AMPEX 351

series 351 full track and half track recorder/reproducer
series 351-2 two track stereophonic recorder/reproducer

TM 2002

model 351

recorder
reproducer

OCTOBER 1959

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DESCRIPTION AND PERFORMANCE CHARACTERISTICS

GENERAL

The AMPEX Series 351 Magnetic Tape Recorder/Reproducers are high quality precision instruments designed for the professional user who requires the finest and most faithful recording and reproduction.

A basic recorder/reproducer in the 351 series consists of a tape transport for operation at tape speed pairs of 3¾ inches per second (ips) and 7½ ips or 7½ and 15 ips; a head assembly for use with the ¼-inch magnetic tape; and an electronic assembly which contains the record amplifier, reproduce amplifier, bias and erase oscillator, and power supply — all featuring etched board construction.

NOTE

This manual is primarily intended for recorders using Ampex Catalog Number 30960 electronics. In instances where there are significant differences between this electronics assembly and earlier models using Catalog Number 30750 or 30950 electronics an appropriate notation will be found.

Head assemblies for either full (single) track, half track or two track stereophonic (351-2) operation are available.

CCIR equalization can be obtained on request

when ordering equipment.

Several mounting arrangements are offered —console, two case portable, and rack mount. In the portable equipment, one case contains the tape transport and the other houses the electronic assembly.

PERFORMANCE CHARACTERISTICS

Tape Width — ¼-inch

Tape Speed Pairs — 3¾-7½ ips
7½-15 ips

Frequency Response

Speed (ips)	*Response (Cycles per second)*
3¾	±2 db 50 to 7,500
7½	±2 db 40 to 10,000
	±4 db 30 to 15,000
15	±2 db 30 to 15,000

Signal-to-Noise Ratio

Speed (ips)	*Peak Record Level to Unweighted Noise (db)*
3¾	50
7½	60 full track
	55 half track or two track
15	Same as 7½ ips

Peak record level is that level at which the overall (input to output) total rms harmonic distortion does not exceed 3 percent when measured on a 400 cycle tone. Noise is measured when erasing a signal of peak recording level in the absence of new signal. Bias, erase and reproduce amplifier noise are included in the measurement. All frequencies between 50 and 15,000 cycles are measured.

Flutter and Wow

Speed (ips)	*Flutter and Wow (percentage rms)*
3¾	.25%
7½	.2 %
15	.15%

Flutter and wow measurements include all components between 0 and 300 cycles using an rms value of constant amplitude sine wave flutter.

Recording or Reproducing Time (NAB 10½ Inch Diameter Reels, 2400 feet of tape)

	Half Track		*Full Track*	
Speed (ips)	*(hrs)*	*(min)*	*(hrs)*	*(min)*
3¾	4	16	2	8
7½	2	8	1	4
15	1	4		32

Starting Time — The tape is accelerated to full speed in less than 1/10 of a second.

Stopping Time — When operating at 15 ips, the tape moves less than two inches after the STOP button is pressed.

Reproduce Timing Accuracy

Accuracy (percentage)	*Accuracy (second)*	*Length of Recording (min)*
±.2%	±3.6	30

Rewind Time — Approximately 1 minute for a full 2,400 foot NAB reel.

Controls

Tape Motion — All tape motion is controlled by four pushbuttons, PLAY, STOP, FAST FORWARD and REWIND.

Record Control — A separate RECORD button on the face of the electronic assembly, when pressed, energizes the record relay which drops out when the STOP button is pressed. The stereophonic function (two track) is controlled by pressing the RECORD buttons on both electronic assemblies simultaneously. In two track operation, for consistency, the master electronic assembly is usually connected to the upper track in the head assembly so that, when the RECORD button on the master (only) is pressed, recording takes place on the upper track.

Tape Speed — Tape speed can be changed by the TAPE SPEED switch. LOW or HIGH positions are used to select drive motor windings.

Equalization — An EQUALIZATION switch on the face of the electronic assembly provides a means for selecting LOW or HIGH speed equalization appropriate to the tape speed used.

Reel Size — A REEL SIZE toggle switch on the tape transport makes possible selection of the proper tape tensioning for the NAB 10½ inch diameter reel or the EIA 5 inch and 7 inch reels.

Record Inputs — The INPUT TRANSFER SWITCH provides a means for selecting three different types of inputs:

Input	*Input Impedance*	*Minimum Input Signal that will produce Operating Level (1% tape characteristic distortion)*
MICROPHONE	150 and 250 ohms nominal (transformer can be strapped for 30-50 ohms nominal.)	150 microvolts
BAL BRIDGE	200K ohms	−10 dbm
UNBAL BRIDGE	100K ohms	−10 dbm

Reproduce Output — Zero indication on the v-u meter corresponds to +8 dbm (±1 db). Sufficient gain and power handling capabilities exist to feed a +14 vu line output into 600 ohms balanced or unbalanced. The center tap of the output transformer can be strapped to ground for balanced output. Plus 4 vu also can be obtained by strapping. (See INSTALLATION).

Head Housing — The erase, record, and reproduce heads are contained in a single head housing (See SECTION 6 on HEAD ASSEMBLIES).

Monitoring (aural and visual) — The signal on the tape can be monitored while the equipment is recording. Two phone jacks are available to allow monitoring the record input signal, or the output signal from the reproduce head. A switch provides a means for making direct comparison between the original program and the recorded program. The same switch transfers a 4 inch vu meter for level comparison and visual monitoring. The vu meter also is used to indicate bias and erase current.

Power Requirements

The half track and single track equipment requires 2.0 amperes at 117 volts ac and is available for 50 or 60 cycle line frequency. Two track equipment requires 2.5 amperes at 117 volts ac, 50 or 60 cycles.

When the Ampex Model 375 Precision Frequency 60 cycle amplifier is used with the equipment, power requirements are greater by 2.5 amperes: single track equipment 4.5 amperes; dual track 5.0 amperes.

EQUIPMENT AVAILABLE

Dimensions and Weight (in.) (lb.)	*Item*	*Height*	*Depth*	*Width*	*Weight*
Rack Mount	Tape Transport	15¾ (rack space)	8 (behind rack)	19	50
	Electronic Assembly	7 (rack space)	8½ (behind rack)	19	18
Console	Console	48 (max)	28½ (max)	24½	155
Two Case Portable	Tape Transport Case (Equipment in Case)	15½	17	20¼	69
	Electronic Ass'y. Case (Equipment in Case)	9	13	21	38
	Two Track Stereophonic Electronic Ass'y. Case (Equipment in Case)	16½	13	21	80

Remote Control

Part Numbers for Remote Control units are located in the Electronic Section Parts List.

INSTALLATION

NOTE

Before operating the equipment read this SECTION AND SECTION 3, OPERATION.

GENERAL

The 351 Series equipment is shipped mounted in consoles or portable cases after a thorough inspection and performance check at the factory. In the event that the equipment is requested disassembled, for customer rack mounting, all assembly hardware is provided.

INTERCONNECTING

See the appropriate interconnecting diagrams at the back of this section.

MOUNTING

Console Models

To assemble the console model proceed as follows:

Step 1: Install the tape transport in the cabinet frame, securing the 8 oval-head screws and finishing washers.

Step 2: Place the two springs in the holes for the electronic assembly cabinet frame.

Step 3: Attach the two rails to the electronic assembly using the number 8 screws.

Step 4: Slide the cabinet back panel up and out to allow connecting of the a-c power cable and plug the input cable and the output cable into their receptacles on the back of the electronic

Ampex Series 351 Recorder/Reproducer—¾ View

assembly.

Step 5: Install the electronic assembly, tightening the four knurled nuts to fasten it to the frame.

Step 6: Connect the captive head cables at their locations on the electronic assembly.

Step 7: Connect the captive CABLE TO ELECTRONICS to the electronic assembly.

Step 8: Replace the back panel, making certain that all cables run freely through the semi-circular cut-outs at the bottom of the sliding panel.

Two Case Portable Models

(For 351-2 see the applicable INTERCONNECTING illustration at the back of this SECTION).

The two case portable models are shipped in a ready to operate condition, except for the connection of interconnecting cables. Convenient rubber feet are located at both ends of each case, and metal rests are provided on the backs of each case. To set up the equipment follow these steps:

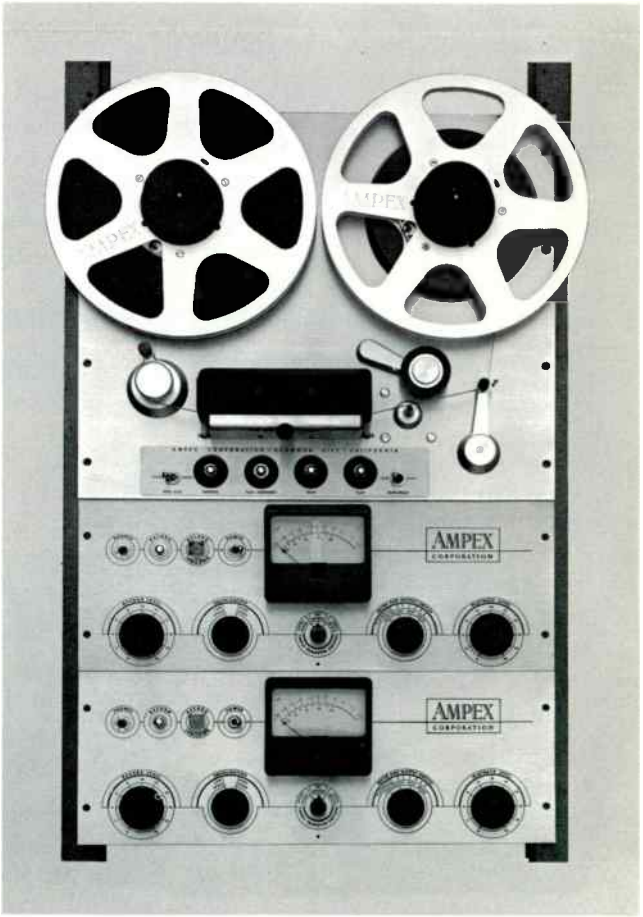
Step 1: Arrange the cases so that the mechanical assembly case is to the right of the electronic assembly case.

Step 2: Unlatch and remove the top cover and the side access door on the mechanical assembly case.

Step 3: Unlatch and remove the front and rear covers on the electronic assembly case.

Step 4: Uncoil the interconnecting cables from behind the cable access door on the tape transport case and plug them into mating receptacles at the rear of the electronic assembly.

Step 5: Connect the a-c power, and the input and output to the rear of the electronic assembly.



Rack layout (Model 351-2)

Rack Mounted Models

Mount these versions of the equipment on a standard 19-inch relay rack with the mechanical assembly above the main electronic panel.

POWER CONNECTION

Connect the power cable from the a-c POWER input connector, J8, on the electronic assembly to a convenient 115 volt a-c power source.

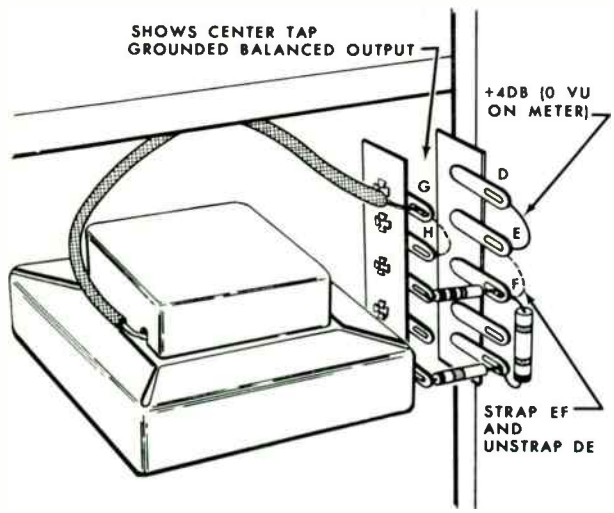
OUTPUT

A mating connector for LINE OUTPUT is supplied. The user must fabricate his own cables, using the connectors supplied with the recorder.

Studio Line

Plus 8 v-u, 600 ohm line output, balanced or unbalanced, is available across terminals 2 and 3 of the line out connector, J5. Pin 1 is the chassis ground.

If unbalanced output is desired, wire the mating connector so that the pin 2 side of the line is tied to ground or tie A to B at TS1. Supply 600 ohm termination to this output at all times to maintain correct meter calibration while recording or reproducing. If the output is not feeding a terminated line, or if the output is not connected, such as on remote pickups, the line out termination switch, S4, must be left in the ON position.



Center tap grounded balanced output and strapping for 4VU output.

To obtain a center tap, grounded balanced output, strap the black lead of transformer T3 to ground at the tie point shown in the illustration.

Plus 4 v-u output can be achieved by unstrapping D and E at transformer T3 and strapping E to F. Readjust the record calibration according the to instructions in SECTION 7 ALIGNMENT AND PERFORMANCE CHECKS.

High Impedance Amplifier Input

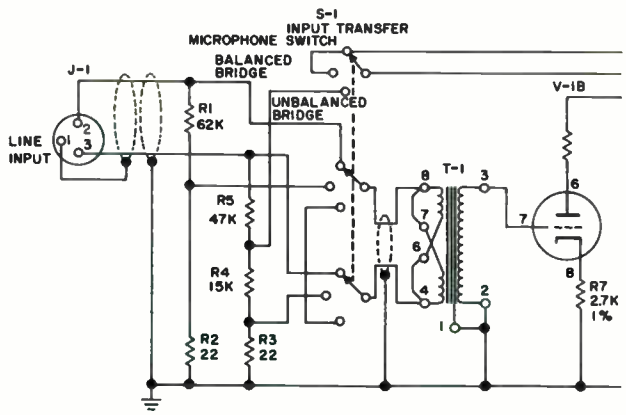
Wire the mating connector so that pin 3 of the line out connector, J5 is connected to the high side of the amplifier input. Strap pins 1 and 2 of the mating connector for connection to the ground side of the amplifier input. The line out termination switch S4, must be left in the ON position at all times.

INPUT

During this discussion refer to the foldout illustration — Schematic Diagram-Electronic Assemblies at the back of SECTION 7.

Microphone Input

Any low impedance microphone having a nominal impedance between 30 and 250 ohms can be plugged directly into the equipment. Wire the mating connector so that the microphone is connected to pins 2 and 3 of LINE INPUT, J1. The cable shield must be connected to pin 1. Place the input transfer switch, S1, in the MIC position.



Microphones with 50 ohms or less impedance.

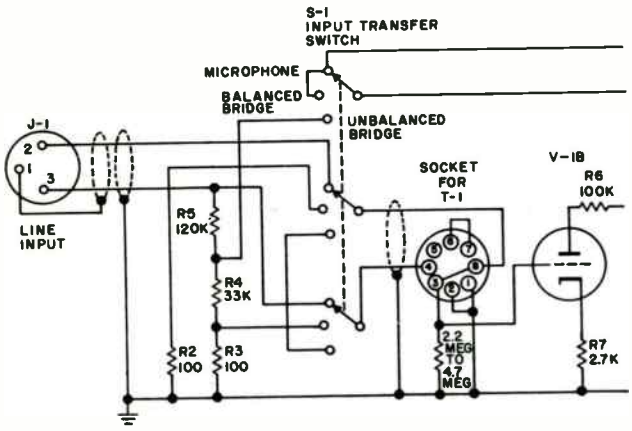
The microphone input transformer is strapped for the optimum step up when using a 150 to 250 ohm source. With microphones of 50 ohms or less impedance, to obtain 6 db additional gain strap the input as shown.

This should be done only if insufficient gain is found to exist when the input is fed from a source impedance less than 50 ohms.

IMPORTANT

To maintain flat response in the balanced bridge condition when the transformer is strapped for 50 ohms, change resistor values of the following:

R1—22K ohms *R3—22 ohms*
R2—22 ohms *R4—3.9K ohms*
R5—18K ohms



High impedance microphone input.

High impedance microphones are not recommended for use in this equipment because, in general, the quality is not satisfactory for professional work. If it becomes necessary to connect a high impedance microphone, the input circuit must be re-wired as shown below:

Step 1: Remove the input transformer T1.

Step 2: Remove the 100K ohm resistor R1 from the switch S1.

Step 3: Between pin 3 and pin 1 on the input transformer socket, connect a resistance the value of which is between 2.2 megs and 4.7 megs.

Step 4: Using a jumper connect pin 3 to pin 8 on the transformer socket.

Step 5: Wire the microphone input connector for connection to pins 1 and 2 (shield to pin 1), and leave pin 3 open.

Bridging a Balanced Studio Line

Connect a balanced line to pins 2 and 3 of the input connector, J1. Pin 1 is ground. Place the input transfer switch, (S401) in the BALANCED BRIDGE position. Input levels of minus 10 to plus 20 v-u can be accommodated. The load placed on the line is approximately 200K ohms.

Bridging an Unbalanced Source

Connect an unbalanced line, radio turner, etc., to pins 1 and 3 of the input connector. Pin 1 is the ground side. Place the input transfer switch S1, in the UNBALANCED BRIDGE position. This connection provides a 100K ohm bridging input for any rms program voltage greater than .25 volt.

Gain Changes in Balanced Bridge or Unbalanced Bridge

An increase of 10 db in balanced and unbalanced bridge can be achieved by changing two resistors. Change R1 to 33K ohms and R5 to 12K ohms. The resulting input impedances will be 66K ohms in the balanced bridge position and 30K ohms in the unbalanced bridge position.

An increase of 14 db unbalanced bridge gain without changing balanced bridge gain can be obtained by shorting out resistor R5 and changing R4 to 100K ohms. Resulting input impedance will be 50K ohms.

For a 10 db increase in balanced bridge gain without changing unbalanced bridge gain, change resistor R1 to 33K ohms, R5 to 27K ohms and R4 to 5.6K ohms. Resulting input impedances will be 66K ohms for balanced bridge and 33 K ohms for unbalanced bridge.

SUMMARY

For Gain Increase	*Component*	*New Value*	*New Input Impedance* BAL BRIDGE	UNBAL BRIDGE
10 db BAL BRIDGE and UNBAL BRIDGE	R1 R5	33K ohms 12K ohms	66K ohms	30K ohms
14 db UNBAL BRIDGE	R5 R4	zero (short out) 100K ohms	200K ohms	50K ohms
10 db BAL BRIDGE	R1 R5 R4	33K ohms 27K ohms 5.6K ohms	66K ohms	33K ohms

PHONES

High impedance head phones must be used. To monitor the incoming line or reproduce output, plug the high impedance phones into phone jack J6 PHONES on the amplifier face panel or J4 MONITOR on the back of the amplifier chassis. The monitor jack J4 is a high impedance unbalanced output isolated from the main line. To preserve low frequency response, feed into an input impedance 50K or higher. To preserve high frequency response the cable should have not over 500 uuf of capacitance.

REMOTE CONTROL

The operation of the tape transport mechanism can be remotely controlled by a Remote Control Unit. The catalog No. 5763-00 or 5763-02 unit is supplied in a wooden case, completely wired and ready to plug into the remote control connector, J502S, on the tape transport circuits assembly. The catalog No. 5763-01 and 5763-03 units are mounted on a flat plate for installation in studio consoles, and are not wired. For Model 351-2, use 5763-02 in the wooden case or 5763-03 mounted on the flat plate. To install, wire as shown in the figure (Schematic Diagram, Remote Control Unit) located in SECTION 5, and plug into J502S.

NOTE

Whenever the remote control unit is not connected, the dummy plug P502P, supplied with the equipment, must be plugged into J502S.

60 CYCLE AMPLIFIER

The Ampex Model 375 Precision 60 Cycle Amplifier can be plugged directly into the equipment at J503S. No other connections are necessary. The Model 375 is used where power sources are erratic and there is need for a precision 60 cycle time base for driving the capstan.

CAUTION

If this unit is used with the Recorder/Reproducer, the control circuit fuse F402 must be increased to 5 amperes.

NOTE

Do not remove the dummy plug P503P unless the 60 cycles amplifier is connected.

OVERALL PERFORMANCE CHECK

(Read SECTION 3, OPERATION before making these checks.)

Make the following equipment performance checks at the time of installation and when necessary thereafter:

REPRODUCE (Playback) LEVEL
REPRODUCE (Playback) RESPONSE
REPRODUCE (Playback) NOISE MEASUREMENT

RECORD CALIBRATION
FREQUENCY RESPONSE
RECORD NOISE MEASUREMENT

NOTE

It should be noted that this machine has been adjusted at the factory to

produce frequency response within specifications when recording on an average tape. In the last few years the high frequency output from tape has improved tremendously. In order to keep pace with these improvements, in the summer of 1959 Ampex sellected a new "average" tape to adjust bias and record equalization. Machines adjusted to the new average tape may be identified by the catalog number of the electronics, No. 30960 representing the revised machine. The 30960 electronics also are adjusted for a 3¾ inches per second (ips) playback response curve incorporating a 120 microsecond turnover.

Complete instructions for making the above checks are given in SECTION 7 ALIGNMENT AND PERFORMANCE CHECKS.

DISTORTION

Overall distortion can be measured by connecting any standard distortion measurement apparatus across the output. The readings from a wave analyzer or selective frequency distortion meter will be more accurate than those from a null type instrument at lower distortion levels. Distortion readings are somewhat dependent on tape. A reading of 1% is normal at operating level while a reading of 3% is normal at 6 db above operating level. Second harmonic distortion is negligible; measured distortion is predominately third order.

FLUTTER AND WOW

Flutter and wow are produced by periodic irregularities in tape speed and appear as cyclic frequency deviations in recording or reproduction. They can be measured by means of any standard flutter bridge. Variations in amplitude as indicated on level measurements do not constitute flutter and are entirely due to tape coating variations. Readings will be near or below .15% rms at 15 inch, .2% rms at 7½ inch, and .25% rms at 3¾ inch speed. The Ampex Professional Products Division primary standard of measurements is based on the use of a flutter meter calibrated to indicate the deviation from mean carrier frequency of any rate between .5 and 300 cps expressed in percent rms. Flutter and wow checks should be made at the peak record level or higher.

INTERCONNECTING

SINGLE TRACK

			From		*To*	
Cable	*Catalog Number*	*Qty.*	*Receptacle*	*Chassis*	*Receptacle*	*Chassis*
A-c	2413-00	(1)	J8 POWER	Electronic Assembly	A-c source	
Power Interconnecting		(1)	J7 TAPE TRANSPORT	Electronic Assembly	CABLE TO ELECTRONICS	Captive at Tape Transport
Reproduce Head		(1)	J3 PLAYBACK HEAD	Electronic Assembly	Captive at Tape Transport	
Record Head		(1)	J2 RECORD HEAD	Electronic Assembly	Captive at Tape Transport	
Erase Head		(1)	J10 ERASE HEAD	Electronic Assembly	Captive at Tape Transport	

PORTABLE SINGLE TRACK

Power Extension	3768-01	(1)	J7 TAPE TRANSPORT	Electronic Assembly	End of Captive Tape Transport power interconnecting cable.	

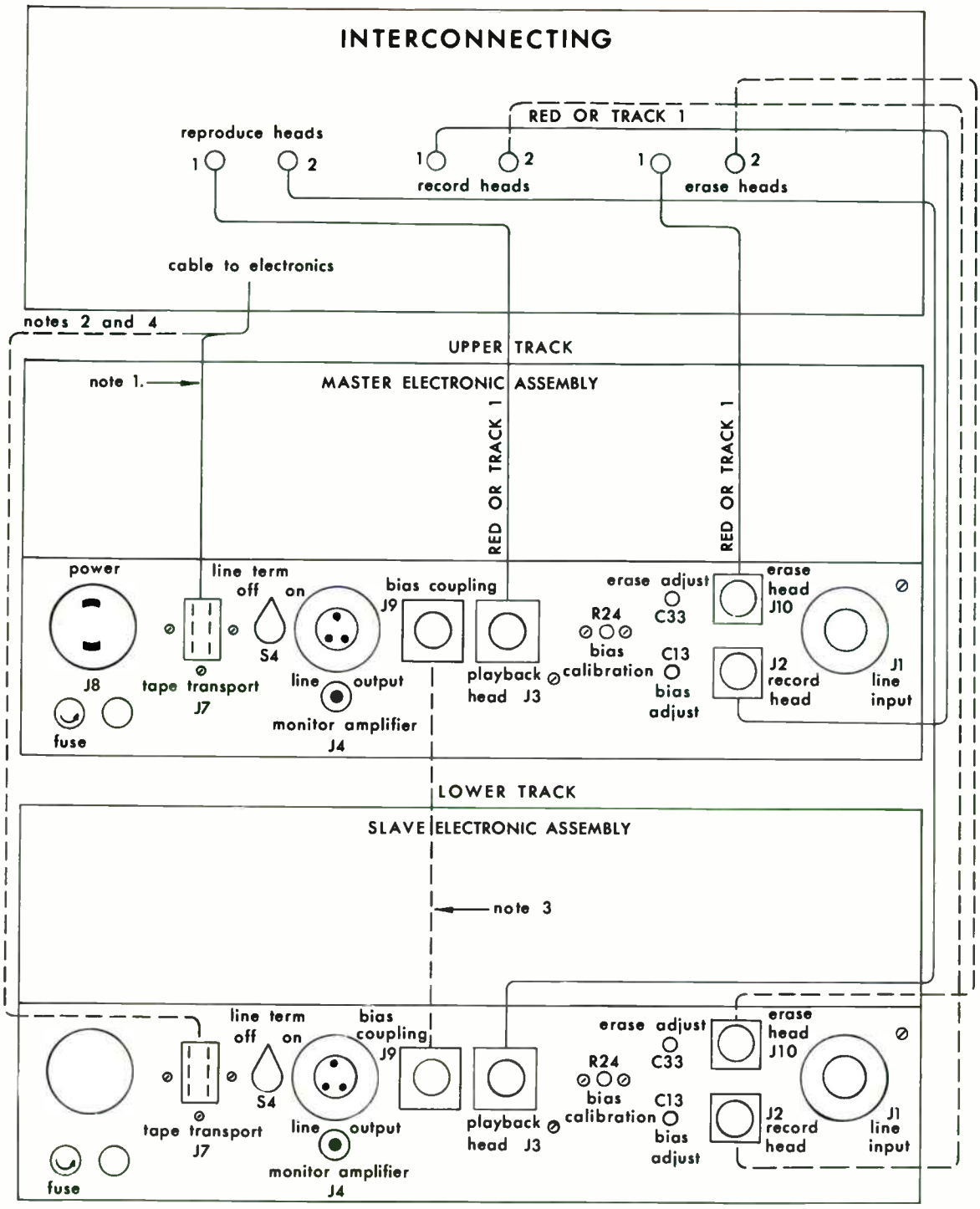
DUAL TRACK EQUIPMENT (Unmounted)

Power Interconnecting	30926-01	(1)	J7 TAPE TRANSPORT	Electronic Assembly 1 and 2	End of Captive Tape Transport power interconnecting cable.	
			From		*To*	
Bias Interconnecting	14943-02	(1)	J9 BIAS COUPLING	Master Electronic Assembly	J9 BIAS COUPLING	Slave Electronic Assembly

DUAL TRACK EQUIPMENT (Portable)

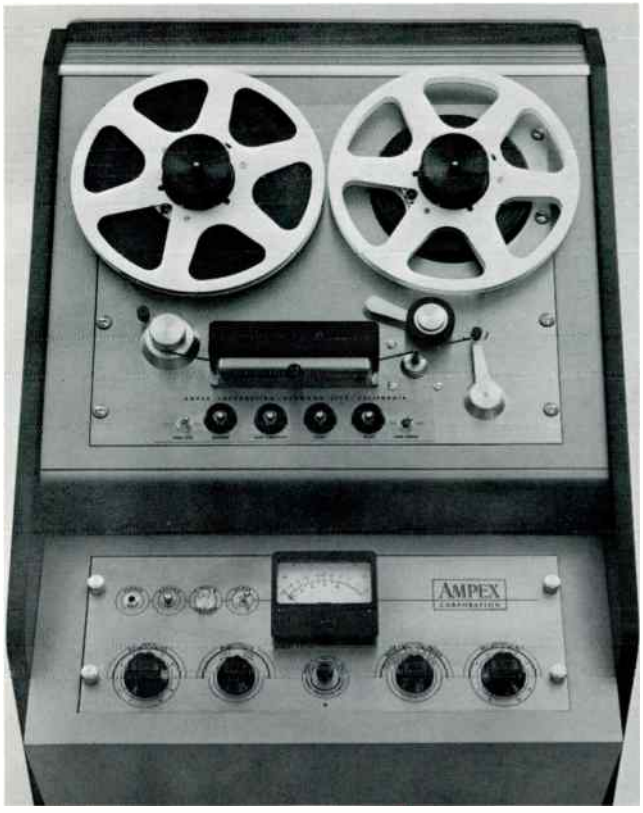
	30926-02		J7 TAPE TRANSPORT	Electronic Assembly 1 and 2	End of Captive Tape Transport power interconnecting cable.	

NOTE: Cables marked with a red band, interconnect in upper electronics for the Model 351-2 only.



NOTES:

1. A 3768-01 POWER EXTENSION CABLE IS USED WITH SINGLE TRACK PORTABLE EQUIPMENT.
2. 30926-01 INTERCONNECTING CABLE IS USED WITH DUAL TRACK STEREPHONIC EQUIPMENT.
3. A 14943-02 BIAS INTERCONNECTING CABLE IS USED WITH PORTABLE DUAL TRACK STEREOPHONIC EQUIPMENT.
4. A 30812-02 POWER INTERCONNECTING CABLE IS USED WITH PORTABLE DUAL TRACK STEREOPHONIC EQUIPMENT.



Model 351 Console

OPERATION

GENERAL

The 351 Series recorder/reproducers are available for full (single) track, half track or two track stereophonic operation. All operating controls are located on the tape transport with the exception of the record control which is on the front panel of the electronic assembly. When the remote control unit is furnished, duplicate tape motion controls, a RECORD button and RECORD INDICATOR light and a TAPE MOTION indicator light are mounted on the remote unit.

The equipment can accommodate the NAB 10½ inch diameter tape reels or the EIA 5 and 7-inch reels. Provision is made for selection of proper tape tensioning at the REEL SIZE switch on the tape transport for the LARGE or SMALL size reels.

NOTE

In the LARGE reel position both the rewind and take-up reels must be NAB type and in the SMALL reel position both reels must be EIA.

Either of two capstan drive motor speeds can be selected at the LOW-HIGH TAPE SPEED switch on the tape transport.

On the front panel of the electronic assembly are facilities for setting RECORD LEVEL and (reproduce) PLAYBACK LEVEL, selecting LOW SPEED or HIGH SPEED EQUALIZATION, selecting three input arrangements by means of the INPUT TRANSFER SWITCH, and switching the vu meter at the METER and

OUTPUT switch so that (reproduce) PLAYBACK, RECORD, BIAS and ERASE LEVEL(S) can be read. A phone jack (PHONES) for monitoring, a RECORD button, a RECORD INDICATOR light, and a POWER OFF-ON switch are also mounted on the electronic assembly front panel.

Another MONITOR AMPLIFIER phone jack and a line termination (LINE TERM) OFF-ON switch are located on the back of the amplifier chassis.

SUMMARY OF CONTROLS, SWITCHES AND INDICATORS

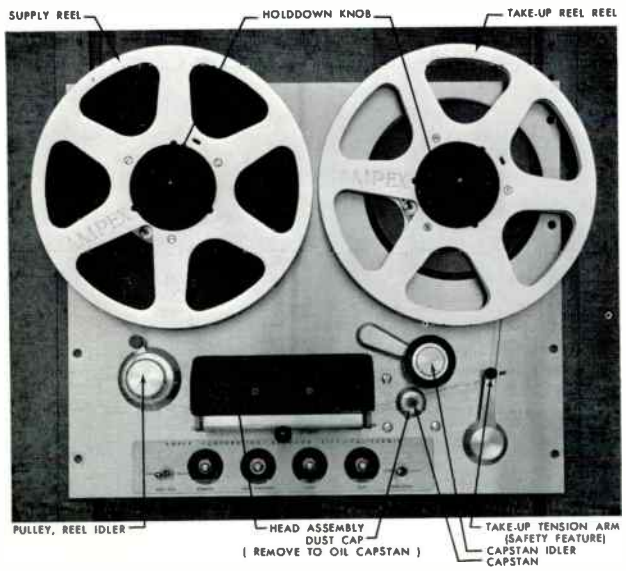
Item	*Schematic Reference Symbol*	*Location*	*Function*
POWER OFF-ON SWITCH	S-5	Electronic Assembly front panel	Controls power to the electronic and mechanical assemblies. When power is on capstan will rotate if tape is properly threaded or the safety switch is mechanically closed. The v-u meter lamps light when power is on, and are unaffected by the safety switch, remaining lighted till the power is turned off. For stereophonic 351-2 operation POWER switches of both electronic assemblies must be in the ON position.
TAPE SPEED	S503	Tape Transport control cluster	Determines speed of the capstan drive motor by high or low speed winding. Used in conjunction with EQUALIZATION switch S2.
EQUALIZATION LOW SPEED HIGH SPEED	S2	Electronic Assembly front panel	Used to select appropriate equalization circuitry for tape speed chosen.
REEL SIZE LARGE SMALL SWITCH	S504	Tape Transport	Adjusts tape tensioning circuitry for the reel size used. The switch is closed when (LARGE position) NAB 10½ inch reels are used. In the SMALL position the switch is open, connecting resistance R502 in series with the torque motors, thereby reducing holdback and take-up tension.
METER AND OUTPUT SWITCH (FUNCTION SWITCH)	S3	Electronic Assembly front panel	Provides a means for switching the meter to read indications of record input, erase and bias, and reproduce output. In the reproduce (PLAYBACK) position, the meter indicates the signal level at the secondary of the output transformer. In the RECORD position the meter indicates a "flat" reading of the input signal. (See Figure of System Block Diagram).
RECORD LEVEL	R9	Electronic Assembly front panel	Adjusts record level.

