SECTION 5

CORRECTIVE MAINTENANCE

5.1 TRANSPORT MECHANICAL ADJUSTMENTS

5.2 ACCESS

5.3 Tension adjustments require access to the back of the transport, so the equipment must be removed from its portable case or other mounting.

5.4 FAST-WINDING TORQUES

5.5 Holdback torques in the rewind and fast-forward modes are determined by the friction between the holdback brakes and plastic sleeves on the turntable shafts. If these tensions are incorrect, the spring-mounted holdback brake assembly must be replaced.

5.6 SUPPLY REEL TORQUES (See Figure 5-1)

5.7 The play holdback and rewind takeup tensions are adjusted simultaneously by repositioning the clutch spring collar. The adjustment range is limited by the fact that the supply clutch tire must be completely engaged by the rewind idler tire (during the rewind mode).

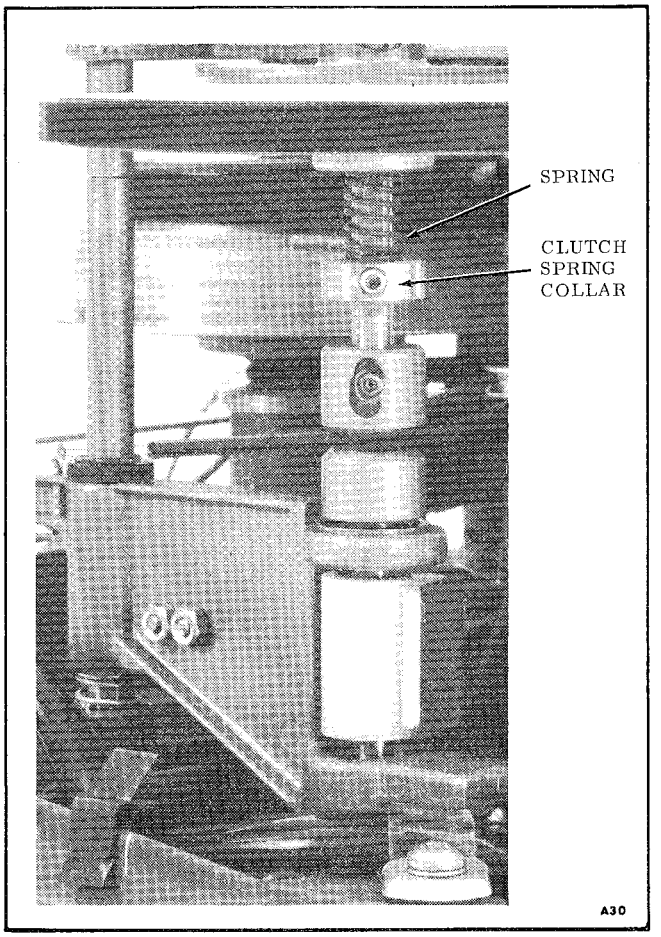

Figure 5-1. Supply Torque Adjustment

Step 1: Loosen the setscrew on the clutch spring collar.

Step 2: Push the collar up to increase torque, or down to decrease torque.

Step 3: Check that the setscrew is opposite the turntable shaft flat, then tighten it.

Step 4: Re-check play holdback and rewind takeup torques (paragraph 4.28).

Step 5: Repeat Steps 1 through 4 until torques are within tolerances. If correct torques cannot be obtained, the spring force is incorrect, or the clutch disc facing is worn or

contaminated with oil and dirt; replace defective spring or disc facing.

5.8 TAKEUP REEL TORQUES (See Figure 5-2)

5.9 Adjust play takeup tension by adjusting the play takeup collar clearance per paragraph 5.12. Adjust the fast-forward takeup clutch per paragraph 5.6.

