SERVICE MANUAL

INSTA LOAD/XL 2200 SERIES

SERVICE INSTRUCTIONS

CUSTOMER SERVICE
1-800-828-6107

TELEX®

TELEX COMMUNICATIONS, INC.
9600 Aldrich Ave. So., Minneapolis, MN 55420 U.S.A.

VOLUME 2200A Litho in U.S.A. November 1984

FOR CHANGEOVER SYSTEM SEE
BULLETIN # 19-520

SECTION I GENERAL INFORMATION

A. PRINCIPLES OF OPERATION

All Telex Insta Load/XL projectors may be divided into eight basic functions:

1. The Main Drive System.
2. The Feed and Rewind System.
3. The Gate and Lens Mount.
4. The Auto-Loop Restorer.
5. The Sound Drum and Optic.
6. The Take-Up System.
7. The Flywheel Drive System.
8. The Electrical System.

A thorough understanding of each function and its relationship with the other functions will be a great assistance in servicing these projectors.

THE MAIN DRIVE SYSTEM

All functions are driven from a single drive shaft (34) which is turned by a reversible motor through a drive belt (Figure 1). Two worm gears (20) & (32) (drive gears), pinned to the shaft, drive the Take-Up Clutch gear and the Feed Sprocket Clutch gear. The Shutter (26) and the Safety Shutter (24) (in models which have the still feature) are mounted on this same drive shaft. Reverse operation of the projector is accomplished by changing the direction of rotation of the drive shaft by reversing the drive motor. (See Power Supply and Motor Drive Circuits.)

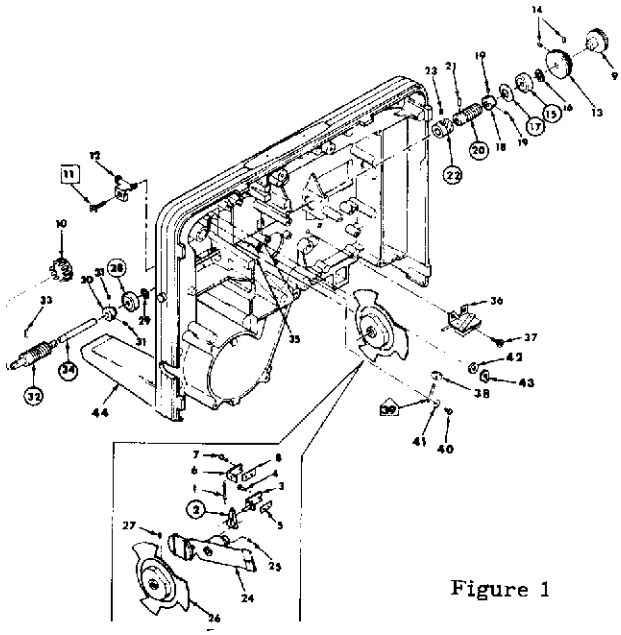


Figure 1

FEED AND REWIND SYSTEM

The feed and rewind system consists of three clutches: the Feed Sprocket Clutch (37), the Rewind Clutch (27) and the Fast Forward Clutch (32) (on models having that feature). (Figure 2).

The Feed Sprocket Clutch is driven by the front worm gear on the main drive shaft (Figure 1). It, in turn, drives the Fast Forward and Rewind Clutches. The drive it supplies is direct in all forward modes and in Rewind, and clutched in Reverse.

The Rewind Clutch slips freely in all forward modes, but is locked in direct drive in Reverse and Rewind by the Rewind Solenoid. It, therefore, provides no drive to the supply reel in forward modes but always supplies direct drive to the supply reel through the reel arm belt in Reverse and Rewind

The Fast Forward Clutch slips freely in every mode but Fast Forward. In the Fast Forward mode, it is locked into direct drive by the Fast Forward Solenoid and drives the take-up reel through the Fast Forward Drive Belt and the Take-up Reel Arm Belt.

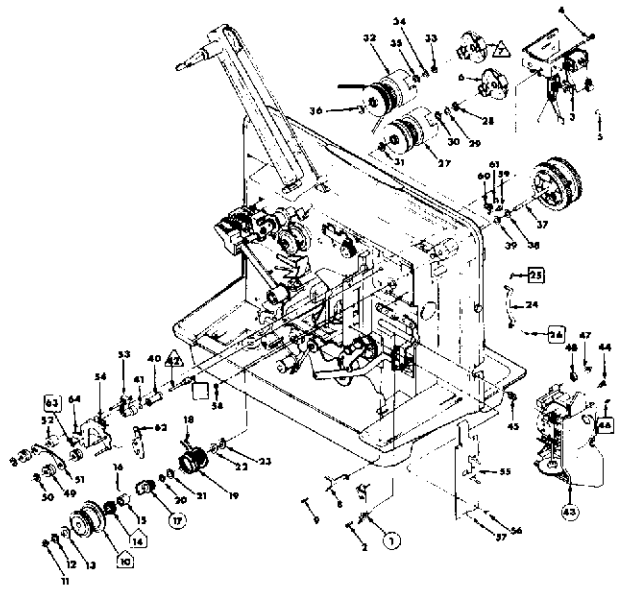


Figure 2

FORWARD (Figure 3)

The tail of the Clutch Spring (6) is permanently trapped in a notch (N) in the Clutch Gear (14). The coil of the spring wraps around the arbor of the Clutched Gear (3). When the projector runs in any forward mode, the clutch gear rotates in a clockwise direction (as viewed from the back of the projector) pushing the tail of the spring to clamp it tightly around the arbor so the Clutched Gear (3) is directly driven by the clutch gear through the clamping action of the spring. The drive of the worm gear on the main shaft is thus directly connected to the Rewind and Fast Forward clutches (Figure 4, 27 & 32) through the clutch gear (14), clutch spring (6) and clutched gear (3).

Since the Rewind Clutch is not locked in direct drive in any forward mode, it does not drive the supply reel. Film is pulled from the supply reel by the feed sprocket, which is fastened to the shaft of the Clutch Gear (14).

The Fast Forward Clutch also slips and does not drive the take-up reel

REVERSE (Figure 3)

When the projector runs in reverse, the notch (N) in the clutch gear (14) moves in a counterclockwise direction moving the tail of the clutch spring (6) to open the spring coil and allow the spring to slip on the arbor of the clutched gear (3). This provides a clutched drive to the Rewind Clutch, which is locked in direct drive in both reverse and rewind. This is necessary so the Rewind Clutch will drive the supply reel in reverse only as fast as film is supplied to it from the feed sprocket.

FAST FORWARD (Figure 4)

In the Fast Forward mode, the Feed Sprocket Clutch is locked into direct drive as described above. Now the Fast Forward solenoid and the Interlock solenoid operate to lock the Fast Forward clutch (32) into positive drive and freeze the gate closing mechanism respectively. Film is thus transported rapidly forward either "In-Path" or Reel to Reel.

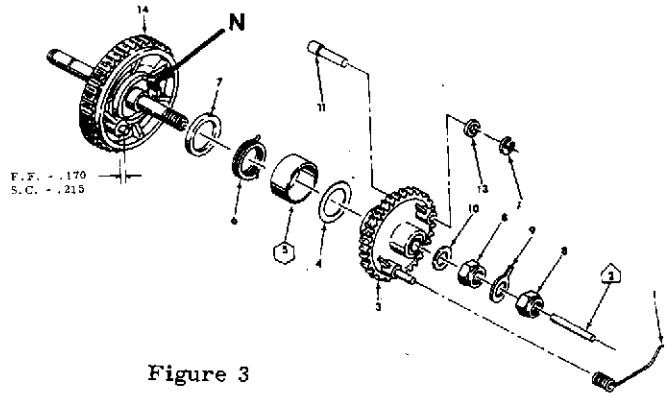


Figure 3

REWIND (Figure 3)

When the projector is operated in the Rewind mode, the interlock solenoid operates and pushes the Guide Pin (2) in. Since the Spring(1) is threaded through the Guide Pin (2) and into the Gear Pin (11), both the spring and the gear are also pushed in. The gear pin strikes the side of the Roll Pin (R) in the Clutch Gear (14) and locks the clutched gear and the clutch gear together to provide direct drive in the rewind mode.

The interlock solenoid also pushes an interlock pin through the main casting into the film gate closing mechanism to prevent the gate from being closed on the film when film is being rewound rapidly "In-Path".

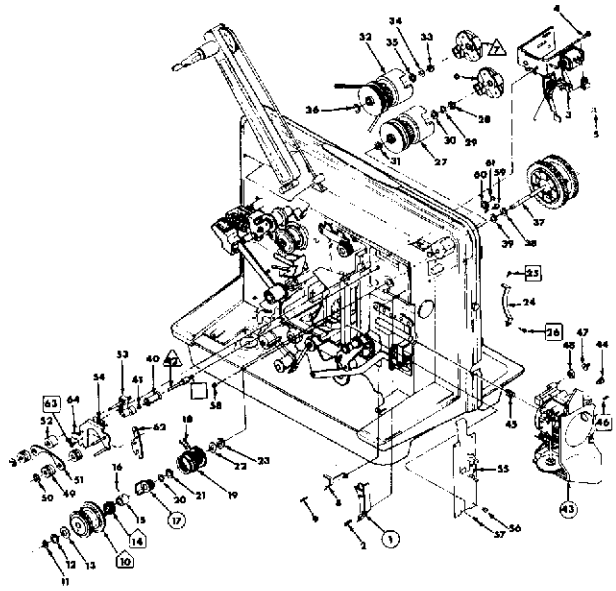


Figure 4

GATE AND LENS MOUNT

The film is held securely in place against the aperture plate by the film pressure shoe (Figure 5). It is fed into this channel from the feed sprocket which is just above the lens mount.

When the Master Control Lever is moved from LOAD to PROJECT, the loop setting cables turn the front sprocket approximately 3/4 turn counterclockwise to establish the upper loop.

The pins on the claw arm enter the sprocket holes from behind the aperture plate and pull the film down through the channel one frame at a time (Figure 6). When the framing adjustment is properly made, each picture frame will line up exactly in front of the hole in the aperture plate through which the projection lamp shines. The light shines through the film and the image is projected onto a screen and focused by means of the projection lens.

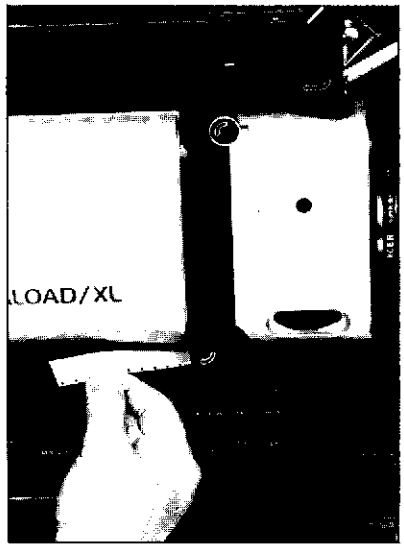


Figure 5

The film is moved through the film gate at the rate of 24 frames/second by moving the claw arm into the sprocket holes, then down, then out of the sprocket holes and then up to start the cycle over again. During the actual movement of the film through the gate area by the claw arm, light is prevented from being projected onto the screen by one of the shutter blades which moves between the projection lamp and the film. As soon as the claw arm has moved the film into position in front of the hole in the aperture plate, the shutter blade moves out of the way to allow light to pass through the film and project an image on the screen. This momentary interruption of light by the shutter blade while the film is moving prevents what would appear to be streaming of the picture. However, the light interruption is so rapid that only a small amount of flicker is discernible by the human eye. The claw arm and shutter are synchronized by a cam which is part of the shutter assembly and turns at the same rate of speed as the main shaft.

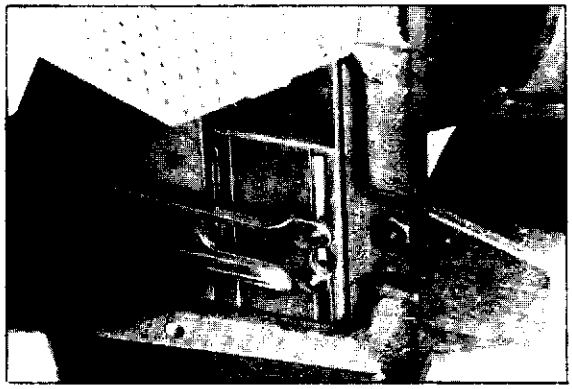


Figure 6

AUTOMATIC LOOP RESET THEORY

The automatic loop reset is driven by a neoprene drive belt from the flywheel drive shaft.

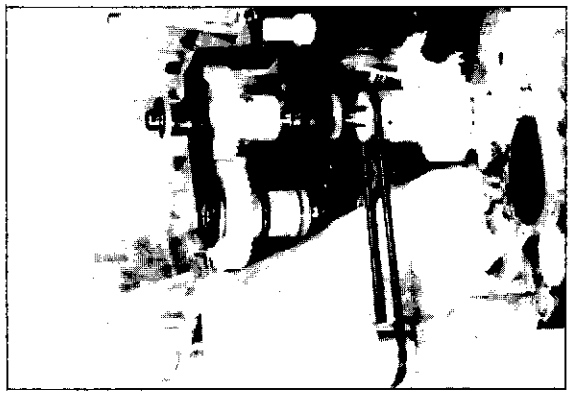


Figure 7

The small pinion gear and idler gear run continuously while the projector is operating. The large loop resetting gear turns only when the lower loop is being reset.

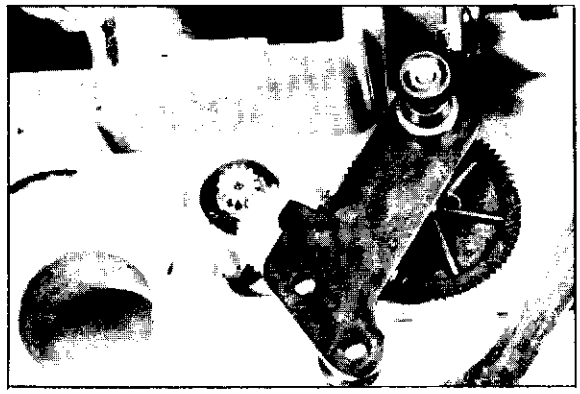


Figure 8

IDLE POSITION

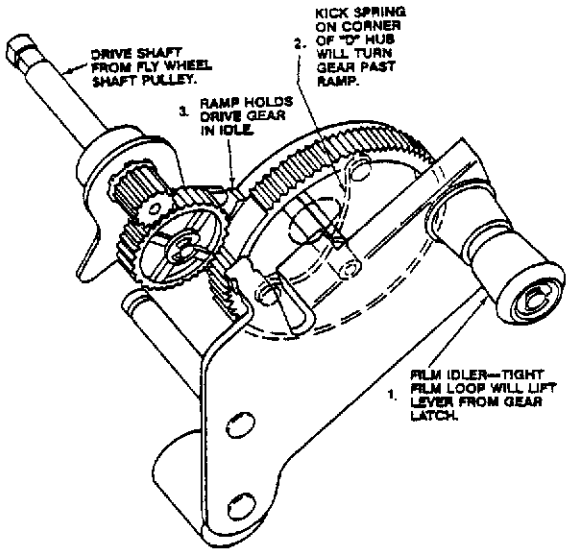


Figure 9

In the idle position, the ramp on the back edge of the loop resetting gear holds the Idler Gear away from the Resetting Gear. The loop resetting gear is prevented from turning by the engagement of the gear latch tab on the loop resetting arm with the raised lip on the eccentric stud of the loop resetting gear. The loop resetting gear is held under tension by the kick spring which is cocked against the upper corner of the "D" shaped mounting hub of the loop setting gear.

When the lower film loop is lost, the loop reset arm is pulled up, lifting the gear latch tab away from the raised lip on the eccentric stud. The kick spring forces the loop reset gear to turn slightly counterclockwise to the flat of the "D" shaped shaft. This rotation forces the ramp down allowing the idler gear to engage the loop reset gear and start it turning. The eccentric stud forces the loop reset arm down and up to reset the lower film loop. At the end of the cycle, the ramp forces the idler gear away from the loop reset gear and the raised lip on the eccentric stud latches against the gear latch tab on the loop reset arm.

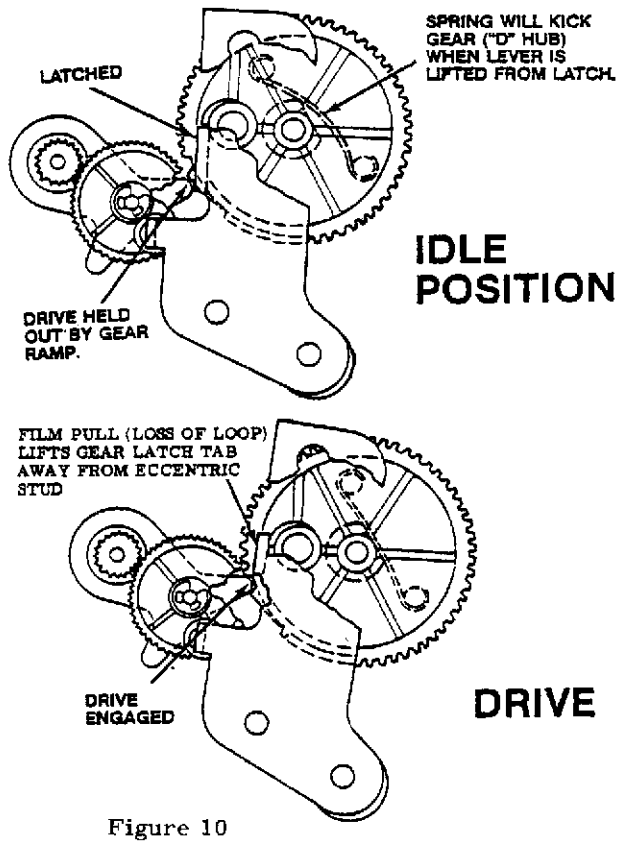


Figure 10

SOUND DRUM AND OPTIC

After leaving the gate and lens mount area, the film passes over the sound drum. It is here that the sound information recorded on the sound track portion of the film is detected.

Sound information is recorded on the film by causing an audio signal to vary the intensity of a beam of light which is focused on the sound track portion of the film. The varying intensity of the light exposes the film in varying degrees corresponding to the frequency and amplitude of the audio signal itself.

To replay the audio track, a beam of light from an exciter lamp is passed through this exposed part of the film and onto a light sensitive device which transforms it into electrical energy (Figure 11). The electrical energy will then vary at the same rate and with the same amplitude as the exposed portions on the film sound track. These electrical variations are fed into the audio amplifier where they are amplfied and eventually drive the speakers to reproduce the original sound.

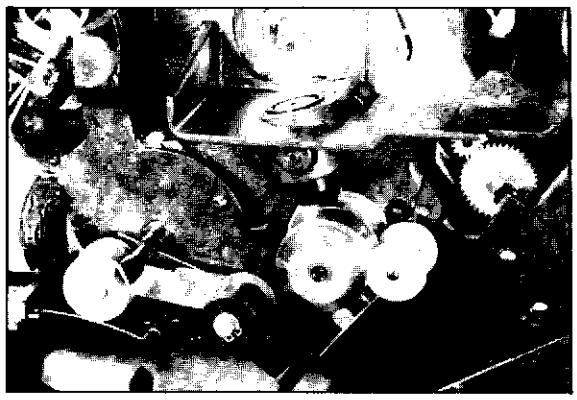


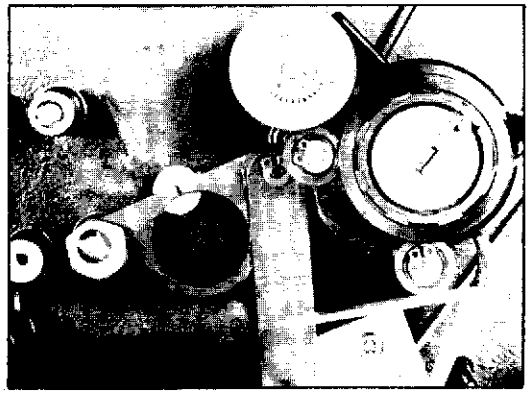
Figure 11

A pressure roller in front of the sound drum holds the film firmly against the sound drum and a dampening roller behind the sound drum maintains a constant film speed over the sound drum for maximum fidelity of sound reproduction.

The movement of film over the sound drum causes the sound drum to rotate. A balanced flywheel mounted on the end of the sound drum shaft maintains a constant rotational speed of the sound drum which also insures maximum fidelity of sound reproduction.

TAKE UP SYSTEM

Film is drawn through the sound drum portion of the projector by the take-up sprocket, then passed over the reel tension arm pulley and is gathered on the take-up reel (Figure 12). The take-up sprocket turns at a constant rate of speed since it is attached to the shaft of the take-up gear which is driven by the rear worm gear on the main drive shaft. Film is thus fed to the take-up reel at a constant rate of speed. However, the take-up reel must be able to turn at a variable speed since the diameter of its take-up surface varies continuously as film is gathered on it. The drive mechanism which drives the take-up reel with the reel arm belt is, therefore, continuously clutched and self-adjusting to compensate for the increased diameter and weight of the take-up reel.



Take-Up Sprocket

Take-Up Clutch

Figure 12

The clutching action is provided by the interaction of the take-up clutch arm and pulley (9), the take-up clutch liner (16), and the take-up clutch gear (17). (Figure 13). The liner fits snugly inside the gear and the pulley fits inside the liner.

The clutch is adjusted so the top part of the pulley contacts the liner when the projector is run in the forward mode. The gear is driven by the worm gear on the main shaft and rotates continuously while the machine is running. The liner rotates along with the gear and turns the pulley. The pulley drives the reel arm pulley by means of the reel arm belt. The surface of the clutch pulley is polished and can slip on the liner when necessary to provide the clutching action.

The system is designed so the take-up reel is capable of taking the film faster than the film is fed to it by the take-up sprocket, so film will not be spilled when the clutch is working properly. Since the take-up reel tries to take up film faster than the film is being fed to it, the mechanism which drives it must provide a sufficient amount of drive while at the same time be able to slip to prevent film from being pulled through the take-up sprocket. The fact that the take-up clutch pulley can slip inside the take-up clutch liner allows for this to happen.

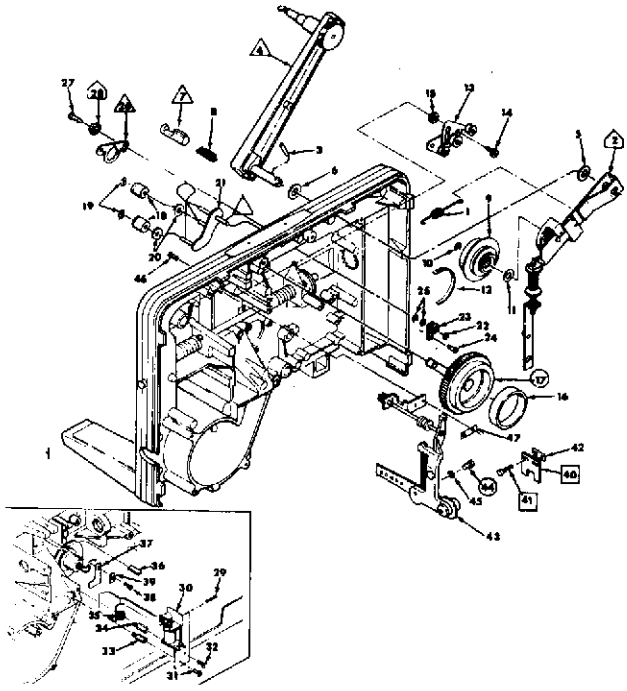


Figure 13

The mechanism is self-adjusting during the entire take-up cycle because of the way the take-up reel arm is attached to the take-up clutch arm. The shaft of the take-up reel arm passes through a hole in the take-up clutch arm. A roll pin is inserted in a hole in the reel arm shaft and pushes down on the upper end of the clutch arm causing the arm to pivot and push up on the lower portion. This forces the pulley against the clutch liner which is inside the clutch gear. More weight placed on the reel arm causes more downward pressure on the roll pin and upper end of the clutch arm, resulting in more upward pressure of the pulley against the clutch liner. This results in more friction between the clutch liner and the pulley producing more take-up drive. Thus when the film take-up reel gets heavier because it is taking on more film, it causes greater force between the clutch pulley and liner resulting in the increased torque needed to drive the heavier reel.

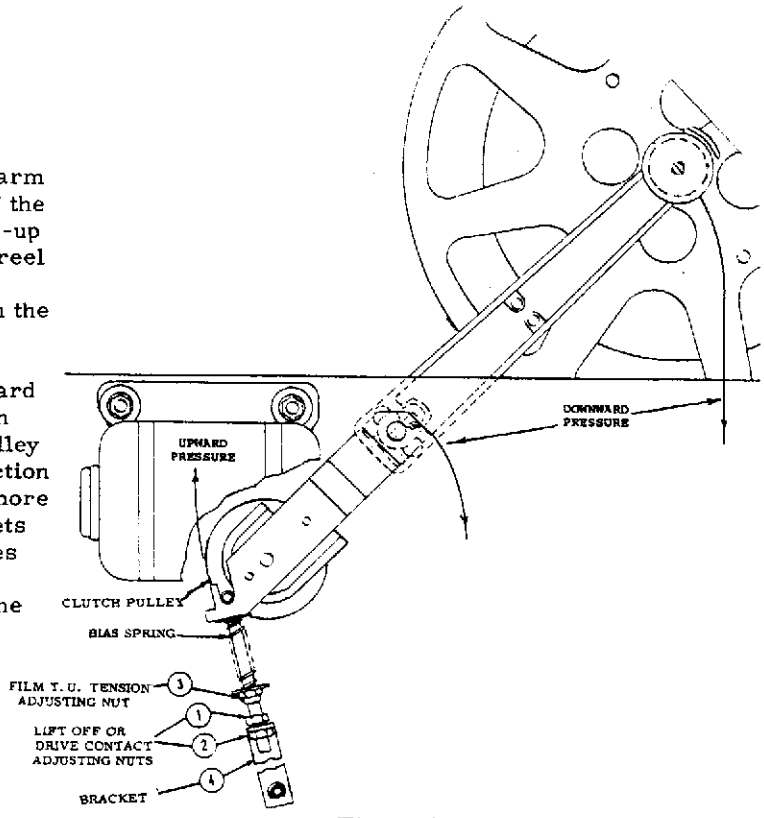
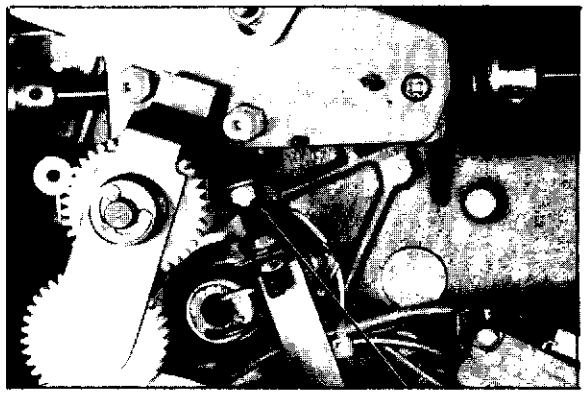


Figure 14

FLYWHEEL DRIVE SYSTEM

When the projector is operated in the Reverse mode, the friction of the film traveling over the sound drum is not sufficient to drive the sound drum. This causes increased drag on the film resulting in the loss of the lower loop with a consequent increase in noise in the film gate area. The flywheel drive system eliminates this problem by driving the flywheel in reverse to reduce the drag on the film and maintain the lower loop.



The Flywheel Drive mechanism is driven by a gear mounted on the main shaft. In the forward modes, the gear friction forces the drive tire away from the Flywheel preventing the mechanism from driving it. However, in the reverse modes, the gear friction forces the drive tire onto the flywheel causing it to rotate.

Figure 15.

B. SPECIFICATIONS

Height; 14.5" 36.83cm Depth; 17.75 45.08cm

Width; 11.625" 29.53cm

Weight Simplified Control Models: Approximately 36 lbs., 16.20kg.

Fast Forward Models: Approximately 38 lbs., 17.10kg.

International Models: Approximately 40 lbs., 18.20kg.

Base to Optical Centerline 8" 20.32cm

Film Speed: 24 frames per second

Auto-Loop Reset: Automatically maintains image to sound synchronization when film has damaged perforations.

Exciter Lamp: ANSI Code "BSW" P/N 38386-P2

Projection Lamp : ANSI Code "ELC" P/N 42762-P2 (24 volt, 250 watt)
ARC MODELS: "EZG" P/N 46554-P1 (CONSULT SVC.)

Lamp Position	Lamp Life
"Hi"	Approx. 50 hours
"Lo"	Approx. 150 hours

Amplifier: 25 watt RMS, continuous power per ANSI Standard PH 7.2

Speakers: Twin 3" x 5" (7.69cm x 12.82cm) Oval, case mounted.

External Speaker: Standard 1/4" (6.35mm)jack. Use 8 ohm speaker for optimum performance. Internal speakers are bypassed when using an external speaker.

Microphone: Standard 1/4" (6.35mm) jack, 400 ohm impedance.

Power Requirement:

Standard Model:	120V, 60 Hz., 4 amp.
International Models:	100V, 50/60 Hz., 4 amp.
	120V, 50/60 Hz., 4 amp.
	220V, 50/60 Hz., 2 amp.
	240V, 50/60 Hz., 2 amp.

INSTA LOAD/XL
2200 SERIES

TERMINALS

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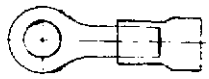
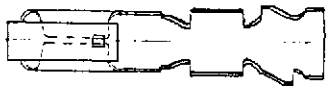
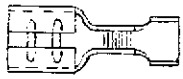
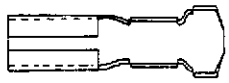
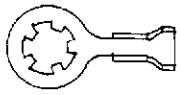
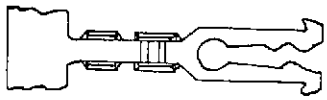
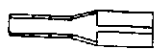
39338	16-22 AWG	140 max	.155-.215	SCREW #8	
41004	16-22 AWG	140 max	.155-.215	#6	
38298	18-22 AWG	.050-.115	.125-.185		
39321	20-24 AWG	.048-.071	1/8"		
38998	18-22 AWG	.90-.132	1/4"	.250	
42423	20-22 AWG	.075 max	.125-.185		
43042	14-18 AWG	.120-.170	.210-.240	.250	
42717	18-22 AWG	.060-.100	.195-.225	.250	
43457	18-24 AWG	.100 max	.125-.155		
41338	18-20 AWG	.080-.120	.156-.219	.103	
43965P1	14-18 AWG	.105-.145	.220-.280		
45144P1	20-26 AWG	.035-.060	.125-.185		
44549P1	20-22 AWG	.060-.100	.155-.185	.100	
41098P1	18-22 AWG	.060-.100	.155-.185	.110	
38994P1	16-20 AWG	.090-.130	.125-.185	.187	
44508P1	24-30 AWG		.100-.125		
44360P1	18-24 AWG	.060-.120	.125-.155		
44360P2	18-24 AWG	.060-.120	.125-.155		

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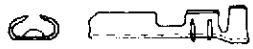
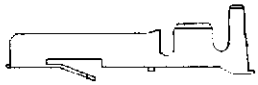
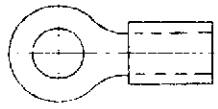
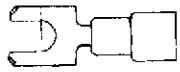
PART NUMBER	WIRE SIZE	INSULATION	STRIPPING	TAB SIZE	ILLUSTRATION
41438	14-18 AWG	.100-.130	.140-.170		
43225	20-22 AWG	.080-.100	.125-.185		
41440	14-18 AWG	.100-.130	.140-.170		
37593	16-22 AWG		7/32	#3 or #4 Screw	
43497	18-22	.136 max	.250-.280	#6 Screw	

C. MATERIALS

ADHESIVES

39490-P2	Glyptal No. 1276; Clear (General Electric Co., Schenectady, New York) 3 oz.
39490-P1	Glyptal No. 7526; Blue (General Electric Co., Schenectady, New York) 3 oz.
LP	A-963-B Cement (W. J. Ruscoe Co., Akron Ohio)
LP	Hysol R9-2039 Resin (Hysol Corp., Olean, New York)
LP	Hysol H2 -3404 Hardener (Hysol Corp., Olean, New York)

LUBRICANTS

39479-P4	FS-1290 Flourosilicone Grease (Dow-Corning Corp., Midland, Michigan) 1/2 oz.
39479-P5	DC-200 Silicone Fluid; 200,000 Centistroke Viscosity (Dow-Corning Corp., Midland, Michigan) 1/2 oz.
39479-P13	DC-200 Silicone Fluid; 200 Centistroke Visosity (Dow-Corning Corp., Midland, Michigan 1/2 oz.
39479-P7	009 Lubricant (Keystone Carbon Co., St. Mary's, Pa.) 1/2 oz.
39479-P8	Instrument Oil N-75 2 oz.
39479-P9	DC-44 Silicone Grease; Light Consistency (Dow-Corning Corp., Midland, Michigan) 2 oz.
39479-P14	G.E. Versilube (G-322L)
39479-P15	Vischem #352 (Ultra Chem Inc., Wilmington, Del) 2 oz.

MISCELLANEOUS

39490-P4	Clyptal Thinner 1511M 8 oz.
LP	8101-S Silicone Compound (General Cement, Rockford, IL)
LP	Chlorothene (Dow Chemical Co., Midland, Michigan) 1+1+1
LP	Methyl Alcohol

TEST FILMS

*40478-P3	TV16AS 16mm Television Test Film(Alignment & Resolution) 40" Loop
*45191-G2	P16-SF-A 7000 Hz Film (PH 22.42-7) 12'
*45191-G3	P16-B.T. Buzz Track Film (PH22.57) 12'
*45191-G8	16-RT 16mm Registration Test Film 12'
*45191-G7	P16-SL, Signal Level Test Film, Optical 400 Hz. 12'
**	P16-PP SMPTE Jiffy Test Film

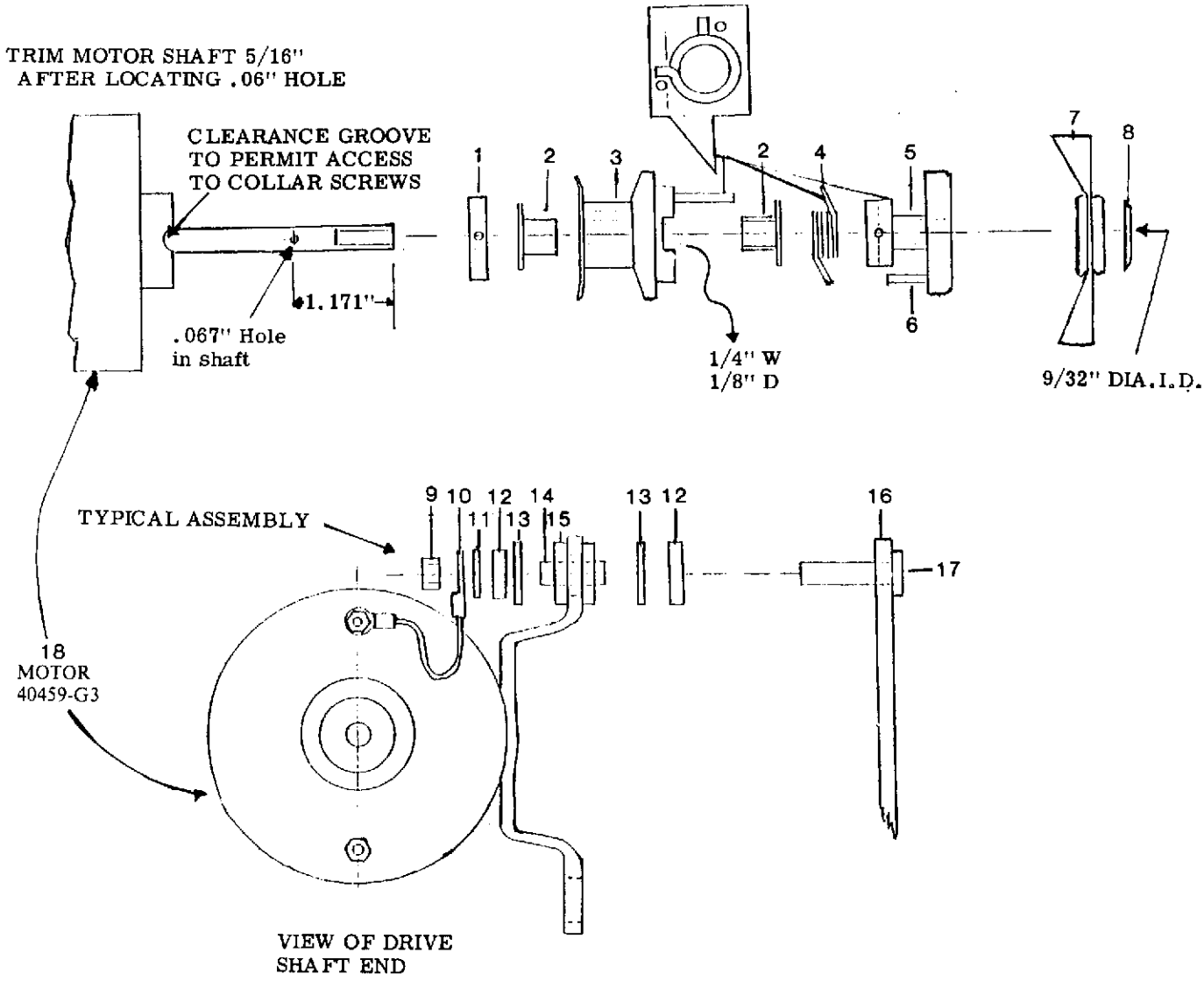
*Available in 100' Roll from: Test Film Dept.
Society of Motion Picture & Television Engineers
862 Scarsdale Avenue, Scarsdale, NY 10583

**Also available through above source.

D. TOOLS

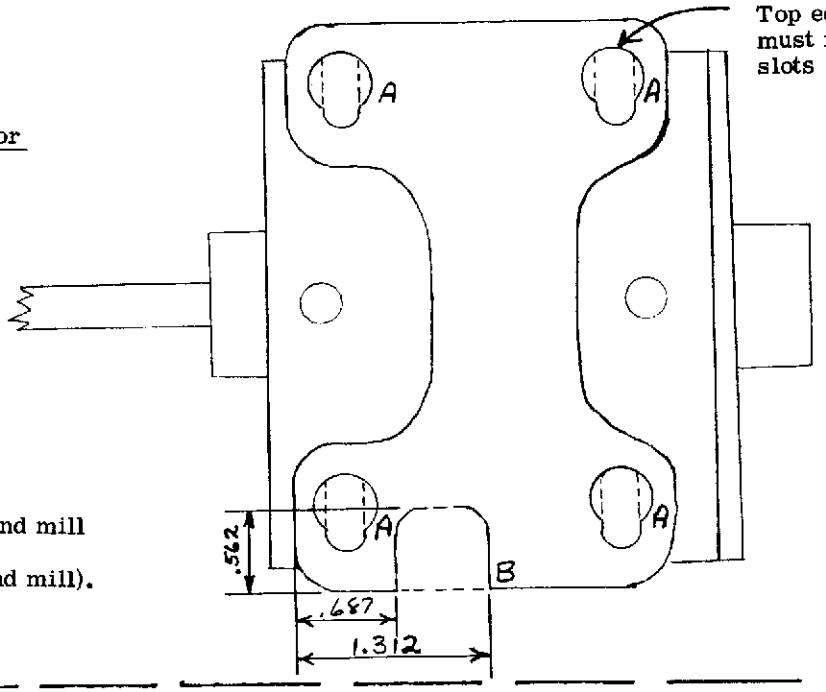
G10-38000	CLAW ARM PROTRUSION GAUGE
ST-5880	STROKE SETTING GAUGE
ST-5884	SHUTTLE CAM ADJUSTING TOOL
T-38000-N	ROLL PIN - INSERTING AND EXTRACTING TOOL
T-38000-N1	REPLACEMENT PIN
T-38000-S	FILM TENSION GAUGE
T-38000-U	WALDES TRU-ARC NO. 52 APPLICATOR
T-38000-V	WALDES TRU-ARC NO. 54 APPLICATOR
T-38000-X	WALDES TRU-ARC NO. CR-31 APPLICATOR
T-38001-G	SOUND DRUM LOCATING PLUG

DRIVE UNIT ASSEMBLY TV



	PART No.	DESCRIPTION
1	39099	COLLAR
2	38206-3	BEARING
3	40465-G2	PULLEY ASSEMBLY
4	39098-P1	SPRING
5	42872-G1	HUB ASSEMBLY
6	192-4-8	PIN
7	39128-P1	FAN
8	257-2	RETAINER, Modified
9	203-8	NUT, Stop
10		GROUND STRAP
11	35473-46X	WASHER
12	39081	SPACER, Rubber
13	30473-P73H	WASHER
14	32090-P48	SPACER
15	265-5	GROMMET
16	47239-G1	MOTOR PLATE
17	116-10R-8H	SCREW, Mounting
18	40459-G3	MOTOR ASSEMBLY
	40460-P2	MOTOR
	44360-P1	TERMINAL (Not Shown)
	44505-P9	HOUSING (Not Shown)

2230 T.V. Projector
Drive Motor Plate
Modification

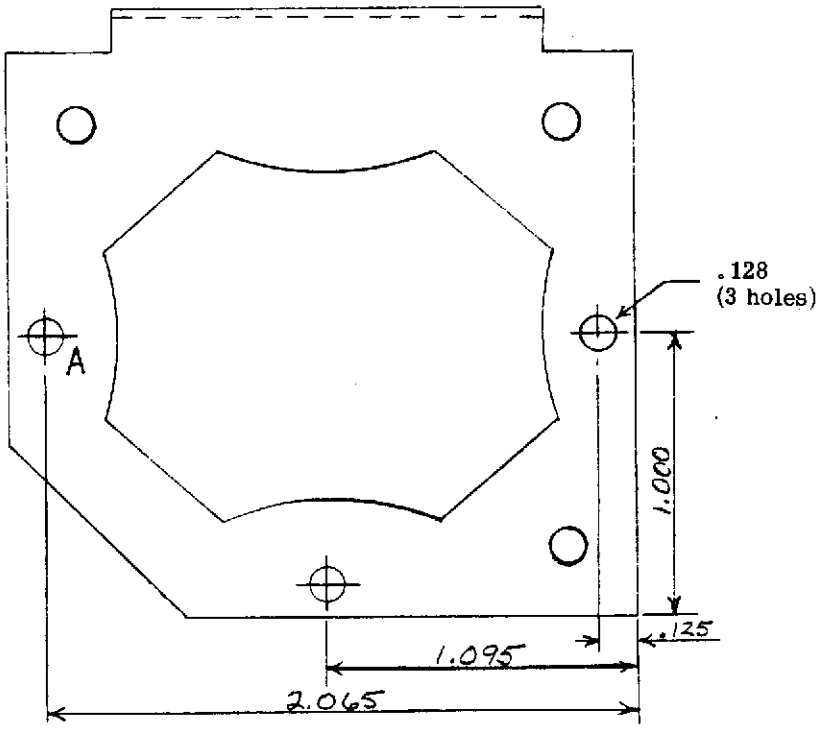


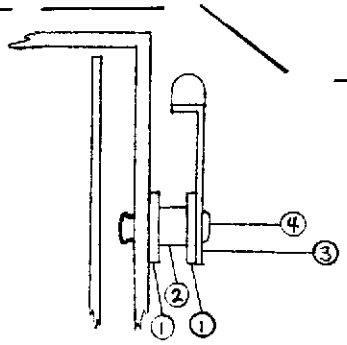
Holes:

A- 7/16" end mill

B- (with end mill).

2230 T.V. Projector
Lampholder Modification
to hold Opal Glass

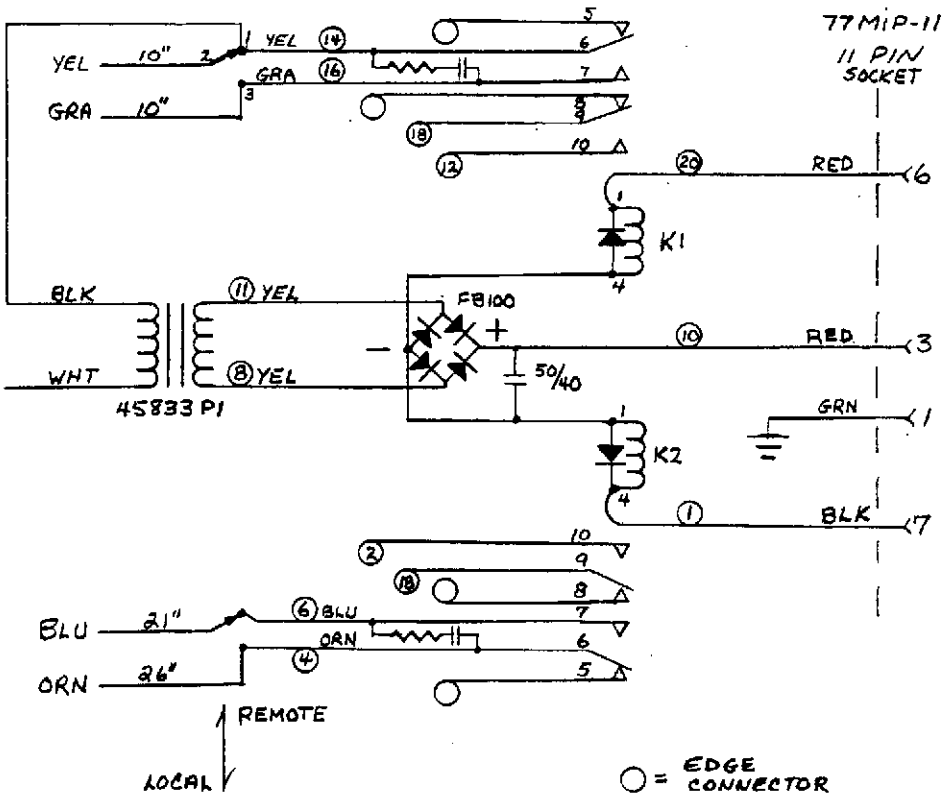




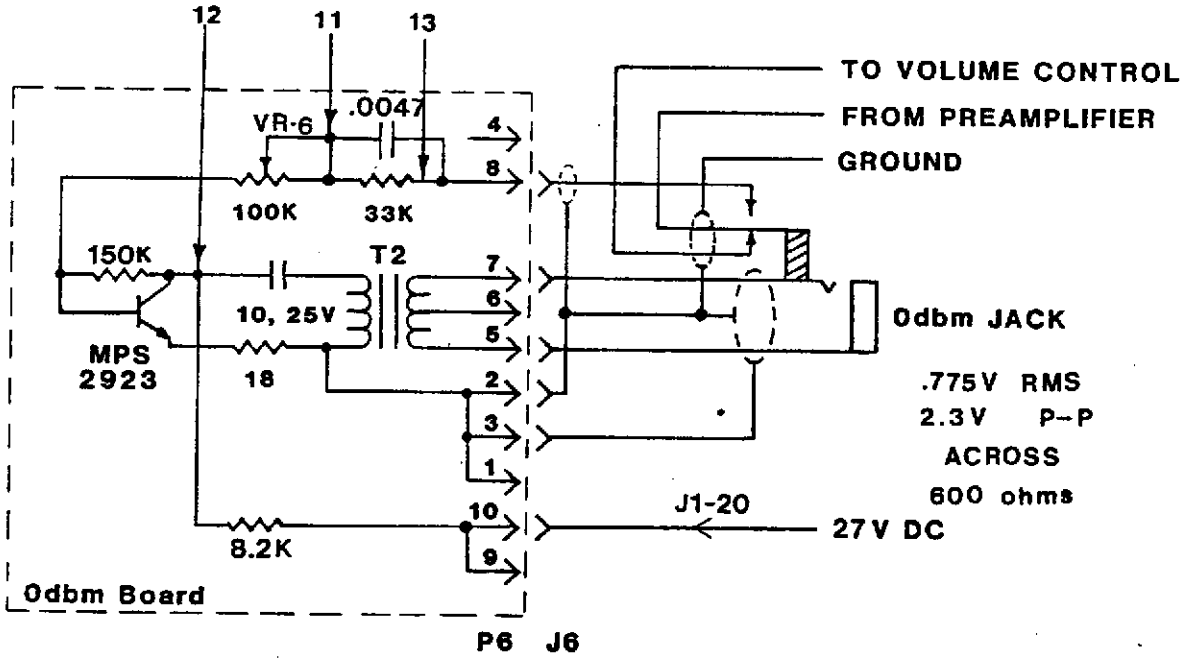
This assembly in "A" hole only.
Other two holes - delete item 3.
Install Opal glass coated side to lamp.