PLAYBACK LEVEL	R36	Electronic Assembly front panel	Adjusts reproduce level.
VU METER	M1	Electronic Assembly front panel	Provides a means for visually monitoring record input level, reproduce level, and bias and erase.
INPUT TRANSFER SWITCH	S1	Electronic Assembly front panel	Provides a means for selecting the appropriate input circuitry to record with a microphone or from a balanced or unbalanced line.
LINE TERM OFF ON	S4	Electronic Assembly front panel	Controls output termination of the reproduce amplifier. In the ON position a 560 ohm resistor is across the output. In the OFF position, the resistor is out of the circuit and the amplifier must then feed a 600 ohm device.
PLAY button	S505	Tape Transport control cluster	Controls tape motion in the reproduce (PLAY) and record modes. Interlocked with rewind and fast forward modes.
RECORD button	S6	Electronic Assembly front panel	Controls the record relay in the electronic assembly. Power is applied to the bias erase oscillator and to the fourth stage of the record amplifier when this button is pressed. The PLAY button must be pressed to put the tape in motion before the record button is used.
REWIND button	S507	Tape Transport control cluster	Controls the rewind relay. Full a-c power is connected directly to the rewind (supply) motor when this button is pressed, the resistance R504 is placed in the a-c circuit to the take-up motor.
FAST FORWARD button	S506	Tape Transport control cluster	Controls the fast forward relay. Connects full a-c power to the take-up motor and places resistance R504 in the a-c circuit to the rewind motor when this button is pressed.
STOP button	S502	Tape Transport control cluster	When this button is pressed, the brake solenoids and all relays are de-energized.

OPERATING TECHNIQUES

Threading the Tape

Thread the tape as shown in the illustration. Unwind and inspect all new factory wound reels of tape by running them through in the FAST FORWARD mode. New tapes may be looped to the hub in such a manner that the tape will not come free at the end of the reel. This will prevent the safety switch (S501) from disengaging the capstan idler from the capstan, which in turn results in a flat being worn on the capstan idler wheel. (Any adhesive material accumulation on the reel hub may also keep the tape from coming free at the end of the reel, and should therefore be removed with solvent.)



Tape Threading Path

Power

Power is supplied through power switch 4S5, which must be turned on to operate the electronic and mechanical assemblies. The mechanical assembly and electronic assembly are individually fused by the 3 ampere control circuit fuse 5F2 and the ½ ampere electronic fuse 5F1.

Speed Switches

There are two switches associated with operating speed. The tape speed switch S503 determines the speed of the capstan drive motor, and the equalization switch 4S2 changes the equalization in the amplifiers appropriately.

Tape Motion

The tape motion is controlled by means of four pushbuttons labeled REWIND, FAST FWD, STOP and PLAY.

PLAY OR RECORD

The tape is set into play motion at the speed selected by the tape speed switch when the PLAY button S505 is pressed. To change from play to the record mode with the tape in motion, press the record button 4S6 on the electronic assembly.

STOP

To stop the tape while it is moving in any mode, press the STOP button S502. The equipment will stop automatically if the tape breaks or runs off either reel.

FAST FORWARD

The equipment can be started in fast forward or switched to fast forward from any of the operating modes by pressing the fast forward button S506.

REWIND

The equipment can be started in rewind or switched to rewind from any of the operating modes by pressing the rewind button S507.

NOTE

In using either the fast forward or rewind mode, it is desirable to remove the tape from direct contact with the heads by opening the gate of the head assembly. This will reduce wear on the heads and prevent the oxide coating on the tape from depositing on the heads and impairing their performance.

Editing and Cueing

Indexing the tape as in editing or cueing, or when approaching the end of the reel, is simplified by holding down a combination of buttons. Tape motion can be reduced by holding down the fast forward and rewind buttons simultaneously, and then alternating between the two to control tape direction. When the desired point is reached, the STOP button must be held down until the fast forward and rewind buttons are released.

CAUTION

Never press the STOP and PLAY buttons in rapid sequence when the tape is traveling at high speed in the REWIND or FAST FORWARD modes. This will almost invariably break the tape since it does not allow the tape to stop before the capstan idler locks it to the capstan.

Reproduce (Playback)

To reproduce a previously recorded tape, turn the METER and OUTPUT SWITCH 4S3, to the extreme left position designated PLAYBACK LEVEL, then start the tape in motion as indicated under PLAY. A PLAYBACK LEVEL Control 4R36 has been provided on the front panel to adjust the tape level to plus 8 vu output (zero on the vu meter).

Record

To record a new program on previously recorded tape, or on blank tape, turn the METER and OUTPUT SWITCH 4S3 to the second position from the left which is designated RECORD LEVEL. Turn the RECORD LEVEL CONTROL 4R9 clockwise until the level reads 0 (zero) on the vu meter on the most intense program peaks. The program can be audibly monitored through either the phone jacks (PHONES) 4J6, Monitor 5J4, or the line out connector (LINE OUTPUT) 5J5 before the tape is in motion. This direct monitor feature allows the program to be set up through the machine without actually recording during the set up period.

NOTE

For correct meter calibration it is important that the line out be properly terminated in a nominal 600 ohms either external to the machine or by the use of the line out termination switch (LINE TERM) 5S4.

When the program level is properly set, start the tape in motion as indicated under PLAY. Then press the RECORD BUTTON 4S6. The record indicator 4I1 next to the record button will now glow and the equipment is recording.

The erase position of the METER and OUTPUT SWITCH provides for metering of erase current. The erase current is not critical and has been factory adjusted to read approximately −½ on the vu meter for half track and stereophonic heads and +1 for full track heads. Both the erase and bias current will vary directly with line voltage. The bias current is more critical and is factory set to read zero at 117 volt line voltage, using an average tape. It should read between −½ and +½ for the optimum high frequency response at 7½ and 3¾ inch tape speeds using a median tape. For the flattest possible response with a given tape, the bias can be reset as described in Section 7 ALIGNMENT AND PERFORMANCE CHECKS. Note the bias current reading for the particular tape and log it for future reference.

The bias is adjusted by means of the Bias Control R460, located on the electronic chassis. The meter calibration for bias measurement can be checked as indicated in SECTION 7.

Half Track Operation

The tape is threaded and operated as described under TAPE THREADING and TAPE MOTION. However, only the upper half of the tape will be used on the half track equipment. To utilize the lower half of the tape, the full reel on the takeup turntable should be removed, turned over and placed on the tape supply turntable upside down. Place an empty reel on the takeup turntable. Repeat the operation as performed on the first track.

Remote Control

For remote operation, remove the dummy plug P502P from the receptacle J502S on the control box of the tape transport and connect the remote control cable from J502S to the remote control unit (see TAPE TRANSPORT MECHANISM—REMOTE CONTROL).

Notes on Stereophonic Operation

Because the stereophonic equipment has a separate erase feature, permitting either track to be erased independently of the other, it is necessary to press the RECORD buttons on each amplifier to place both amplifiers in the record mode.

When using the remote control unit the single RECORD button will energize both electronics (concurrent record feature).

THE DEVELOPMENT AND THEORY OF MAGNETIC TAPE RECORDING

There is no definite beginning to the history of magnetic recording but we can be certain that credit for building the first magnetic recorder belongs to Valdemar Poulsen. This Danish telephone engineer who is often referred to as the "Father of Magnetic Recording" designed the microphonograph which was an invention of great scientific significance. In this apparatus a steel wire was moved with considerable velocity between the poles of a small electromagnet. By using this device a conversation could be permanently recorded for reproduction at any time.

In the early 1900's many scientists were attempting to use magnetic tape in preference to the earlier idea of wire. About 1927 a German inventor named PFleumer was experimenting with powdered coatings on tape. So far as we know he did not use magnetic oxide but coated his tapes with powdered metallic materials. Development continued and finally about the year 1939 the Germans produced a tape using a durable plastic backing. This began a new era in the improvement of magnetic tapes, culminating in the superior fidelity we all know.

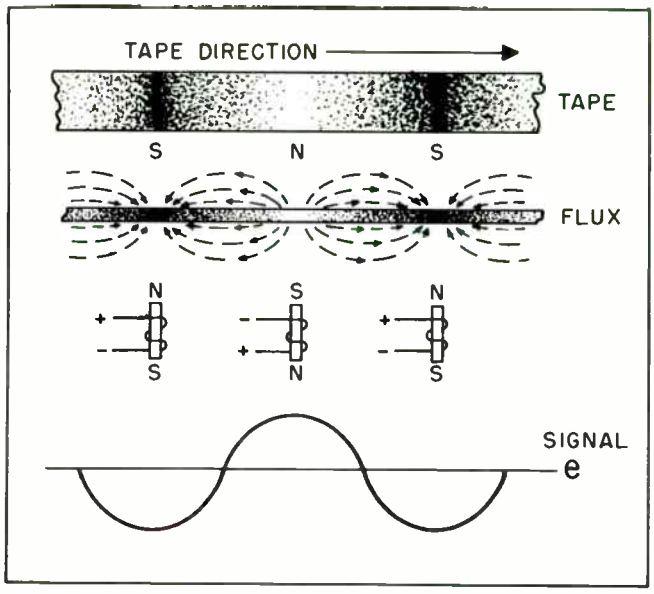
Valdemar Poulsen

To understand completely the uses and operating techniques of your Ampex Series 300 Tape Transport, the basic theory of Magnetic Tape Recording should be emphasized at this time . . .

THEORY OF MAGNETIC TAPE RECORDING

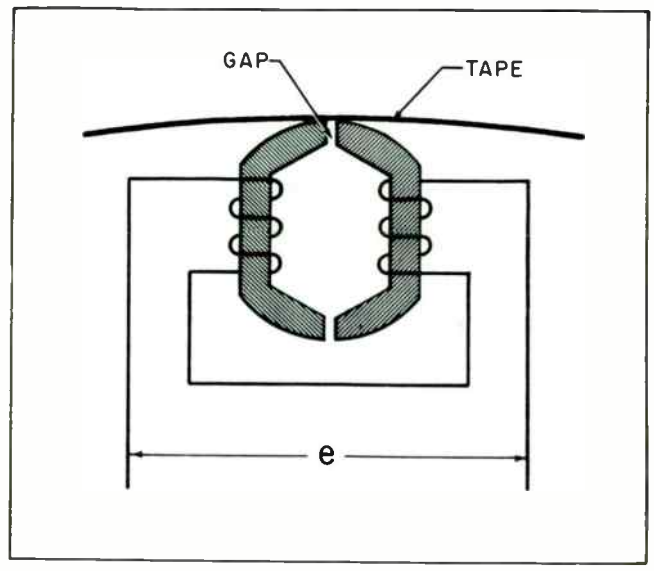
If a material capable of being magnetized is placed in the proximity of a magnetic field the molecules of that material will be oriented according to the direction of the field. Any of several methods may be used to produce a magnetic field, but of most interest in magnetic recording is the field produced by a current flowing through a coil of wire. The current itself may be derived from a transducer such as a microphone which converts the mechanical energy of sound to electric current.

Magnetic recording tape consists of finely divided iron-oxide particles deposited upon a plastic backing. During the recording process this tape is moved through a magnetic field in which the magnetizing force is alternating, and the iron oxide particles are aligned according to the instantaneous direction and magnitude of the field.



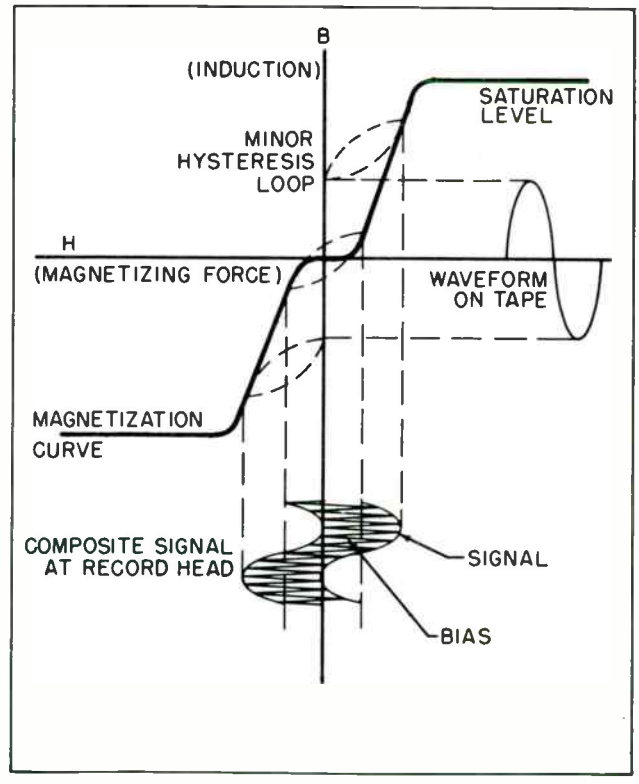
Magnetization of Tape

The magnetic field is produced in the gap of a recording head (which is essentially an electro-magnet) over which the recording tape passes. The head consists of an incomplete ring of highly permeable material inserted in a coil of wire. The discontinuity in the ring forms the gap, and the ring itself is the core of the electromagnet. The recording head and its gap thus constitute a series magnetic circuit.



Record Head

The magnetization curve of the iron oxide used as the recording medium is similar to that shown as the heavy line in the illustration above.



Recording medium magnetization curve

At points near the origin the curve is extremely non-linear and, without some corrective factor, the signal recorded on the tape would not be directly proportional to the signal applied to the head, resulting in a high degree of distortion when the tape was reproduced. This distortion is greatly reduced by mixing a high frequency, constant amplitude, bias signal with the actual signal being recorded, so that operation is obtained on the linear portion of the curve. This may be likened to applying a d-c bias to a tube to force it to work on the linear portion of its curve. The bias signal is generally selected to be at least five times the highest frequency to be recorded so that no beating will occur between the bias frequency and the harmonics of the recorded signal.

While the tape is in the recording gap the bias causes the magnetization characteristics of the iron oxide to follow the dashed line loops known as the "minor hysteresis loops." As the tape leaves the gap the influence of the magnetic field created by the bias is reduced to zero and the tape assumes a permanent state of magnetization (known as "remanent induction") determined by the gap influx at that time.

After the recording process there exists on the tape a flux pattern which is proportional in magnitude and direction to the signal recorded. If the tape is then moved past a reproduce head—which is similar in construction to the record head—the magnetic flux on the moving tape will induce a voltage in the coil of the reproduce head. This induced voltage is proportional to the number of turns of wire on the head and the rate of change of flux. This is expressed by the equation $E=N(d\phi/dt)$

Where

E = induced voltage

N = number of turns of wire

$d\phi/dt$ = rate of change of flux

It is desirable that the gap in the reproduce head be as small as possible so it will intercept less than one wave length of the signal on the tape at the highest frequency to be reproduced. However, as the gap is made smaller the induced voltage decreases, so there is a practical limitation in decreasing the gap and still maintaining an adequate signal-to-noise ratio.

The voltage induced in the reproduce head during reproduction is computed by the equation $E=B_M\ V\ SIN\pi\omega/\lambda$

Where

E = induced voltage

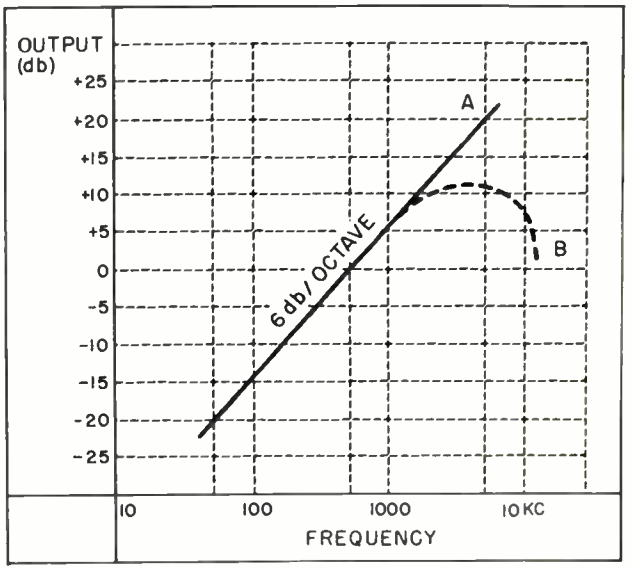
B_M = maximum flux density of the recording material

V = velocity of tape over the head

ω = width of the gap

λ = wavelength of the signal on the tape

From this equation it can be seen that the voltage across the coil increases directly as the velocity increases and as the wavelength decreases (frequency increases). If the tape velocity and gap width are assumed to be constant, the output voltage from the head is directly proportional to the frequency as long as the wavelength on the tape is large compared to the gap width. This results in an output vs. frequency characteristic such as is shown in curve A of the figure below.



Reproduce head characteristics

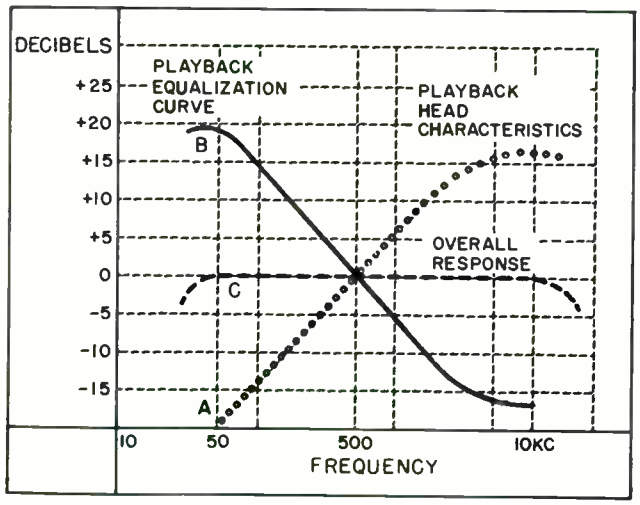
The voltage does not continue to rise indefinitely. As electrical losses in the core material increase and as the wavelength on the tape approaches the same dimensions as the reproduce head gap, the actual output resembles curve B in the same figure.

In order to provide an over-all frequency response that is flat (see the figure below) an equalization circuit consisting of a series resistance and capacitance is inserted in one of the early stages of the reproduce amplifier. This equalizing circuit has a high-frequency droop characteristic (curve B) which is the inverse of

the reproduce head characteristic curve A of above figure. In order to extend the high frequency response, additional equalization is included in the record amplifier in the form of a high frequency boost circuit designed to compensate for the droop in record and reproduce head characteristics caused by core losses, self-demagnetization of the tape at the short wave lengths and the wave length approaching the gap dimensions.

Disregarding the response of the associated amplifiers, the physical aspects of maintaining constant tape speed and good head-to-tape contact, and core losses in the head—all of which can be placed at a high performance level by good engineering design—there are certain inherent properties which define the frequency limits in recording and reproducing information on a specific magnetic tape recorder-reproducer. While these properties can be varied to meet differing requirements, the over-all result represents a compromise arrangement in which frequency response, signal-to-noise, and distortion are interrelated.

In this respect the high frequency response is primarily limited by the dimension of the reproduce head gap, and the frequency at which the head resonates with the capacity in the circuit.



Achieving flat overall response

During the recording process the tape assumes a permanent state of magnetization as it leaves the head gap, thus the record head gap width is relatively uncritical. However, in the reproduce mode the magnetic flux on the moving tape must induce a voltage differential across the reproduce head coil if a current is to flow in that coil. This induced voltage is attained as the flux travels through each branch of the head core, forced into that path by the high reluctance of the head gap. Therefore, an instantaneous difference in the magnitude of the moving flux must exist across the head gap to cause the flux to travel through the core and magnetically induce a voltage difference in the head winding.

When the recorded frequency rises to a degree where the reproduce head gap intercepts a complete wavelength of the signal (as it appears on the tape) there can be no difference in flux magnitude across the gap, and head output will reduce to zero. This cancellation effect will occur at multiples of the represented frequency, and for all practicable purposes the output is useless.

There are two means of counter-acting this "gap effect"—either the reproduce head gap width can be reduced or the record-reproduce tape speed can be increased. There are limitations in reducing the gap width and retaining adequate signal level and realistic manufacturing tolerances; as these limitations are reached any further extension of high frequency requirements must be accompanied by corresponding increases in record-reproduce tape speed. (In instrumentation applications it is also possible to record at a high tape speed and reproduce at a low tape speed, thus providing a signal expansion characteristic. For example, a 10 kc signal recorded at 7½ ips, will reproduce as a 5 kc signal if the reproduce tape speed is 3¾ ips. This procedure of course cannot be used in standard audio applications where music or voice is recorded, and will result in the loss of the low frequency components of the signal.) Increasing the record-reproduce tape speed lengthens the wavelength of the signal as it appears on the tape, with the result that higher frequency wavelengths do not approach the gap dimension. (It also decreases the "self-demagnitizing" effect which occurs as the opposite poles of individual magnetic fields on the tape come closer and closer together.)

The resonant frequency of the inductance of the head coil and the capacitance—either actual or distributed—of its circuit must normally be

either outside the pass band of the system (so the drop in output following the point of resonance will not adversely effect the frequency response) or so placed at the extreme upper limit so that the increased output at the moment of resonance actually provides an extended response. When good engineering design has reduced circuit capacitance to an irreducible minimum, the only means of placing head resonance at a higher frequency is to reduce the inductance of the head coil by reducing the number of turns of wire. This adversely affects the output over the entire frequency range, and will particularly influence the low frequency limit.

Low frequency response if primarily determined by the relationship of the required signal-to-noise ratio, the characteristic curve of the reproduce head, the distortion which can be tolerated, and the bandwidth which must be recorded.

As previously explained the output of a reproduce head rises directly with frequency at an approximate 6 db per octave rate. Stated conversely, the reproduce head output drops directly with frequency at an approximate 6 db per octave rate. The low frequency limit is determined by how far this decreasing output can be tolerated while maintaing an adequate signal-to-noise ratio. Thus, the noise generated by the associated electronic assemblies will have a definite effect on low frequency response. Increasing the record level to offset this decreasing output will eventually result in an increase in distortion.

Bandwidth is a determining factor in low frequency response because the 6 db per octave drop off in reproduce head output normally starts at the highest frequency which must be reproduced, and is constant regardless of tape speed. Thus as the upper frequency requirement is extended, the lower frequency limit—dictated by the required signal-to-noise ratio rises inexorably with it, octave for octave. A general rule is that the maximum bandwidth which can be effectively reproduced by any magnetic tape device is approximately ten octaves.

It should now be apparent that compromises are necessary in designing a magnetic tape recorder for a given purpose. If a high frequency requirement is imposed, then low frequency, signal-to-noise, or distortion must be limited (or perhaps a modulating-demodulating system employed which will effectively compress the bandpass requirements). Conversely, a low frequency requisite limits the high frequency response which can be obtained.

TAPE TRANSPORT MECHANISM

GENERAL

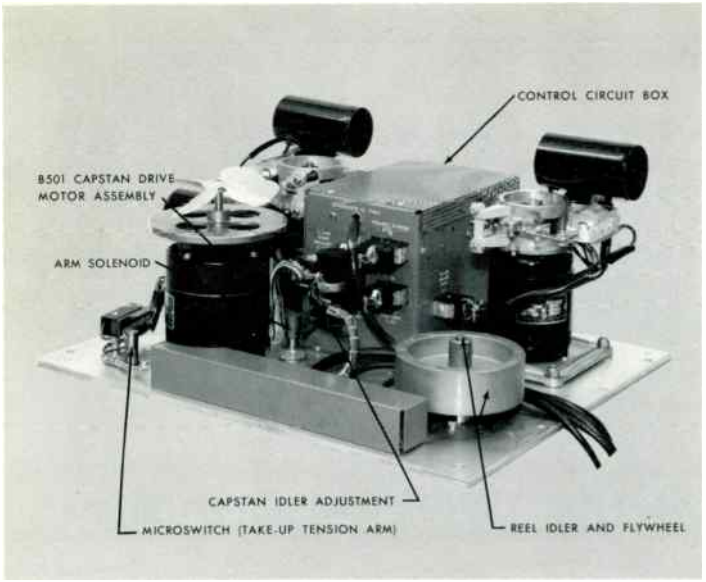
The tape transport mechanism provides tape motion for all modes of operation. Interaction of four basic assemblies and their associated components—the tape supply system, the tape take-up system, the tape drive system, and the control circuit—insures smooth, positive movement of the tape across the head assembly, and proper tape tension. All tape motion controls, a reel size selector, a safety microswitch and the head assembly are located on the tape transport.

TAPE SUPPLY AND TAKE-UP SYSTEMS

From the supply reel, on the left side of the tape transport as the operator faces the equipment, tape is delivered to the take-up reel when the PLAY or FAST FORWARD buttons are pressed, tape is rewound onto the supply reel when the REWIND button is pressed. Proper tape tensioning is maintained during all modes by means of two induction torque motors.

The reel idler assembly on the supply side of the tape transport is composed of a pulley, a spring-pivot-mounted arm and a flywheel for smoothing out transient speed variations in the supply turntable assembly.

On the take-up side of the tape transport, the tension arm assembly with a spring-pivot-mounted arm performs two main functions. The first function of this assembly is to provide a small tape storage loop which prevents tape breakage during the starting and stopping of tape motion. Secondly, this arm is used to stop



Component and assembly callouts

the machine if tension is lost due to tape breakage at the end of the tape or other failure. Near the base of the shaft on which the tension arm is mounted, a drive-lock pin actuates the safety switch (S501).

Both the tape supply and take-up assemblies are composed of induction torque motors (B503 supply-rewind, B502 take-up), a turntable mounted directly on each motor shaft, a brake housing assembly and a flange for mounting the entire assembly. Because the brake housings are mirror images of each other, these assemblies are not interchangeable although the motors are identical. The brakes are solenoid operated, remaining in the braking position until the brake solenoids K505 and K506 are energized at which time the brakes are released.

During all operating modes, the two induction torque motors B502 and B503 act as tensioning devices and in the fast forward and rewind modes the motors respond to the commands from either pushbutton by alternately operating each motor at maximum torque in the selected function.

The supply (rewind) and take-up induction torque motors are so connected that when power is applied with no tape threaded, the turntables, fixed to their shafts, will rotate in opposite directions. The tape supply turntable will rotate clockwise and the tape take-up turntable, counterclockwise.

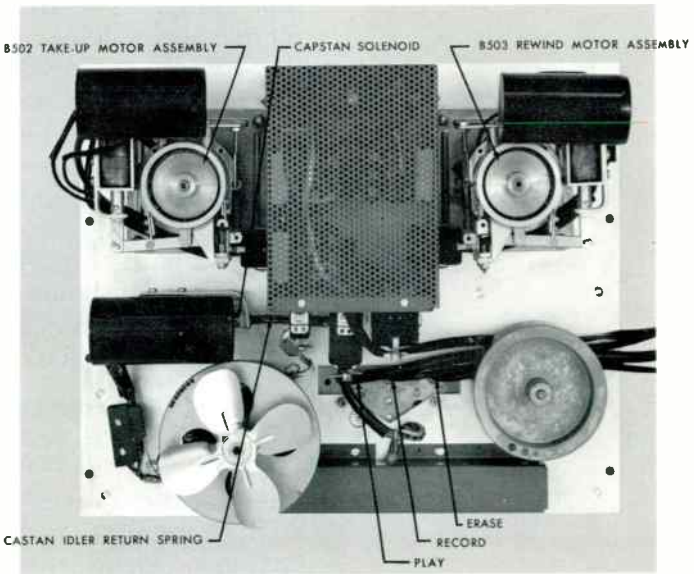
Motor torque in the reproduce and record modes is adjusted to equality by the tensioning adjustment resistors (R503 TAKE-UP and R503 HOLDBACK) in series with each motor. In the fast forward mode, the torque of the supply (rewind) motor is reduced considerably by introduction of a series resistance (R504). In the rewind mode, R504 is in series with the take-up motor. Basic tape tensioning operation is shown in the illustrations.

In the fast forward mode, the take-up motor operates at full torque, the supply motor at reduced torque, and the tape is pulled from the tape supply reel. Because the torque of the tape supply turntable motor (rewind motor) is applied in the opposite direction to the turntable rotation, the tape is held under continuous tension as it is pulled from the reel.

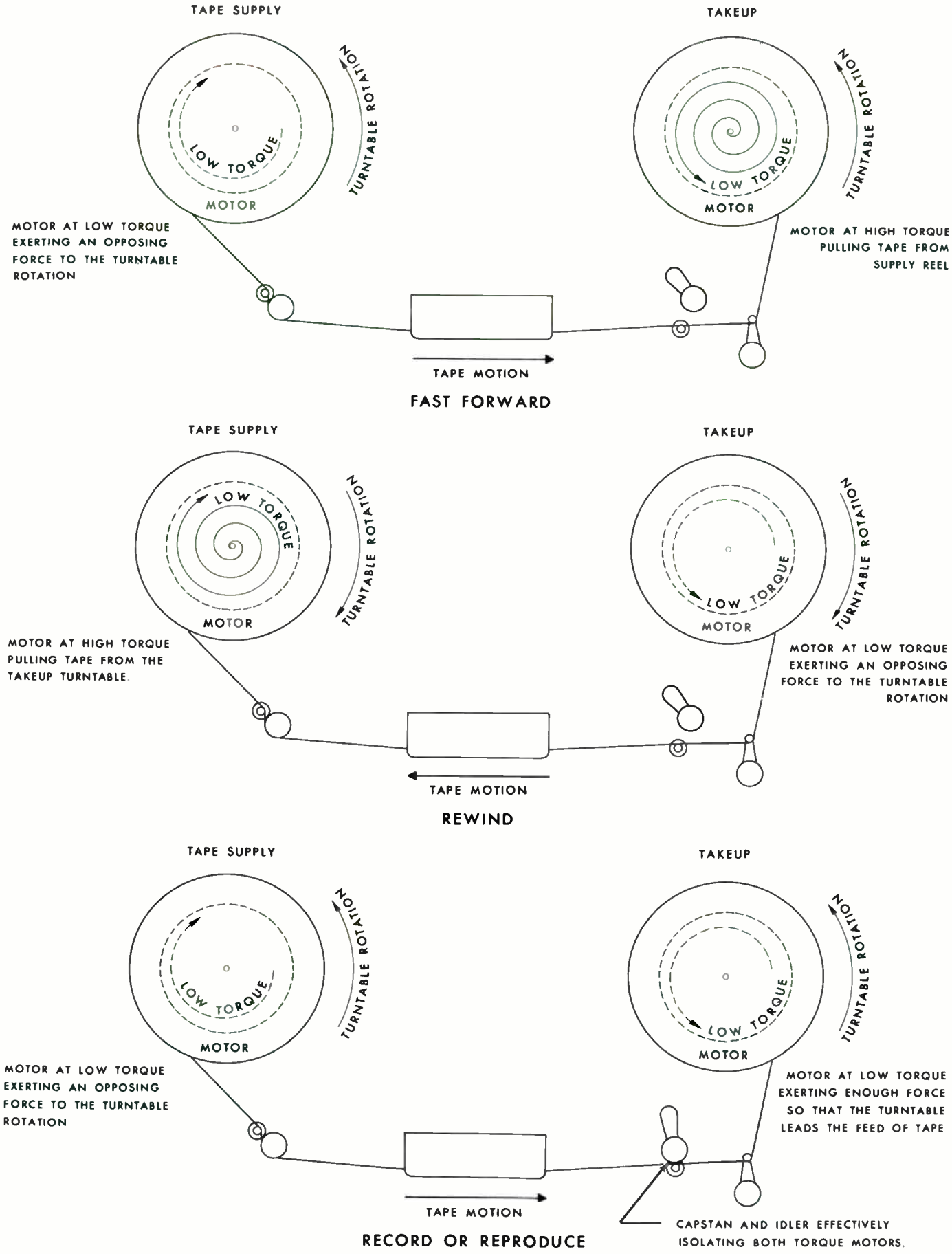
In the rewind mode, the supply motor operates at full torque and the take-up motor holds the tape under continuous tension by its opposite and reduced torque.

In the reproduce or record modes, both torque motors operate at the same value of reduced torque. The tape drive capstan and the capstan idler, between which the tape is clamped, then determines the tape speed, and the tensioning system supplies tape or takes it up as metered by the capstan drive.

