AMPEX
MODELS 400A, 401A

Figure 1

AMPEX
MODELS 400A, 401A

GENERAL INFORMATION

The Ampex Models 400A and 401A are identical in every respect except for the Head Assembly. Model 400A incorporates heads to erase and record on only one-half of the standard 1/4 inch tape. Model 401A incorporates heads to erase and record over the full width of the tape. Thus tapes recorded on the Model 401A may be played back on the Model 300 and Model 201 Recorders without pre-erasing the unused portion of the tape and without necessitating level adjustment.

Both the Model 400A and 401A will play back either full or half-track recordings made on any Ampex recorder.

CONTROLS-

Four buttons control the functions of Start (Play), Fast Forward, Rewind and Stop. A separate record button energizes the record relay, which drops out when the machine is stopped. Since the functions are relay operated, the control buttons may be placed at a remote location.

POWER INPUT REQUIREMENTS-

115 Volts AC2 Amperes. Recorders are available for either 60 or 50 cycle operation. See serial number plate.

Manufactured by:

Ampex Electric Corporation
Redwood City, California

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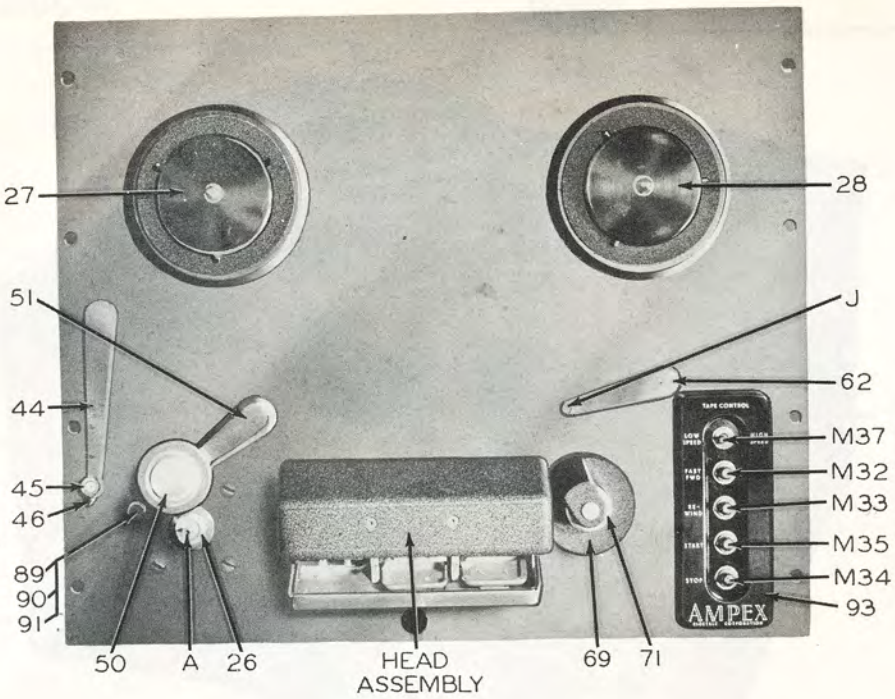

Figure 2

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SECTION I

SPECIFICATIONS

TAPE SPEED-

15 inches per second and 7.5 inches per second, with motor speed change and equalization switches conveniently located.

FREQUENCY RESPONSE-

At 15 inches ± 2db 50-15,000 cycles. At 7 1/2 inches ± 2db 70-10,000 cycles and down no more than 4db at 30 and 15,000 cycles.

SIGNAL-TO-NOISE RATIO-

Over 55db at both 7 1/2 inches per second and 15 inches per second, as defined by the N.A.B. standards. By definition, the signal-to-noise ratio is the ratio of peak recording level to the total unweighted playback noise when erasing a signal of peak recording level and in the absence of a new signal. Thus, bias and erase noise are included, as well as playback amplifier noise. All frequencies between 20 and 20,000 cycles are measured. The peak recording level is defined as that level at which the overall (input to output) total RMS harmonic distortion does not exceed 3% when measured on a 400 cycle tone.

STARTING TIME-

Instantaneous. (When starting, the tape accelerates to full speed in less than 1/10 second because the capstan motor operates whenever the power is on).

STOPPING TIME-

When playing at 15 inches per second, the tape moves less than 2 inches after the stop switch is operated.

FLUTTER AND WOW-

At 15 inches well under 2/10% RMS measuring all flutter components from 0 to 300 cycles using a tone of 3,000 cycles. At 7 1/2 inches per second under 1/4%.

PLAYBACK TIMING ACCURACY-

2/10%.

PLAYING TIME-

32 minutes at 15 inch speed with standard N.A.B. reel; 64 minutes at 7.5 inch speed (on each track). The standard R.M.A. reel may also be used on the tape supply turntable.

REWIND TIME-

Approximately one and a half minutes for a full N.A.B. reel.

PLUG-IN HEAD HOUSING-

Erase, Record and Playback Heads are contained in a single plug-in head housing.

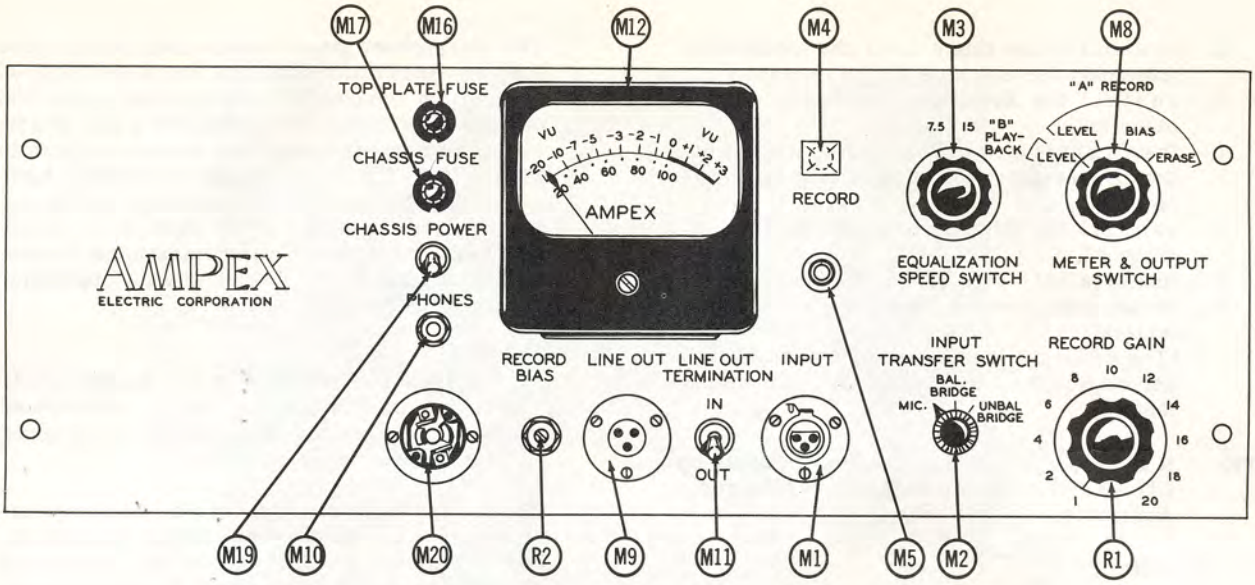


Figure 3

MONITORING-

Independent record and playback systems allow the tape to be monitored while recording.

INPUT-

A switch allows the recorder to accommodate either microphone level low impedance input or to bridge 600Ω plus 4 VU line balanced or unbalanced.

PLAYBACK AMPLIFIER-

Plus 4 VU output into 600Ω balanced or unbalanced.

METERING-

A 4 inch VU meter is mounted on the front panel and provides for:

a. Direct monitor of record input signal before or during recording.
b. Monitor of recorded output signal from playback head while recording or during playback.
c. Reading bias current.
d. Reading erase current.

PHONE MONITORING-

A phone monitor jack is provided for direct monitor of record input signal before or during recording and monitor of recorded output signal from playback head while recording or during playback. An A-B switch is incorporated in order that direct comparison can be made between the original program and the recorded program while a recording is being made. The same switch transfers the VU meter for level comparison and monitoring.

PLUG IN OF REMOTE CONTROLS-

The Model 400A and 401A are available with connectors installed in the Mechanical Assembly for "plug-in" of Remote Controls, the Model 375 60 Cycle Amplifier or Speed Lock Equipment.

MODEL 375 60 CYCLE AMPLIFIER-

The Model 375 Amplifier is a precision 60 cycle amplifier designed to provide a source of constant frequency to the capstan drive motor in localities where the available 60 cycle power is not stable in frequency

MODEL 380 SPEED LOCK EQUIPMENT-

The Model 380 Speed Lock Equipment is designed to automatically control the playback speed of the Model 400A Recorder to synchronize with motion picture equipment.

SECTION II

INSTALLATION

IMPORTANT-

Before attempting to operate the recorder, first read the following sections on Installation and Operation.

The portable machine is shipped in a ready-to-operate condition. All connections are readily accessable from the front panel. Release the front panel cover by unlatching and removing the top cover.

The rack mounted machine should be mounted on a standard 19" relay rack with the Mechanical unit above the main Electronic Panel. The Electronic Power Supply Panel should be mounted directly above the Mechanical Assembly, or at least 5" below the Electronic Assembly. Greater proximity to the Electronic Assembly will result in increased hum level.

If two 400A's or 401A's are to be mounted on a standard rack, the following placement is recommended (starting at the top of the rack):

1. Install a 13/4 inch spacer panel at the top of the rack.

2. Install below this panel the Mechanical Assembly for machine #1.
3. Install the Electronic Assembly for machine #1.
4. Install a 1 3/4 inch or 3 1/2 inch spacer panel.
5. Install the Mechanical Assembly for machine #2.
6. Install the Electronic Assembly for machine #2.
7. Install a 5 1/4 inch or 7 inch spacer panel
8. Install both Power Supply Panels at the bottom.
   (The cable on the power supply for the upper recorder will have to be extended in length).

NOTE: It is important that no Power Supply be closer than 5 inches to an Electronic Assembly.

I. AC POWER:

Connect the power cable, part #2413, from the AC Power Input Connector (M20) on the front panel of the Electronics Assembly to a source of 115 Volt AC power.

NOTE: This machine is available for either 50 or 60 cycle operation. The power line frequency is indicated on the serial number plate located on the Power Supply Panel for rack mounted machines and on the rear of the portable case for portable machines.

II. OUTPUT:

A. For Studio Line:
Plus 4VU, 600Ω line output, balanced or unbalanced, is available across Terminals 2 and 3 of the Line Out Connector, (M9). Pin 1 is the chassis ground. If unbalanced output is desired, tie either side of the line to ground. It is necessary to supply 600Ω termination to this output at all times in order to maintain correct meter calibration while recording or playing back. Therefore, if the output is not feeding a terminated line or if the output is not connected, such as on remote pickups, the Line Output Termination Switch, (M11), must be switched to In.

B. For Connection To High Impedance Amplifier Input:

Connect pin 3 of the line out connector (M9), to the high side of the amplifier input. Strap pins 1 and 2 of the connector and connect to the ground side of the amplifier input. The line output termination switch, (M11), must be left in the position designated "In" at all times, as explained in "For Studio Line", above.

III. INPUT:

A. Microphones:
Any low impedance microphone, the nominal impedance of which is in the range of 30 to 250Ω can be plugged in directly. Connect the microphone to pins 2 and 3 of the input connector, (M1). Connect cable shield to pin 1. Place the input transfer switch, (M2), in the "Mic" position.

The microphone input transformer is strapped for the optimum step up for a 150 to 250Ω source. In the case of microphones having 50Ω or less impedance, 6db additional gain can be obtained by strapping the input as shown in Figure 16B. This is not usually necessary, however, and should not be done unless insufficient gain is found to exist. If the input is re-strapped, serious frequency discrimination will exist should the input be fed from a source impedance greater than 50Ω.

IMPORTANT:
(R9) and (R10) will have to be changed to 24Ω to maintain a flat responce on balanced bridging when the transformer is strapped for 50Ω source impedance.

High impedance microphones are not recommended for use on this equipment. In general, the quality obtainable from high impedance microphones is not satisfactory for professional work. In the event that it becomes necessary to to connect a high impedance microphone, the input circuit will have to be rewired as shown in Figure 16A.

B. Bridging A Balanced Studio Line:
Connect a balanced line to pins 2 and 3 of the input connector (M1). Pin 1 is ground. Place the input transfer switch, (M2), in the Balanced Bridge position. Input levels of minus 10 to plus 10 VU can be accommodated. The load placed on the line is approximately 400,000Ω.

If the input transformer is re-strapped for 50Ω, the input level accommodated on the balanced bridge position is minus 4 to plus 16 VU.