1. 38473-P7X Washer
2. 41086-P8 Spacer
3. AV16-41-8 Retainer
4. 1/8" x 1/4" Pop Rivet

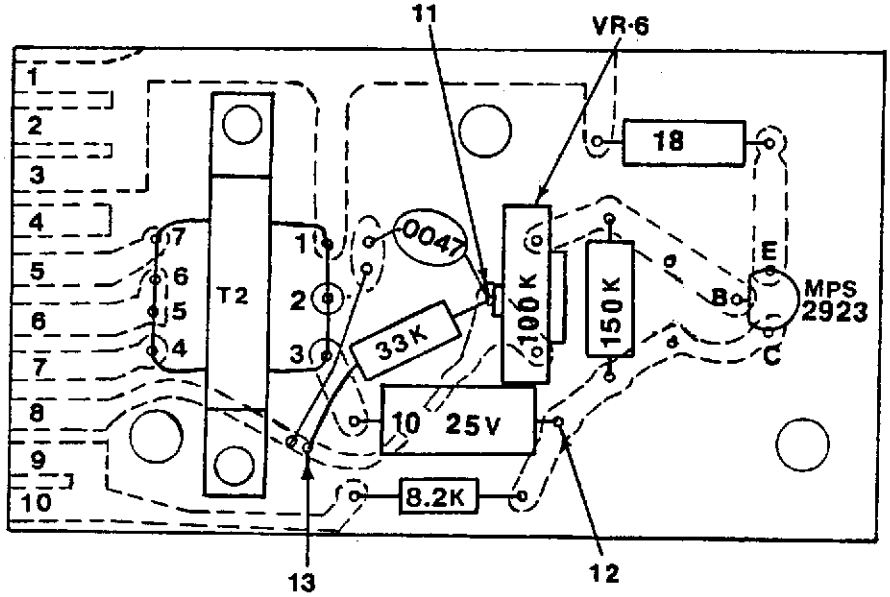
LOW VOLTAGE REMOTE



○ = EDGE CONNECTOR
DIODES - 1N2069
RELAYS - P&B R10-E2-W2-V700
SWITCH - 43178P4
ARC SUPPRESSORS-44007P2

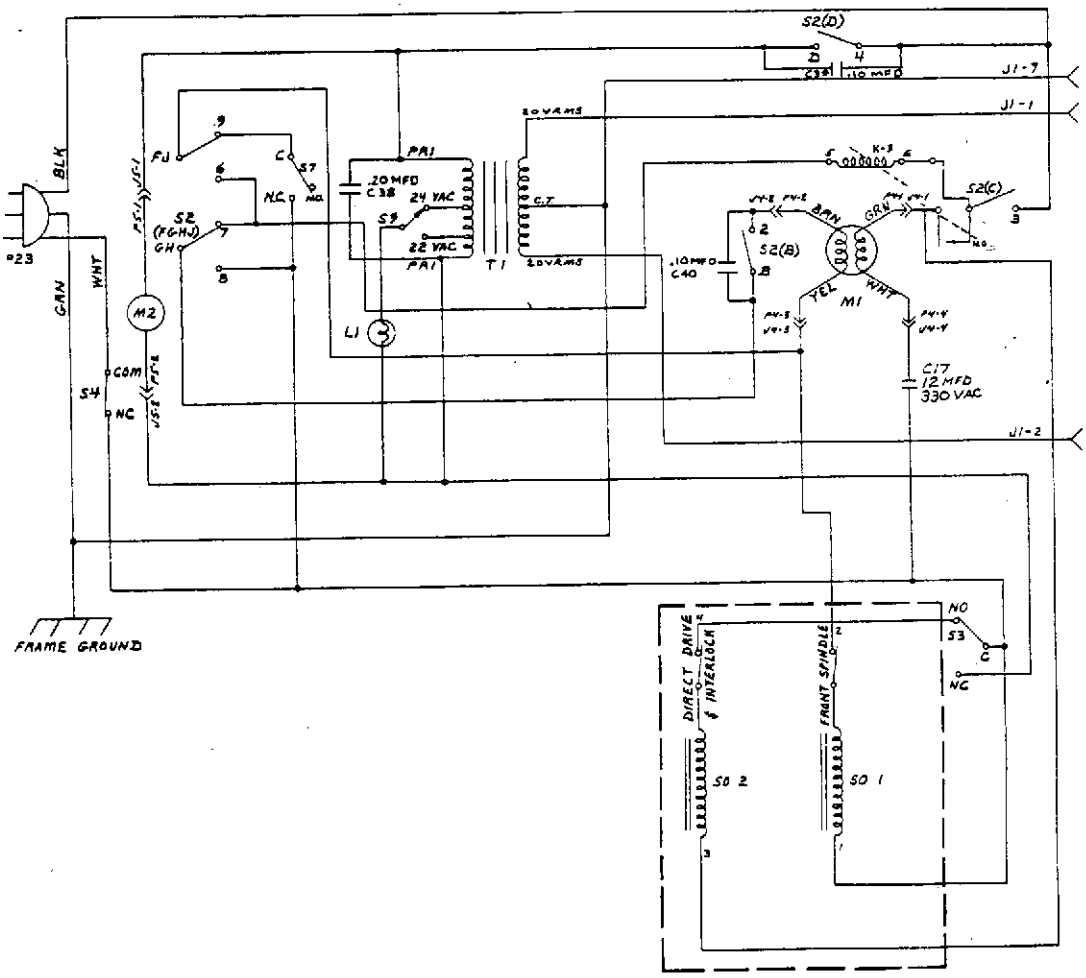


Odbm CIRCUIT

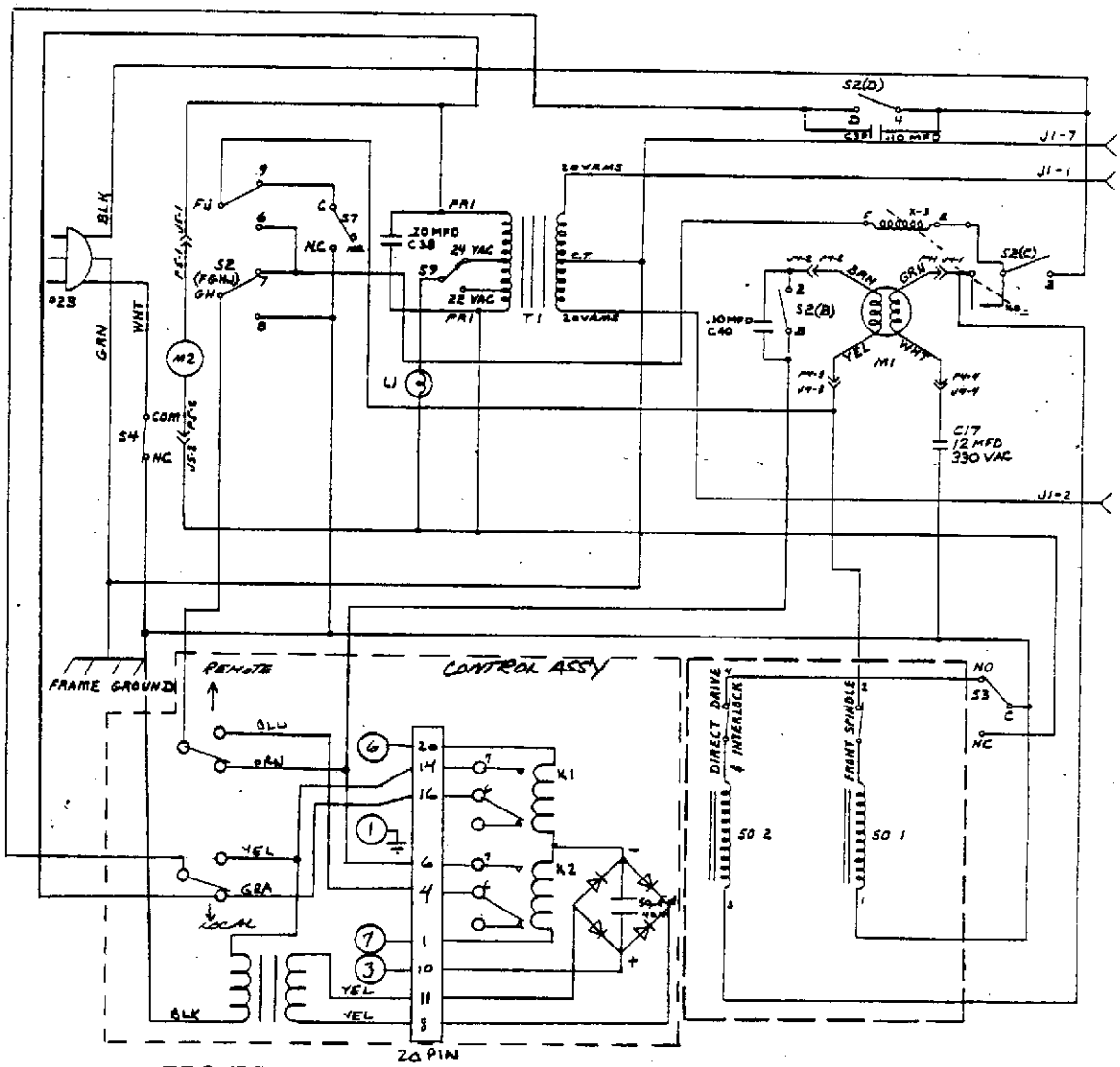


0 dbm
List of Materials

1	43176-P2	Jack	
1	Triad T32X	Transformer	
1	42267-P1	Capacitor,	10 mfd., 25 volt
1	45147-P6	Capacitor,	.0015 mfd., 100 volt
1	415B-P472K-C	Capacitor,	.0047 mfd., 12 volt
1	402-18-0-3	Resistor,	18 ohm, 1/2 watt
1	406-392-3	Resistor,	3.9K, 1/4 watt
1	406-822-3	Resistor,	8.2K, 1/4 watt
1	406-103-3	Resistor,	10K, 1/4 watt
1	406-333-3	Resistor,	33K, 1/4 watt
1	406-154-3	Resistor,	150K, 1/4 watt
1	40761-P12	Potentiometer, 100K	
1	42727-P1	Transistor, 2N2923	
1	AV16-12-11	Circuit Board	
AR	43618-G2	Cable	
1	39472-P1	Butt Connector	
1		0 dbm Label	
3	43485-P1	Standoff	
2	200-4	Nut, 4-40	
2	116-4R-4H	Screw, 4-40 X 1/4	

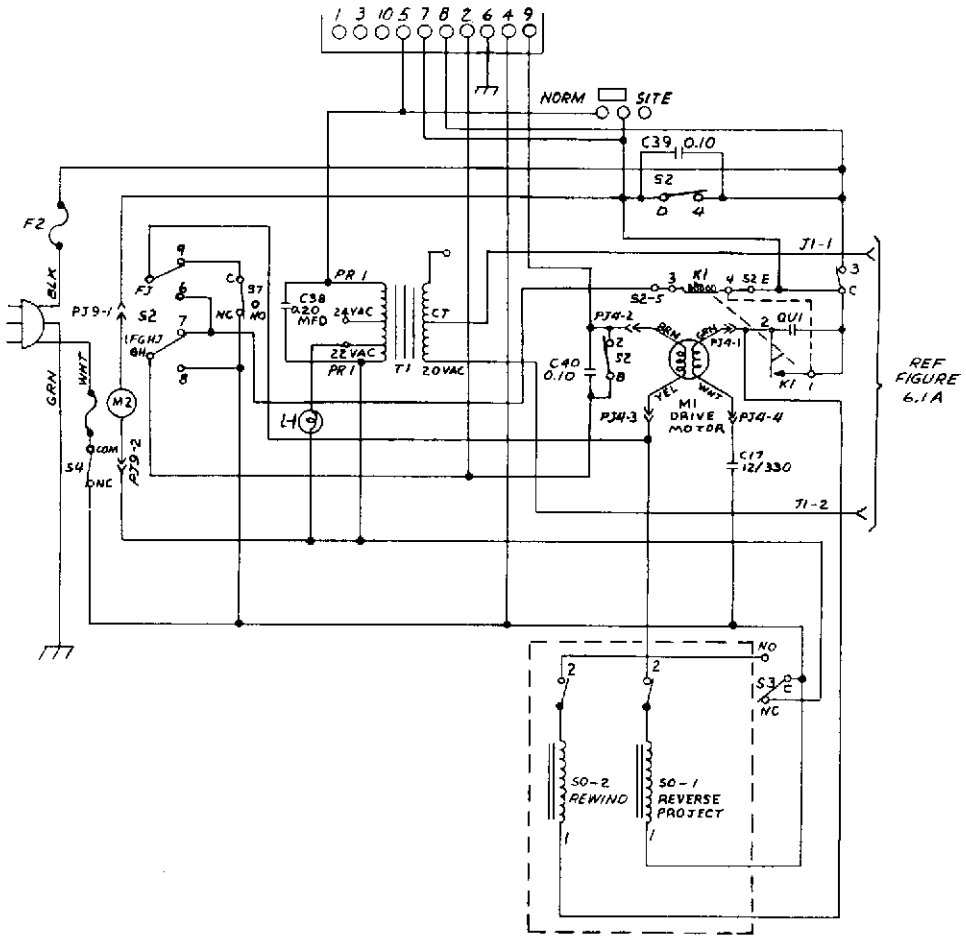


PROJECTOR SCHEMATIC DIAGRAM MODEL 2210
WITH SYNCHRONOUS MOTOR



PROJECTOR SCHEMATIC DIAGRAM MODEL 2230

◯ = 11 PIN SOCKET

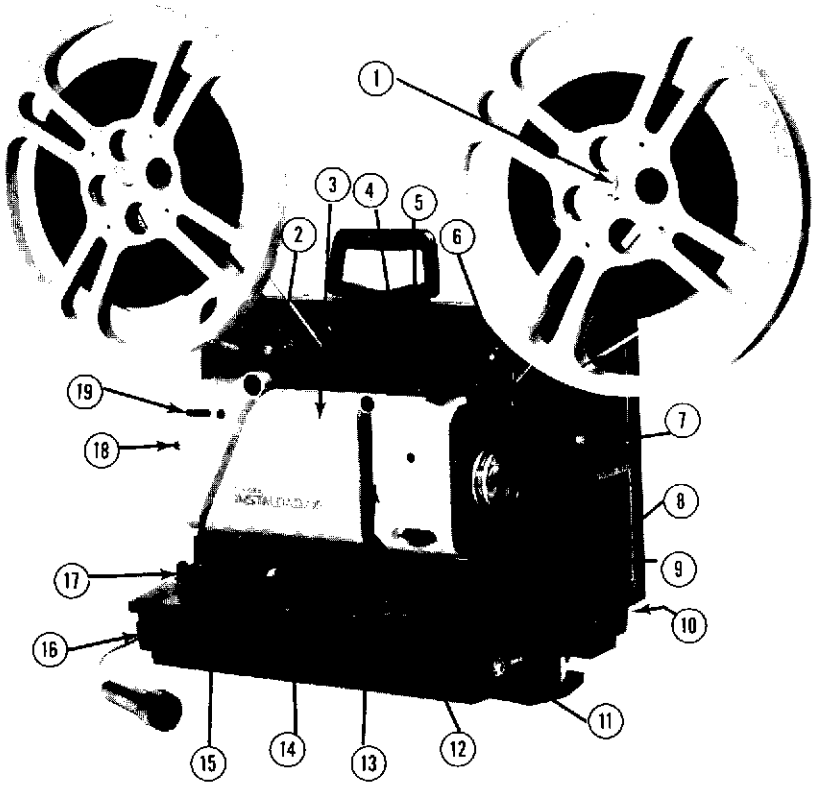


PROJECTOR SCHEMATIC DIAGRAM - MODEL 2230N

SECTION II PREVENTIVE MAINTENANCE

SECTION II PREVENTIVE MAINTENANCE

To insure proper operation of Telex Model 2200 Projectors, preventive maintenance should be performed every 500 hours or once a year, whichever occurs first. The Projector should be thoroughly cleaned and then checked for proper operation before any parts replacement or adjustments are attempted.



1. Reel Spindle Lock Lever
2. Take-up Sprocket
3. Lamphouse Cover
4. Framing Knob
5. Feed Sprocket
6. Reel Arm Lock
7. Manual Advance Knob
8. Elevation Knob
9. Auto Loop Restorer
10. Hi-Lo Lamp Switch
11. Speaker Jack
12. Film Control Buttons
13. Film Pressure Shoe
14. Volume/Tone Control
15. Main Power Switch (2270 & 2280)
16. Microphone Jack (2270 & 2280)
17. Microphone Control (2270 & 2280)
18. Master Control Lever
19. Film Counter

START WITH A CLEAN BENCH-

FINISH WITH A CLEAN BENCH.

Left over parts?

Check your reassembly.

Cleaning Suggestions

1. All dust and grime should be removed from external surfaces of covers, main casting, etc. Any good household detergent should be sufficient.

2. Projection lens - Remove lens. Remove dust from front and rear exposed lens surfaces by brushing gently with a soft brush. Then wipe lens gently with a clean lens tissue (slightly moistened with lens cleaner if necessary).

   CAUTION: Never pour lens cleaner or other solvents on the lens elements. DO NOT use silicone impregnated lens tissue.

3. Projection Lamp and Exciter Lamp. Remove dust by brushing gently with a soft brush. Then wipe gently with a clean lens tissue (slightly moistened with lens cleaner if necessary).

4. Aperture Plate and Film Pressure Shoe

   Open the film channel by moving the Master Control Lever to PROJECT. Turn the lens forward. Insert the Aperture Brush (Cat. 3694) into the top of the channel and move it vigorously up and down. Use care to keep the shaft of the brush away from the pressure shoe or the film track. If necessary necessary, dampen the brush with solvent to loosen and remove any hardened substance.

5. Claw Arm - Remove all lint and dirt from pins on Claw Arm with a soft bristled brush. Examine pins for looseness or grooves cut in them by film. (Solvents may be used for this cleaning).

6. Film Rollers For proper cleaning, Rollers should be removed and wiped thoroughly with clean, dry rag. Remove stubborn dirt from plastic Rollers with detergent and warm water. Dry thoroughly. Shaft holes may be cleaned with cotton swabs or a pipe cleaner moistened with instrument oil N-75. Roller end play should be .002" to .005".

7. Sprockets - Wipe with clean, dry cloth. (Cloth may be moistened with alcohol if necessary.)

8. Reel Arm Pulleys - Clean grooves with cotton swabs moistened with alcohol or chlorothene. Wipe flat surfaces with clean rag moistened with alcohol or chlorothene.

9. Sound Drum - Clean grease and dirt from general area with alcohol. Moisten cotton swab with alcohol and clean Photo-diode and back edge of Sound Drum.

10. Sound Optic - Moisten cotton swab with lens cleaner or alcohol and clean upper and lower lenses.

11. Motor Pulley and Main Shaft Pulley - Clean drive surfaces with clean rag moistened with alcohol or chlorothene.

12. Shutter - Wipe all visible surfaces of Shutter and Cam Assembly using a cloth dampened with chlorothene or alcohol.

13. Safety Shutter - Wipe all visible surfaces of Safety Shutter using a cloth dampened with chlorothene or alcohol.

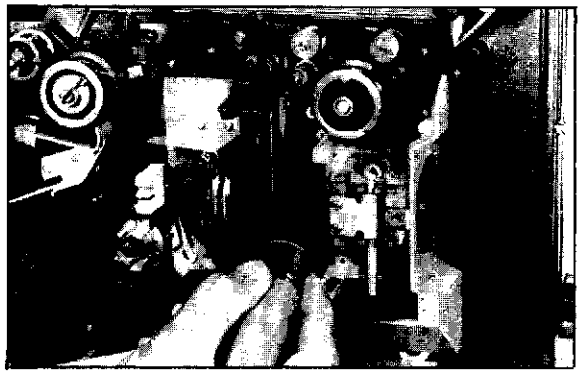
14. Lexan Gears - (Main Drive Shaft Worm Gears, Film Feed Clutch Gear and Takeup Clutch Gear) - DO NOT clean Lexan Gears with ANY solvent. Wipe clean with clean, dry cloth or remove excess, dirty grease with toothbrush.

A. CLEANING and LUBRICATION

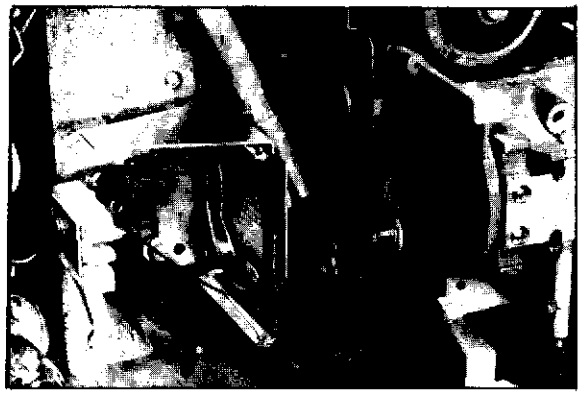
Some Useful Cleaning tools.

Be sure to use correct lubricant as specified by the lube charts and instructions. Improper lubricant can cause damage.

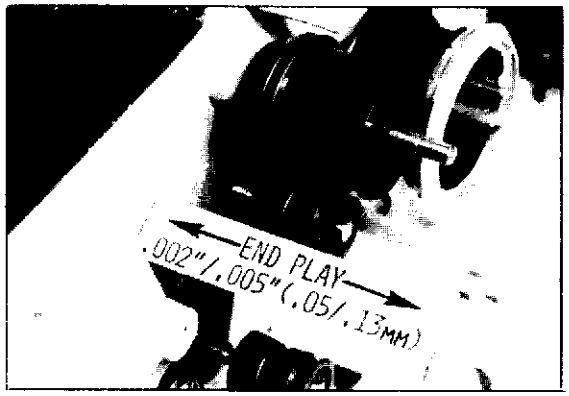
Clean the front of the projector thoroughly. Stubborn dirt may be removed with Isopropyl Alcohol, Chlorothene 1+1+1 or equivalent.



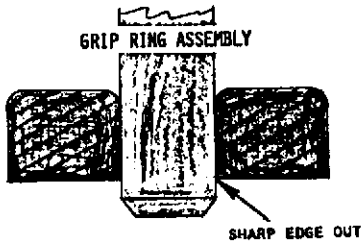
Be sure to clean the claw thoroughly. Remove all accumulated dirt from the claw pins.



The idlers at the take-up sprocket are secured with grip rings. The idler must turn freely with approximately 0.002" to 0.005" (0.05 to 0.13mm) end play.

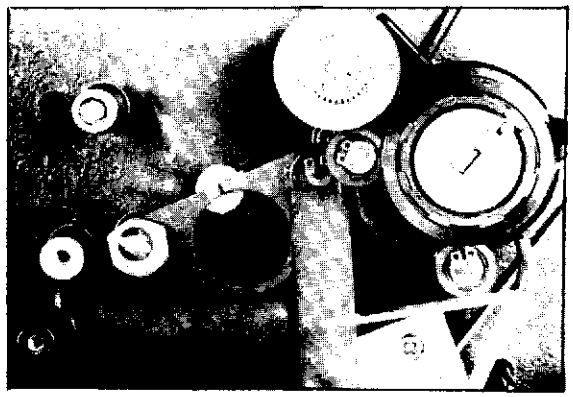


Assemble grip rings with the sharp edge away from part being held in place so the ring will grip the shaft better.



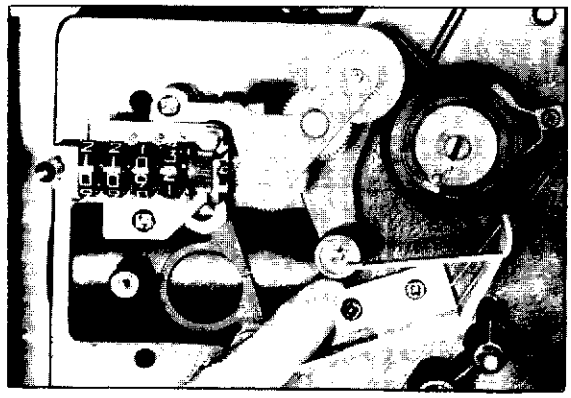
B. SPRING LINK ADJUSTMENT

With the Master Control Lever in the PROJECT position, loosen the brass pivot screw and adjust the pivot Counterclockwise until the lower idler roller touches the take-up sprocket enough to cause the gap in the spring link to close 0.003" to 0.005" (0.08 to 0.13mm).



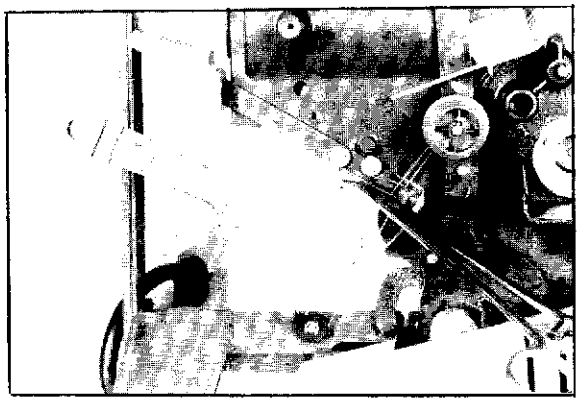
C. COUNTER ADJUSTMENT

After mounting the counter(Fast Forward Models), be sure the idler arm swings open freely when moving the control lever to the LOAD position. If the arm is sluggish, reposition the counter until the arm swings freely. Tighten the screws and check for free arm movement.



D. LOOP SETTING CABLE REQUIREMENT

Hang a claw arm (38041-G1) on the cable as shown. The top edge of the claw arm should be parallel with the bottom edge of the Master Control Lever.

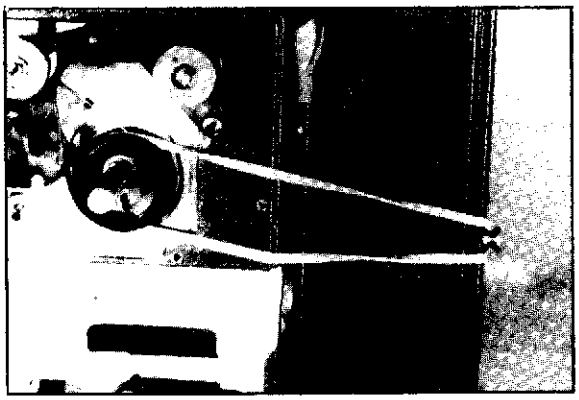


E. LOOP SETTING CABLE ADJUSTMENT

Position the cable drum with the gear section located between 6 and 9 o'clock.

Align the right edge of the bottom tooth with the back edge of the bearing slot.

Hold the drum in position with a rubber band as illustrated, pull the inside cable (Short end) tight, wrap it counterclockwise, twice around the post on the Master Control Lever and secure it under the front screw and washer.



Thread the outside cable (Long end) as illustrated.

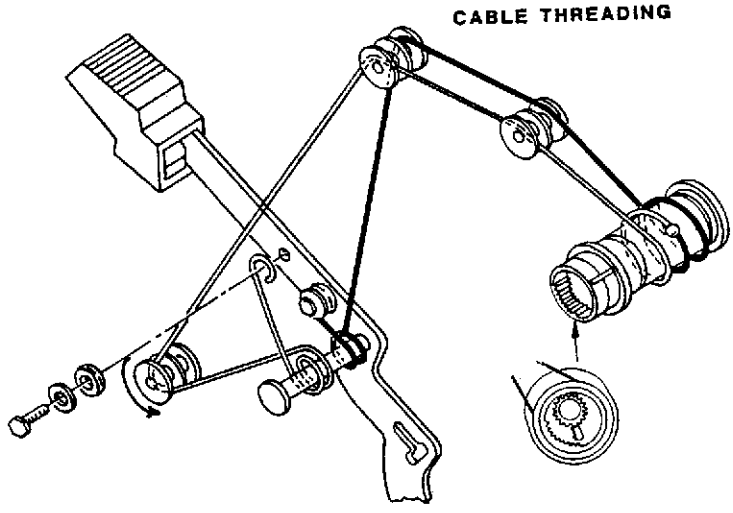
Wrap it clockwise, twice around the post on the Master Control Lever and secure it under the rear screw and washer.

Hang a claw arm (38041-G1) on the cable as shown and adjust the cable tension until the top edge of the claw arm is parallel with the bottom edge of the Master Control Lever.

Tighten the screws holding both ends of the cable to the Master Control Lever to 5.5 to 6.5 inch/pounds of torque and recheck the position of the claw arm.

Remove the rubber band from the cable drum and operate the Master Control Lever between the LOAD and PROJECT positions several times. In the LOAD position, the left edge of the bottom tooth of the cable drum gear should align with the front edge of the bearing slot. In the PROJECT position, the right edge of the bottom tooth should align with the back edge of the bearing slot. If not, readjust the cables.

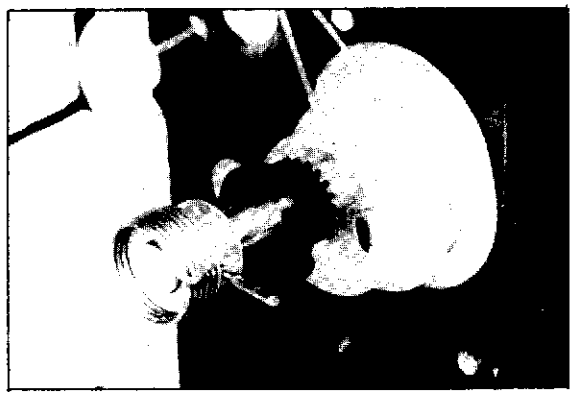
CABLE THREADING



LOOP SETTING GEAR AND ARBOR INSTALLATION

Lubricate the loop setting gear with a film of DC 44 grease (39470-P9).

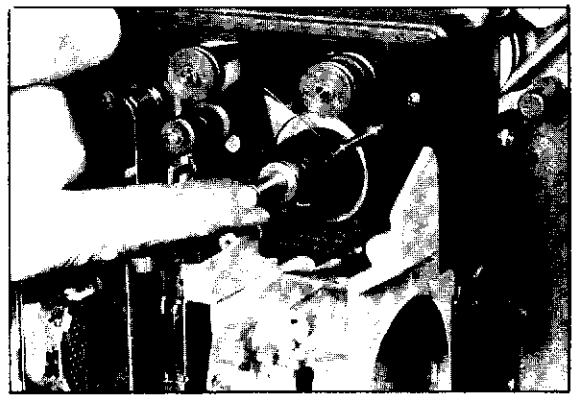
Lubricate the clutch spring arbor with a drop of Teresso Instrument oil (39479-P8) and assemble as shown.



The loop setting gear should turn smoothly in both directions.

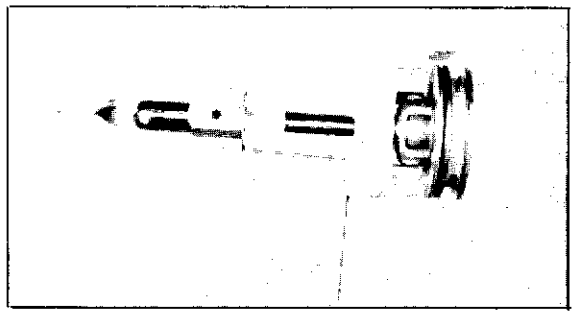
Move the master control lever up and down several times after assembling each part. If binding occurs, the last part assembled is probably the cause.

Continue assembling the sprocket and film stripper and check for smooth operation of the Master Control Lever.

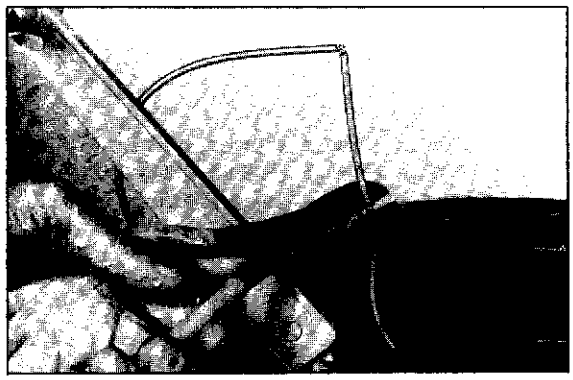


F. REEL ARM PULLEY SERVICING

OILITE bearings in the Reel Arms require cleaning and lubricating each time preventive maintenance or overhaul is performed.

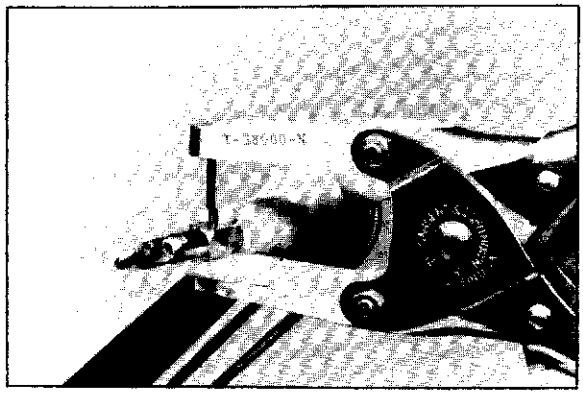


Remove and discard the reel belts.

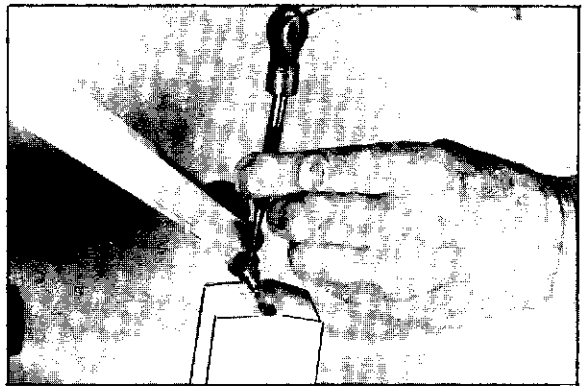


Mark one of the flat sides of the reel arm lock with a felt marker and mark the face of the pulley to correspond with this mark so proper orientation of the roll pin hole can be maintained during reassembly.

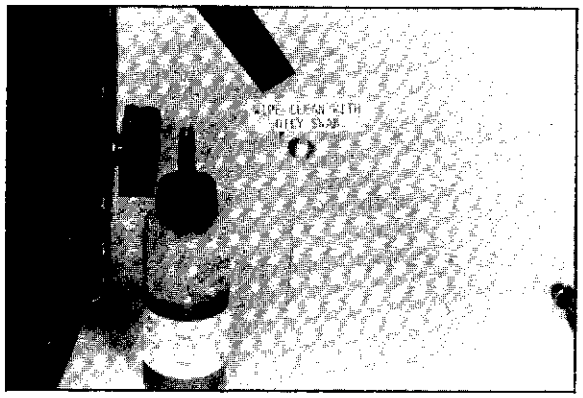
Use the roll pin inserting and extracting tool (T-38000-N) to remove and insert the roll pin (shown being inserted).



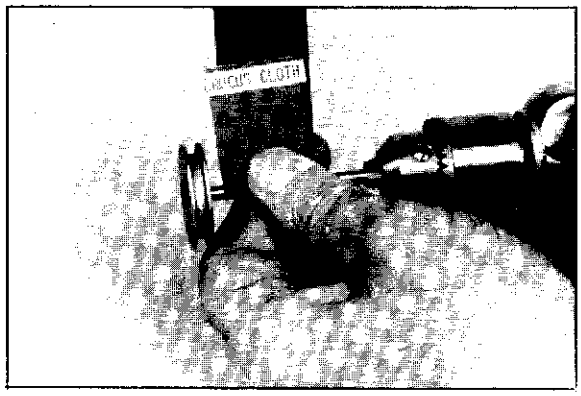
The roll pin may be removed by using a pin punch. Support the spindle on a block of wood when knocking out the pin.



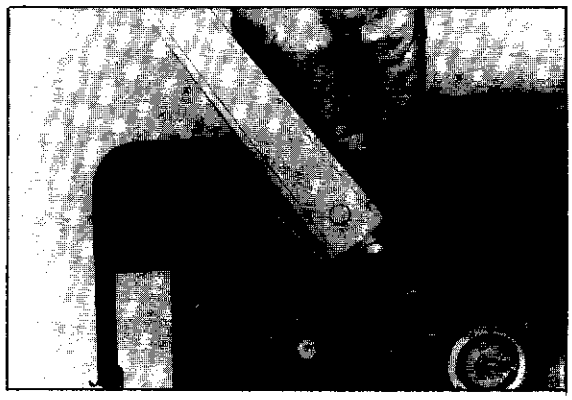
Clean the oilite bearing with a cotton swab saturated with Teresso Instrument Oil (39479-P8). DO NOT USE SOLVENTS ON OILITE BEARINGS.



Clean the pulley and shaft with crocus cloth. DO NOT USE SANDPAPER OR EMERY PAPER. If the shaft is scored, the pulley assembly must be replaced.



Insert the new spring belts from the top side of the pulley. In the case of the take-up belt, the control lever should be in the LOAD position.



G. SOUND DRUM AREA SERVICING

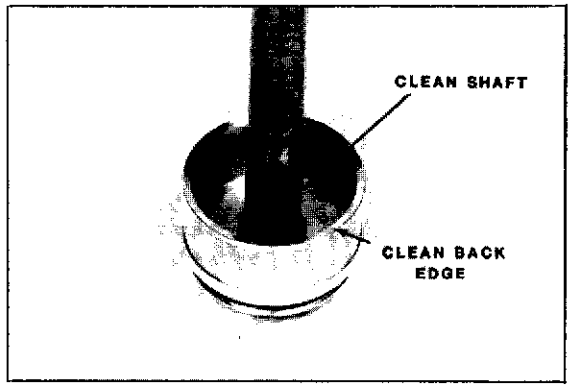
LOOK

→ ALL SINGER INSTA-LOAD PROJECTORS use a BSW, 7 volt exciter lamp. 200 MA 50 HOURS

Lamps having a darkened envelope around the filament cause reduced sound output.

Try a new exciter lamp first if the projector has poor or low sound. (Driver Trainer Projectors are seriously affected by exciter lamps with low light output).

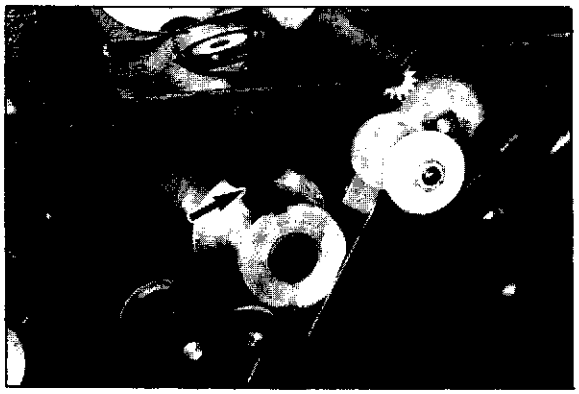
Thoroughly clean the sound drum area.



Remove the flywheel and the sound drum. Thoroughly clean the sound drum shaft, the inside of the sound drum, and the back edge of the sound drum.

Soak a cotton swab with Teresso Instrument Oil (39479-P8) and clean the oilite bearing in the sound drum support.

Moisten a cotton swab with Alcohol and clean the photo diode in the sound support.



G.1. FILM DAMPENER ARM ADJUSTMENTS

If the dampener arm doesn't drop in 3 to 5 seconds, DO NOT BEND THE DAMPENER ARM SPRING.

Remove the dampener arm roller and spring (note orientation of spring).

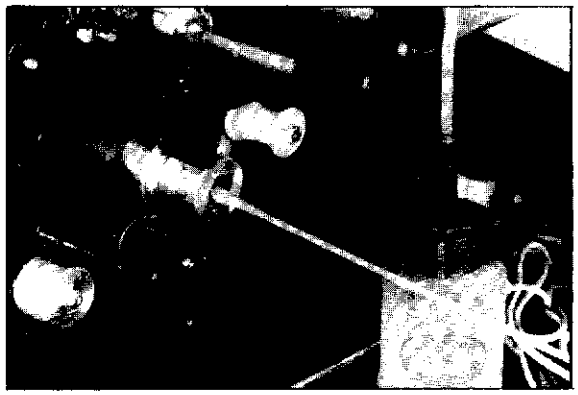
Remove the dampener arm.

Disassemble the Dampener Arm and wipe the dampening fluid off the arm hub and aluminum cup.

Apply 2 or 3 drops of very heavy DC 200 (200,000 Centistoke) dampening fluid (39479-P5) in an even coat on the hub and reassemble the aluminum cup to the arm.

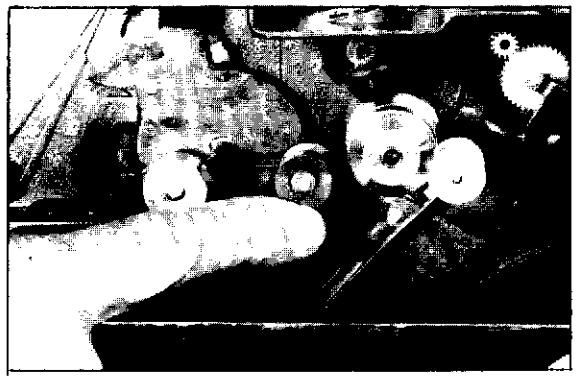
Wipe a thin coat of dampening fluid on the post on which the arm mounts and reassemble the arm and spring to the projector.

Add more dampening fluid if the arm drops in less than 3 to 5 seconds. Remove fluid if the arm drops too slowly.



Reassemble the Sound Drum and Flywheel.

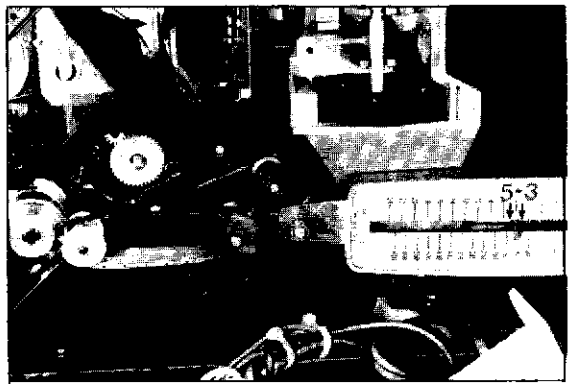
With the Master Control Lever in the PROJECT position, raise the film dampener arm (Behind the sound drum) to its uppermost position. When released it should take 3 to 5 seconds to drop to its rest position.



G.2. FRONT PRESSURE ROLLER ADJUSTMENTS

Connect the take-up tension gage (T-38000-S) to the sound drum front pressure roller with a small loop of film as shown.

When the gage measures 3 to 5 ounces, the roller should just start to move away from the sound drum.

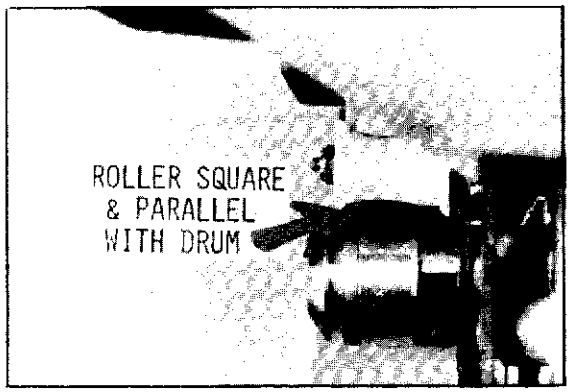


Form Front Pressure Roller Spring along its entire length to increase or decrease pressure. DO NOT BEND THIS SPRING - FORM IT.

The front pressure roller must be square and parallel with the sound drum.

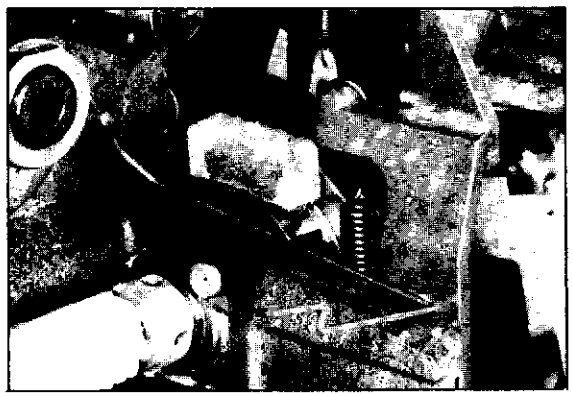
Make sure pressure roller rivets or pressure roller spring rivets are not loose. Tighten by squeezing with vise grips.

Twist the pressure roller spring if necessary to obtain parallelism. Recheck pressure roller lift-off tension.



H. CAM LUBRICATING PAD SERVICING

The Cam Lubricating Pad must be changed each time preventive maintenance or overhaul is performed on a projector.

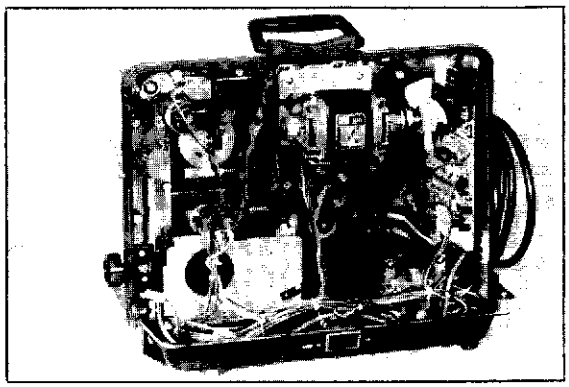


Loosen the two lube pad spring retaining screws and replace pad.

New Pads are supplied with the correct amount of lubricant already on them. (16 drops of Teresso Instrument Oil #39479-P8).

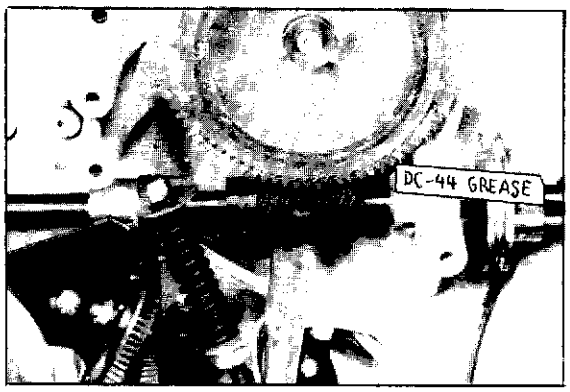
J. INTERNAL MECHANISM SERVICING

The internal mechanism must be thoroughly cleaned and relubricated.



Clean Worm Gears with a clean dry cloth or a clean, dry toothbrush. DO NOT USE SOLVENTS.

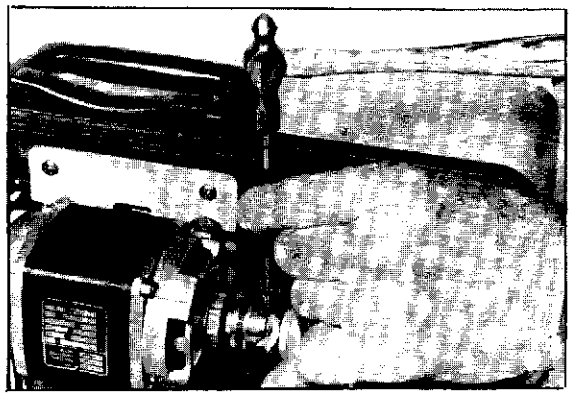
Relubricate by brushing DC44 Grease (39479P9) into the teeth.



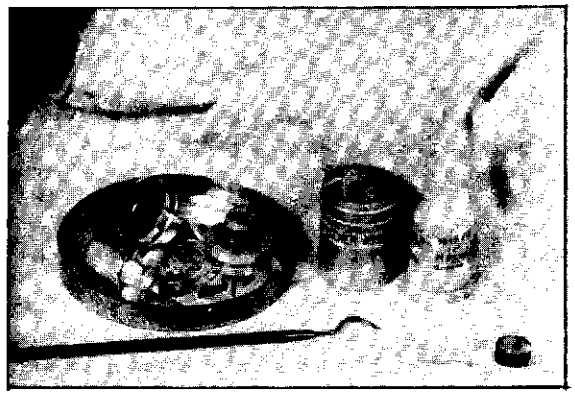
K. MOTOR PULLEY SERVICING

If the motor pulley wobbles on the shaft, replace the nylon pulley bearing.

