

AMPEX

MAINTENANCE MANUAL

FOR TAPE RECORDER MODELS :

121,890,960,961,1150,1153,1160,1163,1165

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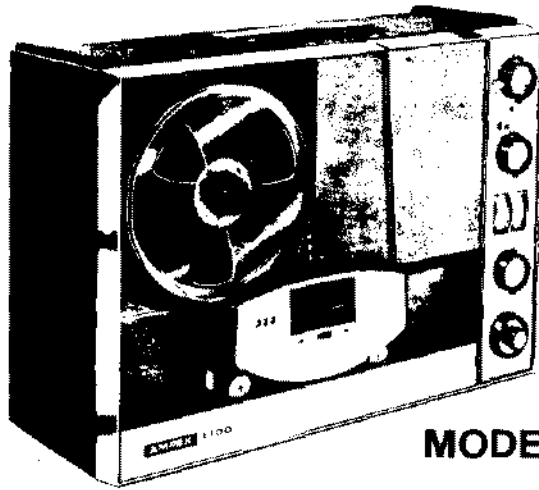
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NOTE: This manual supercedes all previously printed manuals of the same part number and Service Bulletins No. 1062, 1064, 1074, 1052, 1088, 1096

INTRODUCTION



MODEL 1160

This book is intended as a basic guide which will enable the serviceman to perform routine maintenance operations. Included are general instructions which will enable the technician to become familiar with the function of each control. Should parts be needed to repair the equipment described in this manual, order as follows:

List the quantity, part number, part description, and model number of the recorder. Include part color, if applicable. Example: 1, 7310001-01, wind drive tire, for model 1160.

For Mechanical Parts:

Use the exploded view to locate the part. A reference number will be printed next to the part. For part number, refer to the numerical parts listing. The part description is listed adjacent to the part number.

For Electrical Parts:

Locate the part on the schematic, then use the schematic symbol and locate the part on the electrical parts list. The part number and description will be printed adjacent to the circuit reference.

1160

The 1160 is a 1/4 track stereo recorder and reproducer. Its capabilities include 1/4 track stereo record, 1/4 track stereo playback, 1/4 track monaural record, 1/4 track monaural playback. Its jack facilities include two microphone input, two line inputs, two speaker outputs and two line outputs. It has individual channel volume controls and each has its own level indicator; (VU meter). It does not have internal speakers, therefore must be connected to external speakers for audio reproduction.

Additional features include automatic threading and automatic reverse (no-reel-turn-over), in the playback mode.

1165

The 1165 is identical to the 1160, however it comes in a walnut case.

1163

The 1163 is an export version of the 1160. It has a 50 cycle pulley installed on the motor shaft. A 115/230 volt A.C. selector switch is installed on the rear panel. A 115/230 volt power transformer having a split primary winding is also incorporated.

1150

The 1150 is the deck version of the 1160. It has no power output amplifiers which necessitates the use of an external power output amplifier and speaker system for audio reproduction.

1153

The 1153 is the export version of the 1150. It has a 50 cycle pulley installed on the motor shaft. A 115/230 volt A.C. selector switch is installed on the rear panel. A 115/230 volt power transformer having a split primary winding is also incorporated.

121 - 122 - 123

The 121, 122, and 123 were made by Ampex for other manufacturers and are identical to the 1150 except for trim and minor circuit variations

890

The 890 is identical to the 1160 except the reverse feature is manual rather than automatic.

950 - 960 - 961

The 900 Series is identical to the 1100 Series except it does not have the auto take-up reel.

REPLACEMENT OF FAST WIND PULLEY

It is recommended that all recorders received for servicing have the fast wind pulley replaced with the new design V-groove configuration. The new pulley will cure the fast wind problem and provide extended belt life. The part number for the new pulleys is listed under Ref. #217-218 in the Parts List.

When ordering pulleys, also order the two screws, Part No. 477-361.

PROCEDURE:

1. Remove the recorder mechanism from case - to do this requires:
 - A. Removing the front escutcheon by pressing the vertical wall until two plastic tabs release from the retaining slots. moving escutcheon forward releases three more tabs.
 - B. Removing plastic head cover by pressing the vertical wall to release retaining tabs, then lift firmly from the head cover base.
 - C. Removing top cover by removing four socket head screws and four Phillips head screws. This will expose the tape transport mechanism and frame. Four screws in the mounting frame and two screws in each end panel must be removed to slip mechanism out of case.
2. When the tape transport is out of the case assembly, remove the three Phillips head screws that retain the motor and shock mounting assembly. As you remove this assembly from the transport, be sure to release the belts from the pulleys.
3. Remove the wind pulley from the motor shaft. Care must be taken when removing the top aluminum pulley as the motor can be damaged by prying or pulling against the motor shaft. To remove the

pulley, a small gear and bearing puller is recommended. See Fig. 41. This puller can be purchased at auto supply houses or local hardware stores. Place the gear and bearing puller over the wind pulley as illustrated in Fig. 1. Tighten the puller drive screw until the pulley is removed from the motor shaft.

4. Place the new pulley on the motor shaft hub-end first, slightly tighten one of the set screws squarely on the flat of the motor shaft.
5. Reinstall the motor assembly to the transport and position belts on the pulleys. Position the wind pulley so that the belt runs true between the wind and idler pulleys. After positioning wind pulley, tighten both set screws.

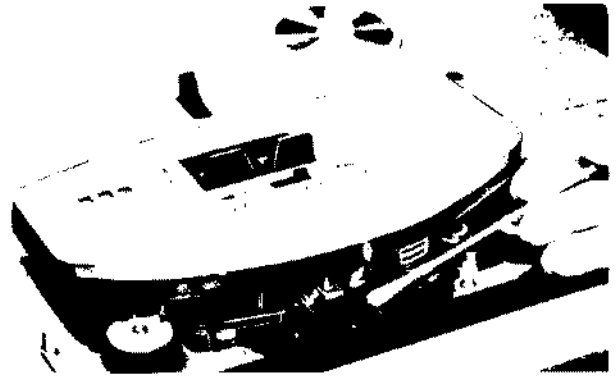
IDLER PULLEY REPLACEMENT

In certain cases, the idler pulley and associated pin have been responsible for excessive mechanical noise. If an idler pulley requires replacement, order it, using part numbers per the Mechanical Parts List, Ref. #181 or 187 and 268. To remove the idler pin and pulley, proceed as follows: Release the fast wind belt and remove the "O" ring and idler pulley. Utilizing a drift punch and a hammer, drive the idler pin out of the base plate. To replace the idler pin and pulley, proceed as follows: Remove three Phillips head screws to free the motor assembly. Place the knurled side of the new idler pin into the mounting hole so the knurls line up with the knurls in the base plate. Utilizing a hammer and a drift punch, gently drive the knurled portion of the idler pin into the base plate. NOTE: To prevent any damage to the brake channel, it may be advisable to remove it before performing previous operation. Replace the idler pulley, "O" ring and wind belt. Replace the brake channel (if previously removed) and motor assembly.

ROUTINE MAINTENANCE

CLEANING THE HEADS

To gain access to the heads, remove the front trim panel by slightly depressing its vertical wall then pulling upward. To clean the heads use a cotton swab moistened in Ampex Head Cleaning solution, Accessory Number 110. Do not use any other solvents on the heads. To avoid damage keep the Head Cleaning solution away from plastic parts. Never use an abrasive or metallic object which may cause scratches or nicks. When cleaning the capstans, the capstan idlers, use a clean lintless cloth moistened with denatured or isopropyl alcohol.



DEMAGNETIZING THE HEADS

To demagnetize the heads use the Ampex Head Demagnetizer, Accessory Number 820 and proceed as follows: Turn the recorder off and remove the front trim panel. Plug the demagnetizer into the 117 Volt, 60 cycle, AC outlet. Align the tips of the demagnetizer to the head so that they straddle the head gap. Do not touch the surface of the head (approximately 1/8 of an inch away from the surface of the head). Run the tips up and down several times and slowly withdraw the demagnetizer. Capstan and tape guide surfaces should also be demagnetized. It is not necessary to demagnetize the erase head.



CASE REMOVAL

The main screws which secure the case assembly to the recorder housing are located underneath the main cover plate assembly. To gain access to the case mounting screws it is necessary to remove the front trim panel, head cover, and cover plate as follows:

1. Remove the front trim panel by depressing its vertical walls and lifting upwards.
2. Remove the head cover by depressing its vertical walls and lifting it firmly from the head cover base. Note: On models with Auto Reverse, you must first remove the automatic tape threading assembly.
3. Remove the main cover plate by removing the four allen head screws and four phillips head screws. Remove the turntable shaft extenders then raise the rear of the cover plate slightly so it clears the picture frame housing and slide it towards the rear of the unit until it clears the head bridge and capstan idler assemblies.
4. Remove the four phillips head wood screws which retain the case assembly to the picture frame housing. See Figure 6.

5. When the case retaining screws are removed place the recorder assembly on its face. The work bench should be covered properly to prevent scratching or other damage to the recorder.
6. Grasp the case firmly and lift upward to remove it from the transport assembly.

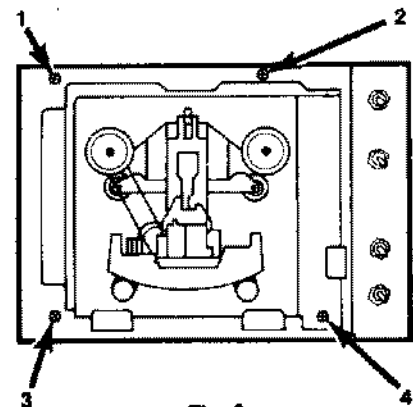


Fig. 6

TRANSPORT THEORY OF OPERATION

When the line cord is plugged into a 117 volt, 60 cycle AC outlet and the mode selector is in either the Stereo, Mono 1, or Mono 2 position, the initial power is supplied which drives the motor. The motor then supplies the mechanical power to drive the transport.

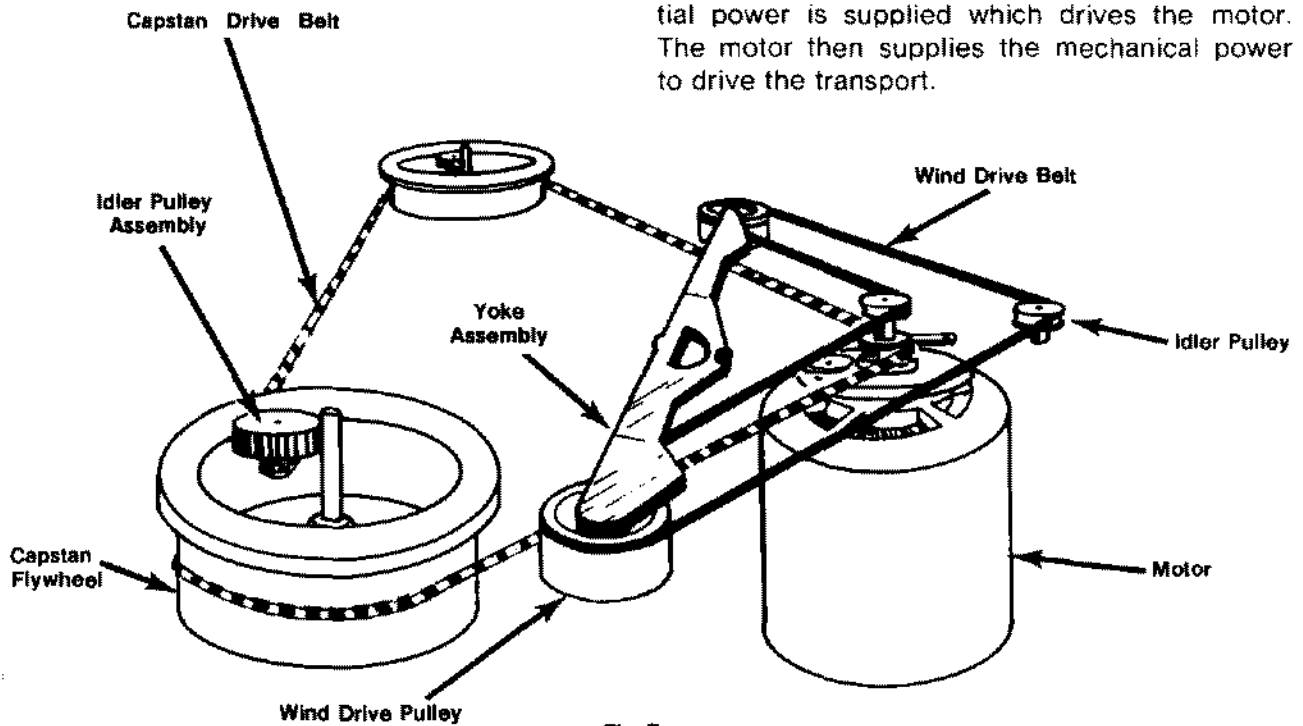


Fig. 7

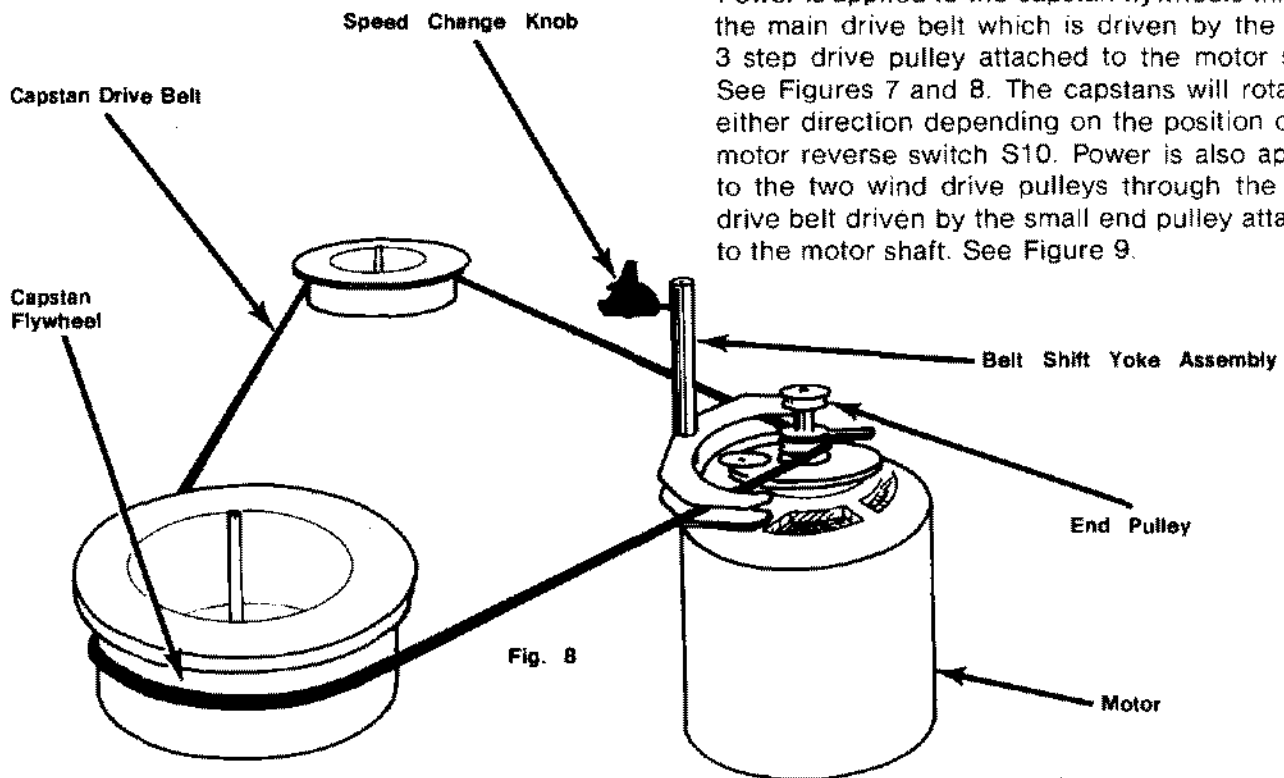


Fig. 8

Power is applied to the capstan flywheels through the main drive belt which is driven by the main 3 step drive pulley attached to the motor shaft. See Figures 7 and 8. The capstans will rotate in either direction depending on the position of the motor reverse switch S10. Power is also applied to the two wind drive pulleys through the wind drive belt driven by the small end pulley attached to the motor shaft. See Figure 9.

TRANSPORT THEORY OF OPERATION (continued)

When the tape transport is placed in either the Play or Record modes, by advancing the record play key, the play slide assembly is advanced and then held to its engaged position by the play solenoid. Simultaneously the play slide activates the wind slide and pressure roller assemblies.

The pressure rollers will begin to rotate the instant they come in contact with the tape and press it to the capstan flywheel shafts. At this time the tape begins to move in the direction the capstans are rotating. The tape is taken from the supply reel and fed to the take up reel. The take up reel is driven as follows.

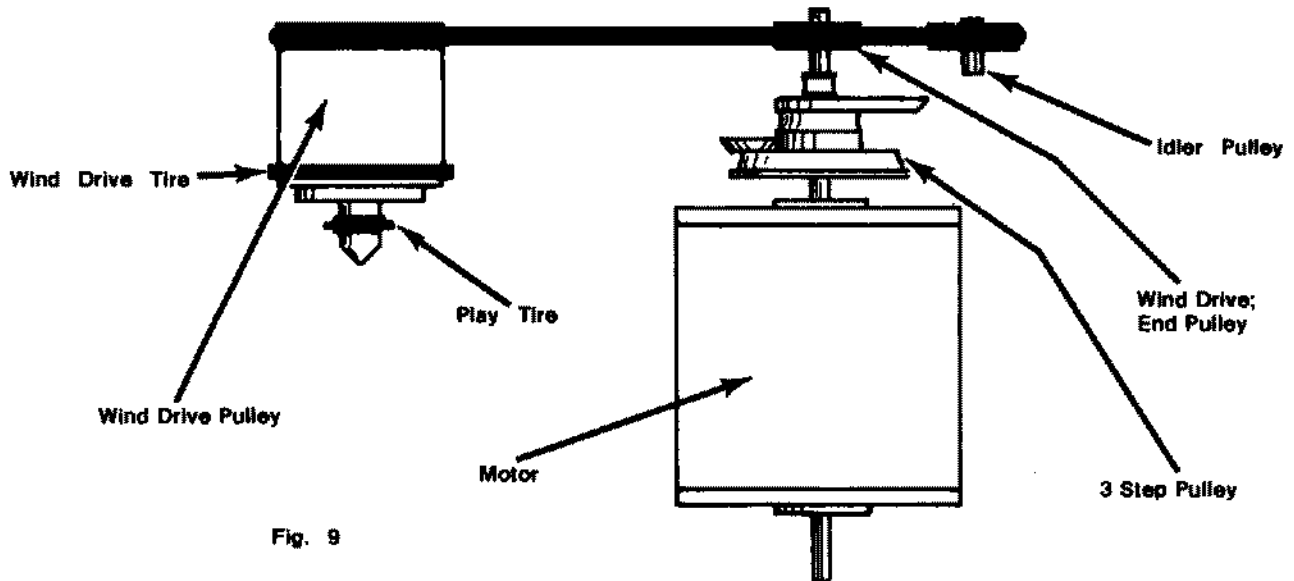


Fig. 9

When the wind slide is moved forward by the play slide, the yoke assembly is released and allowed to swing slightly. The friction supplied by the wind pulleys to the wind drive belts will cause the yoke assembly to swing towards one of the take up assemblies. The direction the yoke assembly will swing is determined by the direction the motor is turning. When the yoke assembly is swung it

is brought into contact with the outer diameter surface of the play wind pulley which was simultaneously activated by the play actuator lever. See Figure 10. The play actuator lever is controlled by the play slide assembly through the play lever actuator pin. Power is supplied to the small clutch pulleys through the friction clutch discs installed between the play pulleys and wind pulleys.

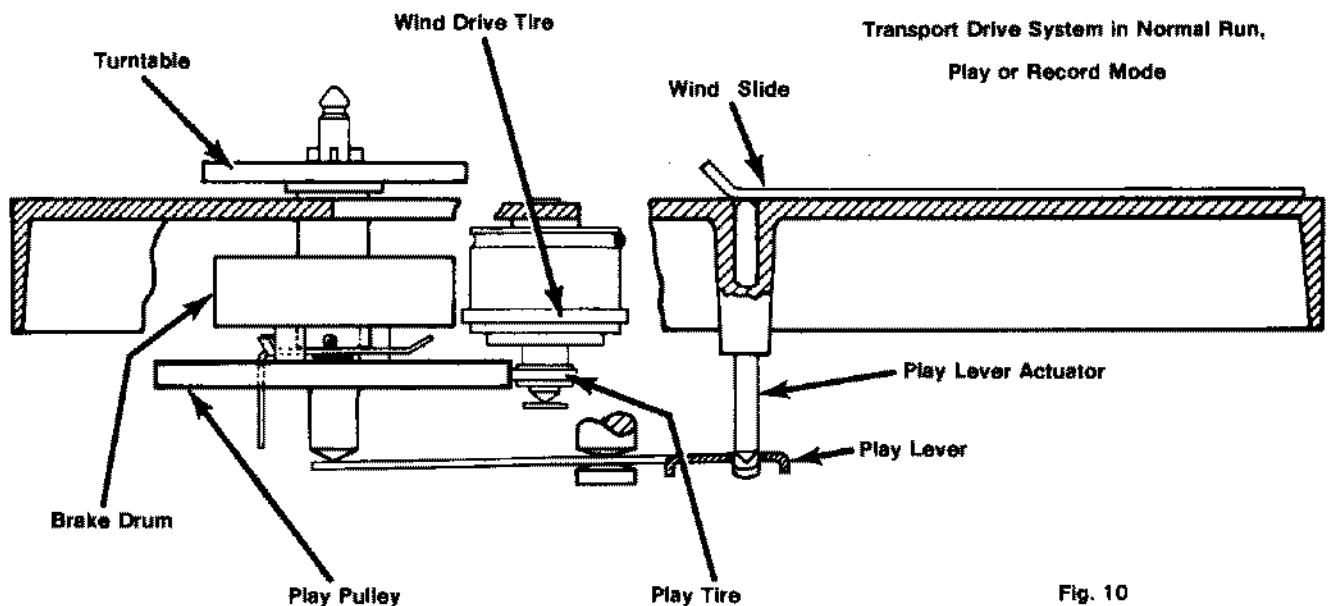


Fig. 10

TRANSPORT THEORY OF OPERATION (continued)

When the tape transport is placed in the fast wind mode the wind slide is moved forward. The play lever is not engaged therefore when the yoke assembly is swung by the friction drive the large wind pulley makes direct contact to the brake drum pulley. See Figure 11. The play slide is not

engaged and the pressure roller assemblies remain in their normal stand-by position. This allows the tape to move freely through the tape guide path. The turntable will start to rotate in a rapid tape motion the instant the wind drive pulley and brake drum make contact.

