Section 4

MAINTENANCE FOREWORD

4.1 INTRODUCTION

This section is divided into the following six parts; and all data numbering includes the part designation as the second digit:

A. Conversion
B. Routine Maintenance
C. Adjustment/Alignment
D. Head Maintenance
E. Transport Maintenance
F. Electronics Maintenance

4.2 CONTENTS

Part A, CONVERSION, contains procedures such as repositioning turntables (for the large CCIR reels), converting to another tape width, adding optional accessories (such as the second tape scrape-flutter idler, and the console rear covers), adding more channels, and converting from a reproducer to a recorder-reproducer.

Part B, PREVENTIVE MAINTENANCE including cleaning, demagnetizing, lubricating, and overall performance checkout.

Part C, ADJUSTMENT/ALIGNMENT, contains normal mechanical/electronic adjustment and adjustment procedures to correct faults indicated by the overall performance checks.

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

NOTE: Refer to the Table of Contents and Index Lists to find specific information.

Section 4

MAINTENANCE
Part A. Conversion

4A.1 TURNTABLE REPOSITIONING

The takeup and rewind assemblies, including turntables, are secured to the reel guards through slotted holes (in the top plate) that permit adjustment to or from the transport center. When shipped, both assemblies are positioned as near as possible to the center; this position allows the use of reels up to 10-1/2 inches in diameter. When the turntables are positioned fully outward, transports cannot be mounted side-by-side on standard 19-inch racks, because the reels protrude over the rack edges.

For use with 11-1/2 inch CCIR reels both turntables can easily be repositioned as follows:

Step 1: 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.

Step 2: Slide the takeup and rewind assemblies as far as possible from the center of the transport.

Step 3: Check that reel guard flats are parallel to transport top edge, and that turntables are centered in the guards, then tighten the nuts.

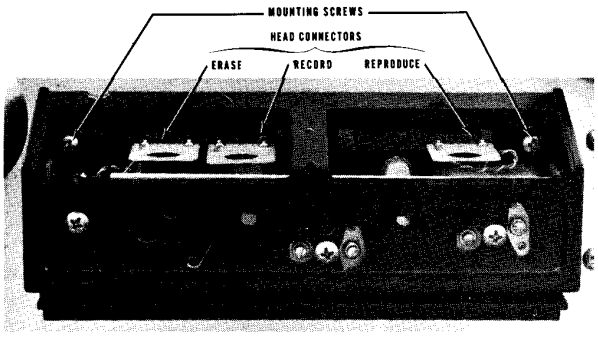
4A.2 TAPE-WIDTH CONVERSION

4A.2.1 General

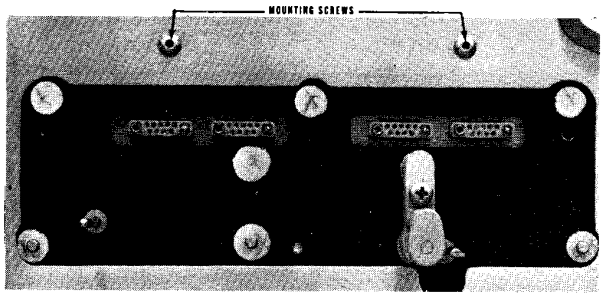
Changing between 1/2-inch and 1/4-inch magnetic tape is easily accomplished on the tape transport by rotating the two tape guides in their mountings. Changing channels between tape sizes or adding channels, may require changing of the head assembly or head cable box. The head azimuth adjustment and electronic alignment is required after any change of heads. The required procedures follow:

4A.2.2 Rotating Tape Guides

To rotate the two tape guides (on the reel idler and the takeup tension arm), lift the guides against the spring pressure and turn them until the correct-size guide is in the tape threading path. The guides snap down into position when correctly aligned. After tape width conversion, adjust tape tension (Table 4C-1).



4A-1. Head Assembly (Overlay Removed)



4A-2. Head Cable Box

4A.2.3 Changing Heads (See Figure 4A-1)

Remove the stainless-steel head cover by loosening the captive screw on the head slanted rear surface. On a four-position head, the switching knob (at the cover center) must be unscrewed to free the cover. Disconnect all head connectors, remove the two screws holding the head to the top plate, and (avoiding the bumping or scratching of the scrape-flutter idler) lift the head up and off. If the head cable box is to be changed, change it per paragraph 4A.2.4 before reinstalling the heads.

Clean the mounting surfaces on the tape transport and the head, then replace the assembly in the reverse order of removal procedures. Assure that head connectors are correctly mated as shown in Fig. 4A-1.

NOTE

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

4A.2.4 Changing Head Cable Box (See Figure 4A-2)

The two conditions under which the head cable box must be changed are: 1) equipment is to have channels added; and 2) conversion to handle 1/4-inch tape (using the four-stack head) or re-conversion to handle 1/2-inch tape. To remove the head cable box for inspection (head removal is unnecessary) just remove the head overlay and disconnect the heads from the receptacles. Change the head cable box as follows:

Step 1: Remove the head assembly per paragraph 4A.2.3.

Step 2: Disconnect all head cables from receptacles.

Step 3: Manually support head cable box and remove the two screws immediately behind the head assembly. This frees the box and it can be removed.

Step 4: Replace the box in the reverse order to removal procedures.

NOTE

Catalog numbers of various head cable box configurations are given in Section 6.

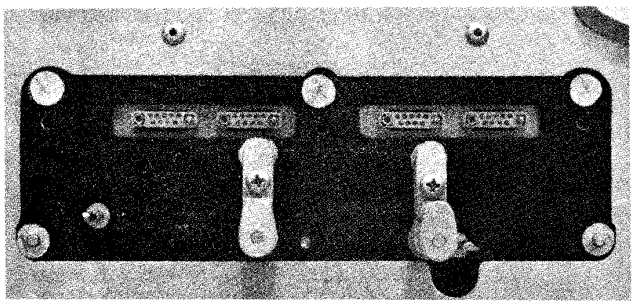
4A.3 SCRAPE-FLUTTER IDLER ADDITION (See Figures 4A-2 and 4A-3).

The tape scrape-flutter idler kit (Catalog No. 4010069) contains the idler, a mounting screw, and a lockwasher. The furnished idler, with small roller (3/8 inch), is mounted between head position 3 and 4. The optional idler, with the large roller (15/32 inch), must be mounted between head positions 2 and 3. Install the optional idler as follows:

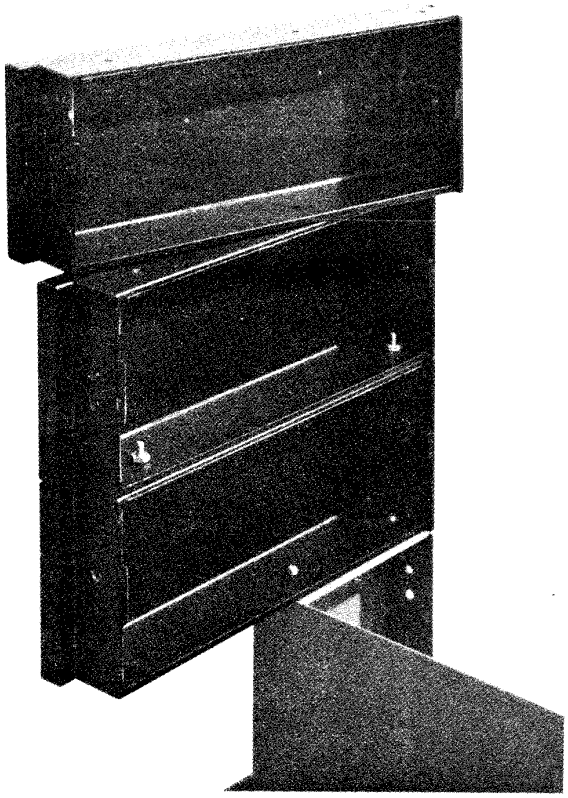
Step 1: Remove the head assembly per paragraph 4A.2.3.

Step 2: Mount the idler on the locating pin and boss and secure it with the screw and washer.

Step 3: Replace the head assembly.



4A-3. Scrape-Flutter Idlers Installed



4A-4. Record/Reproduce Unit Supports

Step 4: Check head azimuth and adjust as necessary per paragraphs 4C.3.6 and 4C.3.8.

4A.4 CHANNEL ADDITION

4A.4.1 General

To add channels (up to a total of four), change the head per paragraph 4A.2.3, and the head cable box per paragraph 4A.2.4. Then add one record/reproduce unit for each added channel as follows:

4A.4.2 Record/Reproduce Unit Installation (See Table 1-2 and Figure 4A-4)

One interconnecting cable (Catalog No. 4050442) must be connected to each added record/reproduce unit. Optional plug-in input units such as the balanced-line transformer, microphone preamplifier, etc. (described in Section 1) may be added.

1. For mounting in racks, or in custom consoles, secure the record/reproduce unit in position next to the installed units. Mounting dimensions are shown in Fig. 2-1.

2. The two portable cases for the record/reproduce units are a two-unit case (Catalog No. 4150330) and a four-unit case (Catalog No. 4150331). Two two-unit cases may be used for three or four-channel portable systems; and stacked on top of each other during use. For one channel or three channel equipment, a blank panel (Catalog No. 4290620) is available for the space left empty. Each unit is secured in the case by two 12-24 x 3/4 oval-head Phillips screws, used with white nylon cup-washers.

3. Each additional record/reproduce unit mounted in an Ampex console requires two supports (Catalog No. 4260404) installed as follows:

Step 1: Remove the top cover over the installed record/reproduce unit(s), and remove the uppermost unit.

Step 2: Attach the new supports to the installed supports (one on each side) with the two supplied 6-32 x 5/8 pan-head screws, two flat washers, two lockwashers, and two 6-32 hex nuts.

Step 3: Replace the top cover and mount the record/reproduce units. Secure each assembly to the supports with two 12-24 x 3/4 oval-head Phillips screws, and two white nylon cup-washers.

Step 4: Connect the record/reproduce units to the tape transport according to paragraphs 2.4 through 2.7.

If the console is equipped with optional rear covers, individual covers (Catalog No. 4040984) should be ordered for each additional record/reproduce unit.

4A.4.3 Reproduce Module Installation

When adding a reproduce module to a system, an equalizer circuit board is also required. Catalog numbers of the equalizers and the module are given in the first tables of Section 6. The reproducer tray holds up to four modules, and may be rack-mounted or console mounted. Install the module as follows:

Step 1: Remove the plug-in reproduce board from the chassis.

Step 2: Remove the front cover of the reproducer tray.

Step 3: Slide the chassis into position in the tray, and secure it with three No. 6 self-tapping screws inserted up through the bottom of the tray.

Step 4: Mate the equalizer connector to the receptacle at the front of the reproduce board.

Step 5: Slide the reproduce board into the chassis on the guides until it mates with its receptacle.

Step 6: Connect the reproduce module to the tape transport according to paragraphs 2.4 through 2.7.

4A.5 CONSOLE REAR COVER INSTALLATION

The optional rear covers (see Table 1-2) are attached to the uprights by captive, spring-loaded, thumbscrews mating with threaded holes in the uprights.

4A.6 RECORD AND REPRODUCE CONVERSION

To convert between reproducer and record/reproduce units: 1) change the circuit board in the electronics power supply (record/reproduce equipment uses a card containing a power supply and a bias oscillator; the bias oscillator is omitted on the reproducer board), 2) change the head assembly and head cable box per paragraphs 4A.2.3 and 4A.2.4, and 3) add the electronic unit(s) per paragraph 4A.4.

NOTE

Catalog numbers of the power supply boards, heads, head cable box assemblies, and the electronics units are included in the first tables of Section 6.

Section 4

MAINTENANCE
Part B. Preventive Maintenance

4B.1 EIGHTH-HOUR CLEANING

4B.1-1 Heads

Clean heads, and all other components in the tape threading path, after each eight hours of operation, or oftener if visual inspection indicates the need. This is to remove the oxide (deposited from the magnetic tape) which will degrade equipment performance as it accumulates. Clean each head thoroughly with a cotton-tipped applicator dampened with Ampex Head Cleaner (Catalog Nos. 4010823 or 087-007).

CAUTION

When cleaning the heads, use only the recommended solvent, to avoid damaging the heads. Keep solvent off of plastic finishes and the capstan idler tire. Do not use metal tools which might scratch the heads.

4B.1-2 Tape Guide Elements

Use iso-propyl alcohol to clean all tape-guiding elements, the capstan, and the capstan idler.

CAUTION

Do not use head-cleaning solution on these components, it will damage the idler rubber tire and cause tape slippage if applied to the capstan.

4B.1-3 Scrape-Flutter Idler

Clean scrape-flutter idlers with a dry cotton-tipped applicator. Be sure to remove all oxide from the top and bottom of the roller holder assemblies.

4B.2 EIGHTH-HOUR DEMAGNETIZING

Heads and other components in the tape threading path can acquire permanent magnetization that increases signal noise and distortion,

and partially erases high frequencies on recorded tapes. Demagnetize components after each eight hours of operation, or oftener if required, using an Ampex Head Demagnetizer (Catalog No. 4010820), or equivalent, as follows:

Step 1: Turn equipment power off, and remove any recorded tape near the transport (tape could be partially erased by the demagnetizer).

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

Step 3: Simultaneously and lightly touch one demagnetizer tip to each face of one head.

Step 4: With a slow even motion, move the tips up and down the stack several times. Slowly withdraw the demagnetizer (slow withdrawal is required for effective demagnetization).

Step 5: Repeat Steps 3 and 4 at each head stack, tape guide (on the reel idler and takeup tension arm), and scrape-flutter idler.

Step 6: Move the demagnetizer at least three feet from the recorder before de-energizing it.

4B.3 LUBRICATING

4B.3.1 General

The only components requiring lubrication are bearings in the capstan drivemotor, capstan idler, and scrape-flutter idler. Ampex Lubricating Oil (Catalog Nos. 4010825 or 087-579) should be used for the drive motor and capstan idler. (Equivalent oils are Esso Standard Oil Co., Teresso No. 47; and Socony Mobil Oil Co., Mobiloil DTE, Medium.) Scrape-flutter idlers require the special equipment and oil described in paragraph 4B.3.4.

4B.3.2 Drive Motor Initial Lubrication

When the equipment is first received (or a replacement motor is installed) the motor bearing might have dried out, even with oil in the reservoir. Running the motor may result in bearing damage before the oil reaches it, so lubrication before operation is required as follows:

Step 1: Use a knife blade (or similar tool) to gently pry the cone-shaped dust cap (item 11 or 12, Fig. 6-8) from the top plate. This exposes a portion of the motor bearing.

Step 2: Manually rotate the capstan while applying four or five oil drops around the base of the capstan shaft (where it enters the motor).

Step 3: After the oil works down around the shaft, secure the takeup tension arm away from the rest position with a piece of pressure-sensitive tape.

Step 4: Apply power to the equipment, and allow the drive motor to operate for approximately 15 minutes.

Step 5: Wipe off any excess oil and replace the dust cap. Remove the tape.

4B.3.3 Motor/Idler Three-Month Lubrication

Every three months, or after each 1,000 hours of operation, (whichever occurs first) lubricate the drive motor and capstan idler as follows:

For drive motor lubrication, pry off the capstan dust cap. On motors that have an oil hole in the end bell, fill the oil reservoir through that hole. On motors without an oil hole, lubricate by applying 10 drops of oil around the base of the capstan shaft, do not overlubricate (the oil will reach the bearing through the shaft). Wipe off excess oil, and replace the dust cap.

For capstan-idler bearing lubrication pry the dust cap from the idler hub. On the exposed felt washer, place not more than three drops of oil.

CAUTION

If oil gets on the idler rubber tire, immediately remove it with isopropyl alcohol. Oil will deteriorate the tire.

4B.3.4 Idler Yearly Lubrication

Ultrasonic-clean and lubricate the scrape-flutter idlers once a year, or after each 2,000 hours of operation (whichever occurs first). This may be done by a local jeweler or watchmaker, who would usually have the ultrasonic cleaner and special jewel oil required. Disassemble and oil the idler as follows:

4B.3.4.1 Disassembly/Lubrication

Step 1: Remove head per paragraph 4A.2.3

Step 2: The idler is secured to the top plate by one screw and lockwasher. Remove screw and lift idler off locating pin. Retain screw and lockwasher for future use.

Step 3: To indicate correct positioning, scribe-mark the holders at the setscrew centerlines (see Fig. 6-7): upper holder on the top circular surface, and the lower holder on the periphery.

Step 4: Remove the two jewel holders and the roller, by loosening the two setscrews (item 6, Fig. 6-7) at the front and sliding holders (item 1, Fig. 6-7) out of yoke (item 4, Fig. 6-7).

Step 5: Ultrasonically clean the two holders and the roller.

NOTE

If cleaning doesn't remove all traces of oxide from the roller shafts, polish it off with jeweler's rouge (or equal). After polishing, re-clean the roller ultrasonically.

Step 6: Lubricate each jewel bearing with one drop of jewel oil (or Ampex precision instrument oil No. 087-239) applied with a No. 21 gauge hypodermic needle.

4B.3.4.2 Reassembly

Assemble the idlers with great care as follows:

Step 1: Align the scribe marks with the centerline of the setscrews as shown in Fig. 6-7.

Step 2: Tighten the setscrew on the lower jewel holder.

Step 3: Apply slight finger pressure on the upper holder, to eliminate endplay, then tighten the upper setscrew.

Step 4: Check that the idler rotates freely. If it doesn't, readjust setscrews to reduce friction.

