Proceed as follows:

1. Remove head assembly from the transport (refer to *Changing Head Assembly* text, paragraph 5-82).

2. Remove head shield (four Allen-head screws shown in Figure 1-3).

3. Loosen scrape flutter idler retaining screw shown in Figure 5-1 and remove idler from head assembly base.

NOTE

Step 4 should be performed by a jeweler or watchmaker.

4. Loosen the two Allen-head bearing clamp screws (Figure 5-2) in the yoke assembly. Slide the two jewel bearing holder assemblies out of the yoke and remove the idler.

   a. Ultrasonically clean the two jewel bearing holder assemblies and the idler.

   b. Lubricate each jewel bearing holder assembly with one drop of jewel oil (or Ampex precision instrument oil, part number 087-738). Use a no. 21 gauge hypodermic needle to apply oil to bearing.

   c. Reassemble idler and jewel bearing holder assemblies into the yoke and lightly tighten the two bearing clamp screws.

5. With the upper and lower bearing clamp screws loose, set idler height (Figure 5-2) to 0.035 ±0.005 inch above the yoke base. Lightly tighten lower bearing clamp screw.

6. With upper bearing clamp screw still loose, remount idler on to the head base plate with front and side of yoke even with the two scribed lines on the base plate (Figure 5-1).

7. While pressing upper jewel bearing holder assembly toward idler with very light finger pressure, lightly tighten upper bearing clamp

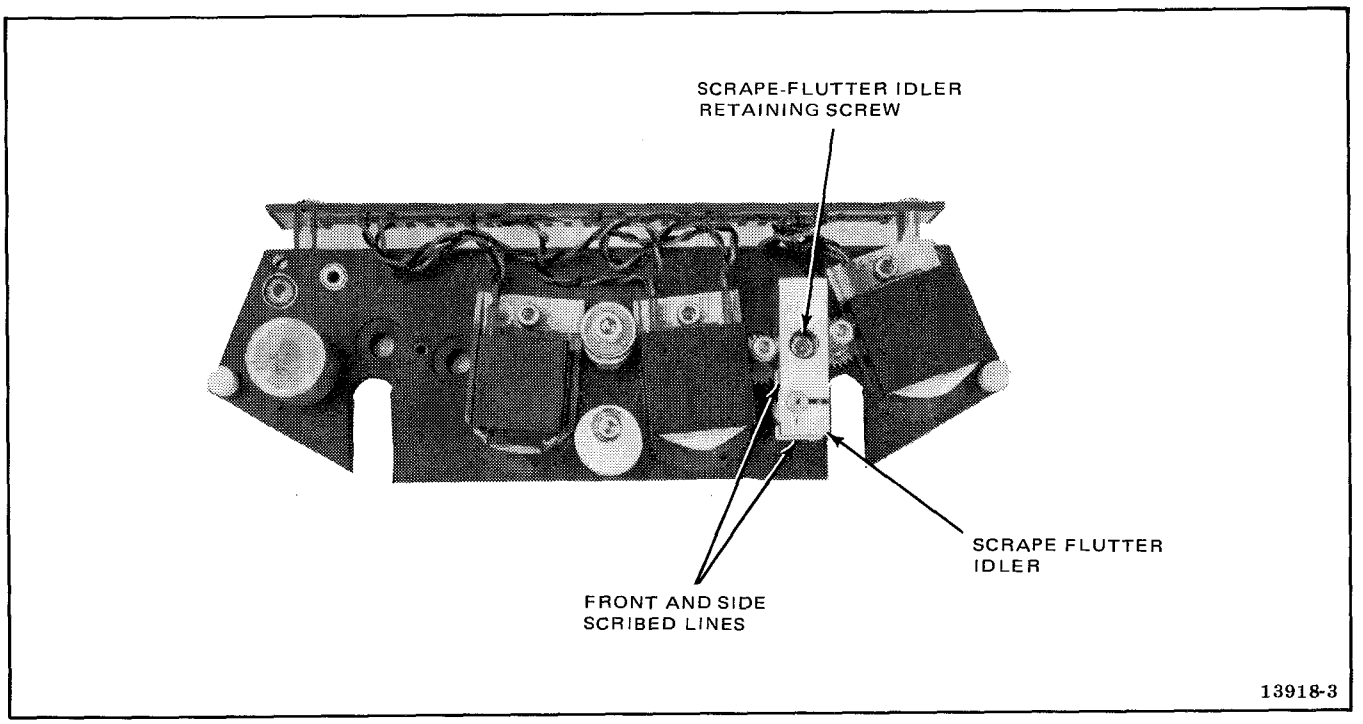


Figure 5-1. Top View of Head Assembly, Head Shield Removed

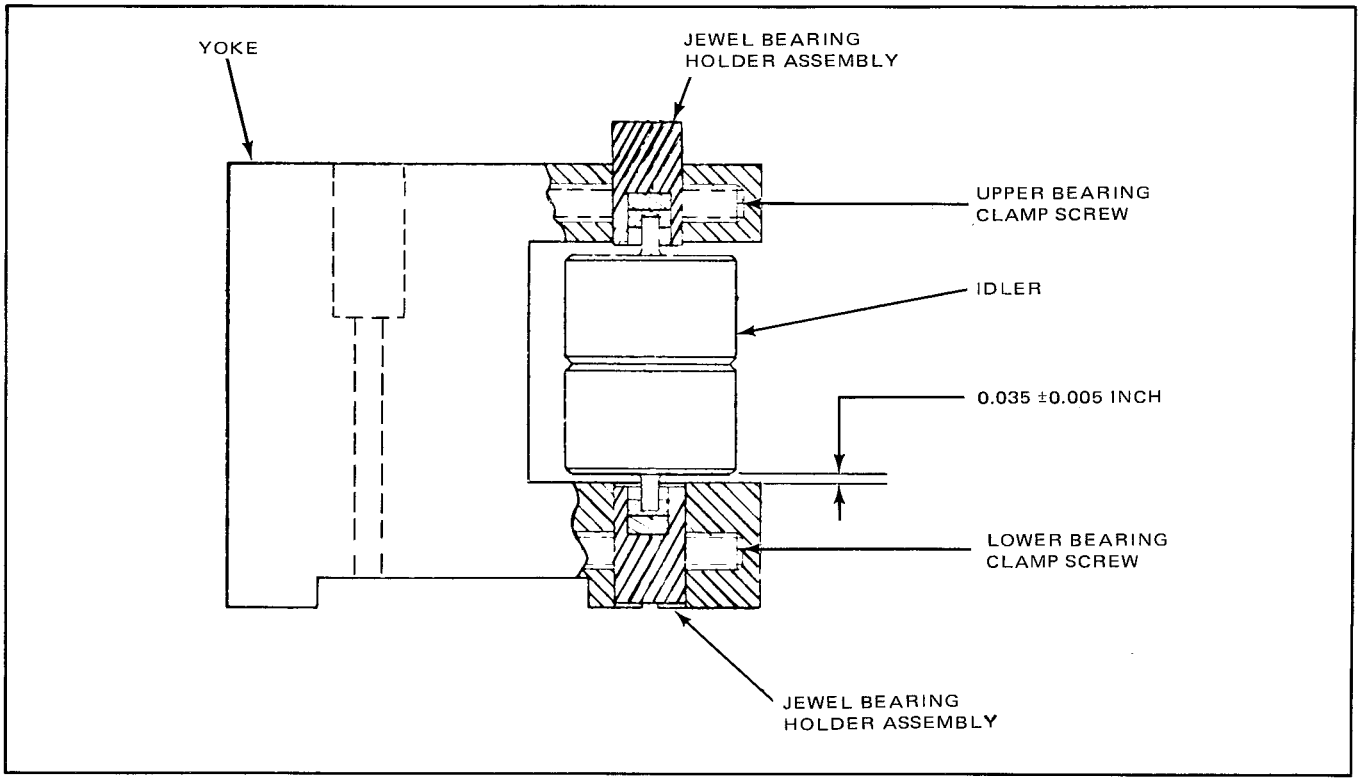


Figure 5-2. Scrape Flutter Idler, Side Cross-Section View

screw. Spin idler with finger. Idler should spin freely with no evidence of binding.

8. Reinstall head shield (four Allen-head screws) and install head assembly on to transport.

5-9. Lubrication

Table 5-2 provides a list of lubricants used on the recorder/reproducer, where the lubricants are used, and application instructions. Note that the capstan motor and tape timer bearings do not require relubrication. If these bearings are replaced with non-prelubricated bearings, use the grease suggested in the table. Except for the scrape flutter idler, that should be cleaned and lubricated after each 2,000 hours of operation, the other items shown in the table should be lubricated as required for proper operation.

5-10. Head Gate Support Bushing. There is only one support for the head gate assembly. The support consists of a shaft (Figure 5-30) that slides inside a bushing that is threaded into the tape transport casting. This bushing has been permanently lubricated; however, if additional lubrication is required, proceed as follows:

1. With the head gate in the latched (down) position, lightly apply MoS_2 high pressure grease (Table 5-2) to the entire surface of the shaft (Figure 5-30).

2. Operate the head gate up and down to distribute the grease inside the bushing bore. Remove any excess grease from shaft or bushing.

5-11. Tape Lifter Arm Bushings. The two tape lifter arm bushings have been permanently lubricated; however, if additional lubrication is required, proceed as follows.

1. Remove the head assembly (paragraph 5-82).

2. Loosen the 6-32 cap screw in the tape-lifter roller (Figure 5-27) nearest the tape lifter

Table 5-2. Lubricants Used on Recorder/Reproducer

WHERE USED	LUBRICANT DESCRIPTION	APPLICATION INSTRUCTIONS
Tape lifter and head gate support bushings	Grease, MoS_2, high pressure, mfd. by Dow Corning Corp., Midland, Michigan	Rub grease into entire surface of bushing bore.
Tape lifter solenoid	Grease, O-ring, mfd. by Parker Seal Co., Culver City, California	Use a small amount around solenoid O-ring.
Scrape flutter idler	Oil, synthetic, jewel bearing, PML-79 oil. Mfd. by William F. Nye Inc., New Bedford, Massachusetts	Ultrasonic clean parts. Use one drop from a #21 Stubbs gauge on each bearing.
Capstan bearings and shaft and tape timer bearing	Grease, general purpose channeling, ANDOK-C. Source: Barden Corp., Danbury, Connecticut	Fill each bearing 30 to 40% if bearings are not prelubricated upon replacement.

solenoid and remove the tape lifter shaft from the roller and the bushing.

3. Loosen the 6-32 cap screw in the tape-lifter roller (Figure 5-27) furthest away from the tape-lifter solenoid and remove the tape lifter shaft from the roller and the bushing.
4. Rub MoS_2 high pressure grease (Table 5-2) into the entire surface of the bushing bore. Remove any excess from bushing.
5. Reinstall the two tape lifter shafts in the reverse order of removal, but do not firmly tighten screws.
6. Reinstall head assembly (paragraph 5-82).
7. Perform steps 4 through 15 of the *Tape Lifter Arms* adjustment procedure, paragraph 5-64.

5-12. CONVERSION

Procedures for changing channel configuration, tape width, and operating-speed pair are presented in the text that follows. (For Ampex part numbers of components required for conversion, refer to Tables 1-2 and 1-3.)

5-13. Changing Channel Configuration

The ATR-100 Series Recorder/Reproducer is prewired to operate with up to four audio channels. The four-channel control unit is used to operate a one-, two-, or four-channel system. To change channel configuration, proceed as follows:

1. For each audio channel, install a main audio PWA and associated PADNET PWA into the electronics assembly as follows:
   a. For a full-track, 1/4-inch tape system, install a main audio PWA and PADNET PWA into position 1 in the electronics assembly.
   b. For a two-channel, 1/4-inch tape system, install a main audio PWA and PADNET PWA into positions 1 and 2 in the electronics assembly.
   c. For a four-channel, 1/2-inch tape system, install a main audio PWA and PADNET PWA into positions 1, 2, 3, and 4 in the electronics assembly.
2. Install the appropriate head assembly (refer to *Changing Head Assembly* text, paragraph 5-82).
3. If conversion involves changing tape width, refer to *Changing Tape Width* procedure, paragraph 5-14.
4. Perform the appropriate signal system alignment procedures given under *Alignment and Adjustments*, paragraph 5-29.

5-14. Changing Tape Width

Converting the tape transport to accommodate 1/4-inch tape or 1/2-inch tape is accomplished by changing the tape guides on the supply and takeup constant-tension arms and changing the head assembly. After conversion, no electrical tension adjustments are required as a jumper on the head connector causes the tape tensions to be automatically changed. Proceed as follows:

1. Remove tape guide by unscrewing the captive knurled-head screw (Figure 5-3) that secures tape guide to the constant tension arm.
2. Clean top surface of tension arm and bottom surface of tape guide with 92% isopropyl alcohol.
3. Install tape guide on tension arm. Secure (finger tight) to arm with captive knurled-head screw supplied with tape guide. (Do not use a screwdriver to tighten screw.)
4. Install the appropriate head assembly (refer to *Changing Head Assembly* text, paragraph 5-82).

5-15. Changing Operating-Speed Pair and Master Bias Operation

The recorder/reproducer can operate at any tape-speed pair selected from the following speeds: 3.75, 7.5, 15, and 30 in/s. (Machines originally shipped from the factory are set to operate at 7.5 and 15 in/s with four-speed master bias operation.) Note that if a speed is selected on the transport control panel (Table 3-1) for which the signal system or master bias has not been set up for, the LOCKOUT indicator will light, and play and record modes for that speed will be inhibited. In addition, the audio output(s) of the basic recorder/reproducer will be muted. If an input/output assembly is being used, the assembly will switch to input signal monitoring.

To change operating-speed pair and master bias operation, jumper plugs are repositioned on audio control PWA No. 5 and on the PADNET PWA(s). The jumper plugs on the audio control PWA No. 5 permit the user to program the recorder/reproducer for two-speed (dual master bias) operation or four-speed master bias operation. When the

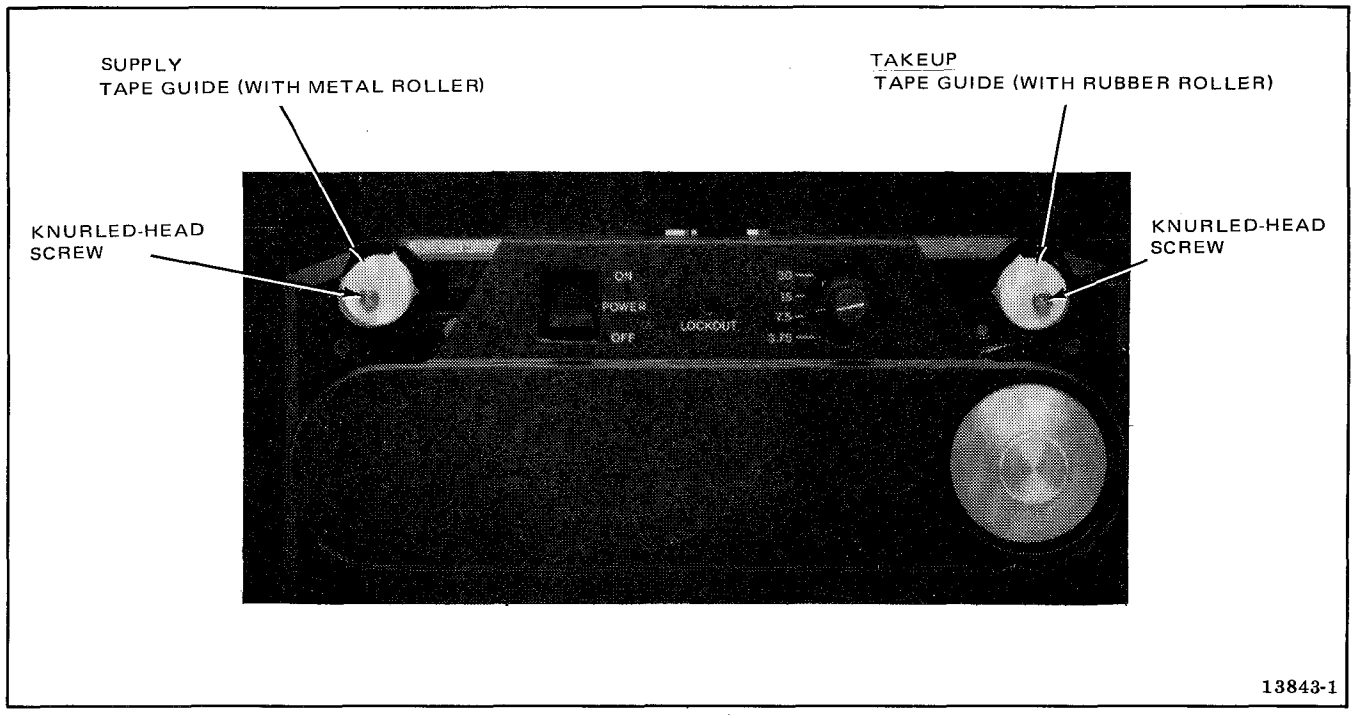


Figure 5-3. Tape Guide Securing Screws

recorder/reproducer is programmed for two-speed master bias operation, a bias switch on the front panel of audio control PWA No. 5 (Figure 5-4) enables the operator to select one of two different master bias levels for each of the two operating speeds.

When the recorder/reproducer is programmed for four-speed operation, the bias switch is permanently placed in the left-hand position and a single master bias level is provided for each speed. This master bias level is automatically switched when a speed is selected on the transport control panel.

NOTE

If the audio control PWA No. 5 jumpers are set for four-speed master bias operation, it is only necessary to reset jumpers on each PADNET when changing operating-speed pair. If the audio control PWA No. 5 jumpers are set for two-speed (dual master bias) master bias operation, then the two speeds selected on the audio control PWA No. 5 must match those selected on the PADNET PWA(s) or the lockout circuitry will operate.

To change the operating speed pair, proceed as follows:

1. With power off, and for each channel, remove the PADNET PWA from the electronics assembly.
2. Position HI speed jumper J1 to the desired high speed: 30, 15, or 7.5 in/s position (Figure 5-5).

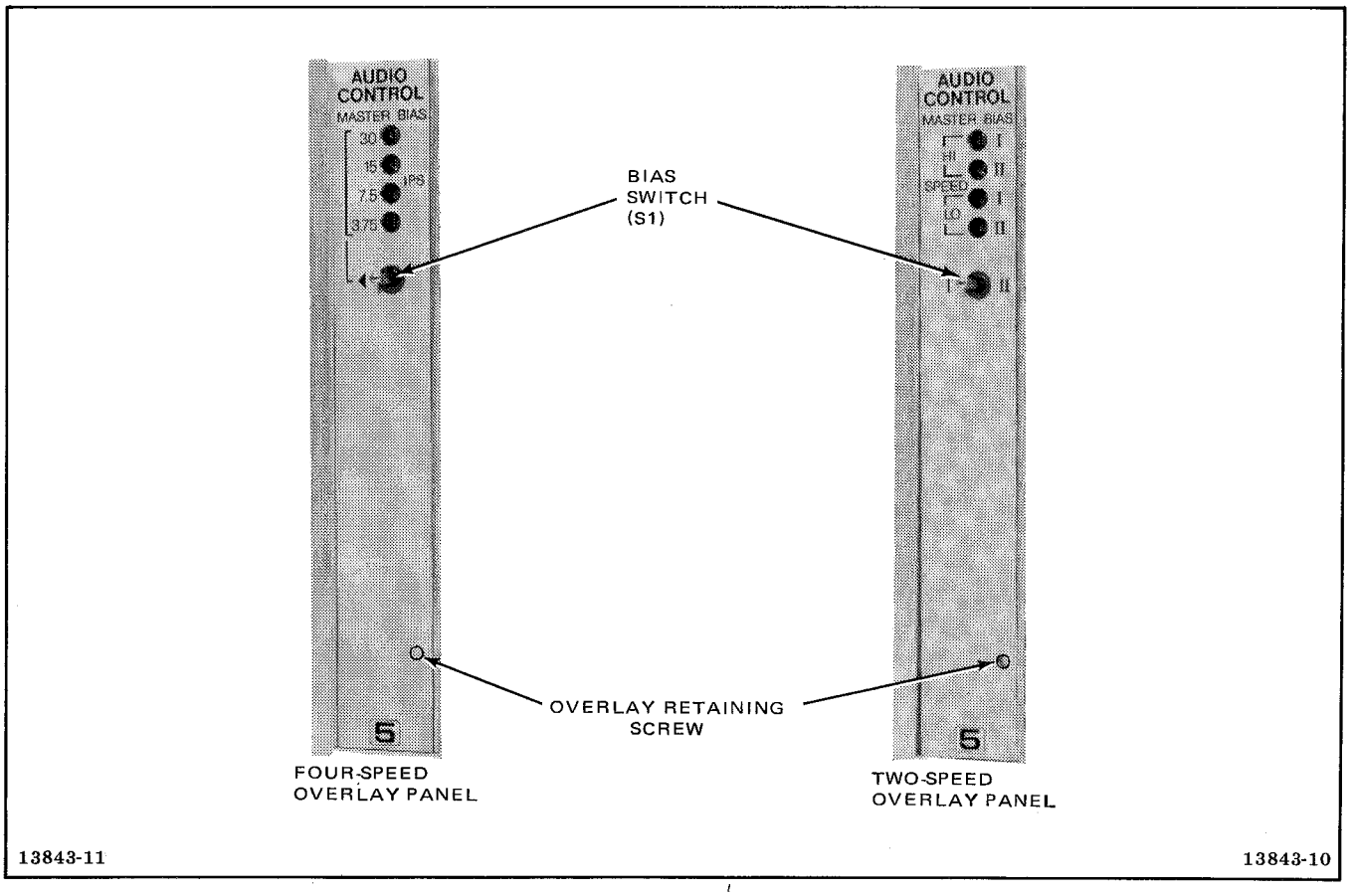


Figure 5-4. Overlay Panels, Audio Control PWA No. 5

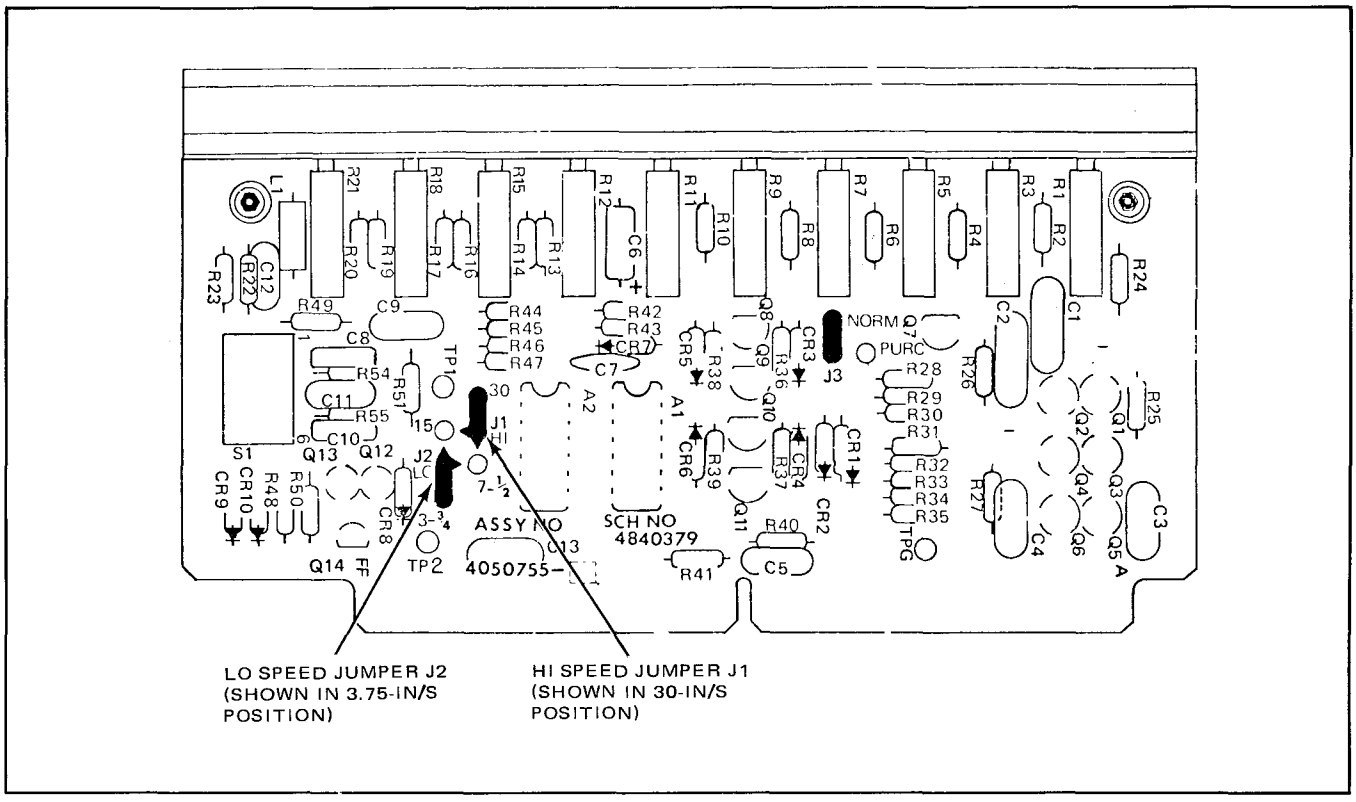


Figure 5-5. Speed Selection Jumpers, PADNET PWA

3. Position LO speed jumper J2 to the desired low speed: 15, 7.5, or 3.75 in/s position. Reinstall PADNET PWA.
4. For each new speed selected, perform the appropriate signal system alignment procedure given under *Alignment and Adjustments*, paragraph 5-29.

5-16. Two-Speed Dual Master Bias. For two-speed dual master bias operation, proceed as follows:

1. With power off, remove audio control PWA No. 5 from the electronics assembly.
2. Two overlay panels are furnished with the PWA. If the two-speed overlay panel (Figure 5-4) is not in the front position on the PWA, remove front-panel screw, interchange overlay panels, and reinstall screw.
3. Position HI speed jumper J1 to the desired high speed: 30, 15, or 7.5 in/s position (Figure 5-6).
4. Position LO speed jumper J2 to the desired low speed: 15, 7.5, or 3.75 in/s position.
5. Position jumpers J3 and J4 to the S (stored) position. Reinstall audio control PWA No. 5.
6. For each new speed selected, perform the appropriate signal system alignment procedure given under *Alignment and Adjustments*, paragraph 5-29.

5-17. Four-Speed Master Bias. For four-speed master bias operation, proceed as follows:

1. With power off, remove audio control PWA No. 5 from the electronics assembly.
2. Two overlay panels are furnished with the PWA. If the four-speed overlay panel (Figure 5-4) is not in the front position on the PWA, remove front-panel screw, interchange overlay panels, and reinstall screw.
3. Position jumper J1 to the 30-in/s position (Figure 5-6).