Transport Drive System in Fast Run; Rapid Wind Mode

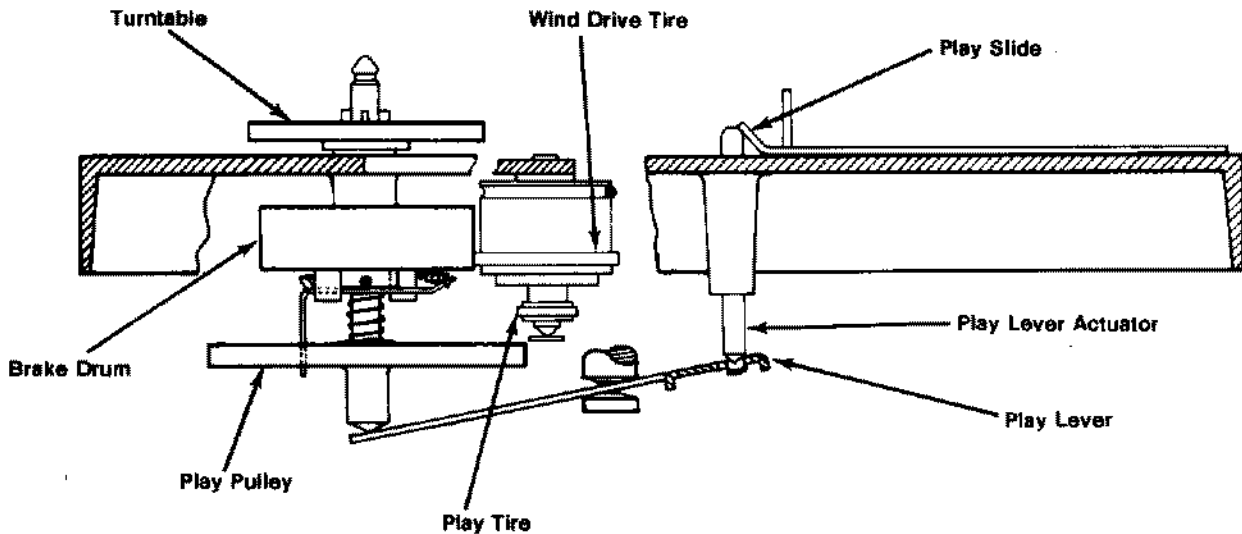


Fig. 11

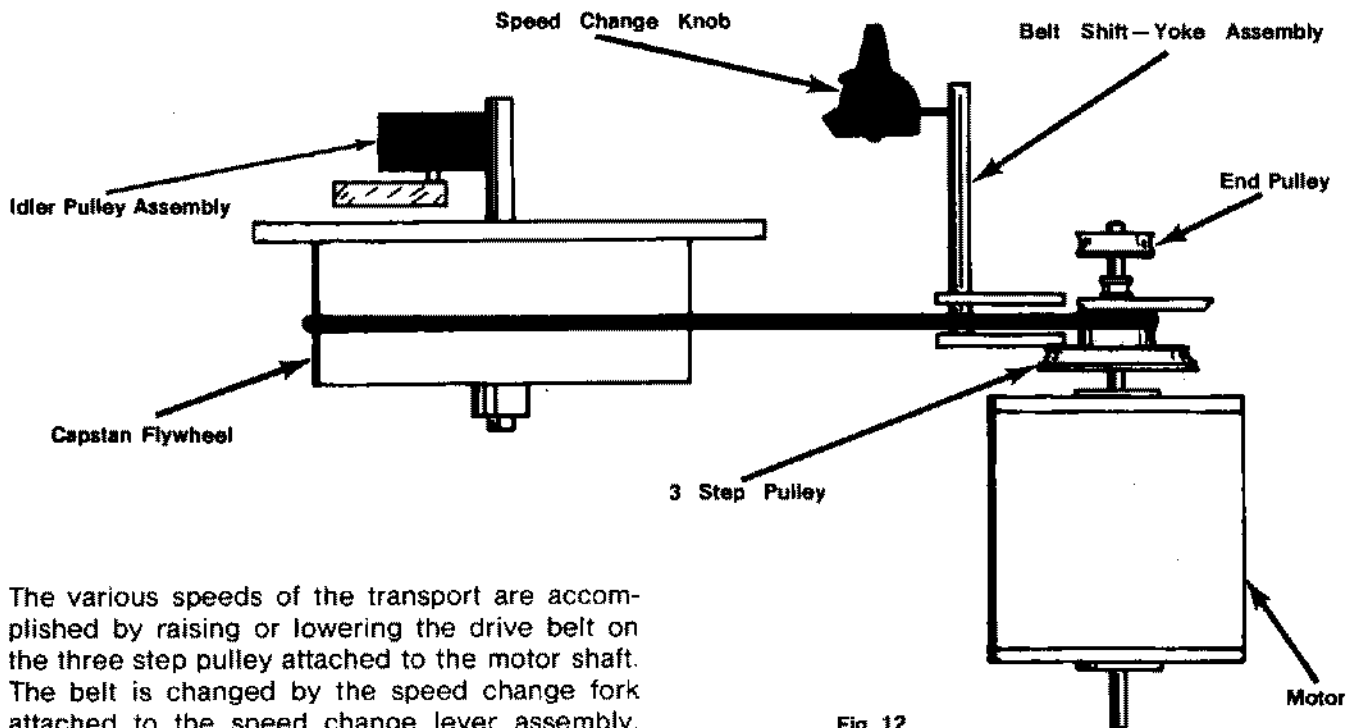


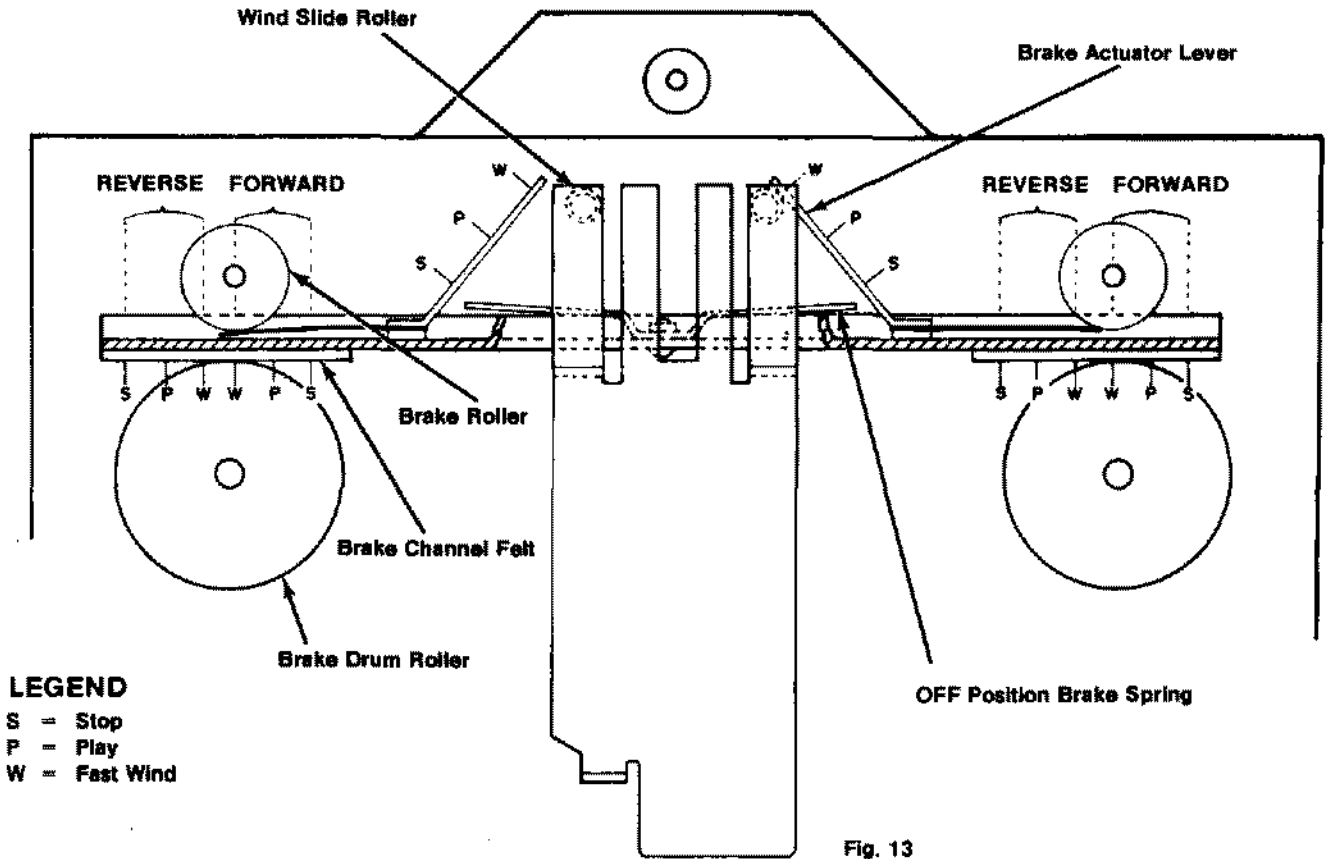
Fig. 12

The various speeds of the transport are accomplished by raising or lowering the drive belt on the three step pulley attached to the motor shaft. The belt is changed by the speed change fork attached to the speed change lever assembly. See Figure 12.

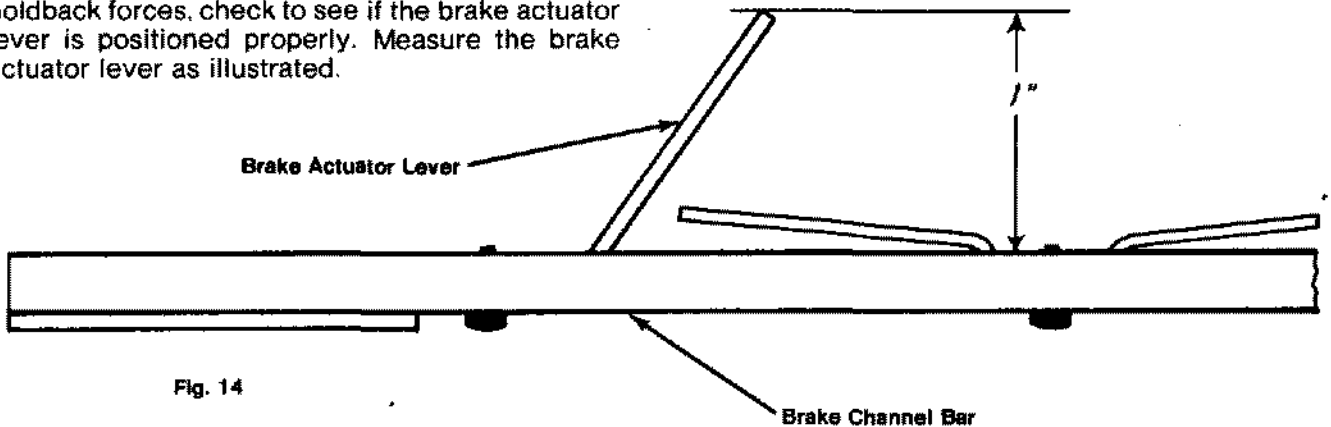
BRAKE CHANNEL ASSEMBLY

The position of the brake channel is controlled by the wind slide rollers and the brake actuators on the brake channel assemblies. See figure 13. When the transport is engaged in a desired mode the wind slide is moved forward and engages the brake actuators. The brake channel assembly is thus moved towards center position. The friction

force supplied to the brake channel felts by the rotating brake drum roller will further move the brake channel to the position for the particular mode of operation. The exact position of the brake channel assembly is determined by the mode of operation and the direction of transport run.



The brake actuator levers are pre-formed before installation on the brake channel bar and should never be adjusted. Should a case exist where it is impossible to make a correct adjustment of holdback forces, check to see if the brake actuator lever is positioned properly. Measure the brake actuator lever as illustrated.



MECHANICAL CHECKS AND ADJUSTMENTS

TORQUE MEASUREMENTS

Torque is a measured force times the distance between the point of measurement and a pivot point. In tape recorders the mechanical measurements, take up and hold back tensions, etc., are expressed in ounces per inch. For example, 5 oz. in. would be a scale reading of 5 oz. measured 1 inch from pivot point, or 2-1/2 oz. read 2 inches from pivot point. On many recorders, turntable tensions can conveniently be made using a standard reel with a 2 inch hub diameter with approximately 30 inches of string or preferable MYLAR based tape with a loop at one end for connecting the measuring scale. Scale reading in this case is a direct reading in ounce inches. If measurement is made using a different diameter, such as with more tape on the reel, then scale reading should be multiplied by distance between measuring point and pivot point for conversion to ounces per inch.

This type requirement is not limited to turntables,

but is also applicable to arm assemblies which turn on a shaft to engage in a definite function. Measurement here is usually force required to just disengage the pulley from this function. This measurement usually requires a conversion to ounces per inch as explained above.

In the case of an arm or rod, the force required to move or hold stationary must be at right angles to the arms or rod. Otherwise torque measurement will be erroneous. In addition, static friction and/or inertia sometimes must be overcome. It is advisable when measuring torque to move the reel very slowly in the direction of reel take-up to relieve friction or inertial effects. Note that the torque indications will be different when gauge is held satisfactory and when gauge is just moving. When measuring holdback tension, note torque measurement after reel has just started to rotate because pull placed on reel by spring gauge and pull on gauge is steady while reel just rotates.

HOLD BACK TORQUE

Hold-back torque with the transport in a normal run position, (play or record mode), should be between 2.5 and 3.4 inch ounces. When the transport is in a fast wind mode, the hold back torque should be between .8 and 2.0 inch ounces.

The amount of hold-back force is determined by the amount of friction drag applied to the brake drums during the particular mode of operation. The amount of friction is controlled by the amount of pressure applied to the brake channel assembly at its various positions. The brake channel is free floating and held in place by the large brake rollers. The large brake rollers are adjustable and the adjustment of each controls the amount of fast-wind, playback, and braking holdback force for a single direction of transport run. Adjusting the left brake roller controls the amount of hold-back force for forward transport run; left to right tape travel. Adjusting the right brake roller controls the amount of holdback force for reverse transport run; right to left tape travel. Moving the roller towards the brake channel assembly increases holdback tension and away from the brake channel decreases hold-back tension. To make the adjustment loosen the Brake roller adjustment screw, Point A., Figure 15.

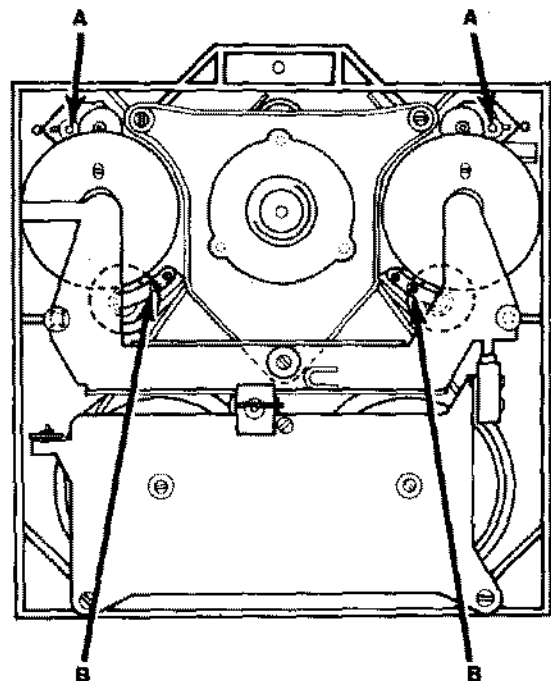


Fig. 15

MECHANICAL CHECKS AND ADJUSTMENTS (continued)

TAKE UP TORQUE

Take up torque with the transport in a normal run position, (play or record mode) should be between 1.7 and 2.9 inch ounces.

The amount of take up torque with the transport in a normal run position is controlled by the tension supplied to the friction clutch discs. These discs are located between the wind drive and clutch pulley assemblies. Adjustment of the clutch drive system is accomplished by turning the take up adjustment screws located on the yoke arm assembly, Point B, Figure 15. Turning the screw clockwise increases take-up torque and counter-clockwise decreases take-up torque. Since fast wind take-up torque is effectively the drive motor torque. There is no adjustment to control the amount of motor torque. Should fast wind take-up

torque become insufficient the problem is most likely to be a slipping end pulley or defective wind drive belt. A defective wind drive tire could also be at fault.

NOTE

When measuring take-up torque the supply reel should be turned in the direction of transport run while the measurement is being made. This relieves the brake channel assembly from the take-up reel and prevents an erroneous reading.

BRAKING

There is no separate adjustment to make for correcting improper braking. When holdback forces are properly adjusted braking force should automatically be set. When holdback forces are adjusted properly and the brakes remain incorrect the following checks should be made.

1. Check to see if proper tension is applied by the wind slide to the off position brake spring.
2. Check to see if the small rollers on the wind slide assembly are in place.
3. Check to see if the brake channel felt is not damaged and is not worn.

PLAY SOLENOID ADJUSTMENT

Should a condition exist where the play-record knob does not stay engaged, it is necessary to check the play solenoid adjustment. Adjustment is made by turning in, or out, on the set screw located in the center of the solenoid plunger. Proceed as follows:

1. Remove the recorder assembly from the case.
2. Place the recorder in a vertical position.
3. Place the recorder in the play mode and examine to see if the solenoid plunger is en-

gaged. NOTE: If the plunger does not engage the electronics is probably at fault. If the solenoid plunger does stay engaged when the recorder is held in the play mode, adjustment of the plunger is necessary.

4. To make the adjustment hold the plunger stationary with a pair of needle nose pliers and, using a 1/16" phillips screw driver, adjust the plunger screw 1/4 turn clockwise.
5. Check to see if the recorder stays in the play mode. If necessary, repeat step four.

MECHANICAL CHECKS AND ADJUSTMENTS (continued)

CORRECTING FAST WIND FALL OUT

Should a case exist where the fast wind knob does not stay engaged, the tension of the wind knob hold spring is probably at fault. Remove the spring, part number 4275003-10, and replace

with new. Should fallout still exist after the spring has been replaced, remove the control plate assembly and examine the tab on the fast wind knob. If the knob is worn, replace with new.

PLAY ACTUATOR LEVER TAB ADJUSTMENT

When the play wind pulley is not making proper contact with the play clutch tire, it is necessary to adjust the tab on the play actuator lever. A minor adjustment of the tab will cause the play wind pulley to engage more, or less, depending on the direction the tab is adjusted.

To make the adjustment proceed as follows:

1. Remove the recorder assembly from the case.
2. Place the recorder in a vertical position.
3. Engage the recorder in a play wind mode and examine to see where the play tire makes contact with the play wind pulley.
4. Bend the tab on the play actuator lever in the direction necessary to make the play wind pulley come in contact at center position on the play wind tire. See the illustration in figure 16.

Transport Drive System Illustrating Proper Play Lever Adjustment

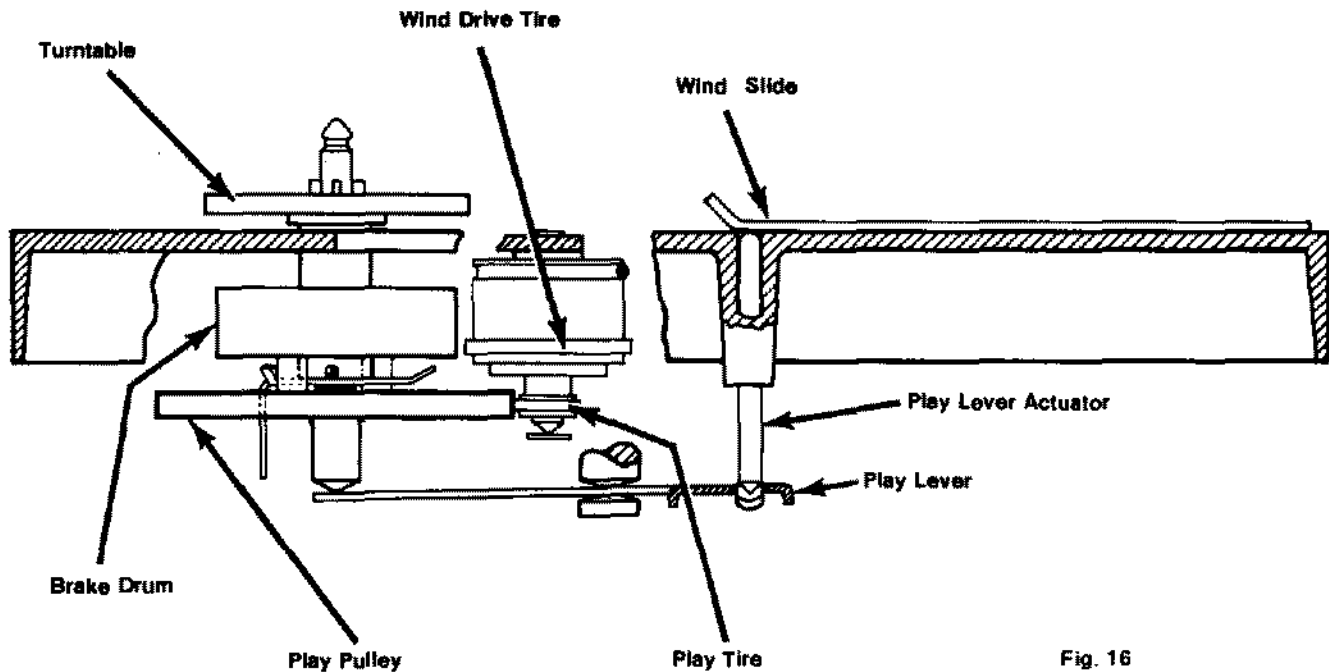


Fig. 16

ELECTRICAL PARTS

CAPACITORS

C 101	7540059-01	680pfd, 1000V.	C 214	7542683-11	.068ufd
C 102	7540052-01	27ufd, 6V.	C 215	7540051-01	10ufd, 10V.
C 103	7540049-01	68ufd, 6V.	C 216	7540046-01	27ufd, 15V.
C 104	7540047-01	1.8ufd, 25V.	C 217	7550016-02	47ufd, 25V.
C 105	7540056-01	0.1ufd, 100V.	C 218	7540051-01	10ufd, 10V.
C 106	7540008-03	820pf, 300V.D.C.	C 219	031-760	250ufd, 6V.
C 107	7541532-10	.0082ufd	C 220	7550013-01	500ufd, 50V., Part of C120, C302
C 108	7540051-01	10ufd, 10V.	C 221	7540053-01	5.6ufd, 20V.
C 109	7540040-01	Variable, 150-335pf	C 222	055-045	.047ufd, 100V.
C 110	7540048-01	.47ufd, 35V.	C 223	4555000-10	500ufd, 50V.
C 111	7540051-01	10ufd, 10V.	C 224	7550015-02	22ufd, 25V.
C 112	7540045-02	300pf, $\pm 5\%$	C 225	7540059-01	680pfd, 1000V., 10%
C 113	7540063-02	.02ufd, 100V.	C 226	7542474-15	.47ufd, 75V.
C 114	7542683-11	.068ufd	C 301	7540057-01	.0043ufd, 100V.
C 115	7540051-01	10ufd, 10V.	C 302	7550013-01	500ufd, 50V., Part of C120, C220
C 116	7540046-01	27ufd, 15V.	C 303	7543683-11	.068ufd
C 117	7550016-02	47ufd, 25V.	C 304	7540056-01	.1ufd, 100V.
C 118	7540051-01	10ufd, 10V.	C 305	7543683-11	.068ufd
C 119	031-760	250ufd, 6V.	C 351, 352	7550014-01	1000ufd, 45V., 890, 1160, 1163, 1165
C 120	7550013-01	500ufd, 50V. Part of C220, C302	C 352	7550019-01	1000ufd, 50V., 121, 1150, 1153
C 121	7540053-01	5.6ufd, 20V.	C 353	7550011-02	10ufd, 150V.
C 122	055-045	.047ufd, 100V.	C 354	7540032-01	3-1ufd, Dual
C 123	4555000-10	500ufd, 50V.	C 355	7540038-01	.01ufd, 1400V.
C 124	7550015-02	22ufd, 25V. Elect.	C 356	7540054-01	.005ufd, 1400V.
C 125	7540059-01	680pfd, 1000V., 10%	C 357	7540054-01	.005ufd, 1400V.
C 126	7542474-15	.47ufd, 75V.	C 401	7540063-03	.02ufd, 100V., 10%
C 201	7540059-01	680pfd, 1000V., 10%	C 402	7551225-10	2.2ufd, 6V.
C 202	7540052-01	27ufd, 6V.	C 403	7551106-42	10ufd, 15V.
C 203	7540049-01	68ufd, 6V.	C 404	7543684-19	.68ufd, 100V.
C 204	7540047-01	1.8ufd, 25V.	C 405	7543334-15	.33ufd, 75V.
C 205	7540056-01	0.1ufd, 100V.	C 406	7543334-15	.33ufd, 75V.
C 206	7540008-03	820pf, 300V.	C 407	7551106-42	10ufd, 15V.
C 207	7541532-10	.0082ufd	C 408	7551106-42	10ufd, 15V.
C 208	7540051-01	10ufd, 10V.	C 409	7542474-15	.47ufd, 100V.
C 209	7540040-01	Variable, 150-335pf	C 410	7550018-02	100ufd, 30V.
C 210	7540048-01	.47ufd, 35V.	C 411	7540056-03	.1ufd, 100V.
C 211	7540051-01	10ufd, 10V.			
C 212	7540045-02	300pf, 500V.			
C 213	7540063-02	.02ufd, 100V. Mylar			

RECTIFIERS

CR 101	7570215-21	Diode, Left Meter	CR 403	7570015-41	Diode, Reverse Circuitry
CR 201	7570215-21	Diode, Right Meter	CR 404	7570015-41	Diode, Reverse Circuitry
CR 351	7570014-02	Diode, Power Supply	CR 405	7570015-41	Diode, Reverse Circuitry
CR 352	7570014-02	Diode, Power Supply	CR 406	7570015-41	Diode, Reverse Circuitry
CR 353	7570015-34	Diode, Power Supply	CR 407	7570015-41	Diode, Reverse Circuitry
CR 401	7570015-41	Diode, Reverse Circuitry			
CR 402	7570015-41	Diode, Reverse Circuitry			

ELECTRICAL PARTS (continued)

RECEPTACLES

J 101	148-023	Pin Jack, Line in, Channel 1	J 201	148-023	Pin Jack, Line in, Channel 2
J 102	7630002-10	Phone Jack, Microphone in, Channel 1	J 202	7630002-10	Phone Jack, Microphone in, Channel 2
J 103	143-070	Miniature Jack, Line out, Channel 1	J 203	143-070	Miniature Jack, Line out, Channel 2
J 104	7630006-01	Phone Jack, Speaker out, Channel 1	J 204	7630006-01	Phone Jack, Speaker out, Channel 2

COILS

L 1	4045042	Record-Play Head, Forward Tape	L 103	7580012-01	Coil, 20 cps, Pick up
L 2	4045043	Play Head, Reverse Tape	L 104	7580021-02	Coil, 80 mh, with Resistor R150
L 3	7030011-01	Erase Head	L 201	7580007-02	Coil, 18 mh
L 101	7580007-02	Coil, 18 mh	L 202	7580007-02	Coil, 18 mh
L 102	7580007-02	Coil, 18 mh	L 401	7040079-01	Coil, Reversing Solenoid
			L 402	4045021-10	Coil, Play Solenoid

METERS

M 101	7140000-01	Record Level Meter, Left	M 201	7140000-02	Record Level Meter, Right
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TRANSISTORS

Q 101	7570005-03	Transistor, 1st Pre Amp., Channel 1	Q 205	7570004-01	Transistor, 3rd Power Amp., Channel 2
Q 102	7570005-01	Transistor, 2nd Pre Amp., Channel 1	Q 206	7570003-01	Transistor, Power Output, Channel 2
Q 103	7570005-01	Transistor, 1st Power Amp., Channel 1	Q 207	7570003-01	Transistor, Power Output, Channel 2
Q 104	7570005-02	Transistor, 2nd Power Amp., Channel 1	Q 301	7570009-31	Transistor, Bias Oscillator
Q 105	7570004-01	Transistor, 3rd Power Amp., Channel 1	Q 302	7570009-31	Transistor, Bias Oscillator
Q 106	7570003-01	Transistor, Power Output, Channel 1	Q 401	7570005-01	Transistor, Reversing Circuit
Q 107	7570003-01	Transistor, Power Output, Channel 1	Q 402	7570005-01	Transistor, Reversing Circuit
Q 201	7570005-03	Transistor, 1st Pre Amp., Channel 2	Q 403	7570005-01	Transistor, Reversing Circuit
Q 202	7570005-01	Transistor, 2nd Pre Amp., Channel 2	Q 404	7570004-01	Transistor, Reversing Circuit
Q 203	7570005-01	Transistor, 1st Power Amp., Channel 2	Q 405	7570008-01	Transistor, Reversing Circuit
Q 204	7570005-02	Transistor, 2nd Power Amp., Channel 2			

ELECTRICAL PARTS (continued)

RESISTORS (continued)

R 246	7510014	15k ohm, ½w, 10%	R 406	7510119-03	110k ohm, ¼w, 5%
R 247	7510132-01	2.2k ohm, ¼w, 10%	R 407	7510118-03	27k ohm, ¼w, 5%
R 248	7510083-01	10k ohm, ¼w, 10%	R 408	7510121-03	13k ohm, ¼w, 5%
R 249	7510019-02	100k ohm, ½w, 10%	R 409	7510120-03	24k ohm, ¼, 5%
R 301	7510106	5100 ohm, ½w, 10%	R 410	7510078-03	3900 ohm, ¼w, 10%
R 302	7510084-02	22k ohm, ¼w, 10%	R 411	7510122-03	510k ohm, ¼w, 5%
R 303	7510084-02	22k ohm, ¼w, 10%	R 412	7510112-03	2.7k ohm, ¼w, 10%
R 304	7510104-01	150 ohm, 5w, 10%	R 413	7510115-03	22 ohm, ¼w, 10%
R 305	7510093-02	33 ohm, ½w, 10%	R 414	7510114-03	100k ohm, ¼w, 10%
R 306	7510093-02	33 ohm, ½w, 10%	R 415	7510114-03	100k ohm, ¼w, 10%
R 351	7510103	10 ohm, 5w, 10%	R 416	7510116-03	39k ohm, ¼w, 10%
R 352	7510016-04	27k ohm, ¼w, 10%	R 417	7510079-04	4.7k ohm, ¼w, 10%
R 353	7510016-04	27k ohm, ¼w, 10%	R 418	7510113-03	1.5 meg ohm, ¼w, 10%
R 354	7510004-05	100 ohm, ½w, 10%	R 419	7510030-04	1.2k ohm, 1w, 10%
R 401	7510126-02	10k ohm, ½w, 5%	R 420	7510072-03	33 ohm, ¼w, 10%
R 402	7510137-02	910k ohm, ¼w, 5%	R 421	7510125-03	1.8 ohm, ½w, 10%
R 403	7510117-03	51k ohm, ½w, 5%	R 422	7510114-03	100k ohm, ¼w, 10%
R 404	7510118-03	27k ohm, ¼w, 5%	R 423	7510005-05	470 ohm, ½w, 10%
R 405	7510111-03	1k ohm, ¼w, 10%	R 424	7510123-02	100 ohm, 1w, 10%

SWITCHES

S 1	7620022	Head Switch	S 5 a-f	7620008-01	Record-Play, Slide, Left Channel
S 2	7620019-01	Record-Play Switch, Rotary Model 890, 1150, 1153, 1160, 1163, 1165	S 6 a-f	7620008-01	Record-Play, Slide, Right Channel
	7620029-01	Record-Play Switch, Rotary Model 121	S 7	7520001-01	Bass Boost Switch, Part of Tone
S 3	4625006-10	Record Switch, Push Button	S 8	4625007-10	Monitor Switch
S 4	7050038-01	Selector, Off-On, Mono, Stereo, Auto Reverse	S 9	4045030-10	Tape Switch
			S 10	7620020-02	Motor Reverse Switch
			S 11	7620004	Selector, 115-230V., 1153, 1163

TRANSFORMERS

T 101	7580008-01	Driver Transformer, Channel 1	T 351	7580013-01	Power Transformer 1160, 1165
T 201	7580008-01	Driver Transformer, Channel 2		7580014-01	Power Transformer, 1150, 121
T 301	7580006-01	Bias Oscillator Transformer		7580019-01	Power Transformer, 1153, 1163
				7580015-01	Power Transformer, 890