4B.4 PERFORMANCE CHECKOUTS

4B.4.1 General

These checkouts should be regularly scheduled to determine when tape transport adjustment/alignment is required. Adjustment/alignment procedures are given in part C of this section. Erased tape or blank tape can be used for the performance checks or recorded tape can be erased during the recording portion of the procedure. Reproducer checkout is explained at the start of each checkout procedure.

NOTE

Always bulk-erase any tape that was recorded on equipment with a different head configuration, to make sure that it is completely erased.

4B.4.2 Test Equipment

Obtain the following test equipment, or equivalent:

1. Signal Generator, Hewlett-Packard Model 200C.
2. Vacuum Tube Voltmeter, AC, Hewlett-Packard Model 400D.

3. Wave analyzer (if available).

4. Flutter Meter, Mincom (Bahr) Model B8100.

5. Ampex Standard 1/4-inch Flutter-Test Tapes, as applicable:

   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 are available on special order.)

6. Noise Filter (see Fig. 4B-1) or ASA "A" Curve Filter (see Fig. 4B-2)

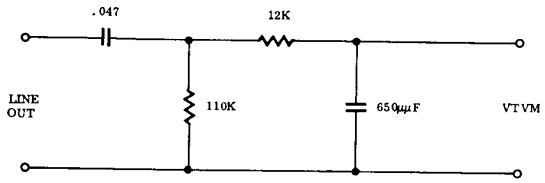


Fig. 4B-1. Noise Filter Schematic

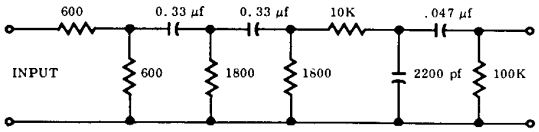


Fig. 4B-2. ASA "A"-Curve Filter Schematic 04773

4B.4.3 Test Conditions

Check that the following test conditions are met:

1. LINE TERMINATION switch (on back of electronics assemblies) at ON, to terminate equipment.

2. Dummy plug in INPUT ACCESS socket (instead of accessory transformer or preamp connector).

3. Heads cleaned and demagnetized.

4. Top and bottom covers installed on electronic assemblies.

5. Low-noise tape, Ampex Series 404 or equal, installed.

4B.4.4 Frequency Response Checkout

4B.4.4.1 AG-445B Checkout

The frequency response of a reproducer can be checked with a tape recorded on a correctly-adjusted recorder with the same head configuration as the reproducer (if unavailable, use a standard tape per paragraph 4C.3.7, , steps 2 through 9 keeping in mind the low-frequency limitations given for this tape).

4B.4.4.2 AG-440B Checkout

The following procedure gives a precise indication of overall frequency response, using external meters (an alternate checkout accurate within approximately ±1 dB, using the equipment VU meters is described in paragraph 4B.4.4.3).

Step 1: Apply power, and thread blank tape on the transport. Select the desired tape speed, and set REEL switches for reel hub sizes in use.

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

Step 3: Connect the vtvm to OUTPUT receptacle.

Step 4: Set OUTPUT SELECTOR to INPUT, and adjust RECORD LEVEL for the vtvm indication in Table 4B-1 (the level depends on tape speed, and whether equipment is strapped for +8 dBm or +4 dBm operating level output).

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

Step 6: Set OUTPUT SELECTOR to REPRO, and adjust REPRODUCE LEVEL for the output level given in Table 4B-1. While simultaneously recording and reproducing, change the signal generator frequency in uniform steps. The response on the vtvm should be within specifications, throughout the frequency range for the tape speed used (refer to Table 1-2, Specifications).

OUTPUT STRAPPING	TAPE SPEED	SET FOR 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 Setting

Step 7: For two-channel equipment with an additional quarter-track head, set controls for the quarter-track head and repeat Step 6 on track one. Check track two per paragraph 4B.4.4.3.

Step 8: Set equipment to second tape speed and repeat procedures starting with Step 4.

Step 9: Repeat the procedure for each additional channel.

Step 10: Any of the following corrective actions may be required to bring the equipment within specifications:

a. Heads, clean/demagnetize per paragraphs 4B.1 and 4B.2.

b. Signal generator, adjust for a flat output.

c. Head azimuths, adjust per paragraphs 4C.3.6 and 4C.3.8.

d. Bias level, adjust per paragraph 4C.3.7.

e. Reproduce equalization, adjust per paragraphs 4C.3.7 and 4C.3.9.

f. Record calibration, adjust per paragraph 4C.3.7.

g. Record equalization, adjust per paragraph 4C.3.10.

h. Tape tensions, adjust per paragraph 4C.2.3.

4B.4.4.3 Frequency Response Check

A check of frequency response, accurate to approximately ±1 dB, can be made using an Ampex Standard Alignment Test Tape, a signal generator, and the equipment VU meter(s). The check can be made simultaneously on all channels, because test tapes are full-track recorded and the signal generator can be connected in parallel to all INPUT connectors. Catalog numbers of the test tapes are given in Table 4C-4.

Step 1: Apply power and set tape speed. Set REEL switches for reel hub sizes in use.

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

Step 3: Start the tape in motion to find the level-set tone on the tape. (At 3-3/4 and 7-1/2 ips, only the last tone on the tape is at the standard operating level.)

Step 4: During level-set tone reproduction, adjust REPRODUCE LEVEL control(s) for a 0 VU meter indication and lock the control(s).

Step 5: Wind tape back to its original reel (as explained in paragraph 4C.3.1c) and remove the reel.

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

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

Step 8: Set OUTPUT SELECTOR to INPUT and adjust the RECORD LEVEL control(s) for a 0 VU meter(s) indication.

Step 9: For tape speeds of 3-3/4 ips and 7-1/2 only, record and reproduce (switch OUTPUT SELECTOR between INPUT and REPRO) while gradually reducing the RECORD LEVEL control setting, and advancing the REPRODUCE LEVEL control setting. Continue adjustment as far as possible, while maintaining a VU meter indication of 0 at the REPRO setting. It should be possible to reduce the record level to between -15 and -20 on the VU meter.

Step 10: Set OUTPUT SELECTOR at REPRO, while still recording and reproducing. Change the frequency of the signal generator in uniform steps across the frequency band of the tape speed being used (refer to Overall Frequency Response specification, Table 1-2). Check the response indicated on the VU meter.

4B.4.5 Overall Signal-to-Noise Check

This check requires a noise filter or an ASA "A"-curve filter to attenuate noise outside of the audible frequencies. Schematic diagrams of the filters are given in Figures 4B-1 and 4B-2. With the noise filter, signal-to-noise ratio is computed, conventionally, from a peak record level at 6 dB above normal operating level. Therefore, on equipment strapped for a +8 dBm operating level, the vtvm noise indication must be increased in magnitude by 14 dB (i.e. a vtvm reading at -46 becomes -60 dB. On equipment strapped for a +4 dBm operating-level output, the vtvm indication must be increased in magnitude by 10 dBm. When an "A" weighted-curve noise measurement is being made, using the ASA filter, increase the vtvm indication by 10 dB for a +8 dBm output, or 6 dB for a +4 dBm output. Check signal-to-noise ratio of the recorded reproducer as follows:

Step 1: Apply power, and thread blank tape on transport. Set tape speed and set REEL switches for reel hub sizes in use.

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

Step 3: Connect the chosen filter to the OUTPUT receptacle, then connect the vtvm to the filter output.

Step 4: Set OUTPUT SELECTOR at INPUT. Adjust the RECORD LEVEL for a vtvm indication of +14 dBm (if strapped for a +8 dBm output) or +10 dBm (if strapped for a +4 dBm output).

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

Step 6: Stop the tape and rewind it to the beginning of the recording just made.

Step 7: Disconnect the signal generator from the INPUT receptacle. Set OUTPUT SELECTOR to REPRO.

Step 8: Start the tape in motion (with the test channel 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 vtvm.

Step 9: Repeat Steps 4 through 8 at second tape speed.

Step 10: Repeat the procedure for each additional channel.

Step 11: To check reproducer noise, remove the tape and connect the vtvm through the

noise filter to the OUTPUT receptacle. With pressure-sensitive tape, or a rubber band, secure the takeup tension arm away from the safety switch. Press the PLAY pushbutton, the signal-to-noise should be as shown in Table 4B-2 (the figures are also computed from peak level, as explained in the overall check).

4B.4.5.1 Noise Causes and Corrections

If the signal-to-noise ratio fails to meet the specifications in Section 1, check for all possible causes, including the following:

a. Head gate open during noise check.

b. Magnetic tape not as specified; correct per paragraph 4B.4.3.

c. External fields from nearby motors, generators, etc; provide shielding or separate the equipment.

d. Heads need cleaning or demagnetizing; correct per paragraphs 4B.1 and 4B.2.

e. Erase current not at peak; correct per paragraph 4C.3.7 steps 12 thru 14.

f. Head cables being rubbed by transport moving parts.

g. Head azimuth incorrectly adjusted; correct per paragraphs 4C.3.6 and 4C.3.8.

h. Head height incorrectly adjusted; correct per paragraph 4D.2.

i. Tape wrap or head zenith incorrectly adjusted; correct per paragraph 4D.3.

j. Record or reproduce level incorrectly adjusted; correct per paragraph 4C.3.7.

4B.4.6 Overall Distortion Check

For accurately checking distortion, use a wave analyzer which measures individual distortion products (instruments that measure total harmonic distortion are affected by tape noise and modulation noise). Also, to avoid error, use a signal generator with less than 0.1% distortion.

To check distortion, record a 500-Hz signal on blank tape, at normal operating level, then reproduce the signal. The second harmonic content should not exceed 0.2%, and the third should be 0.6 to 1.1%.

Check reproducer distortion with a tape recorded on a unit that is correctly adjusted, and has a head track configuration identical to the reproducer.

4B.4.6.1 Distortion Causes

Excessive second harmonic distortion is usually caused by magnetized heads, or a malfunctioning bias oscillator, bias amplifier, record amplifier, or reproduce amplifier. To eliminate a high second-harmonic distortion, check the erase-adjust control per paragraph 4C.3.7, adjust the slugs in T3 and T4 of the bias amplifier card (on an extender) using plastic tuning wand of the proper size, but don't adjust them so the second-harmonic distortion at the output is less than the distortion of the signal generator in use.

Third harmonic distortion may result from the type of magnetic tape used, the bias setting, or the accuracy of the "normal operating level" adjustment. Most tape will have a third harmonic distortion of 0.8% to 1.1% at operating level.

4B.4.7 Flutter Check

This check must be made with Ampex Standard Flutter Test Tapes (refer to paragraph 4B.4.2). These tapes, recorded on very precise equipment, have an inherent flutter below 0.3% rms--which can be ignored. Flutter test tapes must be used only at the speed they are made for. For storage and handling of standard

TAPE SPEED	HEAD TYPE (1/4-inch tape)	REPRODUCE CIRCUIT SIGNAL/NOISE
3-3/4 ips	Full Track	66 dB
	Half Track	61 dB
	Two Track	61 dB
7-1/2 ips	Full Track	70 dB
	Half Track	66 dB
	Two Track	66 dB
15 ips	Full Track	70 dB
	Half Track	66 dB
	Two Track	66 dB
TAPE SPEED	HEAD TYPE (1/2-inch tape)	REPRODUCE CIRCUIT 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

tapes refer to paragraph 4C.3.1. Flutter measurement is the same for the reproducer and the record/reproduce units.

Flutter meters are sensitive to amplitude modulation that results from poor head-to-tape contact or from signal dropouts. Therefore heads must be cleaned and demagnetized per paragraphs 4B.1 and 4B.2 before flutter tests are made.

This procedure applies to the use of the Mincon (Bahr) Model B8100 flutter meter. If a different flutter meter is used, the manufacturer's instructions should be followed. Check tape flutter as follows, on any correctly aligned reproduce channel:

Step 1: Set RECORD SELECTOR on all record/reproduce units to SAFE (to avoid accidentally entering the record mode, which will erase the flutter-test tape).

Step 2: Connect reproduce channel OUTPUT connector to the flutter meter EXT SIGNAL, SIGNAL INPUT connector.

Step 3: On the flutter meter, set FLUTTER WEIGHTING to NAB UNWTD; MOD INPUT SELECT to 100 MB-5V EXT SIGNAL; and FLUTTER % FULL SCALE to 0.1% or 0.3% (depending upon tape speed).

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

Step 5: Thread the flutter-test tape on the tape transport, with the tape reel on the takeup turntable. Rewind the tape to a reel on the supply turntable. Set tape speed to conform to the test tape. Set REEL switches for the reel hub sizes in use.

Step 6: Start the test tape in motion in the reproduce mode (NORMAL lamp on flutter meter should light, otherwise there is no reproduce output to the meter, the DEMOD INPUT SELECT is incorrectly positioned, or lamp circuit is defective).

Step 7: Read indication on the FLUTTER meter, and if necessary, reposition the FLUTTER % FULL SCALE control. Flutter

COMPONENT	TAPE SPEED			
	3-3/4 ips	7-1/2 ips		15 ips
	ROTATIONAL RATE (Hz)			
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)	3.4	6.3		12.7
(Optional)	2.5	5.1		10.2

Table 4B-3. Rotational Rates

should meet the specification given in Table 1-2.

Step 8: Allow the flutter-test tape to completely unwind from the supply reel.

4B.4.7.1 Flutter Causes

Excessive flutter can be caused by any component that affects the tape motion, but is usually caused by the following:

a. Oxide or dirt: on components in the tape-handling path.

b. Drive motor: not in synchronism (too-low line voltage); excessive tape tension; defective motor capacitor; bearings defective or need lubrication; or motor shaft bent.

c. Supply motor; excessive or erratic holdback tension; dragging brakes; or bent shaft.

d. Capstan idler; defective rubber tire; bearing defective or needs lubrication; pressure incorrectly adjusted.

e. Reel idler; bent shaft; flywheel not balanced; damaged bearing.

f. Head assembly; poor tape guiding.

g. Tape scrape; warped or damaged reels.

4B.4.7.2 Flutter Troubleshooting Aids

As an aid in troubleshooting, a sound-and-vibration analyzer (such as General Radio Type 1564-A) can be used to isolate flutter to certain frequencies, by connecting the analyzer to the flutter meter output. Compare the results with the rotational rates in Table 4B-3 for an indication of the cause of trouble.

If flutter is caused by the supply motor assembly, the frequency will vary from low, when the tape quantity on the supply reel is large, and will progressively increase as the tape quantity gets smaller. The takeup motor assembly seldom causes appreciable flutter, because it is isolated from the heads by the capstan and capstan idler. If it causes flutter, the frequency would vary inversely to that of the supply motor (high with a small tape pack on the takeup reel and decreasing as the pack increases).

Section 4

MAINTENANCE

Part C. Adjustment and Alignment

4C.1 GENERAL

When a failure is noted during the performance checks of Routine Maintenance (part B) the following applicable adjustment or alignment procedures must be performed:

Transport Adjustment Procedures paragraph 4C.2; Electronic Alignment Procedures, paragraph 4C.3; and Sel Sync Adjustments, paragraph 4C.4; Procedures for removal/installation, special positioning, and troubleshooting are included in Corrective Maintenance as follows: Part D, Heads; Part E, Tape Transport; and Part F, Electronic Assemblies.

4C.2 TAPE TRANSPORT ADJUSTMENTS

4C.2.1 Test Equipment

Obtain the following equipment or equivalent:

1. Spring scales, 0-16 oz. and 0-10 lbs, Chatillon.
2. Cord or twine, about 30 inches long, with small loop at one end.
3. Empty reel, NAB hub.
4. Technician tools.

4C.2.2 Different Tape Sizes

Tape transports for one or two-channel equipment are adjusted at the factory for use with 1/4-inch tape. Transports for three or four-channel equipment are adjusted for use with either 1/4-inch or 1/2-inch tape (so the quick conversion feature can be used). If only one tape width is to be used, make adjustments for that tape only. In the following procedures, correct indications are given for all three conditions of operation:

a. For a transport used only with 1/4-inch tape.

b. For a transport used only with 1/2-inch tape.

c. For a transport used with both 1/4-inch and 1/2-inch tape.

4C.2.3 TAPE TENSION (See Figure 4C-1)

Tape tension is determined indirectly by measuring the torque of both tape reel motors. Required tension adjustments are made by positioning sliders on the resistors under the cover of the transport control box. The resistors, and what they adjust, are listed in Table 4C-1. The circuit schematic is shown on Figure 6-20.

CAUTION

WHEN TRANSPORT POWER SWITCH IS ON, FULL LINE VOLTAGE IS PRESENT AT THE RESISTORS. TURN POWER OFF WHEN ADJUSTING THESE RESISTORS.

In the following steps, an empty NAB 4-1/2 inch hub) reel is used, and the cord (or twine) is wrapped, on the reel being checked, in the same direction as recording tape is pulled onto that reel. The spring scale is hooked onto a small loop formed in the free end of the cord and is held stationary, with little or no slack in the cord, so that it will indicate cord tension when PLAY or a FAST WIND button is pushed. Always assure that both the REEL HUB size switches are in the same position during the test procedures.

