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 after each eight-hour operating period, or oftener if visual inspection indicates the need.

NOTE

On console-mounted equipment the transport can be rotated for servicing. Simply loosen the knurled knob (see Fig. 3-3) and tilt the transport on its pivot so that the turntable side moves up and forward. Use care not to place undue strain on the head cables during this procedure.

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

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

4.1.3.2 Capstan Drive Motor

Lubrication of the drive motor requires its removal from the tape transport.

Step 1: Disconnect motor plug J504P from receptacle J504S at the transport control box.

Step 2: Remove the capstan idler from its arm by loosening the Allen head set screw and lifting the rubber-tired idler from the arm. This exposes one of the motor mounting screws.

Step 3: Remove the cone-shaped dust cap that surrounds the capstan by inserting a knife blade or some similar pointed instrument between the base of the cap and the transport and gently prying it up.

Step 4: Manually support the drive motor while removing the four mounting screws at the front of the transport. Using care not to bump or scrape the capstan, remove the motor.

Step 5: Some drive motors have an oil hole located on the motor end bell; fill the oil reservoir through this hole. Ashland drive motors are lubricated by putting 10 drops of the recommended lubricant at the base of the capstan (motor) shaft (do not overlubricate); three passages are provided for the oil to reach the bearings. Wipe off any excess oil.

Step 6: Replace the motor, capstan dust cap, and capstan idler. Reconnect the motor plug.

NOTE

The capstan idler must be properly positioned in relation to the tape, so thread tape on the equipment and position the idler so that the tape is centered on the tire. Visual alignment is adequate. Check idler pressure (refer to paragraph 4. 2. 4) after replacement.

If the equipment is not used for some time, the motor bearing might become dry. Because it takes some time for the lubricant to reach the bearing from the reservoir, even if the latter is filled, it is then necessary to lubricate the bearing directly.

Step 1: Pry off the capstan dust cap as explained in Step 3 of the regular lubricating procedure. This exposes the motor bearing.

Step 2: Apply not more than four drops of the recommended lubricant on the bearing.

Step 3: Replace the dust cap 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 4: Apply power. The drive motor will operate. Allow a fifteen minute warm up period, then stop operation.

Step 5: Allow the motor to cool, then remove the dust cap and inspect the bearing. If it appears dry, repeat the lubrication (Step 2).

4. 1. 3. 3 Capstan Idler

To lubricate the idler, pry off the dust cap on the idler hub. Place not more than three drops of the recommended lubricant on the felt washer exposed when the cap was removed. Do not overlubricate or oil might be thrown during operation.

CAUTION

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

4.2 CHECKOUT AND ADJUSTMENT

4. 2. 1 Test Equipment Required

Spring scales as necessary to measure 5 - 6-1/2 ounces, 12 - 17 ounces, and 4-1/2 - 5-1/2 pounds.

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

NAB reel, empty

Flutter meter, D and R Model FL3-D or equivalent.

Ampex Standard Flutter Tape

3-3/4 ips	No. 01-31336-01
7-1/2 ips	No. 01-31326-01
15 ips	No. 01-31316-01

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 in the transport control box.

Step 1: Apply power to the equipment and place an empty NAB reel on the supply turntable. Check that the REEL switch is to the right (toward the large circle).

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 and press the Play 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 5 and 6-1/2 ounces.

NOTE

When a four position head assembly is used, the reading in Step 5 should be between 4 and 4-1/2 ounces.

Step 6: If the indication in Step 5 is incorrect, turn power off, remove the cover on the transport control box, and adjust the slider on resistor R505 (see Fig. 4-1) as applicable. Correcting a high reading requires that the slider short a lesser part of the resistor, correcting a low reading requires that more of the resistor be shorted. After adjustment, re-apply power and check the torque. Repeat as necessary to obtain the readings quoted.

WARNING

FULL LINE VOLTAGE IS PRESENT IN THE CONTROL BOX WHEN POWER IS APPLIED. DO NOT MAKE THIS ADJUSTMENT WITH POWER ON.

