

SERVICE MANUAL

AKAI TAPE RECORDER

MODEL X-5000W

ALSO APPLICABLE TO MODEL **X-5000L**



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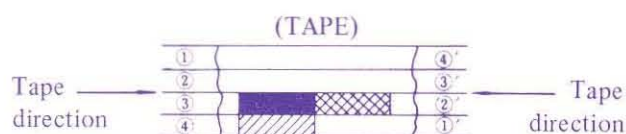
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When placing order for parts, please use separate
PARTS LIST or PRICE LIST FOR PARTS.

I. SPECIFICATIONS

STYLE	: Portable	MOTOR	: Hysteresis Synchronous 2-speed (2-4 pole) motor.
WEIGHT	: 32 lbs. (14.6 kg) (X-5000 L) 31 lbs. (14.22 kg) (X-5000 W)		Condenser Capacity 2.8 μ (50 Hz) Condenser Capacity 2.0 μ (60 Hz) Revolutions 3,000–1,500 r.p.m. (50 Hz) Revolutions 3,600–1,800 r.p.m. (60 Hz)
DIMENSIONS	: 14" x 13-3/8" x 9-7/16" (356 x 340 x 240 mm)	HEADS	
POWER SUPPLY	: AC 100 to 240 V ; 50/60 Hz	REC/PLAY HEAD	: In-Line 4-track stereo and monaural Impedance 1,200 Ω at 1,000 Hz Gap 2/1,000 mm
POWER CONSUMPTION	: 60 VA	ERASE HEAD	: Impedance 500 Ω at 60 KHz Gap 0.2 mm
RECORDING SYSTEM	: In-Line 4-track stereo, monaural recording by using Cross-Field Bias Head.	BIAS HEAD	: Impedance 500 Ω at 60 KHz Gap 0.2 mm
PLAYBACK SYSTEM	: In-Line 4-track stereo, monaural playback.	RECORDING LEVEL INDICATOR	: VERTICAL Indicator, "A" VU Meter x 2
TAPE SPEED	: 1-7/8, 3-3/4, and 7-1/2 ips	TRANSISTORS USED	: 2SC458 (B) x 2 2SC458 (C) or 2SC454 (C) x 2 2SC971 x 2 2SC931 (D), (E) x 4
TAPE SPEED DEVIATION	: Within $\pm 0.8\%$	I.C. Used	: AN1368 Q x 2
WOW AND FLUTTER	(Playback Only) : Less than 0.15% rms at 7-1/2 ips Less than 0.2% rms at 3-3/4 ips Less than 0.3% rms at 1-7/8 ips	DIODES USED	: 10DC-1 x2
FREQUENCY RESPONSE	: 40 to 20,000 Hz (± 3 dB) at 7-1/2 ips 40 to 16,000 Hz (± 3 dB) at 3-3/4 ips 50 to 7,000 Hz (± 3 dB) at 1-7/8 ips	SPEAKERS	: Two built-in 5" x 7" 8 Ω 4 W Speakers.
SIGNAL TO NOISE RATIO	: Better than 45 dB (External Speaker Output Jack).		
DISTORTION	: Within 3% at Speaker Output 4 V RMS, 8 Ω .		
CROSS TALK	: Less than -40 dB (Stereo) Less than -45 dB (Monaural)		
ERASE RATIO	: Less than -65 dB		
BIAS OSC FREQUENCY	: 100 KHz		
INSULATION RESISTANCE	: More than 50 M ohms		
INSULATION DURABILITY	: 500 V AC for more than one minute duration.		
POWER OUTPUT	: More than 5 V RMS (3.2 W), Playback 250 Hz recorded tape.		
LINE OUTPUT	: Required load impedance more than 50 K ohms 1.23 V (+4.5 dB) (Speaker Off).		
DIN OUTPUT	: Required load impedance more than 50 K ohms 0.6 V.		
MIC INPUT	: Above 0.5 mV (-65 db) Impedance 4.7 K Ω		
LINE INPUT	: Above 25 mV (-30 db) Impedance 100 K Ω		
DIN INPUT	: Above 7.5 mV (-40 dB) Impedance 10 K Ω		
FAST FORWARD AND REWIND TIME	: 95 seconds for a full 1,200 ft. tape at 50 Hz 75 seconds for a full 1,200 ft. tape at 60 Hz		

CROSSTALK (Crosstalk between the tracks)



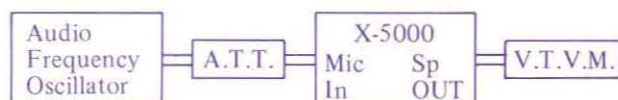
As shown in the above figure, first record a 1,000 Hz sine wave on track No. 3 at +3 VU level. Next, remove the 1,000 Hz input signal and record under a non-input condition.

Then, playback the tape on track No. 3 and No. 1 (reverse condition of tape) through the 1,000 Hz B.P.F. (Band Pass Filter, Sensitivity . . . 1 : 1) and obtain a ratio between the two from the following formula:

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

- | | | |
|---|--|--|
| { | C = Desired crosstalk ratio (db) | |
| | E ₀ = 1,000 Hz signal output level | |
| | E ₂ = 1,000 Hz crosstalk output level | |
| | E ₁ = No-input signal record level | |

FREQUENCY RESPONSE



Connect the measuring instruments as in the above diagram, and measure the frequency response in the following sequence :

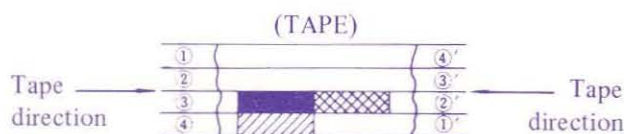
RECORD :

- 1) Introduce a sine wave of 1,000 Hz (–60 dB) to the Mic. Input of the recorder to be tested, through an attenuator from an audio frequency generator.
- 2) Set the Record/Playback Knob to “Rec” position and adjust the Mic input volume so that the VU meter needle indicates “0” VU.
- 3) Under the condition described in (2), lower the input level –16 dB by means of the attenuator.
- 4) Record the spot frequency in the range of 30 Hz to 25,000 Hz from the audio frequency generator.

PLAYBACK :

- 5) Set the Record/Playback Knob in to “Play” position.
- 6) Set the Equalizer Switch to 7-1/2” or 3-3/4” position (tone control max).
- 7) Connect a V.T.V.M. to the 8 Ω Speaker output terminal.
- 8) Playback the tape previously recorded.
- 9) Adjust the output level to “0” dBm at 1,000 Hz. (indicated on range selector of V.T.V.M.).
- 10) Playback the recorded spot frequencies under the conditions in (9) ; make a memo of output level and plot the value on a graph.

CROSSTALK (Crosstalk between the tracks)



As shown in the above figure, first record a 1,000 Hz sine wave on track No. 3 at +3 VU level. Next, remove the 1,000 Hz input signal and record under a non-input condition.

Then, playback the tape on track No. 3 and No. 1 (reverse condition of tape) through the 1,000 Hz B.P.F. (Band Pass Filter, Sensitivity . . . 1 : 1) and obtain a ratio between the two from the following formula:

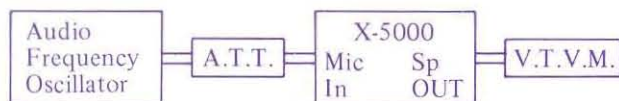
$$C = 20 \log \frac{E_0}{E_2 - E_1} \text{ (db)}$$

- | | | |
|---|---|--|
| { | C = Desired crosstalk ratio (db) | |
| | E_0 = 1,000 Hz signal output level | |
| | E_2 = 1,000 Hz crosstalk output level | |
| | E_1 = No-input signal record level | |

PLAYBACK :

- 5) Set the Record/Playback Knob in to "Play" position.
- 6) Set the Equalizer Switch to 7-1/2" or 3-3/4" position (tone control max).
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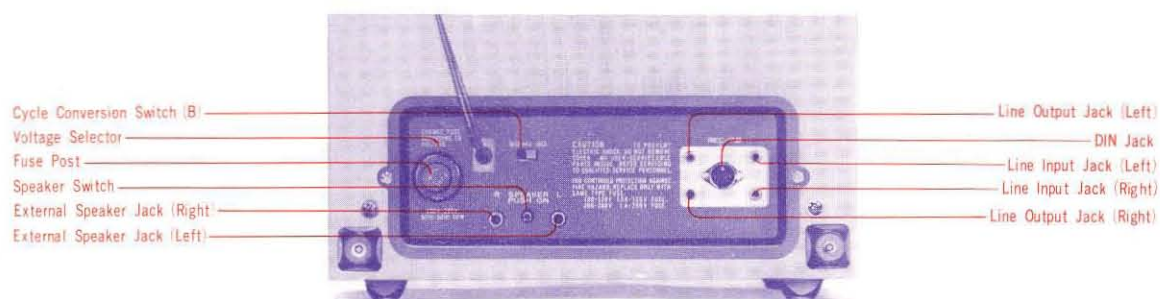
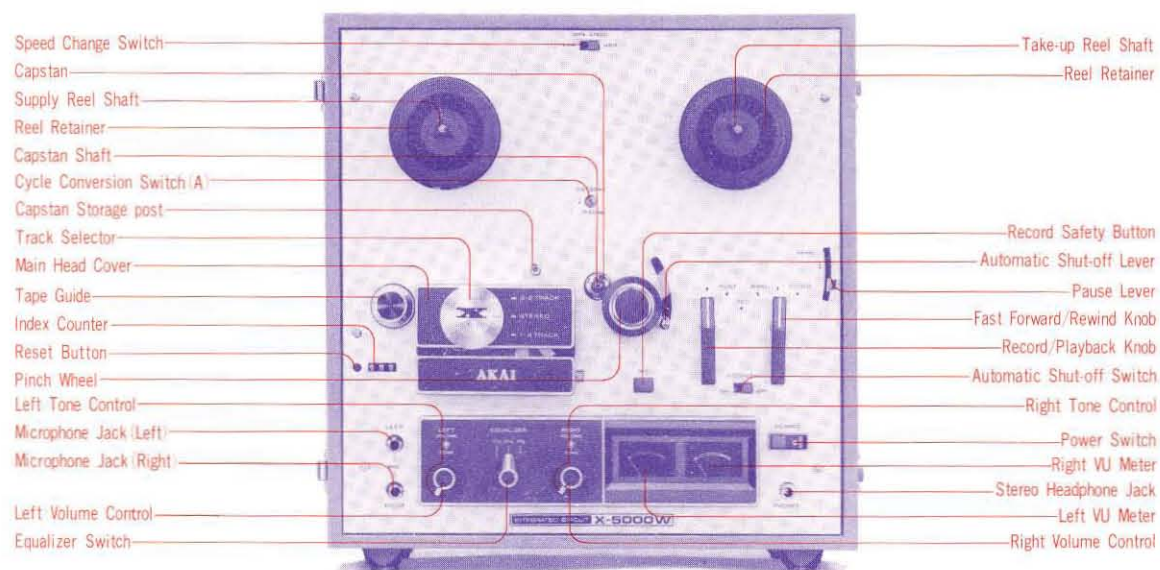


Connect the measuring instruments as in the above diagram, and measure the frequency response in the following sequence :

RECORD :

- 1) Introduce a sine wave of 1,000 Hz (−60 dB) to the Mic. Input of the recorder to be tested, through an attenuator from an audio frequency generator.
- 2) Set the Record/Playback Knob to "Rec" position and adjust the Mic input volume so that the VU meter needle indicates "0" VU.
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- 4) Record the spot frequency in the range of 30 Hz to 25,000 Hz from the audio frequency generator.

