Section 4

TRANSPORT MAINTENANCE

4.1 ROUTINE MAINTENANCE

4.1.1 Cleaning

Cleaning components in the tape path is described in Section 6. It is extremely important that such cleaning be accomplished on a daily basis, or after each eight-hour operating period.

Visually inspect all components at the back of the transport each month. Use a small brush, or a small vacuum cleaner, to remove any accumulations of dirt or dust. If more comprehensive cleaning is required, a clean, lintless cloth moistened with Iso-Propyl alcohol may be used.

CAUTION

DO NOT USE THE BLOWER ACTION OF A VACUUM CLEANER OR ANY OTHER COMPRESSED AIR DEVICE IN CLEANING, BECAUSE DUST MIGHT BE BLOWN INTO BEARINGS OR OTHER ROTATING PARTS. ALSO, IF ALCOHOL IS USED, DO NOT ALLOW IT TO DRIP OR SPRAY INTO SUCH CRITICAL PARTS.

4.1.2 Head Demagnetization

Demagnetization of the heads, explained in Section 6, must be accomplished on a daily basis, or oftener if there is any suspicion that such action is necessary.

4.1.3 Lubrication

4.1.3.1 General

Lubrication of the capstan drive motor, the capstan, and the capstan idler bearing is required each three months or after 1, 000-hour operating period, whichever occurs first. No lubrication of any other component is required.

Ampex lubricating oil (Part No. 4010825), Caloil OC-11, or Shell Turbo #29, can be used.

4.1.3.2 Lubricating Drive Motor

Two oil cups, one from each motor end bell, are provided on the capstan drive motor. Insert four drops of the lubricant (refer to para-

graph 4.1.3.1) in each cup. Do not over-lubricate; wipe off any excess oil.

4.1.3.3 Lubricating Capstan Assembly

Step 1: Loosen the set screw which secures the capstan idler to the arm, and remove the idler.

Step 2: Loosen the set screw which secures the capstan dust cap, and remove the cap.

Step 3: Remove the felt washer exposed in Step 2.

Step 4: Fill the small hole in the upper bearing of the capstan with the recommended lubricant (refer to paragraph 4.1.3.1). Do not over-lubricate; wipe off any excess oil.

Step 5: Replace the felt washer, capstan dust cap, and capstan idler.

NOTE

The capstan idler must be properly positioned in relation to the tape, so thread tape on the equipment and center the idler on the tape. Visual alignment is adequate. Check idler pressure (refer to paragraph 4.2.4 after replacement).

4.1.3.4 Lubricating Capstan Idler Bearing

Step 1: Use a knife blade, or some similar tool to pry the dust cap from the middle of the idler.

Step 2: Place three drops of the recommended lubricant (refer to paragraph 4.1.3.1) directly on the felt washer exposed in Step 1. Do not over-lubricate; wipe off any excess oil.

CAUTION

IF ANY OIL IS SPILLED ON THE RUBBER TIRE OF THE IDLER, CLEAN IT OFF IMMEDIATELY -- USING ISO-PROPYL ALCOHOL. OIL WILL CAUSE DETERIORATION ON THE TIRE.

Step 3: Replace the capstan idler dust cap.

4.2 CHECKOUT AND ADJUSTMENT

4.2.1 Test Equipment Required

Spring scales, as required to measure 1/2 - 1-1/2 ounce, 6 - 11 ounces, 12-21 ounces, 4-1/2 - 5-1/2 pounds.

Length of cord or twine, approximately 30 inches long, with loop tied in one end.

Empty reel, NAB, 10-1/2 inch

Ampex Standard Flutter Tape

30 ips	(Special order)
15 ips	01-31336-01
7-1/2 ips	01-31326-01
3-3/4 ips	01-31316-01

Flutter meter, D & R Model FL3D or equivalent.

Usual tools used by technician.

4.2.2 Takeup and Supply Tension

Tape tension is measured indirectly by determining the takeup and supply reel motor torques in the play mode. These torques are adjusted by positioning sliders on resistors located on the control box at the back of the transport. If EIA reels are to be used, adjust the torques to the low side of the tolerances quoted (as measured on NAB hub).

Step 1: Apply power to the equipment and place an empty NAB reel on the supply turntable.

Step 2: Wind the length of cord or twine counterclockwise on the hub of the empty reel, leaving the loop in the cord at the free end.

Step 3: Use pressure sensitive tape or a rubber band to hold the takeup tension arm away from its rest position, so that it does not contact the safety switch.

Step 4: Insert the hook on the appropriate spring scale (see Step 5) in the loop on the cord. Hold the scale stationary, place the mode selector switch in the PLAY position, and press the START pushbutton.

Step 5: Still holding the scale stationary, tap lightly on the reel (to ensure a true reading) and note the scale indication. It should be between 6 and 7-1/2 ounces for a 1/4-inch tape transport, between 8 and 11 ounces for a 1/2-inch tape transport.

NOTE

To gain access to the resistors refer-

enced in Steps 6, 7, and 8; remove the perforated cover at the end of the control box toward the center of the transport.

Step 6: If the indication in Step 5 is incorrect, adjust the slider on HOLDBACK resistor R801 (see Fig. 4-1) to obtain the quoted torque.