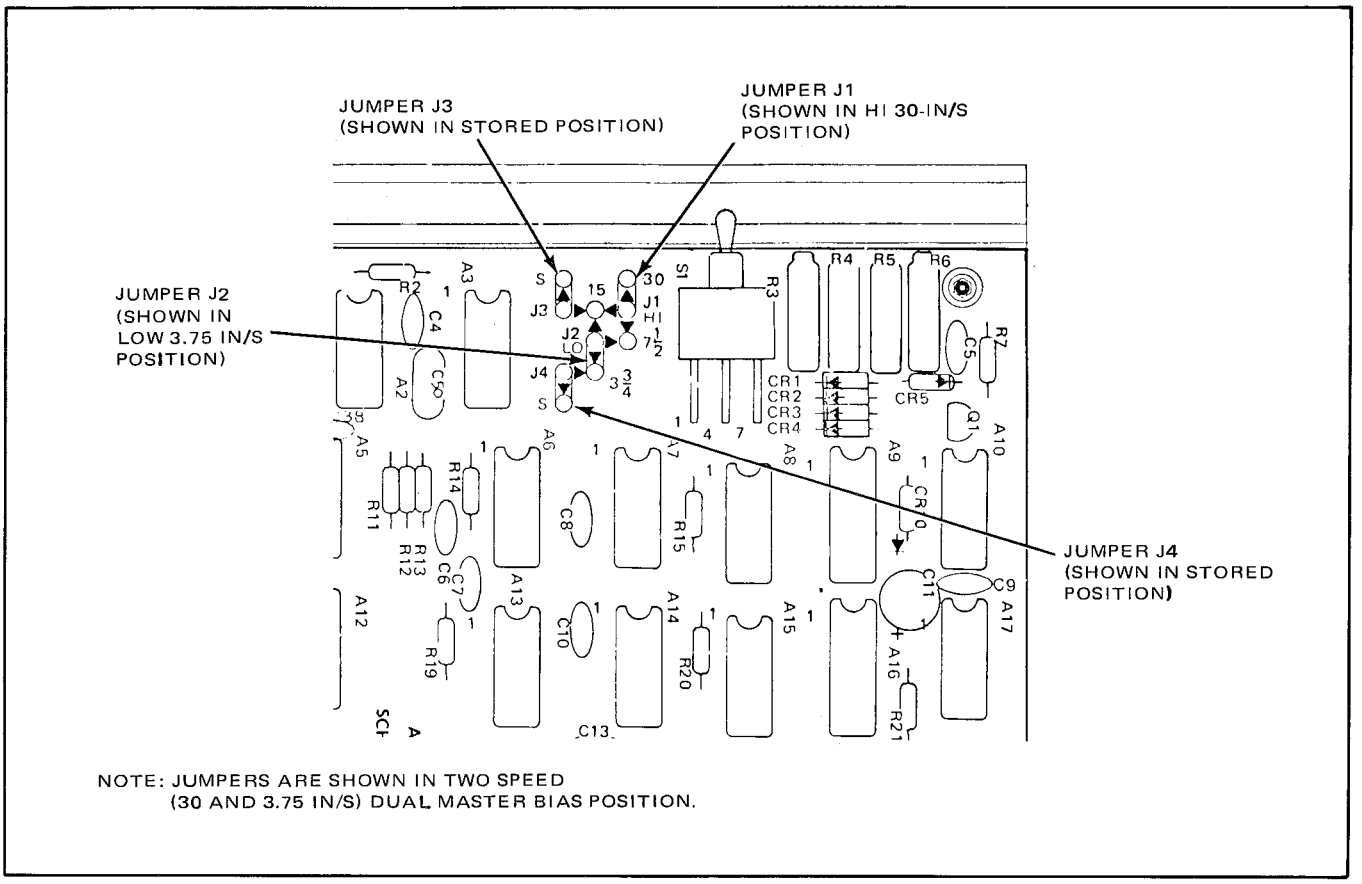


Figure 5-6. Speed/Bias Selection Jumpers, Audio Control PWA No. 5

4. Position jumper J2 to the 7.5-in/s position.
5. Position jumper J3 to the 15-in/s position.
6. Position jumper J4 to the 3.75-in/s position. Reinstall audio control PWA No. 5.
7. For each new speed selected, perform the appropriate signal system alignment procedure given under *Alignment and Adjustments*, paragraph 5-29.

5-18. Changing Input/Output Assembly Operating Configuration

The input/output assembly is shipped from the factory with the following input and output operating characteristics:

- Input impedance — 50K ohms balanced
- Output impedance — 30 ohms balanced

The input/output assembly operating characteristics can be changed by adding a capacitor and by adding or removing jumpers from terminals located on the input/output assembly module (Figure 5-7). Separate modification instructions are given for the input and output amplifier sections of the module.

5-19. Input Amplifier. To change the input amplifier operating configuration, proceed as follows:

5-20. Increasing Input Sensitivity. For a balanced input, input impedance of 25K ohms, and input sensitivity increased by 6 dB, perform the following modification.

1. Install a jumper between E16 and E17, and solder in place.

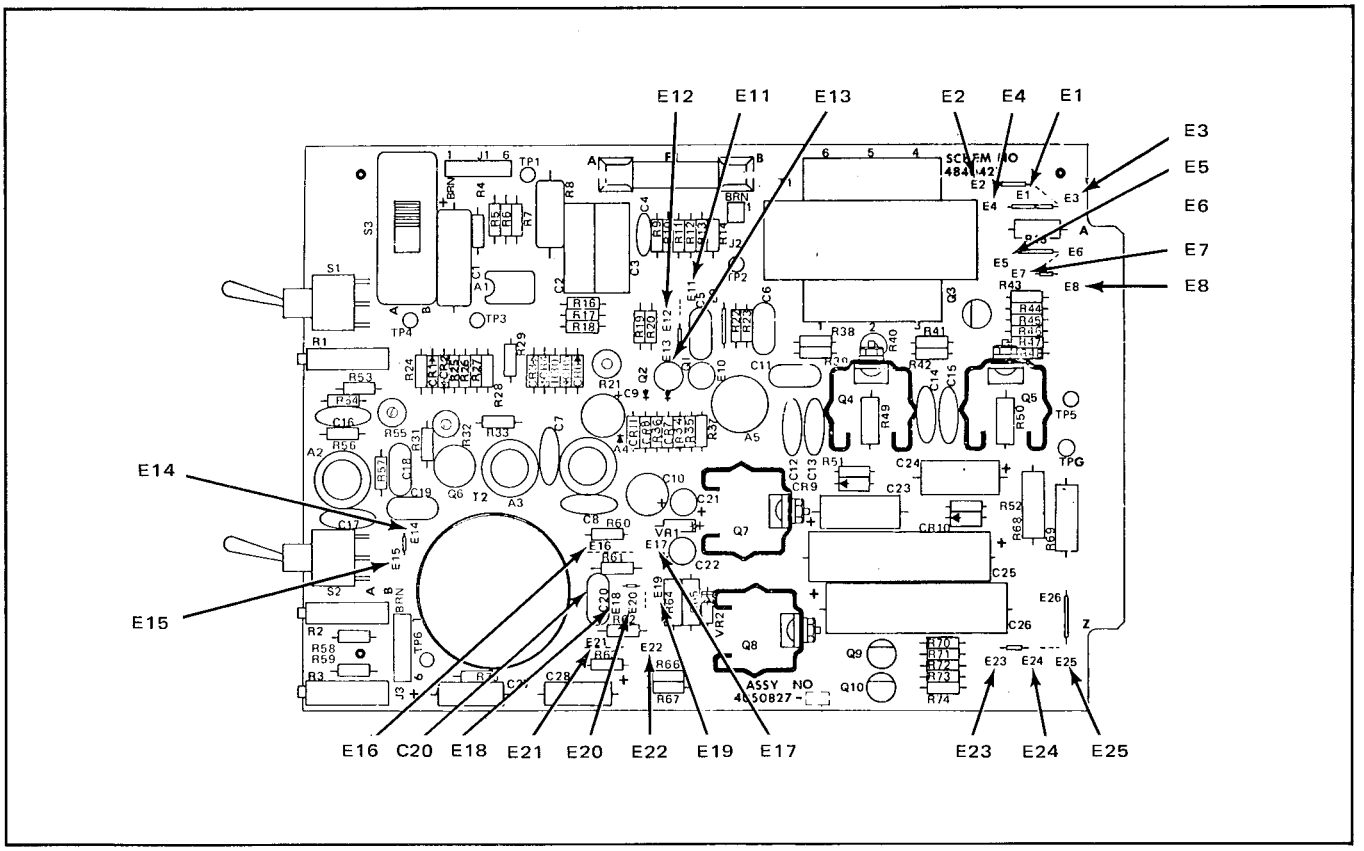


Figure 5-7. Input/Output Assembly Module — Jumper Terminals and Capacitor C20

2. Install a jumper between E21 and E22, and solder in place.

3. Install capacitor C20 (47 pF, 5%, mica — customer furnished) on the input/output module PWA, and solder in place. Install the capacitor in circuit pad location designated on the module PWA. (See note 6 on input/output module PWA schematic no. 4840421, and Figure 5-7.)

5-21. Balanced or Unbalanced Input. The input can be either balanced or unbalanced by the absence or presence of a jumper. For an unbalanced input, place a jumper between E24 and E25, and solder in place. For a balanced input, remove the jumper between E24 and E25.

5-22. Bypassing Input Transformer. If the input transformer is bypassed, the input will be unbalanced. Proceed as follows.

NOTE

If either the input or output transformer is bypassed, the signal phase will shift 180°. However, if both transformers are bypassed, the overall phase will remain the same.

1. Remove the following jumpers:

   E14 to E15
   E18 to E19
   E23 to E24

2. Add the following jumpers and solder in place:

   E24 to E25
   E19 to E20

3. After performing steps 1 and 2, the input impedance will be 25K ohms. To increase the

gain by 6 dB and provide an imput impedance of 12.7K ohms, install a jumper between E16 and E17 and solder in place.

5-23. Shield Grounding. The input connector (XLR type) is shipped from the factory with the shield grounded. If desired to have a "floating" shield, remove jumper between E25 and E26.

5-24. Output Amplifier. To change the output amplifier operating configuration, proceed as follows:

5-25. Balanced or Unbalanced Output. The output can be either balanced or unbalanced by the absence or presence of a jumper. For an unbalanced output, place a jumper between E6 and E7 and solder in place. For a balanced output, remove the jumper between E6 and E7.

5-26. Bypassing Output Transformer. If the output transformer is bypassed, the output will be unbalanced. Proceed as follows:

NOTE

If either the input or output transformer is bypassed, the signal phase will shift 180°. However, if both transformers are bypassed, the overall phase will remain the same.

1. Remove the following jumpers:

   E12 to E13
   E1 to E2
   E3 to E4
   E5 to E6

2. Add the following jumpers and solder in place:

   E11 to E12
   E1 to E3
   E6 to E7

3. Change resistor R20 from 10K to 1.5K ohms, 1/4 watt.

4. Recalibrate the level meter as follows:

   a. Connect an audio oscillator to the line input connector (Figure 2-14).

   b. Set oscillator frequency to 1.0 kHz and adjust oscillator output level to +4 dBm (or other operating level selected by the user).

   c. Set RECORD MANUAL/PRESET switch to PRESET position.

   d. Place input/output module on an extender board and insert board into mainframe.

   e. Apply power and place ATR-100 into input mode.

   f. Adjust meter calibration potentiometer R21 (Figure 5-17) for −6 (meter switch S3 in peak position) or 0 (meter switch S3 in vu position).

   g. With power off, remove input/output module and extender board from mainframe and reinstall input/output module into mainframe.

   h. Disconnect audio oscillator.

5-27. Increasing Output Resistance with Balanced Output. To increase the output resistance of the amplifier, install appropriate equal value resistors between E3 and E4 and between E5 and E6. For example, if a nominal output resistance of 600 ohms is desired, install 300-ohm resistors between E3 and E4 and between E5 and E6. Solder resistors in place.

5-28. Shield Grounding. The output connector (XLR type) is shipped from the factory with the shield grounded. If desired to have a "floating" shield, remove jumper from between E7 and E8.

5-29. ALIGNMENT AND ADJUSTMENTS

5-30. Audio Signal System Alignment

The reproduce alignment procedure must be performed prior to the record alignment procedure. Reproduce alignment consists of setting low and high frequency equalization of each channel, adjusting reproduce head azimuth and phasing (multichannel systems), and setting operating level of each channel. Record alignment consists

of setting bias level, setting record high frequency equalization, and setting system output level.

The alignment procedures are presented step-by-step in serial form for reproduce and record alignment of each channel. For the alignment of 2- or 4-channel systems, and after the reader has become familiar with the procedures, it may be more convenient to perform the steps in parallel for each channel.

The basic recorder/reproducer input and output level is set to −5 dBm, regardless of the actual operating level flux level selected for use. For maximum performance, the use of Ampex 456 tape with an operating level of 370 nWb/m is recommended. (This level is 6 dB higher than the 185 nWb/m-reference level on Ampex Standard Alignment Tapes.) Procedures are included in this manual for setting the operating level to 185 nWb/m, 260 nWb/m, and 370 nWb/m.

When the basic recorder/reproducer is correctly adjusted, the Ampex input/output accessory or any input/output assembly (either one correctly adjusted) can be connected to the recorder/reproducer without any adjustment.

NOTE

All voltage levels are expressed in dB referenced to 0.775 volt rms across 600 ohms. Therefore a level of zero dBm corresponds to 0.775 volt rms.

5-31. Use of Alignment Tapes – General Discussion

The alignment tapes have been precisely recorded and must be correctly handled and stored to retain their accuracy. The following requirements should be especially followed.

1. Clean and demagnetize the heads and other tape-handling components before using the test tape.
2. Never store test tapes in areas where there are temperature or humidity extremes or where magnetic fields may be present.
3. Remove test tapes from equipment only after a normal play or spool mode run (never after a fast-winding mode).

The test tape is threaded on the recorder/reproducer in the normal tape path (from the supply to the takeup reel). During alignment procedures, the rewind and fast forward modes may be used as necessary. After alignment, wind the tape completely on the takeup reel and then place the recorder/reproducer in the rewind spool mode to wind the tape back on its original reel. Note that after extensive use, high frequency tones on the alignment tape may drop as much as 2 dB, particularly at the slower tape speeds.

Operating level and reproduce frequency response can be checked with a standard alignment tape (Table 5-1). When using a standard alignment tape that is recorded the full width of the tape to check a system with heads less than full width, the response readings below approximately 10.0 kHz become progressively invalid as the frequency decreases. This is caused by the low-frequency fringing effect of the reproduce head. The reproduce head picks up additional flux beyond the track width of the head as the frequency decreases. This error, being wavelength dependent, becomes worse as the wavelength increases.

NOTE

All Ampex full track 1/2-inch alignment tapes listed in Table 5-1 have flux/frequency characteristics that include compensation for fringing.

Therefore, if the equalization is correctly adjusted, the reproduce response when using a full-track alignment tape on either a 2-track, 1/4-inch tape system or a 4-track, 1/2-inch tape system should conform to the relative curves shown in Figure 5-8 within the tolerances given in Table 5-3. The curves given in Figure 5-8 display the *relative* fringing frequency response and *do not* include the fixed error due to the wider reproduce core width (as compared to the record head width).

Table 5-4 provides the amplitude correction factors to be used when setting operating level using a full-track alignment tape on a 2-track, 1/4-inch tape system or a 4-track, 1/2-inch tape system.

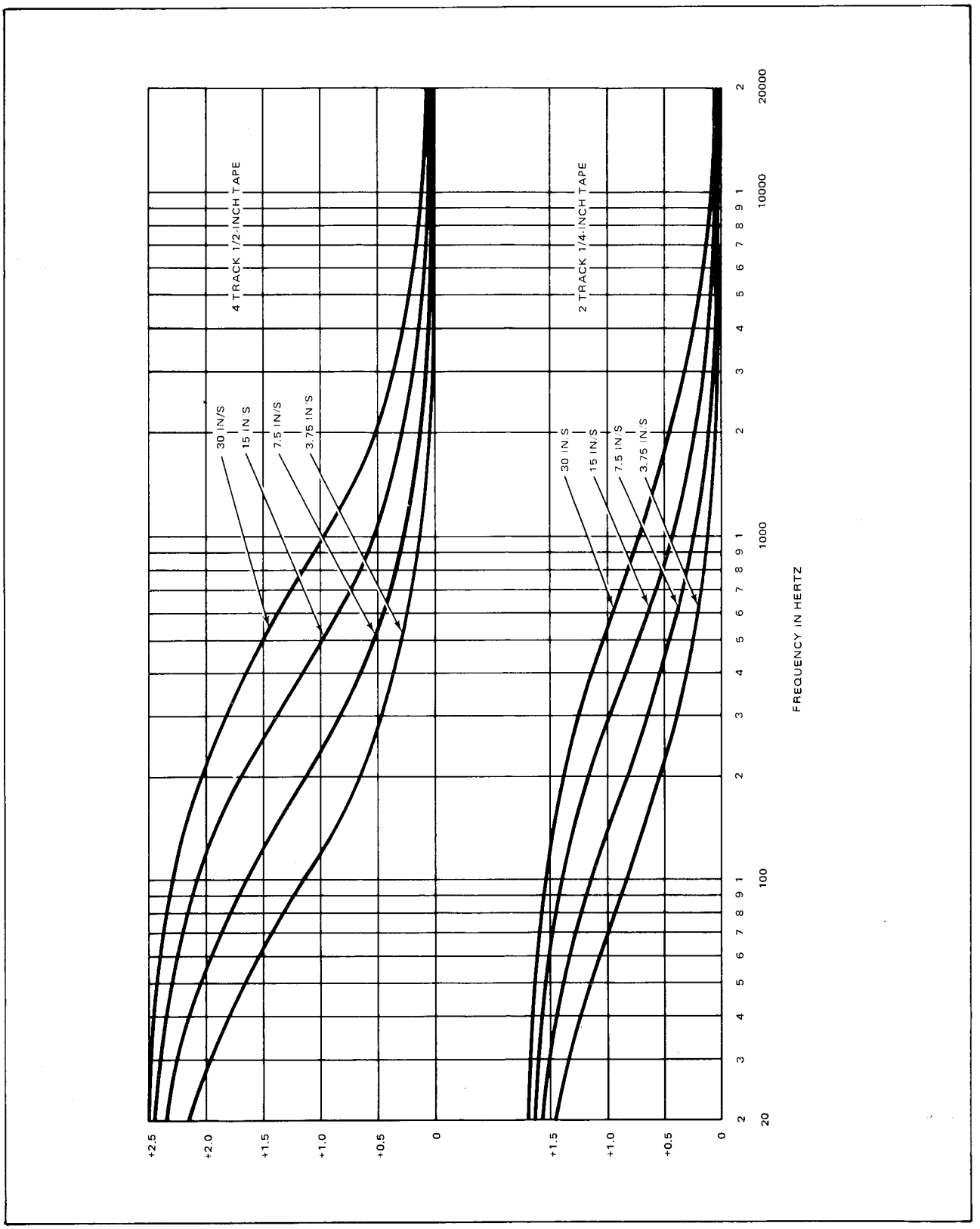


Figure 5-8. Relative Fringing Frequency Response Due to Fringing Effect

Table 5-3. Reproduce Frequency Response Tolerances

SPEED	TOLERANCE ±0.5 dB	TOLERANCE ±1.5 dB	SEL SYNC ±2.0 dB
30 in/s	250 Hz – 20 kHz	35 Hz – 250 Hz 20 kHz – 28 kHz	50 Hz – 15 kHz
15 in/s	125 Hz – 15 kHz	20 Hz – 125 Hz 15 kHz – 20 kHz	40 Hz – 12 kHz
7.5 in/s	125 Hz – 10 kHz	30 Hz – 125 Hz 10 kHz – 15 kHz	–
3.75 in/s	125 Hz – 5 kHz	30 Hz – 125 Hz 5 kHz – 10 kHz	–

NOTE: To the above tolerances, add manufacturing tolerances of the alignment tape and relative fringing frequency response due to fringing effect (Figure 5-8).

Table 5-4. Amplitude Correction Factors for Setting Operating Level when using Full-Track Alignment Tapes on 2-Track or 4-Track Systems

SPEED	REFERENCE FREQUENCY	CORRECTION FACTOR*	
		2 TRACK	4 TRACK
30 in/s	500 Hz	+1.61 dB	+2.10 dB
	700 Hz	+1.46 dB	+1.85 dB
	1.0 kHz	+1.29 dB	+1.58 dB
15 in/s	500 Hz	+1.29 dB	+1.58 dB
	700 Hz	+1.14 dB	+1.34 dB
	1.0 kHz	+1.01 dB	+1.13 dB
7.5 in/s	500 Hz	+1.01 dB	+1.13 dB
	700 Hz	+0.90 dB	+0.99 dB
	1.0 kHz	+0.81 dB	+0.87 dB
3.75 in/s	500 Hz	+0.81 dB	+0.87 dB
	700 Hz	+0.74 dB	+0.79 dB
	1.0 kHz	+0.69 dB	+0.74 dB

*The amplitude correction factors shown in the table are the sum of the values shown in Figure 5-8 for the frequencies shown in the table, and the fixed errors due to wider reproduce core width as follows:

2 track – 0.56 dB due to 80-mil reproduce core on 75-mil track
4 track – 0.6 dB due to 75-mil reproduce core on 70-mil track

NOTE

Ampex full-track, 1/2-inch alignment tapes have compensation for fringing, and therefore only compensation for core width (0.6 dB) is required (Table 5-4).

The correction factors in Table 5-4 are the amounts by which the actual measured reproduce output from a full width alignment tape will exceed the reproduce output of the correct track width recorded to the same fluxivity. The table includes the fixed error due to the wider reproduce core width and the relative fringing error (shown in Figure 5-8) for frequencies of 500 Hz, 700 Hz, and 1.0 kHz. For example, when reproducing the 700-Hz, 185-nWb/m tone on an Ampex 15 in/s full-width alignment tape on a 2-track, 1/4-inch tape system, the output (as read on an ac voltmeter) will be +1.14 dB higher (Table 5-4) as compared to reproducing an alignment tape that has the same track format as the recorder/reproducer.

The amplitude correction factor of 1.14 dB was obtained by adding the following figures:

0.56 dB	– compensation for wide reproduce core width (See asterisk, Table 5-4).
0.58 dB	– relative fringing frequency response due to fringing error effect at 700 Hz and 15 in/s (Figure 5-8).
1.14 dB	– Amplitude correction factor.

Note that if the alignment tape used matches the head track format, the correction factors given in Table 5-4 are not used. Also no corrections are required when using a full-width alignment tape to align a full-track head assembly system.

Another source of error is the reproduce head pole contour effect. This effect is prevalent when using the low-frequency sections of the alignment tape. If the alignment tape track format matches the reproduce head format, the error is not severe. This type of error can be minimized by adjustment of the low frequency reproduce equalizers while performing the overall record/reproduce alignment procedure.

5-32. Using a Flux Loop – General Discussion. An accurate method of setting equalization involves the use of a flux loop driven by an audio oscillator in order to induce an electromagnetic field into the reproduce head. The field produced by the flux loop may be equalized to simulate the short circuit flux/frequency response from an ideally recorded alignment tape. The response of a correctly equalized reproduce system to a correctly equalized flux loop will be an almost constant output with frequency over the audio range of interest. However the use of the flux loop will not disclose the following errors:

- Reproduce head low frequency pole contour and secondary gap effect.
- Reproduce head high frequency gap loss.
- Effects due to head-to-tape contact or azimuth errors.

The ATR-100 incorporates automatically selected preset equalization to correct for secondary gap rise at 15 and 30 in/s. Therefore at 15 and 30 in/s, with the reproduce low frequency and high frequency equalizer controls correctly set, the actual flux-looped low-frequency response will depart from a flat response by a specific amount depending on frequency. Figure 5-9 shows the correct response that should be obtained at 15 and 30 in/s with the reproduce equalizers adjusted to match the equalization standard set on the equalized flux loop. The output frequency response using a correctly equalized flux loop should be flat for 3.75 and 7.5 in/s.

A recommended flux loop for use with the ATR-100 is the Ampex flux loop (Ampex Part No. 4020423) used with an Ampex flux loop equalizing amplifier (Ampex Part No. 4040424). This equalizing amplifier contains inverse compensation for the secondary gap rise for the setting of equalization at 15 and 30 in/s. Therefore Figure 5-9 does not apply when using the Ampex equalizing amplifier.

When an equalizing amplifier is not used, the flux loop may be passively equalized by use of a capacitor connected across the oscillator terminals, to provide the high-frequency transition. Table 5-5 provides capacitor values for specified equalization

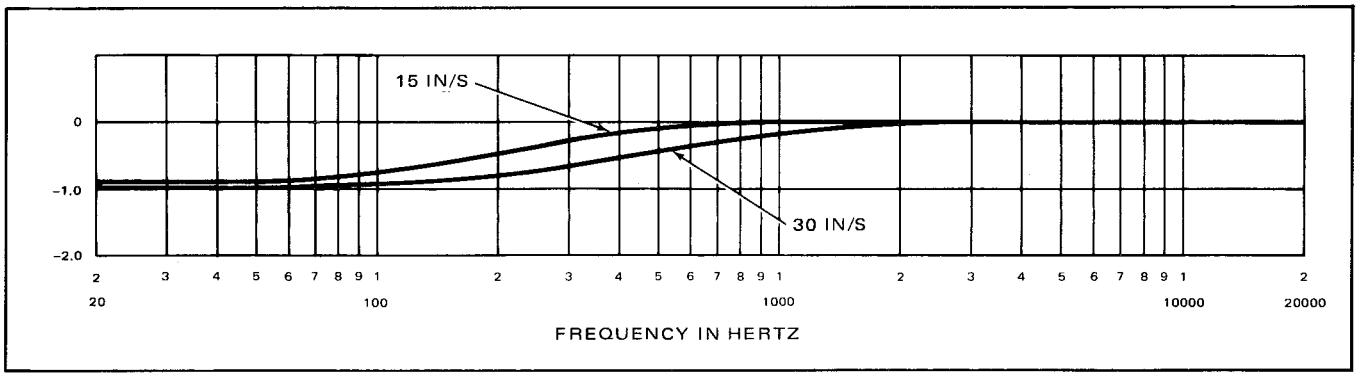


Figure 5-9. Equalized Flux Loop Response for 15 in/s and 30 in/s

Table 5-5. Capacitor Values for Passive Equalization of High Frequency Turnover

TAPE SPEED AND EQUALIZATION STANDARD	HIGH FREQUENCY TRANSITION TIME CONSTANT	−3 dB FREQUENCY	CAPACITOR VALUE*
30 in/s AES	17.5 μs	9,095 Hz	0.204 μF
15 in/s IEC/CCIR	35 μs	4,547 Hz	0.408 μF
7.5/15 in/s NAB	50 μs	3,183 Hz	0.583 μF
7.5 in/s IEC/CCIR	70 μs	2,274 Hz	0.817 μF
3.75 in/s	90 μs	1,768 Hz	1.05 μF

*Capacitor value when using audio oscillator with 600-ohm output impedance and Ampex flux loop, part number 4020423-01 (R_{loop} = 100 ohms).

standards when using an audio oscillator with 600 ohms output and an Ampex flux loop that has a dc resistance of 100 ohms. If a flux loop or audio oscillator with other characteristics is used, a nominal capacitor value may be calculated by the following formula:

$$C = \frac{T(R_o + R_1)}{R_o \cdot R_1}$$

Where:

- T = equalization transition time constant (seconds) (Table 5-5)
- R_0 = oscillator output resistance (ohms)
- R_1 = flux loop dc resistance (ohms)
- C = capacity in μF

Figure 10 shows the desired system response from an unequalized flux loop, with constant current drive, for the most common equalization standards.

