

# 2B RECORDER AND RA-1574-A AMPLIFIER

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# Westrex Corporation

HOLLYWOOD DIVISION

## TECHNICAL INFORMATION BULLETIN OPERATING AND MAINTENANCE INSTRUCTIONS FOR 2B RECORDER AND RA-1574-A AMPLIFIER

### 1.0 Use

The 2B Recorder is designed to make lateral disk master records on wax or lacquer blanks. It can be used with the RA-1574-A or RA-1541-A Amplifier. The associated amplifier employs feedback generated by a coil mounted on the moving element of the recorder to provide stabilization of the recorder and amplifier in combination. This arrangement achieves a high degree of uniformity of response throughout the frequency range, uniformity of sensitivity between recorders, operating characteristics independent of recording medium, low distortion and minimum noise. High-level recording without a significant increase in distortion or hum level is provided by the use of the RA-1574-A Amplifier.

### 2.0 Illustrations

- Figure 1 Top View of 2B Recorder
- Figure 2 Bottom View of 2B Recorder
- Figure 3 Moving Element Subassembly
- Figure 4 View Showing Stylus Heating Facilities
- Figure 5 Schematic Circuit of ASO-77251 Power Supply
- Figure 6 Schematic Circuit of RA-1574-A Amplifier
- Figure 7 Testing Circuit with Recorder and Amplifier
- Figure 8 Wiring Diagram of RA-1574-A Amplifier

Figure 9 Testing Circuit for Feedback Response

Figure 10 Testing Circuit for Signal Circuit Response

### 3.0 General Data

Input Impedance:	600 ohms balanced or unbalanced input Drive coil—5 ohms Feedback coil—16 ohms
Power Output:	Approximately 75 watts maximum.
Frequency Response:	2B Recorder with RA-1574-A Amplifier, 40 to 15,000 cps—flat within $\pm 2$ db.
Recording Characteristic:	Provided by equalizers preceding the amplifier.
Sensitivity:	An input level of $-26$ dbm produces a recording velocity of 7 cm/sec with normal feedback setting. Maximum recording velocity is greater than 50 cm/sec in mid-frequency range, decreasing to approximately 25 cm/sec at high frequencies.
Noise:	Total noise is 70 db below 7 cm/sec velocity. Hum level is 80 db or more below 7 cm/sec velocity.
Monitor Output Level:	Approximately $-3$ dbm at 1000 cps for 7 cm/sec velocity.

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### **3.0 General Data (Continued)**

Monitor	RIAA
Equalization:	
Controls:	Advance-ball adjusting screws.
	Adjustable feedback from zero to approximately 16 db at 300 cps. (Normal operation is with 14 to 16 db of feedback.)
	Low-frequency equalization of zero to +3 db at 70 cps (in five steps).
	High-frequency equalization of zero to -5 db at 10,000 cps (continuously adjustable).
Power Supply:	RA-1567-type required.

### **4.0 Description**

#### **4.1 2B Recorder**

Figure 1 shows a top view of the 2B Recorder and Figure 2 shows a bottom view with the principal items of interest called out. The recorder contains a moving element of cast magnesium on which are mounted the driving coil and the feedback coil. Each of these coils is free to move in its annular air gap, the magnetic fields of which are maintained by separate permanent magnets.

Figure 3 shows an enlarged view of the moving element. The magnesium casting is designed to minimize mass and at the same time provide sufficient rigidity to avoid vibration in spurious modes. The casting is attached to the recorder proper by two beryllium-copper cantilever springs which act as hinges. A fin-shaped extension on the casting is embedded in a compliant material which allows the hinge to flex normally but resists rotation about any but the intended axis. This arrangement provides an extension of the frequency range essentially flat to beyond 20 kc with the use of a relatively simple electrical network to correct a 4-db dip in the region of 15 kc.

The moving element has a stylus holder for accepting a tapered-shank stylus. The P-77106 Tool may be ordered separately to mount and remove the stylus. In order to prevent dust or magnetic particles from entering the air gaps, a transparent plastic closure is provided. This includes a flexible neoprene insert through which the stylus holder protrudes. The entire moving coil assembly is centered in the air gap by means of dowel pins in the mounting plates which fit in corresponding holes in the pole pieces. One of the four types of ASP-77232 Styli is used for recording, depending on the type of recording. The KS-7555 Advance Ball is also required. The stylus and advance ball are not furnished and must be ordered separately.

The advance-ball mounting is shown in Figures 1 and 2. Two thumb screws provide vertical and lateral adjustment of the advance ball. The former controls the depth and cut and the latter centers the path of the advance ball within the area of removed material.

The recorder is supplied with facilities for hot-stylus recording as shown in Figure 4. The ASO-77251 Power Supply or the equivalent is required. A single cord attached to the power supply and terminated in a No. 219 "Herman Smith" Banana Plug connects to the jack at the end of the recorder arm. Connections to the amplifier are made through a cord with a 5-pin plug, one end of which is connected to and is part of the RA-1574-A Amplifier. The recorder is furnished in a carrying case.

#### **4.2 RA-1323 Recorder Holder**

The RA-1323 Recorder Holder is designed for mounting the 2B Recorder. It provides for vertical motion of the recording head and for raising and lowering the head at the beginning and end of recording. The weight of the recording head is counterbalanced by a coil spring so that the force on the advance ball may be adjusted to any desired value. Accurate ball bearings allow the head to follow variations in the surface of the record blank with extremely small friction. The recorder is raised or lowered by means of the lever which takes the form of a cam operating against a hardened surface. The cam is



## **2B RECORDER AND RA-1574-A AMPLIFIER**

### **4.0 Description (Continued)**

shaped so that the recorder head will be lowered gently on to the record blank without introducing vibration. The cone-pointed screws which hold the movable saddle may be adjusted and locked to eliminate lateral motion of the saddle. The RA-1323 Recorder Holder is not supplied with the recorder and must be ordered separately.

### **4.3 Tapered-Shank Stylus**

The 2B Recorder provides a tapered hole in the stylus holder which will accommodate the tapered shanks of the ASP-77232 styli and requires no cementing operation. The method of inserting and removing a tapered stylus is covered in Section 7.1. The ASP-77232 Styli are available in four types for standard or micro-groove pitch and for hot or cold-stylus recording.

The following tapered-shank styli are used for the types of cutting indicated:

- ASP-77232—Detail 1 For Standard-Groove, Hot-Stylus Recording
- ASP-77232—Detail 2 For Micro-Groove, Hot-Stylus Recording
- ASP-77232—Detail 3 For Standard-Groove, Cold-Stylus Recording on Lacquer
- ASP-77232—Detail 4 For Micro-Groove, Cold-Stylus Recording on Lacquer

### **4.4 Hot-Stylus Recording**

Stylus heating facilities have been provided in the 2B Recorder. As shown in Figure 4, these consist of two small terminals to which may be attached the leads from a simple heater coil energized with 6 volts from an a-c source. The heater coil is designed to slide over the stylus after it has been set in the stylus holder, and the coil is held in place by the natural spring tension of the coil leads. The coil consists of  $7\frac{1}{2}$  turns of resistance wire of 0.005 inch diame-

ter having a resistance of 32 ohms per foot and close wound on a 0.029 inch mandrel, such as the shank of a No. 69 drill. The coil is easily installed or removed for stylus cleaning or replacement.

The ASO-77251 Power Supply may be ordered separately to supply power to the heating coil. Its circuit schematic is shown in Figure 5. One side of the circuit is through the banana plug Pg-1 which is connected to the jack on the recorder arm. The other side of the circuit is through the ground lug which may be fastened under one of the cable-clamp screws on the adapter plate. Sharp-edged styli are used for hot-stylus recording.

It will be observed that as current is applied to the heater coil, the noise level at any particular diameter of cut will decrease as the current is increased up to about one ampere. It is not desirable to increase the current beyond this value as too much heat may cause burned chips to adhere so tightly to the stylus that their removal may cause the destruction of the stylus. *The suction pump should be operating whenever the heating coil is energized to avoid adhesion of burned chips to the stylus.*

### **5.0 Installation**

Caution—A strong magnetic field surrounds the 2B Recorder which may be harmful in the following respects unless simple precautions are taken:

- (a) Watches may be magnetized.
- (b) The recorder may be pulled from the hand or tools may be drawn forcibly against the stylus or advance-ball assembly.
- (c) Do not remove the feedback magnet except as an assembly.
- (d) The recorder will be drawn down with excessive force toward a turntable platter of magnetic material.

