

IBM[®]

Field Engineering

Theory - Maintenance

(Instruction - Maintenance)

1134 Paper Tape Reader

PREFACE

This manual, the IBM 1134 Paper Tape Reader Field Engineering Theory-Maintenance (Instruction-Maintenance) Manual (Form Y26-3662), describes the theory of operation and maintenance procedures for the IBM 1134 Paper Tape Reader, Model 2. The Model 1 has the same reading and tape drive mechanism as the Model 2. The Model 1 does not have the tape reels or a tape reel drive mechanism which the Model 2 has.

The users of this manual are cautioned that specifications are subject to change at any time and without prior notice by IBM. Wiring diagrams (logics) at the engineering change level of that specific machine are included in each machine shipment.

This manual, form Y26-3662-1, is a major revision of form 227-3662-0. Y26-3662-1 makes 227-3662-0 obsolete.

Copies of this and other IBM publications can be obtained through IBM Branch Offices.

A form is provided at the back of this publication for reader's comments.

This manual was prepared by the IBM Systems Development Division, Product Publication, Dept. 455, Bldg. 014, San Jose, Calif. Address comments concerning the contents of this manual to this address.

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LIST OF ABBREVIATIONS

cps	Cycles per second
dc	Direct current
hp	Horse power
max.	Maximum
min.	Minimum
N/C	Normally closed
N/O	Normally open
vac	Volts alternating current

1.1 INTRODUCTION

The IBM 1134 Paper Tape Reader is a self-contained device for reading any standard five to eight channel

perforated tape asynchronously at speeds up to 60 characters per second in the forward direction of tape feed (Figure 1-1). Tape wear is exceptionally low, and standard tape may be reread many times.

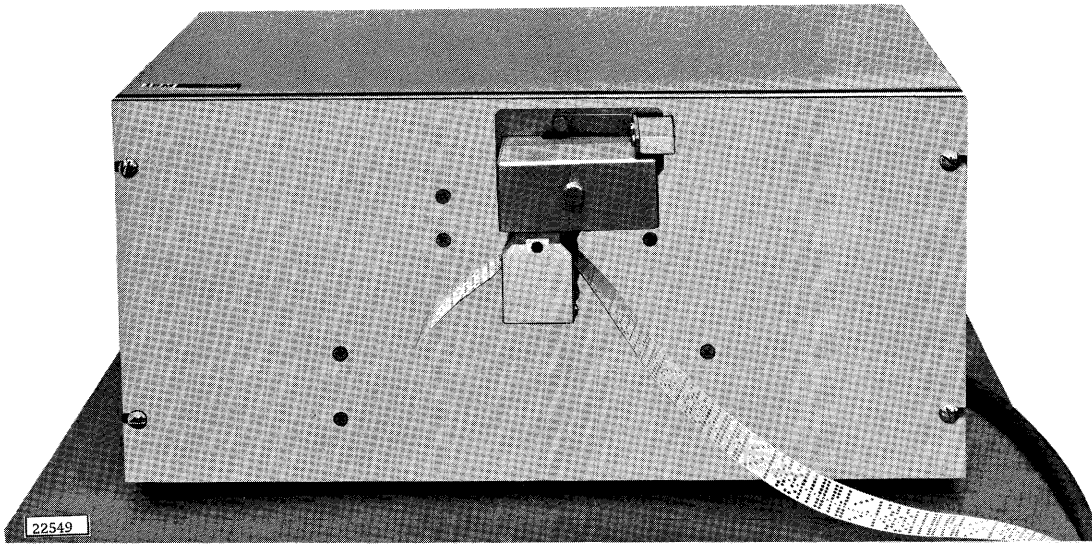


Figure 1-1a. 1134 Paper Tape Reader, Model 1

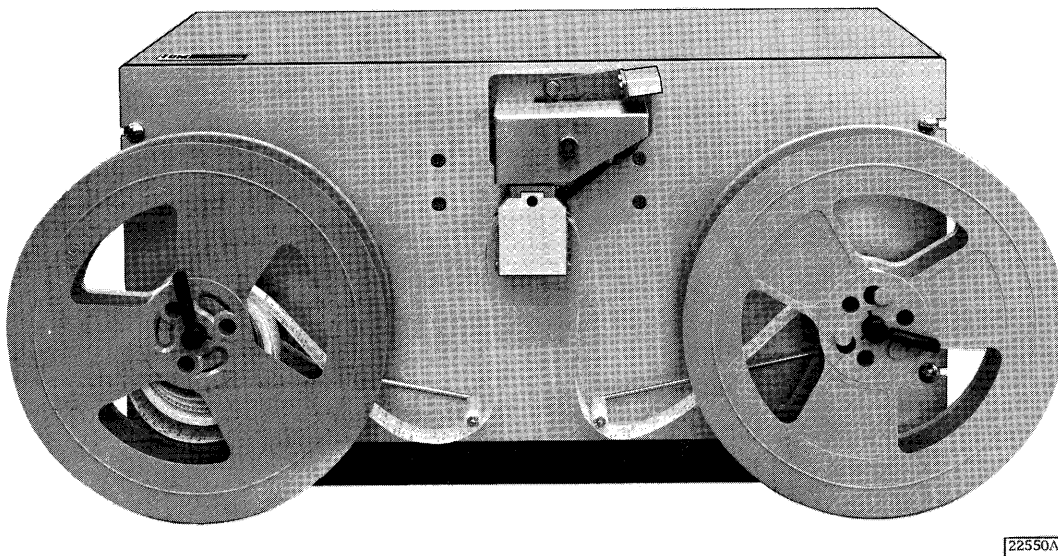


Figure 1-1b. 1134 Paper Tape Reader, Model 2

NOTE: The illustrations in this manual have a code number in the lower corner. This is a publishing control number and is unrelated to the subject matter.

The Paper Tape Reader can sense both the absence and presence of tape holes, thus giving positive hole/space identification.

An integrally mounted 1/35 hp motor supplies drive power to the capstan through a bevel gear and differential drive assembly. Special clutches in the drive assembly permit high speed response for tape movement.

The 1134 Paper Tape Reader has the mechanical capability of feeding tape in a forward or reverse direction, but does not have the electrical connections to drive the reverse clutch.

1.1.1 Environmental Limitations

The unit is designed for continuous operation in a temperature range of 60 to 90 degrees Fahrenheit at 10 to 80 percent relative humidity.

1.1.2 Input Requirements

The drive motor requires 105 vac to 125 vac, 60 cps, or 200 v, 50 cycle power at 0.4 amperes. To move the tape, a 4.5 millisecond dc pulse is applied to the forward escapement assembly. One pulse must be supplied for each movement of tape.

NOTE: Pulley ratios differ with cycles per second change 60/50.

At the maximum reading rate of 60 characters per second, the drive pulses are 16.7 milliseconds apart (leading edge to leading edge).

1.1.3 Tape Handling

The Paper Tape Reader Model 2 is supplied with bi-directional tape reeling equipment mounted on either

side of the read head. The tape reels are rotated by a differential gear and brake mechanism actuated by tape tension arms. Both mechanisms are driven by belts from the capstan drive assembly. Since the reels are bi-directional, either reel can be the take-up or supply side, depending upon the direction of tape movement (forward only under program control). No tape threading change is required when reversing (manual operation) the direction of tape movement. Slack on the supply reel is taken up through the action of the tension arms.

The Paper Tape Reader Model 2 is supplied with a removable 8-1/2" plastic reel.

1.2 INSTRUCTIONS FOR USE

1.2.1 Reel Belts

When installing reel belts, adjust the belts by moving the pulleys on drive shafts, so that both belts and pulleys run parallel to the front panel, as shown in Figure 1-2. Improper installation wears belts unduly.

1.2.2 Threading Tape

To thread a tape through the read head, raise the lift lever handle (Figure 1-3). This raises the read head so the capstan is clear. Lay the tape across the capstan so that the pins project through the sprocket holes. Do not position the tape so the pins project through the holes of a data channel. Also be certain that the tape is threaded with the three-hole side nearest the operator. While holding the tape in position on the capstan, push the lift lever down until it locks in place. The tape is now properly threaded, and the reader is ready for use.

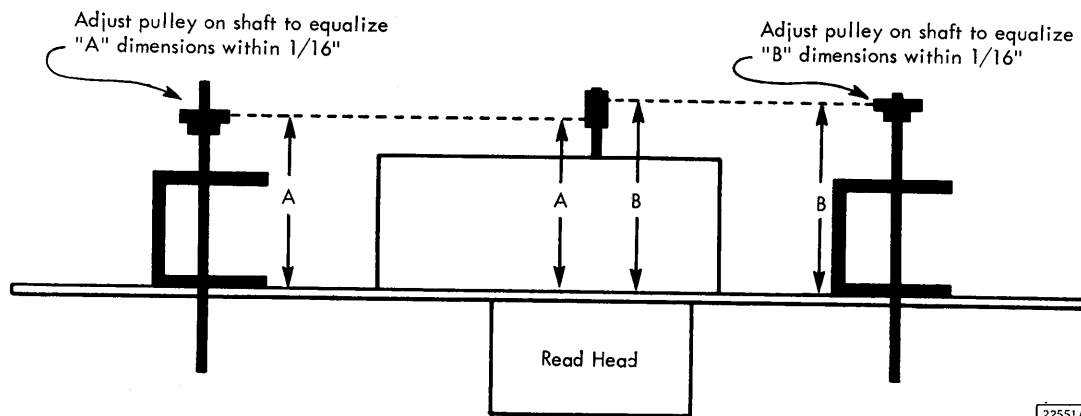


Figure 1-2. Reel Belt Alignment

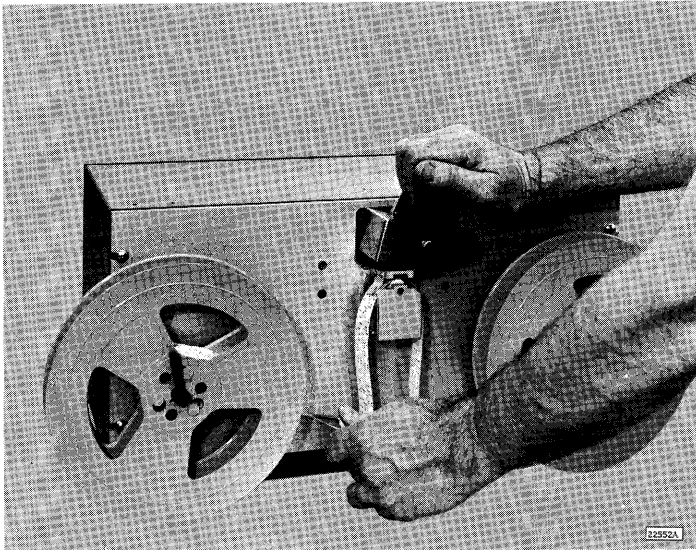


Figure 1-3. Threading Tape

1.2.3 Tape Rewind

To rewind the tape, remove tape from read head and allow tape to run under the tension arms. Lift the arm on the full reel side and the tape will feed to the other reel.

