

**AMPEX**

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**AG-440  
and AG-445  
Recorder and  
Reproducer**

Operation and Maintenance  
Manual

ISSUED: JANUARY 1967

AG-440 and AG-445 RECORDER and REPRODUCER  
OPERATION and MAINTENANCE MANUAL

CORRECTION SHEET #2

6 June 1967

Ref: 401595A change as follows:

Delete CR610 (013-678) and replace with C16 to pins 6 & 8 of J607

Delete CR607 (013-678) and replace with C15 to pins 5 & 6 of J603

**LIST OF EFFECTIVE PAGES**  
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"A"	401630A	4B-6	401660A	4F-3	401695A	P. L.	401588A
i	401625A	4B-7	401661A	4F-4	401696A	Fig. 6-12	D4030265
ii	401626A	4B-8	401662A	4F-5	401697A	P. L.	401589A
iii	401627A			4F-6	401698A	Fig. 6-13	D4030266
iv	401628A	4C-1	401663A			P. L.	401590A
v	401629A	4C-2	401664A	5-1	401699A	Fig. 6-14	D4030264B
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## DESCRIPTION

## 1.1 GENERAL

Ampex Model AG-440 and AG-445 Magnetic Tape Recorders and Reproducers feature a tape transport capable of handling both 1/4-inch and 1/2-inch tape, and solid-state electronic circuitry constructed on plug-in modules. The AG-440 is a record/reproduce equipment, while the AG-445 is a reproduce-only machine.

Equipment in the AG-440 line is available mounted in Ampex consoles as shown in Fig. 1-1, mounted in portable cases, or unmounted for installation in racks or custom consoles. A basic system consists of one electronic assembly for each channel, a tape transport, and a head assembly.

Each electronic assembly for record/reproduce equipment contains a built-in Sel-Sync\* circuit, which allows recording separate channels at different times while maintaining perfect synchronization. Plug-in accessories, such as microphone preamplifiers, balanced line input transformers, and remote control units are available as optional equipment.

The AG-445, reproduce-only equipment, is available mounted in an Ampex console, or unmounted for rack or custom console installation. Four reproduce-only electronic modules will fit in a tray 3-1/2 inches in height.

\* TM Ampex Corp.



*Fig. 1-1. Ampex Model AG-440, Four Channel, Console Mount*

Insofar as possible, modular construction is used throughout the system. The tape transport is composed of various sub-assemblies, any of which may be removed without unsoldering any connection. Heads plug into receptacles immediately beneath the head housing, and the entire assembly can be easily removed and reinstalled. All relays are of the plug-in type, as is the major portion of the record/reproduce electronic circuitry.

The number of record or reproduce channels which can be accommodated depends on tape width. One or two channels can be utilized with 1/4-inch tape, three or four channels with 1/2-inch tape.

## 1.2 TAPE TRANSPORT

A rigid casting is used as the mounting base for all components of the tape transport. This rigid base makes possible the precise handling of either 1/4-inch or 1/2-inch tape. Supplementing this capability is a quick conversion feature, which allows changing from one width tape to the other in a matter of minutes.

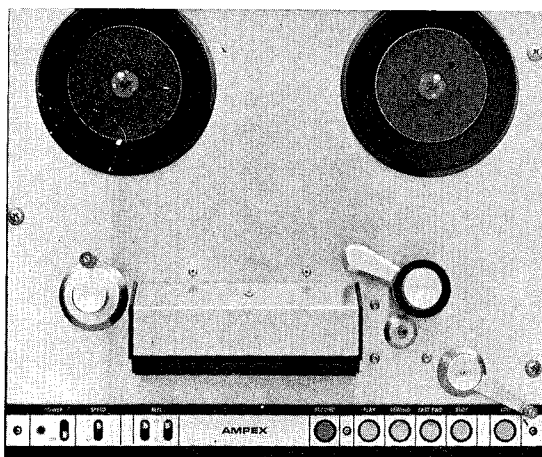


Fig. 1-2. *Tape Transport*

Two tape speeds are available on each transport. Standard speed pairs are 3-3/4 - 7-1/2 inches per second (ips) and 7-1/2 - 15 ips. Speed selection is made at a toggle switch, with electronic equalization automatically switched in accordance with that selection.

Reel switches are provided for each turntable. These are positioned in accordance with

the diameter of the reel hub which is being used. A large NAB hub can be used on one turntable and a small EIA hub on the other.

The transport, as shipped from the factory, will accommodate reels of tape 10-1/2 inches, 8 inches, 7 inches, and 5 inches in diameter. Also, the turntables can be quickly repositioned for use with 11-1/2-inch CCIR reel.

Tape scrape flutter is minimized by the inclusion of a scrape flutter idler, utilizing jeweled bearings, positioned between the record and reproduce head stacks. Mounting facility for a second such idler, which can be ordered as an optional accessory, is provided. The optional idler is mounted to the left of the record head.

A solenoid-controlled tape lifting mechanism automatically removes the tape from contact with the heads during the fast forward or rewind modes. To allow these modes to be used during a cueing operation, manual or electronic override of the tape lifter is possible under local control while electronic override is provided on the optional remote control unit.

Included in a power supply box, mounted to the back of the tape transport, is a plug-in printed circuit card which contains the power supply and master bias and erase oscillator. These circuits are used in conjunction with the record/reproduce electronics. For reproduce-only equipment, the bias oscillator is omitted.

Pushbutton controls are employed to select the mode of operation--play, fast forward, rewind, record, stop, and edit. These switches are mounted on the tape transport control box, positioned adjacent to the head assembly. This control box also contains the receptacles for cables from all other sub-assemblies of the transport, the main fuses, and four plug-in relays (play, rewind, fast forward and edit). Two receptacles allow connection of an optional remote control unit and a precision frequency source; when these accessories are not used the dummy plugs which are provided must be inserted in the receptacles.

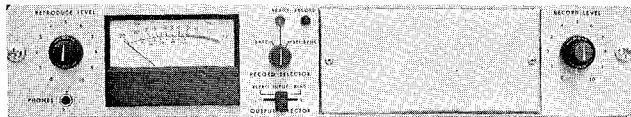
## 1.3 RECORD/REPRODUCE ELECTRONICS

One electronic assembly (see Fig. 1-3) is required for each record/reproduce channel. The assembly consists of an electronic chassis with plug-in printed circuit board modules.

The front panel of the electronic chassis contains all controls and indicators required for the record/reproduce operation. These include

record and reproduce level controls, a three position record selector switch, and a three position output and meter selector switch. Pilot lights indicate that the channel is ready to record and that it is recording. A large meter provides visual monitoring facilities for record, reproduce, and bias levels. The plug-in modules are inserted through an aperture in the front panel, and are guided to printed circuit board receptacles.

Receptacles for interconnecting cables and input/output signal cables are located on the back panel of the electronic chassis, together with an octal socket for accommodating an input accessory or the dummy plug. A line termination switch (which provides correct termination during alignment and maintenance procedures), two alignment controls for the Sel-Sync function, a plug-in relay (record), and a fuse, are also included on this panel.



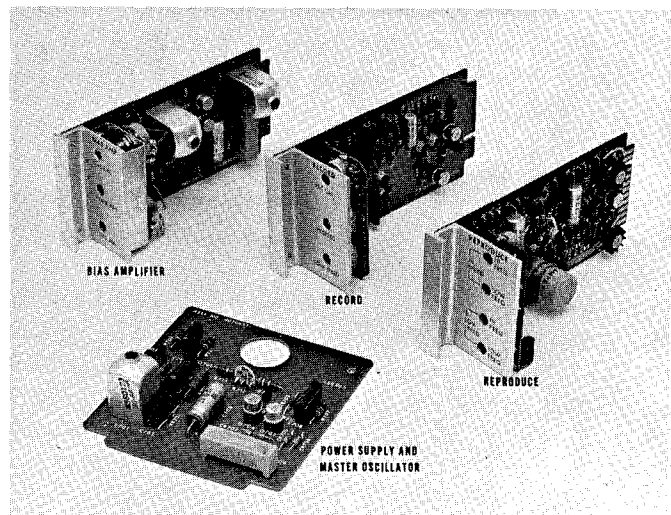
*Fig. 1-3. Record/Reproduce Electronic Assembly*

Supplied with each record/reproduce electronic assembly is a dummy plug and bridging input transformer. The dummy plug is inserted in the accessory socket, on the back panel of the electronics assembly, if an unbalanced line input is used. The bridging transformer is inserted in that socket for a balanced line input; input impedance with the transformer is 20,000 ohms. The equipment is shipped with the dummy plug installed in the socket.

Three plug-in printed circuit boards provide for record, reproduce, and bias amplification. As previously mentioned, these modules are installed through the front panel of the electronic chassis. The record and reproduce modules contain plug-in receptacles for separate equalization printed circuit boards. These equalization boards are mounted at right angles to the main boards, so that alignment controls are available from the front. Equalization is automatically switched, in accordance with the tape speed selected, by a solid state switching circuit.

Internal strapping allows the selection of either a +8 dbm or +4 dbm nominal output level

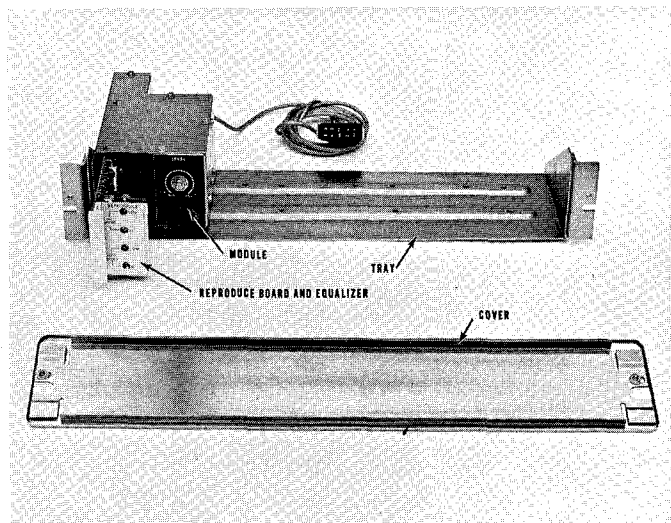
into a 600 ohm line. The equipment is shipped from the factory strapped for a +8 dbm output, but this can be easily changed if necessary.



*Fig. 1-4. Printed Circuit Boards*

#### 1.4 REPRODUCE-ONLY ELECTRONICS

The reproduce-only electronic assemblies are constructed so that up to four reproduce modules will fit in a tray 3 1/2 inches high. That tray can be mounted in a 19-inch rack, or in an Ampex console.



*Fig. 1-5. Reproduce-only Electronic Assembly*

Plug-in reproduce and equalizer printed circuit boards are the same as those used in the record/reproduce equipment. Other required components are mounted on a separate chassis for each electronic channel. The reproduce boards plug into a printed circuit receptacle on that chassis. Complete circuitry required for a reproduce electronic channel is thus provided in each module. As previously noted, up to four modules can be accommodated in the tray.

A screwdriver-operated reproduce level control is provided on the front panel of each module. The back panel contains the reproduce head input receptacle, the line output receptacle, a monitor jack, and a line termination switch (for use during tests and adjustments). A captive power cable, which connects to the electronic power supply box on the tape transport, leaves the module at the back.

## 1.5 HEAD ASSEMBLY

Several head configurations are available. Head housings provide mounting positions for four head stacks; these positions are numbered one through four from left to right when the assembly is viewed from the front. The erase, record, and reproduce head stacks are normally mounted in positions 1, 3, and 4 respectively.

For operation with 1/4-inch magnetic tape, full track heads or two track heads (either normal two track or quarter track) are available. Note that for single channel half track operation, a complete two track head assembly is provided. A special four stack record/reproduce assembly is available which provides two track erase, two track record, quarter track reproduce, and two track reproduce heads; this assembly has a switch which is positioned to connect either the quarter track or two track reproduce heads into the circuit.

For 1/2-inch magnetic tape, three track or four track heads are available. Erase, record, and reproduce stacks are mounted in the normal positions.

Complete head assemblies can be easily changed. In conjunction with the quick conversion feature of the tape transport, this provides a very flexible system, which can be changed in a few minutes from a three or four channel recorder using 1/2-inch tape to a one or two channel recorder using 1/4-inch tape.

Heads for reproduce-only equipment contain only reproduce heads: a dummy post is mounted in the normal erase head position to provide correct tape passage through the assembly. One or two track heads are available for 1/4-inch tape. The two track assembly is provided with both the normal two track head and a 1/4 track head; a switch provides means of selecting the head desired. Three or four track heads are available for 1/2-inch tape operation.

## 1.6 ACCESSORY EQUIPMENT

### 1.6.1 Input Accessories

An octal socket is located on the back panel of each electronic assembly. A dummy plug is provided with each assembly; this plug is inserted in the octal socket when recording from an unbalanced line. If a balanced line or microphone input is to be used, the dummy plug must be replaced with one of the following accessory items.

Also provided for each electronic assembly, is a bridging input transformer (Catalog No. 4580200-01). This transformer provides unity gain, with an input of 20,000 ohms, when a balanced line input is used. It replaces the dummy plug in the accessory socket.

Available as an optional accessory is a matching input transformer (Catalog No. 4580200-02) which provides a gain of approximately 14 db from a balanced line.

Recording directly from a microphone requires the use of a microphone preamplifier (Catalog No. 4010066). This is a two stage solid state preamplifier wired so that when it is inserted in the octal socket the record level control is connected between the two stages. The preamplifier is thereby made a variable gain device, which will accommodate a wide range of professional-quality microphones. This is an optional accessory.

### 1.6.2 Remote Control (Optional)

A desk type remote control unit, Catalog No. 4010080, allows operation of the system from a remote location. The play, record, fast forward, rewind, and stop functions can be pushbutton-controlled from this unit. A sixth pushbutton electrically defeats the tape lifter action in fast-winding modes, so that those modes can be used to quickly cue a tape to the desired spot. Three indicator lights--for ready, tape motion, and record--are provided.

### 1.6.3 Precision Frequency Source

A motor drive amplifier can be plugged into a receptacle on the tape transport control box to provide a precise drive for the capstan motor. The dummy plug (which is provided) can be used as a mating plug for the receptacle by removing the jumper.

If a precision frequency source is not used, the dummy plug (as supplied) must be inserted in the receptacle at the tape transport.

### 1.6.4 Rear Covers, Consoles (Optional)

If covers for the back of console mounted equipment are desired, they are available as optional accessories. Catalog numbers for rear cover sets (1 cover for console base, 1 cover for each electronic assembly) are 4010076-01, 4010076-02, 4010076-03, and 4010076-04 (dash numbers indicate the number of electronic covers in the set).

When ordered separately the rear cover for the console base is Catalog No. 4040982, individual covers for electronic assemblies are Catalog No. 4040984.

### 1.6.5 Scrape Flutter Idler (Optional)

One scrape flutter idler is furnished on the tape transport. A second idler is available as an optional accessory kit under Catalog No.

4010069. All transports have mounting facilities for the second idler. Note that the optional idler is not interchangeable with the one normally supplied, because it is larger.

### 1.6.6 Extender Boards (Optional)

Extender boards are available for the plug-in printed circuit boards (bias amplifier, record, reproduce, and power supply and bias oscillator boards). These extender boards plug into the receptacle inside the housing, the circuit boards then plug into the extender card. Testing of voltages, continuity, etc., during corrective maintenance procedures, can then be performed with the printed circuit boards outside of the housing. Catalog numbers of the extender boards are:

For reproduce board	4020151
For record board	4020152
For bias amplifier board	4020153
For power supply board	4020154

### 1.6.7 CCIR Record Equalizer (Optional)

A CCIR plug-in equalizer, Catalog No. 4020269-03, is available for the record circuit. Note that the standard reproduce equalizer supplied with the equipment has an adjustment range sufficient to allow its use for either NAB or CCIR equalization.

---

## 1.7 SPECIFICATIONS

### Tape Width and Channel Configurations

1/4-inch Tape -- 1 or 2 Channels  
1/2-inch Tape -- 3 or 4 Channels

### Tape Speeds Available

Two Speeds:  
3-3/4 and 7-1/2 ips or  
7-1/2 and 15 ips

### Reel Size

5 inch, 7 inch, 10-1/2 inch, EIA or NAB. Adjustable to accept 11-1/2 inch CCIR; CCIR reel adaptors available. Reel switches for each turntable provide proper tension for large or small reel hubs.

### Input

100,000 ohms unbalanced; convertible to 20,000 ohms balanced with plug-in bridging transformer supplied. Will accept line levels from -17 dbm to produce recommended operating level.

### Output

600 ohms balanced or unbalanced, with nominal output levels of +4 dbm or +8 dbm.

Equalization Switched automatically by transport speed selector; solid state switching employed. Equalization circuits on plug-in cards.

Electronics Completely solid state. Plug-in printed circuit boards for record, reproduce, and bias amplifiers. Built-in Sel-Sync (selective synchronization) feature. Power supply and bias oscillator on separate plug-in printed circuit board inserted in power supply box on tape transport.

Overall Frequency Response 15 ips NAB:  $\pm 2$  db 30 Hz to 18,000 Hz  
 7-1/2 ips NAB:  $\pm 2$  db 40 Hz to 10,000 Hz  
                   +2-4 db 30 Hz to 15,000 Hz  
 3-3/4 ips:  $\pm 2$  db 50 Hz to 7,500 Hz

Signal-to-Noise Ratio

<u>Tape Speed</u>	<u>Full Track</u>	<u>Half Track or 2-Track</u>	<u>3-Track</u>	<u>4-Track</u>
15 ips NAB	68 db	60 db	62 db	60 db
7-1/2 ips NAB	68 db	60 db	62 db	60 db
3-3/4 ips (120 micro secs.)	63 db	56 db	----	----

Signal-to-noise is measured from peak record level, which is 6 db above Ampex operating level, to unweighted noise. Noise is measured while erasing a 500 Hz signal which was recorded at peak record level, using a filter to attenuate noise outside of the audio spectrum. 201-type low noise tape, biased for maximum sensitivity at 15 mil wavelength is used.

When noise is measured on an ASA "A" weighted curve, the signal-to-noise ratio is:

<u>Tape Speed</u>	<u>Full Track</u>	<u>Half-Track or 2-Track</u>	<u>3-Track</u>	<u>4-Track</u>
15 ips NAB	70 db	64 db	65 db	64 db
7-1/2 ips NAB	70 db	64 db	65 db	64 db
3-3/4 ips (120 micro secs.)	65 db	58 db	----	----

Bias Oscillator and Power Supply

Power supply box on tape transport contains plug-in bias oscillator and electronic power supply. Nominal bias/erase frequency 150,000 Hz.

Tape Lifters

Tape automatically lifted from heads in fast forward or rewind modes. Manual or electronic override possible during local control, electronic override feature on remote control.

<u>Capstan</u>	Hard chrome plated capstan shaft.
<u>Even-Order Distortion</u>	Second harmonic distortion of a 500 Hz signal recorded at peak record level is less than 0.4%.
<u>Flutter and Wow</u>	15 ips: Maximum 0.08% rms 7-1/2 ips: Maximum 0.1% 3-3/4 ips: Maximum 0.15% rms
	Measured according to ASA Z57.1-1954 measuring all components from 0.5 Hz to 200 Hz.
<u>Start Time</u>	Up to speed in 0.1 second; maximum of 3.5 seconds to reach stable tape motion (within Flutter and Wow specification).
<u>Tape</u>	Specifications based on use of M. M. M. Type 201 Low Noise Tape, or equivalent.
<u>Speed Accuracy</u>	Better than $\pm 0.2\%$ .
<u>Rewind Time</u>	Approximately 1 minute for 2400-foot NAB reel.
<u>Electronic Overload Margin</u>	Record Amplifier -- record level before clipping is at least 28 db above normal operating record level. Distortion less than 1% up to clip level.  Reproduce Amplifier -- output level before clipping is +29 dbm (21 db above normal operating level).
<u>Operating Controls</u>	Input and output level rotary controls, supplied with knob lock.  Record selector -- 3 positions, "Safe", "Ready", "Sel-Sync".  Output and meter selector -- 3 positions, "Reproduce", "Input", "Bias".  Toggle switches for Power, Tape Speed, and Reel(2).  Mode controls -- Pushbutton control of Play, Fast Forward, Rewind, Record, Stop, and Edit. Edit modes available are Stop/Edit, Play/Edit, and Fast-winding/Edit. All modes except Stop/Edit and Play/Edit can be remotely controlled.



Power Requirement

105 to 125 volts, ac, 60 Hz. Equipment for operation with 50 Hz power line frequency available.

Approximate Power Consumption

1 channel system: 2.3 amps

2 channel system: 2.5 amps

3 channel system: 2.7 amps

4 channel system: 2.9 amps



## INSTALLATION

### 2.1 UNPACKING

#### 2.1.1 General

Equipment received from the factory should be examined for any sign of damage incurred in transit. Also, check the shipment against the packing list to determine that all items have been received.

#### NOTE

Plug-in electronic modules, and the associated equalizer circuits, are shipped mounted in position behind a cover on the front panel of the electronic assemblies. The plug-in power supply and bias oscillator is mounted in the power supply box in back of the tape transport.

If any damage or shortage is noted, immediately report the circumstances to your Ampex distributor and to the transportation company involved.

#### 2.1.2 Console Mounted Equipment

Equipment ordered with the Ampex console is shipped with all assemblies mounted in the console, and connections completed between the assemblies.

Single channel equipment, or reproduce-only equipment, is shipped with the console upright. Open the shipping container completely to remove the machine. Screw the four casters into the threaded holes.

Two, three, and four channel equipment is shipped with the console lying on its back. The tape transport is rotated 90° so that it is in the horizontal position during transit. Open the shipping container completely. Check that the casters are screwed fully in, so that the studs will not be bent when the recorder is tilted to the upright position. Place a board in position to block the casters. Grasp the console at the uprights between the electronic housing and the tape transport and tilt the console up and forward so that it comes to the vertical position, resting on the four casters. Manually support the transport, and loosen the knurled knob on the left inner side of the console base. Position the transport horizontally, and retighten the knob.

#### 2.1.3 Unmounted and Portable Equipment

Equipment which is unmounted, or is mounted in portable cases, is shipped with the tape transport and the electronic assemblies packaged separately. Use special care in unpacking unmounted equipment to prevent damaging critical components, such as the capstan, head assembly, takeup tension arm, etc.

## 2.2 MOUNTING

When the equipment is ordered with the console, or with portable cases, all assemblies are mounted in position at the factory.

Other equipment can be mounted in standard 19-inch racks, or in custom cabinets. Mounting dimensions are given in Fig. 2-1. The major factor in such mounting is that adequate ventilation must be provided.

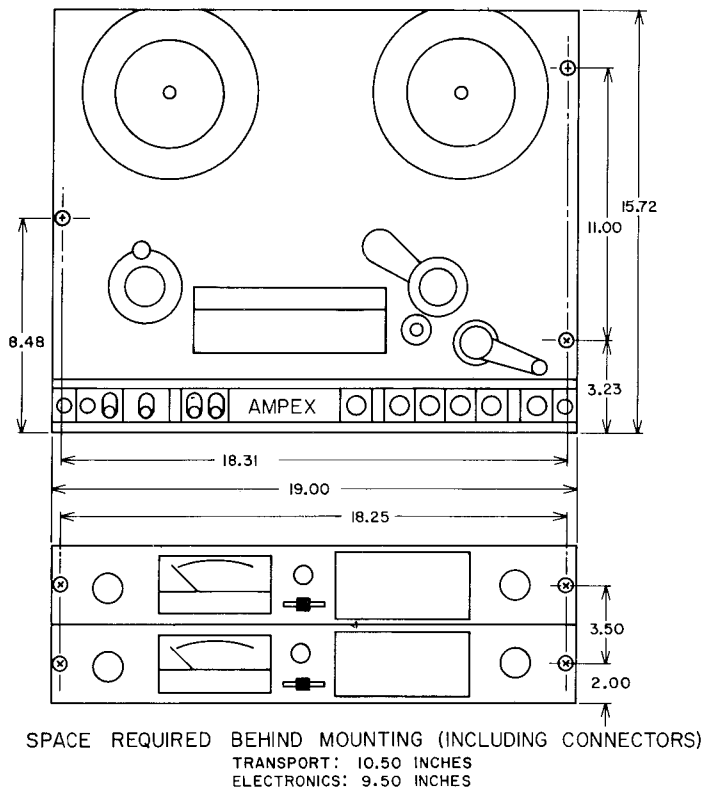


Fig. 2-1. Mounting Dimensions

## 2.3 REMOVING FRONT PANEL, CONSOLE

Console mounted equipment has a front panel which extends from the front edge of the transport down and around the bottom of the control panel. Its removal will be required to perform some of the installation procedures which are subsequently described.

The panel has a shroud and duct over the drive motor fan (see Fig. 2-2). To remove the panel, first fully loosen the two captive thumb screws on the lower edge (under the transport). Then press up on the angled portion of the panel,

just below the front edge of the transport, and force the lip of the cover out of the slit between the front edge of the transport and the transport frame of the console. Move the top of the panel out to clear the transport frame, then let the whole panel drop down until the shroud and duct are clear of the fan.

To replace the panel, first position the shroud and duct up over the drive motor fan. Insert the lip on the top surface in the slit between the front edge of the transport and the transport frame of the console, pressing it firmly into position. Then tighten the two captive thumb screws.

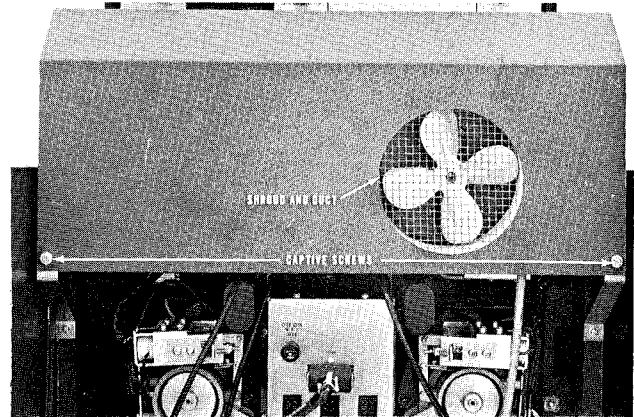


Fig. 2-2. Removing Front Panel, Console

## 2.4 INTERCONNECTING

When equipment is shipped in a console, all assemblies are interconnected at the factory. It is advisable, however, to check that cables have not vibrated loose in transit.

For portable (record/reproduce) equipment, all connections described must be made each time the recorder is set up in the field. Open the covers on the cases to gain access to cables and receptacles.

Always route power and control cables as far as possible from the input-output cables and the head cables. Receptacles referenced in the following discussion are shown in Figs. 2-3 and 2-4.

a. Connect the power and control cable(s) from the POWER TO ELECTRONICS receptacles (J701 through J704) on the tape transport power supply panel to receptacle J11 on the electronic assemblies. The four receptacles on the tape transport are connected in parallel, so any or all

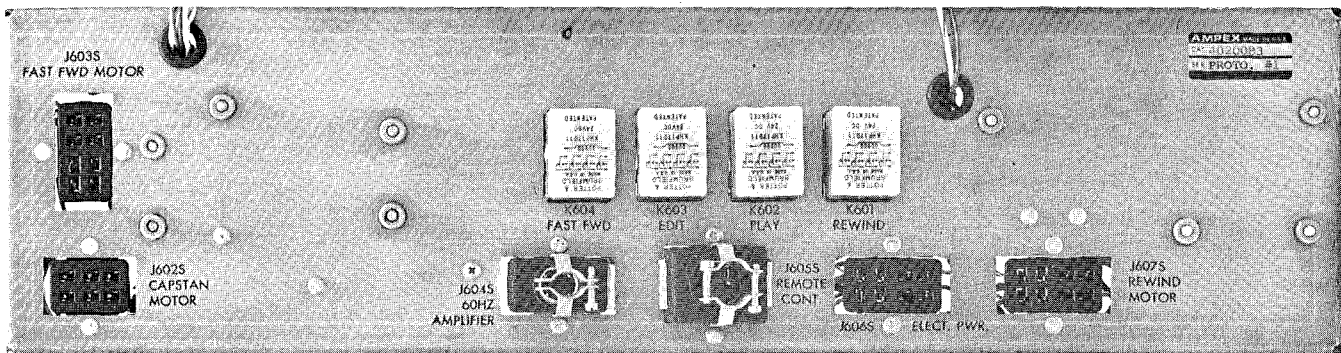


Fig. 2-3. Tape Transport Receptacles

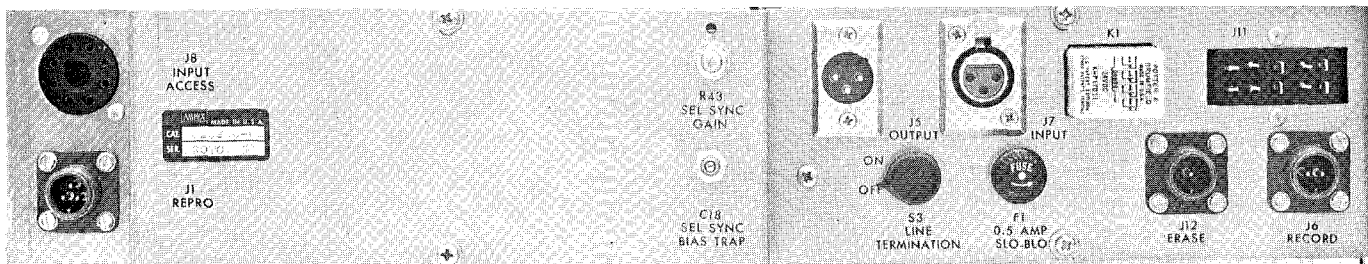


Fig. 2-4. Electronic Assembly Receptacles

of them may be used to connect from one to four electronic assemblies. On reproduce-only equipment, captive power cables are provided on each reproduce module; these cables also are plugged into J701 through J704 on the transport.

b. Connect the head cables, which are captive at the tape transport, to the applicable receptacles on the electronic assemblies. Note that reproduce head cables are terminated in a three pin connector, record head cables in a two pin connector, and erase head cables in a one pin connector. On multi-channel equipment, the head cables are marked with the number of the track to which they correspond; track 1 is that farthest from the top plate.

## 2.5 CONNECTING SIGNAL LINES

### 2.5.1 General

Signal INPUT and OUTPUT receptacles are located on the rear panel of the electronic assemblies (see Fig. 2-4). These are standard XL receptacles, and mating connectors for each are provided with the equipment.

### 2.5.2 Signal Input Connections

To connect a two-conductor, shielded, cable to the line input, wire the signal leads to pin 3 and pin 2 (ground), and the shield to pin 1. With this connection, the dummy plug (which is furnished) will provide an unbalanced line input, either of the accessory plug-in transformers will provide a balanced line input, and the accessory microphone preamplifier will provide a microphone input. These units are inserted in the input accessory receptacle on the back panel of the electronic assembly.

If a single conductor, shielded, line is used, connect the conductor to pin 3 and the shield to pin 2 (this type of connection is applicable only to unbalanced line inputs). Insert the dummy plug in the INPUT ACCESS receptacle.

### 2.5.3 Signal Output Connections

An unbalanced line output, using two conductor shielded cable, is obtained by wiring the signal leads to pin 3 and pin 2 (ground) and the shield to pin 1, then jumpering pin 1 to pin 2; a balanced line output requires the same connections,

but the jumper is omitted. If a single conductor shielded cable is employed (unbalanced line only) wire the conductor to pin 3, the shield to pin 2, and jumper pins 1 and 2.

In most instances, the LINE TERMINATION switch, on the back panel of the electronic assembly (see Fig. 2-4), is to be left in the OFF position except during test or adjustment procedures. However, if the equipment is to be used to drive a high impedance load (2,000 ohms or more), place that switch in the ON position.

#### 2.5.4 Strapping Output

Record/reproduce equipment is shipped from the factory with the output strapped to provide a +8 dbm operating level output into a 600 ohm line. If a +4 dbm operating level output is required, the circuit can easily be restrapped. Remove the top cover from the electronic assembly. On the right panel (viewing the electronic assembly from the front) there are two terminal strips (see Fig. 6-28).

Terminal strip TB3, toward the back of the assembly, has a jumper wire (item 13, Fig. 6-28) connected between terminals 2 and 3. Remove the end of the jumper from terminal 3, and move it to terminal 1 (the jumper is then connected between terminals 1 and 2). This completes the restrapping procedure. If the operating level output is thus changed, recalibrate the record, reproduce, and bias levels as explained in paragraph 4C.3.7.

Reproduce-only equipment has no optional strapping. The output is adjusted to the desired level by means of the LEVEL control.

## 2.6 CONNECTING POWER

A power cable is furnished with the equipment. Connect this cable from AC POWER receptacle J601S, on the tape transport control box to the power source.

## 2.7 INSTALLING ACCESSORIES OR DUMMY PLUGS

### 2.7.1 Input Transformer or Microphone Preamplifier

The equipment is shipped with a dummy plug (Catalog No. 4030034-30) installed in the INPUT ACCESS socket on the back panel of each electronic assembly (see Fig. 2-4). This plug

provides proper input for an unbalanced line; input impedance is 100,000 ohms. Also supplied for each electronic assembly is a bridging input transformer (Catalog No. 4580200-01). If a balanced line input is employed, remove the dummy plug and insert the transformer in the accessory socket; input impedance with the transformer is 20,000 ohms.

Another input transformer is available. This second unit (Catalog No. 4580200-02) is a matching transformer which supplies approximately 14 db gain; input impedance with this optional accessory is 600 ohms.

If the equipment is to record from a microphone, an optional accessory microphone preamplifier, Catalog No. 4010066, must be installed in the accessory socket. When this two-stage preamplifier is used, the RECORD LEVEL control is connected between the two stages, which effectively makes the preamplifier a variable gain device able to accommodate a wide variety of professional-quality microphones.

### 2.7.2 Remote Control Unit

With the exception of the edit function, which must be operated at the equipment proper, all modes can be controlled from a remote location. Ampex remote control unit, Catalog No. 4010080, can be plugged into REMOTE CONTROL receptacle J605S on the tape transport control box (see Fig. 2-3).

A feature of the remote control unit is that the automatic tape lifting mechanism can be defeated in the fast-winding modes, so that cueing can be quickly accomplished.

If remote control is not employed, the dummy plug (provided with the equipment) must be inserted in J605S or the recorder will not operate.

### 2.7.3 Motor Drive Amplifier

A precision drive frequency for the capstan motor can be applied by connecting a motor drive amplifier to 60 Hz AMPLIFIER receptacle J604S on the tape transport control box (see Fig. 2-3). The ac power to the amplifier is taken from pins 1 and 5 of J604S and the precision frequency is returned at pins 4 and 8.

If a motor drive amplifier is not used, a dummy plug (provided with each equipment) must be inserted in J604S or the capstan motor will not operate.

#### 2.7.4 Rear Covers, Console

Rear covers for console mounted equipment are available as optional accessories. These consist of a cover for the console base (Catalog No. 4040982) and individual covers for each electronic assembly (Catalog No. 4040984). When ordered as a set for a complete system the Catalog number is 4010076-01, 4010076-02, 4010076-03, or 4010076-04 (dash numbers indicate the number of electronic covers included in the set).

The rear covers are secured to the back uprights of the console and electronics by captive, spring-loaded, thumb screws which mate with threaded holes in the uprights.

#### 2.7.5 Scrape Flutter Idler

Standard equipment is furnished with a single scrape flutter idler, mounted on the tape transport so that it is between head positions 3 and 4. Mounting facilities are provided on the transport for a second scrape flutter idler, which is mounted so that it is between head positions 2 and 3. Catalog number of the second idler assembly kit is 4010069. The optional idler is larger in diameter than the one normally supplied, so the two idlers are not interchangeable.

Installation of the idler is explained in Section 4, Part A, Conversion and Expansion.

### 2.8 CHECKING OTHER ITEMS

Check that the following connections and plug-in electronics assemblies have not vibrated loose during shipment.

a. Check that the captive cable from the takeup motor assembly is plugged into receptacle J603S on the tape transport control box.

b. Check that the captive cable from the rewind motor assembly is plugged into receptacle J607S on the tape transport control box.

c. Check that the captive cable from the capstan drive motor assembly is plugged into J602S on the tape transport control box.

d. Check that the captive cable from the electronic power supply box on the tape transport is plugged into J606S on the tape transport control box.

e. The record/reproduce plug-in electronic printed circuit boards are located behind a cover (see Fig. 2-5) which is secured by two screws to the front panel of the electronics assembly. Check that the bias amplifier board, the record board, and the reproduce board are in position.

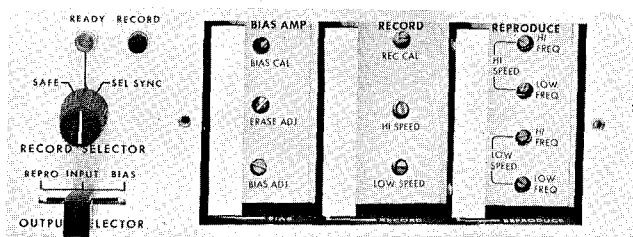


Fig. 2-5. *Printed Circuit Boards, in Position*

Reproduce-only modules are mounted in one tray behind a solid front cover secured to the tray by captive thumbscrews. Check that a reproduce printed circuit board is plugged into each module.

f. Equalizer circuits are contained on printed circuit boards which plug into connectors at the forward end of the record and reproduce boards (see Fig. 2-6). Check that these boards are in position.

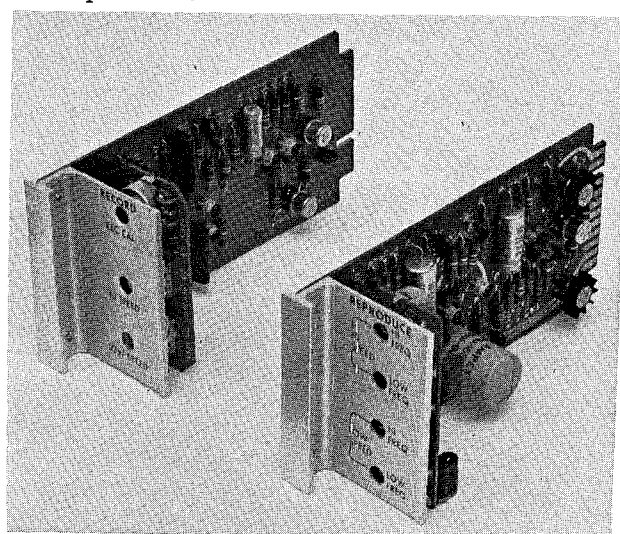


Fig. 2-6. *Equalizers, in Position*

g. Check that the fuses are intact and are firmly secured in the fuse extractor posts. Two fuses are mounted on the tape transport control box, one is mounted on the power supply box of the tape transport, and one is mounted on the rear panel of each record/reproduce electronic assembly (or each reproduce-only module).

h. Check that the plug-in relays have not vibrated loose. Four of these relays are located on the tape transport control box, and one is located on the back panel of each electronic assembly.

i. Check that the power supply and bias oscillator (power supply only for reproduce-only equipment) printed circuit board is seated in the plug-in receptacle within the power supply box mounted at the back of the tape transport.

## **2.9 INITIAL LUBRICATION**

Before placing the equipment in operation, perform the initial lubrication of the drive motor explained in Section 4B, paragraph 4B.3.2.



## OPERATING INSTRUCTIONS

### 3.1 OPERATING CONTROLS AND INDICATORS

#### 3.1.1 Tape Transport (see Fig. 3-1)

POWER toggle switch	Used to control application of power to entire equipment.
Power indicator light (amber)	Illuminates when power is applied.
SPEED toggle switch	Used to select the slow (∨) or fast (∧) tape speed. Equilization is automatically switched in accordance with speed selection.
REEL toggle switches (2)	Used to select proper tension for large (O) or small (o) reel hubs. One switch is provided for each turntable.
RECORD pushbutton	Used to place the equipment in the record mode. Tape motion must first be started by pushing the PLAY pushbutton, and the RECORD SELECTOR switch on the electronic assembly must be in the READY position.
EDIT pushbutton	Used to place equipment in the stop/edit or play/edit mode when the equipment is stopped or is in the reproduce (play) mode. Also used to provide electronic override of automatic tape lifter mechanism in the fast-winding modes, thus providing the fast-winding/edit mode.
REWIND pushbutton	Used to move tape from the takeup reel to the supply reel at the fast-winding speed. The rewind mode cannot be entered from the record or play/edit modes, but can be initiated from any other mode.



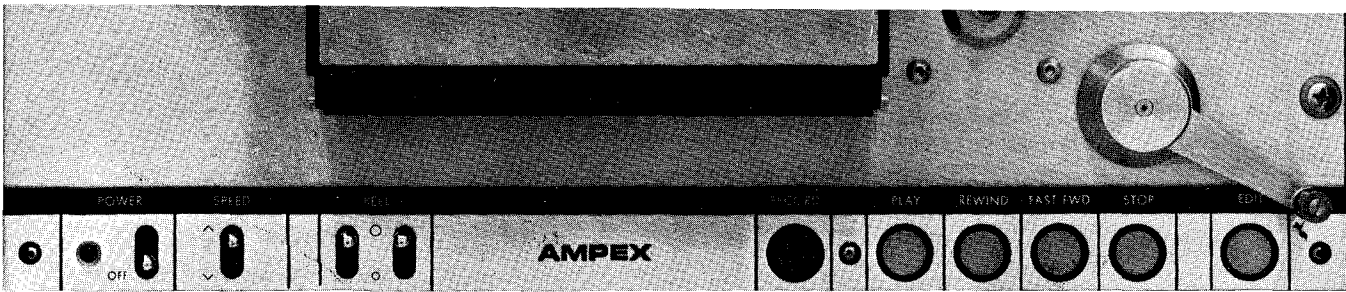


Fig. 3-1. Tape Transport, Controls and Indicators

- |                     |  |
|---------------------|--|
| FAST FWD pushbutton | Used to move tape from the supply reel to the takeup reel at the fast-winding speed. The fast forward mode cannot be entered from the record or play/edit modes, but can be initiated from any other mode. |
| STOP pushbutton     | Used to stop the equipment from any mode of operation, will drop out the record or edit modes when applicable.   |
| PLAY pushbutton     | Used to place equipment in the reproduce mode. Must be pressed before the record mode can be initiated.  |

3.1.2 Record/Reproduce Electronic Assembly (see Fig. 3-2)

- |                                |  |
|--------------------------------|--|
| REPRODUCE LEVEL rotary control | Used to adjust reproduce level.  |
| Meter                          | VU meter indicates reproduce, record, or bias level as selected at the OUTPUT SELECTOR switch. Meter lights illuminate when power is applied.  |
| RECORD SELECTOR rotary switch  | Is positioned to select one of three conditions:<br>SAFE (Channel cannot be placed in the record mode).<br>READY (Channel can be placed in the record mode).<br>SEL SYNC (Channel will operate in the Sel Sync condition -- refer to paragraph 3.3.2). |
| Ready indicator light (amber)  | Illuminates when the RECORD SELECTOR is placed in the READY position; remains illuminated while the channel is operating in the record mode.   |

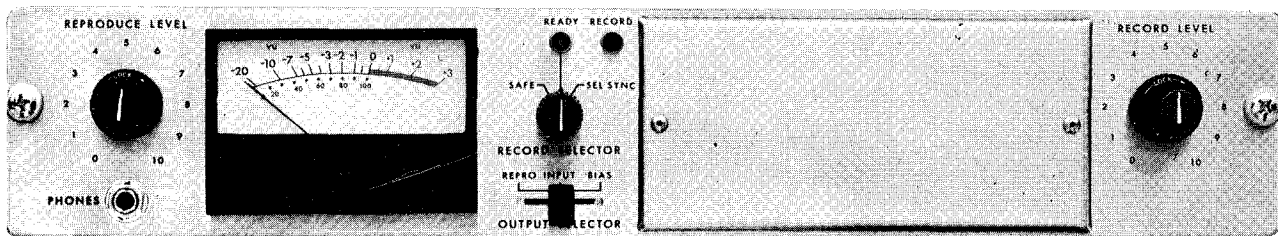


Fig. 3-2. Electronics Controls and Indicators

Record indicator light (red)	Illuminates when the channel is operating in the record mode.
OUTPUT SELECTOR slider switch	Positioned to select one of three signals to be connected as shown.  REPRO: Signal reproduced from the tape, connected to monitor and output lines and to vu meter. INPUT: Signal to be recorded, connected to monitor and output lines, and to the vu meter. BIAS: Bias signal (record mode), connected to vu meter.
RECORD LEVEL rotary control	Used to adjust record level.

3.1.3 Reproduce-only Electronic Assembly

LEVEL screwdriver control	Used to adjust reproduce level.
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## 3.2 PRE-OPERATING PROCEDURES

### 3.2.1 Applying Power

To apply power to the complete equipment, place the POWER toggle switch on the tape transport in the on (up) position. The power indicator on the transport and the vu meter lights on the record/reproduce electronic assembly will illuminate. (There is no power indication on reproduce-only modules, only the power indicator on the transport will light).

### 3.2.2 Selecting Tape Speed

Two tape speeds are available on each transport. Standard speeds are 3-3/4 and 7-1/2 ips, or 7-1/2 and 15 ips. The low speed and the high speed are selected by positioning the SPEED toggle switch on the tape transport in the ∨ (low speed) or ^ (high speed) position. Electronic equalization is automatically switched when the tape speed is selected.

### 3.2.3 Selecting Reel Hub Size

There are two REEL toggle switches, one each for supply and takeup. These switches are positioned in accordance with the size of the hubs on the reels being used. For NAB hubs (4-1/2 inch diameter) place the switch in O (large hub) position. For EIA hubs (2-1/4 inch diameter) place the switch in the o (small hub) position. A large hub can be used on one turntable and a small one on the other.

Note again that these switches are to be used in reference to the diameter of the hub, not the size of the reel.

### 3.2.4 Threading Tape

The tape threading path is shown in Fig. 3-3. Note that the threading procedure will be facilitated by applying power to the equipment, moving the takeup tension arm so it does not contact the safety switch, and pressing the EDIT push-button. This reduces the braking force at each turntable to the point where the reels can be easily turned. After threading the tape, be sure to press

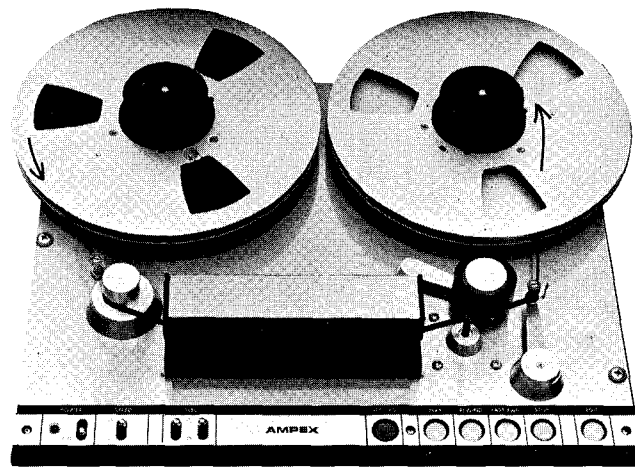


Fig. 3-3. Tape Threading Path

the STOP pushbutton to remove the equipment from the stop/edit mode.

When threading is completed, with the tape anchored to the hub of the takeup reel, manually turn the takeup reel until the supply reel starts to rotate. This removes all tape slack and ensures that the takeup tension arm is not contacting the safety switch.

### 3.2.5 Monitoring Facilities

Monitoring can be accomplished by plugging headsets or an amplifier/loudspeaker into the PHONES jack on the front panel of the electronics assemblies. Of course, an amplifier/loudspeaker can be connected to the output line if desired.

## 3.3 RECORDING

### 3.3.1 Without Using Sel-Sync

Step 1: Apply power to the equipment.

Step 2: Thread blank tape, or tape recorded with program material not necessary to save, on the tape transport. Close the head gate when threading is completed.

#### NOTE

Always bulk erase tape if it was previously recorded on equipment which employed a different head configuration than will now be used, because it is possible that the original recording will not be completely erased.

Step 3: At the tape transport, select the tape speed. Place the REEL toggle switches in the positions appropriate to the size of the reel hubs being used.

Step 4: On the electronic assembly for the channel(s) which will record, place the RECORD SELECTOR switch in the READY position (the READY indicator will illuminate). If certain channels are not to record, leave the RECORD SELECTOR on the corresponding electronic assemblies in the SAFE position.

Step 5: Place the OUTPUT SELECTOR switches, on the electronics assemblies for the channels which will record, in the INPUT position. Use a rehearsal run, or test signal, and adjust the RECORD LEVEL control so that the indicator on the vu meter swings to 0 on most program

peaks (maximum peaks can result in a swing to +2 or +3 on the vu meter).

Step 6: When the recording run is to start, press the PLAY pushbutton to start tape in motion, then press the RECORD pushbutton. All channels which were in the ready condition will be placed in the record mode (the RECORD indicator on the corresponding electronic assemblies will illuminate).

#### NOTE

In monitoring the record run, it is possible to compare the input signal with the signal actually being recorded and reproduced from the tape. This is accomplished by moving the OUTPUT SELECTOR switch(es) back and forth between the INPUT and REPRO position.

Step 7: At the completion of the record run, press the STOP pushbutton to stop tape motion and remove the equipment from the record mode.

### 3.3.2 Using Sel-Sync

Sel-Sync capability is provided as an integral part of this equipment. The Sel-Sync feature allows a certain channel (or channels) to be initially recorded, then another channel (or channels) to be subsequently recorded in perfect synchronization with the first.

Step 1: Make the first recording run, on the selected channel(s), exactly as described in paragraph 3.3.1.

Step 2: Rewind and cue the tape to the beginning of the recording made in Step 1.

Step 3: On the electronic assemblies corresponding to the channel(s) which recorded the first run, turn the RECORD SELECTOR switch(es) to the SEL-SYNC position.

Step 4: Select the channel(s) which will record the second run, by placing the RECORD SELECTOR switch(es) on the corresponding electronic assemblies in the READY position. Place the OUTPUT SELECTOR switch(es) on those electronic assemblies in the INPUT position, and adjust the record level.

Step 5: Place the OUTPUT SELECTOR switch on the channels operating in Sel-Sync in the REPRO position. Furnish a headset monitor to the performer, and place the equipment in the

record mode. The performer will hear the first recording, and can sing or play in perfect synchronization.

**Step 6:** When the second recording run is completed, press the STOP pushbutton to stop tape motion and remove the equipment from the record mode.

**Step 7:** If three (or more) recording runs are to be made, continue the described procedure. Before starting each run, be sure that the RECORD SELECTOR switches for all previously recorded channels are turned from the READY position. (If the performer desires to monitor every previously recorded channel, place all RECORD SELECTOR switches in the SEL-SYNC position. If he desires to monitor only selected channels, place the switches for those channels in the SEL-SYNC position, the rest in the SAFE position.)

### 3.4 REPRODUCING

**Step 1:** Apply power to the equipment. On record/reproduce assemblies place all RECORD SELECTOR switches in the SAFE position.

**Step 2:** Thread the recorded tape on the transport. Close the head gate when threading is completed. Note that on two channel equipment which employs both the normal two track head and a 1/4 track head, the switching knob on the head assembly is pushed down to select the two track head, or pulled up to select the 1/4 track head.

**Step 3:** Select the tape speed which corresponds to the speed at which the tape was recorded. Place the REEL toggle switches for each turntable in the positions applicable to the size of the reel hubs being used.

**Step 4:** Place the OUTPUT SELECTOR switch in the REPRO position on record/reproduce electronics. (There will be no output if this switch is not so positioned.)

**Step 5:** Press the PLAY pushbutton. Tape will start in motion in the reproduce mode. Adjust the REPRODUCE LEVEL control, if necessary. (The screwdriver-operated level control on reproduce-only modules is behind the front cover on the tray.)

**Step 6:** To stop tape motion, press the STOP pushbutton. If the tape is allowed to run completely off the supply reel, operation will automatically stop.

### 3.5 USING FAST-WINDING MODES

Tape can be shuttled quickly from one reel to the other by using the fast-winding modes, which are controlled by pressing the REWIND and FAST FWD pushbuttons. When tape is being cued or edited, these pushbuttons can be pressed alternately, with no need for stopping tape motion. When the desired portion of the tape is reached, stop tape motion by pressing the STOP pushbutton. If the tape is allowed to run completely off either reel, operation will automatically stop.

Either fast-winding mode can be entered from the other, and also from the stop or play modes. Fast-winding is locked out whenever the equipment is in the record mode, or in the play/edit mode (in play/edit the takeup tension arm will normally not be holding the safety switch closed, thus fast-winding is locked out).

To enter any but the other fast-winding mode when the equipment is operating in fast forward or rewind, it is necessary to press the STOP pushbutton, wait until tape motion stops, then select the desired mode.



Always allow fast-winding tape motion to stop completely before pressing the play pushbutton. If this precaution is not observed, tape will probably be broken or stretched.

An automatic tape lifting mechanism, which removes the tape from contact with the heads, is actuated in either fast-winding mode. If monitoring is required, press and hold the EDIT pushbutton after the fast-winding mode is started. This defeats the tape lifter action. (Manual override of the tape lifter action can be exercised by opening the head gate and pushing the head lifter post back.)

### 3.6 USING EDIT MODES

There are three edit modes available -- the stop/edit, play/edit, and fast-winding edit -- on the tape transport.

The stop/edit mode can be initiated, when power is applied and the tape is at a standstill, by pressing the EDIT pushbutton (if tape is not threaded, the takeup tension arm must be moved so that

it does not contact the safety switch). This reduces the braking force acting on each turntable, and the reels can be easily rotated by hand. The stop/edit function will facilitate operating procedures such as manual cueing and threading of the tape. To remove the equipment from the stop/edit mode, press the STOP pushbutton.

The play/edit mode can be initiated at any time that the equipment is operating in the reproduce mode, by pressing the EDIT pushbutton. Tape will continue in motion, with the speed controlled by the capstan, and monitoring is possible. The takeup turntable will not rotate, and the tape will spill off the right side of the transport. The mode is provided primarily to allow unwanted

lengths of tape to be cut from the reel. Note that if the tape leader is to be discarded it is not necessary to anchor it to the takeup reel hub. Thread the tape in the normal path past the capstan and idler, manually move the takeup tension arm from its rest position, press the PLAY pushbutton and the EDIT pushbutton (the takeup tension arm can then be released).

Fast-winding/edit is entered by pushing the EDIT pushbutton when the equipment is operating in either fast forward or rewind. This defeats the tape lifter mechanism and monitoring is possible. This mode would be used primarily for quickly reaching an approximate point on the tape (rough cueing).



Section 4  
**MAINTENANCE  
FOREWORD**

This section is divided into six parts, designated A, B, C, D, E, and F. Page, paragraph, figure, and table numbering include the section number and part designation letter as a prefix; for example, the first page in part A is numbered 4A-1, the third page in part C is numbered 4C-3, etc.

Part A covers expansion or conversion of the original equipment. Subjects covered include repositioning the turntables for the large CCIR reels, converting from one tape width to another, adding optional accessory items such as the second tape scrape flutter idler and the rear covers for consoles, adding more channels, and converting from a reproduce-only to a record-reproduce equipment.

Part B explains routing maintenance, including cleaning, demagnetizing, lubricating, and overall performance checks of the equipment.

Part C is concerned with normal adjustment and alignment procedures which will usually suffice to correct any fault indicated by the overall performance checks. This includes both tape transport adjustments and electronic alignment.

Parts D, E, and F describe corrective maintenance procedures for the magnetic heads, tape transport, and electronic assemblies respectively.

Reference to the Table of Contents and to the Index should make it relatively easy to find any information included herein.

**MAINTENANCE****Part A. Conversion and Expansion****4A.1 REPOSITIONING TURNTABLES**

The takeup and rewind assemblies, which include the turntables, are secured to the reel guards through slotted holes in the top plate. This allows those assemblies and guards to be moved toward or away from the center of the transport. As shipped from the factory, both assemblies are positioned as far as possible toward the center, allowing reels up to 10-1/2 inches in diameter to be used.

If it is desired to operate with the 11-1/2 inch CCIR reels, both turntables can be easily repositioned. At the back of the tape transport, loosen the three self-locking nuts (Item 77, Fig. 6-9) which secure each assembly to the reel guard. Slide both the takeup and rewind assemblies as far as possible away from the center of the transport. Check that the flat portion of the reel guards are parallel to the top edge of the transport, and that the turntables are centered in the guards, then tighten the nuts.

Note that when the turntables are positioned fully outward two or more transports cannot be mounted side-by-side on standard 19-inch racks, because the reels protrude over the edge of the racks.

**4A.2 TAPE WIDTH CONVERSION****4A.2.1 General**

Changing from 1/2-inch to 1/4-inch magnetic tape, and vice versa, is easily accomplished. As far as the tape transport proper is concerned, it is necessary only to rotate two tape guides in their mountings. The head assembly must be changed, and sometimes the head cable box assembly (which is located at the back of the transport) must be changed.

**4A.2.2 Rotating Tape Guides**

To rotate the tape guides, one on the reel idler assembly and the other on the takeup tension arm assembly, simply lift the guides against the spring pressure and turn them until the appropriate face of the guides (1/4-inch or 1/2-inch) is in the tape threading path. The guides snap down into position when properly aligned.

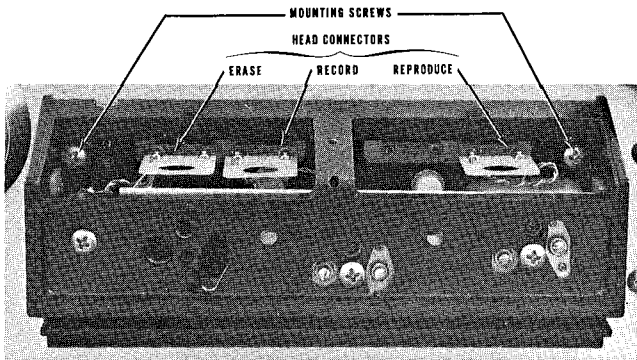
**4A.2.3 Changing Head Assembly**

First remove the stainless steel head housing overlay (cover) by loosening the captive screw on the slanted back surface of the head assembly. (Note that if this is a four position

head, the switching knob at the middle of the overlay must be unscrewed before the cover will come free.) Disconnect all head connectors (see Fig. 4A-1). Remove the two screws which secure the head assembly to the top plate, and (using care not to bump or scratch the scrape flutter idler) lift the complete head assembly up and off. If the head cable box assembly must be changed (refer to paragraph 4A.2.4) do that before replacing the heads.

Replace the assembly in the reverse order of its removal, first cleaning the mounting surfaces on both the tape transport and the head assembly of any dirt or dust. Also, be sure the head connectors are plugged into the correct receptacles as shown in Fig. 4A-1.

Catalog numbers of the various head assemblies are listed in the parts lists, Section 6.



*Fig. 4A-1. Head Assembly,  
Overlay Removed*

#### 4A.2.4 Changing Head Cable Box

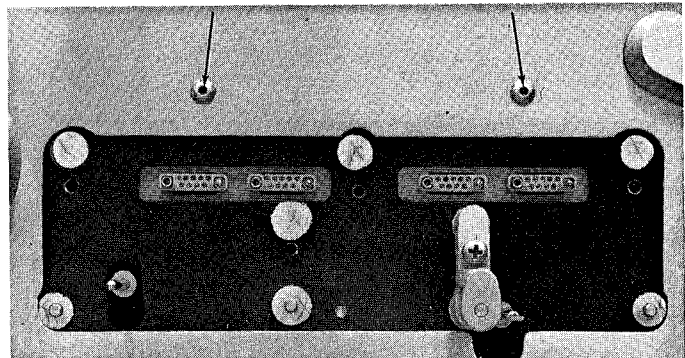
Only under two conditions is it necessary to change the head cable box.

(a) If the equipment is being expanded to operate with more channels than originally planned. For example, if the recorder was ordered as a one or two channel, 1/4-inch tape, machine and is being converted to three or four channels using 1/2-inch tape. Note that the box need not be changed when converting from three or four channels, 1/2-inch tape, to one or two channels, 1/4-inch tape, except as noted in (b).

(b) If the conversion is to 1/4-inch tape using the special four stack head assembly. If the equipment is then re-converted to operate with 1/2-inch tape, the box must again be changed.

To change the head cable box, first remove the head assembly (refer to paragraph 4A.2.3). (Note that if the head cable box is being removed for inspection, it is not necessary to remove the head assembly; simply remove the head overlay and disconnect the heads from the receptacles.) Disconnect all head cables from the receptacles at the back of the electronic assemblies. Manually support the head cable box at the back of the transport, and remove the two screws (see Fig. 4A-2) located immediately behind the head assembly. This frees the box and it can be removed. Replacement is in the reverse order of removal.

Catalog numbers of various configurations of the head cable boxes are included in the parts lists, Section 6.



*Fig. 4A-2. Mounting Screws,  
Head Cable Box*

#### 4A.3 ADDING SCRAPE FLUTTER IDLER

Standard equipment is furnished with one tape scrape flutter idler mounted on the top plate so that it is between positions 3 and 4 of the head assembly. Facilities are provided for mounting a second such idler, which can be ordered as an optional accessory.

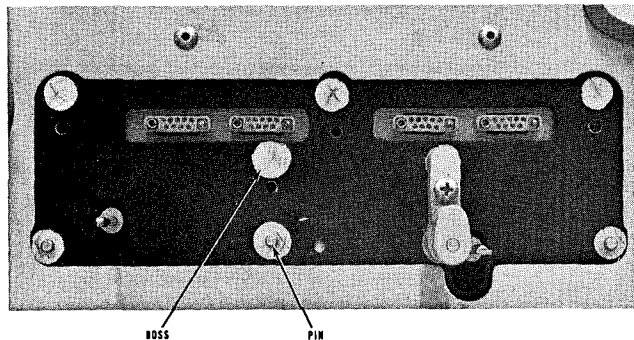
The optional tape scrape flutter idler kit is available under Catalog No. 4010069. This kit contains the idler, a mounting screw, and a lock washer.

#### NOTE

When two idlers are employed, the rollers are of different diameters, to minimize any rotational interaction. The idler with

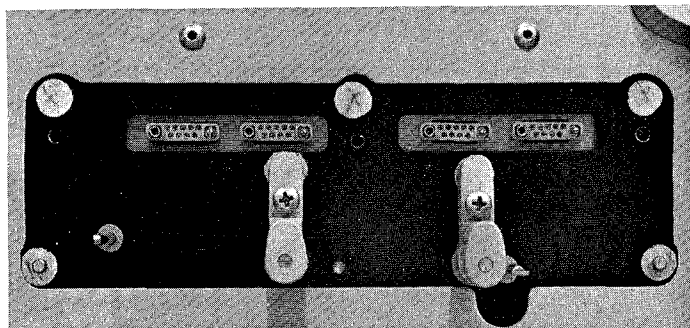


the small roller (3/8 inch) must be mounted so that it is between head positions 3 and 4. The idler with the large roller (15/32 inch) must be mounted so that it is between head positions 2 and 3.



*Fig. 4A-3. Mounting, Tape Scrape Flutter Idler*

To install the optional idler, remove the head assembly (refer to paragraph 4A.2.3). A locating pin, threaded hole, and raised boss are located as shown in Fig. 4A-3. Place the idler in position on the locating pin and boss, and secure it to the top plate using the screw and washer (see Fig. 4A-4). Replace the head assembly.



*Fig. 4A-4. Scrape Flutter Idler Installed*

#### 4A.4 ADDING CHANNELS

##### 4A.4.1 General

It is comparatively simple to add channels to an existing system. Any such expansion of course requires changing the head assem-

bly (refer to paragraph 4A.2.3) and the head cable box (refer to paragraph 4A.2.4). It is then necessary to add one electronic assembly, and an equalizer for each additional channel required. (The electronic assembly includes the plug-in record, reproduce and bias amplifier printed circuit boards). The equipment will operate with any number of channels up to four.

##### 4A.4.2 Record/Reproduce Electronics

In addition to the electronic assemblies and equalizers, one electronic interconnecting cable (Catalog No. 4050442) is required for each channel to be added. Optional accessory plug-in input units (balanced line transformer, microphone preamplifier, etc., as described in Section 1) may be desired. Other items required to mount the electronics are described in following paragraphs.

For mounting in racks, or in custom consoles, secure the electronic assemblies in position adjacent to the existing assemblies. Mounting dimensions are shown in Section 2, Installation.

Portable cases for the electronic assemblies come in two sizes. One (Catalog No. 4150330) will accommodate two assemblies, the other (Catalog No. 4150331) will accommodate four. In expanding a one or two channel portable system to three or four channels, a new case is therefore required. If it is desired to have all electronic assemblies in one case, order the 4150331 case. Two 4150330 cases may be used for three or four channel portable systems; these would be stacked one on top of the other while operating. Note that for one channel or three channel equipment, a blank panel (Catalog No. 4290620) is available for the unused space. Each electronic assembly is secured in the case by two 12-24 x 3/4 oval head Phillips screws, together with white nylon cup washers.

Mounting additional electronic assemblies in an Ampex console requires adding two electronics supports (Catalog No. 4260404) for each such assembly. First remove the top cover over the existing electronics, and the uppermost existing electronics assembly. The new supports then are bolted to the existing supports (one on each side per channel) by two 6-32 x 5/8 pan head screws, two flat washers, two lock washers, and a 6-32 hex nut (see Fig. 4A-5). When the supports are secured in position, replace the top cover and mount the electronic assemblies. Each assembly

is secured to the supports by two 12-24 x 3/4 oval head Phillips screws, together with two white nylon cup washers.



*Fig. 4A-5. Installing Electronics Supports, Console*

#### NOTE

If the console is equipped with the optional accessory rear covers (refer to paragraph 4A.5) individual covers (Catalog No. 4040984) should be ordered for each additional electronic assembly.

Connecting the electronic assemblies to the tape transport, to the heads, and to the input/output lines is explained in Section 2, Installation.

#### 4A.4.3 Reproduce-only Electronics

When ordering reproduce-only electronics to be added to an existing system, order the equalizer printed circuit board in addition to the reproduce-only module (the module includes the reproduce printed circuit board). Catalog numbers of the equalizers and the module are included in the parts lists, Section 6.

The reproduce-only electronic tray will hold up to four modules, so it makes no difference in the installation of additional modules if the system is rack-mounted or console mounted. To install the module, remove the plug-in reproduce board from the chassis. Remove the front cover of the electronic tray, slide the chassis into position in the tray, and secure it with three No. 6 self-tapping screws (inserting the screws up through the bottom of the tray). Plug the equalizer in the receptacle at the front of the reproduce board, then slide the reproduce board in the guides on the chassis until it mates with its receptacle.

Connecting the captive power cable, the reproduce head cable, and the output line, is explained in Section 2, Installation.

#### 4A.5 REAR COVERS, CONSOLE

No rear covers are provided on standard console-mounted equipment. If such covers are required, they are available as an optional accessory. Rear cover assembly, Catalog No. 4010076, consists of a rear cover for the console base, and one rear cover for each electronic position. The assembly is numbered 4010076-01 through -04, corresponding to one channel through four channels of electronics. Rear covers can be ordered separately; for the console base order Catalog No. 4040982, and for electronic assemblies Catalog No. 4040984.

The rear covers are secured to the uprights through captive, spring-loaded, thumb screws which mate with threaded holes in the uprights.

#### 4A.6 CONVERSION, RECORD AND REPRODUCE

Converting from a reproduce-only to a record/reproduce equipment (or vice versa) can be easily accomplished. Such conversion consists of changing the printed circuit board in the electronics power supply (record/reproduce equipment uses a card with both a power supply and a master bias oscillator, the bias oscillator is omitted on

the reproduce-only card), changing the head assembly and head cable box, and adding the applicable electronic assemblies.

The power supply printed circuit board simply plugs into a receptacle in the electronic power supply box on the back of the transport. Changing the head assembly and head cable box is

described in paragraphs 4A.2.3 and 4A.2.4. Adding electronic assemblies is described in paragraph 4A.4.

Catalog numbers for the power supply boards, all head and head cable box assemblies, and the electronics assemblies are included in the parts lists in Section 6.



## MAINTENANCE

### Part B. Routine Maintenance

#### 4B.1 CLEANING

Heads, and all other components in the tape threading path, must be cleaned after each eight hour operating period, or oftener if visual inspection indicates the need. This is to remove the oxide from the magnetic tape, which will be deposited on such components and which will affect equipment performance if allowed to build up.



When cleaning the heads, use only the recommended solvent (some solvents will damage the heads). Do not allow the solvent to drip or spray on plastic finishes or on the tire of the capstan idler. Do not use any metal tools which might scratch the heads.

Clean the heads by moistening a cotton-tipped applicator with Ampex Head Cleaner, Catalog Nos. 4010823 or 087-007. Clean each head thoroughly.

Use iso-propyl alcohol to clean all tape guiding elements, the capstan, and the capstan idler. Do not use the head cleaning solution on these components, it will damage the rubber

tire on the capstan idler and cause tape slippage if applied to the capstan.

Clean the scrape flutter idler(s) using a dry cotton-tipped applicator. Be sure to remove all oxide from the holder assemblies at the top and bottom of the roller.

#### 4B.2 DEMAGNETIZING

Heads and other components in the tape threading path occasionally acquire a degree of permanent magnetization which can result in increased noise and distortion, and the partial erasure of high frequencies on recorded tapes. Demagnetize after each eight hour operating period, or oftener if there is any suspicion that demagnetization is required, using an Ampex Head Demagnetizer (Catalog No. 4010820) or equivalent.