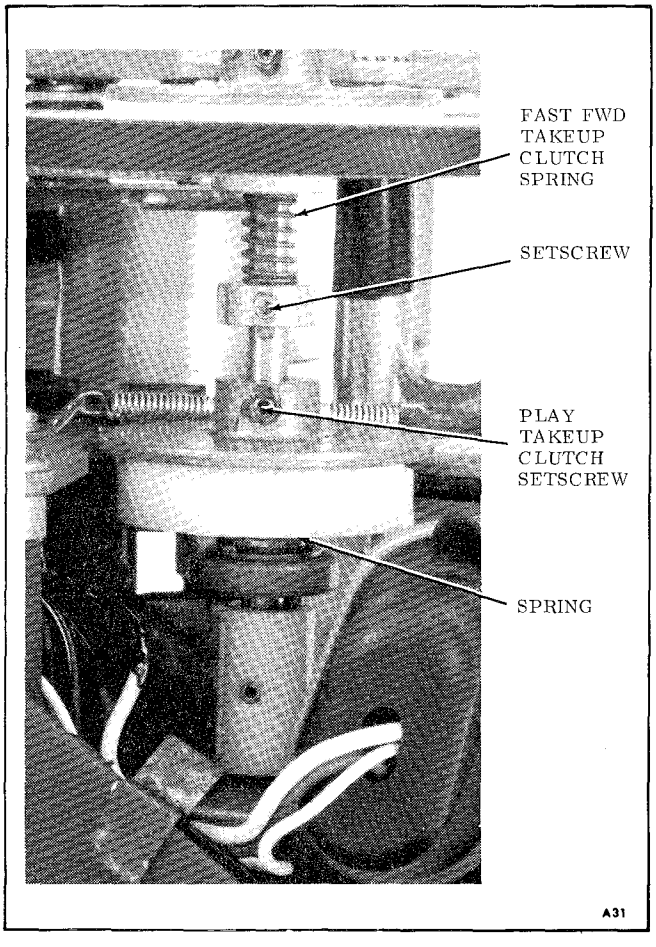

Figure 5-2. Takeup Torque Adjustment

5.10 CAPSTAN THRUST (See Figure 5-3)

5.11 The capstan thrust is applied by a hardened steel ball pressing against a nylon disc. The required end play, 0.003 to 0.005 inch, is set as follows:

Step 1: Cover the nylon thrust disc with heavy coat of wheel-bearing grease (sub-zero) and insert it in the the threaded subplate hole over the capstan shaft.

Step 2: Insert the setscrew until it bottoms against the thrust disc.

Step 3: Maintain a slight downward pressure on the setscrew, then screw it out 1/4 turn.

Step 4: Carefully tighten the setscrew locking nut, checking that the adjustment does not change.

5.12 PLAY TAKEUP CLUTCH (See Figure 5-2)

NOTE

Assembly drawings are provided in Section 7 of this manual.

5.13 The play takeup clutch assembly consists of a felt-faced aluminum disc and a spring-loaded clutch plate. A 0.015-inch clearance is required between the bearing end and the disc bottom. This clearance (not measurable with a gauge) can be accurately set as follows:

Step 1: Loosen the setscrew on the disc hub. Insert a 0.015-inch feeler gauge between the thrust washer (on the inner race of the lower ball bearing of the takeup turntable pivot) and the oilite bushing.

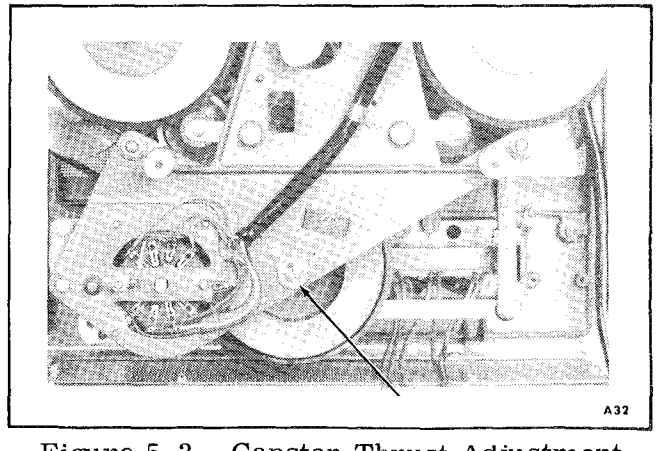

Figure 5-3. Capstan Thrust Adjustment

Step 2: Push the aluminum disc down until it firmly bottoms on the bushing end and hold it in that position while tightening the setscrew.

Step 3: Remove the feeler gauge (the conical spring will push the bushing from the disc, thus setting the clearance). If tension is not corrected, the clutch disc facing may be worn or contaminated, or the spring below the clutch may be applying incorrect force; replace defective felt or spring.

5.14 TURNTABLE HEIGHT (See Figure 5-4)

5.15 Adjust the distance from the turntable top surface to the metal grille to 0.125 (±0.008) inch with lamicoid washers of the correct number and thickness.