5-33. Head Azimuth and Phase — General Discussion. The only head adjustment required is for record and reproduce head stack azimuth. Precision mounting of the record and reproduce head stack has eliminated the need for adjusting tape wrap, height, and zenith. The azimuth adjustment is made by turning a hex socket screw accessible through the top of the head shield (Figure 5-11) which causes a tapered gear to rotate underneath the head-stack precision plate. The azimuth adjustment is adjustable over a range of ±15 minutes of arc.

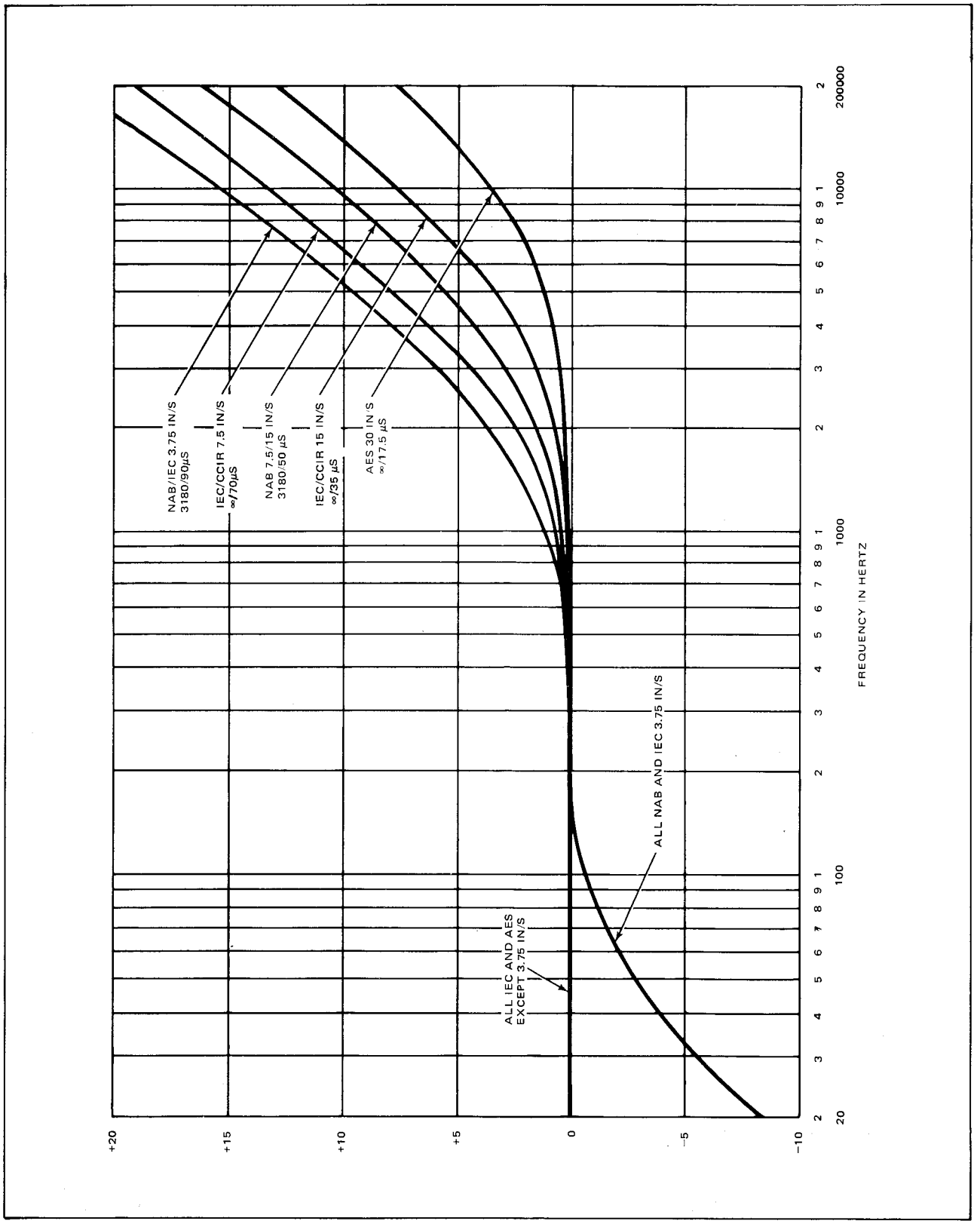


Figure 5-10. Reproduce Response From Unequalized Flux Loop

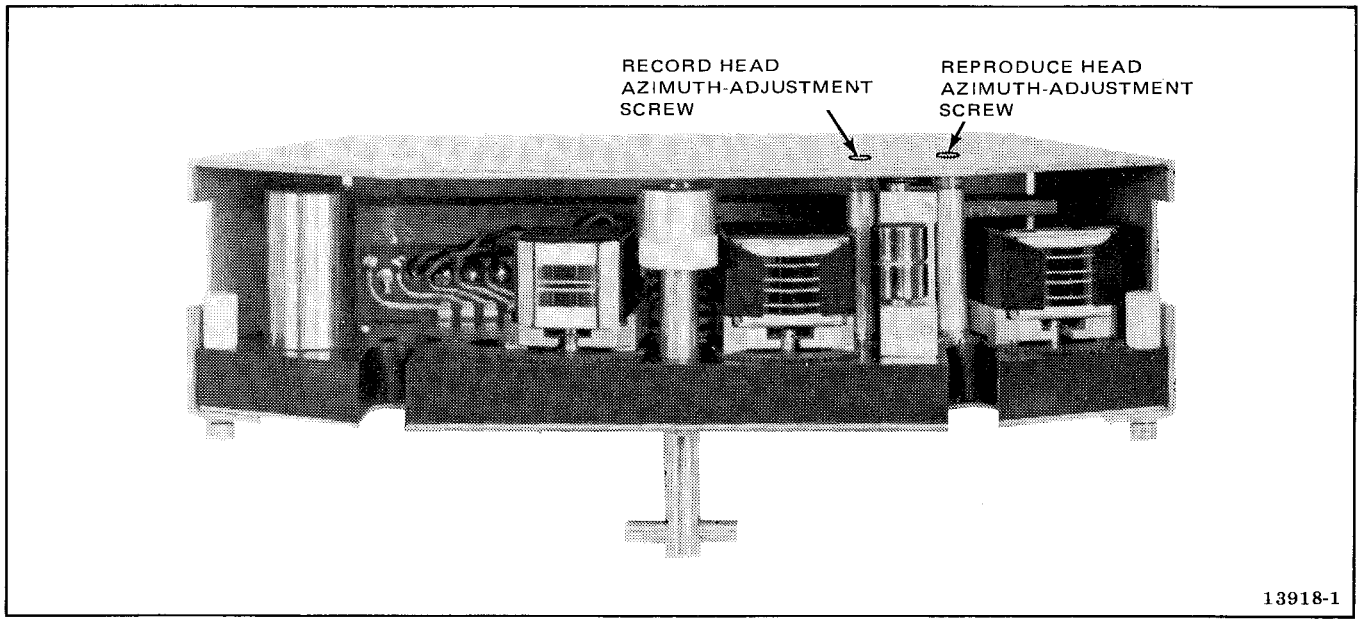


Figure 5-11. Azimuth Adjustment Screw Location

The adjustment of head phase can be considered a fine adjustment of head azimuth and is adjusted to eliminate phase error between tracks of a 2-track or 4-track head assembly. Prior to the adjustment of head phase, the following criteria should be met:

1. Reproduce head – Reproduce equalization is correct.

2. Record head – Reproduce equalization and reproduce head azimuth have been adjusted. Record equalization and bias have been set for overall system high-frequency response and azimuth adjusted for maximum short wavelength output.

Failure to observe the above criteria can result in incorrect mechanical azimuth being set in order to compensate for inter-track phasing errors. These errors are electrical in origin (differences between tracks in reproduce equalization, record equalization and/or record bias).

5-34. Operating Level – General Discussion. The operating level used is a matter of individual preference by the user of the recorder/reproducer. However, the use of Ampex 456 tape (or direct equivalent) with an operating level of 370 nWb/m is recommended. This level will provide the lowest distortion and adequate headroom prior to tape saturation. Use of Ampex 456 tape with a lower operating level will degrade signal-to-noise ratio but will lower distortion and increase headroom. With other types of tape, other operating levels may be preferrable. For example, when using Ampex 406/407 tape, an operating level of not more than 260 nWb/m is recommended.

Operating level is set while reproducing a standard alignment tape of known short circuit fluxivity, and adjusting the recorder/reproducer reproduce gain appropriately. In the case of the Ampex alignment tapes, reference levels of 700 Hz (500 Hz at 3.75 in/s) at 185 nWb/m are used. (Other manufacturers of alignment tapes have standard reference levels at 200 nWb/m or 250 nWb/m at 1.0 kHz, or 320 nWb/m at 1.0 kHz.) Table 5-6 shows the relative differences in level between Ampex reference level (185 nWb/m) and other reference levels in domestic and international use.

If a full width alignment tape is used to set reproduce gain on a 2- or 4-track system, errors in absolute reproduce sensitivity to recorded fluxivity will result due to the fringing effect. This

Table 5-6. Relative Operating Levels

DESCRIPTION	RELATIVE LEVEL	SHORT CIRCUIT FLUXIVITY	FREQUENCY
Ampex reference level (standard operating level)	0 dB	185 nWb/m	700 Hz or 500 Hz
Other U.S. reference levels	+0.7 dB	200 nWb/m	1.0 kHz
Elevated operating level	+3 dB	250/260 nWb/m	1.0 kHz
IEC reference level	+4.8 dB	320 nWb/m	1.0 kHz
Recommended operating level for ATR-100 and 456 tape	+6 dB	370 nWb/m	700 Hz

error becomes more pronounced at the higher tape speeds. Table 5-4 lists the correction factors to be applied when using a full-width alignment tape for setting reference level when using a 2-track or 4-track reproduce head assembly.

The correction factors in Table 5-4 are the amounts by which the actual measured reproduce output from a full-width alignment tape will exceed the reproduce output of the correct track width recorded to the same fluxivity. For example, when reproducing the 700-Hz, 185-nWb/m tone of an Ampex 15 in/s full-width alignment tape on a 2-track, 1/4-inch head assembly, the reproduce gain is set to provide 1.14 dB higher output than actually required. This correction factor provided in Table 5-4 also compensates for the wider-than-normal core head used on the ATR-100. The wider reproduce core minimizes level errors when reproducing tape recorded on other machines with head heights set incorrectly.

Note that if the alignment tape used matches the head track format, the correction factors given in Table 5-4 are not used. Also no corrections are required when using a full-width alignment tape to align a full-track head assembly system.

5-35. Reproduce Equalization Adjustment. Reproduce equalization adjustment consists of setting the low and high frequency equalization of each audio channel, utilizing a standard alignment tape or a flux loop. The more accurate method of setting equalization involves the use of a flux loop driven by an audio oscillator to induce a flux into the reproduce head. Both methods of setting equalization are given in the procedures. Prior to performing the alignment procedure, refer to the general discussion regarding the use of flux loops, paragraph 5-32.

NOTE

Where input and output line levels pertaining to the input/output assembly are stated, it is assumed that the input/output assembly has been set to the factory-adjusted input and output line level of +4-dBm operating level (0 vu). If another value line input and output operating level is being used, the levels stated in the adjustment procedures should be amended by the amount of deviation from the +4-dBm operating level.

CAUTION

TO PREVENT POSSIBLE DAMAGE TO ELECTRICAL COMPONENTS ON A PRINTED WIRING ASSEMBLY (PWA), ALWAYS TURN RECORDER/REPRODUCER POWER OFF BEFORE REMOVING OR INSTALLING A PWA IN THE RECORDER/REPRODUCER OR INPUT/OUTPUT ASSEMBLY.

5-36. Equalization Adjustment Using an Alignment Tape. The procedure assumes use of an Ampex alignment tape. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the

Preventive Maintenance portion of the manual, paragraphs 5-4 and 5-7.

2. Remove main audio PWA from electronics assembly corresponding to channel being adjusted.

3. Set control R34 (Figure 5-12) to midrange. Reinstall PWA.

4. Set REPR GAIN control R1 on PADNET PWA (Table 5-7) to full clockwise position.

5. Connect ac voltmeter to one of the following output connectors.

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

   b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figures 2-14 and 2-15).

6. Select appropriate system tape speed at the transport control panel.

7. Thread appropriate alignment tape (Table 5-1) on the transport and place system in thread mode.

NOTE

If a full-track alignment tape is used to adjust a multitrack system, it will be necessary to correct for the fringing effect. Refer to fringing effect discussion given under *Use of Alignment Tapes*, paragraph 5-31.

8. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

9. Place system in play mode and establish reference frequency level as follows:

   a. 3.75 in/s — Set REPR GAIN control so that ac voltmeter reads −15 dBm at the 500-Hz reference tone (−10 dB below 185 nWb/m, first tone on tape) at the output of the recorder/reproducer, or −6 dBm at the output of the input/output assembly.

   b. 7.5 in/s — Set REPR GAIN control so that ac voltmeter reads −15 dBm at the 700-Hz reference tone (−10 dB below 185 nWb/m, first tone on tape) at the output of the recorder/reproducer, or −6 dBm at the output of the input/output assembly.

   c. 15 or 30 in/s — Set REPR GAIN control so that ac voltmeter reads −5 dBm at the 700-Hz reference tone (185 nWb/m, first tone on tape) at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

10. While reproducing the highest frequency tone on the alignment tape (7.5 kHz at 3.75 in/s or 15 kHz at 7.5, 15, and 30 in/s), adjust the reproduce head azimuth screw (Figure 5-11) for maximum output.

11. While reproducing the 10.0-kHz tone (7.50 kHz at 3.75 in/s), adjust appropriate reproduce equalizer control (HI SPEED HF or LO SPEED HF) on PADNET (Table 5-7) for the same level obtained in step 9 (or to required relative level as indicated in Figure 5-8, if applicable).

12. While reproducing the 50-Hz tone, adjust appropriate reproduce equalizer control (HI SPEED LF or LO SPEED LF) on PADNET for the same level obtained in step 9. (Note: This is an approximate setting, final adjustment will be made during an overall record/reproduce alignment procedure.)

13. Reproduce the frequency response test tones on the alignment tape. Reproduce response should conform to tolerances shown in Table 5-3. If applicable, refer to relative fringing error curves shown in Figure 5-8.

14. Repeat steps 2 through 13 for other audio channels to be adjusted.

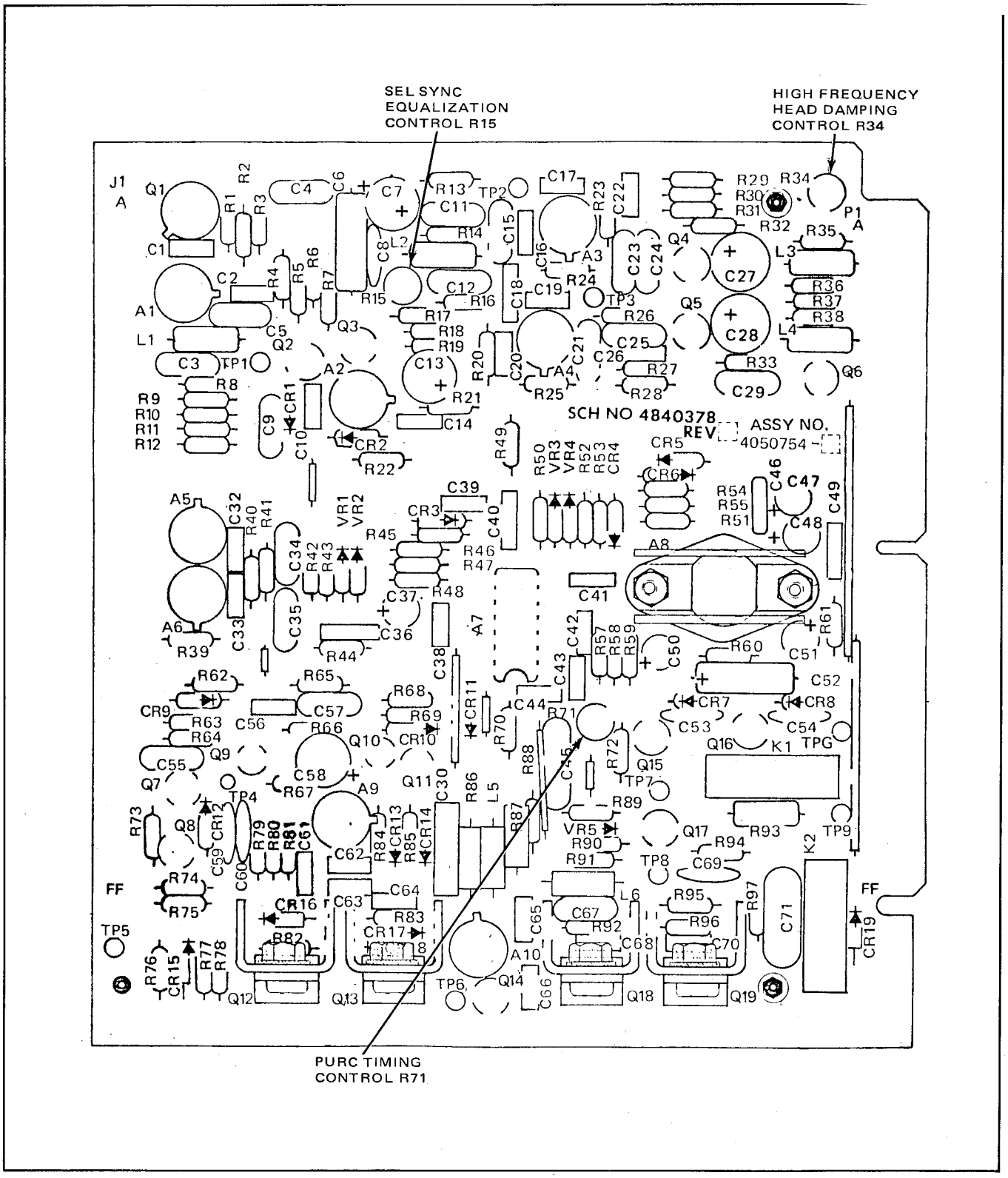


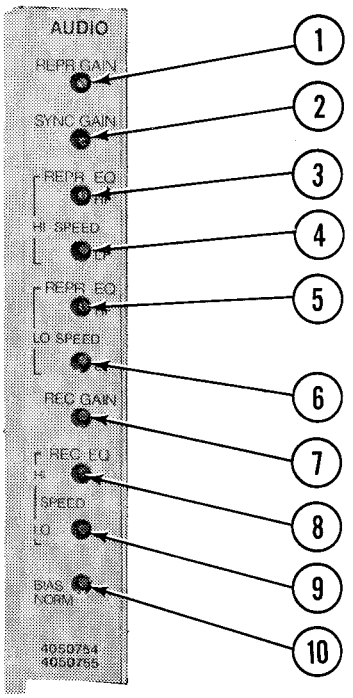
Figure 5-12. Main Audio PWA 1, 2, 3, or 4 — Alignment Controls

15. Adjust operating level by following instructions given starting with paragraph 5-41.

NOTE

Final adjustment of the reproduce low frequency equalizers for optimum low-frequency response will be accomplished during an overall record/reproduce alignment procedure given later in this section of the manual.

Table 5-7. PADNET PWA – Alignment Controls



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INDEX NO.	CONTROL	FUNCTION
1	REPR GAIN (R1)	Adjusts basic recorder/reproducer interface reproduce level.
2	SYNC GAIN (R3)	Adjusts basic recorder/reproducer sel sync reproduce interface level.
3	HI SPEED HF (R5)	Adjusts high-speed, high-frequency reproduce equalization.
4	HI SPEED LF (R7)	Adjusts high-speed, low-frequency reproduce equalization.
5	LO SPEED HF (R9)	Adjusts low-speed, high-frequency reproduce equalization.
6	LO SPEED LF (R11)	Adjusts low-speed, low-frequency reproduce equalization.
7	REC GAIN (R12)	Adjusts basic recorder/reproducer interface record level.
8	HI SPEED (R15)	Adjusts high-speed, high-frequency record equalization.
9	LO SPEED (R18)	Adjusts low-speed, high-frequency record equalization.
10	BIAS NORM (R21)	Normalizes bias level for individual channel to common master bias bus level.

5-37. Reproduce Equalization Adjustment Using a Flux Loop. A flux loop is used to induce an electromagnetic field into the reproduce head for the purpose of adjusting reproduce equalization. Prior to performing the alignment procedure, refer to the general discussion concerning the use of flux loops, paragraph 5-32. Proceed as follows:

1. With system power off, remove main audio PWA from electronics assembly corresponding to channel being adjusted.

2. Set control R34 (Figure 5-12) to midrange. Reinstall PWA.

3. Select appropriate system tape speed at the transport control panel.

4. Clip flux loop to reproduce head.

5. If a flux loop equalizing amplifier is being used (Table 5-1), select the appropriate equalization time constant on the amplifier and connect amplifier to audio oscillator. Observe that amplifier is not overdriven so as to cause clipping, particularly of low-frequency signals.

6. If a flux loop equalizing amplifier is not being used, connect an appropriate equalizing capacitor (Table 5-5) across audio oscillator terminals and connect flux loop (Ampex Part No. 4020423) to the oscillator.

7. Set oscillator to +4 dBm output at 1.0 kHz.

8. Connect ac voltmeter to one of the following output connectors:

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 and J14 (Figure 2-13 and Tables 2-2 and 2-3).

   b. If an input/output assembly is being used, connect ac voltmeter to appropriate recorder/reproducer output connector (Figures 2-14 and 2-15).

9. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

10. Apply system power and set REPR GAIN control so that ac voltmeter reads −20 dBm at the output of the recorder/reproducer, or −10 dBm at the output of the input/output assembly.

11. Change oscillator frequency to 15.0 kHz.

12. Adjust appropriate reproduce equalizer control (HI SPEED HF or LOW SPEED HF) on PADNET for the same level obtained in step 10.

13. Sweep oscillator through frequency range of 10 kHz to 20 kHz. The response should be within ±0.25 dB of the level at 10 kHz. If not, remove power and make slight adjustment of R34 on main audio PWA. Reinstall PWA and apply power.

14. Repeat step 13 as necessary to achieve the desired results.

15. Change oscillator frequency to 30 Hz.

16. Adjust appropriate reproduce equalizer control (HI SPEED LF or LOW SPEED LF) on PADNET for same level obtained in step 10 for 3.75 in/s or 7.5 in/s, or for level to conform to response curves in Figure 5-9 for 15 in/s or 30 in/s.

NOTE

The Ampex flux loop equalizing amplifier contains compensation for secondary gap rise. Therefore the equalizer control should be set for flat response and reference to Figure 5-9 is not required.

17. Sweep oscillator through frequency range of 20 Hz to 20 kHz. For speeds 3.75 in/s and 7.5 in/s, response should be flat ±0.25 dB. For speeds 15 in/s and 30 in/s, response should match curves in Figure 5-9 within ±0.25 dB.

18. Repeat steps 1 through 17 for the other audio channels to be adjusted.

NOTE

Final adjustment of the reproduce low-frequency equalizers for optimum low-frequency response will be accomplished during an overall record/reproduce alignment procedure given later in this section of the manual.

5-38. Reproduce Head Azimuth and Phase Adjustment. The adjustment of head phase can be considered a fine adjustment of head azimuth and is adjusted to eliminate phase error between tracks of a 2-track or 4-track head assembly. Prior to performing the alignment procedure, refer to the general discussion concerning head azimuth and phase adjustment, paragraph 5-33.

5-39. 2-Track or 4-Track Reproduce Head Azimuth and Phase Adjustment. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described under *Preventive Maintenance*, paragraphs 5-4 and 5-7.

2. As a preliminary adjustment, turn reproduce head azimuth adjusting screw (Figure 5-11) so that reference hole in tapered gear is in front of the head-gap region.

3. Connect a dual trace scope as follows:

NOTE

If a dual trace scope is not available, proceed to step 4.

   a. For a 2-track head assembly system, connect scope to channel 1 and channel 2 outputs of the recorder system.

   b. For a 4-track head assembly system, connect scope to channel 1 and channel 4 outputs of the recorder system.

   c. Trigger scope from recorder channel 1 output.

   d. Proceed to step 5.

4. If a dual trace scope is not available, connect a single channel scope to display a Lissajou pattern as follows:

   a. For a 2-track head assembly system, connect channel 1 output to the vertical input of scope, and connect channel 2 output to the horizontal input of the scope.

   b. For a 4-track head assembly system, connect channel 1 output to the vertical input of scope, and connect channel 4 output to the horizontal input of the scope.

5. Thread appropriate alignment tape (Table 5-1) on transport and place system in thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust reproduce head azimuth adjusting screw to obtain minimum phase error as viewed on scope (or Lissajou pattern straight line at 45°).

7. Minimize average phase error by carefully adjusting the head azimuth adjusting screw while playing back one of the following higher frequency test tones on the alignment tape.

   a. 30 in/s – 15 kHz

   b. 15 in/s – 10 kHz

   c. 7.5 in/s – 5.0 kHz

   d. 3.75 in/s – 2.5 kHz

NOTE

The frequencies given in step 7 were chosen to provide a wavelength on tape of 1.5 mils or longer. For use of alignment tapes with other than the above frequencies, wavelength may be calculated by the formula:

$$\lambda = \frac{v}{f}$$

Where:

λ = wavelength on tape (inches)

v = tape speed (in/s)

f = frequency (Hz)

8. Minimize mean phase error by repeating step 7 but playing back the highest frequency test tone on the alignment tape.

9. For a 4-track head assembly system, play back full sequence of test tones and observe that no phase reversal occurs. If phase reversal occurs, repeat steps 6 through 8. (Note that for a 2-track head assembly system, it is not possible to incorrectly set phase if wavelength is 1.5 mil or longer.)