Step 1: Turn equipment power off, and remove any tape that is on or near the transport (tape would be partially erased by the action of the demagnetizer).

Step 2: Cover the tips of the demagnetizer with pressure sensitive tape to prevent scratching the heads, and plug the demagnetizer into a source of 110-120 volt a-c power.

Step 3: Bring the tips of the demagnetizer into very light contact with the head, posi-

tioned so the tips straddle the gap in the center of the head.

Step 4: With a slow, smooth motion, run the tips up and down the stack several times. Then slowly withdraw the demagnetizer (slow withdrawal is required for effective demagnetization).

Step 5: Repeat Steps 3 and 4 at all head stacks, at the tape guides on the reel idler and takeup tension arm, and at the scrape flutter idlers.

Step 6: Withdraw the demagnetizer at least three feet from the recorder before unplugging it from the power source.

## 4B.3 LUBRICATING

### 4B.3.1 General

Bearings in the capstan drive motor, the capstan idler, and the scrape flutter idler, are the only components requiring lubrication.

Ampex Lubricating Oil (Catalog Nos. 4010825 or 087-579) should be used for the drive motor and capstan idler. Equivalent oils are available from Esso Standard Oil Co. (Teresso No. 47) and Socony Mobil Oil Co. (Mobiloil DTE Medium).

Special equipment and oil are required for the scrape flutter idler(s). These are described in paragraph 4B.3.4

### 4B.3.2 Initial Lubrication, Drive Motor

When the equipment is first received, or if a replacement capstan drive motor is installed, it is possible that some time has elapsed since the motor was operated. If this is the case, the motor bearing might be dry--even though there is oil in the reservoir. Running the motor under this condition may result in damage to the bearing before the oil in the reservoir can reach it. Initial lubrication before operation is therefore required.

Using a knife blade, or some similar tool, gently pry the cone shaped dust cap (Item 11 or 12, Fig. 6-8) from the top plate. Removal of the dust cap exposes a portion of the bearing end ball on the motor. While manually rotating the capstan, apply four or five drops of oil around the base of the capstan shaft (where it enters the motor).

When the oil has worked down around the shaft, hold the takeup tension arm away from its rest position, using a piece of pressure sensitive tape. Apply power to the equipment, and al-

low the drive motor to operate for approximately 15 minutes. Wipe off any excess oil and replace the dust cap.

### 4B.3.3 Scheduled Lubrication, Drive Motor and Capstan Idler

Scheduled lubrication of the drive motor and capstan idler is required every three months or after each 1,000 hour operating period, whichever occurs first.

To lubricate the drive motor, pry off the capstan dust cap the same as for initial lubrication (paragraph 4B.3.2). Some motors have an oil hole in the bearing end bell, accessible when the dust cap is removed; fill the oil reservoir through that hole. Other motors, which do not have an oil hole, are lubricated by applying 10 drops of oil around the base of the capstan shaft (do not overlubricate); passages are provided for the oil to reach the bearing. Wipe off any excess oil, and replace the dust cap.

Lubricating the capstan idler bearing requires prying off the dust cap from the idler hub. This exposes a felt washer. Place not more than three drops of oil on this washer. Do not over-lubricate.



If oil is spilled or thrown on the rubber tire of the idler, clean it immediately using iso-propyl alcohol. Oil will cause deterioration of the tire.

### 4B.3.4 Scheduled Lubrication, Scrape Flutter Idler

Ultrasonic cleaning and lubrication of scrape flutter idlers is required after each 2,000 hour operating period, or once a year, whichever occurs first. It is recommended that this be accomplished by a local jeweler or watchmaker, most of whom have the ultrasonic cleaner and special jewel oil required.

To remove the complete scrape flutter idler assembly, first remove the head assembly (refer to paragraph 4A.2.3). The idler assembly is secured to the top plate by one screw and lock washer. Remove the screw and lift the idler off the locating pin. Save the screw and lock washer.

Have the jeweler or watchmaker remove the two jewel holders and the roller, by loosening the two set screws (Item 6, Fig. 6-7) at the front of the assembly and sliding the holders (Item 1, Fig. 6-7) out of the yoke (Item 4, Fig. 6-7). The two holders and the roller are then to be cleaned ultrasonically.

#### NOTE

If the ultrasonic cleaning does not remove all traces of oxide from the shafts of the roller, polish them with jeweler's rouge, or some similar substance, until all oxide is removed. If such polishing is required, re-clean the roller ultrasonically before assembly.

After the ultrasonic cleaning, the jewel bearings in the holders are to be lubricated. Use one drop of jewel oil (or Ampex precision instrument oil No. 087-239), administered with a No. 21 gauge hypodermic needle, on each bearing.

Great care must be taken during reassembly. Scribe marks are used both to identify the upper and lower jewel holders and to indicate correct positioning. The upper holder is scribed on the top circular surface, the lower holder on the periphery. The scribe marks are to be aligned with the centerline of the set screws as shown in Fig. 6-7. Clearance and endplay of the roller must be as noted on Fig. 6-7.

If the recorder is equipped with two scrape flutter idlers (a second one can be ordered as an optional accessory, see paragraph 4A.3) the rollers will be of different diameters---the smaller 3/8 inch, the larger 15/32 inch. This configuration is required to minimize rotational interaction between the two idlers, which could cause increased flutter. The idlers must be mounted in the correct positions on the transport, as explained in paragraph 4A.3.

### 4B.4 CHECKING OVERALL PERFORMANCE

#### 4B.4.1 General

These checks should be performed at regularly scheduled intervals to determine if tape transport adjustment or electronic alignment is required. Adjustment and alignment procedures are described in part C of this section, paragraphs 4C.2, 4C.3, and 4C.4.

Wherever the use of blank tape is mentioned in the explanation of the performance checks, it is permissible to use tape that is recorded with material that is not necessary to save. Such material will be erased during the recording portion of the procedure.

#### NOTE

Always bulk-erase tape that was prerecorded on equipment employing a different head configuration than the recorder being checked. It is possible that the prerecorded material would not be completely erased during the record process, and cross talk might then cause false indications.

Checking the performance of reproduce-only equipment is explained at the start of each descriptions of overall checking procedures.

#### 4B.4.2 Test Equipment Required

Signal Generator, Hewlett Packard Model 200C or equivalent.  
Vacuum Tube Voltmeter, AC, Hewlett Packard Model 400D or equivalent.  
Wave analyzer (if available).  
Flutter Meter, Mincom (Bahr) Model B8100 or equivalent.  
Ampex Standard Flutter Test Tapes, as applicable: (1/4-inch)  
15 ips: No. 01-31316-01  
7 1/2 ips: No. 01-31326-01  
3 3/4 ips: No. 01-31336-01  
(flutter tapes for 1/2-inch equipment available on special order.)  
Noise Filter (see Fig. 4B-1) or  
ASA "A" Curve Filter (see Fig. 4B-2)

#### 4B.4.3 Test Conditions

LINE TERMINATION switch on back of electronics assemblies in ON position to terminate equipment.

Dummy plug in INPUT ACCESS socket (not accessory transformer or preamp).

Heads cleaned and demagnetized.

Top and bottom covers installed on electronic assemblies.

Magnetic tape of low noise type (MMM No. 201 or equivalent).

#### 4B.4.4 Overall Frequency Response Check

##### 4B.4.4.1 General

The frequency response of a reproduce only equipment can be checked by recording the tape, as described, on a properly adjusted recorder with the same head track configuration as the reproducer. If such a recorder is unavailable, make the check with a standard tape (steps 2 through 9, paragraph 4C.3.7) bearing in mind the low frequency limitations noted for this such procedure.

##### 4B.4.4.2 Normal Checkout

The procedure which follows will give a precise indication of overall frequency response using external meters. An operational check, accurate to approximately  $\pm 1$  db when using the equipment vu meters, is described in paragraph 4B.4.4.3.

Step 1: Apply power and thread blank tape on the equipment. Select the desired tape speed, and position the REEL switches in accordance with the size of reel hubs used.

Step 2: Connect the signal generator to the INPUT receptacle. Set it to 500 Hz at a nominal 1 volt rms level.

Step 3: Connect the vtvm to the OUTPUT receptacle.

Step 4: Place the OUTPUT SELECTOR switch in the INPUT position, and adjust the RECORD LEVEL control to achieve the vtvm indication shown in Table 4B-1. (The level is dependent on tape speed and on whether the equipment is strapped for a +8 dbm or +4 dbm operating level output.)

OUTPUT STRAPPING	TAPE SPEED	VTVM INDICATION
+8 dbm	15 ips	0 dbm
	7-1/2 ips	-10 dbm
	3-3/4 ips	-10 dbm
+4 dbm	15 ips	-4 dbm
	7-1/2 ips	-14 dbm
	3-3/4 ips	-14 dbm

Table 4B-1. Record Level, Frequency Response Check

Step 5: Place the tape in motion, with the channel under test operating in the record mode.

Step 6: Place the OUTPUT SELECTOR switch in the REPRO position, and adjust the REPRODUCE LEVEL control to achieve the same output level quoted in Table 4B-1. While thus simultaneously recording and reproducing, change the frequency of the signal generator in discrete steps, noting the response as indicated on the vtvm. This response should be within specifications throughout the frequency range for the tape speed involved (refer to Specifications, Section 1).

Step 7: If this is two channel equipment with an additional quarter track head, select the quarter track head and repeat Step 6, noting the frequency response.

Step 8: Select the second tape speed, and repeat Steps 4, 5, and 6. Repeat Step 7 if applicable.

Step 9: Repeat the entire procedure for all other channels.

Any of the following listed causes can result in the response not meeting specifications:

- Heads need cleaning or demagnetizing (refer to paragraphs 4B.1 and 4B.2).
- Head azimuths incorrectly adjusted (refer to paragraphs 4C.3.6 and 4C.3.8).
- Bias level incorrectly adjusted (refer to paragraph 4C.3.7).
- Reproduce equalization incorrectly adjusted (refer to paragraphs 4C.3.7 and 4C.3.9).
- Record calibration incorrectly adjusted (refer to paragraph 4C.3.7).
- Record equalization incorrectly adjusted (refer to paragraph 4C.3.10).
- Tape tensions incorrectly adjusted (refer to paragraph 4C.2.3).
- Signal generator output not flat.

##### 4B.4.4.3 Response Check, Operational

An operational check of overall frequency response, accurate to approximately  $\pm 1$  db, can be made using an Ampex Standard Alignment Test Tape, a signal generator, and the equipment vu meters. On multichannel equipment the check can be made simultaneously on all channels, because the test tapes are recorded full track and the signal generator can be connected in parallel to all INPUT connectors. Catalog numbers of the test tapes are included in Table 4C-8.

Step 1: Apply power and select tape

speed. Position the REEL switches in accordance with the size of the reel hubs being used.

Step 2: Thread the applicable standard alignment tape on the transport.

Step 3: Start the standard alignment tape in motion, and proceed to the level set tone on the tape. (At the 15 ips speed, all tones are recorded at normal level. At 3-3/4 and 7-1/2 ips, only the last tone on the tape is at standard operating level.)

Step 4: As the level set tone is reproduced, adjust the reproduce level control(s) to achieve a 0 indication on the equipment vu meter. Lock the control in that position.

Step 5: Remove the standard tape from the equipment, winding it back to its original reel as explained in paragraph 4C.3.1.

Step 6: Connect the signal generator to the INPUT connector(s), setting it to provide a nominal 1 volt rms output at 1,000 Hz (15 ips), 500 Hz (7-1/2 ips), or 250 Hz (3-3/4 ips).

Step 7: Thread blank tape on the equipment and start it in motion with the channel(s) under test operating in the record mode.

Step 8: Place the OUTPUT SELECTOR switch in the INPUT position and adjust the RECORD LEVEL control(s) to achieve a 0 indication on the vu meter(s).

Step 9: (Applicable for tape speeds of 3-3/4 ips and 7-1/2 ips. For 15 ips operation continue at Step 10.) While recording and reproducing, switch the OUTPUT SELECTOR back and forth between the INPUT and REPRO positions, backing off the RECORD LEVEL control and advancing the REPRODUCE LEVEL control. Continue this adjustment as far as is possible while still maintaining a vu meter indication of 0 reproduce level. It should be possible to reduce the record level to from -15 to -20 on the vu meter.

Step 10: Place the OUTPUT SELECTOR in the REPRO position, while still recording and reproducing. Change the frequency of the signal generator in discrete steps across the frequency band of the tape speed being used (refer to Overall Frequency Response specification, paragraph 1.7). Note the response as indicated on the vu meter.

#### 4B.4.5 Overall Signal-to-Noise Check

Noise on reproduce-only equipment can be checked as explained after the steps for the overall check.

This check requires the use of either

a noise filter which will attenuate noise frequencies that are outside of the audible range, or an ASA "A" curve filter. A schematic diagram of the noise filter is furnished in Fig. 4B-1, of the ASA filter in Fig. 4B-2.

Step 1: Apply power, and thread blank tape on the equipment. Select tape speed and position the REEL switches in accordance with the size of reel hubs being used.

Step 2: Connect the signal generator to the INPUT receptacle. Set it to 500 Hz at a nominal 1 volt rms level.

Step 3: Connect the noise filter or ASA filter to the OUTPUT receptacle, then connect the vtm to the output of the filter.

Step 4: Place the OUTPUT SELECTOR switch in the INPUT position. Adjust the RECORD LEVEL control to achieve either a +14 dbm (output strapped for +8 dbm operating level output) or a +10 dbm (output strapped for a +4 dbm operating level output) indication on the vtm.

Step 5: Place the tape in motion, with the channel under test operating in the record mode (be sure the head gate is closed). Record a section of tape with the 500 Hz signal (which is being recorded at peak level).

Step 6: Stop tape motion and rewind the tape to the beginning of the recording made in Step 5.

Step 7: Remove the signal generator from the INPUT receptacle. Place the OUTPUT SELECTOR switch in the REPRO position.

Step 8: Start the tape in motion, with the channel under test again operating in the record mode but with no input signal (be sure the head gate is closed). The noise level, while thus erasing the 500 Hz signal, will be indicated on the vtm.

Step 9: Select the second tape speed, and repeat Steps 4 through 8.

Step 10: Repeat the entire procedure for all other channels.

Using the noise filter, the signal-to-noise ratio is computed from peak record level, which is 6 db higher than normal record level. If the equipment is strapped to provide a +8 dbm operating level output, the signal-to-noise ratio is therefore 14 db better than the vtm indication in Step 8 (for example, if the vtm indicates -46 dbm the signal-to-noise ratio is 60 db). Similarly, if the strapping is for a +4 dbm operating level output, the signal-to-noise is 10 db better than the vtm indication.



When an "A" weighted curve noise measurement is being made, using the ASA filter, add either 10 db (+8 dbm output) or 6 db (+4 dbm output) to the vtvm indication.

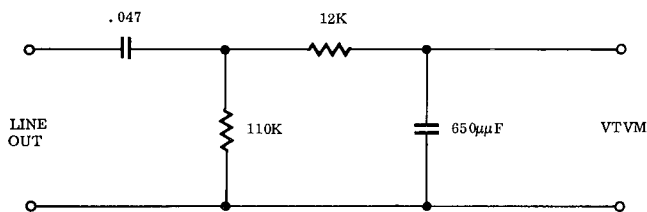


Fig. 4B-1. Noise Filter

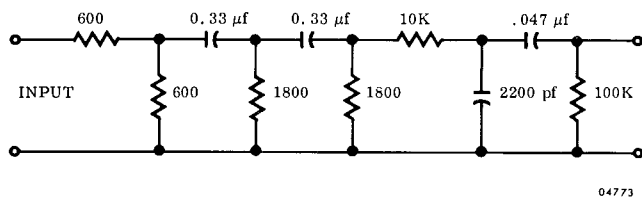


Fig. 4B-2. ASA "A" Curve Filter

If the signal-to-noise ratio does not meet the specifications quoted in Section 1, there are many possible causes, including the following:

- a. Heads need cleaning or demagnetizing (refer to paragraphs 4B.1 and 4B.2).
- b. Magnetic tape not as specified (refer to paragraph 4B.4.3).
- c. External fields from nearby motors, generators, etc.
- d. Making noise check with head gate open.
- e. Erase current not peaked (refer to paragraph 4C.3.7).
- f. Head cables rubbing against moving parts on transport.
- g. Head azimuth incorrectly adjusted (refer to paragraphs 4C.3.6 and 4C.3.8).
- h. Head height incorrectly adjusted (refer to paragraph 4D.2).
- i. Tape wrap or head zenith incorrectly adjusted (refer to paragraph 4D.3).
- j. Record or reproduce level incorrectly adjusted (refer to paragraph 4C.3.7).

To check reproduce noise, remove the tape from the equipment. Connect the vtvm, through the noise filter, to the OUTPUT receptacle. Use pressure sensitive tape, or a rubber band, to hold the takeup tension arm away from its rest position (so it does not contact the safety

switch). Then press the PLAY pushbutton to put the equipment in the reproduce mode. Under these circumstances, the signal-to-noise should be as shown in Table 4B-2; note that the figures given are also computed from peak level, as explained in the overall check.

#### 4B.4.6 Overall Distortion Check

An accurate check of distortion on this equipment requires the use of a wave analyzer, which measures individual distortion products. (An instrument that measures total harmonic distortion will be influenced by tape noise and modulation noise in addition to actual distortion.) Also, the signal generator which is used must have very low distortion (less than 0.1%) or addition and cancellation effects may occur.

To check distortion, record a 500 Hz signal, on blank tape, at normal operating level. When that signal is reproduced, the second harmonic content should not exceed 0.4%, and the third harmonic content should be between 0.6% and 1.1%.

TAPE SPEED	HEAD TYPE (1/4-inch tape)	REPRODUCE SIGNAL/NOISE
3-3/4 ips	Full Track	66 db
	Half Track	61 db
	Two Track	61 db
7-1/2 ips	Full Track	72 db
	Half Track	66 db
	Two Track	66 db
15 ips	Full Track	72 db
	Half Track	66 db
	Two Track	66 db

TAPE SPEED	HEAD TYPE (1/2-inch tape)	REPRODUCE SIGNAL/NOISE
7-1/2 ips	Three Track	66 db
	Four Track	66 db
15 ips	Three Track	66 db
	Four Track	66 db

Table 4B-2. Reproduce Signal/Noise from Peak Record Level

The most common cause of excessive second harmonic distortion is that the heads are magnetized. It could also result from a malfunctioning bias oscillator, bias amplifier, record amplifier, or reproduce amplifier. If second harmonic distortion is high, a slight adjustment of the erase adjust control (refer to paragraph 4C.3.7) may result in improvement. However, do not try to adjust in this fashion so that the second harmonic distortion at the output is less than the distortion of the signal generator being used.

Third harmonic distortion is dependent on the type of magnetic tape that is employed, the bias setting, and the accuracy with which "normal operating level" is adjusted. A typical reel of tape will give a third harmonic distortion of 0.8% at operating level, but this might range as high as 1.1%.

Checking distortion on reproduce-only equipment requires that a properly adjusted recorder with the same head track configuration be available to record a tape.

#### 4B.4.7 Flutter Check

This check requires the use of Ampex Standard Flutter Test Tapes (refer to paragraph 4B.4.2). These tapes are recorded on very precise equipment, and have an inherent flutter content of less than .03% rms--which for practical purposes can be ignored when making flutter measurements. Flutter test tapes are made for a specific tape speed, and can be used at only that speed (flutter meters accept only a 3,000 Hz signal). A discussion of the storage and handling of standard tapes is included under Electronic Alignment in paragraph 4C.3.1.

Measurement of flutter is the same for reproduce-only and record/reproduce equipment.

Flutter meters are sensitive to some extent to amplitude modulation, which can result from poor head-to-tape contact or from signal dropouts. Heads must therefore be cleaned and demagnetized before flutter measurements are started.

The procedure in checking flutter depends on the type of flutter meter being used, and the manufacturer's instructions should be followed. The procedure described is that used when the recommended meter (refer to paragraph 4B.4.2) is employed.

Step 1: Place the RECORD SELECT-OR switches on all electronic assemblies in the

SAFE position, to prevent accidentally entering the record mode and thus erasing the flutter test tape.

Step 2: Connect the OUTPUT connector to the EXT SIGNAL, SIGNAL INPUT connector on the flutter meter. On multi-channel equipment, any channel may be used for the flutter test, provided that the electronics are properly aligned.

Step 3: At the flutter meter, place the WEIGHTING control in the NAB UNWTD position, the DEMOD INPUT SELECT to the 100 MV to 5V, EXT position, the METER SELECT in the DEMOD position, and the FLUTTER control to the 0.1 or 0.3% FULL SCALE position (depending on tape speed).

Step 4: Apply power to the recorder and to the flutter meter.

Step 5: Thread the applicable flutter test tape on the tape transport, by placing the flutter test tape reel on the takeup turntable and rewinding to another reel on the supply turntable. Select tape speed in accordance with the test tape, and position the REEL switches for the size of the reel hub being used.

Step 6: Start the test tape in motion in the reproduce mode. The NORMAL indicator light on the flutter meter should illuminate. If not, there is either no reproduce output to the meter, or the DEMOD INPUT SELECT is incorrectly positioned.

Step 7: Read the flutter indication on the FLUTTER meter, if necessary repositioning the FLUTTER % FULL SCALE control. Flutter should meet the specification quoted in Section 1.

Step 8: When the measurement is completed, allow the flutter test tape to continue in motion in the reproduce mode until it is completely wound on the flutter test tape reel.

Excessive flutter can be caused by any component on the tape transport that affects the tape motion, and it is manifestly impossible to delineate all causes and remedies. However, such causes include the following:

- a. Accumulations of oxide or dirt on components in the tape threading path.
- b. Drive Motor: Not in synchronism (low line voltage); Excessive tape tension; defective motor capacitor; bearings defective or in need of lubrication; motor shaft bent.
- c. Supply Motor: Excessive or erratic holdback tension; dragging brake; shaft bent.
- d. Capstan Idler: Defective rubber tire; bearing defective or in need of lubrication;

capstan idler force incorrectly adjusted.

e. Reel Idler: Shaft bent; flywheel not balanced.

f. Head Assembly: Poor tape guiding.

g. Tape Scrape: Warped or damaged reels.

COMPONENT	ROTATIONAL RATE (Hz)		
	3-3/4 ips	7-1/2 ips	15 ips
Drive Motor (Capstan)	10	20 10	20
Capstan Idler	0.6	1.2	2.4
Reel Idler	0.8	1.6	3.2
Scrape Flutter Idler (Normal) (Optional)	3.4	6.3	12.7
	2.5	5.1	10.2

*Table 4B-3. Rotational Rates*

If a sound and vibration analyzer (such as a General Radio Type 1564-A) is available, flutter can be isolated to certain frequencies by connecting the analyzer to the output of the flutter meter. Comparing the results with the rotational rates shown in Table 4B-3 may then indicate the offending assembly.

Note that if the flutter is caused by components in the supply motor assembly, its frequency will vary -- being relatively low when the tape pack on the supply reel is large, and progressively increasing (with reel rotation) as the tape pack gets smaller. The takeup motor assembly seldom contributes appreciable flutter, because it is effectively isolated from the heads by the capstan and capstan idler; however, if it should do so, the flutter frequency would vary inversely with that of the supply motor, being relatively high with a small tape pack on the takeup reel and progressively decreasing as the pack grows larger.

A discussion on tape scrape flutter is included in Section 5, Principles of Operation, paragraph 5.1.8.

**MAINTENANCE****Part C. Normal Adjustment and Alignment****4C.1 GENERAL**

The overall performance checks for the equipment are described under Routine Maintenance, in part B of this section (paragraph 4B.4). If the recorder operates normally in all of the overall performance checks, there is no need to perform any of the adjustment or alignment procedures described herein.

Also, the procedures in this part of Section 4 apply only to readjustment or realignment of spring tensions, controls, etc. The removal or installation of assemblies, special positioning, or trouble shooting, are included in the Corrective Maintenance parts of this section (Part D. Heads; Part E. Tape Transport; and Part F. Electronic Assemblies). Transport Adjustment Procedures are described in 4C.2, Electronic Alignment Procedures in 4C.3, and Self Sync Adjustments in 4C.4.

**4C.2 TAPE TRANSPORT ADJUSTMENTS****4C.2.1 Test Equipment Required**

Spring scales, 0-16 oz. and 0-10 lbs, Chatillon or equivalent.

Length of cord or twine, approximately 30 inches long, with small loop formed on one end.

Empty reel, NAB hub

Tools used by technician

**4C.2.2 Measurements for Different Operating Conditions**

At the factory, tape transports for one or two channel equipment are adjusted for use with 1/4-inch tape. Transports for three or four channel equipment, however, are adjusted for use with either 1/4-inch or 1/2-inch tape, so that the quick conversion feature can be realized. If only one tape width is to be employed, it may be advantageous to make adjustments for that tape only. In the following procedures, correct indications are therefore quoted for three conditions of operation:

a. For equipment which will be operated exclusively with 1/4-inch magnetic tape.

b. For equipment which will be operated exclusively with 1/2-inch magnetic tape.

c. For equipment which will be operated using the convertible feature, changed between 1/4-inch and 1/2-inch magnetic tape as required.

**4C.2.3 Tape Tension**

Tape tension is determined indirectly by measuring the rotational force supplied by the supply and takeup motors. Any required adjustments are made by positioning the sliders on resistors which are located beneath a cover on the back of the tape transport control box (see Fig. 4C-1). The resistors, and the adjustment they control, are listed in Table 4C-1.

RESISTOR	ADJUSTMENT FOR
R604	Supply reel holdback tension in play mode, large reel hubs.
R605	Takeup reel tension in play mode, large reel hubs.
R606	Takeup reel tension in play mode, small reel hubs.
R607	Holdback tension in fastwinding mode (supply reel in fast forward, takeup reel in rewind).
R608	Supply reel holdback tension in play mode, small reel hubs.

Table 4C-1. Tension Adjusting Resistors

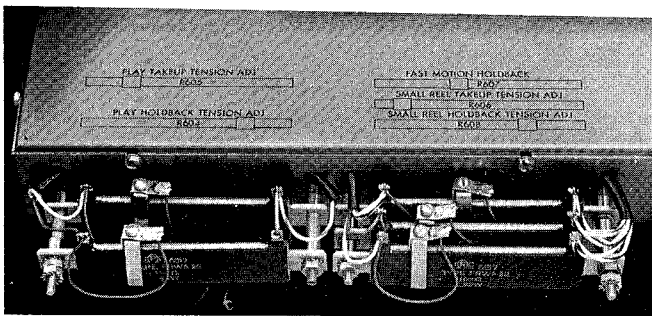


Fig. 4C-1. Tension Adjustment Points

**Step 1:** Apply power to the equipment. Place the REEL switches in the large reel hub positions.

**NOTE**

Either the high or low tape speed can be used for this procedure.

**Step 2:** Use pressure sensitive tape, or a rubber band, to hold the takeup tension arm away from its rest position (so it does not contact the safety switch).

**Step 3:** Place the empty NAB reel on the supply turntable. Wrap the cord or twine on the reel hub in a counterclockwise direction, leaving the loop at the free end of the cord.

**Step 4:** Insert the hook on the applicable spring scale (see Table 4C-2) in the loop on the cord. Hold the scale stationary and press the PLAY pushbutton.

**Step 5:** Still holding the scale stationary, tap lightly on the reel (to ensure a true read-

ing) and note the scale indication. Correct indications are shown in Table 4C-2. Adjust R604 as required.

TYPE OF OPERATION	TENSION, LARGE HUB
1/4-inch tape only	5-6 oz.
1/2-inch tape only	8-11 oz.
1/4-inch & 1/2-inch tape	6-7 oz.

Table 4C-2. Tension, Large Reel Hub

**Step 6:** Continue to hold the scale stationary, and change the supply REEL switch to the small hub position. Tap on the reel and note the scale indication, which should be as shown in Table 4C-3. Adjust R608 as required (The small reel position is not used with 1/2-inch tape, so machines used only with that tape need not be checked.)

TYPE OF OPERATION	TENSION, SMALL HUB
1/4-inch tape only	2-1/2 - 3-1/2 oz.
1/4-inch & 1/2-inch tape	3 - 4 oz.

Table 4C-3. Tension, Small Reel Hub

**Step 7:** Return the supply REEL switch to the large reel position. Hold the scale stationary and press the FAST FWD pushbutton.

**Step 8:** Tap on the reel, and note the scale indication, which should be as shown in Table 4C-4.

**NOTE**

Resistor R607 must be adjusted so that both the supply reel holdback during fast forward and the takeup reel holdback during rewind are within tolerances.

TYPE OF OPERATION	TENSION
1/4-inch tape only	1/2 to 1 oz.
1/2-inch tape only	1 to 1-1/2 oz.
1/4-inch and 1/2-inch tape	1/2 to 1 oz.

Table 4C-4. Tension, Fast-Winding

**Step 9:** Press the STOP pushbutton, and change the empty NAB reel from the supply to the takeup turntable. Wind the cord or twine on the reel hub in a clockwise direction, leaving the loop at the free end of the cord.

**Step 10:** Repeat Steps 4 through 8 (at Step 7, press the REWIND pushbutton) with the reel on the takeup turntable. Scale indications should be the same as quoted for the supply turntable, as shown in Tables 4C-2, 4C-3, and 4C-4. Adjust the applicable resistors (R605, R606, and R607) as required.

#### 4C.2.4 Brakes

There are two braking functions on each reel. The main brake system is used to stop reel rotation and maintain tape tension when the equipment is removed from an operating mode. The edit brake system is employed to partially release the brake bands, and thus reduce braking force, when the equipment is placed in the stop/edit mode.

A brake differential is necessary to maintain tape tension while stopping; the force at the main brakes is therefore different for each direction of reel rotation.

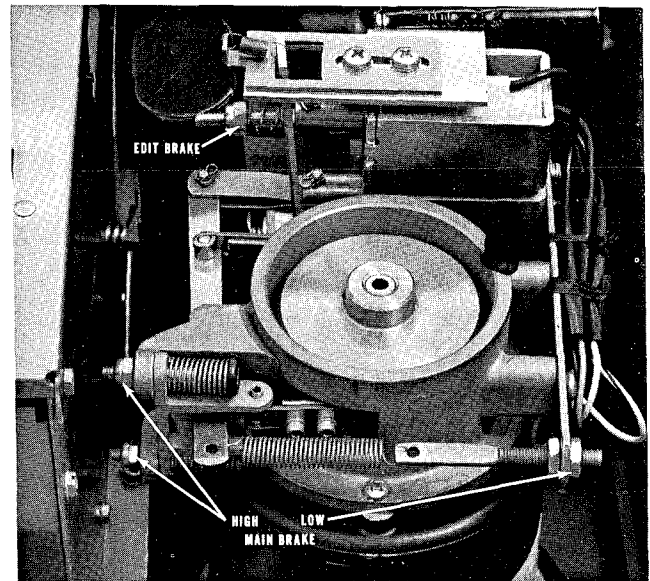


Fig. 4C-2. Brake Adjustment Points

Any required adjustments are made by tightening or loosening the nuts shown on Fig. 4C-2. In adjusting the high braking force for the main brakes, be sure to turn the two nuts an equal number of turns.

**Step 1:** Apply power to the equipment. Place the NAB reel on the supply turntable.

**Step 2:** Wrap the cord or twine on the reel hub in a counterclockwise direction, leaving the loop at the free end of the cord.

**Step 3:** Insert the hook on the applicable spring scale (see Table 4C-5) through the loop in the cord. Pull on the scale to make the reel rotate and note the scale indication when the reel is in slow, steady motion. This measures the high braking force of the main brake; correct indications are shown in Table 4C-5. Adjust the

TYPE OF OPERATION	SUPPLY		TAKEUP	
	CW	CCW	CW	CCW
1/4-inch tape only	4 to 5 oz.	15 to 17 oz.	15 to 17 oz.	4 to 5 oz.
1/2-inch tape only	5 to 6 oz.	16 to 21 oz.	16 to 21 oz.	5 to 6 oz.
1/4-inch & 1/2-inch tape	4 to 5 oz.	15 to 17 oz.	15 to 17 oz.	4 to 5 oz.

Table 4C-5. Braking Force, Main Brakes

high braking force as required, running the two nuts in to increase the force, or running them out to decrease the force.

**NOTE**

The initial force required to start reel rotation will be high. Do not take the reading until the reel is rotating slowly and steadily.

Step 4: Rewind the cord on the reel hub, still in a counterclockwise direction. Press the EDIT pushbutton to place the equipment in the stop/edit mode.

Step 5: Repeat Step 3. Minimum scale indications for the edit brakes are shown in Table 4C-6. Adjust as required; running the nut in will decrease force, running it out will increase the force. When properly adjusted there will be no differential action for directions of rotation. Press the STOP pushbutton when the measurement is completed.

**NOTE**

Edit brake force is not critical, and can be set to the force preferred by each operator. The minimum specified is to ensure sufficient force to hold the takeup tension arm from contacting the safety switch.

indications are shown in Table 4C-5. Adjust the low braking force as required, running the nut in to increase force, running it out to decrease force.

Step 7: Move the empty reel to the takeup turntable. Wind the cord on the hub in a clockwise direction. Measure and adjust the high braking force of the main brakes as explained in Step 3. Correct force is shown in Table 4C-5.

Step 8: Rewind the cord on the reel hub in a clockwise direction. Press the EDIT pushbutton. Measure and adjust the edit braking force as explained in Step 5. (see Table 4C-6). Press the STOP pushbutton when the measurement is completed.

Step 9: Wind the cord on the reel hub in a counterclockwise direction. Measure and adjust the low braking force of the main brake in that direction of reel rotation. The correct indication is shown on Table 4C-5.

4C.2.5 Capstan Idler

The force of the capstan idler against the capstan, during the reproduce and record modes, is determined by a pressure spring on the capstan solenoid. The force is adjusted by means of a lock nut on the capstan solenoid spade bolt (see Fig. 4C-3).

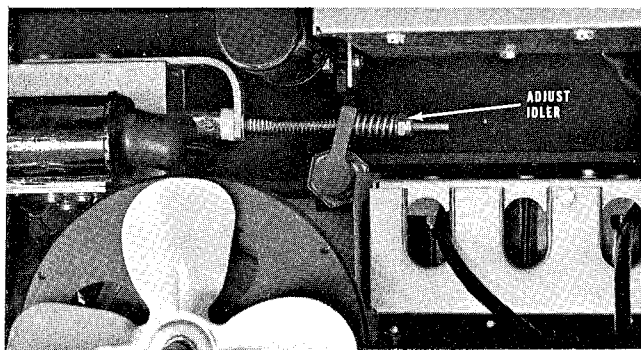


Fig. 4C-3. Capstan Idler Adjustment Point

As the temperature of the solenoid rises, its resistance will also rise. In areas where power line regulation is poor, it is advisable to allow an approximate 30 minute warm up period (with the equipment operating in the reproduce mode) before making any adjustment of the capstan idler force. At the factory, the solenoid is checked to be sure it will bottom at line voltages of 90 volts (cold) and 105 volts (hot).

TYPE OF OPERATION	SUPPLY AND TAKEUP
1/4-inch tape only	2 oz. min.
1/2-inch tape only	2 oz. min.
1/4-inch and 1/2-inch tape	2 oz. min.

Table 4C-6. Braking Force, Edit Brakes

Step 6: Wind the cord on the reel hub in a clockwise direction. Measure the low braking force of the main brake in that direction of rotation (as explained in Step 3). Correct scale

IDLER AT INSTANT IT LEAVES CAPSTAN

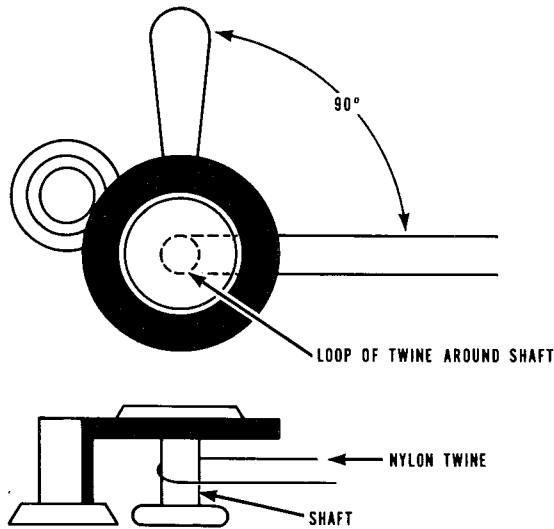


Fig. 4C-4. Measuring Force, Capstan Idler

**Step 1:** Apply power to the equipment. Use pressure sensitive tape or a rubber band to hold the takeup tension arm from its rest position (so it does not contact the safety switch).

**Step 2:** Tie the two ends of the cord together, so it forms a continuous loop. Place the loop over the capstan idler, positioning it on the capstan idler shaft between the idler and the arm (see Fig. 4C-4).

**Step 3:** Press the PLAY pushbutton. The idler will move to contact the capstan, and both will rotate.

**Step 4:** Insert the hook on the spring scale through the loop, and pull the cord taut at a 90° angle to the idler arm.

**Step 5:** Pull on the scale, noting the indication at the point where the idler barely loses contact with the capstan (the idler will stop rotating at that point). Correct indications are given on Table 4C-7.

TYPE OF OPERATION	INDICATION
1/4-inch tape only	5 to 6 lbs
1/2-inch tape only	5 to 6 lbs
1/4-inch and 1/2-inch tape	5 to 6 lbs

Table 4C-7. Capstan Idler Force

**Step 6:** After completing any required adjustment, check that the capstan idler solenoid will bottom in the reproduce mode. If not, the adjusting lock nut must be run out until bottoming is possible.

#### 4C.2.6 Tape Lifter

The automatic tape lifter mechanism is controlled by a solenoid which is energized in either of the fast-winding modes. A spring provides coupling between the solenoid plunger and the tape lifter mechanism. When the solenoid is deenergized, there should be no slack between the solenoid plunger, the spring, and the tape lifter bracket. However, the spring should not be extended, and the tape lifter arms at the base of the posts should be 1/16-inch from the end of the slot. When the solenoid energizes, the tape lifter arms should move to a position 1/16-inch from the other end of the slot.

Any condition other than that described requires a complete adjustment of the tape lifter mechanism. This is considered a corrective maintenance procedure, which is covered in part E of this section, paragraph 4E.9.

### 4C.3 ELECTRONIC ALIGNMENT

#### 4C.3.1 Standard Alignment Test Tapes

In the electronic alignment procedures, the reproduce function is adjusted to a standard while playing an Ampex Standard Alignment Test Tape. The record circuit is then adjusted to provide normal operation, using the reproduce circuit as a reference.

Standard test tapes are precisely recorded in an Ampex laboratory under stringently controlled conditions. They must be handled and stored with proper care if they are to retain their usefulness over extended periods of time. The following points should be given particular attention in this respect.

- a. Clean and demagnetize the heads, and other components in the tape threading path, before installing a standard test tape.
- b. Do not store the test tapes in areas where extremes in temperature or humidity are encountered.
- c. Store the test tapes under the conditions existing after a normal play run--not after it is run in a fast-winding mode.

After extensive use, the standard tape will exhibit signs of deterioration. High frequen-



cy tones may be down as much as 2 db, and flutter indications may rise even though actual flutter remains unchanged. This impairment is caused by demagnetization of the recorded signal in repeated passes through the tape path; by physical deformation of the tape due to tape tension, changes in temperature and humidity, etc; and by increased dropouts resulting from tape wear.

When using a standard tape, thread it in the normal path from the supply to the takeup turntables. During the alignment procedures, use the rewind and fast forward modes as necessary. When alignment is completed, allow the tape to be completely wound on the takeup reel. Then change that reel to the supply turntable, and the standard tape reel to the takeup turntable. Thread the tape, place the equipment in the reproduce mode, and wind the tape back on its original reel while in that mode.

Note that all tones on 15 ips standard alignment tapes are recorded at operating level. On tapes for slower speeds, all tones except the last are recorded 10 db below operating level.

4C.3.2 Test Equipment Required

Voltmeter, dc, 20,000 ohms-per-volt.  
 Vacuum Tube Voltmeter, ac, Hewlett Packard Model 400D or equivalent.  
 Signal Generator, Hewlett Packard Model 200C or equivalent.  
 Noise Filter (see Fig. 4B-1) or ASA "A" Curve Filter (see Fig. 4B-2).  
 Ampex Standard Alignment Tapes as applicable (see Table 4C-8).  
 Usual tools used by technician.

TAPE SPEED	TYPE OF EQUALIZATION	MAGNETIC TAPE	
		1/4-inch	1/2-inch
15 ips	NAB	01-31311-01	01-31311-05
	AME	01-31312-01	01-31312-05
	CCIR	01-31313-01	01-31313-05
7-1/2 ips	NAB	01-31321-01	01-31321-05
	CCIR	01-31323-01	01-31323-05
3-3/4 ips	120 micro sec	01-31331-01	-----
	200 micro sec	01-31334-01	-----

Table 4C-8. Catalog Numbers, Standard Alignment Tapes

4C.3.3 Test Conditions

LINE TERMINATION switch on back of electronics assemblies in ON position to terminate equipment.

Dummy plug in INPUT ACCESS socket (not accessory transformer or preamp).

Heads cleaned and demagnetized.

Covers installed on electronics.

Magnetic tape of low noise type (MMM No. 201 or equivalent).

4C.3.4 Introduction to Alignment Procedures

Procedures described in paragraphs 4C.3.5 through 4C.3.8 will usually suffice to correct any deficient operation revealed by the Overall Performance Checks (refer to part B, paragraph 4B.4). Other adjustments, which are seldom required, are included in paragraphs 4C.3.9 and 4C.3.10. Sel-Sync adjustments are described in paragraph 4C.4.

#### 4C.3.5 Power Supply Adjustment

The electronics power supply, together with the bias and erase oscillator, is mounted on a plug-in printed circuit board which is located within the power supply box behind the tape transport. Proper operation of the supply can be checked by connecting the dc voltmeter across pins 9 (positive) and 5 of any of the four receptacles (J701 through J704) on the power supply box. With the equipment operating in the reproduce mode, the voltmeter should indicate 39 volts ( $-1/2$  +1 volt).

If need for adjustment is indicated by the foregoing check, open the cover on the power supply box (see Fig. 4C-5).

### WARNING

Full power line voltage is present within this box. Use special care not to touch the fuse post or transformer leads while making the following adjustments.

A variable resistor (R712) adjusts the regulated voltage output. With the voltmeter connected as previously described, place the equipment in the reproduce mode. Adjust R712 (see Fig. 4C-5) to achieve an indication of 39 volts ( $\pm 1/2$  volt).

#### 4C.3.6 Reproduce Head Azimuth Adjustment

In adjusting head azimuth on record/reproduce equipment, the vu meters on each electronic assembly can be used to measure the output of each head simultaneously. This is particularly convenient for multi-channel equipment, because the simultaneous metering allows easy determination of the optimum setting. For reproduce-only machines, vtm's must be connected to the output connector; either use as many vtm's as there are head tracks, or use a trial and error method--adjusting first one head, then another and working back and forth to reach an optimum setting.

Standard alignment tapes for the 15 ips speed have all tones recorded at normal operating level, while standard tapes for slower speeds have all tones (except the last) recorded at 10 db

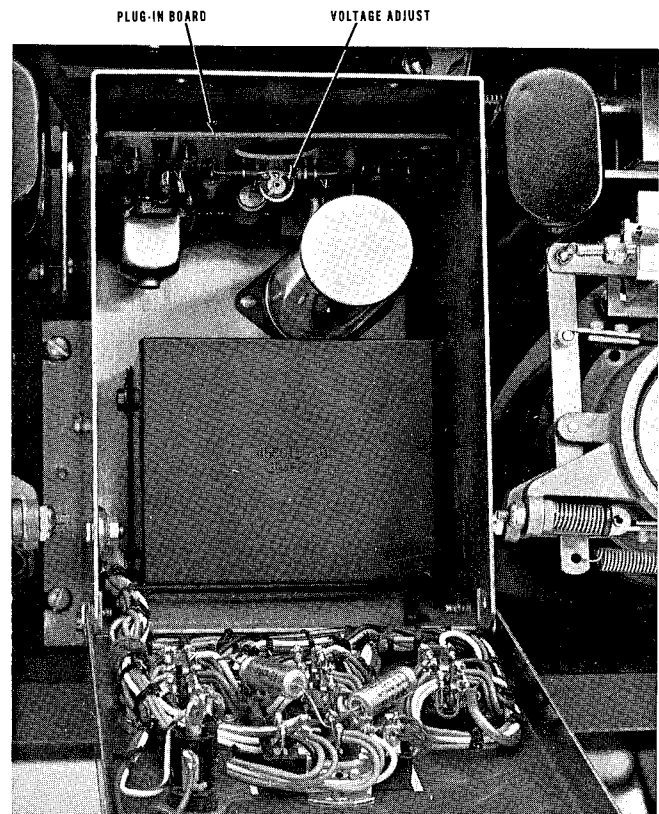


Fig. 4C-5. Power Supply Box, Opened

below operating level. If record/reproduce equipment provides a 15 ips speed, make the adjustment at normal operating level at that speed. If this is a 3-3/4 and 7-1/2 ips recorder/reproducer, it will probably be necessary to turn the REPRODUCE LEVEL control full clockwise (do not exceed an indication of 0 on the vu meter) in Step 7. For reproduce-only equipment, adjust the level control to achieve any convenient vtm indication.

### CAUTION

Do not tamper with any nut or screw on the head assembly other than the nut for azimuth adjustment.

**Step 1:** Remove the head overlay (cover), by loosening the captive screw on the angled back surface of the cover.

**Step 2:** Apply power to the equipment. Select tape speed (15 ips if available) and position the REEL switches in accordance with the size of reel hubs to be used.

Step 3: Position the RECORD SELECTOR switch(es) on all record/reproduce electronics assemblies in the SAFE position. This prevents accidentally entering the record mode and erasing the standard tape.

Step 4: Place the OUTPUT SELECTOR switch(es) on all record/reproduce electronic assemblies in the REPRODUCE position.

Step 5: Thread the standard alignment tape, applicable to the tape speed involved, on the tape transport. If this is a reproduce-only equipment, connect the vtvm(s) to the output connector(s).

#### NOTE

Voice announcements on the standard tape can be monitored through headsets or an amplifier/loudspeaker plugged into the PHONES jack, or through an amplifier/loudspeaker connected to the output.

Step 6: Start the standard tape in motion in the reproduce mode.

Step 7: If the adjustment is being made at 15 ips, adjust the REPRODUCE LEVEL control on each electronic assembly to achieve a vu meter indication of 0 as the first tone on the standard tape is reproduced. (Any convenient indication on the vtvm is used for reproduce-only equipment.) If a slower speed is being used, it may be impossible to achieve this level; if so, simply turn the REPRODUCE LEVEL control full clockwise.

Step 8: The second tone on the standard tape is the azimuth adjustment tone. As this tone is reproduced, turn the azimuth adjustment

nut (not the screw) for the reproduce head (see Fig. 4C-6) to achieve a maximum output indication as indicated on the vu meters (or vtvm). If this is a multi-channel equipment and all heads do not peak at exactly the same setting, adjust for optimum output of all heads in the stack.

#### NOTE

If the azimuth is far out of adjustment, minor peaks may be observed on each side of the correct setting. Proper adjustment will be unmistakable, because it will result in an output obviously higher than the minor peaks.

When the adjustment is completed, replace the head overlay.

#### 4C.3.7 Reproduce/Record Alignment

If record/reproduce equipment is to be operated a major part of the time at one speed, that is the speed which should be used in making the initial alignment run (where bias and record levels are set and calibrated). In those cases where both speeds will be used on an approximately equal basis, it is recommended that the initial run be made at 7-1/2 ips, which provides the optimum bias and record adjustments for both the 3-3/4 - 7-1/2 ips and the 7-1/2 - 15 ips equipment. The second run, for the other speed, will then be concerned only with reproduce equalization for that speed.

In adjusting reproduce equalization (Steps 1 through 9) at the 15 ips speed, the equipment vu meters can be used. However, since record level calibration (and reproduce-only equipment) requires an external vtvm, the following procedure will be explained using the external meter. For reproduce-only equipment complete Steps 1 through 9.

Step 1: Remove the cover over the plug-in boards at the front panel of the electronics assembly (or remove the front cover from the reproduce-only electronics tray).

Step 2: Apply power to the equipment. Select tape speed, and position the REEL switches in accordance with the size of the reel hubs to be used.

Step 3: Position the RECORD SELECTOR switches on all record/reproduce electronic assemblies in the SAFE position. This will pre-

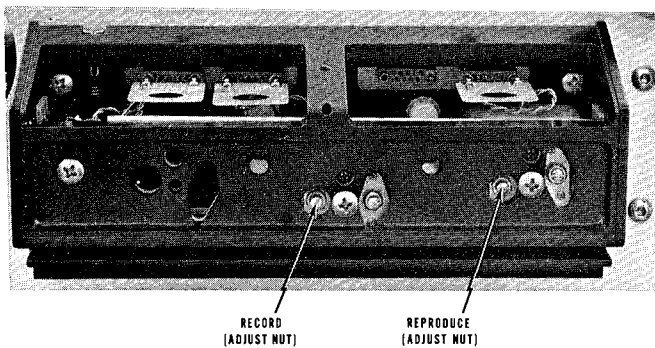


Fig. 4C-6. Head Azimuth Adjustment Nuts

vent accidentally entering the record mode and thus erasing the standard tape.

**Step 4:** Place the OUTPUT SELECTOR switch of the record/reproduce channel to be tested in the REPRODUCE POSITION.

**Step 5:** Connect the vtvm to the OUTPUT connector of the channel to be tested.

**Step 6:** Thread the standard alignment tape, applicable to the tape speed involved, on the tape transport.

**Step 7:** Start the standard tape in motion in the reproduce mode. As the first tone is reproduced adjust the REPRODUCE LEVEL control on the channel under test to achieve an output level indication on the vtvm as shown on Table 4C-9. Lock the control in that position.

OUTPUT STRAPPING	TAPE SPEED	VTVM INDICATION
+8 dbm	15 ips	+8 dbm
	7-1/2 ips	-2 dbm
	3-3/4 ips	-2 dbm
+4 dbm	15 ips	+4 dbm
	7-1/2 ips	-6 dbm
	3-3/4 ips	-6 dbm

Table 4C-9. Output Level, Reproduce Equalization

**Step 8:** The standard tape is next recorded with a series of tones, starting with the highest frequencies. As these tones are reproduced, adjust the appropriate HIGH FREQ control, at the front of the reproduce board, as necessary to achieve the flattest possible response, within specifications. However, the reproduce response must not be moved more than  $\pm 2$  db from the theoretical response curve (refer to Figs. 6-32, 6-33, and to paragraph 4F.10); if any further adjustment were required it would indicate some other trouble in the record/reproduce process, which should not be corrected by equalization adjustment.

**NOTE**

The standard tape is recorded full track. When such a tape is reproduced by a half-track or multi-track head, the "fringing" effect makes response indications invalid at frequencies below 700 Hz (15 and 7-1/2 ips) or 500 Hz (3-3/4 ips). This effect, which causes high indications at the lower frequencies, does not occur when tapes are recorded and reproduced using heads of the same configuration.

**Step 9:** If the test is being made at 7-1/2 or 3-3/4 ips, as the last tone on the tape is reproduced adjust the REPRODUCE LEVEL control to achieve a +8 dbm or +4 dbm indication on the vtvm (level on record/reproduce equipment is dependent on output strapping). The record/reproduce equipment vu meter should indicate 0 ( $\pm 3/4$  db).

This completes the reproduce equalization adjustment, and the setting of reproduce level to the reference required for record calibration. Do not change this reference level until after the completion of Step 18.

**Step 10:** Remove the standard tape, after winding it back on its original reel in the reproduce mode as explained in paragraph 4C.3.1.

**Step 11:** Connect the signal generator to the INPUT connector, leaving the vtvm connected to the output.

**Step 12:** Set the signal generator to provide a nominal 1 volt rms output at the appropriate frequency:

15 ips	1,000 Hz
7-1/2 ips	500 Hz
3-3/4 ips	250 Hz

**Step 13:** Thread blank tape on the equipment. At the electronic assembly place the OUTPUT SELECTOR switch in the BIAS position, and the RECORD SELECTOR switch in the READY position. Start the tape in motion, with the channel under test operating in the record mode.

**Step 14:** Adjust the ERASE ADJ control, at the front of the bias amplifier module, to achieve a peak indication on the equipment vu me-



**NOTE**

Minor peaks may be observed on each side of the correct setting. Proper adjustment will be unmistakable, however, for it will result in an obviously higher output.

Step 11: To return the reproduce level to the normal operating condition, replace the head overlay and change the frequency of the signal generator to 500 Hz. While simultaneously recording and reproducing, place the OUTPUT SELECTOR switch in the INPUT position and adjust the RECORD LEVEL control to achieve a 0 indication on the vu meter. Then change the OUTPUT SELECTOR switch to the REPRO position and adjust the REPRODUCE LEVEL control to obtain a 0 indication on the vu meter.

**4C.3.9 Low Frequency Reproduce Equalization**

This procedure will be required infrequently. The adjustment requires access to the front of the plug-in boards so the small cover must be removed from the front panel of the electronics assembly (or the front cover removed from the reproduce-only electronic tray).

The procedure consists of adjusting the low frequency response of the reproduce circuit to compensate for head "bumps", which occur at those frequencies. The adjustment on reproduce-only equipment requires that a properly adjusted recorder, with the same head track configuration, be available to record the tape. That tape is then played back on the reproducer while the adjustment is made.

Step 1: Connect the vtvm to the OUTPUT connector.

Step 2: Connect the signal generator to the INPUT connector. Set it to 500 Hz at a nominal 1 volt rms level.

Step 3: Apply power to the equipment. Select tape speed, and position the REEL switches in accordance with the size of the reel hubs to be used.

Step 4: Thread blank tape on the equipment.

Step 5: Place the OUTPUT SELECTOR switch in the INPUT position, and adjust the RECORD LEVEL control as necessary to achieve normal record level (+8 dbm or +4 dbm, depending on output strapping) as indicated on the vtvm.

Step 6: Place the OUTPUT SELECTOR switch in the REPRO position, and start the tape in motion with the channel under test operating in the record mode.

Step 7: Adjust the REPRODUCE LEVEL control as necessary to achieve normal operating level (+8 dbm or +4 dbm, depending on output strapping) as indicated on the vtvm.

Step 8: While thus simultaneously recording and reproducing, sweep the signal generator frequency between 250 Hz and 30 Hz, noting the magnitude of any positive-going or negative-going head bumps.

Step 9: Adjust the appropriate LO FREQ control at the front of the reproduce board to achieve the flattest possible response, within specifications. This is accomplished by adjusting for an equal magnitude of head bump excursions from the reference frequency of 500 Hz.

Step 10: Repeat Steps 8 and 9 for the second tape speed, adjusting the appropriate LO FREQ control.

Step 11: Repeat the entire procedure for all other channels.

**4C.3.10 Record Equalization**

The small cover over the plug-in modules must be removed from the front panel of the electronics assembly. The procedure is not applicable for reproduce-only equipment.

Step 1: Repeat Steps 1 through 4 of the Low Frequency Reproduce Equalization procedure, paragraph 4C.3.9.

Step 2: Place the OUTPUT SELECTOR switch in the INPUT position, and adjust the RECORD LEVEL control to achieve a vtvm indication as shown in Table 4C-10. This establishes the 500 Hz reference level.

TAPE SPEED	OUTPUT STRAPPING	VTVM INDICATION
15 ips	+8 dbm	+8 dbm
	+4 dbm	+4 dbm
7-1/2 ips	+8 dbm	-10 dbm
	+4 dbm	-14 dbm
3-3/4 ips	+8 dbm	-10 dbm
	+4 dbm	-14 dbm

*Table 4C-10. Record Level, Record Equalization*

Step 3: Change the frequency of the signal generator as applicable for the tape speed involved.

15 ips	18,000 Hz
7-1/2 ips	15,000 Hz
3-3/4 ips	8,000 Hz

Step 4: Start the tape in motion, with the channel under test operating in the record mode.

Step 5: Place the OUTPUT SELECTOR switch in the REPRO position.

Step 6: While thus simultaneously recording and reproducing, change the frequency of the signal generator in discrete steps to cover the high end of the response spectrum for the tape speed involved. Adjust the HI SPEED or LOW SPEED control, at the front of the record board, for the flattest possible high frequency response, in reference to 500 Hz, in accordance with specifications.

Step 7: Repeat Steps 3 through 6 for the second tape speed.

Step 8: Repeat the entire procedure for all other channels.

#### 4C.4 SEL-SYNC ADJUSTMENTS

##### 4C.4.1 Test Equipment Required

Ampex Standard Alignment Tape as applicable (see Table 4C-8)  
Tools normally used by technician

##### 4C.4.2 Test Conditions

LINE TERMINATION switch on back of electronics assembly in ON position to terminate equipment.

Dummy plug in INPUT ACCESS socket (not accessory transformer or preamp).

Heads cleaned and demagnetized.

Covers installed on electronics.

Both adjustments require access to the back panels of the electronics assemblies. Sel-Sync adjustment is not applicable for reproduce-only equipment.

##### 4C.4.3 Sel-Sync Level Adjustment

Step 1: Place the RECORD SELECTOR switch on each electronic assembly in the

SAFE position. This will prevent entering the record mode accidentally and thus erasing the standard alignment tape.

Step 2: Apply power, select tape speed, and position the REEL switches in accordance with the size of the reel hubs to be used.

Step 3: Thread the applicable standard alignment tape on the transport.

Step 4: Place all OUTPUT SELECTOR switches in the REPRO position.

Step 5: Advance the standard alignment tape to the operating level tone. (This will be the first tone on a 15 ips standard tape, the last tone on a tape for slower speeds.)

Step 6: As the operating level tone is reproduced, check that the REPRODUCE LEVEL controls are adjusted to provide a 0 indication on the equipment vu meters.

Step 7: Rewind the standard tape to the beginning of the operating level tone. Place all RECORD SELECTOR switches in the SEL SYNC position.

Step 8: Place the standard tape in motion in the reproduce mode. As the operating level tone is reproduced, adjust the SEL SYNC GAIN controls (on the back panel of each electronic assembly) to achieve a 0 indication on the equipment vu meter.

Step 9: Remove the standard tape, after winding it on its original reel as explained in paragraph 4C.3.1.

##### 4C.4.4 Sel-Sync Bias Trap Adjustment

When the Sel-Sync feature is used, the bias from a channel that is recording could leak into an adjacent channel which is operating in the Sel-Sync mode. Nothing would be recorded on the latter channel, but visual monitoring (using the vu meters) might be masked. A trap is therefore provided to minimize such bias leakage.

The bias trap is adjusted at the factory, and there should be no need for readjustment. If the bias from channels which are recording causes objectionable vu meter indications on channels which are operating in Sel-Sync, the adjustment is quite easily accomplished. Operate one channel at a time under Sel-Sync, and all other channels in the record mode. Adjust the Sel-Sync BIAS TRAP control, on the back panel of the electronic assembly operating in Sel-Sync, to null the vu meter indication.

**MAINTENANCE****Part D. Heads, Corrective Maintenance****4D.1 GENERAL**

Cleaning and demagnetizing the heads is explained in part B, Routine Maintenance. Adjusting the head azimuth is explained under Electronic Alignment Procedures in Part C, Normal Adjustment and Alignment. Changing the complete head assembly is described in Part A, Conversion and Expansion.

**4D.2 ADJUSTING HEAD HEIGHT****4D.2.1 Record/Reproduce Heads (Not 1/4-Track)**

The height of all heads was precisely set at the factory, and no adjustment should be required unless a head stack is changed.

Step 1: Remove the head housing overlay (cover) by loosening the captive screw on the angled back surface.

Step 2: Thread tape on the equipment, and place it in motion at the high tape speed.

Step 3: Loosen the two nuts (items 42 and 43, Fig. 6-1) on the two slotted head screws (Item 39, Fig. 6-1, or 30, Fig. 6-3) approximately 1/4 turn.

Step 4: Turning both the same number of turns, turn the two hex socket set screws (see Fig. 4D-1) clockwise until the head laminations are barely visible at the bottom edge of the tape.

Step 5: Carefully counting the turns required, turn the two hex socket set screws (in equal turns) counterclockwise until the head laminations are barely visible above the top edge of the tape.

Step 6: Now turn the two set screws clockwise exactly half the number of turns counted in Step 5. Turn the two nuts loosened in Step 3 clockwise until they are snug.

Step 7: Check head zenith and tape wrap (refer to paragraph 4D.3). Check head azimuth (refer to Electronic Alignment, paragraphs 4C.3.6 and 4C.3.8).

**4D.2.2 Quarter Track Record/Reproduce Heads**

To set the height of a quarter-track record or reproduce head, start by repeating Steps 1, 2, and 3, paragraph 4D.2.1. Then adjust the two hex socket set screws so that the mu-metal portion of the upper head in the stack is exactly even with the top edge of the tape.

**4D.2.3 Erase Heads**

The height of erase heads are adjusted by using shims, in thicknesses of .010, .002, .003, and .005 inch. These are available from Ampex under Part Nos. 4350025-01, 4350025-02, 4350025-



03, and 4350025-04 respectively. The head must be removed each time shims are added or removed. It is held in position by one cross head screw (item 40, Fig. 6-1 and item 31, Fig. 6-3).

For all except quarter track erase heads, use shims until the ferrite portion of the top head in the stack is just visible at the top edge of the tape. Then add shims until that portion of the bottom head in the stack is barely visible below the bottom edge of the tape. Then remove exactly half the shim thickness required to move the head from the top to bottom of the tape.

If a quarter track erase head is employed on some special equipment, use shims to position the ferrite portion of the top head in the stack so that it is even with the top edge of the tape. Then remove shims to raise the head .006 mils. (The erase head is wider than record or playback heads so must be positioned above the top edge of the tape.)

#### 4D.3 ADJUSTING TAPE WRAP AND ZENITH

The tape must contact the heads so that the gap is centered in the tape contact area. Also, the tape must contact the top of the head and the bottom of the head equally well.

To check both tape wrap and head zenith, use a grease pencil or crayon to lightly cover the face of the head. Thread tape on the equipment, start it in motion at the high tape speed, and allow it to run for approximately ten seconds. Lift the tape from the head, and examine the coating on the head. The area cleaned by the tape should extend an equal distance from each side of the head gap (in the center of the head). This checks tape wrap. The area should also be equally clean at the top and bottom of the tape contact area. This checks head zenith.

If adjustment of the tape wrap is indicated as necessary, remove the head housing overlay (cover) by loosening the captive screw on the angled back surface. Loosen the large cross head mounting screw (item 40, Fig. 6-1, or 31, Fig. 6-3). Directly behind the mounting screw there is a hole, with a smaller cross head screw visible in that hole. Loosen the small cross head screw, and use a screw driver (at the side of the stack) to pry the head stack (not the can) in the indicated direction. Tighten the screws, being sure the shield can is aligned with the head shield on the head gate, and recheck the tape wrap as des-

cribed in the preceding paragraph. Repeat the adjustment as required until the tape wrap is correct. Note that the erase head is adjusted for tape wrap simply by loosening the mounting screw and rotating the head.

To adjust head zenith, use the two hex socket set screws (also used for head height adjustment see Fig. 4D-1). Running the set screw toward the front of the head assembly in, and the set screw toward the back of the assembly out, will move the bottom of the stack in (away from the tape). If the back set screw is run in and the front set screw out, the bottom of the head will move out (toward the tape). Be sure both set screws remain snug. Visually check the zenith as the adjustment is being made, by lining up the head with the capstan or scrape flutter idler. When the adjustment seems correct, recheck the zenith with the grease pencil method previously described. Repeat the adjustment as required until the head zenith is correct. (There is no zenith adjustment for the erase head.)

Whenever head zenith or tape wrap is changed, check the head azimuth alignment (refer to Electronic Alignment Procedures, paragraphs 4C.3.6 and 4C.3.8):

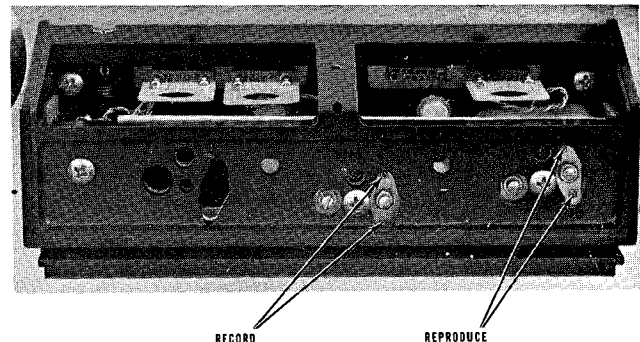


Fig. 4D-1. Head Height and Zenith Adjustment Points

#### 4D.4 CHANGING HEAD STACKS

##### 4D.4.1 Record or Reproduce Stack

**Step 1:** Remove the complete head assembly (refer to paragraph 4A.2.3).

**Step 2:** Remove the large cross head mounting screw (item 41, Fig. 6-1, or item 31, Fig. 6-3). This frees the shield can, which contains the head stack, from the head assembly.

## NOTE

If the replacement head stack is already mounted in a shield can, simply mount that can in position. Before tightening the screw, check through the bottom of the casting that the can is aligned with the head shield, and is parallel to the top front edge of the casting.

Step 3: To remove the head stack from the shield can, use a screw driver to remove the two slot head screws and nuts (items 39-42 and 39-43, Fig. 6-1, or items 30-32 and 30-33, Fig. 6-3). Be careful not to lose the double coil lock washer. The head stack and two head springs (item 3, Fig. 6-1 and Fig. 6-3) will now be loose from the shield can. Unsolder the leads at the head stack.

Step 4: Run the leads from the connector assembly through the hole in the back of the shield can, and solder them to the terminals on the new head stack (correct connections are shown on Figs. 6-2, 6-3, and 6-5).

Step 5: Run the two hex socket head set screws out until the ends are even with the inside of the can.

Step 6: Take the two slot head screws and nuts which were removed in Step 3. Run the nuts fully on the screws, tightening them firmly against the screw head. Place the double coil lock washer over the end of the screw which has the plain hex nut (the other screw has a self-locking nut).

Step 7a: (Heads for 1/4-inch tape.) Place the two head springs in the indentations in the top of the head stack. Slip the head stack into the shield can, using care not to displace the springs.

Step 7b: (Heads for 1/2-inch tape.) Hold the shield can upside down, and place the

two head springs in the indentation in the shield can. Looking through the open side of the inverted shield can, these indentations are at the right front and right rear. Being careful not to displace the springs, slide the head stack (also upside down) into the can.

Step 8: Insert the two slotted head screws through the plate and can, with the screw, plain hex nut, and double coil lock washer, in the position shown for items 39 and 42, Fig. 6-1, or items 30 and 32, Fig. 6-3. Mate the two screws with the threaded holes in the head stacks, and tighten them firmly.

Step 9: Mount the head stack and shield can in the head assembly, using the large cross head screw removed in Step 2. Refer to the note following Step 2 regarding shield can alignment.

Step 10: Run the two hex socket head set screws down, thus lowering the head stack, until head height is approximately correct.

Step 11: Run the two nuts on the cross head screws down against the plate, using the azimuth adjusting nut (see Fig. 4C-6) to set the head azimuth to the approximately correct position.

Step 12: Install the head assembly on the tape transport, being sure to plug the connectors into the correct receptacles (see Fig. 4A-1).

Step 13: Check and adjust head height (refer to paragraph 4D.2), tape wrap and zenith (refer to paragraph 4D.3), and head azimuth (refer to paragraph 4C.3.6 or 4C.3.8).

### 4D.4.2 Erase Head Stack

To change an erase head stack, remove the complete head assembly from the transport. Remove the large cross head mounting screw (item 40, Fig. 6-1, or 31, Fig. 6-3). The erase head stack, spacer, and shims will come free.

Place the spacer and shims on the new assembly and mount them on the casting, using the mounting screw. Check erase head height (refer to paragraph 4D.2.3) and tape wrap (refer to paragraph 4D.3).

**MAINTENANCE****Part E. Transport, Corrective Maintenance****4E.1 GENERAL**

Routine maintenance procedures (cleaning, lubricating, etc.) are described in part B of this section. Normal checkout and adjustment procedures for the transport are described in part C, paragraph 4C.2. The discussions herein are concerned with corrective maintenance, the replacement of parts, and special adjustment procedures required thereafter.

Practically all of the procedures described herein will require the removal of the front panel on console-mounted equipment. This panel must be removed and installed as described in Section 2, Installation, paragraph 2.3.

**4E.2 SERVICING HINTS****4E.2.1 Brake Bands**

Brake bands which become glazed, but are not contaminated with oil, can sometimes be renovated by sanding them with a fine grain sandpaper (4.0 or finer). Do not use emery cloth or carborundum-coated papers.

**4E.2.2 Solenoids**

Solenoid plungers occasionally become corroded to the point where they will not slide freely in the solenoid. Such a condition can be corrected

by putting the plunger in a drill press and polishing it with crocus cloth. Do not lubricate.

**4E.2.3 Relays**

All plug-in relays are fitted with snap-on dust covers, which can be removed by slipping a knife blade under the cover and prying it from the base. If there is any question of whether a relay is being energized, remove the cover and observe its action. Relay contacts can be cleaned, using bond paper or a relay contact burnishing tool.