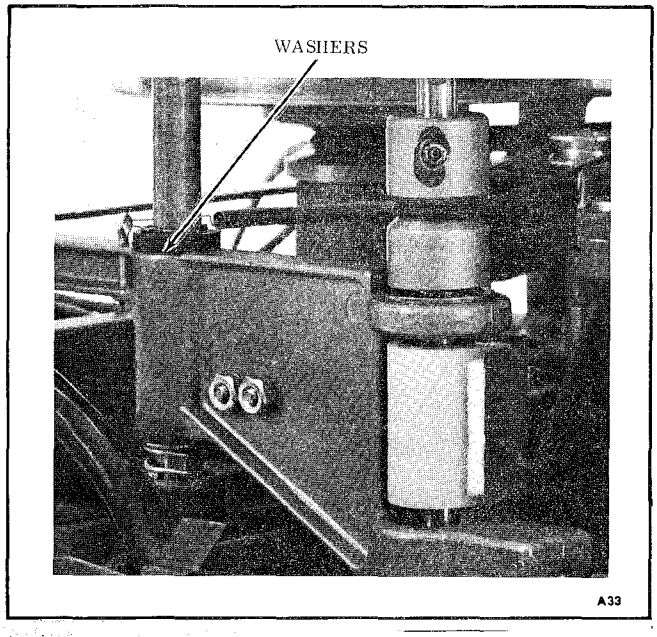

Figure 5-4. Turntable Height Adjustment

5.16 TRANSPORT DISASSEMBLY

5.17 GENERAL

5.18 During the disassembly procedures, always note the number, type, and location of washers, shims, etc. To replace lost or damaged small hardware, kit 4010897-02 (containing an assortment of mounting hardware) is available from Ampex.

5.19 REMOVING SUBPLATE (See Figure 5-5)

5.20 The subplate must be removed for disassembly of parts beneath the tape transport casting. Remove the three subplate mounting nuts, then remove the cotterpin and clevis pin that hold the slide lever to the lower yoke of the rewind/fast-forward actuator. This frees the subplate. Do not remove or loosen the capstan-thrust adjustment screw; if the screw setting is changed, adjust capstan thrust per paragraph 5.10.

NOTE

The nylon thrust discs beneath the subplate are coated with grease and will normally stick in position when the plate is lifted. However, if they fall be sure to retrieve them.

5.21 Re-install the subplate with the PLAY/REC control set at PLAY.

5.22 HEAD ADJUSTMENTS

5.23 HEAD AZIMUTH

5.24 Reproduce-head and record-head azimuth adjustments are given in electronic maintenance, paragraphs 5.50 and 5.54 respectively.

5.25 TAPE GUIDE (See Figure 5-6)

5.26 The tape guide between the record and reproduce heads can be adjusted both in height and position.

5.27 To check the guide height, remove the head cover and shield. Install tape on transport and initiate the play mode at 7-1/2 ips. The tape should track in the middle of the guide sleeve with no deviation from a