1.2.4 Paper Tape Standards and Channel Identification

The Paper Tape Reader is designed to read any standard perforated tape. For standard dimensions and channel designations, refer to Figure 1-4.

1.2.5 Tape Splicing

Splice tapes carefully to help prevent erroneous reading. For instance, a rough joint at a no-hole position on the tape will catch the star wheel, causing it to roll over the splice. This action, represented in Figure 1-5a, does not produce an erroneous reading in itself, but if a joint is just forward of a perforation, the star wheel will straddle the perforation, thereby misreading that bit. Because of the chance of misreading, any lap-joint splice for forward tape movement must be on the side of the tape opposite the star wheels, as shown in dotted lines on Figure 1-5.

1.3 MECHANICAL OPERATION

1.3.1 Motor and Capstan Drive

- Provides drive power to the tape.

Drive power is transmitted from the motor (Figure 1-6) by a timing belt and pulleys to the input shaft (Figure 1-7) with bevel gear (3) through the two idler bevel gears (1 and 10) and to the two clutch assemblies (4 and 7). When the tape is not being moved, an armature on each of two escapement assemblies (2 and 12) engages a tooth of the escapement wheel on the corresponding clutch assembly, causing the clutches to slip. When the tape is to be advanced (capstan rotation counterclockwise), an electric pulse energizes the magnet on the forward escapement assembly (12), disengaging the armature from the escapement wheel and permitting the forward clutch assembly to rotate. Rotation of the clutch

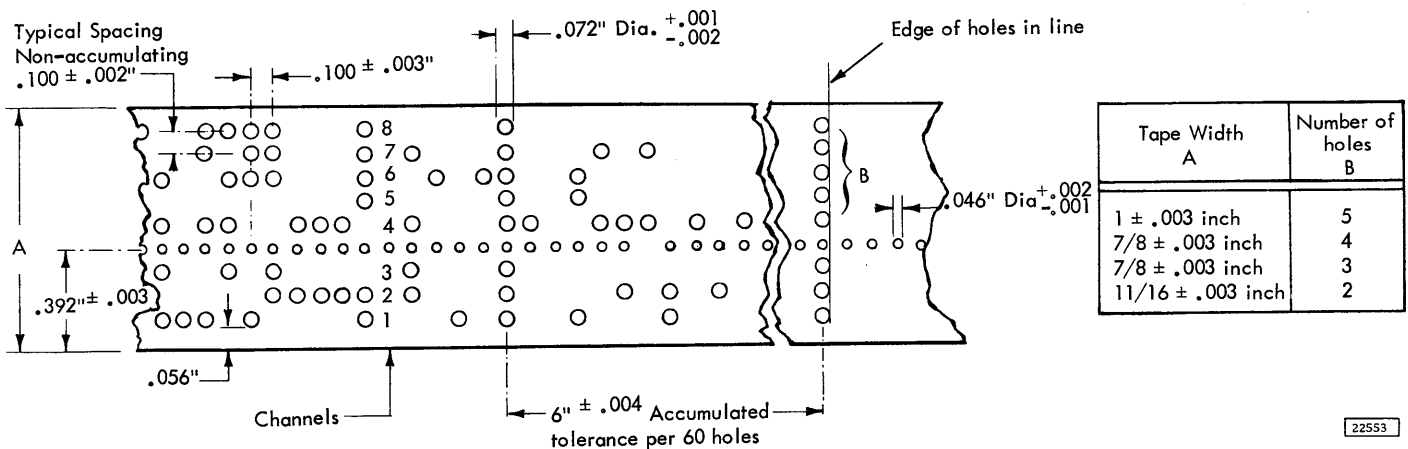


Figure 1-4. Standard Tape Dimensions

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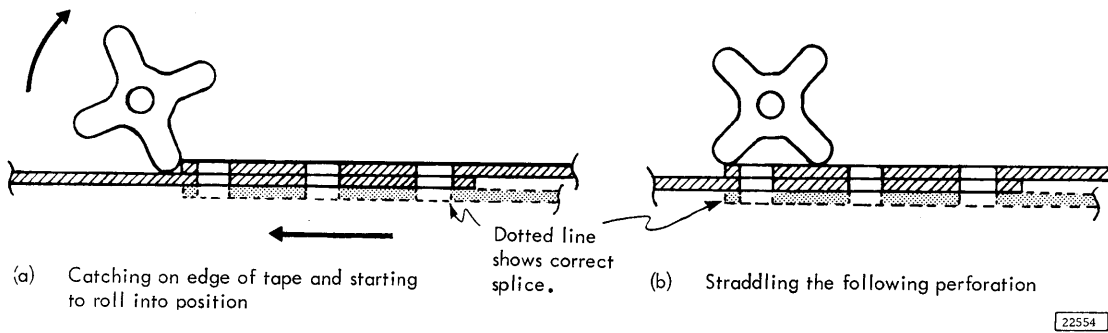