Since all relays are identical (including the record relay on the electronic assembly) it is possible that play/record operation could be continued on an emergency basis if either the play or record relay became defective and would not energize. This might be accomplished by interchanging the defective relay with the fast forward, rewind, or edit relay, depending on which of these three functions is least important at the time. Note that the fast forward, rewind, and edit relays complete the play/record circuit through normally closed contact sets, and therefore need not energize to provide emergency operation. The defective relay cannot be left out of the circuit, be sure it is plugged into the receptacle from which the good relay was removed.

#### 4E.2.4 Capstan Idler

An arm (item 33, Fig. 6-9) is fastened to the shaft of the capstan idler by means of a rollpin (item 59, Fig. 6-9). Removing this rollpin requires special tools, as it must be pressed out (and in). Do not use a drift pin and hammer to drive this pin out or in, because pounding on the pin can easily result in irreparable distortion of the tape transport.

### 4E.3 REMOVING HEAD CABLE AND POWER SUPPLY BOXES

Despite the fact that the head cable box and electronic power supply assembly are mounted to the back of the tape transport, they are not considered part of the transport. Their removal is sometimes required during corrective maintenance procedures.

Removal and installation of the head cable box is discussed in Part A of this section, paragraph 4A.2.4.

To remove the electronic power supply box, disconnect all cables from receptacles J701 through J704. Disconnect the cable captive at the power supply box from its receptacle on the tape transport control box. Remove the four screws which secure the power supply box to the transport casting, and the box can be lifted off. Note that the power transistor is mounted on the side of the box which was next to the transport. Use care not to damage the transistor while the box is detached.

Installation is in the reverse order of removal. The captive cable is routed from under the power supply box out the side toward the transport control box.

### 4E.4 TAKEUP AND REWIND ASSEMBLIES

#### 4E.4.1 General

The two major components in the takeup and rewind assemblies are the torque motor assembly and the brake assembly. Other parts include a turntable pad, a reel drive plate, and the 8-pin connector. The motor capacitors are mounted separately on the top plate.

On the torque motor assembly, the turntable and the brake drum are affixed to the motor shafts, and cannot be adjusted or replaced. The fixed position of the turntable also prevents removing the motor flange. If any of these com-

ponents are damaged, the complete motor assembly must be ordered.

Assembly drawings of the takeup and rewind assemblies are in Figs. 6-12 and 6-13 of the Parts List and Drawings section.

Adjustment of tape tension (motor torques) and braking force are described in part C of this section, paragraphs 4C.2.3 and 4C.2.4.

#### 4E.4.2 Replacing Entire Assembly

Both the takeup and rewind assemblies are secured, through slotted holes in the top plate, to the reel guards (this allows quick conversion to use the 11-1/2-inch CCIR reels). Note that when the assembly is removed, the reel guard will also come free.

To remove either assembly, first disconnect the applicable 8-pin connector from the receptacle on the tape transport control box. Slide the plastic sleeving from the solderless connectors in the leads to the capacitor and disconnect those wires. Manually support the assembly, and remove the three nuts and washers (items 77 and 79, Fig. 6-9) which secure the assembly to the reel guard. Remove the reel guard, and guide the turntable through the hole in the top plate to remove the entire assembly.

Replace the assembly in the reverse order of its removal. Note that if the 10-1/2-inch NAB reel is the largest which will be used, the assembly should be positioned in the slotted holes as far as possible toward the center of the transport. If the 11-1/2-inch CCIR reel is used, secure the assembly in its full outward position. Check before tightening the mounting nuts that the flat portion of the reel guard is parallel with the top edge of the transport (see Fig. 6-8) and that the turntables are centered in the guard.

See Figs. 6-12 (takeup assembly) or 6-13 (rewind assembly) when connecting the leads to the motor capacitor.

#### 4E.4.3 Replacing Reel Drive Plate

A reel drive plate (item 4, Fig. 6-12) is located in the center of each turntable, around the spindle. The drive plate has three equal spaced extrusions which mate with the hubs on EIA reels. It is secured to the turntable by three screws.

To replace the drive plate, simply remove the three mounting screws and lift the plate from the spindle. Place the new drive plate in position, and reinstall the screws.

#### 4E.4.4 Replacing Turntable Pad

A cork turntable pad (item 3, Fig. 6-12) covers the top surface of each turntable. To replace the pad, use a putty knife or some similar instrument to lift one edge of the pad. It can then be peeled off the turntable.

Clean all adhesive from the turntable, using lacquer thinner, MEK, etc. Peel the backing from the new pad, exposing the adhesive surface, and carefully position the pad on the turntable, being sure the reel hold down holes in the pad are aligned with those in the turntable. Press the pad firmly in position.

#### 4E.4.5 Removing Brake Assembly

Cut the lacing twine which ties the wires to the solenoid bracket. Slide the plastic sleeving from the solderless connectors in the four leads to the two solenoids, and disconnect those wires. Remove the three screws (item 9, Fig. 6-12). Manually actuate the main brake solenoid (the one closest to the motor) and slide the entire assembly from the brake drum.

Refer to paragraph 4E.4.8 for the installation procedure, which entails proper positioning of components and setting correct clearances.

#### 4E.4.6 Replacing Brake Bands

With the brake assembly removed from the takeup or rewind assembly (refer to paragraph 4E.4.5) proceed as follows to replace the brake band.

Step 1: Remove the brake spring (item 11, Fig. 6-14).

Step 2: Remove the two socket head cap screws and washers which secure the end of the brake band farthest from the solenoids. These two screws are shown directly below item 27, Fig. 6-14. Note that a band link clamp will also come free.

Step 3: Loosen (do not remove the other two socket head cap screws at the opposite end of the brake band. Using care not to lose the leaf spring, slide that end of the brake band from between the clamp and the screws. The brake band can now be removed.

Step 4: Position the new brake band through the holes in the housing, with the slotted end to the side next to the solenoids.

Step 5: Secure the end of the brake band farthest from the solenoids (refer to Step 2), using the band link clamp, the two socket head

cap screws, and the lock washers. Tighten the cap screws.

Step 6: Slip the slotted end of the brake band between the band link clamp and the band link. Install the leaf spring between the brake band and the band link clamp (so that the spring is on the inner side of the band, on the same side as the lining). Tighten the two socket head cap screws so that they are snug but the brake band will still slip in and out of the clamp.

Step 7: Reinstall the brake spring removed in Step 1.

Further adjustments must be made when the brake assembly is reinstalled on the takeup or rewind assembly. These are explained in paragraph 4E.4.8.

#### 4E.4.7 Removing Brake Solenoids

Cut the lacing twine which ties the wires to the solenoid bracket. Slide the plastic sleeving from the solderless connectors in the leads to the solenoids, and disconnect those wires.

To remove the edit brake solenoid (the one farthest from the motor) remove the two screws and washers (items 29 and 38, Fig. 6-14). Note that there are four places where these screws and washers are used, remove the two which secure the edit solenoid to the edit solenoid bracket (item 7 or 8, Fig. 6-14). The solenoid is now free (the plunger will slide out). If the plunger must be removed, it is accomplished by removing the self locking nut (item 37, Fig. 6-14) and the spring beneath it, and sliding the spade bolt (item 34, Fig. 6-14) out through the hole in the edit solenoid stop plate (item 18, Fig. 6-14). The plunger can be freed from the spade bolt by removing the cotter pin and clevis pin (items 24 and 25, Fig. 6-14).

To remove the main brake solenoid, remove the two screws and washers (items 29 and 38, Fig. 6-14). Note that there are six places where these screws are used, remove the two which secure the main brake solenoid to the edit solenoid bracket (item 7, Fig. 6-14). Now remove the two screws (item 31, Fig. 6-14) which secure the end of the main brake solenoid to the solenoid bracket (item 6, Fig. 6-14). Pivot the edit brake solenoid bracket so that the main brake solenoid can be removed (the plunger will slide out of the solenoid). To free the plunger, remove the cotter pin and clevis pin (items 24 and 25, Fig. 6-14).

Replacement is made in the reverse

order of the removal. Be sure to align the faces of both solenoids (the ends with the plungers) with the edit solenoid bracket. Note also that adjustment procedures described in paragraph 4E.4.8 must be performed whenever the solenoids are removed and replaced.

#### 4E.4.8 Replacement and Adjustment, Brake Assembly

To replace the complete brake assembly on the reel motor, manually actuate the main brake solenoid and slip the brake band over the brake drum on the motor shaft. Secure the assembly in position with the three screws (item 9, Fig. 6-12).

Whenever any item on the brake assembly is removed or replaced, the adjustment procedure described in the following steps must be performed. Designations used in this description are illustrated on the takeup and supply brake adjustment portion of Fig. 6-10.

Step 1: Check that the front surface of both the main brake solenoid and the edit brake solenoid are flush with the front surface of the edit solenoid bracket. If adjustment is required, move the edit solenoid bracket so it is flush with the front surface of the main brake solenoid, then move the edit brake solenoid flush with the bracket.

Step 2: Move the edit solenoid spring anchor full forward in its slotted holes.

Step 3: Manually actuate the main brake solenoid, and measure the distance that the plunger protrudes from the solenoid in its fully bottomed position.

Step 4: Check that the brake band is square on the drum. Slide the slotted end of the band (see Brake Band Adjustment, Fig. 6-10) in its clamp until it holds the main brake solenoid plunger in a position from 5/32 to 3/16 inch out from the fully bottomed position measured in Step 3 (solenoid not actuated). Secure the band in that position by tightening the two socket head cap screws.

Step 5: Manually actuate the main brake solenoid, checking that the brake band does not buckle (any buckling will be visible near the brake band adjustment point). If any buckling is evident, slide the end of the band further into the clamp just to the point where the buckling is removed (refer to Step 6).

Step 6: Manually actuate the main brake solenoid. Rotate the motor and check that

the band does not drag on the brake drum. If any dragging is noted, the band was shortened too much in Step 5, and must be lengthened by sliding it out of the clamp. The final adjustment must result in no buckling of the band (Step 5) and no drag on the drum, when the solenoid is fully bottomed.

Step 7: Position the edit solenoid spring anchor so that the edit solenoid stop plate clears the end of the main brake solenoid plunger by 1/16 inch ( $\pm 1/64$  inch). Secure the anchor in that position.

Step 8: Connect the leads to the solenoids at the solderless connectors. Slide the plastic sleeving over the connectors.

Step 9: Use lacing twine to tie all leads to the solenoid bracket (item 6, Fig. 6-14) so that they cannot contact any rotating parts.

Step 10: Adjust the main brake and edit brake forces as described in part C, paragraph 4C.2.4.

#### 4E.4.9 Replacing Motor Capacitors

Removal of either the takeup or rewind motor capacitors (item 22, Fig. 6-9) requires the removal of the electronics power supply box (refer to paragraph 4E.3). Then slide the plastic sleeving from the solderless connectors in the leads to the capacitor, and disconnect those wires. Loosen the two screws on the mounting plate (item 42, Fig. 6-9) and slide the capacitor and plate from the extrusions in the casting. Remove the mounting plate and use the screws, nuts and washers to secure the new capacitor on the plate (do not tighten the screws). Slide the capacitor and plate into position and tighten the screws. Connect the leads (see Figs. 6-12, takeup, or 6-13, rewind) and replace the power supply box.

### 4E.5 **DRIVE MOTOR ASSEMBLY**

#### 4E.5.1 General

Drive motor lubrication is explained in part B, paragraphs 4B.3.1, 4B.3.2, and 4B.3.3

#### 4E.5.2 Removing Fan and Flywheel

Both the fan and the flywheel are secured to the drive motor shaft by set screws. To remove these components, simply loosen the set screws and slide them from the shaft.

To reinstall, slide the flywheel on the shaft, until the hub is against the shoulder on the shaft (the set screw portion of the hub should be

out, away from the motor). Tighten the set screw against the flat portion of the shaft. Slide the fan on the shaft, set screw side in (toward the motor) and bottom it against the hub on the flywheel. Tighten the set screw against the flat portion of the shaft.

#### 4E.5.3 Removing Drive Motor Assembly

To remove the drive motor assembly, first disconnect the drive motor cable from its receptacle on the tape transport control box. At the front of the tape transport, remove the capstan idler (item 4, 5, Fig. 6-8) by loosening the set screw (item 75, Fig. 6-8) and lifting the idler from the arm (item 39, Fig. 6-8).

Manually support the drive motor, at the back of the transport. At the front of the transport remove the four screws (item 60, Fig. 6-8) which secure the motor to the top plate (the motor shield will also come free). Use care not to bump or scrape the capstan as the motor is removed.

Installation of the drive motor is performed in the reverse order of its removal. Be sure to reinstall the motor shield (item 37, Fig. 6-9), positioning it as shown. When installing the capstan idler, adjust its height so that the top surface of the rubber tire is 1/32 inch ( $\pm 1/64$  inch) below the top surface of the capstan shaft.

#### 4E.5.4 Replacing Motor Capacitor

The drive motor capacitor (item 13, Fig. 6-9) is secured by two screws to the capstan solenoid mounting plate (item 43, Fig. 6-9). Slide the plastic sleeving from the solderless connectors in the leads to the capacitor, and disconnect those two wires. Free the capacitor by using a stubby screwdriver (or offset screwdriver) to remove the two screws and washers (items 69 and 80, Fig. 6-9) from the threaded holes in the plate. Use the screws and washers to mount the new capacitor in position, and reconnect the leads (see Fig. 6-10 for correct connections).

## 4E.6 REEL IDLER

### 4E.6.1 Removing Tape Guide

The tape guide can be removed from the reel idler arm by unscrewing the spring-loaded screw (item 9, Fig. 6-15). The idler, screw, spring, and flat washers used as shims will come free. When re-installing the tape guide, insert the spring and screw in the top of the guide, and be sure to install all of the washers. Then seat

the slot in the bottom of the guide over the spring pin on the arm, and tighten the screw.

### 4E.6.2 Removing Pulley Assembly

The pulley assembly is held in the reel idler housing by the reel idler flywheel, which is secured by a set screw to the pulley shaft. Note that the set screw side of the flywheel is to the inside, toward the transport, and must be located by feel. Rotate the flywheel so that the flat portion of the pulley shaft is toward the outer edge of the rewind motor. Insert a 3/32 Allen wrench (the long-shafted type with a handle) past the outer edge of the rewind motor, manually feeling for the set screw hole. If the transport is in a face down position--such as when rotated in a console--manually support the reel idler pulley while the set screw is loosened and the flywheel removed. The pulley will then slide out of the housing.

Installation consists of sliding the pulley shaft back through the housing, and re-mounting the flywheel. However, an end play of from .003 to .005 inch must be provided to prevent damaging the ball bearings. This can be most accurately achieved by holding the pulley firmly down in the housing and using a feeler gauge to determine the space between the pulley and the housing, at the side opposite the arm. When this has been determined add .004 inch, and use the appropriate feeler gauge or gauges. (For example, if the clearance with the pulley fully bottomed is .021 inch, use a .025 inch gauge). Insert the gauge between the pulley and housing at the side opposite the arm. Hold the pulley firmly down on the gauge, and push the flywheel on the pulley shaft (set screw side in) so that it is in firm contact with the bottom of the housing. Tighten the flywheel set screw, and remove the feeler gauge.

### 4E.6.3 Adjusting Arm Tension Force

This force is not critical. However, if it becomes excessively high, and cannot be corrected by adjustment, it will indicate that some damage to the reel idler has caused a binding condition.

To check the force, use a spring scale, measuring at the outer end of the arm. It should require approximately two ounces of pressure to move the arm from its stop.

If adjustment is required, remove the pulley assembly (refer to paragraph 4E.6.2). This will reveal two screws (item 21, Fig. 6-15). Loos-

en these screws, and rotate the bushing (item 2, Fig. 6-15); clockwise rotation will increase pressure, counterclockwise rotation will decrease pressure. Tighten the two screws, and recheck the spring force. Continue until proper force is attained.

Reinstall the pulley, maintaining correct end play as explained in paragraph 4E.6.2.

#### 4E.6.4 Removing Arm Assembly

To remove the arm assembly, first remove the pulley assembly (refer to paragraph 4E.6.2). Then remove the two screws (item 21, Fig. 6-15). The arm, bushing and idler mount (items 5, 2, and 8, Fig. 6-15) will now be free and can be lifted from the housing. Note that the arm is sandwiched between the bushing and the mount, which in turn are press-fit together to very close tolerance. They cannot therefore be ordered as separate parts. Contact Ampex Audio Technical Support Department if replacement is required. The tension spring can be replaced, it simply hooks over two pins, one on the arm and the other on the mount.

To install the arm assembly, insert it in the housing with the arm in the slot to the upper left. Insert the two screws, not tightening them completely. Check and adjust arm tension force (refer to paragraph 4E.6.3). Replace the pulley assembly, maintaining correct end play, as described in paragraph 4E.6.2.

#### 4E.6.5 Removing Complete Assembly

To remove the complete reel idler assembly, first remove the pulley assembly (refer to paragraph 4E.6.2). At the back of the tape transport, two screws and washers (items 66 and 85, Fig. 6-9) secure the reel idler housing to the casting. Manually support the housing at the front of the transport, and remove these screws. The housing and arm assembly can now be removed from the front of the transport.

Installation is in the reverse order of removal. If the arm assembly was removed from the housing, check and adjust the arm tension force (refer to paragraph 4E.6.3). When installing the pulley assembly, provide correct end play as explained in paragraph 4E.6.2.

#### 4E.6.6 Replacing Ball Bearings

Replacing the ball bearings (item 17, Fig. 6-15) in the reel idler assembly requires that the complete assembly be removed from the

transport (refer to paragraph 4E.6.5). Then remove the arm assembly from the housing (refer to paragraph 4E.6.4). The top ball bearing can now be removed by inserting a pencil (or some similar object) up through the hole in the lower bearing, and pushing the top bearing out of the housing.

To remove the lower ball bearing, use Truarc pliers to remove the lower retaining ring. Insert the pencil or other object from the top of the housing, and push the lower bearing out.

Care must be exercised when installing the new bearings. Use no lubrication. Note that the bearings are slip fitted (not press-fitted) in the housing, and that finger pressure is all that is required to push them into position. Be very careful not to cock the bearings in the housing bore. Push only on the outer race (not toward the inside) of the bearing, applying equal pressure on the diametrically opposite sides of the bearing face. Using this procedure, install the lower bearing, pushing it into position against the retaining ring. Install the lower retaining ring below the bearing. Push the other bearing into position.

Mount the housing on the transport, and install the arm assembly. Check and adjust the arm tension force (refer to paragraph 4E.6.3). When installing the pulley assembly, maintain correct end play as described in paragraph 4E.6.2.

## 4E.7 TAKEUP TENSION ARM

### 4E.7.1 Adjusting Arm Spring Force

To check the spring force on the take-up tension arm, use a spring scale and measure at the tape guide on the outer end of the arm. Hold the arm with the scale so that the centerline of the arm is parallel to the bottom edge of the transport. The scale should indicate from 1/4 to 3/8 ounce (7 to 11 grams).

If adjustment is required, remove the cap which covers the tension arm base, by removing the socket head screw in the middle of the cap. A spring is wound around the bushing below the arm. One end of this spring is inserted in a hole in the bushing, the other end is hooked to one of two pins, located 180° apart and upright on the base. Adjustment is made by using a soldering aid, or some similar tool, to move the hook end of the scale from one pin to the other until correct force is achieved. Note that a spacer beneath the spring hook must also be moved. Winding the spring tighter around the bushing will increase the



force, allowing it to spring back to the next pin (become looser around the bushing) will decrease the force. Adjustment to the force quoted is required if the transport is changed between the vertical and horizontal position.

#### 4E.7.2 Adjusting Safety Switch Actuation

To check the position of the takeup tension arm when it actuates the safety switch to stop tape motion, move the arm up to the tape threaded position. Now allow the arm to return slowly towards its rest position, listening closely for the click which denotes actuation of the safety switch. At that point, the tape contacting surface of the tape guide should be 3-3/4 inch (+0, -3/4 inch) up from the bottom edge of the transport.

Any adjustment required is made from the back of the transport. Remove the drive motor connector and the takeup motor connector from their receptacles on the transport control box, and hold other wires aside so that the safety switch (item 23, Fig. 6-9) is accessible. Use long nose pliers to bend the safety switch spring actuator. Bending the actuator out from the switch will result in the safety switch being actuated when the takeup tension arm is higher in position, bending it toward the switch will result in a lower position.

Replace the drive motor and takeup motor connectors when the adjustment is completed.

#### 4E.7.3 Removing Tape Guide and Hook

Removal of the tape guide and hook from the takeup tension arm is accomplished by removing the spring loaded screw from the top of the guide. The screw, spring, guide, shim washers, and hook will come free.

To install the hook and guide, mate the locating hole on the hook and the slot at the bottom of the guide with the spring pin. Be sure to return all the shim washers to position between the guide and hook. Insert the spring and screw in the guide, and tighten the screw in the threaded hole in the arm.

#### 4E.7.4 Replacing Tension Spring

It is difficult, but possible, to replace the tension spring around the bushing. To remove the spring, first remove the cap which covers the base, by removing the socket head screw in the middle of the cap. Unhook the end of the spring from the pin, and allow it to unwind completely. Remove the straight end of the spring from the hole in the bushing. Use long nose pliers to

start the top end of the spring up over the arm, and simply unscrew the spring from the bushing.

To install the spring, start the straight end on the bushing (the hook end of the spring is up). Screw the spring on the bushing. When it is in position, insert the straight end of the spring into the hole in the base of the bushing, tighten the spring by winding the hook end two or three times around, and hook the end to one of the pins on the base. Then check and adjust the arm spring force (refer to paragraph 4E.7.1).

#### 4E.7.5 Replacing Complete Assembly

All replaceable parts of the takeup tension arm assembly have been called out in paragraphs 4E.7.3 and 4E.7.4. If any other component becomes defective, the complete assembly must be replaced.

To remove the takeup tension arm assembly, disconnect the drive motor and takeup motor cables from their receptacles on the transport control box. Hold other wires aside so that the base of the tension arm is accessible. The assembly is secured to the top plate by one screw (item 68, Fig. 6-9). Remove this screw, and lift the assembly off from the front of the transport. Note that a drive pin, which protrudes from the inner end of the assembly, must be guided out through the hole in the top plate.

When the assembly is free from the transport, remove the set screw (item 73, Fig. 6-9) from the base. Install this set screw in the new assembly, screwing it in until it protrudes 3/16 inch. Guide the end of the new assembly through the hole in the top plate, mating the set screw with the hole to the upper left. Secure the assembly to the transport with the one screw.

After installation, check and adjust the actuation of the safety switch (refer to paragraph 4E.7.2). Reconnect the drive motor and takeup motor cables to their receptacles on the transport control box.

## 4E.8 CAPSTAN IDLER

### 4E.8.1 General

Lubrication of the capstan idler is described in part B of this section, paragraph 4B.3.3. The adjustment of idler force against the capstan is described in part C, paragraph 4C.2.5.

#### 4E.8.2 Parts Not Removable

Note that the capstan idler arm (item 39, Fig. 6-8) and its associated components cannot be removed from the transport. This is because the solenoid arm (item 33, Fig. 6-9) is secured to the shaft of the idler arm by a rollpin. Removing and installing this rollpin requires special tools, as it must be pressed out and in. The solenoid arm will not fit through the hole in the transport, so no part between the idler arm and the solenoid arm can be removed in the field.



Do not use a drift pin and hammer to drive out the rollpin. Pounding on the pin can easily result in irreparable distortion of the tape transport.

It is unlikely that any of these parts will ever need replacement. If some damage should occur which requires removal, the transport should be returned to the factory for repair.

#### 4E.8.3 Adjusting Idler Position

When the capstan solenoid is not energized, the clearance between the rubber tire of the idler and the capstan should be from 1/2 inch to 5/8 inch. Adjustment is made by moving the stop which limits the outward travel of the capstan solenoid plunger.

Loosen the two screws which secure the stop to the top of the capstan solenoid (item 9, Fig. 6-9). Slide the stop, in its slotted holes, to the position that results in the correct clearance, and tighten the screws.

If this adjustment is made, it must be followed by checking and adjusting capstan idler pressure (refer to paragraph 4C.2.5).

#### 4E.8.4 Removing Idler

The rubber tired idler (item 4,5, Fig. 6-8) is held on the idler arm (item 39, Fig. 6-8) by a set screw (item 75, Fig. 6-8). To remove the idler, loosen the set screw and slide the idler shaft from the arm.

When installing the idler, position it so that the top surface of the rubber tire is 1/32 inch ( $\pm 1/64$  inch) below the top surface of the capstan.

#### 4E.8.5 Removing Capstan Solenoid

Removal of the capstan solenoid requires that the drive motor and drive motor capacitor be previously removed (refer to paragraphs 4E.5.3 and 4E.5.4). Also, disconnect the takeup motor cable from its receptacle on the transport control box.

The capstan solenoid is item 9, Fig. 6-9. The first step in its removal is to remove the self locking nut and the adjustment spring from the end of the bolt which is inserted through the hole in the solenoid arm (item 33, Fig. 6-9). Then slide the plastic sleeving from the solderless connectors in the leads to the solenoid, and disconnect those wires.

A mounting plate is used to clamp the solenoid to extrusions on the transport casting. Loosen the four screws (items 63 and 67, Fig. 6-9), and slide the plate and solenoid from the extrusions while guiding the bolt out of the hole in the solenoid arm.

To install the solenoid, secure the mounting plate to the solenoid using the four screws and washers (do not tighten the screws). Note that the solenoid leads are fastened in a cable clamp (item 58, Fig. 6-9) which is secured by one of the four screws (item 67, Fig. 6-9). With the solenoid return spring in position on the bolt as shown in Fig. 6-9, insert the end of the bolt through the hole in the solenoid arm (item 33, Fig. 6-9), and slide the plate and the solenoid over the extrusions on the casting. Tighten the screws to clamp the solenoid in position. Install the solenoid adjusting spring and the self locking nut on the end of the bolt. Connect the leads to the solenoid.

Install the drive motor capacitor and the drive motor (refer to paragraphs 4E.5.4 and 4E.5.3, respectively). Reconnect the takeup motor cable. Check and adjust the capstan idler position (refer to paragraph 4E.8.3).

After the installation is completed, check and adjust the capstan idler pressure (refer to part C of this section, paragraph 4C.2.5).

### 4E.9 TAPE LIFTER

#### 4E.9.1 Adjustment Procedure

When the equipment is operated in the play mode, the tape lifter posts must not touch the tape. In either fast-winding mode, the tape must be lifted from all of the heads; however, it must not contact the head shield covers on the headgate.

Adjustment is usually required only if damage has occurred requiring replacement of tape lifter components, or if the solenoid is replaced.

Adjustment of the tape lifter must be preceded by removing the reel idler flywheel and pulley (refer to paragraph 4E.6.2). Disconnect the rewind motor and electronic power supply cables from their receptacles on the transport control box. Remove the dummy plugs (or cables) from the 60 Hz amplifier and remote control receptacles, and remove the four plug-in relays, at the transport control box. Move the head cables to one side if they are in the way.

See the tape lifter assembly adjustment portion of Fig. 6-10 in following these instructions.

The first step is to position the tape lifter solenoid stop  $21/32$  inch from the face of the solenoid, by loosening the two screws which secure the stop to the solenoid, sliding the stop to the required position, and tightening the two screws. Note that it is possible that this position will have to be changed later in the procedure.

Loosen the two hex head self tapping screws, one at each end of the tape lifter bracket, and slide that bracket as far as possible toward the solenoid. Insert the end of the auto tape lifter spring (between the link on the solenoid plunger and tape lifter bracket) in the hole in the tape lifter bracket which is nearest to that end without requiring any extension of the spring. (This will usually be the third or fourth hole from the solenoid end of the bracket).

Now hold either tape lifter arm in the retracted position, so that there is a clearance of  $1/16$  inch between it and the back of the slot (see Fig. 6-10). Slide the tape lifter bracket away from the solenoid just to the point where all slack is removed from the auto tape lifter spring, the link to the solenoid plunger, and the plunger itself. (The plunger must be full out, against the stop.) Tighten the two hex head self tapping screws to secure the tape lifter bracket in that position. If all slack cannot be removed as described, slide the tape lifter bracket back toward the solenoid, and move the end of the auto tape lifter spring to the next hole in the bracket. Then repeat the procedure described.

Manually actuate the solenoid plunger to the fully bottomed position. The tape lifter arm should move so that there is a  $1/16$  inch clearance between it and the other end of the slot. If the travel of the arm is not as described, correction is made by repositioning the tape lifter solenoid stop

from the  $21/32$  inch previously set. Moving the stop farther from the face of the solenoid will result in more travel of the arm, moving it closer will result in less travel. Note that there is a 2:1 ratio between arm travel and solenoid plunger travel (moving the solenoid stop  $1/16$  inch will result in changing the travel of the arm by  $1/8$  inch). If the solenoid stop has to be repositioned, the complete adjustment procedure must be repeated. The final adjustment must result in a tape lifter arm clearance of  $1/16$  inch from each end of the slot in the deenergized and energized positions.

Replace the reel idler pulley and flywheel, providing proper end play as described in paragraph 4E.6.2. Connect all cables and return the relays and dummy plugs to the receptacles on the transport control box.

#### 4E.9.2 Removing Tape Lifter Solenoid

Removing the tape lifter solenoid requires the previous removal of the reel idler pulley and flywheel (refer to paragraph 4E.6.2). Also, disconnect the rewind motor and electronic power supply cables from their receptacles on the transport control box.

Remove the auto tape lifter spring (see Fig. 6-10). Slide the plastic sleeving from the solderless connectors in the leads to the solenoid and disconnect those two wires. The solenoid (item 10, Fig. 6-9) is clamped to extrusions on the side of the transport casting by a mounting plate (item 41, Fig. 6-9). Use an open end wrench to loosen the two hex-head screws (item 62, Fig. 6-9), and slide the solenoid and plate off the extrusions.

Installation consists of mounting the plate on the end of the solenoid, using the two screws, lockwashers, and flat washers (items 62, 84, and 88, Fig. 6-9). Slide the solenoid and plate over the extrusions on the casting, and use an open end wrench to tighten the two mounting screws, thus clamping the solenoid in position. Connect the leads to the solenoid, and return the auto tape lifter spring to its position.

Whenever the solenoid is removed and replaced, tape lifter action must be adjusted (refer to paragraph 4E.9.1). Do this before reinstalling the reel idler pulley and flywheel, or reconnecting cables.

#### 4E.9.3 Removing Tape Lifter Assembly

Removal of the tape lifter assembly requires the previous removal of the reel idler

flywheel and pulley (refer to paragraph 4E.6.2). Disconnect the rewind motor and electronic power supply cables from their receptacles on the transport control box, remove the dummy plugs (or cables) in the 60 Hz amplifier and remote control receptacles, and remove the four plug-in relays.

Remove the tape lifter solenoid (refer to paragraph 4E.9.2). Remove the tape lifter return spring (item 35, Fig. 6-9) from between the end of the tape lifter assembly and the post on the transport. Remove the two socket head shoulder screws (item 44, Fig. 6-9) which secure the tape lifter assembly to the transport casting, and the complete assembly will come free. Note that flat washers (item 83, Fig. 6-9) are installed between the assembly and the transport.

An assembly drawing of the tape lifter assembly is provided in Fig. 6-11. Replaceable parts are listed in the tape transport parts list. Note that the spring (item 5, Fig. 6-11) is installed to take up any slack between the clevis pins which secure the tape lifter arms, and thus to prevent any backlash or rattle.

Installation of the lifter assembly on the transport is in the reverse order of its removal. Be sure to install the washers (item 83, Fig. 6-9) between the assembly and the transport. Install the tape lifter solenoid (refer to paragraph 4E.9.2). Before returning the reel idler pulley and flywheel, and connecting cables, dummy plugs, and relays, adjust the tape lifter action as described in paragraph 4E.9.1.

#### 4E.10 SAFETY SWITCH

To remove the safety switch (item 23, Fig. 6-9) first disconnect the drive motor and takeup motor cables from their receptacles on the transport control box. Move other wiring aside.

Slide the plastic sleeving from the solderless connectors in the leads to the safety switch, and disconnect those two wires. The switch is secured to mounting posts on the transport casting, by two screws and washers, (items 70 and 82, Fig. 6-9). Remove these screws, and the switch will come free with the shield (item 30, Fig. 6-7).

Installation consists of placing the shield over the switch, and using the two screws and washers to secure them to the casting. Connect the leads to the switch (see Fig. 6-10 for correct connections).

Check and adjust safety switch actuation by the takeup tension arm assembly (refer to

paragraph 4E.7.2), before connecting the drive motor and takeup motor cables to the transport control box.

#### 4E.11 SERVICING PROCEDURES

##### 4E.11.1 General

Power distribution to the three motors, and the six solenoids on the tape transport is controlled by components on or in the transport control box. All switches, relays, fuses, switching transistors, and power supply components for transport control are included in the control box.

A schematic diagram of the tape transport is provided on Fig. 6-20, while a simplified schematic diagram is shown on Fig. 6-21. As shown on Fig. 6-21, there are actually three control circuits. One routes the ac line power to the electronic power supply, the takeup and rewind motors, the drive motor, the 24 volt dc supply, and the 115 volt dc supply. The 24 volt dc control circuit supplies the play, edit, fast forward, rewind, and record relays (the record relay is on the electronic assembly); this circuit also provides power to the tape lifter solenoid. (The two switching transistors are in the 24 volt dc circuit). The 115 volt dc control circuit is used for power to the capstan solenoid, the two main brake solenoids, and the two edit brake solenoids.

Assembly drawings for the transport control box are provided on Figs. 6-17 and 6-18, and a power distribution and fusing diagram on Fig. 6-19.

##### 4E.11.2 Removing Bottom Cover, Control Box

Access to components inside the control box is attained by removing the bottom cover from the box. Turn power off, and remove the cover over the tension adjusting resistors, by removing the two nuts (one at each end). Then use an open end wrench to loosen the seven hex head screws (two at each end, three on one side) around the edge of the bottom cover. Use the finger holes in the cover to pull it off (the screws will slide out of slots on the box).

### WARNING

Dangerous voltages exist at many points inside the box and across the tension adjusting resistors when power

is applied. Only those who are thoroughly experienced in working with live circuits should attempt servicing when power is on.

#### 4E.11.3 Removing Complete Control Box

To remove the complete control box from the transport, remove all cable connectors from the receptacles. Disconnect the solderless connectors in leads to the tape lifter solenoid, the capstan solenoid, the drive motor capacitor, and the safety switch.

At the front of the transport remove the two screws (item 61, Fig. 6-8) from the escutcheon over the pushbuttons; that escutcheon and the pushbuttons will come free. Remove the two screws (items 65 and 61, Fig. 6-8) from the escutcheon over the toggle switches, and remove that escutcheon.

Manually support the control box, and remove the three screws (item 71, Fig. 6-8) which secure the front of the control box to the casting. The control box can now be removed.

Note that the actuation of relays and distribution of power can be checked with the control box removed and the dummy plugs in their receptacles. To do this, connect the two leads that were connected to the safety switch, and use electrician's tape to cover the connections. Do not connect any of the other leads, but tape each solderless connector separately. Replace the cover over the tension adjusting resistors. The power cord can now be connected and power applied.

### **WARNING**

Dangerous voltages exist in many points within the control box, and across the tension adjusting resistors. Only personnel thoroughly experienced in working with live circuits should attempt servicing procedures with the bottom cover or the resistor cover removed when power is applied.

Installing the control box is in the reverse order of its removal. Proper connections

of leads to the solenoids, drive motor capacitor, and safety switch are shown on Fig. 6-10.

#### 4E.11.4 Checking Power

##### 4E.11.4.1 General

In this discussion, it is assumed that the power cord is properly connected to the transport and to a power source.

##### 4E.11.4.2 Checking Input Power

When the power switch is placed in the ON position, the power indicator should light. If not, move the takeup tension arm from its rest position (so it does not contact the safety switch); if the capstan motor starts in rotation the lamp in the power indicator must be replaced (refer to paragraph 4E.11.10). If the motor does not start when the arm is moved, check line power, fuses F601 and F602, the power switch, and capacitors C606 and C607 (see Figs. 6-18 and 6-20).

Note that the fuses are located on the back panel of the control box. Power switch opening and closing can be checked by removing the two fuses, and checking with an ohmmeter across the outer contacts in the fuse posts while turning the power switch on and off. To check the capacitors, remove the bottom cover of the control box (refer to paragraph 4E.11.2). The capacitors are connected at the inner side of the power receptacle (item 28, Fig. 6-18).

##### 4E.11.4.3 Checking 24 Volt Supply

Trouble in the 24 volt dc power supply would be indicated by the inability to actuate any of the mode relays (play, fast forward, rewind, or edit). None of these modes would therefore operate. Components in this supply are transformer T1, diodes CR601 through CR604, capacitor C609, and resistor R602. Remove the bottom cover (refer to paragraph 4E.11.2) and apply power to the equipment.

### **WARNING**

Dangerous voltages exist at many points within the control box and across the tension adjusting resistors. Only personnel familiar with working with live circuits should perform this check.

Use a dc voltmeter to check the voltage across capacitor C609 (item 27, Fig. 6-18). Note that the 24 volts dc is a nominal voltage, varying with power line voltage and with the load applied (with no load it will be approximately 34 volts dc). If the voltage is not present, or is excessively low, check the components in the 24 volt dc supply. Note that the diodes (in the full wave bridge circuit) and R602 are mounted on a pair of two lug terminal strips located to the right of transformer T1 and just above the rewind motor receptacle (when the bottom of the control box is viewed from the side with the tension adjusting resistors). If no defective component is found, check wiring continuity from the input of the 24 volt power supply to both sides of the ac line.

#### 4E.11.4.4 Checking 115 Volt Supply

Trouble in the 115 volt dc power supply would be indicated if none of the 115 volt solenoids (capstan, main brakes, edit brakes) would actuate in any mode of operation.

The components in this supply are resistor R609 (item 39, Fig. 6-18), capacitor C614 (item 38, Fig. 6-18), and diode CR615 (located as item 22 on the three lug terminal strip to which both C614 and C609--item 27--are connected. Remove the bottom cover of the control box (refer to paragraph 4E.11.2) and apply power to the equipment.

### WARNING

Dangerous voltages exist at many points within the control box and across the tension adjusting resistors. Only personnel familiar with working with live circuits should perform this check.

Use a dc voltmeter to check the voltage across C614 (item 38, Fig. 6-18). Note that the 115 volt dc designation represents a nominal value under load. With no load it might rise as high as 150 volts dc. If the voltage is not present, or is excessively low, check the components previously listed. If no defective component is found, check wiring continuity from the input of the 115 volt dc power supply to both sides of the ac line.

#### 4E.11.5 Checking Relay Actuation

In the following discussion, it is assumed that the power indicator illuminates when power is applied (if not, refer to paragraph 4E.11.4.2). Also, refer to the simplified schematic diagram of Fig. 6-21, which shows the interaction of the relays; if a relay does not actuate, it may be because of a malfunction in another relay.

If it is suspected that a relay is not actuating, a visual check is possible. Use a knife blade, or some similar sharp instrument, to pry the dust cover from the suspected relay. Hold the takeup tension arm so that it does not contact the safety switch. With power applied, press the pushbutton which should actuate the relay, and visually observe the relay action. If the relay actuates, check that all contacts make, then turn power off, and clean the contacts, using bond paper or a contact burnishing tool. If the relay does not actuate, proceed as follows:

(a) If the relay does not actuate, turn off power and remove the relay from its receptacle. Check with an ohmmeter across the relay coil (pins 13 and 14 on the relay). The ohmmeter should indicate approximately 650 ohms. If the coil is open (or shorted, which is more unlikely) the relay must be replaced. If a replacement is not immediately available, refer to Servicing Hints, paragraph 4E.2.3, relative to maintaining normal play/record operation on an emergency basis.

(b) If the relay does not actuate, but the coil seems in good condition, replace the relay in its receptacle. Test the other modes of operation (for example, if the fast forward relay is being tested, check the play, rewind, and edit functions). If all other functions operate normally, turn power off and interchange the suspected relay with one known to be good. Recheck all modes of operation. If the original circuit operates normally but the trouble shows up in the circuit which now contains the suspected relay, it is probable that the relay is defective despite the coil testing correctly; replace the relay. If the original circuit still does not operate, some other component is preventing relay actuation. Turn power off, and remove the bottom cover from the control box (refer to paragraph 4E.11.2).

Remove the relay, and use an ohmmeter to check wiring continuity (see Schematic diagrams Figs. 6-20, 6-21), from the 24 volt dc supply to the pushbutton switch, and thence to the relay coil. Check the diode across the relay coil.

Check switch closure when the pushbutton is pressed. Check wiring continuity to the negative side of the 24 volt dc supply.

(c) If only the play function is normal in procedure (b), and the rewind, fast forward, and edit modes are inoperative, turn power off and remove the bottom cover (refer to paragraph 4E.11.2). Check transistors Q601 and Q602, and other components in that circuit (see schematic diagrams Fig. 6-20, 6-21).

(d) If no mode of operation is available in procedure (b), check the 24 volt dc power supply (refer to paragraph 4E.11.4.3).

#### 4E.11.6 Checking Solenoid Actuation

##### 4E.11.6.1 General

The main brake and edit brake solenoids and the capstan solenoid are actuated by the application of the 115 volt dc power; the tape lifter solenoid is actuated by the application of the 24 volt dc power. Actuation of all solenoids can be visually checked at the back of the tape transport.

##### 4E.11.6.2 Checking Tape Lifter Solenoid

(a) If the tape is not lifted from contact with the heads during either fast forward or rewind modes, but those modes otherwise operate normally, visually check actuation of the tape lifter solenoid. If the solenoid actuates, manually check that the plunger is fully bottomed. If these two conditions exist, it is probable that all that is required is adjustment of the tape lifter mechanism (refer to paragraph 4E.9.1).

(b) If the tape lifter solenoid does not actuate in either fast forward or rewind, but those modes otherwise operate normally, there are very few components which could be responsible. Remove the remote control dummy plug, and check the jumper from pin 12 to pin 8 on that plug. Do not replace the plug until instructed. Disconnect the solderless connectors to the tape lifter solenoid. Check resistance of the solenoid coil (across the solderless connectors in the leads to the coil), it should be approximately 30 ohms; if the coil is open or shorted, the solenoid must be replaced (refer to paragraph 4E.9.2). Check continuity from the "A" lead at the solenoid (see Fig. 6-20) to pin 12 of the remote control receptacle, little or no resistance indicates proper making of the edit switch in its up position. Check the diode across the solenoid coil by checking with the ohm-

meter across the solenoid leads into the control box; if the diode is defective it must be replaced (this is the diode inside the control box which is connected from the remote control receptacle to the rewind relay receptacle).

(c) Use alligator clips to connect a dc voltmeter to the two leads into the control box (the "B" lead, see Fig. 6-20, is positive). Replace the dummy plug in its receptacle. Apply power to the equipment, and start it in the fast forward mode. The nominal 24 volt dc power should be indicated on the meter. The same should be true in the rewind mode. If power is present, it is probable that the solenoid is defective despite its coil testing correctly; replace the solenoid (refer to paragraph 4E.9.2). If power is not present, check wiring continuity to the negative and positive sides of the 24 volt power supply. Overall continuity can be easily checked by removing the dust covers on the fast forward and rewind relays. Check from the positive ("B") lead into the control box to the positive side of C609 (item 27, Fig. 6-18) manually actuating first the fast forward, then the rewind relay; little or no resistance should be encountered. Then check from the negative ("A") lead to the negative side of C609 (do not actuate the relays).

(d) If the tape lifter solenoid actuates in one fast-winding mode and not in the other but both modes otherwise operate normally, it would indicate either improper making of the relay contacts in the fast forward or rewind relays, or poor wiring connections to those contacts. Check contact set 11-3-7 and the wiring to it, on the relay indicated to be at fault.

##### 4E.11.6.3 Checking Capstan Solenoid

(a) If the capstan idler does not move to clamp the tape to the capstan when the play pushbutton is pressed, first visually check actuation of the main brake solenoids on the takeup and rewind motors. If those solenoids are not actuating when the play pushbutton is pressed, check their actuation in fast forward and rewind; if they actuate in those modes it is probable that the trouble is in the play relay. Check that relay and its contacts (refer to paragraph 4E.11.5). Replace if necessary.

(b) If the brake solenoids do not actuate in any mode, and the capstan solenoid does not actuate in the play mode, place the equipment in the stop/edit mode and check actuation of the edit brake solenoids. If no solenoid can be actuated,

check the 115 volt dc power supply (refer to paragraph 4E.11.4.4), and the 24 volt dc power supply (refer to paragraph 4E.11.3).

(c) If the main brake solenoids are actuated when the play pushbutton is pressed in (a), the capstan solenoid and its circuit must be checked. Disconnect the solderless connectors in the leads to the capstan solenoid. Use an ohmmeter to check the resistance of the solenoid coil (across the two disconnected leads); it should be approximately 1,570 ohms. If the coil is open or shorted, the solenoid must be replaced (refer to paragraph 4E.8.5). Use alligator clips to connect a dc voltmeter to the solenoid leads into the control box (the "A" lead is positive, see Fig. 6-20), and press the play pushbutton. The nominal 115 volt power should be available across those leads. If that power is present, it is probable that the solenoid is defective despite the coil checking correctly; replace the solenoid.

(d) If power is not present in (c), remove the bottom cover of the control box (refer to paragraph 4E.11.2). Check wiring continuity from the solenoid to the negative and positive sides of the 115 volt dc power supply. Overall continuity can be easily checked by removing the dust cover from the play relay. Check with an ohmmeter from the positive ("A") lead of the solenoid into the control box to the positive side of capacitor C614 (item 38, Fig. 6-18) while manually actuating the play relay; little or no resistance should be encountered. Without actuating the relay, check from the negative ("B") lead to the negative side of C614, again little or no resistance should be encountered.

#### 4E.11.6.4 Checking Main Brake Solenoids

(a) Main brake solenoids should be actuated in the play, fast forward, and rewind modes of operation. In the play mode, the capstan solenoid should also be actuated, so that the idler moves to clamp the tape to the capstan. If neither of the brake solenoids or the capstan solenoid are actuated in the play mode, follow the procedures described in (a) and (b) paragraph 4E.11.6.3.

(b) If the rewind main brake solenoid is actuated in the play mode, but the takeup main brake solenoid is not, check contacts in the edit relay (refer to paragraph 4E.11.5). Remove the bottom cover of the control box (refer to paragraph 4E.11.2). Remove the takeup motor cable from its receptacle on the control box. Use an

ohmmeter to check the diode (CR607) which is located on the pins at the back of the rewind motor receptacle. Replace if defective. Check the resistance of the solenoid coil, across pins 5 and 6, of the rewind motor plug; it should be approximately 2,300 ohms. If the coil is opened or shorted, the main brake solenoid must be replaced (refer to paragraph 4E.4.7). Reconnect the takeup motor cable to its receptacle on the control box, and disconnect the solderless connectors to the main brake solenoid. Use alligator clips to connect a dc voltmeter to the solenoid leads from the motor plug (the lead to pin 5 of the plug is positive). Apply power, and place the equipment in the play mode. The nominal 115 volt dc voltage should be present across those leads. If the voltage is present, it is probable that the main brake solenoid is defective despite its coil testing correctly; replace the solenoid (refer to paragraph 4E.4.7). If voltage is not present, check wiring continuity from the leads to the positive and negative side of the 115 volt power supply. Overall continuity is easily checked by removing the dust covers from the play, rewind and fast forward relays. Check from the negative lead (pin 6 of the plug) to the negative side of C614 (item 38, Fig. 6-18), and manually actuate first the play relay, then the rewind relay, then the fast forward relay; little or no resistance should be encountered when any one of the relays is actuated. Without actuating any relay, check from the positive lead to the positive side of C614. Little or no resistance should be encountered.

(c) If the takeup main brake solenoid actuates in the play mode, but the rewind main brake solenoid does not, remove the rewind motor cable from the receptacle on the control box. Check the resistance of the solenoid coil, across pins 5 and 6 of the rewind motor cable plug. It should be approximately 2,300 ohms; if the coil is opened or shorted the solenoid must be replaced (refer to paragraph 4E.4.7). Remove the bottom cover of the control box, and use an ohmmeter to check the diode (CR610) which is soldered across pins 5 and 6 on the back of the rewind motor receptacle. Replace the diode if it is defective. Reconnect the rewind motor cable to its receptacle on the control box, and disconnect the solderless connectors in the leads to the solenoid. Use alligator clips to connect a dc voltmeter across the two solenoid leads to the plug. Apply power, and place the equipment in the play mode. The nominal 115 volts dc should be available across



those leads. If the voltage is present, it is probable that the solenoid is defective despite its coil checking correctly; replace the solenoid (refer to paragraph 4E.4.7). If the voltage is not present, check wiring continuity from the solenoid leads to the positive and negative sides of the 115 volt dc power supply. Overall continuity can be easily checked by removing the dust covers from the play, fast forward, and rewind relays. Connect the ohmmeter from the negative (pin 6 of the plug) lead to the negative side of C614 (item 38, Fig. 6-18). Manually actuate first the play, then the fast forward, then the rewind relays. Little or no resistance should be encountered when any one of the three relays is actuated. Without actuating any relay, check from the positive (pin 5 of the plug) lead to the positive side of C614, little or no resistance should be encountered.

#### 4E.11.6.5 Checking Edit Brake Solenoids

(a) Edit brake solenoids on both the takeup and rewind motors should actuate in the stop/edit mode. If neither of the solenoids actuates in this mode, check actuation of the main brake solenoids in the fast forward and rewind modes, and the main brake solenoids and capstan solenoid in the play mode. If none of these solenoids can be actuated, check the 115 volt dc power supply (refer to paragraph 4E.11.4.4). If all other solenoids actuate normally, the trouble is probably in the edit relay; check relay action and contacts (refer to paragraph 4E.11.5) and replace the relay if necessary. If the relay action is normal, remove the bottom cover from the control box (refer to paragraph 4E.11.2) and disconnect both the rewind and takeup motor cables from their receptacles on the control box. Use an ohmmeter to check the diode (CR611) which is connected across pins 7 and 8 on the back of the rewind motor receptacle; replace the diode if it is defective.

(b) Probably the only other thing that could cause neither solenoid to actuate, would be the wiring to the 115 volt dc power supply. Disconnect the solderless connectors to either edit brake solenoid, and use alligator clips to connect a dc voltmeter across the leads to the plug (the lead to pin 7 is positive). Apply power to the equipment and press the edit pushbutton. The nominal 115 volt dc power should be present across the leads. If it is not present, remove the dust cover from the edit relay. Check with an ohmmeter from the positive lead to the positive side of C614 (item 38, Fig. 6-18) while manually

actuating the edit relay; there should be little or no resistance. Without actuating the relay check from the negative lead to the negative side of C614, there should again be little or no resistance.

(c) If only one of the solenoids actuates in the stop/edit mode, it is probable that the non-actuating solenoid is defective, because the two are tied directly together across the rewind and takeup receptacles. Disconnect the cable from its receptacle on the control box. Check the resistance of the solenoid coil, across pins 7 and 8 on the motor cable plug; it should be approximately 2,300 ohms. If the coil is open or shorted, the solenoid must be replaced (refer to paragraph 4E.4.7). Check voltage and resistance from the non-actuating relay as explained in (b).

#### 4E.11.7 Checking Drive Motor

(a) If the power indicator lights when power is applied, but the capstan motor does not start in rotation when tape is threaded, manually move the takeup tension arm to be sure it is not contacting the safety switch. Then, with power applied, press the edit pushbutton to place the equipment in the stop/edit mode; if braking force at the reel turntables is reduced to where the reels can easily be turned, the safety switch is all right. If not, it is probable that the actuation of the safety switch is incorrectly adjusted (refer to paragraph 4E.7.2), the spring force of the takeup tension arm is incorrectly adjusted (refer to paragraph 4E.7.1) or the safety switch is defective and must be replaced (refer to paragraph 4E.10).

(b) Next, check that the dummy plug is inserted in the 60 Hz amplifier receptacle, and check the jumpers in that plug (see P604P, Fig. 6-20). (If a 60 Hz precision amplifier is being used, check the operation of that unit.)

(c) Now remove the drive motor cable from its receptacle on the control box. If the speed switch is in the high speed position, apply power and check with an ac vtm across receptacle pins 4 and 5, and then across receptacle pins 3 and 5. (If the speed switch is in the low speed position, check across receptacle pins 1 and 5, and 2 and 5). Full line power should be available at both positions. If so, it indicates that the speed switch is closed and that the motor capacitor is not open. If voltage is available at pins 4 and 5 (1 and 5) and not across 3 and 5 (2 and 5) the motor capacitor is probably open; check and replace if required (refer to paragraph 4E.5.4). Even if voltages are correct, check that the motor capac-

itor is not shorted; also check the connections to the motor capacitor at the solderless disconnects (see Fig. 6-10).

(d) If the motor capacitor is all right, or if power is not available across either pair of receptacle pins, turn power off, remove the bottom cover, and check the make-break action at all contacts of the speed switch (view A-A, Fig. 6-18) using an ohmmeter and placing the switch first in one position then the other. (If any capacitor C602 through C605 is shorted, voltage will appear at receptacle pin pairs for the opposite speed selected. In this case, the motor probably would always run at the slow speed--regardless of the speed selected--with very little torque).

(e) If voltages are present at both receptacle pin pairs, and if the motor capacitor is alright, it indicates that the drive motor is defective; check and replace (refer to paragraph 4E.5.3). Motor cabling connections are shown on Fig. 6-16.

#### 4E.11.8 Checking Takeup Motor

If the power indicator does not light when power is applied refer to paragraph 4E.11.4.2. If the capstan motor does not operate when tape is threaded refer to paragraph 4E.11.7.

(a) When both of the above components operate normally, pressing the play push-button should result in the capstan idler clamping the tape against the rotating capstan, and the takeup motor starting in rotation to reel in the tape. If the capstan idler operates normally, but the takeup motor does not start, check deactuation of the edit relay (refer to paragraph 4E.11.5); if it does not deactuate, remove the bottom cover and use an ohmmeter to check opening and closure of the edit switch. If the edit relay does deactuate, check the actuation of the safety switch as described in paragraph 4E.7.2 (even if the safety switch is misadjusted, it would probably still leave some trouble in the takeup motor circuit.)

(b) If the capstan idler does not move to clamp the tape to the capstan, check that the dummy plug (or remote control unit) is plugged into the remote control receptacle on the control box. Check the jumpers in the dummy plug. Check if the rewind motor is applying holdback tension on the tape. If not, check actuation and contacts of the play relay (refer to paragraph 4E.11.5.).

(c) If the capstan idler clamps the tape to the capstan, and the takeup motor starts,

but a tape loop allows the takeup tension arm to actuate the safety switch (thus stopping all operation) check the takeup and rewind tape tensions (refer to paragraph 4C.2.3 in part C of this section) and the spring force on the takeup tension arm (refer to paragraph 4E.7.1).

(d) If the capstan clamps the tape to the capstan and the takeup motor gives no indication of starting, it is an indication of a malfunction in the motor circuit. First, check fast forward operation. If the motor operates normally, it indicates that the motor and capacitor are alright, and that the brake solenoid is being energized. Check deactuation and contacts of the fast forward relay (refer to paragraph 4E.11.5) and takeup tension adjusting resistor R605, mounted at the back of the control box. (Note that malfunction of the play and edit relays will cause other malfunctions previously explained).

(e) If the motor does not operate in either play or fast forward, check the takeup reel switch; if it is in the small reel hub position change it to the large reel hub position. If this clears the trouble check small reel hub tensioning resistor R606 mounted on the back of the control panel. If not, or if the switch was originally in the large reel hub position, visually check actuation of the main brake solenoid. If it is not actuating, refer to paragraph 4E.11.6.4. If it is actuating, remove the takeup motor cable from its receptacle on the control box. Remove any tape threaded on the equipment, and hold the takeup tension arm from its rest position (so it does not contact the safety switch). Press the fast forward pushbutton, and use an ac vtvm to check voltage across pins 1 and 2 of the motor receptacle. Full line power should be available across those pins. If not, check wiring continuity to both sides of the ac line. Note that overall continuity can be easily checked, by removing the dummy plug from the 60 Hz amplifier receptacle. Check continuity of ac neutral by using an ohmmeter connected across pins 1 on the motor receptacle and 4 on the 60 Hz amplifier receptacle, no appreciable resistance should be present. Check the high side of the line by removing the dust caps from the play and fast forward relays. Connect the ohmmeter between pins 2 on the motor receptacle and 1 on the 60 Hz amplifier receptacle. Manually actuate the fast forward relay; no appreciable resistance should be present (reel switch in large reel hub position). Release the fast forward relay, and manually actuate the play relay. The only resistance encount-

ered should be that set at takeup tensioning resistor R605. Replace the dummy plug in the 60 Hz amplifier receptacle when checking is completed.

(f) If voltage is present as explained in (e), check the motor capacitor connections at the solderless connectors (see Fig. 6-12), then check the capacitor. If it is open or shorted, it must be replaced (refer to paragraph 4E.4.9). If voltage is present and the capacitor is alright, the takeup motor is probably defective. Check and replace the motor (refer to paragraphs 4E.4.2 and 4E.4.5). Motor cabling connections are shown on Fig. 6-12.

#### 4E.11.9 Checking Rewind Motor

If the power indicator does not light when power is applied refer to paragraph 4E.11.4.2. If the capstan drive motor does not operate when tape is threaded, refer to paragraph 4E.11.7. If the takeup motor does not operate, refer to paragraph 4E.11.8.

(a) If all of the above components operate normally, but there is no rewind function, remove the tape from the transport. Hold the takeup tension arm from its rest position (so it does not contact the safety switch) and put the equipment in the play mode. The rewind turntable should rotate clockwise, the takeup turntable should rotate counterclockwise, and the capstan idler should move to contact the capstan. If operation is as described, press the rewind pushbutton. If this does not drop out the play mode (capstan idler does not move away from capstan) check actuation and contacts of the rewind relay (refer to paragraph 4E.11.4). If the play mode drops out, it will indicate that the rewind relay is actuating.

(b) If only the takeup motor operates in (a) check the supply reel switch. If it is in the small reel hub position, move it to the large reel hub position. If the rewind motor now operates, check small reel hub tensioning resistor R608. Also, visually check actuation of the main brake solenoid; if it does not actuate, refer to paragraph 4E.11.6.4.

(c) If changing the position of the reel switch has no effect, and if the main brake solenoid actuated in (b), remove the rewind motor cable from the receptacle on the transport control box. Hold the takeup tension arm from contacting the safety switch, and press the rewind pushbutton. Use an ac vtm to check voltage across pins 1 and 2 of the rewind motor receptacle on the control

box. Full power line voltage should be available across those pins (reel size switch in large reel position). If voltage is not as quoted, or is excessively low, check wiring continuity to the ac line. Note that overall continuity can be easily checked by removing the dummy plug from the 60 Hz amplifier receptacle. Check the neutral side of the line from pin 1 on the rewind motor receptacle to pin 4 of the 60 Hz amplifier receptacle; little or no resistance should be encountered. To check the high side of the line, remove the dust cover over the rewind and play relays, and connect the ohmmeter from pin 2 of the rewind motor receptacle to pin 1 on the 60 Hz amplifier receptacle. Manually actuate the rewind relay, little or no resistance should be encountered. Release the rewind relay, and manually actuate the play relay. The resistance set across holdback tension adjusting resistor R604 should be all that is encountered. If continuity checks are as quoted, recheck actuation and contacts on both the play and rewind relays (refer to paragraph 4E.11.5).

(d) If voltage is present as quoted in (c), check the rewind motor capacitor connections at the solderless connectors (see Fig. 6-13), then check the capacitor. If it is open or shorted, it must be replaced (refer to paragraph 4E.4.9). If voltage is present and the capacitor is alright, the rewind motor is probably defective. Check and replace the motor (refer to paragraphs 4E.4.2 and 4E.4.5). Motor cabling connections are shown on Fig. 6-13.

#### 4E.11.10 Replacing Power Indicator Lamp

To replace the lamp in the power indicator remove the two screws (item 61, Fig. 6-8) which secure the escutcheon over the pushbuttons. That escutcheon, and the pushbuttons beneath it, will come free. Remove the two screws (items 61 and 65, Fig. 6-8) which secure the escutcheon over the toggle switches, that escutcheon will come free. The lamp can now be removed from the socket if a lamp extracting tool is available. If such a tool is not available, it will be necessary to complete the removal of the control box from the transport (refer to paragraph 4E.11.3).

#### 4E.11.11 Replacing Switches

Replacing any switch on the control box requires removing the control box from the transport (refer to paragraph 4E.11.3). Note that when new pushbutton switches are installed the protrusion of the switch from the face of the chassis is to

be set at 19/32 inch ( $\pm 1/32$  inch). The protrusion of any toggle switch handle from the face of the chassis is to be set at 1-5/16 inch ( $\pm 1/32$  inch).

#### 4E.11.12 Checking Record Circuit

Placing the equipment in the record mode, basically speaking, consists of starting tape in the play mode at the transport and actuating the record circuits in the electronic assembly. In addition to this, on this equipment there are two switching transistors, Q601 and Q602. The purpose of these transistors is to lock out the edit, fast forward, and rewind modes while the equip-

ment is recording. Q601 is therefore placed in the negative return lead from the edit, fast forward, and rewind relays. When the record mode is initiated, transistor Q602 is turned on, and this turns Q601 off.

If it becomes possible to start the edit, fast forward, or rewind modes of operation from the record mode, transistor Q602 (item 24, Fig. 6-18) may be open, or Q601 (item 23, Fig. 6-18) may be shorted. If it becomes impossible to start those three modes at any time, transistor Q602 may be shorted or Q601 may be open. No malfunction of either transistor will prevent entering the record mode.



**MAINTENANCE****Part F. Electronics, Corrective Maintenance****4F.1 GENERAL**

Overall performance checks for the equipment are described in part B of this section, paragraph 4B.4. Normal alignment procedures are included in part C of this section, paragraphs 4C.3 and 4C.4.

Standard audio trouble shooting techniques should be used in isolating a fault to a certain stage or component. Note that dc, signal, and bias voltages are included at many points on the schematic diagram as a further aid in locating any malfunctions. The schematic diagram for record/reproduce electronic circuits are on Fig. 6-22 and 6-24, for reproduce-only equipment on Figs. 6-23 and 6-25. A power distribution and fusing diagram is on Fig. 6-19.

**4F.2 USING EXTENDER BOARDS**

Corrective maintenance procedures will be greatly facilitated if the optional accessory extender boards are available. The extender plugs into the circuit board receptacle in the electronic chassis (or power supply), and the circuit board then plugs into the extender. The circuit board is thus held in position outside the chassis, with all circuits connected and all components available for testing.

Catalog numbers of the extender boards are as follows:

For reproduce	4020151
For record	4020152
For bias amplifier	4020153
For power supply	4020154

**4F.3 CHECKING INPUT POWER AND INDICATORS****4F.3.1 Record/Reproduce Equipment**

When the power is turned on at the tape transport, the power indicator on the transport, and the vu meter lights on record/reproduce electronic assemblies should be illuminated. If the power indicator on the transport does not light, refer to paragraph 4E.11.4. A power distribution and fusing diagram is on Fig. 6-19.

(a) If the power indicator is illuminated, but the vu meter lights are not, place the record selector switch on the electronic assembly in the ready position, and check the ready indicator. If it illuminates, it is probable that one of the vu meter lights is defective (these lights are connected in series). Replace the meter light (refer to paragraph 4F.9.1.2).

(b) If the ready indicator does not illuminate in (a), check fuse 4F1 on the back panel of the electronic assembly. If that fuse is alright, check fuse F701 on the electronic power supply box mounted behind the transport. If both fuses are alright, check with a dc voltmeter at any receptacle J701 through J704 on the electronic power supply box, checking across pins 9 (positive) and 5. The 39 volt dc power should be available across those pins; if not check the power supply board (see schematic diagram, Fig. 6-22). If the voltage is present, the trouble must be in the interconnecting cable to the electronics, or in internal wiring.

(c) If the power indicator on the transport, and the vu meter lights, are illuminated when power is applied, but the ready indicator does not light when the record selector switch is placed in the ready position, it is probable that the ready indicator light is defective. Replace the light (refer to paragraph 4F.9.1.1).

(d) If the vu meter lights and the ready indicator illuminate correctly, but the record indicator does not light when the equipment is placed in the record mode, turn the output selector switch to the bias position (while still in the record mode). If the vu meter indicates normal bias, it is probable that the record indicator light is defective; replace the light (refer to paragraph 4F.9.9.1).

(e) If no bias indication is present at the vu meter in (d) it is probable that the trouble is in the record relay. Check relay actuation, contacts, and holding circuit (refer to paragraph 4F.4).

#### 4F.3.2 Reproduce-only Equipment

(a) There is no vu meter on reproduce-only equipment. If it is suspected that operating power is not available, check with a dc voltmeter across pins 9 and 5 on any receptacle J701 through J704 on the electronic power supply box behind the tape transport. The +39 volt dc power should be available. If not check fuse F701 on the power supply box.

(b) If no voltage is present in (a) but the fuse is alright, check the power supply printed circuit board (see schematic diagram Fig. 6-23).

(c) If voltage is present in (a) insert the reproduce board in position on an extender card and check the +39 volt voltage at any convenient point (see schematic diagram, Fig. 6-25). If no voltage is present, the fault is indicated to be in the interconnecting cable, or in internal wiring.

#### 4F.4 CHECKING RECORD RELAY

The record relay, which plugs in at the back panel of the record/reproduce electronic assembly, is the only relay used in the record/reproduce circuit. It is identical to the four relays employed on the tape transport. (This check is not applicable to reproduce-only equipment.)

(a) If it is suspected that the record relay is not actuating, its action can be checked visually by removing the dust cover from the relay. Hold the takeup tension arm so that it does not contact the safety switch, put the record selector in the ready position, and start operation in the play mode. (Note that it is assumed here that transport operation in the play mode is normal.) Then press and release the record pushbutton. If the relay actuates and holds in the energized position, check contact closure. If contacts are dirty, clean them with bond paper or a contact burnishing tool.

(b) If the relay does not actuate and hold in (a), remove the relay from its receptacle. Check the dc resistance of the coil across relay terminals 13 and 13; it should be approximately 650 ohms. If the coil is open or shorted, the relay must be replaced. (Refer to Service Hints, paragraph 4E.2, relative to maintaining record/reproduce operation on an emergency basis if a replacement relay is not available.)

(c) If the relay coil checks correctly in (b), remove the power interconnecting cable at J11 on the electronic assembly. Place the equipment in the play mode, and use a dc voltmeter to check across pins 10 (positive) and 5 on the cable plug; the 24 volt dc holding voltage should be present across those pins. Connect the dc voltmeter across pins 4 (positive) and 8 on the cable plug; with the equipment in the play mode, press and hold the record pushbutton. The 24 volt energizing power should be available across those pins. These voltages are supplied from the 24 volt dc power supply in the tape transport control circuit, if either is not present, check wiring continuity back to that supply (through the electronic power supply box).

(d) If both the holding and energizing voltages are present in (c), remove the relay from its receptacle and leave the plug to J11 disconnected. Use an ohmmeter to check the diode across pin 4 of J11 to pin 14 of the relay receptacle. Check the other diode across pins 14 and 13 of the relay receptacle. Check resistor 4R77 across

pins 14 and 12 of the relay receptacle. Check opening and closure of the record selector switch, connecting the ohmmeter from pin 8 of J11 to pin 13 of the relay receptacle and switching the record selector from the safe (open) to the ready (closed) positions.

(e) If voltage is present in (c) and no faulty component is found in (d) the relay is probably defective despite its coil testing correctly. Replace the relay.

#### 4F.5 CHECKING POWER SUPPLY

Adjusting the voltage regulator in the electronic power supply is described in part C of this section, paragraph 4C.3.5. Note that in this discussion it is assumed that the tape transport operates normally.

(a) The power supply provides 39 volts dc, regulated to  $-1/2+1$  volt. This voltage should be available at three pins of any of the power to electronics receptacles (J701 through J704) on the power supply box. Place the equipment in the reproduce mode. Check with a dc voltmeter between pins 9 (positive) and 5 of the receptacle (if this is four channel equipment remove one of the electronic cables for this test). Select high speed, with the equipment still in the reproduce mode, check with the dc voltmeter across pins 7 (positive) and 5 (this is the high speed equalization switching voltage). Select low speed and check across pins 6 (positive) and 5 (this is low speed equalization switching voltage). The regulated dc voltage should be present at all three points as checked. Note that if it is present across pins 9 and 5, and not present at either one or both of the other points, the trouble is probably in the speed switch on the tape transport, or in the cabling or internal wiring.

(b) If no voltage is present, first check fuse F701 on the power supply box. If that fuse is alright, open the power supply box and use the extender card to hold the printed circuit board in position outside of the box. If voltage is present but is excessively high, proceed to (f).

### WARNING

Dangerous voltage exists across the fuse post and across the transformer

leads. Use special care when making the following checks which require application of power.

(c) With all electronic assemblies connected, place all channels in the record mode. Use the dc voltmeter to check across CR706, CR705, and R707 (as the board is positioned in the extender, the positive lead of the voltmeter is to be placed at the end of CR706 which is nearest the extender, the negative lead to the end of R707 farthest from the extender). Voltage present at this point is dependent on load, and component tolerances, and can only be given in approximate terms. For one channel of electronics it should be approximately 72 volts, for two channels approximately 66 volts, for three channels approximately 60 volts, and for four channels approximately 54 volts.