MISCELLANEOUS ELECTRICAL COMPONENTS

W 1	4735000-10	A.C. Power Cord, Model 121, 890, 1150, 1160, 1165		7590008-01	Drive Motor, Transport, Model 890
	7730064	A.C. Cord, Model 1153, 1163	F 1	070-004	Fuse, Slow Blow 1.0 Amp, Model 121, 1150
DS 1	060-121	Record-On Indicator		070-047	Fuse, Slow Blow 1.5 Amp, Model 890, 1160, 1165
DS 2	060-278	Power-On Indicator		070-993	Fuse, Slow Blow 1.5 Amp, Model 1153, 1163
B 1	4595000-10	Drive Motor, Transport		7050087-01	Bias Oscillator Circuit Board

MECHANICAL PARTS

001	420-031	Bearing, Speed Change	042	477-360	Set screw, fan mounting
002	429-001	Nut, erase head mounting	043	477-361	Screw, motor pulley
003	430-229	E ring, Truarc #5555-G9	044	492-027	Nut, play solenoid mounting
004	430-230	E ring, Truarc #5133-9	045	492-105	Nut, thrust bearing adjust
005	430-339	E ring, brake roller	046	496-005	Nut, motor capacitor and power amp.
006	430-340	E ring, capstan idler and yoke assy.	047	497-165	Speed nut, reverse lever link
007	430-358	E ring, play wind interlock lever	048	497-166	Push nut, reverse lever linkage
008	430-375	Reverse lever retaining ring, tru-arc #5101-25	049	498-221	Nut, brake channel assy.
009	430-380	E ring, capstan idler tension spring	050	501-609	Washer, brake roller adjust
010	435-107	Tubular spring clip, head cover mounting	051	502-004	Washer, motor mounting
011	435-180	Cable clip	052	502-023	Washer, erase head mount
012	471-064	Screw, P.C. board mounting	053	4035001-10	Capstan idler assembly, left hand
013	471-066	Screw, head shield mounting #6/32 x 316	054	4035001-20	Capstan idler assembly, right hand
014	471-067	Screw, head switch, motor reverse switch and amplifier mounting	055	4035002-10	Clutch, play, with tire
015	471-344	Screw, wind slide mounting	056	4035003-10	Pulley, wind drive, with tire
016	471-494	Screw, brake roller adj.	057	4035004-10	Brake channel assembly
017	471-693	Screw, tape lever	058	4045000-10	Capstan Flywheel
018	472-058	Screw, head base	059	4045007-10	Yoke arm assembly, machined
019	472-362	Set screw, take up lever	060	4045008-10	Yoke arm assembly, complete with clutch assembly
020	472-639	Screw, brake channel	061	4045009-10	Arm, capstan idler, left hand
021	472-640	Screw, amplifier mounting	062	4045009-20	Arm, capstan idler, right hand
022	472-855	Screw, motor mounting	063	4045011-10	Play slide, assembly
023	472-859	Screw, capstan idler	064	4045012-10	Brake roller mounting assembly
024	472-861	Screw, cover plate mounting, #6/32 x 5/16 allen	065	4045013-10	Turntable take up lever assembly
025	472-864	Screw, capacitor clamp and latch plate	066	4045014-10	Control plate sub assembly
* 026	472-867	Screw, terminal strip, toggle plate bracket and reverse solenoid linkage	067	4045015-10	Wind slide sub assembly
027	472-868	Screw, control plate and tape counter mounting	068	4045016-20	Wind slide assembly, complete
028	472-869	Screw, tape switch and belt guide mounting	069	4045017-10	Capstan idler roller
029	472-874	Screw, thrust plate and motor mounting	070	4045019-10	Record button slide assembly
030	472-875	Screw, actuator support post	071	4045021-10	Solenoid, play
031	472-884	Screw, spring retainer, speed change index	072	4045024-10	Arm, tape switch dampener
032	472-920	Screw, take up tension adj.	073	4045025-10	Pulley, 3 step, 50 cycles, model 1153, 1163
033	472-930	Screw, head mounting, 2/56 x 3/8	074	4045025-20	Pulley, 3 step, 60 cycle, model 1150, 1160, 1165, 121
034	472-943	Screw, control panel and cover plate mounting	075	4045025-30	Pulley, 3 step, 60 cycle, model 890
035	472-944	Screw, amplifier mounting	076	4045029-20	Arm assembly, tape switch
036	472-950	Screw, play wind interlock lever	077	4045030-10	Switch, tape
037	472-952	Screw, thrust bearing mounting	078	4045032-10	Cover plate assembly, model 121
038	475-044	Screw, reverse solenoid mounting	079	4045032-30	Cover plate assembly, model 1150, 1160, 1163, 1165
039	475-057	Screw, transport mount	080	4045042	Record play head, forward tape motion
040	475-099	Screw, play slide	081	4045043	Play head, reverse tape motion
041	476-187	Screw, case mounting	082	4045045-10	Reel assembly, auto take up
			083	4045046-50	Head cover assembly, model 1150, 1153, 1160, 1163, 1165
			084	4045046-80	Head cover assembly, model 890
			085	4045055-20	Cover plate assembly, model 890
			086	4045058-10	Tape take up assembly
			087	4105001-10	Knob, fast wind
			088	4105002-10	Knob, play-record

*See Page 10A

MECHANICAL PARTS (continued)

089	4105003-10	Knob, direction	140	4295008-10	Reel cover, right hand, model 121
090	4105010-10	Knob, speed shift	141	4295008-30	Reel cover, right hand, model 1150, 1153, 1160, 1163, 1165
091	4105011-10	Turntable cap	142	4295009-10	Reel cover, left hand, model 121
092	4135000-10	Pad, thrust bearing	143	4295009-30	Reel cover, left hand, model 1150, 1153, 1160, 1163, 1165
093	4135001-10	Grommet, motor mounting	144	4295013-10	Head shield, lower L.H.
094	4135004-10	Cap, reel hold down	145	4295013-20	Head shield, lower R.H.
095	4145000-10	Digital tape counter	146	4295014-10	Head shield, left hand
096	4165000-10	Pin, play lever actuator	147	4295014-20	Head shield, right hand
097	4215006-10	Guide slide	148	4315002-10	Belt, counter
098	4215007-10	Pin, insert, speed change	149	4315003-10	Belt, wind drive
099	4215009-10	Shaft, speed change	150	4315004-10	Belt, capstan drive
100	4215018-10	Belt guide, speed change	151	4335000-10	Pressure plate, clutch mounting
101	4215019-10	Post, interlock	152	4335009-30	Mounting frame, model 890, 1150, 1153, 1160, 1163, 1165
102	4215021-10	Post, actuator support	153	4405000-10	Screw, tape guide
103	4215026-10	Rod, play solenoid	154	4405003-10	Screw, head base
104	4215033-10	Tape guide, center	155	4445001-10	Washer, motor grommet
105	4215043-10	Tape guide, upper left and lower right	156	4445002-10	Washer, tape guide
106	4215043-20	Tape guide, upper right	157	4445003-10	Washer, isolator spacer, transport
107	4215043-30	Tape guide, lower left	158	4445004-10	Spacer, clutch pressure plate
108	4225000-10	Spacer, direction knob	159	4445005-10	Felt clutch disc
109	4225001-10	Spacer, tape guide	160	4445006-30	Thrust washer, capstan idler
110	4225002-10	Spacer, belt guide	161	4445006-40	Thrust washer, delrin
111	4225003-10	Spacer, motor grommet	162	4445008-20	Thrust washer, tape switch
112	4225005-10	Spacer, play slide	163	4445009-10	Washer, belt guide and brake adjustment
113	4225006-10	Spacer, brake spring	164	4595000-10	Motor, hysteresis synchronous
114	4225007-10	Tube, tape lifter	165	4605002-10	Clamp, motor capacitor mounting
115	4225010-01	Play clutch	166	4985000-10	Casting, head base
116	4225017-10	Tube, guide post, tape takeup assembly	167	7030011-01	Erase head
117	4235001-10	Brake actuator	168	7030022-01	Control plate assembly
118	4235003-10	Lever, play wind interlock	169	7040001-10	Knob, volume, model 121
119	4235016-10	Lever, play actuator	170	7040001-20	Knob, volume, model 890, 1150, 1153, 1160, 1163, 1165
120	4255000-10	Roller	171	7040030-01	Knob, two required, model 121
121	4255001-10	Brake roller	172	7040030-02	Knob, three required for model 890, two required for 1150, 1153, 1160, 1163, 1165
122	4255002-10	Snubber, take up lever	173	7040031-01	Knob, volume, model 121
123	4255007-10	Brake drum pulley	174	7040031-02	Knob, volume, model 890, 1150, 1153, 1160, 1163, 1165
124	4255008-10	Roller, yoke guide	175	7040037-02	Control panel assembly, model 890
125	4255009-10	Pulley, play wind	176	7040037-03	Control panel assembly, model 1150, 1153
126	4255010-10	Pulley, wind drive	177	7040037-04	Control panel assembly, model 1160, 1163, 1165
127	4255012-10	Turntable	178	7040037-06	Control panel assembly, model 121
128	4255016-10	Fan, drive motor	179	7040043-01	Case assembly, model 890, 1160, 1163
129	4275001-10	Spring, clutch pressure	180	7040045-01	Case assembly, model 1165
130	4275003-10	Spring, wind knob hold	181	7040032-01	Idler pulley, model 890
131	4275004-10	Spring, brake pulley	182	7040047-01	Tape lever assembly
132	4275006-01	Spring, speed shift knob			
133	4275007-10	Spring, wind slide			
134	4275008-01	Spring, speed shift index			
135	4275010-10	Spring, play drive pulley			
136	4275016-10	Spring, head mounting			
137	4275019-10	Spring, take up reel			
138	4275021-10	Spring, tape take up			
139	4285000-10	Felt, brake channel			

MECHANICAL PARTS (continued)

183	7040079-01	Solenoid, reversing	214	7230014-01	Link, reverse lever
184	7040080-01	Lever assembly, reverse actuator	215	7230015-01	Lever, reverse interlock
185	7040081-02	Knob, selector, model 121	216	7230017-01	Toggle plate, reverse linkage
186	7040081-01	Knob, selector, model 1150, 1153, 1160, 1163, 1165	* 217	7250075-05	End pulley, wind drive, model 121, 1150, 1153, 1160, 1163, 1165
* 187A	7040082-01	Idler pulley, model 121, 1150, 1160, 1165	* 218	7250075-06	End pulley, wind drive, model 890
* 187B	7040082-02	Idler pulley, model 1153, 1163	219	7260003-01	Bracket, erase head mounting
188	7040084-01	Lever, reverse signal	220	7260005-01	Ball guide
189	7040085-01	Mainplate sub assembly, machined	221	7260010-10	Mounting bracket, toggle plate
190	7040085-02	Main plate, machined	222	7260027-01	Bracket, toggle anchor
191	7040086-01	Mounting plate, motor	223	7270003-10	Spring, brake
192	7040087-02	Head cover assembly, model 121	224	7270006-01	Spring, capstan roller tension
193	7045065-50	Top front cover assembly, model 1150, 1153, 1160, 1163, 1165	225	7270023-01	Spring, toggle anchor
194	7045065-70	Top front cover assembly, model 121	226	7270025-01	Brake spring, off position
195	7045065-80	Top front cover assembly, model 890	227	7290018-01	Guard, transport, model 121, 1150, 1153
196	7050004-20	Switch, head	228	7310001-01	Tire, wind drive, two required, replace in pairs
197	7050023-08	Amplifier assembly, model 890	229	7310002-01	Tire, play clutch, two required, replace in pairs
198	7050024-01	Amplifier assembly, power output, model 890, 1160, 1163, 1165	230	7310003-01	Retaining O ring, vinyl, idler pulley
199	7050037-01	Amplifier assembly, model 1150	231	7330016-01	Thrust plate sub assembly, machined
200	7050037-02	Amplifier assembly, model 1160	232	7330020-01	Mounting frame, model 121
201	7050037-03	Amplifier assembly, model 1165	233	7400002-01	Thumb screw, auto take up reel
202	7050037-04	Amplifier assembly, model 1153	234	7440001	Washer, shim, control plate
203	7050037-05	Amplifier assembly, model 1163	235	7440003-10	Washer, retaining, reverse lever
204	7050037-06	Amplifier assembly, model 121	236	7440005-10	Felt washer, idler pulley, oil absorbant
205	7050040-01	Printed circuit board assembly, Rev.	237	7440016-01	Washer, knob spacer
206	7060000-10	Empty reel, plastic	238	7440017-02	Washer, reverse signal lever
207	7100000-10	Cover plate, capstan idler	239	7440021-01	Washer, spacer, reverse lever
208	7110016-01	Insert, turntable	240	7445013-10	Washer, shim
209	7200006-01	Bushing, spacer	241	7540032-01	Motor capacitor
210	7210003-01	Shaft, capstan tension	242	7540058-10	Motor capacitor
211	7210038-01	Pin, arm pivot	243	7590008-01	Motor, induction model 890
212	7220001-10	Lockout, record slide	244	7040107-01	Plunger Assembly
213	7220016-01	Block actuator			

MISCELLANEOUS PARTS

244	7030027-01	Microphone kit, model 890	256	7880105-01	Filler, cap, model 1150, 1153, 890, 121
245	7680000-01	Microphone, dynamic, model 1160, 1165	257	7880129-01	Carton, recorder, model 1165, 1160
246	7710001-01	Plastic bag, recorder, general	258	7880130-01	Foam, top, model 1160, 1165
247	7820036-01	Schematic, owners, 1100 series	259	7880131-01	Foam, corner, model 1160
248	7870000-01	Mounting template, model 1150	260	7880133-01	Foam, corner, model 1165
249	7880025-01	Pad, recorder, flat, model 1165, 1160	261	7880136-01	End pads, model 1160
250	7880081-01	Recorder carton, 1153, 890, 1150	262	7890026-02	Envelope, owners kit
251	7880082-01	Filler, sleeve, model 1153, 121, 1150	263	7890028-01	Owners operating manual, 1160, 1165, 1150
252	7880083-01	Recorder, pad, flat	264	7890032-01	Owners operating manual, model 890
253	7880084-01	Carton, recorder, model 1163	265	7890033-01	Schematic, owners, model 890
254	7880085-01	Pad, recorder, flat, model 1163	266	7950002-01	Accessory bag
255	7880094-01	Filler support, model 1153, 1150, 121	267	7950003-01	Plastic bag, model 121, 1150
			268	7210012-02	Idler Pin
			269	7440028-02	Washer
			270	7440028-04	Washer

PRINTED CIRCUIT BOARD WITH COMPONENTS

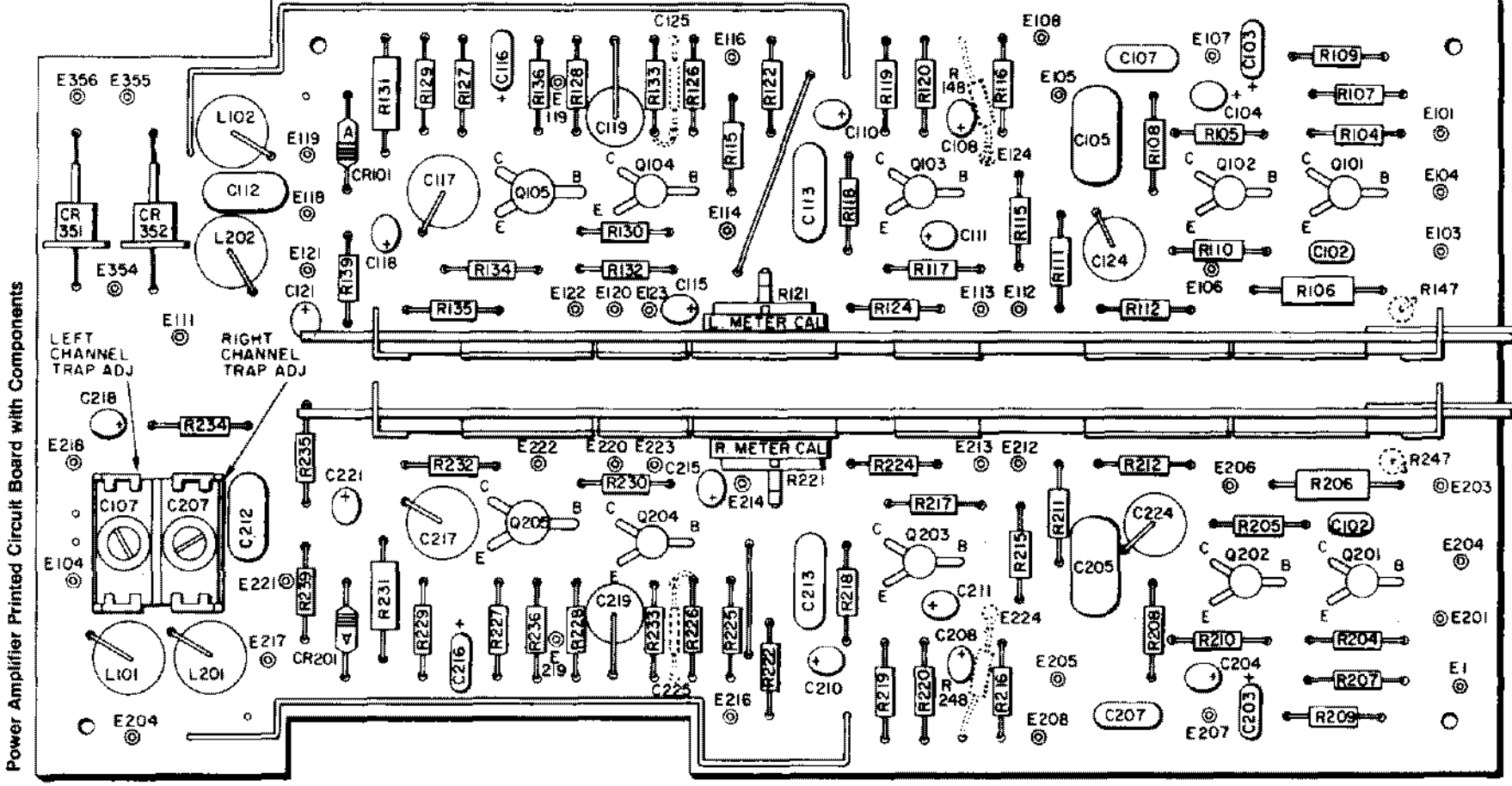


Fig. 23

NOTE: C125, C225, R148, R248, R147, R247 are components incorporated in model 121 only.

PRINTED CIRCUIT BOARD WITH COMPONENTS

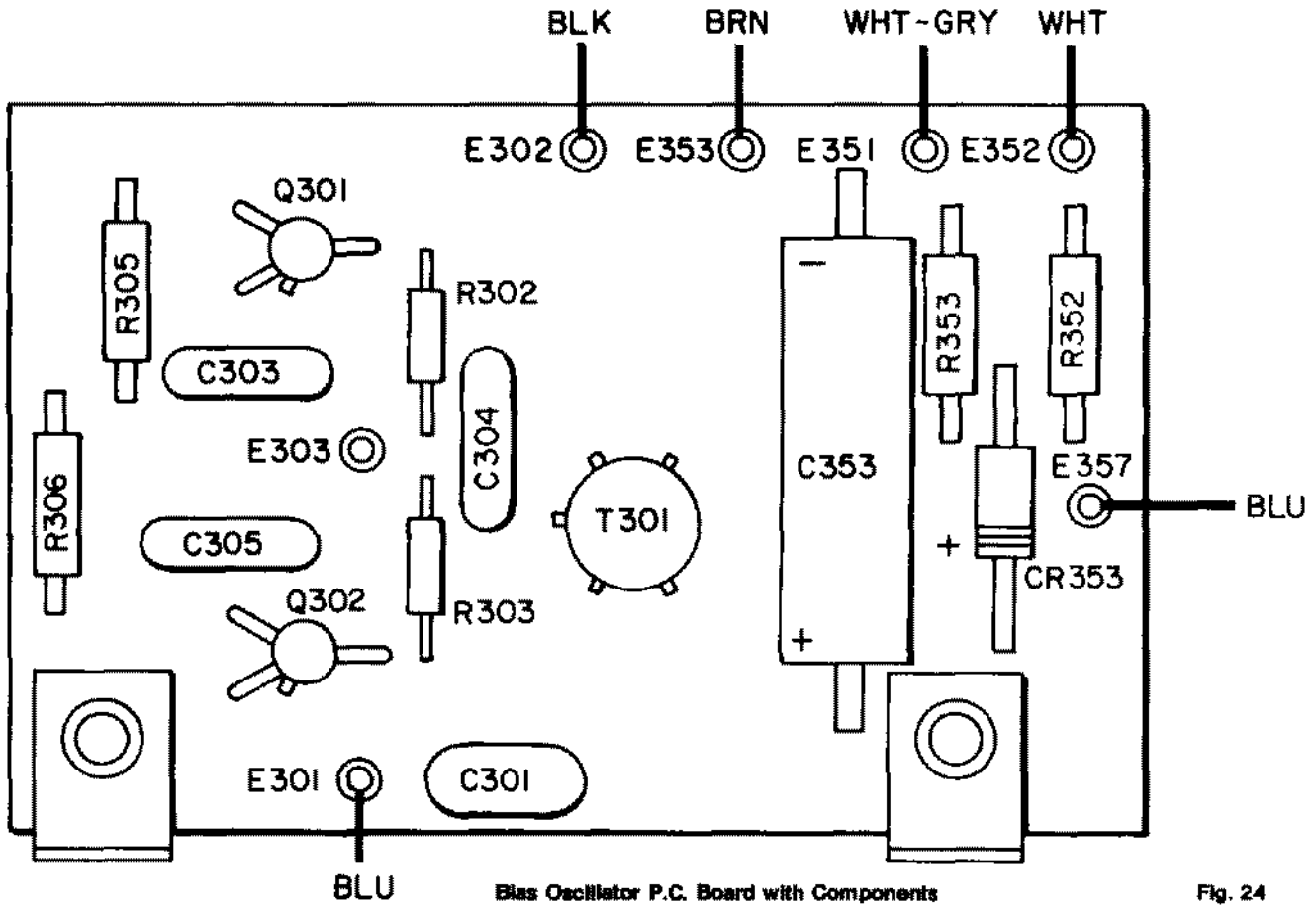
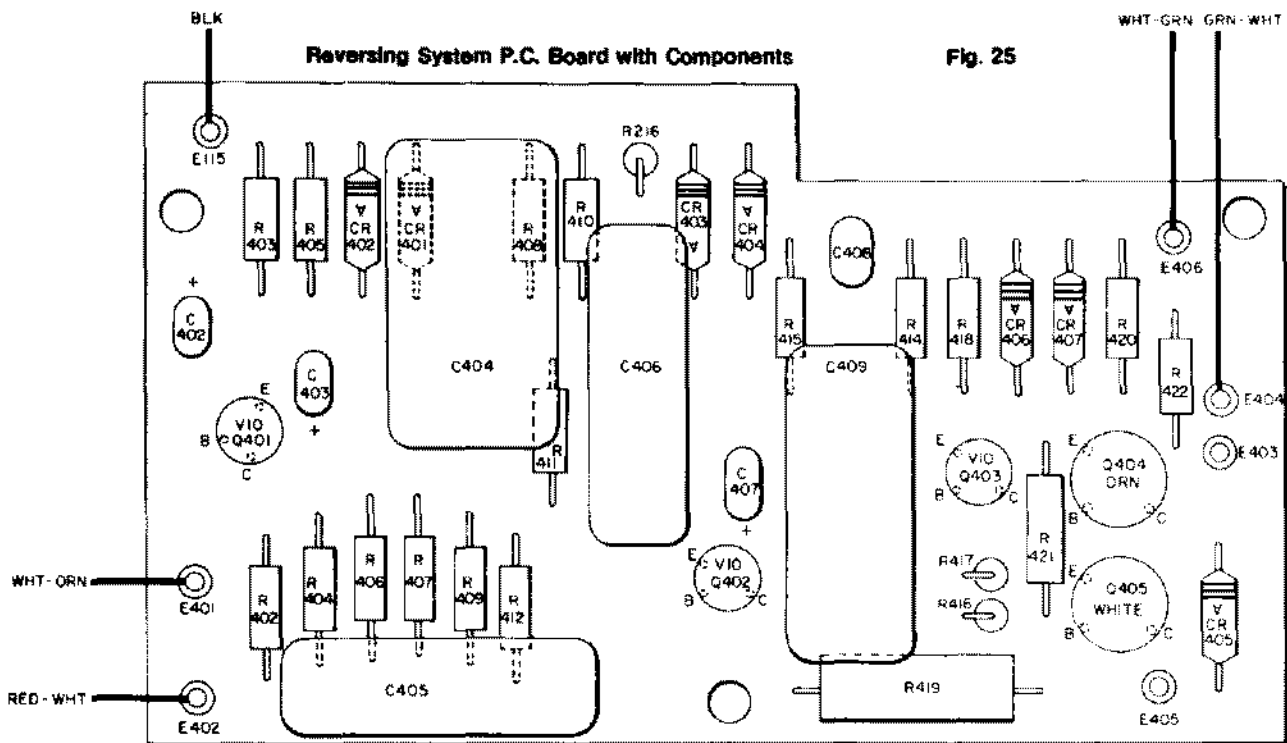
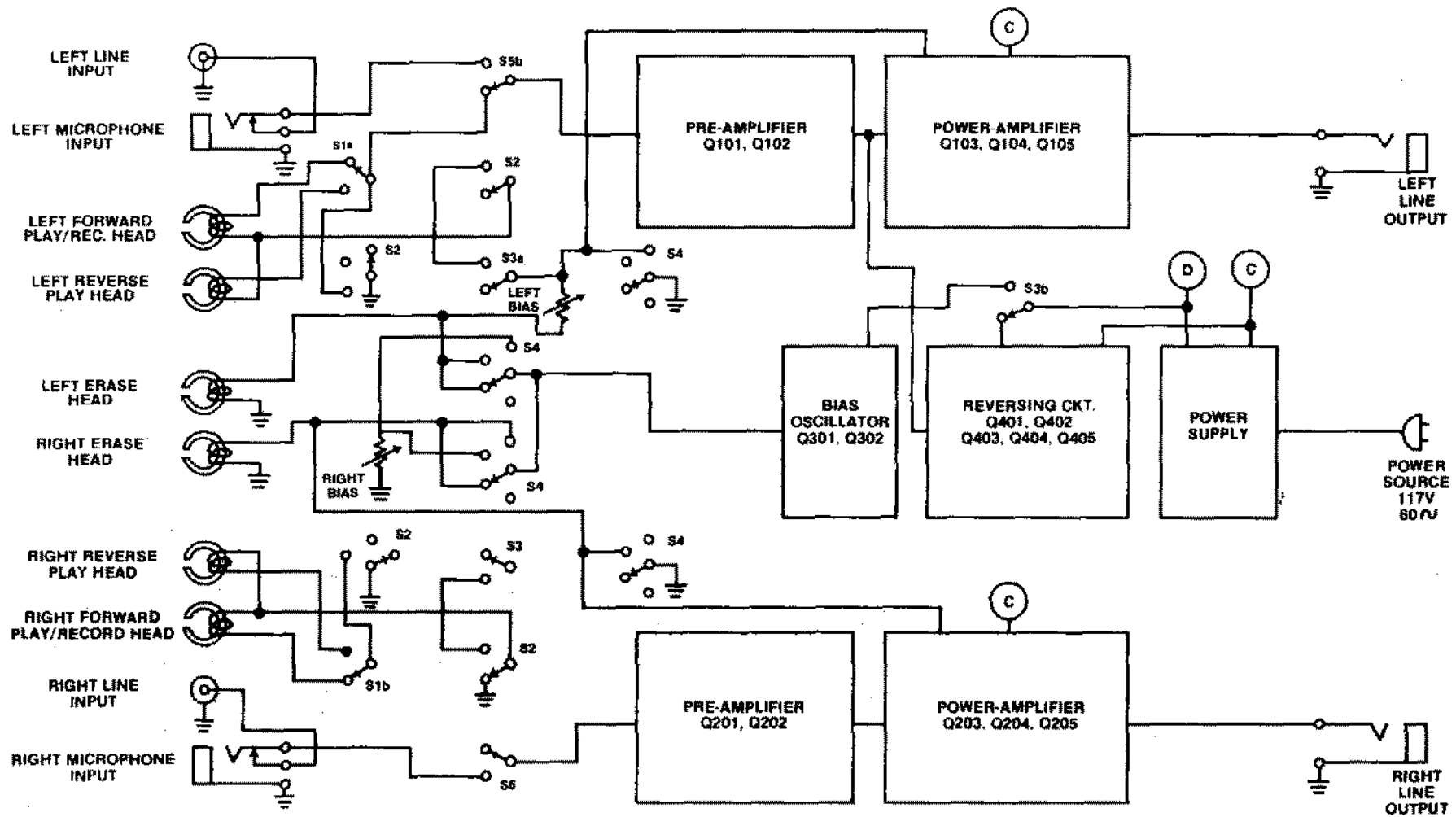
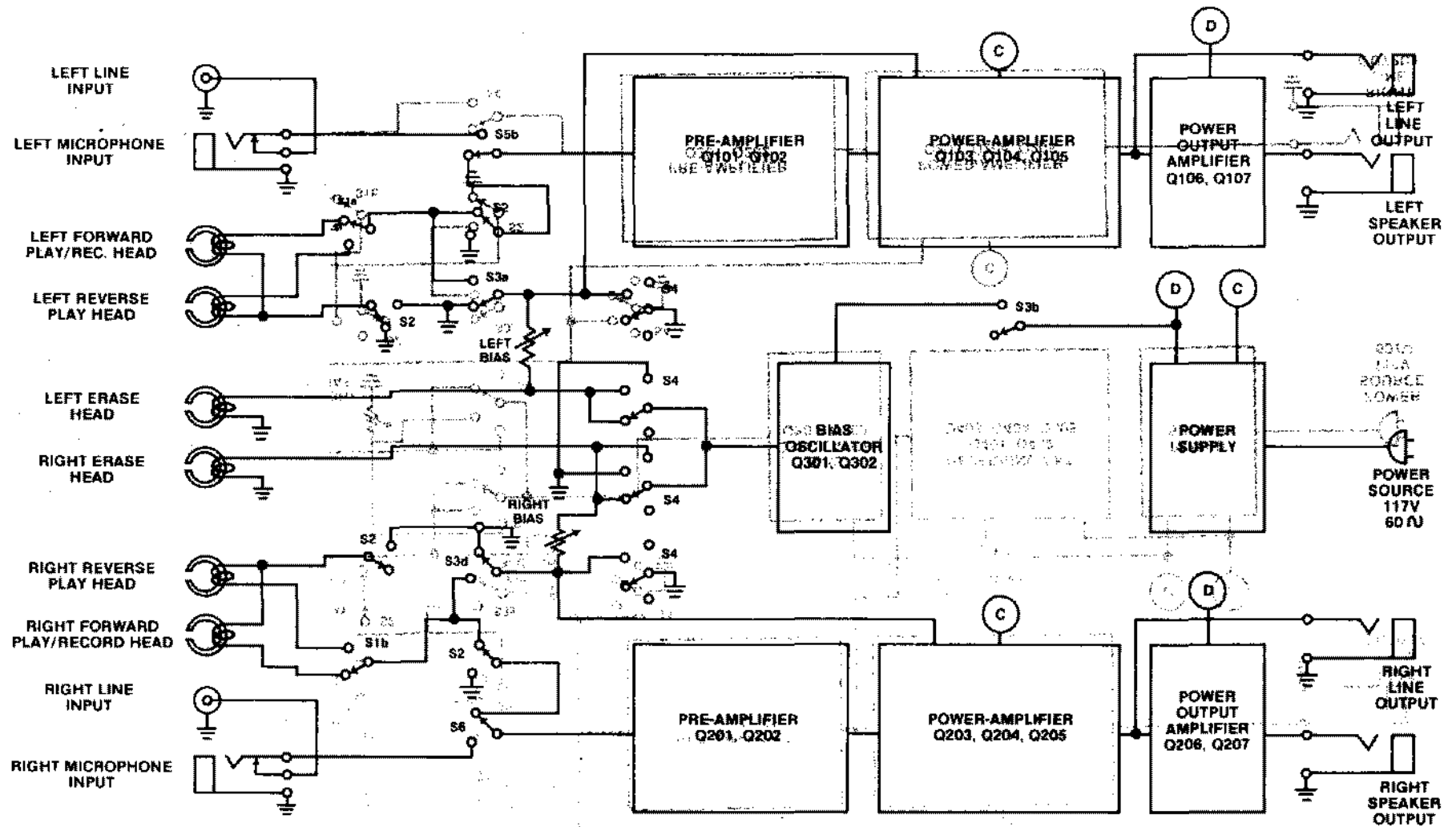


