VOLTAGE: 1500V. RMS
T101	811A1		PRI * 1 PRI * 2 SEC * 2	NO. 34 E NO. 34 E NO. 34 E	450 450 1000	60 (TOTAL PRI) 67	600Ω CT. PRI. IMPEDANCE 600Ω SEC. IMPEDANCE FREQ. ±3 DB FROM 60 CPS TO 15,000 CPS
T102	811A2		PRI * 1 SEC * 1 SEC * 2	NO. 38 E NO. 42 E NO. 42 E	2600 3800 3800	520 3900 (TOTAL SEC.)	6,000Ω PRI. IMPEDANCE 50,000Ω CT. SEC. IMPEDANCE FREQ. ±3 DB FROM 60 CPS TO 15,000 CPS MAX POWER 1.0 WATTS MIN POWER 0.1 WATTS TEST VOLTS = 1000 V. RMS
T103	811A6		PRIMARY SECONDARY	NO. 37 E NO. 23 E	2600 42	470 0.37	10,000Ω CT PRI. IMPEDANCE 6Ω SEC. IMPEDANCE PRI. TEST VOLTS = 1500 V. RMS SEC. TEST VOLTS = 500 V. RMS
T104	811P1		PRI * 1 PRI * 2 SEC * 1 SEC * 2 SEC * 3	NO. 23 E NO. 25 E NO. 16 E NO. 22 E NO. 32 E	291 291 17 17 1590 TAP AT 795	10 (TOTAL PRI.) 0.067 0.247 190	NO LOAD VOLTS / FULL LOAD VOLTS D-115-23 50-60 CY 6.72 V / 6.3 V @ 4.0A 6.72 V / 6.3 V @ 1.0A 314 V / 610 V CT @ EACH SIDE / 80 MA DC. TEST VOLTS 1000 V. RMS

