

universal model 352

reproducer

Manufactured in the U.K. by:

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Marketed by:

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DESCRIPTION AND PERFORMANCE CHARACTERISTICS

GENERAL

The AMPEX Universal Model 352 Magnetic Tape Reproducers are high quality precision instruments designed for the professional user who requires the finest and most faithful reproduction.

A basic reproducer in the Universal 352 series consists of a tape transport for operation at tape speed pairs of $3\frac{3}{4}$ inches per second (ips) and $7\frac{1}{2}$ ips or $7\frac{1}{2}$ and 15 ips; a head assembly for use with the $\frac{1}{4}$ inch magnetic tape; an electronic assembly which contains the reproduce amplifier; and a control panel. Both NAB and CCIR equalisation is incorporated and either may be selected by operating a switch on the electronics chassis.

Head assemblies for either full (single) track, half track or two track stereophonic (352-2) operation are available.

Two mounting arrangements are offered—console mounting and units suitable for rack mounting.

PERFORMANCE CHARACTERISTICS

<i>Tape Width</i>	1/4 inch	
<i>Tape Speed Pairs</i>	3 3/4-7 1/2 ips 7 1/2-15 ips	
<i>Frequency Response</i>	<i>Speed (ips)</i> 3 3/4 7 1/2 15	<i>Response (Cycles per second)</i> ±2 db 50 to 7500 ±2 db 40 to 10000 ±4 db 30 to 15000 ±2 db 30 to 15000
<i>Signal-to-Noise Ratio</i>	<i>Speed (ips)</i> 3 3/4 7 1/2 15	<i>Ratio (db)</i> 50 full track 45 half track or stereophonic 60 full track 55 half track or stereophonic as 7 1/2 ips

These figures are referenced to a signal recorded at a nominal 3% rms distortion level.

<i>Wow and Flutter</i>	<i>Speed (ips)</i> 3 3/4 7 1/2 15	<i>Wow and Flutter (% rms)</i> less than 0.25 less than 0.2 less than 0.15
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Wow and Flutter measurements include all components between 0 and 300 c/s using an rms value of constant amplitude sine wave flutter.

<i>Reproducing Time</i> (NAB 10 1/2 Inch Diameter Reels, 2400 feet of tape)	<i>Half Track</i>		<i>Full Track</i>		
	<i>Speed (ips)</i>	<i>(hours)</i>	<i>(min)</i>	<i>(hours)</i>	<i>(min)</i>
	3 3/4	4	16	2	8
	7 1/2	2	8	1	4
15	1	4		32	

Starting Time The tape is accelerated to full speed in less than 1/10th of a second, and stable motion is achieved in under 2 seconds.

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

Reproducing Timing Accuracy Within 0.2% (±3.6 seconds in a 30 minute period).

Rewind Time Less than 70 seconds for 2400 feet of tape.

Controls

Tape Motion	All tape motion is controlled by four push buttons, PLAY, STOP, FAST FORWARD and REWIND.
Tape Speed	Tape Speed can be changed by the TAPE SPEED switch. LOW or HIGH positions are used to select drive motor windings.
Equalisation	An equalisation switch on the electronic chassis provides a means for selecting either NAB or CCIR equalisation.

Reel Size A REEL SIZE toggle switch on the tape transport makes possible selection of the proper tape tensioning for both large and small reels.

Output Level Plus 8 dbm output into 600Ω, balanced or unbalanced, from tapes recorded at normal level (point of approximately 1% distortion). Maximum output + 14 dbm.

Head Full track, half track, or two track in-line stereophonic reproduce.

Power Requirements A multi-tapped power transformer is built in to provide direct operation on voltages from 90 to 130 volts ac and 200 to 240 volts ac. The reproducer will perform within specification on supply voltages varying by ±5% from these nominal values. The half track or full track equipment requires approximately 2 amperes at 110 volts (1 ampere at 220 volts). Two track equipment requires approximately 2.5 amperes at 110 volts (1.25 amperes at 220 volts). All equipments will operate where specified on 50 or 60 c/s supplies.

EQUIPMENT AVAILABLE

<i>Dimensions and Weight in (mm) lb (kg)</i>	EQUIPMENT AVAILABLE				
	<i>Item</i>	<i>Height</i>	<i>Depth</i>	<i>Width</i>	<i>Weight</i>
<i>Rack mount</i>	Tape Transport	15 $\frac{3}{4}$ (400) (rack space)	8 (203) (behind rack)	19 (483)	57 (25.8)
	Electronic Assembly	5 $\frac{1}{2}$ (140) (rack space)	6 (152) (behind rack)	19 (483)	10 (4.5)
	Power Panel	1 $\frac{3}{4}$ (44) (rack space)	4 (102) (behind rack)	19 (483)	0.75 (0.37)
<i>Console</i>	Console	35 (889) (max)	24 $\frac{3}{4}$ (629) (max)	24 $\frac{1}{2}$ (616)	140 (63.5)

INSTALLATION

NOTE

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

GENERAL

The Universal Model 352 equipment is normally shipped mounted in consoles 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 diagram at the end of this section.

MOUNTING

Console Models (figure 2-1)

To assemble the console model proceed as follows:

- Step 1:* Install the tape transport in the cabinet frame, securing the eight 12-24 x 1 $\frac{1}{4}$ inch raised countersunk screws and finishing washers.
- Step 2:* Slide up and remove the back panel of the cabinet.
- Step 3:* Install the electronic assembly using four woodscrews to secure it to the base of the cabinet. A cover panel (Catalogue number 5520-10 for Console and 17206-10 for Rack Mounted) is installed simultaneously with the electronic assembly, utilizing the same screws.
- Step 4:* Connect cables as follows:
1. Connect the captive cable from the control panel to the CONTROL socket, 1J2, on the reproduce amplifier chassis.
 2. Connect the captive cable (P507P) from the tape transport to the TRANSPORT socket, 1J1, on the reproduce amplifier chassis.

3. Connect the captive cable from the reproduce head to the **PLAYBACK HEAD** socket, 1J5, on the reproduce amplifier chassis.

CAUTION

Do not attempt to lengthen the head cable, as the additional cable capacitance will affect the frequency characteristics of the equipment.

4. Connect the output connector to the **LINE OUTPUT** socket, 1J6, on the reproduce amplifier chassis.
 5. Connect the power cable from the control circuit box to 1J3, **AC POWER IN**, on the reproduce amplifier chassis.
 6. On stereophonic equipment, connect sockets 1J1 on both master and slave electronics and the power cable from the control circuit box with stereophonic cable 500327-10.
- 5: Replace the back panel, making certain that all cables run freely through the semi-circular cut-outs at the bottom of the sliding panel.



figure 2-1 — Universal Model 352 Reproducer — in Console

CAUTION

The back of the console cabinet should be placed at least 4 inches from the wall to permit proper ventilation.

Rack Mounted Models (figure 2-2)

Mount these versions of the equipment on a standard 19 inch rack with the tape transport above the electronic assembly.

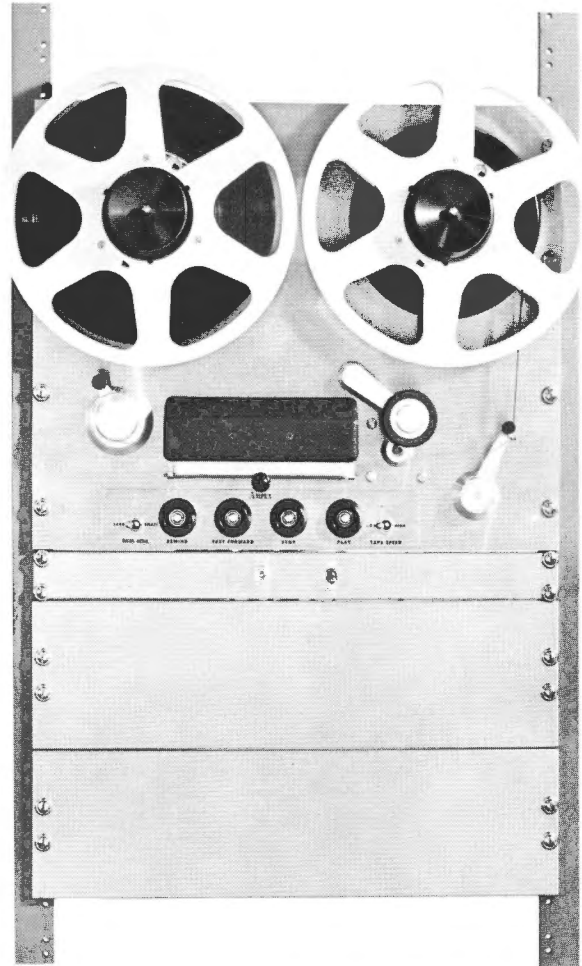


figure 2-2 — Universal Model 352-2 Stereophonic Reproducer — Rack Mounted

POWER CONNECTION

The supply voltage selector panel is mounted on the control box at the rear of the tape transport. Set this selector to the voltage of the supply to which the machine will be connected. For example, for 230 volt supplies set the horizontal plug to 220 and the vertical plug to + 10 (see figure 5-2).

Connect a power plug to the power lead supplied, observing the following code :

RED	SUPPLY LIVE
BLACK	SUPPLY NEUTRAL
GREEN	SUPPLY GROUND

Before applying power, check the rating of fuse 1F2 to be :

90 to 130 volts supply	...	3 Amperes
200 to 240 volts supply	...	1.5 Amperes

If the power connections are made as described, all chassis metalwork and circuit grounds will be connected to the power supply ground. In some installations it may be desirable to maintain isolation between the power supply ground and the circuit ground. If the bare jumper wire is removed on the tag strip beside the power input socket, chassis and circuit grounds will be isolated from supply ground and can be connected to a programme ground.

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

A +8VU, 600Ω output, balanced or unbalanced, is available across pins 2 and 3 of LINE OUTPUT connector 1J6. Pin 1 is chassis ground. If an unbalanced output is desired, connect either side of the line to ground. The output of the equipment must be terminated at all times. Therefore, if it is not feeding a terminated line, connect an external 600Ω load across the output.

High Impedance Input

Connect pin 3 of LINE OUTPUT connector 1J6 to the high side of the amplifier input. Strap pins 1 and 2, and connect to the ground side of the amplifier input. An external 600Ω termination must be connected from pin 3 to pins 1 and 2.

REMOTE CONTROL

NOTE

A Remote Control box, wired for stereophonic operation, must NOT be used with a monaural machine.

The tape transport mechanism can be remotely operated by a Remote Control Unit. The catalogue No. 31022-10 unit is supplied as a desk-top unit, completely wired and ready to plug into the remote control connector, J502S, on the tape transport assembly.

The catalogue No. 31022-20 unit is mounted on a flat plate for installation in studio consoles, and is not wired. For Universal Model 351-2, use 31022-30 individual unit or 31022-40 mounted on the flat plate. To install, wire as shown in figure 5-10 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.

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
- FREQUENCY RESPONSE

Complete instructions for making the above checks are given in SECTION 6, 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 analyser 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 6db above operating level. Second harmonic distortion is negligible; measured distortion is predominately third order.

WOW AND FLUTTER

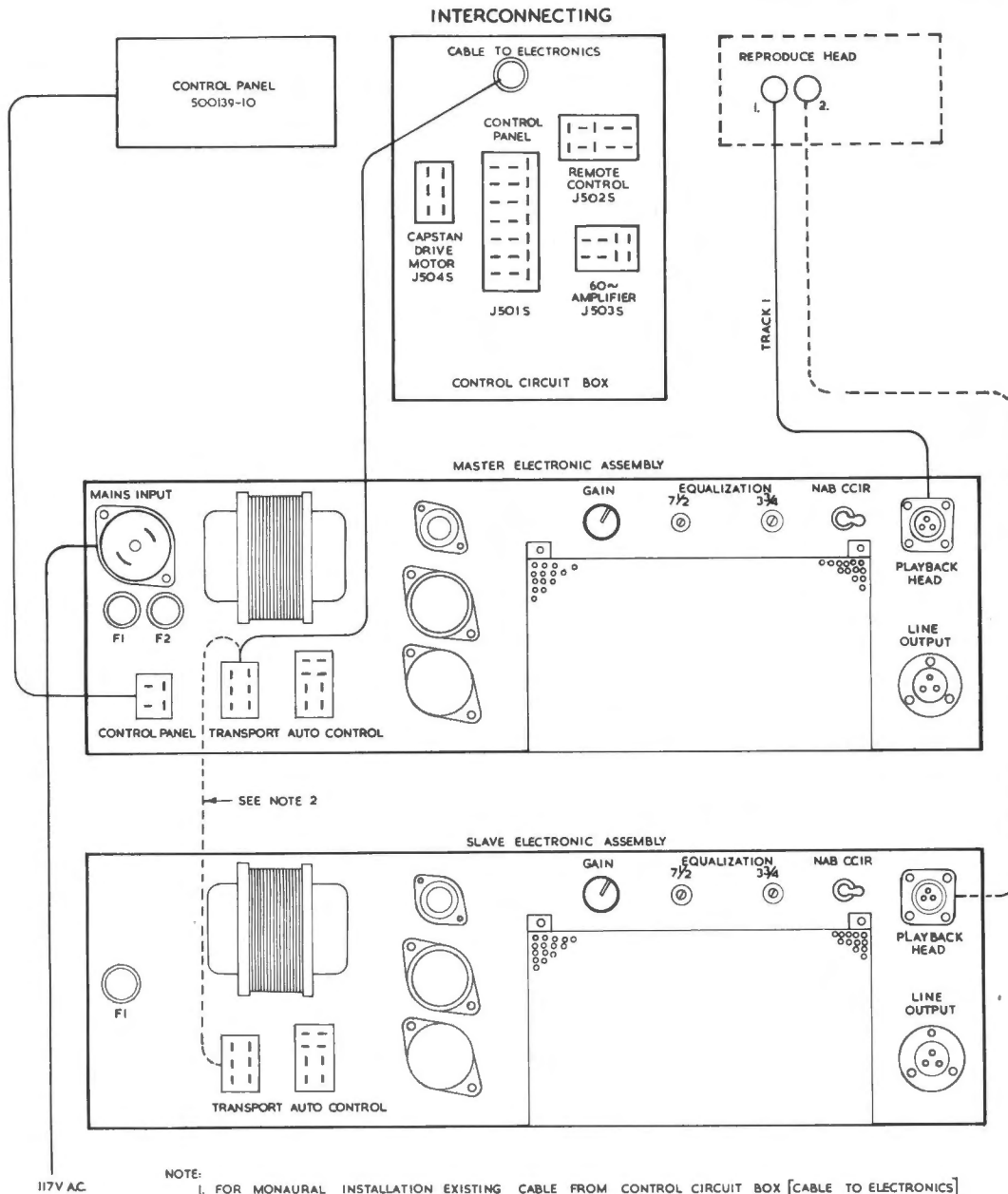
Wow and flutter are produced by periodic irregularities in tape speed and appear as cyclic frequency deviations in reproduction. They can be measured by means of any standard flutter bridge. Variations in amplitude as indicated on level measurements do not constitute flutter and are entirely due to tape coating variations. Readings will be near or below 0.15% rms at 15 ips, 0.2% rms at 7½ ips, and 0.25% rms at 3¾ ips. The Ampex primary standard of measurement is based on the use of a flutter meter calibrated to indicate the deviation from mean carrier frequency of any rate between 0.5 and 300 c/s expressed in per cent rms.