Figure 1-5. Bad Splice Showing Star Wheel

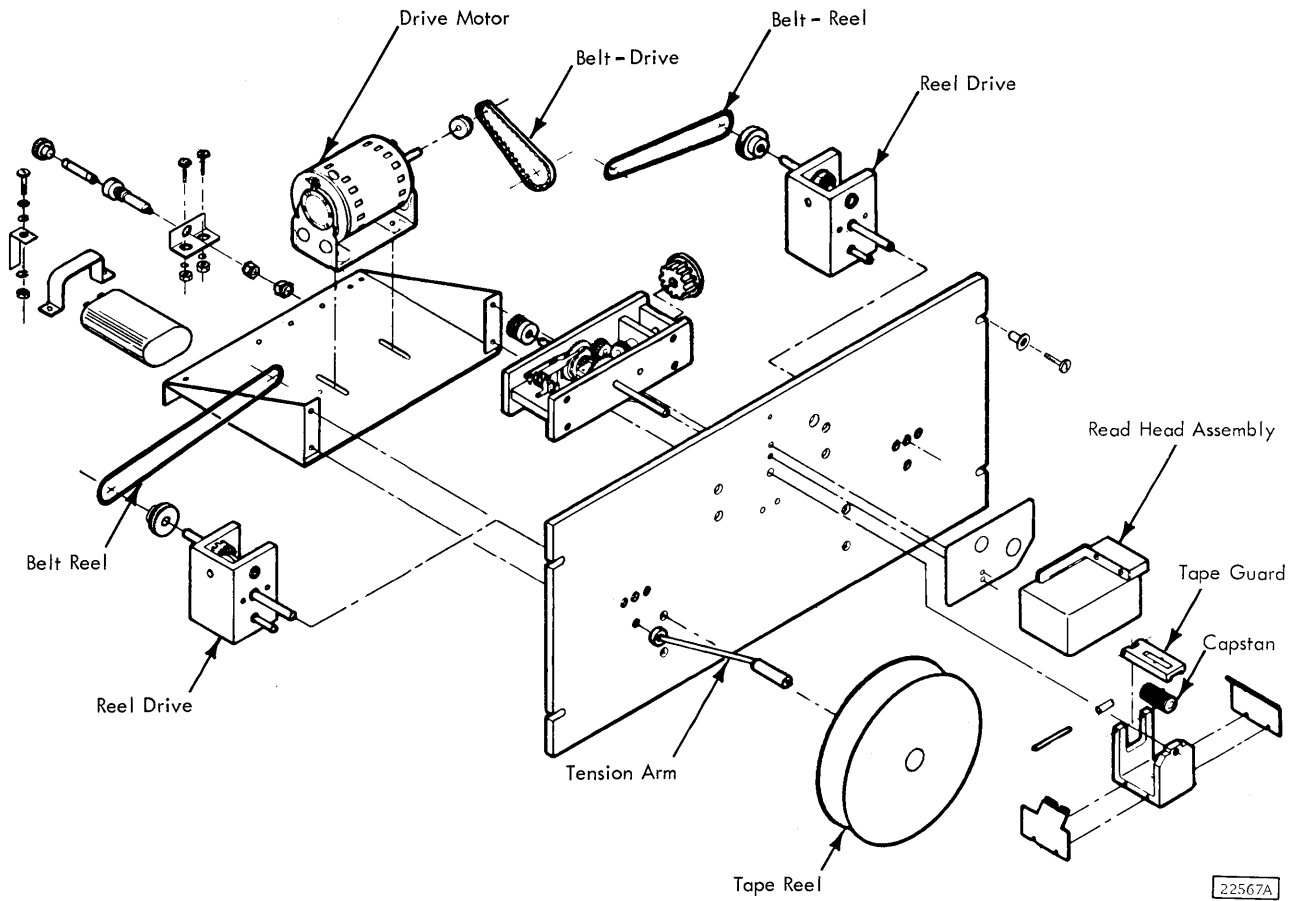


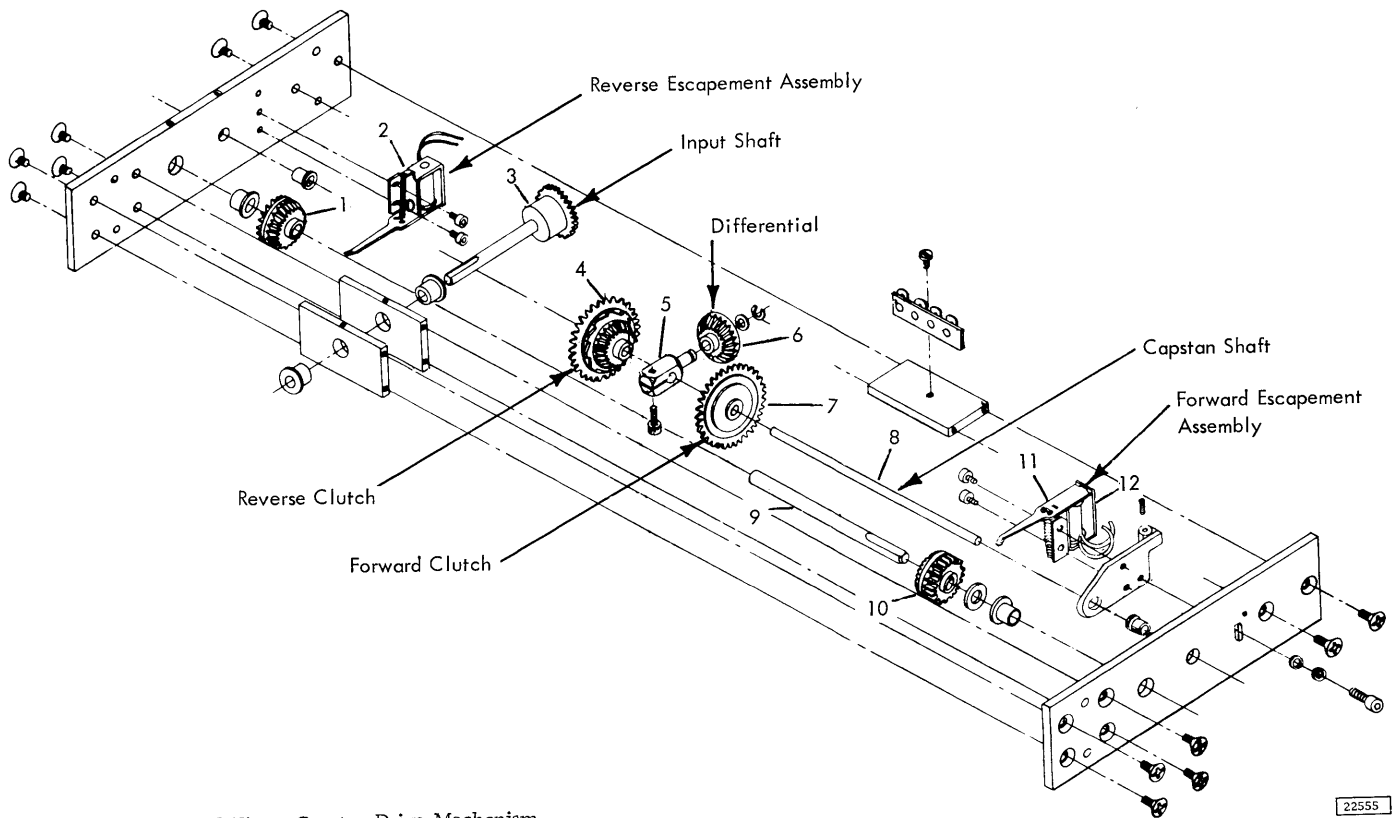
Figure 1-6. Exploded View, General Assembly

assembly transfers torque from the clutch through the differential (5 and 6) to the capstan shaft (8). When the escapement coil is de-energized, allowing the armature to drop and engage the next tooth of the escapement wheel, the capstan is stopped in position to read the next character. Manually releasing the reverse clutch assembly causes clockwise rotation of the capstan, moving the tape in the reverse direction.

1.3.2 Tape Reel Drive

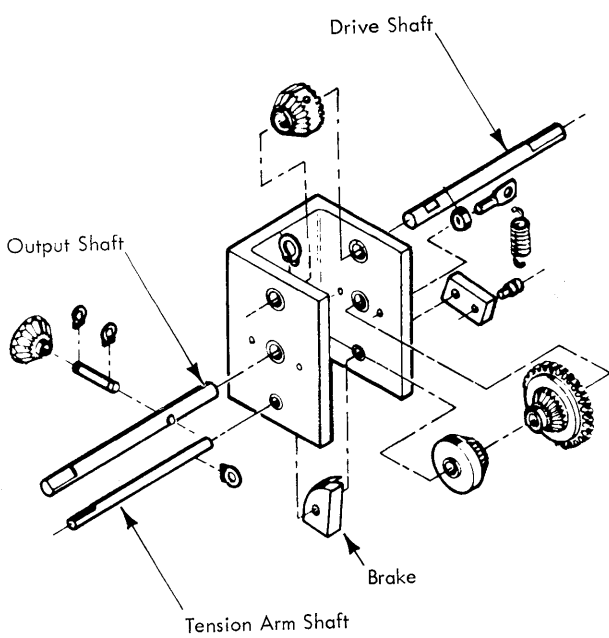
- Provides drive to take up tape on Model 2 only.

Mechanically controlled clutches drive the reels (Figures 1-6 and 1-8). The action of the tape on the tension arms causes the two reels to act as tape take up or supply reels.

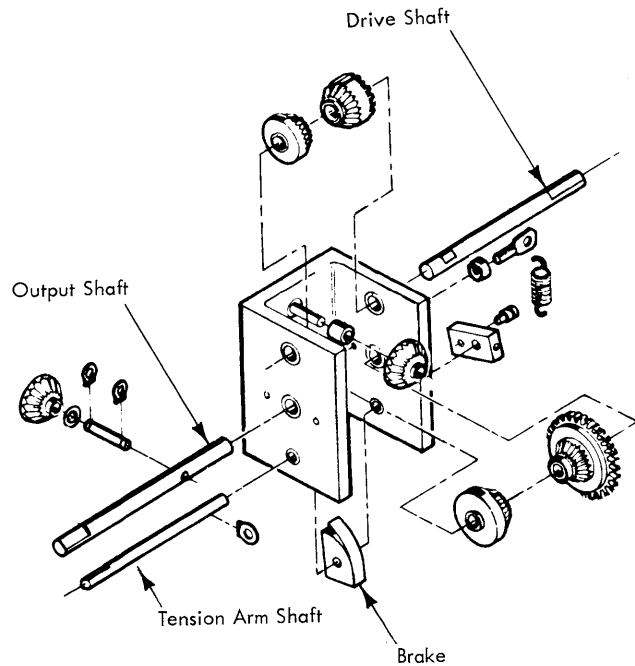


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Figure 1-7. Exploded View, Capstan Drive Mechanism



Right Hand



Left Hand

22570

Figure 1-8. Exploded View, Reeling Mechanism

1.3.3 Tape Read Head

- Provides for tape reading.

As the capstan moves the tape through the read head (Figure 1-9), it feeds the tape and takes it up to provide approximately 120 degrees of wrap on the capstan (Figure 1-10). This retards elongation of sprocket holes in tapes that must be read many times. The strippers on either side of the capstan prevent the tape from wrapping around the capstan.

The four-point star wheels sense perforations (holes) in the tape. Spring pressure applied to the star wheel lever by each pair of movable contacts (Figure 1-10) holds the star wheel lightly against the tape, but with enough pressure to avoid contact bounce.

As shown in Figure 1-10, when a no-hole condition is sensed, the star wheel rides the tape on two of its points, and the movable contact is switched to the upper, normally closed (N/C) position. When a hole is sensed (with the tape moving in either direction), one of the star wheel points drops through the hole as shown in Figure 1-10, into the normally open (N/O) position. An electric pulse delivered to the movable contact wire (common) is conducted to the N/C terminal if a no-hole is sensed, or, to the N/O terminal if a hole is sensed.

By definition, the normally closed contact (N/C) is that contact which is closed when the star wheel reads a no-hole condition on the tape. Similarly, the normally open (N/O) contact is closed when the star wheel reads a hole in the tape.

