SECTION VII

MAINTENANCE

7-1. GENERAL.

7-2. The TM-2 Tape Transport is designed to require minimum maintenance and service. Such maintenance as is required will be facilitated by a well-planned program of preventive maintenance, a systematically kept maintenance log, and carefully performed corrective maintenance as required. Adherence to such a program will ensure optimum performance of the equipment over many years.

7-3. A listing of the recommended tools and equipment used in maintenance of the tape transport will be found at the end of this section.

7-4. PREVENTIVE MAINTENANCE SCHEDULE.

7-5. A program of planned periodic maintenance is the most effective way of keeping the tape transport operating at its designed potential. A recommended schedule is shown in the table below. It should be noted that these maintenance procedures are scheduled by number of eight-hour shifts, as well as by hours of running time as indicated on the elapsed time meter at the rear of the tape transport.

Maintenance Operation	Frequency Shifts (1 shift = 8 hrs.)	Frequency Hours	Approx. Min. Ea.	Qty	Total Time (Min.)	Text Paragraph Reference
Check Servo Amplifier Bias	1	8	1	2	2	7-7
Clean Transport	2	16	10	1	10	7-8
Check capstan roller adjustment	2	16	1	2	2	7-9

Maintenance Operation	Frequency Shifts	Frequency Hours	Approx. Min. Ea.	Qty	Total Time (Min.)	Text Paragraph Reference
Check tape transport tracking	1	8	1	2	2	7-10
Check pack follower alignment	12	96	2	2	4	7-11
Adjust capstan rollers	12	96	10	2	20	7-12
Degauss heads and tape guides	24	192	.5	16	8	7-13
Clean rack	24	192	5	1	5	7-14
Replace air filters	24	192	.25	4	1	7-15
Check and adjust vacuum	24	192	3	1	3	7-16
Align chamber guides if necessary	24	192	3	4	12	7-17
Check and adjust reel servos	24	192	6	2	12	7-18
Check holddown operation and torque	24	192	2.5	2	5	7-19
Check Actuator Firing circuitry	24	192	7.5	2	15	7-20
Align pack follower	60	480	10	2	20	7-21
Replace thyratrons	60	480	1	13	13	7-22

Maintenance Operation	Frequency Shifts	Frequency Hours	Approx. Min. Ea.	Qty	Total Time (Min.)	Text Paragraph Reference
Check and adjust reel servos			6	2	12	7-22
Check actuator firing circuitry			7.5	15	15	7-22
Replace static strip	60	480	20	1	20	7-23
Align chamber guides if necessary			3	2	6	7-23
Check head wear	124	992	3	1	3	7-24
Check vacuum switch	124	992	10	2	20	7-25
Replace vacuum tubes	124	992	.25	6	3	7-26
Check and adjust reel servos			6	2	12	7-26
Replace vacuum blower motor brushes	250	2000	1	1	1	7-27
Check and adjust vacuum			3	1	3	7-27
Check capstan drive belt	250	2000	1	1	1	7-28
Replace capstan rollers	250	2000				7-28
Reverse (incl. adj.)			30	1	30	7-29
Forward (incl. adj.)			30	1	30	7-29
Replace capstan assemblies	250	2000				7-29
Reverse			30	1	30	7-29
Forward			15	1	15	7-29
Adjust capstan rollers			10	2	20	7-29

Maintenance Operation	Frequency Shifts	Frequency Hours	Approx. Min. Ea.	Qty	Total Time	Text Paragraph Reference
Replace actuators	250	2000	10	2	20	7-29
Replace and adjust capstan drive belt	250	2000	10	1	10	7-30
Replace Chamber Guides	250	2000	10	4	40	7-31
Align Guides			3	4	12	7-31
Replace reel motor brushes	250	2000	15	2	30	7-32
Adjust holddown knob torque	250	2000	15	1	15	7-33
Replace positive pressure blower	625	5000	30	1	30	7-34
Replace pack follower assemblies	625	5000	45	2	90	7-35
Replace reel motors	625	5000	30	2	60	7-36
Replace capstan motor	625	5000	20	1	20	7-37
Adjust reel motor brake	625	5000	5	2	10	7-38

7-6. MAINTENANCE OPERATIONS

7-7. Checking Servo Amplifier Bias--Servo amplifier bias must be checked each eight hours of operating time. The following equipment is required to accomplish the check:

1) Voltmeter, Simpson Model 260 or equivalent

2) Screwdriver with 3/16" blade

NOTE

The following procedure assumes that servo adjustment switch S501 and test points TP501 and TP502 are present on the electronics assembly. Early transport electronics assemblies which did not incorporate these components may be adjusted by following the procedure enclosed in parentheses.

Step 1: Connect voltmeter leads to TP501 and TP502, observing proper polarity. Turn S501 to position 3. (Using a pair of short test leads, jumper pins 12 and 13 of the servo amplifier board to pins 11. The pins are numbered from left to right as viewed from the end opposite the connector. Connect the voltmeter leads to pins 11 and 16: pin 11 is grounded).

Step 2: Adjust the upper servo bias control (figure 7-8) for a reading as near as possible to, but not more positive than, -5.5 vdc.

NOTE

The setting indicated above may be modified to obtain optimum results. In general, more negative bias decreases reel motor heating while reducing the program capabilities of the tape transport. The final setting of servo bias, therefore, must be determined with experience gained from running programs on the tape transport.

Step 3: Turn switch S501 to position 5. (Use the test leads to jumper pins 8 and 9 to pin 10; connect the voltmeter leads from pin 4 to pin 10: pin 10 is grounded).

Step 4: Adjust the lower servo bias control for a reading as near as possible to, but not more positive than, -5.5 vdc.

NOTE

The servo testing switch S501 must be returned to position 1 before the machine may be operated. (Remove the voltmeter leads and jumper leads before attempting to operate the transport).

7-8. Cleaning the Tape Transport--The write/read head assembly is cleaned with a lint-free cloth or cotton swab moistened with Ampex Head Cleaner (Ampex Catalog Number 087-007) as shown in Figure 7-1. The head stacks and guides should be wiped carefully so as to remove all traces of oxide, dirt, etc. It is not necessary to remove the head assembly from the transport for this cleaning operation.

WARNING

Use only the indicated cleaner on the head assembly. Use of solvents such as carbon tetrachloride may dissolve the head lamination adhesive.

The vacuum chambers and servo loop sensing slots in the chambers should also be cleaned and freed of any oxide accumulation. The primary cleaning of the servo loop sensing slots is accomplished by inserting the slot cleaning tool (Ampex Part No. 61375-10) into the top of each sensing slot and drawing it once from top to bottom. (Figure 7-2).

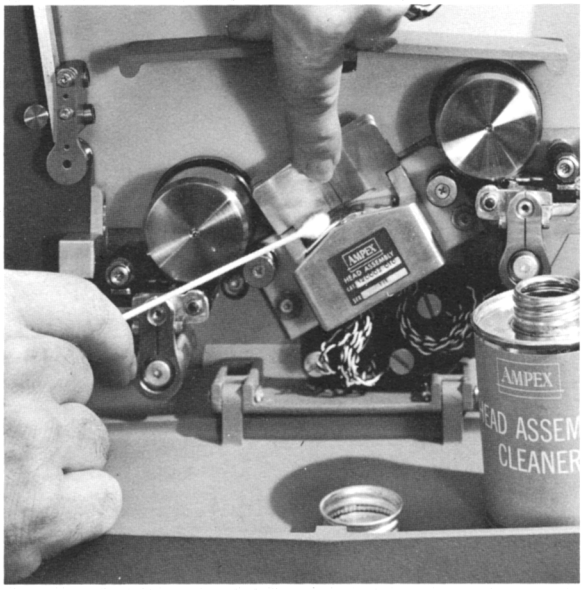

Figure 7-1.
Cleaning Head Assembly

CAUTION

Use only the indicated special tool. Objects extending more than 1/8" into the sensing slots may cause permanent damage.

The chambers proper should be thoroughly cleaned with a cloth moistened in head cleaner. Be particularly careful to remove all traces of foreign material from the glass cover doors. The capstan roller assemblies, capstans, and fixed tape guides should be thoroughly cleaned with a lint-free cloth moistened with head cleaner. All traces of dirt, etc., should be removed. The inside of the transport access door and the face of the transport casting (especially the ledge under the take-up reel) should be wiped free of all traces of foreign material. The tape packer arm shoes should be carefully cleaned and inspected. Any accumulation especially on the lower (take-up) reel packer arm shoe should be removed with a lint-free cloth moistened in head cleaner. Inspect the shoes for any roughness.