Step 7: Repeat Steps 1 through 6 at the takeup turntable. Note that the cord should be wrapped clockwise on the reel hub, and that adjustment is made at the slider of TAKEUP resistor R803 (see Fig. 4-1). Torque indications should be the same as at the supply turntable.

Step 8: With the same test setup as in Step 7, place the mode selector switch in the REWIND position and press the START pushbutton. Hold the scale stationary, tap lightly on the reel, and note the scale indication. It should be between 1/2 and 1-1/2 ounces. Any adjustment required is made at FAST MODE HOLDBACK resistor R802 (see Fig. 4-1).

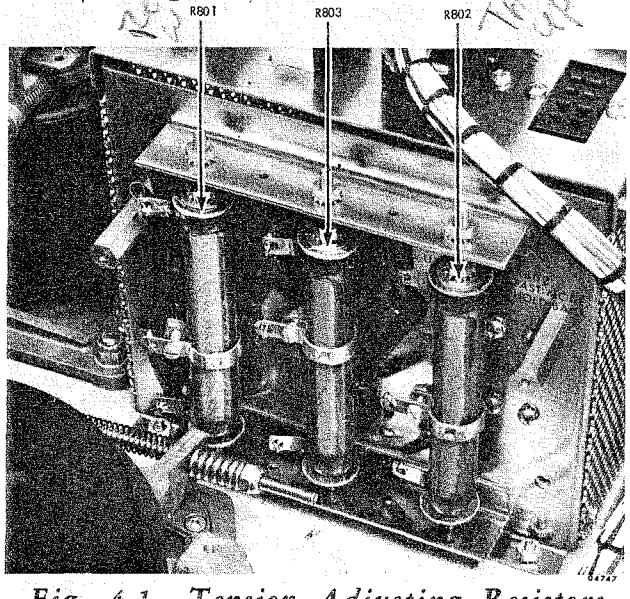

Fig. 4-1 Tension Adjusting Resistors

4.2.3 Brakes

Brakes are checked and adjusted with no power applied to the equipment. Since the braking force is different for each direction of rotation (to provide the brake differential) the force must be checked and adjusted for each direction.

Step 1: Place an empty NAB reel on the supply turntable.

Step 2: Wind the cord or twine counterclockwise on the reel hub, leaving the loop at the free end of the cord.

Step 3: Insert the hook on the appropriate spring scale (see Step 4) through the loop at the end of the cord.

Step 4: Being sure the cord does not touch either reel flange, pull on the scale to make the reel rotate counterclockwise. Take the reading with the scale in slow, steady motion. It should be from 12 to 17 ounces for 1/4-inch tape transports, from 16 to 21 ounces for 1/2-inch tape transports.

NOTE

The initial force required to start the reel in rotation will be excessively high. Do not take the reading until the reel is in slow, steady rotation.

Step 5: If the indication in Step 4 is incorrect, adjustment for this "high" force is made at the two points shown in Fig. 4-2. Run the two nuts in to increase braking force, out to decrease. Be sure both nuts are turned an equal number of turns.

Step 6: Wrap the cord on the supply reel in the clockwise direction and repeat Steps 3 and 4, using the appropriate scale. The indication should be 40% (±1 ounce) of that obtained for the counterclockwise rotation. If necessary, adjust the "low" braking force at the point indicated in Fig 4-2.

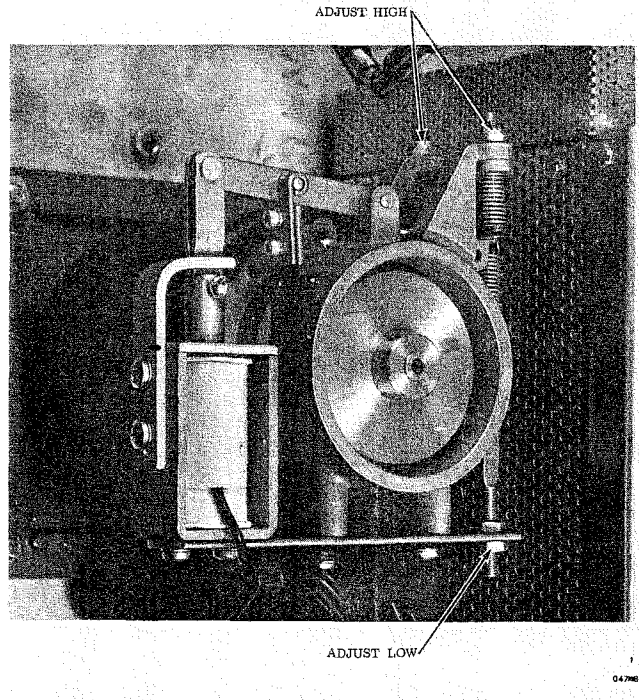

Fig. 4-2 Brake Adjustment Points

Step 7: Repeat the entire procedure at the

takeup turntable. Note that the high braking force acts when this reel is rotated clockwise. Indications should be within the same tolerances quoted for the supply brake.

4.2.4 Capstan Idler Force

The force of the capstan idler against the capstan is determined by a pressure spring on the capstan solenoid. It is adjusted by a lock nut on the capstan solenoid spade bolt. If the recorder is operated in areas where line voltage is low, read the discussion following the step-by-step procedure before making any adjustments.