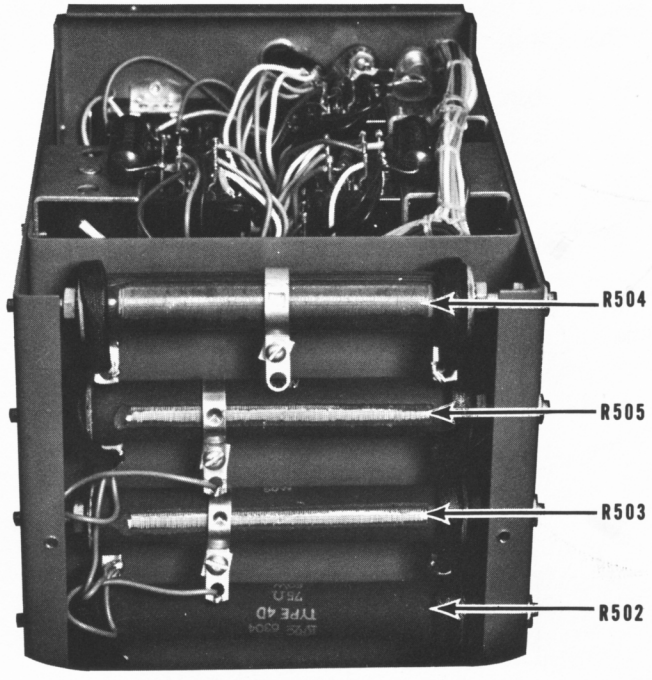

Fig. 4-1 Tape Tensioning Resistors

Step 7: To check proper adjustment, place the REEL SIZE switch to the left (toward the small circle) and recheck motor torque. The indication should be from 2-1/2 to 3-1/2 ounces (still on the NAB hub). If not, readjust the torque until it is within tolerances for both the large and small reel positions of the REEL switch.

Step 8: Repeat the entire procedure 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 R503 (see Fig. 4-1). Scale INDICATION should be the same as for the rewind turntable.

4.2-3 Brakes

Brakes are 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.

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, adjust the "high" braking force with the two nuts indicated in Fig. 4-2. Run the nuts in to increasing braking force, out to decrease. Be sure both nuts are turned in and out 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 1/2 that obtained for the counterclockwise rotation (+2 -1 ounce). If necessary, adjust the

"low" braking force at the point indicated in Fig. 4-2.

Step 7: Repeat the entire procedure at the take-up 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.

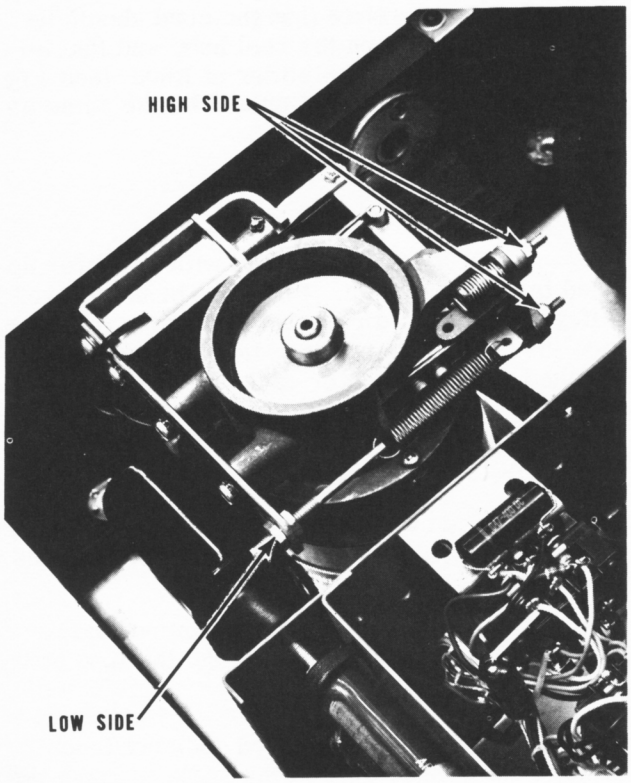

Fig. 4-2 Brake Adjustment Points

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).

Step 3: Press the Play 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).

Step 6: If the indication in Step 5 is incorrect, adjust the lock nut on the capstan solenoid as required to achieve a reading within tolerances. Running the nut in will increase pressure, out will decrease.

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 its 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).