(d) If voltage is not present, or is excessively low, in (c) remove power from the equipment and use an ohmmeter to check CR706, CR705, and R707 on the printed circuit board. If those components check correctly, remove the power supply box from the transport (refer to part E of this section, paragraph 4E.3). On the side which was next to the transport, capacitor C707, resistor R706, and the diodes (CR701 through CR704) which make up the full wave bridge rectifier are available. Check each of those components. If they are alright, remove the heat sink panel on which the power transistor (Q705) is mounted. Apply power (connect the box to the transport) and use an ac vtm to check primary (white/black leads) and secondary (red/red leads) voltages to check the power transformer (T702). See warning after (b).

(e) If the voltage seems correct in (c) check transistors Q706 (shorted), Q704 (open), and Q703 (open). Then check all other components associated with those stages (all are mounted on the printed circuit board). Check capacitor C706 (shorted) on the printed circuit board. Finally check power transistor Q705 (open) which is mounted on the heat sink.

(f) If voltage is present in (a) but is excessively high, try adjusting the regulator to bring it within tolerance (refer to paragraph 4C.3.5). If adjustment cannot be made, remove the printed circuit board from the power supply box. Check transistors Q706 (open), Q704 (shorted), and Q703 (shorted). Check all components associated

with those stages. Finally check power transistor Q705 (shorted), which is mounted on the heat sink on the side of the box next to the transport.

#### 4F.6 CHECKING BIAS

This check is applicable to record/reproduce equipment only.

If trouble is experienced in the bias or erase circuit, the malfunction could be in either the master bias oscillator (on the same printed circuit board as the power supply), or the bias amplifier module. On multi-channel equipment if the trouble is present on all channels, it can be assumed that the master bias oscillator is at fault; if the trouble is on only one channel, it is probable that the bias amplifier for that channel is at fault.

Trouble can also be easily isolated to one circuit or the other by inserting the bias amplifier extender card in the amplifier receptacle, plugging the bias amplifier module into the extender, and measuring the bias input with an ac vtm across resistors 3R90 and 3R91. Correct bias voltage at those points is shown on the schematic diagram, Fig. 6-24. If this input voltage is correct, the trouble is probably in the bias amplifier module; if it is incorrect, the master bias oscillator is probably at fault.

Bias and dc voltages under correct operating conditions are shown on the schematic diagram, Fig. 6-24, at key points on the bias amplifier module. Placing the equipment in the record mode and checking these voltages should quickly isolate any trouble to a particular stage and component. Note that dc voltage is applied to the bias amplifier only in the record mode. There should be no difficulty in checking the very simple push-pull master bias oscillator. Use an extender card to position the power supply and oscillator printed circuit board so that all components are available.

### WARNING

Dangerous voltages exist across the fuse post and at the transformer leads inside the power supply box. Use special care when checking the master bias oscillator with power applied.

#### 4F.7 CHECKING RECORD/REPRODUCE

##### 4F.7.1 General

On record/reproduce equipment, if a tape does not play back correctly on the same machine on which it was recorded, the fault can be in either the record circuit or the reproduce circuit. This can be quickly checked by playing back a tape known to be properly recorded. If that tape reproduces normally, the trouble is in the record circuit; if it does not, the trouble is in the reproduce circuit.

Whenever any trouble is experienced, check power indications (refer to paragraph 4F.3). Also check the high speed and low speed equalization switching voltages from the power supply (refer to paragraph 4F.5).

The schematic diagram is on Fig. 6-24.

##### 4F.7.2 Checking Record

If the trouble is indicated to be in the record circuit, check that the signal input is properly connected and that the dummy plug (or accessory) is plugged into the input accessory socket on the back panel of the electronic assembly. Check the bias by placing the equipment in the record mode and turning the output selector to the bias position; if the bias is not normal refer to paragraph 4F.6. Check the actuation and contacts of the record relay (refer to paragraph 4F.4). Check that the record head is properly connected.

Signal voltages and dc voltages are given on the schematic diagram, Fig. 6-24. Using the extender card and checking these voltages should quickly isolate the fault to a specific stage and component.

Following are some servicing hints which might be helpful.

(a) With the equipment in the record mode and the output selector in the input position, check if the vu meter indication is normal with a signal input. If not, the trouble is indicated to be in stage 2Q9 or in the plug-in equalizer board; if the vu meter indication is normal, the trouble is in stages 2Q10 through 2Q15.

(b) Transistor 2Q10 conducts only when the low tape speed is selected; 2Q11 conducts only when the high tape speed is selected.

(c) DC voltage is applied to stages 2Q9 through 2Q11 whenever power is on. It is applied to stages 2Q12 through 2Q15 only when the equipment is operating in the record mode.



Signal voltages and dc voltages are shown on the schematic diagram, Fig. 6-24. Use the extender card and check these voltages. This should quickly isolate the fault to a specific stage and component.

Note that if the output selector is put in the input position, and the vu meter indication seems normal when a signal is applied to the record line input, the fault is indicated to be in stages 1Q1 through 1Q4. If the indication is not normal the fault is indicated to be in stages 1Q5 through 1Q8.

#### 4F.7.3 Checking Reproduce

If trouble is indicated in the reproduce circuit, check that the reproduce head and the output line are connected. Check with head sets at the phones jack on the front of the assembly; if the signal is normal at that point the fault is probably in the output transformer or output line.

### 4F.8 CHECKING REPRODUCE-ONLY

Check signal and dc voltages as shown on the schematic diagram, Fig. 6-25. Note that the same reproduce extender card is used as that for the reproduce circuit in record/reproduce equipment.

### 4F.9 REPLACEMENT OF PARTS

#### 4F.9.1 Indicator Lamps

##### 4F.9.1.1 Ready/Record Lamps

The ready and the record indicator lamps are held in position by a spring clip. Remove the top cover from the electronic assembly. Pull off the wired sockets from the lamps. Then, using long nose pliers, press the two extrusions on the clip together and remove the clip--being careful not to let it slip from the pliers. The lamp is now free and can be removed through the front of the assembly. When installing the new lamp, press the clip against the panel, so that the lamp is held firmly in position.

##### 4F.9.1.2 VU Meter Lamps

To remove the vu meter lamps, remove the bottom cover of the electronic assembly. Pull off the wired sockets from the lamps then simply pull the lamps out of the meter housing. Replace the lamps in the reverse order of removal.

#### 4F.9.2 Components on Printed Circuit Boards

Removing components from printed circuit boards requires proper tools and correct procedures. Required tools are a low-wattage (50 watts or less) pencil-type soldering iron, noncorrosive soldering flux (rosin alcohol base), and a length of small diameter shielding braid. (If a plunger type solder remover is available, use it instead of the soldering flux and shielding braid).

To remove a component from a board, dip the length of shielding braid in the soldering flux. Heat the solder junction with the soldering pencil (do not use a soldering gun or high wattage iron), and dip the braid into the molten solder. The solder will be drawn up into the braid. When solder has been removed in this fashion from all component leads, the part can be removed without exerting excessive force. Be sure not to overheat any of the soldering junctions during this procedure.

To install the replacement part, bend its leads to fit through the mounting holes. Bend the leads down against the foil path, and use the soldering pencil, and low melting point rosin core solder to solder the junctions. Avoid overheating the junction. Remove any excess rosin from the joint by cleaning it with alcohol.

If a diode or transistor is replaced, allow the board to cool for approximately five minutes before reinserting it in the housing and applying power. This is to prevent thermal runaway which might result from the soldering operation if power is applied immediately after replacing a semiconductor device.

#### 4F.9.3 Other Components

All other components are accessible if either the top or bottom cover is removed. On the schematic diagram of Fig. 6-24, component location is indicated by the number preceding the identification letter. A table on the diagrams shows the prefixes used and the indicated locations. Assembly drawings, Fig. 6-26 through 6-29, are also provided to help in locating parts.

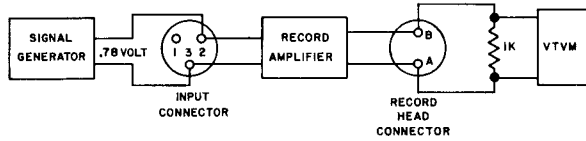
### 4F.10 ACHIEVING RESPONSE CURVES

Response curves for record and reproduce are provided on Figs. 6-32 and 6-33. To achieve these curves, disconnect the head cables, input cable, and output cable from their receptacles at the back of the electronic assembly. Connect the signal generator and the vtm as shown in

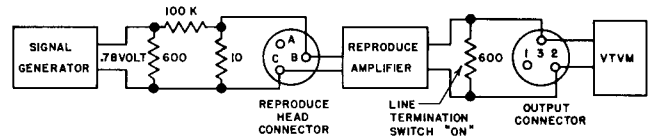
Fig. 4F-1 (record) and Fig. 4F-2 (reproduce), using the resistor networks shown. Set the generator to provide a 0.78 volt (0 dbm) output. To check the record amplifier curve, remove the bias amplifier plug-in circuit board. Hold the takeup tension arm from its rest position, so that it does not contact the safety switch, and place the equipment in the

record mode. Simply apply power to check the reproduce amplifier curve.

Run the generator in discrete steps over the frequency range specified for the tape speed involved, and adjust the equalization controls to place the amplifiers on curve.



*Fig. 4F-1. Connections, Record Response Curves*



*Fig. 4F-2. Connections, Reproduce Response Curves*

## THEORY OF OPERATION

### 5.1 TAPE TRANSPORT

#### 5.1.1 General

Tape motion in all modes of operation is controlled by the tape transport mechanism. The transport consists basically of a tape supply system, a tape drive system, a tape takeup system, and a control system. These systems act to provide smooth and positive tape motion across the magnetic heads, and to maintain correct tape tension.

A schematic diagram of the tape transport is provided on Fig. 6-20, and a simplified version of this schematic on Fig. 6-21. Components at the front and back of the transport are shown on Figs. 5-1 and 5-2.

A power distribution and fusing diagram is on Fig. 6-19.

#### 5.1.2 Tape Supply and Takeup Systems

Torque motors provide power for the supply and takeup assemblies. These motors are connected so that if power is applied to them when no tape is threaded the turntables will rotate in opposite directions--the supply turntable clockwise and the takeup turntable counterclockwise.

In the play or record modes of operation, the capstan is the sole determinant of tape speed. It pulls tape from the supply reel, whose opposing torque acts to maintain tape tension, and

delivers it to the takeup reel, which reels in the tape under proper tension. The torque of the motors, and thus the tape tension, is adjustable at resistors R604 (supply) and R605 (takeup).

During fast forward or rewind operation, the capstan is removed as the tape speed determining element. The torque of one motor is reduced by placing a resistor (R607) in series with it, while the other motor operates with full torque. The turntable under full power then simply pulls the tape from the other turntable, whose opposing torque provides tape tension. The torque at the trailing turntable (from which tape is being pulled), and thus the tape tension, is adjusted at resistor R607.

Additional resistors are switched into the circuit to lower tape tension when reels with small hubs are used. These resistors (R608, supply, and R606, takeup) are shorted by the reel switches for large hub operation. Both are adjustable.

Solenoid-controlled brakes are mounted on each torque motor. In this equipment there are two braking systems. The main brake system is energized (brakes released) whenever tape is placed in motion in any mode. The edit brake system is energized only in the stop-edit mode, when it acts to reduce braking force at each turntable.

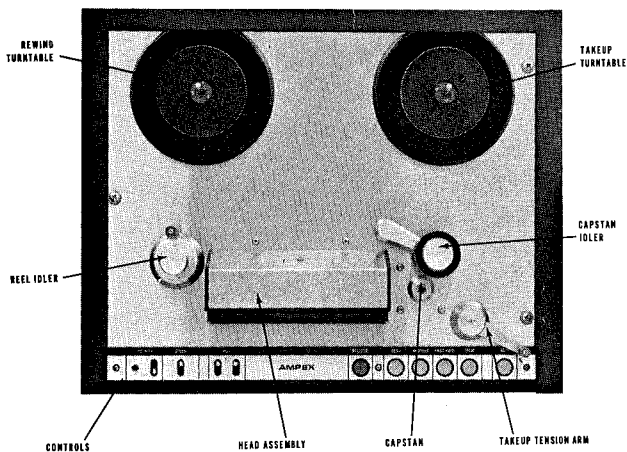


Fig. 5-1. Tape Transport, Front

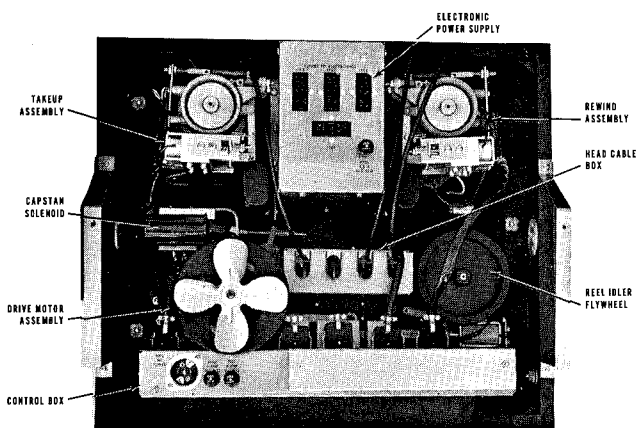


Fig. 5-2. Tape Transport, Rear

There are thus two brake solenoids on each torque motor. When the main brake solenoid is energized, brakes are fully released; when it is de-energized (disregarding action of the edit solenoid) brakes are fully applied. The action of the edit brake solenoid is limited by its mechanical coupling so that when it is energized the brake band still contacts the drum but full braking force is not applied.

A braking differential is required on the main brakes to prevent the formation of tape loops when tape motion is being stopped. The braking force in one direction of rotation (supply counterclockwise, takeup clockwise) is thus adjusted to approximately three times the force in the other direction.

#### 5.1.3 Tape Drive System

A hysteresis-synchronous drive motor is used. One end of the motor shaft is precisely

machined and hard chrome plated to act as the capstan. Mounted on the other end of the shaft is a flywheel and fan. A solenoid-controlled capstan idler is employed to clamp the tape to the capstan, thus providing a surface against which the tape can be driven.

The drive motor has two sets of windings to provide two rotational speeds and thus two tape speeds. The speed toggle switch is used to select the winding which will result in the desired speed; this switch also controls the solid-state equalization switching in the electronic assembly. The drive motor operates continuously whenever power is applied to the equipment and tape is properly threaded.

When the equipment is placed in the play (or record) mode, the capstan idler solenoid (K610) is energized, moving the capstan idler so that it clamps the tape in firm, positive contact with the rotating capstan. The main brake solenoids (K605 and K607) are energized, releasing the brakes. The capstan then drives the tape at the selected speed across the head assembly.

#### 5.1.4 Reel Idler

A reel idler assembly, located on the left side of the transport below the supply turntable, is utilized to minimize any transient effects in tape motion which might be imparted by the supply assembly. The reel idler arm absorbs most of the momentary strain applied to the tape when tape motion is started, thus preventing stretching or breaking the tape or the formation of a tape loop on the supply side of the heads. The idler pulley, which has a heavy flywheel, acts to smooth out transients in tape speed caused by torque motor cogging and irregularities caused by an uneven tape wrap on the supply reel.

The tape guide on the idler arm will accommodate either 1/4-inch or 1/2-inch wide tape. The guide is simply lifted and rotated to present the correct face (1/4-inch or 1/2-inch) to the tape.

#### 5.1.5 Takeup Tension Arm

A takeup tension arm is mounted on the takeup side of the transport. This arm has two functions. First, it supplies a small tape storage loop which prevents breaking or stretching the tape during start and stop operations. Second, it actuates the safety switch (S603) and thus stops operation if a large tape loop forms or if tape should break. The second feature also results in auto-

matic stopping when tape is allowed to run completely off either reel. The tape guide is similar to that on the reel idler (refer to paragraph 5.1.4). In addition, a tape hook is provided to prevent tape from falling off the guide if the tape becomes slack or during tape threading.

#### 5.1.6 Tape Lifter Assembly

A solenoid-operated tape lifter assembly raises the tape from contact with the heads during fast forward or rewind operation. When either of these modes are started, tape lifter solenoid K609 is energized thus actuating the tape lifter mechanism. Pressing the edit pushbutton at the tape transport (or at the optional remote control unit) defeats the tape lifter action for the length of time that the pushbutton is held down. Manual override of the tape lifter may be accomplished by opening the head gate and pushing the right hand tape lifter arm back to its retracted position.

#### 5.1.7 Control Circuit

##### 5.1.7.1 Play Mode

When tape is properly threaded and power is applied, the capstan will be rotating at the speed selected at the speed switch. Pressing the PLAY pushbutton then results in the following circuit action.

Play relay K602, in the 24 volt dc circuit, is energized. Contact set 1-9-5 of that relay forms a holding circuit across the play pushbutton. Contact set 2-10-6 applies ac power, through the tension adjusting resistors, to the takeup and rewind (supply) motors. Contact set 3-11-7 completes the 115 volt dc circuit to the capstan idler solenoid, energizing that solenoid. Contact set 4-12-8 completes the 115 volt dc circuit to the supply and takeup main brake solenoids, energizing those solenoids. Thus the brakes are released, the turntable motors are operating, and the tape (pressed against the rotating capstan) is driven at the selected speed.

##### 5.1.7.2 Fast Forward Mode.

Note that the negative return for fast forward, rewind, and edit relays is through transistor Q601, which must be able to conduct for those modes to be actuated (refer to record mode, paragraph 5.1.7.5).

With power applied and tape properly threaded, pressing the FAST FWD pushbutton energizes fast forward relay K604. Contact set 1-9-5

of that relay breaks the 24 volt dc circuit to the play circuit, and makes a holding circuit across the fast forward switch. Contact set 2-10-6 connects full ac power to the takeup motor (reel switch in large hub position) and reduced power through resistor R607 to the rewind motor. Contact set 3-11-7 breaks the 24 vdc circuit to the rewind relay, and makes the 24 vdc circuit to the tape lifter solenoid K609, through edit switch S611. Contact set 4-12-8 connects the 115 vdc to the main brake solenoids K605 and K607, which are energized. The takeup motor therefore operates at full torque, the rewind motor under reduced torque; tape is lifted from contact with the heads, and the brakes are released. Tape is thus pulled from the rewind to the takeup reel.

Note that the negative return for the tape lifter solenoid is through normally closed contacts of the edit switch. If the EDIT pushbutton is pressed, the circuit is opened and the tape lifter action defeated (for as long as the pushbutton is held down).

##### 5.1.7.3 Rewind Mode

The negative return for the rewind, fast forward, and edit relays is through transistor Q601, which must be able to conduct for those modes to be actuated (refer to record mode, paragraph 5.1.7.5).

When power is applied and tape properly threaded, pushing the REWIND pushbutton energizes rewind relay K601. Contact set 1-9-5 forms a holding circuit across the rewind switch. Contact set 2-10-6 connects full ac power to the rewind motor (reel switch in large hub position), and reduced ac power through resistor R607 to the takeup motor. Contact set 3-11-7 breaks the 24 vdc circuit to the play and fast forward circuit and connects 24 vdc to tape lifter solenoid K609. Contact set 4-12-8 connects 115 vdc to the main brake solenoids K605 and K607, which are energized. The rewind motor thus operates at full torque, the takeup motor operates at reduced torque, brakes are released, and tape is lifted from contact with the heads. Tape will be pulled from the takeup reel to the supply reel.

Tape lifter action can be defeated by pressing the EDIT pushbutton, the same as in the fast forward mode.

##### 5.1.7.4 Edit Modes

The negative return for the edit, rewind, and fast forward relays is through transis-

tor Q601, which must be able to conduct for those modes to be actuated (refer to record mode, paragraph 5.1.7.5).

When the edit relay is energized in either the stop/edit or the play/edit mode, contact set 1-9-5 forms a holding circuit across the edit switch. Contact set 2-10-6 breaks the 115 vdc circuit to the takeup main brake solenoid and makes the 115 vdc circuit to the takeup and supply edit brake solenoids. Contact set 3-11-7 breaks the 24 vdc circuit to the record switch, locking out the record mode. Contact set 4-12-8 breaks the ac circuit to the takeup motor and makes a shorting circuit across the safety switch, which is then ineffective.

In the stop/edit mode, therefore, the safety switch is shorted and the low braking force supplied by the edit brake solenoids makes it easy to turn the reels manually. In the play/edit mode, the safety switch is shorted, the record mode is locked out, ac power is removed from the takeup motor, the supply brake is fully released (by the supply main brake solenoid), and the takeup turntable is held by the action of the takeup brake solenoid; the takeup turntable will not rotate, and tape will be spilled off the right side of the transport.

The edit relay is not energized in the fast-winding/edit mode. This mode is simply the defeat of the tape lifting mechanism by pressing and holding the edit pushbutton during fast forward or rewind operation. This opens the negative return lead to the tape lifter solenoid, which will be de-energized as long as the pushbutton is held down. Tape will then contact the heads, and monitoring is possible.

#### 5.1.7.5 Record Mode

Strictly speaking, the record mode is not a tape motion control function. The tape is first placed in motion in the play mode, and the record pushbutton is then pressed to place the electronic assemblies in the record mode by energizing the record relays in those assemblies.

The record mode, however, does have effect on other tape transport control circuits. As shown on Fig. 6-21, when the record relay in any electronic assembly is energized, contact set 4-12-8 of that relay makes a return connection to the transport. As previously described, transistor Q601 must be able to conduct to allow the fast forward, rewind, or edit modes to be entered.

Normally, Q601 will conduct whenever any of those modes are initiated. However, if the equipment is operating in the record mode, the connection from the record relay places a bias on transistor Q602 which allows it to conduct. When Q602 is conducting, Q601 is biased to cutoff. Therefore the edit, rewind, and fast forward modes are locked out when the equipment is recording.

#### 5.1.8 Tape Scrape Flutter

Tape scrape flutter can be likened to the effect of drawing a bow across a violin string. The string will vibrate at a resonant frequency. One of the major factors in determining that resonant frequency is the unsupported length of the string.

On a tape transport, the magnetic head acts as the bow and the tape as the violin string. Of course, instead of drawing the bow across the string, the tape is drawn across the head. As it moves across the head the tape will vibrate at its resonant frequency. For a given tape and tension, that frequency will depend upon the unsupported length of tape between the reel idler and the capstan. This frequency is usually in the range to which the human ear is most sensitive, from 1,000 to 6,000 Hz. For example, the scrape flutter frequency on this transport if no tape scrape flutter idler were used would be in the neighborhood of 3,500 Hz.

When a rotating idler (such as the tape scrape flutter idler supplied as standard equipment) is installed in the tape path approximately midway between the reel idler and capstan, the length of unsupported tape is halved. This results in practically doubling the scrape flutter frequency (in the example quoted, that frequency would now be approximately 7,000 Hz). Not only is the flutter frequency moved out of the range of greatest ear sensitivity, but the higher frequency automatically entails a drop in level. The effect of tape scrape flutter is reduced to approximately 25% of its former value.

If the second tape scrape flutter idler (optional accessory) is installed on the transport, the flutter frequency is again raised--to approximately 10,000 Hz. An additional drop in level is also realized, and for all practical purposes tape scrape flutter can be ignored.

## 5.2 ELECTRONICS

### 5.2.1 Power Supply

Components for the regulated power

supply in record/reproduce equipment are mounted on the same printed circuit board as those for the bias oscillator (see Fig. 6-22). For reproduce-only equipment the bias oscillator is omitted (see Fig. 6-23). In either case, the printed circuit board plugs into the electronics power supply box mounted at the back of the tape transport. Note that the series regulating transistor (Q705) is mounted on the power supply box chassis.

A-C power is delivered to the power supply from the tape transport. It is fused by fuse F701, rectified by the bridge rectifier formed by diodes CR701 through CR704, and filtered by resistor R706 and capacitor C707. It then is connected to the voltage regulator.

In the regulator, a reference voltage is established by Zener diode VR702. A sampling voltage is taken at variable resistor R712, which is in a voltage divider circuit with resistors R711 and R712 across the output line. Voltage adjustment is made at R712. If the output voltage tends to vary with load, it will affect the conductance of transistor Q706. This will, in turn, change the conductance of transistors Q704 and Q705, which are connected in a Darlington circuit, and the voltage will be maintained at normal level.

Transistor Q703 acts as a constant current source for Q704 and Q706. Overload protection is also provided with this transistor, in conjunction with diode CR707 and resistor R709. If a serious overload occurs, the increased voltage across R709 will also appear across resistor R708, through diode CR707. This will bias transistor Q703 to cutoff. Deprived of their current source, Q704 and Q706 will also be cutoff, removing the bias on Q705. The power supply will thus automatically shut off until the overload is removed.

The regulator is adjusted to provide a +39 vdc (-1/2+1 vdc) to the electronic assemblies. It is also connected back to the speed selector on the tape transport. That selector switches the +39 vdc to one of two lines, which are then returned, through the power supply box, to the solid state equalization switching circuits in the electronics.

A power distribution and fusing diagram is provided on Fig. 6-19.

### 5.2.2 Bias Oscillator and Amplifier Circuits

These circuits are not provided with reproduce-only equipment.

The master bias oscillator is mounted on the same card as the electronic power supply

for record/reproduce equipment (see Fig. 6-22). This is simply a capacitively-coupled push-pull oscillator, operating at a nominal frequency of 150,000 Hz. Operating power of +39 vdc is taken directly from the power supply, so the oscillator operates continuously whenever power is applied to the equipment. Its transformer-coupled output is delivered to the bias amplifiers in each electronic assembly.

Two push-pull bias amplifier stages are mounted on a plug-in printed circuit board for each electronic assembly. Operating power is delivered to these stages through contact set 3-7-11 of record relay K1, when that relay is energized. The circuits, therefore, operate only when the equipment is placed in the record mode.

The push-pull bias input from the oscillator, is connected at pins 1 (shield), 2, and 3 of receptacle 4J11 (see Fig. 6-24). It is connected to the amplifier printed circuit board, and routed to the bases of transistor 3Q18 and 3Q19. Both this circuit and the following (3Q16 and 3Q17) provide normal, push-pull amplification of the bias frequency. They do, however, operate at clipping level to eliminate the need for a bias symmetry adjustment (an unsymmetrical bias waveform causes magnetization of the record heads and high second harmonic distortion). A fully acceptable sine wave is achieved at the output when transformer 3T3 is resonated with the record head, by adjusting the bias adjust control (3C40) to peak the current output to the erase head. The output is also taken through bias adjust resistor 3R80, routed through the bias trap of capacitor 5C35 and inductor 5L2, and then mixed with the record signal before being delivered to the record head. A third output is through bias calibrate resistor 3R44, the output selector switch, and thence to the vu meter; note that a contact set on the output selector switch shorts bias calibrate resistor 3R44 except when that switch is placed in the bias position. This is done to remove the rf from the line and thus reduce the amount of rf being induced into other circuits during the record or reproduce modes.

### 5.2.3 Record Amplifier Circuit

A schematic diagram of the record amplifier circuit is included on Fig. 6-24. No record amplifier is provided with reproduce-only equipment.

The signal to be recorded is connected to input connector 4J7, and then is routed through the input accessory or dummy plug in re-

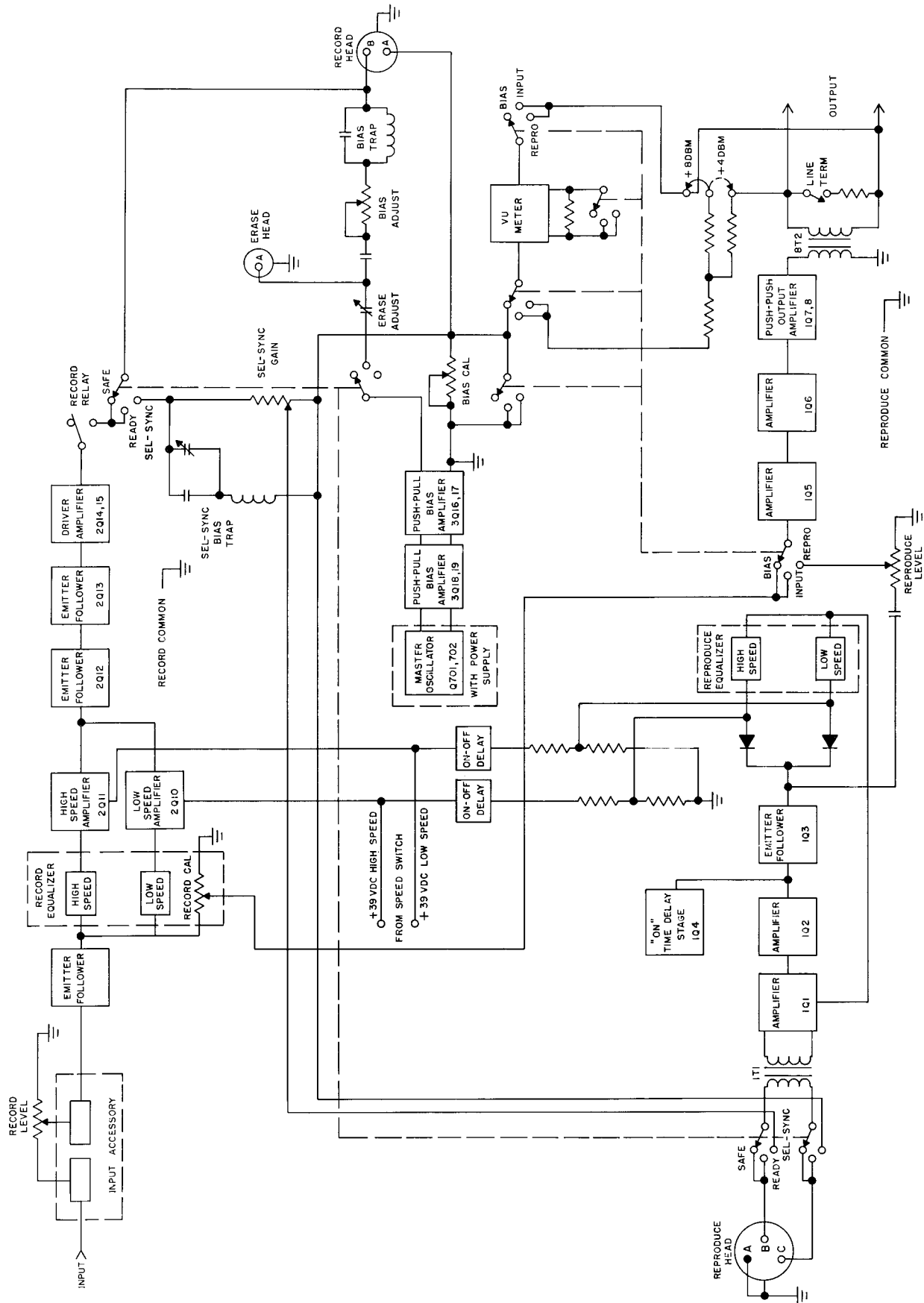


Fig. 5-3. Block Diagram



ceptacle 4J8. Note that 4J8 is wired so that when the optional microphone preamplifier is employed, the record level control is connected between the two stages in the preamplifier. This effectively makes the preamplifier a variable gain device which will accommodate a wide variety of professional-type microphones.

From the input accessory socket, the signal enters the plug-in printed wiring board circuit, first encountering emitter-follower stage 2Q9. From there it proceeds to the plug-in record equalizer circuit. Note that the record calibrate control, 11R108, is on the equalizer board but is connected before equalization is applied. From that control the signal is wired, through contacts of the output selector switch, to stage 1Q5 in the reproduce amplifier circuit. It proceeds through the reproduce circuit to the output line and the vu meter so that record monitoring is possible and record level can be measured (refer to paragraph 5.2.4).

Both the high speed and low speed equalizers receive the signal from stage 2Q9. Equalization consists of placing a variable capacitor (11C53 for low speed, 11C54 for high speed) in parallel with a fixed resistor (2R51 for low speed, 2R52 for high speed). The capacitor is then adjusted to provide the correct high frequency response.

From the equalizer, the signal is routed through one of the two equalizer amplifiers, 2Q10 or 2Q11. Note that if the low speed is selected at the tape transport, +39 vdc is applied to pin 6 of receptacle 4J11. This voltage is applied, through resistor 2R64, to the emitter circuit of 2Q11, biasing that transistor to cutoff. In the low speed, therefore, transistor 2Q10 passes and amplifies the signal. When high speed is selected, the +39 vdc is applied to pin 7 of 4J11. The voltage is connected to cutoff transistor 2Q10, and stage 2Q11 thus acts as the high speed equalization amplifier. In both 2Q10 and 2Q11 a low frequency boost is realized, by inserting 2R54 and 2C25 (2Q10) and 2R59 and 2C27 (2Q11) in the base circuits.

Time constant circuits in both stages provide a delay in the record on-off function, to minimize popping when the equipment enters or leaves the record mode. The low speed circuit, in the emitter circuit of 2Q10, consists of 2C26 and 2R57 ("on" time delay) and 2C26 and 2R55 ("off" time delay). For high speed the circuit consists of 2C29 and 2R64 ("on" time delay) and 2C29 and 2R60 ("off" time delay). In both cases

the time delay in entering record is longer than it is in leaving record.

From the equalizer amplifier the signal is routed through two emitter-follower stages, 2Q12 and 2Q13, to the output driver stage formed by 2Q14 and 2Q15. The output driver stage is a high impedance, constant current, amplifier. Transistor 2Q15 acts as an active load resistance for the collector of 2Q14, thus providing a relatively low d-c resistance and a relatively high a-c resistance. In the audio frequency range, therefore, transistor 2Q14 works into an impedance which is sufficiently high to provide the constant current source for the record head, yet allows full utilization of the d-c operating voltage available.

The signal leaves the printed circuit board at connectors 7 and 8, and proceeds through contact set 1-5-9 of the record relay. It is mixed with the bias frequency following the bias trap (5C35 and 5L2), and proceeds through the record selector switch, in the ready position, to the record head.

Record relay 4K1 is energized by pushing the RECORD pushbutton on the tape transport after the equipment has been started in the play mode. It is held energized (refer to Fig. 6-21) by contacts of the play relay, in the tape transport circuit, through resistor R601. Energizing voltage is connected at pin 4, and the holding voltage at pin 10, of receptacle 4J11. Contact set 1-5-9, when energized, removes ground from the record amplifier output, and routes that output to the record head. Contact set 3-7-11 connects the +39 vdc operating voltage to transistors 2Q12, 2Q13, 2Q14, and 2Q15, which can then conduct (they cannot operate until the equipment is placed in the record mode).

Contact set 4-8-12 acts in conjunction with transistors in the tape transport control circuit (refer to paragraph 5.1.7.5) to lock out the edit, rewind, and fast forward modes whenever the equipment is recording.

Diode 4CR6 in the record relay circuit, isolates the record mode to electronic assemblies which were in the ready condition when the record pushbutton was pressed. For example, if one electronic assembly was in the safe condition when the record mode was started, it will not go into record if its record selector were inadvertently turned from the safe or Sel-Sync to the ready position.

#### 5.2.4 Reproduce Amplifier Circuit

No vu meter is supplied with reproduce-only equipment, otherwise the reproduce circuit for record/reproduce and reproduce-only is essentially the same. Refer to schematic diagrams 6-24 (record/reproduce) and 6-25 (reproduce-only). A monitor jack for reproduce-only equipment is mounted on the back panel of the module.

From the reproduce head, the signal reproduced from the tape is routed through contacts of the record selector switch, then enters the circuitry on the reproduce printed circuit board. It first passes through transformer 1T1. In some special applications it may be necessary to alter the head output at high frequencies, so blank terminals are provided across the secondary winding of the transformer.

After the input transformer, the signal is connected to the base of amplifier stage 1Q1; base bias on this transistor is derived from the current through resistor 1R4, which is filtered by capacitor 1C1. Following 1Q1 is another amplifier stage, 1Q2. D-C feedback is applied through 1R3, bypassed by 1C4 and 1C2, from the collector of Q2 to the collector of Q1. Collector voltage for both 1Q1 and 1Q2 is delivered through transistor 1Q4; those stages cannot operate until 1Q4 conducts. A time constant circuit (1C8 and 1R38) delays conduction of Q4, so that application of power to the equipment does not result in pinning the vu meter indicator, or causing pops at the output.

The signal path from 1Q2 proceeds through emitter follower stage 1Q3. Reproduce equalization is connected from the emitter of that stage back to the emitter of Q1. Either high speed or low speed equalization is selected by turning on diode 1CR2 (low speed) or 1CR1 (high speed) and thus allowing them to pass the signal. At low speed, +39 vdc is delivered to pin 6 of receptacle 4J11. At high speed, the +39 vdc is delivered to pin 7 of that receptacle. A time constant circuit is inserted in both +39 vdc lines, again to protect the vu meter and prevent pops when the speed is switched. Note that when a speed is first selected, the "on" time constant is determined by both a 100 mfd and a 35 mfd capacitor (all contained in capacitor 9C9). When that speed is turned off (other speed selected) the 100 mfd capacitor is not in the circuit, and the delay is determined only by the 35 mfd capacitor. Thus the "on" time when a speed is selected is greater than the "off" time

for that speed.

If low speed is selected, the positive voltage from the time delay circuit is connected through 1R15 to diode 1CR2, biasing that diode so that it will conduct and pass the signal from the emitter of 1Q3 to the low frequency equalizer. If high speed is selected, the positive voltage, connected through 1R14 causes diode 1CR1 to conduct and pass the signal to the high speed equalizer. Thus either the low speed or high speed equalizer is connected from the emitter circuit of 1Q3 back to the emitter of 1Q1.

From the emitter of 1Q3 the equalized signal is routed through capacitor 1C7, the reproduce level control, and contacts of the output selector switch, to the base of amplifier stage 1Q5. (Note that this is the stage where the record monitor is connected, refer to paragraph 5.2.3). Capacitor 1C10 in the base circuit of 1Q5, provides an rf bypass, while 1C12 decouples the dc bias to stage 1Q5. Capacitor 1C14, in the collector circuit, is inserted to permit realization of high levels, without clipping.

After 1Q5, the signal is connected to stage 1Q6, which provides drive for the push-push output stage formed by the complementary pair of transistors 1Q7 and 1Q8. The output is taken at the emitter junction of those two transistors, and leaves the printed circuit board.

The output signal is connected to the phones jack, and through transformer 8T2 to the output connector. Line termination switch 4S3 is connected directly across the output line to terminate the equipment during checks and adjustments.

The secondary of the output transformer is connected to the vu meter through a strapping circuit that allows the equipment to be calibrated for either +8 dbm or +4 dbm normal operating level (see Fig. 5-4). When the equipment is strapped for a +8 dbm output, resistors 8R34 and 8R35 are connected as a voltage divider across the transformer, with 8R36 connected to their junction to feed the vu meter. When the strapping is for +4 dbm, resistors 8R34 and 8R35 are connected in parallel with one side of the line, with series resistor 8R36 feeding the vu meter.

#### 5.2.5 Sel-Sync Circuit

The Sel-Sync circuit is shown between the record and reproduce heads on Fig. 6-24. Note that when the record selector switch is placed in the Sel-Sync position, the reproduce head is dis-

connected from the reproduce amplifier. The record head is disconnected from the record amplifier and connected to the input of the reproduce amplifier. The record head will reproduce the signal

from the tape and deliver it to the reproduce amplifier, where it is amplified for monitoring purposes.

A Sel-Sync gain control (4R43) allows the level to be set for monitoring purposes, and a series bias trap (4C18, 4C38, and 4L1) is tuned to prevent bias leakage from a channel operating in the record mode. Note that other contact sets of the record selector open the leads from the bias amplifier to the record head, and the negative return to the record relay.

In the Sel-Sync mode, then, the record head acts as a reproduce head for monitoring purposes. Another record head in the same stack but operating on a different track can be used to record that track synchronously with the first.

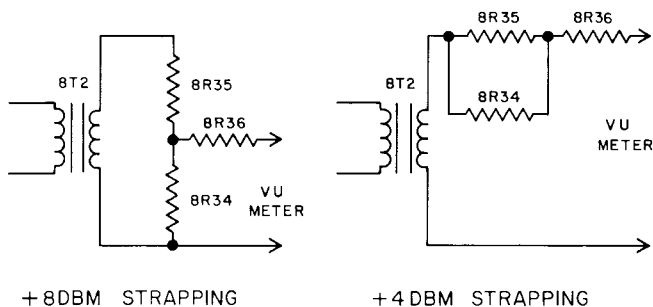


Fig. 5-4. Strapping Circuit, Simplified



Section 6

**PARTS LISTS AND DRAWINGS  
FOREWORD**

This section includes parts lists and drawings required for ordering or identifying parts. Insofar as possible, parts lists are printed on the apron toward the binding edge of the foldout drawings. More than one drawing is necessary for certain assemblies, and the parts list is then printed on the apron of the first drawing. When the parts list requires more than one page, it is printed one side on separate pages, which are inserted directly before the applicable drawing.

All parts lists, with the exception of those for complete systems, are referenced to the applicable drawing or drawings.

When ordering replacement parts, always include the Ampex part number (not the reference designation), and the model and serial number of the equipment. Your Ampex Professional Audio Distributor provides a convenient replacement parts service.

MODEL AG-440  
SINGLE CHANNEL RECORDER/REPRODUCER  
1/4-INCH TAPE, FULL TRACK  
7 1/2 and 15 ips

01	02	03	04	05	06	DESCRIPTION	Ampex Part No.
X						Unmounted, 60 Hz	4010071-01
	X					Unmounted, 50 Hz	4010071-02
		X				Console Mounted, 60 Hz	4010071-03
			X			Console Mounted, 50 Hz	4010071-04
				X		Portable, 60 Hz	4010071-05
					X	Portable, 50 Hz	4010071-06
		1	1			Console, assembly	4020084-01
1	1	1	1	1	1	Electronics, assembly, without equalizers	4020260-01
1	1	1	1	1	1	Equalizer, assembly, 7 1/2 and 15 ips, NAB, Record	4020269-01
1	1	1	1	1	1	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
1		1		1		Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1		1		1	Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
1	1	1	1	1	1	Head, assembly, full track	4020272-01
		2	2			Knob, editing	4030145-10
2	2			2	2	Knob, reel	4040492-10
				1	1	Backing Panel	4040945-01
1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	Cable, assembly, power	4050416-01
1	1	1	1	1	1	Cable, assembly, interconnect	4050442-01
1	1	1	1	1	1	Box, assembly, head cable mounting	4050447-01
2	2			2	2	Knob, reel hold down	4100137-10
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 7-inch, one or two electronics	4150330-01
				1	1	Panel, front facing, blank	4290620-01
1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	Power Supply, assembly	4020274-01
1	1	1	1	1	1	Connector, plug, 3 socket, female	144-003
1	1	1	1	1	1	Connector, plug, 3 pin, male	145-009
1	1	1	1	1	1	Transformer, input, bridging	4580200-01

MODEL AG-440  
SINGLE CHANNEL RECORDER/REPRODUCER  
1/4-INCH TAPE, HALF TRACK  
7 1/2 and 15 ips

07	08	09	10	11	12	DESCRIPTION	Ampex Part No.
X						Unmounted, 60 Hz	4010071-07
	X					Unmounted, 50 Hz	4010071-08
		X				Console Mounted, 60 Hz	4010071-09
			X			Console Mounted, 50 Hz	4010071-10
				X		Portable, 60 Hz	4010071-11
					X	Portable, 50 Hz	4010071-12
		1	1			Console, assembly	4020084-01
1	1	1	1	1	1	Electronics, assembly, without equalizers	4020260-01
1	1	1	1	1	1	Equalizer, assembly, 7 1/2 and 15 ips, NAB, Record	4020269-01
1	1	1	1	1	1	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
1		1		1		Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1		1		1	Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
1	1	1	1	1	1	Head, assembly, two track	4020272-02
		2	2			Knob, editing	4030145-10
2	2			2	2	Knob, reel	4040492-10
				1	1	Backing Panel	4040945-01
1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	Cable, assembly, power	4050416-01
1	1	1	1	1	1	Cable, assembly, interconnect	4050442-01
1	1	1	1	1	1	Box, assembly, head cable mounting	4050447-01
2	2			2	2	Knob, reel hold down	4100137-10
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 7-inch, one or two electronics	4150330-01
				1	1	Panel, front facing, blank	4290620-01
1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	Power Supply, assembly	4020274-01
1	1	1	1	1	1	Connector, plug, 3 socket, female	144-003
1	1	1	1	1	1	Connector, plug, 3 pin, male	145-009
1	1	1	1	1	1	Transformer, input, bridging	4580200-01

MODEL AG-440  
SINGLE CHANNEL RECORDER/REPRODUCER  
1/4-INCH TAPE, FULL TRACK  
3 3/4 and 7 1/2 ips

13	14	15	16	17	18	DESCRIPTION	Ampex Part No.
	X					Unmounted, 60 Hz	4010071-13
		X				Unmounted, 50 Hz	4010071-14
			X			Console Mounted, 60 Hz	4010071-15
				X		Console Mounted, 50 Hz	4010071-16
					X	Portable, 60 Hz	4010071-17
					X	Portable, 50 Hz	4010071-18
		1	1			Console, assembly	4020084-01
	1	1	1	1	1	Electronics, assembly, without equalizers	4020260-01
	1	1	1	1	1	Equalizer, assembly, 3 3/4 and 7 1/2 ips, NAB, Record	4020269-02
	1	1	1	1	1	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
	1	1	1	1	1	Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 60 Hz	4020271-03
	1	1	1	1	1	Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 50 Hz	4020271-04
	1	1	1	1	1	Head, assembly, full track	4020272-01
		2	2			Knob, editing	4030145-10
	2	2		2	2	Knob, reel	4040492-10
				1	1	Backing Panel	4040945-01
	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
	1	1	1	1	1	Cable, assembly, power	4050416-01
	1	1	1	1	1	Cable, assembly, interconnect	4050442-01
	1	1	1	1	1	Box, assembly, head cable mounting	4050447-01
	2	2		2	2	Knob, reel hold down	4100137-10
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 7-inch, one or two electronics	4150330-01
				1	1	Panel, front facing, blank	4290620-01
	1	1	1	1	1	Reel, assembly	4690003-10
	1	1	1	1	1	Instruction Manual	4890172
	1	1	1	1	1	Power Supply, assembly	4020274-01
	1	1	1	1	1	Connector, plug, 3 socket, female	144-003
	1	1	1	1	1	Connector, plug, 3 pin, male	145-009
	1	1	1	1	1	Transformer, input, bridging	4580200-01

MODEL AG-440  
SINGLE CHANNEL RECORDER/REPRODUCER  
1/4-INCH TAPE, HALF TRACK  
3 3/4 and 7 1/2 ips

19	20	21	22	23	24	DESCRIPTION	Ampex Part No.
	X					Unmounted, 60 Hz	4010071-19
		X				Unmounted, 50 Hz	4010071-20
			X			Console Mounted, 60 Hz	4010071-21
				X		Console Mounted, 50 Hz	4010071-22
					X	Portable, 60 Hz	4010071-23
					X	Portable, 50 Hz	4010071-24
		1	1			Console, assembly	4020084-01
	1	1	1	1	1	Electronics, assembly, without equalizers	4020260-01
	1	1	1	1	1	Equalizer, assembly, 3 3/4 and 7 1/2 ips, NAB, Record	4020269-02
	1	1	1	1	1	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
	1	1	1	1	1	Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 60 Hz	4020271-03
	1	1	1	1	1	Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 50 Hz	4020271-04
	1	1	1	1	1	Head, assembly, two track	4020272-02
		2	2			Knob, editing	4030145-10
	2	2		2	2	Knob, reel hold down	4040492-10
				1	1	Backing Panel	4040945-01
	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
	1	1	1	1	1	Cable, assembly, power	4050416-01
	1	1	1	1	1	Cable, assembly, interconnect	4050442-01
	1	1	1	1	1	Box, assembly, head cable mounting	4050447-01
	2	2		2	2	Knob, reel hold down	4100137-10
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 7-inch, one or two electronics	4150330-01
				1	1	Panel, front facing, blank	4290620-01
	1	1	1	1	1	Reel, assembly	4690003-10
	1	1	1	1	1	Instruction Manual	4890172
	1	1	1	1	1	Power Supply, assembly	4020274-01
	1	1	1	1	1	Connector, plug, 3 socket, female	144-003
	1	1	1	1	1	Connector, plug, 3 pins, male	145-009
	1	1	1	1	1	Transformer, input, bridging	4580200-01

MODEL AG-440  
TWO CHANNEL RECORDER/REPRODUCER  
1/4-INCH TAPE, TWO TRACK  
7 1/2 and 15 ips

01	02	03	04	05	06	DESCRIPTION	Ampex Part No.
	X					Unmounted, 60 Hz	4010072-01
		X				Unmounted, 50 Hz	4010072-02
			X			Console Mounted, 60 Hz	4010072-03
				X		Console Mounted, 50 Hz	4010072-04
					X	Portable, 60 Hz	4010072-05
						Portable, 50 Hz	4010072-06
		1	1			Console, assembly	4020084-02
2	2	2	2	2	2	Electronics, assembly, without equalizers	4020260-01
2	2	2	2	2	2	Equalizer, assembly, 7 1/2 and 15 ips, NAB, Record	4020269-01
2	2	2	2	2	2	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
1		1		1		Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1		1		1	Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
1	1	1	1	1	1	Head, assembly, two track	4020272-02
		2	2			Knob, editing	4030145-10
2	2			2	2	Knob, reel	4040492-10
1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	Cable, assembly, power	4050416-01
2	2	2	2	2	2	Cable, assembly, interconnect	4050442-01
1	1	1	1	1	1	Box, assembly, head cable mounting	4050447-02
2	2			2	2	Knob, reel hold down	4100137-10
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 7-inch, one or two electronics	4150330-01
1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	Power Supply, assembly	4020274-01
2	2	2	2	2	2	Connector, plug, 3 socket, female	144-003
2	2	2	2	2	2	Connector, plug, 3 pin, male	145-009
2	2	2	2	2	2	Transformer, input, bridging	4580200-01

MODEL AG-440  
TWO CHANNEL RECORDER/REPRODUCER  
1/4-INCH TAPE, TWO TRACK  
3 3/4 and 7 1/2 ips

07	08	09	10	11	12	DESCRIPTION	Ampex Part No.
	X					Unmounted, 60 Hz	4010072-07
		X				Unmounted, 50 Hz	4010072-08
			X			Console Mounted, 60 Hz	4010072-09
				X		Console Mounted, 50 Hz	4010072-10
					X	Portable, 60 Hz	4010072-11
						Portable, 50 Hz	4010072-12
		1	1			Console, assembly	4020084-02
2	2	2	2	2	2	Electronics, assembly, without equalizers	4020260-01
2	2	2	2	2	2	Equalizer, assembly, 3 3/4 and 7 1/2 ips, NAB, Record	4020269-02
2	2	2	2	2	2	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
1		1		1		Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 60 Hz	4020271-03
	1		1		1	Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 50 Hz	4020271-04
1	1	1	1	1	1	Head, assembly, two track	4020272-02
		2	2			Knob, editing	4030145-10
2	2			2	2	Knob, reel	4040492-10
1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	Cable, assembly, power	4050416-01
2	2	2	2	2	2	Cable, assembly, interconnect	4050442-01
1	1	1	1	1	1	Box, assembly, head cable mounting	4050447-02
2	2			2	2	Knob, reel hold down	4100137-10
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 7-inch, one or two electronics	4150330-01
1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	Power Supply, assembly	4020274-01
2	2	2	2	2	2	Connector, plug, 3 socket, female	144-003
2	2	2	2	2	2	Connector, plug, 3 pin, male	145-009
2	2	2	2	2	2	Transformer, input, bridging	4580200-01

MODEL AG-440  
TWO CHANNEL RECORDER/REPRODUCER  
1/4-INCH TAPE, 4 POSITION HEAD ASSEMBLY  
7 1/2 and 15 ips

13	14	15	16	17	18	DESCRIPTION	Ampex Part No.
X						Unmounted, 60 Hz, 4 Position Head	4010072-13
	X					Unmounted, 50 Hz, 4 Position Head	4010072-14
		X				Console Mounted, 60 Hz, 4 Position Head	4010072-15
			X			Console Mounted, 50 Hz, 4 Position Head	4010072-16
				X		Portable, 60 Hz, 4 Position Head	4010072-17
					X	Portable, 50 Hz, 4 Position Head	4010072-18
		1	1			Console, assembly	4020084-02
2	2	2	2	2	2	Electronics, assembly, without equalizers	4020260-01
2	2	2	2	2	2	Equalizer, assembly, 7 1/2 and 15 ips, NAB, Record	4020269-01
2	2	2	2	2	2	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
1		1		1		Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1	1	1	1	1	Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
1	1	1	1	1	1	Head, assembly, 4 position	4020272-03
		2	2			Knob, editing	4030145-10
2	2			2	2	Knob, reel	4040492-10
1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	Cable, assembly, power	4050416-01
2	2	2	2	2	2	Cable, assembly, interconnect	4050442-01
1	1	1	1	1	1	Box, assembly, head cable mounting	4050447-05
2	2			2	2	Knob, reel hold down	4100137-10
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 7-inch, one or two electronics	4150330-01
1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	Power Supply, assembly	4020274-01
2	2	2	2	2	2	Connector, plug, 3 socket, female	144-003
2	2	2	2	2	2	Connector, plug, 3 pin, male	145-009
2	2	2	2	2	2	Transformer, input, bridging	4580200-01

MODEL AG-440  
TWO CHANNEL RECORDER/REPRODUCER  
1/4-INCH TAPE, 4 POSITION HEAD ASSEMBLY  
3 3/4 and 7 1/2 ips

19	20	21	22	23	24	DESCRIPTION	Ampex Part No.
X						Unmounted, 60 Hz, 4 Position Head	4010072-19
	X					Unmounted, 50 Hz, 4 Position Head	4010072-20
		X				Console Mounted, 60 Hz, 4 Position Head	4010072-21
			X			Console Mounted, 50 Hz, 4 Position Head	4010072-22
				X		Portable, 60 Hz, 4 Position Head	4010072-23
					X	Portable, 50 Hz, 4 Position Head	4010072-24
		1	1			Console, assembly	4020084-02
2	2	2	2	2	2	Electronics, assembly, without equalizers	4020260-02
2	2	2	2	2	2	Equalizer, assembly, 3 3/4 and 7 1/2 ips, NAB, Record	4020269-01
2	2	2	2	2	2	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
1		1		1		Tape Transport, assembly, 3 3/4, and 7 1/2 ips, 60 Hz	4020271-03
	1	1	1	1	1	Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 50 Hz	4020271-04
1	1	1	1	1	1	Head, assembly, 4 position	4020272-03
		2	2			Knob, editing	4030145-10
2	2			2	2	Knob, reel	4040492-10
1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	Cable, assembly, power	4050416-01
2	2	2	2	2	2	Cable, assembly, interconnect	4050442-01
1	1	1	1	1	1	Box, assembly, head cable mounting	4050447-05
2	2			2	2	Knob, reel hold down	4100137-10
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 7-inch, one or two electronics	4150330-01
1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	Power Supply, assembly	4020274-01
2	2	2	2	2	2	Connector, plug, 3 socket, female	144-003
2	2	2	2	2	2	Connector, plug, 3 pin, male	145-009
2	2	2	2	2	2	Transformer, input, bridging	4580200-01



MODEL AG-440  
THREE CHANNEL RECORDER/REPRODUCER  
1/2-INCH TAPE, 3 TRACK  
7 1/2 and 15 ips

01	02	03	04	05	06	DESCRIPTION	Ampex Part No.
X						Unmounted, 60 Hz	4010073-01
	X					Unmounted, 50 Hz	4010073-02
		X				Console Mounted, 60 Hz	4010073-03
			X			Console Mounted, 50 Hz	4010073-04
				X		Portable, 60 Hz	4010073-05
					X	Portable, 50 Hz	4010073-06
		1	1			Console, assembly	4020084-03
3	3	3	3	3	3	Electronics, assembly, without equalizers	4020260-01
3	3	3	3	3	3	Equalizer, assembly, 7 1/2 and 15 ips, NAB, Record	4020269-01
3	3	3	3	3	3	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
1		1		1		Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1		1		1	Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
1	1	1	1	1	1	Head, assembly, three track	4020273-01
		2	2			Knob, editing	4030145-10
2	2			2	2	Knob, reel	4040492-10
				1	1	Backing Panel	4040945-01
1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	Cable, assembly, power	4050416-01
3	3	3	3	3	3	Cable, assembly, interconnect	4050442-01
1	1	1	1	1	1	Box, assembly, head cable mounting	4050447-03
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 14-inch, three or four electronics	4150331-01
				1	1	Panel, front facing, blank	4290620-01
1	1	1	1	1	1	Reel, assembly	4690003-20
1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	Power Supply, assembly	4020274-01
3	3	3	3	3	3	Connector, plug, 3 socket, female	144-003
3	3	3	3	3	3	Connector, plug, 3 pin, male	145-009
3	3	3	3	3	3	Transformer, input, bridging	4580200-01

MODEL AG-440  
FOUR CHANNEL RECORDER/REPRODUCER  
1/2-INCH TAPE, 4 TRACK  
7 1/2 and 15 ips

01	02	03	04	05	06	DESCRIPTION	Ampex Part No.
X						Unmounted, 60 Hz	4010074-01
	X					Unmounted, 50 Hz	4010074-02
		X				Console Mounted, 60 Hz	4010074-03
			X			Console Mounted, 50 Hz	4010074-04
				X		Portable, 60 Hz	4010074-05
					X	Portable, 50 Hz	4010074-06
		1	1			Console, assembly	4020084-04
4	4	4	4	4	4	Electronics, assembly, without equalizers	4020260-01
4	4	4	4	4	4	Equalizer, assembly, 7 1/2 and 15 ips, NAB, Record	4020269-01
4	4	4	4	4	4	Equalizer, assembly, NAB-CCIR, Reproduce	4020270-01
1		1		1		Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1		1		1	Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
1	1	1	1	1	1	Head, assembly, four track	4020273-02
		2	2			Knob, editing	4030145-10
2	2			2	2	Knob, reel	4040492-10
1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	Cable, assembly, power	4050415-01
4	4	4	4	4	4	Cable, assembly, interconnect	4050442-01
1	1	1	1	1	1	Box, assembly, head cable mounting	4050447-04
				1	1	Case, assembly, transport	4150329-01
				1	1	Case, assembly, 7-inch, three or four electronics	4150331-01
1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	Power Supply, assembly	4020274-01
4	4	4	4	4	4	Connector, plug, 3 socket, female	144-003
4	4	4	4	4	4	Connector, plug, 3 pin, male	145-009
4	4	4	4	4	4	Transformer, input, bridging	4580200-01

MODEL AG-445  
SINGLE CHANNEL REPRODUCER  
7 1/2 - 15 ips, 1/4-INCH TAPE

01	02	03	04	07	08	09	10	DESCRIPTION	Ampex Part No.
	X							Full Track, Unmounted, 60 Hz	4010081-01
		X						Full Track, Unmounted, 50 Hz	4010081-02
			X					Full Track, Console Mounted, 60 Hz	4010081-03
				X				Full Track, Console Mounted, 50 Hz	4010081-04
					X			Half Track, Unmounted, 60 Hz	4010081-07
						X		Half Track, Unmounted, 50 Hz	4010081-08
							X	Half Track, Console Mounted, 60 Hz	4010081-09
							X	Half Track, Console Mounted, 50 Hz	4010081-10
		1	1			1	1	Console Assembly	4020084-01
1	1	1	1	1	1	1	1	Reproduce Module (includes reproduce board)	4020150-01
1	1	1	1	1	1	1	1	Equalizer, assembly, 7 1/2 - 15 ips, NAB-CCIR	4020270-01
1	1	1	1	1	1	1	1	Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1	1	1	1	1	1	1	Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
1	1	1	1					Head, assembly, full track	4020272-04
				1	1	1	1	Head, assembly, two track	4020272-05
1	1	1	1	1	1	1	1	Power Supply, assembly	4020274-02
		2	2			2	2	Knob, editing	4030145-10
1	1	1	1	1	1	1	1	Tray, assembly, reproducer	4040346-01
1	1	1	1	1	1	1	1	Facing panel, assembly	4040347-01
2	2			2	2			Knob, reel	4040492-10
1	1	1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	1	1	Cable, assembly, power	4050416-01
1	1	1	1	1	1	1	1	Box, assembly, head cable mounting	4050448-01
2	2			2	2			Knob, reel hold down	4100137-10
1	1	1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	1	1	Connector, plug, 3 socket, female	144-003

MODEL AG-445  
SINGLE CHANNEL REPRODUCER  
3 3/4 - 7 1/2 ips  
1/4-INCH TAPE

13	14	15	16	19	20	21	22	DESCRIPTION	Ampex Part No.
	X							Full Track, Unmounted, 60 Hz	4010081-13
		X						Full Track, Unmounted, 50 Hz	4010081-14
			X					Full Track, Console Mounted, 60 Hz	4010081-15
				X				Full Track, Console Mounted, 50 Hz	4010081-16
					X			Half Track, Unmounted, 60 Hz	4010081-19
						X		Half Track, Unmounted, 50 Hz	4010081-20
							X	Half Track, Console Mounted, 60 Hz	4010081-21
							X	Half Track, Console Mounted, 50 Hz	4010081-22
		1	1			1	1	Console Assembly	4020084-01
1	1	1	1	1	1	1	1	Reproduce Module (includes reproduce board)	4020150-01
1	1	1	1	1	1	1	1	Equalizer, assembly, 7 1/2 - 15 ips, NAB-CCIR	4020270-01
1	1	1	1	1	1	1	1	Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 60 Hz	4020271-03
	1	1	1	1	1	1	1	Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 50 Hz	4020271-04
1	1	1	1					Head, assembly, full track	4020272-04
				1	1	1	1	Head, assembly, two track	4020272-05
1	1	1	1	1	1	1	1	Power Supply, assembly	4020274-02
		2	2			2	2	Knob, editing	4030145-10
1	1	1	1	1	1	1	1	Tray, assembly, reproducer	4040346-01
1	1	1	1	1	1	1	1	Facing panel, assembly	4040347-01
2	2			2	2			Knob, reel	4040492-10
1	1	1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	1	1	Cable, assembly, power	4050416-01
1	1	1	1	1	1	1	1	Box, assembly, head cable mounting	4050448-01
2	2			2	2			Knob, reel hold down	4100137-10
1	1	1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	1	1	Instruction Manual	4890172
1	1	1	1	1	1	1	1	Connector, plug, 3 socket, female	144-003

MODEL AG-445  
TWO CHANNEL REPRODUCER  
1/4-INCH TAPE  
(With two-track and quarter-track head assembly)

01	02	03	04	07	08	09	10	DESCRIPTION	Amper Part No.
	X							Two Track, Unmounted, 60 Hz, 7 1/2 and 15 ips	4010082-01
		X						Two Track, Unmounted, 50 Hz, 7 1/2 and 15 ips	4010082-02
			X					Two Track, Console Mounted, 60 Hz, 7 1/2 and 15 ips	4010082-03
				X				Two Track, Console Mounted, 50 Hz, 7 1/2 and 15 ips	4010082-04
					X			Two Track, Unmounted, 60 Hz, 3 3/4 and 7 1/2 ips	4010082-07
						X		Two Track, Unmounted, 50 Hz, 3 3/4 and 7 1/2 ips	4010082-08
							X	Two Track, Console Mounted, 60 Hz, 3 3/4 and 7 1/2 ips	4010082-09
							X	Two Track, Console Mounted, 50 Hz, 3 3/4 and 7 1/2 ips	4010082-10
			1	1		1	1	Console Assembly	4020084-01
2	2	2	2	2	2	2	2	Reproduce Module (includes reproduce board)	4020150-01
2	2	2	2	2	2	2	2	Equalizer, assembly, 7 1/2 - 15 ips, NAB-CCIR	4020270-01
1		1						Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1		1					Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
				1		1		Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 60 Hz	4020271-03
					1	1		Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 50 Hz	4020271-04
1	1	1	1	1	1	1	1	Head, assembly, two track and quarter track	4020272-05
1	1	1	1	1	1	1	1	Power Supply, assembly	4020274-02
		2	2			2	2	Knob, editing	4030145-10
1	1	1	1	1	1	1	1	Tray, assembly, reproducer	4040346-01
1	1	1	1	1	1	1	1	Facing panel, assembly	4040347-01
2	2			2	2			Knob, reel	4040492-10
1	1	1	1	1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	1	1	1	1	Cable, assembly, power	4050416-01
1	1	1	1	1	1	1	1	Box, assembly, head cable mounting	4050448-02
2	2			2	2			Knob, reel hold down	4100137-10
1	1	1	1	1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	1	1	1	1	Instruction Manual	4890172
2	2	2	2	2	2	2	2	Connector, plug, 3 socket, female	144-003

MODEL AG-445  
THREE CHANNEL REPRODUCER  
7 1/2 - 15 ips  
1/2-INCH TAPE

01	02	03	04	DESCRIPTION	Amper Part No.
	X			Three Track, Unmounted, 60 Hz	4010083-01
		X		Three Track, Unmounted, 50 Hz	4010083-02
			X	Three Track, Console Mounted, 60 Hz	4010083-03
				Three Track, Console Mounted, 50 Hz	4010083-04
		1	1	Console Assembly	4020084-01
3	3	3	3	Reproduce Module (includes reproduce board)	4020150-01
3	3	3	3	Equalizer, assembly, 7 1/2 - 15 ips, NAB-CCIR	4020270-01
1		1		Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1		1	Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
1	1	1	1	Head, assembly, three track	4020273-03
1	1	1	1	Power Supply, assembly	4020274-02
		2	2	Knob, editing	4030145-10
1	1	1	1	Tray, assembly, reproducer	4040346-01
1	1	1	1	Facing panel, assembly	4040347-01
2	2			Knob, reel	4040492-10
1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	Cable, assembly, power	4050416-01
1	1	1	1	Box, assembly, head cable mounting	4050448-03
1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	Instruction Manual	4890172
3	3	3	3	Connector, plug, 3 socket, female	144-003

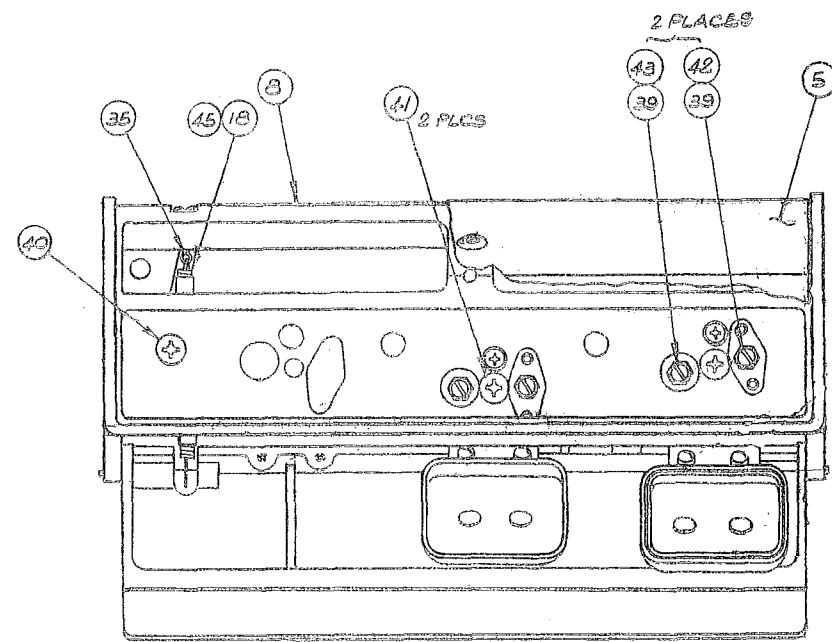
MODEL AG-445  
 FOUR CHANNEL REPRODUCER  
 7 1/2 - 15 ips  
 1/2-INCH TAPE

01	02	03	04	DESCRIPTION	Ampex Part No.
X				Four Track, Unmounted, 60 Hz	4010084-01
	X			Four Track, Unmounted, 50 Hz	4010084-02
		X		Four Track, Console Mounted, 60 Hz	4010084-03
			X	Four Track, Console Mounted, 50 Hz	4010084-04
			1	Console Assembly	4020084-01
4	4	4	4	Reproduce Module (includes reproduce board)	4020150-01
4	4	4	4	Equalizer, assembly, 7 1/2 - 15 ips, NAB-CCIR	4020270-01
1		1		Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
	1		1	Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
1	1	1	1	Head, assembly, four track	4020273-04
1	1	1	1	Power Supply, assembly	4020274-02
		2	2	Knob, editing	4030145-10
1	1	1	1	Tray, assembly, reproducer	4040346-01
1	1	1	1	Facing, panel, assembly	4040347-01
2	2			Knob, reel	4040492-10
1	1	1	1	Scrape Flutter Idler, assembly	4040955-01
1	1	1	1	Cable, assembly, power	4050416-01
1	1	1	1	Box, assembly, head cable mounting	4050448-04
1	1	1	1	Reel, assembly	4690003-10
1	1	1	1	Instruction Manual	4890172
4	4	4	4	Connector, plug, 3 socket, female	144-003