From the point of view of the tape supply turntable, the capstan and idler action exerts sufficient pull on the tape to overcome the opposing torque of the supply motor, which constitutes the hold back tension. From the point



Component and assembly callouts



Tape tensioning

of view of the tape take-up turntable, the capstan and idler action is feeding the tape to it. The tape is held under tension here, because the take-up rate exceeds the feed rate (a tape loop will be thrown on the right side of the capstan whenever any malfunction causes the feed rate to exceed the take-up rate).

If a tape loop is thrown, or the tape breaks, the take-up tension arm will actuate the safety switch S501 and stop the equipment. The take-up tension arm is not a part of the tape tension system. Its function is to takeup tape slack, especially when starting, and to operate the safety switch.

The reel idler assembly smooths out transients in the supply reel system. For example, when starting the tape in the reproduce mode, the momentary strain transmitted through the tape to the tape supply turntable when the capstan idler forces the tape against the capstan is considerable. Under some circumstances, this impulse tends to stretch or break the tape. A momentary decrease in holdback tension might be sufficient to start a transient oscillation in the tape tension system which would be reflected as a periodic variation in the distance of the tape from the heads. This variation might be of sufficient magnitude to appear as an undesirable fluctuation in the signal level at the start of recording or reproduction. The reel idler arm absorbs most of the starting strain, and prevents or minimizes this type of oscillation. The reel idler pulley and flywheel provide additional stability in the tape tension system, by smoothing out such transients as motor torque fluctuations and irregularities due to faulty tape wrap on the supply reel. This is accomplished because the high inertia of the reel idler pulley and flywheel effectively isolate the reel assembly from the heads.

TAPE DRIVE SYSTEM

The tape drive system is composed of the drive motor, the extended shaft of which forms the capstan, the capstan idler arm and idler, and the tape guides at the tape entrance and exit within the head assembly.

The purpose of the tape drive system is to transport the tape across the heads at a uniform speed during the record and reproduce processes. By means of a hysteresis synchronous capstan drive motor (B501) and a capstan idler, the magnetic tape is driven at a constant speed after power has been applied to the equipment and the PLAY button is pressed. (The drive motor has two sets of windings to provide two tape speeds, either of which can be selected at TAPE SPEED toggle switch S503).

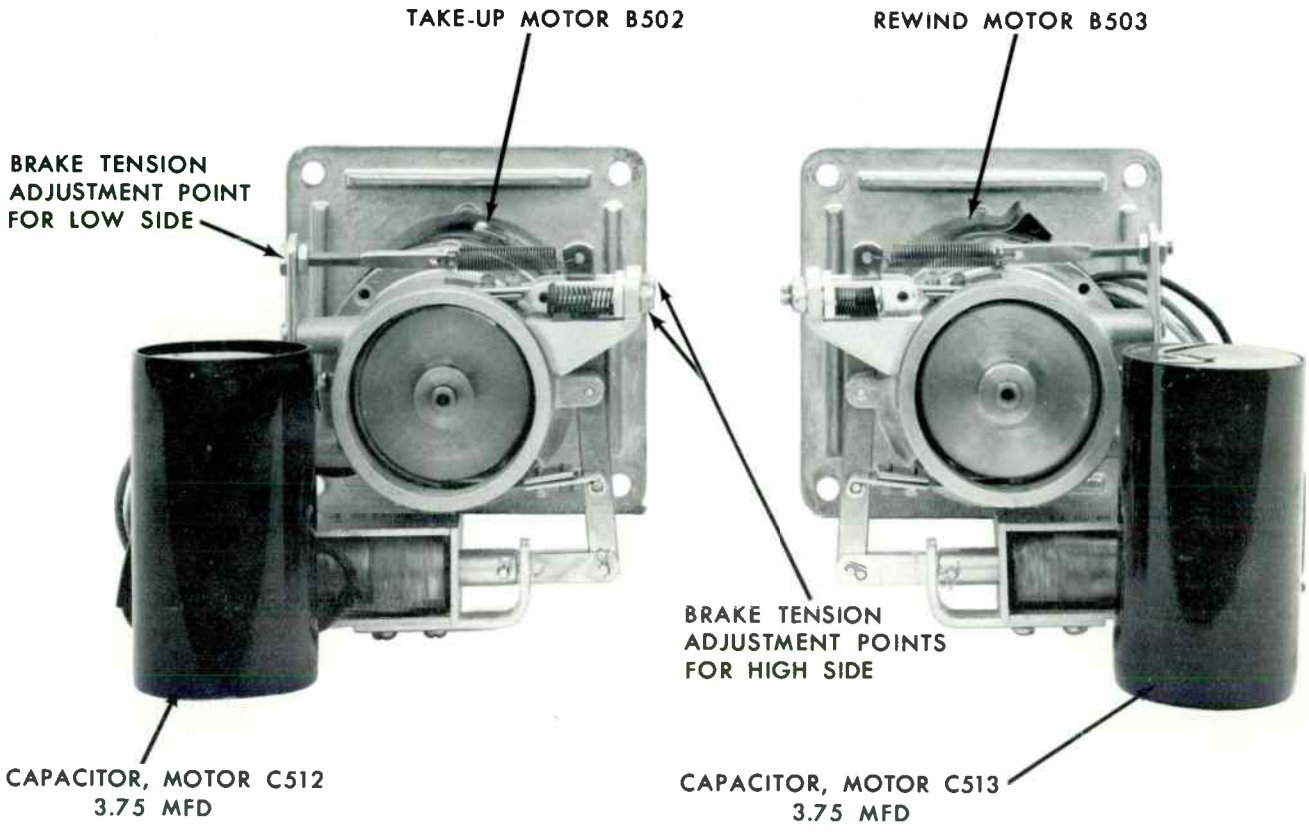
After the POWER switch at the electronic assembly has been placed in the ON position and the tape is threaded actuating the safety switch, the drive motor operates continuously, its capstan awaiting the PLAY command (the RECORD function is selected at the amplifier). When the PLAY button is pressed, the capstan solenoid (K501) and the brake solenoids (K505 and K506—releasing brake pressure) are energized. The capstan solenoid pulls the rubber tired capstan idler wheel, which is mounted on a swivel type arm, against the tape, causing the tape to make firm positive contact with the capstan. The tape is then driven at a constant speed across the head assembly.

BRAKE OPERATION

Smooth brake operation is extremely important in maintaining proper tape tension when stopping the tape. Because the holdback tension, supplied by the trailing turntable motor torque, is lost after the STOP button is pressed, maintenance of tape tension then becomes a function of brake operation. The braking force acting on the turntable from which the tape is being pulled (trailing turntable) in any of the modes of operation must exceed the braking force acting on the turntable taking up the tape (the leading turntable) to prevent tape loops forming.

One end of the brake band is fixed to the cross head by a roll pin and two socket head cap screws which is attached to the anchor mounted on the brake housing. The other end is linked to the brake lever by a drivelock pin and is free to move. When the brake solenoid is de-energized, the brake tension spring acting on the brake lever draws the brake band against the brake drum.

If the brake drum of the supply motor, as viewed from the brake housing end, is rotating clockwise when the brake band is applied, the frictional force will cause the band to wrap



Take-up and rewind motor assemblies

itself tightly around the brake drum as the brake lever end of the band moves to the right, increasing braking force. When the drum is rotating counterclockwise, the process is reversed, causing the band to tend to pull away from the drum, decreasing the braking force.

The ratio of the braking force in one direction to the braking force in the other — the brake differential — is approximately two to one on this equipment.

In all modes of operation, the greater braking force always acts on the trailing turntable, maintaining the proper tape tension as the system is stopped.

CONTROL CIRCUIT

(Refer to schematic diagram—Tape Transport Control Circuits)

Located in the control circuit box underneath the tape transport are all relays, the tension adjustment resistors, and electronic components such as the capacitors and resistors shown in the foldout illustration, Tape Transport Control Circuits, with the exception of the three motor starting capacitors, the capstan solenoid, the brake solenoids and the safety microswitch (which are mounted adjacent to the assemblies they serve).

On the outside of the control circuit box receptacles are available for cables from the drive motor, supply motor, take-up motor and control cluster. Female receptacles and plugs (cables not supplied) are also available for interconnecting the tape transport and accessory units such as remote control panels and a precision frequency source when furnished.

NOTE

The special connector jumper plugs supplied for receptacles J503S 60 CYCLE AMPLIFIER and J502S REMOTE CONTROL must be plugged into their receptacles when these accessory units are not used because jumpers in these plugs complete the necessary circuits in the system for proper operation.

Control circuit box

All functional control of the tape transport, with one exception, takes place at the control circuit switch assembly comprising four push-buttons: REWIND, FAST FORWARD, STOP and PLAY. Two toggle switches REEL SIZE and TAPE SPEED are mounted at either end of the control cluster. The exception is the RECORD function which is controlled at the amplifier. The safety switch (not an operating control) is mounted under the tape transport.

Play

When PLAY button S505 is pressed, play relay K502 is energized. Capstan solenoid K501 is energized through K502-1. Contact sets K502-1, K503-1, K504-3, and the normally closed STOP button S502 form a holding circuit. Power is connected to the turntable reel motors through contact K502-2. Through contact K502-3, D.C. voltage is applied to the brake solenoids K505 and K506. The reel motors are powered and the brakes are released simultaneously, causing the equipment to operate in the reproduce mode at the speed selected by TAPE SPEED SWITCH S503.

Rewind

When REWIND button S507 is pressed, rewind relay K504 is energized and held in this condition by relay contact sets K504-1, K503-3 and the normally closed STOP button S502. Contact set K504-2 connects the full a-c power directly to the rewind (supply) motor, and places R504 in the a-c circuit to the take-up motor. The rewind motor thus operates at full torque and the take-up motor at reduced torque, and tape is pulled at a maximum speed from the take-up to the rewind reel. Contact set K504-3 completes the d-c circuit to the brake solenoids at each reel assembly, thus releasing the brakes.

Fast Forward

When FAST FORWARD button S506 is pressed, fast forward relay K503 is energized and held through contacts K503-1, K504-3 and the normally closed STOP button S502. Contact set K503-2 connects the full a-c power to the take-up motor, and places R504 in the circuit to the rewind motor. The take-up motor now operates at full torque and the rewind motor at reduced torque, causing the tape to be pulled at a maximum speed from the rewind to the take-up reel.

Stop

When the tape is moving in any mode and the STOP button (S502) is pressed, the brake solenoids and all relays are de-energized. The brakes are applied to both turntable motors. The capstan drive motor will continue to operate so long as the tape remains properly threaded.

NOTE

The record mode is not a tape motion control function, but it is interlocked and dependent on the PLAY button, which must be pressed before the record mode can be energized at the amplifier.

Safety Interlocks

When the tape is moving in either of the high speed modes (fast forward or rewind) it is impossible to switch to the play mode without first pushing the STOP button. In fast forward, contact K503-1 interlocks the play relay and capstan solenoid. In rewind, K504-3 is the interlock.

CAUTION

If the STOP and PLAY buttons are pressed in too rapid a sequence when the tape is in either fast winding mode, tape will almost invariably be broken or deformed. Always allow

time for the tape to stop completely when switching from either of the fast modes to play.

Reel Size Switch

Selection of proper holdback tension, depending on reel hub size, is made at the two position toggle switch labeled LARGE-SMALL. Holdback tension is not a constant in any mode of operation, varying directly as a function of the trailing turntable motor torque, and inversely as a function of the effective trailing reel hub diameter (hub meter includes the tape wound on the hub). For a given torque on the trailing motor, the holdback tension will increase as the effective hub diameter of the trailing reel decreases. Reducing the torque on the trailing turntable motor will decrease the holdback tension.

The holdback tension resistors for adjustment of take-up and rewind motor/torques are factory-set for NAB 10½ inch reels. If the smaller (7 or 5 inch) EIA (formerly RETMA) reels are used, compensation for the overall increase in holdback tension must be made by placing the switch in the SMALL position. This places resistor R502 in series with the take-up and rewind motors, thus reducing the torque of both motors in any mode of operation when the EIA reels are used. If it is desired to accelerate faster in the rewind or fast forward modes, the switch may be placed in the LARGE position during these modes. The REEL SIZE switch is a SPST switch placed across the resistor R502. It is closed when the LARGE position for 10½ inch diameter NAB is selected; and open (resistor R502 in the torque motor circuits) when the SMALL position is selected.

NOTE

In the LARGE reel position both the rewind and take-up reels must be NAB type and in the SMALL reel position both reels must be EIA.

NOTE

The Catalog Number 5700 tape transports used on earlier models changed PLAY tension only when in the SMALL reel position.

ROUTINE MAINTENANCE

Carefully follow the routine maintenance program outlined below if proper performance is to be expected of the equipment at all times. It is recommended that an Operation and Maintenance Log be kept.

Cleaning

Clean the capstan, the head faces and tape guides daily. Clean the capstan idler wheel weekly. Great care must be taken to see that oil does not reach the rubber tire. Avoid, as much as possible, touching the tire with the fingers.

The agent for cleaning Ampex head assemblies is a mixture of Xylene and 0.1% Aerosol, and is available in 4 oz. bottles (Ampex Catalog No. 087-007). Other solvents can have detrimental effects on these precision parts.

To clean any head assembly, wind a clean, lintless cloth on a wooden swab-stick and moisten with this mixture. Swab the heads periodically to remove all dirt and accumulated oxide deposited from some tapes.

CAUTION

Do not use any other solvents as there are some which may damage the laminations of the head assembly. Do not use metal swab-sticks.

Cleanliness of all parts of the tape drive mechanism is required for consistent optimum performance. Clean all parts except the head assembly using a lintless cloth moistened with Iso-Propyl alcohol (easily obtained). This cleaning is of particular importance because most tape manufacturers lubricate their tapes, and the lubricant will gradually form a coating on the components in the tape threading path which will result in a loss of positive drive at the capstan, flutter and wow, drop-outs or poor high frequency response.

NOTE

It is imperative that Iso-Propyl alcohol be used on the cleaning of the capstan idler wheel (rubber) and not the recommended Xylene cleaner for heads.

Lubrication

The following parts of the tape transport mechanism require lubrication every three months, or after every thousand hours of operation, whichever occurs first.

CAPSTAN DRIVE MOTOR LUBRICATION

Lubricate the upper sleeve bearing of the capstan drive motor with this oil or its equivalent:

Caloil OC-11 (Ampex Catalog Number 087-005) Standard Oil Company, San Francisco, California. Class "C"

Medium turbine oil, petroleum base with inhibitor additives to increase oxidization and corrosion preventive properties. Essential characteristics are as follows:

Characteristics	*Required (Limit)*
Viscosity in Centistrokes at 130° F	40.0-48.0
Pour Point	25° F (Max.)
Flash Point	370° F (Min.) ±20° F

There are two ways to lubricate the drive motor, the first of which requires its removal. The second, and simpler method, does not require removal of the motor. See alternate method. To remove the drive motor proceed as follows:

Step 1: Unplug the motor connector P504P from its receptacle J504S at the control circuit box.

Step 2: Remove the capstan idler by loosening the Allen head screw on the idler arm and gently pulling the idler assembly away (the capstan idler must be removed because one of the mount-screws is beneath it).

Step 3: Support the motor in one hand and remove the four mounting screws that hold it to the tape transport.

Step 4: Now pull the motor free.

Step 5: Locate the oil hole which will be on the top or the side of the motor end bell.

Step 6: Place not more than four drops of a recommended lubricant in the oil hole (OC-11).

CAUTION

Do not over-lubricate. Wipe off excess oil.

Step 7: Replace the motor.

Step 8: Replace the capstan idler.

CAUTION

The capstan idler must be properly placed in relation to the tape. Thread tape on the equipment along the prescribed tape thread-path, and set the idler so that the tape travel is centered on the tire. Placement is not critical and visual alignment is adequate.

Step 9: Readjust the capstan idler pressure if necessary (see *Capstan Idler Pressure*).

The alternate method for drive motor lubrication is:

Step 1: Gently pry up and remove the capstan dust cap.

Step 2: Before activating the safety switch, apply not more than four drops of lubricant (OC-11) to the exposed bearing surface.

Step 3: Replace the capstan dust cap.

Step 4: Start the drive motor by placing the POWER switch in the ON position, activate the safety switch and allow the motor to warm up (requires about 15 minutes).

Step 5: Turn off the equipment when the warm-up period is complete.

Step 6: If the bearing appears dry after the motor has cooled, repeat the above procedure.

Step 7: Wipe the capstan dry of any excess oil that may have been applied accidentally.

CAPSTAN IDLER LUBRICATION

Gently pry the dust cap from the wheel hub (a knife blade can be used) and oil with not more than 3 drops of OC-11, on the felt washer. Failure to perform capstan idler lubrication can result in the felt washer becoming completely dry, and a dragging idler can contribute to flutter.

CAUTION

DO NOT OVER-LUBRICATE or the wheel will throw oil in operation. If oil spills on the rubber tire, clean it immediately with Iso-Propyl. Oil will deteriorate the rubber wheel.

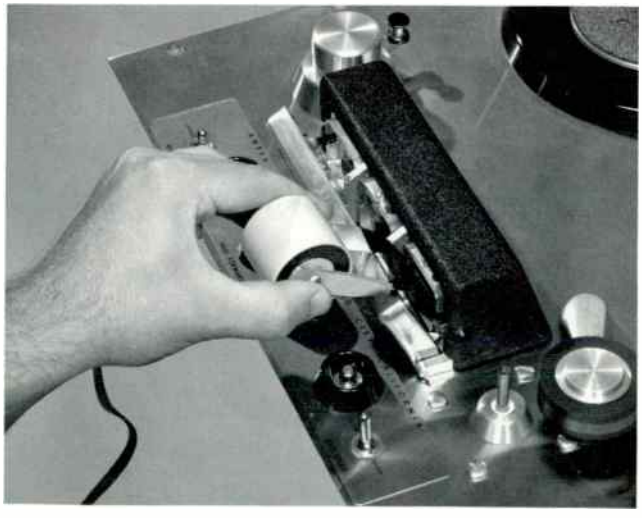
NOTE

The reel idler assembly, the take-up tension arm assembly and the take-up and rewind motors contain permanently lubricated bearings, and require no lubrication.

Head Demagnetization

Occasionally, the heads may become permanently magnetized through electrical faults in the amplifiers, improper use of the equipment, or by contact with magnetized objects. Magnetized heads may cause an increase of 5 to 10 db in background noise level, and can impair good recordings by partially erasing high frequencies. The full dynamic range of the equipment cannot be realized if the heads are magnetized.

Any phenomena that tend to put large unbalanced pulses through the record head will magnetize it. Observe these precautions and no difficulty should be experienced. Do not remove any tube from the record amplifier while the equipment is recording. Do not connect or disconnect the input leads or the head leads while recording.



Demagnetizing the heads

Do not saturate the record amplifiers with abnormally high input signals. Such signals would be 10 db greater than tape saturation or approximately 30 db greater than normal operating level.

If it becomes necessary to test the heads with an ohmmeter, they must be demagnetized afterwards.

If the heads become magnetized, proceed as follows, using an Ampex Demagnetizer, Catalog No. 704:

Step 1: Place the equipment power switch in the OFF position.

Step 2: Plug the demagnetizer into a 117-volt a-c source.

NOTE

If the plastic coating wears off, place one layer of electrical friction tape on the demagnetizer tips. Scratching the heads will then be prevented.

Step 3: Bring the tips of the demagnetizer to within approximately ⅛-inch (if the demagnetizer tips are taped or covered, contact with the heads can be made) of the record head core stack, straddle the head gap and draw the demagnetizer tips up and down the length of the core stack three or four times.

Step 4: Remove the demagnetizer slowly from the head stack to a distance of 3 or 4 feet, thus allowing its a-c field to diminish gradually. This slow removal is extremely important.

CAUTION

Do not unplug the demagnetizer while it is near the heads; the collapse of its magnetic field may re-magnetize the head.

Step 5: Repeat Steps 3 and 4 at the reproduce and erase heads.

Step 6: If necessary, repeat the process till complete demagnetization is effected in each case.

NOTE

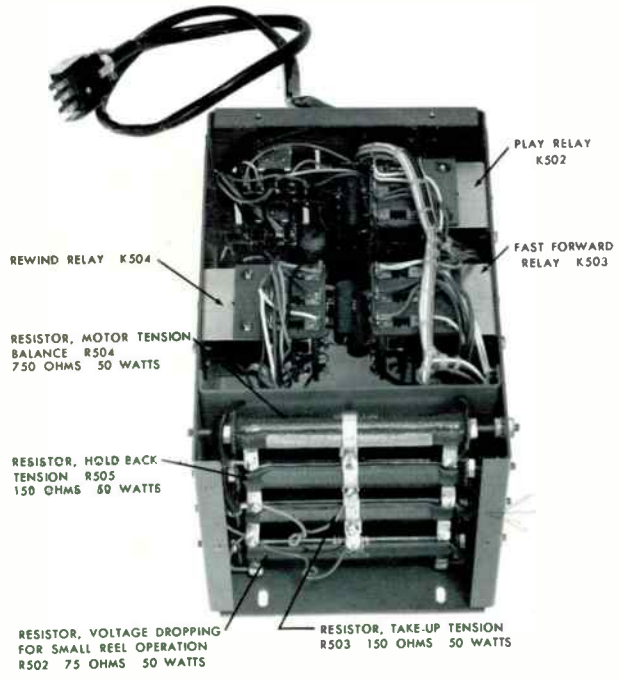
The erase head, under certain conditions, is susceptible to magnetization by spurious sources and can require demagnetization.

If the capstan, tape guides or other metal parts be come magnetized, a few passes of the demagnetizer along their lengths and the slow withdrawing technique should be adequate.

ADJUSTMENTS

The mechanical assembly is shipped from the factory with all adjustments set for correct performance. It should be unnecessary to change any adjustment before putting the equipment into service, unless shipping damage has occurred. In the course of wear in normal service, or in the event of component failure, and replacement of parts, some readjustments may be necessary.

Equipment Required:
- Spring Scale 0-16 oz.
- Spring Scale 0-80 oz.
- 3/8-inch Nut Driver
- 3/16-inch Screwdriver
- Nylon Lacing Twine or Strong String
- 7/16-inch Socket Wrench
- 5/64-inch Allen Wrench



Control circuit box callouts

Take-up and Supply (Rewind) Tension

Take-up and supply tensions are determined by the positioning of the sliders on resistors R503 and R505 located in the tape transport control circuit box. The torque of both the rewind and take-up motors must be adjusted to between 6 and 7½ ounces as read on the 16 oz. spring scale at NAB reel hub diameter. Checking techniques are not difficult and should be performed carefully.

Step 1: Place an empty 10½ inch NAB reel on the tape supply turntable.

Step 2: Place the POWER switch in the ON position.

Step 3: Place the REEL SIZE switch in the LARGE position.

Step 4: Hold the take-up tension arm so that the safety switch is activated (a rubber band or piece of masking tape will hold the arm as though tape were threaded on the equipment).

Step 5: Make small loops at both ends of a thirty inch piece of nylon lacing twine.

Step 6: Attach one loop to the tape anchor on the reel hub and the other to a 0 to 16 oz. spring scale.

Step 7: Press the PLAY button and allow the clockwise motion of the supply reel (torque motor tension) to draw a turn of twine onto the hub.

Step 8: Make certain that the twine is now parallel to the plane of the top of the tape transport and that the twine is centered and not touching either reel flange.

Step 9: Now, let the torque motor pull the twine slowly onto the hub by following the torque motor force with the scale.

Step 10: Using this "following" technique, observe the readings on the scale until a constant reading is obtained.

Step 11: If necessary, adjust the slide on resistor R505 in the control circuit box until a scale reading between 6 and 7½ ounces is achieved.

Step 12: A good check consists in placing the REEL SIZE switch in the SMALL position, then checking the torque using the same procedure as above. The

scale should indicate tape tension as 2-2½ ounces.

Step 13: Use the procedures in the preceding steps to check and adjust the take-up tension which is set at R503 (note that the reel on this side will move counterclockwise).

Brake Adjustment

Brake adjustment is made (*with no power applied to the equipment*) at the point shown in the illustration.

Step 1: Place an empty 10½ NAB reel on the tape supply turntable.

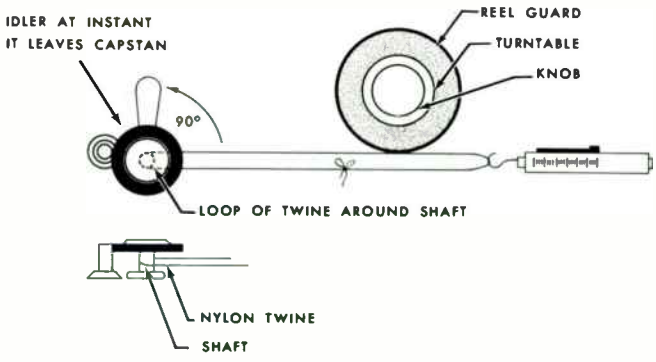
Step 2: Make small loops at both ends of a thirty inch piece of nylon lacing twine.

Step 3: Attach one loop to the tape anchor on the reel hub and the other to a 0-16 oz. spring scale.

Step 4: Manually rotate the reel clockwise to wind several turns of twine onto the hub.

Step 5: Pull the scale, making certain that the twine does not touch either flange of the reel. The turntable will rotate counterclockwise. Take a reading only when the turntable is in steady motion, because the force required to overcome the static friction will produce a false and excessively high initial reading.

Step 6: Adjust the supply and takeup motors' brakes for scale readings listed below. Points of adjustment are shown by illustration.



Capstan idler pressure measurement

Step 7: Now wind the twine on the hub by rotating the reel counterclockwise; pull, and take a reading. The turntable will rotate clockwise.

Step 8: Repeat the entire process on the take-up turntable.

SPRING SCALE READING

Tape Width	*Direction of Most Resistance—Supply Counterclockwise Takeup Clockwise*	*Direction of Least Resistance—Supply Clockwise—Takeup Counterclockwise*
¼ inch	15 to 16 ounces	2:1 ratio ±1 ounce in accordance with High Side

Capstan Idler Pressure

The capstan idler is forced against the capstan by the action of capstan solenoid K501. Idler pressure is supplied by the capstan idler pressure spring, and is adjusted by a lock nut on the capstan solenoid spade bolt. See the illustration. Tightening the lock nut increases idler pressure until a point is reached where the solenoid will not bottom. At this point, idler pressure drops to a value which is inadequate to permit the capstan to drive the tape, and slippage will occur unless the nut is backed off. Excessive pressure also throws an unnecessary load on the upper sleeve bearing of the drive motor. The recommended procedure for adjusting idler pressure is as follows:

Step 1: Hold the take-up arm so that the safety switch is activated.

Step 2: With the POWER switch in the ON position, press the PLAY button, and note whether the capstan solenoid is bottomed. (The capstan idler can be pushed off the capstan easily by pushing on the idler arm, if the solenoid is not bottomed). If necessary, back off the lock nut until the solenoid does bottom at 90 volts a-c when cold, or 105 volts when warm (after ½ hour running). The pressure ("dig") against the capstan shaft should be approximately 5 pounds.

NOTE

In the course of normal operation in the reproduce or record modes, the

temperature of the capstan solenoid will rise, and its d-c resistance will increase. Therefore, the minimum line voltage required to bottom the solenoid when it is hot will be greater than that required when it is cold. If the equipment is operating on unusually low line voltage (below 100 to 105v), sometimes encountered in areas where regulation is poor, the solenoid may fail to bottom after it has reached normal operating temperature. It is advisable, therefore, to allow the equipment to operate in the reproduce mode for about half an hour before making any necessary solenoid adjustments. This will allow the widest margin of safety with respect to line voltage variations. The solenoid is factory-adjusted to bottom at 90 line volts cold and 105 line volts hot.

Step 3: If it is desired to measure capstan dig, press the STOP button at this point and select a piece of nylon lacing twine about 30 inches long and tie the ends together.

Step 4: Slip the twine loop just formed between the idler and idler arm so that the nylon rests against the idler shaft.

Step 5: Attach the other side of the loop to a 0 to 80 oz. scale, letting the nylon twine remain slack.

Step 6: Press the PLAY pushbutton, causing the capstan idler to clamp against the capstan.

Step 7: Pull the scale away so that the nylon twine is taut and makes a 90 degree angle with the idler arm.

Step 8: Now, slowly pull the scale away with sufficient power to cause the capstan idler to leave the capstan, reading the scale at the instant the capstan idler leaves the capstan. The scale reading should be 5 lbs ±½ lb. If necessary, adjust the capstan dig at the point shown in the illustration.

Replacement of Parts

All sub-assemblies of the tape transport mechanism can be easily dismounted with the use of a screwdriver and a few small socket-head screw keys.

CAUTION

Do not attempt complete disassembly of any of the sub-assemblies. The list of individually replaceable parts under each assembly listing in the parts list should be used as a guide to disassembly limits. Replacement of parts other than those listed calls for precision work which should not be attempted in the field. Assemblies with defects in parts other than those listed as replaceable should be returned to the factory or to an Ampex Authorized Service Center for repair or replacement.

Write the Service Department for a proper authorized equipment return tag. Do NOT ship unidentified parts to factory; Ampex can assume no responsibility for their proper care or return under such circumstances.

BRAKE BAND REPLACEMENT

NOTE

Brake Bands may be replaced without removing motor from tape transport on rackmount machines and deleting the first two steps.

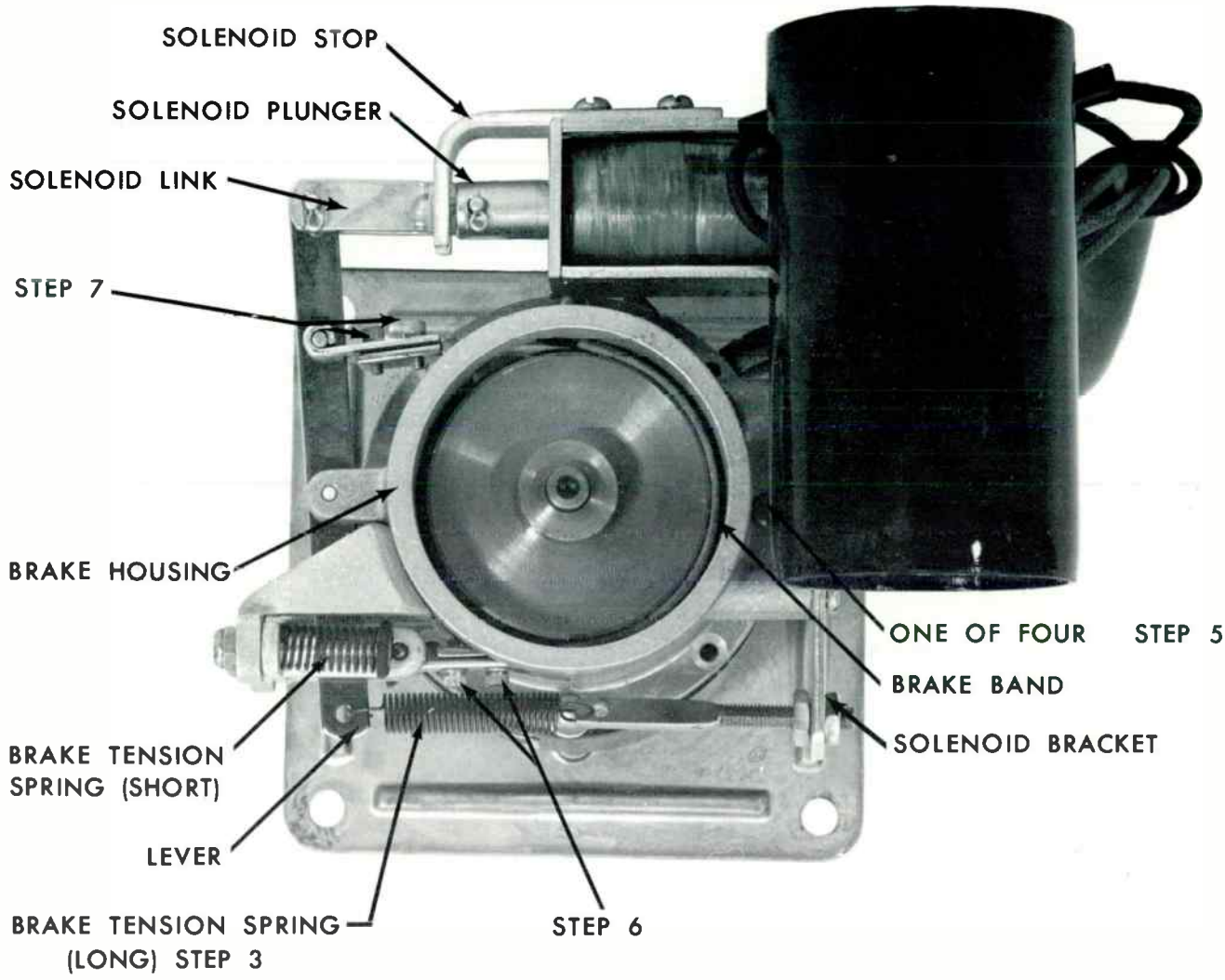
The most convenient method for changing the brake band is first to remove the entire motor assembly.