10. For a 4-track head assembly system only while observing a 1.5-mil wavelength, replace the channel 4 output to the oscilloscope with channel 3 and then with channel 2. The mean phase error at this wavelength should be less than ±10°. (Note: This figure depends on the accuracy that reproduce high-frequency equalization has been set, and upon the quality and mechanical condition of the alignment tape.)

5-40. Full Track Reproduce Head Azimuth Adjustment. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual.

2. As a preliminary adjustment, turn reproduce head azimuth adjusting screw (Figure 5-11) so that reference hole in tapered gear is in front of the head-gap region.

3. If an input/output assembly is not being used, connect scope or ac voltmeter to output of recorder system.

4. Select the lower of the two operating speeds selected for recorder operation.

5. Thread the appropriate full-track alignment tape (Table 5-1) on transport, and place system in thread mode.

6. While reproducing the highest tone on the alignment tape (shortest wavelength), adjust the reproduce head azimuth adjusting screw for maximum signal amplitude as read on input/output assembly meter, or on scope or ac voltmeter. (Note: At the slower tape speeds, it may be possible to set azimuth to an incorrect secondary peak. Rotate azimuth adjusting screw through 360° to ensure that the maximum amplitude peak is obtained. Continuous rotation of azimuth adjusting screw provides only ±15 minute of arc change.)

5-41. Operating Level Adjustment. Operating level is set by reproducing a standard alignment tape of known short circuit fluxivity, and adjusting the recorder/reproducer reproduce gain for the desired operating level. Prior to performing the alignment procedure, refer to the general discussion concerning operating level, paragraph 5-34. Note that on Ampex alignment tapes for 15 and 30 in/s, the 185 nWb/m, 700 Hz reference tone is the first tone on the tape. For 3.75 and 7.5 in/s, the 185 nWb/m, 700 Hz (500 Hz at 3.75 in/s) tone is the last tone on the tape.

NOTE

Where input and output line levels pertaining to the input/output assembly are stated, it is assumed that the input/output assembly has been set to the factory adjusted input and output line level of +4 dBm operating level (0 vu). If another value line input and output operating level is being used, the levels stated in the adjustment procedures should be amended by the amount of deviation from the +4 dBm operating level.

CAUTION

IF THE TAPE IN USE OR LOCAL STANDARDS REQUIRE THE USE OF OPERATING FLUXIVITIES LESS THAN 185 nWb/m, OR IF A HIGHER INTERFACE OUTPUT LEVEL IS DESIRED (GREATER THAN −5-dBm OUTPUT LEVEL), NOTE THAT THE REPRO GAIN ON THE PADNET MUST NOT BE INCREASED ABOVE A SENSITIVITY EQUIVALENT TO −5-dBm OUTPUT FROM THE BASIC RECORDER/REPRODUCER WHEN

REPRODUCING A 185-nWb/m, 700-Hz (500-Hz AT 3.75 in/s) TONE. IF THIS PRECAUTION IS NOT OBSERVED AND A HIGH OUTPUT TAPE, SUCH AS AMPEX 456 TAPE, IS REPRODUCED ON THE ATR-100, ELECTRONIC CLIPPING MAY OCCUR BEFORE TAPE SATURATION. (THE MID BAND SATURATED OUTPUT OF AMPEX 456 TAPE IS APPROXIMATELY +20.5 dB ABOVE 185 nWb/m.)

5-42. 370 nWb/m Operating Level Adjustment. Use Ampex 456 tape (or direct equivalent) and proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described under *Preventive Maintenance*, paragraphs 5-4 and 5-7.

2. Select system tape speed at the transport control panel.

3. Connect voltmeter to one of the following output connectors:

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

   b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figures 2-14 and 2-15).

4. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

5. Thread appropriate alignment tape (Table 5-1) on transport and place system into thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPR GAIN control as follows:

   a. If alignment tape track format matches the head track format, adjust REPR GAIN control R-1 on PADNET for −11 dBm at the output of the recorder/reproducer, or −2 dBm at the output of the input/output assembly.

   b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 6a but algebraically add the appropriate correction factor given in Table 5-4 to the −11 dBm or −2 dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: −11 dBm + (+1.14 dBm) = −9.86 dBm.)

7. Repeat steps 2 through 6 for other audio channels to be adjusted.

5-43. 260 nWb/m Operating Level Adjustment. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual.

2. Select system tape speed at the transport control panel.

3. Connect ac voltmeter to one of the following output connectors:

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13).

   b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figure 2-14).

4. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

5. Thread appropriate alignment tape (Table 5-1) on transport and place system in thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPR GAIN control as follows.

a. If alignment tape track format matches the head track format, adjust REPR GAIN control on PADNET for –8 dBm at the output of the recorder/reproducer, or +1 dBm at the output of the input/output assembly.

b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 6a but algebraically add the appropriate correction factor given in Table 5-4 to the –8-dBm or +1-dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –8 dBm + (+1.14 dBm) = –6.86 dBm.)

7. Repeat steps 2 through 6 for other audio channels to be adjusted.

5-44. 185 nWb/m Operating Level Adjustment. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described under *Preventive Maintenance*, paragraphs 5-4 and 5-7.

2. Select system tape speed at the transport control panel.

3. Connect ac voltmeter to one of the following output connectors.

   a. If an input/output assembly is not being used, connect ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

   b. If an input/output assembly is being used, connect ac voltmeter to appropriate output connector (Figures 2-14 and 2-15).

4. If an input/output assembly is being used, place REPRODUCE MANUAL/PRESET switch on input/output module to PRESET position.

5. Thread appropriate alignment tape (Table 5-1) on transport and place system in thread mode.

6. While reproducing the 700-Hz (500-Hz at 3.75 in/s), 185-nWb/m tone, adjust REPR GAIN control as follows:

   a. If alignment tape track format matches the head track format, adjust REPR GAIN control R-1 on PADNET for –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

   b. If using a full-width alignment tape on a 2- or 4-track system, follow directions in step 6a but algebraically add the appropriate correction factor given in Table 5-4 to the –5-dBm or +4-dBm level for the tape speed, track format, and reference frequency in use. (For example: at 15 in/s, 2-track system, at 700 Hz: –5 dBm + (+1.14 dBm) = –3.86 dBm.)

7. Repeat steps 2 through 6 for other audio channels to be adjusted.

5-45. Record Alignment. The record alignment procedure should only be performed after reproduce equalization, reproduce gain, and reproduce head azimuth have been set or are known to be correct. Record alignment consists of setting bias level, setting record high frequency equalization, and setting system output level. The alignment procedures include instructions for aligning the record system for the first speed followed by the second speed record alignment procedure. The second speed record alignment procedure is abbreviated, as it does not require the readjustment of BIAS NORM or record head azimuth.

The following general information and conditions are applicable to both record alignment procedures.

1. Operating level is 370 nWb/m when using Ampex 456 tape or direct equivalent.

2. Operating level is 260 nWb/m when using Ampex 406 tape or equivalent.

3. Frequency response alignment is performed at the following operating levels: 15 and 30 in/s at operating level, 7.5 in/s at 10 dB below operating level, and 3.75 in/s at 20 dB below operating level.

4. Master bias operation has been set for either two-speed dual master bias operation or for four-speed master bias operation as desired. See *Changing Operating Speed Pair and Master Bias Operation* text, paragraph 5-15. (Recorder/reproducers shipped from the factory are set for four-speed master bias operation.) If two-speed dual master bias operation is selected, perform the entire record alignment procedure with bias switch S1 (Figure 5-4) in position I or II. The other position may be used to provide a preadjusted bias position for another type of tape.

5. If an input/output assembly is connected to the recorder/reproducer, the assembly is assumed to be correctly calibrated and set for +4-dBm line input and output operating level and at −5-dBm recorder/reproducer interface operating level (see *Input/Output Assembly Adjustment* procedure, paragraph 5-52).

5-46. First Speed Record Alignment. Perform the following alignment procedure for each channel (as applicable).

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual, paragraphs 5-4 and 5-7.

2. Set preset record equalization standard selector switch S1 (Figure 5-13) on PADNET to equalization standard desired for each of the two operating speeds, as shown in Table 5-8. Note that switches S1-1 through S1-3 are for the higher speed, and switches S1-4 through S1-6 are for the lower speed.

3. If not already set, set speed select jumpers on PADNET PWA for the two desired operating speeds, and set master bias operation jumpers on audio control PWA No. 5 for either two-speed or four-speed master bias operation. (See *Changing Operating Speed Pair and Master Bias Operation* text, paragraph 5-15.)

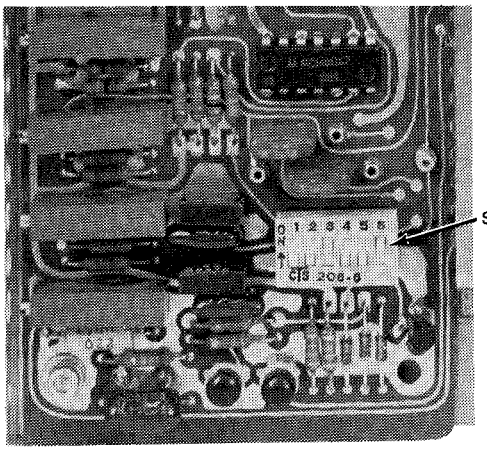


Figure 5-13. Record Equalization Standard Selector Switch S1, PADNET PWA

Table 5-8. Record Equalization Standard Selector Switch S1 Switch Positions (PADNET PWA)

EQUALIZATION STANDARD/μs	IN/S	SWITCH S1-1 OR S1-4 (SHELF DOWN)	SWITCH S1-2 OR S1-5 (SHELF UP)	SWITCH S1-3 OR S1-6 (∞ OR 3180 μs)
AES 17.5/∞	30	OFF	OFF	ON
NAB 50/3180	15	ON	OFF	OFF
NAB 50/3180	7.5	OFF	ON	OFF
IEC 35/∞	15	OFF	OFF	ON
IEC 70/∞	7.5	OFF	OFF	ON
NAB/IEC 90/3180	3.75	OFF	ON	OFF

NOTE: Switches S1-1 through S1-3 are for the higher of the two speeds. Switches S1-4 through S1-6 are for the lower of the two speeds.

4. Select first tape speed to be aligned at the transport control panel.

5. If an input/output assembly is being used, connect an ac voltmeter to appropriate output connector, and connect an audio oscillator to appropriate input connector (Figures 2-14 and 2-15). Set MANUAL/PRESET switch to PRESET.

6. If an input/output assembly is not being used, connect an ac voltmeter to appropriate recorder/reproducer output connector J13 or J14, and connect audio oscillator to appropriate input connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

7. Set oscillator frequency to 1.0 kHz.

8. If erase alignment has not been performed or is not known to be correct, set master erase bus level control R34 (Figure 5-14), on audio control PWA No. 5, to midrange position.

9. Connect scope probe to one of the following locations to monitor the amplitude of the master bias signal.

   a. If test point TP1 is present on audio control PWA No. 5 (later versions of the PWA), place PWA on extender board and reinstall into electronics assembly. Connect probe to TP1.

   b. If TP1 (step 9a) is not present (early versions of the PWA), place a main audio PWA and PADNET on extender board and reinstall into electronics assembly. Connect probe to pin FF on PADNET.

10. Apply power, and adjust appropriate MASTER BIAS level control (Table 5-9 or Table 5-10)

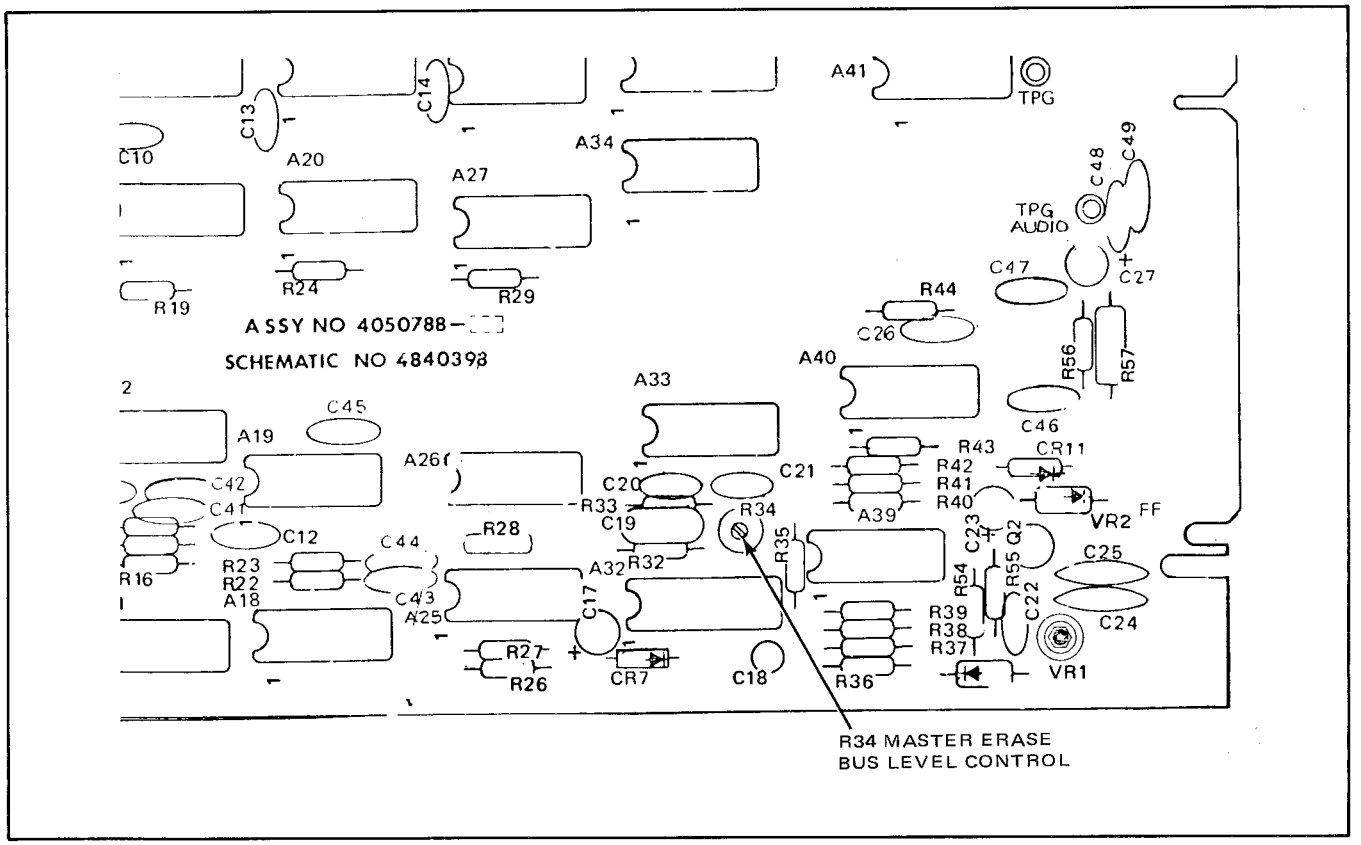
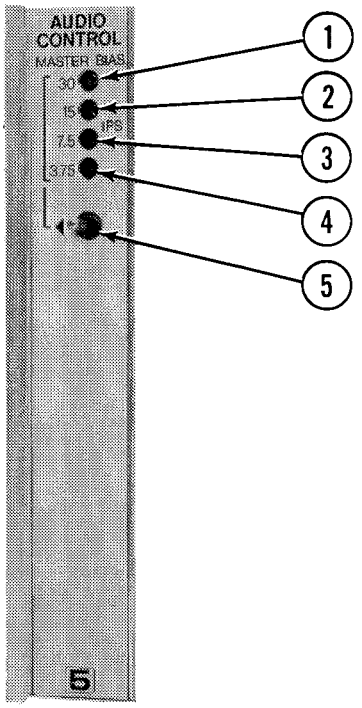


Figure 5-14. Audio Control PWA No. 5

Table 5-9. Audio Control PWA No. 5 — Four-Speed Alignment Controls



13843-11

INDEX NO.	CONTROL	FUNCTION
1	30 (R6)	Adjusts 30-in/s master bias level.
2	15 (R5)	Adjusts 15-in/s master bias level.
3	7.5 (R4)	Adjusts 7.5-in/s master bias level.
4	3.75 (R3)	Adjusts 3.75-in/s master bias level.
5	Switch (S1)	(Switch to remain in left-hand position for four-speed operation.)

for the speed in use to provide a 2.5-Vp-p, 432-kHz square wave on scope.

11. Remove power and scope probe from PWA (step 9). Reinstall PWA into electronics assembly.

12. Apply system power, thread a reel of bulk-erased tape on transport, and place system into thread mode.

13. Select input monitoring for channel being aligned.

14. Adjust audio oscillator output to provide −5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

15. Place channel(s) being aligned in ready mode.

16. Place system in record mode.

17. Select repro monitoring for channel being aligned.

18. Adjust BIAS NORM control (Table 5-7) on PADNET for maximum 1.0-kHz output.

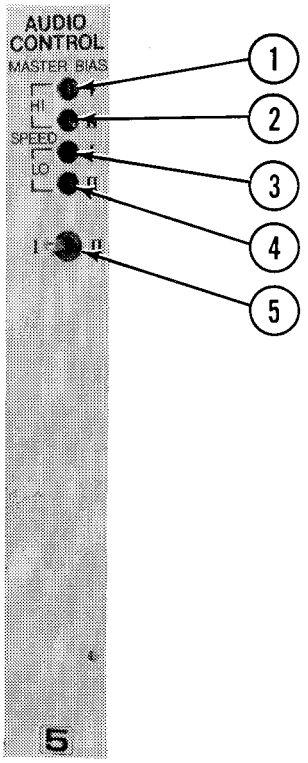
19. Adjust REC GAIN control (Table 5-7) on PADNET for −5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

20. Set audio oscillator to 25 kHz at 30 in/s, 15 kHz at 15 in/s or 7.5 in/s, or 7.5 kHz at 3.75 in/s.

21. Adjust record head azimuth adjustment screw (Figure 5-11) for maximum signal output.

22. Adjust bias by overbiasing a short wavelength signal (1.5 mils) for the speed in use as follows.

Table 5-10. Audio Control PWA No. 5 – Two-Speed Alignment Controls



INDEX NO.	CONTROL	FUNCTION
1	HI I (R6)	Adjusts high-speed I master bias level.
2	HI II (R5)	Adjusts high-speed II master bias level.
3	LO I (R4)	Adjusts low-speed I master bias level.
4	LO II (R3)	Adjusts low-speed II master bias level.
5	I/II Switch (S1)	Selects master bias I or II.

a. Set oscillator to frequency given in Table 5-11 for speed in use.

b. Reduce oscillator output level to obtain signal output level given in Table 5-11 for speed in use. (The output level is relative to the level set in step 19.)

c. Adjust BIAS NORM control (Table 5-7) on PADNET counterclockwise until level of signal being reproduced starts to fall. Then turn BIAS NORM slowly clockwise for maximum signal output. (If necessary, reduce oscillator level to maintain level set in step 22b.)

d. Continue turning BIAS NORM control clockwise until level has dropped from the maximum level obtained in step 22c by the amount specified in Table 5-11 for the speed and tape in use.

23. Set oscillator frequency to 1.0 kHz (500 Hz at 3.75 in/s).

24. Adjust audio oscillator output level to provide the following system output level:

    a. If input/output assembly is not being used, adjust oscillator output for −5 dBm at 15 and 30 in/s, −15 dBm at 7.5 in/s, or −25 dBm at 3.75 in/s.

    b. If input/output assembly is being used, adjust oscillator output for +4 dBm at 15 and 30 in/s, −6 dBm at 7.5 in/s, or −16 dBm at 3.75 in/s.

25. Set oscillator frequency to 20 kHz at 30 in/s, 15 kHz at 15 in/s, 10 kHz at 7.5 in/s, or 7.5 kHz at 3.75 in/s.

26. Adjust appropriate record equalizer control (HI SPEED or LO SPEED) on PADNET (Table 5-7) for same level as in step 24.

Table 5-11. Recommended Frequency, Signal Level, and Overbias Values for Bias and Equalization Adjustment

SPEED	FREQUENCY	LEVEL FOR BIAS AND EQUALIZATION ADJUSTMENT (Relative to 1.0 kHz Operating Level*)	OVERBIAS VALUE	
			406/407 TAPE	456 TAPE
30 in/s	20 kHz	0	1.75 ±0.25 dB	2.75 ±0.25 dB
15 in/s	10 kHz	0	1.75 ±0.25 dB	2.75 ±0.25 dB
7.5 in/s	5 kHz	−10 dB	1.75 ±0.25 dB	2.75 ±0.25 dB
3.75 in/s	2.5 kHz	−20 dB	1.75 ±0.25 dB	2.75 ±0.25 dB

*Recommended operating level is 370 nWb/m using Ampex 456 tape or 260 nWb/m using Ampex 406/407 tape.
NOTE: Frequency at each tape speed shown in the table has been chosen to provide a short wavelength signal of 1.5 mils.

27. Sweep oscillator through the following frequency range and fine-adjust the appropriate reproduce equalizer control (HI SPEED LF or LO SPEED LF) on PADNET (Table 5-7) to obtain the most uniform low frequency response.
    a. 30 in/s – 35 Hz to 400 Hz
    b. 15 in/s, 7.5 in/s, or 3.75 in/s – 20 Hz to 200 Hz
28. Sweep oscillator through frequency ranges given in Table 5-12 for speed in use. Output should remain within limits shown in Table 5-12 for each frequency range. If necessary, make slight adjustments to the appropriate record high-frequency equalizer control (HI SPEED or LO SPEED) and/or reproduce low-frequency equalizer control (HI SPEED LF or LO SPEED LF) on PADNET PWA (Table 5-7) to obtain flattest midband response consistent with meeting extreme high- and low-frequency tolerances.
29. Select input monitoring for channel being aligned.
30. Set oscillator frequency to 1.0 kHz (500 Hz at 3.75 in/s).
31. Adjust oscillator output level for −5 dBm at the output of the recorder/reproducer, or for +4 dBm at the output of the input/output assembly.
32. Select repro monitoring for channel being aligned.
33. Adjust REC GAIN on PADNET PWA (Table 5-7) for −5 dBm at the output of the recorder/reproducer, or for +4 dBm at the output of the input/output assembly.
34. For a single-channel system, this completes the record alignment for the first speed selected for adjustment. To adjust for the second speed, proceed to the *Second Speed Record Alignment* procedure, paragraph 5-47.
35. For a 2-track or 4-track system, align the other channels for the same speed in use by following the *First Speed Record Alignment* procedure, steps 2, 5, 6, 14 through 20, and 22 through 33. Do not readjust MASTER BIAS level control on audio control PWA No. 5 (steps 9 and 10) and do not readjust record head azimuth (steps 20 and 21).

5-47. Second Speed Record Alignment. When aligning the record system for a second speed after all channels have been adjusted for the first speed, none of the BIAS NORM controls are readjusted. Bias level for the second speed is set by adjusting the appropriate MASTER BIAS level control on audio control PWA No. 5. When aligning a 2-track or 4-track system, the MASTER BIAS level need only be set once while monitoring the output of any one channel. The bias level for the other channel(s) is automatically set correctly to the

Table 5-12. Overall Record/Reproduce Frequency Response

SPEED/EQUALIZATION STANDARD	REFERENCE FREQUENCY	TOLERANCE ±0.75 dB	TOLERANCE ±2.0 dB	LEVEL FOR FREQUENCY RESPONSE RELATIVE TO OPERATING LEVEL*
30 in/s AES	1 kHz	200 Hz – 20 kHz	35 Hz – 25 kHz	0 dB
15 in/s NAB or IEC	1 kHz	100 Hz – 15 kHz	20 Hz – 20 kHz	0 dB
7.5 in/s NAB or IEC	500 Hz	100 Hz – 10 kHz	30 Hz – 15 kHz	–10 dB
3.75 in/s NAB/IEC	500 Hz	(not specified)	30 Hz – 10 kHz**	–20 dB

*Operating level is 370 nWb/m at 700 Hz for Ampex 456 tape and 260 nWb/m at 700 Hz for Ampex 406/407 tape.
**For Ampex 456 tape.
For Ampex **406/407** tape specification is: 30 Hz – 7.5 kHz, ±2.0 dB.

same biasing point as the channel that was monitored.

To align the record system for a second speed after the first speed has been adjusted, proceed as follows:

1. Set system tape speed at the transport control panel.
2. Set oscillator frequency to 1.0 kHz.
3. Select input monitoring for channel being aligned.
4. Adjust audio oscillator output to provide –5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.
5. Place channel being aligned in ready mode.
6. Place system in record mode.
7. Select repro monitoring for channel being aligned.
8. Adjust bias by overbiasing a short wavelength signal (1.5 mils) for the speed in use as follows:
   a. Set oscillator to frequency given in Table 5-11 for speed in use.
   b. Reduce oscillator output level to obtain signal output level given in Table 5-11 for speed in use.
   c. Adjust appropriate MASTER BIAS control (Table 5-9 or 5-10), on audio control PWA No. 5, counterclockwise until level of signal being reproduced starts to fall. Then turn MASTER BIAS control slowly clockwise for maximum signal output. (If necessary, reduce oscillator level to maintain level set in step 8b.)
   d. Continue turning MASTER BIAS control clockwise until level has dropped from the maximum level obtained in step 8c by the amount specified in Table 5-11 for the speed and tape in use.
9. Set oscillator frequency to 1.0 kHz (500 Hz at 3.75 in/s).
10. Adjust audio oscillator output level to provide the following system output level:
    a. If input/output assembly is not being used, adjust oscillator output for –5 dBm at 15 and 30 in/s, –15 dBm at 7.5 in/s, or –25 dBm at 3.75 in/s.
    b. If input/output assembly is being used, adjust oscillator output for +4 dBm at 15 and 30 in/s, –6 dBm at 7.5 in/s, or –16 dBm at 3.75 in/s.
11. Set oscillator frequency to 20 kHz at 30 in/s, 15 kHz at 15 in/s, 10 kHz at 7.5 in/s, or 7.5 kHz at 3.75 in/s.

12. Adjust appropriate record equalizer control (HI SPEED or LO SPEED) on PADNET (Table 5-7) for same level as in step 10.

13. Sweep oscillator through the following frequency range and fine-adjust the appropriate reproduce equalizer control (HI SPEED LF or LO SPEED LF) on PADNET (Table 5-7) to obtain the most uniform low-frequency response.

    a. 30 in/s – 35 Hz to 400 Hz.

    b. 15 in/s, 7.5 in/s, or 3.75 in/s – 20 Hz to 200 Hz.