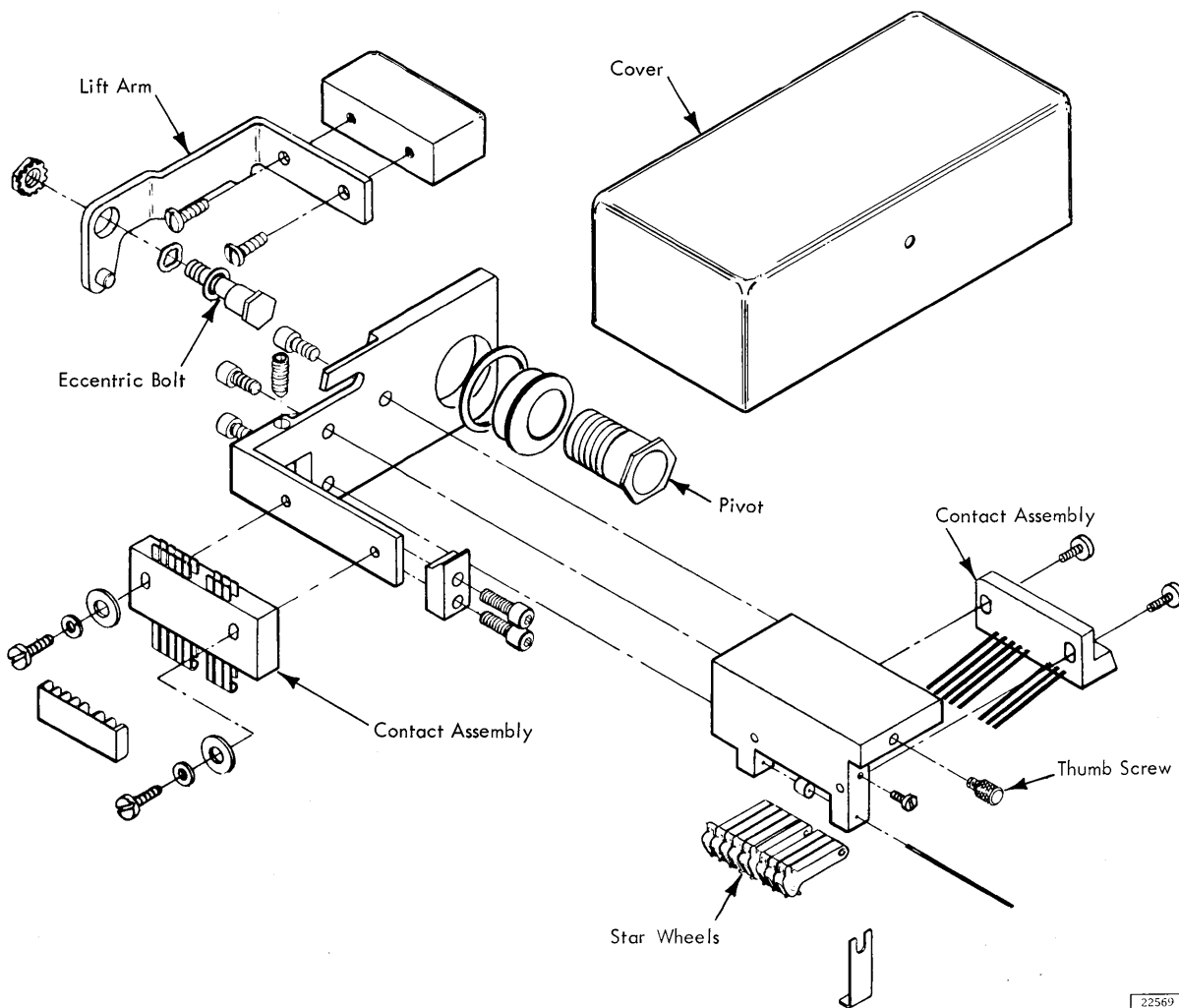


Figure 1-9. Exploded View, Read Head Assembly

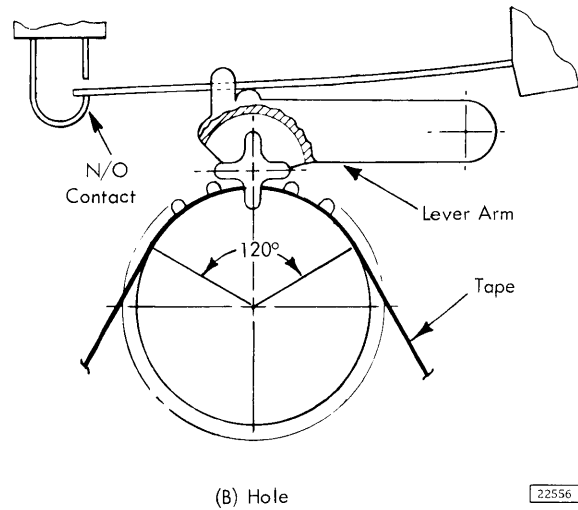
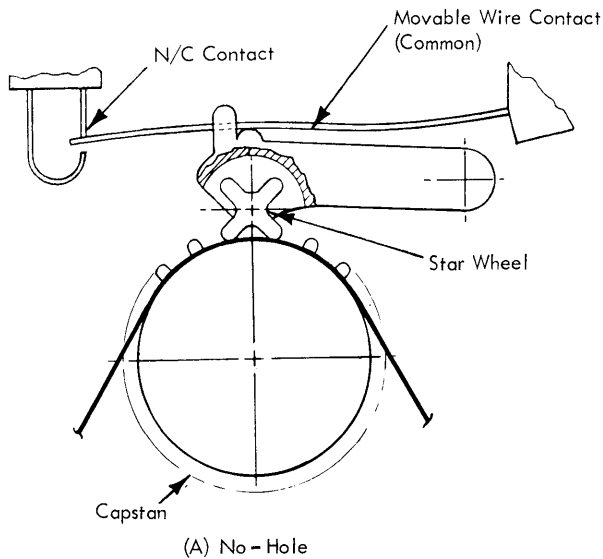


Figure 1-10. Star Wheels Reading Perforated Tape

1.4 ELECTRICAL OPERATION

1.4.1 Escapement Operation

- Control tape movement and direction.

To advance the tape (capstan rotation counterclockwise), a drive pulse is applied to the forward escapement assembly. The energized magnet disengages the armature from the escapement wheel, allowing the clutch assembly to rotate. Similarly, the tape may be moved in the reverse direction by tripping the reverse escapement assembly. The escapement coils are 50 ohm 24 v coils as shown in Figure 1-11.

1.4.2 Switching Action

- Reading holes in the tape.

A contact in each of the eight channels is read by sensing the N/O contact before the tape is moved.

If the N/O contact is at ground level, a hole is being read. A no hole condition is sensed if the N/O contact is above ground level.

1.4.3 Timing

- Character rate is 60 per second.

- Drive rate is 16.7 milliseconds.

The following discussion and the timing diagram are based on (1) a maximum reading rate of 60 characters per second, (2) a drive motor speed of 1650 rpm, and (3) a drive pulse of 4.5 milliseconds ± 0.5 ms duration. Under these conditions, the minimum time duration of one cycle is 16.7 milliseconds, i. e., drive pulses must be at least 16.7 milliseconds apart (leading edge to leading edge).

Figure 1-12 shows the timing relationships and pulse duration requirements of the Paper Tape Reader. To start a cycle, a pulse is applied to the forward magnet. The magnet momentarily disengages the armature from the escapement wheel in the clutch assembly. Torque is transmitted to the capstan shaft until the armature engages the following tooth. This torque moves the capstan one space.

As the tape is moved over the capstan, it is read by the star wheels. If no holes are read, the movable contacts will remain in the normally closed position. When a hole in the tape is read, the movable wire contacts for that particular channel are transferred from the normally closed to the normally open position. However, due to the mechanical delay designed into the reader, contact switching occurs between 7 and 14 milliseconds after the drive pulse has been applied.