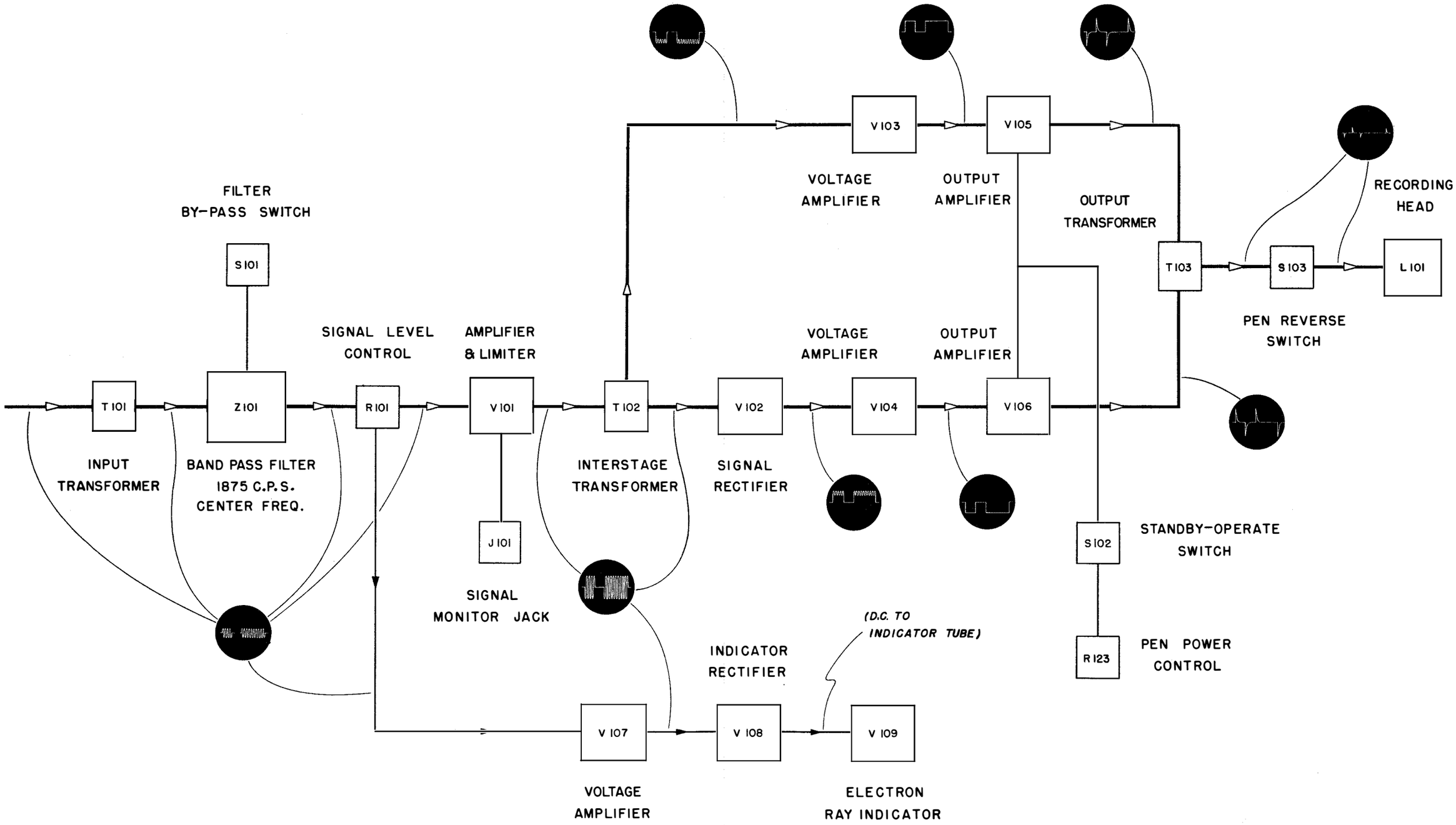


Figure 5-7. Servicing Block Diagram

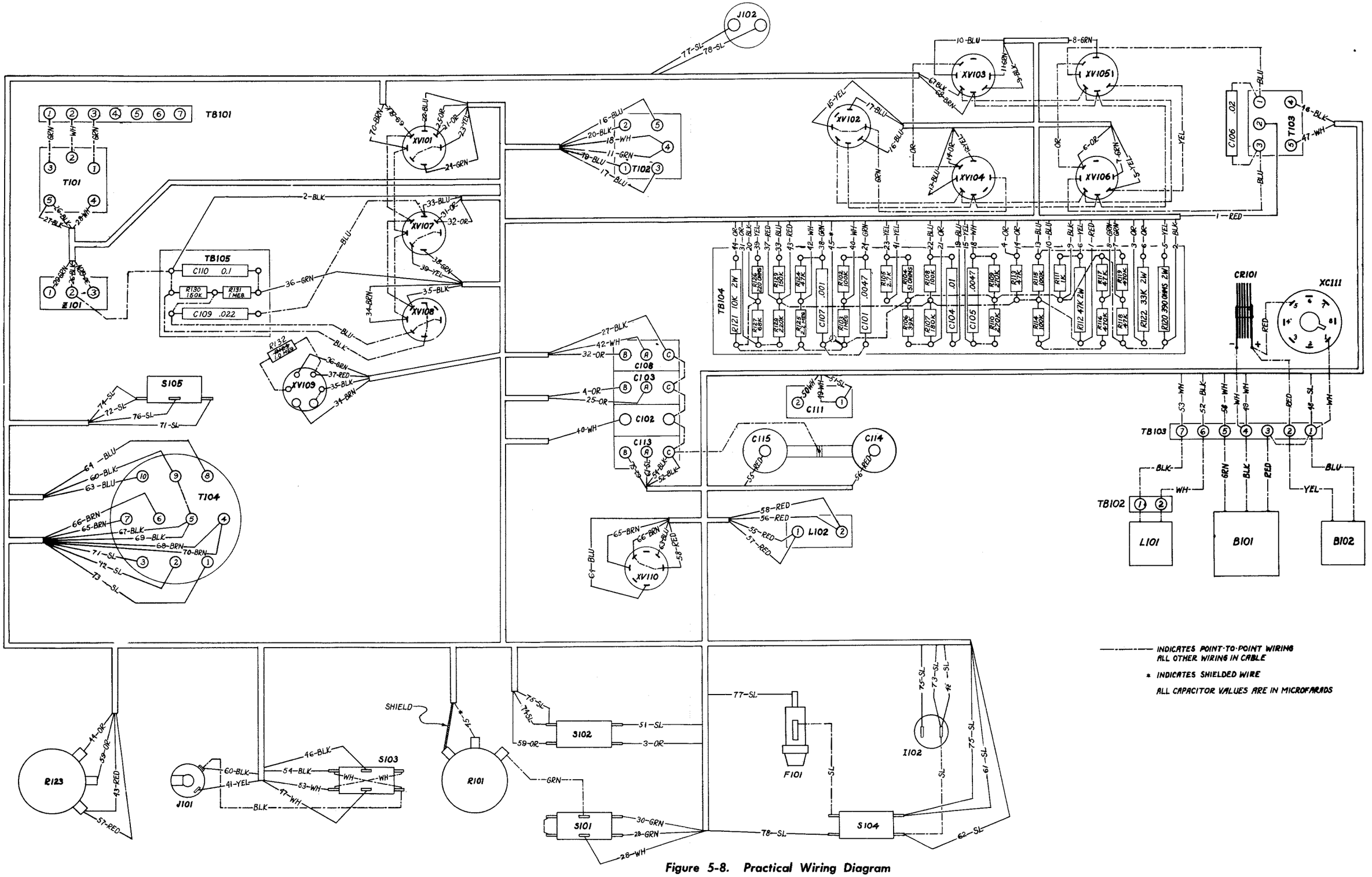
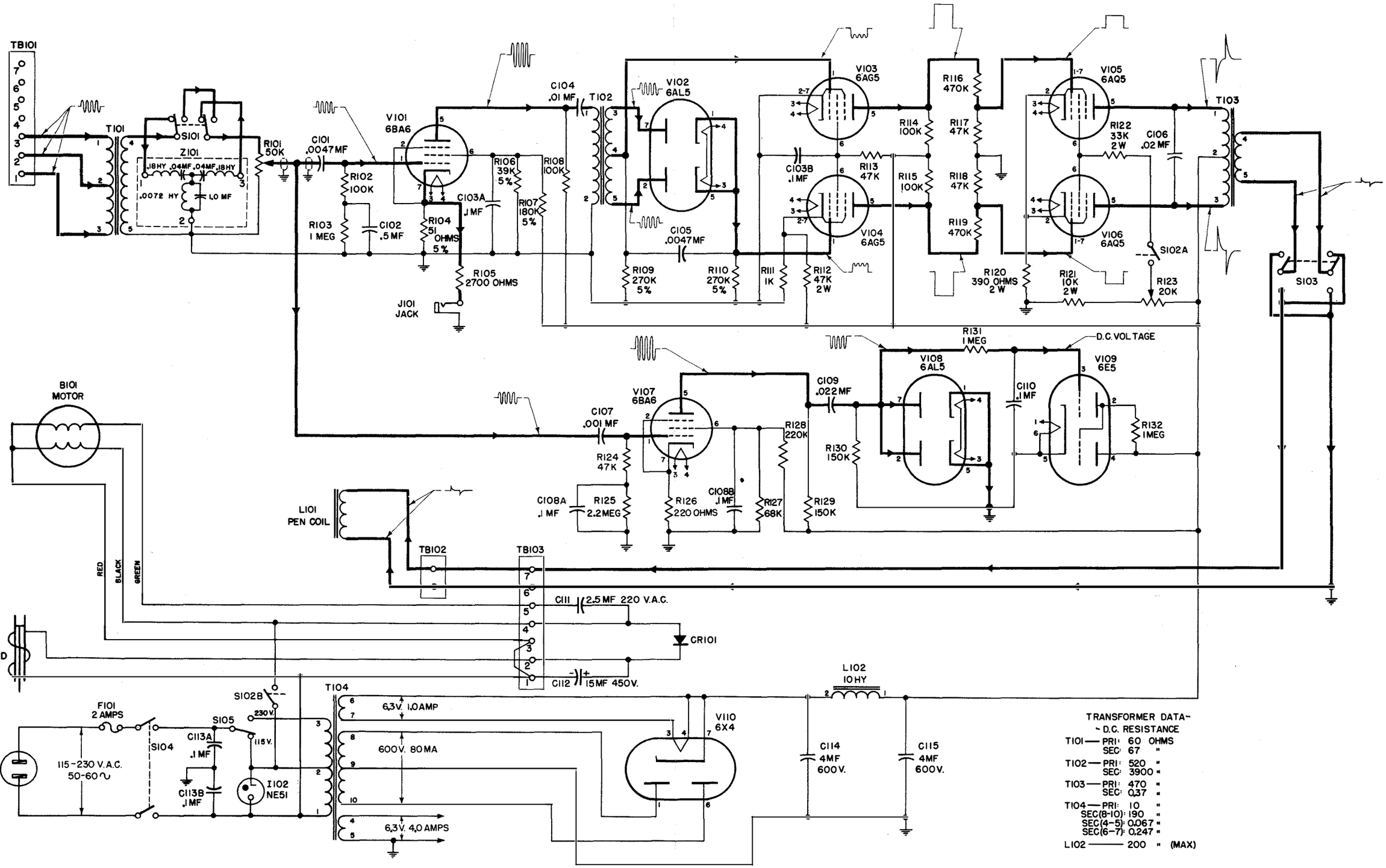