14. Sweep oscillator through frequency ranges given in Table 5-12 for speed in use. Output should remain within limits shown in Table 5-12 for each frequency range. If necessary, make slight adjustments to the appropriate record high-frequency equalizer control (HI SPEED or LO SPEED) and/or reproduce low-frequency equalizer control (HI SPEED LF or LO SPEED LF) on PADNET PWA (Table 5-7) to obtain flattest midband response consistent with meeting extreme high- and low-frequency tolerances.

15. Select input monitoring for channel being aligned.

16. Set oscillator frequency to 1.0 kHz (500 Hz at 3.75 in/s).

17. Adjust oscillator output level for −5 dBm at the output of the recorder/reproducer, or for +4 dBm at the output of the input/output assembly.

18. Select repro monitoring for channel being used.

19. Check that reproduced level is −5 dBm ±0.5 dB at the output of the recorder/reproducer, or is +4 dBm ±0.5 dB at the output of the input/output assembly.

5-48. 2-Track or 4-Track Record Head Azimuth and Phase Adjustment. The adjustment of record head azimuth and phase (multitrack systems only) should not be attempted unless the following criteria have been met: reproduce equalization is correct, reproduce head azimuth has been set using a standard alignment tape, and record equalization and bias are known to be correct. Prior to performing the alignment procedure, refer to the general discussion concerning head azimuth and phase adjustment, paragraph 5-33. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* section of the manual, paragraphs 5-4 and 5-7.

2. As a preliminary adjustment, turn record head azimuth adjusting screw (Figure 5-11) so that reference hole in tapered gear is in front of the head-gap region.

3. Connect a dual trace scope as follows:

   NOTE

   If a dual trace scope is not available, proceed to step 4.

    a. For a 2-track head assembly system, connect scope to channel 1 and to channel 2 outputs of the recorder system.

    b. For a 4-track head assembly system, connect scope to channel 1 output and to channel 4 output of the recorder system.

    c. Trigger scope from recorder channel 1 output.

    d. Proceed to step 5.

4. If a dual trace scope is not available, connect a single-channel scope to display a Lissajou pattern as follows:

    a. For a 2-track head assembly system, connect channel 1 output to the vertical input of scope and connect channel 2 output to the horizontal input of the scope.

    b. For a 4-track head assembly system, connect channel 1 output to the vertical input of scope and connect channel 4 output to the horizontal input of the scope.

5. Connect audio oscillator to input of recorder system to drive all channels simultaneously.

6. Set oscillator frequency to 1.0 kHz.

7. Connect ac voltmeter to any one of the audio outputs.

8. Apply power and thread a reel of tape on transport and place system into thread mode.

9. Select the lower of the two operating speeds.

10. Place all channels into record mode.

11. Select repro monitoring mode.

12. Adjust oscillator output level for −5 dBm at the output of the recorder/reproducer or for +4 dBm at the output of the input/output assembly.

13. Adjust record head azimuth adjusting screw (Figure 5-11) for minimum phase error (or straight 45° line on Lissajou display).

14. Increase oscillator frequency to frequency specified in Table 5-11 for speed in use.

15. Reduce oscillator output level as required to provide system output level specified in Table 5-11 relative to level set in step 12 at 1.0 kHz.

16. Fine-adjust record head azimuth adjusting screw to further minimize mean phase error.

17. If system is a 4-track head assembly system, replace channel 4 input to oscilloscope with channel 3 and repeat step 15. Repeat this step and step 15, but with scope connected to channel 2. The maximum mean phase error difference from channel 1 to channel 4 should not exceed ±10° at frequencies shown in frequency column of Table 5-11.

NOTE

Dynamic phase errors are mainly dependent upon tape slitting accuracy and other tape related factors. Typical dynamic phase errors are as follows:

2 track — 1/4 inch tape systems, ±15° at 1.5 mil wavelength recorded on tape.

4 track — 1/2 inch tape systems, ±25° at 1.5 mil wavelength recorded on tape.

(A 1.5-mil wavelength recorded on tape is equivalent to 20 kHz at 30 in/s, 10 kHz at 15 in/s, 5 kHz at 7.5 in/s, or 2.5 kHz at 3.75 in/s.)

5-49. Full-Track Record Head Azimuth Adjustment. The adjustment of record head azimuth should not be attempted unless the reproduce head azimuth has been set using a standard alignment tape. Prior to performing the alignment procedure, refer to the general discussion concerning head azimuth adjustment, paragraph 5-33. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* section of the manual, paragraphs 5-4 and 5-7.

2. As a preliminary adjustment, turn record head azimuth adjusting screw (Figure 5-11) so that reference hole in tapered gear is in front of the head-gap region.

3. Connect a scope or ac voltmeter to the output of the recorder system.

4. Connect an audio oscillator to input of recorder system.

5. Apply power and thread a reel of tape on transport and place system into thread mode.

6. Select the lower of the two operating speeds.

7. Place recorder/reproducer into record mode.

8. Select repro monitoring mode.

9. Set oscillator frequency to upper band edge frequency shown in Table 5-12 for speed in use.

10. Adjust oscillator output to level for −5 dBm at the output of the recorder/reproducer,

or for +4 dBm at the output of the input/output assembly.

11. Readjust oscillator output level shown in Table 5-12 for the level for frequency response relative to operating level for the speed in use.

12. Adjust record head azimuth adjusting screw (Figure 5-11) for maximum system output level.

5-50. Sel Sync Equalization and Gain Adjustment. The sel sync equalization and gain adjustment is made while reproducing a recording made on the recorder/reproducer. The recorder/reproducer has an additional low-frequency reproduce equalizer for the sel-sync mode which must be adjusted prior to the adjustment of SEL SYNC gain. Since sel-sync mode is most commonly used for 15- and 30-in/s operation, adjustment instructions are given for these two speeds. The sel-sync adjustment procedure should only be performed after the reproduce and record alignment procedures have been performed. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual, paragraphs 5-4 and 5-7.

2. Set sel-sync equalization control R15 on main audio PWA (Figure 5-12) to the center of its range.

3. Place main audio PWA of channel to be aligned on extender board and install into electronics assembly.

4. If an input/output assembly is being used, connect an ac voltmeter to appropriate output connector, and connect an audio oscillator to appropriate input connector (Figures 2-14 and 2-15).

5. If an input/output assembly is not being used, connect an ac voltmeter to appropriate recorder/reproducer output connector J13 or J14, and connect audio oscillator to appropriate input connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

6. Apply power, thread reel of tape on transport, and place system into thread mode.

7. Set oscillator frequency to 1.0 kHz.

8. Select input monitoring for channel being aligned.

9. Adjust audio oscillator output to provide −5 dBm at the output of the recorder/reproducer or +4 dBm at the output of the input/output assembly.

10. Place channel being aligned in ready mode.

11. Select 15- or 30-in/s tape speed and place system into record mode.

12. Select repro monitoring for channel being aligned.

13. Verify that system output level is −5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly. If output is not as specified, perform the applicable reproduce or record alignment procedure.

14. Set tape timer to zero and continue to record 1.0-kHz signal for five seconds.

15. Switch oscillator frequency to 100 Hz and note 100-Hz reproduced output level relative to 1.0-kHz output level. Continue alternating oscillator input frequency between 1.0 kHz and 100 Hz at five-second intervals for at least two minutes.

16. Stop recording and rewind tape to tape-timer zero.

17. Place channel being aligned in sync mode.

18. Place system in play mode.

19. Adjust SYNC GAIN control (Table 5-7) on PADNET PWA to obtain output of −5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

20. Carefully adjust sel-sync equalization control R15 (Figure 5-12) during 1.0-kHz tone until 100-Hz level and 1.0-kHz level have the same value.

21. Remove system power and replace main audio PWA into electronics assembly without extender board.

22. Reapply system power, select sync mode for channel being aligned, and place system in play mode to reproduce recording made in step 15.

23. Note the relative difference between the 100-Hz signal and the 1.0-kHz signal as compared to relative difference noted in step 15. If relative error differs more than ±0.5 dB, remove system power and make a small adjustment to R15 on main audio PWA. (Note: Turning R15 clockwise increases 1.0-kHz level relative to 100-Hz level.)

24. Repeat steps 22 and 23 as necessary to reduce error to within ±0.5 dB.

25. Set tape timer to zero and record a 1.0-kHz signal for 15 seconds.

26. While still recording, record a slow sweep in frequency from 40 Hz to 12 kHz at 15 in/s, or 80 Hz to 15 kHz at 30 in/s.

27. Stop recording and rewind tape to tape-timer zero.

28. Select sync mode for channel being aligned.

29. Place system in play mode.

30. While reproducing the 1-kHz tone, adjust SYNC GAIN for −5 dBm at the output of the recorder/reproducer, or +4 dBm output of the input/output assembly.

31. While reproducing the sweep tone recorded in step 26, verify that the output is within ±2 dB of the 1-kHz level recorded in step 25.

5-51. Erasure Depth Adjustment and Measurement. The erase current supplied to the erase head is adjustable by means of a master erase bus potentiometer control on audio control PWA No. 5. This is the only adjustment required for the erase system. Because of the extreme erase depth of which the recorder/reproducer is capable, it is mandatory that the tape used for adjustment and depth measurement be thoroughly bulk degaussed. This will prevent any crosstalk from an unerased portion of the tape being interpreted as the erased signal level. For accurate measurement of erasure depth, a spectrum analyzer, wave analyzer, or 1/10 octave filter should be used. If these instruments are unavailable, a reasonably accurate adjustment can be made by listening to the erased signal at an elevated monitoring level. The erase performance specifications given in this procedure apply to Ampex 406, 407, or 456 tape or the exact equivalent. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual, paragraphs 5-3 and 5-7.

2. Set master erase bus level control R34 on audio control PWA No. 5 (Figure 5-14) to the center of its range.

3. Place audio control PWA No. 5 on an extender board and install into electronics assembly.

4. If an input/output assembly is being used, connect a spectrum analyzer, wave analyzer, or 1/10 octave filter to appropriate output connector, and connect an audio oscillator to appropriate input connector (Figures 2-14 and 2-15).

5. If an input/output assembly is not being used, connect a spectrum analyzer, wave analyzer, or 1/10 octave filter to appropriate recorder/reproducer output connector J13 or J14, and connect an audio oscillator to appropriate input connector J13 or J14 (Figures 2-13 and Tables 2-2 and 2-3).

6. Apply power, thread a reel of bulk-degaussed tape of the same kind that was used to align the reproduce and record circuits. Place system into thread mode.

7. Set speed select switch to highest operating speed.

8. Place system in record mode (channels not under test should also be placed in record mode).

9. Set oscillator frequency to appropriate frequency as follows: 400 Hz at 30 in/s, 200 Hz at 15 in/s, or 100 Hz at 7.5 in/s. Adjust oscillator output level for +5 dBm at the output of the recorder/reproducer, or +14 dBM at the output of the input/output assembly.

10. Adjust analyzer to zero reference, or note analyzer range setting and meter reading.

11. Reset tape timer display to zero.

12. Record continuously for five minutes and rewind tape to tape timer display zero.

13. Remove oscillator and short signal input terminals (or short input with an impedance not greater than 300 ohms).

14. Again place system into record mode and adjust analyzer range setting to observe residual erase signal level.

15. Adjust R34 (Figure 5-14) slowly counterclockwise, and note when erased signal amplitude suddenly increases. Then adjust R34 slowly clockwise until erase signal is 85 dB below unerased level established in step 9 (−80 dBm at the output of the recorder/reproducer or −71 dBm at the output of the input/output assembly). If a wave analyzer or spectrum analyzer with a resolution bandwidth less than 5 Hz is being used, continue turning R34 clockwise until a minimum amplitude erased signal is seen.

16. Without disturbing the setting of R34 established in step 15, repeat steps 8 through 14 for the other channel(s). If any channel does not measure at least 85 dB below the unerased level, repeat step 15 for that channel.

17. Connect oscilloscope to TP2 (144 kHz) on audio control PWA No. 5.

18. Note peak-to-peak amplitude of square wave signal. Voltage level at TP2 should not exceed 6 Vp-p. At that setting of R34, the residual erased signal level will normally be greater than 90 dB below unerased level set in step 9.

5-52. Input/Output Assembly Adjustment. Procedures for adjusting offset null, input and output operating level, and level meter calibration are given below. Instructions for setting the operating input and output level to +4 dBm are given, but other values may be selected by the user. Input levels can be from +30 to −5 dBm in the variable mode or +20 dBm to −1 dBm in the preset mode. Output levels can be from +12 dBm to −25 dBm in the variable mode or from +20 dBm to −1 dBm in the preset mode. (However, the interface input and output operating level to and from the ATR-100 should be set to −5 dBm regardless of the levels selected for the input/output assembly line input and line output.)

Two methods for adjusting the input and output levels are presented. Method 1 requires a jumper/clip lead and standard test equipment interconnect cables. Method 2 requires an I/O Level Set Accessory (Ampex Part No. 4020425) shown in Figure 5-15. This accessory consists of a printed circuit board that is plugged into the ATR-100 electronics assembly (on an extender board) in place of the standard audio PWA. The accessory connects the signal input and output of the input/output assembly together and provides a coaxial cable fitted with a GR plug that connects to an ac voltmeter. Each method will enable equal results but method 2 is more convenient for the user and, therefore, is the preferred method. Refer to Figures 5-16 and 5-17 and proceed as follows:

CAUTION

DO NOT REMOVE OR INSERT AN INPUT/OUTPUT MODULE OR ATR-100 PWA WITH POWER ON. TO DO SO MAY CAUSE DAMAGE TO COMPONENTS.

5-53. Offset Null Adjustments. Perform these steps on each input/output module only if repairs have been made or components have been changed on the input/output assembly that may affect circuit operation.

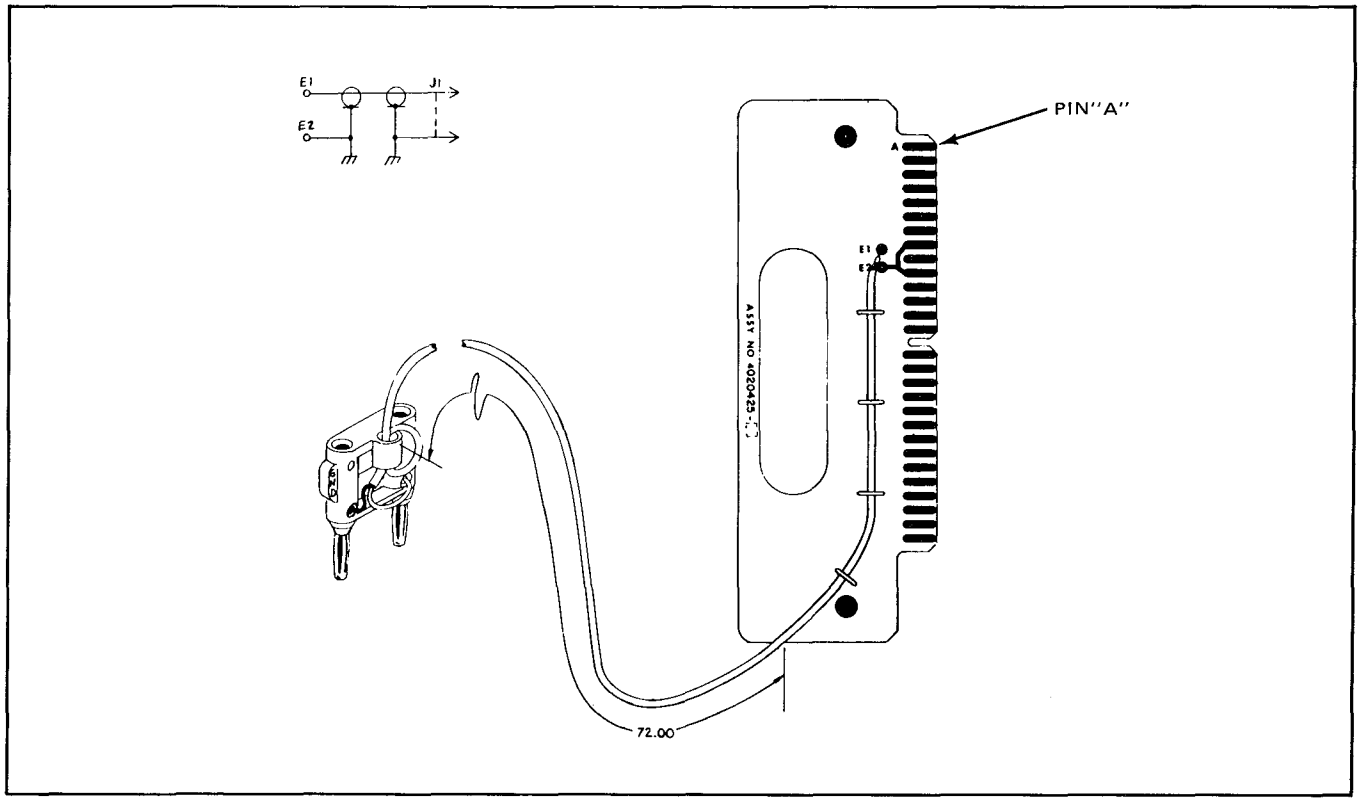


Figure 5-15. I/O Level Set Accessory

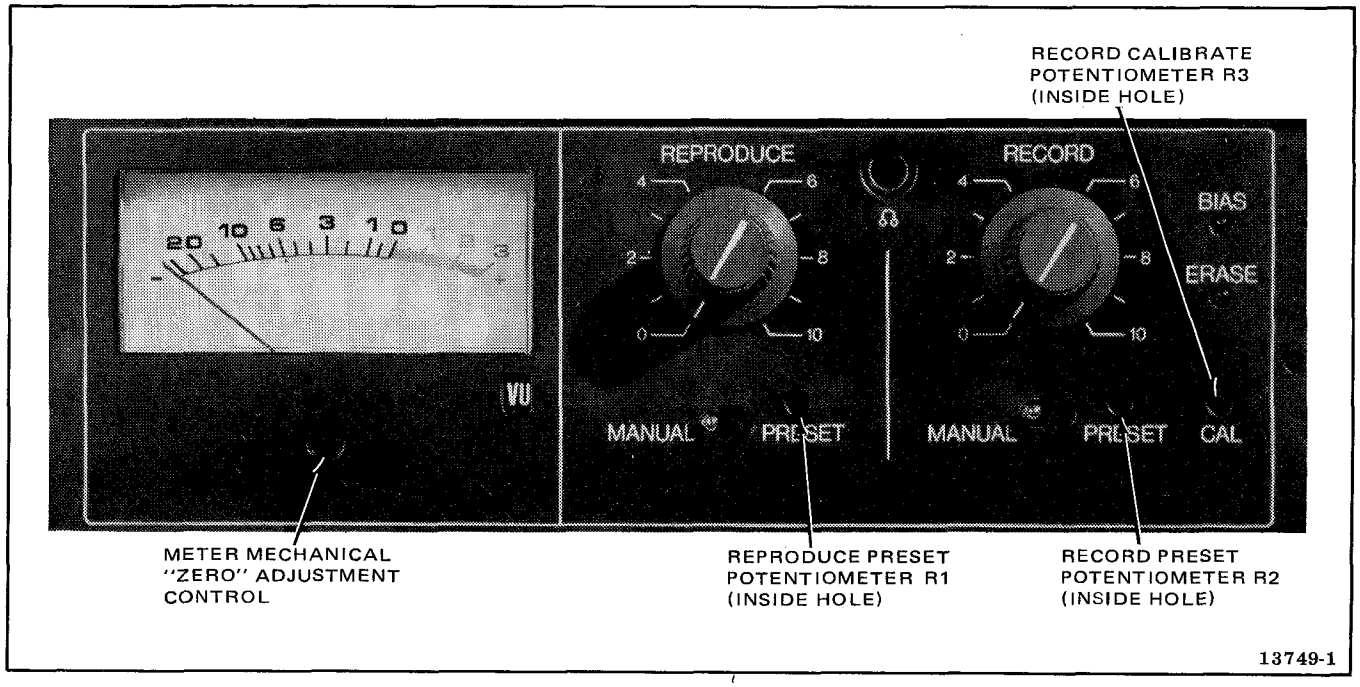


Figure 5-16. Input/Output Module Adjustment Control Locations

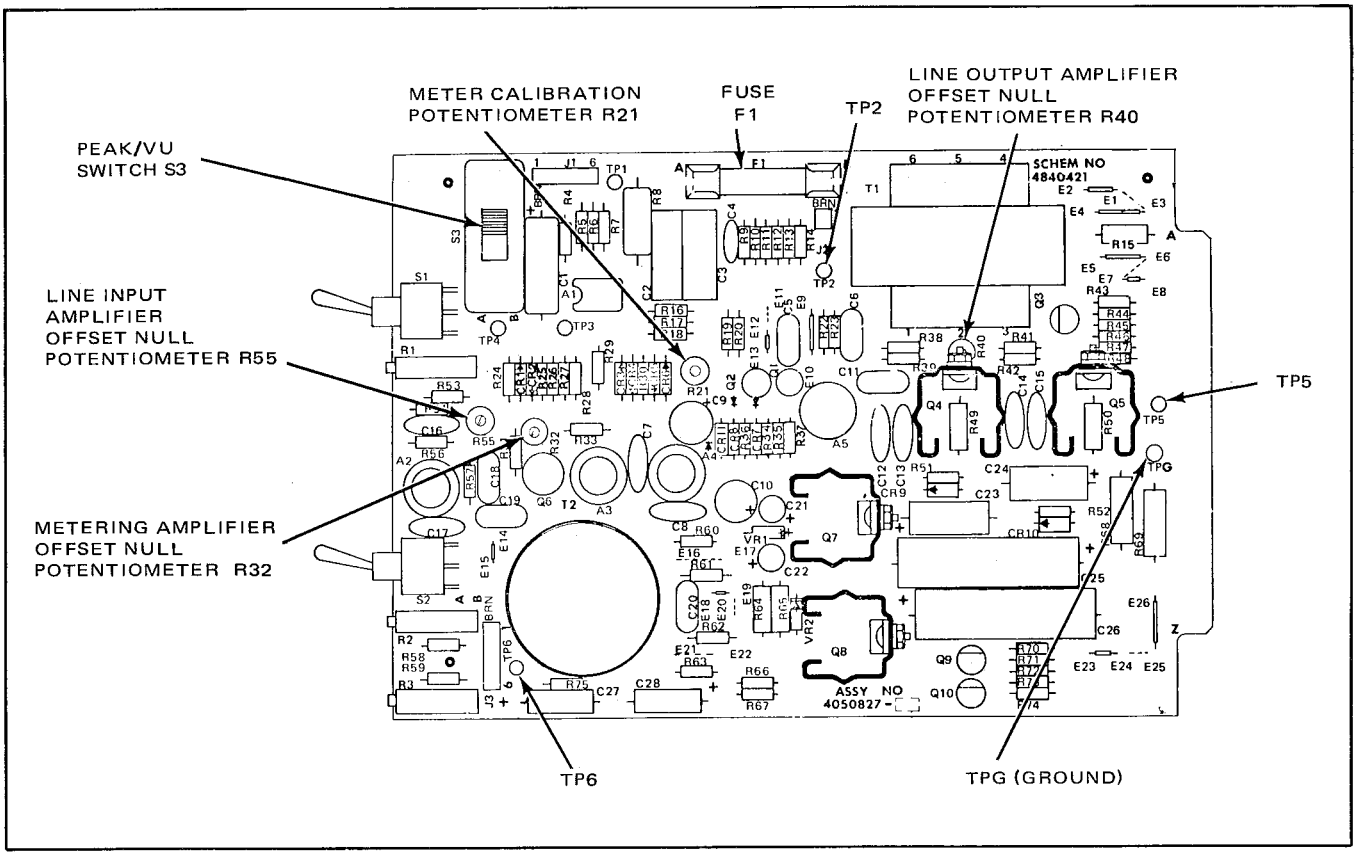


Figure 5-17. Input/Output Module Assembly

1. With power removed, adjust the meter mechanical "zero" adjustment control (Figure 5-16) for mechanical zero (meter at left-hand dial position).

2. Remove input/output module from input/output mainframe and place module on an extender board (Table 5-1). Insert extender board into mainframe.

3. Remove fuse F1 (Figure 5-17).

4. Set peak/vu switch S3 to desired operating position (peak or vu reading on vu/peak meter).

5. Disconnect signal input so that there is no signal being fed to input/output assembly.

6. Apply power and adjust metering amplifier offset null potentiometer R32 (Figure 5-17) for zero indication (same as step 1) on the level meter.

7. Connect a dc voltmeter to TP6 and ground (Figure 5-17).

8. Set RECORD MANUAL/PRESET switch to MANUAL position.

9. Adjust line input amplifier offset null potentiometer R55 for zero change in voltage at TP6 while rotating RECORD potentiometer through its range.

10. Connect dc voltmeter to TP2 and ground (Figure 5-17).

11. Adjust line output amplifier offset null potentiometer R40 (Figure 5-17) for 0 ±30 mV at TP2. Remove dc voltmeter.

12. Remove power and resinstall fuse F1.

5-54. Record Level Adjustment (Method 1). Proceed as follows:

1. Connect an audio oscillator to the line input connector (Figure 2-14). Set oscillator frequency to 1.0 kHz and adjust oscillator output level to +4 dBm (or other operating level selected by the user).
2. Connect ac voltmeter to TP6 and ground (Figure 5-17).
3. Set RECORD MANUAL/PRESET switch to PRESET position.
4. Adjust record preset potentiometer R2 (Figure 5-16) for −5-dBm level at TP6.
5. Connect ac voltmeter to line output connector (Figure 2-14) and terminate line output with 600 ohms, or place switch (Figure 2-14) in the terminate position.
6. Select input monitoring for channel being aligned.
7. Adjust record calibrate potentiometer R3 (Figure 5-16) for +4-dBm level on the ac voltmeter (or other line output operating level selected by the user).
8. Remove power and set peak/vu meter switch S3 (Figure 5-17) to desired operating position, peak or vu. Reapply power.
9. Select input monitoring for channel being aligned.
10. Adjust meter calibration potentiometer R21 (Figure 5-17) for indication of −6 dB (meter switch S3 in peak position) or 0 vu (meter switch S3 in vu position).

5-55. Reproduce Level Adjustment (Method 1). Proceed as follows:

1. Remove power and remove all audio PWAs from the recorder/reproducer electronics assembly.
2. Connect a jumper from TP5 to TP6 (Figure 5-17).
3. Connect an audio oscillator to the line input connector (Figure 2-14). Set frequency to 1.0 kHz and output level to +4 dBm (or other operating level selected by the user).
4. Set REPRODUCE MANUAL/PRESET switch to PRESET position.
5. Connect ac voltmeter to line output connector (Figure 2-14) and terminate line output with 600 ohms or place switch (Figure 2-14) in the terminate position.
6. Apply power and adjust reproduce preset potentiometer R1 (Figure 5-16) for +4-dBm level on the ac voltmeter (or other line operating level selected by the user).
7. Repeat the *Record Level Adjustment (Method 1)* and *Reproduce Level Adjustment (Method 1)* procedures for the other audio channels.
8. With power off, remove input/output module and extender board from input/output mainframe. Remove jumper connected from TP5 to TP6. Reinstall input/output module into mainframe.
9. Reinstall all audio PWAs into the recorder/reproducer electronics assembly.

