TM-4
TAPE TRANSPORT

AMPEX

7 TRACK TAPE
2400' TAPE MAX
200 BITS DENSITY

FEBRUARY 15, 1963

31 06518 10

TECHNICAL MANUAL FOR

SDSTM-4 TAPE TRANSPORT

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SECTION I
GENERAL DESCRIPTION

1-1. GENERAL.

1-2. The Ampex Series TM-4 Tape Transport is designed for use in conjunction with computer mechanisms. The equipment will perform within specifications under varying conditions of supply voltage, temperature, and humidity normally encountered in a business office or laboratory. Any sequence of programming may be used.

1-3. The tape transport consists basically of two assemblies: a tape transport assembly and a transport electronics assembly. The former provides the means of transporting the tape over the head assembly for writing and reading; the electronics contains the necessary circuitry for controlling tape transport operation.

1-4. Provisions are made on the transport electronics assembly for customer-supplied control circuitry. This control circuitry provides for automatic or manual command-input signals from a program source, and includes transport-status-indicator output lines.

1-5. TAPE TRANSPORT. (See Figure 1-1.)

1-6. Once the tape has been threaded on the machine, and the transport electronics properly connected to a command source, the tape transport is ready to be placed in operation.

1-7. (See Figure 1-2.) Program signals from a command source to the forward or reverse control circuits in the actuator unit of the transport electronics assembly energize one of two actuators associated with the two counter-rotating capstans. Whichever actuator is placed in the ON position clamps the capstan roller against its capstan. This action moves the tape in either the forward (supply reel to takeup reel) direction or the reverse (takeup reel to supply reel) direction. The tape motion continues in one direction or the other until the command signal is removed. When the command signal is removed, the actuator that has determined the direction of tape movement moves the capstan roller away from the capstan, stopping tape movement. The tape transport and transport electronics assembly are now ready to receive and respond to another command to move in either direction.

1-8. When the electrical power is turned on, the vacuum pump creates loops of tape in the vacuum chamber. The vacuum chamber eliminates a source of tension-arm oscillation and tape tension variation. As tape changes direction, the tension arms move in an arc; this movement, in

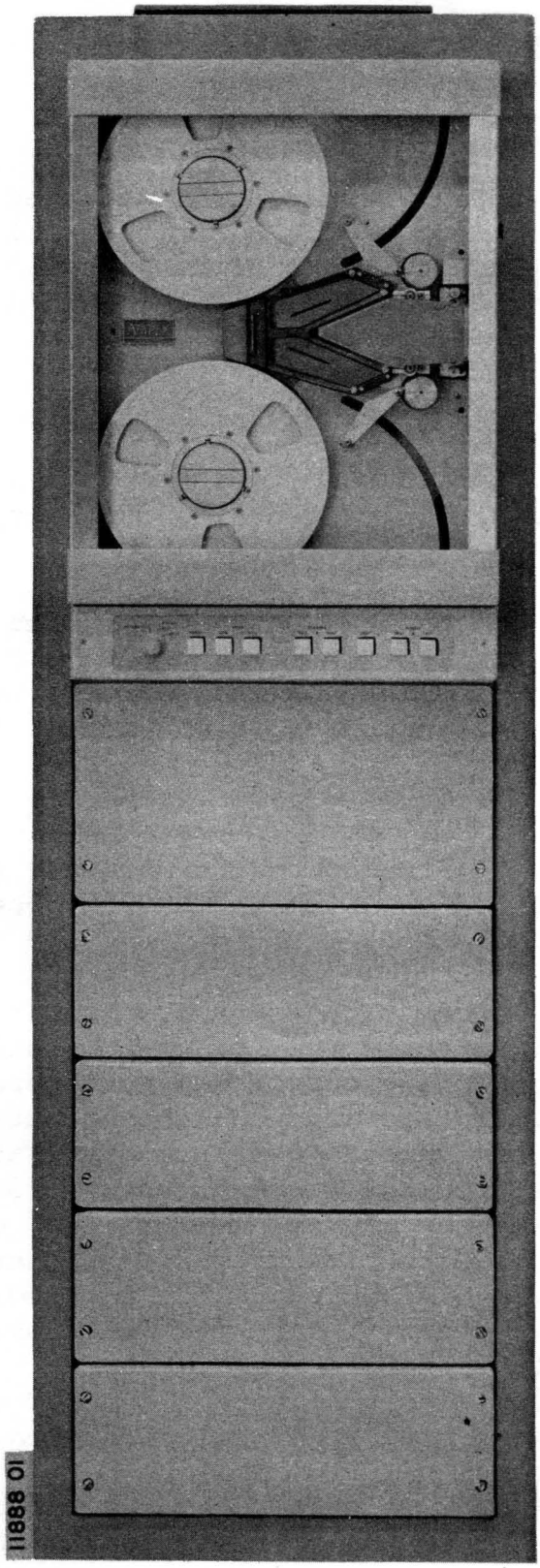


Figure 1-1. Tape Transport

turn, causes movement in the servo contact assembly. The servo contact assembly converts mechanical movement into electrical signals which, in turn, apply electrical power to the reel motor to supply or take up tape.

1-9. Safety features include switches which stop the transport in the event of power failure, tape breakage, or current overload. Operational features are the brake-release switch, which releases the brakes by energizing the brake solenoids so that the supply and takeup reels can be rotated for threading; and the thread-lever-handle switch, which when pulled off its stop, terminates the tape transport input power.

1-10. TRANSPORT ELECTRONICS ASSEMBLY. (See Figure 1-2.)

1-11. The transport electronics assembly contains all control circuits for the tape transport assembly. These circuits exercise complete control over the tape transport assembly in accordance with signals originating from a command source.

1-12. In this assembly are power supplies to operate the reel motors, control circuits, mercury relays, and the actuator control unit.

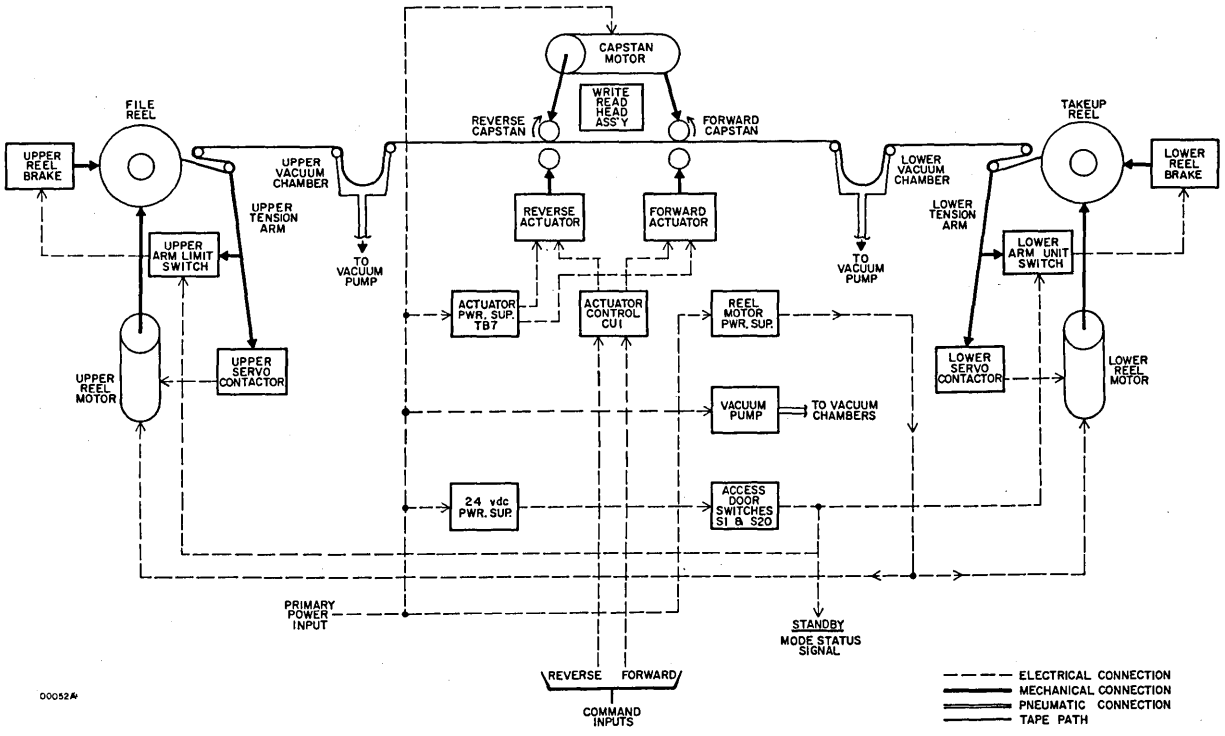


Figure 1-2. Block Diagram of Tape Transport and Transport Electronics

The transport electronics assembly also contains both safety and overload relays.

1-13. PHOTOSENSOR ELECTRONIC CHASSIS ASSEMBLY. (See Figure 1-3.)

1-14. The photosensor electronic chassis assembly senses and indicates by providing a level-change signal. Reflective tabs are placed on the mylar (non oxide) side of the tape. Channel A (beginning-of-file) is placed nearest the operator; channel B (end-of-file) is placed nearest the tape transport.

1-15. The photosensor electronic chassis assembly consists of two units: the photocell detector head and a two-channel electronic chassis. Passing a reflective metallic-type marker under the photocell detector head provides the signal. In the chassis, one channel is used to indicate the beginning-of-file, and the other channel is used to indicate the end-of-file. Each channel furnishes the following output signals, depending on which photosensor unit is chosen:

1. Voltage-level change.

2. Voltage-level change and relay-contact transfer.

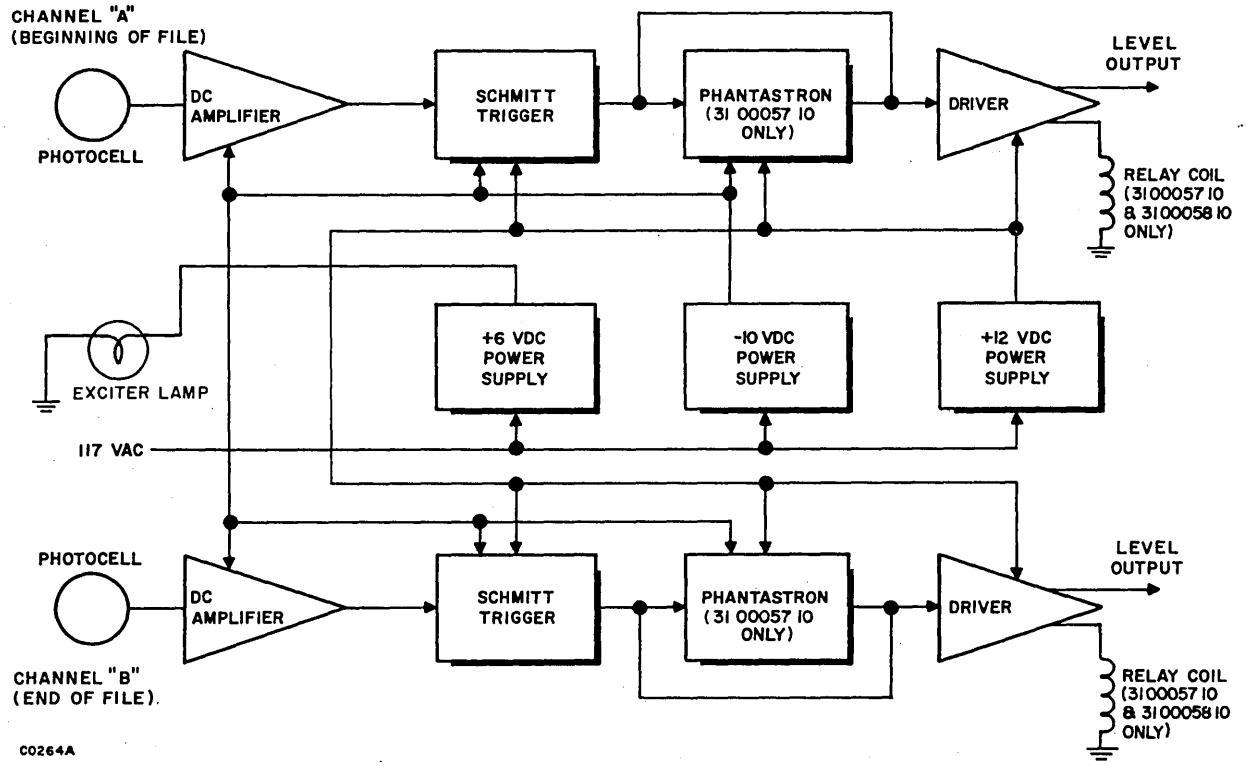


Figure 1-3. Block Diagram of Photosensor Electronics System

3. Voltage-level change and relay-contact transfer, with hold circuits to maintain both channel outputs for a standard time length.

1-16. PUSHBUTTON CONTROL ASSEMBLY.

1-17. Manual operation is obtained by setting the AUTOMATIC-MANUAL switch of the pushbutton control assembly to either of the two MANUAL positions. The operator can, by using the pushbutton control assembly, program the tape transport as required for various operations such as tape threading and checkout.

1-18. To place the tape transport in the automatic mode use the AUTOMATIC-MANUAL switch.

1-19. BUFFER AND INTERLOCK UNIT.

1-20. The buffer and interlock unit changes the customer-supplied drive-command signals to signals with a predictable level and rise/fall time. In conjunction with the actuator control unit, it provides an interlock which prevents simultaneous forward and reverse commands to the actuators.

1-21. BUFFER DELAY AND INTERLOCK UNIT.

1-22. The buffer delay and interlock unit provides the same functions as described for the buffer and interlock unit. In addition, it provides an adjustable time delay before any start or stop command.

1-23. SPECIFICATIONS.

Tape Type:	Computer grade ½-inch mylar base, 0.001- or 0.0015-inch hard binder, oxide coated tape.
Tape Reel Hubs:	1. IBM
	2. NARTB
	3. Fixed (non-removable)
Choice of Tape Speeds:	1. 30 ips/60 ips
	2. 37.5 ips/75 ips

NOTE

Special tape speeds are available upon request. Performance of the TM-4 tape transport above 75 ips is not specified. It is recommended that tape speeds above 75 ips be restricted to fast forward and fast reverse modes only.

Transport Input Power Requirements

Voltage	Frequency	Standby Current	Operating Current
117 ±10%	60 ±3 cps	5.2 amps	5.4 to 8.0 amps
220 ±10%	50 ±3 cps	2.5 amps	2.7 to 4.0 amps

Head Assembly

8-track, 2-stack heads or 7-track, 2-stack heads

Write Lockout Switches

IBM compatible or NARTB compatible

Buffer Delay and Interlock

1. Adjustable Delay to START and STOP commands.
2. Inhibits an actuator ON command until the other actuator is OFF.

Pushbutton Control Assembly

DRIVE CONTROLS

1. Power Switch
2. Manual-Automatic Mode Switch
3. Hi/Lo Speed Select
4. Forward Drive

5. Reverse Drive

6. Fast Forward

7. Fast Reverse

8. Stop

Table 1-1. Physical Dimensions

Unit	Height	Width	Depth	Weight
Tape Transport Assembly	24-1/4"	19"	14-1/2"	180 lbs. max.
Transport Electronics Assembly	5-3/4"	19"	10"	23 lbs.
Photosensor Chassis Assembly	3-1/2"	19"	5"	7 lbs.
Pushbutton Control Assembly	3-1/2"	19"	10"	10 lbs.
Transport Access Door	24-1/2"	19"	3-7/8"	25 lbs. max.
Cabinet Assembly	66-1/2"	23"	24"	170 lbs.
	73-1/2"	23"	24"	190 lbs.
	77-1/2"	23"	24"	200 lbs.
	80-1/2"	23"	24"	210 lbs.
	84-1/2"	23"	24"	220 lbs.

Operating Environment:

Ambient air temperature..... 50° to 90°F
Relative humidity..... 40 to 70%
Altitude..... 0 to 7,000 ft.

Cooling Environment:

Tape transport enclosed..... 0 to 140°F max. hot spot temperature
Tape transport only..... Airflow of 250 cfm and maximum inlet temperature of 90°F

Storage Environment:

Ambient temperature.....	$20^{o}F$ to $+150^{o}F$
Relative humidity.....	95% max.
Altitude.....	0 to 40,000 ft.

Start-Stop Characteristics

Start Time: The start time is defined as the time from the application of a "Start Command" until the tape passing over the magnetic head has obtained an instaneous speed variation of 10% or less from nominal speed. The start time shall be 3.3 ms.

Start Distance: The start distance is the distance that the tape moves over the magnetic head during the "Start Time".

TAPE SPEED IN IPS	START DISTANCE IN INCHES MIN.	MAX.
1. 30	0.064	0.092
2. 37.5	0.080	0.114
3. 60	0.120	0.182
4. 75	0.162	0.203

Stop Time: The stop time is defined as the time from the application of a "stop command" until tape motion over the magnetic head has stopped. The stop time shall be 1.8 ms maximum.

Stop Distance: The stop distance is the distance that the tape moves over the magnetic head from the time of a stop command until tape motion over the magnetic head has stopped.

TAPE SPEED IN IPS	STOP DISTANCE IN INCHES MIN.	MAX.
1. 30	0.006	0.030
2. 37.5	0.009	0.037
3. 60	0.018	0.068
4. 75	0.030	0.100

Tape Speed Characteristics

Instantaneous Speed Variations:	ISV is defined as the speed variation from the specified nominal speed at any instant of time. The ISV at any instant of time following the start time of 3.3 ms, is ±10%; 6.3 ms or more after receipt of a start command, the ISV is ±5%. This does not include effects caused by variation in line frequency.
Short Term Average Speed Variation:	The short term average speed variation is defined as the variation from the specified nominal speed, averaged over any interval of 15 ms occurring 3.3 ms or more after a "start command". The variation shall be 3% maximum.
Long Term Average Speed Variation:	The long term average speed variation is defined as the variation from the specified nominal speed averaged over any interval of 30 ms occurring 3.3 ms or more after a "start command". This variation shall be 2% maximum.
Rewind Time, Forward Direction:	3 minutes, maximum
Rewind Time, Reverse Direction:	3 minutes, maximum
Rewind Stop Distance, Forward or Reverse Direction:	6 feet, maximum
Speed Change Times:	Acceleration from low to high speed in forward or reverse directions shall be 10 seconds or less. Deceleration from high to low speed in forward or reverse direction shall be 10 seconds or less.
Special High-Speed Drive:	At 120 or 150 ips, average tape speed shall be within 5% of the nominal value.

Interchannel Time Displacement: ITD is the time band within which all bits of a character-frame arrive at the head output when reading a tape written on the same or another TM-4 tape transport. ITD is the sum of the static skew contributed by the mechanical tolerances of the magnetic head assembly, plus one-half the dynamic skew contributed by the tape drive. ITD = Static Skew + Dynamic Skew/2.

Dynamic Skew: Dynamic skew is defined as the varying time displacement between the recorded signals of any two heads in the same stack with the tape traveling over the heads at the specified nominal speed in either direction. This time displacement is caused by random displacement of the tape as it is moved and guided across the head. Dynamic skew is measured as the jitter band produced by the pulse output of one outside track referenced to the output of the other outside track in the same character frame. Jitter introduced by read/write electronics must be discounted.

Tape Drive Programming: The transport shall be free of program restrictions within the limits specified below.

DUTY	MODE	MINIMUM TIME BETWEEN COMMANDS
Continuous	Unidirectional	8.5 ms
Continuous	Bidirectional	4.3 ms
Intermittent	Either Mode	2.5 ms

Table 1-2. Interchannel Time Displacement

SPEED inches/sec	Dynamic Skew u sec	Static Skew u sec	ITD u sec
30	15.0	17.0	24.5
37.5	12.0	13.6	19.6
60	7.5	8.5	12.3
75	6.0	6.8	9.8

SECTION II
INSTALLATION

2-1. GENERAL.

2-2. The tape transport, transport electronics assembly, photosensor chassis assembly, and pushbutton control assembly are designed so that they can be mounted in a standard relay rack or cabinet.

2-3. Read and write electronics must be located so that lengthening of the head cables is not required. Any increase in cable length will increase distributed capacitance and reduce high-frequency response.

CAUTION

The tape unit must not be located near strong magnetic fields, or in areas of high air temperature.

2-4. The location selected for the tape transport should meet the following ambient temperature, humidity, and altitude specifications:

Ambient Temp.	Humidity	Altitude
50° - 90°F	40% - 70% RH	Sea level to 7,000 feet

2-5. When the tape transport is enclosed, sufficient air must be circulated around the major components to maintain the maximum exhaust air temperature at less than 140°F.

2-6. Storage or non-operating environment should meet the following specifications:

1) Temperature should not exceed -20°F to +150°F

2) Relative humidity not to exceed 95%; no abrupt changes in temperature which can cause moisture condensation are permissible.

3) Altitude: 0 to 40,000 feet

2-7. UNCRATING.

2-8. When no cabinet rack is furnished, the tape transport is packed and shipped in a custom-built case. This case will provide maximum protection during, and is designed for, "flat" shipment. It should not be handled in an upright position.

CAUTION

To prevent damage to the tape transport when removing from the packing case, grasp or lift it only by the tape transport plate.

2-9. The transport electronics assembly, photosensor chassis assembly, and pushbutton control assembly are shipped in the same packing case as the tape transport. When removing these assemblies from the packing case, exercise caution to avoid damage.

2-10. When the tape transport is furnished with an Ampex cabinet rack, the components are shipped mounted in the cabinet rack. Carefully open and unpack the packing case. Check the contents accurately against the packing slip. Visually check the equipment for damage incurred during shipment.

2-11. MOUNTING THE TAPE TRANSPORT. (See Figure 2-1.)

CAUTION

To prevent damage to the tape transport during custom installation, do not lift by any mechanism other than an eye bolt installed in the casting.

Step 1: Install a 1/4-20 eye bolt in the casting just above the upper reel motor.

Step 2: Using the eye bolt, lift the tape transport up and move it to the cabinet rack.

Step 3: Install tape transport mounting hinge on cabinet rack.

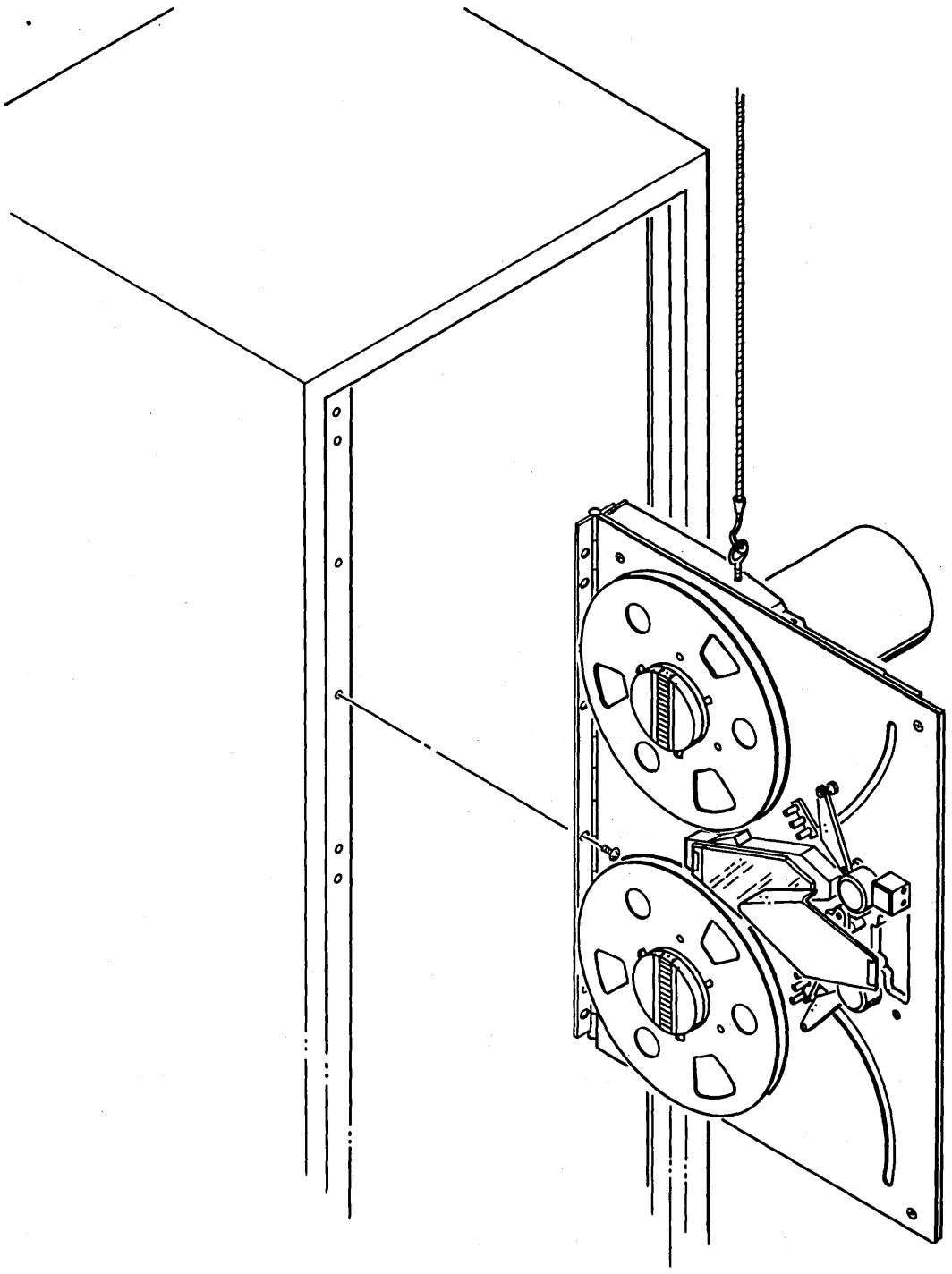


Figure 2-1. Mounting the Tape Transport

WARNING

The cabinet rack must be securely fastened to the floor before the tape transport can be swung out on its mounting hinge. Otherwise, the cabinet rack and tape transport may tip forward, injuring personnel and damaging the equipment.

Step 4: Slowly swing the tape transport out and in on its mounting hinge. Observe the cables to ensure they are not stretched as the tape transport is swung out, or pinched between the plate and cabinet rack as the tape transport is swung in.

2-12. MOUNTING THE TRANSPORT ELECTRONICS ASSEMBLY.

2-13. The transport electronics assembly may be mounted in any convenient position. The cables will govern the distance at which the transport electronics assembly may be mounted from the tape transport.

2-14. MOUNTING THE PHOTOSENSOR CHASSIS ASSEMBLY.

2-15. The photosensor chassis assembly may be mounted in the horizontal or vertical position. The photosensor chassis head cable will govern the distance at which the assembly may be mounted from the tape transport.

2-16. MOUNTING THE PUSHBUTTON CONTROL ASSEMBLY.

2-17. The pushbutton control assembly should be mounted directly above or below the tape transport in a horizontal position.

2-18. TAPE TRANSPORT ASSEMBLY CABLE CONNECTIONS. (See Figure 2-2.)

Step 1: Connect tape transport plug P1 to receptacle J1 on the transport electronics assembly.

Step 2: Connect a 117-vac power source to P4 on the transport electronics assembly.

Step 3: Connect pushbutton control assembly plug P2 to receptacle J2 on the transport electronics assembly.

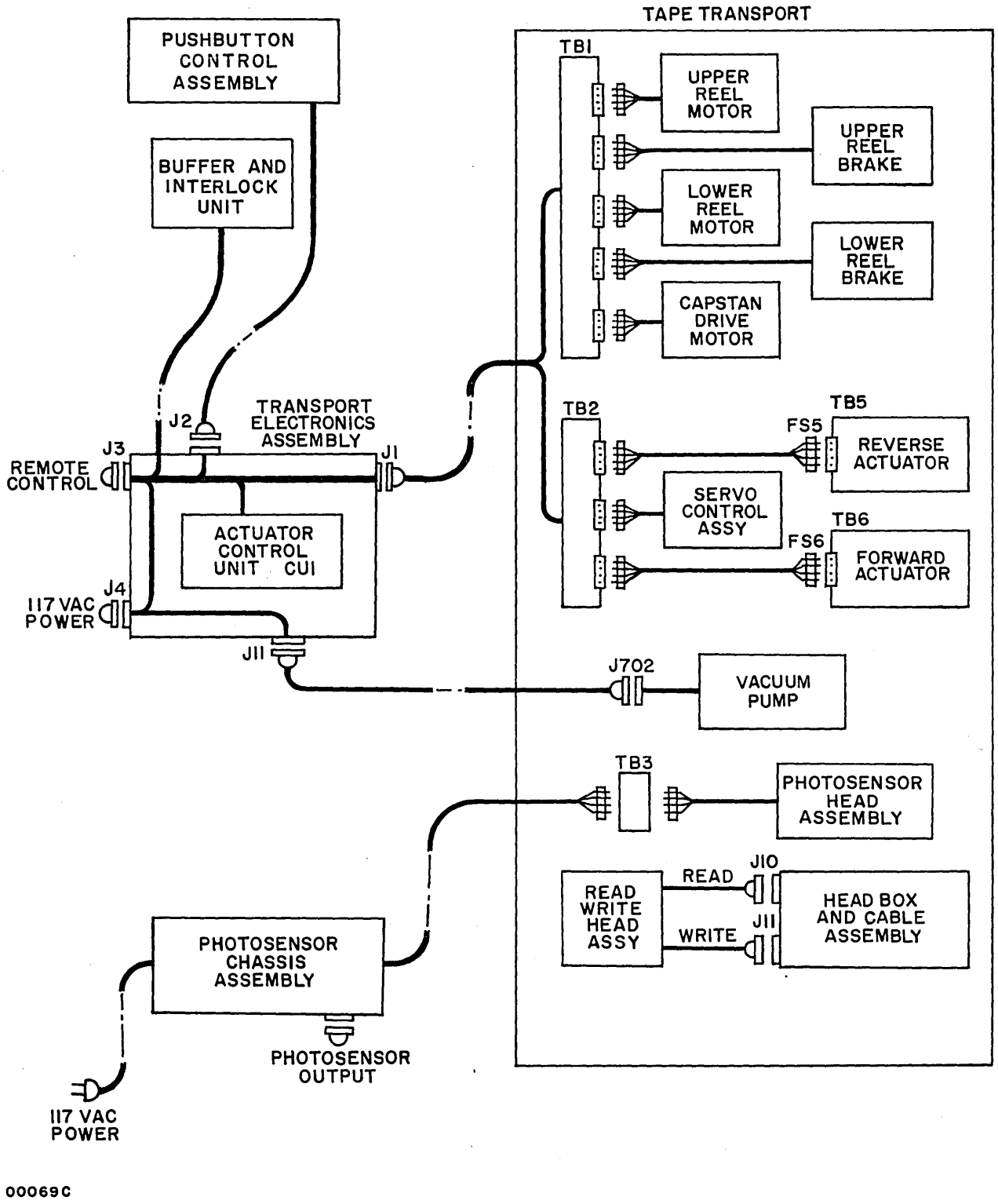


Figure 2-2.
Tape Transport and Transport Electronics Cable Connections

2-19. REMOTE CONTROL PLUG CONNECTIONS. Table 2-1 identifies the connections of J3 on the transport electronics assembly. This is the connection that ties the transport to the customer tape-drive command source.

Table 2-1. Remote Control Plug Connections

J3 PIN NO.	FUNCTION
A	Failure signal to remote control (see Figures 6-1 and 6-2)
B	Failure signal to remote control (see Figures 6-1 and 6-2)
C	Failure signal to remote control (see Figures 6-1 and 6-2)
D	Write-enable signal to remote control (used in conjunction with pin J)
E	End-of-takeup-reel sensing signal
F	Chassis ground
G	Failure signal to remote control (see Figures 6-1 and 6-2)
H	End-of-supply-reel sensing signal
J	Write-enable signal to remote control (used in conjunction with pin D)
K	Chassis ground
L	Manual input for reverse drive OFF
M	Automatic input for reverse drive ON and OFF
N	Safety relay ground (remote control only)
P	Manual input for reverse drive ON
Q	Manual input for forward drive OFF
R	Automatic input for forward drive ON and OFF

Table 2-1. Remote Control Plug Connections (Cont.)

J3 PIN NO.	FUNCTION
S	Failure signal to remote signal (see Figures 6-1 and 6-2)
T	Chassis ground
U	Manual input for forward drive ON
V	Ground signal input for automatic fast forward (remote)
W	Ground signal input for automatic fast reverse (remote)
X	Connects to pin "M" of J2 (+14V)
Y	Lower servo ground for remote control
Z	Upper servo ground for remote control

2-20. HEAD CABLE AND BOX ASSEMBLY CONNECTIONS.

NOTE

In this manual, channel 1 is that channel nearest the operator. The head cable and box assembly is mounted on the rear of the tape transport, just below the lower capstan.

Step 1: When a read-head is used, connect the read-head cable plug to the READ receptacle on the head cable and box assembly. (See Figure 2-2.) Head box read cable connections are shown in Table 2-2.

Table 2-2. Read and Write Cable Output Connections

CHANNEL REFERENCE	FROM CABLE BOX RECEPTACLE CONNECTOR	TO REMOTE SOURCE PLUG CONNECTOR	COLOR CODE
1	A E	1 4	Blue Red

Table 2-2. Read and Write Cable Output Connections (Cont.)

CHANNEL REFERENCE	FROM CABLE BOX RECEPTACLE CONNECTOR	TO REMOTE SOURCE PLUG CONNECTOR	COLOR CODE
2	H M	8 13	Blue Red
3	P U	2 5	Blue Red
4	W AA	9 14	Blue Red
5	BB X	3 6	Blue Red
6	V R	10 15	Blue Red
7	N J	7 12	Blue Red
8	F B	11 16	Blue Red
D-C Bias (write cable only)	C	17	Blue
Write Cable (write cable only)	D	18	Red

Step 2: When a write head is used, connect the write-head cable plug to the WRITE receptacle on the head cable and box assembly. Head box write cable connections are identical to read-head connections.

2-21. PHOTOSENSOR KIT CABLE CONNECTIONS.

CAUTION

Ensure that the numbers on the fanning strip match the numbers on the photosensor head terminal board. Damage to the photocells may result if wiring is incorrect.

Step 1: Connect the photosensor chassis assembly cable with fanning strip to the photosensor head terminal board.

NOTE

The photosensor head terminal board is located near the upper capstan.

Step 2: Connect the three-wire ground-pin type input power plug to a 117-vac, 48-to 62-cps power source.

2-22. Output to the command source is terminated at receptacle J6 on the photosensor chassis assembly. An unwired mating plug is provided for customer use, and may be wired as shown in Table 2-3. Table 2-4 identifies the wire connections from the photosensing head.

Table 2-3. Photosensor Output Connector

RECEPTACLE J6 PIN NO.	CIRCUIT	COMMENTS
10	Channel A Relay (N.C.)	Not in Ampex Catalog
9	Channel A Relay (Common)	Number 31 0059 10
8	Channel A Relay (N.O.)	
7	Channel A Level	
6	Channel A Ground	
5	Channel B Relay (N.C.)	Not in Ampex Catalog
4	Channel B Relay (Common)	Number 31 0059 10

Table 2-3. Photosensor Output Connector (Cont.)

RECEPTACLE J6 PIN NO.	CIRCUIT	COMMENTS
3	Channel B Relay (N.O.)	
2	Channel B Level	
1	Channel B Ground	

Table 2-4. Photosensing Head Assembly Connections

COMPONENT	COLOR CODE	TERMINAL
Photocell	Red	2
Channel "A"	Blue	1
Photocell	White	4
Channel "B"	Green	3
Lamp	Black	5
Lamp	Black	6

2-23. INITIAL CHECKOUT.

2-24. When the installation procedures described above have been complated, the initial checkout may be undertaken. Thread a reel of tape on the tape transport as detailed in the Operation section of this technical manual.

2-25. Apply power to the equipment. Ensure that the vacuum unit motor operates properly, forming a tape loop in the two pockets of the vacuum chamber. Ensure that the capstans are rotating and driving the capstan rollers through the quad rings. Ensure that the tension arms assume a position approximating a proper servo null point, that is, in the midpoint of their respective arcs.

2-26. Grasp the upper reel and rotate it slowly in a clockwise direction. The reel motor should oppose the action after the reel has rotated slightly. Check the upper reel in the counterclockwise direction.

Repeat the procedure in the clockwise and counterclockwise directions for the lower reel.

2-27. Open the thread lever handle. As the handle moves, the vacuum unit motor should stop, the capstan drive motor (and thus the capstans) should stop, the reel motors should be rendered inoperative, and the reel brakes applied. When the thread lever handle has been moved to the open position, a latch engages to hold it open. At this point, the reel brakes should release to permit free rotation of the upper and lower reels. Release the thread lever handle by pulling toward the left until the latch operates, then close the thread lever handle. When the thread lever handle is closed, the vacuum unit motor and capstan drive motors should operate and the reel motors again control positioning of the tension arms.

2-28. Disconnect power from the equipment and insert a 0.009-inch feeler gage between the upper capstan and upper capstan roller. Slight resistance to the feeler gage should be encountered. If the capstan roller gap is badly out of adjustment, refer to the Maintenance section of this technical manual for the adjustment procedure, paragraph 5-24. Repeat the process for the lower capstan roller gap.

2-29. Operate the tape transport from the control source. Observe the tape as it emerges from the capstan and capstan rollers to the head guides for any signs of rippling or curling of the edges of the tape. Similarly, examine the tape as it passes between the capstans and the vacuum chambers. If rippling or curling of the tape occurs, repeat the procedures in paragraph 2-28. If the capstan roller gap adjustment does not correct rippling or curling of the tape, refer to the Maintenance Section of this manual, paragraph 5-44.

SECTION III
OPERATION

3-1. GENERAL.

3-2. The information contained in this section describes in detail the steps necessary to put the tape transport into operation.

3-3. TAPE THREADING PROCEDURE. (See Figure 3-1.)

CAUTION

The following procedure must be accomplished with electrical power off.

Step 1: Clean head and head tape guide rollers before threading operation. Use Ampex Part No. 087-007 head cleaner and a cotton swab to clean the head and the guides.

Step 2: Pull open the thread lever handle. As the thread lever handle opens, the tape tension arms move to the tape threading position.

CAUTION

Do not handle the reels in a manner that will compress the reel flanges against the tape.

Step 3: Install supply (upper) reel by holding the reel firmly against the turntable spacer disc. Turn the knob assembly clockwise to ensure a firm contact with the reel to prevent reel slippage during operation.

Step 4: Unwind approximately 6 to 8 feet of tape from supply reel.

The supply reel of tape (upper reel) should have approximately 15 feet of metallized leader spliced to each end.

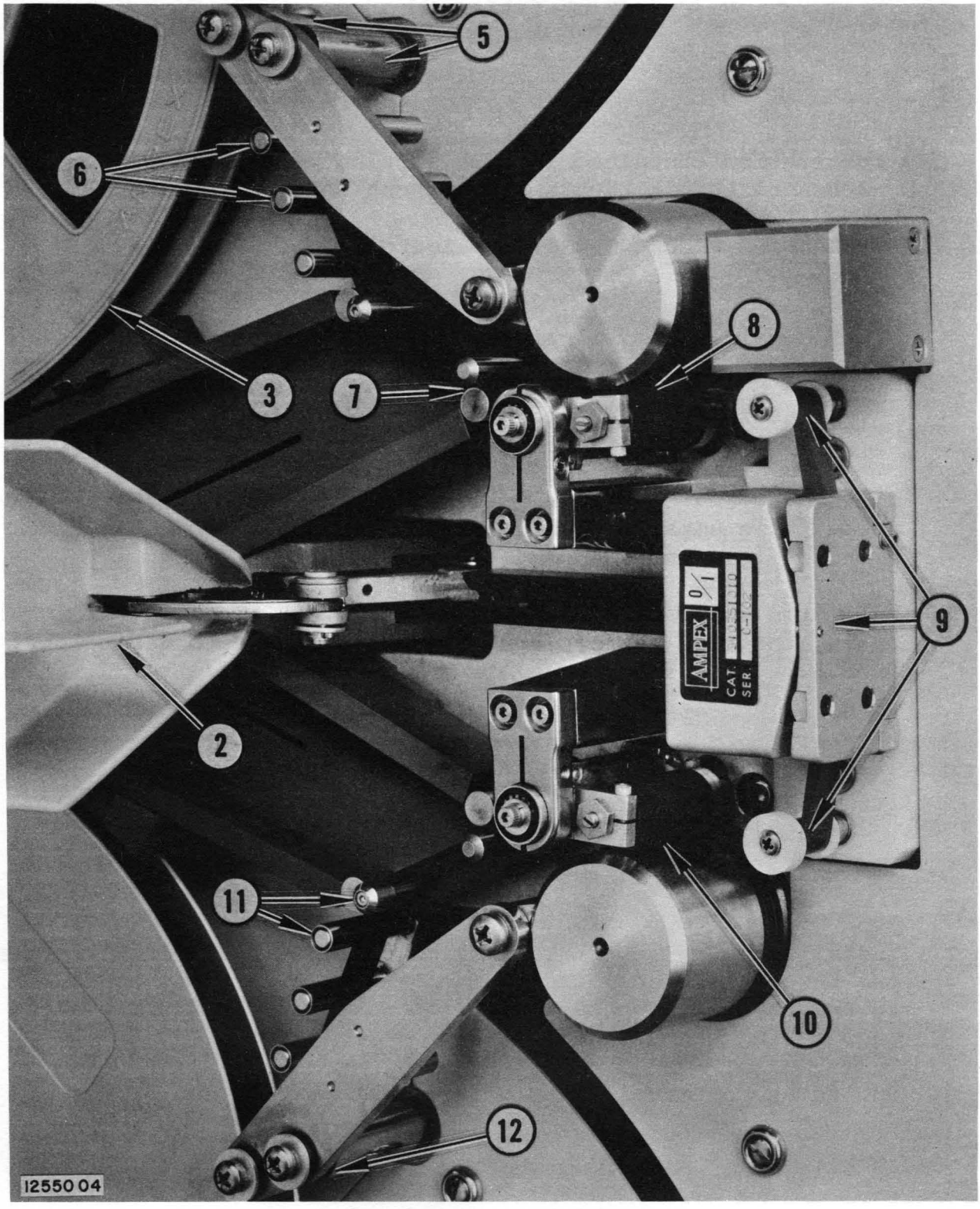


Figure 3-1. Threading the Tape Transport

Step 5: Starting with the point where the tape emerges from the supply reel, place the tape under the sense post guide assembly.

Step 6: Place the tape across the tension arm rollers.

Step 7: Thread tape between pin guides and glass cover door on the upper half of the vacuum chamber. Push the tape back against the chamber base.

Step 8: Insert tape between upper capstan and capstan roller.

Step 9: Lift and hold open the head assembly gate. Place the tape over the head assembly tape guide and across the head. Close the head assembly gate.

Step 10: Place the tape under the lower head assembly tape guide and insert between the lower capstan and capstan roller.

Step 11: Repeat Steps 6 & 7 for the lower half of the vacuum chamber.

Step 12: Place tape over the sense post guide assembly and attach to takeup (lower) reel by holding the tape on the hub of the reel and rotating the reel in the clockwise direction about 8 revolutions.

CAUTION

With the following step, the tension arms will automatically move to the null position.

Step 13: Return thread lever handle to the operating (closed) position by applying a light force to the left to release the latch.

3-4. The transport is now ready to receive signals from a manual or automatic command.source.

NOTE

In this manual, read/write channel 1 is that channel on the tape that is nearest the operator.

SECTION IV
THEORY OF OPERATION

4-1. TAPE TRANSPORT ASSEMBLY.

4-2. The tape transport consists of a tape supply system, a tape drive system, a tape takeup system, and a servo control system. The operation of each of these systems is controlled by circuits in the transport electronics assembly. In the following discussions, the upper reel will be referred to as the tape supply reel, and the lower reel as the tape takeup reel. Components that are not shown in the referenced figures may be found in Figures 6-1 through 6-3, and the applicable IBP drawing.

4-3. TAPE SUPPLY SYSTEM. (See Figure 4-1.) The tape supply system consists of a supply reel motor assembly, a tension arm assembly, a vacuum chamber, and a servo control assembly.

4-4. The reel brake assembly has a loading spring which applies the reel brakes whenever the solenoid is not energized. When the solenoid is energized, the brake shoe is pulled away from the turntable, allowing the reel to turn freely. The solenoid (L1) is energized when the tape transport is in an operating mode, or when the thread lever handle is opened, actuating brake release switch S20. (See Figure 4-2.) This action permits rotation of the supply and takeup reels for tape threading. The reel brakes are automatically applied by the loading spring whenever there is a power failure or tape breakage occurs.

4-5. All other components of the tape supply system operating in conjunction with the tension arm assembly. The arm is free to move between limits. A tape tensioning spring, connected to the arm, tends to pull the arm outward to maintain the tape loop. A control contactor is attached to the tension arm shaft and moves with the tension arm. Motion of the tension arm away from a "null" position midway between its two limits, combined with the action of a centering spring and contactor damping dashpot, causes contacts of the control contactor to drive the reel motor which will return the tension arm to the "null" position.

4-6. Should the tension arm move to its outer limit, a microswitch (tension arm limit switch S2) opens to disable the tape drive system, disconnect power to the reel motors, apply the reel brakes, and signal the command source of a failure. When the condition has been corrected, the reel motor will rotate to take up slack tape, and the equipment will resume operation. However, the logical sequence of the programming will have been interrupted.

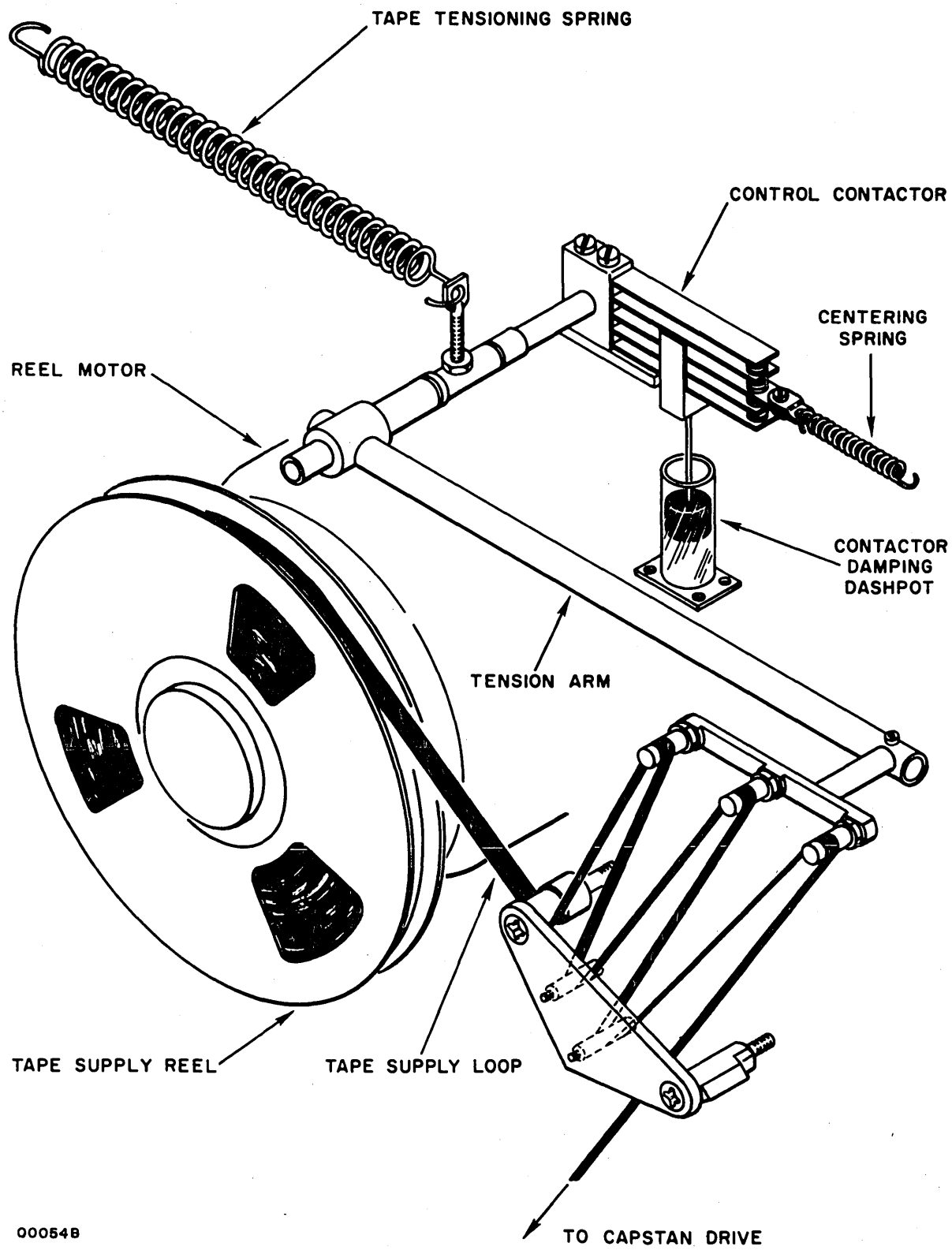


Figure 4-1. Tape Supply System

4-7. The vacuum unit motor creates tape loops in the vacuum chamber. The tape stored in this chamber is used during start and stop transients, and aids in damping out tension arm oscillation and variations in tape tension.

4-8. TAPE DRIVE SYSTEM. The tape drive system consists of capstans, capstan rollers, actuators, and a capstan drive motor. The purpose of the tape drive system is to move tape from the supply reel across the magnetic heads to the takeup reel.

4-9. The two counter-rotating capstans are coupled through a belt and pulley arrangement to the hysteresis synchronous capstan drive motor. This dual speed motor (1800/3600 RPM) provides the source for low and high tape speeds. The motor and capstans operate continuously whenever power is applied to the drive motor. Each capstan continuously drives its associated capstan roller through a rubber quad-ring; thus the capstan rollers are also continuously rotating whenever power is applied. Shifting transport operation from low to high speed is accomplished by switching the input power to the low or high speed windings of the capstan drive motor.

4-10. While the speed of tape travel is determined solely by the RPM of the capstans, actual movement of tape is controlled by the actuator assemblies which position the capstan roller. Two actuator assemblies are provided, one for each capstan roller. These actuator assemblies,

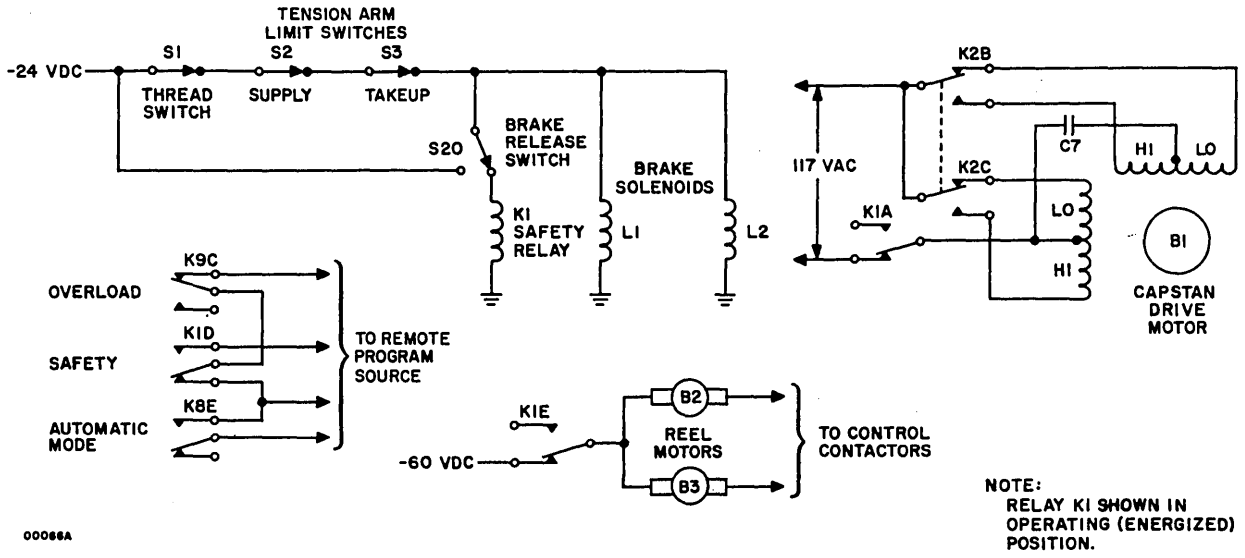


Figure 4-2. Tension Arm Limit Switch and Motor Details

mounted on the back of the tape transport plate, have an actuator shaft extending through the plate to the front of the transport. On each shaft is a yoke assembly to which the capstan roller is attached. Operation of the actuators is controlled by a thyratron circuit in the transport electronics assembly.

4-11. TAPE TAKEUP SYSTEM. The tape takeup system is a mirror image of the tape supply system discussed above.

4-12. SERVO CONTROL SYSTEM. (See Figure 4-3.) With both actuators in the OFF position, neither capstan roller is engaged, the tape is not in motion, and the tape tension arms are positioned between the inner and outer limits of travel. The position of the tension arms is established as follows: with the reel brakes off, both reels are free to turn. The tape tensioning springs pull the tension arms outward until the tape is begining to feed from the reels. This action continues until the tension arms reach the position where the center contacts of the control contactor "make" with the set of inner contacts, applying limited power to the reel motors. (See Figure 4-4.) The supply reel motor has power applied to the counterclockwise winding; the takeup reel motor has power applied to the clockwise winding (servo operation of each reel motor is independent of the other; both are covered at one time because of similarity of operation). The limited power applied to the reel motors causes them to rotate (in opposing directions, rewinding tape on each reel) until the effect of the torque applied to the reel equals the pull exerted by the tape tensioning springs

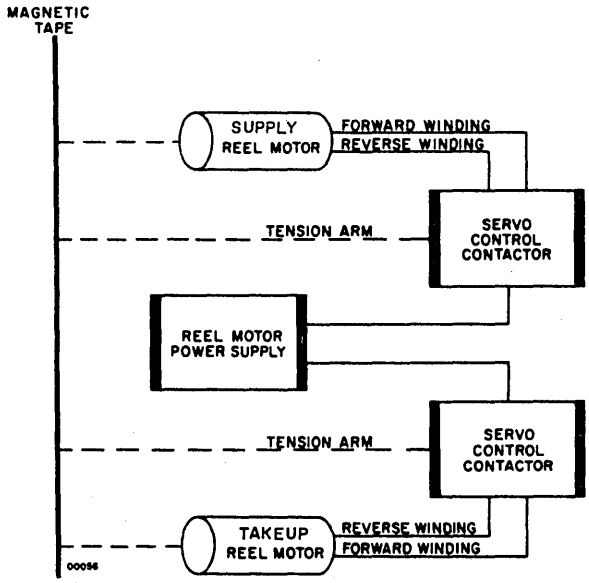


Figure 4-3.
Servo Control System

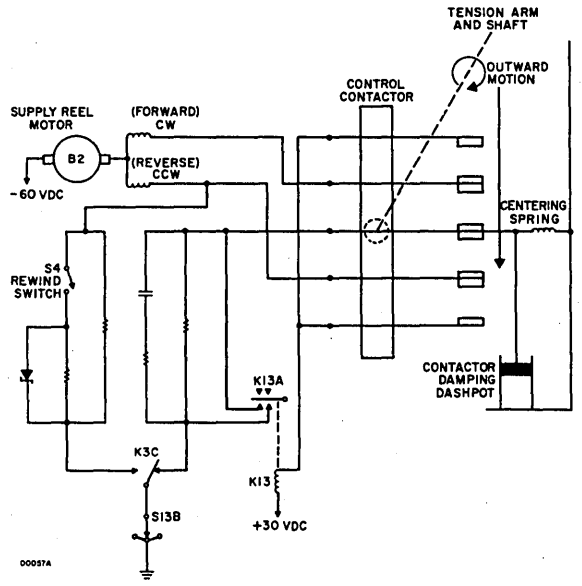


Figure 4-4.
Supply Reel Servo Control System

through the tension arms. At this point, all forces are balanced and the tension arms are in a "null" position.

4-13. When the forward actuator is shifted to the ON position, the associated capstan roller clamps the tape against the forward drive capstan. The tape starts to move, causing the tension arm associated with the supply reel to pull inward, disconnecting the center contact of the control contactor from the reel motor counterclockwise winding contact and connecting it to the clockwise winding contact. (See Figure 4-4.) This action applies limited power to the reel motor, rotating the supply reel to the clockwise direction, supplying tape to the tape drive assembly. Since the tape drive assembly requires tape at a constant rate and the reel motor has not yet reached the proper speed, the tension arm is pulled inward until the reel motor clockwise winding contact "makes" with the outer contact of the control contactor. The outer contact energizes relay (K13); contacts (K13A) close to apply full power to the reel motor, accelerating the movement of tape to the tape drive assembly. During normal operation, the transport responds rapidly and the reel motors will almost immediately be connected to full power.