Figure 5-8. Practical Wiring Diagram



NOTE: ALL RESISTORS $\frac{1}{2}$W, 10% UNLESS OTHERWISE NOTED

Figure 5-9. Schematic Wiring Diagram

SECTION 6.
PARTS LIST

THIS SECTION CONTAINS THE FOLLOWING TABLES:

Table 6-1 Table of Replaceable Parts

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
A-101	N17-R-235001-104	RESERVOIR: inkwell & valve assy; inkwell, clear lucite; valve assy, stainless steel.	Holds and regulates flow of ink to pen.
A-101-A	"Listed for Reference Only"	RESERVOIR: includes well cover & cover gasket; well & cover, clear lucite; cylindrical shape, cover gasket, neoprene; p/o A-101.	Container for ink supply.
A-101-B	N17-B-11101-1002	VALVE, NEEDLE: includes needle valve, valve seat, spring, hex clamping nut, knurled mtg. nut, knurled cover nut & neoprene gaskets; accommodates flexible rubber hose; p/o A-101.	Regulates flow of ink to pen.
A-102*	N17-B-700001-273	BRACKET: ink reservoir; aluminum, gray finish; reservoir mts by knurled thumb nut, H-113.	Mounting for ink reservoir.
B-101	N17-M-54310-2791	MOTOR, A. C.: synchronous; 0.0017 H.P.; 3600 rpm; 115 volts; 60 cycles; single phase.	Supplies power to tape drive assy.
B-102	N17-S-41883-1618	SOLENOID, ELECTRICAL: push type; 1 coil; 1200 ohms resistance; DC; 115 volts; 0.085 amp.	Actuates tape drive.
C-101	N16-C-41052-5865	CAPACITOR, FIXED, PAPER DIELECTRIC: 0.0047 mf; ± 10% 600v DC, working voltage.	Couples signal to V-101.
C-102	N16-C-47297-2854	CAPACITOR, FIXED, PAPER DIELECTRIC: 0.5 mf; ± 10% 600v DC, working voltage; JAN type #CP69B1EF504K.	By-pass capacitor for R-103 of V-101.

* "Not furnished as maintenance part. If failure occurs, do not request replacement unless the item cannot be repaired or fabricated."

Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
C-103-A C-103-B	N16-C-53159-5310	CAPACITOR, FIXED, PAPER DIELECTRIC: 2 section; each section 0.1 mf; ± 10% 600v DC, working voltage; JAN type #CP69B4EF104K.	A- By-pass capacitor for screen grid of V-101 B- By-pass capacitor for screen grids of V-103 and V-104
C-104	N16-C-42736-8450	CAPACITOR, FIXED, PAPER DIELECTRIC; 0.01 mf; ± 10% 600v DC, working voltage.	Couples signal to T-102
C-105		CAPACITOR, FIXED, PAPER DIELECTRIC: same as C-101	Phase shift capacitor for V-104.
C-106	N16-C-43117-2318	CAPACITOR, FIXED, PAPER DIELECTRIC: 0.02 mf; ± 10% 600v DC, working voltage; JAN type #CP29A1EF203K.	Peak surge suppressor for T-103.
C-107	N16-C-39696-6250	CAPACITOR, FIXED PAPER DIELECTRIC: 0.001 mf; ± 10%; 600v DC, working voltage.	Couples signal to grid of V-107.
C-108-A C-108-B		CAPACITOR, FIXED, PAPER DIELECTRIC: same as C-103-A C-103-B	A- By-pass capacitor for R-125 of V-107. B- By-pass capacitor for Screen grid of V-107.
C-109	N16-C-43160-3177	CAPACITOR, FIXED, PAPER DIELECTRIC: 0.022 mf; ± 10% 600v DC, working voltage.	Coupling capacitor to plates of V-108.
C-110	N16-C-45776-6935	CAPACITOR, FIXED, PAPER DIELECTRIC: 0.1 mf; ± 10% 600v DC, working voltage.	Filter for V-109.
C-111	N16-C-49380-6510	CAPACITOR, FIXED, PAPER DIELECTRIC: 2.5 mf; ± 10% 220v AC, working voltage.	Phase splitting capacitor for drive motor B-101.

C-112	N16-C-19643-8705	CAPACITOR, FIXED, ELECTROLYTIC: 15 mf; 450v DC, working voltage; JAN type #CE51D150R.	Filter for solenoid B-102, DC power supply.
C-113-A C-113-B		CAPACITOR, FIXED, PAPER DIELECTRIC: same as C-103-A C-103-B	A- AC line to ground by-pass capacitor. B- AC line to ground by-pass capacitor.
C-114	N16-C-49958-7507	CAPACITOR, FIXED, PAPER DIELECTRIC: 4.0 mf; ± 10% 600v DC, working voltage; JAN type #CP40B2EF405K.	Filter for DC high voltage power supply.
C-115		CAPACITOR, FIXED, PAPER DIELECTRIC: same as C-114	Filter for DC high voltage power supply.
CR-101	N17-R-51401-8351	RECTIFIER, METALLIC: selenium; half wave; input, 130 max RMS, 1 phase; output, 125 max RMS; 100 ma, max. current.	Rectifier for solenoid DC power supply.
E-101	N17-C-781827-877	CLAMP, ELECTRICAL: steel nickel plated.	Locks handle of S-105 in etther 110v or 220v position.
E-102	N16-R-503580-270	RETAINER, ELECTRON TUBE: steel, stainless.	Placement holder for C-112.
E-103	N17-C-780669-501	CLAMP, ELECTRICAL: steel; cadmium plated; extruded channel cushion; synthetic; holds 1/4 in. dia. material.	Fastens wiring harness to chassis; 3 used.
E-104	N17-C-780960-575	CLAMP, ELECTRICAL: steel; cadmium plated; extruded channel cushion; synthetic; holds 5/16 in. dia. material.	Fastens wiring harness to chassis; 4 used.

Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
E-105	N17-C-781200-677	CLAMP, ELECTRICAL: steel; cadmium plated; extruded channel cushion; synthetic; holds 7/16 in.dia. material.	Fastens wiring harness to chassis.
E-106	N17-S-117001-207	DIAL, SCALE: movable scale type; graduated in 30 scale divisions; 5-35.	Indicates tape speed.
E-107	N17-D-36739-4051	DIAL, CONTROL: movable scale type; graduated in 10 scale divisions; 0-10.	Pen power calibration.
E-108		DIAL, CONTROL: same as E-107.	Amplifier gain control.
E-109*	N16-K-700304-214	KNOB: round; aluminum; black anodized.	Adjusts tape speed.
E-110	N16-S-34607-6039	SHIELD, ELECTRON TUBE: locking groove type; miniature; JAN type #TS-102-U03.	Tube shields for V-105, V-106, & V-110.
E-111	N16-S-34557-8351	SHIELD, ELECTRON TUBE: locking groove type; miniature; JAN type #TS-102-U02.	Tube shields for V-101, V-103, V-104 & V-107.
E-112	N16-S-34520-3864	SHIELD, ELECTRON TUBE: locking groove type; miniature; JAN type #TS-102-U01.	Tube shields for V-102, & V-103.
F-101	N17-F-14309-0340	FUSE, CARTRIDGE: 2 amp; 250v AC; enclosed type; glass body; ferrule terminals; Buss type #AGS.	Protects amplifier from overload.
H-101	N41-S-5007-442	STICK, ABRASIVE: half round file type; p/oO-110.	For honing pen.

H-102	N17-S-118052-941	SCREW ADJUSTMENT; steel; nickel pl.; slotted head; thread 5-40; RH; 15/16 in. lg.	Adjusts space limit of pen travel.
H-103	N17-S-118053-221	SCREW ADJUSTMENT: steel; nickel pl.; slotted head; thread 5-40; RH; 1 in. lg.	Adjusts mark limit of pen travel.
H-104	N17-T-901103-331	TUBING, NON-METALIC: rubber; flexible; 5 1/8 in lg.; 1/16 in ID; 1/8 in. OD.	Supplies ink to pen from ink reservoir.
H-105*	N17-S-650901-101	STOP, PEN: plastic; laminated; 1/4 in dia; 5/16 in lg.	Limits pen stroke.
H-106*	N17-L-300001-133	LEVER: brass; gray finish; irregular shape; 2 9/16 in. lg.; 1 13/16 in. wide; 1 1/8 in. deep; includes tape platen mounting.	Regulates pen pressure against tape.
H-107*	N43-S-19125-9895	SCREW, THUMB: aluminum; black anodized; knurled thumb head; 1/2 in. OD; 3/16 in. thick; thread 6-32; RH; 1 1/8 in. overall.	Lock for platen lever adjustment bolt.
H-108*	N17-S-118901-108	SCREW, THUMB: aluminum; black anodized; knurled thumb head; 5/8 in. OD; 5/32 in. thick; thread 10-32; RH.	Platen lever adjustment bolt.
H-109*	N17-C-860001-152	COLLAR, SPACING: aluminum; black anodized; one 17/64 in diam. hole; axial; overall dimensions 9/16 in. lg. by 11/16 in. hex.	Stand-off spacer for tape drive mounting plate.

*"Not furnished as maintenance part. If failure occurs, do not request replacement unless the item cannot be repaired or fabricated."

Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
H-110*	N17-N-88554-1011	NUT, HEXAGON: aluminum; black anodized; one 1/4-20 tapped hole; axial; overall dimensions 7/16 in. lg. by 11/16 in. hex.	Mounting for tape puller assembly.
H-111*	N16-T-753001-101	TOOL, BEARING: steel; nickel plated; overall dimensions 2 in. lg. by 1/2 in. dia.; p/o O-110.	Installation & adjustment tool for pen bearings.
H-112*	N43-N-10159-110	NUT, PLAIN, KNURLED: aluminum; black anodized; thumb drive; 1 in. OD by 1/4 in. thick; p/o A-101-A.	Holds inkwell cover in place.
H-113*	N43-N-10159-100	NUT, PLAIN, KNURLED: aluminum; black anodized; thumb drive; 1 in. OD by 1/4 in. thick; p/o A-101-A.	Mounting nut for ink reservoir.
H-114*	N17-N-88554-1010	NUT, PLAIN, HEXAGON: aluminum; black anodized; wrench type; 7/8 in. dia. by 5/32 in. thick; p/o A-101-B.	Mounting nut for valve assembly.
H-115*	N17-B-802527-195	BUSHING: naval bronze; 4 lead, LH thread; 0.5635 in. dia. by 3/8 in. thick; p/o shuttle block assy.	Moves motor & cone to change drive ratio.
H-116	N17-N-88554-1017	NUT, HEXAGON: aluminum; black anodized; 10-32 tapped hole; axial; overall dimensions 19/32 in. lg. by 11/16 in dia.	Mounting for recording head.

I-101	N16-S-62156-5536	SOCKET, ELECTRON TUBE: includes XV-109, R-132, mounting bracket, escutcheon and sleeve.	Provides visual indication of signal level.
I-102	N17-L-76902-2626	LIGHT, INDICATOR: includes lampholder, NE 51 lamp & lens; 100 k. resistor built-in; overall dimensions 2 1/8 in. lg. by 15/16 in. dia.	Indicates "power-on".
I-102-A	N17-L-76662-4688	LAMPHOLDER: plastic; accommodates NE 51 lamp, 200,000 ohm resistor built into base; overall dimensions 1 3/4 in. lg. by 1 in. dia; p/o I-102.	Mounting for lamp & lens.
I-102-B	N17-L-250842-801	LENS, INDICATOR LIGHT: plastic; white; translucent; hemispherical; screw type; 9/16 in. dia.	Provides uniform distribution of light.
J-101	N17-J-39248-4418	JACK, TELEPHONE; accommodates 2 conductor telephone plug; overall dimensions 1 1/4 in. lg. by 49/64 in. dia.	Monitor jack.
J-102	N17-C-73446-5848	CONNECTOR, RECEPTACLE: 2 contacts; male; flat; not polarized; 15 amp; 115v AC.	Receptacle for power cable assy.
L-101	N17-C-57849-1001	COIL, RECORDER HEAD: pivot assy; steel; chromium plated; coil, 70 uH inductance; 6 ohms impedance.	Transfers power to recording pen.
L-102	N16-R-29237-4141	REACTOR: filter choke; 10H inductance; 120ma DC; 200 ohms resistance.	DC smoothing choke.

