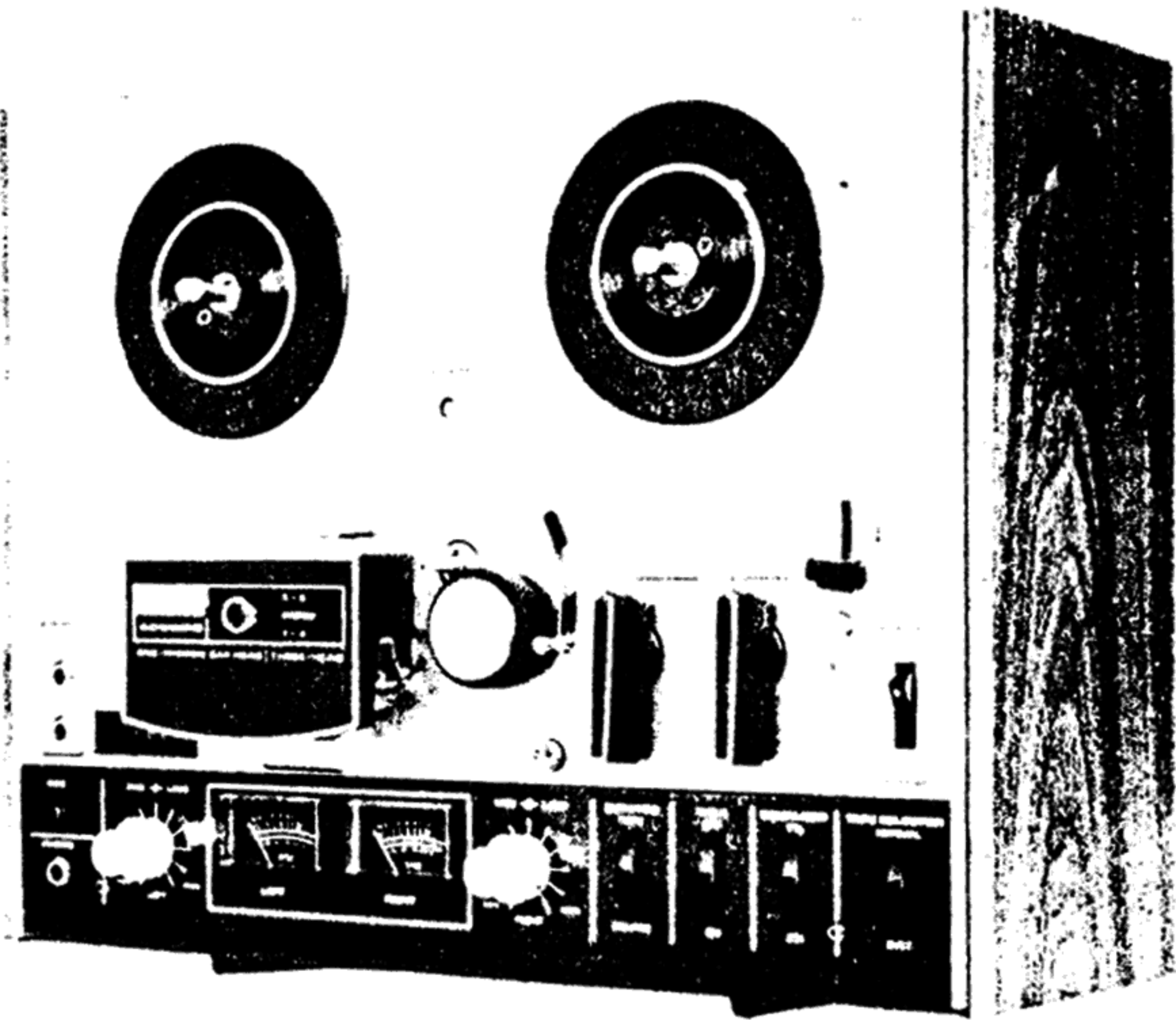


# **AKAI - Service Manual**

**Stéréo Tape Deck**

**4000 DS - 4000 DS-MK2**



## STEREO TAPE DECK

MODEL 4000DS

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**SECTION 1**

**SERVICE MANUAL**

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# I. SPECIFICATIONS

An asterisk next to a figure indicates the minimum guaranteed performance.

TRACK SYSTEM	4-track 2-channel stereo/monaural system	
REEL CAPACITY	Up to 7" reel	
TAPE SPEED	7-1/2 and 3-3/4 ips $\pm 2\%$ (* $\pm 3\%$ )	
WOW AND FLUTTER	Less than 0.15% (*0.22%) RMS at 7-1/2 ips Less than 0.20% (*0.30%) RMS at 3-3/4 ips	
FREQUENCY RESPONSE	AKAI SRT tape Regular tape	30 to 23,000 Hz (*40 to 22,000 Hz) $\pm 3$ dB at 7-1/2 ips 30 to 16,000 Hz (*40 to 14,000 Hz) $\pm 3$ dB at 3-3/4 ips 30 to 20,000 Hz (*40 to 20,000 Hz) $\pm 3$ dB at 7-1/2 ips 30 to 14,000 Hz (*40 to 14,000 Hz) $\pm 3$ dB at 3-3/4 ips
SIGNAL TO NOISE RATIO	Better than 50 dB at 7-1/2 ips Better than 48 dB at 3-3/4 ips	
DISTORTION	Less than 1.5% (*2.0%) at 7-1/2 ips Less than 2.5% at 3-3/4 ips	
CROSS TALK	Better than 70 dB (*60 dB) monaural Better than 50 dB (*45 dB) stereo	
ERASE RATIO	Better than 70 dB	
INPUTS	Mic input Line input Din input	0.8 mV Impedance 5 k $\Omega$ 70 mV Impedance 150 k $\Omega$ 7 mV
OUTPUTS	Line output Din output	1.228V (4 $\pm$ 1 dB) using a 250 Hz "0" VU recorded tape 0.4V
BIAS FREQUENCY	105 kHz $\pm 5\%$	
BIAS LEAK	Less than -30 VU	
HIGH FREQUENCY DEVIATION	Within 2 dB using an 8,000 Hz 3-3/4 ips recorded tape at 7-1/2 ips	
RECORDING CAPACITY	60 min. stereo recording using a 1,200 ft. tape at 7-1/2 ips	
FAST FORWARD AND REWIND TIME	152/190 sec. using a 1,200 ft. tape at 60/50 Hz	
MOTOR	4-pole induction 1-speed motor Type: SSM-1 Revolutions: 1,800/1,500 rpm. at 60/50 Hz	
HEADS	Recording Head  Playback Head  Erase Head	In-line 4-track 2-channel recording head Type: P4-154 Gap: 1 micron Impedance: 95 $\Omega$ $\pm 15\%$ at 1,000 Hz In-line 4-track 2-channel playback head Type: P4-150 Gap: 1 micron Impedance: 1,250 $\Omega$ $\pm 15\%$ at 1,000 Hz In-line 4-track 2-channel erase head Type: E4-200 Gap: 0.6 mm Impedance: 200 $\Omega$ $\pm 5\%$ at 100 kHz
TRANSISTORS	6 . . . . . 2SC458 LG (C) (D) 2 . . . . . 2SC871 (E) (F)	2 . . . . . 2SC971 (2) (3) (red) 1 . . . . . 2SC1098 (L) (M)
IC	4 . . . . . LD3141	
DIODES	2 . . . . . 1N34A 1 . . . . . 10DC-1 1 . . . . . 1S339A	
POWER SUPPLY	100 to 240V A.C., 50/60 Hz 120V A.C., 60 Hz for CSA/UL Models 220V A.C., 50 Hz for CEE model	
POWER CONSUMPTION	35W	
INSULATION RESISTANCE	More than 50 M $\Omega$	
INSULATION DURABILITY	1,000V A.C. for more than 1 min. duration	
DIMENSIONS	406 (W) X 314 (H) X 194 (D) mm (15.9" X 12.4" X 7.6")	
WEIGHT	11.4 kg (25 lbs.)	

NOTE: Specifications subject to change without notice.

## II. MEASURING METHOD

### 1. TAPE SPEED DEVIATION

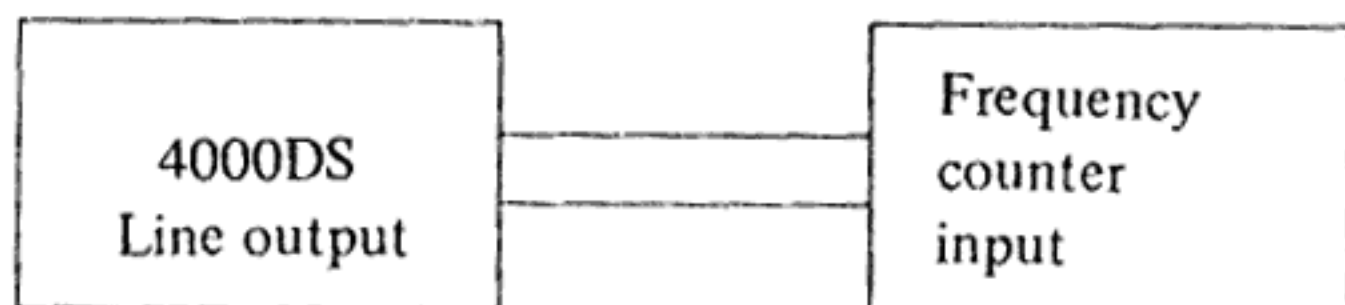


Fig. 1

As shown in Figure 1, connect a Frequency Counter to the Line Output of Model 4000DS.

Take a frequency counter reading at the beginning, middle, and end of tape winding during playback. The maximum value of these respective readings will represent tape speed deviation.

### 2. WOW AND FLUTTER



Fig. 2

#### Method A

As shown in Fig. 2, connect the Line Output of Model 4000DS to the Input of a Wow and Flutter Meter. Use a 3,000 Hz pre-recorded test tape and take a wow and flutter meter reading at the beginning, middle, and end of tape winding. The maximum value of these respective readings will represent the wow and flutter.

#### Method B

Supply a 3,000 Hz sine wave signal from an Audio Frequency Oscillator and make a recording on a blank tape at the beginning, middle, and end of tape winding. Rewind and playback tape. Measure wow and flutter with a Wow and Flutter Meter. (The wow and flutter value of Method B will be close to twice that of Method A.)

### 3. FREQUENCY RESPONSE

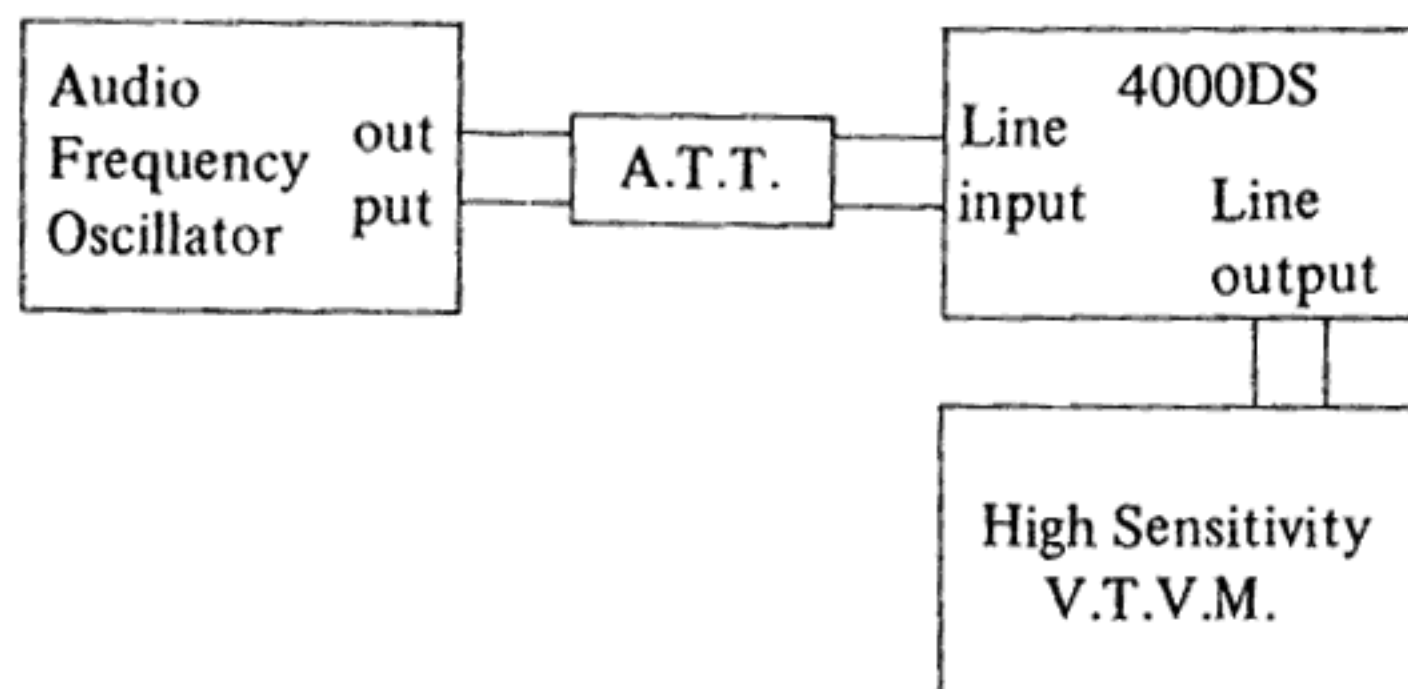


Fig. 3

For measuring frequency response, connect instruments as shown in Fig. 3 and proceed as follows:

- 1) Supply a 1,000 Hz sine wave to the Line Input of Model 4000DS from an Audio Frequency Oscillator through an Attenuator. Set recorder to recording mode and turn recording level volume control to maximum. Adjust Attenuator to obtain a +4 dB V.T.V.M. reading.
- 2) Under conditions described in 1) above, re-adjust Attenuator so that the Line Output is -16 dB, and record 40 to 20,000 Hz spot frequencies.
- 3) Rewind tape and playback from the beginning. Take V.T.V.M. spot frequency readings and plot values on a graph.