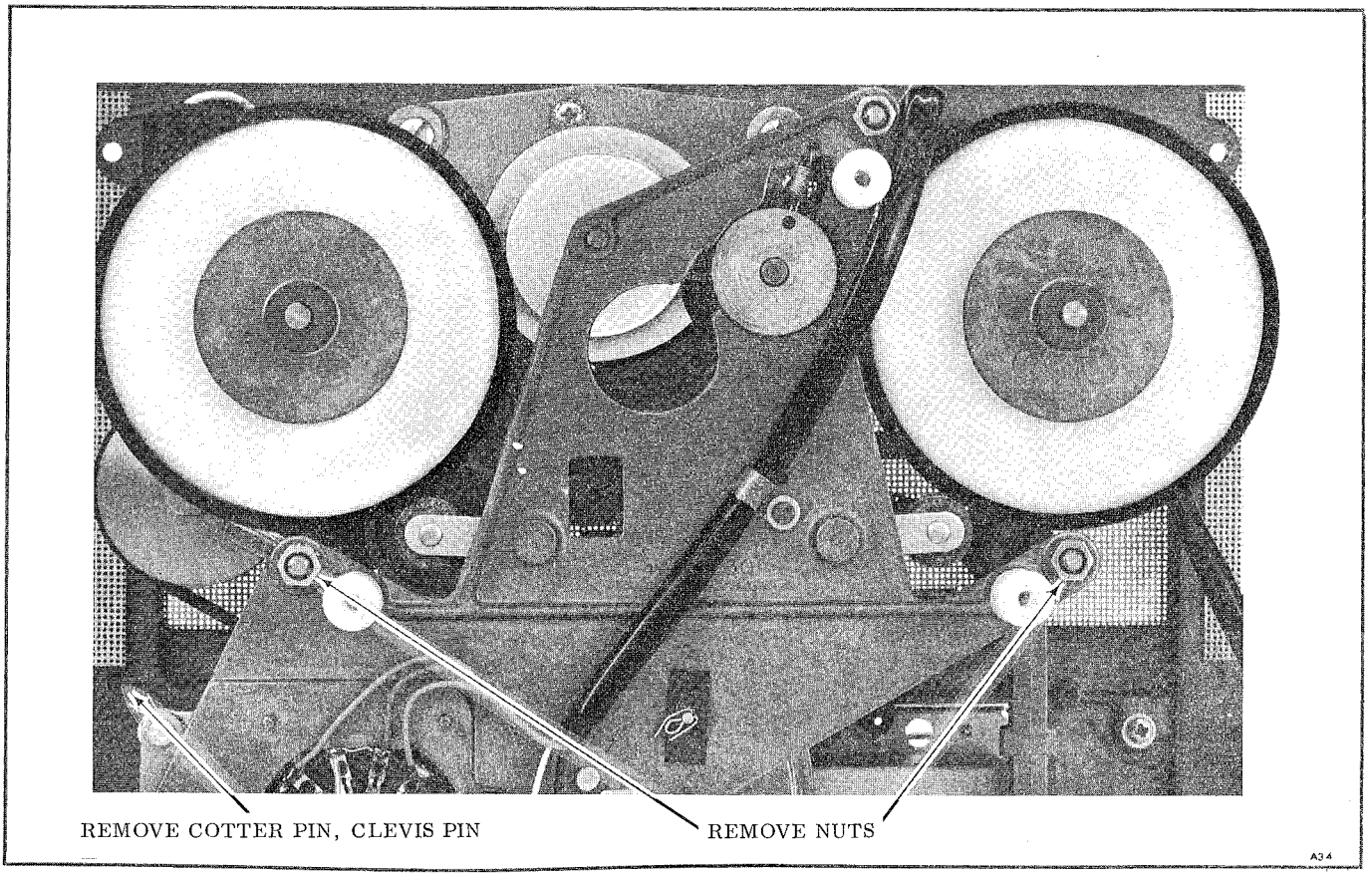

Figure 5-5. Transport Subplate Removal

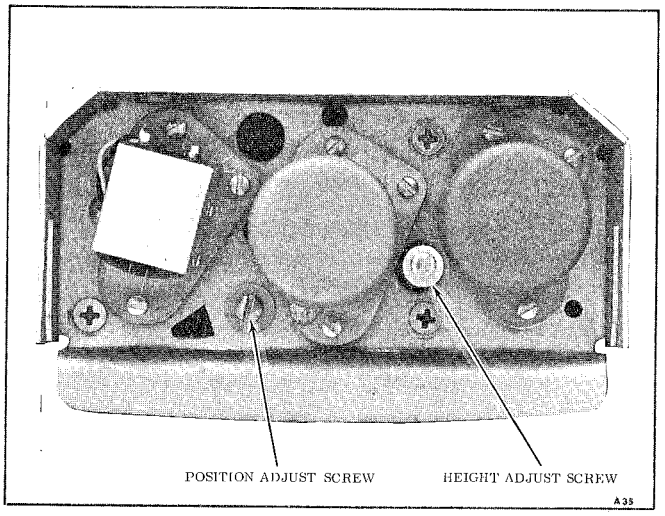

Figure 5-6. Tape Guide Adjustments

straight line as it enters and leaves the guide. Adjust the height as necessary by turning the screw at the guide top in (to lower) or out (to raise).

5.28 To check the tape guide position, use a ruler or straightedge which will not scratch the heads. Place this straightedge between the faces of the record and reproduce head stacks so it just touches the tape guide sleeve. If this is impossible, loosen the position screw and use a small screwdriver to move the lever adjustment and correctly position the guide.

5.29 HEAD HEIGHT (See Figure 5-7)

5.30 Introduction

5.31 Head heights are precisely factory-adjusted, so readjustment is usually required only when a head stack is changed. Before adjusting head heights, check that the tape guide height (refer to paragraph 5.25) is correct.

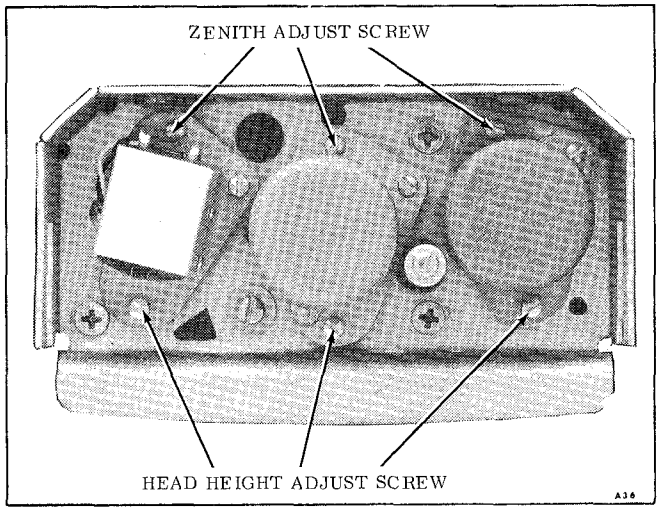

Figure 5-7. Head Adjustments

5.32 Full-Track and Half-Track Heads

Step 1: Remove the head cover and head shield (refer to Step 1, paragraph 5.52).

Step 2: Coarsely adjust the head height and azimuth, in the direction indicated by checks, by turning the three height-adjust screws an equal number of turns.