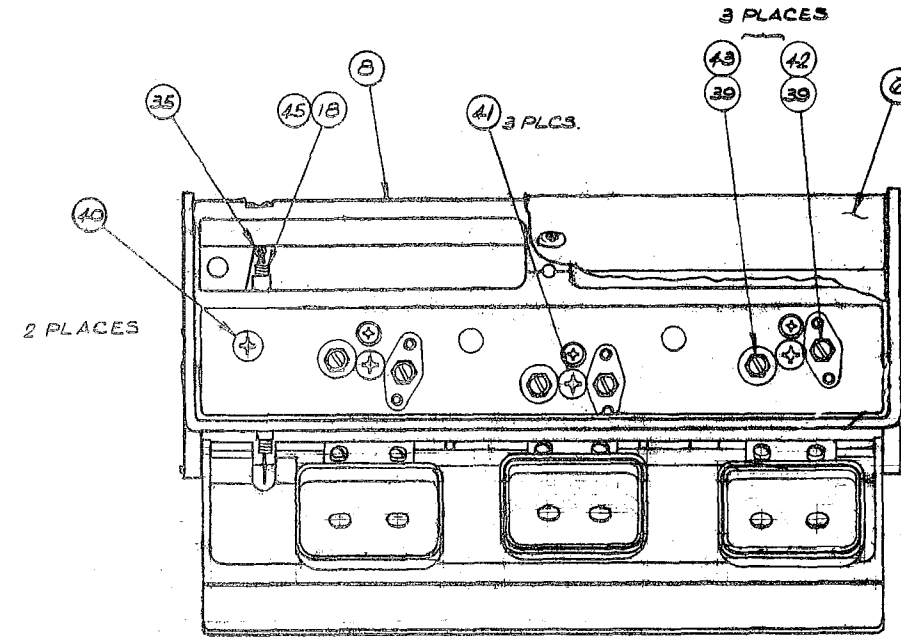
HEAD ASSEMBLY, 1/4-inch Tape  
 CATALOG NO. 4020272  
 (See Figs. 6-1 and 6-2)

ITEM	-01	-02	-03	-04	-05	-06	DESCRIPTION	Ampex Part No.
	X						Head Assembly, full track, record/reproduce	4020272-01
		X					Head Assembly, two track, record/reproduce	4020272-02
			X				Head Assembly, two and four track, record/reproduce	4020272-03
				X			Head Assembly, full track, reproduce-only	4020272-04
					X		Head Assembly, two track, reproduce-only	4020272-05
						X	Head Assembly, two and four track, reproduce-only	4020272-06
1	3			1			Connector, assembly, head (see Fig. 6-3)	4050446-01
2		3	4		1	2	Connector, assembly, head (see Fig. 6-3)	4050446-02
3	4	4	6	2	2	4	Spring, head	4270167-10
4			1			1	Knob	4350011-01
5	1	1		1	1		Overlay, head housing	4350038-01
6			1			1	Overlay, head housing	4350038-02
7	1	1	1	1	1	1	Spacer, head, 1/4-inch tape	4350016-01
8	1	1	1	1	1	1	Base, head mounting	4350017-01
9	1	1	1				Spacer, erase head	4350019-01
10			1				Shield Can, assembly, record, position #2	4350021-01
11	1	1					Shield Can, assembly, record, position #3	4350022-01
12			1			1	Shield Can, assembly, reproduce, position #3	4350023-01
13	1	1	1	1	1	1	Shield Can, assembly, reproduce, position #4	4350024-01
14	1	1					Gate, assembly, head	4350029-01
15			1				Gate, assembly, head	4350029-02
19				1	1		Gate, assembly, head	4350029-03
20						1	Gate, assembly, head	4350029-04
	1	1	1	1	1	1	Gate	4350018-01
	1	1	1				Shield Cover, assembly	4350026-01
		1				1	Shield Cover, assembly	4350027-01
	1	1	1	1	1	1	Shield Cover, assembly	4350028-01
	2	2	3	1	1	2	Plate	4270155-10
16	2	2	2	2	2	2	Tape Guide, Assembly	4350030-01
17			1			1	Shaft, switch	4210313-01
18	1	1	1	1	1	1	Spring, head gate	4350035-01
21				1	1	1	Post, Dummy head	4210136-01
22		1	1				Head Unit, record, 2 track	4040437-05
23		1	1		1	1	Head Unit, reproduce, 2 track	4040437-06
24	1						Head Stack, assembly, record, full track	4040438-67
25	1			1			Head Stack, assembly, reproduce, full track	4040438-68
26	1						Head Stack, assembly, erase, full track	4040829-02
27		1	1				Head Stack, assembly, erase, 2 track	4040831-02
28			1			1	Head Stack, assembly, reproduce, 1/4 track stereo	4350037-01
29	As Required						Shim, erase head, .010 thick	4350025-01
30	As Required						Shim, erase head, .002 thick	4350025-02
31	As Required						Shim, erase head, .003 thick	4350025-03
32	As Required						Shim, erase head, .005 thick	4350025-04

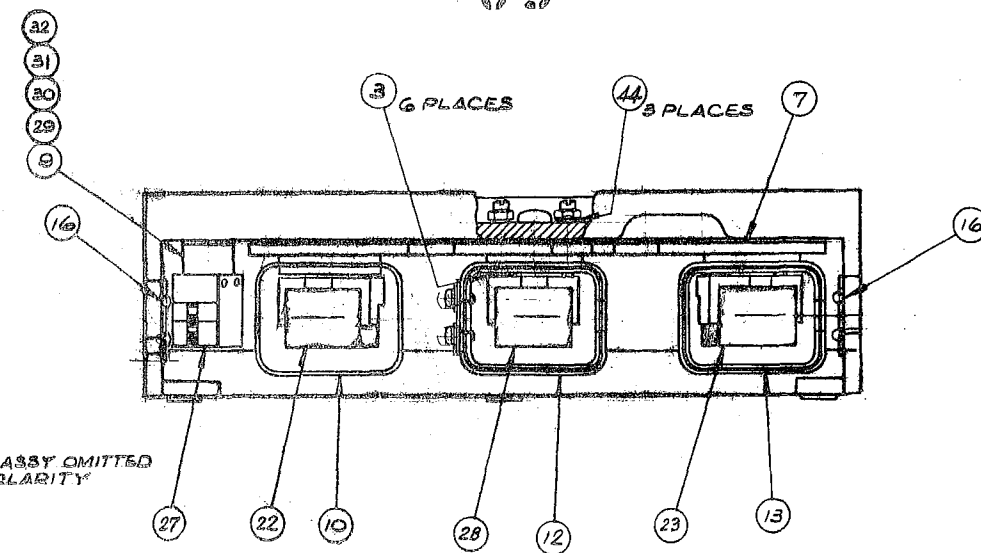
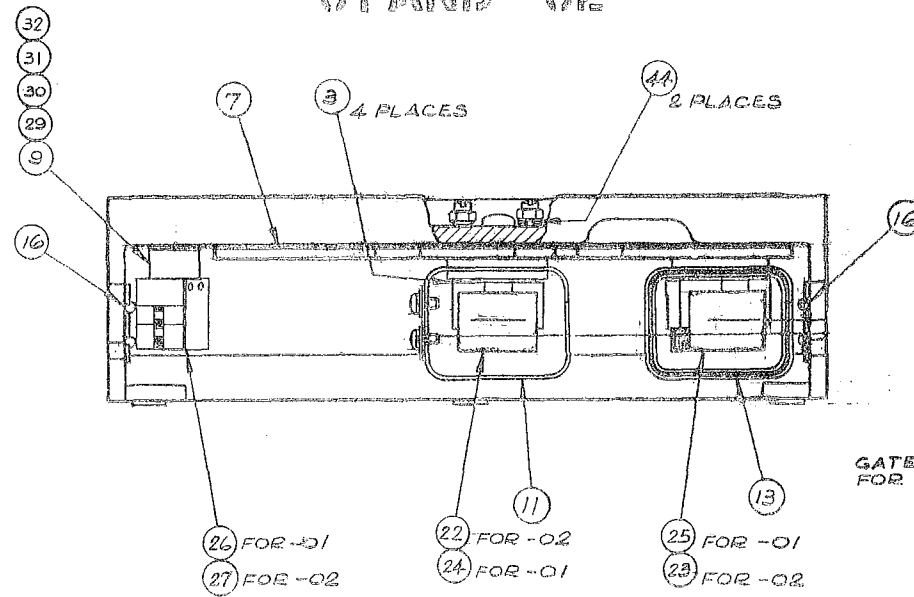
Items of standard hardware not listed



-01 AND -02



-03



GATE ASSY OMITTED FOR CLARITY

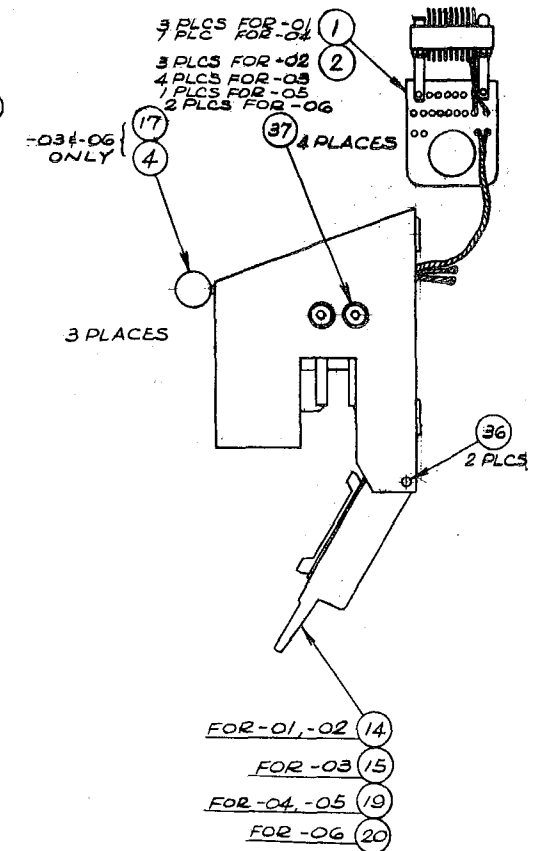


TABLE I		
PART NO.	DESCRIPTION	MODEL
4020272-01	FULL TRACK	AG 440
4020272-02	TWO TRACK	AG 440
4020272-03	TWO-FOUR TRACK	AG 440
4020272-04	FULL TRACK	AG 445
4020272-05	TWO TRACK	AG 445
4020272-06	TWO-FOUR TRACK	AG 445

Fig. 6-1. Head Assembly, Record/Reproduce, 1/4-inch Tape

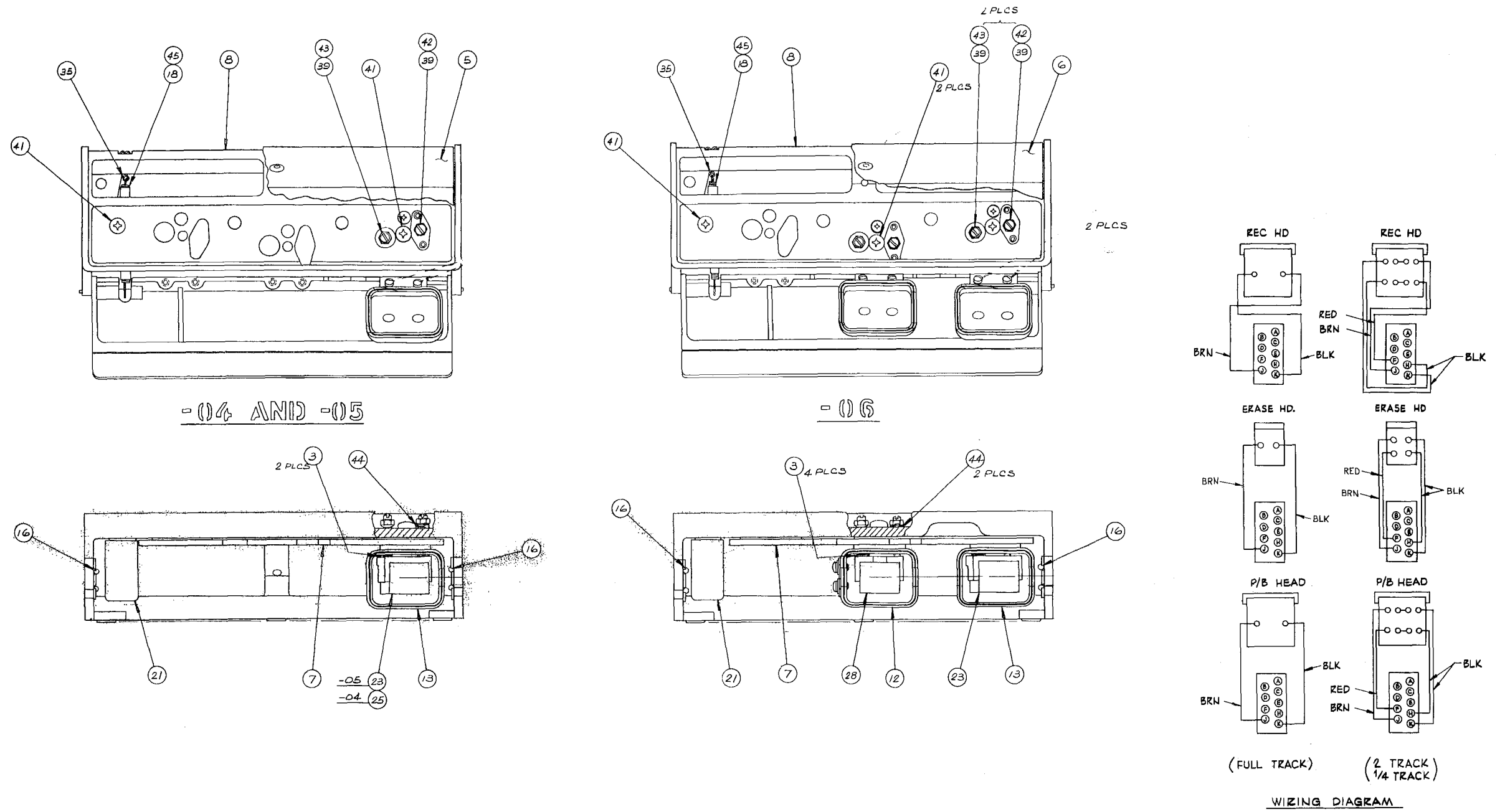


Fig. 6-2. Head Assembly, Reproduce-only, 1/4-inch Tape

HEAD ASSEMBLY, 1/2-inch Tape  
 CATALOG NO. 4020273  
 (See Figs. 6-3 and 6-4)

ITEM	-01	-02	-03	-04	DESCRIPTION	Ampex Part No.
	X				Head Assembly, 3 track, record/reproduce	4020273-01
		X			Head Assembly, 4 track, record/reproduce	4020273-02
			X		Head Assembly, 3 track, reproduce-only	4020273-03
				X	Head Assembly, 4 track, reproduce-only	4020273-04
1	3		1		Connector, assembly, head (see Fig. 6-3)	4050446-03
2		3		1	Connector, assembly, head (see Fig. 6-3)	4050446-04
3	4	4	2	2	Spring, head adjust	4270169-10
4	1	1	1	1	Overlay, head housing	4350038-01
5	1	1	1	1	Base, head mounting	4350017-01
6	1	1			Spacer, erase head	4350019-02
7	1	1			Shield Can, assembly, record, position #3	4350022-02
8	1	1	1	1	Shield Can, assembly, reproduce, position #4	4350024-02
9	1	1			Gate, assembly, head	4350029-01
13			1	1	Gate, assembly, head	4350029-03
	1	1	1	1	Gate	4350018-01
	1	1			Shield Cover, assembly	4350026-01
			1	1	Shield Cover, assembly	4350028-01
	2	2	1	1	Plate	4270155-10
10	1	1	1	1	Tape Guide, assembly, L. H.	4350033-01
11	1	1	1	1	Tape Guide, assembly, R. H.	4350033-02
12	1	1	1	1	Spring, extension, head gate	4350035-01
14			1	1	Post, dummy head	4210136-01
16	1				Head, assembly, erase, 3 track	1231886-03
17		1			Head, assembly, erase, 4 track	1231888-03
18	1		1		Head Stack, assembly, high density, reproduce, 3 track	4040534-04
19	1				Head Stack, assembly, high density, record, 3 track	4040534-05
20		1			Head Stack, assembly, record, 4 track	4040558-04
21		1		1	Head Stack, assembly, reproduce, 4 track	4040558-05
22	As Required				Shim, erase head, .010 thick	4350025-01
23	As Required				Shim, erase head, .002 thick	4350025-02
24	As Required				Shim, erase head, .003 thick	4350025-03
25	As Required				Shim, erase head, .005 thick	4350025-04

Items of standard hardware not listed.



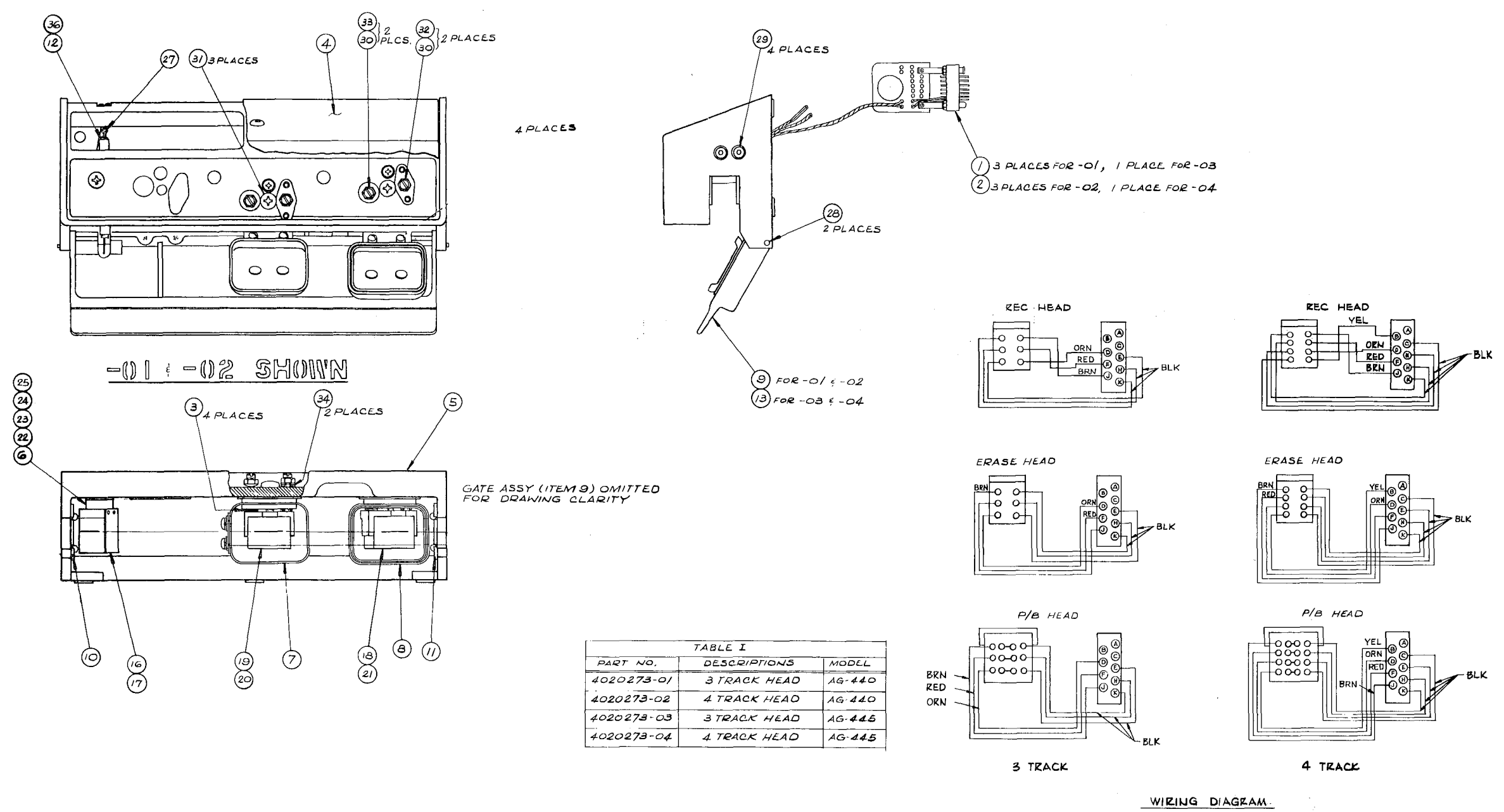
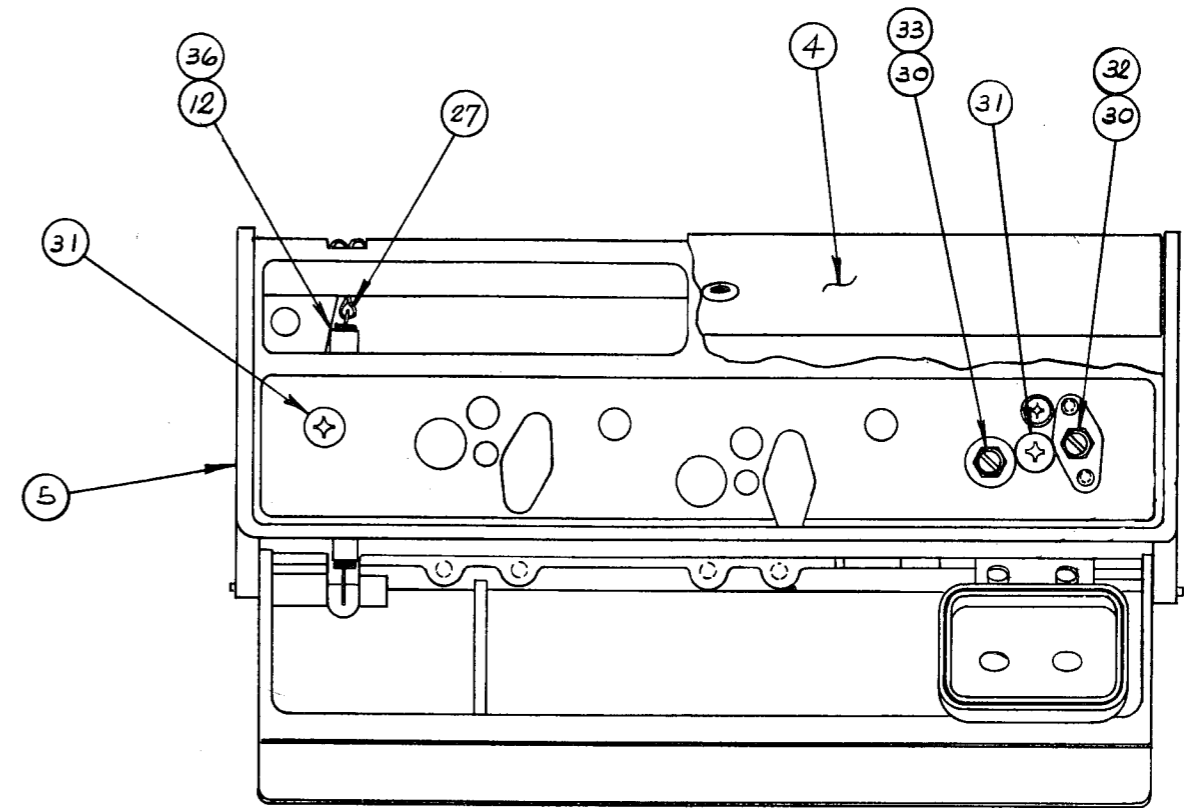
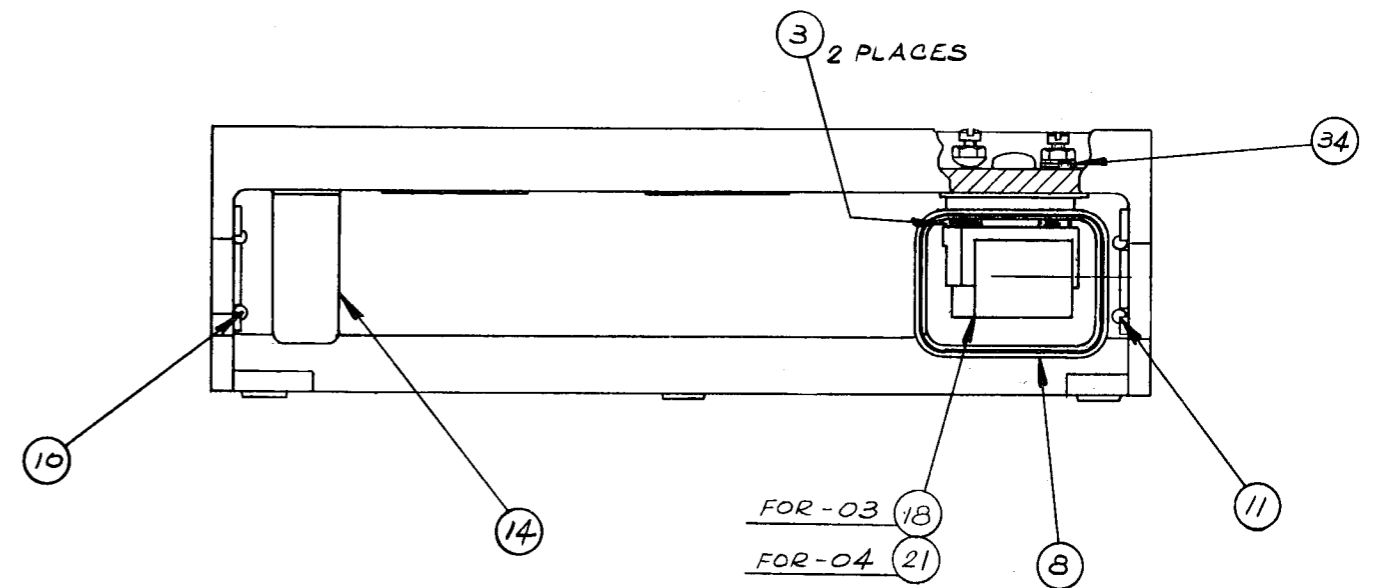


Fig. 6-3. Head Assembly, Record/Reproduce, 1/2-inch Tape



-03 & -04 SHOWN

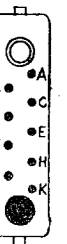
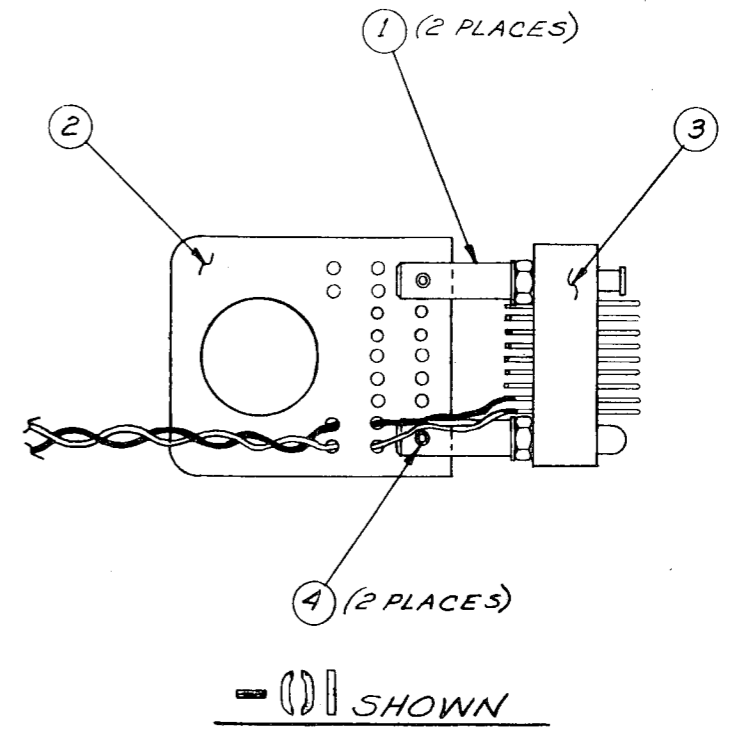


GATE ASSY (ITEM 13) OMITTED  
FOR DWG. CLARITY.

HEAD CONNECTOR ASSEMBLY  
 CATALOG NO. 4050446  
 (See Fig. 6-5)

ITEM	-01	-02	-03	-04	DESCRIPTION	Ampex Part No.
		X			Head Connector, assembly, 1 track head	4050446-01
		X			Head Connector, assembly, 2 track head	4050446-02
			X		Head Connector, assembly, 3 track head	4050446-03
				X	Head Connector, assembly, 4 track head	4050446-04
1	2	2	2	2	Standoff, head connector	4220243-01
2	1	1	1	1	Handle, head connector	4350031-01
3	1	1	1	1	Connector, male, rect., 9 pin	143-300
4	2	2	2	2	Rollpin, .062 dia. x .187 lg.	406-272

See Fig. 6-3 for wire color coding



ASSY NO.	TERMINAL LETTER									
	A	B	C	D	E	F	H	J	K	
4050446-01	-	-	-	-	-	-	-	BRN	BLK	
4050446-02	-	-	-	-	-	RED	BLK	BRN	BLK	
4050446-03	-	-	-	ORN	BLK	RED	BLK	BRN	BLK	
4050446-04	-	YEL	BLK	ORN	BLK	RED	BLK	BRN	BLK	

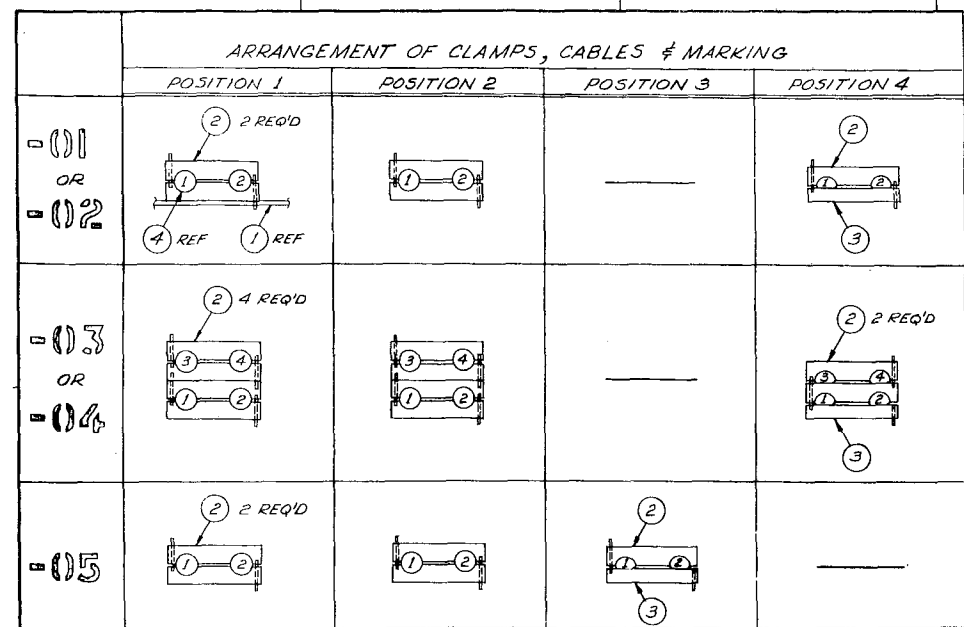
Fig.6-5. Head Connector Assembly

HEAD CABLE BOX ASSEMBLY

CATALOG NO. 4050447

(See Fig. 6-6)

ITEM	-01	-02	-03	-04	-05	DESCRIPTION	Ampex Part No.
	X					Head Cable Box, assembly, 1 channel, 3 position	4050447-01
		X				Head Cable Box, assembly, 2 channel, 3 position	4050447-02
			X			Head Cable Box, assembly, 3 channel, 3 position	4050447-03
				X		Head Cable Box, assembly, 4 channel, 3 position	4050447-04
					X	Head Cable Box, assembly, 2 channel, 4 position	4050447-05
1	1	1	1	1	1	Bracket, head cable mounting	4040947-01
2	5	5	10	10	5	Clamp, assembly, cable	4040951-01
3	1	1	1	1	1	Clamp, assembly, playback cable	4040952-01
4	1	2	3	4	2	Head Cable, assembly, erase	4050143-60
5	1	2	3	4	2	Head Cable, assembly, record	4050144-70
6	1	2	3	4	2	Head Cable, assembly, reproduce	4050446-01
7					1	Rod, switch	4350034-01
8	1	1	1	1	1	Cover, head cable bracket	4290644-01
9	1	1	1	1	1	Shield, head connector	4290645-01
10					1	Wire, retaining	4320115-10
11					1	Switch, slide	4620124-10
12	4	4	4	4	4	Connector, receptacle, female, 9 socket	143-301
13	3	3	3	3	3	Marker Strip, No. 1	202-006
14		3	3	3	3	Marker Strip, No. 2	202-007
15			3	3	3	Marker Strip, No. 3	202-008
16				3	3	Marker Strip, No. 4	202-009
27					1	Terminal Strip, A1, A1, D	180-983
Items of standard hardware, wire, etc., not listed							



CONN A			
ITEM NO.	MARKER NO.	WIRE COLOR	PIN LETTER
④ (ERASE)	1	WHT	J
		BLK	K
	2	WHT	F
		BLK	H
	3	WHT	D
		BLK	E
	4	WHT	B
		BLK	C

CONN D			
ITEM NO.	MARKER NO.	WIRE COLOR	PIN LETTER
⑥ (REP)	1	RED	J
		BLK	K
	2	RED	F
		BLK	H
	3	RED	D
		BLK	E
	4	RED	B
		BLK	C

CONN B			
ITEM NO.	MARKER NO.	WIRE COLOR	PIN LETTER
⑤ (REC)	1	WHT	J
		BLK	K
	2	WHT	F
		BLK	H
	3	WHT	D
		BLK	E
	4	WHT	B
		BLK	C

**-05 ONLY**  
FOR HOOKUP TO  
CONNECTORS C & D,  
SEE SCHEMATIC

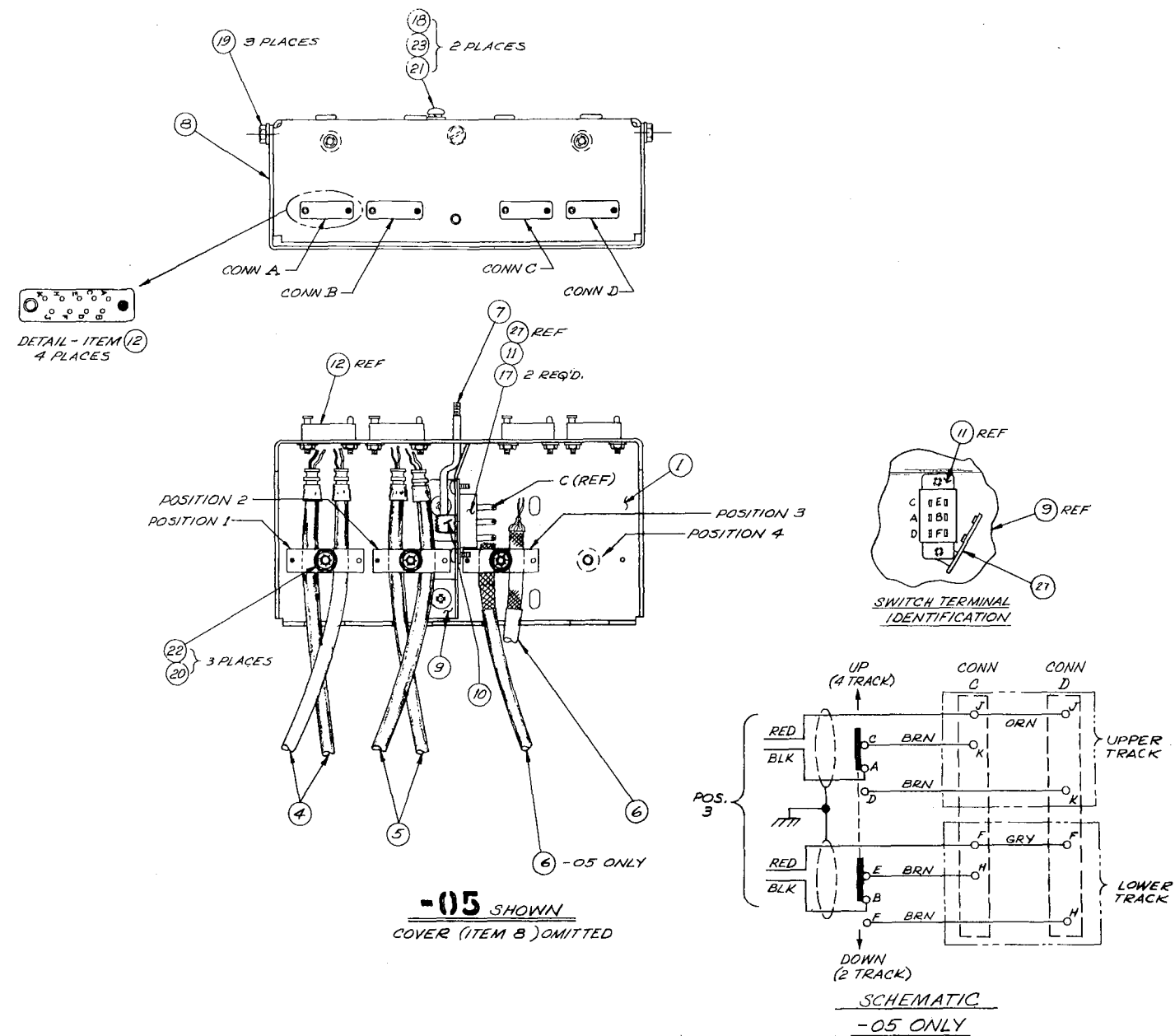


Fig. 6-6 . Head Cable Box Assembly

SCRAPE FLUTTER IDLER ASSEMBLY  
 CATALOG NO. 4040955  
 (See Fig. 6-7)

ITEM	-01	-02	DESCRIPTION	Ampex Part No.
		X	Scrape Flutter Idler, assembly, furnished as standard equipment (3/8-inch roller)	4040955-01
		X	Scrape Flutter Idler, assembly, optional accessory (15/32-inch roller)	4040955-02
<p><u>No parts of the scrape flutter idlers are replaceable.</u></p>				
<p>Note          Optional scrape flutter idler kit Catalog No. 4010069</p>				

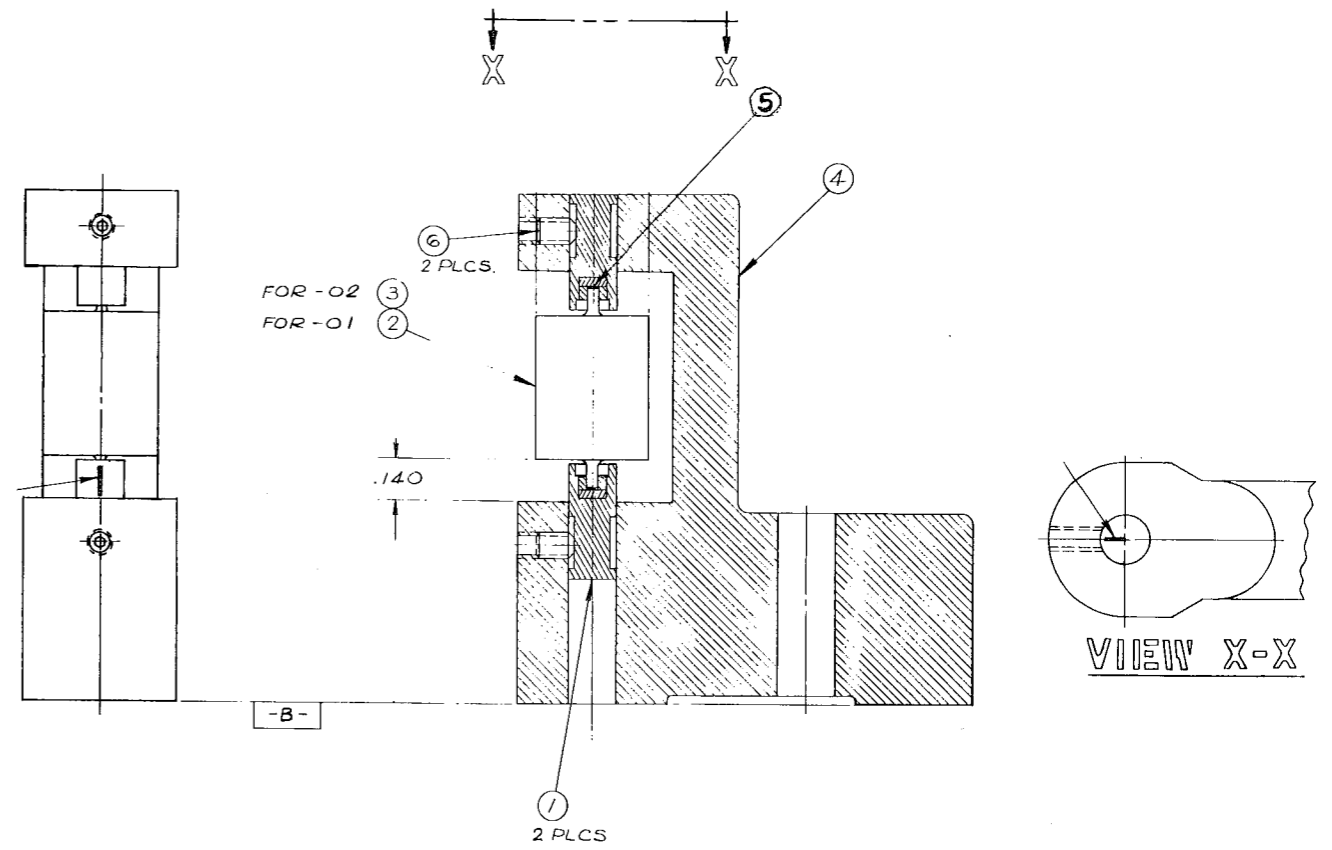


Fig.6-7. Scrape Flutter Idler Assembly

TAPE TRANSPORT ASSEMBLY  
 CATALOG NO. 4020271  
 (See Figs. 6-8 and 6-9)

ITEM	-01	-02	-03	-04	DESCRIPTION	Ampex Part No.
	X				Tape Transport, assembly, 7 1/2 and 15 ips, 60 Hz	4020271-01
		X			Tape Transport, assembly, 7 1/2 and 15 ips, 50 Hz	4020271-02
			X		Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 60 Hz	4020271-03
				X	Tape Transport, assembly, 3 3/4 and 7 1/2 ips, 50 Hz	4020271-04
1	1	1	1	1	Oil Kit, motor	4010825-02
2	1	1	1	1	Control Box, assembly (see Figs. 6-15, 6-16, 6-18)	4020083-01
4	1	1			Capstan Idler, assembly, 7 1/2 and 15 ips	4030203-10
5		1	1	1	Capstan Idler, assembly, 3 3/4 and 7 1/2 ips	4030203-40
	1	1			Wheel, assembly	4040404-10
			1	1	Wheel, assembly	4040404-50
	1	1	1	1	Cap, capstan idler	4100166-10
					(No other parts replaceable)	-----
6	1	1	1	1	Tape Lifter, assembly (see Fig. 6-9)	4030259-01
7	1	1	1	1	Takeup, assembly (see Fig. 6-10)	4030265-01
8	1	1	1	1	Rewind, assembly (see Fig. 6-11)	4030266-01
9	1	1	1	1	Solenoid, assembly, capstan idler	4030272-01
	1	1	1	1	Stop, Solenoid	4220139-20
	1	1	1	1	Spring, solenoid return	4270161-10
	1	1	1	1	Spring, capstan idler adjustment	4270162-10
	1	1	1	1	Shield, solenoid	4290642-01
	1	1	1	1	Bolt, eye	4400604-20
	1	1	1	1	Solenoid	4590063-10
	2	2	2	2	Solderless Connectors	171-008
	1	1	1	1	Washer, felt	503-015
10	1	1	1	1	Solenoid, assembly, tape lifter	4030273-01
	1	1	1	1	Link	4230242-01
	1	1	1	1	Stop, solenoid	4260184-10
	1	1	1	1	Solenoid	4590118-01
	2	2	2	2	Solderless Connectors	171-008
11			1	1	Dust Cap, assembly, capstan	4040406-10
12	1	1			Dust Cap, assembly, capstan	4040406-20
13	1	1	1	1	Capacitor, assembly, drive motor (see Fig. 6-18)	4040591-02
14	1	1	1	1	Reel Idler, assembly (see Fig. 6-13)	4040970-02
15	1	1	1	1	Takeup Tension Arm, assembly	4040974-02
	1	1	1	1	Tape Guide	4210310-01
	1	1	1	1	Hook	4230158-20
	1	1	1	1	Cap	4250193-01
	1	1	1	1	Spring, tension	4270158-10
	1	1	1	1	Screw, tape guide and hook mounting	4400593-01
16	1	1	1	1	Top Plate, assembly (no replaceable parts)	4040990-01
17	1	1	1	1	Escutcheon, assembly, left	4040991-01
18	1				Drive Motor, assembly, 7 1/2 and 15 ips, 60 Hz (see Fig. 6-14)	4040993-01
19			1		Drive Motor, assembly, 3 3/4 and 7 1/2 ips, 60 Hz (see Fig. 6-14)	4040993-02
20	1				Drive Motor, assembly, 7 1/2 and 15 ips, 50 Hz (see Fig. 6-14)	4040993-03
21				1	Drive Motor, assembly, 3 3/4 and 7 1/2 ips, 50 Hz (see Fig. 6-14)	4040993-04
22	2	2	2	2	Capacitor, assembly, takeup and rewind motors (see Fig. 6-18)	4050361-10
23	1	1	1	1	Safety Switch, assembly (see Fig. 6-18)	4050436-01
24	4	4	4	4	Pushbutton, white	4100182-01
25	1	1	1	1	Pushbutton, yellow	4100182-02
26	1	1	1	1	Pushbutton, red	4100182-03
27	1	1	1	1	Escutcheon, pushbutton, right	4110266-01
28	2	2	2	2	Guard reel	4110267-01
29	4	4	4	4	Pad, toggle switch	4130103-01
30	1	1	1	1	Shield, safety switch	4170184-01
34	1	1	1	1	Flywheel, reel idler	4250202-01
35	1	1	1	1	Spring, tape lifter return	4270252-01
36	1	1	1	1	Spring, tape lifter solenoid	4270253-01
37	1	1	1	1	Shield, drive motor	4290641-01
41	1	1	1	1	Plate, tape lifter solenoid mounting	4330255-01
42	2	2	2	2	Plate, motor capacitor mounting	4330256-01
43	1	1	1	1	Plate, capstan solenoid mounting	4330257-01
44	2	2	2	2	Screw, tape lifter mounting	4400594-01
53	1	1	1	1	Label, identification	6000035-02
87	1	1	1	1	Fan, 5-inch dia.	591-001

Non-replaceable parts, standard hardware, wire, etc.,  
not listed.

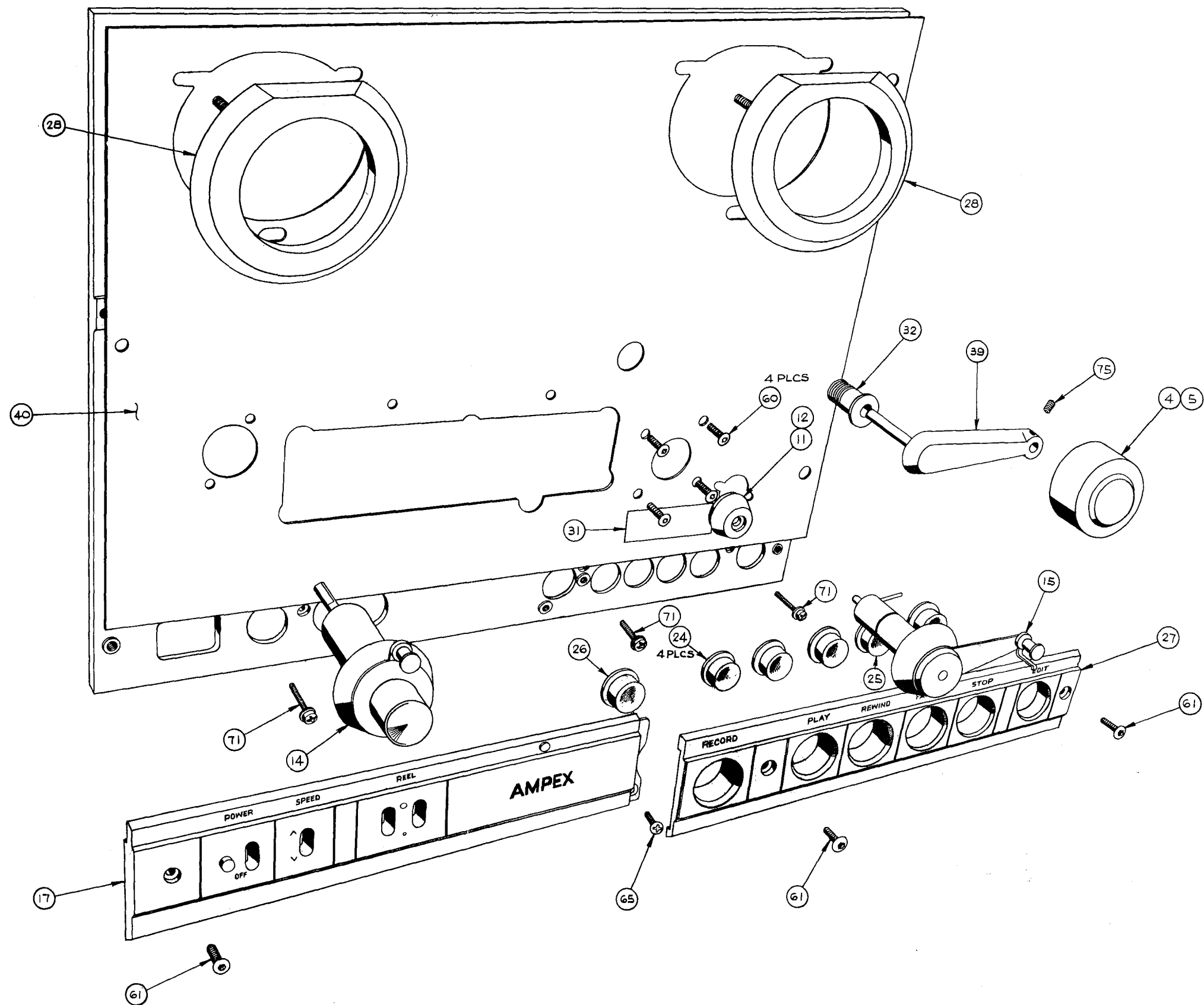
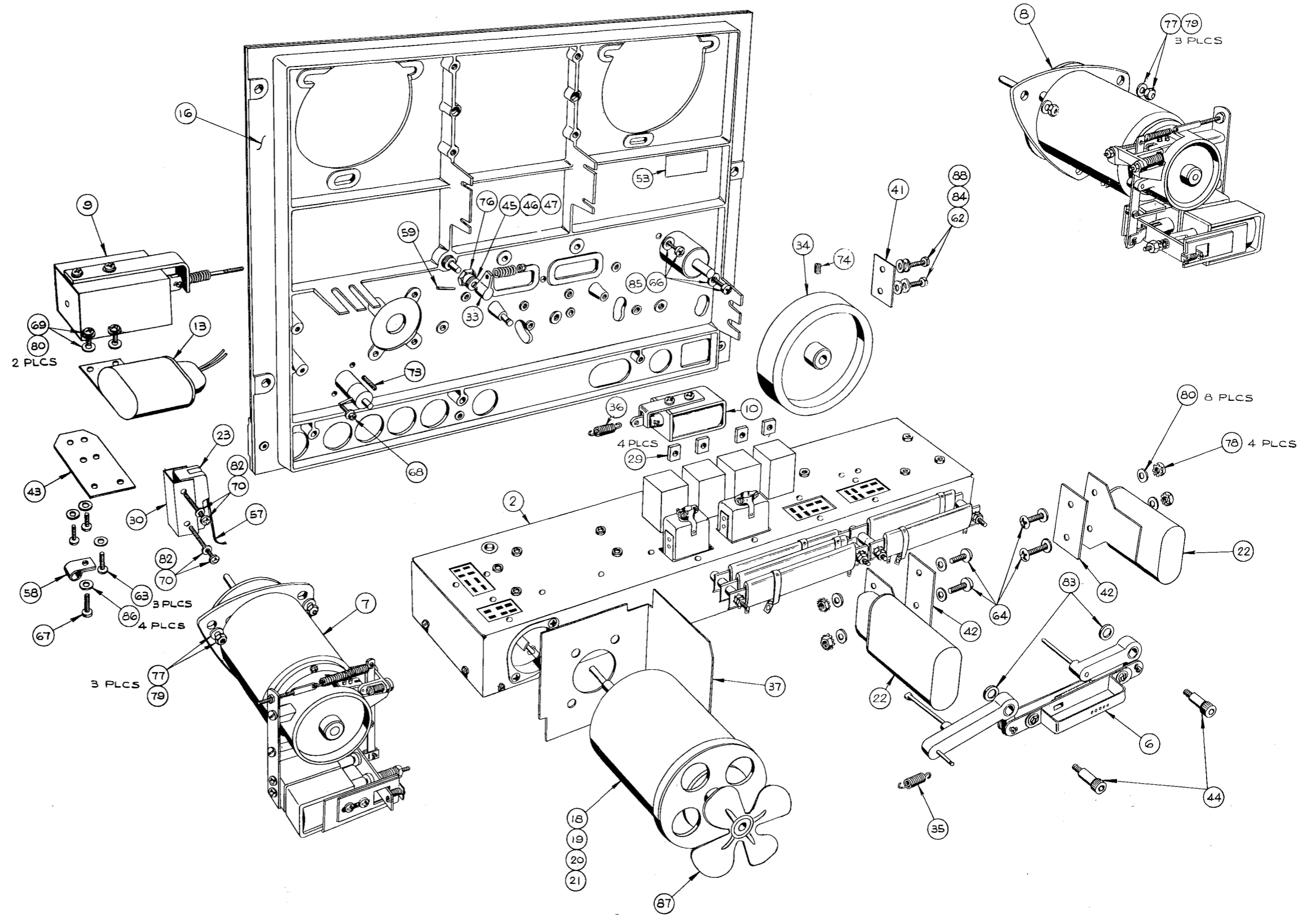


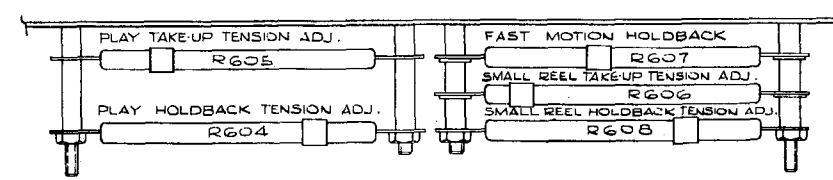
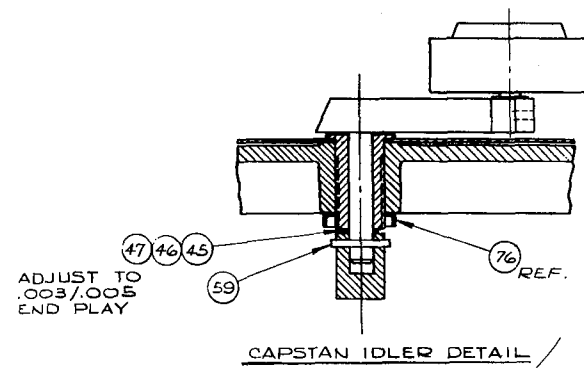
Fig. 6-8. Tape Transport Assembly, Front





PARTS LIST ON FIG. 6-8.

Fig. 6-9, Tape Transport Assembly, Rear



TAKE-UP & SUPPLY TENSION ADJUSTMENTS

CONTROL BOX KNIFE DISCONNECT  
CONNECTION INFORMATION

HARNES WIRE COLOR	PART DESCRIPTION	TERM. COLOR
BRN	K609 SOLENOID, TAPE LIFTER	BLK
WHT/VIO	K609 SOLENOID, TAPE LIFTER	BLK
BLU	K610 SOLENOID, CAPSTAN	BLK
WHT/YEL	K610 SOLENOID, CAPSTAN	BLK
YEL	C601 CAPACITOR, CAPSTAN MOTOR	BRN
WHT/VIO	C601 CAPACITOR, CAPSTAN MOTOR	BRN
WHT/RED/2	S603 SWITCH, SAFETY	WHT/RED
VIO	S603 SWITCH, SAFETY	VIO

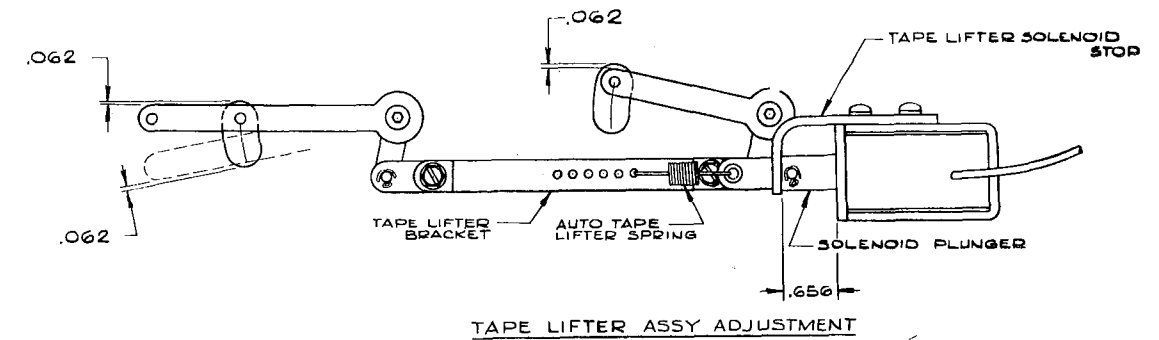
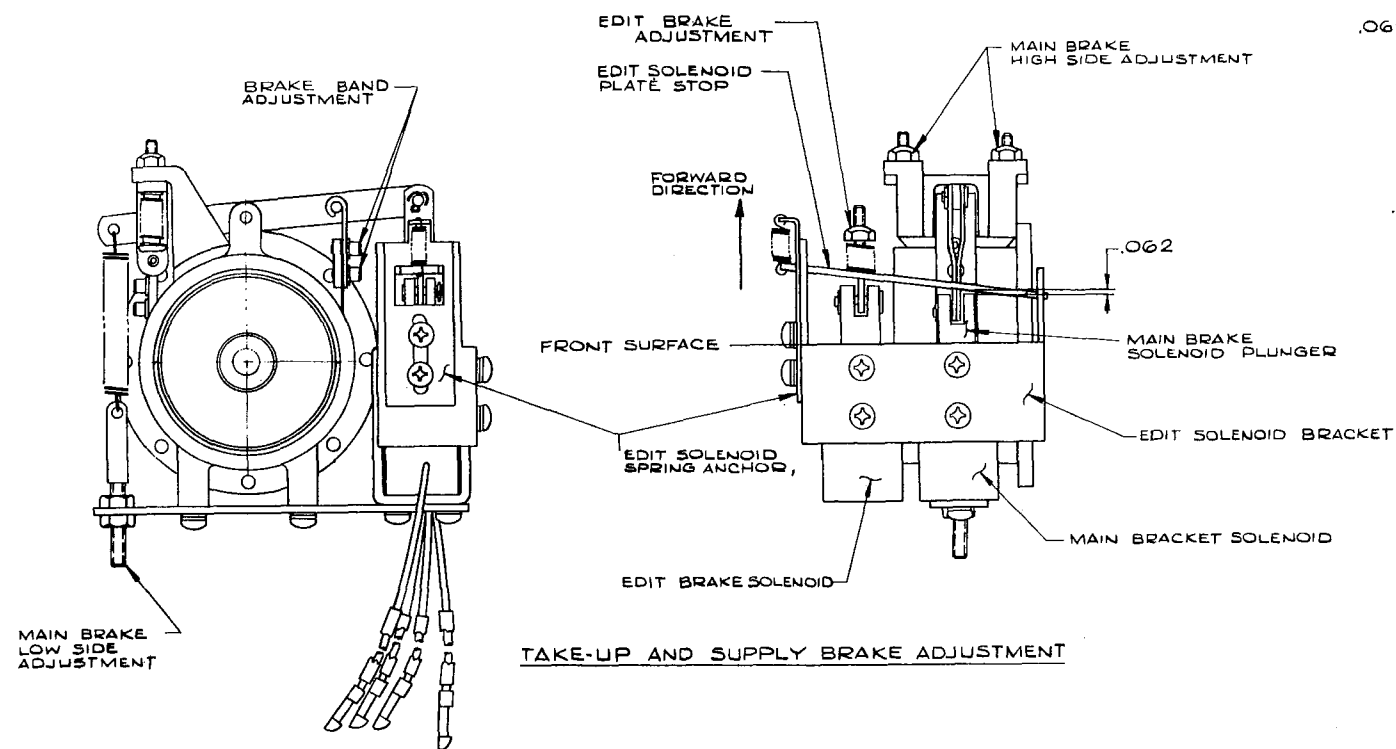


Fig. 6-10. Tape Transport Adjustments

TAPE LIFTER ASSEMBLY  
 CATALOG NO. 4030259  
 (See Fig. 6-11)

ITEM -01	DESCRIPTION	Ampex Part No.
	Tape lifter, assembly	4030259-01
1	1 Tape Lifter, left hand	4040965-01
2	1 Tape Lifter, right hand	4040966-01
3	2 Link	4230244-01
4	1 Bracket	4260384-01
5	1 Spring	4270254-01
6	2 Pin, Clevis, 1/8-inch dia.	400-004
	Items of standard hardware not listed	

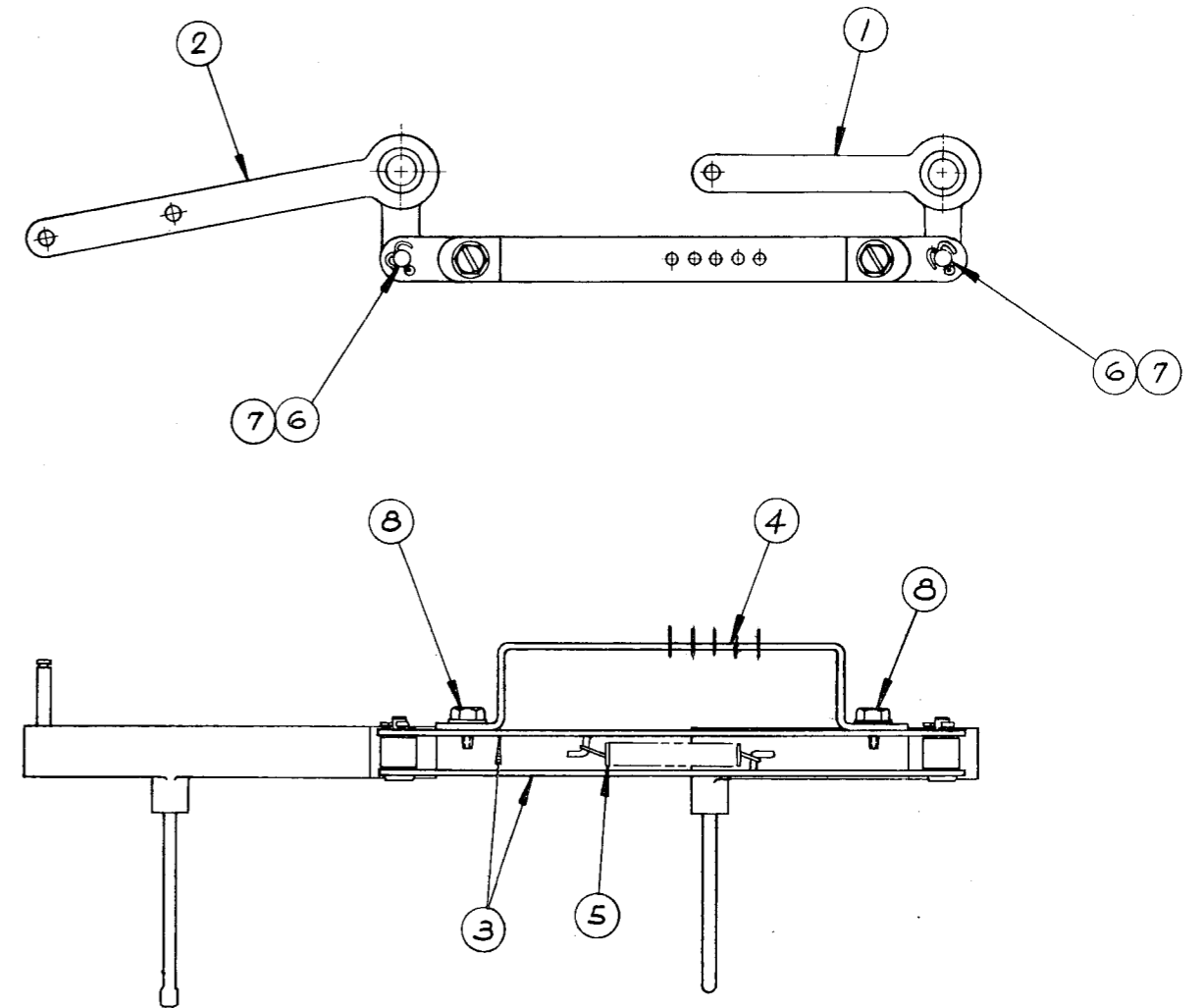
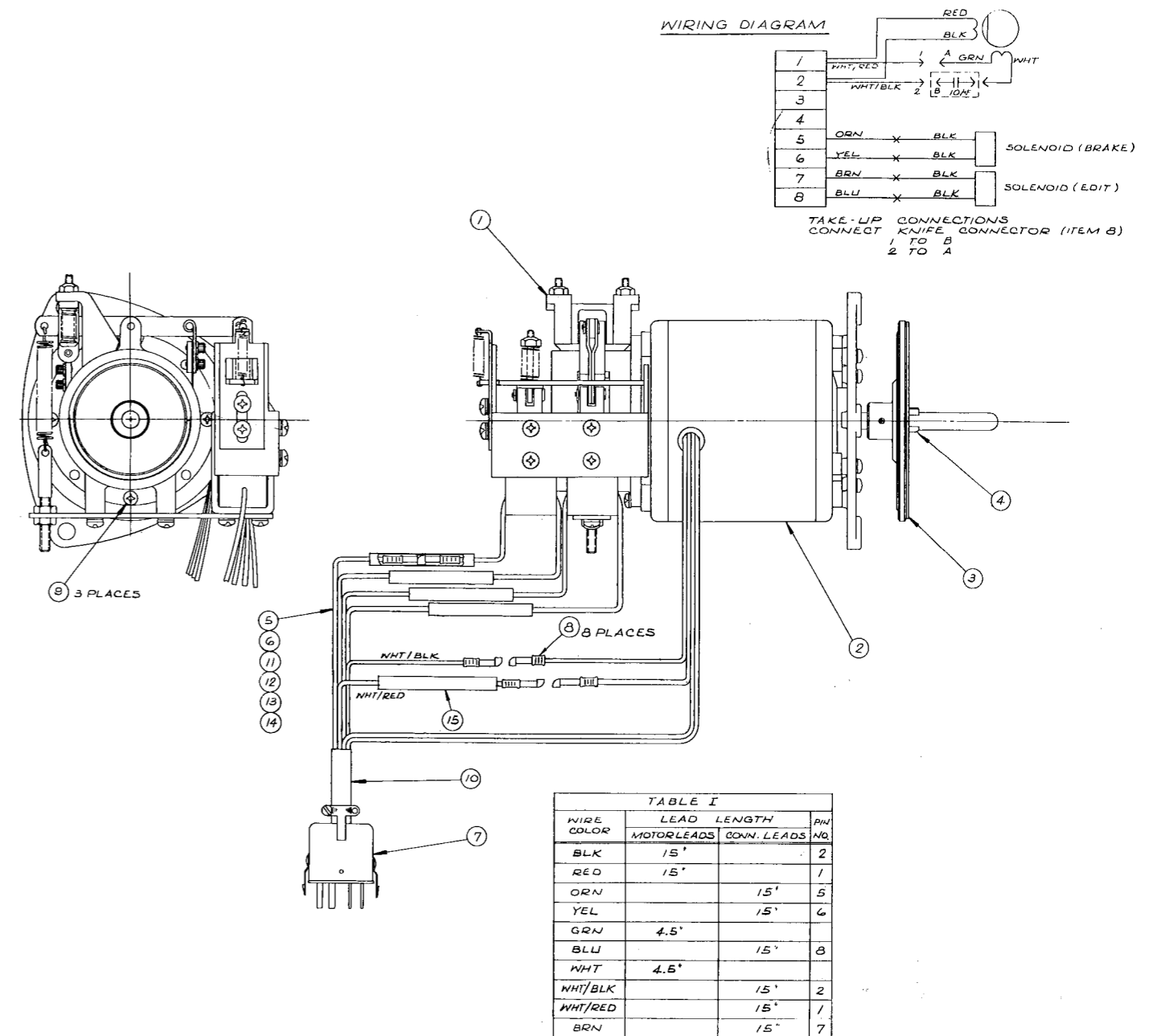


Fig. 6-11. Tape Lifter Assembly

TAKEUP ASSEMBLY  
 CATALOG NO. 4030265  
 (See Fig. 6-12)

ITEM -01		DESCRIPTION	Ampex Part No.
	X	Takeup, assembly	4030265-01
1	1	Brake, assembly (see Fig. 6-12)	4030264-01
2	2	Motor, assembly	4040969-01
3	1	Pad, turntable	4130163-01
4	1	Drive Plate	4320128-10
7	1	Connector, plug, 8 pins, male	145-013
8	8	Solderless Connector	171-008
		Items of standard hardware, wire, etc., not listed	



REWIND ASSEMBLY  
 CATALOG NO. 4030266  
 (See Fig. 6-13)

ITEM-01		DESCRIPTION	Ampex Part No.
	X	Rewind, assembly	
1	1	Brake, assembly (see Fig. 6-12)	4030266-01
2	1	Motor, assembly	4030264-02
3	1	Pad, turntable	4040969-01
4	1	Drive Plate	4180163-01
7	1	Connector, plug, 8 pins, male	4230128-10
8	8	Solderless connectors	145-013 171-008
		Items of standard hardware, wire, etc., not listed.	