**NOTE:** When measuring frequency response, new tape should be used.

### 4. SIGNAL TO NOISE RATIO

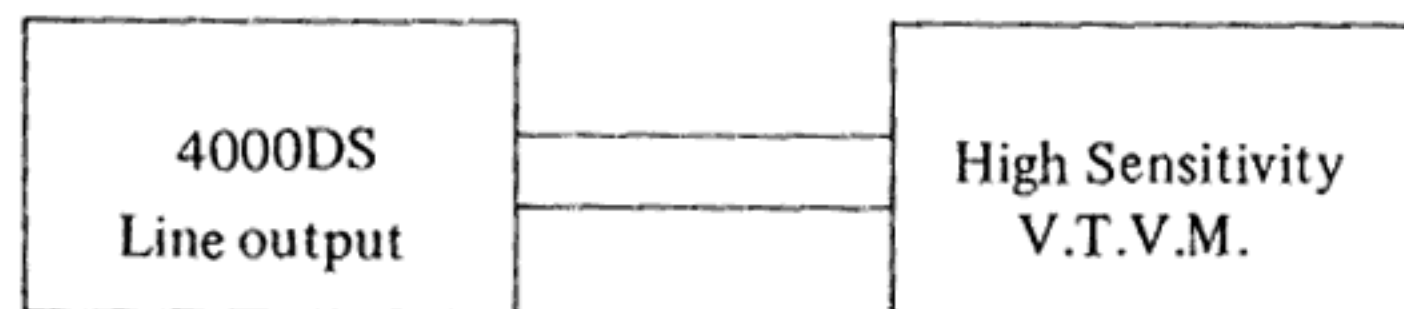


Fig. 4

As shown in Fig. 4, connect a High Sensitivity V.T.V.M. to the Line output of Model 4000DS. Playback a 250 Hz "O" VU pre-recorded test tape and measure the output. Then remove the tape and measure the noise level under the same condition. Convert each of the measured values into decibels.

## 5. TOTAL HARMONIC DISTORTION FACTOR

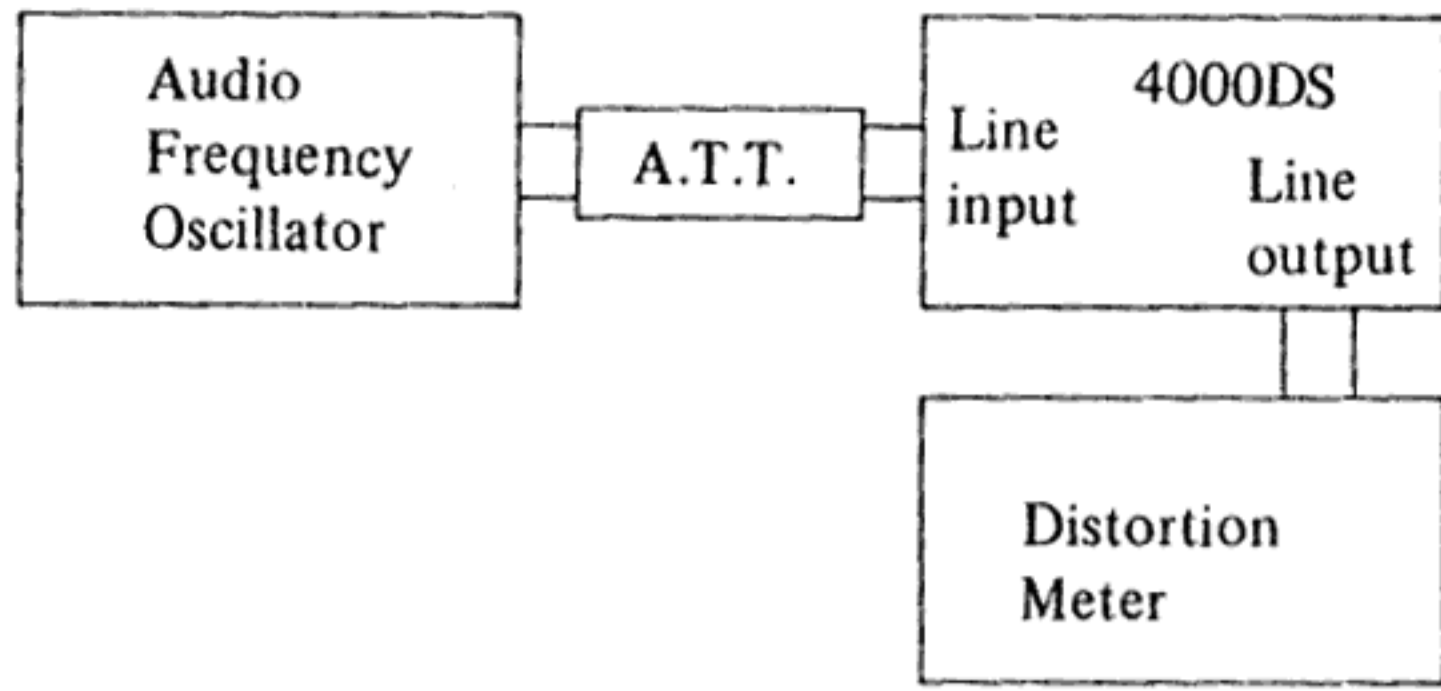


Fig. 5

Connect the measuring instruments as shown in Fig. 5 and record a 1,000 Hz sine wave signal at "0" VU. Playback the resultant signal and measure the overall distortion factor. Measure the noise level of the tape recorder without the tape. Connect the Audio Frequency Oscillator directly to the distortion meter for measurement of the distortion factor of the oscillator. The required distortion factor can be obtained from the results of the above measurement by the following formula:

$$d_0 = d - d_1 - d_2$$

where,  $d_0$  – Required distortion factor  
 $d$  – Overall distortion factor  
 $d_1$  – Noise level  
 $d_2$  – Distortion factor of the oscillator

**NOTE:** When measuring the distortion factor, new tape should be used.

## 6. CROSS TALK (Cross talk between the tracks)

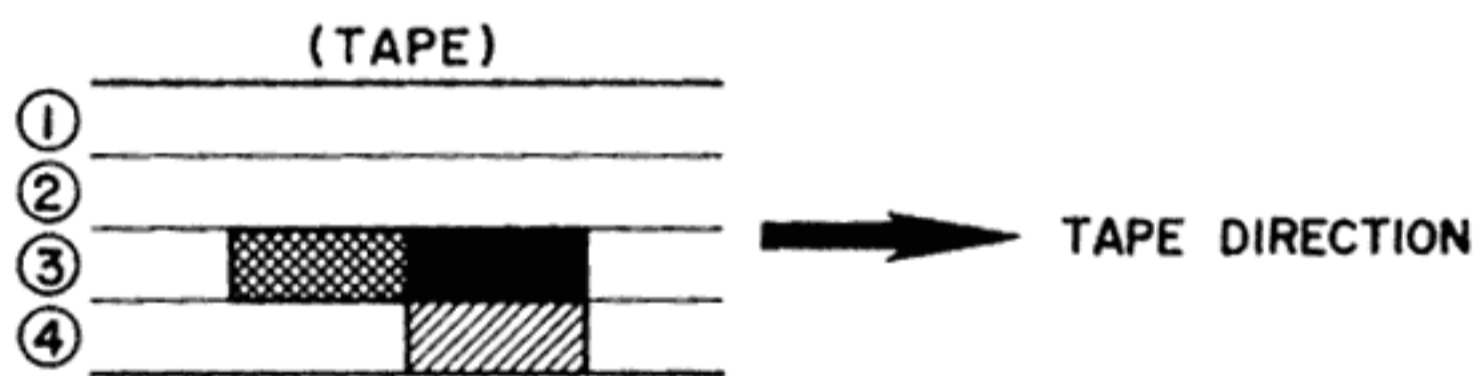


Fig. 6

As shown in Fig. 6, first record a 1,000 Hz sine wave signal on Track No. 3 at +3 VU level. Next, record under a non-input condition. Then, playback the tape on Tracks No. 3 and 4 through the B.P.F. (band pass filter sensitivity ... 1:1) and obtain a ratio between the two from the following formula:

$$C = 20 \log \frac{E_0}{E_2 - E_1} \text{ (dB)}$$

where,  $C$  – Desired cross talk ratio (dB)  
 $E_0$  – 1,000 Hz signal output level   
 $E_2$  – 1,000 Hz cross talk level   
 $E_1$  – Non-input signal recorded level

## 7. ERASE RATIO

As shown in Fig. 4, connect a High Sensitivity V.T.V.M. to the Line Output of Model 4000DS. Playback a virgin tape and take a V.T.V.M. reading of the output level. Next, record a 1,000 Hz sine wave signal at +3 dB, then playback this recorded signal and take a V.T.V.M. reading of the output level. Next, using this pre-recorded tape, record under a non-input condition and take a reading of the noise level output of the erased signal and obtain a ratio between the two from the following formula:

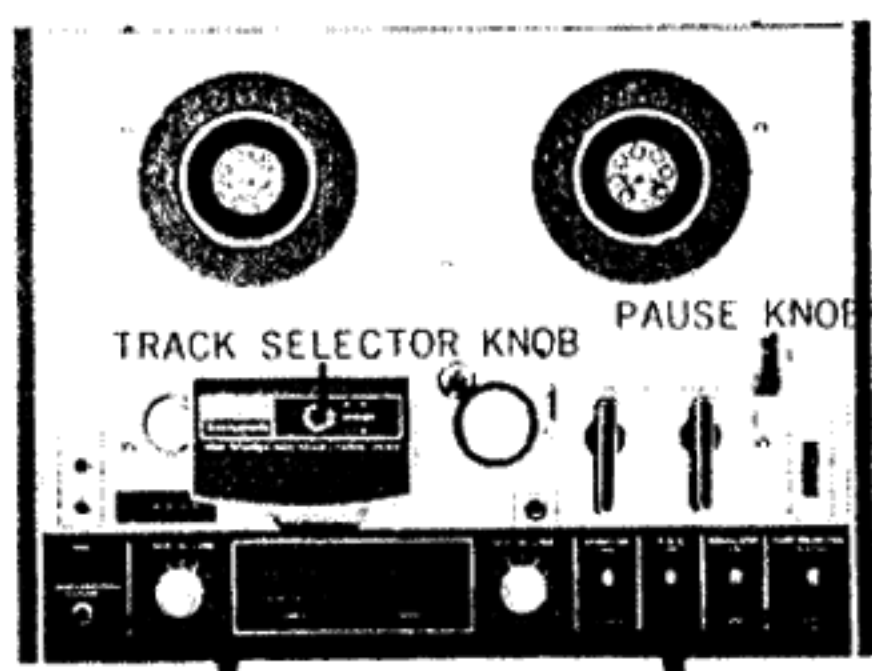
$$Er = 20 \log \frac{E_0}{E_2 - E_1} \text{ (dB)}$$

Where,  $Er$  – Desired erase ratio (dB)  
 $E_0$  – 1,000 Hz signal output level  
 $E_2$  – Non-input signal recorded level  
 $E_1$  – Virgin tape noise output level

### III. DISMANTLING OF TAPE TRANSPORT UNIT & AMPLIFIERS

In case of trouble, etc. necessitating disassembly, please disassemble in the order shown in photographs. Re-assemble in reverse order.