The effect of stray field decreases rapidly with distance and it is unlikely that mechanisms will be disturbed at distances greater than 8 inches.



### **5.0 Installation (Continued)**

#### **5.1 Mechanical**

##### **5.11 Recorder Preparations**

The recorder should be made ready for use by inserting a stylus, selected for the type of cutting desired as outlined in Section 7.1. An advance ball should also be mounted. Instructions for mounting are given in Section 7.1.

##### **5.12 Mounting on Machine**

It is assumed that a suitable disk recording machine is in readiness for the installation of the 2B Recorder and accessories. Operating instructions for the RA-1389 or D-85249 type Disk Recording Machines may be used for reference. The ASO-71389 Adapter or the equivalent should be attached to the carriage. Suction equipment should also be available for use. For use with the 2B Recorder, the threaded stud of the RA-1323 Recorder Holder is inserted in the front hole ( $\frac{3}{32}$ " Dia.) of the ASO-71389 Adapter and is clamped in place by tightening the large knurled nut supplied with the holder. During this operation the holder should be pressed down to insure contact with the machined lip of the adapter. The recorder is then mounted in the recorder holder. The two upper screws of the holder, when tightened sufficiently, will hold the recorder in place. During these operations the recording head should be at one side of the turntable to avoid possible damage to the stylus or the advance ball. The recorder should be moved forward or back until the stylus is on a line between the center pin and the center of the carriage.

##### **5.13 Adjustments**

The height of the recorder holder should be adjusted to bring it into position for obtaining the best results from the lever and cam control. First adjust the height of the advance ball to be the same as that of the stylus point by means of the large thumb screw on the recorder. The lever which raises or lowers the recorder provides a total travel of about  $\frac{1}{2}$  inch. When the the recorder holder is at optimum height, lower-

ing the lever half way down lowers the stylus about  $\frac{3}{8}$  inch and additional movement of the lever lowers the lever about  $\frac{1}{8}$  inch. This enables the recorder to be lowered to the disk very gradually, and after the stylus makes contact additional lever travel provides *clearance* between the cam and hardened surface to enable the recorder to follow variations in the disk without interference.

The counterbalance spring is then adjusted to provide the proper vertical force on the advance ball. This adjustment is made by first turning the thumb screw that controls the counterbalance spring tension counterclockwise to insure the advance ball is resting on the disk. The thumb screw is next turned clockwise until the advance ball barely clears the disk. The thumb screw is then turned counterclockwise  $\frac{1}{8}$  turn. This will apply approximately 80 to 90 grams pressure on the stylus and advance ball. This pressure will be found satisfactory in most cases.

When the above adjustments are made correctly, the stylus should be vertical when it touches the record blank and the recorder arm should be horizontal. Any departure from this condition should be such that the front part of the arm is above the horizontal by a maximum of 5 degrees. The stylus should be in line with the center pin to within  $\pm\frac{1}{16}$  inch. The advance ball should be adjusted laterally by means of the lateral-adjustment small thumb screw on the recorder so that it leads the stylus by one or two groove pitches, and so that the track it leaves will fall within the cut groove. The width of the cut groove is controlled by the large thumb screw on the recorder. Test cuts should be made at the desired groove pitch and width to determine that the grooves are clean and uniformly spaced and that no advance-ball marks or chatter are introduced. Some lacquer blanks show variations in hardness or flatness which may require occasional adjustment of advance-ball force. After some practice, these adjustments may be made while recording by observing the grooves under the microscope. It should not be necessary to adjust the height of the carriage for normal variations in thickness of lacquer disks. The advance ball adjusting screws should be secured in the tested position



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### **5.0 Installation (Continued)**

until a different groove width is desired, such as to accommodate a change in groove pitch.

#### **5.14 Suction Equipment**

The 2B Recorder requires a suction equipment to remove the cut chips. Connection should be made to the suction tube on the recorder.

#### **5.2 Electrical**

The RA-1574-A Amplifier is described in detail in Section 8. The amplifier should be installed close to the recorder with which it will be associated. The normal length of the cable which connects the recorder to the amplifier is 8 feet. Tests have shown that cable lengths up to 20 feet are satisfactory.

The amplifier requires the RA-1567-B Power Supply for its operation. If the amplifier and power supply are to be mounted close together, their relative positions are important if the signal-to-noise capability of the amplifier is to be realized. When mounted adjacent to each other in a relay rack, the power supply must be mounted above the amplifier.

Applying direct current to the amplifier filaments and mounting the power supply at least one foot from the amplifier will reduce the hum level still more for very special recording conditions.

The amplifier and power supply should be interconnected, an external ground should be applied and a 115-volt, 50 or 60-cycle, single-phase, a-c power source should be connected as shown in Figure 6. The RA-1567-Type Power Supply is described in a separate bulletin.

The amplifier and the power supply are equipped with safety switches which open one side of the 115-volt line when either front panel is removed. However a considerable portion of 600 volts remains at terminal 24 of TS2 in the amplifier for some time after the power supply is turned off. As a precautionary measure, this terminal should be shorted to the chassis before attempting to work on the circuit.

It may be found desirable to interconnect the 115-volt leads to the ASO-77251 Power Supply and to the suction equipment so that the suction equipment must be in operation when the heater coil on the stylus is energized for hot-stylus recording. Aside from this, the power supply for hot-stylus recording is connected as outlined in Section 4.4.

The case of the recorder is connected to the amplifier ground at terminal 9 of TS2 through the 5-point plug and shield of the cable. The fuse F-1 in the amplifier should be in place at all times and its value should not be changed.

The portion of the recording system preceding the RA-1574-A Amplifier should include an equalizer for providing the desired over-all recording characteristic. Jacks should be provided to enable test signals to be applied with or without equalization. Since two or more recording machines will usually be operated simultaneously, this requires a bridging bus or equivalent network for feeding each amplifier-recorder combination as well as circuit arrangements for volume-indicator and direct-monitoring facilities. For the above condition, it is recommended that a 600/600 ohm variable attenuator be connected ahead of each RA-1574-A Amplifier in order to compensate for differences in amplifier gain and recorder sensitivity. These attenuators may conveniently provide up to 8 db in 0.5 or 1.0 db steps.

### **6.0 Test and Operation**

#### **6.1 Recorder Response Calibration**

The 2B Recorder without feedback has a resonance rise of approximately 35 db in the vicinity of 1000 cps. The application of the correct amount of feedback results in a recorder modulation characteristic which is flat  $\pm 2$  db from 40 to 15,000 cps. This condition is normally obtained with the use of 14 to 16 db of feedback at 300 cps. A dip of about 4 db centers at about 15,000 cps, and this can be corrected if necessary by the use of a simple equalizer network.

The low-frequency equalizer has five steps. Turning the control switch clockwise raises the response at 70 cps approximately  $\frac{3}{4}$  db per step.



### 6.0 Test and Operation (Continued)

The high-frequency equalizer is continuously variable. Turning the control clockwise lowers the response at 10,000 cps a maximum of 5 db.

The following procedure and explanation describe an electrical method of calibrating the recorder and amplifier. It is based on the fact that the velocity of the recorder stylus is indicated accurately up to a frequency of 8,000 cps by the voltage developed across the feedback coil.

To test for sensitivity, the test circuit shown in Figure 7 is used. With the low-frequency and high-frequency controls at their extreme counterclockwise positions which cuts out the equalization and with the feedback control at its extreme clockwise position for maximum feedback, a 1,000-cps signal at a level of  $-26 \pm 2$  dbm at the input of the amplifier should produce a voltage reading across the feedback coil at terminals 7 and 8 of TS2 of 0.045 volts. This value of feedback voltage represents a stylus velocity of 7 centimeters per second.

The over-all frequency response may be measured out to 8,000 cps by using the same test circuit and varying the frequency of the input signal. The feedback voltage should not vary by more than  $\pm 0.75$  db over a frequency range from 50 to 8,000 cps. The setting of the feedback control may be varied to obtain the flattest frequency response. In most cases it will be found that maximum feedback produces the best frequency characteristic. The low-frequency and high-frequency controls may be used to further adjust the frequency characteristic as desired.

### 6.2 Amplifier-Recorder Sensitivity Tests

Although some information as to amplifier-recorder sensitivity is obtained when calibrating the frequency characteristic, additional tests may be necessary. This is particularly true when two or more recorders are operated with a channel and the recorded levels should be matched closely or be different by a definite amount such as 1.0 or 2.0 db.

