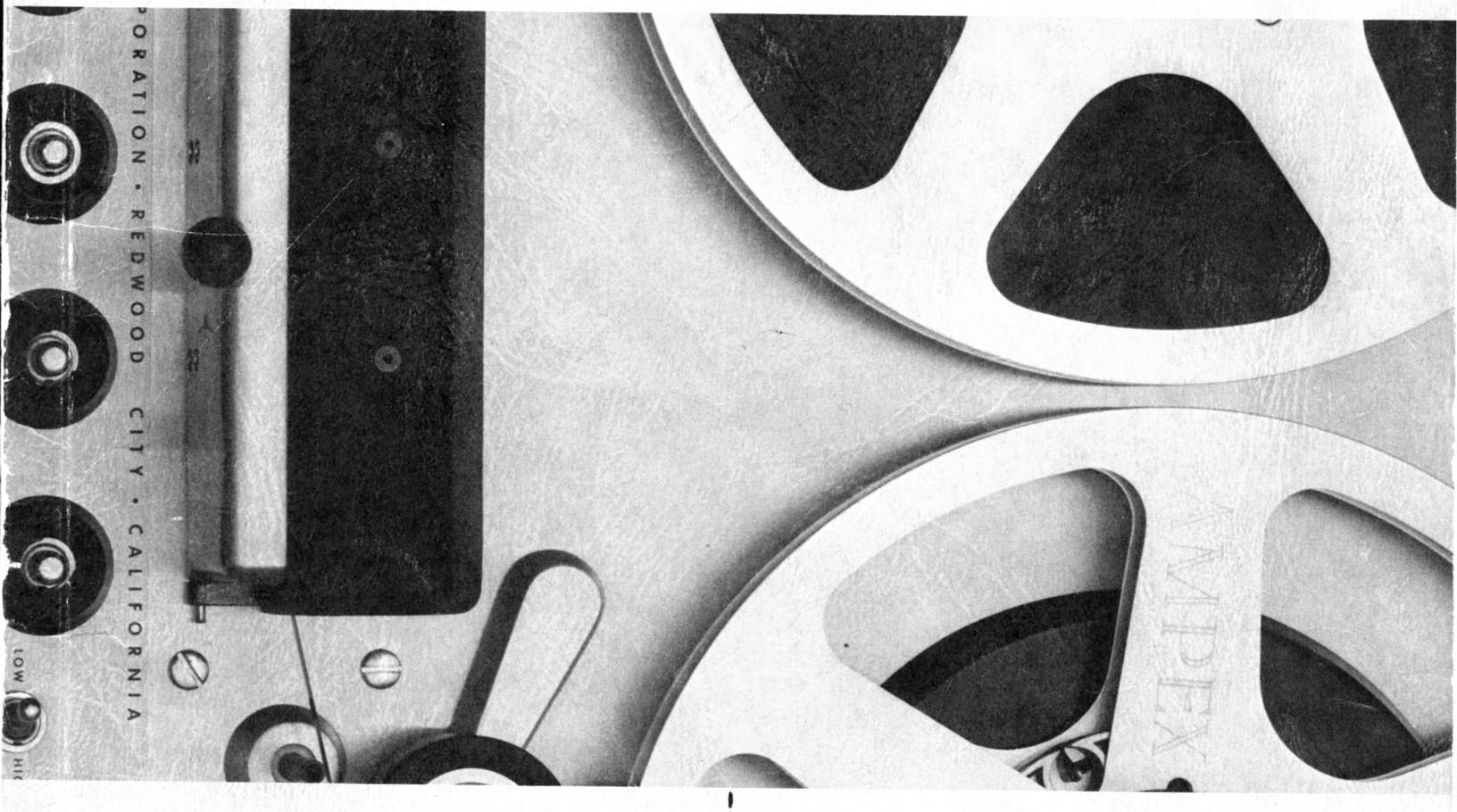
TM 2004

AMPEX SERIES

352

MAGNETIC TAPE REPRODUCER



352
MONAURAL
REPRODUCER

352-2 TWO CHANNEL
STEREOPHONIC
REPRODUCER

AMPEX SERIES 352 MAGNETIC TAPE REPRODUCER

352 monaural reproducer

352-2 two channel stereophonic reproducer

november 1959

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SECTION 1

DESCRIPTION AND PERFORMANCE CHARACTERISTICS

GENERAL

The Ampex Series 352 and 352-2 Tape Reproducers are versions of the Model 350 equipment, featuring monaural (full track or half-track) or 2-channel stereophonic reproduction from pre-recorded ¼-inch magnetic tape. A tape speed pair of 7½ and 15 inches per second (ips) is standard with all Model 352 and 352-2 equipment. (Models operating at tape speeds of 3¾ and 7½ inches per second may be obtained on special order.) This equipment is furnished in either console or rack mounted styles for the monaural machines; stereophonic equipment is provided only in the rack mounted version. Customers supply racks for mounting. In the console model, the tape transport mechanism, reproduce amplifier, power panel, and cabinet are shipped as individual items with all hardware for assembly included.

Reproduce head configurations include full track, half-track or two-track stereophonic assemblies. For further information on magnetic heads refer to Section 6.

Complete monaural equipment comprises a tape transport mechanism, a reproduce amplifier, and a power panel. Stereophonic reproducers have an additional reproduce amplifier.

PERFORMANCE CHARACTERISTICS

Tape Speeds

7½ and 15 inches per second (ips).

Speed (ips)	*Response*
7½	± 2 db 40 to 10,000 cps
	± 4 db 30 to 15,000 cps
15	± 2 db 30 to 15,000 cps

Signal-to-Noise Ratio

At either tape speed (7½ or 15 ips):

60 db for full track reproducer.
55 db for half-track or stereophonic reproducer.

This figure is referenced to a signal recorded at a nominal 3% rms distortion level. These levels may be determined by a professional quality Ampex alignment tape.

Flutter and Wow

Speed (ips)	*Flutter and Wow (percentage rms)*
7½	0.20%
15	0.15%

The flutter and wow measurements include all components between 0 and 300 cycles, using a meter calibrated to read the rms value of constant amplitude sine wave flutter.

Output Level

Plus 4 vu output into 600 ohms, balanced or unbalanced, from tapes recorded at normal level (point of approximately 1% distortion).

Reproducing Time (with NAB 10½ inch reels -2400 feet of tape),

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

Starting Time

The tape is accelerated to full speed in less than 1/10 second.

Reproduce Timing Accuracy

± 0.2% or 3.6 seconds in thirty-minute recording.

Rewind Time

Approximately one minute for a full 2,400 foot NAB reel.

Controls

Tape motion is controlled by four pushbuttons: PLAY, STOP, FAST FORWARD, and REWIND. The tape speed is changed by a TAPE SPEED SWITCH. A REEL SIZE SWITCH provides proper tape tension for either the NAB 10½ inch reel or the smaller EIA 5 inch and 7 inch reels.

Head

Full track, half-track or two channel stereophonic configuration.

Power Requirements

2.0 amperes at 117 volts, 50 or 60 cycles single channel equipment. 2.5 amperes at 117 volts, 50 or 60 cycles for two channel equipment. When the Ampex Model 375 Precision Frequency 60 cycle amplifier is used with the equipment, power requirements are greater by 2.5 amperes; single channel equipment will then total 4.5 amperes and two channel 5.0 amperes.

Dimensions and Weight

Rack Mount

(Standard 19 inch wide panel with commercial notching.)

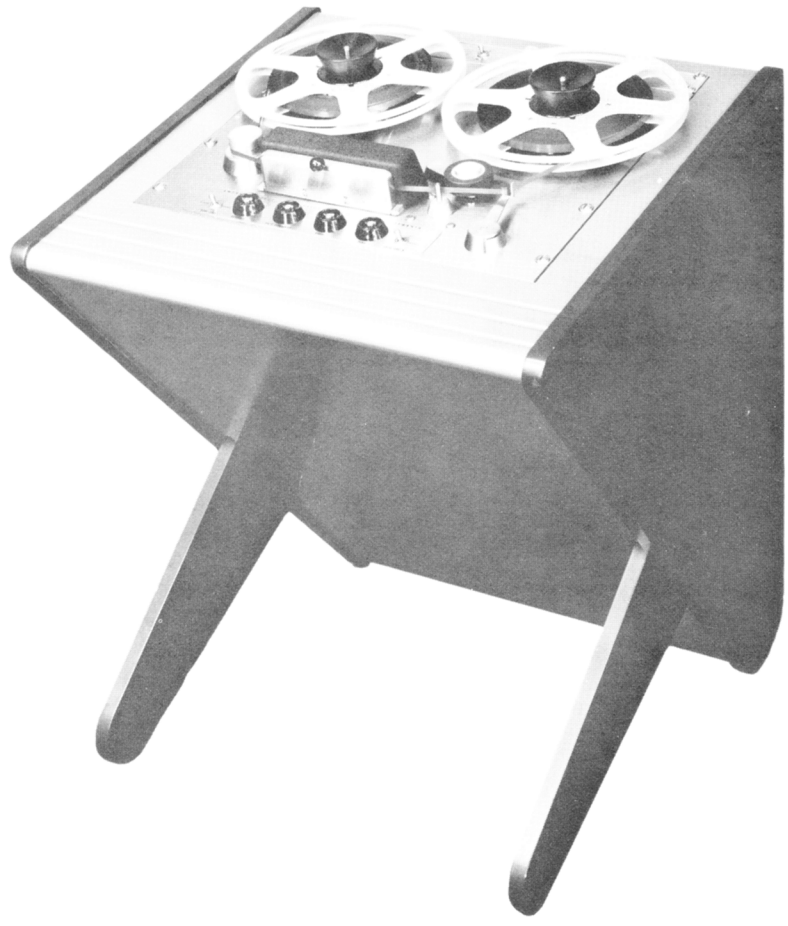
Tape Transport—15¾ inches of rack space, 50 pounds.

Reproduce Amplifier (each)—5¼ inches of rack space, 14 pounds.

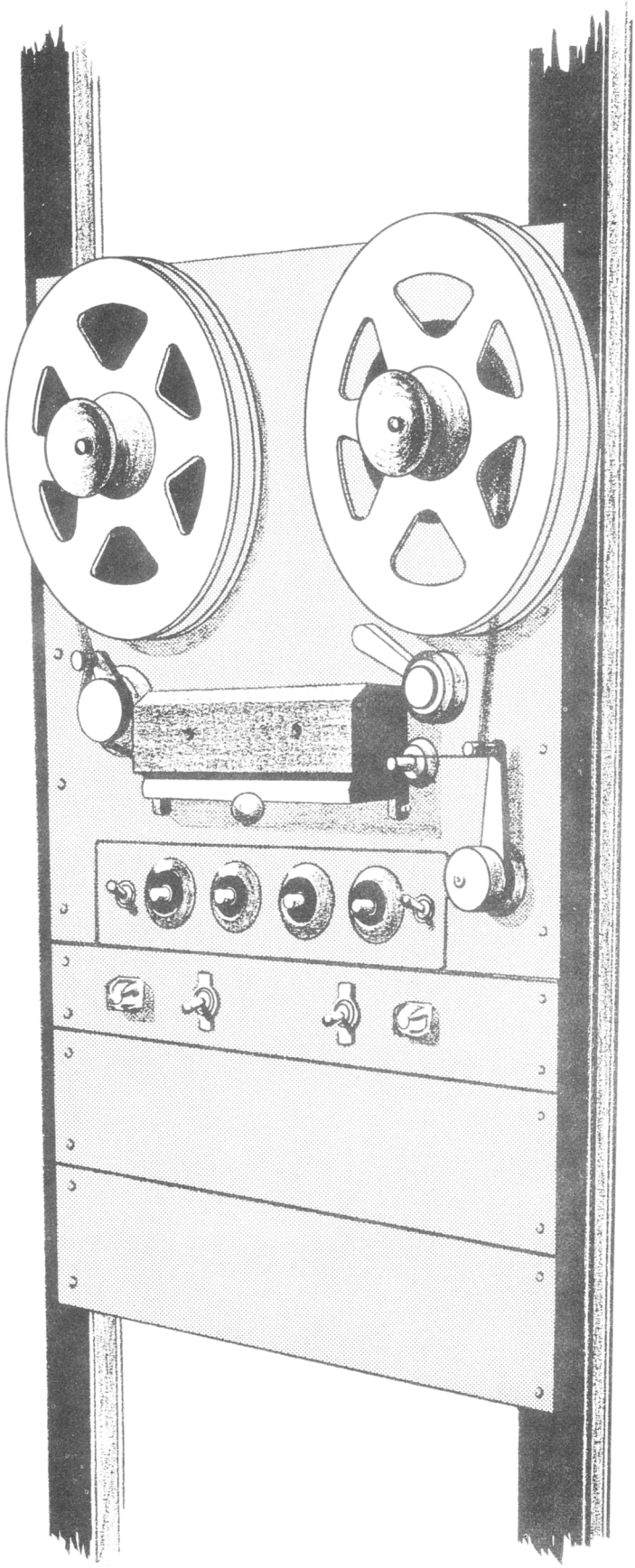
Power Panel—1¾ inches of rack space, 1 pound.

Console

Height:	35 inches
Depth:	24½ inches
Width:	24½ inches
Weight:	109 pounds (44 pounds empty)



Console model 352 reproducer



Suggested rack layout

INSTALLATION

MOUNTING

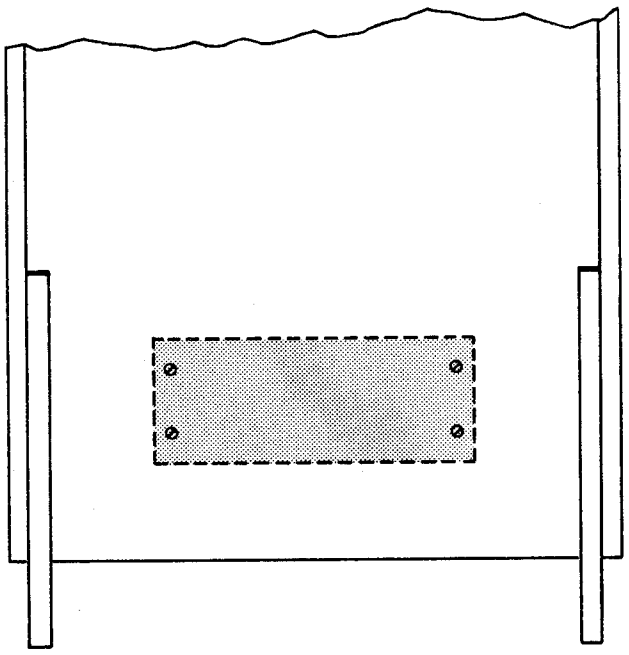
Console models are shipped with the cabinet, tape transport, power panel, and reproduce amplifier packed individually. All hardware and cables needed to install this equipment in the cabinet have been included. The back of the cabinet is open to provide easy access to the chassis connectors on the electronic chassis when assembly is complete.

The following steps denote the mounting procedures:

Step 1: Install the tape transport in the cabinet frame, securing it with eight of the 12-24 x 1¼ oval head screws and washers.

Step 2: Remove the back panel of the cabinet.

Step 3: Install the electronic assembly using four of the 12-24 x 1¼ oval head screws and secure it to the cabinet. A cover panel (Catalog number 5520-02 for Console and 17206-01 for Rack Mounted) is installed simultaneously with the electronic assembly, utilizing the same screws.



Mounting of reproduce amplifier

NOTE

Holes for mounting the electronic chassis to the cabinet are predrilled before shipping.

Step 4: After the interconnecting procedure (See Installation of Cable Assemblies) replace the back panel of the cabinet so that all external cables run freely through the semi-circular cuts in the lower edge.

