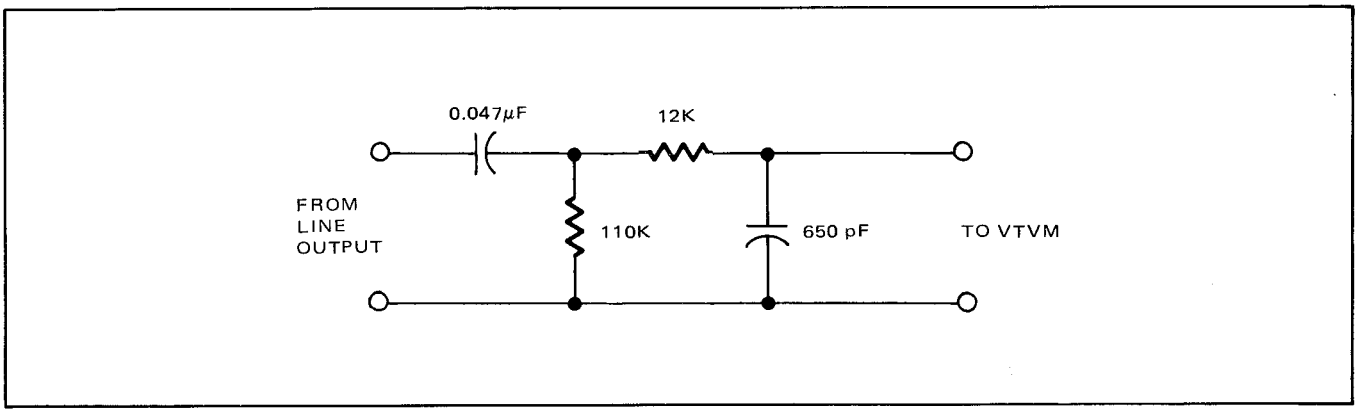


Figure 5-33. 30-Hz to 18-kHz Band Limiting Filter

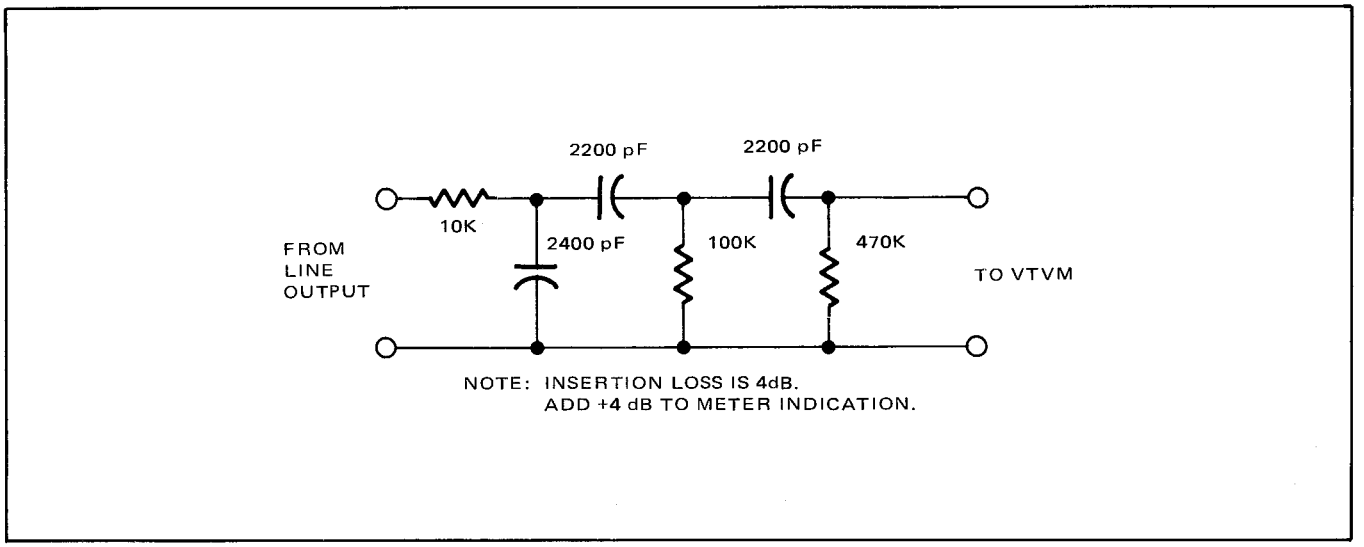


Figure 5-34. ANSI 'A' Weighted Filter

+4 dB to the ac voltmeter indication when making the measurement. For example, if the meter reads −61 dBm through the filter, the actual reading is −57 dBm.

Figure 5-35 is a schematic diagram of a universal noise filter (constructed by the user) that has a four-position selector switch for measurement to standards CCIR, ANSI A Weighted, and 30 - 18 kHz. The fourth position of the selector switch enables the filter to be used as a buffer. A gain switch permits unity gain or 20 dB gain.

Table 5-13 gives signal-to-noise ratios for tape speed, equalization standard, track format, and noise measurement weighting filter in use when using Ampex 456 tape (or direct equivalent), and with the recorder adjusted for 370-nWb/m operating level at 700 Hz. Table 5-14 provides signal-to-noise ratios with the system in standby mode. All signal-to-noise ratios given in Tables 5-13 and 5-14 are measured relative to nominal 3% third harmonic distortion which is 9 dB above 370-nWb/m level when using Ampex 456 tape. The signal-to-noise ratio measurement should only be performed if the reproduce, record, and erase system alignment has been performed or is known to be correct.

To measure signal-to-noise ratio, 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. If an input/output assembly is being used, connect an ac voltmeter through a band limiting filter (Figure 5-33, 5-34, or 5-35) to appropriate output connector, and connect an audio oscillator to appropriate input connector (Figures 2-14 and 2-15).

3. If an input/output assembly is not being used, connect an ac voltmeter through a band limiting filter (Figure 5-33, 5-34 or 5-35) to appropriate output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3) and connect an audio oscillator to appropriate input connector J13 or J14.

4. Apply power and thread a reel of bulk-degaussed tape on the transport and place system into thread mode.

5. Set speed switch to tape speed selected for measurement.

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

7. Set oscillator frequency to 1.0 kHz and adjust oscillator output level for +5 dBm at the output of the recorder/reproducer, or for +14 dBm at the output of the input/output assembly. (Note: For convenience, these levels are 10 dB above operating level.)

8. Reset tape timer display to zero.

9. Record continuously for at least two minutes and rewind tape to tape timer display zero.

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

11. Again place system into record mode and read residual noise on the ac voltmeter. Calculate the signal-to-noise ratio as follows:

    a. If an input/output assembly is being used, the ac voltmeter reading should be 13 dB less than the amount (after correction for filter insertion loss) shown in Table 5-13. (This assumes input/output assembly has been aligned to provide a +4-dBm line output level for a −5-dBm interface level at operating level.) For example, if ac meter reads −62 dBm, signal-to-noise ratio is −62 plus −13 or 75 dB.

    b. If an input/output assembly is not being used, the ac voltmeter reading should be 4 dB less than the amount (after correction for insertion loss) shown in Table 5-13. (This assumes recorder/reproducer has been aligned for −5-dBm interface operating level.)

12. Press stop pushbutton to stop transport and place system into standby mode.

13. Read residual noise on ac voltmeter and compare with readings in standby signal-to-noise ratio table, Table 5-14.

14. Repeat all steps in sync monitor mode. The signal-to-noise ratio should meet or exceed all readings in Table 5-13.

5-77. Harmonic Distortion

It is recommended that harmonic wave levels be measured using a wave or spectrum analyzer (the use of a total harmonic distortion analyzer to measure off-tape distortion is not recommended). The audio oscillator used for measurement should not have a residual second harmonic component greater than 0.03% rms (−70 dB) for fundamental frequencies from 500 Hz to 1.0 kHz. Also the third harmonic component should not be greater than 0.05% rms (−66 dB).

Table 5-15 gives harmonic and intermodulation distortion system specifications when Ampex

Table 5-15. Harmonic and SMPTE Intermodulation System Distortion Specifications

ELECTRONICS DISTORTION:

System electronics distortion, including record amplifier, reproduce amplifier and input/output system, at any operating level up to 20 dB above operating level at mid-frequency is <0.03% total harmonic distortion and <0.05% SMPTE intermodulation distortion.

Overall record/reproduce distortion (using Ampex 456 tape or direct equivalent):	At system operating level (0 vu = 370 nWb/m; 6 dB above 185 nWb/m).

Even Order Distortion:

Even order distortion of a 1-kHz signal recorded at 370 nWb/m is less than 0.1%.

7.5 in/s – 30 in/s:

Third Harmonic Distortion at 1 kHz:	<0.3% at recorded flux level of 370 nWb/m (0 vu). <3.0% at recorded flux level of 1040 nWb/m (+9 vu).
SMPTE Intermodulation Distortion:	<1.0% at recorded flux level of 370 nWb/m (0 vu).

3.75 in/s:

Third Harmonic Distortion at 500 Hz:	<0.5% at recorded flux level of 370 nWb/m (0 vu). <3.0% at recorded flux level of 740 nWb/m (+6 vu).
SMPTE Intermodulation Distortion:	<2.0% at recorded flux level of 370 nWb/m (0 vu).

456 tape or its direct equivalent is used. The harmonic distortion measurement should only be performed if the reproduce, record, and bias adjustments have been correctly made or are 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. If an input/output assembly is being used, connect a spectrum analyzer or wave analyzer to appropriate output connector, and connect an audio oscillator to appropriate input connector (Figures 2-14 and 2-15).

3. If an input/output assembly is not being used, connect a spectrum analyzer or wave analyzer to appropriate recorder/reproducer output connector J13 or J14, and connect an audio oscillator with a source impedance of not greater than 200 ohms to appropriate input connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

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

5. Set speed switch to tape speed selected for measurement.

6. Place system into record mode.

7. Set oscillator frequency to 1 kHz (500 Hz at 3.75 in/s only) and adjust oscillator output level for −5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

8. Adjust wave analyzer to measure second harmonic content; this should not exceed −60 dB with respect to the level of the fundamental set in step 7.

9. Adjust wave analyzer to measure third harmonic content. The harmonic content should not exceed levels given in Table 5-15 relative to the level of the fundamental set in step 7.

10. Increase oscillator output level to system peak operating level. This is +4 dBm at the output of the recorder/reproducer or +13 dBm at the output of the input/output assembly.

11. Adjust wave analyzer to measure third harmonic content. The harmonic content should not exceed levels given in Table 5-15 relative to the level of the fundamental set in step 10.