NOTE

An empty EIA (2-1/4" hub) reel may be used, but in this event, all of the scale readings of tables 4C-1 and 4C-2 must be doubled in value.

a. In adjusting resistors during the following steps, loosen contact screws just enough to slide the contacts, then tighten screws just enough to make good electrical contact.

b. Turn power ON and set SPEED to high or low.

c. Use tape or a rubber band, to hold the take-up tension arm away from the safety switch.

d. Install the empty NAB reel on the take-up turntable and set the REEL HUB size switches to the SMALL REEL HUB position. Press the FAST FORWARD button and adjust R606 for 8 to 9 oz.

e. Press STOP. Press the PLAY button and adjust R605 for the scale reading given in Table 4C-1 in the PLAY TENSION column for the tape width used. Switch the REEL HUB switches to the LARGE REEL HUB position and check for the scale reading given in Table 4C-1 in the PLAY TENSION column for the tape width used. It may be necessary to switch between LARGE REEL HUB position and SMALL REEL HUB position to optimize R605 in both positions. If these specs cannot be met, return to step d. and readjust R606 slightly, but within range of its specified tension, then repeat step e.

f. Press STOP. Place the REEL HUB size switches in the LARGE REEL HUB position. Press the REWIND button and adjust R607 for 1/2 to 1 oz.

g. Press STOP. Install the empty NAB reel on the supply turntable and set the supply REEL HUB size switches to the SMALL REEL HUB position. Press the REWIND button and adjust R608 for 8 to 9 oz.

h. Press STOP. Press the PLAY button and adjust R604 for the scale reading given in Table 4C-1 in the PLAY TENSION column for the tape width used. Switch the REEL HUB switches to the LARGE REEL HUB position and check for the scale reading given in Table 4C-1 in the PLAY TENSION column for the tape width used. It may be necessary to switch between LARGE REEL HUB position and SMALL REEL HUB position to optimize R604 in both positions. If these specs cannot be met, return to step g, and readjust R608 lightly, but within range of its specified tension, then repeat step h.

Tape Usually in Use	PLAY Tensions Hold-back Tension. Adjust R604 Take-up Tension. Adjust R605		FAST MODE Tensions Small Reel Hub Fast Forward Take-up Tension. Adjust R606 Small Reel Hub Rewind Take-up Tension. Adjust R608	Hold-back Tension. Adjust R607 Small Reel Hub Position Hold-back Ounces
	SMALL REEL HUB Position Ounces	LARGE REEL HUB Position Ounces	Small Reel Hub Position Take-up Ounces	Small Reel Hub Position Hold-back Ounces
1/4 inch	2-1/2 to 3-1/2	5 to 6	8 to 9	1/2 to 1
1/2 inch	N/A	8 to 11	8 to 9	1/2 to 1
Both	3 to 4	6 to 7	8 to 9	1/2 to 1

Table 4C-1. Tape Tension Adjustments (NAB 4-1/2" Hub Reel)

TAPE USED	SUPPLY REEL	TAKEUP REEL
	CCW Motion	CW Motion
1/4-inch (only)	15 to 17 oz.	15 to 17 oz.
1/2-inch (only)	16 to 21 oz.	16 to 21 oz.
1/4-inch and 1/2-inch	15 to 17 oz.	15 to 17 oz.

Table 4C-2. Main Brake Force*

4C.2.4 Brakes *(See Table 4C-2)

The main brake system on each reel stops reel rotation and maintains tape tension. An edit brake system partially releases the brake bands to reduce braking force when the stop/edit mode is selected.

Torrington clutches on both brake drums eliminate CW braking of the supply reel and CCW braking of the takeup reel. Braking is applied only to the reel supplying the tape at the time STOP mode is initiated.

Required adjustments are made with the nuts shown in Fig. 4C-2; in adjusting the main braking force, the two nuts for the main brake adjustment must be turned equally.

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

Step 2: Wrap the cord or twin on reel hub counterclockwise with the loop at the cord free end.

Step 3: Insert the spring scale hook in cord loop. Pull the scale to rotate the reel and check the scale indication while the reel is moving slowly and steadily. Adjust brake nuts as necessary (screw in to increase force, and out to decrease force).

NOTE

The force required to start reel rotation will be much higher than that required when the reel is rotating slowly and steadily.

*Brake force is affected by humidity and temperature extremes.

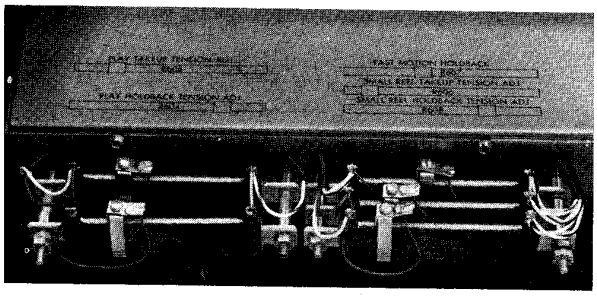


Fig. 4C-1. Tape Tension Adjustments

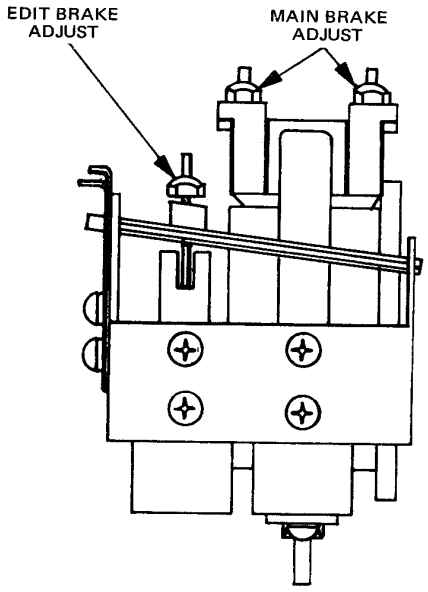


Fig. 4C-2. Brake Adjustments

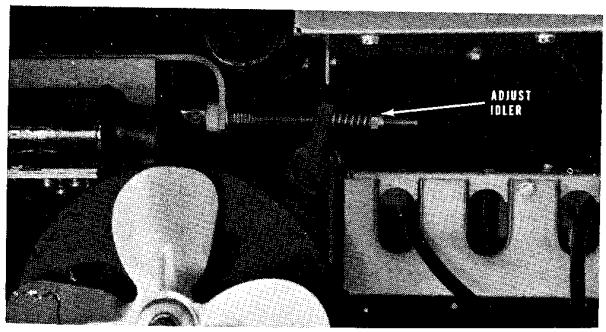


Fig. 4C-3. Capstan Idler Adjustment

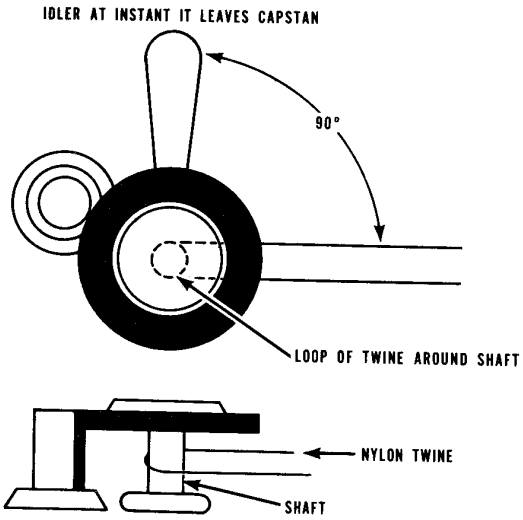


Fig. 4C-4. Capstan Idler Force Measurement

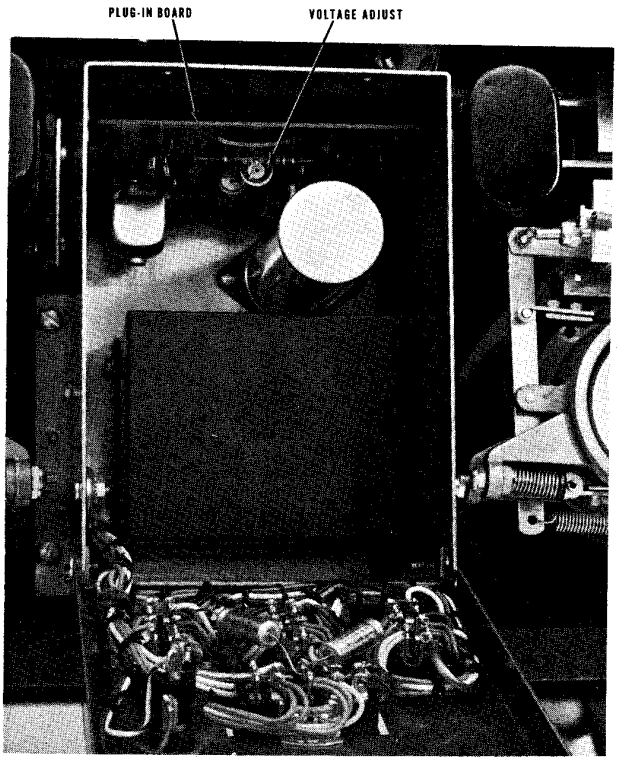


Fig. 4C-5. Power Supply Box Interior

Step 4: Rewind the cord on the reel hub, counterclockwise. Press the EDIT pushbutton.

NOTE

In the following steps, edit brake force can be set as preferred by each operator. The minimum tension specified ensures holding the takeup tension arm away from the safety switch.

Step 5: Insert the spring scale hook in the cord loop. Pull the scale to rotate the reel and check the scale indication while the reel is moving slowly and steadily. Scale should indicate 1 to 4 ounces. Adjust edit-brake nut as necessary (screw in to decrease force, and out to increase force). Adjust so there is no braking difference between the directions of rotation. Press the STOP pushbutton.

Step 6: Move the empty reel to the takeup turntable. Wind the cord on the hub clockwise. Measure and adjust brake nut per Step 3.

Step 7: Rewind the cord on the reel hub clockwise. Press EDIT pushbutton. Measure and adjust the edit braking force per Step 5.

Step 8: Press the STOP pushbutton.

4C.2.5 Capstan Idler (See Figures 4C-3 and 4C-4)

The capstan idler force against the moving capstan is determined by the capstan solenoid spring. The force is adjusted by a lock nut on the capstan solenoid spade bolt shown in Figure 4C-3.

As the solenoid temperature rises, its resistance also rises. When power line regulation is poor, allow 30 minutes or more for warm-up (operating in the reproduce mode) before adjusting 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).

Step 1: Apply power to equipment. Use pressure-sensitive tape or a rubber band to hold takeup tension arm away from the safety switch.

Step 2: Tie the cord together to form a continuous loop. Place the loop around the capstan idler shaft as shown in Fig. 4C-4.

Step 3: Press PLAY pushbutton (the idler moves to contact the capstan, and then both rotate).

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

Step 5: Pull on the scale, and note the scale indication when the idler just loses contact with the capstan (the idler stops when touched).

Step 6: If indications are not as shown in Table 4C-3, adjust idler spring-tension nut as necessary. After any adjustment, check that capstan-idler solenoid bottoms in the reproduce mode; if it doesn't, screw out spring-tension nut until it does.

4C.2.6 Tape Lifter

The automatic tape lifter is actuated by a solenoid that energizes in either of the fast-wind modes. A spring mechanically couples the solenoid plunger to the tape lifter. When deenergized, no slack is permitted between the solenoid plunger,

TAPE IN USE	SCALE INDICATION
1/4-inch (only)	6 to 7 lbs
1/2-inch (only)	6 to 7 lbs
1/4 and 1/2-inch	6 to 7 lbs

Table 4C-3. Capstan Idler Force

the spring, and the tape lifter bracket. However, the spring should not be extended, and the tape lifter arms should be 1/16-inch from the slot end. When the solenoid energizes, the tape lifter arms should stop 1/16-inch from the other end of the slot.

If any of these conditions are not met, a complete adjustment of the tape lifter is required per paragraph 4E.9.

4C.3 ELECTRONIC ALIGNMENT

4C.3.1 Standard Test Tapes

The system's reproduce function is aligned while playing an Ampex Standard Alignment Test Tape, and the record circuit is then adjusted with the reproduce circuit as a reference.

Standard test tapes are precisely recorded in an Ampex laboratory and must be correctly handled and stored to retain their accuracy. The following requirements should especially be followed:

a. Clean and demagnetize equipment heads and other tape-handling components before installing the test tape.

b. Never store test tapes in areas where there are temperature or humidity extremes.

c. Remove test tapes from equipment only after a normal play run (never after a fast-winding mode).

4C.3.1.1 Tape Degradation

After extensive use, high-frequency tones may drop as much as 2 dB, and flutter indications may rise even though actual flutter remains unchanged. Flutter increase is caused by: demagnetization of the recorded signal from repeated runs; tape deformation due to tape tension, changes in temperature and humidity; and increased dropouts resulting from tape wear.

The test tape is threaded in the normal tape path (from the supply to takeup turntable). During the alignment procedures, the rewind and fast forward modes may be used as necessary. After alignment, wind the tape completely on the takeup reel, interchange reels, thread the tape, and place the equipment in the reproduce mode to wind the tape back on its original reel.

All tones on 15-ips standard alignment tapes are recorded at operating level. On slower speed tapes, all tones are recorded 10 dB below operating level, except for the last tone.

4C.3.2 Test Equipment

Obtain the following test equipment, or equivalent:

1. Voltmeter, dc, 20,000 ohms-per-volt.

2. Vacuum Tube Voltmeter, ac, Hewlett-Packard Model 400D.

3. Signal Generator, Hewlett-Packard Model 200C.

4. Noise Filter, (see Fig. 4B-1) or ASA"A" Curve Filter (see Fig. 4B-2).

5. Ampex Standard Alignment Tapes that apply (see Table 4C-4).

TAPE SPEED	TYPE OF EQUALIZATION	MAGNETIC TAPE 1/4-inch	1/2-inch
15 ips	NAB	01-31311-01	01-31311-05
	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-4. Standard Alignment Tapes

6. Technician tools.

4C.3.3 Test Conditions

Check for the following test conditions:

a. LINE TERMINATION switch at ON.

b. Dummy plug, instead of accessory transformer or preamp, in INPUT ACCESS socket.

c. Heads cleaned and demagnetized.

d. Covers installed on electronic units.

e. Magnetic tape of low-noise type, Series 404 , or equivalent.

4C.3.4 Alignment Procedures Introduction

Procedures in paragraphs 4C.3.5 through 4C.3.8 will usually correct deficient operation. Other adjustments (seldom required) are 4C.3.9 and 4C.3.10. Sel-Sync adjustments are described in paragraph 4C.4.

4C.3.5 Power Supply (See Figure 4C-5)

The power supply (with the bias and erase oscillator) is mounted on a plug-in printed circuit board in the transport power supply box. Operation can be checked by connecting the dc voltmeter across pin 9 (positive) and pin 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 (-1/2, +1) volts.

If adjustment is necessary, open the cover on the power supply box (see Fig. 4C-5).

WARNING

Full line voltage is present in the box. Do not touch the fuse post or transformer leads while the system is energized.

With the voltmeter connected as previously described, place the equipment in the reproduce mode, then adjust R712 (see Fig. 4C-5) for an indication of 39 (-1/2, +1) volts.

4C.3.6 Reproduce-Head Azimuth (See Fig. 4C-6)

The VU meter on each record/reproduce unit can be simultaneously used to measure the output of each head. This simultaneous metering facilitates determination of the optimum setting. For a reproducer, use a vtvm for each head track, or use one vtvm to adjust one head and then another-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 below operating level. If the recorder/reproducer has a 15 ips speed, make the normal-operating-level adjustment at that speed. If speed is 3-3/4 or 7-1/2 ips, it will probably be necessary to turn the REPRODUCE LEVEL control full

clockwise (do not exceed a VU meter indication of 0) in Step 7. For a reproducer, adjust the level control for any convenient vtvm indication.

CAUTION

Do not adjust any nut or screw on the head assembly except the azimuth adjustment nut.

Step 1: Remove the head cover by loosening the captive screw on its angled back surface.

Step 2: Apply power to equipment. Set tape speed (15 ips if available) and set REEL switches for reel sizes in use.

Step 3: Set RECORD SELECTOR switches on all record/reproduce units to SAFE (this prevents accidentally entering the record mode and erasing the test tape).

Step 4: Set OUTPUT SELECTOR switch(es) on all record/reproduce units to REPRODUCE.

Step 5: Thread the correct speed test tape on the transport. If this is a reproducer, connect the vtvm(s) to the output connector(s).

NOTE

Voice announcements on the test tape can be monitored through headsets, or by an amplifier/speaker connected to the phones jack, or to the output.

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

Step 7: For adjustments at 15 ips tape speed, adjust the REPRODUCE LEVEL control on each record/reproduce unit for an indication of 0, as the first tape tone is reproduced. (Any convenient indication on the vtvm is used for a reproducer. If a slower speed is being used, and it is impossible to achieve this level, set the REPRODUCE LEVEL control to the full-clockwise position.

Step 8: The second tone on the test tape is the azimuth adjustment tone. As this tone reproduces, adjust the reproduce head azimuth adjustment nut (not the screw) for a maximum output indication on the VU meters (or vtvm). On multi-channel equipment, if all heads do not peak at the same setting, adjust for optimum output of all the heads.

NOTE

If the azimuth is far out of adjustment, minor peaks will appear on each side of the correct setting. Correct adjustment results in an output markedly higher than the minor peaks.

Step 9: Replace the head cover.

4C.3.7 Reproduce/Record Alignment

The initial alignment run, for setting bias and record levels, should be made at the speed at which the equipment will usually be run. When both speed pairs will be used about equally, the initial run should be made at 7-1/2 ips (which provides optimum bias and record adjustments for both speed pairs). The second run, at the other speed, will then be made only for reproduce equalization at that speed.