Rack mount models will fit standard 19-inch relay racks. The units should be mounted in the following order, from top to bottom: tape transport mechanism, power panel, and reproduce amplifiers.

CAUTION

THE BACK OF THE CONSOLE CABINET SHOULD BE PLACED AT LEAST 4 INCHES FROM THE WALL TO PERMIT PROPER VENTILATION.

RACK MOUNTED MODELS

Mount these versions of the equipment on a standard 19-inch relay rack with the mechanical assemblies above the reproduce amplifiers.

INSTALLATION OF CABLE ASSEMBLIES

Single Track Equipment

Step 1: Plug the free end of the captive cable (P201P) from the control strip into J105S of the Reproduce Amplifier Assembly.

Step 2: Plug the free end of the captive cable (P507P) from the tape Transport into J104S on the Reproduce Amplifier Assembly.

Step 3: The captive cable from the reproduce head must be plugged into J101P of the Reproduce Amplifier Assembly.

Step 4: The output connector should be plugged into J102P on the electronic assembly.

Step 5: Plug the female end of the ac power cable into J103P (AC POWER IN) and connect the male end to a 117 volt ac source.

Stereophonic Equipment

Step 1: Plug the female two pin ac connector (P302S) located on the free end of the captive cable from the control panel into J103P of Channel 2 Reproduce Amplifier.

Step 2: Connect the four pin plug (P301P) located on the captive cable from the control panel to J105S Channel 1.

Step 3: Dummy 30867-00 is plugged into J105S on Channel 2.

Step 4: Plug the free end of the captive cable (P507P) from the Tape Transport into J104S on Channel 1 Reproduce Amplifier.

Step 5: Connect the reproduce head cable marked Track 1 or with red tape, into J101P (PLAYBACK HEAD INPUT) of Channel 1 amplifier.

Step 6: Cable marked Track 2 is connected to J101P of Channel 2 amplifier. J102P of Channel 1 provides output for half-track or left channel in stereophonic operation. J102P of Channel 2 provides right channel in stereophonic operation.

NOTE

The eight-contact receptacle (J106S), located on the Reproduce Amplifier, is not utilized in this equipment.

NOTE

This equipment is designed for either 50 cycles per second (CPS) or 60 cycles per second power line frequency. Power line frequency is indicated on the serial number plate located on the rear of the console models, and on the amplifier chassis in rack mounted models.

CAUTION

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

OUTPUT CONNECTIONS

Studio Line. — A +4 vu, 600-ohm output, balanced or unbalanced, is available across pins 2 and 3 of output connector J102P. 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 600-ohm load across the output.

High Impedence Input. — Connect pin 3 of output connector J102P 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 600-ohm termination must be connected from pin 3 to pins 1 and 2.

REMOTE CONTROL (ACCESSORY EQUIPMENT)

The operation of the tape transport mechanism can be controlled at a location removed from the equipment proper, through a remote control unit (Ampex Catalog Number 5763-00 or 5763-01). The Catalog Number 5763-00 unit is supplied in a wooden case, and is completely wired, ready to plug into remote control connector J502S on the front of the control circuit box. The Calalog Number 5763-01 unit is mounted on a flat plate for installation in studio consoles. To install, plug into receptacle J502S. Note that no speed change facilities are included in the remote control unit.

NOTE

A dummy plug, (P502P) supplied with the equipment, must be plugged into J502S, whenever a remote control unit is not connected. Do not remove dummy plug P503S, supplied with the equipment, unless one of these units is to be connected.

60 CYCLE AMPLIFIER (ACCESSORY EQUIPMENT)

Provision has been made for plug-in of Ampex Model 375, 60-cps Amplifier. This unit can be plugged into J503S on the front of the control circuit box. No other connections are necessary. *If either of these systems is used, tape transport fuse F101 must be increased to 5 amperes.*

CHARACTERISTICS OF STANDARD CURVES

The reproduce amplifier responses are factory-adjusted to the standard 50 micro-second curve shown at the back of the manual. In addition, for stereophonic operation the output levels are set to the same value on both amplifiers. For best results, the tapes reproduced on this equipment will be recorded at the operating level determined by AMPEX Alignment tape, with characteristics that will produce a flat overall response when the reproduce response is adjusted to the standard curve. (The Ampex recommended recording level can be determined on this equipment by playing an Ampex Alignment Tape. See Section 6. All Ampex Professional Audio recorders will produce the desired record characteristics.)

OVERALL PERFORMANCE CHECK

NOTE

Operating instructions necessary in making the performance checks are included in Section 3.

The following procedures are recommended

for checking the performance of the equipment at the time of installation.

Frequency Response

Thread an Ampex Alignment Tape (Catalog Number 31321-01 for 7½ inches per second equipment or Catalog Number 31311-01 for 15 inches per second equipment) on the tape transport. Connect a 600-ohm termination, a vtvm, and a high impedance aural monitoring device (speaker or headphone) across the output (J102P) and press the PLAY button (S505). The frequency response check-tones on the Standard Alignment Tape, are all preceeded by a voice announcement. The 7½ ips tape has been recorded 10 db below operating level, while the 15 ips tape has been recorded at the operating level of 0 vu .

Noise Measurement

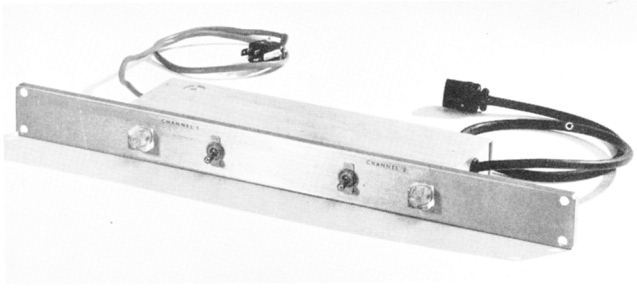
Wide band noise is measured with a vtvm (see illustration) while reproducing a blank tape. If the gain has been adjusted with an Ampex Alignment Tape (See Section 6), the noise will be -45 dbm (.0043 volts) or less for half-track operation and -50 dbm (.0024 volts) or less for full track or stereophonic operation.

Distortion

Overall distortion can be measured by connecting any standard distortion-measuring apparatus across the output. The readings from a wave analyzer or selective frequency distortion meter will be more accurate than those from a null-type instrument at low distortion levels. Distortion readings are dependent on the tape being used. A reading of 1% is normal at operating level.

Flutter and Wow

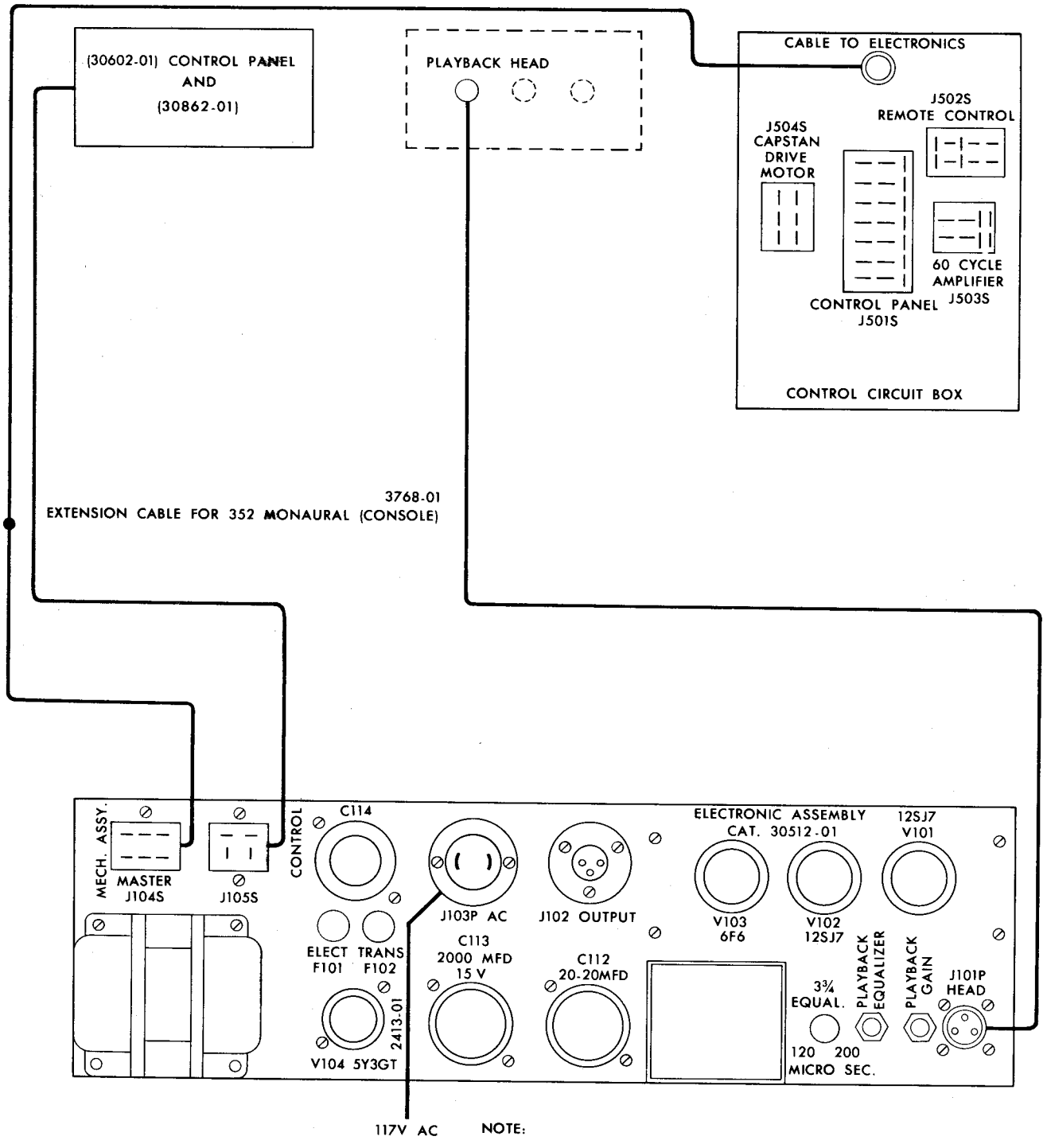
Flutter and wow are produced by periodic irregularities in tape speed, and appear as cyclic frequency deviations in reproduction. They can be measured by means of any standard flutter bridge. To measure flutter, record a 3,000 cycle signal at the desired speed on a reliable tape recorder. Connect any standard flutter meter to the output of the machine to be tested and play this recorded signal back. The flutter readings will be less than 0.2% for 7½ inches per second (ips) tape speed, and under 0.15% at 15 inches per second (ips) tape speed.



Power panel, two channel

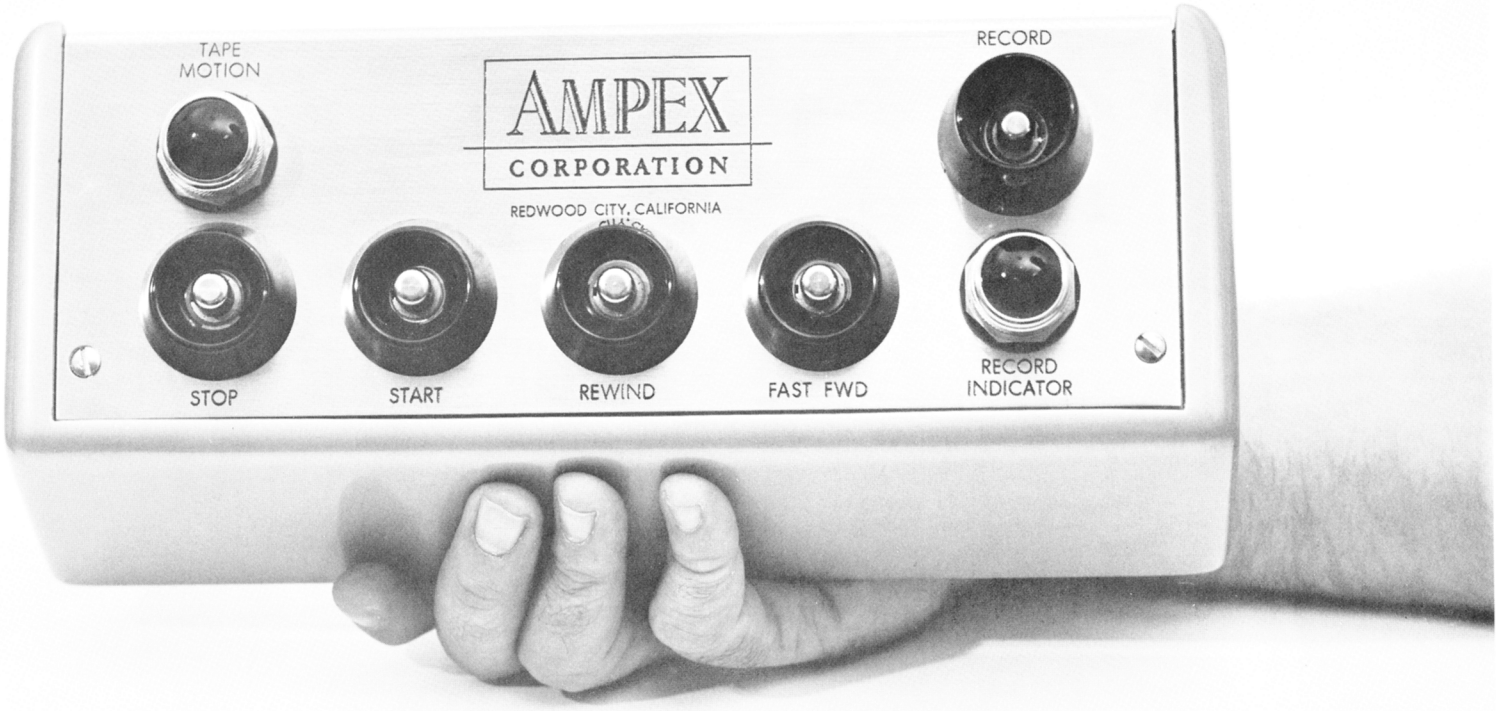
Power panel, single channel

INTERCONNECTING



NOTE:

1. FOR MONAURAL RACK INSTALLATION EXISTING CABLE FROM CONTROL CIRCUIT BOX (CABLE TO ELECTRONICS) CONNECTS DIRECTLY TO THE MECH. ASS'Y. (J104S) PLUG.
2. ON MODEL 352-2, CONNECT TAPE TRANSPORT TO J104S ON CHANNEL 1 ELECTRONICS. INSTALL DUMMY PLUG NO. 30867 IN J105S ON CHANNEL 2
3. CONSOLE MOUNTED MACHINES REQUIRE EXTENSION CABLES (CATALOG NUMBER 3768-01) CONNECTED TO THE CAPTIVE CABLE FROM TAPE TRANSPORT.