Step 3: Install tape on transport and initiate the play mode at 7-1/2 ips.

Step 4: Turn the height-adjust screw counterclockwise until the head laminations are even with the tape top edge.

Step 5: While carefully counting the number of turns, turn the height-adjust screw clockwise until the head laminations are even with the tape bottom edge.

Step 6: Turn the height-adjust screw counterclockwise half the number of turns counted in Step 5 (this centers the heads to the tape).

Step 7: Adjust head azimuth per paragraph 5.54 and head zenith per paragraph 5.34 (there may be some interaction between the height and zenith alignments).

5.33 Quarter-Track Heads

Step 1: Perform Steps 1, 2, and 3 of paragraph 5.32.

Step 2: Adjust the height-adjust screw until the mu-metal portion of the stack upper head is exactly even with the tape top edge.

Step 3: On a quarter-track erase head, turn the height-adjust screw 1/8 turn (45°) counterclockwise to move the erase head top slightly above the tape top edge (this is required because the erase head is slightly wider than the record and reproduce heads).

5.34 HEAD ZENITH AND TAPE WRAP (See Figure 5-7)

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

5.36 To check tape wrap and head zenith, lightly cover the head face with grease pencil or crayon. Install tape on transport, start it in high speed motion, 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).

5.37 If adjustment is necessary, turn the zenith-adjust screw in small increments. To move the top of the head out (toward the tape), turn the zenith-adjust screw out; turn it in to move the top of the head in (away from the tape). Recheck and re-adjust as necessary, using the grease-pencil method, until zenith is correct.

5.38 Check head height and azimuth alignment and adjust as necessary per paragraphs 5.29 and 5.54 or 5.56.

5.39 HEAD ASSEMBLY REMOVAL (See Figure 5-8)

Step 1: Disconnect all head cables from the electronic assemblies.

Step 2: Remove the head cover and head shield.

Step 3: Remove the three mounting screws to release the head assembly from the transport casting.

Step 4: Lift the head assembly from the casting, guiding the cables through the casting hole.

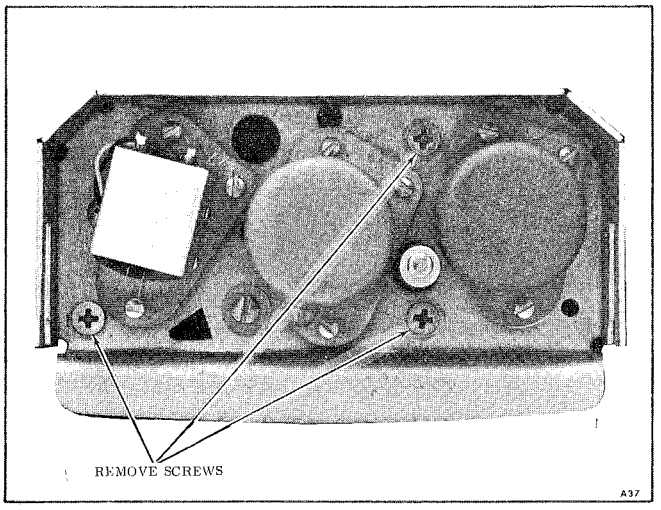

Figure 5-8. Head Assembly Removal

5.40 HEAD STACK ALTERATION (See Figures 7-11 through 7-14)

Step 1: Remove the head assembly from transport per paragraph 5.39.

Step 2: Remove the cover on the cable assembly bracket (item 10, Figures 7-11 through 7-14).

Step 3: On the head stack to be altered, unsolder the leads from the terminals in the cable assembly bracket.

Step 4: Being careful not to lose released springs, remove the three screws from the head stack and lift the head stack from the base, guiding the leads through the base hole.

Step 5: Insert the leads on the new head assembly through the base hole, mount the new assembly on the base (with the three screws previously removed), and insert the mounting springs between the head stack and base.

Step 6: Twist the new head leads together, cut them to length, then strip the ends 1/8-inch. Lay the leads in the terminals, check connections against Figures 7-11 through 7-14, then solder leads to terminals.

Step 7: Re-install the cover on the cable assembly bracket, remount the head assembly on the transport, and re-connect all head cables to the electronic assemblies.

Step 8: Check and adjust head height per paragraph 5.29, head zenith per paragraph 5.34, and head azimuth per paragraph 5.54 or 5.56.

