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SERVICE INSTRUCTIONS

AUTOLOAD[®]

FILMOSOUND[®] 16mm PROJECTOR

(AUTOMATIC THREADING)

MODELS 2585, 2590, 2592

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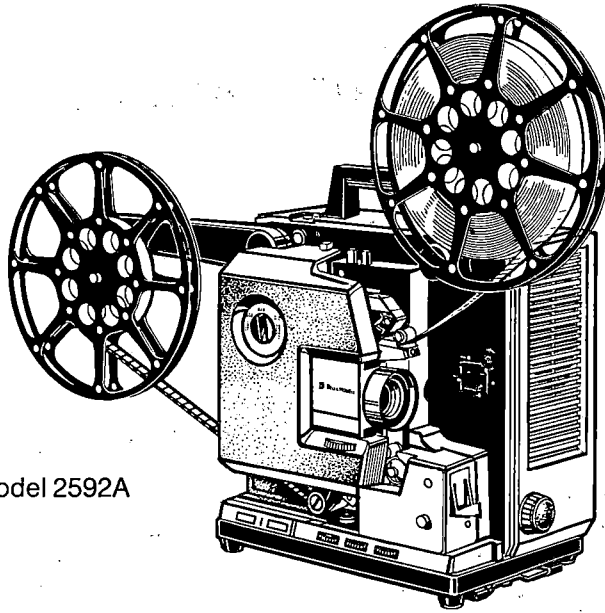
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Model 2592A

16mm Automatic Threading Projectors

FEATURE DESCRIPTION LIST

Color Charcoal gray	Shutter — 2585A/AML, 2590A, 2592A Rotating three blade 2585AX/AXU, 2592AX/ASX Rotating two blade
Input Voltage — 2585A/AML 120VAC, 60Hz 2585AX/AXU 120/220/240V, 50/60Hz 2590A, 2592A 120VAC, 60Hz 2592AX/ASX 120/220/240V, 50/60Hz	Exciter Lamp . . . Type BAK, 4V/0.75 Amp, 300 hr (approx.)
Film Threading Fully automatic	Amplifier Output 20 Watts RMS
Film Speeds — Sound 24fps in forward and reverse Silent 18fps in forward and reverse	Built-In Speaker 4" x 6" permanent magnet 16 ohm (over- load protected)
Projector Controls — 2585, 2590 Forward/Reverse 2592AX/ASX . Forward/Reverse/Still-Run 2592A Forward/Reverse/Still-Run and Directamotion	Amplifier Controls — 2585, 2590 Volume/Tone 2592 Volume/Treble/Bass
Projection Lamp — 2585, 2592 . . . Type ELC, 24V/250W/50 hr 2590 Type BHB, 120V/250W/25 hr	Dimensions . . 14-1/4"w x 16"h x 10-1/4"d
Projection Lens — 2585 2 inches (51mm) f/1.6 2590, 2592 2 inches (51mm) f/1.2	Approximate Weight — 2585A/AML 33 pounds (15Kg) 2585AX/AXU 35.5 pounds (16Kg) 2590A 29 pounds (13.2Kg) 2592A 34 pounds (15.4Kg) 2592AX 36.5 pounds (16.5Kg) 2592ASX 39.5 pounds (17.9Kg)

RECOMMENDED SPARE PARTS LIST
FOR REPAIR OF 50

MODEL 2585, 2590 AND 2592 AUTOMATIC THREADING
16MM SOUND PROJECTORS

REFERENCE: SERVICE MANUAL NO. 74421

PART NO.	DESCRIPTION	QTY
24047	Belt, Take-up - - - - -	6
34884	Lamp, Exciter, Type BAK - - - - -	6
44223	Lamp, Projector, Type BHB - - - - -	2
44459	Belt, Drive - - - - -	6
45695	Switch, Rotary - - - - -	1
49945	Switch, Rotary - - - - -	2
117172	Fuse, Slo-Blo, 4 amp - - - - -	6
305792	Fuse, Slo-Blo, 2 amp - - - - -	6
308638	Fuse, Slo-Blo, 3/4 amp - - - - -	6
710396	Lamp, Projector, Type ELC - - - - -	6
710660	Switch, Rotary - - - - -	2
707257	Motor, Drive - - - - -	1
015569	Photodiode Assembly - - - - -	1
015921	Thermal Fuse and Sleeve Assembly - - - - -	6
077195	PCB Amplifier Assembly - - - - -	2
077632	Thermal Fuse and Sleeve Assembly - - - - -	6
078577	PCB Amplifier Assembly - - - - -	2

INTRODUCTION

1. GENERAL.

This Service Manual provides the necessary information for the repair and adjustment of the Bell & Howell Company 16mm Automatic Loading Sound Projectors, Models 2585, 2590 and 2592. Major design and operating characteristics are listed in the Feature Description List on the preceding page. An illustrated Parts Catalog is included at the rear of the manual to identify replacement parts and to assist in the disassembly and reassembly of these projectors.

2. DESCRIPTION OF MODELS.

As noted in the following chart, this manual covers several variations of the basic 2500-series automatic loading projectors. Each model is "letter-coded" in the Parts Catalog so that replacement parts which are not common to all projectors can be readily identified. Parts peculiar to Canadian versions are so indicated in the parts lists.

<u>MODEL</u>	<u>CODE</u>
2585A	A
2585AML	B
2585AX	C
2585AXU	D
2590A	E
2592A	F
2592AX	G
2592ASX	H

Except for differences in operating voltages (single-line or multi-line) and certain special features, all projector models covered in this service manual are basically identical. The single-line voltage units (suffix letter "A" in the model designator) operate on 120VAC, 60Hz and are equipped with a line cord that is wired into the projector. The multi-line voltage units (all "AX" models) are equipped with a voltage selector switch which provides a means for varying input voltages (120 - 240V, 50/60Hz) and to match input voltages with those available globally.

A male plug is supplied to mate with a female receptacle located on the rear cover for accommodation of global requirements.

Model 2585AML is a militarized version of the 2585A unit and is further identifiable by two 5 amp Slo-Blo fuses mounted on the top cover. The 2585AXU and 2592ASX models are the only projectors in this series that are equipped with a front cover containing speakers.

The sound system control knobs located on the operating side of the base are not the same for all models. The 2585/2590 models are equipped with a volume control and a single tone control. All 2592 models are equipped with a volume control and two tone controls; one for treble and one for bass.

All of the 2592 models are designed for "still" projection, however, only the 2592A model is equipped with the Directamotion® (animation) feature. To activate the animation feature place the main switch in the "forward project" or "reverse project" position. Then, with the projector running, place the run/still lever in the "still" position. To advance film frame-by-frame, press and release the animation lever located at the top left corner of the projector mechanism housing. To advance several frames of film (or a length of film at regular projection speed) press and hold the animation lever down. Release the lever to stop film motion. To resume normal film projection return the run/still lever to the "run" position.

3. AUTOMATIC LOADING OPERATION.

The automatic loading system consists of a series of film guides, loopformers and rollers designed to advance and guide the film smoothly and precisely through the film path to the take-up reel. This is accomplished when the system is in the "load" (closed) position. When the system is in the "open" (run) position, all guides are clear of the film path. All projectors are

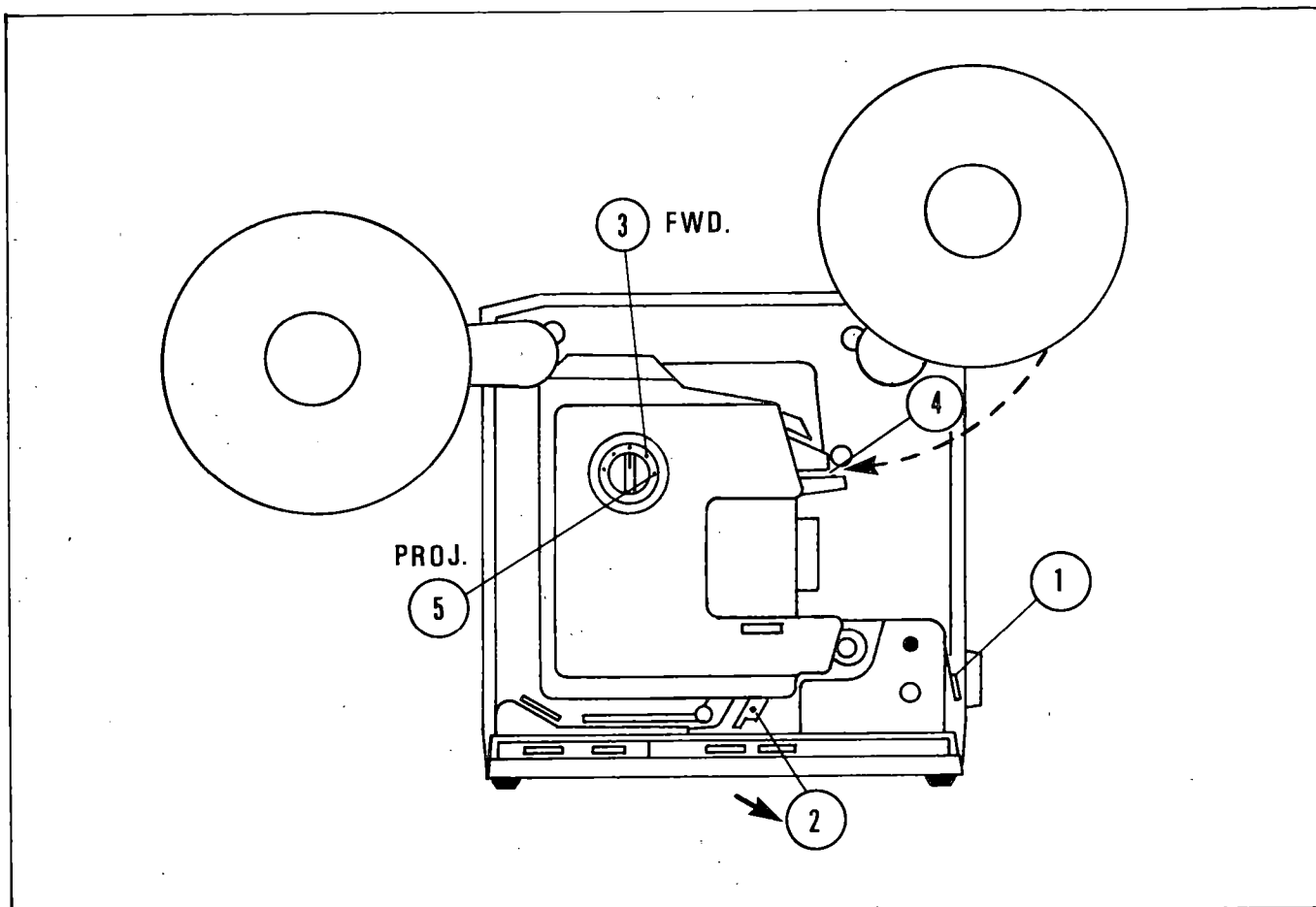


Figure A: Automatic Loading Operation

completely gear-driven, with shifting from forward to reverse accomplished by means of a rocker plate/idler gear arrangement.

The upper and lower guides are connected by a mechanical linkage with a locking lever at the lower end to actuate (close) the system. A film escape mechanism is included at the upper end of the linkage to prevent damage to the film due to jamming. When a film jam occurs, the film will fold and flow out through the kickplate of the escape mechanism until the operator has had an opportunity to stop the projector.

To thread film using the automatic loading system, refer to Figure A and proceed as follows:

Step 1: Check the leader (first three feet of film) for defects. If the film end is damaged or torn, insert it into the film trimmer (1) and trim the end.

Step 2: Push the auto-load lever (2) forward until it locks. (Note: If the projector being threaded is equipped with the still feature, place the run-still lever in the "run" position.)

Step 3: Turn the main switch to the "forward project" position (3).

Step 4: Insert the leader into the film channel under roller (4). Push the leader in until it engages the sprocket and the automatic loading system begins to thread the film. After two feet of leader has passed through the projector, pull lightly on the leader end until a "click" is heard signaling the release of the threading mechanism.

Step 5: Turn the main switch "off." Attach the leader end to the take-up reel and rotate the reel in a clockwise direction to take up film slack.

4. SPECIAL MAINTENANCE PRECAUTIONS.

Before beginning repairs, check specific customer complaints against the trouble shooting charts in this service manual for the most probable causes and suggested remedies. When repairs have been made, be sure to clean and lubricate the projector before it is returned to the customer.

The removal and installation of most projector components can be accomplished with tools normally found in an audio-visual equipment repair shop. Although most wiring connections are made by quick disconnects, a soldering gun should be available for some repairs. Special tools and gages necessary for projector alignments and adjustments are illustrated and listed in Figure B and its accompanying chart. The setscrew wrenches and test films are listed in separate charts and are not shown in Figure B.