7-9. Checking Capstan Roller Adjustment--Capstan roller gap and tape brake gap are extremely important adjustments in terms of meeting start/stop time and distance specifications. The capstan roller gap should be set for .006" penetration of the capstan roller by the capstan when the capstan roller is engaged. The brake gap should be .010" (plus .003", minus .001"). If the capstan roller gap and/or brake gap measurements are outside specifications, they should be adjusted as detailed in paragraph 7-12.

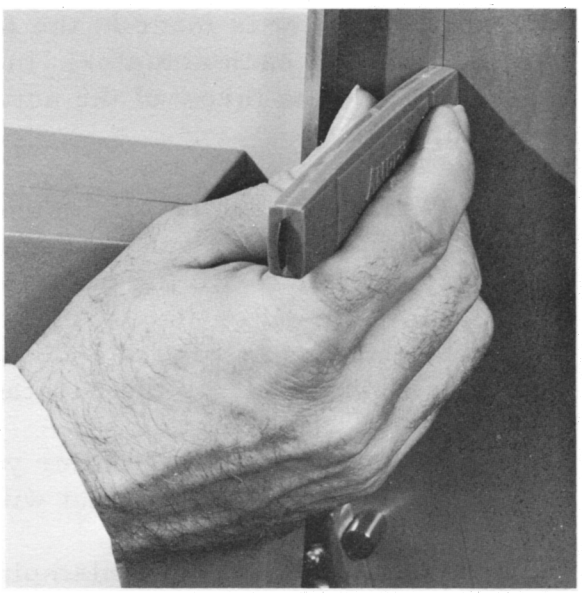

Figure 7-2
Cleaning Sensing Slots

7-10. Checking Tape Tracking--Tape tracking is most readily checked by cycling the tape transport

rapidly between the forward and reverse direction. The operator should observe the tape path between the capstan roller assemblies and the vacuum chambers (the eyes should be at the level of the capstan rollers). There should be no evidence of skew or tape misguiding; that is, the tape should be perfectly flat with no twist or ripple. When the tape is viewed across the head, there should be no discernible horizontal shift of the tape. Adjustment of the tape guides is detailed in paragraph 7-17. The cycling of the transport also permits observation of the servos which control the length of the tape loops in the vacuum chambers. If servo response appears sluggish or overenergetic, it should be checked as detailed in paragraph 7-18.

7-11. Checking Pack Follower Alignment--During the check of tape tracking, observe the action of the pack follower arms. The shoe mounted at the end of the arm must at no time touch the flanges of the reel. Should the shoe contact the reel, it may be adjusted as detailed in paragraph 7-21.

7-12. Capstan Roller Adjustment--The capstan rollers must be carefully adjusted to meet start/stop time and distance specifications. In addition, no "skew" of the tape as it emerges from the capstan and capstan roller may be tolerated. The procedure requires that the throw of each actuator be known. This measurement is made at the factory and the result shown on a gummed label attached to each actuator. In the event that this label has been removed or lost, the throw of the actuator may be determined by the following procedure:

Step 1: With the machine off, remove the tape and manually rotate the right hand (forward) capstan roller assembly to its ON position (in contact with the capstan).

Step 2: Referring to Figure 7-3, loosen the two socket head cap screws (A) which clamp the capstan roller yoke to the actuator shaft.

Step 3: Rotate the capstan roller yoke on the actuator shaft so that the roller is just in contact with the capstan.

Step 4: Tighten the screws clamping the yoke to the actuator shaft. Check to see that the roller is still in contact with the capstan.

Step 5: Manually rotate the capstan roller assembly to its OFF position.

Step 6: Using a feeler gauge, determine the gap between the capstan and the capstan roller. This figure represents the actuator throw. Mark this figure on the actuator for future reference.

Step 7: Repeat Steps 1 through 6 for the left hand (reverse) capstan roller actuator.

When the actuator throw has been determined, either from a label on the actuator or by the procedure described above, the capstan roller gap may be set as follows:

NOTE

If capstan roller is to be adjusted, it is recommended that the two screws which clamp the capstan roller eccentrics in the yoke be loosened and the eccentrics rotated so as to place the roller at its furthest point from the capstan. The screws should then be tightened.

Step 8: Subtract .006" from the actuator throw measurement. The remainder will be the proper gap setting for any capstan roller assembly used with the one actuator.

Step 9: Loosen the two socket head cap screws (A) clamping the capstan roller yoke to the actuator shaft.

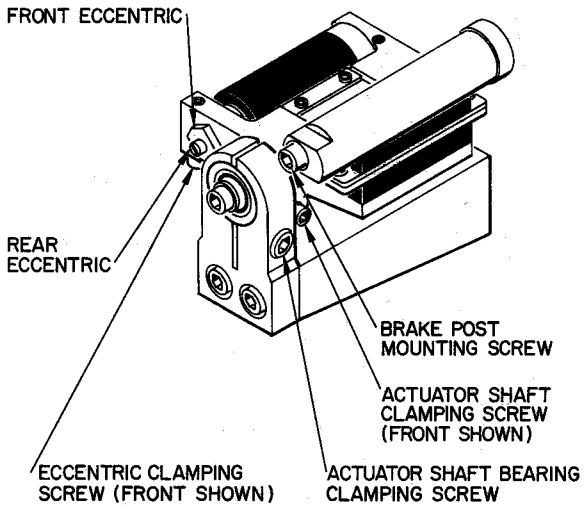

Figure 7-3
Capstan Roller Adjustment Points

Step 10: Using a feeler gauge .002" or .003" smaller than the remainder determined in Step 1, rotate the yoke on the actuator shaft (actuator in OFF position) so that the leaf of the feeler gauge is clamped between the capstan roller and capstan.

Step 11: Tighten the two screws (A) clamping the yoke to the actuator shaft. The effect of this will be to clamp the yoke to the shaft; at the same time, a slight rotation of the yoke on the shaft will consume the .002" - .003" provided in Step 3.

Step 12: Loosen setscres (F) then retighten.

Step 13: Check the gap with a feeler gauge of the thickness determined by Step 1. The gap should be within ± .001" of this figure. If this result is not achieved, repeat Steps 2 through 4 as necessary.

Step 14: Repeat Steps 8 through 13 for the second actuator.

Step 15: Loosen the socket head cap screw (B) for the left hand tape brake post.

Step 16: Place a .010" feeler gauge between the brake pad on the capstan roller assembly and the brake post. Using a wrench, rotate the brake post on its eccentric until the leaf of the feeler guage is held between the post and the pad. Holding the post in this position with the wrench, tighten the brake post mounting screw (B).

Step 17: Repeat Steps 15 and 16 for the right hand tape brake.

Step 18: Thread the transport with a fresh roll of tape.

Step 19: Operate the transport in the FORWARD DRIVE mode. Observe the tape as it passes through the right hand capstan roller. If any distortion (bowing, waving, etc.) of the tape is observed, loosen the two socket head cap screws which clamp the eccentrics within the yoke (C). Manipulate the front and rear eccentrics (D and E) until tape emerging from the capstan roller is smooth, flat, and straight. Tighten the socket head cap screws (C).

Step 20: Check capstan roller gap and adjust, as necessary, using the procedure of Steps 9 through 13.

Step 21: Check brake gap and adjust, as necessary, using the procedure of Steps 15 through 16.

Step 22: Operate the transport in the REVERSE DRIVE mode. Repeat Steps 19 through 21 for the left hand capstan roller.

7-13. Degaussing Tape Path--Elements within the tape path should be demagnetized regularly. Head demagnetization is an extremely important operation, especially demagnetization of the read head. When any element in contact with the tape becomes permanently magnetized, recorded data may be partially erased. Any phenomena tending to place large unbalanced pulses through the write or read head may cause magnetization. The following precautions should be observed:

1) Do not connect or disconnect head leads while writing.

2) Do not test head continuity with an ohmmeter.

3) Do not allow any magnetized object to come into contact with any portion of the transport.

The heads and guides may be demagnetized by the following procedure:

Step 1: Remove all tape from the transport.

Step 2: Disconnect all power from the equipment.

Step 3: Plug an Ampex Model 704 Demagnetizer into a source of 117 vac power.

Step 4: Bring the tips of the demagnetizer into close proximity to, but not in contact with, the head (Figure 7-4).