Carefully tap out the 1/16" roll pin which secures the fan hub to the motor shaft.



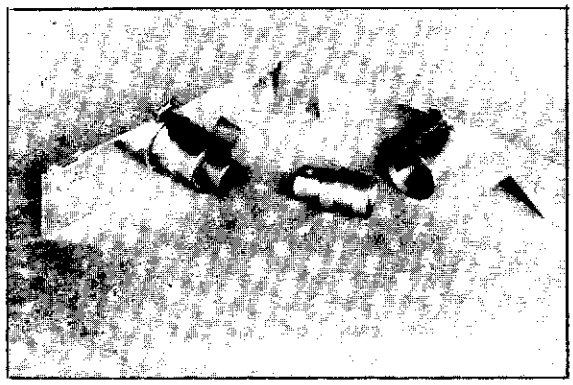
Slide the fan hub, motor pulley and bearing from the motor shaft carefully noting the positioning of the fiber washer and nylon bearing. Wash all parts in alcohol or chlorothene 1+ 1+1.



Lubricate the inside and outside of the nylon bearing with FS 1290 grease (39479P4).

Lubricate the fan hub kick spring by applying Vischem 352 grease (39479P15) between the spring and the fan hub.

When reassembling, make sure that the pin on the motor pulley and the pin on the fan hub do not trap one of the tails of the spring between them.There should always be spring action between these two pins, otherwise damage may result to the projector.

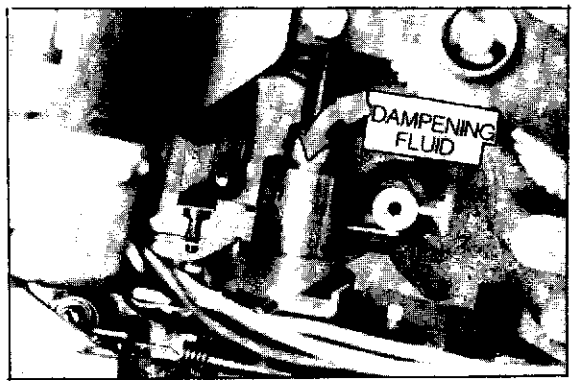


L. SAFETY SHUTTER THEORY

The safety shutter is operated by a Viscous Fluid which sets up a drag between the steel hub, which is secured to and turns with the main shaft and the brass cylinder of the safety shutter.

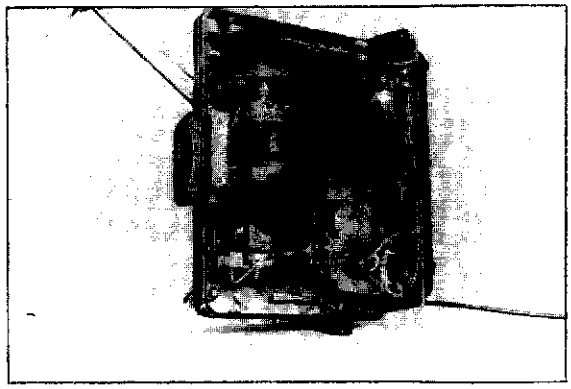
SAFETY SHUTTER SERVICING

Replenish the DC 200 Viscous fluid (200 Centistoke, #39479-P17) each time preventive maintenance or overhaul is performed by standing the projector on its nose and applying two or three drops in the small crack between the steel hub and the sealing washer. Turn the main shaft while rocking the safety shutter back and forth to "WICK" the fluid down into the shutter.



Run the projector for several seconds to distribute the fluid inside the brass cylinder.

Repeat the procedure two or three times to completely fill the reservoir.



M. SHUTTER AND CAM OPERATION

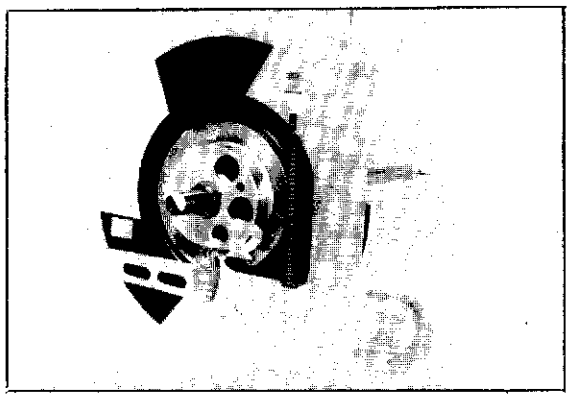
The shutter and cam are locked together and require no timing.

The cam moves the claw arm up and down (stroke) and in and out of the film sprocket holes(protrusion).

Up-and-down movement occurs as the cam follower on the front of the claw arm follows the radial (round) surface of the cam.

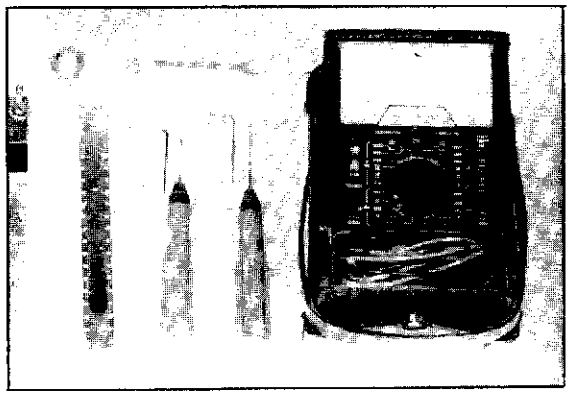
In-and-out movement occurs as the cam follower Button (see arrow) on the back of the claw arm follows the axial surface (wobble plate) of the cam.

The pivot (lower right) is used to adjust stroke,and repositioning of the shutter and cam assembly on the main shaft is what determines protrusion.



Tools required for adjusting stroke and protrusion are:

a. Protrusion Gage G10-38000 (Left)
b. Pivot Adjusting Tool ST-5884 (Upper Left)
c. Stroke Gage ST-5880 (second from left)
d. .050" Allen wrench
e. 1/16" Allen wrench
f. 1/4" - 3/16" open-end wrench
g. Continuity Tester

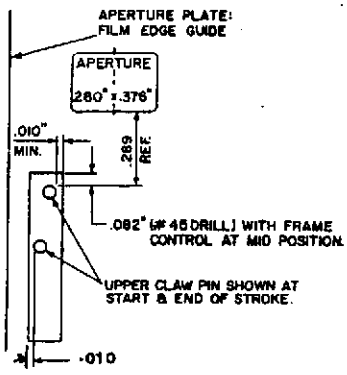


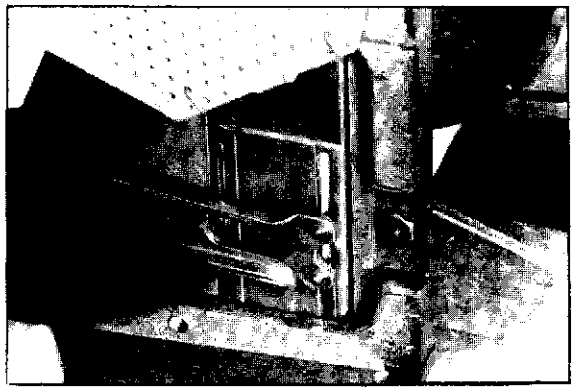
M.1. SIDE CLEARANCE ADJUSTMENT

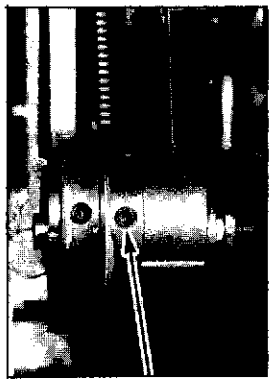
Before attampting any adjustments, manually rotate the inching knob to make sure the Claw Arm Pins do not strike the sides of the Aperture Plate Claw Slot.

At the bottom of its travel, this Pin will be nearer to the outside edge of the Aperture Plate Slot.

To observe this condition, watch the back of the aperture plate as the Claw Arm is cycled slowly through its stroke by turning the main shaft.

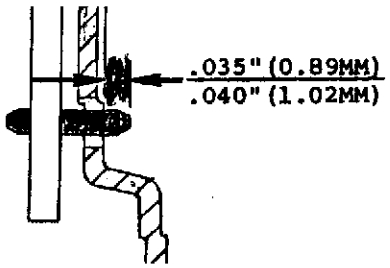






To adjust, loosen the setscrew in the Claw Arm with the .050" Allen wrench and move the oilite bushing so the two distances are equal.

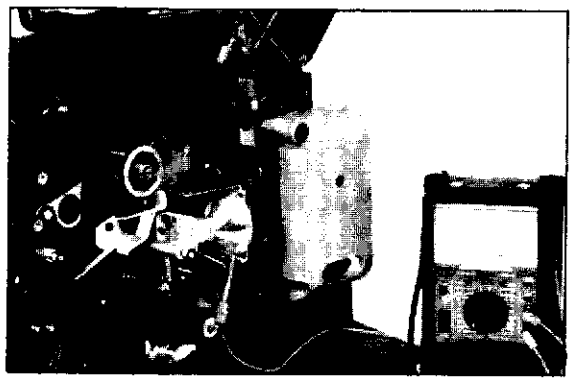
M.2. CLAW PIN PROTRUSION REQUIREMENT



Pin protrusion is the distance which the Claw Pins extend through the aperture plate and is one of the most critical adjustments on all Singer 16mm Projectors. If protrusion is not correct, the operation of the machine may be erratic even though all other adjustments are correct.

The end of the Claw Pin must extend .035" to .040" beyond the film rail of the aperture plate.

CLAW PIN PROTRUSION MEASUREMENT



a Raise the Master Control Lever to PROJECT position.

b Move the Master Control Lever down and open the lensmount just enough to insert the gate. Then raise the control lever just enough to hold the gage snugly in place.

NOTE: Do not insert the gage and then close the lensmount. The lensmount may pop open and not hold the gage properly.

c Connect the screw on the Prot rusion Gage to one side of the continuity meter. Connect the other side of the continuity meter to the chassis of the projector (connecting point must be free from paint, dirt or grease).

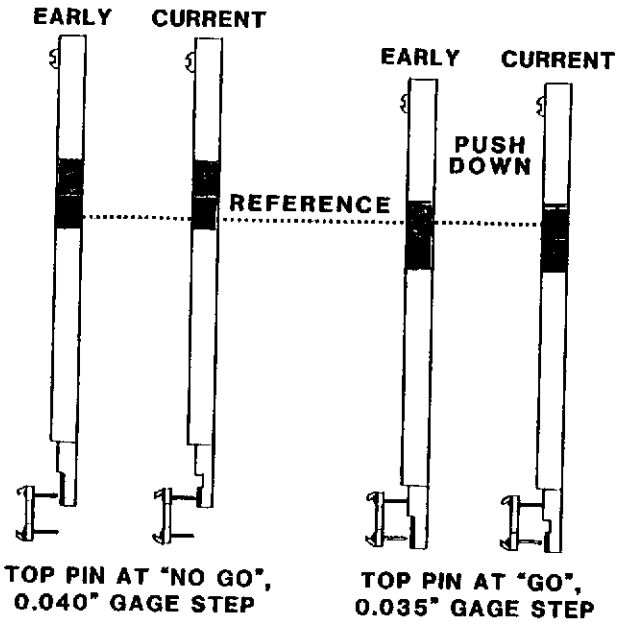
d Rotate the Inching Knob clockwise and observe the Claw Arm. Stop rotating the Inching Knob when the Claw Arm Pins enter the slot in the Aperture Plate and start down. (The edge of the Shutter blade will be just below the Aperture).

e Push the Claw Arm toward the Aperture Plate and gently push the Gage down until the bottom of the gage touches the top pin of the Claw Arm. (The ohm meter or continuity tester will show continuity).

f Release the Claw Arm and reference the position of the red and yellow reference tapes to a point on the projector. Slide Gage down 1/2 width (1/4 width with new style gage) of either tape. The Bottom step of the gage should be opposite the top pin of the Claw Arm. (Figure A)

g If the meter or tester shows continuity, protrusion is more than .040" and should be adjusted. If no continuity is shown, gently push gage down one width of tape. The top step of the gage should be opposite the top pin of the Claw Arm. Continuity indicates correct protrusion between .035" and .040". No continuity indicates protrusion is less than .035" and should be adjusted. (Figure B)

NOTE: The protrusion on NEW projectors is set at .040" to .045" to allow for run in. This measurement is acceptable for NEW projectors. However, when replacing the claw arm, adjust to the .035" to .040" requirement.



CLAW PIN PROTRUSION ADJUSTMENT

a To adjust, loosen the "W" point screw and remove the outer oval point screw.

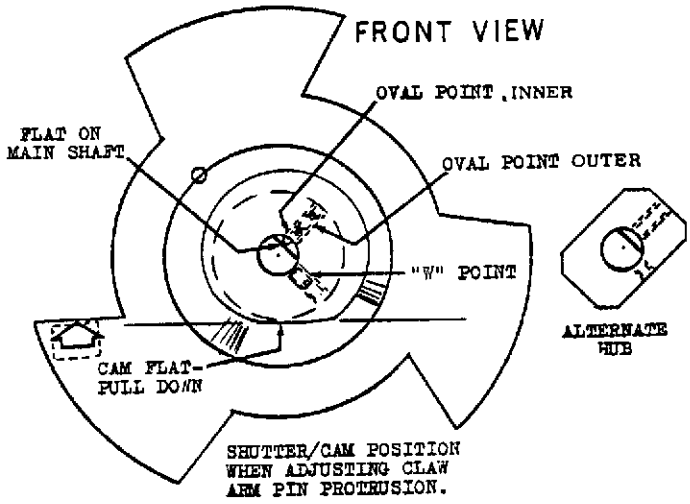
b Position the gage with the bottom step aligned with the top pin of the Claw (Claw must be positioned as in step (d) above). Grasp the Shutter and loosen the inner oval point screw.

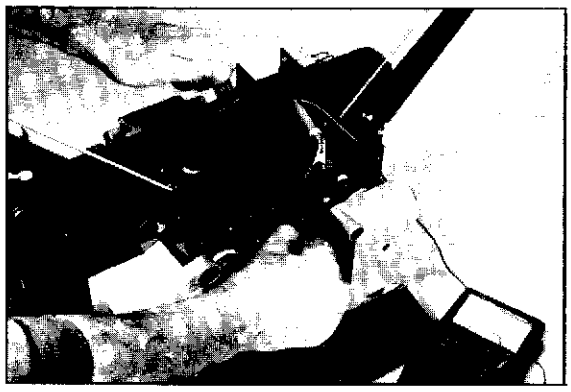
c Move the shutter on the Main Drive Shaft while observing the meter or tester. When continuity is established, allow the shutter to move back to the point of just breaking continuity and tighten the inner oval point screw on the flat of the shaft. Rocking the shutter slightly while tightening this screw will insure proper alignment on the flat of the shaft.

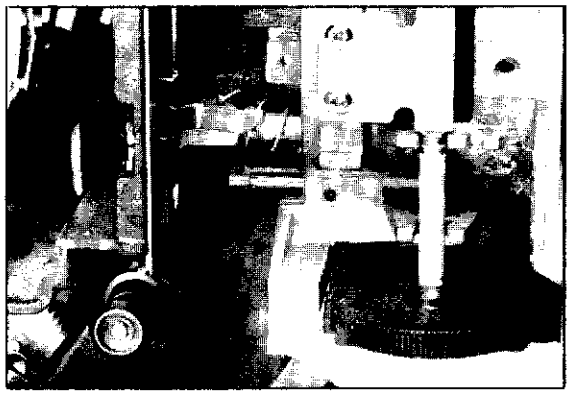
d Push the gage down as in step (g) above and check for continuity. If no continuity exists, repeat this entire process until no continuity exists on the lower step of the gage but continuity does exist on the upper step.

e Tighten the "W" point screw and recheck the requirements of step (d) above. If tightening the "W" point screw results in failure to meet these requirements, repeat steps (c) and (d) until tightening of the "W" point screw no longer causes failure.

f Tighten the "W" point screw and the inner oval point screw to 140 inch ounces of torque. Replace the outer oval point screw to 140 inch/ounces of torque. (If a torque wrench is not available, tighten the screws until the allen wrench shaft starts to twist.







N. LENSHOLDER STOP PIN THEORY

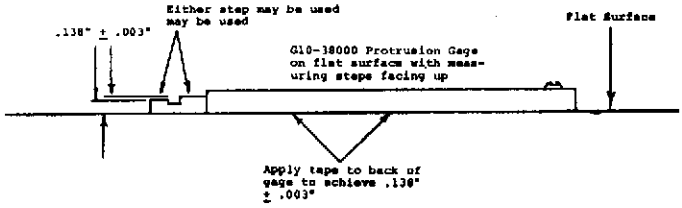
The Lensholder Stop Pin limits the distance that the bottom of the pressure shoe moves away from the Aperture Plate when the Loop Restorer resets the lower loop. This should be checked and reset if necessary each time preventive maintenance or overhaul is performed on the projector.

LENSHOLDER STOP PIN GAGE

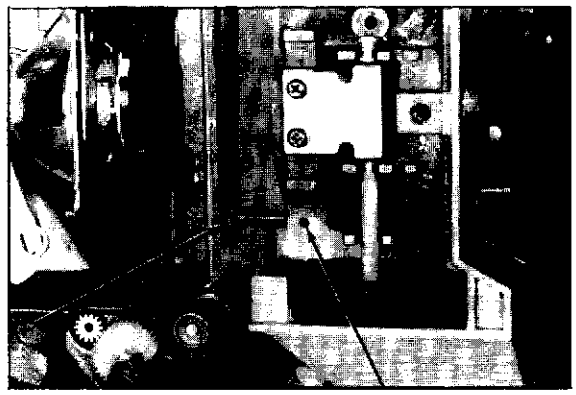
Lay the Protrusion Gage (G10-38000) on a flat surface with the protrusion measuring steps facing up.

With a set of calipers or a depth gage, measure from both steps to the flat surface. Select the step which measures .138± .003" for the lensholder stop pin adjustment.

If neither step measures .138" ± .003", build up the back side of the gage with tape until the correct thickness is obtained.



LENSHOLDER STOP PIN ADJUSTMENT



Move the Master Control Lever to LOAD and remove the lensholder cover.

Rotate the inching knob until the Claw Arm pins have been completely retracted from the Aperture Plate.

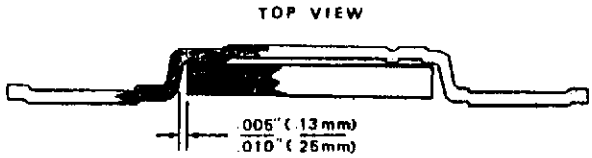
Insert the Protrusion Gage in the Aperture Plate with the measuring steps facing the lensholder stop pin and the .138" ±.003" step directly in line with the pin.

Move the master control lever to PROJECT.

Loosen the Stop Pin Setscrew and adjust the Pin until it just touches the .138"±.003" step. Tighten the screw.

O. PRESSURE SHOE REQUIREMENT

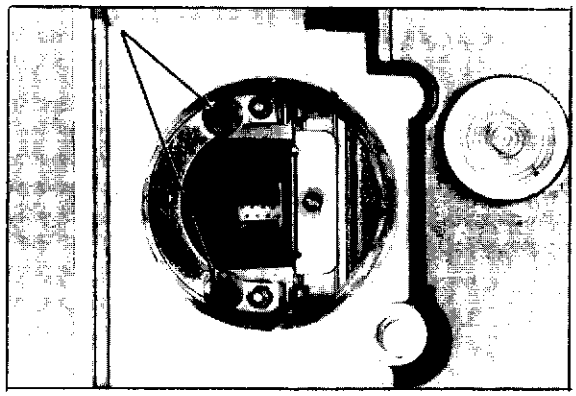
Move the Master Control Lever to LOAD AND assemble the Lensholder Cover with the Pressure Shoe.



Place an Index Card below the Pressure Shoe and sight down the edge of the Pressure Shoe as the Master Control Lever is moved toward PROJECT.

The Pressure Shoe should enter the aperture plate channel without striking either side. The outside edge clearance should be .005" to .010".

PRESSURE SHOE ADJUSTMENT

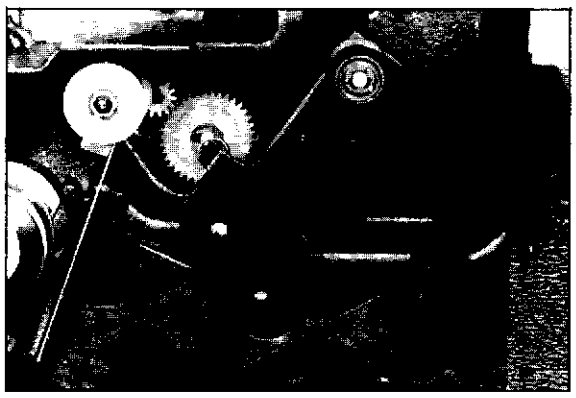


Adjust by loosening the two socket head screws which hold the "C" carrier to the lensholder and moving the carrier to obtain the .005" to .010" dimension. (Loosen the screws just enough to permit carrier movement with considerable resistance. The carrier should not be too loose.)

Run the projector forward with film. Move the carrier to obtain quietest operation and steadiest picture. These two requirements will generally occur simultaneously.

Reverse project. Readjust, if necessary, for quiet, steady operation. Recheck (b) above.

Tighten the carrier.

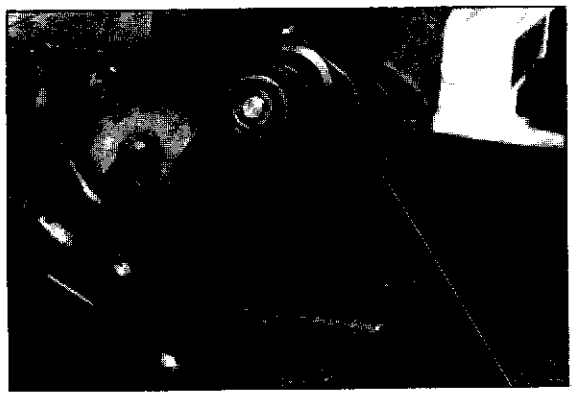


Move the control lever up and down several times to be sure that the pressure shoe seats properly and recheck with film.

P. AUTOMATIC LOOP RESET SERVICING

Move the Master Control Lever to LOAD.

By hand, rotate loop reset gear clockwise about 90° and hold.



Push the lower spring loaded arm down and examine the raised lip on the eccentric stud.

Replace the gear if this lip is worn.

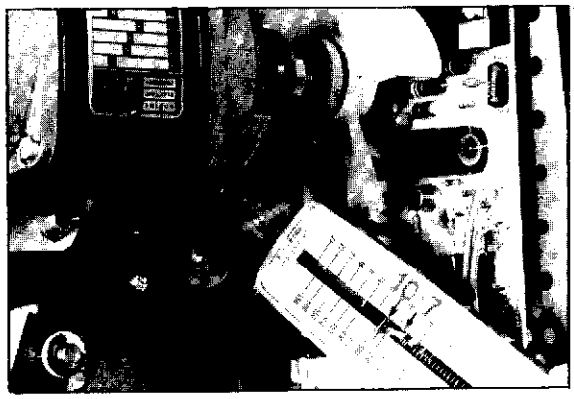
While the loop reset arm is disassembled, check the gear latch tab for burrs. If a burr is found, replace the arm.

AUTOMATIC LOOP RESET ECCENTRIC ADJUSTMENT

When the Master Control Lever is in the LOAD position, the cradle in the end of the arm link should trap the loop reset arm eccentric so the arm is neither forced up by the cradle nor able to be pushed up with the cradle in place. This would result in the release of the engagement of the gear latch tab with the raised lip on the loop reset gear eccentric, causing continuous recycling of the loop reset mechanism in the fast modes of operation.

Loosen the setscrew in the eccentric and rotate it to fit into the cradle of the master control lever without releasing the loop reset gear when the projector is in the LOAD position.

Q. DRIVE MOTOR BELT REQUIREMENT

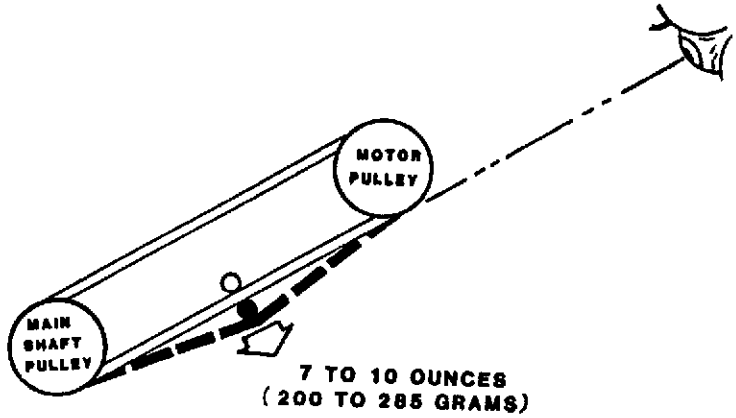


Reinstall the motor to the projector.

Hook the take-up tension gage to the motor drive belt as shown in the illustration and pull down on the gage.

Sight along an imaginary line which touches the botton of the motor pulley and main shaft pulley while pulling down on the tension gage.

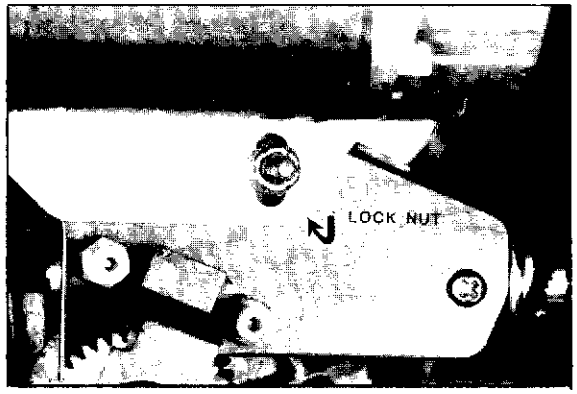
When the top of the gage wire touches this line, the gage should read 7 to 10 ounces.



DRIVE MOTOR BELT ADJUSTMENT

Back the lock nut away from the motor plate and adjust the belt tension nut for correct tension. Turn it counterclockwise to increase belt tension and clockwise to decrease tension.

Tighten the lock nut securely against the motor plate when adjustment is completed.

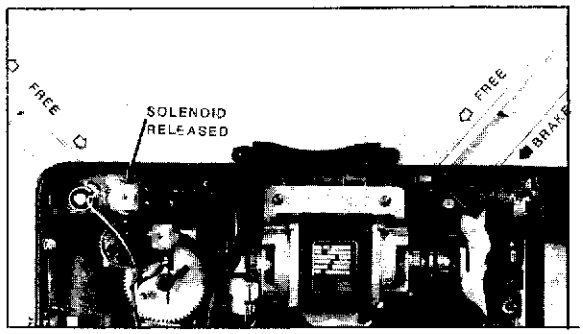


R. REWIND BRAKE REQUIREMENTS

Before attempting any take-up or lift-off adjustments, check the operation of the rewind brake (on models without Fast Forward).

Move the Master Control Lever to LOAD.

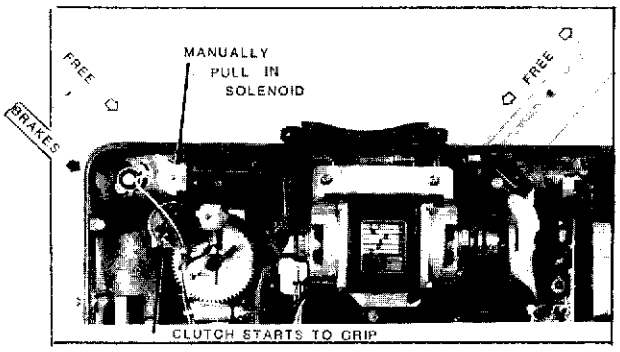
Viewed from the motor side of the projector, the take-up reel arm belt should move freely in a counterclockwise direction but bind or grip in a clockwise direction. The feed and rewind arm belt should move freely in both directions.



Manually operate the rewind solenoid.

The take-up reel arm belt should move freely in both directions and the feed and rewind arm belt should bind in the counterclockwise direction but move freely in the clockwise direction.

If the above requirements are not met, make sure the brake cable is on the pulleys. If so, adjust the brake cable by loosening the clamp screw on the solenoid paddle and lengthen or shorten the cable as required.

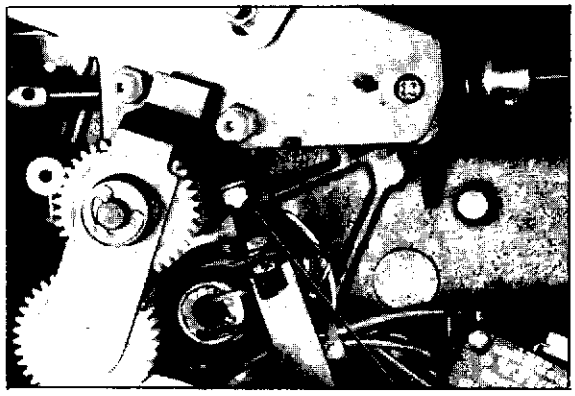


S. TAKE-UP ADJUSTMENT

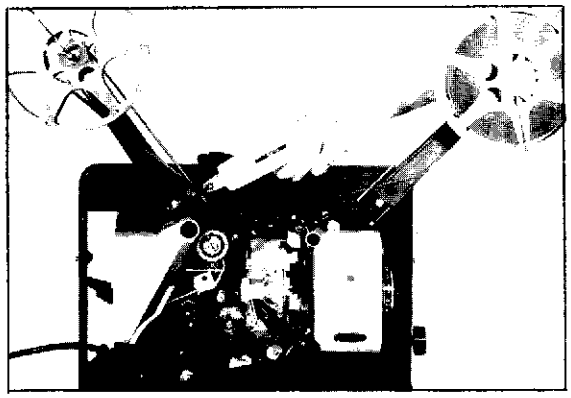
Take-up tension is adjusted with the nut directly under the bias spring.

Place an empty 400-foot reel on the take-up arm.

Thread the projector. (Film may be pulled from the front reel directly to the rear sprocket, bypassing the normal film path if desired.)



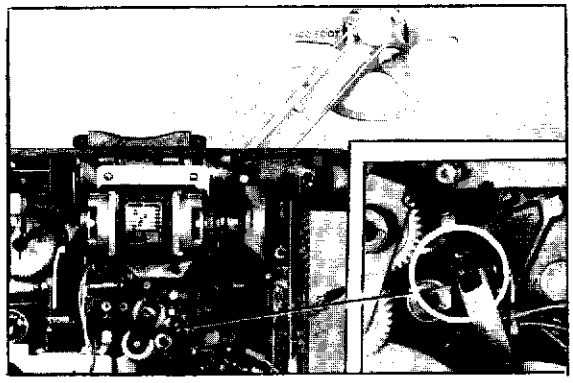
Insert the film tension gage (T-38000-S) as illustrated with the idler directly above the last roller of the film path. Hold the gage at about a 30° angle, operate the projector in FORWARD PROJECT. The gage should read 4 to 6 ounces with 25 to 40 feet of film on the take-up reel. Favor the low side of this requirement with the blue or green clutch liner.



Adjust the take-up tension adjusting nut up to increase tension and down to decrease it.

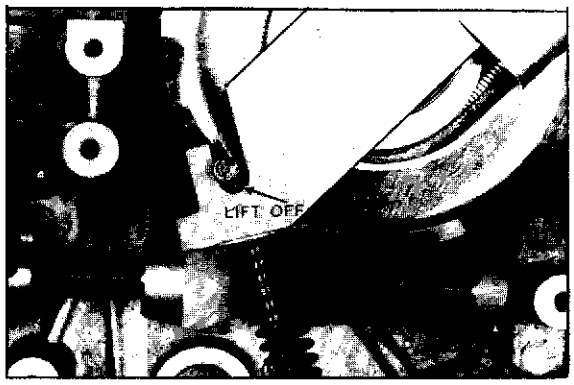
If difficulty is experienced meeting the take-up adjustment requirement, perform the lift-off adjustment and try the take-up adjustment again. If the take-up requirement is met, it is not necessary to do the lift-off adjustment.

T. LIFT-OFF THEORY AND ADJUSTMENT



The lift-off adjustment establishes the proper point of contact of the take-up clutch pulley with the take-up clutch liner. It is accomplished by adjusting the bottom two nuts on the threaded rod so the pulley exerts just the right amount of pressure on the liner. Too little pressure will result in erratic take-up, and too much pressure may break the take-up gear.

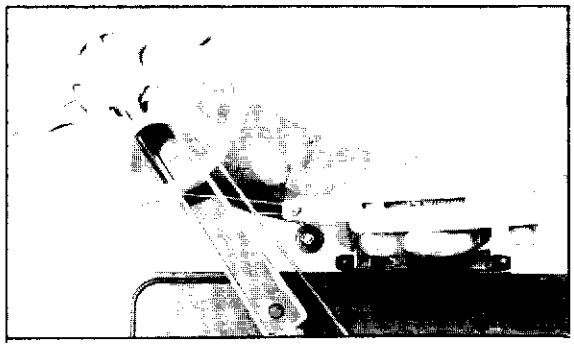
Mount an empty 400-foot reel on the take-up arm, move the master control lever to PROJECT and run the projector in FORWARD.



Turn both bottom nuts up until the 400-foot reel just stops turning. Make sure the flat plate always remains firmly trapped between these two nuts.

Mark one face of the bottom nut for reference and turn the bottom nut down three turns. Turn the top nut down until it snugs tightly against the flat plate. This establishes correct lift-off.

U. FAST FORWARD DRIVE REQUIREMENT



Place an empty 400-foot reel on the take-up arm. Connect the Take-up Film Tension Gage (T-38000-S) to this reel about 3" out from the center by means of a paper clip or other wire suitable for this purpose.

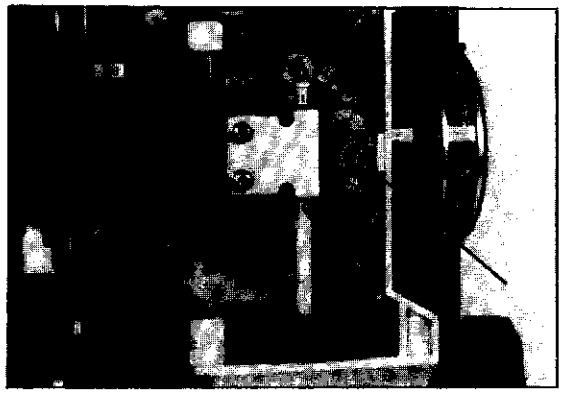
Run projector in "FAST FORWARD" mode. The gage should read 13 to 18 ounces.

FAST FORWARD DRIVE BELT ADJUSTMENT

Loosen the screw holding the Adjusting Plate and move the plate either up to decrease torque or down to increase torque. Tighten the screw.

Note: If this fails to change the torque, make sure the FAST FORWARD Solenoid is causing the FAST FORWARD clutch to engage. As a last resort, it is permissible to adjust the lift-off setting (the double nuts on the bottom of the take-up clutch threaded rod). Turn these nuts up 1/2 turn.

PROJECTION LENS



Clean and replace the projection lens.

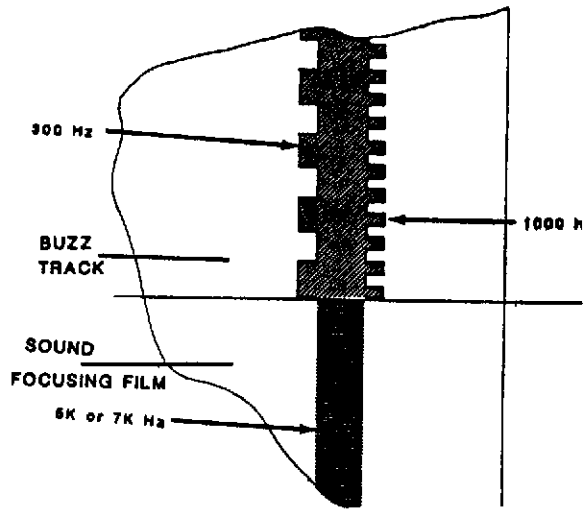
Make sure the lens is positioned so the antitheft screw is flush with the lensholder casting. If this screw is not seated properly, the lensholder cover cannot be assembled properly and the projector will not handle film.

V. BUZZ AND SOUND OPTIC FOCUSING

a SMPTE P16-BT Buzz Track film (45191-G3) is used to adjust the lateral position of the front pressure roller with respect to the sound drum.

b SMPTE P16-SF-A 7000 Hz sound focusing film (Telex 45191-G2) or SMPTE P16-SF-B 5000 Hz sound focusing film (Telex 45191-G1) is used to adjust the focusing of the sound optic and the azimuth of the sound optic.

c These two adjustments are interdependent. If difficulty is experienced in making either of these adjustments, check the other one and adjust it as necessary.



V.1. SOUND OPTIC FOCUSING ADJUSTMENT

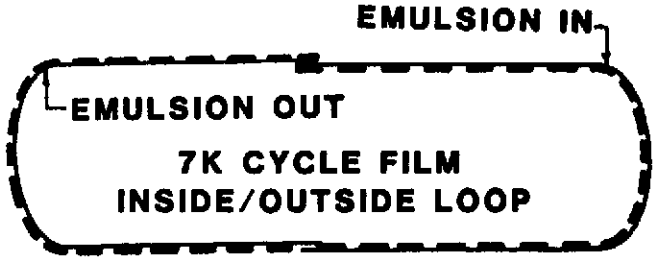
a Cut two strips of 7000 Hz sound focusing film about 40" long. SMPTE P16-SF-A, P/N 45191-G2).

b Splice them together to form a closed loop with the emulsion side of one strip on the outside circumference of the loop and the emulsion side of the other strip on the inside circumference of the closed loop.

c Thread this loop in the projector and adjust the Tone Control to its maximum right-hand position.

d Connect an AC Voltmeter across the speaker terminals and set the meter range switch to read 50 volts full scale minimum.

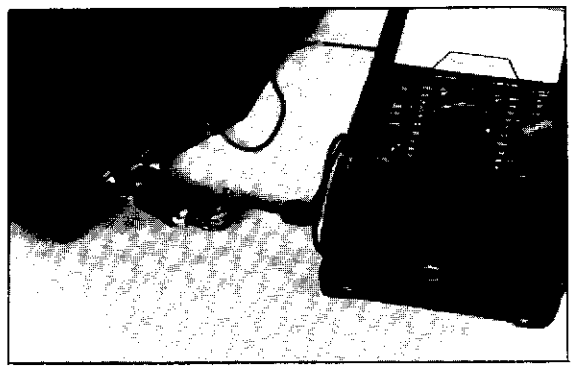
e Run the projector Forward and adjust the Volume Control for comfortable listening level. Adjust the voltmeter range scale for a reading between 1/2 scale and full scale.



Requirement : Meter readings from both sections of the loop must be within 3 db of each other.

If the meter used does not have db scales, set the Volume Control so one section of the loop produces one of the Set Value voltage readings shown in the Chart and check that the other section of the loop meets the Allowable Deviation Requirements.

If this requirement cannot be met, proceed to Step f. Otherwise, disconnect the meter and proceed with the "Buzz" adjustment.



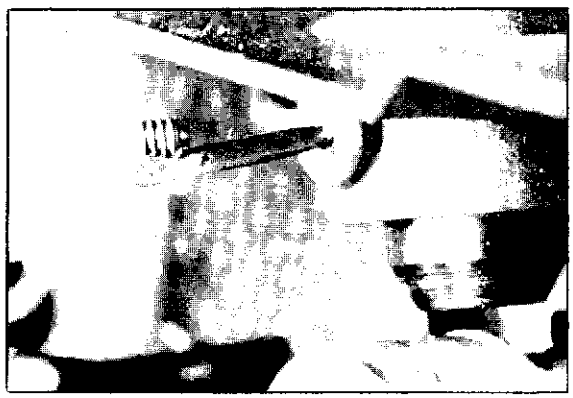
Loop Section I Set Value	Loop Section II Allowable Deviation	
	Maximum Reading	Minimum Reading
.775 VAC	1.10 VAC	.54 VAC
2.450 VAC	3.45 VAC	1.73 VAC
7.750 VAC	10.95 VAC	5.40 VAC

Loosen the Sound Optics Setscrew and remove the Sound Optics. It may be difficult to remove due to the wedging action of the nylon plug used to lock it in place. Rotating it back and forth while pushing up on it will aid in its removal. DO NOT pry up on the bottom of the cartridge as this may damage the bottom lens. Inspect bottom element for damage.

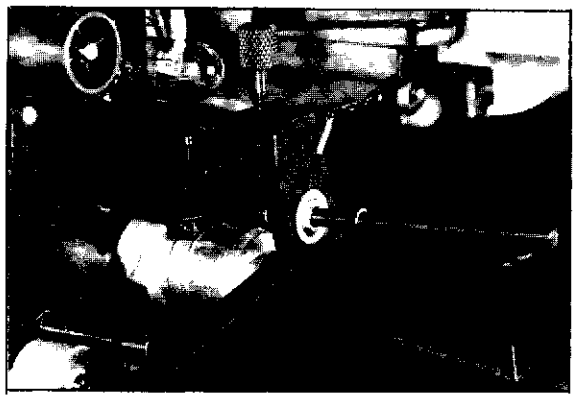
Turn the setscrew as though tightening. This will force the nylon plug out of the hole. Be careful to prevent the plug from falling into the projector.

Remove the setscrew. Insert a NEW NYLON PLUG (38162-P1) and start the setscrew into the threads. After cleaning the top and bottom lenses of the optic, insert it in the projector and tighten the set-screw until it is held in place but can be turned and moved up and down easily. Be careful to prevent the optic from dropping onto the sound drum as this may damage the bottom lens.

Note: You may find it more convenient to replace the nylon plug and setscrew with a new NYLON Tip Setscrew (45209-P1).



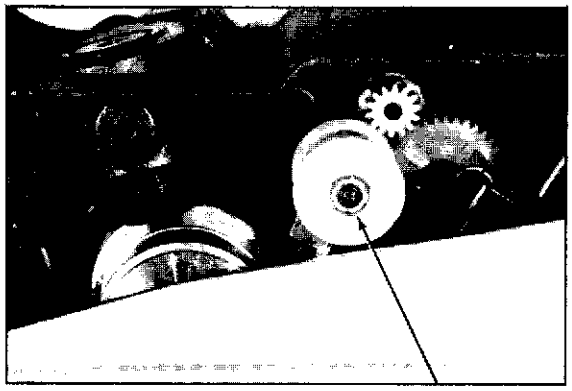
Run the projector in Forward and focus the Sound Optics Cartridge by moving it up or down while rotating it back and forth until both requirements of Step (e) above are met. Tighten setscrew VERY tight when adjustments are complete.



Note 1: Use of Tool T-43680-G1 might make focusing of the Sound Optic more convenient. To use the tool, attach the ring portion to the optic and clamp the adjusting rod portion to the lamp-house platform of the main casting.

Note 2: No attempt should be made to remove the lens elements. If difficulty is encountered meeting the above requirements and the Sound Optic is suspected, replace the entire cartridge.

V.2. BUZZ ADJUSTMENT



Thread a continuous loop of "BUZZ" track film (SMPTE-P16-BT) (45191-G3) in projector and set the Tone Control to its maximum right=hand position. Set the Volume Control for comfortable listening.
Run the projector Forward and adjust the BUZZ adjusting nut until no sound is heard or until the high and low frequencies are heard with equal volume. (There is a Buzz Track included as part of the Jiffy Test Film SMPTE-P16-PP).

W. FINAL PERFORMANCE TEST

Place a Jiffy Test Film in the projector and check for proper operation.

Replace the covers and clean.

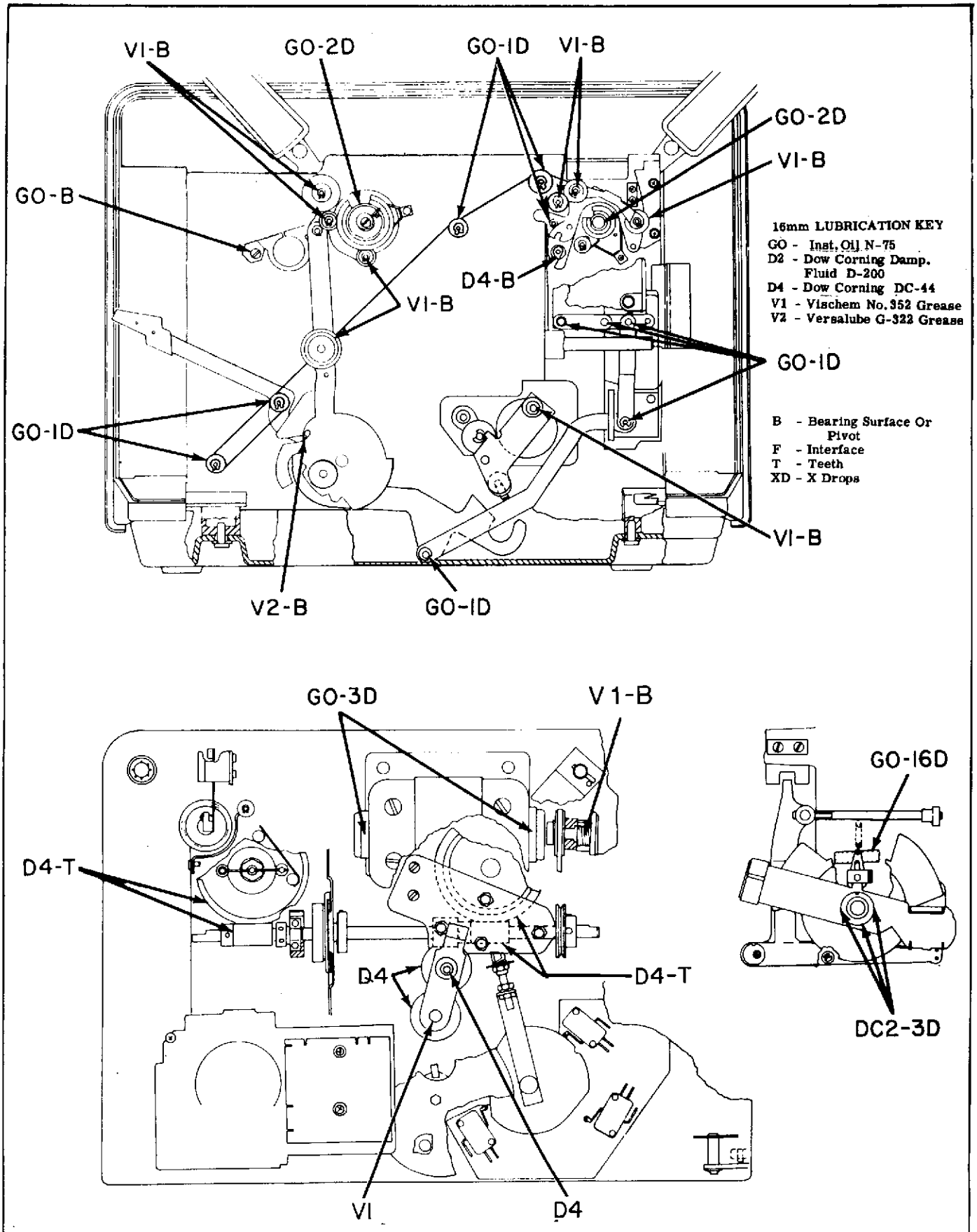


Figure 3-46. PREVENTIVE MAINTENANCE LUBRICATION POINT DIAGRAM

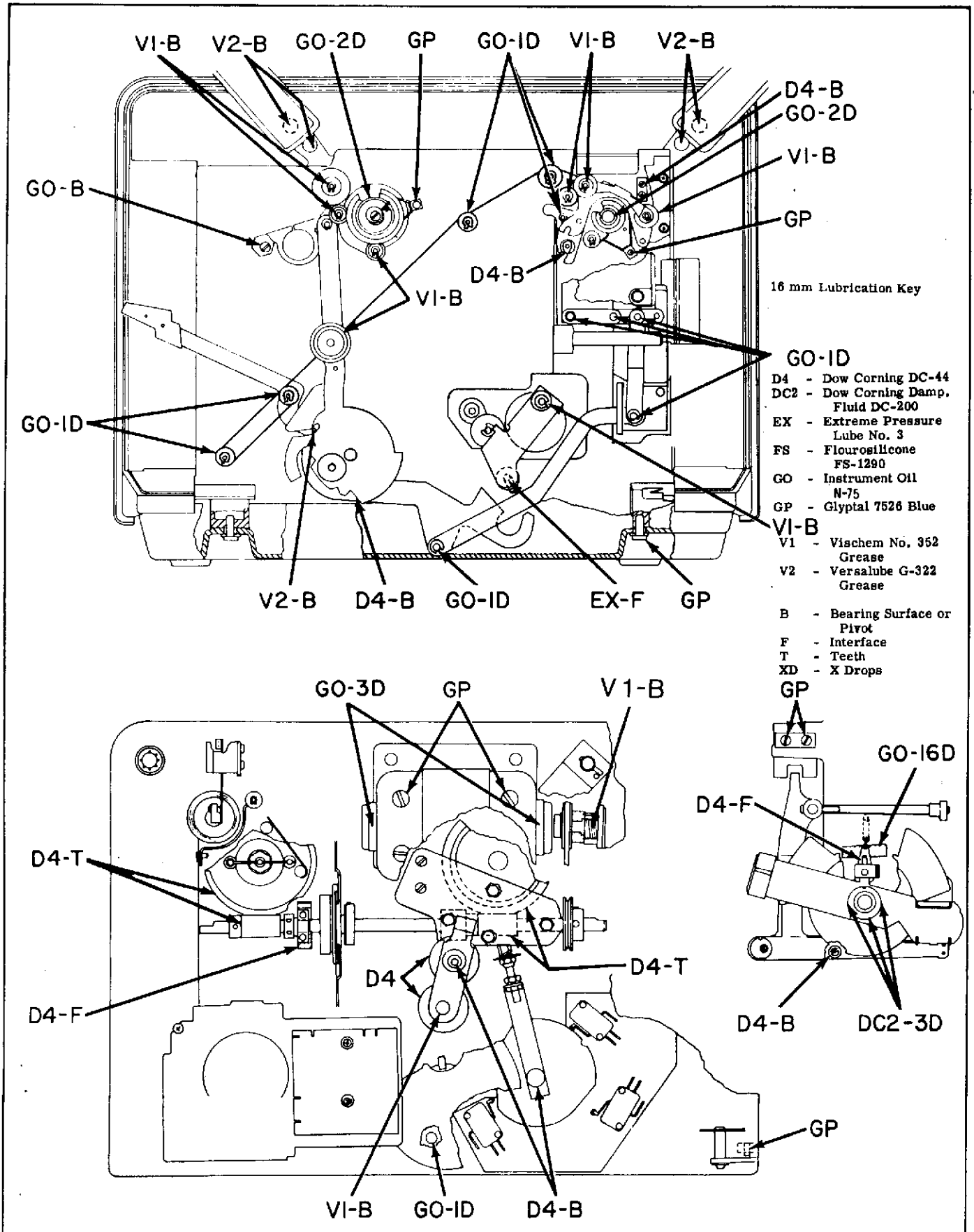


Figure 3-47. OVERHAUL MAINTENANCE LUBRICATION POINT DIAGRAM

Z. OPERATION CHECK

It is recommended an old film be used for the initial part of this check. This will prevent damage to a valuable test film in case the projector is malfunctioning to the extent that it damages film. An SMPTE jiffy test film Mo. P16-PP should be used for the latter portion of this check.