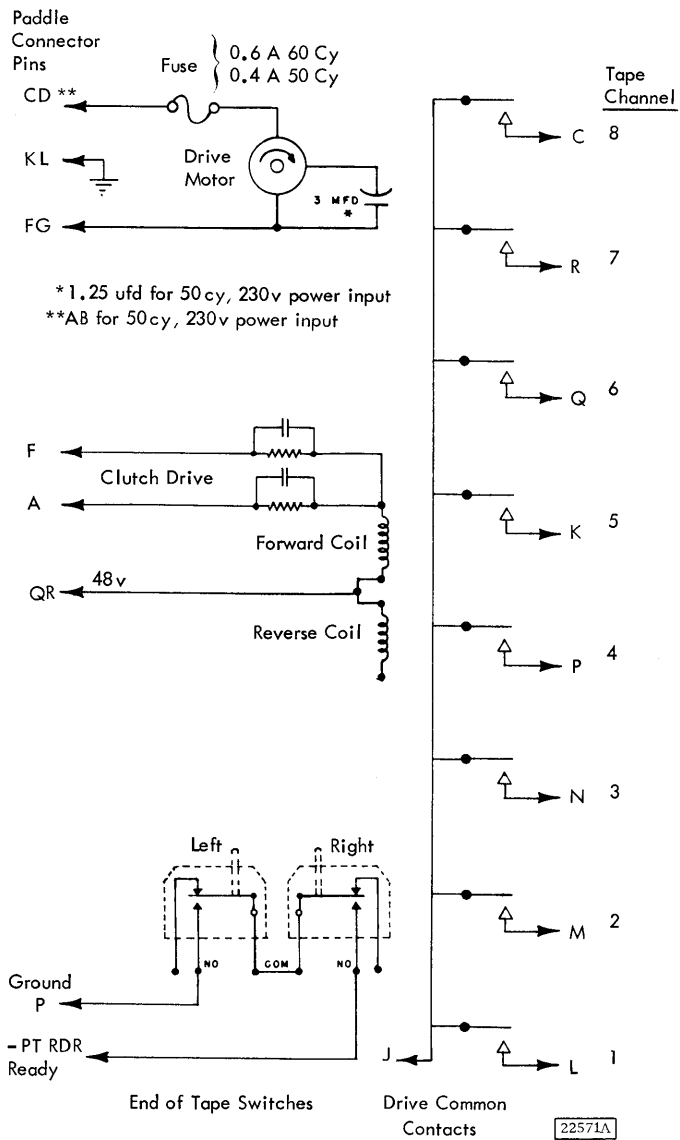


Figure 1-11. Wiring Diagram

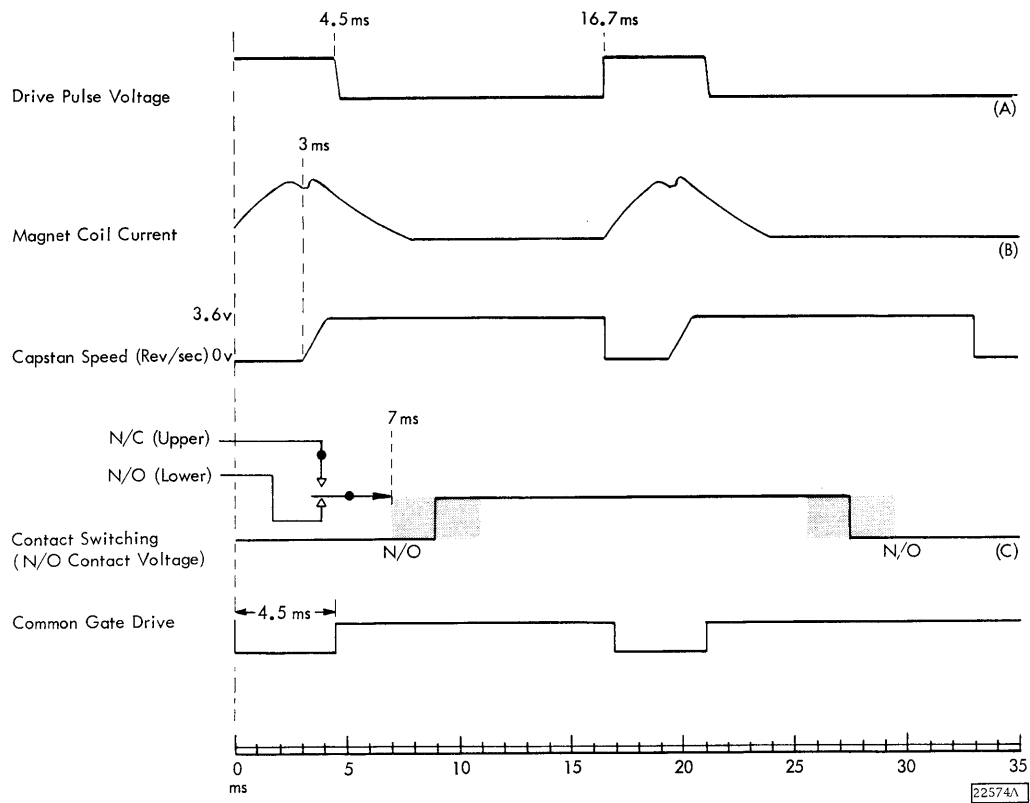


Figure 1-12. Timing Diagram

2.1 SCHEDULED MAINTENANCE

2.1.1 Cleaning

When inspection indicates the need for cleaning the capstan drive and/or reeling mechanism (Figure 2-1), clean it with a stiff brush. Do not use a wire brush. Wipe the unit free of loose dirt and excess oil with a lint-free cloth.

Remove one thumb screw from the front of the read head cover and remove the cover from the front panel to gain access to the read head contacts. Clean the read head area with a soft brush, or by blowing. Take extreme care against bending the small movable contacts. Clean lint and hair from the star wheels.

2.1.2 Lubrication

While lubrication of the Paper Tape Reader is necessary (Figures 2-2 and 2-3), over-lubrication can cause service problems. The customer engineer should therefore use lubricants sparingly. When the unit is left unused for long periods of time, check the lubrication points for signs of drying. Relubricate as necessary.

Code		Location Operation	Freq.	Operation
U	R			
1		Read Head		Clean tape path and star wheel area with a brush. Remove all lint from the cavities in the star wheel levers. Blow any dust from the contact area. Check for evidence of contact burning. If contact cleaning is necessary, follow the procedure outlined in Contact Cleaning - Read Head Section.
3		Drive	3	Lubricate all shaft bearings and idler gear bearings. Use IBM #6. (See lubrication chart, point #1.) Clean escapement armatures and pole faces. Moisten the felt pads with IBM #6. (See lubrication chart, point #2.) Check for worn bearings.
	4	Armature Anti-residual Shim		Check for wear on heel of armature. Check for wear at point of contact with Core.
5		Escapement Clutches		Lubricate both sides of each escapement clutch between the driven gear and the fiber friction washer. (See lubrication chart, point #3). Use silicone grease pn 265390. Check tape pull 300 grams minimum after lubricating, as shown in Escapement Assembly Adjustment Section.

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Figure 2-1. Scheduled Maintenance Chart

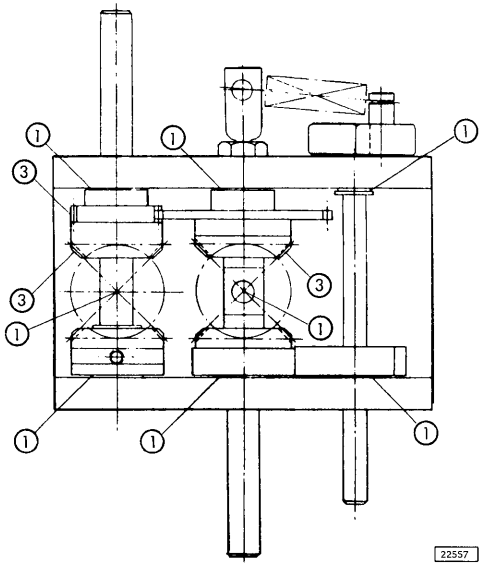


Figure 2-2. Lubrication Points, Reeling Mechanism

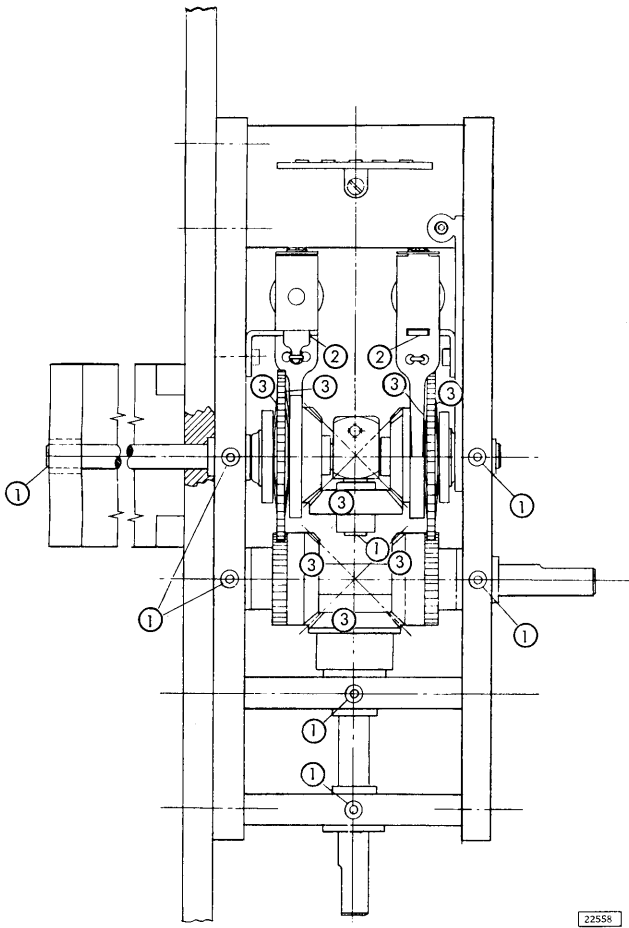


Figure 2-3. Lubrication Points, Capstan Drive Mechanism

CHECKS, ADJUSTMENTS, AND REMOVAL PROCEDURES

2.2 READ HEAD

2.2.1 Contact Cleaning – Read Head

If read head contacts require cleaning, remove the insulating comb from the stationary contacts and lower the head onto a section of un-punched tape. Slide the contact wires to the side and allow wires to move down out of stationary contacts. Place a 0.008" feeler gage between the N/O and N/C contacts. Place a burnishing blade between the N/O contacts and the feeler gage and wipe until clean.

Wipe moveable contact wires with a lint free cloth. After servicing the contact area, make sure the wires are properly aligned and not crossed. Be sure to replace the insulating comb.

2.2.2 Read Head and Contact Adjustment

Incorrect adjustment of the read head assembly may cause reading errors. The first step of the

adjustment is to verify that each of the eight star wheel levers is free to move vertically without dragging on the adjacent levers.

The star wheels must also be centered over the capstan, as seen in Figure 1-10. Adjust the star wheel position horizontally in relationship to the center of the capstan by loosening the pivot bushing (A, Figure 2-4) and moving the read head adjusting eccentric (B).

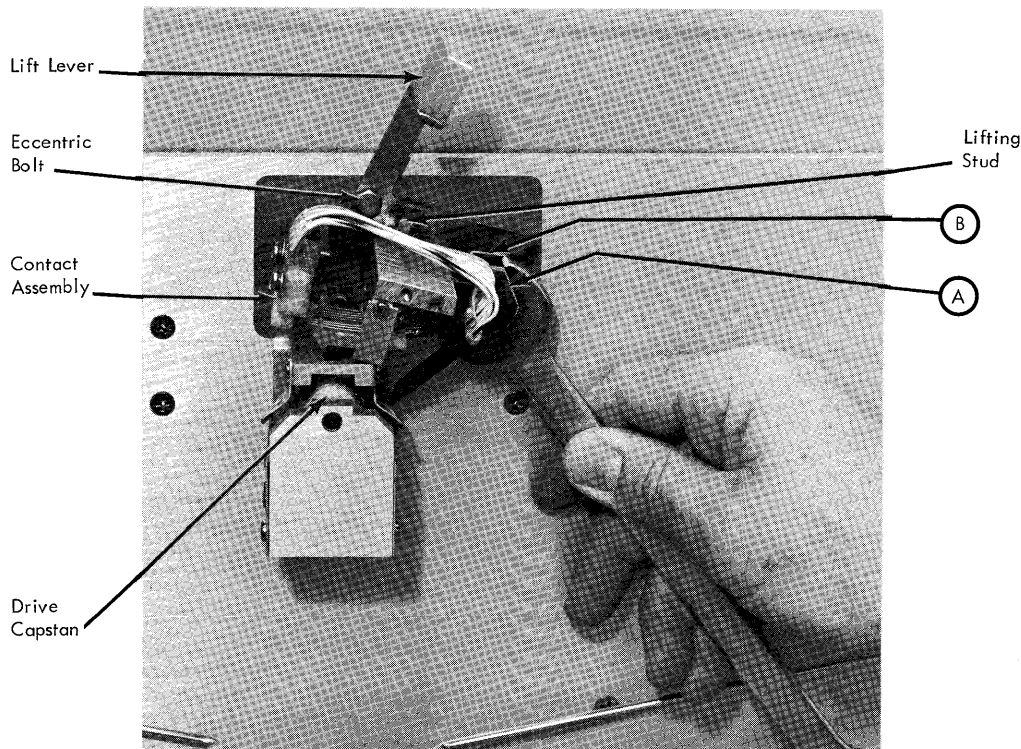
NOTE: It is possible to center the star wheels in two eccentric positions. Use the position in which the eccentric position's true center is high.