Step 5: With the tips of the demagnetizer straddling the head gap, run the demagnetizer slowly over the full length of the head.

Step 6: Remove the demagnetizer slowly, allowing the influence of the a-c field to die gradually.

Step 7: Repeat the process for the other head stack, and for all tape guides and elements in the tape path.

NOTE

Should larger elements of the tape path, such as the capstans, become magnetized, several passes of the demagnetizer may be required to remove all traces of permanent magnetism.

7-14. Cleaning Rack--The entire rack housing the tape transport and that tape transport itself should be thoroughly cleaned on a regular schedule. The front of the transport should be carefully wiped with a lint-free cloth moistened with Tek-Kleen or ethyl alcohol.

WARNING

Do not permit any of the cleaning fluid to come into contact with the capstan bearings or capstan roller bearings. Under no circumstances should the cleaning fluid be allowed to come into contact with the head assembly.

A vacuum cleaner is useful in reaching otherwise inaccessible dirt on the rear of the transport, inside cabinet racks, etc. The entire rear of the transport and the cabinet housing the transport should be thoroughly cleaned.

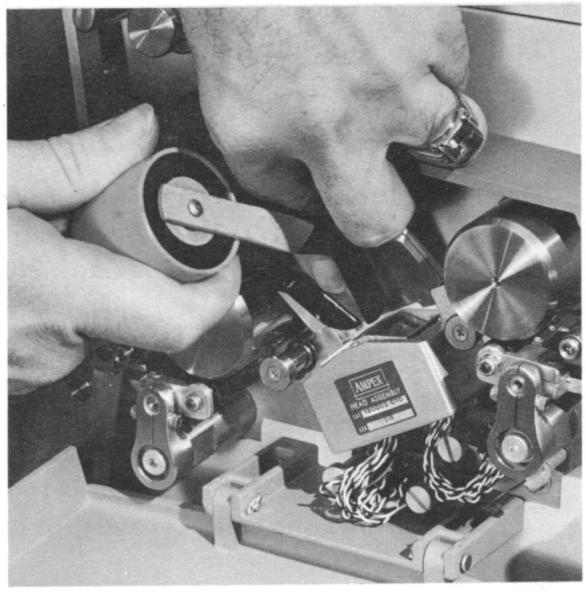

Figure 7-4
Head Demagnetization

WARNING

Do not use the vacuum cleaner as a blower or use compressed air to clean the transport.

7-15. Replacing Air Filters--The servo blower vacuum filter, positive pressure blower filter, and the two filters in the rear door of the rack cabinet should be changed regularly. The servo vacuum blower filter is replaced by releasing the retainer and pulling the filter straight forward by means of the two loops provided. The new filter is installed by reversing the above process. The positive pressure blower filter is replaced by removing the pan head screw which holds the filter housing in its closed position. The two filters in the rear door of the rack cabinet are replaced by lifting them from their retaining slides. All filters are reusable, and may be cleaned with a vacuum cleaner. Following this cleaning, the filters should be thoroughly washed in clear water and allowed to dry.

CAUTION

Be certain that any filter cleaned in this manner is allowed to dry thoroughly before being returned to service. Failure to dry the filter completely may result in moist air being pumped into the tape transport, harming the tape, transport, etc.

7-16. Checking and Adjusting Vacuum--The vacuum level in the vacuum chambers should be checked each time the filters are replaced and adjusted if necessary. Vacuum level is checked by attaching a vacuum gauge or manometer to the long loop sensing port of either vacuum chamber. Access to the port is obtained by removing the normal tubing from the take-up vacuum chamber long loop port (located at the top left of the transport casting as viewed from the rear). The manometer or vacuum gauge may then be connected to the stud which protrudes through the casting. With a normal length loop (13-1/2" plus or minus 1/2") a reading taken at this

point should indicate a vacuum level equivalent to 13-15 inches of water. A flap over a bleeder port (Figure 7-5) provides adjustment of vacuum level. Recent TM-2 tape transports are equipped with a vacuum test assembly, located on the left side web of the casting as viewed from the rear of the transport. This assembly, located in the transducer vacuum lines, permits monitoring of vacuum level with a gauge or manometer. Viewed from the left side of the transport, the upper left hand connection may be removed to measure vacuum level at the right long loop sensing port.

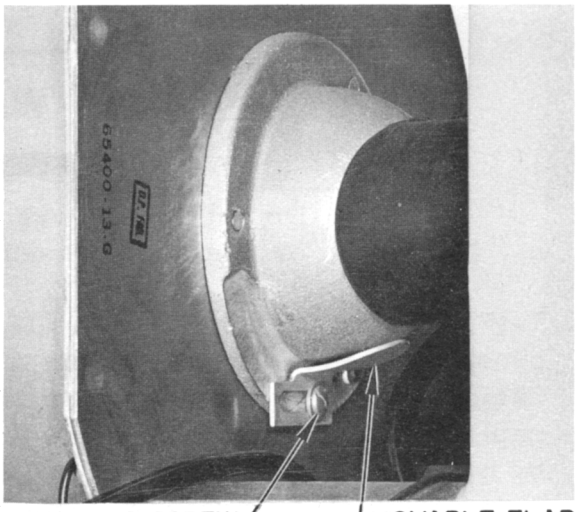

Figure 7-5
Vacuum Level Adjustment Points

7-17. Aligning Chamber Guides--Guide alignment is checked visually by operating the transport in the Forward Drive and Reverse Drive modes. There should be no evidences of rippling or curling of the edges of the tape. The buffer spring guides located nearest the heads in the tape path are aligned by loosening the screws which secure the outboard bearing and manipulating the support with the spanner provided until proper guiding is achieved. (See Figure 7-7.)

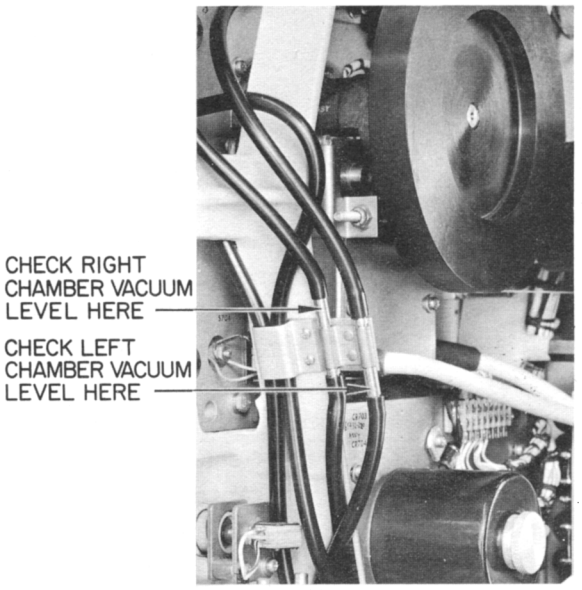

Figure 7-6
Vacuum Test Assembly

NOTE

Once the proper axis of the buffer spring guide has been thus determined, rotating of the guide on this axis may be required to meet start/stop time specifications.

The rotary tape guides are aligned by loosening the two screws which secure the outboard bearing support (Figure 7-6) and manipulating the support with the spanner provided until correct tape guiding is achieved.

7-18. Checking and Adjusting Reel Servos--In general, it should be assumed that the reel servos are operating properly if the transport is accepting normal programming without difficulty. If adjustment of the servos appears necessary, the following procedure is recommended.

NOTE

In the following steps encompassing servo balance, bias, and null adjustments, transport electronics assemblies later are provided with a seven-position switch (S501) and two test points (TP501 and TP502) to facilitate adjustment. Earlier transport electronics assemblies incorporate no such facilities. For these earlier units, connect the test gear as indicated within the parentheses.