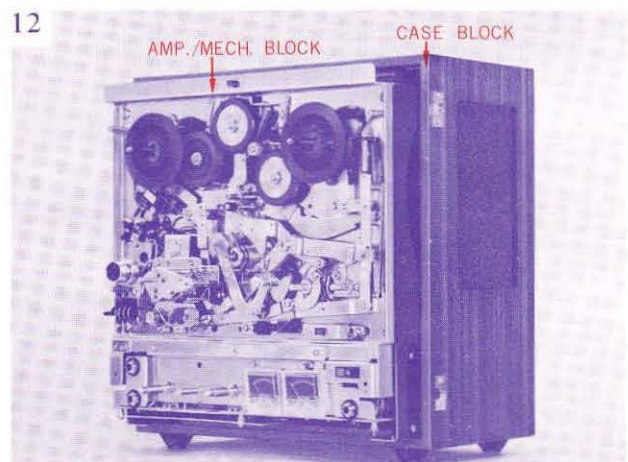
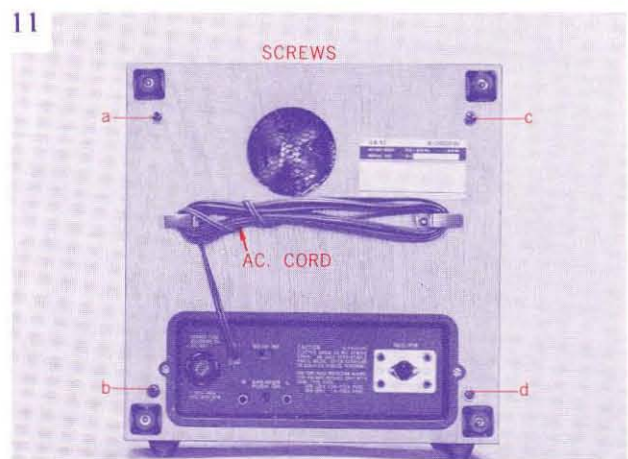
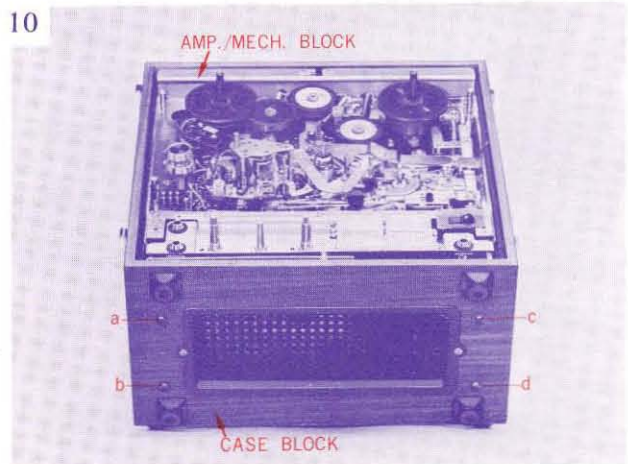
III. CONTROL LOCATIONS



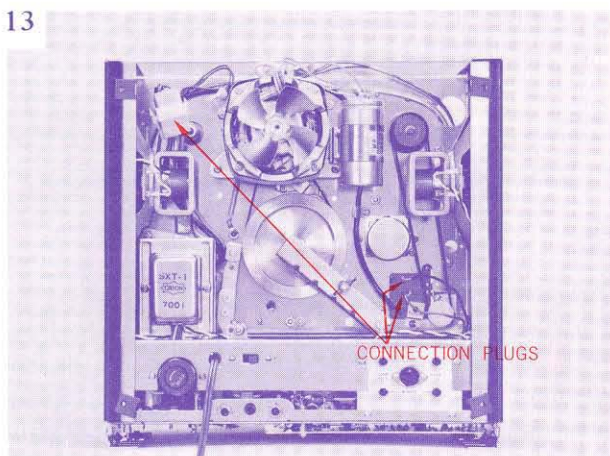
IV. DISMANTLING OF TAPE TRANSPORT UNIT & AMPLIFIERS

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

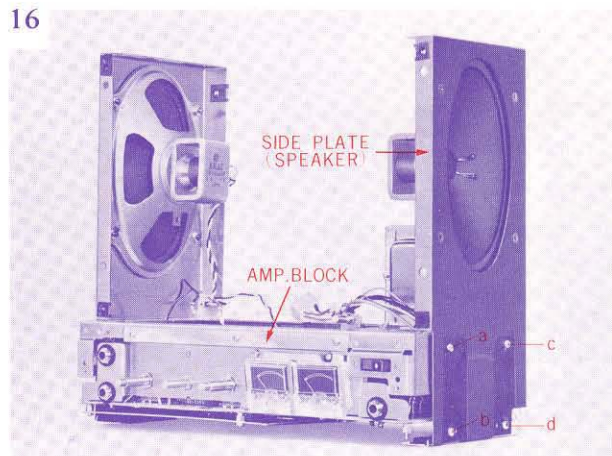




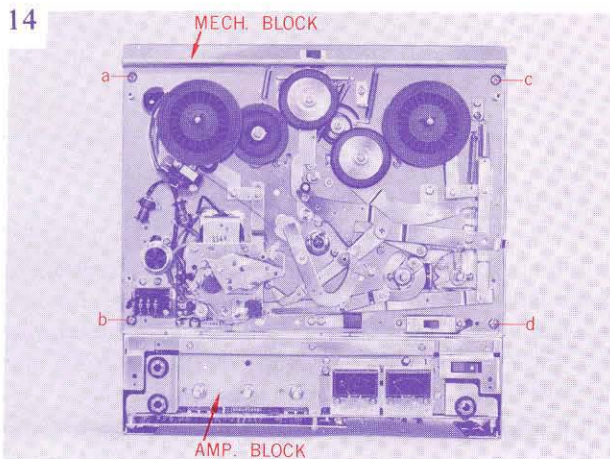
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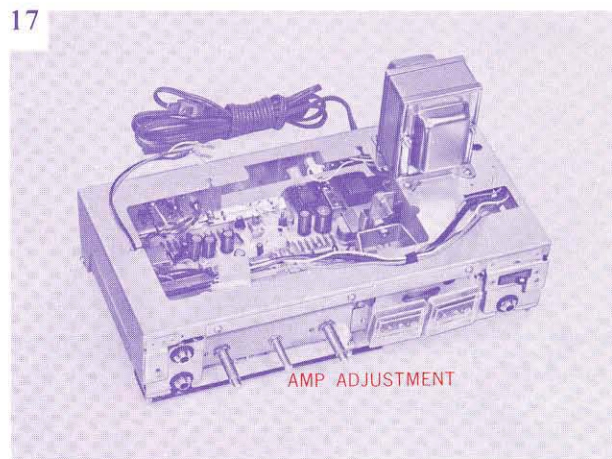
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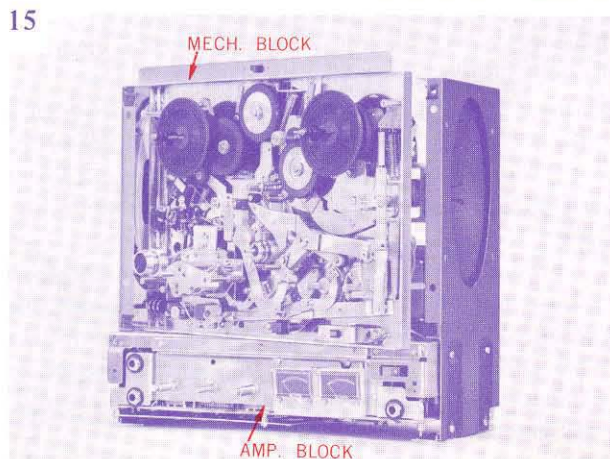
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V. TRANSPORT MECHANISM

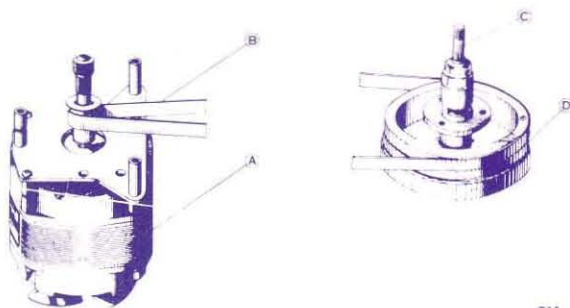


Fig. 1

DRIVING OF CAPSTAN

Figure 1.

- Ⓐ Motor
- Ⓑ Driving Belt (flat belt)
- Ⓒ Capstan
- Ⓓ Flywheel

High-speed rotation of *Motor* Ⓐ is reduced by *Driving Belt* Ⓑ and transmitted to *Capstan* Ⓒ, which is connected with *flywheel* with ample inertia. This enables the rated rotation to be attained by absorbing minor rotation distortion of the motor itself.

Capstan Rotation :

606 R.P.M. at 7-1/2" (19 cm) per sec.

303 R.P.M. at 3-3/4" (9.5 cm) per sec.

151.5 R.P.M. at 1-7/8" (4.75 cm) per sec.

Motor Rotation :

3,000 to 1,500 R.P.M. at 50 Hz.

3,600 to 1,800 R.P.M. at 60 Hz.

DRIVING OF PINCH WHEEL

Put tape between rotating capstan and pinch wheel, and push the pinch wheel against the capstan. This will transport the tape at rated speed. The appropriate pressure of pinch wheel is between 1,000 to 1,150 grams at the tape speed of 7-1/2" (19 cm) per second.

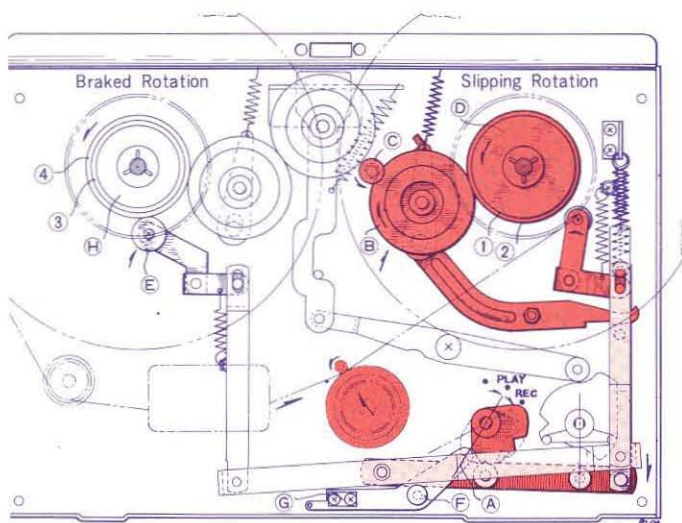


Fig. 2

RECORDING AND PLAYBACK

Turn the RECORD/PLAYBACK KNOB Ⓐ to "PLAY" position, and pinch wheel presses against capstan to move tape at the rated speed. At the same time, *Idler* Ⓑ moves between *Motor Bushing* Ⓒ and the *Take-Up Reel Spindle* Ⓓ to transmit the motor rotation to Ⓓ so that the tape is moved and wound on the take-up reel.

The Take-up Reel Spindle Base is made up of two plastic rollers (1 and 2) with a clutch felt in between. The Idler is rotating the plastic roller ② underneath. Therefore, the tape-winding friction is adjusted by the slipping of the felt to maintain the winding of the tape.

On the other hand, the *Supply Reel Spindle* Ⓗ has a *Brake Roller* Ⓔ hung on the Plastic Roller ④ underneath, which provides appropriate back tension (by the felt clutch slipping) to the rotation of the Pulley ③ above.

To prevent accidental erasure, the *Record Interlock Button* Ⓕ must be depressed before the RECORD/PLAYBACK KNOB can be moved to the "REC" position. The *Safety device* Ⓖ is depressed to operate the recording mechanism. (See figure 2)

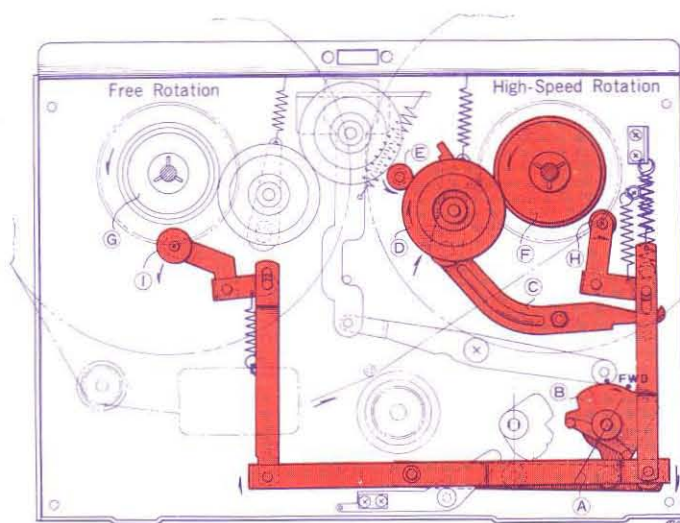


Fig. 3

FAST-FORWARD MECHANISM

Turn the *FAST FWD-REWIND knob (A)* to "FAST FWD" position, and the cam (B) under the knob pushes up the *Lever (C)*. The *Idler (D)* moves into the space between the *Plastic Roller (F)* above the *Take-Up Reel Spindle* and the upper part of the rotating motor drive bushing to transmit the motor rotation to the take-up reel spindle. At the same time, *Brake Rollers (H) and (I)* come off the reel spindle to free the *Supply Reel Spindle (G)*, thereby allowing fast winding of the tape onto the take-up reel.