For bridging higher or lower level lines, an external bridge can be wired in the line to the machine. This would consist of two resistors, the value of which should be from 15,000 to 50,000 times the RMS program voltage, in series with each side of the line. A 24Ω resistor should terminate each leg of the output side of the two bridging resistors. The junction of the two 24Ω resistors should go to chassis ground. The output of the bridge must be fed to the microphone input of the recorder. The input of the recorder may be connected for any impedance from 50 to 250Ω.

C. Bridging An Unbalanced Source:
Connect unbalanced line, radio tuner ect., to pins 3 and 1 of the input connector (M1). Pin 1 is the ground side. Place the input transfer switch (M2), in the unbalanced bridge position. This connection provides a 100,000Ω bridging input for any RMS program voltage greater than 1/2 volt. To increase the input impedance above 100,000Ω, a series resistance of 470,000Ω can be wired into the input plug in series with pin 3 and the input cable. This will necessitate an input voltage of at least 2 1/2 volts RMS. It is important that this resistor be physically placed in the cable connector that plugs into the recorder input (M1) in order that the cable capacity be on the input side of the resistor.

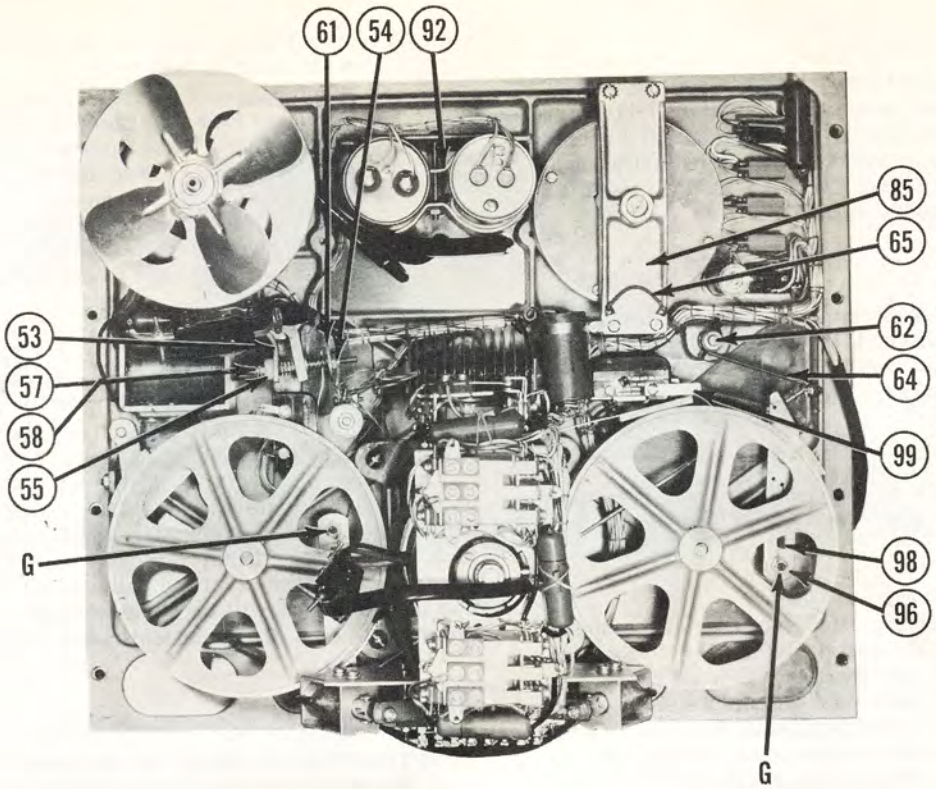


Figure 4

IV. PHONES:

Any sensitive high impedance head phones can be plugged in the phone jack (M10), provided for monitoring the incoming line or playback output.

VII. Conversion From Portable To Rack Mount:

If a portable or console recorder is converted to a rack mount, takeup tension arm counterbalance spring (65) must be added. This spring is supplied with the recorder and is hooked to the reel idler thrust bracket (85). To install, remove from bracket (85) and install between the lug provided on safety switch (M24) and the anchor (66) provided on the takeup tension arm collar (63). When shipped as a rack mount machine the spring will be installed. If the conversion is to be permanent, the oiling caps of the turntable motor (6), if equipped with sleeve bearings, should be rotated to be accessible for oiling.

SECTION III

OPERATING PROCEDURE

I. Reel Size:

The turntable on the left side (tape supply) is equipped to handle either the NARTB 10 1/2" reel of tape or the smaller R.M.A. 5" and 7" sizes. On portable machines position the small reels on the turntable engaging the turntable keys. For the large 10 1/2" reel, use the black plastic centering guide (catalog #976) that has been provided. On rack mount machine, use the hold-down knob (catalog #534) with both small and large reels. With small reels avoid excessive pressure when positioning the knob or the reel flanges will be distorted.

The turntable on the right side (Takeup Reel) is designed to handle only the NARTB 10 1/2" reel. No attempt should be made to use the small reel sizes on this turntable as the performance of the recorder will be seriously impaired.

II. Tape Threading:

Thread the tape as indicated in Figure 1. All new factory wound reels should be unwound and inspected by running through at Fast Forward before making a recording on the tape. New tapes are usually looped to the hub in such a manner that the tape will not come free of the reel at the end of the reel. This will prevent safety switch (M24) from disengaging the capstan idler (50) from capstan (A) which results in a flat being worn on the rubber capstan idler wheel. Any adhesive material accumulation on the reel hub must be removed with solvent for the same reason.

III. Half-Track Operation:

The handling of half-track tapes on this machine is accomplished in the following manner. The tape is threaded and operated as described under "Tape Treading" and "Tape Motion". However only the upper half of the tape will be used on the half-track machine. To utilize the lower half of the tape, the full reel on the Takeup Turntable should be removed, turned over and placed on the Tape Supply Turntable upside down. Place an empty reel on the Takeup Turntable. Repeat the operation as performed on the first track.

IV. Power:

Power is supplied through power switch, (M19), which must be turned on to operate the Electronics and Mechanical Assemblies. The Mechanical Assembly and Electronics Assembly are individually fused by the 2 ampere Control Circuit Fuse (M16) and the 1 ampere Electronics Fuse (M17).

V. Speed Switches:

There are two switches associated with operating speed. Speed Switch (M37) governs the motor and the Equalization Speed Switch (M3) corrects the equalization in the amplifiers.

VI. Tape Motion:

The tape motion is controlled by means of four pushbuttons labeled Stop, Start, Fast Forward, and Rewind.

1. Play Or Record:
The tape is set into Play motion at the speed selected by the Speed Switch (7 1/2"/Sec. or 15"/Sec.) when the Start Button (M35) is depressed. The tape must be completely stopped before starting in this position. To change from Play position to Record position with the tape in motion, press Record Button (M5).

2. Stop:
To stop the tape motion while it is moving in any mode press the Stop Button (M34). This will occur automatically if the tape should break or run off either reel.

3. Fast Forward:
If the tape is in the Play or Record mode, press the Fast Forward Button (M32). If the tape is stopped, first press the Start Button, then the Fast Forward Button or press both at the same time. This provides a Fast Forward speed which is used to arrive rapidly at a point within a reel.

4. Rewind:
If the tape is in the Play or Record mode, press the Rewind Button (M33). If the tape is stopped, press the Start Button then the Rewind Button or press both at the same time. This provides a fast reverse to rewind a tape completely or to return to an earlier section. In using either the Fast Forward or Rewind mode, it is desirable to remove the tape from direct contact with the heads by opening the gate of the Head Assembly. This will reduce wear on the heads and prevent the oxide coating on the tape from depositing on the heads and impairing their performance. It is not possible to switch from Rewind to Fast Forward or vice versa unless the machine is returned to Stop. Interlocking the machine in this manner provides the least possible wear on the Tape Transport System.

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. Hold down the Stop and Fast Forward or the Stop and Rewind Buttons. Now press the Start Button and control the tape speed with this button.

CAUTION: Avoid this operation at high speeds, as it will result in tape breakage if the wrong combination of buttons should be pushed. When the tape is traveling at high speed in the Rewind or Fast Forward mode, the tape will break if the Stop and Start Buttons are pressed in rapid sequence. This is caused because sufficient time is not allowed for the brakes to stop the tape before the Capstan Idler locks the tape to the Capstan.

VII. Playback:

To play back a previously recorded tape, turn the Meter and Output Switch, (M8), to the extreme left position designated Playback. Then start the tape in motion as indicated under "Play". If the recording was made at the correct level, the VU Meter will peak on 0 (zero). No attempt should be made to alter the gain of the Playback Amplifier if the meter does not peak on 0 (zero). Otherwise, the calibration of this meter as a record level indicator will be destroyed. The playback gain will be close when playing any tape recorder to N. A. B. specifications at 15"/Sec.

VIII. Record:

To record a new program on previously recorded tape, or on blank tape, turn the Meter and Output Switch to the Second position from the left which is designated Record Level. Turn the Record Gain Control clockwise until the level reads 0 (zero) on the VU Meter on the most intense program peaks. The program can be audibly monitored through either the Phone Jack or the Line Out Connector before the tape is in motion. (For correct meter calibration it is important that the Line Out be properly terminated either external to the machine or by use of the Line Output Termination Switch). This direct monitor feature allows the program to be set up through the machine without actually recording during the set up period.

When the program level is properly set, start the tape in motion as indicated under "Play". Then push the Record Button. (Be sure there is a delay of at least 1/2 second before operating the Record Button, as the surge from operating the Start Button may magnetize the record head, thereby increasing the noise level on the tape). The Record Indicator above the Record Button will now glow and the machine is recording.

It is desirable to check the record bias and erase currents occasionally. In order to do this, reposition the Meter and Output Switch to the positions designated Bias and Erase, respectively. The erase is not critical and should read approximately zero on the meter scale. The bias should read between - 1/2 and + 1/2 on the VU scale. The bias is somewhat critical and must be kept within the indicated range in order to record the higher frequencies at 7 1/2 inch tape speed.

The bias is adjusted by means of the locked Bias Control (R2). The meter calibration for bias measurement can be checked as described under "Tape Motion" (VI.).

An actual comparision of the recording with the direct program can be made both audibly and on the

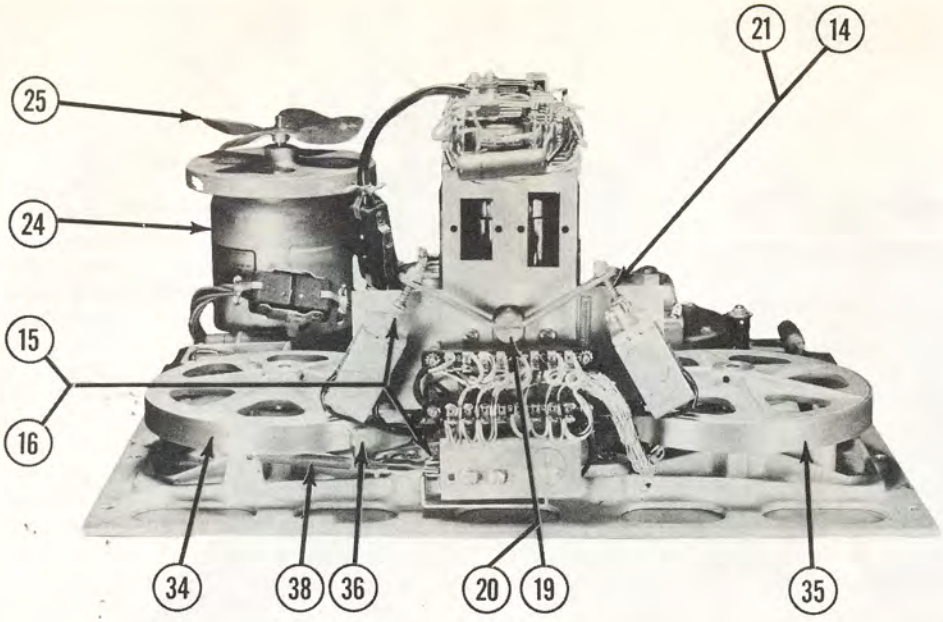


Figure 5

VU Meter by moving the Meter and Output Switch to the extreme left position for playback monitor, and then to the second from the left position for monitor of the unrecorded program. The levels as read on the meter and the quality as heard will be the same within the tolerances of the machine. It should be noted that some change in level as read on the VU Meter while switching from A to B will be experienced if a tape of different manufacture than the one used to set up the machine is used.

When the program being recorded is finished, press the Stop Button. The Tape Transport will stop and the Record Relay will drop out, making the record circuits inactive. The record circuits will remain inactive until the Record Button is again depressed while the tape is moving in the Play mode.

NOTE: Because of the extremely wide frequency range of the VU Meter, some pickup of the erase and bias frequency will be experienced while monitoring the record or playback level while recording. The pickup of this oscillator frequency (approximately 100KC) can be read on the VU Meter approximately 20db below the program level, but does not interfere in any way with the performance of the machine.