INTERCONNECTING

Cable	Catalogue No.	Qty.	Socket Point	FROM	Chassis	Socket Point	TO	Chassis
ac	500069-10	(1)	1J3 MAINS INPUT	Reproduce Amplifier	ac source			
Power Interconnecting	500276-10	(1)	1J1 TAPE TRANSPORT	Reproduce Amplifier	CABLE TO ELECTRONICS			Captive at Tape Transport
Reproduce Head		(1)	1J5 PLAYBACK HEAD	Reproduce Amplifier		ELECTRONICS		Captive at Tape Transport

DUAL TRACK EQUIPMENT

Power Interconnecting 500237-10 (1) 1J1 TAPE TRANSPORT Reproduce Amplifier 1 and 2 End of Captive Tape Transport power interconnecting cable 500276-10



- NOTE:
1. FOR MONAURAL INSTALLATION EXISTING CABLE FROM CONTROL CIRCUIT BOX [CABLE TO ELECTRONICS] CONNECTS DIRECTLY TO TRANSPORT PLUG ON ELECTRONICS
 2. A 500237-10 INTERCONNECTING CABLE IS USED WITH DUAL TRACK STEREOGRAPHIC EQUIPMENT
 3. BROKEN LINES INDICATE STEREOGRAPHIC INSTALLATION

figure 2-3 — Interconnecting

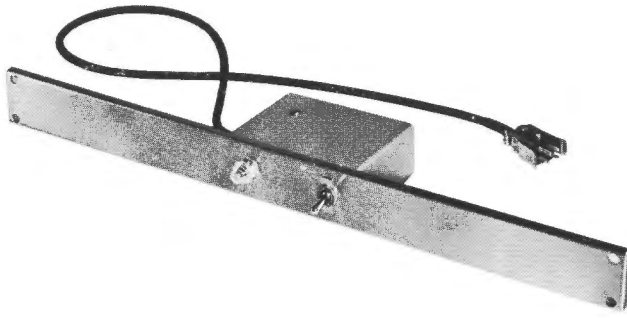


figure 2-4 — Control Panel

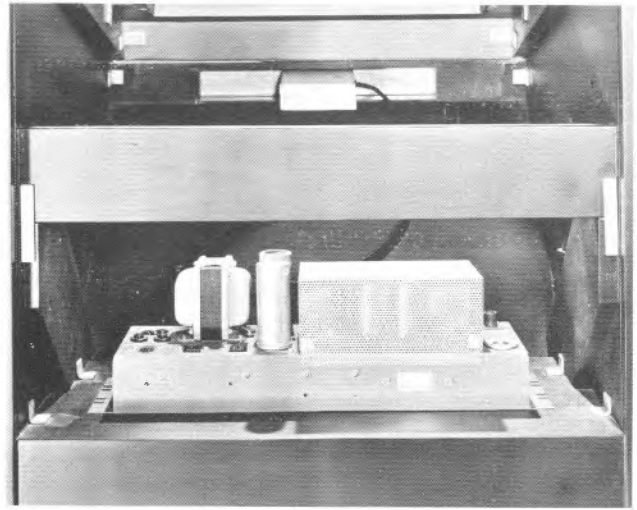


figure 2-5 — Mounting Position of the Reproduce Amplifier

OPERATION

GENERAL

Universal Model 352 reproducers are available for full (single) track, half track, or two track stereophonic operation. All operating controls are located on the tape transport. When the remote control unit is furnished, duplicate tape motion controls and a TAPE MOTION indicator light are mounted on the remote control unit.

The equipment can accommodate NAB, CCIR and EIA Cine reels up to 10½ inches in diameter. 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. Hold down knobs are supplied with all variations of the Universal Model 352 reproducer, to maintain the reels in position on the turntable.

NOTE

Both the rewind and take-up reels must be of the identical size and type.

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

On the reproduce amplifier chassis are facilities for setting PLAYBACK LEVEL, and selecting NAB or CCIR equalisation.

A POWER OFF-ON switch and an indicator light are fitted on the front of the control panel.

SUMMARY OF CONTROLS, SWITCHES, AND INDICATORS

<i>Item</i>	<i>Schematic Reference Symbol</i>	<i>Location</i>	<i>Function</i>
POWER OFF-ON SWITCH		Control Panel	Controls power to the reproduce amplifier and tape transport. When power is on, capstan will rotate if tape is properly threaded or the safety switch is mechanically closed.
TAPE SPEED	S503	Tape Transport control panel	Determines speed of the capstan drive motor by high or low speed winding. In addition to selecting capstan drive motor winding, the TAPE SPEED switch also activates relay 1K101 in the reproduce amplifier chassis, which automatically selects high or low speed equalisation circuitry for either NAB or CCIR equalisation standard, whichever is appropriate.
NAB OR CCIR EQUALISATION	1S1	Reproduce Amplifier Chassis	Used to select appropriate equalisation circuitry for standard chosen. High or low speed equalisation circuitry is automatically selected when the TAPE SPEED switch is operated.
REEL SIZE LARGE SMALL SWITCH	S504	Tape Transport control panel	Adjusts tape tensioning circuitry for the reel size used. The switch is closed when LARGE (10½ inch) reels are used. In the SMALL position the switch is open, connecting resistance R502 in series with the torque motors, thereby reducing hold back and take-up tension.
GAIN (Playback Level)		Reproduce Amplifier Chassis	Adjusts reproduce level.
PLAY button	S505	Tape Transport control panel	Controls tape motion in the reproduced (PLAY) operation. Interlocked with rewind and fast forward controls.
REWIND button	S507	Tape Transport control panel	Controls the rewind relay. Full ac power is connected directly to the rewind (supply) motor when this button is pressed, the resistance R504 is placed in the ac circuit to the take-up motor.
FAST FORWARD button	S506	Tape Transport control panel	Controls the fast forward relay. Connects full ac power to the take-up motor and places resistance R504 in the ac circuit to the rewind motor when this button is pressed.
STOP button	S502	Tape Transport control panel	When this button is pressed the brake solenoids and all relays are de-energised.

OPERATING TECHNIQUES

Threading the Tape

Thread the tape as shown in figure 3-1, unless a tape timer is fitted. Unwind and inspect all new reels of tape by running them through the machine on FAST FORWARD. 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.)

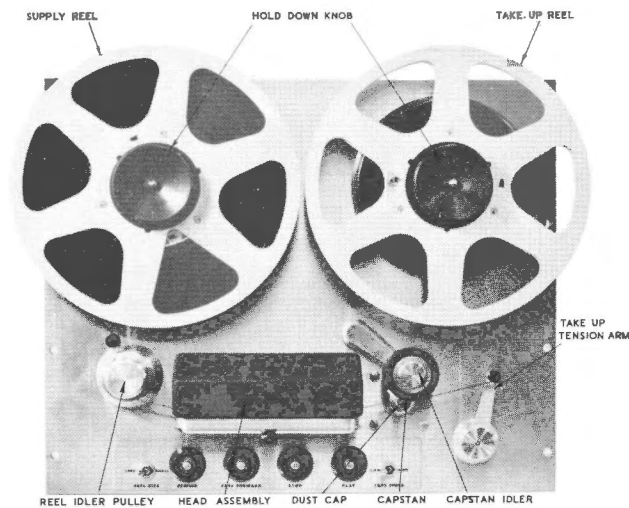


figure 3-1 — Tape Threading Path

Power

Power is supplied through the power switch on the control panel which must be turned on to operate the reproduce amplifier and tape transport. The tape transport and reproduce amplifier are individually fused by the control circuit fuse 1F2 (3A for 90 to 130 volts supply or 1.5A for 200 to 240 volts supply) and the $\frac{1}{2}$ A electronic fuse 1F1.

Speed Switch

The TAPE SPEED switch S503 determines the speed of the capstan drive motor and thus the tape speed. In addition the TAPE SPEED switch activates relay 1K101 in the reproduce amplifier. In the LOW speed position, relay 1K101 is energised and contacts 1K101A and 1K101B connect the low tape speed equalisation circuitry for either NAB or CCIR, whichever standard is being used. In the HIGH speed position, relay 1K101 is de-energised causing contacts 1K101A and 1K101B to connect the high tape speed equalisation circuitry.

Tape Motion

The tape motion is controlled by means of four push-buttons labelled REWIND, FAST FORWARD, STOP, and PLAY.

PLAY

The tape is set into playmotion at the speed selected by the TAPE SPEED switch when the PLAY button, S505, is pressed. The tape must be completely stopped before instituting this condition. The PLAYBACK GAIN adjustment is factory set to give a +8 VU output from tapes recorded at the Ampex recommended operating level (approximately 1% distortion point).

STOP

To stop the tape while it is moving in any operation, 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 conditions by pressing the FAST FORWARD button S506.

REWIND

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

NOTE

When using either the fast forward or rewind conditions, 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 head and impairing its 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 travelling at high speed in the REWIND or FAST FORWARD conditions. This will invariably break the tape since it does not allow the tape to stop before the capstan idler locks on to the capstan.

Half Track Operation

Half track pre-recorded tapes may be reproduced on those models equipped with half track heads in the following manner: Thread the tape and operate the equipment as described under TAPE THREADING and TAPE MOTION. Only the upper half of the tape will be reproduced.

To reproduce the second or lower half of the tape, the full reel, now on the take-up turntable, should be removed, turned over and placed on the tape supply turntable. Place an empty reel on the take-up turntable and repeat the threading and operation as above.

When reproducing half track pre-recorded tapes on stereophonic equipment, disconnect or otherwise disable the output of the lower Reproduce Amplifier and operate as above.

Full Track Operation

Full track pre-recorded tapes can only be reproduced on those models equipped with full track heads.

Two track Stereophonic Operation

To reproduce stereophonic pre-recorded tapes, Channel No. 1 is normally connected to the left-hand speaker system and Channel No. 2 is connected to the right-hand speaker system. Both reproduce amplifiers must be connected to an output.

Remote Control

For remote operation, remove the dummy plug P502P from the socket 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).

Automatic Timing

An automatic mechanical timing device, Catalogue No. 500170, is available as an optional extra. It consists of a dial calibrated in minutes and seconds and has a simple reset mechanism.

When fitted, the timing device is mounted between the two turntables and above the head assembly.

Threading the tape will be slightly modified when using the timing device and should be as shown in figure 3-2. The tape tensioning arm on the reel idler assembly is not used when the timer is employed, but is included in the assembly for use when the timer is not required.

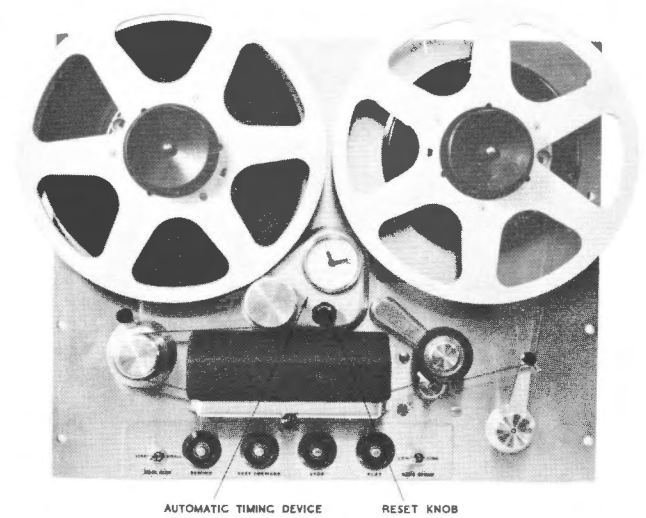


figure 3-2 — Tape Threading Path—When Tape Timer Fitted

THE DEVELOPMENT AND THEORY OF MAGNETIC TAPE RECORDING

DEVELOPMENT

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 Pfeumer 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. To understand completely the uses and operating techniques of your Ampex Universal Equipment, the basic theory of Magnetic Tape Recording should now be emphasised.

THEORY OF MAGNETIC TAPE RECORDING

If a material capable of being magnetised is placed in the proximity of a magnetic field, the molecules of that material will be orientated 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 into 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 magnetising force is alternating, and the iron oxide particles are aligned according to the instantaneous direction and magnitude of the field as in figure 4-1.

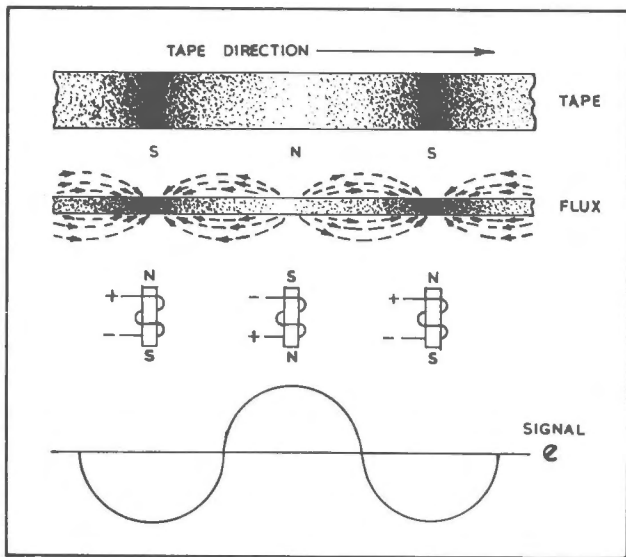


figure 4-1 — Magnetisation of Tape

The magnetic field is produced in the gap of a recording head (which is essentially an electromagnet) over which the recording tape passes. The head consists of an incomplete ring of high permeability 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 (figure 4-2).

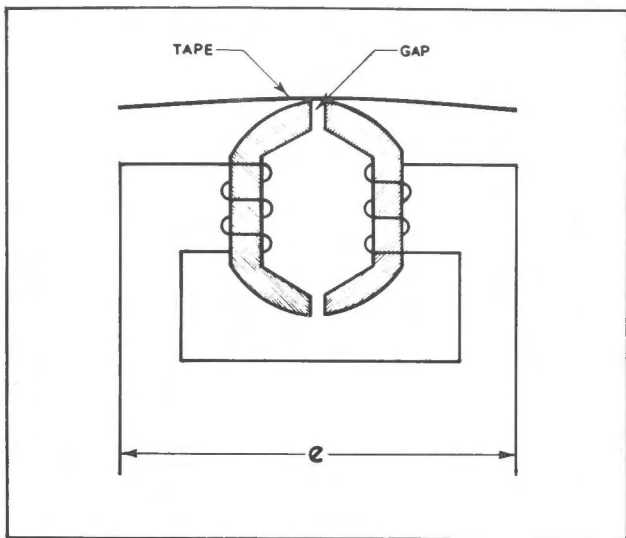


figure 4-2 — Record Head

The magnetisation curve of the iron oxide used as the recording medium is similar to that shown as the heavy line in figure 4-3.

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 dc bias to a valve 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.

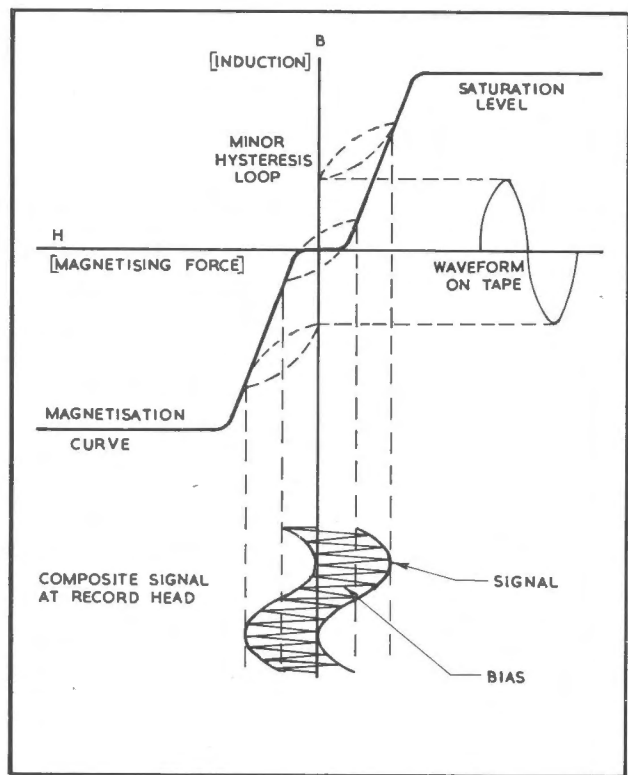


figure 4-3 — Recording Medium Magnetisation Curve

While the tape is in the recording gap the bias causes the magnetisation characteristics of the iron oxide to follow the broken line loops (figure 4-3) 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 magnetisation (known as "remanent inductance") determined by the gap flux 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 wavelength 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 calculated 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 = length of the gap in the direction of tape motion
- 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 length 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 length. This results in an output versus frequency characteristic such as is shown in curve A of figure 4-4.

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 figure 4-4.

In order to provide an all-over frequency response that is flat (see figure 4-5) an equalisation circuit consisting of a series resistance and capacitance is inserted in one of the early stages of the reproduce amplifier. This equalising circuit has a high frequency droop characteristic (curve B, figure 4-5) which is the inverse of the reproduce head characteristic curve A. In order to extend the high frequency response, additional equalisation 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 demagnetisation of the tape at the short wavelengths, and the wavelength 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 inter-related.