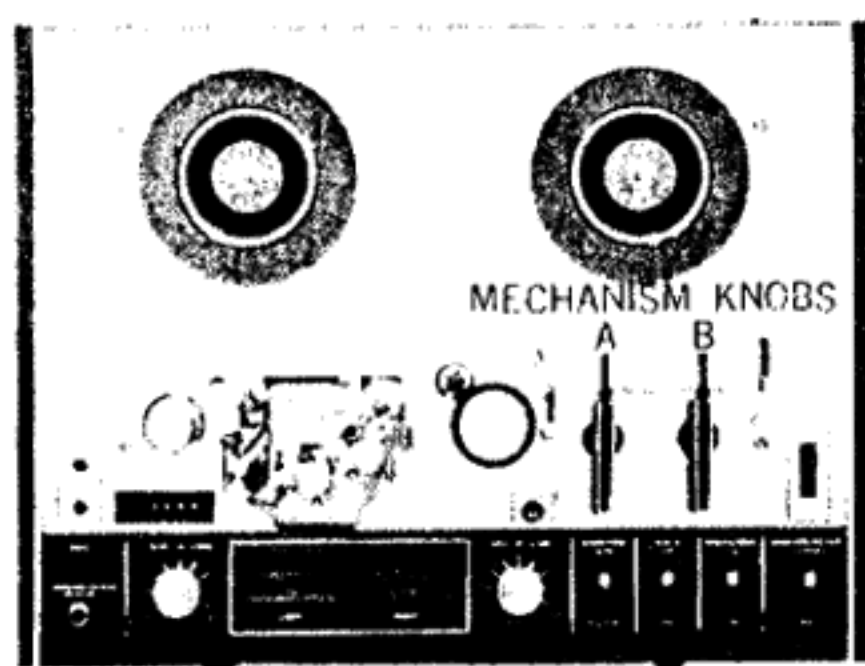
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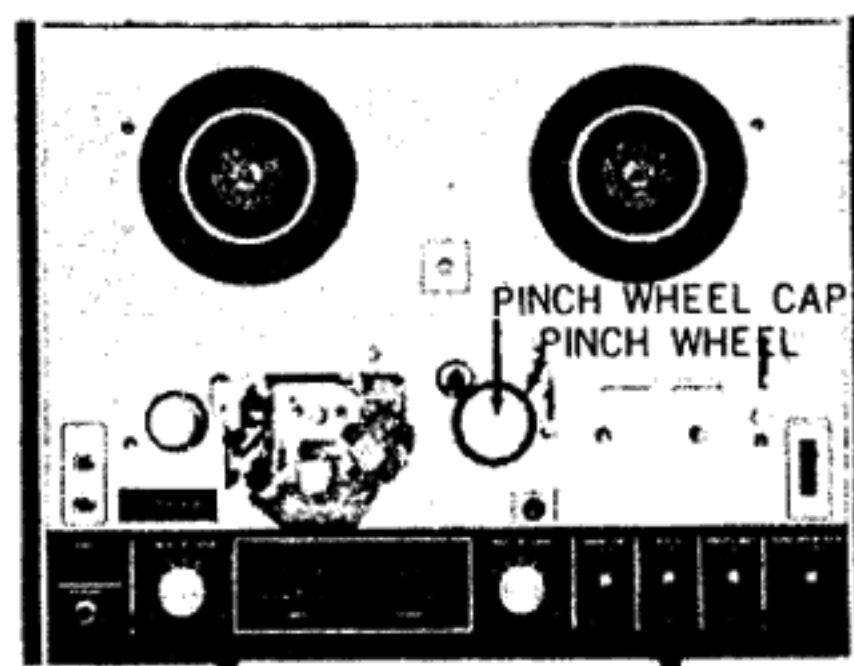
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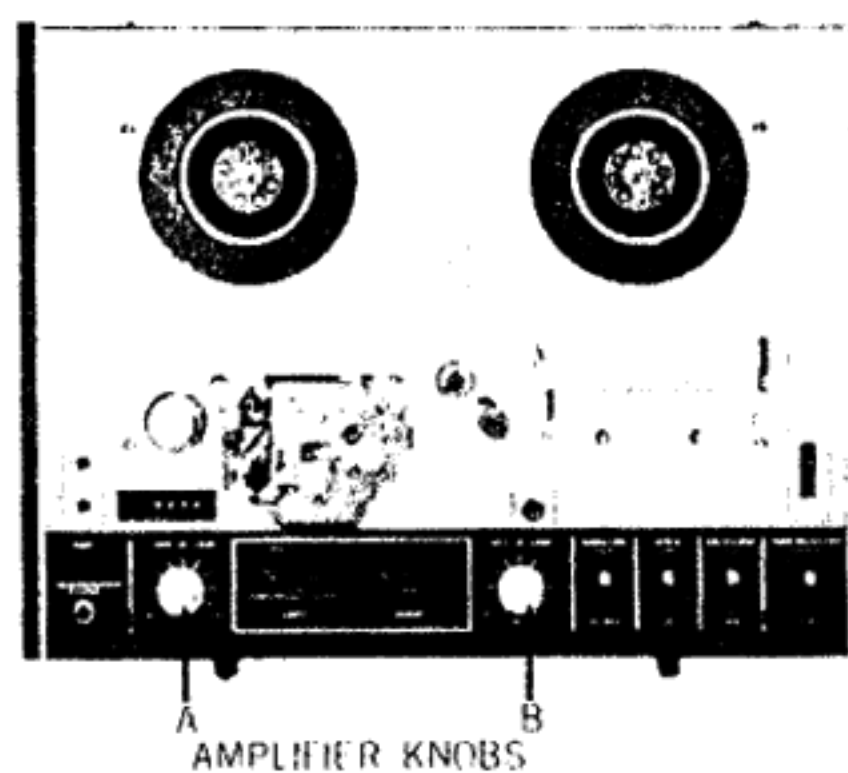
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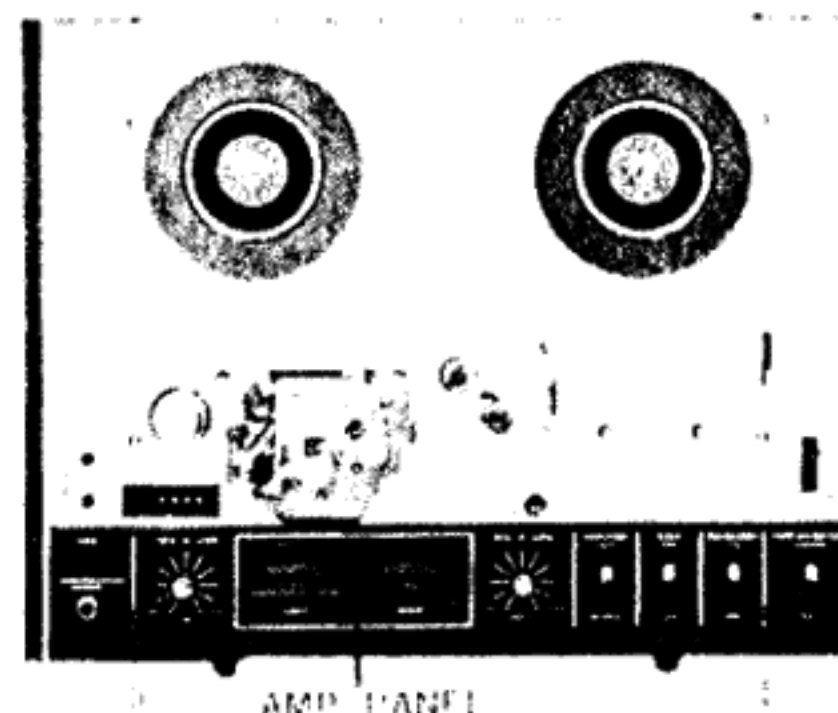
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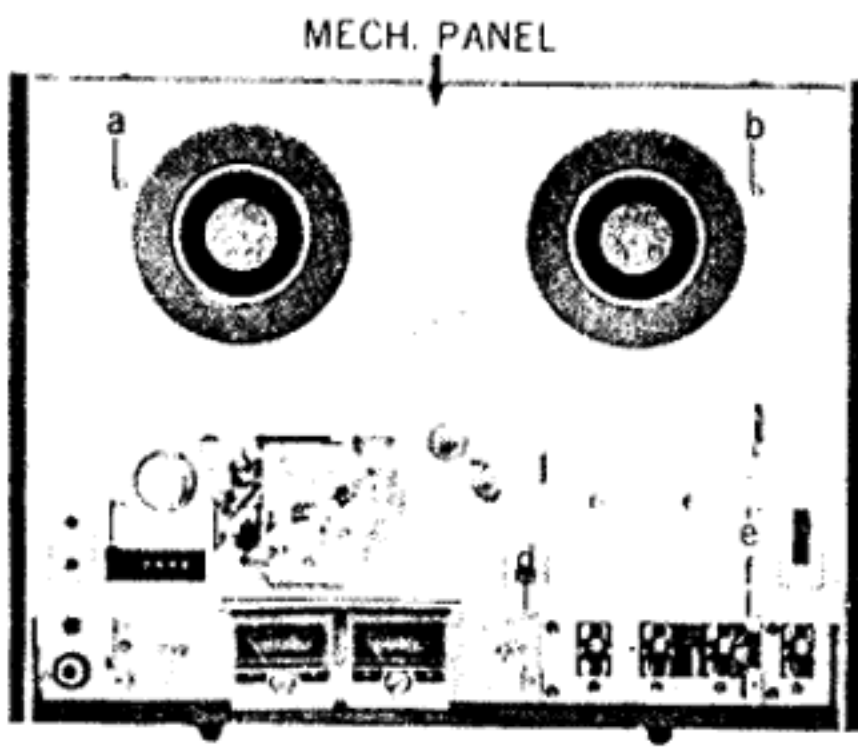
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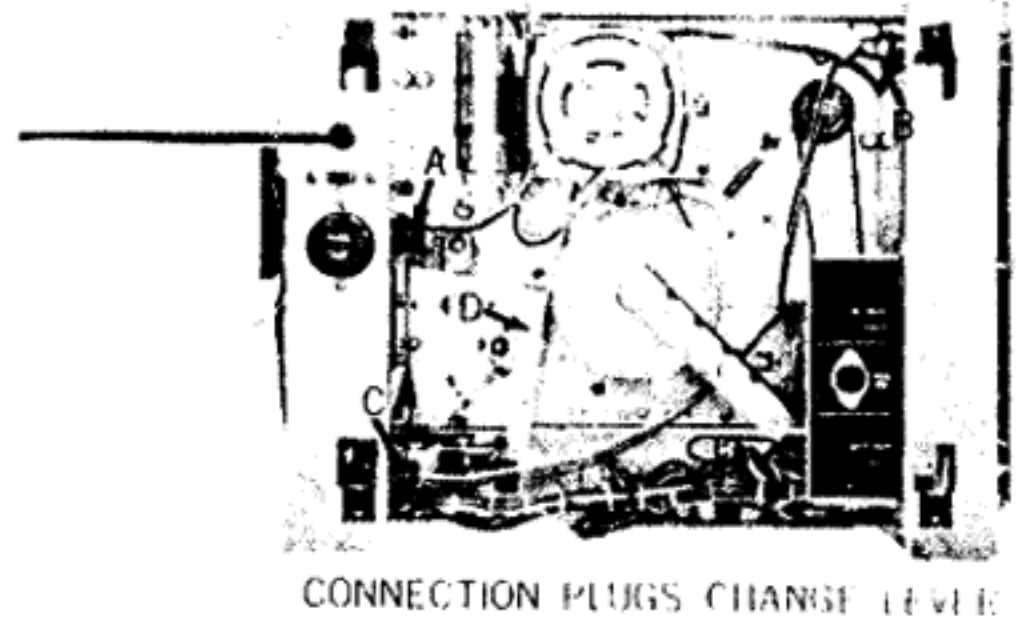
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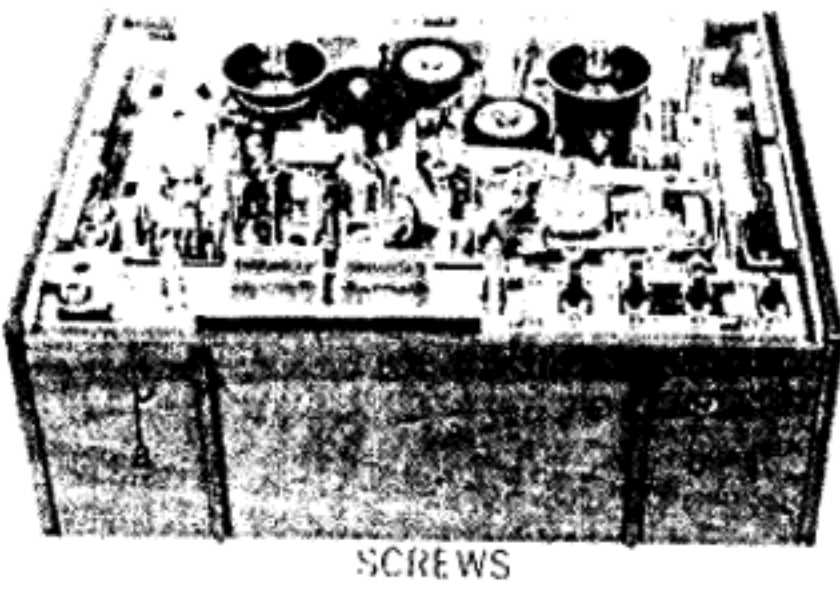
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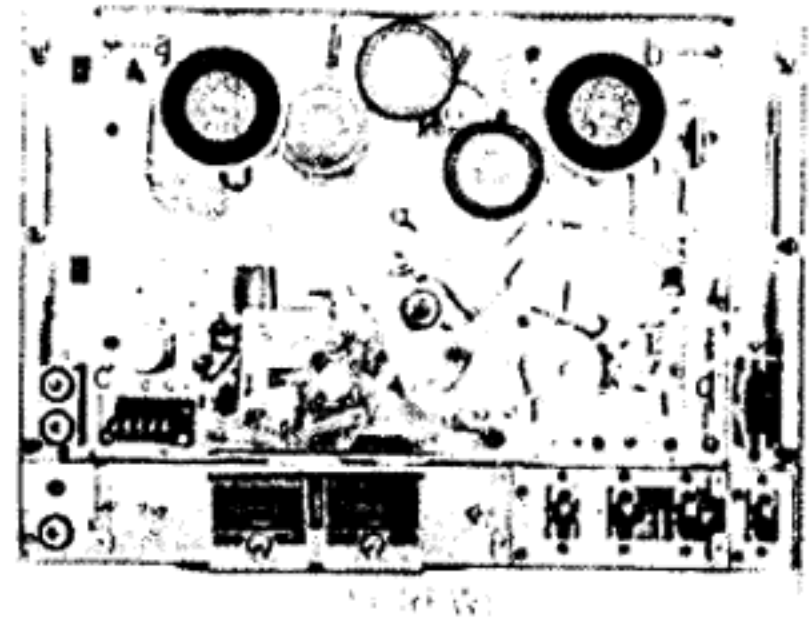
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9