4-14. As the reel motor approaches full speed, tape is supplied to the tension arm at a slightly faster rate than the tape drive assembly is pulling it off. As the slack increases the tension arm moves toward its "null" position. When the arm is near the null position the outer contacts of the control contactor are disconnected, de-energizing relay (K13), opening the contacts (K13A) to limit power applied to the reel motor and reduce the speed. As the reel motor reduces speed, the tension arm again moves inward until the outer contact of the control contactor "makes" with the reel motor clockwise winding contact, causing full power to be applied to the reel motor.

4-15. If the reel motor should supply more tape than is necessary to return the tension arm to the null position, the contacts of the control contactor open, disconnecting power to the reel motor. If the tension arm passes the null position, the center contact of the control contactor makes with the reel motor counterclockwise winding contact, applying limited power to the reel motor. This power retards rotation of the reel motor in a clockwise direction. If power is applied long enough, the reel motor will stop, and start rotating in the opposite direction.

4-16. Action of the contactor damping dashpot and the centering spring help the tension arm to find the null position which is offset from the midway point between the inner and outer limits. During drive-forward operation, the null position will be offset toward the inner limit. This provides storage for tape supplied by the reel motor after

tape motion has stopped and while the reel motor is slowing down. During reverse drive operation, the null position will be offset toward the outer limit. This allows the reel motor to take up additional tape after tape motion has stopped and while the reel motor is slowing down. The tension arm associated with the takeup reel seeks a null position in the opposite direction from the supply tension arm.

4-17. When the forward actuator is shifted to the OFF position, the associated capstan roller releases the tape from the capstan. Tape motion begins to stop, causing the tension arms to move outward. This action connects the center contact of the control contactor to the supply reel motor counterclockwise winding contact. The takeup reel motor control contactor center contact connects to the takeup reel motor clockwise winding contact. This applies limited power to the reel motor, stopping the reel motors and placing the tape transport in the condition described in paragraph 4-12.

4-18. The operation of the tape takeup system is similar, except that the direction of tape motion tends to permit the tension arm to move toward its outer limit. This causes the reel motor to operate in the clockwise direction to take up tape, returning the tension arm to the null position.

4-19. When the reverse actuator is shifted to the ON position, the associated capstan roller clamps the tape against the reverse drive capstan. The reel motor control system operates in the same manner as in forward drive, except that tape is now being supplied by the takeup reel and rewound on the supply reel. When the reverse actuator is shifted to the OFF position, the tape is stopped as described in paragraph 4-12.

4-20. To prevent the servo control system from going into oscillation (resulting from full power being applied to the reel motors for minor control contactor errors) a damping dashpot is attached by mechanical linkage to the control contactor. The effect of the dashpot is to damp out rapid oscillations of the control contactor.

4-21. When the tape transport is operated in the fast forward mode, limited power is applied directly to the clockwise windings of the takeup reel motor, instead of through the control contactor. The servo control system of the supply reel motor operates in the normal manner. As the takeup reel motor increases in speed, the tension arm moves inward to its inner limit of travel, closing forward rewind switch (S5). When forward rewind switch (S5) is closed, more power is applied to the takeup reel motor, increasing the speed.

The tension arm will remain at the extreme inner position as long as the tape transport is in fast forward mode. By applying the power directly to the clockwise winding of the reel motor, the tape is transported rapidly in the forward direction. The supply reel servo control system supplies the proper holdback tension to the tape to prevent tape spillage.

4-22. The tape transport must be stopped before switching to another mode of operation to prevent damage to the tape that could occur due to the inertia of the takeup reel motor. After the tape transport is stopped, it can then be operated in any mode.

4-23. When the tape transport is operated in the fast reverse mode, limited power is applied directly to the counterclockwise winding of the supply reel motor, instead of through the control contactor. The servo system of the takeup reel motor operates in the normal manner. As the supply reel motor increases in speed, the tension arm moves inward to its inner limit and closes rewind switch (S4). When rewind switch (S4) is closed, more power is applied to the supply reel motor increasing the speed further. The tension arm will remain at the extreme inner position as long as the tape transport is in fast reverse mode. By applying the power directly to the counterclockwise winding of the reel motor, the tape is transported rapidly in the reverse direction. The takeup servo system supplies the correct holdback tension to the tape to prevent tape spillage.

4-24. The tape transport must be stopped before switching to another mode of operation to prevent damage to the tape that could occur due to the inertia of the supply reel motor. After the tape transport is stopped, it can then be operated in any mode.

4-25. TRANSPORT ELECTRONICS ASSEMBLY.

4-26. The transport electronics assembly consists of the actuator control unit, power supplies, and protective circuits.

4-27. ACTUATOR CONTROL UNIT. The actuator control unit (Figure 4-5) contains four thyratrons (V12 through V15), two pulse transformers (T8 and T9), resistors, and capacitors mounted on an etched board. The thyratrons are used as controllers for the movement of the capstan roller actuator. Each actuator has one end of its pair of coils attached to a common point, with the outer ends of these coils connected to the anode of the associated thyratron. In the following discussion, operation of the forward actuator and associated thyratron

V12 and V13 will be discussed. Operation of reverse actuator is identical for control of reverse tape motion.

4-28. Input power of approximately 500 vdc is supplied to the coils of (K11) from capacitor (C4) in the power supply section of the transport electronics assembly. With C4 changed to this potential, this voltage is applied through the actuator coils to the anodes of V12 and V13. These thyratrons cannot conduct at this time due to the negative DC bias at the grids. This negative bias is developed by applying 26 vac through etched board terminal 8 to silicon rectifier CR9, half wave rectifying at CR9, and filtering the output voltage with R42, electrolytic capacitor C29, and zener diode CR28. Capacitor C16 is used to bypass any high-frequency transients. Zener diode CR28 regulates the negative bias voltage to -8 vdc. This negative DC bias is applied to the grids through the center-tapped secondary winding of T8 and isolating-decoupling resistors R34, R29, R35, and R30.

4-29. To shift the forward actuator from OFF to ON, a positive-going voltage level change of sufficient amplitude to drive the grid of V12 more positive than -2 volts must be provided from the remote command source. As the grid voltage of V12 drops below the voltage required to hold the thyratron cutoff, V12 conducts and discharges capacitor C4 through the ON winding of the actuator. The current (approximately three amperes peak) through conducting V12 is sufficient to saturate the reed in the actuator, causing it to shift from

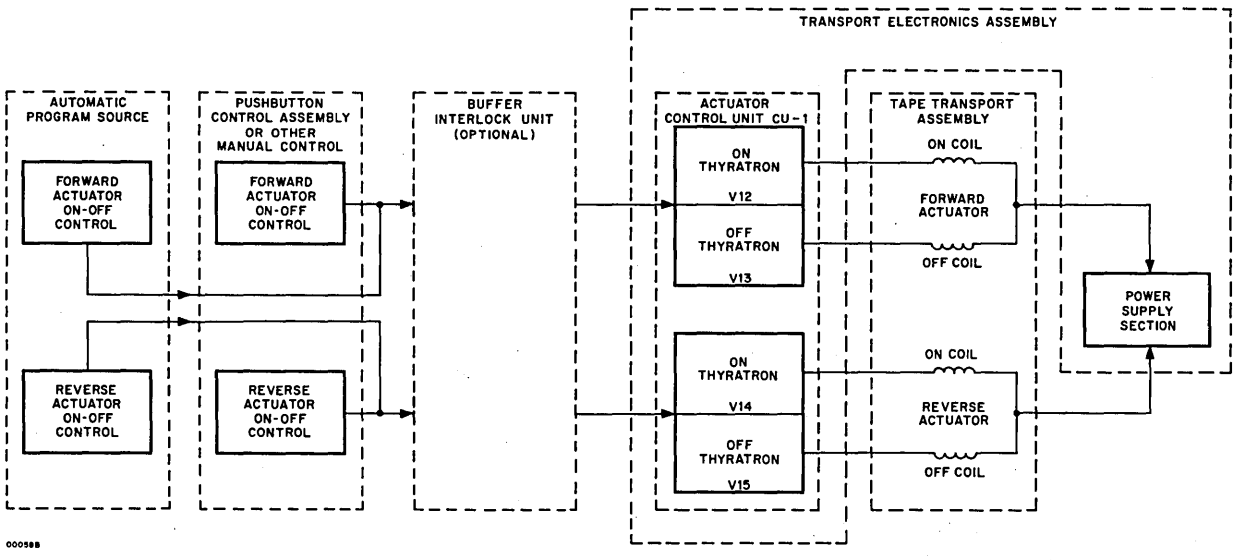


Figure 4-5. Block Diagram of Actuator Control System

the OFF to ON position. The actuator shifts because the force due to the permanent magnets is overcome by the force due to the current in the windings.

4-30. One characteristic of a thyratron is that once conduction has started, it will continue until the thyratron anode voltage shifts negative with respect to the cathode, regardless of the grid signal applied during the conduction period. Cutoff of V12 is accomplished by utilizing the inductive back E.M.F., a collapsing magnetic field within the actuator coil, that follows discharge of capacitor C4.

4-31. Figure 4-6 shows the voltage waveform that can be expected at the anode of V12 under the following conditions. At time T_o, V12 is fired ON by a positive pulse; the anode voltage drops abruptly from 500 volts to approximately 10 volts and remains at this level during the time that (C4) is discharging. This 10-volt level represents the constant drop across V12 during conduction. At approximately 1.2 milliseconds after T_o, C4 has completely discharged through the actuator coil, and the collapsing magnetic field within the coil causes the anode voltage to shift negative, cutting off V12. At approximately 1.4 milliseconds after T_o, the anode voltage returns to the original 500 volt level, indicating that C4 has been charged. At time T_o, the anode voltage of V13 rises in a positive direction to a peak of about 700 volts. This positive spike is created by the transformer coupling between the two coils of the forward actuator. The current through the ON coil of the actuator induces enough voltage in the OFF coil to create this positive going pulse. This pulse is of short duraction, and the anode voltage at V13 follows the voltage established by the discharge of C4 through V12.

4-32. Figure 4-7 indicates the voltage waveform at C4 during the discussion in paragraph 4-31. The slope of the waveform is established by the time constant of the series circuit consisting of C4, the actuator coil, and the effective resistance of the conducting thyratron.

4-33. Figure 4-8 shows the current waveform during the discharge and charge cycle of C4. These waveforms are obtained by measuring across a temporarily installed 0.1-ohm resistor in the ground circuit of capacitor C4. With zero current at T_o, the current increases to a maximum of approximately 3 amperes at 0.4 milliseconds, then decreases exponentially back to zero current at approximately 1.0 milliseconds, indicating complete discharge of C4. The slight discontinuity in the curve between 200 and 250 microseconds is caused by the saturation point of the reed and the point at which the reed begins to move from one position to another. At 1.2 milliseconds the capacitor starts to charge through V1 (peak charging current is approximately 8.5 amperes).

The slow rise time of the discharge waveform is caused by the inductance of the forward actuator coil.

4-34. During actuator operation it is mandatory to avoid an external, shunt-loading effect across the actuator coil, because the resultant lowering of the "Q" of the circuit reduces the inductive back E.M.F. until the associated thyratron is not cut off. The purpose of thyratron V1 is to function as a time-delay electronic switch, isolating the power supply section from C4 until after the actuator cycle has been completed, and then connecting the power supply section to C4 to charge the capacitor.

4-35. When power is first applied to the transport electronics assembly, 400 vac power from the secondary of T1 is applied to the bridge rectifier. This bridge rectifier is made up of silicon rectifiers CR1 through CR8. The output from this bridge rectifier is connected to capacitors C8 and C9 through the coil of overload relay K9 and shunt resistor R1 and a pair of series connected contacts of K9. Voltage at the capacitors of the filter network is approximately 500 vdc. This 500-volt supply charges C4 and C5 through resistor R5 and current limiting resistors R7 and R8. The time constant of this initial charging circuit is relatively long, but C4 and C5 are fully charged before the filament of V1 has heated sufficiently to allow electron emission. As V1 warms up it will not conduct, as the anode and cathode are at the same positive potential and the grid is at ground potential (through grid resistor R4) making the grid more negative than the cathode.

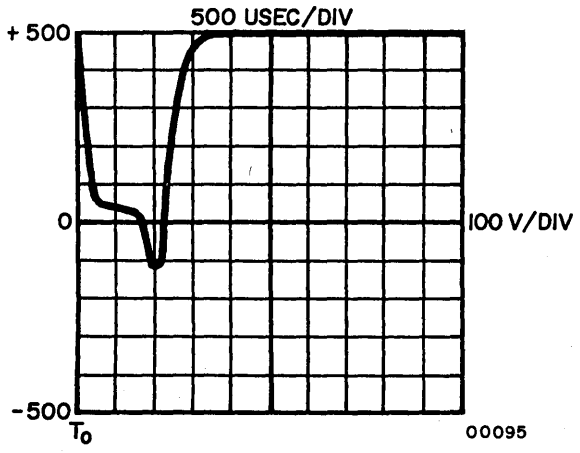


Figure 4-6.
Voltage Waveform, Anode of V12

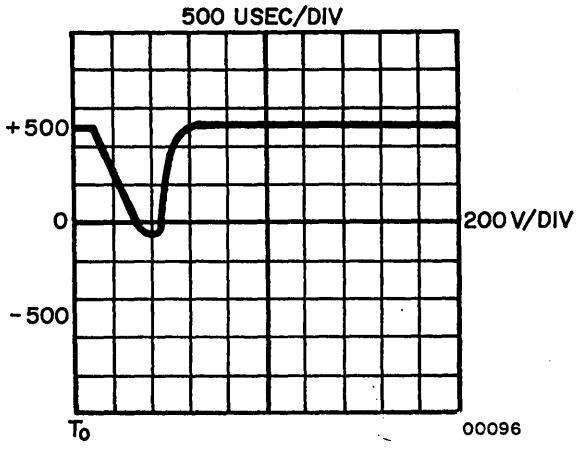


Figure 4-7.
Voltage Waveform Capacitor C4

4-36. Figure 4-9 illustrates the cathode and grid voltage waveforms of V1 during one cycle of operation. At T_o, V12 is fired to shift the forward actuator ON. The cathode voltage of V1 follows the exponential discharge curve of V4. Capacitive coupling between the cathode and the grid of V1 is furnished by capacitor C3. As the cathode potential is driven in a negative direction, the grid is also driven negative because of the capacitive coupling. However, as soon as the rate-of-change of cathode potential decreases, the negative potential on the grids start to leak off through R4 and the grid voltage tends to return to zero (ground). At approximately 1.3 milliseconds after T_o, the grid bias is so low it can no longer hold V1 cut off and V1 fires. When V1 conducts, it acts as a short circuit, allowing C8 and C9 to charge C4 through choke L4, and through limiting resistor R8. Because the grid assumes a potential somewhere between the potential of the cathode and the anode during conduction, the grid voltage is raised along with that of the cathode. Approximately 0.2 milliseconds is required for the charging of C4. It is necessary to cut off V1 before the next actuator cycle can begin. This is accomplished by using the collapsing field in L4 to provide an inductive back E.M.F. when C4 is fully charged, with the result that the cathode is momentarily driven more positive than the anode, which cuts off V1 and allows the grid to regain control. Since the grid was at essentially cathode potential at the time of cut off, this positive grid potential must leak off to ground through R4. Reference to Figure 4-9 shows that the grid is at nearly ground potential after a total elapsed time of 4.0 milliseconds from T_o.

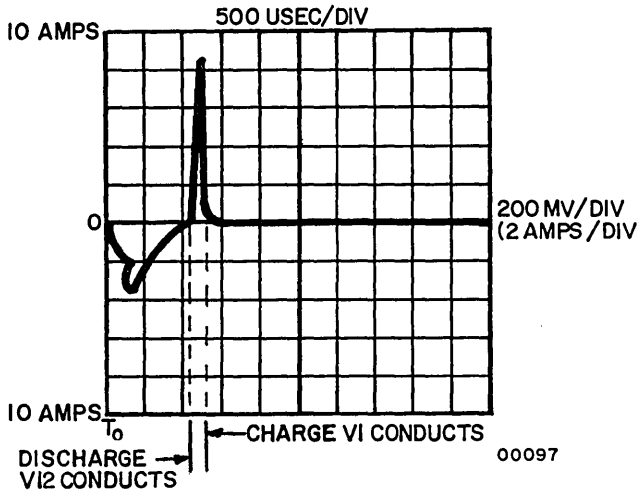


Figure 4-8. Current Waveform, Discharge and Charge of C4

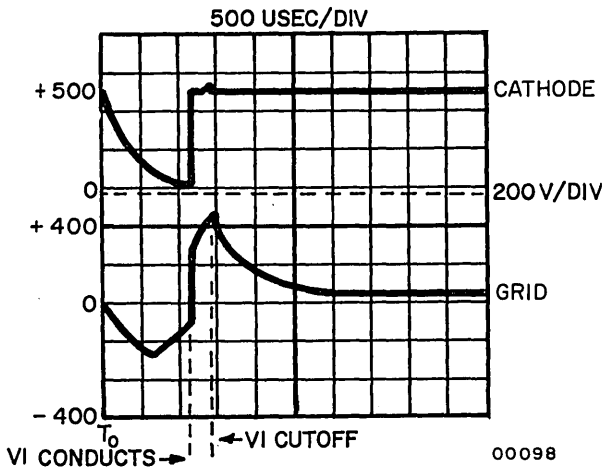


Figure 4-9. Voltage Waveforms, Cathode and Grid of V1

4-37. The reverse actuator is controlled in the same manner as the forward actuator, except that capacitor C5 supplies the actuating power instead of C4.

4-38. POWER SUPPLY SECTION. The power supply furnishes the necessary DC and AC voltages required for operation of the reel motors, the actuator control, and the buffer delay and interlock unit.

4-39. Primary power of 117 vac is applied to power transformer T1 when the tape transport is first turned on. Transformer T1 furnishes 6.3 vac for the thyratron filaments on the actuator control unit; 24 vac which is rectified by silicon rectifiers CR11 and CR12 to produce -24 vdc for use in the control circuits; -60 vac used to power the reel motors; and 2.5 vac for the filament of the high-voltage control thyratron V1.

4-40. Transformer T1 also furnishes 400 vac which is rectified by silicon rectifiers CR1 through CR8 to produce +500 vdc for use in the actuator control unit. The DC output of the bridge rectifier is connected to capacitors C8 and C9 through the coil and contacts of overload relay K9. This relay is set to operate on an overload of approximately 500 ma and breaks the overload through its own contacts, causing the relay to drop out and recycle rapidly.

4-41. ACTUATOR CONTROL. (See Figures 6-2 and 6-3.)

4-42. The forward and reverse actuators can be controlled automatically or manually. Actuator operation, when using the optional push-button control assembly is discussed in paragraph 4-45.

4-43. AUTOMATIC CONTROL. The DC signal from the remote program source is applied through current limiting resistor R45, and differentiating network C30 and R43 to the primary of pulse transformer T8. Resistor R43 raises the DC input impedance to prevent loading of the remote program source. The combination of the differentiating network and the pulse transformer shapes the input signal at terminal 1 of T8 to a narrow pulse. This pulse signal is stepped up in the primary of T8 at a ratio of 1:2 and applied to the grids of V12 and V13. An ON signal causes a positive pulse to be applied to the grid of V12, causing V12 to conduct and shift the actuator to the ON position. At the same time, a negative pulse is applied to the grid of V13, adding to the already-present, fixed DC bias and driving the grid more negative. If the input command is for OFF the signal will shift from +10 volts to 0 volts; a positive pulse is applied to the grid of V13 causing it to conduct, and a negative pulse is applied to the grid of V12 driving it more negative.

4-44. MANUAL CONTROL. When an Ampex pushbutton control assembly is used together with an Ampex buffer-interlock unit, the command signals from the pushbutton control assembly bypass the buffer-interlock unit and are routed directly to the actuator control unit. Application of +14 vdc (from the pushbutton control assembly or customer-supplied manual control unit) to the manual drive input terminals of J3 on the transport electronics chassis will cause actuator operation to occur.

4-45. (Switch S13 on the pushbutton control assembly must be set to one of the MANUAL positions when manual control is used.) Four, external, manual control connections are provided at pins U, Q, P, and L of receptacle J3 on the transport electronics assembly (pins n, g, f, and c, of receptacle J2 on the same assembly and terminals 4, 5, 6, and 7, respectively, of actuator control unit (CU-1). Application of approximately +14 vdc to these points will cause the indicated actuator operation to occur. For example, suppose it is desired to shift the forward actuator to ON. Applying +14 vdc to pin U of receptacle J3 (or to pin n of receptacle J2) by means of an external relay or switch will cause a positive pulse to appear at the grid of V12, allowing V12 to conduct and shift the forward actuator to ON. The pulse is produced by the charging of 0.002 mfd capacitor C17 through resistor R34 in the grid circuit of V12. When the +14 vdc is subsequently removed from pin U of receptacle J3, C17 discharges through shunt resistor R33 and is ready for the next similar command. As the +14 vdc is removed from pin U of receptacle J3 it is applied to pin Q of receptacle J3 which causes a positive pulse to appear at the grid of V13, allowing V13 to conduct and shift the forward actuator to OFF. Shunt capacitor C14A bypasses any stray high frequency impulses that may be picked up in the external wiring.

4-46. The manual control system of the remote program source must be interlocked by means of switches and/or relays to prevent application of opposed or contrary commands. For example, it should not be possible to apply "forward on" and "reverse on" commands simultaneously, or in sequence, without going through an "off" command. The limitation on spacing of commands is the same as during automatic operation, 2.5 milliseconds minimum spacing between any adjacent commands. It is also recommended that the AUTOMATIC and MANUAL inputs be interlocked so that it is impossible to apply simultaneous MANUAL and AUTOMATIC signals. Such interlocks are included in the pushbutton control assembly and prevent automatic commands from reaching the grids of the actuator thyratrons when manual control (at the pushbutton control assembly) is being used.

4-47. BUFFER AND INTERLOCK UNIT. (See Figure 6-9.) The buffer and interlock unit is used between the command source and the actuator

control unit. It stabilizes the voltage level and rise/fall time of command signals to the actuator control unit. It also provides an interlock function which prevents one actuator from being driven to the ON position when the other actuator is already in the ON position. Countermanding signals are locked-out by preventing any signal from entering one channel when at that moment a positive going signal enters the other channel. One channel is for forward commands (input terminal B) and one channel is for reverse commands (input terminal N). Each channel contains an amplifier, and a flip-flop interlock circuit.

4-48. Forward input commands enter the forward channel at terminal B and lock out any reverse commands appearing at the reverse channel input terminal N during the forward cycle by placing a positive potential on the base of Q9. When the forward channel ceases to conduct, the potential on the base of Q9 is reduced to ground level which unlocks the reverse input and allows the reverse channel to accept commands and in turn locks out forward commands through Q8.

4-49. The FORWARD START command signal raises the base of Q1 above ground level and allows it to conduct. This puts Q2 in a non-conductive state. When Q2 becomes non-conductive, CR1 ceases to conduct and the potential at the base of Q4 rises, CR2 starts to conduct and the potential at the base of Q7 is lowered. As Q4 conducts and Q7 becomes non-conductive, the base potential of Q5 is lowered and Q5 goes into a non-conducting state. As Q5 goes into a non-conducting state, Q6 goes into a conductive state, driving Q3 off and setting terminal A (output to the forward actuator control unit) at +16 volts. When Q3 is conducting, terminal A is grounded.

4-50. The FORWARD STOP signal lowers the base of Q1, placing it in a non-conductive state; at the same time Q2 returns to a conductive state. When Q1 returns to a non-conductive state, CR2 also becomes non-conductive, which starts CR1 to conduct. When CR2 ceases to conduct, the potential at the base of Q7 rises and drives Q6 off. When CR1 returns to a conductive state Q4 becomes non-conductive. As Q6 is driven off, Q5 is driven on, and Q5 drives Q3 on which clamps terminal A to ground.

4-51. The REVERSE START-STOP command operation is similar to the FORWARD START-STOP commands as described in paragraphs 4-48 through 4-50.

4-52. The buffer and interlock unit power requirements are +20 vdc at 50 ma and -5 vdc at 3 ma as furnished by the buffer power supply (TB-12), mounted on the transport electronics assembly. Forward and reverse START commands require an input of +20 +4/-6 vdc; input

voltage is returned to zero for STOP commands. The output level for a forward or reverse START command changes from zero to 16 +4/2 vdc.

4-53. Forward and reverse output (both channels) will fire the actuator control unit OFF when the input line is disconnected in the forward and reverse ON position.

4-54. BUFFER DELAY AND INTERLOCK UNIT. (See Figure 6-8.) The buffer delay and interlock unit is used between the command source and the actuator control unit. Like the buffer and interlock unit, it stabilizes the voltage level and rise/fall time of command signals to the actuator voltage unit and provides an interlock to prevent both actuators from being ON at the same time. In addition, the buffer delay and interlock unit provides an adjustable time delay before any START or STOP commands. The circuits are identical to those detailed for the buffer and interlock unit, except as described below.

4-55. When a forward ON command is received, Q1 conducts, Q2 is turned off, CR1 turns off, and the potential at the base of Q4 rises in accordance with the RC time constant of R18, R19, and C2. Since R19 is a variable resistance, the RC time constant and hence the ON time delay is also variable.

4-56. When a forward OFF command is received, Q1 and CR2 are turned off, and Q2 conducts. When CR2 ceases to conduct, the potential at the base of Q7 rises in accordance with the RC time constant of R20, R21, C3. Since R21 is a variable resistance, the RC time constant and hence the OFF time delay is also variable.

4-57. The buffer delay and interlock unit requires different input voltages, as follows: forward and reverse ON, +5 +2½/-1½ VDC; forward and reverse OFF, -5 +1½/-2½ VDC. The range of the adjustable delay for ON and OFF commands is 0.5 to 4.5 milliseconds. Normally, the ON command is set at 4 ms and the OFF command at 0.5 ms delay time.

4-58. PUSHBUTTON CONTROL ASSEMBLY. (See Figures 6-1 and 6-4.)

4-59. The pushbutton control assembly offers facilities for power control, selection of command source (manual or automatic), and selection of tape motion under manual control. The control functions are so arranged that it is impossible to present simultaneous "on" signals to both actuators (when under manual control).

4-60. POWER CONTROL. Application of input power to the tape transport is controlled by POWER switch S6 on the pushbutton control assembly.

When S6 is closed, input power is applied to power transformer T1 in the power supply section of the transport electronics assembly and to one side of the vacuum-unit motor-winding. Input power is also applied through speed control relay K2 to one side of the low speed windings of the capstan drive motor. When tape-threading switch S1 and tension-arm-limit switches S2 and S3 are closed, -24 vdc from the power supply section will energize safety relay K1. Input power will then be applied through the safety relay to the other side of the low speed windings of the capstan drive motor and the capstans will start to rotate. Input power is also applied through K1 to the other side of the vacuum-unit motor-winding to operate the motor. The power supply section supplies 6.3 vac to LOW SPEED indicator DS1 through speed control relay K2.

4-61. Reel motors receive power through relay K1 from the -60 vdc supply when K1 is energized, or from the -24 vdc supply when K1 is de-energized. The motors are grounded through contactors S16 and S17 and rewind relays K3 and K6.

4-62. The power supply section also furnishes +500 vdc to the actuator control circuit and the pushbutton control assembly.

4-63. AUTOMATIC CONTROL. When AUTOMATIC-MANUAL READ-MANUAL WRITE switch S13 is set to the AUTOMATIC position, "automatic" relay K8 is energized by -24 vdc from the power supply section. Contact K8A of the energized automatic relay disconnects the -24 vdc from the pushbutton control assembly switches that are used to manually control the tape motion. Contact K8B disconnects the ground from one side of the primary of pulse transformer T9, thus allowing external control signals to be applied to this side of the transformer. Contact K8C disconnects the voltage used for manual control of the actuators. Contact K8D disconnects the ground from one side of the primary of pulse transformer T8, thus allowing external control signals to be applied to this side of the transformer. Contact K8E connects pins X and C of receptacle J3 and may be used for any additional customer requirements.

4-64. MANUAL CONTROL. When AUTOMATIC-MANUAL READ-MANUAL WRITE switch S13 is set to either the MANUAL READ or MANUAL WRITE position, automatic relay K8 is de-energized. Contact K8A of the de-energized automatic relay connects -24 vdc to the pushbutton control assembly switches that are used to manually control tape motion. The -24 vdc from contact K8A is first routed to "normally-closed" STOP pushbutton switch S11. The -24 vdc from the other side of S11 is routed through contact K5B of the drive reverse relay to DRIVE FORWARD pushbutton switch S10, and also through contact K4B of the drive forward relay

to DRIVE REVERSE pushbutton switch S12. The -24 vdc from S11 is also routed through contact K3A of the fast reverse relay to FAST FORWARD pushbutton switch S8, and also through contact K6A of the fast forward relay to FAST REVERSE pushbutton switch S9.

4-65. When the DRIVE FORWARD pushbutton (S10) is momentarily pressed, -24 vdc is applied to drive forward relay K4, energizing the relay. Contact K4B of the energized relay disconnects the -24 vdc from DRIVE REVERSE pushbutton switch S12 (providing an electrical interlock circuit that prevents shifting the reverse actuator to ON when the forward actuator is ON) and connects it to relay K4 to hold the relay in the energized position. Contact K4A applies +14 vdc to pin n of plug P2, energizing the forward actuator to ON as described in paragraph 4-45. When the STOP pushbutton (S11) is momentarily pressed, the -24 vdc is disconnected from drive forward relay K4, de-energizing the relay. Contact K4B of the de-energized relay reconnects the -24 vdc to DRIVE REVERSE pushbutton switch S12. Contact K4A disconnects the +14 vdc from pin n of plug P2 and connects it to pin g, energizing the forward actuator to OFF as described in paragraph 4-45.

4-66. When the DRIVE RELEASE pushbutton (S12) is momentarily pressed, -24 vdc is applied to drive-reverse relay K5 energizing the relay. Contact K5B of the energized relay disconnects the -24 vdc from DRIVE FORWARD pushbutton switch S10 (providing an electrical interlock circuit that prevents shifting the forward actuator to ON when the reverse actuator is ON) and connects it to relay K5 to hold the relay in the energized position. Contact K5A applies +14 vdc to pin f of plug P2, energizing the reverse actuator to ON as described in paragraph 4-45. When the STOP pushbutton (S11) is momentarily pressed, the -24 vdc is disconnected from drive-reverse relay K5, de-energizing the relay. Contact K5B of the de-energized relay reconnects the -24 vdc to DRIVE FORWARD pushbutton switch S10. Contact K5A disconnects the +14 vdc from pin f of plug P2 and connects it to pin c, energizing the reverse actuator to OFF as described in paragraph 4-45.

4-67. When the FAST FORWARD pushbutton (S8) is momentarily pressed, -24 vdc is applied to fast-forward relay K6, energizing the relay. Contact K6A of the energized relay disconnects the -24 vdc from FAST REVERSE pushbutton switch S9 (providing an electrical interlock circuit that prevents operating the supply reel motor in "fast reverse" when the takeup reel motor is operating in "fast forward") and connects it to relay K6 to hold the relay in the energized position. Contact K6B opens the circuit between drive forward relay K4 and ground and between drive-reverse relay K5 and ground so that these relays cannot be energized during fast forward operation. Contact K6C disconnects the ground from control contactor S17 and connects the ground to rewind resistors

R10 and R21, operating the tape transport in "fast forward" as described in paragraph 4-21. When the STOP pushbutton (S11) is momentarily pressed, the -24 vdc is disconnected from fast forward relay K6 de-energizing the relay. Contact K6A of the de-energized relay reconnects the -24 vdc to FAST REVERSE pushbutton switch S9. Contact K6B closes the circuit between drive-forward relay K4 and ground and between drive reverse-relay K5 and ground so that these relays can be energized. Contact K6C disconnects the ground from rewind resistors R10 and R21 and connects the ground to control contactor S17.

4-68. When the FAST REVERSE pushbutton (S9) is momentarily pressed, -24 vdc is applied to fast-reverse relay K3, energizing the relay. Contact K3A of the energized relay disconnects the -24 vdc from FAST FORWARD pushbutton switch S8 (providing an electrical interlock circuit that prevents operating the takeup reel motor in "fast forward" when the supply reel motor is operating in "fast reverse") and connects it to relay K3 to hold the relay in the energized position. Contact K3B opens the circuit between drive-forward relay K4 and ground, and between drive-reverse relay K5 and ground so that these relays cannot be energized during fast-reverse operation. Contact K3C disconnects the ground from control contactor S16 and connects the ground to rewind resistors R9 and R20, operating the tape transport in "fast reverse" as described in paragraph 4-23. When the STOP pushbutton (S11) is momentarily pressed, -24 vdc is disconnected from fast-reverse relay K3, de-energizing the relay. Contact K3A of the de-energized relay reconnects the -24 vdc to FAST FORWARD pushbutton switch S8. Contact K9B closes the circuit between drive-forward relay K4 and ground, and between drive-reverse relay K5 and ground so that these relays can be energized. Contact K3C disconnects the ground from rewind resistors R9 and R20 and connects the ground to control contactor S16.

4-69. PROTECTIVE CIRCUITS.

4-70. The protective circuits are designed to aid in the prevention of injury to personnel and damage to equipment. The protective circuits in the TM-4 Tape Transport include: automatic-manual interlock, tape-threading and tension-arm limit switches, reel-end sensing, a power supply overload circuit, and a write-enable switch.

4-71. AUTOMATIC-MANUAL INTERLOCK. The automatic-manual interlock circuit is described in paragraph 4-63.

4-72. TAPE-THREADING AND TENSION-ARM LIMIT SWITCHES. (See Figure 4-2.) If tape-threading switch S1 or tension-arm limit switches S2 or S3 are opened at any time during the operation of the equipment,

-24 vdc to safety relay K1 will be disconnected, de-energizing the relay. The -24 vdc will also be disconnected from brake solenoids L1 and L2, thus applying the reel brakes.

4-73. When safety relay K1 is de-energized, contact K1A of the de-energized relay disconnects the power to the capstan drive motor; contact K1B of the relay disconnects the -24 vdc supplied to all of the manual tape motion control relays, thus effectively stopping tape motion. Contact K1E disconnects the -60 vdc from the reel motors.

4-74. The safety relay will remain de-energized until such time as the cause for the interruption is corrected (tape-threading switch S1 or tension-arm limit switches S2 or S3 are closed). When the cause for the interruption is corrected, -24 vdc is again applied to safety relay K1, returning the relay to its normal, energized condition.

4-75. REEL-END SENSING. (See Figure 6-1.) Reel-end sensing posts S14 and S15 are used to connect one side of reel-end relay K7 to ground whenever metallized leader tape passes over the posts. The voltage on the other side of relay K7 is derived from the +500 vdc power supply. A voltage divider consisting of resistors R2, R6, and R13 provides a voltage of approximately +25 vdc at the junction of R2 and R6. The +25 vdc is used to charge capacitor C6 during periods when relay K7 is not grounded. When reel-end relay K7 is grounded by one of the sensing posts, capacitor C6 discharges through the relay and energizes it. Contact K7A of the energized, reel-end relay disconnects the ground from one side of the safety relay K1 and connects the ground to reel-end relay K7, holding the relay energized until capacitor C6 has almost completely discharged, at which time relay K7 will de-energize.

4-76. During the time that reel end relay K7 is energized, safety relay K1 is de-energized and will perform in a similar manner to that described under Tape-Threading and Tension-Arm Limit Switches, with the exception that the brakes will not be applied and that -24 VDC will be applied to the reel motors.

4-77. Capacitor C6 discharges in approximately 0.5 seconds and reel end relay K7 is de-energized; safety relay K1 then returns to its normal energized condition.

4-78. POWER SUPPLY OVERLOAD CIRCUIT. The power supply overload circuit is discussed in paragraph 4-40.

4-79. WRITE-ENABLE SWITCH ASSEMBLY. (See Figure 6-1.) The write-enable switch assembly helps prevent accidental writing on tape through use of a write-enable ring. The write-enable ring fits over the supply

reel hub. When it is in position inside a supply reel of tape, it depresses the switch activating arm and closes the normally-open switch contacts. With the switch closed, continuity appears between terminals D and J of remote control plug J3.

4-80. When power is applied to the tape transport, a -12 vdc signal is applied to the solenoid on the write-enable switch. When the switch-arm is depressed by a write-enable ring, the solenoid circuit is completed and the solenoid energizes and holds the switch arm in the closed position. Thus, continuity appears between terminals D and J of J3 until the supply reel is removed or the thread lever handle is opened.

4-81. PHOTOSENSOR KIT. (See Figures 4-10 and 6-6, 6-7 or 6-8.)

4-82. The photosensor kit is employed as a means of detecting and indicating the beginning and end of tape containing information. To effect the sensing, reflective alumimized tabs are affixed to the mylar

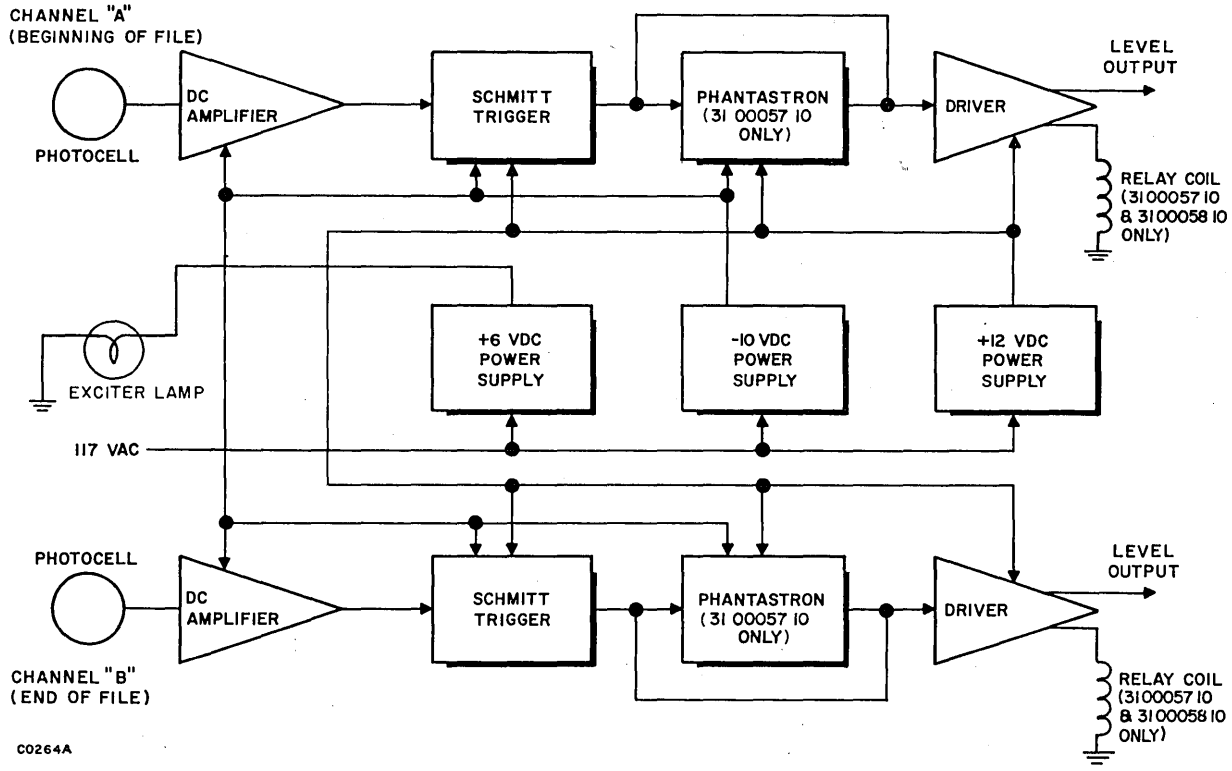


Figure 4-10. Block Diagram of Photosensor Kit

side of the beginning and end of that portion of the magnetic tape containing information or to which information is to be added. The photosensor kit consists of a two-channel photosensor head assembly, and a photosensor chassis assembly containing a base card composite assembly for each channel, optional output circuits, and associated power supply card assemblies. All circuitry is completely solid-state and modular in design.

4-83. Each base card composite assembly consists of three assemblies, or packets, mounted on a base card. The following three circuits are contained on separate packets: DC amplifier, Schmitt trigger, and driver circuit. A fourth packet containing a phantastron circuit is used in the Ampex Catalog No. 31 00057 10 version of the photosensor kit.

4-84. The two-channel photosensor head assembly is positioned over the magnetic tape. A single exciter lamp is used as the source of light for the two photo-voltaic-cell detectors (one for each channel). The light is reflected from one of the aluminized tabs on the tape as it passes under the photosensor head assembly, and is detected by the photo-voltaic-cell (photocell) in the affected channel. The photosensor head assembly is mounted between the capstan and read/write head on the tape transport's tape supply side. The signal from the photocell is amplified in the DC amplifier and triggers the Schmitt trigger stage, thus converting the detected signal to the voltage levels and rise/fall times required by the remaining circuitry. The output of the Schmitt trigger is applied to a phantastron (when used) and to optional driver stages to provide signal levels and relay switching to accord with customer requirements. The phantastron circuit is used to provide an output signal of constant duration (100 milliseconds) independent of the length of time the reflective tab is under the photosensor head assembly.

4-85. POWER SUPPLY CARD ASSEMBLIES. Three power supply card assemblies are used: a -10 vdc supply, a +12 vdc supply, and a +6 vdc supply. Each power supply card assembly consists of a plug-in printed circuit board containing the power supply circuit. Power transformer T1 (mounted on the photosensor chassis assembly) supplies the input voltage to each of the power supplies. The 117-vac input power is reduced to 32-vac and 16-vac power by transformer T1. The 32-vac output from T1 is applied to both the -10 vdc and +12 vdc supplies. The 16-vac output from T1 is applied to the +6 vdc supply. The three power supplies use full-wave rectification and RC filtering (pi) networks. The output of each supply is maintained at the rated voltage by a zener diode (CR1, CR2, or CR3, mounted in the photosensor chassis assembly) connected directly across the output of each supply. The output of the +6 vdc supply is applied to the exciter lamp only. The outputs of the -10 vdc and +12 vdc supplies are applied to the base card composite assemblies.

4-86. In the following description of operation, only channel "A" is discussed, operation of channel "B" is identical.

4-87. DC AMPLIFIER. With no reflective tab present under the photosensor head assembly, the base voltage of transistor Q1 is determined by the voltage drop across forward-biased diode CR1. The photocell is biased in the reverse direction, and under this condition, produces a near constant voltage output with the light value changes occurring during photosensor kit operation. As the amount of light reaching the photocell increases, the output current of the photocell increases in proportion. The mylar back of the tape reflects a small amount of light into the photocell, producing an off-tab output current. This current flows through two parallel circuits; part of the current through resistor R1 and potentiometer R4, the remainder of the current through collector load resistor R5 and the collector and emitter of transistor Q1. Since these circuits are, in effect, a parallel resistance network, changing the resistance of potentiometer R4 changes the proportion of photocell current flowing through transistor Q1. Potentiometer R4 is adjusted to provide output voltage levels from the DC amplifier that will "trigger" the Schmitt trigger during an on-tab condition, and permit the Schmitt trigger to return to the quiescent state during an off-tab condition.

4-88. The output from transistor Q1 appears across collector load resistor R5 and is directly coupled to the base of emitter-follower transistor Q2. The emitter follower is used to provide a low impedance output from the DC amplifier, and also to isolate the amplifier stage from the loading effects of the Schmitt trigger input circuits. The output of the emitter follower is directly coupled to the base of transistor Q1 in the Schmitt trigger packet.

4-89. When a reflective tab is present under the photosensor head assembly, current from the photocell will increase. Since the voltage output of the photocell is nearly constant, the same amount of current flows through resistor R1 and potentiometer R4. Thus, the increase in current flows through the collector and emitter circuits of transistor Q1, causing a proportionate increase in the voltage drop across collector load resistor R5. This positive-going level change is coupled through the emitter-follower to the base of transistor Q1 in the Schmitt trigger packet, "triggering" the circuit.

4-90. Diode CR2 limits the voltage across the photocell to prevent forward biasing if the photocell output current falls below the level necessary to maintain conduction in transistor Q1.

4-91. SCHMITT TRIGGER. With an off-tab input from the DC amplifier packet, transistor Q1 remains in the cut-off state and transistor Q2

remains in the conducting state. This condition is established as follows: a divider network, consisting of resistors R1, R3, and R5, maintains the base of transistor Q2 at a voltage level that causes conduction. The emitter current of transistor Q2 flows through common-emitter resistor R2, thus holding the emitter voltage of Q1 at a set value. The voltage at the base of transistor Q1 is negative with respect to the emitter, maintaining Q1 in the cut-off state. When transistor Q2 is conducting, the collector voltage is clamped at ground level by diode CR1. This ground-level voltage is applied to the base of transistor Q1 in the driver packet, holding Q1 cut off.

4-92. An on-tab input (positive-going level change) from the DC amplifier packet causes transistor Q1 to start conducting, increasing current flow through common-emitter resistor R2 and collector load/divider network resistor R1. This increases the voltage drop across resistor R1, producing a negative-going level change at the base of transistor Q2, thus reducing current flow through Q2. As current flow through Q2 decreases, the voltage at the emitter goes more positive, further decreasing current flow through the transistor due to the change in the emitter-to-base voltage. This action continues until transistor Q2 is cut off. When Q2 is cut off, the collector voltage rises towards +12 vdc. This rising voltage is applied to the base of transistor Q1 in the driver packet, causing Q1 to start conducting when the applied voltage exceeds the cut off voltage.

4-93. When a phantastron packet is used, the negative-going level change at the collector of transistor Q1 of the Schmitt trigger is applied to input capacitor C1 of the phantastron packet to initiate phantastron action.

4-94. As long as the on-tab input signal is applied to the Schmitt trigger packet, transistor Q1 remains in the conducting state. When the signal applied to the base of transistor Q1 changes to off-tab, the transistor is cut off, producing a positive-going level change to the collector. This positive-going change is coupled through the divider network to the base of transistor Q2, causing Q2 to conduct. The Schmitt trigger then remains in this quiescent state until the next on-tab signal is applied to the input.

4-95. PHANTASTRON. (See Figure 6-6.) In the quiescent state, transistor Q3 is held on by R6, so that its collector is very nearly at +12 vdc. The emitter of transistor Q2 is fixed by divider R3/CR4 at a voltage slightly more positive than ground. The transistor, therefore, is held on (in saturation) by resistor R2; the collector voltage (which is the emitter voltage of transistor Q1) is thus very nearly at ground. Resistive divider R1/R5 is so designed that diodes CR2 and

CR3 are forward biased, with the base of Q1 reverse biased so as to hold Q1 off. Diodes CR1 and CR5 are both reverse biased.

4-96. When the negative-going change occurs at the phantastron input, it is coupled by C1 through CR2 (which is conducting) to the base of Q1, causing Q1 to turn on slightly. Thus, a changing positive-going voltage is established at the collector of Q1. Coupled through C3, this voltage causes Q3 to turn off, allowing R1 to hold Q1 on. Diode CR1 now becomes forward biased and clamps the base of Q1 to a voltage slightly more negative than ground, allowing Q1 to function as a common-base amplifier. The voltage at the collector of Q1 establishes itself so that the base current in Qq is just sufficient to cause the correct current flow in Q1.

4-97. The phantastron action thus begins. Resistors R2 and R4, capacitor C2, and transistors Q1 and Q2 form a Miller Capacitor which discharges at a nearly linear rate. The rate of voltage change at the collector of Q1 is large enough to cause sufficient current flow in C3 that Q3 begins to turn on. The circuit becomes regenerative and returns to its quiescent state, save for the collector voltage of Q1. Capacitors C2 and C3 must recharge through R4. When this is accomplished, the circuit may be triggered again.

4-98. Diode CR2 is included in the circuit so that should the Schmitt trigger return to its normal off-tab state during the rundown period, the resulting positive-going input to the phantastron cannot turn transistor Q1 off to return the phantastron to its quiescent state. It will be seen that since transistor Q3 is off during the rundown period, resistors R7 and R8 will hold driver transistor Q2 on, regardless of the state of the Schmitt trigger. This arrangement causes the output from the driver stage to be held in the on-tab condition for 100 milliseconds, regardless of how short a time the reflective tab is under the photosensor head.

4-99. DRIVER AND OUTPUT CIRCUITS. Three different driver and output circuits are used with the photosensor kit. These can be identified as follows: the Ampex Catalog No. 31 00057 10 photosensor kit, described in subparagraph (a) below, has a sealed relay mounted adjacent to the zener diodes and has a phantastron packet mounted in the center of the base card composite assembly; the Ampex Catalog No. 31 00058 10 photosensor kit, described in subparagraph (b) below, has the sealed relay but does not have the phantastron packet; the Ampex Catalog No. 31 00059 10 photosensor kit, described in subparagraph (c) below, does not have the sealed relay or the phantastron packet.

a. Ampex Catalog No. 31 00057 10 (Figure 6-5). The driver circuit is operated by either of the two following signals: the

+12 vdc input (on-tab) from the collector of transistor Q2 in the Schmitt trigger packet; or the negative-going level change input (100 millisecond hold) from the collector of transistor Q3 in the phantastron packet. When the driver is in the quiescent state, the output voltage at pin 7 of receptacle J6 is at ground level and pins 10 and 9 of receptacle J6 are connected through contacts of de-energized relay K1. When the driver is operating, the output voltage at pin 7 of receptacle J6 is approximately +10 vdc and pins 9 and 8 of receptacle J6 are connected by contacts of energized relay K1.

1. In the quiescent state, transistor Q2 is held cut off by +12 vdc applied to the base through resistor R2 (the input through resistor R8 of the phantastron packet is also +12 vdc). The emitter of transistor Q2 is held at a voltage slightly less than +12 vdc by the voltage drop across resistor R3, established by current flow through forward-biased diode CR1. Transistor Q1 is held cut off by the ground level voltage from the collector of transistor Q2 in the Schmitt trigger packet. When driver transistor Q2 is cut off, no current flows through resistor R4 or relay K1, therefore, relay K1 is de-energized, and the voltage at pin 7 of receptacle J6 is at ground level. When relay K1 is de-energized, contacts of the relay connect pins 9 and 10 of receptacle J6.

2. When the on-tab signal (+12 vdc) from the Schmitt trigger packet is applied to the base of driver transistor Q1, Q1 conducts heavily, producing a negative-going level change at the base of transistor Q2. This level change causes Q2 to conduct heavily. Current flows through resistor R4, diode CR2, transistor Q2, and diode CR1, producing approximately +10 vdc across resistor R4, which is coupled to pin 7 of receptacle J6. Current also flows through relay K1, transistor Q2, and diode CR1, energizing relay K1. When relay K1 is energized, pin 9 of receptacle J6 is disconnected from pin 10 and connected to pin 8. Diode CR4, across relay K1, reduces the inductive surge when relay K1 is de-energized. Diode CR2 isolates the "level" output from the relay circuit. Transistors Q1 and Q2 remain on as long as the on-tab signal is received from the Schmitt trigger packet.

3. When a 100-millisecond hold signal (negative-going level change) from the phantastron packet is applied to the base of transistor Q2, Q2 conducts heavily, providing the same output signals as described in paragraph 4-99-a-2. Transistor Q2 remains on as long as the 100-millisecond hold signal is received from the phantastron packet.

b. Ampex Catalog No. 31 00058 10 (Figure 6-6). When the driver is in the quiescent state, the output voltage at pin 7 of receptacle J6 is at ground level and pins 9 and 10 of receptacle J6 are connected

through contacts of de-energized relay K1. When the driver is operating, the output voltage at pin 7 of receptacle J6 is approximately +10 vdc and pins 9 and 8 of receptacle J6 are connected through contacts of energized relay K1.

1. In the quiescent state, transistor Q2 is held cut off by +12 vdc applied to the base through resistor R2. The emitter of transistor Q2 is held at a voltage slightly less than +12 vdc by the voltage drop across resistor R3, established by current flow through forward-biased diode CR1. Transistor Q1 is held cut off by the ground level voltage from the collector of transistor Q2 in the Schmitt trigger packet. When driver transistor Q2 is cut off, no current flows through resistor R4 or relay K1; therefore, relay K1 is de-energized, and the voltage at pin 7 of receptacle J6 is at ground level. When relay K1 is de-energized, contacts of the relay connect pins 9 and 10 of receptacle J6. Operation of the driver circuit is identical to that described in paragraph 4-99-a-2.

c. Ampex Catalog No. 31 00059 10 (Figure 6-7). When the driver is in the quiescent state, the output voltage at pin 7 of receptacle J6 is at ground level. When the driver is operating, the output voltage at pin 7 of receptacle J6 is approximately +10 vdc.

1. In the quiescent state, transistor Q2 is held cut off by the +12 vdc applied to the base through resistor R2. The emitter of transistor Q2 is held at a voltage slightly less than +12 vdc by the voltage drop across resistor R3, established by current flow through forward-biased diode CR1. Transistor Q1 is held cut off by the ground-level voltage from the collector of transistor Q2 in the Schmitt trigger packet. When transistor Q2 is cut off, no current flows through resistor R4; therefore, the voltage at pin 7 of receptacle J6 is at ground level.

2. When the on-tab signal (+12 vdc) from the Schmitt trigger packet is applied to the base of driver transistor Q1, Q1 conducts heavily, producing a negative-going level change at the base of transistor Q2. This level change causes Q2 to conduct heavily. Current flows through resistor R4, diode CR2, transistor Q2, and diode CR1, producing approximately +10 vdc at the collector of Q2, which is coupled to pin 7 of receptacle J6. Transistors Q1 and Q2 remain on as long as the on-tab signal is received from the Schmitt trigger packet.

4-100. HEAD ASSEMBLY.

4-101. The head assembly is composed of two, head, tape guides, a write-head stack (where used), a read-head stack (where used), a

hinged, head gate, and a base plate. Accuracy of tape guiding across the heads is ensured by the precise machining of the base and the head-tape guides which are mounted at either side of the read and write heads. For an eight-channel system, the inner tape edge is the spacing reference edge. For a seven-channel system, the outer tape edge is the spacing reference edge.

4-102. In this manual, read/write channel 1 is that channel nearest the operator.

SECTION V
MAINTENANCE

5-1. GENERAL.

5-2. The TM-4 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 described in paragraph 5-23.

5-3. A listing of the tools and equipment used in maintenance of the tape transport will be found at the end of this section.

5-4. PREVENTIVE MAINTENANCE.

5-5. 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. Maintenance procedures are scheduled by the number of eight-hour shifts, or as hours of running time.

Table 5-1. Schedule of Preventive Maintenance

Maintenance Operation	Frequency		Approx.	Qty.	Total Time	Text Ref.
	Shifts	Hours	Min. Ea.			
Clean transport	1 D	8	3	1	3	5-6
Check capstan roller adjustment	2	16	1	2	2	5-24 P5-15
Check tape tracking	2	16			5	5-25 PG-19
Check servo contactor	12	96	5	2	10	5-26
Check dashpot adjustment	12	96	3	2	6	5-27
Clean rack	24	192	10	1	10	5-7
Clean vacuum unit motor filter	24	192	2	1	4	5-6
Check tape guides	24	192	1	10	10	5-28

Table 5-1. Schedule of Preventive Maintenance (Cont.)

Maintenance Operation	Frequency		Approx. Min. Ea.	Qty.	Total Time	Text Ref.
	Shifts	Hours				
Check actuator firing circuitry	24	192	5	1	5	5-29
Check reel motor	625	5000	15	2	30	5-30
Check brushes in reel motor	625	5000	15	2	30	5-44 (1 thru n)
Replace capstan	250	2000	20	2	40	5-39
Remove and replace capstan rollers	250	2000	20	2	40	5-38
Replace capstan drive belt	250	2000	10	1	10	5-40
Replace vacuum unit motor brushes	250	2000	15	1	20	5-46
Replace vacuum unit motor	500	4000	15	1	15	5-46
Replace capstan drive motor	625	5000	2	1	25	5-50

5-6. CLEANING THE TAPE TRANSPORT. Clean the tape transport as follows:

CAUTION

Use only Ampex Head Cleaner, Ampex Catalog No. 087-007. Use of solvents or cleaners such as carbon tetrachloride may dissolve the head lamination adhesive.

Step 1: Using a clean, lint-free cloth, or cotton swab moistened with Ampex Head Cleaner, carefully wipe off all oxide and dirt that may have gathered on and around read/write stacks and head cover.