SECTION IV

OPERATING THEORY

I. Mechanical Assembly:

To understand the operation of the Tape Transport Mechanism it is necessary to examine the following assemblies in the various modes of operation:

1. Capstan Drive Motor (24), Figure 5.
The capstan motor is a synchronous motor whose extended shaft forms the tape drive capstan (A) Figure 2. It has two sets of windings to provide the two tape speeds.

2. Turntable Motor (6) Figure 6.
The turntable motor is an induction motor which drives either the Tape Supply or Takeup Turntable by means of a Rubber-tired Pulley (7) on its shaft. The motor is positioned to contact either of the turntable Brake Drums (34 and 35), Figure 5, by the Tilt Solenoids (M43 and M44).

3. Capstan Idler (50), Figure 2.
The capstan idler is positioned by the Capstan Solenoid (M41). In the Play mode of operation the Idler is positioned against the Capstan (A) and drives the tape at a constant speed.

4. Stopping Brakes (36 and 39) Figure 5 & 8.
The Stopping Brakes are solenoid operated to stop the turntables whenever the machine is stopped.

5. Reel Idler (69), Figure 2.
The Reel Idler is provided to smooth out any takeup speed variations in the tape system.

6. Takeup Tension Arm (62), Figure 2.
The Takeup Tension Arm provides automatic stop at the end of the reel of tape or if the tape should break.

7. Constant Tension Brake (47), Figure 8.
The constant tension brake is mechanically operated by the constant tension arm (44), Figure 2. It provides constant hold-back tension to the tape supply turntable (27), regardless of the amount of tape on the reel or its size.

When the Power "On-Off" Switch (M19) is thrown, AC voltage is applied to the Electronics Assembly and to the Capstan Motor. Therefore, the Capstan is turning whenever the recorder is turned on, which makes possible the fast start feature. When the tape is threaded the Safety Switch (M24) is actuated by the takeup tension arm (62). This energizes the DC Power Supply which in turn provides power to operate the solenoids and relays.

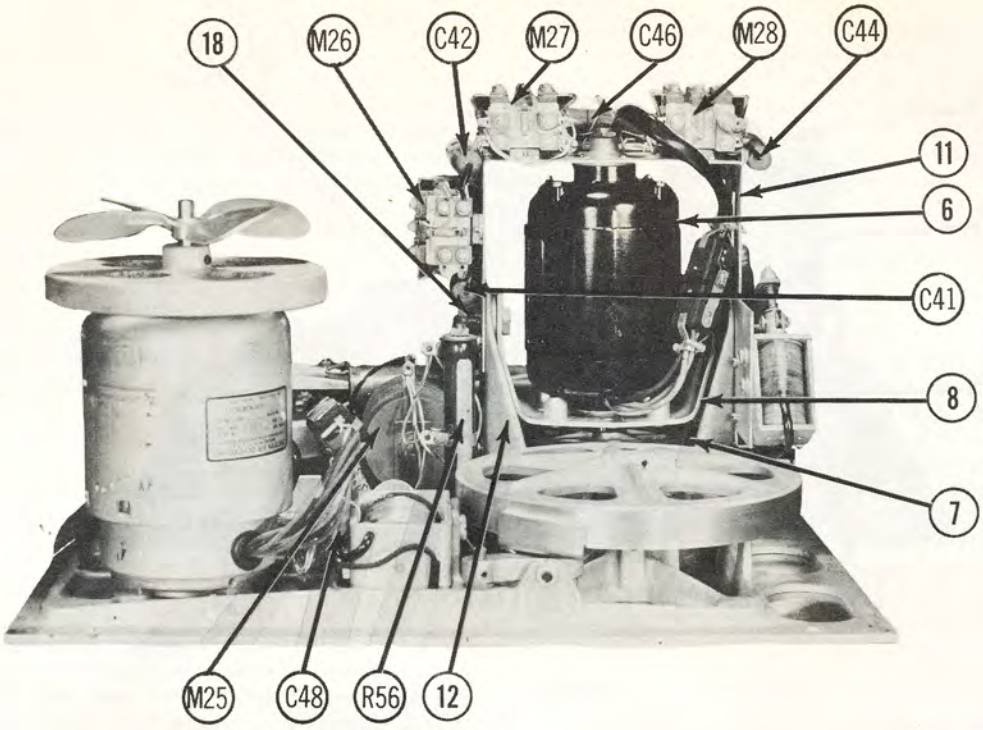


Figure 6

Start:

When the Start Button (M35) is pressed the Start Relay (M26) will be energized. It is held energized through its own contacts and the normally closed Stop Button (M34). The Start Relay, through appropriate interlocks, performs the following functions:

1. Energizes the Brake Solenoid (M42) thus releasing the Stopping Brakes (36 and 39).
2. Energizes the Forward Tilt Solenoid (M44) thus positioning the Turntable Motor in the takeup position.
3. Applies AC power through the Takeup Torque Switch (M40) to the Turntable Motor.
4. Energizes the Capstan Solenoid (M41) which positions the Capstan Idler (50) to contact the tape and the Capstan.

The Capstan Solenoid when energized mechanically opens the Takeup Torque Switch which inserts a resistor (R56) in series with the Turntable Motor. This allows the high starting torque to be reduced to a more suitable value for operating conditions. (Full power is utilized in Fast Forward or Rewind). The recorder is now operating in the Play mode of operation with the tape moving at the speed selected by the Speed Switch (M37).

Fast Forward:

If the Fast Forward Button (M32) is pressed and the machine is in the Play mode of operation, the Fast Forward Relay (M27) will be energized. The relay performs the following functions:

1. It interlocks the Rewind Relay (M28) so it can not be energized.
2. If breaks the circuit to the Capstan Solenoid.

When the Capstan Solenoid is de-energized the Takeup Torque Switch closes, thus applying full power to the Turntable Motor. Since the Forward Solenoid is still energized the machine is now operating in the Fast Forward mode of operation. If the Rewind Button is pressed nothing will happen and it is necessary to return to Stop before the mode of operation can again be changed. This interlocking prevents scuffing the Turntable Motor Tire on the Brake Drums.

Rewind:

If the Rewind Button (M33) is pressed and the machine is in the Play mode, the Rewind Relay (M28) will be energized. The relay performs the following functions:

1. It interlocks the Fast Forward Relay (M27) so it can not be energized.
2. It breaks the circuit to the Capstan Solenoid (M41) and the Forward Tilt Solenoid (M44).
3. It energizes the Rewind Tilt Solenoid (M43) thus positioning the Turntable Motor in the Rewind position.
4. It reverses the polarity on one winding of the Turntable Motor thus reversing its direction.

When the Capstan Solenoid is de-energized the Takeup Torque Switch closes applying full power to the Turntable Motor. The machine is now operating in the Rewind mode of operation. If the Fast Forward Button is pressed nothing will happen and it is necessary to return to Stop before the mode of operation can again be changed.

Stop:

When the Stop Button is pressed during any mode of operation, the Start Relay will be de-energized. This in turn breaks the circuits to the Rewind and Fast Forward Relays and to the circuits described in the paragraph on Start. The Stopping Brakes will be applied to both turntables. In addition it ap-

plies DC power through a series resistor (R55) to the capacitor winding on the Turntable Motor. This brakes the motor and prevents throwing a tape loop when the tape direction is changed.

II. Head Assembly:

The Head Housing is a die cast assembly which contains the three heads used in the recording process. The heads are respectively Erase, Record and Playback as viewed from left to right when facing the machine. The gate on the housing holds the Playback and Record Shield Covers and the Tape-lifting Fingers. The function of the Tape-lifting Fingers is to remove the tape from the heads when the gate is open during Rewind or Fast Forward position. This reduces head wear considerably. The tape may leave a deposit on the heads if allowed to contact them at high speeds. Such a deposit will seriously impair the performance of the machine and should be guarded against by always opening the gate on Fast Forward and Rewind. If a deposit is left, it may be easily removed with carbon tetrachloride on a soft rag. Never use metal of any kind to touch the head surfaces. The gate should never be allowed to spring shut but should be closed gently.

The Model 400A Recorder incorporates half-track Erase, Record, and Playback Heads. These heads function on the upper half of the tape only. In order to use the remaining half of the tape the reels must be turned over as explained in paragraph on "Half Track Operation". The Head Assembly of the Model 401 Recorder incorporates full track Erase and Record Heads thus producing tapes interchangeable on any full track equipment. A half track Playback Head is still used on this machine and provides adequate playback on both full track and half-track tapes.

III. Electronics Assembly:

The Electronic Assembly of the Model 400A Recorder consists of a Record Amplifier, a Playback Amplifier and an Erase and Bias Oscillator on one chassis and a Power Supply on a seperate chassis.

The Record Amplifier is a four stage, high gain amplifier that feeds the Record Head through the Noise Balance Circuit and Record Relay (M6). The Record Relay is energized by the Record Button (M5) through contacts of the Start Relay (M26) in the energized position and contacts of the Fast Forward Relay (M27) and the Rewind Relay (M28) in de-energized positions. Therefore the Record mode of operation can only be realized when a tape is traveling at the Play speeds. Whenever the Fast Forward, Rewind or Stop Buttons are depressed, the Record Relay will be de-energized. Three input impedances can be selected by the Input Transfer Switch (M2); low impedance microphone, balanced bridge and unbalanced bridge. The Record Amplifier also provides seperate high frequency pre-emphasis for each speed. This change in equalization is made by the Equalization Speed Switch (M3) located on the front panel. The Record Gain Control (R1) is located on the front panel.

The Playback Amplifier is a three stage amplifier which provides plus 4 VU 600Ω output at the Line Out Connector (M9). The playback equalization is the same for both speeds and is adjusted to a standard curve by (R5), located on top of the Electronics Chassis. The playback gain is controlled by (R4) also located on top of the Electronic Chassis. An output termination is provided by the Line Out Termination Switch (M11).

Monitoring is provided by a VU Meter and a Phone Jack connected to the Playback Amplifier output. The Meter and Output Switch provides four monitoring checks: Playback Level, Record Level, Bias Current and Erase Current. In the Erase position the VU Meter is connected across the 7Ω resistor (R52) to read erase current. In the Bias position the meter is connected across the adjustable 500Ω resistor (R3) to read bias current. In both the Record and Playback Level positions the meter is connected across the Playback Amplifier output. In the Playback position the Playback Amplifier functions normally and the output of the tape is monitored. In the Record position the last two stages of the Playback Amplifier are disconnected from the first stage and bridged across the Record Amplifier before pre-emphasis through the Record Level Meter Calibration Control (R7). The Calibration Control is adjusted so that the meter will read the same when monitoring either playback or record.

The Erase and Bias oscillator provides the 100 KC erase and bias frequency. It feeds the erase head through the Erase Trimmer (C33) located on the top plate of the Electronics Chassis. It feeds the record head through the Record Bias Control located on the front panel. The Power Supply provides the 6.3 Volt AC heater power, the 12.6 Volt DC heater power through Full Wave Selenium Rectifier (M21) and the 350 Volt plate supply through the 5Y3G Full Wave Rectifier (V10).

SECTION V

ROUTINE MAINTENANCE

I. Cleaning:

The Tape Transport Mechanism should at all times be kept clean and dry. The following parts should be inspected daily before the use of the recorder and cleaned with a soft rag and carbon tetrachloride or alcohol, if necessary. Refer to Figure 2.

1. Head surfaces contacted by tape.
2. Capstan (A).
3. Capstan Idler (50). Cleaning is required only if foreign matter should adhere to the rubber.
4. Capstan Tape Guide (89).
5. Constant Tension Arm Tape Guide (45).
6. Reel Idler Pulley (71).
7. Takeup Tension Arm Tape Guide (J).