5-56. Record and Reproduce Level Adjustment (Method 2). Proceed as follows:

1. Remove power and remove all audio PWAs from the recorder/reproducer.
2. Install recorder/reproducer extender board into electronics assembly corresponding to channel to be adjusted.
3. Install I/O level set accessory connector (Figure 5-15) into extender board with pin A in the uppermost position. Connect cable to ac voltmeter.
4. Remove input/output module from input/output mainframe and place module on an extender board (Table 5-1). Insert extender board into mainframe.

5. Connect an audio oscillator to line input connector (Figure 2-14). Set oscillator frequency to 1.0 kHz and adjust oscillator output level to +4 dBm (or other input operating level selected by the user).

6. Set RECORD MANUAL/PRESET switch to PRESET position.

7. Apply power and adjust record preset potentiometer R2 (Figure 5-16) for −5-dBm level on the ac voltmeter connected to the I/O level set accessory.

8. Connect ac voltmeter to line output connector (Figure 2-14) and terminate line output with 600 ohms or place switch (Figure 2-14) in the terminate position.

9. Select input monitoring for channel being aligned.

10. Adjust record calibrate potentiometer R3 (Figure 5-16) for +4-dBm level on the ac voltmeter (or other line output operating level selected by the user).

11. Select repro monitoring for channel being aligned.

12. Set REPRODUCE MANUAL/PRESET switch in the PRESET position.

13. Adjust reproduce preset potentiometer R1 (Figure 5-16) for +4-dBm level on the ac voltmeter (or other line output operating level selected by the user).

14. Remove power and set peak/vu meter switch S3 (Figure 5-17) to desired operation position, peak or vu. Reapply power.

15. Adjust meter calibration potentiometer R21 (Figure 5-17) for indication of −6 dB (meter switch S3 in peak position) or 0 vu (meter switch S3 in vu position).

16. Repeat procedure for the other audio channels.

17. With power off, remove input/output module and extender board from input/output mainframe. Reinstall input/output module into mainframe.

18. Remove extender board from electronics assembly and reinstall audio PWAs removed in step 1.

5-57. PURC Timing Alignment. The recorder/reproducer is capable of operating with or without PURC operation on each channel, as desired, by placement of a jumper located on each PADNET PWA. See Installation section of the manual (paragraph 2-30) for jumpering information. (Note: recorder/reproducers shipped from the factory are set for normal, non-PURC, operation.)

The only adjustment required for PURC alignment is the adjustment of PURC timing to normalize the delay timing to establish correct operation for all speeds. Once the adjustment control has been set for one speed, timing is automatically set when the other speed is selected.

To aid in the alignment of the PURC timing, an optional automatic record/play cycler may be used to cycle the recorder/reproducer for insert-edit operation (paragraph 3-19) while the PURC timing adjustment is being made. (The cycler is constructed by the user. See Figure 5-18 for cycler schematic diagram and parts list.) The PURC alignment procedure should only be performed if the record, reproduce, and erase alignment is known to be correct. Proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual, paragraphs 5-4 and 5-7.

2. Connect an audio oscillator to audio input connector corresponding to first channel to be aligned.

3. Set oscillator frequency to 1.0 kHz.

4. Connect scope to audio output connector corresponding to first channel to be aligned.

5. Adjust scope time base for 1.0-second horizontal sweep.

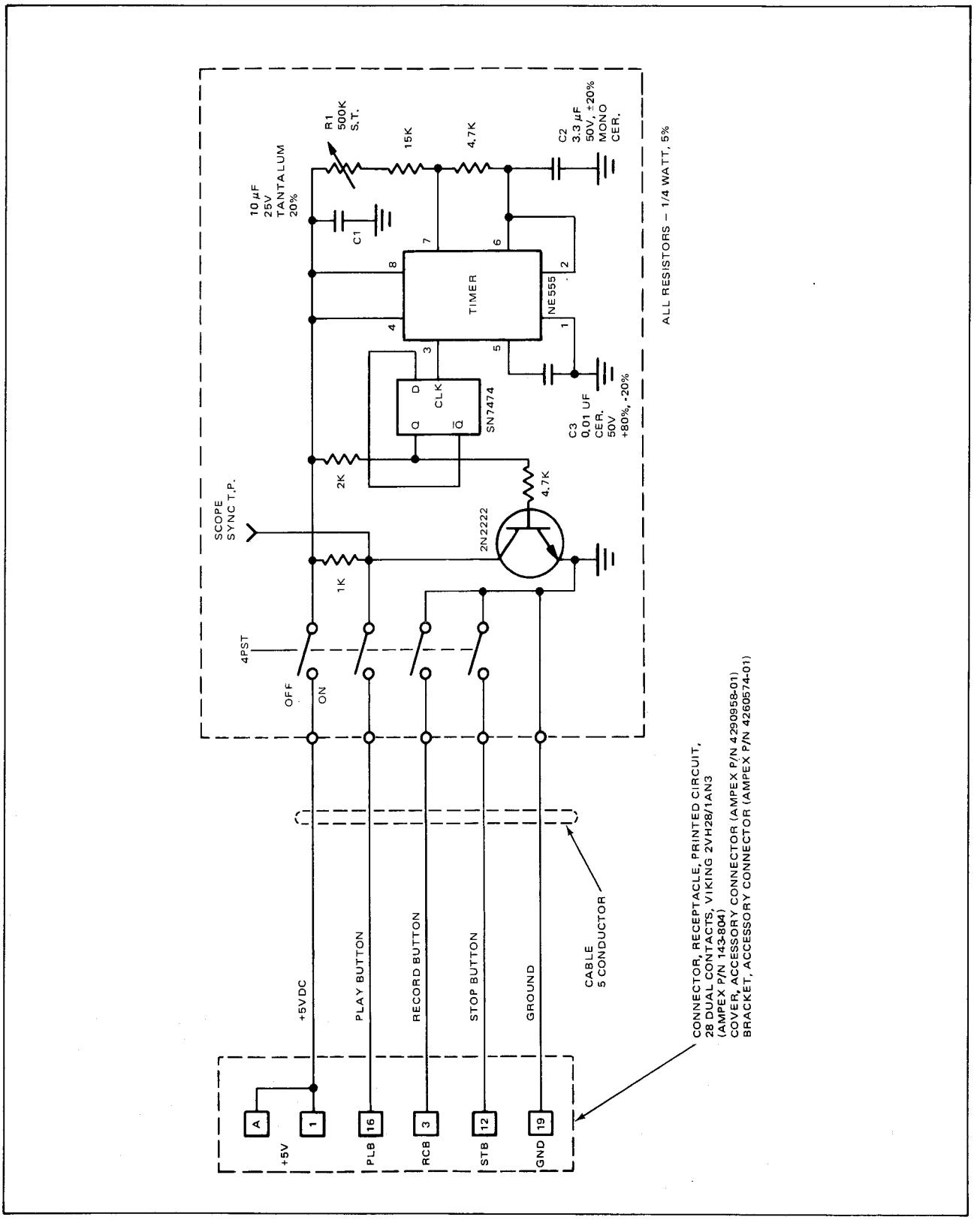


Figure 5-18. Automatic Record/Play Cycler

6. Apply power and thread a reel of tape on transport and place system into thread mode.

7. Place all channels into record mode at the speed most commonly used.

8. Adjust oscillator output level for system operating level; −5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

9. Set tape timer display to zero and record continuously for five minutes.

10. Rewind tape to tape-timer zero.

11. Remove power and place audio PWA of channel to be aligned on an extender board and reinstall into electronics assembly.

12. If automatic cycler is being used, connect cycler to external remote control connector J11 (Figure 2-13) and trigger scope from scope sync test point on cycler.

13. Change oscillator frequency to 1.5 kHz.

14. Reapply power and place system into play mode with channel being adjusted in ready mode and other channels in safe mode.

15. If cycler is being used, turn cycler power on and adjust cycle rate time control R1 on cycler to show ingoing and outgoing edges of insert on scope. Adjust PURC timing control R71 on main audio PWA (Figure 5-12) to minimize overlap on ingoing insert consistent with minimum gap on outgoing edge, as viewed on scope.

16. If cycler is not being used, perform insert edits manually. While in play mode, press and hold record pushbutton switch and then press and hold stop pushbutton switch. While still holding the record and stop pushbutton switches depressed, slowly press and release play pushbutton switch (system enters record mode when play pushbutton is depressed), and adjust R71 for condition described in step 15. Repeat pressing of play pushbutton switch, and adjust R71 as required to achieve conditions described in step 15.

17. Change transport speed to second speed and perform several insert edits (step 15 or 16). If necessary, readjust R71 for best compromise. Note: if only one speed will be used for PURC operation, then optimize operation at that speed.

18. Repeat steps 2 through 16 for other channel(s) selected for PURC operation.

19. Remove power and remove extender board from electronics assembly. Reinstall audio PWA into electronics assembly.

20. If automatic cycler was used, disconnect cycler from J11.

21. Disconnect audio oscillator from audio input connector.

5-58. Tape Transport Adjustments

5-59. Capstan Tach Sensor. Use the following procedures to check the operation of the capstan tach sensor PWA (Figure 5-19) and capstan tach LED PWA (Figure 5-47) and, if required, adjust the position of the capstan tach sensor PWA (steps 13 through 29). Normally an adjustment is required if the capstan motor "runs away" or if the capstan tach sensor PWA or capstan tach LED PWA is replaced. Proceed as follows:

1. Remove tape from recorder/reproducer.

2. Remove power and unplug reel servo PWA No. 9 within the electronics assembly (disables reel servo so that reel motors do not operate).

3. Place capstan servo PWA No. 8 on an extender board and install into electronics assembly.

4. Connect a dual trace scope to TP5 and TP6. Adjust scope for chop mode and trigger scope from either one of the two signals.

5. Apply power and press play pushbutton switch. Amplitude of sine wave signals on scope should be approximately 15 Vp-p. Note: The signal at TP6 will appear distorted because of hysteresis (distortion near the zero crossings).

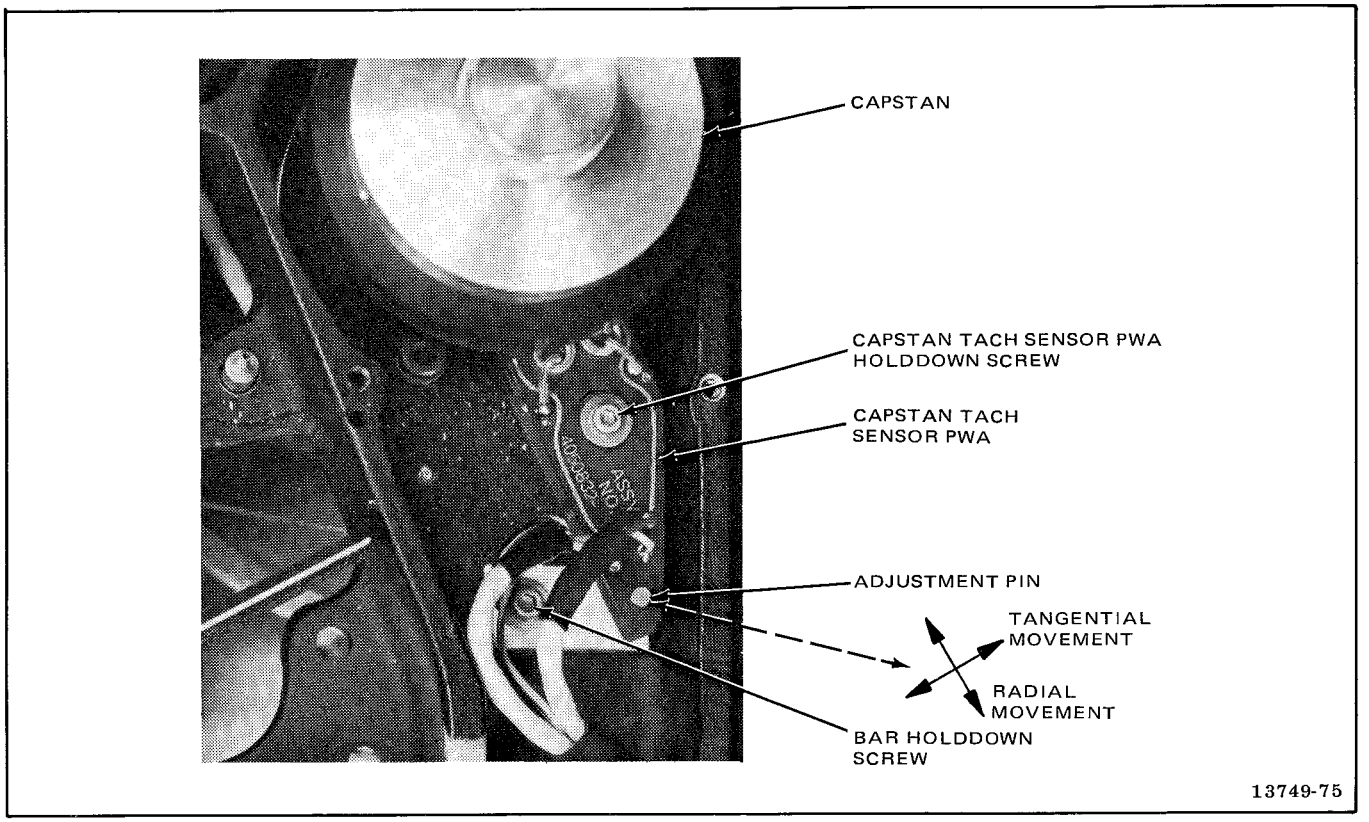


Figure 5-19. Capstan Tach Sensor Adjustment

6. Connect scope to TP3 and TP4. Adjust scope for chop mode and trigger scope from either one of the two signals.

7. The two signals should be 90° out of phase (Figure 5-20A or Figure 5-20B).

8. Check for the correct 90° phase relationship by pressing the stop pushbutton switch, and observe that the capstan quickly stops.

9. Press fast forward pushbutton and observe that the phase relationship of signals at TP3 and TP4 remain fairly constant as the capstan accelerates to full speed.

NOTE

If scope chop rate is too slow to observe the phase relationship, switch scope to algebraically add mode to observe the waveform (Figure 5-20D). The waveform shelves and spaces should be stable and not disappear or close.

10. Press stop pushbutton and observe that capstan quickly stops.

11. Repeat steps 9 and 10 in rewind mode.

12. If the preceding measurements of amplitude and phase were correct, but the capstan ran faster when the stop pushbutton was pressed, the capstan servo PWA No. 8 may have a malfunction or the capstan tach sensor PWA position may need to be adjusted to obtain the opposite 90° phase relationship of the signals at TP3 and TP4 (see Figure 5-20 and steps 13 through 29). If any of the previous conditions were not met, proceed to adjust the position of the capstan tach sensor PWA to obtain tach signals of proper amplitude and phase relationship by performing steps 13 through 29.

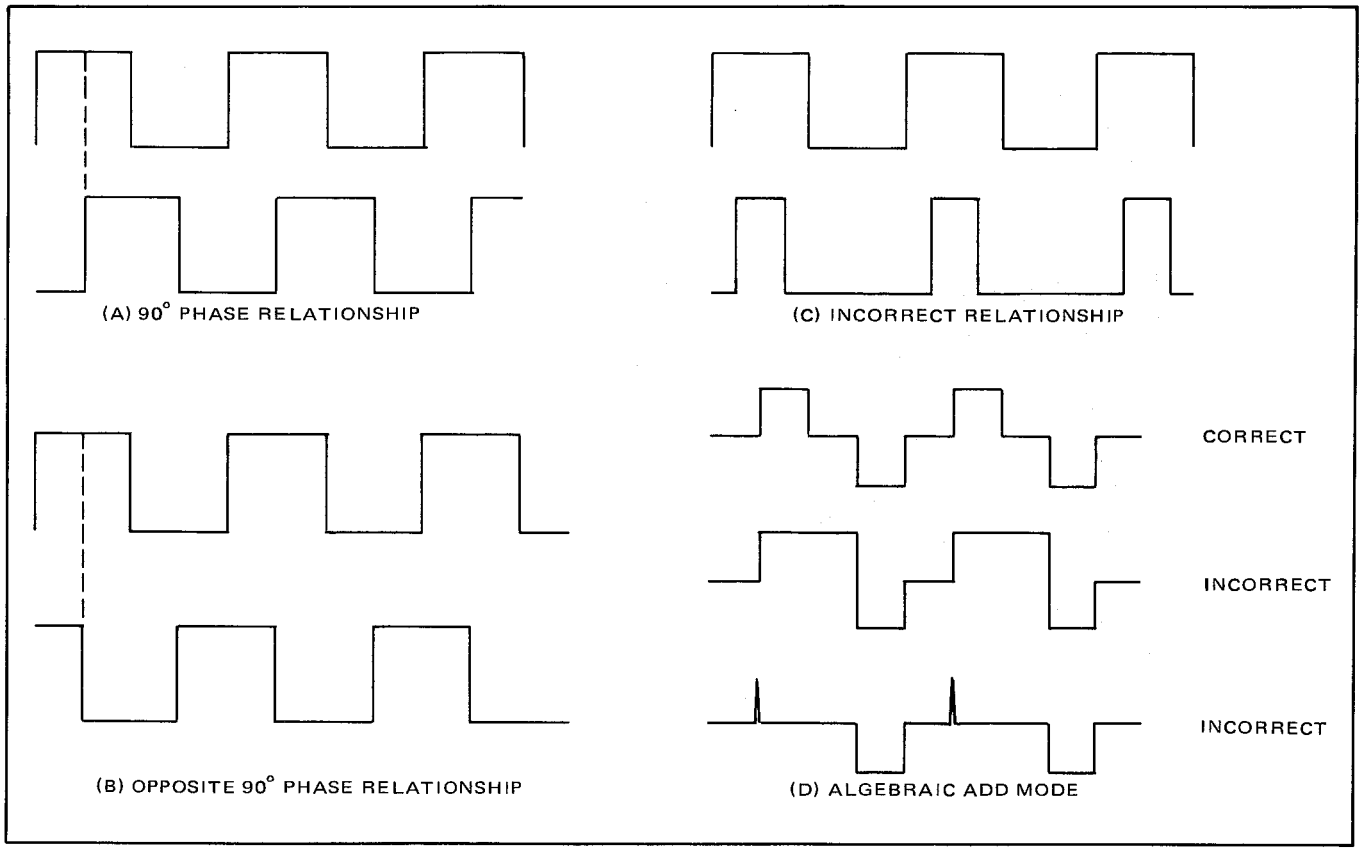


Figure 5-20. TP3 and TP4 Waveforms, PWA No. 8

13. Remove the head cover assembly and head assembly from the top of the transport.

14. Remove the transport front overlay panel from the top of the transport by removing two screws (Figure 5-22).

15. Remove front tach cover panel by removing one flat-head screw and banana plug shown in Figure 5-21.

16. Connect dual trace scope to TP5 and TP6. Adjust scope for chop mode and trigger scope from either one of the two signals.

17. Loosen the two holddown screws shown in Figure 5-19, but so there is still some tension against the lock washers.

CAUTION

FOR THE ADJUSTMENT THAT FOLLOWS AND WHILE THE TWO SCREWS ARE LOOSE (STEP 17), DO NOT PERMIT PWA TO CONTACT THE ROTATING CAPSTAN TACHOMETER AS DAMAGE TO THE TACHOMETER COULD OCCUR.

18. Carefully move adjustment pin (Figure 5-19) tangentially (left and right) and radially (in and out) to the capstan to obtain maximum output at TP5 and TP6.

19. Adjust potentiometers R32 and R50, on capstan servo PWA No. 8, to obtain a 15-Vp-p signal (approximately) at TP5 and TP6 respectively.

20. Connect scope to TP3 and TP4. Use chop mode and trigger scope from either one of these two signals.

21. Carefully move adjustment pin a very small amount radially (only) from the capstan to

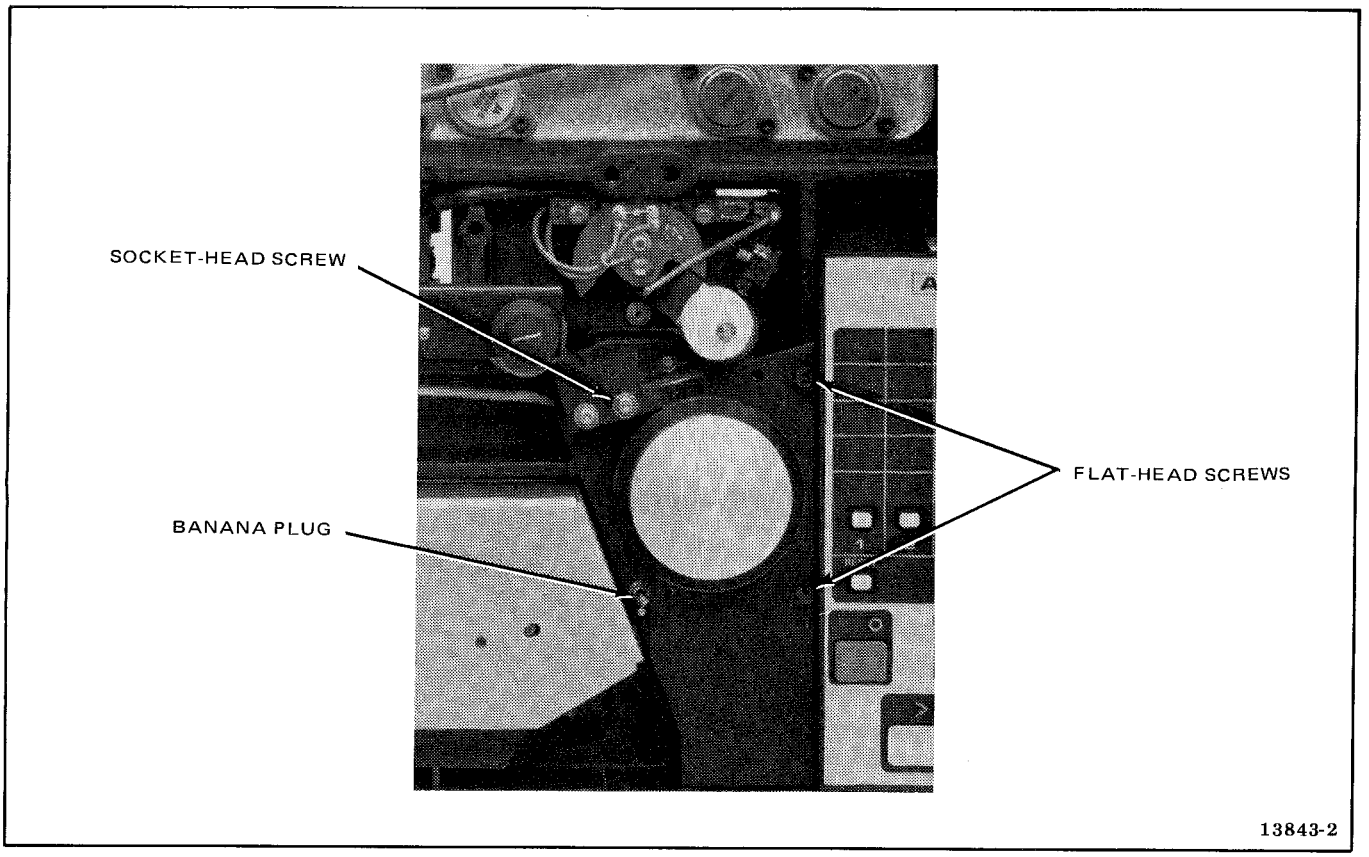


Figure 5-21. Front and Rear Tach, Cover Panel Removal

obtain a 90° phase difference between the two signals (Figure 5-20A or 5-20B).

22. Check for the correct 90° phase relationship by pressing the stop pushbutton switch and observing if the capstan quickly stops. If capstan quickly stopped, proceed to step 24; otherwise perform step 23.

23. If capstan ran faster when stop pushbutton was pressed, press rewind pushbutton to stop capstan and then press play pushbutton. Re-adjust adjustment pin radially (only) for a 90° phase relationship opposite to that previously observed in step 21.

NOTE

Capstan may have to be held by hand to prevent runaway at high speed before proper phase is found. If desired, capstan motor connector P18 (Figure 5-26) may be temporarily disconnected and capstan rotated by hand until the proper phase relationship is found.

24. After correct phase is established, first tighten the bar holddown screw, and then tighten the capstan tach sensor PWA holddown screw (Figure 5-19).

25. Connect scope to TP5 and TP6. Use chop mode and trigger scope from either one of the two signals.

26. Verify that the level set while performing step 19 has not changed. If level has changed, repeat step 19.

27. Further confirm the correct 90° phase relationship by performing steps 6, 9, 10 and 11.

28. Remove power and reinstall reel servo PWA No. 8, capstan servo PWA No. 9, tach cover panel, transport front overlay panel, head assembly, and head cover assembly.

29. Reconnect capstan motor connector P18 (if disconnected).

5-60. Tension Arm Limits. During recorder/reproducer operation, if a condition exists where either tension arm moves too far in toward the head assembly or too far out toward the reels, the recorder should enter stop/edit (unthread) mode. The supply and takeup potentiometers sense the arm position and cause the recorder to enter stop/edit mode just before the arm reaches its mechanical stop. If the recorder/reproducer fails to meet the tests that follow, adjust the position of the associated LED PWA. The enlarged mounting hole of the LED PWA permits movement of the LED PWA on the tension arm. Proceed as follows:

1. With power off, place reel servo PWA No. 9 on an extender board and reinstall into electronics assembly.

2. Connect a scope probe or dc voltmeter to outer limit test point TP5 of reel servo PWA.

3. With no tape on transport, apply power and hold both tension arms in mid position of travel. Indication should be high (+5 Vdc).

4. Hold both arms in mid position, and then release supply arm. Indication should go low (0 Vdc).

5. Hold both arms in mid position, and then release takeup arm. Indication should go low (0 Vdc).

6. Connect scope probe or dc voltmeter to inner limit test point TP6.

7. With both arms resting in the outer position, indication should be high (+5.0 Vdc).

8. Move supply arm in toward head. Indication should be low (0 Vdc).

9. With supply arm resting in outer position, move takeup arm in toward head. Indication should be low (0 Vdc).

10. If any of the preceding conditions were not met, proceed as follows:

    a. Remove head cover assembly and transport rear overlay panel (Figure 5-22).