(See figure 3)

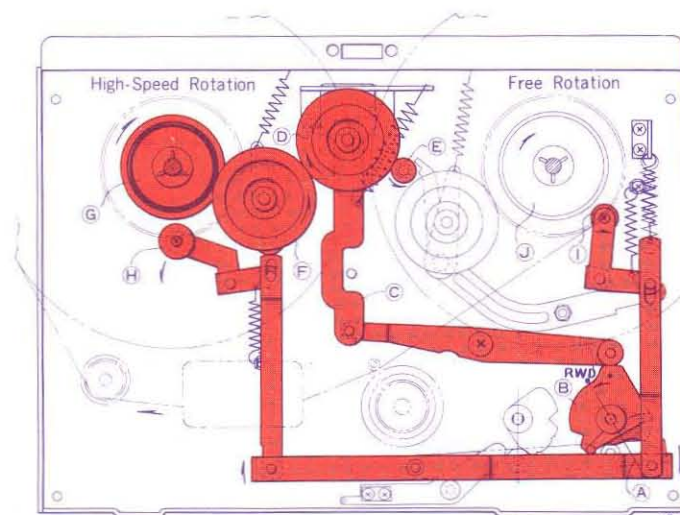


Fig. 4

REWIND MECHANISM

Turn the *FAST FWD-REWIND knob (A)* to "REWIND" position, and the cam (B) under the knob pushes the *Lever (C)* up. The *Idler (D)* moves into the space between the upper part of the rotating *Motor drive bushing (E)* and the *Intermediate Pulley (F)* to transmit the high-speed rotation of the motor through the intermediate pulley to the *Supply Reel Spindle (G)*. At the same time, *Brake Rollers (H) and (I)* come off the reel spindle to free the *take-up reel spindle (J)*, thereby rewinding the tape onto the supply reel at a fast speed.

(See figure 4)

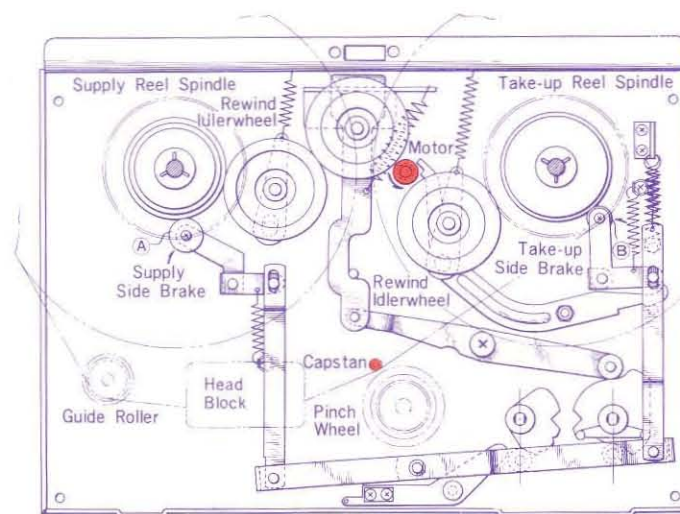


Fig. 5

STOP CONTROL

Push the stop lever to "STOP" position. *Brake Rollers (A) and (B)* depress reel spindles to stop rotation of the reel spindles.

As the brake rubber depresses the plastic rollers under the reel spindles, no friction is brought to bear on the tape itself.

Modes of Operation	Pinch Wheel	Take-up Idler Wheel	Rewind Idler Wheel	Take-up side Brake	Supply side Brake
(a) STOP	!X	X	X	○	○
(b) FAST-FORWARD	X	○	X	X	X
(c) REWIND	X	X	○	X	X
(d) RECORDING/PLAYBACK	○	○	X	X	○

NOTES : X-marks indicates "open" and ○-marks "engaged"

RECORDING/PLAYBACK CHANGING MECHANISM (NEW TYPE)

Turning the RECORD/PLAYBACK KNOB (N) to recording position causes CAM (a) to push RECORDING LEVERS (b), (c) and (d), as illustrated by the dotted line; then the RECORD/PLAYBACK CHANGING SWITCHES (SW101) and (SW201) turns to recording position. If the LEVERS (b) and (c) do not push the LEVERS (d) properly, the (SW101) and (SW201) do not operate properly, and abnormal oscillation may occur. Also recording cannot take place.

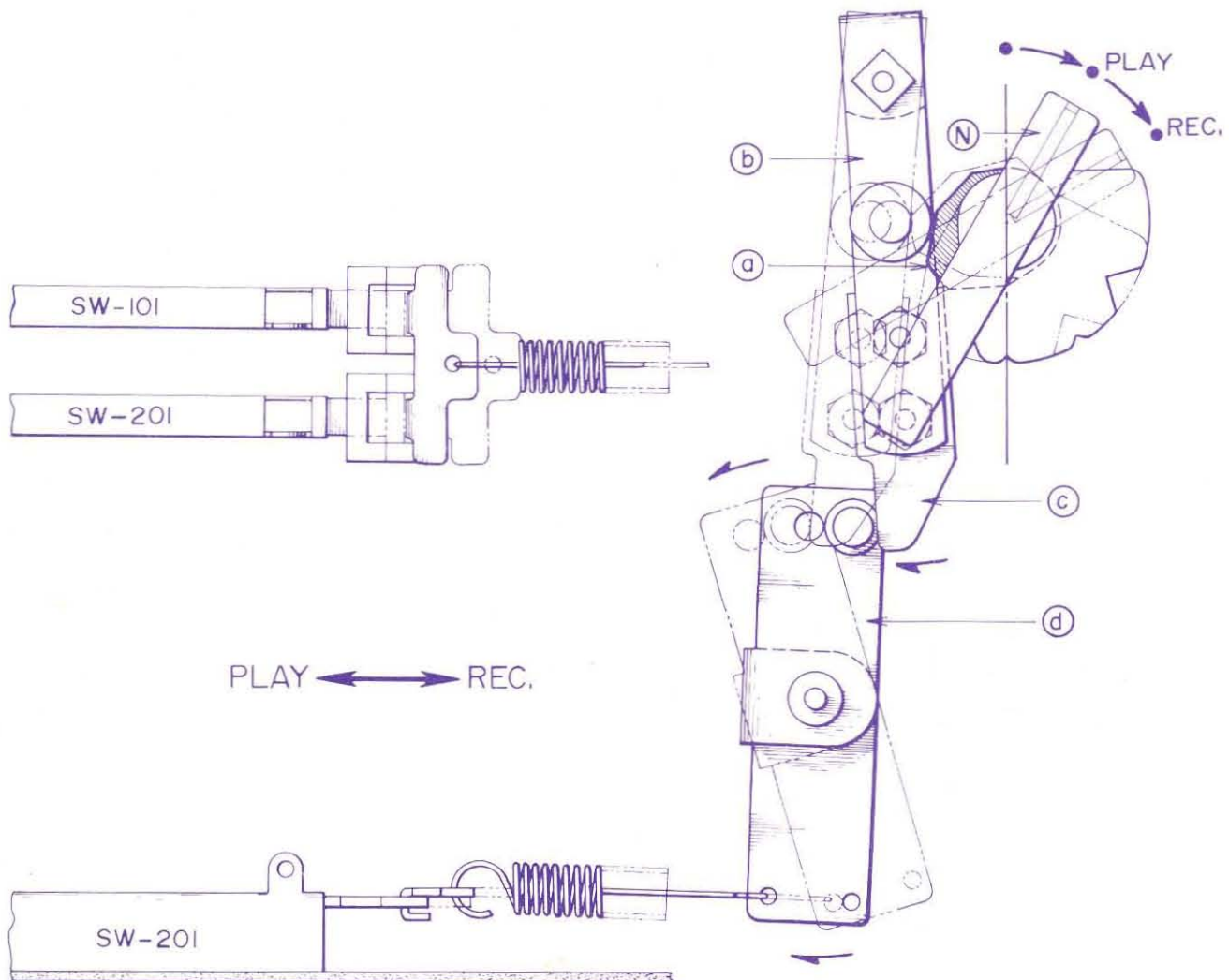


Fig. 6

VI. MECHANISM ADJUSTMENT

1. ADJUSTMENT OF PINCH WHEEL

It is important that the pinch wheel shaft be kept in complete 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 7-1/2 ips. Any deviation from this specification will result in wow and flutter. Check pinch wheel pressure by means of a spring scale, and if necessary, adjust the pinch wheel load spring.

2. ADJUSTMENT OF TAKE-UP IDLER WHEEL

The take-up idler wheel must be kept in complete alignment with the take-up reel shaft. When the unit is set to fast forward mode, the idler wheel will contact with the upper knurled wheel of the take-up reel shaft assembly, and it will contact with the lower knurled wheel during record or play operation. Adjust idler wheel load spring so that the idler wheel pressure is kept between 50 and 80 grams. The idler wheel rapidly wears if the pressure is excessive. Slippage occurs if the pressure is smaller than the specification.

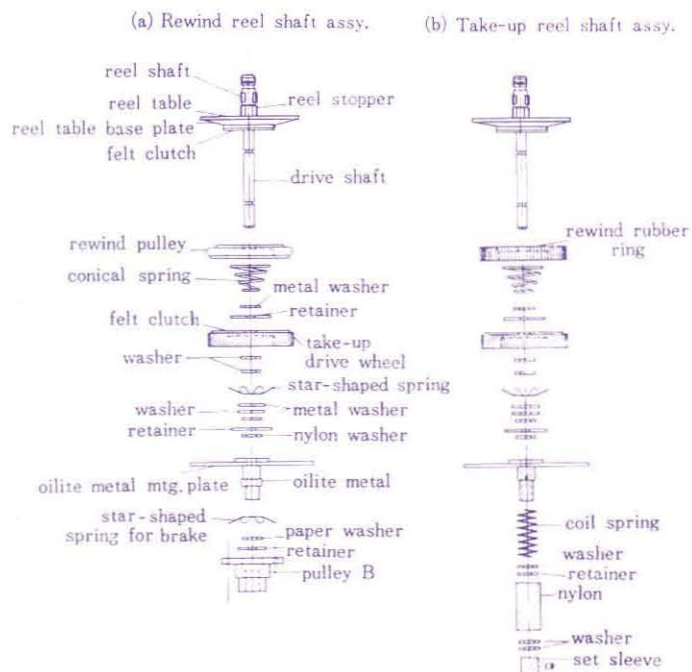


Fig. 1

3. ADJUSTMENT OF REWIND IDLER WHEEL

The rewind idler wheel must be kept in complete alignment with the rewind reel shaft. The amount of pressure on the knurled motor bushing should be maintained at about 50 grams during rewind operation. Adjust both the idler load spring and rewind roller.

4. ADJUSTMENT OF INTERMEDIATE WHEEL

The intermediate wheel is located between the rewind idler wheel and the rubber ring which is used on the upper part of the supply reel shaft assembly. When the unit is set in rewind mode, it will contact with these parts simultaneously transmitting motor torque. An adequate pressure is 50 grams. Adjust the load spring of the intermediate wheel if the pressure is not sufficient.

5. ADJUSTMENT OF TAKE-UP SHAFT ASSEMBLY

Felt clutch material is attached to the bottom side of the reel table base plate so that recording tape will not be stretched during fast forward operation because of excessive tension. To check the amount of friction of this part, place on the take-up reel table a 5-inch reel with a tape 60 m/m in diameter, and gently pull the end of tape upward using a spring scale. Adjust the conical spring so that the amount of tension at this part will be kept between 400 and 500 grams. Other felt clutch material is attached to the take-up drive wheel. It is to provide proper slipping operation during record or play operation. The procedure for checking friction of this part is the same as the foregoing, and between 150 and 200 grams of friction will provide the best result. Adjust the star-shaped spring just under the take-up drive wheel. When the unit is set for rewind operation, the amount of friction of this part will be greatly reduced and will become 15 to 20 grams. Check to see whether this is satisfactory, if not, readjust the star-shaped spring for Brake, and the pressure of the spring retainer will be adjusted accordingly.