II. Head Demagnetization:

Occasionally the heads may become magnetized through an electrical fault in the amplifiers, improper use of the machine, or by the heads coming in contact with a magnetized object. This will result in an increase of noise level from 5 to 10db. It is especially important that the heads be free of magnetization if you are to realize the dynamic range of the machine. It should be remembered that any phenomena that tends to put an unbalanced pulse through the Record Head will magnetize it. Such pulses can appear in the form of signal or power line pulses. If the following pre-

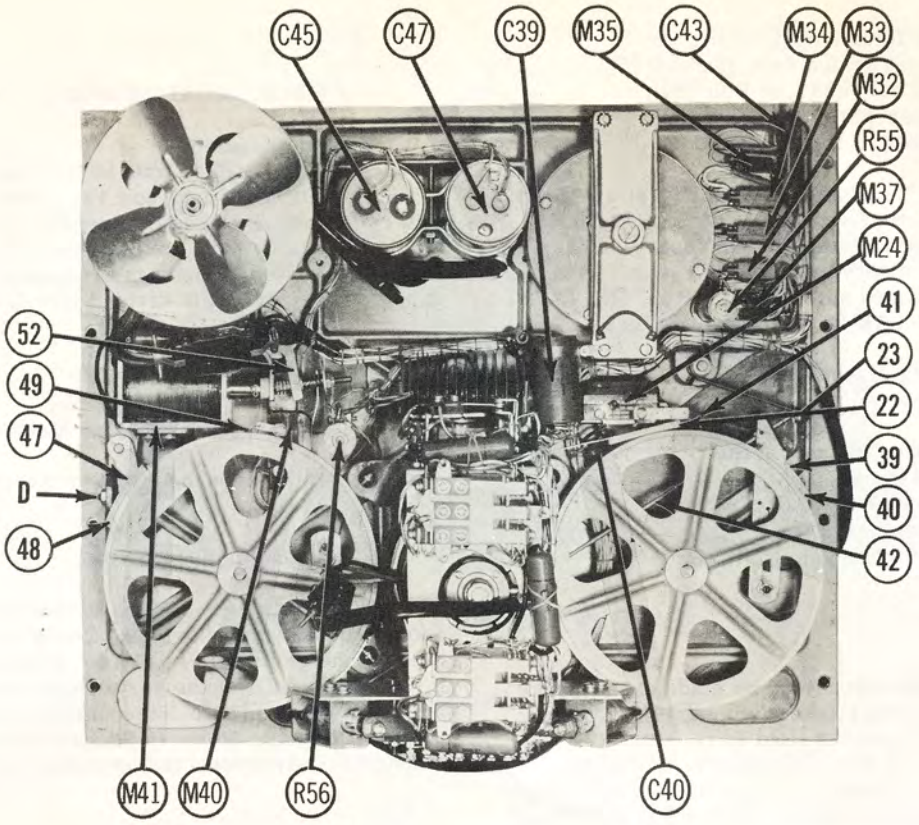


Figure 8

d. Takeup Torque Switch (M40). For adjustment, see Section VII-7.

2. DC Relay and Solenoid Power Supply.
   a. Selenium Rectifier (M25).
   b. Resistor (R54).
   c. Electrolytic Capacitor (C39).

3. Relays.
   a. Start Relay (M26).
   b. Rewind Relay (M28).
   c. Fast Forward Relay (M27).

4. Solenoids.
   a. Capstan Solenoid (M41). For adjustment, see Section VII-1.
   b. Forward Tilt Solenoid (M44). For adjustment, see Section VII-8.
   c. Brake Solenoid (M42). For adjustment, see Section VII-2.

5. Play Resistor (R56) for an open circuit.

6. Jumper from Terminal 7 to 8 on the Remote Control Terminal Strip (M36).

NOTE: Machines equipped for "plug in" of Remote Control must have the properly jumpered Dummy Plug (catalog #3461) inserted in the Remote Control Connector in absence of a Remote Control System.

7. Binding of Turntable Motor Pivots (18) and (19).

8. Cables interfering with the Brake Drums (34) and (35).

9. Counterbalance Spring (65) in rack mount position on portable machines. See Section II-VII.

II. Irregularities In Play Mode:

A. Unsatisfactory starting in Play Mode. Check the following:

1. Takeup Torque Switch (M40) for adjustment. (May be opening too early). See Section VII-7.

2. Binding of Turntable Motor Pivots (18) and (19) may cause late engagement of Turntable Motor.

3. Tilt Solenoids (M43) and (M44) if misadjusted can cause slippage or late engagement of Turntable Motor. See Section VII-8.

4. Insufficient takeup torque in the Play mode.
   a. Play Resistor (R56) set too high. See Section VII-9.
   b. Cable interfering with Takeup Brake Drum (35).

5. Stopping Brakes (36) and (39).
   a. Dragging brakes.
   b. Brake Clearance adjustment too great so that brakes are slow in releasing. See Section VII-2.

6. Capstan Idler Pressure adjustment. See Section VII-1.

7. Takeup Tension Arm (62) sluggish.

8. Constant Tension Brake (47) adjustment. See Section VII-3.

9. Low relay and solenoid supply voltage which would slow down the relay and solenoid operation time.

B. High flutter. The low flutter specifications on this equipment are rigidly met. Any noticable flutter can probably be traced to one of the following:

1. Cable dragging on:
   a. Takeup Brake Drum (35).
   b. Reel Idler Flywheel (78).
   c. Capstan Drive Motor Flywheel.

2. Foreign material such as a deposit left by the tape on:
   a. Capstan (A), Figure 2.
   b. Reel Idler Pully (71), Figure 2.
   c. Capstan Idler (50), Figure 2.
   d. Turntable Motor Tire (7), Figure 6.
   e. Takeup Brake Drum (35), Figure 5.
   f. Head Surfaces.
   g. Tape Guides (45), (89), and (J), Figure 2.

3. Excessive drag in Reel Idler (69). If Reel Idler is quiet and turns freely it is not likely to contribute to the flutter and should not be disassembled. If the Reel Idler will not turn freely or is noisy, check the following. Refer to Figure 9.
   a. Reel Idler Adjustment. See Section VII-6.
   b. Top Bearing (72) insufficiently lubricated. See Section V-IV.
   c. Thrust Bearing (86) worn.
   d. Foreign material in Lower Bearing (75).

4. Capstan Drive Motor (24).
   a. Top Bearing insufficiently lubricated. Do not over-lubricate. See Section V-IV.
   b. Bent Capstan (A).
   c. Motor windings partially open or shorted.

5. Capstan Idler (50) defective.

6. Takeup Torque Switch (M40) (not opening). See Section VII-7 for adjustment.

7. Bad Tape (worn, ragged, or of poor quality).

8. Recorder subjected to excessive external vibration.

C. Recorder fails to shut off when tape runs out. Check the following:

1. Takeup Tension Arm (62) sluggish due to:
   a. Dirt between Takeup Tension Arm (62) and Bushing (3).
   b. Takeup Tension Arm Return Spring (64) disconnected or broken.
   c. Safety Switch (M24) inoperative or out of adjustment. See Section VII-10.
   d. Safety Switch Capacitor (C40) shorted.

D. Instability of Tape on Capstan. Check the following:

1. Oil on Capstan (A) or Capstan Idler (50).

2. Takeup Torque Switch (M40) not opening causing excessive takeup tension. See Section VII-7 for adjustment.

3. Capstan Idler Pressure Adjustment. See Section VII-1.

4. Capstan Solenoid (M41) (not seating).

5. Constant Tension Brake Spring (49) disconnected or broken.

6. Constant Tension Arm (44) binding in Bushing (5).

7. Bad Tape (stretched edges or bad splices).

E. Recorder goes into Fast Forward Mode when Start Button is depressed. Check the following:
   1. Capstan Idler Pressure Adjustment. See Section VII-1.

   2. Capstan Solenoid (M41) for defect.

III. Irregularities In Fast Forward Or Rewind Mode.

A. Recorder stops when Fast Forward or Rewind Buttons are depressed. Check the following:

1. Fast Forward Button (M32).

2. Rewind Button (M33).

3. Fast Forward Relay (M27).

4. Rewind Relay (M28).

5. Rewind Tilt Solenoid (M43). For adjustment, See Section VII-8.

B. Recorder sluggish in Fast Forward or Rewind. Check the following:

1. Takeup Torque Switch (M40) (stays open), See Section VII-7 for adjustment.

2. Cable Dragging on either Brake Drum (34) or (35).

3. Stopping Brakes (36) and (39).
   a. Dragging Brakes.
   b. Brake Solenoid (M42) loose or inoperative. See Section VII-2.

4. Turntable Motor (6) for insufficient lubrication. See Section V-IV.

5. Slippage between Turntable Motor Tire (7) and Brake Drums (34) or (35).

the linkage. Improper adjustment will result in excess braking differential.

F. Brake Drum Cleaning Procedure.

In servicing the recorder the Brake Drums (34 and 35) may become contaminated by handling or by oil or grease getting upon them. Mild cases of contamination will soon disappear through the normal operation of the machine. The Brake Shoe may chatter until the contamination wears off. In such cases cleaning is not necessary if the recorder handles the tape satisfactorily. If operation is unsatisfactory clean both brake drums as follows:

1. Hold a piece of #320 wet-or-dry sandpaper firmly against the braking surface of the Brake Drum.

2. Rotate the Brake Drum four or five revolutions by turning the turntable. It is not necessary to release the brakes for this operation. Shift the sandpaper to a clean spot frequently to avoid contamination of the paper.

3. If this does not cure the condition the Brake Linings have become contaminated and should be replaced. See Section V-V.

3. Constant Tension Brake Adjustment.

The Constant Tension Brake (47) is adjusted for minimum clearance between the Constant Tension Brake Lining (48) and the Tape Supply Brake Drum (34) when the Brake is released. The adjustment is made by the Brake Stop, a set screw and lock-nut shown in Figure 8, Point D. As the Brake Lining wears readjustment of the Stop is desirable.

a. Loosen the lock nut. With both the Stopping Brakes and Constant Tension Brakes released, screw in the set screw until a slight drag is noticed on the Brake Drum.
b. Back off the set screw until the drag just disappears.
c. Tighten the lock nut and re-check for drag. The drum should spin freely with both Brakes released. The Constant Tension Arm (44) should have a very short travel - approximately 1/8 inch at the end of the arm.

NOTE: It is important that the force applied to the Constant Tension Brake (47) by the Constant Tension Brake Spring (49) be in the correct direction; otherwise the Brake Lining may wear unevenly and the Brake may oscillate or chatter causing high flutter. This should not be confused with the normal motion of the arm to compensate for discontinuities in the reels. If the Spring is attached to the Takeup Torque Switch (M40) with a solder lug, this lug should be positioned at right angles to the edge of the Switch.

4. Turntable and Brake Drum Height.

The height of both the Turntables (27 or 28) and their respective Brakes Drums (34 and 35) must be carefully adjusted whenever they are removed. Their removal should be avoided unless absolutely necessary. When removing Brake Drums, first loosen the Turntable Set Screws. Loosen the Brake Drum set screws backing them off far enough to prevent galling of the Turntable Shaft. Lift the Turntable from the Brake Drum. Carefully mark the Brake Drums so they will be returned to the same shafts. If it is necessary to replace either a Brake Drum or a Turntable, they must be replaced as a pair.

When replacing Brake Drums, place a little oil on the Turntable Shaft and work the Drum on the shaft. Adjust the Turntable Height so that the top surface of the Turntable Pad (30), is 0.635 inches from the surface of the Mechanical top plate. Be sure to tighten the set screws.

After the correct Turntable Height is set, adjust the Brake Drum height so that the lower spoke side of the Brake Drum lines up with the Turntable Motor Tire. Approximately 1/32 inch of the Drum should show below the tire. Tighten the set screws, being sure that they line up with the flats on the Turntable Shaft. Clean the braking surface of the Brake Drum thoroughly as explained in Section VII-2F as it will become contaminated by handling.

5. Rewind Holdback Brake Adjustment.

The Rewind Holdback Brake (22) is adjusted to give a slight tension during rewind. It should only require adjustment if it is accidentally bent. With the Takeup Brake Drum (35) removed, the lining of the Holdback Brake should assume a position 2 5/8 inches from the edge of the Takeup Turntable Shaft.

6. Reel Idler Adjustment.

Should the Reel Idler (69) be removed, it must be reassembled as shown in Figure 9. Vertical play in the Reel Idler Pulley and Shaft Assembly (71) is provided by the Reel Idler Thrust Bearing (86).

a. Assemble the Reel Idler Housing (70) to the Mechanical Top Plate as shown in Figure 9.
b. Place a spacer 1/16 inch thick between the top of the Reel Idler Pulley (71) and the Reel Idler Housing (70).
c. Make sure that the Reel Idler Ball Bearing is in place. Slide the Reel Idler Spacer (84) on the shaft. Holding the Reel Idler Flywheel (78) by the Square Hub, bottom it against the Spacer and Ball Bearing. Then tighten the set screw.
d. Remove the 1/16 inch spacer between the Reel Idler Pulley and Housing.
e. Insert the Reel Idler Thrust Ball (87), using a little light grease to hold it in place in the center of the Reel Idler Shaft. Attach the Reel Idler Thrust Bracket (85).
f. Screw in the Thrust Bearing (86) until the vertical play in the Reel Idler Shaft and Pulley (71) is between, .010 and .020 inches. Tighten the Lock Nut (88). In the case of rack mounted machines, it is desirable to reduce the play to .003 to .005 inches.
g. Re-check to see that the play still exists after the Lock Nut is tightened. Insufficient clearance will prevent the proper operation of the idler. It should spin without drag.

7. Takeup Torque Switch Adjustment.

The Takeup Torque Switch (M40) plays an important role in starting the recorder in the Play mode. It allows full voltage to be applied to the Turntable Motor until the Capstan Idler engages the tape, facilitating fast starting without throwing tape slack. The adjustment is made by bending the tongue of the micro switch. To check for correct adjustment, actuate the armature of the Capstan Solenoid (M41) by hand. The Takeup Torque Switch should "click" or open after the Capstan Idler (50) has made firm contact with the Capstan (A) but slightly before the armature of the Solenoid seats. Allow approximately 1/32 inch over travel for safety. Check the Play Takeup Torque as explained in Part 9 of this Section. If the torque is considerably more than 7 ounces, the Takeup Torque Switch is not opening. Severe deformation of tape may result and the Turntable Motor may overheat to the point of destruction.