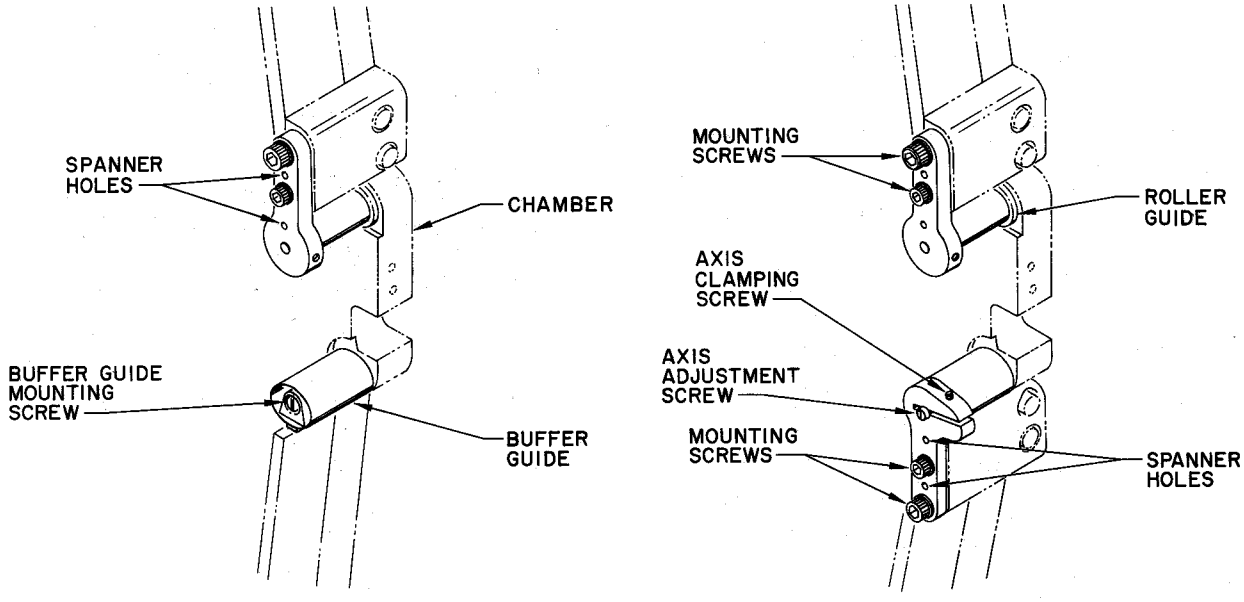

Figure 7-7
Tape Guide Adjustment Points

The following equipment is required to adjust the servos:

1) Voltmeter, Simpson Model 260 or equivalent
2) Screwdriver with 3/16" blade
3) 18-inch ruler

Step 1: Connect the meter leads to TP501 and TP502, observing proper polarity. Place the transport in the Standby mode. Turn the switch S501 to position 2. (Connect the voltmeter leads to pins 16 and 17 of the servo amplifier board; the pins are numbered from left to right as viewed from the end away from the connector. Use a pair of short test leads to Jumper pins 12 and 13 to pin 11.)

Step 2: Adjust the servo balance control for the upper servo (Figure 7-8) for a zero vdc differential reading of the voltmeter.

Step 3: Turn switch S501 to position 3. (Remove the positive lead of the voltmeter from pin 16 or 17 and reconnect to pin 11.

Step 4: Adjust the upper servo bias control for a -5.5 vdc reading on the voltmeter.

Step 5: Turn switch S501 to position 4. (Connect the voltmeter leads to pins 4 and 5 of the servo amplifier board; use the two short test leads to short pins 8 and 9 to pin 10.)

Step 6: Adjust the lower servo balance control for a zero vdc differential

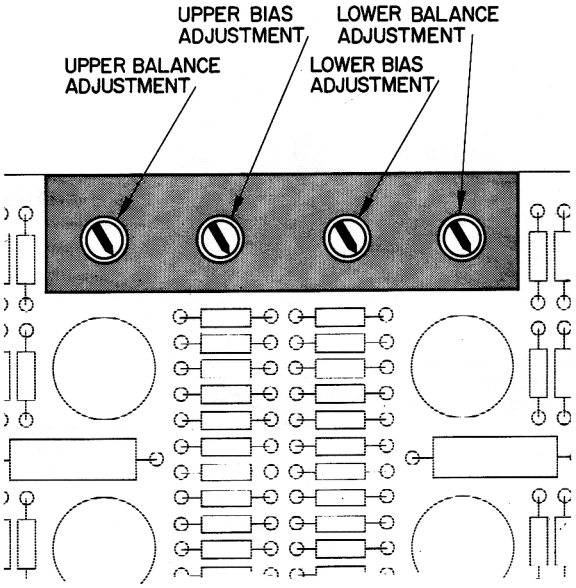

Figure 7-8
Servo Amplifier Adjustment Points

indication on the voltmeter.

Step 7: Turn switch S501 to position 5. (Remove the positive lead of the voltmeter from either pin 4 or 5 and connect to pin 10.)

Step 8: Adjust the lower servo bias control for a -5.5 vdc reading of the voltmeter.

Step 9: Turn switch S501 to position 6. (Connect the voltmeter leads to pins 4 and 5 of the servo amplifier board, remove the shorting jumper.)

Step 10: Press the lower REEL BRAKE pushbutton and rotate the take-up reel so that a 13-1/2" plus or minus 1/2" tape loop is formed in the right vacuum chamber.

Step 11: Close the transport access door.

Step 12: Manipulate the adjustment screw on the transducer mounted on the lower servo control assembly (Figure 7-9) for a zero indication of the voltmeter.

Step 13: Turn switch S501 to position 7. (Connect the voltmeter leads to pins 16 and 17 of the servo amplifier board.)

Step 14: Open the transport access door. Press the upper REEL BRAKE pushbutton and rotate the supply reel so as to form a 13-1/2" plus or minus 1/2" tape loop in the left vacuum chamber. Close the transport access door.

Figure 7-9
Adjusting Servo Transducer

Step 15: Manipulate the adjustment screw on the transducer mounted on the upper servo control assembly for a zero indication of the voltmeter.

Step 16: Return S501 to position 1. (Remove all test leads from the servo amplifier board.)

NOTE

Failure to return switch S501 to position 1 will disable the transport.

Step 17: Place the transport in the Manual Ready mode. There should be no appreciable change in the length of loop in either vacuum chamber. Changes of more than 1/2" from the nominal 13-1/2" loop length require that the steps 9 through 15 be repeated.

NOTE

The following steps provide an approximate initial setting of servo gain. In practice, servo gain adjustment is dependent on program requirements. For unidirectional operation, servo gain is best set at a point just below oscillation; for a bidirectional program, lower servo gain is indicated for optimum performance.

NOTE

Test points for servo gain adjustment are provided on most tape transports. Instructions within parentheses refer to transports without servo gain test points.

Step 18: Connect the voltmeter to TP702 and TP703 on the oscillator chassis assembly at the rear of the transport. Observe proper polarity. (Connect the voltmeter leads to the transducer primary connections for the lower servo. These are the yellow and brown wires at the fanning strip of the lower servo control assembly; the yellow lead is grounded.)

Step 19: Adjust the LOWER servo gain control potentiometer on the oscillator chassis assembly (Figure 7-10) for a 4 volt rms reading of the voltmeter.

Step 20: Connect the voltmeter to TP702 and TP703 on the oscillator chassis assembly. Observe proper polarity. (Connect the voltmeter leads to the transducer primary connections for the upper servo. These are the yellow and brown wires appearing at the fanning strip of the upper servo control assembly; the yellow lead is grounded.)

Step 21: Adjust the UPPER servo gain control potentiometer on the oscillator chassis assembly for a 4 volt rms reading of the voltmeter.

Step 22: Program the transport for a normal program. Increase the servo gain settings to the maximum level consistent with short loop operation, i.e., causing the tape to stop short of the short loop sensing holes in the vacuum chambers. Decrease the gain setting to a point just short of the condition where tape passes the long loop sensing holes in the vacuum chambers.

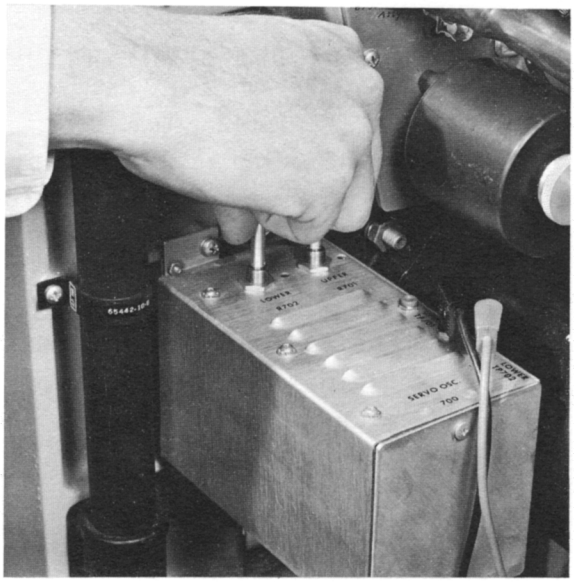

Figure 7-10
Adjusting Servo Gain

Correct adjustment of servo gain lies between these two extremes.