Step 2: Using a clean, lint-free cloth or cotton swab moistened with Ampex Head Cleaner, carefully wipe off all oxide and dirt that may be on head tape guides.

Step 3: Carefully place a clean, lint-free cloth or cotton swab moistened with alcohol against the capstan.

Step 4: Rotate capstan by turning capstan pulley by hand until all oxide and dirt are removed.

NOTE

Allow no alcohol to reach the capstan roller bearings.

Step 5: Carefully place a clean, lint-free cloth or cotton swab moistened with alcohol against capstan roller and rotate slowly. Be sure to remove all oxide and dirt.

Step 6: Using a clean, lint-free cloth or cotton swab moistened with Ampex Head Cleaner, thoroughly clean inside of the vacuum chamber. Be sure to remove all oxide and dirt.

Step 7: Clean vacuum chamber door and tape guide posts by repeating above procedure.

Step 8: Clean vacuum unit motor filter with a vacuum cleaner, then wash in clean water and dry thoroughly. (See Paragraph 5-46.)

5-7. CLEANING RACK. The entire rack or cabinet housing the tape transport and the tape transport itself should be thoroughly cleaned on a regular schedule. The front of the tape transport should be wiped clean with a cloth moistened in Tek-Kleen or ethyl alcohol.

5-8. LUBRICATION. No periodic lubrication of the tape transport is necessary.

5-9. TOOLS AND TEST EQUIPMENT. Table 5-2 indicates the general nature of tools and test equipment required to maintain the TM-4. Manufacturers' names and numbers are given only as a guide; any equivalent tools or test equipment may be used.

Table 5-2. Suggested Tools and Test Equipment

Tool or Test Equipment	Manufacturer and Number
Allen wrench set, handled, 0.35" 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, 12pt, 3/8-inch 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, 2-½" blade	Wiss #173E
Open end wrench set, 15° and 75°, 3/16" through 5/8"	Williams #1142PR
Tube puller	G. C. #9130
Setting gage	Ampex #31 00914 10
Pen light	
Scale, 0 to 30 oz.	
Standard screwdriver set	Snap-On #SD-130-K
Stub screwdriver, small	Xcelite #R-184

Table 5-2. Suggested Tools and Test Equipment (Cont)

Tool or Test Equipment	Manufacturer and Number
Soldering iron	
Stub screwdriver, medium	Xcelite #$-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
Offset ratchet, slot	
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 gage	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 set	Xcelite #99SM
Nutdriver, #18	Xcelite #HS-18

Table 5-2. Suggested Tools and Test Equipment (Cont)

Tool or Test Equipment	Manufacturer and Number
File, 6" smooth cut	
File, 4" round, second cut	
Tape, steel, 8'	Lufkin #688
Inspection mirror	G. C. #5090
Wire stripper	Miller #100
Burnishing tool	
Pliers, 7-½"	Proto #242
Read/write electronics	Customer supplied
Oscilloscope	Tektronix 535 or equivalent
FM discriminator	Ampex #15790-280 with Ampex #18910 power supply, or equivalent
Waveform generators (four)	Tektronix 162 or equivalent
Frequency counter	Hewlett-Packard 523B or equivalent
Pulse generator	Tektronix 161 or equivalent
Power supply	Tektronix 160A or equivalent
Variable transformer	General Radio Variac 150 VAC, 10 amp, or equivalent
Voltage-level converter (to convert output of waveform generators to 10 VDC level change required by transport actuators)	Homemade

5-10. CHECKING OPERATING PARAMETERS.

5-11. CHECKOUT FOR START TIME. Start time is defined as that time following the start command until instantaneous speed variation

decreases to within 10% of nominal. The following equipment is required to check out start time:

1) Test tape with a 25 kc (±0.1%) NRZ signal recorded at 75 ips

2) Read amplifier

3) Calibrated oscilloscope

4) FM discriminator

5-12. Check out the start time as follows:

Step 1: Adjust FM discriminator to produce zero volts output at 25 kc.

Step 2: Connect test equipment as shown in Figure 5-1.

Step 3: Cycle transport to operate in Forward and Reverse Drive modes at a convenient rate. Instantaneous speed variation must fall below 10% within 3.3 msec from start command. A typical waveshape is shown in Figure 5-1.

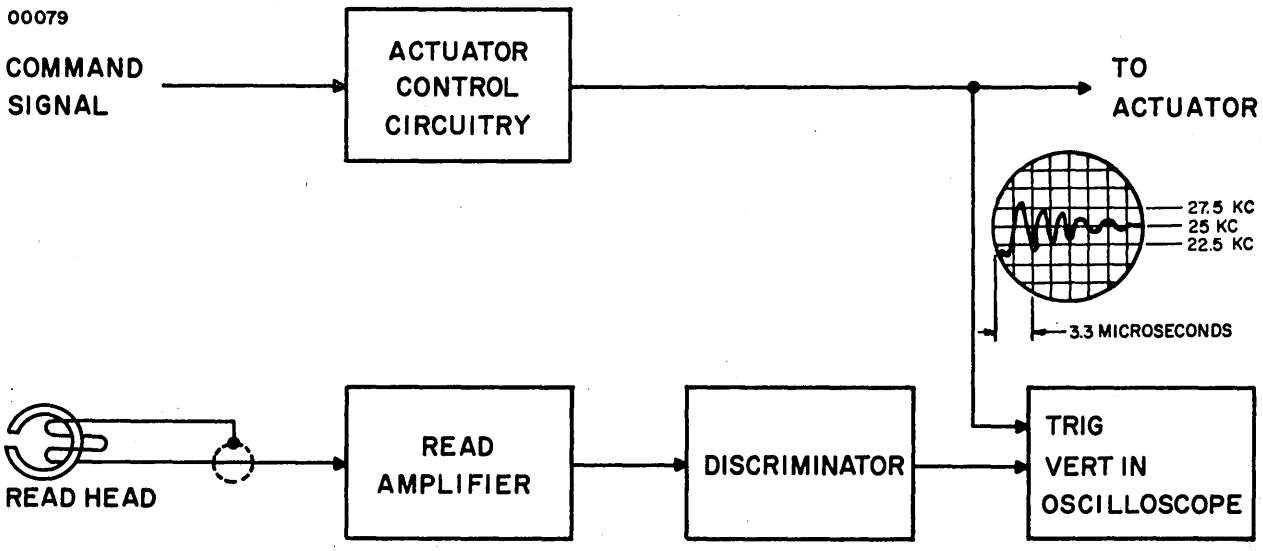


Figure 5-1. Test Setup, Start Time Measurement

5-13. CHECKOUT FOR STOP TIME. Stop time is defined as that interval following a stop command until tape motion across the read/write head ceases. The equipment used to check start time is also used to check stop time, except that the discriminator is not used. The equipment is connected as shown in Figure 5-2.

5-14. Check out the stop time as follows:

Step 1: Cycle transport at a convenient rate in Forward and Reverse Drive modes.

Step 2: Observe decay time of signal displayed on oscilloscope. Decay time should be less than 2.5 msec. A typical waveshape is shown in Figure 5-2.

5-15. CHECKOUT FOR START AND STOP DISTANCE. Start distance and stop distance are defined as the amount of tape passing over the read/write head during the start time and stop time, respectively. The equipment is connected as shown in Figure 5-3. The following test equipment is required:

1) Test tape with a 25 kc (±0.1%) NRZ signal recorded at 75 ips

2) Four waveform generators (Tektronix 162 or equivalent)

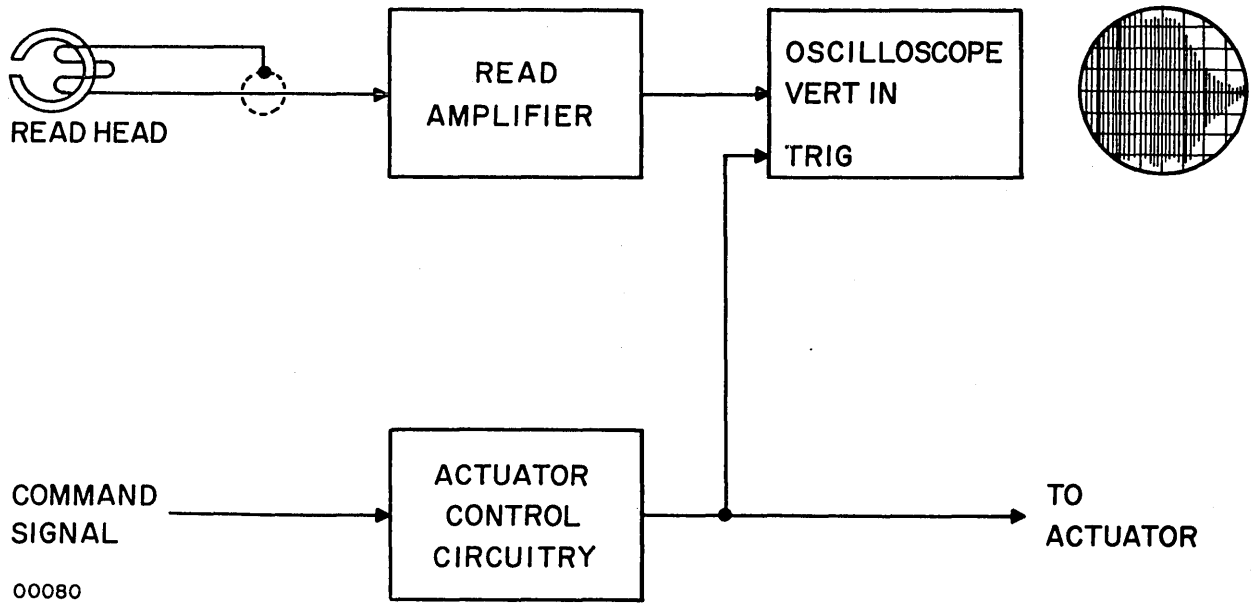


Figure 5-2. Test Setup, Stop Time Measurement

3) Read amplifier capable of developing 2.0 volts p-p output across an impedance of 600 ohms with a rise time of 7 to 9 usec.

4) Oscilloscope

5) Frequency counter

6) Pulse generator

7) Power supply

5-16. Check out the start and stop distance as follows:

Step 1: Connect test equipment as shown in Figure 5-3 and connect waveform generators and pulse generators to power supply.

Step 2: Thread test tape on tape transport.

Step 3: Put all four operating MODE switches on waveform generators in triggered position.

Step 4: Put all four VERNIER controls on waveform generator in calibrated position.

Step 5: Select program at waveform generator DURATION and MULTIPLIER controls (example: fwd on 40ms, fwd off 20ms, rvs on 40ms, rvs off 20ms). This program (40-20-40-20) states that the forward actuator is ON for 40 msec and OFF for 20 msec. The same is true for the reverse actuator.

Step 6: Set the GATE OUT/PULSE OUT switch to GATEOUT position.

Step 7: Connect four cables (A,B,C,D) as shown. This connects a sawtooth waveform to trigger the next waveform generator.

Step 8: Connect cables from points E and G to level converter.

Step 9: Connect cable J and K to remote plug on tape handler.

Step 10: Put test tape on machine, and place in automatic mode. Machine should now be programming at a 40-20-40-20 rate.

Step 11: Connect a power cable from pulse generator to 160A power supply.

Step 12: Connect cable L as shown. This cable should be long enough to reach the fourth waveform generator.

Step 13: Connect cable M and probe N as shown.

Step 14: Connect read head cable to read amplifier and connect probe P and cable R as shown. Use 10K isolation resistor as shown in Figure 5-3.

Step 15: Turn test equipment on for a warmup period.

Step 16: Pulse generator controls are set as follows:

(a) Pulse TRIGGER SELECTOR in POSITIVE position.

(b) PULSE WIDTH to 1 MSEC.

(c) PULSE WIDTH MULTIPLIER to THREE.

(d) PULSE DELAY center scale.

Step 17: Electronic counter 523B controls are set as follows:

(a) FUNCTION SELECTOR to TIME INTERVAL.

(b) TIME UNIT to USEC (Check position).

(c) FREQUENCY UNIT to 1 second.

(d) DISPLAY TIME to MIN.

(e) 100 KC STD to INT STD.

(f) GATE to OPEN.

(g) TIME INTERVAL No. 1 to X1; rotate TRIGGER LEVEL until a count of near 3000 usec appears.

Step 18: Rotate PULSE WIDTH knob on 161 pulse generator until 3300 usec $\pm$5 (3.3 msec) appears on counter.

Step 19: Switch to pre-amp #2 on oscilloscope (probe N) using DC INPUT at 5 VOLTS/CM sensisivity and INTERNAL SYNC.

Step 20: Set TIME/CM to 100 usec, and put MULTIPLIER in the 2-5-1 position; then adjust for 3.3 msec gate to cover the full 10 cm oscilloscope face. Place waveform in lower half of oscilloscope face.

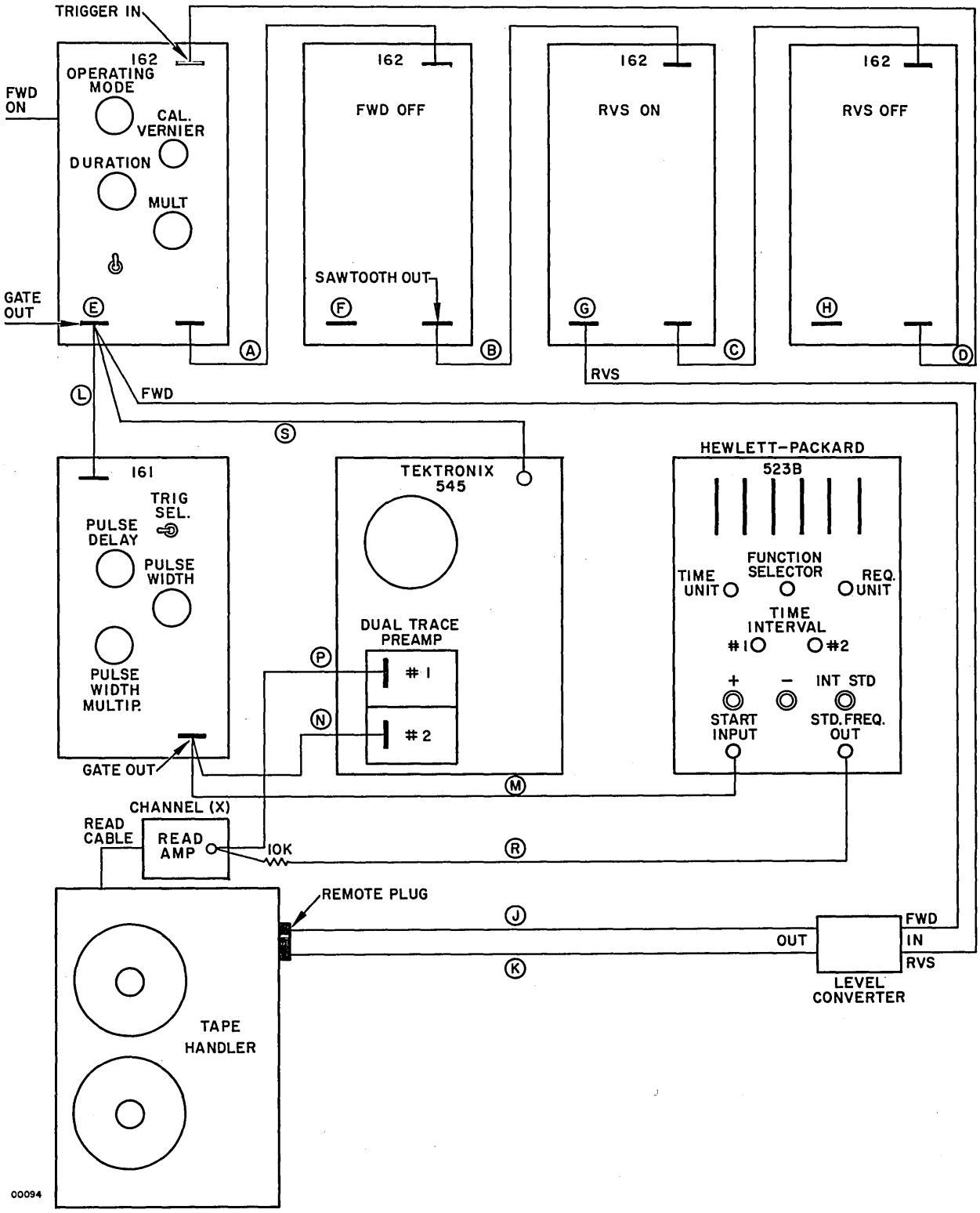


Figure 5-3. Test Setup, Start/Stop Distance Measurement

Step 21: Place TIME SELECTOR switch on the 523B counter to EXT. position (count position), and run tape handler in AUTOMATIC MODE.

Step 22: Place cable L in the following positions, and move cables (oscilloscope sync.) with each movement.

(a) To measure forward start distance: attach cable L to E; multiply counter reading by .003 inch.

(b) To measure forward stop distance: attach cable L to F; multiply counter reading by .003 inch.

(c) To measure reverse start distance: attach cable L to G; multiply counter reading by .003 inch.

(d) To measure reverse stop distance: attach cable L to H; multiply counter reading by .003 inch.

(e) During test 1 through 4, the proper start and stop waveforms may be viewed by switching to pre-amp #1 (probe P), using DC INPUT at .2 VOLT/CM sensitivity and EXTERNAL SYNC.

NOTE

Photograph the waveforms and make an actual count of the pulses for an additional check.

5-17. CHECKOUT FOR LONG TERM SPEED VARIATION. Long term speed variation is checked by using a test tape such as was prepared for CHECKOUT FOR START TIME above. An electronic counter is used to count the number of pulses passing the head each second. The following test equipment is required to check out the long term speed variations.

1) Dual trace oscilloscope

2) Read amplifier

3) Oscilloscope

4) Counter

5-18. Check out the long term speed variations as follows:

Step 1: Connect equipment as shown in Figure 5-4.

Step 2: Operate tape transport in Forward Drive mode through at least half a roll of tape while observing count displayed on counter. At no time should reading deviate more than ±2% from nominal KC rate.

5-19. CHECKOUT FOR INTERCHANNEL TIME DISPLACEMENT ERROR. The following procedure permits measurement of interchannel time displacement error of any data track from any data track from any other data track or reference track. The procedure does not permit separation of errors introduced by write and read electronics. The following equipment is required to measure ITDE:

1) Test tape with a 25 kc (±0.1%) NRZ signal recorded at 75 ips

2) Dual trace oscilloscope

3) Read amplifiers (customer supplied)

4) Connect the test equipment as shown in Figure 5-5

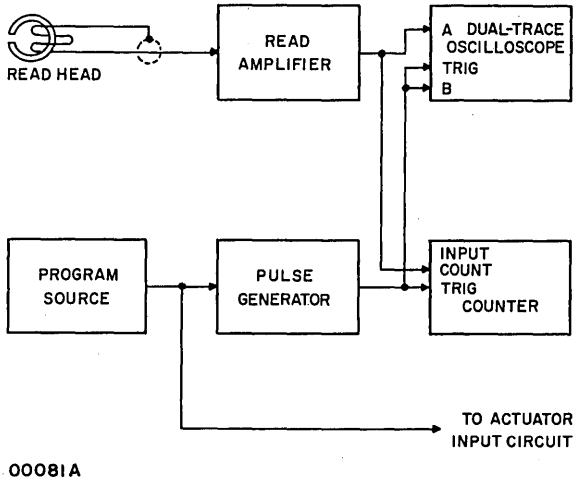


Figure 5-4. Test Setup, Long Term Speed Variation

5-20. Check out the interchannel time displacement error as follows follows:

Step 1: Program tape transport to operate in Forward Drive mode. A presentation such as is shown in Figure 5-6 should appear on oscilloscope.

Step 2: Switch non-reference input of oscilloscope to other tracks in turn to measure ITDE of each track with respect to reference track.

5-21. CHECKOUT FOR PHOTOSENSOR KIT. (See Figure 5-7 for waveforms). The following test equipment is required:

(a) Test tape with a ½-inch wide strip of reflective marker across the width of the mylar side

(b) Vacuum tube voltmeter

(c) Oscilloscope

(d) Turn on electrical power

5-22. Check out the photosensor kit as follows:

Step 1: Thread tape on tape transport.

Step 2: Turn supply and takeup reels by hand until mylar side of tape (without reflective marker) is under photosensor head assembly.

Step 3: Remove cover of photosensor chassis assembly and locate composite base card assemblies for channels A and B. (See photosensor kit schematic.)

Step 4: Starting with base card assembly for channel A, locate TP1, TP2, and R4 in DC amplifier circuit. (See schematic.)

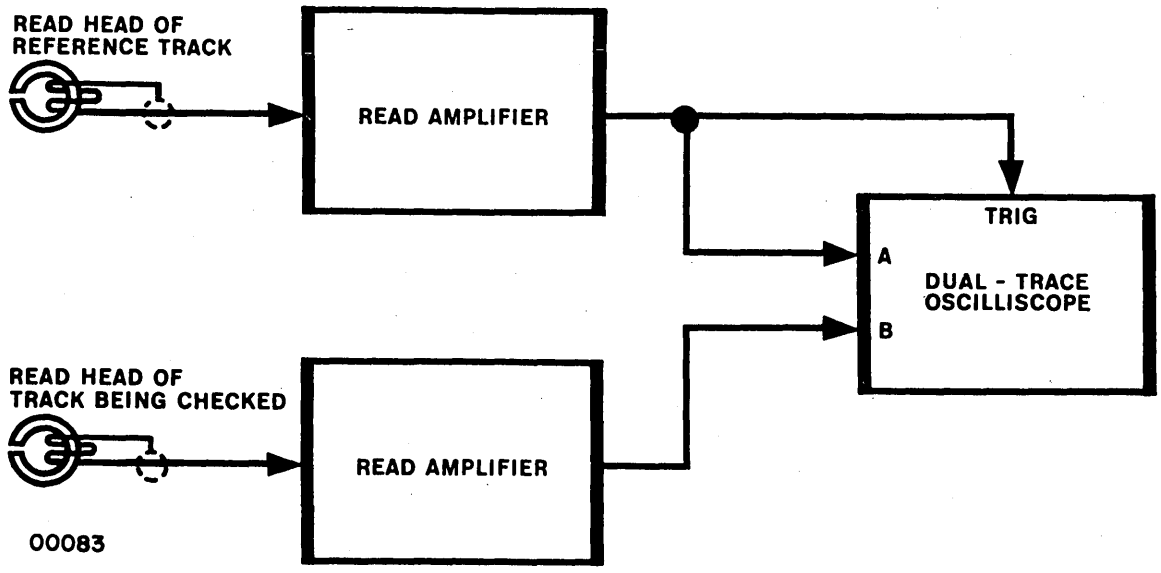


Figure 5-5. Test Setup, Interchannel Time Displacement Error

Step 5: Attach voltmeter ground lead to TP2. Attach voltmeter test lead to TP1. Adjust R4 for a level as close as possible to, but not more positive than -7.8 vdc.

Step 6: Repeat Steps 1 and 2 for channel B.

Step 7: To check phantastron hold and driver circuits used in channel A, connect oscilloscope ground lead to pin 1 of connector P1, and input lead to pin 11.

Step 8: Set oscilloscope to trigger on level change when reflective marker passes under photosensor head assembly.

Step 9: Observe output on oscilloscope. 100 msec (±20%) time duration must be obtained by phantastron hold circuit even though reflective marker is actually sensed for a much shorter time. At the same time, a minimum of +10 vdc level should appear on oscilloscope from driver circuit.

Step 10: Move reflective marker from beneath photosensor head assembly. The +10 vdc level should drop to a level of -0 to -0.5 vdc.

Step 11: To check the phantastron hold and driver circuits used in channel B, disconnect oscilloscope input lead from pin 11 of P1 and connect it to pin 11 of P2. Disconnect oscilloscope ground lead from pin 1 of P1 and connect it to Pin 1 of P2.

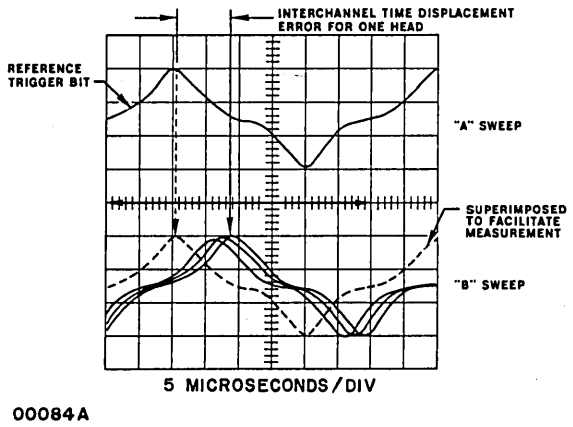


Figure 5-6. Waveshape, Interchannel Time Displacement Error

Step 12: Repeat Steps 8 and 9 for channel B. Malfunction symptoms, possible causes, and remedies are listed in Table 5-3.

5-23. CORRECTIVE MAINTENANCE.

5-24. CHECKOUT AND ADJUSTMENT FOR CAPSTAN ROLLER PARALLELISM AND GAP. (See Figures 5-8 and 5-9.) Parallelism between the capstan roller is checked by using an Ampex setting gage (Part No. 31 00914 10) and a pen light. The amount of light seen through the relief between the capstan roller and the gage must be the same distance all the way across the capstan roller. The amount

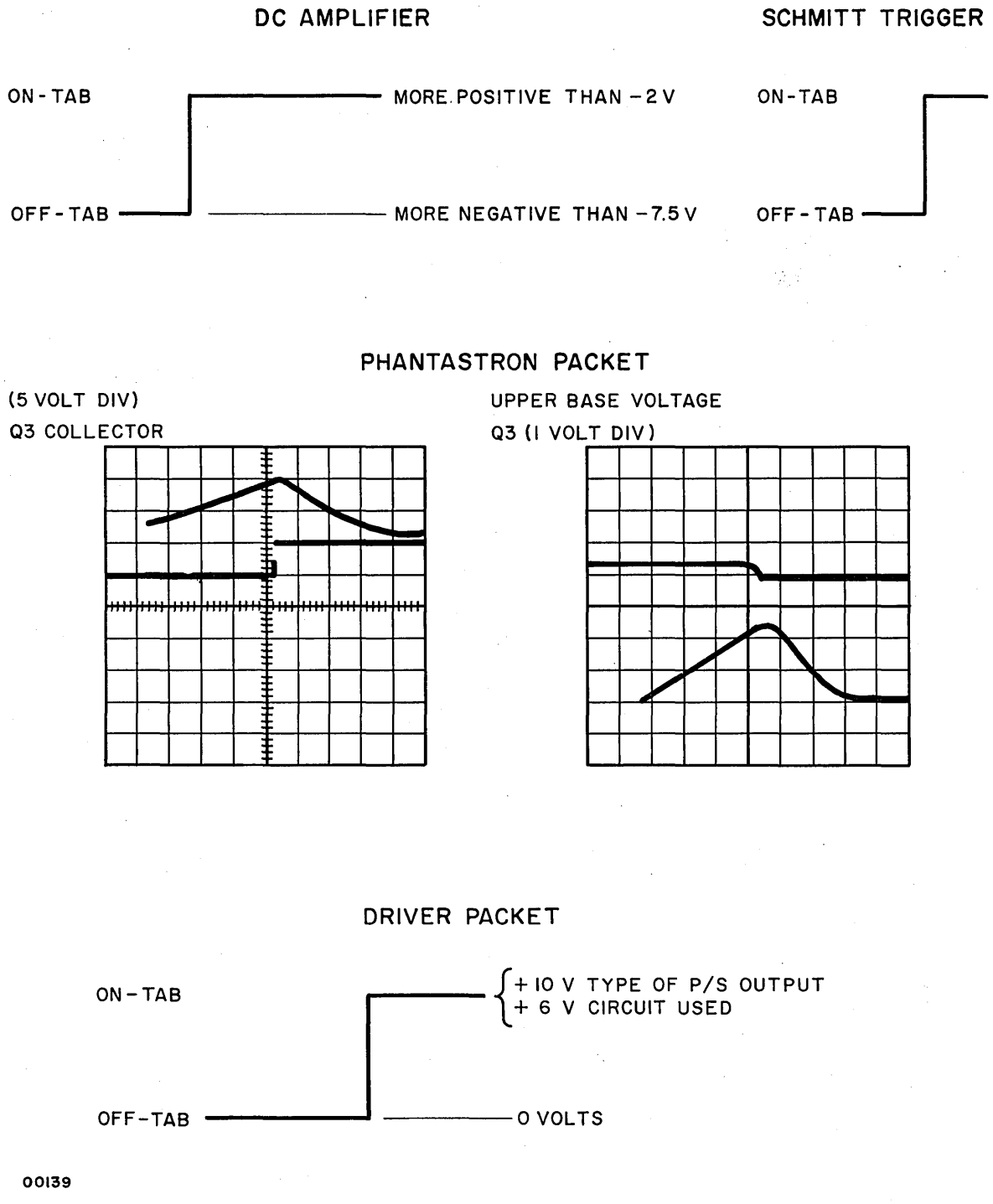


Figure 5-7. Photosensor Waveform

of light seen through the gap between the capstan and capstan roller must be the same across the entire surface to show parallelism between the capstan and capstan roller. The nominal gap between the capstan and capstan roller is 0.008 inch to 0.010 inch. Both adjustments must be made if the tape transport is experiencing start time and distance difficulties. Check out and adjust the capstan roller parallelism and gap as follows:

CAUTION

Turn off tape transport electrical power.

Step 1: Loosen two yoke clamping screws (A) until yoke can be turned on actuator shaft with a slight drag as shown in Figure 5-9a.

Step 2: Place capstan roller against capstan by pushing at center of the capstan roller.

Step 3: Place pen light in a position so light will shine toward you through the capstan and capstan roller gap.

Step 4: Observe any difference in light illuminating from gap between capstan and capstan roller and record it. (High, low, forward, backward)

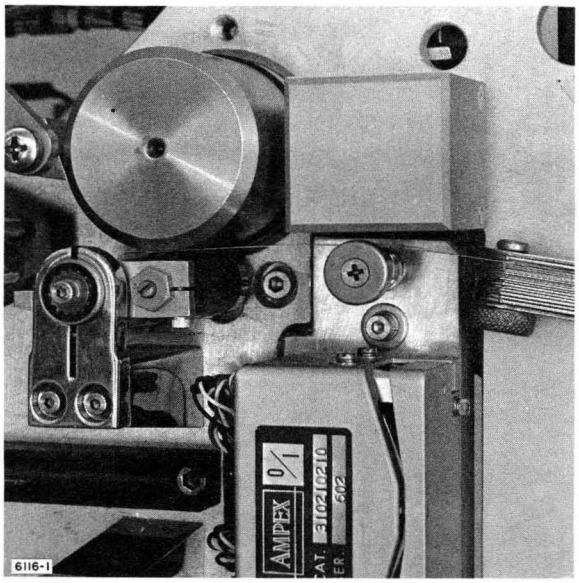


Figure 5-8.
Checking Capstan Roller Gap

CAUTION

Care must be taken when using the setting gage to avoid scarring the capstan roller.

Step 5: Slip setting gage Ampex Part No. 31 00914 10 over capstan, as shown in Figure 5-9b.

Step 6: Shine pen light into gap between capstan roller and setting gage.

Step 7: Observe any difference in light illuminating from gap between capstan roller and setting gage and record it. (High, low, forward, backward)

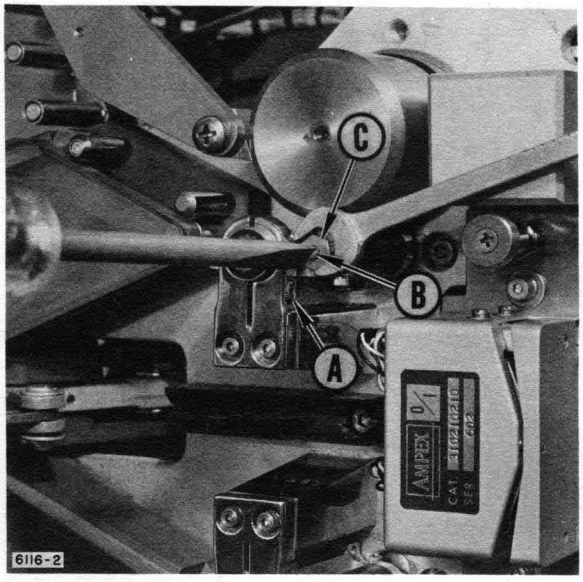
Step 8: Using recorded information from Steps 4 and 7, rotation of dual eccentric of capstan roller for parallelism can now be accomplished.

NOTE

The hexagonal element (c) in Figure 5-9a, adjusts the eccentric nearest the operator; the slotted element (b) in Figure 5-9a, adjusts the eccentric nearest the transport.

Step 9: Repeat Steps 3, 6 and 8 until parallelism established in Step 8 is parallel by observation.

Step 10: Insert a 0.009 inch feeler gage between capstan and capstan roller. Clamp feeler gage between capstan and capstan roller while turning one screw a little and then the other until both screws are tight.



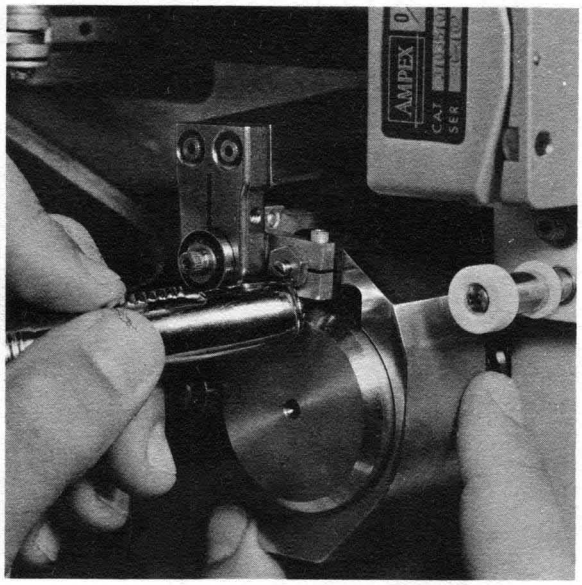


Figure 5-9a. Figure 5-9b.
Adjusting Capstan Roller Parallelism and Gap

Step 11: Repeat Steps 3 and 6 to be sure that Step 10 did not cause any change in parallelism. If change is noticed, readjustment must be made by repeating Steps 1 through 4.

NOTE

Recheck gap after completing Step 14.

Step 12: Place tape transport in operation and observe tape for skew.

Step 13: If tape skew is accessive, repeat Steps 1 through 12.

Step 14: If tape skew is slight, final adjustment can be made while tape transport is in operation using the rotation of dual eccentric of capstan roller.

5-25. CHECKOUT AND ADJUSTMENT FOR TAPE TRACKING.

CAUTION

Capstan and capstan-roller parallel position and gap must be set before this procedure is undertaken.

NOTE

Be sure to check tape travel in both directions.

Step 1: Grasp a length of tape at the vacuum chamber guide.

Step 2: Grasp the other end of the tape between head and head stack.

Step 3: Pull tape gently in both directions, holding tape flat.

Step 4: See Figure 5-10. Tape held in a horizontal plane should not touch either capstan roller or capstan. If tape touches capstan, vacuum chamber assembly and/or head assembly must be adjusted.

NOTE

The following steps need be taken only for misalignment of vacuum chamber.

Step 5: Loosen mounting screws holding head assembly and position head assembly mounting base so that mounting screws are in center of base holes.

Step 6: Tighten head mounting screws.

Step 7: Loosen mounting screws holding vacuum chamber to casting (access from rear of transport).

Step 8: See Figure 5-11. Position vacuum chamber in horizontal plane. Be sure that vacuum chamber does not interfere with rotation of reels on left or capstan roller yokes on the right. At the same time, position vacuum chamber in the vertical plane so that tape passes between capstan roller and capstan without touching either. (Refer to Step 4 above.)

Step 9: Snug up mounting screws on vacuum chamber, and repeat Steps 1 through 4 above.

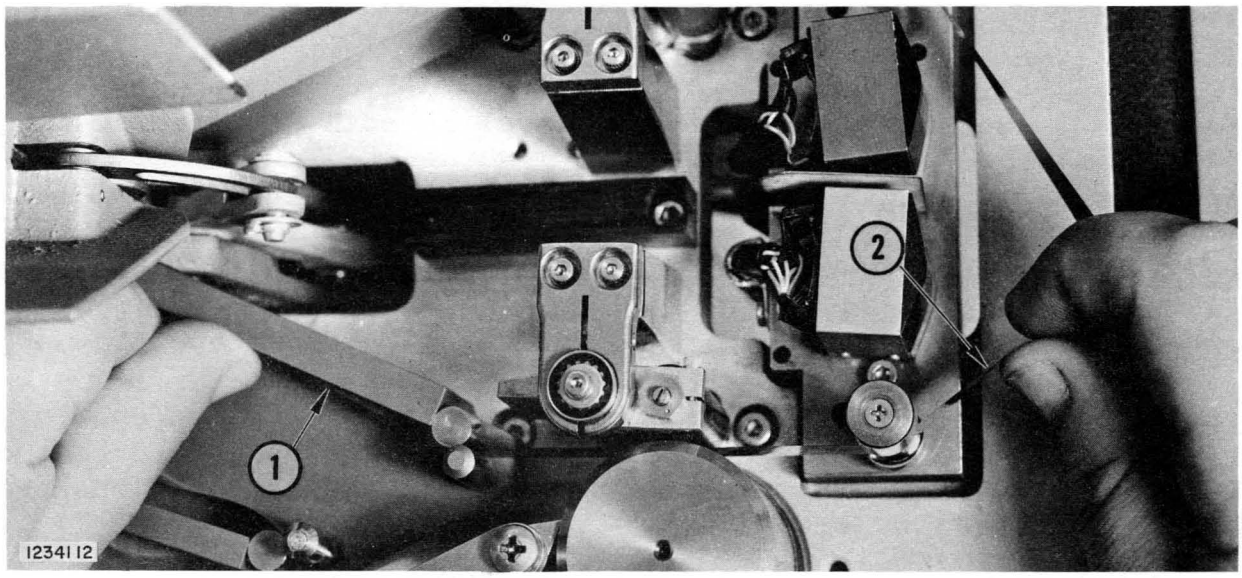


Figure 5-10. Checking Vacuum Chamber Alignment

Step 10: If any fine adjustment is still needed, it may be advantageous to move head assembly. Refer to Step 1 of adjustment procedure. If the head assembly is moved, it will affect tape travel at the upper and lower vacuum chambers; thus, repositioning of chambers may be required.

Step 11: When adjustment has been established; tighten mounting hardware for vacuum chamber to 40-45 inch-ounces torque. Tighten mounting hardware for head assembly.

5-26. CHECKOUT AND ADJUSTMENT OF SERVO CONTACTOR.

WARNING

Initial adjustment of the servo contactor assembly should be made with the power off. Otherwise, injury to personnel may result.

Step 1: Remove cover from servo control assembly.

Step 2: Set tension arm roller guide support at center-of-travel position by manually rotating upper or lower reel.

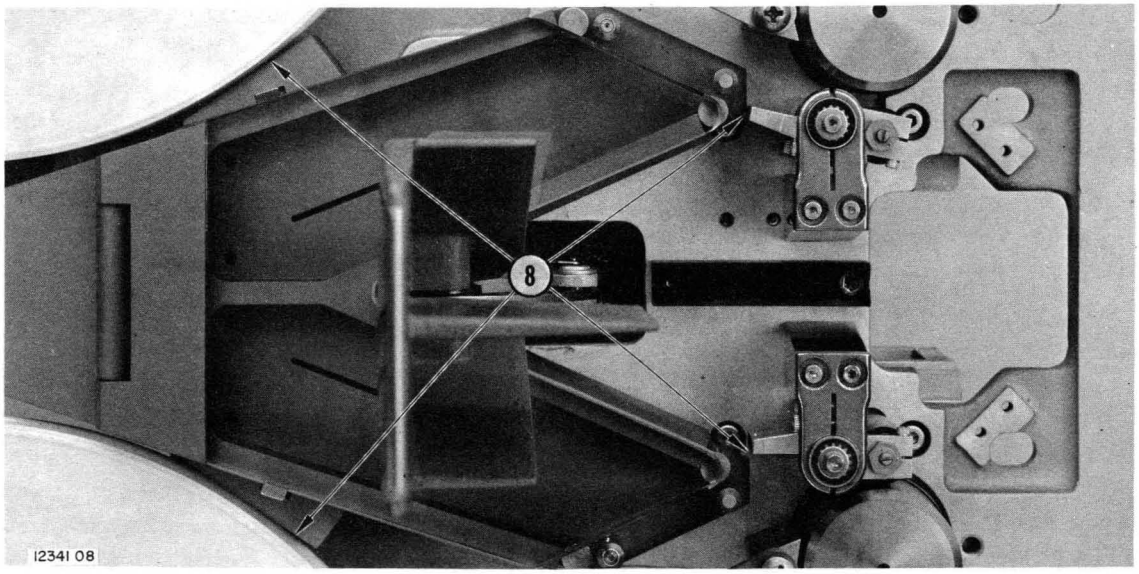


Figure 5-11. Adjusting Vacuum Chamber Alignment

Step 3: Check alignment of center contact of contact assembly and centering spring. These components should be in a straight line.

Step 4: See Figure 5-12. Insert a 0.010-inch feeler gage between contacts on center contact leaf and inner leaf (one at a time). The gap should be 0.010 ±0.005-inch for each set of contacts.

NOTE

If Steps 1 through 4 check out, proceed to Step 10. If Steps 1 through 4 do not check out, use adjustment procedure Steps 5 through 10.

Step 5: Set tension arm at center-of-travel position.

Step 6: Using 3/32-inch Allen wrench, loosen cap screw holding contact clamp to tension arm shaft.

Step 7: Rotate contactor assembly on shaft until spring and contactor form a straight line.

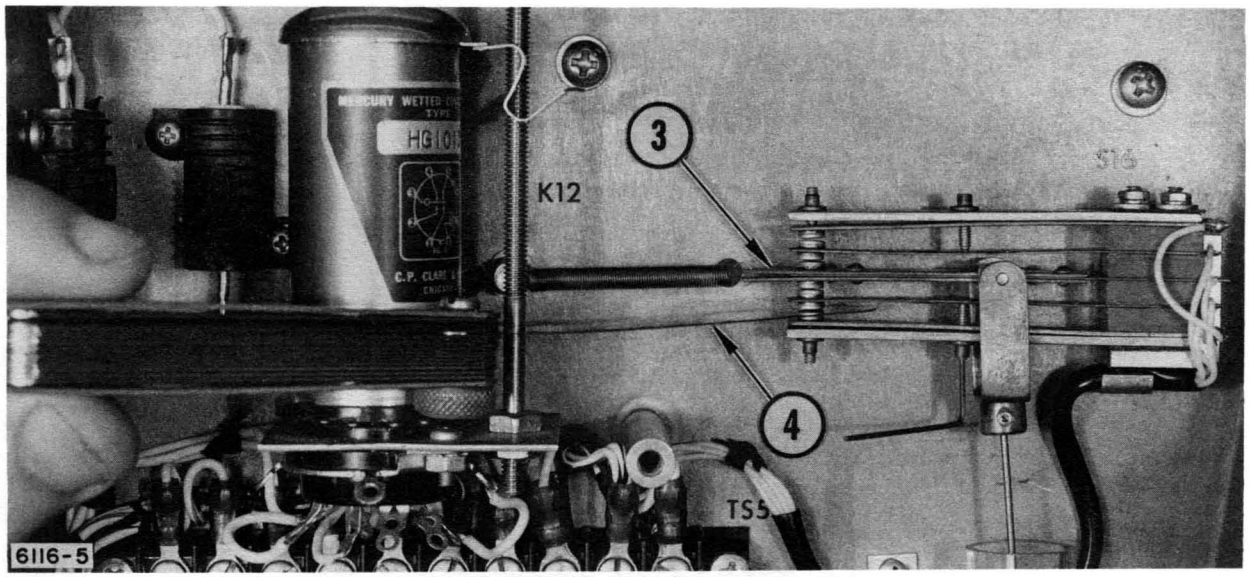


Figure 5-12. Checking Servo Contactor

Step 8: Tighten cap screw holding contact clamp to tension arm shaft.

Step 9: Position contactor assembly on the tension-arm shaft so that contactor assembly and dashpot rod form a straight line.

Step 10: Repeat Step 4 using an Allen wrench; gently turn adjustment screw until a slight drag is felt on the 0.010-inch feeler gage.

NOTE

When power is on, do not touch any equipment or parts in the servo control box. With reel motors active, any movement of tension arm must be made very slowly to prevent a lead signal from the dashpot from upsetting the servo contact assemblies.

Step 11: Gently move tension arm up and down from center-of-travel position. Observe outer contact leaves. The outer contact should provide an arm travel of 3/4 inch ±1/4 inch on each side of center before power is applied to reel motor.

NOTE

Turn on the power. With servo motors active, any movement of the tension arm must be made very slowly to prevent a lead signal from the dashpot from upsetting the servo contactor assembly.

Step 12: Slowly move tension arm up from center-of-travel position until full power is applied to reel motor. The null setting before the outer contacts give full power to reel motor is 3/4 inch ±1/4 inch. If full power is given to reel motor before or after the movement of 3/4 inch ±1/4 inch, turn off the electrical power.

Step 13: Using an Allen wrench, gently turn adjustment screw "in" to increase and "out" to decrease tension arm travel null setting.

CAUTION

Do not twist contact leaves during adjustment.

Step 14: Turn on electrical power and repeat Steps 12 and 13 until null setting is within tolerance.

5-27. CHECKOUT AND ADJUSTMENT OF DASHPOT.

Step 1: Thread tape on tape transport.

Step 2: Turn electrical power on.

Step 3: Grasp upper reel and quickly rotate in a clockwise direction, then immediately release. Check that tension arm does not oscillate, but reacts swiftly. Should there be oscillation for more than two cycles, or sluggishness, refer to Steps 6 through 8 below.

Step 4: Repeat for counterclockwise rotation.

Step 5: Repeat Steps 3 and 4 for lower reel.

NOTE

Supply reel and upper tension arm are connected to upper dashpot, takeup reel, and lower tension arm are connected to lower dashpot.

Step 6: See Figure 5-13. Screw in dashpot adjusting screw clockwise to bottom.

Step 7: Grasp reel and turn in either direction until associated outer contact of servo contactor assembly closes. Release reel and permit reel to oscillate.

Step 8: Turn adjusting screw counterclockwise until oscillation stops plus 1/16 of a turn.

5-28. CHECKOUT OF ROTARY TAPE GUIDES. The guides on the tension arms and on the fixed support are checked by spinning each guide separately to ensure that it rotates smoothly and quietly. Stiff or noisy guides should be replaced. Refer to paragraph 5-43.

5-29. CHECKOUT OF ACTUATOR FIRING CIRCUITRY. Operation of the actuator firing circuitry may be checked by programming the transport at the maximum permissible rate. No actuator functions should be missed during this test. Failures should be pinpointed as to the responsible thyratron, e.g., forward on, and the component replaced.

5-30. CHECKOUT OF REEL MOTOR.

Step 1: Remove supply reel.

Step 2: Grasp hold-down knob firmly; push it in and pull out, checking for shaft end play.

Step 3: If any end play is felt, remove and replace reel motor. (Refer to paragraph 5-44.)

NOTE

If evidence of end play cannot be determined by hand, measure it with a dial indicator. End play should be a maximum of 0.005 inch.

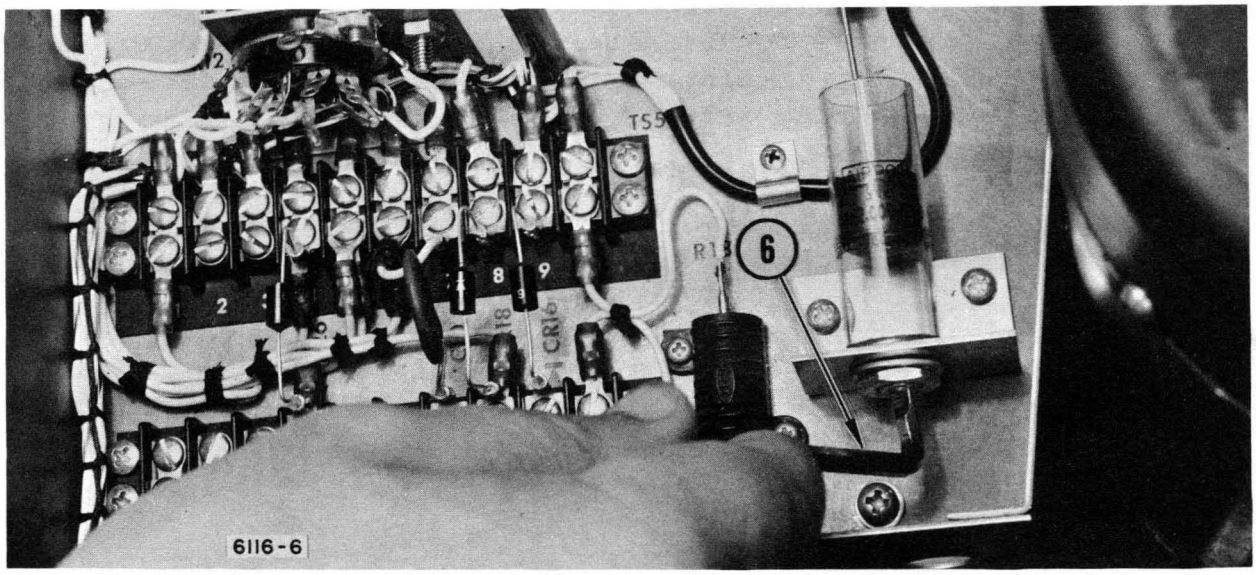


Figure 5-13. Adjusting Servo Dashpot

Step 4: Grasp fixed takeup-reel (or remove any other type of takeup-reel) at the hub and repeat Steps 2 and 3.

5-31. CHECKOUT AND ADJUSTMENT OF REEL BRAKES. (See Figure 5-14.)

Step 1: Turn on electrical power and install an empty reel.

Step 2: Open thread lever handle to thread position and rotate reel in a clockwise and counterclockwise direction. Check for drag of reel brake shoe on turntable brake drum.

Step 3: The reel should spin freely. If any drag is felt, an adjustment of brake spring and solenoid is required.

Step 4: Remove attaching hardware and lay aside terminal mounting strip bracket.

Step 5: Plug tape transport electrical cord into variable transformer.

Step 6: Turn on variable transformer and set line voltage at 100 vac.

Step 7: Turn on electrical power to tape transport.

Step 8: Place 6 inch scale on brake solenoid parallel to plunger. Turn electrical power on and off at the variable transformer, observing travel of the plunger. Plunger travel should be 1/16 inch maximum.

Step 9: If plunger travel needs to be adjusted, loosen but do not remove, solenoid mounting screws. Slide solenoid up or down in slotted holes in plate until proper plunger travel is obtained. Tighten mounting screws.

Step 10: Energize solenoid; plunger should overcome spring tension and pick up at 100 volts. If more than 100 volts is required to move plunger, re-adjust (decrease) spring tension.

Step 11: Turn off transport. Decrease line voltage to 95 volts. Plunger should not pick up. If plunger picks up when power is turned on at 95 volts, re-adjust (increase) brake spring tension.

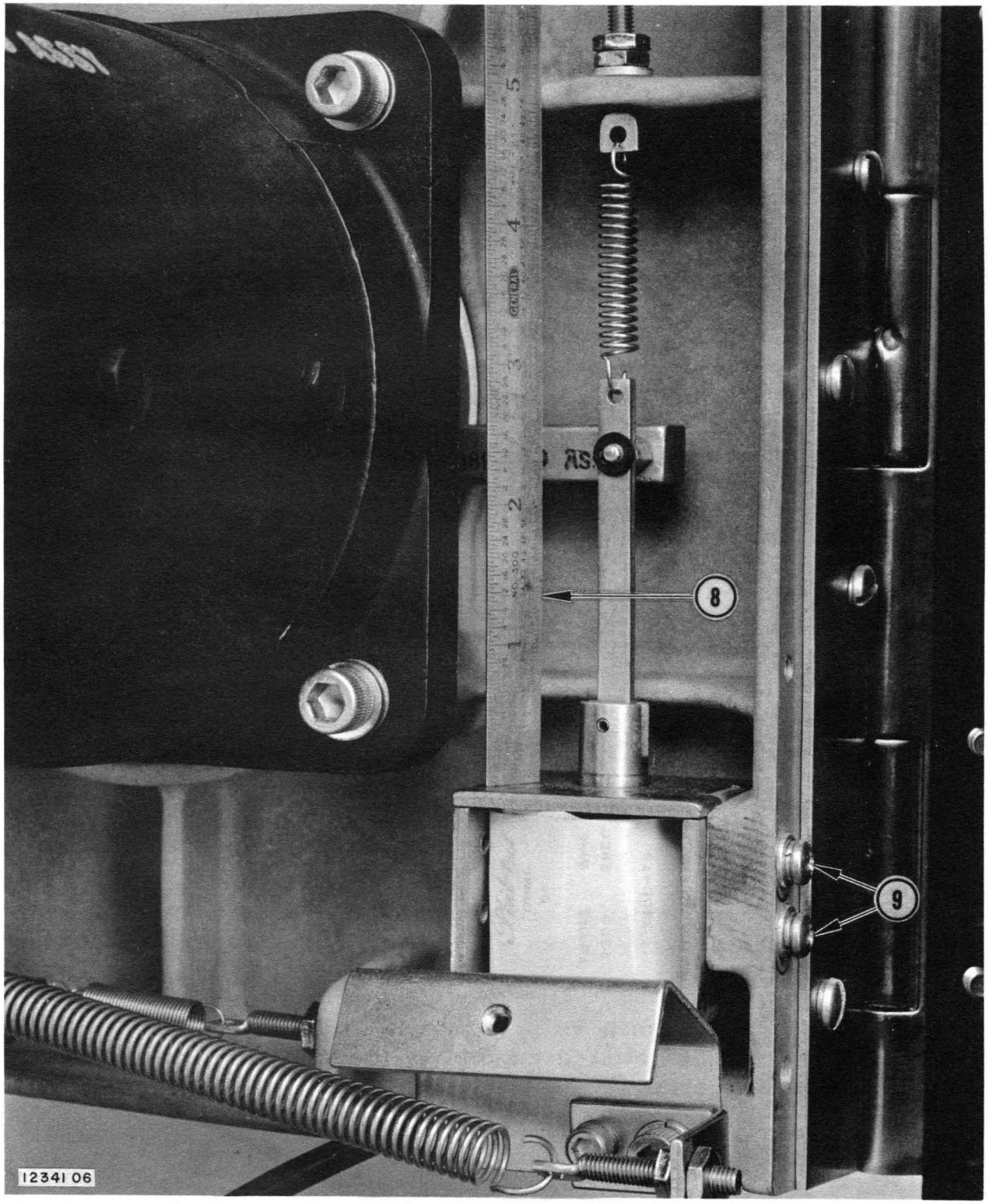


Figure 5-14. Adjusting Reel Brake

5-32. CHECKOUT AND ADJUSTMENT OF WRITE-ENABLE SWITCH ASSEMBLY. (See Figures 5-15a, 1-15b, and 5-15c.)

NOTE

Do not unsolder any connections.

Step 1: Remove write enable switch assembly from tape transport. Refer to paragraph 5-56.

Step 2: Remove attaching hardware and rotary solenoid from actuator bracket.

Step 3: Decrease tension on rotary actuator spring until spring will just return the rotary actuator to a de-energized position when power is turned off. Spring tension is adjusted by moving outer end of coiled spring to desired position. Clockwise movement of outer spring end will decrease tension; counter-clockwise movement will increase tension.

Step 4: Install rotary solenoid on actuator bracket.

Step 5: Measure distance from tip of actuator arm to mounting face of actuator bracket. This distance must be 1 inch. If actuator needs adjustment, see Steps 6 through 8.

Step 6: Loosen lock nut holding set screw on actuator arm.

Step 7: Repeat Step 5 setting proper distance with set screw.

Step 8: Tighten lock nut.

Step 9: Loosen attaching hardware holding switches to actuator bracket so that all switches will slide in slots cut in actuator bracket.

Step 10: Slide switches to a position on actuator bracket so that rollers of switch arms rest on actuator arm without bending switch arms.

Step 11: Tighten attaching hardware.

Step 12: Replace write-enable switch on tape transport. Refer to paragraph 5-56.