5.41 ELECTRONIC ALIGNMENT

5.42 ALIGNMENT EQUIPMENT

5.43 Obtain the following alignment equipment, or equal:

1. D-C Voltmeter, 20,000 ohms-per-volt
2. A-C Vacuum Tube Voltmeter, Hewlett-Packard Model 400 D
3. Signal Generator, Hewlett-Packard Model 200 C
4. Wave Analyzer (if available)
5. Electronic Counter (if available)
6. Bias Filter (see Figure 4-6)
7. Bandpass Filter (see Figure 4-7)
8. Normal tools used by technician
9. Ampex Standard Alignment Tapes, as applicable (refer to paragraph 4.35):

7-1/2 NAB:	No. 01-31321-01
7-1/2 CCIR:	No. 01-31323-01
3-3/4 ips (120 Usec):	No. 01-31331-01
3-3/4 ips (200 Usec):	No. 01-31334-01

5.44 ALIGNMENT CONDITIONS

5.45 Check that the following conditions are met:

1. Line output terminated in 600 ohms
2. Dummy plug in input socket (not an accessory item)
3. Heads cleaned and demagnetized (paragraph 4.1 and 4.6)
4. Covers installed on electronics, unless otherwise indicated
5. Ampex No. 631, or equivalent, tape installed

5.46 INTRODUCTION

5.47 These procedures will usually correct any deficient operation revealed during operation or in checkout procedures. Corrective action given in paragraphs 5.56 and 5.58 is rarely required.

5.48 If the recorder will usually be operated at one tape speed, that speed should be used for the alignment run (bias level set and record level calibrated). Reproduce equalization only should then be adjusted for the other speed.

5.49 When both speeds are to be used about equally, alignment should be started at the 7-1/2 ips speed, to provide optimum setting for bias and record levels.

5.50 REPRODUCE HEAD AZIMUTH

5.51 The VU meter on the electronic assembly is very useful for aligning two-channel equipment, because the output of each head can be measured simultaneously to easily determine the optimum setting.

5.52 Standard alignment tapes for 3-3/4 and 7-1/2 ips tape speeds have all tones (except the last) recorded at 10 dB below operating level, so, in Step 7, it may be necessary to turn the reproduce level control fully clockwise (not to exceed 0 on the VU meter). This screwdriver-adjusted control is beneath a small cover (on the front panel) which must be removed.

CAUTION

DO NOT ADJUST ANY HEAD ASSEMBLY SCREW OTHER THAN THE ONE FOR AZIMUTH ADJUSTMENT.

Step 1: Remove the head cover mounting screw, and lift the head cover off. Remove the two screws at the back (reel side) of the head assembly, and lift the head shield off.

Step 2: Turn power ON. At the tape transport, set SPEED/EQUALIZATION switch for desired tape speed.

Step 3: Set the RECORD SELECTOR to SAFE.

CAUTION

BE SURE EACH RECORD SELECTOR SWITCH IS AT SAFE, TO PREVENT ACCIDENTALLY ENTERING THE RECORD MODE AND ERASING THE STANDARD TAPE.

Step 4: Set OUTPUT SELECTOR to REPRODUCE.

Step 5: Thread the standard alignment tape (corresponding to the tape speed) on the tape transport.

NOTE

Announcements recorded on the standard tape can be monitored through headsets connected to the PHONES jack, or through an external amplifier/loudspeaker connected to the output.

Step 6: Initiate the reproduce mode. As the first tone reproduces, adjust REPRODUCE LEVEL control(s) for any convenient reference indication on the VU meter(s).

Step 7: The second tone on the tape is the reproduce head azimuth tone. As this tone reproduces, turn the azimuth-adjust screw on the reproduce head (see Figure 5-9) for maximum VU meter indications. On two-channel equipment, adjust screw to the optimum setting for both heads in the stack.

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 signal markedly higher than the minor peaks.

Step 8: Re-install the head shield and head cover.

NOTE

If reproduce/record alignment is to be made, leave test equipment connected, the front panel cover removed, and the alignment tape installed.

5.53 REPRODUCE/RECORD ALIGNMENT

Step 1: Connect the vtvm to the OUTPUT connector. Then repeat steps 2, 3, 4, and 5 of paragraph 5.50.

Step 2: Initiate the reproduce mode. As the first tone reproduces, adjust the REPRODUCE LEVEL control for any convenient reference indication on the vtvm.

Step 3: After the first tape tone, there is a series of tones used to check reproduce high-frequency equalization. As these tones reproduce, adjust the appropriate HI-FREQ EQUAL control (at the back of the electronic assembly) for the flattest possible response within specifications, but do not move response more than ±2 dB from the theoretical curves in Figure 7-21.

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 4: As the final tape tone reproduces, adjust the REPRODUCE LEVEL control for a +4 dBm indication on the vtvm (the equipment VU meter should indicate 0, ±3/4, dB).

NOTE

This REPRODUCE LEVEL control setting must not be changed until the record level is calibrated in Step 13.

Step 5: After the alignment tape is completely wound on the takeup reel, interchange the reels. Initiate the play mode to wind the alignment tape back to its original reel.

Step 6: With the vtvm still connected to the OUTPUT connector, connect the signal generator to either INPUT connector (A or B).