Fig. 24



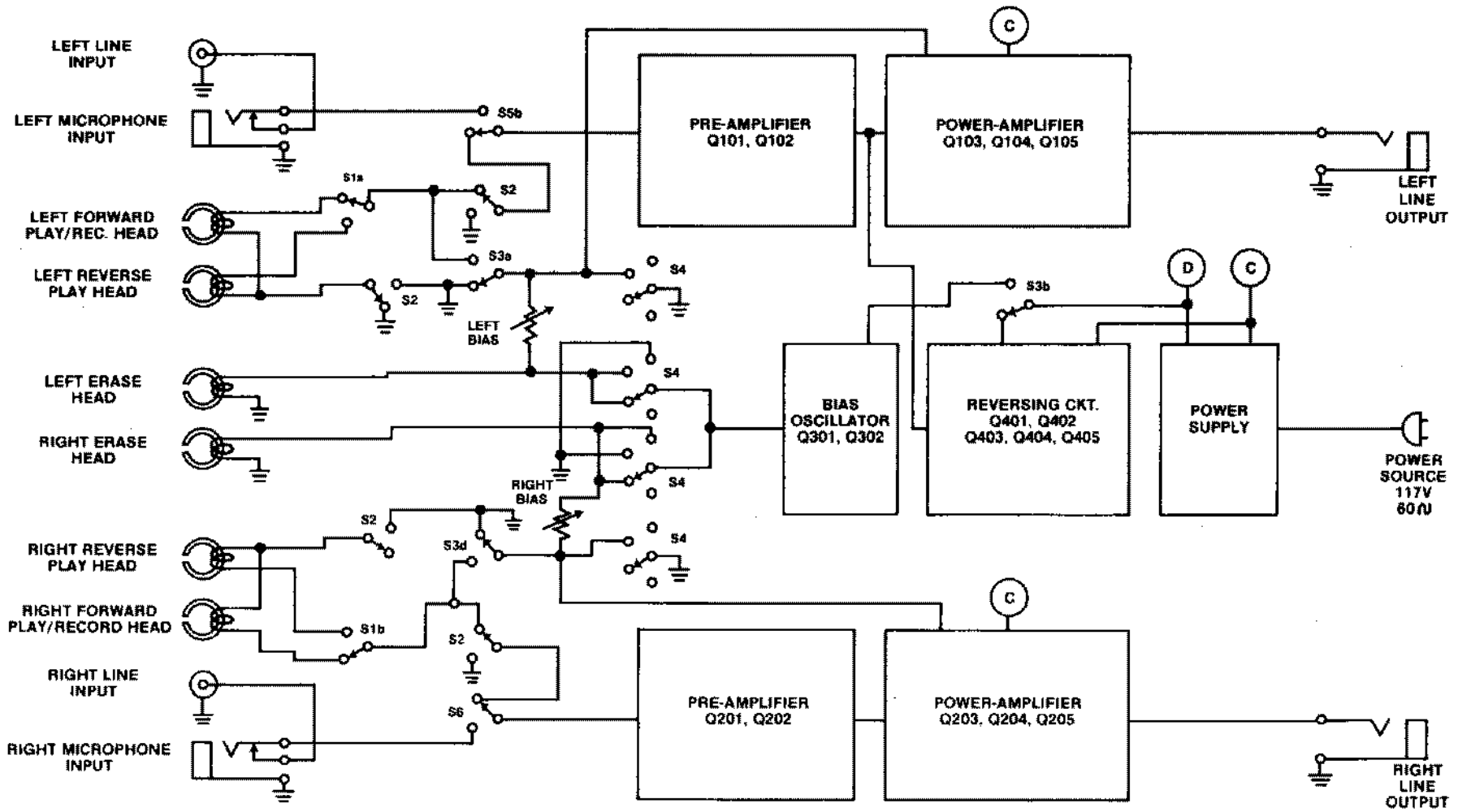
BLOCK DIAGRAM, MODEL 121

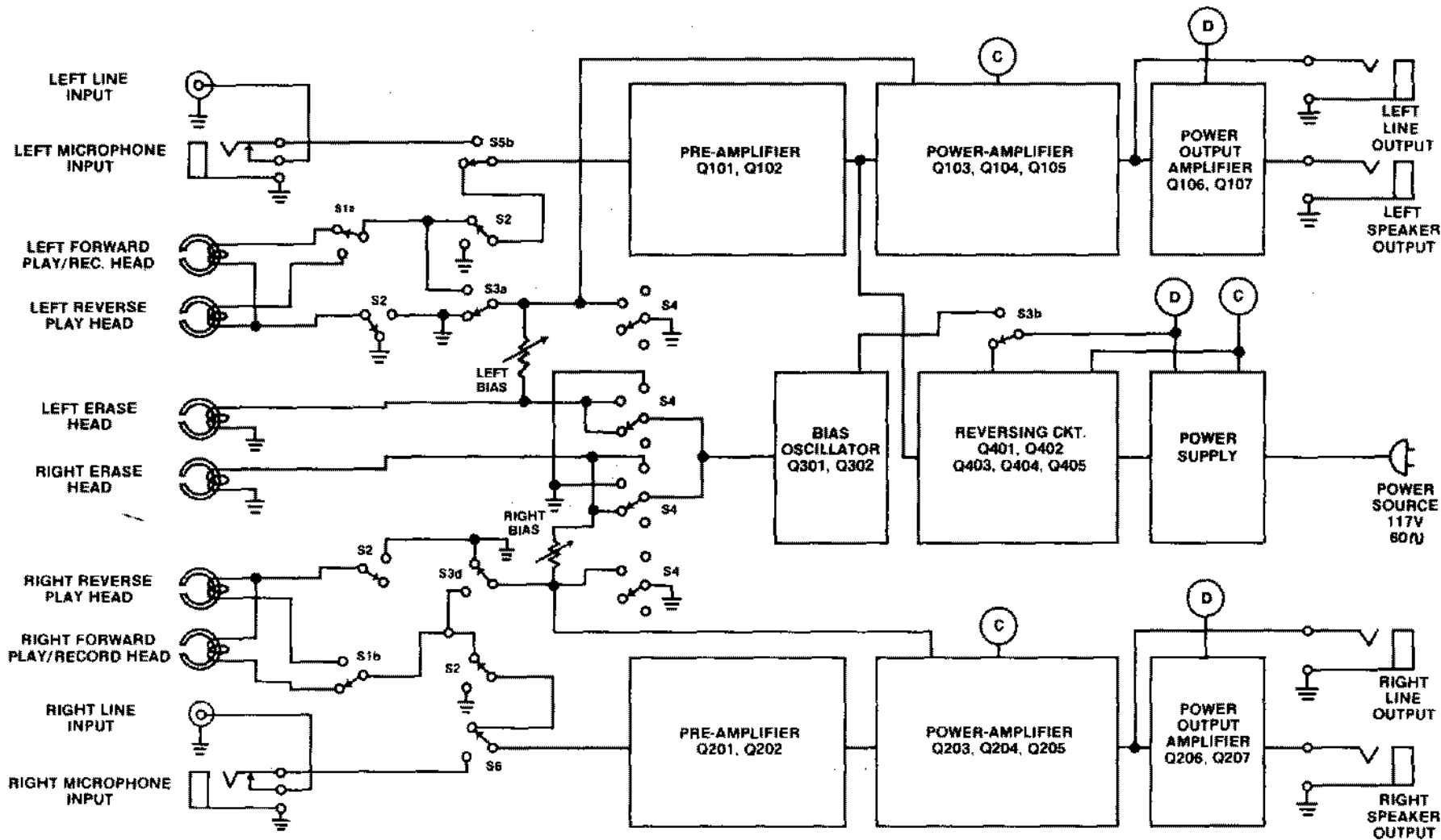




BLOCK DIAGRAM MODEL 890

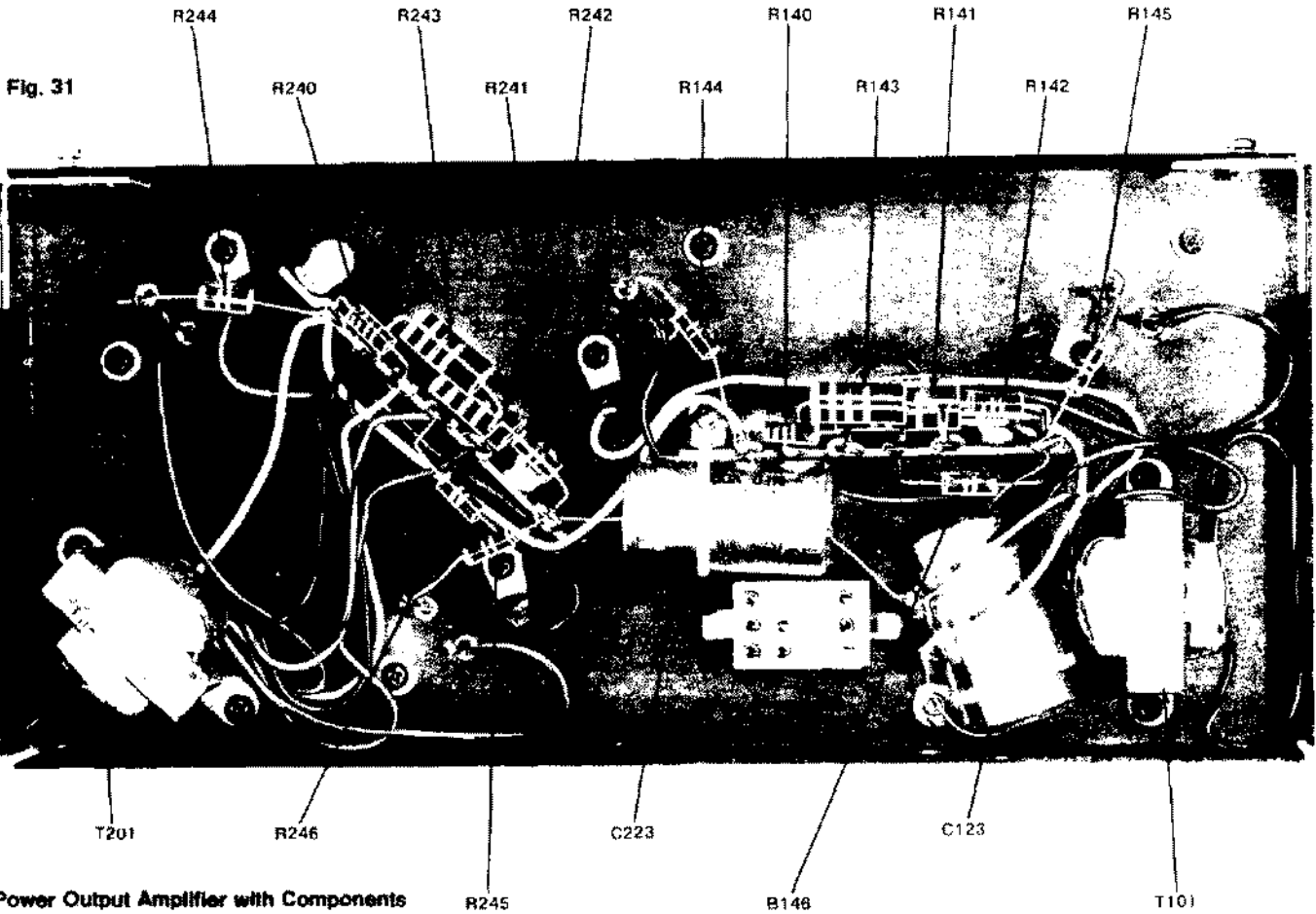
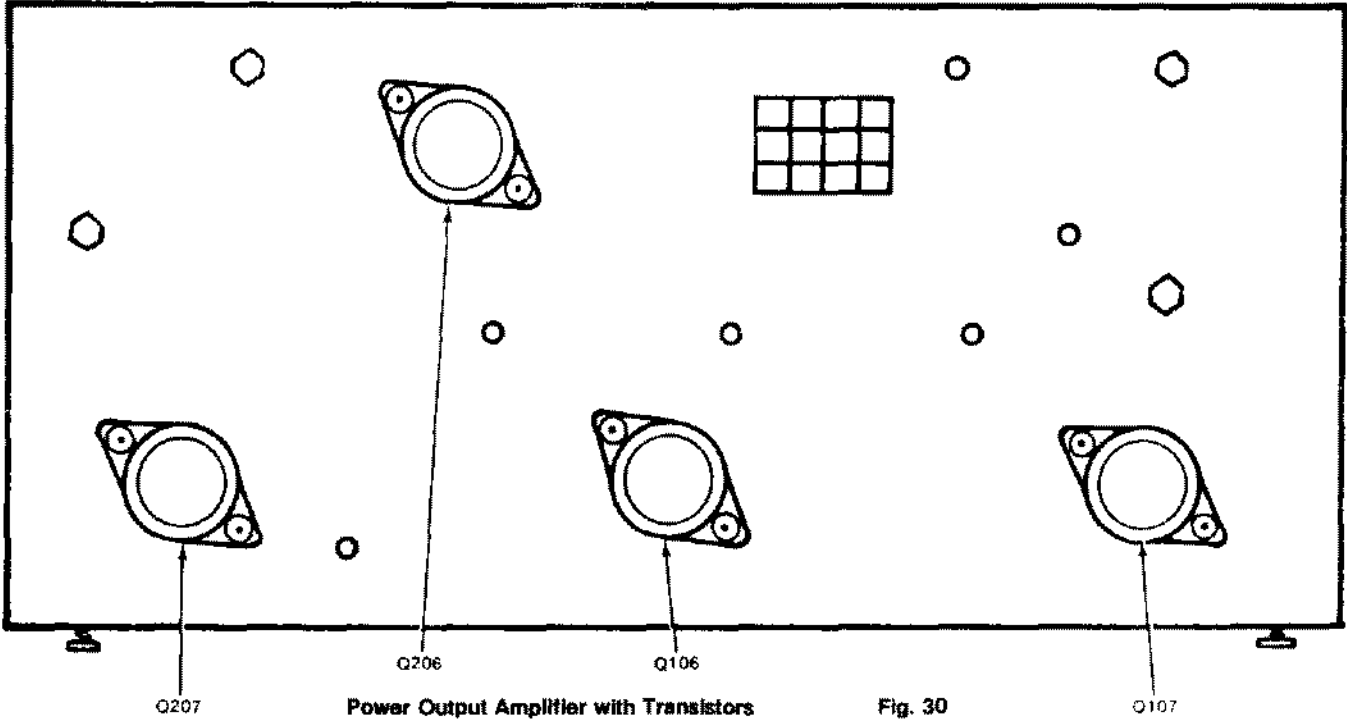
BLOCK DIAGRAM, MODELS 1150, 1153