Step 1: Apply power to the equipment and use pressure-sensitive tape or a rubber band to hold the takeup tension arm away from its rest position (so it does not contact the safety switch).

Step 2: Tie the two ends of the cord or twine together, so that it forms a continuous loop. Place one end of the loop over the capstan idler and position it on the idler shaft (between the idler and arm, see Fig. 4-3).

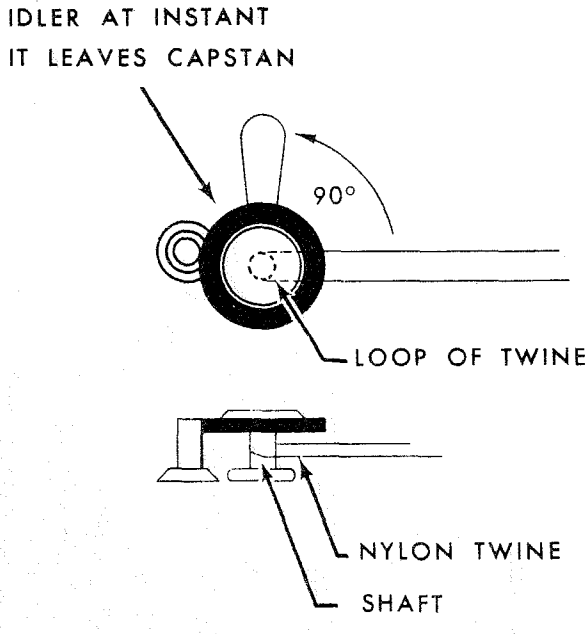

Fig. 4-3 Measuring Capstan Idler Force

Step 3: Place the mode selector switch in the PLAY position and press the START pushbutton. The idler will move to contact the capstan and both will rotate.

Step 4: Insert the hook on the appropriate spring scale (see Step 5) through the loop of cord, and pull the cord taut at a 90° angle to the idler arm.

Step 5: Pull on the scale and take the reading just as the idler loses contact with the capstan (the idler will stop rotating at that point). The scale indication should be 5 pounds (±1/2 pound) for 3-3/4 - 7-1/2 ips equipment, or between 5 and 8 pounds for 7-1/2 - 15 and 15 - 30 ips equipment.

Step 6: If the indication in Step 5 is incorrect, adjust the lock nut (see Fig. 4-4) as required to achieve a reading within tolerances. Running the nut in will increase pressure, out will decrease.

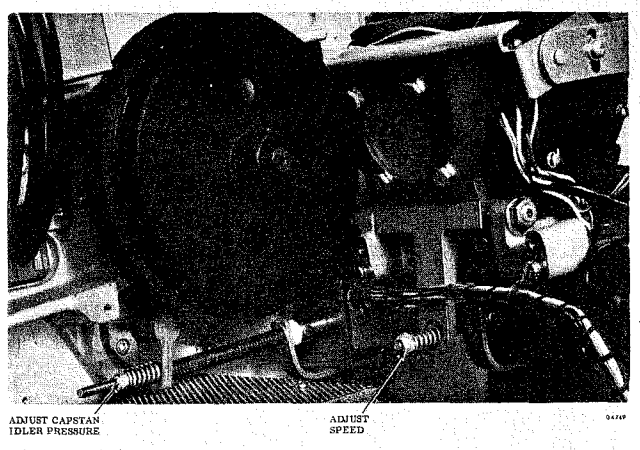

Fig. 4-4 Capstan Idler and Tape Speed Adjustment Points

Step 7: After the adjustment is completed, check that the solenoid will bottom (if not, the idler can be easily pushed away from the capstan). If the solenoid does not bottom, the locknut must be run out until bottoming is possible.

The resistance of the solenoid will rise with temperature during operation, and the voltage required to bottom the solenoid will be greater when it is hot. In areas where power line regulation is poor it is advisable to allow the equipment to operate continuously in the play mode for approximately 30 minutes before making any adjustments to the capstan solenoid. At the factory the solenoid is checked to assure it will bottom at line voltages of 90 volts (cold) and 105 volts (hot).

4.2.5 Flutter and Wow

This check requires that the electronics assembly be previously aligned (see Section 5). An Ampex Standard Flutter Test Tape, applicable to the tape speed involved, and a flutter meter such as the D & R Model FL3-D, are also required.

Ampex Standard Flutter Test Tapes are prepared on very precise equipment, result-

ing in rms flutter content of less than .03% on these tapes. For all practical purposes, this can be disregarded when making flutter measurements. Flutter test tapes are made for a specific tape speed and, since flutter meters accept only 3,000 Hz signals, they cannot be used at other speeds.

Flutter meters are sensitive to some extent to amplitude modulation, such as could occur with poor head-to-tape contact or with signal dropouts. Heads must therefore be cleaned and demagnetized before flutter measurements are taken.

As the flutter tapes are used over a long period of time, the flutter indication will rise -- even though the flutter of the equipment remains unchanged. This is caused by increased dropouts, demagnetization of the recorded signal by repeated passes over the heads, and physical deformation of the tape due to tensions, changes in temperature and humidity, etc.