7-19. Checking Holddown Operation and Torque-- The torque required to lock the holddown knob may be checked with a torque wrench. Locking torque should be 25 plus or minus 2 in/lb. Adjustment, if required, is detailed in paragraph 7-36.

7-20. Checking Actuator Firing Circuitry--Operation of the actuator firing circuitry may be checked by programming the transport at the maximum rate permissible within the actuator duty cycles (see chapter one, description/specifications). No actuator functions should be missed within this program. Operation of the interlock circuitry may be checked by inserting a conflicting command 2.5 milliseconds after issuance of a tape drive command. If the transport is operating in Forward Drive and a Reverse command is issued without an intervening Stop command, the reverse actuator should not close, and vice versa.

7-21. Aligning Pack Follower--Alignment of the pack follower consists of adjusting the tension of the follower and the position of the shoe between the flanges of the takeup and supply reels.

The following equipment is required to align the tape packer arm:

1) 12-inch ruler
2) Spring scale, 8 ounce capacity
3) Screwdriver with 1/8-inch blade
4) Allen wrench, .050" across flats

Step 1: Attach the spring scale to the follower arm at the point where the tape packer shoe is pivoted to the arm. With a tape pack diameter of 10 inches, a force of 4-1/2 oz. plus or minus 1/2 oz. should be required to lift the shoe from the pack (Figure 7-11).

NOTE

In measuring the force required to lift the upper tape follower from the pack, correction must be made for the inversion of the spring scale.

Step 2: If the force required to lift the arm from the pack is incorrect, loosen the setscrew through the pivot housing at the rear of the transport (Figure 7-12) and rotate the rear bearing to increase or decrease spring tension as required.

NOTE

The servo control assembly must be removed from the rear of the transport to gain access to the adjustment point.

Step 3: Operating the transport in either the Forward Drive or Reverse Drive mode. If either shoe touches the flange of a reel, loosen the set screw at the side of the support post (Figure 7-12), using the small screwdriver. Use the Allen wrench to loosen the tape

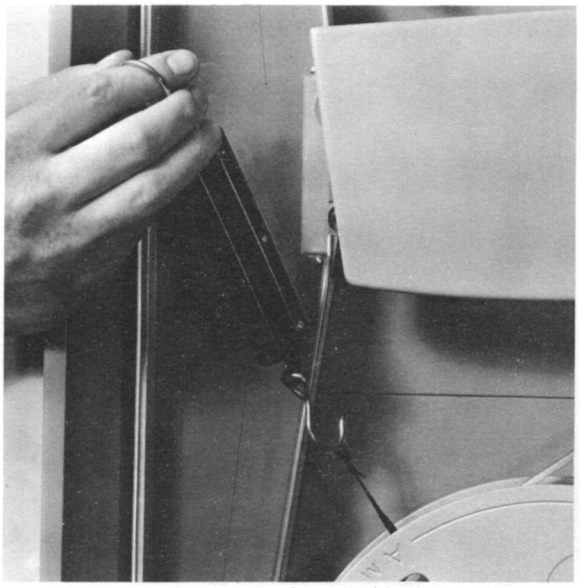

Figure 7-11
Measuring Tape
Packer Arm Tension

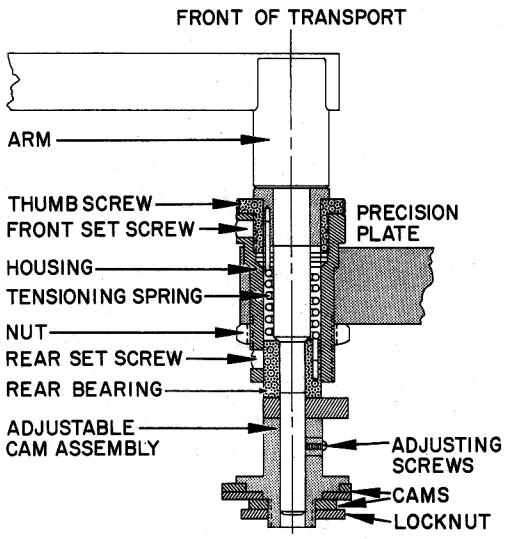

Figure 7-12
Cutaway View,
Tape Packer Assembly

packer release arm and adjustable cam assembly at the rear of the transport.

Step 4: Pressing firmly against the tape packer arm shaft, rotate the knurled thumb nut at the front of the precision plate to achieve proper tape packer arm height. Re-tighten the setscrew.

Step 5: Pressing firmly against the tape packer arm shaft, tighten the Allen setscrew holding the tape packer release arm on the shaft. The tape packer release arm should be held as tightly as possible without causing binding of the tape packer assembly against the rear bearing.

Step 6: Tighten the Allen setscrew holding the adjustable cam assembly to the shaft.

Step 7: The pack follower switch on the rear of the transport (Figure 7-13) should operate when the pack follower arm is resting on a 4-13/16 in. plus or minus 1/16 in. diameter tape pack. The operating point is adjusted by loosening the setscrew, on the end of the pack follower arm shaft and rotating the cam assembly which adjusts the microswitch to the designed point. The setscrew should be securely fastened when the adjustment is completed. Alternatively, the bracket on which the microswitch is mounted may be loosened and moved on its two slotted screwholes to achieve

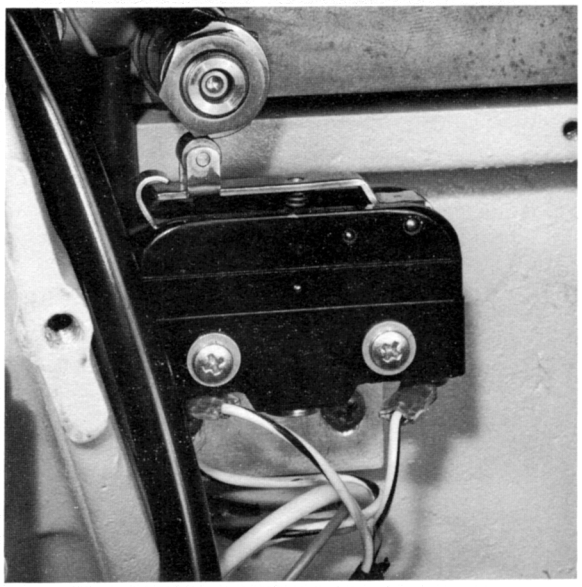

Figure 7-13
Location of Pack Follower Switch

the desired operating point.

NOTE

Only the lower pack follower switch is connected to the transport control circuitry, and accordingly, is the only one which need be adjusted. The upper pack follower switch may be wired and adjusted as desired by the customer.

7-22. Replacing Thyratrons--The four thyratrons on the actuator control unit AC-400, the eight thyratrons on the servo motor power supply PS-22, and the thyratron in the electronics power supply PS-100 should be replaced after each 480 hours operating time.

Following replacement, the servos should be checked and adjusted as detailed in paragraph 7-18; the actuators should be checked and adjusted as detailed in paragraph 7-20.

7-23. Replacing Anti-Static Strip--All tape transports are equipped with anti-static discharger strips in the vacuum chambers. Earlier tape transports utilize crinkle-finish pressure sensitive adhesive strips as dischargers. Later tape transports have been equipped with Scotchlite strips, which need not be replaced. The older strips may be removed from the chamber wall by loosening one corner and peeling the strip away. All traces of adhesive, etc., should be removed with ethyl alcohol. The Scotchlite strip is installed by coating the chamber wall with Minnesota Mining and Manufacturing Co. #A-2 adhesive activator and smoothing the discharger strip in place on the chamber wall. All surplus activator should be removed from the edges of the discharger strip before the transport is returned to service.

7-24. Checking Head Wear--The simplest check of head wear is to place a short length of .025" brass shim stock, which is the minimal width of the tape (plus .000", minus .005"), across the head stack and sighting across the stack from the side. If the outer surface of the shim stock is below the unworn portion of the head stack, the head assembly should be replaced. (Figure 7-14)

7-25. Adjusting Vacuum Switch--The operation of the vacuum switches which signal long loop or short loop conditions is checked as follows:

Step 1: Connect an ohmmeter across the terminals of the lower loop warning switch (S707).

Step 2: Apply power to the tape unit; place the unit in the Standby mode. The tape loops in the vacuum chamber should be at the normal 13-1/2-inch plus or minus 1/2-inch length.