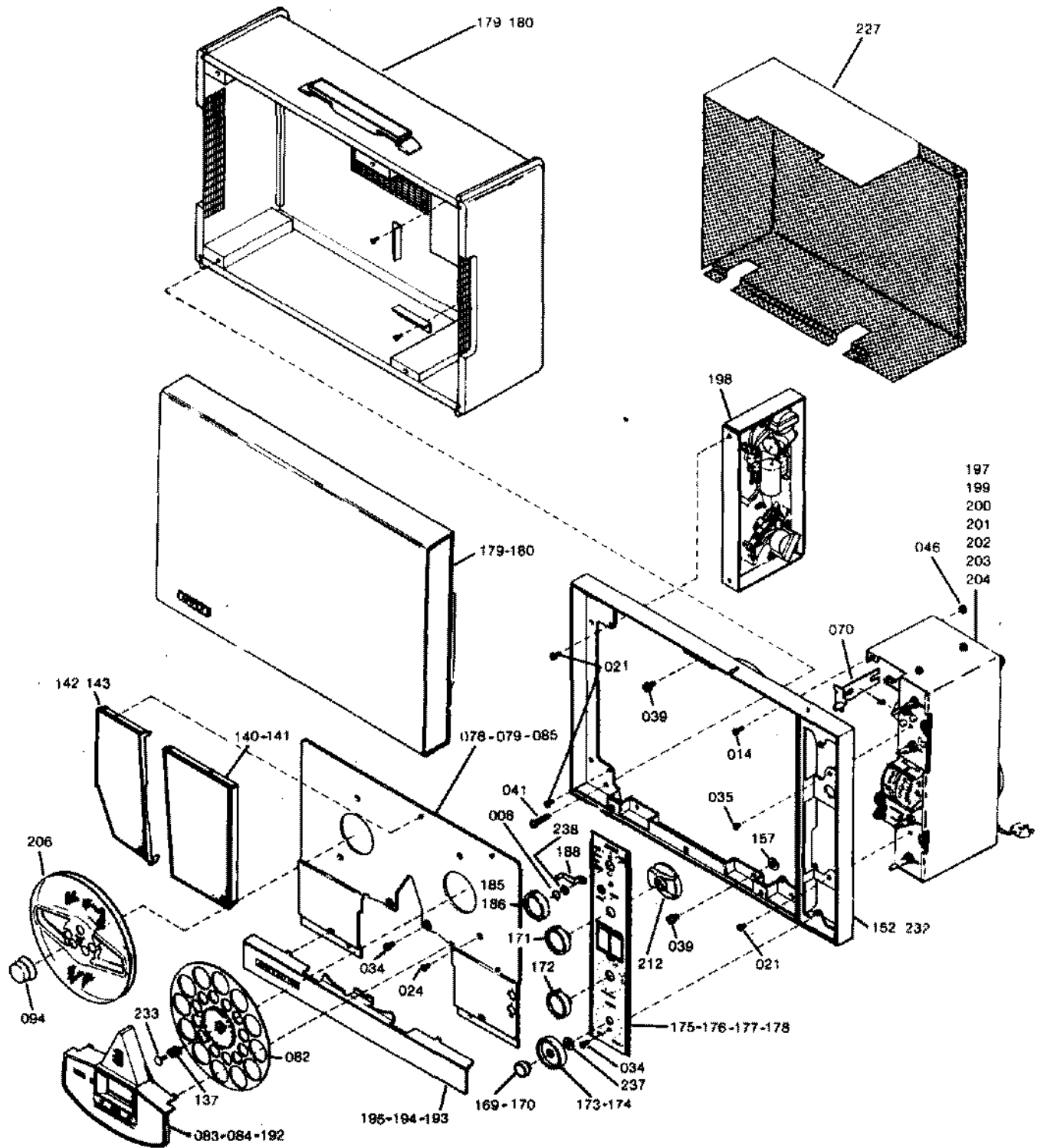


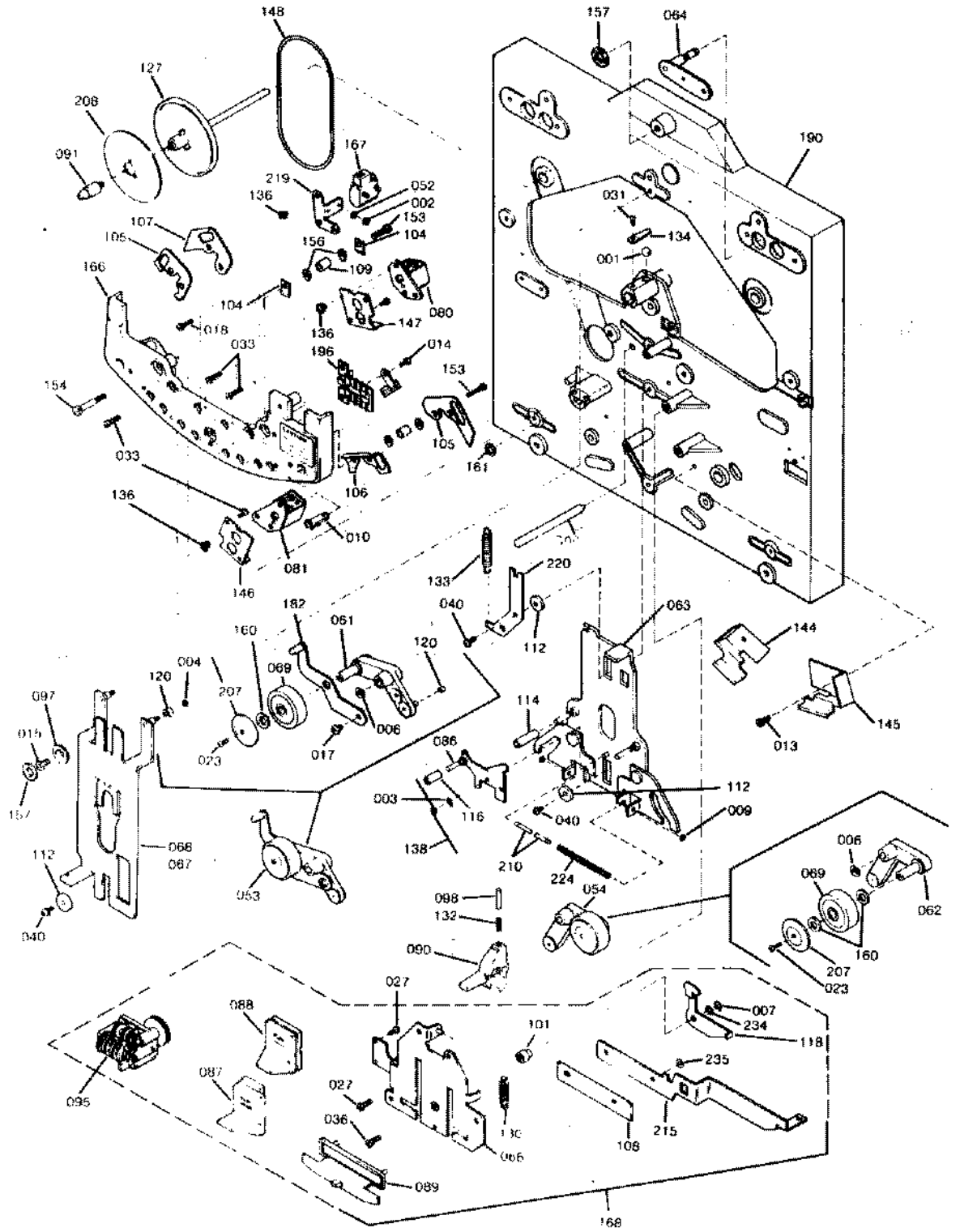


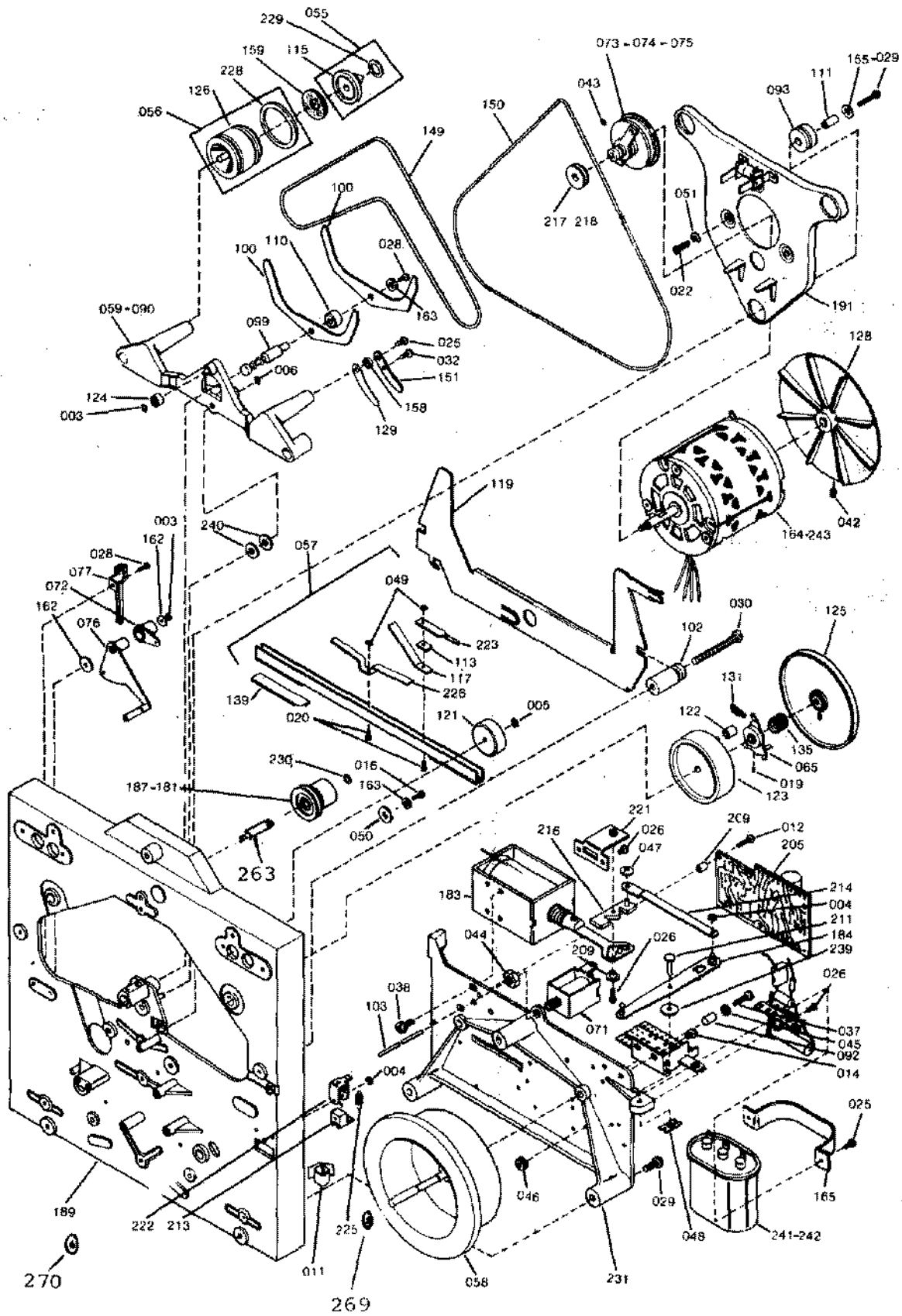
BLOCK DIAGRAM, MODELS 160, 163, 165

POWER OUTPUT AMPLIFIER



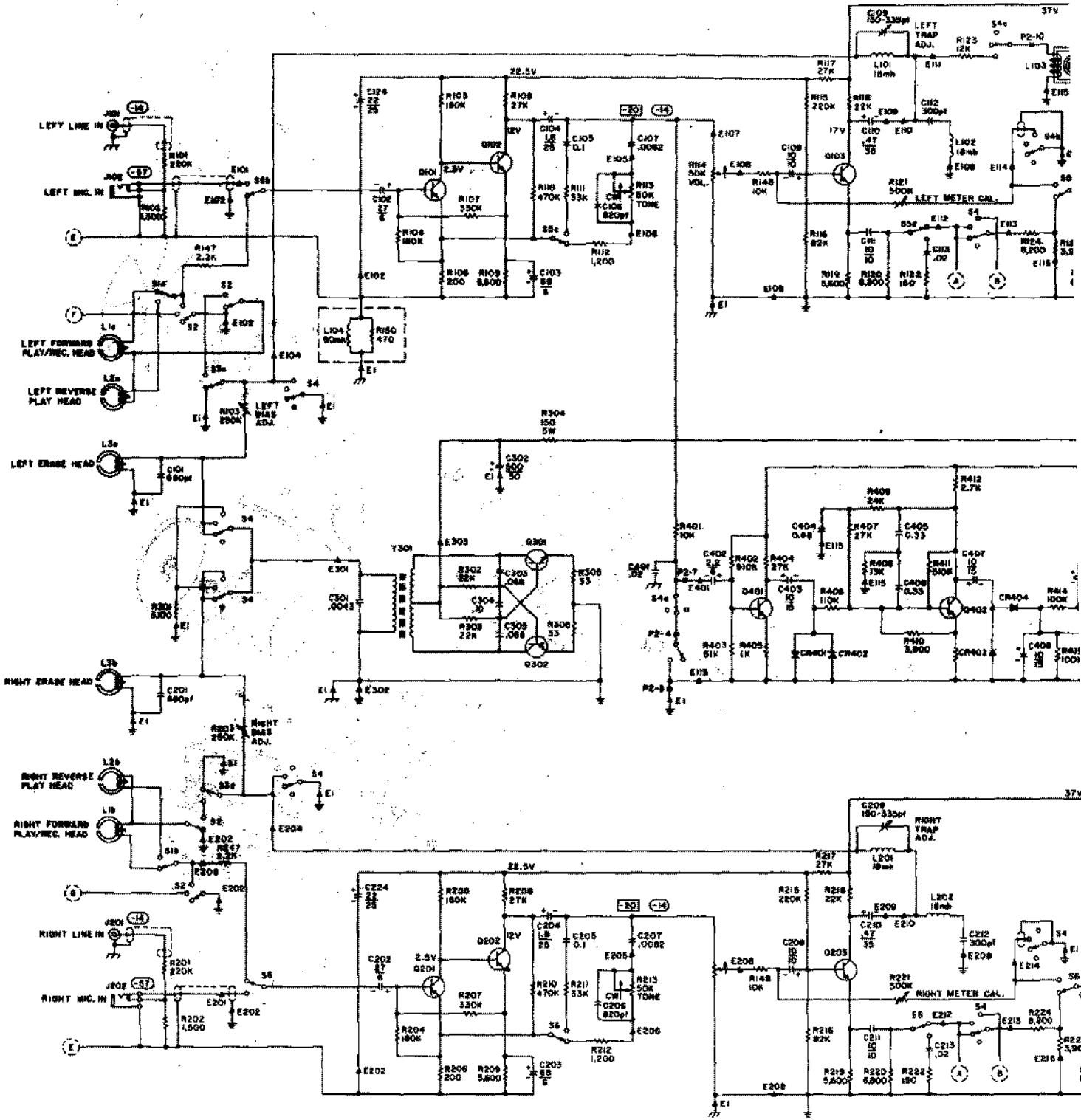


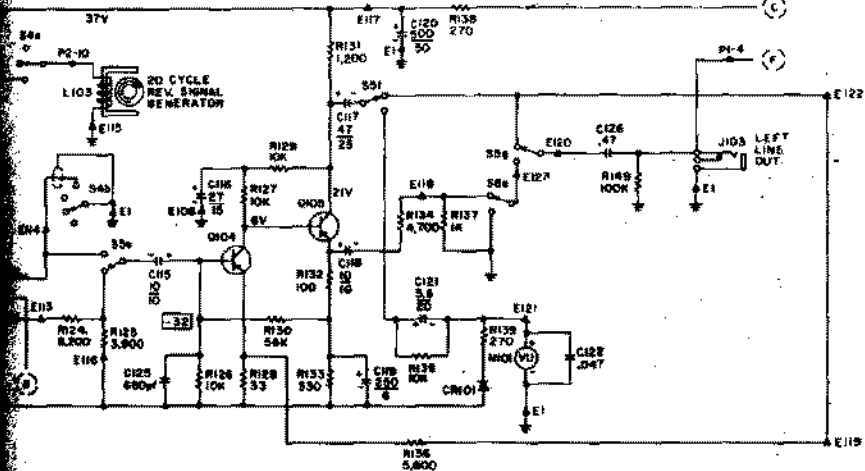




SCHEMATIC DIAGRAM

MODEL 121

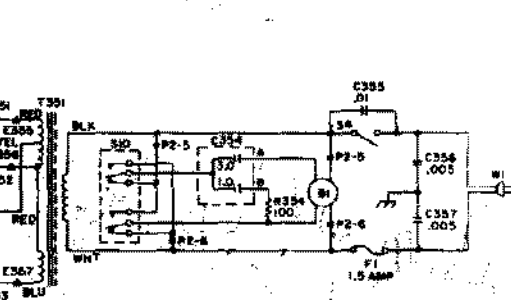
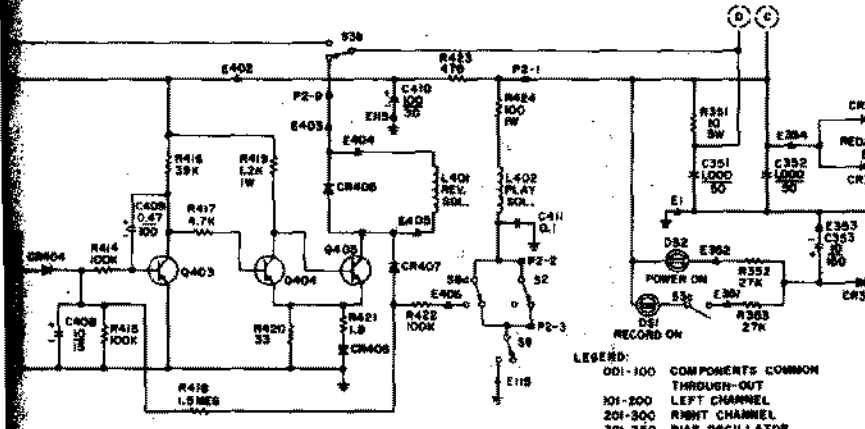




MODEL 121

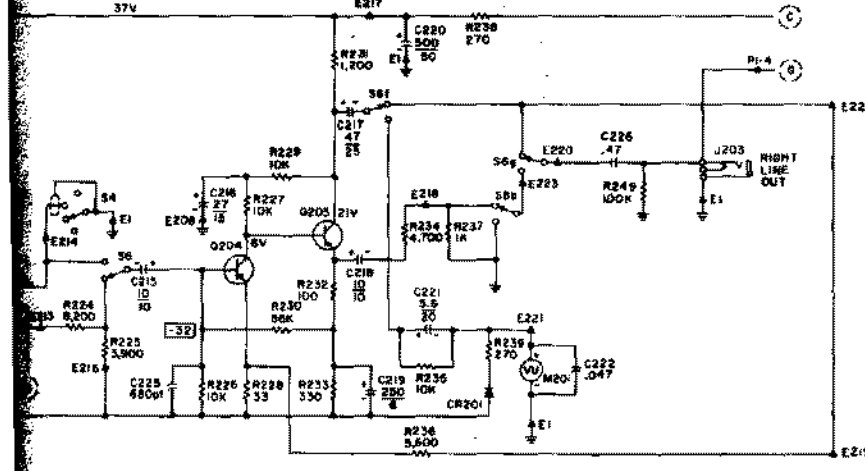
LAST DESIGNATION NUMBERS

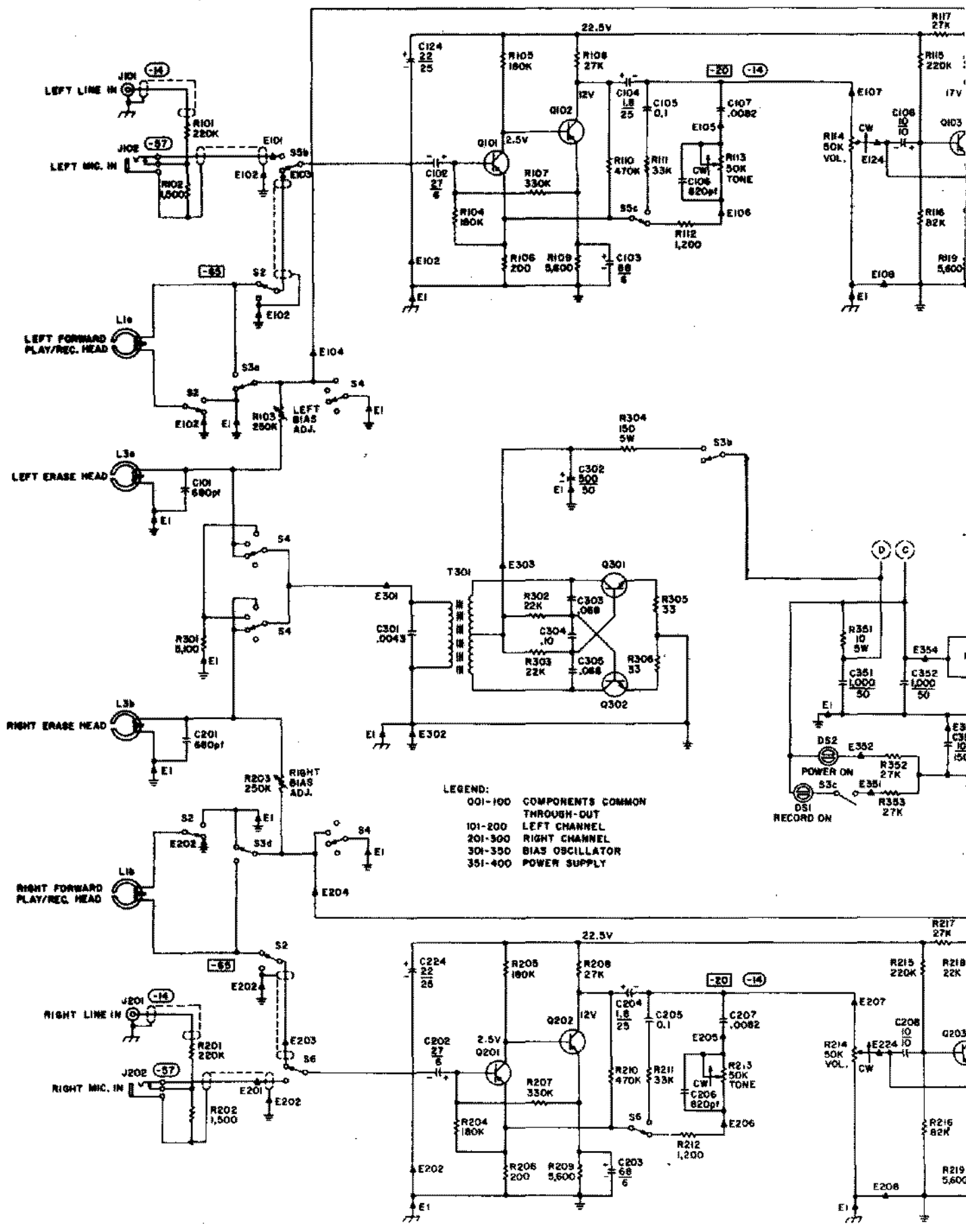
- LEFT CHANNEL AMPLIFIER:
 - RESISTOR-R150 COIL-L104
 - CAPACITOR-C126 TRANSFORMER-T101
 - RECEPTACLE-J104 TRANSISTOR-Q107
 - METER-M104 RECTIFIER-CR104
- RIGHT CHANNEL AMPLIFIER:
 - RESISTOR-R168 COIL-L203
 - CAPACITOR-C226 TRANSFORMER-T201
 - RECEPTACLE-J204 TRANSISTOR-Q207
 - METER-M201 RECTIFIER-CR201
- BIAS OSCILLATOR:
 - RESISTOR-R306 COIL-L301
 - CAPACITOR-C305 TRANSFORMER-T301
 - RECEPTACLE- TRANSISTOR-Q302
 - METER- RECTIFIER-
- POWER SUPPLY:
 - RESISTOR-R354 COIL-
 - CAPACITOR-C357 TRANSFORMER-T301
 - RECEPTACLE- TRANSISTOR-
 - METER- RECTIFIER-CR353
- REVERSING CIRCUIT:
 - RESISTOR-R424 COIL-L402
 - CAPACITOR-C411 TRANSFORMER-
 - RECEPTACLE- TRANSISTOR-Q405
 - METER- RECTIFIER-CR407
- COMPONENTS COMMON THROUGH-OUT:
 - SWITCH-S10 MOTOR-M1
 - CONNECTOR-P2 COIL-L3
 - PLUG-W1 LIGHT-D52



- LEGEND:
- 001-100 COMPONENTS COMMON THROUGH-OUT
 - 101-200 LEFT CHANNEL
 - 201-300 RIGHT CHANNEL
 - 301-350 BIAS OSCILLATOR
 - 351-400 POWER SUPPLY
 - 401-500 REVERSING CIRCUIT
 - ⊥ INDICATES CHASSIS GROUND
 - ⊥ INDICATES FOIL GROUND

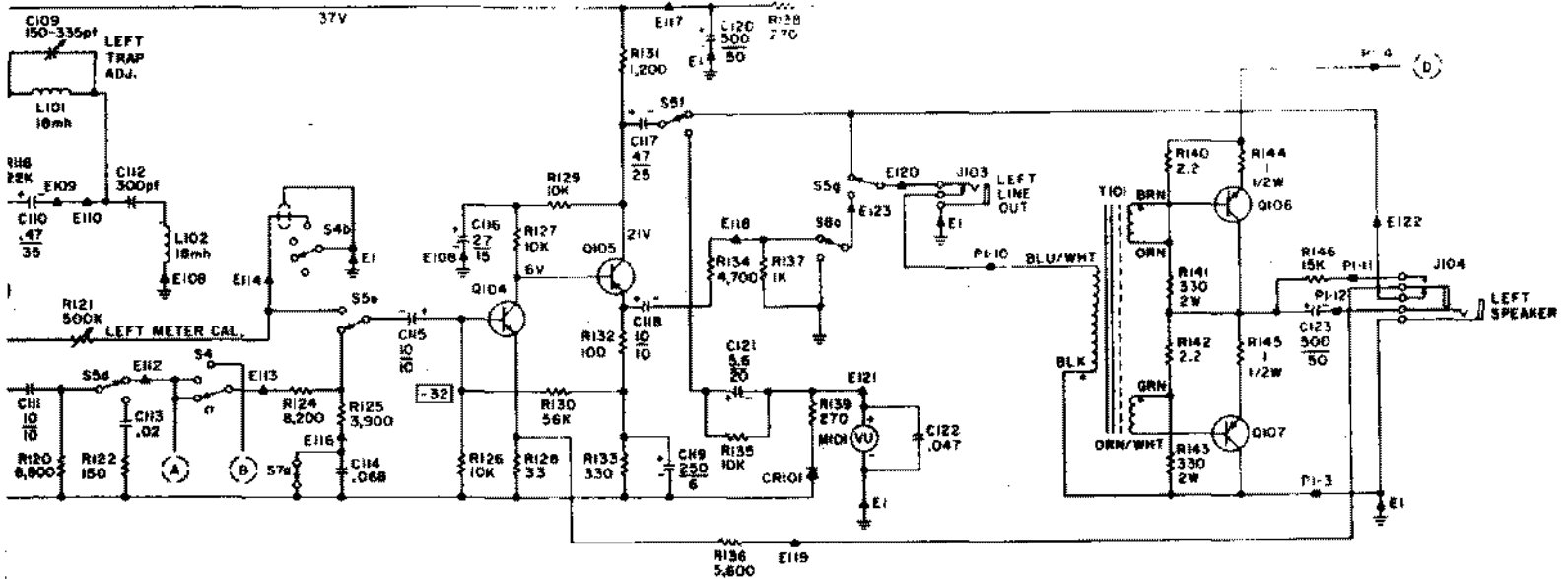
- NOTES:
1. SWITCHES SHOWN AS FOLLOWS:
 - S1 FORWARD PLAY, LEFT TO RIGHT TAPE MOTION.
 - S2 PLAY
 - S3 NOT ENGAGED
 - S4 STEREO
 - S5 PLAY
 - S6 PLAY
 - S7 NOT ENGAGED
 - S8 NOT ENGAGED
 - S9 ENGAGED WHEN TAPE IS ON TRANSPORT
 - S10 LEFT TO RIGHT TAPE MOTION
 2. ALL RESISTOR VALUES IN OHMS, 1/4W, UNLESS OTHERWISE SPECIFIED.
 3. ALL CAPACITOR VALUES IN MICRO FARADS, UNLESS OTHERWISE SPECIFIED.
 4. D.C. VOLTAGES MEASURED FROM POINT TO GROUND USING 20,000 OHMS PE VOLT METER AND RECORDER IN RECORD MODE.
 5. □ INDICATES PLAY-BAL SIGNAL VOLTAGES.
 6. ○ INDICATES RECORD SIGNAL VOLTAGES.
 7. SIGNAL VOLTAGES MEASURED WITH A.C. VTVM, (100 OHM DP EQUIVALENT), AND EXPRESSED IN dB, REF. TO .775 VOLTS at 500cps, WITH FOLLOWING CIRCUIT CONDITIONS:
 - a. VOLUME CONTROLS, FULLY CLOCKWISE ROTATION.
 - b. 500 CYCLE INPUT.
 - c. 1000 OHM RESISTOR SUSTITUTED FOR HEAD IN RECORD MODE.
 8. SWITCH IDENTIFICATION:
 - S1 HEAD
 - S2 RECORD PLAY, ROTARY
 - S3 RECORD BUTTON
 - S4 SELECTOR: OFF ON, MON., STEREO, AUTO REV.
 - S5 RECORD PLAY, SLIDE, LEFT CHANNEL
 - S6 RECORD PLAY, SLIDE, RIGHT CHANNEL
 - S7 BASS BOOST
 - S8 MONITOR
 - S9 TAPE
 - S10 MOTOR REVERSE.





SCHEMATIC DIAGRAM

MODEL 890



NOTES:

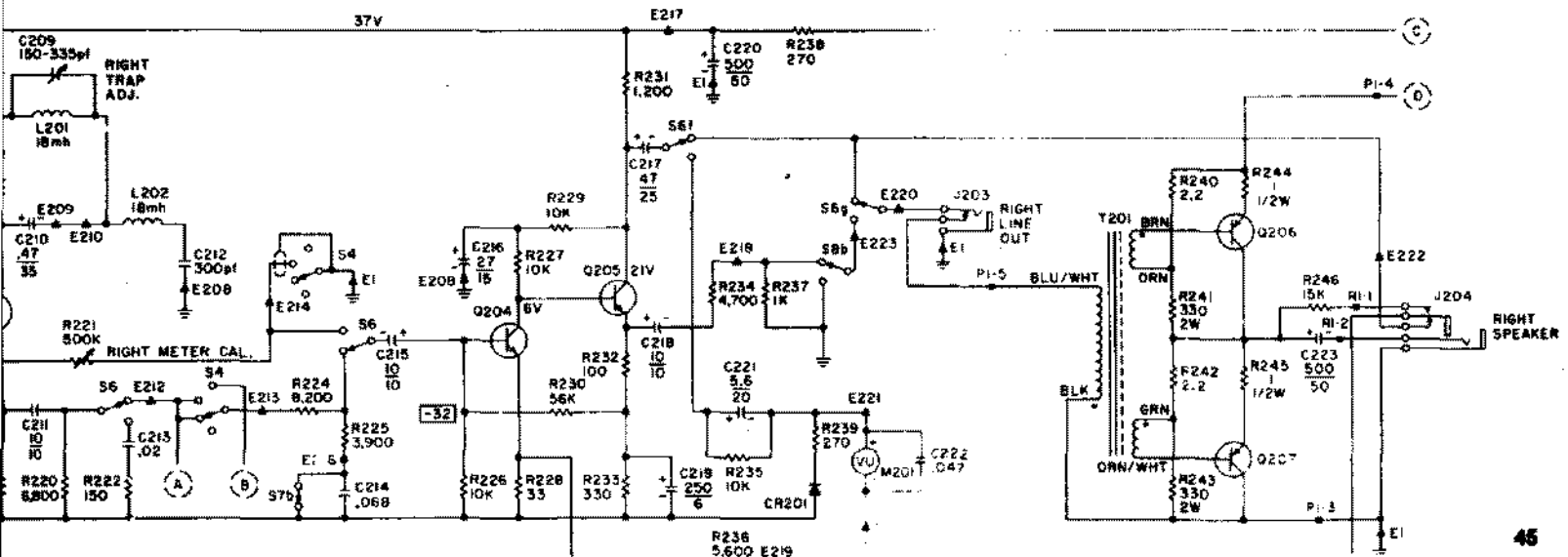
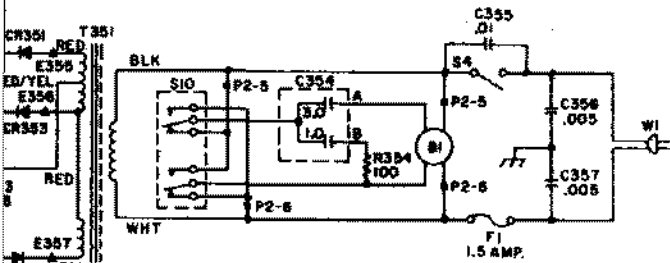
1. SWITCHES SHOWN AS FOLLOWS:

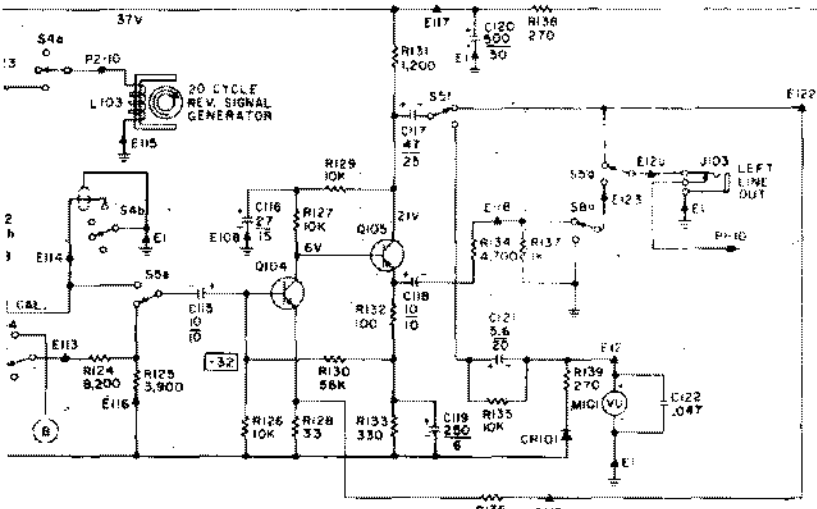
- S1 FORWARD PLAY, LEFT TO RIGHT TAPE MOTION.
- S2 PLAY
- S3 NOT ENGAGED
- S4 STEREO
- S5 PLAY
- S6 PLAY
- S7 NOT ENGAGED
- S8 NOT ENGAGED
- S9 ENGAGED WHEN TAPE IS ON TRANSPORT.
- S10 LEFT TO RIGHT TAPE MOTION

- 2. ALL RESISTOR VALUES IN OHMS, 1/4W, UNLESS OTHERWISE SPECIFIED.
- 3. ALL CAPACITOR VALUES IN MICRO FARADS, UNLESS OTHERWISE SPECIFIED.
- 4. D.C. VOLTAGES MEASURED FROM POINT TO GROUND USING 20,000 OHMS PER VOLT METER AND RECORDER IN RECORD MODE.
- 5. INDICATES PLAY-BACK SIGNAL VOLTAGES.
- 6. INDICATES RECORD SIGNAL VOLTAGES.
- 7. SIGNAL VOLTAGES MEASURED WITH A.C. VTVM, (IMP 400 OR EQUIVALENT), AND EXPRESSED IN db, REF. TO .775 VOLTS at 500cps, WITH FOLLOWING CIRCUIT CONDITIONS:
 - a. VOLUME CONTROLS, FULLY CLOCKWISE ROTATION.
 - b. 300 CYCLE INPUT.
 - c. 1,000 OHM RESISTOR SUBSTITUTED FOR HEAD IN RECORD MODE.