Remote control unit

OPERATING PROCEDURE

REEL SIZE AND REEL KNOBS

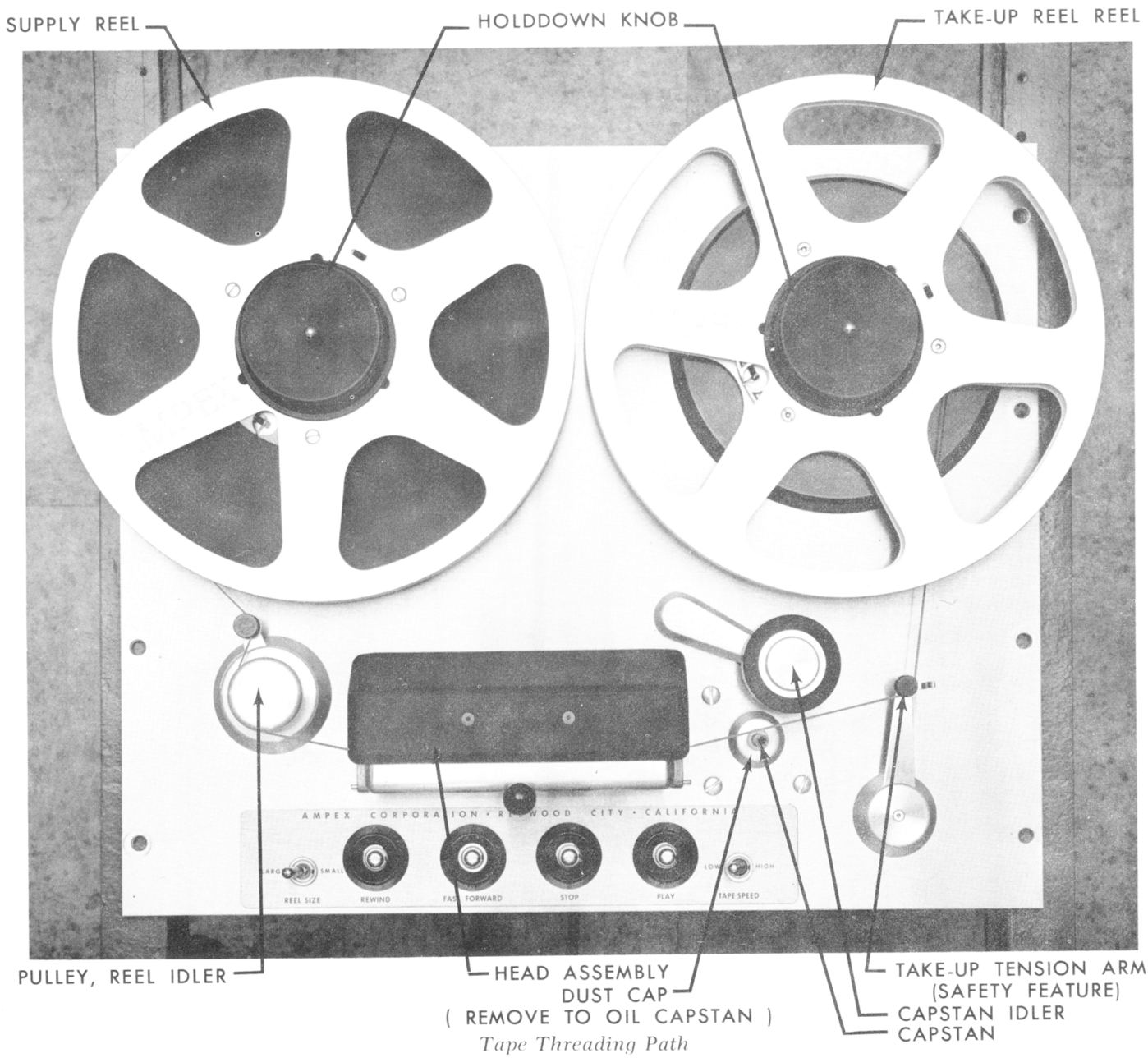
The reproducer is equipped to handle either the NAB 10½ inch reel of tape or the smaller EIA 5 inch and 7 inch reel sizes. REEL SIZE switch (S504) changes tape tension appropriately for the reel size used. To use large 10½ inch reels on console models, editing knobs (Catalog Number 1917-00) have been provided. Rack mounted equipment is supplied with holddown knobs (Catalog Number 9093-00) for 10½ inch reels. On all models, EIA reels (5 inch or 7 inch) are positioned on the turntables, so that the reels engage the turntable pins and holddown knobs (Catalog Number 30971-01) are provided with each machine to hold these reels in place.

TAPE THREADING

NOTE

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

Thread the tape along the path indicated in the Tape Threading Path illustration. *Do Not* loop the tape to the hub in such manner



Tape Threading Path

that it will not come free of the reel at the end. This would prevent safety switch S501 from causing the capstan idler to disengage from the capstan, and might result in a flat being worn on the capstan idler wheel. (Any adhesive material accumulated 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.)

POWER

On monaural models, power is supplied through power switch S201 on the control strip, which must be turned on to operate the electronic and mechanical assemblies.

On stereophonic models the power switch S301 on the power panel turns on the Tape Transport and Channel No. 1 Reproduce Amplifier only. Switch S302 on the power panel turns on Channel No. 2 Reproduce Amplifier only. Both power switches must be in the on position for stereophonic operation. The mechanical assembly and electronic assembly are individually fused by the 3 ampere fuse (F101)

in the tape transport and the 1 ampere fuse (F102) in the electronic assembly.

SPEED SWITCH

The Tape Speed switch S502 determines the speed of the Capstan Drive Motor and thus the tape speed.

TAPE MOTION

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

PLAY: The tape is set into motion at the speed selected by the TAPE SPEED switch when PLAY button S505 is pressed. *The tape must be completely stopped before instituting this mode.* The PLAYBACK GAIN adjustments are factory-set to give a +4 vu output from tapes recorded at the AMPEX-recommended operating level (approximately 1% distortion point).

FAST FORWARD: The equipment can be started in fast forward, or switched to fast forward from any of the operating modes, by pressing FAST FORWARD button S505.

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

NOTE

In using either FAST FORWARD or REWIND mode, it is desirable to remove the tape from direct contact with the head by opening the head housing gate. This will reduce wear on the head and prevent the oxide coating on the tape from depositing on the head and impairing its performance.

STOP: To stop the tape while it is moving in any mode, press the STOP button S502. (The equipment will stop automatically if the tape should break or run off either reel.)

HALF TRACK OPERATION

Half-track pre-recorded tapes may be reproduced on those models equipped with half-track heads in the following manner: The tape is threaded and the equipment operated 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. Again thread the tape and operate the equipment as noted.

When using stereophonic equipment (for reproducing half-track or full track pre-recorded tapes) disconnect or otherwise disable the output of the lower Reproduce Amplifier. The machine is then operated as described above.

FULL TRACK OR STEREOPHONIC OPERATION

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

EDITING AND CUEING TECHNIQUE

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 should be held down until the other buttons are released.

CAUTION

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

REMOTE CONTROL

For remote operation, remove dummy plug P502P from receptacle J502S and connect the remote control unit (See TAPE TRANSPORT MECHANISM-REMOTE CONTROL).

SUMMARY OF CONTROLS AND SWITCHES

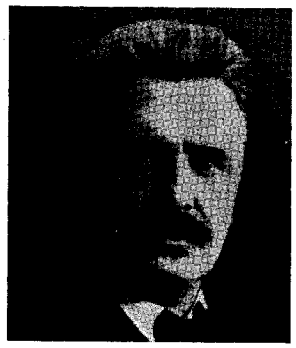
Item	*Schematic Reference Symbol*	*Location*	*Function*
TAPE SPEED	S503	Tape transport control cluster	Determines speed of the capstan drive motor by selecting high or low speed winding.
Real Size Large-Small Switch	S504	Tape Transport	Adjusts tape tensioning circuitry for the reel size used. The switch is closed when (LARGE position) NAB 10½ inch reels are used. In the SMALL position the switch is open, connecting resistance R502 in series with the torque motors, thereby reducing holdback and takeup tension.
Power On-Off Switch	Monaural	Power Panel	Supplies AC power to the Tape Transport and Reproduce Amplifier (indicated by a neon light).
Power On-Off 2 Switches	Stereophonic	Power Panel	Supplies AC power to the Tape Transport and to each Reproduce Amplifiers (indicated by two neon lights).
Play Button	S505	Tape Transport Control Cluster	Controls tape motion in the reproduce (PLAY) modes. Interlocked with rewind and fast forward modes.
Rewind Button	S507	Tape Transport Control Cluster	Controls the rewind relay. Connects full AC power to the rewind (supply) motor and places resistor R504 in the AC circuit to the takeup motor when this button is pressed.
Fast Forward Button	S506	Tape Transport Control Cluster	Controls the fast forward relay. Connects full AC power to the takeup motor and places resistor R504 in the AC circuit to the rewind motor when this button is pressed.
Stop Button	S502	Tape Transport Control Cluster	When this button is pressed, the brake solenoids and all relays are de-energized.

THE DEVELOPMENT AND THEORY OF MAGNETIC TAPE RECORDING

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

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

Valdemar Poulsen

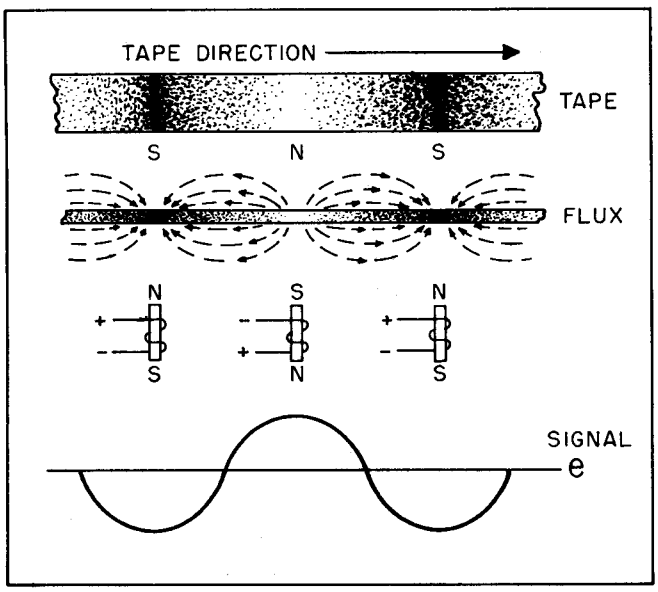


To understand completely the uses and operating techniques of your Ampex Series 300 Tape Transport, the basic theory of Magnetic Tape Recording should be emphasized at this time . . .

THEORY OF MAGNETIC TAPE RECORDING

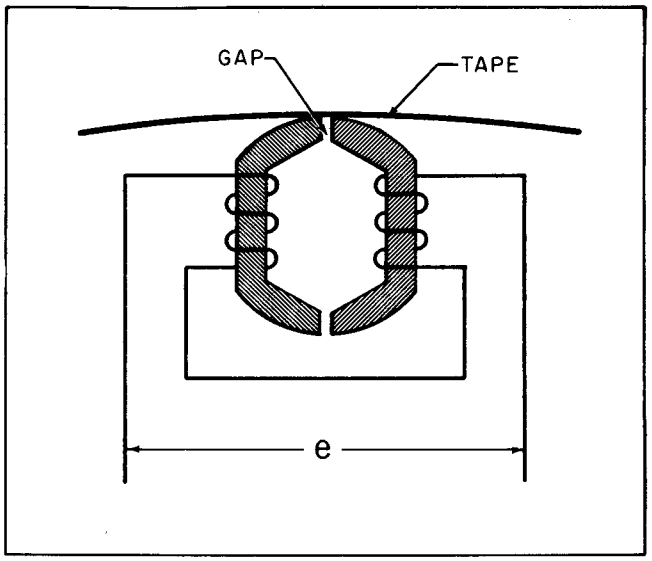
If a material capable of being magnetized is placed in the proximity of a magnetic field the molecules of that material will be oriented according to the direction of the field. Any of several methods may be used to produce a magnetic field, but of most interest in magnetic recording is the field produced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

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



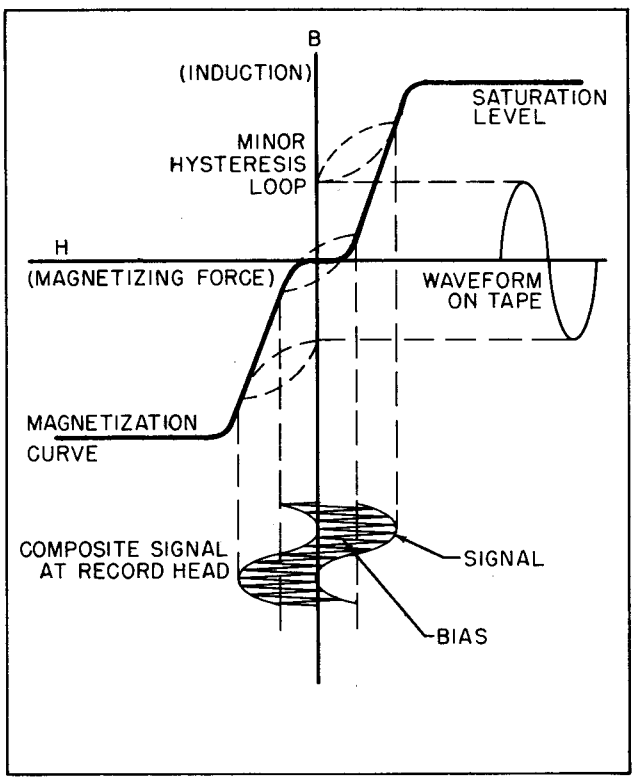
Magnetization of Tape

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



Record Head

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



Recording medium magnetization curve

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

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

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

Where

E=induced voltage

N=number of turns of wire

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

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

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

Where

E=induced voltage

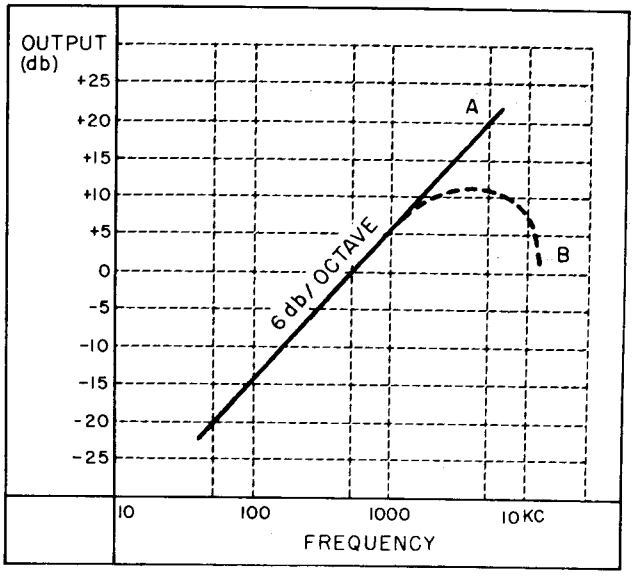
B_M=maximum flux density of the recording material

V=velocity of tape over the head

ω=width of the gap

λ=wavelength of the signal on the tape

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



Reproduce head characteristics

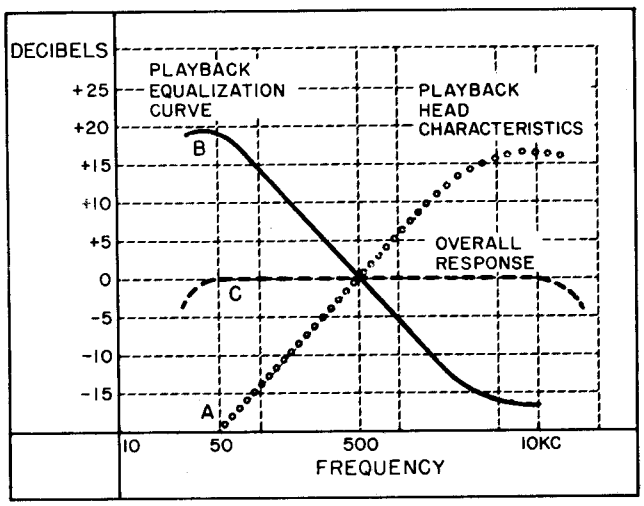
The voltage does not continue to rise indefinitely. As electrical losses in the core material increase and as the wavelength on the tape approaches the same dimensions as the reproduce head gap, the actual output resembles curve B in the same figure.