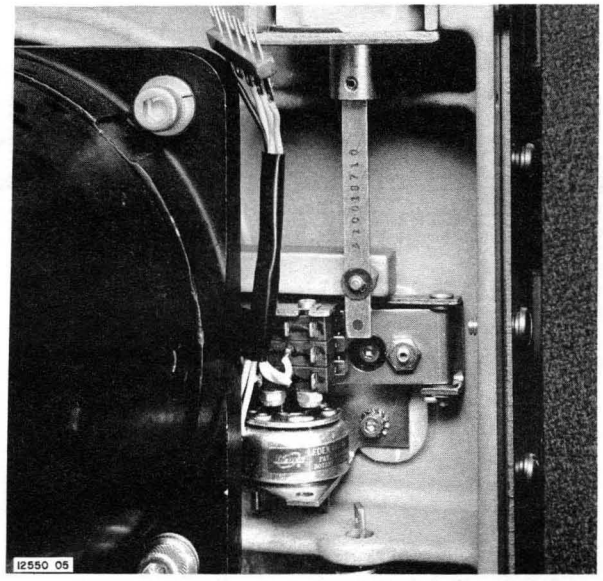
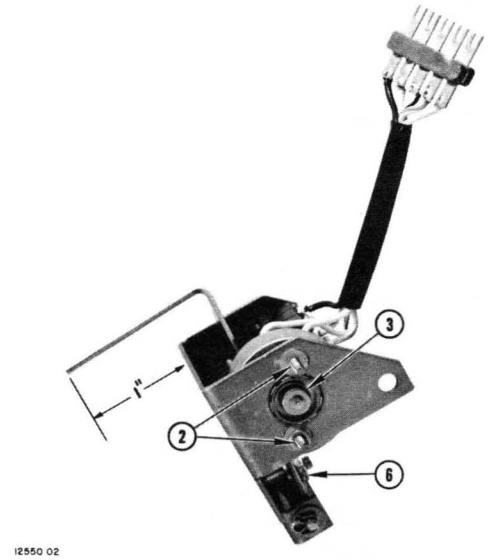


Figure 5-15a.



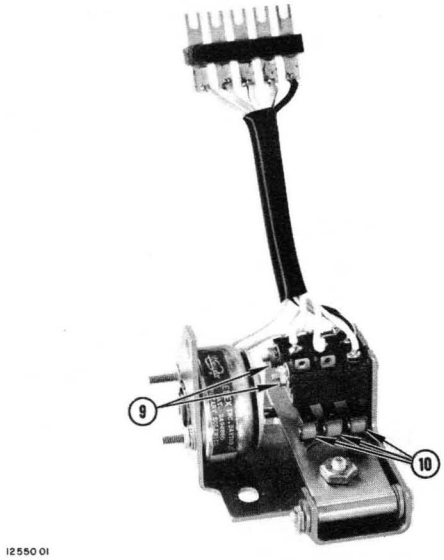


Figure 5-15b.

Figure 5-15c.

Adjusting Write-Enable Switch

5-33. CHECKOUT AND ADJUSTMENT OF BUFFER TIME DELAY. This procedure is for a transport with a buffer delay and interlock unit. The ON command delay-time is adjusted by the horizontally-mounted trimpots (R19 for forward ON, R37 for reverse ON). The OFF command delay-time is adjusted by the vertically-mounted trimpots (R22 for forward OFF, R45 for reverse OFF). Clockwise rotation of the trimpots increases delay time; counter-clockwise rotation decreases delay time.

5-34. CHECKOUT OF HEAD ASSEMBLY.

Step 1: Clean head stacks and head tape guides. Refer to paragraph 5-6.

Step 2: Thread a blank tape known to be in good condition on tape transport.

Step 3: Program tape transport in forward mode.

Step 4: Operate all write amplifiers at a 15 KC bit rate per second (200 bits per inch). All write amplifier inputs should be connected in parallel and in phase.

NOTE

Channel No. 1 is the channel nearest the operator.

Step 5: With tape moving across read/write head stacks, monitor read head output channels 1 through 7.

Step 6: When read pulse width on all channels at the 25% level exceeds 28 usec with a simultaneous decrease in read output voltage below 25 millivolts peak-to-peak, this head assembly should be replaced. Refer to paragraph 5-54, Removal and Replacement of the Head Assembly.

5-35. TROUBLESHOOTING.

5-36. Table 5-3 lists various transport malfunctions, including possible causes and remedies. Table 5-4 lists relay designation, contact number, and function for each relay in the transport.

Table 5-3. Troubleshooting Chart

SYMPTOM	POSSIBLE CAUSE	REMEDY
1. Edge damage to tape (noted by raised edge on reel).	Capstan roller out of adjustment.	Adjust capstan roller (refer to paragraph 5-24).
	Tape rubbing reel flange.	Reseat reel and/or reshim reel hub (refer to paragraph 5-44).
	Severe oxide deposit on tape guides.	Clean tape guides (refer to paragraph 5-6).
2. Poor tape pack.	Edge damage. Note: tape may have been damaged on another tape transport.	See Symptom No. 1.
	Reel not installed properly.	Reinstall reel (refer to Section III).
	Turntable out of line.	Check alignment of hold-down assembly and turntable (refer to paragraph 5-44).
3. Oxide accumulation.	Rough surface on component.	Replace component.
	Dirty tape guides.	Clean guides (refer to paragraph 5-6).
	Worn head.	Replace head (refer to paragraph 5-54).
4. Parity and bit error.	Damaged or worn tape.	See Symptom No. 1, 2, and 3 and/or replace tape.
	Defective or loose head cable connection.	Tighten connector or replace defective connector.
	Dirty or worn out head assembly.	Clean or replace (refer to paragraphs 5-6 and 5-54).

Table 5-3. Troubleshooting Chart (Cont)

SYMPTOM	POSSIBLE CAUSE	REMEDY
4. (Continued)	Capstan roller guides out of adjustment.	Adjust capstan roller guides (refer to paragraph 5-24).
5. Inoperative actuator.	Defective thyratron V1.	Replace thyratron (see schematic).
	Defective rectifier in high voltage bridge.	Replace diode (see schematic.
	Defective capacitor C2.	Replace capacitor C2 (see schematic).
	Defective overload relay.	Clean contact or replace relay or replace fuse F4 (see schematic).
6. Actuator flips but tape does not move.	Capstan roller gap too large.	Adjust capstan roller (refer to paragraph 5-24).
7. Actuator flips but capstan roller bounces off.	Capstan roller gap too tight.	Adjust capstan roller.
8. Only one actuator fails to go either ON or OFF.	Defective actuator.	Replace actuator (refer to paragraph 5-48).
	Defective capacitor C4 or C5.	Replace capacitor.
9. Actuator goes ON but fails to go OFF.	Defective thyratron V13 or V15.	Replace thyratron V13 (forward) or V15 (reverse).
10. Actuator goes OFF but fails to go ON.	Defective thyratron V12 or V14.	Replace thyratron V12 (forward) or V14 (reverse).

Table 5-3. Troubleshooting Chart (Cont)

SYMPTOM	POSSIBLE CAUSE	REMEDY
11. Tension arm oscillates.	Dashpot out of adjustment.	Adjust dashpot (refer to paragraph 5-27).
	Gap null band too narrow.	Adjust servo contacts (refer to paragraph 5-27).
12. Servo contacts arcing.	Mercury relay K12 or K13 contacts shorted.	Replace relay K12 (takeup) or K13 (supply).
	Defective reel motor.	Replace reel motor (refer to paragraph 5-44).
	Defective suppression diode CR26 or CR27.	Replace diode CR26 or CR27 (see schematic).
	Defective mercury relay rectifier diodes CR19 or CR20.	Replace diode CR19 or CR20 (see schematic).
	Gap setting incorrect.	Reset gap (refer to paragraph 5-24).
13. Tension arm travel not enough for tape threading position.	Tension arm cable out of adjustment.	Adjust cable (refer to paragraph 5-43).
	Tension arm return spring deformed.	Replace spring (refer to paragraph 5-43).
14. Reel motor and vacuum unit motor do not shut off when tension arms are all the way out.	Switches S2 and S3 are out of adjustment.	Adjust switches S2 or S3 (refer to paragraph 5-43).
15. Reel motor and vacuum unit motor do not shut off when thread lever handle is opened.	Switch S1 is out of adjustment.	Adjust switch S1 (refer to paragraph 5-43).

Table 5-3. Troubleshooting Chart (Cont)

SYMPTOM	POSSIBLE CAUSE	REMEDY
16. Reel brakes do not release when thread lever handle is in thread position.	Switch S20 is out of adjustment. Reel brake is out of adjustment. Reel brake solenoid not receiving power.	Adjust switch (refer to paragraph 5-43). Adjust reel brake (refer to paragraph 5-31). Check power supply (see schematic).
17. Power failure.	No power input. FA2 10 amp fuse blown.	Check power connections (refer to Section III). Replace fuse and check current (see schematic and refer to Section III).
18. No -24V, -60V and mercury relay power.	FA3 or FA5 3 amp slo blo fuse blown.	Replace fuse (refer to Section III).
19. No vacuum unit or capstan drive motor power; reel brakes stay on; fuses OK.	Defective safety relay K1. 24V power supply inoperative.	Replace safety relay K1 (see schematic). Check 24V power supply (see schematic).
20. Vacuum unit motor operates; fuses OK; no reel motor power present.	Defective diode CR10 or CR13 in reel motor supply. -60V power supply inoperative. Relay contacts dirty.	Replace diode CR10 or CR13 and check circuit (see schematic). Check -60V power supply (see schematic). Clean relay contacts.
21. Reel motor does not have full torque.	Defective mercury relay K12 or K13.	Replace relay K12 or K13 (see schematic).

Table 5-3. Troubleshooting Chart (Cont)

SYMPTOM	POSSIBLE CAUSE	REMEDY
22. Power on, thread lever handle closed, relays do not energize, brakes do not release.	-24V power supply. Defective switches S1, S2, or S3.	Check -24V power supply (see schematic). Replace switch (refer to
23. Power on, thread lever handle closed, relays do not energize, brakes release.	Defective switch S20.	Replace switch (refer to Section VII).
24. In fast rewind mode, tape loop in upper vacuum chamber increases and decreases in size.	Rewind switch S4 is out of adjustment. Vacuum leak.	Gently bend switch arm toward tension arm. Check vacuum chamber door alignment (refer to paragraph 5-25).
25. In fast forward mode, tape loop in lower vacuum chamber increases and decreases in size.	Rewind switch S5 is out of adjustment. Vacuum leak.	Gently bend switch arm toward tension arm. Check vacuum chamber door alignment (refer to paragraph 5-25).
26. One actuator is on and other actuator is fired on.	Buffer and interlock unit.	Replace buffer and interlock unit (refer to Section VII).
27. One or both actuators are in ON position after power to tape transport has been disconnected.	Buffer and interlock unit.	Replace buffer and interlock unit (refer to Section VII).

Table 5-3. Troubleshooting Chart (Cont)

SYMPTOM	POSSIBLE CAUSE	REMEDY
28. No light in photosensor head.	F1 0.25-amp, slo-blo fuse blown.	Replace fuse.
	+6 vdc supply card.	Replace +6 vdc supply card assembly.
29. Photosensor hold circuit time is less than 100 milli-seconds.	Phantastron packet.	Replace phantastron packet.
	Relay K1.	Replace relay K1.

Table 5-4. Relay Function List

RELAY	CONTACT	FUNCTION
K1 Safety	K1A	Applies 117 vac to vacuum unit motor and capstan drive motor
	K1B	Applies -24 vdc to pushbutton control assembly for operation of control relays
	K1C	Provides return of actuators to OFF position when K1 is de-energized (Automatic Mode only)
	K1D	Optional circuit - can be used with warning light
	K1E	Applies -60 vdc to one side of reel motors
K2 Capstan Drive Motor Speed Select	K2A	Applies 6.3 vac to LOW or HIGH speed indicator
	K2B & K2C	Applies 117 vac to LOW or HIGH speed windings of capstan drive motor

Table 5-4. Relay Function List (Cont)

RELAY	CONTACT	FUNCTION
K3 Manual Fast Reverse	K3A	Holding contacts for relay K3
	K3B	Opens ground circuit of relays K4 and K5
	K3C	Transfers ground from S16 to rewind circuit (CCW windings) of supply reel motor
K4 Manual Drive Forward	K4A	Applies control signal for forward actuator ON/OFF operation
	K4B	Holding contacts for relay K4
	K4C	Spare
K5 Manual Drive Reverse	K5A	Applies control signal for reverse actuator ON/OFF operation
	K5B	Holding contacts for relay K5
	K5C	Spare
K6 Manual Fast Forward	K6A	Holding contacts for relay K6
	K6B	Opens ground circuit of relays K4 and K5
	K6C	Transfers ground from S17 to rewind circuit (CW winding) of takeup reel motor
K7 End Reel Sensing	K7A	Opens ground circuit of relay K1, placing transport in standby mode
K8 Automatic/Manual	K8A	Opens -24 vdc circuit to remove power from pushbutton control assembly circuits
	K8B	Removes ground from one side of T9

Table 5-4. Relay Function List (Cont.)

RELAY	CONTACT	FUNCTION
K8 Automatic/Manual (Cont.)	K8C	Removes control signal voltage used for manual control of actuators
	K8D	Removes ground from one side of T8
	K8E	Optional circuit
K9 Overload	K9A & K9B	Removes high voltage applied to V1, V12, V13, V14, and V15
	K9C	Optional circuit, used in conjunction with K1D
K11 "Ready" Delay	K11-3 & K11-9	Time delay before power is applied to transport power supply.
K12 (Mercury Relay)	K12A	Shorts out R11 to apply full power to takeup reel motor
K13 (Mercury Relay)	K13A	Shorts out R12 to apply full power to supply reel motor

5-37. REMOVAL AND REPLACEMENT PROCEDURES.

5-38. REMOVAL AND REPLACEMENT OF THE CAPSTAN ROLLER ASSEMBLY. (See Figure 5-16.)

Step 1: Loosen cap screw on actuator shaft support arm holding outboard bearing.

Step 2: Remove attaching hardware for outboard bearing.

Step 3: Remove attaching hardware and actuator shaft support arm with the outboard bearing intact.

Step 4: Loosen attaching hardware clamping capstan roller assembly to actuator shaft.

Step 5: Remove capstan roller assembly.

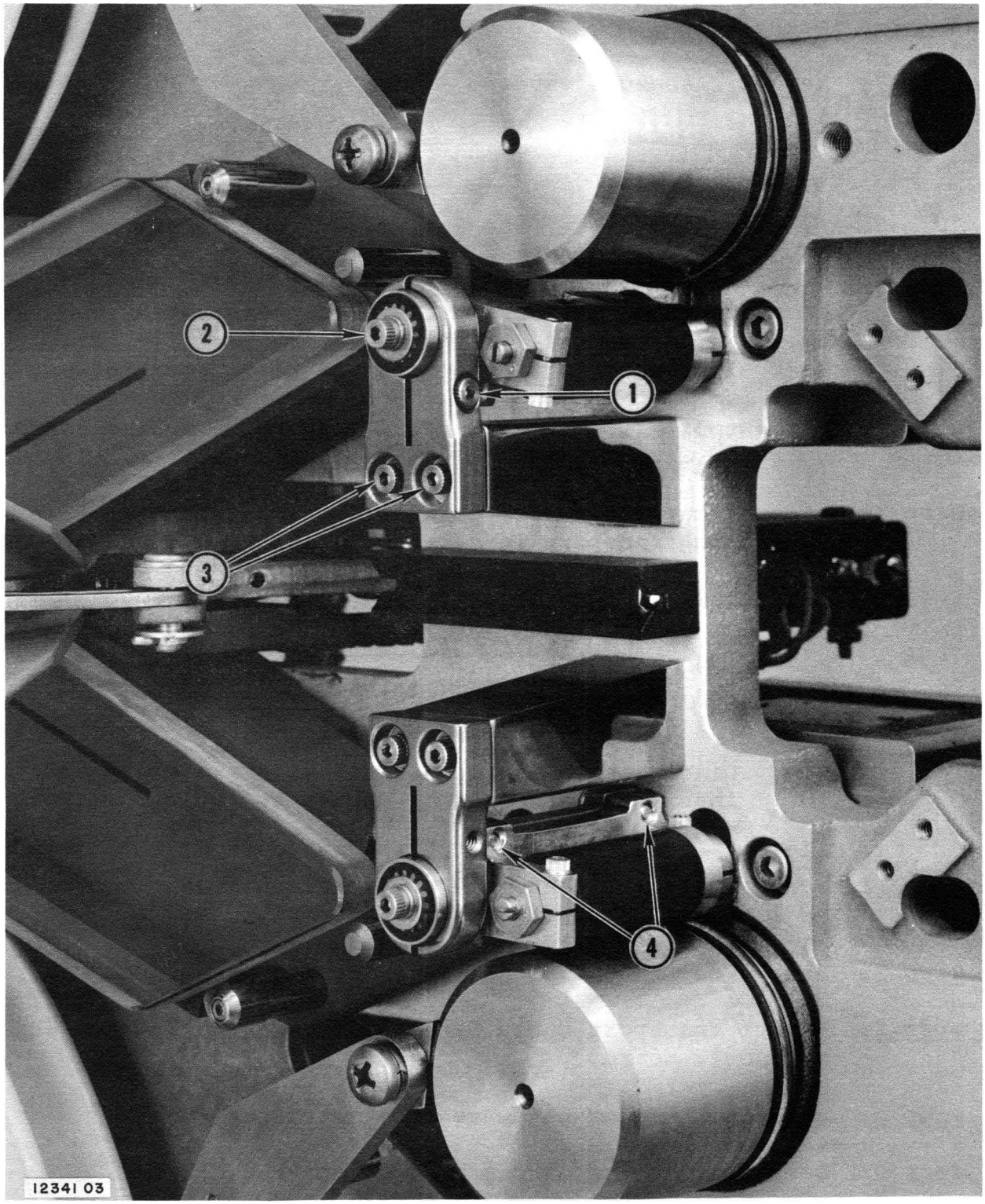


Figure 5-16. Removing Capstan Roller Assembly

Step 6: Loosen attaching hardware clamping capstan roller shaft to yoke.

Step 7: Remove flanged sleeve.

NOTE

Record amount and location of shim washers at each end of capstan roller.

Step 8: Remove capstan roller shaft from capstan roller and yoke.

Step 9: Remove ball bearings from each end of capstan roller.

Step 10: Reassemble capstan roller and yoke by reversing the procedure of Steps 1 through 9.

Step 11: Adjust capstan roller parallelism and gap prior to placing the tape transport in service. (Refer to paragraph 5-24.)

5-39. REMOVAL AND REPLACEMENT OF THE CAPSTAN.

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment may result.

Step 1: Perform Steps 1 through 4 of paragraph 5-34, Removal and Replacement of Capstan Roller Assembly.

Step 2: Remove capstan drive belt. (Refer to paragraph 5-40.)

Step 3: Remove transport cable assembly fanning strip from actuator terminal board.

Step 4: Remove attaching hardware from actuator.

Step 5: Remove attaching hardware from capstan.

Step 6: Remove capstan and actuator together.

Step 7: Reassemble capstan by reversing the procedure of Steps 1 through 6.

Step 8: Adjust capstan and capstan roller parallelism and gap prior to placing tape transport in service. (Refer to paragraph 5-24.)

5-40. REPLACING CAPSTAN DRIVE BELT AND PULLEY ALIGNMENT. (See Figures 5-17 and 5-18.)

Step 1: Remove capstan drive belt by moving belt idler pulley to obtain slack in drive belt.

Step 2: Replace drive belt by installing it on pulleys and taking up slack with belt idler pulley.

Step 3: Visually check alignment of belt and pulleys. Belt should track in a straight line, with tape transport running.

NOTE

If any alignment is needed, use the following procedure.

Step 4: Remove belt.

Step 5: Turn idler arm so that pulleys of idler arm and capstan drive motor are together and matched.

Step 6: Using Allen wrench, loosen set screws in capstan drive motor pulley and adjust to line up with idler arm pulley.

Step 7: Using Allen wrench, loosen set screws on either or both capstan drive pulleys and align with belt roller assembly pulley.

Step 8: Make a loop of nylon twine approximately 18 inches from center to center.

Step 9: Place one end of loop around belt idler arm and hook other end of the loop to scale.

Step 10: Pull scale at a 90° angle to belt idler arm until there is an indication of slack in belt. The scale should read 25 oz. ±2 oz.

Step 11: When any other reading is obtained loosen screw on bracket holding tension spring and raise bracket to increase or lower bracket to decrease the tension. Repeat until proper scale reading is obtained.

Step 12: Reinstall belt and repeat Step 3.

5-41. REMOVAL AND REPLACEMENT OF SERVO CONTACTOR. (See Figure 5-18.)

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Remove cover from servo assembly.

Step 2: Remove centering spring from center leaf of contactor assembly.

Step 3: Disconnect cable leads from terminal board in servo control box assembly.

Step 4: Remove attaching hardware holding cable clamp and cable to servo control box assembly.

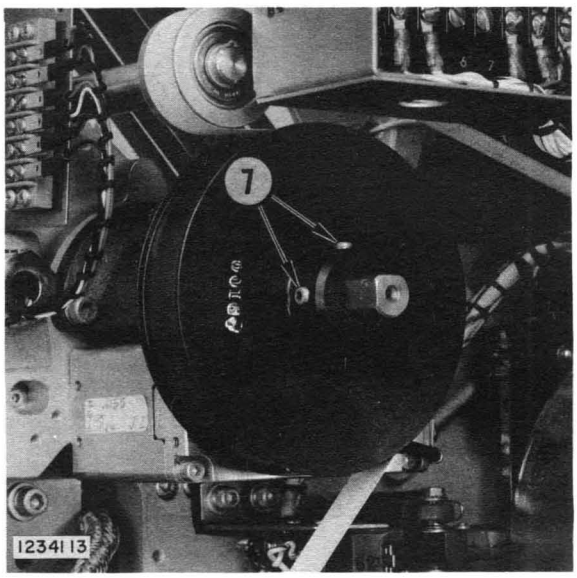


Figure 5-17a.

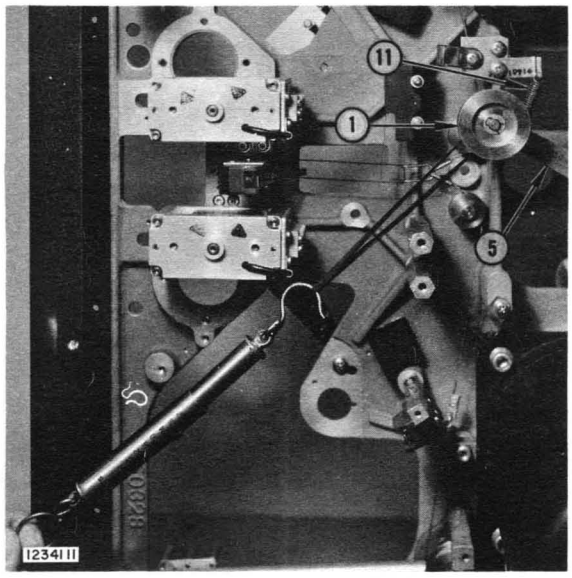


Figure 5-17b.

Removing Capstan Drive Belt

NOTE

Do not let lower dashpot piston drop out of cylinder when lower servo contactor is removed.

Step 5: Loosen set screw holding dashpot connecting rod stiffener to contactor assembly.

Step 6: Loosen cap screw clamping contactor assembly on tension arm mounting shaft, and remove contactor assembly.

Step 7: Reassemble the servo contactor assembly by reversing Steps 1 through 5.

Step 8: Adjust servo contactor. Refer to paragraph 5-26.

5-42. REMOVAL AND REPLACEMENT OF DASHPOT.

Step 1: Loosen set screw holding dashpot connecting rod stiffener to contactor assembly.

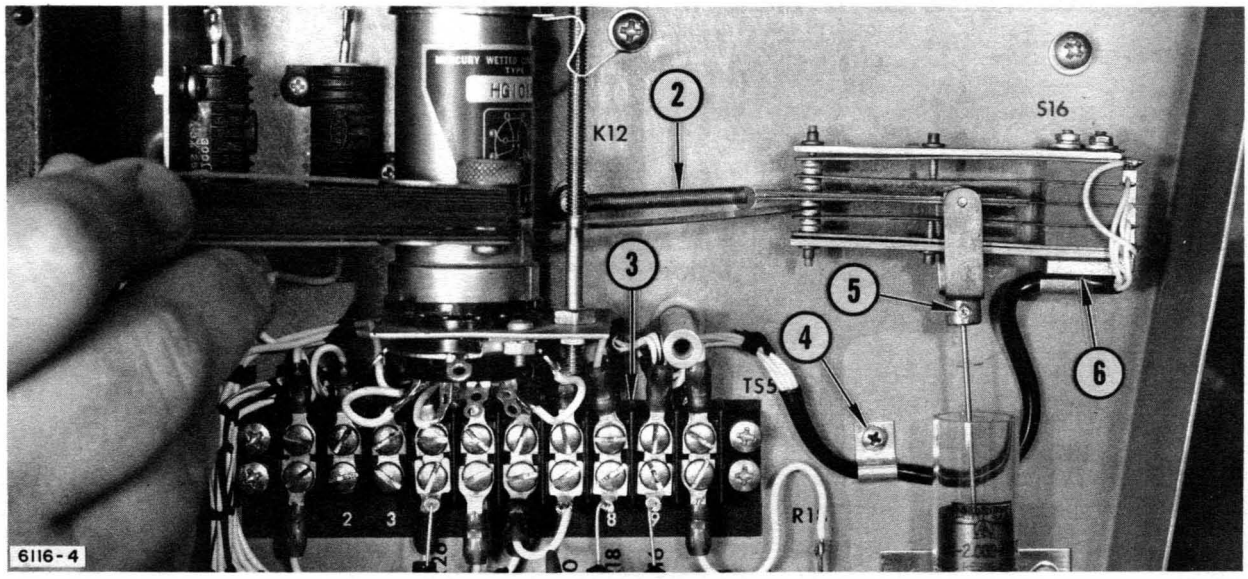


Figure 5-18. Removing Servo Contactor

Step 2: Remove attaching hardware holding dashpot to mounting bracket.

Step 3: Reassemble dashpot by reversing Steps 1 and 2.

Step 4: Adjust dashpot. Refer to paragraph 5-27.

5-43. REMOVAL AND REPLACEMENT OF THE TENSION ARM MOUNTING ASSEMBLY AND TAPE GUIDES. (See Figures 5-19a through 5-19e.

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Remove supply reel.

Step 2: Remove attaching hardware and tension arm tape guide assembly from tension arm.

Step 3: Pull thread lever handle to open to thread position.

Step 4: Remove attaching hardware and right hand half of overlay plate.

Step 5: Pull back to unlock and place thread lever handle in closed position.

Step 6: Remove cover from servo assembly.

CAUTION

Cover cylinder of dashpot to prevent piston from dropping out or dirt from entering cylinder.

Step 7: Complete Step 1, Removal and Replacement of Dashpot.

Step 8: Complete Steps 1 and 5 only, Removal and Replacement of Servo Contactor.

Step 9: Remove attaching hardware and servo assembly (lay it aside).

Step 10: Disconnect long cable assembly from buffer arm cable spring and helical extension spring.

Step 11: Remove attaching hardware and tension arm mounting assembly from transport frame.

NOTE

The following Steps 12 through 20 will be used when removing and replacing parts in tension arm mounting assembly.

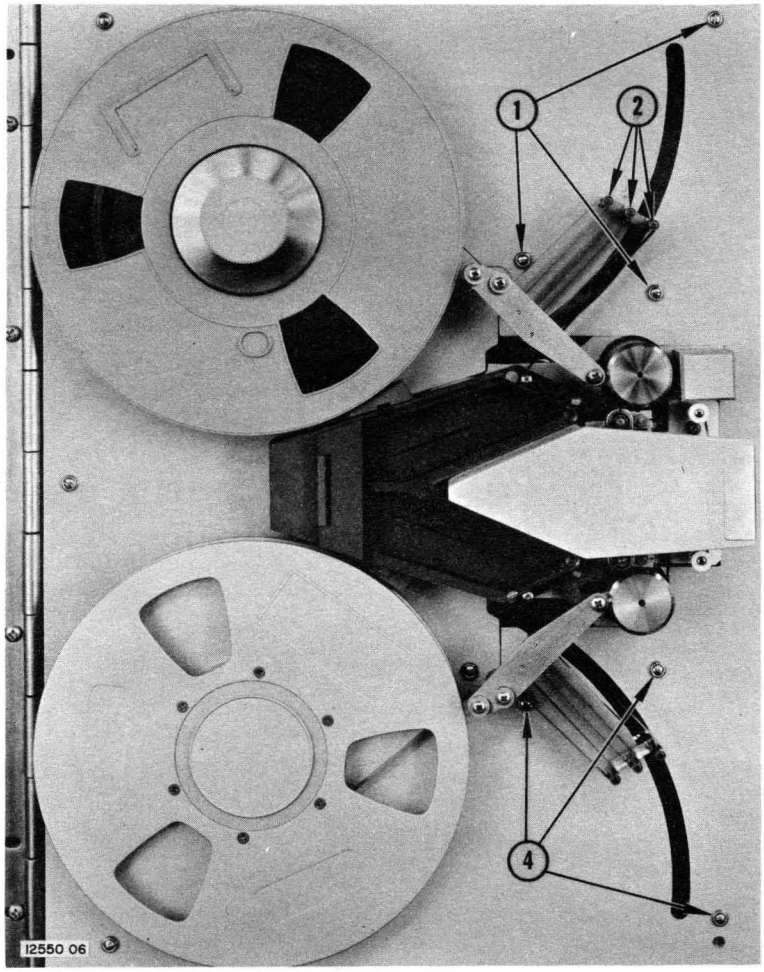


Figure 5-19a.
Removing Tension Arm Mounting Assembly and Tape Guides

Step 12: Remove long cable assembly from cable pulley.

Step 13: Remove internal retaining, flat retaining washer and ball bearing washer from servo contactor end of tension arm shaft.

Step 14: Remove spade bolt from tension arm shaft.

Step 15: Remove ball bearing from servo contactor end of tension arm shaft.

Step 16: Remove external retaining ring and flat washer mounting cable pulley on tension arm shaft.

Step 17: Remove tension arm shaft from tension arm bracket.

Step 18: Remove cable pulley from tension arm shaft.

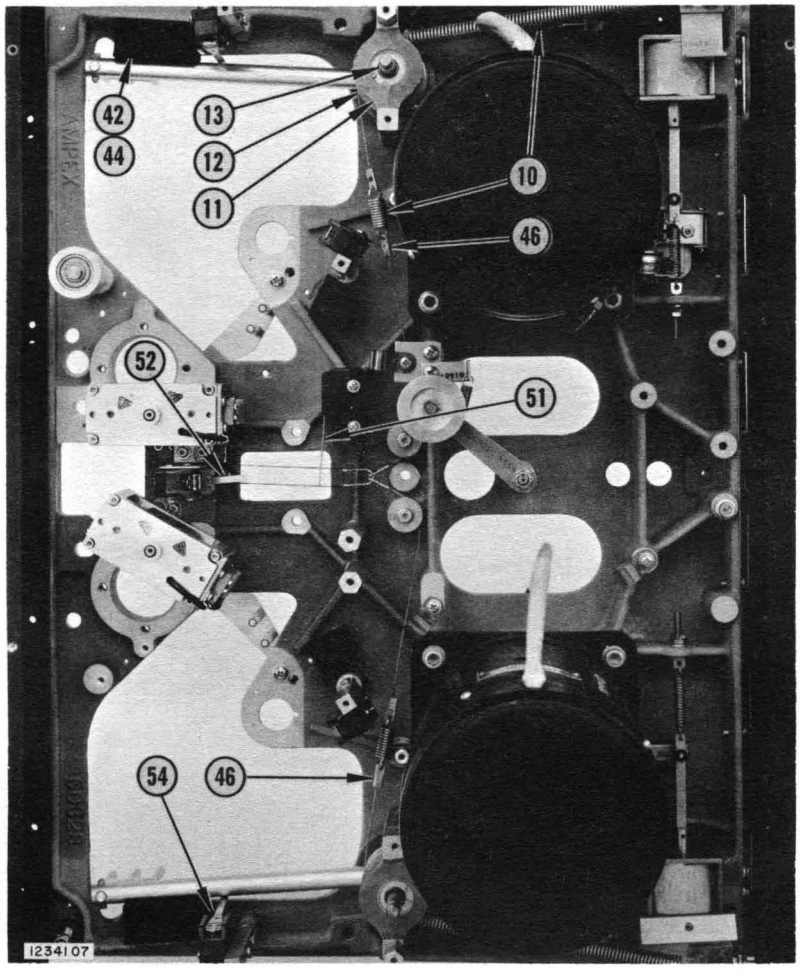


Figure 5-19b.
Removing Tension Arm Mounting Assembly and Tape Guides

Step 19: Remove ball bearing from transport end of tension arm shaft.

Step 20: Remove internal retaining ring from tension arm bracket.

Step 21: Reassemble tension arm mounting assembly by reversing the procedure of Steps 12 through 16.

Step 22: Reassemble the tension arm mounting assembly by reversing the procedure of Steps 1 through 8.

Step 23: Adjust servo contactor. Refer to paragraph 5-24.

Step 24: Adjust dashpot. Refer to paragraph 5-27.

Step 25: Loosen tension arm at end of tension arm shaft, using a 5/32-inch Allen wrench.

Step 26: With tension arm in line with tape guide rollers on stationary tape guide, adjust tension arm length manually until a clearance of 1/16 ±1/64 inch is obtained between each roller.

Step 27: Using 5/32 inch Allen wrench, tighten locking screw enough to hold tension arm in place.

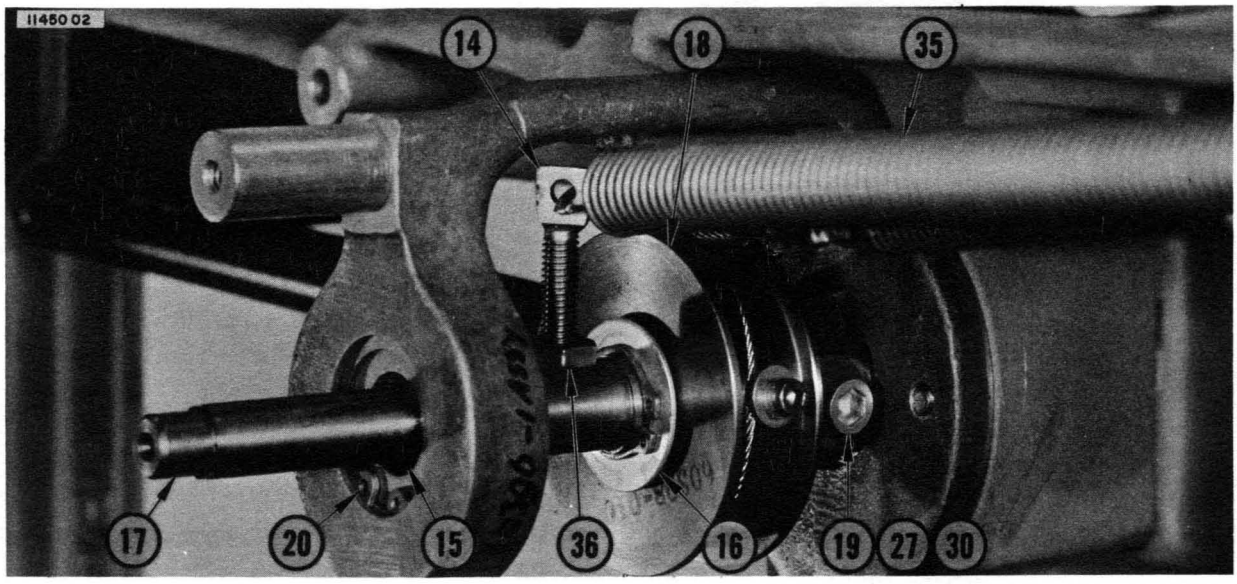


Figure 5-19c.
Removing Tension Arm Mounting Assembly and Tape Guides

Step 28: Move tension arm to top of its travel. Place a 90° angle base on cover plate. Check tension arm tape guide rollers to assure an angle of 90° to cover plate. Tighten tension lock screw.

Step 29: If tension arm tape roller guides do not check out to be 90°, gently turn tension arm until rollers are 90° to cover plate.

Step 30: Recheck clearance setting made in Step 12. If this clearance has not changed, tighten tension arm locking screw to 45 to 50 inch-ounces torque.

Step 31: Make a loop of nylon twine approximately 12 inches from center to center.

Step 32: Place one end of loop around tape guide roller support on tension arm. Feed other end under stationary tape guide and hook it to scale.

Step 33: Holding scale in left hand, place tension arm in center of travel in its arc (marked on cover plate by a small indention).

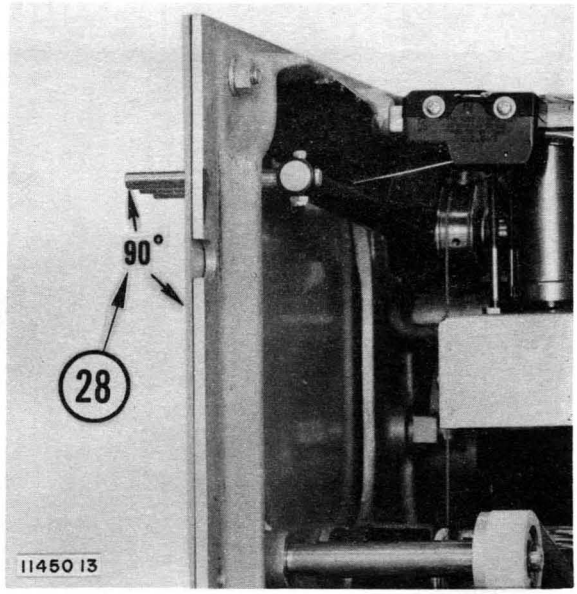


Figure 5-19d. Figure 5-19e.
Removing Tension Arm Mounting Assembly and Tape Guides

Step 34: Hold tension arm, keeping scale at a 90° angle to tension arm. The scale should read 13 to 15 ounces. If any other reading is obtained, use the following procedure for adjustment.

Step 35: Disconnect tension spring from spade bolt screwed into tension arm shaft.

Step 36: Loosen lock nut on spade bolt. Hold spade bolt in position.

Step 37: If tension is below 13 ounces, screw spade bolt out of shaft. If tension is above 15 ounces, screw spade bolt into shaft.

Step 38: Hold spade bolt in new position and tighten lock nut.

Step 39: Connect tension spring to spade bolt.

Step 40: Repeat Steps 30 through 32.

Step 41: With tension arms against bumper, check that rollpin in large cable pulley of tension arm mounting assembly is resting against tension arm. If rollpin is not resting against tension arm, adjust as detailed below.

Step 42: With tension arms placed against bumper, pull thread lever handle open. Tension arms should start to move to tape threading position when thread lever handle has been moved approximately ½ inch. If one or both tension arms fail to respond in the above described manner, adjust as detailed below.

Step 43: Open thread lever handle. Tension arms should move to tape threading position on a direct line with vacuum chamber guides. A minimum distance of ½ inch is required between tension arm and stationary tape guides.

NOTE

If tension arms do not line up with the vacuum chamber guides, adjust as detailed in Steps 43 through 47.

Step 44: With thread lever resting against stop (operating position), place tension arm against tension arm bumper.

Step 45: Check rollpin in large cable pulley of tension arm mounting assembly to be sure that it is resting against tension arm. If not, loosen cable clamping screws on large cable pulley.

Step 46: Starting at point where cable connects to thread lever handle and working towards large cable pulley, slip cable back and forth until all slack between tension arm shaft of the tension arm mounting assembly and cable equalizing spring is removed.

Step 47: Slowly open thread lever handle to tape thread position.

Step 48: Measure distance of travel of thread lever handle as it leaves stop in closed position. At a distance of between ½ inch and 1 inch of travel, thread lever handle switch should de-energize brake solenoids and safety relay K1.

Step 49: Bend, but do not twist, actuating arm of thread lever handle switch until proper thread lever handle travel is obtained.

Step 50: Open thread lever handle. The switch must energize brake solenoids after thread lever handle has traveled one-half of distance between closed position and just prior to full locked open position.

Step 51: Observe actuating arm of switch to ensure arm clears pawl and will not cause a malfunction of thread lever handle operations.

Step 52: Bend, but do not twist, actuating arm of tape brake switch until proper thread lever handle travel is obtained.

Step 53: Move tension arm gently in its arc, toward tension arm bumper from back of casting. The tension arm should actuate limit switch 1/8 inch ±1/16 inch and turn off electrical power before tension arm rests against tension arm bumper.

Step 54: Bend, but do not twist, actuating arm of limit switch up or down to increase or decrease distance.

Step 55: Repeat Step 42.

5-44. REMOVAL AND REPLACEMENT OF REEL MOTOR ASSEMBLY AND BRUSHES.

NOTE

Steps 12 through 14 shall be used for removal and replacement of reel motor brushes. Brushes may be replaced with reel motor mounted to tape transport.

Step 1: Remove reel (supply or takeup) of reel motor to be replaced.

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 2: Remove reel motor fanning strip from tape transport terminal.

Step 3: Remove attaching hardware and reel motor from tape transport plate.

CAUTION

Do not re-use any shims found under reel hub and mounting flange of reel motor.

Step 4: Remove reel hold-down knob assembly and shims.

Step 5: Install reel hold-down knob assembly without shims.

Step 6: Install reel motor without shims.

Step 7: Thread tape on tape transport.

CAUTION

Careful observation is needed to prevent damage to tape or tape transport.

Step 8: Program tape transport forward and reverse, observing tape tracking at reel of newly installed reel motor.

NOTE

Use Step 9 or 10 as required by Step 8.

Step 9: If tape rubs rear flange of reel, shims are needed between reel motor mounting flange and tape transport plate. Put the same size and number of shims under each mounting flange hole to keep reel motor and turntable in a parallel plane to overlay plate. Shims are necessary until proper tape tracking is achieved.

Step 10: If tape rubs front flange of reel, shims are needed between reel hold down assembly and turntable. Shims are necessary until proper tape tracking is achieved.

Step 11: Repeat Steps 8, 9, or 10 until tape tracking is correct.

Step 12: Remove attaching hardware and dust cover from reel motor.

Step 13: Remove attaching hardware, lift spring up, and remove reel motor brush.

Step 14: Reassemble reel motor brushes by reversing Steps 12 and 13.

5-45. REMOVAL AND REPLACEMENT OF REEL BRAKE SHOE. (See Figure 5-14.)

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Remove reel motor (refer to paragraphs 5-44 and 5-45), upper reel motor, upper brake shoe, lower reel motor, lower brake shoe.

Step 2: Loosen reel-brake lock nut and adjusting nut.

Step 3: Remove tension spring.

Step 4: Remove cap screw and bushing from pivot end of brake shoe.

Step 5: Remove cotter pin, washer, and disconnect brake from link.

Step 6: Reassemble reel brake shoe assembly by reversing Steps 1 through 5.

Step 7: Adjust reel brake assembly (refer to paragraph 5-31).

5-46. REMOVAL AND REPLACEMENT OF VACUUM UNIT MOTOR, FILTER AND BRUSHES. (See Figure 5-20.)

CAUTION

Filter must be thoroughly dry before installation or damage to equipment may result.

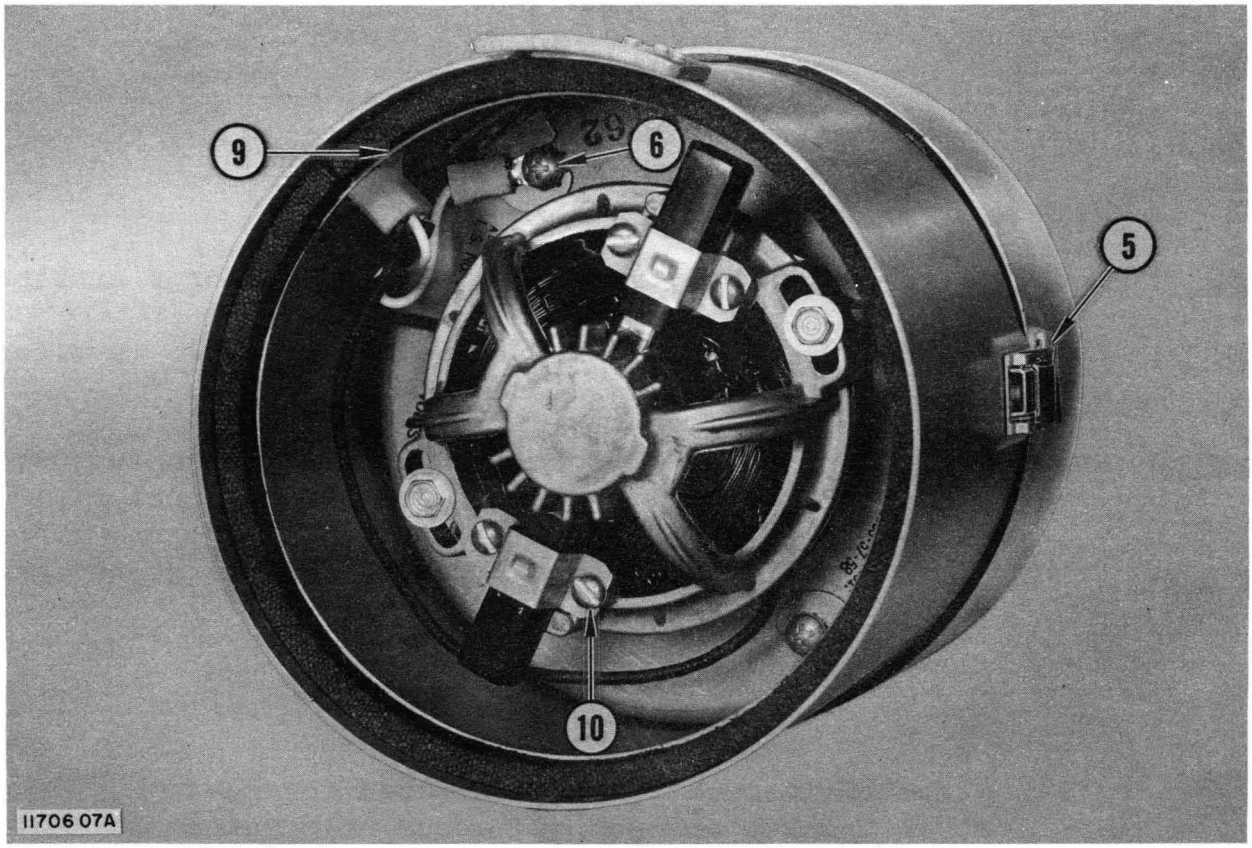


Figure 5-20. Removing Vacuum Unit Motor and Brushes

Step 1: Unlatch lever arm which holds filter in motor housing assembly.

Step 2: Remove filter using the two loops attached.

Step 3: Reassemble filter by reversing Steps 1 and 2.

NOTE

Steps 4 through 9 shall be used for the removal and replacement of the vacuum unit motor.

Step 4: Disconnect power cable at vacuum unit motor assembly.

Step 5: Unsnap latches on motor housing assembly and remove this assembly from mounting bracket.

NOTE

If spare vacuum unit is available, replace old unit with spare at this point and continue maintenance procedure without affecting transport downtime.

Step 6: Loosen screws attaching vacuum unit motor to motor housing.

Step 7: Rotate vacuum unit motor until attaching hardware is clear of slotted bracket.

Step 8: Remove vacuum unit motor from motor housing assembly just far enough to take up slack in wires of chassis connector plug.

Step 9: Squeeze nylon clips together and remove chassis connector plug from motor housing assembly.

NOTE

Steps 10 through 13 shall be used for removal and replacement of vacuum unit motor brushes.

Step 10: Remove attaching hardware holding brush holder to motor frame.

Step 11: Remove old brush and insert new one.

Step 12: Reassemble brush holder to motor frame.

Step 13: Repeat Steps 10 through 12 for second brush.

Step 14: Reassemble vacuum unit by reversing steps 1 through 14.

5-47. REMOVAL AND REPLACEMENT OF THE VACUUM CHAMBER AND THREAD LEVER ASSEMBLY.

WARNING

Disconnect electrical power to the tape transport to prevent injury to personnel or damage to equipment.

Step 1: Remove vacuum unit motor (refer to paragraph 5-46).

Step 2: Remove attaching hardware and blower bracket.

Step 3: Remove blower tube.

Step 4: Place thread lever handle in operating position.

Step 5: Disconnect short cable assembly from cable spring.

CAUTION

Be sure not to let the vacuum chamber and thread lever handle assembly, which come off together, fall from the tape transport.

Step 6: Remove attaching hardware from vacuum chamber. When removing vacuum chamber and thread lever handle assembly from tape transport plate, the assembly must be tilted to permit attaching linkage to be lifted through opening in tape transport plate.

Step 7: Reassemble vacuum chamber and thread lever handle assembly by reversing Steps 1 through 6.

Step 8: Adjust vacuum chamber. Refer to paragraph 5-25.

5-48. REMOVAL AND REPLACEMENT OF THE ACTUATOR. Removal and replacement of the actuator is identical to paragraph 5-39, Removal and Replacement of the Capstan.

5-49. REMOVAL AND REPLACEMENT OF HEAD CABLE AND BOX ASSEMBLY.

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Disconnect head cables from head box.

Step 2: Remove cover from servo control assembly.

Step 3: Remove attaching hardware and box assembly from servo control assembly.

Step 4: Remove attaching hardware and cable retainer from box assembly.

Step 5: Remove attaching hardware from female receptacle connector.

Step 6: Push cable assembly into box approximately 2 inches; lift female receptacle connector off box assembly.

Step 7: Tilt female receptacle connector downward so that it is parallel to cable assembly. Gently push female receptacle connector through slot opening in box assembly, at the same time gently pull cable assembly out of box assembly.

Step 8: Reassemble head cable and box assembly by reversing Steps 1 through 7.

Step 9: Make a continuity check of cable assembly prior to placing in operation.

5-50. REMOVAL AND REPLACEMENT OF THE CAPSTAN DRIVE MOTOR AND MOTOR CAPACITOR. (See Figure 5-21.)

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Remove capstan drive motor fanning strip from terminal strip.

Step 2: Remove capstan drive belt (refer to paragraph 5-40).

Step 3: Remove attaching hardware and lay aside terminal mounting strip bracket.

Step 4: Remove attaching hardware and capstan motor bracket from tape transport plate.

Step 5: Unsolder leads from capacitor to motor.

Step 6: Loosen set screws and remove pulley.

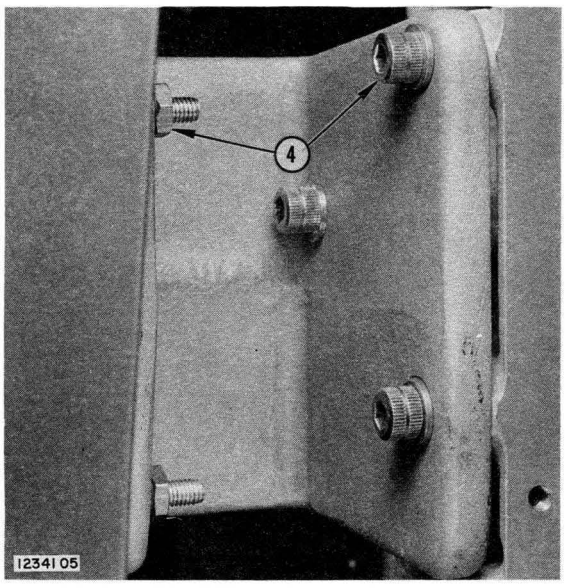


Figure 5-21.
Removing Capstan Drive Motor

Step 7: Remove attaching hardware and capstan drive motor from capstan motor bracket.

Step 8: Remove attaching hardware and motor capacitor from capstan motor bracket.

Step 9: Reassemble capstan drive motor assembly by reversing Steps 1 through 8.

Step 10: Adjust capstan drive. Refer to paragraph 5-40.

5-51. REMOVAL, REPLACEMENT, AND ALIGNMENT OF VACUUM CHAMBER DOOR. (See Figure 5-22.)

NOTE

Do not move the hinge block. If hinge block is moved, vacuum chamber door will have to be aligned.

Step 1: Open vacuum chamber door.

Step 2: Remove set screw in hinge block.

Step 3: Remove hinge pin, being very careful not to move hinge block and vacuum chamber door.

NOTE

Steps 4 through 6 shall be used to align vacuum chamber door.

Step 4: Loosen attaching hardware holding hinge block to vacuum chamber.

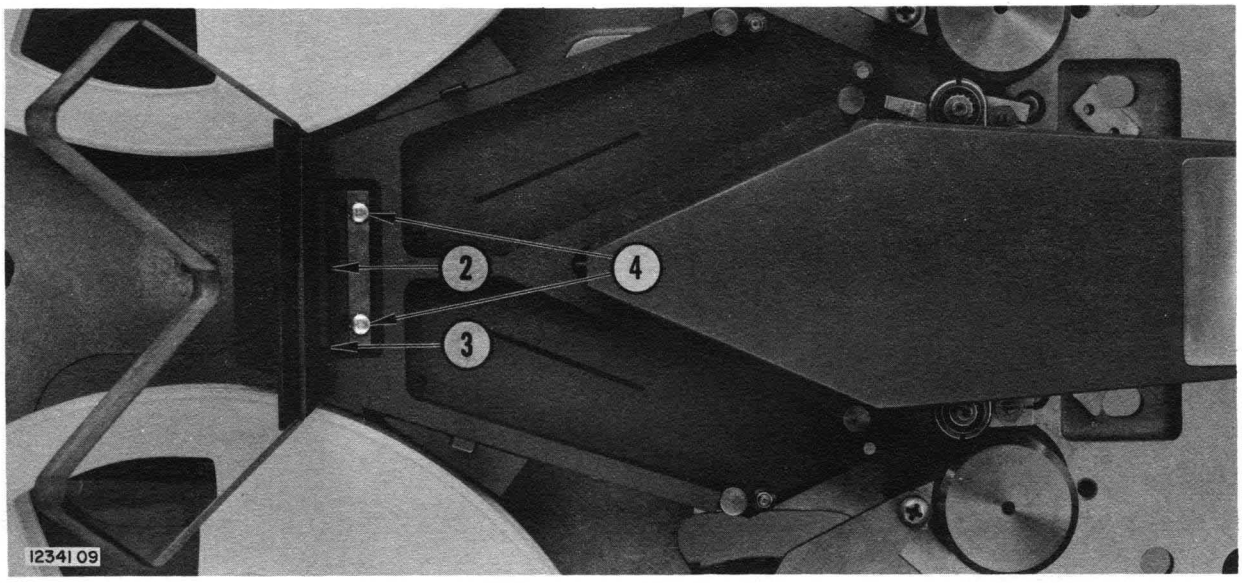


Figure 5-22. Removing Vacuum Chamber Door

NOTE

Steps 5 and 6 must be done together.

CAUTION

Care must be taken when moving the vacuum chamber door to avoid scratching the thread lever assembly.

Step 5: Slide vacuum chamber door as close as possible in a vertical plane to thread lever handle without interfering with the operation of thread lever handle.

Step 6: Slide vacuum chamber door up and down in a horizontal plane until the opening between vacuum chamber door and tape guide pins is an equal distance for the upper half and lower half of vacuum chamber door.

Step 7: Reassemble vacuum chamber assembly by reversing Steps 1 through 6.

Step 8: Prior to placing tape transport in service checkout and adjustment for tape tracking (refer to paragraph 5-25) is required.

5-52. REMOVAL AND REPLACEMENT OF THE ACTUATOR BOARD ASSEMBLY.

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Disconnect all connectors at transport electronics chassis assembly.

Step 2: Remove attaching hardware and chassis cover from tape transport.

Step 3: Remove attaching hardware and etched board cover from electronics chassis assembly.

Step 4: Remove tube shield and thyratron tube from etched board assembly.

Step 5: Remove attaching hardware and etched board assembly from electronics chassis assembly.

Step 6: Reassemble actuator board assembly by reversing Steps 1 through 5.

5-53. REMOVAL AND REPLACEMENT OF PHOTOSENSOR HEAD ASSEMBLY. (See Figure 5-23.)

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Disconnect photosensor head cable from terminal strip.

Step 2: Remove hollow stud from photosensor head assembly.

Step 3: Gently draw the photosensor head cable through hollow stud.

NOTE

Photosensor head must be mounted with its bottom surface parallel to edge of mounting base of head assembly and 5/32 ±1/32 inch from tape.

Step 4: Reassemble photosensor head assembly by reversing Steps 1 through 3.

5-54. REMOVAL AND REPLACEMENT OF THE HEAD ASSEMBLY.

Step 1: Remove tape from head assembly.

Step 2: Disconnect read and/or write cable connectors.