Tests for determining the sensitivity of each amplifier and recorder combination should include test records in which a constant level is applied to a bridging bus or to the input of each amplifier, with the previously determined setting of feedback adjustment (P-1) for each amplifier and recorder. The feedback voltage during recording (approximately 0.045) should be noted for reference. The record or records should then be reproduced over a constant-gain system and the levels read on a volume indicator. The variable attenuators ahead of each RA-1574-A Amplifier should then be adjusted to correct for the difference in recorded levels as determined by reproduction. These steps will compensate for total variations in amplifier gain and recorder sensitivity within each combination.

It may also be desirable to check the sensitivity of several recorders individually, in order to determine how one or more recorders (such as a spare) may be interchanged quickly with another recorder. This may be done by connecting each recorder successively to the same amplifier, individually adjusting P-1 if necessary to provide a flat response for each recorder, and then making a test record at 400 cps with each recorder. These test cuts with constant input level at the RA-1574-A Amplifier, when reproduced will give volume-indicator readings proportional to the sensitivity of each recorder.

The normal variation in sensitivity of the 2B Recorders as supplied to the field is generally well within  $\pm 2.0$  db. This is the possible variation in stylus velocity in a given medium such as air, lacquer or wax for a constant level applied to the input of a reference RA-1574-A Amplifier and with the feedback adjusted for a flat modulation characteristic. In most cases recorders will not vary in sensitivity below 8000 cps by more than  $\pm 0.75$  db. While the resonant frequency of the 2B Recorders may vary by  $\pm 150$  cps from the average, this does not appreciably affect either frequency response or sensitivity. Careful tests have shown that the stylus velocity when cutting in cellulose-nitrate lacquer is about 0.25 db less than when operating in air, and this difference is practically



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### **6.0 Test and Operation (Continued)**

constant for all frequencies between 40 and 11000 cps.

### **6.3 System Line-up**

High-quality recording of original speech or music involves numerous factors such as orchestration, special effects and pickup technique which frequently are not under the control of the recording department. In addition there are various equipment items such as microphones, mixing consoles, equalizers and the volume control which are not controlled by the disk-recorder operator. Although a discussion of these factors and the equipment is outside the scope of this instruction, they must be understood and correlated by the recording department in order to obtain the best results from the system.

For the purpose of this instruction covering the 2B Recorder and associated equipment, it is essential to determine the best possible relationship between the volume and balance of the program material as observed in the monitoring room and the resulting modulation on the master record. This "system line-up" must establish settings of gain controls, such that definite volume-indicator deflections and loudspeaker volume may be referred to some point of the system such as a bridging bus, and also to define modulation of the stylus.

The previous calibration and sensitivity tests are helpful in a preliminary line-up of the system but since that work was done without equalizers, a recheck is desirable including the equalizer for providing the characteristic preferred. The insertion loss of these equalizers is different at various frequencies, and when combined with the energy-frequency distribution of the music as "heard" by various microphones, the resulting signal is quite different from the "flat" or constant levels of tones used in the initial tests. These signals contain components which are not only constantly changing in intensity but the relative levels of low and high frequencies have been altered to conform with the physical requirements of the disk recording and reproducing method. In general, frequen-

cies between about 50 and 500 cps should be recorded at approximately the same amplitude, whereas higher frequencies should be quite uniform in average velocity and decreasing in amplitude.

No exact correlation can be established between oscillator test tones and signals produced by musical instruments or voice. However, an approximation can be made which is a compromise between over-cutting and distortion during loud passages and overriding background noise during soft passages.

As a matter of convenience testing, it may be found desirable to relate the vacuum-tube voltmeter reading obtained across the feedback coil at terminals 7 and 8 with the reading obtained at the monitor output terminals 4 and 6, which are normally terminated in a monitor jack at installation. Thereafter the voltage across the feedback coil can be measured by plugging a vacuum-tube voltmeter into the monitor jack and applying the predetermined correction.

### **6.4 Operation**

Information required for operating the 2B Recorder and RA-1574-A Amplifier is given in considerable detail in other sections of this bulletin. Very useful experience in operation may be gained in performing preliminary or routine tests such as recorder calibration and sensitivity checks. After having made the preliminary tests and adjustments correctly, successful operation is primarily the result of practicing the basic procedures and giving attention to each step of the process.

The average micro-groove recording is made at 226 lines per inch, but feeds from 210 to 274 lines per inch are used at times.

High-frequency compensation is in general use on all micro-groove recordings. For 33 $\frac{1}{3}$  rpm operation the general rule is to raise the high-frequency end of the spectrum 1 db at 8000 cps for each 3-minute interval after a 10-inch diameter has been passed. This amounts to approximately 1 db of compensation per inch of diameter. For 45-rpm recordings which start at a 7-inch diameter, the high-frequency response is



## **2B RECORDER AND RA-1574-A AMPLIFIER**

### **6.0 Test and Operation (Continued)**

raised 2 db at the start and is then increased 1 db at the end of the first three minutes. The following summary may be a helpful guide as to the important details of operation:

1. Determine and check the setting of the recording machine controls such as:

- (a) Turntable speed.
- (b) Pitch of grooves.
- (c) Direction of feed.
- (d) Diameter of cut—maximum and minimum.
- (e) Special Spirals.

2. Make cuts in advance or during rehearsal to check:

- (a) Width and uniformity of grooves.
- (b) Absence of advance-ball marks.
- (c) Correct adjustment of suction—continuous thread and no fouling.
- (d) Examine grooves under microscope for evidence of chatter, noise, broken or worn stylus.

3. Cooperate with the mixer man in maintaining proper recording levels.

- (a) Amplitude of low-frequency signals should be checked under microscope for cut-overs.
- (b) Remember that the loudest record is probably not the best record.

There is a great tendency on the part of some recording groups to record at excessive levels. This is often done for commercial reasons in order to put out records that will sound as loud (or louder than) any competitive record on the market. A trend of this nature results in all records being overloaded and having poor wearing qualities. Other reasons for overloading are the use of microphones having peaks or generally excessive response at high frequencies or an attempt to override deficiencies in processing and in pressing materials. In this connection it should be noted that the full performance of the 2B Recorder and associated ampli-

fier will not be realized if the levels exceed the tracking capabilities of the reproducing equipment.

### **7.0 Maintenance**

Extensive field trials and subsequent use in studio production have shown that the 2B Recorder requires little maintenance. With reasonable care, the instrument should operate over long periods without change in performance. However, periodic checks as to characteristic and sensitivity should be made about once a week to insure that optimum results are obtained.

#### **7.1 Stylus and Advance Ball**

These items are not mounted in the recorder as supplied and must be inserted or replaced in the field. It is not necessary to remove the advance-ball assembly and suction tube to mount these items. The stylus may be mounted in the following manner:

An ASP-77106 Tool is required for this operation and must be ordered separately.

Open the jaws of the tool by releasing the knurled thumbscrew. Mount the stylus in the tool by approaching the stylus with the end of the tool and when the parallel end of the stylus is within the hole in the tool, lightly tighten the thumbscrew. The flat side of the stylus is to be parallel with the end of the tool.

Carefully bring the tool down on the recorder, keeping the tool parallel with the edge of the machined surface of the recorder and insert the tapered shank of the stylus into the stylus holder. Press the stylus lightly into place. Thumbnail pressure (approximately one lb.) is about the correct amount required. Then loosen the thumbscrew and remove the tool by drawing it away from the side of the stylus.

To rotate or remove the stylus, approach it from the side with the end of the opened tool and lightly clamp the tool on the stylus. A slight lateral twisting motion of the tool, pulling up at the same time, will release the stylus.

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### **7.0 Maintenance (Continued)**

The KS-7555 Advance Ball should be cemented in the holder with shellac heated with a small soldering iron. These items have a shoulder for location vertically and are not critical in other respects.

### **7.2 Heater Coil (Hot Stylus Recording)**

When it is necessary to change or replace a stylus in the recorder, the old heater coil is discarded and a new one is formed and mounted on the stylus after it has been set in the stylus holder. The recommended procedure is as follows:

Use about 6 inches of approximately 0.005-inch diameter enameled resistance wire, which leaves sufficiently long leads for installation in the 2B Recorder. Close wind  $7\frac{1}{2}$  turns on a 0.029-inch mandrel, such as the shank of a No. 69 drill. The mandrel is held preferably in a small chuck or similar mounting. It is not necessary to have a tight fit of the coil on the stylus.

After the coil is placed on the stylus and approximately centered on the extended portion of the sapphire, attach the left-hand lead to the grounded or left-hand terminal, as the recorder is viewed, bottom up. Then carefully tighten the right-hand lead under the other terminal.