Step 1: With a 7/16-inch socket wrench remove the four mounting nuts and washers at the motor mounting plate, carefully holding the motor with one hand to prevent it from falling. The turntable will remain attached to the motor assembly.

Step 2: Take the motor to a convenient work area.

Step 3: Unhook the brake tension spring from the brake lever.

Step 4: Remove the two screws holding the capacitor. Disconnect the wires at the knife disconnects and free the capacitor from the bracket.



Brake band replacement

Step 5: Remove the screws that hold the brake housing to the motor, noting the positioning of the washers, and spacers, and remove the entire housing.

Step 6: Remove the two cap screws holding one end of the brake band between the brake lever spring and the housing using a 5/64-inch Allen wrench.

Step 7: Loosen (do not remove) the two cap screws at the end of the brake band next to the solenoid.

Step 8: The brake band may now be removed taking caution not to lose the band leaf on the solenoid side. There is only one band leaf per assembly.

Step 9: Position the new brake band through the hole in the housing and place between the clamp and tighten the two cap screws loosened in step 7.

Step 10: Replace the brake housing, making certain that the spacers, the housing, the washers and the screws are replaced in that order, and tighten the screws.

Step 11: Insert the brake band between the band link and band link clamp. Replace the two cap screws but DO NOT TIGHTEN.

Step 12: Push the solenoid in until it bottoms. Adjust the depth of insertion of the brake band between the link and

clamp so that the brake drum rotates freely with no drag; then tighten the screws.

CAUTION

If the band is set too far forward in the link, it will buckle slightly when the solenoid plunger is bottomed by hand. If this condition exists the plunger may not bottom when the solenoid is energized. The purpose of the band leaf is to keep the band from splitting when it buckles at the band clamp.

Step 13: Interconnect the wires at the knife disconnects and replace the capacitor to the bracket with the two screws removed in Step 4.

Step 14: Hook the brake spring to the brake lever. Step 3.

Step 15: Replace the motor assembly tightening the four nuts and adding the washers that were removed in Step 1.

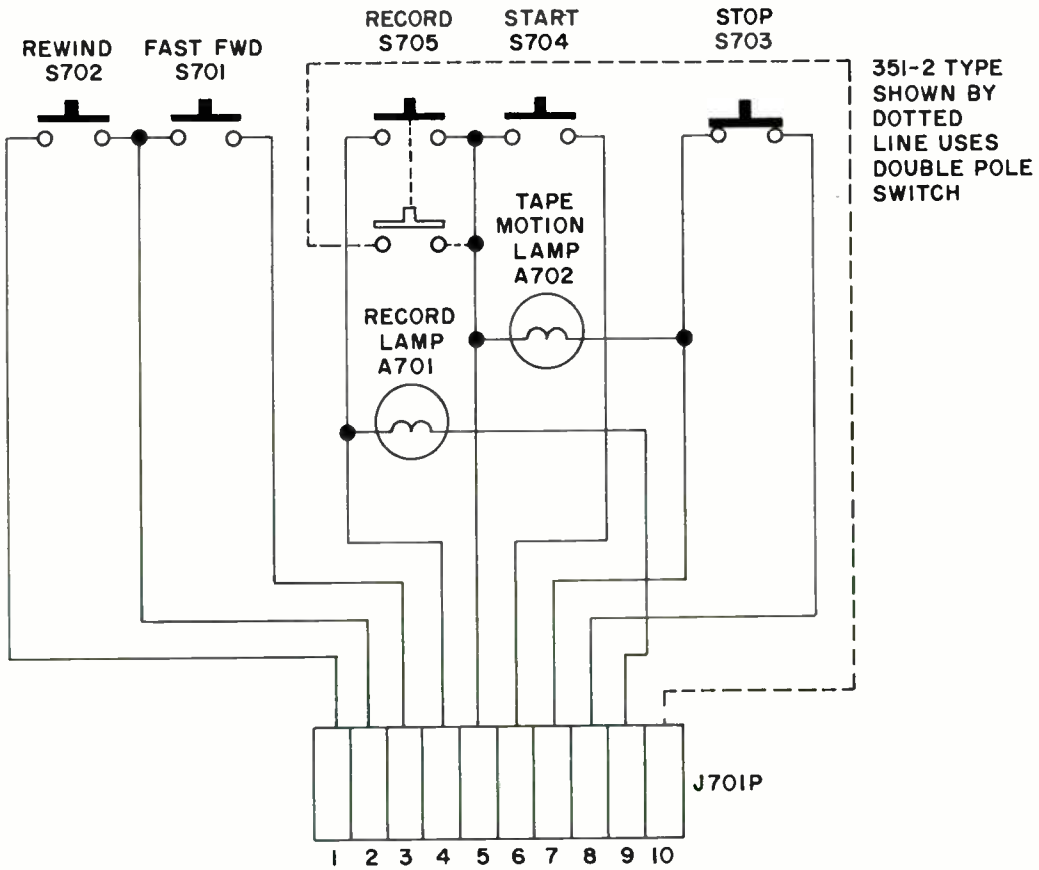
PACKING PRECAUTIONS FOR MOTORS

In packing motors for return to the factory, take particular care to prevent the bending of their shafts in transit.

REMOTE CONTROL

NOTE

Pin 5 of the tape transport is connected to pin 4 of the slave electronics by means of an internal connection in cable number 30812.



Remote control

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
	TAPE TRANSPORT MECHANISM	
B501	DRIVE MOTOR ASSEMBLY	
	7-1/2 - 15 ips, 60 cycle motor	31210-01
	7-1/2 - 15 ips, 50 cycle motor	31210-02
	3-3/4 - 7-1/2 ips, 60 cycle motor	31210-04
	3-3/4 - 7-1/2 ips, 50 cycle motor	31210-03
	Each includes:	
C501	Capacitor	9487-02
	Flywheel - Bodine motor	981
	Ashland motor	2212
	Set screw, 10-32 x 1/4	477-118
	Plug, 6-contact, Jones	145-012
	FAN	
B502	TAKEUP ASSEMBLY	9451-03
	(Alternate)	9451-04
	Turntable Motor Assembly includes motor, mounting flange, brake drum and turntable with pad.	7558
	Turntable	61462-01
	Pad	958-00
C512	Capacitor 3.75 mfd (60 cycle)	035-111
	Brake Assembly, complete	17327-01
	Brake Housing	17614-01
	Brake Band	17612-01
	Brake Band Leaf, 1-1/8" long	61460-01
	Brake Tension Spring long	322-01
	Brake Tension Spring short	17323-00
	Eye Bolt	396-06
	Crosshead	17324-01
	Anchor	17322-01
	Spacer	406-031
	Roll Pin - 1/8 inch x 3/4 inch	406-031
	Screw, Socket head cpa stl. cad. pl.	470-008
	Brake Band Link	330-00
	Brake Band Clamp	331-00
	Brake Lever	332-00
	Drivelock Pin - 1/8 inch x 1/2 inch	403-008
	Cotter - 1/16 inch x 1/2 inch	401-005
	Clevis Pin - 1/8 inch x 9/32 inch	400-002
	Plug, 8-contact, Jones	17313-01
K505-K506	Brake Solenoid	337
B503	REWIND ASSEMBLY (60 cycle)	9452-03, 04
	(50 cycle)	9452-05
	Turntable Motor Assembly includes motor, mounting flange, brake drum and turntable with pad.	
	Turntable	61462-01
	Pad	958-00
C513	Capacitor 3.75 mfd. (60 cycle)	035-111
	Capacitor 5 mfd. (50 cycle)	035-117

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
	Brake Assembly, complete	17327-02
	Brake Housing	17614-02
	Brake Band	17612-01
	Brake Band Leaf, 1-1/8" long	61480-01
	Brake Tension Spring long	322-00
	Brake Tension Spring short	17323-01
	Plug, 8-contact, Jones	17313-01
	Brake Solenoid	337
	TAKEUP TENSION ARM ASSEMBLY	425-0
	Individually replaceable parts:	
	Takeup Tension Arm Spring	30546-01
	Tape Guide	675-00
	Tape Guide Hook	355-00
	REEL IDLER ASSEMBLY, with arm and guide, but without flywheel.	4040
	For 7-1/2 - 15 ips machine	4459-00
	For 3-3/4 - 7-1/2 ips machine	4459-03
	Tape Guide	257-00
	Pulley Assembly (7-1/2 - 15 ips)	5893-00
	Pulley Assembly (3-3/4 - 7-1/2 ips)	5893-01
	Reel Idler Flywheel	636-01
	CAPSTAN IDLER WHEEL ASSEMBLY	
	For 7-1/2 - 15 ips machine	30945-01
	For 3-3/4 - 7-1/2 ips machine	6092-01
	Capstan Idler Arm	372-01
	Capstan Idler Arm Bushing	5755-00
	Capstan Dust Cap	
	For 7-1/2 - 15 ips machine	3506-00
	For 3-3/4 - 7-1/2 ips machine	3506-01
	Individually replaceable parts:	
	Felt Washer	3583-02
	Retaining Ring	432-007
	CAPSTAN IDLER SOLENOID ASSEMBLY	5783-01
	Individually replaceable parts:	
K501	Capstan solenoid	670-00
	Capstan solenoid eye-bolt	306-03
	Capstan solenoid stop	388-00
	Capstan solenoid felt washer 1/4" thick	503-015
	1/8" thick	503-017
	Capstan solenoid pressure spring	389-00
	Capstan solenoid return spring	400-00
	PUSHBUTTON GUARDS	361-00
	REEL GUARD	5708-00
	SWITCH HARNESS ASSEMBLY	5782-01
	Individually replaceable parts:	
	Connector, plug: Male, 21-contact	145-022
	Microswitch, safety switch assy, SPST, normally open	6582-00
	Microswitch shield	5730-00
	PUSHBUTTON SWITCHS:	
	Step (SPST)	120-014
	Play, fast forward, rewind, normally open	120-013

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
	TOGGLE SWITCHES	
	Tape Speed (DPST)	120-004
	Reel Size (SPST) LG Shank	120-005
	TOP PLATE CONTROL BOX ASSEMBLY	5700-03
	Individually replaceable parts:	
	Chassis cover	5739-01
P502P	Connector, Plug: Male 10 contacts (Remote Dummy)	3461-00
P503P	Connector, Plug: Male 8 contacts (60 Cycle Dummy)	567-01

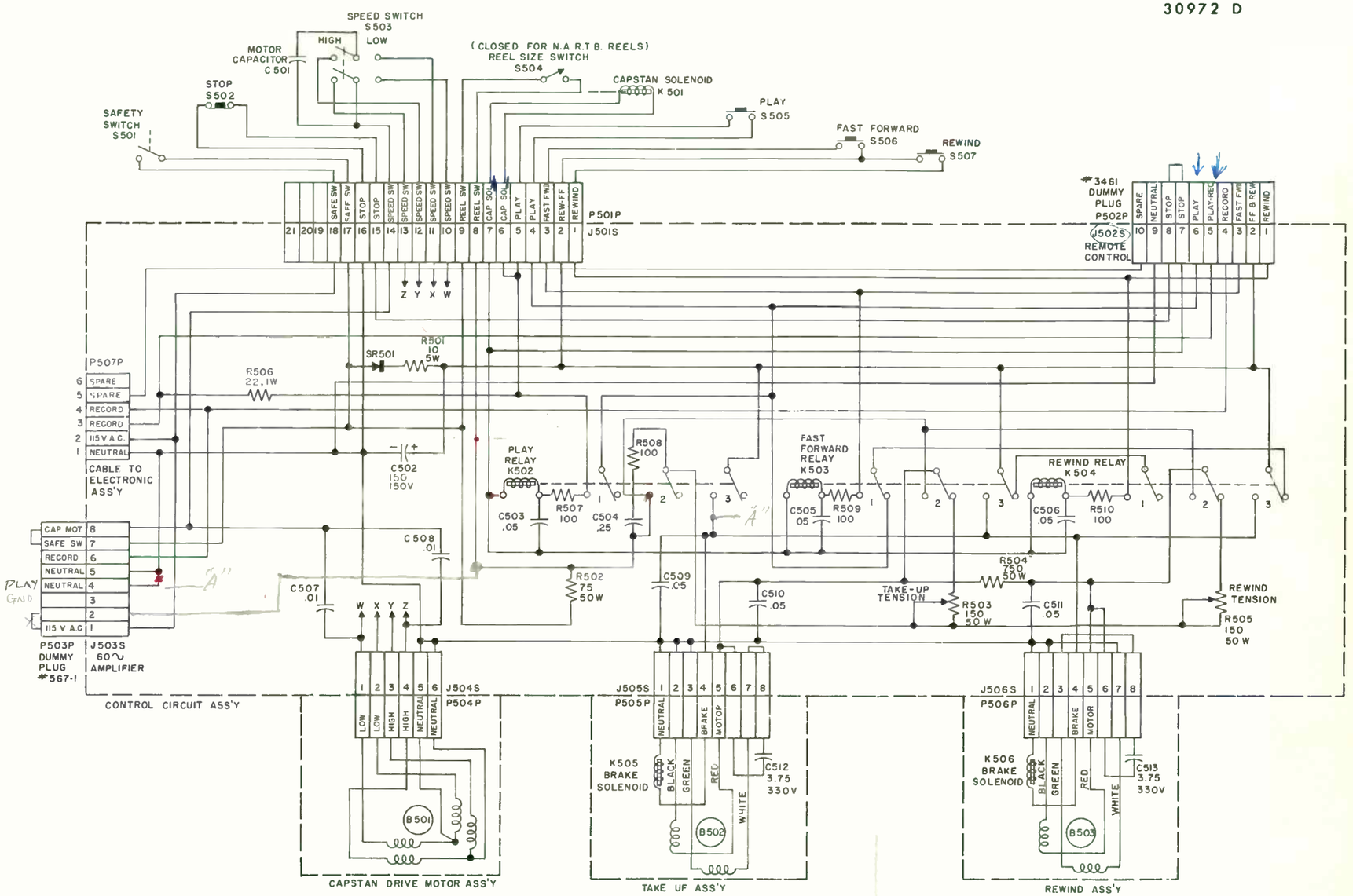
ORDER BY AMPEX CATALOG NUMBER

CONTROL CIRCUIT ASSEMBLY
Catalog No. 5703-03

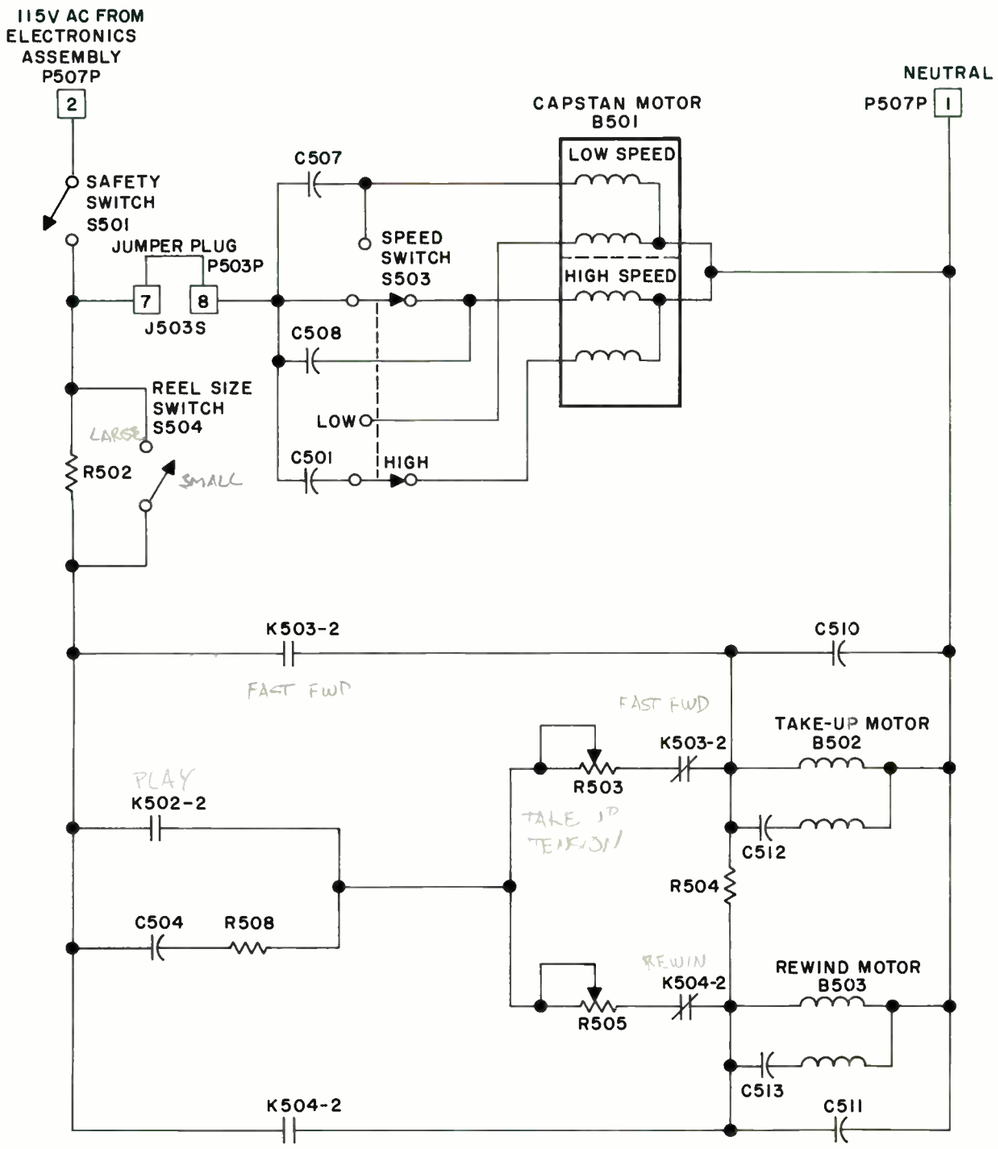
C502	CAPACITOR, fixed: electrolytic tubular, 150 uf, 150 vdcw; Cornel Dubilier Part No. 15015	031-045
C503	CAPACITOR, fixed: metallized tubular, axial leads, .05 uf, ±20%, 400 vdcw; Astron Part No. ML-4-05	033-006
C504	CAPACITOR, fixed: metallized tubular, axial leads, .25 uf, ±20%, 400 vdcw; Astron Part No. ML-4-25	033-008
C505	Same as C503	033-006
C506	Same as C503	033-006
C507	CAPACITOR, fixed: metallized tubular, axial leads, .01 uf, ±20%, 400 vdcw; Astron Part No. ML-4-01	033-005
C508	Same as C507	033-005
C509	Same as C503	033-006
C510	Same as C503	033-006
C511	Same as C503	033-006
J501S	CONNECTOR, receptacle: female, 21 contacts chassis mounted; Jones Part No. S-321-AB	146-057
J502S	CONNECTOR, receptacle: female, 10 contacts chassis mounted; Jones Part No. S-310-AB	146-018
J503S	CONNECTOR, receptacle: female, 8 contact chassis mounted; Jones Part No. S-308-AB	146-003
J504S	CONNECTOR, receptacle: female, 6 contact chassis mounted; Jones Part No. S-306-AB	146-004
J505S	Same as J503S	146-003
J506S	Same as J503S	146-003
K502	RELAY, PLAY: 3PDT, 115 volt dc coil std. 10 amp contact; Philtrol Part No. 33QA	020-006
K503	RELAY, FAST FWD: Same as K502	020-006
K504	RELAY, REWIND: Same as K502	020-006
P501P	CONNECTOR, plug, male, 21 contacts; Jones Part No. P-321-CCT-L	145-022
P504P	CONNECTOR, plug, male, 6 contacts; Jones Part No. P-306-CCT-L	145-012
P505P	CONNECTOR, plug, male, 8 contacts; Jones Part No. P-308-CCT-L	145-013
P506P	Same as P505P	145-013
P507P	Same as P504P	145-012

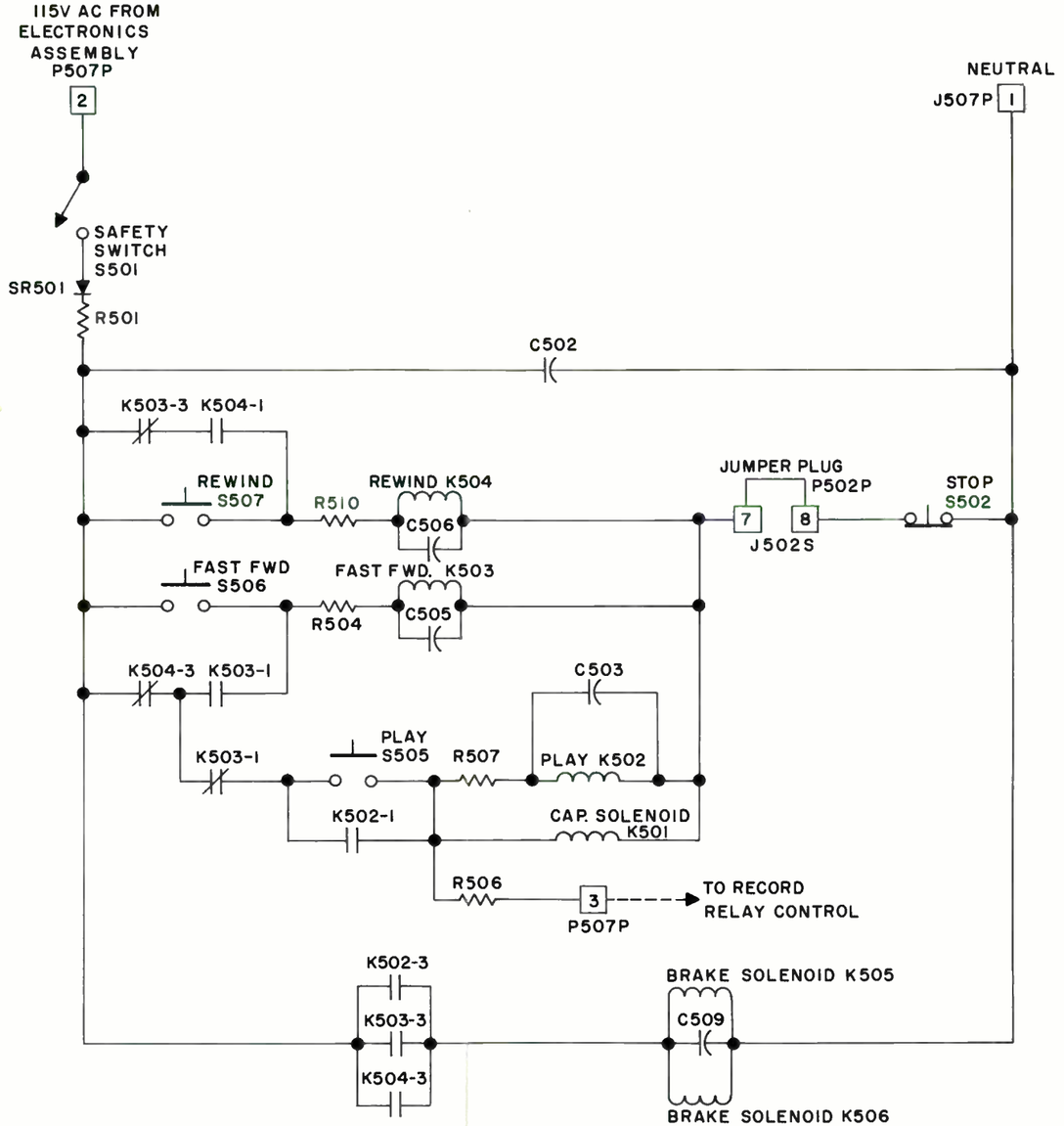
REF. NO.	PART DESCRIPTION	AMPEX PART NO.
R501	RESISTOR, fixed: wirewound, 20 ohm ±10%, 5 watts; Tru-Ohm Part No. type FRL-5	043-154
R502	RESISTOR, fixed: wirewound, 75 ohm ±5%, 75 watts; Tru-Ohm Part No. FR-50	043-002
R503	RESISTOR, adjustable: wirewound, 150 ohm ±5%, 50 watts; Tru-Ohm Part No. AR-50	040-011
R504	RESISTOR, adjustable: wirewound, 750 ohm ±5%, 50 watts; Tru-Ohm Part No. AR-50	040-007
R505	Same as R503	040-011
R506	RESISTOR, fixed: composition, 100 ohm ±10%, $\frac{1}{2}$ W; MIL-R-11A, RC20GF101K	041-038
R507	Same as R506	041-038
R508	Same as R506	041-038
R509	Same as R506	041-038
R510	Same as R506	041-038
SR501	RECTIFIER, selenium: single phase, half wave; G. E. Part No. 6RS25PH6ATD1	582-016

SCHEMATIC DIAGRAM
MODEL 351 TAPE TRANSPORT
CONTROL CIRCUITS
CATALOG NUMBER 30970
30972 D



NOTE
1 ALL RESISTORS IN OHMS & RATED 1/2 WATT UNLESS OTHERWISE NOTED
2 ALL CONDENSERS IN MICROFARADS AND RATED 400 V UNLESS OTHERWISE SPECIFIED.





RELAY CONTACTS

NORMALLY OPEN ⊣⊢

NORMALLY CLOSED ⊣/⊢

CAPACITORS ⊣(⊢

A-C CONTROL CIRCUIT

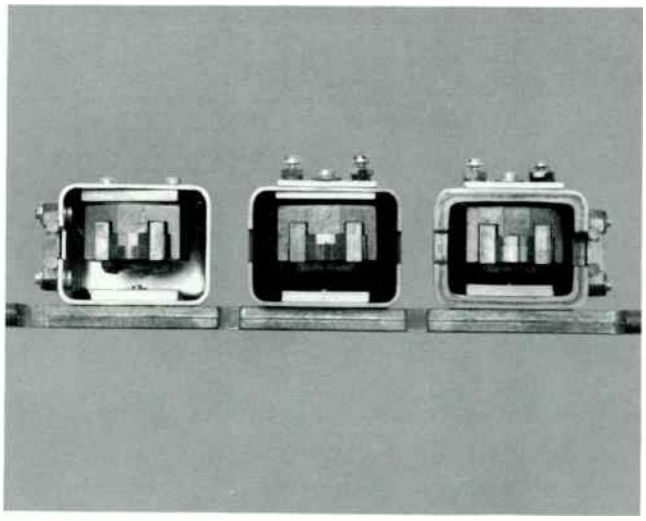
D-C CONTROL CIRCUIT

SIMPLIFIED CONTROL CIRCUIT SCHEMATIC MODEL 351 TAPE TRANSPORT

THE AMPEX HEAD

The head assembly of an Ampex magnetic tape recorder is the heart of the equipment. The technical and detailed know-how required for the fabrication of these head assemblies has made Ampex the foremost manufacturer of magnetic recording equipment in the world today.

In theory, a tape recorder head assembly is a simple device. In practice however, building a head assembly is a complicated task requiring extremely precise manufacturing techniques. There are three head stacks in an assembly—erase, record and playback. In recording, the erase head eliminates any previous recording from the tape. The record head puts a new signal on the tape by magnetizing the iron oxide particles in the coating on the tape. In playback, the magnetic flux in the *moving* tape in-



Half-track head assembly

duces a voltage in the playback head.

The design and construction of these heads is extremely critical. Their surfaces are lapped to finishes so smooth that variations are measured in wave lengths of light. In typical playback heads the gap is .00025 inch, which give an indication of the precision required in building the heads.

Each of these heads is designed for a specific function with *no compromise* in the overall head assembly. Professional use demands top performance and there is no room for design compromise.

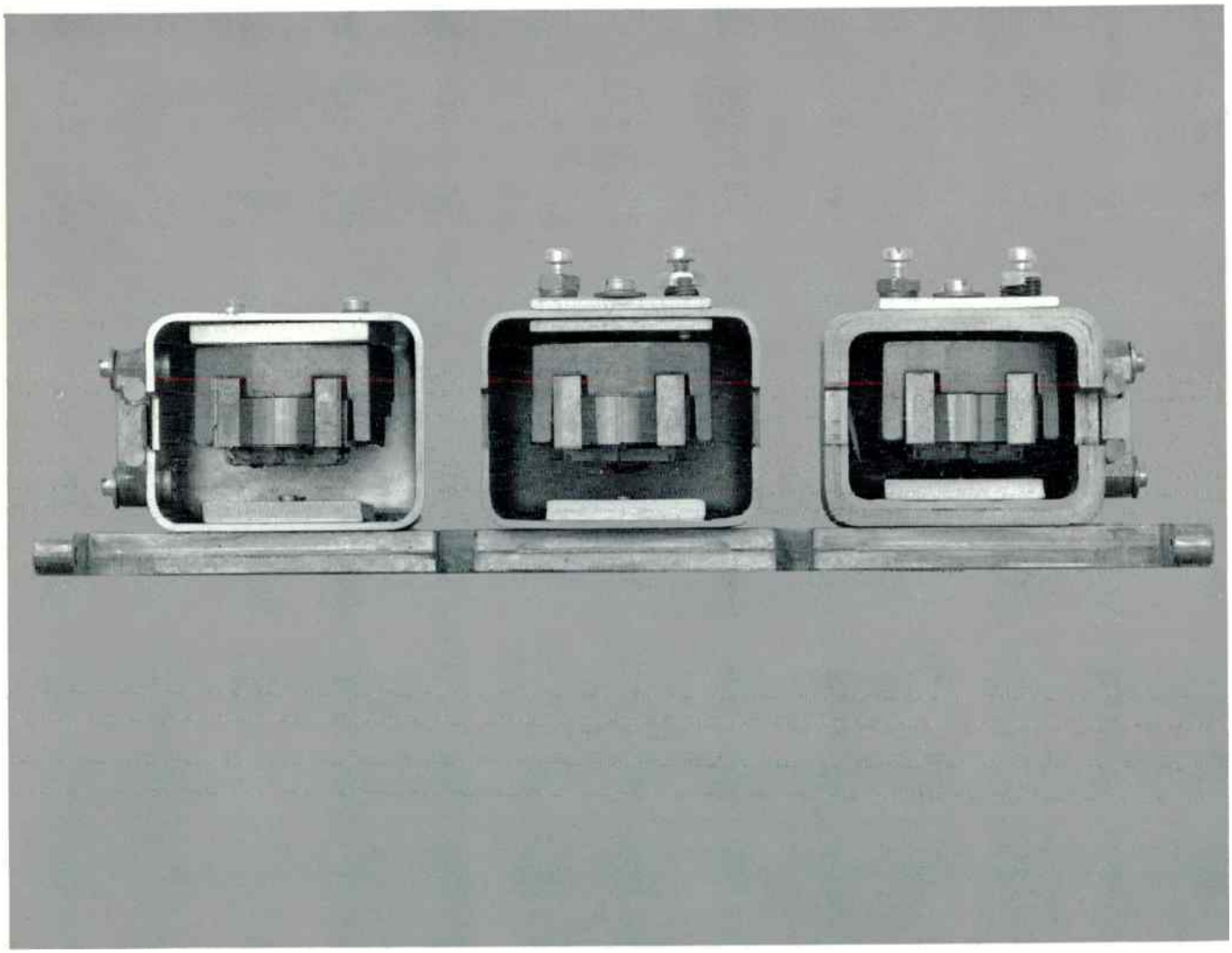
The superb design, engineering and manufacturing care built into Ampex head assemblies assures dependable long life and economical operation at the lowest cost per operating hours.

A portion of the section following will describe briefly by photography the different types of heads used in Ampex Series 351 equipment and a few significant features of development and alignment.

Head assemblies of the Multichannel equipment ordered through Ampex Corporation by including information relating to equipment type, equipment serial number, Ampex catalog number and the description of the part.