Keep your work bench clean and uncluttered. As parts are removed, group them together in an orderly fashion and reassemble attaching parts loosely to the parts they attach. Note or tag electrical wires or connectors so that they can be properly reconnected. If there is any doubt as to the connection of leadwires, refer to the proper wiring diagram at the rear of the Parts Catalog.

5. CLEANING INSTRUCTIONS.

Keep film path areas free of dirt and emulsion build-up; otherwise film jamming may occur during loading operations and projection. Use isopropyl alcohol and the special cleaning pad (P/N 48478) to remove hardened emulsion, and be careful not to scratch the surfaces that contact the film. Pay particular attention to the sound drum and the soundhead rollers.

Use isopropyl alcohol to clean plastic parts and be careful not to remove lubricants from critical areas, especially in the film threading linkage. These lubricants are applied during the assembly of the projector and, in many cases, it would be necessary to partially disassemble the projector to re-lubricate these parts. Blow away dust and

film chips with a low-pressure jet of compressed air and wipe with a soft, lint-free cloth.

If the projector is especially dirty, the transport mechanism should be removed from the mainplate and thoroughly cleaned. Brush or blow out all accumulations of dirt and film chips. Wash "Oilite" bearings and cams with naphtha. If cleaning does not remove old lubricant from the felt wiper and wick, these items should be replaced. Clean all other moving parts with isopropyl alcohol and dry all parts with a low-pressure jet of compressed air. As soon as all parts have been cleaned and dried, apply a light film of the specified lubricants and reinstall the transport mechanism.

6. LUBRICATION INSTRUCTIONS.

The Lubrication Chart in this section indicates those parts and areas requiring lubrication. These are also pointed out in the Parts Catalog illustrations by means of ballooned letters "L" (for oil) and "G" (for grease). Specified lubricants are available from the Bell & Howell Company. Be sure that the part or area to be lubricated is clean before lubricant is applied, and be careful not to over-lubricate. A drop or two of oil or a very light film of grease will be adequate. Apply grease with a camel's hair brush and wipe away excess lubricant with a lint-free cloth.

Felt pads and wicks should be placed in a shallow pan containing the specified grease and allowed to stand until they are completely saturated. Wipe away excess grease before installing these felt parts.

7. GENERAL REPLACEMENT DATA.

These projectors are designed for easy accessibility, removal and replacement of most major components. Routine inspection, trouble shooting and lubrication generally can be accomplished by the removal of the front cover, the rear cover and the two covers located on the underside of the base. Most of the wiring connections

for the major electrical components are made by means of quick disconnect connectors or screw-on wire nuts, thus minimizing unsoldering operations. Wiring connections and leadwire colors are indicated in the wiring diagrams at the rear of the Parts Catalog.

The front cover is easily removed by unlatching the two top cover latches and lifting the cover from the projector. The rear cover is secured to the projector base with three screws and to the end caps with two screws each (see Figure C). When these seven screws have been removed, carefully work the cover free from the projector to the limit of the interconnecting leadwires. The covers on the underside of the base are secured by screws and can be removed to expose the amplifier and its controls.

8. FUSE REPLACEMENT.

a. Single-Line Voltage Models. The amplifier power input circuit and the audio system of these models is protected by a Slo-Blo fuse located adjacent to the rotary switch on the gear side of the mainplate. Remove the projector rear cover (paragraph 11) to gain access to this fuse. Additional protection is provided for the 2585AML units by two Slo-Blo fuses mounted on the top cover of the projector.

b. Multi-Line Voltage Models. The amplifier power input circuit of these models is protected by a Slo-Blo fuse located adjacent to the rotary switch on the gear side of the mainplate. The audio system of these models is protected by three Slo-Blo fuses that are mounted on a fuseboard/support assembly

attached to the power transformer assembly. To gain access to all fuses, remove the rear cover as instructed in paragraph 11.

NOTE: Refer to the appropriate schematic wiring diagram in the Parts Catalog for correct values when replacing fuses.

c. All Models. The electrical system of all projectors is protected against accidental overheating by a special thermal fuse. This fuse is installed on the bracket located just above the drive motor. The projector rear cover must be removed (paragraph 11) and the wire nuts disconnected from the fuse leads for replacement.

9. LAMP REPLACEMENT.

a. Projection Lamp. With the line cord disconnected and the front cover removed, swing open the lamphouse cover and press in on the top of the lamp retainer spring to unlock the spring, then swing the spring down to release the tension on the projection lamp. Pull the lamp straight out from its socket (do not twist or wiggle the lamp during removal). Assemble the new lamp into the socket and swing the lamp retainer spring up into place. Close the lamphouse cover and replace the front cover.

b. Exciter Lamp. Disconnect the line cord. Loosen the thumbscrew on the exciter lamp cover and remove the cover. Rotate the lamp release ring until the exciter lamp can be turned and lifted from the lamp socket pins. Install the new lamp in the lamp socket. Then press down on the release ring and rotate to close the ring. Remove fingerprints from the lamp with lens tissue or a lint-free cloth and reinstall the covers.

LUBRICATION CHART

<u>Parts To Be Lubricated</u>	<u>Lubricant</u>
Non-bearing machined surfaces of castings - - - - -	Oil P/N 07003 (L1)
Upper sprocket shaft - - - - -	Oil P/N 08963 (L2)
Framer shaft - - - - -	Oil P/N 04978 (L3)
Bearing face of worm gear - - - - -	Oil P/N 04978 (L3)
Lower sprocket shaft - - - - -	Oil P/N 078215 (L4)
Felt pads - - - - -	Oil P/N 070032 (L5)
Friction surfaces of all sliding parts (not otherwise specified)	Oil P/N 070032 (L5)
Worm gear and sprocket gear teeth - - - - -	Grease P/N 070043 (G1)
All other gear and pinion teeth - - - - -	Grease P/N 070034 (G2)
Reel arm lock buttons - - - - -	Grease P/N 070034 (G2)
Shuttle link bearings - - - - -	Grease P/N 070034 (G2)
In-out cam, cam follower and cam wicks - - - - -	Grease P/N 070034 (G2)
All pivot posts and bearings (in the mechanism housing)	Grease P/N 070034 (G2)

MULTI-SPLINE SETSCREW TOOL CHART

TOOL NO.	DESCRIPTION	USED FOR
G1271-F1	Setscrew Wrench and Handle	4-40 multi-spline setscrews
G1271-X2	Setscrew Wrench	4-40 multi-spline setscrews
STK3852-B	Setscrew Wrench and Handle	6-32 multi-spline setscrews
STK3863-B	Setscrew Wrench	6-32 multi-spline setscrews
G165-F1	Setscrew Wrench and Handle	8-32 multi-spline setscrews
G165-X2	Setscrew Wrench	8-32 multi-spline setscrews
G165-F3	Special Setscrew Wrench	For setscrews in wrench handles

TEST FILM CHART

PART NO.	DESCRIPTION	USE
TFL-55 NX1	Test Film Loop	Adjust centering and framing
TFL-37 NX1	Test Film Loop	Check buzz track
TFL-26 NX3	Test Film Loop	Check 7KHz azimuth
TFL-23 NX1	Test Film Loop	Check 400Hz power output
TFL-D1580 NX2	Test Film Loop	Adjust centering and framing
TFR-D550 NX5	Test Film Roll	Final audio/centering/framing
TFS-D550 NX1	Test Film Strip (bad holes)	Check loop restorer function
TFS-D550 NX5	Test Film Strip (elongated holes)	Check loop restorer function

SERVICE TOOLS AND SUPPLIES CHART

Figure B Index No.	Tool No.	Tool Description	Tool Usage
1	S-078175-6 F1	Lamp Plug (ELC Lamp)	Optical system alignment (Fig. Q).
1A	S-1552-1 N1	Lamp Plug (BLB Lamp)	Optical system alignment (Fig. Q).
2	S-550-2 N1	Lens Plug	Optical system alignment (Fig. Q).
3	S-550-2 N2	Alignment Rod	Optical system alignment (Fig. Q).
4	S-550-2 N3	Aperture Plug	Optical system alignment (Fig. Q).
5	P/N 44507	Tension Spring	Optical system alignment (Fig. Q).
6	Make in Shop	Torque Wrench	Adjust rewind torque (para. 38).
7	P/N 710365	Rewind Torque Reel	Adjust rewind torque (para. 38).
	Purchase	Push-Pull Torque Scale (Chatillon #LP-72, Master Gage Co., Chicago, IL 60622)	Adjust rewind torque (para. 38).
8	S-09701-35 N2	Shuttle Height Gage	Check shuttle protrusion (Fig. T).
9	S-550-8 N1	Alignment Tool	Align sound drum (Fig. AC).
10	Make in Shop	Adjustment Tool	Remove play from sprocket plate.
11	S-552-1 N1	Timing and Alignment Plate	Timing the sprockets (para. 37).
12	S-552-2 N1	Loop Restorer Roller Gage	Adjusting loop restorer (para. 36).
13	Make from 707588	Decal Removal Tool	Remove decals.
14	P/N 48478	Cleaning Tool	Clean film path area.
	P/N 70507	Adhesive (A1)	See parts catalog illustrations.
	P/N 70910	Heat Sync Compound (HS)	See paragraph 23.

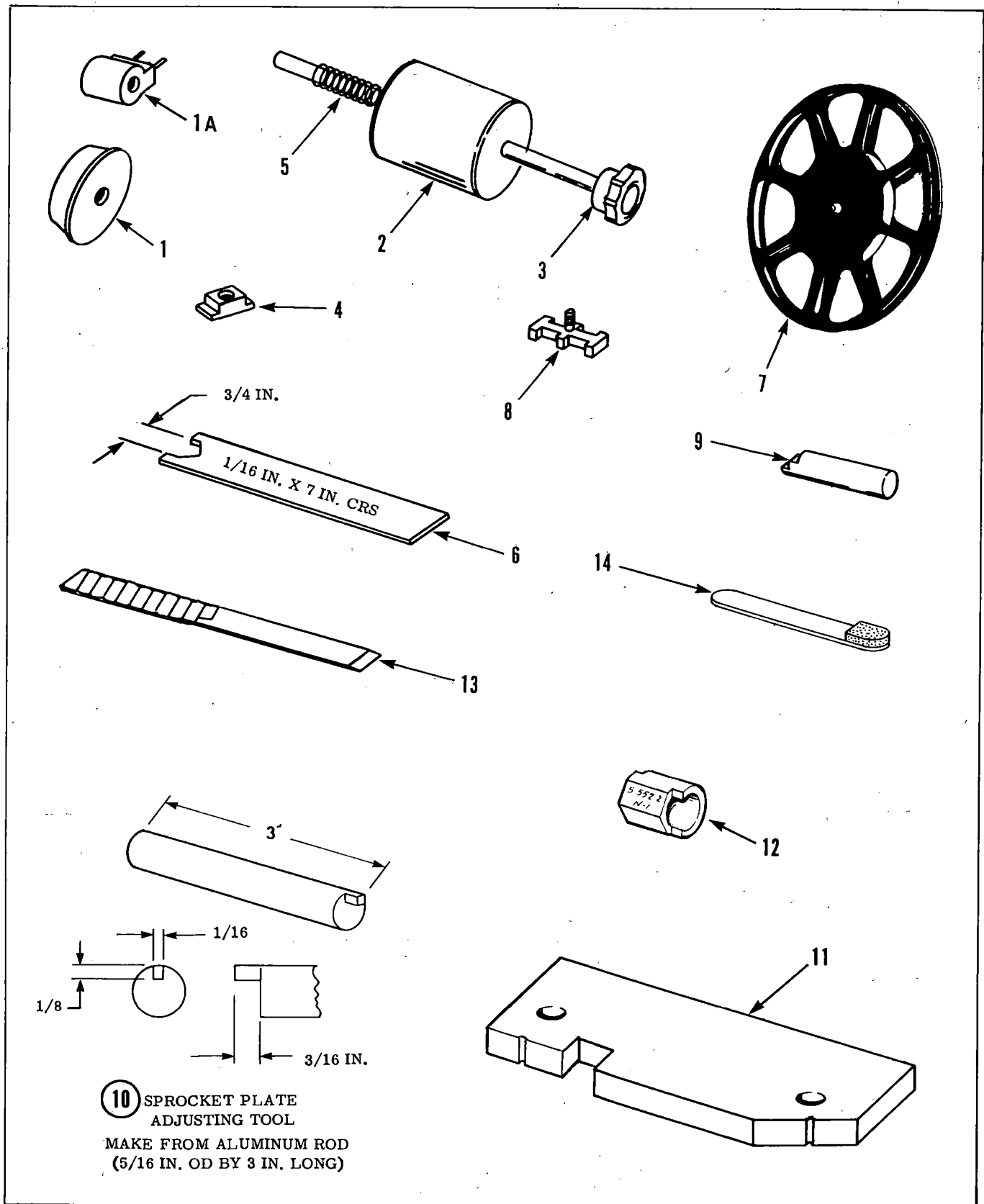


Figure B. Service Tools

DISASSEMBLY/REASSEMBLY PROCEDURES

10. GENERAL PRECAUTIONS.

a. Be sure to use the proper size tools for disassembly and reassembly procedures. After removing attaching parts (screws, nuts, etc.), loosely assemble these parts to the removed component or to the tapped holes in the major casting to prevent their loss.

b. Cemented or adhesive-backed parts are so noted in the parts lists and can be removed by carefully prying up one edge with a decal removal tool. Be careful not to scratch surrounding areas and remove traces of old adhesive with solvent before installing new labels or nameplates. If the new item is to be cemented in place, use Bell & Howell Company P/N 70507 cement. If the new item is adhesive-backed, peel off the protective tissue and smooth the item in place.

c. When disconnecting leadwires prior to the removal of electrical components, tag the leads or make a rough sketch of more complicated connections to assist in re-installation. Where unsoldering is necessary, use a soldering gun and a heat sink to avoid the transfer of heat to adjacent parts. Leadwire colors and connections are shown in the wiring diagrams at the rear of the Parts Catalog section.

d. When removing riveted parts for replacement, drill out the old rivets with a drill equal in size or slightly smaller than the diameter of the rivets. Use screws and nuts of corresponding size to attach the replacement part, making sure that these parts do not interfere with the proper operation of the equipment.

e. The instructions contained in this section are limited to the replacement and/or repair and adjustment of major projector components. If further disassembly is required, refer to the Parts Catalog section for a more complete breakdown. All parts

listings are arranged in a suggested order of disassembly to assist service personnel in the removal and replacement of worn or damaged parts.