Step 3: Observe the indication of the ohmmeter. If the ohmmeter shows no continuity, the switch is in its normal open position. If continuity is shown, the switch contacts are closed, as they would be in the case of long loop, short loop, or vacuum failure, and the switch must be adjusted.

Step 4: Press the lower REEL BRAKE pushbutton and elongate the tape loop until it passes over the long loop sensing port. The normally-open contacts of the loop warning switch should close. If the normally-open contacts fail to close, adjustment is required. If no adjustment is required, proceed to Step 12.

Step 5: Turn off power to the tape unit.

Step 6: Remove the screws which fasten the lower servo control assembly to the tape transport. Allow the assembly to hang by its cable. Disconnect the rubber tubing which connects the long loop

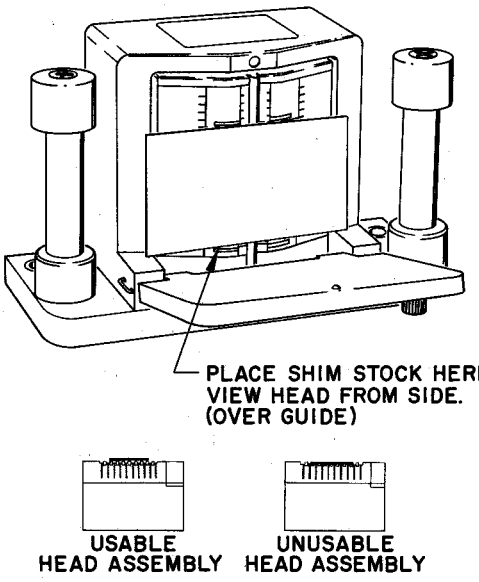

Figure 7-14
Checking Head Wear

sensing hole to the pressure input port.

Step 7: Adjust the setscrew (accessible through the pressure input port, Figure 7-15). Observe that manipulation of the setscrew causes the contacts to open and close. Adjust the setscrew to the position in which the contacts are barely open.

Step 8: Replace the long loop sensing port tubing on the pressure input port.

Step 9: Apply power to the tape transport; place the tape transport in the Standby mode.

CAUTION

Do not permit the servo control assembly to short out on the main frame of the tape transport.

Step 10: Press the lower REEL BRAKE pushbutton and elongate the loop in the vacuum chamber until it passes the long loop sensing port. If the vacuum switch fails to close, repeat Steps 5 through 9 until the switch closes as the loop passes the long loop sensing port, but remains open under normal loop conditions.

Step 11: Press the lower REEL BRAKE pushbutton and shorten the loop in the vacuum chamber until it passes the short loop sensing port. The switch contacts should close.

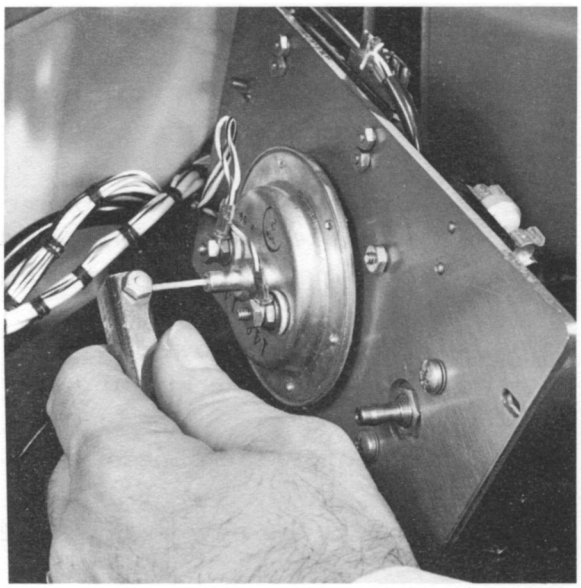

Figure 7-15
Adjusting Loop Warning Switch

Should the switch fail to close in the short loop condition while operating satisfactorily in the long loop condition, it should be replaced.

Step 12: Remount the lower servo control assembly.

Step 13: Repeat the above procedure for the upper servo.

7-26. Replacing Vacuum Tubes-- The vacuum tubes on the oscillator (OSC-700) and servo amplifier (SA-500) printed circuit boards should be replaced each 992 hours operating time. Following the replacement, the servos should be completely adjusted as detailed in paragraph 7-18.

7-27. Replacing Vacuum Blower Motor Brushes--The vacuum blower motor brushes are replaced as follows:

Step 1: Remove the vacuum blower assembly from the tape transport by disconnecting the power plug to the blower and unsnapping the two latches which hold the blower assembly to the base.

Step 2: Remove the filter.

Step 3: Loosen the two screws which secure the blower motor to the blower housing.

Step 4: Remove the power connector from the housing by pressing the two nylon legs toward the center of the body from the outside of the housing, then pressing the connector through the housing.

Step 5: Rotate the blower slightly to clear the screws which secure the blower to the housing and remove the blower.

Step 6: Unscrew the caps of the brushholders. Remove the old brushes.

Step 7: Insert the new brushes (Ampex Part No. 650-154).

Step 8: Reassemble the vacuum blower assembly and reinstall on the tape transport by reversing Steps 1 through 5.

NOTE

Spare blower assemblies (pre-assembled) are installed by performance of step 1 and step 4 only.

7-28. Checking Capstan Drive Belt--The periodic inspection of the capstan drive belt should include check of wear and fraying, as well as any misalignment of the pulleys, idler, etc. Replacement of the belt is outlined in paragraph 7-30.

7-29. Replacing Capstan Roller Assemblies,

Replacing Capstan Assemblies,

Replacing Actuators--The operations in replacing capstan roller assemblies, capstan assemblies, and actuators are so interrelated that they are treated here as a single sequence of operations.

Step 1: Remove the capstan drive motor assembly by removing the belt, separating FS707 from TB707, and removing the three socket head cap screws which hold the assembly to the standoffs.

Step 2: Remove the forward capstan flywheel by loosening the two Allen head setscrews which mount it to its shaft.

Step 3: Remove the reverse capstan flywheel by loosening the two Allen head set screws which mount it to its shaft.

Step 4: Remove the head assembly from the front of the transport by removing the read and write connectors from their receptacles and removing the two socket head cap screws which secure the head assembly base plate to the precision plate.

Step 5: Remove the two socket head cap screws passing through the outboard actuator support bearings to the actuator shafts. Remove the four socket head cap screws which mount the shaft support arms to the shaft support posts.

Step 6: Loosen the socket head cap screws which clamp the capstan roller assemblies to the actuator shafts; slide the capstan roller assemblies from the shafts.

Step 7: From the front of the transport, remove the two socket head cap-screws which pass through the precision plate into each of the two actuators.

Step 8: From the rear of the transport, remove the three socket head cap screws which mount each capstan assembly to the precision plate.

Step 9: Disconnect the belt idler spade bolt from its bracket at the side of the forward actuator. Disconnect the fanning strips which connect the two actuators to the transport cabling.

Step 10: Remove each of the capstan assembly/actuator combinations. The actuators fit into sections removed from the capstan housings.

Step 11: Transfer the belt idler spade bolt bracket from the old actuator to a new unit.

Step 12: Reversing the order of Steps 1 through 10, install the new capstan assemblies, actuators, and capstan roller assemblies.

Step 13: Adjust the capstan roller gap and brake gap as detailed in paragraph 7-12.

7-30. Replacing Capstan Drive Belt-- The capstan drive belt can be changed without removal of any assemblies from the machine. The belt path is shown in Figure 7-16.

Following installation, drive belt tension should be measured as shown in Figure 7-17. A force of approximately 5 lbs. plus or minus 1/2 lb. should be required to decrease drive belt tension to the point where a slowing of the reverse capstan is apparent when

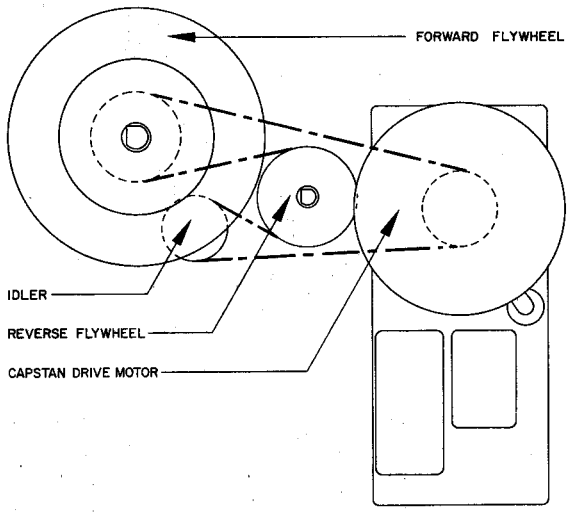

Figure 7-16
Capstan Drive Belt Path

monitored with a tachometer. Drive belt tension is adjusted as shown in Figure 7-18.