CAUTION

REMOVE POWER BEFORE ADJUSTING THE POSITION OF AN LED PWA. ALSO DO NOT ALLOW METAL LUG UNDER AN LED HOLDDOWN SCREW TO SHORT AGAINST CIRCUIT TRACES ON THE PWA.

    b. Loosen the appropriate LED PWA holddown screw (Figure 5-23) and rotate the PWA relative to the tension arm. Tighten screw.

    c. Place overlay panel loosely in place to prevent ambient light affecting photopotentiometer operation.

    d. Repeat steps 2 through 10c, as necessary.

    e. Reinstall rear overlay panel and head cover assembly removed in step 10a. Verify that rear overlay panel does not interfere with the free rotation of the tension arms.

11. If any adjustments were made to the position of the LED PWAs, perform the *Tape Tension* adjustment procedure, paragraph 5-61.

5-61. Tape Tension. Adjust tape tension if tape should creep in either direction in stop mode or after changing or adjusting any component associated with the reel servo system. Proceed as follows:

1. Remove head cover assembly, and transport front overlay panel (Figure 5-22).

2. With power off, place reel servo PWA No. 9 (Figure 5-24) on an extender board.

3. Thread tape on recorder/reproducer and advance tape so there is equal tape pack on both reels.

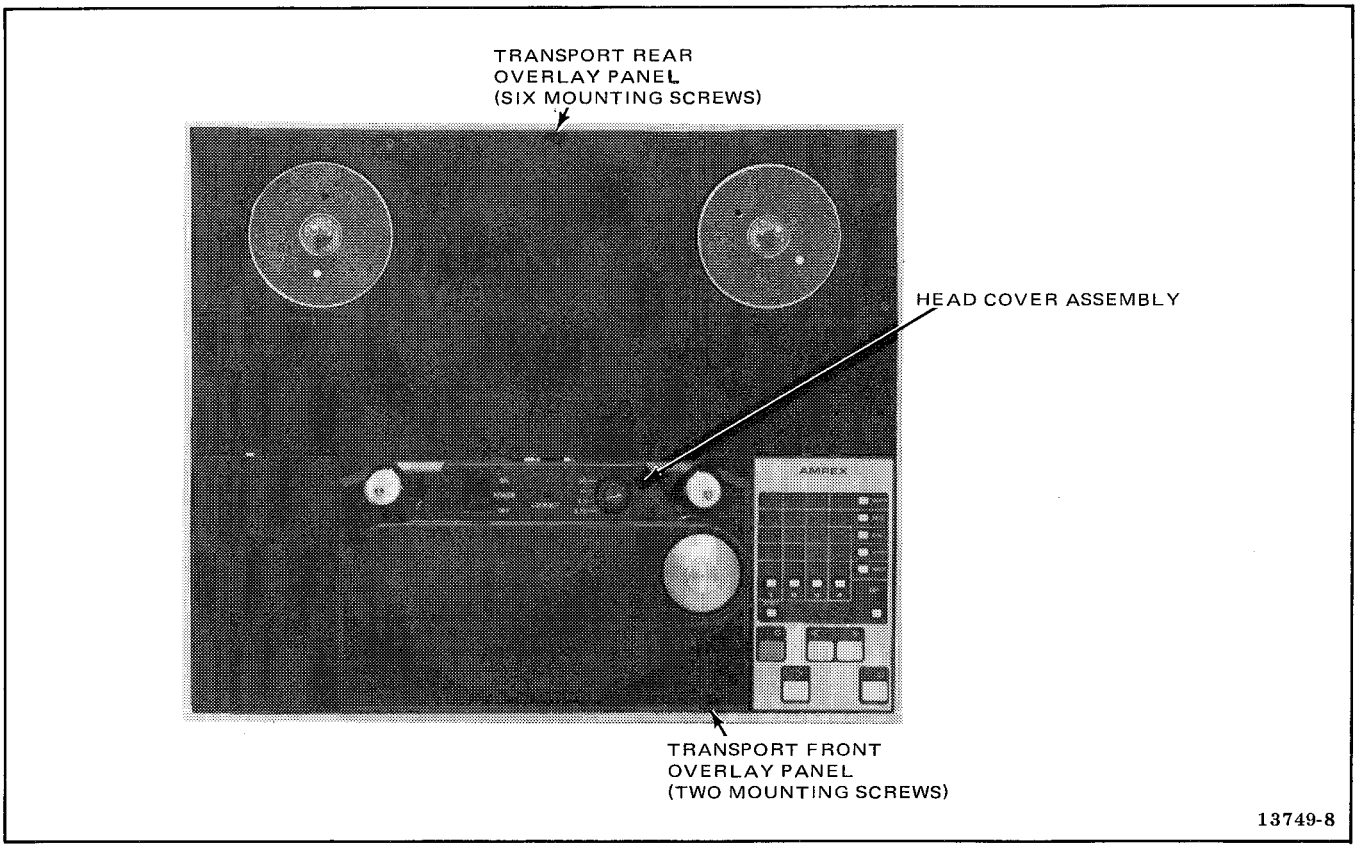


Figure 5-22. Head Cover and Overlay Panels

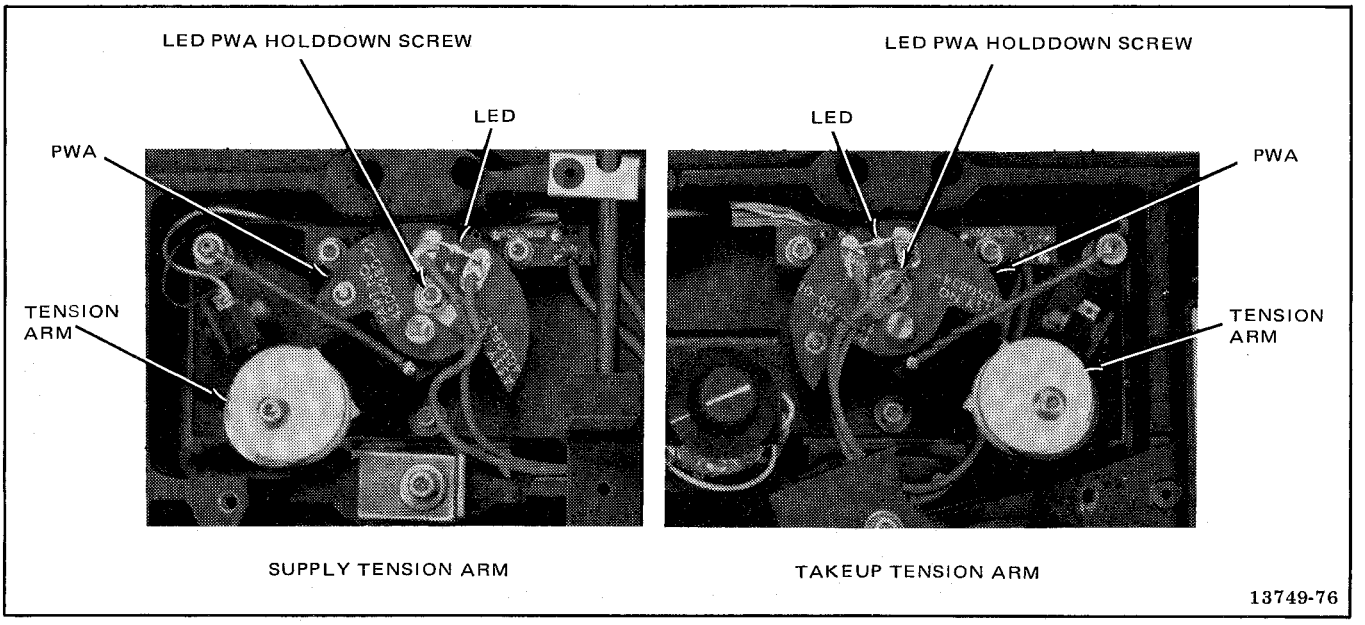


Figure 5-23. Tension Arm Limits Adjustment

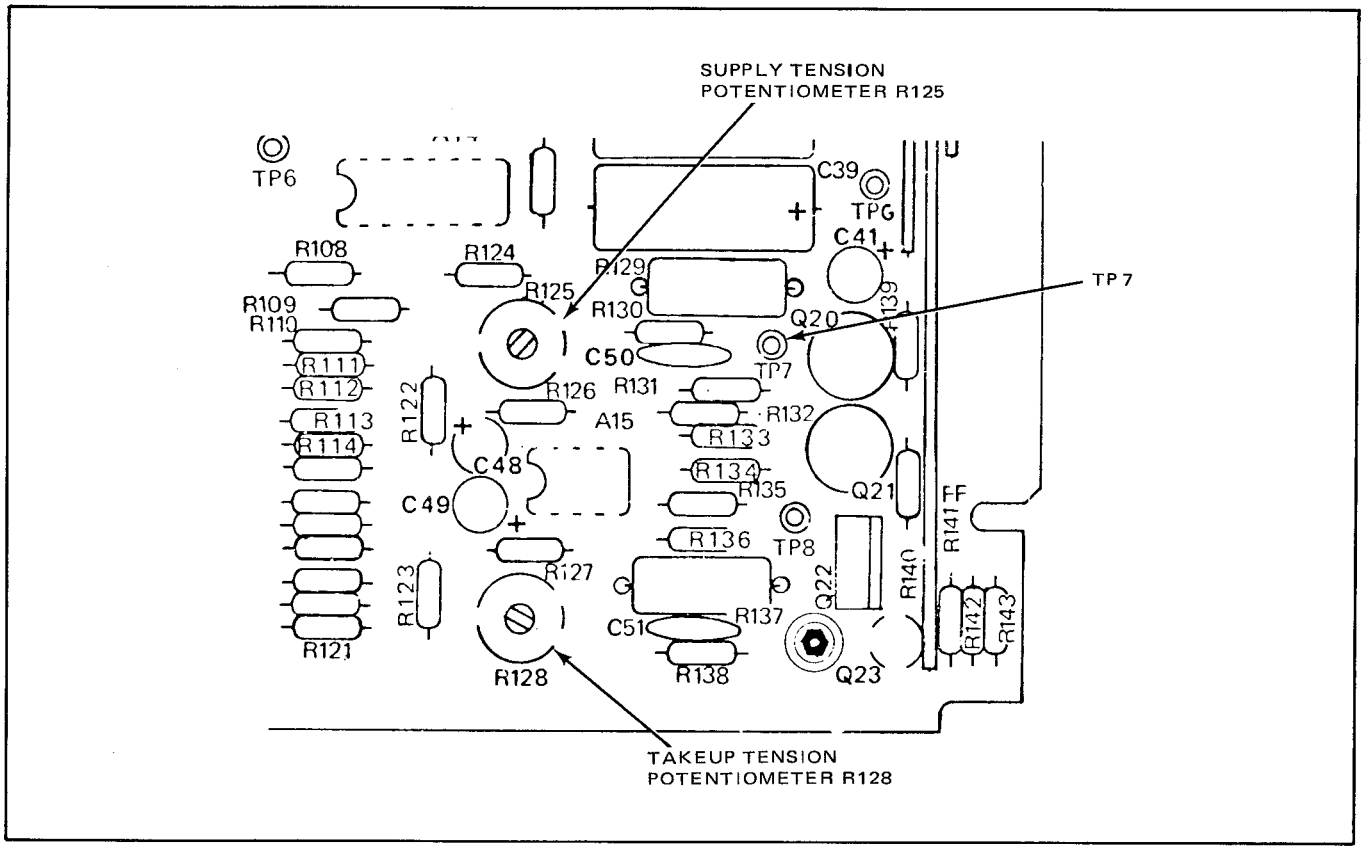


Figure 5-24. Tape Tension Adjustment Controls, PWA No. 9

4. With tape speed set to 7.5, 15, or 30 in/s, place recorder/reproducer into play mode.

5. Place Tentelometer tension sensor arms to straddle tape at the supply side of the capstan (between capstan and head assembly) as shown in Figure 5-25. (If Tentelometer is not available, connect dc voltmeter to TP7 on PWA No. 9.)

6. Observe tape tension on Tentelometer gauge. Tension should be 3.75 ounces (330 mV) for 1/4-inch tape, or 7.5 ounces (440 mV) for 1/2-inch tape.

7. If tension is not as specified, adjust supply tension potentiometer R125 for 3.75 ounces (330 mV) for 1/4-inch tape, or 7.5 ounces (440 mV) for 1/2-inch tape. Press stop pushbutton switch.

8. Press play pushbutton and then press EDIT pushbutton to enter play/edit mode. Then press stop pushbutton. Capstan should stop and remain stopped with no tendency to turn in either direction. If capstan creeps in either direction, slightly readjust supply tension potentiometer R125.

9. Press EDIT pushbutton to cancel play/edit mode. Rethread tape and place system into thread mode. Manually spin capstan edit knob in one direction and then the other direction with equal force. Tape should coast approximately an equal amount in each direction before coming to a stop. If tape does not coast an equal amount, adjust takeup tension potentiometer R128 as required.

5-62. Tape Lifters. Use these instructions to adjust the tape lifter solenoid and the position of the tape lifter arms.

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Figure 5-25. Measuring Tape Tension

5-63. Tape Lifter Solenoid. When the tape lifter solenoid is energized or de-energized, trapped air between the plunger and solenoid housing is permitted to leak out slowly to provide slow and smooth tape-lifter action. Unless the tape lifter arms and cable linkage have been disassembled, the only adjustment that may be required is the solenoid air leak control. Proceed as follows:

1. Disconnect capstan motor connector P18 (Figure 5-26).

2. Thread tape on transport and place recorder/reproducer into fast forward mode (tape will not move as capstan motor is disconnected).

CAUTION

WHILE PERFORMING THE NEXT STEP, BE CAREFUL NOT TO SHORT THE SOLENOID POWER TERMINALS.

3. Adjust the tape lifter solenoid air-leak screw (Figure 5-26) for fast, smooth tape-lifter action when EDIT pushbutton is alternately pressed and released. The solenoid should take approximately 0.5 second to lift or retract tape. (Note: The air-leak screw has a thread-locking device and is held in place by friction.)

4. Reconnect capstan motor connector P18.

5-64. Tape Lifter Arms. The tape lifter arms must retract clear of the tape surface in stop and play/record modes (solenoid de-energized). The tape lifters can be adjusted to permit information on the tape to be monitored by the reproduce or record head (sel-sync mode) while in fast forward, rewind, or spool modes. (Note: The tape does not actually contact the heads in fast modes when the tape lifters are properly adjusted.)

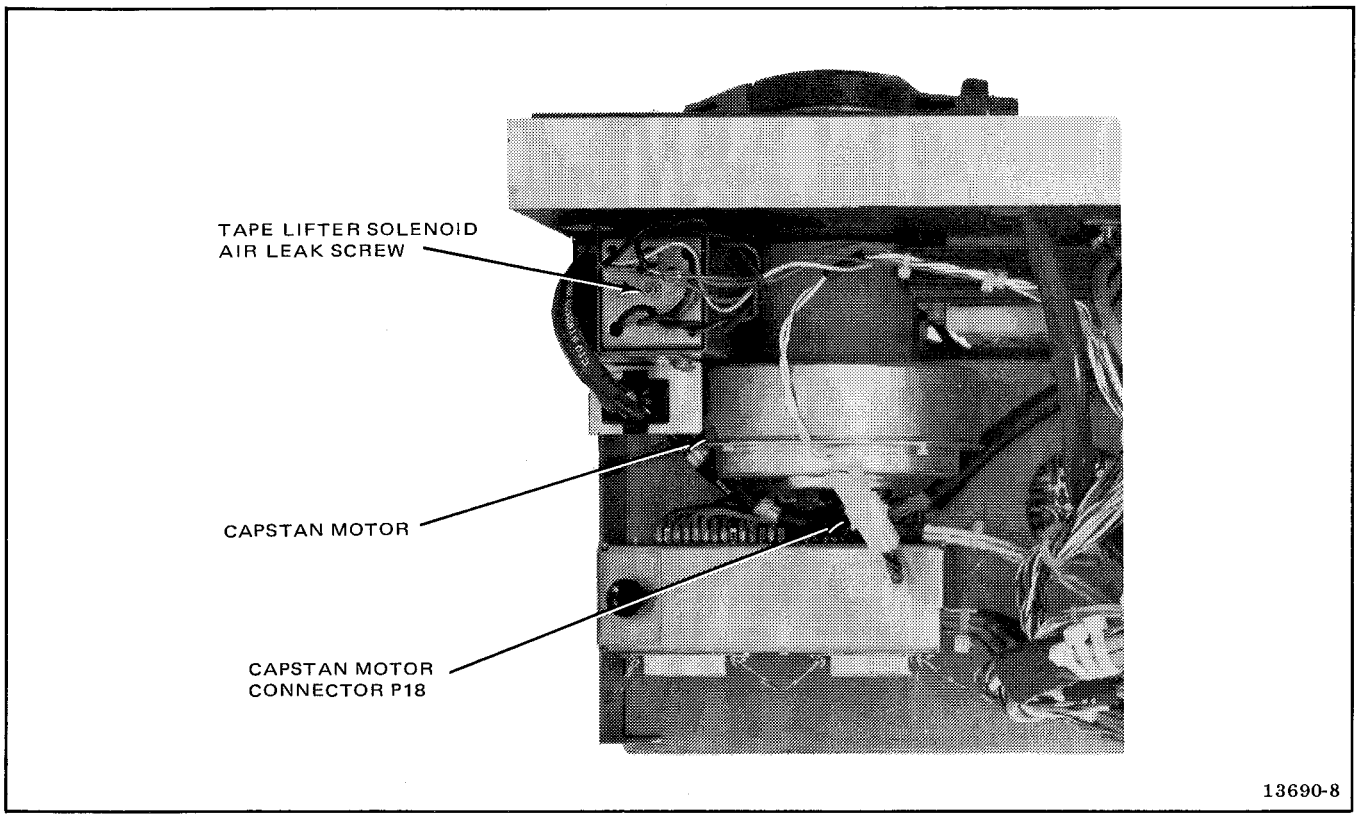

Figure 5-26. Tape Lifter Solenoid Adjustment Screw, Right Side of Tape Transport

If one or both tape-lifter arms contact the tape when solenoid is de-energized, perform steps 1, 2 and 3. If tape monitoring in fast forward, rewind, and spool modes is unsatisfactory, perform steps 4 through 10. Proceed as follows:

1. With power off, thread tape onto transport.

2. Loosen two button-head screws (Figure 5-27) that hold the tape-lifter solenoid shield to the solenoid.

3. Slide the shield towards the head assembly to retract both lifter arms further from the tape, or slide the shield away from the head assembly to advance the arms toward the tape. While maintaining tape tension, adjust the shield position so that there is approximately 1/32-inch clearance between the arms and tape. Tighten the shield button-head screws and recheck clearance.

NOTE

For the following steps, tape lifters are to be set such that while in fast forward, rewind, and spool modes, tape does not actually contact the heads or contact the scrape flutter idler, causing it to rotate. Also tape lifters must not lift tape so far from heads so as to lose contact with the upper and lower tape-edge ceramic guides shown in Figure 1-3.

4. Thread a prerecorded tape on to the transport, select play mode, and adjust signal levels for normal play mode operation. Press stop pushbutton.

5. Loosen the 6-32 cap screw in the tape-lifter roller (Figure 5-27) nearest the tape-lifter solenoid. Then lightly tighten the screw to provide limited holding power against the tape lifter shaft.

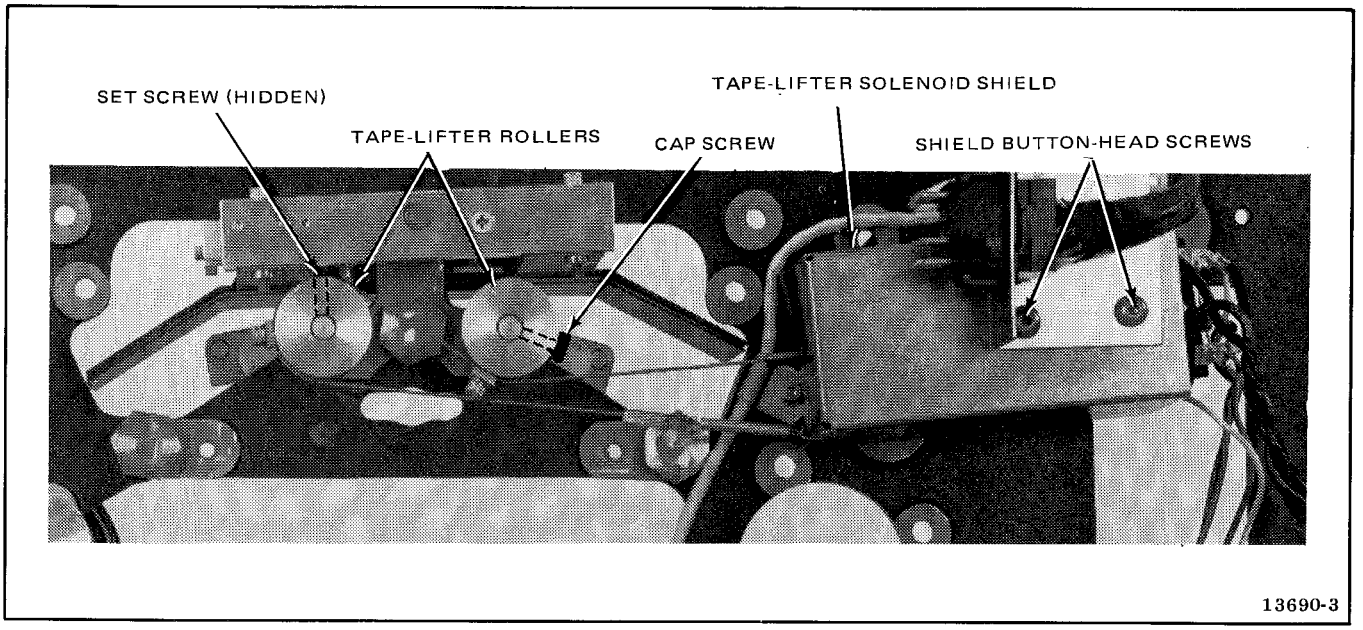

Figure 5-27. Tape Lifter Rollers and Solenoid, Rear View of Transport

CAUTION

IN THE FOLLOWING STEP, DO NOT OVER-TIGHTEN ROLLER SCREWS, AS DAMAGE TO THREADS MAY OCCUR.

6. Place system into spool mode.

7. Turn lifter shaft nearest the reproduce head, with respect to the roller, to obtain the desired audio level for monitoring purposes.

8. Before tightening cap screw, use a paper shim (about the thickness of this manual page) to establish clearance and prevent binding between the roller and the lifter bushing that is attached to the transport casting. Tighten cap screw while holding roller against paper shim.

9. Select stop mode.

10. Loosen the 6-32 setscrew in the roller (Figure 5-27) furthest away from the tape-lifter solenoid. Then lightly tighten the screw to provide limited holding power against the tape lifter shaft.

11. Place system into sel-sync mode, and transport into spool mode.

12. Turn lifter shaft nearest erase head, with respect to the roller, to obtain an audio level comparable to that set for the reproduce head in step 7.

13. Before tightening setscrew, use a paper shim (about the thickness of this manual page) to establish clearance and prevent binding between the roller and the lifter bushing that is attached to the transport casting. Tighten setscrew while holding roller against paper shim.

14. Check results while operating in spool mode and switching between repro and sync monitoring modes. Readjust lifter shaft positions if necessary.

15. While in spool mode, visually inspect tape path to check that tape does not touch any head stack or the scrape flutter idler(s), and is within the ceramic tape guides.

5-65. Head Gate. The movable head gate (Figure 5-28) shields the head assembly from electromagnetic interface pickup when the recorder/reproducer is in operation. The head gate does not normally need adjustment but, if required, perform the applicable adjustment procedure.

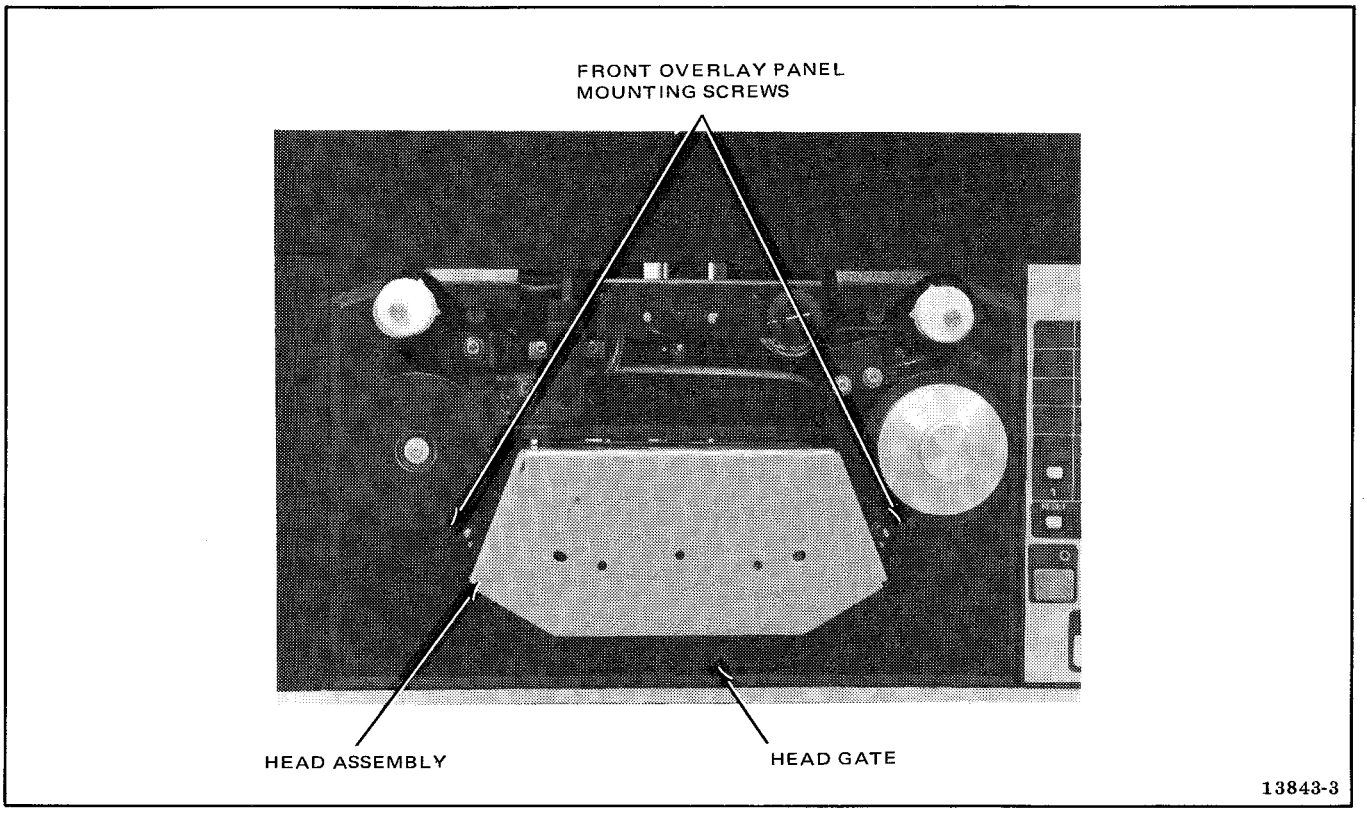

Figure 5-28. Top View of Transport, Head Cover Removed

NOTE

All head gate adjustments are made with power off.