1. Connect power cord to AC receptacle supplying correct line voltage and frequency. Swing reel arms up until they lock.

2. Set Master Control Lever to PROJECT position.

3. Press FORWARD button. Check that sprockets and reels turn properly, that screen is illuminated evenly and blower is operating. Listen for unusual noises.

4. Press Still button (if projector has this feature). Illumination should decrease and motion of sprockets and reel pulleys should stop. (Screen may be partially or totally dark. If so, rotate manual advance knob slightly to move shutter blade away from aperture.)

5. Press REVERSE button. Check that sprockets and reels turn properly.

6. Press STOP button. Projector should stop.

7. Move Master Control Lever to LOAD/FAST MODE.

8. Press FAST FORWARD button (on projectors with this option). Check that sprockets and take-up reel operate and the fast mode interlock light comes on after a slight delay.

9. Press STOP button. Projector should stop and fast mode interlock light (on FAST FORWARD models) should remain on for three to five seconds.

10. Press REVERSE button. Check that sprockets and supply reel operate in the fast reverse mode. On fast forward models, interlock light will light.

11. Press STOP button. Projector should stop. On Fast Forward models, the interlock light should remain on for three to five seconds.

12. Thread an old film into the projector and move the Master Control Lever to the PROJECT position.

13. Check for proper threading by manually rotating the manual advance knob and checking the film movement through the projector.

14. Press the FORWARD button and observe that film moves smoothly through the projector and is gathered on the take-up reel. Set volume and tone controls for comfortable listening.

15. Check for proper film handling in the film gate by observing smooth quiet operation in this area.

16. Check picture for focus, double image or ghosting.

17. Adjust framing knob maximum clockwise and then maximum counterclockwise. Observe that the frame line moves an equal distance into the top and bottom of the projected image. Check for picture jump, side shake or weave, and mechanical noise at both extremities of framing.

18. Readjust framing knob to eliminate frame line from projected image.

19. Press REVERSE button and observe that the film moves smoothly and quietly through the projector and is gathered on the supply reel.

    Note: At this point, the balance of the old film may be run through the projector and rewound or rewound immediately at the operator's discretion.

20. Press the STOP button. Move the Master Control Lever to the LOAD position and thread a jiffy test film (SMPTE P16-PP) onto the projector.

21. Move the Master Control Lever to the PROJECT position.

22. Check for proper threading by manually rotating the manual advance knob and checking the film movement through the projector.

23. Press the FORWARD button and observe that film moves smoothly through the projector and is gathered on the take-up reel.

24. Move the tone control and listen for a change in pitch.

25. Advance the volume control momentarily to a loud listening level. Check for case rattle or buzz.

26. Follow directions on jiffy test film.

27. Rewind jiffy test film when test is complete.

28. Check Elevation.

29. Check Loop Restorer.

SECTION III DISASSEMBLY and REASSEMBLY ADJUSTMENTS

SECTION III

SERVICE PROCEDURES

A. GENERAL

This section provides repair, reassembly, adjustments, and preventive maintenance instructions.

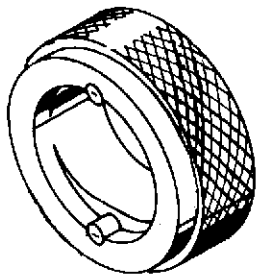
B. TOOLS AND EQUIPMENT

Servicing Telex INSTA-LOAD 2200 SERIES Projectors will be facilitated by tools and equipment described in this section. Some tools are standard tools. Special tools have been assigned tool numbers and are available from Telex Communications, Inc.

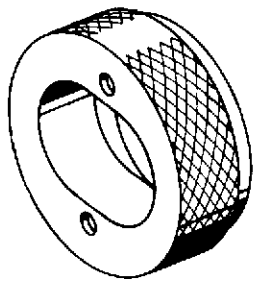
1. Special Tools

Special tools required in the repair of the projector are listed below. For a description of these tools, refer to the applicable illustration.

ST-5884	Claw Arm Adjusting Tool (Pg. 3-ii)
G10-38000	Claw Arm Protrusion Gage (Pg. 3-iii)
T-38000-N	Rollpin - Insert and Extracting Tool (Pg. 3-iii)
T-38000-S	Take-up Film Tension Gage (Pg. 3-iii)
ST-5880	Stroke Setting Gage (Pg. 3-iii)
T-38001-G	Sound Drum Locating Plug (Pg. 3-iv)
SS-305	Retainer Feeler Gage (Pg. 3-iv)
T-43411-G1A	Solenoid Holding Clamp (Pg. 3-iv)
SS-327	Solenoid Stroke Gage (Pg. 3-iv)
T-43680-G1G	Sound Optics Adjusting Tool (Pg. 3-iv)



FRONT VIEW



REAR VIEW

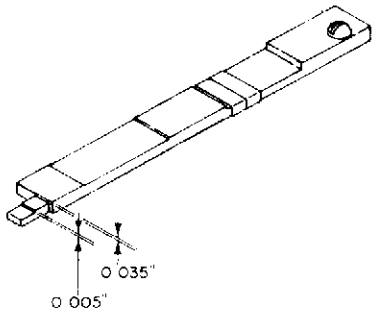
Used to adjust claw arm side clearance and pull-down stroke.

CLAW ARM ADJUSTING TOOL
No. ST 5884

2. Commercial Tools

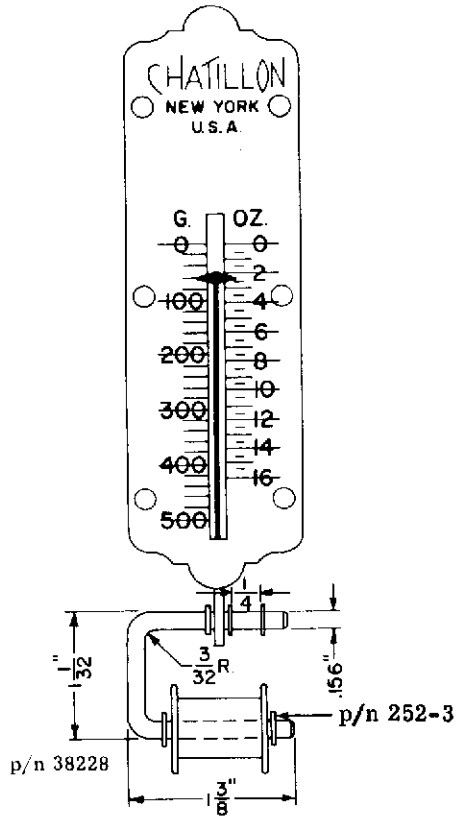
The commercial tools used in the repair of the projector are listed in the table below. These tools are available from Telex Communications, Inc.

EDUCATION SYSTEMS NO.	DESCRIPTION	USE
SS-307	Waldes Retaining Ring Applicator M-C 012	To install retaining rings.
T-38000-U	Waldes Tru-Arc No. 1520 Applicator	To remove and install small retaining rings.
T-38000-V	Waldes Tru-Arc No. 1540 Applicator	To remove and install large retaining rings.
T-38000-W	Claw Cam Wrench (Pair)	Claw arm eccentric pivot nuts.
T-38000-X	Waldes Tru-Arc No. CR-0310	To remove and install "C" rings.



Used to set claw pin protrusion **electrically.**

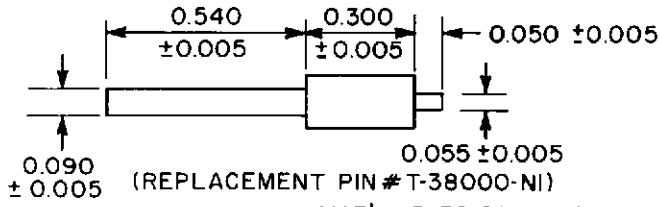
CLAW ARM PROTRUSION GAGE,
No. G10-38000



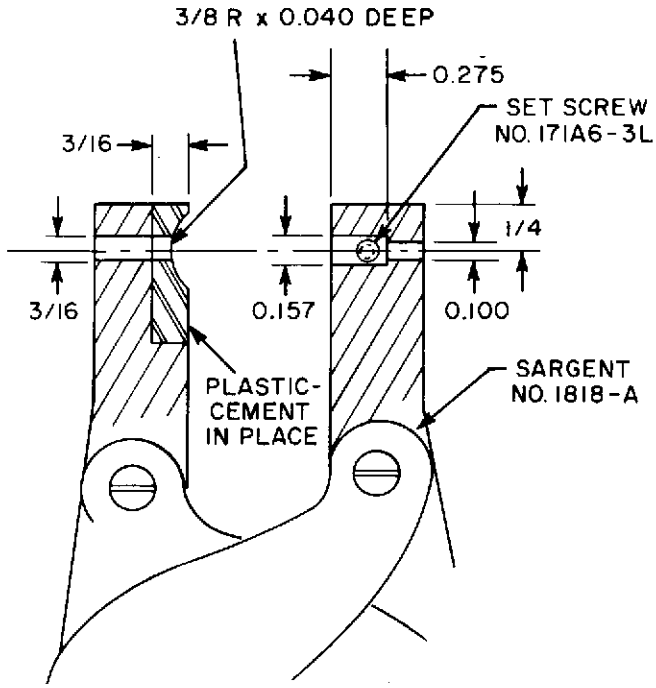
Used to measure forward take-up tension, belt tension and fast forward take-up tension. The scale reading is twice the actual film tension.

TAKE-UP FILM TENSION GAGE
No. T-38000-S

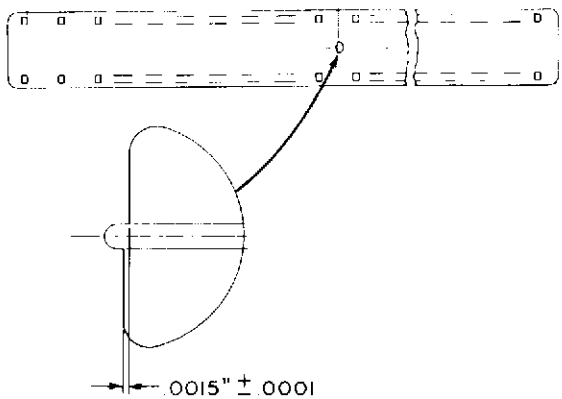
DETAIL I



(REPLACEMENT PIN # T-38000-NI)
MAT'L: 5/32 DRILLROD
BREAK ALL EDGES 0.005"

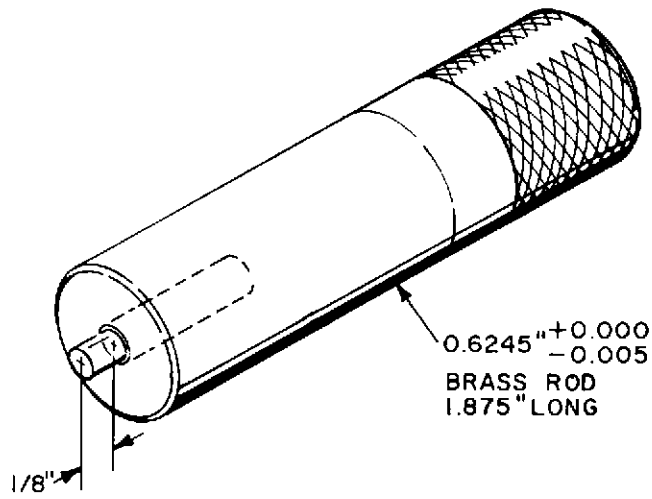


ROLLPIN-INSERT AND EXTRACTING
TOOL, No. T-38000-N



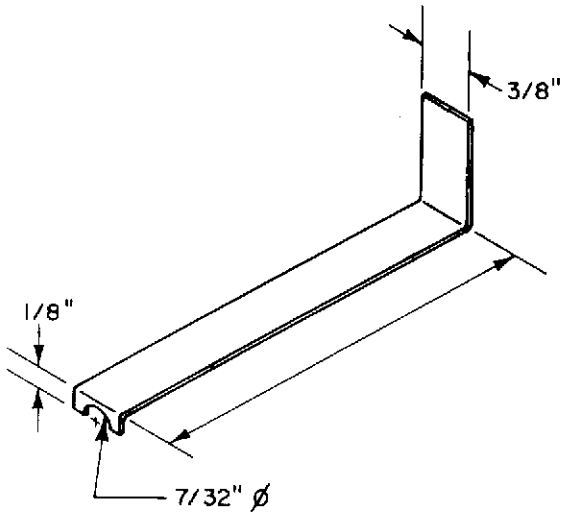
This gage is a piece of stainless steel with perforations simulating double-perforated 16mm motion picture film. This gage is used to adjust the stroke of the projector. The projector functions as an optical comparator when this tool is used.

STROKE SETTING GAGE,
No. ST-5880



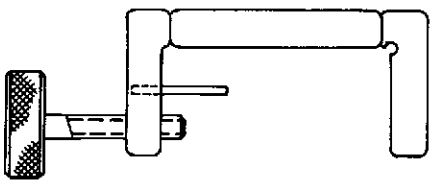
Used to locate the lateral and rotational position of the sound drum.

SOUND DRUM LOCATING PLUG,
No. T-38001-G



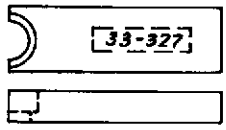
MATERIAL : .025 PHOS. BRONZE
OR SPE. BR.

RETAINER FEELER GAGE,
No. SS-305



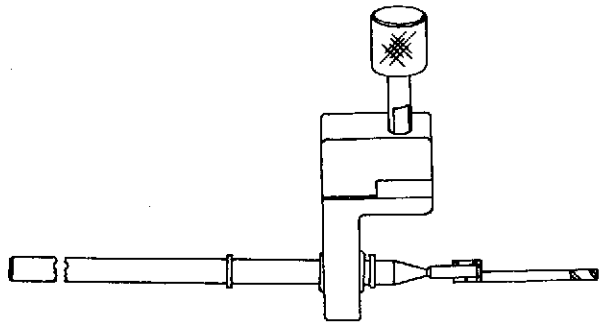
Used to hold solenoid while setting stroke.

SOLENOID HOLDING CLAMP
No. T-43411-G1-A



Used to set solenoid stroke.

SOLENOID STROKE GAGE
No. SS-327



Used to set Sound Optics.

SOUND OPTICS ADJUSTING TOOL
No. T-43680-G1-G

C. MATERIALS

Materials required are listed in the following table. The stock numbers of materials available from Telex Communications are given. If there is no number, the product will not be supplied by Telex Communications. Only those test films showing our stock numbers can be procured, others must be ordered by PH number from SMPTE.

LUBRICANTS AND CEMENTS

STOCK NO.	STOCK PACKAGE	DESCRIPTION
39479P5	1/2 oz.	DC-200 Silicone Fluid; 200,000 centistroke viscosity (Dow-Corning Corp., Midland, Mich.)
39479P13	1/2 oz.	D200 Silicone Damping Fluid, 200 centistroke viscosity (Dow-Corning Corp., Midland, Mich.)
39479P7	1/2 oz.	009 Lubricant (Keystone Carbon Co., St. Mary's, Pa.)
39479P8	2 oz.	Instrument Oil-Teresso Oil, No. N-75 (Humble Oil & Refining Co., New York, N.Y. N
39479P9	2 oz.	DC-44 Light Consistency Silicone Grease (Dow-Corning Corp., Midland, Mich.)
39479P15	2 oz.	Vischem No. 352 (Ultra Chem Inc., Wilmington, Del.)
39479P4	1/2 oz.	FS-1290 Fluorosilicone Grease (Dow-Corning Corp., Midland, Mich.)
39479P14	2 oz.	Versalube - G-322L (General Electric)
39490P1	3 oz.	7526 Blue Glyptal (General Electric Co., Schenectady, N.Y.) N-75
39479P16	4 oz.	Extreme Pressure Lube No. 3
39490P2	3 oz.	1276 Clear Glyptal (General Electric Co., Schenectady, N.Y.)
39479-P17	1/2 oz.	DC 350 Dampening Fluid (Used on Insta Load safety shutter P/N 42994-G2 (Replaces 39479-P13, DC 200-200CS)
- - - - -	- - - -	8101-S Silicone Compound (General Cement Electronic Co., Rockford, Ill.)
- - - - -	- - - -	No. 59 Loctite, Screw Lock (Loctite Corp., Newington, Conn.)
- - - - - -	3 oz.	EC-880 (Minnesota Mining & Manufacturing Co., St. Paul, Minn.)
45191-G3	12 ft.	PH22.57 Buzz Track Film (P16BT)
- - - - -	- - - -	PH22.43 3000 cps Film
45191-G7	- - - -	PH22.45 400 Cycle Test Film
45191-G2	12 ft.	PH22.42 7000 cps Film (P16SFA)
45191-G6	12 ft.	16.3 mm Registration Test Film (Reg. 16)
39490P4	8 oz.	Glyptal Thinner 1511M
- - - - -	- - - -	Chlorothene (Dow Chemical Co., Midland, Mich.)
39490P12	4 oz.	Tan Paint
39490P13	4 oz.	Brown Paint

SECTION III DISASSEMBLY AND REASSEMBLY PROCEDURES

Where disassembly and reassembly seems straightforward and self explanatory, no procedures are given in this service manual. However, where certain steps may not be obvious or where a definite order of steps should be followed, we would like to pass on a few tips or tricks we've learned to make your job a little easier and cut repair time.

Disassembly of the projector and subassemblies thereof should only be performed to the extent necessary to accomplish repair.

Note: Internal electrical connections may be "LIVE" when covers are removed. USE CAUTION .

Always clean parts thoroughly before any lubrication or reassembly is attempted. See cleaning suggestions under Preventive Maintenance, Section II.

A. Removal of Lensholder

1. Remove the Film Stripper (8), the "C" Ring (11) and the Front Sprocket (10). (Figure 3-1).
2. Loosen Screw (63) enough to allow the Lobster Claw (62) to slip off the Guide Arm Roller (47).
3. Move the Master Control Lever to the LOAD position and remove Screw (44). (This Screw is accessible from the back of the projector below the front Worm Gear and to the right of the motor start capacitor.)
4. Slide the Lensholder (43) off its mounting rod taking care not to lose the Spring (45) and the Guide Arm Roller (47).

B. Reassembly of Lensholder to Projector

1. Raise the Master Control Lever to the PROJECT position and make sure the Lensholder Link is straight and resting on top of the Lensholder Rod Boss of the main casting.
2. Slide the Spring (45) and the Lensholder onto the Lensholder Rod and push the Lensholder in until the screw hole is visable toward the back edge of the access slot for Screw (44).
3. Slowly move the Master Control Lever toward LOAD while observing the Lensholder Link.
4. When the hole in the Link just starts to become visible, insert the end of Screw (44) into the hole. (It will be very helpful to hold the screw with a Holding type screwdriver).

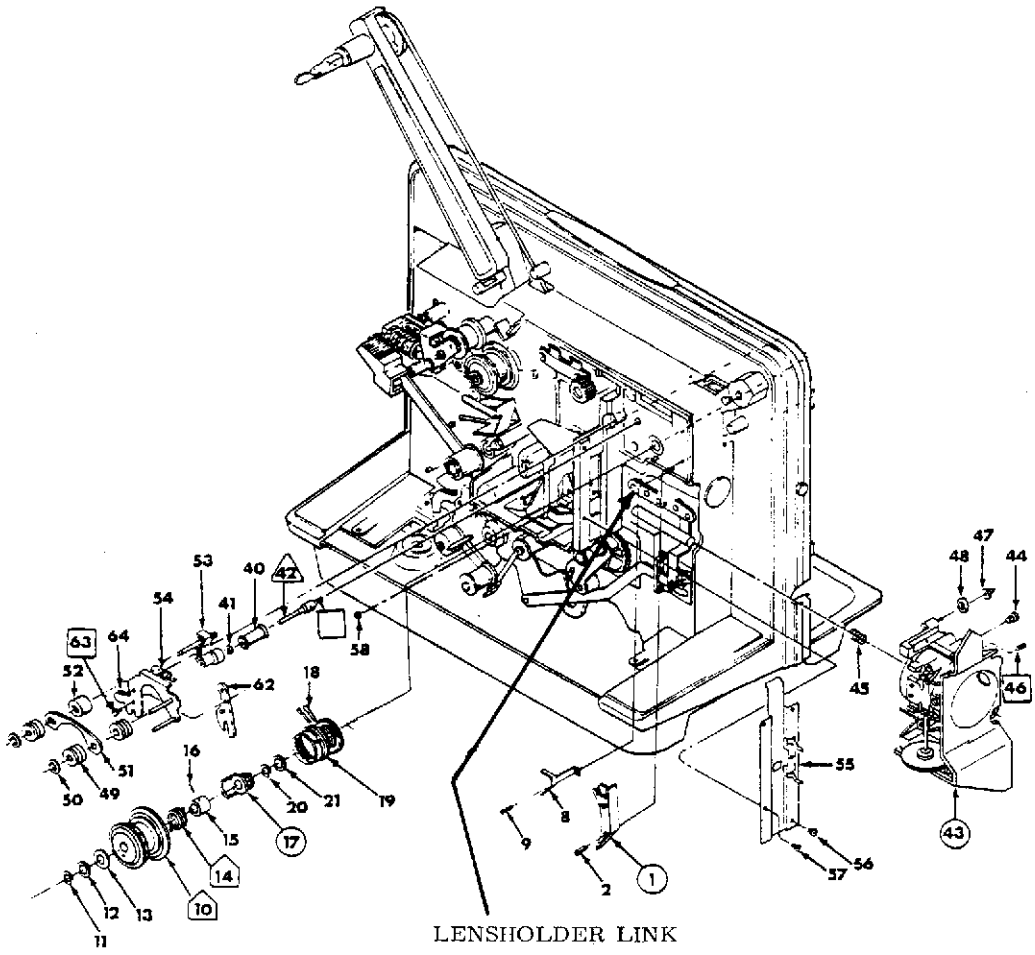


Figure 3-1. REMOVAL AND REASSEMBLY OF LENSHOLDER

5. Continue to move the Master Control Lever slowly toward LOAD until the hole in the link lines up with the hole in the Lensholder and start the Screw (44) into the hole in the Lensholder.

6. While tightening the Screw (44) make sure the oversize hole in the link slips over the shoulder on the Screw (44) so the Lensholder does not bind during operation. Tighten the Screw (44) securely.

7. Replace the Front Sprocket (10) and the Film Stripper (8).

8. Adjust Setscrew (46) to provide .002" to .010" clearence between the Setscrew and the main housing throughout the total Lensholder travel.

C. Removal of Front Clutches

1. Remove the Film Stripper (8), the "C" Ring (11) and the Front Sprocket (10).

2. Remove the Spring (14) being very careful not to allow the Pin (16) to slip out of the Arbor (15) and drop into the base of the projector.

3. Remove the Pin (16), Arbor (15) and Gear (17).

4. Remove the "C" Ring (20), Screws (25) and (26) and the reel arm Belt Guide (24).

5. Remove the three Screws (4) which hold the Solenoid Package in place and lay the Solenoid Package (3) to one side out of the way. (Be careful not to allow the Rewind and Fast Forward Clutch Actuator Caps (6) and (7) to drop off their shafts until you have noted which one goes where - THEY ARE DIFFERENT.)

6. Remove the Front Reel Arm Belt.

7. Move the Master Control Lever to the PROJECT position.

8. Remove "E" Rings (28) and (33) and start sliding the Rewind Clutch (27) and the Fast Forward Clutch (32) off their shafts.

9. While sliding the Rewind and Fast Forward Clutches off their shafts, push in on the shaft of the Front Sprocket Clutch (37). The Washers (21) may lodge in the "C" Ring slot of the shaft making it difficult to push the shaft out of the bearing. Move the Washers (21) around while pushing in on the shaft until the shaft pushes in easily.

10. While pushing in on the shaft of the Front Sprocket Clutch and pulling out on the Rewind and Fast Forward Clutches, a point will be reached where the Fast Forward Drive Belt will prevent further movement of these clutches. Reach in and push the drive belt over the flange of the Fast Forward Clutch Pulley and draw the Rewind and Fast Forward Clutches and the Front Sprocket Clutch out of the projector.

11. Be careful not to lose Washers (31), (36), (38) and (39).

12. Be careful not to allow the Fast Forward Drive Belt to touch the Fast Forward Clutch Shaft and pick up lubricant on its driving surface.

D. Reassembly of Front Clutches to Projector

1. Clean the front sprocket clutch Main Casting Oilite Bearing with a cotton swab moistened with Teresso Instrument Oil (39479-P8).

2. Lubricate the gear teeth of the Front Sprocket Clutch and the Rewind and Fast Forward Clutches with a light coat of DC 44 grease (39479-P9).

3. Lubricate the rewind and fast forward clutch Shafts with a thin film of Extreme Pressure Lube #3 (39479-P16) and assemble Washers (31) and (36).

4. Assemble Washers (38) and (39) to the shaft of the Front Sprocket Clutch (37) and start the shaft into the Main Casting Bearing.

5. Inspect the needle bearings in the pulleys of the Rewind and Fast Forward Clutches to make sure all are in place and none are missing.

6. Engage the gear teeth of the Rewind and Fast Forward Clutches with the gear teeth of the clutched gear on the Front Sprocket Clutch and align the Rewind and Fast Forward Clutches with their shafts.

7. Push all three clutches toward the main casting simultaneously until the Rewind and Fast Forward Clutches have started onto their shafts.

8. Continue pushing the clutches toward the main casting until the fast forward Drive Belt can be seated on the Fast Forward Clutch Pulley. Seat the belt and push the three clutches all the way to the main casting.

9. Use the correct number of Washers (30) and (35) to obtain an end play of .001" to .005" on clutches (27) and (32) when Washers (29) and (34) and "E" Rings (28) and (33) are assembled.

10. Assemble the correct number of Washers (21) to obtain an end play of .001" to .005" on clutch (37) when "C" Ring (20) is assembled.

11. Apply a light coat of DC 44 grease (39479-P9) to gear (17) and assemble the gear to the shaft of the Front Sprocket Clutch (37).

12. Assemble Arbor (15) to the shaft and pin it in place with Pin (16).

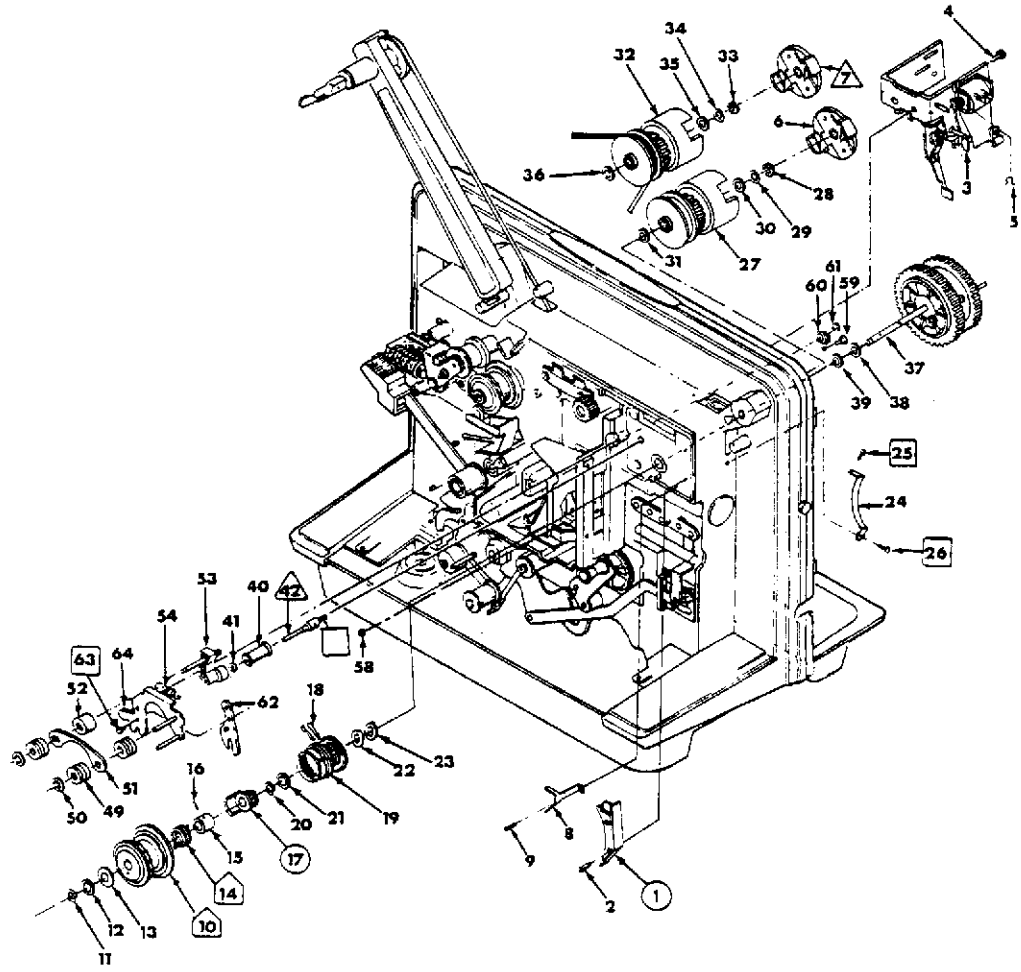


Figure 3-2. REMOVAL AND REASSEMBLY OF FRONT CLUTCHES

13. Apply a light film of Teresso Instrument Oil (39479-P8) to the surface of Arbor (15) and assemble the Clutch Spring (14) on the Arbor. Make sure the tails of the Spring turn away from the raised sector of Gear (17). The Master Control Lever should move up and down easily with no binding after the Spring (14) is installed.

14. Assemble the Front Sprocket (10) using the correct number of Washer (13) to obtain an end play of .003" to .007" for the Sprocket. (In order to correctly check the end play of the Sprocket, the front sprocket clutch Shaft must be prevented from moving since it has its own end play of .001" to .005".)

15. Assemble the Film Stripper (8).

16. Apply a thin film of Extreme Pressure Lube #3 (39479-P16) to the tail of the clutch Springs in the Rewind and Fast Forward Clutches.

17. Assemble the rewind and fast forward clutch Actuator Caps (6) and (7) such that the ramps on the Caps engage the tails on the clutch Springs to make the springs wrap tighter around their arbors when the Actuator Caps are pushed in.

18. Hold the Actuator Caps (6) and (7) in place and assemble the Solenoid Package (3) with three Screws (4) making sure to insert the interlock link wire into the slot in the bottom of the Interlock Solenoid Paddle.

E. Removal of Take-Up Clutch

1. Remove the motor and motor mounting plate to expose the take-up clutch for servicing.

2. In its normal position, the roll pin which holds the upper end of the clutch arm to the reel arm shaft is difficult to remove.

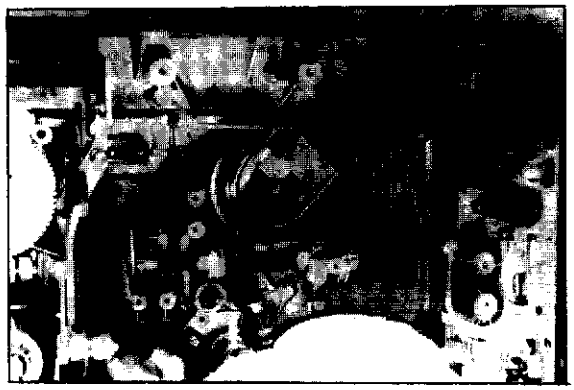


Figure 3-3. TAKE-UP CLUTCH

3. Remove the reel arm belt and place a block of wood under the arm as shown to hold it in a vertical position.

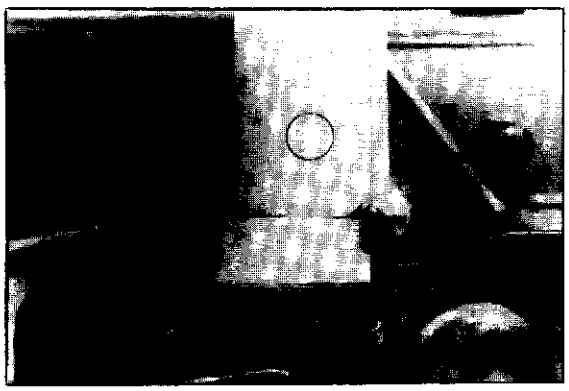


Figure 3-4. REEL ARM BLOCKED

4. Drive the roll pin out with a 3/32" (2.5mm) pin punch.

5. Remove the upper end of the clutch arm from the reel shaft. Remove the reel arm. Clean the shaft and casting hole and relubricate with G.E. Versilube G-322L. (39479-P14)

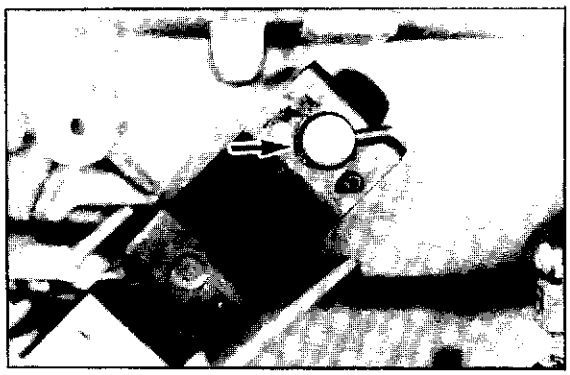


Figure 3-5. ROLL PIN IN POSITION

6. Pull the clutch hub (pulley) out of the take-up gear and push down on it to compress the bias spring and allow the hook of the rod to rise up in the slot.

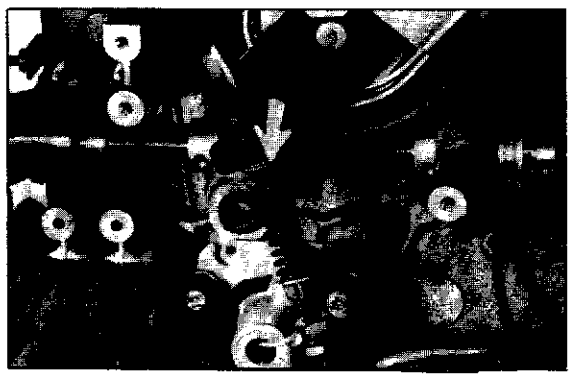


Figure 3-6. PUSH DOWN ON BIAS SPRING

7. As soon as the hook clears the slot, the clutch arm can be swung out and lifted up off the rod.

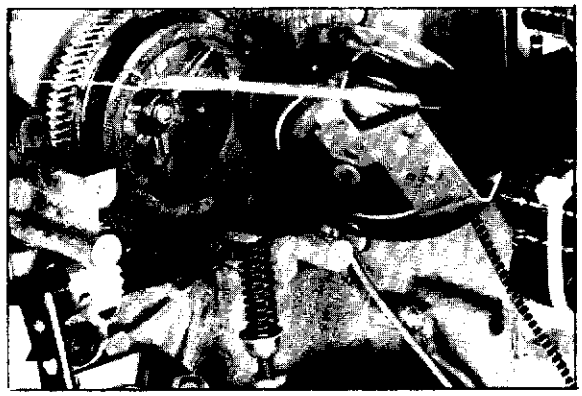


Figure 3-7. SWING CLUTCH ARM OUT

8. Clean the main shaft worm gear and the take-up gear with a clean, dry cloth or toothbrush. (DO NOT USE SOLVENTS ON THESE GEARS AS THEY WILL CRAZE OR CRACK).

9. Grasp the take-up gear and attempt to move it up and down. If noticeable movement is detected, the rear main casting bearing is worn and must be replaced. Remove the rear sprocket and take-up gear, press the old bearing out and a new bearing in and reassemble the sprocket and take-up gear.

10. Lubricate the worm gear and take-up gear with DC 44 grease (39479-P9) applied with a brush onto the teeth.

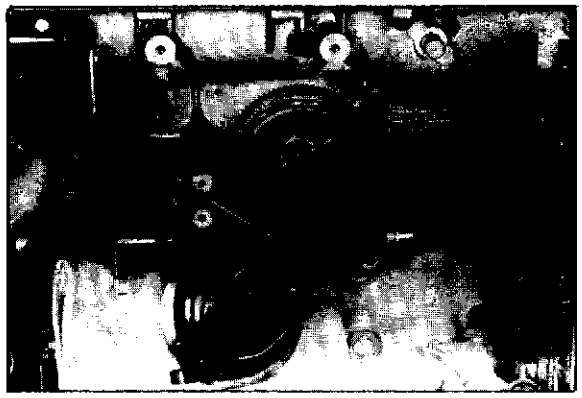


Figure 3-8. CHECK and CLEAN GEARS and BEARING

Installation of Blue or GREEN Take-Up Clutch Liner

1. Butt the two ends of the liner against the key inside the take-up gear.

2. Form a slight belly in the liner opposite the key and push the liner into the take-up gear.

3. Push out on the belly formed in step 2 and the liner will snap into correct position inside the gear.

Note: The liner may appear to be too long. However, it is not. DO NOT CUT THE LINER TO MAKE IT SHORTER.

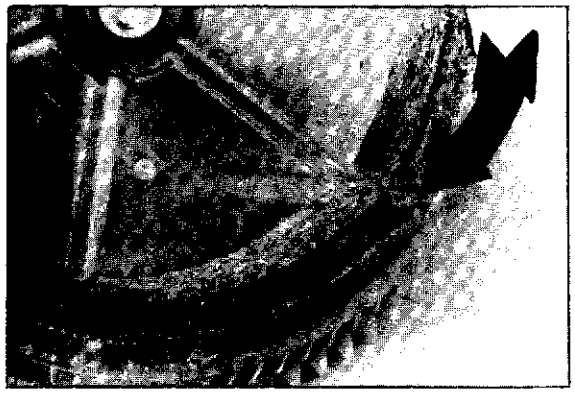


Figure 3-9. INSTALLATION OF CLUTCH LINER

Take-Up Clutch Arm Servicing

1. On projectors without the FAST FORWARD option, it is necessary to disassemble and thoroughly clean the take-up pulley and brake spring.

2. Use a cotton swab saturated with Teresso Instrument Oil (39479-P8) to clean the pulley oilite bearing. DO NOT IMMERSE THE BEARING IN SOLVENT.

3. Replace the brake spring and brake spring hub if deformed or scored.

4. Lubricate the brake spring hub with four small drops of Teresso Instrument Oil.

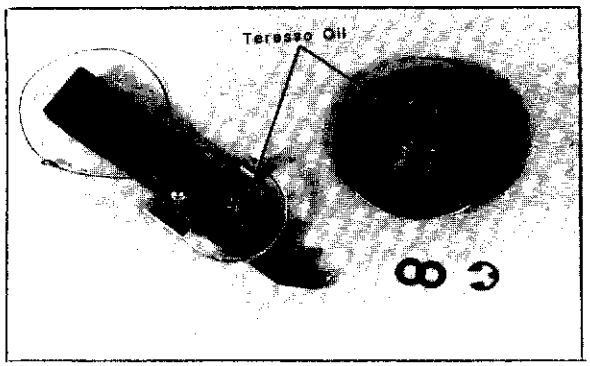


Figure 3-10. CLEAN and SERVICE CLUTCH ARM

F. Take- Up Clutch Reassembly

1. Reassemble the take-up clutch and assemble it to the projector.

2. Press a new roll pin in place making sure that it extends far enough to contact the roll pin on the take-up arm.

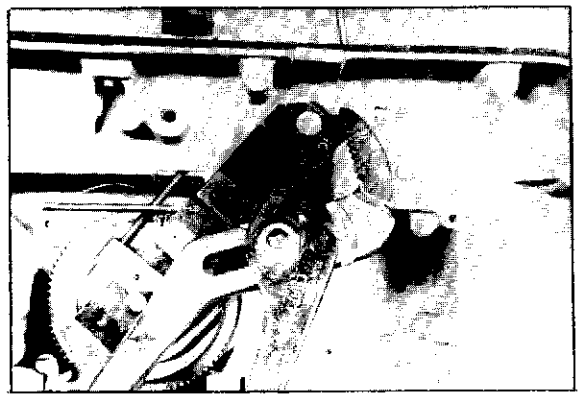


Figure 3-11. INSTALL ROLL PIN

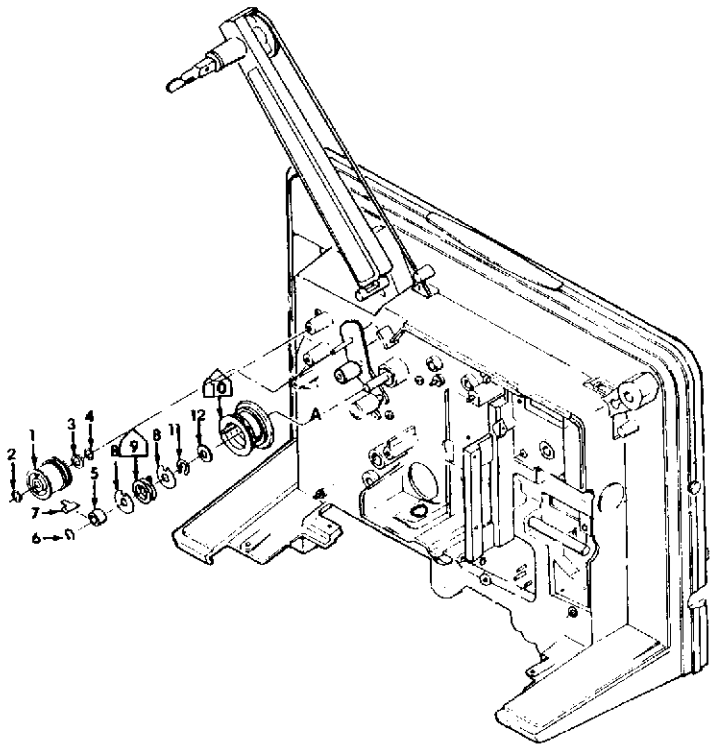


Figure 3-12 REMOVAL AND REASSEMBLY OF TAKE-UP SPROCKET

G. Removal of Take-Up Sprocket and Gear

1. Remove the Take-Up Clutch.

2. Remove the Grip Ring (6) and manually rotate the take-up Sprocket (10) clockwise slightly to move the sprocket Pin away from the stop (7). (Figure 3-12)

3. Grasp the Stop (7) with a pair of pliers and pull it straight out.

4. Slowly release your grip on the Sprocket (10) and allow the Spring (9) to unwind.

5. Remove the Spacer (5), Outside Washer (8), Spring (9) and Inside Washer (8). (The two washers (8) are usually removed easily with a magnet.)

6. Remove Grip Ring (11), Washer (12) and Sprocket (10).

7. Slide the Take-Up Gear out of the main casting bearing (Figure 3-13).

H. Reassembly of Take-Up Gear and Sprocket

1. Clean the main casting Oilite Bearing with a cotton swab moistened with Teresso Instrument Oil (39479 -P8).

2. Lubricate the teeth of the Take-Up Gear with a light coat of DC-44 grease and push the shaft of the gear through the main casting Oilite Bearing.

3. Assemble the sprocket (10) and the correct number of Washers (12) to allow for .003 to .007" end play of the sprocket (10) when the Grip Ring (11) is installed (Figure 3-12).

4. Install Inside Washer (8) and Spring (9).(The Spring (9) should be installed so turning the Sprocket (10) clockwise will tighten the Spring.)

5. Install Outside Washer (8) after lubricating the surface of the Spring (9) with Terreso Instrument Oil (39479-P8).

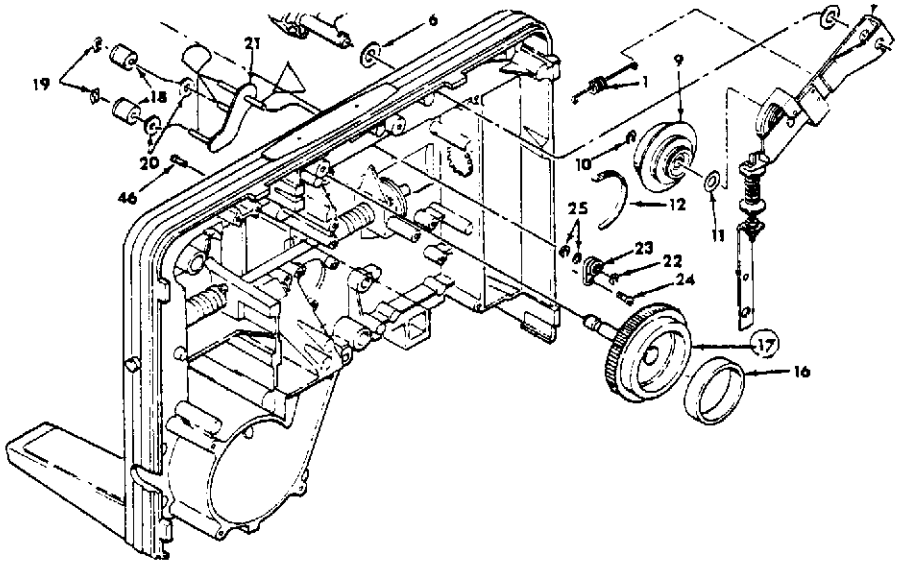


Figure 3-13. REMOVAL AND REASSEMBLY OF TAKE-UP GEAR

6. Wind the Sprocket (10) clockwise until the Spring (9) is fully wound. Then allow the Sprocket to unwind one full turn. (Use the pin in the Sprocket as your point of reference.)