Step 7: Set the signal generator to provide a nominal 1-volt rms output at the following frequency: for 7-1/2 ips, 500 Hz; for 3-3/4 ips, 250 Hz.

Step 8: Thread blank tape on the transport.

Step 9: At the electronic assembly, set OUTPUT SELECTOR to REPRODUCE and RECORD SELECTOR to RECORD. On two-channel equipment, leave the RECORD SELECTOR on the second electronic assembly in the SAFE position, so that it will not record.

Step 10: Remove the small cover, secured by two screws, from the electronic assembly front panel.

Step 11: Initiate the record mode and adjust the applicable RECORD LEVEL control for any convenient vtvm reference indication.

Step 12: Set BIAS ADJUST for a peak vtvm indication.

Step 13: Set the signal generator to 500 Hz, at a nominal 1-volt level. Adjust RECORD LEVEL for a +4 dBm indication on the vtvm.

Step 14: Set OUTPUT SELECTOR to INPUT. Adjust RECORD CAL for a 0 indication on the VU meter.

Step 15: Repeat Steps 1, 2, 3, and 5, at the second tape speed, using the corresponding standard alignment tape and HI FREQ EQUAL control.

Step 16: On two-channel equipment, repeat the entire procedure for the second channel.

5.54 RECORD-HEAD AZIMUTH (See Figure 5-9)

5.55 Equipment VU meters can be used in making this adjustment.

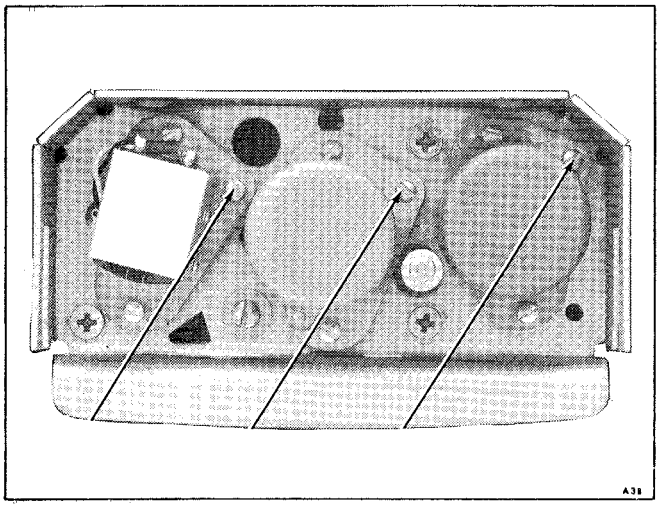

Figure 5-9. Head Azimuth Adjustments

CAUTION

DO NOT ADJUST ANY HEAD ASSEMBLY SCREW OTHER THAN THE ONE FOR AZIMUTH ADJUSTMENT, OR IT MAY BE NECESSARY TO ADJUST HEAD HEIGHT.

Step 1: On one-channel equipment, connect the signal generator to either INPUT connector (A or B). On two-channel equipment, connect the signal generator to the input of both channels.

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

Step 3: At the electronic assembly, set RECORD SELECTOR to RECORD and OUTPUT SELECTOR to INPUT.

Step 4: Adjust RECORD LEVEL control(s) for a -10 indication on the VU meter(s). Set OUTPUT SELECTOR to REPRODUCE.

Step 5: Thread blank tape on the transport.

Step 6: Initiate the record mode (both channels on two-channel equipment).

Step 7: During this simultaneous recording and reproducing, adjust the record head azimuth screw for a maximum indication on the vtvm. On two-channel equipment, adjust screw for the optimum setting of both heads in the record stack.

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 signal markedly higher than the minor peaks.

5.56 RECORD EQUALIZATION

5.57 This adjustment will be simplified by using a bias filter as shown in Figure 4-5. Otherwise, a trial-and-error method must be used, in which the tape is recorded at different settings of the REC EQUALIZATION control, and then is reproduced to determine the correct setting (this requires several record and reproduce runs before the correct adjustment can be determined). With the bias filter, proceed as follows:

Step 1: Connect the bias filter to the OUTPUT connector and the vtvm to the filter output.

Step 2: Connect the signal generator to either INPUT connector (A or B) and set it to 500 Hz, at a nominal 1-volt level.

Step 3: Turn power ON. Set SPEED/EQUALIZATION switch for tape speed desired.

Step 4: Remove the small cover (secured by two screws) from the electronic assembly front panel.

Step 5: Set the signal generators to provide a 1-volt rms output at the following frequency: for 7-1/2 ips, 15,000 Hz; for 3-3/4 ips, 8,000 Hz.

Step 6: Thread blank tape on the transport. Set the OUTPUT SELECTOR to INPUT and adjust RECORD LEVEL control for a -10 dBm indication on the vtvm.