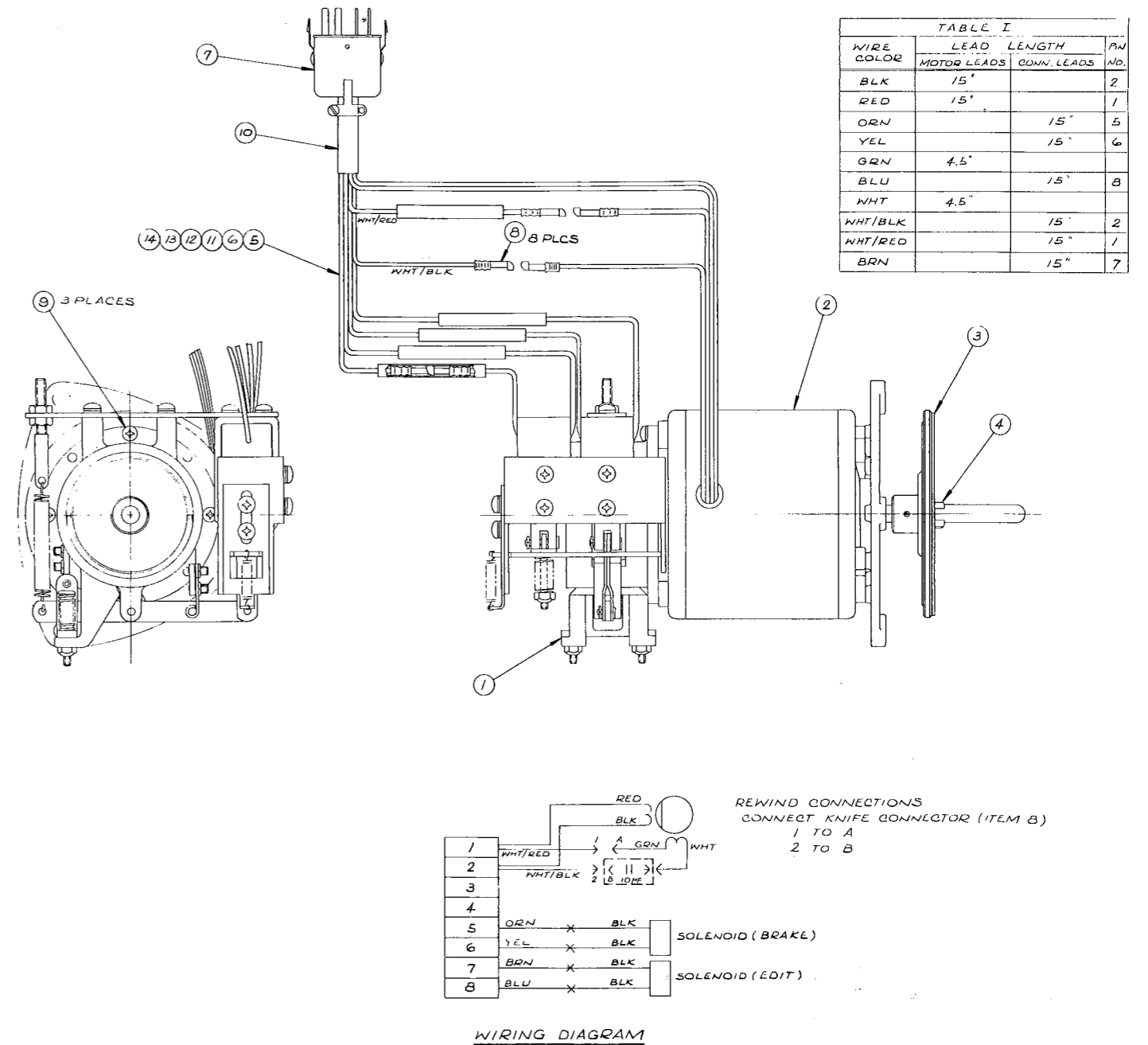
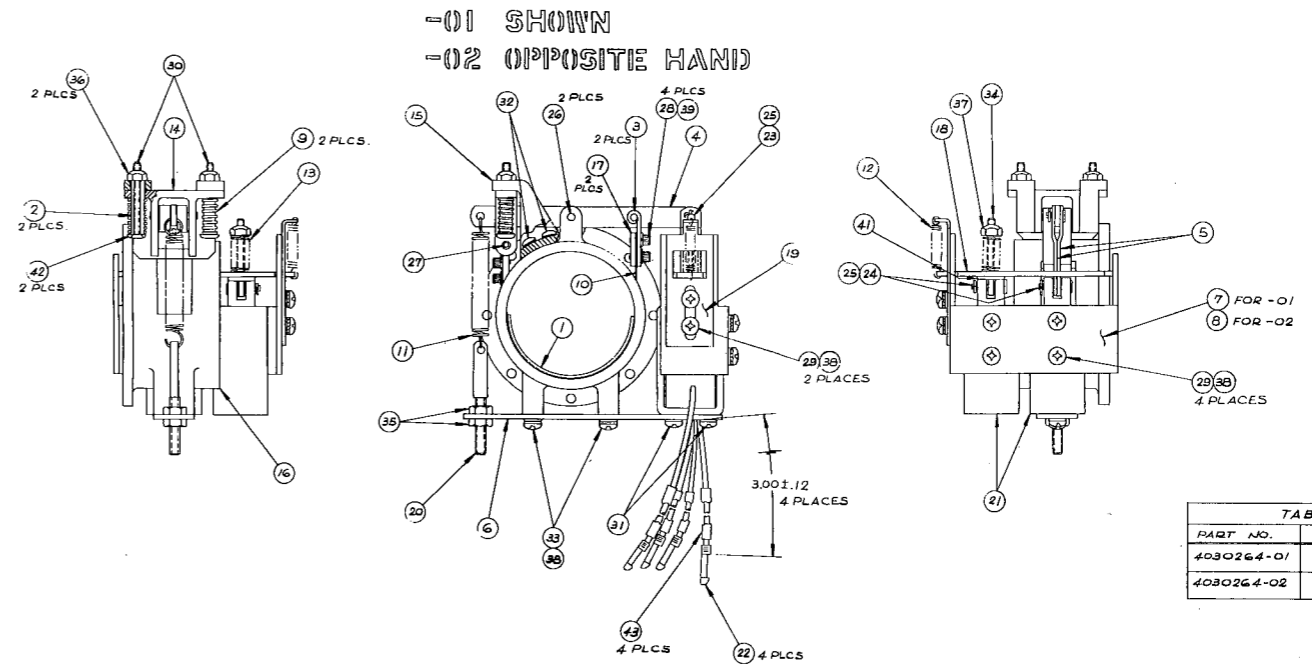


Fig. 6-13. Rewind Assembly

BRAKE ASSEMBLY  
 CATALOG NO. 4030264  
 (See Fig. 6-14)

ITEM	-01	-02	DESCRIPTION	Ampex Part No.
		X	Brake, assembly, takeup	4030264-01
		X	Brake, assembly, rewind	4030264-02
1	1	1	Band, assembly	4040414-10
2	2	2	Spacer	4220141-10
3	2	2	Link, brake band	4230161-10
4	1	1	Lever, brake	4230162-10
5	2	2	Link, solenoid	4230163-10
6	1	1	Bracket, solenoid	4260183-10
7	1	1	Bracket, edit solenoid	4260386-03
8	1	1	Bracket, edit solenoid	4260386-04
9	2	2	Spring, compression	4270163-10
10	1	1	Spring, leaf	4270164-10
11	1	1	Spring, brake	4270178-10
12	1	1	Spring, edit brake return	4270251-01
13	1	1	Spring, compression	352-085
14	1	1	Cross Head, brake	4330109-10
15	1	1	Anchor, brake	4330110-10
16	1	1	Housing, brake	4330112-10
17	2	2	Clamp, band link	4330113-10
19	1	1	Anchor, spring, edit solenoid	4330260-01
20	1	1	Bolt, spade	4400496-60
21	2	2	Solenoid, brake	4590067-10
22	4	4	Solderless Connectors	171-008

Items of standard hardware not listed.



REEL IDLER ASSEMBLY  
 CATALOG NO. 4040970  
 (See Fig. 6-15)

ITEM	-02	DESCRIPTION	Ampex Part No.
X		Reel Idler, assembly	4040970-02
1	1	Pulley, assembly	4040408-80
2	1	Bushing (see note below)	4200121-10
4	1	Tape Guide	4210311-01
5	1	Arm, reel idler (see note below)	4230245-01
6	1	Spring, tension, arm	4270160-20
7	1	Housing, reel idler	4290272-10
8	1	Mount, reel idler (see note below)	4290273-10
9	1	Screw, tape guide mounting	4400593-01
11	1	Washer, .003 thick	4440282-01
12	a/r	Washer, .025 thick	4440282-02
15	1	Spring, compression	352-084
17	2	Bearing, ball	421-116
18	3	Retaining ring, internal	430-027

NOTE  
 Items 2, 5, and 8, not replaceable separately.  
 Contact Ampex Technical Support, Professional Audio,  
 for information if replacement is required.

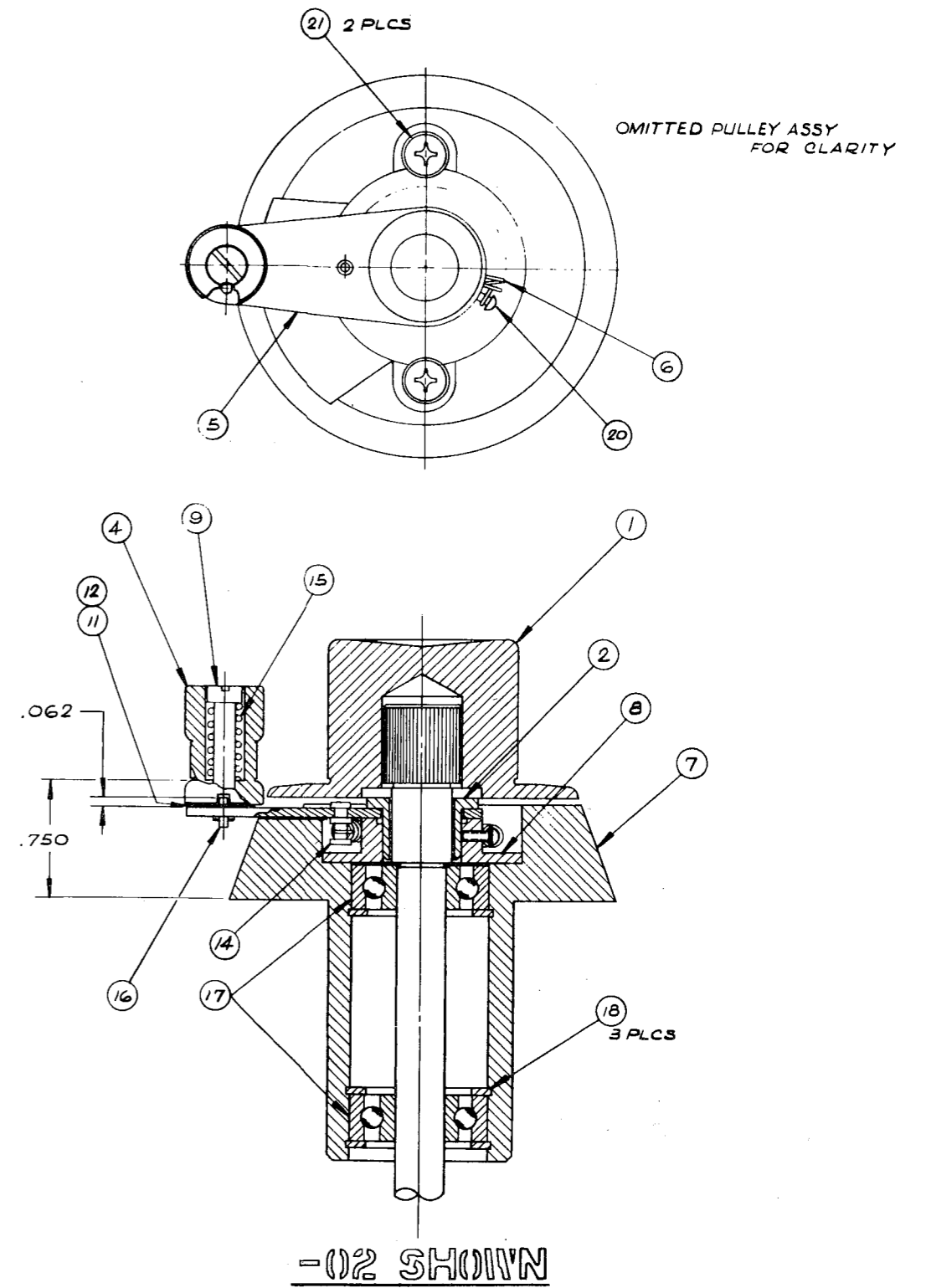
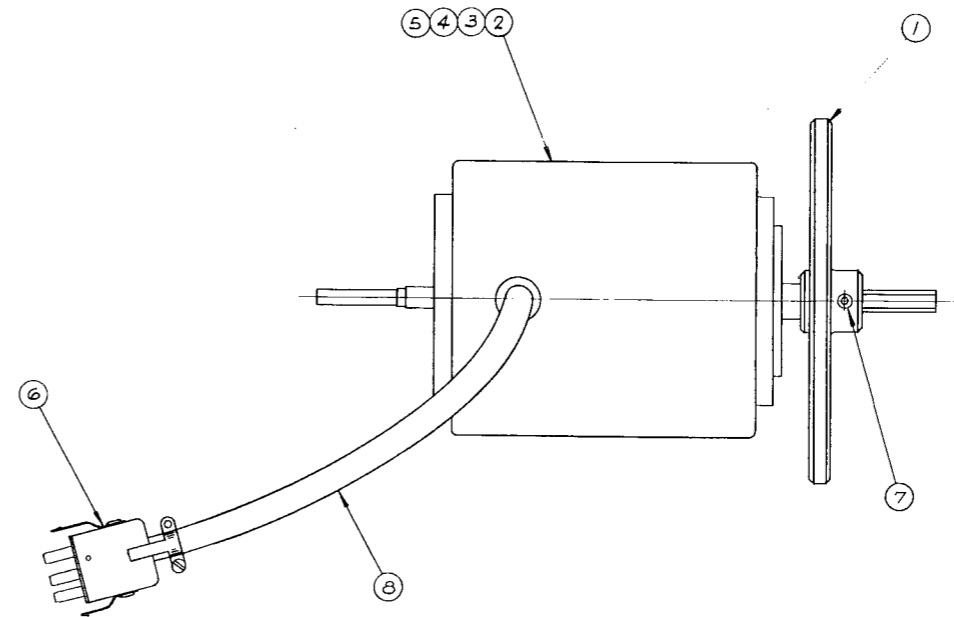


Fig. 6-15. Reel Idler Assembly

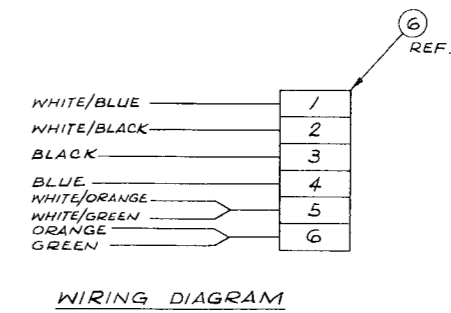
DRIVE MOTOR ASSEMBLY  
 CATALOG NO. 4040993  
 (See Fig. 6-16)

ITEM	-01	-02	-03	-04	DESCRIPTION	Ampex Part No.
	X				Drive Motor, assembly, 7 1/2 and 15 ips, 60 Hz	4040993-01
		X			Drive Motor, assembly, 3 3/4 and 7 1/2 ips, 60 Hz	4040993-02
			X		Drive Motor, assembly, 7 1/2 and 15 ips, 50 Hz	4040993-03
				X	Drive Motor, assembly, 3 3/4 and 7 1/2 ips, 50 Hz	4040993-04
1	1	1			Flywheel	4250113-10
2	1				Motor, drive	4590120-01
3		1			Motor, drive	4590120-02
4			1		Motor, drive	4590121-01
5				1	Motor, drive	4590121-02
6	1	1	1	1	Connector, plug, 6 pins, male	145-012
7	1	1	1	1	Screw, set, hex socket, cup point, 10-32 x 1/4	477-336
9			1	1	Flywheel	4250114-10

NOTE  
 Capstan hard chrome plated (drive motor)



PART NO.	SPEED	CYCLE
4040993-01	7.5 - 15 IPS	60
4040993-02	3.75 - 7.5 IPS	60
4040993-03	7.5 - 15 IPS	50
4040993-04	3.75 - 7.5 IPS	50



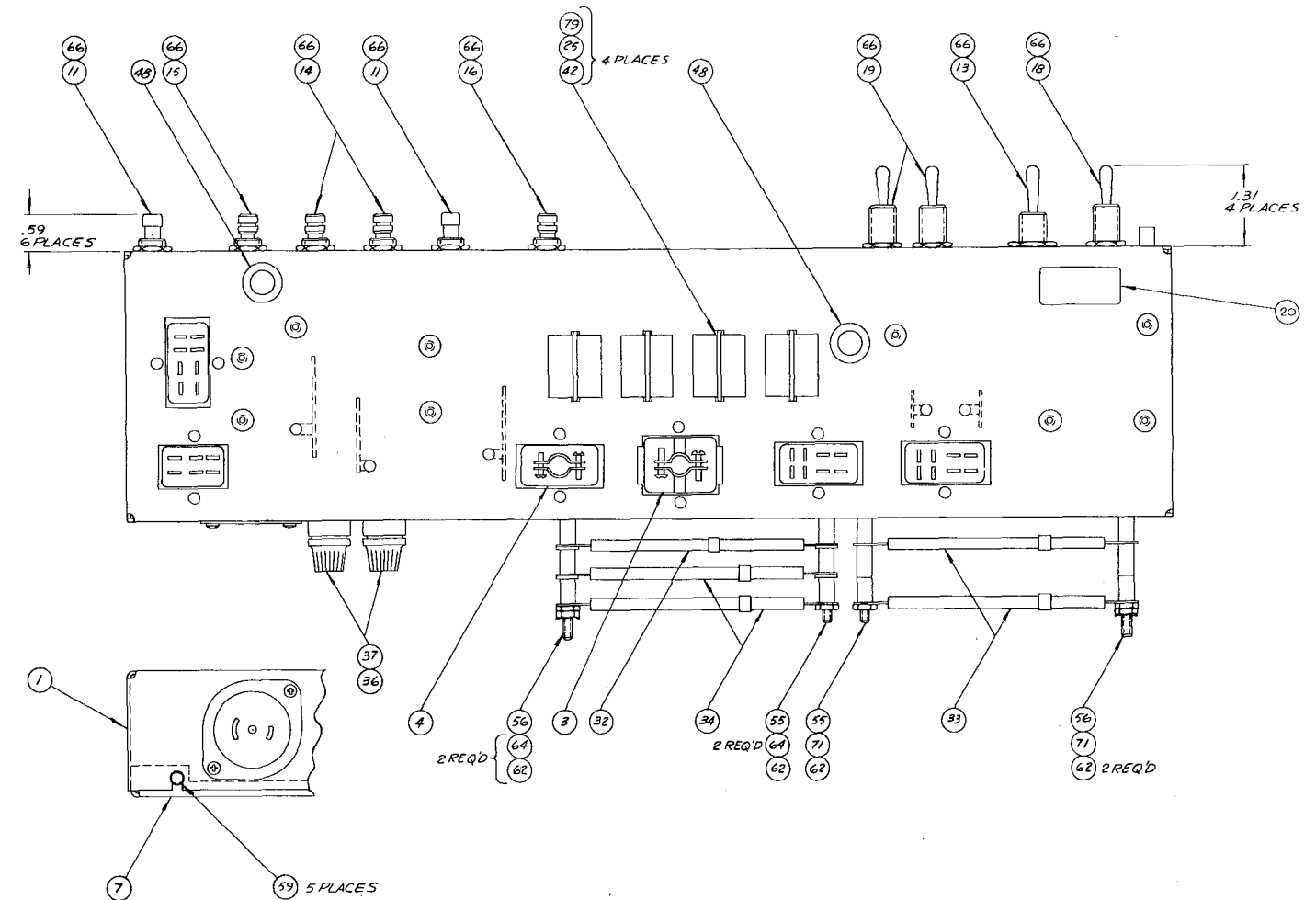


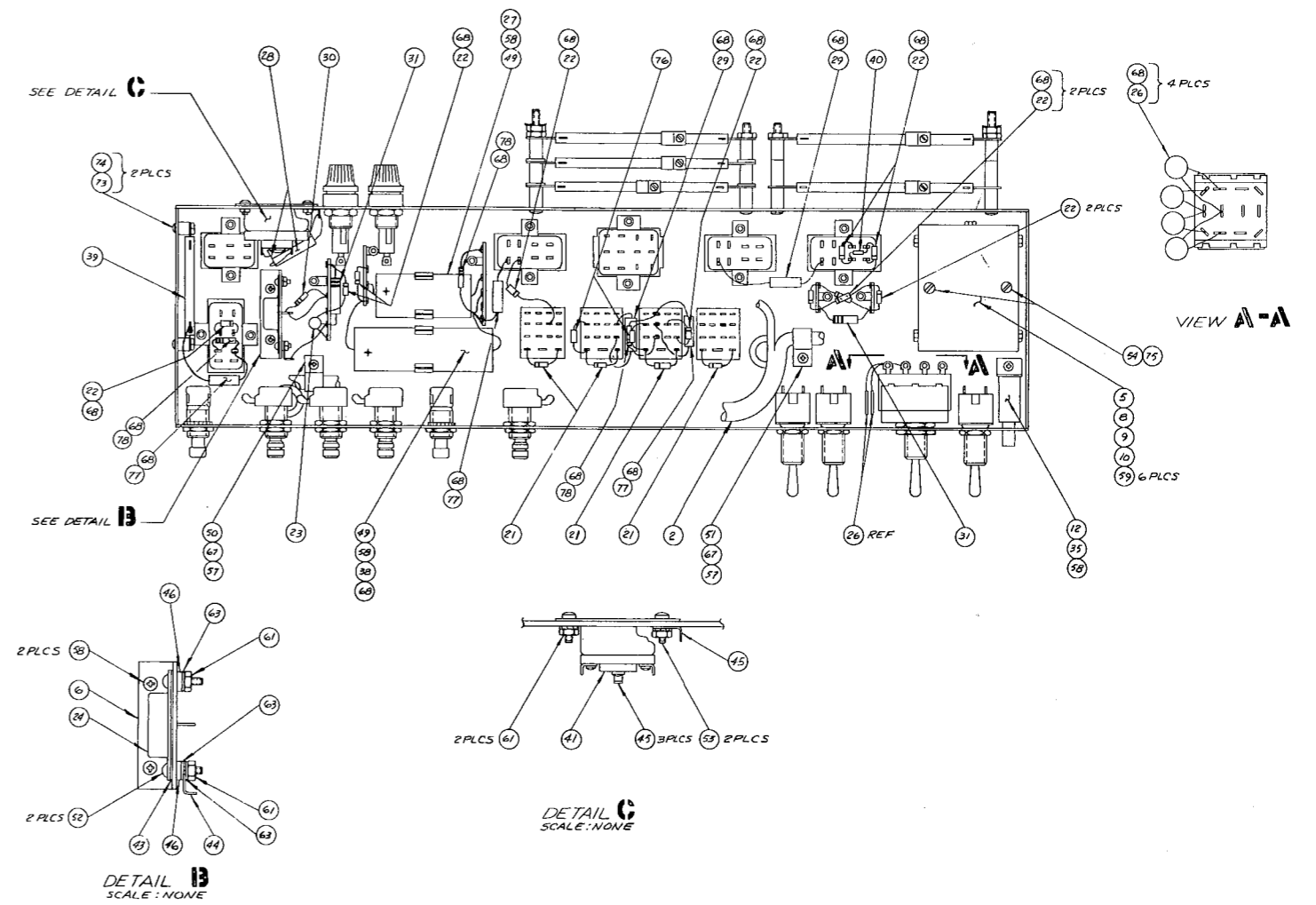
CONTROL BOX  
 CATALOG NO. 4020083  
 (See Figs. 6-17 and 6-18)

(Alpha-Numerical listing of electronic parts with Fig. 6-20)

ITEM -01	DESCRIPTION	Ampex Part No.
X	Control Box	4020083-01
3	1 Dummy Plug, remote control (P605P)	4050444-01
4	1 Dummy Plug, motor drive amplifier (P604P)	4050138-10
5	1 Insulator, wraparound, transformer	4170108-01
6	1 Bracket, transistor mounting	4260399-01
7	1 Cover, assembly, control box	4041015-01
8	1 Transformer, power, (T601)	4580198-01
9	1 Shield, power transformer	4600149-01
10	2 Shield, power transformer	4600150-01
11	2 Switch, pushbutton (S608, S611)	4620064-01
12	1 Lamp Holder, pilot light	4610083-01
13	1 Switch, speed, 3 P. D. T., toggle (S602)	4620053-01
14	2 Switch, pushbutton, normally open (S604, S605)	4620144-10
15	1 Switch, pushbutton, normally closed (S606)	4620144-20
16	1 Switch, pushbutton, normally open (S609)	4620144-30
18	1 Switch, power (S601)	4620199-01
19	2 Switch, reel (S607, S610)	4620200-01
21	4 Diode, silicon (CR608, CR609, CR612, CR614)	013-599
22	11 Diode, silicon (CR601 thru CR607, CR610, CR611, CR613, CR615)	013-678
23	1 Transistor, silicon, (Q601)	014-611
24	1 Transistor, germanium, 40022 (Q602)	014-728
25	4 Relay, 4PDT (K601, K602, K603, K604)	020-144
26	4 Capacitor, ceramic; .02 mfd, 500 vdcw (C602, C603, C604, C605)	030-001
27	1 Capacitor, electrolytic; 500 mfd, 50 vdcw (C609)	031-134
28	2 Capacitor, ceramic disc; .005 mfd, 1400 vdcw (C606, C607)	030-465
29	2 Capacitor, paper; .047 mfd, 400 vdcw (C608, C613)	035-985
30	1 Resistor, fixed, comp.; 10 ohms, 10%, 1/2w (R601)	041-032
31	2 Resistor, fixed, comp.; 1,200 ohms, ±10%, 1w (R602, R603)	041-147
32	1 Resistor, adjustable, wirewound; 750 ohms, 55w (R607)	059-013
33	2 Resistor, adjustable, wirewound; 150 ohms, 55w (R604, R605)	059-014
34	2 Resistor, adjustable, wirewound; 100 ohms, 55w (R606, R608)	059-015
35	1 Lamp, 120V, .025 amp (DS601)	060-323
36	2 Fuse, 3 amp, slo-blo (F601, F602)	070-002
37	2 Fuseholder, short body	085-001
38	1 Capacitor, electrolytic; 150 mfd, 180 vdcw (C614)	031-624
39	1 Resistor, wirewound; 20 ohms, 20w (R609)	059-056
40	1 Resistor, fixed, comp.; 47,000 ohms, 1w (R611)	041-166
41	1 Connector, power; 3 contacts, male (J601S)	147-079
42	4 Socket, relay	150-119
43	1 Washer, mica, transistor mounting	014-703
46	2 Washer, shoulder, nylon	503-089
49	2 Clamp, capacitor	301-011
50	1 Clamp, cable, plastic, 7/16 ID	302-006
51	1 Clamp, cable, plastic, 3/8 ID	302-036
71	2 Spacer, plain	280-026
76	2 Resistor, fixed, comp.; 180 ohms, 1/2w (R610, R615)	041-257
77	3 Capacitor, paper; 0.1 mfd, 400 vdcw (C610, C611, C612)	035-999
78	3 Resistor, fixed, comp.; 100 ohms, 1/2w (R612, R613, R614)	041-038
79	4 Spring, relay hold down	020-492
4	Connector, receptacle, 8 sockets, female (J603S, J604S, J606S, J607S)	146-003
1	Connector, receptacle, 6 sockets, female (J602S)	146-004
1	Connector, receptacle, 12 sockets, female (J605S)	146-009

Items of standard hardware, wire, etc., not listed.





PARTS LIST ON FIG. 6-17.

Fig. 6-18. Control Box Assembly, Inner

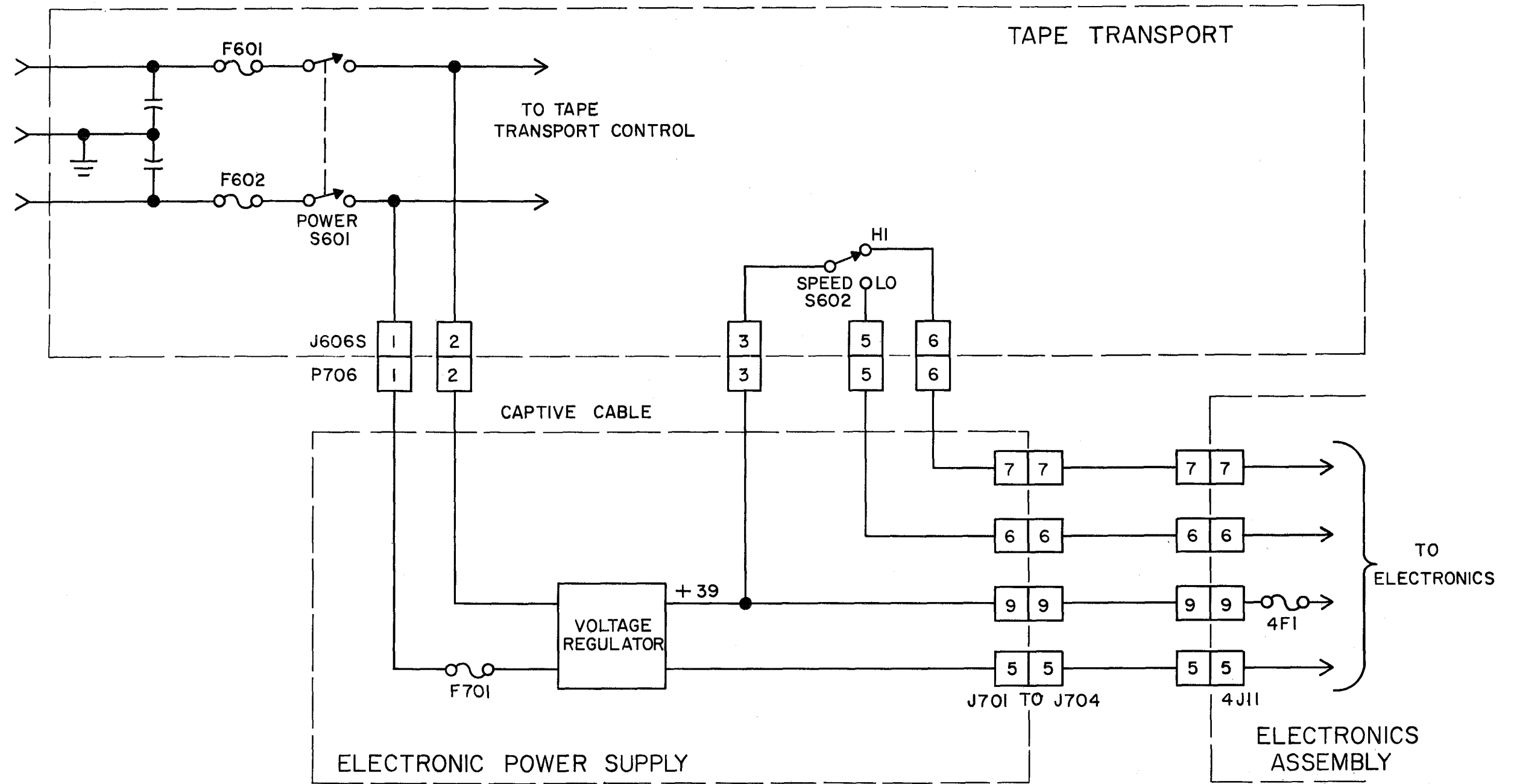


Fig. 6-19. Fusing Diagram

ELECTRONIC COMPONENTS, TAPE TRANSPORT  
(See Fig. 6-20)

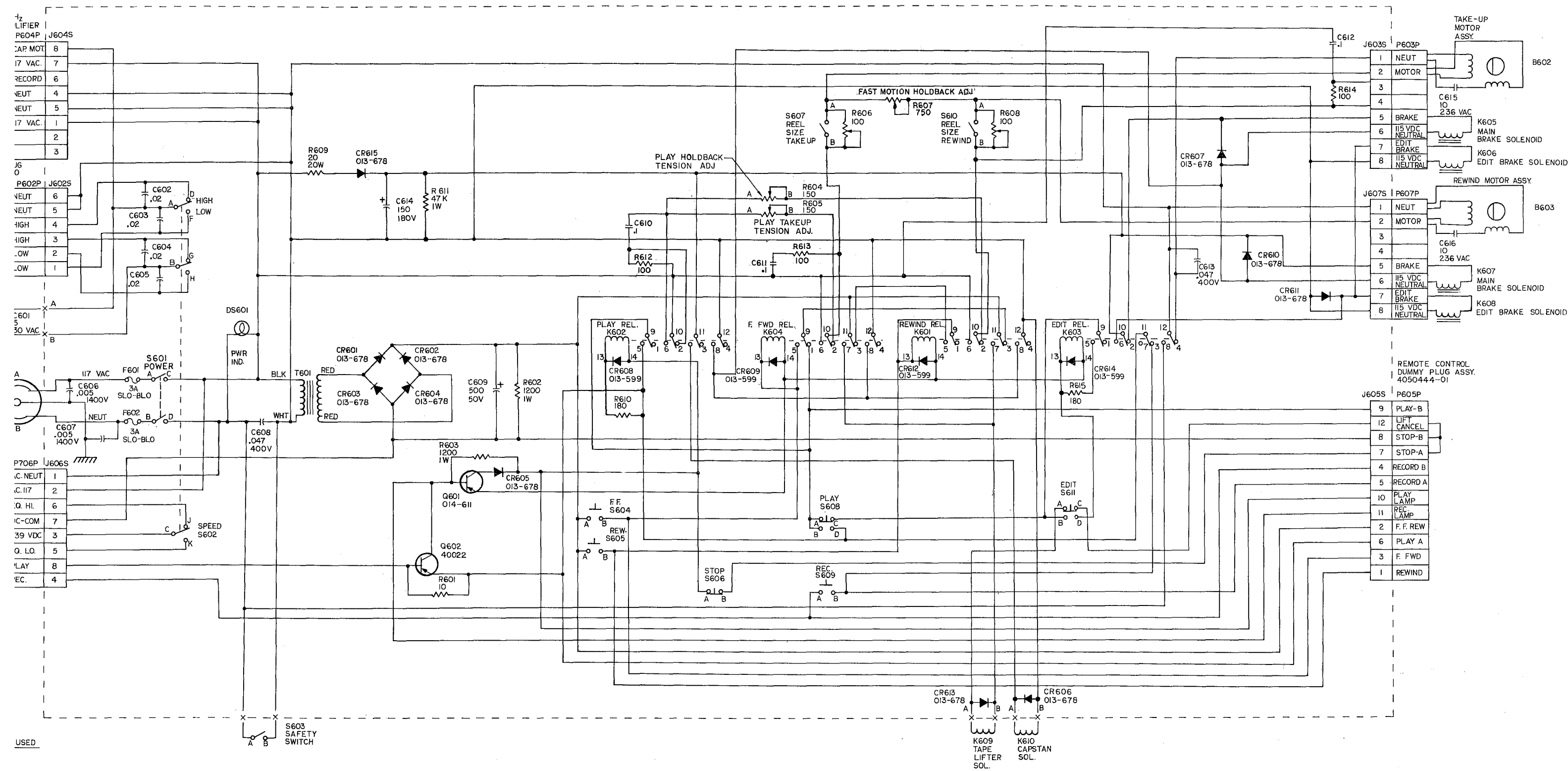
(Location of components in control box shown with Figs. 6-17 and 6-18)

Ref. No.	Qty	DESCRIPTION	LOCATION	Ampex Part No.
B601	1	Motor, drive, assembly (see Fig. 6-14)	T	4040993
B602	1	Motor, takeup, assembly (see Fig. 6-10)	T	4030265-01
B603	1	Motor, rewind, assembly (see Fig. 6-11)	T	4030266-01
C601	1	Capacitor, assembly, drive motor	T	4040591-02
	1	Capacitor, 5.0 mfd, 330 vac		4540292-30
	1	Safety Boot		032-082
	2	Solderless Connectors		171-008
C602	4	Capacitor, ceramic disc; .02 mfd, 500 vdcw	CB	030-001
C603	-	Same as C602	CB	
C604	-	Same as C602	CB	
C605	-	Same as C602	CB	
C606	2	Capacitor, ceramic disc; .005 mfd, -20+80%, 1400 vdcw	CB	030-465
C607	-	Same as C606	CB	
C608	2	Capacitor, mylar, tubular; .047 mfd, ±20%, 400 vdcw	CB	035-985
C609	1	Capacitor, electrolytic; 500 mfd, -10+150%, 50 vdcw	CB	031-134
C610	3	Capacitor, mylar, tubular; 0.1 mfd, ±10%, 400 vdcw	CB	035-999
C611	-	Same as C610	CB	
C612	-	Same as C610	CB	
C613	-	Same as C608	CB	
C614	1	Capacitor, electrolytic; 150 mfd, -10+100%, 180 vdcw	CB	031-624
C615	2	Capacitor, assembly, takeup motor	T	4050361-10
	2	Capacitor, 10 mfd, 236 vac		4540312-10
	2	Safety Boot		032-082
	4	Solderless Connectors		171-008
C616	-	Same as C615, for rewind motor	T	
CR601	11	Diode, silicon, large signal, rectifier	CB	013-678
CR602	-	Same as CR601	CB	
CR603	-	Same as CR601	CB	
CR604	-	Same as CR601	CB	
CR605	-	Same as CR601	CB	
CR606	-	Same as CR601	CB	
CR607	-	Same as CR601	CB	
CR608	4	Diode, silicon, small signal, switching	CB	013-599
CR609	-	Same as CR608	CB	
CR610	-	Same as CR601	CB	
CR611	-	Same as CR601	CB	
CR612	-	Same as CR608	CB	
CR613	-	Same as CR601	CB	
CR614	-	Same as CR608	CB	
CR615	-	Same as CR601	CB	
DS601	1	Lamp, incandescent; 120 volts, .025 amp	CB	060-323
F601	2	Fuse, slo-blo; 3 amps, 125 volts	CB	070-002
F602	-	Same as F601	CB	
J601S	1	Connector, power, 3 contacts, male; flush base, polarized	CB	147-079
J602S	1	Connector, receptacle, 6 sockets, female	CB	146-004
J603S	4	Connector, receptacle, 8 sockets, female	CB	146-003
J604S	-	Same as J603S	CB	
J605S	1	Connector, receptacle, 12 sockets, female	CB	146-009
J606S	-	Same as J603S	CB	
J607S	-	Same as J603S	CB	
K601	4	Relay, armature, 4P2T; 24 volts, 650 ohms; with nylon dust cover	CB	020-144
K602	-	Same as K601	CB	
K603	-	Same as K601	CB	
K604	-	Same as K601	CB	
K605	4	Solenoid, takeup, main brake (see Fig. 6-12)	T	4590067-10
K606	-	Same as K605 (takeup edit brake) (see Fig. 6-12)	T	
K607	-	Same as K605 (supply main brake) (see Fig. 6-12)	T	
K608	-	Same as K605 (supply edit brake) (see Fig. 6-12)	T	
K609	1	Solenoid, assembly, tape lifter (see Figs. 6-6 and 6-7)	T	4030273
K610	1	Solenoid, assembly, capstan idler (see Figs. 6-6 and 6-7)	T	4030272
P601P	-	Not used		
P602P	1	Connector, plug, 6 pins, male (drive motor -- see Fig. 6-14)	T	145-012

ELECTRONIC COMPONENTS, TAPE TRANSPORT  
(cont.)

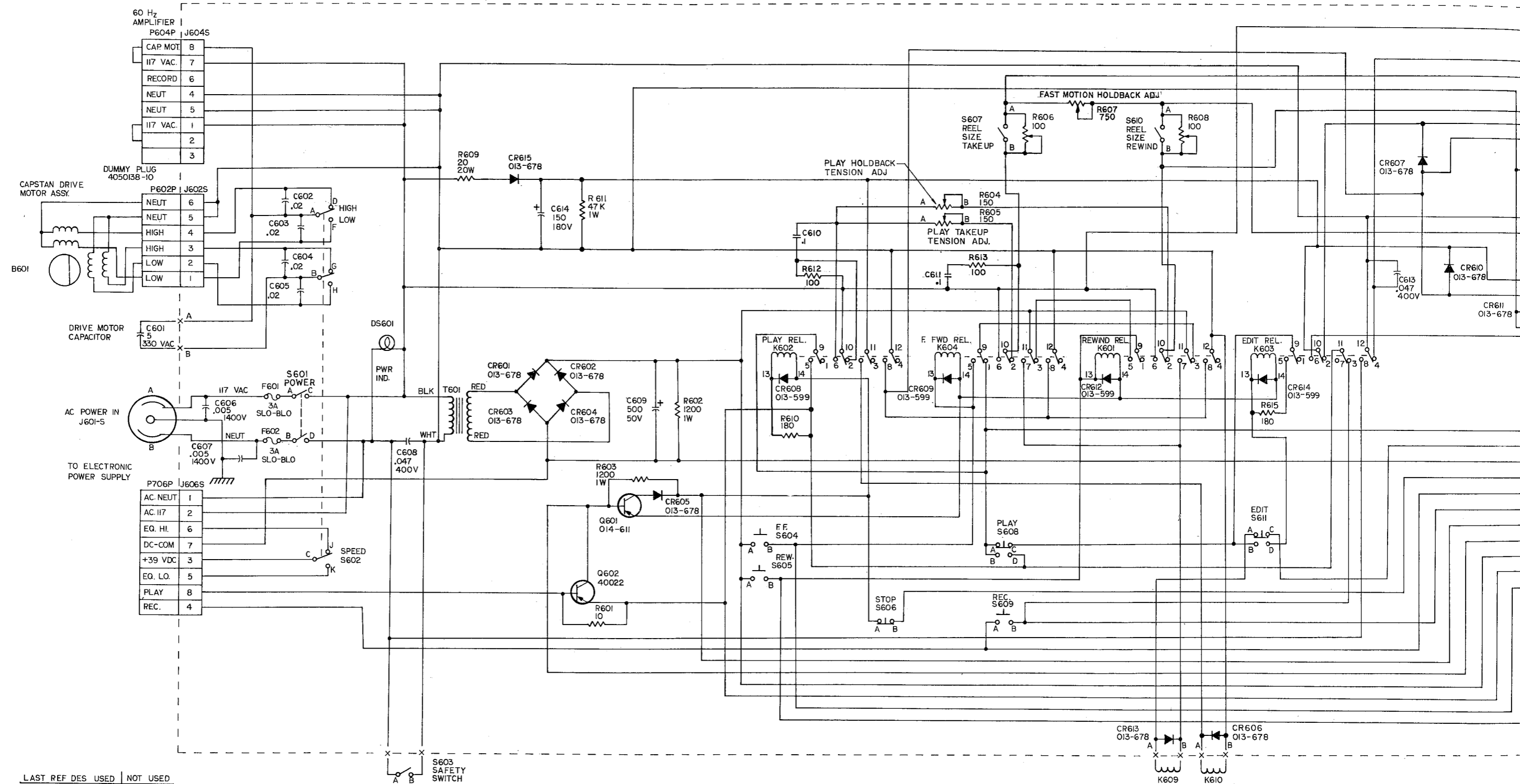
Ref. No.	Qty	DESCRIPTION	LOCATION	Ampex Part No.
P603P	2	Connector, plug, 8 pins, male (takeup motor--see Fig. 6-10)	T	145-013
P604P	1	Dummy Plug, motor drive amplifier	CB	4050138-10
P605P	1	Dummy Plug, remote control	CB	4050444-01
P606P	-	Not used		
P607P	-	Same as P603P (rewind motor -- see Fig. 6-11)	T	
Q601	1	Transistor, silicon, pnp, 300 mw	CB	014-611
Q602	1	Transistor, Germanium, power, pnp; 40022	CB	014-728
R601	1	Resistor, fixed, comp; 10 ohms, ±10%, 1/2w; RC20GF100K	CB	041-032
R602	2	Resistor, fixed, comp; 1,200 ohms, ±10%, 1w; RC32GF122K	CB	041-147
R603	-	Same as R602	CB	
R604	2	Resistor, wirewound, adjustable; 150 ohms, ±10%, 55w	CB	059-014
R605	-	Same as R604	CB	
R606	2	Resistor, wirewound, adjustable; 100 ohms, ±10%, 55w	CB	059-015
R607	1	Resistor, wirewound, adjustable; 750 ohms, ±10%, 55w	CB	059-013
R608	-	Same as R606	CB	
R609	1	Resistor, wirewound, fixed; 20 ohms, ±5%, 20w	CB	059-056
R610				
R611				
R612	3	Resistor, fixed, comp; 100 ohms, ±10%, 1/2w; RC20GF101K	CB	041-038
R613	-	Same as R612	CB	
R614	-	Same as R612	CB	
R615			CB	
S601	1	Switch, power, toggle; DPST, 2 position	CB	4620199-01
S602	1	Switch, speed, toggle; 3PDT, 2 position (on-on)	CB	4620053-01
S603	1	Switch, safety, assembly; (switch only, Part No. 4620145-01)	CB	4050436-01
S604	2	Switch, fast forward, pushbutton; normally open	CB	4620144-10
S605	-	Same as S604, (rewind pushbutton)	CB	
S606	1	Switch, stop, pushbutton; normally closed	CB	4620144-20
S607	2	Switch, reel, takeup; toggle; SPST	CB	4620200-01
S608	2	Switch, play, pushbutton; 2 circuit	CB	4620064-01
S609	1	Switch, record, pushbutton; normally open	CB	4620144-30
S610	-	Same as S607; (rewind pushbutton)	CB	
S611	-	Same as S608; (edit pushbutton)	CB	
T601	1	Transformer, power	CB	4580198-01

LOCATION GUIDE: T (TRANSPORT)  
CB (CONTROL BOX)



NOTES: UNLESS OTHERWISE SPECIFIED.  
 1. ALL RESISTOR VALUES ARE IN OHMS, 1/2 W, 10%.  
 2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

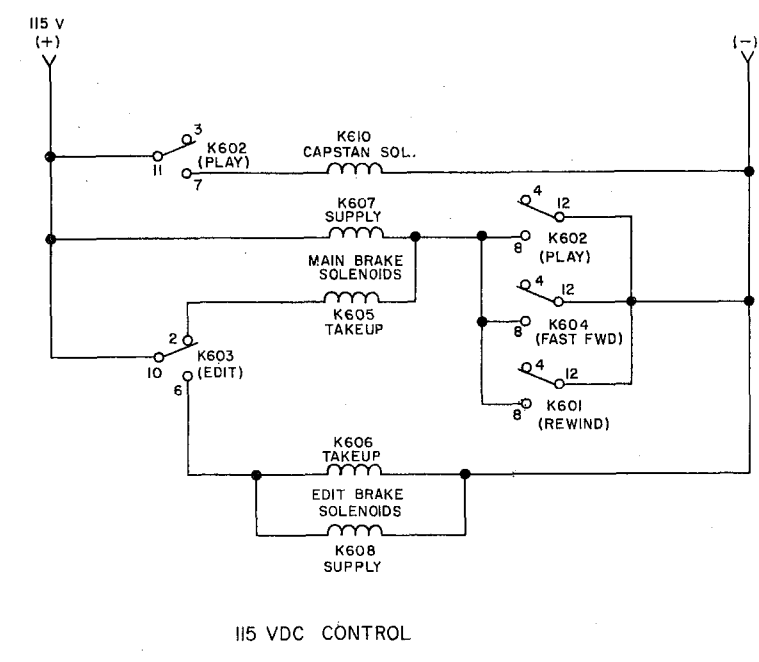
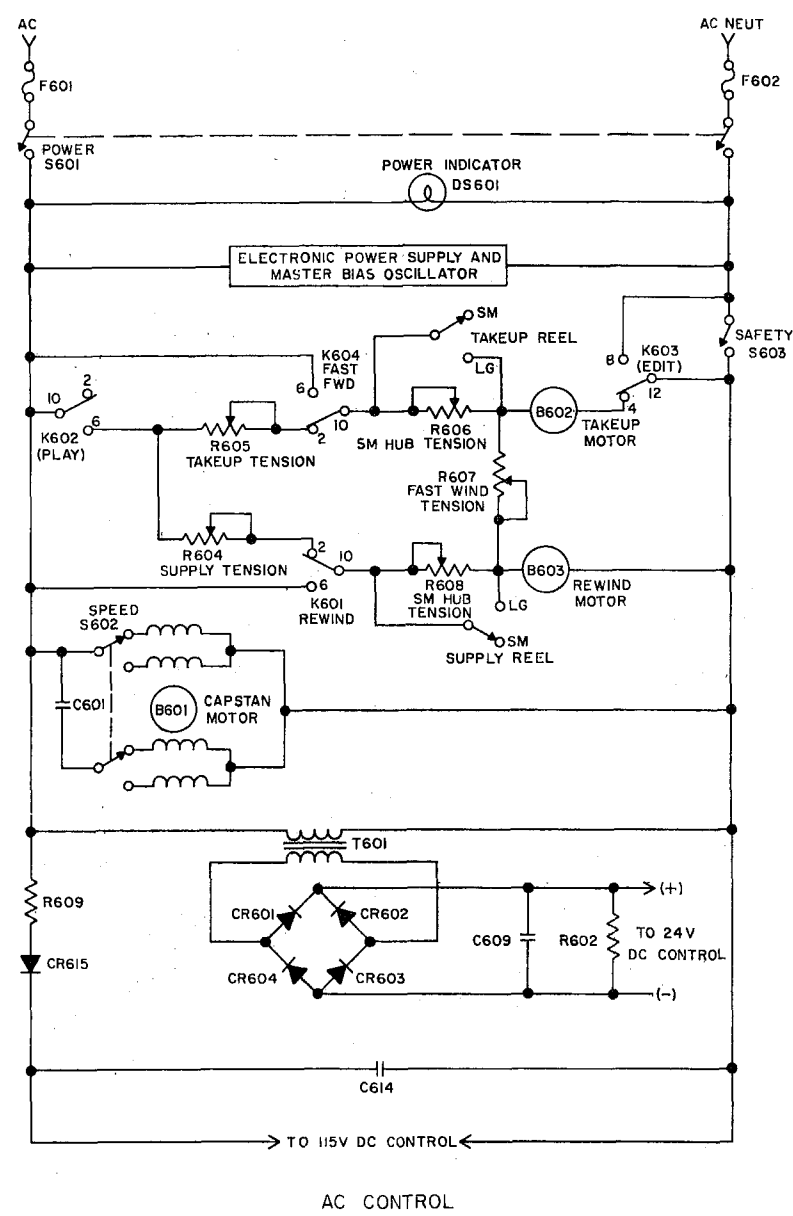
Fig. 6-20. Tape Transport Schematic



LAST REF DES USED	NOT USED
R615	
C614	
Q602	
F602	
CR615	
T601	
DS601	
J607S	
P607P	
K610	
S611	
B603	
	P601P

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTOR VALUES ARE IN OHMS, 1/2 W, 10%.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.



- RELAYS**  
 K601 REWIND  
 K602 PLAY  
 K603 EDIT  
 K604 FAST FWD  
 K1 RECORD (ELECTRONICS)
- SOLENOIDS**  
 K605 MAIN BRAKE, TAKEUP  
 K606 EDIT BRAKE, TAKEUP  
 K607 MAIN BRAKE, SUPPLY  
 K608 EDIT BRAKE, SUPPLY  
 K609 TAPE LIFTER  
 K610 CAPSTAN

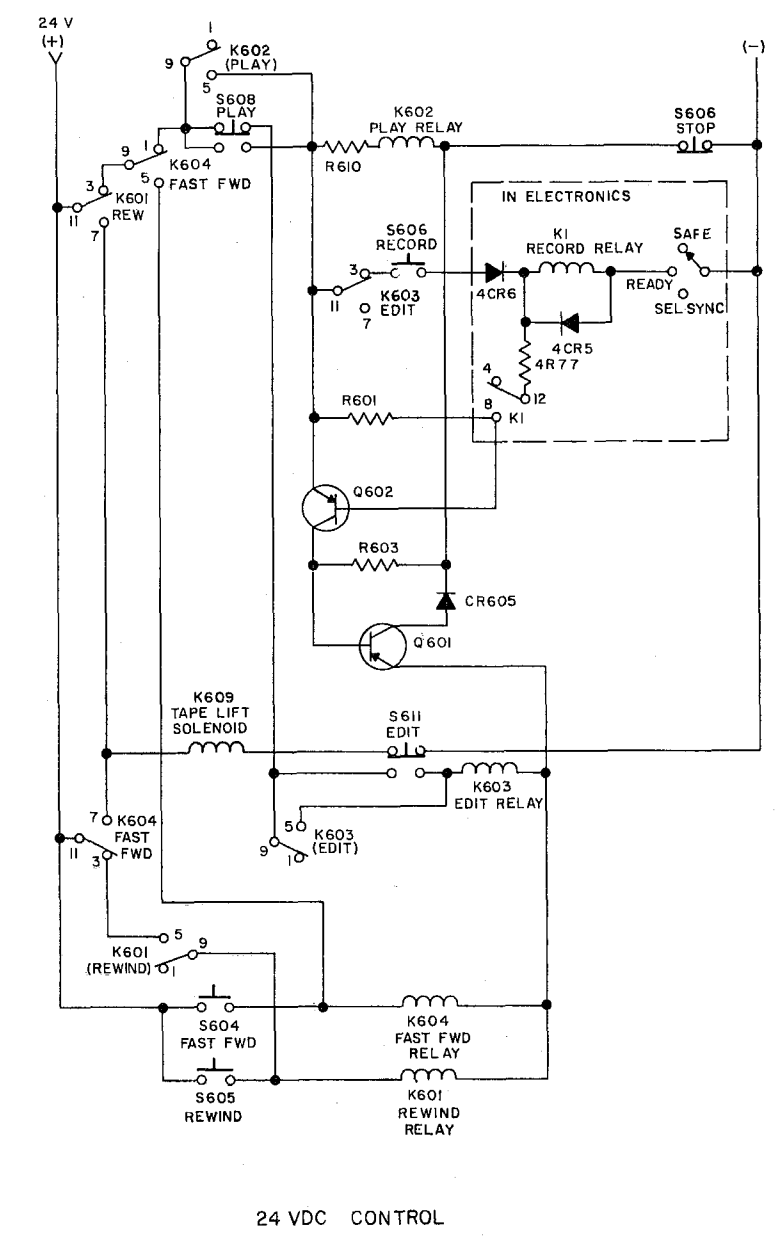


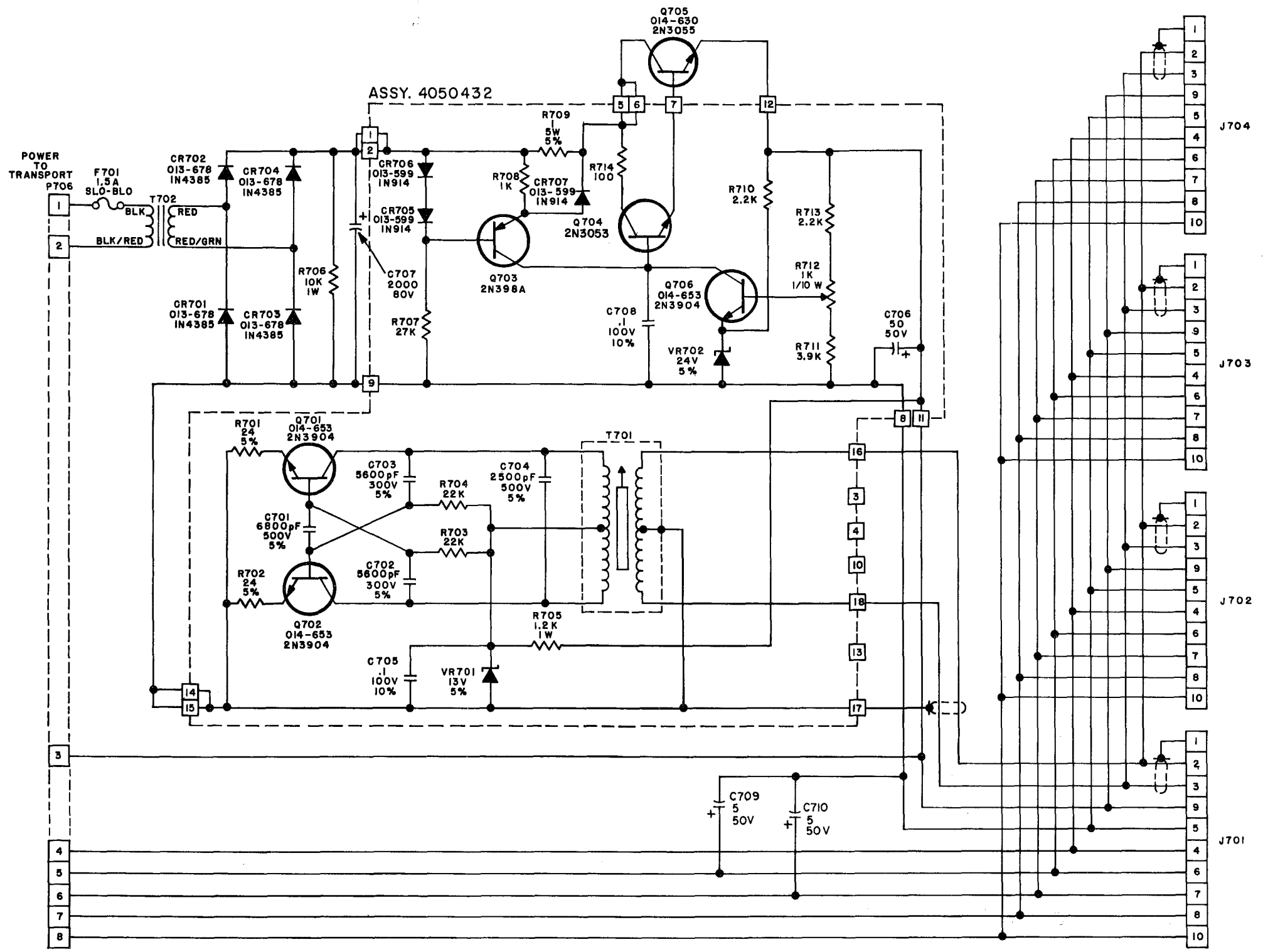
Fig. 6-21. Tape Transport Schematic, Simplified



RECORD/REPRODUCE  
POWER SUPPLY ASSEMBLY  
CATALOG NO. 4020274-01  
(see Fig. 6-22)

Ref. No.	Qty	DESCRIPTION	Ampex Part No.
C701	1	Capacitor, mica; 6800 pfd, $\pm 5\%$ , 500 vdcw	056-108
C702	2	Capacitor, mica; 5600 pfd, $\pm 5\%$ , 300 vdcw	034-507
C703	-	Same as C702	
C704	1	Capacitor, mica; 2500 pfd, $\pm 5\%$ , 500 vdcw	034-994
C705	2	Capacitor, mylar; 0.1 mfd, $\pm 10\%$ , 100 vdcw	055-106
C706	1	Capacitor, electrolytic; 50 mfd, $-10+75\%$ , 50 vdcw	031-187
C707	1	Capacitor, electrolytic; 2000 mfd, $-10+250\%$ , 80 vdcw	* 4550147-03
C708	-	Same as C705	
C709	2	Capacitor, electrolytic; 5 mfd, $-10+75\%$ , 50 vdcw	031-205
C710	-	Same as C709	
CR701	4	Diode, silicon, large signal rectifier	* 013-678
CR702	-	Same as CR701	*
CR703	-	Same as CR701	*
CR704	-	Same as CR701	*
CR705	3	Diode, silicon, small signal switching	013-599
CR706	-	Same as CR705	
CR707	-	Same as CR705	
F701	1	Fuse, slo-blo; 1.5 amp, 125v	* 070-075
J701	4	Connector, receptacle; 10 sockets, female	* 146-018
J702	-	Same as J701	*
J703	-	Same as J701	*
J704	-	Same as J701	*
P706	1	Connector, plug; 8 pins, male	* 145-013
Q701	3	Transistor, silicon	014-653
Q702	-	Same as Q701	
Q703	1	Transistor, Germanium, 2N398A	014-704
Q704	1	Transistor, silicon; 2N3053	014-590
Q705	1	Transistor, silicon, power	014-630
Q706	-	Same as Q701	
R701	2	Resistor, fixed, comp; 24 ohms, $\pm 5\%$ , 1/2w; RC20GF240J	041-533
R702	-	Same as R701	
R703	2	Resistor, fixed, comp; 22,000 ohms, $\pm 10\%$ , 1/2w; RC20GF223K	041-064
R704	-	Same as R703	
R705	1	Resistor, fixed, comp; 1,200 ohms, $\pm 10\%$ , 1w; RC32GF122K	041-147
R706	1	Resistor, fixed, comp; 10,000 ohms, $\pm 10\%$ , 1w; RC32GF103K	* 041-158
R707	1	Resistor, fixed, comp; 27,000 ohms, $\pm 10\%$ , 1/2w; RC20GF273K	041-065
R708	1	Resistor, fixed, comp; 1,000 ohms, $\pm 10\%$ , 1/2w; RC20GF102K	041-048
R709	1	Resistor, fixed, wirewound; 1 ohm, $\pm 5\%$ , 5w	059-016
R710	2	Resistor, fixed, comp; 2,200 ohms, $\pm 10\%$ , 1/2w; RC20GF222K	041-052
R711	1	Resistor, fixed, comp; 3,900 ohms, $\pm 10\%$ , 1/2w; RC20GF392K	041-055
R712	1	Resistor, variable, comp; 1,000 ohms, $\pm 30\%$ , 1/10w	044-370
R713	-	Same as R710	
R714	1	Resistor, fixed, comp; 100 ohms, $\pm 10\%$ , 1/2w; RC20GF101K	041-038
T701	1	Coil, bias oscillator	4580123-01
T702	1	Transformer, power supply	* 4580156-01
VR701	1	Diode, silicon, zener; 13 volt, $\pm 5\%$	013-747
VR702	1	Diode, silicon, zener; 24 volt, $\pm 5\%$	013-712
	2	Card Guide	530-102
	1	Fuse holder, short body	085-001
	1	Kit, transistor mounting (for Q705)	014-630
	2	Pad, transistor (for Q703, Q704)	280-131

NOTE: All items except those marked \* are on  
printed circuit board



NOTES:  
 UNLESS OTHERWISE SPECIFIED  
 1. ALL CAPACITOR VALUES ARE IN MICROFARADS, RATINGS AS INDICATED.  
 2. ALL RESISTORS VALUES ARE IN OHMS, 1/2 WATT, 10%.