Test tapes should not be rewound before storage, because the tape pack and tension within the reel might cause physical damage to the tape -- such as edge damage, stretching, etc. Extremes in temperature and humidity must be avoided in storage areas, and the tape must not be stored near sources of magnetic fields -- such as motors, generators, permanent magnet loudspeakers, etc.

Flutter measurement is made as follows:

Step 1: At all electronic assemblies, place the RECORD SELECTOR switch in the SAFE position. Apply power to the equipment.

Step 2: Connect the flutter meter to the OUTPUT connector of the applicable channel (which channel makes no difference, as long as the electronics are properly aligned).

Step 3: Thread the flutter test tape on the transport, by putting the flutter tape reel on the takeup turntable and rewinding to an empty reel on the supply turntable. (Open the head gate while rewinding so the tape lifters remove the flutter tape from contact with the heads.)

CAUTION

BE SURE ALL RECORD SELECTOR SWITCHES ARE IN THE SAFE POSITION. THIS WILL PREVENT ACCIDENTALLY ENTERING THE RECORD MODE AND THUS ERASING THE TEST TAPE.

Step 4: Start tape in motion in the reproduce mode. Adjust the REPRODUCE LEVEL control on the electronic assembly as required to achieve a 0 vu indication on the vu meter.

Step 5: Adjust the flutter meter level as described in the instruction manual for that equipment.

Step 6: Switch the flutter meter to the discriminator adjustment, and adjust the trimmer for a minimum reading on the flutter meter.

Step 7: Switch the flutter meter to readout at 0.5 to 250 Hz, and read the flutter as indicated on the flutter meter. Flutter specifications are given in Section 1.

Step 8: When the measurements are completed, allow the tape to continue in motion in the reproduce mode until the tape is completely wound on the takeup reel. Store the test tape in that condition.

Excess flutter can be caused by any component in the tape transport that affects tape motion, and is manifestly impossible to delineate specific causes and remedies. However, such causes include:

Accumulations of dirt or oxide on components in tape threading path.

Drivemotor: Not in synchronism (low line voltage), excessive takeup tenstion, defective motor capacitor, bearings in need of lubrication (or defective bearings), motor shaft bent, capstan flywheel tire defective.

Supply Motor: Excessive or erratic holdback tension, dragging brake, shafts bent.

Capstan Idler: Defective rubber tire or bearing in need of lubrication, wrong capstan idler force against capstan.

Reel Idler: Shaft bent, flywheel unbalanced.

Head Assembly: Poor tape guiding.

Tape Scrape: Warped or damaged reels.

If a sound and vibration analyzer (such as General Radio's Type 1564-A) is avail-

COMPONENT	ROTATIONAL PERIOD (Hz)			
	3-3/4 ips	7-1/2 ips	15 ips	30 ips
Drive Motor	30	60/30	60/30	60
Capstan and Flywheel	2.5	5	10	20
Capstan Idler	0.6	1.2	2.4	4.8
Reel Idler	0.8	1.6	3.2	6.4

Table 4-1. Rotational Periods of Components

able, excessive flutter can be isolated to certain frequencies by connecting the analyzer to the output of the flutter meter. Comparing the results with the rotational periods given on Table 4-1, may then isolate the offending assembly.

Note that if the flutter disturbance is caused by components in the supply motor assembly, the frequency of the flutter will vary -- being relatively low when the supply-reel tape pack is large and progressively increasing with reel velocity as the pack diminishes. It is seldom that the takeup motor assembly introduces flutter, because it is effectively isolated from the heads by the capstan and capstan idler; if it should, the frequency would vary inversely to that of the supply motor -- being relatively high with a small tape pack on the takeup reel and progressively decreasing as the pack increased.

4.2.6 Tape Speed

This equipment utilizes an indirect drive to the capstan. The drive motor pulley is brought into contact with the rubber tire on the capstan flywheel, and thus drives the flywheel (which is attached to the capstan). This configuration allows slight adjustment of tape speed, by varying the pressure of the motor pulley against the capstan flywheel. This pressure is controlled by a lock nut on the capstan solenoid.

A strobosticker, Ampex Part No. 4170128-10 (60 cycle equipment) or 4170128-20 (50 cycle equipment), is provided with each recorder to check tape speed. Place the strobosticker on the end of the capstan, thread tape, and start the equipment in the reproduce mode. View the rotating strobosticker under a 60 Hz or 50 Hz light (as applicable to the particular recorder). If the capstan speed is exactly correct, the spokes on the strobe will appear stationary; if not, they will appear to drift clockwise (speed fast) or counterclockwise (speed slow). The percentage of speed error can be determined by counting the number of spokes which appear to pass a fixed point in a given time. Tape speed error is 0.1% for each seven spokes which pass a fixed point in one minute (on 50 cycle equipment the error is 0.1% for each six spokes).

Actual tape speed, rather than the speed of rotation on the capstan, can be checked using a tape strobe -- such as the Dubbings Electronics Tape Strobe Model AA. This is a hand-held strobe wheel device which is pressed against the tape, moving in the reproduce mode. For accurate measurement, it must be held against the tape between the head assembly and the capstan, so that the moving tape drives the strobe wheel. The percentage of speed error is determined in the same manner as with the strobosticker.