*"Not furnished as maintenance part. If failure occurs, do not request replacement unless the item cannot be repaired or fabricated.

Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
N-102*	N17-P-403461-474	PLATE, IDENTIFICATION aluminum; white engraved inscription; orange background; 3 7/8 in. lg. by 2 3/4 in. wide by 1/16 in. thick.	Input name plate.
O-101	N77B-115-00319-2000	BEARING, BALL; single row; axial; sealed; double shield; 7 balls.	Absorbs load of friction wheel shaft.
O-102	N77B-115-00409-2000	BEARING, BALL: single row; axial; sealed; double shield; 8 balls.	Absorbs load of output shaft.
O-103*	N17-B-600021-102	BLOCK, ADJUSTING: aluminum; black anodized 3/4 in. high; 3/8 in. wide; 5/8 in. deep adjusting screw 1 3/16 in. long by 5/8 in. dia; knurled head.	Holds tape in position against pen.
O-104*	N43-S-99500-410	SCREW, SET: steel; stainless; headless; slot drive; thread 10-32; 3/8 in. lg.; RH.	Locks friction wheel and output shaft assy.
O-105	N17-C-67231-1003	CONE, ROTARY DRIVE: p/o tape drive assy; brass; chromium plated; 1.010 in. lg. by 0.472 in. dia.; mounting hole 9/16 in. deep; press fit.	Transfers power from motor to friction wheel.
O-106	N17-G-432405-917	GEAR: laminated phenolic; spur type; straight teeth; 75 teeth; 1.604 in. dia. by 1/8 in. thick.	Transfers power from friction wheel shaft to output shaft.
O-107	N17-G-431213-851	GEAR, PLAIN SPUR: steel; stainless; spur type straight teeth; 15 teeth; 0.354 in. dia. by 1/4 in. thick.	Transfers power from friction wheel shaft to output shaft gear.

O-108	N17-G-431215-350	GEAR: naval brass; chromium plated; pinion type; straight teeth; 16 teeth; 0.562 in. dia. by 9/16 in. lg.	Dial drive gear.
O-109	N17-H-901148-101	HUB: includes hub, knurled nut, screw and shaft; hub, circular shape; 2 1/4 in. dia. by 3/8 in. thick.	Holds recording tape.
O-110	N17-M-133502-218	MAINTENANCE KIT: This kit contains 5 - 2 amp. fuses, F-101; 2- NE 51 lamps (p/o I-102); 1- 0.015 in. dia. recording pen, O-114; 1- 0.050 in. dia. recording pen, O-116; 1- screwdriver, O-122; 1 bearing wrench, H-111; 1- friction drive wheel, O-130; 1 friction drive wheel, O-121-A; 1 #6 Allen wrench, O-132; 1- #8 Allen wrench, O-133; 1 #10 Allen wrench, O-131; 1 plastic tube containing: one abrasive stick, H-101; 1- 5 1/8 in. lg. hose, H-104; (2 pcs. 1/4 in. lg. plastic hose); 5 pcs. 0.004 in. Dia Cleaning Wire, O-122; 2 pcs. 0.008 in. dia. cleaning wire, O-111; 4 pcs. 0.024 in. wide cleaning wire ribbon, O-113; 6 locking screw cushions, O-139.	Operational maintenance and spare parts.
O-111	N17-C-793201-104	CLEANER, PEN: wire; steel, stainless; 0.008 in. dia. by 3 in. lg.; p/o O-110.	For cleaning 0.025 in. dia. recording pen.
O-112	N17-C-793201-103	CLEANER, PEN: wire; steel, stainless; 0.004 in. dia. by 3 in. lg; p/o O-110.	For cleaning 0.015 in. dia. recording pen.

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Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
O-113*	N17-C-793201-105	CLEANER, PEN: ribbon; wire, steel; stainless; 0.024 in. wide by 0.0035 in. thick by 3 in. lg; p/o O-110.	For cleaning 0.050 oval pen.
O-114	N17-P-34291-1006	PEN, RECORDER: steel, stainless; chromium plated; cone bearing each end; capillary tubing point; 0.015 in. dia.' p/o O-110.	Applies ink to tape.
O-115	N17-P-34291-1005	PEN, RECORDER: steel, stainless; chromium plated; cone bearing each end; capillary tubing point; 0.025 in. dia.	Applies ink to tape.
O-116	N17-P-34291-1004	PEN, RECORDER: steel, stainless; chromium plated; cone bearing each end; capillary tubing point; oval shaped; 0.050 in.; p/o O-110.	Applies ink to tape.
O-117	N17-P-410801-102	PLATEN, CODE RECORDER: aluminum; black anodized; 1 in. high by 3/4 in. wide by 13/16 in. thick including finger grip.	Guides recording tape.
O-118*	N17-A-700041-112	ARM: includes pressure arm, knob, roller, spacer, & ball bearing; overall dimensions 1 5/8 in. lg. by 1 in. wide by 3/4 in. thick.	Applies pressure to tape against roller, drive assy.
O-119*	N17-P-370101-106	PIVOT, PEN: nylon; screw type; 5/16 in. lg.; by 1/4 in. dia.	Recording pen bearings.