8. SWITCH IDENTIFICATION:

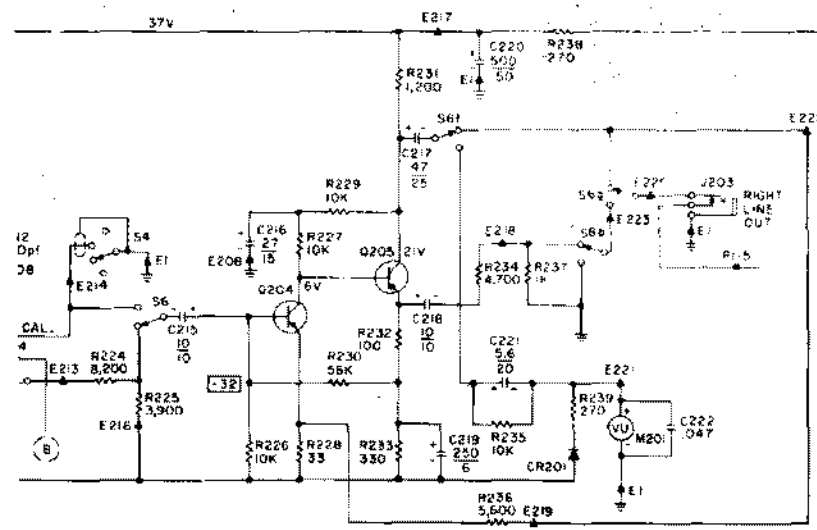
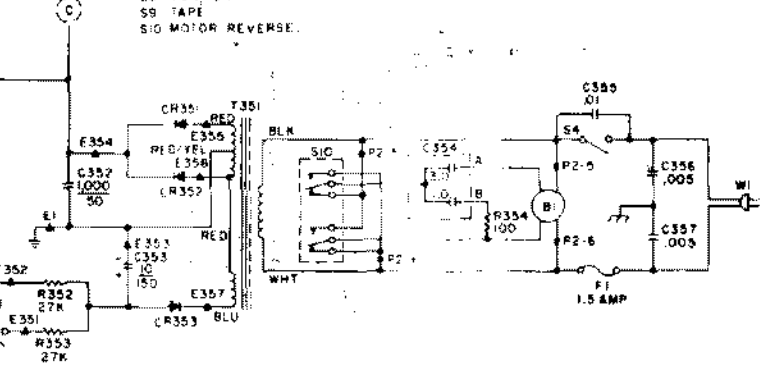
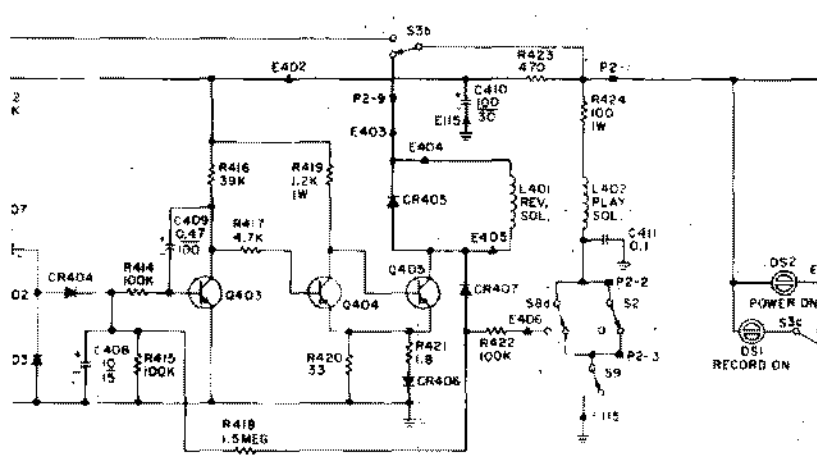
- S1 HEAD
- S2 RECORD PLAY, ROTARY
- S3 RECORD BUTTON
- S4 SELECTOR: OFF ON, MON., STEREO.
- S5 RECORD PLAY, SLIDE, LEFT CHANNEL
- S6 RECORD PLAY, SLIDE, RIGHT CHANNEL
- S7 BASS BOOST
- S8 MONITOR
- S9 TAPE
- S10 MOTOR REVERSE.





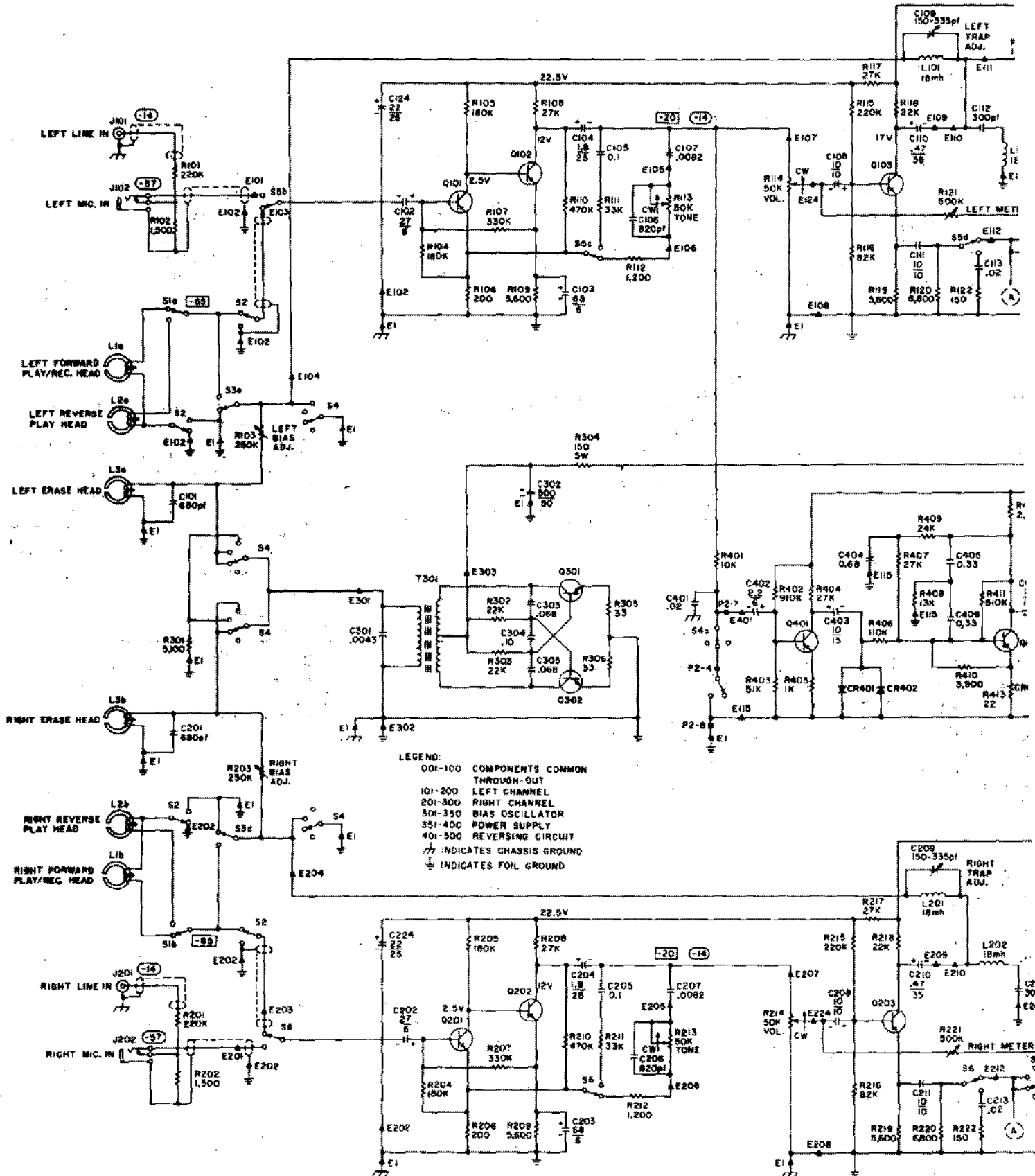
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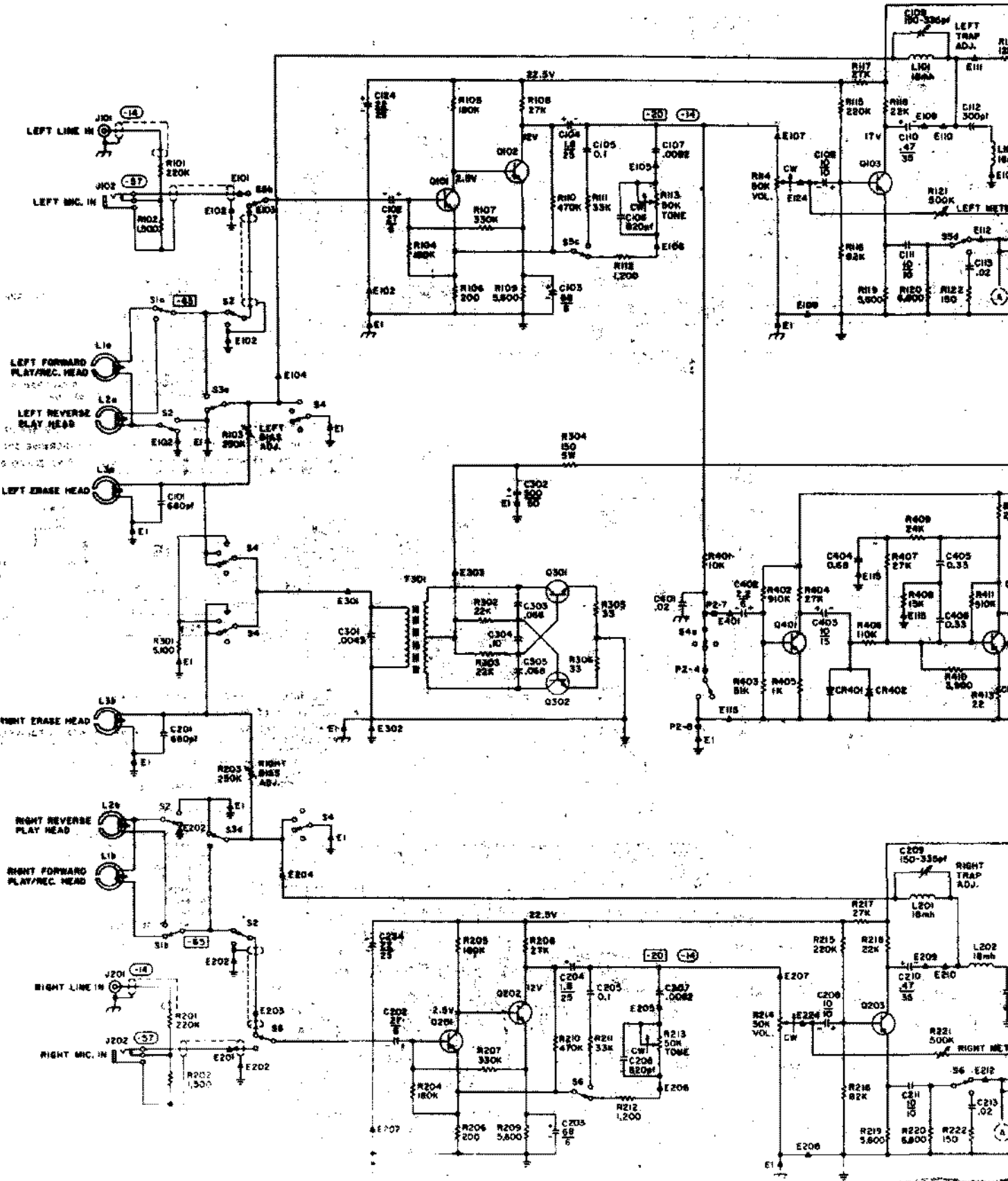
1. SWITCHES SHOWN AS FOLLOWS
2. FORWARD PLAY, LEFT OR RIGHT CHANNEL ACTION
3. NOT ENGAGED
4. NOT ENGAGED
5. PLAY
6. PLAY
7. NONE
8. NOT ENGAGED
9. ENGAGED WHEN TAPE IS IN POSITION FOR LEFT TO RIGHT TAPE MOTION
10. ENGAGED WHEN TAPE IS IN POSITION FOR RIGHT TO LEFT TAPE MOTION
11. ALL RESISTOR VALUES IN OHMS, UNLESS OTHERWISE SPECIFIED.
12. ALL CAPACITOR VALUES IN MICROGRAMS UNLESS OTHERWISE SPECIFIED.
13. DC VOLTAGES MEASURED FROM POINT TO GROUND USING 20,000 OHMS PER VOLT METER AND RECORDER IN RECORD MODE.
14. [Symbol] INDICATES PLAY-BACK SIGNAL VOLTAGES.
15. [Symbol] INDICATES RECORD SIGNAL VOLTAGES.
16. SIGNAL VOLTAGES MEASURED WITH A CATHODE RAY 400 OR EQUIVALENT, AND EXPRESSED IN DB, REF. TO 0.775 VOLTS AT 500cps, WITH FOLLOWING CIRCUIT CONDITIONS:
 - a. VOLUME CONTROLS, FULL COUNTERCLOCKWISE ROTATION.
 - b. 500 CYCLE INPUT.
 - c. 1000 OHM RESISTOR SUBSTITUTED FOR HEAD IN RECORD MODE.
17. SWITCH IDENTIFICATION:
 - S1 HEAD
 - S2 RECORD PLAY, ROTARY
 - S3 RECORD BUTTON
 - S4 SELECTOR: OFF ON, MON., STEREO, AUTO REV.
 - S5 RECORD PLAY, SLIDE, LEFT CHANNEL
 - S6 RECORD PLAY, SLIDE, RIGHT CHANNEL
 - S7 BASS BOOST
 - S8 MONITOR
 - S9 TAPE
 - S10 MOTOR REVERSE.



SCHEMATIC DIAGRAM

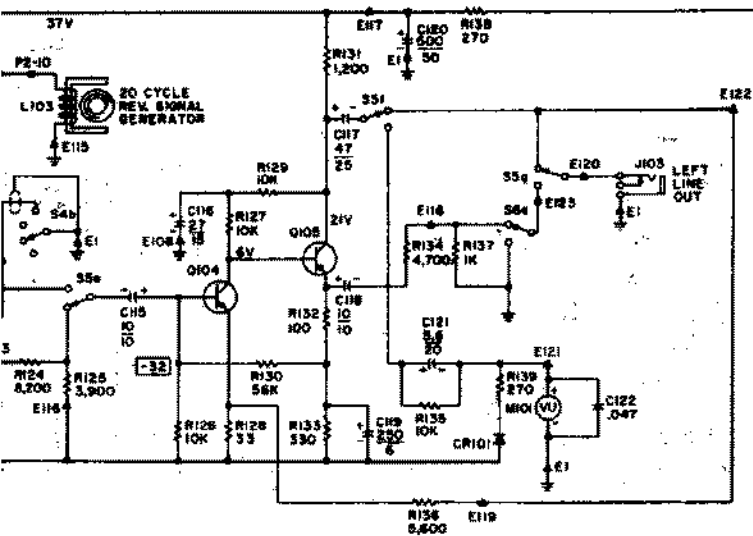
MODEL 1





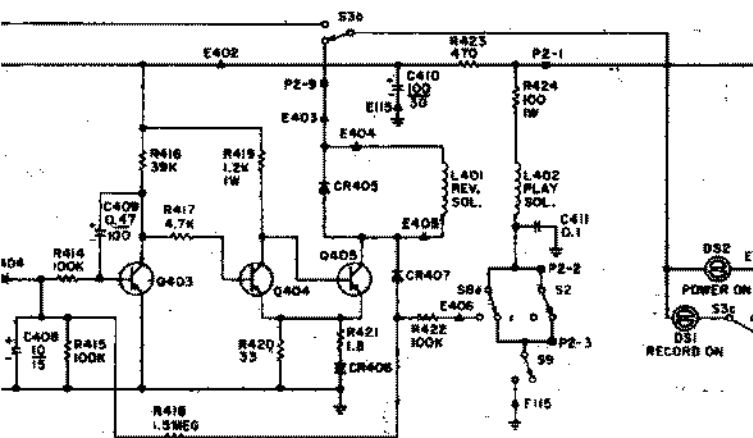
SCHEMATIC DIAGRAM

MODEL 1153



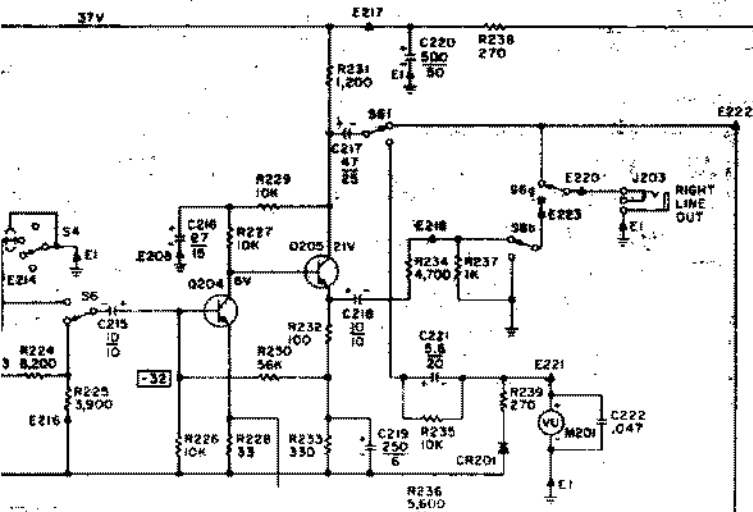
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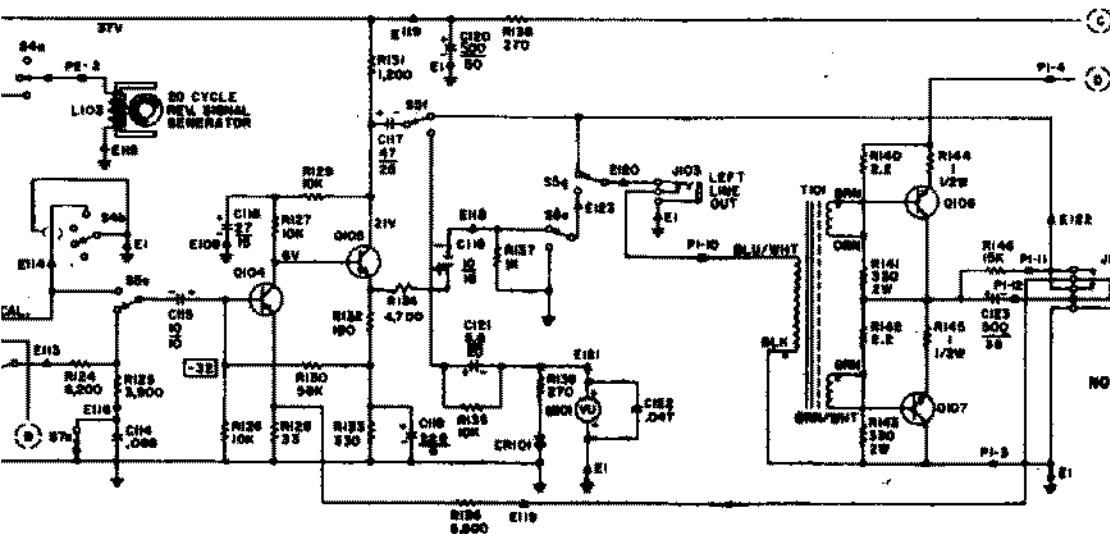
- SWITCHES SHOWN AS FOLLOWS:
 S1 FORWARD PLAY, LEFT TO RIGHT TAPE MOTION.
 S2 PLAY
 S3 NOT ENGAGED
 S4 STEREO
 S5 PLAY
 S6 PLAY
 S7 NONE
 S8 NOT ENGAGED
 S9 ENGAGED WHEN TAPE IS ON TRANSPORT
 S10 LEFT TO RIGHT TAPE MOTION
 S11 115V LINE INPUT
- ALL RESISTOR VALUES IN OHMS, 1/4 W, UNLESS OTHERWISE SPECIFIED.
- ALL CAPACITOR VALUES IN MICRO FARADS, UNLESS OTHERWISE SPECIFIED.
- D.C. VOLTAGES MEASURED FROM POINT TO GROUND USING 20,000 OHMS PER VOLT METER AND RECORDER IN RECORD MODE.
- INDICATES PLAY-BACK SIGNAL VOLTAGES.
- INDICATES RECORD SIGNAL VOLTAGES.
- SIGNAL VOLTAGES MEASURED WITH A.C. VTVM, 1hp 400 OR EQUIVALENT, AND EXPRESSED IN db, REF. TO .775 VOLTS at 500cps, WITH FOLLOWING CIRCUIT CONDITIONS:
 a. VOLUME CONTROLS, FULLY CLOCKWISE ROTATION.
 b. 500 CYCLE INPUT.
 c. 1000 OHM RESISTOR SUBSTITUTED FOR HEAD IN RECORD MODE.



5. SWITCH IDENTIFICATION:

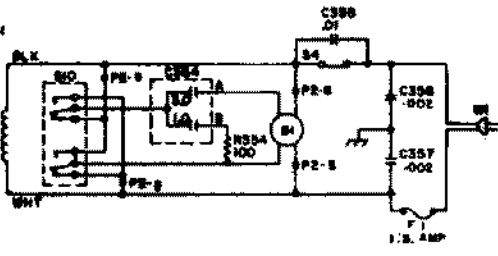
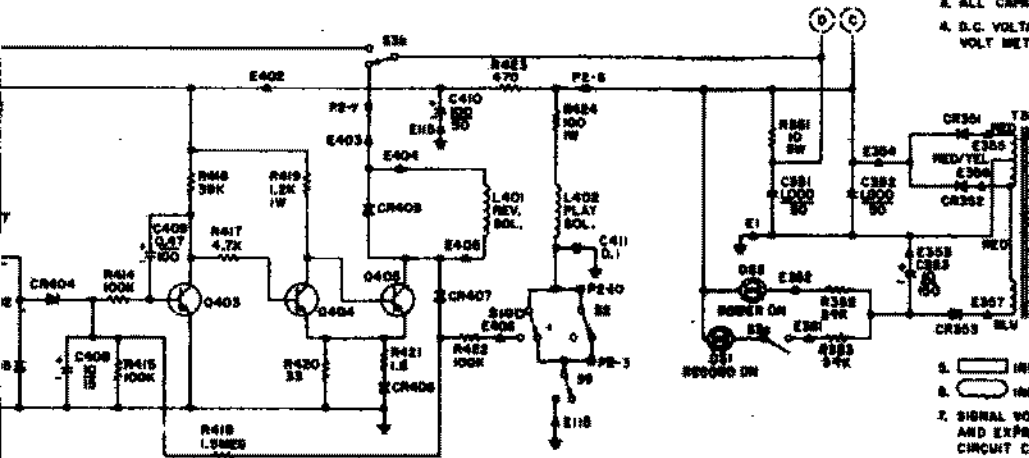
- HEAD
- RECORD PLAY, ROTARY
- RECORD BUTTON
- SELECTOR: OFF ON, MON., STEREO, AUTO REV.
- RECORD PLAY, SLIDE, LEFT CHANNEL
- RECORD PLAY, SLIDE, RIGHT CHANNEL
- BASS BOOST
- MONITOR
- TAPE
- MOTOR REVERSE
- 115-230V LINE INPUT SELECTOR



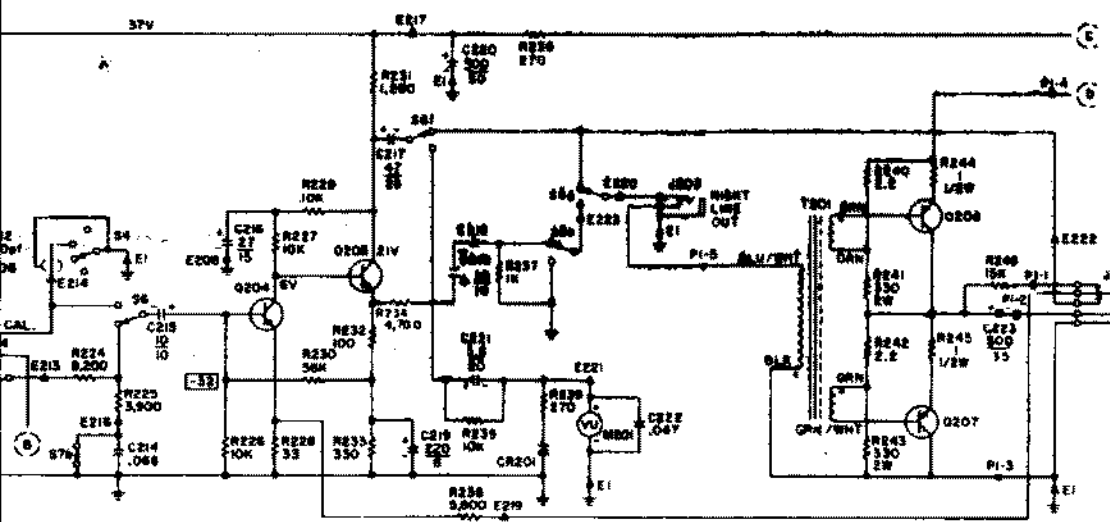


- NOTES:
- SWITCHES SHOWN AS FOLLOWS:
 S1 FORWARD PLAY, LEFT TO RIGHT TAPE MOTION.
 S2 PLAY
 S3 NOT ENGAGED
 S4 STEREO
 S5 PLAY
 S6 PLAY
 S7 NOT ENGAGED
 S8 NOT ENGAGED
 S9 ENGAGED WHEN TAPE IS ON TRANSPORT
 S10 LEFT TO RIGHT TAPE MOTION

- ALL RESISTOR VALUES IN OHMS, UNLESS OTHERWISE SPECIFIED.
- ALL CAPACITOR VALUES IN MICRO FARADS, UNLESS OTHERWISE SPECIFIED.
- D.C. VOLTAGES MEASURED FROM POINT TO GROUND USING 50,000 OHMS PER VOLT METER AND RECORDER IN RECORD MODE.