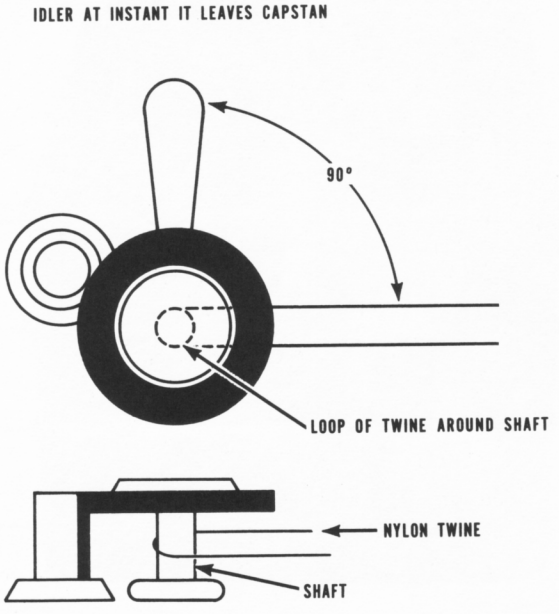

Fig. 4-3 Measuring Capstan Idler Pressure

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, resulting 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 cps 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 drop-outs, 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 bridge meter.

Step 7: Switch the flutter meter to readout at 0.5 to 250 cps, and read the flutter as indicated on the flutter bridge meter.

Step 8: When the measurement is 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.

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

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

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

Supply motor: Excessive or erratic hold back tension, dragging brake, shafts bent.

Capstan idler: Defective rubber tire or bearing, 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 available, excessive flutter might 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.

Table 4-1. Rotational Periods of Components

	Rotational Period (cps)		
COMPONENT	3-3/4 ips	7-1/2 ips	15 ips
Drive Motor (Capstan)	10	20 10	20
Capstan Idler	0.6	1.2	2.4
Reel Idler	0.8	1.6	3.2

4.2.6 Tape Speed

This equipment utilizes a direct drive, (that is, the capstan is an integral part of the drive motor). Therefore, there is no adjustment for tape speed. As long as the drive motor is running in synchronism with power line frequency, and the capstan and capstan idler are kept clean of grease or oil which could cause slippage, tape speed can be considered within tolerance. Synchronism can be easily checked by use of a strobe light, or a simple neon bulb, driven by the power line which drives the motor. View the flywheel under the strobe device, if the motor is in synchronism the flywheel will appear stationary. The most common cause for a motor not to be in synchronism is low line voltage (below 105 volts). Other causes could be excessive capstan idler force, or high tape tensions.

Actual tape speed, rather than capstan rotation, can be checked using a tape strobe -- such as the Dubbings Electronics Tape Strobe Model AA. This is a hand held, wheel device which is pressed against the tape, moving in the reproduce mode. It should be held between the capstan and head assembly so that the moving tape drives the strobe wheel. The percentage of any tape speed error can then be determined by counting the number of spokes on the strobe which appear to pass a fixed point in a given time. The tape speed error is 0.1% for each seven spokes which appear to pass a fixed point in one minute -- therefore, as many as 10 spokes could pass and speed would still be within tolerance. (On 50 cycle equipment, the speed error is 0.1% for each six spokes that pass the fixed point in one minute.)

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 the Audio Service Department 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.

4.3.2 Replacing Brake Bands

The most convenient method of replacing the brake band is to remove the applicable

motor assembly from the transport, although this is not required for equipment that is rack mounted.

To remove the motor from the transport, disconnect the motor plug (P505P takeup or P506P supply) from the receptacle on the transport control box. At the back of the transport, manually support the motor and remove the four nuts and washers that secure the motor mounting plate (and the reel escutcheons) to the transport and remove the motor assembly (the turntable will still be attached to the motor and the reel escutcheons will be loose).

To replace the brake band then proceed as follows (numbers in parenthesis refer to item and figure numbers in Section 7).

Step 1: Remove the brake tension spring (10; 7-12) from the brake lever (4; 7-12).

Step 2: Remove the two screws holding the capacitor (9; 7-11). Disconnect the wires to the capacitor at the knife disconnect points, and remove the capacitor.

Step 3: Remove the three screws (22; 7-11) 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; 7-12) that secure the end of the brake band near the two "high side" brake adjustment points (farthest from the solenoid). A clamp will also come free.

Step 5: Loosen, but do not remove, the two socket head cap screws (26; 7-12) 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; 7-12) and the band link (3; 7-12). Run the two cap screws in until they are snug but the band will still slip.

Step 9: Check that the solenoid stop (7; 7-12) 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 (9 and 3; 7-12) 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 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, (refer to Step 12) must be slid further into the clamp (effectively shortening the band). The final adjustment must result in the proper clearance between the solenoid 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 (paragraph 4.2.3). This can be done before reinstalling the motor assembly on the transport.