O-120*	N17-P-853001-101	PUMP, INK: body, aluminum; cover plate, plexiglass; knurled stem, offset roller; overall dimensions 1 3/8 in. lg. by 13/16 in. wide by 1 1/4 in. deep.	Starts flow of ink to pen.
O-121*	N17-R-750891-107	ROLLER, DRIVE: aluminum; black anodized; includes friction drive wheel, O-121-A; overall dimensions 1 1/8 in. dia. by 3/4 in. thick; sleeve held in place by rear flange.	Pulls inked tape.
O-121-A	N17-W-220321-105	WHEEL, FRICTION DRIVE: includes sleeve & tire; sleeve, aluminum; tire, rubber; overall dimensions 1.040 in. dia. by 0.399 in. thick p/o O-121; p/o O-110.	Pulls inked tape.
O-122	N41-S-1335-500	SCREWDRIVER: steel; nickel plated; 2 1/2 in. lg.; p/o O-110.	For installation and adjustment of recorder pen.
O-123	N17-S-37226-1027	SHAFT: steel, cold rolled; 5 13/16 in lg.; 5/8 in. dia; worm type gear; 13/32-16, 4 lead; LH; 1 3/16 in. lg.; bushing type bearing.	Speed control shaft.
O-124*	N17-S-36992-3082	SHAFT: steel, stainless; 3 9/16 in. lg; 5/16 in. dia; straight knurl on one end; 3/8 in. lg.	Slide shaft.
O-125*	N17-S-37013-4629	SHAFT: steel, stainless; 4 7/8 in. lg; 1/4 in. dia; straight knurl 1/4 in. lg. one end; shaft flatted 5/8 in. lg. by 1/32 in. deep other end; includes hub pressed onto knurled end.	Output shaft.

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Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
O-126*	N17-R-47346-1015	RECORDER, SUB ASSY: includes stainless steel shaft; 2 9/32 in. lg. by 3/16 in. dia; hub pressed onto 3/8 in. lg. straight knurled portion; 4-40 tapped hole 1/2 in. deep other end; hub 1 7/8 in. dia. o/a x 0.399 in. thk; flange 0.999 in. dia. x 0.180 in. wd; flange 1/2 in. dia. x 1/8 in. ed; gear 0.354 in. O.D. x 1/4 in. thk. 15 teeth, 48 pitch, reamed hole 0.1855 in. dia.; gear pressed onto knurled end of shaft.	Friction wheel shaft.
O-127	N17-S-46697-9130	SPRING: helical compression type; steel, stainless; 1 7/8 in. lg. by 0.140 in. OD; 40 turns.	Solenoid spring.
O-128*	N17-S-46730-8456	SPRING: helical extension type; steel; stainless; 5/8 in. lg. by 1/4 in. OD; 20 turns.	Loading for platen lever.
O-129*	N17-S-46731-2801	SPRING: helical extension type; steel; stainless; 45/64 in. lg. by 0.240 in. OD; 20 turns.	Pressure arm spring.
O-130	N17-W-220321-104	WHEEL, FRICTION DRIVE: aluminum; black anodized; moulded rubber tire; overall dimensions 2.500 in. dia. by 0.180 in. thick; p/o O-110.	Transfers power from motor to drive shaft.
O-131	G41-W-2449	WRENCH, ALLEN: #10; 3/32 in.; hexkey; head offset 90 degrees; p/o O-110.	For mechanical parts adjustment.

O-132	G41-W-2445	WRENCH, ALLEN: #6; 1/16 in.; hexkey; head offset 90 degrees; p/o O-110.	For mechanical parts adjustment.
O-133	G41-W-2446	WRENCH, ALLEN: #8; 5/64 in.; hexkey; head offset 90 degrees; p/o O-110.	For mechanical parts adjustment.
O-134	N17-R-235001-105	RESERVOIR: includes cover and gasket; well & cover; clear lucite; gasket; neoprene; overall dimensions 2 1/4 in. dia. by 2 1/8 in. high; p/o A-101.	Holds ink supply for pen.
O-135	N17-N-450101-101	NEEDLE VALVE: steel, stainless; overall dimensions 3/8 in. dia. by 3 1/4 in. lg; p/o A-101.	Controls flow of ink to pen.
O-136	N17-M-86740-4207	MOUNTING, SEAT: steel, stainless; overall dimensions 7/8 in. dia. by 2 7/16 in. lg; p/o A-101.	Seats needle valve.
O-137*	N17-S-46679-9551	SPRING, HELICAL COMPRESSION; steel, stainless; 1 3/8 in. lg. by 0.262 in. OD; 16 turns; p/o A-101-B.	Maintains uniform valve tension.
O-138	G77-B-111-00503-0000	BEARING, BALL, ANNULAR; steel; single row axial; not sealed; 6 balls p/o B-101.	Absorbs load of motor shaft.
O-139*	N17-C-965001-396	CUSHION, LOCKING SCREW: poppy-seed; nylon; 0.085 in. dia. by 1/32 in. thick.	Cushions locking screw.
O-140		BEARING, BALL: same as O-101.	Absorbs load of tape roller.

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Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
O-141	N17-B-801134-745	BUSHING: vinyl plastic; 0.085 in. OD x 0.055 in. I.D. x 1/4 in. long.	Secures ink hose to pen.
P-101	N17-C-71130-6673	CONNECTOR, PLUG: 2 contacts; female; flat; not polarized; 10 amp; 250v; p/o W-101.	Plugs into J-102.
P-102	N17-C-71426-7829	CONNECTOR, PLUG: 2 contacts; male; flat; not polarized; 10 amp; 250v; p/o W-101.	Plugs into AC outlet.
R-101	N16-R-87848-7238	RESISTOR, VARIABLE: composition element; 1 section; 50,000 ohms; ± 10%; 1/2 W power dissipation; std V taper.	Amplifier gain control. (Signal Level Control).
R-102	N16-R-50633-971	RESISTOR, FIXED COMPOSITION: 100,000 ohms; ± 10%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF104K.	Grid resistor for V-101.
R-103	N16-R-50975-971	RESISTOR, FIXED, COMPOSITION: 1 megohm; ± 10%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF105K.	Grid resistor for V-101.
R-104	N16-R-49444-591	RESISTOR, FIXED, COMPOSITION: 51 ohms; ± 5%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF510J.	Cathode resistor for V-101.
R-105	N16-R-50039-971	RESISTOR, FIXED, COMPOSITION: 2700 ohms ± 10%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF272K.	Isolating resistor for monitor circuit.
R-106	N16-R-50443-591	RESISTOR, FIXED, COMPOSITION: 39,000 ohms; ± 5%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF393J.	Voltage divider for screen grid of V-101.