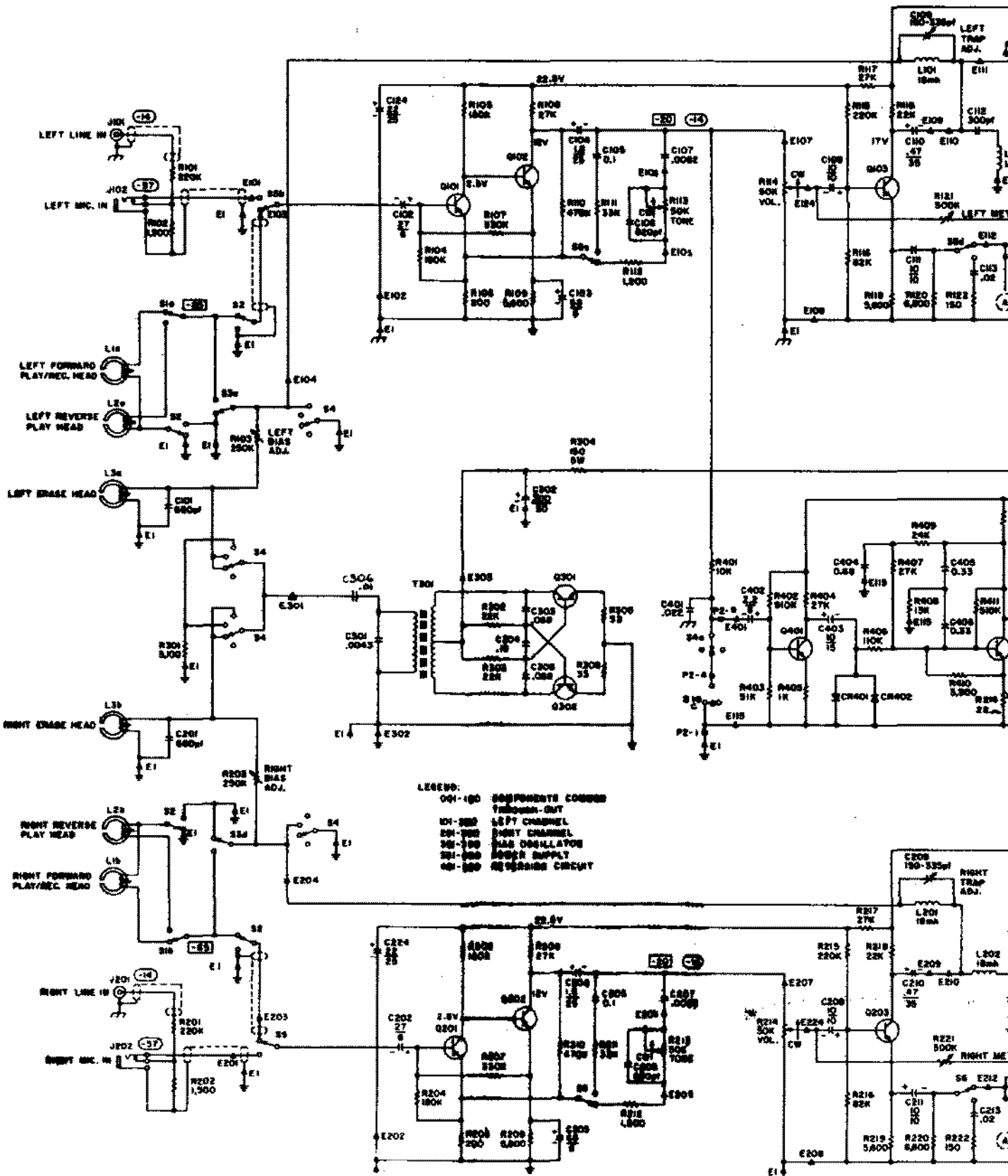
- INDICATES PLAY-BACK SIGNAL VOLTAGES.
- INDICATES RECORD SIGNAL VOLTAGES.
- SIGNAL VOLTAGES MEASURED WITH D.C. VTVM, (up 400 OH OR EQUIVALENT), AND EXPRESSED IN μ V, MV, TO .775 VOLTS @ 500cps, WITH FOLLOWING CIRCUIT CONDITIONS:
 a. VOLUME CONTROLS, FULLY CLOCKWISE ROTATION.
 b. 500 CYCLE INPUT.
 c. LOAD 500 OHMS RESISTOR SUBSTITUTED FOR HEAD IN RECORD MODE.

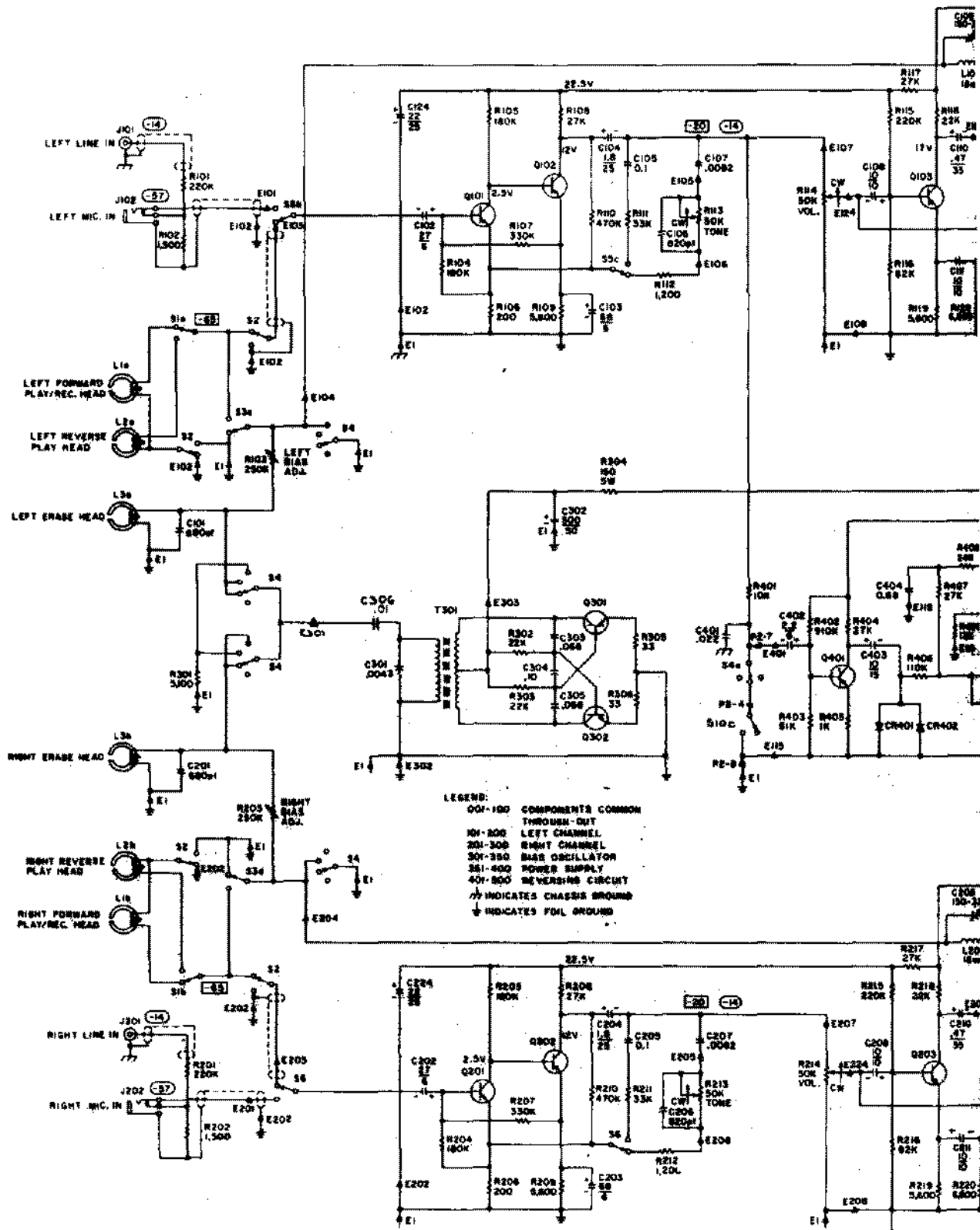


- SWITCH IDENTIFICATION:
 S1 HEAD
 S2 RECORD PLAY, ROTARY
 S3 RECORD BUTTON
 S4 SELECTOR: OFF ON, MON., STEREO, AUTO REV.
 S5 RECORD PLAY, SLIDE, LEFT CHANNEL
 S6 RECORD PLAY, SLIDE, RIGHT CHANNEL
 S7 REEL MOTOR
 S8 MOTOR
 S9 TAPE
 S10 MOTOR REVERSE.

SCHEMATIC DIAGRAM

MODELS 1100, 1



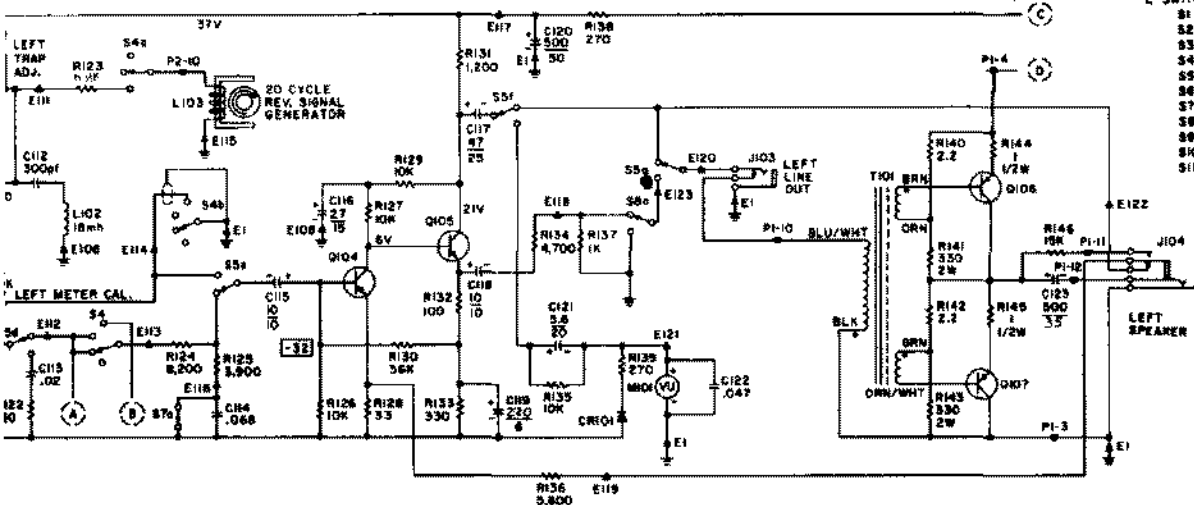


SCHEMATIC DIAGRAM

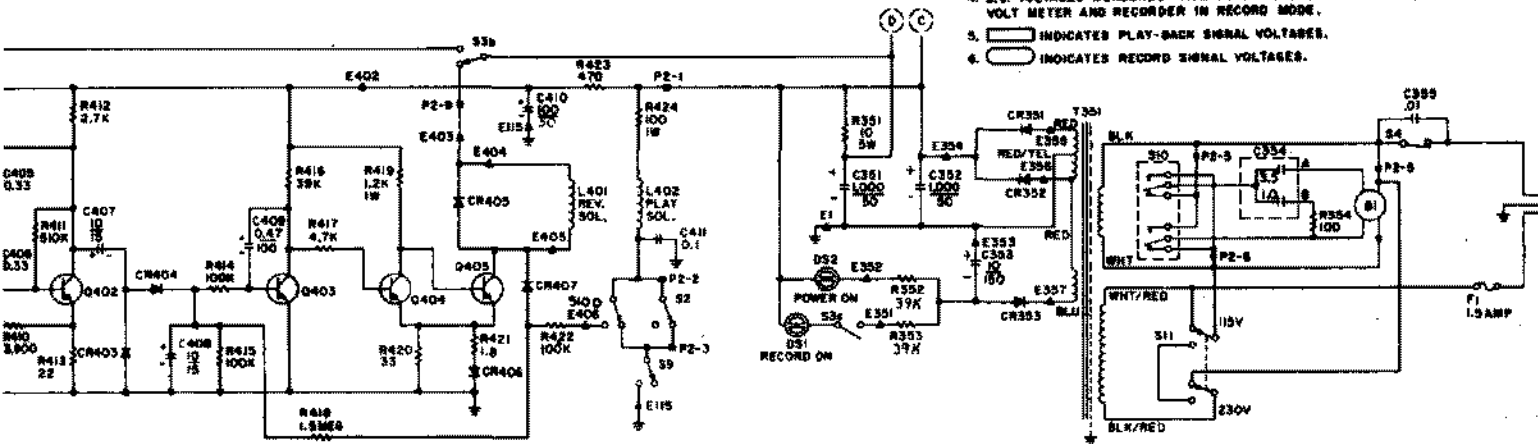
MODEL 1163.

NOTES:

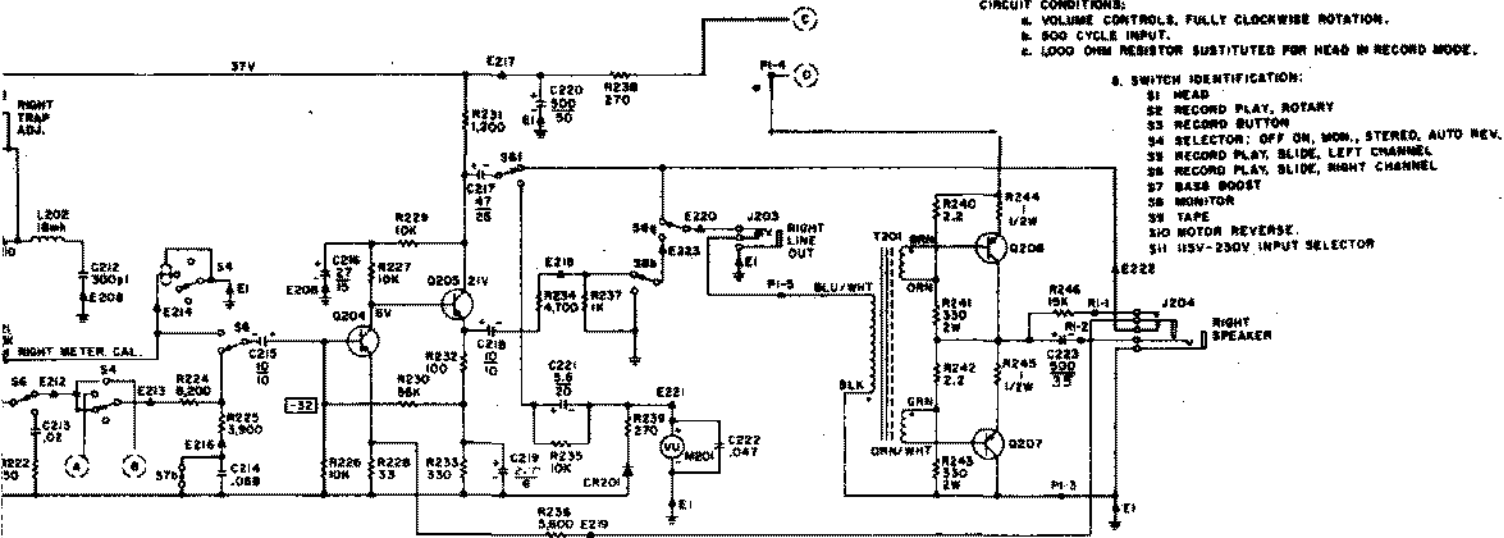
1. SWITCHES SHOWN AS FOLLOWS:
S1 FORWARD PLAY, LEFT TO RIGHT TAPE MOTION.
S2 PLAY
S3 NOT ENGAGED
S4 STEREO
S5 PLAY
S6 PLAY
S7 NOT ENGAGED
S8 NOT ENGAGED
S9 ENGAGED WHEN TAPE IS ON TRANSPORT
S10 LEFT TO RIGHT TAPE MOTION
S11 115V LINE INPUT



2. ALL RESISTOR VALUES IN OHMS, UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITOR VALUES IN MICRO FARADS, UNLESS OTHERWISE SPECIFIED.
4. D.C. VOLTAGES MEASURED FROM POINT TO GROUND USING 50,000 OHMS PER VOLT METER AND RECORDER IN RECORD MODE.
5. INDICATES PLAY-BACK SIGNAL VOLTAGES.
6. INDICATES RECORD SIGNAL VOLTAGES.



7. SIGNAL VOLTAGES MEASURED WITH A.C. VTVM (2p 400 OHM EQUIVALENT), AND EXPRESSED IN dB, REF. TO .775 VOLTS @ 500cps, WITH FOLLOWING CIRCUIT CONDITIONS:
a. VOLUME CONTROLS, FULLY CLOCKWISE ROTATION.
b. 500 CYCLE INPUT.
c. 1000 OHM RESISTOR SUBSTITUTED FOR HEAD IN RECORD MODE.



8. SWITCH IDENTIFICATION:
S1 HEAD
S2 RECORD PLAY, ROTARY
S3 RECORD BUTTON
S4 SELECTOR: OFF ON, MON., STEREO, AUTO REV.
S5 RECORD PLAY, SLIDE, LEFT CHANNEL
S6 RECORD PLAY, SLIDE, RIGHT CHANNEL
S7 BASS BOOST
S8 MONITOR
S9 TAPE
S10 MOTOR REVERSE.
S11 115V-230V INPUT SELECTOR

ADDITIONAL SERVICE INFORMATION

LUBRICATION

Motor

The motor bearings should have several drops of Ampex Oil P/N 01-0825 after each 1000 hours operation. A small oil port is located on each bearing casting. Do not allow oil to run out between bearing and motor shaft as this is an indication of excessive oil.

Transport Mechanism

Lubrication of the tape mechanism can be performed by using the following recommendations:

1. Use Ampex P/N 087-060 grease on all moving but not rotating parts such as yoke bearings, etc.
2. Use Ampex P/N 087-516 (fluid, D.C. 266,000 centistrokes), on the tape tension switch (beneath casting) ONLY.
3. Use Ampex P/N 087-527 grease to deaden ringing sounds where necessary. It should never be used on fast moving or rotating parts.
4. Use Ampex P/N 01-0825 on all rotating or fast moving parts. This is the same type oil as is used to lubricate the motor.

REVERSE CIRCUIT CHECK

1. Remove the recorder assembly from the case.
2. Place the recorder in the play mode.
3. Connect the audio oscillator to point E401 (schematic reference).
4. Adjust the oscillator frequency for 20 cycles @ .15 volts.
5. Connect the dc VTVM at the point between CR4C1 and R414.
6. Vary the oscillator frequency for maximum reading on the VTVM. Meter reading should be approximately 1.7 volts and the oscillator frequency should be between 19 and 21 cycles. Note the exact oscillator frequency. The frequency noted will be the resonant frequency.
7. Hold the frequency constant and increase the oscillator gain for .25 volts input at point E401, (Schematic reference). NOTE: At the resonant frequency the recorder should reverse with a minimum voltage of .15 volts and a maximum voltage of .25 volts. With the reversing solenoid engaged the following D.C. voltages can be measured:
At the point between CR204 and R217, 1.7 volts D.C. \pm 10%.
At the base of Q204, 1.5 volts D.C. \pm 10%.
At the collector of Q204, 2.2 volts D.C. \pm 10%.

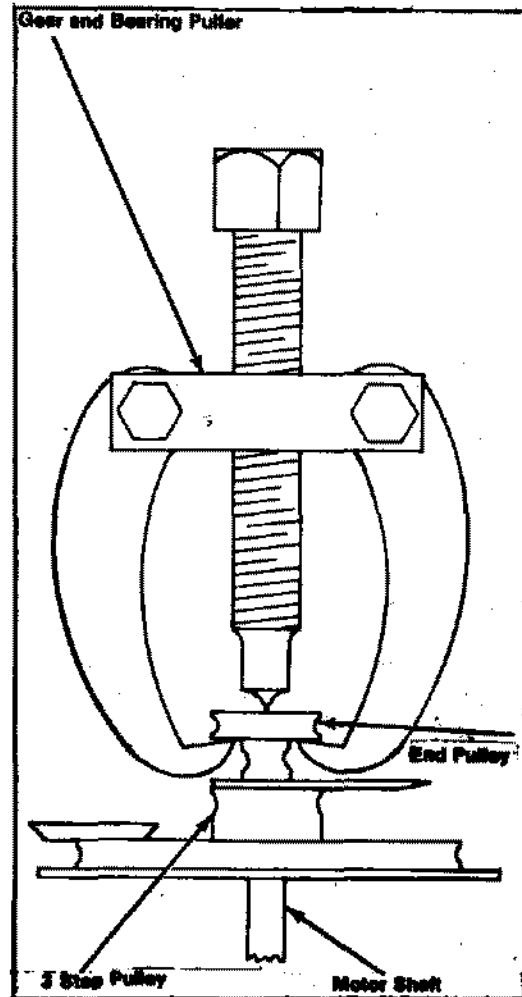


Fig. 41

CONVERTING FROM 117 VOLT, 60 CYCLE, TO 117 VOLT, 50 CYCLE OPERATION

The models affected are the 121, 890, 1150 and 1160. The conversion is performed by changing the motor pulleys and the motor capacitor. All parts necessary are contained in the 50 CPS Frequency Conversion Kit (P/N 7030068-02).

To make the conversion remove the recorder mechanism from the case. See case removal instructions on Page 11. When the tape transport is out of the case assembly, remove the three phillips head screws which retain the motor and shock mounting assembly. As you remove this assembly from the transport, be sure to release the belts from the pulleys.

Remove the end pulley from the motor shaft. Care must be taken when removing the end pulley as the motor can be damaged by prying or pulling against the motor shaft. To remove the pulley, a small gear and bearing puller is recommended.

The puller is available at most hardware and auto supply houses. Place the puller over the wind pulley as illustrated in Figure 41. Tighten the puller drive screw until the pulley is removed from the motor shaft.

Loosen the set screw and remove the three step aluminum pulley. Note: Later production units will have two set screws securing the 3 step pulley. Assemble the new conversion, 3 step pulley, making sure that the set screw is tightened squarely on the flat, or undercut section, of the motor shaft. The bottom surface of the pulley should be $7/64$ " above the top surface of the motor plate. Due to variation of end play in the motor shaft, this may have to be readjusted after the motor is mounted. Assemble the new set screw type end pulley. The new pulley should be mounted about $1/8$ " below the end of the motor shaft.

On the 121, 1150 and 1160 models remove the "O" ring which retains the idler pulley assembly. Remove the old idler pulley assembly and install the new. Install the new "O" ring retainer on the idler pulley mounting shaft.

Re-install the motor shock mounting assembly to the mechanism making sure the sheet metal tabs on the plate are below and do not interfere with the belt shift yoke. Re-install the belts on the proper pulleys. The 3 step pulley may have to be repositioned so at any speed the belt runs in the center of the speed shifter fork. Make sure all screws are tight.

CONVERTING FROM 117/234 VOLT, 50 CYCLE, TO 117/234 VOLT 60 CYCLE OPERATION

Conversion of the Model 1153 or 1163 requires the parts contained in the 60 CPS conversion kit (P/N 7030068-01).

AMPEX

MAINTENANCE MANUAL

FOR TAPE RECORDER MODELS :

121,890,960,961,1150,1153,1160,1163,1165

AMPEX SERVICE COMPANY
2601 GREENLEAF AVENUE
ELK GROVE VILLAGE
ILLINOIS 60007

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NOTE: This manual supercedes all previously printed manuals of the same part number and Service Bulletins No. 1062, 1064, 1074, 1052, 1088, 1096

CIRCUIT DESCRIPTION

All references reflect to the left channel amplifier. Function of the right channel amplifier is the same but different components are involved. Schematic references, such as E1, E121, E351, etc. are to indicate tie points for the electronic assembly and are not to be mistaken for components of the circuit.

POWER SUPPLY CIRCUIT

When the line cord is plugged into a 117 Volt, 60 cycle A.C. outlet and the Selector is placed in either the Stereo, Monaural 1 or Monaural 2 position, the following is accomplished. 117 Volts alternating current is allowed to pass through ON-OFF switch S4 to the motor B1, which supplies the mechanical power, and through the power transformer T351 to the voltage rectifiers CR351, CR352 and CR353. Voltage is changed from A.C. to D.C. by voltage rectifiers CR351, CR352 and CR353 and the D.C. voltages which

energize the electronics are accomplished as follows. 37 Volts D.C. is supplied to the left channel amplifier via R138. 37 Volts D.C. is supplied to the right channel amplifier via R238. 39 Volts, D.C. is supplied to the left and right channel power amplifier and to the reversing circuit via R351. 39 Volts D.C. is supplied to the reversing circuit via R423. 41 Volts D.C. is supplied to the play solenoid via R424. 24 Volts, D.C. is supplied to the bias oscillator via R304 when the Record button S3 is depressed.

SWITCH OPERATION

Rotating the Record Play control to either the Play or Record positions changes S5 and S6 slide switches and S2 rotary switch to accomplish the desired mode of operation. The Record button S3 must be depressed in addition to adjusting the Record Play Control to accomplish the Record mode. S3a allows record bias voltage to the left channel head L1a. S3d allows record bias voltage to the right channel head L1b. S3c allows a D.C. voltage to ignite the record indicator light.

The Selector S4 controls the amplifiers for the type of recording or playback desired. Stereo, Monaural 1 and Monaural 2 may be selected. In addition it serves as the power ON-OFF switch. Power is supplied when the selector is in either the Stereo, Monaural 1 or Monaural 2 position.

S10 controls the direction of the motor. It may be activated manually, by changing the position of the reverse lever, or automatically when a signal is supplied to the reversing solenoid via the reversing circuitry.

S9 is controlled by the tape. When tape is placed in the transport guide path, S9 closes which allows a voltage across L402 play solenoid.

The head switch S1 is controlled by the reverse lever linkage. When the Reverse Lever is located in the right hand position the forward record-play head is used, for record or playback, depending on the mode of operation. When the Reverse Lever is located in the left hand position the reverse play head is used for playback only.

RECORD CIRCUIT

In the Record mode an audible source of sound is introduced to the microphone, or an inaudible signal is applied through connector cables to the line input receptacle. Sound, when introduced to the microphone, is transformed by the microphone element into an electrical current. This signal is fed by switch S5b through capacitor C102 to the pre-amplifier transistors Q101 and Q102. The output of Q102 is fed through capacitor C104 to capacitor C105 and resistor R111. This provides record equalization. Capacitor C113 and resistor R122, in the emitter circuit of Q103 also provide record equalization. The output of Q102 is applied to Q103 for additional amplification. The signal from the collector of Q103 is applied through

capacitor C110 to series resonant, 67kc, components C112, and L102. The signal from Q103 is also applied to the parallel resonant circuit, 67kc trap, components coil L101 and capacitor C109. The signal from the parallel resonant circuit C109 and L101 is fed through switch S3a and applied to the record head, section L1a. Bias current is applied at the same time via resistor R103 and switches S3a and S1a. Signal from the volume control, in addition to being applied to transistors Q104 and Q105. Transistor Q105 is a meter driving device when in the Record mode of operation. Rotating R121 varies the deflection of meter M101 when in the Record mode.

CIRCUIT DESCRIPTION (continued)

PLAYBACK CIRCUIT

In Playback when the magnetized tape passes the Playback head an electrical current is induced corresponding to the recorded pattern on the tape. This current is fed through switches S1a, S2 and S5 to the pre-amplifier transistors Q101 and Q102 where the signal is amplified. The amplified signal is then coupled by capacitor C104 to capacitor C107 and resistors R113 and R114 to provide playback equalization through negative feedback. From Q102 the signal is applied to resistor R114 which controls volume. From the Volume Control the signal is applied to transistor Q103 for additional amplification.

On the 1160 and 1165 models the signal from transistor Q103 is applied to the bass boost components, resistor R125, switch S7a and capacitor

C114. When switch S7 is closed the frequency response is flat. If switch S7 is open, capacitor C114 appears as a high reactance to low audio frequencies, (200 cps and lower). Since the impedance is higher at low audio frequencies an increase in bass response is accomplished. With frequencies above 200 cps the reactance of capacitor C114 is lower and the total impedance is primarily the resistance of R125. The high frequencies are therefore smaller in amplitude than low frequencies.

On the 1150 and 1180 Models the output of transistor Q103 is applied to transistor Q104. Q104 output drives Q105. The output of Q105 is applied to the left channel line output jack.

REVERSING CIRCUIT

In Playback a 20 cycle signal is introduced either through the left channel forward play head or left channel reverse play head. The signal from the head is fed through head switch S1a to switch S2 and from switch S2 to Switch S5b. The signal from switch S5b is fed through capacitor C102 to preamplifier transistors Q101 and Q102. The output from Q102 is fed through capacitor C104 to resistor R401 and from R401 through capacitor C402. The output of C402 is fed through transistor Q401 for additional amplification. The signal from Q401 is coupled to transistor Q402 via capacitor C403 and resistor R406. At this point all frequencies other than 20 cycles are filtered to

ground by Components C404, C405, C406, R407, R408, R409 and R411. The remaining 20 cycle signal is fed through transistor Q402 where it is amplified further. From transistor Q402 the signal is fed through capacitor C407. At this point the signal is changed from A.C. to D.C. by rectifiers CR403 and CR404. From CR404 the D.C. pulse is amplified by transistors Q403, Q404 and Q405. The voltage from Q405 engages L401 reversing solenoid. In Record the 20 cycle signal is introduced by the changing magnetic field through L103. When switch S4a reverse signal lever is placed in the Reverse Signal position the 20 cycle is fed to the record head by way of resistor R123, coil L101 and switches S3a and S1a.