For a reproducer, perform Steps 1 through 9 for reproduce equalization, using a vtvm.

Step 1: Remove cover from record/reproduce unit front panel (or reproducer electronics tray).

Step 2: Apply power to equipment. Set tape speed, and set REEL switches for reel hub sizes.

Step 3: Set RECORD SELECTOR switches on all record/reproduce units to SAFE (this prevents accidentally entering the record mode and thus erasing the standard tape).

Step 4: Set OUTPUT SELECTOR switch of record/reproduce channel under test to REPRODUCE.

OUTPUT STRAPPING	TAPE SPEED	SET AT 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-5. Reproduce Equalization Output

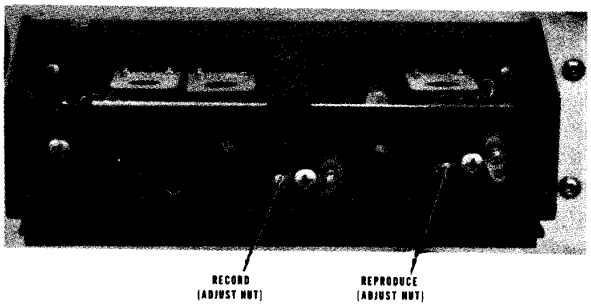


Fig. 4C-6. Head Azimuth Adjustments

Step 5: Connect vtvm to OUTPUT connector of the channel under test.

Step 6: Thread correct-speed test tape on transport.

Step 7: Start test tape in motion in the reproduce mode. As the first tone reproduces, adjust REPRODUCE LEVEL control for the output level indication shown on Table 4C-5. Lock the control in that position.

Step 8: Reproduce the test tone series from the recorded test tape, starting with the highest frequencies. Adjust the appropriate HIGH FREQ control (at the front of reproduce board) as necessary for the flattest possible response, within specifications, but do not move response more than ±2 dB from the theoretical response curve (refer to Figs. 6-32, 6-33, and to paragraph 4F.10). If further adjustment is indicated, there is trouble in the record/reproduce process not correctable by equalization adjustment.

NOTE

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

Step 9: For tests at 7-1/2 or 3-3/4 ips tape speed, as the last tone reproduced, adjust the REPRODUCE LEVEL control for a vtvm indication of +8 dBm, or +4 dBm (depending on equipment strapping). The VU meter should indicate 0 (±3/4 dB).

NOTE

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

Step 10: Wind the test tape on its original reel, in the reproduce mode (per paragraph 4C.3.1), and remove the reel.

Step 11: Connect the signal generator to the INPUT connector, with the vtvm still connected to the output.

Step 12: Set the signal generator to provide a nominal 1-volt rms output at the frequency that applies: at 15 ips, 1,000 Hz; at 7-1/2 ips, 500 Hz; or at 3-3/4 ips, 250 Hz.

Step 13: Thread blank tape on transport. Set OUTPUT SELECTOR switch to BIAS, and RECORD SELECTOR switch to READY. Start the tape in motion, with the test channel operating in the record mode.

Step 14: Adjust the ERASE ADJ control, (at bias amplifier module front) for a VU meter peak indication, then readjust the BIAS CAL control as necessary to keep the VU meter indicator on scale. The peak is very broad. When the approximate peak is found, turn the control counterclockwise until a distinct drop is indicated on the VU meter. Then turn the control very slowly clockwise to pass through the peak until the meter indication justs starts to fall. Return the control setting just to the point where the drop-off started, turning it clockwise.

Step 15: Set OUTPUT SELECTOR switch to REPRO. Adjust BIAS ADJ control for maximum output indication on vtvm, turning it clockwise.

Step 16: Reset OUTPUT SELECTOR to BIAS. Adjust BIAS CAL control for a 0 VU meter indication.

Step 17: Reset OUTPUT SELECTOR switch to REPRO. Set the signal generator for a 500 Hz output. Adjust RECORD LEVEL control for a vtvm indication of +8 or +4 dBm, depending on equipment output strapping.

Step 18: Set OUTPUT SELECTOR switch to INPUT. Adjust REC CAL control (at record module front) for a 0 VU meter indication.

Step 19: Disconnect the signal generator from INPUT connector.

Step 20: Repeat Steps 2 through 9 for the second tape speed, using the correct speed test tape and adjusting the applicable HIGH FREQ control as necessary.

Step 21: Repeat the complete procedure for each channel (steps 1 through 20).

4C.3.8 Record-Head Azimuth (See Figure 4C-6)

This adjustment (similar to the reproduce head azimuth adjustment) is made while simultaneously recording and reproducing. The record head azimuth is adjusted to coincide with the reproduce head (previously adjusted to a reference position). This procedure doesn't apply to a reproducer.

CAUTION

Do not adjust any head assembly nut or screw, except the nut for azimuth adjustment on the record head.

Step 1: Remove the head cover, by loosening the captive screw on the angled back surface.

Step 2: Connect the signal generator to the INPUT connector. On multi-channel equipment, connect the signal generator to all INPUT connectors (in parallel).

Step 3: Apply power to equipment, set tape speed, and set REEL switches for the reel hub sizes.

Step 4: Set the signal generator for a nominal 1-volt rms output, at the frequency that applies: at 15 ips, 15,000 Hz; at 7-1/2 ips, 15,000 Hz; and at 3-3/4 ips, 7,500 Hz.

Step 5: Thread blank tape on equipment.

Step 6: Set RECORD SELECTOR switch for each channel to READY.

Step 7: Set OUTPUT SELECTOR switch for each channel to INPUT. Then adjust RECORD LEVEL control(s) for the following VU meter indication: at 15 ips, 0; at 7-1/2 ips, -10; and at 3-3/4 ips, -10.

Step 8: Set OUTPUT SELECTOR switch for each channel to REPRO, then start tape in motion with all channels operating in the record mode.

Step 9: While thus simultaneously recording and reproducing, adjust REPRODUCE LEVEL control(s) for 0 VU meter(s) indication. If adjustment is being made at 7-1/2 or 3-3/4 ips, and it is impossible to reach the 0 level, set the REPRODUCE GAIN control at full-clockwise position.

Step 10: Adjust record head azimuth nut (not the screw) for maximum output indications on the VU meter(s). On a multi-channel recorder, if all heads do not peak at the same setting, adjust for optimum output of all heads.

NOTE

Minor peaks may appear on each side of the correct setting. Correct adjustment, however, is indicated by a definitely higher output.

Step 11: Return the reproduce level to normal operating condition, replace the head cover, and change the frequency of the signal generator to 500 Hz.

Step 12: While simultaneously recording and reproducing, set OUTPUT SELECTOR switch to INPUT and adjust the RECORD LEVEL control for a 0 VU meter indication. Then set OUTPUT SELECTOR switch to REPRO and adjust the REPRODUCE LEVEL control for a 0 VU meter indication.

4C.3.9 Low-Frequency Reproduce Equalization

This procedure will seldom be required. The cover must be removed from the front panel of the reproduce/recorder unit (front cover on the reproduce electronic tray).

The reproduce circuit is adjusted to compensate for head "bumps" which occur at low frequencies. The adjustment of a reproducer requires that the head track configuration be the same as on the recorder that made the tape.

Step 1: Connect the vtvm to the OUTPUT connector.

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

Step 3: Apply power to equipment. Set tape speed, and set REEL switches for the reel hub sizes.

Step 4: Thread blank tape on equipment.

Step 5: Set OUTPUT SELECTOR switch to INPUT, and adjust the RECORD LEVEL control as necessary for a normal record level (+8 dBm or +4 dBm, depending on equipment output strapping) as indicated on the vtvm.

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

Step 7: Adjust REPRODUCE LEVEL control as necessary for a normal operating level (+8 dBm or +4 dBm, depending on equipment output strapping) as indicated on the vtvm.

Step 8: While thus simultaneously recording and reproducing, vary signal generator frequency from 250 Hz to 30KHz, and note the magnitude of any positive-going or negative-going head "bumps".

Step 9: Adjust the applicable LO FREQ control (at front of reproduce board) for the flattest possible response, within specifications. This is done by adjusting head "bump" excursions for an equal magnitude above or below the reference frequency of 500 Hz.

Step 10: Repeat Steps 8 and 9 for the second tape speed.

Step 11: Repeat the complete procedure for each channel.

4C.3.10 Record Equalization

Remove the small cover over the record/reproduce plug-in modules and proceed as follows:

Step 1: Perform Steps 1 through 4 of paragraph 4C.3.9.

Step 2: Set OUTPUT SELECTOR switch to INPUT, and adjust the RECORD LEVEL control for the vtvm indication shown in Table 4C-6 (this establishes the 500 Hz reference level).

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

Table 4C-6. Record Equalization Level.

Step 3: Change the frequency of the signal generator to conform to the tape speed: at 15 ips, 18,000 Hz; at 7-1/2 ips, 15,000 Hz; or at 3-3/4 ips, 8,000 Hz.

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

Step 5: Set OUTPUT SELECTOR switch to REPRO.

Step 6: While thus simultaneously recording and reproducing, change the signal generator frequency in uniform steps over the upper half of the response spectrum for the applicable tape speed. Adjust HI SPEED or LOW SPEED control (at front of record board) for the flattest possible high-frequency response, referenced to 500 Hz, conforming to specifications.

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

Step 8: Repeat the complete procedure for each additional channel.

4C.4 SEL-SYNC ADJUSTMENTS

Both adjustments require access to the record/reproduce unit back panels. Sel-Sync adjustments are not applicable to the reproducer.

4C.4.1 Test Equipment

Obtain the following equipment:

1. Ampex Standard Alignment Tape (see Table 4C-4)
2. Technician's tools.

4C.4.2 Test Conditions

Check for the following test conditions:

1. LINE TERMINATION switch (on back of record/reproduce unit) ON.
2. Dummy plug (not the accessory transformer or preamp) in INPUT ACCESS socket.
3. Heads cleaned and demagnetized.
4. Covers installed on electronic units.

4C.4.3 Sel-Sync Level Adjustment

Step 1: Set RECORD SELECTOR switch on each record/reproduce unit to SAFE (this prevents entering the record mode accidentally and thus erasing the tape).

Step 2: Apply equipment power, set tape speed, and set REEL switches for the reel hub sizes.

Step 3: Thread the correct-speed standard alignment tape on the transport.

Step 4: Set OUTPUT SELECTOR switches to REPRO.

Step 5: Run the standard alignment tape to operating-level tone (first tone on 15-ips tape, and last tone on a tape for slower speeds).

Step 6: As the operating-level tone reproduces, adjust REPRODUCE LEVEL controls for 0 VU meter indications.

Step 7: Rewind tape to beginning of the operating-level tone. Set all RECORD SELECTOR switches to SEL SYNC.

Step 8: Place tape in motion in the reproduce mode. As the operating level tone reproduces, adjust SEL SYNC GAIN controls (on back panel of each record/reproduce unit) for 0 VU meter indications.

Step 9: Wind tape on original reel (per paragraph 4C.3.1) and remove reel.

4C.4.4 Sel-Sync Bias Trap Adjustment

When operating with Sel-Sync, the bias from one recording channel could leak into another. Nothing would be recorded on the latter channel, but VU meter monitoring could be masked, so a trap is provided to minimize the leakage.

The bias trap (adjusted at the factory) usually requires no readjustment. If the bias from recording channels affects VU meter indications for other channels, adjust as follows: Operate one channel with Sel Sync, and all other channels in the record mode. Adjust the operating Sel-Sync BIAS TRAP control (on record/reproduce unit back panel) to null the VU meter indication. Repeat the procedure for each channel.

MAINTENANCE
Part D. Head Maintenance

4D.1 GENERAL

Head cleaning and demagnetizing is given in part B, Preventive Maintenance. Head azimuth adjustment is given under Electronic Alignment Procedures in Part C, Adjustment/Alignment. Changing the complete head assembly is described in Part A, Conversion. Head and tape adjustments are given in the following paragraphs. The head height is precisely set at the factory, so head adjustment is seldom required except when a head stack is changed.

4D.2 ADJUSTING HEAD HEIGHT

4D.2.1 Record/Reproduce Heads (Not 1/4-Track))

Adjust head height as follows:

Step 1: Remove the head housing cover by disengaging the captive screw on the angled back surface.

Step 2: Thread tape on transport, and initiate the play mode at the highest speed available.

Step 3: Loosen two nuts (items 42 and 43, Fig. 6-1) approximately 1/4 turn.

Step 4: Turn the two hex-socket setscrews (see Fig. 4D-1) clockwise the same number of turns, until the head laminations barely appear at the tape bottom edge.

Step 5: Carefully count the turns, while turning the two hex-socket setscrews counterclockwise (in exactly equal turns) until the head laminations barely appear above the tape top edge.

Step 6: Turn the same two setscrews back half the number of turns counted in Step 5. Turn the two nuts loosened in Step 3 clockwise until they are snug.

Step 7: Stop tape motion.

Step 8: Check head zenith and tape wrap per paragraph 4D.3. Check head azimuth per paragraphs 4C.3.6 and 4C.3.8.

Step 9: Replace head housing cover.

4D.2.2 Quarter-Track Record/Reproduce Heads

To set the height of a quarter-track record or reproduce head: repeat Steps 1, 2, and 3, paragraph 4D.2.1; then adjust the two hex-socket setscrews so that the mu-metal portion of the outermost head is exactly even with the outermost edge of the tape.

4D.2.3 Erase Heads

Erase head height is adjusted with shims (0.010, 0.002, 0.003, and 0.005 inch thick, Ampex Part Nos. 4350025-01, 4350025-02, 4350025-03, and 4350025-04 respectively). To change shims, the head must be removed by removing one cross-head screw (item 40, Fig. 6-1; or item 31, Fig. 6-3).

Except for quarter-track erase heads, shim the heads until the ferrite portion of the outermost head is just visible at the outermost edge of the tape. Add shims until the similar portion of the bottom head is barely visible below the tape bottom edge. Then remove exactly half the shim thickness needed to move the head stack from the top to bottom of the tape.

If a quarter-track erase head is used, use shims to position the ferrite portion of the outermost head even with the outermost edge of the tape, then remove shims to raise the head 0.006 inches. (The erase head is wider than the record or playback heads, so it must be positioned above the outermost edge of the tape.)

4D.3 ADJUSTING TAPE WRAP AND ZENITH

The head gap must be centered in the tape contact area, and the tape must contact the head top and bottom equally.

To check tape wrap and head zenith, lightly cover the head face with grease pencil or crayon. Thread tape on transport, initiate the high speed play mode, and stop it after ten seconds. Lift the tape from the head, the head area visibly cleaned by the tape should be centered on the head gap (this checks tape wrap). The head tape-contact area should also be equally clean at the top and bottom (this checks head zenith).

If tape wrap adjustment is indicated, remove the head housing cover by disengaging the captive screw on the angled back surface. Loosen the large cross-head screw (item 40, Fig. 6-1; or 31, Fig. 6-3). Beneath the mounting screw there is a smaller cross-head screw in a hole. Loosen the small cross-head screw, and carefully use a screwdriver to pry at the side of the head stack (not the shield) in the required direction. Check that the shield is aligned with the head gate shield then tighten the screws. Recheck the tape wrap per the preceding paragraph. Repeat the process until the tape wrap is correct. The erase head is adjusted for tape wrap by loosening the mounting screw, rotating the head as required, and tightening the screw.

To adjust the head zenith, use the two hex-socket setscrews (also used for head height adjustment, see Fig. 4D-1). As the adjustment is being made, visually check the zenith by lining up the head with the capstan or the scrape-flutter idler. Turn the outermost setscrew in and the innermost setscrew out, to move the stack bottom in (away from the tape). To move the bottom of the head out (toward the tape), reverse the procedure. Be sure both setscrews remain snug. When the zenith adjustment seems correct, recheck it with the grease pencil method described above. Repeat the adjustment until the head zenith is correct (no zenith adjustment is required for the erase head).

Whenever head zenith or tape wrap is changed, check the head azimuth and height per paragraphs 4C.3.6, 4C.3.8, and 4D.2.

4D.4 CHANGING HEAD STACKS

4D.4.1 Record or Reproduce Stack

Step 1: Remove the complete head assembly per paragraph 4A.2.3.

Step 2: Remove the large cross-head screw (item 41, Fig. 6-1; or item 31, Fig. 6-3) and then the shield (containing the head stack).

Step 3: If the replacement head stack is in a shield, mount the shield in position. Check (through the bottom of the casting) that the head stack shield is aligned with the head shield, and is parallel to the casting top front edge, then

tighten the mounting screw.

Step 4: If the head stack is not in a shield, use a screwdriver to remove the two slot-head screws and the nuts (items 39-42 and 39-43, Fig. 6-1; or items 30-32 and 30-33, Fig. 6-3) and remove the head stack from the shield. Be careful not to lose the double-coil lockwasher. Remove head stack and two head springs (item 3, Fig. 6-1 and Fig. 6-3) from the shield. Unsolder the leads at the head stack.

Step 5: Pass the leads from the connector assembly through the hole in the back of the shield, and solder them to the terminals on the new head stack as shown in Figs. 6-2, 6-3, or 6-5.

Step 6: Turn the two hex-socket setscrews out until the ends are even with the inside of the shield.

Step 7: Obtain the two slot-head screws and the nuts removed in Step 3. Turn the nuts tightly against the screw heads. Place the double-coil lockwasher over the end of the screw with the plain hex nut (the other screw has a self-locking nut).