R-107	N16-R-50695-591	RESISTOR, FIXED, COMPOSITION: 180,000 ohms; ± 5%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF184J.	Voltage dropping resistor for screen grid of V-101.
R-108		RESISTOR, FIXED, COMPOSITION: same as R-102.	Plate load for V-101.
R-109	N16-R-50740-591	RESISTOR, FIXED, COMPOSITION: 270,000 ohms; ± 5%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF274J.	Grid resistor for V-103.
R-110		RESISTOR, FIXED, COMPOSITION: same as R-109.	Grid resistor for V-104.
R-111	N16-R-49922-971	RESISTOR, FIXED, COMPOSITION: 1,000 ohms; ± 10%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF102K.	Cathode resistor for V-104.
R-112	N16-R-50481-726	RESISTOR, FIXED, COMPOSITION: 47,000 ohms; ± 10%; 2 W power dissipation; E temp. characteristic; insulated; JAN type #RC41BE473K.	Fixed bias resistor for V-104.
R-113	N16-R-50480-971	RESISTOR, FIXED, COMPOSITION: 47,000 ohms; ± 10%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF473K.	Voltage dropping resistor for screen grids of V-103 & V-104.
R-114		RESISTOR, FIXED, COMPOSITION: same as R-102.	Plate load for V-103.
R-115		RESISTOR, FIXED, COMPOSITION: same as R-102.	Plate load for V-104.
R-116	N16-R-50822-971	RESISTOR, FIXED, COMPOSITION: 470,000 ohms; ± 10%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF474K.	Isolating resistor for grid of V-105.

Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
R-117		RESISTOR, FIXED, COMPOSITION: same as R-113.	Grid resistor for V-105.
R-118		RESISTOR, FIXED, COMPOSITION: same as R-113.	Grid resistor for V-106.
R-119		RESISTOR, FIXED, COMPOSITION: same as R-116.	Isolating resistor for grid of V-106.
R-120	N16-R-49734-711	RESISTOR, FIXED, COMPOSITION: 390 ohms; ± 10%; 2 W power dissipation; E temp. characteristic; insulated; JAN type #RC41BE391K.	Cathode resistor for V-105 & V-106.
R-121	N16-R-50283-726	RESISTOR, FIXED, COMPOSITION: 10,000 ohms; ± 10%; 2 W power dissipation; E temp. characteristic; insulated; JAN type #RC41BE103K.	Fixed minimum pen power.
R-122	N16-R-50418-726	RESISTOR, FIXED, COMPOSITION: 33,000 ohms; ± 10%; 2 W power dissipation; E temp. characteristic; insulated; JAN type #RC41BE333K.	Screen grid resistor for V-105 & V-106.
R-123	N16-R-91373-5730	RESISTOR, VARIABLE: wire wound element; 1 section; 20,000 ohms; ± 10%; 4 W power dissipation; std. A taper.	Controls pen power from minimum to maximum. (Pen power control)
R-124		RESISTOR, FIXED, COMPOSITION: same as R-113.	Grid resistor for V-107.
R-125	N16-R-51065-971	RESISTOR, FIXED, COMPOSITION: 2.2 meg; ± 10%; 1/2 W power dissipation; F temp; characteristic; insulated; JAN type #RC21BF225K.	Grid resistor for V-107.
R-126	N16-R-49661-971	RESISTOR, FIXED, COMPOSITION: 220 ohms; ± 10%; 1/2 W power dissipation; F temp; characteristic insulated; JAN type #RC21BF221K.	Cathode resistor for V-107.

R-127	N16-R-50552-971	RESISTOR, FIXED, COMPOSITION: 68,000 ohms; ± 10%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF683K.	Voltage divider for screen grid of V-107.
R-128	N16-R-50714-971	RESISTOR, FIXED, COMPOSITION: 220,000 ohms; ± 10%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF224K.	Voltage dropping resistor for screen grid of V-107.
R-129	N16-R-50678-971	RESISTOR, FIXED, COMPOSITION: 150,000 ohms; ± 10%; 1/2 W power dissipation; F temp. characteristic; insulated; JAN type #RC21BF154K.	Plate load for V-107.
R-130		RESISTOR, FIXED, COMPOSITION: same as R-129.	Plate load for V-108.
R-131		RESISTOR, FIXED, COMPOSITION: Same as R-103.	Isolating resistor for grid of V-109.
R-132		RESISTOR, FIXED, COMPOSITION: same as R-103; p/o I-101.	Voltage dropping resistor for target of V-109.
S-101	N17-S-74139-7130	SWITCH, TOGGLE: DPDT: 5 amp; 125v AC. JAN type #ST26N.	Filter "in-out" switch.
S-102-A S-102-B	N17-S-73083-3285	SWITCH, TOGGLE: DPST: 5 amp; 125v AC. JAN type #ST26K.	Operate- Standby switch
S-103		SWITCH, TOGGLE: same as S-101.	Pen reverse switch.
S-104		SWITCH, TOGGLE: same as S-102.	Power "on-off' switch.
S-105	N17-S-72018-9294	SWITCH, TOGGLE: DPST. 5 amp; 125v AC. JAN type #ST16D.	110-220 voltage adaptor switch.

Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
T-101	N17-T-62660-8212	TRANSFORMER, AUDIO FREQUENCY: line to line type; impedance data; primary, 600 ohms, center tapped, secondary, 600 ohms; resistance data; primary 60 ohms secondary, 67 ohms; frequency data; ± 3db from 60 cps to 15,000 cps.	Signal input transformer.
T-102	N17-T-64668-1121	TRANSFORMER, AUDIO FREQUENCY: plate coupling type; impedance data; primary, 6,000 ohms; secondary, 50,000 ohms, center tapped; resistance data; primary, 520 ohms; secondary, 3900 ohms; frequency data; ± 3db from 60 cps to 15,000 cps.	Inter-stage coupling transformer.
T-103	N17-T-65515-5285	TRANSFORMER, AUDIO FREQUENCY: plate coupling type; impedance data; primary, 10,000 ohms center tapped; secondary, 6 ohms, resistance data; primary, 470 ohms; secondary, 0.37 ohms; power level; 2 watts.	Output transformer.
T-104	N17-T-75684-8301	TRANSFORMER, POWER, STEP DOWN, STEP UP: input; 115-230v AC; 50-60 cps; single phase; 3 secondaries: #1 secondary; 6.3v 4 amp; DC resistance; 0.067 ohms; terminals 4 & 5; #2 secondary; 6.3v; 1 amp; DC resistance; 0.247 ohms; terminals 6 & 7; #3 secondary; 600v, center tapped; 0.080 amp; DC resistance; 190 ohms; terminals 8 & 10; primary DC resistance; 10 ohms.	Power transformer.