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

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

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

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



Achieving flat overall response

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

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

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

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

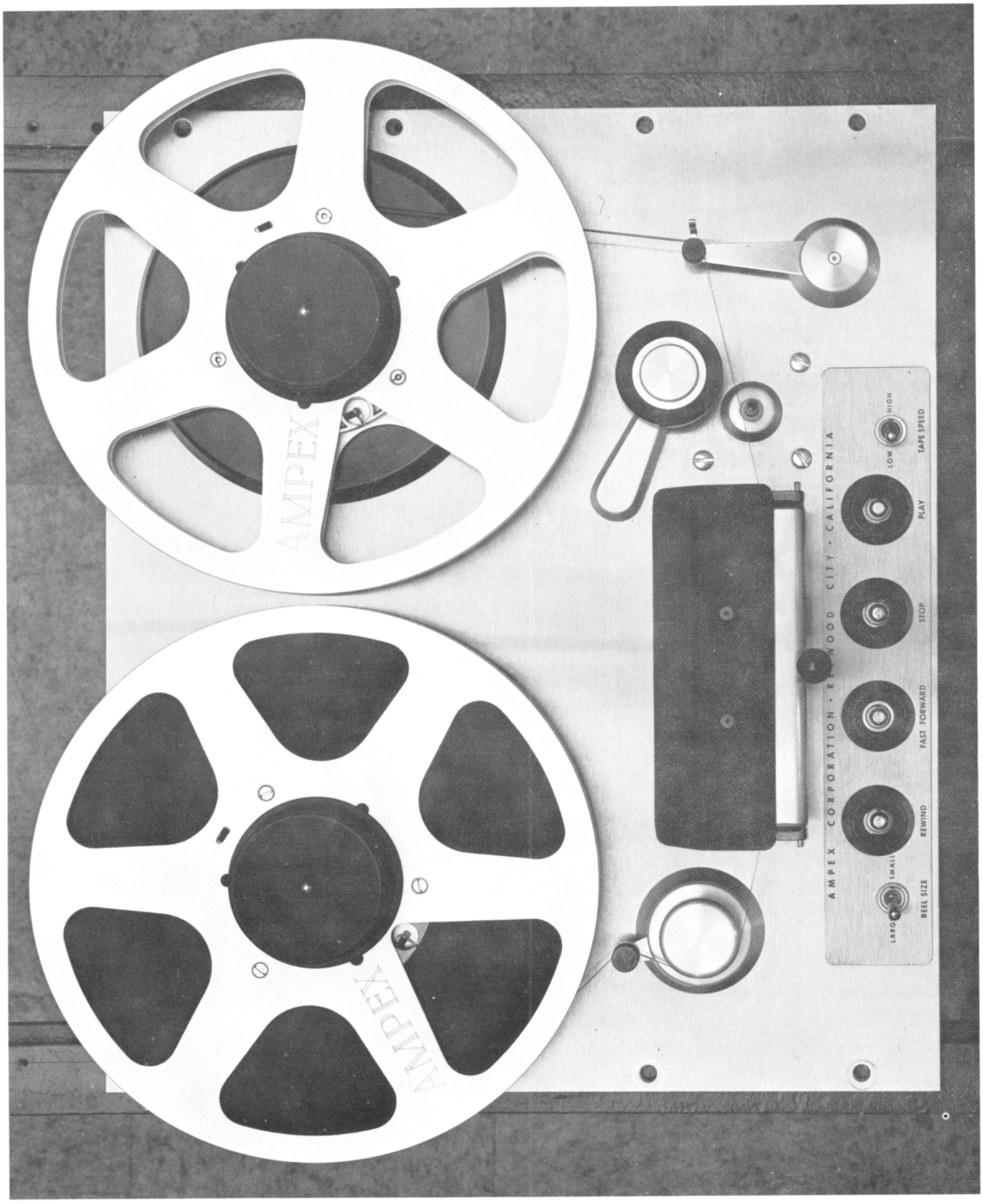
either outside the pass band of the system (so the drop in output following the point of resonance will not adversely effect the frequency response) or so placed at the extreme upper limit so that the increased output at the moment of resonance actually provides an extended response. When good engineering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

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

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

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

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



Tape transport mechanism

TAPE TRANSPORT MECHANISM

GENERAL

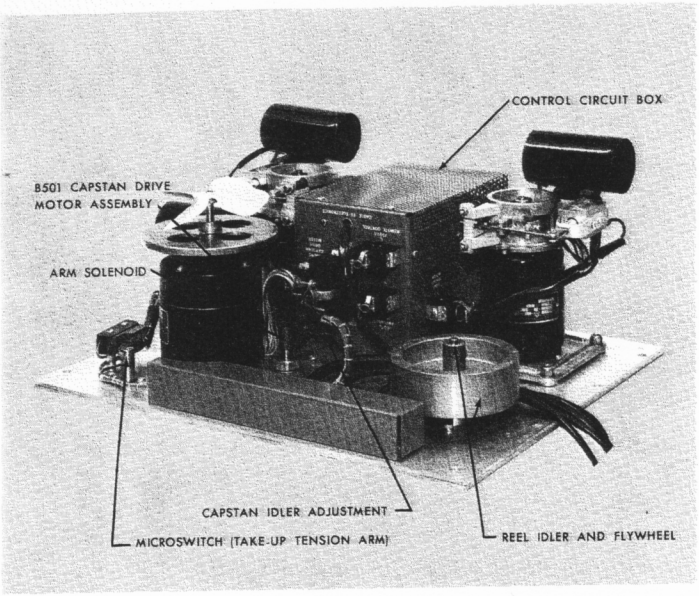
The tape transport mechanism provides tape motion for all modes of operation. Interaction of four basic assemblies and their associated components—the tape supply system, the tape take-up system, the tape drive system, and the control circuit—insures smooth, positive movement of the tape across the head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

TAPE SUPPLY AND TAKE-UP SYSTEMS

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

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

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



Component and assembly callouts

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

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

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

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

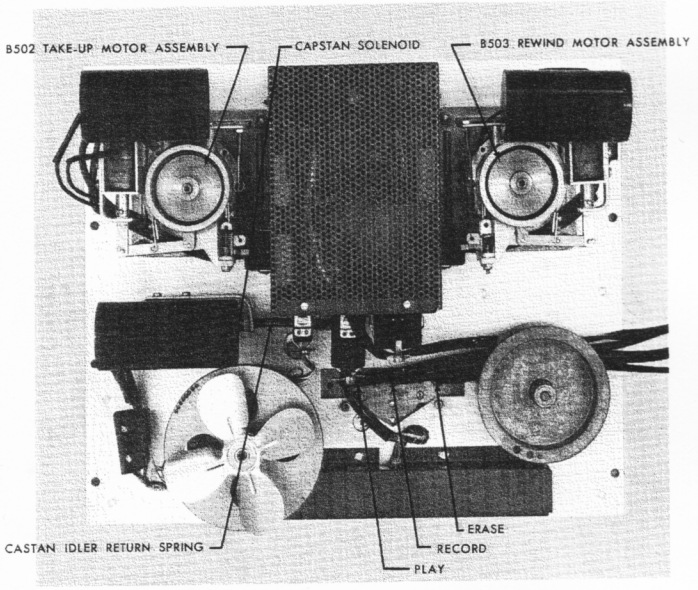
Motor torque in the reproduce mode is adjusted to equality by the tensioning adjustment resistors (R503 TAKE-UP and R503 HOLD-BACK) in series with each motor. In the fast forward mode, the torque of the supply (rewind) motor is reduced considerably by the introduction of a series resistance (R504). In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

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

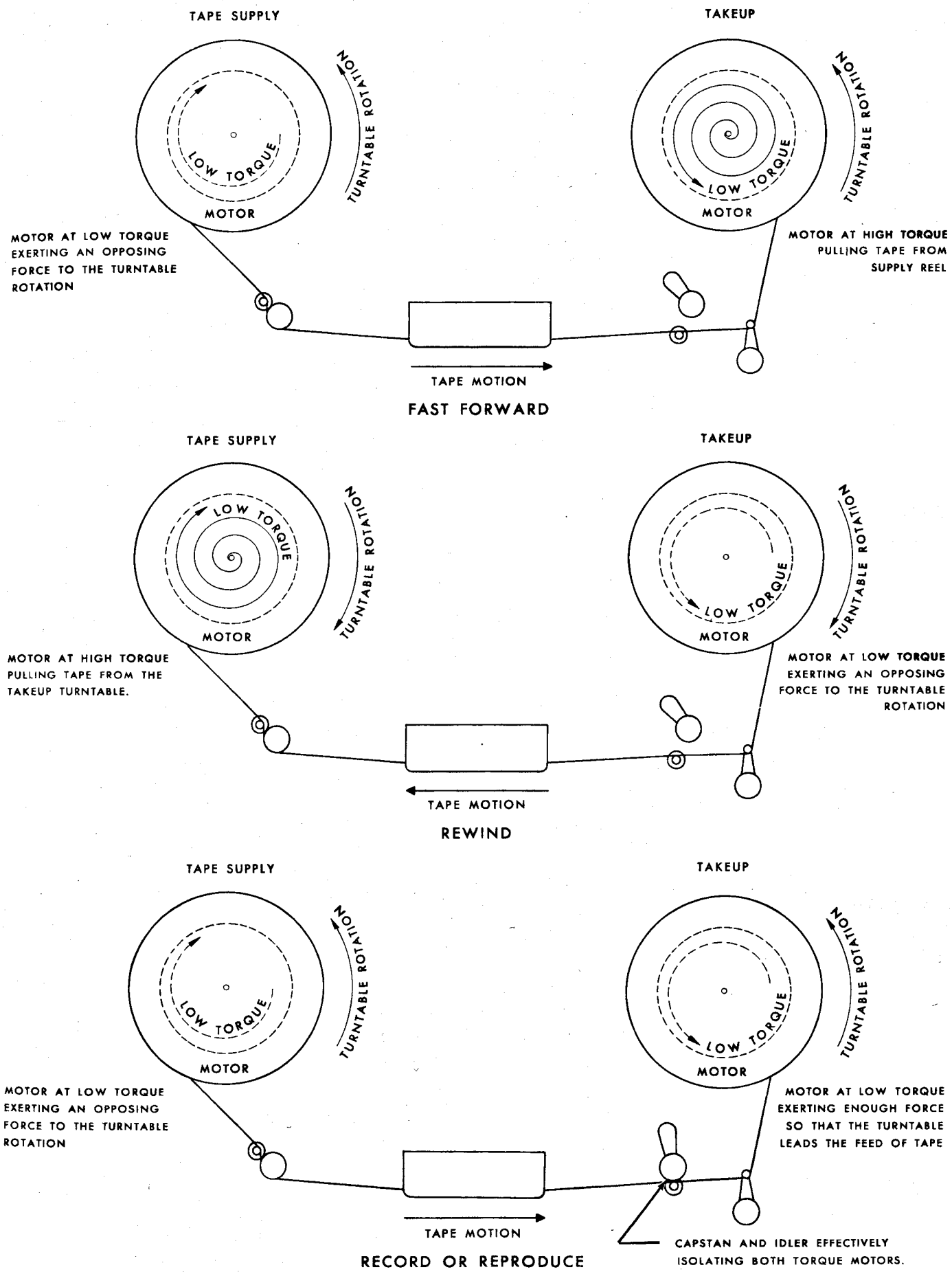
In the rewind mode, the supply motor operates at full torque and the take-up motor holds the tape under continuous tension by its opposite and reduced torque.

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

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



Component and assembly callouts



Tape tensioning

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

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

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

TAPE DRIVE SYSTEM

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

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

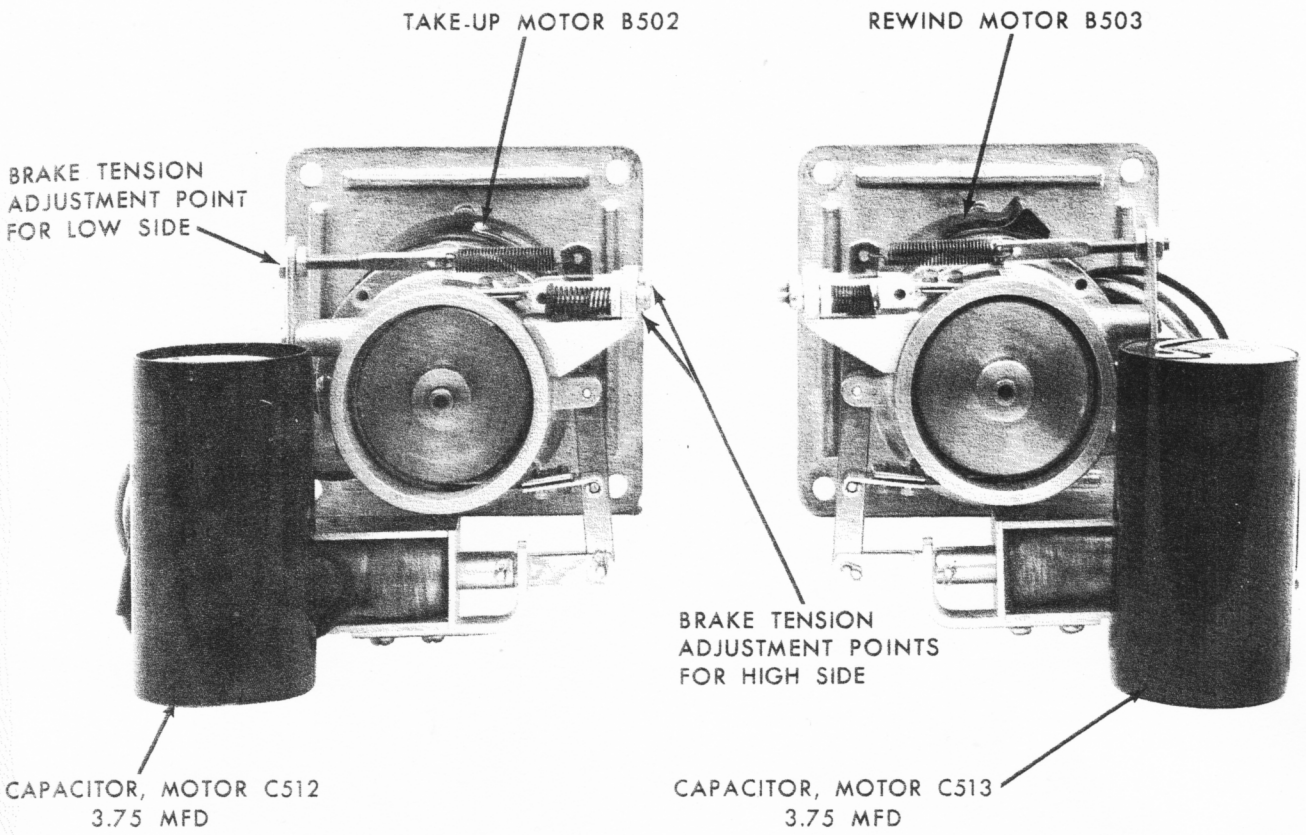
After the POWER switch at the electronic assembly has been placed in the ON position and the tape is threaded actuating the safety switch, the drive motor operates continuously, its capstan awaiting the PLAY command. When the PLAY button is pressed, the capstan solenoid (K501) and the brake solenoids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

BRAKE OPERATION

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

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

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



Take-up and rewind motor assemblies

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

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

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

CONTROL CIRCUIT

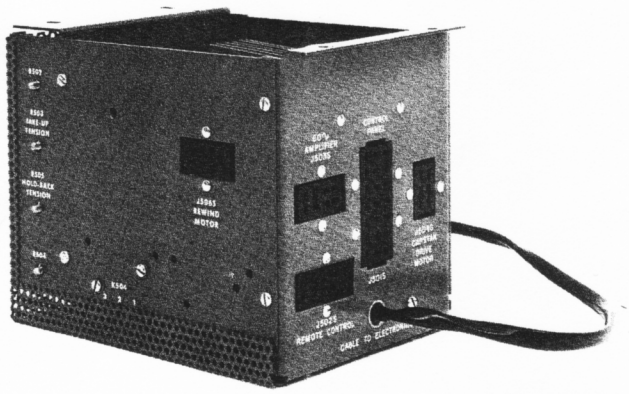
(Refer to schematic diagram—Tape Transport Control Circuits)

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

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

NOTE

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



Control circuit box

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

Play

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

Rewind

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

Fast Forward

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

Stop

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

Safety Interlocks

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

CAUTION

If the STOP and PLAY buttons are pressed in too rapid a sequence when the tape is in either fast winding mode, tape will almost invariably be broken or deformed. Always allow time for the tape to stop completely when switching from either of the fast modes to play.