6. ADJUSTMENT OF SUPPLY REEL SHAFT ASSEMBLY

Felt clutch material is used between the lower side of the reel table base plate and the rewind rubber ring to protect recording tape from excessive tension during the rewind operation. To check the amount of friction of this part, place on the take-up reel table a 5-inch reel with a tape 60 m/m in diameter, and gently pull the end of tape upward using a spring scale. Adjust the conical spring so that the amount of tension at this part will be kept between 400 and 500 grams. Other felt clutch material is attached to the take-up drive wheel. It is to provide proper slipping operation during record or play operation. The procedure for checking friction of this part is the same as the foregoing, and between 150 and 200 grams of friction will provide the best result. Adjust the star-shaped spring just under the take-up drive wheel. When the unit is set for rewind operation. The amount of friction of this part will be greatly reduced and will become 15 to 20 grams. Check to see whether this is satisfactory, if not, readjust the star-shaped spring for Brake, and the pressure of the spring retainer will be adjusted accordingly.

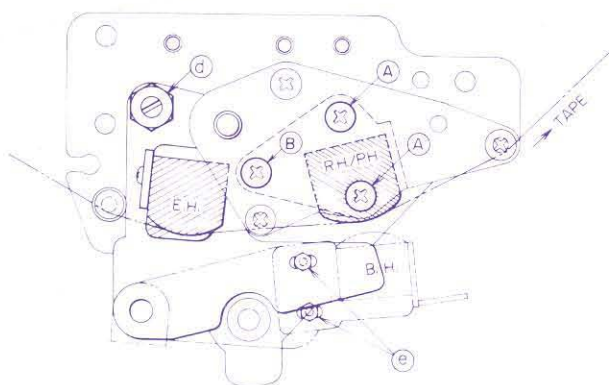


Fig. 2

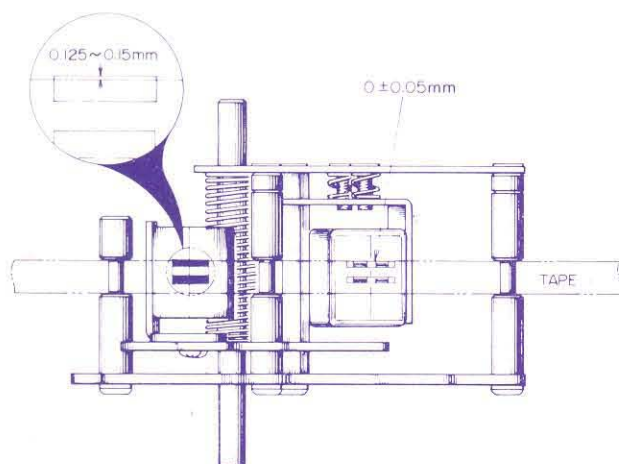


Fig. 3

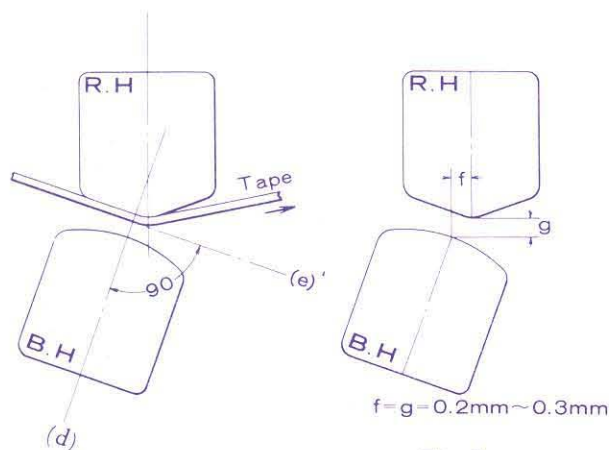


Fig. 4

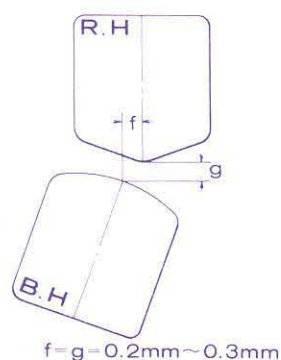


Fig. 5

7. ADJUSTMENT OF HEADS

- a) Azimuth alignment of the Recording/Playback Head (See Fig. 2)

Playback an Alignment Tape 8,000 Hz at 7-1/2" tape speed and turn the screw (B) until the Line Out-Put Level reaches the Maximum.

- b) Angle of the Bias Head (See Fig. 2 and Fig. 4)
Unfasten two screws and move the Bias Head by hand until the center line (d) of the Bias Head makes an angle of 90° with the direction of the tape. Then fasten screws.

- c) Clearance of the Bias Head (See Fig. 5)
Unfasten the two screws and move the Bias Head by hand until the clearance (f) and (g) reaches 0.2 ~ 0.3 mm. Then fasten screws.

Note : If the clearance (f) and (g) becomes less than 0.2 ~ 0.3 mm, the Frequency Characteristic will be too low, but Distortion will decrease. If the clearance (f) and (g) becomes more than 0.2 ~ 0.3 mm, the Frequency Characteristic will be too high, and Distortion will increase.

VII. AMPLIFIER ADJUSTMENT

1. ADJUSTMENT OF RECORDING BIAS FREQUENCY (See Fig. 1)

- Put on the resistor 10 or 50 Ohms in series with the Bias Head and connect the Vertical Input Terminal of the Oscilloscope to points (a) and (b).
- Feed in a sine wave signal from an Audio Frequency Oscillator to the Horizontal Input of the Oscilloscope and tune the Dial of the Audio Frequency Oscillator until the Oscilloscope displays a circular or linear pattern. Then read the figure on the Dial of the Audio Frequency Oscillator.
- If it reads $100 \text{ KHz} \pm 15 \text{ KC}$ the Recording Bias Frequency is correct.
- If it is not correct, it can be adjusted by inserting another condenser (C-128).

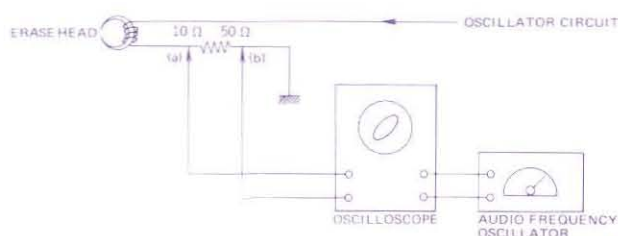


Fig. 1

2. ADJUSTMENT OF RECORDING BIAS VOLTAGE

- Reel (See Fig. 2)
Connect a V.T.V.M. to point (a) and adjust the recording bias voltage by turning L3 in the bias oscillator circuit until it reads the same as the voltage stamped on the back of the head assembly.
Note : There is no way of adjusting the erasing bias voltage, but the correct bias voltage is about 100 V.

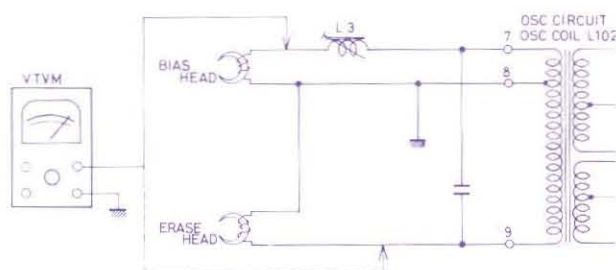
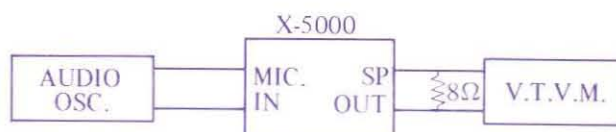


Fig. 2

3. PLAYBACK MODE (PLAYBACK REEL ADJUSTMENTS)

- On Model X-5000 (L) (W), when using any output testing equipment, an 8Ω load resistor must be connected to the Speaker Output Terminals.



- Playback a 250 Hz "0" VU pre-recorded tape. Turn up both Volume Controls so that the VU Meters register "0" VU. The power output from both speaker terminals will be within 4 V (± 0.5). At this time, the Left and Right Volume Controls should be turned to about a 45° position.
- Output voltage from the Line Output and DIN Output is existent only when the Speaker Switch is at "Off" position.
The Line Output Voltage is about +4 dB at "0" VU. When the position of the Volume and Tone Controls are changed, this changes the Output Voltage.

4. RECORDING MODE (RECORDING AND VU METER SENSITIVITY ADJUSTMENTS)

- a) As in (b) of Playback Reel Adjustments above, playback a 250 Hz Tape and with Volume Controls at fixed position (VU Meters at "0" VU), supply a -60 dB signal (1 kHz) to the Microphone Jack. At this time, adjust Potentiometers VR103 (30 k Ω) (left), and VR203 (30 k Ω) (right), so that the VU

Meters indicate "0" VU (VU METER SENSITIVITY ADJUSTMENT—SEE FIG. 2)

- b) After recording a 1 kHz "0" VU signal, play it back and adjust Potentiometers VR102 and VR202 (30 k Ω) so that the VU Meters indicate "0" VU (RECORDING LEVEL ADJUSTMENT—SEE FIG. 2).

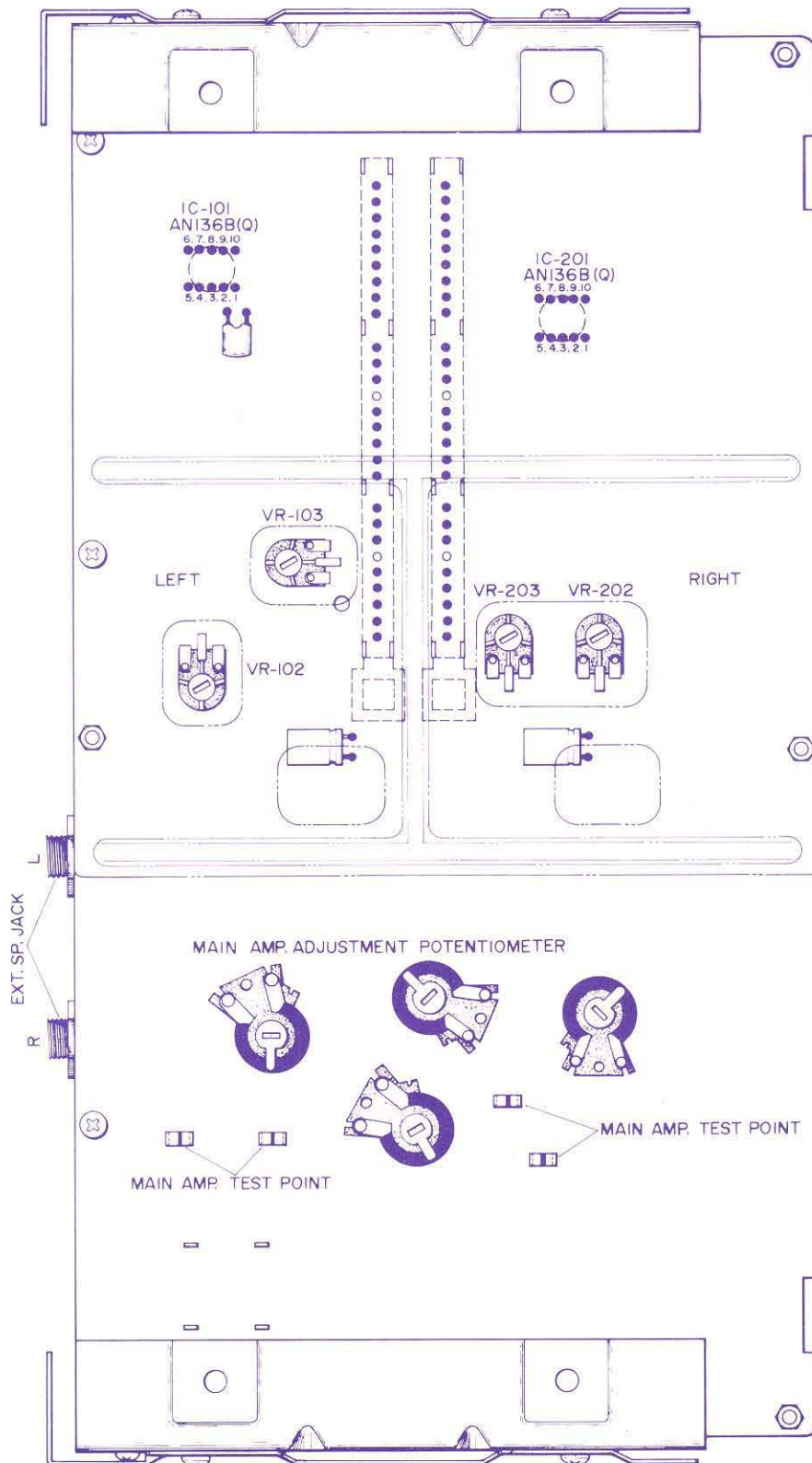


Fig. 2

5. MAIN AMPLIFIER ADJUSTMENTS

- a) The test point of the Power Output Transistor (2SC931) Collector Circuit is located on the back of the Printed Board. Remove the solder from around the point and connect an Ammeter to the test point (FIG. 2 and FIG. 3).