*Caution:* The lead will probably "crawl" as the screw is tightened, thus placing excessive pull on the stylus, and may break the stylus. If more than a very light force is exerted on the stylus, loosen the screw, provide some slack in the lead and retighten the screw. The coil will stay in place without any appreciable tension on the leads.

### **8.0 RA-1574-A Amplifier**

The RA-1574-A Amplifier is used to drive the 2B Recorder. It provides a feedback circuit, which includes a separate coil on the recorder in its loop, for stabilizing the recorder response. A monitor amplifier with RIAA reproducing equalization, and high-frequency and low-frequency

equalization are included. An RA-1567-B Power Supply is required for operation.

The RA-1541-A Amplifier modifier per P-91478 is electrically and mechanically identical with the RA-1574-A Amplifier.

### **8.1 Description**

The schematic circuit of the amplifier is shown in Figure 6. The 600-ohm input circuit is intended to operate from either a 600-ohm balanced or unbalanced circuit. In the secondary circuit of the input transformer there are five steps of low-frequency equalization controlled by a selector switch. A continuously adjustable equalizer attenuates the high-frequency range from zero to 5 db at 10,000 cps. The signal is amplified by V2A. V2B is a direct-coupled inverter stage which couples to the push-pull stage V3. This stage drives V4, V5, V6 and V7 which are connected in parallel push pull in class-A operation to provide a maximum output of 75 watts. The tap on the secondary winding of the output transformer has been selected for optimum performance with the 2B Recorder. V8 and V9 regulate the 300 volts on the screen grids of the four tubes in the output stage. If either V8 or V9 is removed the plate supply to the amplifier is open.

A cable and plug are included in the amplifier. They connect the output of the amplifier to the drive coil of the recorder and the output of the feedback coil in the recorder to the amplifier. A one-ampere fuse (Catalogue No. 8AG Fuse, Littlefuse) is included in the output circuit as protection for the recorder. This fuse should be replaced only with one having the same current rating.

The output of the feedback coil goes through P-1 which controls it, through a network which raises the high-frequency response slightly and to the grid circuit of V2A. The feedback circuit also goes through a network, which provides the low-frequency end of the RIAA reproducing characteristic, and then goes to the monitor amplifier consisting of V-1A and V-1B. The voltage feedback between the plate circuit of V-1B and the cathode of V-1A provides the



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### 8.0 RA-1574-A Amplifier (Continued)

high-frequency end of the RIAA reproducing characteristic. The output transformer of the monitor amplifier is connected for either a 50 or 600-ohm unbalanced output.

The time delay relay S-1 is adjusted to operate with a time delay when the amplifier is cold of 20 to 30 seconds to permit the heaters to reach operating temperature before the plate voltage is applied.

### 8.2 Amplifier Maintenance

The amplifier should require very little maintenance. However, periodic tests of gain, frequency response, noise and the condition of tubes are desirable to insure that optimum performance is being realized. In general, selection of tubes in the V2 position is indicated for minimum microphonic noise. Selection of tubes in the V3, V4, V5, V6 and V7 positions should be made for minimum hum. The use of direct current for the filaments of V3 through V7 eliminates the selection of tubes for minimum hum.

The wiring diagram of the amplifier is shown in Figure 8. Normal point-to-ground voltages are shown in the schematic circuit in Figure 6.

### 8.21 Feedback Circuit Gain and Frequency Response

Connect the equipment as shown in Figure 9. Make the following settings on the gain set and oscillator:

Input: +10 dbm  
Frequency: 1000 cps  
Output Z: 30 ohms  
Load Z: 600 ohms  
Output VI  
Multiplier: +10  
Attenuator: 24 db

Rotate the feedback control P-1 to the extreme clockwise position.

The following are typical voltage readings measured across the 5-ohm load resistor:

Frequency (cps)	Output (volts)
1000	M ( $2.5 \pm 0.5$ volts)
100	M to M - 0.3
50	M - 0.4 to M - 0.7
5000	M to M + 0.4
10000	M + 0.25 to M + 0.75

Rotate the feedback control P-1 to the extreme counterclockwise position and verify that the output drops by at least 36 db.

### 8.22 Signal Circuit Gain and Frequency Response

Connect the equipment as shown in Figure 10. The cable to the recorder need not be removed, but the recorder must not be plugged in. Adjust the transmission set and oscillator as follows:

Input: +10 dbm  
Frequency: 1000 cps  
Output Z: 600 ohms  
Attenuation: 38 db

Set the low and high-frequency equalizers and the feedback control P-1 to their extreme counterclockwise positions.

The following are typical readings measured across the 5-ohm load resistor:

Frequency (cps)	Output
1000	M ( $2.5 \pm 0.25$ Volts)
500	M $\pm$ 0.5 db
100	M $\pm$ 0.5 db
50	M to M - 2.0 db
30	M - 2.5 to M - 5.0 db
5000	M to M - 0.75 db
10000	M to M - 0.75 db
20000	M + 1.0 to M - 2.0 db

### 8.23 Noise

Using the test circuit shown in Figure 10, replace the input to terminals 1 and 3 with a 600-ohm resistor. The voltage, measured across the 5-ohm load resistor should not exceed 0.003 volts.

## **2B RECORDER AND RA-1574-A AMPLIFIER**

### **8.0 RA-1574-A Amplifier**

(Continued)

#### **8.24 Monitor Circuit Gain and Frequency Response**

Connect the equipment as shown in Figure 9, but move the vacuum-tube voltmeter to be in parallel with the load jack of the gain set. Make the following settings on the gain set and oscillator:

Frequency:	1000 cps
Gain Set Attenuator:	28 db
Gain Set Input:	+16 dbm
Gain Set Load Z:	600 ohms
Gain Set Source Z:	30 ohms
Gain Set Load VI:	+10

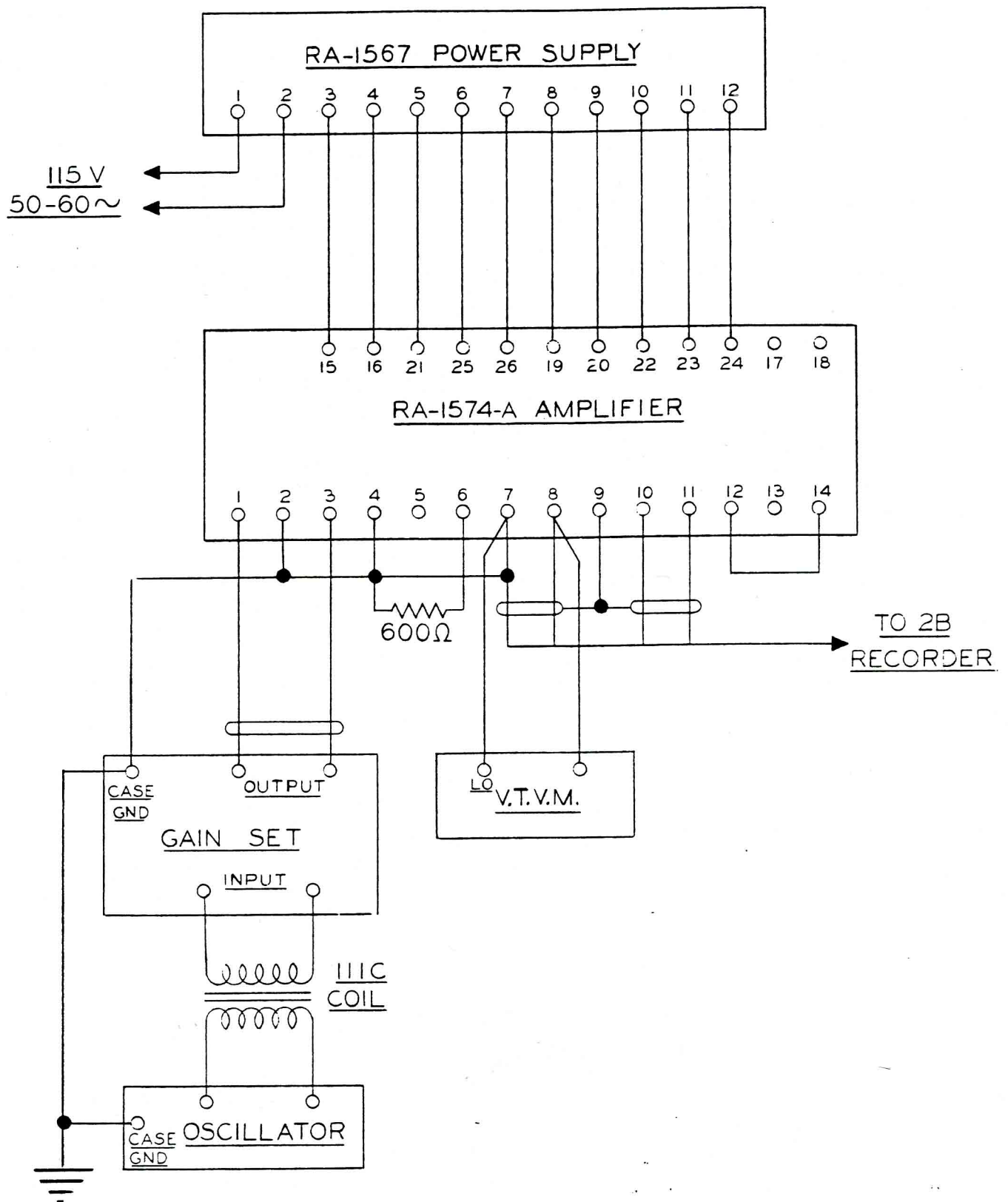
The following are typical values of output as measured on the vacuum-tube voltmeter:

<i>Frequency (cps)</i>	<i>Output</i>
1000	M (-1.5 to -4.5 dbm)
100	M +11.5 ± 0.5 db
50	M +13.5 ± 0.5 db
5000	M -9.5 ± 0.5 db
10000	M -14.75 ± 1.0 db

### **9.0 Associated Technical Information Bulletin**

RA-1567-Type Power Supply





**Figure 7 Testing Circuit with Recorder and Amplifier**

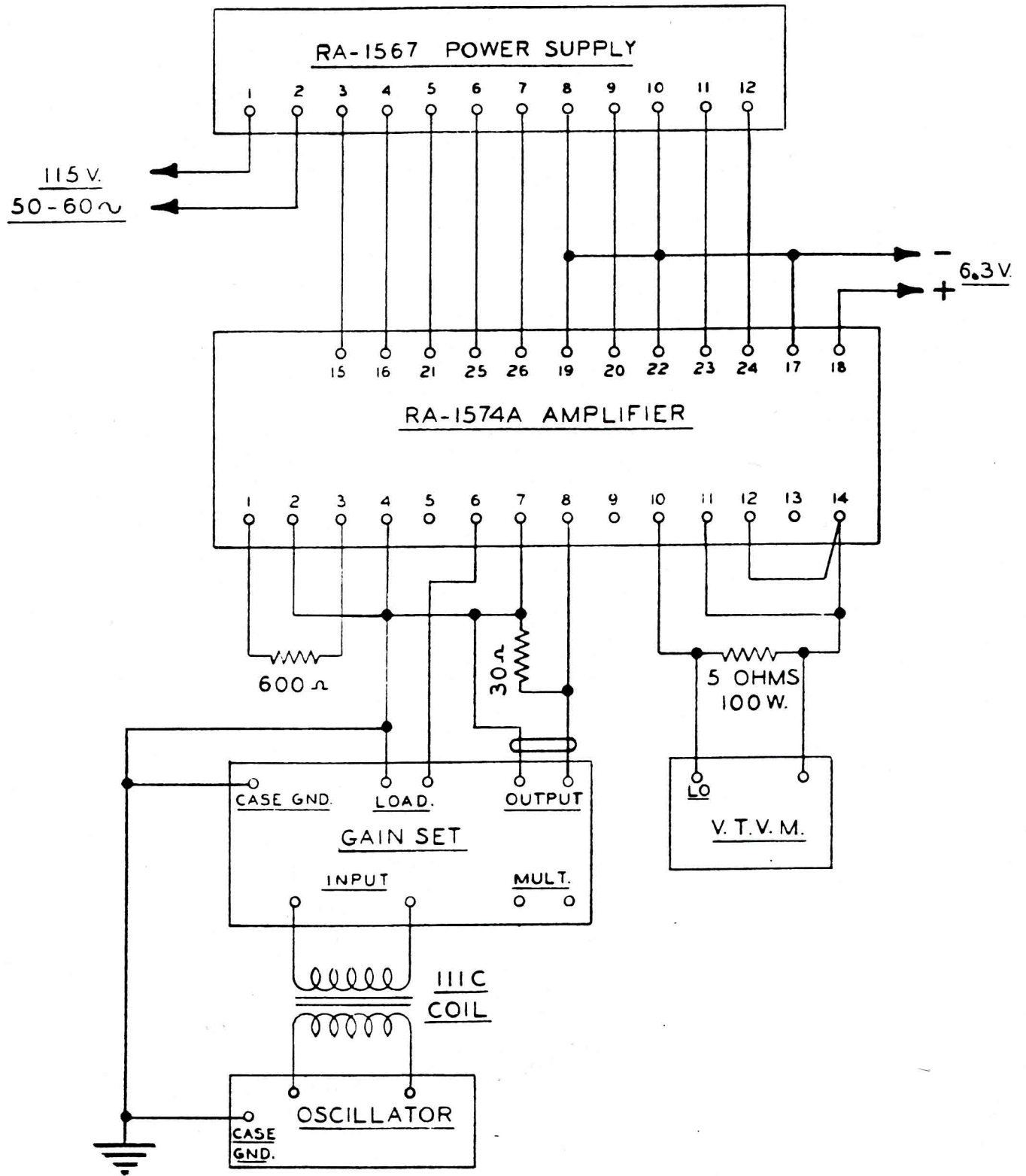


Figure 9 Testing Circuit for Feedback Response



Changes

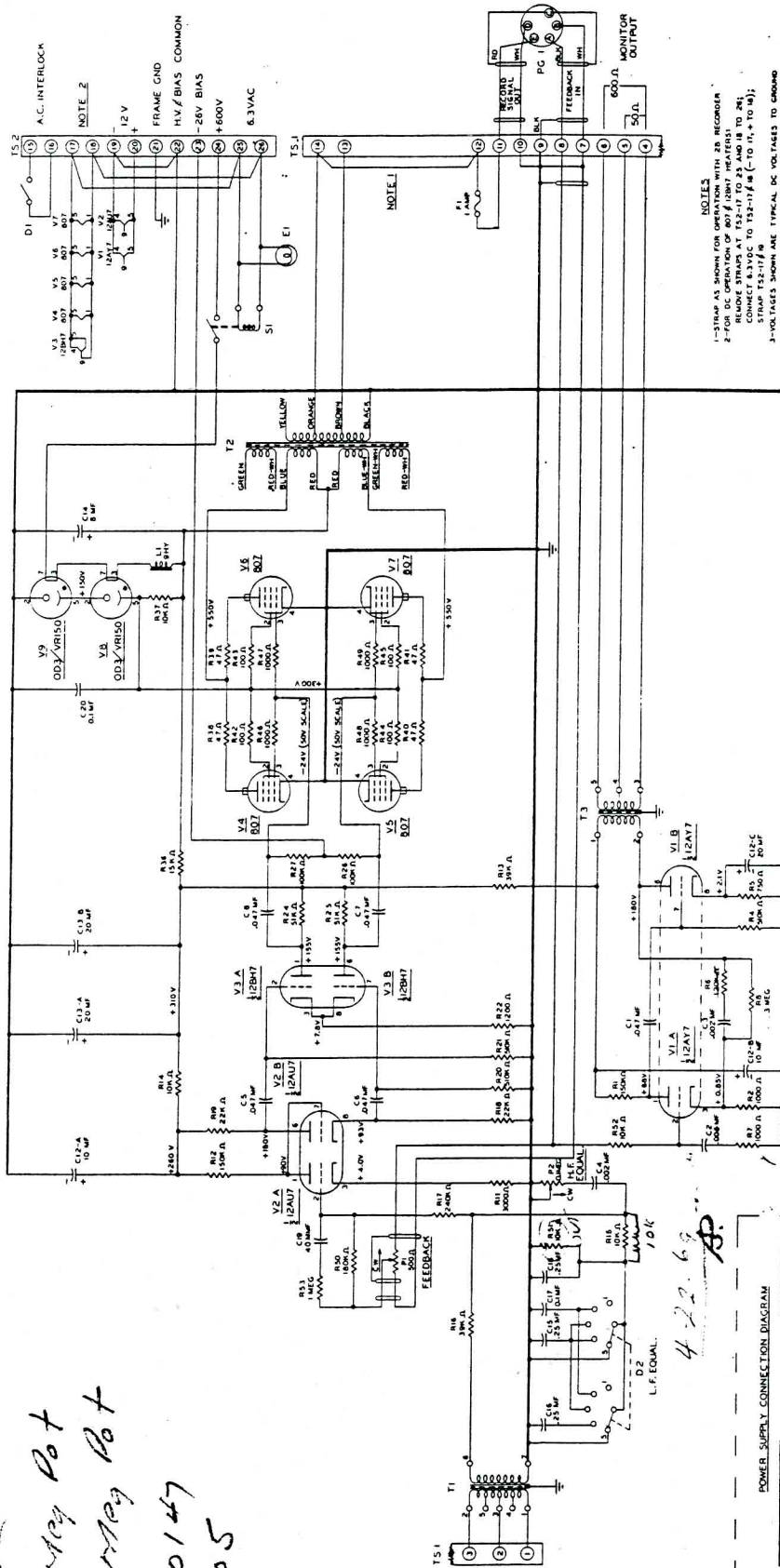
R6 - 56K

R7 - 15 Meg Pot

R8 - 5 Meg Pot

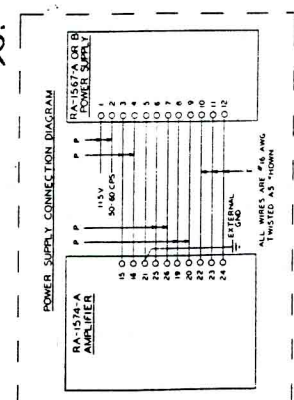
C2 - .00147

C3 - .005



NOTES

- 1-STRAP AS SHOWN FOR OPERATION WITH AS RECORDED
- 2-FOR DC OPERATION OF 607 (50W HEATER) REMOVE STRAPS AT T2-T7 TO 23 AND 18 TO 21; CONNECT 8.3VDC TO T2-T7 (8 (- TO IT, + TO 18));
- 3-VOLTAGES SHOWN ARE TYPICAL DC VOLTAGES TO GROUND MEASURED WITH A 20000 Ω PER VOLT METER



4-22-69

1 .25  
 2 .35 - 1 @ 50W - 2 @ 30W - final position  
 3 .50  
 4 .75  
 5 short

Cutter changed to new type with high level coil & slight suspension.