Step 15: Reconnect the solenoid leads. Replace the capacitor and reconnect its leads. If the motor assembly was removed, reinstall it on the transport.

4.4 PRINCIPLES OF OPERATION

4.4.1 General

The tape transport mechanism (Fig. 4-4) provides tape motion for all modes of operation. Interaction of four basic assemblies and their associated components -- the tape supply system, the tape take-up system, the tape drive system, and the control circuit -- insures smooth positive movement of the tape across the head assembly, and proper tape tension. All tape motion controls, a reel size selector, a safety microswitch, and the head assembly are located on the tape transport.

Location of components at the back of the tape transport is shown in Fig. 4-5).

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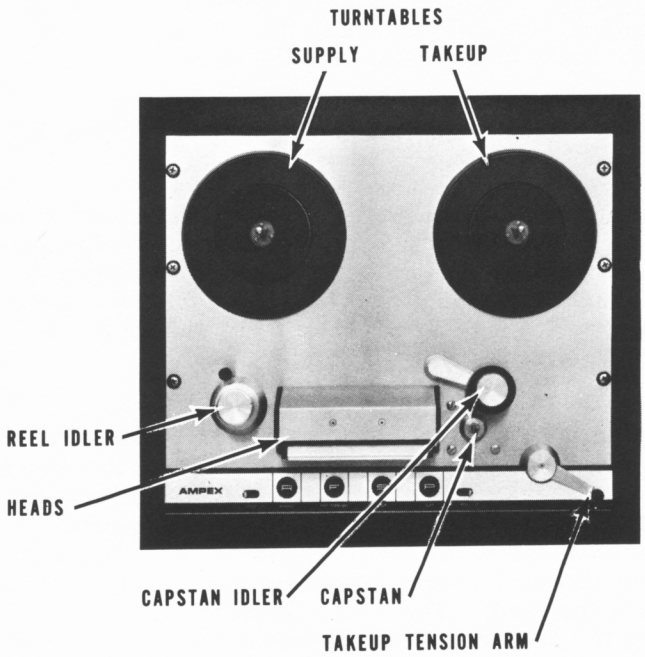

Fig. 4-4 Tape Transport, Front View

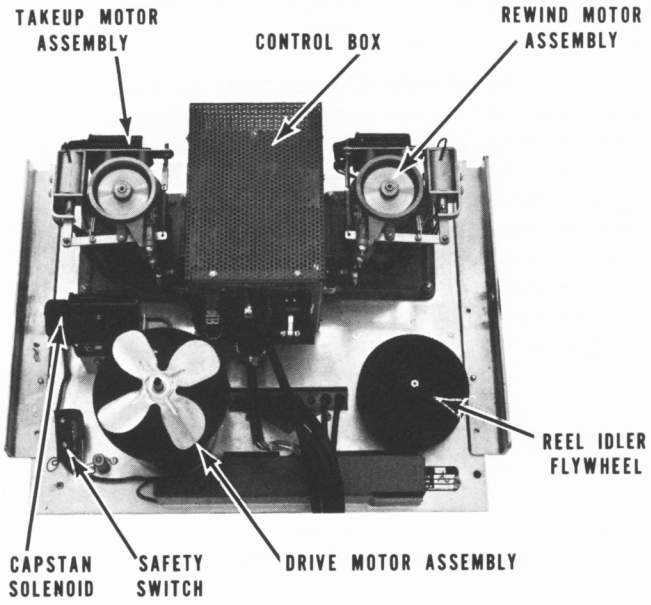

Fig. 4-5 Tape Transport,Rear View

4.4.2 Tape Supply and Take-up Systems

From the supply reel, on the left side of the tape transport as the operator faces the equipment, tape is delivered to the take-up reel when the Play or Fast Forward buttons are pressed, tape is rewound onto the supply reel when the Rewind button is pressed. Proper tape tensioning is maintained during all modes by the opposing action of two induction torque motors.

The reel idler assembly on the supply side of the tape transport is composed of a pulley, a spring-pivot-mounted arm, and a flywheel for smoothing out transient speed variations in the supply turntable assembly.