Head Assembly

The head assembly is housed in a die cast housing and contains three heads used in the



Full-track head assembly

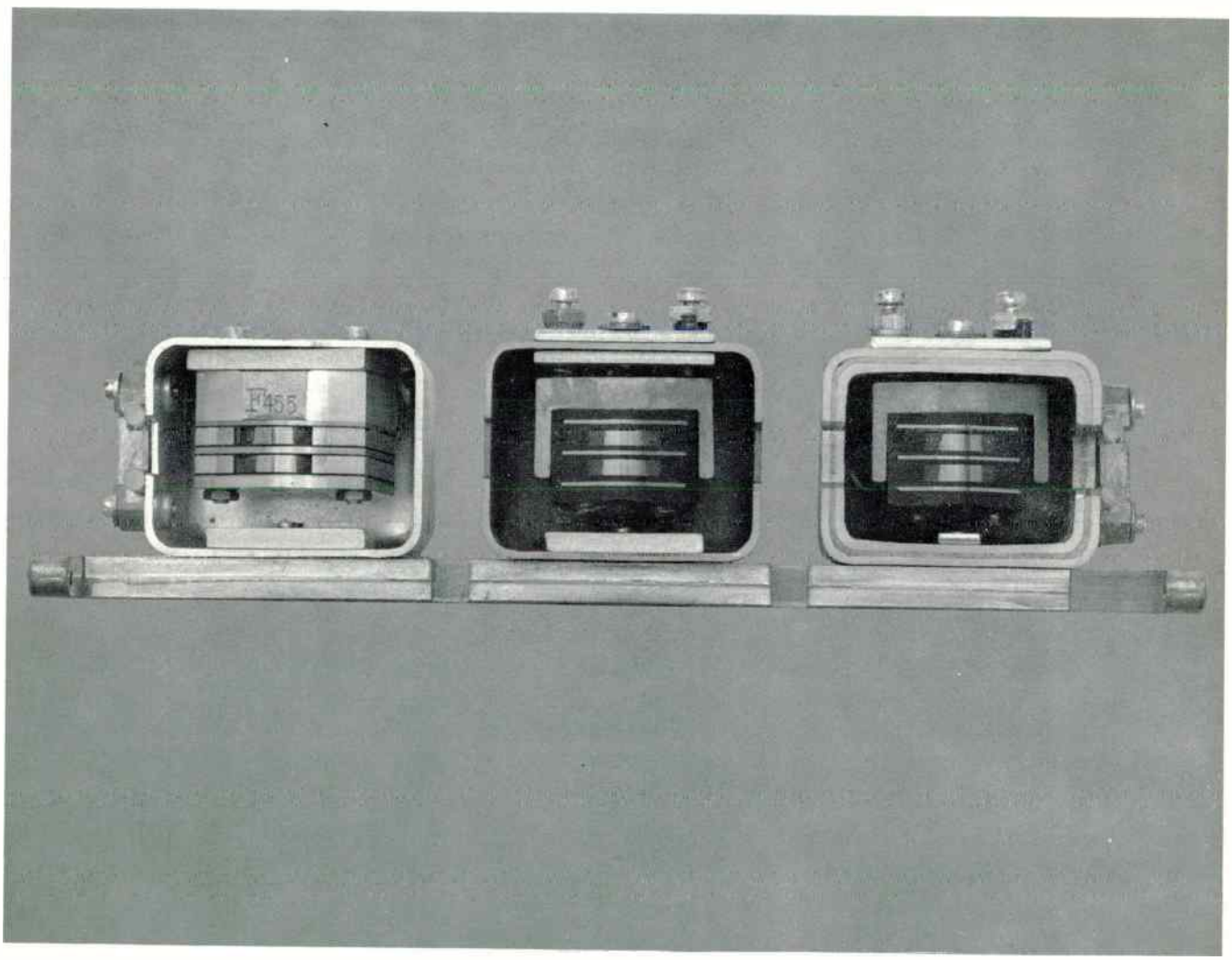
operating process. The heads are respectively erase, record and playback as viewed from left to right when facing the machine. The gate on the assembly holds the playback and record shield covers and the tape-lifting fingers. The function of the tape lifting fingers is to remove the tape from the heads when the gate is open during the REWIND and FAST FORWARD operation. The tape may leave a deposit on the heads if allowed to contact them at high speeds. Such a deposit will seriously impair the performance of the machine and should be guarded against by always opening the gate in the FAST FORWARD and REWIND modes. If a deposit is left, it may be removed by xylene on a soft cloth or tissue. Never use metal of any kind to touch the head surfaces. The gates should never be allowed to spring shut, but should be closed gently.

SINGLE TRACK HEAD ASSEMBLIES

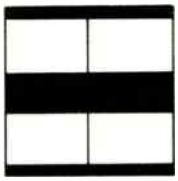
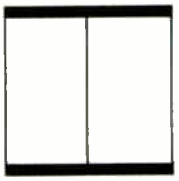
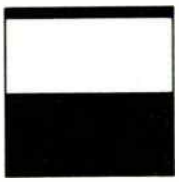
Single track head assemblies offered for use in the 351 equipment are half track or full track configurations. The half track operation is constructed to allow only a portion of the tape to be erased, recorded or reproduced. Full track operation allows the entire width of the tape to be utilized (see chart for information on head configuration and Ampex Catalog Numbers).

DUAL TRACK HEAD ASSEMBLIES . . . . . .

The dual track head assembly is constructed for two track erase (separate erase) operation,



Two-track head assembly

MODEL	ERASE HEAD	HEAD CONFIGURATION	AMPEX CATALOG NUMBER
351-2 STEREO	2-TRACK	 ¼-INCH TAPE	30028-02
351	FULL TRACK	 ¼-INCH TAPE	475-18
351	HALF TRACK	 ¼-INCH TAPE	475-17

NOTE:

ERASE, RECORD AND PLAYBACK ALL UTILIZE THE SAME CONFIGURATION

Standard 351 head configurations

utilizing ¼-inch magnetic tape (see chart for information on head configuration and Ampex Catalog Numbers).

INDIVIDUAL REPLACEABLE HEAD PARTS

Part Description	*Ampex Part Number*
Gate spring, two required	438-01 — 427016G-10
Gate pin, two required	403-006
Glass rod, tape guide, ½-inch long, four required	1372-00
Gate assembly (¼-inch tape)	479-00
Housing (¼-inch tape)	433-01

ELECTRONIC ASSEMBLY

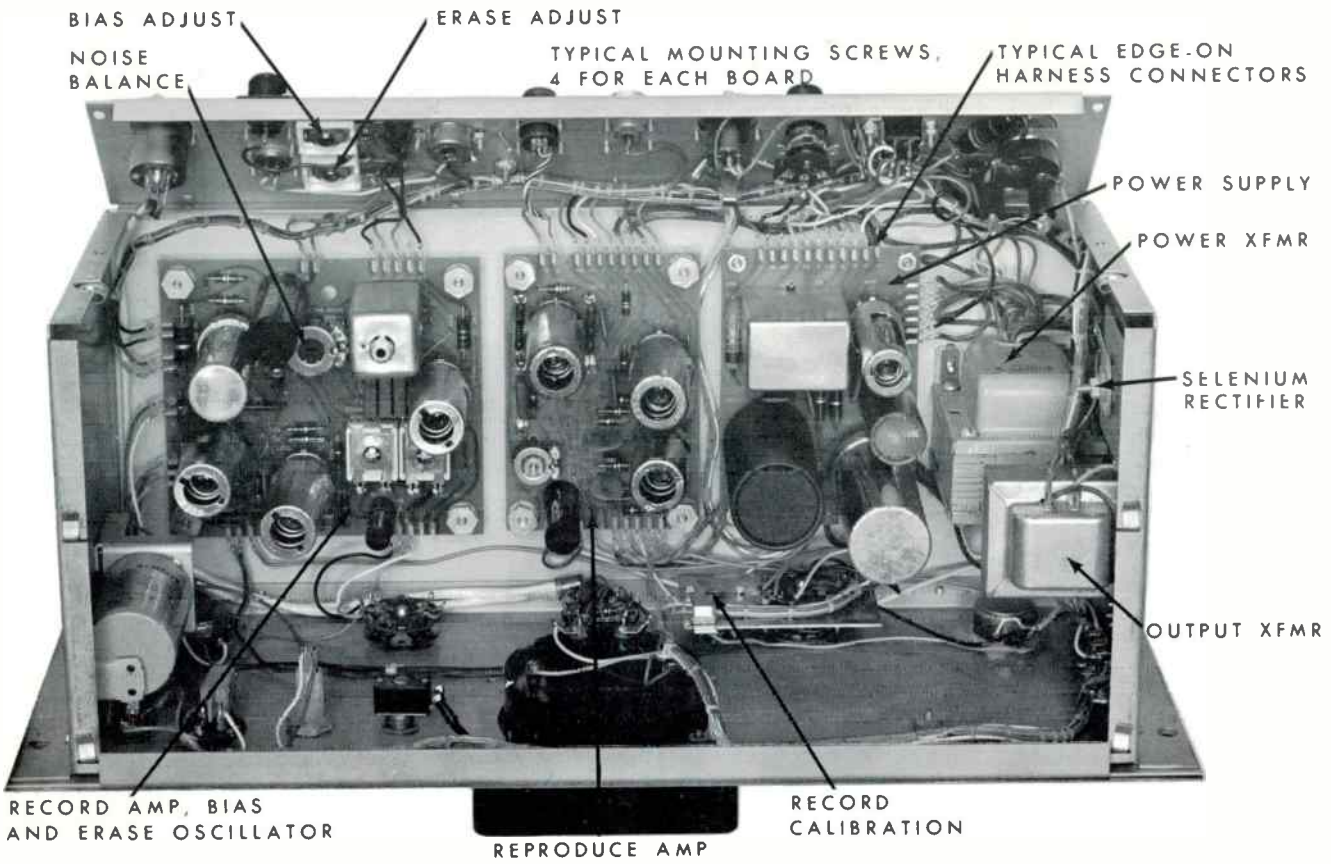
NOTE

This manual is primarily intended for recorders using Ampex Catalog Number 30960 electronics. In instances where there are significant differences between this electronics assembly and earlier models using Catalog Number 30750 or 30950 electronics, an appropriate notation will be found.

GENERAL

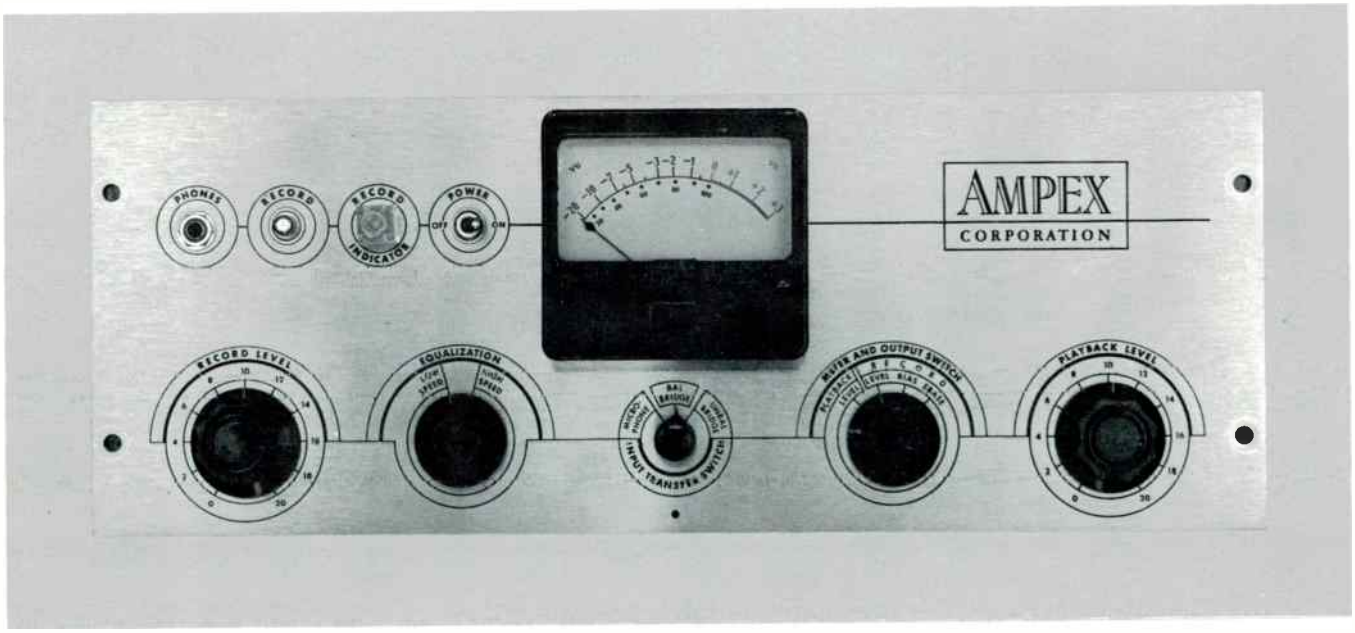
The electronic assembly consists of a single chassis on which are mounted three subassemblies of etched board construction — the record amplifier with bias and erase oscillator, the reproduce amplifier, and the power supply. Each subassembly is an etched board entity which can be taken from the main assembly by disconnecting the edge-on harness connectors and removing 4 mounting sleeve nuts.

On the face panel, facilities are available for setting record and reproduce levels, selecting high or low speed equalization circuitry, making input transfers for microphone, balanced bridge or unbalanced bridge inputs, and switching meter and output circuitry. Visual monitoring of reproduce, record, bias, and erase levels is provided by the vu meter on the face panel. Two phone jacks for aural monitoring are provided, one on the face panel and another on the back of the electronic chassis. Power on-off is controlled at the front of the assembly. A control for the record function, signified by an accompanying indicator light, completes the front panel arrangement.

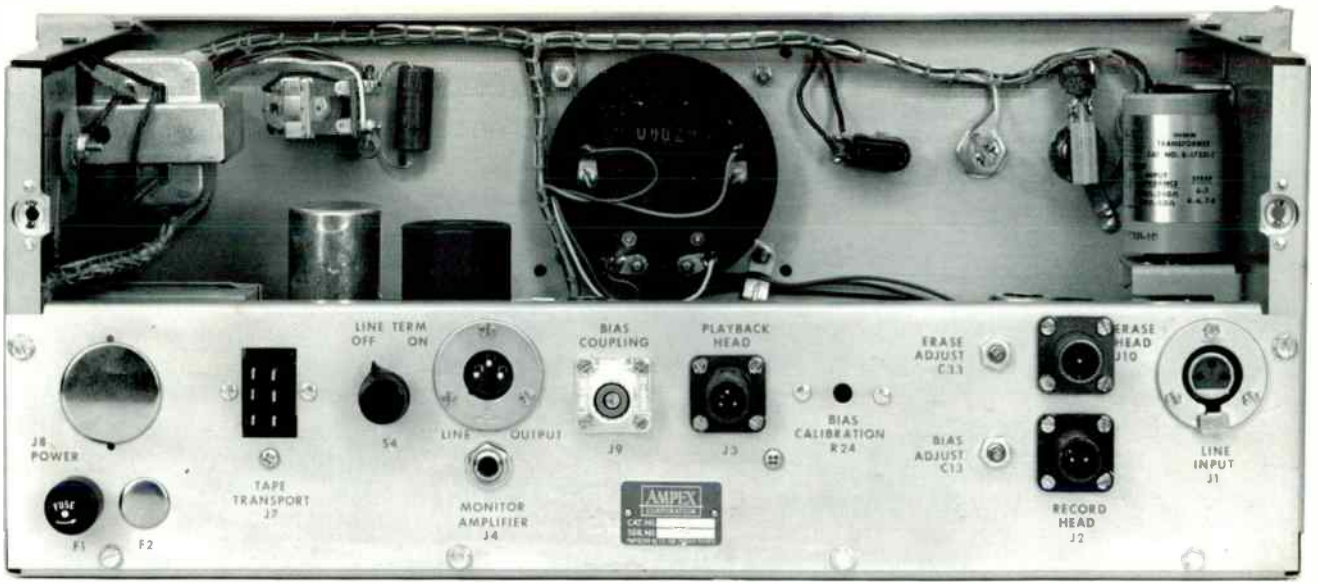


Location of electronic subassemblies

On the back of the electronic assembly chassis are all connecting and interconnecting provisions for power input, line input, line output, power to the tape transport, head connections and bias coupling. Two screw-type fuse posts and a line termination selector switch are



Amplifier chassis, front panel



Amplifier chassis, rear view

also provided on the chassis back panel.

When two electronic assemblies are used for stereophonic operation, the only external differences are that the slave amplifier has one fuse post instead of two and the ac power input receptacle (J8) is not furnished.

RECORD AMPLIFIER

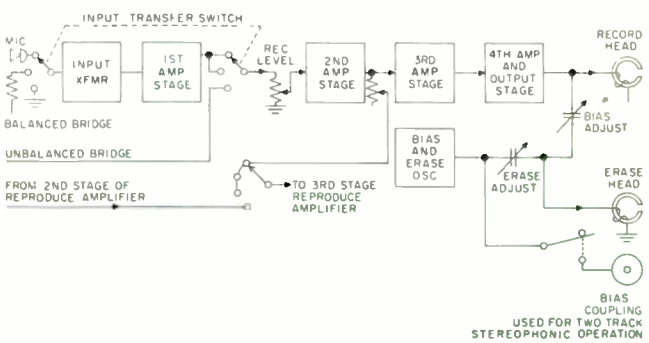
The record section of the electronic assembly is a four stage, high gain, resistance coupled amplifier using transformer coupling for microphone or balanced bridge inputs, and by-passing the transformer and the first stage when unbalanced bridge input is selected. Two dual triodes, 1V1 and 1V2 and their related circuitry, form the four stages of amplification.

When the microphone INPUT is selected the signal from 5J1 is impressed across the primary of input transformer 6T1 and delivered through the secondary to the grid of 1V1.

In the balanced bridge arrangement, the signal passes through resistor network 4R1, 4R4 and 4R5 to input transformer 6T1 with resistors 4R2 and 4R3 providing the balance above ground. From the secondary of transformer 6T1 the signal then appears at the grid of 1V1.

Using the unbalanced bridge arrangement, transformer 6T1 and the first stage of 1V1 are by-passed, the signal appearing at the grid of the second stage through resistor 4R5 and across potentiometer 4R9 with resistor 4R3 and 4R4 completing the circuit to ground.

At the first stage, bias and negative feedback is achieved by means of unbypassed resistor 1R7. When this first stage is used, the amplified signal is coupled through capacitor 1C1 and potentiometer 4R9 and resistor 1R8 (in parallel) to the grid of the second stage, where further amplification takes place. Potentiometer 4R9 provides a means for setting RECORD LEVEL. Bias and negative feedback in the second stage are attained by unbypassed resistor 1R11. Capacitor 1C2A and resistor 1R13 form a plate decoupling network. Capacitors 1C3 and 1C4 and potentiometer 4R12 (RECORD CALIBRATE) provide record calibration circuitry.



Block diagram, record circuit

NOTE

When reading meter indications with the METER AND OUTPUT SWITCH in the record position, only the first two stages of the record amplifier and the last three stages of the reproduce amplifier are connected in the circuit, omitting record pre-emphasis and reproduce equalization circuitry so that meter indications will reflect only the flat action of each amplifier.

The signal now is coupled to the grid of the third stage by capacitor 1C5, bias and negative feedback is provided through unbypassed resistor 1R16. Further amplification takes place in this third stage and pre-emphasis circuitry for HIGH and LOW tape speeds is provided at capacitors 1C46, 1C7 and 1R17 which provide the necessary high frequency rise. At the low end of the frequency spectrum, an effective 3 db gain is furnished by the resistor/capacitor combination 1R18 and 1C8.

In the fourth stage, coupled to the third stage by capacitor 1C9, the signal is applied to the grid of 1V2. Bias and negative feedback is supplied by unbypassed resistor 1R21 and 1R22.

NOTE

Catalog Number 30750 and 30950 electronics used an LC network (1L1 and 1C11 or 1C12) which supplied a high frequency boost by its resonant characteristics.

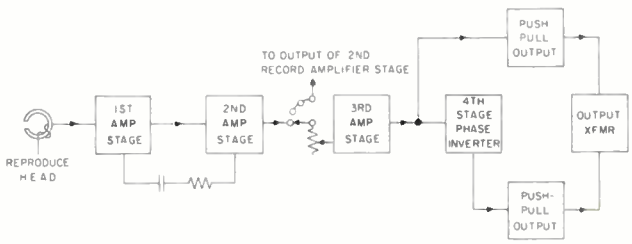
The fourth stage is a constant current circuit which minimizes level variations which would normally occur between different frequencies as they were fed to the reactive load presented by the record head. The output of this fourth stage is mixed with the signal from the bias and erase oscillator before being delivered to the record head.

Plate voltage for the first three stages is supplied whenever POWER switch 4S5 is in the ON position. For plate voltage to be applied to the final stage, the equipment must be in the record mode, at which time relay contacts 3K1C complete the necessary circuitry.

REPRODUCE AMPLIFIER

The reproduce section of the electronic assembly is a resistance coupled audio amplifier. Three dual triodes are used to provide three stages of amplification, phase inversion and a push-pull output amplifier.

Signals on the moving magnetic tape induce voltages in the reproduce head. When high impedance heads are used, this induced voltage appears across resistor 2R25 and then on the grid of 2V3. Bias on this first stage is derived from the voltage divider network consisting of resistors 2R26 and 2R28. Capacitor 3C16a and resistor 3R32 form a plate decoupling network. The amplifier output of this first stage is coupled to the second stage grid through capacitor 2C14. Capacitor 3C16b and resistor 3R35 form a plate decoupling network. Reproduce equalization is achieved by means of capacitor 2C15 and resistors 2R29, 2R30 and 2R31. For the 3¾ and 7½ ips tape speed pair, potentiom-



Block diagram, reproduce circuit

eter 2R30 is selected when EQUALIZATION SWITCH 4S2 on the face panel of the electronic assembly is in the LOW position; POTENTIOMETER 2R31 is selected by the HIGH position. For the 7½ and 15 ips tape speed pair, potentiometer 2R31 serves both speeds.

The signal now is delivered to amplifier stage 2V4, the tube receiving the signal through coupling capacitor 2C17, PLAYBACK LEVEL potentiometer 4R36 and switch 4S3a. The output of 2V4a is coupled through 2C19 to one grid of the push-pull output stage, and a portion of this output is coupled through capacitor 2C18 to phase inverter 2V4b. Both signals, now 180 degrees out of phase with each other, are fed through coupling capacitors to the respective grids of push-pull amplifier 2V5 and then to the primary of center tapped output transformer 6T3.

Plate voltage is supplied to all reproduce stages when the POWER switch is in the ON position. The signal can be monitored from the output of the feedback winding by using phone jack 5J4 MONITOR AMPLIFIER. This same output winding provides negative feedback to the cathode of 2V4A. This position can be useful for feeding such devices as low gain amplifiers, sensing strips, et cetera.

NOTE

Catalog number 30750 and 30950 electronics provide the signal to MONITOR JACK 5J4 from the plate of 2V5.

One secondary of output transformer 6T3 delivers signal to 5J5 output jack, and to LINE TERM switch 5S4 for selecting resistor 5R48 to obtain a nominal 600 ohm termination when necessary. The output signal is also delivered to VU meter 4M1 through resistor network 6R51, 6R53, and 6R52 which determines the amount of signal required to obtain a reading of *0* on the meter. The output signal also appears across 4J6 PHONES jack for aural monitoring.

Transformer strapping and cabling connections for various outputs are discussed in SECTION 2 INSTALLATION.

BIAS AND ERASE OSCILLATOR

A dual triode tube 1V6, connected as a push-pull oscillator, provides a high frequency bias and erase signal. Both halves of the tube are resistance coupled triode amplifiers, with the output of each plate coupled to the grid of the other triode section. Any signal on the grid of either tube will be amplified in the plate circuit and coupled to the grid of the other tube. The signal then will appear at the plate of the second tube and be coupled back to the grid of the first tube in phase with the original signal. Frequency of oscillation is approximately *100* kc.

The oscillator output is fed through variable capacitor 5C33 ERASE ADJUST where erase current adjustments are made. From 5C33 it follows another path through variable capacitor 5C13 BIAS ADJUST where bias current adjustments take place. The bias signal is then mixed with the record signal and delivered to the record head.

NOISE BALANCE control, potentiometer 1R63, in the oscillator grid circuits is adjusted to correct for any asymmetry in wave form, which would cause random noise during reproduction and distortion while recording.

Plate voltage is supplied through relay contact K1C only when the equipment is in the record mode.

POWER SUPPLY

Vacuum tube 3V7, connected as a conventional full wave rectifier, supplies plate power for all tubes in the electronic assembly, and it also supplies the record indicator light. Selenium rectifier CR1, connected as a conventional full wave rectifier provides d-c filament voltage for 1V1, 1V2 and 2V3.

The center tap of the 2V3 tube filament provides a ground for the d-c filaments. *This tube must be in its socket for proper operation.* A-c power input is connected at 5J8 POWER receptacle and is controlled by switch 4S5 POWER.

The power is fed through fuse 5F1 and impressed across the primary of power transformer 6T4 and also through fuse 5F2 to the tape transport.

There are four secondary windings on the power transformer—three for filament supply and one for high voltage. One filament winding serves rectifier tube 3V7, one center-tapped winding provides 12.6 volt d-c filament voltage after rectification, one winding supplies 12.6 and 6.3 volt a-c voltage, and the other center-tapped winding furnishes high voltage. An rc network consisting of the four section capacitor 3C16 and resistors 3R54, 3R55 and 3R56 provides filtering action. Relay contact 3K1B shorts resistor 3R54 in the record mode to provide a nearly constant B+ supply in any mode of operation.

Through record relay 3K1C, B+ is applied to the bias oscillator and the last stage of the record amplifier. Whenever the PLAY button on the tape transport is pressed, 115 volt d-c is available at pin 3 of 5J7, and when RECORD button 4S6 is pressed, the 115 volt d-c is applied to the record relay coil. As long as 115 volt d-c is available at pin 3 of 5J7, contact 3K1A holds

the relay energized. When the STOP button on the tape transport is pressed, the 115 volt d-c no longer reaches pin 3 of 5J7 and relay 3K1 is de-energized and drops out. Slave electronics relay 4K3 provides a coupling contact, 4K3A, when both electronics are in the record mode (concurrent recording). This relay remains energized for a short time after the second relay 3K1 is de-energized to maintain oscillator coupling during the decay period of the oscillators.

NOTE

In catalog numbers 30950 and 30960 slave electronics, relay 4K3A contacts serve as interconnection between the master and slave oscillators. Catalog number 30750 slave electronics did not have relay 4K3.

CAUTION

Before performing alignment and performance checks on stereophonic equipment see special notes on aligning stereophonic equipment.

ALIGNMENT AND PERFORMANCE CHECKS

Equipment Required:

Ampex Standard Alignment Tapes for ¼ Inch Tape.

Speed	*Number Ampex Catalog*
3¾ inches per second (ips)	31331-01
7½ inches per second (ips)	31321-01
15 inches per second (NAB)	31311-01
15 inches per second (AME)	31312-01

A-c Vacuum Tube Voltmeter capable of indicating rms voltages of .004 or less.
Audio Oscillator with stable output from 50 cps to 15 kc.
Earphones or Speaker for Aural Monitoring.
Nutdriver, number 8 (¼ inch).
Reel of unrecorded tape.
Long Screwdriver (approximately 7 inch bit).
Small Screwdriver.

Reproduce Alignment:

Step 1: Remove the head cover.
Step 2: With the equipment connected as

STANDARD TAPES

Order of Recording	*3¾ ips*			*7½ ips*			*15 ips*		
	Tone (cps)	*Level*	*Function*	*Tone (cps)*	*Level*	*Function*	*Tone (cps)*	*Level*	*Function*
First Tone	500	-10 db	reproduce reference	700	-10 db	reproduce reference	700	operating	reproduce gain calibration & reference
Second Tone	7500	-10 db	reproduce head alignment	15,000	-10 db	reproduce head alignment	15,000	operating	reproduce head alignment
Series of Tones	7500 to 50	-10 db	check frequency response*	15,000 to 30	-10 db	check frequency response*	15,000 to 30	operating	check frequency response*
Last Tone	500	operating	reproduce gain calibration	700	operating	reproduce gain calibration	NOT USED		

* Adjust high frequency equalizers if necessary.

shown and all power switches in the ON position, thread an Ampex standard tape for the appropriate speed along the prescribed path.

CAUTION

The standard alignment tape used in the following procedures may be partially erased if the record and reproduce heads are permanently magnetized. Demagnetize the heads before proceeding. Do not replace the head cover on the head assembly.

Step 3: Set the EQUALIZATION switch to the desired speed.

Step 4: Place the METER AND OUTPUT switch in the PLAYBACK position.

Step 5: Terminate the output in a nominal 600 ohms (LINE TERM switch in the ON position or use a 600 ohm external load).

Step 6: Start the standard tape. The first tone on all standard tapes is a reference level, 700 cycles for 7½ and 15 inches per second, and 500 cycles for 3¾ inches per second. For 15 inches per second, adjust the playback level control so the VU meter reads zero or a VTVM across the output reads +8 dbm. For 3¾ or 7½ inches per second adjust the playback level control to a convenient meter reading for checking alignment and response.

Step 7: The next tone will be 15,000 cycles at 7½ and 15 inches per second, and 7500 cycles at 3¾ inches per second for adjusting reproduce head alignment. Take the number 8 nut driver and adjust the left hand stop nut on the reproduce head for maximum output on VU meter or VTVM. If the peak is broad adjust for minimum output variation.

NOTE

If the head azimuth is far out of alignment (possible if inexperienced personnel without proper equipment have attempted alignment procedures) minor peaks may be observed on both sides of the maximum. The proper setting is 15 to 20 db higher than these peaks.

Step 8: Depending on tape speed, tones from 15,000 cycles to 30 cycles now will be reproduced from the standard tape. Adjust the appropriate variable equalizer (2R31 for 7½ and 15 ips, and 2R30 for 3¾) to give the flattest possible high frequency response.

CAUTION

The equalizers should not be used to compensate for system deficiencies (dirty leads, bad alignment, etc.). In general the playback equalizer should not be moved more than 2 db from the standard curve.

NOTE

Catalog #30750 and 30950 electronics used fixed equalization. Variable equalization may be provided in these units by installation of Ampex catalog #31172 kit.

NOTE

When reproducing Ampex standard alignment tapes on multi-track equipment, the bass end of the frequency spectrum will rise in response. The actual amount of rise will vary with the width and location of the track. This phenomena is present because the reproduce head "sees" additional flux on each side of the head at long wavelengths since the standard tapes are recorded across the complete width of the tape. This fringing effect is not present when recording a track the same width as the reproduce head. The electronics should not be readjusted to compensate for this rise.

Step 9: Reproduce level control calibration—The next tone to be heard on the 3¾ and 7½ inch per second standard tapes is a reference tone at operating level. Adjust the playback level control to obtain a zero reading on the

VU meter or a +8 dbm (1.95V) output on a VTVM. On the 15 inch per second standard tape, all tones are at operating level, so this calibration was made in Step 6.

NOTE

Do not change this playback level setting for the remainder of the adjustments.

Reproduce Amplifier Noise Measurement

Step 1: After performing the previous alignment checks, stop the tape motion.

Step 2: Read the stopped tape noise measurement on the VTVM. Noise should be below the level specified in performance characteristics. Inaudible low frequency bounce can cause the meter to read higher than performance characteristics tolerances. Disregard these momentary readings because they are frequencies far below the operating range.

Record Amplifier Erase Current Adjustment

Step 1: After the equipment has been properly installed and connected, and all POWER switches are in the ON position, thread blank tape along the prescribed path.

Step 2: Place the INPUT TRANSFER SWITCH in the UNBAL BRIDGE position.

Step 3: Set the METER AND OUTPUT SWITCH to the ERASE function.

Step 4: Center the noise balance potentiometer. When the user faces the front panel, the slot should parallel the face plate.

Step 5: Place the equipment in the record mode.

NOTE

Erase adjustment on stereophonic recorders must be made with only one amplifier in the record mode at a time as false readings may be obtained if both amplifiers are in the record mode.

Step 6: Using a small screwdriver, set the ERASE ADJUST trimmer on the back of the electronic chassis to obtain vu meter readings at 117 volt ac line voltage as follows:

Full (Single) Track Equipment:	Half Track and Stereophonic Equipment:
+1	−½

NOTE

Erase current will be directly proportional to line voltage and the vu meter readings will reflect any changes from the 117 volt a-c voltage.

Record Amplifier Bias Adjustment

NOTE

This adjustment should be made using the brand of tape that normally will be used on the equipment.

Step 1: Place the METER AND OUTPUT SWITCH in the PLAYBACK position.

Step 2: Place the equipment in the record mode at 7½ ips tape speed.

Step 3: Set the oscillator frequency at 500 cycles per second (cps) with an output of approximately 1 volt.

NOTE

Bias is set at a specific wavelength. It it is desired to set bias as 15 inch tape speed, use a frequency of 1000 cps.

Step 4: Place the RECORD LEVEL knob at a position that will obtain an on-scale VU meter reading.

Step 5: With a small screwdriver set the BIAS ADJUST trimmer for a maximum reading on the VU meter. An accurate way to set peak bias is to adjust the bias control clockwise until the 500 cycle signal drops ½ db below maximum reading. Note the current reading by placing the meter output switch in the BIAS position. Turn the bias control counterclockwise until the 500 cycle signal again drops ½

db and note current reading. Set the bias at the median of these two readings.