7. Note the position of the slot in the end of the shaft with relation to the pin in the Sprocket. This determines which way the Stop (7) will be installed to stop the sprocket rotation as soon as possible during its next rotation.

8. Release the sprocket and allow the spring to unwind completely.

9. Install the Stop (7) in the position determined in Step 7 above but allow the end of the Stop (7) to be lifted up enough to allow the Sprocket Pin to rotate under it when the Spring (9) is wound.

10. Wind the Sprocket (10) until the Spring (9) is completely wound and then allow the Sprocket to unwind just enough that the Sprocket Pin passes under the Stop (7) once. Push the Stop down all the way and allow the Sprocket to unwind until the Pin comes to rest against the Stop.

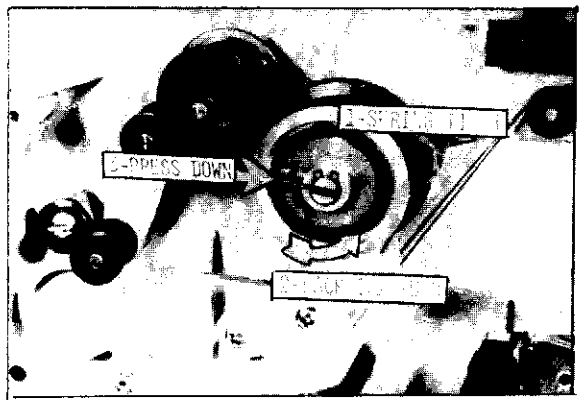


Figure 3-14. TAKE-UP SPROCKET LOADING

J. Spring Loading Tip

1. An easy way to load the Spring is to use the projector drive motor, running in REVERSE.
2. Assemble the spring to the projector as described above.
3. While holding both the Spring (9) and the Sprocket (10), push the REVERSE button and allow the turning of the shaft to wind the Spring.
4. When the Spring is small enough, it can be pushed into the Sprocket. The same method may be used to load the Spring after the Stop (7) has been installed.

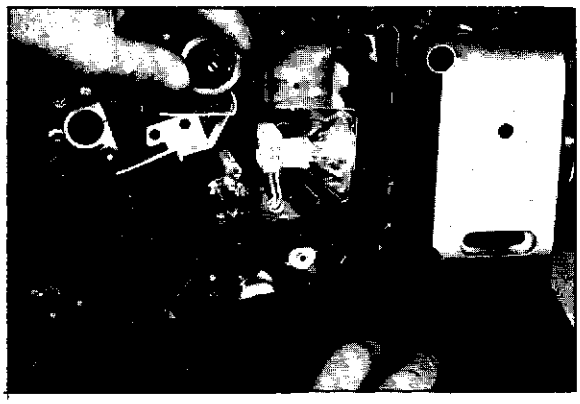


Figure 3-15. WINDING TAKE-UP SPROCKET SPRING

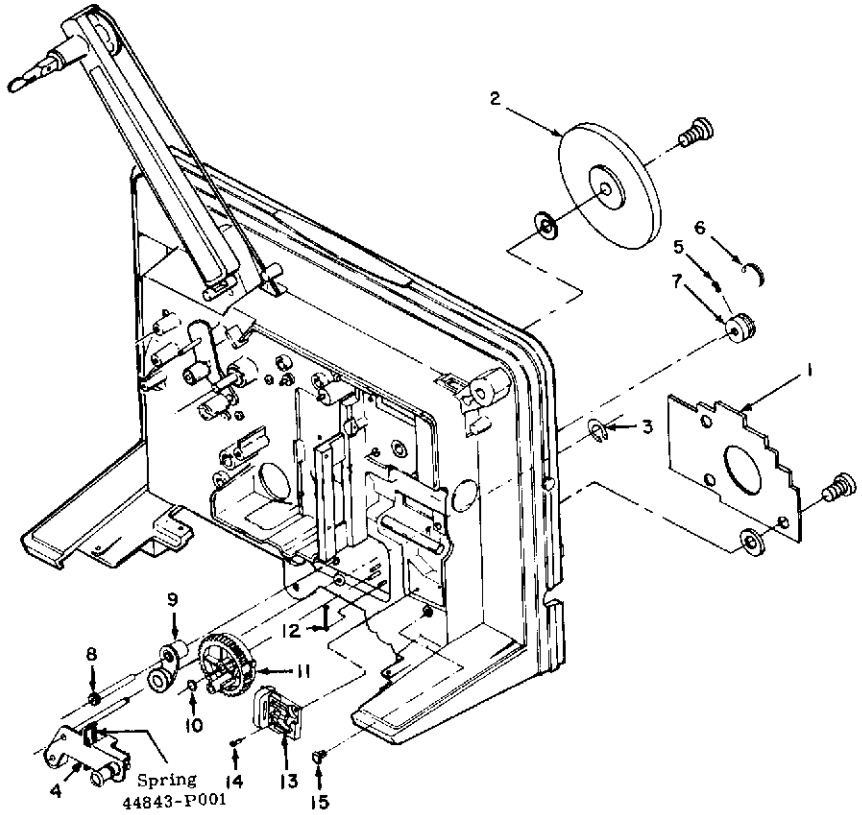


Figure 3-16. AUTOMATIC LOOP RESET REMOVAL AND REASSEMBLY

K. Removal of Automatic Loop Reset Assembly

1. Remove the venturi plate (1).
2. Remove the sound drum Flywheel (2).
3. With a long, flat-blade screwdriver, reach in behind the blower venturi plate and remove the "E" Ring (3).
4. Slide the Arm Complete (4) out of its mounting hole in the main casting.
5. Loosen the Set Screws (5), remove Belt loop setter (6), the Pulley (7) and slide the Pinion (8) out of the bearing of the Pivot (9).
6. Remove the "E" Ring (10), the Gear (11) and the Kick Spring (12).

L. Reassembly of Automatic Loop Reset Assembly
Ref. Figure 3-16

1. Clean the Oilite Bearing in the Pivot (9) with a cotton swab moistened with Teresso Instrument Oil (39479-P8).

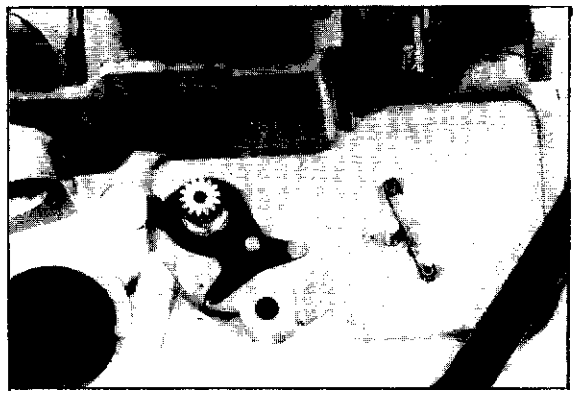


Figure 3-17. KICK SPRING ORIENTATION

2. Assemble the Kick Spring (12) immediately next to the loop reset gear mounting shaft as shown.

3. Insert a dental pick through the small hole next to the hub of the Loop Reset Gear (11) and push the Kick Spring (12) out of the way so the gear can be pushed onto its shaft. Secure the gear with the "E" Ring (10) (251-7-1).

4. Slide the Pinion (8) into the oilite bearing of the Pivot (9) and assemble the Pulley (7) allowing for .001" to .007" end play. Tighten Set Screws (5).

5. Slide the Arm Complete (4) into its mounting hole in the main casting and secure it in place with the "E" Ring (3). (A set of surgical hemostats are very helpful for holding this "E" Ring during installation.)

6. Replace the sound drum Flywheel (2).

7. Move the Master Control Lever to the LOAD position and observe that the cradle in the end of the arm link traps the Loop Reset Arm Eccentric so the Reset Arm is neither forced up by the cradle nor able to be pushed up with the cradle in place (Figure 3-18).

Figure 3-18. LOOP RESET ARM ECCENTRIC ORIENTATION

8. Loosen the Set Screw in the Eccentric and rotate it to fit into the cradle of the Master Control Lever without releasing the Loop Reset Gear with the Master Control Lever in the LOAD position.

M. Removal of Main Shaft Ref. Figure 3-19

1. Unhook the top of the Claw Arm Spring from the Framing Arm and make sure all tension is off the Claw Arm before proceeding with these instructions. Throughout this procedure, be extremely careful of the Claw Arm Pins (Figure 3-20).

2. Loosen both Set Screws (14) in the Pulley (13) so the Pulley will rotate freely on the Main Shaft. (Figure 3-19)

3. Loosen both Set Screws (19) in the Collar (18) so the Collar will rotate freely on the Main Shaft (34).

4. Loosen Set Screw (23) in the pinion (22) so the Pinion will rotate freely on the main shaft.

5. Remove the oval point Jam Screw (27) and loosen the remaining two Set Screws in the Shutter and Cam Assembly (26) so the Cam Assembly will rotate freely on the Main Shaft.

6. Loosen both Set Screws (31) in the Collar (30) so the Collar will rotate freely on the Main Shaft.

7. Loosen Set Screw (25) in the Safety Shutter (24) so the collar of the Safety Shutter rotates freely on the Main Shaft. Unhook the Link (2) from the Safety Shutter and allow the Spring (1) to pull the Link against the Pin on the Bracket Assembly (3). (Disregard for projectors having no Safety Shutter.)

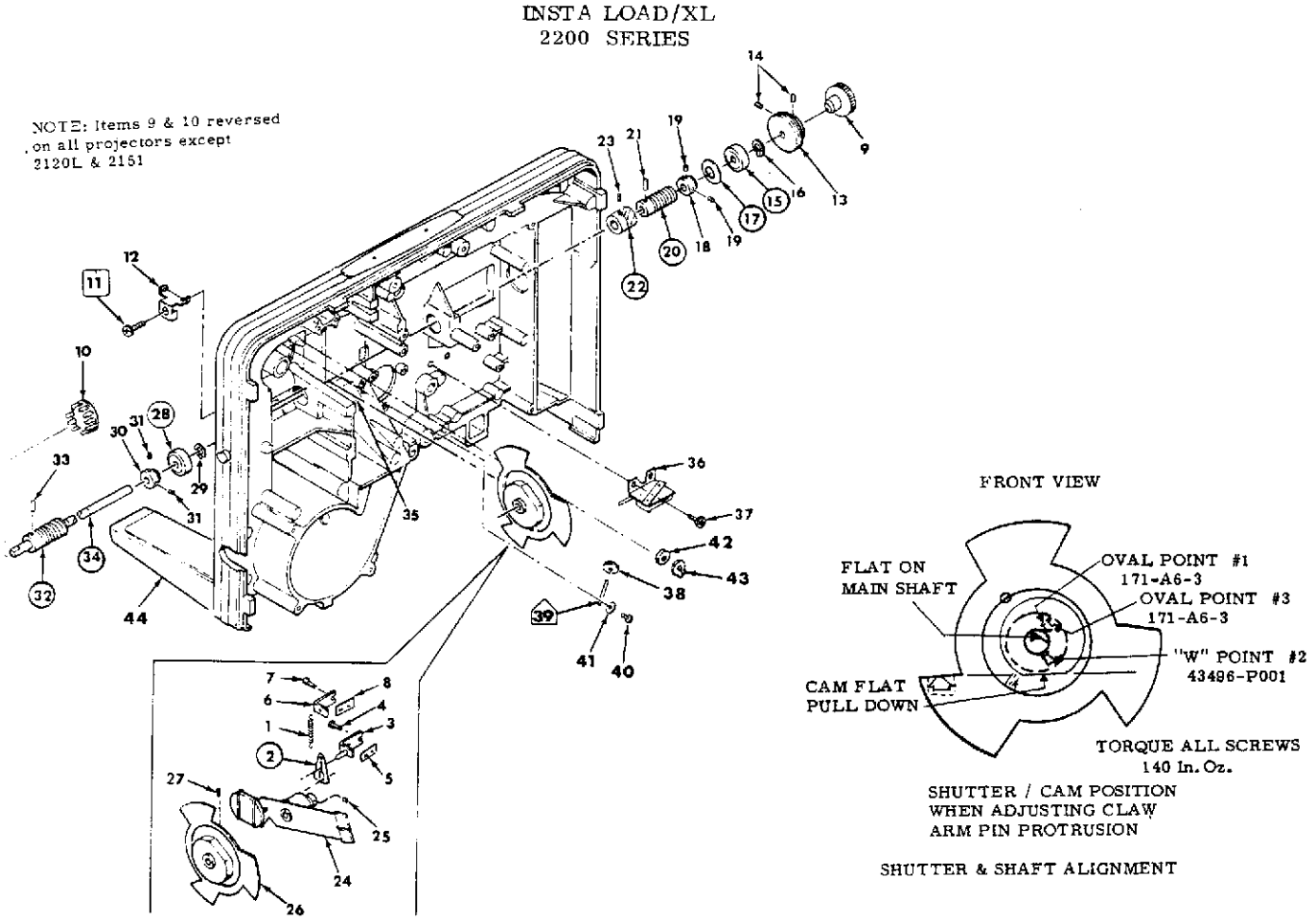


Figure 3-19. REMOVAL AND REASSEMBLY OF MAIN SHAFT

8. Slide the Shutter and Cam Assembly (26) along the main shaft toward the rear of the projector as far as it will go.

9. Pull the Inching Knob (9) off the front of the main shaft and push the main shaft toward the rear of the projector as far as it will go.

10. Tuck a cleaning cloth under the main shaft bearings. Remove "C" Ring (29) located between the Shutter and Cam Assembly (26) and the Front Bearing (28).

11. Remove "C" Ring (16).

12. Drive Pin (21) completely out of Gear (20).

13. Remove the cam Lubricating Pad.

14. Put the Inching Knob (9) back on the front of the main shaft and pull the main shaft toward the front of the projector, removing the Pulley (13) and other parts in order until the Shutter and Cam Assembly (26) can be removed.

N. Reassembly of Main Shaft

1. Assemble the parts to the main shaft in reverse order from which they were removed.

2. Apply a thin coat of DC 44 grease (39479-P9) to the outside circumference of main shaft Bearings (15) and (28).

3. Install "C" Rings (16) and (29) with Waldes retaining ring applicator CR-0310.

4. Align the Set Screws (31) in Collar (30) with their corresponding recesses in the main shaft and start tightening them. Be sure the points of the screws seat properly in the recesses. Otherwise, the main shaft will be burred and will not be positioned properly in the projector. It is best to tighten each one a little bit at a time and alternately with the other one until they cannot be tightened further. The main shaft should visibly move forward during the tightening process. Manually pushing the main shaft forward while starting to tighten these screws will help insure they are seated properly.

5. Tighten Set Screws (19) in Collar (18) observing the proper alignment and seating of the Set Screw points as noted in Step 4. The main shaft will not move forward when these screws are tightened.

6. Use a new Roll Pin (21) (P/N 191-N6-9) when reassembling Gear (20) to the main shaft.

7. Position the Pinion (22) .146" to .156" (diameter of a 5/32" drill bit) from the Drive Gear (20) and tighten Screw (23) on the flat of the main shaft.

8. Install a new Cam Lubricating Pad (P/N 39002 G3).

9. Rotate the Main Shaft (34) until the flat on the shaft just behind the Front Bearing (28) is at about 2 o'clock (See Shutter and Shaft Alignment insert on Figure 3-19). Rotate the Shutter and Cam Assembly (26) until the Setscrew (#1 in insert) lines up with the flat on the Shaft (34). Gently push the Shutter and Cam Assembly forward while pushing down on the Claw Arm until the cam follower on the Claw Arm slips under the the Cam. Tighten the Setscrew (#1 in insert) on the flat of the Shaft (34). Make sure the Claw Arm is not hitting the Aperture Plate.

   Note: Be very careful not to damage the Claw Arm pins.

10. Hook the Claw Arm Spring on the Framing Arm, being very careful that the Cam Follower on the Claw Arm contacts the radial surface of the Cam.

    Note: Be very careful not to damage the Claw Arm pins.

11. Perform all Claw Arm adjustments - Pin protrusion, Side clearance, Pull-down stroke and Framing.

12. Align the main shaft Pulley (13) with the motor pulley for proper drive belt tracking.

13. Lubricate the Drive Gears (20) and (32) with a thin coat of DC 44 grease (39479-P9).

14. Lubricate the Safety Shutter (24) with DC 200 Dampening Fluid (39479-P13).

15. Lubricate the Pinion (22) with a light coat of DC 44 (39479-P9).

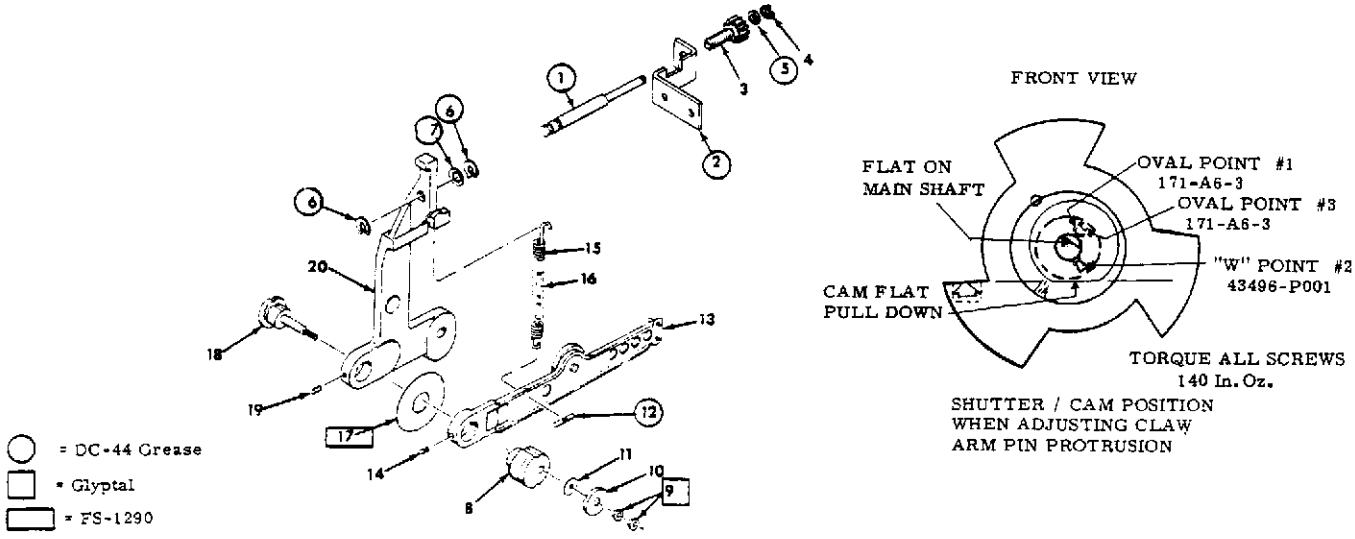


Figure 3-20. REMOVAL AND REASSEMBLY OF CLAW ARM

P. Removal of Claw Arm

Note: Extreme care should be exercised during this procedure to insure that the pins on the Claw Arm are not allowed to hit the aperture plate or any other part of the projector, causing damage to them.

1. Unhook the top of the Claw Arm Spring (15) from the Framing Arm (20) and make sure all tension is off the Claw Arm (13) before proceeding with these instructions.

2. Remove the oval point Jam Screw (#3 in the Shutter and Shaft Alignment insert on Figure 3-20) and loosen the remaining two Setscrews (#1 and #2 in the insert) and move the Shutter and Cam Assembly back on the main shaft to make clearance for removal of the Claw Arm (13).

3. Remove two Nuts (9) and Washers (10) and (11).

4. Loosen the two Setscrews (14) and (19) and remove the Bushing (8), the Washer (17) and the Pivot (18).

   Note: Wipe the Pivot (17) and the Bushing (18) with a Clean, dry rag. DO NOT clean these two parts with solvent.

5. Grasp the Claw Arm (13) and pull toward you being careful not to lose the Spring (15) or Pin (12) or damage the Claw Arm Pins.

6. Unhook the Spring (15) and remove the Pin (12).

Q. Reassembly of Claw Arm to Projector

Note: Extreme care should be exercised during this procedure to insure that the pins on the Claw Arm are not allowed to hit the aperture plate or any other part of the projector, causing damage to them.

1. Apply DC 44 grease (39479-P9) to the Pin (12) and stick the Pin in place on the Claw Arm (13) making sure the notch lines up with the hole in the Claw Arm (13).
2. Apply DC 44 grease to Rod (1) threads.
3. Hook Spring (15) onto the Claw Arm (13) and insert the Claw Arm (13) into the projector between the Framing Arm (20) and the Shutter and Cam Assembly .
4. Lubricate both sides of Washer (17) with FS-1290 lubricant (39479-P4).
5. Assemble Pivot (18), Washer (17), Claw Arm (13), Bushing (8), Washers (11) and (10) and Nuts (9).
6. Tighten Nuts (9) for .001" end play and coat Nuts with Blue Glyptal (39490-P1). The outside Nut is a jam nut to prevent the inside nut from turning off the Pivot shaft.
7. Rotate the Pivot (18) so the Eccentric Pin is between 6 and 7 o'clock when viewed from the front of the projector. Tighten the Pivot Setscrew (19).
8. Rotate the Bushing (8) so its circumference lines up with the circumference of the Pivot (18) and the groove in its side is slightly below the groove in the side of the Pivot (18). Tighten the Claw Arm Setscrew (14).
9. Gently push the Shutter and Cam Assembly forward while pushing down on the Claw Arm (13) making sure the cam follower on the Claw Arm slides under the Cam. Tighten the Setscrew (#1 in the Shutter and Shaft Alignment insert of Figure 3-20) on the flat of the main drive shaft. (See Step 9 under Reassembly of Main Shaft.) Make sure the Claw Arm (13) is not hitting the aperture plate.
10. Hook the top of the Claw Arm Spring (15) on the Framing Arm (20) being very careful that the cam follower on the Claw Arm contacts the radial surface of the Cam.

    Note: Be very careful not to damage the Claw Arm pins.

11. Make sure Pin (12) is trapped in place by Spring (15).
12. Perform all Claw Arm Adjustments - Side Clearance, Pull-down Stroke, Framing and Pin Protrusion.

Claw Arm Adjustments
Side Clearance
Pull-down Stroke

Note: These two adjustments are interdependent and must be adjusted at the same time. If either one is adjusted, the other must be checked and adjusted as necessary until requirements for both can be met.

A good starting position for the Pivot (18) (Figure 3-21) places its eccentric pin at about 7 o'clock when viewed from the front of the projector. (See Figure 3-25) The notch in Bushing (8) should be slightly below the notch in Pivot (18) so an imaginary line drawn across the top of the Bushing notch aligns with the bottom of the Pivot notch.

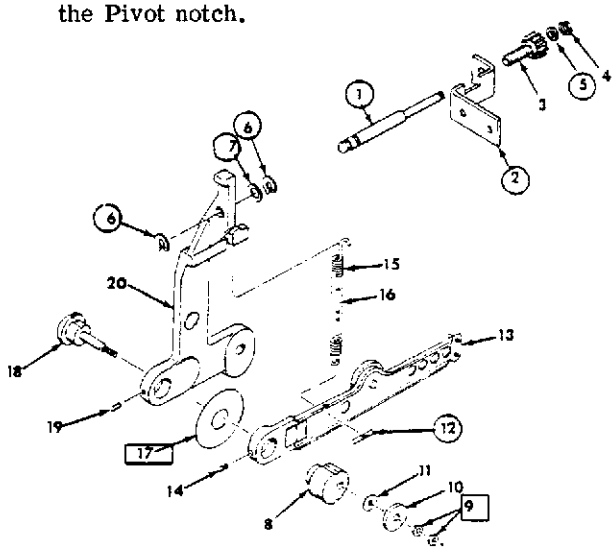


Figure 3-21. CLAW ARM ADJUSTMENTS

Before attempting any adjustments, manually rotate the inching knob to make sure the Claw Arm pins do not strike the sides of the Aperture Plate Claw Slot. At the top of the Claw Arm Stroke, the Top Claw Arm Pin will be nearer the inside edge of the Aperture Plate Slot (Figure 3-22). At the bottom of its travel, this Pin will be nearer the outside edge of the Aperture Plate Slot. Loosen Screw (14) and adjust Bushing (8) (Figure 3-21) so these two distances are equal. (Removing the Lamphouse Cover and viewing the Pins from behind the Aperture Plate aids in this adjustment.)

1. Thread an old film in the projector (do not use a good film for this adjustment) and adjust the Framing Knob to eliminate any frame lines at the top or bottom of the projected image with the projector running in FORWARD. If excessive noise results when the Framing Knob is moved, stop the projector and check the location of the Claw Arm Pins in the sprocket holes of the film. When Framing is correct, the Top Claw Arm Pin should be the same distance from the inside edge of the sprocket hole at the top of its stroke as it is from the outside edge of the sprocket hole at the bottom of its stroke.(Figure 3-22). Loosen Screw (14) and adjust the Bushing (8) (Figure 3-21) so these two distances are equal. Remove the film from the projector after proper Framing and Side Clearance are established.

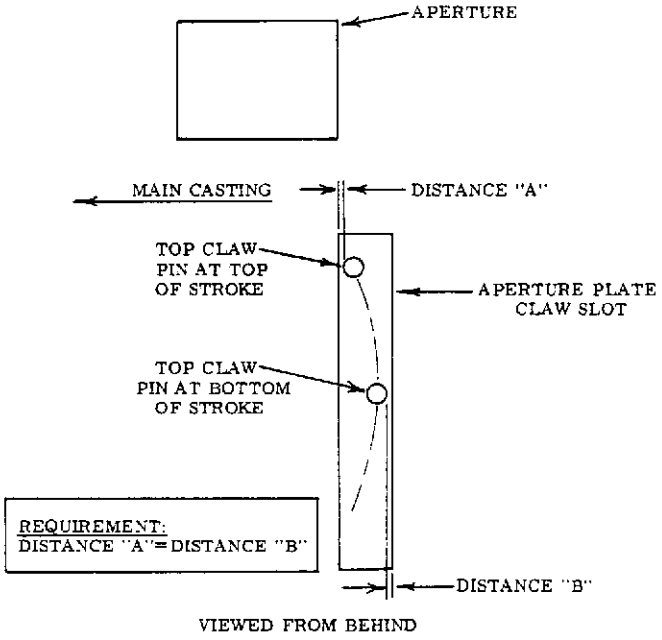


Figure 3-22. SIDE CLEARANCE

2. Remove the Motor Drive Belt or disconnect the Motor wires so the Main Drive Shaft will not turn during the next adjustments. Be careful not to disconnect the Blower wires.

   (As an alternative, the STILL button may be depressed on models having that feature.)

3. Rotate the Inching Knob clockwise until the Claw Arm Pins are in the Aperture Plate Slot at the bottom of their travel. Insert the Stroke Setting Gauge (ST-5880) into the Aperture Plate Film Channel. Close the Film Gate. Make sure the Pressure Shoe seats properly. Push the Gauge down until it hits the Claw Arm Pins.

4. Rotate the Inching Knob clockwise through enough cycles of the Claw Arm to draw the target in the Gauge into the Aperture. Be careful not to allow the Claw Arm to move up at any time when the Pins are engaged in the sprocket holes. The Pins must pull the Gauge down smoothly for the measurement to be valid.

5. After the Gauge Target has been moved into the Aperture, continue turning the Inching Knob clockwise so the Claw Arm Pins withdraw at the bottom of the stroke and raise to the top of the stroke. STOP turning the Inching Knob when the Pins reenter the sprocket holes BEFORE they start moving down. (The Shutter Blade will be even with the bottom edge of the Aperture.)

   Note: If you go too far, go back to Step (3) and repeat.

6. Turn the Lamp on and project an image at least 8" wide (a wide angle lens will help achieve this width at a shorter projection distance), raise the elevation approximately 1" (this will get you set up in case the Stroke is in need of adjustment), and draw a reference line the full width of the Target on the bottom step (Figure 3-23).

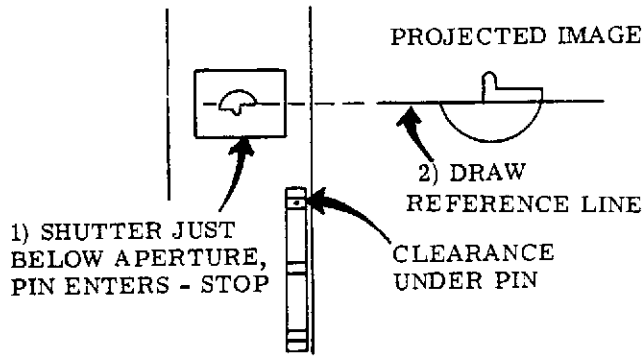


Figure 3-23. CLAW PULL DOWN STROKE SET-UP

7. Pull up on the Gauge. The projected Target will move down. The upper Target step must touch the reference line drawn in Step 6 for correct stroke (Figure 3-24).

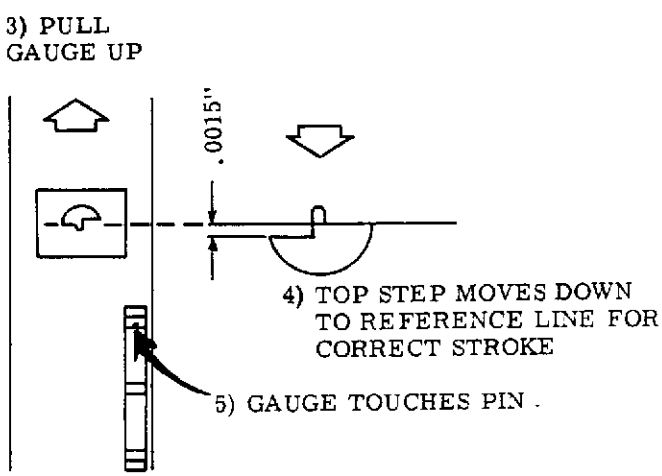


Figure 3-24. CLAW PULL DOWN STROKE

8. Adjust stroke by placing the Shuttle Cam Adjusting Tool (ST- 5884) on the Claw Arm Pivot (18) (Figure 3-21), loosening Screws (14) and (19) and rotating the Pivot (18) and Bushing (8) the same amount in the same direction simultaneously. Turn counterclockwise (as viewed from the front of the projector) to shorten the stroke, and clockwise to lengthen the stroke (Figure 3-25).

Note: Theoretically, turning the Pivot (18) and the Bushing (8) equally will change Pull-Down Stroke but not Side Clearance. However, Side Clearance should be checked.

REQUIREMENT:
The Top Claw Arm Pin should be the same distance from the inside edge of the Gauge sprocket hole at the top of its stroke as it is from the outside edge of the gauge sprocket hole at the bottom of its stroke. (Figure 3-22)

Loosen Screw (14) and adjust the Bushing (8) (Figure 3-21) so these two distances are equal.

WHEN ADJUSTMENTS ARE COMPLETE, THE ECCENTRIC PIN IN THE FRONT PIVOT (18) MUST ALWAYS BE BETWEEN 6 AND 9 O'CLOCK AS VIEWED FROM THE FRONT OF THE PROJECTOR. IF NOT, the cam follower on the Claw Arm may be severely worn requiring replacement of the Claw Arm.

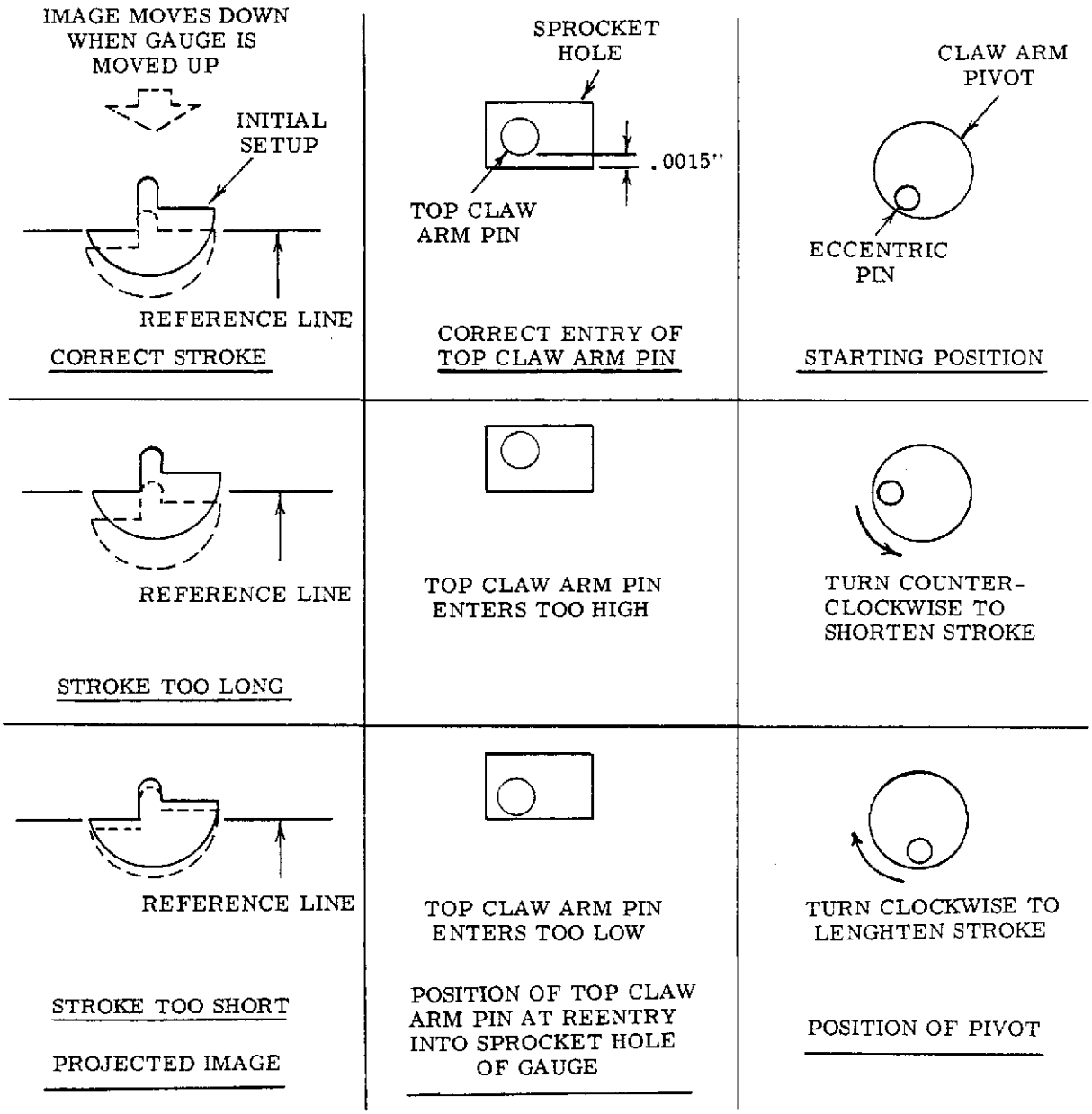


Figure 3-25. CLAW PULL DOWN STROKE ADJUSTMENTS

9. If the stroke was adjusted, repeat Steps 3 through 8. When performing Step 6, it is quite probable that the bottom step of the projected Target no longer rests on the reference line. ADJUST THE ELEVATION to line up the bottom step of the projected Target with the reference line and then proceed with Steps 7 and 8. It may be necessary to repeat this sequence of steps several times until correct stroke and side clearance are obtained.

10. A final, dynamic check for proper Side Clearance is made during the Framing Adjustment which follows.

Claw Arm Adjustments-Model 2280

Side Clearance
Pull-down Stroke

CAUTION: When working on Model 2280 Projectors, NEVER LOOK AT THE LAMP! It is advisable to wear dark or tinted glasses (preferably safety glasses) when working on these projectors.

Note: These two adjustments are interdependent and must be adjusted at the same time. If either one is adjusted, the other must be checked and adjusted as necessary until requirements for both can be met.

A good starting position for the Pivot (18) (Figure 3-26) places its eccentric pin at about 7 o'clock when viewed from the front of the projector. (See Figure 3-25) The notch in Bushing (8) should be slightly below the notch in Pivot (18) so an imaginary line drawn across the top of the Bushing notch aligns with the bottom of the Pivot notch.

Before attempting any adjustments, manually rotate the Inching Knob to make sure the Claw Arm pins do not strike the sides of the Aperture Plate Claw Slot. At the top of the Claw Arm Stroke, the Top Claw Arm Pin will be nearer the inside edge of the Aperture Plate Slot (Figure 3-27). At the bottom of its travel, this Pin will be nearer the outside edge of the Aperture Plate Slot. Loosen Screw (14) and adjust Bushing (8) (Figure 3-26) so these two distances are equal. (Removing the Lamphouse Cover and viewing the Pins from behind the Aperture Plate aids in this adjustment.)

1. Thread an old film in the projector (do not use a good film for this adjustment) and adjust the Framing Knob to eliminate any frame lines at the top or bottom of the projected image with the projector running in FORWARD. If excessive noise results when the Framing Knob is moved, stop the projector and check the location of the Claw

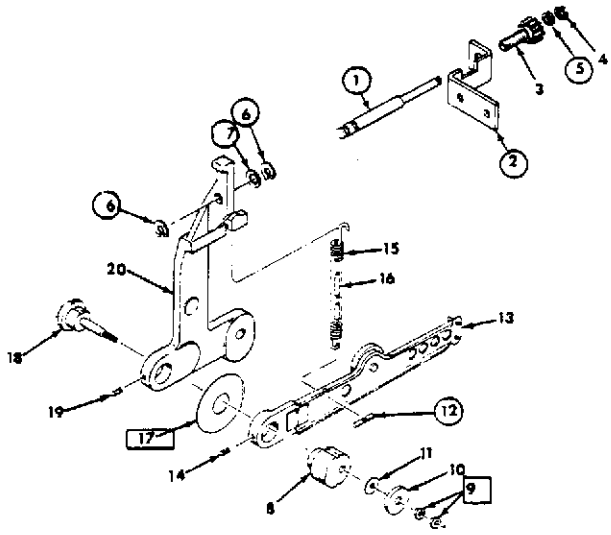
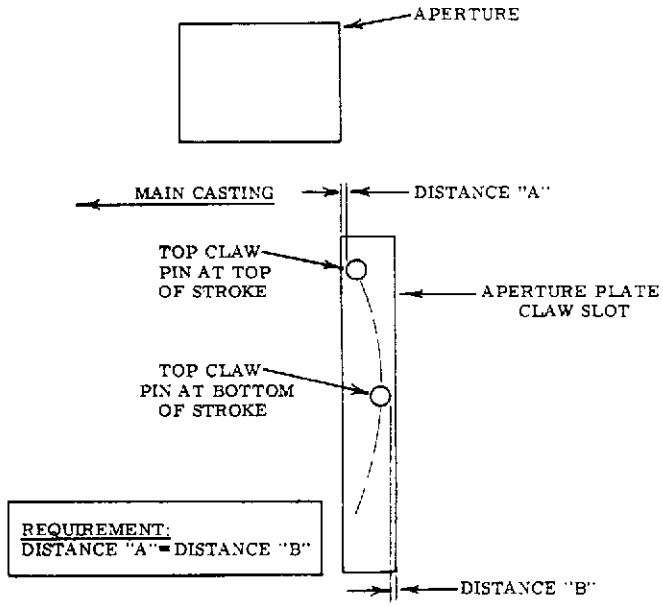


Figure 3-26. CLAW ARM ADJUSTMENTS

Arm Pins in the sprocket holes of the film. When Framing is correct, the Top Claw Arm Pin should be the same distance from the inside edge of the sprocket hole at the top of its stroke as it is from the outside edge of the sprocket hole at the bottom of its stroke. (Figure 3-27) Loosen Screw (14) and adjust the Bushing (8) (Figure 3-26) so these two distances are equal. Remove the film from the projector after proper Framing and Side Clearance are established.



VIEWED FROM BEHIND

Figure 3-27. SIDE CLEARANCE

2. Rotate the Inching Knob clockwise until the Claw Arm Pins are in the Aperture Plate Slot at the bottom of their travel. Insert the Stroke Setting Gauge (ST-5880) into the Aperture Plate Film Channel. Close the Film Gate. Make sure the Pressure Shoe seats properly. Push the Gauge down until it hits the Claw Arm Pins.

3. Rotate the Inching Knob clockwise through enough cycles of the Claw Arm to draw the Target in the Gauge into the Aperture. Be careful not to allow the Claw Arm to move up at any time when the Pins are engaged in the sprocket holes. The Pins must pull the Gauge down smoothly for the measurement to be valid.

4. After the Gauge Target has been moved into the Aperture, continue turning the Inching Knob clockwise so the Claw Arm Pins withdraw at the bottom of the stroke and raise to the top of the stroke. STOP turning the Inching Knob when the Pins reenter the sprocket holes BEFORE they start moving down. (The Shutter Blade will be even with the bottom edge of the Aperture.)

   Note: If you go too far, go back to Step (2) and repeat.

5. Modify a discarded 42994-G1 Safety Shutter as shown in (Figure 3-28). (A similar heat filter may be used)

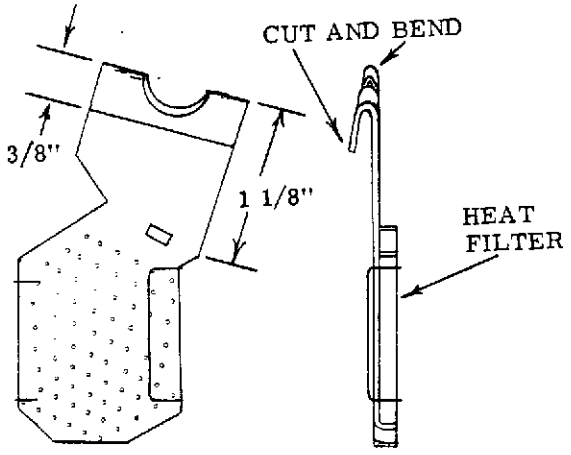


Figure 3-28. MODIFIED SAFETY SHUTTER (42994-G1)

6. Hang this Heat Filter on the front of the Arc Lamp Mounting Bracket so it is between the Lamp and the Aperture. Make sure there is enough clearance so the Douser does not hit the Filter when the Douser is raised.

7. Operate the LAMP switch to "ON" . Leave the main pushbutton switch on "STOP". It is suggested that the Lamp be left "ON" during the remaining tests. If the Lamp is turned "OFF", it must be allowed to cool before it will strike again.

8. Manually raise the Douser and project an image at least 8" wide (a wide angle lens will help achieve this width at a shorter projection distance), raise the elevation approximately 1" (this will get you set up in case stroke is in need of adjustment), and draw a reference line the full width of the Target on the bottom step. (Figure 3-29)

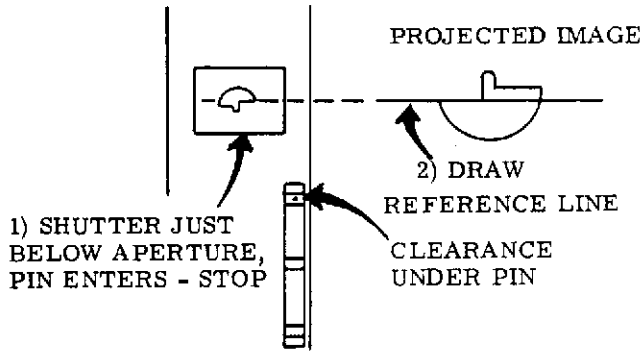


Figure 3-29. CLAW PULL DOWN STROKE SET-UP

9. Pull up on the Gauge. The projected Target will move down. The upper Target step must touch the reference line drawn in Step 8 for correct stroke (Figure 3-30).

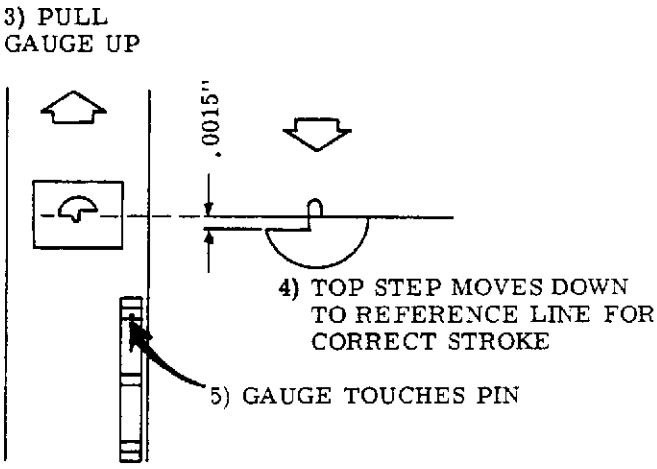


Figure 3-30. CLAW PULL DOWN STROKE

10. Adjust stroke by placing the Shuttle Cam Adjusting Tool (ST-5884) on the Claw Arm Pivot (18) (Figure 3-26), loosening Screws (14) and (19) and rotating the Pivot (18) and the Bushing (8) the same amount in the same direction simultaneously. Turn counterclockwise (as viewed from the front of the projector) to shorten the stroke, and clockwise to lengthen the stroke. (Figure 3-31)

    Note: Theoretically, turning the Pivot (18) and the Bushing (8) equally will change Pull-Down Stroke but not Side Clearance. However, Side Clearance should be checked.

    REQUIREMENT:
    The Top Claw Arm Pin should be the same distance from the inside edge of the Gauge sprocket hole at the top of its stroke as it is from the outside edge of the Gauge sprocket hole at the bottom of its stroke. (Figure 3-27)

Loosen Screw (14) and adjust the Bushing (8) (Figure 3-26) so these two distances are equal.

WHEN ADJUSTMENTS ARE COMPLETE, THE ECCENTRIC PIN IN THE FRONT PIVOT (18) MUST ALWAYS BE BETWEEN 6 and 9 O'CLOCK AS VIEWED FROM THE FRONT OF THE PROJECTOR. IF NOT, the cam follower on the Claw Arm may be severely worn requiring replacement of the Claw Arm.

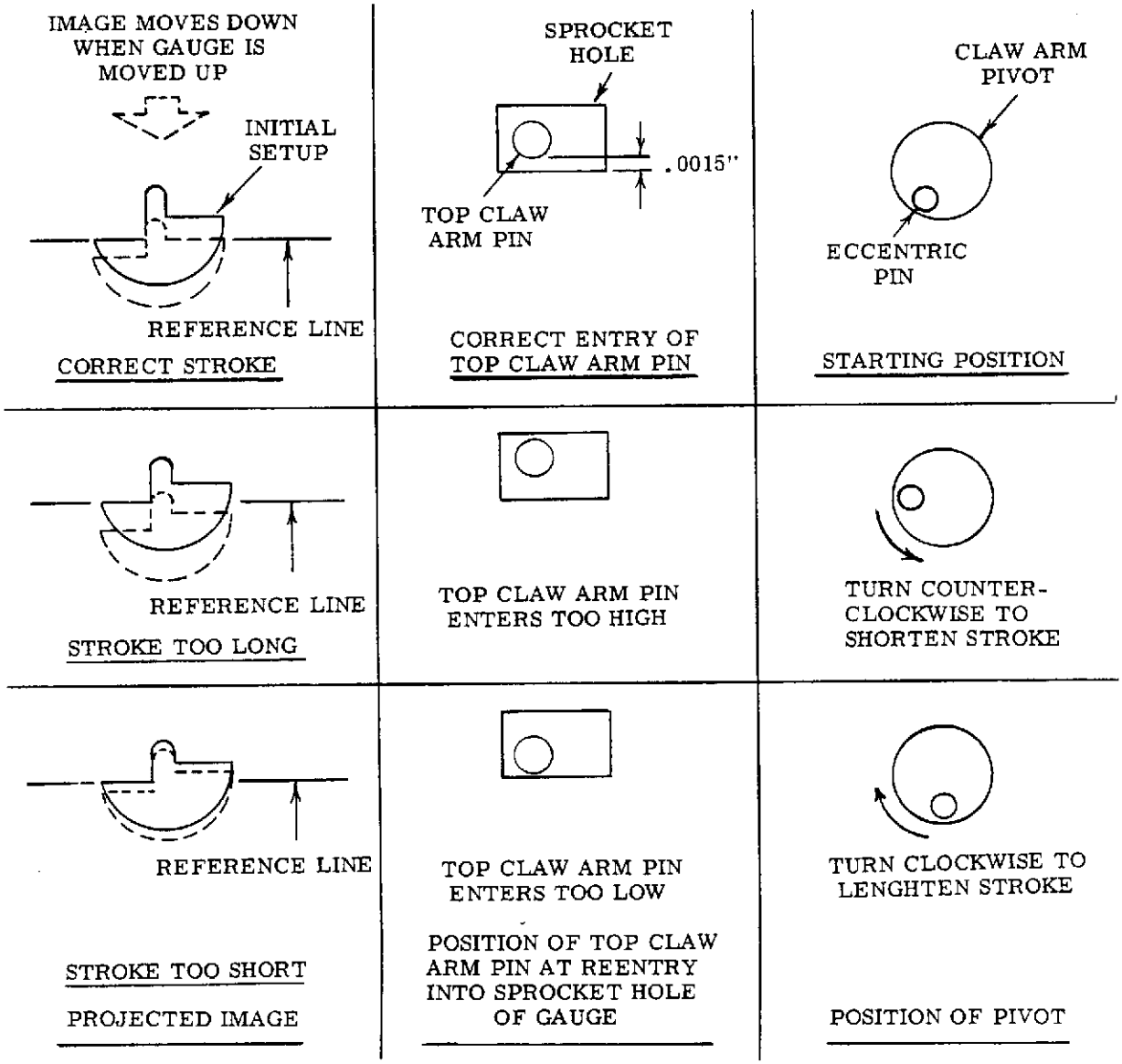


Figure 3-31. CLAW PULL DOWN STROKE ADJUSTMENTS

11. If the stroke was adjusted, repeat Steps 2 through 10. When performing Step 8, it is quite probable that the bottom step of the projected Target no longer rests on the reference line. ADJUST THE ELEVATION to line up the bottom step of the projected Target with the reference line and then proceed with Steps 9 and 10. It may be necessary to repeat this sequence of steps several times until correct stroke and side clearance are obtained.