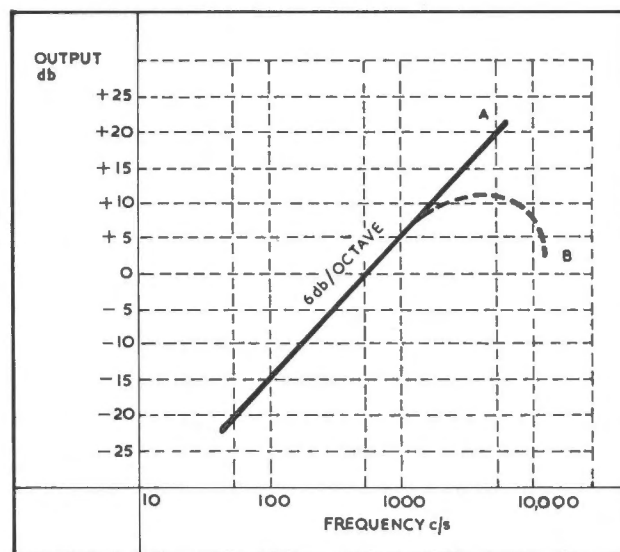


figure 4-4 — Reproduce Head Characteristics

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 capacitance in the circuit.

During the recording process the tape assumes a permanent state of magnetisation as it leaves the head gap, thus the record head gap length is relatively uncritical. However, in the reproduce process 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 recording 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.

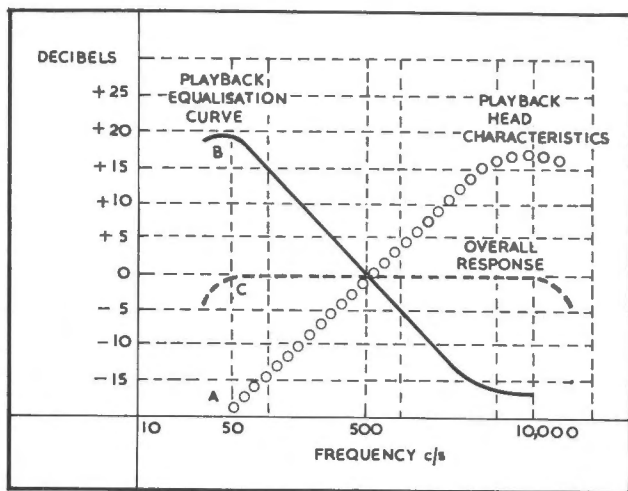


figure 4-5 — Achieving Flat Overall Response

There are two means of counteracting this “gap effect”—either the reproduce head gap length can be reduced or the record-reproduce tape speed can be increased. There are limitations in reducing the gap length 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/s signal recorded at $7\frac{1}{2}$ ips, will reproduce as a 5 kc/s signal if the reproduce tape speed is $3\frac{3}{4}$ ips. This procedure cannot of course be used in standard audio applications where music or voice is recorded. It would 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 demagnetising” 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 of its circuit must normally be either outside the pass band of the system (so that 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 the 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 is 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 maintaining 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 operating conditions. 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, the reel size selector, the 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 operations 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 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 pin is located which 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 energised, at which time the brakes are released.

During all operating conditions, the two induction torque motors B502 and B503 act as tensioning devices and in the fast forward and rewind conditions 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, anticlockwise.

Motor torque in the reproduce condition is adjusted by the tensioning adjustment resistors (R503 TAKE UP and R505 HOLDBACK) in series with each motor. In the fast forward condition, the torque of the supply (rewind) motor is reduced considerably by introduction of a series resistance (R504). In the rewind condition, R504 is in series with the take-up motor. Basic tape tensioning operation is shown in figure 5-1.

In the fast forward condition, 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 condition, 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 condition, 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 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 take up 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 condition, 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 minimises 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 reproduce process. 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 by 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 thereby actuating the safety switch, the drive motor operates continuously, awaiting the PLAY command.

When the PLAY button is pressed, the capstan solenoid (K501) and the brake solenoids (K505 and K506) are energised. The capstan solenoid pulls the rubber tyred 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.

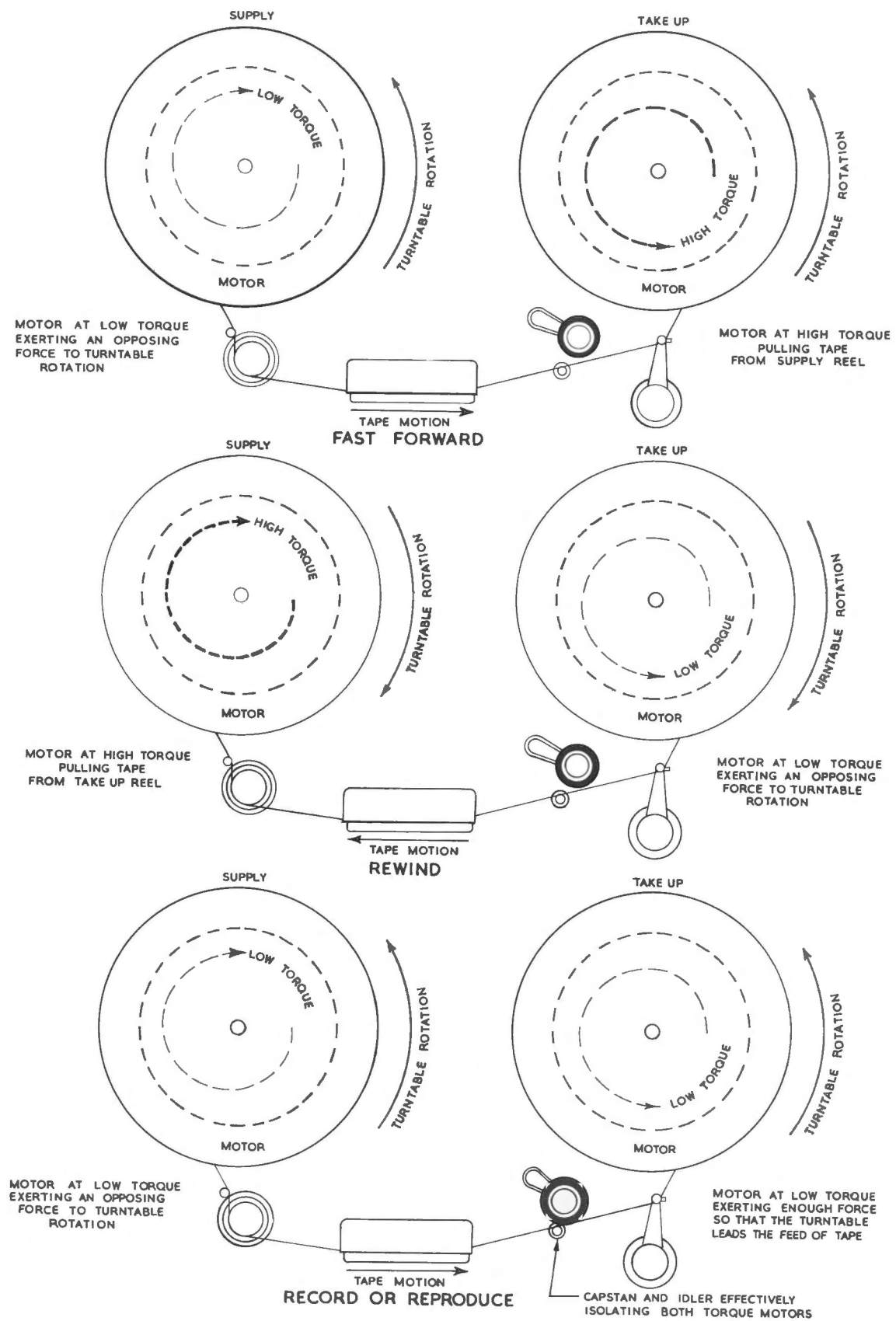


figure 5-1 — Tape Tensioning

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 operating conditions 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 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 pin and is free to move. When the brake solenoid is de-energised, 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 itself tightly around the brake drum as the brake lever end of the band moves to the right, thereby increasing braking force. When the drum is rotating anticlockwise, the process is reversed, causing the band to tend to pull away from the drum, thereby 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 operating conditions, the greater braking force always acts on the trailing turntable, maintaining the proper tape tension as the system is stopped.

CONTROL CIRCUIT

Located in the control circuit box (figure 5-2) underneath the tape transport are all the relays, the tension adjustment resistors and other electronic components, the power auto-transformer, and the 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 (figure 5-3), sockets are available for cables from the drive motor, supply motor, take-up motor, and control panel. Sockets and plugs (cables not supplied) are also available for interconnecting the tape transport and accessory units such as the remote control unit.

NOTE

The special connector jumper plugs supplied for sockets J503S 60 CYCLE AMPLIFIER and J502S REMOTE CONTROL must be plugged into their sockets when these accessory units are not used because jumpers in these

plugs complete the necessary circuits in the system for proper operation.

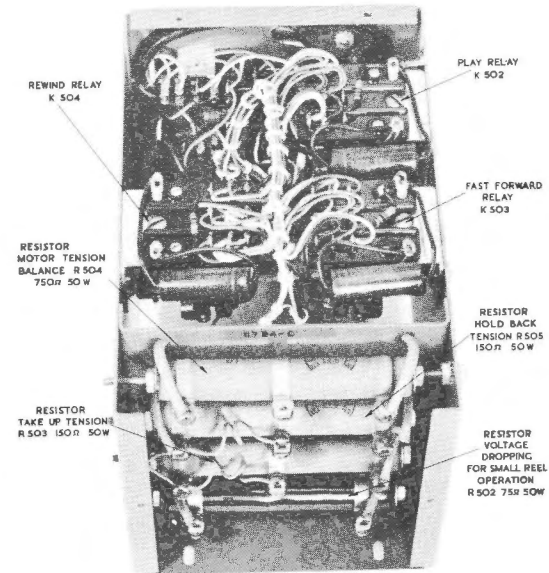


figure 5-2 — Control Circuit Box—Parts Location

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

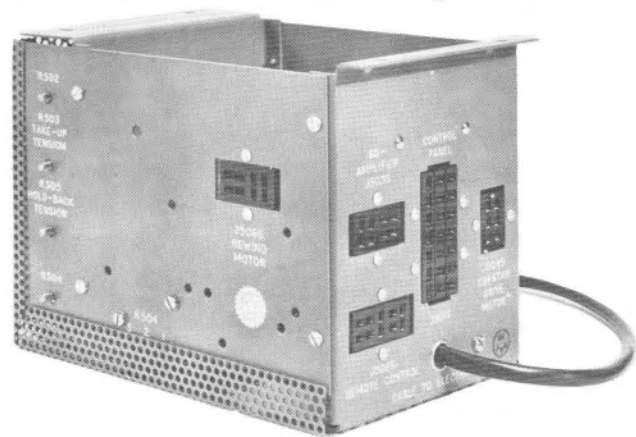


figure 5-3 — Control Circuit Box

Play

When PLAY button S505 is pressed, play relay K502 is energised. Capstan solenoid K501 is energised through K502-1. Contacts 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, dc 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 condition at the speed selected by TAPE SPEED SWITCH S503.

Rewind

When REWIND button S507 is pressed, rewind relay K504 is energised and held in this condition by relay contacts K504-1, K503-3 and the normally closed STOP button S502. Contact K504-2 connects the full ac power directly to the rewind (supply) motor, and places R504 in the ac 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 K504-3 completes the dc 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 energised and held through contacts K503-1, K504-3 and the normally closed STOP button S502. Contact K503-2 connects the full ac 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 operating condition and the STOP button, S502, is pressed, the brake solenoids and all relays are de-energised. The brakes are applied to both turntable motors. The capstan drive motor will continue to operate so long as the tape remains properly threaded.

Safety Interlocks

When the tape is moving in either of the high speed conditions (fast forward or rewind) it is impossible to switch to the play condition 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 condition, tape will almost invariably be broken or deformed. Always allow time for the tape to stop completely when switching from either of the fast conditions to play.

Reel Size Switch

Selection of proper holdback tension, depending on reel hub size, is made at the two position toggle switch labelled LARGE-SMALL. Holdback tension is not a constant in any operating condition, varying directly as a function of the trailing turntable motor torque, and inversely as a function of the effective trailing reel hub

diameter (that is, hub diameter plus 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 torque are factory set for NAB 10½ inch reels. If the smaller 7 or 5 inch EIA Cine 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 operating condition when the smaller reels are used. If it is desired to accelerate faster in the rewind or fast forward conditions, the switch may be placed in the LARGE position during these operations. The REEL SIZE switch is a single pole, single throw switch placed across the resistor R502. It is closed when the LARGE position for 10½ inch diameter reels is selected; and open (resistor R502 in the torque motor circuits) when the SMALL position is selected.

NOTE

Both reels on the rewind and take-up turntable must be of the same size and type.

ROUTINE MAINTENANCE

Carefully follow the routine maintenance programme 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 the tape guides daily. Clean the capstan idler wheel weekly. Great care must be taken to see that oil does not reach the rubber tyre. Avoid as much as possible, touching the tyre 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 Catalogue 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 which is sometimes deposited from magnetic tapes.

CAUTION

Do not use any other solvent 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, increased wow and flutter, drop-outs or poor high frequency response.

NOTE

It is imperative that Iso-Propyl alcohol be used for cleaning 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 the following oil or its equivalent:

Caloil OC-11 Standard Oil Company Class "C".	
Medium turbine oil, petroleum base with inhibitor additives to increase oxidation and corrosion preventive properties. Essential characteristics are as follows:	
<i>Characteristics</i>	<i>Limit Values</i>
Viscosity in Centistokes at 130° F (54° C)	40-48
Pour Point	25° F (-4° C) max
Flash Point	370° F ±20 degF (188° C ±11 degC) min.

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 alternative method. To remove the drive motor proceed as follows:

- Step 1:* Unplug the motor connector P504P from its socket J504S at the control circuit box.
- Step 2:* Remove the capstan idler by loosening the Allen head screws on the idler arm and gently pulling the idler assembly away (the capstan idler must be removed because one of the mounting 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:* Pull the motor free.
- Step 5:* Locate the oil hole which will be on the top or the side of the motor end housing.
- Step 6:* Place not more than four drops of the recommended lubricant (OC-11) in the oil hole.

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 centred on the tyre. Position is not critical and visual alignment is adequate.

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

The alternative method for drive motor lubrication is:

- Step 1:* Gently prise 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 the 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 prise the dust cap from 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 tyre, 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 Demagnetisation (figure 5-4)

Occasionally, the heads may become permanently magnetised through electrical faults in the amplifiers, improper use of the equipment, or by contact with magnetised objects. Magnetised 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 realised if the heads are magnetised.

If it becomes necessary to test the heads with an ohm

meter, they must be demagnetised afterwards.

If the heads become magnetised, proceed as follows, using an Ampex Demagnetiser, Catalogue No. 704 :

- Step 1:* Place the equipment POWER switch in the OFF position.
Step 2: Plug the demagnetiser into a 117 volt ac source.

NOTE

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

- Step 3:* Bring the tips of the demagnetiser to within approximately $\frac{1}{8}$ inch (if the demagnetiser tips are taped or covered, contact with the heads can be made) of the reproduce head core stack, straddle the head gap and draw the demagnetiser tips up and down the length of the core stack three or four times.
Step 4: Remove the demagnetiser slowly from the head stack to a distance of 3 or 4 feet, thus allowing its ac field to diminish gradually. This slow removal is extremely important.

CAUTION

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

- Step 5:* If necessary, repeat the process until complete demagnetisation is effected in each case.

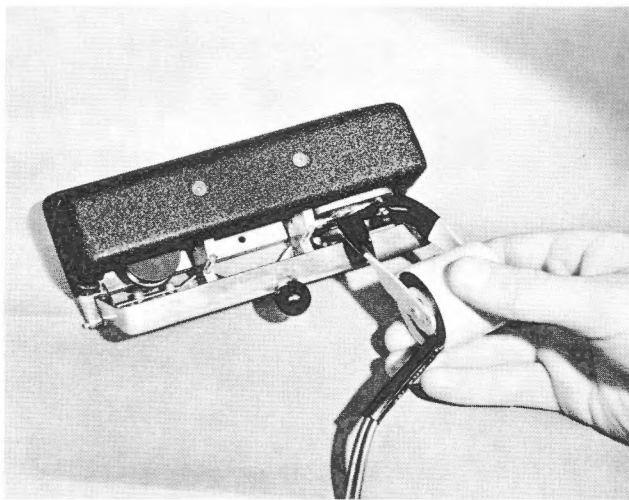


figure 5-4 — Demagnetising the Head

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

ADJUSTMENTS

The tape transport 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.
- $\frac{3}{8}$ -inch Nut Driver
- $\frac{1}{8}$ -inch Screwdriver
- Nylon Twine or Strong String
- $\frac{7}{8}$ -inch Socket Wrench
- $\frac{3}{4}$ -inch Allen Wrench

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 $7\frac{1}{2}$ ounces as read on the 16 oz spring scale at NAB reel hub diameter. Checking techniques are not difficult if performed carefully.