Record Level Calibration

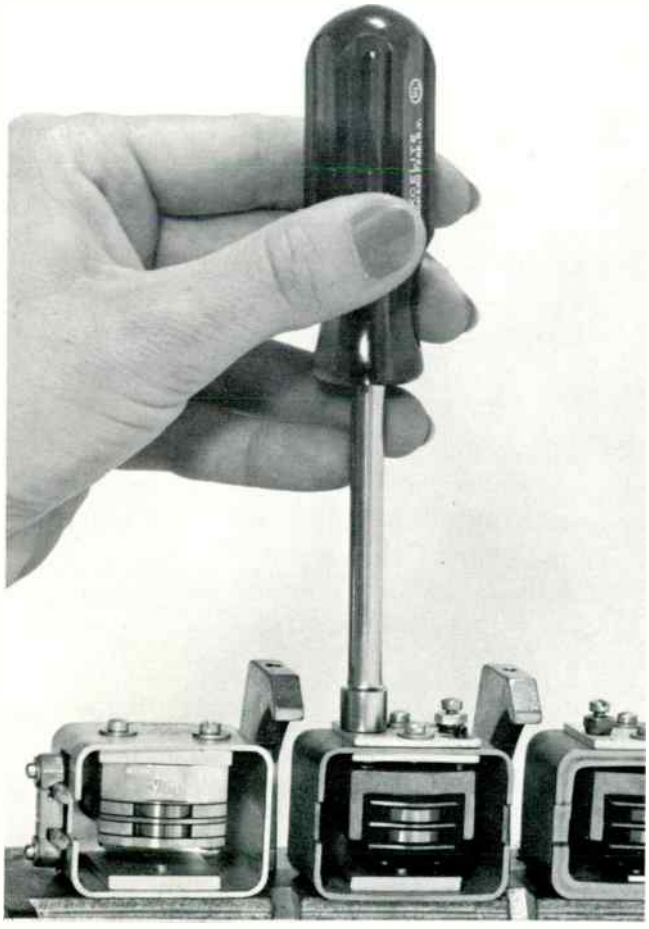
NOTE

The reproduce level must be calibrated using standard tape before calibrating the record level (see Reproduce Level Control Calibration).

Step 1: Set the audio oscillator to 500 cps. Leave the METER AND OUTPUT SWITCH in the PLAYBACK position.

Step 2: Set the RECORD LEVEL knob to a position that will obtain a zero reading on the VU meter.

Step 3: Place the METER AND OUTPUT SWITCH in the RECORD LEVEL position.



Head azimuth adjustment

Step 4: Using a long shank screwdriver (to avoid burns from the hot electron tubes), adjust the record level potentiometer for a zero VU reading.

Record Azimuth Adjustment

Step 1: Set the oscillator at 500 cps.

Step 2: Place METER and OUTPUT SWITCH in the RECORD LEVEL position.

Step 3: Set the RECORD LEVEL knob to obtain a VU meter reading of approximately −20 (−12 on VTVM).

Step 4: Place the METER and OUTPUT SWITCH in the PLAYBACK position.

Step 5: Set the audio oscillator to 7500 cps for 3¾ ips, 15 kc for 7½ and 15 ips.

Step 6: With the nut driver, rotate the adjustment nut on the left side of the record head (as the user faces the front of the equipment) to obtain a maximum VTVM reading. Several peaks may appear, but the maximum peak is obvious because it is much greater than the minor peaks.

CAUTION

The right hand nuts are factory set. DO NOT ADJUST THEM.

NOTE

If it is desired to make this azimuth adjustment using the VU meter instead of the VTVM, place the PLAYBACK LEVEL control in the full clockwise position and adjust the azimuth nut to obtain a maximum VU meter reading.

Overall Frequency Response

To avoid tape compression, frequency response at 15 ips tape speed should be made at least 10 db below operating level (−2 dbm), at 3¾ and 7½ ips at least 20 db below operating level (−12 dbm). The standard alignment tapes are recorded at a higher level to facilitate measurements on the VU meter.

Step 1: Place the METER and OUTPUT SWITCH in the RECORD LEVEL position.

Step 2: Set the oscillator at 500 cycles and adjust the RECORD LEVEL control to obtain a VTVM reading of approximately −12 dbm (.195v).

Step 3: Now place the METER and OUTPUT SWITCH in the PLAYBACK LEVEL position.

Step 4: Make a frequency response check by sweeping the oscillator through all frequencies from 50 to 15,000 cycles.

NOTE

Models using 30750 or 30950 electronic assemblies utilize fixed equalization. Variable equalization may be provided in these assemblies by installation of Ampex Catalog Number 31172 conversion kit.

The high frequency response may vary with tapes of different manufacturers. This machine has been adjusted to give optimum performance within specification with an average tape. The high frequency record equalizers 1C46 or 1C7 (depending on tape speed) may be adjusted to give the flattest possible response with the tape you intend to use. Do not use the playback equalizers 2R30 or 2R31 to compensate for tape variations. The bias setting will also change the high frequency response, especially at the lower tape speeds (3¾ and 7½ ips). Before adjusting the record equalizers make sure the bias has been correctly adjusted as previously described.

CAUTION

Changing bias may change the RECORD LEVEL CALIBRATION and may require re-adjustment as described earlier in this section on "RECORD LEVEL CALIBRATION."

If tolerances are not met, trouble-shooting is indicated or the tape can be faulty.

Overall Frequency Response Using the VU-Meter

Step 1: Thread blank tape along the prescribed path.

Step 2: Place the METER and OUTPUT SWITCH in the RECORD LEVEL position.

Step 3: Set the audio oscillator to 500 cps.

Step 4: Set the record level to approximately −20 reading on the VU meter for 3¾ and 7½ ips tape speed, −10 for 15 ips tape speed.

Step 5: Now place the METER and OUTPUT SWITCH in the PLAYBACK LEVEL position.

Step 6: Note the position of the PLAYBACK LEVEL knob for future reference.

Step 7: Rotate the PLAYBACK LEVEL until the 500 cycle plays back at a convenient reference on the VU meter. Sweep oscillator through the frequency band checking response on the VU meter.

Step 8: Re-establish the PLAYBACK LEVEL CONTROL setting by placing this knob in its original position (see Step 6).

Record Noise Balance Adjustment

CAUTION

For stereophonic equipment see NOTES ON ALIGNING STEREOPHONIC EQUIPMENT.

Step 1: Position the RECORD LEVEL knob fully counterclockwise.

Step 2: Disconnect any input.

Step 3: Plug a set of earphones into the monitor jack and listen for the point of minimum noise while adjusting the noise balance control.

NOTE

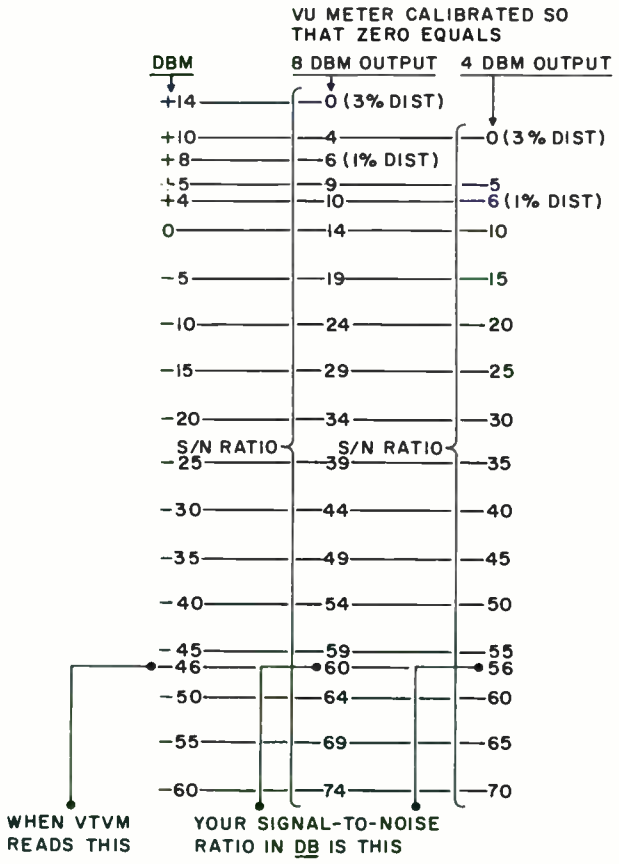
If the slot of the noise balance adjustment is more than 45 degrees from a line parallel to the plane of the face plate, troubleshooting is indicated. If the noise tends to null at either adjustment extreme, it indicates excessive leakage in capacitor 1C10, trouble in the oscillator circuitry or magnetized heads.

Record Noise Measurement

To translate vtvm readings into specific signal-to-noise ratios when the vu meter is so calibrated that zero vu corresponds to +8 dbm output, add 6 db to obtain the output value from the 3% distortion level, arriving at a total of 14 dbm. Having made this computation, bear in mind that, although the noise reading taken on the vtvm is dbm, the measurement is a *ratio* which must include the 14 dbm computed to arrive at the 3% distortion level. Therefore, the vtvm reading must be converted to the signal-to-noise *ratio*.

Example: 14 (dbm, includes +8 dbm normal level and +6 dbm to 3% distortion level)
−46 (dbm, vtvm reading)
60 db signal-to-noise ratio

Any reading below −46 dbm meets performance characteristics specifications of 60 db signal-to-noise and satisfies the signal-to-noise ratio definition.



Signal-to-noise ratio computations

When the VU meter is so calibrated that zero VU corresponds to +4 dbm output add 6 db to obtain the output value to the 3% distortion level arriving at a total of 10 dbm.

Example: 10 (dbm, 4 +6)
−46 (dbm vtvm reading)
56 (db, signal-to-noise ratio)

Ampex signal-to-noise ratio specifications on audio instruments define in decibels the ratio existing between the level of a steady 1000 cycle tone, recorded at a level at which distortion produced by the approach of tape saturation equals 3% total rms, and that level of total rms noise, in the band from 30 to 15,000 cycles, which exists in reproduction under the same gain conditions.

Ampex audio instruments normally are calibrated so that the VU meter reads zero level when reproducing a steady 1000 cycle tone the level of which produces 1% total rms distortion due to the approach of tape saturation.

A recorded 1000 cycle tone at the 3% distortion level will be 6 db higher in level than the same tone recorded at the 1% level.

Step 1: Place the METER AND OUTPUT SWITCH in the RECORD LEVEL position.

Step 2: Set the oscillator to 400 cps.

Step 3: Adjust the RECORD LEVEL control to obtain a vtvm reading 6 db above operating level (+14 dbm for equipment with 8 dbm output).

Step 4: Record the 400 cps on a section of tape, noting where the recording begins for later reference.

Step 5: Disconnect the oscillator.

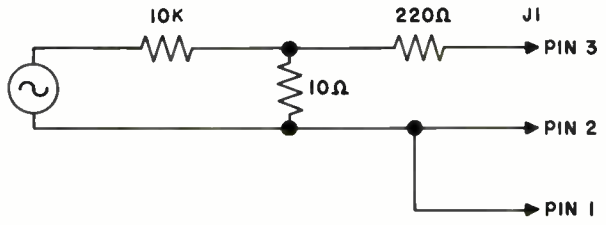
Step 6: Set the RECORD LEVEL control to zero. (Fully counterclockwise).

Step 7: Rewind to the beginning of the 400 cps recording.

Step 8: Erase the tape by recording with zero signal.

Step 9: Rewind again to the beginning of the recording.

Step 10: Read the vtvm and check the reading against the table.



Microphone response set-up

Microphone Response

Connect an audio oscillator as shown in the illustration and make the response check by sweeping the oscillator through the frequency range to be checked.

NOTES ON ALIGNING STEREOPHONIC EQUIPMENT

Stereophonic equipment, consisting of two electronic assemblies—a master and a slave, and two track head assemblies, is aligned in an almost identical fashion to the monaural system by considering and aligning each amplifier separately.

Certain simple differences are outlined for the user's guidance. Before attempting alignment of the two track stereophonic equipment, note the instructions for each category.

Head Azimuth Adjustment

Because there are two heads in each record and reproduce stack, make the azimuth adjustment for an average maximum meter indication, adjusting first one head and then the other, and finally adjusting for the average maximum meter indication.

This compromise azimuth adjustment applies to reproduce and record heads alike. When aligning the record heads, energize the record relays by depressing the record buttons on each electronic assembly.

Record Alignment of Stereophonic Equipment

Treat each amplifier as though aligning for single track operation, and following the instructions in this section, proceed in this sequence:

1. Center the noise balance (slot parallel to plane of the chassis face panel if it is not within 45° of center position).

2. Set the ERASE ADJUST trimmer for proper indication.

NOTE

When the METER and OUTPUT SWITCH is in the ERASE position, meter readings must be made with only one amplifier in the record mode because, if both amplifiers are recording, false readings will be taken.

3. Set the BIAS ADJUST trimmer for proper indication.

4. Set the record calibration for proper reading. Repeat on second channel.

Frequency Response

Frequency response checks can be made on both systems simultaneously, or the tracks can be checked individually.

Noise Balance Adjustment

Step 1: Position the number one amplifier RECORD LEVEL knob fully counterclockwise.

Step 2: Disconnect any input.

Step 3: Place amplifier number one ONLY in the record mode.

Step 4: Plug a set of earphones into the monitor jack and listen for the minimum noise location while adjusting the noise balance control.

Step 5: Stop the recorder.

Step 6: Perform steps 1 and 2 on amplifier number two.

Step 7: Place amplifier number two ONLY in the record mode.

Step 8: Listen for the point of minimum noise while adjusting the noise balance control. Noise balance control slots should be within 45 degrees of a line paralleling the face panel of the chassis.

MAINTENANCE AND TROUBLESHOOTING

General Maintenance Information

Faithful adherence to the recommended ROUTINE MAINTENANCE found in SEC-

TION 5 TAPE TRANSPORT MECHANISM and careful performance checks will insure excellent equipment operation. When the cleaning, lubricating and demagnetizing procedures are followed as prescribed and the system is set up according to the instructions in this manual, equipment performance should meet the high Ampex standards.

Neglect of maintenance procedures, such as failure to clean the capstan, the head faces and the tape guides daily can cause deficiencies that are reflected in the amplifiers. For instance, poor tape-to-head contact, due to tape oxide accumulations, will diminish high end frequency response.

Improper head azimuth adjustment will also affect high frequency response.

When the user suspects faults, the above information should be considered, and, if satisfied that the cause is in the amplifier, he then can begin troubleshooting.

Progressive Maintenance of the Amplifiers

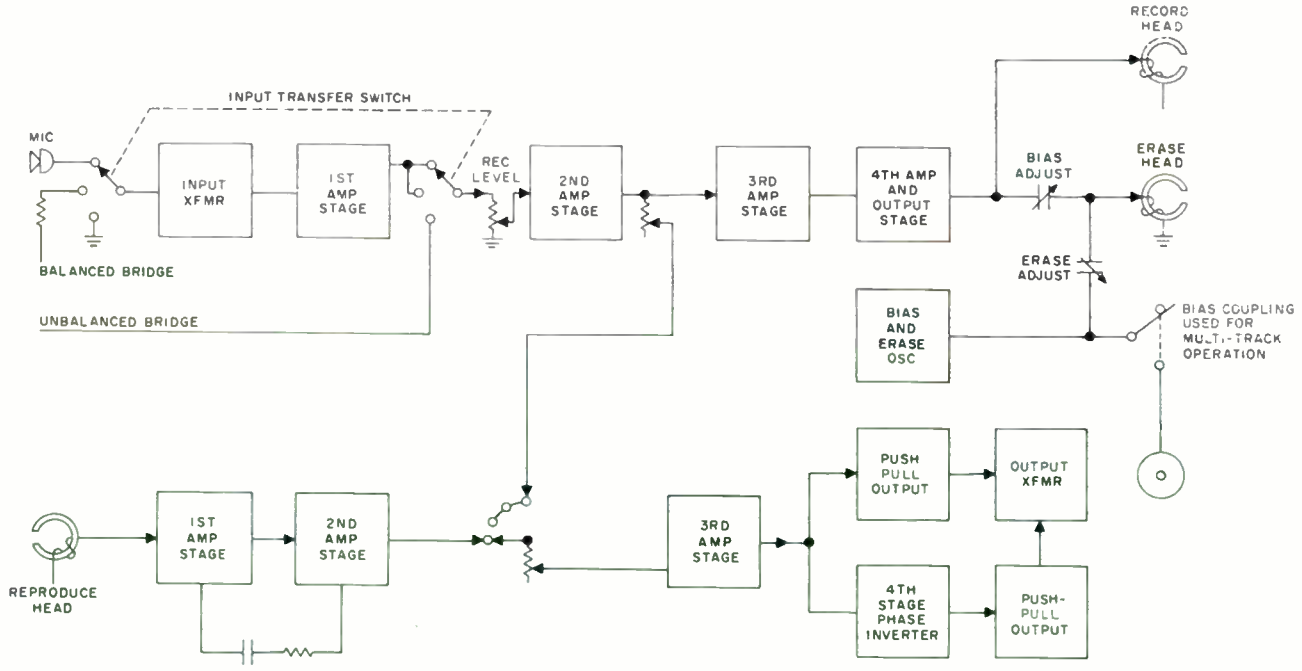
Depending on equipment, check B+ voltage at junction of 3R55 and 3R58 and make a check of tube emission. Make sure tubes are returned to same socket. Check DC filament voltage to note aging of 6CR1. 3R60 may be reduced in value or shorted out as rectifier ages. Clean the relay contacts by inserting a piece of high quality bond paper between contacts and pulling it back and forth several times.

Corrective Maintenance

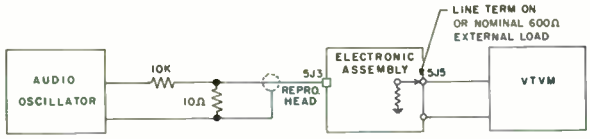
The first step in any corrective maintenance procedure is localizing the faulty circuit. If a tape recorded on the equipment itself does not reproduce correctly, the trouble can be in either the record or the reproduce circuit. In this case, the faulty circuit can be identified by reproducing a standard alignment tape or a commercially recorded tape; if, while reproducing the standard tape, trouble still exists the fault is in the reproduce circuit, if the reproduce function is normal, the fault is in the record circuit. A run through of the alignment and performance checks for the offending circuit will further isolate the trouble or may rectify it, and the faulty component or mechanical device then should be identified easily.

Troubleshooting the Reproduce Amplifier

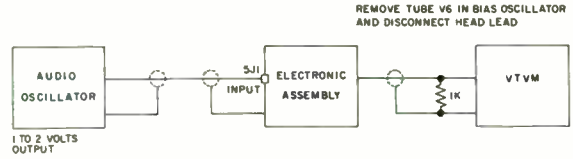
A circuit for troubleshooting the reproduce amplifier is shown below (see also — PARTS



System block diagram



Trouble shooting the reproduce amplifier



Trouble shooting the record amplifier

LOCATION POWER SUPPLY AND REPRODUCE AMPLIFIER, and foldout SCHEMATIC DIAGRAM — ELECTRONIC ASSEMBLIES).

Proceed as in troubleshooting the reproduce amplifier. Typical voltage readings are shown on the foldout schematic diagram. Using the circuit below, check the record amplifier against the appropriate response curve. *Remove tube 1V6, and disconnect the record head lead before checking amplifier response.*

Servicing and Repairing Printed Circuits

Because of the uniform wiring layout and translucent boards, printed circuits can be traced more easily than conventional circuits, troubleshooting is less difficult, and any qualified person will be able to service and repair the equipment including replacement of components by following the instructions, suggestions and procedures in this section. The translucency of the board makes locating connections and test points easier if a light bulb is placed underneath the circuit to be traced. Continuity checks and measurement of resistors, coils and some types of capacitors can be made at the component side of the etched board. Very small breaks in wiring can be located by means of a magnifying glass. The parts location illustrations and the schematic diagram in this section can be used to advantage when tracing circuitry, especially where tube sockets are concerned. Pin numbers are plainly marked.

Equipment and Tools Required

Diagonal cutters
Long-nosed pliers
Pocket knife
¼-inch nut driver
Solder pick
Small wire brush
Pencil soldering iron
60/40 resin core solder

Precautions

Be careful when removing components from the board to avoid damaging the components themselves or the copper foil wiring. If damage occurs, small breaks can be joined with solder, new foil can be cut to simulate the damaged sections, and large breaks can be repaired with hook-up wire. When applying new foil, first remove all coatings such as flux, grease and wax from the damaged portion and place the adhesive side of the foil toward the board. With the tip of the smooth wedge-shaped soldering iron heat the new foil, sliding the tip slowly along the copper surface for about a minute to cure the bond.

Excessive pressure can crack the boards. Access to certain components may not be possible when the boards are in the chassis. To remove the board from the chassis, remove the four mounting nuts carefully. When disconnecting the edge-on harness connectors, make certain that the diagonal pliers grasping the individual connector will not strike and break an adjacent component. To prevent this type of damage, insert a screw driver or similar protective device between the diagonal pliers and the vulnerable component. A vise with protected jaws can be used to hold the boards while servicing. Avoid excessive pressure against the boards when using the vise.

Another source of damage can come from overheating during the soldering process. Excessive heat can cause breaks in the bond between the board and foil, necessitating costly repair of the foil connections. Use 60/40 resin core solder, the melting point of which is 375 degrees F. Some soldering irons are available with tip temperature of 650 degrees F., but the more skilled repair man can speed up the soldering process by using an iron with a tip temperature in the neighborhood of 750 degrees F.

Removing a Resistor

A convenient method of removing resistors is to clip the leads with cutters, leaving sufficient wire at each point so that wiring terminals remain. New components can be soldered to these remnant leads.

Replacing the Resistor

Make mechanical joints by wrapping a turn of each new resistor wire around the remnant wires left from the old component. Perform the soldering quickly and efficiently.

Solder Method of Removing and Replacing Components

On the wiring side of the board at the component to be replaced, heat the connections with an iron until the solder melts. Quickly remove the iron and brush away the solder using the wire brush. Two or more heating passes may be required; but take special care to avoid excessive heat.

Now the mechanical joint will be revealed. Insert a knife blade between the board and the exposed wire, and carefully raise the wire until it is perpendicular to the board and will come free in the next step. Again apply the soldering iron to the connection point while simultaneously moving the lead back and forth until it breaks free of the molten solder.

Take the replacement component, cut the leads to the desired length, insert them into the holes, bending the leads against the board to make mechanical connections, and solder the connections.

Replacing Electrolytic Capacitors, Relays and Coils

The replacement of these types of components can be accomplished as follows:

Step 1: With the soldering iron, heat each connection and brush away melted solder. Some parts may require prying the mounting lugs perpendicular to the board in order to brush away the melted solder.

Step 2: Trim the lugs as close as possible to the board.

Step 3: Again apply the soldering iron to the connections, brush away the melted solder.

Step 4: Insert replacement component and solder the connections.

Replacing of Tube Sockets

Step 1: With soldering iron, heat each contion and brush away melted solder. If the connections do not come free on the first pass, repeat the heating process until connections are broken.

Step 2: With a pen knife inserted between the socket lug and wiring foil, bend each lug upward — except the grounding lug.

Step 3: When all socket lugs have been freed from the wiring foil, heat the grounding lug until the solder melts and slowly pull the socket away from the board.

ORDERING PARTS

The purpose of the parts list is to aid you in ordering replacement parts. Ampex can offer fast and efficient service in providing normally replaceable parts of the components in the system when proper information is furnished. Parts listed according to the schematic reference symbol, a description of the part and the Ampex part number. The Ampex Corporation offers some replacement parts that are not necessarily exact replicas of those used on the original version of the equipment; but these parts are interchangeable with the original parts. The description column names the part, its composition, electrical value and manufacturer's number (or military specification when available)—and the AMPEX PART NUMBER.

Ampex part numbers are the exact designation for all parts used in Ampex equipment. For example, CAPACITOR, fixed: ceramic, .02 uf + 80%-20%, 500 vdcw; Sprague Part No. 36C205 will always bear the Ampex catalog number 030-059. THIS IS THE NUMBER YOU SHOULD USE WHEN ORDERING REPLACEMENT PARTS. The schematic reference number should NOT be used for ordering purposes as it will vary with different equipment types. Include the following information when ordering parts: Equipment Type, Equipment Serial Number, Ampex Part Number, Description of Part. Example: 4-030-059 capacitors for Series 351.

ELECTRONIC ASSEMBLY PARTS LIST
MODEL 351 AND 351-2
CATALOG NUMBER 30960-01 thru -04

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
1C1	CAPACITOR, tubular: paper, .15 uf ±20%, 400 vdcw; Sprague Part No. 89D15404	035-205
1C2	CAPACITOR, electrolytic -- 10 uf, 450 volt; 20 uf, 450 volt; 10 uf, 350 volt --	30770-01
1C3	CAPACITOR, fixed: ceramic, .02 uf +80% -20%, 500 vdcw; Sprague Part No. 36C205	030-059
1C4	Same as 1C3	030-059
1C5	Same as 1C3	030-059
1C7 ($7\frac{1}{2}$-15)	CAPACITOR, variable: ceramic, 7-45 uuf, 500 vdcw; MIL-C-81A: CV11D4-50	038-009
1C7 ($3\frac{3}{4}$-$7\frac{1}{2}$)	CAPACITOR, variable: mica, 550-1600 uuf, 250 vdcw; El Menco Part No. 309	038-015
1C8	CAPACITOR, tubular: paper, .020 uf, 5%, 400 vdcw; Sprague Part No. 89P20354	035-267
1C9	Same as 1C3	030-059
1C10	CAPACITOR, fixed: paper, .47 uf ±20%, 400 vdcw; Cornell Dubilier Part No. BC4P47 ±20%	035-206
5C13	CAPACITOR, variable: mica, 15-130 uuf, 175 vdcw; El Menco Part No. 302 (type 30)	038-002
2C14	Same as 1C3	030-059
2C15	CAPACITOR, fixed: mica, 750 uuf ±5%, 500 vdcw; El Menco Part No. CM20C751J	034-144
3C16	CAPACITOR, electrolytic -- 15 uf, 350 volt: 15 uf, 350 volt; 75 uf, 450 volt; 20 uf, 450 volt --	30769-02
2C17	CAPACITOR, tubular: paper, .15 uf, 20%, 400 vdcw; Sprague Part No. 89D15404	035-205
2C18	Same as 1C3	030-059
2C19	Same as 1C3	030-059
2C20	CAPACITOR, fixed: ceramic, 150 uuf, ±20%, 500 vdcw; Sprague Part No. 40C218	030-046
2C21	Same as 1C3	030-059
2C22	CAPACITOR, ceramic: .1 mfd +80 -20%, 50 vdcw; Sprague Part No. 33C41	030-063

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
4C23	CAPACITOR, fixed: ceramic, 2 x .001 uf, 500 vdcw; Erie Part No. 812-.001	030-004
5C24	CAPACITOR, fixed: ceramic, .0047 uf, ±2%, 500 vdcw; JAN-C 20A: CC36CH470G	035-028
5C25	Same as 5C24	035-028
3C26	CAPACITOR, fixed: electrolytic, 20 uf, 450 vdcw; Cornell Dubilier Part No. BR10422	031-144
3C27	Same as 1C3	030-059
3C28	CAPACITOR: electrolytic, 4000 uf, 15 volt	30769-01
3C29	CAPACITOR, fixed: ceramic, .01 uf, ±20%, 1000 vdcw; Sprague Part No. 33C35A	030-045
3C30	Same as 3C29	030-045
5C32	CAPACITOR, mica: .00035 uf, 1%, 500 vdcw; Cornell Dubilier Part No. 5A5T35	034-169
5C33	CAPACITOR, variable: mica, 100-550 uuf, 175vdcw; El Menco Part No. 304 (type 30)	038-009
1C34 (slave only)	CAPACITOR, mica: .00091 uf, 5%, 500 vdcw; Cornell Dubilier Part No. 5A5T91	034-145
1C35	Same as 5C32	034-169
1C36	CAPACITOR, fixed: mica, .001 uf ±5%, 500 vdcw; Cornell Dubilier Part No. 5AT535	034-147
4C37	CAPACITOR, fixed: ceramic, .01 uf, 500 vdcw; Erie Part No. 811-.01	030-002
5C39	CAPACITOR, fixed: mica, 33 uuf, 500 vdcw; 5%; Cornell Dubilier Part No. 22A5233	034-168
4C43 (slave only)	CAPACITOR, electrolytic: 10 uf, 150 vdcw; Cornell Dubilier Part No. BBR-10-150	031-157
1C46 ($3\frac{3}{4}$-$7\frac{1}{2}$)	CAPACITOR, variable: mica, 780-2110 uuf, 250 vdcw; El Menco Part No. 311	038-026
1C46 ($7\frac{1}{2}$-15)	CAPACITOR, variable: mica, 550-1600 uuf, 250 vdcw; El Menco Part No. 309	038-015
6CR1	RECTIFIER, selenium: single phase, center tap, 26 volt ac rms max. in -- 1.26 amp dc max. out; General Electric Part No. 6RS5WH5	581-001
4CR2	RECTIFIER, selenium: single phase, halfwave, 90 volt ac rms max. in -- .025 amp dc max. out; General Electric Part No. 6RS20PH4RAD1	582-031

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
5F1	FUSE: ½ amp, 250 volt, slow blow; Littlefuse Part No. 313.500	070-026
5F2	FUSE: 3 amp, 250 volt, fast blow; Littlefuse Part No. 312003 Master only	070-001
4I1	POST LIGHT: 1/4 watt neon without internal resistor; Drake Mfg. Part No. 105	132-003
5J1	CONNECTOR, receptacle: female, 3 contact; Cannon Part No. XL-3-13	146-007
5J2	CONNECTOR, receptacle: male, 2 contact; AN3102A-10SL-4P	143-009
5J3	CONNECTOR, receptacle: male, 3 contact; AN3102A-10S-3P	143-008
5J4	PHONE JACK, open circuit type, 2 conductor; Switchcraft Part No. 11	148-015
5J5	CONNECTOR, receptacle: male, 3 contact; Cannon Part No. XL-3-14	147-004
4J6	Same as 5J4	148-015
5J7	CONNECTOR, receptacle: female, 6 contact; Jones Part No. S-306-AB (master only)	146-004
5J7	CONNECTOR, receptacle: male, 6 contact; Jones Part No. P-306-AB (slave only)	147-011
5J8	CONNECTOR, receptacle: male, 2 contact; Hubbel Part No. 7466 (master only)	147-013
5J9	CONNECTOR, receptacle: female, 1 contact; Amphenol Part No. 83-1R	146-067
5J10	CONNECTOR, receptacle: male, 1 contact; AN3102A-10S-2P	143-010
3K1	RELAY, record: 115V dc, ½ amp max. out	30763-01
4K3	RELAY, bias coupling: 115V dc, NA, DPST; Comar Part No. C6605	020-066
4M1	METER, vu: frosted lamps 6.3 volt, .3 amp	30667-01
4R1	RESISTOR, fixed: carbon, .1 meg ohm, 10%, ½ watt MIL-R-11-RC20GF104K	041-072
4R2	RESISTOR, fixed: carbon, 100 ohm, ½ watt, 10%; MIL-R-11A, RC20GF101K	041-038
4R3	Same as 4R2	041-038
4R4	RESISTOR, fixed: carbon, 20K ohms, 5%, ½ watt; MIL-R-11: RC20GF202J	041-356

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REF. NO.	PART DESCRIPTION	AMPEX PART NO.
4R5	RESISTOR, fixed: carbon, 82K ohms, 10%, ½ watt; MIL-R-11: RC20GF823K	041-071
1R6	RESISTOR, fixed: film, .1 meg ±1%, ½ watt; Electra Part No. Type DC-½	042-092
1R7	RESISTOR, fixed: film, 2700 ohms, ½ watt, 10%; MIL-R-10509A, RN15R2701F	042-123
1R8	RESISTOR, fixed: composition, 1 meg, ½ watt; MIL-R-11A, RC20GF105K	041-031
4R9	RESISTOR, variable: composition, .1 meg, 2 watts; Allen Bradley Part No. JA1041	044-015
1R10	RESISTOR, fixed: composition, .1 meg, ½ watt; MIL-R-11A, RC20GF104K	041-072
1R11	RESISTOR, fixed: carbon, 3.3K ohms, 10%, ½ watt; MIL-R-11: RC20GF332K	041-054
4R12	RESISTOR, variable: carbon, .25 meg, 1/4 watt, 20%; Chicago Telephone Supply Type PM-45	044-179
1R13	RESISTOR, fixed: carbon, 27K ohms, ½ watt, 10%; MIL-R-11A, RC20GF273K	041-065
1R14	RESISTOR, fixed: composition, .33 meg, ½ watt; MIL-R-11A, RC20GF334K	041-078
1R15	Same as 1R8	041-031
1R16	RESISTOR, fixed: carbon, 1500 ohms, ½ watt; MIL-R-11A, RC20GF152K	041-050
1R17	Same as 1R11	041-054
1R18	RESISTOR, fixed: carbon, .12 meg, ½ watt, 5%; MIL-R-11A, RC20GF124J	041-318
1R19	RESISTOR, fixed: carbon, 22K ohms, 1 watt, 10%; MIL-R-11A, RC32GF223K124J	041-162
1R20	Same as 1R8	041-031
1R21	RESISTOR, fixed: carbon, 220 ohms, ½ watt, 10%; MIL-R-11A, RC20GF221K	041-040
1R22	RESISTOR, fixed: carbon, 2.2K ohms, 10%, ½ watt; MIL-R-11: RC20GF222K	041-052
1R23	RESISTOR, fixed: carbon, 8200 ohms, ½ watt, 10%; MIL-R-11A, RC20GF822K	041-059
5R24	RESISTOR, variable: wirewound, 500 ohms, 2 watts, 20%; Claro Part No. 39-500	044-178
2R25	RESISTOR, fixed: carbon, 330K ohms, 10%, 1/4 watt; Allen Bradley Part No. Type CB	041-325