2.2.2.1 Movable Contacts

The movable contact wires must be free to move up and down in the gap between the fixed contacts. Improper alignment may be corrected by carefully forming the movable contact wire at its base.

2.2.2.2 Fixed Contacts

The fixed contact gap opening must be between .025 and .030 inches wide. Incorrect gap may be corrected by forming the normally open (lower) contact.



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Figure 2-4. Read Head Adjustment

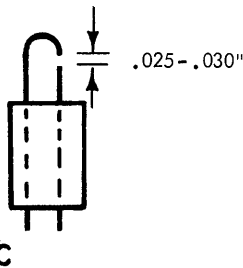
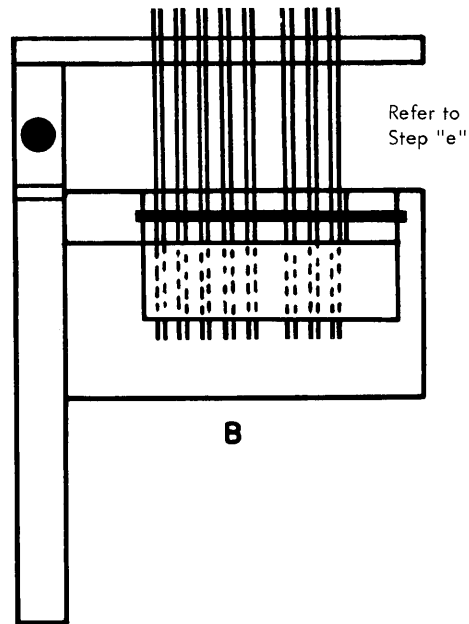
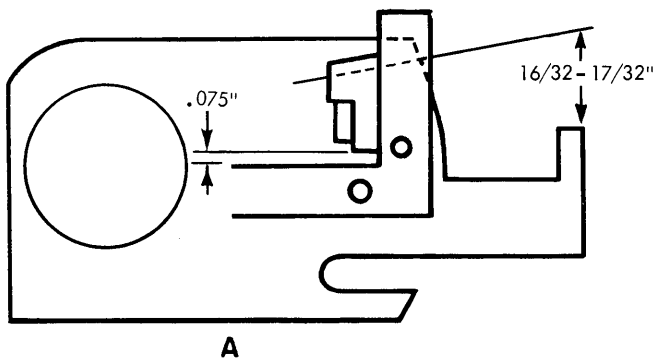
To adjust the contacts, use the following procedure:

- a. Set the movable contact assembly at .075 inch from the star wheel bracket (Figure 2-5A).
- b. Line up the wires straight and parallel. Check alignment against the fixed contacts, holding the fixed contact block in line with its mounting holes (Figure 2-5B).
- c. Bend the wires so the distance from the arm base plate to the underside of the wire is $16/32$ to $17/32$ inch (Figure 2-5A).
- d. Check step b.
- e. Set the read head on a flat surface in the position shown in Figure 2-5A. With an edge perpendicular to the flat surface, apply pressure toward the arm base plate at the point where the star wheel carriers would make contact. See that each set of wires moves

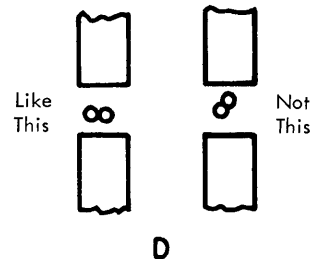
together, with neither wire hanging up on the adjacent wire (Figure 2-5D).

2.2.2.3 Contact Pressure

Contact pressure should be 15 to 20 grams per pair of wires when in either the N/O or N/C position. Lower contact (N/O) pressure may be checked by applying force under the wires adjacent to the fixed contact, with a gram gauge and the wire tool as shown in Figure 2-6. Place an Ohmmeter from the common contacts to a N/O or a N/C contact. Observe the force required to lift the wires when switch contact is broken. Lower contact pressure is increased by moving the fixed contact upward. Insert no-hole tape in the read head, and apply downward force on the wires with the gram gauge and a formed paper clip to check upper contact pressure, as shown in Figure 2-6. Upper contact pressure is increased by lowering the read head through use of the depth adjusting screw and the lever eccentric.

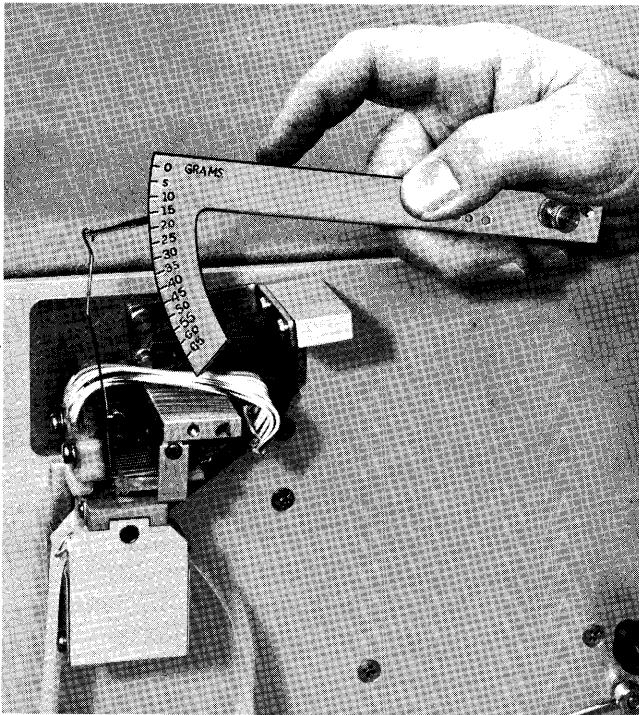


Fixed Contact Block, End View

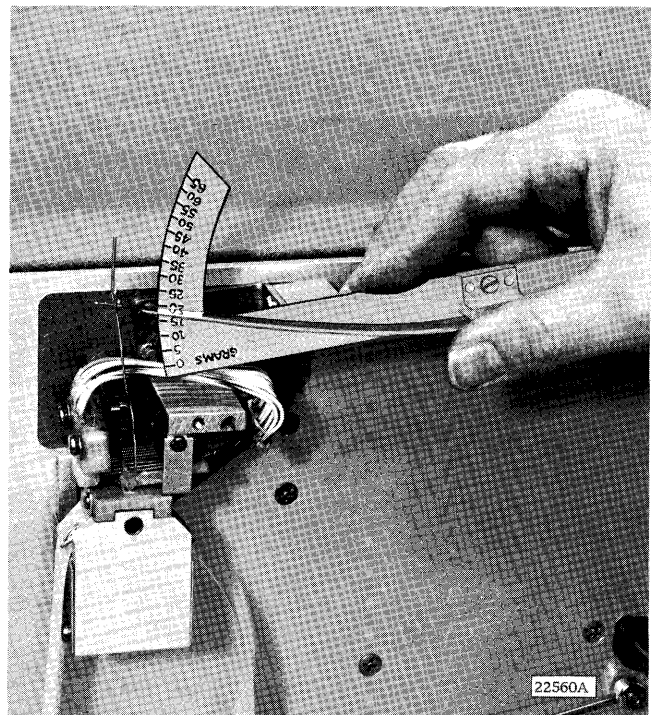


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Figure 2-5. Read Head Contact Measurements



Lower Contact Pressure.



Upper Contact Pressure.

Figure 2-6. Checking Contact Pressure

2.2.2.4 Switch Timing

Contact switching should be checked by placing a jumper from the common contacts to ground and manually stepping the tape first forward and then reverse. Check with an oscilloscope from ground to the N/O contact. If the switching in both directions is not within the 7-14 millisecond zone (Figure 1-12), loosen the recessed-head clamp screw (B, Figure 2-7) and turn the adjusting screw (A) counter-clockwise to advance the tape; clockwise to delay it.

NOTE: Do not move tape more than a few seconds with the jumper installed.

If the above adjustment proves insufficient to achieve correct timing, insert a short length of alternate hole pattern tape in the reader. Loosen the set screw on the differential spider (5, Figure 1-7). With the motor running, turn the capstan shaft manually until star wheels sensing "no-hole" are equally spaced between holes. See Figure 2-8. Retighten the set screw, and readjust as per the preceding paragraph.

Switching time from upper to lower contacts should be the same as that from lower to upper contacts. Check channel 1 with an oscilloscope. If the times are not equal, adjust the channel 1 side of the fixed contact block until they are. Repeat for channel 8, and recheck channel 1. If switching time is correct on channels 1 and 8, it should be correct for channels 2 through 7. If not, correct the erroneous channels by forming the movable contacts, as shown in Figure 2-5 and accompanying text. Recheck contact pressure.

2.2.3 Lift Lever

The lift lever (Figure 2-4) should be adjusted so the lifting stud passes over center with the lever down firmly against the base plate. If adjustment is required, loosen the eccentric bolt, and turn the eccentric so that the lever locks over center.

WARNING: Do not move the depth adjusting screw, for this screw adjusts upper contact (N/C) pressure.