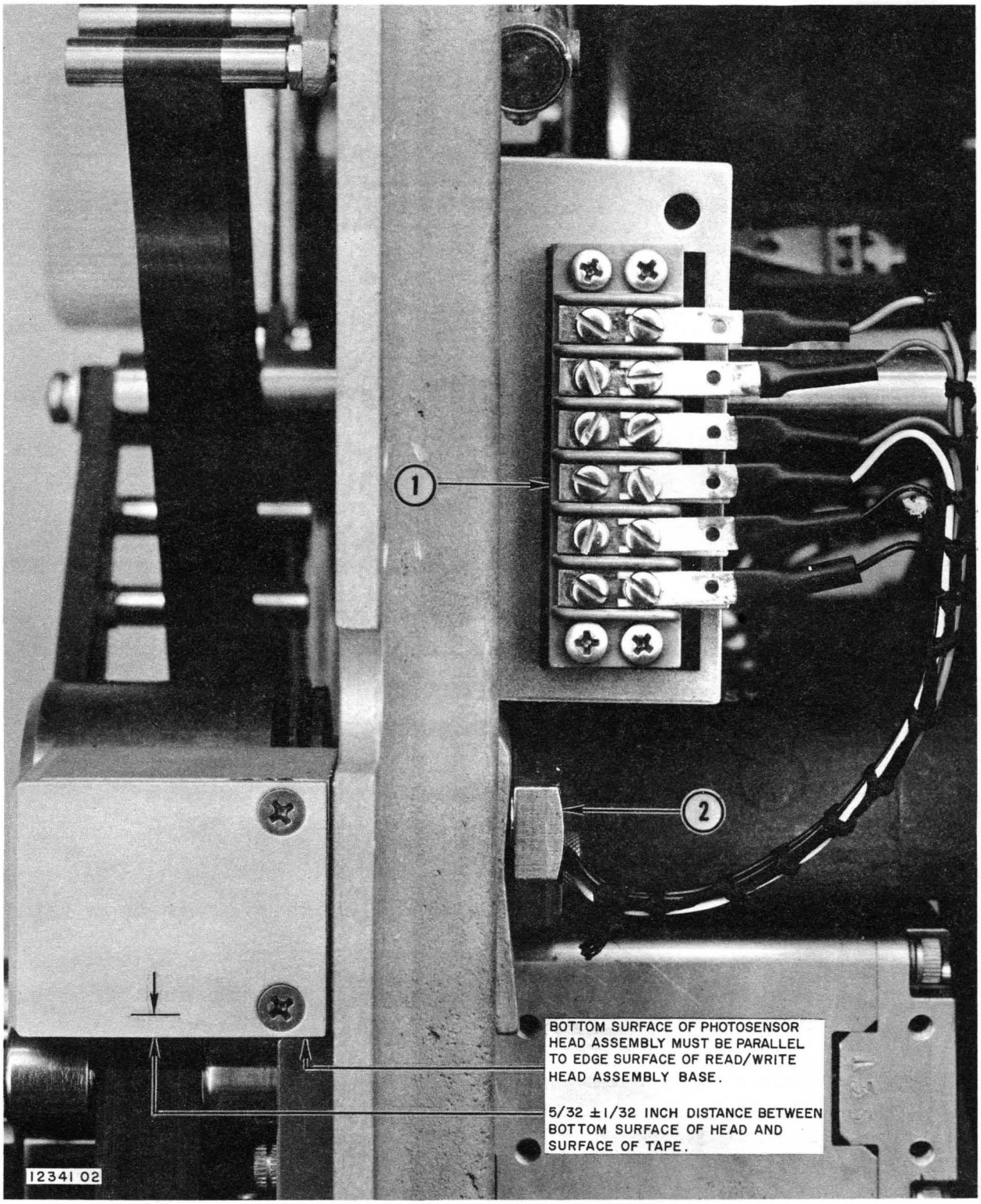


Figure 5-23. Removing Photosensor Head Assembly

Step 3: Remove attaching hardware and cable clamp from tape transport plate.

Step 4: Remove attaching hardware and head assembly from tape transport plate.

NOTE

If head guides are to be replaced, remove attaching hardware from front and back of head assembly plate.

Step 5: Reassemble head assembly by reversing Steps 1 through 4.

Step 6: Prior to placing the tape transport in operation, the procedures in paragraph 5-25 (checkout for tape tracking) must be performed.

5-55. REMOVAL AND REPLACEMENT OF HIGH VOLTAGE POWER SUPPLY FUSE.

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Remove attaching hardware and chassis cover from tape transport.

Step 2: Remove high voltage power supply 0.5 amp fuse from electronics chassis assembly.

Step 3: Reassemble electronics chassis assembly by reversing Steps 1 through 3.

5-56. REMOVAL AND REPLACEMENT OF THE WRITE ENABLE SWITCH ASSEMBLY.

WARNING

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Unlock, swing open and lock open tape transport.

Step 2: Remove write-enable-switch fanning strip from terminal strip.

Step 3: Remove attaching hardware and lay aside terminal strip mounting bracket, for TS-1 and TS-2, from transport frame (vertically-mounted, long terminal strips directly behind brake solenoid).

Step 4: Disconnect brake solenoid spring.

NOTE

Perform Steps 5 and 6 for removal and replacement of rotary solenoid.

Step 5: Unsolder solenoid leads.

Step 6: Remove attaching hardware and rotary solenoid from mounting bracket.

NOTE

Use Steps 7 through 9 for removal and replacement of actuator switch.

Step 7: Unsolder solenoid leads.

Step 8: Loosen attaching hardware and remove actuator switch from mounting bracket.

Step 9: Unsolder switch leads from fanning strip.

Step 10: Reassemble write enable switch assembly by reversing Steps 1 through 9.

Step 11: Prior to placing transport in operation, complete procedures in paragraph 5-32.

SECTION VI
DRAWINGS

6-1. INTRODUCTION.

6-2. This section contains schematic drawings pertinent to the TM-4 Tape Transport and its components. A complete listing of all drawings in Section VI is given in the List of Illustrations at the front of this manual

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL DIODES ARE IN2069.
   ALL RESISTORS IN OHMS
   ALL CAPACITORS IN MICROFARADS
   ALL RELAYS SHOWN IN DEENERGIZED POSITION
2. SI IS SHOWN IN A POSITION WHEN THE MACHINE IS IN AN OPERATING CONDITION.
3. RED WIRES CARRY -60V.D.C.
   YEL. WIRES CARRY -24V.D.C.
   BRN. WIRES CARRY 117V.A.C.
   BRN. & WHT. TWISTED WIRES CARRY LINE VOLTAGE
   BLACK WIRES ARE GRD RETURNS.
4. DOT "•" DENOTES LOWER CASE LETTERS
5. ALL GROUND CONNECTIONS (⏚) ARE CONNECTED TO A POINT NEAR TS 15-1

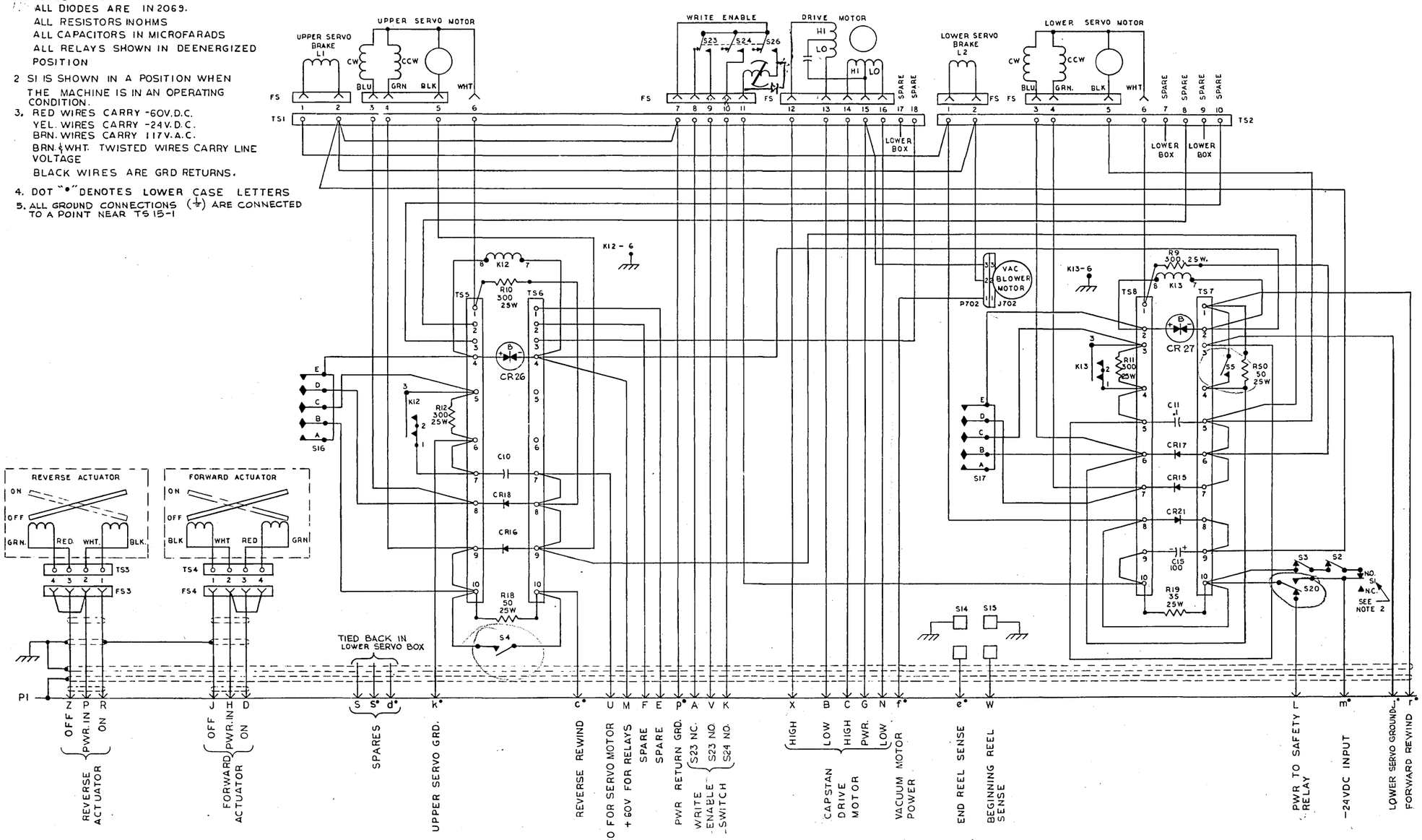


Figure 6-1
Tape Transport Assembly, Schematic Diagram
(31 02335 10B)

1. UNLESS OTHERWISE SPECIFIED:
   ALL DIODES ARE IN2069.
   ALL RESISTORS IN OHMS
   ALL CAPACITORS IN MICROFARADS
   ALL RELAYS SHOWN IN DEENERGIZED POSITION
2. SI IS SHOWN IN A POSITION WHEN THE MACHINE IS IN AN OPERATING CONDITION.
3. RED WIRES CARRY -60V.D.C.
   YEL. WIRES CARRY -24V.D.C.
   BRN. WIRES CARRY 117V.A.C.
   BRN. & WHT. TWISTED WIRES CARRY LINE VOLTAGE
   BLACK WIRES ARE GRD RETURNS.
4. DOT "•" DENOTES LOWER CASE LETTERS
5. ALL GROUND CONNECTIONS (⏚) ARE CONNECTED TO A POINT NEAR TS 15-1

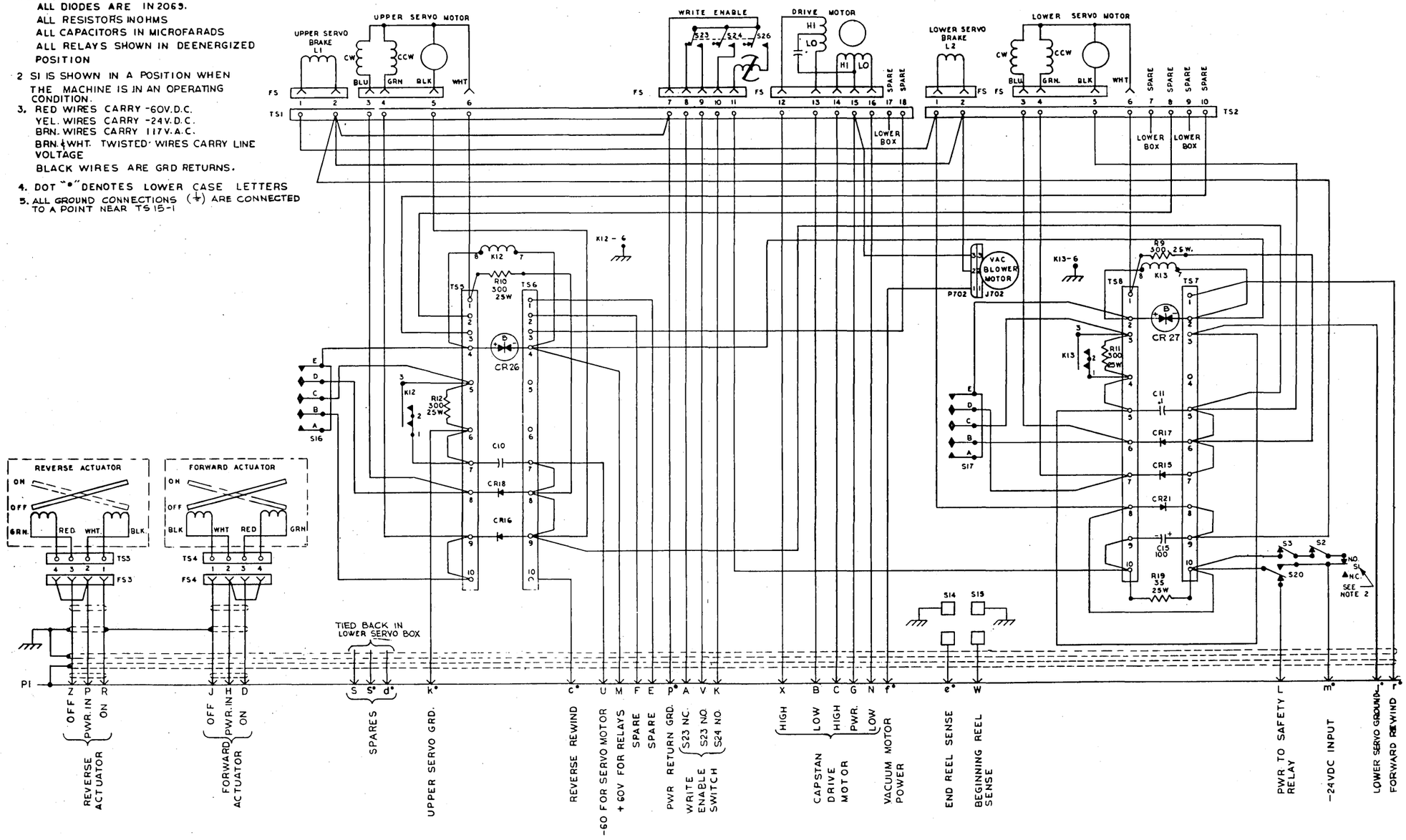


Figure 6-1.
Tape Transport Assembly, Schematic Diagram
(31 04438 10C)

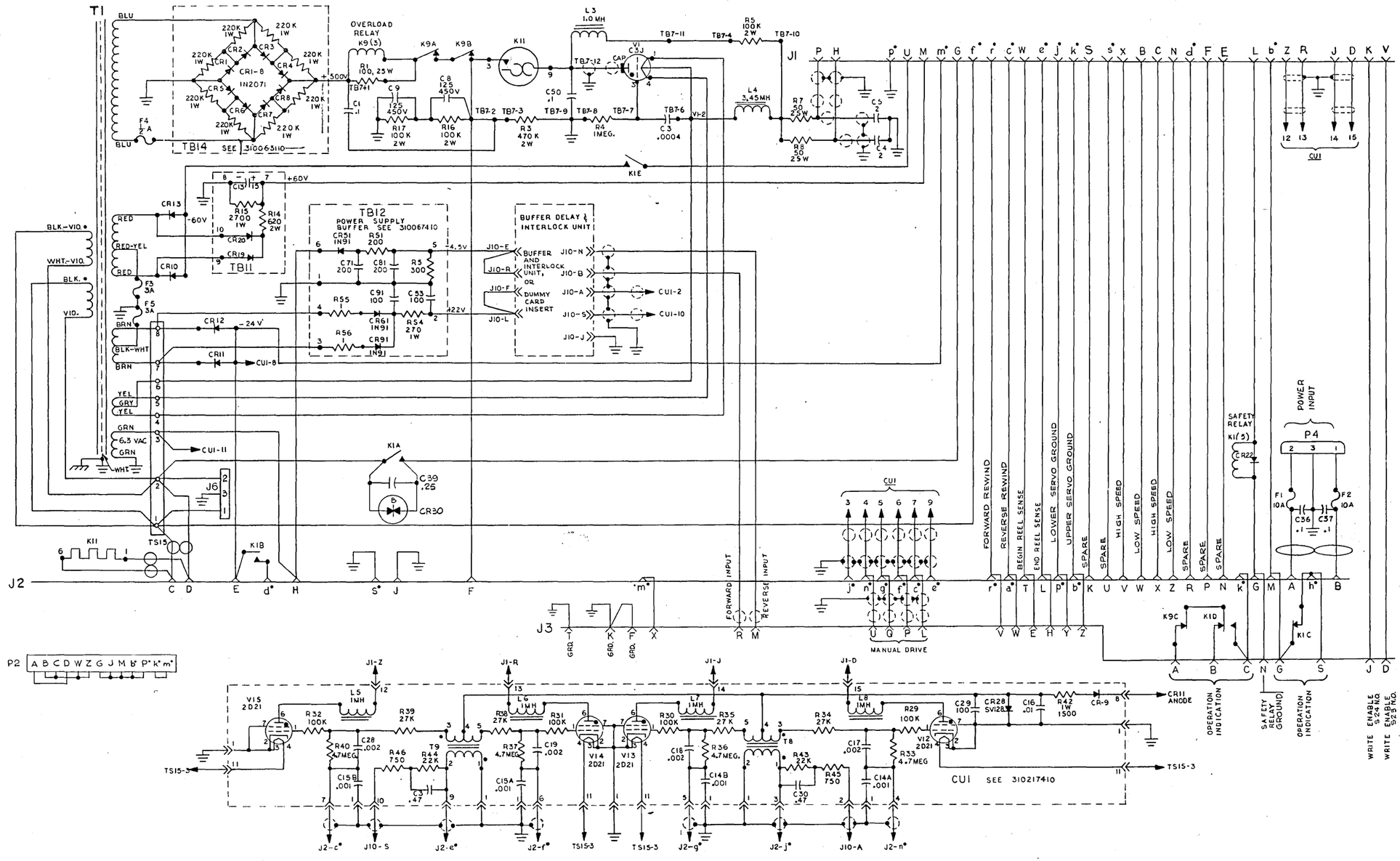


Figure 6-2
Transport Electronics Assembly, Schematic Diagram
(31 02335 10B)

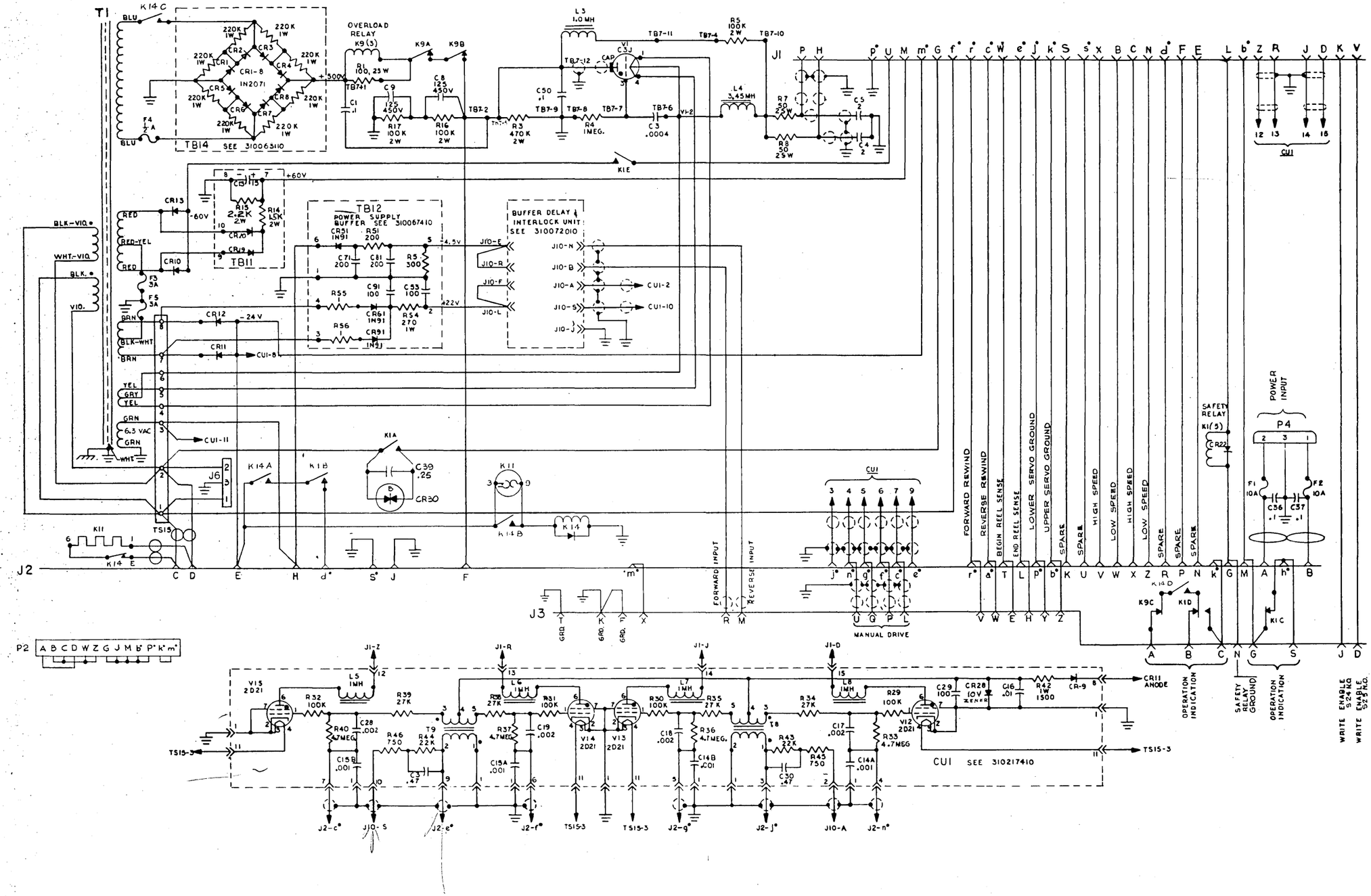


Figure 6-2.
Transport Electronics Assembly, Schematic Diagram
(31 04438 10C)

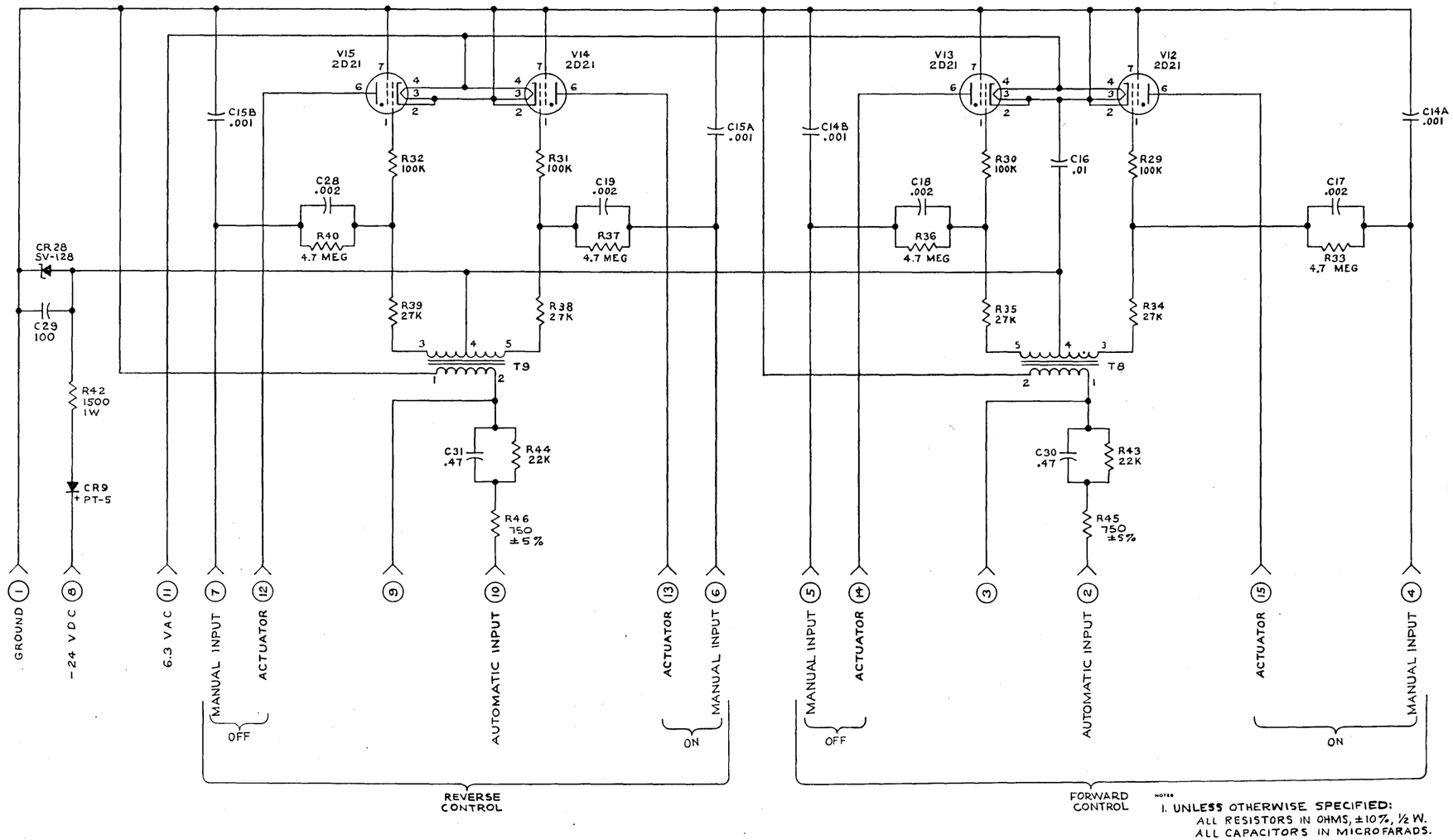
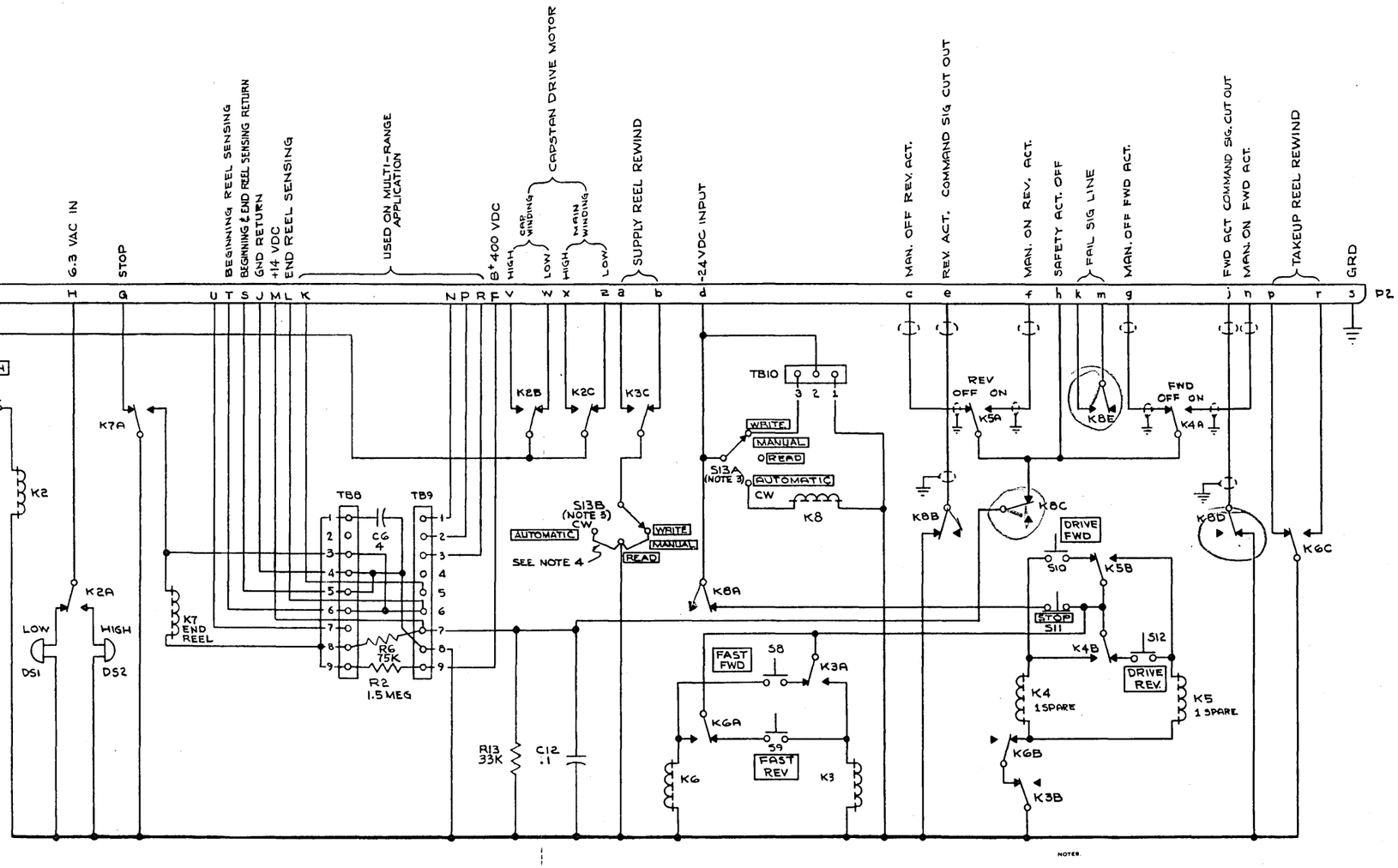


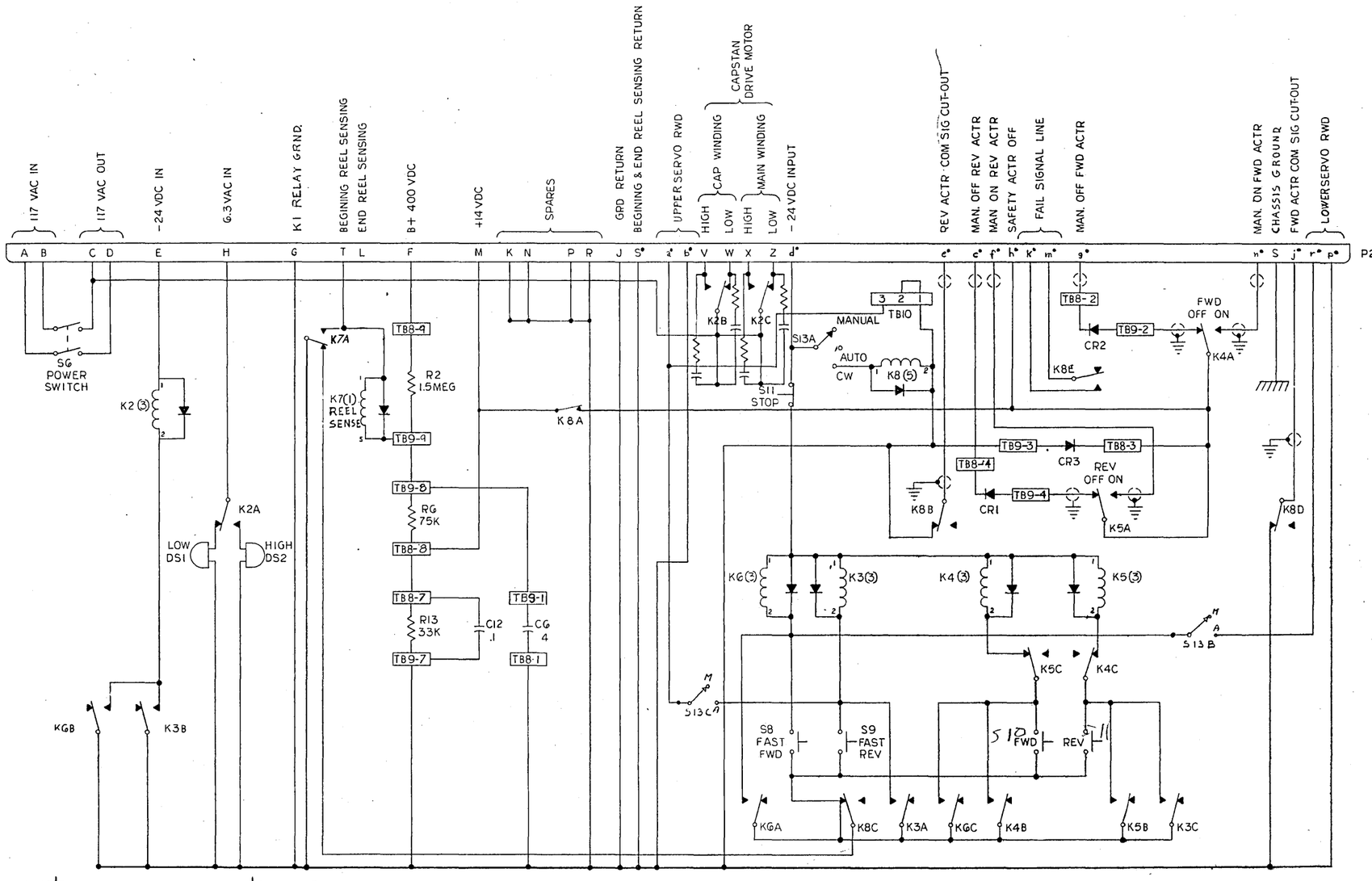
Figure 6-3
Actuator Control Unit CU-1, Schematic Diagram
(31 00723 10)



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS IN OHMS.
   ALL CAPACITORS IN MICROFARADS.
   ALL RELAYS SHOWN DEENERGIZED.
   NO POWER APPLIED

Figure 6-4
Pushbutton Control Assembly, Schematic Diagram
(31 00725 10)



7. ⫽ SIGNIFIES CHASSIS GRND. ⏚ SIGNIFIES COMMON GROUND.
6. USED WITH ASS'Y NO. 31054371O
5. S13- D-E NOT USED.
4. ALL DIODES ARE IN2069.
3. ALL RELAYS SHOWN IN DEENERGIZED POSITION
2. ALL RESISTORS IN OHMS
1. ALL CAPACITORS IN MICROFARADS

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 6-4.
Pushbutton Control Assembly, Schematic Diagram
(31 05438 10B)

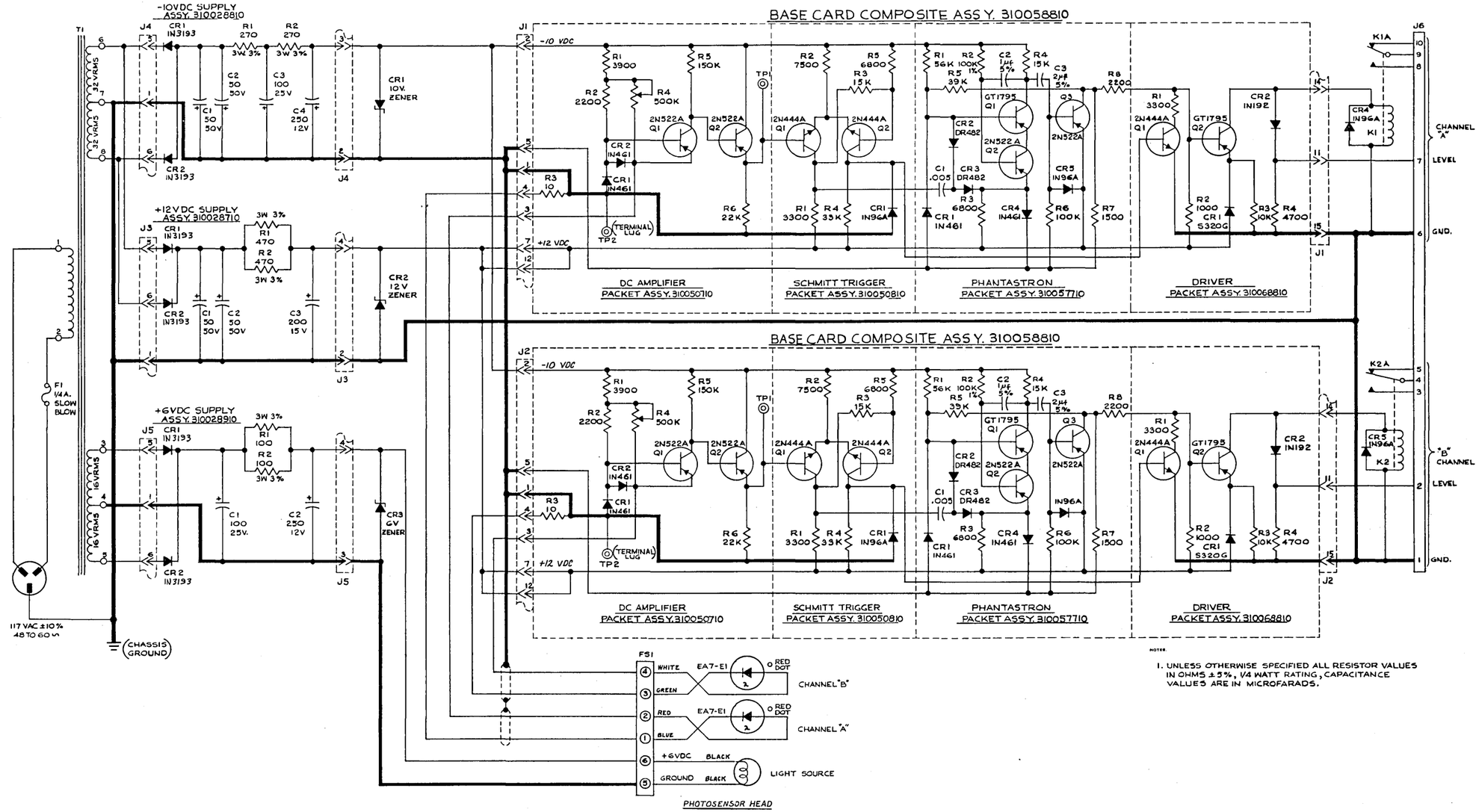
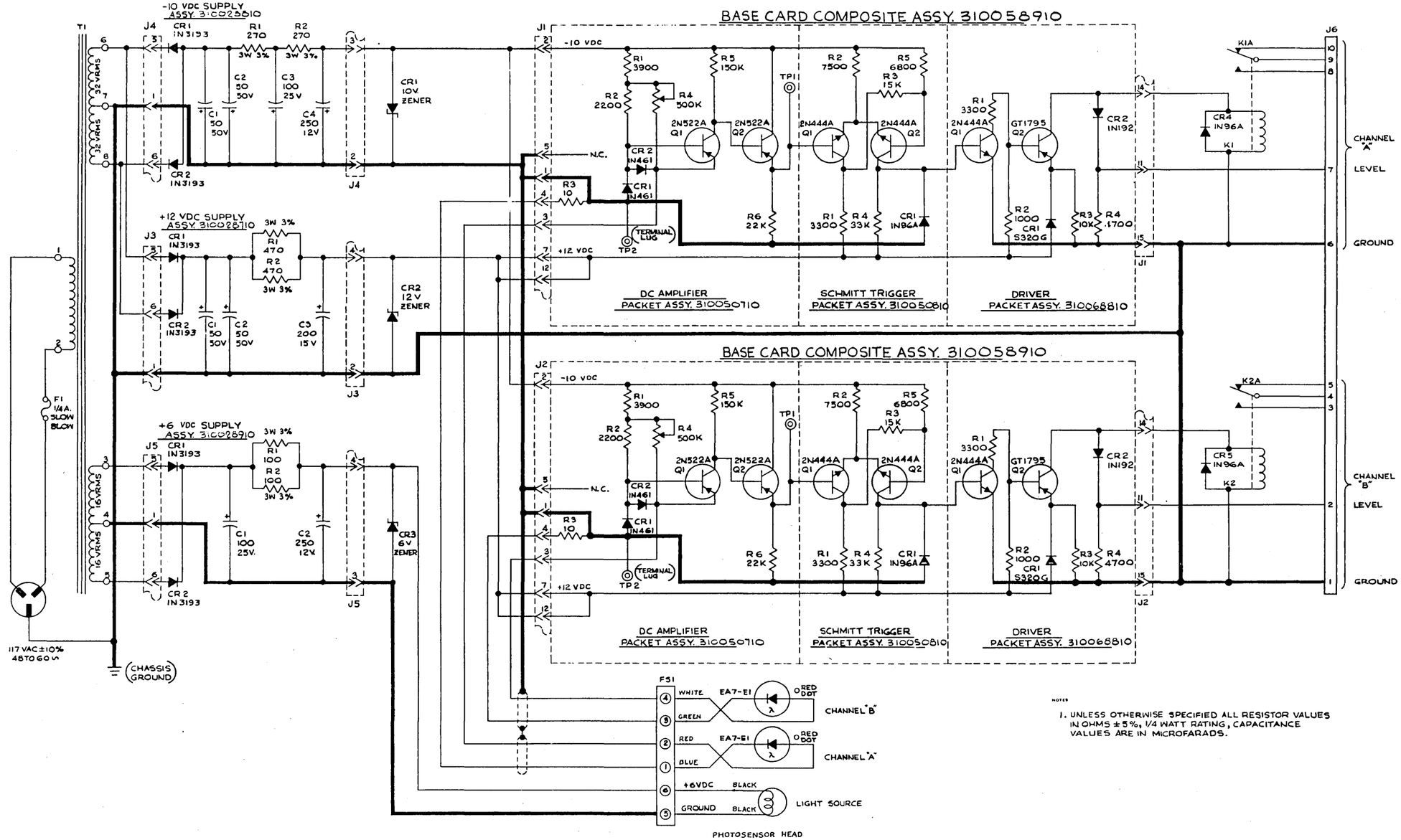


Figure 6-5
Photosensor Kit, Schematic Diagram
(31 00612 10)



NOTES

1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES IN OHMS ±5%, 1/4 WATT RATING, CAPACITANCE VALUES ARE IN MICROFARADS.

Figure 6-6
Photosensor Kit, Schematic Diagram
(31 00613 10)

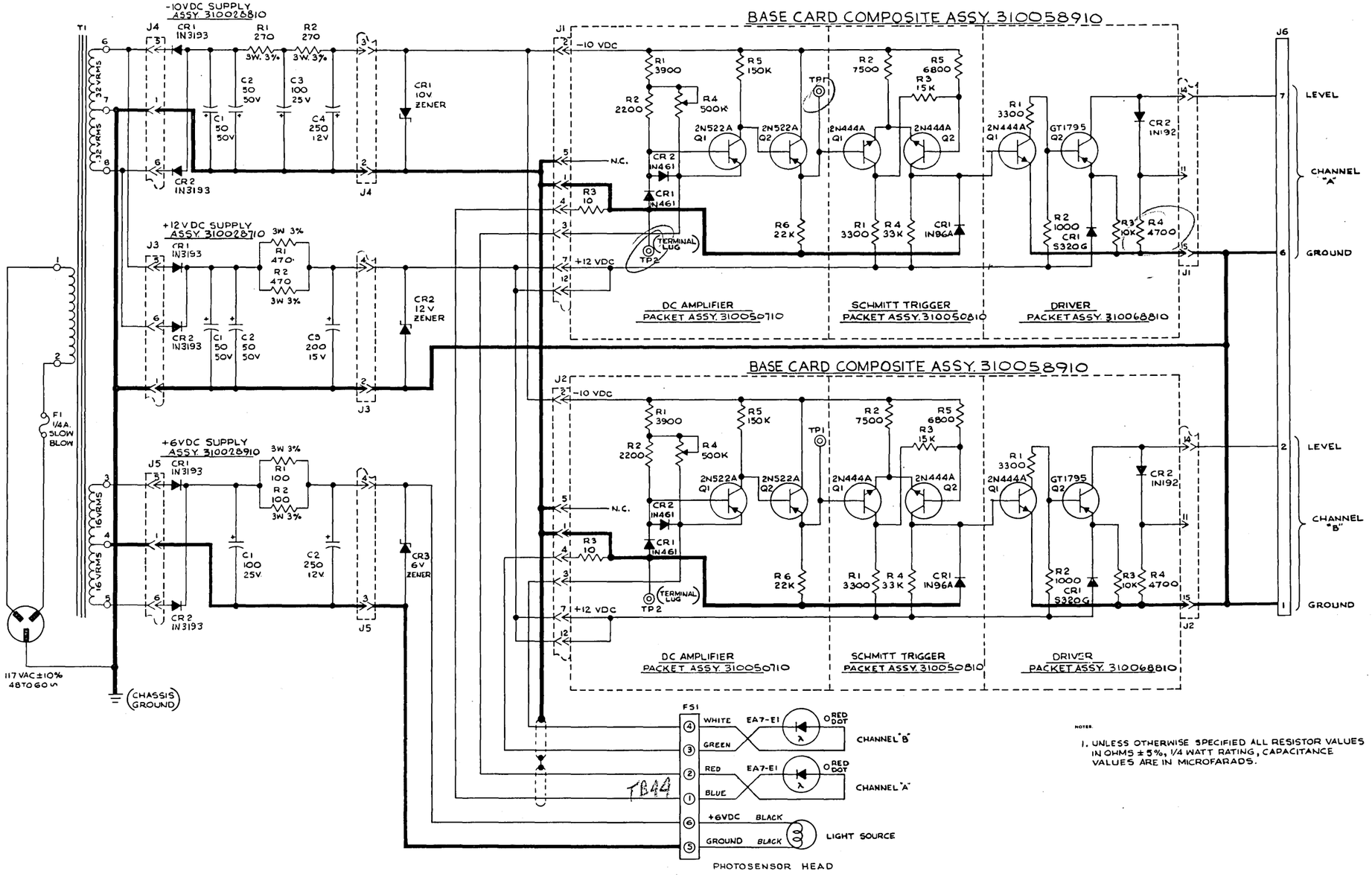
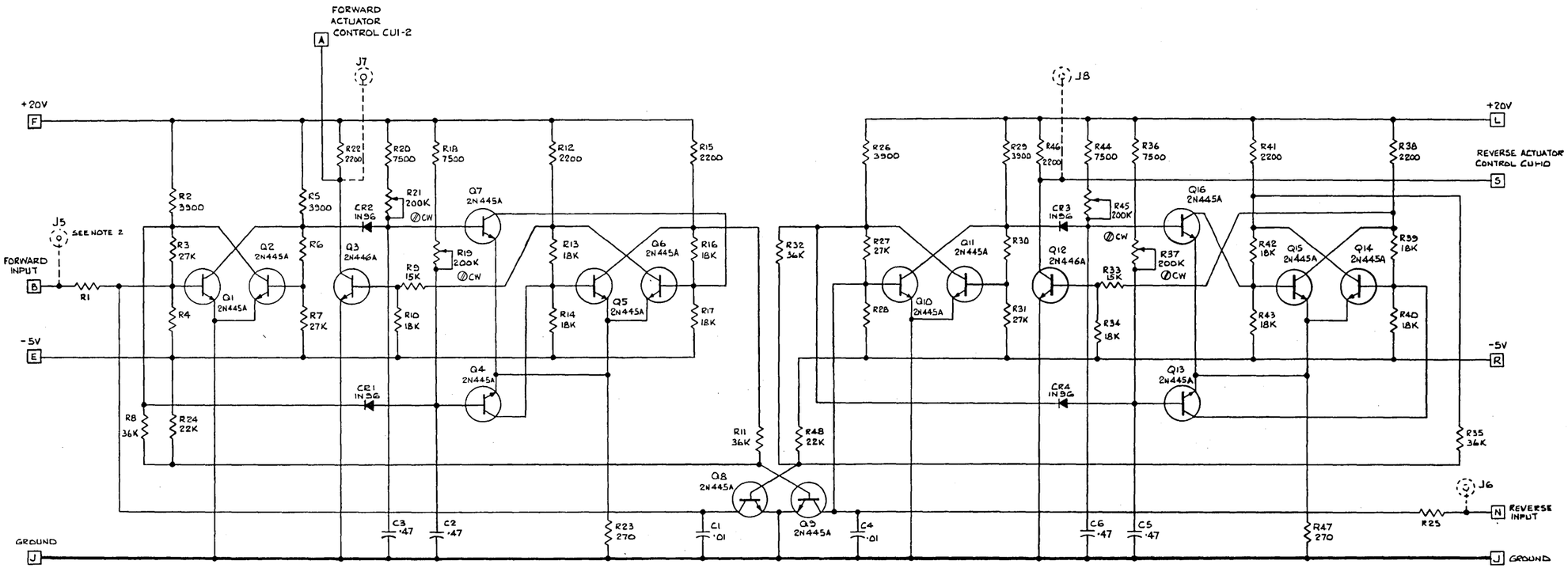
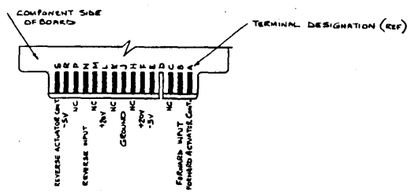


Figure 6-7
Photosensor Kit, Schematic Diagram
(31 00481 10)





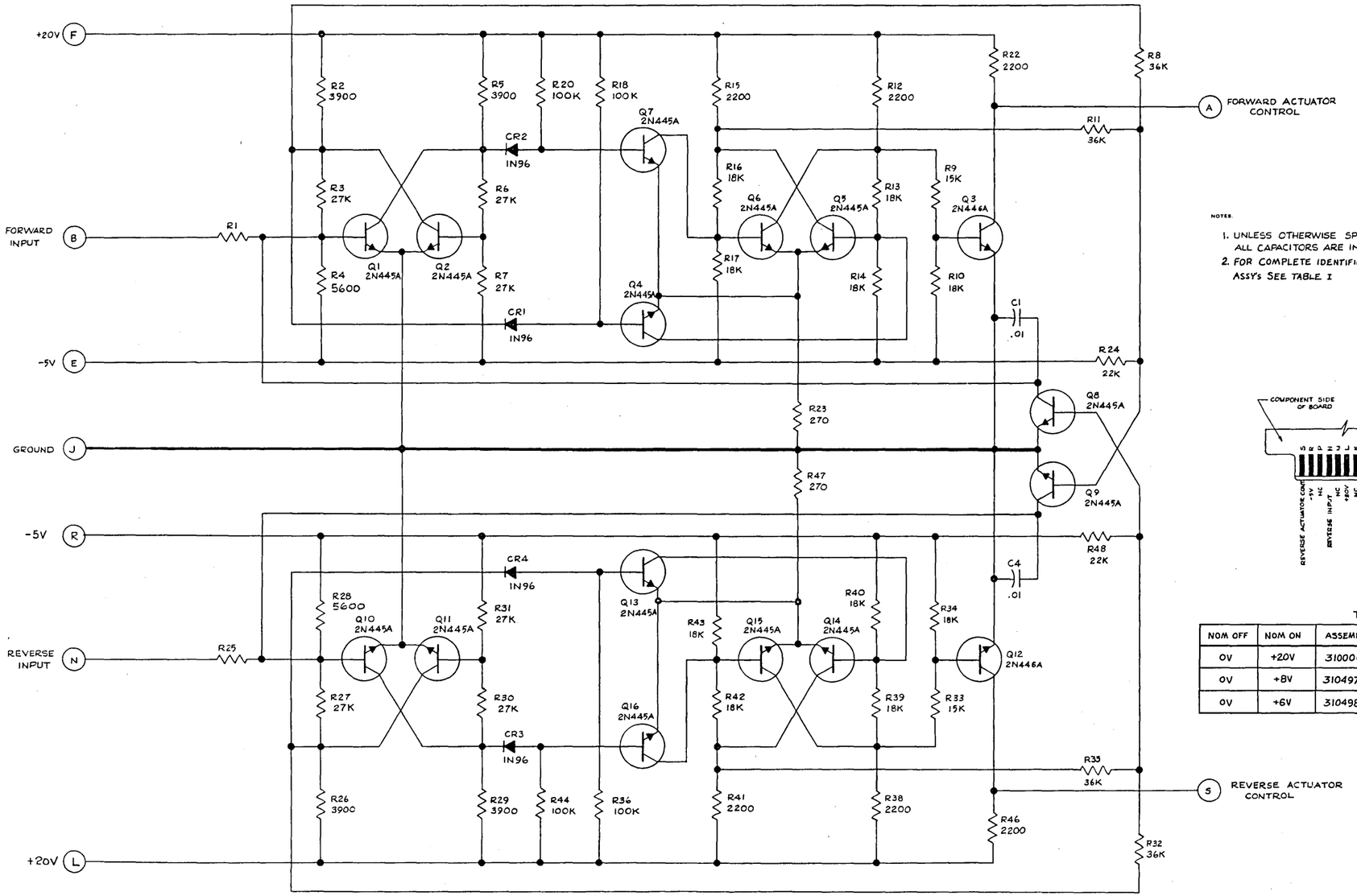
NOTES

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS 1/2 W. 5% ALL CAPACITORS ARE IN MICROFARADS
2. TEST JACKS SHOWN DOTTED ARE EXTERNAL TO THE BOARD.
3. FOR COMPLETE IDENTIFICATION OF COMPONENTS IN DIFFERENT ASSY'S SEE TABLE I

TABLE I

NOM OFF	NOM ON	ASSEMBLY	PRODUCT SPEC	R1	R4	R6	R25	R28	R30
-5V	+5V	310006110	310083010	5.6K	27K	27K	5.6K	27K	27K
0V	+10V	310441110	310441410	12K	9.1K	6.8K	12K	9.1K	6.8K

Figure 6-8
Buffer Delay and Interlock Unit, Schematic Diagram
(31 00727 10B)



NOTES.

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS ½W, 5%
   ALL CAPACITORS ARE IN MICROFARADS
2. FOR COMPLETE IDENTIFICATION OF COMPONENTS IN DIFFERENT ASSY'S SEE TABLE I

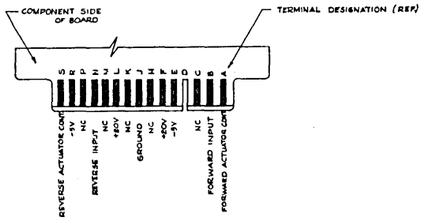


TABLE I

NOM OFF	NOM ON	ASSEMBLY	PRODUCT SPEC	R1	R25
0V	+20V	310006210	310083110	10K	10K
0V	+8V	310497010	310497110	6.8K	6.8K
0V	+6V	310498010	310498110	4.7K	4.7K

Figure 6-9
Buffer Interlock Unit, Schematic Diagram
(31 00720 10B)

SECTION VII
ILLUSTRATED PARTS BREAKDOWN

7-1. INTRODUCTION.

7-2. The following pages constitute an Illustrated Parts Breakdown for the SDSTM-407 Tape Transport.

7-3. Parts are listed in order of disassembly sequence, except that this may be modified where sequence of disassembly cannot be maintained. In general, the Illustrated Parts Breakdown indicates the maximum permissible disassembly of parts in the field. Further disassembly may require special tools and fixtures on reassembly, and should not be undertaken.

7-4. An indention system is used in the DESCRIPTION column of the Illustrated Parts Breakdown to indicate parts relationship. An assembly beginning in column 1 will have its detail parts listed in column 2; a subassembly beginning in column 2 will have its detail parts listed in column 3; etc.

7-5. To locate a part, determine the function and application of the part required. Turn to the List of Illustrations and locate the title of the figure where the part is most likely to be found. From the illustration, obtain the index number assigned to the part. Refer to the accompanying description for specific information regarding the part.

7-6. In correspondence with Ampex or when ordering parts for the equipment, order by Ampex Part Number. Handling of the order may also be expedited by noting the serial number of the machine for which the part is ordered.