R. Framing Adjustment

1. After the Claw Arm Adjustments have been checked and/or made, the Framing Limit Plate can be adjusted. (Figure 3-32)

2. Thread film in the Projector and run it in FORWARD. Adjust the Framing Knob to eliminate any frame lines at the top or bottom of the projected image.

3. Loosen two Screws (41) and slide the Framing Limit Plate (40) so the top of the Framing Arm (43) is centered in the notch of the Framing Limit Plate (40). Tighten the two Screws (41).

4. Run the projector in FORWARD and adjust the Framing Knob maximum in both directions. A frame line should move into the projected picture an equal amount on both top and bottom. Readjust the Framing Limit Plate (40) until this requirement is met.

   Note: If the projector becomes noisy when the Framing Knob is rotated maximum in either direction, the Side Clearance is not correct and must be adjusted. (See Claw Arm Adjustments.)

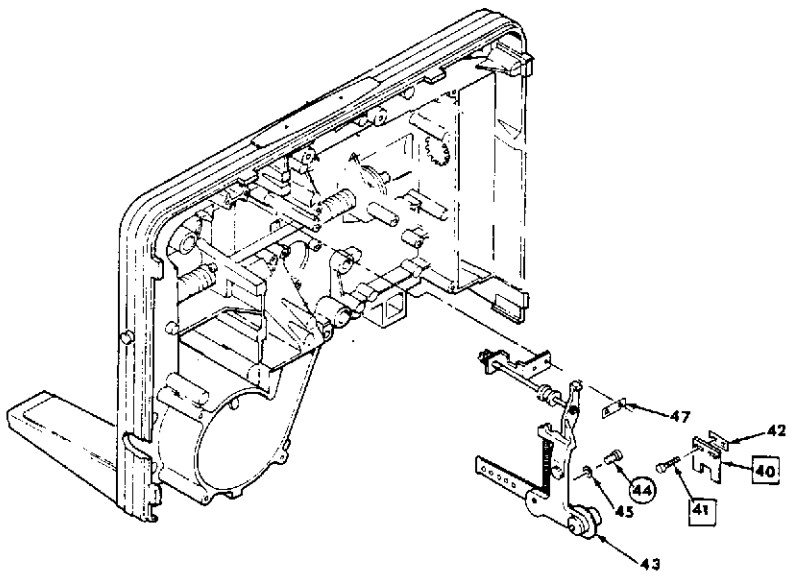


Figure 3-32. FRAMING ADJUSTMENT

S. Replacing Photo Diode Chip in Sound Drum

1. Mark the body of the Sound Drum Support at the outer end of the Photo Diode (this establishes proper orientation for installation of a new Diode).

2. Remove the Retainer (1) and the Photo Diode (2) out of the slot. Clip the leads and discard the Diode. (Figure 3-33)

3. Remove the Insulating Tubing (3) and unsolder the remaining portion of the Diode leads.

4. Clean the residual epoxy cement from the Photo Diode Slot.

5. Position a new Photo Diode into the slot with the shiny, black surface up (red wire) and the end aligned with the mark made in Step 1. Assemble the Retainer (1) to hold the Photo Diode in place, orienting the Retainer as shown in Figure 3-33. Make sure the Photo Diode is perfectly flat in the slot. (The end of the Photo Diode should be .293" --about 9/32"-- from the end of the Sound Drum Support.) THE PHOTO DIODE IS VERY FRAGILE. BE VERY CAREFUL NOT TO BREAK IT!

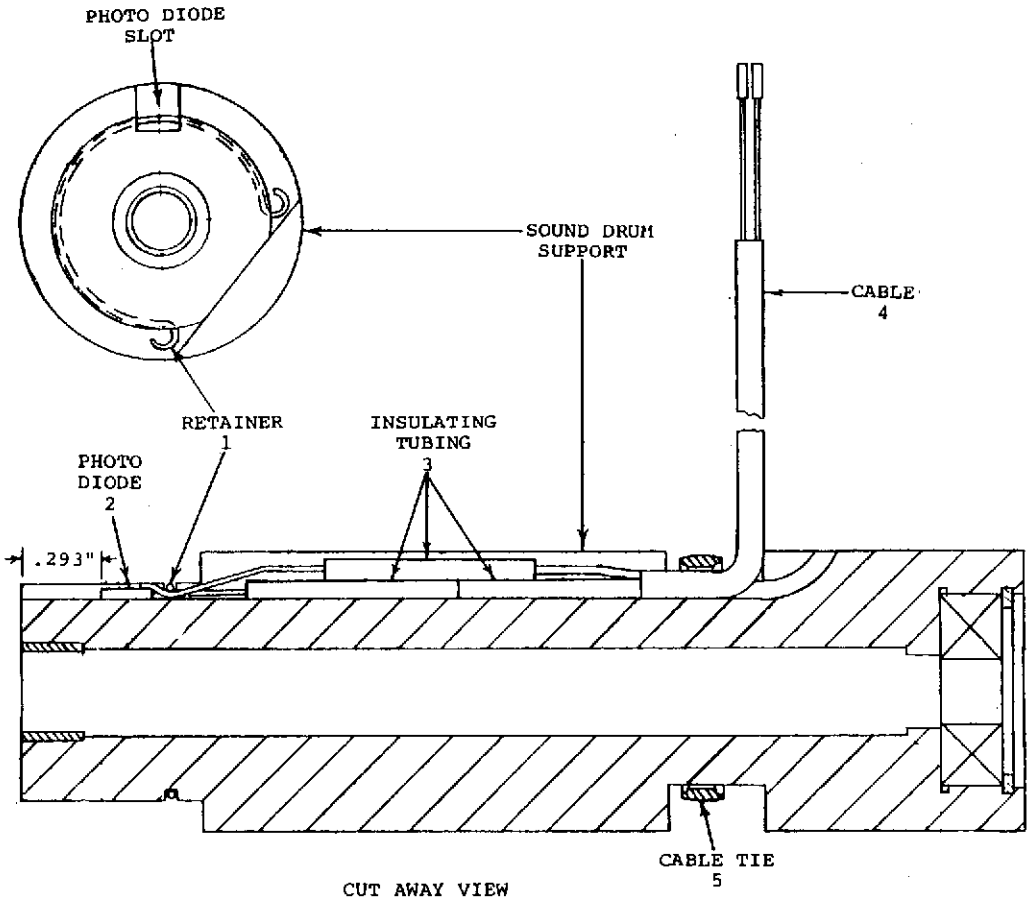


Figure 3-33. REPLACING PHOTO DIODE CHIP IN SOUND DRUM SUPPORT

6. Mix 100 parts of Hysol R9-2039 Resin to 11 parts of Hysol H2-3404 Hardener (by weight). Dip a toothpick or paperclip in the cement mixture and apply cement to the slot, contacting the front edge of the Photo Diode so the cement will run under the Diode. DO NOT allow the cement to get on the top surface of the Diode. Allow the cement to dry thoroughly (overnight) before proceeding.

7. Slide the insulating tubing on the leads of the Photo Diode and make sure that the third piece of tubing is on the shield of the Cable (4). Solder the Black lead of the Photo Diode to the Shield of the Cable and the Red lead to the Center Conductor. Slide the tubing over the solder connections (It may be helpful to cut the Cable Tie (5) so the Cable can be lifted out of the slot for soldering). Dress the wires into the slot and replace the Cable Tie, if cut.

8. Measure the resistance between the Shield of the Cable and the Sound Drum Support with an Ohmmeter. The resistance must be 5 Megohms MINIMUM.

T. Sound Drum Adjustments

1. Loosen the Sound Optic Setscrew and remove the Sound Optic Cartridge. (This Cartridge may be very difficult to remove due to the wedging action of the nylon plug used to lock it in place. Rotating it back and forth while pushing up on it will aid in its removal. DO NOT pry up on the bottom of the Cartridge as this will damage the bottom lens.) Inspect the bottom lens element for damage.

2. Insert the Sound Drum Locating Plug (T-38001-G) in place of the Sound Optic Cartridge. Push the Plug down until the small pin in its end is just above the Photo Diode in the Sound Drum Support (the pin should not touch the Diode).

3. Loosen the Sound Drum Support Retaining Screw and rotate the Support until the Photo Diode notch of the Support is centered on the pin in the end of the locating Plug. (The sound drum support Setscrew is accessible through a small hole in the bottom of the projector base. Use a long-bladed 1/16" Allen Wrench.)

4. Insert the Sound Drum in the Sound Drum Support and push this entire assembly toward the main casting until the back edge of the Sound Drum just touches the Pin on the Locating Plug. (Figure 3-34) Be sure to maintain the centering accomplished in Step 3 while making this adjustment.

   Note: Be sure the Sound Drum is butted against the end of the Sound Drum Support during this adjustment. Having the Flywheel attached during this adjustment will help in holding these parts together in proper orientation.

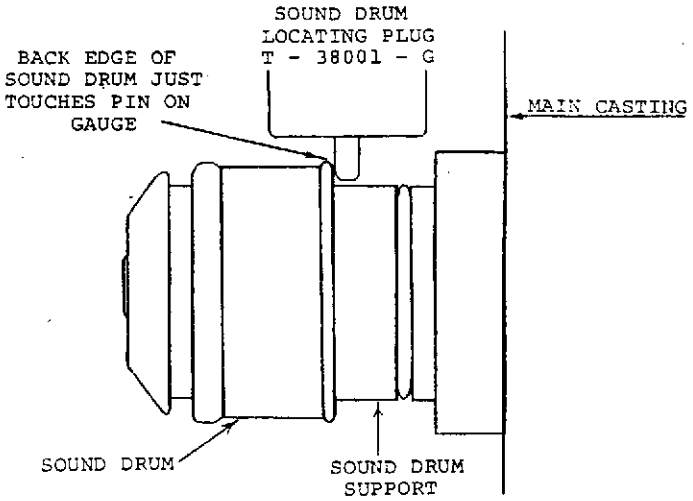


Figure 3-34. SOUND DRUM ALIGNMENT

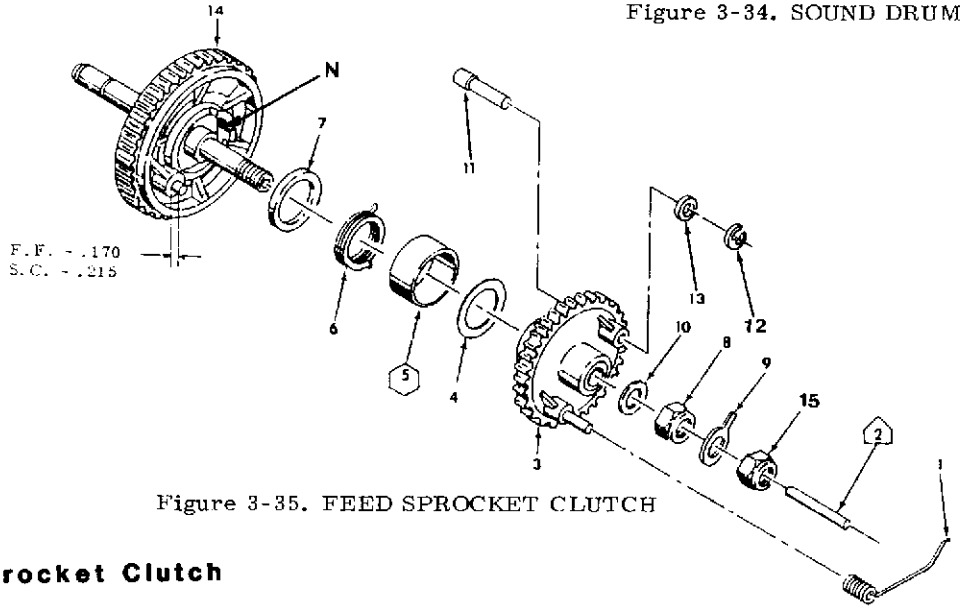


Figure 3-35. FEED SPROCKET CLUTCH

U. Feed Sprocket Clutch

1. Lubricate the Spring (6) with 009 Lubricant (39479-P7) (Figure 3-35).

2. Assemble the Lubricating Pad (7) and the Clutch Spring (6) making sure the tail of the Spring (6) is trapped in the Notch (N) of Gear (14).

3. Assemble Pin (11) to the Gear and Hub Assembly (3) and assemble the remaining parts on the shaft of Gear (14) in the order shown.

4. Adjust the Nut (8) to obtain .002" to .010" end play on the Gear and Hub Assembly (3).

5. Assemble the clutch to the projector (see Reassembly of Front Clutches to Projector).

STEPS 6 THROUGH 10 PERTAIN TO FAST FORWARD PROJECTORS ONLY. PROCEED TO STEP 11 IF YOUR PROJECTOR IS NOT A FAST FORWARD MODEL.

6. Assemble Stop (9) and Nut (15) and tighten the Nut (15) just enough to hold the Stop in place.

7. Depress Pin (A) and turn Clutch Gear (B) clockwise until Pin (A) touches Pin (C). HOLD GEAR (B) — DO NOT ALLOW IT TO SPRING BACK. (Figure 3-36)

8. Position the Stop (D) so that the corner or edge is just over the small cross pin of Pin (A) as shown.

9. Hold Nut (F) to prevent it from turning and tighten Nut (E) being careful not to allow Stop (D) to turn during this tightening process.

10. Recheck the end play of the Gear and Hub Assembly (B) for .002" to .010". Repeat Steps 6 through 9 until the Stop (D) is positioned properly and the end play is correct.

11. Lubricate the outside diameter of Pin (2) with Teresso Instrument Oil (39479-P8) and insert the pin in the hole in the end of the shaft of Gear (14). (Figure 3-35)

12. Insert the Spring (1) through the hole in the end of Pin (2) and then into the hole in the end of Pin (11).

13. Push the Spring (1) onto the Roll Pin protruding from the Gear and Hub Assembly (3). (On Fast Forward models, be sure the cross pin in Pin (11) is pointing toward the shaft of Gear (14).

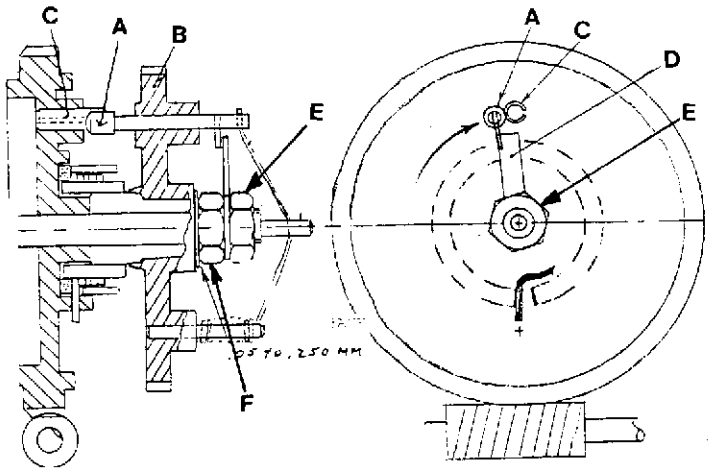


Figure 3-36. FEED SPROCKET CLUTCH ADJUSTMENT

V. Fast Forward and Rewind Clutches

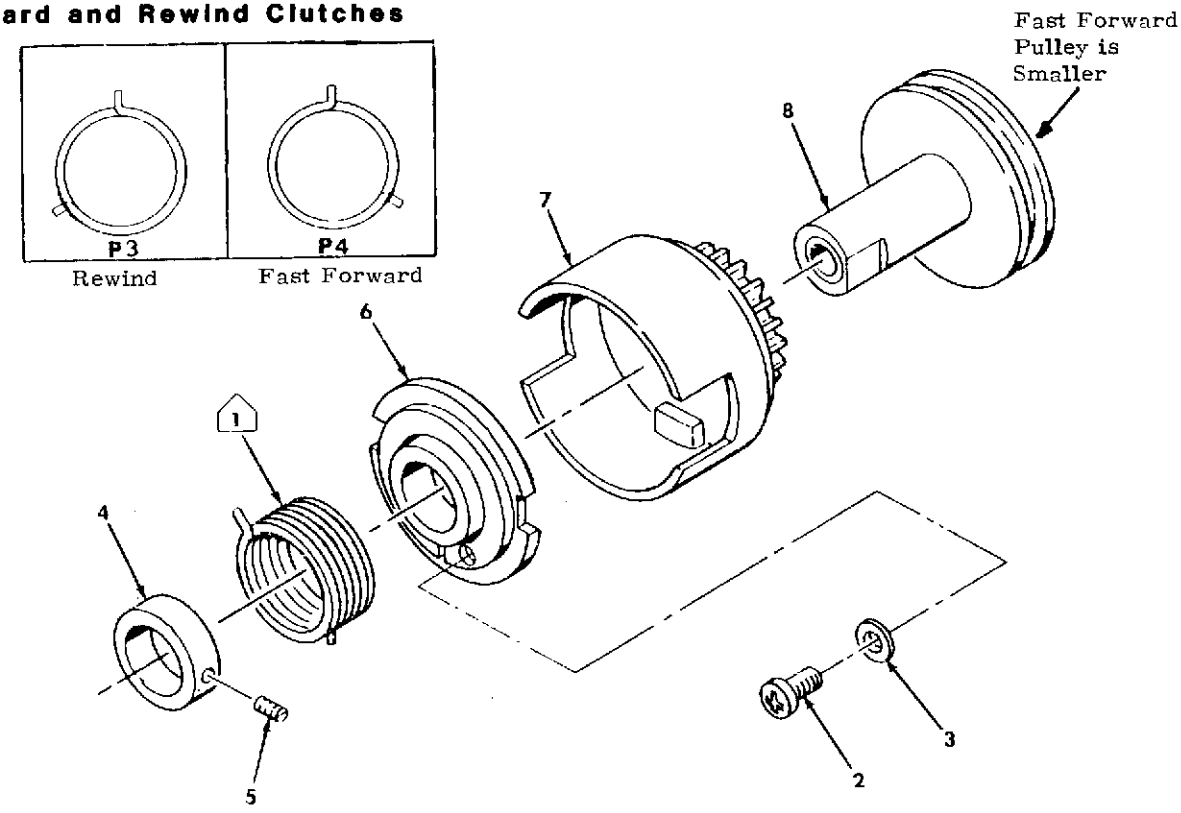


Figure 3-37. REWIND and FAST FORWARD CLUTCH REASSEMBLY

1. Lubricate the outside diameter of the shaft of the Pulley Assembly (8) and assemble the Gear (7) and the Drum (6) to the shaft as shown (Figure 3-37)

2. Seat the notches of the Drum (6) over the raised lugs inside the Cup Gear (7).

3. Assemble the Arbor (4) on the shaft of the Pulley (8) and tighten the Setscrew (5) in the notch in the end of the shaft allowing for end play of .005" to .010".

4. Apply three or four small drops of Teresso Instrument Oil (39479-P8) on the Arbor (4) and push the Spring (1) over the Arbor until it is seated on the Drum (6) with its tail trapped in the slot in the Drum.

5. Assemble Screw (2) and Washer (3) to the Drum (6) trapping the tail of the Spring (1) permanently in the slot of the Drum (6).

6. Assemble the Clutch to the projector (see Reassembly of Front Clutches to Projector).

W. Switch Adjustments

1. Switches (S-3), (S-5), (S-6), and (S-7) should be adjusted to actuate in the LOAD position and relax in the PROJECT position. (Figure 3-38)

2. Switch (S-4) should be adjusted to relax in the LOAD and PROJECT positions and actuate between these two positions.

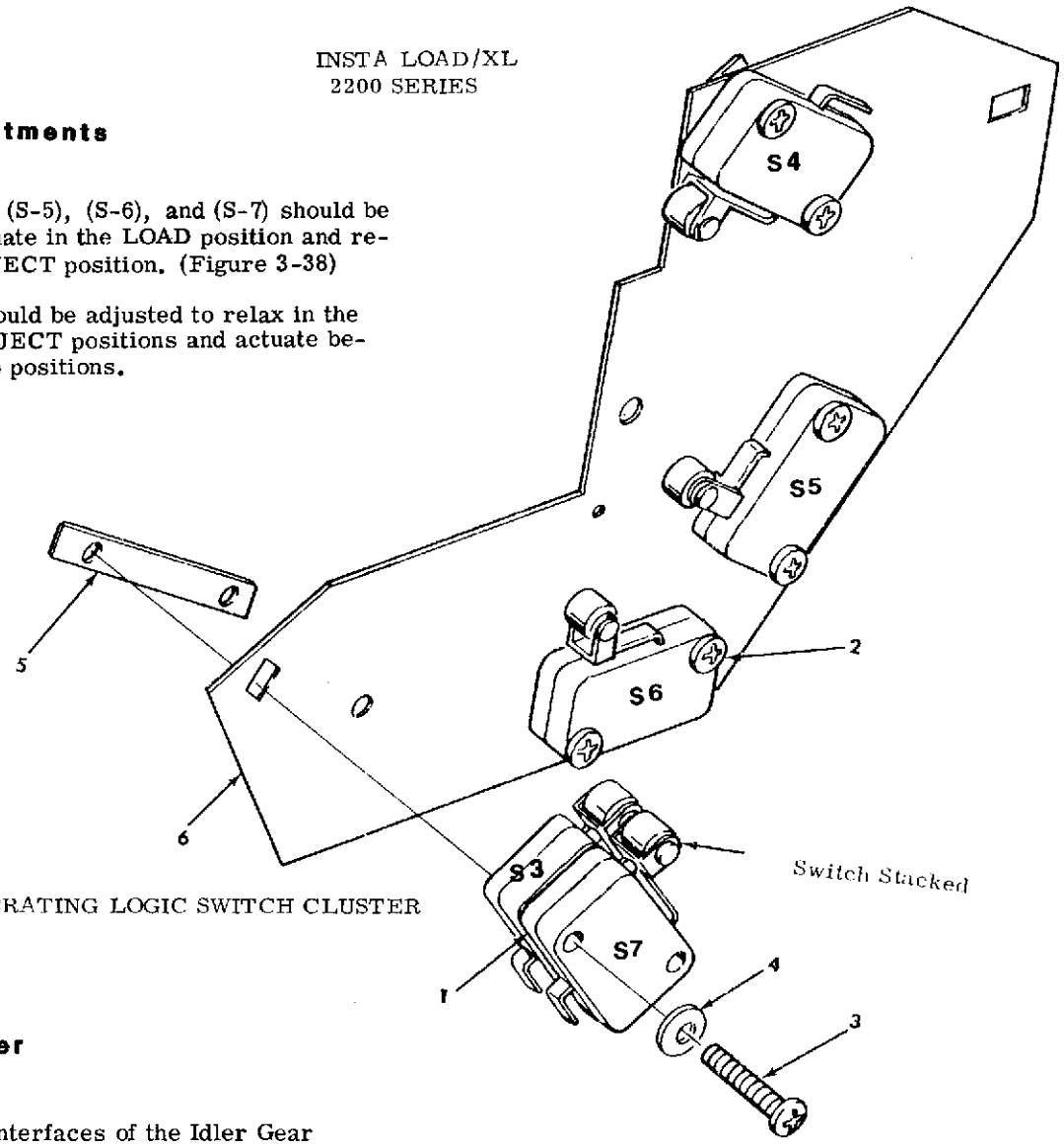


Figure 3-38. OPERATING LOGIC SWITCH CLUSTER

X. Film Counter

1. Lubricate the interfaces of the Idler Gear Assembly Shaft (8) and the Bearing (10) with Teresso Instrument Oil (39479-P8). (Figure 3-39)

2. When the Gear (6) is rotated, the entire gear train and counter must operate freely and smoothly.

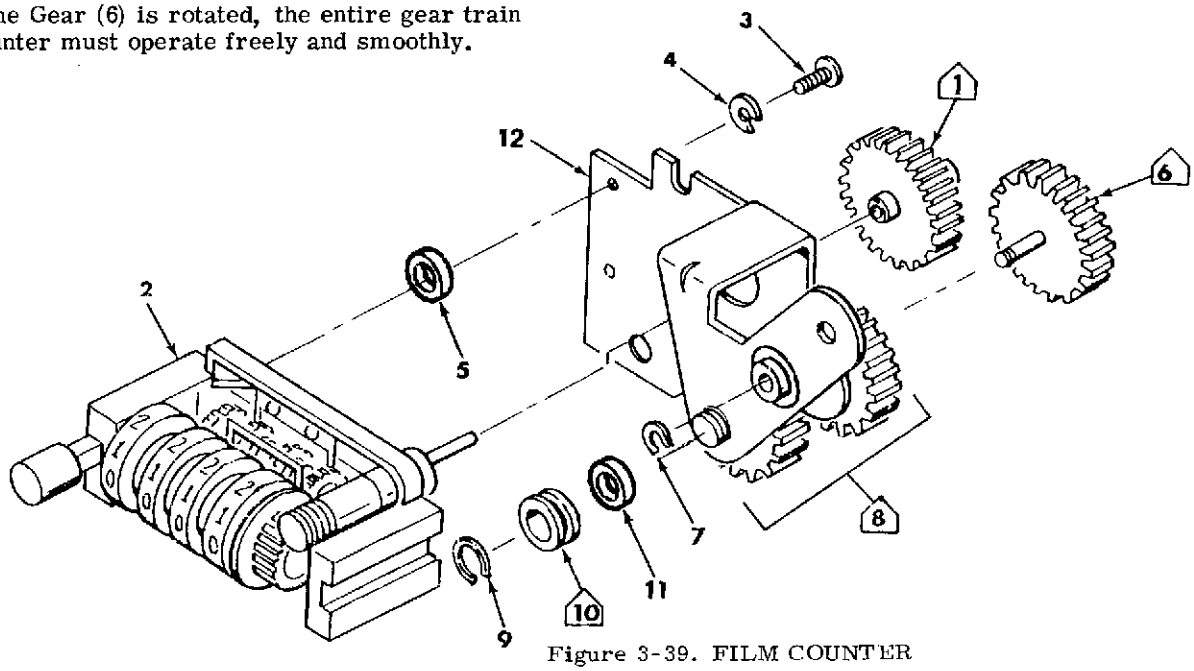


Figure 3-39. FILM COUNTER

SECTION IV ELECTRICAL SYSTEM

SECTION IV ELECTRICAL SYSTEM

The electrical system in the 2200 series projectors is divided into two sections.

1. Motor Drive and Mode Logic Circuits
2. Audio Amplifier and miscellaneous circuits

MOTOR DRIVE AND MODE LOGIC CIRCUITS

These circuits are basically the same in all 2200 projectors. This discussion covers the 2270 model since it contains all options except the Gemini 300 arc lamp. When working with a different model, omit the circuits which do not apply.

A. FORWARD PROJECT - 2270 MODELS

Power is supplied to all the projector circuits by operating the Main Power Switch (S14) to "ON".

With the Forward button depressed and the Main Control Lever in the Project mode, Main Control Switch contact (S2C) is closed feeding the "LIVE" side of the power line (mains) to the normally open contacts of Relay (K3) and through the winding of (K3) to terminal (7) of (S2).

Swinger (GH) of (S2) feeds the "LIVE" side of the line from terminal (7) to (S2B) which is also closed to connect the "LIVE" power to the brown wire of the Main Drive Motor run winding.

Contacts (GH) of (S2) also supply "LIVE" power to terminal 6 of the Fast Forward Solenoid (SO3), but the solenoid does not operate since its terminal 5 is not connected to line "NEUTRAL".

Swinger (FJ) of (S2) connects the "NEUTRAL" side of the line to the yellow wire of the Main Drive Motor run winding and also to the Rewind Solenoid (SO-1) (Terminal 2). Current flows through the run winding and the winding of Relay (K3) operating the relay to connect "LIVE" power through its contacts to the black wire of the Main Drive Motor start winding. The white wire of the start winding is connected through capacitor (C-17) to the "NEUTRAL" side of the line completing the start circuit and causing the Main Drive Motor to run the projector in the Forward mode.

The Rewind Solenoid (SO-1) does not operate since the "NEUTRAL" side of the line is also connected to the other side of the solenoid coil (terminal 1) through switches (S-5) and (S-3).

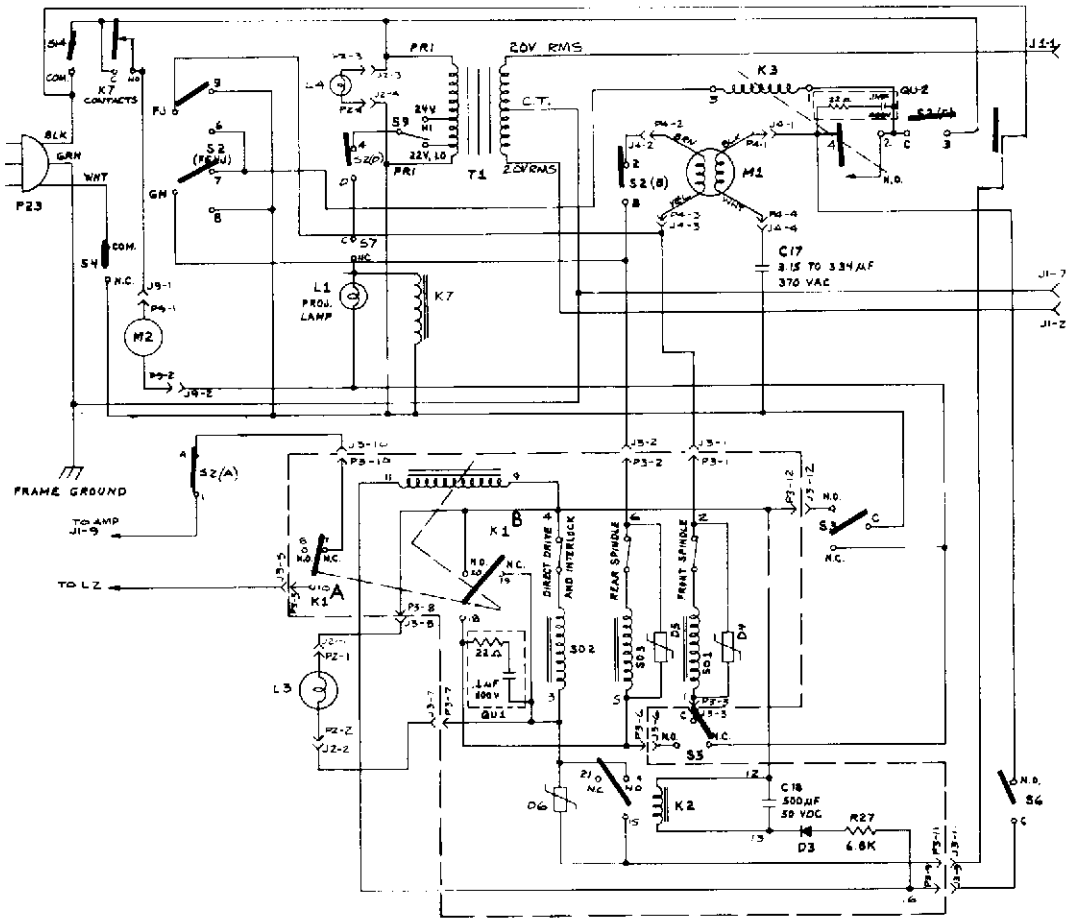


Figure 15. Forward Project

Switches (S2D) and (S7) are closed applying either 22 or 24 volts AC from the "Hi-Lo" Lamp Switch (S9) to the Blower Motor Relay (K7) and Projection Lamp (L1). The Relay operates since the other side of its coil is connected directly to the "NEUTRAL" side of the primary of the Transformer (T1). The Projection Lamp lights having its circuit completed through the (C) and (NC) contacts of switch (S3), and the blower Motor operates with "LIVE" power connected to one side of it through the closed contacts of Relay (K7) and "NEUTRAL" power connected to its other side through the (C) and (N.C.) contacts of Switch (S3).

NOTE: The Projection Lamp and Blower Motor operate only when the Master Control Lever is in the PROJECT position. Switches (S3) and (S7) move to their (N.O.) contacts when the Master Control Lever is in the LOAD position, removing power from the Lamp and Blower Motor Relay circuits.

Switch (S2A) closes only when the Forward button on the Main Control Switch is depressed. It completes the exciter lamp circuit through the normally closed contacts of Relay (K1), allowing the exciter lamp to light and produce sound from the film.

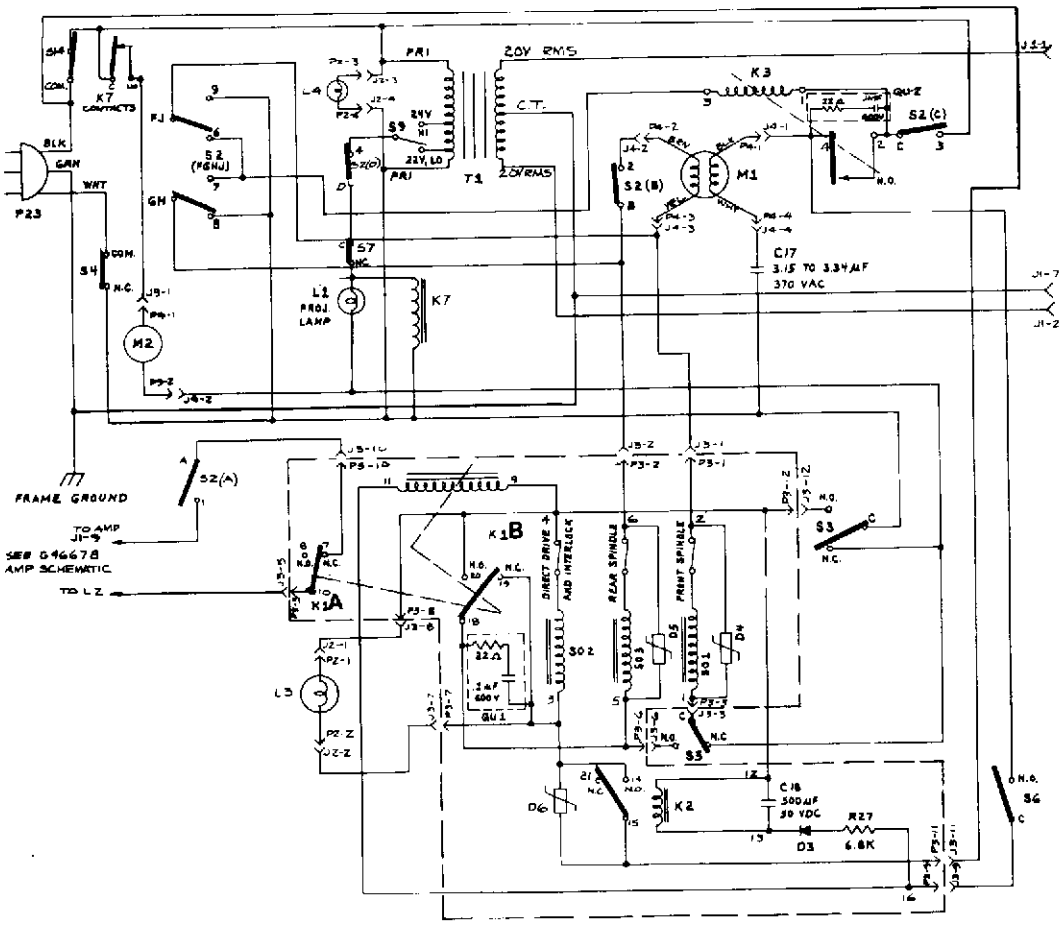


Figure 16. Reverse Project

B. REVERSE PROJECT - 2270 MODELS

With the Reverse button depressed, the Main Control Lever in the Project mode and the Main Power Switch "ON", switches (S2B), (S2C). (S2D), and (S14) are closed. The movable contacts are connected to the normally closed contacts on switches (S3) and (S5) and Relay (K-1). Relay (K-3) is operated closing its normally open contacts. Switch (S-6) is open. Switch (S-9) may be in the "Hi" or "Lo" position. Switch (S2FJ) is connected to terminal (6) and (S2GH) is connected to terminal (8).

The "LIVE" side of the line is connected to the black wire of the start winding and the yellow wire of the run winding of the Main Drive Motor. The "NEUTRAL" side of the line is connected to the white wire of the start winding and the brown wire of the run winding of this motor. Thus, the phase relationship is established between the two windings which causes the motor to run in reverse.

The Rewind Solenoid (SO1) operates since the "LIVE" side of the line is connected to its terminal (2) from (S2FJ) and the "NEUTRAL" side of the line is connected to its terminal (1) through (S5) and (S3).

The operated Rewind Solenoid locks the Rewind Clutch in direct drive so it can drive the supply reel to take up film in reverse. The Rewind Clutch is driven by the Feed Sprocket Clutch which is not locked into direct drive because solenoid (S02) is not operated. The Feed Sprocket Clutch slips to provide the proper Reverse take-up tension and prevent film damage in the front sprocket.

Switch (S2A) mutes the sound by opening the exciter lamp circuit so the exciter lamp goes out.

C. FAST FORWARD - 2270 MODELS

Power is supplied to all the projector circuits by operating the Main Power Switch (S14) to "ON".

With the Forward button depressed, the Master Control Lever in the Fast mode and the Main Power Switch "ON", switches (S2A), (S2B), (S2C), (S2D) and (S14) are closed. The movable contacts (C) are connected to the normally open (N. O.) contacts on switches (S3), (S5) and (S6). Switch (S9) may be in the "Hi" or "Lo" position. Switch (S2FJ) is connected to terminal (9) and (S2GH) is connected to terminal (7). Relay (K3) is operated closing its normally open contacts.

The "LIVE" side of the line is connected to the black wire of the start winding and the brown wire of the run winding of the Main Drive Motor. The "NEUTRAL" side of the line is connected to the white wire of the start winding and the yellow wire of the run winding of this motor. Thus the phase relationship is established between the windings which causes the motor to run in forward.

Relay (K1) is operated because one side of its winding (terminal 9) is connected to the line "NEUTRAL" through switches (S3) and (S4), and the other side of its winding (terminal 11) is connected to the line "LIVE" through switch (S6), Relay contacts (K3) and switches (S2C) and (S14). The normally closed contacts (K1A) open, breaking the exciter lamp circuit to mute the sound in the fast mode. Contact (K1B) connects the line or mains "NEUTRAL" to the Fast Forward Solenoid (SO3) (terminal 5). The solenoid operates because its other end (terminal 6) is connected to line "LIVE" through switch (S2GH), Relay (K3), and switches (S2C) and (S14). With the Fast Forward solenoid operated, the Fast Forward Clutch is locked into direct drive to transport film rapidly through the projector in the forward direction.

When film is transported rapidly "IN-PATH" through the projector, it must not be possible to raise the Master Control Lever to the Project Mode and close the mechanism tightly on the film or else the film would be damaged. A Fast mode interlock system is used to prevent this from happening.

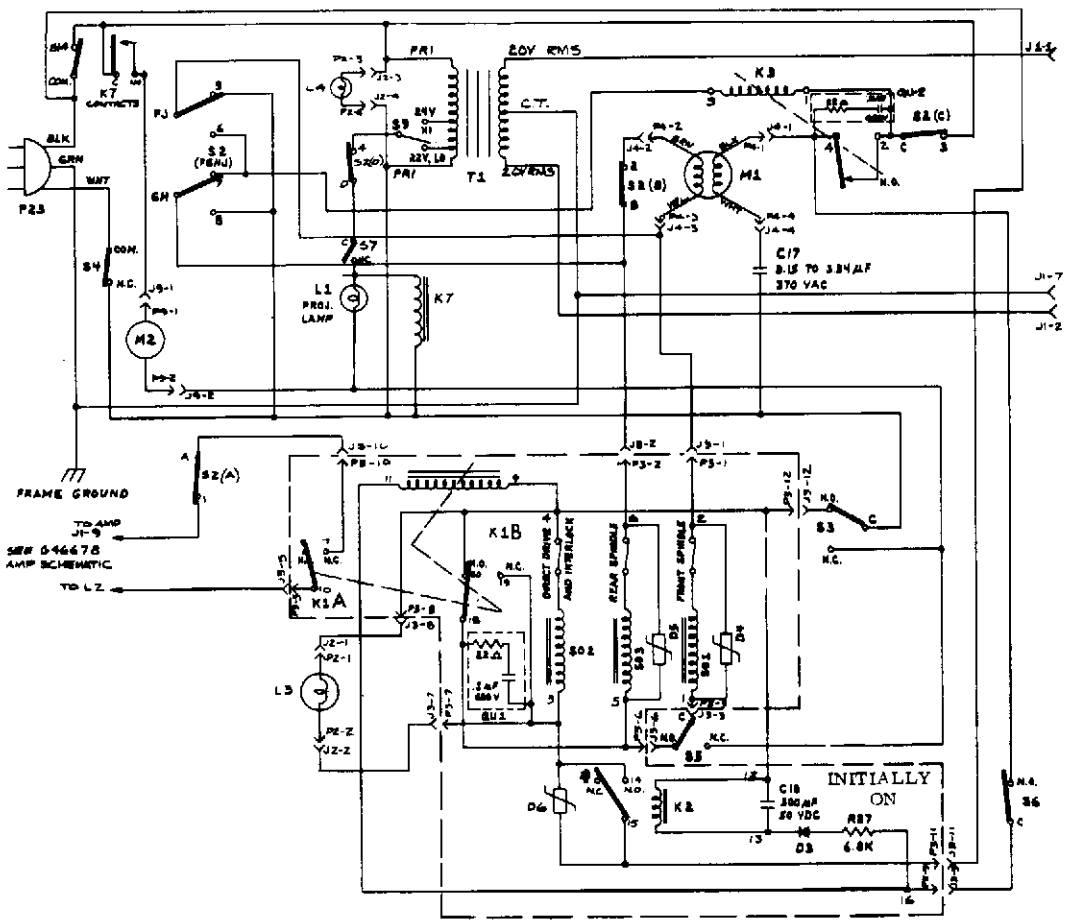


Figure 17. Fast Forward Initially On

This interlock system is activated and held by Relay (K2) and Interlock Solenoid (SO2).

When the projector is initially turned on in the Fast Forward mode, Relay (K2) does not operate because capacitor (C18) acts as a momentary short across it while it is charging. After 3 to 5 seconds, (C18) is charged and (K2) operates to connect the "LIVE" side of the line to Interlock Solenoid (SO2), and Interlock Indicator Lamp (L3). These operate because their other side is connected to the line "NEUTRAL" through the N.O. contacts of Switch (S3) and Switch (S4). Interlock Solenoid (SO2) operates the mechanism which locks the Master Control Lever in the Fast Mode position during Fast Forward operation.

Interlock Indicator Lamp (L3) lights to show that the mechanism is in the Fast Mode function.

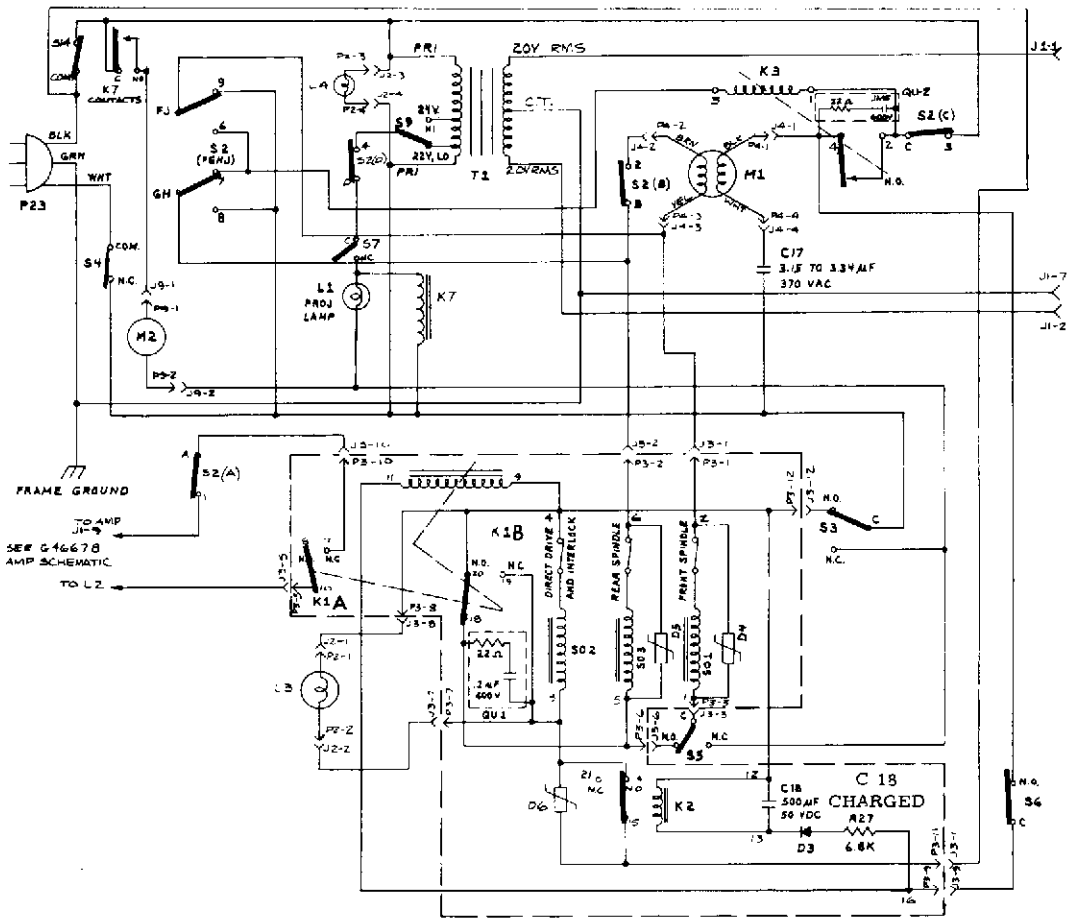


Figure 18. C 18 Charged

When the projector is turned off, "LIVE" AC power is removed from the Main Drive Motor (M1), Relays (K1), (K2) and (K3), and Fast Forward Solenoid (S03). Relays (K1) and (K3) and Fast Forward Solenoid (S03) release. Relay (K2) remains operated for 3 to 5 seconds while (C18) discharges through it.

The contacts of (K2) continue to apply "LIVE" AC power to the Interlock Solenoid (S02) and now also to the Rewind Solenoid (S01) through the N.C. contacts of Relay (K1) and the N.O. contacts of Switch (S5).

The Interlock Solenoid (SO-2) remains operated for 3 to 5 seconds preventing the Master Control Lever from being raised before the film comes to a complete stop.

The Rewind Solenoid (S01) operates to lock the Rewind Clutch in direct drive braking the front reel and stopping fast film movement through the projector.