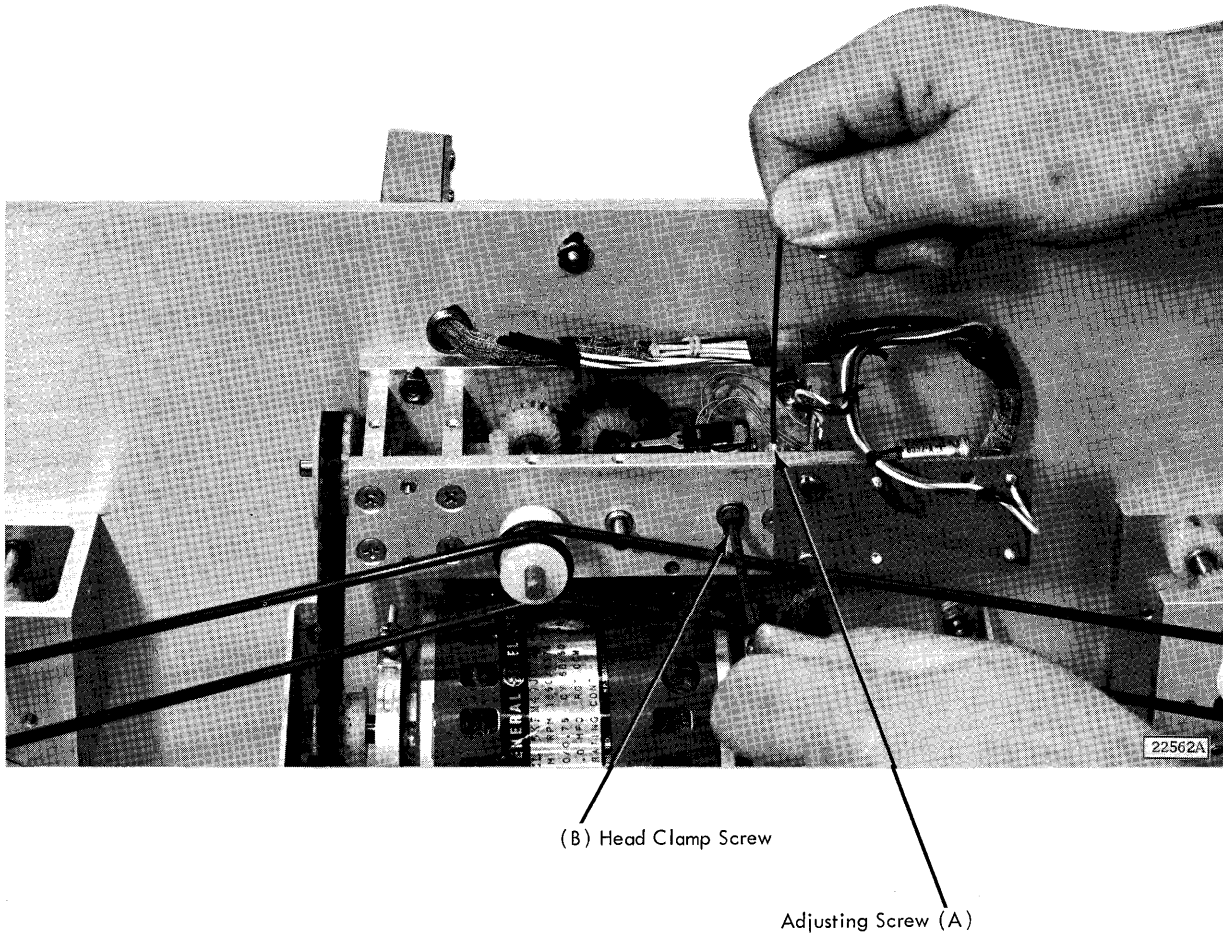


Figure 2-7. Timing Adjustment

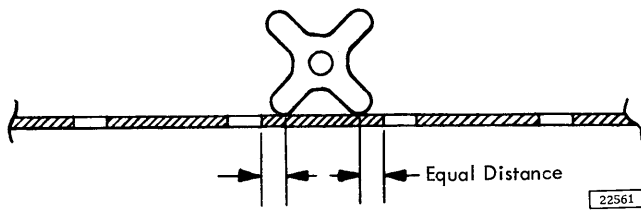


Figure 2-8. Star Wheel Positioning

2.3 DRIVE SYSTEM

2.3.1 Replacement

To replace damaged gears or shafts (Figure 1-7), loosen all set screws clamping gears to the shaft. Noting the position of all shim washers, slide the shaft through its bearings.

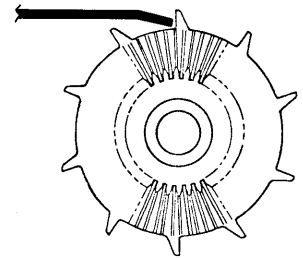
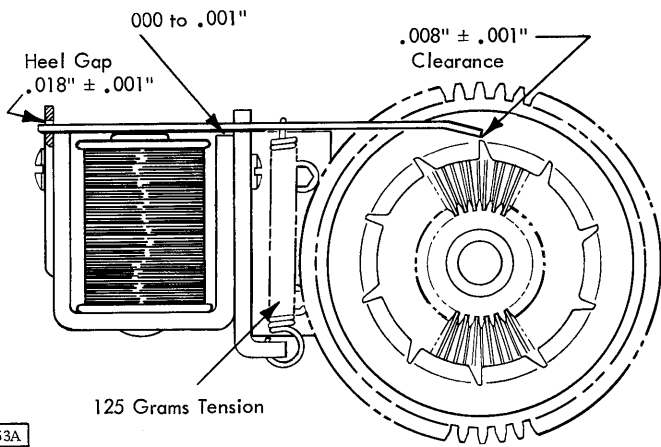
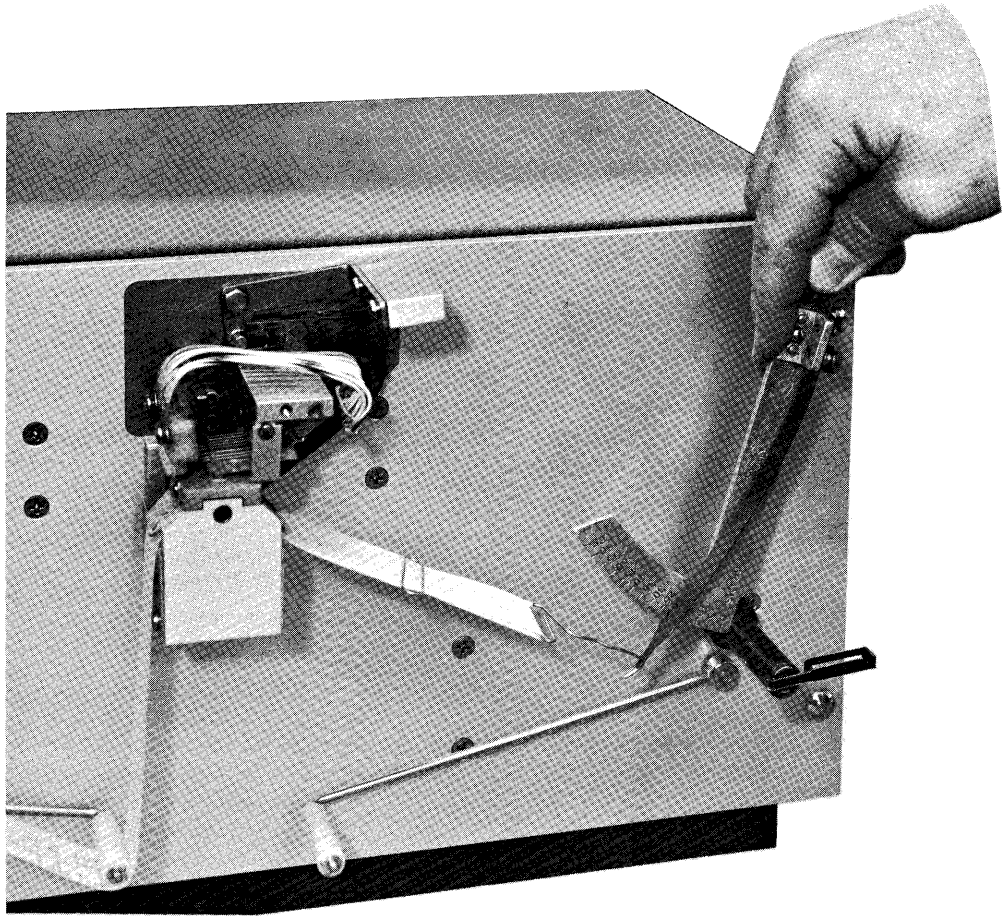
When re-assembling components, re-insert the shaft through its bearings, picking up shim washers,

gears or other components one at a time. Be sure all shim washers are in their proper places. This will usually keep shaft end-play and gear backlash within the tolerances shown in the following table. It may be necessary to add or take away shims when new gears are installed.

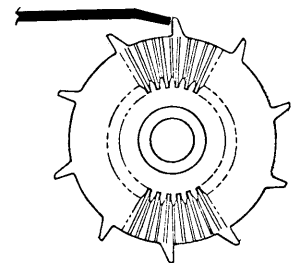
Part	End Play	
	Max.	Min.
Motor Input Shaft	.010"	.001"
Auxiliary Drive Gear	.010"	.001"
Capstan Shaft	.010"	.005"
Spider Bevel Gear	.010"	.001"

2.3.2 Escapement Assembly Adjustment

If any parts of the escapement assembly have been repaired or replaced, adjust the assembly to provide the clearances shown in Figure 2-9.



Adjusted too low



Adjusted Correct

Figure 2-9. Escapement Adjustments

Tape pull is 300 gram minimum. Insert a short length of alternate hole pattern tape in the reader. Hook a gram gauge to the end of the tape with a formed paper clip (Figure 2-9). Pull on the gauge until it reads about 400 grams. Press on the armature to release the escapement and observe the reading while allowing the tape to slip through the read head. Check both forward and reverse friction clutches.

2.4 END OF TAPE ACCESSORY SWITCH

The end-of-tape sensing switch is designed to provide a contact transfer to indicate the end of a tape.

When the switch is made with tape in place, the paper-tape-reader-ready line is activated.