On the take-up side of the tape transport, a tension arm assembly with a spring-pivot-mounted arm performs two main functions. The first is to provide a small tape storage loop which prevents tape breakage during the starting and stopping of tape motion. Secondly, this arm 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 take-up assemblies are composed of induction torque motors (B503 supply-rewind, B502 takeup), a turntable mounted directly on each motor shaft, a brake housing assembly and a flange for mounting the entire assembly. Because the brake housings are mirror images of each other, these assemblies are not interchangeable although the motors are identical. The brakes are solenoid operated, remaining in the braking position until the brake solenoids, K505 and K506, are energized -- at which time the brakes are released.

The supply and take-up motors are so connected that when power is applied with no tape threaded, the turntables, will rotate in opposite directions. The tape supply turntable will rotate clockwise and the tape take-up turntable, counterclockwise.

During all operating modes, the two torque motors act as tensioning devices. In the fast forward and rewind modes one motor operates at maximum torque, the other at reduced torque.

Motor torque in the reproduce and record modes is adjusted to equality by the tensioning adjustment resistors (R503 takeup and R505 holdback) in series with each motor. In the fast forward modes, the torque of the supply (rewind) motor is reduced by introduction of a series resistance (R504). In the rewind mode, R504 is connected in series with the take-up motor.

In the fast forward mode, the take-up motor operates at full torque, the supply motor at reduced torque, and the tape is pulled from the tape supply reel. Because the torque of the tape supply turntable motor (rewind motor) is applied in the opposite direction to the turntable rotation,

the tape is held under continuous tension as it is pulled from the reel.

In the rewind mode, the supply motor operates at full torque and the take-up motor holds the tape under continuous tension by its opposite and reduced torque.

In the reproduce or record modes, both torque motors operate at the same reduced torque. The capstan and the capstan idler, between which the tape is clamped, 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 of the supply motor, which constitutes the hold back tension. 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 here because the take-up 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 take-up rate).

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

The reel idler assembly smooths out transients in 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 tends to stretch or break the tape. A 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 this type of oscillation. The reel idler pulley and flywheel provide 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. This is accomplished because the high inertia of the reel idler pulley and flywheel effectively isolate the reel assembly from the heads.

4.4.3 Tape Drive System

The tape drive system is composed of the drive motor, the extended shaft of which forms the capstan, 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. By means of a hysteresis synchronous capstan drive motor (B501) and a capstan idler, the magnetic tape is driven at a constant speed after power has been applied to the equipment and the Play button pressed. The drive motor has two sets of windings to provide two tape speeds, either of which can be selected at SPEED toggle switch S503. The SPEED switch also controls the actuation of the equalization relay in the electronic assembly.

After the POWER switch at the electronic assembly has been placed in the ON position and the tape is threaded (actuating the safety switch) the drive motor operates continuously, awaiting the PLAY command (the RECORD function is selected at the amplifier). When the PLAY button is pressed, the capstan solenoid (K501) and the brake solenoids (K505 and K506 -- releasing brake pressure) are energized. The capstan solenoid pulls the rubber tired capstan idler wheel, which is mounted on a swivel type arm, against the tape, causing the tape to make firm positive contact with the capstan. The tape is then driven at a constant speed across the head assembly.

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 button 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 all modes of operation must exceed the braking force acting on the turntable taking up the tape (the leading turntable) to prevent tape loops forming.

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. This differential is determined by three springs -- two of which determine the "high" braking force and one (which acts on the brake lever) the "low" braking force.

4.4.5 Control Circuit

4.4.5.1 General

Located in the control circuit box underneath the tape transport are all relays, the tension adjustment resistors, and electronic components such as capacitors and resistors (with the exception of the three motor starting capacitors, the capstan solenoid, the brake solenoids and the safety microswitch, which are mounted adjacent to the assemblies they serve).

On the outside of the control circuit box, receptacles are available for cables from the drive motor, supply motor, take-up motor and control cluster. Female receptacles and plugs (cables not supplied) are also available for interconnecting the tape transport and accessory units such as remote control panels and a precision frequency source.

NOTE

The special connector jumper plugs supplied for receptacles J503S 60 CYCLE AMPLIFIER and J502S REMOTE CONTROL must be plugged into their receptacles when these accessory units are not used. Jumpers in these plugs complete the necessary circuits in the system for proper operation.

All control of the tape transport takes place at the control circuit switch assembly comprising four pushbuttons: Rewind, Fast forward, Stop and Play. Two toggle switches REEL (size) and SPEED are mounted at either end of the control cluster. (The RECORD function is controlled at the amplifier.) The safety switch (not an operating control) is mounted under the tape transport.