If it is determined that adjustment of tape speed is required, proceed as follows:

Step 1: Place the equipment in the reproduce mode, and back off the lock nut on the drive solenoid (see Fig. 4-4) until the drive motor pulley does not contact the capstan flywheel (capstan is not driven).

Step 2: Watching the strobe, start running the solenoid lock nut in. Capstan speed will increase as the motor pulley is brought into firmer contact with the flywheel. Continue turning the lock nut in as long as speed is increasing.

Step 3: When peak capstan speed is attained, it will be faster than synchronous speed. Slowly turn the lock nut further in until speed drops to the correct rate as indicated by the strobe.

NOTE

When the adjustment is in the correct range, running the lock nut further in will decrease speed, backing it out

will increase speed. If these indications are reversed, the adjustment has been made on the wrong side of the peak.

4.3 REPLACEMENT OF PARTS

4.3.1 General

All subassemblies of the tape transport can be easily removed from the top plate. Use the parts lists and the assembly drawings in the Parts Lists and Drawings section of this manual as a guide in determining how far each subassembly may be disassembled, because the replacement of some components requires precision work which should not be attempted in the field. If faults should become evident in such components, the entire subassembly should be returned to your Ampex dealer or to the factory for overhaul.

NOTE

Ampex can accept no responsibility for care or return of unidentified parts returned to the factory. Always write Ampex Service Engineering for a properly authorized return tag before shipping.

When packing motors which are to be returned, take particular care to protect the motor shafts from being bent in transit.

To replace the brake band proceed as follows (numbers in parentheses refer to items and figure numbers in Section 7).

Step 1: Remove the brake tension spring (10:7-19) from the brake lever (4:7-19).

Step 2: Remove the two screws holding the capacitor bracket (9:7-18). Disconnect the wires to the capacitor at the knife disconnect points, and remove the capacitor.

Step 3: Remove the three screws that secure the brake housing to the motor, disconnect the solenoid leads at the knife disconnect points, and remove the entire brake assembly from the motor.

Step 4: Remove the two socket head cap screws (26:7-19) that secure the end of the brake band near the two "high side" brake adjustment points (furthest from the solenoid). A clamp will also come free.

Step 5: Loosen, but do not remove, the two socket head cap screws that clamp the other end of the brake band (nearest the solenoid). Using care not to lose the leaf spring, slide that end of the band from the clamp.

Step 6: Remove the brake band.

Step 7: Position the new brake band through the holes in the housing. Replace the two cap screws and clamp removed in Step 4, tightening the screws.

Step 8: Slip the slotted end of the brake band between the leaf spring (9:7-19) and the band link (3:7-19). Run the two cap screws in until they are snug but the band will still slip.

Step 9: Check that the solenoid stop (7:7-19) is positioned so that the travel of the solenoid plunger is limited to 3/16 inch.

Step 10: Replace the brake assembly on the motor, manually actuating the solenoid to allow the brake band to slip over the drum.

Step 11: Replace the spring removed in Step 1.

Step 12: Manually actuate the solenoid, and slide the slotted end of the band in or out of the linkage so that the band flattens against the housing without buckling. Tighten the two cap screws. (This determines the maximum looseness of the band around the drum.)

Step 13: Release the solenoid. The brake band should limit the travel of the solenoid plunger so that there is a clearance of from 1/16 to 3/32 inch between the plunger and the solenoid stop. If not, the slotted end of the band must be slid further into the clamp (effectively shortening the band). The final adjustment must result in the proper clearance between the solenoid stop and plunger (solenoid deactuated) and free rotation of the drum with no drag when the solenoid is actuated. Also, there must be no buckling of the band (indicating the band is too long) when the solenoid is actuated.

Step 14: Check and adjust brake tensions (refer to paragraph 4.2.3.).

Step 15: Reconnect the solenoid leads. Replace the capacitor and reconnect its leads.

4.4 PRINCIPLES OF OPERATION

4.4.1 General

The tape transport mechanism (Fig. 4-5) provides tape motion for all modes of operation. Interaction of four basic assemblies and their associated components -- the tape supply system, the tape takeup system, the tape

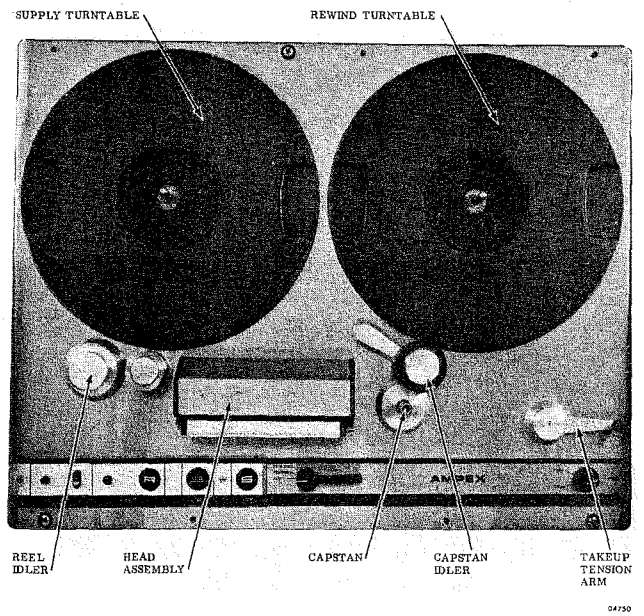

Fig. 4-5 Tape Transport, Top

drive system, and the control circuit -- insures smooth, positive movement of the tape across the head assembly, and proper tape tension.