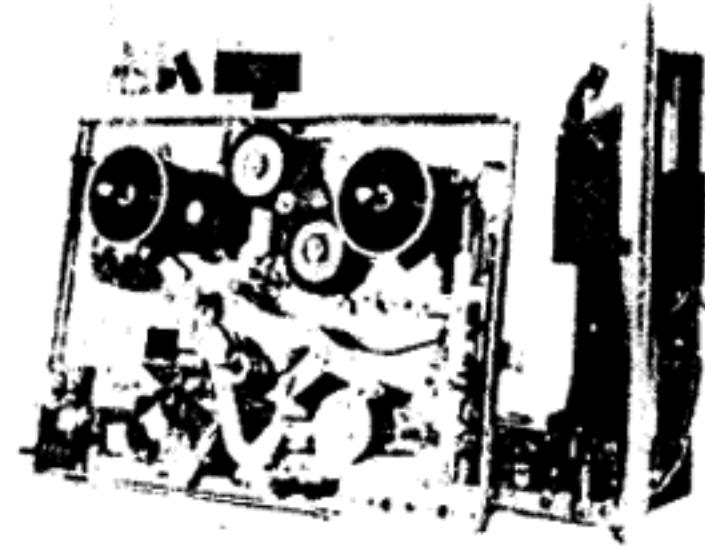
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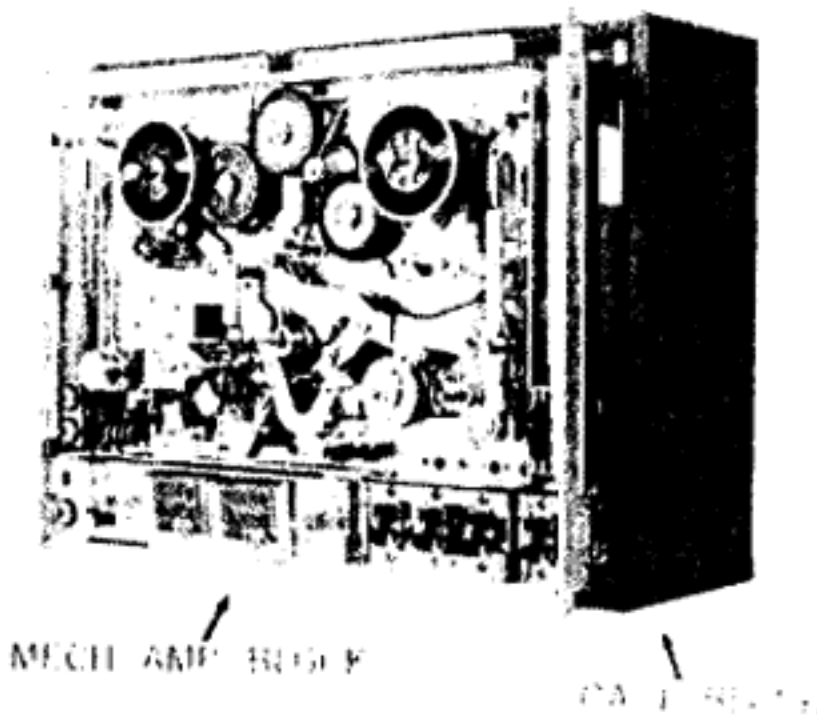
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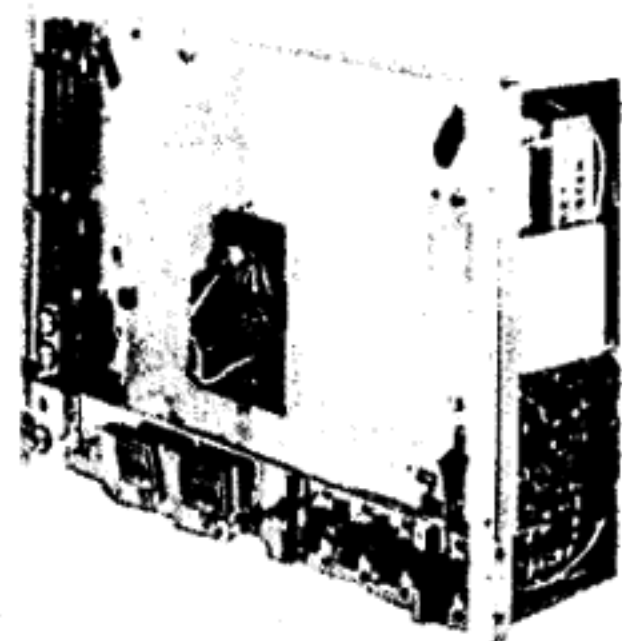
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11



15





# IV. MECHANISM ADJUSTMENTS

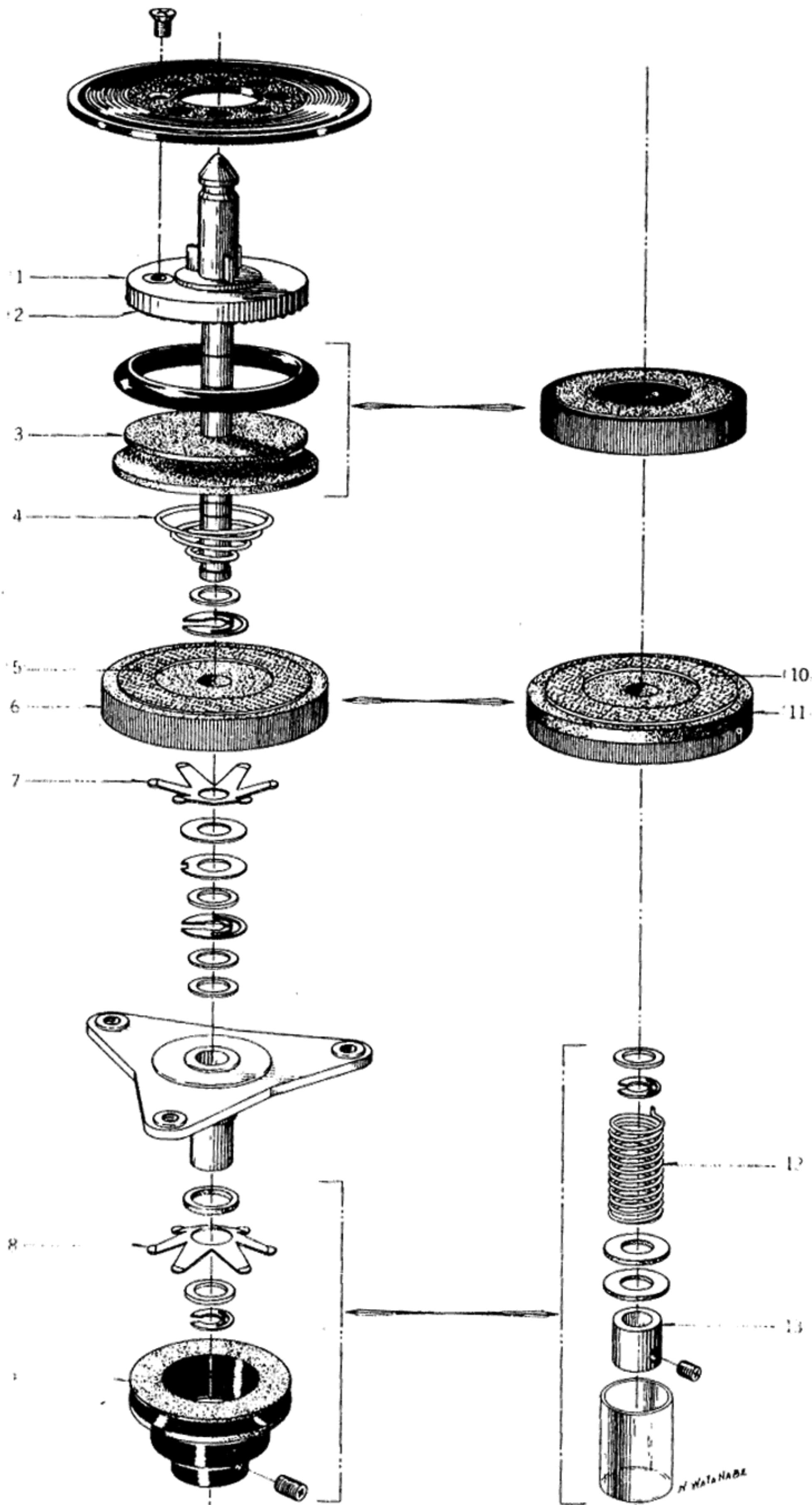


Fig. 7

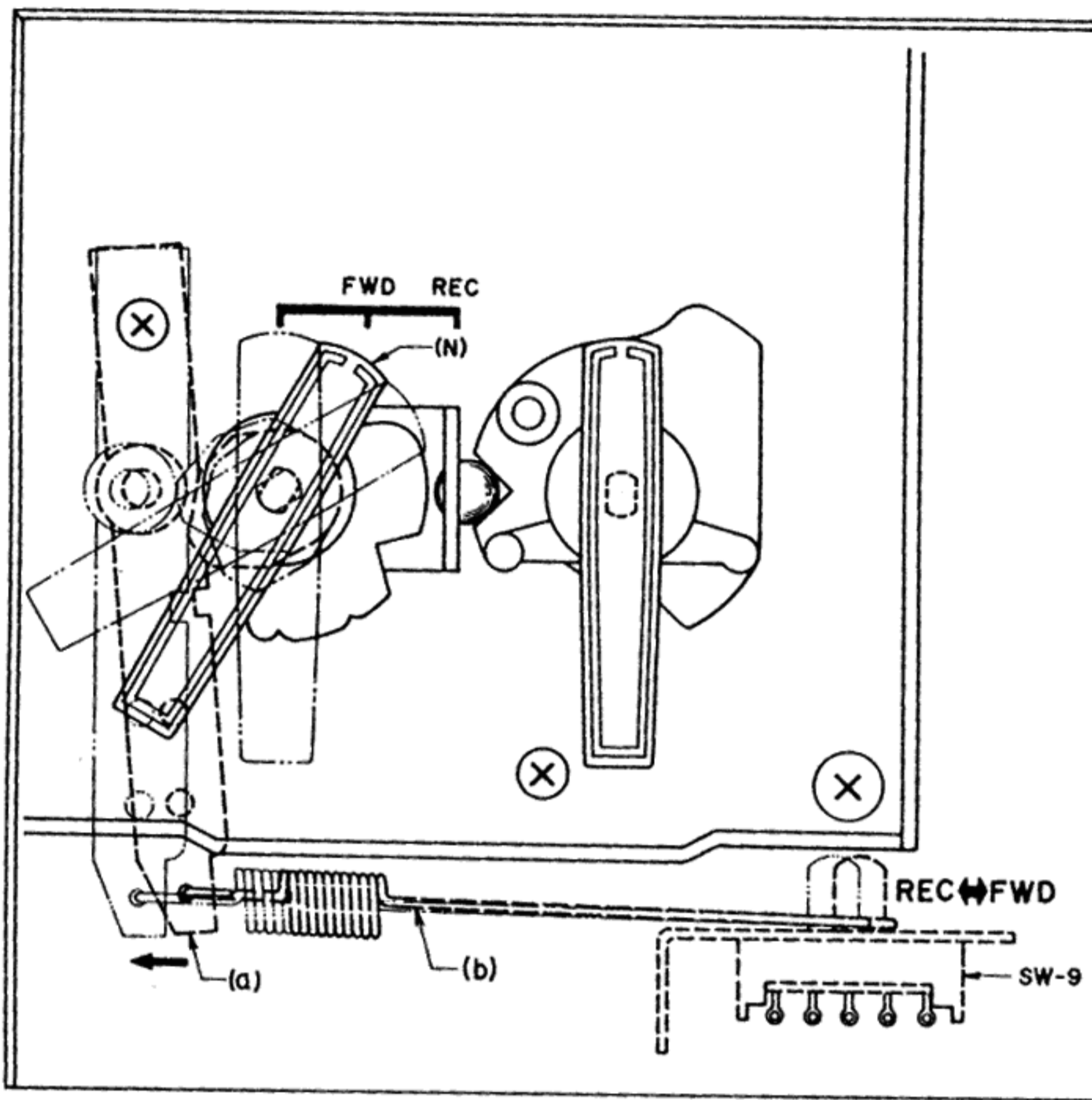


Fig. 8

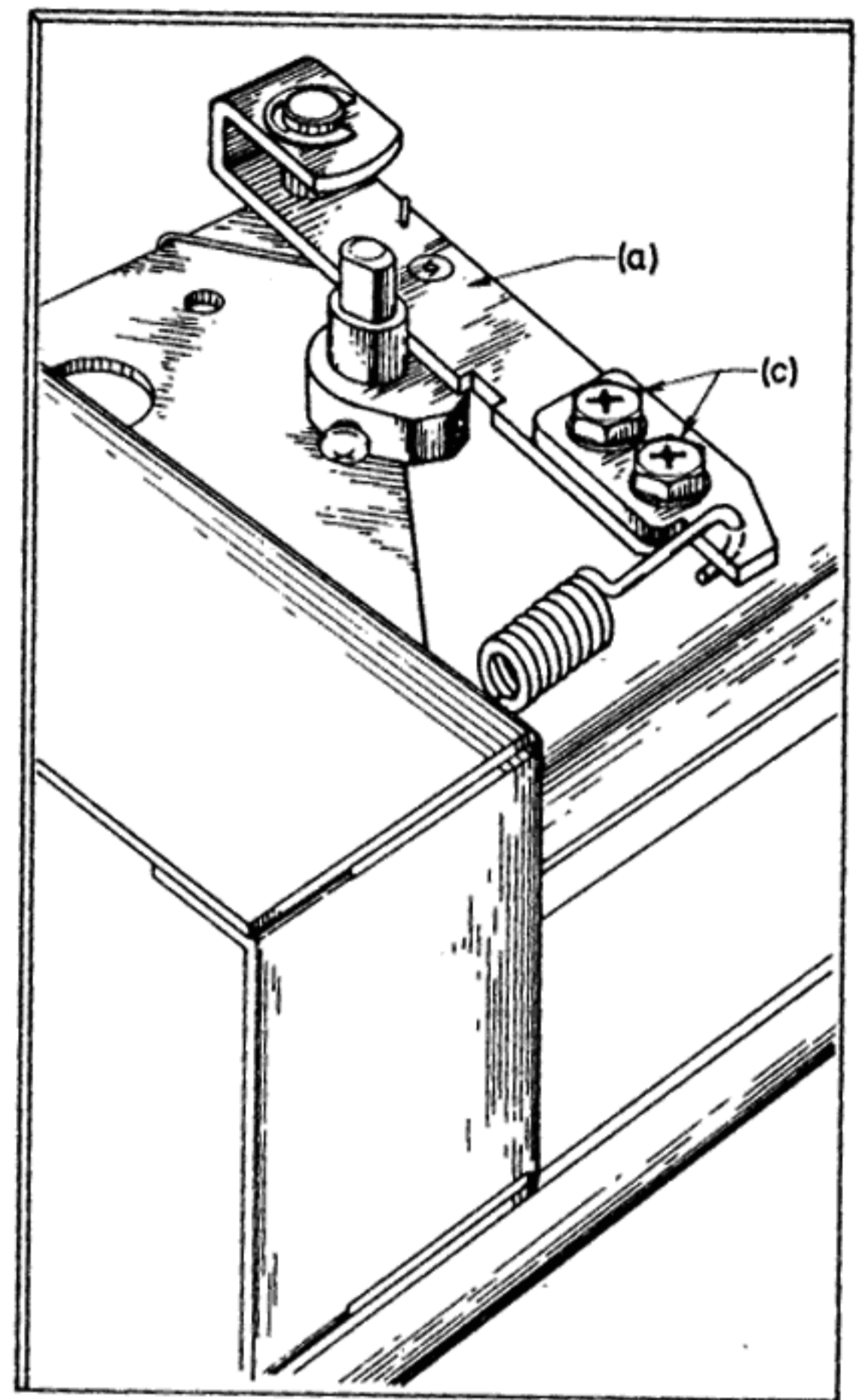


Fig. 9

## 1. PINCH WHEEL ADJUSTMENT

It is important that the pinch wheel shaft be kept in perfect alignment with the capstan shaft. Proper pinch wheel pressure is between 1,000 and 1,150 grams when the unit is operated at the tape speed of  $7\frac{1}{2}$  ips. Any deviation from this specification will result in wow and flutter. Check pinch wheel pressure with a spring scale, and if necessary, adjust the pinch wheel load spring.