Reel Size Switch

Selection of proper holdback tension, depending on reel hub size, is made at the two

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

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

NOTE

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

NOTE

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

ROUTINE MAINTENANCE

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

Cleaning

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

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

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

CAUTION

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

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

NOTE

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

Lubrication

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

CAPSTAN DRIVE MOTOR LUBRICATION

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

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

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

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

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

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

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

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

Step 4: Now pull the motor free.

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

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

CAUTION

Do not over-lubricate. Wipe off excess oil.

Step 7: Replace the motor.

Step 8: Replace the capstan idler.

CAUTION

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

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

The alternate method for drive motor lubrication is:

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

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

Step 3: Replace the capstan dust cap.

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

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

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

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

CAPSTAN IDLER LUBRICATION

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

CAUTION

DO NOT OVER-LUBRICATE or the wheel will throw oil in operation. If

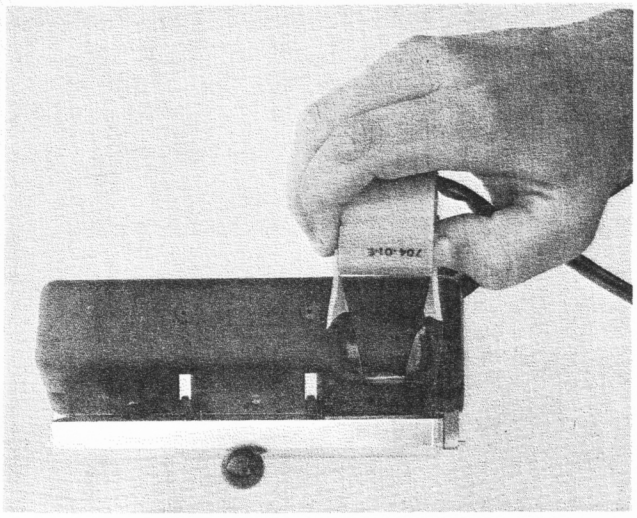
oil spills on the rubber tire, clean it immediately with Iso-Propyl. Oil will deteriorate the rubber wheel.

NOTE

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

Head Demagnetization

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



Demagnetizing the heads

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

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

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

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

NOTE

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

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

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

CAUTION

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

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

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

NOTE

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

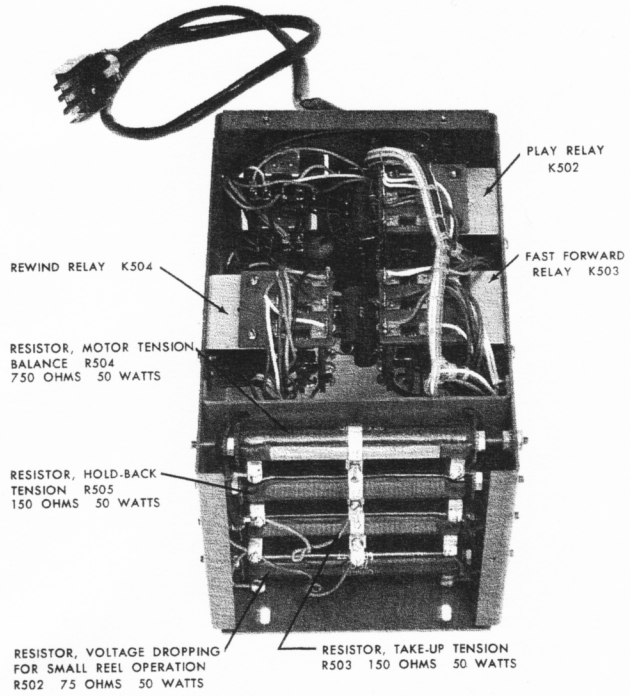
If the capstan, tape guides or other metal parts be come magnetized, a few passes of the demagnetizer along their lengths and the slow withdrawing technique should be adequate.

ADJUSTMENTS

The mechanical assembly is shipped from the factory with all adjustments set for correct performance. It should be unnecessary to change any adjustment before putting the

equipment into service, unless shipping damage has occurred. In the course of wear in normal service, or in the event of component failure, and replacement of parts, some readjustments may be necessary.

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



Control circuit box callouts

Take-up and Supply (Rewind) Tension

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

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

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

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

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

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

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

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

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

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

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

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

Step 12: A good check consists in placing the REEL SIZE switch in the SMALL position, then checking the torque using the same procedure as above. The scale should indicate tape tension as 2-2½ ounces.

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

Brake Adjustment

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

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

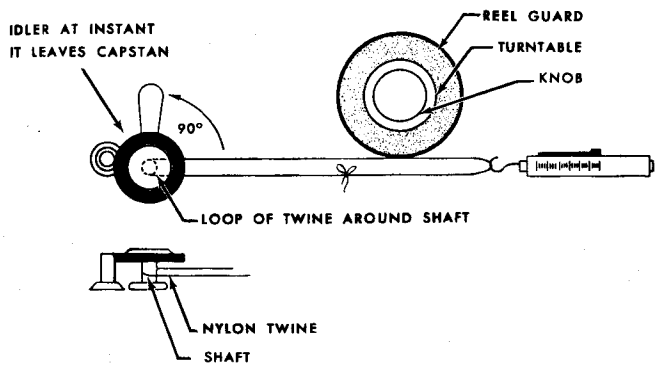
Step 2: Make small loops at both ends of a thirty inch piece of nylon lacing twine.

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

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

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

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



Capstan idler pressure measurement

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

Step 8: Repeat the entire process on the takeup turntable.

SPRING SCALE READING

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

Capstan Idler Pressure

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

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

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

NOTE

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

widest margin of safety with respect to line voltage variations. The solenoid is factory-adjusted to bottom at 90 line volts cold and 105 line volts hot.

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

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

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

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

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

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

Replacement of Parts

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

CAUTION

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

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

BRAKE BAND REPLACEMENT

NOTE

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

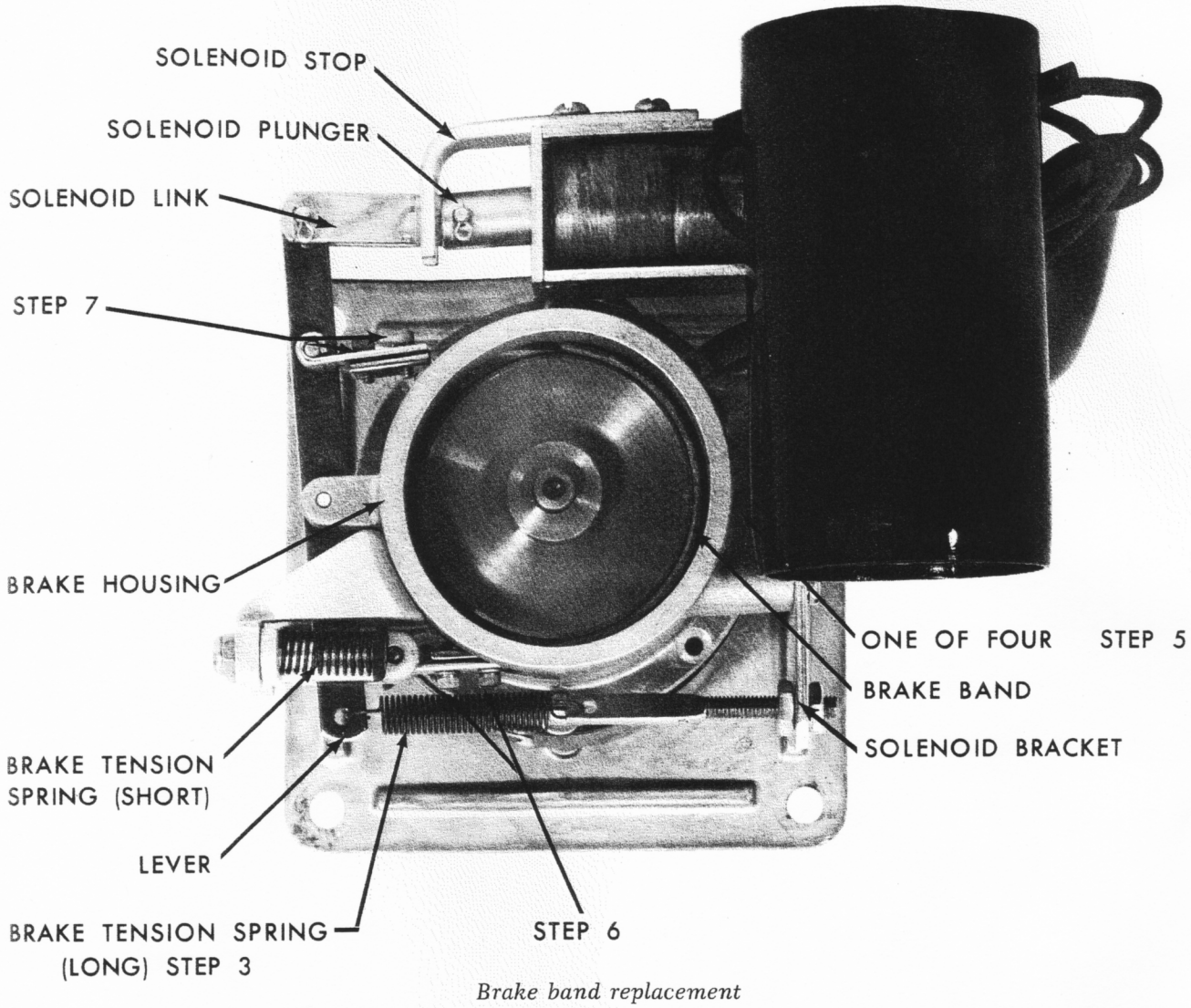
The most convenient method for changing the brake band is first to remove the entire motor assembly.

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

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

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

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



Brake band replacement

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

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

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

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

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

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

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

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

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

CAUTION

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

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

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

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

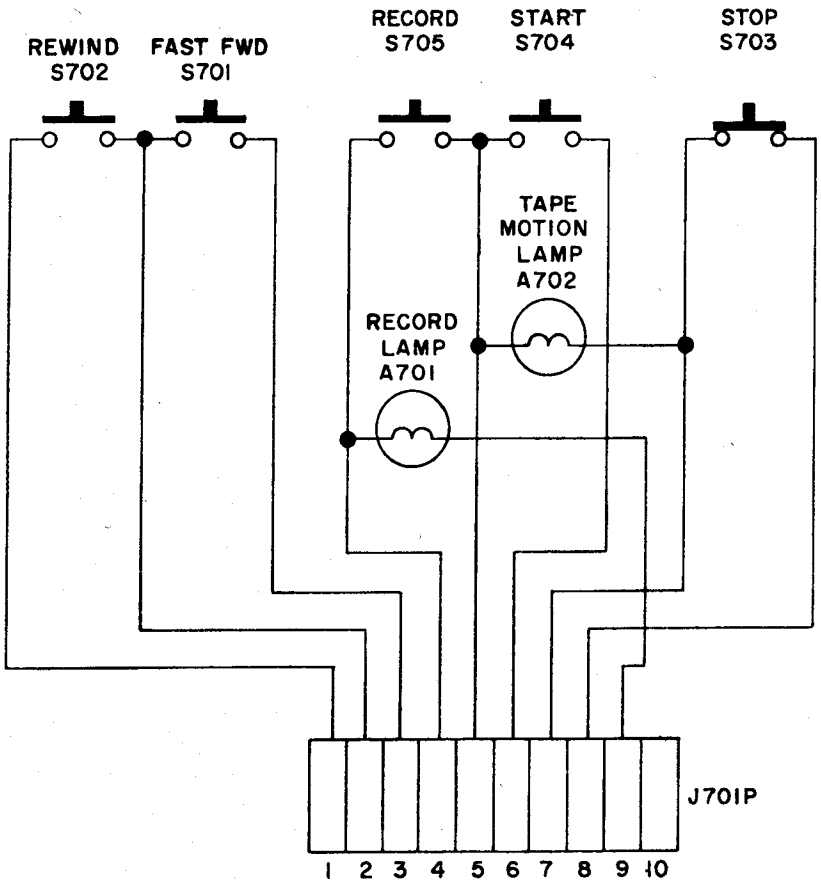
PACKING PRECAUTIONS FOR MOTORS

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

REMOTE CONTROL

NOTE

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



Remote control

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

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

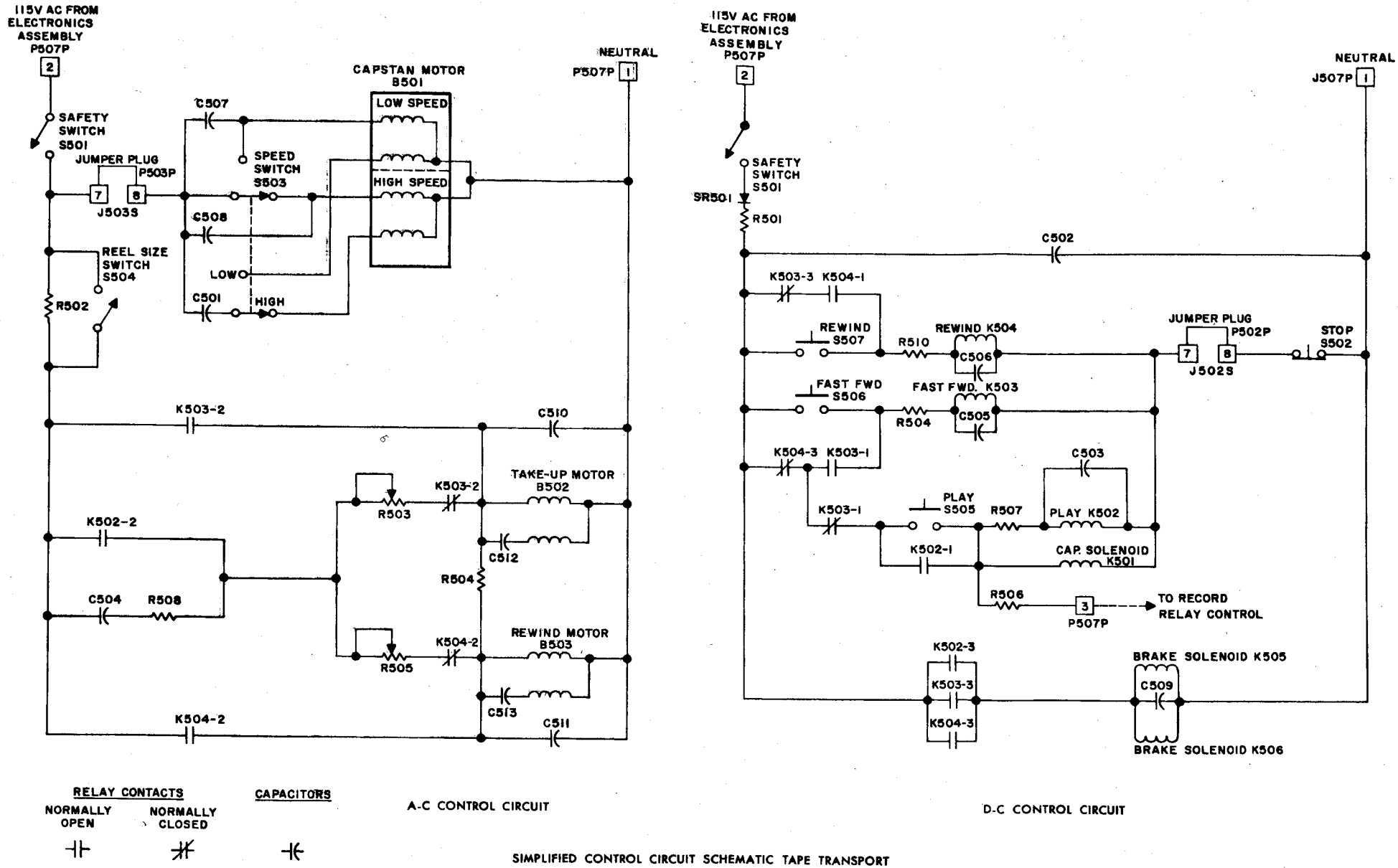
REF. NO.	PART DESCRIPTION	AMPEX PART NO.
	TOGGLE SWITCHES	
	Tape Speed (DPST)	120-004
	Reel Size (SPST) LG Shank	120-005
	TOP PLATE CONTROL BOX ASSEMBLY	5700-03
	Individually replaceable parts:	
	Chassis cover	5739-01
P502P	Connector, Plug: Male 10 contacts (Remote Dummy)	3461-00
P503P	Connector, Plug: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