Location of components at the back of the tape transport is shown in Fig. 4-6. The assemblies which make up the tape transport are interconnected at the control box connector panel (see Fig. 2-3). This panel is hinged and can be swung up as shown in Fig. 4-7 by removing two screws at the top outer edge.

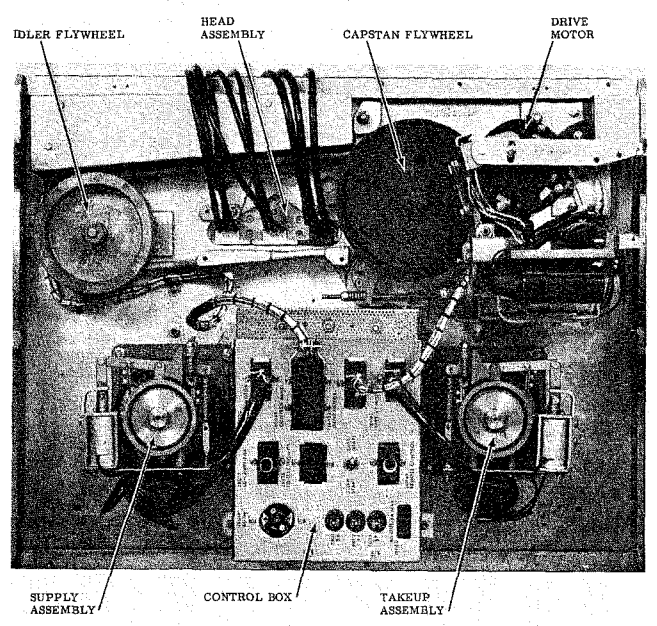

Fig. 4-6 Tape Transport, Bottom

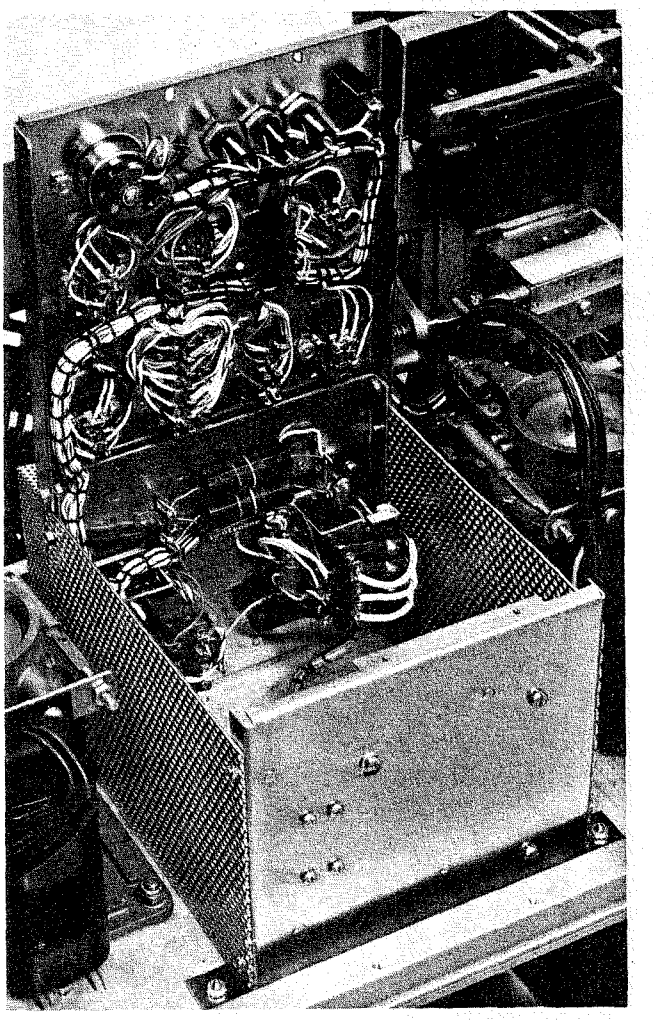

Fig. 4-7 Control Box, Connector Panel Open

4.4.2 Tape Supply and Takeup Systems

From the supply reel, on the left side of the tape transport as the operator faces the equipment, tape is delivered to the takeup reel in the play or fast forward modes. Tape is rewound onto the supply reel in the rewind mode. Tape tensioning is maintained during all modes by the opposing action of the two reel motors.

On the takeup side of the tape transport, a tension arm assembly with a spring-pivot-mounted arm performs two main functions. First, it provides a small tape storage loop which prevents tape breakage during the starting and stopping of tape motion. Second, it is used to stop the equipment if tension is lost (due to tape breakage, at the end of the tape, etc.) by actuating safety switch S501.

Both the tape supply and takeup as-

semblies are composed of induction torque motors (B601 supply-rewind, B701 takeup), a turntable mounted directly on each motor shaft, a brake housing assembly, and a flange for mounting the entire assembly. The brake housings are mirror images of each other, and so the assemblies are not interchangeable although the motors are identical. The brakes are solenoid operated, remaining in the braking position until the brake solenoids, K601 and K701 are energized -- at which time the brakes are released. The supply and takeup motors are so connected that when power is applied to them with no tape threaded, the turntables would rotate in opposite directions -- the tape supply turntable clockwise, and the tape takeup turntable counterclockwise.