## 2. SUPPLY REEL SHAFT ASSEMBLY ADJUSTMENT (See Fig. 7 at left)

Felt clutch material (2) is used between the lower side of the reel table base plate (1) and the rewind pulley (3) to protect recording tape from excessive tension during rewind operation. To check the amount of friction of this part, install a 5-inch reel with a 60 mm diameter tape, and gently pull the end of the tape upward with a spring scale. Adjust the conical spring (4) so that the amount of tension is kept between 400 and 500 grams. Other felt clutch material (5) is attached to the supply roller (6) to provide proper slippage during FWD and REC operation. The procedure for checking friction of this part is the same as the foregoing, and between 80 and 100 grams of tension gives best result. Adjust the spring (7) just under the supply roller (6). When the unit is set to fast forward operation, the amount of friction will decrease to from 15 to 20 grams. Check to see whether this is satisfactory. If not, adjust the spring plate (8) and the pressure of the pulley. (9).

### **3. TAKE-UP REEL SHAFT ASSEMBLY ADJUSTMENT (See Fig. 7 at right)**

Felt clutch material (2) is attached to the bottom side of the reel table base plate (1) so that the recording tape will not stretch during fast forward operation due to excessive tension. To check the amount of friction of this part, install a 5-inch reel with a 60 mm diameter tape, and gently pull the end of tape upward with a spring scale. Adjust the conical spring (4) so that the amount of tension at this part is kept between 400 and 500 grams. Other felt clutch material (10) is attached to the take-up roller (11). This is to provide proper slippage during FWD or REC operation. The procedure for checking friction of this part is the same as the foregoing, and between 150 and 180 grams of friction provides the best results. Adjust the spring plate (7) just under the take-up roller (11). When the unit is set to rewind operation, the amount of friction of this part will decrease to from 15 to 20 grams. Check to see whether this is satisfactory. If not, adjust the spring (12) and the pressure of the set sleeve (13).

### **4. RECORDING/PLAYBACK CHANGING MECHANISM (See Figs. 8, 9)**

Turning The FWD/REC knob (N) to recording position causes Lever (a) to pull. Recording Lever (b) (as illustrated by dotted line), and the FWD/REC changing Switch (SW-9) is turned to recording position. If Lever (a) does not pull Lever (b) properly, Changing Switch SW-9 will not operate properly. This may cause abnormal oscillation and inability to record. In this case, loosen Screw (c) and adjust lever.

## V. HEAD ADJUSTMENTS

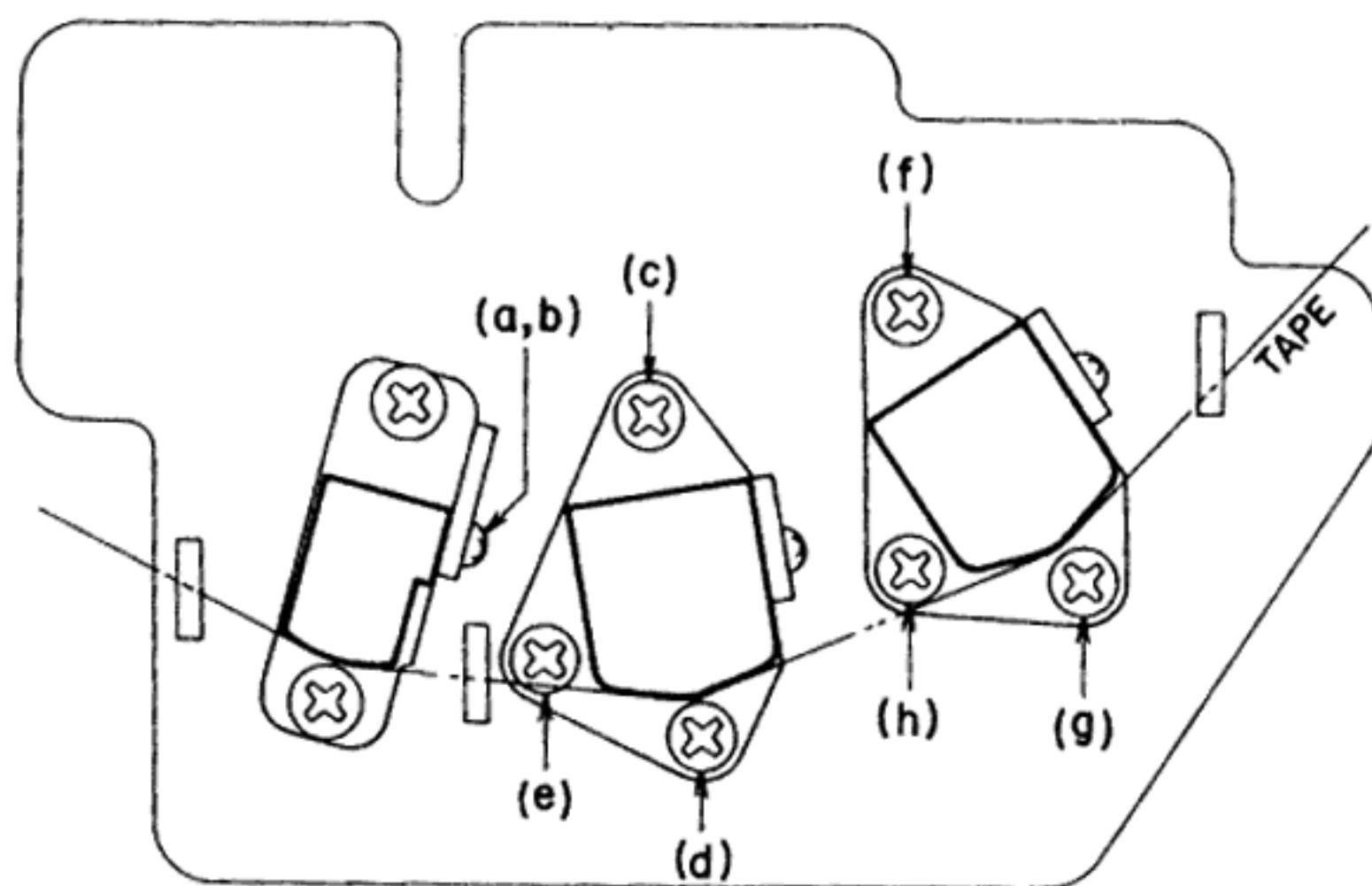


Fig. 10

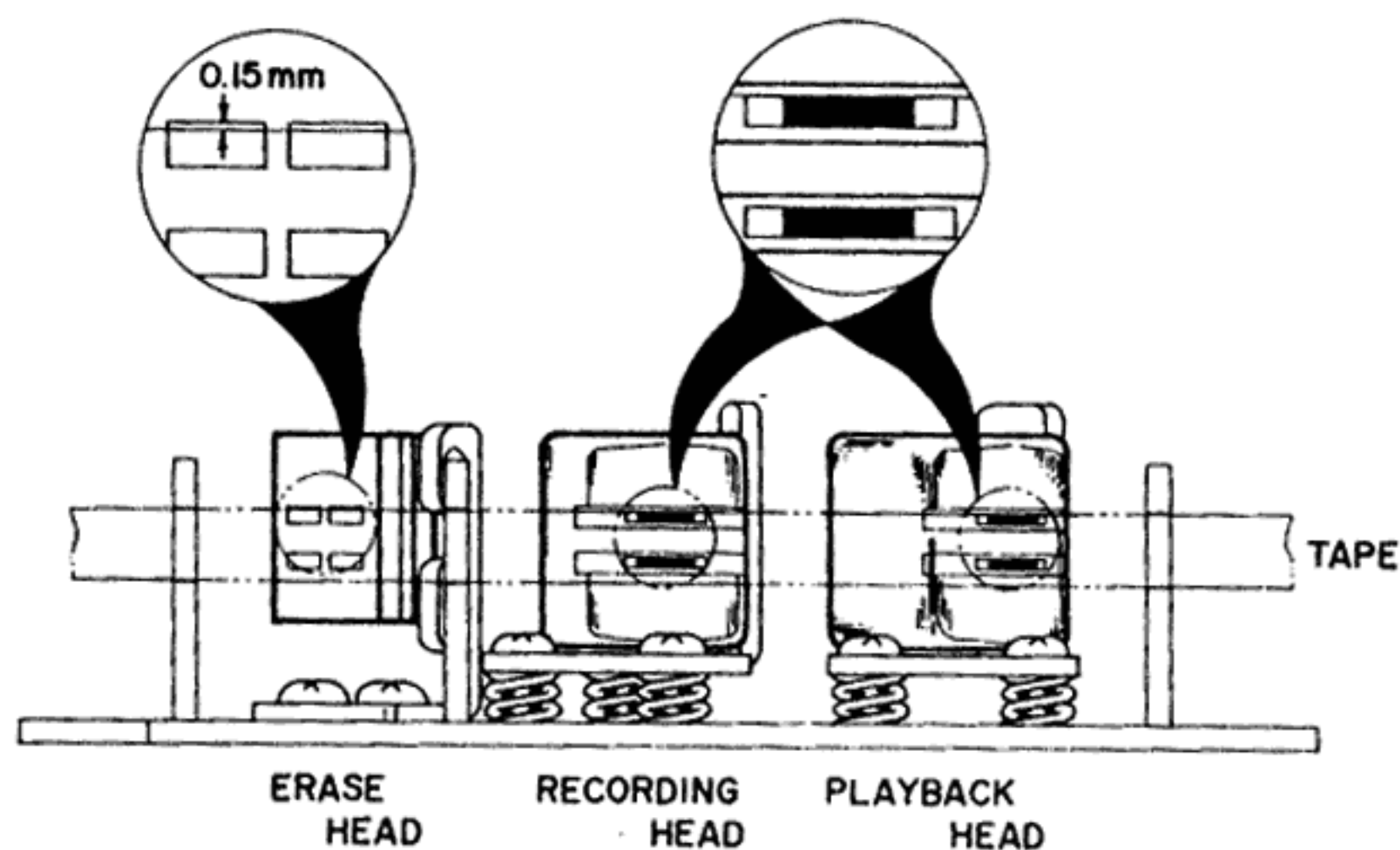


Fig. 11

Since adjustment of the Heads critically affects tape recorder performance, it is essential that Heads be carefully adjusted with precision measuring equipment and suitable recorded tape.

### 1. HEAD HEIGHT ADJUSTMENTS

(See Figs. 10, 11)

#### 1) Erase Head

Adjust height control screws (a), (b) by turning to left and right so that the upper edge of the tape is 0.15 mm lower than the upper edge of the erase head core.

#### 2) Recording Head

Adjust the screws (c), (d) by turning to left and right until the width between the upper edge of channel 1 head core and upper edge of the tape is equal.

#### 3) Playback Head

Adjust the screws (f), (g) by turning to left and right until the width between the upper edge of channel 1 head core and upper edge of the tape is equal.

### 2. HEAD SLANT ADJUSTMENT

(See Figs. 10, 11)

Adjust the screws (Head Height control screw) by turning to left and right so that each head (Erase, Recording and Playback Head) contacts the tape surface at a right angle.

### 3. HEAD AZIMUTH ALIGNMENT

ADJUSTMENTS (See Figs. 10, 11)

#### 1) Playback Head

Playback an Ampex Alignment test tape (8,000 Hz 3¼ ips.) at 7½ ips. Adjust screw (h) by turning to left and right until the various line outputs are maximum.

#### 2) Recording Head

At recording mode, supply a 15,000 Hz sine wave at a -16 dB recording level an Audio Frequency Oscillator to the line input of the 4000DS, and set the monitor switch to "TAPE" position. Then adjust screw (e) by turning to left and right until the various line outputs are maximum.