7-31. Replacing Chamber Guides--- The two buffer spring guides and two roller guides on the vacuum chamber may be changed without removing the chamber from the transport. The buffer spring guide is held in place on the chamber with a single machine screw. The roller guide is replaced by removing the two socket head cap screws which fasten the outboard support element to its base. The roller assembly is then removed, a new roller assembly installed, and the outboard support element reinstalled. The buffer spring guides and the roller guides are aligned as described in paragraph 7-17.

7-32. Replacing Reel Motor Brushes---Access to the reel motor brushes is achieved by removing the end dust cap from the motor. Reel motors bearing an Eicor trade mark utilize two brushes, held in spring-cap brush holders. Reel motors bearing the Lamb trademark utilize four reel brushes, held against the commutator by flat springs.

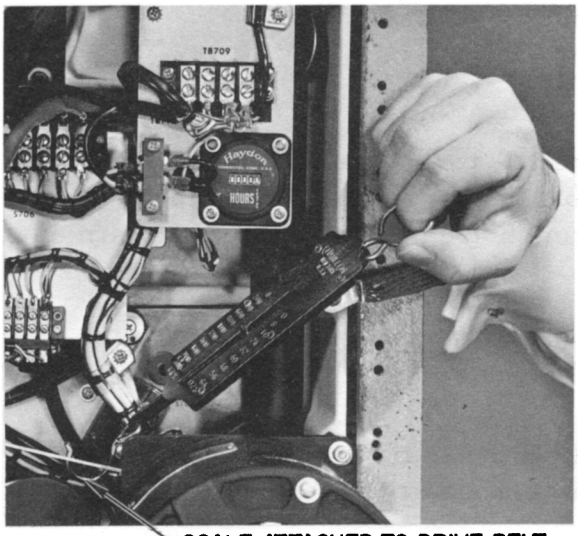

Figure 7-17
Measuring Capstan
Drive Belt Tension

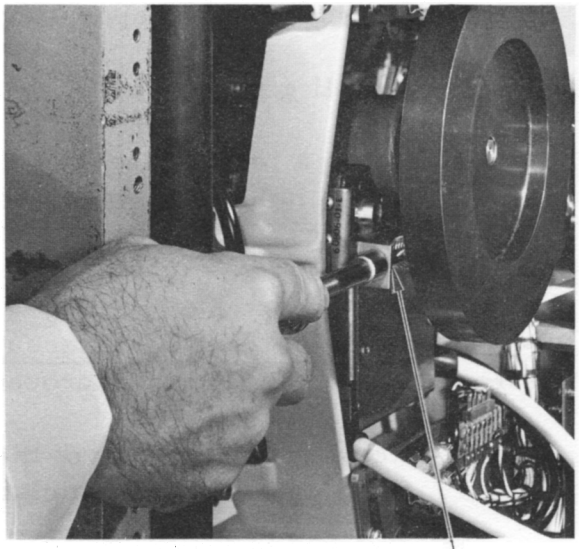

Figure 7-18
Adjusting Capstan
Drive Belt Tension

7-33. Adjusting Holddown Knob Torque--The torque required to lock the holddown knob is adjusted as follows:

Step 1: Remove the reel from the holddown knob.

Step 2: Turn the holddown knob so that the operating handle points straight up and down, serrated end up (holddown knob in released condition.

Step 3: Using a prick punch or similar device, press the spring-loaded operating handler retainer at the upper left side of the operating handle so as to free the handle.

Step 4: Remove the operating handle, exercising care not to lose the compression spring.

Step 5: Loosen the screw in the center of the knob.

Step 6: Tighten the nut in the center of the reel slightly. Tighten the lock screw.

Step 7: Reassemble the operating handle.

Step 8: Install a reel.

Step 9: Using a torque wrench, measure the torque required to lock a reel on the holddown, which should be 25 in-oz. plus or minus 2 in-oz. If necessary, repeat steps 1 through 7 until the proper adjustment is achieved.

7-34. Replacing Positive Pressure Blower-- The positive pressure blower is replaced by the following procedure:

Step 1: Remove the end cap of the positive pressure blower by loosening the bright band which clamps the end cap to the blower housing.

Step 2: Remove the blower wiring at TB708 (located inside the end cap).

Step 3: Remove the four machine screws which attach the blower assembly to the throat projecting from the transport. Remove the blower.

Step 4: Install the new blower assembly by reversing the order of steps 1 through 3.

7-35. Replacing Pack Follower Assemblies--Replacement of the pack follower assemblies is accomplished by the following procedure:

Step 1: Remove the capstan drive belt.

Step 2: Remove the forward capstan flywheel by loosening the two set screws which mount it to its shaft.

Step 3: Remove the two servo control assemblies by removing the fanning strips, the two screws which mount each assembly to the transport frame, and the tubing which connects the transducers and loop sensing switches to the vacuum chambers.

Step 4: Remove the lower follower arm assembly by removing the adjustable cam assembly, the clamp, the nut which holds the assembly to the precision plate, then pressing the assembly out through the precision plate to the front of the transport (See Figure 7-12).

Step 5: Install the new follower assembly by reversing the procedures of Step 4.

Step 6: Remove the upper follower arm assembly by removing the adjustable cam assembly, the clamp which connects the follower arm through the linkage to the tape clamp, and the nut which secures the assembly to the precision plate. Push the follower assembly through to the front of the transport.

Step 7: Install the new follower assembly by reversing the procedures of Step 6.

Step 8: Adjust follower arm tension and actuation point of the pack follower switches as detailed in Paragraph 7-21.

Step 9: Reinstall the servo control assemblies, forward flywheel, and capstan drive belt.

7-36. Replacing Reel Motors--The replacement procedure for the reel motors is as follows:

Step 1: Snap the hub cap from the lower(fixed) reel assembly. Using an Allen wrench, remove the screws which hold the precision reel

assembly to the turntable.

Step 2: Disassemble the upper holddown knob assembly. Remove the base of the holddown assembly from the turntable.

Step 3: Disconnect the fanning strips by which the reel motors are connected to the transport cabling.

Step 4: Remove the four nuts which hold each reel motor to its mounting studs on the transport frame.

Step 5: Install the new reel motors.

Step 6: Install the upper holddown knob. Using a dial indicator, adjust the position of the holddown for minimum eccentricity.

Step 7: Install the fixed lower reel assembly. Using a dial indicator, adjust the position of the assembly for minimum eccentricity.

Step 8: Connect the fanning strips from the reel motors to the appropriate terminal strips.

NOTE

If misalignment of the reel motors is evidenced by curling of the edges of the tape, etc., the offending reel motor must be shimmed from the transport frame until proper tape tracking is achieved.

7-37. Replacing Capstan Drive Motor--The capstan drive motor is replaced by the following procedure:

Step 1: Remove the capstan drive belt.

Step 2: Disconnect the fanning strip with which the capstan drive motor assembly is connected to the transport.

Step 3: Remove the three socket head cap screws which attached the capstan drive motor assembly to the transport standoffs; remove the assembly.

Step 4: Remove the capstan drive pulley from the drive motor by loosening the two screws which fasten it to the motor shaft.

Step 5: Remove the four cap screws which hold the capstan motor to the base plate.

Step 6: Unsolder the motor leads. Remove the capstan drive motor from the base plate.

Step 7: Install the new capstan drive motor by reversing the order of steps 1 through 5.

7-38. Adjusting Reel Motor Brakes--Brake adjustment is accomplished by the following procedure:

Step 1: Place a ruler next to the brake solenoid arm. Note the measurement at any particular point along the arm.

Step 2: Depress the REEL BRAKE pushbutton for the brake being adjusted and note the new measurement should be approximately 1/16".

Step 3: If the difference in positions is incorrect, loosen the two screws which hold the brake solenoid (Figure 7-19) and move the solenoid to a new position. Repeat steps 1 and 2.