Step 8a: On heads for 1/4-inch tape, place the two head-springs in the indentations in the top of the head stack. Slip the head stackinto the shield without displacing the springs.

Step 8b: On heads for 1/2-inch tape, hold the shield upside down, and place the two head-springs in the indentation in the shield (looking through the shield open side, the indentations are at the right front and right rear). Without displacing the springs, slide the head stack (upside down) into the shield.

Step 9: Insert the two slotted-head screws through the plate and shield, along with the screw, plain hex nut, and double-coil lockwasher, in the position shown for items 39 and 42, Fig. 6-1; or items 30 and 32, Fig. 6-3. Engage the two screws in the head stack holes, and tighten them firmly.

Step 10: Secure the head stack and shield in the head assembly with the large cross-head screw removed in Step 2. Check (through the bottom of the casting) that the head stack shield is aligned with the head shield, and is parallel to the casting top front edge, then tighten the mounting screw.

Step 11: Turn-in the two hex socket-head setscrews to lower the head stack, until head height is approximately correct.

Step 12: Turn the two nuts on the cross-head screws down against the plate, and use the azimuth-adjusting nut (see Fig. 4C-6) to set the head azimuth to the approximate correct position.

Step 13: Install head assembly on the transport and mate the connectors with the correct receptacles (see Fig. 4A-1).

Step 14: Check and adjust head height per paragraph 4D.2; tape wrap and zenith per paragraph 4D.3; and head azimuth per paragraph 4C.3.6 (reproduce) or 4C.3.8 (record).

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 screw (item 40, Fig. 6-1, or 31, Fig. 6-3), then remove the erase head stack, spacer, and shims.

Place the spacer and shims on the new assembly and mount them on the casting with the mounting screw. Check erase head height per paragraph 4D.2.3, and the tape wrap per paragraph 4D.3.

4D.5 TAPE SKEW CHECKOUT

To check tape skew, play back the 15-Hz tone on a 7-1/2 ips Ampex Standard Test Tape, then adjust the reproduce level control for a convenient VU meter indication. Manually stall the reel idler, then the scrape-flutter idler, the VU meter indication should not drop over 1 dB in either case.

To correct excess drop, check that the tape guides (in the tape housing) are set 0.750 inch from the top of the transport stainless-steel overlay, then adjust reproduce head azimuth per paragraph 4C.3.6. Recheck tape skew by

manually stalling reel idler and the scrape-flutter idler; if the meter indication is still outside of tolerance, proceed as follows:

Step 1: Loosen the two tape-guide mounting screws on the reproduce side of the head assembly (item 37, Fig. 6-1; or item 29, Fig. 6-2) so they will maintain the guide position, but can be moved.

Step 2: Adjust the tape guide very slightly up or down, then repeat the tape skew check. If the high frequency drop is still not within tolerance, move the tape guide in minute increments until tape skew is corrected. Tighten the guide mounting screws, then adjust head azimuths per paragraphs 4C.3.6 and 4C.3.8.

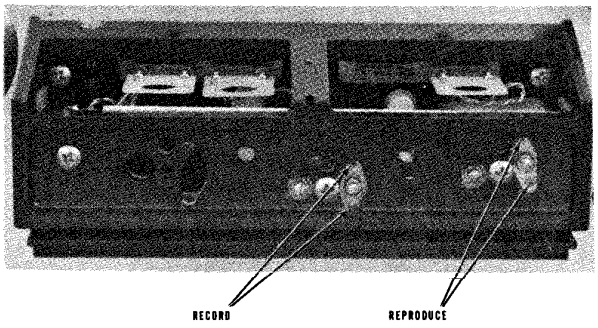


Fig. 4D-1. . Head Height and Zenith Adjustments

Section 4

MAINTENANCE
Part E. Transport Maintenance

4E.1 GENERAL

The following paragraphs contain transport corrective maintenance, parts replacement, and the special adjustment procedures required thereafter. Most of these procedures require removal of the console front panel per paragraph 2.3.

NOTE

Transport preventive maintenance procedures (cleaning, lubricating, etc.) are in part B of this section, and normal checkout and adjustment procedures are in paragraph 4C.2.

4E.2 SERVICING HINTS

4E.2.1 Brake Bands

Glazed brake bands that are not contaminated with oil can sometimes be renovated by abrading them only with sandpaper 4.0 grit or finer. Do not use emery cloth or carborundum-coated paper.

4E.2.2 Solenoids

A corroded solenoid plunger, which doesn't slide freely, can be renovated by rotating it in a drill press while holding crocus cloth against it.

CAUTION

Do not lubricate plungers, since oil can eventually cause sticking.

4E.2.3 Relays

To visually check if a relay is energizing, remove the snap-on cover with a thin-blade tool. Rub any contaminated relay contacts clean with bond paper or a relay-contact burnishing tool.

Since most relays are identical, play/record operations may be continued in an emergency by interchanging a defective play/record relay with a sound fast-forward, rewind, or edit relay (depending on importance of the function).

4E.2.4 Capstan Idler

The capstan idler (item 90, 91, Figure 6-8) is removed from idler arm (39) by loosening setscrew (75). No other parts of the idler arm assembly are replaceable (refer to paragraph 4E.8.2).

4E.3 HEAD-CABLE AND POWER-SUPPLY BOXES REPLACEMENT

The head-cable and power-supply boxes must sometimes be removed during corrective maintenance procedures.

4E.3.1 Head-cable Box

Remove and install the head-cable box per paragraph 4A.2.4.

4E.3.2 Power Supply Removal

To remove the power supply, disconnect cables from receptacles J701 through J704. Disconnect the captive power-supply cable from the receptacle on the transport control box. Remove the four mounting screws and remove the power supply box.

CAUTION

A power transistor is mounted on the side of the power supply, next to the transport. Use care not to damage the transistor while removing the power supply.

4E.3.3 Power Supply Installation

Install the power supply in reverse order to removal procedures. (The captive cable is routed from under the power supply box, out of the side toward the transport control box.)

4E.4 TAKEUP AND REWIND ASSEMBLIES

4E.4.1 General

Major components in the takeup and rewind assemblies are the torque motor and the brake. The turntable and brake drum (fixed to the motor shafts) cannot be adjusted or individually replaced. The fixed position of the turntable also prevents removal of the motor flange. If any of these three components are damaged beyond use, the complete motor assembly must be replaced.

The takeup and rewind assembly drawings are shown in Figs. 6-12 and 6-13.

Adjustment of tape tension (motor torques) and braking force are given in paragraphs 4C.2.3 and 4C.2.4.

4E.4.2 Replacing Takeup or Rewind Assembly

The takeup and rewind assemblies are each secured, through slotted holes in the top plate, to the reel guards (for quick conversion to 11-1/2-inch CCIR reels). When either assembly is removed, the reel guard will also be released.

To remove either assembly, disconnect the connector from the tape transport, slide the plastic sleeving from the capacitor solderless connectors and disconnect them. Manually support the assembly, and remove the three nuts and washers (items 77 and 79, Fig. 6-9) from the assembly and the reel guard. Remove the reel guard, then guide the turntable through the top plate hole and remove the assembly.

Reinstall the assembly in the reverse order of removal procedures. If the 10-1/2-inch NAB reel is the largest to be used, secure the assembly in the innermost position. If the 11-1/2-inch CCIR reel is to be used, secure the assembly in the outermost position. Before tightening the mounting nuts, check that the flat portion of the reel guard is parallel with the transport top edge (see Fig. 6-8) and that the turntables are centered in the guard. Connect the leads to the motor capacitor as shown in Fig. 6-12 (takeup assembly) or 6-13 (rewind assembly).

4E.4.3 Reel Drive Plate Replacement

A reel drive plate (item 4, Fig. 6-12), in the center of each turntable, has three extrusions which mate with the EIA reel hubs. Three screws secure the plates to the turntable. To replace the drive plate, remove the three screws, lift the plate from the spindle, place the new drive plate in position, and reinstall the screws.

4E.4.4 Turntable Pad Replacement

To replace the cork pad (item 3, Fig. 6-12) on the turntable top, use a putty knife (or similar tool) to lift one edge of the pad, then peel it off the turntable. Clean all adhesive from the turntable, with lacquer thinner, MEK, or similar solvent. Peel the backing from the new pad (exposing the adhesive surface) and carefully align the reel holddown holes in the pad with those in the turntable. Press the pad firmly in position.

4E.4.5 Brake Assembly Removal (See Figure 6-12)

Remove cable clamp which secures the wires to the solenoid bracket. Slide the plastic sleeving from the solderless connectors on the two solenoids, and disconnect the wires. Remove the three screws (item 9, Fig. 6-12), then manually actuate the main brake solenoid (the one closest to the motor) and slide the entire assembly from the brake drum.

Install the brake assembly per paragraph 4E.4.8.

4E.4.6 Brake Band Replacement (See Figure 6-14)

Remove the brake assembly from the takeup or rewind assembly per paragraph 4E.4.5, then 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, below item 27, Fig. 6-14, which secure the brake band (at the end farthest from the solenoids). A band link clamp will also be released.

Step 3: Loosen (do not remove) the two socket-head cap-screws at the other end of the brake band. Take care not to lose the leaf spring, then slide the brake band end from between the clamp and the screws, and remove the brake band.

Step 4: Insert the new brake band through the holes in the housing, with the slotted end toward the solenoids.

Step 5: Secure the brake band end, farthest from the solenoids, with the band link clamp, the two socket-head cap-screws, and the lockwashers removed in Step 2.

Step 6: Insert the brake band's slotted end between the band link and its clamp. Install the leaf spring between the brake band and the band-link clamp (so the spring is on the band inner side, which is on the same side as the lining). Tighten the two socket-head cap-screws snugly, but so the brake band will still slide in and out of the clamp.

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

Step 8: Adjust the brake assembly per paragraph 4E.4.8.

4E.4.7 Brake Solenoids Replacement (See Figure 6-14)

Remove cable clamp which secures the wires to the solenoid bracket. Slide the plastic sleeving from the solderless connectors on the two solenoids, and disconnect the 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). These screws and washers are used in four places; remove the two from the edit solenoid and its bracket (item 7 or 8, Fig. 6-14; the solenoid plunger will slide partly out. If the plunger must be removed, remove the self-locking nut (item 37, Fig. 6-14) and the spring beneath it, and slide the spade bolt (item 34, Fig. 6-14) out through the hole in the edit-solenoid stop-plate (item 18, Fig. 6-14). Remove the plunger 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). These screws are used in six places, remove the two from the main brake solenoid and the edit solenoid bracket (item 7, Fig. 6-14). Remove the two screws (item 31, Fig. 6-14) from the end of the main brake solenoid and the solenoid bracket (item 6, Fig. 6-14). Pivot the edit brake solenoid bracket for access, then remove the main brake solenoid (the plunger slides partly out of the solenoid). If the plunger must be removed, remove the cotter pin and clevis pin (items 24 and 25, Fig. 6-14).

Replace the solenoids in the reverse order to removal procedures. Check that both solenoids faces are aligned with the edit solenoid bracket. Perform adjustment procedures given in paragraph 4E.4.8.

4E.4.8 Brake Installation and Adjustment (See Figures 6-10 and 6-12)

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

After installing any item on the brake assembly, adjust the brakes as follows:

NOTE

Parts that are adjusted are illustrated in the takeup and supply brake adjustment portion of Fig. 6-10.

Step 1: Check that the edit-brake solenoid is flush with the edit solenoid bracket. Adjust the edit solenoid bracket so it is 1/16 inch above the inboard face of the main-brake solenoid.

Step 2: Move the edit-solenoid spring-anchor fully forward.

Step 3: Manually actuate the main-brake solenoid, and measure the plunger protrusion from the solenoid in its bottomed position.

Step 4: Check that the brake band is correctly aligned to the drum. Slide the slotted end of the band (see Fig. 6-10) into its clamp until the main-brake solenoid plunger is 5/32 to 3/16 inch from the fully-bottomed position measured in Step 3 (solenoid not actuated). Secure the band in that position by tightening the two socket-head capscrews.

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

Step 6: Manually actuate the main brake solenoid. Rotate the motor and check for the band dragging on the brake drum. If 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 band buckling or drag, with the solenoid fully bottomed.

Step 7: Position the edit-solenoid spring-anchor so the edit-solenoid stop-plate clears the main-brake solenoid plunger by 1/16 (±1/64) inch, then secure the anchor in that position.

Step 8: Connect the solderless connectors to the solenoids and slide the plastic sleeving over the connectors.

Step 9: Using cable clamps, secure all leads to the solenoid bracket (item 6, Fig. 6-14) and away from rotating parts.

Step 10: Adjust the main brake and edit brake per paragraph 4C.2.4.

4E.4.9 Motor Capacitor Replacement (See Figure 6-9)

To remove a takeup or rewind motor capacitor (item 22, Fig. 6-9) remove the power supply per paragraph 4E.3. Slide the plastic sleeving from the solderless connectors on the capacitor leads, and disconnect the wires. Loosen the two screws on the mounting plate (item 42,

Fig. 6-9), and slide the capacitor and plate from the casting. Remove the mounting plate and use the removed screws, nuts, and washers to secure the new capacitor on the plate (do not tighten the screws). Slide the capacitor and plate into position, then tighten the screws. Connect the leads (see Figs. 6-12 for takeup; or 6-13 for rewind) and reinstall the power supply.

4E.5 DRIVE MOTOR

4E.5.1 Lubrication

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

4E.5.2 Fan and Flywheel Replacement

The fan and the flywheel are secured to the drive motor shaft by setscrews. To remove the components, loosen the setscrews and slide the parts off the shaft.

To reinstall the components, slide the flywheel on the shaft until the hub is against the shaft shoulder (the hub setscrew portion should be away from the motor). Tighten the setscrew against the shaft flat. Slide the fan on the shaft (setscrew side toward the motor) and bottom it against the flywheel hub. Tighten the setscrew against the shaft flat.

4E.5.3 Drive Motor Replacement (See Figures 6-8 and 6-9)

CAUTION

Do not bump or scrape the capstan as the motor is removed or installed.

To remove the drive motor, disconnect the drive motor cable from the tape transport. Remove the transport capstan idler (item 4, 5, Fig. 6-8) by loosening the setscrew (item 75, Fig. 6-8) and lifting the idler from the arm (item 39, Fig. 6-8). Manually support the drive motor, and remove the four screws (item 60, Fig. 6-8) from the motor and the top plate (the motor shield is also released).

Install the drive motor in the reverse order of removal procedures. Be sure to reinstall the motor shield (item 37, Fig. 6-9) as pictured. Install the capstan idler so that the top of the rubber tire is 1/32 (±1/64) inch below the capstan shaft end.

4E.5.4 Motor Capacitor Replacement (See Figure 6-9 and 6-10)

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 on the capacitor leads, and disconnect the wires. Use a short screwdriver (or offset screwdriver) to remove the two screws and washers (items 69 and 80, Fig. 6-9) and remove the capacitor. Use the removed screws and washers to mount the new capacitor in position, and reconnect the leads as shown in Fig. 6-10.

4E.6 REEL IDLER

4E.6.1 Tape Guide Replacement (See Figure 6-15)

To remove the tape guide from the reel idler arm, unscrew the spring-loaded screw (item 9, Fig. 6-15), then remove the guide, the idler, screw, spring, and flat washers (used as shims). To install the tape guide, insert the spring and screw in the top of the guide, and install all of the washers; seat the guide slot (in the bottom) over the spring pin on the arm, and tighten the screw.

4E.6.2 Pulley Replacement (See Figure 6-15)

The pulley is held in the reel idler housing by the reel idler flywheel, which is secured to the pulley shaft by a setscrew. The setscrew is in the side of the flywheel toward the transport, and must be found by feel. Rotate the flywheel so the pulley shaft flat is toward the outer edge of the rewind motor. Insert a 3/32 Allen wrench (with a handle and long-shaft) past the outer edge of the rewind motor, and then into the setscrew hole by feel. If the transport is face down, manually support the reel idler pulley while loosening the setscrew and removing the flywheel, then slide the pulley out of the housing.

Install the pulley by sliding the pulley shaft back through the housing, and then remounting the flywheel. End play must be 0.003-0.005 inch to avoid damaging the ball bearings.

Check the play by firmly holding the pulley down in the housing and using a feeler gauge between the pulley and the housing (at the side opposite the arm). To this measurement add 0.004 inch, and select the feeler gauge leaves equal to the total. Insert the gauge between the pulley and housing, at the side opposite the idler arm. Hold the pulley firmly down on the gauge, and push the flywheel (setscrew side in) so it firmly contacts the bottom of the housing. Tighten the flywheel setscrew, and remove the feeler gauge.

4E.6.3 Idler Tension Adjustment (See Figure 6-15)

The idler tension is not critical; however, if it becomes too high, and cannot be correctly adjusted, it indicates that reel idler damage is causing binding.

Measure the force at the outer end of the arm with a spring scale. Approximately two ounces of pressure should be required to move the arm from its stop.

If adjustment is indicated, remove the pulley assembly per paragraph 4E.6.2, which reveals two screws (item 21, Fig. 6-15). Loosen the screws, and rotate the bushing (item 2, Fig. 6-15) clockwise to increase pressure, or counterclockwise to decrease pressure. Tighten the two screws, and recheck the spring force. Repeat the procedure until force is approximately 2 ounces.

Reinstall the pulley per paragraph 4E.6.2.