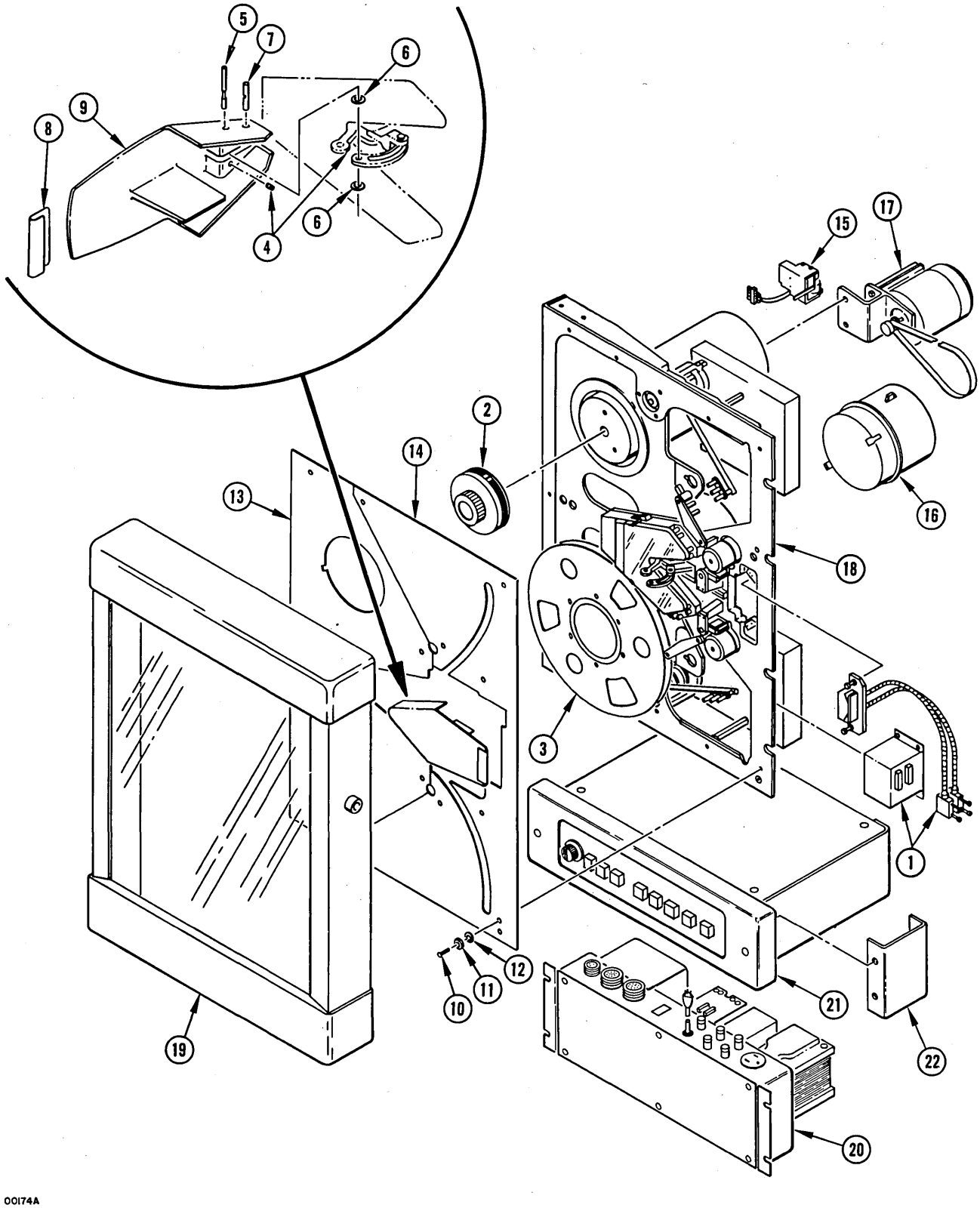


Figure 7-1.
SDSTM-407 Tape Transport

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-1-		SDSTM-407 TAPE TRANSPORT				
	310263010	Tape Transport, SDSTM-407, IBM Compatible, 1/2 in., 75/150 ips, 117 vac, 60 cps	1			
1	310566510	. Head and Cable Box Assembly (See Figure 7-2)	1			
2	310261010	. Knob Assembly, reel hold down, IBM Compatible (See Figure 7-3)	1			
3	310078710	. Fixed Reel Assembly (See Figure 7-3)	1			
	310263110	. Cover Installation, thread lever	1			
4	477-027	. . Setscrew, headless, 2-56 NC-3A by 3/16 in., hex soc, cup point, stl cad plt (MS51017-2)	2			
5	310091110	. . Pin, radius rod	1			
6	501-003	. . Washer, #6 flat, brass cad plt (Type AN960B)	2			
7	310091010	. . Pin, head cover	1			
8	310075510	. . Handle, head cover	1			
9	310264010	. . Cover, thread lever	1			
	310263210	. Overlay Plate Installation	1			
10	472-067	. . Screw, machine, 6-32 NC-2A by 3/8 in., oval hd Phillips, brass nickel plt	13			
11	506-023	. . Washer, #6, finishing, countersunk, brass nickel plt (H. H. Smith #1115)	13			
12	503-053	. . Ring, backup, #6, nylon (Wesco Electronic #MW-15-6)	13			
13	310264110	. . Overlay Plate, reel side	1			
14	310264210	. . Overlay Plate, head side	1			
15	310085610	. Switch Assembly, write enable (See Figure 7-4)	1			
16	310229710	. Motor Installation, vacuum unit (See Figure 7-5)	1			
17	310084410	. Drive Motor, Pulley and Belt Installation (See Figure 7-6)	1			
18	310052510	. Tape Transport Assembly (See Figures 7-7 thru 7-15)	1			
19	310263310	. Access Door Assembly (See Figure 7-16)	1			
20	310441010	. Transport Electronics Assembly, with Buffer Delay and Interlock (See Figures 7-17 thru 7-19)	1			
21	310263410	. Pushbutton Control Assembly (See Figure 7-20)	1			
22	310263510	. Spacer, control panel	2			

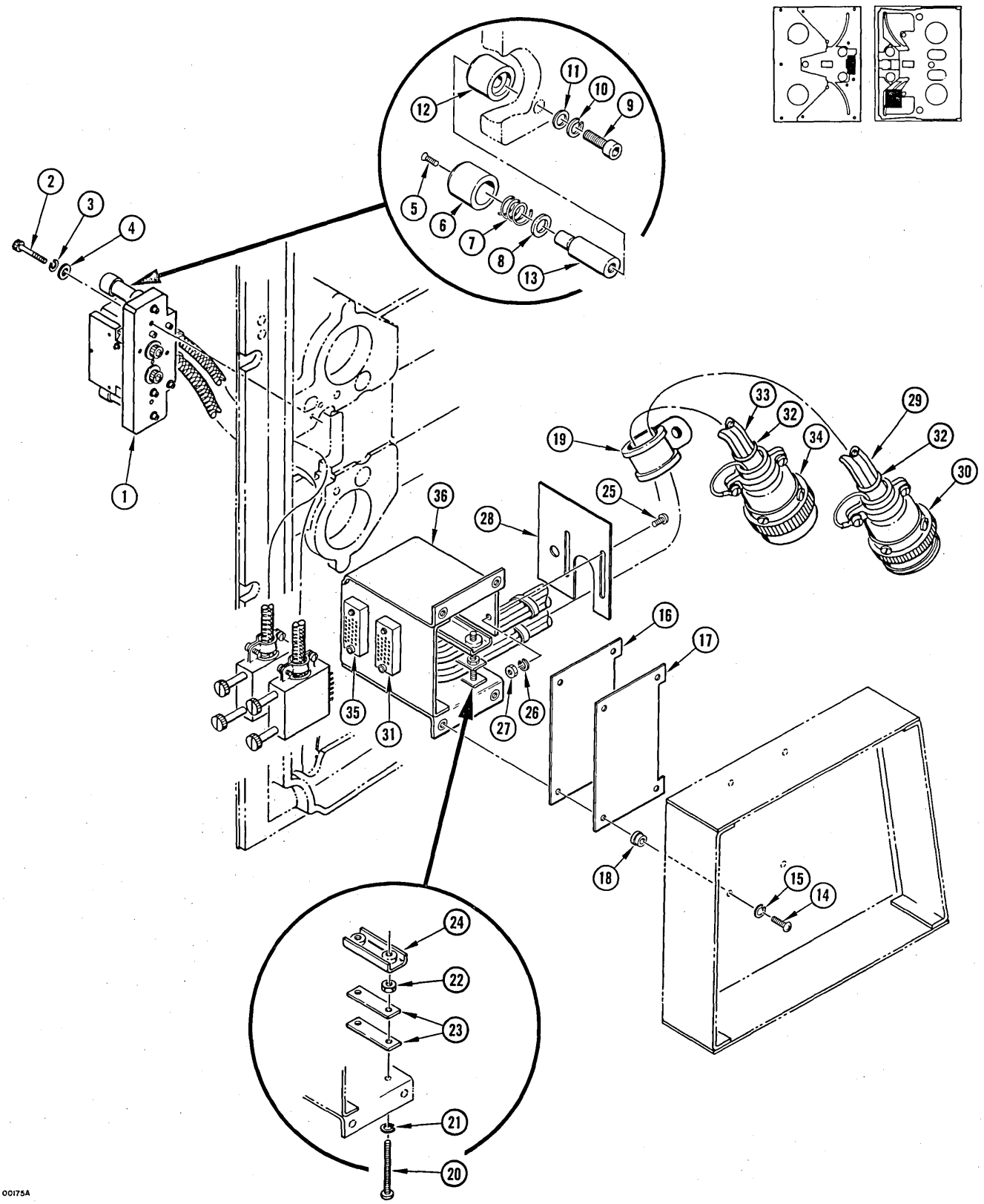


Figure 7-2.
Read/Write Head and Cable Box

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-2-		READ/WRITE HEAD AND CABLE BOX				
	310566510	Head and Cable Box Assembly (See Figure 7-1)	Ref			
1	310353410	. Head Assembly, read/write, 7 channel	1			
2	470-023	. . Screw, cap, 6-32 NC-3A by 7/8 in., hex soc, stl cad plt (MS35457-11)	2			
3	502-009	. . Washer, #6 spring lock, sst, passivated (MS35338-79)	2			
4	501-015	. . Washer, #6 flat, sst, passivated (MS15795-306)	2			
	310365910	. . Guide Assembly, ceramic, inner edge	2			
5	471-379	. . . Screw, machine, 4-40 NC-2A by 1/4 in., flat hd Phillips, sst, passivated (MS35200-12)	1			
6	310300810	. . . Cap, guide	1			
7	310202810	. . . Spring, compression	1			
8	310348810	. . . Ring, guide	1			
9	470-137	. . . Screw, cap, 6-32 NC-2A by 1-1/8 in., hex soc, stl cad plt	1			
10	502-009	. . . Washer, #6 spring lock, sst, passivated (MS35338-78)	1			
11	501-020	. . . Washer, flat, special, 0.015 in. thk, brass cad plt	1			
12	310348910	. . . Base, guide	1			
13	310301710	. . . Guide, post	1			
	310566310	. Head Cable and Box Assembly	1			
14	471-072	. . Screw, machine, 6-32 NC-2A by 5/8 in., pan hd Phillips, stl cad plt (MS35208-28)	4			
15	502-003	. . Washer, #6 lock, stl cad plt (MS35338-41)	4			
16	310612510	. . Spacer, cable box	1			
17	310519210	. . Spacer, isolating, phenolic	1			
18	503-012	. . Washer, shoulder, fiber (Walsco #7856)	4			
19	302-054	. . Clamp, cable (Adel #760-14-2-10)	1			
20	471-456	. . Screw, machine, 6-32 NC-2A by 1-3/4 in., pan hd Phillips, brass cad plt (MS35212-34)	2			
21	502-003	. . Washer, #6 spring lock, stl cad plt (MS35338-41)	2			
22	492-009	. . Nut, plain hex, 6-32 NC-2B, stl cad plt (MS35649-62)	2			
23	310023110	. . Strap, head cable clamp	2			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-2-						
24	310023010	. . Clamp, head cable	1			
25	471-072	. . Screw, machine, 6-32 NC-2A by 5/8 in., pan hd Phillips, stl cad plt (MS35208-28)	2			
26	502-003	. . Washer, #6 lock, stl cad plt (MS35338-41)	2			
27	492-009	. . Nut, plain hex, 6-32 NC-2B, stl cad plt (MS35649-62)	2			
28	310566410	. . Shield	1			
29	310566710	. . Cable Assembly, read	1			
30	145-207	. . . Connector, plug, male, 19 contact (Cannon #RSK-19-22C-3/4)	1			
31	146-173	. . . Connector, receptacle, female, 26 contact (Winchester #MRE-26S-J-30)	1			
32	262-006	. . . Bushing, telescoping (AN3420-12)	2			
33	310566610	. . Cable Assembly, write	1			
34	144-050	. . . Connector, plug, female, 19 contact (Cannon #SK-19-21C-3/4)	1			
35	146-173	. . . Connector, receptacle, female, 26 contact (Winchester #MRE-26S-J-30)	1			
36	310612810	. . Box, head cable	1			

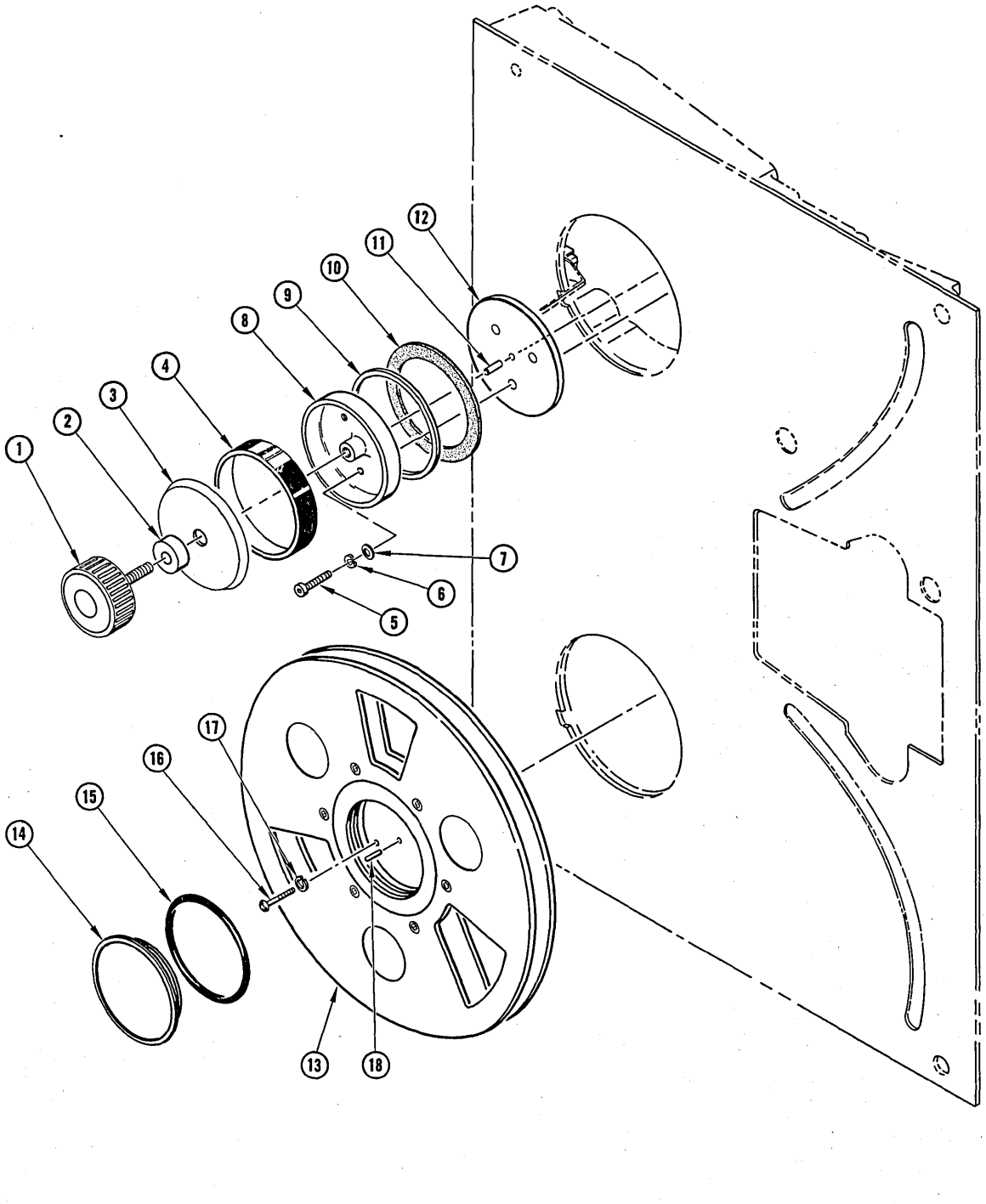


Figure 7-3.
Reel Hold Down Knob and Fixed Reel

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-3-		REEL HOLD DOWN KNOB AND FIXED REEL				
	310261010	Knob Assembly, reel hold down, IBM Compatible (See Figure 7-1)	Ref			
1	310147910	. Knob, hold down	1			
2	423-045	. Bearing, thrust (Boston Bronze #602)	1			
3	310034510	. Cover, latch, hold down knob	1			
4	310090010	. Ring, hold down knob	1			
5	470-093	. Screw, cap, 10-32 NF-3A by 1 in., hex soc, sst, passivated	3			
6	502-011	. Washer, #10 spring lock, sst (MS35338-81)	3			
7	501-017	. Washer, #10 flat, sst, passivated (MS15795-308)	3			
8	310034110	. Hub, hold down knob	1			
9	310034610	. Spacer	1			
10	310034010	. Pad, turntable	1			
11	403-024	. Pin, drive, 1/4 in. dia by 1/2 in. lg, sst (Driv-Lok Pin Co Type E)	1			
12	310034410	. Spacer	1			
13	310078710	Fixed Reel Assembly (See Figure 7-1)	Ref			
14	310079210	. Cap, hub, fixed reel	1			
15	432-043	. O-Ring, neoprene (MS29513-139)	1			
16	471-093	. Screw, machine, 10-32 NF-2A by 1 in., pan hd Phillips, stl cad plt (MS35209-59)	3			
17	502-005	. Washer, #10 spring lock, stl cad plt (MS35338-43)	3			
18	402-011	. Pin, dowel, 0.125 in. dia by 1/2 in. lg (Anti-Corrosive Metal Products)	1			

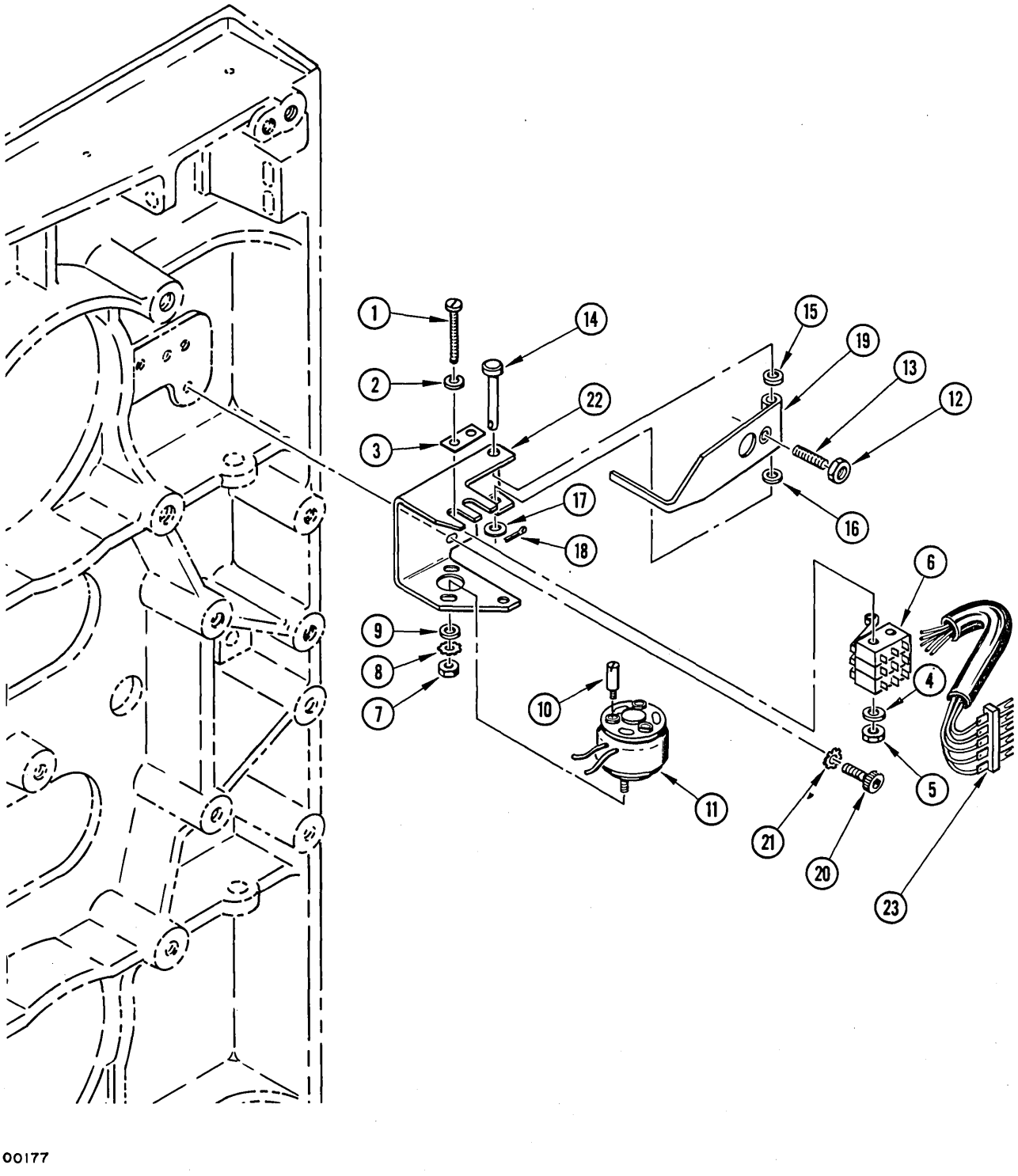


Figure 7-4.
Write Enable Switch

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-4-		WRITE ENABLE SWITCH				
	310085610	Switch Assembly, write enable (See Figure 7-1)	Ref			
1	471-803	. Screw, machine, 2-56 by 1 in., slotted binder hd, stl cad plt	2			
2	502-001	. Washer, #2 spring lock, stl cad plt (MS35338-39)	2			
3	310262610	. Strip, locking	1			
4	501-007	. Washer, #2 flat, stl cad plt (MS15795-202)	2			
5	493-013	. Nut, self-locking hex, 2-56 NC-3B, stl cad plt w/nylon insert (Esna Type NM-26)	2			
6	120-083	. Switch, w/roller actuator, spdt (Unimax #USMW)	3			
7	492-059	. Nut, plain hex, 3-48 NC-2B, stl cad plt	2			
8	502-093	. Washer, #3 lock, external tooth, stl cad plt (Shakeproof #1103)	2			
9	501-007	. Washer, #2 flat, stl cad plt (MS15795-202)	2			
10	310046010	. Pin, solenoid	1			
11	310046110	. Solenoid, rotary	1			
12	492-009	. Nut, plain hex, 6-32 NC-2B, stl cad plt (MS35649-62)	1			
13	477-065	. Setscrew, headless, 6-32 NC-3A by ½ in., hex soc, flat point, stl cad plt (AN565A6H8)	1			
14	400-012	. Pin, clevis, pan hd, stl cad plt (MS20392-1-31)	1			
15	501-026	. Washer, #4 flat, 0.003 in. thk, brass, unplated	A/R			
16	501-061	. Washer, #4 flat, 0.017 in. thk, brass, white nickel plt	A/R			
17	501-008	. Washer, #4 flat, stl cad plt (MS15795-204)	1			
18	401-005	. Pin, cotter, 1/16 in. dia by ½ in. lg, stl cad plt	1			
19	310045910	. Arm, actuator	1			
20	470-018	. Screw, cap, 6-32 NC-3A by 3/8 in., hex soc, stl cad plt (MS35457-7)	2			
21	502-014	. Washer, #6 lock, external tooth, stl cad plt (MS35335-30)	2			
22	310045810	. Bracket, actuator	1			
23	310036010	. Fanning Strip	1			

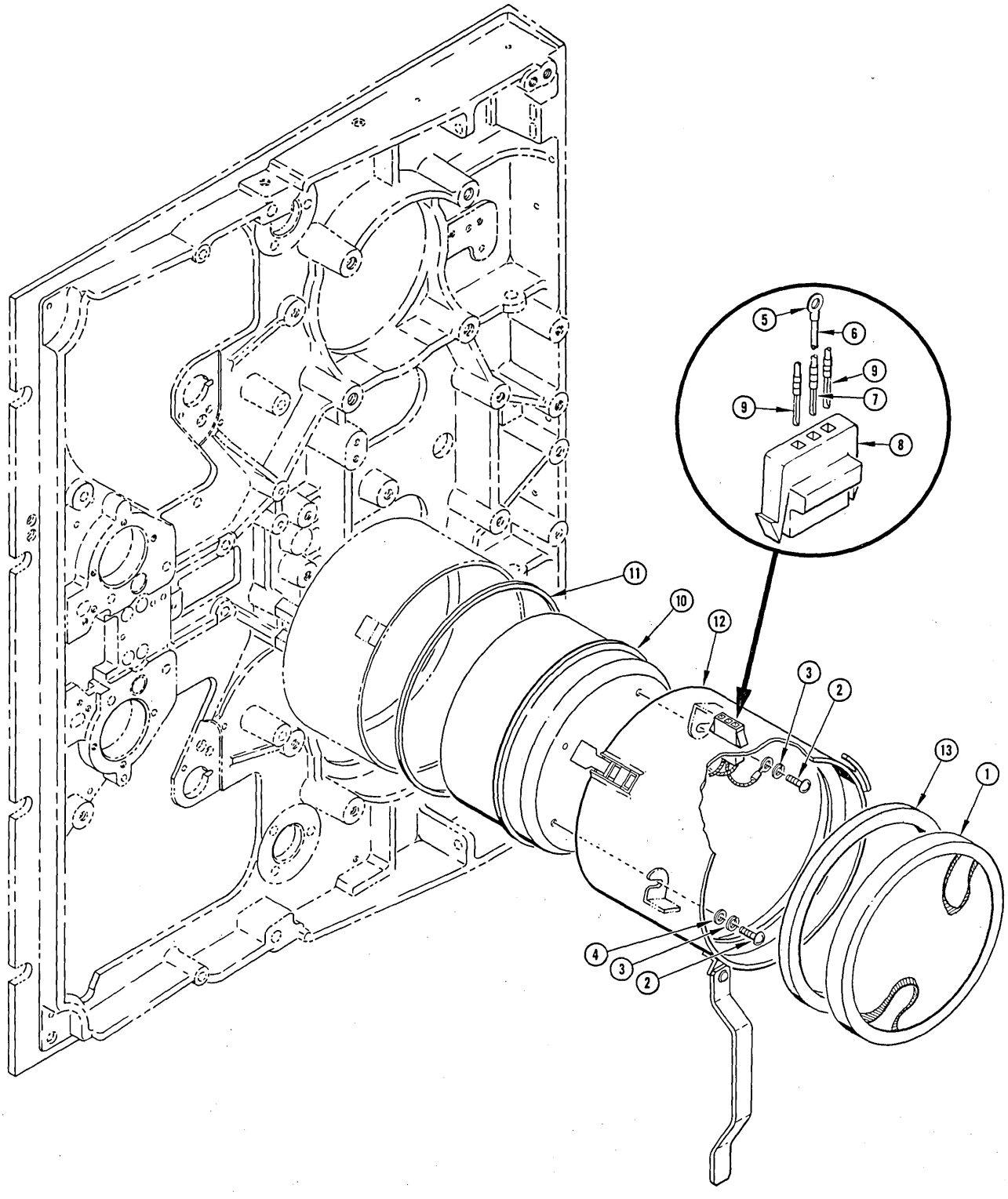


Figure 7-5.
Vacuum Unit Motor

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-5-		VACUUM UNIT MOTOR				
	310229710	Motor Installation, vacuum unit, 117 vac (See Figure 7-1)	Ref			
1	310153310	. Filter, vacuum blower	1			
2	471-087	. Screw, machine, 10-32 NF-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35209-53)	2			
3	502-005	. Washer, #10 spring lock, stl cad plt (MS35338-43)	2			
4	501-011	. Washer, #10 flat, stl cad plt (MS15795-208)	1			
5	171-016	. Connector, solderless, ring tongue, #10 stud (AMP #34170)	1			
6	611-595	. Wire, stranded, insulated, #16 (MIL-W-16878)	A/R			
7	169-019	. Connector, contact pin, brass (AMP #42641-1)	1			
8	169-987	. Connector, chassis plug, 3 way (AMP #480177-1)	1			
	310076710	. Motor Assembly, vacuum unit, 117 vac	1			
9	169-019	. . Connector, contact pin, brass (AMP #42641-1)	2			
10	592-030	. . Motor, vacuum unit (Lamb Electric #IS-14894)	1			
	650-154	. . . Brush, contact (Lamb Electric #33185)	2			
11	310236610	. Ring, seal	1			
12	310074710	. Housing Assembly, vacuum motor	1			
13	269-116	. . Gasket, foam rubber, 1/2 in. by 3/4 in. by 19 in. (Bracamonte)	1			

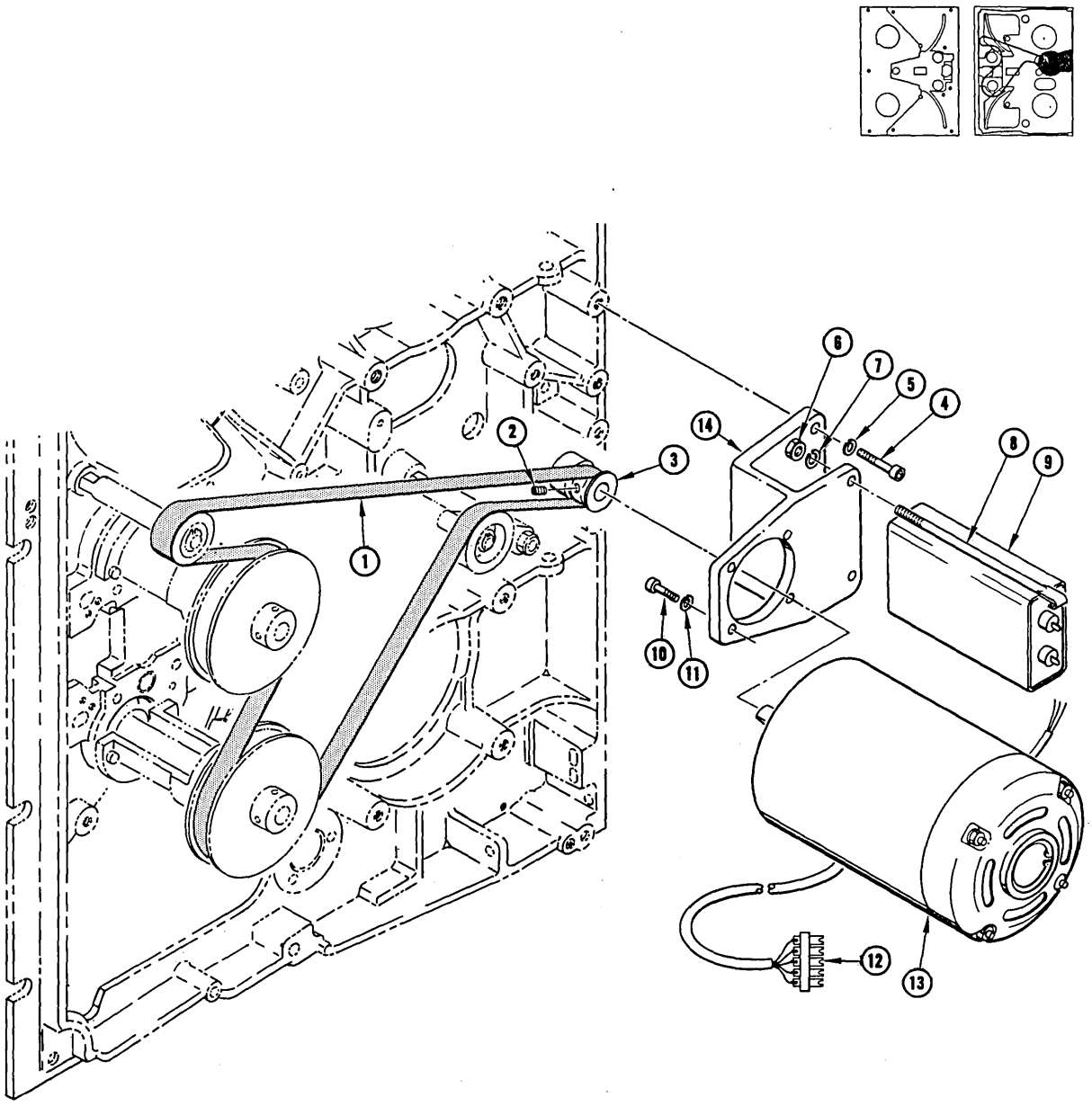


Figure 7-6.
Capstan Drive Motor, Pulley and Belt

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-6-		CAPSTAN DRIVE MOTOR, PULLEY AND BELT				
	310084410	Drive Motor, Pulley and Belt Installation, 117 vac, 60 cps, 75/150 ips (See Figure 7-1)	Ref			
1	081-006	. Belt, endless, nylon, 1/2 in. w by 43-3/8 in. lg (Tilton #S5-TW Light)	1			
2	477-048	. Setscrew, headless, 10-32 NF-3A by 5/16 in., hex soc, cup point, stl cad plt (MS51018-50)	2			
3	310024110	. Pulley, capstan motor	1			
4	470-048	. Screw, cap, 1/4-20 UNC-3A by 7/8 in., hex soc, stl cad plt (MS35457-36)	3			
5	502-006	. Washer, 1/4 spring lock, stl cad plt (MS35338-44)	3			
	310012410	. Drive Motor Assembly, capstan, 117 vac, 60 cps	1			
6	492-017	. . Nut, plain hex, 10-32 NF-2B, sst, passivated (MS35650-104)	2			
7	502-005	. . Washer, #10 spring lock, stl cad plt (MS35338-43)	2			
8	290-019	. . Bracket, capacitor, spade lug type (MIL-C-25:CP07SB5)	2			
9	036-007	. . Capacitor, paper, rectangular, 6 uf, 600 volt (General Electric #23F352)	1			
10	470-103	. . Screw, cap, 10-24 NC-3A by 5/8 in., hex soc, stl cad plt (MS35457-24)	4			
11	502-005	. . Washer, #10 spring lock, stl cad plt (MS35338-43)	4			
	310043410	. . Drive Motor, capstan	1			
12	310036010	. . . Fanning Strip, 5 terminal	1			
13	310063610	. . . Drive Motor, 117 vac	1			
14	310043510	. . Bracket, capstan motor	1			

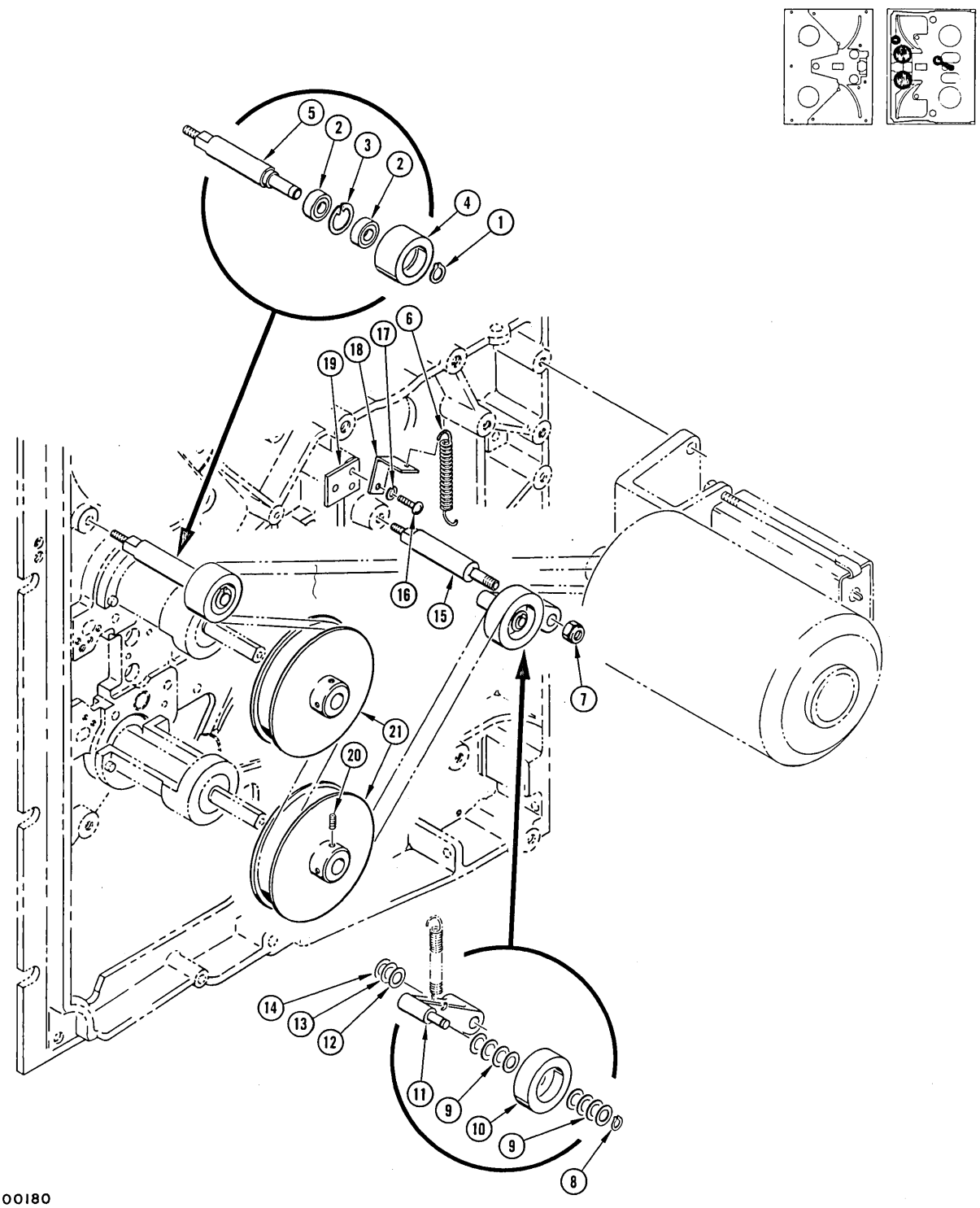


Figure 7-7.
Capstan Drive Pulleys and Idler Arm

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-7-		CAPSTAN DRIVE PULLEYS AND IDLER ARM				
	310052510	Tape Transport Assembly (See Figure 7-1)	Ref			
	310008510	. Roller Assembly, drive belt	1			
1	430-086	. . Ring, retaining, external, stl cad plt (Truarc #5100-37-S-MD)	1			
2	421-001	. . Bearing, ball, double shield (Fafnir #S3KDD)	2			
3	430-085	. . Ring, retaining, internal, stl cad plt (Truarc #N5000-87-S-MD)	1			
4	310034710	. . Roller, drive belt	1			
5	310034810	. . Shaft, drive belt	1			
6	310021810	. Spring, belt idler	1			
7	493-012	. Nut, self-locking, hex, ¼-20 NC-3B, stl cad plt w/nylon insert (Esna Type NM)	1			
	310008210	. Arm Assembly, belt idler	1			
8	431-006	. . Retainer, hairpin, external (Connor #7802)	1			
9	310033910	. . Washer, thrust	A/R			
10	310033810	. . Pulley, belt idler	1			
11	310033710	. . Arm, belt idler	1			
12	501-045	. Washer, shim, flat, brass, 0.005 in. thk	A/R			
13	501-052	. Washer, shim, flat, brass, 0.003 in. thk	A/R			
14	501-059	. Washer, shim, flat, brass, 0.010 in. thk	A/R			
15	310017410	. Stud, shouldered	1			
16	471-088	. Screw, machine, 10-32 NF-3A by 7/16 in., pan hd Phillips, stl cad plt (MS35209-54)	2			
17	502-005	. Washer, #10 spring lock, stl cad plt (MS35338-43)	2			
18	310019710	. Bracket, angle, belt tension	1			
19	310088310	. Bracket, harness	1			
20	477-049	. Setscrew, headless, 10-32 NF-3A by 3/8 in., hex soc, cup point, stl cad plt (MS51018-51)	4			
21	310016710	. Pulley, capstan drive	2			

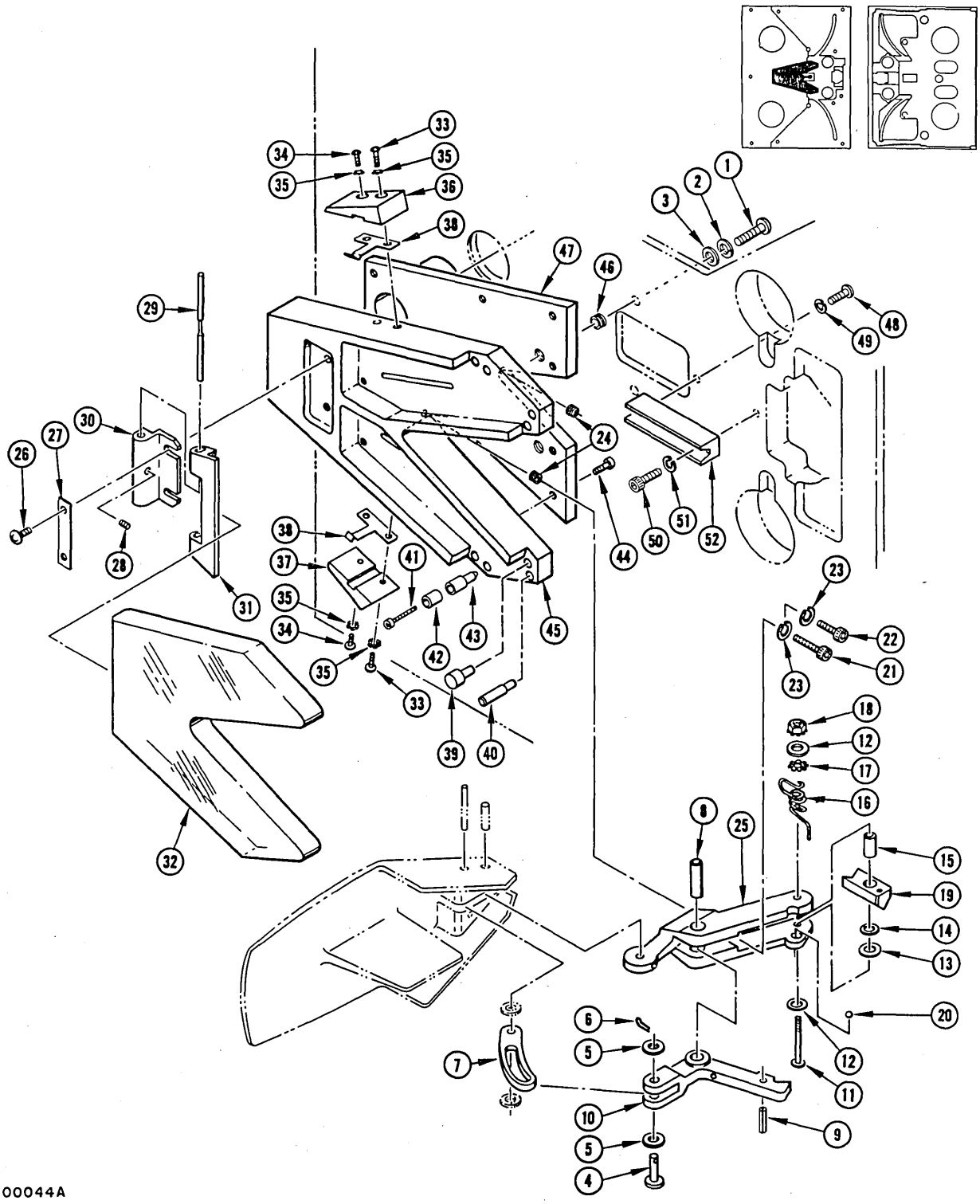


Figure 7-8.
Vacuum Chamber

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-8-		VACUUM CHAMBER				
	310052510	Tape Transport Assembly (See Figure 7-1)	Ref			
1	471-092	. Screw, machine, 10-32 NF-2A by 7/8 in., pan hd Phillips, stl cad plt (MS35209-58)	3			
2	502-005	. Washer, #10 spring lock, stl cad plt (MS35338-43)	3			
3	501-011	. Washer, #10 flat, stl cad plt (MS15795-208)	3			
	310216710	. Vacuum Chamber Assembly	1			
4	400-017	. . Pin, clevis, pan hd, stl cad plt (MS20392-2-15)	1			
5	501-019	. . Washer, #10 flat, stl cad plt (AN960-10L)	2			
6	401-004	. . Pin, cotter, extended prong, mitre end, 1/16 in. dia by 3/8 in. lg	1			
7	310075310	. . Link, thread lever	1			
8	304020340	. . Pin, dowel	1			
	310215110	. . Thread Lever Assembly	1			
9	406-029	. . . Rollpin, sst (Esna #79-028-125-0500)	1			
10	310208510	. . . Support, thread lever	1			
11	471-469	. . Screw, machine, 4-40 NC-2A by 1-¼ in., pan hd Phillips, stl cad plt	1			
12	501-008	. . Washer, #4 flat, stl cad plt (MS15795-204)	2			
13	501-057	. . Washer, flat, shim, 0.010 in. thk, brass (Tilley)	A/R			
14	501-019	. . Washer, #10 flat, stl cad plt (AN960-10L)	1			
15	310036610	. . Bushing, support	1			
16	310036710	. . Spring, latch, thread lever	1			
17	502-013	. . Washer, #4 lock, external tooth, stl cad plt (MS35335-20)	1			
18	496-004	. . Nut, keps, 4-40 NC-2B, external washer, stl cad plt (Shakeproof)	1			
19	310037910	. . Latch, thread lever	1			
20	420-002	. . Bearing, ball, sst, 0.187 in. dia	1			
21	470-013	. . Screw, cap, 4-40 NC-3A by 5/8 in., hex soc, stl cad plt (MS35457-4)	1			
22	470-011	. . Screw, cap, 4-40 NC-3A by 7/16 in., hex soc, stl cad plt	1			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-8-						
23	502-002	. . Washer, #4 spring lock, stl cad plt (MS35338-40)	2			
24	495-017	. . Insert, sst (Heli-Coil #1185-04CNX.224)	2			
25	310075210	. . Hinge, thread lever	1			
26	471-060	. . Screw, machine, 4-40 NC-2A by 1/4 in., pan hd Phillips, stl cad plt (MS35208-12)	2			
27	310076110	. . Strip, locking	1			
28	477-131	. . Setscrew, headless, 2-56 NC-3A by 1/8 in., hex soc, cup point, stl cad plt (MS51017-1)	1			
29	310075910	. . Pin, hinge	1			
30	310075810	. . Block, hinge	1			
	310074010	. . Door Assembly, vacuum chamber	1			
31	310075710	. . . Hinge, vacuum chamber door	1			
32	310076010	. . . Door, vacuum chamber	1			
33	471-063	. . Screw, machine, 4-40 NC-2A by 7/16 in., pan hd Phillips, stl cad plt (MS35208-15)	2			
34	471-060	. . Screw, machine, 4-40 NC-2A by 1/4 in., pan hd Phillips, stl cad (MS35208-12)	2			
35	502-013	. . Washer, #4 lock, external tooth, stl cad plt (MS35335-20)	4			
36	310074410	. . Guard, upper, vacuum chamber	1			
37	310074510	. . Guard, lower, vacuum chamber	1			
38	310192110	. . Spring, door retainer	2			
39	310074210	. . Pin, tape guide	4			
40	310217110	. . Pin, guide	2			
41	470-189	. . Screw, cap, 2-56 NC-3A by 7/16 in., hex soc, sst	2			
42	310262710	. . Cap, tape guide	2			
43	310262810	. . Tape Guide	2			
44	470-002	. . Screw, cap, 2-56 NC-3A by 3/16 in., hex soc, stl cad plt	9			
45	310074110	. . Vacuum Chamber	1			
46	495-010	. . Insert, sst (Heli-Coil #1191-3CNX.285)	3			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-8-						
47	310216910	. . Base, vacuum chamber	1			
48	471-065	. Screw, machine, 4-40 NC-2A by 5/8 in., pan hd Phillips, stl cad plt (MS35208-17)	1			
49	502-002	. Washer, #4 spring lock, stl cad plt (MS35338-40)	1			
50	470-027	. Screw, cap, 8-32 NC-3A by 3/8 in., hex soc, stl cad plt (MS35457-14)	1			
51	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	1			
52	310073710	. Stop, head cover	1			

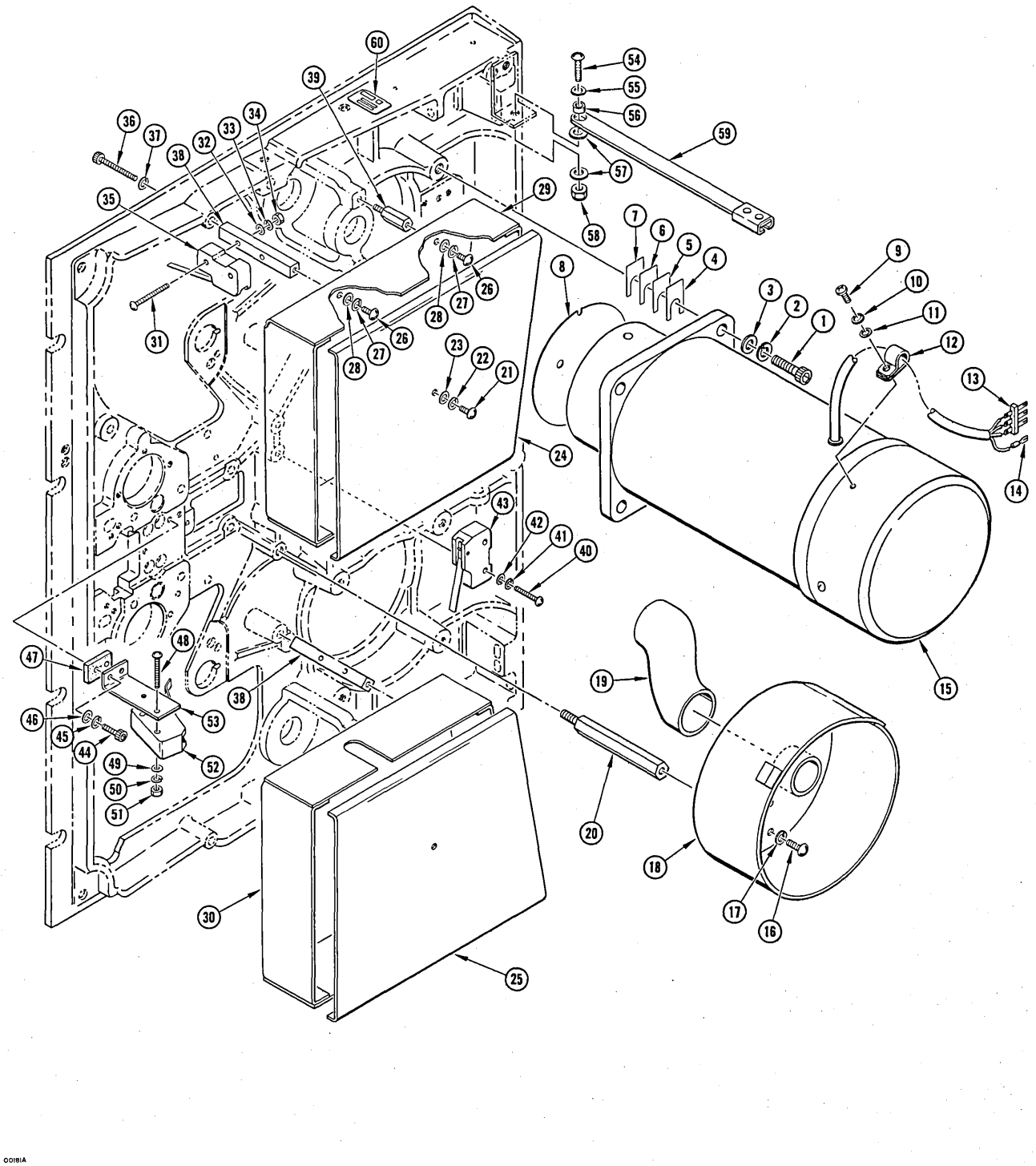


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Figure 7-9.
Reel Motors and Switches

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-9-		REEL MOTORS AND SWITCHES				
	310052510	Tape Transport Assembly (See Figure 7-1)	Ref			
1	470-134	. Screw, cap, 5/16-24 NF-2A by 1 in., hex soc, stl cad plt (MS35458-35)	8			
2	502-066	. Washer, 5/16 spring lock, sst, passivated (MS35338-83)	8			
3	501-022	. Washer, 5/16 flat, stl cad plt (AN960-516L)	8			
4	310021210	. Shim, brass, 0.0015 in. thk	A/R			
5	310021310	. Shim, brass, 0.003 in. thk	A/R			
6	310021410	. Shim, brass, 0.005 in. thk	A/R			
7	310021510	. Shim, brass, 0.010 in. thk	A/R			
8	310019610	. Shim, turntable	2			
9	471-069	. Screw, machine, 6-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-25)	2			
10	502-009	. Washer, #6 spring lock, sst (MS35338-79)	2			
11	501-009	. Washer, #6 flat, stl cad plt (MS15795-206)	2			
12	302-037	. Clamp, cable, plastic, 5/16 in. ID (Commercial Plastics #742-5)	2			
	310009110	. Reel Motor Assembly	2			
13	310035810	. . Fanning Strip	1			
14	171-063	. . Connector, solderless (Burndy #YAE18-Z1)	1			
15	310035710	. . Reel Motor	1			
16	471-090	. Screw, machine, 10-32 NF-2A by 5/8 in., pan hd Phillips, stl cad plt (MS35209-56)	2			
17	502-005	. Washer, #10 spring lock, stl cad plt (MS35338-43)	2			
18	310081610	. Bracket, blower	1			
19	310081710	. Tube, blower	1			
20	310081810	. Standoff, blower	2			
21	471-078	. Screw, machine, 8-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-40)	2			
22	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	2			
23	501-010	. Washer, #8 flat, stl cad plt (MS15795-207)	2			
24	310086810	. Cover, servo box, upper	1			
25	310086710	. Cover, servo box, lower	1			
26	471-078	. Screw, machine, 8-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-40)	6			
27	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	6			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-9-						
28	501-010	. Washer, #8 flat, stl cad plt (MS15795-207)	6			
29	310076310	. Servo Control Assembly, upper (See Figure 7-10)	1			
30	310076210	. Servo Control Assembly, lower (See Figure 7-11)	1			
31	471-448	. Screw, machine, 6-32 NC-2A by 1-¼ in., pan hd Phillips, stl cad plt (MS35208-32)	4			
32	501-009	. Washer, #6 flat, stl cad plt (MS15795-206)	4			
33	502-014	. Washer, #6 lock, external tooth, stl cad plt (MS35335-30)	4			
34	492-009	. Nut, plain hex, 6-32 NC-2B, stl cad plt (MS35649-62)	4			
35	120-062	. Switch, sensitive, spdt (S2,S3) (Unimax #2HBT215-1)	2			
36	470-104	. Screw, cap, 8-32 NC-3A by 1-¼ in., hex soc, stl cad plt (MS35457-20)	2			
37	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	4			
38	310016510	. Standoff, servo control	4			
39	310017510	. Stud, extension	2			
40	471-468	. Screw, machine, 4-40 NC-2A by 7/8 in., pan hd Phillips, stl cad plt (MS35208-19)	2			
41	502-002	. Washer, #4 spring lock, stl cad plt (MS35338-40)	2			
42	501-008	. Washer, #4 flat, stl cad plt (MS15795-204)	2			
43	120-062	. Switch, sensitive, spdt (S1) (Unimax #2HBT215-1)	1			
44	470-030	. Screw, cap, 8-32 NC-3A by 5/8 in., hex soc, stl cad plt (MS35457-16)	2			
45	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	2			
46	501-010	. Washer, #8 flat, stl cad plt (MS15795-207)	2			
47	310021110	. Pad, spacer	1			
	310011010	. Bracket Assembly, thread lever switch	1			
48	471-591	. . Screw, machine, 4-40 NC-2A by 1 in., binder hd slotted, brass, white nickel plt	2			
49	501-008	. . Washer, #4 flat, stl cad plt (MS15795-204)	2			
50	502-002	. . Washer, #4 spring lock, stl cad plt (MS35338-40)	2			
51	492-008	. . Nut, plain hex, 4-40 NC-2B, stl cad plt (MS35649-42)	2			
52	120-062	. . Switch, sensitive, spdt (S20) (Unimax #2HBT215-1)	1			
53	310040210	. . Bracket, angle	1			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-9-						
*54	471-082	. Screw, machine, 8-32 NC-2A by 3/4 in., pan hd Phillips, stl cad plt (MS35208-44)	2			
*55	310021710	. Washer, hinge stop cap	2			
*56	310021610	. Washer, hinge stop	2			
*57	501-010	. Washer, #8 flat, stl cad plt (MS15795-207)	4			
*58	493-007	. Nut, self-locking, hex, 8-32 NC-3B, stl cad plt w/nylon insert (Esna Type NM)	2			
*59	310009510	. Arm Assembly, stop	2			
60	310C24910	. Identification Plate	1			

* Packed and shipped separately.