12. Repeat entire procedure for each channel.

5-78. SMPTE Intermodulation Distortion

Intermodulation distortion is produced by nonlinearity in the record/reproduce process which produces frequencies in the output signal equal to the sums and differences of integral multiples of the component frequencies present in the input signal (harmonics not included). Measurement of intermodulation distortion is a convenient method of obtaining a qualitive indication of system performance. However, a reading in excess of specifications gives no indication of the possible cause, as a poor or damaged tape may produce amplitude fluctuations in high-frequency carrier which greatly exceed the true intermodulation products. Therefore a judgment is required when attempting to interpret the measurements.

Table 5-15 gives harmonic and intermodulation distortion system specifications when Ampex 456 tape or its direct equivalent is used. The measurement should only be performed if the reproduce, record, and bias adjustments have been performed or are known to be correct. To measure intermodulation distortion as defined by the SMPTE, 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. If an input/output assembly is being used, connect intermodulation analyzer test signal output to appropriate input connector (Figures 2-14 and 2-15), and connect appropriate output connector of input/output assembly to input of intermodulation analyzer.

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

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

5. Set speed switch to tape speed selected for measurement.

6. Place system into record mode.

7. Adjust intermodulation analyzer composite signal output amplitude for −5 dBm at the output of the recorder/reproducer, or +4 dBm at the output of the input/output assembly.

8. Adjust intermodulation analyzer to normalize the input signal, and then read intermodulation distortion. Compare readings with specifications given in Table 5-15 for tape speed and equalization standard in use.

9. If type of intermodulation analyzer permits, verify tape condition and validity of measurement in step 8 as follows:

   Remove or switch off the low-frequency test signal. Intermodulation distortion reading should drop at least to 40% of reading obtained in step 8. If the reading did not drop, this is an indication that the tape is mechanically damaged or dirty, or that some element in the tape path is causing excessive amplitude fluctuation of the high-frequency test signal.

5-79. Flutter

Flutter is measured by recording and reproducing a constant frequency tone. Any non-uniform

motion in the recorder/reproducer mechanism frequency modulates the tone. This modulation, called flutter, is measured with an fm demodulator within a flutter meter. The ATR-100 flutter specifications are measured according to standards specified by DIN 45 507 and ANSI S4.3 peak weighted and unweighted. The rms flutter is measured as specified by the NAB standard.

When performing measurements, it is possible for the record mode flutter to add or subtract from the reproduce mode flutter, depending upon the phase relationship of the recorded and reproduced signals; therefore, it is necessary to play the tape several times and average the flutter meter readings.

Prior to making a flutter measurement, perform the following steps.

1. Clean and demagnetize the heads and other tape patch components as described in the *Preventive Maintenance* portion of this section of the manual, paragraphs 5-4 and 5-7. (Note: Flutter meters are sensitive to amplitude modulation that results from poor head-to-tape contact or from signal dropouts.)

2. Check tape tension and adjust, if necessary, as described under *Tape Tension* adjustments, paragraph 5-61.

3. The audio channel to be used for flutter measurement should be in correct alignment. If necessary, perform the *Audio Signal System Alignment* procedure (paragraph 5-30).

4. Use good quality bulk erase tape (Ampex 456 or equivalent). Use a typical reel size for tape speed in use; i.e., NAB type A reel for 30-in/s operation.

The following procedure applies to the use of a Micom (Bahrs) Model 8100-W flutter meter. If a different flutter meter is used, the manufacturer's instructions should be followed.

To measure flutter, proceed as follows:

1. If an input/output assembly is being used, connect the test oscillator output of the flutter meter to the input connector of the channel selected for test, and connect signal input connector of flutter meter to appropriate output connector (Figures 2-14 and 2-15).

2. If an input/output assembly is not being used, connect the test oscillator output of the flutter meter to recorder/reproducer input connector J13 or J14 corresponding to the channel selected for test, and connect signal input connector of flutter meter to appropriate output connector J13 or J14 (Figure 2-13 and Tables 2-2 and 2-3).

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

4. Select input monitoring for channel being used. Adjust recorder/reproducer output level and/or flutter meter input level for required flutter meter input level.

5. While in input mode (tape not moving), measure static signal flutter and verify that flutter is way below level of flutter anticipated (Table 1-4). Typical levels are below 0.005% peak weighted or 0.01% unweighted.

6. Set flutter meter to measure peak weighted and meter scale to read 0.1% full scale.

7. Select repro monitoring mode for channel being used, place system into record mode, and record for approximately one minute. While recording, note flutter indication on flutter meter.

8. Rewind tape to the beginning of the recording, place system into play mode, and read indication on flutter meter. Repeat this step three times and average the four readings along with the reading obtained while recording (step 7). The average reading should meet the flutter specifications given in Table 1-4.

5-80. CORRECTIVE MAINTENANCE

When a failure is noted, perform the appropriate head maintenance, troubleshooting, or component replacement procedure.

CAUTION

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

5-81. Head Maintenance

Head cleaning, demagnetizing, and cleaning and lubrication of the scrape flutter idler was covered under *Preventive Maintenance*, paragraph 5-3, and adjustment of head azimuth was covered under *Alignment and Adjustments*, paragraph 5-29. Use the following instructions to change the entire head assembly or to change an individual head stack on the head assembly.

5-82. Changing Head Assembly. To remove head assembly, proceed as follows:

1. Remove power from ATR-100.
2. Remove head cover assembly (Figure 5-22) from transport by carefully lifting cover straight up.
3. Insert Allen wrench through center hole in head shield (Figure 5-36) and turn spring-loaded screw 1/4-turn clockwise to release head assembly.
4. Carefully lift head assembly straight up from the transport.

To install head assembly, proceed as follows:

1. Carefully lower head assembly over transport to mate the head-centering pins (Figure 5-37) on the transport into the bottom of the head assembly. Lower head assembly onto transport and fully mate the head connector.

NOTE

For removal or installation of head assembly, the spring-loaded screw is always turned 1/4-turn clockwise.