- Step 1:* Place an empty $10\frac{1}{2}$ 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 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 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 centred 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 resistance R505 in the control circuit box until a scale reading between $5\frac{1}{2}$ and 6 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 $1\frac{1}{2}$ - $3\frac{1}{4}$ 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 anticlockwise).

Brake Adjustment

Brake adjustment is made (with no power applied to the equipment) at the point shown in figure 5-5.

Step 1: Place an empty $10\frac{1}{2}$ inch NAB reel on the tape supply turntable.

Step 2: Make small loops at both ends of a thirty inch piece of nylon 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 anticlockwise. 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 take-up motors' brakes for scale readings listed below. Points of adjustment are shown by illustration in figure 5-5.

Step 7: Now wind the twine on the hub by rotating the reel anticlockwise; 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 Anticlockwise—Take-up Clockwise	Direction of Least Resistance, Supply Clockwise—Take-up Anticlockwise
$\frac{1}{4}$ 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 figure 5-6.) 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 slip 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 ac when cold, or 105 volts when warm (after $\frac{1}{2}$ hour running) with the voltage selector set to 110 volts. A similar test can be made in other output voltage ranges. The pressure against the capstan shaft should be approximately 5 pounds.

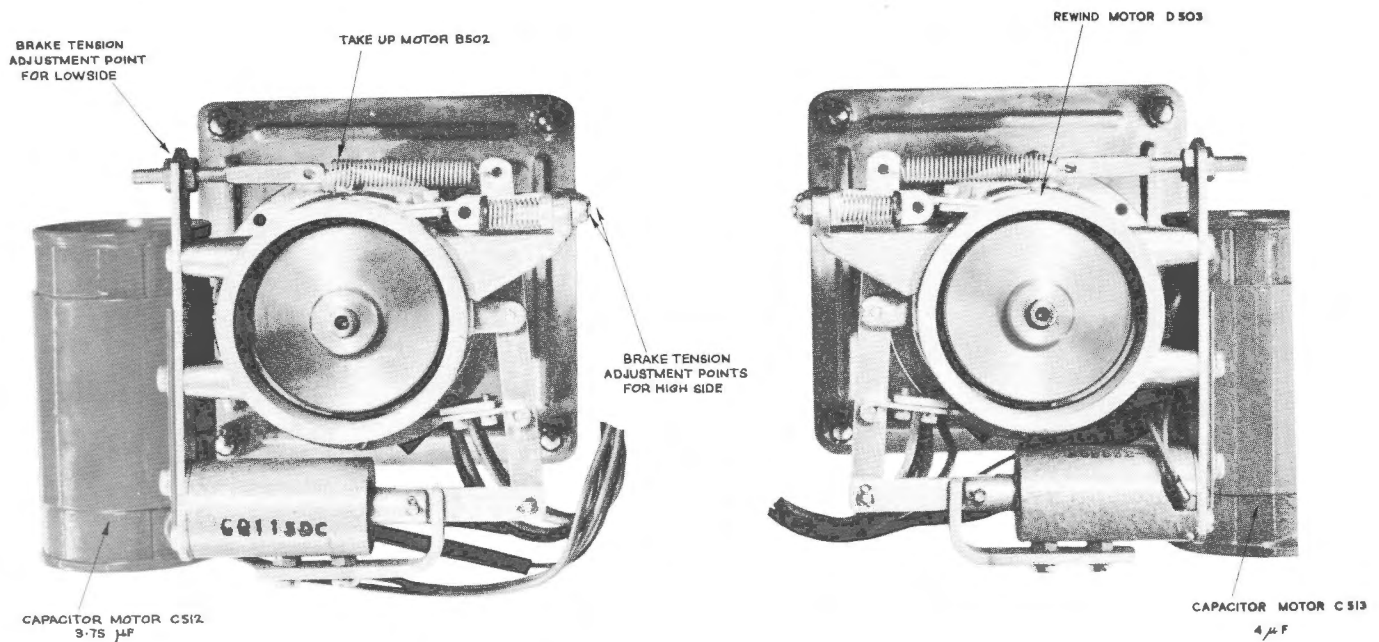


figure 5-5 — Take-up and Rewind Motor Assemblies

NOTE

In the course of normal operation in the reproduce condition, the temperature of the capstan solenoid will rise, and its dc 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 an unusually low line voltage 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 condition 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.

- Step 3:** If it is desired to measure capstan pressure, press the STOP button at this point and select a piece of nylon 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 0-80 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° angle with the idler arm (figure 5-8).
- 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 lb $\pm \frac{1}{2}$ lb. If necessary, adjust the capstan pressure at the point shown in figure 5-6.

Replacement of Parts

All sub-assemblies of the tape transport mechanism can be easily dismantled with the use of a screwdriver and a few small socket spanners.

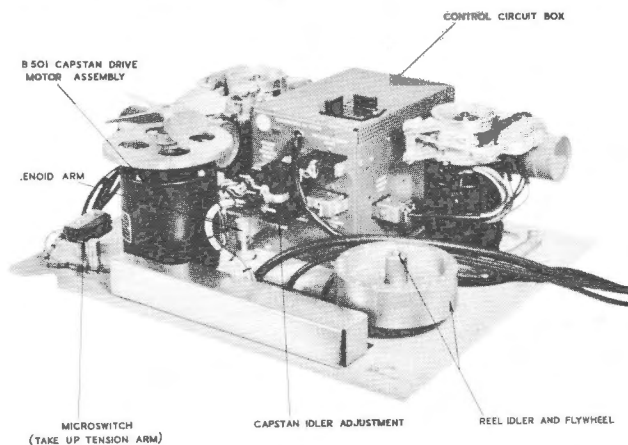


figure 5-6 — Tape Transport Underside Parts Location

CAUTION

Do not attempt complete dismantling of any of the sub-assemblies. The schedule of individually replaceable parts under each assembly tabulated in the parts list should be used as a guide to dismantling 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 Authorised Service Centre for repair or replacement.

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

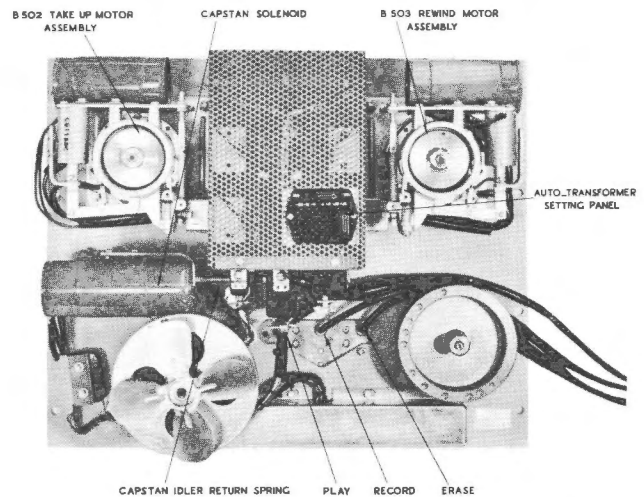


figure 5-7 — Tape Transport Underside Parts Location

Brake Band Replacement (figure 5-9)

NOTE

Brake Bands may be replaced without removing motor from tape transport on rack mounted machines and in this case, the first two steps should be ignored.

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

- Step 1:** With a $\frac{7}{16}$ 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 connectors and free the capacitor from the bracket.

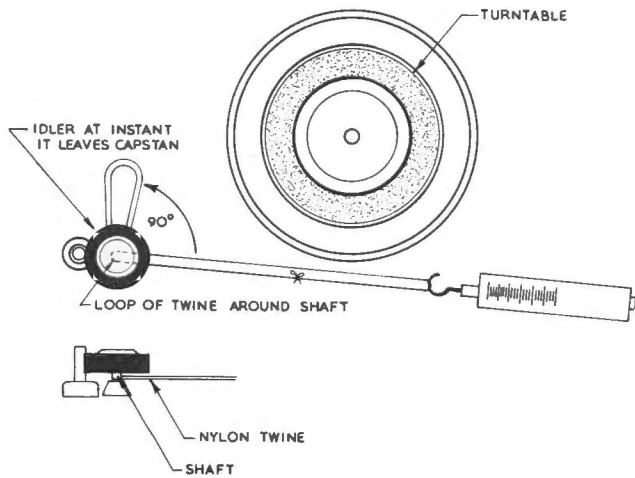


figure 5-8 — Capstan Idler Pressure Measurement Arrangement

- Step 5:** Remove the screws that hold the brake housing to the motor, noting the position 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 $\frac{5}{16}$ 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 care 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

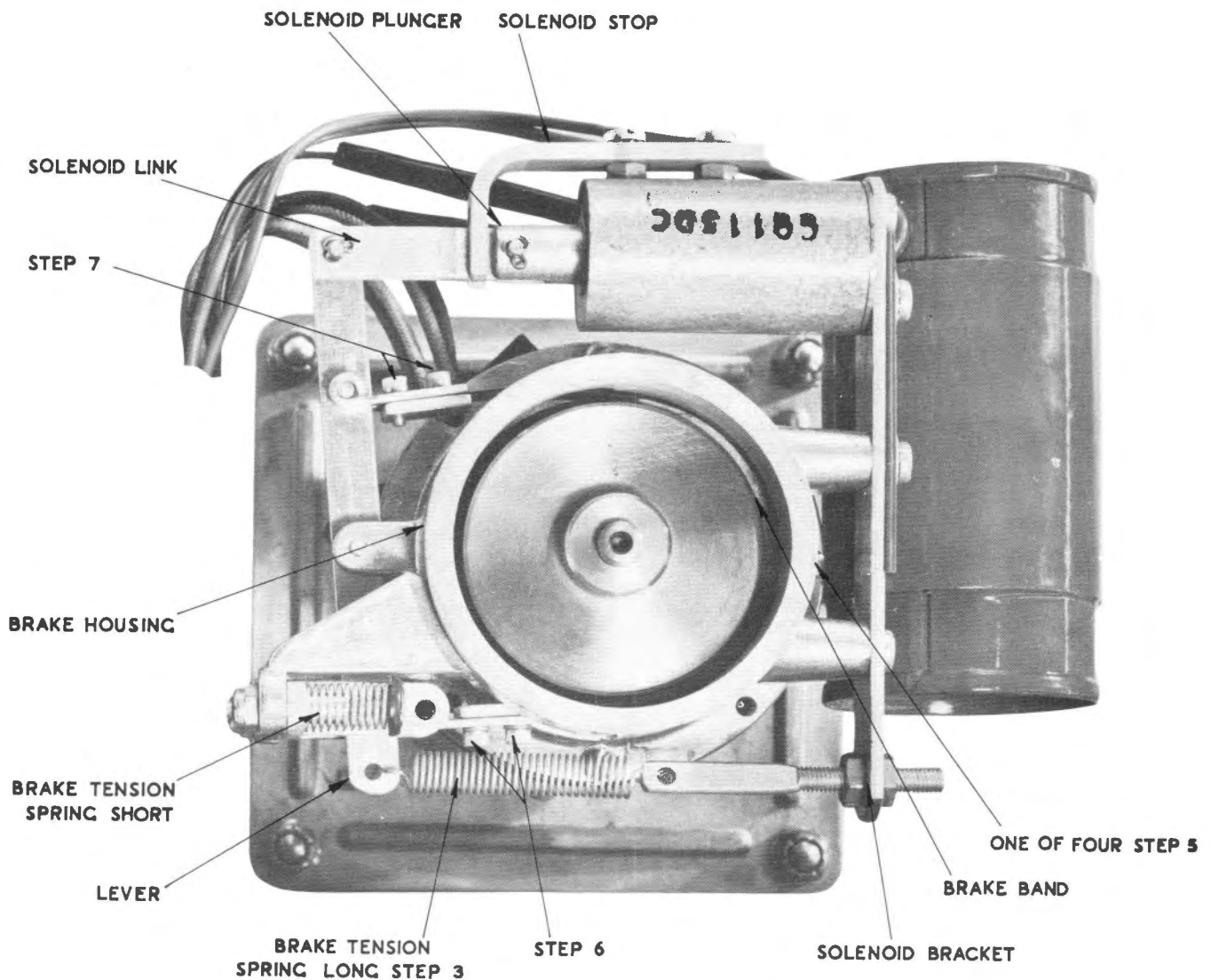


figure 5-9.— Brake Band Replacement

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 energised. The purpose of the band leaf is to keep the band from splitting when it buckles at the band clamp.

Step 13: Reconnect the wires to the capacitor with the knife connectors, replace it in the bracket, and secure it 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, adding the four washers and tightening the four nuts which 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.

AUTOMATIC TIMING

The automatic timing device, which has a repeatability of better than 10 seconds, is housed in an aluminium casing and can be mounted on the tape transport between the two turntables and above the head assembly.

Drive is provided by the tape which is threaded around the rubber tyred pulley. (See figure 3-2.) This drive is transmitted by a geared shaft assembly to the clock mechanism which in turn drives a minute hand and a second hand.

The clock dial is marked for high and low tape speeds, the high speed markings in red and the low speed markings in black.

Instantaneous resetting of the hands is achieved when the reset knob—below the dial—is turned clockwise.