During all operating modes, the two torque motors act as tensioning devices.

In the fast forward mode, the torque of the supply (rewind) motor is reduced by placing resistors R801, R802, and R803 in series with the motor. In the rewind mode those resistors are in series with the takeup motor. One motor thus operates at full torque, the other at reduced torque, and the tape is pulled from the reel with lesser torque. The tape is held under tension as it is pulled from the reel by the opposing torque of the trailing reel motor.

In the reproduce or record modes, both torque motors operate at the same reduced torque, adjusted by resistors R801 and R803. The capstan, with the idler clamping the tape against it, then determines the tape speed, and the tensioning system supplies tape or takes it up as metered by the capstan drive. From the point of view of the tape supply turntable, the capstan and idler action exerts sufficient pull on the tape to overcome the opposing torque (holdback tension) of the supply motor. From the point of view of the tape takeup turntable, the capstan and idler action is feeding the tape to it; the tape is held under tension because the takeup rate exceeds the feed rate (a tape loop will be thrown on the right side of the capstan whenever any malfunction causes the feed rate to exceed the takeup rate).

If a tape loop is thrown, or the tape breaks, the takeup tension arm will actuate safety switch S501 and stop the equipment. The takeup tension arm is not a part of the tape tension system. Its function is to prevent tape slack, especially when starting, and to operate the safety switch.

The reel idler assembly smooths out transients introduced by the supply reel system. For example, when starting the tape in the reproduce mode, the momentary strain transmitted through the tape to the tape supply turntable when the capstan idler forces the tape against the capstan is considerable. Under some circumstances, this impulse would tend to stretch or break the tape. Any momentary decrease in holdback tension might be sufficient to start a transient oscillation in the tape tension system, which would be reflected as a periodic variation in the distance of the tape from the heads. This variation might be of sufficient magnitude to appear as an undesirable fluctuation in the signal level at the start of recording or reproduction. The reel idler arm absorbs most of the starting strain, and prevents or minimizes transient oscillation. The high inertia of the reel idler pulley and flywheel provides additional stability in the tape tension system, by smoothing out such transients as motor torque fluctuations and irregularities due to faulty tape wrap on the supply reel.

4.4.3 Tape Drive System

The tape drive system is composed of the drive motor, the capstan and flywheel, the capstan idler arm and idler, and the tape guides at the tape entrance and exit within the head assembly.

The purpose of the tape drive system is to transport the tape across the heads at a uniform speed during the record and reproduce processes. A hysteresis synchronous capstan drive motor and a capstan idler are employed. The drive motor has two sets of windings to provide two tape speeds, either of which can be selected at speed switch S503. The speed switch also controls the actuation of the equalization relay in the electronic assembly.

An indirect drive system is employed, with the drive motor assembly and capstan assembly separate entities. The drive motor is mounted on a hinged bracket which is held by spring action so that the motor pulley does not contact the capstan flywheel except when the motor is operating. When the drive motor is operating, a drive solenoid (K502) is energized and pulls the motor assembly into the drive position against the capstan flywheel.

When the START pushbutton is pressed, in the record or reproduce modes, a capstan idler solenoid (K501) moves the capstan idler to the capstan. The tape is thus held in firm contact with the capstan which drives it at the selected speed.

The drive motor return spring, which

holds the motor from contact with the capstan flywheel, is fastened to a spring arm on the top of the motor. Note that a stronger return spring is required when the transport is operated in the vertical position than that used when it is operated horizontally.

A FAST START-SLOW START switch is provided on the control box at the back of the transport. When this switch is placed in the FAST START position, drive solenoid K502 and drive motor relay K803 are energized whenever power is applied and tape is properly threaded. Relay contacts of K803 apply power to the drive motor, and solenoid K502 moves the motor so that its pulley contacts the capstan flywheel. The capstan will thus be rotating, and tape can quickly be brought up to speed when the START pushbutton is pressed. In the SLOW START position of this switch, the capstan will not start in rotation until the START pushbutton is pressed.

4.4.4 Brake Operation

Smooth brake operation is important in maintaining proper tape tension when stopping the tape. Because the holdback tension, supplied by the trailing turntable motor torque, is lost after the STOP pushbutton is pressed, maintenance of tape tension then becomes a function of brake operation. The braking force acting on the turntable from which the tape is being pulled (trailing turntable) in any of the modes of operation must exceed the braking force acting on the turntable taking up the tape (the leading turntable) to prevent tape loops forming. This differential is determined by springs at opposite ends of the brake band.

When the brake solenoid is de-energized, the brake tension spring (acting on the brake lever) draws the brake band against the drum. The ratio of the braking force in one direction to the braking force in the other -- the brake differential -- is approximately two to one on this equipment.

4.4.5 Control Circuit

4.4.5.1 General

The following discussion can be followed by referring to Figs. 7-1 and 7-2 in the Parts Lists and Drawings section. The explanation will be on a functional basis, treating each operating condition. Numbers in parentheses refer to line numbers marked on the simplified control circuit diagram of Fig. 7-2.