ORDER BY AMPEX CATALOG NUMBER

CONTROL CIRCUIT ASSEMBLY
Catalog No. 5703-03

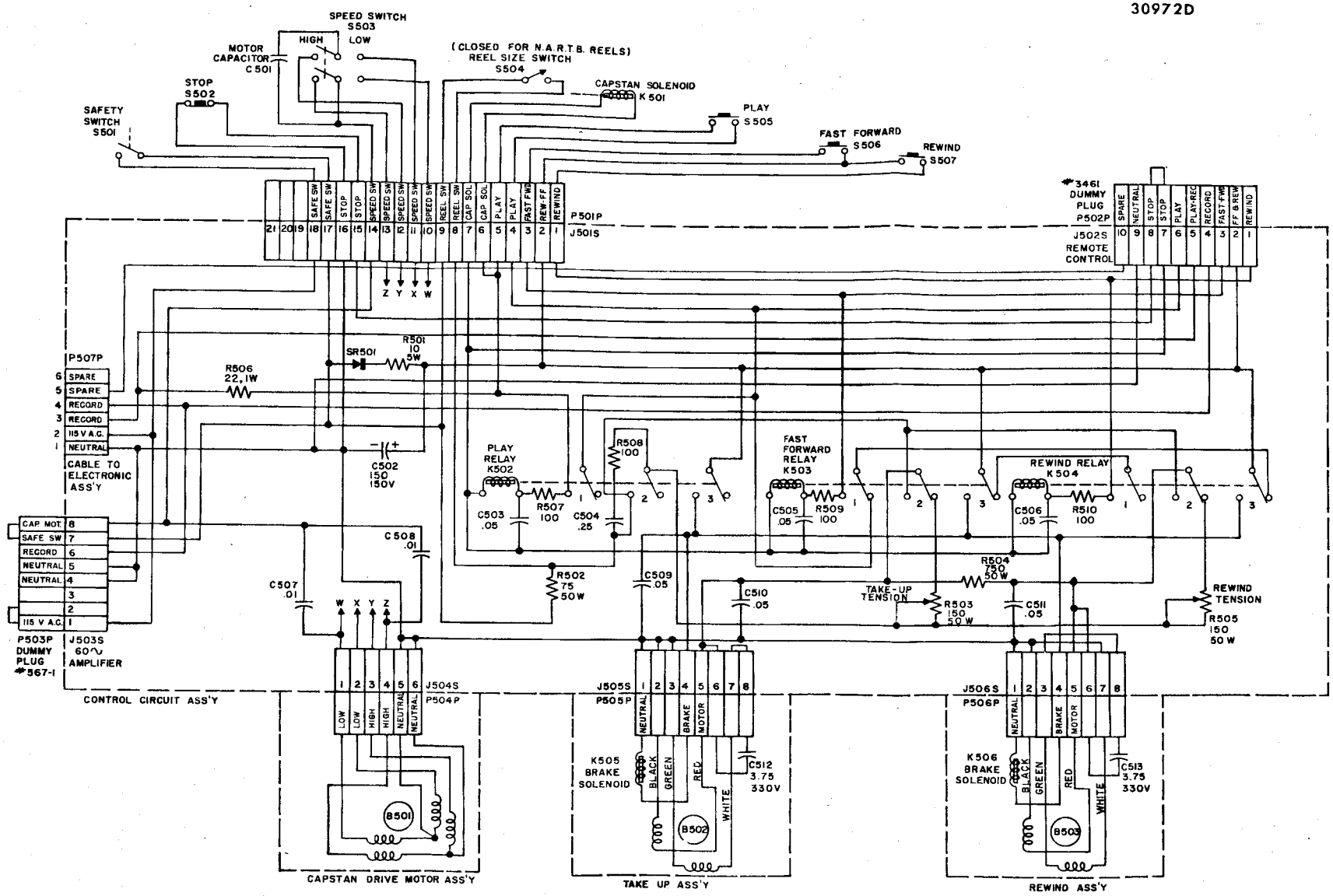
C502	CAPACITOR, fixed: electrolytic tubular, 150 uf, 150 vdcw; Cornel Dubilier Part No. 15015	031-045
C503	CAPACITOR, fixed: metallized tubular, axial leads, .05 uf, ±20%, 400 vdcw; Astron Part No. ML-4-05	033-006
C504	CAPACITOR, fixed: metallized tubular, axial leads, .25 uf, ±20%, 400 vdcw; Astron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

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



SIMPLIFIED CONTROL CIRCUIT SCHEMATIC TAPE TRANSPORT

SCHEMATIC DIAGRAM
TAPE TRANSPORT CONTROL CIRCUITS
30972D



NOTE

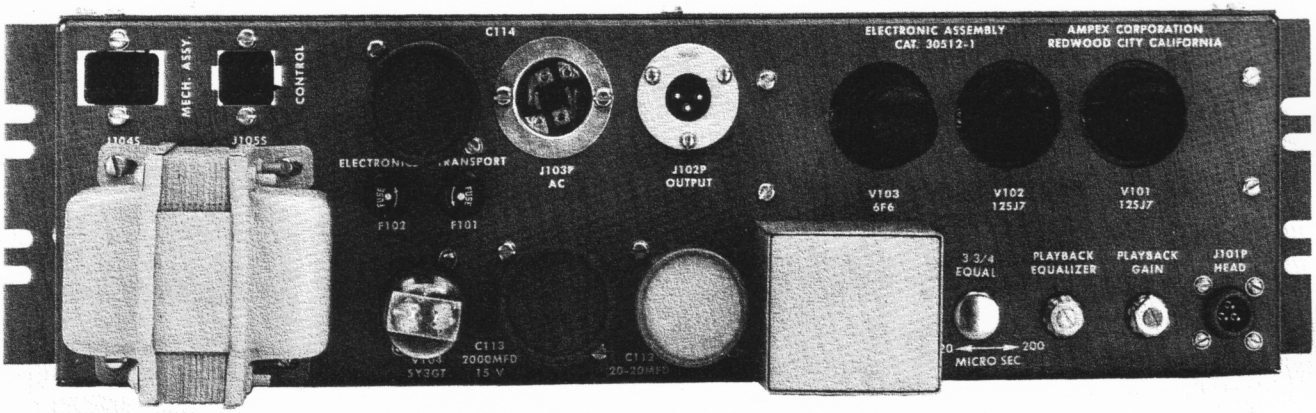
1. ALL RESISTORS IN OHMS & RATED 1/2 WATT UNLESS OTHERWISE NOTED
2. ALL CONDENSERS IN MICROFARADS AND RATED 400 V UNLESS OTHERWISE SPECIFIED.

ELECTRONIC ASSEMBLY

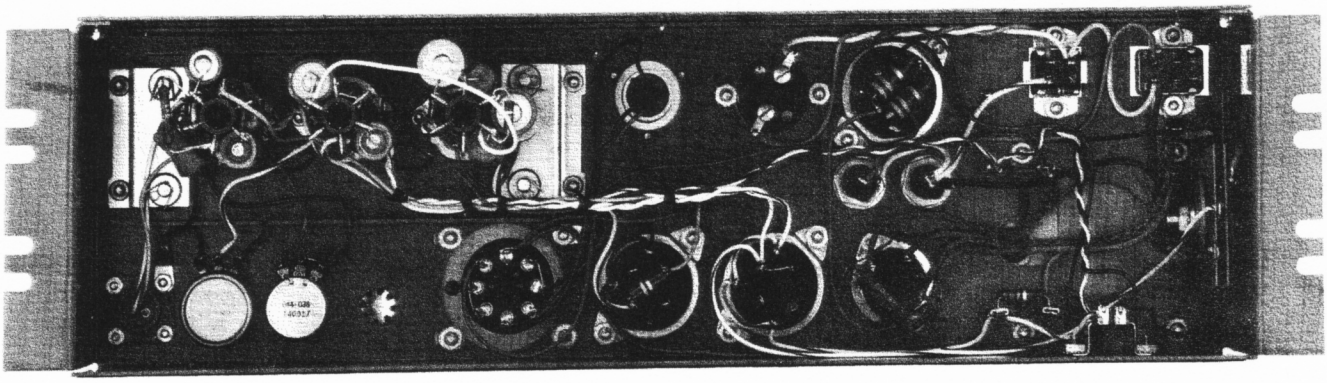
GENERAL

The reproduce amplifier is a three-stage amplifier which provides up to +8 vu (factory setting up to +4 vu) into a 600 ohm output. The required equilization is provided by C102 and R108 (the EQUALIZATION control) in the plate circuit of V101. The equalization circuit is adjusted to give a response conforming with the standard curve shown at the back of SECTION 6. Reproduce gain is adjusted by R111, in the grid circuit of V102.

The power supply provides 6.3 ac heater power, the 12.6 dc heater power through a full



Reproduce amplifier, rear view



Reproduce amplifier, internal view

wave selenium rectifier SR101, and the plate supply through a 5Y3G full wave rectifier V104.

ELECTRONIC ALIGNMENT

Alignment consists of making all adjustments necessary for proper electronic performance. Equipment out of alignment may be characterized by poor frequency response, high noise, low output, or a combination of these faults. All AMPEX equipment is correctly aligned at the factory before shipment, and should not be necessary to realign the machine on arrival. Should there be a doubt at any time concerning the condition of the reproducer, it it suggested that an overall performance check be made as described in SECTION 2. Realignment is called for only if the performance does not fall within limits given in SECTION 1.

Alignment and Test Equipment Requirements—The following list covers the minimum equipment requirements for proper alignment and testing.

Audio Oscillator

Hewlett-Packard Model 200C or equivalent Hewlett-Packard Model 400C or equivalent Ampex Catalog Number 31321-01 for 7½ inches per second (ips), Catalog Number 31311-01 for 15 inches per second. The tape is recorded at 10 db below the Ampex recommended operating level at both speeds. The tape contains voice announcements for the following tone sequence; head azimuth check tone, reference tone for reproduce level adjustment, and tone series for reproduce response check.

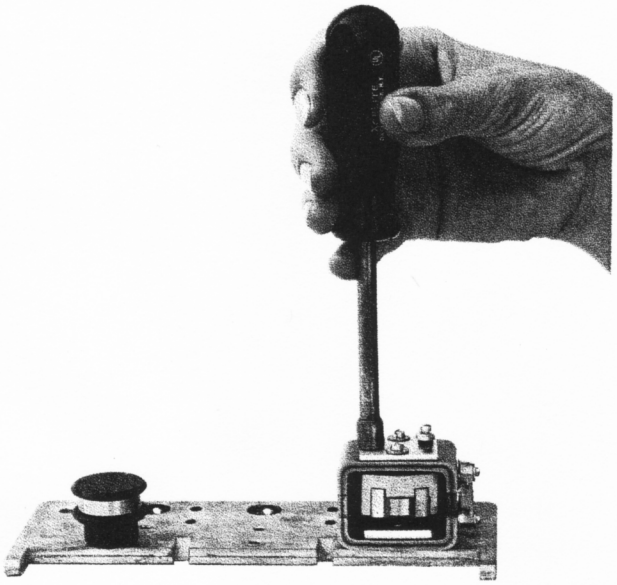
Ampex Head Demagnetizer — Ampex Catalog Number 704-00

High Impedance Headphones

¼-inch Hexagonal Socket Wrench

General Precautions—It is always advisable to demagnetize the head, BEFORE putting an alignment tape on the machine. Magnetization of the head will cause partial erasure of the high frequencies on the tape and make it useless as a standard. The demagnetization procedure is given in SECTION 5. The amplifier output must always be terminated in a nominal 600 ohm load when testing or aligning by placing this load across pins 2 and 3 of output connector J102P.

Reproduce Level Adjustment—The first tone on the tape is used for reproduce level adjustment. With the machine reproducing this tone, adjust the reproduce GAIN control (R111) for a reading of −6 dbm on the vtvm.



Reproduce head azimuth adjust

Head Alignment

Step 1: Remove the head housing cover by removing the two screws that hold it, then lift it gently up and back. The left-hand elastic stop nut on the top of the head is the azimuth adjust.

CAUTION

Do not attempt to adjust any other nut or screw on this head.

Step 2: Thread an AMPEX alignment tape on the machine.

Step 3: Connect a vtvm to the output, throw the TAPE SPEED switch to the proper position and press the PLAY button. The second tone on the tape will be announced as the head alignment tone.

Step 4: Using the ¼-inch hexagonal socket wrench, adjust the left-hand elastic stop nut on top of the head for maximum output. If the peak adjustment for maximum output is broad, adjust for minimum variation of output.

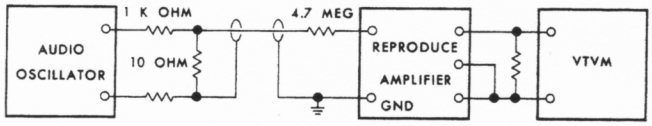
NOTE

When replacing the head housing cover, use caution in tightening the screws; overtightening may cause the head mounting plate to bow and the head to be thrown out of alignment.