TB-101	N17-B-77790-5917	BOARD, TERMINAL: phenolic; 7 terminals; single screw, single solder lug type; barrier type.	Amplifier signal input connections.
TB-102	N17-B-77534-5169	BOARD, TERMINAL: phenolic; 2 terminals; double screw type; barrier type.	Reproducer head connections.
TB-103		BOARD, TERMINAL: same as TB-101.	Motor, solenoid, and reproducer head connections.
TB-104*	N17-B-78326-5611	BOARD, TERMINAL: phenolic; 52 terminals; turret type; w/o barriers.	Mounting for resistors and capacitors.
TB-105*	N17-B-77787-3552	BOARD, TERMINAL: phenolic; 7 terminals; turrets type; w/o barriers.	Mounting for resistors and capacitors.
V-101	N16-T-56211	TUBE, ELECTRON: pentode; glass envelope; miniature; JAN type #6BA6.	Input stage amplifier.
V-102	N16-T-56195	TUBE, ELECTRON: duo-diode; glass envelope; miniature; JAN type #6AL5.	Signal rectifier.
V-103	N16-T-56175	TUBE, ELECTRON: pentode; glass envelope; miniature; JAN type #6AG5.	DC amplifier; push-pull driver for V-105.
V-104		TUBE, ELECTRON: same as V-103.	DC amplifier; push-pull driver for V-106.
V-105	N16-T-56191-50	TUBE, ELECTRON: tetrode; glass envelope; miniature; JAN type #6AQ5.	Output amplifier.
V-106		TUBE, ELECTRON: same as V-105.	Output amplifier.
V-107		TUBE, ELECTRON: same as V-101.	Amplifier for signal level indicator.

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Table 6-1 Table of Replaceable Parts (Cont.)

REFERENCE DESIGNATION	STOCK NUMBERS	NAME & DESCRIPTION	LOCATING FUNCTIONS
V-108		TUBE, ELECTRON: same as V-102.	Rectifier for signal level indicator.
V-109	N16-T-56255	TUBE, ELECTRON: electron ray indicator; w/triode unit; glass envelope; T-9 bulb type; JAN type #6E5; p/o I-101.	Signal level indicator.
V-110	N16-T-56840	TUBE, ELECTRON: duo-diode rectifier; glass envelope; miniature; JAN type #6X4.	High voltage rectifier.
W-101*	N17-C-48249-1015	CABLE ASSY, POWER, ELECTRICAL: includes cable, W-102; 1 Male plug, P-102, one end; 1 female plug, P-101, other end.	AC power cable assy.
W-102*	N15-C-31025-9025	CABLE, POWER, ELECTRICAL: 2 conductor; stranded; #18 AWG; synthetic rubber insulation; jute filler; cotton filler; cotton braid; rubber jacket; 600v RMS; 10 feet long; p/o W-101.	AC power cable assy.
XV-101 thru XV-108 & XV-110	N16-S-62603-6676	SOCKET, ELECTRON TUBE: 7 contacts; phosphor bronze; silver plated; miniature; center shield.	Mounting for V-101 thru V-108 & V-110.
XV-109	N16-S-62153-2625	SOCKET, ELECTRON TUBE: 6 contacts; beryllium copper; silver plated; p/o I-101.	Mounting for V-109.
XC-111	N16-S-63515-4160	SOCKET, ELECTRON TUBE: 8 contacts; beryllium copper; silver plated; octal type.	Mounting for C-112.
XF-112	N17-F-74266-9361	FUSEHOLDER: extractor post type; 250v; 18 amp; accommodates; 1 fuse; cartridge type; 1 1/4 in. lg. by 1/4 in. dia.; Bussman type HCM.	Mounting for F-101.

Z-101	N16-F-32166-9607	FILTER, BAND PASS: operating frequency; 1875cps; bandwidth 1725cps to 2025cps; input impedance; 600 ohms; output impedance; 50,000 ohms.	Limits pass band of amplifier.

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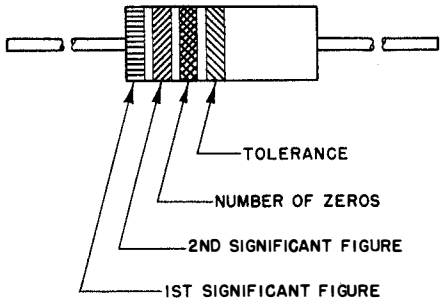
TABLE 6-2
MAINTENANCE KIT

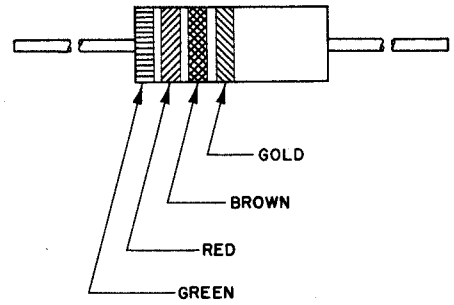
REFERENCE DESIGNATION	QUANTITY	REFERENCE DESIGNATION	QUANTITY
F-101	5	O-114	1
H-101	1	O-116	1
H-104	1	O-121-A	1
H-111	1	O-122	1
I-102	2	O-130	1
O-111	2	O-131	1
O-112	2	O-132	1
O-113	2	O-133	1
NOTE: SEE FIG. 1-3, FOR REFERENCED IDENTIFICATION			

TABLE 6-3. RESISTOR COLOR CODE

AXIAL LEAD RESISTOR



AN EXAMPLE: 520 OHMS ± 5%



COLOR	1ST BAND VALUE	2ND BAND VALUE	3RD BAND VALUE	4TH BAND VALUE
BLACK	0	0	NONE	
BROWN	1	1	0	
RED	2	2	00	
ORANGE	3	3	000	
YELLOW	4	4	0000	
GREEN	5	5	00000	
BLUE	6	6	000000	
VIOLET	7	7	0000000	
GRAY	8	8	00000000	
WHITE	9	9	000000000	
GOLD				±5%
SILVER				±10%
NONE				±20%