As shown in Fig. 2, connect two Voltmeters and with no input power signal (Volume Controls at "0"), adjust Potentiometers VR105 (L), VR205 (R) (1 k Ω). With Collector Current at about 15 mA, obtain equal indications on the two Voltmeters.

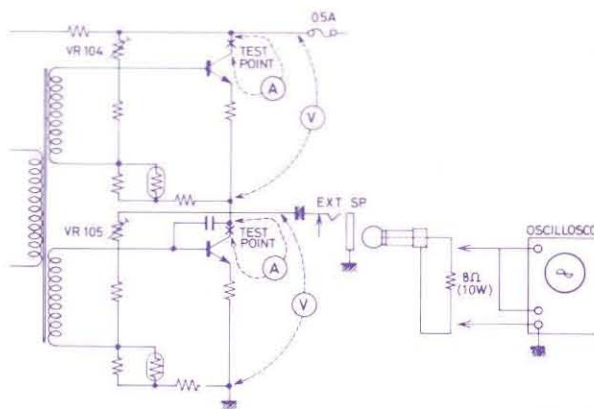


Fig. 3

- b) If an Oscilloscope is used for adjustments, supply 1 KC from Audio Oscillator. At maximum output (without "overshoot dot" appearing on waveform), and with Volume Controls turned up, adjust Potentiometers VR104, VR204 and VR105, VR205 so that the peaks of the upper and lower output waveforms begin to be clipped simultaneously.

6. PLAYBACK GAIN ADJUSTMENTS AND IC PRECAUTIONS

- a) The IC (AN 136BQ) Total Gain is between 85 dB and 95 dB. In case the difference in Left and Right Amplifier IC Gain is too great (one Volume Control must be turned up much higher than the other), the difference in IC gain can be adjusted at the 5-500 K Ω resistor located parallel to the 2.2 K Ω resistor which is connected between No. 8 IC terminal and the ground terminal. The smaller the resistor, the higher the gain, but in order to avoid distortion, a resistor of minimum 500 Ω should be used (see Fig. 1).

VIII. MAINTENANCE PROCEDURES

1. LUBRICATION INSTRUCTIONS

For maximum service life and optimum performance, lubricate the parts identified below after each 500 hours of operation. Use only light machine oil of good quality.

Motor Flywheel Assembly

Rewind Idler Wheel and Wind Take-Up Idler 1 drop

Intermediate Idler 1 drop

Pinch Wheel 1 drop

Also apply a liberal film of light machine grease to each roller surface of all levers and cams.

CAUTION: DO NOT OVER-LUBRICATE, AND WIPE OFF EXCESS OIL WITH A COTTON SWAB SOAKED IN ALCOHOL. OTHERWISE, THE EXCESS LUBRICANT MAY BE SCATTERED DURING OPERATION, AND THE RUBBER COMPONENT PARTS WILL DETERIORATE.

2. CLEANING TAPE HEADS AND OTHER PARTS

Wipe surface of tape heads, guide roller bearing, capstan bushing and pinch wheel periodically with a soft cloth soaked in alcohol.

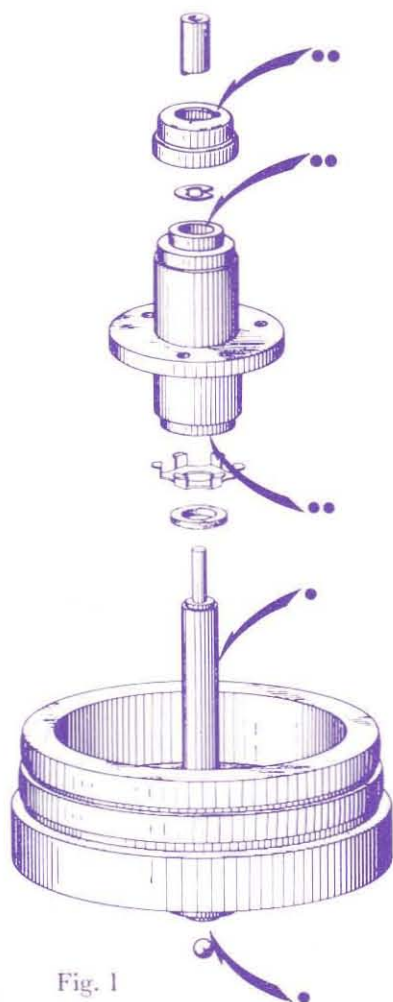
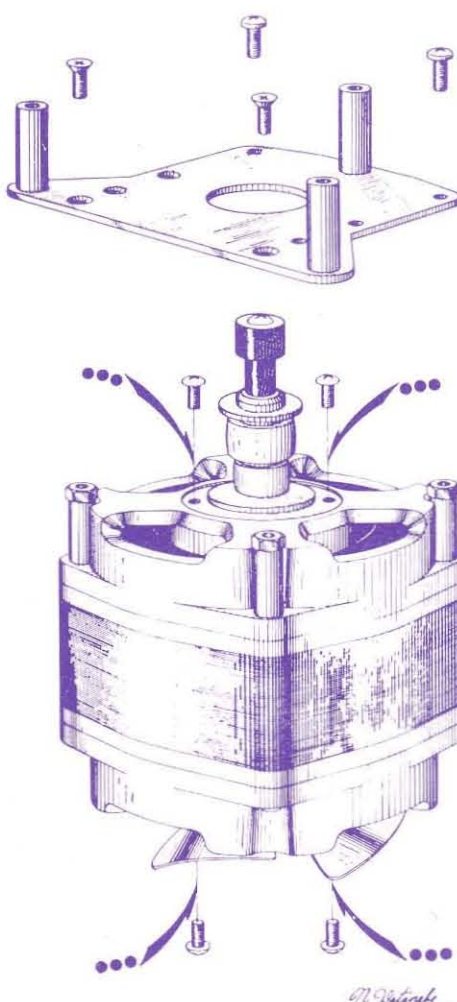