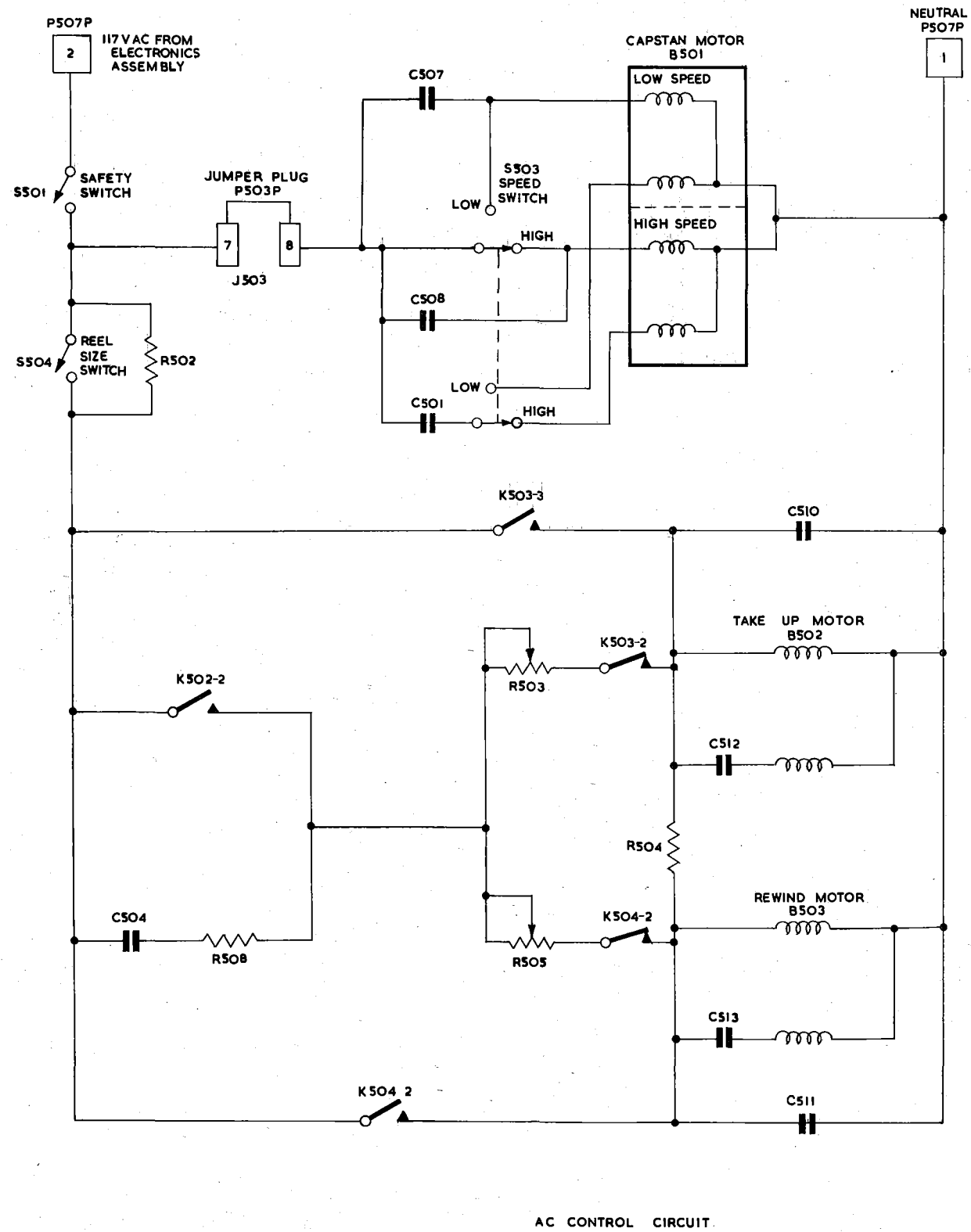
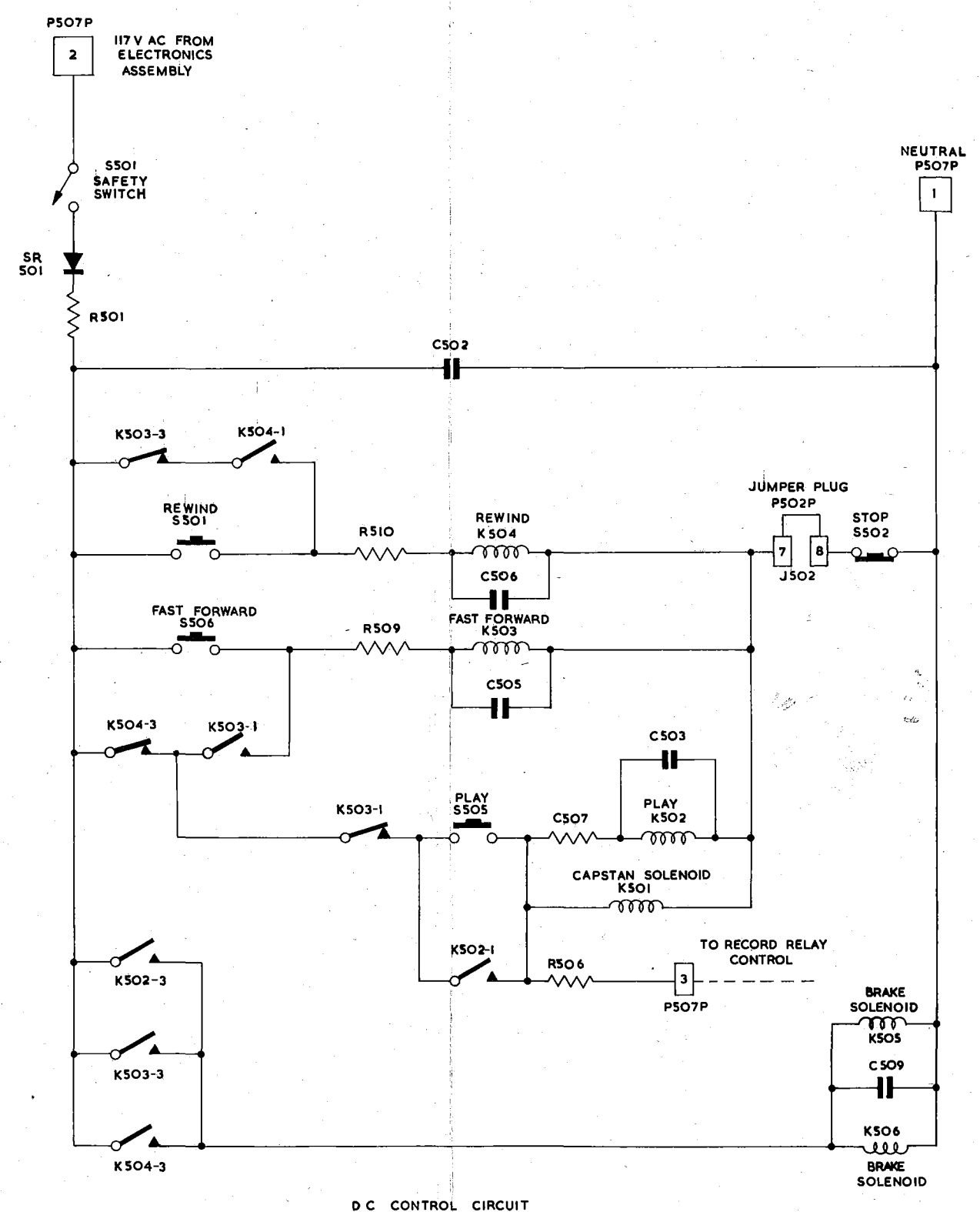
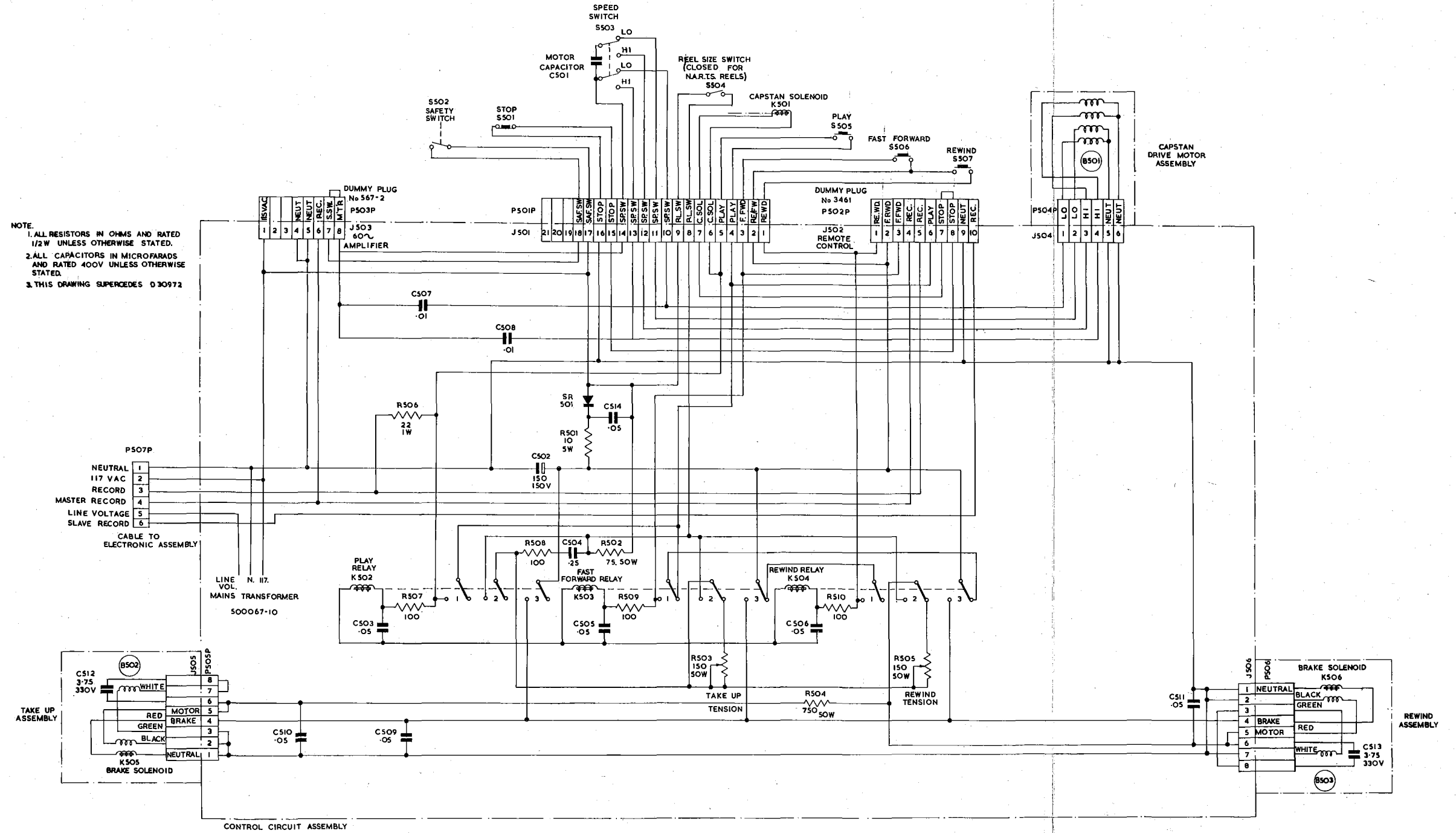


figure 5-10
Tape Transport AC Control Circuit Schematic Diagram



SIMPLIFIED CONTROL CIRCUIT SCHEMATIC UNIVERSAL TAPE TRANSPORT

figure 5-11
Tape Transport DC Control Circuit Schematic Diagram



NOTE:
 1. ALL RESISTORS IN OHMS AND RATED 1/2W UNLESS OTHERWISE STATED.
 2. ALL CAPACITORS IN MICROFARADS AND RATED 400V UNLESS OTHERWISE STATED.
 3. THIS DRAWING SUPERCEDES D 30972

figure 5-12 Control Circuit Box Schematic Diagram

ELECTRONIC ASSEMBLY

REPRODUCE AMPLIFIER (figure 6-1)

The reproduce amplifier is a resistance coupled audio amplifier using three double triodes to provide three stages of amplification, phase inversion, and a push-pull output amplifier (see figure 6-2).

Signal on the moving magnetic tape induce voltages in the reproduce head. When high impedance heads are used, this induced voltage is applied across resistor 2R25 and passed on to the grid of 2V3a. Bias on this first stage is derived from the potential divider 2R26 and 2R28. Capacitor 1C105a and resistor 1R157 form the anode decoupling. The amplified output of the first stage is coupled to the second stage grid (2V3b) through capacitor 2C14. Capacitor 1C105b and resistor 1R156 form the anode decoupling. CCIR equalisation is achieved through capacitor 2C15, resistor 2R29 and potentiometer 2R30 for the low tape speed, and through 2C15, 2R29 and potentiometer 2R31 for high tape speed. NAB equalisation for $7\frac{1}{2}$ and 15 ips is through capacitor 1C100, resistor 1R152 and potentiometer 1R150. On $3\frac{3}{4}$ and $7\frac{1}{2}$ ips machines, NAB equalisation is through 1C100, 1R152, and 1R150 for $7\frac{1}{2}$ ips, and through 1C100, 1R152 and potentiometer 1R151 for $3\frac{3}{4}$ ips.

The signal is now fed to amplifier stage 2V4, the valve receiving the signal through capacitor 2C17 and GAIN CONTROL potentiometer 1R158. 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 splitter 2V4b. Both signals, now 180 degrees out of phase, are fed through coupling capacitors to the respective grids of push-pull amplifier 2V5 and then to the primary of centre tapped output transformer 1T2.

One secondary winding of the output transformer provides negative feedback to the cathode of 2V4a. The other secondary delivers the signal to 1J6 LINE OUTPUT.

HT is supplied to all reproduce stages when the POWER switch is in the ON position.

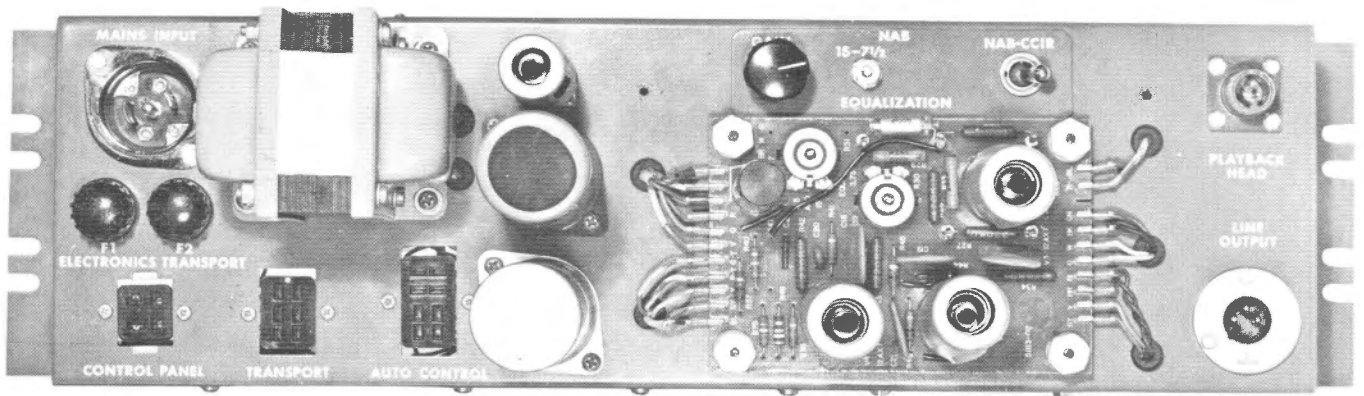


figure 6-1 — Reproduce Amplifier Chassis

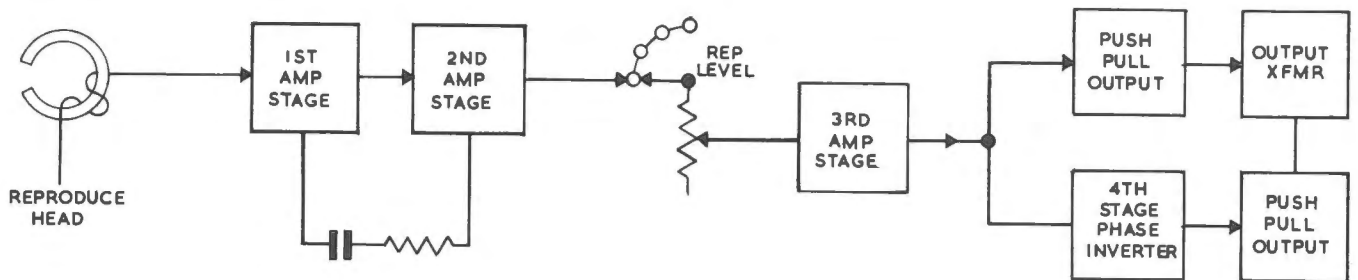


figure 6-2 — Reproduce Amplifier — Block Diagram

POWER SUPPLY

Full wave rectifier valve, 1V1, supplies HT for all valves in the reproduce amplifier. The selenium rectifier, 1 CR100, connected as a conventional full wave rectifier, provides dc filament voltage for 2V3, 2V4 and 2V5, with the centre tap of each filament connected to ground.

Incoming ac power as connected at the 1J3 MAINS INPUT socket and fed through the control panel. POWER switch, fuse 1F2, and interconnecting cable to the auto-transformer on the tape transport. When the voltage selector panel is set correctly, 117 volts is returned via the interconnecting cable to power the reproduce amplifier chassis. The incoming 117 volts is fed through fuse 1F1 and applied across the primary of the power transformer 1T1.

There are four secondary windings on the power transformer—three for LT voltages and one for high voltage. One winding serves the filament of rectifier valve 1V1, one centre tapped winding provides 12.6 volt dc filament voltage after rectification, one winding supplies 12.6 volts ac to the AUTO CONTROL socket 1J4 and the other centre tapped winding provides high voltage. Capacitors 1C106 and 1C105c and resistor 1R159 form the smoothing circuit.

Power to the slave electronics chassis is supplied

through the stereophonic interconnecting cable 500237.

ALIGNMENT AND PERFORMANCE CHECKS

All Ampex equipment is correctly aligned at the factory before shipment, and should not require re-aligning on arrival. Re-aligning should only be necessary when performance fails to fall within the limits given in SECTION 1, or, after the repair or replacement of a component part.

Equipment Required

Ampex Standard Alignment Tapes for machines using $\frac{1}{4}$ inch tape.

Speed	Equalisation Standard	Ampex Catalogue No.
3 $\frac{3}{4}$ ips	NAB 120 microseconds	3131-01
7 $\frac{1}{2}$ ips	NAB	3132-01
7 $\frac{1}{2}$ ips	CCIR	31323-01
15 ips	NAB	31311-01
15 ips	CCIR	31313-01

AC valve voltmeter capable of indicating rms voltages of 0.004 or less.

Audio Frequency Oscillator with stable output from 50 c/s to 15 kc/s.

High Impedance Earphones.

Screwdriver.

Head Demagnetiser. Nutdriver, number 8 ($\frac{1}{4}$ inch).

STANDARD ALIGNMENT TAPES

Order of Recording	Tone c/s	3 $\frac{3}{4}$ ips		7 $\frac{1}{2}$ ips		15 ips		Function
		Level	Function	Tone c/s	Level	Tone c/s	Level	
First Tone	500	-10db	reproduce reference	700	-10db	700	operating	reproduce gain calibration & reference
Second Tone	7500	-10db	reproduce head alignment	15000	-10db	15000	operating	reproduce head alignment
Series of Tones	7500 to 50	-10db	check frequency response*	15000 to 30	-10db	15000 to 30	operating	check frequency response*
Last Tone	500	operating	reproduce gain calibration	700	operating	reproduce gain calibration	NOT USED	

* Adjust high frequency equalisation if necessary.