2.4.1 Operation

A lever actuated switch is mounted on the inside face of the read stripper plate. The roller on the end of the switch actuator protrudes through a slot in both the stripper plate and the tape pressure guide. When tape is under the tape guide, the switch contacts are transferred to the normally open position, due to tape pressure against the switch actuator. When no tape is present, the switch contacts are in the normally closed position, as seen in Figure 2-10. One sensing switch is positioned on each side of the capstan, so that end-of-tape is indicated in whatever direction tape is moving.

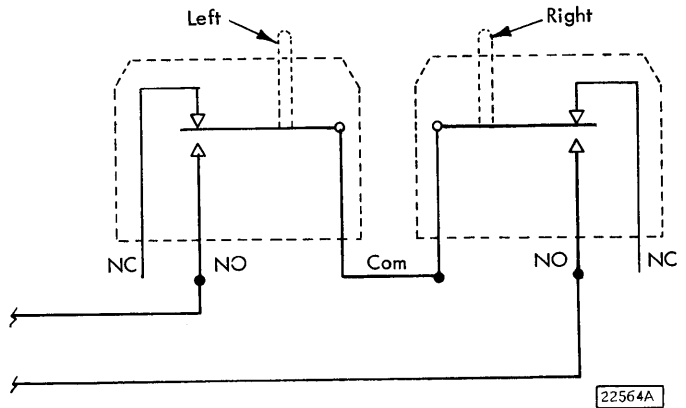
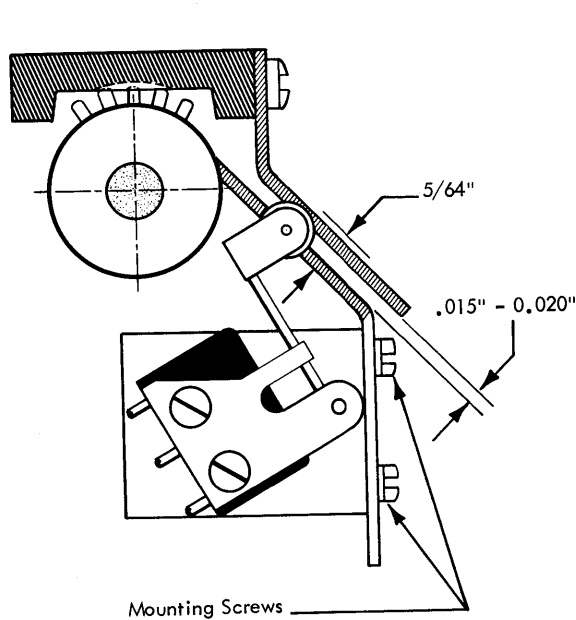


Figure 2-10. Wiring, End of Tape Sensing Switch

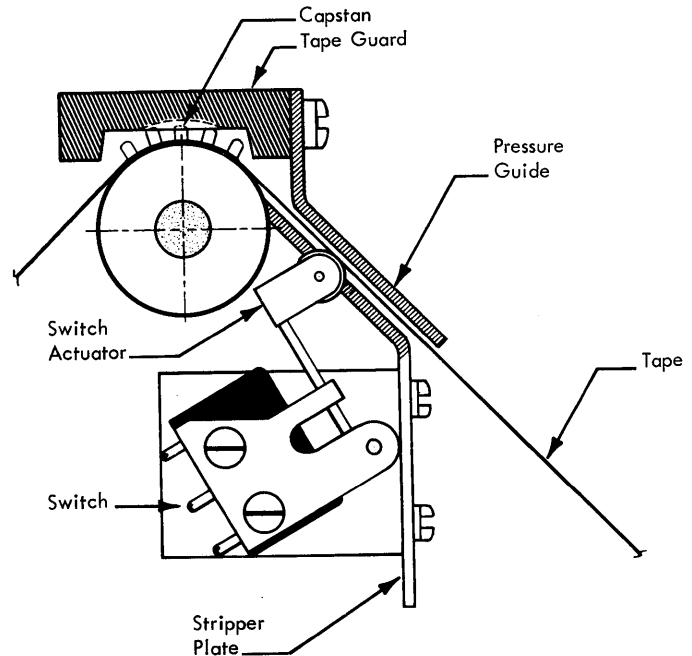
2.4.2 Adjustment

The roller on the switch actuator (Figures 2-11 and 2-12) should protrude through the stripper plate $5/64$ inch, so that the switch will be closed when tape is moving under the tape pressure guide. This adjustment is made by loosening the two mounting screws on the outside face of the stripper plate and moving the block assembly up or down. The tape pressure guide should be adjusted so that there is $.015$ - $.020$ inch clearance between the stripper plate and guide.



(a) Switch sensing end of tape.

Figure 2-11. End of Tape Switch Adjustment



(b) Switch sensing tape.

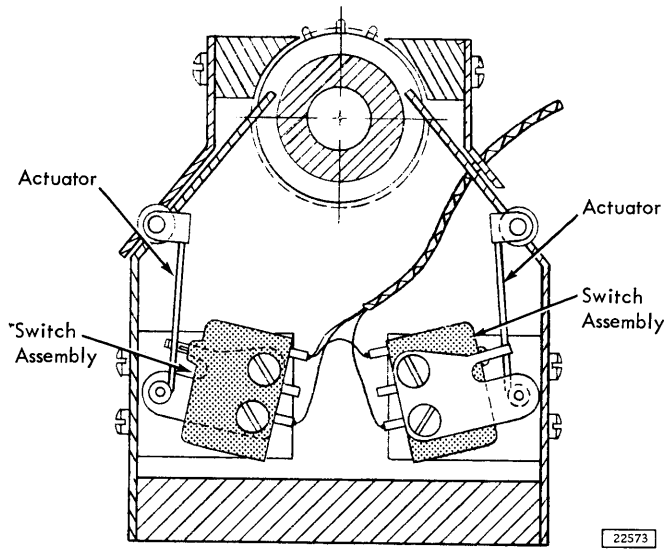


Figure 2-12. Outboard Bearing Block, with End of Tape Switch

3.1 DIAGNOSTIC PROCEDURES

The following discussion is divided into three major areas:

Stepping Errors, Reading Errors and Reeling Failure.

The first step in trouble-shooting the unit is to examine it in operation in order to localize the problem. Stop the unit, and examine the subassembly in question for worn or damaged parts.

3.1.1 Stepping Errors – Capstan Drive Mechanism

1. Improper drive pulse. Inspect with scope and adjust if necessary. See 1.1.2 Input Requirements, and Timing Diagram, Figure 1-12.
2. If neither of the above is responsible, remove the armature from each escapement assembly. Inspect and thoroughly clean the assembly. Ascertain that the capstan drive mechanism conforms to the following specifications. Refer to Figure 2-9.
 - a. Bracket – Frame Alignment – flush to .001.
 - b. Heel Gap (with shim) – .018 ± .001 inch.
 - c. Tooth Clearance – .008 ± .001 inch.
 - d. Spring Tension – 125 ± 20 grams.
 - e. IBM #6 on armature's felt pad.
 - f. Capstan Shaft end play – .005 – .010 inch.
 - g. Differential Spider Gear end play – .001 – .010 inch.
 - h. Differential Spider Screw tightness – Must be very tight.
 - i. Capstan Set Screw tightness (where applicable).
 - j. Armature tip engagement full on tooth (dynamic). (Figure 2-9).

NOTE: Armature tip should have a slight radius. A sharp edge can cause the armature to dig into the gear.

- k. Tape pull – 300 gram minimum. Check both forward and reverse friction clutches.
- l. Check drive pulse voltage. (Traces A and B, Figure 1-12).
- m. Worn antiresidual shim can cause stepping or read errors.

3.1.2 Reading Errors – Read Head

1. Incorrect hole spacing on tape being read. Sprocket and/or bit holes in tape badly worn,

causing poor location of tape in relationship to star wheels. Inspect tape.

2. Be sure that the read head's condition meets the following specifications:
 - a. Condition of contacts – check for burning or dirt.
 - b. Stationary contact gap – .025 – .030 inch.
 - c. Wire alignment – straight and parallel.
 - d. Stripper alignment – fingers in grooves.
 - e. Star wheels centered in grooves.
 - f. Star wheels secure and free.
 - g. Read Head holds open with lift lever up.
 - h. Tape Hold Down Adjustment – see 2.2.3.
 - i. Contact pressure – 15 to 20 grams – see 2.2.2.3.
 - j. Switching zone – 7 – 14 milliseconds. See 2.2.2.4.
3. If the contacts need adjustment, refer to 2.2.2.2.

3.1.3 Reeling Failure

1. Look at the reeling mechanism while it is in operation.
2. Be sure that the tape tension arm (Figure 3-1) is adjusted to 1 1/8 ± 1/8 inch above the bottom edge of the panel, in an "at rest" position.
3. Be sure that the tension spring, when extended, exerts 100 to 150 grams pressure at the end of the arm.
4. Be sure that the tension arm goes over center to within 45° of the vertical, and holds against the reel shaft.

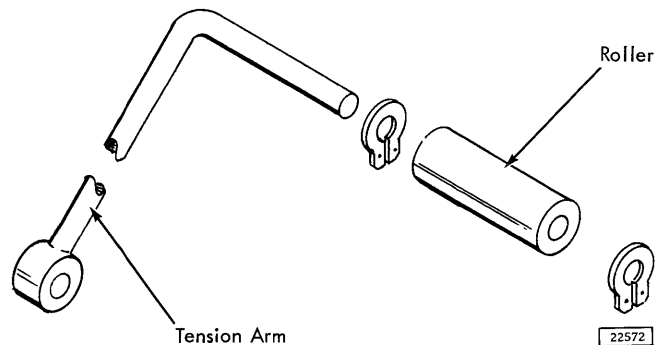


Figure 3-1. Exploded View, Tension Arm Assembly

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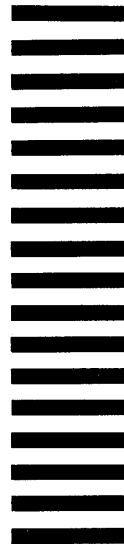
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