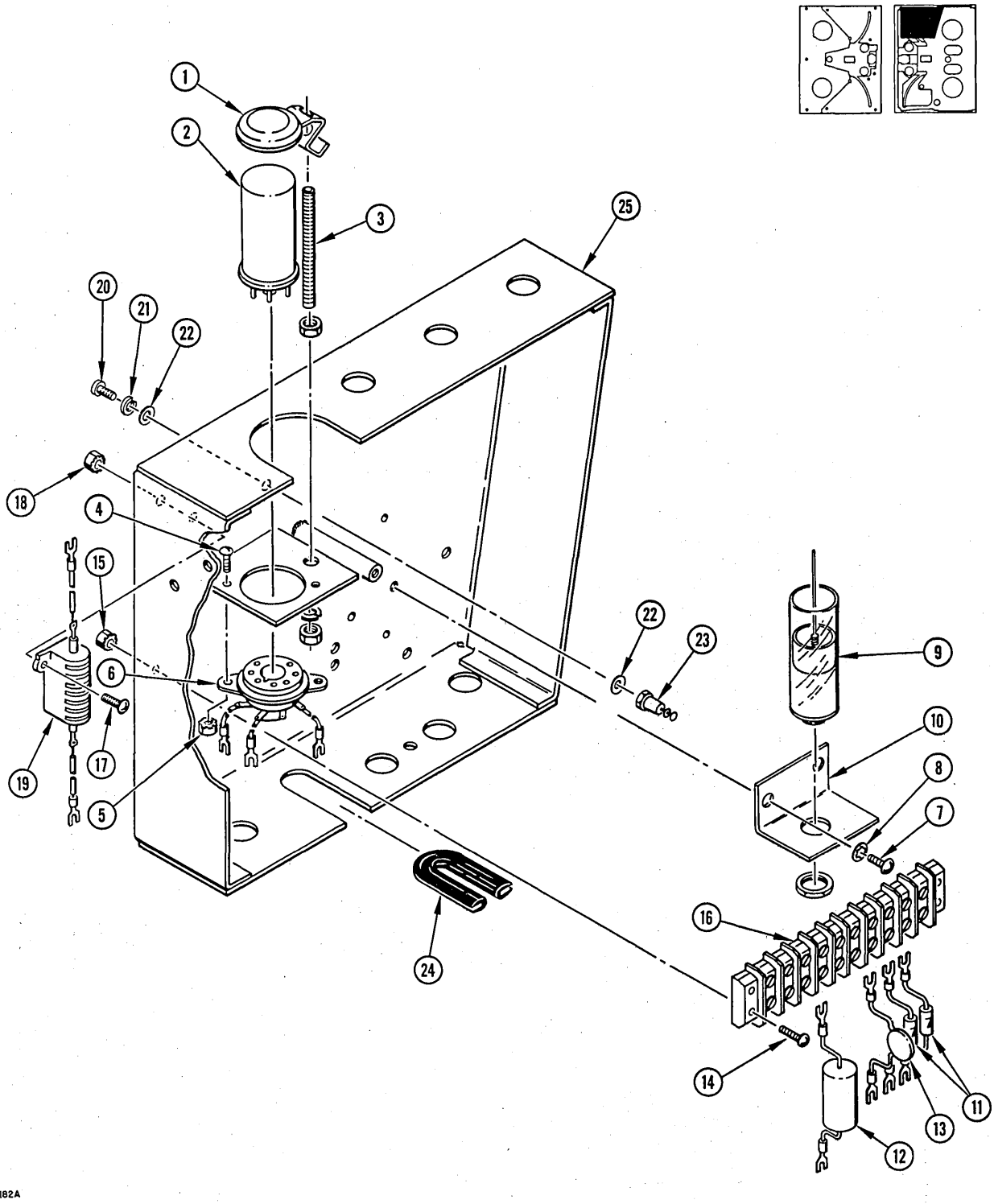


Figure 7-10.
Upper Servo Control

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-10-		UPPER SERVO CONTROL				
	310076310	Servo Control Assembly, upper (See Figure 7-9)	Ref			
1	300-021	. Clamp, tube, sst (Top Hat #2T)	1			
2	020-072	. Relay, mercury wetted contact, spdt (K12) (C.P. Clare #HG-1013)	1			
3	300-020	. Post, tube clamp, sst, w/mounting hardware (Top Hat #32)	1			
4	471-061	. Screw, machine, 4-40 NC-2A by 5/16 in., pan hd Phillips, stl cad plt (MS35208-13)	2			
5	496-004	. Nut, keps, 4-40 NC-2B, external washer, stl cad plt (Shakeproof)	2			
6	310081910	. Socket Assembly, relay, upper box	1			
7	471-069	. Screw, machine, 6-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-25)	2			
8	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	2			
9	310262910	. Dashpot Assembly, stud mounted	1			
10	310250410	. Bracket, dashpot, upper	1			
11	310082210	. Diode Assembly, 1N2069 (CR16, CR18)	2			
12	310258910	. Diode Assembly, transient suppressor (CR26)	1			
13	310082310	. Capacitor Assembly, 0.1 uf, 500 volt (C10)	1			
14	471-071	. Screw, machine, 6-32 NC-2A by 1/2 in., pan hd Phillips, stl cad plt (MS35208-27)	8			
15	496-005	. Nut, keps, 6-32 NC-2B, external washer, stl cad plt (Shakeproof)	8			
16	180-031	. Terminal Strip, barrier, phenolic (TS5, TS6) (Jones #10-140 w/marker strip)	2			
17	471-061	. Screw, machine, 4-40 NC-2A by 5/16 in., pan hd Phillips, stl cad plt (MS35208-13)	2			
18	496-004	. Nut, keps, 4-40 NC-2B, external washer, stl cad plt (Shakeproof)	2			
19	310082610	. Resistor Assembly, 300 ohm, 25w, 3% (R12)	1			
20	471-061	. Screw, machine, 4-40 NC-2A by 5/16 in., pan hd Phillips, stl cad plt (MS35208-13)	1			
21	502-002	. Washer, #4 spring lock, stl cad plt (MS35338-40)	1			
22	501-008	. Washer, #4 flat, stl cad plt (MS15795-204)	2			
23	173-068	. Terminal Lug, insulated (Lerco #6122)	1			
24	269-008	. Seal, neoprene (Rubbercraft #73)	1			
25	310086310	. Box Assembly, servo control upper	1			

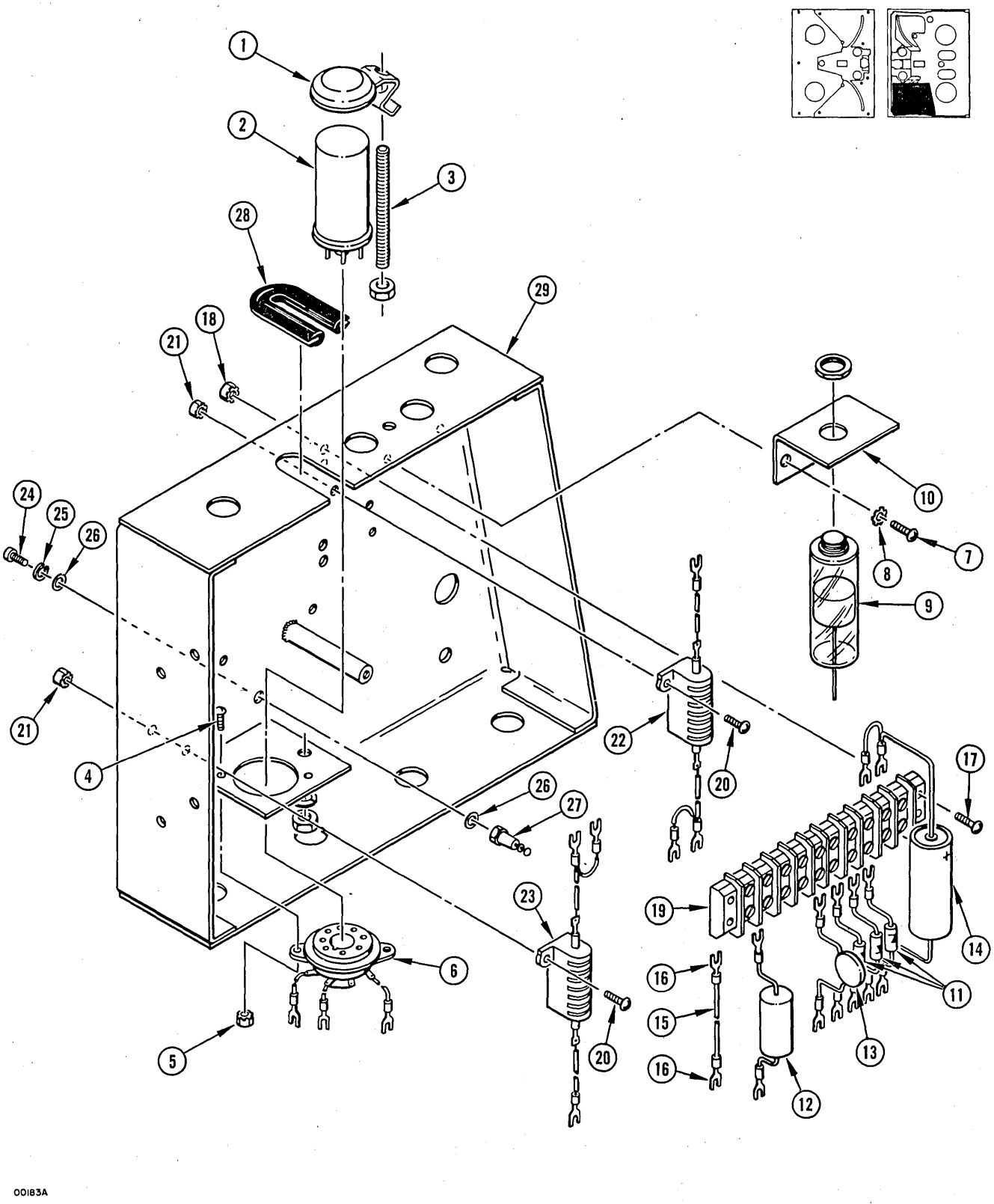


Figure 7-11.
Lower Servo Control

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-11-		LOWER SERVO CONTROL				
	310076210	Servo Control Assembly, lower (See Figure 7-9)	Ref			
1	300-021	. Clamp, tube, sst (Top Hat #2T)	1			
2	020-072	. Relay, mercury wetted contact, spdt (K13) (C.P. Clare #HG-1013)	1			
3	300-020	. Post, tube clamp, sst, w/mounting hardware (Top Hat #32)	1			
4	471-061	. Screw, machine, 4-40 NC-2A by 5/16 in., pan hd Phillips, stl cad plt (MS35208-13)	2			
5	496-004	. Nut, keps, 4-40 NC-2B, external washer, stl cad plt (Shakeproof)	2			
6	310082010	. Socket Assembly, relay, lower box	1			
7	471-069	. Screw, machine, 6-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-25)	2			
8	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	2			
9	310262910	. Dashpot Assembly, stud mounted	1			
10	310262510	. Bracket, dashpot, lower	1			
11	310082210	. Diode Assembly, 1N2069 (CR15,CR17,CR21)	3			
12	310258910	. Diode Assembly, transient suppressor (CR27)	1			
13	310082310	. Capacitor Assembly, 0.1 uf, 500 volt (C11)	1			
14	310084310	. Capacitor Assembly, 100 uf, 50 volt (C15)	1			
15	611-057	. Wire, stranded, insulated, MIL-W-16878 Type C, 22GA, 12 in. lg	1			
16	301711230	. Lug, forked tongue	2			
17	471-071	. Screw, machine, 6-32 NC-2A by 1/2 in., pan hd Phillips, stl cad plt (MS35208-27)	8			
18	496-005	. Nut, keps, 6-32 NC-2B, external washer, stl cad plt (Shakeproof)	8			
19	180-031	. Terminal Strip, barrier, phenolic (TS7, TS8) (Jones #10-140 w/marker strip)	2			
20	471-061	. Screw, machine, 4-40 NC-2A by 5/16 in., pan hd Phillips, stl cad plt (MS35208-13)	4			
21	496-004	. Nut, keps, 4-40 NC-2B, external washer, stl cad plt (Shakeproof)	4			
22	310082410	. Resistor Assembly, 35 ohm, 25w, 3% (R19)	1			
23	310082710	. Resistor Assembly, 300 ohm, 25w, 3% (R11)	1			
24	471-061	. Screw, machine, 4-40 NC-2A by 5/16 in., pan hd Phillips, stl cad plt (MS35208-13)	1			
25	502-002	. Washer, #4 spring lock, stl cad plt (MS35338-40)	1			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-11-						
26	501-008	. Washer, #4 flat, stl cad plt (MS15795-204)	2			
27	173-068	. Terminal Lug, insulated (Lerco #6122)	1			
28	269-008	. Seal, neoprene (Rubbercraft #73)	1			
29	310086210	. Box Assembly, servo control lower	1			

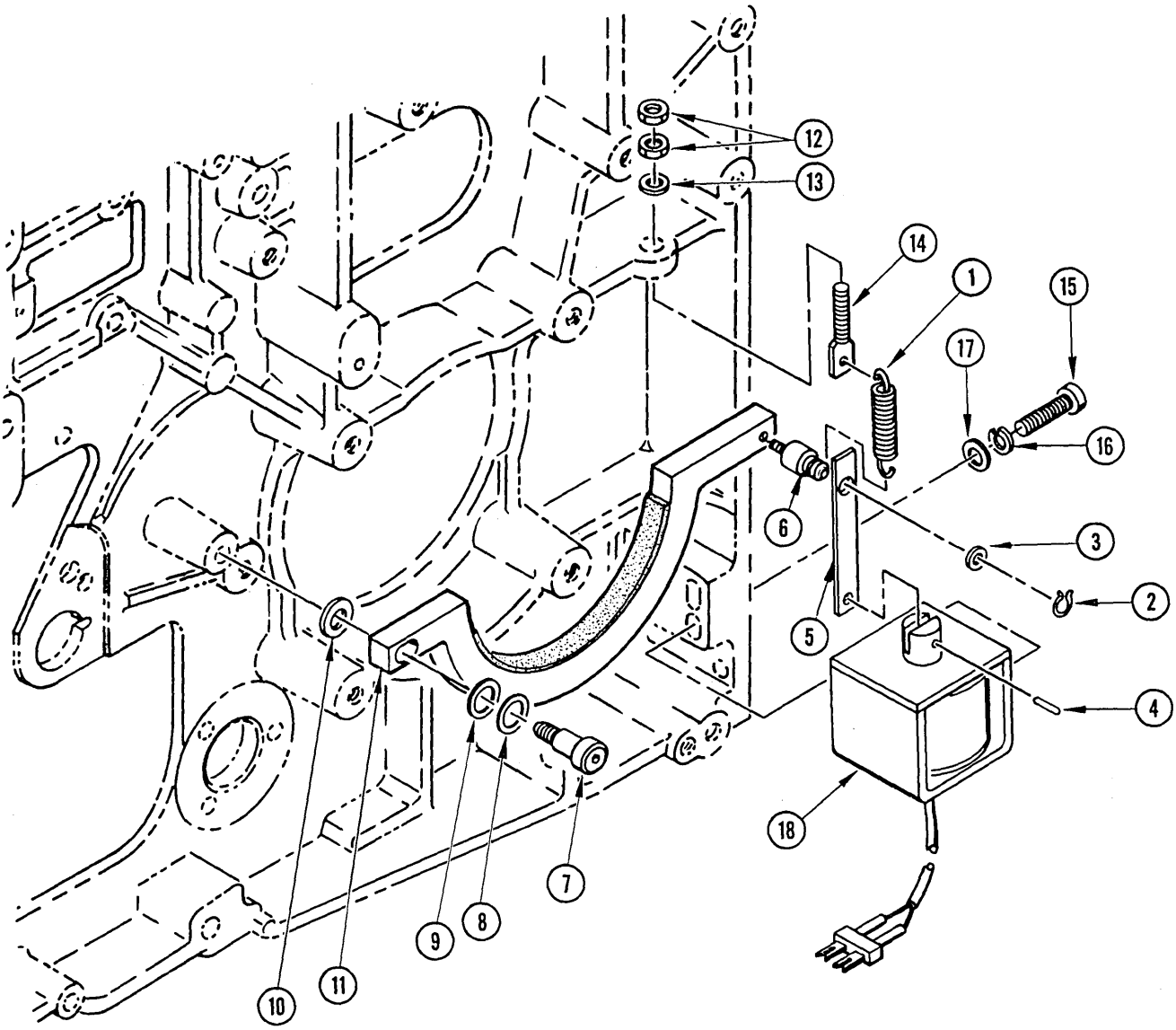


Figure 7-12.
Reel Brakes and Solenoid

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-12-		REEL BRAKES AND SOLENOID				
	310052510	Tape Transport Assembly (See Figure 7-1)	Ref			
1	310021810	. Spring, reel brake	2			
2	430-076	. Ring, retaining, external, flat, 1/8 in., beryllium copper (Truarc #5100-12-C)	2			
3	501-124	. Washer, flat, 0.126 in. ID, 0.315 in. OD, 0.016 in. thk (Bearing Engineering, Bellville #BS-8-3.2-0.4)	2			
4	406-026	. Pin, roll, sst (Esna #79-022-094-500)	2			
5	310018710	. Link, solenoid	2			
6	310089410	. Standoff, reel brake	2			
7	304714260	. Screw, shoulder, socket head cap	2			
8	501-055	. Washer, shim, flat, 0.005 in. thk, brass unplated	A/R			
9	501-058	. Washer, shim, flat, 0.010 in. thk, brass (Tilley)	A/R			
10	310016610	. Washer, flat	2			
11	310089210	. Shoe Assembly, reel brake	2			
12	492-011	. Nut, plain hex, 10-32 NF-2B, stl cad plt (MS35650-102)	4			
13	501-011	. Washer, #10 flat, stl cad plt (MS15795-208)	A/R			
14	310016010	. Bolt, spade	2			
15	471-082	. Screw, machine, 8-32 NC-2A by 3/4 in., pan hd Phillips, stl cad plt (MS35208-44)	4			
16	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	4			
17	501-010	. Washer, #8 flat, stl cad plt (MS15795-207)	4			
18	310085210	. Solenoid and Cable Assembly, DC	2			

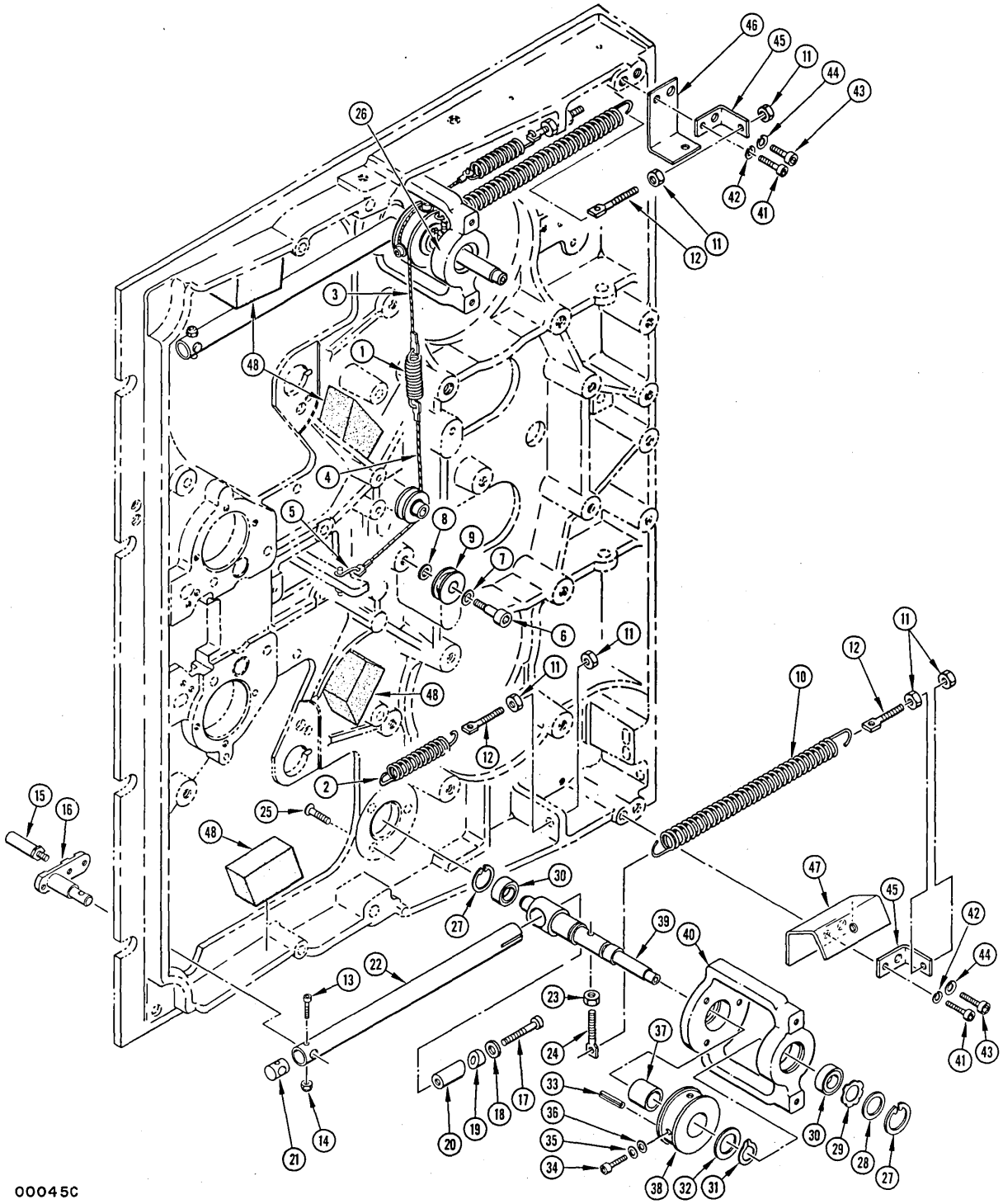


Figure 7-13.
Tension Arms

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-13-		TENSION ARMS				
	310052510	Tape Transport Assembly (See Figure 7-1)	Ref			
1	310209010	. Spring, buffer arm cable	2			
2	310020110	. Spring, extension, helical	2			
3	310208710	. Cable Assembly, long	2			
4	310208810	. Cable Assembly, short	2			
5	310209110	. Shackle, thread latch	1			
6	304717310	. Screw, shoulder, socket head cap	2			
7	501-011	. Washer, #10 flat, stl cad plt (MS15795-208)	2			
8	501-058	. Washer, shim, flat, 0.010 in. thk, brass (Tilley)	2			
9	310016810	. Roller, cable	2			
10	310018010	. Spring, tape tensioning	2			
11	492-011	. Nut, plain hex, 10-32 NF-2B, stl cad plt (MS35650-102)	8			
12	310016010	. Bolt, spade	4			
13	470-064	. Screw, cap, 4-40 NC-3A by 5/8 in., hex soc, sst, passivated	2			
14	493-026	. Nut, self-locking, hex, 4-40 NC-2B, brass cad plt (Esna #92-1660-40)	2			
	310080410	. Tape Guide Assembly	2			
15	310019910	. . Roller, tape guide	3			
16	310074910	. . Support, tape guide	1			
17	470-042	. Screw, cap, 10-32 NF-3A by 1 in., hex soc, stl cad plt (MS35458-15)	2			
18	310018510	. Washer, flat	2			
19	310016210	. Wedge, expansion	2			
20	310016110	. Wedge, expansion	2			
	310009410	. Tension Arm Assembly	2			
21	310036210	. . Plug, tension arm	1			
22	310036310	. . Tension Arm	1			
23	492-011	. Nut, plain hex, 10-32 NF-2B, stl cad plt (MS35650-102)	2			
24	310016010	. Bolt, spade	2			
25	471-347	. Screw, machine, 8-32 NC-2A by ½ in., 82° flat hd Phillips, stl cad plt (MS35192-42)	6			
26	310008610	. Mounting Assembly, tension arm	2			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-13-						
27	430-085	. . Ring, retaining, internal (Truarc #N5000-87-S-MD)	2			
28	310034910	. . Washer, flat, retaining	1			
29	352-007	. . Washer, spring, ball bearing (Wallace Barnes #R6)	1			
30	421-001	. . Bearing, ball, double shield (Fafnir #S3KDD)	2			
31	430-014	. . Ring, retaining, external (Truarc #5100-50-S-ZD)	1			
32	501-032	. . Washer, flat, ½ in., stl cad plt (AN960-816L)	1			
33	406-031	. . Pin, roll, sst (Esna #79-028-125-0750)	1			
34	470-008	. . Screw, cap, 4-40 NC-3A by ¼ in., hex soc, stl cad plt (MS35457-1)	2			
35	501-008	. . Washer, #4 flat, stl cad plt (MS15795-204)	2			
36	503-035	. . Washer, flat, fiber (Walsco #7836)	2			
	310035010	. . Pulley Assembly	1			
37	423-024	. . . Bearing, plain sleeve, bronze (Boston Bronze #B-810-5)	1			
38	310061510	. . . Pulley, uncrowned	1			
39	310035110	. . Shaft, tension arm	1			
40	310035210	. . Bracket, tension arm	1			
41	470-039	. Screw, cap, 10-32 NF-3A by 5/8 in., hex soc, stl cad plt (MS35458-12)	2			
42	502-005	. Washer, #10 spring lock, stl cad plt (MS35338-43)	2			
43	470-045	. Screw, cap, ¼-20 UNC-3A by ½ in., hex soc, stl cad plt (MS35457-33)	2			
44	502-006	. Washer, ¼ spring lock, stl cad plt (MS35338-44)	2			
45	310020810	. Bracket, angle	2			
46	310019810	. Bracket, angle	1			
47	310088210	. Bracket, cable clamp	1			
48	310017110	. Pad, rubber	4			

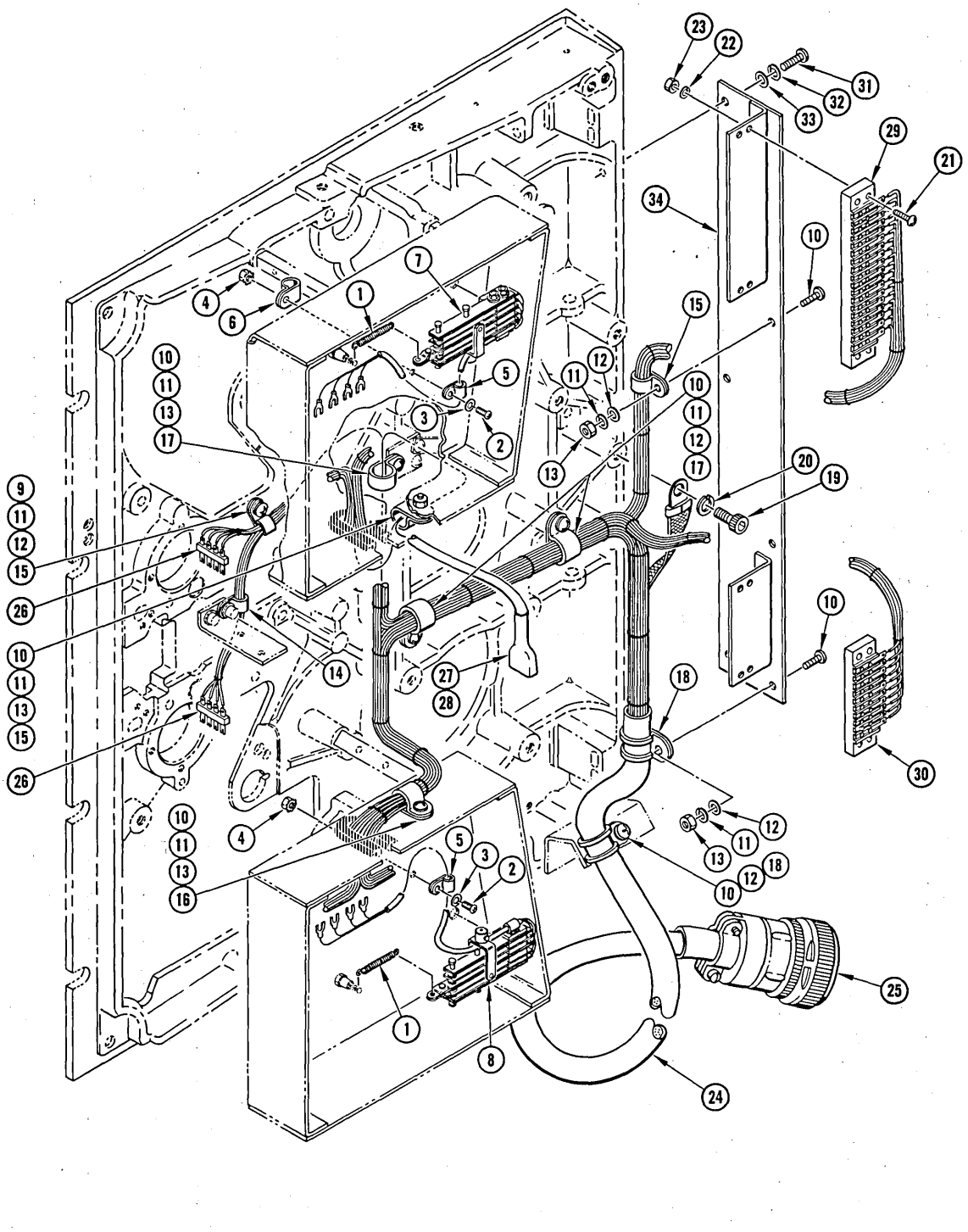


Figure 7-14.
Servo Contact and Transport Cables

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-14-		SERVO CONTACT AND TRANSPORT CABLES				
	310052510	Tape Transport Assembly (See Figure 7-1)	Ref			
1	310044110	. Spring, contact centering	2			
2	471-062	. Screw, machine, 4-40 NC-2A by 3/8 in. pan hd Phillips, stl cad plt (MS35208-14)	2			
3	501-008	. Washer, #4 flat, stl cad plt (MS15795-204)	2			
4	496-004	. Nut, keps, 4-40 NC-2B, stl cad plt (Shakeproof)	2			
5	302-058	. Clamp, cable, plastic, 1/8 in. ID (Commercial Plastics #742-2)	2			
6	302-041	. Clamp, cable, stl cad plt (Cinch-Jones #85A)	2			
7	310259310	. Servo Contact and Cable Assembly, upper	1			
8	310259210	. Servo Contact and Cable Assembly, lower	1			
9	471-078	. Screw, machine, 8-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-40)	1			
10	471-080	. Screw, machine 8-32 NC-2A by 1/2 in., pan hd Phillips, stl cad plt (MS35208-42)	8			
11	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	8			
12	501-010	. Washer, #8 flat, stl cad plt (MS15795-207)	6			
13	492-010	. Nut, plain hex, 8-32 NC-2B, stl cad plt (MS35649-82)	5			
14	302-007	. Clamp, cable, plastic, 1/4 in. ID (Commercial Plastics #742-4)	1			
15	302-037	. Clamp, cable, plastic, 5/16 in. ID (Commercial Plastics #742-5)	3			
16	302-036	. Clamp, cable, plastic, 3/8 in. ID (Commercial Plastics #742-6)	1			
17	302-049	. Clamp, cable, plastic, 1/2 in. ID (Commercial Plastics #742-8)	3			
18	302-029	. Clamp, cable, loop (AN742D14C)	2			
19	470-045	. Screw, cap, 1/4-20 UNC-3A by 1/2 in., hex soc, stl cad plt (MS35457-33)	1			
20	502-006	. Washer, 1/4 spring lock, stl cad plt (MS35338-44)	1			
21	471-063	. Screw, machine, 4-40 NC-2A by 7/16 in., pan hd Phillips, stl cad plt (MS35208-15)	8			
22	502-002	. Washer, #4 spring lock, stl cad plt (MS35338-40)	8			
23	492-008	. Nut, plain hex, 4-40 NC-2B, stl cad plt (MS35649-42)	8			
24	310087810	. Cable Assembly, transport	1			
25	301451870	. . Connector, plug, 37 pin (P1)	1			
26	310064010	. . Fanning Strip (FS3, FS4)	2			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-14-						
27	169-988	. . Connector, three way, nylon housing (P702) (AMP #480177-1)	1			
28	169-019	. . Connector, contact pin, brass (AMP #42641-1)	3			
29	301801340	. . Terminal Strip, 18 terminals (TS1)	1			
30	301801350	. . Terminal Strip, 10 terminals (TS2)	1			
31	471-088	. Screw, machine, 10-32 NF-3A by 7/16 in., pan hd Phillips, stl cad plt (MS35209-54)	3			
32	502-005	. Washer, #10 spring lock, stl cad plt (MS35338-43)	3			
33	501-011	. Washer, #10 flat, stl cad plt (MS15795-208)	3			
34	310087010	. Support Assembly	1			

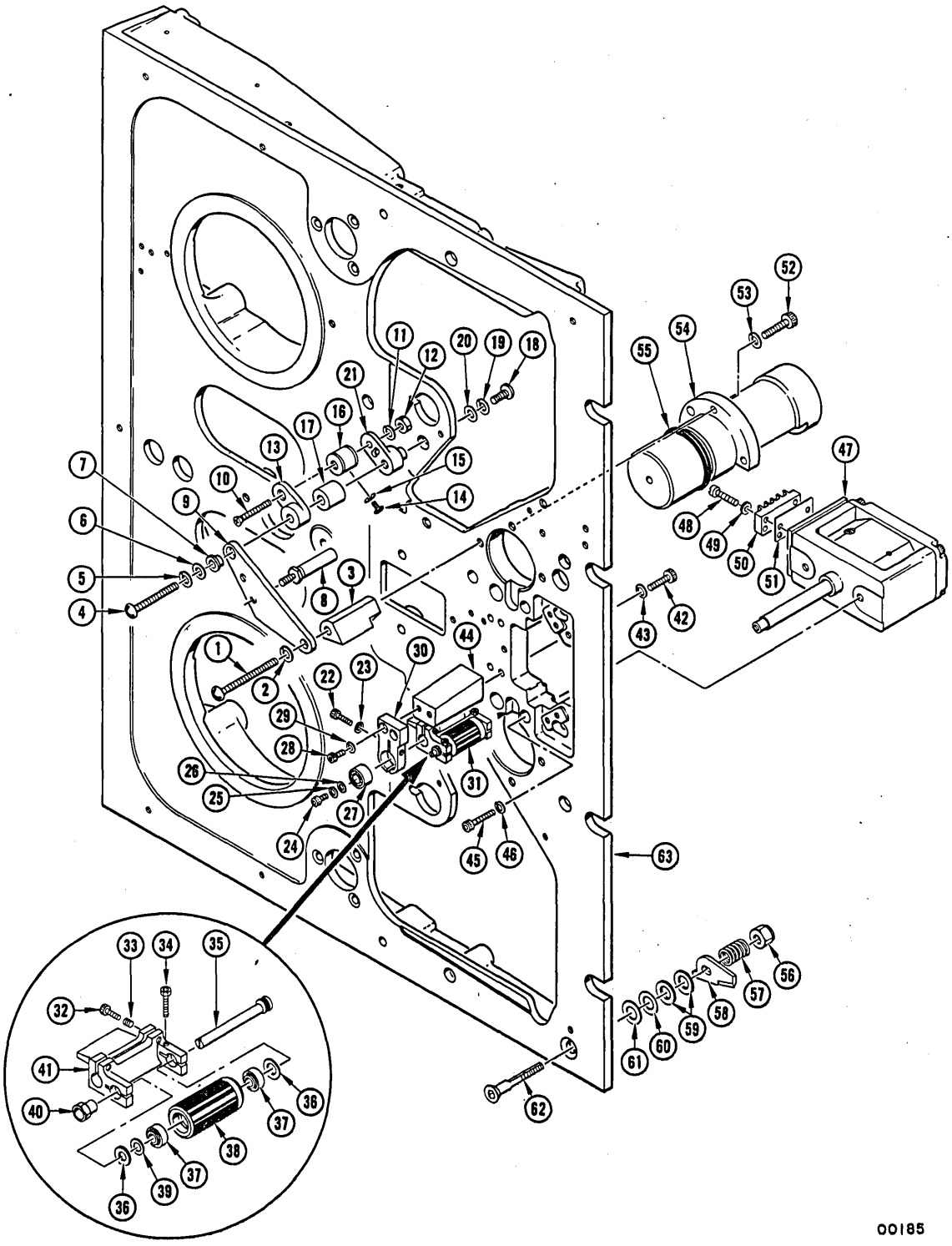


Figure 7-15.
Tape Guides, Actuators, Capstans and Capstan Rollers

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-15-		TAPE GUIDES, ACTUATORS, CAPSTANS AND CAPSTAN ROLLERS				
	310052510	Tape Transport Assembly (See Figure 7-1)	Ref			
1	471-732	. Screw, machine, 10-32 NC-2A by 2 in., pan hd Phillips, sst, passivated (MS35217-63)	2			
2	502-011	. Washer, #10 spring lock, sst (MS35338-81)	2			
3	310017210	. Spacer, sleeve	2			
4	304720100	. Screw, machine, 10-32 by 1-½ in., pan hd Phillips, sst	2			
5	502-011	. Washer, #10 spring lock, sst (MS35338-81)	2			
6	501-011	. Washer, #10 flat, stl cad plt (MS15795-208)	2			
7	503-038	. Washer, shoulder, fiber (General Cement #6527)	2			
8	310019910	. Roller, tape guide	4			
9	310075010	. Tie, stationary tape guide	2			
10	471-402	. Screw, machine, 8-32 NC-2A by 1 in., flat hd Phillips, sst, passivated (MS35200-46)	2			
11	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	2			
12	492-010	. Nut, plain hex, 8-32 NC-2B, stl cad plt (MS35649-82)	2			
13	310088810	. Support, tape guide, upper	2			
14	471-838	. Screw, machine, 2-56 NC-2A by 3/16 in., pan hd slotted, stl cad plt (MS35225-2)	2			
15	502-023	. Washer, #2 lock, internal tooth, stl cad plt (MS35333-35)	2			
16	310089010	. Tape Guide Assembly	2			
17	310089110	. Tape Guide, back	2			
18	471-087	. Screw, machine, 10-32 NF-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35209-53)	2			
19	502-005	. Washer, #10 spring lock, stl cad plt (MS35338-43)	2			
20	501-011	. Washer, #10 flat, stl cad plt (MS15795-208)	2			
21	310088710	. Support, tape guide, lower	2			
22	470-063	. Screw, cap, 4-40 NC-3A by ½ in., hex soc, sst, passivated	2			
23	502-008	. Washer, #4 spring lock, sst (MS35338-78)	2			
24	470-059	. Screw, cap, 4-40 NC-3A by ¼ in., hex soc, sst, passivated	2			
25	502-008	. Washer, #4 spring lock, sst (MS35338-78)	2			
26	501-014	. Washer, #4 flat, sst, passivated (MS15795-304)	2			
27	310084010	. Bearing, outboard	2			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-15-						
28	470-061	. Screw, cap, 4-40 NC-3A by 3/8 in., hex soc, sst, passivated	4			
29	502-008	. Washer, #4 spring lock, sst (MS35338-78)	4			
30	310157010	. Arm, actuator shaft support	2			
31	310084110	. Capstan Roller Assembly, lower	1			
	310084210	. Capstan Roller Assembly, upper	1			
32	470-177	. . Screw, cap, self-locking, hex soc, 4-40 by 3/8 in., alloy stl cad plt (Nylok #M60HS440-6C)	2			
33	495-004	. . Insert, sst, 4-40 (Heli-Coil #1185-04CNX.168)	2			
34	470-178	. . Screw, cap, self-locking, hex soc, 2-56 by 7/16 in., alloy stl cad plt (Nylok #M60HS256-7C)	2			
35	310176410	. . Shaft Assembly, capstan roller	1			
36	310183310	. . Spacer, bearing	2			
37	310178210	. . Bearing, ball	2			
38	310176510	. . Roller, capstan	1			
39	501-119	. . Washer, spring, #5, beryllium copper (Shakeproof #3502-05-23-2114)	1			
40	310183810	. . Sleeve, flanged	1			
41	310084510	. . Yoke, capstan roller, lower	1			
	310084610	. . Yoke, capstan roller, upper	1			
42	470-030	. Screw, cap, 8-32 NC-3A by 5/8 in., hex soc, stl cad plt (MS35457-16)	4			
43	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	4			
44	310085010	. Post, actuator shaft support	2			
45	470-031	. Screw, cap, 8-32 NC-3A by 3/4 in., hex soc, stl cad plt (MS35457-17)	4			
46	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	4			
47	310083710	. Actuator Assembly, capstan roller	2			
48	471-019	. . Screw, machine, 6-32 NC-2A by 3/8 in., pan hd Phillips, brass cad plt (Type MS35212)	4			
49	502-025	. . Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	4			
50	180-080	. . Terminal Strip, barrier, phenolic (Kulka #410-3/4ST-4M)	1			
51	310041510	. . Plate, insulator	1			
52	470-039	. Screw, cap, 10-32 NF-3A by 5/8 in., hex soc, stl cad plt (MS35458-12)	6			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-15-						
53	502-005	. Washer, #10 spring lock, stl cad plt (MS35338-43)	6			
54	310280410	. Capstan Assembly	2			
55	432-032	. . Quad Ring (Minnesota Rubber and Gasket #MRQ1-Q24)	1			
56	493-012	. Nut, self-locking, hex, 1/4-20 NC-3B, stl cad plt w/nylon insert (Esna Type NM)	1			
57	310018110	. Spring, transport lock	1			
58	310018310	. Latch, thumb	1			
59	310016610	. Washer, flat	2			
60	501-055	. Washer, shim, flat, brass, unplated, 0.005 in. thk	A/R			
61	501-058	. Washer, shim, flat, brass, 0.010 in. thk (Tilley)	A/R			
62	310018610	. Screw, machine, latch	1			
63	310091310	. Frame, transport	1			

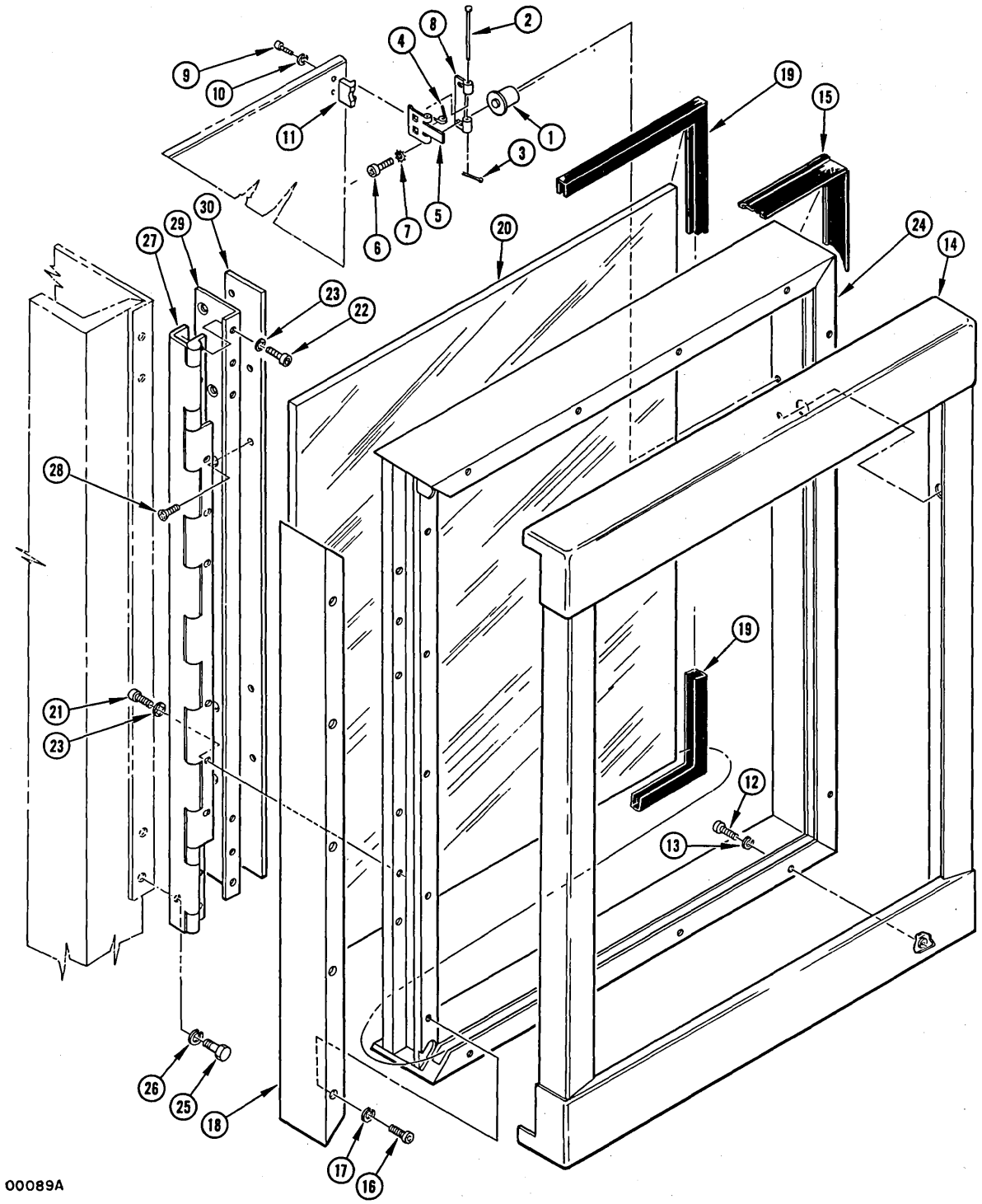


Figure 7-16.
Access Door

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-16-		ACCESS DOOR				
	310263310	Access Door Assembly (See Figure 7-1)	Ref			
1	310025810	. Button, latch finger	1			
2	400-021	. Pin, clevis, 1/8 in. dia by 1-31/32 in. lg, pan hd, stl cad plt (MS20392-1-63)	1			
3	401-004	. Pin, cotter, 1/16 in. dia by 3/8 in. lg, sst	1			
4	310025510	. Spring, helical torsion	1			
5	310025410	. Strike, latch	1			
6	471-059	. Screw, machine, 4-40 NC-2A by 3/16 in., pan hd Phillips, stl cad plt (MS35208-11)	2			
7	502-013	. Washer, #4 lock, external tooth, stl cad plt (MS35335-20)	2			
8	310025310	. Hinge, strike latch	1			
9	470-009	. Screw, cap, 4-40 NC-3A by 5/16 in., hex soc, stl cad plt	2			
10	502-002	. Washer, #4 spring lock, stl cad plt (MS35338-40)	2			
11	310022710	. Bolt, latch	1			
12	470-031	. Screw, cap, 8-32 NC-3A by 3/4 in., hex soc, stl cad plt (MS35457-17)	8			
13	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	8			
14	310264310	. Door Frame, transport access	1			
15	269-124	. Seal, extrusion, black (Rubbercraft #1133 non-staining)	A/R			
16	470-030	. Screw, cap, 8-32 NC-3A by 5/8 in., hex soc, stl cad plt (MS35457-16)	5			
17	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-42)	5			
18	310025110	. Channel, window	1			
19	PACKING	. Packing (Everseal #616, 632 or 664)	A/R			
20	310025010	. Pane, glass, dust cover	1			
21	470-030	. Screw, cap, 8-32 NC-3A by 5/8 in., hex soc, stl cad plt (MS35457-16)	6			
22	470-027	. Screw, cap, 8-32 NC-3A by 3/8 in., hex soc, stl cad plt (MS35457-14)	6			
23	502-026	. Washer, #8 lock, internal tooth, stl cad plt (MS35333-38)	12			
24	310025210	. Window, access door	1			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-16-						
25	471-465	. Screw, machine, 12-24 NC-2A by 1/2 in., hex hd, stl cad plt	6			
26	502-049	. Washer, #12 spring lock, stl cad plt	6			
27	310017810	. Hinge, butt	1			
28	471-734	. Screw, machine, 10-24 NC-2A by 1/2 in., flat hd Phillips, stl cad plt	10			
29	310017710	. Bracket, hinge	1			
30	310017610	. Spacer, hinge	1			

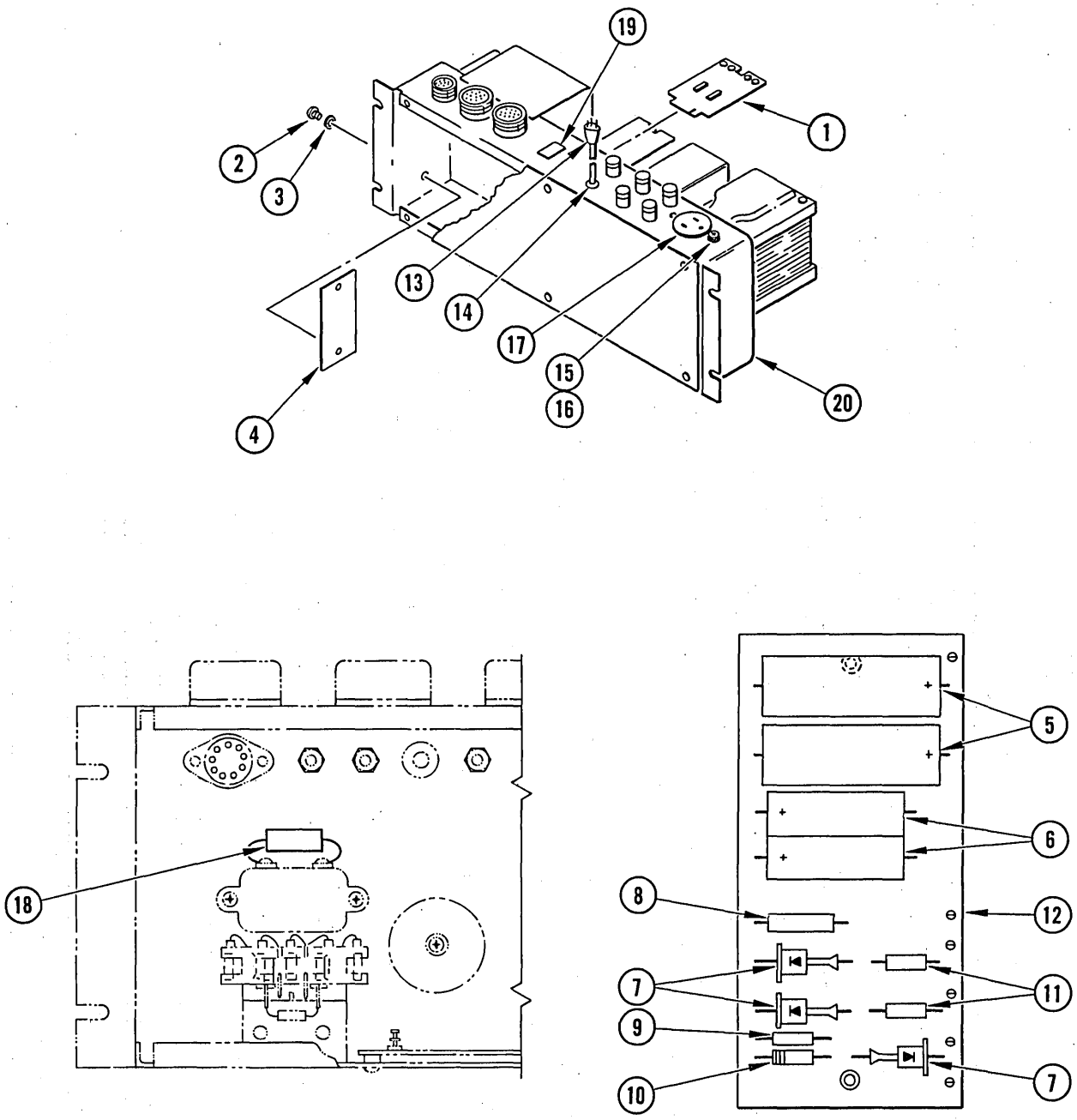


Figure 7-17.
Transport Electronics

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-17-		TRANSPORT ELECTRONICS				
	310441010	Transport Electronics Assembly, 117 vac, with Buffer Delay and Interlock (See Figure 7-1)	Ref			
1	310497010	. Buffer Delay and Interlock Unit Assembly (See Figure 7-18)	1			
2	471-067	. Screw, machine, 6-32 NC-2A by 1/4 in., pan hd Phillips, stl cad plt (MS35208-23)	2			
3	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	2			
4	310067410	. Power Supply Board Assembly (TB12)	1			
5	031-263	. . Capacitor, electrolytic, 100 uf, 50 volt (C53, C91) (Cornell-Dubilier #BR1005)	2			
6	031-219	. . Capacitor, electrolytic, 200 uf, 12 volt (C71, C81) (Sprague #30D156A1)	2			
7	013-015	. . Diode, crystal (CR51, CR61, CR71) (General Electric #1N91)	3			
8	041-099	. . Resistor, fixed, composition, 270 ohm, 1w, 5% (R54) (MIL-R-11:RC32GF271J)	1			
9	041-528	. . Resistor, fixed, composition, 300 ohm, 1/2w, 5% (R52) (MIL-R-11:RC200GF301J)	1			
10	041-334	. . Resistor, fixed, composition, 200 ohm, 1/2w, 5% (R51) (MIL-R-11:RC20GF201J)	1			
11	043-391	. . Resistor, fixed, wirewound, 1 ohm, 1/2w, 5% (R55, R56) (Continental Carbon #NA15)	2			
12	310073310	. . Printed Circuit Board	1			
13	084-008	. Cord Set, 3 conductor, male plug (Cornish #3532)	1			
14	302640040	. Strain Relief, nylon	1			
15	471-076	. Screw, machine, 8-32 NC-2A by 1/4 in., pan hd Phillips, stl cad plt (MS35208-38)	2			
16	502-004	. Washer, #8 spring lock, stl cad plt (MS35338-43)	2			
17	146-175	. Connector, receptacle, female, 2 contact, 3 pole (J6) (Hubbell #5258)	1			
18	300132710	. Diode, transient voltage suppressor	1			
19	310024910	. Identification Plate	1			
20	310443610	. Transport Electronics Assembly, basic unit (See Figure 7-19)	1			