After 3 to 5 seconds, Capacitor (C18) discharges sufficiently so Relay (K 2) releases and removes power from this entire circuit causing the Rewind Solenoid (SO1) and the Interlock Solenoid (SO2) to release, thus restoring the circuit to its rest condition.

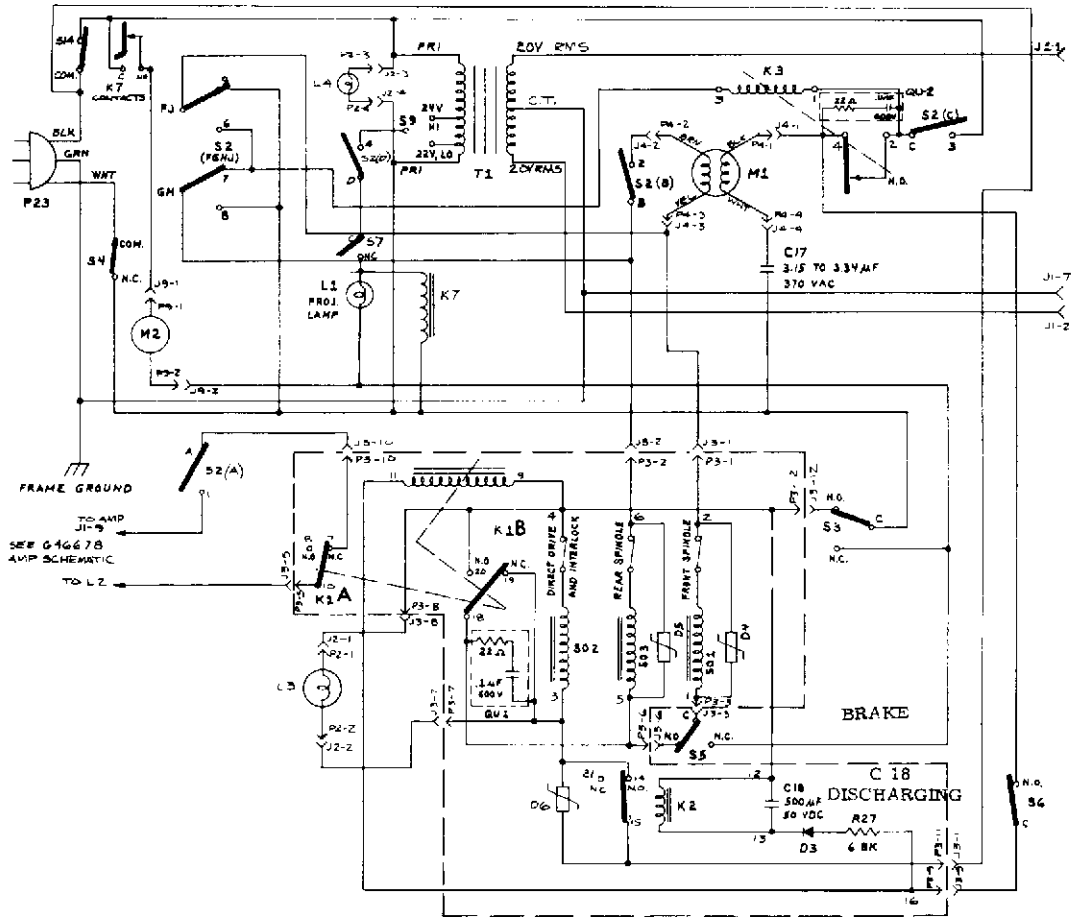


Figure 19. Stop Fast Forward 2270 Model

D. FAST REWIND - 2270 MODELS

Power is supplied to all the projector circuits by operating the Main Power Switch (S14) to "ON".

With the Rewind Button depressed, the Master Control Lever in the Fast Mode and the Main Power Switch "ON", switches (S2B), (S2C), and (S2D), and (S14) are closed. The movable contacts (C) are connected to the normally open (N.O.) contacts on switches (S3), (S5) and (S6). Switch (S9) may be in the "Hi" or "Lo" position. Switch (S2FJ) is connected to terminal (6) and (S2GH) is connected to terminal (8). Relay (K3) is operated closing its normally open contacts. Switch (S2A) is open.

The "LIVE side of the line is connected to the black wire of the start winding and the yellow wire of the run winding of the Main Drive Motor. The "NEUTRAL" side of the line is connected to the white wire of the start winding and the brown wire of the run winding of this motor. Thus the phase relationship is established between the two windings which causes the motor to run in reverse.

Relay (K1) is operated because one side of its winding (terminal 9) is connected to the line "NEUTRAL" through switches (S3) and (S4), and the other side of its winding (terminal 11) is connected to the line "LIVE" through switch (S6), Relay contacts (K3) and switches (S2C) and (S14). The normally closed contacts (F1A) open, open breaking the exciter lamp circuit, along with open switch (S2A) to mute the sound in the Fast Mode. Contact (F1B) connects the line "NEUTRAL" to the Rewind Solenoid (SO-1) (Terminal 1). The Solenoid operates because its other end.(Terminal 2) is connected to line "LIVE" through switch (S2FJ), Relay (K3) and Switches (S2C) and (S14).

With the Rewind Solenoid operated, the Rewind Clutch is locked into direct drive to transport film rapidly through the projector in the reverse direction.

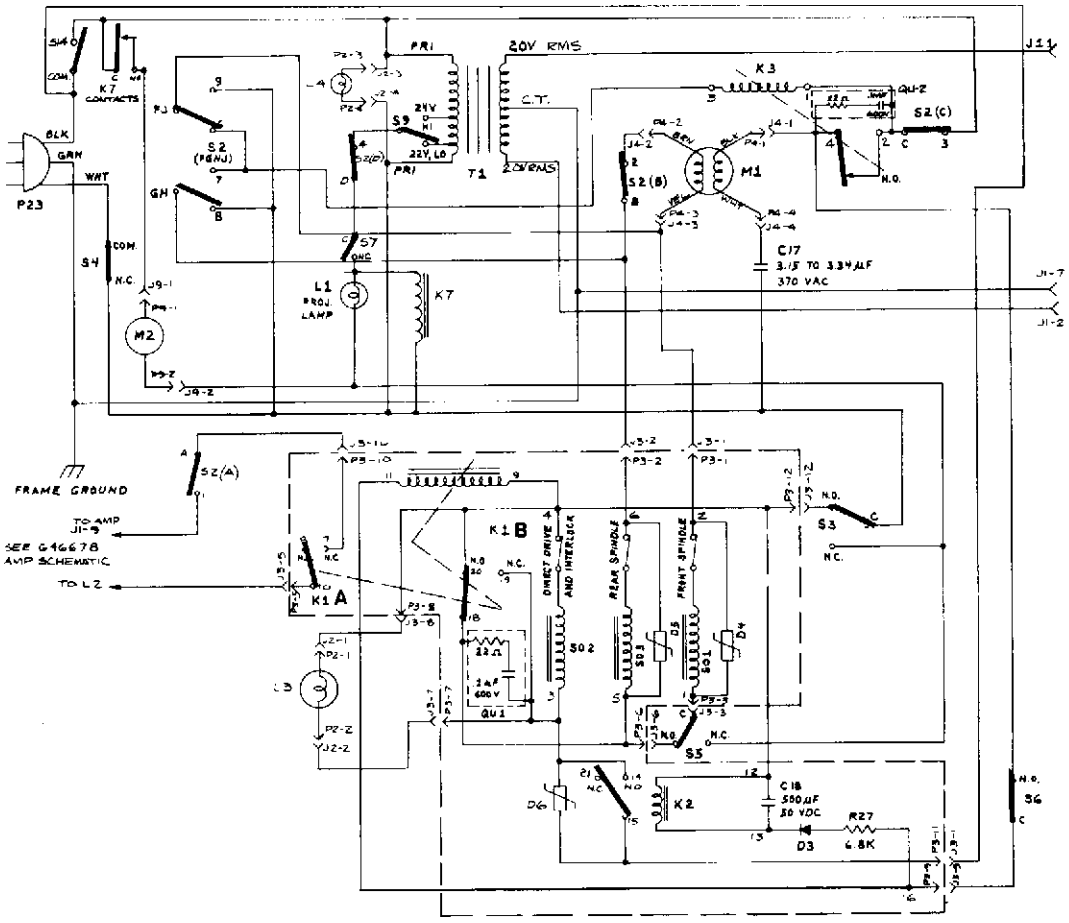


Figure 20. Rewind 2270 Initially On

When film is transported rapidly "In-Path" through the projector, it must not be possible to raise the Master Control Lever to the Project mode and close the mechanism tightly on the film or else the film would be damaged. A Fast mode interlock system is used to prevent this from happening. This interlock system is activated and held by Relay (K2) and Interlock Solenoid (SO2).

When the projector is initially turned on in the Rewind mode, Relay (K2) does not operate because capacitor (C18) acts as a momentary short across it while it is charging. After 3 to 5 seconds, (C18) is charged and (K2) operates to connect the "LIVE" side of the line to Interlock Solenoid (SO2) and Interlock Indicator Lamp (L3). These operate because their other side is connected to the line "NEUTRAL" through the N. O. contacts of Switch (S3) and Switch (S4).

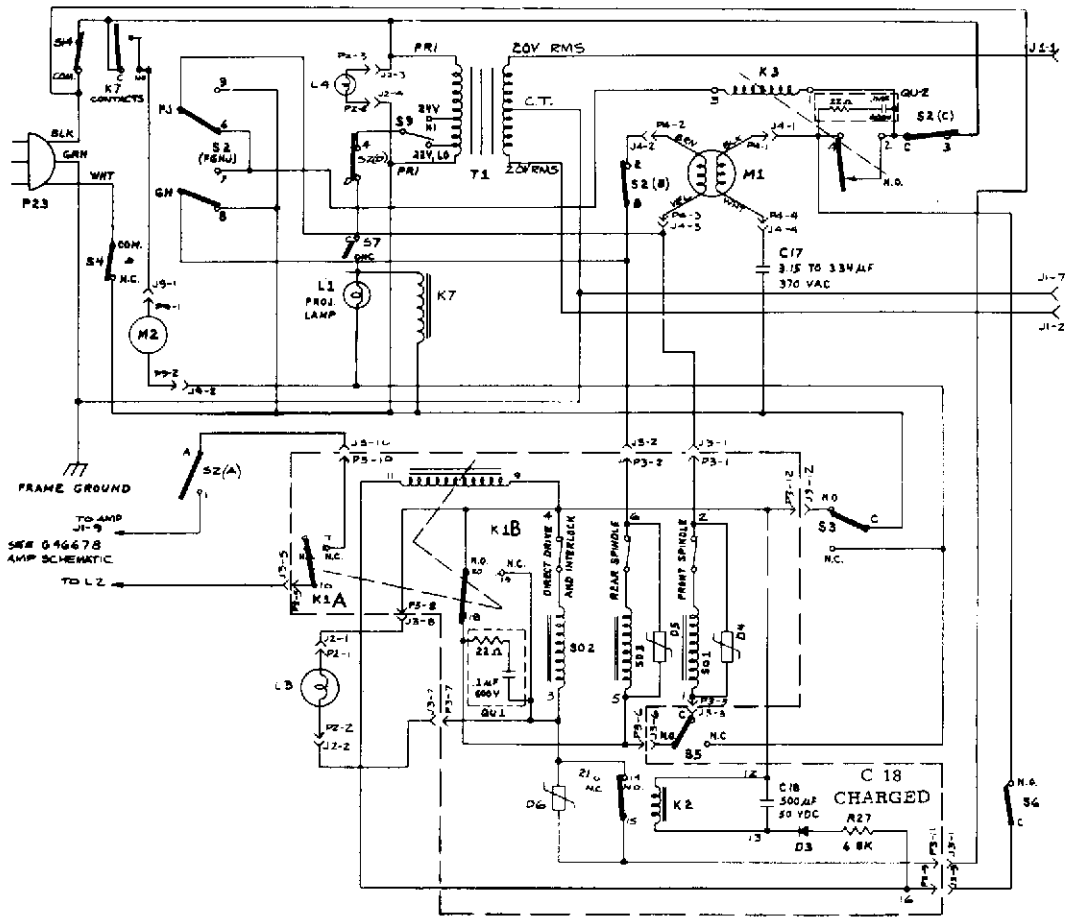


Figure 21. Rewind 2270 C-18 Charged

Interlock Solenoid (S02) performs two distinct functions in Rewind. First, it operates the mechanism which locks the Master Control Lever in the Fast Mode position. Second, it causes the Feed Sprocket Clutch to go into direct drive so it will not slip when driving the Rewind Clutch in Rewind. (See REWIND under FEED AND REWIND SYSTEM)

Interlock Indicator Lamp (L3) lights to show that the mechanism is in a Fast Mode function.

When the projector is turned off, "LIVE" AC power is removed from the Main Drive Motor (M1), Relays (K1), (K2), and (K3) and Rewind Solenoid (S01). Relays (K1) and (K3) and Rewind Solenoid (S01) release. Relay (K2) remains operated for 3 to 5 seconds while (C18) discharges through it.

The contacts of Relay (K2) continue to apply "LIVE" AC power to the interlock circuit and now also to the Fast Forward Solenoid (S03) through the N.C. contacts of Relay (K1B).

The Interlock Solenoid (S02) remains operated for 3 to 5 seconds preventing the Master Control Lever from being raised before the film comes to a complete stop.

The Fast Forward Solenoid (S03) operates to lock the Fast Forward Clutch in direct drive braking the rear reel and stopping fast film movement through the projector.

After 3 to 5 seconds, Capacitor (C18) discharges sufficiently so Relay (K2) releases and removes power from this entire circuit causing the Fast Forward Solenoid (SO3) and Interlock Solenoid (SO2) to release, thus restoring the circuit to its rest condition.

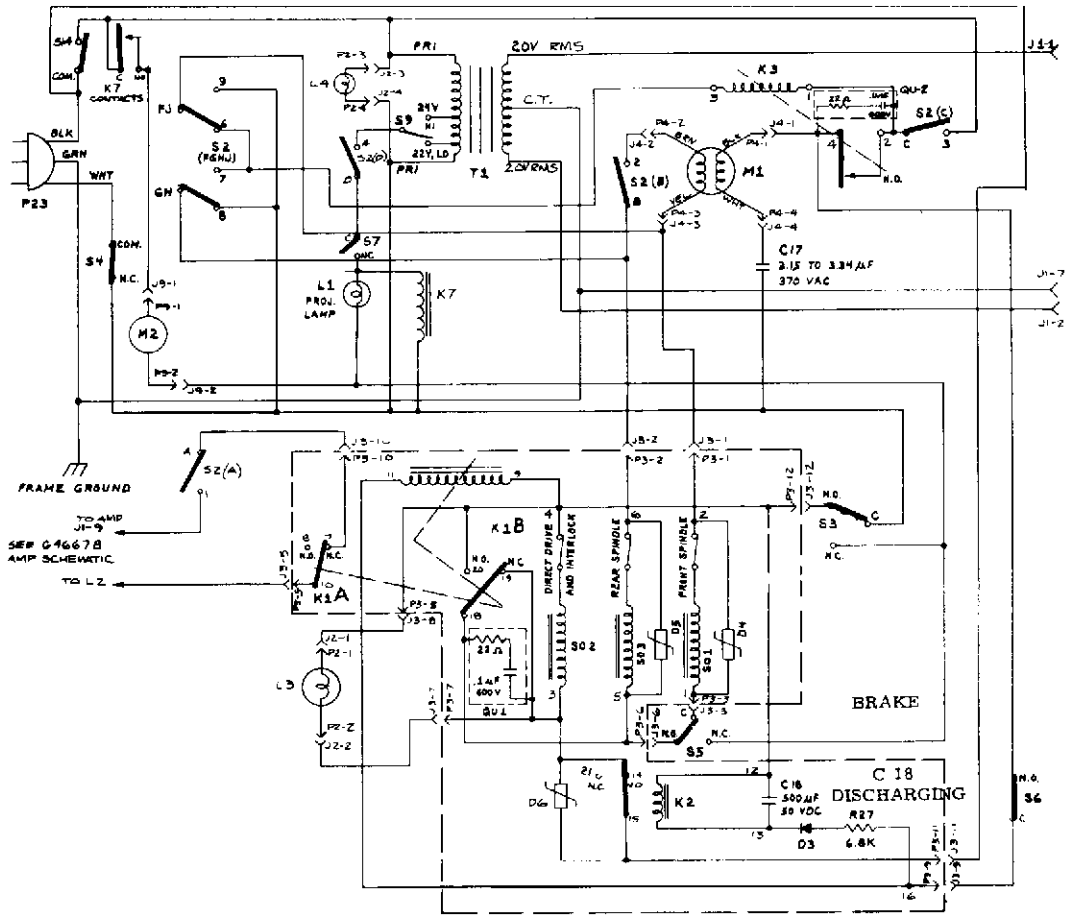


Figure 22. Stop Rewind 2270 Model

E. AUDIO AMPLIFIER

The Audio Amplifier in the 2200 series projectors is a basic operational amplifier type providing excellent linearity with high gain. For the purpose of our discussion, we have chosen the amplifier used in the 2270 models, since it contains all the options available. If the projector you are servicing in another model, simply omit the circuitry which does not apply.

The 2200 series amplifier is made up of four basic sections.

1. The Main Amplifier
2. The Microphone Preamplifier
3. The Muting Circuit
4. The Power Supply.

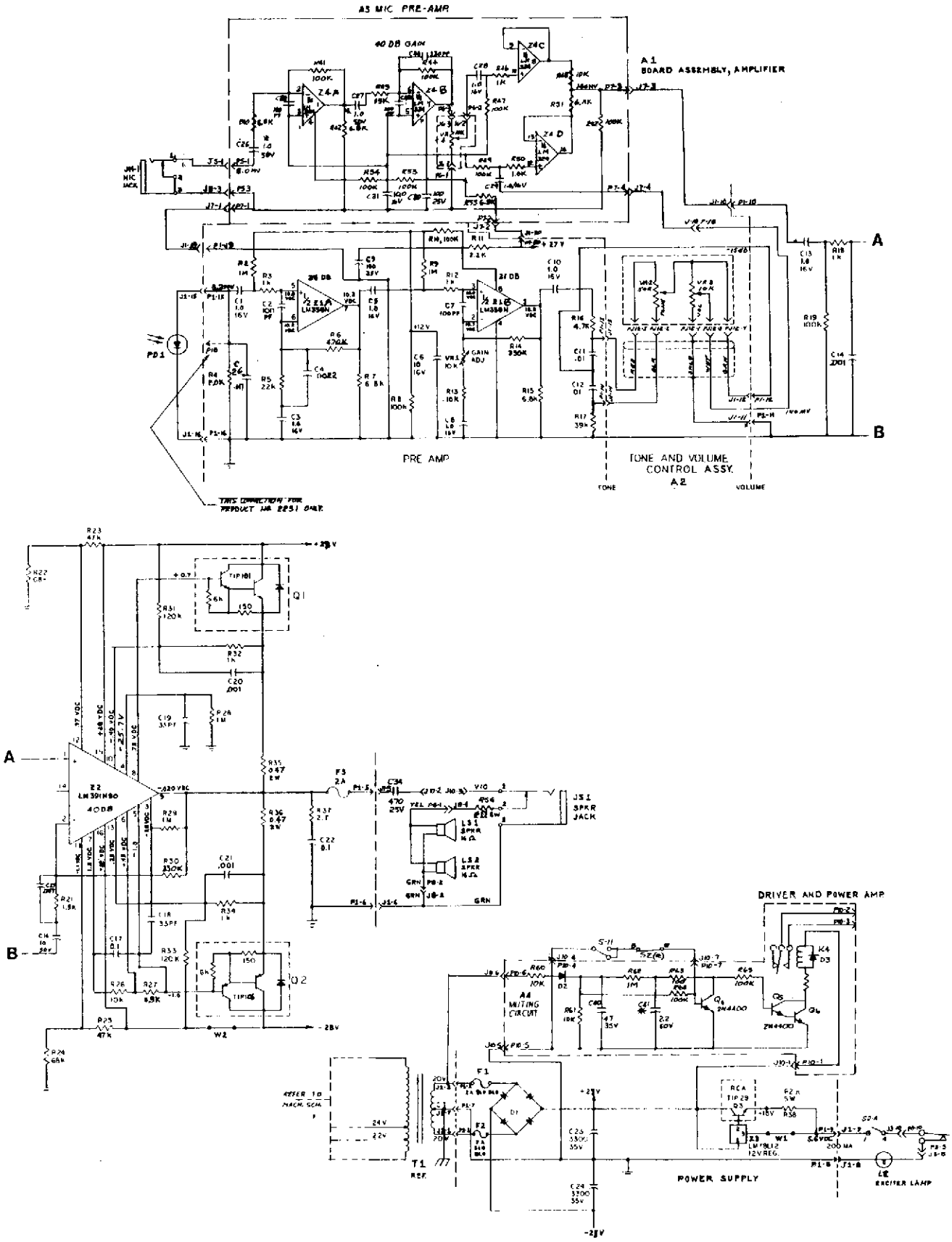


Figure 23. 25 Watt Amplifier Schematic 2270 Model

THE MAIN AMPLIFIER

The Main Amplifier consists of Preamplifier (Z1A) and (Z1B), Tone Control (VR-2), Volume Control (VR-3), Mixer Amplifier (Z4D), and Driver and Power Amplifier (Z2), (Q1) and (Q2).

The variations of light intensity produced by the exciter lamp shining through the sound track on the film are picked up by a photo-sensitive diode (PD-1) and converted to electrical variations. These electrical variations are fed into the Preamplifier (Z1A) and (Z1B) where they are amplified and fed to the Tone/Volume Control (VR-2) and (VR-3). From there they pass into the Mixer Amplifier (Z4D) and then into the Driver and Power Amplifier (Z2), (Q1) and (Q2). The Power Amplifier then drives the Speakers (LS1) and (LS2) mounted in the projector. A standard $\frac{1}{4}$" audio jack (JS1) is provided for connecting an external speaker. The external speaker plug opens the normally closed contacts of this jack and removes the internal speakers from the circuit.

THE MICROPHONE PREAMPLIFIER

With the Microphone plugged into the Mic Jack (JM-1) and the Microphone Level Control (VR4) adjusted to the desired level, the signals introduced by the microphone are amplified by the Preamplifier (Z4A) and (Z4B) and fed from the Level Control (VR4) to the Mixer Amplifier (Z4C). From there they are fed to the Drive and Power Amplifier (Z2), (Q1) and (Q2) and then to the Speakers (LS1) and (LS2).

Since the Microphone signal is fed through Mixer Amplifier (Z4C) at the same time that the Main Amplifier signal is fed through Mixer Amplifier (Z4D), it is possible to talk over the sound on the film with the microphone. It is also possible to use the projector as a P.A. amplifier by using just the microphone feature with no film running in the projector.

THE MUTING CIRCUIT

The purpose of the Muting Circuit is to open the circuit between the Main Amplifier output and the speakers each time a button on the Main Control Switch is depressed, thereby eliminating "switch clicks" or "popping" in the speakers caused by transients produced from opening and closing switch contacts.

Half Wave Rectifier (D2) and Filter Capacitor (C40) produce the positive voltage required to operate Transistors (Q4), (Q5), and (Q6). A small portion of this positive voltage is impressed on the base of (Q5) through Resistors (R62), (R63), and R65), forward biasing the transistor and allowing it to conduct. In turn, (Q5) forward biases (Q6) and it conducts through Relay (K4). The Relay operates and its contacts close completing the speaker circuit. Transistor (Q4) is cut off at this time by the ground connected to its base through the switches (S11) and (S2E).

When any button is depressed on the Main Control Switch (S2), contact (S2E) opens as the button starts down and closes when the button reaches the bottom of its travel. This lifts the ground from the base of (Q4) allowing (Q4) to conduct while the button is being pressed. The resulting drop in voltage at the collector of (Q4) is coupled to the base of (Q5) cutting (Q5) and (Q6) off and releasing the Relay (K4). The contacts of (Q4) open to disconnect the speakers from the output amplifier and mute switch clicks.

THE POWER SUPPLY

The 40 volts AC from the secondary of the Lamp-Amplifier Transformer (T1) is rectified by Full Wave Bridge Rectifier (D1) to produce 54 volts DC which is centertapped to produce a positive and negative 27 volts DC.

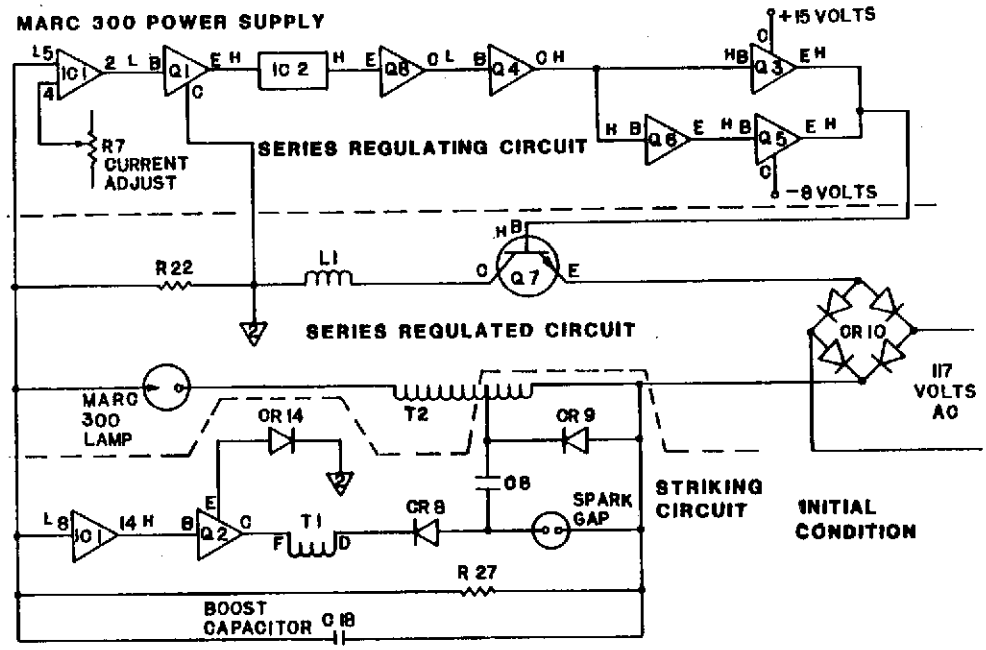
The positive 27 volts feeds the current regulator circuit (Q3) and (Z3) and the relay portion of the muting circuit (K4) as well as the main amplifier and microphone preamplifier. The negative 27 volts is used for the driver and power amplifier stages of the main amplifier (Z2) and (Q2).

Current regulation is accomplished by transistor (Q3) and regulator chip (Z3). This regulated current is required to keep the exciter lamp brilliance constant and prevent any variations in sound which would occur if the brightness of the exciter lamp were to vary.

When the DC voltage to the circuit increases because of the line voltage increase, the DC output current from the emitter of the transistor tries to increase. However, since the base is held at a constant voltage by the regulator chip (Z3), any attemped increase in emitter voltage is recognized as an increase in reverse bias causing the transister to conduct less and maintain a constant current at its emitter

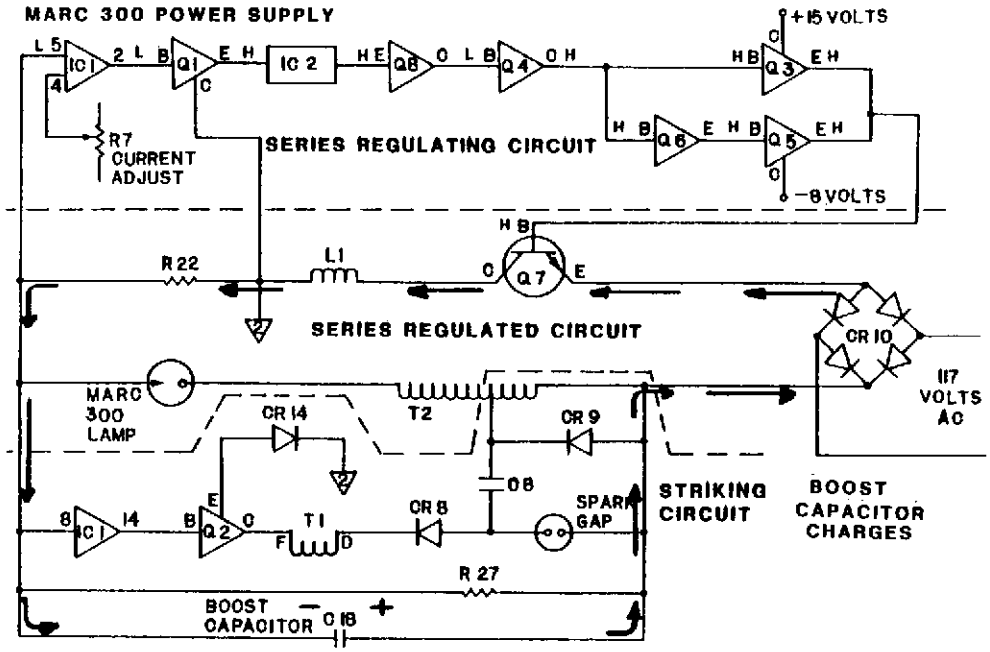
When the input DC voltage drops due to a drop in line voltage, the voltage at the emitter of (Q3) tries to drop. With the base still held at a constant voltage by the regulator chip (Z3), this attempted drop in voltage at the emitter causes greater forward bias, the transistor conducts more, and the output at its emitter remains the same.

Resistor (R38) is in a series with the exciter lamp (L2) to reduce the 18 volt regulated supply to approximately 5.6 volts for the exciter lamp. When the exciter lamp is removed from the circuit, the voltage measured between P1-8 and P1-9 will be 18 volts. This is an open circuit voltage since no circuit is flowing in the circuit with the exciter lamp removed.

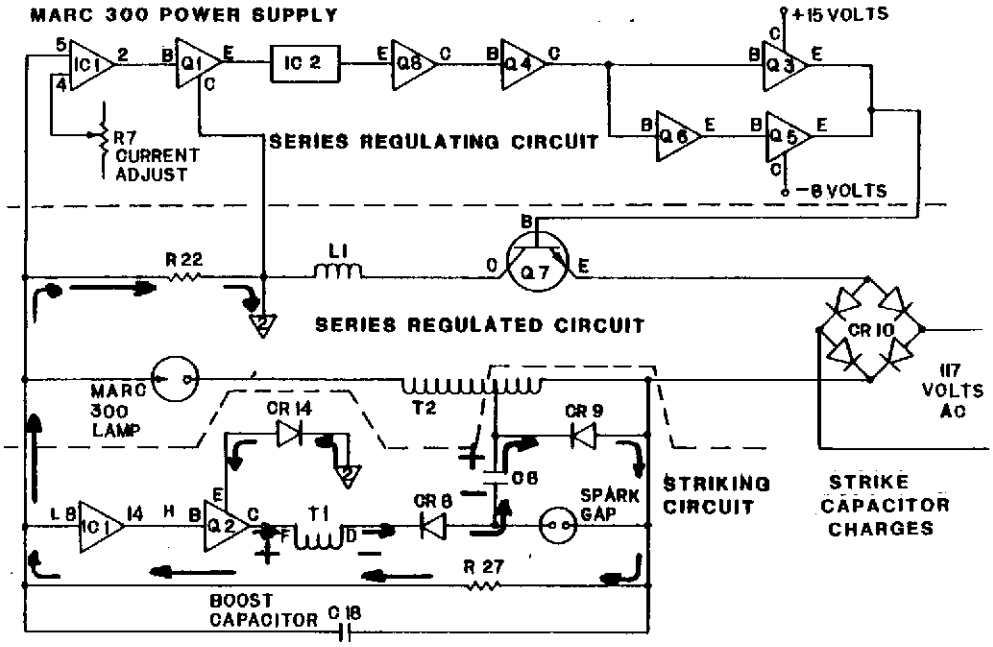


F. MARC 300 POWER SUPPLY

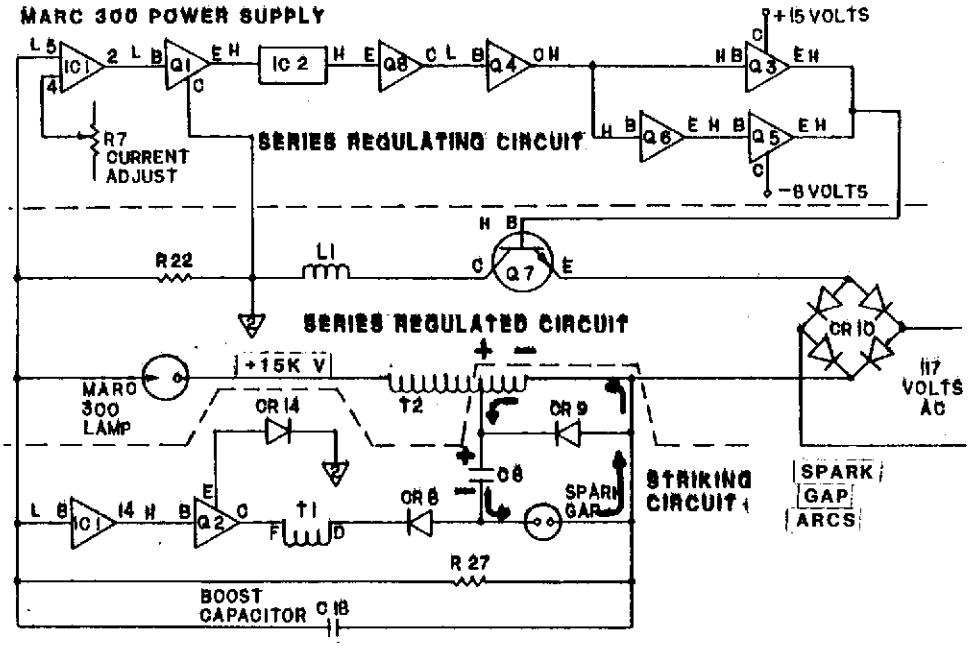
The key to operation of the regulated Mark 300 Arc Lamp Power Supply is the voltage developed across Resistor (R22) when Arc Lamp current flows. When the Power Pack is initially turned on, there is no voltage across (R22) and a low appears on pins 5 and 8 of (IC1).



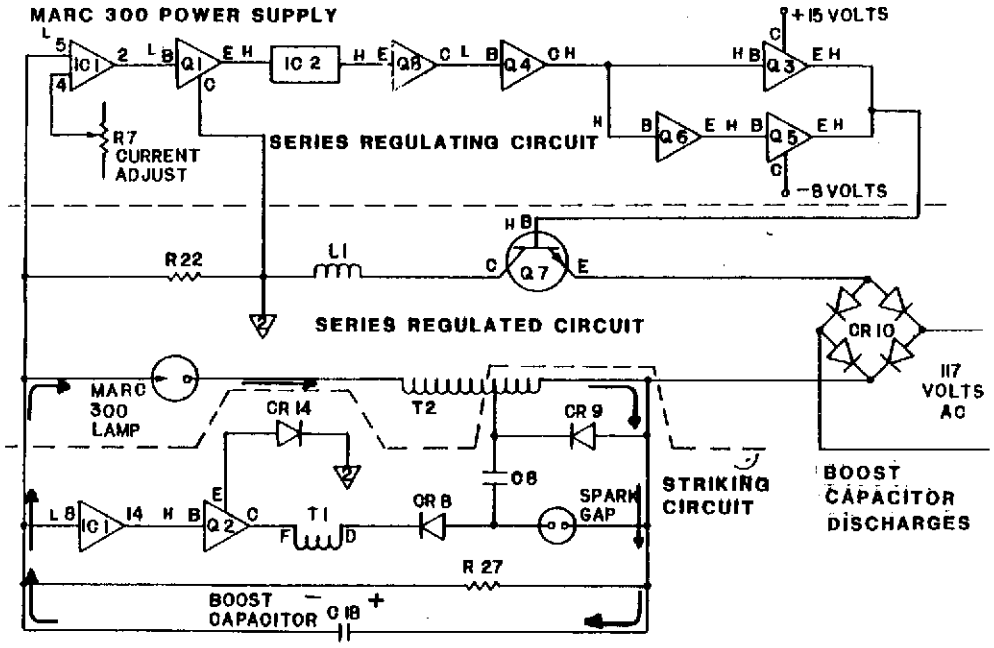
The low output from pin 2 of (IC1) conditions the series regulating circuit to turn Transistor (Q7) fully on allowing the boost capacitor (C18) to charge.



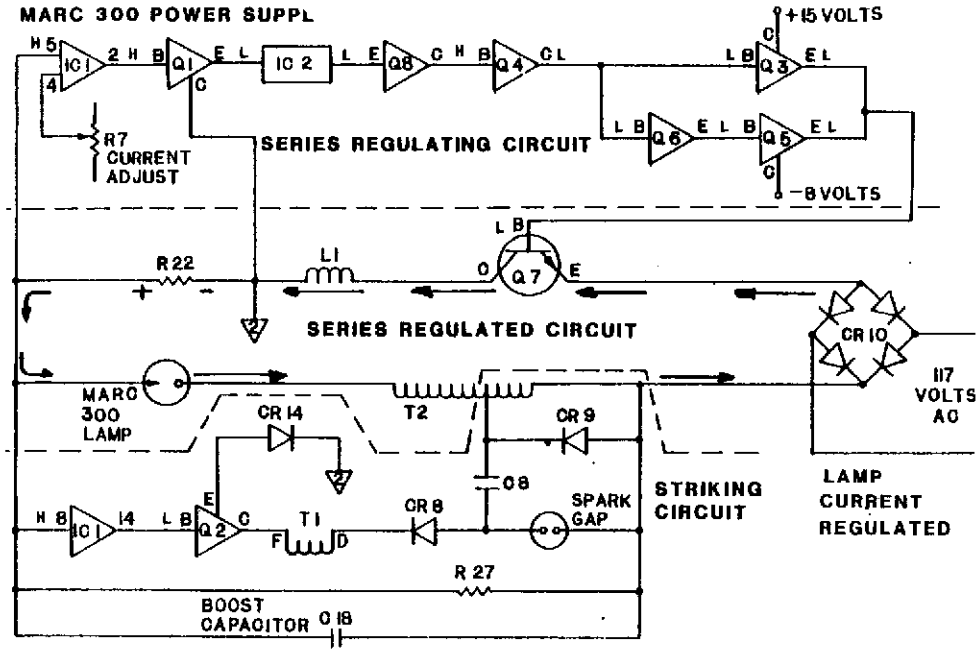
The high output from pin 14 of (IC1) turns transistor (Q2) fully on so the high voltage winding (F-D) of auxiliary transformer (T1) can charge the strike capacitor (C8) to the 375 volt breakdown voltage of the spark gap.



When the spark gap arcs, (C8) discharges through the primary winding of pulse Transformer (T2), which applies a 15,000 volt pulse on the anode of the Gemini 300 Lamp.



The Arc Lamp ignites and the boost Capacitor (C18) discharges through it to sustain conduction long enough for the series regulated circuit to take over.



A voltage appears across Resistor (R22) which causes a high to appear at pins 5 and 8 of (IC1). The high output from pin 2 of (IC1) conditions the series regulating circuit to drop the voltage on the base of (Q7) so it will regulate current in the series regulated circuit to 7.7 amps as preset by resistor (R7). The low output from pin 14 of (IC1) turns transistor (Q2) off and disables the strike circuit.

A reduction in lamp current reduces the voltage across (R22), reducing the high applied to pin 5 of (IC1). The output high from pin 2 of (IC1) is reduced, conditioning the series regulating circuit to allow (Q7) to conduct more to compensate for the reduction in lamp current. The converse is true if lamp current increases.

SECTION V ELECTRONIC CIRCUIT ADJUSTMENTS

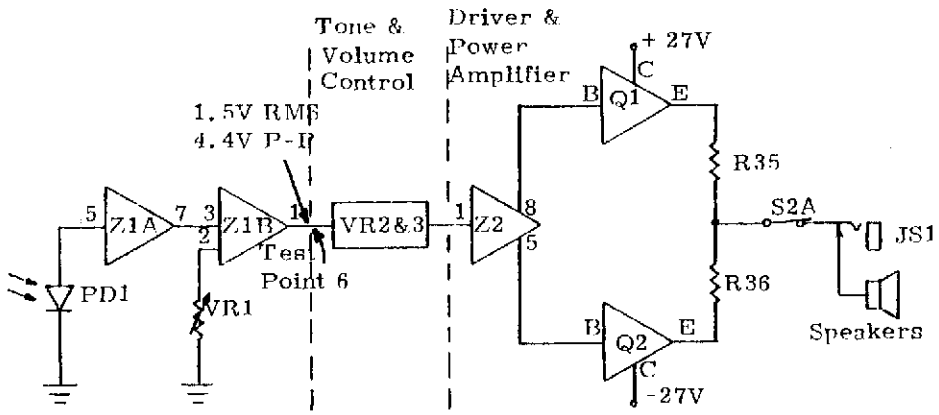


Figure 5-1. 16mm AUDIO AMPLIFIER-BLOCK DIAGRAM

A. ADJUSTMENT OF VR-1

Before attempting to adjust VR-1, perform the Buzz track adjustment and the Sound Optic Focusing adjustment.

1. Thread a continuous loop of 400 Hz Signal Level Test Film (SMPTE P16-SL) in projector.

2. Connect an Oscilloscope and/or an AC VTVM between pin 1 of Z1 (Test Point 6) and ground (Test Point 9).

3. Run the projector in Forward and observe the signal on the oscilloscope.

4. The Signal should be an undistorted sine wave with an amplitude of 1.5 volts RMS(4.4 volts P-P)

5. Adjust VR-1 to obtain the above reading.

6. Stop the projector.

7. Plug an 8 ohm, 25 watt dummy load into the speaker jack (JS1)

8. Set the volume control to its extreme Left position and the Tone Control to its extreme Right position.

9. Disconnect the Oscilloscope and/or VTVM from pin 1 of Z1 and connect them across the 8 ohm resistor.

10. Run the projector in Forward and gradually move the Volume Control to the Right(increasing volume) until the signal on the oscilloscope just starts to show clipping of the peaks.

11. The voltage across the 8 ohm resistor should be 14 volts RMS minimum(39.5 volts P-P(+25db)

12. Remove the 400 Hz loop from the projector and run the projector in Forward without film in it. DO NOT MOVE THE TONE OR VOLUME CONTROL.

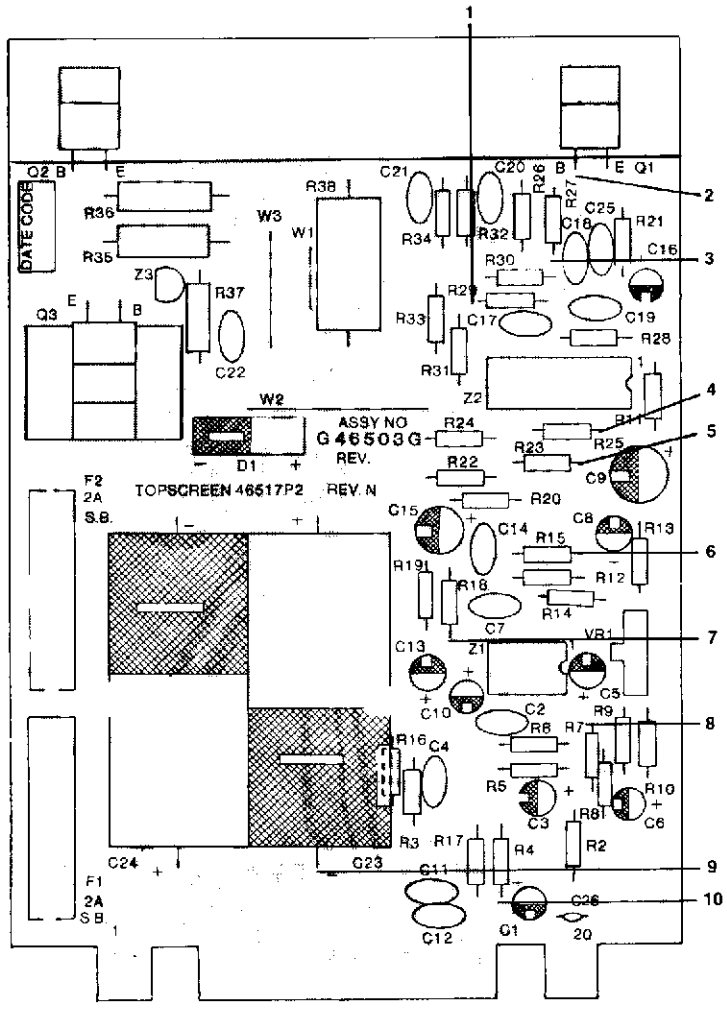


Figure 5-2. CIRCUIT BOARD TEST POINTS

13. The reading on the Oscilloscope and/or VTVM should be .14 volts RMS maximum (.395 volts P-P) (-15 db)

This is equivalent to a signal-to-noise ratio of -40db.

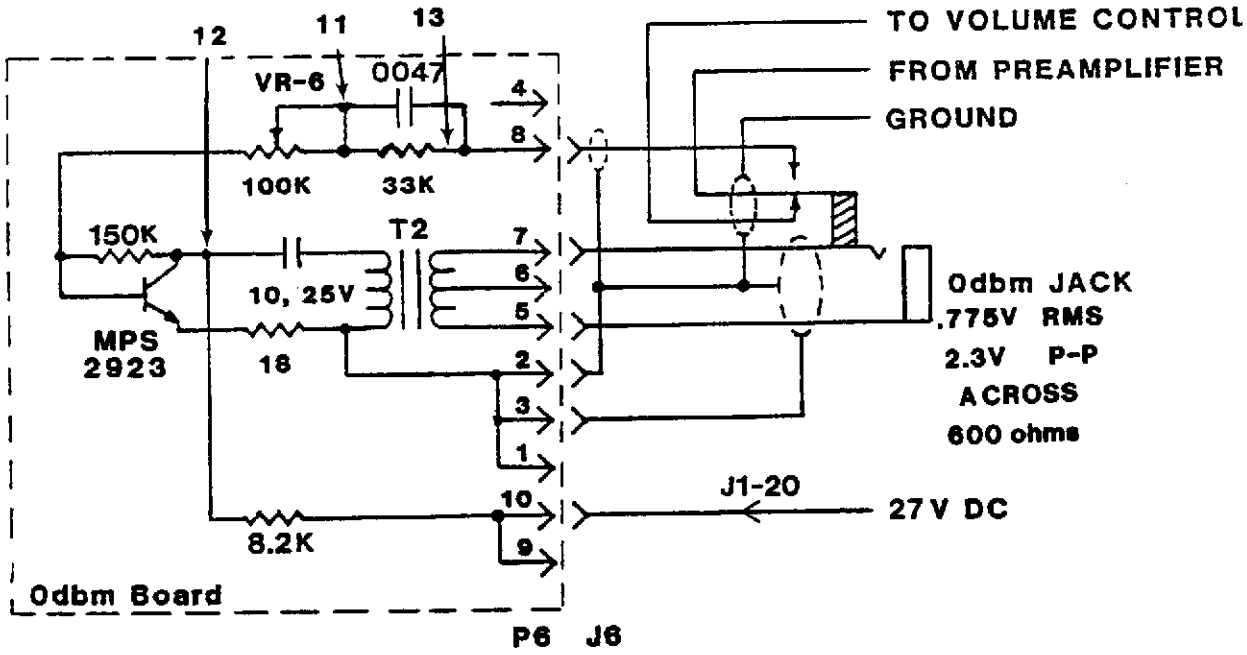


Figure 5-3. 0dbm CIRCUIT

B. 0dbm ADJUSTMENT

1. Adjust (VR-1) on the main amplifier board per procedure.

2. With the 400 Hz. Signal Level Test Film (SMPTE P16-SL, Singer P/N 45191-G7) running in Forward through the projector, plug a 600 ohm, 1 Watt resistor into the 0 dbm jack (J-7) and connect an AC VTVM across the resistor. Adjust VR-6 on the 0dbm Circuit Board for 0dbm reading on the AC VTVM (.775 volt).