4. Repeat adjustments outlined in Items 1-2) to 3, above 2 or 3 times to obtain optimum adjusted condition.

## VI. AMPLIFIER ADJUSTMENTS

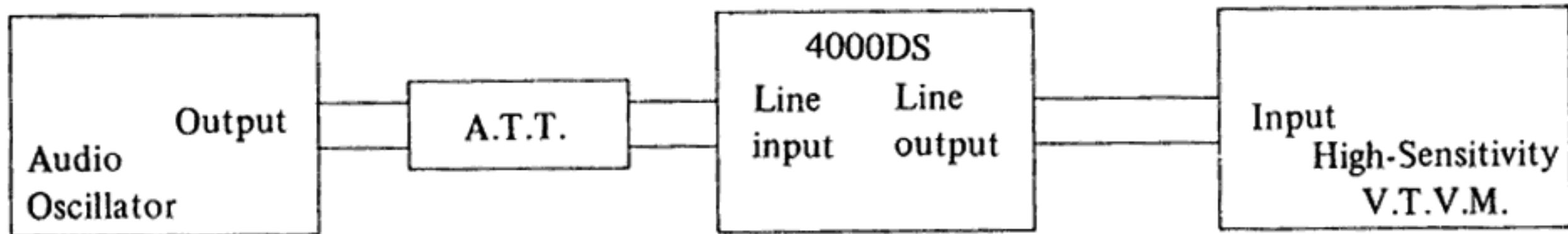


Fig. 12

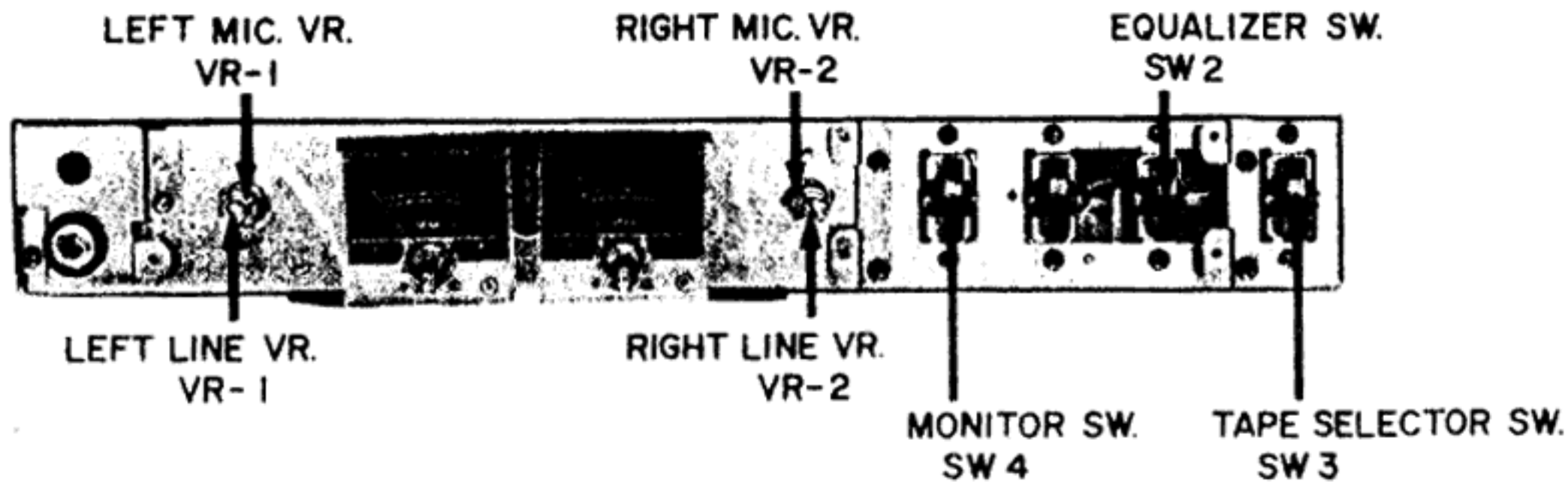


Fig. 14

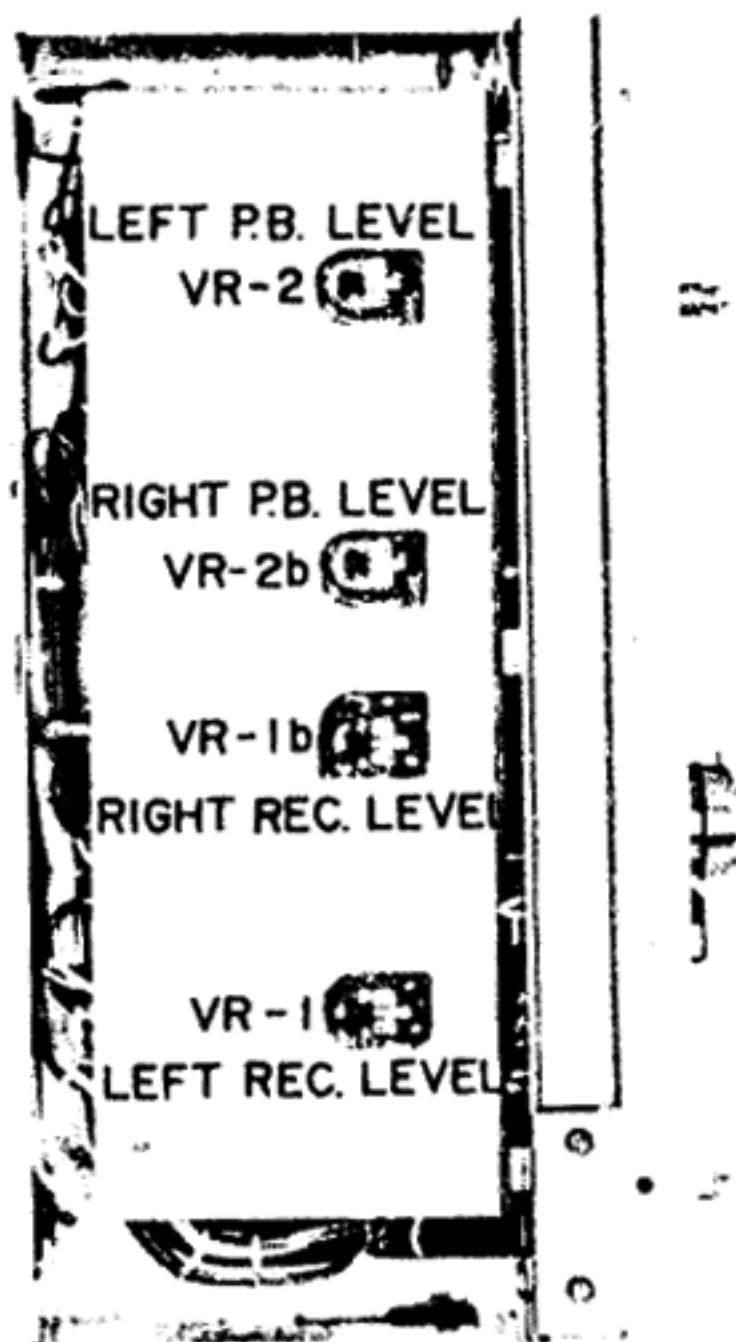


Fig. 13

### 1. PLAYBACK LEVEL ADJUSTMENT (See Figs. 12, 13, and 14)

- 1) Set the monitor switch to "TAPE" position and Equalizer switch to  $7\frac{1}{2}$  ips.
- 2) Connect a High Sensitivity V.T.V.M. to the line output.
- 3) Playback a 250 Hz pre-recorded test tape at  $7\frac{1}{2}$  ips., and adjust semi-fixed resistor VR-2 and VR-2b (20 k $\Omega$ ) to obtain a 4 dB P.B. level. (VU meter indicates "O" VU)

Recording Amplifier Adjustment should be made only after Head Adjustments and Playback Amplifier Adjustments have been made.

### 2. RECORDING LEVEL ADJUSTMENT (See Figs. 12, 13, and 14)

- 1) Set the monitor switch to "TAPE" position and Equalizer switch to  $7\frac{1}{2}$  ips.
- 2) Connect an Audio Frequency Oscillator to the line input and High Sensitivity V.T.V.M. to the line output.
- 3) Load a Scotch-111 blank tape and set recorder to "REC" mode.
- 4) Supply a 1,000 Hz sine wave from an Audio Frequency Oscillator and adjust the line recording level control volumes (VR-1 and VR-2 50 k $\Omega$ ) until the line output level reaches 4 dB. (VU meter indicates "O" VU)
- 5) Set the monitor switch to "SOURCE" position.
- 6) Adjust semi-fixed resistor VR-1 and VR-1b (2 k $\Omega$ ) to obtain 4 dB recording level. (VU meter indicates "O" VU)
- 7) Repeat 2 times in the same way as indicated in Items 4) to 6) above.

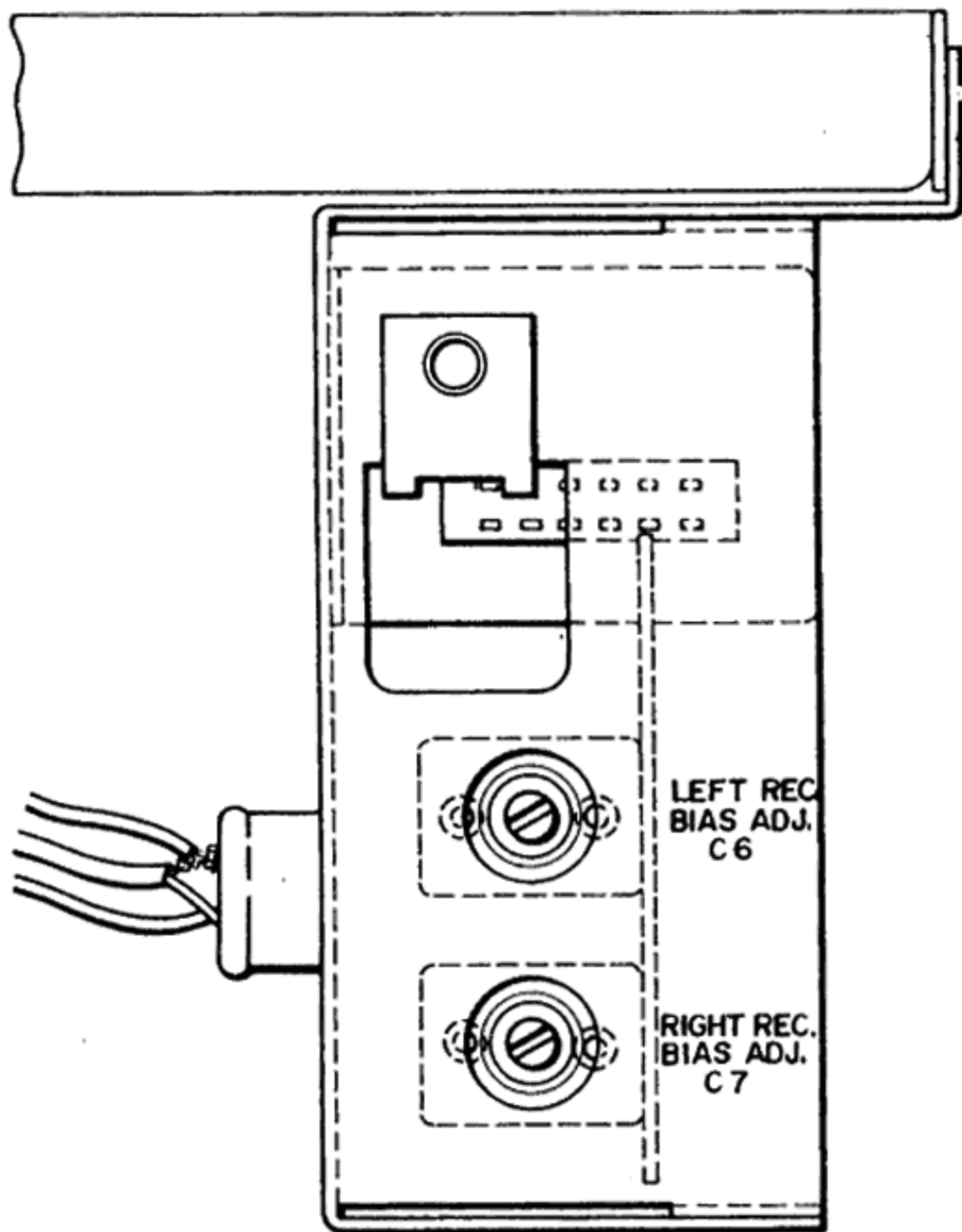


Fig. 15

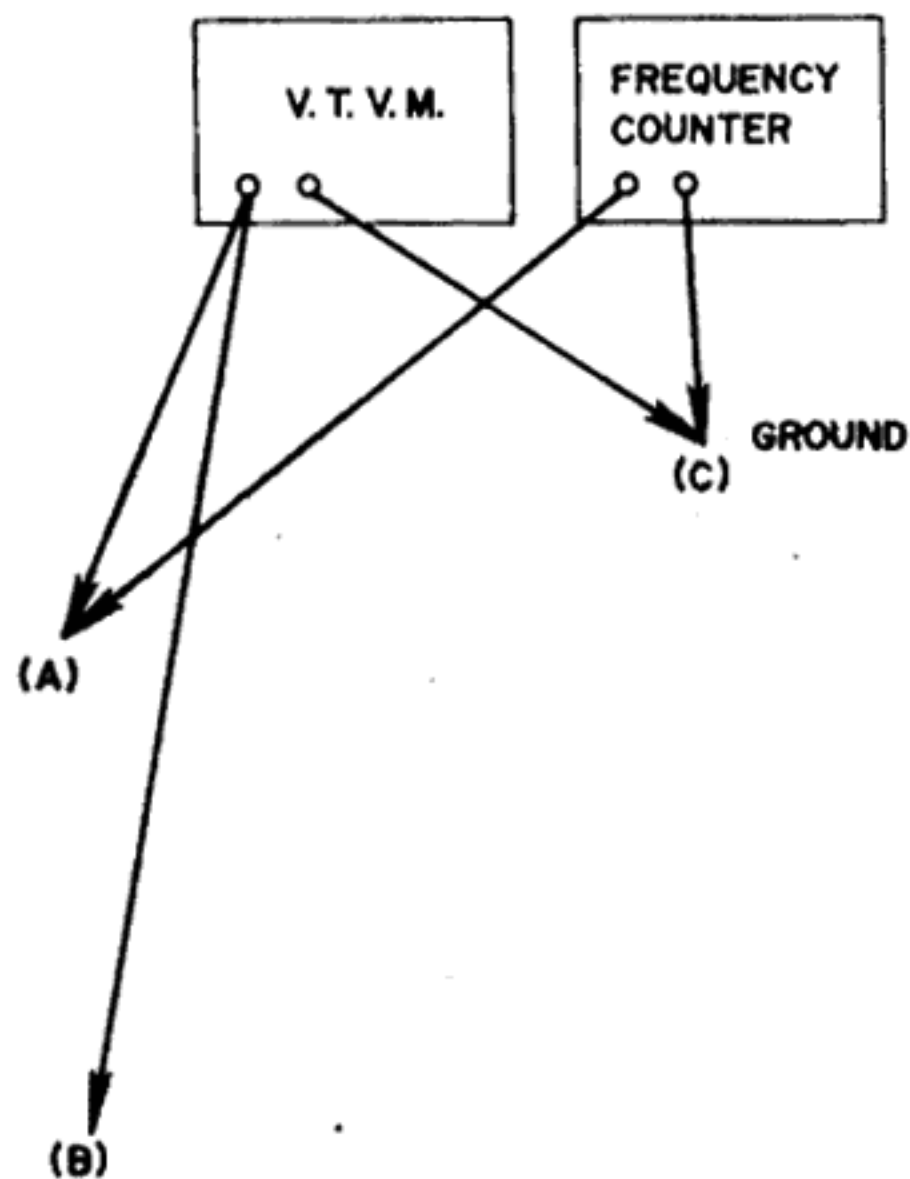


Fig. 16

### 3. RECORDING BIAS FREQUENCY ADJUSTMENT (See Fig. 16)

- 1) Set the recorder to recording mode.
- 2) Connect a Frequency counter to points (A) and (C) in Fig. 16 of the oscillator P.C. Board (LE-5021) and read the frequency indication.
- 3) If the bias frequency is 105 kHz  $\pm$ 5%, the bias frequency is correct.
- 4) If the bias frequency is incorrect, it can be adjusted by changing the value of condenser C8 (5600 PF) of the oscillator P.C. Board (LE-5021)