11. PROJECTOR REAR COVER REMOVAL (Figure C).

The lower end of the rear cover is secured to the base of the projector with three screws and to each end cap with two screws. When these seven screws have been removed, the rear cover can be carefully pulled away from the projector base and end caps to the limit of the interconnecting leadwires. Normally, this will be enough to expose all projector mainplate and base-mounted components for inspection, cleaning, lubrication and parts replacement. If it is necessary for the rear cover to be completely removed, all leadwires to the rear cover components must be disconnected. When reinstalling the rear cover, be sure that no leadwires have become caught and that the cover is fully seated before installing the mounting screws.

12. DRIVE BELT REPLACEMENT.

a. Remove the projector rear cover (paragraph 11), top cover (paragraph 13) and rear end cap (paragraph 15, step b).

b. If the drive belt is badly worn and in need of replacement, cut the old belt and remove it from the projector. Unplug the motor lead connector. Loosen the screw at the upper end of each motor bracket strap and disengage the straps from the motor mounting bracket. Remove the four screws that secure the motor brackets to the projector base and raise the motor just enough to permit the new belt to be passed around the motor toward the blower. Be careful not to lift the motor so high as to damage the blower fan. Clean both belt pulleys with isopropyl alcohol and loop the belt around the pulleys with as little stretching as possible. Reassemble the bracket straps to the

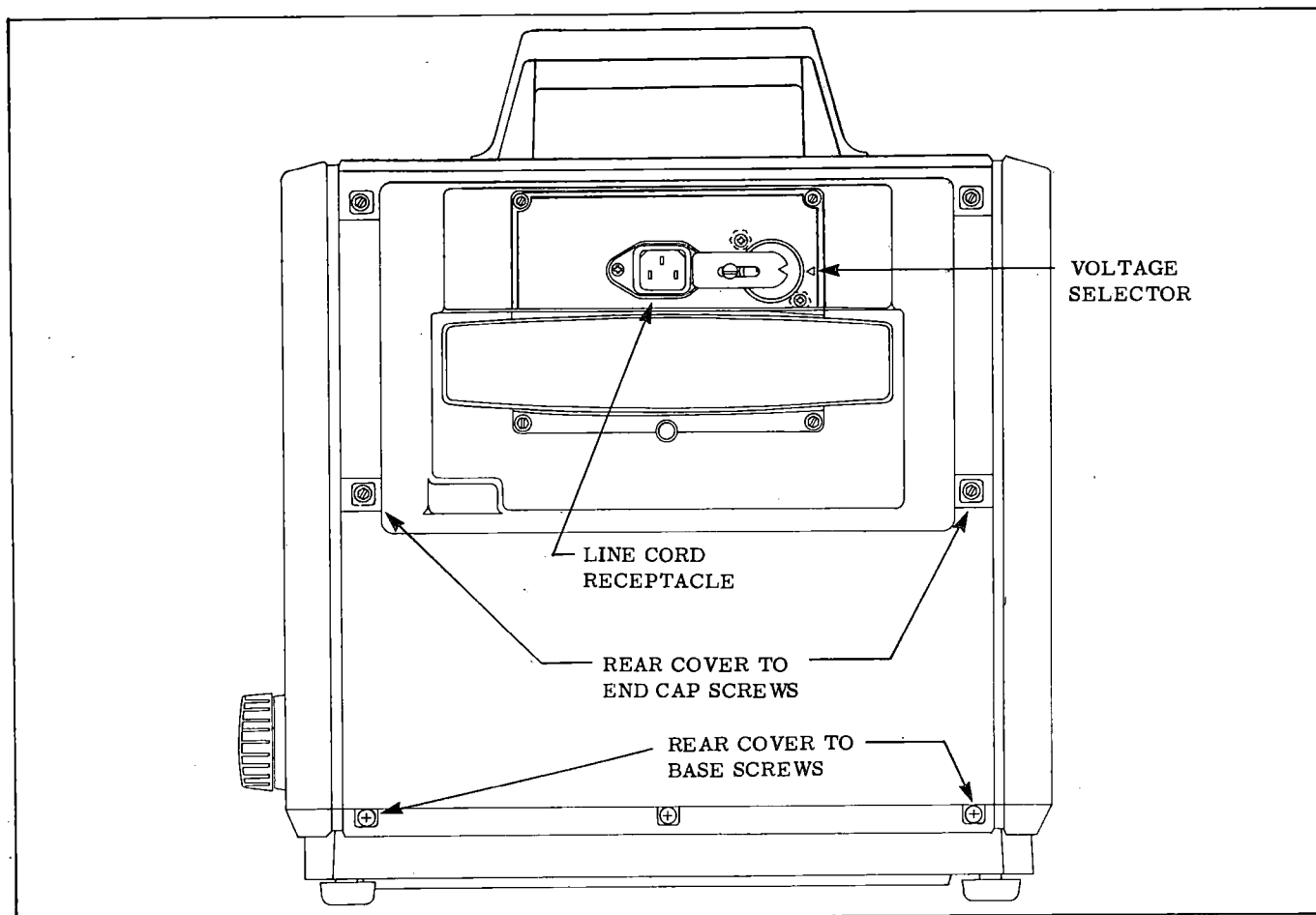


Figure C. Projector Rear Cover
(Multi-Line Voltage Models Shown)

motor brackets and tighten the screws securely. Secure the motor mounting brackets to the projector base with the four screws and reconnect the motor lead connector. Reinstall the rear end cap and projector covers.

13. PROJECTOR TOP COVER AND HANDLE REMOVAL (Figure D).

Remove the rear cover (paragraph 11). The top cover is secured by two screws which are inserted through the upper sides of the mainplate and threaded into tapped mounting brackets on the underside of the top cover (see Figure D). Remove these two screws and lift the top cover from the projector. To replace the carrying handle, the two handle screws and cover mounting brackets must be disassembled from the top cover.

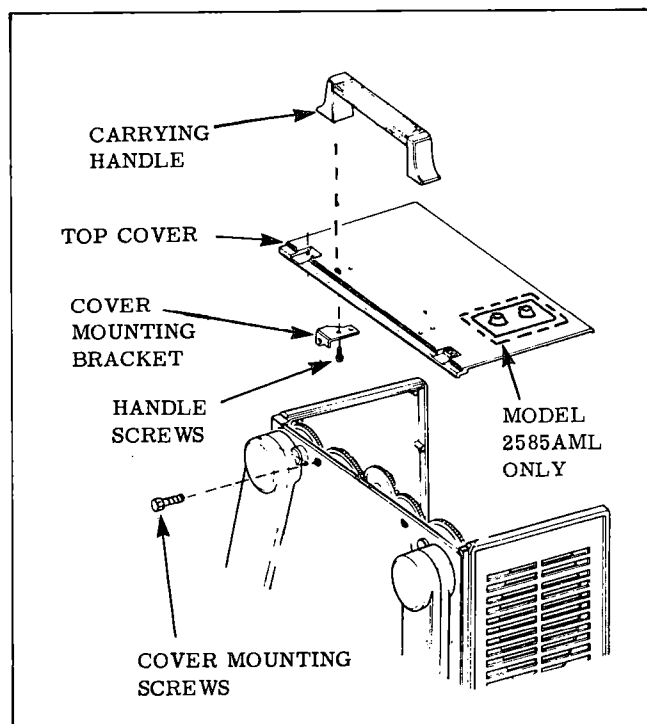


Figure D. Removing Top Cover and Handle

14. INTERNAL SPEAKER REPLACEMENT (Figure E).

The internal speaker is mounted to the front end cap and can be removed without disassembling the front end cap from the projector. Remove the rear cover (paragraph 11) to expose the speaker, and disconnect the two leads from the speaker terminals. Remove the four speed nuts from the mounting studs in the end cap and lift the speaker out from the projector. Reinstall the speaker in reverse fashion, pressing the leadwire lug connectors firmly in place on the speaker terminals. Redress any leadwires which may have been disturbed during speaker removal.

15. END CAP REMOVAL (Figure E).

If it should become necessary to remove the front or rear end caps from the projector, either for replacement or to gain access to other components, proceed in the following manner.

a. Front End Cap. Remove the rear cover (paragraph 11) and top cover (paragraph 13) from the projector. Disconnect the leadwires from the internal speaker terminals and tip the projector so that the underside of the base is exposed. Rotate the tilt knob until its setscrew is visible through the cut-out in the collar surrounding the tilt knob. Loosen this setscrew and withdraw the tilt knob. Disassemble the screw and washer from the tilt bar assembly and from the projector rubber foot and remove these parts from the base. Remove the two screws that are inserted through the base and threaded into the lower Tinnerman nuts assembled to the underside of the end cap. Remove the two screws that are inserted through the mainplate and threaded into the Tinnerman nuts assembled to the front edge of the end cap. Reinstall the end cap in reverse fashion and reconnect the speaker leads to the speaker terminals. Reassemble the top and rear covers to the projector.

b. Rear End Cap. Remove the rear cover (paragraph 11) and top cover (paragraph 13) from the projector. Tip the projector so that the underside of the base is exposed and remove the two screws that are inserted

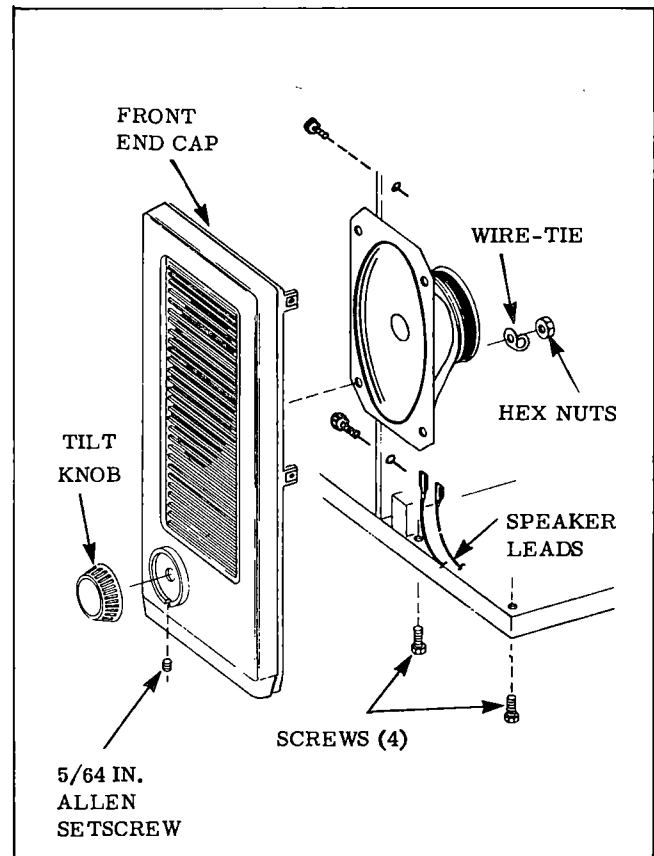


Figure E. Front End Cap and
Speaker Removal

through the base and threaded into the lower Tinnerman nuts assembled to the underside of the end cap. Remove the two screws that are inserted through the mainplate and threaded into the Tinnerman nuts assembled to the front edge of the end cap. If the rear end cap is to be replaced, move the end cap far enough away from the projector so that the leadwires to the end cap receptacles can be disconnected. Reinstall the end cap in reverse fashion, making certain that all leadwires are properly connected.