ELECTRICAL CHECKS AND ADJUSTMENTS

HEAD REPLACEMENT

1. When it is necessary to replace a head you must remove the head cover, front trim panel, and cover plate assemblies.
2. Remove the head bridge assembly by removing the three mounting screws. See Figure 19.
3. Lift the head mounting assembly away from the transport and remove the three screws securing the defective head to the head casting.
4. Unsolder the four wires from the defective head noting the exact terminal from which each individual wire is removed.
5. Resolder the wires to the proper terminals of the replacement head, using 15 watt newly tinned soldering iron. Do not hold the iron to the head terminals for more than a few seconds to prevent damage to the new head.
6. Install the new head assembly to the head mounting casting making sure the mounting springs are re-installed to allow for head alignment.
7. Re-install the head bridge assembly on the recorder.
8. Realign the new head. See Head Alignment instructions.

ELECTRICAL CHECKS AND ADJUSTMENTS (continued)

HEAD REPLACEMENT (continued)

Because the 121, 890 and 1100 series recorders play in the forward and reverse direction, the heads must be matched within specified toler-

ances to avoid changes of volume. Both the play and the play/record heads are marked to indicate their interchangeability.

HEAD REPLACEMENT TABLE

The heads in the left hand table may be mated with heads in the right hand table and vice-versa. No other combinations may be made.

MATCHING CHART

50 = 50, 6-	7+ = 8-, 80, 9-
5+ = 6-, 60, 7-	8- = 6+, 70, 7+
6- = 50, 5+, 60	80 = 7+, 80, 8+, 9-
60 = 5+, 6-, 60, 7-	8+ = 80, 9-, 90
6+ = 7-, 70, 8-	9- = 7+, 80, 8+
7- = 5+, 60, 6+	90 = 8+, 90
70 = 6+, 70, 8-	

PREFERRED MATCHING ORDER

50 = 6-	60 = 60	7+ = 8-
50 = 50	6+ = 7-	80 = 7+
5+ = 6-	6+ = 8-	80 = 9-
5+ = 7-	70 = 8-	80 = 8+
60 = 6-	70 = 6+	80 = 80
60 = 7-	70 = 70	8+ = 90
60 = 5+	7+ = 9-	90 = 90

HEAD ALIGNMENT

Record and Reproduce Heads

1. Thread the reproduce alignment tape, Ampex part number 31321-04, on the recorder and adjust the head alignment screws so all plains of the head are perpendicular to the tape. The face of the head must be exactly parallel to the oxide surface of the tape. The brass liners of the head must be visible when looking at the head with tape on the transport. The upper edge of the top pole piece should just come to the upper edge of the tape. See fig. 18.
2. Connect the VTVM to the line output jacks.
3. Advance the transport to the 3kc tone on the tape. Play the tone and adjust the alignment screws for equal output at each channel.
4. Advance the transport to the 15kc tone. Play the tone and adjust the azimuth adjust screw for maximum output on the VTVM.
5. Turn the reproduce alignment tape over. Place the recorder in reverse play and follow steps one through four to align the reverse play head.

Erase Head

1. Place a blank tape on the recorder and adjust the three alignment screws so head height is correct and head gaps are at right angles to the tape.
2. Connect the audio oscillator to the recorder line inputs and adjust for .5 Volt, 500 cycle, input.
3. Place the recorder in the Stereo Record Mode and adjust the Volume Controls for zero (0) indication on the record level meters.
4. Connect the VTVM to the recorder line outputs.
5. Advance the recorder volume controls for a 7 db increase on the VTVM.
6. Place the recorder in the Record Mode and record to counter reading 010.
7. Rewind to counter reading 000.
8. Turn the Volume Controls to minimum and record to counter reading 010.
9. Rewind to the beginning of the tape and playback with the Volume Controls at maximum clockwise position. The erased portion of the tape shall be 52db less than recorded portion.

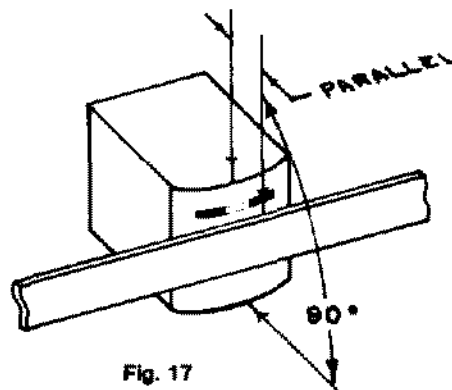


Fig. 17

ELECTRICAL CHECKS AND ADJUSTMENTS (continued)

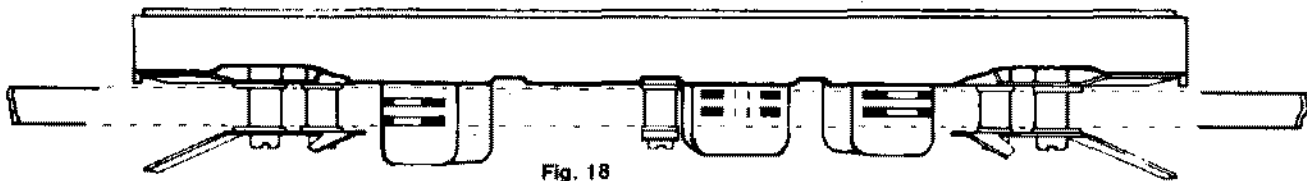


Fig. 18

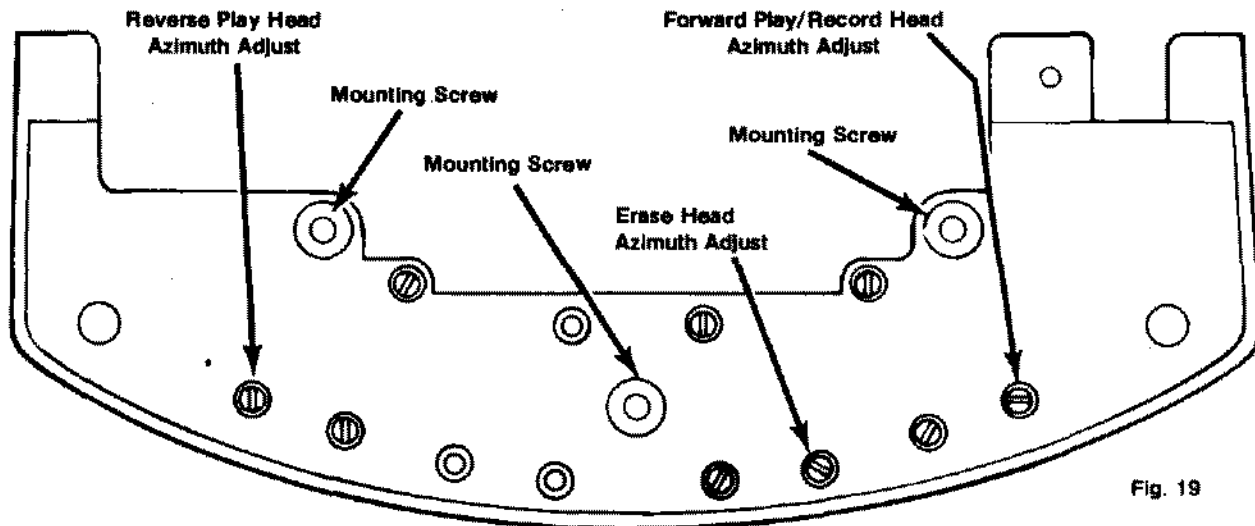


Fig. 19

CROSS-TALK

1. Place the Mode Selector Switch in Stereo.
2. Place the Record Play Switch in Record.
3. Place the Tone Control at 7-1/2. On 890, 1160, 1163 and 1165 models, pull up on the Tone Control to disengage the bass boost circuit.
4. Connect the VTVM to the line outs with noise filters in meter circuit.
5. Connect the audio oscillator to the line inputs and adjust for .5 volt @ 5,000 C.P.S.
6. Adjust the recorder Volume Controls for zero (0) reading on the record level meters.
7. Remove the oscillator from the input of the right channel and record to counter reading 010.
8. Rewind to counter reading zero (000) and play back. Observe reading on VTVM. Output on erased channel, (right channel), shall be 38 db below recorded channel, (left channel). Repeat for opposite channel. Specifications are the same.

STANDBY NOISE AT LINE OUT

1. Place the Mode Selector Switch in Stereo.
2. Place the Record Play Switch in Play.
3. Adjust the Tone Control to the 7-1/2 ips position. On the 890, 1160, 1163 and 1165 models, pull up on the Tone Control to disengage the bass boost circuit.
4. Set the Speed Selector to 7-1/2 ips.
5. Connect the VTVM to the left channel line output with noise filter in meter circuit.
6. Turn the left channel Volume Control fully clockwise and note reading on VTVM.
7. Turn left channel Volume Control fully counterclockwise and note reading on VTVM.
8. Playback noise shall be less than 25MV with Volume Control in clockwise position and less than .44MV in counterclockwise position.
9. Connect the VTVM to the right channel line out and note reading when adjusting the right channel Volume Control. Specification is the same.

ELECTRICAL CHECKS AND ADJUSTMENTS (continued)

RECORD LEVEL METER CALIBRATION

1. Place the Mode Selector Switch in Stereo.
2. Place the Record Play Switch in Play. Do not press the Record button.
3. Turn the Volume Controls to the maximum clockwise position.
4. Connect the audio oscillator to the line inputs.
5. Connect the VTVM across the output of the oscillator.
6. Adjust the oscillator for .15 Volt. @ 500 cps.
7. Adjust R121 and R221 meter calibration pots for zero (0) db reading on record level meters.

BIAS ADJUSTMENT

1. Set the Mode Selector switch in Stereo.
2. Set the Record Play switch in Record.
3. Turn the Volume Controls to maximum clockwise position.
4. Connect the 100 to 1 divider probe to the VTVM.
5. Depress the Record Button.
6. Connect the meter probe to point E104, schematic reference, and adjust R103 for .25 volt reading on the VTVM.
7. Connect the meter probe to point E204, schematic reference, and adjust R203 for .25 volt reading on the VTVM.

NOTE: BIAS AT THE RECORD HEADS SHALL BE 25 VOLTS \pm 1 VOLT.

BIAS TRAP ADJUSTMENT

1. Test conditions are the same as those in steps one through five of bias adjustment procedures.
2. Connect the meter probe to point E109, schematic reference, and adjust the left channel Bias Trap, capacitor C109, for maximum rejection; minimum reading on the VTVM.
3. Connect the meter probe to point E209, schematic reference, and adjust the right channel Bias Trap, capacitor C209, for maximum rejection; minimum reading on the VTVM.
4. Repeat the procedures in step two.

NOTE: BIAS VOLTAGE AT THE COLLECTORS OF Q103 and Q203 SHALL NOT EXCEED .5 VOLT.

POWER AMPLIFIER GAIN CHECK

1. Disconnect the wiper wire on the volume controls; (center terminal on the printed circuit board).
2. Connect a 15 ohm 10 watt resistor across the speaker output jack.
3. Connect the oscillator to the printed circuit board at the point where the wire from the left channel volume control was removed.
4. Adjust the oscillator for a 500 cycle .068 volts.
5. Connect the VTVM and oscilloscope to the left channel speaker output jack.
6. The Tone control should be in center rotation with Bass Boost up. (No Bass Boost)
7. Place the Stereo-Mono switch in Stereo.
8. Place the Record-Play control in Playback.
9. The VTVM should indicate 8.4 volts + or - 3db. The oscilloscope should show no clipping.
10. Connect the oscillator to the point on the printed circuit board where the right channel volume control wiper wire was removed.
11. Connect the meter and scope to the right speaker output with 15 ohm load resistor in circuit. Specification for right channel output is the same.

ELECTRICAL CHECKS AND ADJUSTMENTS (continued)

NOTE:

The following Preliminary Set Up is necessary before checking record amplifier gain, record amplifier clipping level, and record level meter tracking.

1. Substitute a 1000 ohm resistor for each section of the record head by disconnecting the wires going to test points E104, left channel, and E204, right channel. Connect the 1000 ohm resistors from these wires to chassis ground. Outputs are measured across the resistors unless otherwise specified.
2. Turn the volume controls to a maximum clockwise position unless otherwise stated.
3. Turn the Off-Stereo-Mono switch to Stereo.
4. Set the Play-Record control to Record. The Record button is not depressed.

RECORD AMPLIFIER GAIN CHECK

1. Connect the oscillator through a 100/1 voltage divider to the left channel microphone connector. This is accomplished by connecting a 100K ohm and a 1K ohm resistor in series across the output of the oscillator. The 1K ohm resistor is connected to the ground side of the osc. terminal. Output to recorder is taken across the 1K ohm resistor.
2. Adjust the Osc. for 500 cycles at .0011 volts and feed to the left microphone input. Indication shall be .048 volts, + or - 2 db with meter connected to left channel 1K ohm resistor substituted for head.
3. Connect the oscillator to the left channel line input receptacle.
4. Adjust the oscillator for 500 cycles at .155 volts. The output across the left channel 1K resistor should be .048 + or - 3db.
5. Repeat the above procedures for right channel checks.

RECORD AMPLIFIER CLIPPING LEVEL

1. Connect the oscillator to the left channel line input receptacle.
2. Connect the oscilloscope across the left channel 1000 ohm resistor.
3. Adjust the oscillator for 500 cycles at a level necessary to give .49 volts at the left channel line output receptacle. The oscilloscope should show no clipping.

RECORD LEVEL METER TRACKING

1. Connect the meter to the left channel 1K ohm resistor.
2. Connect the oscillator to the left channel line input receptacle.
3. Adjust the oscillator for 500 cycles and output necessary to give exactly zero indication on the record level meters.
NOTE: This is zero reference.
4. Vary the oscillator frequency from 100 cps to 10,000 cps. At any frequency keep the recorder level meter indicating at zero. This is accomplished by reducing the gain of the oscillator. At all frequencies the VTVM must always indicate within + or - 4db of reference.
NOTE: If the VTVM indication was .048 volts when 500 cycles was applied then this is reference level and is considered as 0 level. Suppose when the 100 cycle signal was applied and the input was adjusted so the record level meters indicated zero, the VTVM indicates -4db from .048 volts. This shows the record level meter is 4db high at 100 cycles but is in specification since the limit is 4db.
5. Repeat the above procedures for right channel checks.

PREVENTING RF INTERFERENCE

To prevent RF interference the following components are added to the printed circuit board, and are available in kit number 7850044-01.

2	7510083-01	resistors, 10k, 10%, ¼ watt
2	7510132-01	resistors, 2.2k, 10%, ¼ watt
2	7540059-01	capacitors, 680pf, 10%, 1kv

To make the conversion the amplifier must be completely removed from the recorder assembly.

PROCEDURE

1. Remove the recorder assembly from the case.
 2. Remove the amplifier as follows:
 - a. Remove the control knobs and control plate assembly.
 - b. Remove the amplifier chassis cover.
 - c. Remove the head casting assembly from the recorder assembly leaving the head cables intact.
 - d. Place the head assembly in a plastic bag for protection against scratches.
 - e. Separate the mate-n-lock connectors to free the amplifier connector cables from the recorder assembly.
 - f. Remove the main screws which secure the amplifier to the picture frame casting.
 - g. Route the amplifier and head casting free from the recorder assembly.
 3. Remove the four (4) screws from the capacitor plate assembly and route the assembly away from the amplifier to expose the printed circuit board.
 4. Separate the foil between points A and B and points C and D. See Figure 20.
 5. Solder the two (2) 10k resistors and the two (2) 680pf capacitors to the foil side of the printed circuit board at the points indicated in Figure 21.
- NOTE:** The leads of the components should only be as long as necessary to connect from point to point. Use only a 15 watt pen type soldering iron.
6. Reinstall the capacitor plate assembly to the amplifier assembly.
 7. Solder the two (2) 2.2k resistors to the component side of the printed circuit board as follows:
 - a. Disconnect the wires connecting the wiper of the volume controls to the printed circuit board. The wire should be cut close to the printed circuit board; just at the top of the terminal post.
 - b. Solder a 2.2k resistor to each terminal post then solder the wire from the volume control wiper to the other side of the resistors. The resistor leads should be kept as short as possible. See Figure 22.
 8. Reassemble all parts to the recorder.

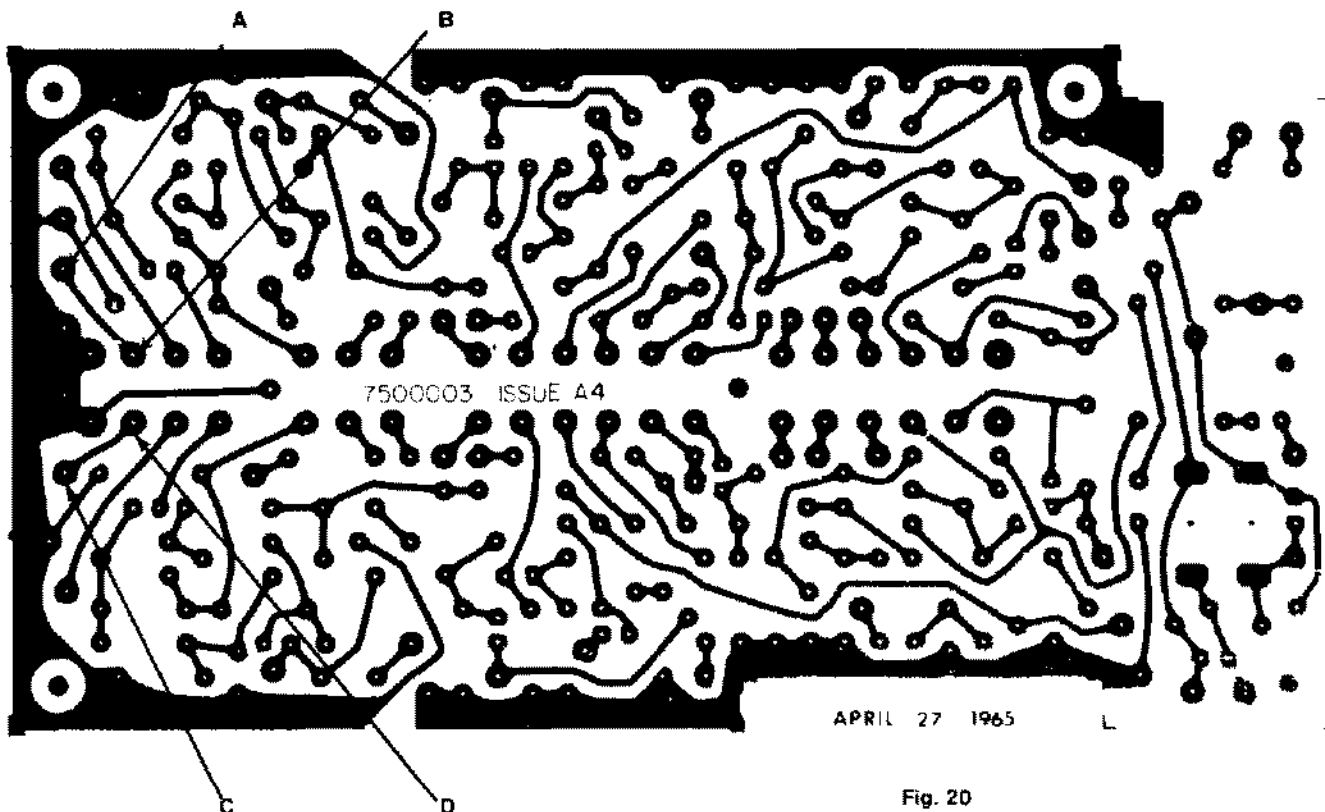


Fig. 20

PREVENTING RF INTERFERENCE (continued)

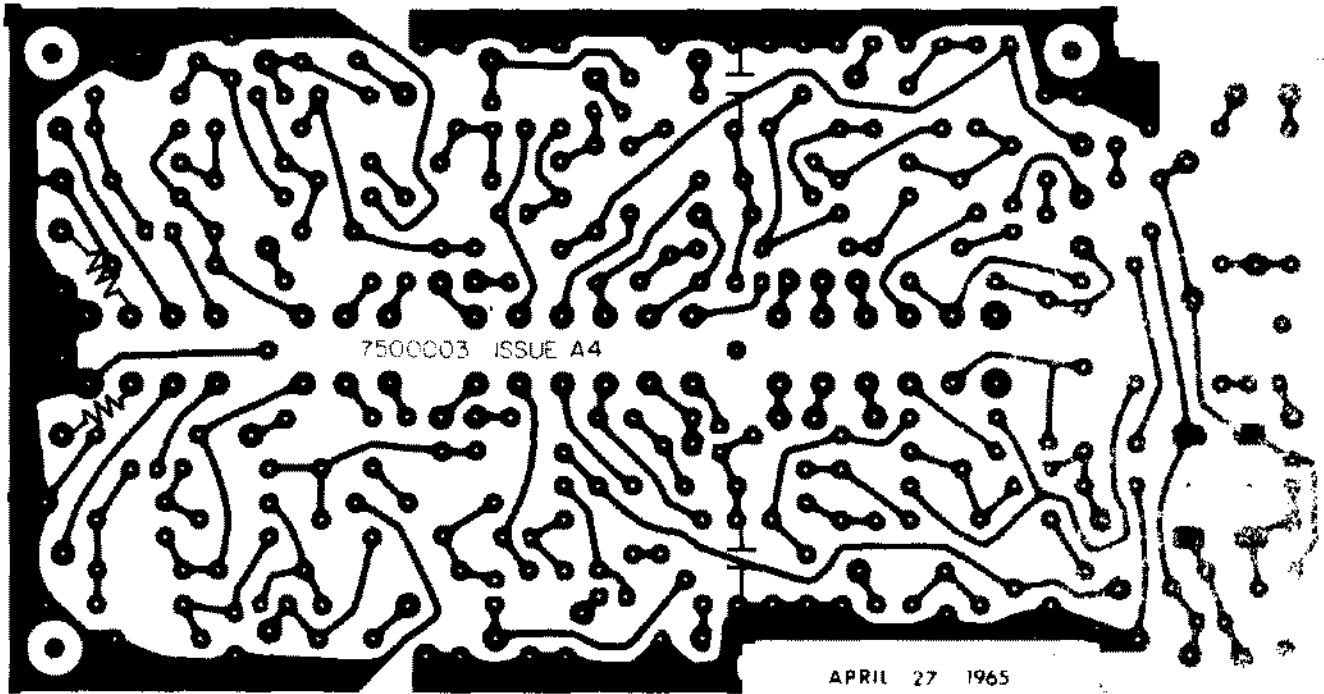


Fig. 21

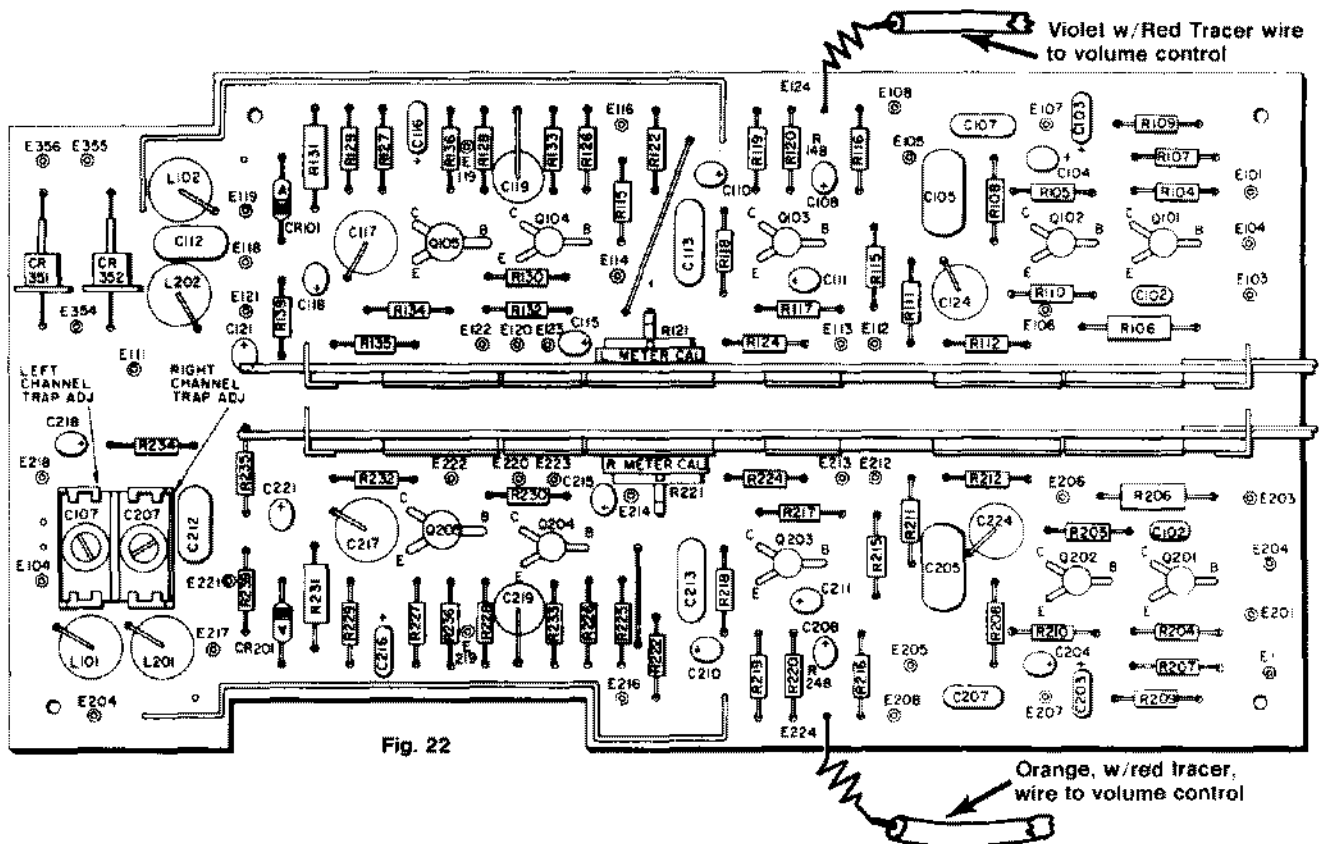


Fig. 22

TRANSISTOR DC VOLTAGES

Measured with respect to chassis with high impedance (10 megohm or higher) VTVM. All voltages are $\pm 20\%$ with no signal applied.

TRANSISTOR	ELEMENT	PLAY	RECORD
Q101, Q201	Emitter Base Collector	.03 .6 2.3	.03 .6 2.25
Q102, Q202	Emitter Base Collector	1.7 2.3 13.5	1.7 2.3 12.8
Q103, Q203	Emitter Base Collector	6.1 6.7 13.0	5.9 6.5 12.6
Q104, Q204	Emitter Base Collector	.08 .6 5.7	.07 .6 5.6
Q105, Q205	Emitter Base Collector	5.0 5.6 21.5	5.0 5.6 20.5
Q106, Q206	Emitter Base Collector	39.0 38.7 18.5	37.0 36.5 17.5
Q107, Q207	Emitter Base Collector	18.4 18.3 0	17.4 17.3 0
Q301	Emitter Base Collector	0 0 0	1.45 1.1 24.0
Q302	Emitter Base Collector	0 0 0	1.45 1.1 24.0
Q401	Emitter Base Collector	.9 1.5 3.3	0 0 0
Q402	Emitter Base Collector	.15 .8 9.0	0 0 0
Q403	Emitter Base Collector	0 0 4.3	0 0 0
Q404	Emitter Base Collector	.65 1.3 .9	0 0 0
Q405	Emitter Base Collector	.65 .9 40.0	0 0 0