### 4. RECORDING BIAS VOLTAGE ADJUSTMENT (FREQUENCY RESPONSE ADJUSTMENT) (See Figs. 15, 16)

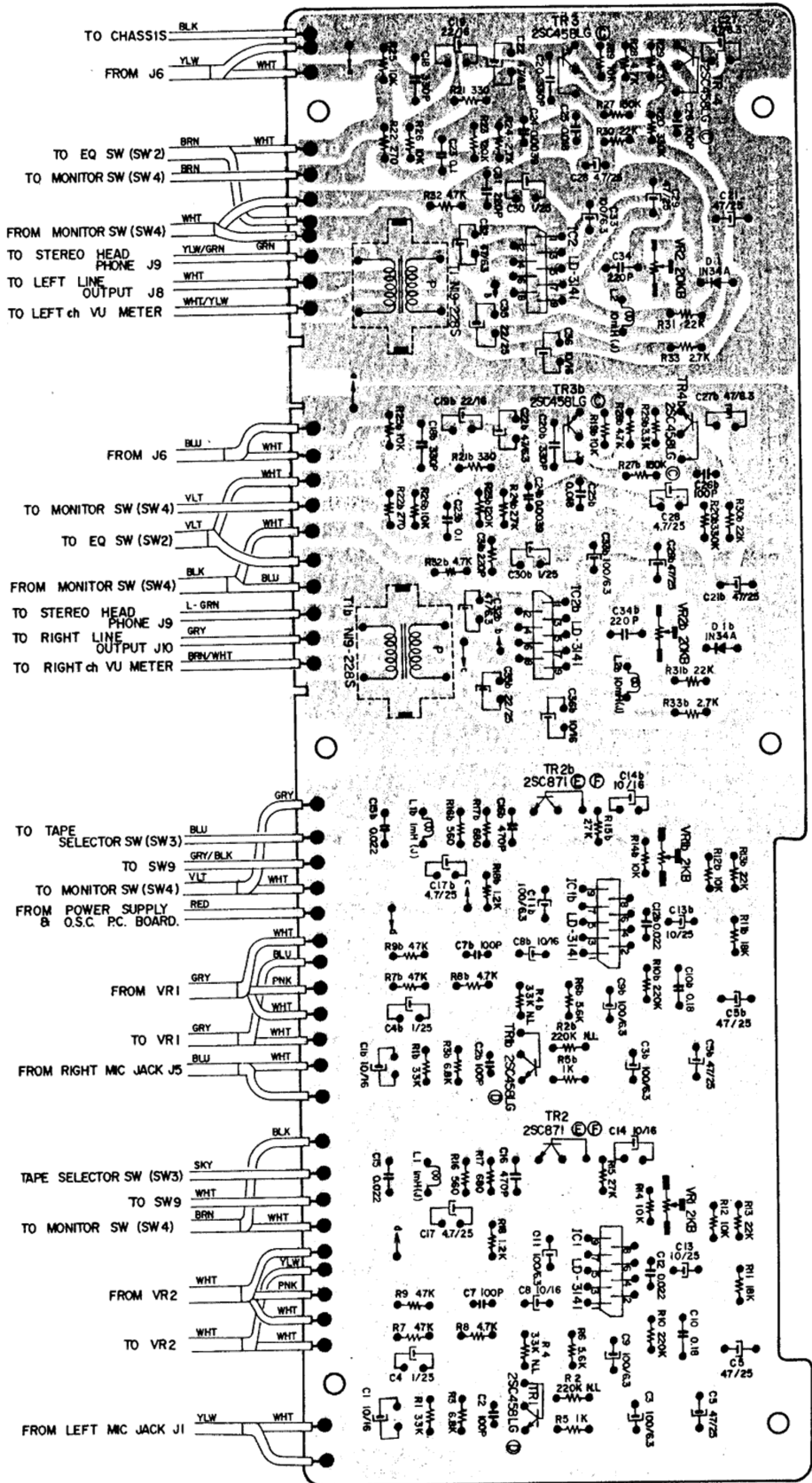
- 1) Set the monitor switch to "TAPE" position and equalizer switch to 7½ ips.
- 2) Connect an Audio Frequency Oscillator to the line input through an Attenuator and a High Sensitivity V.T.V.M. to the line output.
- 3) Load a blank test tape "AKAI 100L" (Fuji S-100) and set the recorder to "REC" mode.
- 4) Turn recording level control volume VR-1 and VR-2 (50k A) to obtain 4 dB V.T.V.M. reading.
- 5) Under conditions described in Item 4) above, readjust attenuator so that the line output level is -16 dB.
- 6) Record from 40 to 20,000 Hz spot frequencies.
- 7) Adjust Bias Adjustment semi-fixed condenser C6 (70 PF max.) so that the output of 1,000 Hz and 15,000 Hz frequencies are equal.
- 8) The bias voltage at this time is around 11V A.C.

### 5. ERASE VOLTAGE

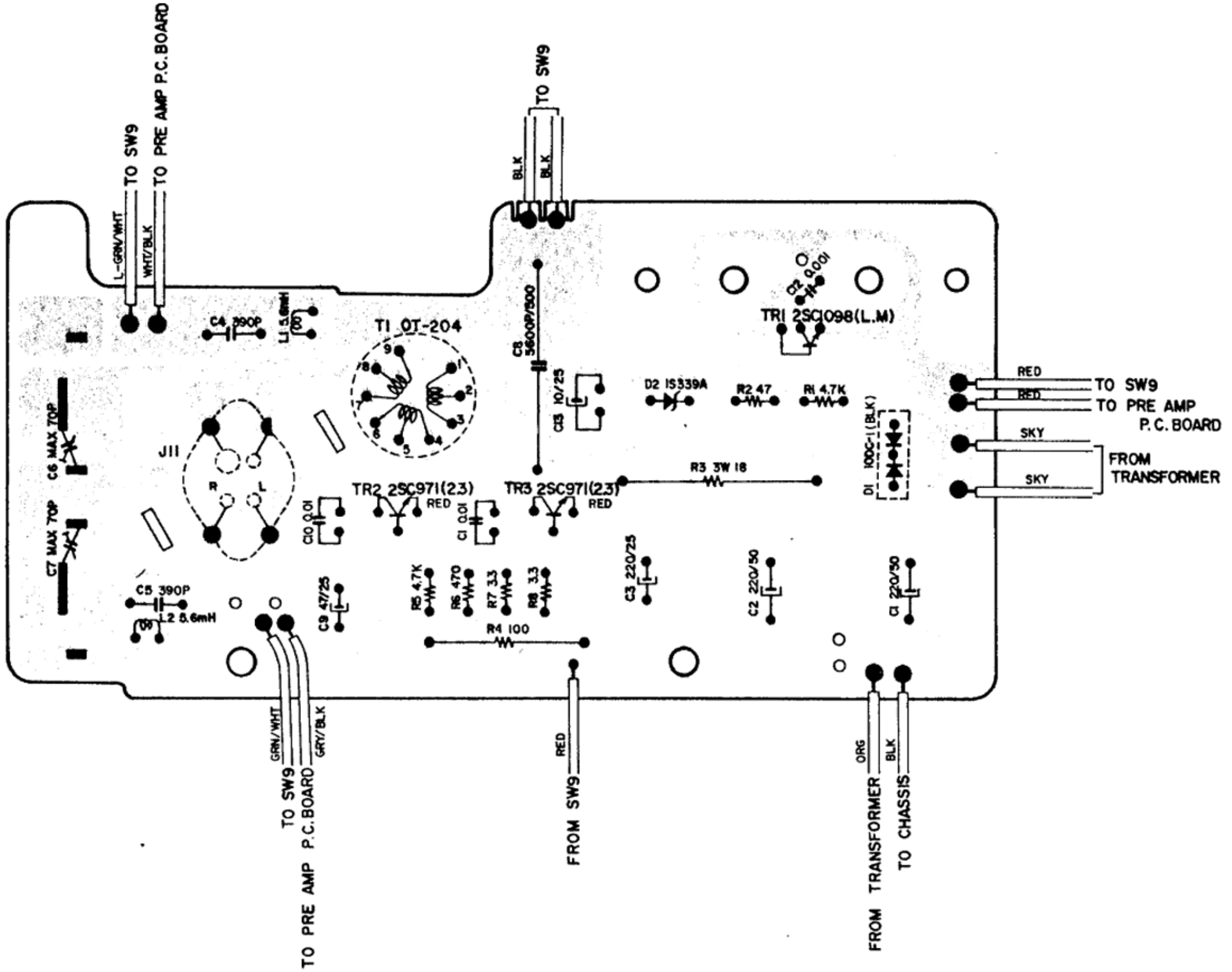
- 1) Set the recorder to "REC" mode.
- 2) Connect a V.T.V.M. to points (B) and (C) in Fig. 16 of the oscillator P.C. Board (LE-5021) and read the V.T.V.M. indication.
- 3) The Erase Voltage is around 52V A.C.

# VII. COMPOSITE VIEWS OF COMPONENTS

## PRE-AMP. P.C. BOARD (LE-5022)



# OSC. POWER P.C. BOARD (LE-5021)





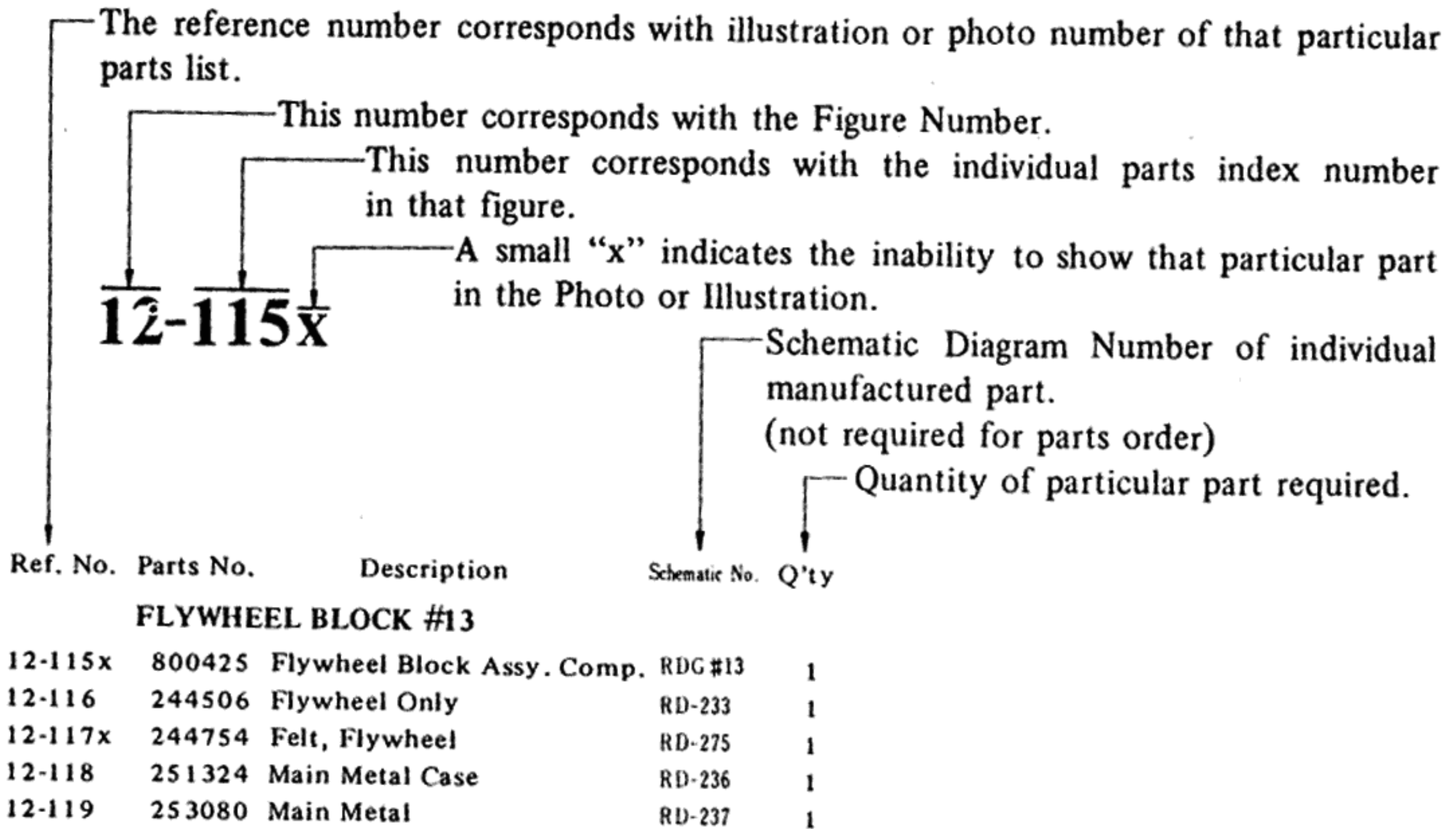
**SECTION 2**  
**PARTS LIST**

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## HOW TO USE THIS PARTS LIST

1. This parts list is compiled by various individual blocks based on assembly process.
2. When ordering parts, please describe parts number, serial number, and model number in detail.
3. How to read list.