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
2R26	RESISTOR, fixed: carbon, .47 meg ohms, 10%, $\frac{1}{2}$ watt; MIL-R-11: RC20GF474K	041-080
2R27	RESISTOR, fixed: film, .33 meg ±1%, $\frac{1}{2}$ watt; Electra Part No. Type DC-$\frac{1}{2}$	042-100
2R28	RESISTOR, fixed: film, 1500 ohms, $\frac{1}{2}$ watt, 1%; Electra Part No. DC-$\frac{1}{2}$	042-076
2R29	RESISTOR, fixed: film, 10 meg, $\frac{1}{2}$ watt, 10%; MIL-R-11: RC20GF106K	041-090
2R30 ($3\frac{3}{4}$-$7\frac{1}{2}$ only)	RESISTOR, variable: 500K ohms, 30%, 1/4 watt; Chicago Telephone Supply Type UPE-70 Spec. 31184	044-207
2R31	RESISTOR, variable: 100K ohms, 20%, 1/4 watt; Chicago Telephone Supply Type UPE-70 Spec. 31186	044-204
3R32	RESISTOR, fixed: carbon, 39K ohms, $\frac{1}{2}$ watt, 10%; MIL-R-11A, RC20GF393K	041-067
2R33	Same as 2R29	041-090
2R34	RESISTOR, fixed: carbon, .22 meg, $\frac{1}{2}$ watt, 10%; MIL-R-11A, RC20GF224K	041-076
3R35	Same as 1R13	041-065
4R36	RESISTOR, variable: carbon, .25 meg, 2 watts, 10%; Allen Bradley Part No. CA2541, SD3056	044-128
2R37	Same as 1R8	041-031
2R38	Same as 1R16	041-050
2R39	Same as 1R8	041-031
2R40	RESISTOR, fixed: carbon, 82K ohms, $\frac{1}{2}$ watt, 10%; MIL-R-11A, RC20GF823K	041-071
2R41	Same as 1R16	041-050
2R42	Same as 2R34	041-076
2R43	Same as 2R34	041-076
2R44	Same as 1R8	041-031
2R45	Same as 1R8	041-031
2R46	RESISTOR, fixed: carbon, 1K ohm, $\frac{1}{2}$ watt, 10%; MIL-R-11A, RC20GF102K	041-048
2R47	RESISTOR, fixed: carbon, 15K ohms, 10%, $\frac{1}{2}$ watt; MIL-R-11: RC20GF153K	041-062
5R48	RESISTOR, fixed: carbon, 560 ohms, $\frac{1}{2}$ watt, 10%; MIL-R-11A, RC20GF561K	041-045

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
2R49	RESISTOR, fixed: carbon, 39K ohms, 10%, ½ watt; MIL-R-11: RC20GF393K	041-067
6R50	RESISTOR, fixed: carbon, 1.5K ohm, ½ watt, 10%; MIL-R-11A, RC20GF152K	041-050
6R51	RESISTOR, fixed: carbon, 4.7K ohms, ½ watt, 10%; MIL-R-11A, RC20GF472J	041-013
6R52	RESISTOR, fixed: carbon, 8.2K ohms, ½ watt, 5%; MIL-R-11A, RC20GF822J	041-309
6R53	RESISTOR, fixed: carbon, 820ohms, ½ watt, 5%; MIL-R-11A, RC20GF821J	041-317
3R54	RESISTOR, fixed: carbon, 1.5K ohm, 1 watt, 10%; MIL-R-11A, RC32GF152K	041-148
3R55	Same as 3R54	041-148
3R56	Same as 4R2	041-038
3R57	Same as 4R2	041-038
3R58	RESISTOR, fixed: carbon, 15K ohms, ½ watt, 10%; MIL-R-11A, RC20GF153K	041-062
1R59	RESISTOR, fixed: carbon, 1.5K ohm, 2 watts, 10%; MIL-R-11A, RC42GF152K	041-204
3R60	RESISTOR, fixed: wirewound, 1.5 ohm, 1 watt, 10%; International Resistance Corp. Type BW-1	043-286
1R61	Same as 1R11	041-054
1R62	Same as 1R61	041-054
1R63	RESISTOR, variable: carbon, 10K ohms, 1/4 watt, 30%; Chicago Telephone Supply Part No. UPM-45, Spec. 3471	044-171
1R64	RESISTOR, fixed: carbon, 8.2 ohms, 1 watt, 5%; MIL-R-11A, RC32GF825J	041-319
1R65	Same as 2R34	041-076
4R70	RESISTOR, fixed: carbon, 330 ohms, 10%, ½ watt; MIL-R-11: RC20GF331K (Slave only)	041-042
2R75	RESISTOR, fixed: carbon 680K ohms, 10%, ½ watt; MIL-R-11: RC20GF684K	041-082
4S1	SWITCH, rotary: INPUT TRANSFER, 3 position	30760-01
4S2	SWITCH, rotary: EQUALIZATION, 2 position	30761-01
4S3	SWITCH, rotary: METER AND OUTPUT, 4 position	30762-01
5S4	SWITCH, rotary: LINE TERM, 3P4T; Oak Part No. 59016-23	122-016

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
4S5	SWITCH, toggle: POWER, SPST; Carling Part no. 110-B-73	120-005
4S6	SWITCH, rotary: RECORD, pushbutton SPST, normally open; Arrow H & H Part 3391BSA	120-013
6T1	TRANSFORMER, microphone input	17331-01
5T2	TRANSFORMER, input (Low impedance heads only)	6299
6T3	TRANSFORMER, output	30633-01
6T4	TRANSFORMER, power	30634-01
1T5	TRANSFORMER, oscillator	30766-01
1V1	TUBE, electron: 12AX7, 9 pin, miniature, Telefunken Part Number	012-024
1V2	TUBE, electron: 12AT7	012-034
2V3	Same as 1V1	012-024
2V4	Same as 1V1	012-024
2V5	TUBE, electron: 12AU7	012-107
1V6	Same as 2V5	012-107
3V7	TUBE, electron: 6X4	012-050
	*BOARD ASSEMBLY, power supply	30754-01
	*BOARD ASSEMBLY, reproduce: $7\frac{1}{2}$-15 ips	30962-01
	*BOARD ASSEMBLY, reproduce: $3\frac{3}{4}$-$7\frac{1}{2}$ ips	30962-02
	*BOARD ASSEMBLY, record: $7\frac{1}{2}$-15 ips	30963-01
	*BOARD ASSEMBLY, record: $3\frac{3}{4}$-$7\frac{1}{2}$ ips	30963-02
	FACING PANEL	5711-02
	HARNESS ASSEMBLY, master	30966-01
	HARNESS ASSEMBLY, slave	30966-02
	HOLD-DOWN KNOB, EIA reels	30971-01
	KNOB, large, skirted	230-004
	KNOB, small, skirted	230-003
	KNOB, small, with pointers	230-008
	POST, fuse (F1 and F2)	085-001
	SHIELD, tube, for all except V7	160-012
	SHIELD, tube V7	160-043

* Etched board assemblies are complete with all mounted components including tubes.

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
	SHOCKMOUNT	350-015
	SLEEVE, nut	21078-01
	SOCKET, tube, 7 pin	150-067
	SOCKET, tube, naval	30818-01
	CABINET, console	5797-00
	CABLE ASSEMBLY, power interconnecting for rack mounted equipment	30812-01
	CABLE ASSEMBLY, power interconnecting portable equipment	30812-02
	CABLE, bias interconnecting for dual track equipment	14943-02
	CABLE, extension	5795-00
	CABLE, power	2413-00
	CASE, portable, Electronic Assembly, single unit	4100-00
	CASE, portable, Electronic Assembly, dual track unit	3935-00
	CASE, tape transport	5727-00
	REEL ADAPTER	976-00
	EDITING KNOB, console and portable	1917-00
	HOLD-DOWN KNOB, reel, for rack	9093-00 -4040492-10
	REMOTE CONTROL UNIT, single track, complete with 30 foot cable	5763-00 42.60
	Remote Control Unit Parts	
J701P	CONNECTOR, receptacle: male, 10 contact; Jones Part No. P-310-AB	147-014
	CONNECTOR, plug: female, 3 contact, output connector; Cannon Part No. XL-3-11	144-003
	CONNECTOR, plug: male, 3 contact, line IN on microphone connector; Cannon Part No. XL-3-12	145-009
A702	LAMP, REMOTE TAPE MOTION:	
	Same as A701	060-006
	LAMP BASE, green	132-007
	LAMP BASE, red	132-006

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
A701	LAMP, REMOTE RECORD: 120 volts, 6 watts	060-006
S701	PUSHBUTTON, fast forward	120-013
S702	Same as S701, rewind	120-013
S703	PUSHBUTTON, STOP	120-014
S704	Same as S701, START	120-013
S705	Same as S701, RECORD, single track	120-013
S705	Same as S701, RECORD, dual track	120-013
	REMOTE CONTROL UNIT, dual track, complete with 30 foot cable	5763-2
	REMOTE CONTROL PANEL, single track, unwired, less cable and box	5763-1
	REMOTE CONTROL PANEL, dual track, unwired, less cable and box	5763-3
	WOODBOX, grey	3661-00

ELECTRONIC ASSEMBLY PARTS LIST
MODEL 351 AND 351-2
CATALOG NUMBER 30750-01 thru -08

REF. NO.	PART DESCRIPTION	AMPEX PART NO.

351 SERIES COMPLETE EQUIPMENT

Rack Mount, 7-1/2 - 15 ips, Full Track, 60 Cycle Power	30700-01
Rack Mount, 7-1/2 - 15 ips, Full Track, 50 Cycle Power	30700-02
Rack Mount, 7-1/2 - 15 ips, Half Track, 60 Cycle Power	30700-07
Rack Mount, 7-1/2 - 15 ips, Half Track, 50 Cycle Power	30700-08
Rack Mount, 3-3/4 - 7-1/2 ips, Full Track, 60 Cycle Power	30700-13
Rack Mount, 3-3/4 - 7-1/2 ips, Full Track, 50 Cycle Power	30700-14
Rack Mount, 3-3/4 - 7-1/2 ips, Half Track, 60 Cycle Power	30700-19
Rack Mount, 3-3/4 - 7-1/2 ips, Half Track, 50 Cycle Power	30700-20
Console, 7-1/2 - 15 ips, Full Track, 60 Cycle Power	30700-03
Console, 7-1/2 - 15 ips, Full Track, 50 Cycle Power	30700-04
Console, 7-1/2 - 15 ips, Half Track, 60 Cycle Power	30700-09
Console, 7-1/2 - 15 ips, Half Track, 50 Cycle Power	30700-10
Console, 3-3/4 - 7-1/2 ips, Full Track, 60 Cycle Power	30700-15
Console, 3-3/4 - 7-1/2 ips, Full Track, 50 Cycle Power	30700-16
Console, 3-3/4 - 7-1/2 ips, Half Track, 60 Cycle Power	30700-21
Console, 3-3/4 - 7-1/2 ips, Half Track, 50 Cycle Power	30700-22
2 Case Portable, 7-1/2 - 15 ips, Full Track, 60 Cycle Power	30700-05
2 Case Portable, 7-1/2 - 15 ips, Full Track, 50 Cycle Power	30700-06
2 Case Portable, 7-1/2 - 15 ips, Half Track, 60 Cycle Power	30700-11
2 Case Portable, 7-1/2 - 15 ips, Half Track, 50 Cycle Power	30700-12
2 Case Portable, 3-3/4 - 7-1/2 ips, Full Track, 60 Cycle Power	30700-17
2 Case Portable, 3-3/4 - 7-1/2 ips, Full Track, 50 Cycle Power	30700-18
2 Case Portable, 3-3/4 - 7-1/2 ips, Half Track, 60 Cycle Power	30700-23
2 Case Portable, 3-3/4 - 7-1/2 ips, Half Track, 50 Cycle Power	30700-24

351-2 EQUIPMENT

Rack Mount, 7-1/2 - 15 ips, 60 Cycle Power	30810-01
Rack Mount, 7-1/2 - 15 ips, 50 Cycle Power	30810-02
Rack Mount, 3-3/4 - 7-1/2 ips, 60 Cycle Power	30810-05
Rack Mount, 3-3/4 - 7-1/2 ips, 50 Cycle Power	30810-06
2 Case Portable, 7-1/2 - 15 ips, 60 Cycle Power	30810-03
2 Case Portable, 7-1/2 - 15 ips, 50 Cycle Power	30810-04
2 Case Portable, 3-3/4 - 7-1/2 ips, 60 Cycle Power	30810-07
2 Case Portable, 3-3/4 - 7-1/2 ips, 50 Cycle Power	30810-08

The prefix number of the following component reference symbols designates physical location (see LEGEND) on the schematic diagram).

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
1C1	CAPACITOR, fixed: paper, .15 uf ± 20%, 400 vdcw; Cornell Dublier Part No. BC4P15±20%	035-205
1C2	CAPACITOR: electrolytic -- 10 uf, 450 volt; 20 uf, 450 volt; 10 uf, 350 volt --	30770-01
1C3	CAPACITOR, fixe ceramic, .02 uf +80% -20%, 500 vdcw; Sprague Part No. 36C205	030-059
1C4	Same as C3	
1C5	Same as C3	
1C6	CAPACITOR, fixed: paper, .0047 uf ± 5%, 400 vdcw; Cornell Dublier Part No. ST4D47	035-026
	Used in 7-1/2 - 15 ips Equipment	
1C6	CAPACITOR, fixed: paper, .0027 uf ± 5%, 400 vdcw; Sprague Part No. 109P27254	035-238
	Used in 3-3/4 - 7-1/2 ips Equipment	
1C7	CAPACITOR, fixed: paper, .0012 uf ± 5%, 400 vdcw; Sprague Part No. 109P12254	035-203
	Used in 7-1/2 - 15 ips Equipment	
1C7	Same as C6 (.0047)	
	Used in 3-3/4 - 7-1/2 ips Equipment	
1C8	CAPACITOR, fixed: paper, .02 uf ± 5%, 400 vdcw; Cornell Dublier Part No. Type PJ	035-020
1C9	Same as C3	
1C10	CAPACITOR, fixed: paper, .47 uf ± 50%, 400 vdcw; Cornell Dublier Part No. BC4P47±20%	035-206
1C11	Same as C6 (.0047)	
	Used in 7-1/2 - 15 ips Equipment	
1C11	CAPACITOR, fixed: paper, .0082 uf ± 5%, 200 vdcw; Cornell Dublier Part No. 109P	035-030
	Used in 3-3/4 - 7-1/2 ips Equipment	
1C12	CAPACITOR, fixed: paper, .0022 uf ± 5%, 400 vdcw; Sprague Part No. 109P22254	035-204
	Used in 7-1/2 - 15 ips Equipment	
1C12	Same as C6 (.0047)	
	Used in 3-3/4 - 7-1/2 ips Equipment	
5C13	CAPACITOR, variable: mica, 15-130 uuf, 175 vdcw; El Menco Part No. 302 (type 30)	038-002
2C14	Same as C3	
2C15	CAPACITOR, fixed: mica, 750 uuf ±5%, 500 vdcw; El Menco Part No. CM20C751J	034-144
3C16	CAPACITOR: electrolytic -- 15 uf, 350 volt; 15 uf, 350 volt; 75 uf, 450 volt; 20 uf, 450 volt--	30769-02
2C17	CAPACITOR, fixed: paper, .1 uf ± 20%, 400 vdcw; CDST4P1(20%)	035-069
2C18	Same as C3	
2C19	Same as C3	
2C20	CAPACITOR, fixed: ceramic, 150 uuf, ± 20%, 500 vdcw; Sprague Part No. 40C218	030-046
2C21	Same as C3	
2C22	CAPACITOR, fixed: ceramic, .05 uf +80% -20%, 500 vdcw; Sprague Part No. 5HK-S5	030-031
4C23	CAPACITOR, fixed: ceramic, 2 x .001 uf, 500 vdcw; Erie Part No. 812-001	030-004
5C24	CAPACITOR, fixed: ceramic, .0047 uf, ± 2%, 500 vdcw; JAN-C 20A: CC36CH470G	035-028
5C25	Same as C24	
3C26	CAPACITOR, fixed: electrolytic, 20 uf, 450 vdcw; Cornell Dublier Part No. BR10422	031-144
3C27	Same as C3	
3C28	CAPACITOR: electrolytic, 4000 uf, 15 volt	30769-01

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
3C29	CAPACITOR, fixed: ceramic, .01 uf, ± 20%, 1000 vdcw; Spargue Part No. 33C35A	030-045
3C30	Same as C29	
1C31	Same as C3	
5C32	CAPACITOR, fixed: mica, 910 uuf, ± 5%, 500 vdcw; Cornell Dublier Part No. 5A5T91	034-145
5C33	CAPACITOR, variable: mica, 100-550 uuf, 175 vdcw; El Menco Part No. 304 Type 30	038-009
1C34	CAPACITOR, fixed: mica, 350 uuf, ± 5%, 500 vdcw; Cornell Dublier Part No. 5A5T35	034-146
1C35	Same as C34	
1C36	CAPACITOR, fixed: mica, .001 uf ± 5%, 500 vdcw Cornell Dublier Part No. 5AT535	034-147
4C37	CAPACITOR, fixed: ceramic, .01 uf, 500 vdcw; Erie Part No. 811-.01	030-002
5C38	CAPACITOR, electrolytic: 10 uf, 150 vdcw; Cornell Dublier Part No. BBR-10-150	031-157
5C39	CAPACITOR, fixed: mica, 33 uuf, 500 vdcw; 5%; Cornell Dublier Part No. 22A5233	034-168
6CR1	RECTIFIER, selenium: single phase, center tap, 26 volt ac rms max. in -- 1.26 amp dc max. out; General Electric Part No. 6RS5WH5	581-001
5F1	FUSE: 1/2 amp, 250 volt, slow blow; Littlefuse Part No. 313.500	070-026
5F2	FUSE: 3 amp, 250 volt, fast blow; Littlefuse Part No. 312003 Master only	070-001
4I1	POST LIGHT: 1/4 watt neon without internal resistor; Drake Mfg. Part No. 105	132-003
5J1	CONNECTOR, receptacle: female, 3 contact; Cannon Part No. XL-3-13	146-007
5J2	CONNECTOR, receptacle: male, 2 contact; AN3102A-10SL-4P	143-009
5J3	CONNECTOR, receptacle: male, 3 contact; AN3102A-10S-3P	143-008
5J4	PHONE JACK, open circuit type, 2 conductor; Switchcraft Part No. 11	148-015
5J5	CONNECTOR, receptacle: male, 3 contact; Cannon Part No. XL-3-14	147-004
4J6	Same as J4	
5J7	CONNECTOR, receptacle: female, 6 contact; Jones Part No. S-306-AB Master only	146-004
5J7	CONNECTOR, receptacle: male, 6 contact; Jones Part No. P-306-AB Slave only	147-011
5J8	CONNECTOR, receptacle: male, 2 contact; Hubbel Part No. 7466 Master only	147-013
5J9	CONNECTOR, receptacle: female, 1 contact; Amphenol Part No. 83-1R	146-067
5J10	CONNECTOR, receptacle: male, 1 contact; AN3102A-10S-2P	143-010
3K1	RELAY, record: 115v dc	30763-01

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
1L1	CHOKE, rf: 20 mh, 125 ma	30767-01
4M1	METER, vu: frosted lamps 6.3 volt, .3 amp	30667-01
4R1	RESISTOR, fixed: composition, .15 meg, 1/2 watt; MIL-R-11A, RC20GF154K	041-074
4R2	RESISTOR, fixed: carbon, 100 ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF101K	041-038
4R3	Same as R2	
4R4	RESISTOR, fixed: carbon, 33K ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF333K	041-066
4R5	RESISTOR, fixed: carbon, .12 meg, 1/2 watt, 10%; MIL-R-11A, RC20GF124K	041-073
1R6	RESISTOR, fixed: film, .1 meg ± 1%, 1/2 watt; Electra Part No. Type DC-1/2	042-092
1R7	RESISTOR, fixed: film, 2700 ohm, 1/2 watt, 10%; MIL-R-10509A, RN15R2701F	042-123
1R8	RESISTOR, fixed: composition, 1 meg, 1/2 watt; MIL-R-11A, RC20GF105K	041-031
4R9	RESISTOR, variable: composition, .1 meg, 2 watts; Allen Bradley Part No. JA1041	044-015
1R10	RESISTOR, fixed: composition, .1 meg, 1/2 watt; MIL-R-11A, RC20GF104K	041-072
1R11	RESISTOR, fixed: carbon, 4700 ohm, 1/2 watt, 10% MIL-R-11A, RC20GF472K	041-056
4R12	RESISTOR, variable: carbon, .25 meg, 1/4 watt, 20%; Chicago Telephone Supply Part No. type PM-45	044-179
1R13	RESISTOR, fixed: carbon, 27K ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF273K	041-065
1R14	RESISTOR, fixed: composition, .33 meg, 1/2 watt; MIL-R-11A, RC20GF334K	041-078
1R15	Same as R8	
1R16	RESISTOR, fixed: composition, 1500 ohm, 1/2 watt; MIL-R-11A, RC20GF152K	041-050
1R17	RESISTOR, fixed: carbon, 22K ohm, 1/2 watt, 5%; MIL-R-11A, RC20GF223J	041-016
1R18	RESISTOR, fixed: carbon, .12 meg, 1/2 watt, 5%; MIL-R-11A, RC20GF124J	041-318
1R19	RESISTOR, fixed: carbon, 22K ohm, 1 watt, 10%; MIL-R-11A, RC32GF223K124J	041-162
1R20	Same as R8	
1R21	RESISTOR, fixed: carbon, 220 ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF221K	041-040
1R22	RESISTOR, fixed: carbon, 2700 ohm, 1/2 watt, 5%; MIL-R-11A, RC20GF272J	041-278
1R23	RESISTOR, fixed: carbon, 8200 ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF822K	041-059
5R24	RESISTOR, variable: wirewound, 500 ohm, 2 watts, 20%; Claro Part No. 39-500	044-178
2R25	RESISTOR, fixed: carbon, .33 meg, 1/4 watt, 10%; Allen Bradley Part No. Type CB	041-325
2R26	RESISTOR, fixed: carbon, .47 meg, 1/2 watt, 10%; MIL-R-11A, RC20GF474K	041-080
2R27	RESISTOR, fixed: film, .33 meg ± 1%, 1/2 watt; Electra Part No. Type DC-1/2	042-100
2R28	RESISTOR, fixed: film: 1500 ohm, 1/2 watt, 1%; Electra Part No. DC-1/2	042-076
2R29	RESISTOR, fixed: film, 10 meg, 1/2 watt, 10%; MIL-R-11 RC20GF106K	041-090

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
2R30	RESISTOR, fixed: carbon, .30 meg, 1/2 watt, 5%; MIL-R-11A, RC20GF304J	041-326
	3-3/4 - 7-1/2 ips Equipment	
2R31	RESISTOR, fixed: film, 68K ohm, 1/2 watt, 1%; Electra Part No. Type DC-1/2	042-088
3R32	RESISTOR, fixed: carbon, 39K ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF393K	041-067
2R33	Same as R29	
2R34	RESISTOR, fixed: carbon, .22 meg, 1/2 watt, 10%; MIL-R-11A, RC20GF224K	041-076
3R35	Same as R13	
4R36	RESISTOR, variable: carbon, .25 meg, 2 watts, 10%; Allen Bradley Part No. CA2541, SD3056	044-128
2R37	Same as R8	
2R38	Same as R16	
2R39	Same as R8	
2R40	RESISTOR, fixed: carbon, 82K ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF823K	041-071
2R41	Same as R16	
2R42	Same as R34	
2R43	Same as R34	
2R44	Same as R8	
2R45	Same as R8	
2R46	RESISTOR, fixed: carbon, 1K ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF102K	041-048
2R47	Same as R13	
5R48	RESISTOR, fixed: carbon, 560 ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF561K	041-045
2R49	Same as R32	
6R50	RESISTOR, fixed: carbon, 1.5K ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF152K	041-050
6R51	RESISTOR, fixed: carbon, 4.7K ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF472J	041-013
6R52	RESISTOR, fixed: carbon, 8.2K ohm, 1/2 watt, 5%; MIL-R-11A, RC20GF822J	041-309
6R53	RESISTOR, fixed: carbon, 820 ohm, 1/2 watt, 5%; MIL-R-11A, RC20GF821J	041-317
3R54	RESISTOR, fixed: carbon, 1.5K ohm, 1 watt, 10%; MIL-R-11A, RC32GF152K	041-148
3R55	Same as R54	
3R56	Same as R2	
3R57	Same as R2	
3R58	RESISTOR, fixed: carbon, 15K ohm, 1/2 watt, 10%; MIL-R-11A, RC20GF153K	041-062
1R59	RESISTOR, fixed: carbon, 1.5K ohm, 2 watts, 10%; MIL-R-11A, RC42GF152K	041-204
3R60	RESISTOR, fixed: wirewound, 1.5 ohm, 1 watt, 10% IRC Type BW-1	043-286
1R61	Same as R11	
1R62	Same as R11	
1R63	RESISTOR, variable: carbon, 10K ohm, 044-171, 1/4 watt, 30%; Chicago Telephone Supply Part No. UPM-45 SPEC3471	044-171
1R64	RESISTOR, fixed: carbon, 8.2 ohm, 1 watt, 5%; MIL-R-11A, RC32GF825J	041-319
1R65	Same as R34	041-076
4S1	SWITCH, rotary: INPUT TRANSFER, 3 position	30760-01
4S2	SWITCH, rotary: EQUALIZATION, 2 position	30761-01

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
4S3	SWITCH, rotary: METER AND OUTPUT, 4 position	30762-01
5S4	SWITCH, rotary: LINE TERM, 3P4T; Oak Part No. 59016-23	122-016
4S5	SWITCH, toggle: POWER, SPST; Carling Part No. 110-B-73	120-005
4S6	SWITCH, rotary: RECORD, pushbutton SPST, normally open; Arrow H and H Part No. 3391BSA	120-013
6T1	TRANSFORMER, microphone input	17331-01
5T2	TRANSFORMER, input Low impedance Heads Only	6299
6T3	TRANSFORMER, output	30633-01
6T4	TRANSFORMER, power	30634-01
1T5	TRANSFORMER, oscillator	30766-01
1V1	TUBE, electron: 12AX7	012-105
1V2	TUBE, electron: 12AT7	012-034
2V3	Same as V1	
2V4	Same as V1	
2V5	TUBE, electron: 12AU7	012-107
1V6	Same as V5	
3V7	TUBE, electron: 6X4	012-050
	*BOARD ASSEMBLY, power supply	30754-01
	*BOARD ASSEMBLY, record: 3-3/4 - 7-1/2 ips	30755-02
	*BOARD ASSEMBLY, record: 7-1/2 - 15 ips	30755-01
	*BOARD ASSEMBLY, reproduce: 3-3/4 - 7-1/2 ips	30756-02
	*BOARD ASSEMBLY, reproduce: 7-1/2 - 15 ips	30756-01
	FACING PANEL	5711-2
	HARNESS ASSEMBLY, master	30819-01
	HARNESS ASSEMBLY, slave	30819-02
	KNOB, large, skirted: Reproduce and Record Level Control	230-004
	KNOB, small, skirted: Equalization and Output	230-003
	KNOB, small with pointer: Input and Line Termination	230-008
	POST, fuse; F1 and F2	085-001
	SHIELD, tube, for all except V7	160-012
	SHIELD, tube; V7	160-043
	SHOCKMOUNT	350-015
	SOCKET, tube: 7 pin	150-067
	SOCKET, tube: 9 pin	30818-01

When ordering replacement parts always include the following information: Equipment Type; Equipment Serial Number; Ampex Part or Catalog Number; and Description of Part. DO NOT simply use the schematic reference number.

Heads 351 ET

E - 4040438-64 $125-

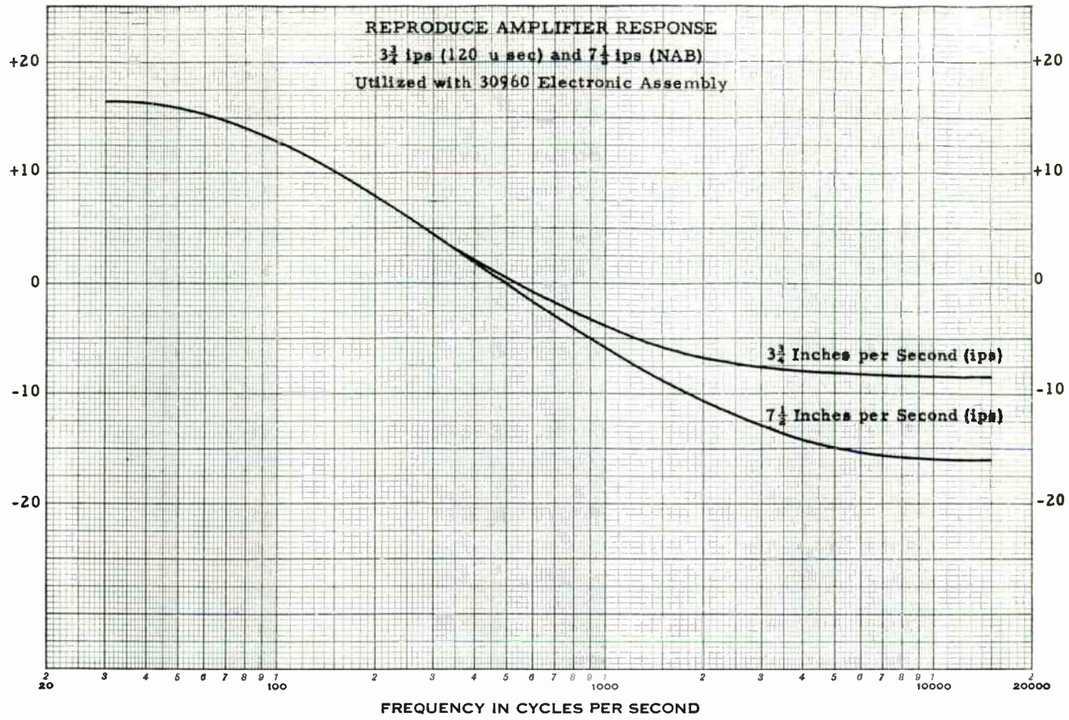
R - 4040438-57 $75-

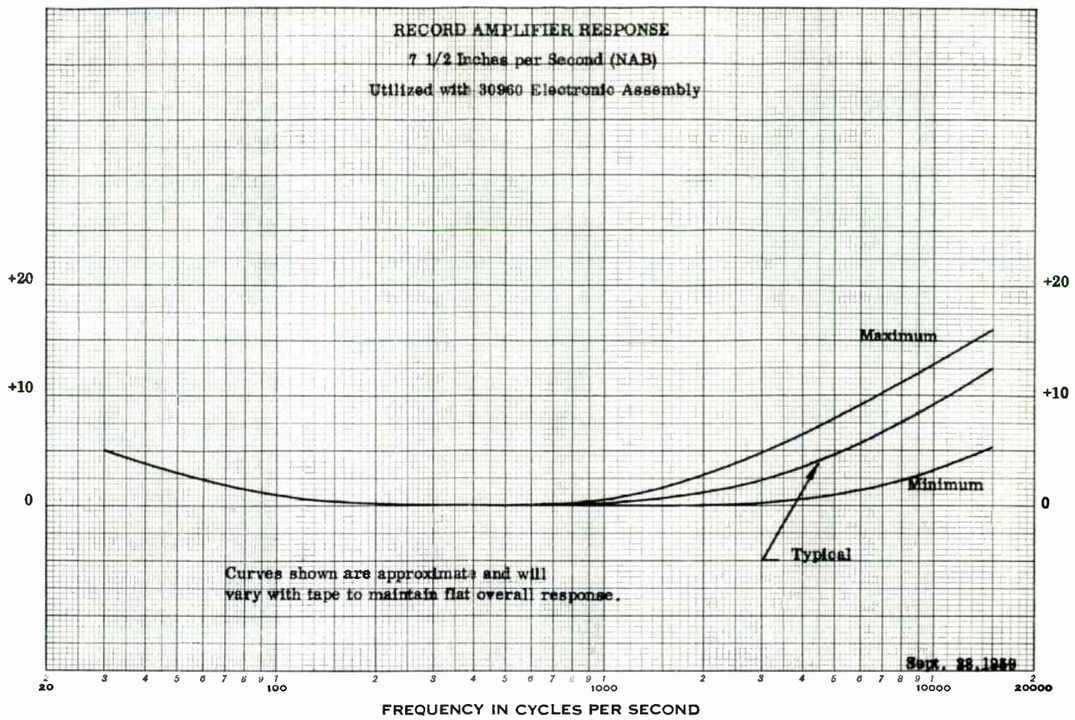
P - 4040438-52 $75-

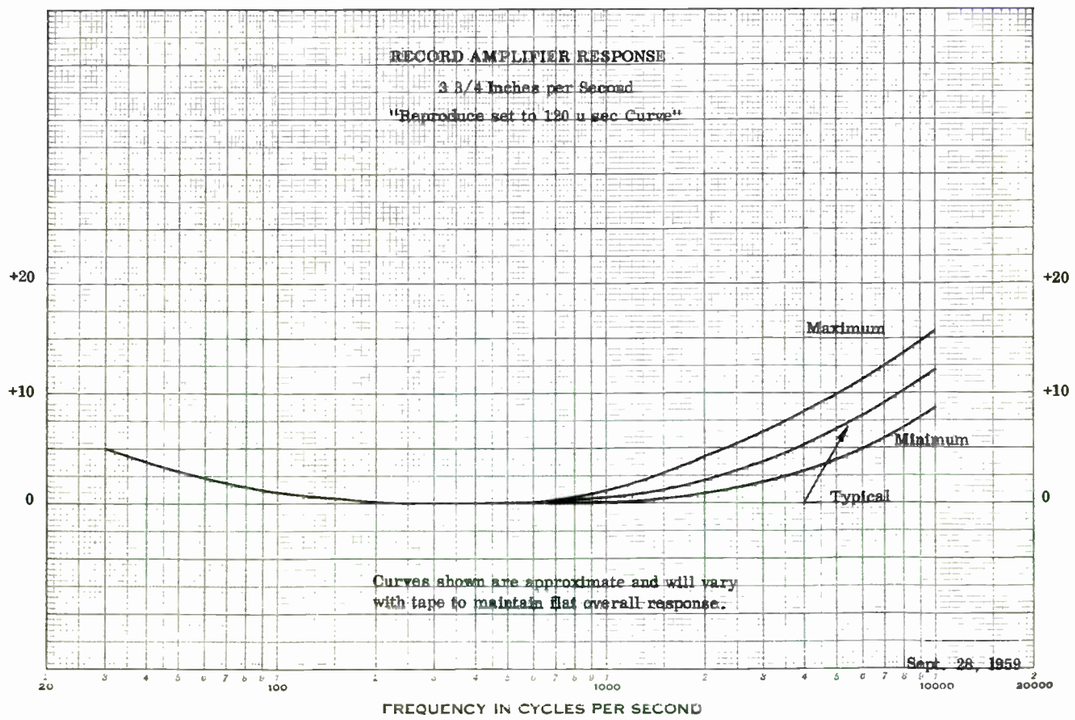
4020475-18 head ass.