Figure 6 Schematic Circuit of RA-1574-A Amplifier

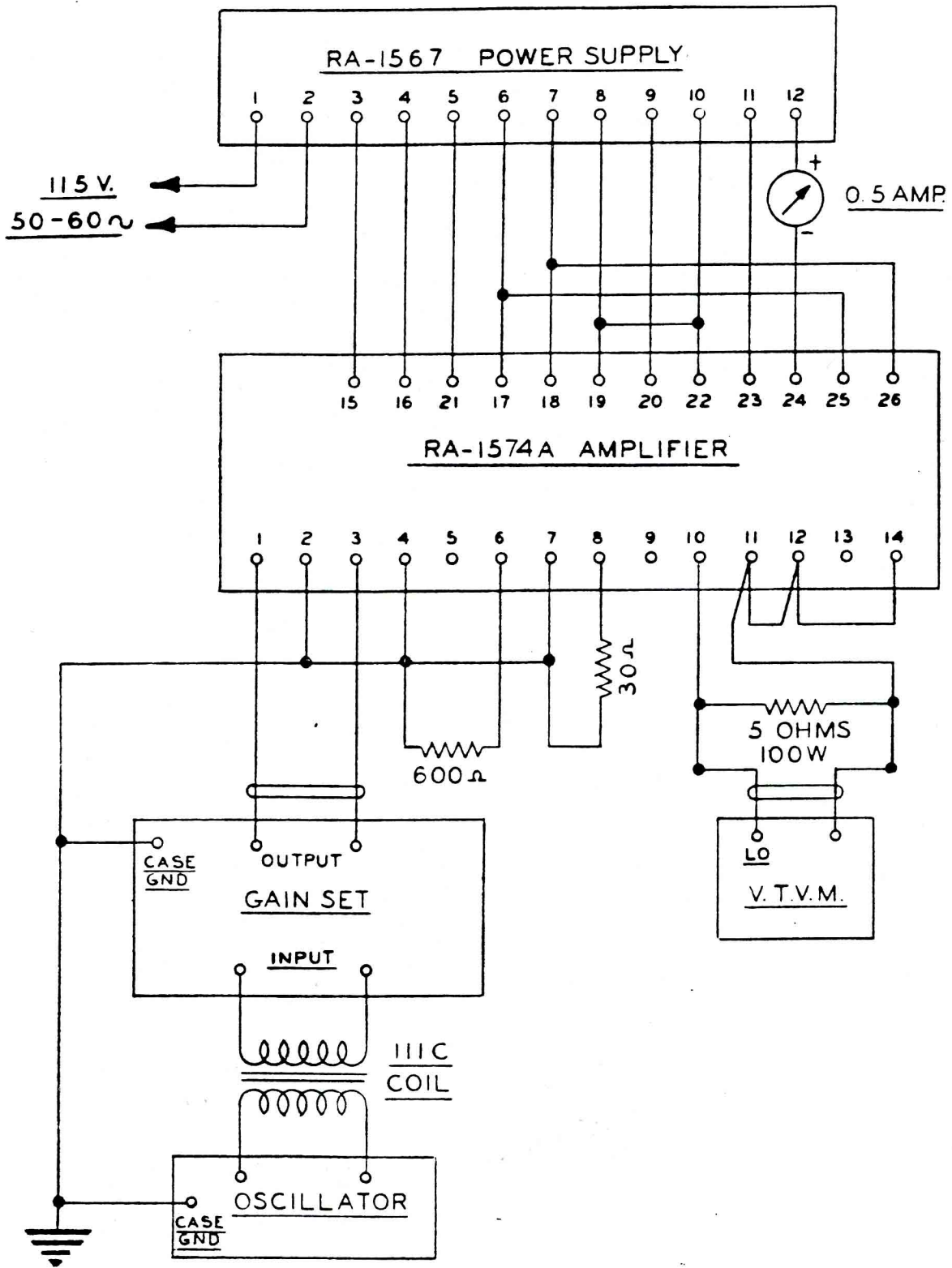


Figure 10 Testing Circuit for Signal Circuit Response





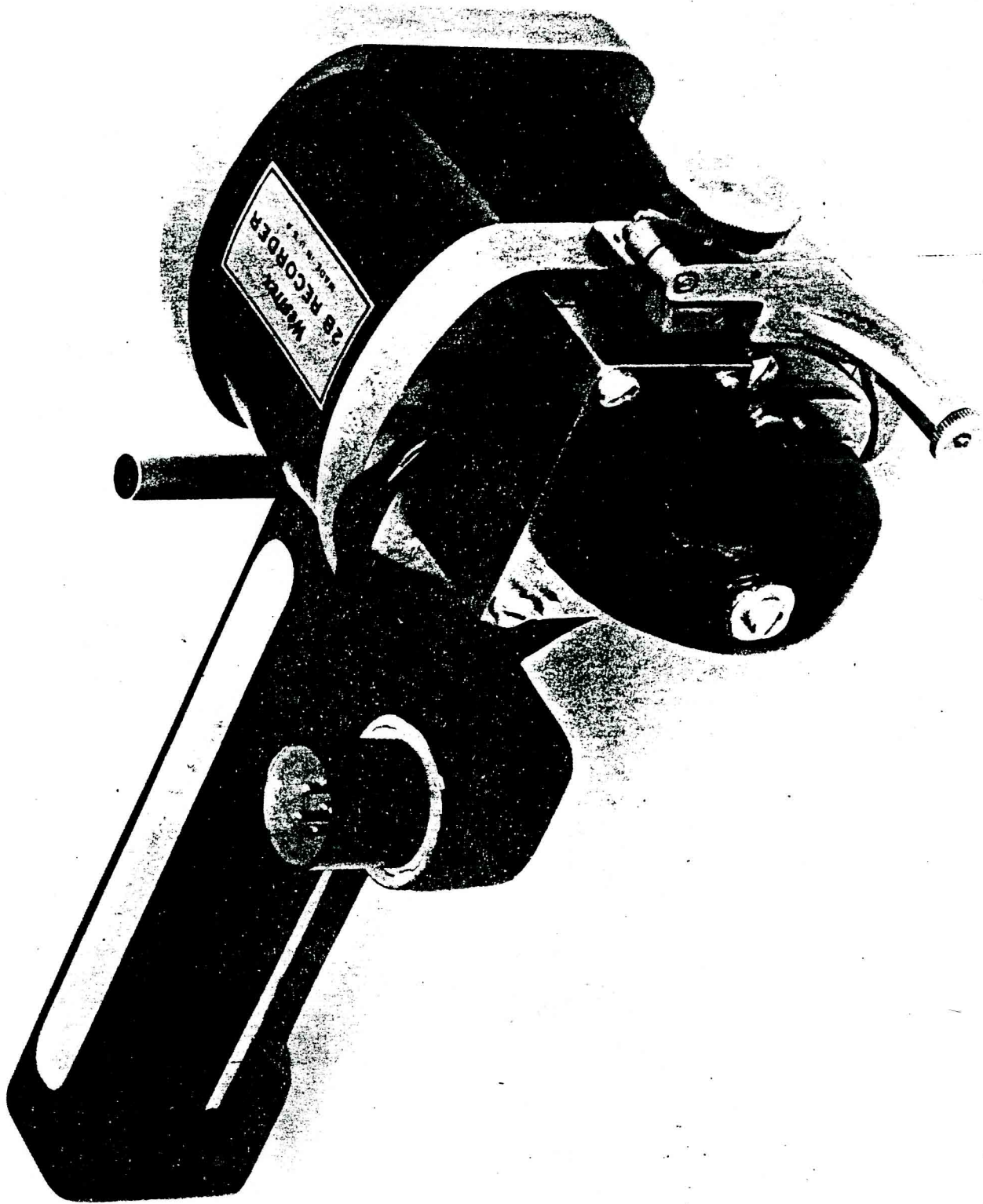