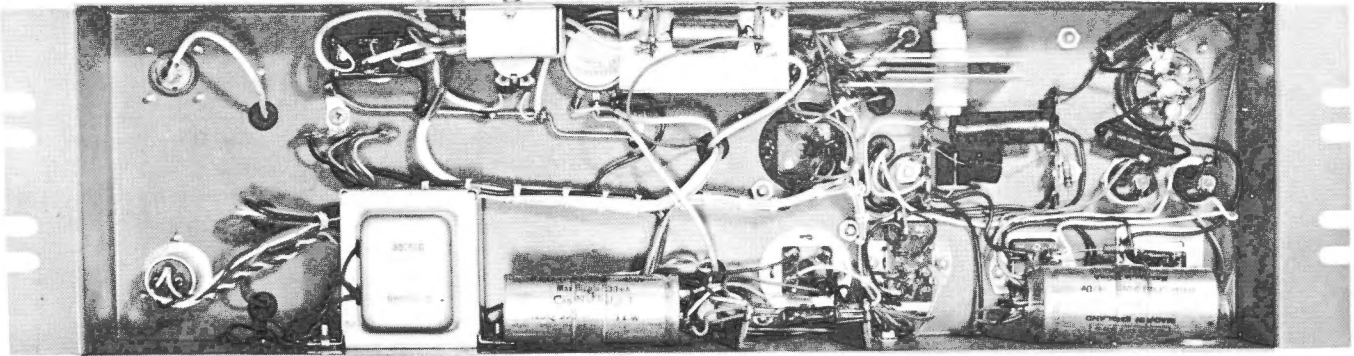


figure 6-3 — Reproduce Amplifier Chassis — Interior

Reproduce Alignment

Step 1: Remove the head cover.

CAUTION

Magnetisation of the head will cause partial erasure of the high frequencies on the standard alignment tape and make it useless as a standard. Demagnetise the head before proceeding. Do not replace the head cover on the head assembly.

- Step 2:* With the equipment connected as previously described and all power switches in the ON position, thread an Ampex standard alignment tape for the appropriate speed along the prescribed path.
- Step 3:* Set the equalisation switch to the desired standard.
- Step 4:* Connect the amplifier output to the ac valve voltmeter with a 600Ω resistance connected across its terminals.
- Step 5:* Start the standard alignment tape. The first tone on all standard alignment tapes is a reference level, 700 c/s for 7 $\frac{1}{2}$ and 15 ips, and 500 c/s for 3 $\frac{3}{4}$ ips. For 15 ips, adjust the GAIN control 1R158, so that a valve volt-

meter across the output will read +8 dbm. For 3 $\frac{3}{4}$ or 7 $\frac{1}{2}$ ips adjust the playback level for a convenient meter reading for checking alignment and response.

- Step 6:* The next tone will be 15000 c/s at 7 $\frac{1}{2}$ and 15 ips, and 7500 c/s at 3 $\frac{3}{4}$ ips for adjusting reproduce head alignment. (See figure 6-4.) Take the number 8 nutdriver and adjust the left hand stop nut on the reproduce head for maximum output on the valve voltmeter. 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 correct setting is 15 to 20 db higher than these peaks.

- Step 7:* Depending on tape speed, tones from 15000 c/s to 30 c/s will now be reproduced from the standard alignment tape. Adjust the appropriate variable equaliser to give the flattest possible high frequency response.

CAUTION

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

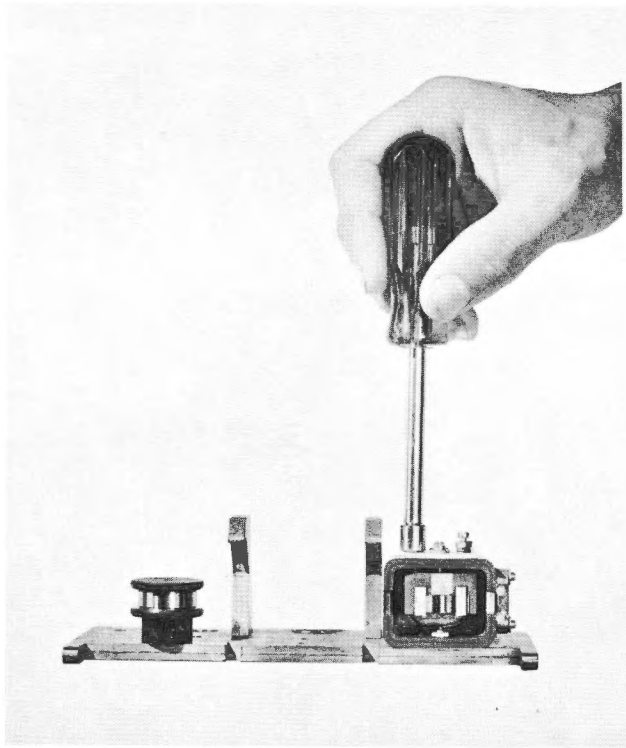


figure 6-4 — Reproduce Head Azimuth Adjustment

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, but 2 db is an average amount. This phenomena is present because the reproduce head 'senses' additional flux on each side of the head at long wavelengths since the standard alignment 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 re-adjusted to compensate for this rise.

Step 8: Reproduce level control calibration. The next tone to be heard on the $3\frac{3}{4}$ and $7\frac{1}{2}$ ips standard alignment tapes is a reference tone at operating level. Adjust the playback GAIN control to obtain a reading of +8dbm (1.95V) output on a valve voltmeter. On the 15 ips standard alignment tape, all tones are at operating level, so this calibration was made in Step 5.

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 valve voltmeter. 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.

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

Example : 14 dbm (+8 dbm normal level and
+6 dbm to 3% distortion
level).
-46 dbm (valve voltmeter 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.

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 (valve voltmeter reading)
56 db signal-to-noise ratio.

Any reading below -46dbm meets the performance characteristics specifications of 56db signal-to-noise ratio, and satisfies the signal-to-noise definition. Corresponding valve voltmeter readings and signal-to-noise ratios are shown in the table in figure 6-5.

Ampex signal-to-noise ratio specifications on audio instruments define in decibels the ratio existing between the level of a steady 500 c/s 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 15000 c/s, which exists in reproduction under the same gain conditions.

VTVM READING [DBM]	SIGNAL TO NOISE RATIO	
	8 DBM OUTPUT	4 DBM OUTPUT
+14 —	— 0 [3% DIST]	— —
+10 —	— 4 [1% DIST]	— 0 [3% DIST]
+8 —	— 6	— —
+5 —	— 9	— 5 [1% DIST]
+4 —	— 10	— 6 [1% DIST]
0 —	— 14	— 10
-5 —	— 19	— 15
-10 —	— 24	— 20
-15 —	— 29	— 25
-20 —	— 34	— 30
-25 —	— 39	— 35
-30 —	— 44	— 40
-35 —	— 49	— 45
-40 —	— 54	— 50
-45 —	— 59	— 55
-50 —	— 64	— 60
-55 —	— 69	— 65
-60 —	— 74	— 70

CALIBRATE VU METER SO THAT ZERO EQUALS 8 DBM &
4DBM THE RESULT SHOWN ABOVE

figure 6-5 — Signal-to-Noise Ratio

NOTES ON ALIGNING STEREOPHONIC EQUIPMENT

Stereophonic equipment, consisting of two reproduce amplifiers and a two track head assembly, is aligned in an almost identical fashion to the monaural system.

However, because there are two heads in the reproduce stack, the azimuth adjustment must be made for an average maximum meter indication, adjusting the azimuth for a maximum reading of the valve voltmeters for first one head and then the other, and finally adjusting for the average maximum meter indication.

MAINTENANCE AND FAULT FINDING

General Maintenance Information

Faithful adherence to the recommended ROUTINE MAINTENANCE found in SECTION 5, TAPE TRANSPORT MECHANISM and careful performance checks will ensure excellent equipment operation. When the cleaning, lubricating and demagnetising 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 amplifier. For instance, poor tape-to-head contact, due to tape oxide accumulations, will diminish high end frequency response.

Incorrect 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 fault finding.

Progressive Maintenance of the Amplifiers

Check HT voltage at the primary centre-tap of transformer 1T2, and make a check of valve emission. Make sure valves are returned to the same base. Check dc filament voltage to note ageing of 1CR100. 1R153 may be reduced in value or shorted out as the rectifier ages.

Fault Finding in the Reproduce Amplifier

A circuit for fault finding in the reproduce amplifier is shown below (figure 6-6 see also figure 6-1 LOCA-

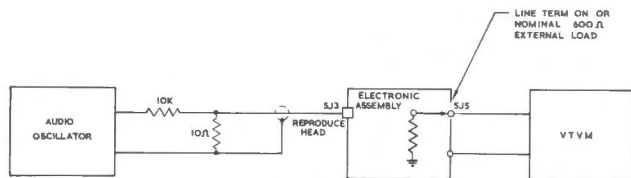


figure 6-6 — Fault Finding Test Set-up

TION OF ELECTRONIC SUB-ASSEMBLIES and figure 6- 7 foldout SCHEMATIC DIAGRAM - ELECTRONIC ASSEMBLY).

A run through of the alignment and performance checks will help to isolate the fault or may even rectify it, and the faulty component should then be easily identified.

Servicing and Repairing Printed Circuits

Because of the uniform wiring layout and translucent boards, printed circuits can be traced more easily than conventional circuits, fault finding 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. Continuity checks and measurement of resistors, inductors, and some types of capacitors can be made at the component side of the printed circuit board. Very small breaks in wiring can be located by means of a magnifying glass. The parts location illustrations and the schematic diagram can be used to advantage when tracing circuitry, especially where valve bases are concerned. Pin numbers are plainly marked.

Equipment and Tools Required

- Diagonal cutters
- Long-nosed pliers
- Pocket knife
- $\frac{1}{4}$ inch AF nutdriver
- 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 section, and large breaks can be repaired with 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 towards 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 complete the bond.

Excessive pressure can crack the board. To remove the board from the chassis, remove the four mounting nuts carefully. When disconnecting the edge-on harness connectors, make certain that the pliers holding the individual connector will not slip and break an adjacent component. To prevent this type of damage, insert a screwdriver or similar protective device between the pliers and the vulnerable component. A vice with protected jaws can be used to hold the board while

servicing. Avoid excessive pressure against the board when using the vice.

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°F (191°C). Some soldering irons are available with tip temperature of 650°F. (343°C), but a more skilled service engineer can speed up the soldering process by using an iron with a tip temperature in the neighbourhood of 750°F. (399°C).

Removing a Resistor

A convenient method of removing resistors is to cut 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 the joints by wrapping a turn of each new resistor wire around the remnant wires left from the old components. Perform the soldering quickly and efficiently.

Solder Method of Removing and Replacing Components

On the wiring side of the board at the components 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 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 the connection, and solder.

Replacing Electrolytic Capacitors, Relays and Inductors

Step 1: With the soldering iron, heat each connection and brush away melted solder. Some parts may require prising the mounting lugs per-

pendicular 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 Valve Bases

Step 1: With soldering iron, heat each connection 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 penknife inserted between the base lug and wiring foil, bend each lug upward—except the grounding lug.

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

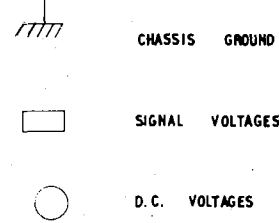
ORDERING PARTS

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 the correct information is supplied. Parts are listed according to the schematic reference symbol, a description of the part and the Ampex part number. Ampex International S.A. offer some replacement parts that are not necessarily exact replicas of those used in 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, and the AMPEX PART NUMBERS.

Ampex part numbers are the exact designation for all parts used in Ampex equipment. For example, CAPACITOR, fixed: ceramic, 0.02 μ F + 80% - 20%, 500 vdcw, Erie Type K7004/CP3 will always bear the Ampex catalogue 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 off 030-059 capacitors for Universal Model 352.

CIRCUIT CONDITIONS

LEVEL CONTROL I-R158 FULLY CLOCKWISE



- NOTES**
1. RESISTOR VALUES ARE IN OHMS $\pm 10\%$ 1/2W UNLESS OTHERWISE STATED
 2. ALL CAPACITORS ARE IN MICROFARADS AND RATED AT 400V UNLESS OTHERWISE STATED
 3. SWITCHES SHOWN AS THEY FUNCTION NOT AS CONSTRUCTED
 4. D.C. VOLTAGES MEASURED WITH 20000 OHMS/VOLT METER
 5. SIGNAL VOLTAGES MEASURED WITH A.C. VTVM EXPRESSED IN db REFERRED TO -78 VOLTS
 6. 334-712 L.P.S. MACHINE AS DRAWN