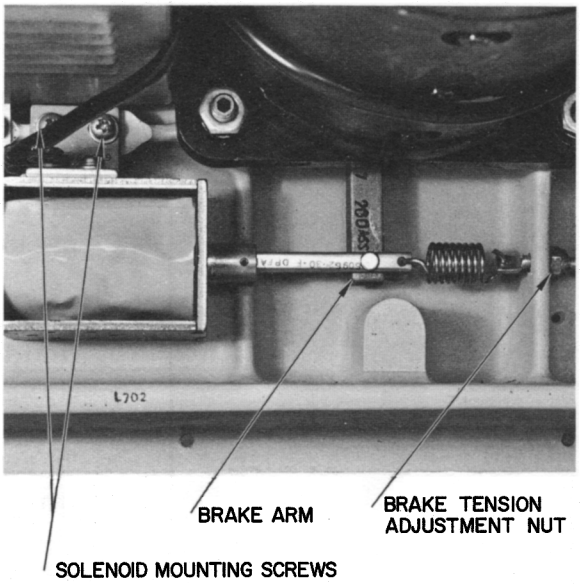

Figure 7-19
Reel Brake Adjustment Points

Step 4: Connect a spring balance to the brake solenoid arm and check brake tension, which should be 7 lbs. plus or minus 1/2 lb. If spring tension is not within tolerance, loosen or tighten the tensioning nut on the spade bolt to which the spring is attached. (Figure 7-19)

7-39. TROUBLESHOOTING CHART

Symptom	Possible Cause	Remedy
Parity and Bit Errors	Dirty Head	Clean Head Assembly (see Paragraph 7-8)
	Edge of tape damaged	Check tape for curled edge, etc. If tape damage is found, check transport guiding with fresh roll of tape.
	Buffer guides misaligned	Align buffer guides
	Roller guides misaligned	Align roller guides
Poor Tape Pack	Insufficient tape packer tension	Adjust packer tension (see Paragraph 7-21)
	Roughness on inside of reel flanges	Replace reel
	Turntable out of line	Check alignment of hold-down or reel assembly
	Reel motor worn out	Check reel motor for end play. Not more than .005" end play permissible. Replace motor if necessary. (see Paragraph 7-36)

Symptom	Possible Cause	Remedy
Poor Tape Pack	Vacuum level improperly set	Adjust vacuum level (See Paragraph 7-16)
	Tape too loose on reel	Replace tape. Tape once loosely wound is extremely difficult to tighten.
Oxide accumulation in Vacuum Chambers	Foreign material in chambers	Clean Chambers (see Paragraph 7-8)
	Roughness or warpage in tape path	Check cleanliness and alignment of all elements in tape path
	Buffer guides misaligned	Align buffer guides
	Roller guides misaligned	Align roller guides
	Defective tape	Replace tape
Improper loop size in vacuum chamber	Transducer misadjusted	Adjust transducer (see Paragraph 7-18)
	Sensing slot dirty	Clean sensing slot (see Paragraph 7-8)
	Faulty tape	Check tape width (reels occasionally too wide or too narrow)
	Faulty transducer	Check transducer output at long and short loop and null conditions

Symptom	Possible Cause	Remedy
Improper loop size in vacuum chamber	Restriction in line between chamber and transducer	Check vacuum at transducer input--should be 12" - 14" of water at short loop, 5" of water at null, 0 at long loop.
Tape loops off center in chamber	Chamber out of adjustment	Adjust position of chamber on transport
	Foreign material in chamber	Clean chamber (see paragraph 7-8)
	Dirty anti-static strip	Replace anti-static strip (see Paragraph 7-23)
	Stretched section of tape	Replace tape
Step-function oscillation of tape in chamber	Faulty transducer	Replace transducer
	Dragging reel brake	Check reel brake adjustment(see Paragraph 7-38)
	Obstruction in chamber	Check for oxide buildup next to guide at chamber wall
	Defective tape	Replace tape
Steady oscillation of tape loop in chamber	Static buildup	Replace anti-static strip (see Paragraph 7-23)
	Servo amplifier board loose in connector	Seat servo amplifier board firmly in connector

Symptom	Possible Cause	Remedy
Servo inoperation	Severe misadjustment	Adjust servo (see Paragraph 7-18)
	Faulty transducer	Replace transducer
	Oscillator failure	Check oscillator output
	Faulty tube in servo amplifier	Check servo amplifier tubes
	Faulty thyratrons in servo motor supply	Check thyratrons in servo motor supply, interchanging to isolate faulty unit.
Servo operation poor	Dirty sensing slot	Clean sensing slot (see Paragraph 7-8)
	Faulty thyratrons in servo motor supply	Interchange thyratrons to isolate faulty unit.
	Transducer out of balance	Check transducer balance at null position
	Faulty tape	Replace tape
	Tape path obstructed	Check for oxide buildup in tape path
	Dragging reel brake	Check reel brake adjustment (see Paragraph 7-38)
	Defective reel motor	Replace reel motor (see Paragraph 7-36)
	Faulty tubes in servo amplifier	Check servo amplifier tubes

Symptom	Possible Cause	Remedy
Reel motor "jitter"	Servo gain too high	Adjust servo gain (see Paragraph 7-18)
	Transducer mis-adjusted	Adjust transducer (see Paragraph 7-18)
	Varying thyratron bias in PS-200	Check stability of thyratron bias
	Faulty tubes in servo amplifier	Check tubes in servo amplifier
	Faulty reel motor diodes (CR701-704)	Replace diodes
	Varying vacuum in chamber	Replace vacuum blower
Inoperative actuator	Faulty thyratron V104 in PS-100	Replace V104
	R110 on PS-100 open	Replace R110
	C109 on PS-100 shorted	Replace C109
	Insufficient actuator command signal	Check input command level
	Faulty diode in high-voltage bridge, PS-100	Replace any faulty diodes
Actuator failure at high repetition rates (2.5 ms OFF, 4.0 ON)	Faulty V104 in PS-100	Replace V104
	Weak actuator	Replace actuator

Symptom	Possible Cause	Remedy
Actuator failure at high repetition rates (2.5 ms OFF, 4.0 ON)	Weak diodes in high-voltage bridge, PS-100	Replace weak diodes

7-40. MAINTENANCE TOOLS

7-41. The following list indicates the general nature of tools required to maintain the TM-2. Manufacturers' names and numbers are indicated only as a guide; any equivalent tool may be used.

Tool	Manufacturer and Number
Allen wrench set, handled, .035" through 1/8"	Allen #6075
Center punch, 5/16" x 4"	Hargrove #284-5/16
Plastic hammer	Stanley #593
Ball peen hammer	Stanley #306B
Socket, 12 pt, 3/8 drive	Williams #B-1218
1/4" to 3/8" drive adaptor	Proto #5256
1/4" extension drive 14" long	Proto #4763
"T" handle, 1/4" drive	Proto #4785
Scale, 6", steel	Starrett #384
Soldering aid	Walsco #2530
Scribe	Starrett #70A
Screw starter screwdriver	Pearson #3
Scissors, 2-1/2" blade	Wiss #173E
Open end wrench set, 15° and 75°, 3/16" through 5/8"	Williams #1142PR
Spring balance, 8 oz. capacity	
Standard screwdriver set	Snap-On #SD-130-K

Stub screwdriver, small	Xcelite #R-184
Stub screwdriver, medium	Xcelite #R-3164
Stub screwdriver, large	Xcelite #R-5166
Phillips screwdriver set	Proto #9600A
Torque wrench, 0-50 in-lb	Apco Mossberg #B50
Offset ratchet driver, Allen and Phillips	Yankee #3600-9
Pliers, extractor, external, black	Truarc #2
Pliers, extractor, internal, black	Truarc #3
Pliers, extractor, external, black, large	Truarc #4
Pliers, extractor, external, black	Truarc #015
Wrench, adjustable, 6"	Crescent #AT16
Thickness gauge	Starrett #66
Drift punch, 1/8"	Hargrove #2868
Drift punch, 3/32"	Hargrove #2866
Drift punch, 1/16"	Hargrove #2864
Pliers, diagonal cutter	Klein #202-5
Pliers, long nose	Klein #303-6
Pliers, needle nose	Utica #777-6
Nutdriver roll	Xcelite #99SM
Nutdriver, #18	Xcelite #HS-18
File, 6" smooth cut	
File, 4" round, second cut	
Tape, steel, 8'	Lufkin #688
Inspection mirror	G. C. #5090
Wire stripper	Miller #100
Pliers, 7-1/2"	Proto #242
Tube puller	G. C. #9130