16. BLOWER REPAIRS (Figure F).

a. Remove the rear cover (paragraph 11), top cover (paragraph 13) and the rear end cap (paragraph 15, step b) from the projector. Move the covers far enough away from the projector to clear the blower housing without placing strain on the interconnecting leadwires.

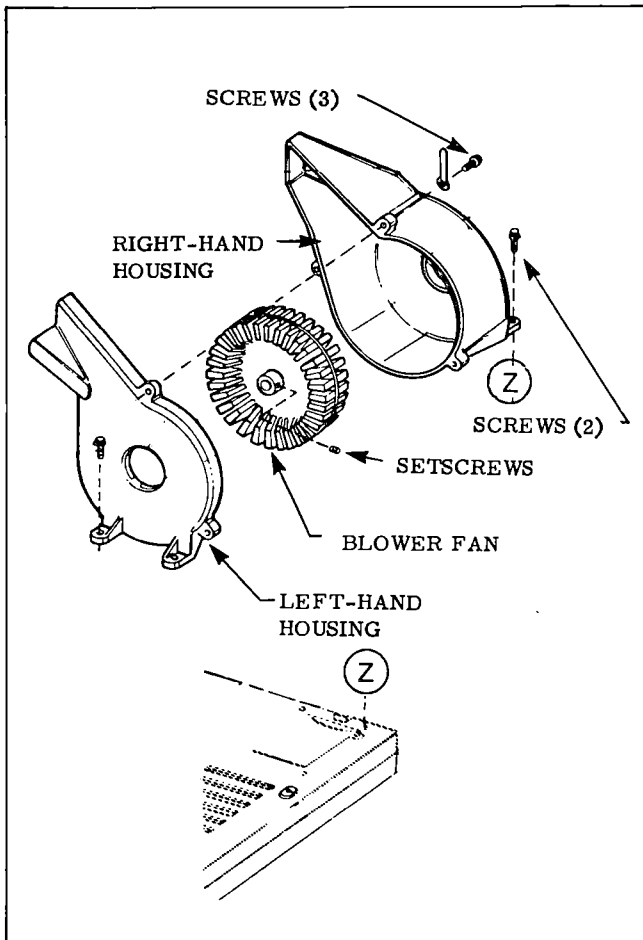


Figure F. Blower Repairs

b. The right-hand blower housing is attached to the left-hand housing with three screws and to the projector base with two screws. Remove these five screws and separate the two housings to expose the blower fan. If the blower fan is to be replaced, loosen the two setscrews and disassemble the blower fan from the motor shaft.

c. When reassembling the blower assembly, it is important that the fan be positioned so as not to strike against the two housings. Assemble the new fan to the motor shaft. Press the motor shaft to the left (to remove end play) and tighten the setscrews just enough to hold. Assemble the right-hand housing and hold in mounted position (screw holes aligned) while spinning the fan. Reposition the fan as necessary until there is clearance between the fan and both housings; then tighten both setscrews securely.

d. Install the five housing mounting screws and check to make certain that all leadwires are properly dressed. Reassemble the rear end cap and projector top and rear covers.

17. MAIN SWITCH REPLACEMENT (Figure G).

Remove the rear cover (paragraph 11) from the projector to expose the switch. Swing open the lamphouse and remove the switch knob and grip ring from the front end of the switch shaft. Unscrew the lock nut that secures the switch to the mounting bracket. Withdraw the switch from the bracket, catching the lock nut and lockwasher as they become free.

NOTE: Some single-line voltage units have capacitors wired across the switch terminals (see inset, Figure G) which must be disconnected from the old switch and reconnected to the replacement switch. Be sure to include the insulating sleeving on the capacitor lead to the fuseholder above the switch.

Insert the shaft of the new switch through the hole in the bracket and assemble the lockwasher and lock nut to the shaft before inserting it through the mainplate. Slide the lockwasher up against the switch boss and tighten the lock nut securely. Assemble the grip ring and switch knob to the end of the switch shaft and close the lamphouse. Reinstall the projector rear cover.

18. DRIVE MOTOR REPLACEMENT (Figure H).

Remove the projector rear cover (paragraph 11), top cover (paragraph 13) and rear end cap (paragraph 15, step b) and disconnect the motor leads. Remove the blower right-hand housing and blower fan (paragraph 16). Loosen the screw in the upper ears of each motor bracket strap and disengage the straps from the tongues of the mounting brackets. Remove the two screws from the left-hand mounting bracket only and slide the motor and bracket forward and out of the projector, while disengaging the drive belt from the motor

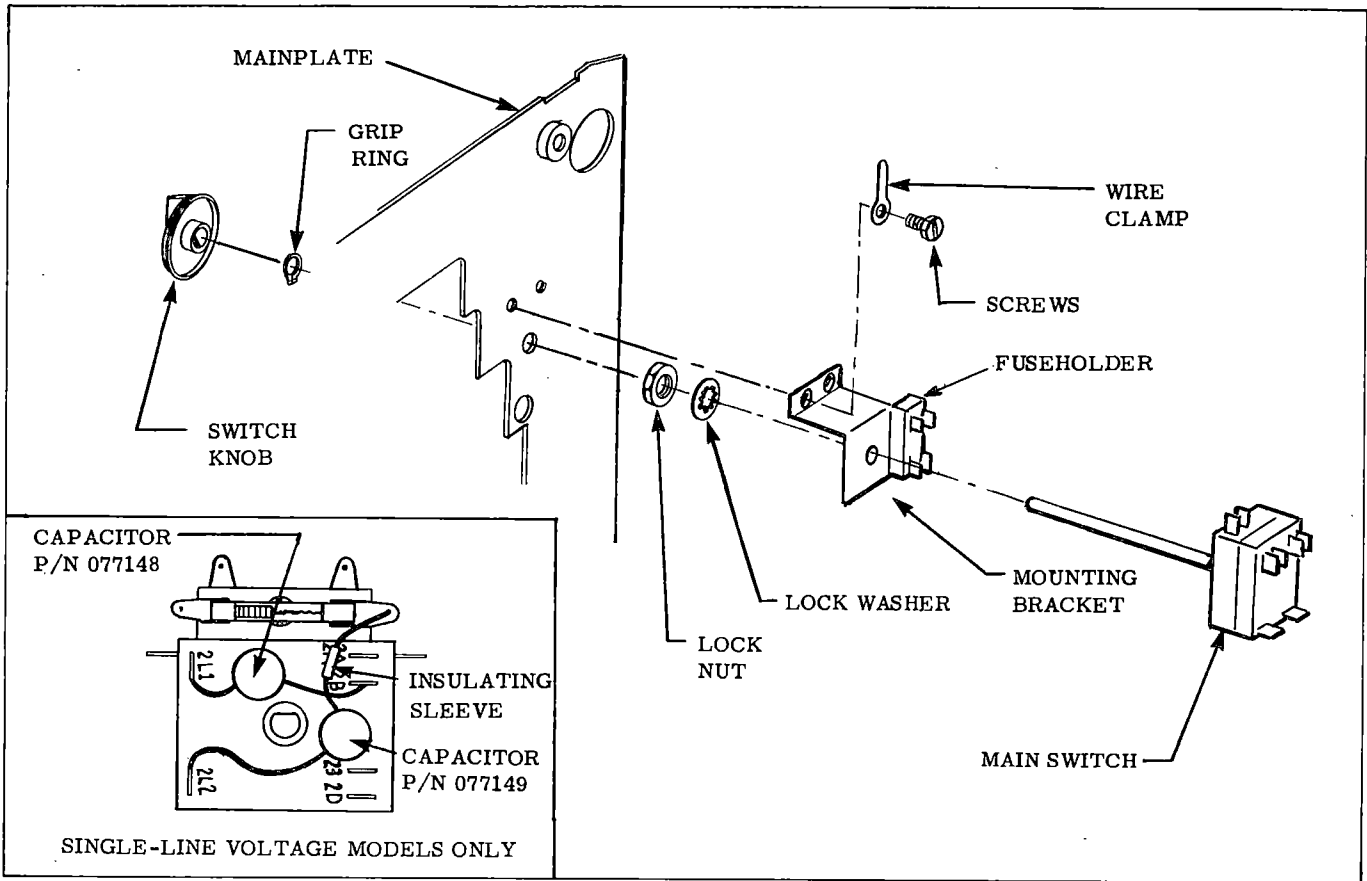


Figure G. Replacing the Main Switch

pulley. If the motor is to be replaced, remove the pulley from the motor shaft. Assemble the new motor and left-hand bracket to the projector base, with the pulley loosely installed on the motor shaft, and the drive belt looped around the pulley. Rest the motor end bell in the cradle of the right-hand mounting bracket and position the left-hand bracket so that the mounting screws can be installed. Assemble the motor bracket straps to the end bells and mounting bracket ears and tighten the strap screws. Insure that the thermal fuse and sleeve assembly is properly positioned and retained against the motor. Reassemble the right-hand blower housing and blower fan to the motor shaft (paragraph 16). Position the drive pulley so that the drive belt is perpendicular between drive pulley and mechanism pulley. Then tighten the two pulley setscrews securely and reconnect the motor leads. Replace the rear end cap and projector top and rear covers.

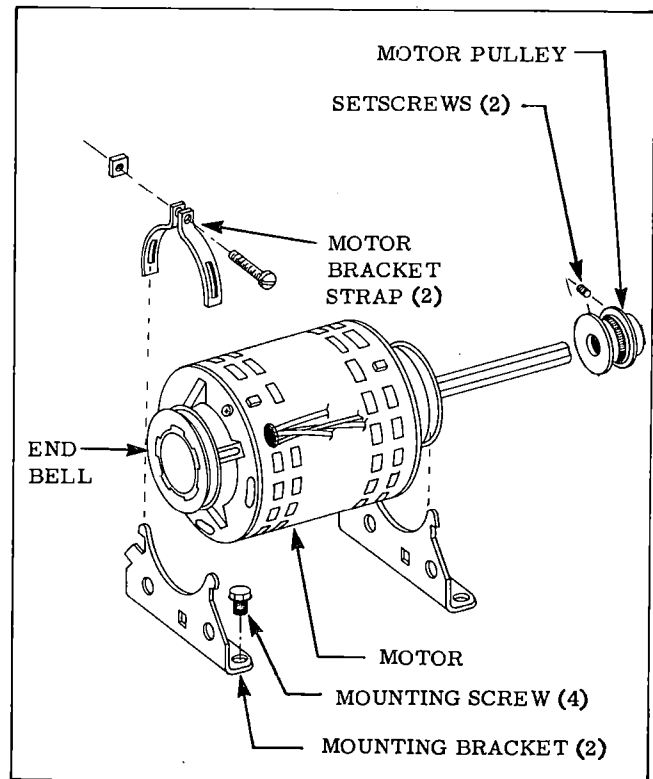


Figure H. Replacing the Drive Motor

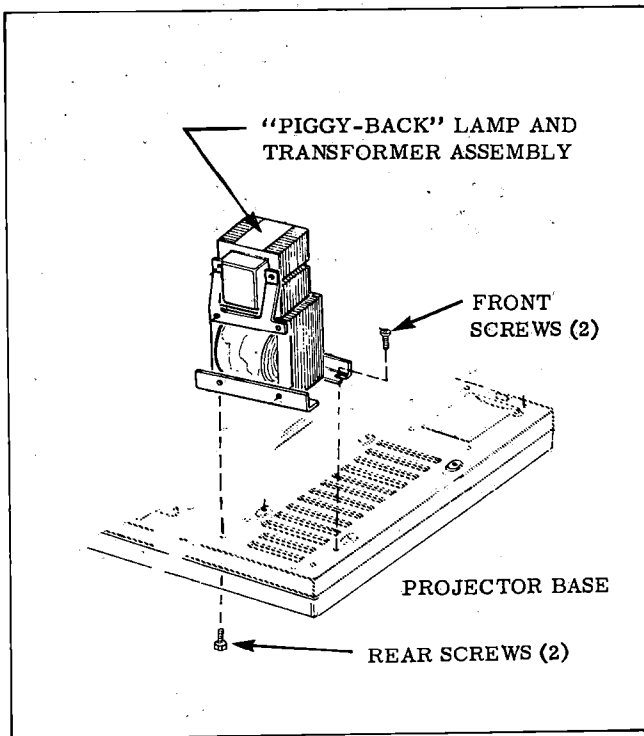


Figure J. Replacing the Transformer (Single-Line Voltage Models Shown)

19. TRANSFORMER REPLACEMENT (Figure J).

a. Single-Line Voltage Models. Although the 2585/2592 units are equipped with a "piggy-back" power and lamp transformer and the 2590 unit is equipped with a power transformer only; transformer replacement procedure for all single-line voltage units is the same. To gain access to the transformer, remove the rear cover (paragraph 11), top cover (paragraph 13) and rear end cap (paragraph 15, step b). To replace the transformer, first remove the two screws closest to the mainplate installed from the underside of the projector base. Then remove the two remaining screws installed from the top of and down into the left-hand and right-hand transformer brackets into the projector base. See Parts Catalog Figures 9A and 9B if further breakdown of the transformer is required. Reinstall the transformer by reversing the removal procedure. Refer to the appropriate wiring diagram in the Parts Catalog for proper wiring connections. Replace the rear end cap and projector covers.

b. Multi-Line Voltage Models. These models are equipped with a power transformer only. To replace the power transformer remove the rear cover (paragraph 11), top cover (paragraph 13) and rear end cap (paragraph 15, step b). Next remove the four screws that are installed from the top of the transformer mounting bracket and down into the projector base. Remove the two hex nuts to disassemble the fuse-board support from the transformer. Reverse the removal procedure to reinstall the transformer. Refer to the appropriate wiring diagram in the Parts Catalog for proper wiring connections. Replace the rear end cap and projector covers.