Refer to Figs. 7-1 and 7-2 to follow the description of operating functions.

4.4.5.2 Play

When Play button S505 is pressed, play relay K502 is energized. Capstan solenoid K501 is energized, and a holding circuit is formed, through contact sets K502-1, K503-1, K504-3, and the normally closed Stop button S502. Power is connected to the turntable reel motors through contact K502-2. Through contact K502-3, d-c voltage is applied to brake solenoids K505 and K506. The reel motors are powered and the brakes are released simultaneously, causing the equipment to operate in the reproduce mode at the tape speed selected by SPEED switch S503.

NOTE

The record mode is not a tape motion control function, but it is interlocked and dependent on the PLAY button, which must be pressed before the record mode can be energized at the amplifier.

4.4.5.3 Rewind

When Rewind button S507 is pressed, rewind relay K504 is energized and held in this condition by relay contact sets K504-1, K503-3 and the normally closed Stop button S502. Contact set K504-2 connects the full a-c power directly to the rewind (supply) motor, and places R504 in the a-c circuit to the take-up motor. The rewind motor thus operates at full torque and the take-up motor at reduced torque, and tape is pulled at a maximum speed from the take-up to the rewind reel. Contact set K504-3 completes the d-c circuit to the brake solenoids, releasing the brakes.

4.4.5.4 Fast Forward

When Fast Forward button S506 is pressed, fast forward relay K503 is energized and held through contacts K503-1, K504-3, and the normally closed Stop button S502. Contact set K503-2 connects the full a-c power to the take-up motor, and places R504 in the circuit to the rewind motor. The take-up motor now operates at full torque and the rewind motor at reduced torque, causing the tape to be pulled at a maximum speed from the rewind to the take-up reel. Contact set K503-3 completes the d-c circuit to the brake solenoid, releasing the brakes.

4.4.5.5 Stop

When the tape is moving in any mode and the Stop button (S502) is pressed, the brake solenoids and all relays are de-energized. The brakes are applied to both turntable motors. The capstan drive motor will continue to operate so long as the tape remains properly threaded.

4.4.5.6 Safety Interlocks

When the tape is moving in either of the high speed modes (fast forward or rewind) it is impossible to switch to the play mode without first

pushing the STOP button. In fast forward, contact K503-1 interlocks the play relay and capstan solenoid. In rewind, K504-3 is the interlock.

CAUTION

IF THE STOP AND PLAY BUTTONS ARE PRESSED IN TOO RAPID A SEQUENCE WHEN THE TAPE IS IN EITHER FAST WINDING MODE, TAPE WILL ALMOST INVARIABLY BE BROKEN OR DEFORMED. ALWAYS ALLOW TIME FOR THE TAPE TO STOP COMPLETELY WHEN SWITCHING FROM EITHER OF THE FAST MODES TO PLAY.

4.4.5.7 Reel Size Switch

Selection of proper holdback tension, depending on reel hub size, is made at the two position toggle switch labeled REEL. Holdback tension is not a constant in any mode of operation, varying directly as a function of the trailing turntable motor torque, and inversely as a function of the effective trailing reel hub diameter (hub diameter includes the tape wound on the hub). For a given torque on the trailing motor, the holdback tension will increase as the effective hub diameter of the trailing reel decreases. Reducing the torque on the trailing turntable motor will decrease the holdback tension.

The holdback tension resistors for adjustment of take-up and rewind motor torques are factory-set for NAB 10-1/2 inch reels. When these reels are used, the REEL switch must be positioned to the right -- toward the large circle. If the smaller (7 or 5 inch) EIA reels are used, compensation for the overall increase in holdback tension must be made by placing the switch to the left -- toward the small circle. This places resistor R502 in series with the take-up and rewind motors, thus reducing the torque of both motors in any mode of operation when the EIA reels are used. If it is desired to accelerate faster in the rewind or fast forward modes, the switch may be placed in the large position during these modes, but be sure it is returned to the small position when fastwinding is completed. The REEL SIZE switch is a SPST switch placed across the resistor R502. It is closed in the position for 10-1/2 inch diameter NAB reels, and open (resistor R502 in the torque motor circuits) for the small reels.

NOTE

In the large reel position both the rewind and take-up reels must be NAB type and in the small reel position both reels must be EIA.