Response Check: The next series of tones is for checking frequency response. If the equipment does not remain within specifications when reproducing these tones, one of the following is indicated:

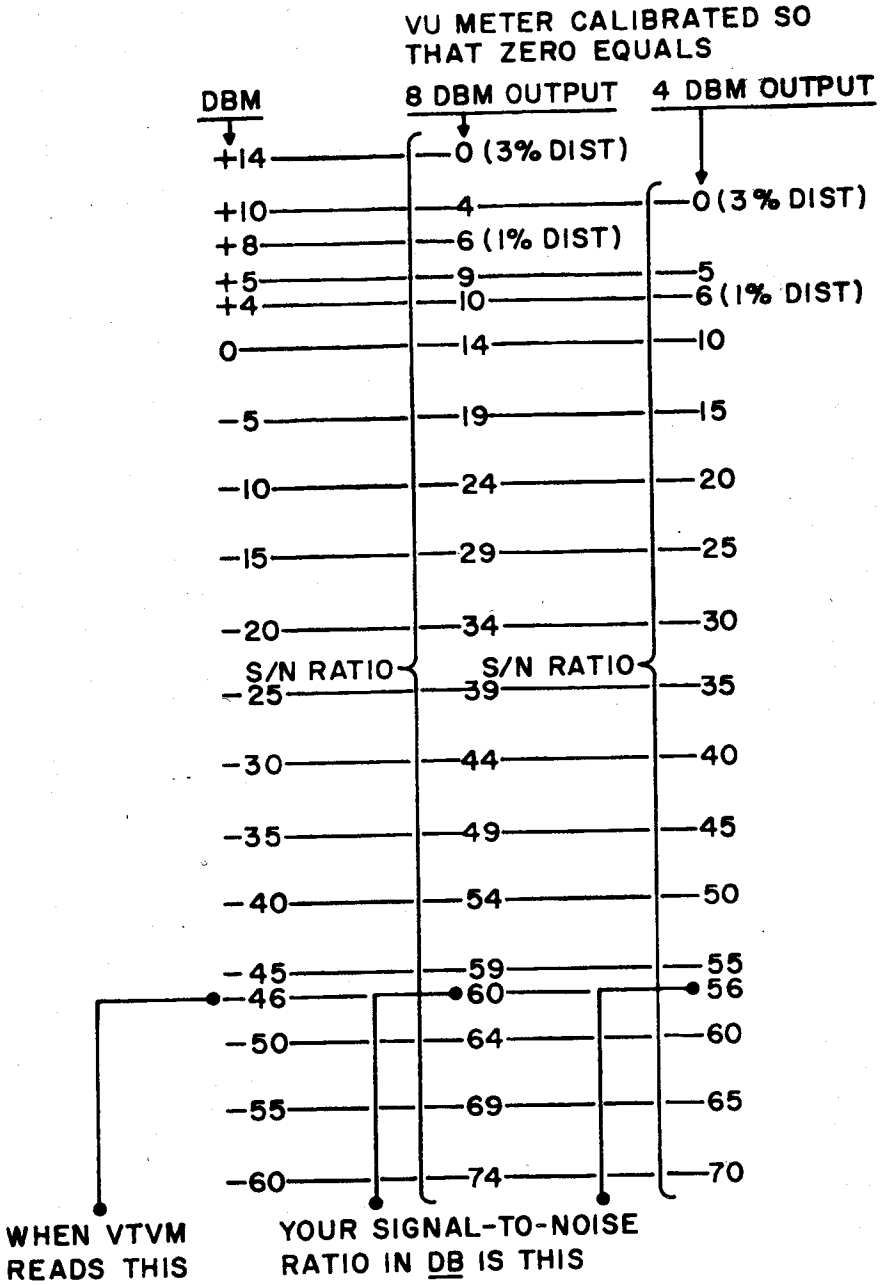
1. Improper equalization.
2. Faulty alignment tape. (High frequencies partially erased by passing over a magnetized head.)
3. Worn or otherwise faulty head.

Equalization Adjustment — Equalization is factory set to the standard curve shown at the back of SECTION 6. Remove the head cable, connect an audio oscillator and vtvm as shown in the illustration, and adjust the reproduce equalizer to obtain the correct response.



Test set-up, reproduce equalization

Signal-to-noise—To translate vtvm readings into specific signal-to-noise ratios when the vu meter is so calibrated that 0 vu corresponds to +4 dbm output, add 6 db to obtain the output value at the 3% distortion level, arriving at a total of +10 dbm. Having made this computation, bear in mind that, although the noise



Signal-to-noise computations

reading taken on the vtvm is dbm, the measurement is a ratio which must include the 10 dbm computed to arrive at the 3% distortion level. Therefore, the dbm level must be converted to the signal-to-noise ratio.

Example: 10 (dbm, includes +4 dbm normal level and +6 dbm to 3% distortion level)
−46 (dbm vtvm reading)
56 (db signal-to-noise ratio)

Any reading below −46 dbm meets the performance specifications of 56 db signal-to-noise ratio, and satisfies the signal-to-noise ratio definition.

When the vu meter is so calibrated that 0 vu corresponds to +8 dbm output value from the 3% distortion level, arriving at a total of 14 dbm.

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

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

Ampex signal-to-noise ratio specifications on audio instruments define (in decibels) the ratio existing between the level of a steady 1000 cycle tone, recorded at a level at which distortion produced by the approach of tape saturation equals 3% total rms, and that level of total rms noise (in the band from 30 to 15,000 cycles) which exist in reproduction under the same gain conditions. Thread an AMPEX Alignment Tape (Catalog Number 31321-01 for 7½ ips or 31311-01 for 15 ips) on the equipment. Press the PLAY button and make a response check. Press the STOP button. Signal-to-noise measurements are made, with no tape motion, on the fully erased blank portion of the tape.

AMPEX ALIGNMENT TAPES FOR ¼-INCH TAPES

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

STANDARD TAPES

	7½ ips			15 ips		
Order of Recording	*Tone (cps)*	*Level*	*Function*	*Tone (cps)*	*Level*	*Function*
First Tone	700	−10 db	reproduce reference	700	operating	reproduce gain calibration and reference
Second Tone	15,000 (30 sec.)	−10 db	reproduce head alignment	15,000 (30 sec.)	operating	reproduce head alignment
Series of Tones	12,000 to 50	−10 db	check frequency response	12,000 to 30	operating	check frequency response
Last Tone	700	operating	reproduce gain calibration		NOT USED	

ELECTRONIC ASSEMBLY

PARTS LIST

CATALOG NO.

30512

MODEL 352 and 352-2 REPRODUCER

MODEL 352 COMPLETE EQUIPMENT

Rack Mount, 7-1/2-15 ips, Full Track, 60 Cycle Power	9991-01
Rack Mount, 7-1/2-15 ips, Full Track, 50 Cycle Power	9991-02
Rack Mount, 7-1/2-15 ips, Half Track, 60 Cycle Power	9991-05
Rack Mount, 7-1/2-15 ips, Half Track, 50 Cycle Power	9991-06
Rack Mount, 7-1/2-15 ips, Stereophonic, 60 Cycle Power	30689-01
Rack Mount, 7-1/2-15 ips, Stereophonic, 50 Cycle Power	30689-02

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
	ELECTRONIC ASSEMBLY	30095
C101	CAPACITOR, fixed: metallized, .1 uf ± 5%, 400 vdcw; Astron Part No. ML2-1	033-003
C102	CAPACITOR, fixed: mica, .006 uf ± 5%, 500 vdcw, Sangamo Part No. CR-1260	034-086
C103	CAPACITOR, electrolytic; 4 uf, 150 vdcw; Astron Part No. MM-4-105	031-020
C104	CAPACITOR, electrolytic; 50 uf, 25 vdcw; Cornell Dubilier Part No. BRM-502	031-030
C105	CAPACITOR, fixed: metallized, .01 uf ± 20%, 400 vdcw; Astron Part No. ML-4-01	033-005
C106	Same as C103	031-020
C107	CAPACITOR, electrolytic; 25 uf, 25 vdcw; Sangamo Part No. MT-0225	031-031

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

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
C108	CAPACITOR, fixed: metallized, .1 uf ± 20%, 400 vdcw; Astron Part No. ML-4-1	033-007
C109	CAPACITOR, fixed: metallized, .25 uf ± 20%, 400 vdcw; Astron Part No. ML-4-1	033-008
C110	Same as C107	
C111	CAPACITOR, electrolytic; 4 uf, 450 vdcw; Sangamo Part No. MT-4504	031-009
C112	CAPACITOR, electrolytic; 20-20-20 uf, 450 vdcw; Mallory Part No. FP376.5	031-080
C113	CAPACITOR, electrolytic; 2,000 uf, 15 vdcw; Mallory Part No. WP-041	031-085
C114	CAPACITOR, electrolytic; 20-30-30 uf, 475 vdcw; Mallory Part No. FP396	031-082
F101	FUSE: fast blow, 250 volt, 3 amp; Littlefuse Part No. 312003	070-001
F102	FUSE: slow blow, 125 volt, 1 amp; Littlefuse Part No. 313001	070-004
J101P	CONNECTOR, receptacle: male, 3 contact; AN-3102-10S-3P	143-008
J102P	CONNECTOR, receptacle: male, 3 contact; Cannon Part No. XL-3-14	147-004
J103P	CONNECTOR, receptacle: male, 2 contact, 250 volt, 10 amp; Hubbell Part No. 7466	147-013
J104S	CONNECTOR, receptacle: female, 6 contact, 730 volt rms, 10 amp; Jones Part No. S-306-AB	146-004
J105S	CONNECTOR, receptacle: female, 4 contact, 730 volt rms, 10 amp; Jones Part No. S-304-AB	146-005
J106S	CONNECTOR, receptacle: female, 8 contact, 730 volt rms, 10 amp; Jones Part No. S-308-AB	146-003
R101	RESISTOR, fixed: carbon, .33 meg ± 1%, 1 watt; Stemag Part No. type D	042-060

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

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
R102	RESISTOR, fixed: carbon, 2.2 K ohm ± 1%, 1/2 watt; Electra Part No. type DC-1/2	042-107
R105	Same as R101	042-060
R106	RESISTOR, fixed: carbon, 2.2 K ohms, 10%, 1/2 watt; MIL-R-11:RC20GF222K	041-052
R108	RESISTOR, variable: carbon, .1 meg ± 20%, 1/4 watt; C.R.L. Part No. Mod 2 (TPR C2)	044-038
R109	RESISTOR, fixed: carbon, 1 meg ± 1%, 1/2 watt; Radell Part No. type CD 1/2 SA	042-010
R110	RESISTOR, fixed: carbon, .15 meg ± 10%, 1 watt; MIL-R-11A, RC32GF154K	041-172
R111	RESISTOR, variable: carbon, 1 meg ± 20%, 2 watts; Allen Bradley Part No. JA1052, SD3056	044-017
R112	RESISTOR, fixed: carbon, 1 meg ± 10%, 1/2 watt; MIL-R-11A, RC20GF105K	041-031
R113	RESISTOR, fixed: carbon, .33 meg ± 10%, 1/2 watt; MIL-R-11A, RC20GF334K	041-078
R114	RESISTOR, fixed: carbon, 2.7 K ohm ± 10%, MIL-R-11A, RC20GF272K	041-053
R115	RESISTOR, fixed: carbon, 220 ohm, ± 10%, 1/2 watt; MIL-R-11A, RC20GF221K	041-040
R116	RESISTOR, fixed: carbon, .15 meg ± 10%, 1/2 watt; MIL-R-11A, RC20GF154K	041-074
R117	RESISTOR, fixed: carbon, .56 meg ± 10%, 1/2 watt; MIL-R-11A, RC20GF564K	041-081
R118	RESISTOR, fixed: carbon, 1.5K ohm ± 10%, 1/2 watt; MIL-R-11A, RC20GF152K	041-050
R119	Same as R116	041-074
R120	RESISTOR, fixed: carbon, 47K ohm ± 10%, 2 watts; MIL-R-11A, RC42GF473K	041-166

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

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
R121	RESISTOR, fixed: carbon, 47K ohm ± 10%, 1 watt; MIL-R-11A, RC32GF473K	041-166
R122	RESISTOR, fixed: carbon, 2.7 ohm ± 10%, 1 watt; Ohmite Part No.	041-094
R123	RESISTOR, fixed: wirewound, 3.5K ohm ± 10%, 5 watts; Dalohm Part No. type C8-5	043-275
R124	RESISTOR, fixed: carbon, 3.3K ohm ± 10%, 2 watts; MIL-R-11A, RC42GF332K	041-207
R125	Same as R124	
R126	RESISTOR, fixed: carbon, 8.2K ohm ± 10%, 1 watt; MIL-R-11A, RC32GF822K	041-157
R127	RESISTOR, fixed: carbon, 22K ohm ± 10%, 1/2 watt; MIL-R-11A, RC20GF223K	041-064
SR101	RECTIFIER, selenium: single phase, center tap 26 volt ac rms in; 1.2 amp dc out; G. E. Part No. 6RS5WH5	581-001
T101	TRANSFORMER: output	6300
T102	TRANSFORMER: power	3953
V101	TUBE, electron: 12SJ7	012-085
V102	Same as V101	012-085
V103	TUBE, electron: 6F6	012-007
V104	TUBE, electron: 5Y3	012-013
XC114	SOCKET, capacitor	150-006
XF101	FUSE POST: finger operated, short body; Littlefuse Part No. 342003	085-001
XF102	Same as XF101	
XV101	SOCKET, turret	1208-00
XV102	Same as XV101	

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

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
XV103	Same as XV101	
XV104	SOCKET, turret	2317-01
	SHOCKMOUNT: Barry Part No. 275-1	350-003
	CLEVIS PIN: Pan Hd, steel, 21/32 long; MS20392-2-21	400-013
	COTTER PIN: Mitre end, 1/16" Dia., 1/2" LG. ASA	401-005
	HEAD ASSEMBLIES	
	(Including Cables and Plugs)	
	Half Track	475-22
	Full Track	475-23
	Two-Track	30028-04
Individual Replaceable Parts:		
	Gate Spring, Two Required	438-01
	Gate Pin, Two Required	403-006
	Glass Rod Tape Guide, 13/16 inches long. Two required	475-00
	Glass Rod Tape Guide, 1/2 inch long. Two required	1372-00
	Gate Assembly	479-00
	Cable Connector, three-contact	140-008
	Clamp	302-010
	Housing	433-01
	Flat Allen Head Screw, 6-32 x 3/8. Two Required	471-476
	Alignment Adjustment Screw	471-481

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

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
	Alignment Adjustment Nut	493-005
	Guide Post	6163-00
	MAINTENANCE ITEMS	
	Ampex Alignment Tape, 15 ips	31311-01
	Ampex Alignment Tape, 7-1/2 ips	3132-01
	Ampex Head Demagnetizer	704-00
	Head Cleaner	087-007
	Lubricating Oil	087-005
	MISCELLANEOUS	
	Console Cabinet	6125-00
	Editing Knob (Portable and Console)	1917-00
	Reel Adapter	976-00
	Reel Hold-Down Knob (Rack)	9093-00
	Cover, Electronics Assembly (Console models)	5520-00
	Cover, Electronics Assembly Stainless Steel (Rack Mount)	17206-01
	Power Cable	2413-00
	Knob Reel Holddown (EIA Reels)	30971-01
	Connector, output: Female, 3 pin; XL-3-11	144-003
	POWER PANEL	
	Single Channel Assembly	30602-01
	Two Channel Assembly	30862-01
P201P	CONNECTOR, plug: male, 4 contact, 730 volt rms, 10 amp; Jones Part No. P-304-CCT-L	145-011