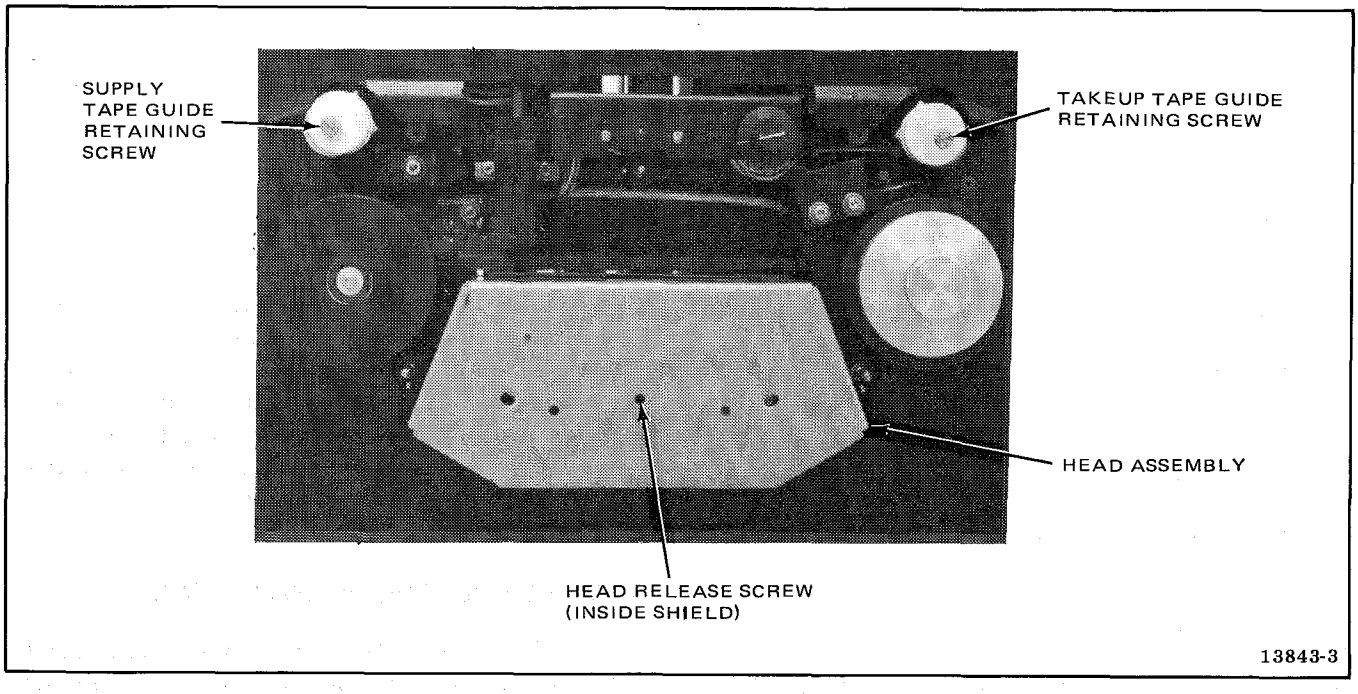


Figure 5-36. Head Assembly and Tape Guides

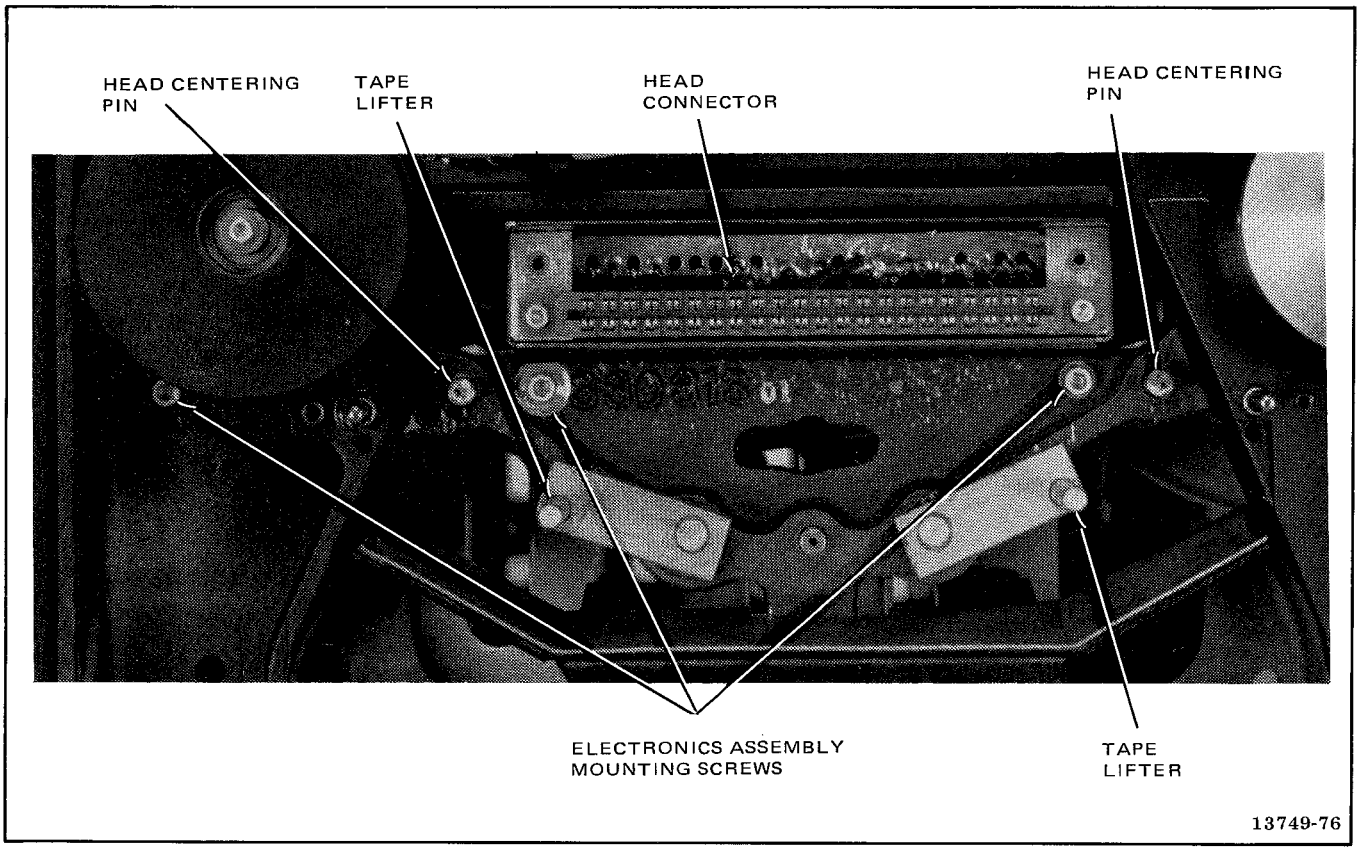


Figure 5-37. Top View of Transport with Head Assembly Removed

2. Lock the head assembly to the transport by inserting an Allen wrench through hole in head shield, and turn spring-loaded screw 1/4-turn clockwise to lock head to transport.

5-83. Changing Head Stacks. To change a record, reproduce, or erase head stack, proceed as follows:

1. Remove power from ATR-100.

2. Remove the entire head assembly from the transport as follows:

   a. Remove head cover assembly (Figure 5-22) from transport by carefully lifting cover straight up.

   b. Insert Allen wrench through center hole in head shield (Figure 5-36) and turn spring-loaded screw 1/4-turn clockwise to release head assembly.

   c. Carefully lift head assembly straight up from transport.

3. Remove the main head shield from the head assembly by removing four screws (Figure 1-3) that secure the main head shield to the base plate.

4. Carefully unplug the head-stack connector(s) of the head stack to be changed (Figure 5-38).

5. Remove head-stack mounting screw and spring (Figure 5-38).

6. Remove stack by pressing the spring-loaded pin (Figure 5-39), from underside of head base plate, and carefully sliding stack toward head connector PWA. When removing the reproduce head stack, rotate the stack on the pin to clear the head connector PWA.

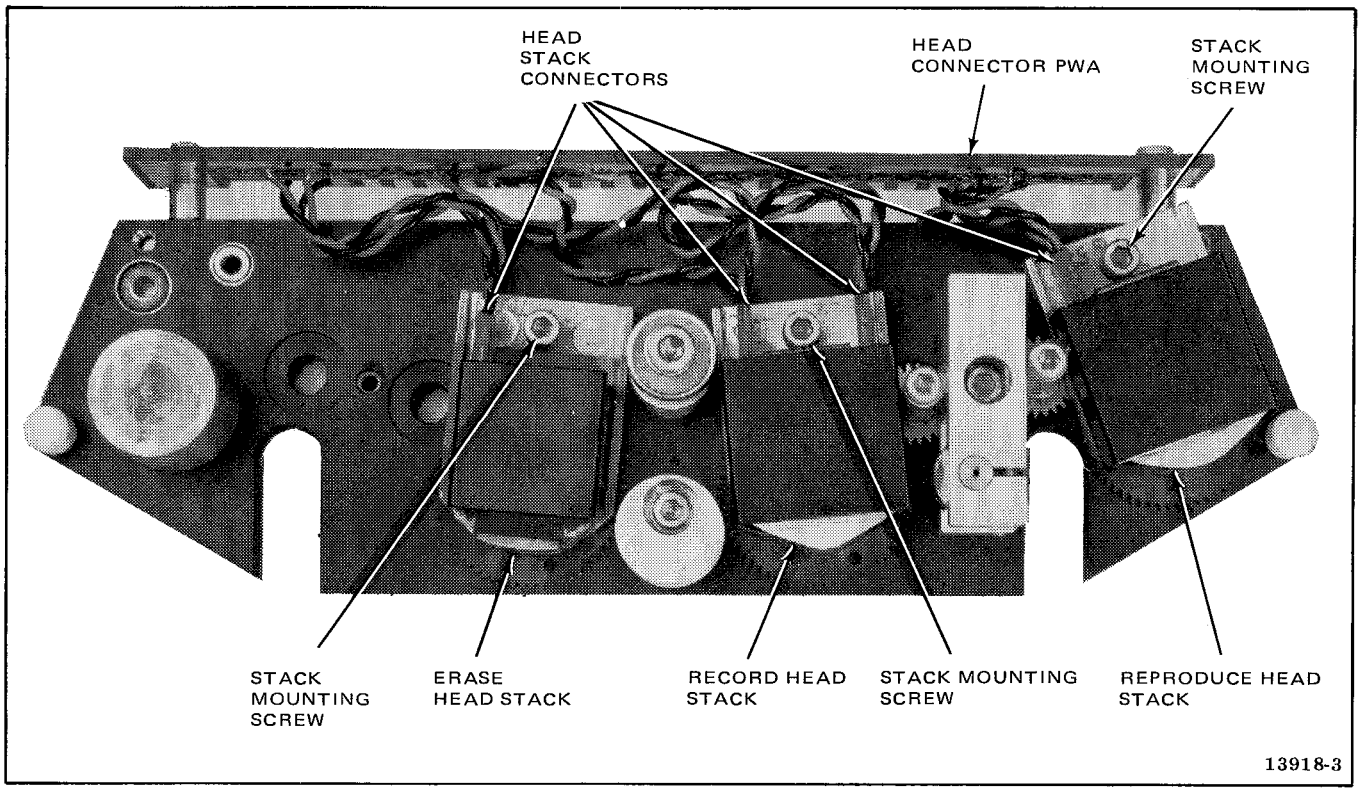


Figure 5-38. Top View of Head Assembly with Main Head Shield Removed

7. Install new stack by pressing spring-loaded pin and sliding new stack forward into place on the tapered gear.

8. Reinstall head-stack mounting screw and spring. Lightly tighten screw to fully compress spring, then turn screw one full turn counterclockwise to permit head azimuth to be adjusted.

9. Carefully reinstall head-stack connector(s).

10. Reinstall main head shield using four screws removed in step 3.

11. Install entire head assembly onto transport as follows:

    a. Carefully lower head assembly over transport to mate the head centering pins (Figure 5-37) on the transport into the bottom of the head assembly. Lower head assembly onto transport and fully mate the head connector.

    b. Lock the head assembly to the transport by inserting an Allen head wrench through hole in head shield and turn spring-loaded screw 1/4-turn clockwise to lock head to transport. (Note: For removal or installation of head assembly, the spring-loaded screw is always turned 1/4-turn clockwise.)

12. Perform the appropriate record, reproduce, or erase alignment procedure given in this section of the manual under the heading *Audio Signal System Alignment*, paragraph 5-30. No azimuth adjustment is required for the erase head stack.

5-84. Troubleshooting

Use standard troubleshooting techniques to isolate a fault as mechanical or electrical in origin. Then proceed to isolate the fault to a certain stage or component. As an aid in locating faults, dc voltages and reference frequencies are given at many

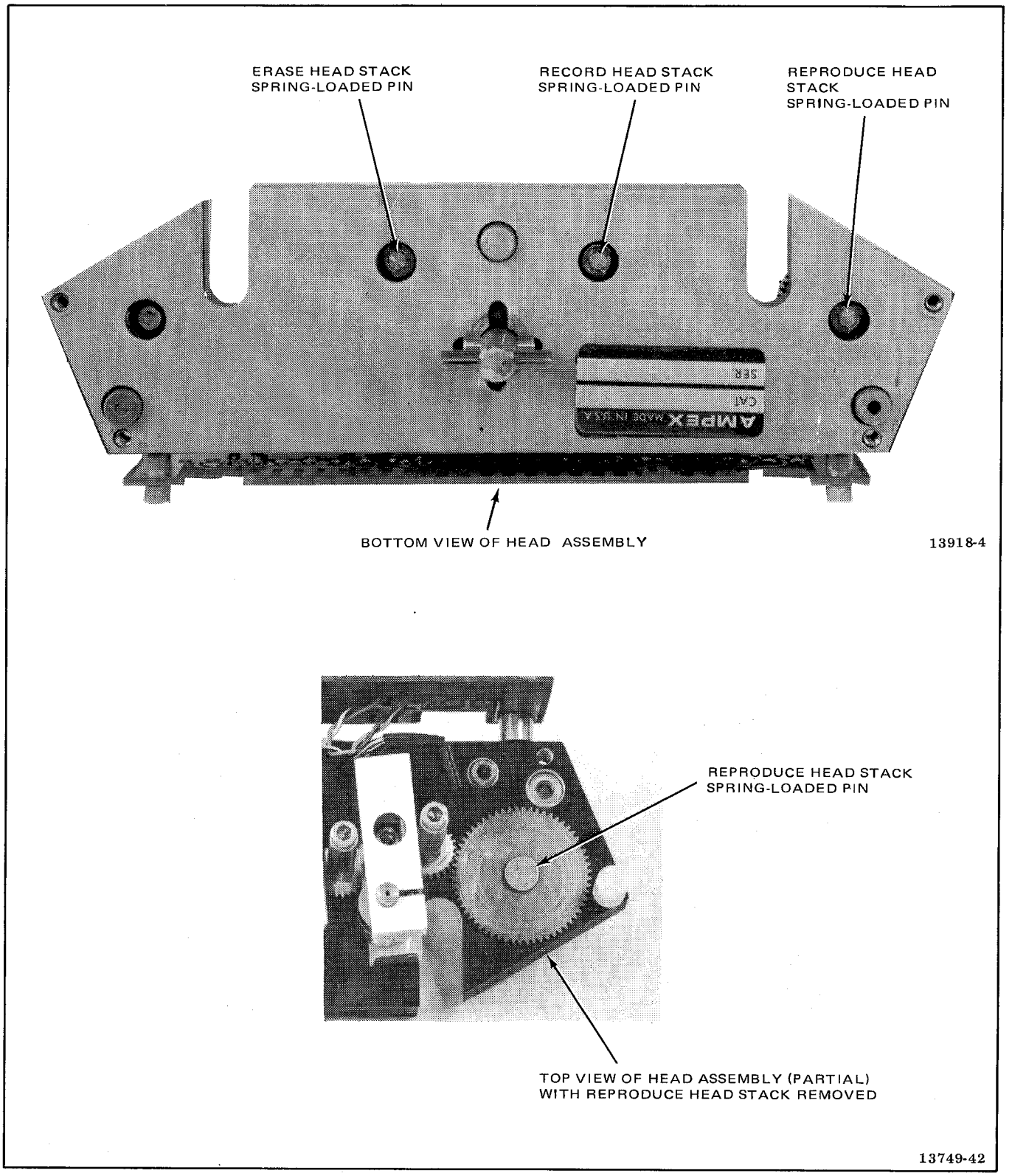


Figure 5-39. Head Assembly Spring Loaded Pin Locations, Main Head Shield Removed

points on the schematic diagrams (Section 6), and in the theory section (Section 4) and associated block diagrams.