20. REAR REEL ARM REPLACEMENT (Figure K).

a. Remove the projector rear cover (paragraph 11) and top cover (paragraph 13) and disassemble the retaining rings, gear and washer from the rear reel arm shaft. Note the manner in which the reel arm disc is oriented in regard to the mainplate. Remove the three screws and disassemble the disc and reel arm from the mainplate. The lock button and its spring will "pop" from position when the reel arm is removed. Be careful not to lose these parts.

NOTE: If further reel arm repair is required, refer to Parts Catalog Figure 12 for a complete breakdown of reel arm parts. When reassembling the reel arm, be sure to maintain a backlash of 0.005 to 0.018 inch (0.127mm to 0.460mm) between the upper face gear and its mating spur gear.

b. Apply a light film of grease (B&H P/N 070034) to the mounting flange of the reel arm and around the reel arm hole in the mainplate. Assemble the tension spring to the shaft of the lock button and insert the button shaft into the small hole adjacent to the reel arm hole. Depress the button while assembling the reel arm to the mainplate. With the reel arm in the "down" position, release the button and assemble the reel arm disc to the reel arm shaft. Install the three disc mounting screws and tighten to 14 inch-pounds. Manually depress the

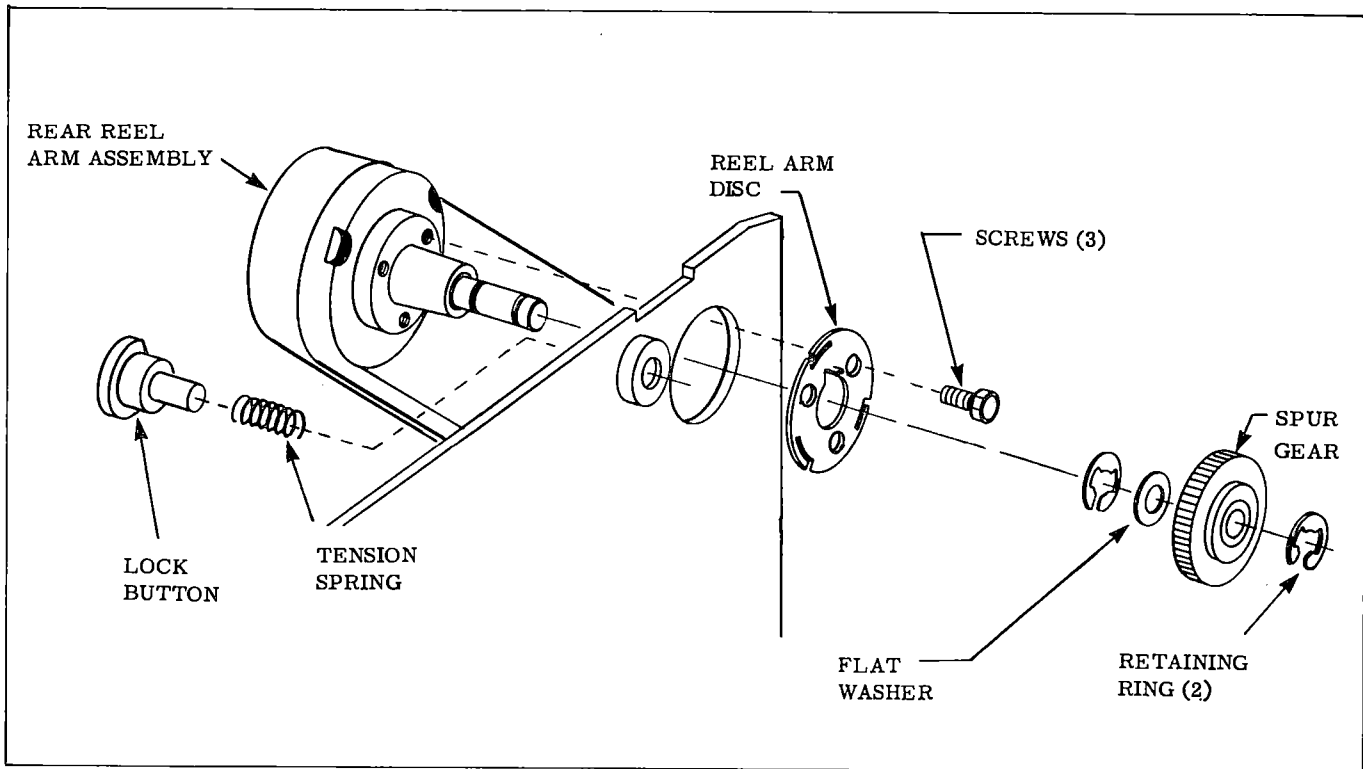


Figure K. Replacing the Rear Reel Arm

lock button and raise and lower the reel arm to check for freedom of movement. Assemble a retaining ring, flat washer and spur gear to the reel arm shaft and secure these parts with the second retaining ring. Lightly brush the gear teeth with grease and manually rotate the spur gear to check engagement with the mating idler gear. There should be a barely perceptible amount of backlash between gears.

21. FRONT REEL ARM REPLACEMENT (Figure L).

a. Remove the projector rear cover (paragraph 11). Note the manner in which the clutch gearing is assembled to the reel arm shaft. Remove the retaining ring and disassemble the gearing from the reel arm shaft. Note the manner in which the reel arm disc is oriented in regard to the mainplate. Remove the three disc screws and disassemble the disc and reel arm from the mainplate. Be careful not to lose the lock button and spring when they "pop" from place.

NOTE: If further reel arm repair is required, refer to Parts Catalog Figure 11 for a complete breakdown of reel arm parts. When reassembling the reel arm be sure to maintain a backlash of 0.005 to 0.018 inch (0.127mm to 0.460mm) between the upper face gear and its mating spur gear.

b. Apply a light film of grease (B&H P/N 070034) to the mounting flange of the reel arm and around the reel arm hole in the mainplate. Assemble the tension spring to the shaft of the lock button and insert the button shaft into the small hole adjacent to the reel arm hole. Hold the lock button in while assembling the reel arm (in "down" position) to the mainplate; then release the button. Assemble the reel arm disc to the reel arm shaft. Install the three disc mounting screws and tighten to 14 inch-pounds. Assemble the rewind gear to the shaft with the square hole in the gear hub engaging the square retaining clip. Assemble the clutch gear and the bearing assembly to the reel arm shaft, turning the spring leg of the bearing assembly and engaging it between the pins of the

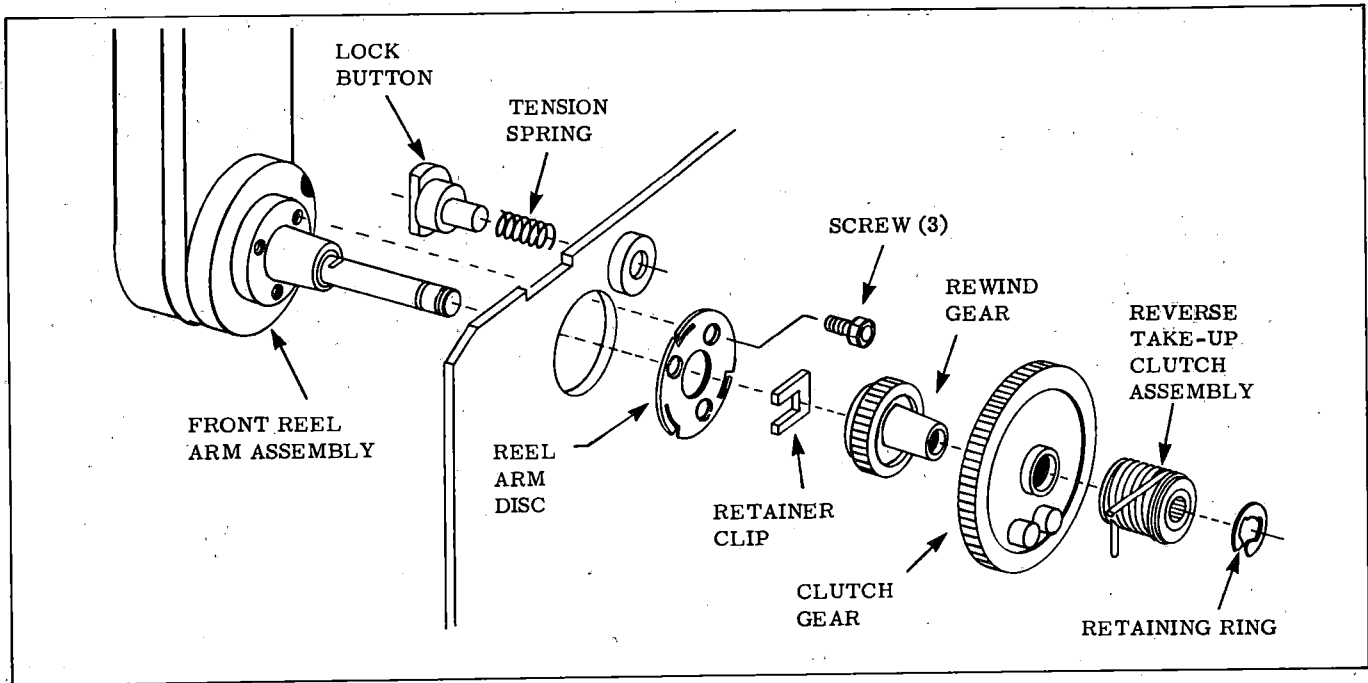


Figure L. Replacing the Front Reel Arm

clutch gear. Secure all parts with the retaining ring. Manually depress the lock button and raise and lower the reel arm to check for freedom of movement. Lightly brush all gear teeth with grease and manually rotate the gears to check the engagement of mating gear teeth. There should be a barely perceptible amount of backlash between mating gears.

22. STILL-RUN/ANIMATION CLUTCH AND HEAT SHUTTER LINKAGE REPAIR (2592 MODELS ONLY).

a. The still-run and animation clutch linkages are shown assembled in Figure W. Except for possible breakage and/or weakening of the compression springs, it is doubtful that any parts replacement will be needed. It may be necessary, however, to adjust these linkages. These adjustment procedures are covered in paragraph 34.

b. The heat shutter linkage is shown in Figure 6 of the Parts Catalog. If the heat shutter compression spring must be replaced, make sure that the beveled face of the collar is toward the spring when replacing the spring and collar on the lower

end of the heat shutter rod. If noise is heard during operation after the spring has been replaced, the collar is set to loose. Loosen the collar setscrew and raise the collar, as necessary, to eliminate noise.