8. Forward and Rewind Tilt Solenoid Adjustment.

The Forward Tilt Solenoid (M44) and the Rewind Tilt Solenoid (M43) position the Turntable Motor (6) to engage the proper Brake Drum depending upon the mode of operation. Adjustment is made by lock nuts. They should be adjusted sufficiently tight to prevent any slippage between the Turntable Motor Tire and the Brake Drums.

The adjustment consists of the following:

a. Remove the Turntable Motor Positioning Spring (68).
b. Back off the Solenoid Adjusting Nuts until the Turntable Tire will not touch the Brake Drums when either Solenoid is bottomed.
c. Tighten either Solenoid Adjusting Nut until the Tire just touches the Drum with the Solenoid bottomed. Then tighten the nut one full turn after this contact. In order to bottom Solenoid and indicate tire contact with the Drum, fasten the Takeup Tension Arm (62) in the operating position and start the recorder in the Rewind or Fast Forward mode as required.
d. Repeat Setp C with the other Solenoid.

9. Play Takeup Torque Adjustment.

The voltage to the Turntable Motor (6) is reduced through the Play Resistor (R56) in the Play mode of operation. Moving the slide on this resistor toward the Mechanical Top Plate increases the voltage to the Turntable Motor and its torque. To check for proper torque:

a. Fasten the Takeup Tension Arm (62) in operating position.
b. Attach a piece of string about 30 inches long to hub of the 10 1/2 inch Takeup Reel with the other end attached to a spring scale (0 to 16 oz. preferred).
c. Place the recorder in Play mode.
d. The Takeup tension should be 7 to 71/2 ounces as the scale is allowed to move slowly in the direction of pull.

10. Safety Switch Adjustment.

The Safety Switch (M24) is factory adjusted and should not require attention unless the switch or Takeup Tension Arm (62) is removed. The Safety Switch is actuated by the pin that holds the Takeup Tension Collar (63) to the Takeup Tension Arm (62). The tongue of the Safety Switch should be bent so the micro switch opens slightly before the end of travel of the Takeup Tension Arm. Allow 1/4 inch over-travel of the arm for dependability.

SECTION VIII

ELECTRONIC ALIGNMENT

Alignment is the necessary adjustments required to have the Electronic Assembly of the recorder perform properly. A machine "out of alignment" may be characterized by poor frequency response, high noise, low output, or high distortion. No adjustments should be necessary except as required by routine maintenance where the machine will not perform as indicated under Specification Section I when checked according to Section II-VIII.

Alignment consists of the following steps:

I. Head Alignment.

II. Erase Adjustment.

III. Record Level Meter Calibration.

A standard tape is available for alignment purposes and contains the following frequency run recorded at 15 inches per second, 10db below 15 inch operating level.

CAUTION: Before playing the standard tape demagnetize the heads with the Ampex Head Demagnetizer, catalog #704. Magnetized heads will cause a partial erasure of the high frequencies on the standard tape.

1 KC for level adjustment.
15 KC for playback azimuth alignment.

50 cycles	8000 cycles
100 cycles	9000 cycles
200 cycles	10,000 cycles
400 cycles	11,000 cycles
800 cycles	12,000 cycles
1600 cycles	14,000 cycles
3200 cycles	15,000 cycles
6400 cycles	

I. Head Alignment:

The high frequency response of the recorder depends on the correct head alignment. If tapes are to be interchangeable from one machine to another the heads of all machines must have the same azimuth setting. This is accomplished by using a standard tape (Catalog #1993) for aligning the heads of all machines. Head alignment is independent of tape speed; however it is recommended that the heads be aligned at 15 inches per second since the standard tape is recorded at this speed.

Remove the top cover from the head housing by removing the two screws from the top and pulling cover gently back and up. Looking at the head housing from the front the three heads from left to right are: Erase, Record and Playback.

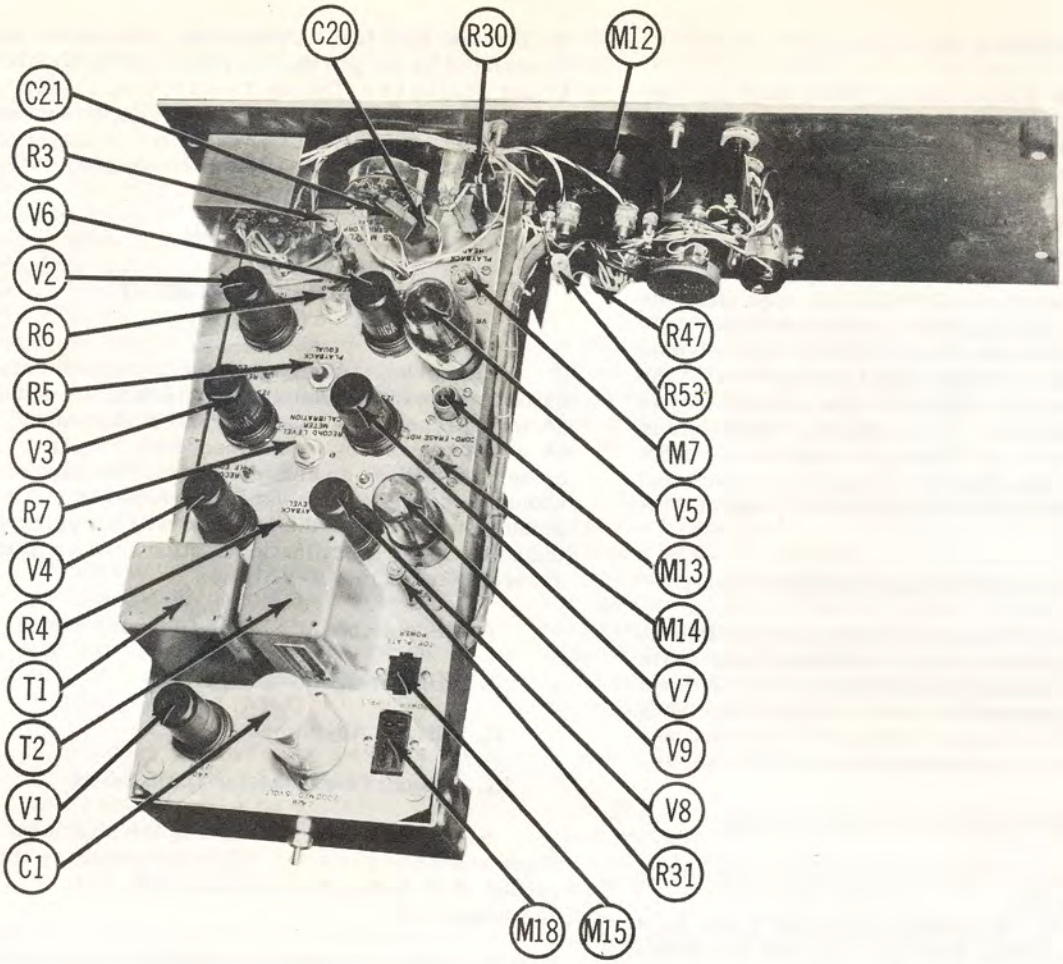


Figure 10

The azimuth angle of the erase head is not adjustable.

The record and playback heads should be aligned only after reading and fully understanding the procedure under Playback and Record Circuit Alignment.

The actual physical alignment of the Record and Playback Heads consists of placing a 1/4" spintite socket wrench on the left hand elastic stop nut in each head and adjusting back and forth until the proper azimuth angle is arrived at.

First adjust the Playback Head azimuth by playing the standard tape at 15 inches per second and adjusting the stop nut for the maximum output of the 15 KC tone (second tone that appears on the standard tape).

The Record Head azimuth is then aligned with the Playback Head by recording a 15,000 cycle signal from an audio oscillator on a blank tape and adjusting the record stop nut for maximum playback output.

II. Erase Adjustment.

The erase current is factory adjusted and no further adjustment should be necessary unless the erase head is replaced: Should this happen the following procedure must be followed:

a. Set the meter and output switch (M8) in the erase position and press the record button (M5).
b. Back off the erase trimmer (C33) to minimum capacity (clockwise direction).
c. Increase the capacity until the meter reads 0 (zero).

III. Record Level Meter Calibration:

The record level meter calibration control (R7) is adjusted so that the program level as read on the VU Meter is the same as monitored from the playback head or the incoming line. This is accomplished by recording a 400 cycle tone (or program in the absence of an audio oscillator) at 0 (zero) on the VU Meter with the meter and output switch (M8) in the Playback-Level position. Then switch the Meter and Output Switch to the Record - Level position and adjust the record level meter calibration control (R7) for 0 (zero) on the VU Meter.