4E.6.4 Arm Assembly Replacement (See Figure 6-15)

To remove the arm assembly, remove the pulley per paragraph 4E.6.2, then remove the two screws (item 21, Fig. 6-15). Remove the arm, bushing, and idler mount (items 5, 2, and 8, Fig. 6-15) from the housing. The arm is between the bushing and the mount; they are press-fit together to a very close tolerance and, therefore, cannot be ordered separately. Contact Ampex Audio Technical Support Department if replacement is required. The tension spring can easily be replaced by unhooking it from 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 upper left slot. Install the two screws loosely, then check and adjust arm tension per paragraph 4E.6.3. Replace the pulley per paragraph 4E.6.2.

4E.6.5 Reel Idler Replacement (See Figure 6-9)

To remove the reel idler, remove the pulley per 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 to the casting. Manually support the reel idler, remove the screws, and remove the idler from the transport.

Install the idler in the reverse order of removal procedures. If the arm was removed from the housing, check and adjust the arm tension per paragraph 4E.6.3. Install the pulley per paragraph 4E.6.2.

4E.6.6 Ball Bearing Replacement (See Figure 6-15)

To replace the ball bearings (item 17, Fig. 6-15) in the reel idler, remove the idler from the transport per paragraph 4E.6.5. Remove the arm from the housing per paragraph 4E.6.4. Insert a pencil (or similar object) up through the hole in the lower bearing to push the top bearing out.

To remove the lower ball bearing, use Truarc pliers to remove the lower retaining ring, then insert the pencil (or similar object) from the top of the housing to push the bearing out.

CAUTION

When installing the new bearings, use no lubrication. Insert the bearings into the housing with finger pressure only, being very careful not to cock the bearings in the housing.

Install the lower bearing, against the retaining ring, by pushing only on the bearing outer race (not toward the inside) with equal pressure on opposite sides of the bearing. Install the lower retaining ring below the bearing,

then push the other bearing into position.

Mount the idler housing on the transport, and install the arm assembly. Check and adjust the arm tension per paragraph 4E.6.3. Install the pulley per paragraph 4E.6.2.

4E.7 TAKEUP TENSION ARM

4E.7.1 Arm Spring Adjustment

This adjustment is always required if the transport mounting is changed between the horizontal and vertical positions.

To check force on the takeup tension arm, use a spring scale to measure the tension at the tape guide on the arm outer end. With the scale, pull the arm so the arm centerline is parallel to the transport bottom edge. The scale should indicate from 1/4 to 3/8 ounce (7 to 11 grams).

To adjust the tension, remove the socket-head screw from the cover cap, then remove the cover cap from the tension arm base. A spring wound around the bushing (below the arm) has one end in a hole in the bushing. The other spring end is hooked to one of two pins that are 180° apart and upright on the base. Adjust the tension by using a soldering aid (or similar tool) to move the spring hook progressively from one pin to the next until the correct force is obtained. A spacer beneath the spring hook must also be moved. Wind the spring tighter around the bushing to increase force, or loosen it to decrease the force.

4E.7.2 Safety Switch Adjustment

To check the position where the takeup tension arm actuates the safety switch (to stop tape motion) move the arm to the tape threaded position. Allow the arm to return slowly toward the rest position, listening closely for the click when the safety switch actuates. At that point, the tape guide tape-contacting surface should be 3-3/4 (+0, -3/4) inch from the transport bottom edge.

Required adjustments are made from the transport back. Remove the connectors for drive and takeup motors from the transport control box. Hold other wires aside so the safety switch (item 23, Fig. 6-9) is accessible. Use long-nose pliers to bend the safety switch spring actuator out from the switch to actuate with the takeup tension arm higher; and toward the switch for a lower position. Reconnect the drive motor and takeup motor connectors.

4E.7.3 Tape Guide and Hook Replacement

Remove the tape guide and hook from the takeup tension arm by removing the spring-loaded screw from the top of the guide.

To install the hook and guide, use the spring pin to mate the hook locating hole to the guide bottom slot, with all shim washers repositioned between the guide and hook. Insert the spring and screw in the guide, then tighten the screw in the arm.

4E.7.4 Tension Spring Replacement

To replace the tension spring around the bushing, remove the base cap by removing the socket-head screw in the cap. Unhook the spring end from the pin, and allow it to unwind. Remove the spring straight end from the bushing hole. Use long-nose pliers to start the spring's top end over the arm, then unscrew the spring from the bushing.

To install the spring, start the straight end onto the bushing and screw it on. Insert the spring straight end into the hole in the bushing base; tighten the spring, by winding the hook end around the pins two or three times; then hook the end to one of the pins on the base. Check and adjust the arm spring force per paragraph 4E.7.1.

4E.7.5 Takeup Tension Arm Replacement (See Figure 6-9)

Replacement of replaceable parts of the takeup tension arm assembly is given in paragraphs 4E.7.3 and 4E.7.4. If any other component is defective, the complete assembly must be replaced.

To remove the takeup tension arm assembly, disconnect the drive-motor and takeup-motor cables from the transport. Secure other wires aside for access to the tension arm base.

Remove one screw (item 68, Fig. 6-9), and lift the assembly off the transport, while carefully guiding the drive pin (protruding from the assembly inner end) out through the top plate.

Remove the setscrew (item 73, Fig. 6-9) from the base, and install it in the new assembly so it protrudes 3/16 inch. Guide the end of the new assembly through the top plate hole and mate the setscrew with the upper left hole. Secure the assembly to the transport with the removed setscrew.

Check and adjust the safety switch actuation per paragraph 4E.7.2. Reconnect the drive-motor and takeup-motor cables to the transport control box.

4E.8 CAPSTAN IDLER

4E.8.1 Lubrication and Adjustment

Lubrication of the capstan idler is given in paragraph 4B.3.3. The adjustment of idler force against the capstan is given in paragraph 4C.2.5.

4E.8.2 Parts Not Removable

The capstan idler arm (item 39, Fig. 6-8) and associated components cannot be removed from the transport, because the solenoid arm (item 33, Fig. 6-9) is secured to the idler arm shaft by a press-fit rollpin. Removing and installing this rollpin requires special tools. The solenoid arm will not pass through the hole in the transport, so parts between the idler arm and the solenoid arm cannot normally be removed. If any of these parts should ever require replacement, the transport should be returned to the factory for repair.

CAUTION

Do not use a drift pin and hammer to drive the rollpin out or in, since irreparable transport distortion can result.

4E.8.3 Idler Positioning (See Figure 6-9)

The normal clearance between the idler tire and the capstan should be 1/2-5/8 inch. To adjust the clearance, loosen the two screws securing the stop to solenoid (item 9, Fig. 6-9). Slide the stop to the position that provides correct clearance, then tighten the screws. Check and adjust the capstan idler pressure per paragraph 4C.2.5.

4E.8.4 Idler Replacement (See Figure 6-8)

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

Install the idler so the tire top surface is 1/32 (±1/64) inch below the capstan top surface, then tighten the setscrew.

4E.8.5 Capstan Solenoid Replacement (See Figure 6-9)

To remove the capstan solenoid (item 9, Fig. 6-9) remove the drive motor (with capacitor) per paragraphs 4E.5.3 and 4E.5.4. Disconnect the takeup motor cable from the transport control box. Remove the self-locking nut and the adjustment spring from the end of the bolt in the solenoid arm (item 33, Fig. 6-9). Slide the plastic sleeving from the solderless connectors on the solenoid leads, and disconnect them. Remove the mounting plate that clamps the solenoid to the transport by loosening the four screws (items 63 and 67, Fig. 6-9). Slide the plate and solenoid off, while guiding the bolt out of the solenoid arm.

To install the solenoid, loosely secure the mounting plate to the solenoid with the four removed screws and washers. (The solenoid leads are fastened in a cable clamp (item 58, Fig. 6-9) that is secured with one screw (item 67, Fig. 6-9)). Place the solenoid return spring on the bolt as shown in Fig. 6-9, then insert the bolt end through the solenoid arm (item 33, Fig. 6-9). Slide the plate and solenoid over the casting extrusions. Tighten the screws to clamp the solenoid in position. Install the solenoid adjusting spring, and then the self-locking nut on the bolt. Connect the leads to the solenoid. Install the drive motor and its capacitor per paragraphs 4E.5.3 and 4E.5.4, respectively. Reconnect the takeup motor cable. Check and adjust the cap-

stan idler per paragraph 4E.8.3. Check and adjust the capstan idler pressure per paragraph 4C.2.5.

4E.9 TAPE LIFTER

4E.9.1 Adjustment Procedure (See Figure 6-10)

During the play mode, the tape lifter arms must not touch the tape. In either fast-wind mode, the lifter must remove the tape from head contact; however, the tape must not contact the head gate shield covers. Adjustment is usually required only when a tape lifter component, or the solenoid is replaced.

To adjust the tape lifter, remove the reel idler flywheel and pulley per paragraph 4E.6.2. Disconnect the transport rewind-motor and power-supply cables. Remove the dummy plugs (or cables) from the 60-Hz-amplifier and remote-control receptacles, and remove the four transport plug-in relays. If head cables are in the way, move them to one side. Refer to the tape lifter portion of Fig. 6-10, then proceed as follows:

Step 1: Loosen the two stop screws and position the stop 21/32 inch from the solenoid face. Tighten the two screws (this position may have to be re-adjusted later).

Step 2: Loosen the hex-head screw at each end of tape lifter bracket. Slide bracket fully toward solenoid. Insert tape lifter spring (between solenoid plunger link, and tape lifter bracket) and hook it in nearest tape lifter bracket hole that doesn't require stretching of spring (usually third or fourth hole from solenoid).

Step 3: Hold either tape lifter arm so there is a 1/16-inch clearance between it and the back of the slot (see Fig. 6-10). Slide tape lifter bracket away from solenoid until all slack is removed from the tape lifter spring, the solenoid plunger link, and the plunger (plunger must be fully against stop). Tighten the two hex-head screws to secure the tape lifter bracket.

Step 4: If slack is not removed, slide tape lifter bracket toward solenoid, and move tape lifter spring hook to the next hole in the bracket. Then repeat step 3.

Step 5: Manually move solenoid plunger to fully-bottomed position. Tape lifter arm should move to 1/16 inch from other end of slot.

Step 6: If clearance is not 1/16 inch, reposition the tape lifter solenoid stop from the 21/32 inch clearance set in step 1 (move stop farther from solenoid face for more arm travel, or closer for less travel; adjustment is a 2:1 ratio, so moving the solenoid stop 1/16 inch will change arm travel by 1/8 inch). If the solenoid stop is repositioned, steps 2 through 5 must be repeated until the final adjustment results in a 1/16 inch clearance between the arm and each end of the slot (with solenoid deenergized, then energized).

Step 7: Replace the reel idler pulley and flywheel per paragraph 4E.6.2. Connect all cables, and reinstall relays and dummy plugs on the transport control box.

4E.9.2 Solenoid Replacement (See Figures 6-9 and 6-10)

To remove the tape lifter solenoid, remove the reel idler pulley and flywheel per paragraph 4E.6.2. Disconnect the rewind-motor and electronic-power-supply cables from the transport control box. Remove tape lifter spring (refer to Fig. 6-10). Slide the plastic sleeving from the solderless connectors on the solenoid leads and disconnect the wires. The solenoid (item 10, Fig. 6-9) is clamped to 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), then slide solenoid and plate off.

To install the solenoid, mount the plate on the solenoid end with the two removed screws, lockwashers, and flat washers (items 62, 84, and 88, Fig. 6-9). Slide the solenoid and plate onto the extrusions on the casting, and use an open-end wrench to tighten the two mounting screws. Connect the leads to the solenoid, and reinstall the tape lifter spring in its original position. Adjust tape lifter action per paragraph 4E.9.1. Reinstall the reel idler pulley and flywheel per paragraph 4E.6.2, and reconnect cables.

4E.9.3 Tape Lifter Replacement (See Figures 6-9 and 6-11)

To remove the tape lifter assembly, remove the reel idler pulley and flywheel per paragraph 4E.6.2. Disconnect the transport rewind-motor and power-supply cables, 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 per paragraph 4E.9.2. Remove the tape-lifter return spring (item 35, Fig. 6-9) from between the tape lifter assembly and the transport post. Remove the two socket-head shoulder screws (item 44, Fig. 6-9), and remove the complete assembly (note that flat washers, item 83, Fig. 6-9, are between the tape lifter and the transport).

The tape lifter assembly drawing is provided in Fig. 6-11. Replaceable parts are listed in the tape transport parts list. The spring (item 5, Fig. 6-11) takes up slack at the end of the clevis pins on the tape lifter arms, to prevent backlash and rattle.

To install the tape lifter assembly, reverse the removal procedures. Be sure to install the washers (item 83, Fig. 6-9) between the assembly and the transport. Install the tape lifter solenoid per paragraph 4E.9.2. Adjust the tape lifter action per paragraph 4E.9.1. Reinstall the reel idler pulley and flywheel per paragraph 4E.6.2. Reinstall the connecting cables, dummy plugs, and relays.

4E.10 SAFETY SWITCH (See Figures 6-7, 6-9, and 6-10)

To remove the safety switch (item 23, Fig. 6-9), disconnect the drive-motor and takeup-motor cables from the transport control box. Move other wiring aside for access. Slide the plastic sleeving from the solderless connectors on the safety switch leads and disconnect the 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, along with the shield (item 30, Fig. 6-7).

To install the safety switch, place the shield over the switch, then use the removed two screws and washers to secure them to the casting. Connect the leads to the switch as shown in Fig. 6-10. Check and adjust safety switch actuation per paragraph 4E.7.2. Connect the drive-motor and takeup-motor cables to the transport control box.

4E.11 SERVICING PROCEDURES

4E.11.1 General

Tape transport power distribution (to three motors, and six solenoids) is controlled by transport control box components, including switches, relays, fuses, switching transistors, and the power supply.

The tape transport schematic diagram is provided on Fig. 6-20. A simplified schematic, Fig. 6-21, shows the three main control circuits, one of which routes all 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 supply furnishes power for the relays (play, edit, fast forward, rewind, and record relays) and the tape lifter solenoid. Two switching transistors are in the 24-volt dc circuit. The 115-volt dc supply powers the solenoids for the capstan, the two main brakes, and the two edit brakes.

Assembly drawings for the transport control box are provided in Figs. 6-17 and 6-19. A power distribution and fusing diagram is shown in Fig. 6-19.

4E.11.2 Control Box Bottom Cover Removal

The control box bottom cover must be removed for access to components inside. To remove the cover, turn power OFF, and remove the cover over the tension-adjust resistors, with the two mounting nuts (one at each end). Use an open-end wrench to loosen the seven hex-head screws (two at each end, and three on one side of the bottom cover). Use the access finger holes to pull the cover off (the screws slide out of slots on the box).

WARNING

Dangerous voltages are present inside the control box and across the tension-adjust resistors when power is applied. Only thoroughly experienced personnel should attempt to service the unit with power on.

4E.11.3 Control Box Removal

To remove the control box, disconnect all cable connectors. Disconnect the solderless connectors from the tape lifter solenoid, the capstan solenoid, the drive motor capacitor, and the safety switch (slide the insulation off connectors before disconnection).

At the front of the transport remove the two screws (item 61, Fig. 6-8) from the push-button escutcheon, and remove the released parts. Remove the two screws (items 65 and 61, Fig. 6-8) from the toggle switch escutcheon, and remove the escutcheon.

Manually support the control box, remove the three screws (item 71, Fig. 6-8) securing the front of the control box, and remove the control box.

Relay actuation and power distribution can be checked with: 1) control box removed, 2) dummy plugs in their receptacles, 3) the two safety switch leads joined and tape-insulated, 4) each solderless connector separately tape-insulated, and 5) cover reinstalled over the tension-adjust resistors. The power cord can then be connected, power applied, and circuits checked.

WARNING

Dangerous voltages are present inside the control box, and across the tension-adjust resistors. Only thoroughly experienced personnel should attempt servicing the energized unit with the bottom cover or the resistor cover removed.

To install the control box, reverse the removal procedures. Check for correct connection of leads to the solenoids, drive motor capacitor, and safety switch as shown on Fig. 6-10.

4E.11.4 Power Checks

4E.11.4.1 General

In the following procedures, it is assumed that a sound power cord is correctly installed between the transport and the required power source.

4E.11.4.2 Input Power Check

Set power switch to ON, the power lamp should light. If not, move the takeup tension arm away from the safety switch; if the capstan motor starts, replace the power indicator lamp per paragraph 4E.11.10. If the motor does not start, check the line power, fuses F601 and F602, the power switch, and capacitors C606 and C607 (see Figs. 6-18 and 6-20).

4E.11.4.3 24-Volt Supply Check

Trouble in the 24-volt dc power supply is indicated by the relays all failing to actuate (play, fast forward, rewind, and edit relays). Major electronic components in this supply are transformer T1, diodes CR601 through CR604, capacitor C609, and resistor R602. Remove the bottom cover per paragraph 4E.11.2 and turn power ON.

WARNING

Dangerous voltages are present inside the control box and across the tension-adjust resistors. Only thoroughly experienced personnel should perform this check, which requires an energized circuit.

With a dc voltmeter, check the voltage across capacitor C609 (item 27, Fig. 6-18) for a nominal applied-load power of 24 volts dc, varying with line voltage; the no-load condition is approximately 34 volts dc. If the voltage is absent, or is excessively low, check the components in the 24-volt dc supply. The supply diodes (in the full-wave bridge circuit) and R602 are on a pair of two-lug terminal strips at the right of transformer T1 (just above the rewind motor receptacle) as viewed from the side that

has the tension-adjust resistors. If components are sound, check wiring continuity from the 24-volt power supply to both sides of the ac line supply.