The performance tests (paragraph 5-71) can be used as an aid in diagnosing a fault. These procedures include tests for checking tape tension, absolute tape speed accuracy, speed variation, operating level, signal-to-noise ratio, harmonic distortion, intermodulation distortion, and flutter. In addition, troubleshooting hint tables and troubleshooting flow diagrams are provided in this section (paragraph 5-88). Any of the corrective actions listed in the Table of Contents for Section 5 may be required. Recommended test equipment that may be required is listed in Table 5-1.

5-85. Extender Boards. Alignment and troubleshooting procedures are greatly simplified by using the electronics assembly extender board (supplied with the recorder/reproducer) and the input/output assembly extender board (accessory). These boards are listed in Table 5-1. The extender board, when installed between the circuit board and its receptacle, moves the circuit board outside the chassis so all components are accessible for testing or adjustment.

CAUTION

DO NOT REMOVE OR INSERT A CIRCUIT BOARD (PWA) WITH POWER ON. TO DO SO MAY CAUSE DAMAGE TO CIRCUIT COMPONENTS. ALSO, USE EXTREME CARE NOT TO INSERT A PWA ON AN EXTENDER BOARD INTO A WRONG SLOT IN THE ELECTRONICS ASSEMBLY. THE EXTENDER BOARD IS NOT KEYED LIKE THE PWAs.

5-86. Power Transistor Locations. Figure 5-40 shows the locations, by schematic symbol reference on schematic diagram no. 4840423, of the various power supply, solenoid driver, and MDA

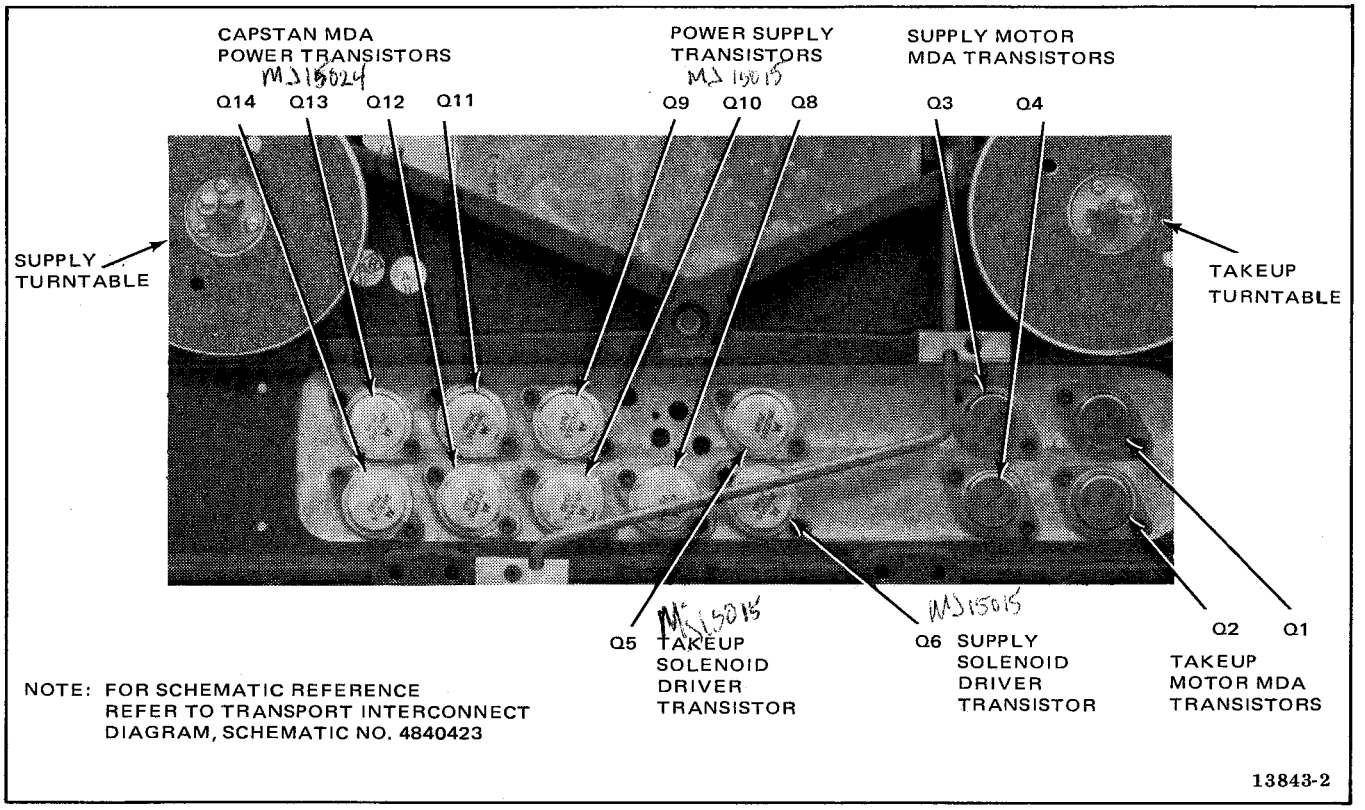


Figure 5-40. Power Transistor Locations on Heatsink

power transistors located on the top surface of the transport heatsink.

5-87. Flutter. The vibration analyzer portion of the flutter meter can be used to help isolate flutter to a certain frequency. Table 5-16 shows normal frequencies generated by the rotating mechanical components for each of the four tape speeds. This table is most useful for flutter evaluation when the weighted flutter measurement is out of specification. Troubleshooting hints for flutter problems are given in Table 5-19.

5-88. Troubleshooting Hints. Troubleshooting hints for problems associated with the tape transport and tape timer are given in Tables 5-17 and 5-18, respectively. Troubleshooting hints pertaining to flutter, excessive noise or poor signal-to-noise ratio, harmonic and intermodulation distortion, and general problems are given in Tables 5-19 through 5-22, respectively. Troubleshooting flow charts pertaining to the audio system are given in Figures 5-41 through 5-44.

Table 5-16. Rotational Rates (Hertz)

COMPONENT	TAPE SPEED			
	3.75 IN/S	7.5 IN/S	15 IN/S	30 IN/S
Capstan	0.50	1.00	2.00	4.00
Tape Timer	0.50	1.00	2.00	4.00
Capstan Second Harmonic	1.00	2.00	4.00	8.00
Takeup Tape Guide	1.43	2.86	5.72	11.45
Supply Tape Guide	1.47	2.93	5.87	11.73
Capstan Third Harmonic	1.50	3.00	6.00	12.00
Takeup Guide Second Harmonic	2.86	5.72	11.45	22.90
Supply Guide Second Harmonic	2.93	5.87	11.73	23.46
Tape Timer Mass Resonance	59 Hz for 1/2-inch tape width 44 Hz for 1/4-inch tape width		Independent of tape speed but slightly dependent on tape type and reel pack.	

Table 5-17. Troubleshooting Hints — Tape Transport

PROBLEM	POSSIBLE CAUSE/CHECK
Power will not switch on	Power actuator bar not actuating main power switch (Figure 2-11). No main power from power source. Main power fuse blown.
Power will not switch off	Power actuator bar not actuating main power switch.
Transport will not enter thread mode	Supply or takeup tension arm microswitch not actuating. Relay K1 in power supply not operating.

Table 5-17. Troubleshooting Hints — Tape Transport (Continued)

PROBLEM	POSSIBLE CAUSE/CHECK
Transport will not enter thread mode (continued)	Supply or takeup LED PWA harness wires binding against rear overlay panel. Tension arm torque. Reel servo malfunction. Stop pushbutton switch. Thread control logic circuitry on PWA No. 7. Reel servo PWA No. 9 not plugged into electronics assembly.
Transport will not unthread	EDIT pushbutton switch or associated circuitry. Capstan still rotating when EDIT pushbutton switch pressed. Motion sense circuit malfunction on PWA No. 8.
Tape slips on tape timer during acceleration	Tape tension too low. Tape tension unbalanced. Tape logic direction command wrong because of capstan tach sensor misadjustment.
Tape slips on capstan in forward or reverse direction	Tape tension too low. Tape tension greatly unbalanced. Tape too wide and being pinched by tension arm roller tape guides. Tape logic direction command unstable because of capstan tach sensor misadjustment or insufficient level.
Transport will not enter play edit mode	Tension arm idler not contacting capstan. Play edit control logic on PWA No. 7. Mode locked out on PWA No. 7.
Transport will not come out of play edit mode	Tape peeler misadjusted too far back allowing tension-arm guide to toggle over center of capstan. Capstan still rotating when EDIT pushbutton switch is pressed. Motion sense circuit malfunction on PWA No. 8.
Transport will enter thread mode but no tape motion in mode	Capstan motor power connection. Capstan MDA malfunction.
Tape motion possible in fast forward, rewind and spool modes but not play or record modes	Lockout circuitry activated because inactive recorder/reproducer speed selected.
Tape lifter arms will not fully retract or operate in fast modes	Tape lifter arm shaft binding in pivot bushings.