4.4.5.2 Application of Power

Line power is connected to the transport at J801. Both sides of the line are fused by F801 and F802 and switched by power switch S801 (line 1, Fig. 7-2). When switch S801 is in the "on" position, power is routed through fuse F803 (line 2) to the power supply in the electronic assembly. Power indicator DS801 (line 3) is illuminated and power is available at auxiliary outlet J806 (line 4).

If tape is properly threaded so that safety switch S501 is closed, and fast/slow start switch S806 (line 9) is in the fast start position, fast start relay K803 (line 9A) and drive solenoid K502 (line 9B) are energized. Relay contact set K803A (line 5) then connects line power to drive motor B501 which operates at the speed selected by speed switch S503. Drive solenoid K502 (line 9B) pulls the motor so that its pulley contacts the capstan flywheel, and the capstan rotates. (No tape motion will occur until the capstan idler solenoid is actuated in the play or record modes.)

Note that the a-c line voltage is rectified by CR801 and filtered by R804/C810 (between lines 6 and 7). Thus d-c power is used to energize all relays and solenoids.

In all succeeding discussions, it will be assumed that power is applied and that tape is properly threaded.

4.4.5.3 Entering Reproduce (Play) Mode

Mode selector switch S802 is a three-position rotary control which utilizes three poles shown on lines 6A, 6B, and 8 of Fig. 7-2. To enter the reproduce mode, this switch must be placed in the PLAY position and START pushbutton S805 (lines 8A and 8C) must be pressed.

When these actions occur, play relay K801 (line 8A) is energized. Contact set K801B (line 8B) forms a holding circuit for the relay. Contact set K801A (line 8C) completes the circuit to mode relay K802 which is energized and held by its contact set K802B. Note that both of these relay coils are in series with normally closed STOP switch S803 (line 8A).

Relay contact sets K802C and K801C (line 10) close the circuit to capstan idler solenoid K501 (line 10A), and reel motor brake solenoids K601 and K701 (lines 10C and 10D), energizing those solenoids. If the fast/slow start switch (line 9) is in the slow start position, these two contact sets also complete the circuit to fast start relay K803 and drive solenoid (K502.) The action of these two components is then the same as that explained for the fast start in paragraph 4.4.5.2.

When the brake solenoids are energized, the brakes on the reel motors are released, and the energized capstan idler solenoid moves the capstan idler to clamp the tape to the rotating capstan.

Relay contact set K802A (line 6) applies power through two poles of S802 (lines 6A and 6B) and variable resistors R801 and R802 are adjusted to apply correct holdback and takeup tension respectively.

Brakes are thus released and tape is placed in motion under correct tension in the reproduce mode.

NOTE

The record pushbutton (line 10B) is not a tape motion control. After the reproduce mode is started as explained, d-c power is available at the RECORD pushbutton. This power is delivered to the record circuit in the electronic assembly when the pushbutton is pressed.

4.4.5.4 Entering Fast Forward Mode

To enter the fast forward mode, the mode selector switch (lines 6A, 6B, and 8) must be placed in the FAST FORWARD position, and the START pushbutton (lines 8A and 8C) must be pressed. When these actions occur, mode relay K802 (line 8C) is energized.

Relay contact set K802B (line 8D) forms a holding circuit for the relay. Contact set K802C (line 10) completes the circuit to the reel motor brake solenoids K601 and K701 (lines 10C and 10D), energizing those solenoids and releasing the brakes. Contact set K802A (line 6) completes the circuit to the takeup motor (which operates under full power) and through resistors R803, R802, and R801 to the supply (rewind) motor which thus operates under reduced power. Resistor R802 is adjusted to provide correct tension.

The brakes are thus released and the higher torque of the takeup motor results in the tape being pulled from the supply reel to the takeup reel.

4.4.5.5 Entering Rewind Mode

The action here is similar to that explained for the fast forward mode. The difference is that in the REWIND position of mode selector switch S802 (lines 6A, 6B, and 8), full power is applied to the rewind motor and R801, R802, and R803 are placed in series with the takeup motor. The higher torque of the rewind motor results in tape being pulled from the takeup to the supply reel.

NOTE

After the equipment is started in either fastwinding mode, it can be switched to the other without going through the stop-start sequence. Tape will simply slow to a stop and then reverse direction. If the mode selector switch is moved from a fastwinding position to the play position, tape motion will stop and will not start until the START pushbutton is pressed.

4.4.5.6 Stopping

Relay coils K801 and K802 and their holding contacts (lines 8A, B, C, and D) are in series with normally closed STOP pushbutton S803 (line 8A). They will be de-energized whenever that pushbutton is pressed (opened).

Together, these two relays control all tape motion functions, and the record mode in the electronics. Therefore, when the STOP pushbutton is pressed in any mode, tape motion will stop (and the record mode will drop out if it is operating).

4.4.5.7 Other Circuits

In addition to selecting drive motor speed (line 5), speed switch S503 controls the equalization relay in the electronics assemblies. As shown in line 11 (Fig. 7-2), a +23 volt line is returned to the transport from the electronic power supply. When switch S503 is in the low speed position, that +23 volts is routed back to the equalization relay in the electronics.

Also, the rectified line voltage is delivered to the electronics assemblies (line 7) to light the READY indicator when the electronics are ready to record.