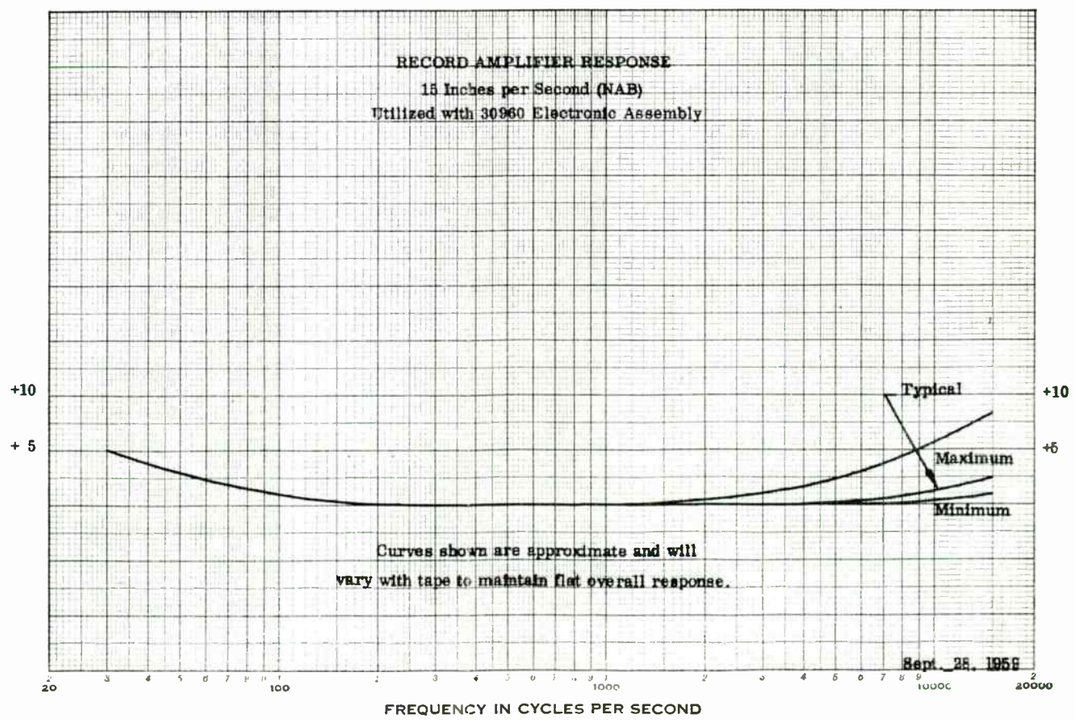
Hold down -

Rubber - 4100157-10 $1.90 4330143-10 adapter. $7.80

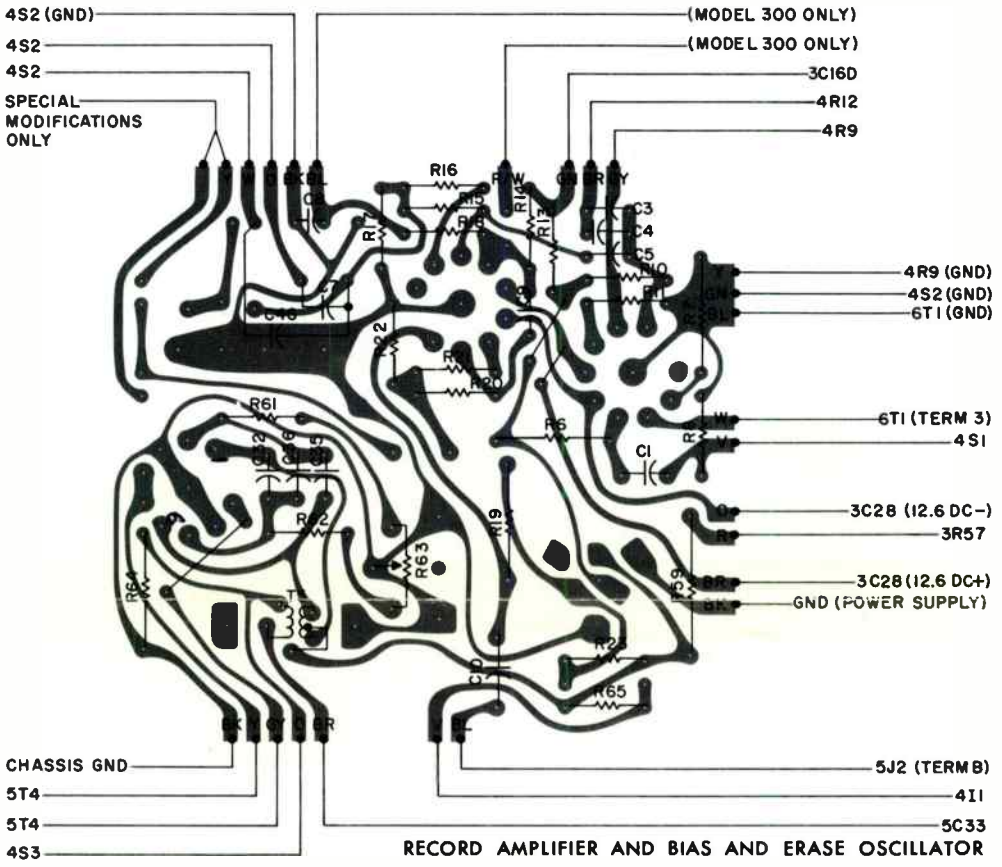




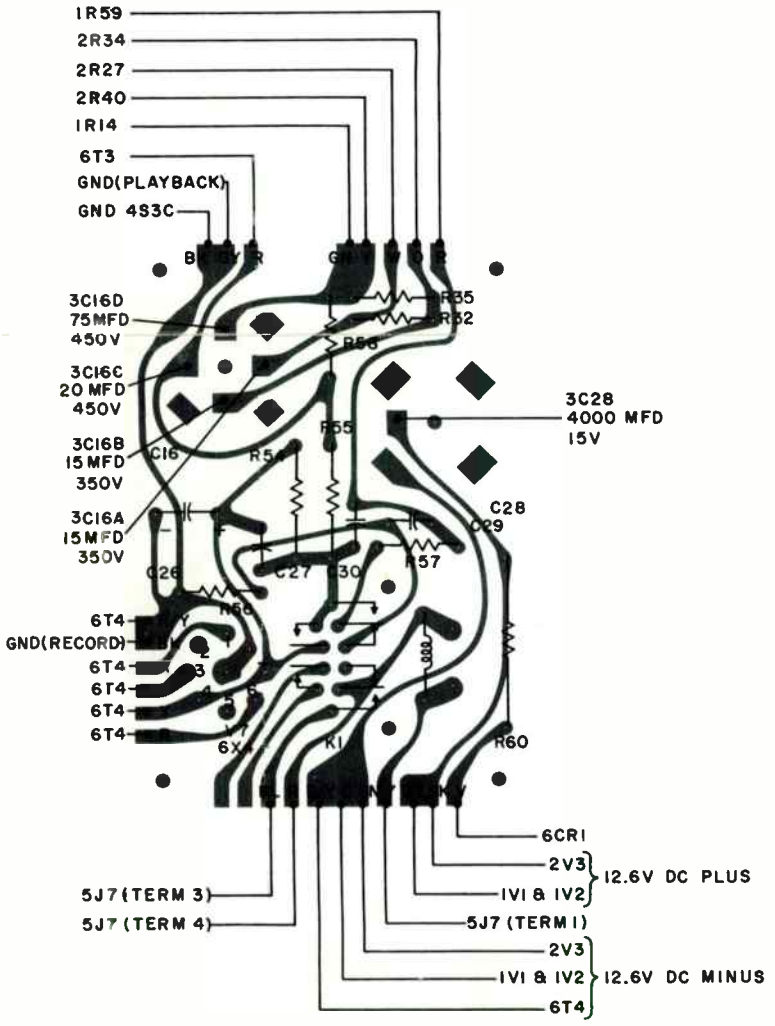




UTILIZED WITH 30960 ELECTRONIC ASSEMBLIES ONLY



PARTS LOCATION
RECORD AMPLIFIER AND BIAS AND ERASE OSCILLATOR



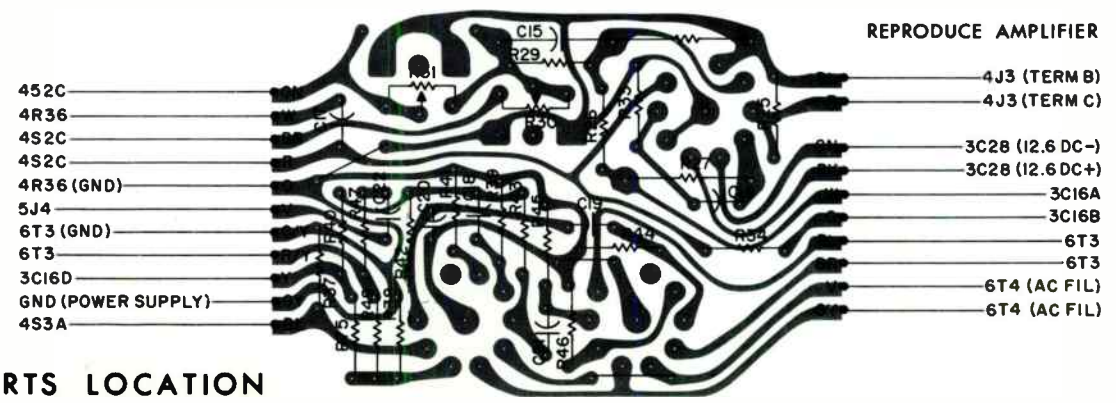
UTILIZED WITH 30960 ELECTRONIC ASSEMBLIES ASSEMBLIES ONLY

LEGEND

THE FIRST NUMBERS SIGNIFY THE LOCATION.

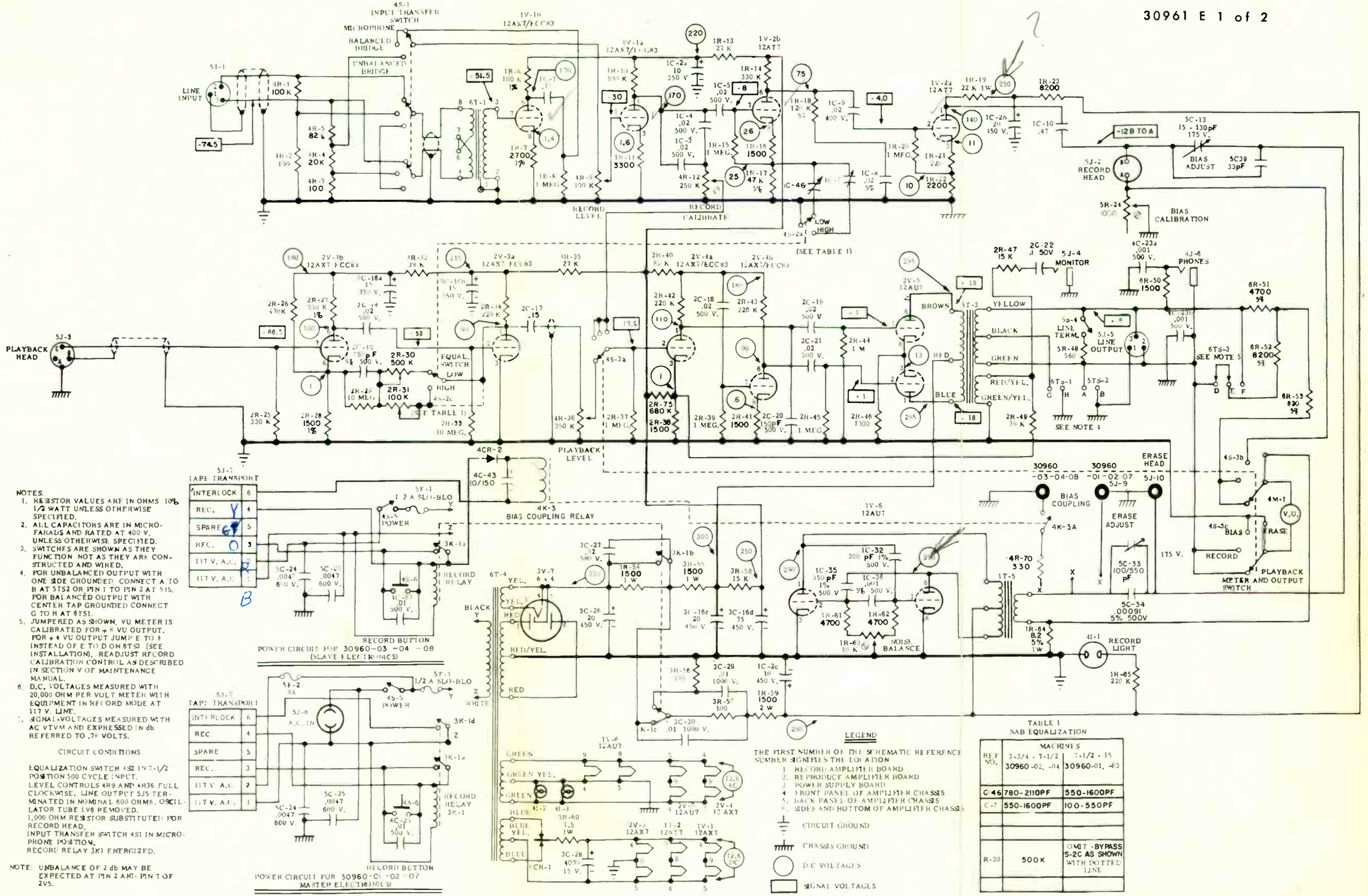
1. RECORD AMPLIFIER BOARD
2. REPRODUCE AMPLIFIER BOARD
3. POWER SUPPLY BOARD
4. FRONT PANEL OF AMP. CHASSIS
5. BACK PANEL OF AMP. CHASSIS
6. SIDES AND BOTTOM

REPRODUCE AMPLIFIER



PARTS LOCATION
POWER SUPPLY AND REPRODUCE AMPLIFIER

ELECTRONIC ASSEMBLY
CATALOG NUMBER 30960-01 thru -04
SCHEMATIC DIAGRAM
30961 E 1 of 2



NOTES:
1. RESISTOR VALUES ARE IN OHMS 10% 1/2 WATT UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS AND RATED AT 400 V. UNLESS OTHERWISE SPECIFIED.
3. SWITCHES ARE SHOWN AS THEY FUNCTION NOT AS THEY ARE CONSTRUCTED AND WIRED.
4. FOR UNBALANCED OUTPUT WITH ONE SIDE GROUNDED, CONNECT A TO B AT 5TS2 OR PIN 1 TO PIN 2 AT 5J5. FOR BALANCED OUTPUT WITH CENTER TAP GROUNDED CONNECT G TO H AT 6TS1.
5. JUMPERED AS SHOWN, VU METER IS CALIBRATED FOR +8 VU OUTPUT. FOR +4 VU OUTPUT JUMPER E TO F INSTEAD OF E TO D ON 6TS3 (SEE INSTALLATION). READJUST RECORD CALIBRATION CONTROL AS DESCRIBED IN SECTION V OF MAINTENANCE MANUAL.
6. D.C. VOLTAGES MEASURED WITH 20,000 OHM PER VOLT METER WITH EQUIPMENT IN RECORD MODE AT 117 V. LINE.
7. SIGNAL VOLTAGES MEASURED WITH AC VTVM AND EXPRESSED IN db REFERRED TO .78 VOLTS.

CIRCUIT CONDITIONS

EQUALIZATION SWITCH 4S2 IN 7-1/2 POSITION 500 CYCLE INPUT. LEVEL CONTROLS 4R9 AND 4R36 FULL CLOCKWISE. LINE OUTPUT 5J5 TERMINATED IN NOMINAL 600 OHMS. OSCILLATOR TUBE 1V6 REMOVED. 1,000 OHM RESISTOR SUBSTITUTED FOR RECORD HEAD. INPUT TRANSFER SWITCH 4S1 IN MICROPHONE POSITION. RECORD RELAY 3K1 ENERGIZED.

NOTE: UNBALANCE OF 2 db MAY BE EXPECTED AT PIN 2 AND PIN 7 OF 2V5.

LEGEND

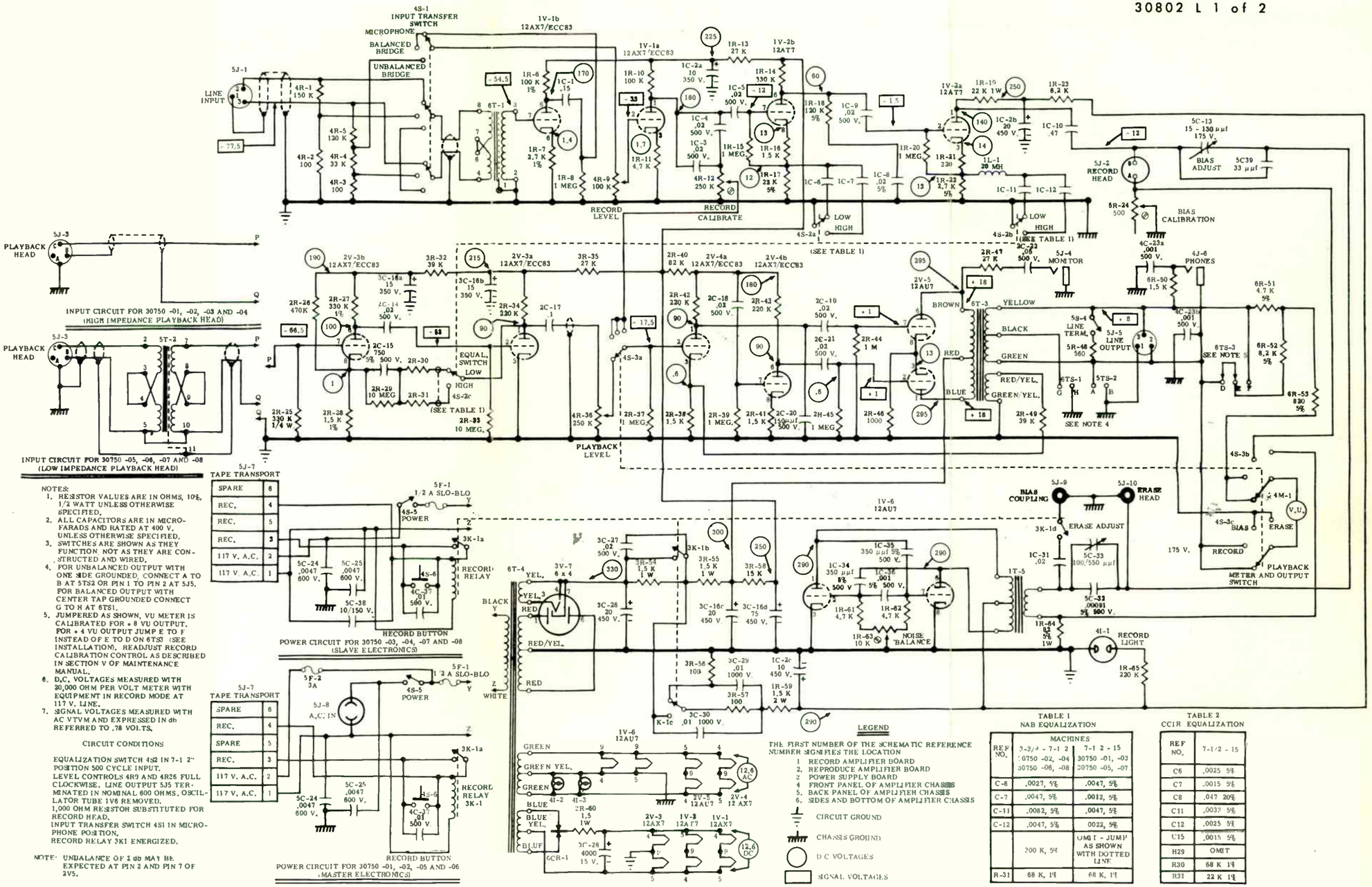
THE FIRST NUMBER OF THE SCHEMATIC REFERENCE NUMBER SIGNIFIES THE LOCATION
1. RECORD AMPLIFIER BOARD
2. REPRODUCE AMPLIFIER BOARD
3. POWER SUPPLY BOARD
4. FRONT PANEL OF AMPLIFIER CHASSIS
5. BACK PANEL OF AMPLIFIER CHASSIS
6. SIDES AND BOTTOM OF AMPLIFIER CHASSIS

CIRCUIT GROUND
CHASSIS GROUND
D.C. VOLTAGES
SIGNAL VOLTAGES

TABLE 1
NAB EQUALIZATION

REF. NO.	MACHINES 3-3/4 - 7-1/2 30960-02, -04	MACHINES 7-1/2 - 15 30960-01, -03
C-46	780-2110PF	550-1600PF
C-47	550-1600PF	100-550PF
R-30	500K	OMIT - BYPASS 5-2C AS SHOWN WITH DOTTED LINE

ELECTRONIC ASSEMBLY
CATALOG NUMBER 30750-01 thru -08
SCHEMATIC DIAGRAM
30802 L 1 of 2



NOTES:

1. RESISTOR VALUES ARE IN OHMS, 10%, 1/2 WATT UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS AND RATED AT 600 V. UNLESS OTHERWISE SPECIFIED.
3. SWITCHES ARE SHOWN AS THEY FUNCTION. NOT AS THEY ARE CONSTRUCTED AND WIRED.
4. FOR UNBALANCED OUTPUT WITH ONE SIDE GROUNDED, CONNECT A TO B AT 5TS2 OR PIN 1 TO PIN 2 AT 5J5. FOR BALANCED OUTPUT WITH CENTER TAP GROUNDED CONNECT G TO H AT 6TS1.
5. JUMPERED AS SHOWN, VU METER IS CALIBRATED FOR + 8 VU OUTPUT. FOR + 4 VU OUTPUT JUMP E TO F INSTEAD OF E TO D ON 6TS3 (SEE INSTALLATION). READJUST RECORD CALIBRATION CONTROL AS DESCRIBED IN SECTION V OF MAINTENANCE MANUAL.
6. D.C. VOLTAGES MEASURED WITH 20,000 OHM PER VOLT METER WITH EQUIPMENT IN RECORD MODE AT 117 V. LINE.
7. SIGNAL VOLTAGES MEASURED WITH AC VTVM AND EXPRESSED IN db REFERRED TO .78 VOLTS.

CIRCUIT CONDITIONS

EQUALIZATION SWITCH 4S2 IN 7-1 2" POSITION 500 CYCLE INPUT.
LEVEL CONTROLS 4R3 AND 4R36 FULL CLOCKWISE. LINE OUTPUT 5J5 TERMINATED IN NOMINAL 600 OHMS. OSCILLATOR TUBE 1V6 REMOVED.
1,000 OHM RESISTOR SUBSTITUTED FOR RECORD HEAD.
INPUT TRANSFER SWITCH 4S1 IN MICROPHONE POSITION.
RECORD RELAY 3K1 ENERGIZED.

NOTE: UNBALANCE OF 1 db MAY BE EXPECTED AT PIN 2 AND PIN 7 OF 2V5.

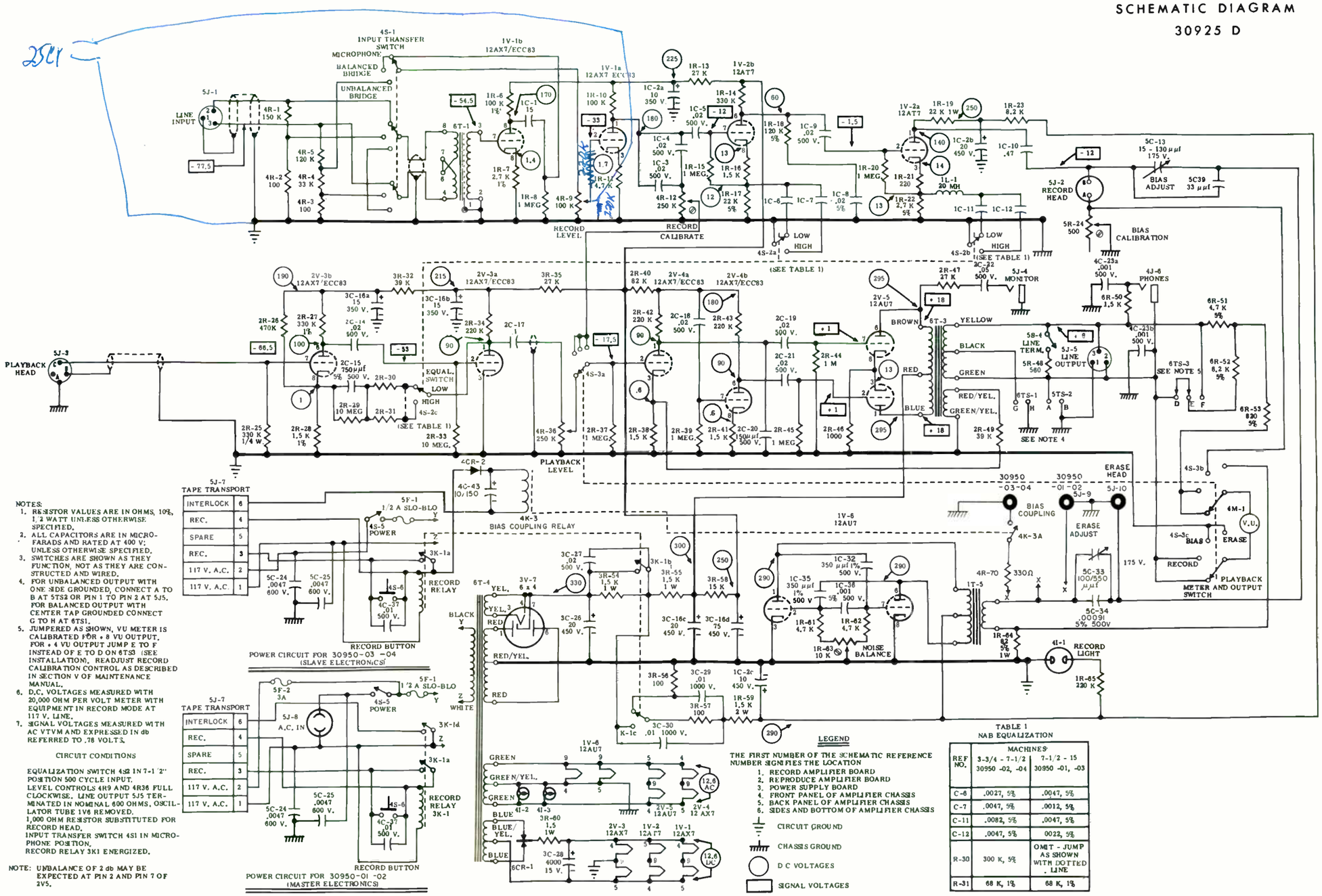
TABLE 1
NAB EQUALIZATION

REF NO.	MACHINES 7-3/4 - 7-1 2 30750 -02, -04 30750 -06, -08	MACHINES 7-1 2 - 15 30750 -01, -03 30750 -05, -07
C-6	.0027, 5%	.0047, 5%
C-7	.0047, 5%	.0012, 5%
C-11	.0082, 5%	.0047, 5%
C-12	.0047, 5%	0022, 5%
	200 K, 5%	OMIT - JUMP AS SHOWN WITH DOTTED LINE
R-31	68 K, 1%	68 K, 1%

TABLE 2
CCIR EQUALIZATION

REF NO.	7-1/2 - 15
C6	.0025 5%
C7	.0015 5%
C8	.047 20%
C11	.0033 5%
C12	.0025 5%
C15	.0015 5%
H29	OMIT
R30	68 K 1%
R31	22 K 1%

ELECTRONIC ASSEMBLY
CATALOG NUMBER 30950
SCHEMATIC DIAGRAM
30925 D



NOTES:
1. RESISTOR VALUES ARE IN OHMS, 10%, 1, 2 WATT UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS AND RATED AT 400 V; UNLESS OTHERWISE SPECIFIED.
3. SWITCHES ARE SHOWN AS THEY FUNCTION, NOT AS THEY ARE CONSTRUCTED AND WIRED.
4. FOR UNBALANCED OUTPUT WITH ONE SIDE GROUNDED, CONNECT A TO B AT 5TS2 OR PIN 1 TO PIN 2 AT 5J5. FOR BALANCED OUTPUT WITH CENTER TAP GROUNDED CONNECT G TO H AT 6TS1.
5. JUMPERED AS SHOWN, VU METER IS CALIBRATED FOR + 8 VU OUTPUT. FOR + 4 VU OUTPUT JUMPER TO F INSTEAD OF E TO D ON 6TS3 (SEE INSTALLATION). READJUST RECORD CALIBRATION CONTROL AS DESCRIBED IN SECTION V OF MAINTENANCE MANUAL.
6. D.C. VOLTAGES MEASURED WITH 20,000 OHM PER VOLT METER WITH EQUIPMENT IN RECORD MODE AT 117 V. LINE.
7. SIGNAL VOLTAGES MEASURED WITH AC VTVM AND EXPRESSED IN db REFERRED TO .78 VOLTS.

CIRCUIT CONDITIONS

EQUALIZATION SWITCH 4S2 IN 7-1/2" POSITION 500 CYCLE INPUT.
LEVEL CONTROLS 4R9 AND 4R36 FULL CLOCKWISE. LINE OUTPUT 5J5 TERMINATED IN NOMINAL 600 OHMS. OSCILLATOR TUBE 1V6 REMOVED.
1,000 OHM RESISTOR SUBSTITUTED FOR RECORD HEAD.
INPUT TRANSFER SWITCH 4S1 IN MICROPHONE POSITION.
RECORD RELAY 3K1 ENERGIZED.

NOTE: UNBALANCE OF 2 db MAY BE EXPECTED AT PIN 2 AND PIN 7 OF 2V5.

LEGEND

THE FIRST NUMBER OF THE SCHEMATIC REFERENCE NUMBER SIGNIFIES THE LOCATION
1. RECORD AMPLIFIER BOARD
2. REPRODUCE AMPLIFIER BOARD
3. POWER SUPPLY BOARD
4. FRONT PANEL OF AMPLIFIER CHASSIS
5. BACK PANEL OF AMPLIFIER CHASSIS
6. SIDES AND BOTTOM OF AMPLIFIER CHASSIS

CIRCUIT GROUND
CHASSIS GROUND
D C VOLTAGES
SIGNAL VOLTAGES

TABLE 1
NAB EQUALIZATION

REF NO.	MACHINES 3-3/4 - 7-1/2 30950 -02, -04	MACHINES 7-1/2 - 15 30950 -01, -03
C-6	.0027, 5%	.0047, 5%
C-7	.0047, 5%	.0012, 5%
C-11	.0082, 5%	.0047, 5%
C-12	.0047, 5%	0022, 5%
R-30	300 K, 5%	OMIT - JUMP AS SHOWN WITH DOTTED LINE
R-31	68 K, 1%	68 K, 1%