Table 5-17. Troubleshooting Hints – Tape Transport (Continued)

PROBLEM	POSSIBLE CAUSE/CHECK
Tape lifter arms will not fully retract or operate in fast modes (continued)	O-ring seal inside tape lifter solenoid hanging up in solenoid. Tape lifter solenoid shield not properly adjusted. Tape lifter solenoid driver (Q23, Q24) on PWA No. 9 is defective.
Tape lifter arms out too far or not far enough in fast tape modes	Individual tape lifter arm position not correct.
Tape lifter operates too slow or too fast	Solenoid air-leak control needs adjusting. O-ring seal in solenoid damaged or binding.
Capstan will not stop rotating	Capstan tach sensor misadjusted. Capstan tach sensor gain misadjusted. Tape tension unbalanced.
Capstan runs fast in one direction continuously	Voltage regulator on PWA No. 8 has failed.
In stop mode, capstan creeps in either direction	Tape tension unbalanced.
Capstan will not phase lock	Tape tension incorrect. Tach signal is noisy. Tach gain set too high or too low.
Transport will not enter stop/edit (unthread) mode when a tension arm is moved to an inner or outer limit	Position of tension arm LED PWA incorrect. LED, on PWA, light output is too low.
Poor tape pack in 180-in/s spool mode in either direction	Tape tension too low. Poorly slit tape. Use of non back-coated tape. Tape needs to be re-conditioned by operating in spool mode several times. Reel drive motor shaft damaged and not perpendicular to tape path. Type of tape used will not pack well at 180 in/s; try 60 in/s.
Poor tape pack in fast wind modes	Normal as air becomes entrapped between layers of tape. Use more accurately slit tape. Use spool modes for packing.
Tape pack height within reel incorrect (metal precision reels or plastic reels)	Turntable height wrong. Tape tension arm guide height wrong or arm shaft is bent.

Table 5-17. Troubleshooting Hints — Tape Transport (Continued)

PROBLEM	POSSIBLE CAUSE/CHECK
Tape pack height within reel incorrect (metal precision reels or plastic reels) (continued)	Reel motor axis not perpendicular with tape path — dirt particles under motor mounting.
	Axis of tape guide nearest reel in question not perpendicular to tape path.
	Poorly slit or damaged tape; try another tape.
Poor takeup tape pack in play and record modes	Very poorly slit tape.
	Axis of tapeup reel motor shaft not perpendicular to tape path.
	Takeup tension arm roller not perpendicular to tape path.

Table 5-18. Troubleshooting Hints — Tape Timer

PROBLEM	POSSIBLE CAUSE/CHECK
Timer display accuracy incorrect in all modes	Check transport direction control logic.
	Check crystal reference frequency.
	Check timer tachometer signal.
Timer accuracy incorrect only at high tape speeds	Capstan tach signal level incorrect.
	Capstan tach sensor incorrectly adjusted.
	Tape tension too low.
Timer will not reset to zero	Timer reset switch.
	Timer reset logic.

Table 5-19. Troubleshooting Hints — Flutter

PROBLEM	POSSIBLE CAUSE/CHECK
Weighted flutter at 15 or 30 in/s out of specification	Low-frequency flutter excessive due to capstan tachometer, supply tension arm tape guide, or takeup tension arm tape guide (see Rotational Rates (Hertz), Table 5-16).
	Poor surface quality of tape used.
	Tape not bulk erased.
Unweighted flutter at 3.75 or 7.5 in/s out of specification	Tape tension balance incorrect.
	Capstan tachometer dirty.
	Poor surface quality of tape used.

Table 5-19. Troubleshooting Hints — Flutter (Continued)

PROBLEM	POSSIBLE CAUSE/CHECK
Unweighted flutter at 3.75 or 7.5 in/s out of specification (continued)	Tape not bulk erased. Tape guide rollers not cleaned. Audio signal system alignment not correct. Capstan tachometer signals not set to proper phase; levels too high or too low. Capstan motor dragging or bearings defective. Capstan motor commutator dirty or damaged.
Excessive scrape flutter (high-frequency flutter)	Dirty or dry scrape flutter idler bearings; clean and lubricate. Tape surface quality poor causing uncontrollable scrape flutter. Scrape flutter idler position incorrect against tape. Scrape flutter idler not perpendicular to tape path causing tape to slide on roller.

Table 5-20. Troubleshooting Hints — Signal-to-Noise Ratio

PROBLEM	POSSIBLE CAUSE/CHECK
Excessive system noise or signal-to-noise ratio is out of specifications	Incorrect operating level is being used. Incorrect noise weighting filter being used for the particular specification being measured. Tape that was used for recordings of a different track format not bulk erased. Check erase depth adjustment. Heads and guides not clean or demagnetized. Check second harmonic distortion. If high, it could indicate magnetized component in tape path which may possibly be defective and cause high noise. Check that grounding straps are secure. Check external test equipment for ground loops. If noise is cyclic over a long period, check for noisy main voltage regulator A8 on main audio PWA.

Table 5-21. Troubleshooting Hints – Harmonic and Intermodulation Distortion

PROBLEM	POSSIBLE CAUSE/CHECK
High second harmonic distortion	Heads and/or tape guides magnetized.
	Audio oscillator used for measurement has a second harmonic component greater than 0.03% rms (–70 dB) for fundamental frequencies from 500 Hz to 1.0 kHz.
	DC offset voltage incorrectly set in input/output assembly input amplifier.
	System output connected to highly nonlinear load, such as overdriven level meters.
	Record amplifier malfunctioning.
	Record head in presence of large dc field.
	Erase circuitry malfunctioning.
High third harmonic distortion	Audio oscillator used for measurement has a third harmonic component greater than 0.05% rms (–66 dB).
	Record and/or reproduce operating levels not set correctly for type of tape in use.
	Bias not set correctly (2.75 dB ±0.5 dB overbias at 1.5-mil wavelength using Ampex 456 tape).
	DC offset voltage incorrectly set in input/output assembly line output amplifier.
High intermodulation distortion	Same causes as for high second or third harmonic distortion.
	Physically damaged tape causing excessive amplitude fluctuation of high frequency carrier.

Table 5-22. Troubleshooting Hints – General

PROBLEM	POSSIBLE CAUSE/CHECK
All LEDs illuminated on control unit and transport inoperative	Master oscillator inoperative.
LEDs on control unit will not illuminate	5-Vdc supply inoperative – check fuse F2 (Figure 2-11).
	Control unit connector P11 disconnected.
Control unit audio status indicators do not match actual system status	System lockout circuit operating as invalid speed has been selected.
	Multiplex circuitry.
When input/output assembly is connected, system monitors input signal at all times	System lockout circuit operating as invalid speed has been selected.

Table 5-22. Troubleshooting Hints – General (Continued)

PROBLEM	POSSIBLE CAUSE/CHECK
BIAS and/or ERASE indicators on input/output assembly illuminate when system not in record mode	Logic circuitry on audio PWA or audio control PWA. ±15-Vdc supply on input/output assembly out of tolerance.
Transport will not stop or change transport modes when in record mode	ERS logic command failure – audio control PWA. MRB logic command not unlatching -- transport control PWA.

5-89. Component Replacement Procedures

5-90. Power Supply. Access to the interior of the power supply is obtained by loosening the four power-supply cover screws (Figure 5-45) and removing the cover. To remove and replace the entire power supply, proceed as follows:

1. If recorder/reproducer is located in a cabinet, remove entire bottom cover of cabinet (ten screws).
2. Disconnect fan connector P20.
3. Remove transport rear overlay panel (six screws shown in Figure 2-2).
4. If a ground strap is connected to the power supply, remove the ground strap on the power supply.
5. Disconnect power supply connectors P1 and P2 (Figure 5-45).

WARNING

THE POWER SUPPLY IS HEAVY AND TWO PEOPLE ARE USUALLY REQUIRED TO SAFELY REMOVE THE SUPPLY FROM THE TRANSPORT.

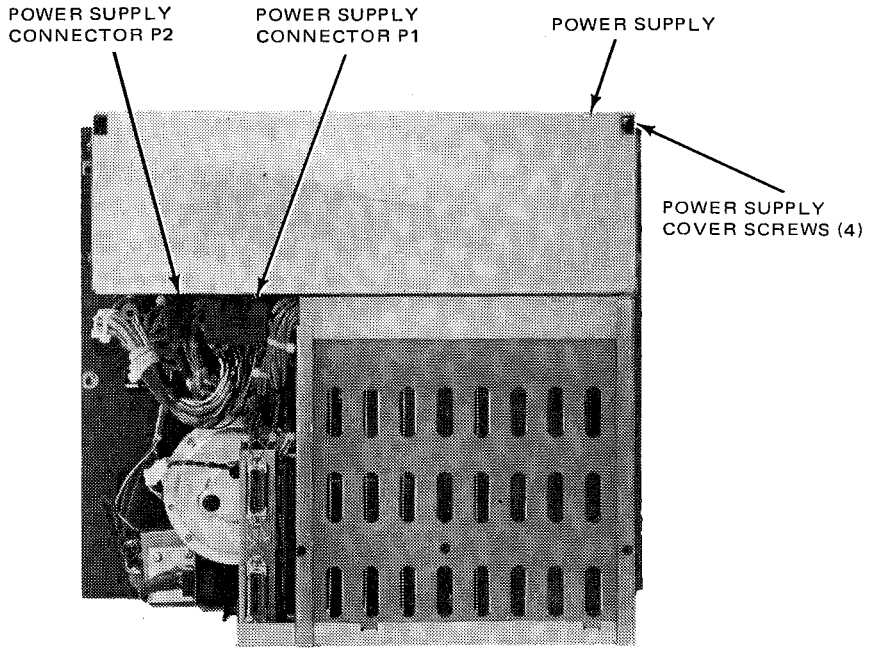
6. Support the weight of the power supply while removing the three hex-socket power supply mounting screws (Figure 5-45) that secure the power supply to the rear of the transport casting.
7. Reinstall power supply in the reverse order of removal while being careful not to damage any transport harness wires located in the power supply area.

5-91. Electronics Assembly. To remove and replace the electronics assembly, proceed as follows:

1. If recorder/reproducer is in a cabinet, remove entire bottom cover of cabinet (ten screws).
2. Disconnect fan connector P20.
3. Remove head cover assembly, head assembly, and front overlay panel (two screws) shown in Figure 5-22.
4. Remove ground strap that connects to electronics assembly from the tape transport. On early production units, strap is located front left of transport. On later units, strap is located in the rear of the head connector area.
5. Disconnect electronics assembly harness connector P16 that connects to tach sensor connector J16.
6. Disconnect electronic assembly harness connector P15 that connects to reel drive connector P15.
7. Disconnect control panel connector P11 from electronics assembly double-sided connector J11.
8. From the top of the transport, remove three 6-32 cap screws (Figure 5-37) that secure the electronics assembly to the transport.
9. From the bottom of the transport, slide electronics assembly chassis toward the supply reel and lift electronics assembly from the transport.
10. Remove electronics assembly rear cover panel (two screws).
11. Remove transport harness connector P10 from electronics assembly motherboard connector J10 to completely free electronics assembly from transport.
12. Reinstall electronics assembly in the reverse order of removal, being careful not to damage any cables (especially cable/connector P10).