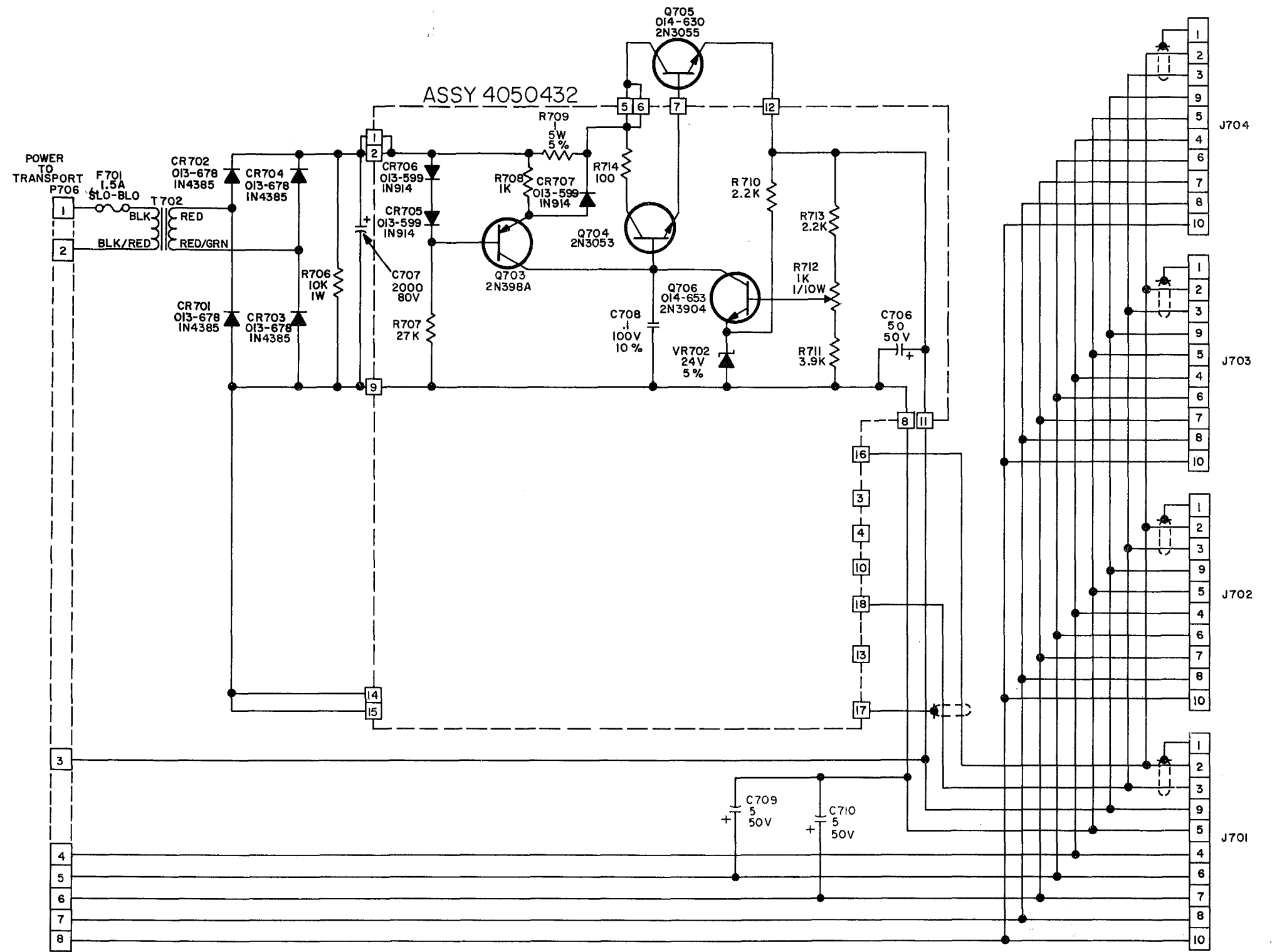
LAST REF. DES. USED	REF. DES. NOT USED
C710	
CR707	
Q706	
VR702	
T702	
R714	

Fig. 6-22. Power Supply Schematic, Record/Reproduce

REPRODUCE-ONLY  
POWER SUPPLY ASSEMBLY  
CATALOG NO. 4020274-02  
(see Fig. 6-23)

Ref. No.	Qty.	DESCRIPTION	Ampex Part No.
C706	1	Capacitor, electrolytic; 50 mfd, -10+75%, 50 vdcw	031-187
C707	1	Capacitor, electrolytic; 2000 mfd, -10+250%, 80 vdcw	* 4550147-03
C708	1	Capacitor, mylar; 0.1 mfd, ±10%, 100 vdcw	055-106
C709	2	Capacitor, electrolytic; 5 mfd, -10+75%, 50 vdcw	031-205
C710	-	Same as C709	
CR701	4	Diode, silicon, large signal rectifier	* 013-678
CR702	-	Same as CR701	*
CR703	-	Same as CR701	*
CR704	-	Same as CR701	*
CR705	3	Diode, silicon, small signal switching	013-599
CR706	-	Same as CR705	
CR707	-	Same as CR705	
F701	1	Fuse, slo-blo; 1.5 amp, 125v	* 070-075
J701	4	Connector, receptacle; 10 sockets, female	* 146-018
J702	-	Same as J701	*
J703	-	Same as J701	*
J704	-	Same as J701	*
P706	1	Connector, plug; 8 pins, male	* 145-013
Q703	1	Transistor, Germanium, 2N398A	014-704
Q704	1	Transistor, silicon; 2N3053	014-590
Q705	1	Transistor, silicon, power	014-630
Q706	1	Transistor, silicon	014-653
R706	1	Resistor, fixed, comp; 10,000 ohms, ±10%, 1w; RC32GF103K	* 041-158
R707	1	Resistor, fixed, comp; 27,000 ohms, ±10%, 1/2w; RC20GF273K	041-065
R708	1	Resistor, fixed, comp; 1,000 ohms, ±10%, 1/2w; RC20GF102K	041-048
R709	1	Resistor, fixed, wirewound; 1 ohm, ±5%, 5w	059-016
R710	2	Resistor, fixed, comp; 2,200 ohms, ±10%, 1/2w; RC20GF222K	041-052
R711	1	Resistor, fixed, comp; 3,900 ohms, ±10%, 1/2w; RC20GF392K	041-055
R712	1	Resistor, variable, comp; 1,000 ohms, ±30%, 1/10w	044-370
R713	-	Same as R710	
R714	1	Resistor, fixed, comp; 100 ohms, ±10%, 1/2w; RC20GF101K	041-038
T702	1	Transformer, power supply	* 4580156-01
VR702	1	Diode, silicon, zener; 24 volt, ±5%	013-712
	2	Card Guide	530-102
	1	Fuse holder, short body	085-001
	1	Kit, transistor mounting (for Q705)	014-630
	2	Pad, transistor (for Q703, Q704)	280-131

NOTE: ALL ITEMS EXCEPT THOSE MARKED \* ARE  
ON PRINTED CIRCUIT BOARD



NOTES:  
 1. UNLESS OTHERWISE SPECIFIED  
 ALL CAPACITOR VALUES ARE IN MICROFARADS, RATINGS AS INDICATED.  
 ALL RESISTOR VALUES ARE IN OHMS, 1/2WATT, 10%

LAST REF. DES. USED	REF. DES. NOT USED
C710	C701 TO C705
CR707	Q701,702
Q706	VR701
VR702	T701
T702	R701 TO R705
R714	

Fig. 6-23. Power Supply Schematic, Reproduce-only

RECORD AND REPRODUCE EQUALIZER  
ASSEMBLIES

Ref.	01	02	03	DESCRIPTION	Ampex Part No.
				RECORD EQUALIZERS (see Fig. 6-24)	
	X			Record Equalizer, assembly, 7 1/2 and 15 ips, NAB	4020269-01
		X		Record Equalizer Assembly, 3 3/4 and 7 1/2 ips, NAB	4020269-02
			X	Record Equalizer Assembly, 7 1/2 and 15 ips, CCIR (optional accessory)	4020269-03
C52	1	1	1	Capacitor, tantalum; 3.9 mfd, ±20%, 25 vdcw	037-445
C53	1	-	1	Capacitor, trimmer; 170 pfd to 780 pfd, 9 plates, 350 vdcw	4540314-03
C53	-	1	-	Capacitor, trimmer; 300 pfd to 1200 pfd, 13 plates, 350 vdcw	4540314-04
C54	1	-	1	Capacitor, trimmer; 50 pfd to 380 pfd, 5 plates, 350 vdcw	4540314-02
C54	-	1	-	Capacitor, trimmer; 170 to 780 pfd, 9 plates, 350 vdcw	4540314-03
C55	-	-	2	Capacitor, tantalum; 3.9 mfd, ±20%, 25 vdcw	037-445
C56	-	-	X	Same as C55	
C57	1	-	-	Capacitor, mylar; .0022 mfd, ±10%, 50 vdcw	055-164
R108	1	1	1	Resistor, variable, potentiometer; audio taper; 100,000 ohms, ±30%, 0.2w	4520153-01
R109	1	-	-	Resistor, fixed, comp; 18,000 ohms, ±5%, 1/4w; RC07GF183J	041-436

Ref.	01	02	03	DESCRIPTION	Ampex Part No.
				REPRODUCE EQUALIZER (see Figs. 6-24 and 6-25)	
				Reproduce Equalizer, assembly, all speeds, NAB or CCIR	4020270-01
C50	2			Capacitor, mylar; .0047 mfd, ±5%, 50vdcw	055-222
C51	-			Same as C50	
R101	1			Resistor, fixed, comp; 2,200 ohms, ±10%, 1/8w	049-527
R102	2			Resistor, variable, potentiometer; 2.5 meg ohms, ±30%, 1/8w, linear taper	4520152-02
R103	2			Resistor, fixed, comp; 220,000 ohms, ±10%, 1/8w	049-528
R104	2			Resistor, variable, potentiometer; 50,000 ohms, ±30%, 1/8w, audio taper	4520152-01
R105	-			Same as R104	
R106	-			Same as R103	
R107	-			Same as R102	

RECORD/REPRODUCE ELECTRONIC ASSEMBLY  
(without equalizers)  
CATALOG NO. 4020260-01  
(see Fig. 6-24)

Ref. No.	Qty	DESCRIPTION	Loc.(Item)	Fig.No.	Ampex Part No.
	1	Reproduce Amplifier, printed circuit board, assembly	1		4050435-01
C1	2	Capacitor, tantalum; 47 mfd, ±20%, 6 vdcw			037-494
C2	6	Capacitor, tantalum; 3.9 mfd, ±20%, 25 vdcw			037-445
C3	-	Same as C2			
C4	2	Capacitor, mica; 47 pfd, ±5%, 500 vdcw			034-181
C5	-	Same as C1			
C6	2	Capacitor, tantalum; 15 mfd, ±20%, 15 vdcw			037-446
C7	-	Same as C2			
C8	1	Capacitor, electrolytic; 50 mfd, -10+75%, 50 vdcw			031-187
C10	-	Same as C4			
C11	-	Same as C2			
C12	-	Same as C2			
C13	1	Capacitor, electrolytic; 50 mfd, -10+75%, 25 vdcw			031-190
C14	-	Same as C6			
C17	-	Same as C2			
CR1	3	Diode, silicon, small signal switching			013-599
CR2	-	Same as CR1			
CR7	-	Same as CR1			
J2	1	Connector, assembly, 10 contact (for equalizer board)			4030270-02
Q1	2	Transistor, silicon; low noise, low level			014-698
Q2	-	Same as Q1			
Q3	2	Transistor, silicon; low noise			014-784
Q4	-	Same as Q3			
Q5	1	Transistor, silicon			014-652
Q6	1	Transistor, silicon, 800 mw			014-247
Q7	1	Transistor, silicon; 2N4037			014-723
Q8	1	Transistor, silicon; 2N2102			014-329
R1	1	Resistor, fixed, comp; 1,000 ohms, ±10%, 1/2w; RC20GF102K			041-048
R2	2	Resistor, fixed, comp; 39,000 ohms, ±10%, 1/2w; RC20GF393K			041-067
R3	1	Resistor, fixed, comp; 180,000 ohms, ±10%, 1/2w; RC20GF184K			041-075
R4	1	Resistor, fixed, comp; 4,300 ohms, ±5%, 1/2w; RC20GF432J			041-012
R5	2	Resistor, fixed, comp; 15,000 ohms, ±10%, 1/2w; RC20GF153K			041-062
R6	2	Resistor, fixed, comp; 680 ohms, ±10%, 1/2w; RC20GF681K			041-046
R7	3	Resistor, fixed, comp; 100,000 ohms, ±10%, 1/2w; RC20GF104K			041-072
R8	1	Resistor, fixed, comp; 6,800 ohms, ±10%, 1/2w; RC20GF682K			041-058
R9	1	Resistor, fixed, comp; 470,000 ohms, ±10%, 1/2w; RC20GF474K			041-080
R10	1	Resistor, fixed, comp; 3,300 ohms, ±10%, 1/2w; RC20GF332K			041-054
R12	2	Resistor, fixed, comp; 220,000 ohms, ±10%, 1/2w; RC20GF224K			041-076
R13	-	Same as R12			
R14	2	Resistor, fixed, comp; 12,000 ohms, ±10%, 1/2w; RC20GF123K			041-061
R15	-	Same as R14			
R18	1	Resistor, fixed, comp; 560,000 ohms, ±10%, 1/2w; RC20GF564K			041-081
R21	-	Same as R2			
R22	1	Resistor, fixed, comp; 56,000 ohms, ±10%, 1/2w; RC20GF563K			041-069
R23	-	Same as R7			
R24	1	Resistor, fixed, comp; 4,700 ohms, ±10%, 1/2w; RC20GF472K			041-056
R25	-	Same as R5			
R26	1	Resistor, fixed, comp; 510 ohms, ±5%, 1/2w; RC20GF511J			041-404
R27	1	Resistor, fixed, comp; 240 ohms, ±5%, 1/2w; RC20GF241J			041-473
R28	-	Same as R6			
R29	1	Resistor, fixed, comp; 2,000 ohms, ±5%, 1/2w; RC20GF202J			041-010
R30	2	Resistor, fixed, comp; 10 ohms, ±10%, 1/2w; RC20GF100K			041-032
R31	-	Same as R30			
R38	-	Same as R7			

RECORD/REPRODUCE ELECTRONIC ASSEMBLY  
(cont.)

Ref. No.	Qty	DESCRIPTION	Loc. (Item) Fig. No.	Amplex Part No.
T1	1	Transformer, input		4580199-01
	1	Front plate, reproduce		4330263-01
	2	Heat sink, transistor (for Q7 and Q8)		014-706
	2	Pad, transistor (for Q1 and Q2)		280-130
	3	Pad, transistor (for Q6, Q7, and Q8)		280-131
	1	Record Amplifier, printed circuit board, assembly	2	4050434-01
C24	2	Capacitor, mylar; 0.1 mfd, ±10%, 100 vdcw		055-106
C25	2	Capacitor, tantalum; 0.68 mfd, ±5%, 25 vdcw		037-495
C26	3	Capacitor, tantalum; 47 mfd, ±20%, 6 vdcw		037-494
C27	-	Same as C25		
C28	1	Capacitor, electrolytic; 10 mfd, -10+75%, 25 vdcw		031-148
C29	-	Same as C26		
C30	-	Same as C24		
C31	-	Same as C26		
C32	1	Capacitor, tantalum; 15 mfd, ±20%, 15 vdcw		037-446
J9	1	Connector, assembly, 9 pin (for equalizer board)		4030270-01
Q9	5	Transistor, silicon; low noise, low level		014-698
Q10	-	Same as Q9		
Q11	-	Same as Q9		
Q12	-	Same as Q9		
Q13	-	Same as Q9		
Q14	2	Transistor, silicon, 800 mw		014-247
Q15	-	Same as Q14		
R47	1	Resistor, fixed, comp; 1.3 meg ohms, ±5%, 1/2w; RC20GF135J		041-377
R48	1	Resistor, fixed, comp; 1.1 meg ohms, ±5%, 1/2w; RC20GF115J		041-898
R49	2	Resistor, fixed, comp; 22,000 ohms, ±10%, 1/2w; RC20GF223K		041-064
R50	2	Resistor, fixed, comp; 100 ohms, ±10%, 1/2w; RC20GF101K		041-038
R51	2	Resistor, fixed, comp; 110,000 ohms, ±5%, 1/2w; RC20GF114J		041-024
R52	-	Same as R51		
R53	2	Resistor, fixed, comp; 39,000 ohms, ±10%, 1/2w; FC20GF393K		041-067
R54	2	Resistor, fixed, comp; 7,500 ohms, ±5%, 1/2w; RC20GF752J		041-361
R55	2	Resistor, fixed, comp; 10,000 ohms, ±10%, 1/2w		041-060
R56	2	Resistor, fixed, comp; 4,300 ohms, ±5%, 1/2w; RC20GF432J		041-012
R57	2	Resistor, fixed, comp; 100,000 ohms, ±10%, 1/2w; RC20GF104K		041-072
R58	-	Same as R53		
R59	-	Same as R54		
R60	-	Same as R55		
R61	-	Same as R56		
R62	1	Resistor, fixed, comp; 68,000 ohms, ±10%, 1/2w; RC20GF683K		041-070
R63	-	Same as R49		
R64	-	Same as R57		
R65	1	Resistor, fixed, comp; 56,000 ohms, ±10%, 1/2w; RC20GF563K		041-069
R66	1	Resistor, fixed, comp; 3,300 ohms, ±10%, 1/2w; RC20GF332K		041-054
R67	1	Resistor, fixed, comp; 470,000 ohms, ±10%, 1/2w; RC20GF474K		041-078
R68	1	Resistor, fixed, comp; 330,000 ohms, ±10%, 1/2w; RC20GF334K		041-080
R69	1	Resistor, fixed, comp; 47,000 ohms, ±10%, 1/2w; RC20GF473K		041-068
R70	1	Resistor, fixed, comp; 680,000 ohms, ±10%, 1/2w; RC20GF684K		041-082
R71	1	Resistor, fixed, comp; 150 ohms, ±10%, 1/2w; RC20GF151K		041-241
R72	-	Same as R50		
	1	Front Plate, record		4330262-01
	5	Pad, transistor (for Q9, Q10, Q11, Q12, Q13)		280-130
	2	Pad, transistor (for Q14, Q15)		280-131
	1	Bias Amplifier, printed circuit board, assembly	3	4050433-01
C39	1	Capacitor, mica; 330 pfd, ±5%, 500 vdcw		034-212
C40	1	Capacitor, mica, variable; 780-2110 pfd, 250 vdcw		038-026
C41	2	Capacitor, mylar; 0.1 mfd, ±10%, 100 vdcw		055-106
C42	1	Capacitor, mica; 2500 pfd, ±5%, 500 vdcw		034-994
C43	-	Same as C41		
C44	1	Capacitor, electrolytic; 50 mfd, -10+75%, 25 vdcw		031-190
C45	1	Capacitor, mica; 5000 pfd, ±5%, 300 vdcw		034-960

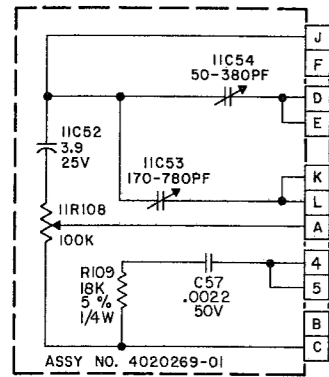
RECORD/REPRODUCE ELECTRONIC ASSEMBLY  
(cont.)

Ref. No.	Qty	DESCRIPTION	Loc. (Item)	Fig. No	Ampex Part No.
Q16	2	Transistor, silicon; 800 mw			014-247
Q17	-	Same as Q16			
Q18	2	Transistor, silicon;			014-653
Q19	-	Same as Q18			
R44	1	Resistor, variable, potentiometer; 750 ohms, linear taper, 0.3w; (Bias Cal.)			4520154-01
R79	1	Resistor, fixed, comp; 7,500 ohms, ±5%, 1w; RC32GF752J			041-108
R80	1	Resistor, variable, potentiometer; 50,000 ohms, linear taper, 1w; (Bias Cal.)			4520155-01
R82	1	Resistor, fixed, wirewound; 180 ohms, ±5%, 5w			059-017
R83	2	Resistor, fixed, comp; 22 ohms, ±10%, 1/2w; RC20GF220K			041-033
R84	2	Resistor, fixed, comp; 3,000 ohms, ±5%, 1/2w; RC20GF302J			041-475
R85	-	Same as R84			
R86	1	Resistor, fixed, comp; 1,600 ohms, ±5%, 1w; RC32GF162J			041-353
R87	-	Same as R83			
R88	2	Resistor, fixed, comp; 20,000 ohms, ±5%, 1/2w; RC20GF203J			041-529
R89	-	Same as R88			
R90	2	Resistor, fixed, comp; 1 meg ohm, ±10%, 1/2w; RC20GF105K			041-031
R91	-	Same as R90			
T3	2	Coil, oscillator			4580123-01
T4	-	Same as T3			
	1	Front Plate, bias			4330261-01
	2	Pad, transistor (for Q16, Q17)			280-131
Components not on printed circuit boards					
C9	1	Capacitor, electrolytic, 4 section; 100, 100, 35, 35 mfd; 50 vdcw	9	(4) 6-29	4550147-05
C15	1	Capacitor, electrolytic; 250 mfd, 25 vdcw (on plug-in receptacle)	5	Not shown	031-457
C16	3	Capacitor, ceramic, disc; .02 mfd, 500 vdcw	5	(10) 6-27	030-001
C18	1	Capacitor, mica, variable; 1400-3055 pfd, 250 vdcw (Sel-Sync Bias Trap)	4	(4) 6-26	038-011
C23	1	Capacitor, electrolytic; 4 mfd, -10+100%, 25 vdcw	4	(4) 6-26	031-309
C33	1	Capacitor, electrolytic, 3 section; 350, 1000, 100 mfd; 35, 25, 25 vdcw	9	(2) 6-29	4550147-06
C34	1	Capacitor, electrolytic; 1500 mfd, -10+250%, 40 vdcw	9	(3) 6-29	4550147-04
C35	1	Capacitor, mica; 220 mfd, ±5%, 300 vdcw	5	(11) 6-27	034-358
C36	-	Same as C16	4	(29) 6-26	
C37	-	Same as C16	4	(29) 6-26	
C38	1	Capacitor, mica; 1500 pfd, ±5%, 500 vdcw	4	(31) 6-26	056-021
CR3	5	Diode, silicon, small signal, switching	9	(5) 6-29	013-599
CR4	-	Same as CR3	9	(5) 6-29	
CR5	-	Same as CR3	4	(30) 6-26	
CR6	-	Same as CR3	4	(30) 6-26	
CR8	-	Same as CR3	9	(5) 6-29	
F1	1	Fuse, slo-blo; 0.5 amp, 125v	4	(7) 6-26	070-026
I1	2	Light, indicator, clear; incandescent, 12v, .17 amp (vu meter)	5	(20) 6-27	060-334
I2	-	Same as I1	5	(20) 6-27	
I3	1	Light, indicator, red; incandescent, 28v, 40 ma (record)	5	(19) 6-27	132-100
I4	1	Light, indicator, amber; incandescent, 28v, 40 ma (ready)	5	(18) 6-27	132-099
J1	1	Connector, receptacle, 3 contact, male; MS3102A10SL-3P (repro. head)	4	(10) 6-26	143-008
J3	1	Connector, assembly, 12 contact, printed circuit board (reproduce board)	5	Not shown	4030269-03
J4	1	Connector, telephone jack, open circuit, 2 conductor (phones jack)	5	(21) 6-27	148-015
J5	1	Connector, receptacle, audio, 3 contacts, male (output)	4	(14) 6-26	147-999
J6	1	Connector, receptacle, 2 contact, male; MS3102A10SL-4P (record head)	4	(11) 6-26	143-008
J7	1	Connector, receptacle, audio, 3 socket, female (input)	4	(13) 6-26	146-998
J8	1	Socket, electron tube, octal (input accessory)	4	(-) 6-26	150-023
J10	1	Connector, assembly, 12 contact, printed circuit board (record board)	5	Not shown	4030269-01
J11	1	Connector, receptacle; 10 pins, male	4	(-) 6-26	147-014
J12	1	Connector, receptacle; 1 contact, male; MS3102A10SL-2P (erase head)	4	(12) 6-26	143-010
J13	1	Connector, assembly, 12 contact, printed circuit board (bias amp. board)	5	Not shown	4030269-02

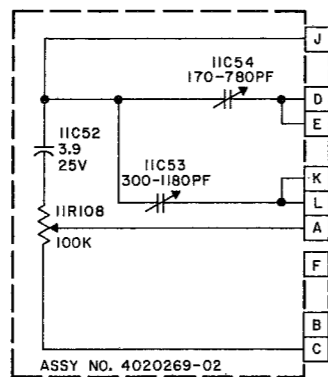


RECORD/REPRODUCE ELECTRONIC ASSEMBLY  
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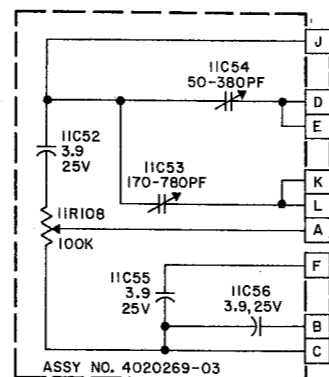
Ref. No.	Qty	DESCRIPTION	Loc. (Item)	Fig. No.	Ampex Part No.
K1	1	Relay, armature, 4P2T; 24 volts, 650 ohms; with nylon dust cover	4	(33) 6-26	020-144
L1	1	Coil, inductor; 330 microhenry, ±5%	4	(6) 6-26	540-030
L2	1	Coil, inductor; 5000 microhenry, ±5%	5	(16) 6-27	051-342
M1	1	Meter, vu	5	(5) 6-27	4140020-01
R11	1	Resistor, variable, comp; 10,000 ohms, ±20%, 2w (reproduce level)	5	(15) 6-27	044-233
R16	2	Resistor, fixed, comp; 15,000 ohms, ±10%, 1/2w; RC20GF153K	9	(7) 6-29	041-062
R17	-	Same as R16	9	(7) 6-29	
R19	2	Resistor, fixed, comp; 10,000 ohms, ±10%, 1/2w; RC20GF103K	9	(6) 6-29	041-060
R20	-	Same as R19	9	(6) 6-29	
R32	1	Resistor, fixed, comp; 220 ohms, ±10%, 1/2w; RC20GF221K	8	(4) 6-28	041-040
R33	1	Resistor, fixed, comp; 680 ohms, ±10%, 1/2w; RC20GF681K	8	(5) 6-28	041-046
R34	1	Resistor, fixed, comp; 9,100 ohms, ±5%, 1/2w; RC20GF912J	8	(7) 6-28	041-373
R35	1	Resistor, fixed, comp; 4,300 ohms, ±5%, 1/2w; RC20GF432J	8	(3) 6-28	041-012
R36	1	Resistor, fixed, comp; 2,400 ohms, ±5%, 1/2w; RC20GF242J	8	(6) 6-28	041-316
R37	1	Resistor, fixed, comp; 6,200 ohms, ±5%, 1/2w; RC20GF622J (on vu meter)	5	Not shown	041-455
R43	1	Resistor, variable, potentiometer; 5,000 ohms, linear taper, 0.3w (Sel-Sync gain)	4	(2) 6-26	4520154-02
R45	1	Resistor, fixed, comp; 27,000 ohms, ±10%, 1/2w; RC20GF273K	4	(5) 6-26	041-065
R46	1	Resistor, variable, comp; 100,000 ohms, ±10%, 2w; (record level)	5	(14) 6-27	044-015
R73	1	Resistor, fixed, comp; 750 ohms, ±5%, 1w; RC32GF751J	9	(8) 6-29	041-833
R74	1	Resistor, fixed, wirewound; 100 ohms, ±5%, 5w	5	(13) 6-27	043-273
R75	2	Resistor, fixed, comp; 560 ohms, ±10%, 2w; RC42GF561K	5	(12) 6-27	041-200
R76	-	Same as R75	5	(12) 6-27	
R77	1	Resistor, fixed, comp; 180 ohms, ±10%, 1/2w; RC20GF181K	4	(32) 6-26	041-257
R78	1	Resistor, fixed, comp; 4,700 ohms, ±10%, 1/2w; RC20GF472K	9	(10) 6-29	041-056
S1	1	Switch, rotary, selector (record selector)	5	(7) 6-27	4620049-01
S2	1	Switch, lever, selector (output selector)	5	(8) 6-27	4620198-01
S3	1	Switch, rotary; SPDT, non-shorting (line termination)	4	(9) 6-26	122-016
T2	1	Transformer, output	8	(2) 6-28	4580193-01
	6	Card Guides		Not shown	530-102
	2	Clip, lamp holder	5	(24) 6-27	435-069
	1	Knob, black, with pointer (line termination switch)	4	(17) 6-26	230-008
	1	Knob, key tab (output selector switch)	5	(2) 6-27	4100102-02
	1	Knob, assembly, black, indexed (reproduce level)	5	(3) 6-27	4100105-02
	1	Knob, assembly, red cap, indexed (record level)	5	(4) 6-27	4100105-32
	1	Knob, pointer, (record selector)	5	(9) 6-27	6000005-20
	2	Knob, lock (for record and reproduce level)	5	(23) 6-27	230-071
	4	Socket, lights	5	(17) 6-27	132-098
	1	Socket, relay	4	(15) 6-26	150-119
	1	Spring, relay hold down	4	(34) 6-26	020-492
	1	Plug, dummy, accessory socket		Not shown	4030034-30



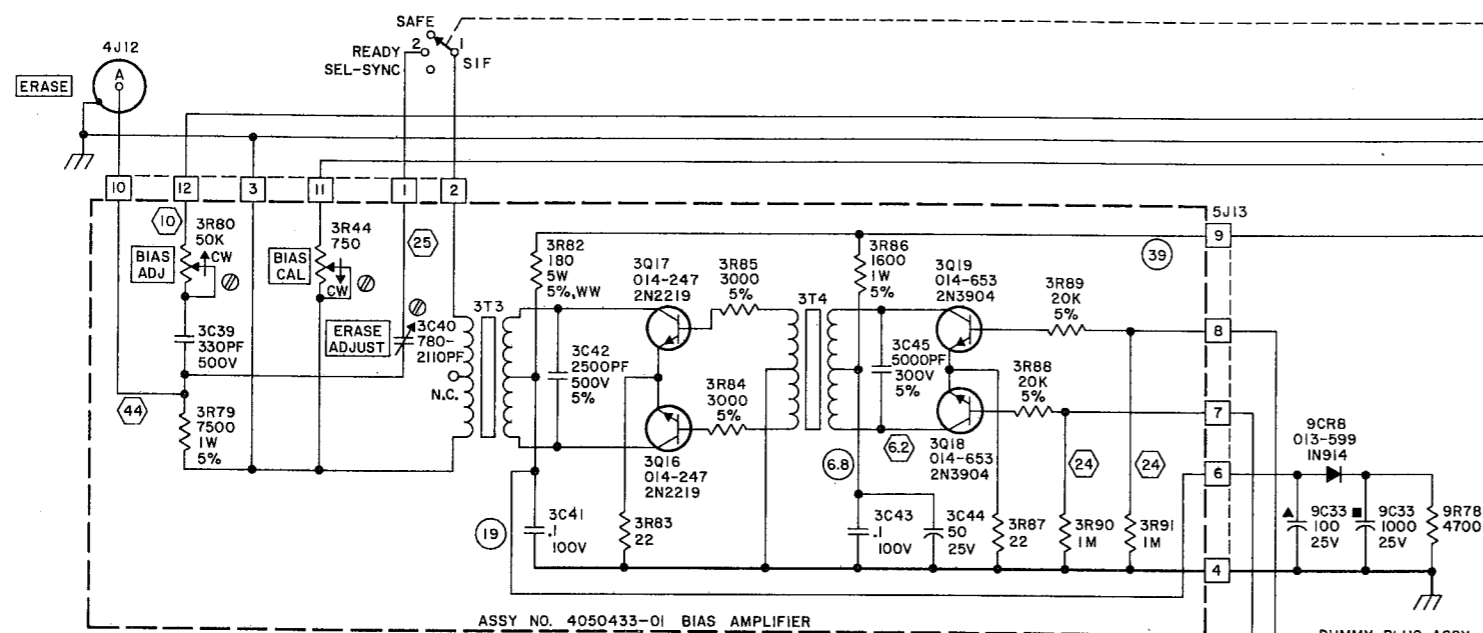
7-1/2-15 IPS NAB  
RECORD EQUALIZER



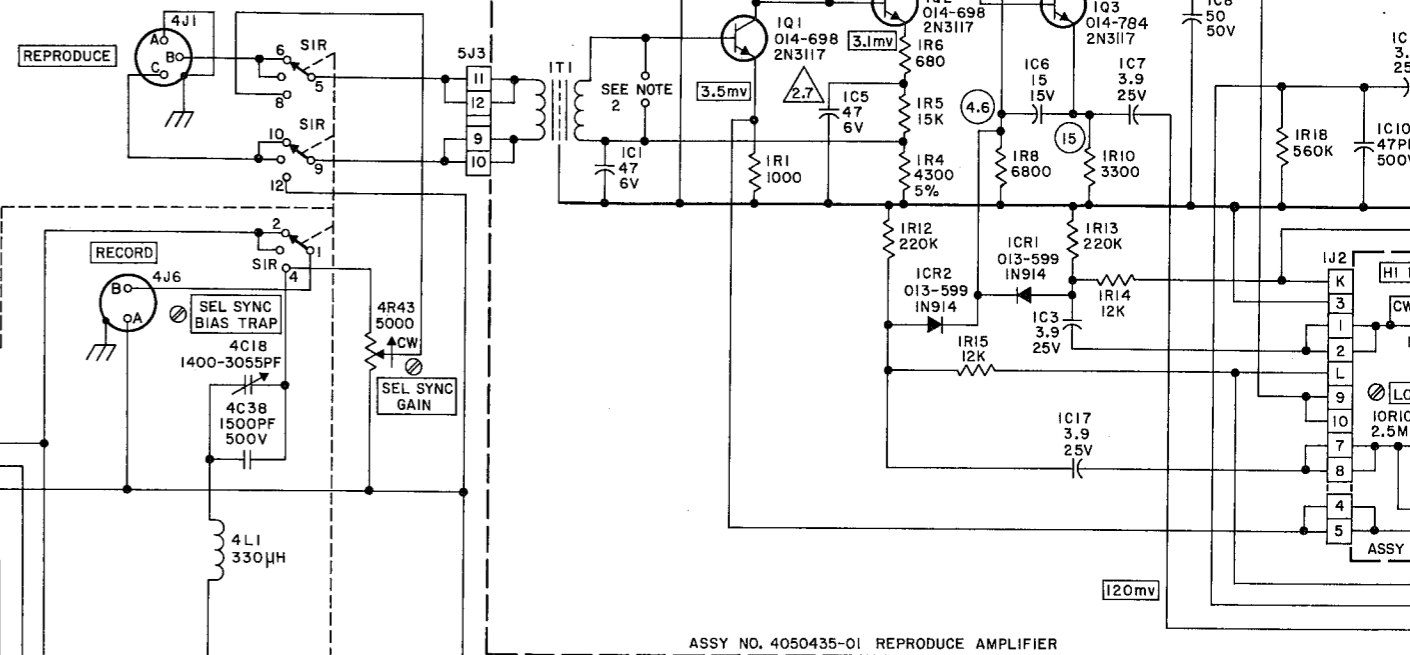
3-3/4-7-1/2 IPS NAB  
RECORD EQUALIZER



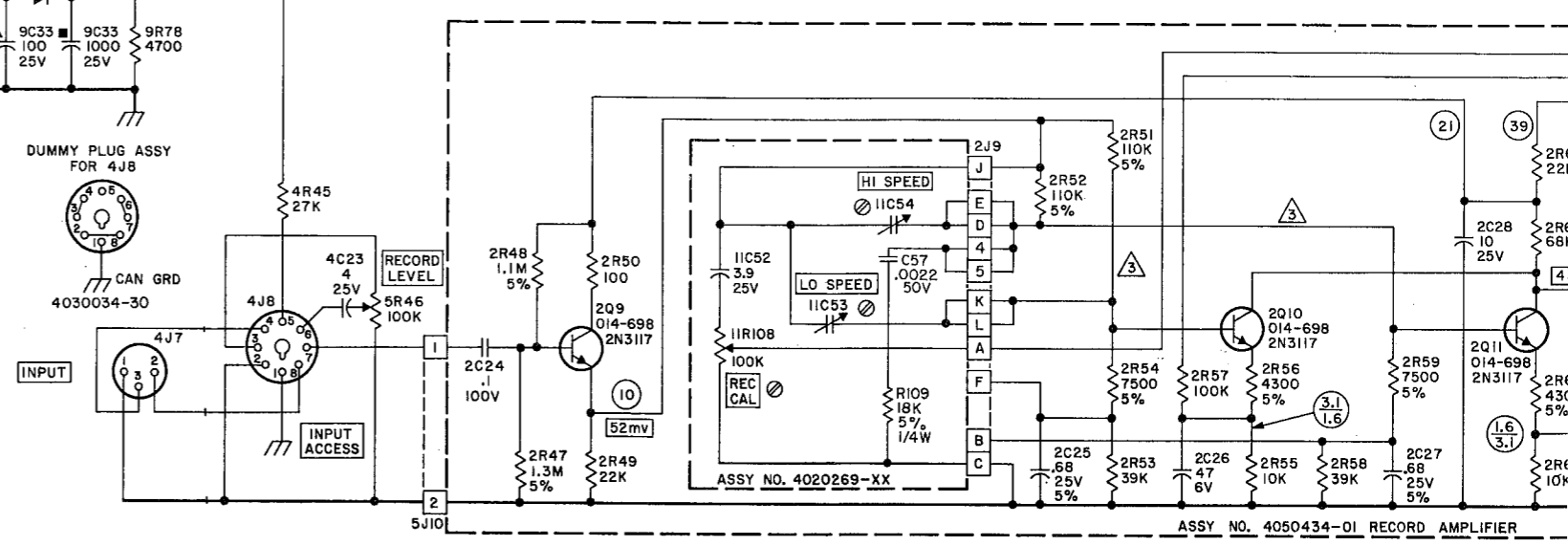
7-1/2-15 IPS CCIR  
RECORD EQUALIZER



ASSY NO. 4050433-01 BIAS AMPLIFIER



ASSY NO. 4050435-01 REPRODUCE AMPLIFIER



ASSY NO. 4050434-01 RECORD AMPLIFIER

NOTES

1. UNLESS OTHERWISE NOTED  
ALL RESISTORS ARE 1/2W, 10%  
ALL CAPACITOR VALUES ARE IN MFD AT INDICATED VOLTAGE
2. PROVISION IS MADE TO PAD HEAD OUTPUT AT HIGH FREQUENCIES
3. CAPACITOR SYMBOLS WITH CURVED PLATE INDICATES POLARITY SENSITIVE PART
4. REPRODUCE EQUALIZER 4020270-01 CAN BE ADJUSTED TO NAB AND/OR CCIR
5. SHIELD DESIGNATIONS OMITTED TO PRESERVE DRAWING CLARITY
6. ○ INDICATES VOLTS DC MEASURED WITH A 20,000 Ω/V METER  
△ INDICATES VOLTS DC MEASURED WITH A HIGH IMPEDANCE VTVM  
□ INDICATES VOLTS RMS MEASURED WITH A HIGH IMPEDANCE VTVM AT OPERATING LEVEL OF 1000Hz  
◇ INDICATES VOLTS RMS MEASURED WITH A HIGH IMPEDANCE VTVM AT BIAS FREQUENCY

REFERENCE DESIGNATOR CODE

1. REPRODUCE BOARD
2. RECORD BOARD
3. ERASE BOARD
4. BACK PANEL
5. FRONT PANEL
6. TRANSPORT
7. POWER SUPPLY
8. RIGHT PANEL (FROM FRONT)
9. LEFT PANEL (FROM FRONT)
10. REPRODUCE EQUALIZER
11. RECORD EQUALIZER

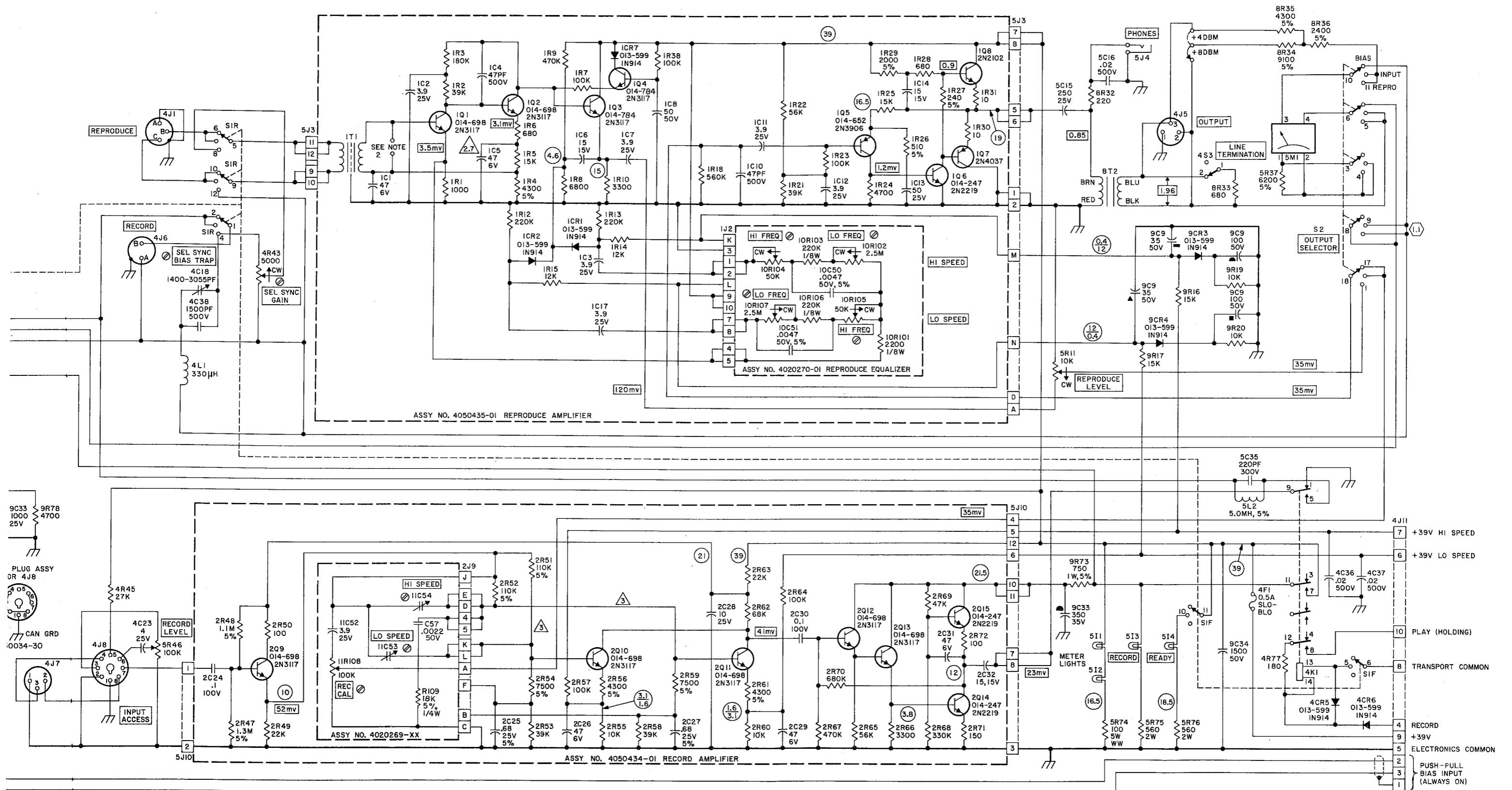
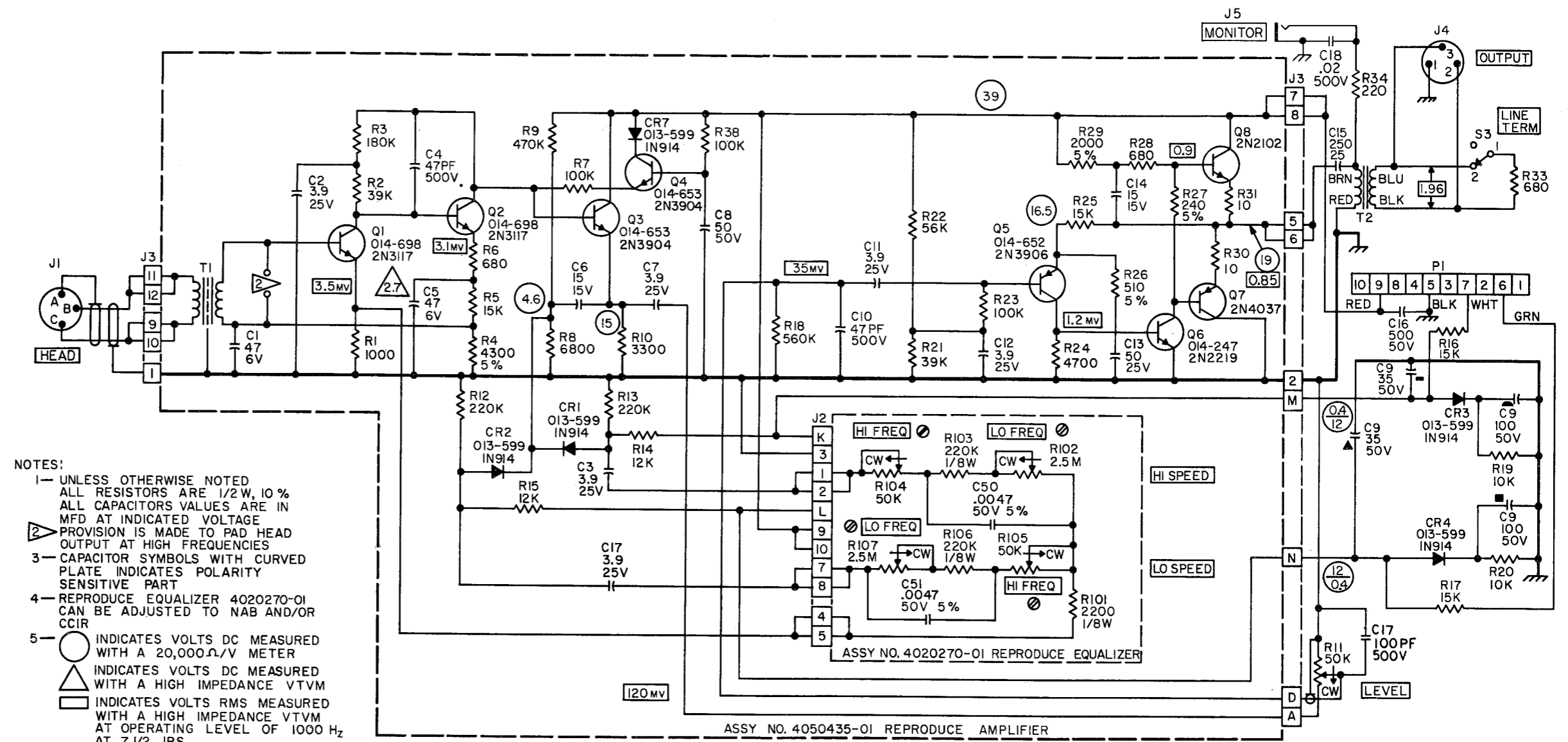


Fig. 6-24. Electronics Schematic, Record/Reproduce.

REPRODUCE-ONLY ELECTRONIC MODULE  
 (without equalizer)  
 CATALOG NO. 4020150  
 (See Fig. No. 6-25)

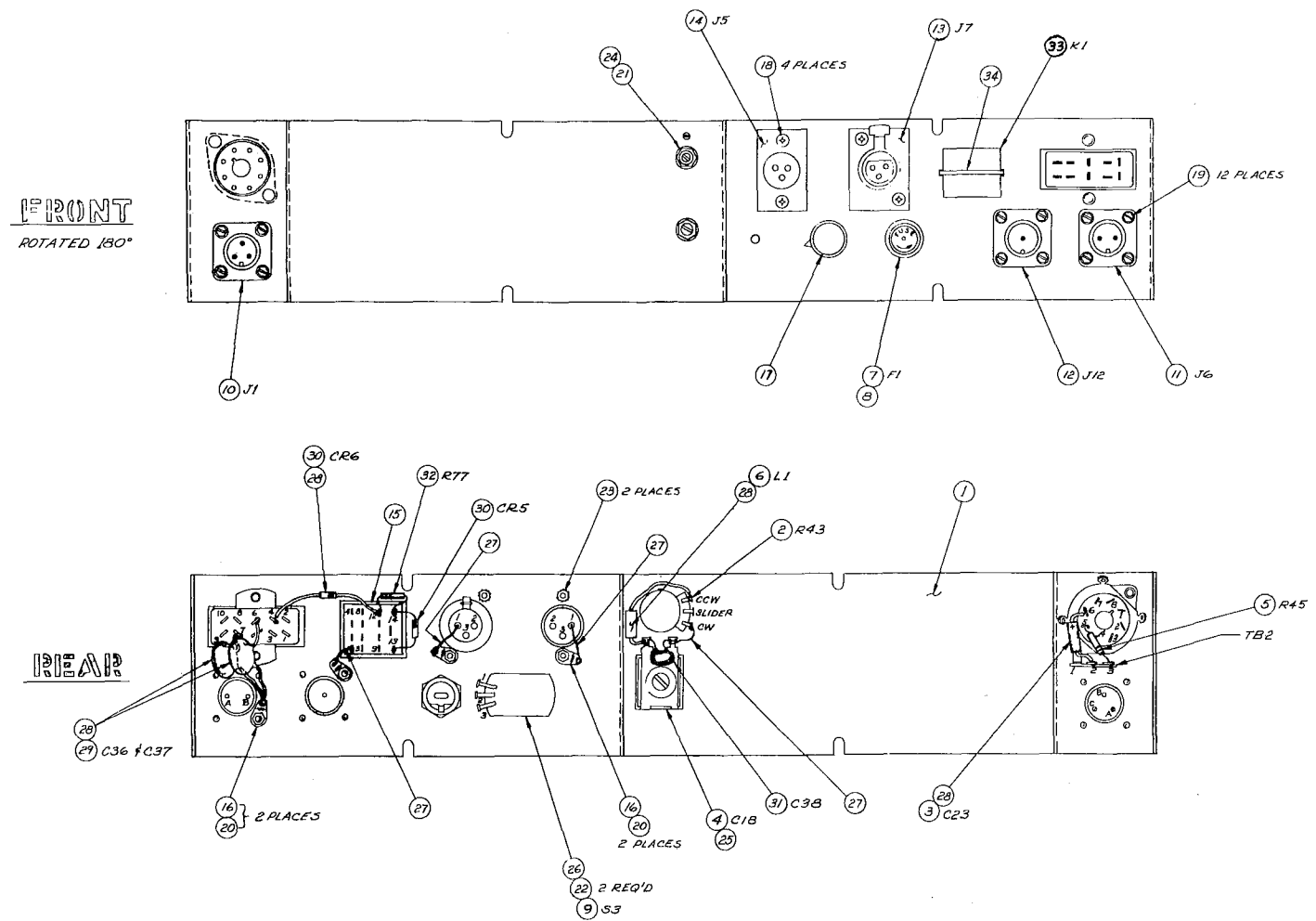
Ref. No.	Qty	DESCRIPTION	Ampex Part No.
	1	Reproduce Amplifier, printed circuit board, assembly (All components on this board same as record/reproduce)	4050435-01
		Components not on printed circuit board	
C9	1	Capacitor, electrolytic, 4 section; 100, 100, 35, 35 mfd; 50 vdcw	4550147-05
C15	1	Capacitor, electrolytic; 250 mfd, 25 vdcw	031-457
C16	1	Capacitor, electrolytic; 500 mfd, -10+150%, 50 vdcw	031-134
C17	1	Capacitor, mica; 100 pfd, ±5%, 500 vdcw	034-177
C18	1	Capacitor, ceramic disc; .02 mfd, 500 vdcw	030-001
CR3	2	Diode, silicon, small signal, switching	013-599
CR4	-	Same as CR3	
J1	1	Connector, receptacle, 3 contact, male; MS3102A10SL-3P (repro. head)	143-008
J3	1	Connector, assembly, 12 contact, printed circuit board (repro. board)	4030269-03
J4	1	Connector, receptacle, audio, 3 contacts, male (output)	147-999
J5	1	Connector, telephone jack; open circuit, 2 conductor (monitor)	148-015
R11	1	Resistor, variable, potentiometer; 50,000 ohms, ±20%, 1/4w (level control)	4520151-01
R16	2	Resistor, fixed, comp; 15,000 ohms, ±10%, 1/2w; RC20GF153K	041-062
R17	-	Same as R16	
R19	2	Resistor, fixed, comp; 10,000 ohms, ±10%, 1/2w; RC20GF103K	041-060
R20	-	Same as R19	
R31	1	Resistor, fixed, comp; 220 ohms, ±10% 1/2w; RC20GF221K	041-040
R33	1	Resistor, fixed, comp; 680 ohms, ±10%, 1/2w; RC20GF681K	041-046
S3	1	Switch, rotary, DPST (line termination)	4620172-10
T2	1	Transformer, output	4580193-01
	1	Cable, interconnecting (captive)	4050087-01
	1	Connector, plug, 10 contacts, male	143-250
	6'	Cable, 4 conductor	616-019
	2	Card Guides	530-102
	1	Retainer, capacitor	301-135

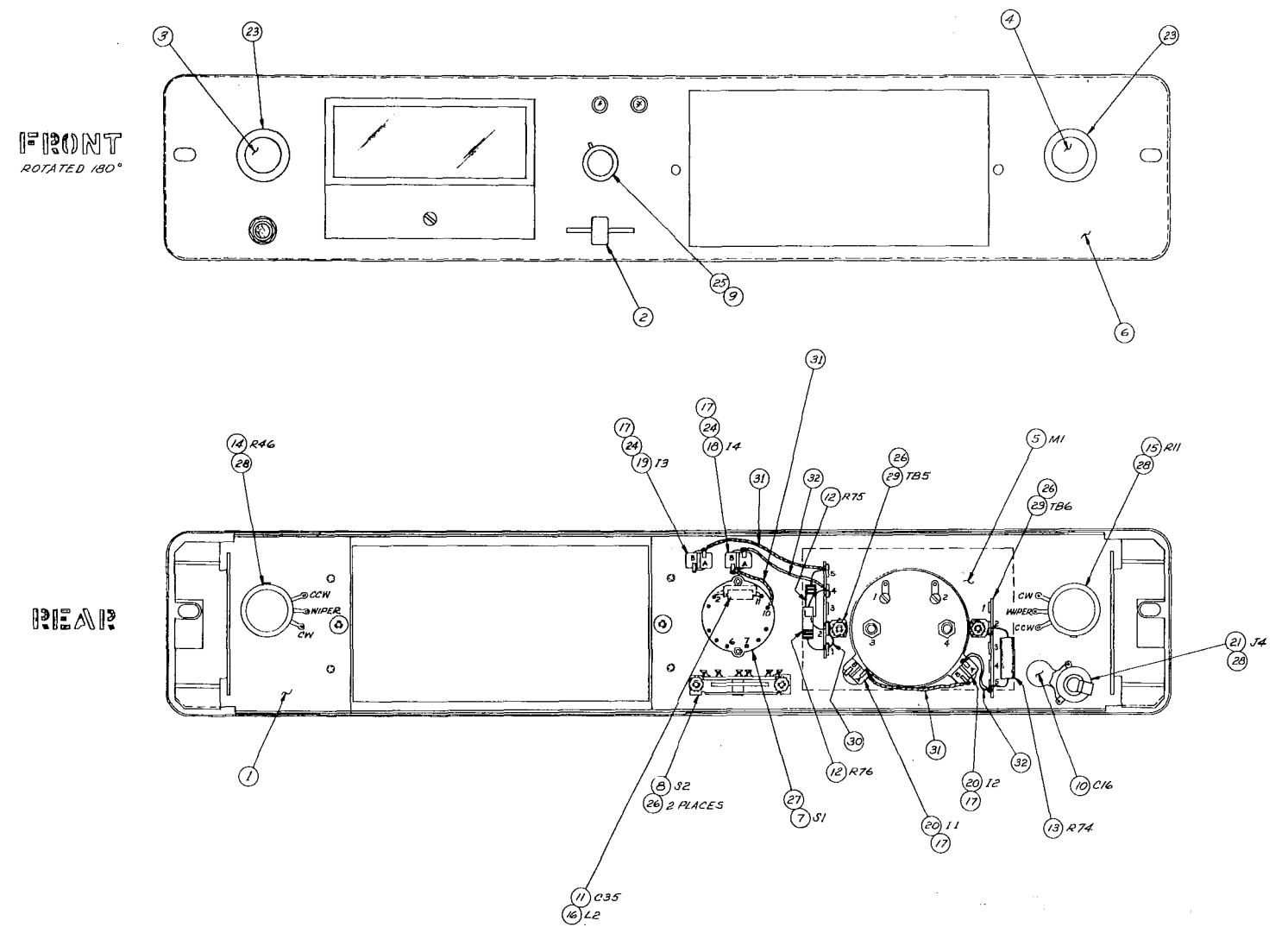


- NOTES:
- UNLESS OTHERWISE NOTED ALL RESISTORS ARE 1/2 W, 10% ALL CAPACITORS VALUES ARE IN MFD AT INDICATED VOLTAGE
  - PROVISION IS MADE TO PAD HEAD OUTPUT AT HIGH FREQUENCIES
  - CAPACITOR SYMBOLS WITH CURVED PLATE INDICATES POLARITY SENSITIVE PART
  - REPRODUCE EQUALIZER 4020270-01 CAN BE ADJUSTED TO NAB AND/OR CCIR
  - INDICATES VOLTS DC MEASURED WITH A 20,000Ω/V METER
    - △ INDICATES VOLTS DC MEASURED WITH A HIGH IMPEDANCE VTVM
    - INDICATES VOLTS RMS MEASURED WITH A HIGH IMPEDANCE VTVM AT OPERATING LEVEL OF 1000 Hz AT 7 1/2 IPS

LAST REF DES USED	REF DES NOT USED
R34	CR5,6
R107	
C18	
C51	
J5	
CR7	
T2	
Q8	
P1	

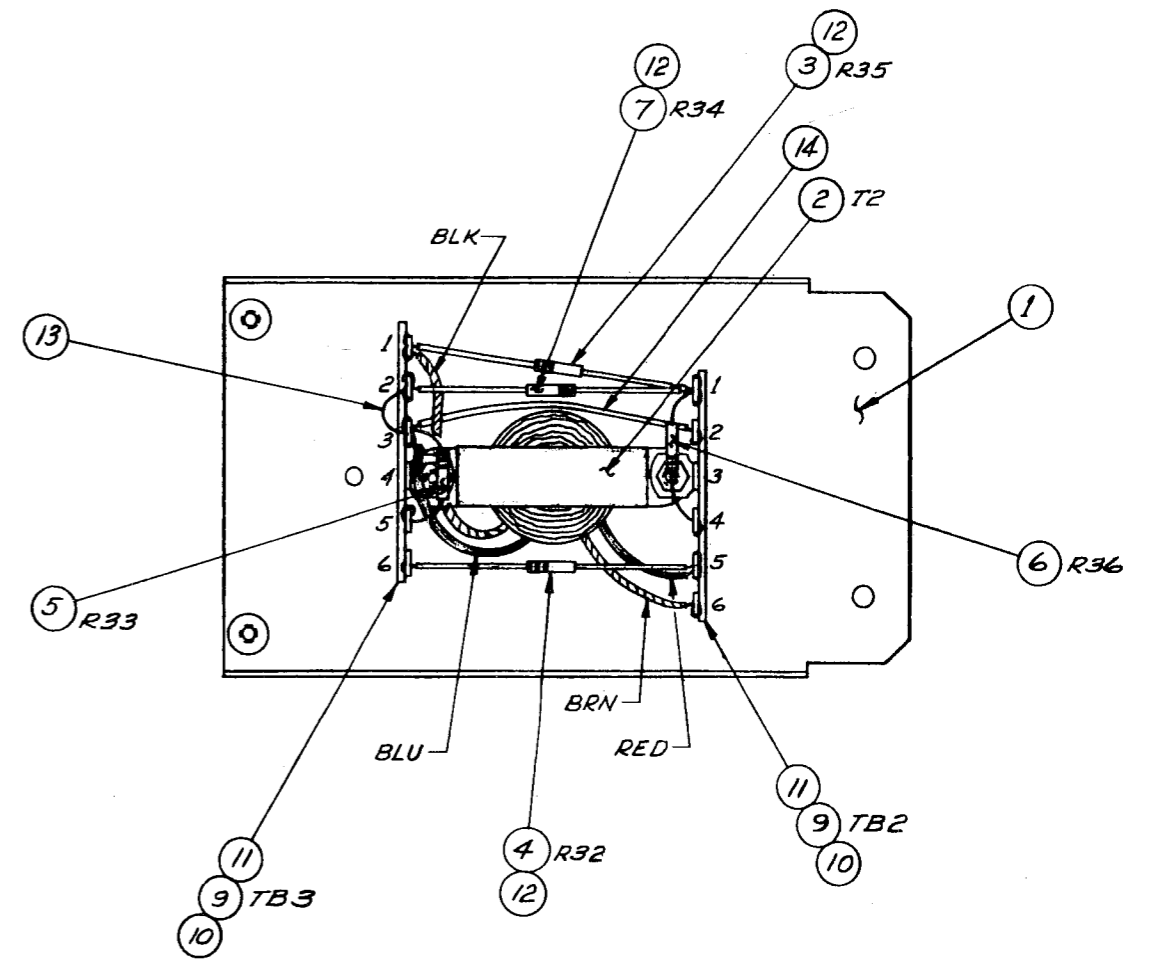
Fig. 6-25. Electronics Schematic, Reproduce-only



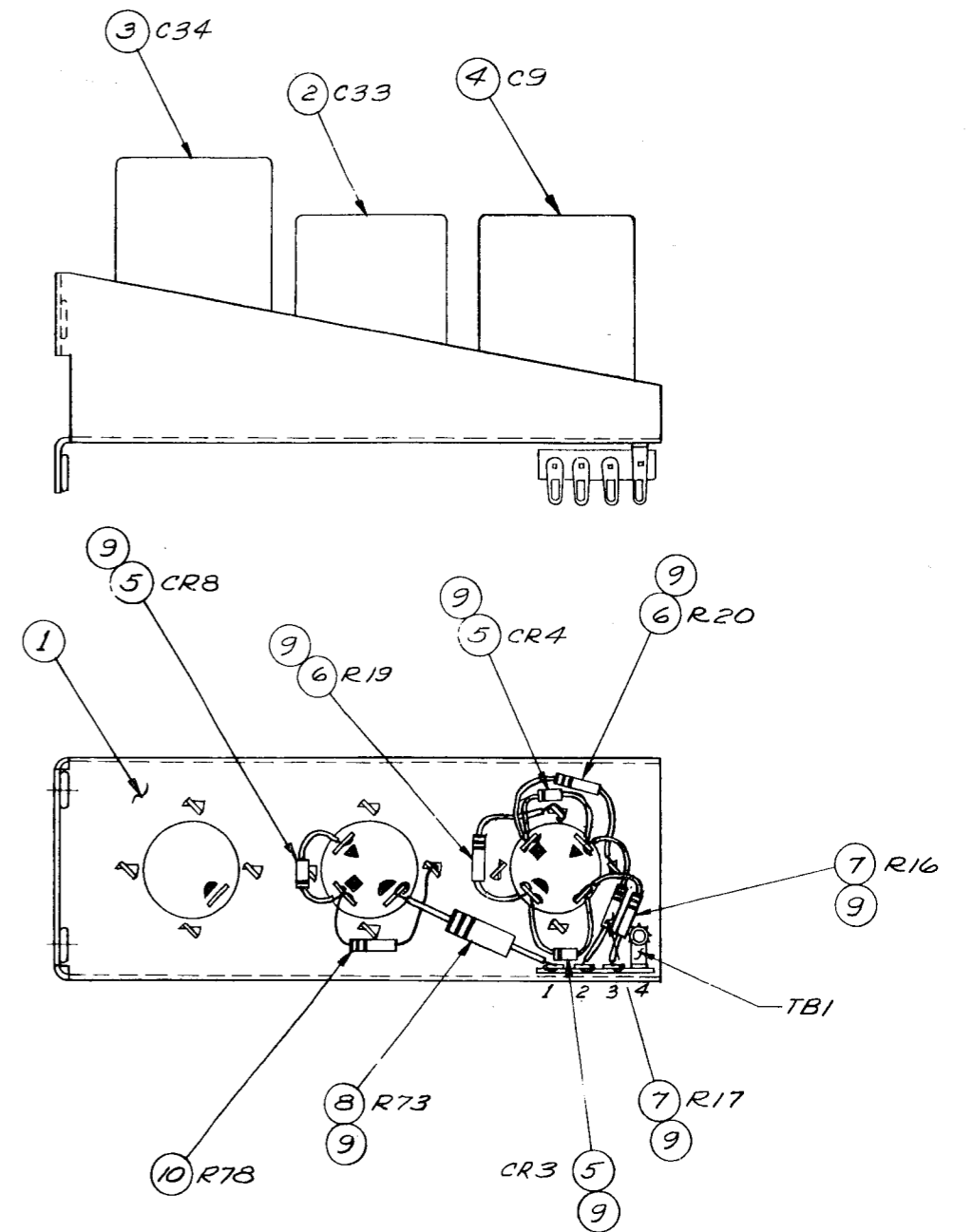


PARTS LIST WITH FIG. 6-24.

Fig. 6-27. Front Panel, Electronics





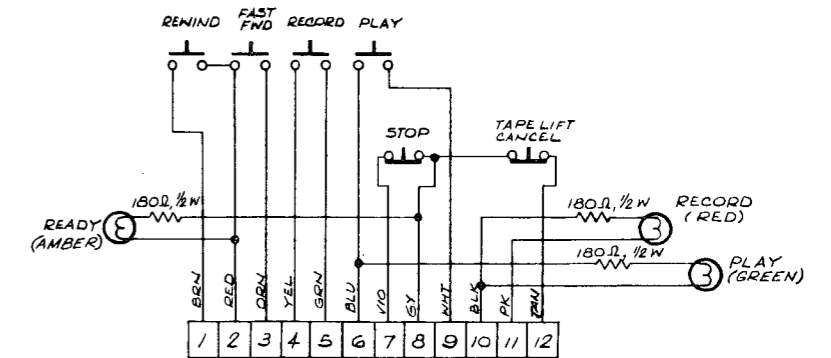
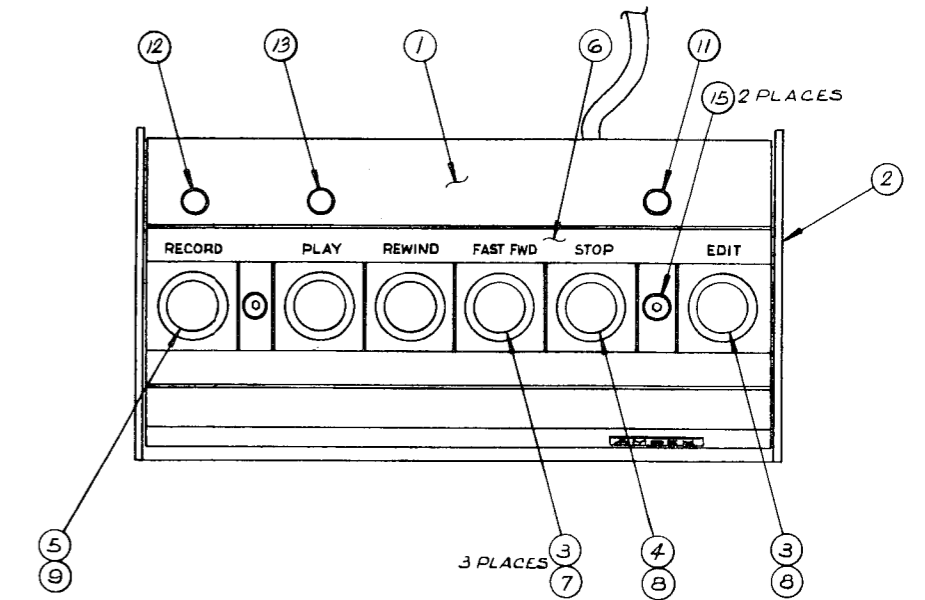
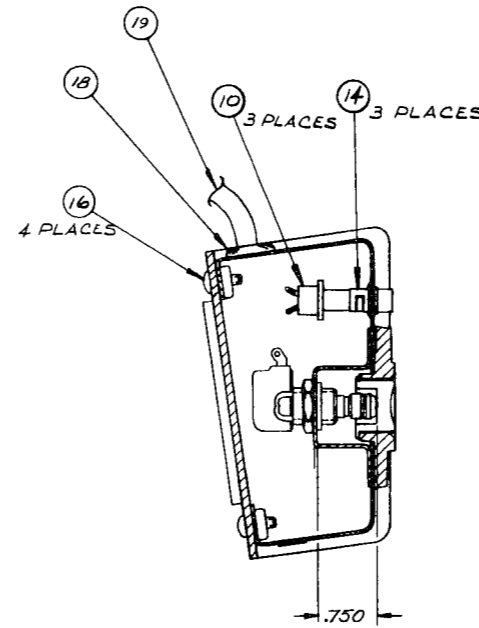


PARTS LIST WITH FIG. 6-24.