23. AMPLIFIER AND CONTROLS REPAIR (Figure M).

NOTE: Amplifier circuit board repairs are not recommended except as an emergency measure and then only if qualified electronics personnel and test equipment are available. Using standard electronic shop test equipment and techniques, check the amplifier assembly and its components for continuity and for shorts and open circuits. Refer to the appropriate wiring diagram for voltages and ratings of components and for test points. If a faulty condition is tracked to the amplifier, replace the complete assembly. See Parts Catalog Figure 7 for NEW and rebuilt amplifier policy.

a. Tip the projector to expose the underside of the projector base. The amplifier cover and volume/tone controls cover are each secured to the base with hex washer

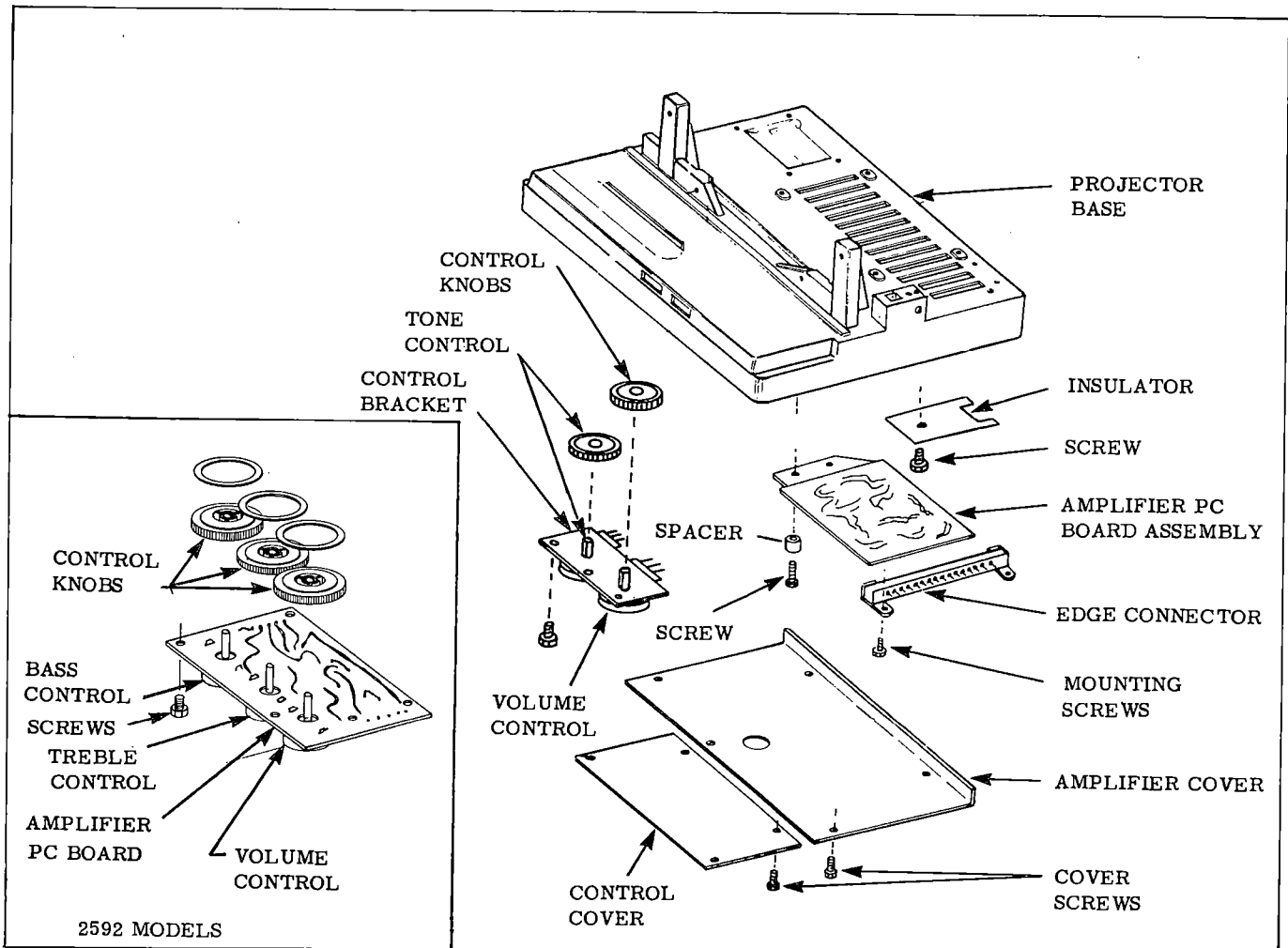


Figure M. Amplifier and Controls Repair

head screws. Remove both covers to expose the amplifier and controls for inspection and repairs.

b. If the amplifier must be replaced, remove the two screws which attach the amplifier edge connector to the base and the three screws and spacers which attach the amplifier assembly to the base. Lift the amplifier from the base and disconnect the amplifier board from the edge connector. Reassemble the new amplifier to the edge connector and apply a fresh coating of heat sink compound and assemble these items back into the base with the screws and spacers. Be sure to redress all leadwires.

c. To replace the volume and/or tone control, remove the screws that attach the

controls bracket to the base. Pull the knobs from the control shafts. Remove the hex nut from the faulty control and disconnect the leadwires. Install the new control, reassemble leads and reinstall the controls assembly.

NOTE: All 2592 models are equipped with three amplifier controls (treble, bass and volume) located on the front of the projector base. All other models are equipped with two controls (tone and volume only).

24. SOUNDHEAD REPLACEMENT (Figure N).

a. Removing the Soundhead Assembly. Remove the rear cover (paragraph 11), top cover (paragraph 13) and the rear end cap

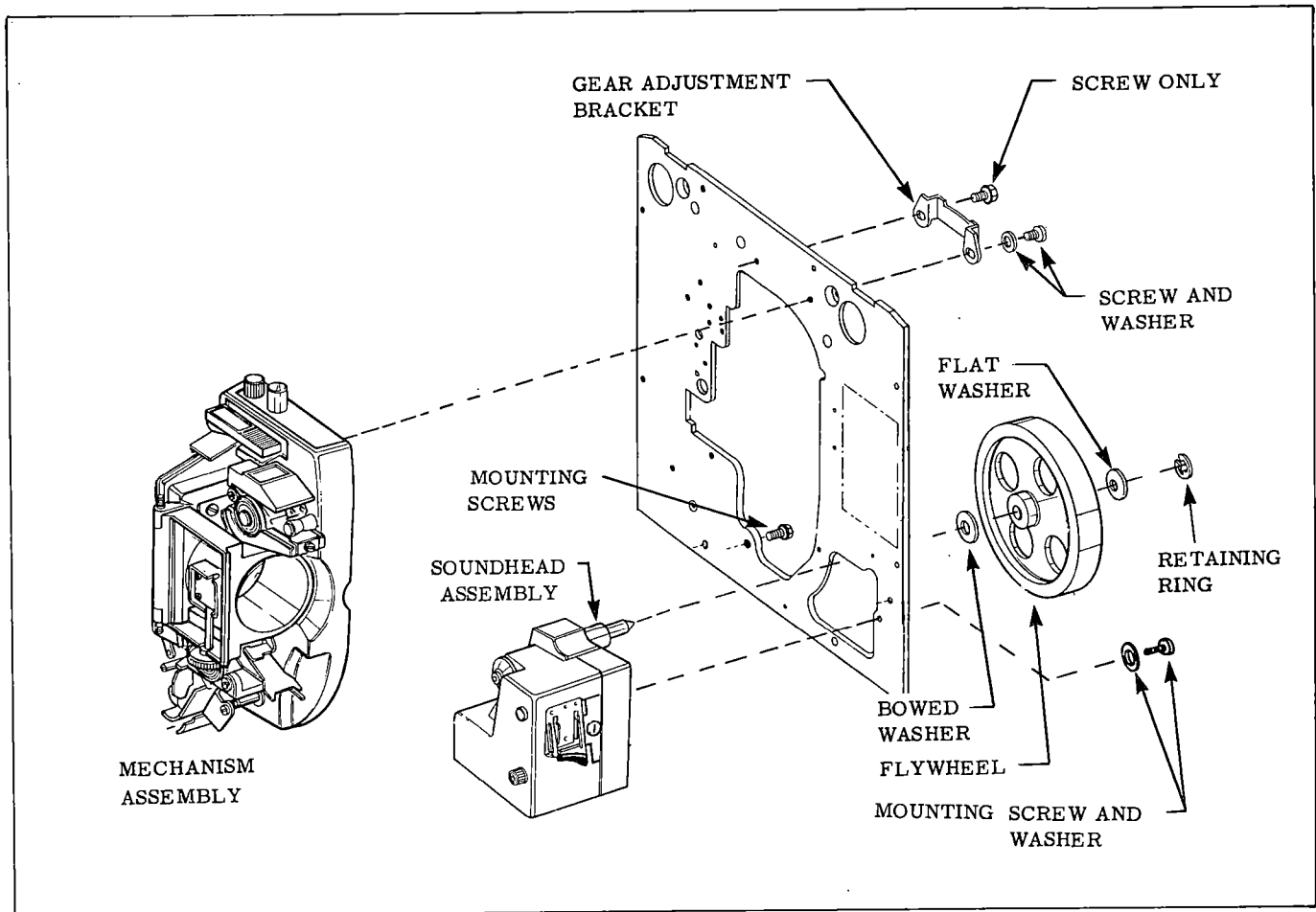


Figure N. Replacing the Soundhead and Mechanism Assemblies

(paragraph 15, step b). Then remove the transformer assembly (paragraph 19) to expose the flywheel. Remove the retaining ring, flat washer, flywheel and bowed washer from the sound drum shaft. Before removing the soundhead assembly from the mainplate, lightly scribe a pencil line on the mainplate along the top and right side of the soundhead housing. This will provide a reference mark for proper positioning of the soundhead assembly after reinstallation. Disconnect the photocell and exciter lamp leadwires. Hold the soundhead firmly and remove the three soundhead mounting screws and washers from the rear of the mainplate. Then withdraw the sound drum shaft through the cut-out in the mainplate. If further disassembly of the soundhead is required, refer to Parts Catalog Figure 13 and to the soundhead adjustments covered in paragraph 39.

NOTE: Be very careful not to strike the sound drum shaft against the cut-out in the mainplate when removing and replace the soundhead assembly.

b. Installing the Soundhead Assembly. Carefully reinsert the sound drum shaft through the cut-out in the mainplate. Hold the soundhead firmly and replace the three soundhead assembly mounting washers and screws. Tighten the screws just enough to hold the soundhead in place (note that the soundhead must be positioned before the mounting screws are tightened, see paragraph 25). Refer to the appropriate wiring diagram in the parts catalog manual and reconnect the photocell and exciter lamp leadwires. Reassemble the bowed washer (bowed face out), the flywheel, the flat washer and the retaining ring to the sound drum shaft.

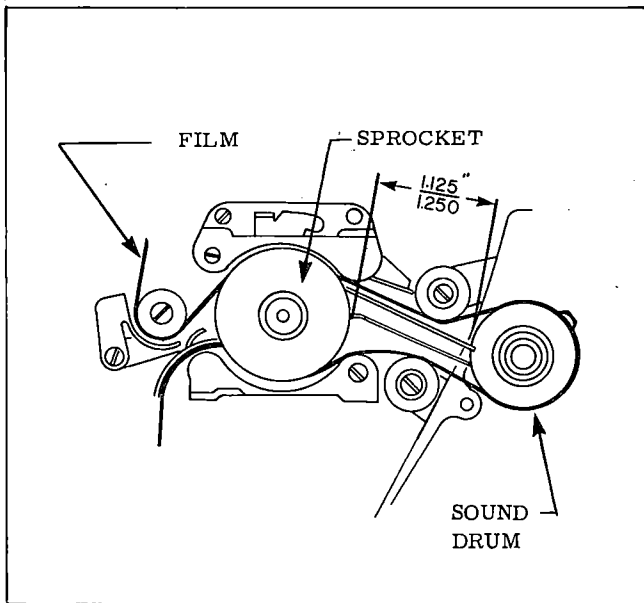


Figure P. Positioning the Soundhead

25. SOUNDHEAD POSITIONING (Figure P). Before the soundhead mounting screws are tightened securely, the soundhead housing must be positioned using one of the following methods.

a. If scribe lines were marked on the mainplate prior to removal of the soundhead housing; align the soundhead housing with the scribe marks on the mainplate and hold in this position while tightening the three mounting screws.

b. If the soundhead housing cannot be positioned by aligning scribe lines; positioning can be obtained without any special tooling using a piece of film, ruler, scale or dial caliper and proceeding as follows. Lock the automatic loading system in the "load" position. Insert a piece of film as shown in Figure P and check that the upper and lower stabilizer arms have "bounce" when touched. Measure for a distance of approximately 1.125 to 1.250 inches from the edge of the lower sprocket to the edge of the sound drum (see Figure P). Then tighten the three mounting screws.

c. After the soundhead housing has been properly positioned, replace the transformer assembly, rear end cap and projector rear and top covers.

26. MECHANISM ASSEMBLY REPLACEMENT (Figure N).

Remove the projection lamp (paragraph 9), rear cover (paragraph 11), top cover (paragraph 13) and rear end cap (paragraph 15, step b). Disengage the drive belt from the mechanism pulley and remove the drive motor (paragraph 18). Remove the rewind clutch and idler gear assemblies from the upper sprocket shaft. From the top rear portion of the mainplate disassemble the two screws and washer from the idler gear adjustment bracket. While supporting the mechanism assembly remove the two screws at the bottom of the mechanism casting. Then carefully lift the complete mechanism assembly from the mainplate. Reverse the removal procedure to reinstall the mechanism assembly.

NOTE: The following paragraphs outline the procedures for complete disassembly and reassembly of mechanism components for replacement.

27. DISASSEMBLY OF MECHANISM COMPONENTS.

Refer to the Parts Catalog manual parts lists and exploded views (Figures 14 - 17) and remove parts in indexed order, noting any special service instructions.

REMOVAL OF FIGURE 14 — MECHANISM COMPONENTS

a. To remove the lens carrier assembly (5), pry out the hinge pins (1) and (2) with a wire cutter or similar tool and lift the lens carrier from the mechanism. Note that the spring washer (3) is used with the upper pin and the flat washer (4) with the lower pin. No special instructions are required for the removal of lens carrier parts (5A through 5N). The adjustment plate (5H) need not be removed unless it has been badly nicked or scratched.

b. Remove the retaining ring (6) and withdraw the actuating lever (7). Pry off the adhesive-backed nameplate (8) only if it is in need of replacement. Remove the two screws (9) and the hood (10).