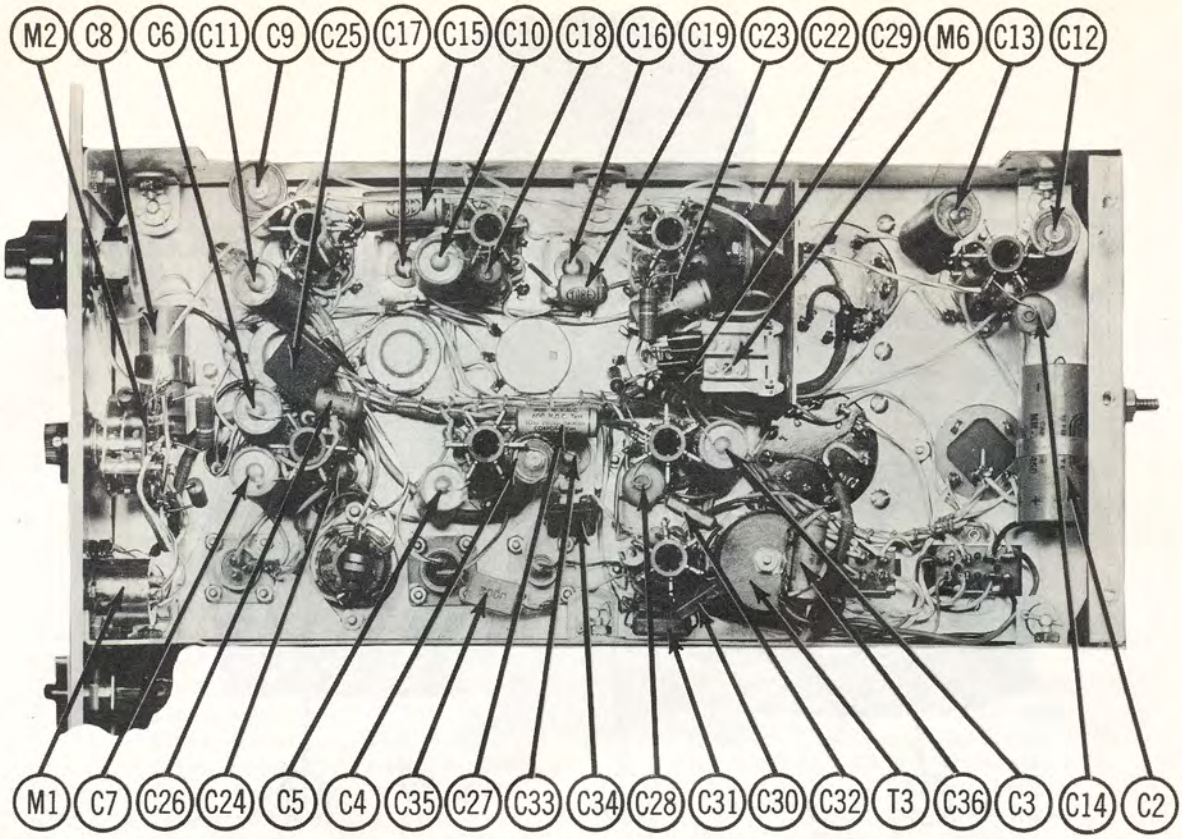


Figure 11

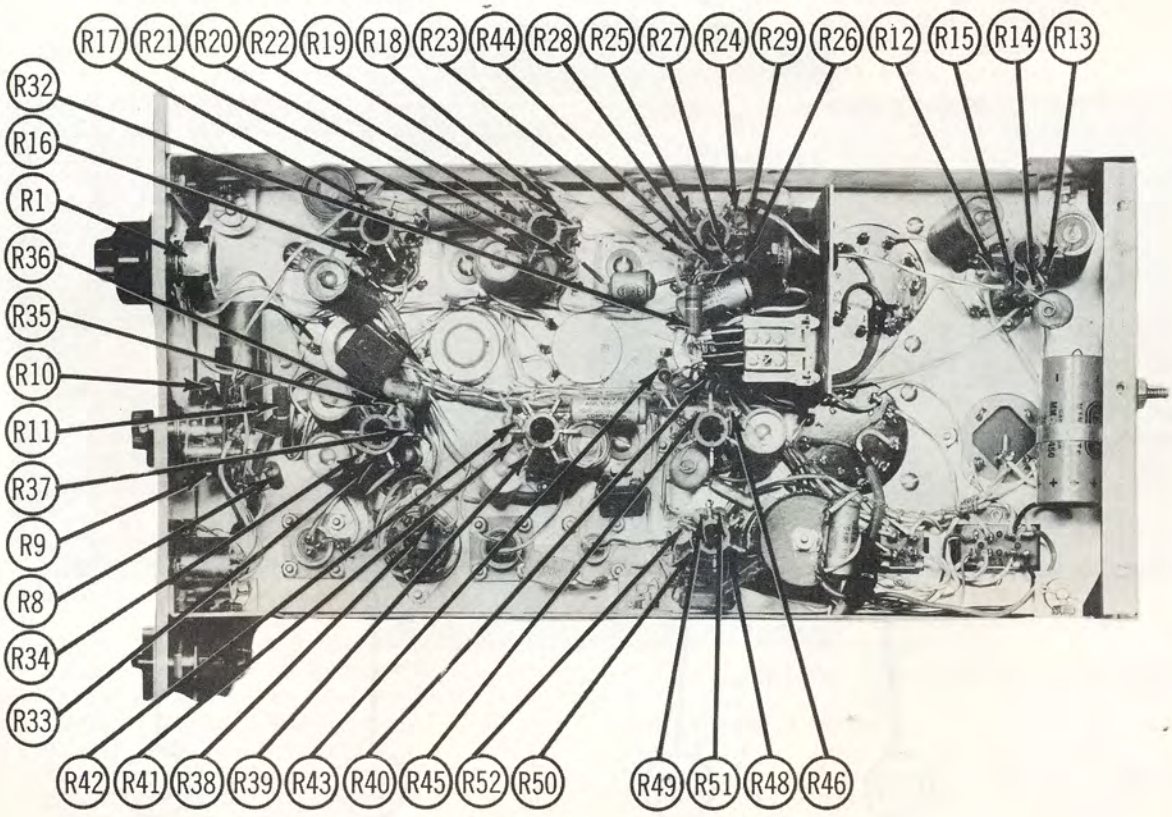


Figure 12

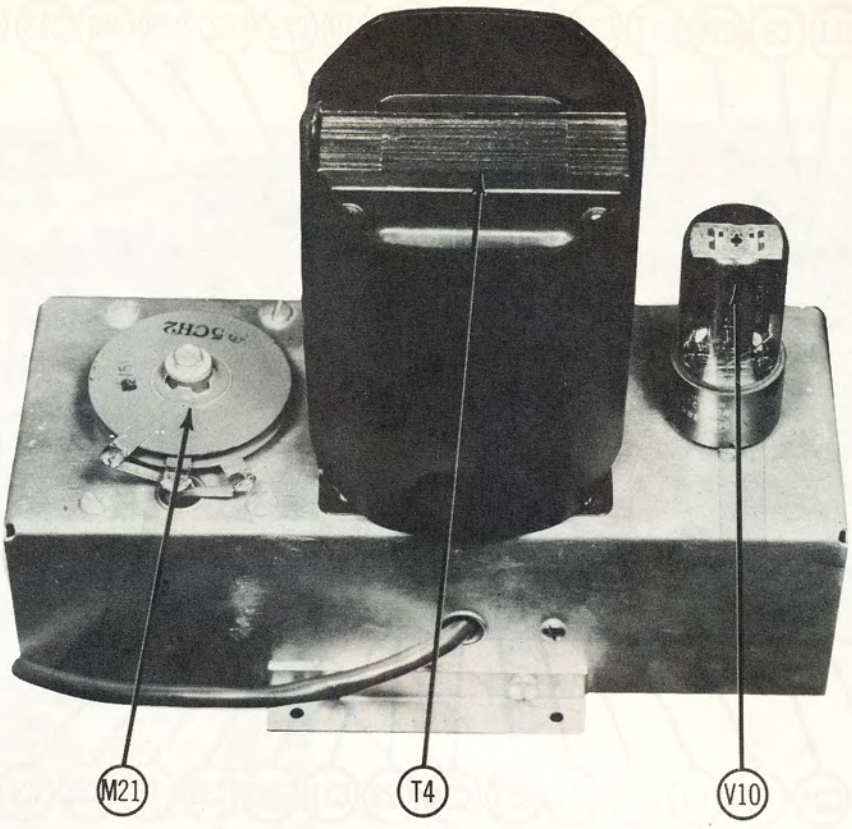


Figure 13

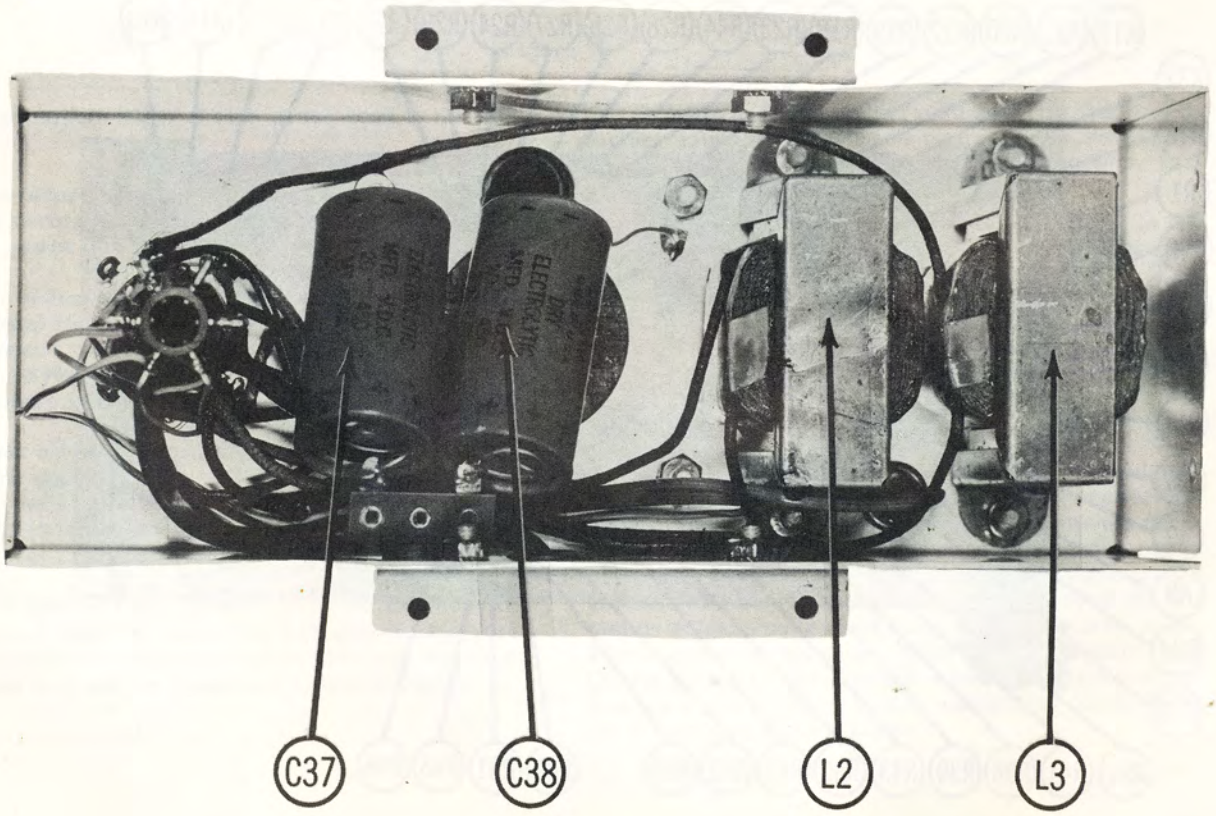


Figure 14

AMPEX
PARTS LIST

ELECTRONIC ASSEMBLY MODEL 400A

Ref. No.	Part No.	Description
V1	TU-11	12SJ7, Mic. Pre-Amp.
V2	TU-11	12SJ7, AF Amp. (Record)
V3	TU-11	12SJ7, AF Amp. (Record)
V4	TU-3	6J5, Record Output
V5	TU-2	VR150/0D3, Voltage Regulator
V6	TU-12	12SJ7, Playback Pre-Amp. (Selected)
V7	TU-11	12SJ7, AF Amp. (Playback & Monitor)
V8	TU-3	6J5, AF Output
V9	TU-13	6SN7, Bias Osc.
C1	C0-66	Elect. Capacitor, 2000 Mfd. @ 15V.
C2	C0-57	Elect. Capacitor, 20 Mfd. @ 450V.
C3	C0-59	Elect. Capacitor, 25 Mfd. @ 25V.
C4	C0-54	Elect. Capacitor, 4 Mfd. @ 450V.
C5	C0-59	Elect. Capacitor, 25 Mfd. @ 25V.
C6	C0-53	Elect. Capacitor, 4 Mfd. @150V.
C7	C0-59	Elect. Capacitor, 25 Mfd. @25V.
C8	C0-56	Elect. Capacitor, 16 Mfd. @150V.
C9	C0-55	Elect. Capacitor, 10 Mfd. @450V.
C10	C0-59	Elect. Capacitor, 25 Mfd. @25V.
C11	C0-59	Elect. Capacitor, 25 Mfd. @25V.
C12	C0-53	Elect. Capacitor, 4 Mfd. @150V.
C13	C0-59	Elect. Capacitor, 25 Mfd. @25V.
C14	C0-45	Metalized Paper Cap.,. 25 Mfd.@400V.
C15	C0-45	Metalized Paper Cap.,. 25 Mfd.@400V.
C16	C0-92	Padder Cap., .0001 Mfd.
C17	C0-92	Padder Cap., .0001 Mfd.
C18	C0-101	Metalized Paper Cap.,.1 Mfd.@400V.
C19	C0-43	Metalized Paper Cap.,.05 Mfd.@400V.
C20	C0-12	Mica Cap. 5%, .005 Mfd. @500V.
C21	C0-8	Mica Cap. 5%, .0025 Mfd. @500V.
C22	C0-47	Metalized Paper Cap.,1 Mfd.@400V.
C23	C0-44	Metalized Paper Cap.,.1 Mfd.@400V.
C24	C0-97	Metalized Paper Cap.,.1 Mfd. @200V.
C25	C0-14	Mica Cap. 5%, .01 Mfd. @300V.
C26	C0-42	Metalized Paper Cap.,.01 Mfd.@400V.
C27	C0-44	Metalized Paper Cap.,.1 Mfd.@400V.
C28	C0-46	Metalized Paper Cap.,.5 Mfd.@400V.
C29	C0-44	Metalized Paper Cap.,.1 Mfd.@400V.
C30	C0-89	Mica Cap. 5%, .0004 Mfd. @500V.
C31	C0-7	Mica Cap. 5%, .002 Mfd. @500V.
C32	C0-89	Mica Cap. 5%, .0004 Mfd. @500V.
C33	C0-91	Padder Cap., .001 Mfd.
C34	C0-5	Mica Cap. 5%, .0005 Mfd. @500V.
C35	C0-90	Mica Cap., .0002 Mfd. @500V.
C36	C0-44	Metalized Paper Cap.,.1 Mfd. @400V.
R1	RE-227	Record Level, 100KΩ Control
R2	RE-278	Bias Control, 40KΩ Control, W. W.
R3	RE-277	Bias Calibration, 500Ω, 10Watt W. W. - Adjustable
R4	RE-232	Playback Level, 1Meg. Control
R5	RE-240	Playback Equalizer, 20Ω Control
R6	RE-226	Noise Balance, 50 KΩ Control
R7	RE-227	Record Level Meter Calibration, 100KΩ Control
R8	RE-27	220 KΩ, 1 Watt Resistor
R9	RE-38	100Ω, 1 Watt Resistor 5%
R10	RE-38	100Ω, 1 Watt Resistor 5%
R11	RE-27	220KΩ, 1 Watt Resistor
R12	RE-261	1200Ω, 1 Watt Resistor
R13	RE-30	330KΩ, 1 Watt Resistor
R14	RE-205	100KΩ, 1 Watt Resistor 1%
R15	RE-32	1 Meg., 1 Watt Resistor
R16	RE-7	2200Ω, 1 Watt Resistor
R17	RE-22	47KΩ, 1 Watt Resistor
R18	RE-48	1 Meg., 1 Watt Resistor 5%
R19	RE-44	39KΩ, 1 Watt Resistor 5%
R20	RE-26	100KΩ, 1 Watt Resistor
R21	RE-7	2200Ω, 1 Watt Resistor
R22	RE-22	47KΩ, 1 Watt Resistor
R23	RE-31	470KΩ, 1 Watt Resistor
R24	RE-2	470 Ω, 1 Watt Resistor
R25	RE-7	2200Ω, 1 Watt Resistor
R26	RE-171	22KΩ, 2 Watt Resistor
R27	RE-32	1 Meg., 1 Watt Resistor
R28	RE-31	470KΩ, 1 Watt Resistor
R29	RE-22	47KΩ, 1 Watt Resistor
R30	RE-26	100KΩ, 1 Watt Resistor
R31	RE-92	15KΩ, 10 Watt Resistor
R32	RE-260	100Ω, 1 Watt Resistor
R33	RE-211	1 Meg., 1 Watt Resistor 1%
R34	RE-7	2200Ω, 1 Watt Resistor
R35	RE-211	1 Meg., 1 Watt Resistor 1%
R36	RE-209	330KΩ, 1 Watt Resistor 1%
R37	RE-32	1 Meg., 1 Watt Resistor
R38	RE-171	22KΩ, 2 Watt Resistor
R39	RE-8	2700Ω, 1 Watt Resistor
R40	RE-3	560Ω, 1 Watt Resistor
R41	RE-32	1 Meg., 1 Watt Resistor
R42	RE-30	330KΩ, 1 Watt Resistor
R43	RE-22	47KΩ, 1 Watt Resistor
R44	RE-168	10KΩ, 2 Watt Resistor
R45	RE-32	1 Meg., 1 Watt Resistor
R46	RE-7	2200Ω, 1 Watt Resistor
R47	RE-3	560Ω, 1 Watt Resistor
R48	RE-260	100Ω, 1 Watt Resistor
R49	RE-22	47KΩ, 1 Watt Resistor
R50	RE-22	47KΩ, 1 Watt Resistor
R51	RE-260	100Ω, 1 Watt Resistor
R52	RE-257	7Ω, 1 W. Resistor 1% (2-14Ω in Parallel)
R53	RE-258	3600Ω, 1 Watt Resistor
T1	1153	Mic. Input Transformer
T2	1154	Output Transformer
T3	1011	Erase Transformer
L1	CH-8	R. F. Choke, 20Mh
M1	PL-58S	Cannon XL-3-13 Chassis Connector
M2	SW-7	Input Switch-3P3T Selector Switch
M3	SW-8	Equalization Switch-3P2T Sel. Switch
M4	DL-4	Record Pilot Lamp
M5	SW-34	Record Pushbutton SPST-Normally Open
M6	RL-8	Record Relay 3PDT 115V. DC
M7	PL-59P	AN-3102-10S-3P Box Mount Connector
M8	SW-13	Meter & Output Sw. -3P4T Sel. Switch
M9	PL-4P	Cannon XL-3-14 Chassis Connector
M10	JA-3	Phone Jack - Open Circuit
M11	SW-9	Line Termination Sw. -SPST Toggle
M12		VU Meter
M13	PL-61P	AN-3102-10S-4P Box Mount Connector
M14	PL-62P	AN-3102-10S-2P Box Mount Connector
M15	PL-56S	Jones S-304-AB Chassis Connector
M16	FU-2	Fuse, 2 Amp., Type 3AG
M17	FU-7	Fuse, 1 Amp., "Slo-Blo" Type 3AG
M18	PL-54S	Jones S-308-AB Chassis Connector
M19	SW-9	AC Power Switch-SPST Toggle
M20	PL-104P	Hubbell #7466 Chassis Connector