Fig. 6-29. Capacitor Mounting Bracket, Electronics

OPTIONAL ACCESSORY  
 REMOTE CONTROL ASSEMBLY  
 CATALOG NO. 4010080  
 (see Fig. 6-30)

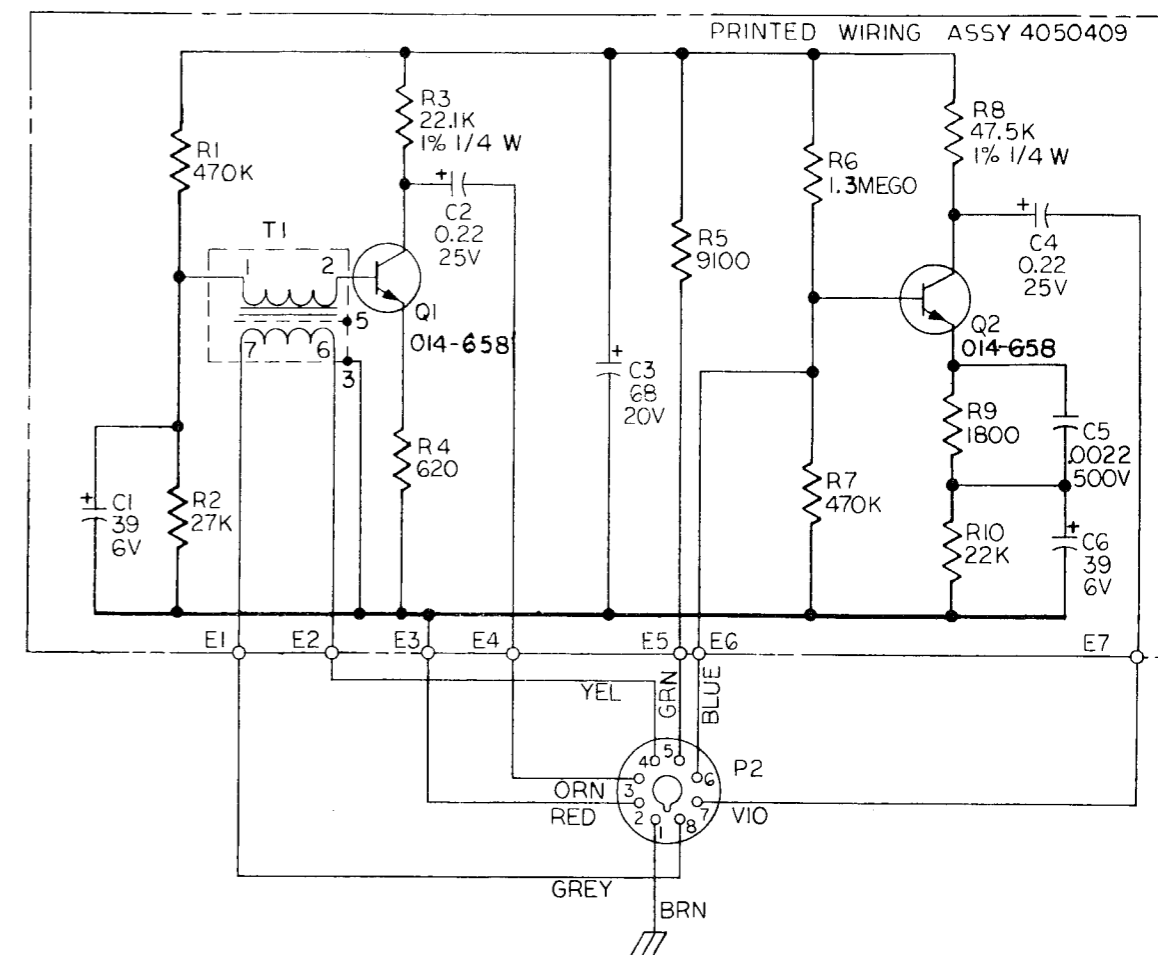
Item	Qty	DESCRIPTION	Ampex Part No.
1	1	Panel, assembly	4040997-01
2	1	Base, assembly	4040999-01
3	4	Pushbutton, white (fast forward, rewind, play, edit)	4100183-01
4	1	Pushbutton, yellow (stop)	4100183-02
5	1	Pushbutton, red (record)	4100183-03
6	1	Escutcheon	4110274-01
7	3	Switch, pushbutton (fast forward, rewind, play)	4620144-10
8	2	Switch, pushbutton (stop, edit)	4620144-20
9	1	Switch, pushbutton (record)	4620144-30
10	3	Socket, light	132-098
11	1	Light, indicator, amber	132-099
12	1	Light, indicator, red	132-100
13	1	Light, indicator, green	060-338
14	3	Clip, lamp holder	435-069
17	3	Resistor, fixed, comp; 180 ohms, ±10%, 1/2w; RC20GF181K	041-257
18	1	Strain Relief	264-011
19	1	Cable, assembly, remote control (captive)	4050086-01
	1	Connector, plug, 12 pins, male	145-019
	25'	Cable, 12 conductor	617-090

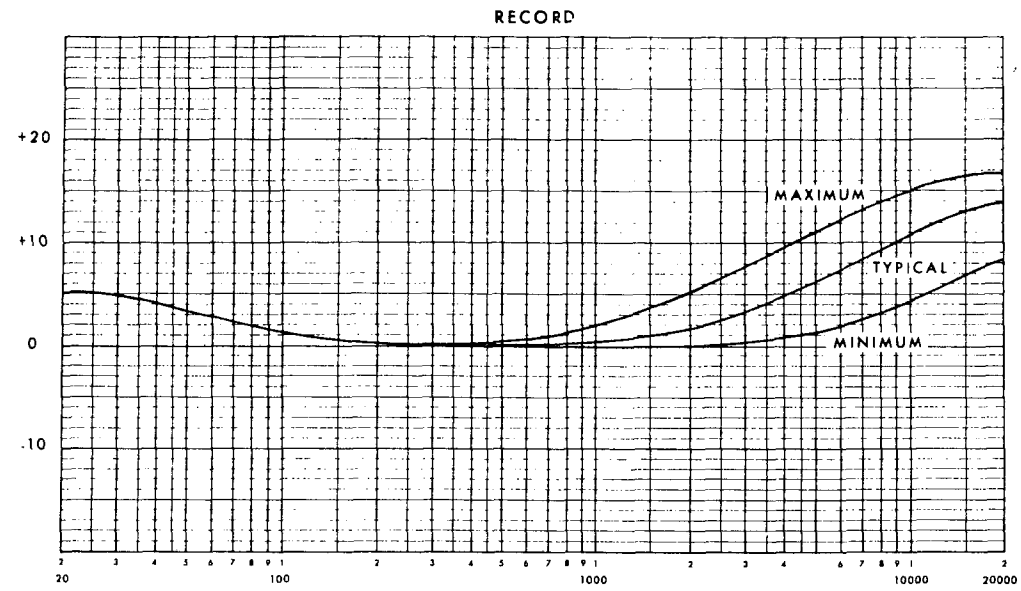


SCHEMATIC DIAGRAM

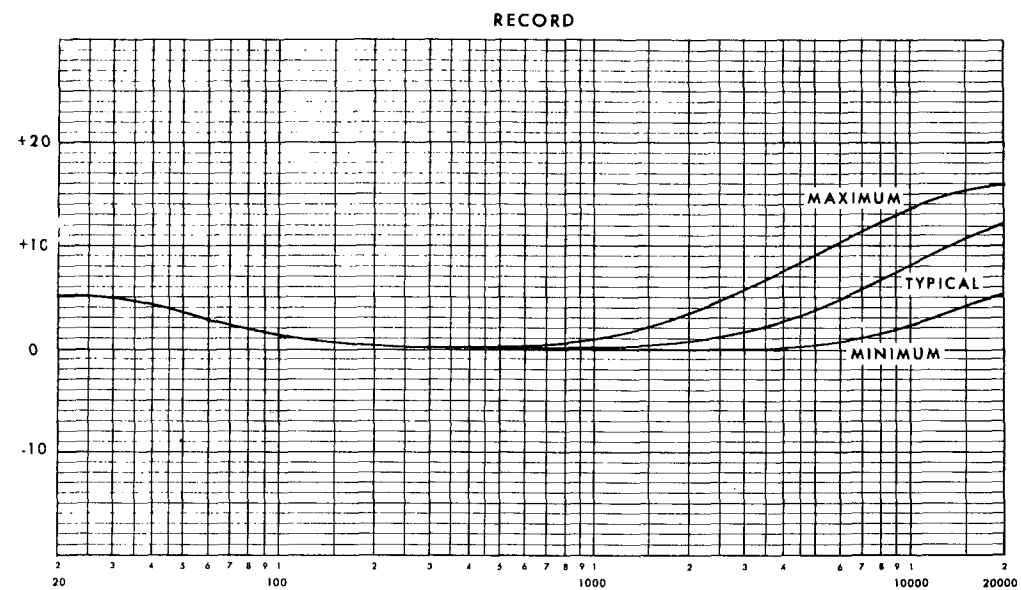
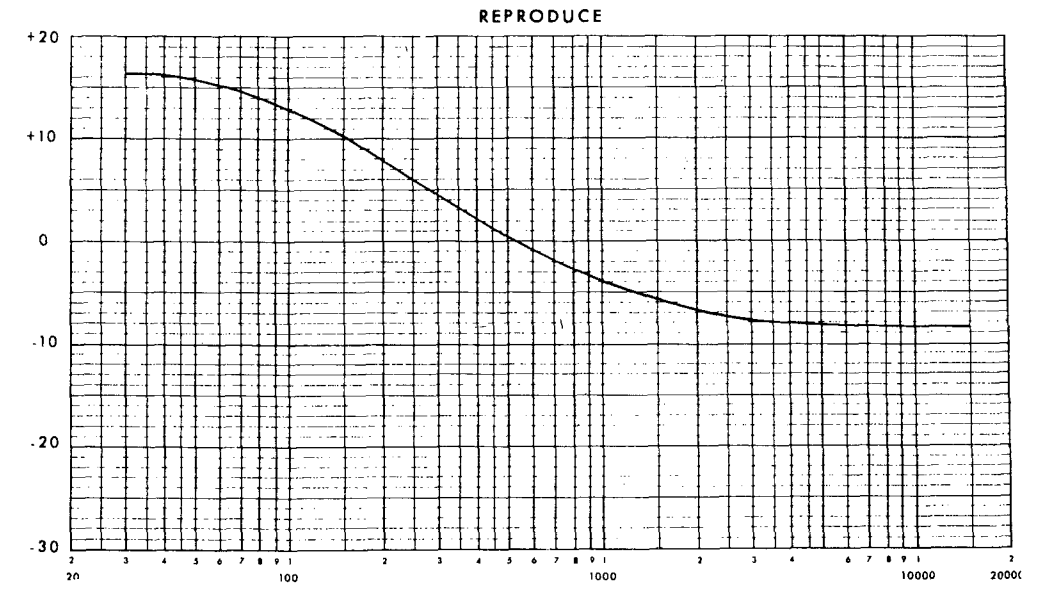
OPTIONAL ACCESSORY  
MICROPHONE PREAMPLIFIER  
CATALOG NO. 4010066  
(see Fig. 6-31)

Ref.	Qty	DESCRIPTION	Ampex Part No.
	1	Printed Circuit Board, assembly	4050409-01
C1	2	Capacitor, tantalum; 39 mfd, ±20%, 6 vdcw	037-452
C2	2	Capacitor, tantalum; 0.22 mfd, ±20%, 25 vdcw	037-450
C3	1	Capacitor, tantalum; 68 mfd, ±20%, 20 vdcw	037-451
C4	-	Same as C2	
C5	1	Capacitor, ceramic disc; .0022 mfd, ±10%, 500 vdcw	030-102
C6	-	Same as C1	
Q1	2	Transistor, silicon; low noise, low level	014-658
Q2	-	Same as Q1	
R1	2	Resistor, fixed, comp; 470,000 ohms, ±5%, 1/2w; RC20GF474J	041-029
R2	1	Resistor, fixed, comp; 27,000 ohms, ±5%, 1/2w; RC20GF273J	041-015
R3	1	Resistor, metal film; 22,100 ohms, ±1%, 1/4w	057-208
R4	1	Resistor, fixed, comp; 620 ohms, ±5%, 1/2w; RC20GF621J	041-006
R5	1	Resistor, fixed, comp; 9,100 ohms, ±5%, 1/2w; RC20GF912J	041-373
R6	1	Resistor, fixed, comp; 1.3 meg ohms, ±5%, 1/2w; RC20GF135J	041-377
R7	-	Same as R1	
R8	1	Resistor, metal film; 47,500 ohms, ±1%, 1/4w	042-482
R9	1	Resistor, fixed, comp; 1,800 ohms, ±5%, 1/2w; RC20GF182J	041-009
R10	1	Resistor, fixed, comp; 22,000 ohms, ±5%, 1/2w; RC20GF223J	041-016
T1	1	Transformer, microphone	4580197-01
	2	Sockets, transistors	150-103
	1	Can, plug-in	4290201-10

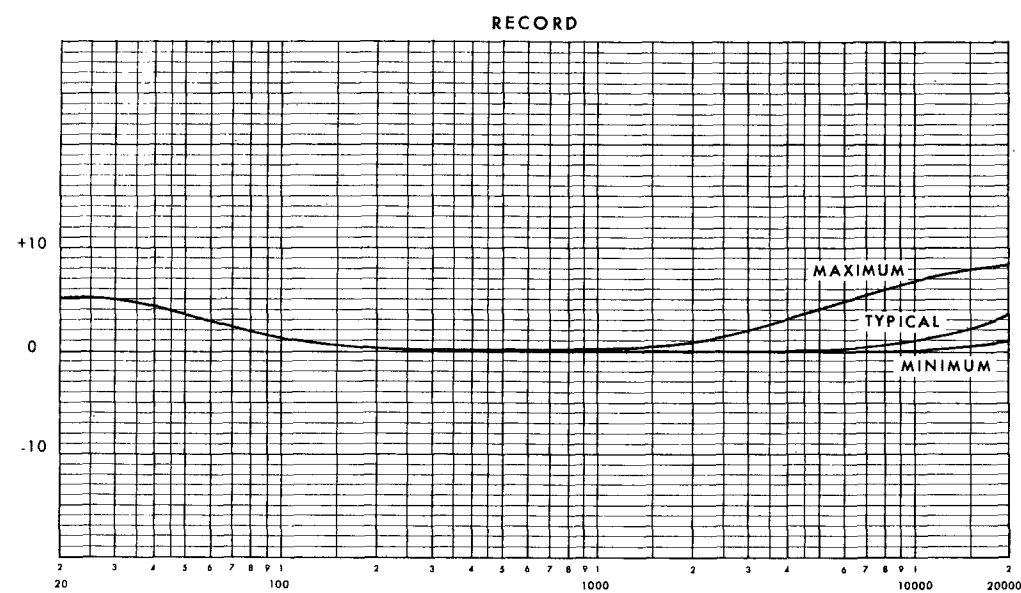
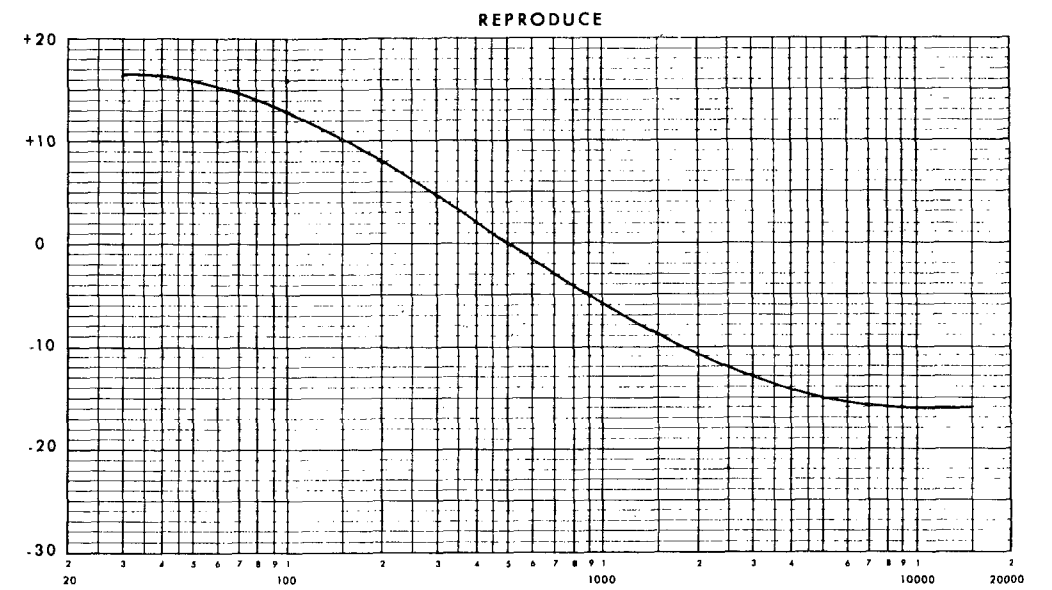




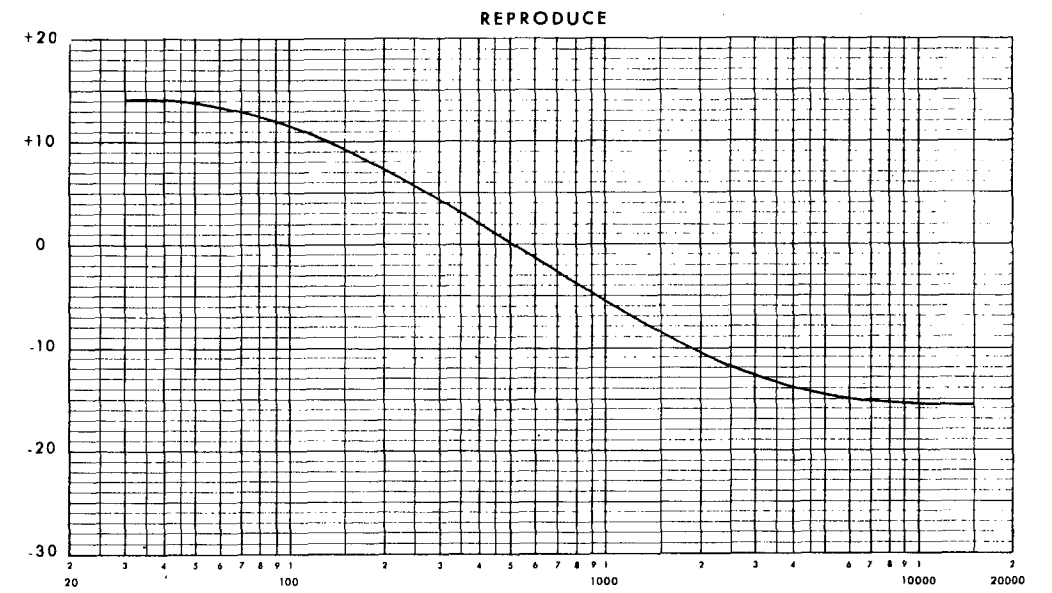
**3 3/4 ips (120 usec)**



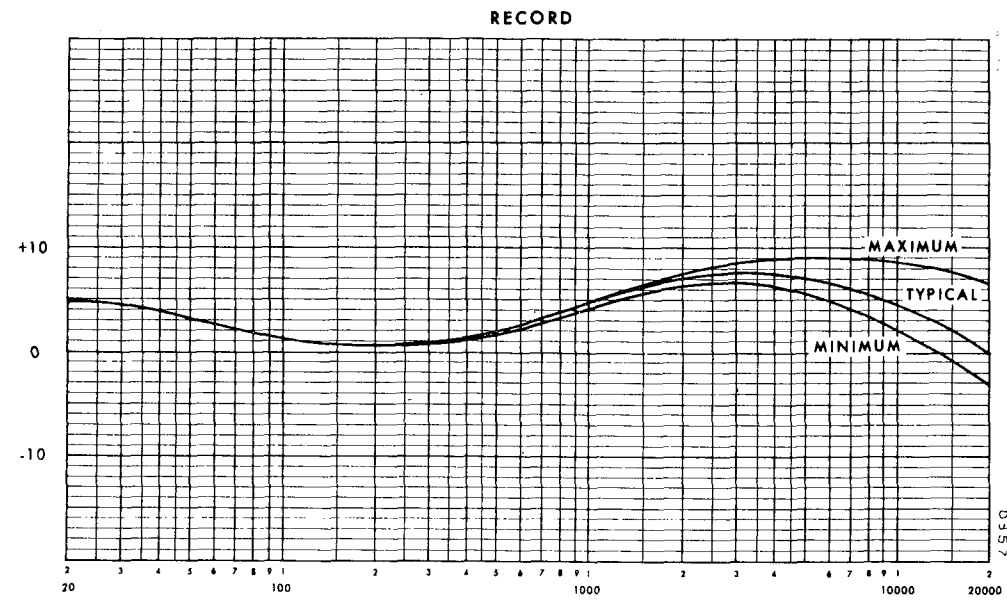
**7 1/2 ips NAB**



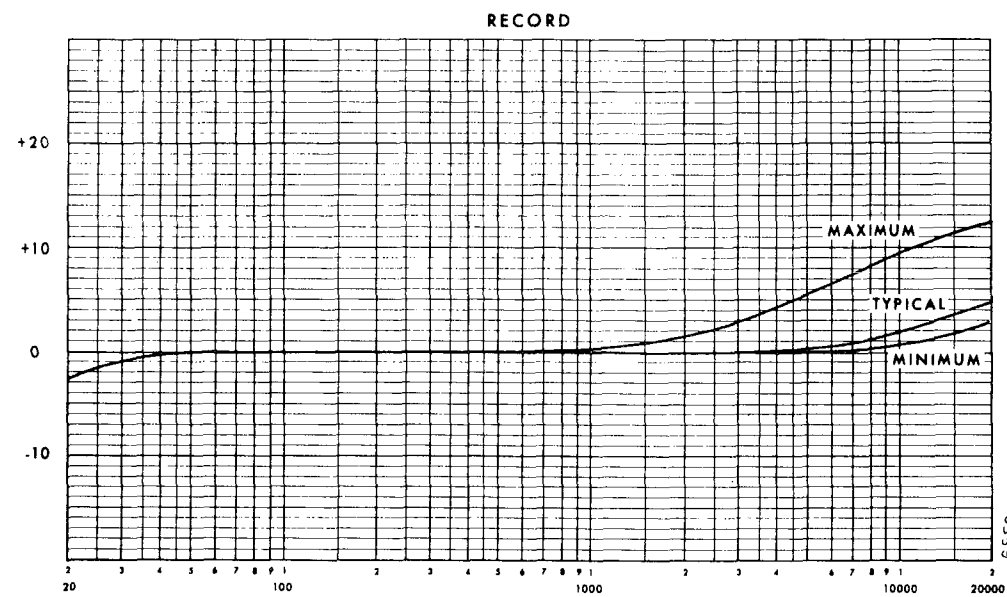
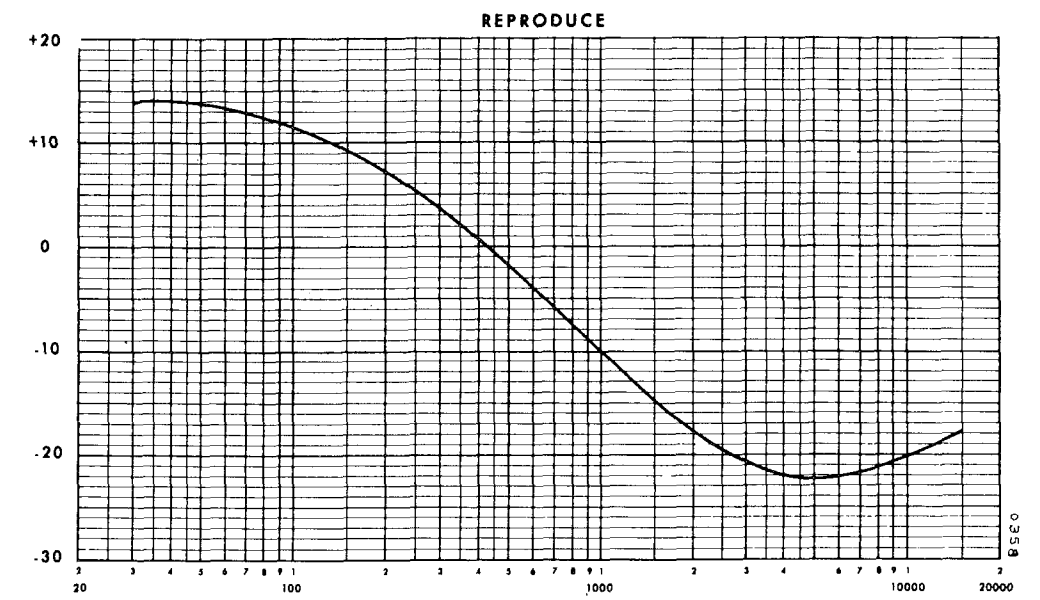
**15 ips NAB**



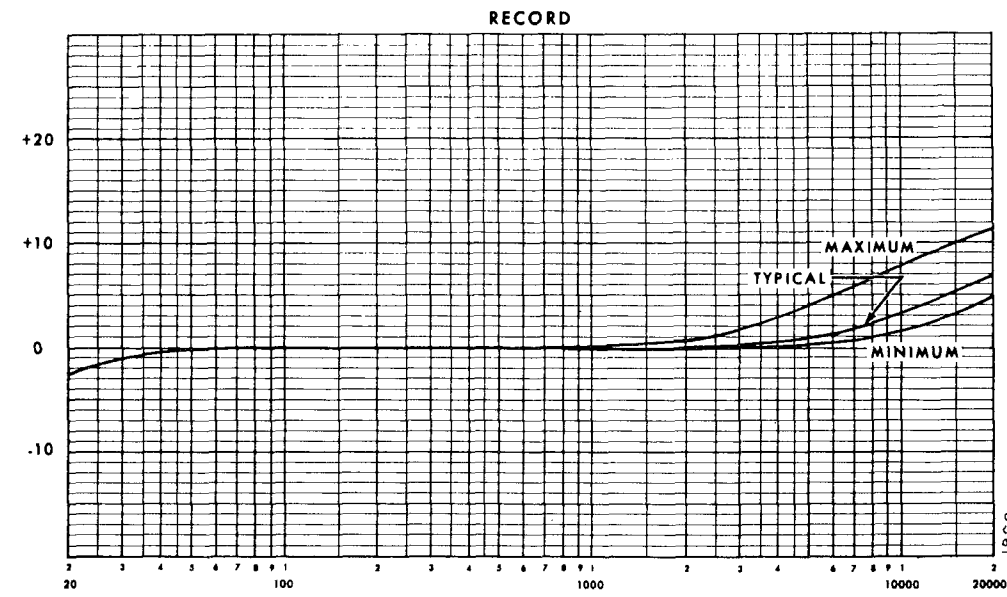
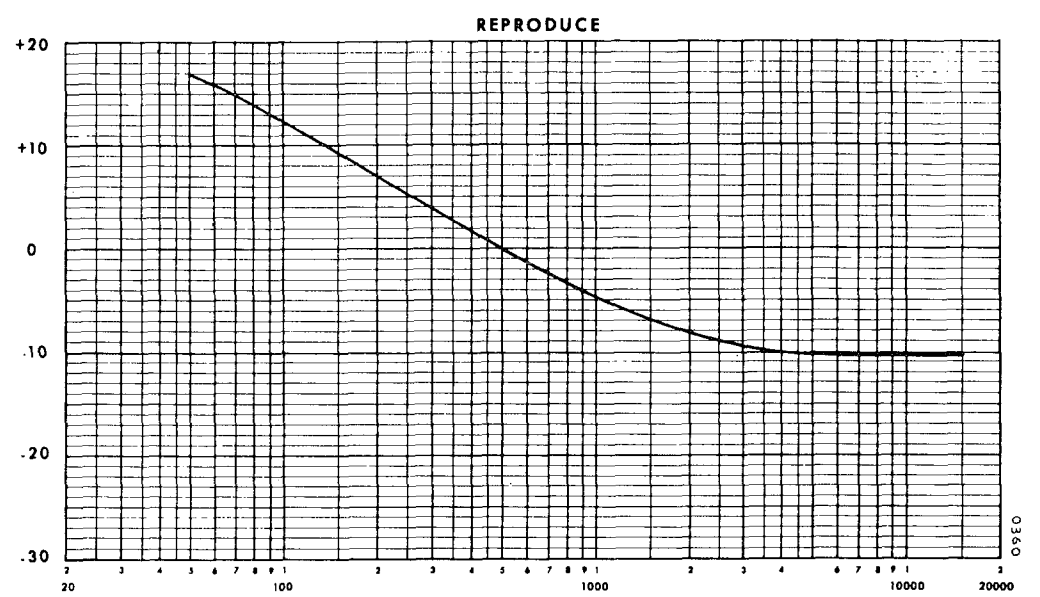
*Fig. 6-32. Response Curves, Sheet 1*



15 ips AME



7 1/2 ips CCIR



15 ips CCIR

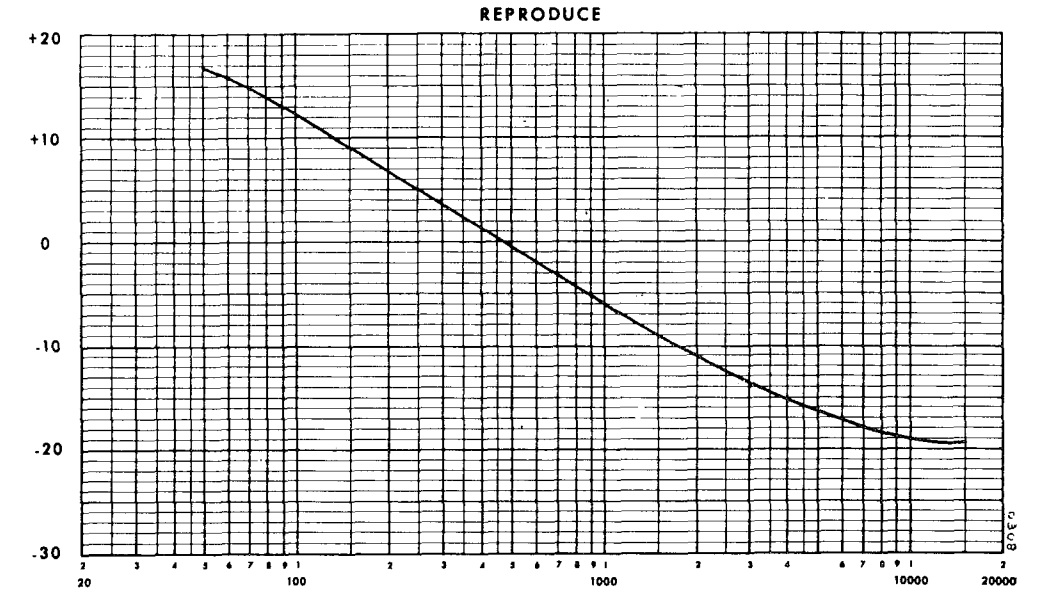
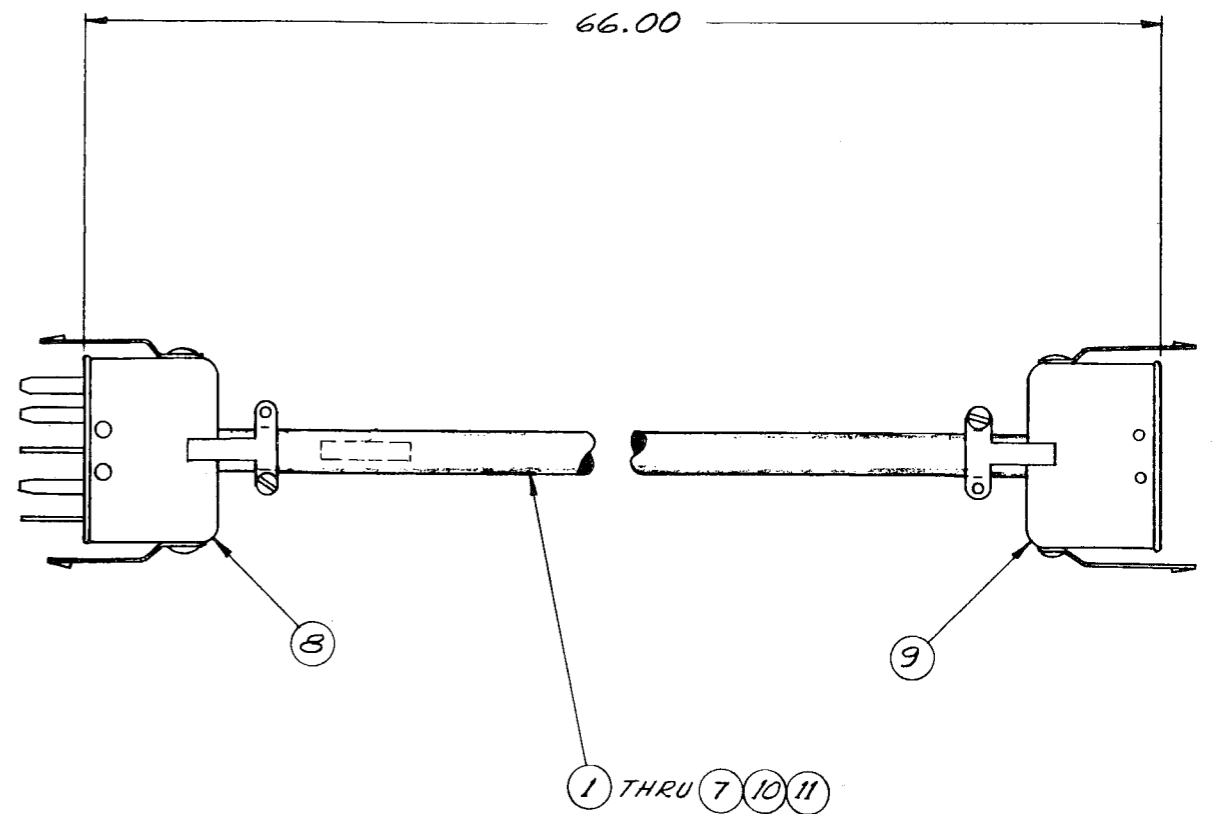


Fig. 6-33. Response Curves, Sheet 2



1		1
2		2
3	YEL	3
4		4
5	GRN	5
6	BLU	6
7	VIO	7
8	GRY	8
9	WHT	9
10	BLK	10

*SCHEMATIC DIAGRAM*

PART NO.	L
4050416-01	120"

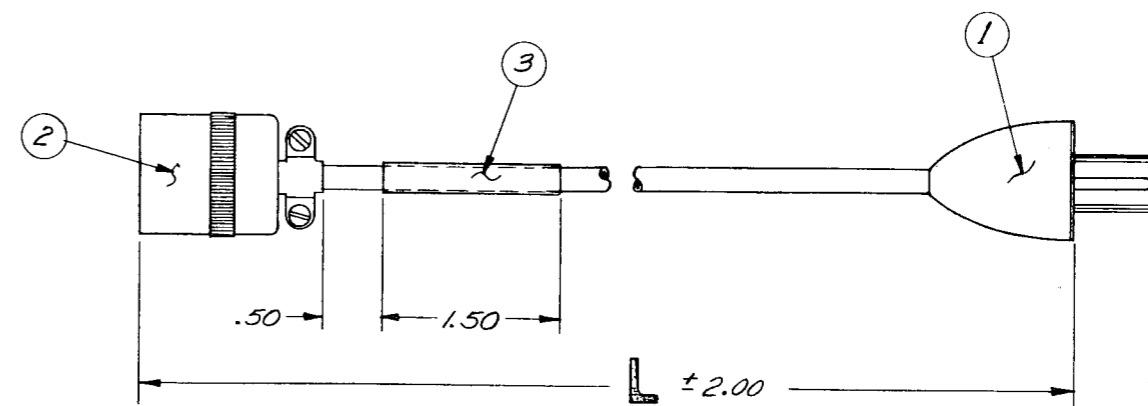
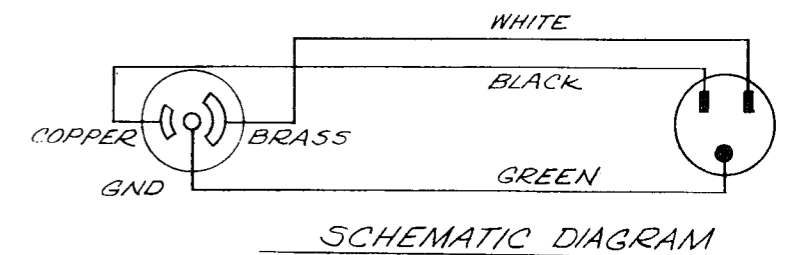


Fig. 6-35. Cable, Power

## MODIFICATIONS

### 1. Tape Transport Control System

#### A1.1 GENERAL

Certain customers have indicated to the Ampex Audio Engineering Department that they had requirements which necessitated defeating some of the features provided on the Model AG440 and AG 445 tape transport. Modifications of the equipment to meet such requirements are fairly simple. The following instructions can be followed most easily by referring to the simplified schematic diagram of the tape transport control system which is provided herewith. All parts referenced are called out on the inner view of the control box assembly, also provided.

#### A1.2 MODIFICATION PROCEDURES

**PROCEDURE 1. TO ALLOW THE EQUIPMENT TO ENTER ANY OTHER MODE FROM THE RECORD MODE.** This defeats the safety feature which makes it impossible to enter any other mode from record without first stopping operation.

(a) Connect a jumper wire from the emitter of Q601 to the negative side of diode CR605.

(b) Open the base lead of Q601 to protect the transistor.

**PROCEDURE 2. TO DEFEAT ALL OR ANY OF THE EDIT FUNCTIONS.** There are three edit modes provided on the AG440/AG445--a stop/edit, a play/edit, and a fastwinding/edit.

(a) To defeat the stop/edit mode simply disconnect the lead which is connected to pin 6 of edit relay K603.

(b) To defeat the play/edit mode, connect two jumper wires across pin 4 and pin 12, and across pin 2 and pin 10, of edit relay K603.

(c) To defeat the fastwinding/edit mode, connect a jumper wire across the normally closed section of EDIT switch S611.

(d) To defeat all edit modes, disconnect the wire from either side (pin 13 or pin 14) of edit relay coil K603 and install the jumper wire as described in (c).

**PROCEDURE 3. TO ENABLE ENTRANCE INTO THE PLAY/EDIT MODE SIMPLY BY PRESSING THE EDIT PUSHBUTTON WHEN TAPE IS STOPPED, EVEN IF THE SAFETY SWITCH IS OPEN.**

(a) Disconnect the four wires from the



EDIT pushbutton switch S611, and remove that switch. Replace it with a DPDT momentary pushbutton-controlled microswitch with two normally open contacts (Licon 79-2920 or equivalent).

(1) Connect the two wires disconnected from the normally open contacts of the original switch to either open contact of the new switch. Solder the ends of the other two discon-

nected wires together, and tape the connection. Note that this forms the same circuit as the jumper wire connected in 2(c).

(2) Connect the other open contacts on the new switch to pin 8 and pin 12 of edit relay K603.

b. Connect a jumper wire across pin 7 and pin 9 of edit relay K603.



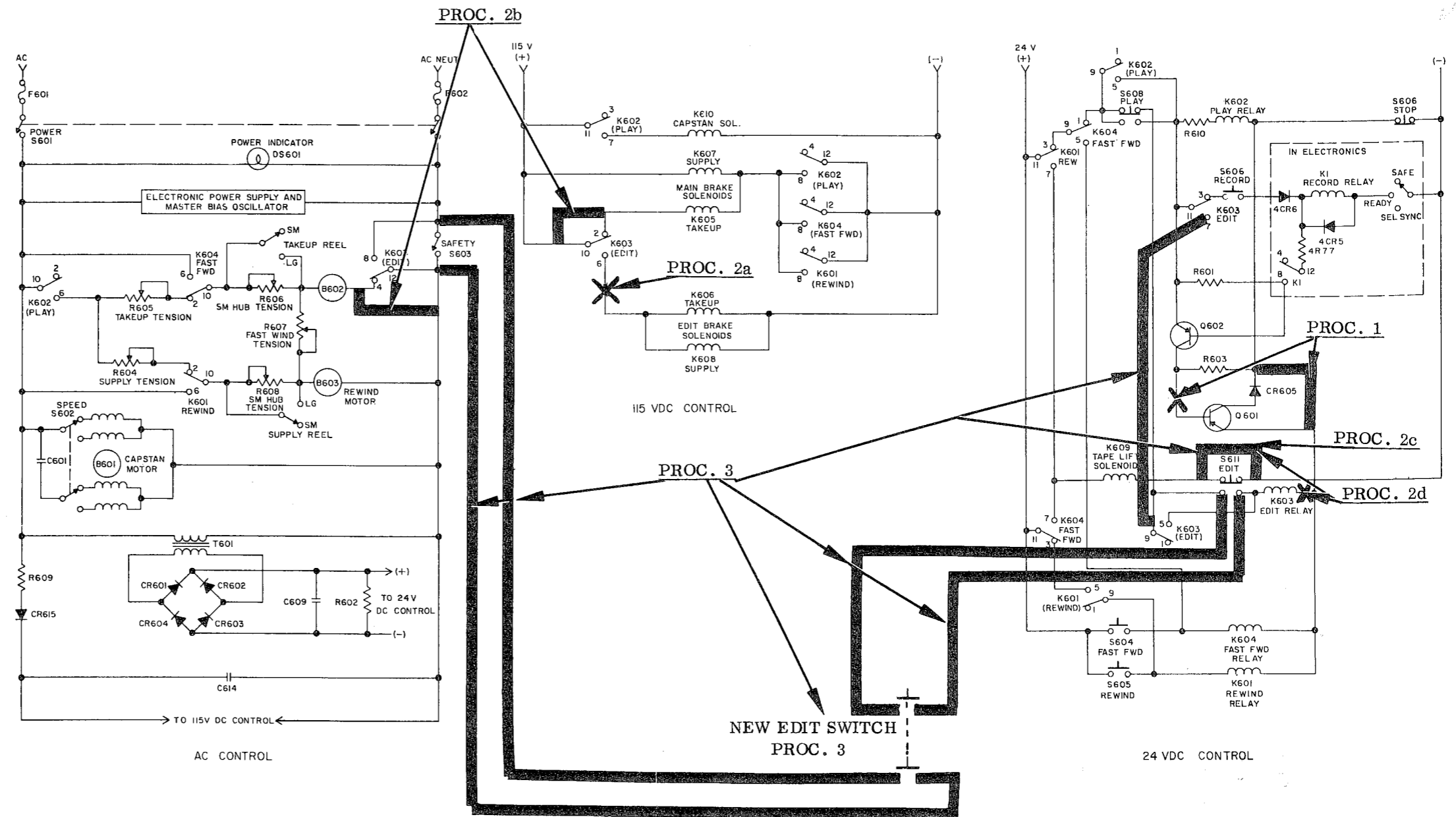


Fig. A1-1. Tape Transport Schematic, Simplified  
Showing Modifications Required

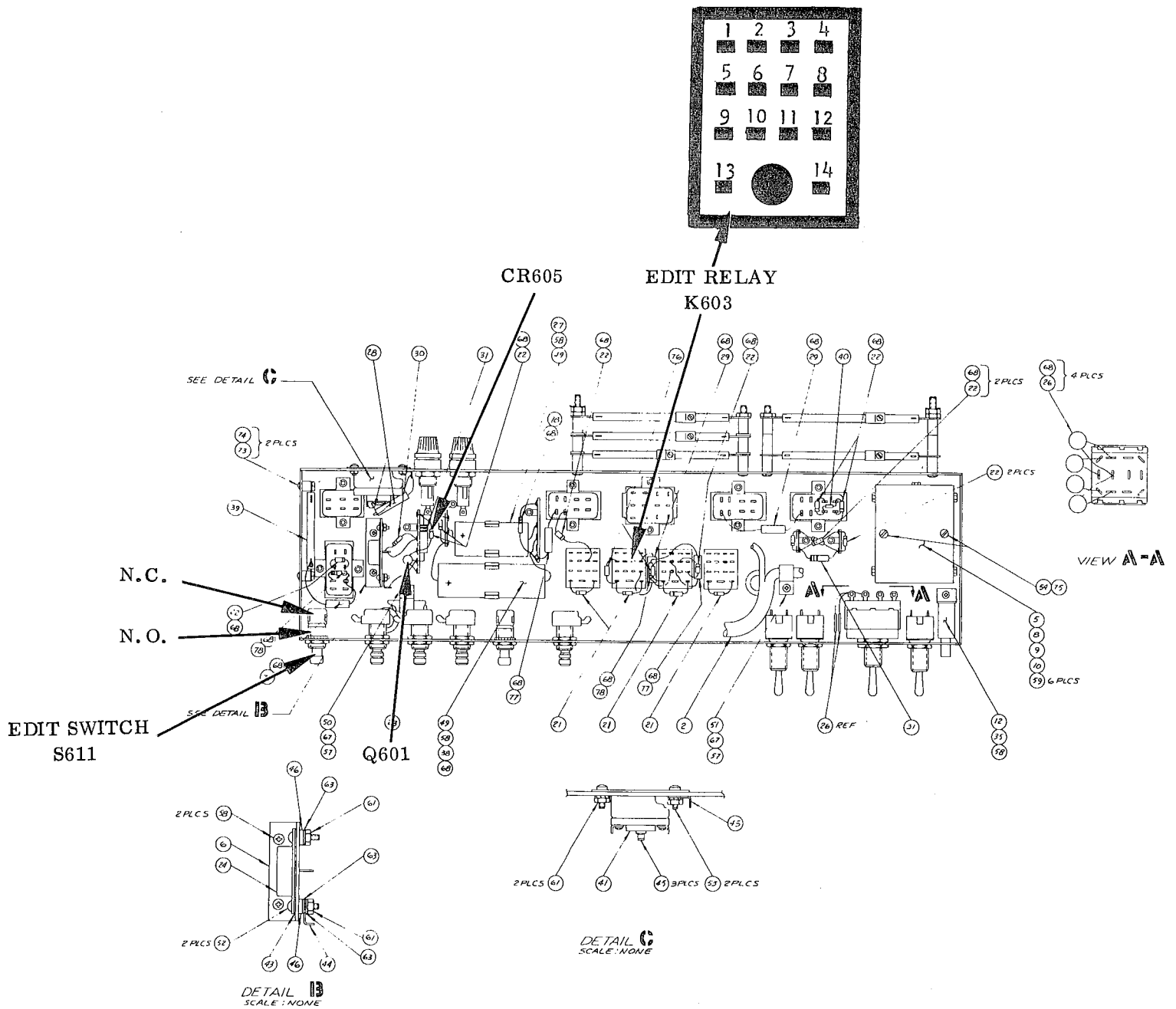


Fig. A1-2. Control Box Assembly,  
Showing Component Location

**MODIFICATIONS****2. Wiring For External Motor Drive Amplifier****A2.1 GENERAL**

In order to continue having the Ampex Models AG440 and AG445 approved by Underwriters' Laboratory, it has been necessary to remove the facility for connecting an external motor drive amplifier. Receptacle J604S (immediately to the left of the REMOTE CONTROL connector) on the tape transport control panel is therefore not internally connected, although the receptacle itself is still mounted on the control panel.

This appendix provides instructions for wiring that receptacle so that an external frequency source can be used. Note that all internal wiring, and the motor drive amplifier itself, must meet U. L. requirements if the installation must be approved by Underwriters' Laboratory.



The output of the motor drive amplifier must be isolated from the normal a-c mains.

The wiring required is shown on Fig. A2-1, the effect of the wiring is depicted on the schematic diagram, Fig. A2-2.

**A2.2 INTERNAL WIRING REQUIRED**

**Step 1:** Remove the control box from the tape transport (refer to instruction manual, paragraph 4E. 11. 2).

**Step 2:** Check at pin 3, receptacle J607S (REWIND MOTOR). The only wires connected to that pin should be a jumper wire and a white/violet wire. Remove the jumper. If any other leads except the white/violet are connected to pin 3, move them to pin 4 (leave the white/violet lead connected to pin 3).

**NOTE**

All wiring described in Steps 3 through 6 is to be accomplished using 22 gauge wire or larger.

**Step 3:** There is a terminal strip adjacent to J604S receptacle (see Fig. A2-1). Connect a wire from any terminal with a white/yellow lead to pin 5 of J604S.

**Step 4:** Connect a jumper wire from pin 5 to pin 8 of J604S.

**Step 5:** Connect a wire from pin 7 of J604S to pin 3 of J607S.

**Step 6:** Connect a wire from pin 1 of J604S to pin 4 of J607S.

### A2.3 CONNECTING MOTOR DRIVE AMPLIFIER

Mating plugs for J604S are available from Ampex under part number 145-013 (H. B. Jones number P-308-CCT-L).

Power input to the motor drive amplifier is connected from pins 1 and 5 ("low side" of a-c line) of this mating plug (this results in the power being controlled by the tape transport POWER switch, and safety switch). The precision frequency power output is routed back to the tape transport through pins 7 ("low side") and 8 of the mating plug.

### A2.4 PREPARING DUMMY PLUG

If it is anticipated that the equipment will employ the motor drive amplifier only part time, and will sometimes be powered directly from the power mains, a dummy plug must be prepared. Use the same mating plug described in paragraph A2-3.

Use a bare 20 gauge wire to jumper pins 7 and 1 of this mating plug (see Fig. A2-2). To change operation from the motor drive amplifier to the power line, simply unplug the connector from the amplifier and insert the dummy plug in J604S.

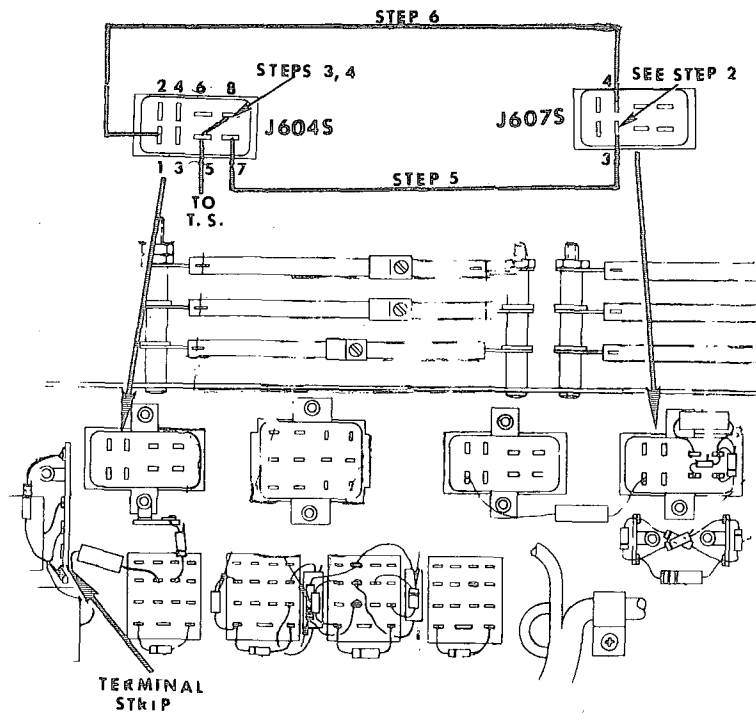
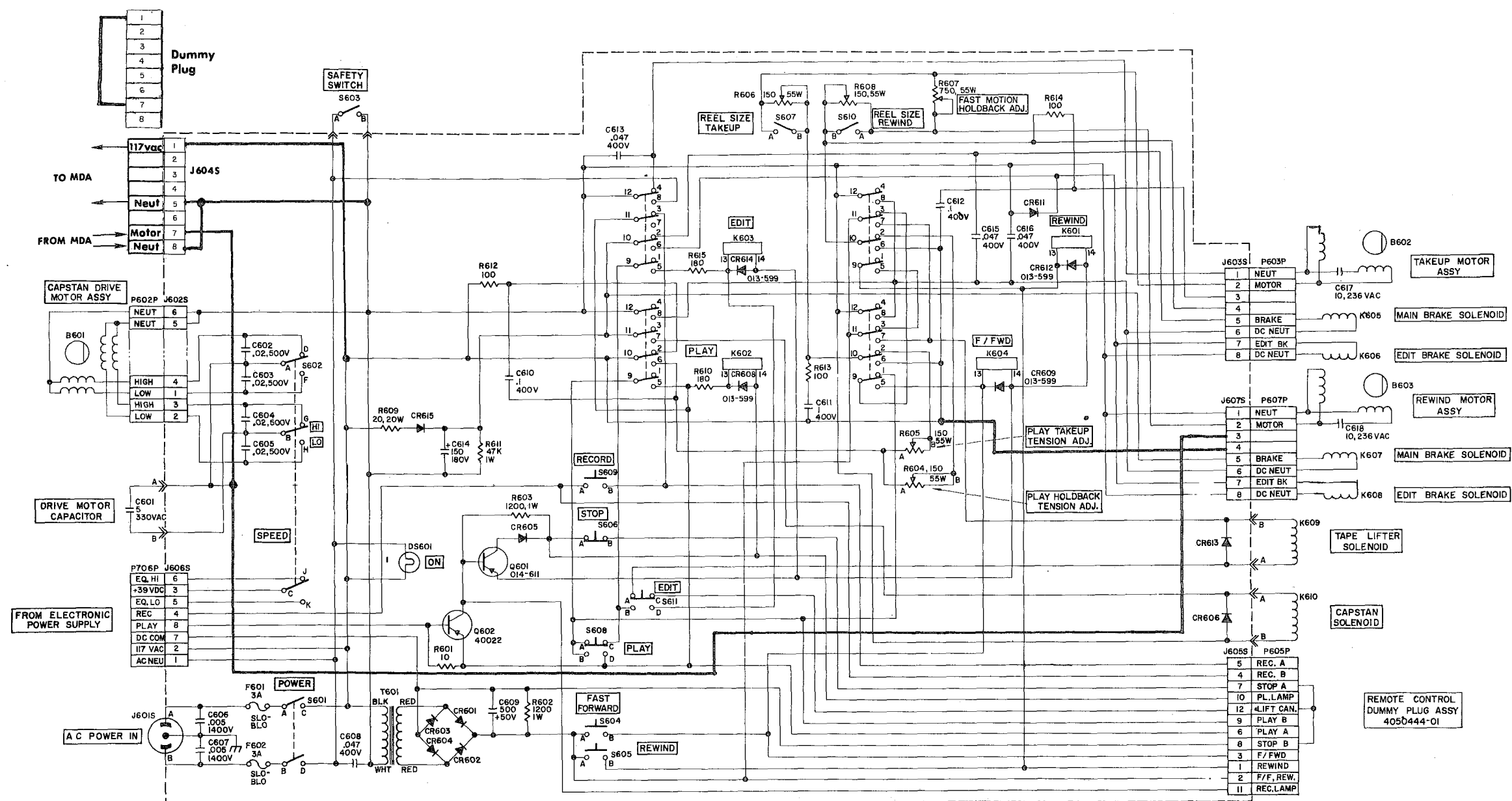


Fig. A2-1. Wiring Required



- NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, 10%.
  2. ALL CAPACITOR VALUES ARE IN MICROFARADS AT INDICATED VOLTAGE.
  3. ALL DIODES ARE TYPE 013-678.

LAST REF. DES. USED	REF. DES. NOT USED
B603	CR607
C618	CR610
CR615	J604S
DS601	P601P
F602	P604P
J607S	
K610	
P607P	
Q602	
R615	
S611	
T601	

401978A

Fig. A2-2. Schematic Diagram  
Changes Shown By Heavy Lines

## INDEX

### ACCESSORY EQUIPMENT

	Para.
Boards, extender	
Catalog Nos.	1.6.6
Description of	1.6.6
Use of	4F.2
 Covers, rear, console	
Catalog Nos.	1.6.4
Description of	1.6.4
Installation of	2.7.4
 Equalizer, record, CCIR	
Catalog No.	1.6.7
 Preamplifier, Microphone (6-31)	
Catalog No.	1.6.1
Description of	1.6.1
Installation of	2.7.1
 Remote Control Unit (6-30)	
Catalog No.	1.6.2
Description of	1.6.2
Installation of	2.7.2
 Scrape Flutter Idler (6-7)	
Catalog No.	1.6.5
Installation of (4A-3, 4)	4A.3
Lubrication of	4B.3.4

### Transformers, input

	Para.
Catalog Nos.	1.6.1
Description of	1.6.1
Installation of	2.7.1

### ADJUSTMENTS AND ALIGNMENT

#### Electronic

Azimuth, record head (4C-6)	4C.3.8
Azimuth, reproduce head (4C-6)	4C.3.6
Equalization, Record	4C.3.10
Equalization, Low Freq., Repro.	4C.3.9
Power Supply (4C-5)	4C.3.5
Reproduce/Record Alignment	4C.3.7
Test Tapes	4C.3.1

#### Sel-Sync (6-24)

Bias Trap	4C.4.4
Level	4C.4.3

#### Tape Transport

Brakes (4C-2)	4C.2.4
Capstan Idler (4C-3, 4)	4C.2.5
Tape Tension (4C-1)	4C.2.3

#### ARM, REEL IDLER (6-15)

Adjusting, tension	4E.6.3
Removal of	4E.6.4

NUMBERS IN PARENTHESIS ARE APPLICABLE ILLUSTRATIONS

ARM, TAKEUP TENSION	Para.	BRAKES, TAPE TRANSPORT (Cont.)	Para.
Adjusting, force	4E.7.1	Replacing brake bands	4E.4.6
Adjusting, safety switch	4E.7.2	Servicing hints	4E.2.1
Principles of Operation	5.1.5	CAPACITOR, DRIVE MOTOR	
Removing Tape Guide and Hook	4E.7.3	Replacement of	4E.5.4
Replacing Tension Spring	4E.7.4	CAPACITOR, REWIND MOTOR	
Replacing Complete Assembly	4E.7.5	Replacement of	4E.4.9
AZIMUTH, HEADS		CAPACITOR, TAKEUP MOTOR	
Adjustment of (4C-6)		Replacement of	4E.4.9
Record	4C.3.8	CAPSTAN IDLER	
Reproduce	4C.3.6	Adjusting, force (4C-3, 4)	4C.2.5
BALL BEARING, REEL IDLER (6-15)		Adjusting, position	4E.8.3
Replacement of	4E.6.6	Lubrication of	4B.3.3
BIAS		Removal of solenoid	4E.8.5
Adjustment of	4C.3.7	Removal of idler	4E.8.4
Checkout of	4F.6	Servicing hints	4E.2.4
BIAS AMPLIFIER (6-24)		CHANNELS, ADDITION OF (4A-5)	4A.4
Checkout of	4F.6	CLEANING, TRANSPORT	4B.1
Principles of Operation	5.2.2	CONNECTOR, HEAD (4A-1, 6-5)	4A.2.3
BIAS OSCILLATOR (6-22)		CONNECTING SIGNAL	
Checkout of	4F.6	Input	2.5.2
Principles of Operation	5.2.2	Output	2.5.3
BOARDS, EXTENDER (Optional Access)		CONNECTING POWER	2.6
Catalog Nos.	1.6.6	CONTROLS, INDICATORS (3-1, 2)	3.1
Description of	1.6.6	CONTROL BOX, TRANSPORT (6-17, 18)	
Use of	4F.2	Removal of (6-8)	4E.11.3
BCARDS, PRINTED CIRCUIT (1-4)		CONTROL CIRCUIT, TRANSPORT (6-20, 21)	
Bias Amplifier	1.3	Principles of Operation	
Power Supply	1.2	Edit Mode	5.1.7.4
Record	1.3	Fast Forward Mode	5.1.7.2
Reproduce	1.3	Play Mode	5.1.7.1
Replacement of Parts	4F.9.2	Record Mode	5.1.7.5
BOX, CONTROL		Rewind Mode	5.1.7.3
Removal of	4E.11.3	CONVERSION AND EXPANSION	
BOX, HEAD CABLE		Channels, addition of (4A-5)	4A.4
Removal of (4A-2)	4A.2.4	Conversion, record and reproduce	4A.6
BOX, POWER SUPPLY		Conversion, tape width	4A.2
Removal of	4E.3	Covers, rear, console	4A.5
BRAKES, TAPE TRANSPORT (6-14)		Idler, scrape flutter	4A.3
Adjusting force (4C-2)	4C.2.4	Turntables, repositioning of	4A.1
Removal of assembly	4E.4.5		
Remounting and adjusting assembly	4E.4.8		

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CORRECTIVE MAINTENANCE	Para.	ELECTRONICS, ASSEMBLIES (Cont.)	Para.
Heads	4D	Input Power and Indicators	4F.3
Transport	4E	Power Supply	4F.5
Electronics	4F	Record/Reproduce circuits	4F.7
COVERS, REAR, CONSOLE (Optional)		Record Relay	4F.4
Catalog Nos.	1.6.4	Replacement of Parts	4F.9
Installation of	2.7.4	Description, General (1-3)	1.3
CURVES, RESPONSE (6-32,33)		Principles of Operation (5-3)	5.2
Achieving (4F-1,2)	4F.10	ELECTRONICS, REPRODUCE-ONLY (6-25)	
DEMAGNETIZING	4B.2	Controls and Indicators	3.1.3
DESCRIPTION, GENERAL		Description of (1-5)	1.4
Accessories	1.6	EQUALIZER, RECORD, CCIR (optional)	1.6.7
Electronics, record/reproduce (1-3)	1.3	EQUALIZERS	
Electronics, reproduce-only (1-5)	1.4	Mounting (2-6)	2.8(f)
Head, assembly	1.5	EQUALIZATION, RECORD	
System (1-1)	1.1	Adjustment of	4C.3.10
Tape Transport (1-2)	1.2	Switching of	5.2.3
DISTORTION, OVERALL		EQUALIZATION, REPRODUCE	
Checking	4B.4.6	Adjustment, high frequency	4C.3.7
Specifications for	1.7	Adjustment, low frequency	4C.3.9
DRIVE MOTOR, ASSEMBLY (6-16)		Switching of	5.2.4
Checking	4E.11.7	ERASE	
Lubrication, initial	4B.3.2	Adjustment of	4C.3.7
Lubrication, scheduled	4B.3.3	FAN, DRIVE MOTOR	
Removal of	4E.5.3	Replacement of	4E.5.2
DRIVE SYSTEM		FAST-WINDING MODES	
Principles of Operation	5.1.3	Operation of	3.5
DRIVE PLATE, REEL		Time Specification	1.7
Replacement of	4E.4.3	FLUTTER	
EDIT MODES		Checking	4B.4.7
Description and Operation	3.6	Description, tape scrape flutter	5.1.8
ELECTRONICS, ASSEMBLIES (6-24)		Specification for	1.7
Alignment of		FLYWHEEL, DRIVE MOTOR	
Azimuth, record head (4C-6)	4C.3.8	Removal of	4E.5.2
Azimuth, reproduce head (4C-6)	4C.3.6	FREQUENCY RESPONSE, OVERALL	
Equalization, Low Freq., repro	4C.3.9	Checking	4B.4.4
Equalization, record	4C.3.10	Specification for	1.7
Power Supply (4C-5)	4C.3.5	FRONT PANEL CONSOLE	
Reproduce/Record function	4C.3.7	Removal of (2-2)	2.3
Controls and Indicators (3-2)	3.1.2		
Corrective Maintenance			
Bias	4F.6		

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GUIDE, TAPE, REEL IDLER	Para.	HUB SIZE, REEL	Para.
Removal of	4E. 6. 1	Selection of (operation)	3. 2. 2
Rotation of	4A. 2. 2	Tension control (reel switch)	3. 1. 1
GUIDE, TAPE, TAKEUP TENSION ARM		HOOK, TAPE TAKEUP TENSION ARM	
Removal of	4E. 7. 3	Removal of	4E. 7. 3
Rotation of	4A. 2. 2		
HEAD, ASSEMBLY		IDLER, REEL (6-15)	
Azimuth, alignment		Corrective Maintenance	4E. 6
Record (4C-6)	4C. 3. 8	Principle of Operation	5. 1. 4
Reproduce (4C-6)	4C. 3. 6	IDLER, SCRAPE FLUTTER	
Changing of (4A-1)	4A. 2. 3	Catalog No. (optional)	1. 6. 5
Cleaning of	4B. 1	Installation of (4A-3, 4)	4A. 3
Corrective Maintenance		Lubrication of (6-7)	4B. 3. 4
Height Adjustment (4D-1)	4D. 2	INDICATOR LAMPS	
Replacing Head Stacks	4D. 4	Power, replacement of	4E. 11. 10
Tape Wrap Adjustment	4D. 3	Record and Ready	
Zenith Adjustment (4D-1)	4D. 3	Check of	4F. 3
HEAD, ERASE		Replacement of	4F. 9. 1. 1
Height Adjustment	4D. 2. 3	VU Meter	
Replacement of	4D. 4. 2	Replacement of	4F. 9. 1. 2
HEAD, RECORD		INSTALLATION	
Azimuth, alignment (4C-6)	4C. 3. 8	Connecting, assemblies (2-3, 4, 6-34)	2. 4
Height Adjustment (4D-1)	4D. 2	Connecting, power (2-3, 6-35)	2. 6
Replacement of	4D. 4. 1	Connecting, signal lines	2. 5
Tape Wrap, Adjustment	4D. 3	Installing Accessories or plugs	2. 7
Zenith Adjustment (4D-1)	4D. 3	Mounting (2-1)	2. 2
HEAD, REPRODUCE		Removing Panel, Console (2-2)	2. 3
Azimuth Alignment (4C-6)	4C. 3. 6	Unpacking	2. 1
Height Adjustment (4D-1)	4D. 2	LEVEL, RECORD	
Replacement of	4D. 4. 1	Calibration of	4C. 3. 7
Tape Wrap Adjustment	4D. 3	LEVEL, REPRODUCE	
Zenith Adjustment (4D-1)	4D. 3	Calibration of	4C. 3. 7
HEAD, QUARTER TRACK		LEVEL, SEL-SYNC	
Height Adjustment (4D-1)	4D. 2. 2	Adjustment of	4C. 4. 3
Replacement of	4D. 4. 1	LIFTER, TAPE (6-11)	
Selection of (Operation)	3. 4(2)	Adjustment of	4E. 9. 1
Tape Wrap Adjustment	4D. 3	Removal of	4E. 9. 2
Zenith Adjustment (4D-1)	4D. 3	Principles of Operation	5. 1. 6
HINTS, SERVICING		LUBRICATION	
Brake Bands	4E. 2. 1	Capstan Idler	4B. 3. 3
Relays	4E. 2. 2	Drive Motor, initial	4B. 3. 2
Solenoids	4E. 2. 3	Drive Motor, scheduled	4B. 3. 3
HEAD CABLE BOX (6-6)		Scrape Flutter Idler	4B. 3. 4
Removal of (4A-2)	4A. 2. 4		

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MAINTENANCE, ROUTINE	Para.	POWER SUPPLY, ELECTRONICS (6-22, 23)	Para.
Checks, overall performance	4B.4	Adjustment of (4C-5)	4C.3.5
Cleaning	4B.1	Checking (6-19)	4F.5
Demagnetizing	4B.2	Principles of Operation	5.2.1
Lubricating	4B.3	Removing Box	4E.3
MONITORING		PREAMPLIFIER, MICROPHONE (Optional)	
MOTOR, DRIVE, assembly(6-16)		Catalog No.	1.6.1
Checking	4E.11.7	Installation of	2.7.1
Lubrication, initial	4B.3.2	PREOPERATING PROCEDURES	
Lubrication, scheduled	4B.3.3	Applying power	3.2.1
Removing assembly	4E.5.3	Monitoring, facilities	3.2.5
Removing Fan and Flywheel	4E.5.2	Selecting Hub Size	3.2.3
Replacing Motor Capacitor	4E.5.4	Selecting Tape Speed	3.2.2
MOTOR, REWIND		Threading Tape (3-3)	3.2.4
Checking	4E.11.9	PRINTED CIRCUIT BOARDS (1-4, 2-5)	
Tension adjustment (4C-1)	4C.2.3	Bias Amplifier	1.3
MOTOR, TAKEUP		Power Supply	1.2
Checking	4E.11.8	Record	1.3
Tension Adjustment (4C-1)	4C.2.3	Reproduce	1.3
OPERATING CONTROLS AND INDICATORS		Replacement of Parts	4F.9.2
Electronics, Record/Reproduce (3-2)	3.1.2	PULLEY, REEL IDLER (6-15)	
Electronics, Reproduce-only	3.1.3	Removal of	4E.6.2
Tape Transport (3-1)	3.1.1	RECORD CIRCUIT (6-24)	
OPERATION		Checking	4F.7.2
Controls and Indicators (3-1, 2)	3.1	Principles of Operation	5.2.3
Edit modes	3.6	RECORDING, OPERATION	
Fast-winding modes	3.5	With Sel-Sync	3.3.2
Record mode	3.3	Without Sel-Sync	3.3.1
Reproduce mode	3.4	RECORD AND REPRODUCE	
Pre-operating procedures (3-3)	3.2	Alignment	4C.3
OSCILLATOR, MASTER BIAS (6-22)		Checking	4F.7
Checking	4F.6	Conversion	4A.6
Principles of Operation	5.2.2	REEL DRIVE PLATE	
PERFORMANCE, OVERALL, CHECK		Replacement of	4E.4.3
Distortion	4B.4.6	REEL IDLER (6-15)	
Flutter	4B.4.7	Corrective Maintenance	
Frequency Response	4B.4.4	Arm Tension, adjustment	4E.6.3
Signal-to-Noise (4B-1, 2)	4B.4.5	Arm Assembly, removal of	4E.6.4
POWER (LINE)		Ball Bearing, replacement of	4E.6.6
Application of (control)	3.2.1	Complete assembly, removal of	4E.6.5
Checking	4E.11.4	Pulley assembly, removal of	4E.6.2
Connection of	2.6	Tape Guide, removal of	4E.6.1
Consumption	1.7	Principles of Operation	5.1.4
Requirements	1.7		

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REEL SWITCH	Para.	SIGNAL-TO-NOISE RATIO, OVERALL	Para.
Use of (hub size)	3.2.3	Checking (4B-1, 2)	4B.4.5
		Specifications for	1.7
REMOTE CONTROL (Optional)		SOLENOIDS	
Catalog No.	1.6.2	Capstan	
Description	1.6.2	Checking	4E.11.6.3
Installation	2.7.2	Removal of	4E.8.5
RELAY, ELECTRONICS, RECORD		Edit Brakes	
Checking	4F.4	Checking	4E.11.6.5
Servicing Hints	4E.2.3	Removal of	4E.4.7
RELAYS, TAPE TRANSPORT		Main Brakes	
Checking	4E.11.5	Checking	4E.11.6.4
Servicing Hints	4E.2.3	Removal of	4E.4.7
REPRODUCING, OPERATION	3.4	Tape Lifter	
		Removal of	4E.9.2
REPRODUCE CIRCUIT		SPECIFICATIONS, OVERALL	1.7
Checking	4F.7.3	SPRING, TAKEUP TENSION ARM	
Principles of Operation	5.2.4	Replacement of	4E.7.4
RESPONSE, FREQUENCY		STRAPPING, OUTPUT (5-4, 6-28)	2.5.4
Checking	4B.4.4	SWITCHES, CONTROL BOX	
Specifications for	1.7	Replacement of	4E.11.11
REWIND ASSEMBLY (6-13)		SWITCH, SAFETY	
Corrective Maintenance		Adjustment of	4E.7.2
Assembly, removal of	4E.4.2	Removal of	4E.10
Brake assembly, removal of	4E.4.5	TAKEUP ASSEMBLY (6-12)	
Brake assembly, remounting	4E.4.8	Corrective Maintenance	
Brake band, replacement of	4E.4.6	Assembly, removal of	4E.4.2
Brake solenoids, removal of	4E.4.7	Brake assembly, removal of	4E.4.5
Motor capacitor, removal of	4E.4.9	Brake assembly, remounting	4E.4.8
Reel Drive Plate, removal of	4E.4.3	Brake Band, replacement of	4E.4.6
Turntable Pad, replacement of	4E.4.4	Brake Solenoids, removal of	4E.4.7
Principles of Operation	5.1.2	Motor Capacitor, removal of	4E.4.9
SCRAPE FLUTTER IDLER (6-7)		Reel Drive Plate, removal of	4E.4.3
Optional Catalog No.	1.6.5	Turntable Pad, replacement of	4E.4.4
Optional, Installation (4A-3,4)	4A.3	Principles of Operation	5.1.2
Lubrication of	4B.3.4	TAKEUP TENSION ARM	
SEL-SYNC (6-24)		Corrective Maintenance	
Adjustment of		Assembly, removal of	4E.7.5
Bias Trap	4C.4.4	Arm Force, adjustment of	4E.7.1
Level	4C.4.3	Safety Switch, adjustment of	4E.7.2
Description	1.1	Tape Guide, removal of	4E.7.3
Recording with	3.3.2	Tape Hook, removal of	4E.7.3
Principles of Operation	5.2.5	Tension Spring, replacement of	4E.7.4
SIGNAL LINES		Principles of Operation	5.1.5
Connection of	2.5		

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<b>TAPE</b>	<b>Para.</b>	<b>TRANSPORT, TAPE (Cont.)</b>	
Threading (3-3)	3.2.4	Normal Adjustments	4C.2
Tension, adjustment of (4C-1)	4C.2.3	Routine Maintenance	
Speeds	1.7	Flutter Check	4B.4.7
Width Conversion	4A.2	Lubrication	4B.3
Wrap	4D.3	Theory of Operation (5-1,2)	5.1
<b>TAPE LIFTER (6-11)</b>		<b>TURNTABLE PAD</b>	
Adjustment of (6-10)	4E.9.1	Replacement of	4E.4.4
Assembly, removal of	4E.9.3		
Solenoid, removal of	4E.9.2	<b>TURNTABLES, Repositioning</b>	4A.1
Principles of Operation	5.1.6		
<b>TAPE SPEED</b>		<b>ZENITH, heads</b>	4D.3
Available	1.7		
Selection of	3.2.2		
<b>TENSION, REEL IDLER ARM</b>			
Adjustment of	4E.6.3		
<b>TENSION TAPE</b>			
Adjustment of (4C-1)	4C.2.3		
<b>TEST CONDITIONS</b>			
Alignment, electronic	4C.3.3		
Overall Performance Checks	4B.4.3		
Sel-Sync Adjustment	4C.4.2		
<b>TEST EQUIPMENT</b>			
Adjustments, Sel-Sync	4C.4.1		
Adjustments, Transport	4C.2.1		
Alignment, electronics	4C.3.2		
Overall Performance Checks	4B.4.2		
<b>TEST TAPES</b>			
Flutter	4B.4.7		
Catalog Nos.	4B.4.2		
Alignment	4C.3.1		
Catalog Nos. (Table)	4C-8		
<b>TRANSFORMERS, INPUT (Optional)</b>			
Catalog Nos.	1.6.1		
Description	1.6.1		
Installation	2.7.1		
<b>TRANSPORT, TAPE (6-8, 6-9)</b>			
Controls and Indicators (3-1)	3.1.1		
Conversion			
Repositioning Turntables	4A.1		
Scrape Flutter Idler	4A.3		
Tape Width	4A.2.2		
Corrective Maintenance	4E		
Description, General (1-2)	1.2		

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