Fig. 1

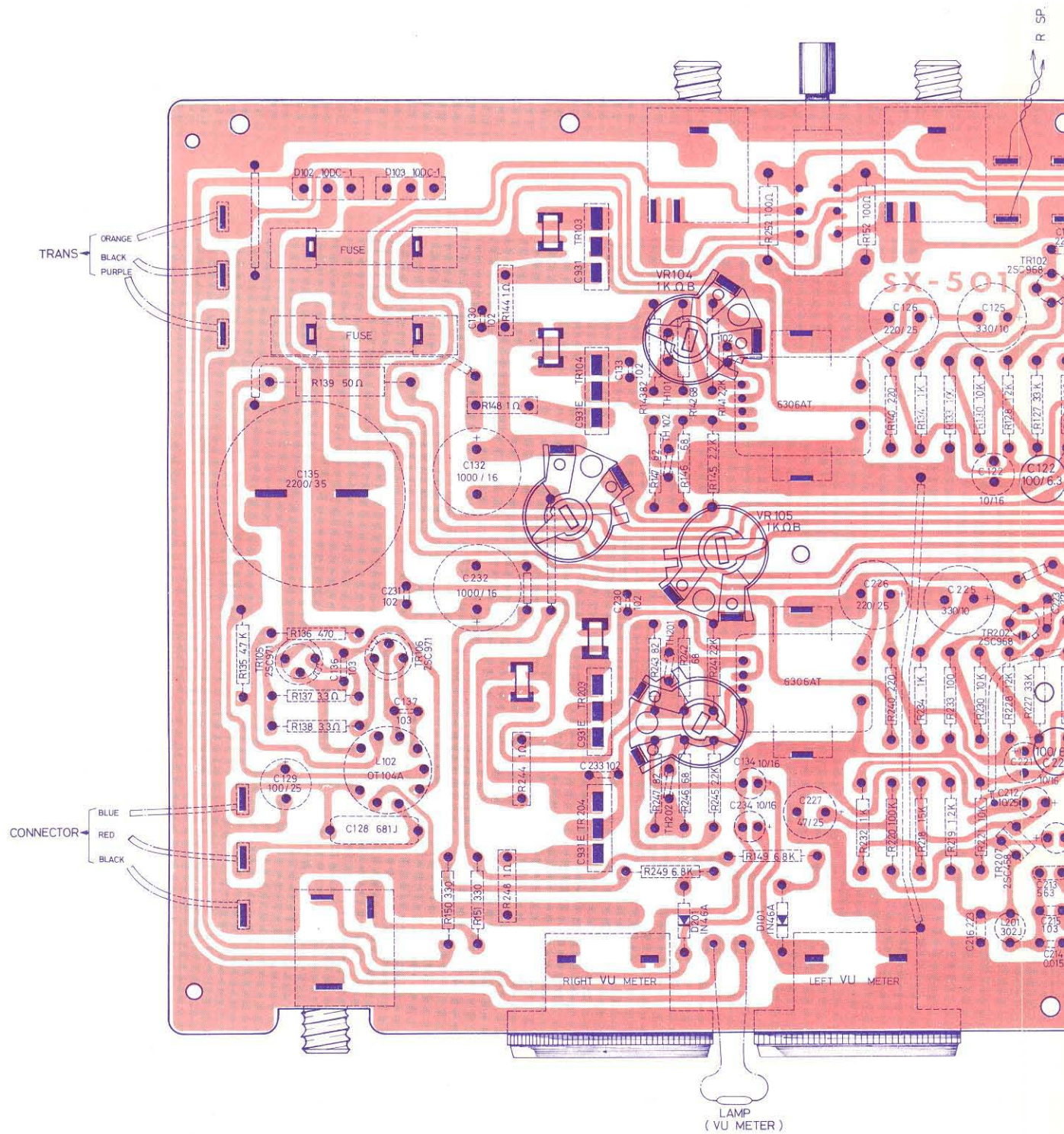
FLYWHEEL

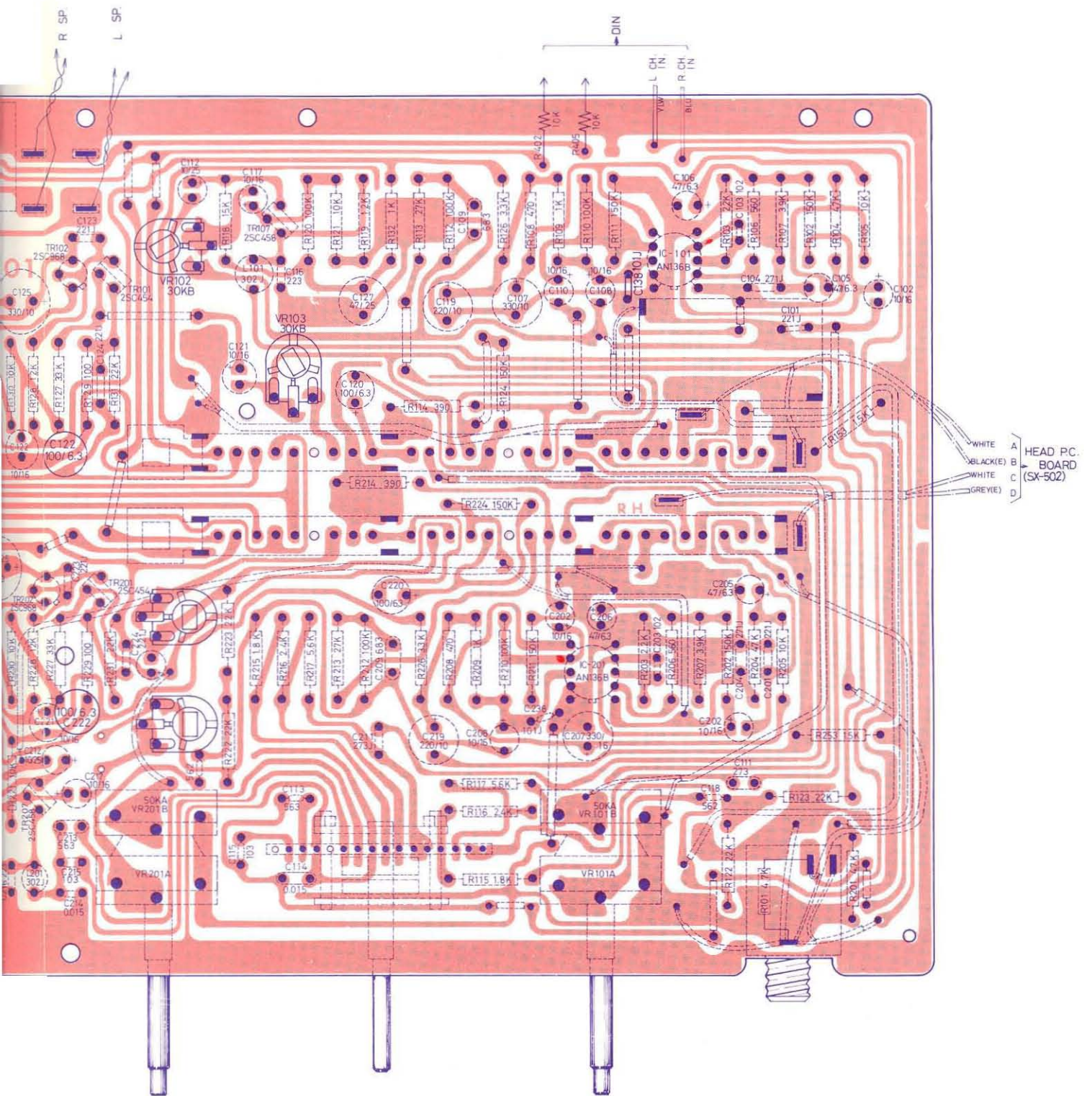
● 1 drop



MOTOR

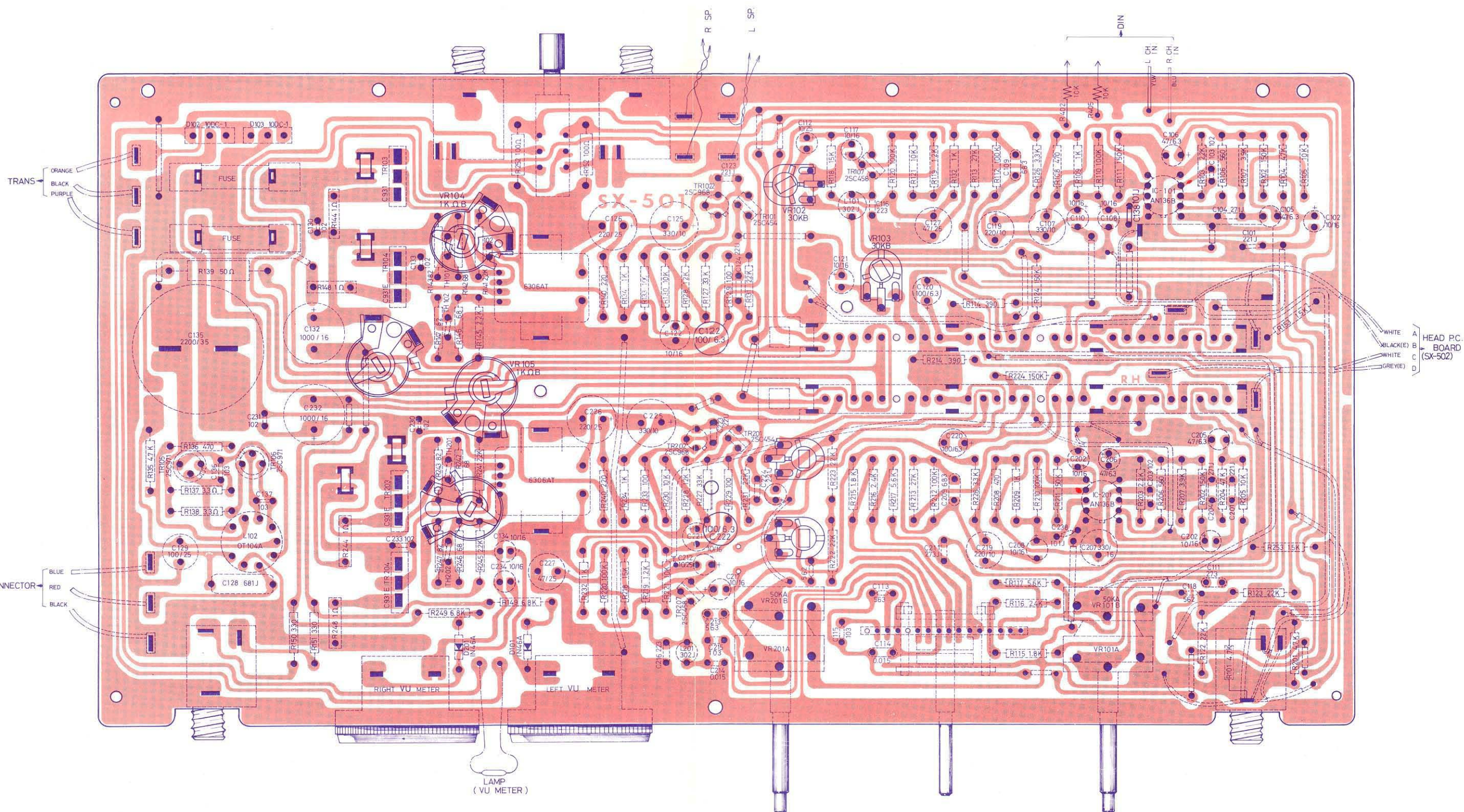
AMPLIFIER PRINTED CARD (SX-501) (PRE. MAIN)





IX. COMPOSITE VIEWS OF COMPONENTS

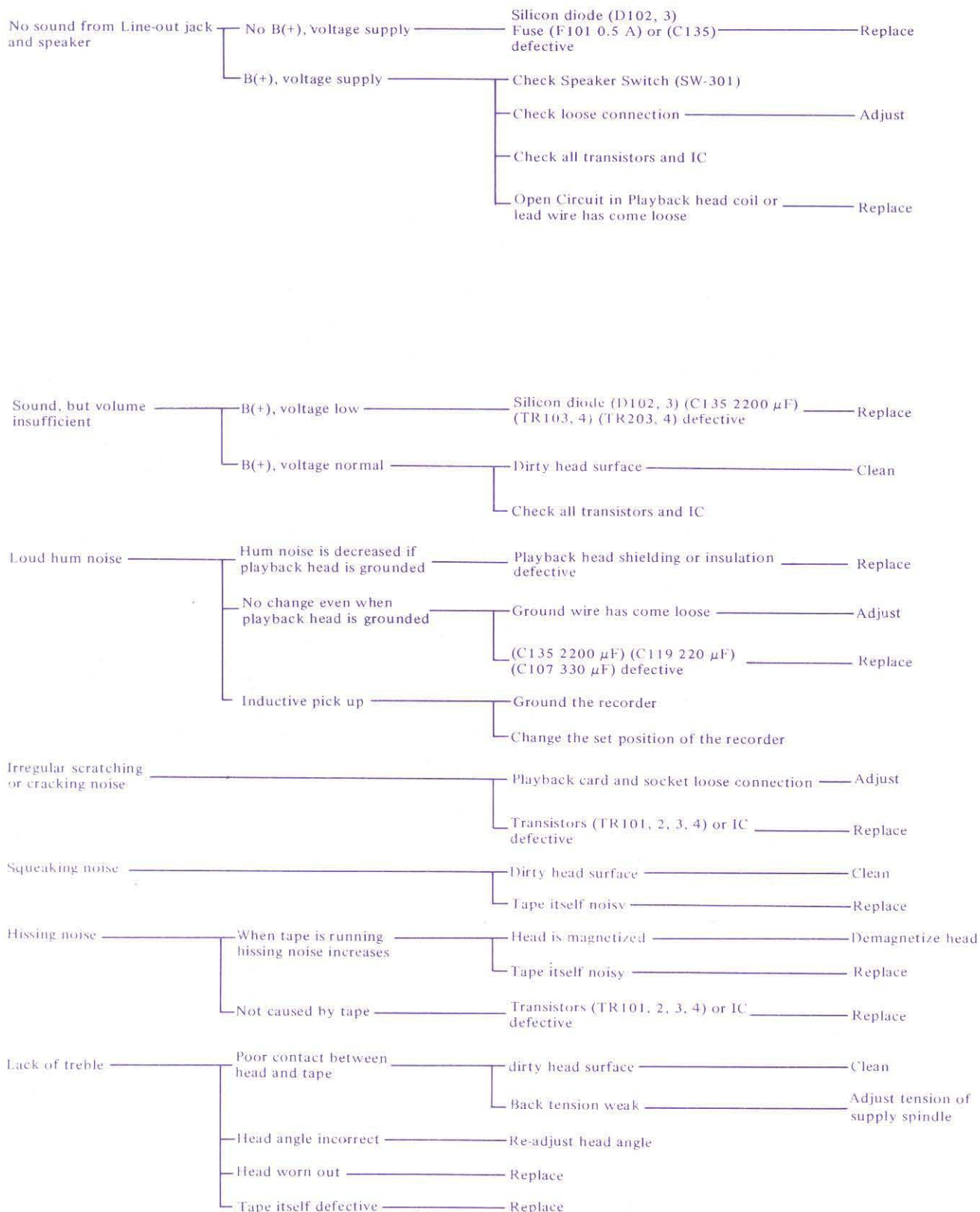
AMPLIFIER PRINTED CARD (SX-501) (PRE. MAIN)