POWER SUPPLY MODEL 400A

Ref. No.	Part No.	Description
V10	TU-14	5Y3-GT, Rectifier
C37	C0-57	Elect. Capacitor, 20 Mfd. @ 450V.
C38	C0-57	Elect. Capacitor, 20 Mfd. @ 450V.
T4	3953	Power Transformer
L2	1155	8 Hy. 80 Ma. Filter Choke
L3	1155	8 Hy. 80 Ma. Filter Choke
M21	SR-3	Selenium Rectifier
M22	PL-103P	Jones P-308-CCT-L Cable Connector

CONTROL CIRCUIT MODELS 400A, 402, 403

Ref. No.	Part No.	Description
C39	C0-105	Elect. Capacitor, 80 Mfd. @ 150V.
C40	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.
C41	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.
C42	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.
C43	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.
C44	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.
C45		Motor Start Capacitor Supplied With Motor - See Note 1.
C46	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.
C47		Motor Start Capacitor Supplied With Motor - See Note 1.
C48	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.
C49	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.
C50	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.
C51	C0-33	Tubular Capacitor, .1 Mfd. @ 600V.

CONTROL CIRCUIT MODELS 400A, 402, 403 (Cont'd.)

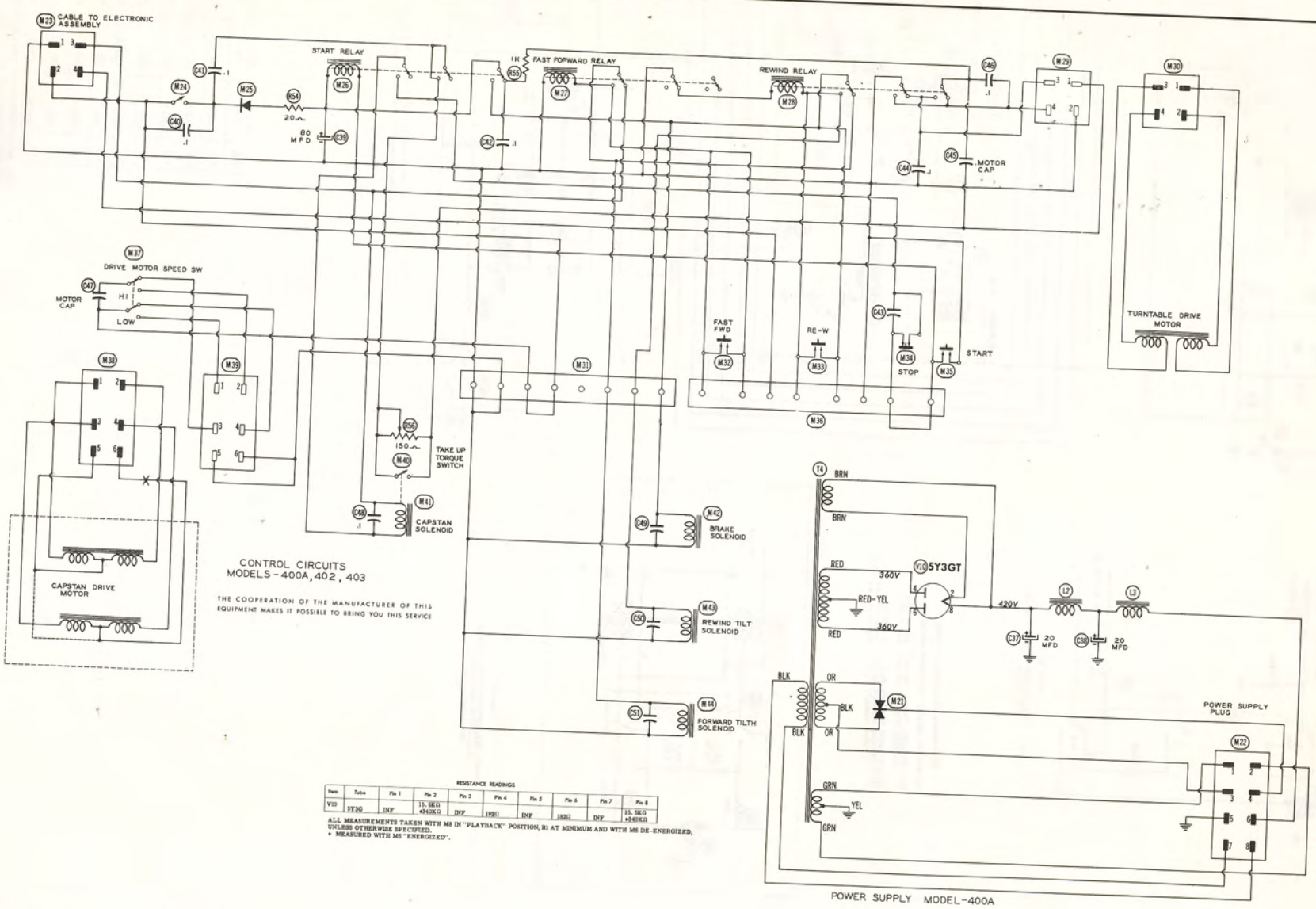
Ref. No.	Part No.	Description
R54	RE-309	20Ω, 10 Watt Resistor W. W.
R55	RE-113	1000Ω, 25 Watt Resistor W. W.
R56	RE-259	150Ω, 50 Watt Adjustable Resistor
M23	PL-99P	Jones P-304-CCT-L Cable Connector
M24	3604	Safety Switch - Micro Switch
M25	SR-4	Selenium Rectifier
M26	RL-26	Start Relay 3PDT, 115V. DC
M27	RL-26	Fast Forward Relay 3PDT, 115V. DC
M28	RL-26	Rewind Relay 3PDT, 115V. DC
M29	PL-100S	Jones S-304-CCT-K Cable Connector
M30		
M31	TS-2-8	60 Cycle Amp. Terminal Strip, Jones 8-170
M32	SW-34	Fast Forward Pushbutton-SPST Normally Open
M33	SW-34	Rewind Pushbutton-SPST Normally Open
M34	SW-35	Stop Pushbutton-SPST Normally Closed
M35	SW-34	Start Pushbutton-SPST Normally Open
M36	TS-2-8	Remote Control Terminal Strip, Jones 8-170
M37	SW-5	Speed Switch-DPDT Toggle
M38	PL-101P	Jones P-306-CCT-L Cable Connector
M39	PL-102S	Jones S-306-CCT-K Cable Connector
M40	SW-2	Takeup Torque Switch-Micro Switch
M41	670	Capstan Solenoid, DC
M42	337	Brake Solenoid, DC
M43	337	Rewind Tilt Solenoid, DC
M44	337	Forward Tilt Solenoid, DC

NOTE 1

When ordering Motor Start Capacitors, include the serial number of the Recorder, whether the motor is the Turntable Motor or Drive Motor, the manufacturer of the motor, and the manufacturer's type number found on the motor name plate.

MECHANICAL PARTS LIST

Ref. No.	Part No.	Description
1	2694	Top Plate Casting
2	2110	Top Plate Facing Plate
3	2093	Bushing, Takeup Tension Arm
4	2094	Bushing, Capstan Idler Arm
5	2092	Bushing, Constant Tension Arm
6	2102	Turntable Motor Assembly, complete with Motor, Bracket, Pulley and Capacitor.
7	934	Rubber Tired Pulley
8	932	Bracket
9	2680	Spacers
10	2101	Solenoid Mounting Bracket
11	3311	Relay Mounting Bracket
12	2107	Turntable Motor Mounting Bracket
13	335	Solenoid Link
14	2081	Solenoid Spade Bolt
15	CP-1/16-2	Solenoid Cotter Pin
16	CQ-1/8-15	Solenoid Clevis Pin
17	2349	Terminal Strip Standoff
18	930	Turntable Motor Pivot - Front
19	3370	Turntable Motor Arm and Pivot Assembly
20	928	Felt Washer
21	2237	Tilt Solenoid Return Spring
22	3359	Rewind Holdback Brake
23	3853	Brake Lining
24	2216	Capstan Drive Motor Assembly-60 Cycle, complete with Flywheel and Capacitor
	3380	Capstan Drive Motor Assembly-50 Cycle, complete with Flywheel and Capacitor
25	FA-1	Drive Motor Fan
26	3506	Capstan Dust Cap
27	2229	Tape Supply Turntable Assembly
28	2229	Takeup Turntable Assembly
29	974	Turntable and Shaft Sub-Assembly
30	958	Turntable Pad
31	BC-7	Ball Bearing
32	2226	Bearing Housing
33	RR-1-3	Retaining Ring
34	977	Tape Supply Brake Drum
35	977	Takeup Brake Drum
36	2098	Tape Supply Stopping Brake
37	3853	Brake Lining
38	3851	Tape Supply Brake Spring
39	2105	Takeup Stopping Brake
40	3853	Brake Lining
41	3850	Takeup Brake Spring
42	2091	Brake Rod
43	967	Brake Adjusting Clamp
44	2099	Constant Tension Arm Assembly
45	3357	Tape Guide
46	355	Tape Guide Hook
47	2104	Constant Tension Brake
48	3853	Brake Lining
49	1024	Constant Tension Brake Spring
50	995	Capstan Idler Assembly
51	2197	Capstan Idler Arm
52	2084	Capstan Solenoid Arm
53	388	Capstan Solenoid Stop
54	396-2	Capstan Solenoid Eye Bolt
55	PW-6-1/4-416-816	Solenoid Felt Washer
56	2372	Solenoid Terminal Strip
57	CP-1/16-2	Solenoid Cotter Pin
58	CQ-1/8-17	Solenoid Clevis Pin
59	389	Capstan Idler Pressure Spring
60	3808	Capstan Idler Return Spring
61	2075	Takeup Torque Switch Engaging Washer
62	2103	Takeup Tension Arm
63	2085	Takeup Tension Collar
64	3809	Takeup Tension Return Spring
65	3689	Counterbalance Spring
66	3683	Counterbalance Spring Anchor
67	3807	Brake Solenoid Stop Bracket
68	3850	Turntable Motor Positioning Spring
69	2213	Reel Idler Assembly
70	2207	Reel Idler Housing
71	2215	Reel Idler Pulley and Shaft Assembly
72	2209	Upper Bearing
73	2248	Felt Washer
74	PB-1-516	Plug Button
75	BC-7	Ball Bearing
76	BD-1	Rubber Bearing Housing
77	2210	Bearing Adapter
78	2223	Reel Idler Flywheel Assembly
79	2221	Flywheel
80	2220	Hub and Dampener Assembly
81	2219	Limit Stop
82	BC-7	Ball Bearing
83	RR-2-4	Retaining Ring
84	352	Reel Idler Spacer
85	2222	Reel Idler Thrust Bracket
86	2208	Reel Idler Thrust Bearing
87	BC-18	Reel Idler Thrust Ball
88	NU-16-816	Reel Idler Jam Nut-1/2-20
89	257	Capstan Tape Guide
90	1402	Capstan Tape Guide Spacer
91	923	Capstan Tape Guide Shimming Washers
92	1098	Motor Capacitor Clamp
93	2691	Pushbutton Excutcheon Plate
94	2371	Selenium Rectifier Terminal Board
95	2373	Selenium Rectifier Insulating Strip
96	910	Brake Pivot Washer
97	3439	Terminal Strip Insulation
98	3582	Brake Pivot Spring
99	3603	Brake Spring Link
100	RR-4X-2	Brake Rod Retaining Ring
101	PW-1-1016	Motor Pivot Washer



RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V10	5Y3G	INF	15.5KΩ *340KΩ	INF	192Ω	INF	182Ω	INF	15.5KΩ *340KΩ

ALL MEASUREMENTS TAKEN WITH M8 IN "PLAYBACK" POSITION, R1 AT MINIMUM AND WITH M6 DE-ENERGIZED, UNLESS OTHERWISE SPECIFIED.
* MEASURED WITH M6 "ENERGIZED".

A PHOTOFACT STANDARD NOTATION SCHEMATIC

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Figure 15

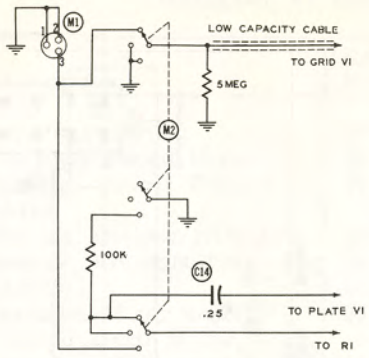


Figure 16A

INPUT FOR HIGH IMPEDANCE MICROPHONE
(SEE INSTALLATION)

T1 TRANSFORMER IMPEDANCE CONNECTIONS–

R44 MUST BE ADJUSTED FOR OUTPUT IMPEDANCE–

500 to 600 OHMS CONNECT TO 1 & 6, JOIN 3 TO 4
333 OHMS CONNECT TO 1 & 5, JOIN 3 TO 4

200 to 250 OHMS CONNECT TO 2 & 5, JOIN 3 TO 4
125 to 150 OHMS CONNECT TO 1 & 4, JOIN 1 TO 3 & 4 TO 6
50 OHMS CONNECT TO 2 & 4, JOIN 2 TO 3 & 4 TO 5

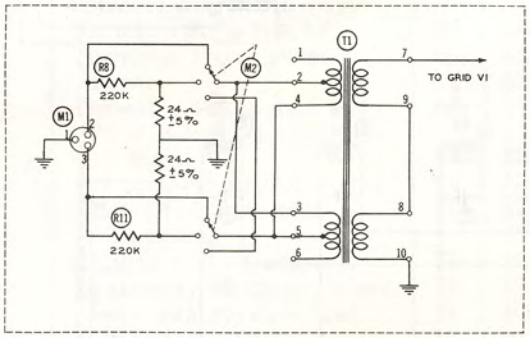
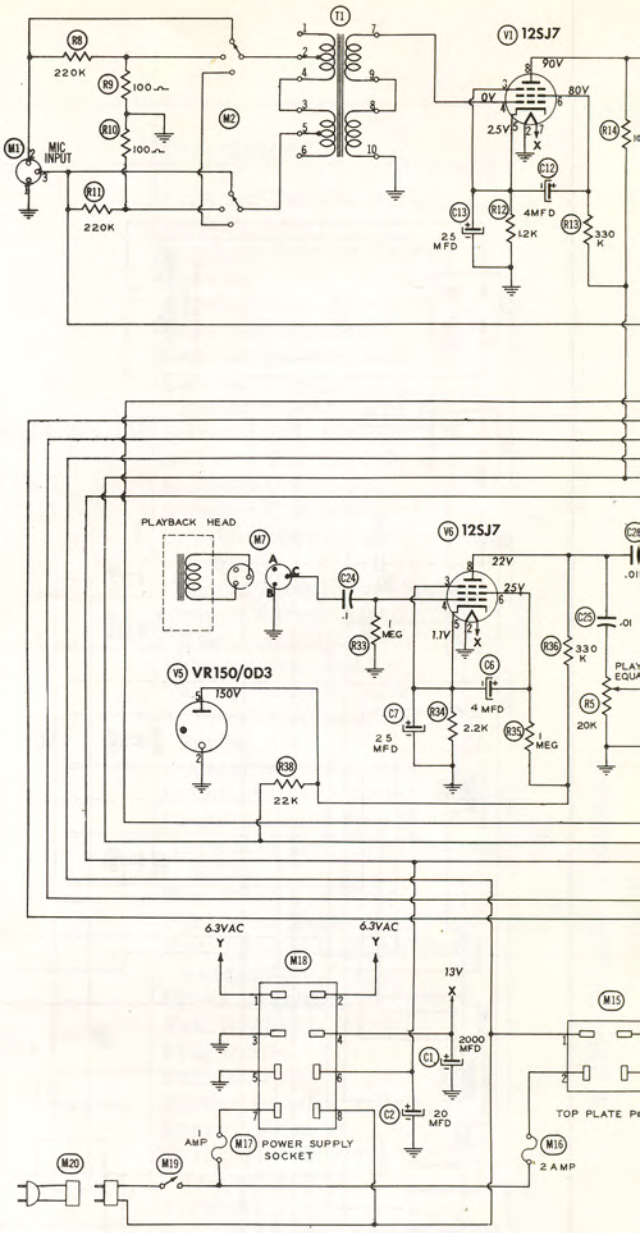


Figure 16B

INPUT TRANSFORMER CONNECTION FOR
30 & 50 OHMS MICROPHONES
(SEE INSTALLATION)

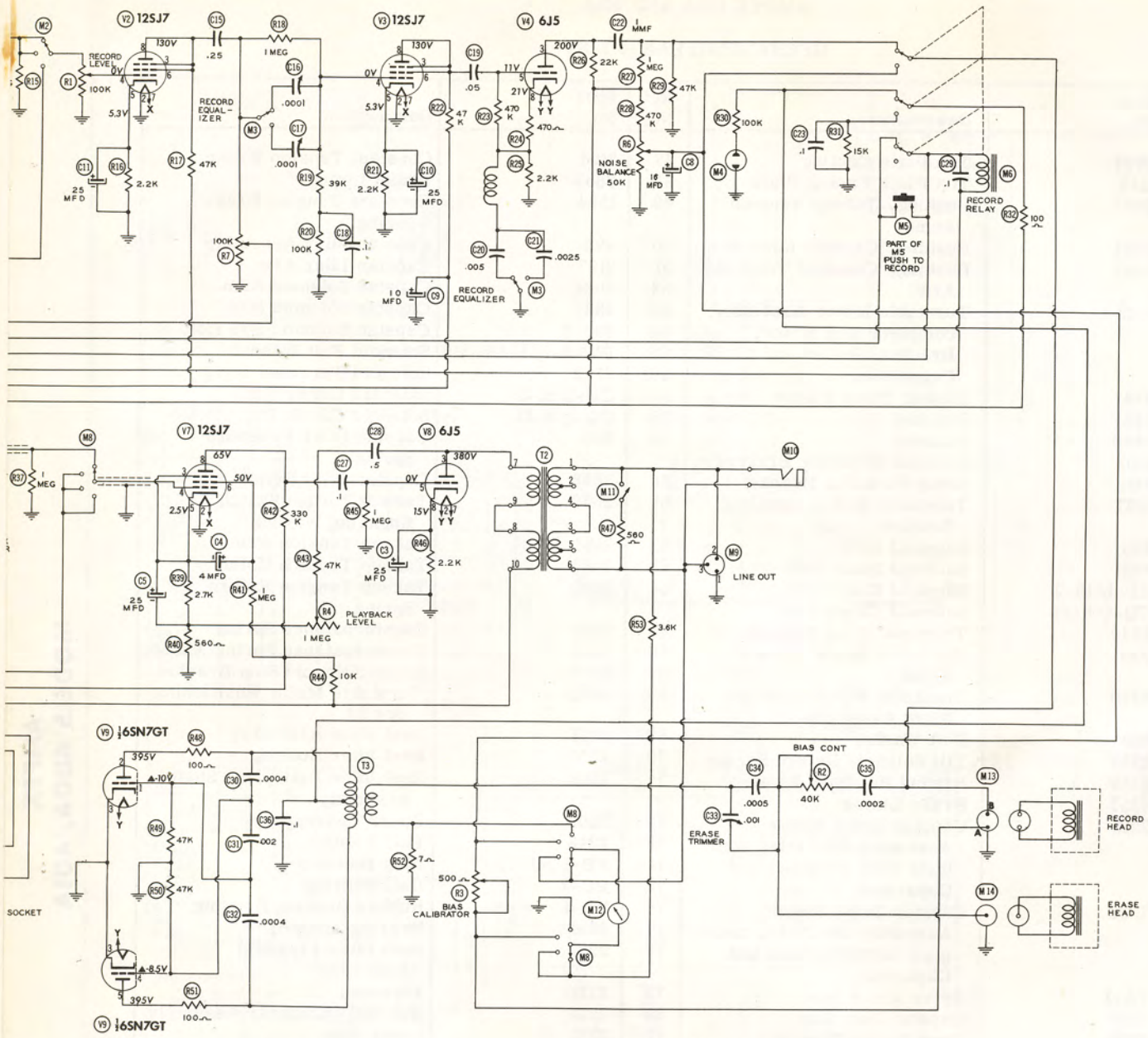


THE COOPERATION OF THE MANUFACTURER OF THIS
EQUIPMENT MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

RESIST

Item	Tube	Pin 1	Pin 2	Pin 3
V 1	12SJ7	0Ω	0Ω	1.2KΩ
V 2	12SJ7	0Ω	0Ω	†57KΩ
V 3	12SJ7	0Ω	0Ω	†57KΩ
V 4	6J5	0Ω	.2Ω	†22KΩ
V 5	0D3/VR150	†10KΩ	0Ω	INF
V 6	12SJ7	0Ω	0Ω	2.2KΩ
V 7	12SJ7	0Ω	0Ω	3.3KΩ
V 8	6J5	0Ω	.2Ω	†1.3KΩ
V 9	6SN7GT	47KΩ	†700Ω	0Ω

ALL MEASUREMENTS TAKEN WITH M8 IN "PLAYE
UNLESS OTHERWISE SPECIFIED.
■ MEASURED WITH M8 IN "RECORD" POSITION .
* DO NOT MEASURE
† MEASURED FROM PIN 2 OF V10.
♦ MEASURED WITH M6 " ENERGIZED".



ELECTRONICS MODEL-400A

A PHOTOFACT STANDARD NOTATION SCHEMATIC

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READINGS

Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
3.1KΩ	1.2KΩ	†340KΩ	2.5Ω	†110KΩ
12Ω	2.2KΩ	†57KΩ	2.5Ω	†57KΩ
125KΩ	2.2KΩ	†57KΩ	2.5Ω	†57KΩ
50KΩ	470KΩ	†10.1KΩ	.2Ω	2.7KΩ
INF	†32KΩ	INF	INF	INF
1 Meg	2.2KΩ	†1Meg	2.5Ω	†360KΩ
1 Meg ■3KΩ	3.3KΩ	†1Meg	2.5Ω	†340KΩ
INF	1 Meg	INF	.2Ω	2.2KΩ
47KΩ	†700Ω	0Ω	.2Ω	.2Ω

"" POSITION, R1 AT MINIMUM AND WITH M6 DE-ENERGIZED,