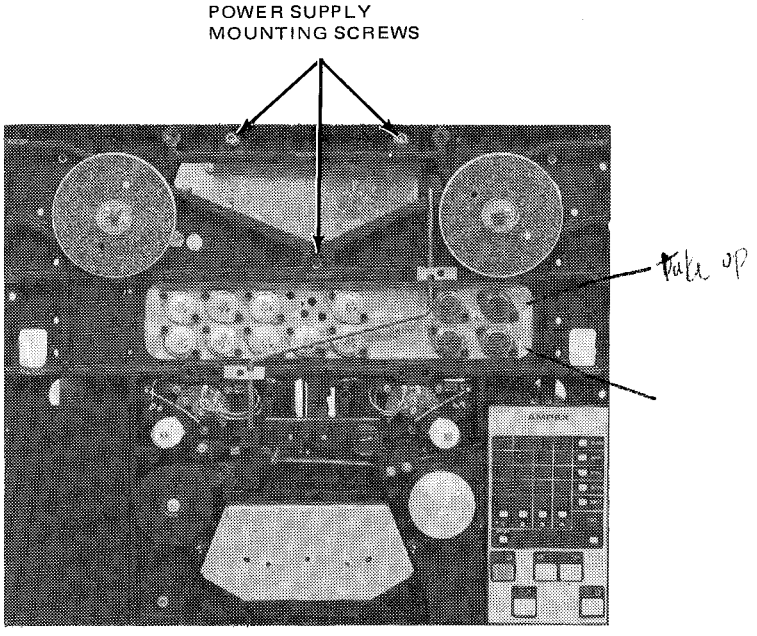
5-92. Capstan/Tach Assembly. The capstan/tach assembly is assembled at the factory and must be replaced as a unit. To remove the capstan/tach assembly, proceed as follows:

1. Remove the head cover assembly and head assembly from the top of the transport.
2. Remove the transport front and rear overlay panels (eight screws) from the top of the recorder/reproducer.



BOTTOM VIEW OF RECORDER/REPRODUCER

13690-12



TOP VIEW OF TRANSPORT

13843-2

Figure 5-45. Power Supply Removal

3. Remove front and rear tach cover panels by removing two flat-head screws, one socket-head screw, and one banana plug shown in Figure 5-20.

4. Remove socket-head screw, lock washer, and flat washer that secure the capstan tach sensor PWA (Figure 5-19). (Note: Do not loosen or remove the bar holddown screw, shown in Figure 5-19, that secures the capstan sensor bar, or adjustment of the capstan tach sensor PWA position will be required.)

5. Carefully lift capstan tach sensor PWA from adjustment pin and the shoulder of PWA mounting post. Carefully turn PWA out of the way of the glass tach disc.

6. Loosen capstan-edit-knob setscrews (two), and remove knob.

7. Loosen the two capstan/tach assembly setscrews 1/4 turn. Carefully lift the capstan/tach assembly on the capstan motor shaft, then continue loosening the lower setscrew (nearest the tach disc) four full turns to remove the capstan/tach assembly from the motor shaft.

CAUTION

IF TACH DISC NEEDS TO BE CLEANED, USE A SOFT LINT-FREE CLOTH OR KIMWIPE MOISTENED WITH WINDEX OR ISOPROPYL ALCOHOL. (FOR INSTRUCTIONS REGARDING THE CLEANING OF PHOTOPOTENTIOMETERS, LEDs, OR ANY PHOTO SENSE DEVICE, SEE PARAGRAPH 5-6.)

8. Replace capstan/tach assembly and capstan tach sensor PWA in the reverse order of removal. If a radial alignment mark is on end of motor shaft and on the capstan/tach assembly, line these two marks up before tightening the setscrews. This alignment position has been chosen at the factory for minimum flutter. Do not overtighten setscrews. (Correct setscrew torque is 1.8 ±0.3 inch pounds.)

9. Before mounting overlay and tach cover panels, verify that tach sensor PWA is in the proper position by performing the following tests:

   a. With power off, unplug reel servo PWA No. 9 within the electronics unit. (This disables reel servo so that reel motors do not operate.)

   b. Apply power and press play pushbutton switch. Capstan should run at the selected speed.

   c. Press stop pushbutton switch and observe if capstan quickly stops.

   d. Press fast forward pushbutton switch and allow capstan to reach full speed, then press stop pushbutton switch. Capstan should quickly stop.

   e. Press rewind pushbutton switch and allow capstan to reach full speed, then press stop pushbutton switch. Capstan should quickly stop.

   f. If the system did not pass any one of the above tests, perform the capstan tach sensor PWA position adjustment procedure given in this section under the heading *Capstan Tach Sensor*, paragraph 5-59.

10. Adjust the position of the tape peeler by performing the adjustment procedure given under the heading *Tape Peeler*, paragraph 5-70.

5-93. Capstan Motor and Parts Replacement. Besides the complete capstan motor, component parts that can be replaced are the motor brushes, flywheel and rotor assembly, capstan shaft assembly, and capstan motor bearings (Figure 5-46). It is not necessary to remove the complete motor to replace any of these component parts. The brushes are located within the rear cover. Note that the flywheel and rotor are not separable parts and therefore must be replaced as a unit.

The capstan rotor, rear cover, and brushes are manufactured by two different companies and these parts are not interchangeable on a given motor. Therefore, when parts are to be replaced, be sure the correct replacement part is used.

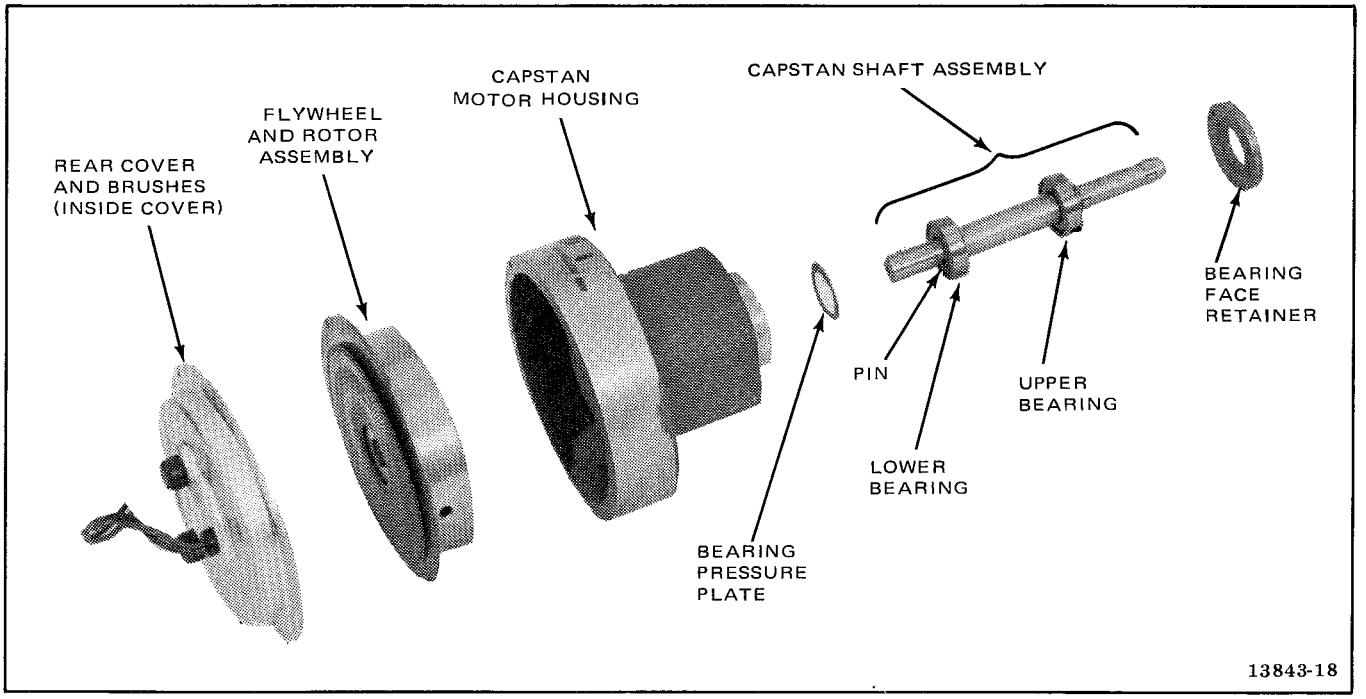


Figure 5-46. Exploded View of Capstan Motor

5-94. Capstan Motor. To replace the entire capstan motor, proceed as follows:

1. Remove the capstan/tach assembly as described under the heading *Capstan/Tach Assembly* in this section of the manual, paragraph 5-92.
2. Disconnect transport harness connector P18 that connects to capstan motor connector P18.
3. Disconnect control unit connector P11 that connects to electronics assembly connector J11.
4. Remove four capstan motor 10-32 holddown screws (Figure 5-47).
5. Carefully slide motor out bottom of transport, tilting motor as required to clear electronics assembly chassis.
6. Reinstall motor in the reverse order of removal with the flat on side of capstan motor housing facing the electronics assembly chassis.

5-95. Capstan Motor Brushes. Use the following procedure to replace the capstan motor brushes. The motor brushes (Figure 5-48) are attached to the inside of the capstan motor rear cover. Proceed as follows:

1. To permit more access space at the rear of the capstan motor, disconnect transport harness connector P18 that connects to capstan motor connector P18, and disconnect control unit connector P11 that connects to electronics assembly connector J11.
2. Remove only the two screws and flat washers shown in Figure 5-48 that secure the capstan motor rear cover to the motor (not the plate screws).
3. Note that the permanent magnet within the rear cover tends to hold the cover to the housing. Carefully pull rear cover from the motor.

CAUTION

TAKE CARE TO PREVENT METALLIC PARTICLES FROM GATHERING ON THE PERMANENT MAGNET.