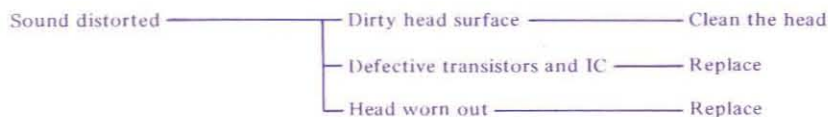


X. TROUBLE SHOOTING CHART

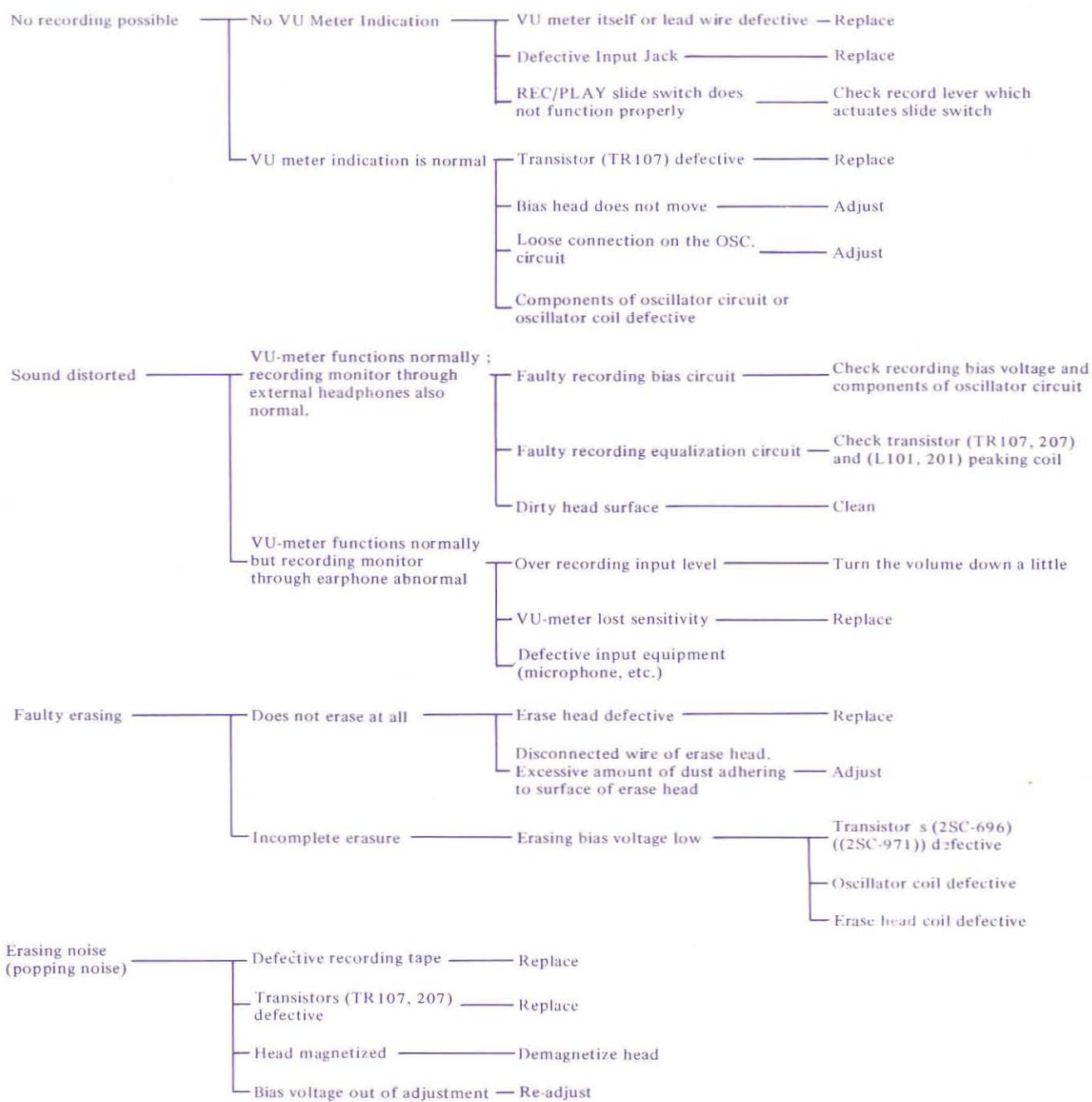
SECTION "A" TROUBLES WITH AMPLIFIER

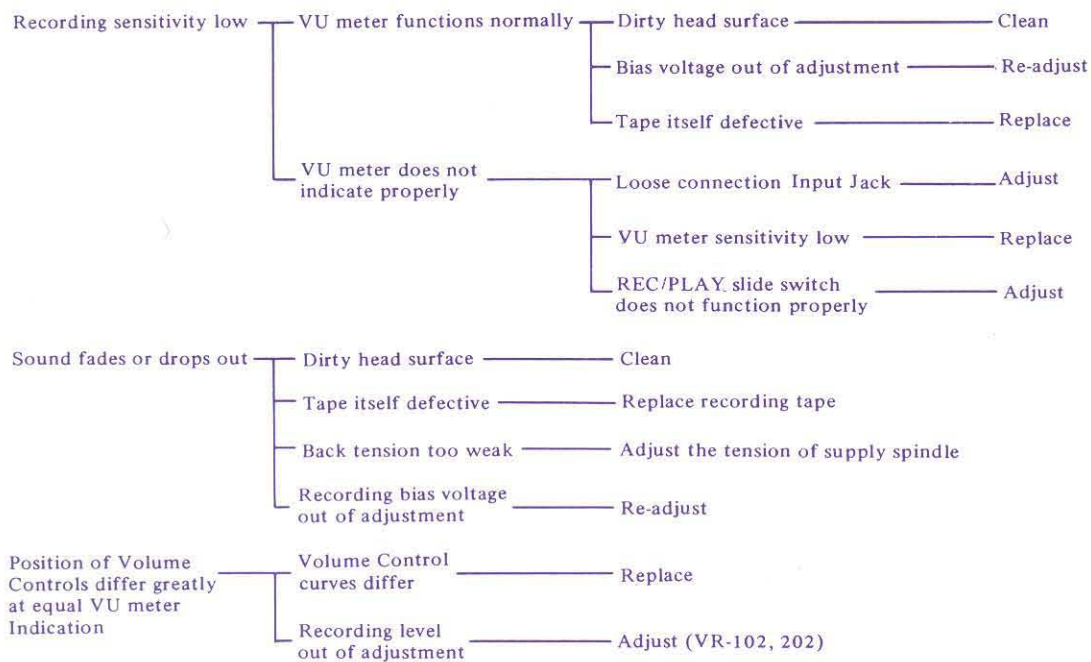
1. Playback problems. (Unit set to play position.)