Figure 1. Top View of 2B Recorder



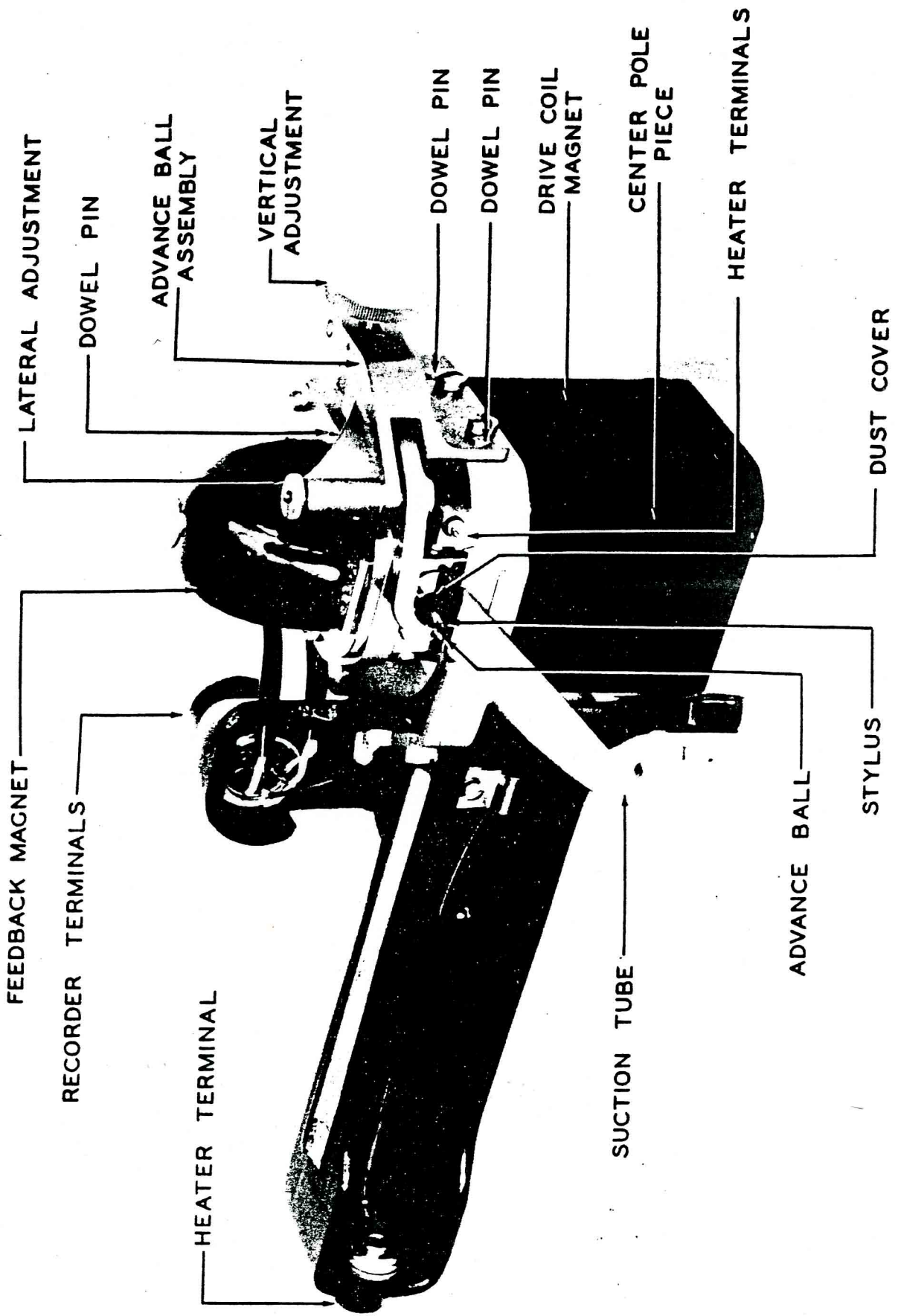


Figure 2. Bottom View of 2B Recorder

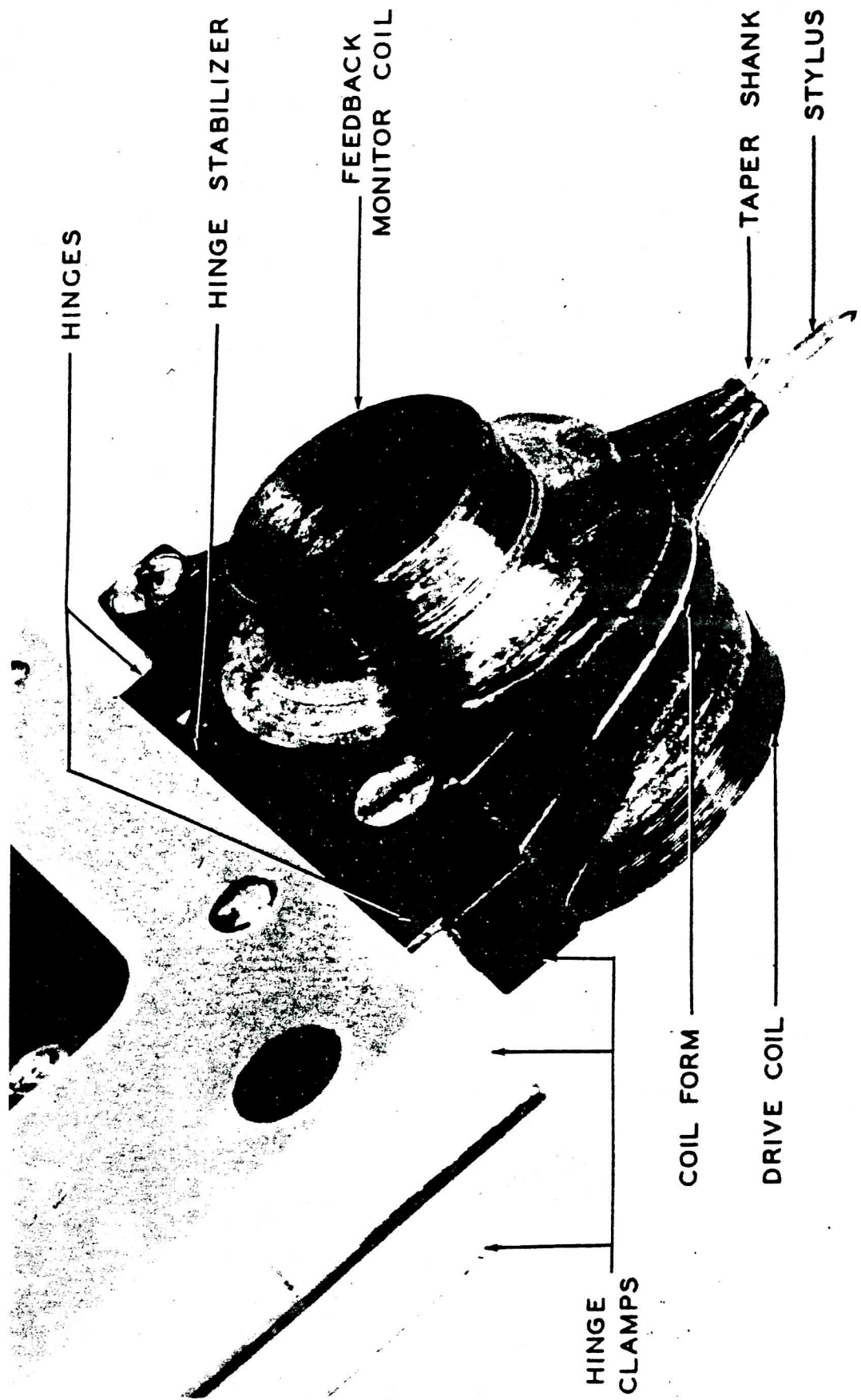
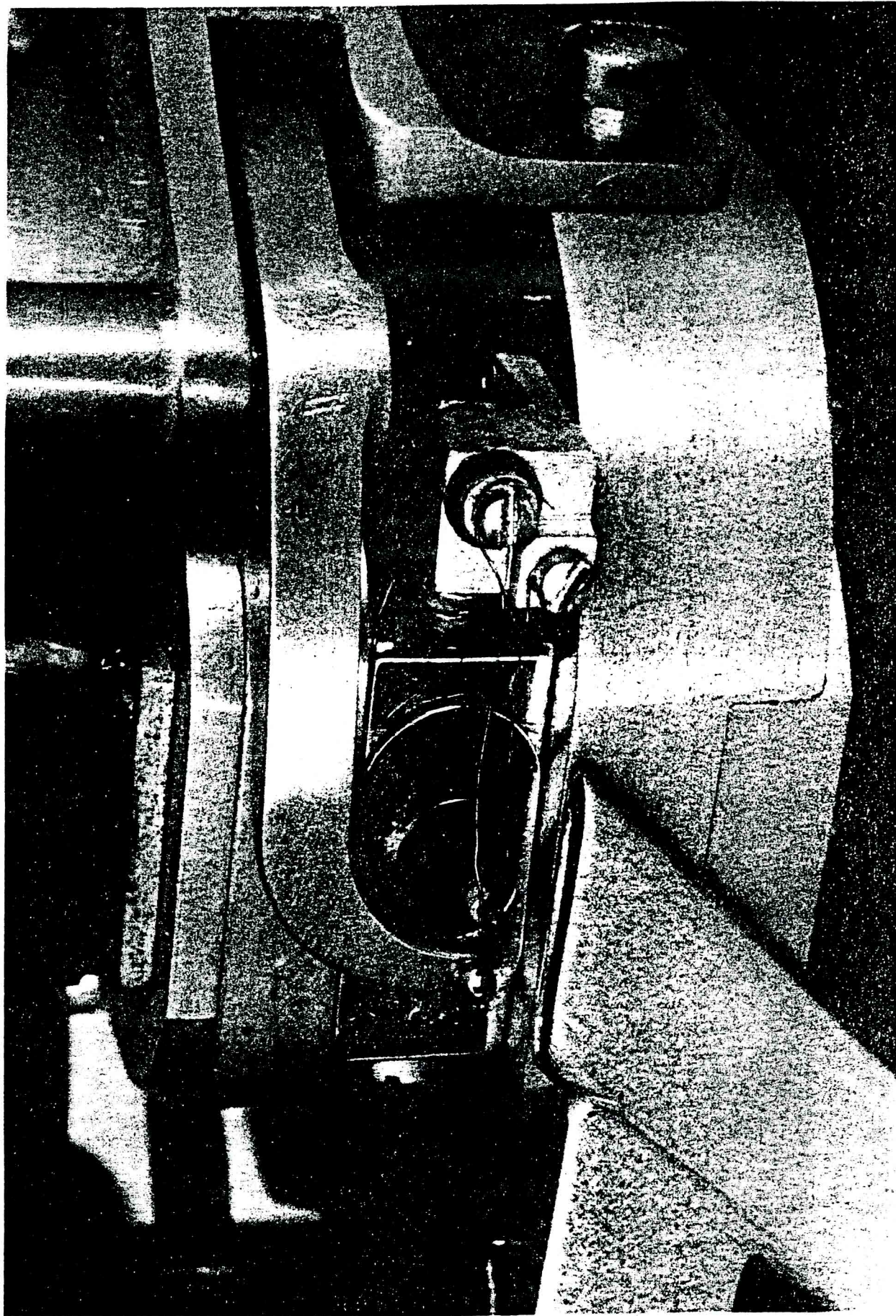