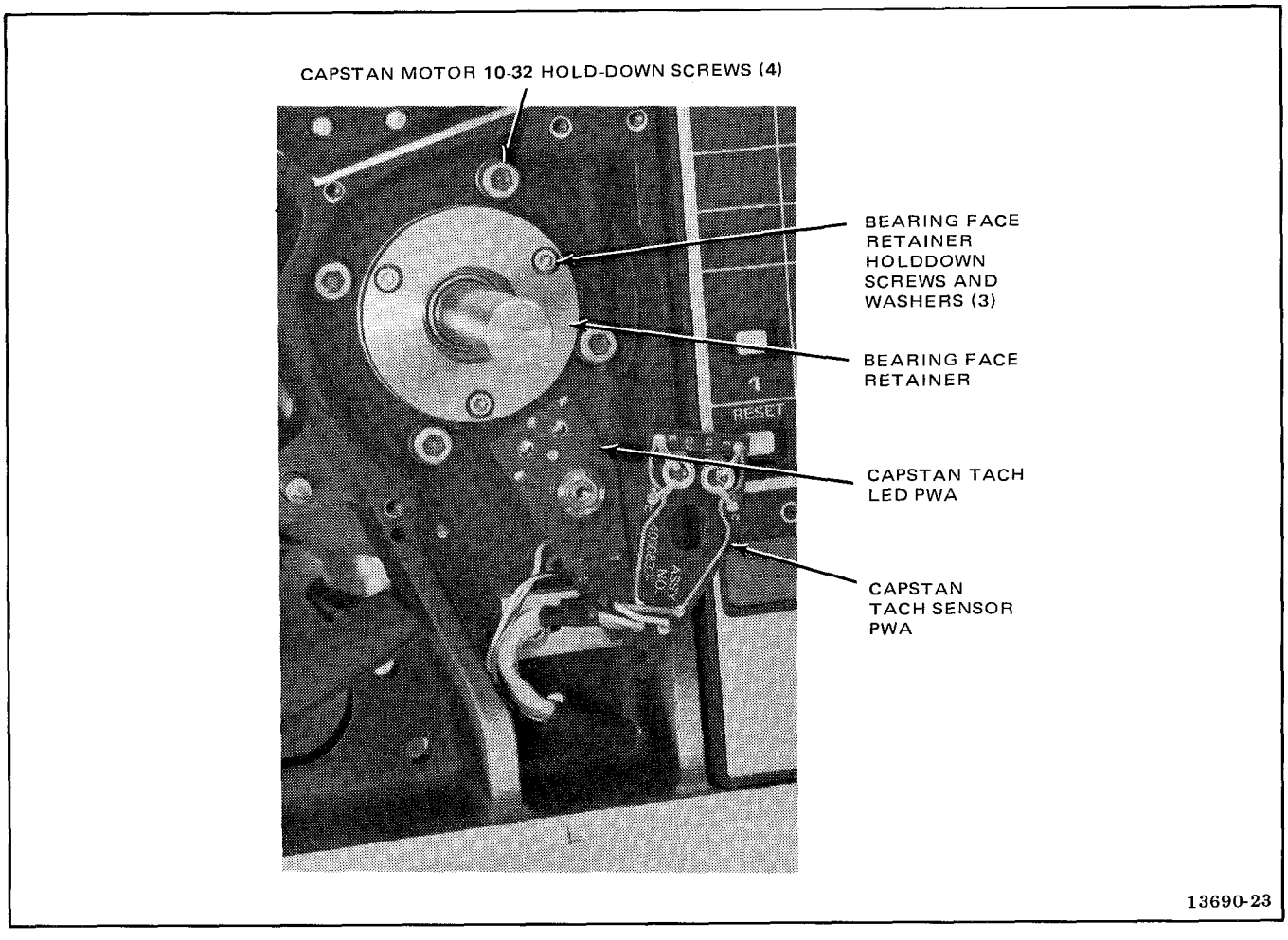


Figure 5-47. Capstan Motor Removal

4. Unsolder each brush lead and remove brushes, taking care to save brush springs.

5. Install new brushes and springs. Before soldering brush leads, adjust lead length so that spring does not force brush from brush holder. While soldering lead, clamp brush lead with a long-nose pliers to prevent solder from entering braid.

6. Contour the brush ends by placing the rear cover face down on a sheet of 400 grit sandpaper placed on a hard flat surface. Rotate rear cover back and forth approximately 90° about five times. Clean all contamination from the magnet and then clean brush ends with isopropyl alcohol.

7. Reinstall rear cover onto motor using screws and flat washers removed in step 2.

8. Reconnect control unit connector P11 to electronics unit connector J11, and reconnect transport harness connector P18 to capstan motor connector P18.

5-96. Flywheel and Rotor. Use the following procedure to replace the flywheel and rotor assembly (Figure 5-46).

1. Perform steps 1, 2, and 3 of the preceding *Capstan Motor Brushes* replacement procedure (paragraph 5-95) to remove the capstan motor rear cover.

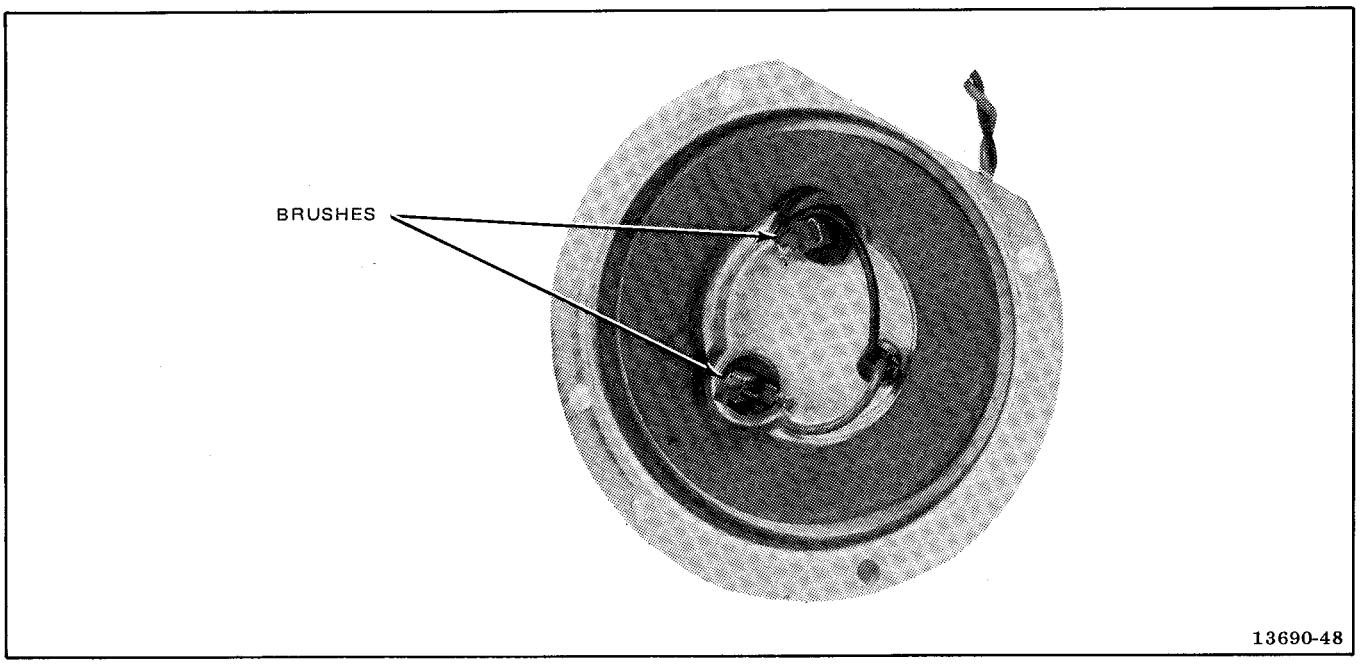


Figure 5-48. Capstan Motor Rear Cover Assembly

2. Remove the two hex-socket plate screws (Figure 5-49) that secure the 1/16-inch thick plate to the capstan housing (Figure 5-46).

3. Disconnect tach sensors connector J16 from electronics assembly connector P16.

4. Turn motor shaft to align hole in flywheel with hole in capstan housing. (Note: There are two holes in flywheel; one hole has a setscrew and the other is a counterbalance hole.) Insert Allen wrench and loosen setscrew about five complete rotations.

5. While supporting flywheel and motor assembly with one hand, remove Allen wrench and carefully slide flywheel and rotor assembly off the shaft.

CAUTION

DO NOT SCRATCH OR TOUCH PRINTED MOTOR SURFACE ESPECIALLY IN AREA WHERE BRUSHES SLIDE.

6. Reassemble motor in the reverse order of disassembly. When installing flywheel and rotor assembly on shaft, be certain that key slot in flywheel engages with pin in capstan shaft before tightening flywheel setscrew.

5-97. Capstan Shaft Assembly. Remove the capstan shaft assembly from the front of the transport as follows:

1. Remove the capstan/tach assembly as described under the heading *Capstan/Tach Assembly* in this section of the manual, paragraph 5-92.

2. Disconnect tach sensors connector J16 from electronics assembly connector P16.

3. Turn motor shaft to align hole in flywheel with hole in capstan housing. (Note: There are two holes in flywheel; one hole has a setscrew and the other is a counterbalance hole.) Insert Allen wrench to loosen setscrew about five complete turns. Insert a spare Allen wrench in flywheel hole to maintain angular position of flywheel.