Service Instructions

c. Loosen two setscrews (11) in each sprocket gear (12) and (13) and remove the gears, tension washers (14) and flat washers (14A) from the sprocket shafts. Remove the two screws (15) and disassemble the upper sprocket guard assembly (16) from the mechanism housing. Withdraw the upper sprocket assembly (17) from the mechanism housing and disassemble the thrust washer (18) and flange (17A) from the upper sprocket. Remove the lower sprocket assembly (19) from the mechanism housing and disassemble the thrust washer (21) and flange (20) from the lower sprocket.

d. Remove the retaining ring (22) from the lower end of the rewind button shaft, and lift the rewind button (23) and its spring (24) from the top of the mechanism housing.

e. When removing sprocket guards (27) and (28), note the manner in which the torsion springs (30) are assembled so that they may be properly reinstalled.

f. Model 2592A Only. Loosen the setscrews (34) and disassemble the animation switch lever (35), grip ring (36) and switch lever crank (37) from the mechanism housing. Note that the crank opening is sealed with a disc (38) on all other units covered in these service instructions.

REMOVAL OF FIGURE 15A — MECHANISM COMPONENTS

a. Remove the three screws (1) and the flanged rollers (2). Note the manner in which the torsion spring (6) is installed. Remove the retaining ring (3) and withdraw the threading arm (4) and torsion spring (6) from the mounting posts of the guard mounting plate (21).

b. Note the manner in which the legs of the torsion spring (14) are engaged. Remove the retaining ring (7), roller stud (8), locking lever eccentric (9) the torsion spring (10) and the automatic loading lever and guide assembly (11).

c. Note the manner in which the legs of the torsion spring (14) are engaged. Remove the retaining ring (12) and lift off

the lower loopformer (13) and the torsion spring (14).

d. Remove the screw (15) and back-up bracket (16). Remove the large retaining ring (17) and lift off the lower film guide (19) and two washers (18). Remove two screws (20) and the lower guard mounting plate (21). Remove the retaining ring (22) and disassemble the toggle lever and pivot assembly (23) and lower film guide (24) from the mounting plate (21).

e. Loosen the locking screw (27) and disassemble the threading lever assembly (28) from the rear shaft end of the upper loopformer (29). Remove the retaining ring (30) and withdraw the upper loopformer assembly (31). Remove the connecting link and stud assembly (36).

f. The hex head screw (37) is used to adjust the lens carrier and should not be disturbed. Do not remove the lens carrier catch (38) unless it is to be replaced.

g. Remove the two screws (39) and the upper guard mounting plate assembly (40). Note the manner in which the legs of the torsion spring (43) are engaged. Loosen two setscrews (41) and disassemble the shaft assembly (42), torsion spring (43) and flat washer (44).

REMOVAL OF FIGURE 15B — MECHANISM COMPONENTS

a. Remove the loopformer and lock pawl assembly (1) from the mechanism housing. Do not disassemble the parts from the loopformer and lock pawl assembly unless visual inspection indicates a need for parts replacement.

b. Remove parts (2) through (6) and lift the cam follower and support assembly (7) from the mechanism housing. Then remove parts (8, 9, 10 and 21) to remove the shaft and lever assembly (22) from the mechanism housing.

c. Remove two screws (11), lock washers (12) and flat washer (13) and disassemble the self-centering assembly (14). Do not attempt to disassemble this assembly.

d. Remove screws (15) to free the aperture plate assembly (16). Refer to Figure 18 for aperture plate parts replacement.

REMOVAL OF FIGURE 16 — MECHANISM COMPONENTS

a. Loosen the two setscrews (1) and withdraw the mechanism pulley (2) from the end of the camshaft (item 28C, Figure 17).

b. 2585/2590 Models Only. Remove four screws (3) and lift the heat shutter assembly (4) from the mechanism housing. Check for the presence and condition of the tension spring (4A).

c. 2592 Models Only. Loosen the heat shutter rod collar setscrew and remove the collar and tension spring from the end of the rod. Remove screws (3) and lift the heat shutter assembly (4) from the mechanism housing. Check for the presence and condition of the tension spring (4A).

d. Remove the two screws (5) and the heat baffle (7). Unscrew the shutter nut (7) and remove the counterbalance weight (8), shutter (9) and fiber washer (10).

e. Unless obviously in need of replacement, do not disassemble the ball and stud assemblies (12) or the shuttle link bearing (17A) from the shuttle arms (17). Inspect the pull-down cam follower (17B) for wear. Badly worn shuttle arms should be replaced. Unhook the extension spring (13) from the end of each shuttle arm and remove the shuttle arms and the felt wiper (14). The felt wick (15) is inserted within the coils of the spring (13). If either of these felts seem unusually dirty, they should be replaced. New felts should be lubricated as instructed in paragraph 6.

f. Withdraw the pull-down cam (18) from the camshaft. Remove the two screws (19) and lift the in-out cam (20) and cam bracket assembly (21) from the mechanism. Inspect the cam follower (21A) and tension spring (21B) and replace if damaged. Remove the two screws (22) and the shuttle arm plate

assembly (23). Inspect the bearing support assembly (24) and replace if damaged or worn.

g. With a sharp-nose pliers, pull out the framer shaft stop pin (25). Unscrew the framer shaft (26) from the mechanism housing. An adhesive-backed decorative disc is located in the recess at the top of framer knob (26). Remove the screw (27), the pin return spring (28) and the shuttle retractor pin (29).

h. 2592 Models Only. To remove the still-run rod and the animation solenoid rod from the stop pawl refer to Figure W in the Adjustments section. Note that the solenoid rod is found only on the 2592A units. Loosen the setscrews in the lower collars (underneath the stop pawl) and remove the collars from the ends of the rods catching the compression spring as it falls from the still-run rod. Disassemble the rods from the stop pawl (32). Remove the two retaining rings (30) and disassemble the stop pawl shaft (31) and stop pawl (32). Remove the screws (33) and (35) and disassemble the bearing bracket (34), stop bracket (34A) and stop pawl shaft bracket (36) from the mechanism housing. Inspect the grommets (36A) and, if damaged, press them from the bracket (36B).

REMOVAL OF FIGURE 17 — MECHANISM COMPONENTS

a. 2592 Models Only. Remove the round nut (1) and washer (2) and disassemble the shuttle adjustment bracket (3) from the animated clutch bracket assembly (7). Remove the screws (4) and (5) and lock washer (6) and lift the animated clutch bracket assembly (7) from the mechanism housing. Do not disassemble the animated clutch bracket assembly unless parts are damaged and in need of replacement.

b. 2592 Models Only. Remove the large retaining ring (8), the two screws (9) and the bearing loading spring (10). Loosen the setscrew (11) in the loop restorer cam (27) and press the camshaft (28C) to the left until the

ball bearing (12) is forced from the mechanism housing. Pull the bearing from the camshaft. Remove retaining rings (16) and (28A) from the camshaft and press the camshaft to the right to force the large ball bearing (28B) from its seat. Remove the clutch, gear and cam parts (13) through (27) as the camshaft is withdrawn. Make a note of the manner in which the torsion spring (14) is assembled.

c. 2585 and 2590 Models Only. Remove the two retaining rings (8) and (28A), the two screws (9) and the bearing loading spring (10). Loosen the setscrews (11) and (24A) in the loop restorer cam (27) and worm gear (24) and press the camshaft (28C) to the left until the ball bearing (12) is forced from its seat in the mechanism housing. Then press the camshaft to the right to force the large ball bearing (28B) from its seat. Remove the worm gear and loop restorer cam as the camshaft is withdrawn from the mechanism housing.

28. GENERAL MECHANISM COMPONENTS REASSEMBLY PRECAUTIONS.

a. Before reassembling mechanism parts, be sure to clean them thoroughly. Metal parts can be immersed in a pan of non-flammable solvent or wiped with a cloth dampened with solvent; then blown dry with a low pressure jet of compressed air or dried with a lint-free cloth. Do not clean plastic or electrical components with solvent. Simply wipe plastic and electrical components with a clean, dry cloth. Clean optical parts with a good quality lens cleaner and lens tissue or a lint-free cloth.

b. When reassembly procedures include staking or riveting operations, it is wise to perform these operations before assembling other parts. Be sure to support the major casting or plate solidly during staking operations to avoid distorting the casting or plate.

NOTE: In many instances, you will find that you can install previously riveted items with screws and nuts. These are mentioned in the reassembly instructions.

c. When installing electrical components, refer to the wiring diagrams at the rear of the Parts Catalog for the proper connection of leadwires. Refer to paragraph 45 for special instructions regarding testing and replacement of the amplifier circuit board.

d. Most of the nameplates and the instruction plates are provided with an adhesive backing. Make certain that the area to which such parts are to be secured is thoroughly clean by wiping with a cloth dampened with solvent. Remove the protective paper backing and brush the adhesive with a mixture of three parts Toluol to one part of trichloroethylene. When the adhesive is tacky, press the nameplate carefully but firmly in place. Wipe away any excess adhesive with a cloth dampened with solvent.

e. Lubrication instructions are provided in the Introduction section of this service manual. Do not over-lubricate. Apply grease and oil sparingly as indicated, and wipe away any excess lubricant with a lint-free cloth. Gears should be lubricated by specking the gear teeth and then running the projector for a few moments to distribute the grease. Where oil is indicated, a drop or two will usually suffice.

29. REASSEMBLY OF MECHANISM COMPONENTS.

To reassemble the mechanism components, refer to parts lists and exploded views (Figures 14 - 17) in the Parts Catalog manual and reassemble the components as outlined in the following paragraphs. Routine adjustments for sliding fits, clearances and end play are included in the reassembly instructions.

INSTALLING FIGURE 17 - MECHANISM COMPONENTS

NOTE: Steps a through i of the following reassembly procedures for Figure 17 apply to the 2585/2590 model projectors. Reassembly procedures for the 2592 models will start with step d and conclude with step j.

a. Lightly grease both bearing openings in the cast arms of the mechanism housing. Press the ball bearing (12) into its bearing opening until fully seated. Assemble the large ball bearing (28B) to the camshaft (28C) until the bearing is seated against the shoulder of the shaft. Install the retaining ring (28A) to the camshaft with the bowed surface of the ring facing away from the bearing.

b. Insert the long end of the camshaft through the bearing hole in the long cast arm of the mechanism housing. As the shaft end protrudes through the cast arm, assemble the loop restorer cam (27), shim washer (26) and worm gear (24) to the shaft. Continue sliding the shaft to the left, inserting the end of the shaft into the left-hand ball bearing (12) while seating the large ball bearing (28B) in the bearing opening of the right-hand cast arm. Make certain that both ball bearings are fully seated; then install the bearing loading spring (10) to the left-hand cast arm with the two screws (9). Assemble the large retaining ring (8) into the inner ring groove in the right-hand ball bearing opening. The bowed surface of the ring must face the large ball bearing (28B).

c. Insert a 0.190 inch feeler gage between the loop restorer cam and the cast arm of the mechanism housing. Hold the cam firmly against the flat of the camshaft. Remove the feeler gage. Tighten the worm gear setscrew (24A) enough to hold until final adjustments are made.

d. Lightly grease both bearing openings in the cast arms of the mechanism housing. Press the ball bearing (12) into its bearing opening until fully seated. Assemble the large ball bearing (28B) to the camshaft (28C) until the bearing is seated against the shoulder of the shaft. Install retaining ring (28A) to the camshaft with the bowed surface of the ring facing away from the ball bearing.

e. Assemble the three rubber bushings (25) into the corresponding openings in the face of the worm gear assembly (24). Assemble the bearing assembly (23) to the worm gear so that the formed ears of the

bearing are aligned with the corresponding notches in the worm gear. Insert the bent ears of the clutch yoke (21) through the slots in the bearing assembly, while assembling the spring (22) over the protruding finger of the clutch yoke and into the hole in the bearing assembly. Hold these parts together while assembling the two shoulder pins (20) to the bearing assembly, pressing them in until they engage the bent ears of the clutch yoke. Assemble the trigger (19) to the sleeve bearing (18) and press the bearing through the bearing assembly (23) and into the worm gear (24).

f. Insert the end of the camshaft (28C), with ball bearing (28B) assembled, through the bearing hole in the right-hand cast arm of the mechanism housing. To the shaft, assemble the loop restorer cam (27), shim washer (26) and the assembled worm gear group. Assemble the torsion spring (14) over the hub of the driven clutch (15), spreading the legs of the spring so that they straddle the bent ear at the top of the clutch. Insert the hub of the driver clutch (13) through the hub of the driven clutch, spreading the legs of the torsion spring still further until one of the lugs of the driver clutch is also straddled by the spring legs. Install the washer (17) and the assembled clutches on the camshaft. When installed, the bent ear of the driven clutch (15) must be parallel with the camshaft flat for the loop restorer cam (27).

g. Slide the camshaft all the way in place, inserting the end of the camshaft into the ball bearing (12) while seating the large ball bearing (28B) in the bearing hole of the cast arm. Assemble the two retaining rings (16) to the camshaft, one between washer (26) and loop restorer cam (27); the other between washer (17) and clutch (15). The clutch and loop restorer will require adjustment after reassembly has been completed.

h. Fasten the bearing loading spring (10) to the cast arm of the mechanism housing with two screws (9). Assemble the large retaining ring (8) into the ring groove of the housing arm, with the bowed face of the ring against the ball bearing (28B).

i. Insert a 0.190-inch feeler gage between the loop restorer cam and the cast arm of the mechanism housing. Hold the cam firmly against the feeler gage while tightening the setscrew (11) against the flat of the camshaft. Remove the feeler gage.

j. 2592 Models Only. Assemble the strike (7J) to the clutch slide bar assembly (7G) with the screw (7H). Insert the shaft (7C) part way through the right-hand arm of the mounting bracket assembly (7K) and install the bumper (7D) on the end of the shaft. Hold the slide bar assembly (7G) in position between the arms of the bracket assembly and continue to insert the shaft, assembling the flat washer (7E) and the spring (7F) on the shaft before it is inserted through the left-hand arms. Install the three retaining rings (7B), with the center ring to the right of the spring and washer. The setscrew (7A) must be adjusted at final assembly to limit slide bar travel. Assemble the complete animated clutch bracket assembly (7) to the mechanism housing with the two screws (4) and (5) and lock washer (6), and press down firmly on the bracket while tightening the screws. Assemble the shuttle adjustment bracket (3) to the end of the longer screw (5) and install the washer (2) and the round nut (1), tightening the nut finger tight.