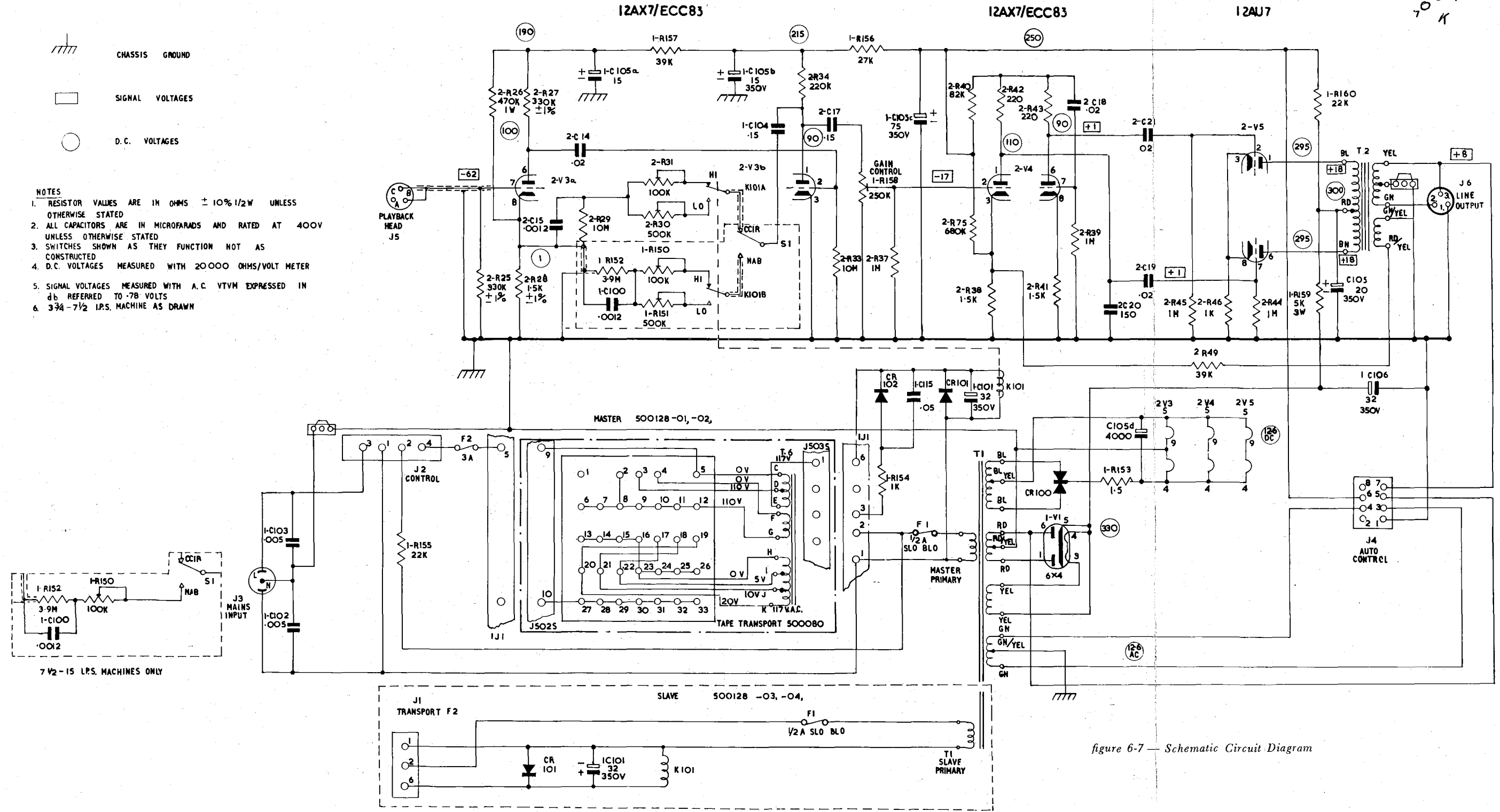
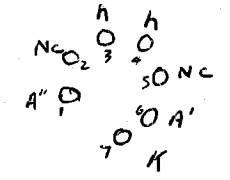
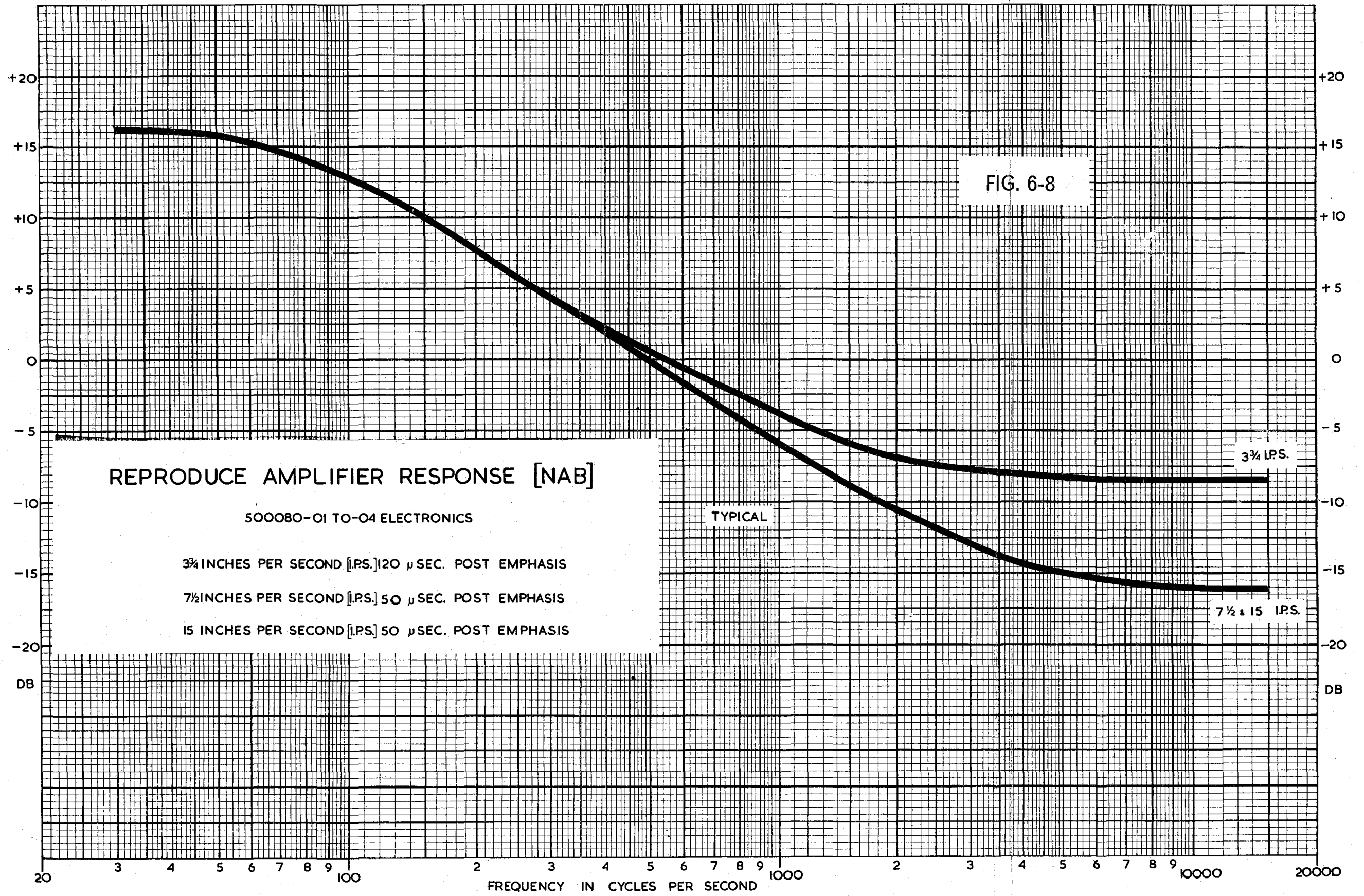
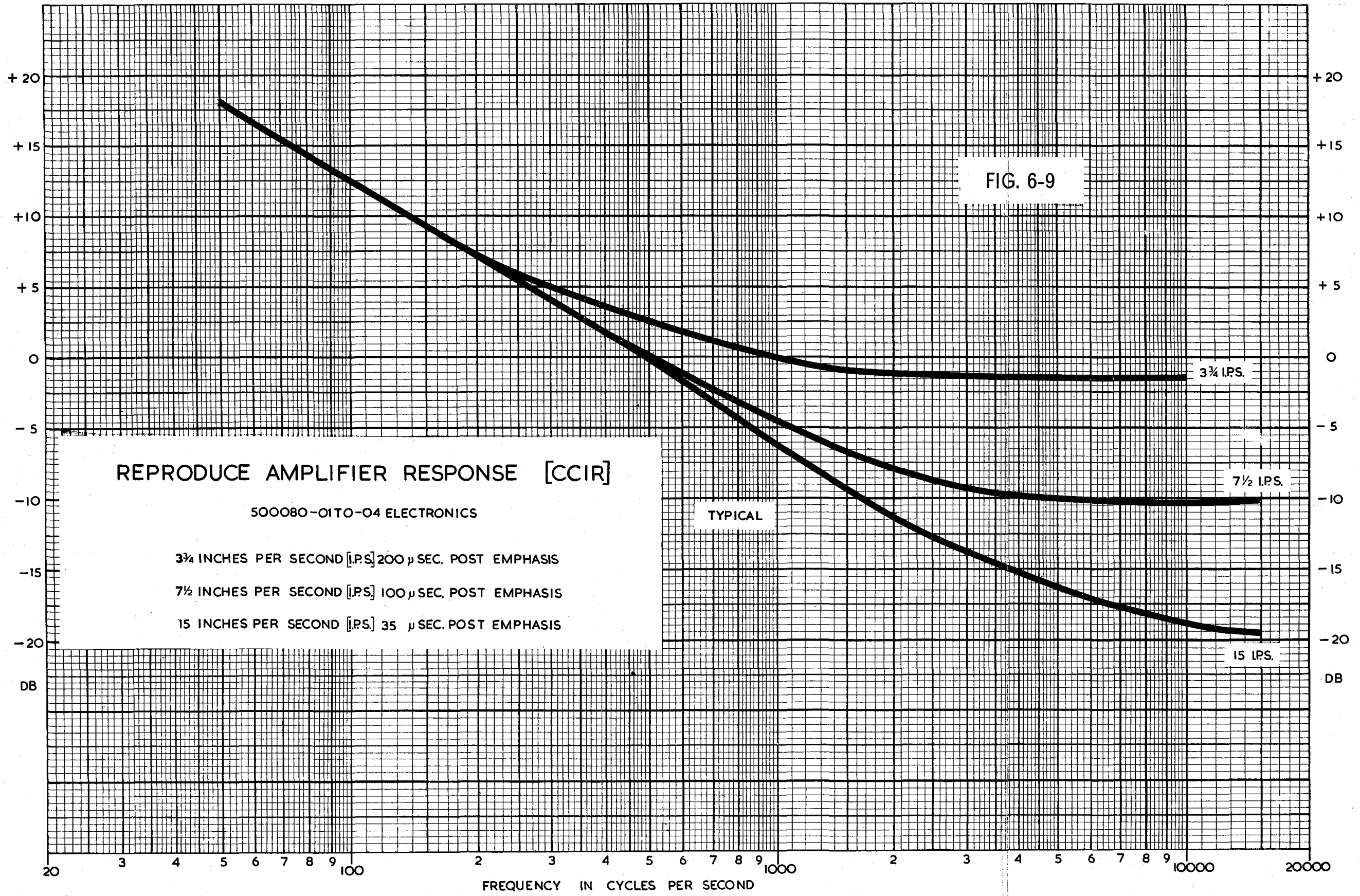


figure 6-7 — Schematic Circuit Diagram





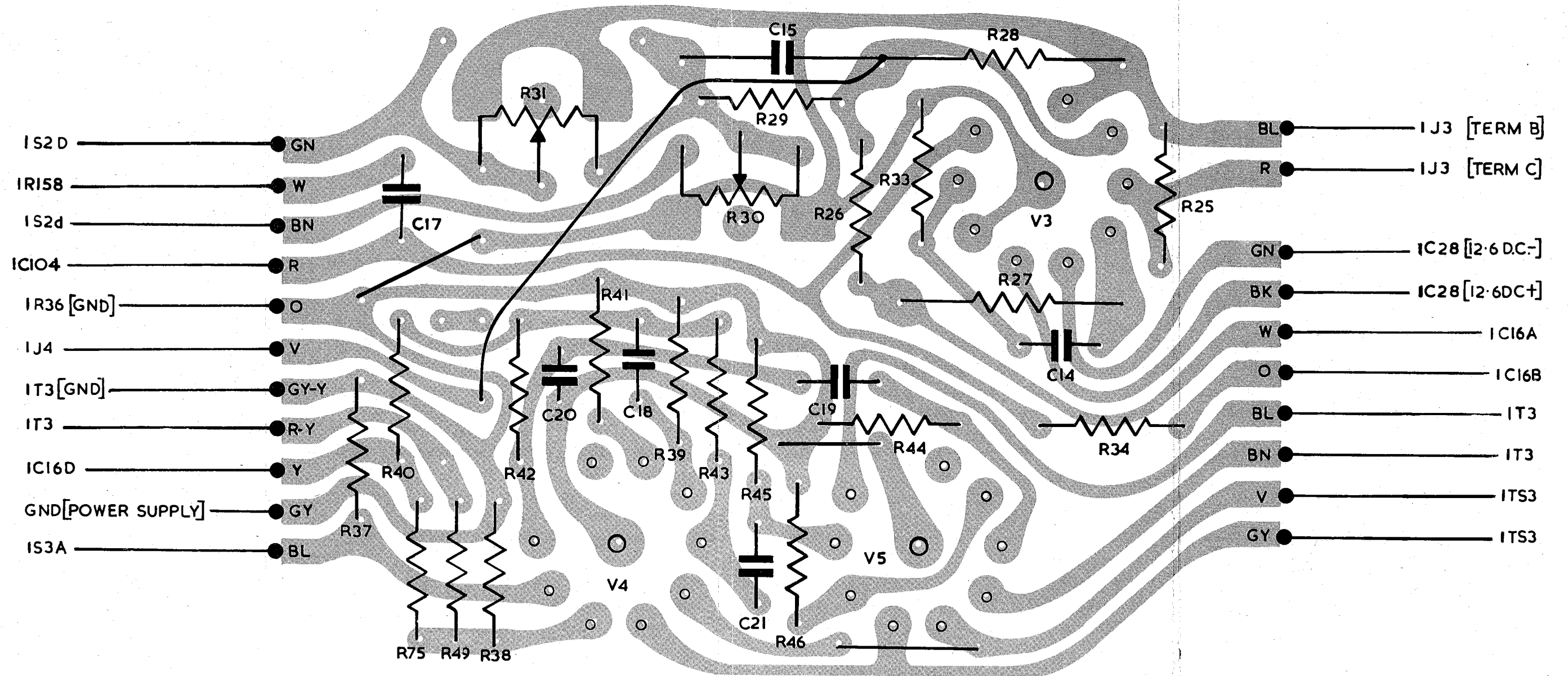


figure 6-10

Printed Circuit Board Assembly

PARTS LIST

TAPE TRANSPORT - Catalogue Number 500080-10 to -40

Schematic Reference No.	Part Description	Ampex Part No.
B501	DRIVE MOTOR ASSEMBLY	
	7 $\frac{1}{2}$ - 15ips 60 c/s motor	17232-15
	7 $\frac{1}{2}$ - 15ips 50 c/s motor	17232-17
	3 $\frac{3}{4}$ - 7 $\frac{1}{2}$ ips 60 c/s motor	17232-16
	3 $\frac{3}{4}$ - 7 $\frac{1}{2}$ ips 50 c/s motor	17232-18
	Each of the above include:	
C501	Capacitor Assembly 5 μ F \pm 10% 330vac	035-117
	Flywheel - Bodine motor	981
	- Ashland motor	2212
	- Set screw 10-32 x $\frac{1}{4}$ inch	477-118
	Plug, 6 contact, Jones.	145-012
	FAN	591-001
B502	TAKE-UP ASSEMBLY	9451-01
	Each turntable-motor Assembly includes motor, mounting flange, brake drum, and turntable with pad.	
	Turntable	61462-01
	Pad	958-00
C512	Capacitor, 3.75 μ F (50 c/s)	035-111

TAPE TRANSPORT cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
	Brake Assembly, Complete	17327-01
	Brake Housing	17614-01
	Brake Band	17612-01
	Brake Band Leaf 1-1/8 inch long	61460-01
	Brake Tension Spring - long	69533-1
	Brake Tension Spring - short	17323-01
	Eye Bolt	69517-6
	Crosshead	17324-01
	Anchor	17325-01
	Spacer	17322-01
	Roll Pin 1/8 inch x $\frac{3}{4}$ inch	406-005
	Screw, Socket Lead C. P. A. stt. pl.	470-008
	Connector, Solderless	171-008
	Brake Band Link	69528-01
	Brake Band Clamp	69529-01
	Brake Lever	69530-01
	Drivelock Pin	403-008
	Cotter Pin 1/16 inch x $\frac{1}{2}$ inch	401-005
	Clevis Pin 1/8 inch x 9/32 inch	400-002
	Plug, 8 contact, Jones.	17313-01
K505, K506	Brake Solenoid	69532-01

TAPE TRANSPORT cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
B503	REWIND ASSEMBLY	9452-04
	Turntable	61462-01
	Pad	958-00
C513	Capacitor $4\mu\text{F} \pm 10\%$ 330vac (50 c/s)	035-116
	Brake Assembly Complete	17327-01
	Brake Housing	17614-01
	Brake Band	17612-01
	Brake Band Leaf 1-1/8 inch long	61460-01
	Brake Tension Spring - long	69533-1
	Brake Tension Spring - short	17323-01
	Eye Bolt	69517-6
	Crosshead	17324-01
	Anchor	17325-01
	Spacer	17322-01
	Roll Pin 1/8 inch x $\frac{3}{4}$ inch	406-005
	Screw Socket Lead C. P. A. stt. pl.	470-008
	Connector, Solderless	171-008
	Brake Band Link	69528-01
	Brake Band Clamp	69529-01
	Brake Lever	69530-01
	Drivelock Pin	403-008

TAPE TRANSPORT cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
	Cotter Pin 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	69532-01
	TAKE-UP TENSION ARM ASSEMBLY	425-00
	Individually replaceable items:	
	Take-up Tension Arm Spring	30946-01
	Tape Guide	675-00
	Tape Guide Hook	69542-01
	REEL IDLER ASSEMBLY	
	(7 1/2 - 15ips machine)	4459-00
	(3 3/4 - 7 1/2ips machine)	4459-03
	Tape Guide	257-00
	Pulley Assembly 7 1/2 - 15 ips	5893-00
	Pulley Assembly 3 3/4 - 7 1/2ips	5893-01
	Reel Idler Flywheel	636-01
	CAPSTAN IDLER WHEEL ASSEMBLY	
	(7 1/2 - 15ips machine)	30945-01
	(3 3/4 - 7 1/2ips machine)	6092-01
	Capstan Idler Arm	372-01
	Capstan Idler Arm Bushing	5755-00
	Capstan Dust Cap	
	(7 1/2 - 15ips machine)	3506-00
	(3 3/4 - 7 1/2ips machine)	3506-01
	Individually replaceable items:	

TAPE TRANSPORT cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
	Felt Washer	3583-02
	Retaining Ring	432-007
	CAPSTAN IDLER SOLENOID ASSEMBLY	5783-01
	Individually replaceable items:	
K501	Capstan Solenoid	69536-01
	Capstan Solenoid Eye Bolt	69517-03
	Capstan Solenoid Stop	388-01
	Capstan Solenoid Felt Washer $\frac{1}{4}$ inch thick	503-015
	Capstan Solenoid Felt Washer $\frac{1}{8}$ inch thick	503-017
	Capstan Solenoid Pressure Spring	69518-1
	Capstan Solenoid Return Spring	5757-01
	Capstan Idler Actuator	381-01
	PUSHBUTTON GUARDS	361-00
	REEL GUARD	5708-00
	SWITCH HARNESS ASSEMBLY	5782-01
	Individually replaceable items:	
	Connector, Plug, Male, 21 contacts	145-022
S501	Microswitch - safety switch - assembly, single pole, single throw, normally open.	120-062
	Microswitch Shield	5730-00
	PUSHBUTTON SWITCHES	