4E.11.4.4 115-Volt Supply Check

Trouble in the 115-volt dc power supply is indicated if the 115-volt solenoids fail to actuate (capstan, main brakes, edit-brakes solenoids).

Major electronic components in this supply are resistor R609 (item 39, Fig. 6-18), capacitor C614 (item 38, Fig. 6-18), and diode bridge rectifier, CR615 through CR618, that is connected to C614 and C609 (item 27). Remove the control box bottom cover per paragraph 4E.11.2 and turn power ON.

WARNING

Dangerous voltages are present inside the control box and across the tension-adjust resistors. Only personnel experienced in working with live circuits should perform this check.

With a dc voltmeter, check the voltage across C614 (item 38, Fig. 6-18) for a 115-volt dc nominal, applied-load, value (the no-load voltage could be up to 150 volts dc). If the voltage is absent, or is excessively low, check the components in the 115-volt dc power supply. If components are sound, check wiring continuity from the 115-volt dc power supply to both sides of the ac line supply.

4E.11.5 Relay Actuation Check (see Figs. 6-20 and 6-21)

Refer to the simplified schematic diagram Fig. 6-21, which shows relay interaction. If one relay fails to actuate, it could result from a malfunction in another relay. Hold the takeup tension arm away from the safety switch, then (with power applied) press the actuating pushbutton and visually check the relay action. If the relay actuates, check that all contacts are made, then turn power OFF, and clean any contaminated contacts with bond paper or a contact-burnishing tool. Turn power ON, and recheck the relay; if the relay doesn't actuate, proceed as follows:

Step 1: Turn power OFF, and remove the relay. Use an ohmmeter to check across the relay coil (relay pins 13 and 14) for approximately 650 ohms resistance. If the coil is open or shorted, replace the relay. If a replacement is not immediately available, the relays may be interchanged for emergency play/record operations.

Step 2: If the coil seems sound, install the relay and test the relays for the other operation modes (fast forward, play, rewind, and/or edit). If all other functions are normal, turn power OFF and interchange the suspected relay with one known to be good. Recheck relays for all operation modes. If the original circuit operates normally, and trouble is still indicated in the suspected relay, replace the relay.

Step 3a: If the original circuit still does not operate correctly, some other component is preventing relay actuation. Turn power OFF, and remove the control box bottom cover per paragraph 4E.11.2. Remove the relay, and use an ohmmeter to check wiring continuity from the 24-volt dc supply to the pushbutton switch, and then to the relay coil. Also check the diode across the relay coil. Check for the switch closing when the pushbutton is pressed. Check wiring continuity to the negative side of the 24-volt dc supply.

Step 3b: If only the play function was normal in Step 2 (rewind, fast forward, and edit modes inoperative), turn power OFF and remove the bottom cover per paragraph 4E.11.2. Check transistors Q601 and Q602, and other components in that circuit (see Fig. 6-20 and 6-21).

Step 3c: If no mode operates correctly in Step 2, check the 24-volt dc power supply per paragraph 4E.11.4.3.

4E.11.6 Solenoid Actuation Check

4E.11.6.1 General

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

4E.11.6.2 Tape-Lifter Solenoid Check

(a) If the tape is not lifted from head contact during fast forward or rewind modes, but operation is otherwise normal, visually check the tape lifter solenoid actuation. If the solenoid actuates, manually check that the plunger fully bottoms; if it bottoms completely, adjust the tape lifter per paragraph 4E.9.1.

(b) If the tape lifter solenoid does not actuate in either fast forward or rewind, but operation is otherwise normal, check components as follows: 1) Remove the remote-control dummy plug, and check for a sound jumper from pin 12 to pin 8 (do not replace the plug at this time). 2) Disconnect the solderless connectors from the tape lifter solenoid and check the solenoid coil, across the solderless connectors, for approximately 30 ohms resistance. If the coil is open or shorted, replace the solenoid per paragraph 4E.9.2, 3) Check continuity from the "A" lead at the solenoid (see Fig. 6-20) to pin 12 of the remote control receptacle, zero (or low) resistance indicates proper making of the edit switch contacts in the up position. 4) With an ohmmeter, check the diode by checking across the solenoid coil leads into the control box; if the diode is defective, replace it.

(c) Use alligator clips to connect a dc voltmeter to the two leads into the control box ("B" lead, see Fig. 6-20, is positive). Reinstall the dummy plug in its receptacle. Turn power ON, and initiate the fast forward mode; the nominal 24-volt dc power should be indicated on the meter. Repeat the check in the rewind mode. If power is present, the solenoid is probably defective (despite its coil testing correctly); replace the solenoid per paragraph 4E.9.2. If power is absent check wiring continuity to both sides of the 24-volt power supply. If necessary, check overall continuity as follows: 1) remove the dust covers on the fast forward and rewind relays, 2) Check from the control box positive ("B") lead to the positive side of C609 (item 27, Fig. 6-18) while manually actuating relays for the fast forward mode, then the rewind mode; resistance should be zero (or low), 3) Check from the negative ("A") lead to the negative side of C609 without actuating the relays.

(d) If the tape-lifter solenoid actuates in only one fast-winding mode, but both modes otherwise operate normally, it indicates incorrect making of the relay contacts in the failed mode, or poor wiring connections to the relay contacts. On the suspected-defective relay, check the contact set 11-3-7 and the wiring to it.

4E.11.6.3 Capstan Solenoid Check

(a) If the capstan idler doesn't clamp the tape to the capstan when the play pushbutton is pressed, visually check solenoid actuation on the main brake takeup and rewind motors. If the solenoids don't actuate, check their actuation in fast forward rewind modes; if they actuate, check the play relay and its contacts per paragraph 4E.11.5. Replace defective solenoid(s) per paragraph 4E.9.2.

(b) If the brake solenoids fail in all modes, and the capstan solenoid fails in the play mode, initiate the stop/edit mode to check the edit-brake solenoids. If no solenoid actuates, check the 115-volt dc power supply per paragraph 4E.11.4.4, and the 24-volt dc power supply per paragraph 4E.11.3.

(c) If the main brake solenoids actuate when the play pushbutton is pressed in paragraph (a), check the capstan solenoid and its circuit: Disconnect the solderless connectors in the leads to the capstan solenoid. Connect an ohmmeter across the two disconnected leads to check for approximately 1,570 ohms resistance. If the coil is open or shorted, replace the solenoid per paragraph 4E.8.5. Use alligator clips to connect a dc voltmeter to the solenoid leads into the control box ("A" lead is positive, see Fig. 6-20), and press the play pushbutton. The nominal 115-volt power should be indicated on the meter. If power is present, the solenoid is probably defective (despite the coil checking correctly). Replace any defective solenoid per paragraph 4E.9.2.

If power is absent, remove the control box bottom cover per paragraph 4E.11.2. Check wiring continuity from the solenoid to both sides of the 115-volt dc power supply. If necessary, check overall continuity by removing the dust cover from the play relay. Check with an

ohmmeter from the solenoid positive ("A") lead into the control box, to the positive side of capacitor C614 (item 38, Fig. 6-18) while manually actuating the play relay; resistance should be zero (or low). Check from the negative ("B") lead to the negative side of C614 without actuating the relay. Resistance should be zero (or low).

4E.11.6.4 Main Brake Solenoids Check

(a) Actuate main brake solenoids in the play, fast-forward, and rewind modes. In the play mode, actuate the capstan solenoid so that the idler clamps the tape to the capstan. If neither of the brake solenoids or the capstan solenoid actuates in the play mode, proceed per sub-paragraphs (a) and (b) of paragraph 4E.11.6.3.

(b) If the rewind main brake solenoid actuates in the play mode, but the takeup main brake solenoid doesn't, check contacts in the edit relay per paragraph 4E.11.5. Turn power off, then remove the bottom cover of the control box per paragraph 4E.11.2. Disconnect the takeup motor cable from the control box. Use an ohmmeter to check diode CR607 (on the pins at the back of the rewind motor receptacle). Replace the diode if it is defective. Check the solenoid coil resistance, across pins 5 and 6 of the rewind motor plug; it should be approximately 2,300 ohms. If the coil is opened or shorted, replace the main brake solenoid per paragraph 4E.4.7. Reconnect the takeup motor cable to the control box, and disconnect the solderless connectors from the main brake solenoid. Use alligator clips to connect a dc voltmeter to the solenoid leads from the motor plug (the pin 5 lead is positive). Turn power ON, and initiate the play mode; the nominal 115-volt dc power should be present across those leads. If voltage is present, the main brake solenoid is probably defective (despite its coil testing correctly); replace the solenoid per paragraph 4E.4.7. If voltage is absent, check wiring continuity from the leads to both sides of the 115-volt power supply. If necessary, check overall continuity 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 the play relay, then the rewind relay, and then the fast forward relay; resistance should be zero (or low) when each relay is actuated. Check from the positive lead to the positive side of C614 without actuating any relay; resistance should be zero (or low).

(c) If the takeup main brake solenoid actuates in the play mode, but the rewind main brake solenoid doesn't, turn power OFF, then disconnect the rewind motor cable from the control box. Check across pins 5 and 6 of the rewind motor cable plug, for approximately 2,300 ohms resistance. If the coil is open or shorted, replace the solenoid per paragraph 4E.4.7. Remove the control box bottom cover and use an ohmmeter to check diode CR610 (soldered across pins 5 and 6 on the back of the rewind motor receptacle). Reconnect the rewind motor cable to 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 connector. Turn power ON, and initiate the play mode. The nominal 115 volts dc power should be present across those leads. If the voltage is present, the solenoid is probably defective (despite its coil checking correctly) replace the solenoid per paragraph 4E.4.7. If the voltage is not present, check wiring continuity from the solenoid leads to both sides of the 115-volt dc power supply. If necessary, check overall continuity by removing the dust covers from the play, fast forward, and rewind relays. Connect the ohmmeter from the negative lead (pin 6 of the plug) to the negative side of C614 (item 38, Fig. 6-18). Manually actuate relays for the play mode, then the fast-forward mode, and then the rewind mode. Resistance should be zero (or nearly zero) when each relay is actuated. Check from the positive pin 5 of the plug lead to the positive side of C614, without actuating any relay. Resistance should be zero (or nearly zero).

4E.11.6.5 Edit-Brake Solenoid Check

(a) If both edit-brake solenoids (on the takeup and rewind motors) fail to actuate in the stop/edit mode, check fast-forward and rewind actuation of the main brake solenoids, and play actuation of the main brake solenoids and capstan solenoid. If none of these solenoids actuate, check the 115-volt dc power supply per paragraph 4E.11.4.4. If all other solenoids actuate normally, check the edit relay action and contacts per paragraph 4E.11.5; replace the relay if necessary. If the relay action is

normal, turn power OFF, then remove the control box bottom cover per paragraph 4E.11.2, and disconnect the rewind and takeup motor cables from the control box. Use an ohmmeter to check diode CR611 (connected across pins 7 and 8 on the back of the rewind motor receptacle); replace the diode if it is defective.

(b) The only other likely cause for solenoid failure to actuate, is defective wiring to the 115-volt dc power supply. Disconnect the solderless connectors to one edit-brake solenoid, and use alligator clips to connect a dc voltmeter across the leads to the plug (the pin 7 lead is positive). Turn power ON and press the edit pushbutton. The nominal 115-volt dc power should be present across the leads; if not, remove the dust cover from the edit relay. With an ohmmeter, check from the positive lead to the positive side of C614 (item 38, Fig. 6-18) while manually actuating the edit relay; resistance should be zero (or near zero). Check from the negative lead to the negative side of C614 without actuating the relay, resistance should be zero (or near zero).

(c) If only one of the solenoids actuates in the stop/edit mode, the non-actuating solenoid is probably defective, because they are tied together across the rewind and takeup receptacles. Disconnect the cable from the control box. Check across pins 7 and 8 on the motor cable plug for approximately 2,300 ohms resistance. If the coil is open or shorted, replace the solenoid per paragraph 4E.4.7. Check voltage and resistance of the non-actuating relay per subparagraph (b).

4E.11.7 Drive Motor Check

(a) If the power lamp lights when power is applied, but the capstan motor does not start in rotation when tape is threaded, manually move the takeup tension arm away from the safety switch. Then press the edit pushbutton to initiate the stop/edit mode, if turntable braking force is reduced so the reels can easily be turned, the safety switch is operating correctly. If not, 1) adjust the safety switch actuation per paragraph 4E.7.2, and/or 2) adjust the spring force of the takeup arm per paragraph 4E.7.1, and/or 3) replace the safety switch per paragraph 4E.10.

(b) Disconnect the drive motor cable from the control box. Set the speed switch to HIGH, turn power ON, and check voltage with an ac vtvm across receptacle pins 4 and 5, and then pins 3 and 5. Full line power should be present at both positions; this indicates that the speed switch is closed and the motor capacitor is not open. When the speed switch is set at LOW, the check is made across receptacle pins 1 and 5. If voltage is available at pins 4 and 5 (or 1 and 5) and not across 3 and 5 (or 2 and 5) the motor capacitor is probably open; replace it per paragraph 4E.5.4. Even though voltages are correct, check that the motor capacitor is not shorted; also check the solderless disconnects at the motor capacitor (see Fig. 6-10).

(c) If the motor capacitor operates correctly, or if power is not available across either pair of receptacle pins, turn power OFF. Remove the bottom cover, and with an ohmmeter, check each position of the speed switch (view A-A, Fig. 6-18) for contact make-break action. If any capacitor C602 through C605 is shorted, voltage will be present at receptacle pins for the circuit opposite to the speed selected, and the motor would probably always run at the slow speed (regardless of the speed selected).

(d) If voltages are present at both receptacle pin pairs, and the motor capacitor is sound, the drive motor is probably defective; check and replace per paragraph 4E.5.3. Motor cabling connections are shown on Fig. 6-16.

4E.11.8 Takeup Motor Check

If the power lamp doesn't light when power is ON, check input power per paragraph 4E.11.4.2. If the capstan motor doesn't operate when tape is threaded, check it per paragraph 4E.11.7.

(a) Press the play pushbutton, the capstan idler should clamp the tape against the rotating capstan, and the takeup motor should start to wind the tape. If the capstan idler operates normally, but the takeup motor fails to

start, check deactuation of the edit relay per paragraph 4E.11.5; if it fails to deactuate, remove the bottom cover and, with an ohmmeter, check the opening and closing of the edit switch. If the edit relay deactuates, check the safety switch actuation per paragraph 4E.7.2 (even when the safety switch is correctly adjusted, some trouble could remain in the takeup motor circuit).

(b) If the capstan idler doesn't clamp the tape to the capstan, check that the dummy plug (or a remote control unit) is plugged into the control box remote-control receptacle. Check that the jumpers in the dummy plug are sound. Check that the rewind motor applies holdback tension on the tape; if not, check the play relay actuation and contacts per paragraph 4E.11.5.

(c) If the capstan idler clamps the tape, and the takeup motor starts, but a loose tape loop allows the takeup tension arm to actuate the safety switch (stopping all operations), check the takeup and rewind tape tensions per paragraph 4C.2.3. Then check the spring force on the takeup tension arm per paragraph 4E.7.1.

(d) If the capstan correctly clamps the tape, but the takeup motor fails to start, there is probably a malfunction in the motor circuit. Initiate the fast-forward mode; if the motor operates normally, the motor and capacitor are sound and the brake solenoid energizes correctly. Check the fast-forward relay deactuation and contacts per paragraph 4E.11.5. Check contacts and continuity of the takeup tension-adjust resistor R605 (at the back of the control box). Malfunction of the play and edit relays can cause other malfunctions covered in the preceding paragraphs of this section.

(e) If the motor fails to operate in either play or fast forward modes, check the takeup reel switch; if it is set at the small hub position change it to the large hub position. If this eliminates the trouble, check the small-hub tension-adjust resistor R606 (on the back of the control box) per paragraph 4C.2.3. If the trouble isn't eliminated, or if the switch was originally in the large hub position, visually check actuation of the main brake solenoid. If it fails to actuate, check it per paragraph 4E.11.6.4. If it actuates, disconnect the takeup motor cable from the control box. Remove any tape threaded on the equipment, and hold the takeup tension arm away from the safety switch. Press the fast forward pushbutton, and use an ac vtvm to check voltage across motor receptacle pins 1 and 2, full line power should be present; if not, check wiring continuity to both sides of the ac line. Remove the dust caps from the play and fast-forward relays, and check the high side of the line. Manually actuate the fast forward relay; resistance should be zero, or near zero (reel switch in large-hub position). Release the fast forward relay, and manually actuate the play relay. The resistance should be that set at takeup tension-adjust resistor R605.

(f) If motor voltage is present, check the motor capacitor connections at the solderless connectors (see Fig. 6-12), then check the capacitor. If it is open or shorted, replace it per paragraph 4E.4.9. If voltage is present and the capacitor is sound, the takeup motor is probably defective. Check the motor per paragraphs 4E.4.2 and 4E.4.5. Motor cabling connections are shown on Fig. 6-12.

4E.11.9 Rewind Motor Check

If the power lamp doesn't light when power is ON, check power per paragraph 4E.11.4.2. If the capstan drive motor doesn't operate when tape is threaded, check the motor per 4E.11.7. If the takeup motor doesn't operate, check it per paragraph 4E.11.8.