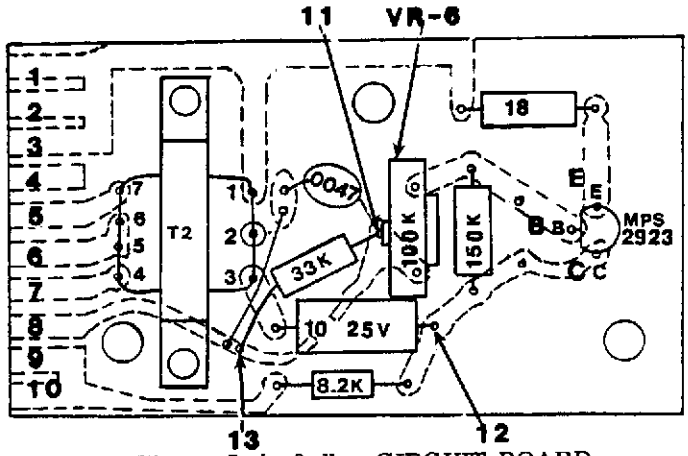


Figure 5-4. 0 dbm CIRCUIT BOARD

C. 5KHz FILTER / AMPLIFIER ADJUSTMENT

1. Connect a jumper wire between Test Point 15 and Test Point 19 on the 5K Hz. Filter Board.

2. Perform the Buzz Track Adjustment and the Sound Optic Focusing Adjustment per the procedures for those adjustments.

3. Remove the jumper connected in Step 1 above.

4. Thread a continuous loop of 400 Hz. Signal Level Test Film (SMPTE P16-SL) in the projector.

5. Connect an Oscilloscope and/or an AC VTVM between pin 1 of Z1 (Test Point 6) and ground (Test Point 9) on the main amplifier board.

6. Run the projector in Forward and adjust the Reserve Gain Potentiometer (VR-1) on the main amplifier board for a reading of 3.0 volts RMS (8.5 volts P-P).

7. Plug an 8 ohm, 25 watt dummy load into the ext. speaker jack (JS-1) and connect the Oscilloscope/ VTVM combination across this load.

8. Set the Tone Control to its mid position and adjust the Volume Control for a reading of 11 volts RMS (31 volts P-P).

9. Remove the 400 Hz. loop from the projector and run the projector in Forward without film in it. DO NOT MOVE THE TONE OR VOLUME CONTROL. The VTVM reading should be .11 volts RMS or less (.31 volts P-P). This represents a Signal to Noise Ratio of 40db.

10. Thread a continuous loop of 5K Hz. Test Film (SMPTE P16-SFB) in the projector and run it in Forward.

11. Adjust the 5K Hz. Null Potentiometer (VR-5) on the 5K Hz. Filter Board for a minimum reading on the VTVM or Oscilloscope. This reading should be .348 volts RMS or less (.984 P-P). (This represents a 30db rejection of the 5K Hz. signal from the audio output.)

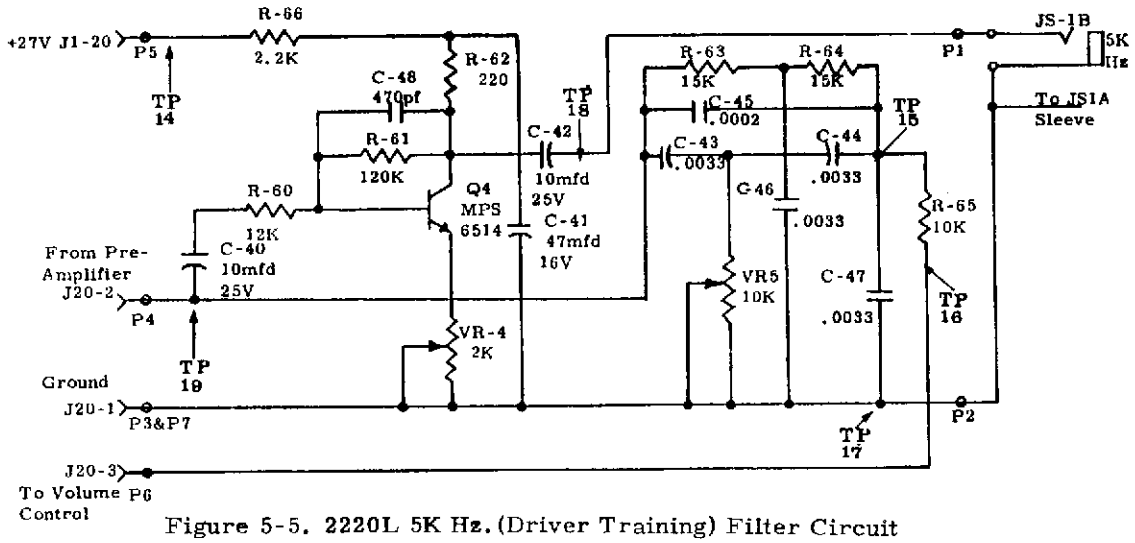


Figure 5-5. 2220L 5K Hz. (Driver Training) Filter Circuit

12. Connect the Oscilloscope and/or VTVM across the 5K Hz. Jack (JS-1B) and terminate the jack with a 1000 ohm, 1 watt resistor.

13. Adjust the 5K Hz. Output Level Potentiometer (VR-4) on the 5K Hz. Filter Board for .505 volt RMS (1.43 volts P-P). If .505 volt cannot be obtained by adjusting (VR-4), leave it at maximum and adjust (VR-1) on the main amplifier board for .550 volt RMS (1.55 volts P-P) at (JS-1B).

14. Remove the 1000 ohm resistor from the 5K Hz. Jack (JS-1B).

15. Adjust (VR-4) on the 5K Hz. Filter Board to reduce the 5K Hz. output at (JS-1B) to .180 volt. (This is a requirement for all driver trainer projectors. Failure to meet this requirement indicates a problem in the 5K Hz. circuit.)

16. Readjust (VR-4) on the 5K Hz. Filter Board for .505 volt at the 5K Hz. Jack (JS-1B) with the 1000 ohm, 1 watt resistor terminating the jack.

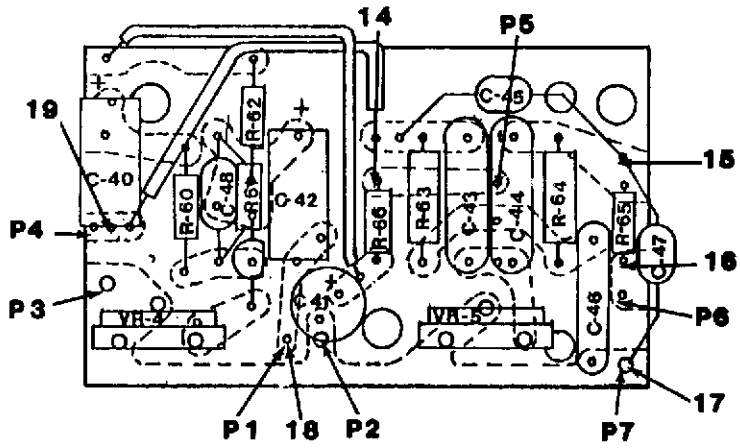


Figure 5-6. 2220L 5K Hz. (Driver Training) Filter Board

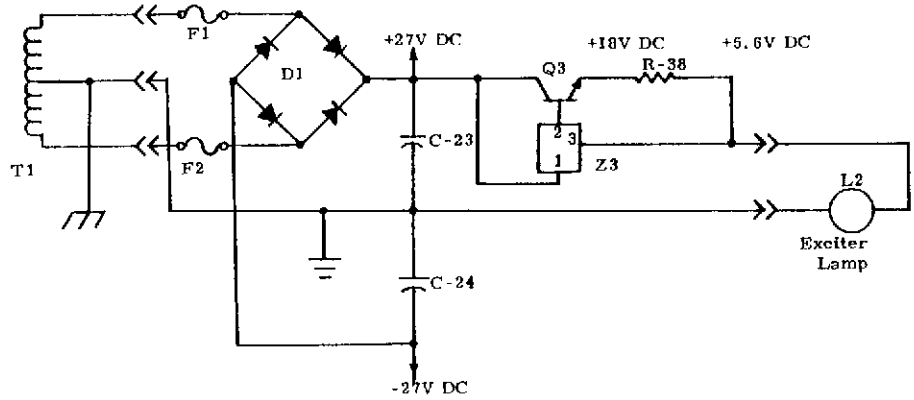


Figure 5-7. DC Power Supply

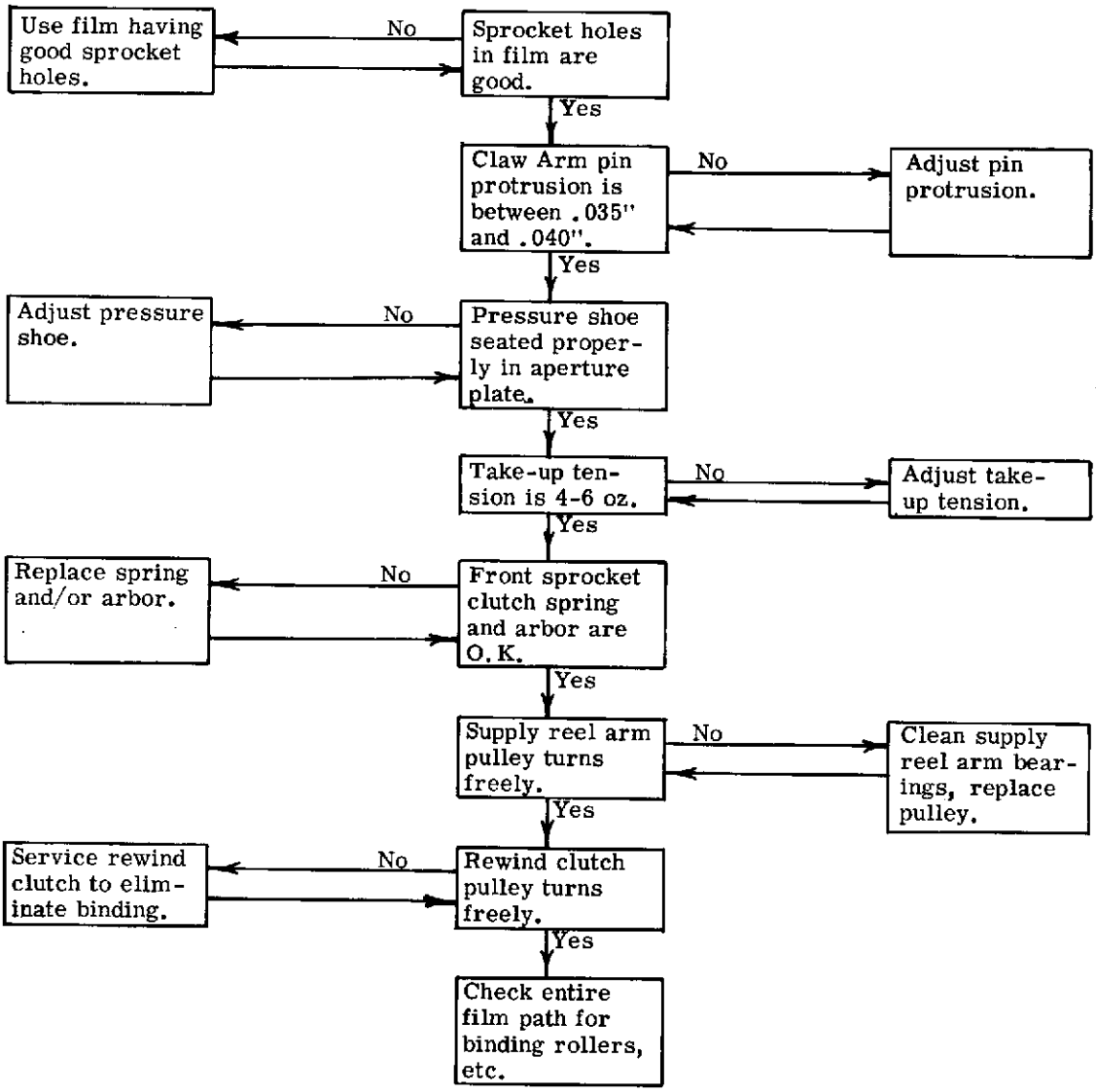
Exciter Lamp voltage on all 2200 Series Projectors should be approximately 5.6 volts DC WITH THE EXCITER LAMP IN THE CIRCUIT. With the Exciter Lamp removed from the circuit, the open circuit voltage is +18 volts, DC.

SECTION VI TROUBLE SHOOTING

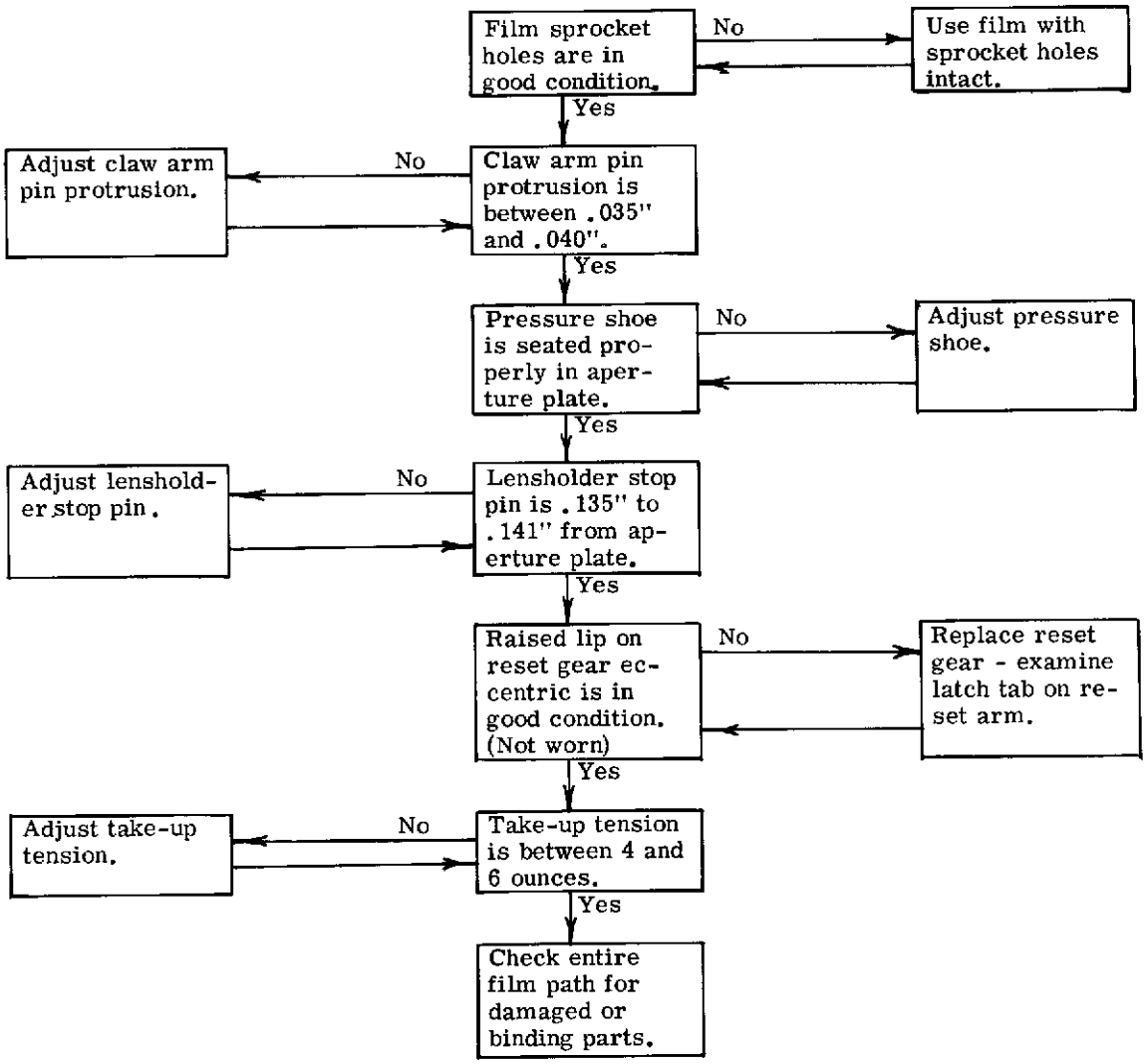
TROUBLESHOOTING AID CHARTS

The Troubleshooting Aid Charts are included as a logical approach to a troubleshooting procedure. They are by no means the final word on how troubles should be traced, but they are designed to eliminate as much duplication of effort as possible. Simply follow the direction of the arrow describing the condition existing during any given test. If following arrows results in a closed loop, then a trouble most likely exists in that area and further testing in that area is recommended.

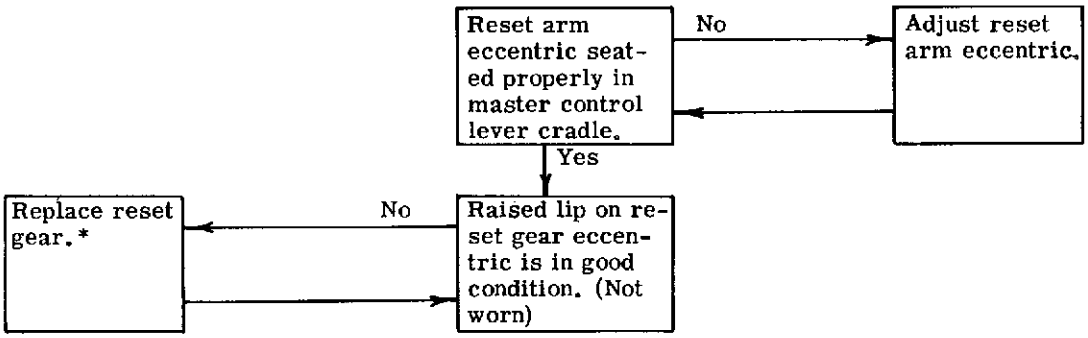
Loses Upper Loop



Auto Loop Restorer Cycles Continuously

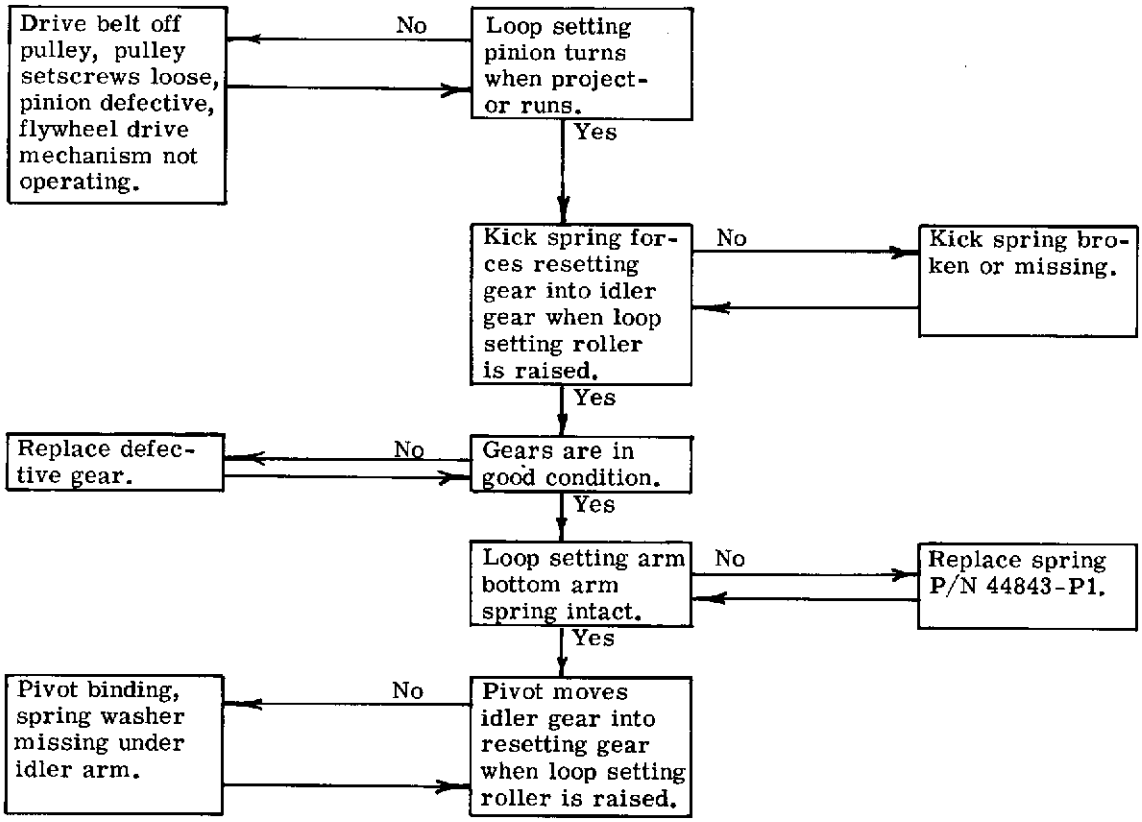


Auto Loop Restorer Recycles Continuously In Fast Forward



* If the gear eccentric is worn, carefully examine the latch tab on the Loop Resetting Arm for rough edges or burrs.

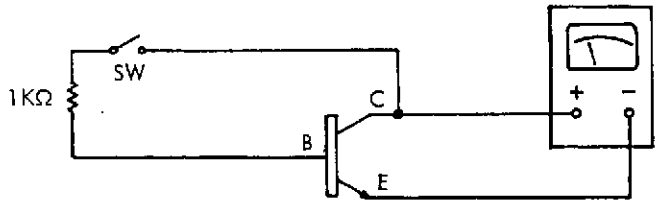
Auto Loop Restorer Doesn't Cycle



SEMICONDUCTOR TESTING

1. Transistors

An effective but simple transistor test for leakage, amplification and short circuit conditions may be performed using any standard 20,000 ohm/volt multimeter. Connect the transistor under test in the circuit shown, observing polarity.



Use the X100 scale for regular small-signal devices and X10 scale for power types. All readings are referred to the X1 scale.

With the base switch open, the reading should be above 200 ohms. A lower reading indicates excessive leakage or a shorted transistor.

With the base switch closed, the reading should be less than 500 ohms. A higher reading indicates low gain, and a very high reading indicates an open transistor.

Polarity is shown for NPN transistors using a Simpson 260/270 Multimeter with the ohmmeter voltage selector switch set on positive DC. PNP transistors may be checked by reversing the VOM polarity. Observe opposite polarity of terminal voltage when using Weston or Triplett instruments.

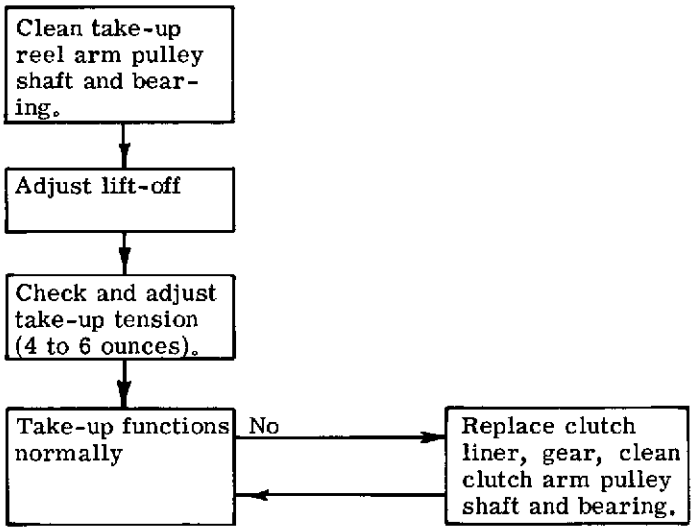
2. Diodes

Front-to-back resistance ratio will indicate silicon and germanium diode defects. Using the RX100 multimeter scale, a diode should measure a very low resistance with one lead (test probe) polarity and very high resistance with leads reversed.

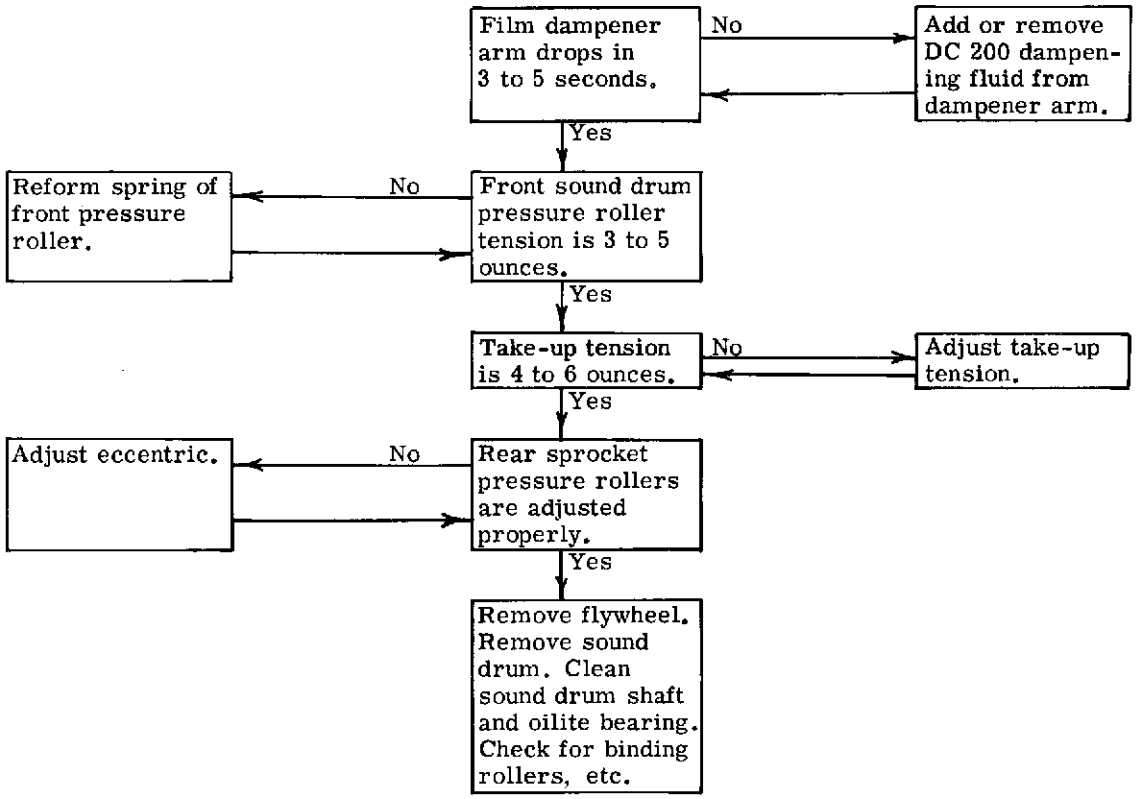
3. Zener Diodes

Depending on voltage rating, Zener diodes will exhibit lower reverse resistance than regular diodes but a marked front-to-back ratio should be evident.

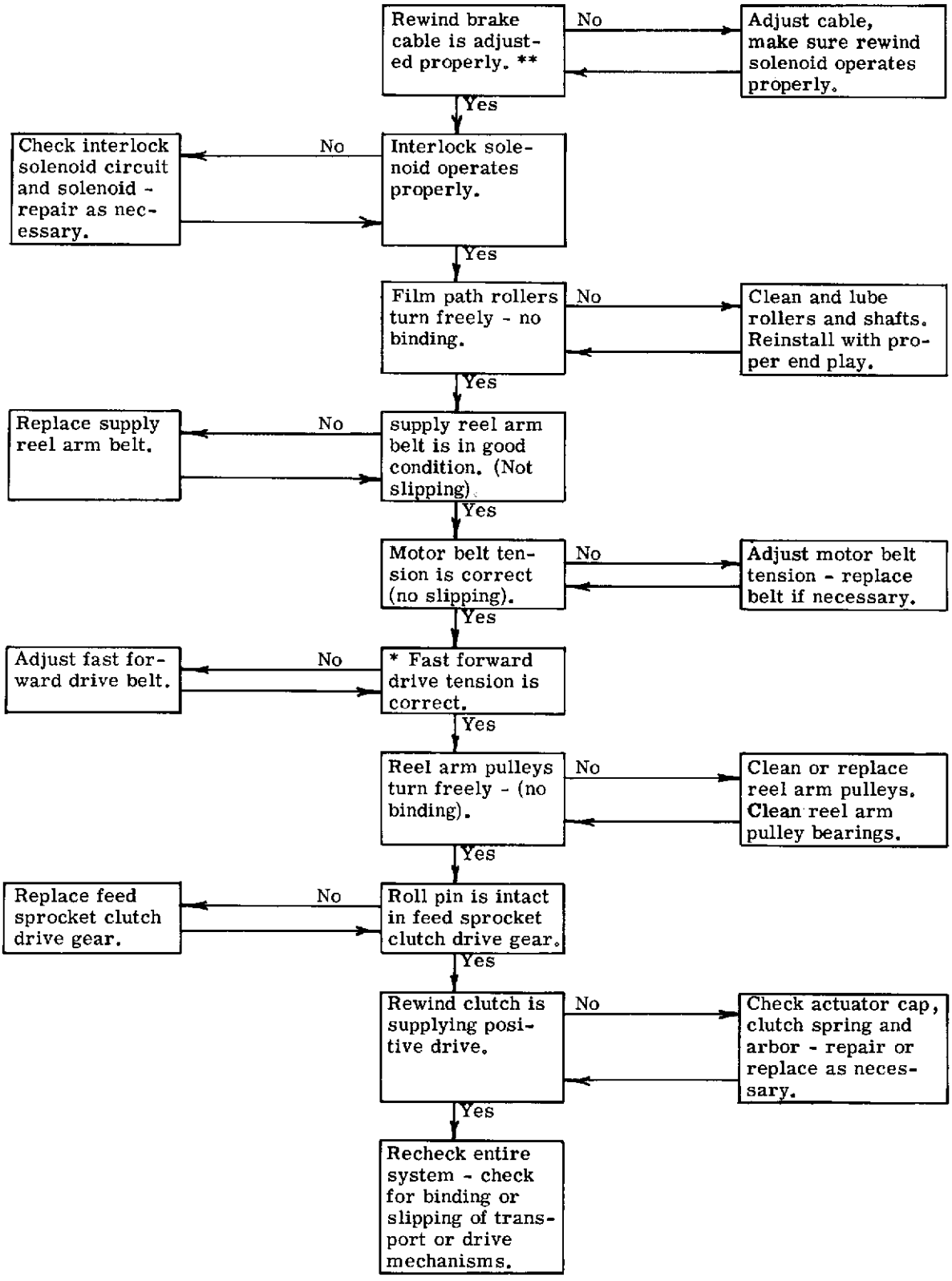
Take-up Sluggish, Erratic or Fails



Projector Exhibits "WOW" In Sound



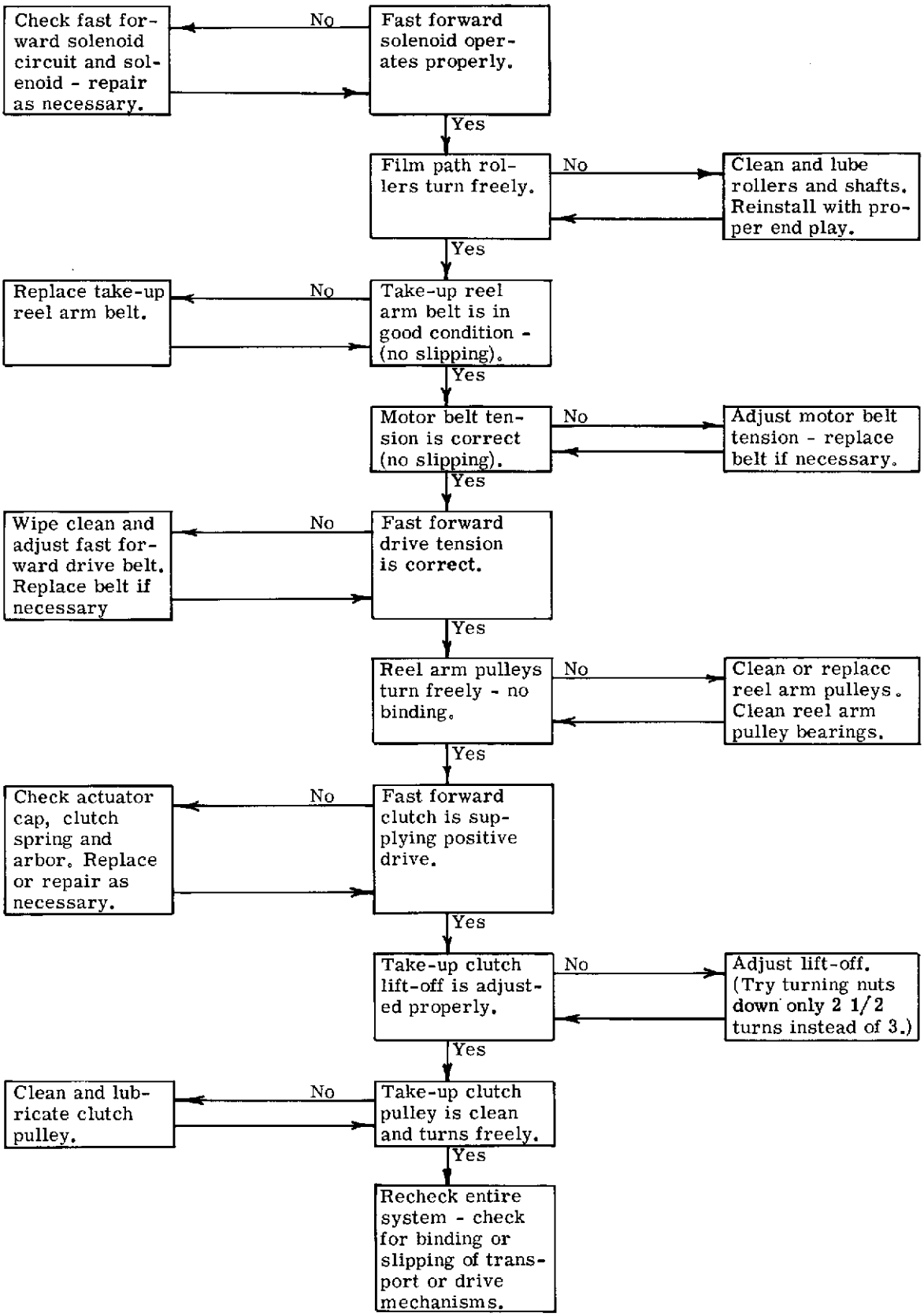
Rewind Sluggish or Fails



* Omit this step if the projector has no fast forward function.

** This step applies to Simplified Control models only.

Fast Forward Sluggish or Fails



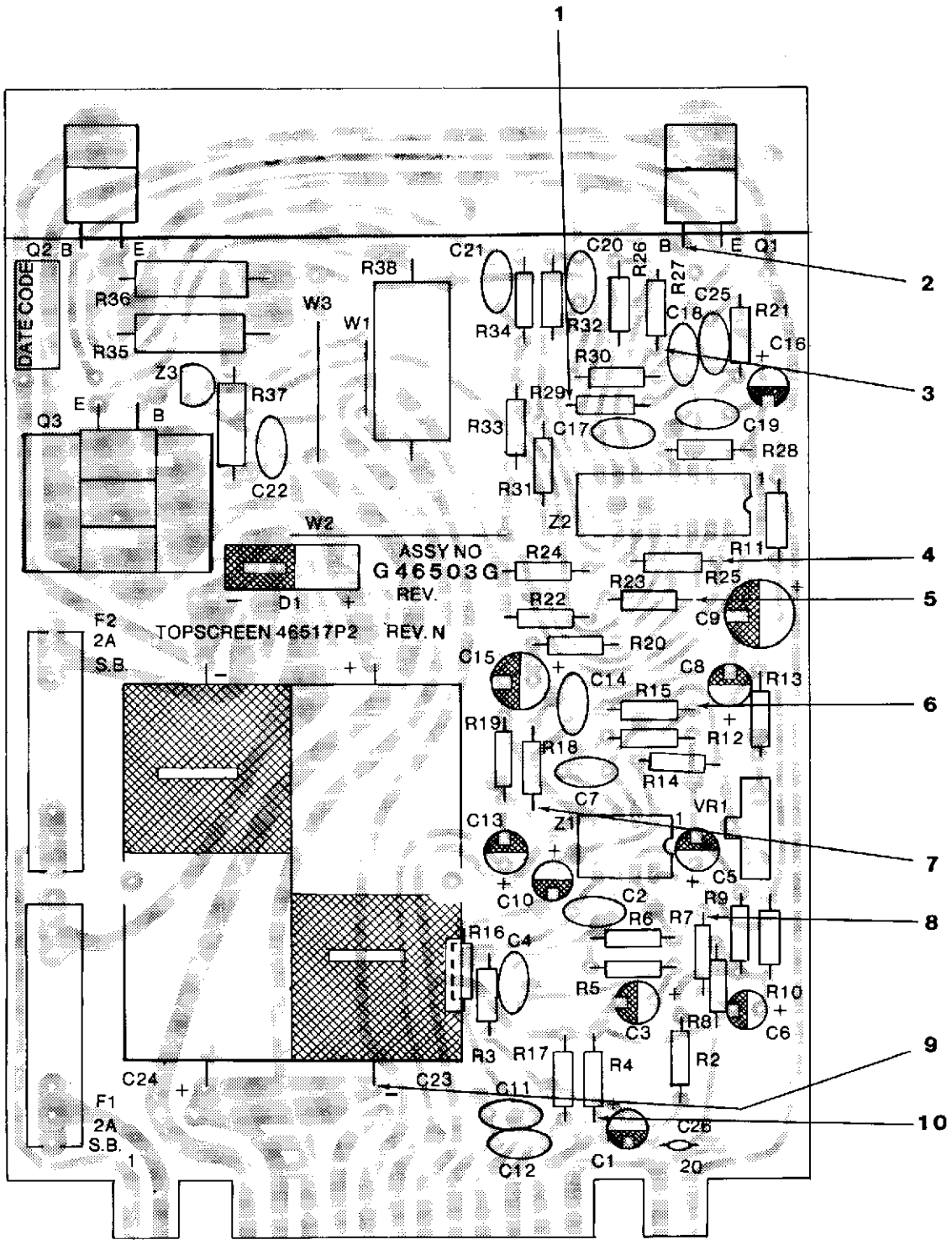
TROUBLE	CAUSE	REMEDY
1. Control System Troubles		
a. Blower Motor does not operate in any mode.	Blower Motor defective	Replace Blower Motor
	Blower Motor Relay defective (Models 2270 and 2280)	Replace Blower Motor Relay (K7 on 2270 and K6 on 2280)
	Switch S2 defective	Replace Switch S2
	Switch S7 defective (Model 2270)	Replace Switch S7 (Model 2270)
b. Projector does not operate when FORWARD button is depressed	Switch S2 defective	Replace Switch S2
	Relay K3 defective (Models 2270 and 2280)	Replace Relay K3
c. Projector operates but projection lamp does not illuminate when the FORWARD button is pressed	Projection lamp defective	Replace lamp
	Transformer T1 defective	Replace transformer
	Switch S2 defective	Replace Switch S2
	Switch S9 defective	Replace Switch S9
	Switch S7 defective (Models 2270 and 2280)	Replace Switch S7
	Lamphouse cover not in place properly (Model 2280)	Assemble lamphouse cover to projector properly
	Switch S8 defective (Model 2280)	Replace Switch S8
d. Low light level on screen during projection	Safety shutter not lifting	Redampen with DC200 (39479-P13)
	Safety shutter sticking	Visually align the safety shutter midway between the shutter and cam assembly. Safety shutter spring and link must clear the shutter cam by 1/8"
	Safety shutter defective	Replace safety shutter
e. Film burns in still mode	Safety shutter sticking on bumper pad	Replace bumper pad
	Safety shutter return spring unhooked or missing	Reassemble or replace spring
	Safety shutter defective	Replace safety shutter
f. Projector does not operate when REVERSE button is depressed	Switch S2 defective (terminals H-8 or J-6)	Replace Switch S2
g. Fast mode interlock light does not come on with Master Control Lever in LOAD/FAST and FORWARD or REVERSE button pressed	Interlock lamp L3 defective	Replace Lamp L3
	Capacitor C18 shorted	Replace Capacitor C18
	Relay K2 defective	Replace Relay K2
	Diode D3 open	Replace Diode D3
	Resistor R27 open	Replace Resistor R27

TROUBLE	CAUSE	REMEDY
h. Fast mode interlock light does not remain on for five seconds after STOP button is pressed (Models 2270 and 2280)	Capacitor C18 open	Replace Capacitor C18
	Relay K5 defective (Model 2280)	Replace Relay K5
	Relay K6 defective (Model 2270)	Replace Relay K6
i. Failure to drive in Fast FORWARD or brake in REWIND (Models 2270 and 2280)	Solenoid SO3 defective	Replace Solenoid SO3
	Relay K1 defective	Replace Relay K1
	Switch S3 defective	Replace Switch S3
	Switch S6 defective	Replace Switch S6
	Fast Forward clutch actuator cap not engaging clutch spring properly	Check cap/spring engagement. Replace actuator cap or spring as necessary
	Fast Forward drive belt tension incorrect	Adjust drive belt tension
j. Failure to REWIND, or brake in FAST FORWARD	Solenoid SO1 defective	Replace Solenoid SO1
	Solenoid SO2 defective	Replace Solenoid SO2
	Relay K1 defective	Replace Relay K1
	Switch S3 defective	Replace Switch S3
	Switch S5 defective	Replace Switch S5
	Rewind clutch actuator cap not engaging clutch spring properly	Check cap/spring engagement. Replace actuator cap or spring as necessary
	Feed sprocket clutch positive drive roll pin missing	Replace feed sprocket clutch gear
k. Failure to brake in REWIND (Models 2210, 2220 and 2220L)	Rewind brake cable off pulleys	Reassemble brake cable
	Wrong rewind brake cable length	Adjust brake cable
	Take-up clutch pulley worn	Replace take-up clutch pulley
	Take-up clutch brake spring worn or dirty	Clean or replace brake spring
m. No interlock on main lever in FAST modes	Solenoid SO2 defective	Replace Solenoid SO2
	Interlock link uncoupled or deformed	Reassemble or reform
2. Film Handling and Picture Troubles (NOTE: Test Film must be in good condition)		
a. Noisy film handling in film gate	Claw protrusion or stroke out of adjustment	Adjust protrusion and/or stroke
	Pressure shoe out of adjustment	Adjust pressure shoe
	Emulsion buildup on pressure shoe and aperture plate	Clean pressure shoe and aperture plate

TROUBLE	CAUSE	REMEDY
2. Film Handling and Picture Troubles (Continued)		
a. Noisy film handling in film gate (Continued)	Claw arm pins worn or damaged	Replace claw arm
b. Film scratch	Dirty film	Clean the film
	Aperture plate or pressure shoe dirty	Clean with Isopropyl Alcohol or Chlorothene 1 + 1 + 1
	Film path rollers stuck	Clean and lubricate film path rollers
c. Film damage at feed sprocket	Supply reel arm pulley binding	Clean or replace reel arm pulley and bearing
	No end play in feed sprocket	Adjust end play by reducing number of washers (35473-P48)
	Sprocket defective	Replace feed sprocket
d. Film spills at supply reel (Reverse operation)	Solenoid SO1 defective	Replace Solenoid SO1
	Rewind clutch actuator cap not engaging clutch spring properly	Check cap/spring engagement. Replace actuator cap or spring as necessary
	Feed sprocket clutch not driving	Check feed sprocket clutch spring and arbor. Replace as necessary
e. Clicking noise (film picking)	Teeth of feed or take-up sprocket damaged or out of alignment	Replace feed or take-up sprocket
	Claw arm teeth worn, damaged or missing	Replace claw arm
	Pressure shoe not seated properly	Adjust pressure shoe
	Claw arm out of adjustment	Adjust stroke and/or protrusion
f. Damaged film at take-up	Film take-up tension too high	Adjust take-up tension
	Bottom idler roller pressure too high or too low	Adjust pressure roller eccentric
	Take-up sprocket defective	Replace take-up sprocket
g. Film spills in FORWARD at supply reel	Rewind clutch driving	Clean and adjust rewind clutch. Check rewind clutch for proper end play. Replace actuator cap, spring or arbor as necessary.
h. Loose film on reel after rewind	Supply or take-up reel bent	Replace bent reel
i. Picture jumps (possible loss of loop)	Claw protrusion, stroke or side clearance out of adjustment	Adjust protrusion, stroke and side clearance
	Aperture plate or pressure shoe dirty	Clean aperture plate and pressure shoe with isopropyl alcohol or chlorothene 1 + 1 + 1

TROUBLE	CAUSE	REMEDY
i. Picture jumps (possible loss of loop) (Continued)	Pressure shoe not aligned properly	Align pressure shoe
	Claw arm damaged	Replace claw arm
j. Picture motion - side-to-side	Film edge guide spring weak or assembled improperly	Replace spring or assemble properly
k. Picture goes in and out of focus at random	Bad film	Check projector with known good film
	Pressure shoe damaged or out of adjustment	Replace or adjust pressure shoe
m. Picture "streams" vertically	Pressure shoe not aligned	Align pressure shoe
	Claw arm protrusion too short	Adjust protrusion
	Film edge guide spring not assembled properly	Reassemble properly
3. Sound System Troubles		
a. Exciter lamp blows or has short life	Defective lamp, Q3, Z3, or R38	Replace lamp first then try each component
b. Exciter lamp doesn't light. Speaker hiss increases with volume control	Defective lamp, Q3, Z3, or R38	Replace lamp first then try each component
	Exciter lamp socket defective or open leads to the lamp socket	Replace lamp socket after checking for open leads to the socket
	Switch S2A defective or Relay K1 defective (Model 2270)	Replace defective component
	Switch S2A defective or Switch S9 defective (Model 2280)	Replace defective component
c. Exciter lamp doesn't light. No speaker hiss	Fuses F1 and F2 blown, Defective D1, T1, C23	Check for defective component, then replace fuses
d. Exciter lamp O.K. No sound from film. Speaker hiss increases with volume control	Defective Photo diode PD1, Z1, C1, C5, broken or shorted wire from sound drum, defective P1-15 or 16	Check for open or shorted wire from sound drum then check each component and plug P1
e. Exciter lamp O.K. No sound from film. Speaker hiss but volume control has no affect on hiss	Defective Z1, C10, P1-15 or 16, Z4 (Models 2270 and 2280)	Check P1 contacts, replace defective component
f. Exciter lamp O.K. No sound, hum or hiss	Defective Fuse F3, Switch S2A (Models 2210, 2220 and 2220L), Speaker jack JS1, C34, Q1, Q2, Z2, Bad connection to speaker	Check for bad fuse and bad connections, then replace defective component
	In addition for models 2270 and 2280: Defective S2E, K4, S11, D2, Q4, Q5, Q6	Replace defective component
g. Exciter lamp O.K. Distorted sound	Defective Z1, Z2, Q1, Q2, C24, C1, C5, C10, C13, C34, Z4 (Models 2270 and 2280), speaker	Replace defective component
h. Excessive hum with sound	Defective C23, C24, C9	Replace defective component

TROUBLE	CAUSE	REMEDY
4. Miscellaneous Troubles		
a. Motor runs, drive shaft does not rotate	Motor belt tension low (belt slips)	Adjust belt tension
	Main shaft pulley loose	Tighten setscrews
	Belt and pulleys dirty	Clean with isopropyl alcohol or chlorothene 1 + 1 + 1
	Motor pulley pin broken	Replace pulley or pin (39092-P1)
b. Failure to start on low power	Kick spring on main drive motor hub not functioning properly	Check as follows: (1) Hold pulley without binding motor shaft. Wind spring to fully tight position by rotating fan. (2) Release fan. Spring must throw fan 180°. If less than 180°, clean and lubricate - replace spring if necessary
c. Loss of power and/or speed	Extremely low line voltage	Check line voltage - consult with power company
	Low drive belt tension	Adjust drive belt tension
d. Failure to set upper loop	Loop set cables loose or off pulley	Reassemble, tighten and adjust
	Defective loop setting gear or drum in front sprocket assy	Replace defective part(s)
e. Master control lever binds when moving from LOAD to PROJECT	Defective loop setting gear or drum in front sprocket assy	Replace defective part(s)
	Lensholder stop pin not set correctly	Adjust lensholder stop pin
	Front sprocket clutch spring assembled improperly	Reassemble properly
f. Projection lens binds	Lens locking screw binding on lens housing	Reassemble screw properly
	Rack and pinion damaged	Replace defective part(s)
g. Projection lens loose	Pinion retainer worn or damaged	Replace defective part(s)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R30
R29
R33
C17
C19
R28
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R5
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R10
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R2
C24
C23
C11
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C12
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C26
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