TAPE TRANSPORT cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
S502	Stop (single pole, single throw). Arrow Type H & H 3391-BSA-13.	120-014
S505	Play - normally open. Arrow Type H & H 3391-EPA-13.	120-013
S506	Fast Forward - normally open. Arrow Type H & H 3391-EPA-13.	120-013
S507	Rewind - normally open. Arrow Type H & H 3391-EPA-13.	120-013
TOGGLE SWITCHES		
S503	Tape Speed (single pole, single throw). Arrow Type H & H 81058-FBT-13.	120-004
S504	Reel size (single pole, single throw) L G Shank Arrow Type H & H 8040-BT-13	120-005
	CONTROL CIRCUIT BOX	500081-10
Individually replaceable items:		
	Chassis Cover	5739-01
P502P	Connector, Plug, Male, 10 contacts - Remote Dummy	3461-00
P503P	Connector, Plug, Male, 8 contacts.	567-01

CONTROL CIRCUIT BOX ASSEMBLY - Catalogue Number 500081-10

Schematic Reference No.	Part Description	Ampex Part No.
C502	CAPACITOR, electrolytic, tubular, 150 μ F 150 vdcw. Dubilier Type BR52/4831/S	031-045
C503	CAPACITOR, metallised, tubular, axial leads, 0.05 μ F \pm 20% 400 vdcw. Dubilier Type 560 Mylar.	033-006
C504	CAPACITOR, metallised, tubular, axial leads, 0.25 μ F \pm 20% 400 vdcw. Dubilier Type 410	033-008
C505	CAPACITOR, metallised, tubular, axial leads, 0.05 μ F \pm 20% 400 vdcw. Dubilier Type 560 Mylar.	033-006
C506	CAPACITOR, metallised, tubular, axial leads, 0.05 μ F \pm 20% 400 vdcw. Dubilier Type 560 Mylar.	033-006
C507	CAPACITOR metallised, tubular, axial leads, 0.01 μ F \pm 20% 400 vdcw. Dubilier Type 2600	033-005
C508	CAPACITOR, metallised, tubular, axial leads, 0.01 μ F \pm 20% 400 vdcw. Dubilier Type 2600	033-005
C509	CAPACITOR, metallised, tubular, axial leads, 0.05 μ F \pm 20% 400 vdcw. Dubilier Type 560 Mylar.	033-006
C510	CAPACITOR, metallised, tubular, axial leads, 0.05 μ F \pm 20% 400 vdcw. Dubilier Type 560 Mylar.	033-006
C511	CAPACITOR, metallised, tubular, axial leads, 0.05 μ F \pm 20% 400 vdcw. Dubilier Type 560 Mylar.	033-006
C514	CAPACITOR, fixed, ceramic, 0.05 μ F \pm 20% 500 vdcw	035-234

CONTROL CIRCUIT BOX ASSEMBLY cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
J501S	CONNECTOR, socket, female, 21 contacts, chassis mounted. Cannon Electric Type S. 321. AB.	146-057
J502S	CONNECTOR, socket, female, 10 contacts, chassis mounted.	146-018
J503S	CONNECTOR, socket, female, 8 contacts, chassis mounted. Cannon Electric Type 308. AB.	146-003
J504S	CONNECTOR, socket, female, 6 contacts, chassis mounted. Cannon Electric Type S. 306. AB.	146-004
J505S	CONNECTOR, socket, female, 8 contacts, chassis mounted. Cannon Electric Type 308. AB.	146-003
J506S	CONNECTOR, socket, female, 8 contacts, chassis mounted. Cannon Electric Type 308. AB.	146-003
K502	RELAY PLAY, 3 PDT, 115 volt dc coil std. 10 ampere contact.	020-006
K503	RELAY FAST FORWARD, 3 PDT, 115 volt dc coil std. 10 ampere contact.	020-006
K504	RELAY REWIND, 3 PDT, 115 volt dc coil std. 10 ampere contact.	020-006
P501P	CONNECTOR, plug, male, 21 contacts.	145-022
P504P	CONNECTOR, plug, male, 6 contacts	145-012
P505P	CONNECTOR plug, male, 8 contacts, Painton and Co. P8/CT/RZE Cat. No. 311450	145-013
P506P	CONNECTOR, plug, male, 8 contacts. Painton and Co. P8/CT/RZE Cat. No. 311450	145-013
P507P	CONNECTOR, plug, male, 6 contacts.	145-012
R501	RESISTOR, wire wound, $10\Omega \pm 10\%$ 5W	043-156

CONTROL CIRCUIT BOX ASSEMBLY cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
R502	RESISTOR, wire wound, $75\Omega \pm 5\%$ 50W Resistances Ltd. Size R. 2. Type A/B.	043-002
R503	RESISTOR, wire wound, $150\Omega \pm 5\%$ 50W Resistances Ltd. Size R. 2. Type J.	040-011
R504	RESISTOR, wire wound, $750\Omega \pm 5\%$ 50W Resistances Ltd. Size R. 2. Type J.	040-007
R505	RESISTOR, wire wound, $150\Omega \pm 5\%$ 50W Resistances Ltd. Size R. 2. Type J	040-011
R506	RESISTOR, composition, 22Ω 1W. Dubilier Type BTS.	041-132
R507	RESISTOR, composition, $100\Omega \frac{1}{2}W$. Dubilier Type BTS.	041-038
R508	RESISTOR, composition, $100\Omega \frac{1}{2}W$. Dubilier Type BTS	041-038
R509	RESISTOR, composition, $100\Omega \frac{1}{2}W$. Dubilier Type BTS.	041-038
R510	RESISTOR, composition, $100\Omega \frac{1}{2}W$. Dubilier Type BTS.	041-038
SR501	RECTIFIER, silicon, 1000 volts, Type S. D. 910 International Rectifier Co.	000-481

REPRODUCE AMPLIFIER ASSEMBLY - Catalogue Number 500128-01 to -04

Schematic Reference No.	Part Description	Ampex Part No.
2C14	CAPACITOR, fixed, ceramic, 0.02 μ F + 80% -20% 500 vdcw. Erie Type K7004/CP3	030-059
2C15	CAPACITOR, fixed, paper, 0.0012 μ F \pm 5% 400 vdcw. Suflex Type H. S.	035-203
2C18	CAPACITOR, fixed, ceramic, 0.02 μ F + 80% -20% 500 vdcw. Erie Type K7004/CP3	030-059
2C19	CAPACITOR, fixed, ceramic, 0.02 μ F + 80% -20% 500 vdcw. Erie Type K7004/CP3	030-059
2C20	CAPACITOR, fixed, ceramic 0.00015 μ F \pm 20% 500 vdcw. Erie Type N3300/831	030-046
2C21	CAPACITOR, fixed, ceramic, 0.02 μ F + 80% - 20% 500 vdcw. Erie Type K7004/CP3	030-059
1C100	CAPACITOR, fixed, paper, 0.0012 μ F \pm 5% 400 vdcw. Suflex Type H. S.	035-203
1C101	CAPACITOR, electrolytic, sleeved, 32 μ F	000-322
1C102	CAPACITOR, fixed, ceramic, 0.0047 μ F \pm 20% 600 vdcw. Dubilier Type 560	035-028
1C103	CAPACITOR, fixed, ceramic, 0.0047 μ F \pm 20% 600 vdcw. Dubilier Type 560	035-028
1C104	CAPACITOR, 0.15 μ F	000-035
1C105	CAPACITOR, electrolytic, 15 μ F, 350v, 15 μ F, 350v, 75 μ F, 450v, 20 μ F, 450v.	30769-02
1C106	CAPACITOR, electrolytic, sleeved, 32 μ F.	000-322
1C108	CAPACITOR, electrolytic, 4000 μ F 15 vdcw	30769-01
1C115	CAPACITOR, 0.05 μ F 400 vdcw.	035-234

REPRODUCE AMPLIFIER ASSEMBLY cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
CR100	RECTIFIER, selenium, single phase, centre-tap, 26v ac rms max in, 1.26A dc max out. Standard Telephones Type 450 SD. N1 - 5.	581-001
CR101	RECTIFIER, silicon, SD94	000-232
CR102	RECTIFIER, silicon, SD94	000-232
1F1	FUSE, $\frac{1}{2}$ A, 250v, slow-blow. K Beswick Type MDL TDA 12.	070-026
1F2	FUSE, 3A, 250v, fast-blow. Belling & Lee Type L 1055	070-001
1J1 (master only)	CONNECTOR, socket, female, 6 contact, Cannon Electric Type S. 306 - AB.	146-004
1J1 (slave only)	CONNECTOR, socket, female, 6 contact. Cannon Electric Type P. 306 - AB.	147-011
1J3	CONNECTOR, socket, male, 3 contact, Hubbel Type 7486	147-079
1J4	CONNECTOR, socket, female, 8 contacts, chassis mounted. Cannon Electric Type 308. AB	147-003
1J5	CONNECTOR, socket, male, 3 contact. Cannon Electric Type MS 3102 A10 SL 3P	143-008
1J6	CONNECTOR, socket, male, 3 contact. Cannon Electric Type XZR - 3 - 14	147-004
2R25	RESISTOR, film, 330k Ω 2% $\frac{1}{2}$ W. Plessey Type A. T. Metallux	000-167
2R26	RESISTOR, film, 470k Ω 5% $\frac{1}{2}$ W. Plessey Type A. T. Metallux	000-168
2R27	RESISTOR, film, 330k Ω 2% $\frac{1}{2}$ W. Plessey Type A. T. Metallux	000-167

REPRODUCE AMPLIFIER ASSEMBLY cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
2R28	RESISTOR, film, 1.5k Ω 5% $\frac{1}{2}$ W. Plessey Type A. T. Metallux	000-230
2R29	RESISTOR, film, 10M Ω 1% $\frac{1}{2}$ W. Dubilier Type BTS	000-089
2R30	RESISTOR, variable, 500k Ω 30% $\frac{1}{4}$ W.	044-207
2R31	RESISTOR, variable, 500k Ω 30% $\frac{1}{4}$ W.	044-207
2R33	RESISTOR, film, 10M Ω 1% $\frac{1}{2}$ W. Dubilier Type BTS	000-089
2R34	RESISTOR, film, 220k Ω 10% $\frac{1}{2}$ W. Plessey Type A. T. Metallux	000-166
2R37	RESISTOR, composition, 1M Ω 10% $\frac{1}{2}$ W. Dubilier Type BTS	041-031
2R38	RESISTOR, carbon, 1.5 k Ω 10% $\frac{1}{2}$ W. Dubilier Type BTS	041-050
2R39	RESISTOR, composition, 1M Ω 10% $\frac{1}{2}$ W. Dubilier Type BTS.	041-031
2R40	RESISTOR, carbon, 82k Ω 10% $\frac{1}{2}$ W. Dubilier Type BTS.	041-071
2R41	RESISTOR, carbon. 1.5k Ω 10% $\frac{1}{2}$ W. Dubilier Type BTS.	041-050
2R42	RESISTOR, film, 220k Ω 10% $\frac{1}{2}$ W. Plessey Type A. T. Metallux	041-076
2R43	RESISTOR, film, 220k Ω 10% $\frac{1}{2}$ W. Plessey Type A. T. Metallux	041-076
2R44	RESISTOR, composition, 1M Ω 10% $\frac{1}{2}$ W. Dubilier Type BTS.	041-031
2R45	RESISTOR, composition, 1M Ω 10% $\frac{1}{2}$ W. Dubilier Type BTS.	041-031

REPRODUCE AMPLIFIER ASSEMBLY cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
2R46	RESISTOR, carbon, $1k\Omega$ 10% $\frac{1}{2}$ W. Dubilier Type BTS	041-048
2R49	RESISTOR, carbon, $39k\Omega$ 10% $\frac{1}{2}$ W. Dubilier Type BTS	041-067
2R75	RESISTOR, carbon, $680k\Omega$ 10% $\frac{1}{2}$ W. Dubilier Type BTS	041-082
1R150	RESISTOR, carbon, variable, $100k\Omega$ 20% $\frac{1}{4}$ W, Linear.	044-186
1R151	RESISTOR, carbon, variable, $500k\Omega$ $\frac{1}{4}$ W, Linear.	044-097
1R152	RESISTOR, carbon, $3.9M\Omega$ 1% $\frac{1}{2}$ W. Radio Resistors Type HS. 3	042-142
1R153	RESISTOR, 1.5Ω 1W 10% W. W. Painton MV1	043-286
1R154	RESISTOR, carbon, $1k\Omega$ 10% $\frac{1}{2}$ W. Dubilier Type BTS.	041-048
1R155	RESISTOR, $22k\Omega$ 5% $\frac{1}{2}$ W. Dubilier Type BTT	041-016
1R156	RESISTOR, $27k\Omega$ 10% $\frac{1}{2}$ W. Dubilier Type BTT	041-065
1R157	RESISTOR, carbon, $39k\Omega$ 10% $\frac{1}{2}$ W. Dubilier Type BTS.	041-067
1R158	RESISTOR, carbon, variable, $250k\Omega$ 10% 2W	044-128
1R159	RESISTOR, $5k\Omega$ 5% 3W. Painton Type P306	000-228
1R160	RESISTOR, $22k\Omega$ 5% $\frac{1}{2}$ W. Dubilier Type BTT	041-016
T1	TRANSFORMER, power.	30765-01
T2	TRANSFORMER, output.	30764-01
1V1	VALVE, full wave rectifier, 6X4, Brimar	012-050

REPRODUCE AMPLIFIER ASSEMBLY cont'd.

Schematic Reference No.	Part Description	Ampex Part No.
2V3	VALVE, double triode, ECC83, Mullard.	012-069
2V4	VALVE, double triode, 12 AU7, Brimar	012-023
2V5	VALVE, double triode, 12 AT7, Brimar	012-122
	BOARD ASSEMBLY complete with valves	500118-01
	POST, fuse (F1 & F2)	085-001

ACCESSORIES

Schematic Reference No.	Part Description	Ampex Part No.
	CABINET, console	500021-10
	CABLE ASSEMBLY, power	500069-10
	CABLE ASSEMBLY, power extension	3768-01
	CABLE ASSEMBLY, stereo interconnecting.	500237-10
	COVER, electronics assembly (console model)	5520-00
	COVER, electronics assembly (rack model)	17206-01
	REEL ADAPTOR, NAB hub	976-00
	KNOB, editing (console)	1917-00
	KNOB, holddown, reel for rack mounted equipment	9093-00
	CONTROL PANEL ASSEMBLY	500139-10
	LIGHT, neon indicator.	500272-10
	SWITCH, on/off, single pole, single throw.	000-225

REMOTE CONTROL UNIT - Catalogue Number 31022 - 10 or 20

Schematic Reference No.	Part Description	Ampex Part No.
	CABLE REMOTE CONTROL	5795-00
	CONNECTOR, plug, male, 10 contacts	147-014
	ESCUTCHEON, Stop, Start, Rewind, Fast Forward.	361-00
	ESCUTCHEON, Record.	463-00
	FEET, tapered, rubber.	250-012
	LAMP, 120v, 6W.	060-006
	NUT, 6 - 32 KEP	496-002
	PILOT LIGHT ASSEMBLY, Green, Tape Motion Indicator.	132-007
	PILOT LIGHT ASSEMBLY, Red, Record, Indicator	132-006
	SCREW, 4 - 40 SEM x $\frac{1}{4}$ inch long	475-001
	SCREW, 6 - 32 x 7/16 inch	471-388
	SWITCH FAST FORWARD, pushbutton, single pole, Single throw, normally open. Arrow Type H & H 3391 - EPA - 13.	120-013
	SWITCH RECORD, pushbutton, double pole, single throw, normally open.	120-063
	SWITCH REWIND pushbutton, single pole, single throw, normally closed. Arrow Type H & H 3391 - BSA - 13.	120-014
	SWITCH START, pushbutton, single pole, single throw, normally open. Arrow Type H & H 3391 - EPA - 13.	120-013
	SWITCH STOP, pushbutton, single pole, single throw, normally open. Arrow Type H & H 3391 - EPA - 13.	120-013