(a) If the rewind mode fails to function, remove the tape from the transport. Hold the takeup tension arm away from the safety switch and initiate the play mode. The rewind turntable should rotate clockwise, the takeup turntable should rotate counterclockwise, and the capstan idler should contact the capstan. If operation is correct, press the rewind pushbutton. If this doesn't stop the play mode (capstan idler moves away from capstan) check rewind relay actuation and contacts per paragraph 4E.11.4. If the play mode drops out, the rewind relay is actuating correctly.

(b) If only the takeup motor operates, check the supply reel switch. If it is in the small-hub position, move it to the large-hub position. If the rewind motor now operates, check small-hub tension-adjust resistor R608 per paragraph

4C.2.3. Also visually check actuation of the main brake solenoid; if it fails to actuate, check it per paragraph 4E.11.6.4.

(c) If changing the reel switch setting has no effect, and the main brake solenoid actuates, disconnect the rewind motor cable from the transport control box. Hold the takeup tension arm away from the safety switch, and press the rewind pushbutton. With an ac vtvm, check voltage across the rewind motor receptacle pins 1 and 2 on the control box; full line-power voltage should be present (reel size switch in large-hub position). If voltage is absent, or is excessively low, check wiring continuity to the ac line. Manually actuate the rewind relay; resistance should be zero (or near zero). Release the rewind relay, and manually actuate the play relay; resistance should be that set across holdback tension-adjust resistor R604. If continuity is correct, recheck actuation and contacts on the play and rewind relays per paragraph 4E.11.5.

(d) If required voltage is present, check the rewind motor capacitor connections at the solderless connectors (see Fig. 6-13), then check the capacitor. If the capacitor is open or shorted, replace it per paragraph 4E.4.9. If voltage is present and the capacitor is sound, the rewind motor is probably defective. Check and replace the motor as necessary per paragraphs 4E.4.2 and 4E.4.5. Motor cabling connections are shown on Fig. 6-13.

4E.11.10 Power Lamp Replacement

To replace the power lamp remove the two screws (item 61, Fig. 6-8) securing the escutcheon over the pushbuttons and remove the released parts. Remove the two screws (items 61 and 65, Fig. 6-8) securing the escutcheon over the toggle switches, and remove the released parts. Remove the lamp from the socket with a lamp extracting tool; if the tool is not available, the control box must be removed from the transport per paragraph 4E.11.3 for lamp removal.

4E.11.11 Switch Replacement

Remove the control box from the transport per paragraph 4E.11.3. When new pushbutton switches are installed, set the switch face to 19/32 (±1/32) inch above the chassis. Set toggle switch handles 1-5/16 (±1/32) inch above the chassis.

4E.11.12 Record Circuit Check

Initiate the record mode, by starting tape in the play mode and actuating the record circuits. Two switching transistors, Q601 and Q602, lock out the edit, fast-forward, and rewind modes while the equipment is recording. Q601 is therefore in the negative return lead from the edit fast-forward, and rewind relays. When the record mode is initiated, transistor Q602 is turned on, which turns Q601 off.

If it is possible to start the edit, fast-forward, or rewind modes 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 is impossible to start the modes, transistor Q602 may be shorted or Q601 may be open. No malfunction of either transistor will prevent initiating of the record mode.

Section 4

MAINTENANCE

Part F. Electronic Corrective Maintenance

4F.1 GENERAL

Use standard audio troubleshooting techniques to isolate faults to a certain stage or component. The dc, signal, and bias voltages are given at many points on the schematic diagram, as an aid in locating malfunctions. Schematic diagrams for the recorder/reproducer circuits are in Figs. 6-22 and 6-24; and for the reproducer, Figs. 6-23 and 6-25. The diagram for power distribution and fusing is in Fig. 6-19.

NOTE

Overall performance checks for the electronic system are described in paragraph 4B.4. Electronic alignment is given in paragraphs 4C.3 and 4C.4.

4F.2 EXTENDER BOARDS USE

Corrective maintenance procedures are greatly simplified by using the optional extender boards. The extender board, when installed between a circuit board and its receptacle, moves the circuit board outside the chassis so all components are accessible for testing/adjustment (the extended circuit boards must be mechanically supported).

Extender board catalog numbers are as follows: reproduce, 4020151; record, 4020152; bias amplifier, 4020153; and power supply, 4020154.

4F.3 INPUT POWER AND INDICATORS CHECK

4F.3.1 Recorder/Reproducer

When power is ON, the transport POWER lamp, and the record/reproduce unit VU meter lamps should light. If the POWER lamp doesn't light, check it per paragraph 4E.11.4 and refer to the power distribution and fusing diagram, Fig. 6-19.

(a) If the POWER lamp lights, but the VU meter lamps don't, set the RECORD SELECTOR switch to READY. If the READY lamp lights, one of the VU meter lamps is probably defective (these lamps are connected in series).

Replace any defective meter lamps per paragraph 4F.9.1.2.

(b) If the READY lamp doesn't light, check fuse 4F1 on the back panel of the record/reproduce unit. If the fuse is sound, check fuse F701 on the transport power supply box. If both fuses are sound, use a dc voltmeter to check any receptacle J701 through J704 (on the power supply box) across pins 9 (positive) and 5. The 39-volt-dc power should be present across those pins; if not, check for the voltage on the power supply board (see schematic diagram, Fig. 6-22). If the voltage is present, check the interconnecting cable, and internal wiring, then correct any defects.

(c) If the POWER and VU meter lamps light, and the READY lamp doesn't, with the SELECTOR switch at READY, replace the lamp per paragraph 4F.9.1.1.

(d) If the VU meter and the READY lamps light, and the RECORD lamp doesn't, when the record mode is initiated, set OUTPUT SELECTOR to BIAS (in the record mode). If the VU meter indicates normal bias, replace the lamp per paragraph 4F.9.9.1.

(e) If bias isn't indicated on the VU meter, check the relay per paragraph 4F.4.

4F.3.2 Reproducer (only)

(a) If it is suspected that operating power is not available, use a dc voltmeter to check across pins 9 (positive) and 5 on any receptacle J701 through J704 (on the transport power supply box). If the +39-volt dc power isn't present, check fuse F701 on the power supply box.

(b) If voltage is absent and the fuse is sound, check the power supply circuit board (see schematic diagram Fig. 6-23).

(c) If voltage is present, install the reproduce board on an extender card and check for the +39-volt power at any convenient point (see schematic diagram, Fig. 6-25). If voltage is absent, check the interconnecting power cable, and internal wiring; correct any defects.

4F.4 RECORD RELAY CHECK

The record relay, the only one used in a record/reproduce unit, is identical to the four relays on the tape transport.

(a) If the record relay is suspected to be inoperative, remove the dust cover from the relay. Hold the takeup tension arm away from the safety switch, set the record selector to READY, and initiate the play mode. Press and release the record pushbutton; if the relay actuates and holds in the energized position, check contact closure. If contacts are dirty, rub them clean with bond paper or a contact-burnishing tool.

(b) If the relay does not actuate and hold, remove it from its receptacle. Check the dc resistance of the coil across relay terminals 13 and 14; resistance should be approximately 650 ohms. If the coil is open or shorted, replace it. For emergency recording, substitute any other sound relay from the tape transport (refer to paragraph 4E.2).

(c) If the relay coil action is correct, remove the interconnecting power cable at J11 (on the record/reproduce unit). Initiate the play mode, and use a dc voltmeter to check across cable plug pins 10 (positive) and 8; the 24-volt dc holding power should be present. Connect the dc voltmeter across cable plug pins 4 (positive) and 8. Initiate the play mode, then press and hold the record pushbutton. The 24-volt power should be present across the pins. If power is absent at either checkpoint, check wiring continuity to the transport 24-volt dc power supply.

(d) If the holding and energizing voltages are both present, remove the relay from its receptacle (leave the J11 receptacle open). Use an ohmmeter to check the diode across pin 4 of J11 to relay receptacle pin 14. Check the other diode across relay receptacle pins 14 and 13. Check resistor 4R77 across relay receptacle pins 14 and 12. Check actuation of the RECORD SELECTOR switch, by connecting the ohmmeter from pin 8 of J11 to relay receptacle pin 13 and switching the record selector from SAFE (open) to READY (closed).

(e) If voltage was present and no faulty component is found, the relay is probably defective (despite its coil testing correctly); replace the relay.

4F.5 POWER SUPPLY CHECK

The power supply voltage-regulator adjustment is given in paragraph 4C.3.5.

(a) The power supply 39 (-1/2,+1) volts dc power should be present at three pins of any of the receptacles J701 through J704 (on the power supply box). Initiate the reproduce mode, then use a dc voltmeter to check between pins 9 (positive) and 5 of one open receptacle. Select high speed (in the reproduce mode) then use the dc voltmeter to check across pins 7 (positive) and 5 for the high-speed equalization switching voltage. Select low speed, then check across pins 6 (positive) and 5 for the low-speed equalization switching voltage. The regulated dc voltage should be present at all three check points. If power is present across pins 9 and 5, and not present at either one of the other points, check the SPEED switch, or continuity of the cabling and internal wiring; correct any defects.

(b) If no voltage is present, check fuse F701 on the power supply box. If the fuse is sound, open the power supply box and mount the power supply board on the extender board. If voltage is present, but is excessively high, proceed to (f).

WARNING

Dangerous voltage is present across the fuse post and across the transformer leads, so use special care when making the following checks.

(c) With all record/reproduce units connected, set all channels to the record mode. Use the dc voltmeter to check across CR706, CR705, and R707; with the voltmeter positive lead at the CR706 innermost end, and the negative lead to the R707 outermost end. The voltage present depends on applied load and the power and component tolerances; therefore, these values are only nominal: for a single channel, 72 volts; two channels, 66 volts; three channels, 60 volts; and four channels. 54 volts.

(d) If voltage is absent or is excessively low, turn power OFF and use an ohmmeter to check CR706, CR705, and R707 on the power supply board. If component values are correct, remove the transport power supply box per paragraph 4E.3. On the box mounting side, check capacitor C707, resistor R706, and the diodes CR701 through CR704 (which make up the full-wave bridge rectifier). If they are sound, remove the heat sink panel with power transistor Q705. Connect the box to the transport and apply power. See the above WARNING, then use an ac vtvm to check voltages at the primary (white/black) lead and secondary (red/red) leads of the power transformer (T702).

(e) If the voltage seems correct in (c), check transistors Q706 (shorted), Q704 (open), and Q703 (open). Then check all other components in their immediate circuits (all are on power supply board). Also check capacitor C706 (shorted) and power transistor Q705 (open) on the heat sink.

(f) If voltage is present in (a), but is excessively high, adjust the regulator per paragraph 4C.3.5. If the regulator won't adjust within tolerance, remove the power supply board from the box. Use the ac vtvm to check transistors Q706 (open), Q704 (shorted), and Q703 (shorted) and all components in their immediate circuits. Check power transistor Q705 (shorted), on the box mounting side.

4F.6 BIAS CHECK

If trouble is found in the recorder/reproducer bias or erase circuit, the malfunction could be in the master bias oscillator (on the power supply's circuit board) or the bias amplifier module. On multi-channel equipment with trouble indicated on all channels, the master bias oscillator is probably defective; if the trouble is on only one channel, that channel's bias amplifier is probably defective.

Isolate trouble to any one circuit by moving its bias amplifier out on the extender board, and measuring the bias input with an ac vtvm connected across resistors 3R90 and 3R91; bias voltage should be as shown on the schematic diagram,

Fig. 6-24. If this voltage is correct, the trouble is probably in the bias amplifier module; if it is incorrect, the master bias oscillator is probably defective.

WARNING

Dangerous voltages are present across the fuse post and at the transformer leads inside the power supply box, so use special care when checking the master bias oscillator.

Bias and dc voltages are shown at key points on the schematic diagram, Fig. 6-24. Initiate the record mode and check these voltages to quickly isolate trouble to a particular stage or component. The dc voltage is applied to the bias amplifier only in the record mode. Check the simple push-pull master bias oscillator with the power supply circuit board on an extender board.

4F.7 RECORD/REPRODUCE CHECK

4F.7.1 General

On a recorder/reproducer, if a tape doesn't play back correctly on the machine which recorded it, the record and/or reproduce circuit could be defective. Check the circuit functions by playing back a tape known to have been recorded correctly. If the tape reproduces normally, the record circuit is defective; if it doesn't, the reproduce circuit is defective.

When trouble is evidenced, check power per paragraph 4F.3 and check both equalization switching voltages per paragraph 4F.5. Refer to the schematic diagram, Fig. 6-24.

4F.7.2 Record Check

If trouble is indicated in the record circuit, check that the record head and signal input are correctly connected and that the dummy plug (or accessory) is in the input accessory socket (on the record/reproduce unit back panel). To check the bias voltage, initiate the record mode and set the output selector to BIAS; if the bias voltage is not normal, check it per paragraph 4F.6. Check the record relay per paragraph 4F.4.

4F.7.2.1 Servicing Hints

Servicing hints, which should prove helpful, follow:

(a) Signal voltages and dc voltages are shown in the schematic diagram, Fig. 6-24. Use extender cards and check the voltages to quickly isolate the fault to a specific stage or component.

(b) Initiate the mode and set the output selector to INPUT. Check that the VU meter indicates a normal signal input. If not, the trouble is probably in stage 2Q9 or the plug-in equalizer board. If the VU meter indication is normal, the trouble is in stages 2Q10 through 2Q15.

(c) Transistor 2Q10 conducts only when the low tape speed is selected; 2Q11 conducts only when the high tape speed is selected.

(d) If the output selector is at INPUT, and the VU meter indication seems normal for the record line input, the fault is in stages 1Q1 through 1Q4. If the indication is not normal, stages 1Q5 through 1Q8 are defective.

4F.7.3 Reproduce Check

If trouble is evidenced or suspected in the reproduce circuit, check that the reproduce head and the output line are correctly connected. Connect head set to the phones jack (on the unit front); if the signal there is normal, the output transformer or output line is defective.

4F.8 8 REPRODUCER CHECK

Check signal and dc voltages to those shown on the schematic diagram, Fig. 6-25, using the extender board for the reproduce circuit in record/reproduce units.

4F.9 PARTS REPLACEMENT

4F.9.1 Indicator Lamps

The Ready/Record lamps are mounted in a spring clip. To replace either lamp, remove the top cover from the record/reproduce unit, pull the wired sockets from the lamps with long nose pliers, then press the two clip extrusions together and remove the clip--being careful not to let the pliers slip. Remove the lamp (now free) through the front of the assembly. Install a lamp in reverse to removal procedures, then press the clip against the panel to secure the lamp.

To remove a VU meter lamp, remove the record/reproduce unit bottom cover. Pull the wired sockets from the lamp then pull the lamp out of the meter housing. Install lamps in the reverse order to removal procedures.

4F.9.2 Circuit Board Components

Required removal tools are: 1) 50-watt (maximum) pencil-type soldering iron, 2) noncorrosive soldering flux with rosin-alcohol base, and 3) piece of small-diameter shielding braid; use a plunger-type solder remover if available (instead of the soldering flux and shielding braid).

To remove a component, dip the shielding braid in the soldering flux. Heat the solder joint with the soldering pencil (never use a soldering gun or high-wattage iron), and dip the braid into the molten solder (the solder flows into the braid). Do not overheat soldering joints during this procedure, and especially avoid heating joints that are not to be unsoldered. When solder has been removed from all component leads, the part should then be removed without exerting excessive force.

To install the replacement part, bend the leads to fit in the mounting holes. Insert the leads through the holes, then bend them flat against the foil path. Use the soldering pencil, and low-melting-point rosin-core solder to solder the joints. Do not overheat the junction or nearby junctions. Remove excess rosin from the joint with a clean lint-free cloth moistened with alcohol.

After replacing a diode or transistor, allow the board to cool approximately five minutes before reinstalling it.

CAUTION

Residual soldering heat could cause thermal runaway if power is applied to a semiconductor device during the five-minute cooling period.

4F.9.3 Other Components

All other components are accessible when the top or bottom cover is removed. Component location on the schematic diagram, Fig. 6-24, is indicated by a number before the identification letter. A table on the diagram gives the prefixes used, and the component locations. The assembly drawings, Fig. 6-26 through 6-29 can help in finding parts.

4F.10 RESPONSE CURVE CHECK

Response curves for record and reproduce are shown in Figs. 6-32 and 6-33. To check these curves proceed as follows:

Disconnect the head cables, input cable, and output cable from the receptacles. Connect the signal generator and the vtvm as shown in Fig. 4F-1 for record; or Fig. 4F-2 for reproduce. Set the generator for 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 away from the safety switch, and initiate the record mode.

To check the reproduce amplifier curve, turn power ON, then operate the generator in small uniform steps over the specified frequency range for the set tape speed. Adjust the equalization controls to set the amplifiers to the curve.

Reinstall the bias amplifier and reconnect the cables.

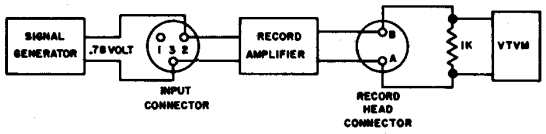


Fig. 4F-1. Record Response Check Setup

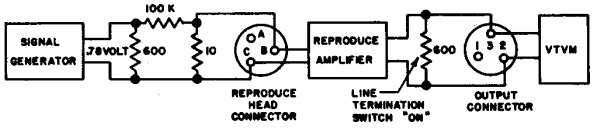


Fig. 4F-2. Reproduce Response Check Setup