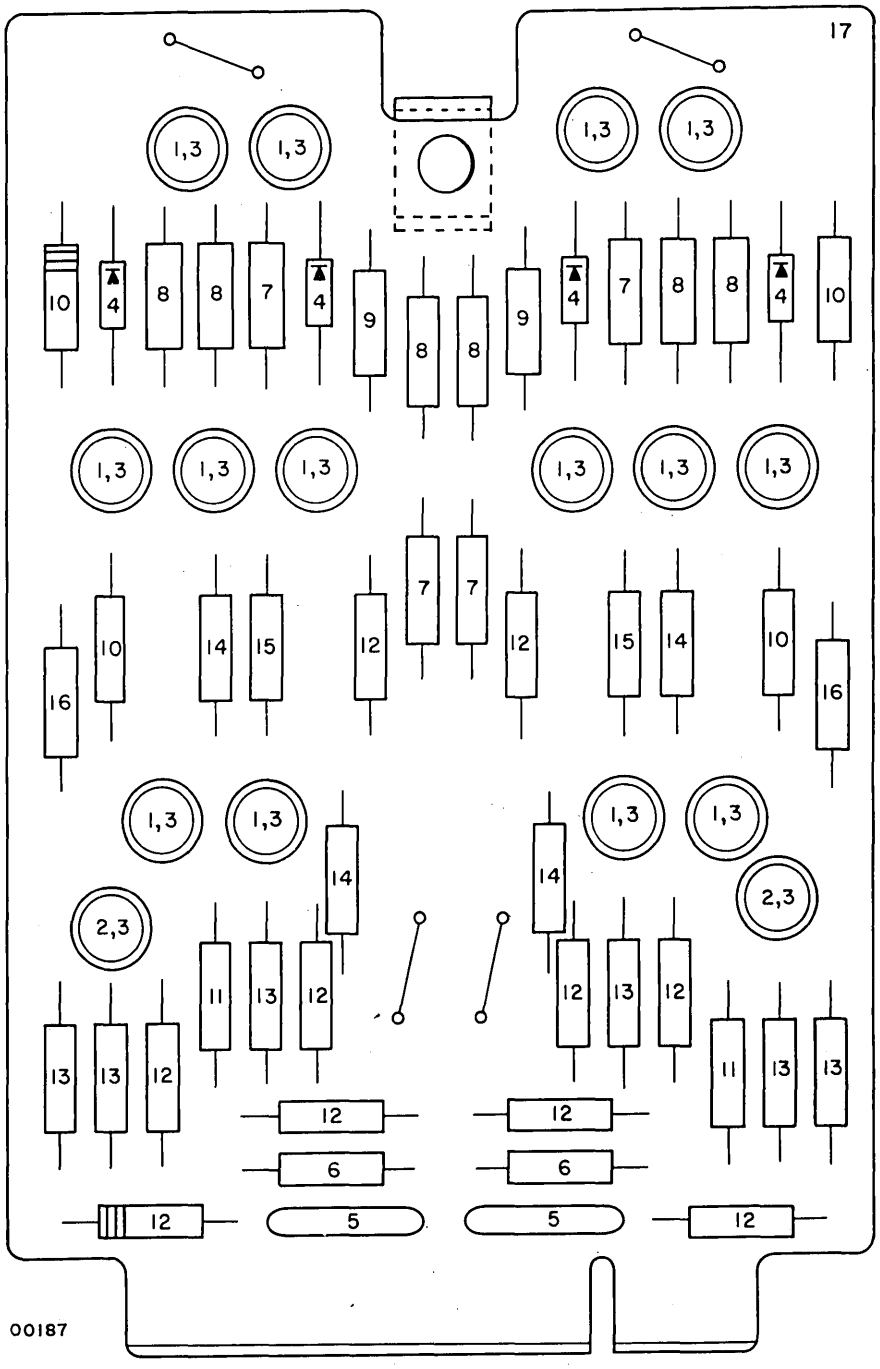


Figure 7-18.
Buffer Delay and Interlock Unit

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-18-		BUFFER DELAY AND INTERLOCK UNIT				
	310497010	Buffer Delay and Interlock Unit Assembly (See Figure 7-17)	Ref			
1	014-078	. Transistor, NPN, switching type (Q1, Q2, Q4 thru Q11, Q13 thru Q16) (General Transistor #2N445A)	14			
2	014-030	. Transistor (Q3, Q12) (General Transistor #2N446A)	2			
3	280-030	. Spacer, transistor mounting pad (Milton Ross Metals #10012)	16			
4	013-054	. Diode, crystal (CR1 thru CR4) (Hughes 1N96)	4			
5	030-129	. Capacitor, ceramic disc, 0.01uf, 1000 volt (C1, C4) (Cornell-Dubilier #BYA10S1M)	2			
6	041-330	. Resistor, fixed, composition, 6800 ohm, 1/2w, 5% (R1, R25) (MIL-R-11:RC20GF682J)	2			
7	041-303	. Resistor, fixed, composition, 3900 ohm, ½w, 5% (R2, R5, R26, R29) (MIL-R-11:RC20GF392J)	4			
8	041-015	. Resistor, fixed, composition, 27K, ½w, 5% (R3, R6, R7, R27, R30, R31) (MIL-R-11: RC20GF273J)	6			
9	041-357	. Resistor, fixed, composition, 5600 ohm, ½w, 5% (R4, R28) (MIL-R-11:RC20GF562J)	2			
10	041-456	. Resistor, fixed, composition, 36K, ½w, 5% (R8, R11, R32, R35) (MIL-R-11:RC20GF363J)	4			
11	041-254	. Resistor, fixed, composition, 15K, ½w, 5% (R9, R33) (MIL-R-11:RC20GF153J)	2			
12	041-322	. Resistor, fixed, composition, 18K, ½w, 5% (R10, R13, R14, R16, R17, R34, R39, R40, R42, R43) (MIL-R-11:RC20GF183J)	10			
13	041-239	. Resistor, fixed, composition, 2200 ohm, ½w, 5% (R12, R15, R22, R38, R41, R46) (MIL-R-11:RC20GF222J)	6			
14	041-023	. Resistor, fixed, composition, 100K, ½w, 5% (R18, R20, R36, R44) (MIL-R-11:RC20GF104J)	4			
15	041-273	. Resistor, fixed, composition, 270 ohm, ½w, 5% (R23, R47) (MIL-R-11:RC20GF271J)	2			
16	041-016	. Resistor, fixed, composition, 22K, ½w, 5% (R24, R48) (MIL-R-11:RC20GF223J)	2			
17	310059710	. Printed Circuit Board	1			

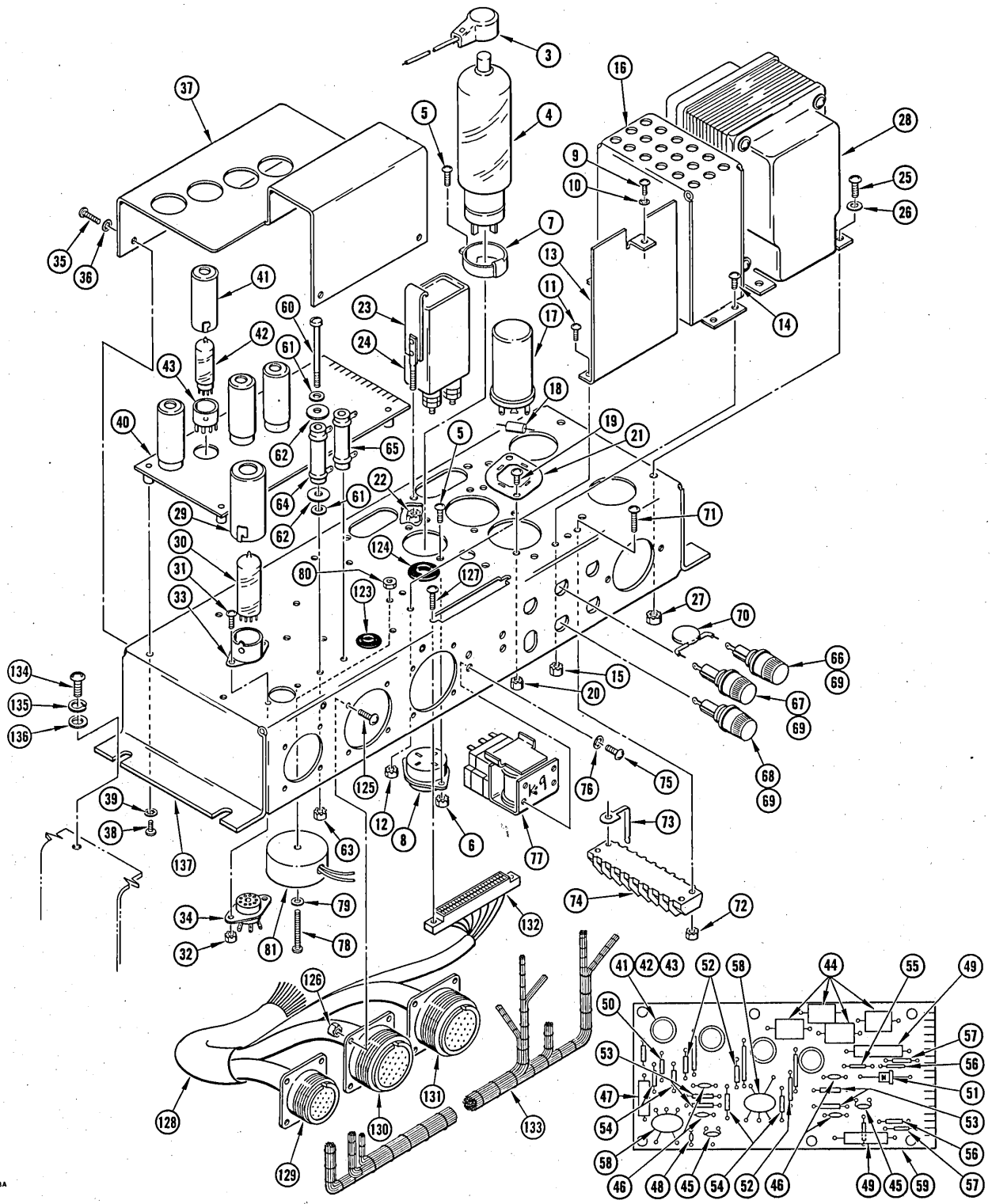


Figure 7-19.
Transport Electronics Chassis (Sheet 1 of 2)

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-19-		TRANSPORT ELECTRONICS CHASSIS				
	310443610	Transport Electronics Assembly, basic unit (See Figure 7-17)	Ref			
1	476-002	. Screw, self-tapping, 6-32 by ¼ in., pan hd Phillips, stl cad plt (Parker-Kalon)	6			
2	310076910	. Cover, chassis	1			
3	162-017	. Cap, vacuum tube (Millen #36001)	1			
4	015-013	. Tube, thyratron, 4 pin base (V1) (Taylor #C3J)	1			
5	471-069	. Screw, machine, 6-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-25)	2			
6	496-005	. Nut, keps, 6-32 NC-2B, external washer, stl cad plt (Shakeproof)	2			
7	300-001	. Clamp, tube hold down (Birtcher #926C-2)	1			
8	150-058	. Socket, tube, 4 contact (Millen #33004)	1			
9	471-062	. Screw, machine, 4-40 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-14)	1			
10	502-024	. Washer, #4 lock, internal tooth, stl cad plt (MS35333-36)	1			
11	471-062	. Screw, machine, 4-40 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-14)	2			
12	496-004	. Nut, keps, 4-40 NC-2B, external washer, stl cad plt (Shakeproof)	2			
13	310076510	. Shield, buffer board	1			
14	471-067	. Screw, machine, 6-32 NC-2A by ¼ in., pan hd Phillips, stl cad plt (MS35208-23)	3			
15	496-005	. Nut, keps, 6-32 NC-2B, external washer, stl cad plt (Shakeproof)	3			
16	310091610	. Shield, capacitor	1			
17	031-039	. Capacitor, electrolytic, 125 uf, 450 volt (C8, C9) (Sprague #TVL-1760)	2			
18	041-224	. Resistor, fixed, composition, 100K, 2w, 10% (R16, R17) (MIL-R-11:RC42GF104K)	2			
19	471-067	. Screw, machine, 6-32 NC-2A by ¼ in., pan hd Phillips, stl cad plt (MS35208-23)	4			
20	496-005	. Nut, keps, 6-32 NC-2B, external washer, stl cad plt (Shakeproof)	4			
21	290-004	. Bracket, capacitor mounting (Mallory #BP-6)	2			
22	496-007	. Nut, keps, 10-32 NF-2B, external washer, stl cad plt (Shakeproof)	4			
23	290-015	. Bracket, capacitor mounting, stl (MIL-C-25: CP07SA3)	4			

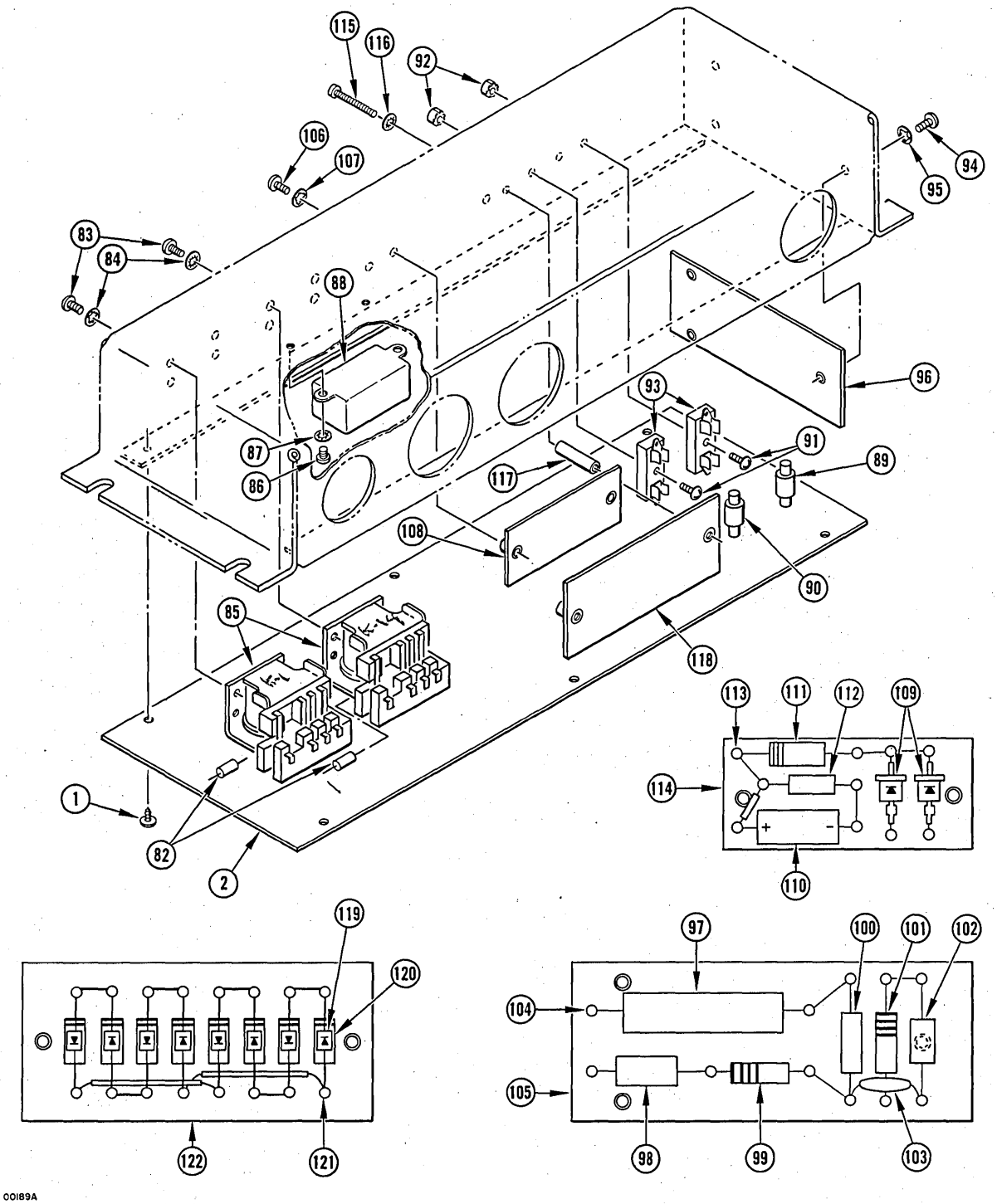


Figure 7-19.
Transport Electronics Chassis (Sheet 2 of 2)

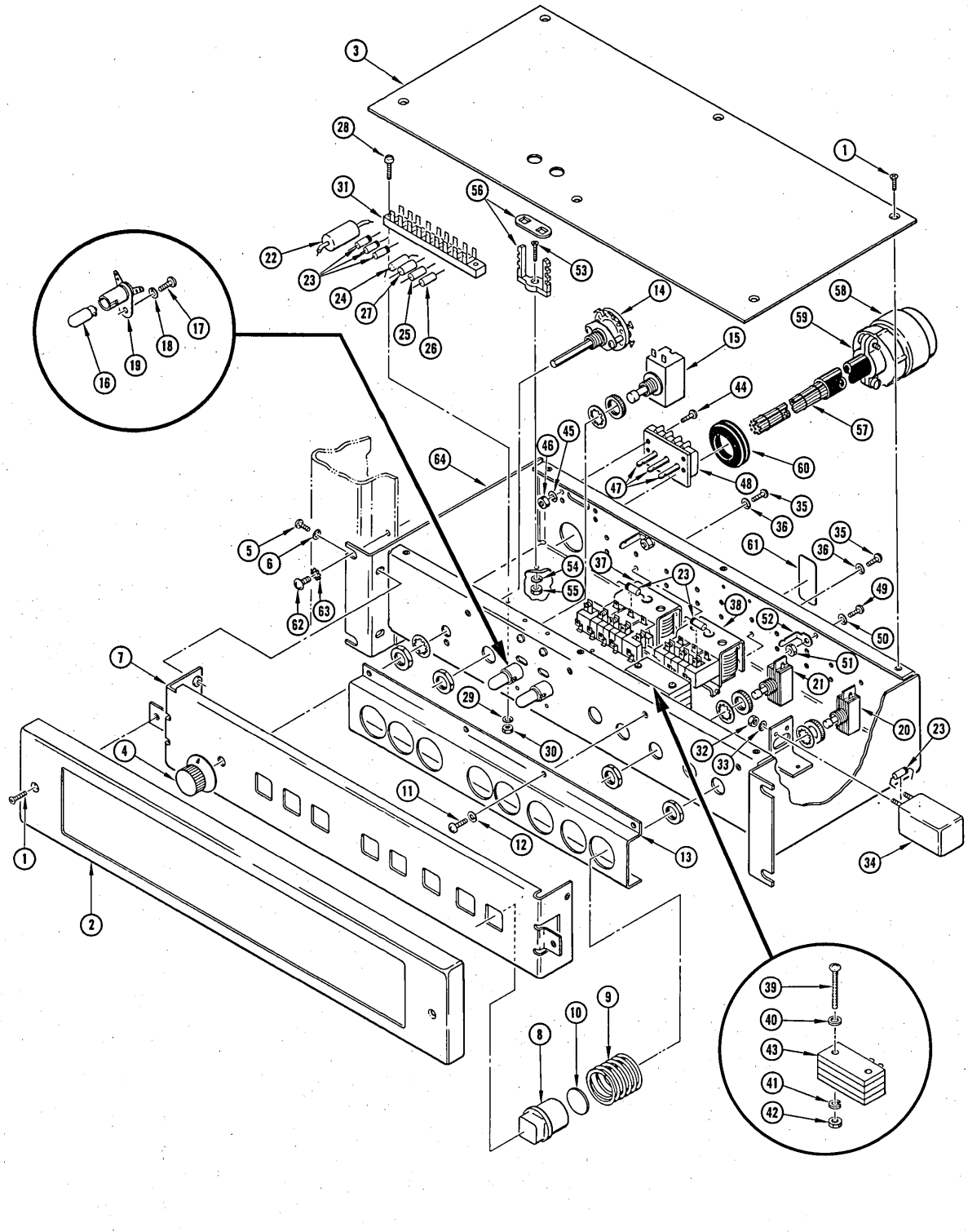
FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-19-						
24	036-059	. Capacitor, paper, rectangular, 2 uf, 600 volt (C4, C5) (Sprague #CP70B1EF205K)	2			
25	471-087	. Screw, machine, 10-32 NF-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35209-53)	4			
26	501-011	. Washer, #10 flat, stl cad plt (MS15795-208)	4			
27	496-007	. Nut, keps, 10-32 NF-2B, external washer, stl cad plt (Shakeproof)	4			
28	310076410	. Transformer (T1)	1			
29	160-020	. Shield, tube (JAN-S-28A:TS103U03)	1			
30	020-164	. Relay, thermal delay, 60 second (K11) (Electronics Fitting Corp #117-60-SG0)	1			
31	471-062	. Screw, machine, 4-40 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-14)	2			
32	496-004	. Nut, keps, 4-40 NC-2B, external washer, stl cad plt (Shakeproof)	2			
33	301600760	. Base, tube shield	1			
34	150-037	. Socket, bottom mounting (Cinch #13398)	1			
35	471-069	. Screw, machine, 6-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-25)	4			
36	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	4			
37	310073510	. Cover, circuit board	1			
38	471-067	. Screw, machine, 6-32 NC-2A by ¼ in., pan hd Phillips, stl cad plt (MS35208-23)	6			
39	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	6			
40	310217410	. Actuator Control Assembly (CU1)	1			
41	160-007	. . Shield, tube, miniature (JAN:TS102U02)	4			
42	015-008	. . Tube, thyratron (V12 thru V15) (RCA, Sylvania #2D21)	4			
43	150-060	. . Socket, tube (Elco #622PHSP)	4			
44	305410520	. . Inductor, 1 MH, ±20%, 3.4 ohms max (L5 thru L8)	4			
45	030-004	. . Capacitor, ceramic disc, 2 x 0.001 uf, 500 volt (C14A, C14B, C15A, C15B) (Centralab #DD2-102)	2			
46	030-043	. . Capacitor, ceramic disc, 0.0022 uf, 500 volt (C17, C18, C19, C28)	4			
47	031-120	. . Capacitor, electrolytic, 100 uf, 10 volt (C29) (Cornell-Dubilier #NL100-10P)	1			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-19-						
48	030-002	. . Capacitor, ceramic disc, 0.01 uf, 500 volt (C16) (Erie #811-000-GP-103P)	1			
49	035-180	. . Capacitor, tubular, 0.47 uf, 100 volt (C30, C31) (Sprague #96P47491S4)	2			
50	013-087	. . Diode, voltage regulator, 8 volt, ±5% (CR28) (Transitron #SV128)	1			
51	582-028	. . Rectifier, silicon, single phase, half wave (CR9) (General Instrument #PT-5)	1			
52	041-072	. . Resistor, fixed, composition, 100K, ½w, 10% (R29 thru R32) (MIL-R-11:RC20GF104K)	4			
53	041-089	. . Resistor, fixed, composition, 4.7 megohm, ½w, 10% (R33, R36, R37, R40) (MIL-R-11:RC20GF475K)	4			
54	041-065	. . Resistor, fixed, composition, 27K, ½w, 10% (R34, R35, R38, R39) (MIL-R-11:RC20GF273K)	4			
55	041-148	. . Resistor, fixed, composition, 1500 ohm, 1w, 10% (R42) (MIL-R-11:RC32GF152K)	1			
56	041-064	. . Resistor, fixed, composition, 22K, ½w, 10% (R43, R44) (MIL-R-11:RC20GF223K)	2			
57	041-007	. . Resistor, fixed, composition, 750 ohm, ½w, 5% (R45, R46) (MIL-R-11:RC20GF751J)	2			
58	310060010	. . Transformer, pulse (T8, T9)	2			
59	310217310	. . Etched Board, actuator control	1			
60	471-524	. Screw, machine, 6-32 NC-2A by 2-½ in., round hd slotted, brass cad plt	3			
61	506-003	. Washer, centering (Ohmite #6000)	6			
62	310031510	. Washer, fiber	6			
63	496-005	. Nut, keps, 6-32 NC-2B, external washer, stl cad plt (Shakeproof)	3			
64	043-055	. Resistor, fixed, wirewound, 100 ohm, 25w, 5% (R1) (Tru-Ohm Type FR-25)	1			
65	043-053	. Resistor, fixed, wirewound, 50 ohm, 25w, 5% (R7, R8) (Tru-Ohm Type FR-25)	2			
66	070-041	. Fuse, cartridge, 10 amp, 250 volt, normal blow (F1, F2) (MS90079-5)	2			
67	070-002	. Fuse, cartridge, 3 amp, 125 volt, slow blow (F3, F5) (Littelfuse #313003)	2			
68	070-026	. Fuse, cartridge, ½ amp, 125 volt, slow blow (F4) (Littelfuse #313.500)	1			
69	085-001	. Fuse Post, finger operated (Littelfuse #342012)	5			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-19-						
70	030-032	. Capacitor, ceramic, 0.1 uf, 500 volt (C36, C37) (Erie #3877-000-Z5V0-104Z)	2			
71	471-071	. Screw, machine, 6-32 NC-2A by ½ in., pan hd Phillips, stl cad plt (MS35208-27)	4			
72	496-005	. Nut, keps, 6-32 NC-2B, external washer, stl cad plt (Shakeproof)	4			
73	172-019	. Lug, soldering, brass (Cinch-Jones #Y-142)	1			
74	301801330	. Terminal Strip, barrier, 8 terminals	1			
75	471-067	. Screw, machine, 6-32 NC-2A by ¼ in., pan hd Phillips, stl cad plt (MS35208-23)	4			
76	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	4			
77	020-006	. Relay, 3 pdt, 10 amp contacts (K9) (Philtrol #33QA)	1			
78	471-448	. Screw, machine, 6-32 NC-2A by 1-¼ in., pan hd Phillips, stl cad plt (MS35208-32)	1			
79	501-009	. Washer, #6 flat, stl cad plt (MS15795-206)	1			
80	496-005	. Nut, keps, 6-32 NC-2B, external washer, stl cad plt (Shakeproof)	1			
81	310033010	. Choke, encapsulated (L4)	1			
82	013-139	. Diode, silicon (Texas Instrument #1N2069)	2			
83	471-067	. Screw, machine, 6-32 NC-2A by ¼ in., pan hd Phillips, stl cad plt (MS35208-23)	8			
84	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	8			
85	020-036	. Relay, 5 pdt, 10 amp contacts (K1,K14) (Philtrol #33BDC-24-5C-13)	2			
86	471-076	. Screw, machine, 8-32 NC-2A by ¼ in., pan hd Phillips, stl cad plt (MS35208-38)	2			
87	502-026	. Washer, #8 lock, internal tooth, stl cad plt (MS35333-38)	2			
88	036-048	. Capacitor, paper, rectangular, 0.25 uf, 600 volt (C39) (Cornell-Dubilier #DYR6025)	1			
89	582-022	. Rectifier, half wave, single phase (CR10, CR13) (Sarkes Tarzian #40LA)	2			
90	582-026	. Rectifier, half wave, single phase (CR11, CR12) (Sarkes Tarzian #20LA)	2			
91	471-062	. Screw, machine, 4-40 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-14)	4			
92	496-004	. Nut, keps, 4-40 NC-2B, external washer, stl cad plt (Shakeproof)	4			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-19-						
93	130-007	. Holder, rectifier (Littelfuse #099062)	4			
94	471-067	. Screw, machine, 6-32 NC-2A by 1/4 in., pan hd Phillips, stl cad plt (MS35208-23)	3			
95	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	3			
96	310073410	. Terminal Board Assembly (TB7)	1			
97	035-073	. . Capacitor, tubular, 0.1 uf, 600 volt, 5% (C1) (Sangamo #330601)	1			
98	034-105	. . Capacitor, mica, 0.00047 uf, 1000 volt, 5% (C3) (Elmenco #VCM20D471J)	1			
99	041-127	. . Resistor, fixed, composition, 1 megohm, 1w, 5% (R4) (MIL-R-11:RC32GF105J)	1			
100	041-229	. . Resistor, fixed, composition, 470K, 2w, 10% (R3) (MIL-R-11:RC42GF474K)	1			
101	041-224	. . Resistor, fixed, composition, 100K, 2w, 10% (R5) (MIL-R-11:RC42GF104K)	1			
102	305410520	. . Inductor, 1 MH, ±20%, 3.4 ohms max (L3)	1			
103	030-129	. . Capacitor, ceramic disc, 0.01 uf, 1000 volt (C50) (Cornell-Dubilier #BYA10S1M)	1			
104	173-015	. . Turret Lug, single end (Useco #1300B-8)	11			
105	310069010	. . Terminal Board	1			
106	471-067	. Screw, machine, 6-32 NC-2A by 1/4 in., pan hd Phillips, stl cad plt (MS35208-23)	2			
107	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	2			
108	310227110	. Terminal Board Assembly (TB11)	1			
109	582-028	. . Rectifier, half wave, single phase (CR19, CR20) (General Instrument #PT-5)	2			
110	037-009	. . Capacitor, tantalum, 15 uf, 75 volt (C13) (Fansteel #PP15B75A2)	1			
111	041-204	. . Resistor, fixed, composition, 1500 ohm, 2w, 10% (R14) (MIL-R-11:RC42GF152K)	1			
112	041-205	. . Resistor, fixed, composition, 2200 ohm, 2w, 10% (R15) (MIL-R-11:RC42GF222K)	1			
113	173-015	. . Turret Lug, single end (Useco #1300B-8)	10			
114	310070810	. . Terminal Board	1			
115	471-448	. Screw, machine, 6-32 NC-2A by 1-1/4 in., pan hd Phillips, stl cad plt (MS35208-32)	2			
116	502-025	. Washer, #6 lock, internal tooth, stl cad plt (MS35333-37)	2			
117	310443910	. Spacer	2			
118	310063110	. Terminal Board Assembly, diode (TB14)	1			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-19-						
119	013-198	. . Diode, silicon (CR1 thru CR8) (Texas Instrument #1N2071)	8			
120	041-174	. . Resistor, fixed, composition, 220K, 1w, 10% (MIL-R-11:RC32GF224K)	8			
121	173-015	. . Turret Lug, single end (Useco #1300B-8)	16			
122	310063510	. . Terminal Board	1			
123	260-005	. Grommet, neoprene (Rubbercraft #6)	2			
124	260-012	. Grommet, neoprene (MS35489-16)	1			
125	471-069	. Screw, machine, 6-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-25)	12			
126	496-005	. Nut, keps, 6-32 NC-2B, external washer, stl cad plt (Shakeproof)	12			
127	471-064	. Screw, machine, 4-40 NC-2A by 1/2 in., pan hd Phillips, stl cad plt (MS35208-16)	2			
128	310228710	. Cable Assembly, transport electronics	1			
129	301462110	. . Connector, receptacle, female, 24 pin (J3)	1			
130	301461990	. . Connector, receptacle, female, 37 pin (J2)	1			
131	301462000	. . Connector, receptacle, female, 37 pin (J1)	1			
132	301680320	. . Connector, printed circuit, 15 pin (J10)	1			
133	310227010	. Cable Assembly, transport	1			
134	471-464	. Screw, machine, 12-24 NC-2A by 5/8 in., pan hd Phillips, stl cad plt	4			
135	502-049	. Washer, #12 spring lock, stl cad plt	4			
136	501-029	. Washer, #12 flat, stl cad plt	4			
137	310043710	. Chassis Assembly, transport electronic	1			



00191A

Figure 7-20.
Pushbutton Control Assembly

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-20-		PUSHBUTTON CONTROL ASSEMBLY				
	310263410	Pushbutton Control Assembly (See Figure 7-1)	Ref			
1	471-387	. Screw, machine, 6-32 NC-2A by 3/8 in., 82° flat hd Phillips, sst, passivated (MS35200-25)	8			
2	310281810	. Cover, panel	1			
3	310281710	. Cover, top	1			
	310543710	. Pushbutton Control Box Assembly	1			
4	230-018	. . Knob, w/2 hex socket setscrews (Raytheon #70-3-2G)	1			
5	471-071	. . Screw, machine, 6-32 NC-2A by 1/2 in., pan hd Phillips, stl cad plt (MS35208-27)	4			
6	502-003	. . Washer, #6 spring lock, stl cad plt (MS35338-41)	4			
7	310026510	. . Panel, front control	1			
8	310026310	. . Button, control	8			
9	310026210	. . Spring, control button	8			
10	310026110	. . Platform, control button	6			
11	471-069	. . Screw, machine, 6-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-25)	4			
12	502-003	. . Washer, #6 spring lock, stl cad plt (MS35338-41)	4			
13	310026610	. . Bracket, pushbutton	1			
14	122-030	. . Switch, rotary, 5 pole, 2-3 position, w/mounting hardware (S13) (Centralab #PA2015)	1			
15	120-037	. . Switch, pushbutton, dpdt, w/mounting hardware (S6) (Arrow Hart & Hegeman #81117)	1			
16	060-001	. . Lamp, incandescent, 6.3 volt, 0.15 amp (General Electric #47)	2			
17	471-069	. . Screw, machine, 6-32 NC-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-25)	2			
18	502-003	. . Washer, #6 spring lock, stl cad plt (MS35338-41)	2			
19	132-027	. . Holder, lamp, bayonet socket (DS1, DS2) (Dialco #7-12)	2			
20	120-013	. . Switch, pushbutton, single pole, w/mounting hardware (S8, S9, S10, S12) (Arrow Hart & Hegeman #3391EPA)	4			
21	120-014	. . Switch, pushbutton, single pole, w/mounting hardware (S11) (Arrow Hart & Hegeman #3391BSA)	1			
22	031-020	. . Capacitor, electrolytic, 4 uf, 150 volt (C6) (Astron #MM-4-150)	1			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-20-						
23	013-139	. . Diode, 200 PIV, 750 MA (Texas Instrument #1N2069)	10			
24	030-032	. . Capacitor, ceramic, 0.1 uf, 500 volt (C12) (Erie #3877-00-ZSVO-104Z)	1			
25	041-253	. . Resistor, fixed, composition, 75K, 1/2w, 5% (R6) (MIL-R-11:RC20GF753J)	1			
26	041-129	. . Resistor, fixed, composition, 1.5 meg, 1w, 5% (R2) (MIL-R-11:RC32GF155J)	1			
27	041-017	. . Resistor, fixed, composition, 33K, 1/2w, 5% (R13) (MIL-R-11:RC20GF333J)	1			
28	471-435	. . Screw, machine, 4-40 NC-2A by 1/2 in., fillister hd Phillips, brass cad plt	4			
29	502-002	. . Washer, #4 spring lock, stl cad plt (MS35338-40)	4			
30	492-008	. . Nut, plain hex, 4-40 NC-2B, stl cad plt (MS35649-42)	4			
31	180-017	. . Terminal Strip, 9 terminal (Cinch Jones #9-170)	2			
32	492-008	. . Nut, plain hex, 4-40 NC-2B, stl cad plt (MS35649-42)	2			
33	502-002	. . Washer, #4 spring lock, stl cad plt (MS35338-40)	2			
34	020-029	. . Relay, sensitive, spdt (K7) (Sigma #26-RJ-12,000W)	1			
35	471-067	. . Screw, machine, 6-32 NC-2A by 1/4 in., pan hd Phillips, stl cad plt (MS35208-23)	24			
36	502-003	. . Washer, #6 spring lock, stl cad plt (MS35338-41)	24			
37	020-036	. . Relay, 5pdt (K8) (Philtrol #33BDC-24-5C-13)	1			
38	020-034	. . Relay, 3 pole (K2 thru K6) (Philtrol #33BDC-24-3C-13)	5			
39	471-470	. . Screw, machine, 6-32 NC-2A by 1-1/2 in., stl cad plt (MS35208-33)	2			
40	501-009	. . Washer, #6 flat, stl cad plt (MS15795-206)	2			
41	502-003	. . Washer, #6 spring lock, stl cad plt (MS35338-41)	2			
42	492-009	. . Nut, plain hex, 6-32 NC-2B, stl cad plt (MS35649-62)	2			
43	580-013	. . Suppressor, noise (Sprague)	4			
44	471-071	. . Screw, machine, 6-32 NC-2A by 1/2 in., pan hd Phillips, stl cad plt (MS35208-27)	4			
45	502-003	. . Washer, #6 spring lock, stl cad plt (MS35338-41)	4			

FIG. & INDEX NO.	AMPEX PART NO.	DESCRIPTION 1 2 3 4 5 6 7	QTY. PER ASSY.	USE ON CODE	EFFECTIVE ON	EFFECTIVE THRU
7-20-						
46	492-034	. . Nut, plain hex, special 6-32 NC-2B, stl cad plt	4			
47	172-030	. . Lug, solder (Cinch-Jones #Y140)	3			
48	180-029	. . Terminal Strip, 3 terminal, w/marker strip (Cinch-Jones #3-140)	1			
49	471-067	. . Screw, machine, 6-32 NC-2A by 1/4 in., pan hd Phillips, stl cad plt (MS35208-23)	2			
50	502-003	. . Washer, #6 spring lock, stl cad plt (MS35338-41)	2			
51	492-009	. . Nut, plain hex, 6-32 NC-2B, stl cad plt (MS35649-62)	2			
52	172-019	. . Lug, solder, brass (Cinch-Jones #Y-142)	2			
53	471-338	. . Screw, machine, 6-32 NC-2A by 1/2 in., 82° flat hd Phillips, stl cad plt (MS35192-27)	1			
54	502-003	. . Washer, #6 spring lock, stl cad plt (MS35338-41)	1			
55	492-009	. . Nut, plain hex, 6-32 NC-2B, stl cad plt (MS35649-62)	1			
56	302-042	. . Clamp, cable, white nylon (Dakota #2C1-50/2C1-50A)	1			
57	310612310	. . Cable Assembly, pushbutton control chassis	1			
58	141-001	. . . Connector, plug, male, 37 contact (MS3106B28-21P)	1			
59	302-002	. . . Clamp, cable, w/bushing (AN3057-16A)	1			
60	260-011	. . Grommet, neoprene (MS35489-19)	1			
61	310024910	. . Identification Plate	1			
62	471-463	. . Screw, machine, 12-24 NC-2A by 3/8 in., pan hd Phillips, stl cad plt	4			
	471-087	. . Screw, machine, 10-32 NF-2A by 3/8 in., pan hd Phillips, stl cad plt (MS35208-53)	4			
63	502-052	. . Washer, #12 lock, external tooth, stl cad plt	4			
	502-016	. . Washer, #10 lock, external tooth, stl cad plt (MS35335-32)	4			
64	310026410	. . Chassis Assembly, pushbutton control welded	1			

TM-4
SPARE PARTS LIST

NOTE: All fractional quantities should be rounded off to the nearest whole number.

* Refer to last page.

QTY	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REFERENCE
ONE/ SITE		Head Assembly	
.25	310349510	. Guide Assy	
1	310202810	. Spring	
1	310349710	. Ring Guide, Ceramic	
ONE/ SITE		. Head Cable and Box Assy	
		Photosense Assembly	
.25	310030910	. Photosense Head Assy	Photosensor Assembly
.5	310028710	. Card Assy, Power Supply +12 vdc	* Photo Elect. Chassis
.5	310028810	. Card Assy, Power Supply -10 vdc	* Photo Elect. Chassis
.5	310028910	. Card Assy, Power Supply +6 vdc	* Photo Elect. Chassis
.25	310029910	. Relay, Holding (K1,K2)	* Photo Elect. Chassis
1	013-156	. Diode, zener 6 v, w/mtg Hardware (CR3)	Photo Elect. Chassis
1	013-145	. Diode, zener 10v, w/mtg Hardware (CR1)	Photo Elect. Chassis

QTY	PART NUMBER	DESCRIPTION 1 2 3 4 5 6		REFERENCE
1	013-146	. Diode, zener, 12v, w/mtg Hardware (CR2)		Photo Elect. Chassis
.5	310050710	. Packet Assy, D.C. Amplifier	*	Photo Elect. Chassis
.5	310055710	. Packet Assy, Phantastron	*	Used on 310058810
.5	310050810	. Packet Assy, Schmitt trigger	*	
.5	310068810	. Packet Assy, Relay driver	*	
.5	310171210	. Packet Assy, output driver	*	
		Hold Down Knob Assembly		
1	310014410	. Knob Assy, Reel Hold Down		Reel Hold Down
.5	310049110	.. Handle Assy		Reel Hold Down
6	310065910	. Spring, Hold Down		Reel Hold Down
1	310022610	. Pad, Turntable		Reel Hold Down
1 pkg	310019510	. Shim, spacer		Reel Hold Down
6	420-010	. Ball, nylon, 1/8 dia.		Reel Hold Down
		IBM Hold Down Knob		
.25	310008410	. Hold Down Knob Assy		IBM Hold Down Knob
3	310034210	. Knob, Hold Down		IBM Hold Down Knob

QTY	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REFERENCE
1	310090010	. Ring, Hold Down	IBM Hold Down Knob
1	310034010	. Pad, Turntable, Hold Down	IBM Hold Down Knob
ONE/ SITE	310008910	Reel Motor Assembly	Reel Motor Assembly
		Capstan Roller Assembly	
.5	310084110	. Capstan Roller Assy, Upper	Quad Ring on Capstan
.5	310084210	. Capstan Roller Assy, Lower	Quad Ring on Capstan
2	310176514	. . Molded Rubber Roller & Bearings	Replacement for 841 & 842 only
		Vacuum Chamber Assembly	
ONE/ SITE	310074010	. Door, plate glass	Vacuum Chamber
2	310192110	. Spring, door retainer	Vacuum Chamber
1	310036710	. Spring Latch, thread lever	Vacuum Chamber
.5	310037910	. Latch, thread lever	Vacuum Chamber
		Tension Arm Assembly	
.5	310208710	. Cable Assembly, Long	Tension Arm
.5	310208810	. Cable Assembly, Short	Tension Arm

QTY	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REFERENCE
4	310209010	. Spring Tension	Tension Arm
2	310209110	. Shackle	Cable Anchor
6	310019910	. Roller, Tape guide	Tension Arm
1	310074910	. Support	For Tape Guide
		Capstan Drive	
1	310022310	. Belt	Capstan Drive
.25	310021810	. Spring	Belt Idler
2	421-001	. Bearing, ball	Idler Arm
2	310033910	. Washer, fiber	Pulley, belt Idler
1	431-006	. Retainer, spring	Pulley, belt Idler
1	310034710	. Roller, drive belt	Belt Idler
		Vacuum Motor Assembly	
.25	310153310	. Filter	Vacuum Motor
1	432-004	. O-Ring, synthetic rubber	Vacuum Motor
2	650-154	. Brushes	Vacuum Motor (Lamb)
1	310074710	. Housing Assembly	** Vac. Motor
1	592-030	. Motor, vacuum unit 4.6 amp 150v	** Vac. Motor
3	169-019	. Connector, contact pin	** Vac. Motor
1	169-049	. Connector, plug	** Vac. Motor

QTY	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REFERENCE
1	171-016	. Connector, solderless ring tongue #10	** Vac. Motor
		Capstan Assemblies	
1	310280410	. Capstan Assembly Std GE407M	W/Quad Ring
1	310083710	. Actuator Assembly	1-1/2" X 3-1/4 Diam.
		Servo Control Assembly	
4	582-022	. Rectifier, selenium, #40LA	CR15 thru CR18
2	020-072	. Relay, mercury wetted	K12, & K13
.25	310259410	. Contact Assembly, lower	Servo Control Assembly
.25	310259310	. Contact Assembly, upper	Servo Control Assembly
6	310044110	. Spring contact centering	Servo Control Assembly
1	310262910	. Dashpot Assy, servo damping	Servo Control Assembly
A/R	310279110	. Servo Contact, Adj. (Replacement Kit)	Bill Material Install Dwg. Instructions
6	310082210	. Diode Assembly 1N2069	CR 17, 26, 16, 21, 15, 18
2	013-271	. Thyractor, Transient suppressor	
2	310082310	. Capacitor Assy 0.1μf 500v	(c10)(C11)
1	310228210	. Resistor Assy, 50 ohm 25w, 5%	R 50

QTY	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REFERENCE
1	310082710	. Resistor Assy, 300 ohm 25w, 3%	(R9,R11)
1	310082410	. Resistor Assy, 35 ohm, 25w, 3%	R19
		Manual Control Panel	
2	060-001	. Lamp, incadescent, 6.3 volt	Push buttons

* All of these cards are not needed for any one assembly. Choose only those which match your system.

** These items should be combined as an assembly for quick change over.

SDS TM-407 TECHNICAL MANUAL
ADDENDUM
SECTION I

1-23. Page 1-6.

Under DRIVE CONTROLS change item #3 from "Hi/Lo Speed Select" to "Hi/Lo Speed Indication".

1-23. Page 1-7.

In Table 1-1, delete the row of information about photosensor chassis.

1-23. Page 1-9.

Change "Rewind time, Forward Direction: 3 minutes, maximum" to read
Rewind Time, Forward Direction: 3.2 minutes, nominal
2400 ft. tape, 150 ips

Change "Rewind Time, Reverse Direction: 3 minutes, maximum" to read
Rewind Time, Reverse Direction: 3.2 minutes, nominal
2400 ft. tape, 150 ips

SECTION II

2-2. Page 2-1.

Delete "...photosensor chassis assembly..."

2-9. Page 2-2.

Delete "...photosensor chassis assembly..."

2-14 and 2-15. Page 2-4.

Delete completly.

Figure 2-2. Page 2-5.

Delete photosensor assemblies from drawing.

2-21 and 2-22. Pages 2-9 and 2-10.

Delete completly.

SECTION IV

Figure 4-4. Page 4-4.

Use new figure provided.

4-21, 4-22, 4-23 and 4-24. Pages 4-6 and 4-7.

Delete completly.

4-35. Page 4-10.

Change first sentence from "When power is... to the bridge rectifier." to "When power is first applied to the transport electronics assembly, time delay relay K11 actuates after 60 seconds. K14 now energizes and 400 vac power from the secondary of T1 is applied to the bridge rectifier."

4-61. Page 4-16.

Change paragraph to read as follows: "Reel motors receive power through relay K1 from the -60 vdc supply when K1 is energized. The motors are grounded through contactors S16 and S17."

4-63, 4-64, 6-65, 4-66, 4-67, and 4-68. Pages 4-16, 4-17, and 4-18.

Change paragraphs to read as follows:

4-63. When AUTOMATIC-MANUAL Switch S13 is set to the AUTOMATIC position, relay K8 is energized by -24 vdc from the power supply section. Contact K8C opens and disconnects S8, S9, S10 and S12 from ground. Contact K8B disconnects ground from one side of the primary of primary of pulse transformer T9, allowing external control signals to be applied to this side of the transformer. Contact K8A disconnects the voltage used for manual control of the actuators. Contact K8D disconnects ground from one side of the primary of pulse transformer T8, thus allowing external control signals to be applied to this side of the transformer. Contact K8E connects pins k and m of receptacle J2 J2 which may be used for any additional customer requirements.

4-64. MANUAL CONTROL. When AUTOMATIC-MANUAL Switch S13 is set to the MANUAL position, relay K8 is de-energized. Contact K8C closes and connects S8, S9, S10 and S12 to ground. The -24 vdc at J2 pin d is routed through STOP switch S11 to one side of the coils of relays K3, K4, K5, and K6.

4-65. When the DRIVE FORWARD pushbutton S10 is momentarily pressed, a circuit from -24 vdc to ground is established through the coil of K4, energizing the relay. Contact K4B closes and provides the path to ground to hold K4 energized. Contact K4C opens and disconnects -24 vdc from DRIVE REVERSE pushbutton S12, providing an interlock circuit that prevents shifting the reverse actuator to ON when the forward actuator is ON. Contact K4A applies +14 vdc to pin n of plug P2, energizing the forward actuator to ON as described in paragraph 4-45. When the STOP pushbutton S11 is momentarily pressed, the -24 vdc is disconnected from forward relay K4, de-energizing the relay. Contact K4C closes and reconnects -24 vdc to DRIVE REVERSE pushbutton S12. Contact K4A disconnects the +14 vdc from pin n of plug P2 and connects it to pin g, energizing the forward actuator to OFF as described in paragraph 4-45.

4-66. When the DRIVE REVERSE pushbutton S12 is momentarily pressed, a circuit from -24 vdc to ground is established through the coil of K5, energizing the relay. Contact K5B closes and provides the path to ground to hold K5 energized. Contact K5C opens and disconnects -24 vdc from DRIVE FORWARD pushbutton S10, providing an interlock circuit that prevents shifting the forward actuator to ON when the reverse actuator is ON. Contact K5A applies +14 vdc to pin f of plug P2, energizing the reverse actuator to ON as described in paragraph 4-45. When the STOP pushbutton S11 is momentarily pressed, the -24 vdc is disconnected from reverse relay K5, de-energizing the relay. Contact K5C closes and reconnects -24 vdc to DRIVE FORWARD pushbutton S10. Contact K5A disconnects +14 vdc from pin f of plug P2 and connects it to pin c, energizing the reverse actuator to OFF as described in paragraph 4-45.

4-67. When the FAST FORWARD pushbutton S8 is momentarily pressed a circuit is established through the coil of K6, energizing the relay. Contact K6A closes, holding the relay energized. Contact K6B closes, energizing speed change relay K2. Contacts K2B and K2C close, switching the capstan motor to high speed. Contact K6C provides the ground necessary to energize K4. Contact K4A supplies +14 vdc to pin n of P2, energizing the forward actuator to ON as described in paragraph 4-45. This provides a capstan drive fast forward mode. When the STOP pushbutton S11 is momentarily pressed, the -24 vdc is disconnected from K6, de-energizing the relay. This, in turn, de-energizes speed change relay K2 which returns the capstan motor to low speed. At the same time K4 de-energizes which disconnects +14 vdc from pin n of P2 and connects it to pin g. This energizes the forward actuator OFF.

4-68. When the FAST REVERSE pushbutton S9 is momentarily pressed a circuit is established through the coil of K3, energizing the relay.

Contact K3A closes, holding the relay energized. Contact K3B closes, energizing speed change relay K2. Contacts K2B and K2C close, switching the capstan motor to high speed. Contact K3C provides the ground necessary to energize K5. Contact K5A supplies +14 vdc to pin f of P2, energizing the reverse actuator to ON as described in paragraph 4-45. This provides a capstan drive fast reverse mode. When the STOP pushbutton S11 is momentarily pressed, the -24 vdc is disconnected from K3, de-energizing the relay. This, in turn, de-energized speed change relay K2 which returns the capstan motor to low speed. At the same time K5 de-energizes which disconnects +14 vdc from pin f of P2 and connects it to pin c. This energizes the reverse actuator OFF.

4-75, 4-76, 4-77. Page 4-19.

Change paragraphs to read as follows:

4-75. REEL SENSING. (See Figure 6-1.) Reel sensing post S15 is used to connect one side of reel-sense relay K7 to ground whenever metallized leader tape passes over the post. The voltage on the other side of relay K7 is derived from the +500 vdc power supply. A voltage divider consisting of resistors R2, R6, and R13 provides a voltage of approximately +25 vdc at the junction of R2 and R6. The +25 vdc is used to charge capacitor C6 during periods when relay K7 is not grounded. When reel-sense relay K7 is grounded by the sensing post, capacitor C6 discharges through the relay and energizes it. Contact K7A of the energized relay disconnects the ground from one side of the safety relay K1 and connects the ground to K7, holding the relay energized until capacitor C6 has almost completely discharged, at which time relay K7 will de-energize.

4-76. During the time that relay K7 is energized, safety relay K1 is de-energized and will perform in a similar manner to that described under Tape-Threading and Tension-Arm Limit Switches, with the exception that the brakes will not be applied and that -24 vdc will be applied to the reel motors.

4-77. Capacitor C6 discharges in approximately 0.5 seconds and relay K7 de-energizes; safety relay K1 then returns to its normal energized condition.

4-81 through 4-99. Pages 4-20 through 4-26.

Delete completely.

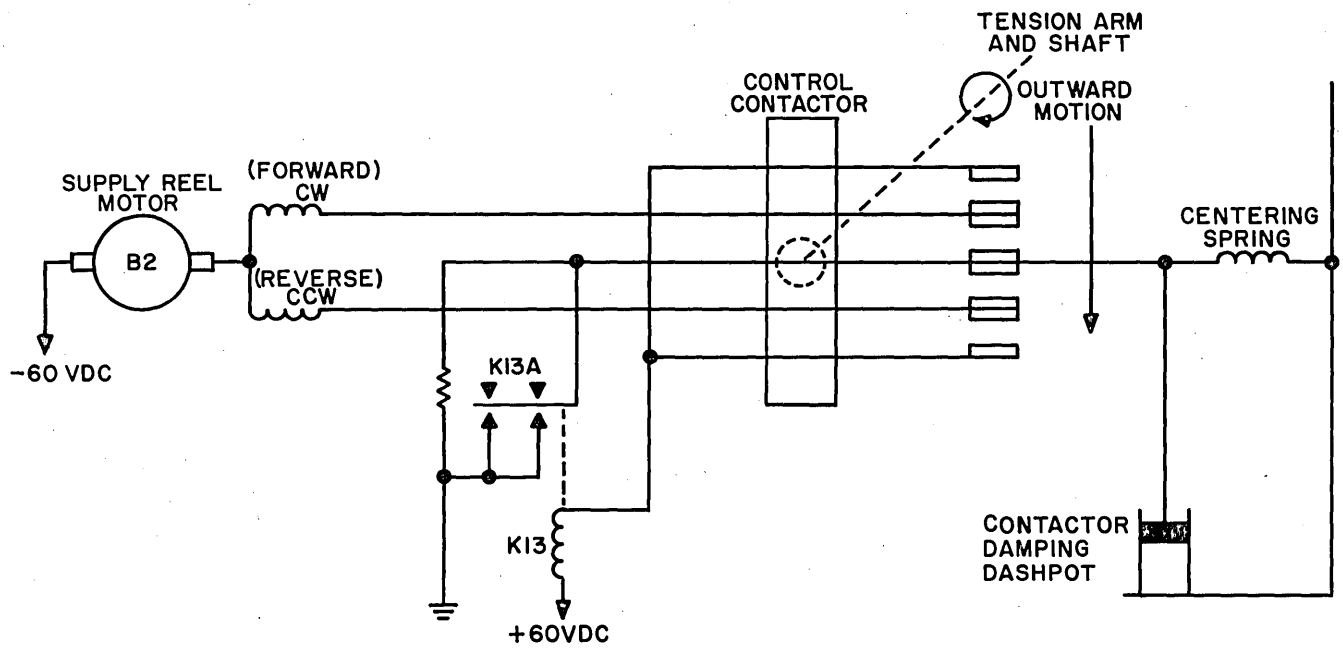


Figure 4-4.
Supply Reel Servo Control System

SECTION V

5-21, 5-22. Pages 5-14, 5-15.

Delete completly.

Figure 5-7. Page 5-16.

Delete completly.

5-35. Page 5-35 and 5-36.

In Table 5-3, delete rows 24, 25, 28 and 29.

5-35. Pages 5-36, 5-37 and 5-38.

Change Table 5-4 to read as follows:

Table 5-4. Relay Function List

RELAY	CONTACT	FUNCTION
K1 Safety	K1A	Applies 117 vac to vacuum unit motor and capstan drive motor
	K1B	Applies -24 vdc to pushbutton control assembly for operation of control relays when K14A closed
	K1C	Provides return of actuators to OFF position when K1 is de-energized (Automatic Mode only)
	K1D	Optional circuit - can be used with warning light
	K1E	Applies -60 vdc to one side of reel motors
K2 Capstan Drive Motor Speed Select	K2A	Applies 6.3 vac to LOW or HIGH speed indicator
	K2B & K2C	Applies 117 vac to LOW or HIGH speed winding of capstan drive motor

Table 5-4. Relay Function List (Cont)

RELAY	CONTACT	FUNCTION
K3 Manual Fast Reverse	K3A	Holding contacts for relay K3
	K3B	Provides ground for K2 relay
	K3C	Provides ground for reverse relay K5
K4 Manual Drive Forward	K4A	Applies control signal for forward actuator ON/OFF operation
	K4B	Holding contacts for relay K4
	K4C	Provides interlock for reverse relay K5
K5 Manual Drive Reverse	K5A	Applies control signal for reverse actuator ON/OFF operation
	K5B	Holding contacts for relay K5
	K5C	Provides interlock for forward relay K4
K6 Manual Fast Forward	K6A	Holding contacts for relay K6
	K6B	Provides ground for K2 relay
	K6C	Provides ground for forward relay K4
K7 End Reel Sensing	K7A	Opens ground circuit of relays K3, K4, K5, and K6 placing transport in standby mode
K8 Automatic/Manual	K8A	Opens +14 vdc circuit to remove power from pushbutton control assembly circuits
	K8B	Removes ground from reverse actuator command signal cut-out

Table 5-4. Relay Function List (Cont)

RELAY	CONTACT	FUNCTION
K8 Automatic/Manual (Cont)	K8C	Removes ground from manual push-button function switches
	K8D	Removes ground from reverse actuator command signal cutout
	K8E	Optional circuit
K9 Overload	K9A & K9B	Removes high voltage applied to V1, V12, V13, V14, and V15
	K9C	Optional circuit, used in conjuction with K1D & K14D
K11 "Ready" Delay	K11-3 & K11-9	Time delay before power is applied to K14 relay
K12 (Mercury Relay)	K12A	Shorts out R11 to apply full power to takeup reel motor
K13 (Mercury Relay)	K13A	Shorts out R12 to apply full power to supply reel motor
K14 (Slave Relay)	K14A	Applies -24 vdc to pushbutton control panel when K1B closed
	K14B	Holding contacts for K14 coil
	K14C	Completes circuit from T1 secondary supplying 500 vac to rectifier bridge TB14
	K14D	Optional circuit
	K14E	Disconnects K11 heater from 117 vac line when K11 contacts close

5-53. Page 5-60.

Delete completly.

Figure 5-23. Page 5-61.

Delete completly.

SECTION VI

Figure 6-1. Page 6-3.

Use new schematic provided.

Figure 6-2. Page 6-5.

Use new schematic provided.

Figure 6-4. Page 6-9.

Use new schematic provided.

Figure 6-5. Page 6-11.

Delete figure.

Figure 6-6. Page 6-13.

Delete figure.

Figure 6-7. Page 6-15.

Delete figure.