2. Recording problems.
(Unit plays back pre-recorded tapes satisfactorily,
but recording not satisfactory.)

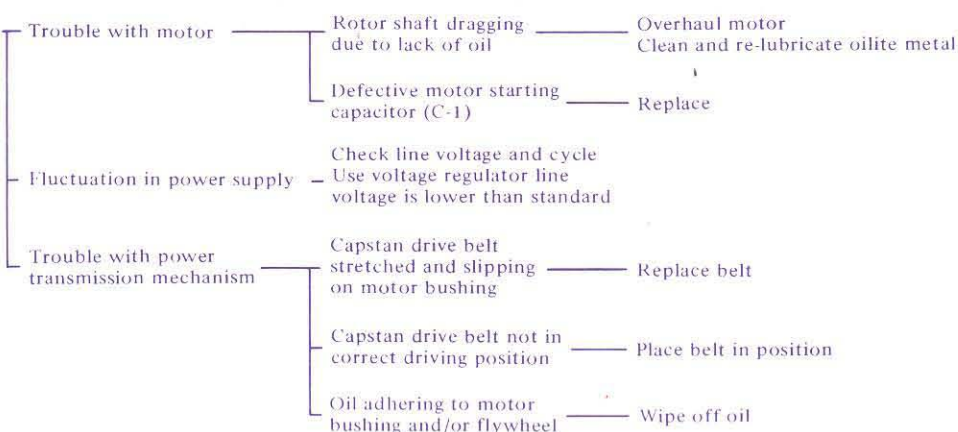




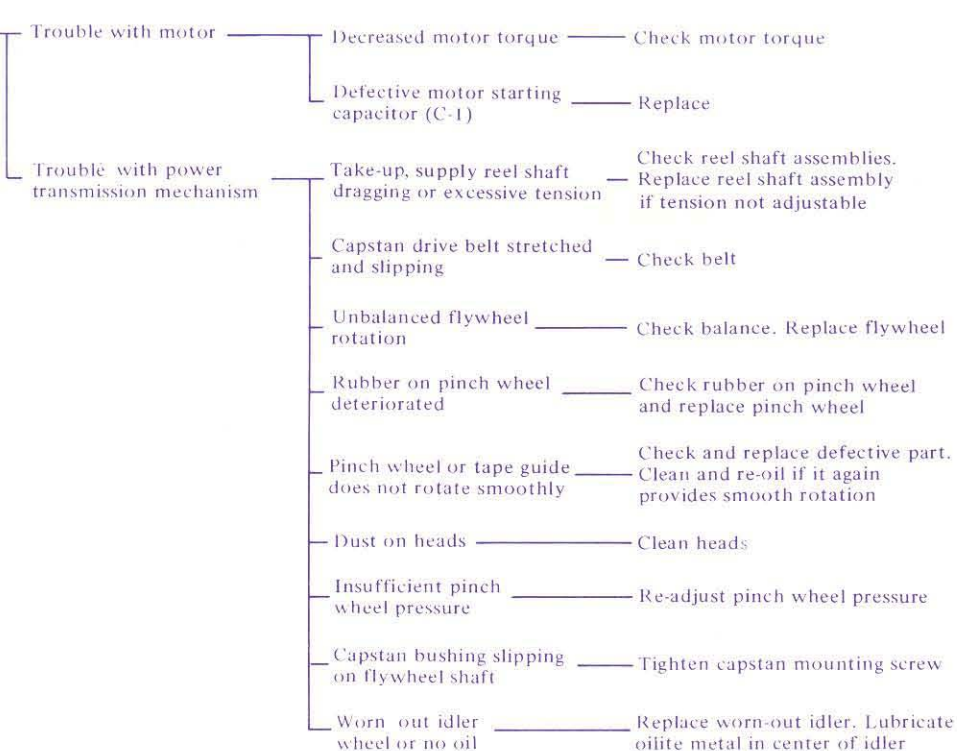
SECTION "B" TROUBLES WITH TAPE TRANSPORT MECHANISM

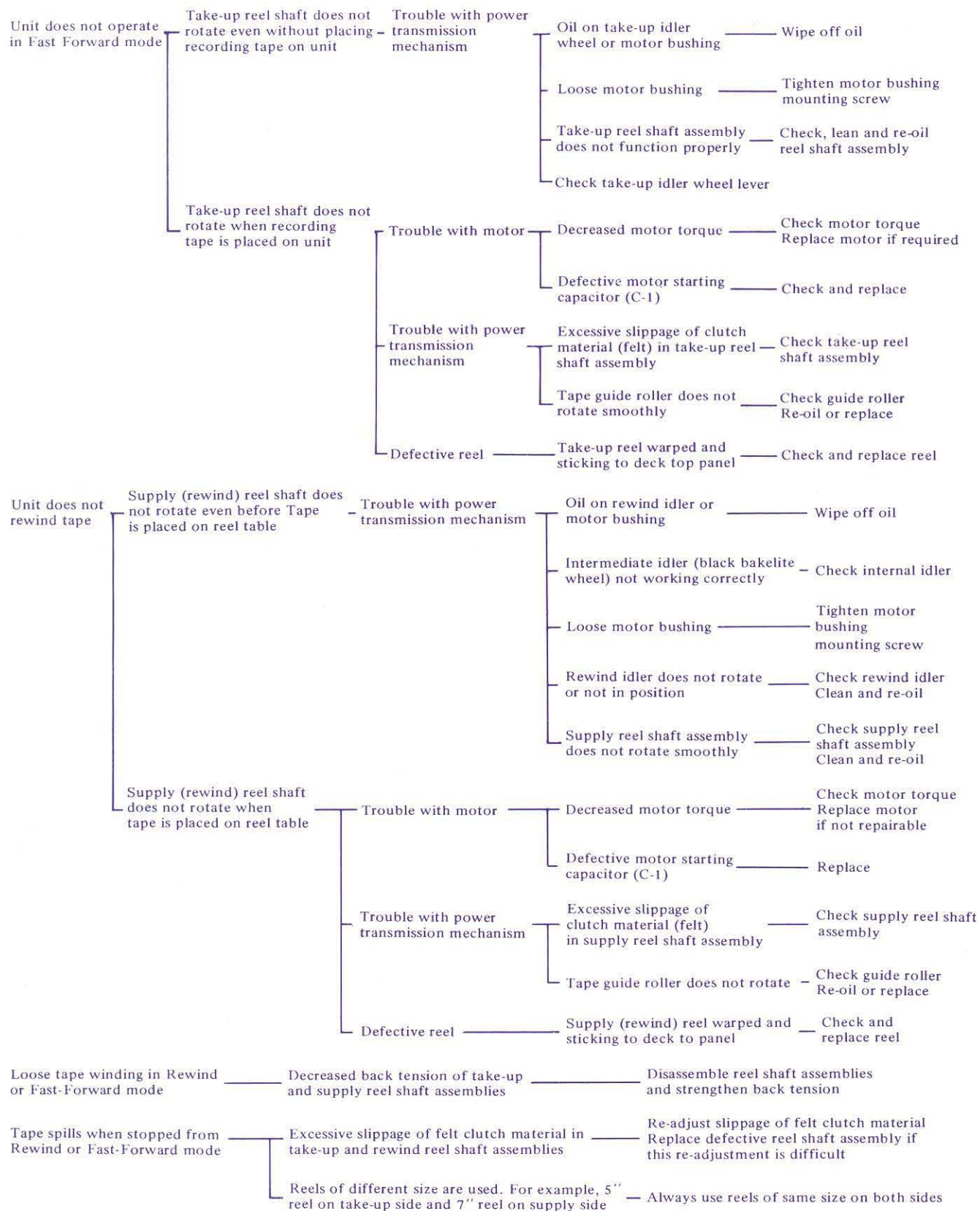


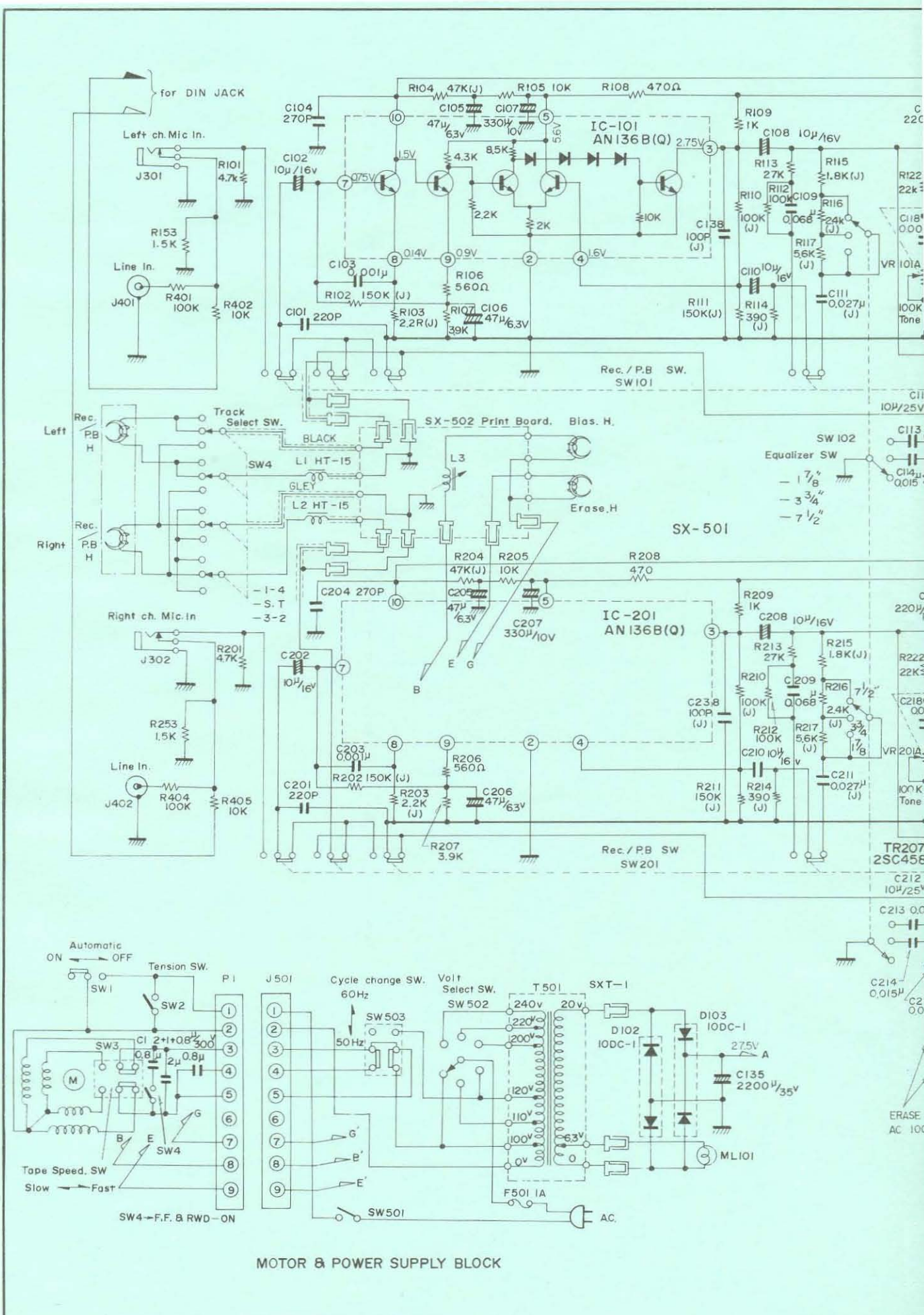
Take-up functions normally, but tape speed lower than regular speed

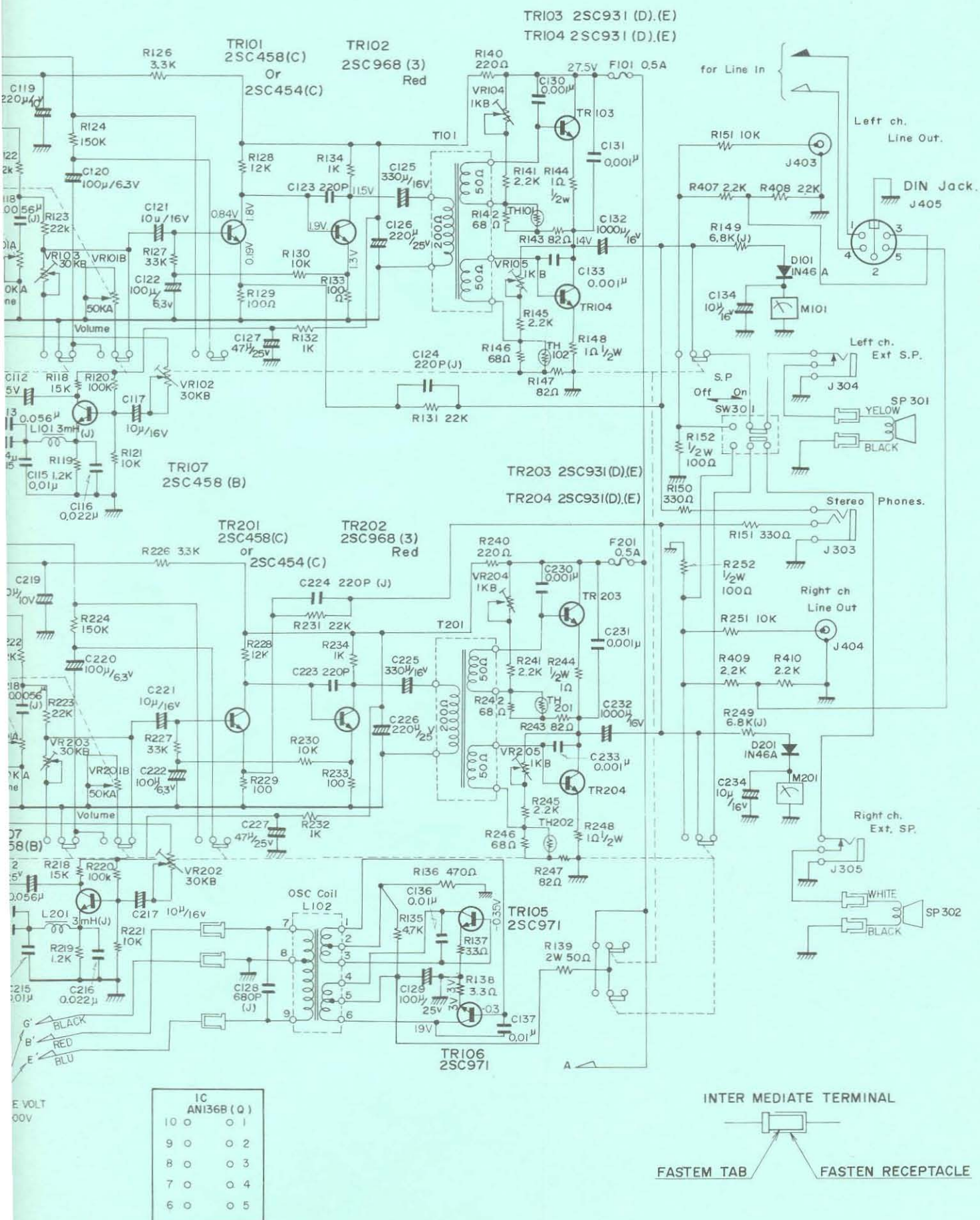


Wow-flutter
Irregular tape movement

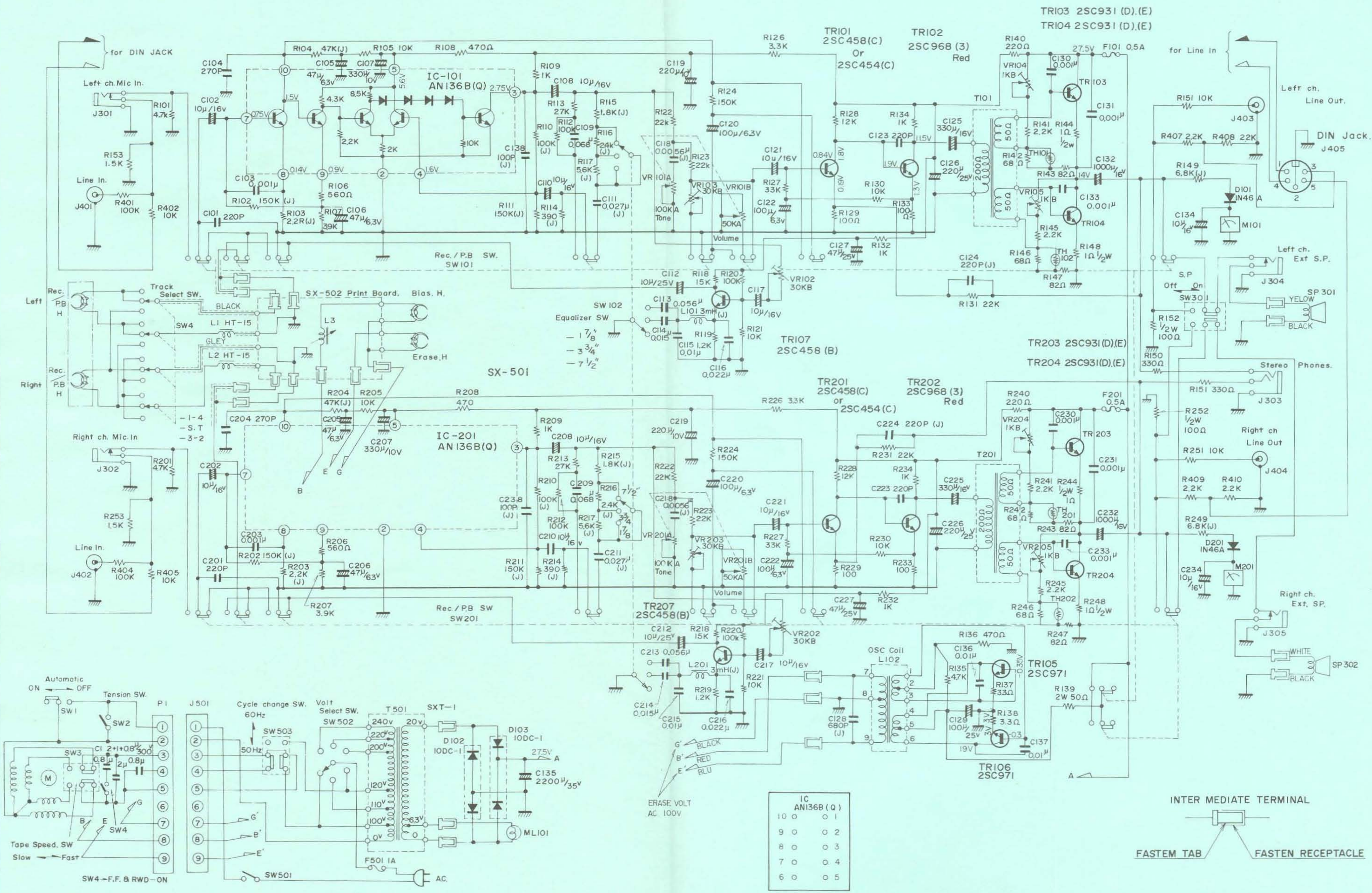








X-5000 SCHEMATIC DIAGRAM 14004381



MOTOR & POWER SUPPLY BLOCK

X-5000 SCHEMATIC DIAGRAM 14004381



AKAI

AKAI ELECTRIC CO., LTD.
AKAI TRADING CO., LTD.

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