4. The symbol numbers shown on the P.C. Board list can be matched with the Composite Views of components of the Schematic Diagram or Service Manual.
5. The indications of Resistors and Capacitors in the photos of P.C. Board are being eliminated.
6. The shape of the parts and parts name, etc. can be confirmed by comparing them with the parts shown on the Electrical Parts List Table of P.C. Board.
7. Both the kind of part and installation position can be determined by the Parts Number. To determine where a parts number is listed, utilize Parts Index at end of Parts List.  
It is necessary first of all to find the Parts Number. This can be accomplished by using the Reference Number listed at right of parts number in the Parts Index. (meaning of ref. no. outlined in Item 3 above).
8. Utilize separate "Price List for Parts" to determine unit price. The most simple method of finding parts Price is to utilize the reference number.

# ELECTRICAL PARTS LIST TABLE













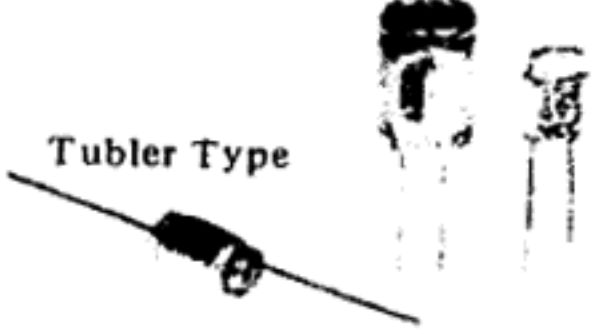

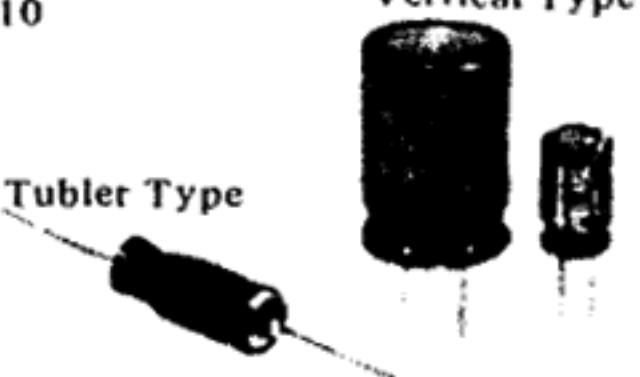
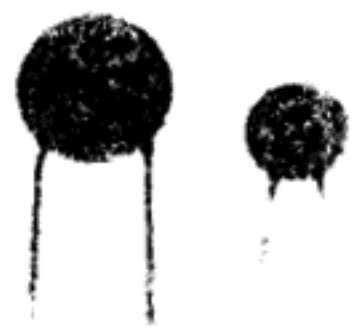





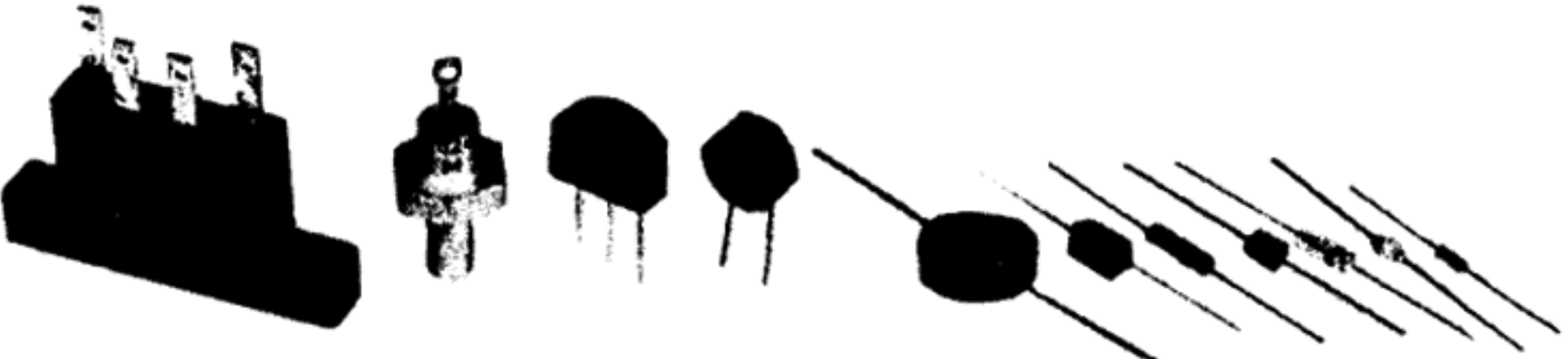
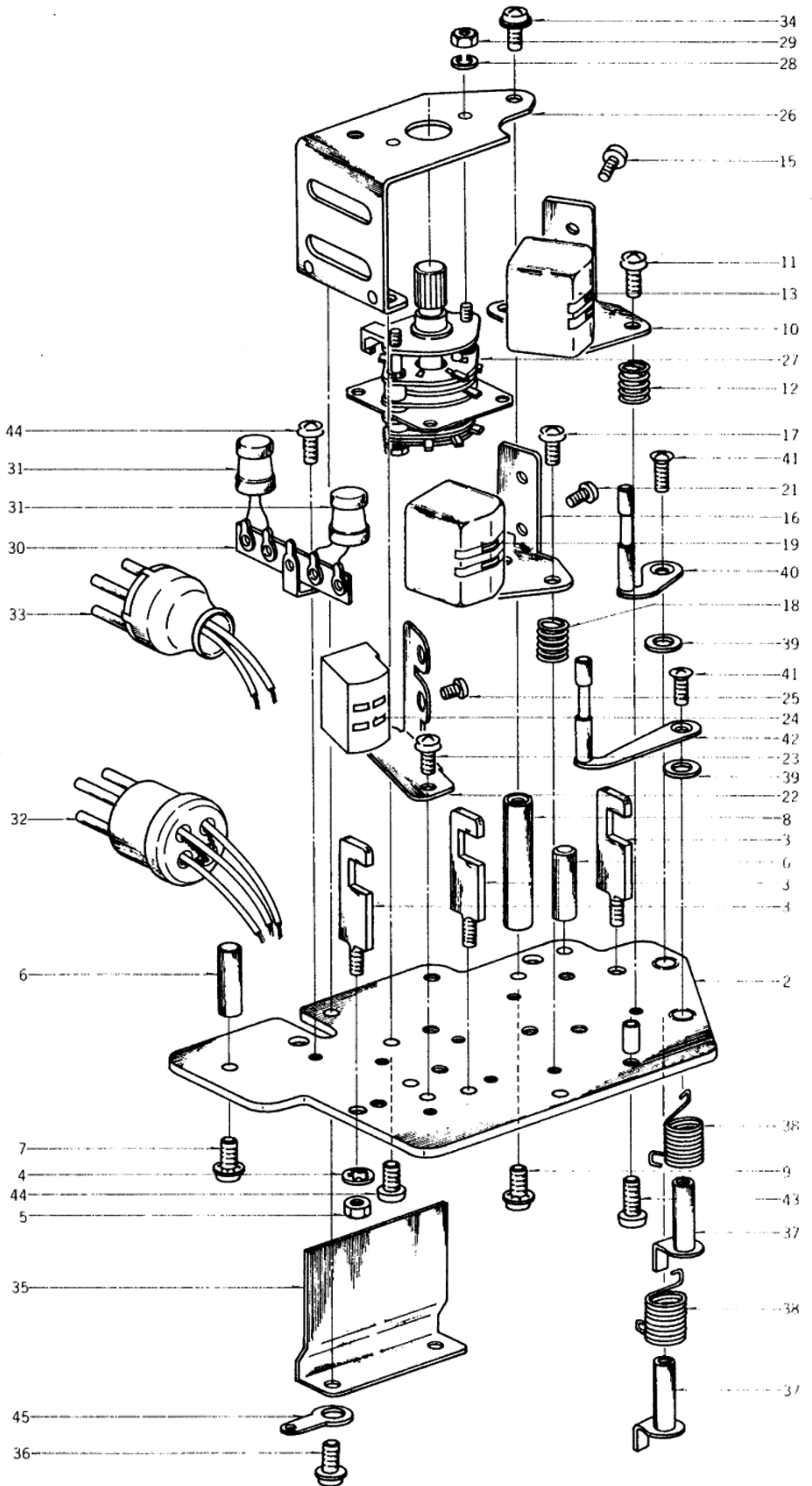
<p>Because the indication of resistors and capacitors in the P. C. Board photos are being eliminated, please confirm parts name and shape by comparing them with the parts shown in this table.</p>	<p>1</p>  <p style="text-align: center;">Solid Resistor</p>	<p>2</p> <p style="text-align: right;">Stopper Type</p>  <p style="text-align: center;">Carbon Resistor</p>	<p>3</p>  <p style="text-align: center;">Metal Oxide Film Resistor</p>
<p>4</p>  <p style="text-align: center;">Cement Resistor</p>	<p>5</p>  <p style="text-align: center;">Wire-Wound Resistor</p>	<p>6</p>  <p style="text-align: center;">Thermistor</p>	<p>7</p>  <p style="text-align: center;">Enamel Resistor</p>
<p>1</p>  <p style="text-align: center;">MP Capacitor (Tubler Type)</p>	<p>2</p>  <p style="text-align: center;">Plastic Capacitor</p>	<p>3</p>  <p style="text-align: center;">Mylar Capacitor</p>	<p>4</p>  <p style="text-align: center;">VFM (Hi-Q) Capacitor</p>
<p>5</p>  <p style="text-align: center;">Mylar Capacitor</p>	<p>6</p>  <p style="text-align: center;">Tantalum Capacitor</p>	<p>7</p>  <p style="text-align: center;">Oil Capacitor (Tubler Type)</p>	<p>8</p> <p style="text-align: right;">Vertical Type</p>  <p style="text-align: center;">Styrol Capacitor</p>
<p>9</p>  <p style="text-align: center;">Electrolytic Capacitor (Tubler Type)</p>	<p>10</p> <p style="text-align: right;">Vertical Type</p>  <p style="text-align: center;">Electrolytic Capacitor</p>		<p>11</p>  <p style="text-align: center;">Ceramic Capacitor</p>
<p>13</p>  <p style="text-align: center;">Trimmer Condenser</p>		<p>VR</p>  <p style="text-align: center;">Semi-Fixed Volume</p>	
<p>L</p>  <p style="text-align: center;">Ferri Inductor</p>	<p>TR</p>  <p style="text-align: center;">Transistor</p>		
<p>CR</p>  <p style="text-align: center;">Spark Quencher</p>	<p>D</p>  <p style="text-align: center;">Diode (Silicon, Zener, Germanium)</p>		

FIG. 1 ILLUSTRATION OF HEAD BLOCK



# HEAD BLOCK

Ref. No.	Parts No.	Description	Schematic No.	Q'ty
1-1x	BH480363	Head Block Comp.	LE-1	1
1-2	HZ490296	LD Head Base B (new), w/metal	LD-11	1
1-3	HZ274162	Tape Guide #1	4TR-5	3
1-4	ZW273802	M3 Toothed Lock Washer		3
1-5	ZW273756	M3 Nut		3
1-6	SZ247015	Head Cover Prop	LD-10	2
1-7	ZW417025	Screw, binding head 3x8, w/washer		2
1-8	MH312827	SW. Prop (new LD)	LD-13	1
1-9	ZW417025	Screw, binding head 3x8, w/washer		1
1-10	HZ480420	PB. Angle Base	LE-0001	1
1-11	ZW464714	Screw, round head 3x12		3
1-12	ZG206144	Angle Adjust Spring	RD-16	3
1-13	HP375131	REC./PB. HEAD P4-150		1
1-14x	HZ393974	I-MK Head Terminal Plate	RC-89	1
1-15	ZW477876	Screw, pan head 2x3		2
1-16	HZ480431	Rec. Angle Table	LE-0002	1
1-17	ZW464714	Screw, round head 3x12		3
1-18	ZG206144	Angle Adjust Spring	RD-16	3
1-19	HR475446	REC. HEAD P4-154		1
1-20x	HZ393974	I-MK Head Terminal Plate	RC-89	1
1-21	ZW477876	Screw, pan head 2x3		2
1-22	HZ480442	Erase Head Base	LE-0003	1
1-23	ZW323728	Screw, binding head 3x5		2
1-24	HE384693	ERASE HEAD E4-200		1
1-25	ZW477876	Screw, pan head 2x3		2
1-26	HZ312895	Switch Table (new LD)	LD-12	1
1-27	ES257668	Rotary Switch ESR-E263L14AS	25-6-3	1
1-28	ZW273723	M2 Spring Washer		2
1-29	ZW273734	M2 Nut		2
1-30	EJ255115	Lug Plate VB2L2	33-4-3	1
1-31	EO390622	Ferri Inductor FL9H 220 $\mu$ H(K)	23-1-4	2
1-32	EJ297843	4-P Plug, w/cap	42-1-3	1
1-33	EJ276963	T type 4-P Plug	42-1-16	1
1-34	ZW417025	Screw, binding head 3x8, w/washer		1
1-35	HZ480475	Head Shield	LE-0004	1
1-36	ZW413223	Screw, binding head 3x5, w/washer		2
1-37	HL223503	Shift Lever B, w/shaft A	M9-3	2
1-38	ZG312928	Shifter Spring	LD-19	1
1-39	ZW336846	Washer (SPC)D4.1x7x1.2t		2
1-40	HL312941	Shift Lever, w/pin	LD-15	1
1-41	ZW480622	Screw, oval countersunk head 2.3x6		2
1-42	HL223536	Shift Lever C, w/pin	M9-5	1
1-43	ZW413155	Screw, binding head 3x6		1
1-44	ZW323728	Screw, binding head 3x5		2
1-45	ZW273778	M3 Earth Lug		1

When ordering parts, please describe Parts Number, Serial Number, and Model Number in detail.