Step 7: Initiate the record mode, then set OUTPUT SELECTOR to REPRODUCE.

Step 8: During this simultaneous recording and reproducing, change the signal generator frequency over the response spectrum top end for this tape speed (refer to Specifications in Section 1). Adjust the REC EQUALIZATION control that corresponds to the speed setting, to obtain the flattest possible high-frequency response at 500 Hz, within specifications.

Step 9: Repeat Steps 3, 4, 5, and 6 at the second speed.

Step 10: On two-channel equipment, repeat the procedure for the second channel.

5.58 BIAS OSCILLATOR FREQUENCY

5.59 This seldom-required adjustment is made at the factory, using an electronic counter. If such a counter is available, connect it across R41 on the record printed-wiring board (with the record head connected). Initiate the record mode (on one channel at a time, on two-channel equipment). Adjust the tuning slug in transformer T1, on the same board, for a bias frequency as close as possible to 100,000 Hz. On two-channel equipment, the frequencies of the bias oscillators in the two electronic assemblies must be identical within ±1,000 Hz.

5.60 On two-channel equipment, if an electronic counter is not available, adjust the bias oscillator frequency when a beat frequency becomes noticeable; minimize it as follows: slowly and carefully adjust the tuning slugs, alternating between the two oscillators.

5.61 BIAS SYMMETRY

5.62 This seldom-required adjustment is made at the factory, using a signal generator with a second harmonic distortion less than 0.2%, and a wave analyzer. The BIAS SYM control, on the back panel of the electronics assembly, is adjusted for minimum second harmonic distortion of a 500 Hz signal, placing only one channel at a time in the record mode.

5.63 If a wave analyzer is not available, do not change the control setting unless some component in the bias-and-erase oscillator requires replacement. After such corrective maintenance, monitor the output through a high-gain amplifier and loudspeaker (or headset) while simultaneously recording and reproducing, with no input signal. Adjust the BIAS SYM control for minimum popping and hissing noise. If the BIAS SYM control has no audible effect, leave it in the mid-position.

5.64 ELECTRONIC DEFECTS AND CORRECTIONS

5.65 POOR FREQUENCY RESPONSE

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

a. Heads, clean/demagnetize per paragraph 4.1 and 4.6.

b. Head azimuths, adjust per paragraphs 5.54 and 5.58.

c. Bias level, adjust per paragraph 5.56.

d. Reproduce equalization, adjust per paragraph 5.56.

e. Record calibration, adjust per paragraph 5.56.

f. Record equalization, adjust per paragraph 5.61.

g. Play holdback tape tension, adjust per paragraph 5.6.

h. Signal generator, adjust for a flat output.

i. Head heights unequal, adjust per paragraph 5.29.

j. Tape low in grade, replace with recommended tape (or equivalent).

5.67 SIGNAL DISTORTION

5.68 Excessive second harmonic distortion is usually caused by magnetized heads, or a malfunctioning bias oscillator, bias amplifier, record amplifier, or reproduce amplifier.

5.69 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 500-Hz third-harmonic distortion of 0.6% to 1.1% at operating level.

5.70 EXCESSIVE NOISE

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

a. Heads need cleaning or demagnetizing; correct per paragraphs 4.1 and 4.6.

b. Magnetic tape not as specified; replace with recommended tape, or equivalent.

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

d. Erase current not at peak; increase as necessary.

e. Head cables being rubbed by transport moving parts; eliminate rubbing.

f. Head azimuth incorrectly adjusted; correct per paragraph 5.54.

g. Head height incorrectly adjusted; correct per paragraph 5.29.

h. Tape wrap or head zenith incorrectly adjusted; correct per paragraph 5.34.

i. Record or reproduce level incorrectly adjusted; correct per paragraph 5.56.

5.72 EXCESSIVE FLUTTER/WOW

5.73 Excessive flutter can be caused by any component that affects the tape motion, but is usually caused by the following (replace all defective parts):

a. Oxide or dirt: on components in the tape-handling path (see paragraph 4.1).

b. Drive motor: not in synchronism (too-low voltage); excessive tape tension (see paragraph 4.23): defective motor capacitor; bearings defective; motor shaft bent; dragging belt-tension idler; drive motor otherwise defective; or dirty/worn belt.

c. Supply turntable: excessive or erratic holdback tension (see paragraph 4.23).

d. Capstan idler: defective rubber tire; bearing defective or needs lubrication (see paragraph 4.13); pressure incorrectly adjusted (see paragraph 4.29).

e. Reel idler: bent shaft; flywheel not balanced.

f. Head assembly: poor tape guiding (see paragraph 5.25 and 5.34).

g. Tape scrape: warped/damaged reels or incorrect turntable heignt (see paragraph 5.14).