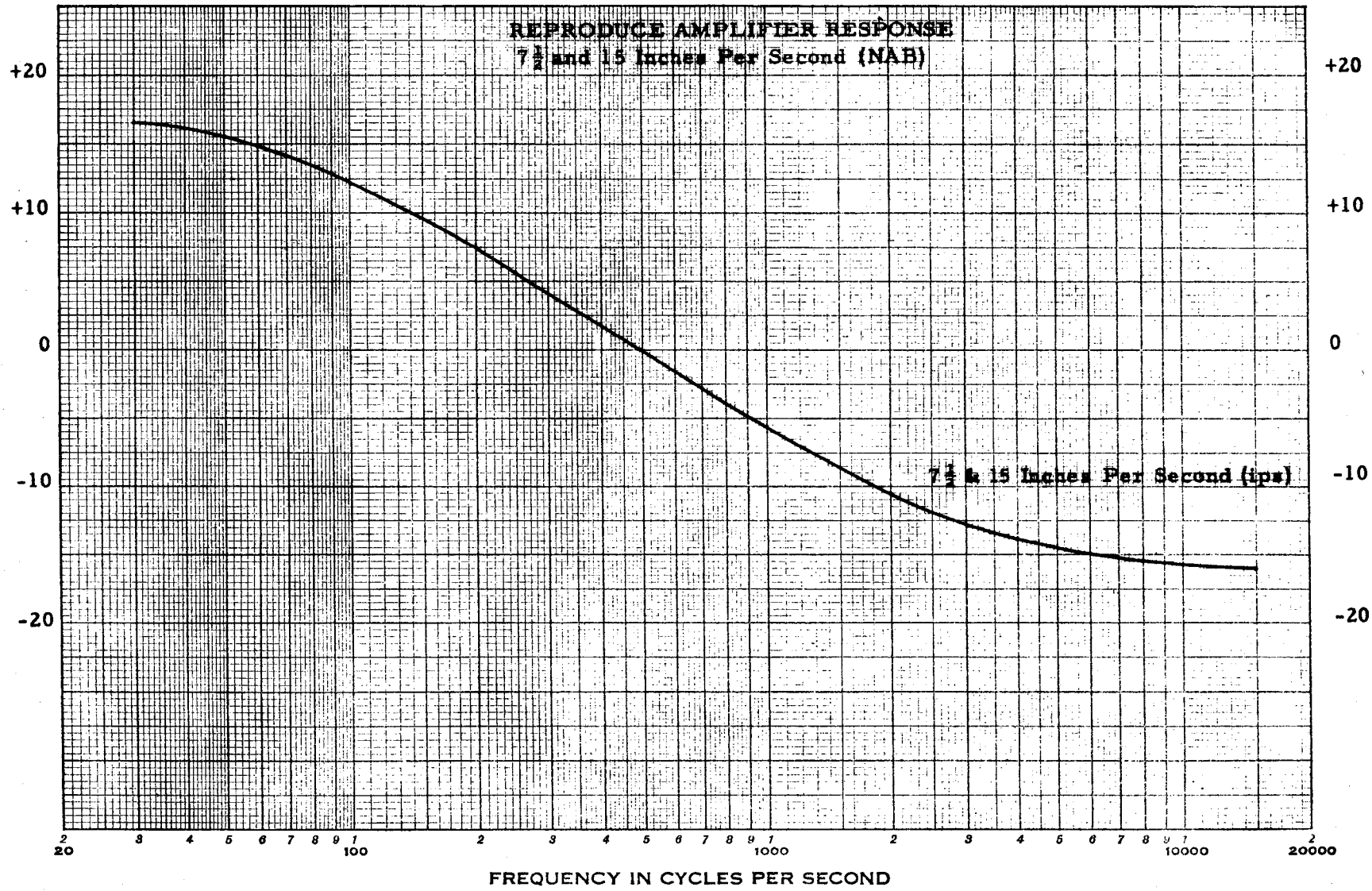
When ordering replacement parts always include the following information: Equipment Type; Equipment Serial Number; Ampex Part or Catalog Number; and Description of Part. DO NOT simply use the schematic reference number.

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
DS201	POST LIGHT: 1/4 watt neon without internal resistor; Drake MGF. Co. Part No. 105	132-003
S201	SWITCH, toggle: 3 amp, 250 volt; Cuttler Hammer Part No. 8280K15	
S301	Same as S201	120-028
S302	Same as S201	120-028
DS301	Same as DS201	132-003
DS302	Same as DS201	132-003
R301	Same as R127	041-064
P302S	CONNECTOR, plug: female, 2 contact, 250 volts, 2 amps; Hubbell Part No. 7464	144-014
P301P	Same as P201P	145-011
	REMOTE CONTROL	
	Remote Control Unit, boxed, with 30' cable	5763-00
	Extension Cable, 30'	5795-00
	Wood Box, Grey	3661-00
	Remote Control Panel, unwired, without cable or box	763-01
A701	LAMP, remote record: 120 volt, 6 watts	064-006
	LAMP BASE, red	132-006
A702	LAMP, remote tape motion: Same as A701	
	LAMP BASE, green	132-007
J701P	CONNECTOR, receptacle: male, 10 contact, Jones Part No. P-310-AB	147-014
	CABLE (with plugs), remote control	5795-00

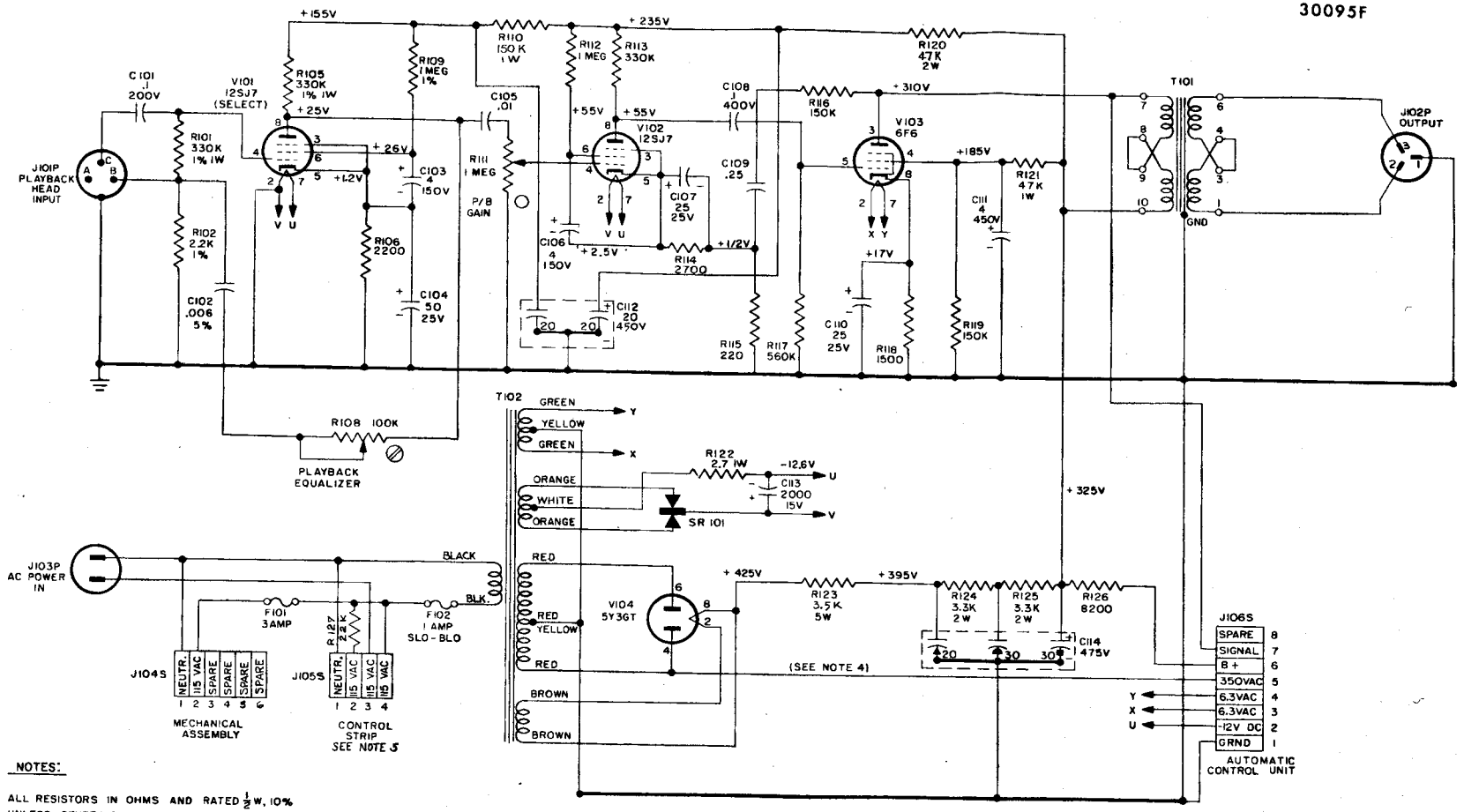
When ordering replacement parts always include the following information: Equipment Type; Equipment Serial Number; Ampex Part or Catalog Number; and Description of Part. DO NOT simply use the schematic reference number.

REF. NO.	PART DESCRIPTION	AMPEX PART NO.
	CABLE, extension: 6 conductor (for monaural) console	3768-01
S701	PUSHBUTTON, FAST FWD: SPST, normally open; A H and H Part No. 3391BSA	120-013
S702	PUSHBUTTON, REWIND: same as S701	120-013
S703	PUSHBUTTON, STOP: SPST, normally closed; A H and H Part No. 3391BSA	120-014
S704	PUSHBUTTON, START: Same as S701	120-013
S705	PUSHBUTTON, RECORD: Same as S701	120-013

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

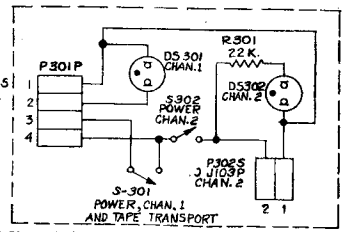

REPRODUCE AMPLIFIER RESPONSE
7½ and 15 Inches Per Second (NAB)
+20
+10
0
-10
-20
7½ & 15 Inches Per Second (ips)
20
100
1000
10000
20000
FREQUENCY IN CYCLES PER SECOND

ELECTRONIC ASSEMBLY
CURRENT SCHEMATIC DIAGRAM
CATALOG NUMBER 30512
30095F

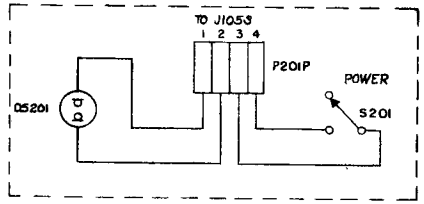


NOTES:

1. ALL RESISTORS IN OHMS AND RATED ½W, 10% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS RATED IN MICROFARADS.
3. ALL VOLTAGES MEASURED WITH 20,000 OHMS/VOLT METER, WITH 115V AC LINE, AND AMPLIFIER CONNECTED TO TAPE TRANSPORT.
4. TRANSFORMER VOLTAGE AT PIN NO.5 OF J106S MUST BE IN PHASE WITH VOLTAGE AT PIN NO.3 OF J106S.
5. ON MODEL 352-2, CONNECT TAPE TRANSPORT TO J104S ON CHANNEL 1 ELECTRONICS. INSTALL DUMMY PLUG #30867 IN J105S ON CHANNEL 2.

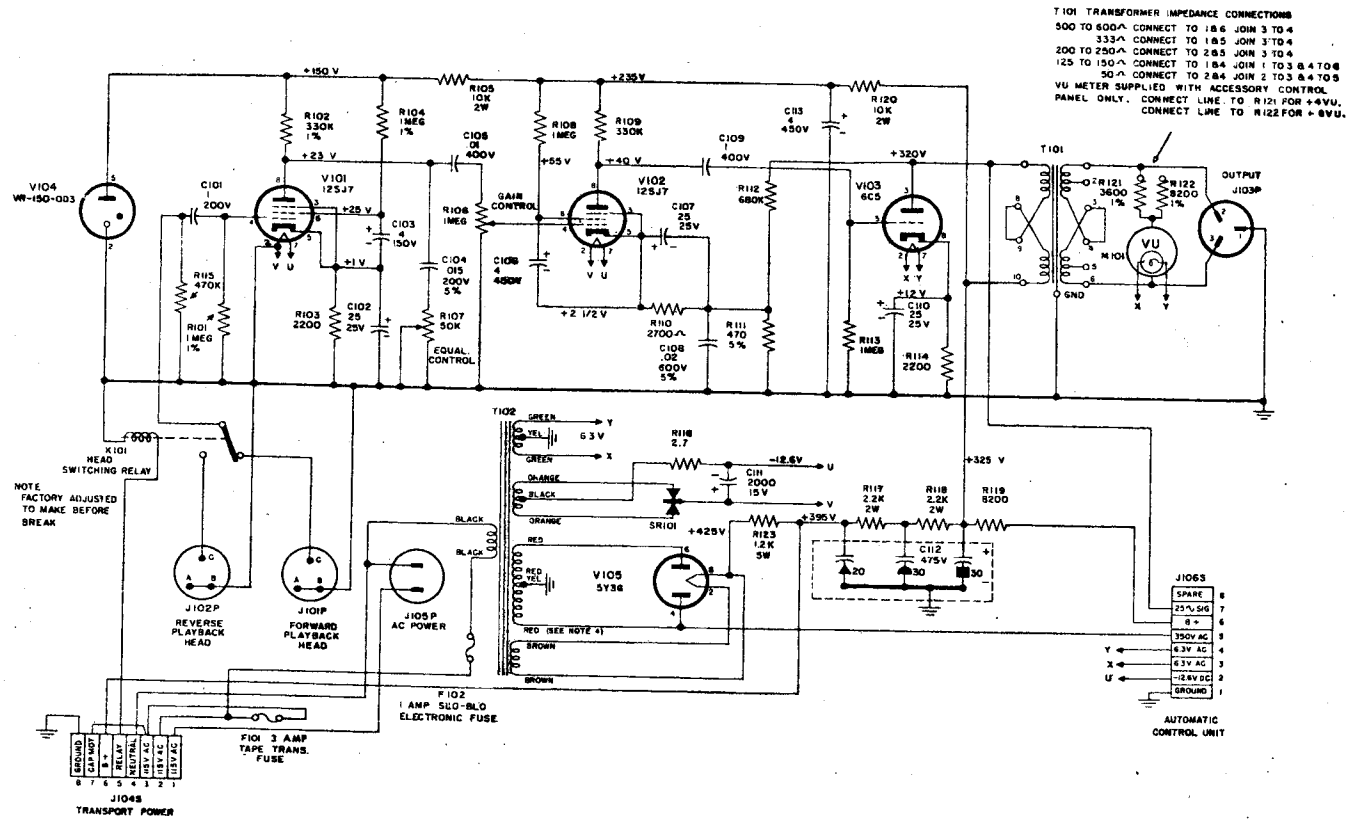


CONTROL PANEL SCHEMATIC FOR MODEL 352-2
REF. C-30862



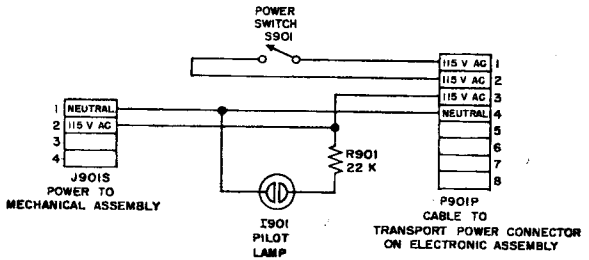
CONTROL STRIP SCHEMATIC FOR MODEL 352
REF. C-30801

ELECTRONIC ASSEMBLY
SCHEMATIC DIAGRAM
MODEL 352
(FORMERLY USED) ED 5593



NOTES

1. ALL RESISTORS IN OHMS AND RATED 1 WATT 10% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS IN MICROFARADS.
3. ALL RELAYS SHOWN DE-ENERGIZED.
4. TRANSFORMER VOLTAGE AT PIN 5 OF J106S MUST BE IN PHASE WITH VOLTAGE AT PIN 3 OF J106S.
5. ALL DC VOLTAGES MEASURED WITH 20,000 OHM PER VOLT METER WITH 115 V AC LINE & AMPLIFIER CONNECTED TO TAPE TRANSPORT. (WITHOUT AUTOMATIC CONTROL UNIT)



POWER PANEL
CATALOG NO. 6120