5-66. Head Gate Height in Latched Position. When pressed down, the gate should latch in a position low enough to permit easy removal of tape from the head assembly without catching on the head gate shield. However, the gate must not be too low to prevent the head gate catch (Figure 5-29) from being unlatched. To set head gate height in latched position, proceed as follows:

1. Remove head cover assembly and front overlay panel (Figure 5-22).

2. With tape threaded on transport and head gate in latched (down) position, check that tape can easily be removed from head assembly without catching on head gate shield. If necessary, adjust head-gate height adjustment setscrew (Figure 5-29) [Turning setscrew counterclockwise one turn raises head gate latched position 0.03 inch (0.76 mm).]

3. After head gate height is adjusted, check gate operation as follows:
   a. Reinstall front overlay panel.
   b. Press head gate down to latched (down) position.
   c. Press head gate down again to verify that head gate catch unlatches allowing head gate to rise. If catch does not unlatch, height may be set too low. Remove front overlay panel and repeat steps 2 and 3 as necessary. If height appears correct but latch does not operate properly, check head gate catch operation (paragraph 5-68).

4. Reinstall front overlay panel and head cover assembly.

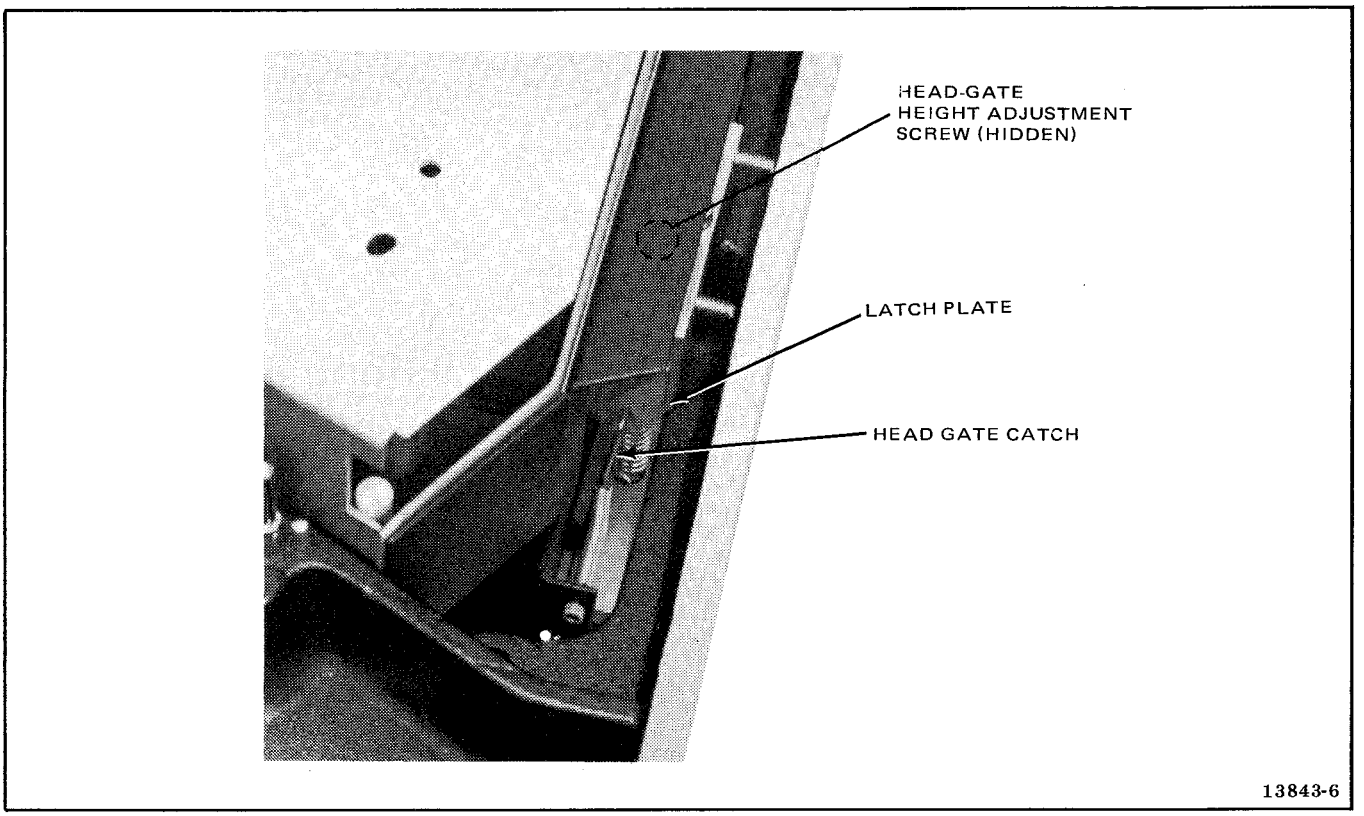

Figure 5-29. Head Gate in Latched (Down) Position

5-67. Head Gate Shield Alignment with Head Assembly Shield. When the head gate is in the unlatched (up) position, the shield of the head gate must close against the shield of the head assembly, especially in the area of the record and reproduce head. Proceed as follows:

1. Place head gate in the unlatched (up) position, and observe head gate shield alignment with head assembly shield.

2. If required, loosen shield-securing screw shown in Figure 5-30 and slightly raise or lower right-hand side of shield (as viewed from the front of recorder/reproducer) to align head gate shield with head shield. Tighten screw.

5-68. Head Gate Catch. The head gate latch is a push-to-set and push-to-release type of latch. The free end of the wire catch must rest in the proper location for the latch to function properly. When the head gate is in the unlatched (up) position, the free end of the wire catch must nearly contact the face of the latch plate at the location shown in Figure 5-31. Align the wire head gate catch as follows:

1. Remove head cover assembly and front overlay panel.

2. With the aid of a long-nose pliers, slightly bend screw through spring at location shown in Figure 5-31, left or right, as required, so that wire catch rests at location shown (Figure 5-31) when gate is in the unlatched (up) position.

3. Check previous adjustment by operating head gate to the latched (down) and unlatched (up) position. Repeat step 2 as necessary.

4. Reinstall front overlay panel and head cover assembly.

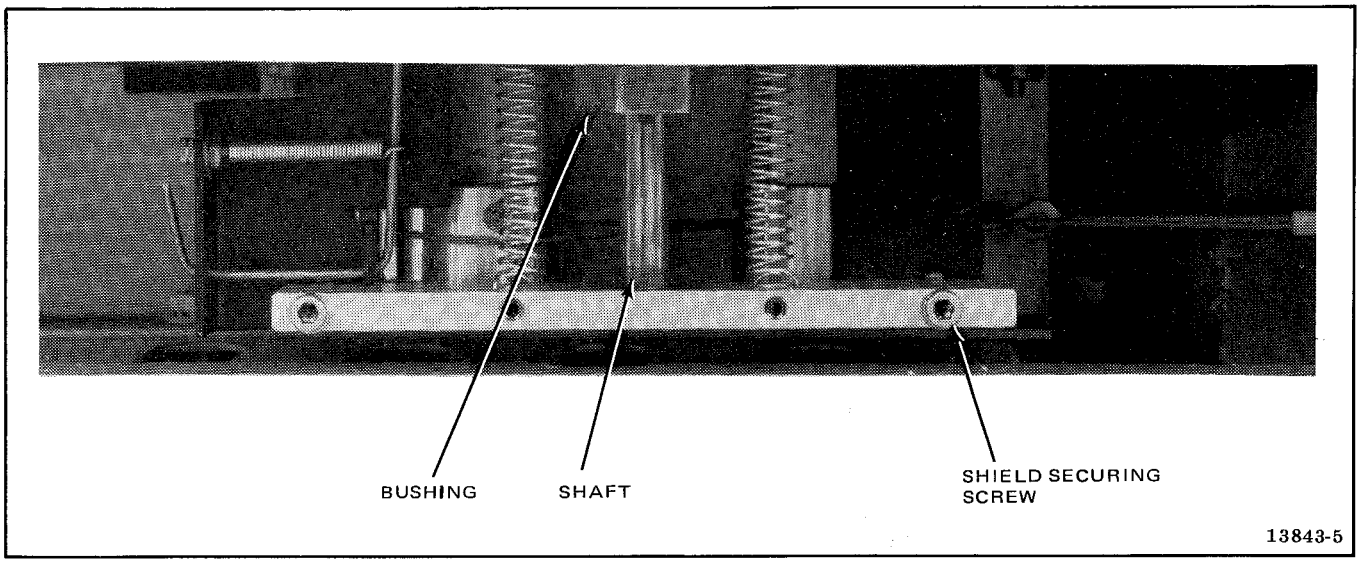

Figure 5-30. Head Gate in Latched (Down) Position, Front View of Transport

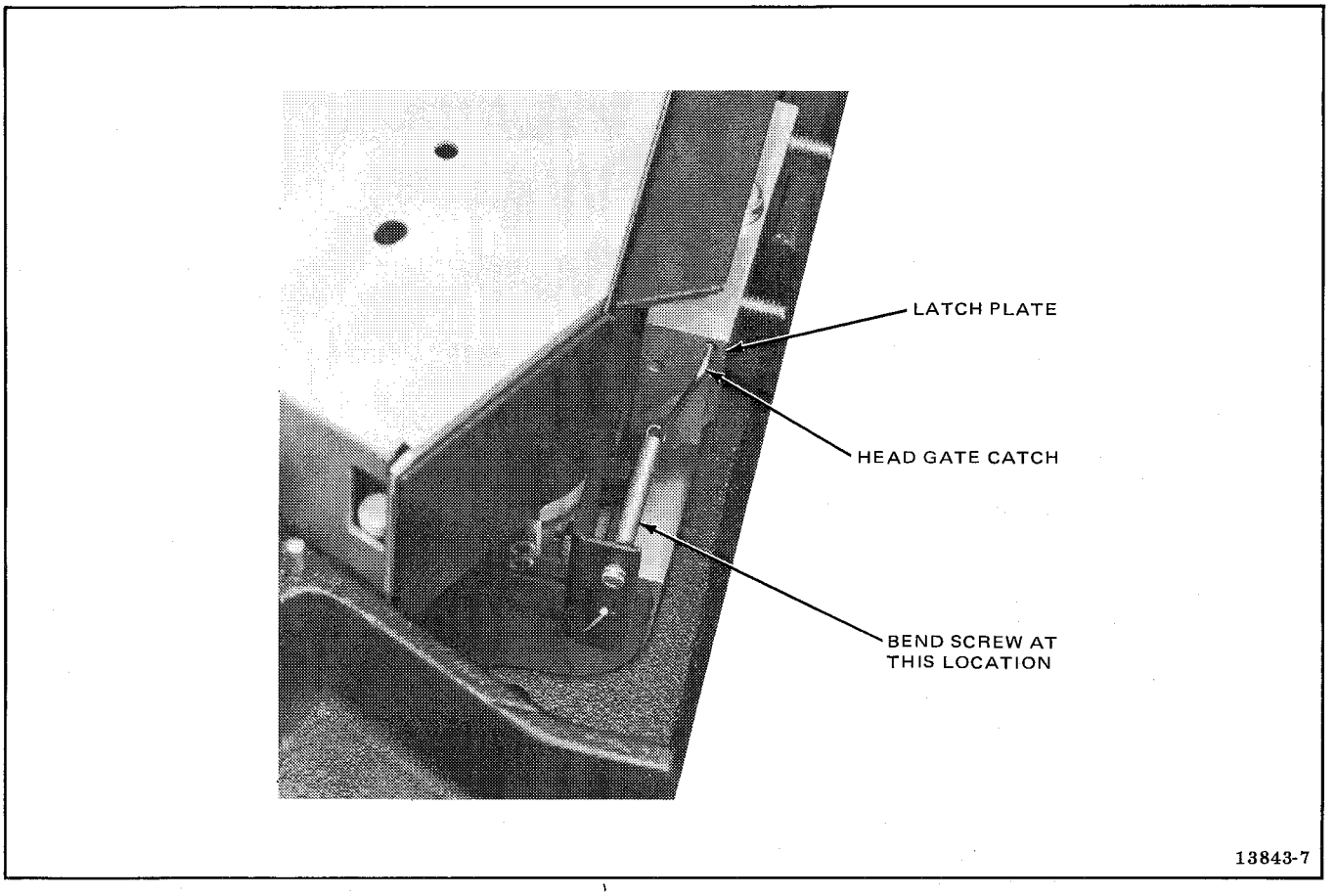

Figure 5-31. Head Gate in Unlatched (Up) Position

5-69. Head Gate Vertical Alignment. In operation, the head gate should not rub on the head assembly or on the front overlay panel. If the head gate does rub on either surface, there may not be enough restoring force in the head gate return springs to fully close the head gate shield against the head assembly shield. Proceed as follows:

1. Operate the head gate and note if the head gate rubs against the head assembly shield or the front overlay panel.

2. If rubbing is noted, remove the head cover assembly and head assembly.

3. With head gate in the unlatched (up) position, carefully bend head gate toward or away from transport as required so that head gate clears front overlay panel with minimum clearance.

4. Reinstall head assembly and check head gate operation for no rubbing.

5-70. Tape Peeler. For proper spilling of tape in the play/edit mode, the tape peeler must be correctly positioned. Proceed as follows:

1. Loosen the two tape peeler mounting screws shown in Figure 5-32.

2. Position the tape peeler so that the following conditions are met:

   a. There is 1.0 to 4.0 mils clearance between the edge of the peeler and the capstan. (A piece of recording tape can be used as a shim.)

   b. When the tension arm idler is pressed against the peeler (Figure 5-32), the

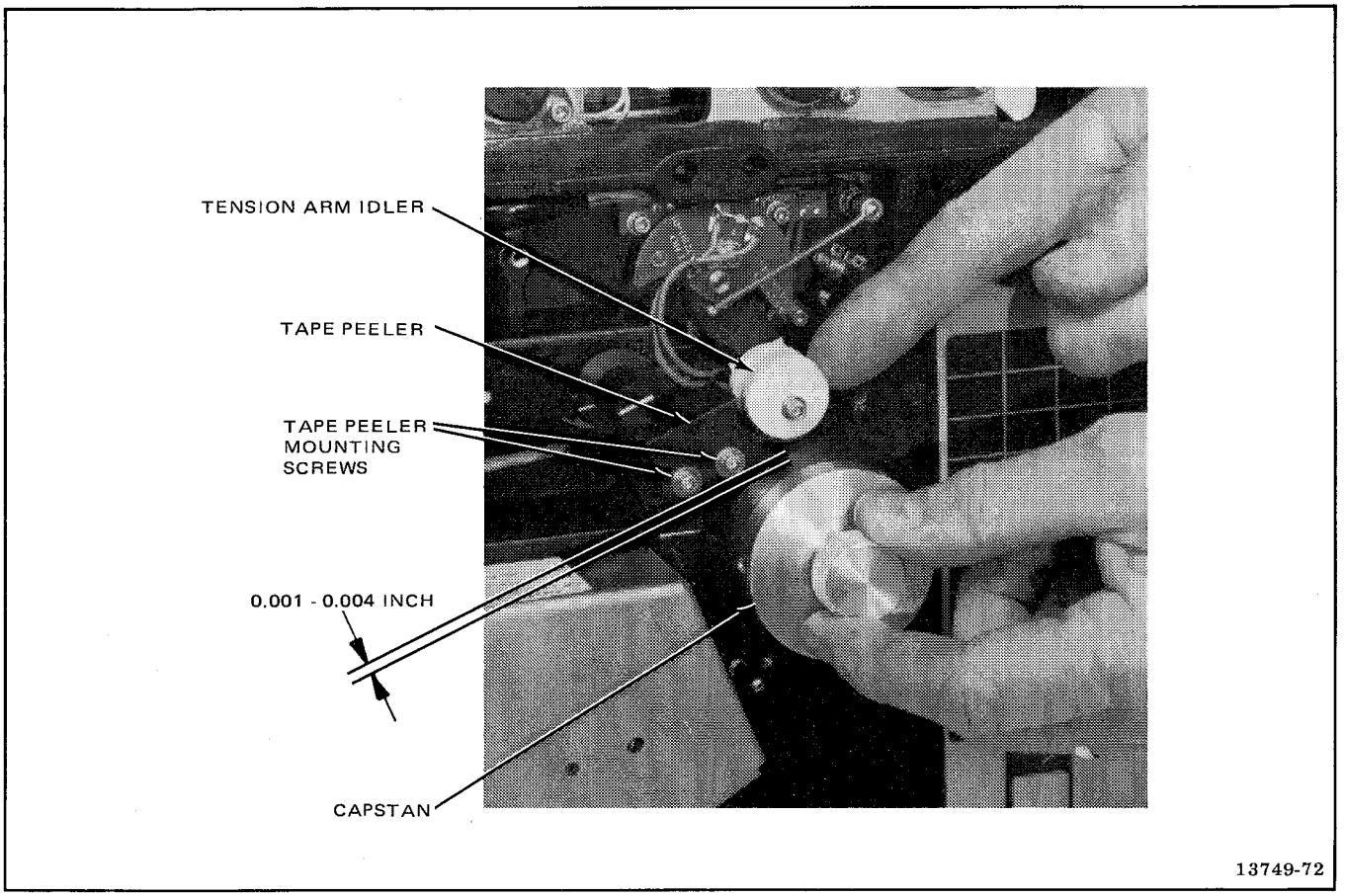

Figure 5-32. Tape Peeler Adjustment

rubber idler is slightly compressed against the capstan, and when released, the arm returns to its rest (up) position.

3. Tighten the two tape peeler mounting screws.

4. Verify that the inner electrical limit circuitry associated with the takeup tension arm is still operational. Check operation by performing steps 1, 7, and 10 through 12 of the *Tension Arms Limits* adjustment procedure, paragraph 5-60.

5-71. PERFORMANCE TESTS

Use the following performance test procedures to check tape tension, absolute tape speed accuracy, speed variation, operating level, signal-to-noise ratio, harmonic distortion, intermodulation distortion, and flutter. The performance test should be performed after each 500 hours of operation to ensure the recorder/reproducer is performing in accordance with the specifications given in Table 1-4. Also, an applicable performance test should be performed whenever the equipment appears to be malfunctioning and following repairs to the equipment that could affect performance.

Test equipment required for the performance tests is listed in Table 5-1. In the event a performance test is unsatisfactory, refer to the troubleshooting section of the manual (paragraph 5-84) and perform the appropriate alignment, adjustment, or corrective maintenance procedure.

5-72. Tape Tension

If tape should creep in either direction while in stop mode, or tape tension appears to be incorrect, check tape tension as follows:

1. Remove head cover assembly and the front overlay panel (two screws).

2. Thread tape on recorder/reproducer with approximately even tape pack on both reels.

3. With tape speed set to speed most commonly used, place recorder/reproducer into play mode.

4. Place Tentelometer tension sensor arms to straddle tape at the supply side of the capstan (between capstan and head assembly) as shown in Figure 5-25. (If Tentelometer is not available, see alternate procedure using a dc voltmeter given in paragraph 5-61, steps 2, 5, and 6.)

5. Observe tape tension on gauge. Tension should be 3.75 ±0.5 ounces for 1/4-inch tape, or 7.5 ±0.5 ounces for 1/2-inch tape. Remove Tentelometer and press stop pushbutton switch.

6. Manually spin capstan edit knob in one direction and then in the opposite direction with equal force. Tape should coast an equal amount in each direction.

5-73. Absolute Tape-Speed Accuracy

The absolute tape speed of the recorder/reproducer refers to the inches of tape that travels past the reproduce head per unit of time. If the tape tensions are correctly adjusted, there will be no tape slippage at the capstan. Therefore the capstan peripheral velocity may be considered a direct indication of absolute tape speed. The capstan is precisely manufactured to have a diameter of 2.3854 ±0.0002 inches (±0.008%). Since this tolerance is very small, absolute tape speed can be determined by measuring the frequency of the capstan tachometer signal while the capstan rotates for 30-in/s operation during a precise unit of time. If desired to measure the capstan diameter, the measuring gauge used should be adequately calibrated consistent with the tolerance to be measured.

To determine absolute tape speed, proceed as follows:

1. Select 30-in/s tape speed. If system is not set up for 30-in/s operation, temporarily enable 30-in/s operation as follows:
   a. Remove power.
   b. Unplug all audio channel PWAs within the electronics assembly.
   c. If recorder/reproducer has been set up for two-speed master bias operation

(instead of four-speed master bias operation as shipped from the factory), remove audio control PWA No. 5 from electronics assembly. Place jumper J1 (Figure 5-6) in the 30-in/s position. Reinstall PWA No. 5 into electronics assembly.

2. With power off, place capstan servo PWA No. 8 on an extender board and reinstall into electronics assembly.

3. Use a shielded lead to connect a counter (Table 5-1) to TP1 and ground on PWA No. 8 to measure capstan tachometer rate.

4. Apply power, thread reel of tape on transport, and place system into play mode.

5. Counter should read 9,600 Hz, which is the tach frequency at 30 in/s.

6. Set counter to read a 10-second interval count. The measured count should be 96,000 ±6 counts. This corresponds to an absolute capstan rotational accuracy of ±0.006%. The combined speed error caused by the capstan diameter and capstan rotational speed error is the total speed error. Note: Counter accuracy is limited to ±1 count in the least significant digit.

7. If applicable, remove power and restore jumper J1 on PWA No. 5 to original position. Reinstall audio PWAs within electronics assembly.

8. Remove power and reinstall capstan servo PWA No. 8 into electronics assembly.

5-74. Speed Variation

To measure speed variation, tape speed is measured at the beginning of a reel and is compared to the speed near the end of the reel. This is accomplished by recording and playing back a stable reference frequency and comparing any difference in frequency count over a precise unit of time. To check speed variation, proceed as follows:

1. With power off, place capstan servo PWA No. 8 on an extender board and reinstall into electronics assembly.

2. If an input/output assembly is being used, use a shielded audio lead and connect TP1, on the capstan servo PWA, to a channel input of the input/output assembly. (Note: TP1 supplies a stable reference signal and the frequency of this signal is 9,600 Hz at 30 in/s, 4,800 Hz at 15 in/s, 2,400 Hz at 7.5 in/s, and 1,200 Hz at 3.75 in/s.)

3. If an input/output assembly is not being used, use a shielded audio lead and connect TP1 of the capstan servo PWA to a channel input of the recorder/reproducer at connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3). Connect signal input of a frequency counter to the same channel output on connector J13 or J14 (Figure 2-13).

4. To detect worst case speed variation, use 7-inch diameter EIA reels with a small hub (NAB type B reels) in the supply and takeup position. Apply power, thread a full reel of tape on transport, and place system into thread mode.

5. Select input mode for channel being used and the highest tape speed that recorder/reproducer has been set up for.

6. Place system into record mode and record for approximately two minutes.

7. While recording, set counter to display a 10-second interval count and note reading.

8. Stop recording, turn the reels over end-for-end (interchange reels), and place system into thread mode.

9. If recorder/reproducer is other than a full-track system, reconnect frequency counter to appropriate channel output so recording made in step 6 may be reproduced.

10. Select repro mode for channel being used and place system into play mode.

11. With counter set to display a 10-second interval count, the total count played back in 10 seconds should be within 9 counts of the input count at 30 in/s, 4 counts at 15 in/s, or 2 counts at 7.5 in/s.

12. Remove power and reinstall capstan servo PWA No. 8 into electronics assembly.

5-75. Operating Level

To determine or check the operating level of the recorder/reproducer, play back a standard alignment tape. Preferably use an alignment tape that has the same track format as the recorder/reproducer (full track, 2 track, or 4 track). If this type of alignment tape is not available and a full-track alignment tape is used on a multitrack recorder/reproducer, refer to the amplitude correction factors given in Table 5-4. (Refer to *Use of Alignment Tapes/General Discussion*, paragraph 5-31, and *Operating Level/General Discussion* paragraph 5-34.)

The following procedures can be used to determine recorder/reproducer operating levels of 370 nWb/m, 260 nWb/m, or 185 nWb/m with the use of a 185-nWb/m reference level alignment tape (Figure 5-1).

NOTE

On Ampex alignment tapes for 15 and 30 in/s, the 185-nWb/m, 700-Hz reference tone is the first tone on the tape. For 3.75 and 7.5 in/s, the 185-nWb/m, 700-Hz (500-Hz, 3.75-in/s) tone is the last tone on the tape.

To check operating level, proceed as follows:

1. Clean and demagnetize the heads and other tape path components as described in the *Preventive Maintenance* portion of this section of the manual (paragraphs 5-4 and 5-7).

2. Select system tape speed at the transport control panel.

3. If an input/output assembly is not being used, connect an ac voltmeter to appropriate recorder/reproducer output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

4. Reproduce the 185-nWb/m operating level 500-Hz tone for 3.75 in/s, or 700-Hz tone for 7.5, 15, or 30 in/s of an Ampex standard alignment tape.

NOTE

For the following step 5 and step 6, apply amplitude correction factor (Table 5-4), if applicable.

5. If an ac voltmeter is being used at the output of the recorder/reproducer, the operating level can be determined from the ac voltmeter reading as follows:

   a. 370 nWb/m – −11 dBm.

   b. 260 nWb/m – −8 dBm.

   c. 185 nWb/m – −5 dBm.

NOTE

Step 6 assumes that the input/output assembly has been calibrated for a line output operating level of +4 dBm (0 vu with meter in vu position or −6 dB with meter in peak position).

6. If an input/output assembly is being used, set the reproduce MANUAL/PRESET switch to PRESET position. The operating level, as read on an ac voltmeter or on the input/output level meter should be as follows:

   a. 370 nWb/m – −2 dBm or −6 vu (meter in vu position) or −12 (meter in peak position).

   b. 260 nWb/m – +1 dBm or −3 vu (meter in vu position) or −9 (meter in peak position).

   c. 185 nWb/m – +4 dBm or 0 vu (meter in vu position) or −6 (meter in peak position).

5-76. Signal-to-Noise Ratio

The signal-to-noise ratio measurement is made using a filter connected to the output of the system to attenuate noise out of the audible-frequency band. Figure 5-33 is a simple passive filter for passing frequencies in the 30 Hz to 18 kHz frequency band and Figure 5-34 is a filter for weighting to the ANSI 'A' characteristic. If desired to use the ANSI 'A' filter shown in Figure 5-34, it is necessary to correct for the insertion loss of the filter at 1 kHz. This is accomplished by adding