4. Remove bearing face retainer (three screws and washers shown in Figure 5-47).

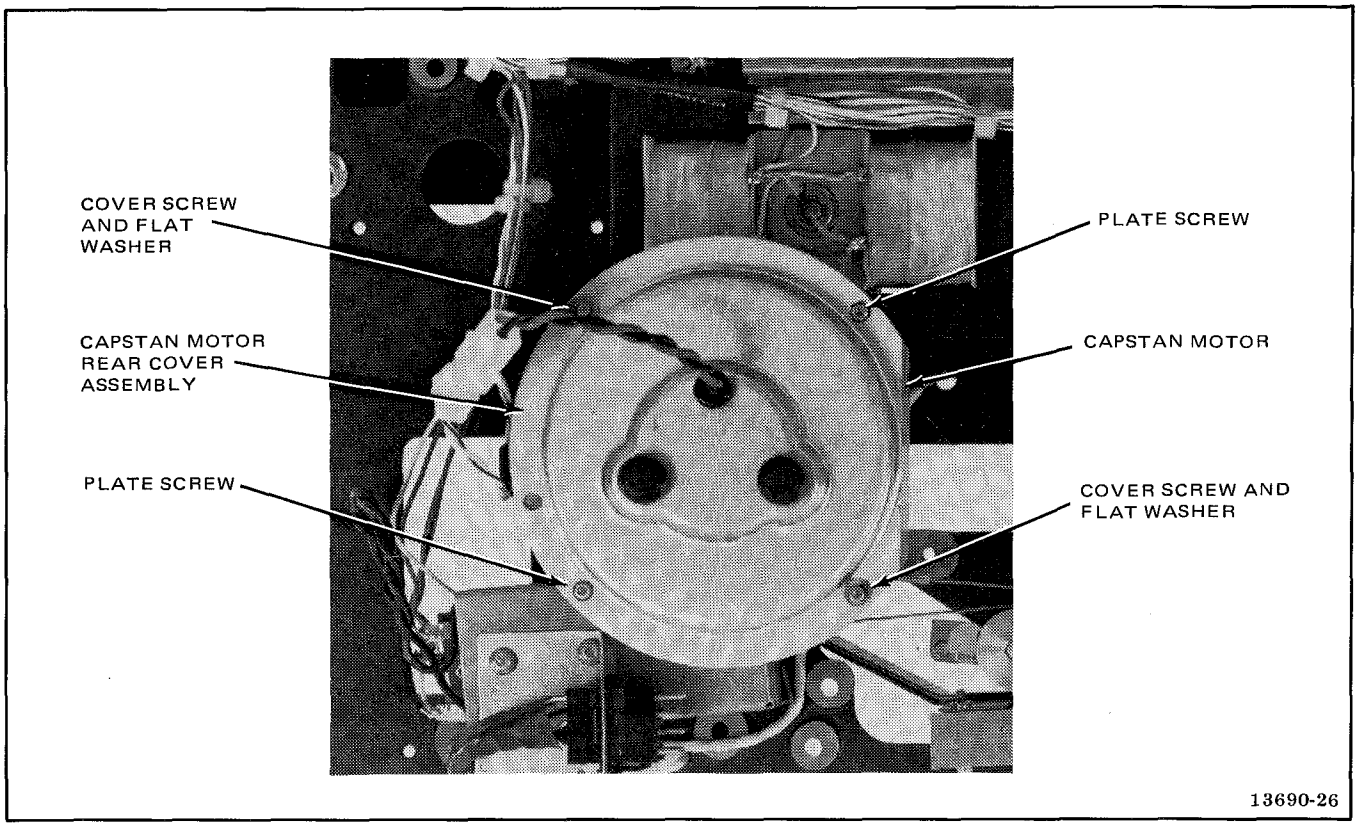


Figure 5-49. Rear View of Capstan Motor Assembly

5. From the top of the transport, carefully pull capstan shaft assembly up and out of the capstan housing. Be careful to retain the three bearing compression springs that fit into holes in the spring retainer attached to the bottom of the capstan housing.

6. Prior to reinstalling the capstan shaft assembly, be sure that the three bearing compression springs are in the holes in the spring retainer inside the capstan housing.

7. Check that the bearing pressure plate shown in Figure 5-46 (looks like a large washer) is either resting on the springs or is held by grease film to the lower bearing on the capstan shaft assembly.

NOTE

Do not remove grease coating within the capstan housing bore.

8. Slide capstan shaft assembly into capstan housing so that pin in side of capstan shaft assembly is aligned with setscrew in flywheel.

9. Place bearing face retainer, removed in step 3, on top of upper bearing and push by hand against end of shaft to fully seat shaft in capstan housing and to compress bearing compression springs. If pin in side of capstan is not aligned with setscrew in flywheel, in order to engage key slot in flywheel, shaft will not fully insert into housing. (Approximately 20 pounds of force are required to fully compress the compression springs.)

10. After ascertaining that shaft is correctly installed and pin is engaged in slot in flywheel, install the three bearing face retainer screws and washers removed in step 4.

11. Tighten setscrew in flywheel against the capstan shaft assembly.

12. Rotate shaft by hand to check for freedom from rubbing or binding.

13. Reinstall capstan tach assembly as described under the heading *Capstan/Tach Assembly*, paragraph 5-92.

14. Reconnect tach sensor connector J16 to electronics assembly connector P16.

5-98. Capstan Shaft Bearings. With the use of proper tools, new bearings may be pressed onto the capstan motor shaft. If the proper tools are not available and the bearings need replacement, it is suggested that a new capstan motor shaft assembly (includes bearings) be installed (Ampex Part No. 4041264). The two ball bearings used are size R8, ABEC class 5 tolerance grade (Ampex Part No. 4200075) and are pregreased and ready for use. The bearings are double shielded, but not sealed, and are greased with type Andok C grease.

To remove and replace the bearings on the capstan shaft, proceed as follows:

1. Remove the capstan shaft assembly from the capstan motor housing as described in the preceding *Capstan Shaft Assembly* removal procedure, paragraph 5-97.

2. Prior to removing the lower bearing (Figure 5-46), remove the 0.062 flywheel drive pin from the capstan shaft.

3. Each bearing is removed by pressing the bearing off the shaft at the end closest to the bearing. Note: Removing the bearings usually causes permanent damage to the bearings and therefore they should not be reused.

4. Prior to pressing the new bearing on the shaft, coat the shaft with heavy grease to reduce friction while pressing the bearing on the shaft.

5. Press the new bearing on the shaft by pressing squarely against the bearing inner race *only*. If force is applied through the ball bearings, the bearing will be damaged. Press the bearings fully against the shoulders of the shaft to obtain correct axial location relative to the shaft.

6. If the lower bearing (Figure 5-46) was replaced, reinstall the 0.062 pin removed in step 2. Use an adhesive such as Loctite to secure pin. Be sure pin is fully bottomed in hole drilled in side of shaft.

7. Protect capstan shaft assembly against dirt and mechanical damage until reinstalled into capstan motor housing. Reinstall capstan shaft assembly as described in the preceding *Capstan Shaft Assembly* removal procedure, paragraph 5-97.

5-99. Reel Drive Motors and Brush Replacement. Besides the complete reel drive motor, the only parts that may be replaced on a motor are the motor brushes. The motors are supplied by several vendors and may be used interchangeably in a supply or takeup motor position. However, the brushes are not interchangeable and the correct brush for a given motor must be used.

5-100. Reel Drive Motor Replacement. To remove and reinstall a supply or takeup reel motor, proceed as follows:

1. Remove the power supply by following the instructions given under heading *Component Replacement Procedures* in this section of the manual, paragraph 5-89.

2. Disconnect the appropriate reel drive motor connector P17 (takeup) or P19 (supply).

3. Remove and reinstall reel motor by following the instructions given for *Turntable Repositioning for Reel Size* (paragraph 2-22) given under the heading *Initial Adjustments* in Section 2 of this manual.

4. Reconnect reel motor connector P17 (takeup) or P19 (supply).

5. Reinstall power supply and reconnect power supply connectors P1 and P2.

6. Reinstall transport upper overlay panel.

5-101. Brush Replacement. The two motor brushes seldom wear out; however, a brush may chip or become noisy and therefore need replacing.

Proceed as follows:

1. If the brush that needs to be replaced is facing the power supply, remove the power supply by following the instructions given under the heading *Component Replacement Procedures* in this section of the manual, paragraph 5-89.

2. To remove a brush, use a large bladed screwdriver and unscrew the motor endplug (Figure 5-50). The brush has a spring attached which maintains pressure against the motor commutator. Slide the old brush out of the retaining hole in the motor.

3. Clean the new brush with isopropyl alcohol and install in the motor.

4. Secure new brush and spring with endplug removed in step 2.

5. If power supply was removed, reinstall in the reverse order of removal.

CAUTION

A NEW BRUSH MAY SQUEAK UNTIL THE MOTOR HAS BEEN RUN LONG ENOUGH TO SEAT THE NEW BRUSH TO THE COMMUTATOR. DO NOT APPLY ANY LUBRICANTS TO THE BRUSH.

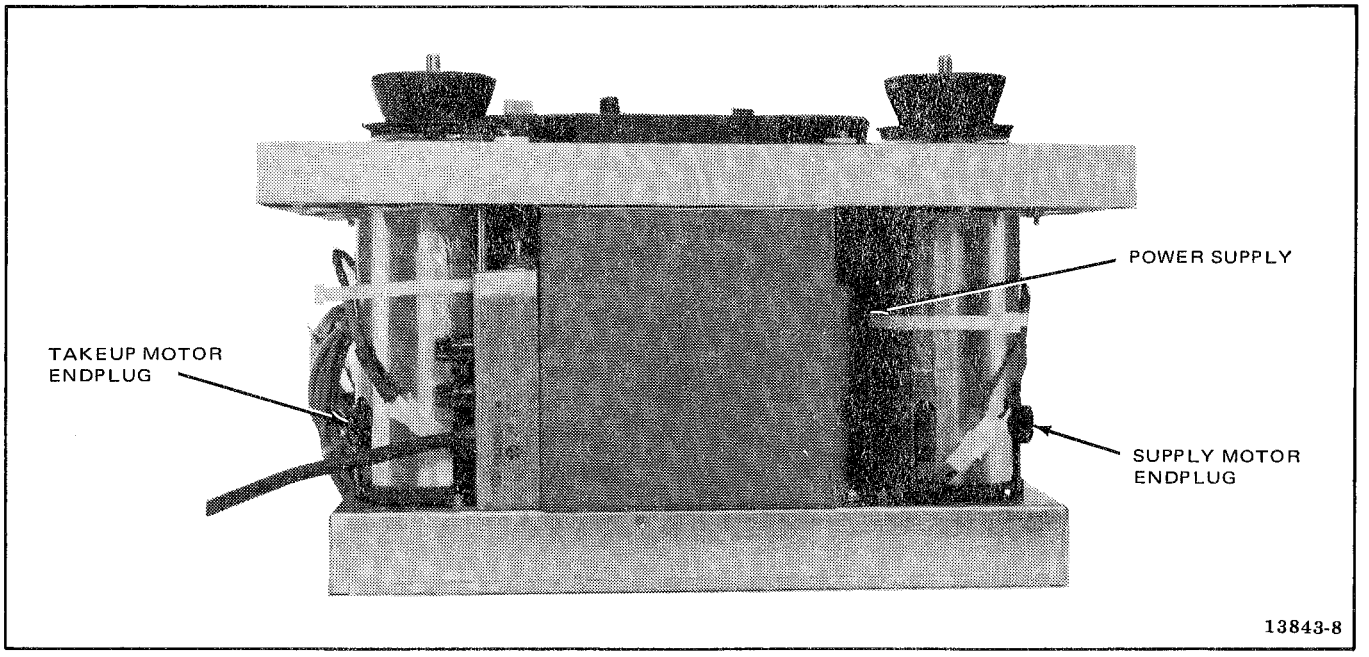


Figure 5-50. Reel Drive Motor Brush Replacement, Rear Side View of Transport