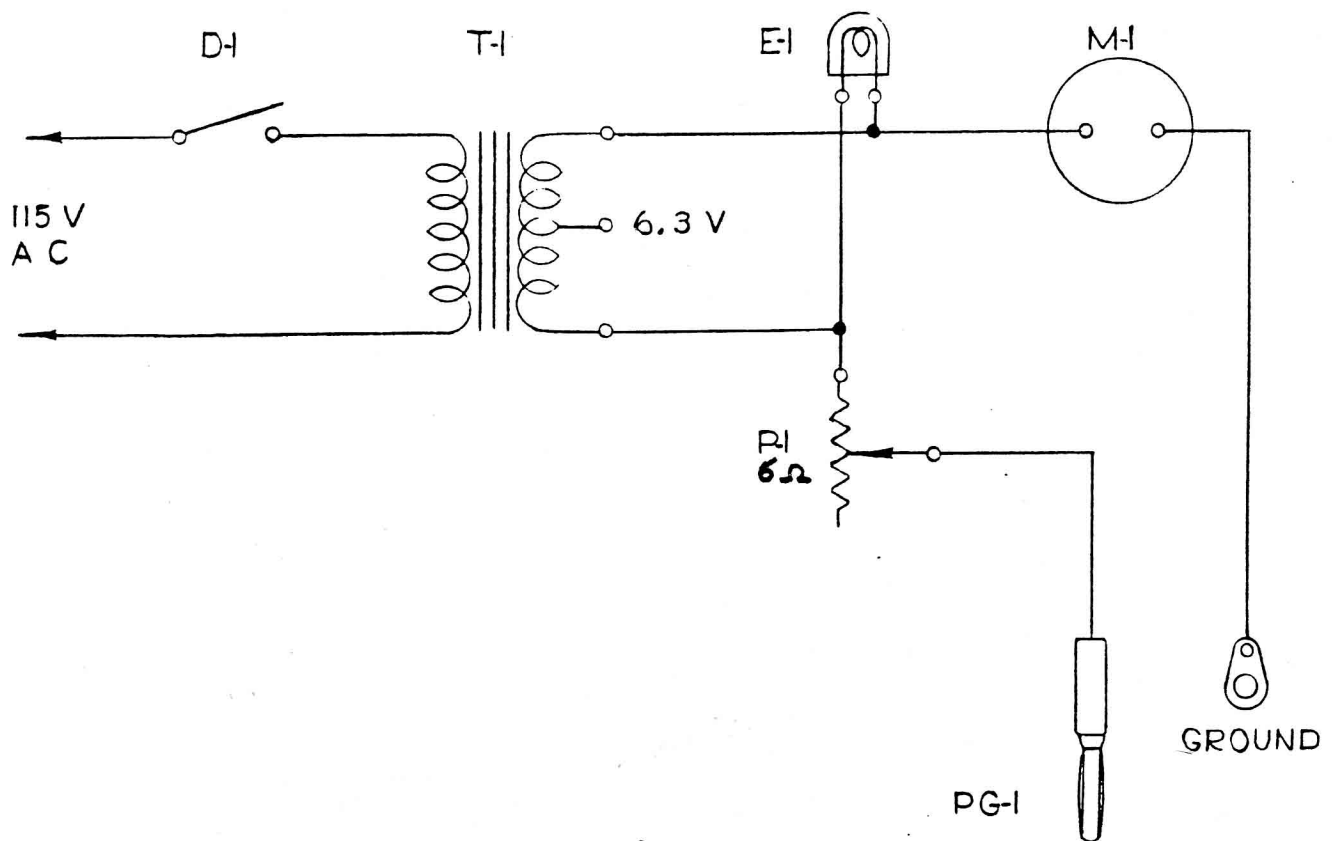


Figure 3. Moving Element Subassembly





**Figure 4. View Showing Stylus Heating Facilities**



**Figure 5. Schematic Circuit of ASO-77251 Power Supply**