INSTALLING FIGURE 16 — MECHANISM COMPONENTS

NOTE: Figure 16 reassembly procedures for units equipped with the still-run feature begin with step a, continue through step h and conclude with step j. All other units begin with procedure step d and conclude with step i.

a. Assemble the rubber grommet (36A) into the stop pawl bracket (36B). Assemble one retaining ring (30) into the first groove (the groove nearest to the end) of the stop pawl shaft (31). Then insert the opposite end of the stop pawl shaft through the shaft hole in the molded tab of the bearing bracket (34) and through both ears of the stop pawl (32). Install the stop bracket (34A) onto the bearing bracket with a hex head screw (33).

NOTE: At this point the solenoid rod on the 2592A units should be assembled to the stop pawl. Slide the stop pawl (32) up over the end of the solenoid rod. Assemble a setscrew to a collar and slide the lower solenoid collar (small diameter down) up against the underside of the stop pawl tightening the collar setscrew just enough to hold the collar on the rod.

b. Loosely attach the stop and bearing brackets to the cast arm of the mechanism housing with the two hex head screws (33). Assemble the stop pawl shaft bracket (36) to the free end of the shaft (31) and fasten the shaft bracket to the mechanism housing with the two shoulder screws (35). Tighten all the bracket mounting screws (33) and (35) securely. Assemble the second retaining ring (30) into the groove of the stop pawl shaft so that the right-hand ear of the stop pawl is held against the bearing bracket (34).

c. Refer to Figure 6 in the parts catalog and assemble a collar (2), small diameter up, to the still-run rod and insert the straight end of the rod up through the stop pawl. If the bent end of the still-run rod is free, rehook the bent end through the hole in the long arm of the pivoting link assembly (16). Assemble the compression spring (3) and the second collar (2) small diameter down, to the upper end of the still-run rod. Slide the lower collar (2) up against the underside of the stop pawl and compress the spring (3) slightly with the upper collar (2). Tighten all collar setscrews (1).

NOTE: After complete reassembly of the mechanism, all linkages must be adjusted as described in the Adjustments section, paragraph 34, step d.

d. Refer to Figure 16 and assemble the shuttle retractor pin (29) and pin return spring (28) and insert the rounded end of the pin into the hole in the long cast arm, just to the right of the camshaft. Secure the loop end of the spring to the casting with the screw (27).

e. Screw the framer knob and shaft (26) down into the mechanism housing. Press the stop pin (25) in place. Screw the bearing support (24) all the way up into the staked nut (24A) of the shuttle arm plate assembly (23). Engage the fork-like end of the shuttle arm plate framing arm with the cut-out at the lower end of the framer shaft, and fasten the plate to the cast arm of the mechanism housing with the two screws (22).

f. Loosely assemble the in-out cam (20) to the cam bracket assembly (21) so that the nylon face of the cam follower (21A) rides against the polished surface of the cam (indicated by the dashed arrow in Figure 16). Install the in-out cam tension spring (21B) to the cam bracket and then install this assembled group over the end of the camshaft securing the cam bracket assembly to the cast arm of the mechanism housing with the two screws (19).

NOTE: At this point, refer to Figure 15B and install the assembled aperture plate (16) with screws (15). Then return to Figure 16 and continue with reassembly as follows.

g. Make certain that the shuttle link bearings (17A) are firmly pressed into the notches at the front end of each shuttle arm (17) and that the cam followers (17B) are assembled into the center notched section of each arm (see Figure S). Insert the lubricated cam wiper wick (15) into the coils of the extension spring (13). Assemble the lubricated felt wiper (14) and the extension spring (13) to the shuttle arms as shown in Figure S. Assemble the ball and stud assemblies (12) to the ends of the arms with the hex nuts (11), tightening the nuts only fingertight. Carefully insert the front ends of the shuttle arms between the guides of the in-out bracket assembly (21). Assemble the shuttle (16) to the front ends of the shuttle arm so that the shuttle teeth extend through the shuttle slot in the aperture plate and face in toward the mechanism housing. Rotate the in-out cam (20) until the tongue protruding from the unpolished surface of the cam rests down in the notch in the shoulder of the camshaft. Assemble the pull-

down cam (18) to the camshaft, spreading the shuttle arms lightly until the cam is fully in place. The notch in the inner face of the pull-down cam must engage a mating protrusion on the face of the in-out cam. Back out the bearing support (24) until its socket-like nylon pad engages the ball of the upper stud assembly (12). The ball of the lower stud assembly should rest in the socket of the nylon pad mounted on the shuttle arm plate assembly (23). It may be necessary to loosen the hex nuts (11) and shift the ball and stud assemblies (12) until proper alignment is obtained.

h. Install the fiber washer (10) on the camshaft and up against the pull-down cam (18) so that the slot in the washers is aligned with the slot in the cam. Assemble the shutter (9) to the camshaft and install the counterbalance weight (8) so that its pin engages the slots in the shutter and the pull-down cam. Install the shutter nut (7) with its shoulder in the center hole of the counterweight. Grip the flats at the end of the camshaft with an open-end wrench and tighten the nut (7) securely.

i. Assemble the heat baffle (6) to the mechanism housing beneath the shutter with the two screws (5). Attach the heat shutter (4) to the mechanism housing with two screws (3). Assemble the pulley (2) to the end of the camshaft and tighten the setscrews (1) down on the flats of the shaft.

j. Assemble the heat baffle (6) to the mechanism housing beneath the shutter with the two screws (5). Insert the long straight end of the heat shutter rod (item 8, Figure 6) down behind the pivoting link assembly (item 16, Figure 6) and through the hole in the bent ear of the link. Slide the compression spring (item 7, Figure 6) and collar (6), beveled face of collar toward the spring, onto the lower end of the heat shutter rod and tighten the collar setscrew (5) just enough to hold the rod in place. Engage the upper (bent) end of the rod with the hole in the heat shutter filter arm and then tighten the collar setscrew (5). Return to Figure 16 and assemble the pulley (2) to the end of the camshaft and tighten the setscrews (1) down on the flats of the shaft.

NOTE: When the still-run lever is placed in the "still" position, the heat shutter should be centered over the aperture opening. In the "run" position, the heat shutter should swing completely away from the aperture opening and the heat shutter collar should be lightly compressing the spring. If noise is heard during projector operation, the heat shutter collar is set too loose.

INSTALLING FIGURE 15B — MECHANISM COMPONENTS

a. Attach the self-centering assembly (14) to the mechanism housing with two screws (11), lock washers (12) and flat washers (13). Assemble the lever and shaft assembly (22) to the mechanism housing and install the washer (10) and arm assembly (9) on the end of the shaft. The fork-like finger of the arm assembly must engage the pin of the self-centering assembly between the two large washers. Insert a 0.0015-inch feeler gage between the washer (10) and the machined boss of the housing. Grip the shaft (22) and arm (10) to hold the feeler gage while tightening the hex head screw (8); then remove the feeler gage. Assemble the retaining ring (21) to the shaft assembly (22).

NOTE: The shaft assembly (22), when installed, must be positioned approximately as shown in Figure 15B, with the notched area in its upper edge positioned beneath the lower sprocket shaft bearing of the mechanism housing.

b. Assemble the cam follower parts (7A) through (7F) as shown in Figure 15B. Attach this assembled group to the arm assembly (9) with the screw (5) and washer (6). Tighten the screw just enough to hold the follower group. Hook one end of the spring (4) around the end of the lever shaft (22) and secure the other end to the mechanism housing with the screw (2) and washer (3).

c. Assemble the film escape mechanism components (1A) through (1G) in the following manner. Assemble the hub assembly (1F) to the locking pawl (1E) with the screw (1D). Insert the shaft (1B) through one ear of the upper loopformer assembly (1G) and install

the spring (1C) and the assembled hub and pawl on the shaft. Then engage the end of the shaft with the second ear of the loopformer. Assemble the retaining rings (1A) to the shaft, with the center ring between the spring (1C) and hub assembly (1F). Hook one end of the spring over the outer ear of the loopformer and hook the other end behind the upper finger of the hub assembly (1F). The spring should tend to rotate the hub and locking pawl in a clockwise direction.

INSTALLING FIGURE 15A — MECHANISM COMPONENTS

a. Install the torsion spring (43), short leg first, on the shaft of the shaft and link assembly (42) and insert the shaft through the bearing in the mechanism housing. Hook the long leg of the spring beneath the tapped mounting boss in the upper left-hand corner of the mechanism housing. Hook the short, bent end of the spring behind the left edge of the link. Assemble the washer (44) and assembled items 1A through 1G, Figure 15B (film escape mechanism parts) to the protruding end of the shaft (42) and temporarily tighten the setscrews (41).

b. Attach the upper sprocket guard mounting plate (40) to the mechanism housing with two screws (39), the upper screw being inserted through the half-moon slot in the upper loopformer (31).

c. Attach the lens carrier catch (38) to the mechanism housing with the screw (37). Turn the hex head lens stop screw (18, Figure 15B) into the tapped hole in the housing until only one thread is visible. It may be necessary to adjust the catch and stop screw at final assembly to insure proper operation of the lens carrier.

d. Assemble the shuttle retractor (35) to the connecting link assembly (36) with the screw (32) lock washer (33) and flat washer (34). Assemble the upper loopformer assembly (31) to the upper end of the connecting link (36) and install the retaining ring (30). Slip the pin end of the threading lever (28) up behind the link (42) engaging the pin with the rectangular slot in the link. Insert the

shaft of the loopformer assembly through the mounting plate (40) and mechanism housing, and into the hub of the threading lever (28). Tighten the hex head locking screw (27) securely. Attach the leaf spring (26) to the upper loopformer with two screws (25).

e. Assemble the small hole in the film guide (24) over the pin in the lower sprocket guard mounting plate (21) and hold the film guide in place while inserting the shaft of the toggle lever assembly (23) through the guard plate. The forked end of the toggle lever must straddle the film guide mounting pin. Secure the toggle lever to the mounting plate with the retaining ring (22). Engage the remaining forked end of the toggle lever with the pin at the lower end of the connecting link (36) and secure the lower mounting plate (21) to the mechanism housing with the two screws (20). The film guide (24) must be lifted slightly during this operation so that its large pivot hole slides over the sprocket shaft bearing in the housing.

f. Assemble one large washer (18) and the lower film guide (19) over the lower sprocket bearing, at the same time inserting the pin at the lower end of the connecting link (36) through the hole in the arm of the film guide (19). Install the second large washer (18) and secure these parts with the retaining ring (17).

g. Fasten the back-up bracket (16) to the mounting plate (21) with the screw (15). Assemble the loopformer (13) and the torsion spring (14) onto the lower pin of the connecting link (36) and install the retaining ring (12). The legs of the spring must bear against the underside of the loopformer in such a manner that they will force the loopformer to pivot clockwise around the connecting link pin.

h. Secure the flanged roller (11C) to the film guide lever (11D) with the washer (11B) and retaining ring (11A).

i. Assemble the automatic threading and guide lever (11) and eccentric (9) to the mounting plate (21) with the idler roller stud (8). The loopformer (13) must be pivoted counterclockwise and held in that position

while installing these parts. Assemble the torsion spring (10), short leg first, to the eccentric (9). Hook the short leg of the spring into the hole in the mechanism housing along and to the left of the eccentric (9). Hook the long leg of the spring in the V-like notch along the left edge of the lever (11).

j. Assemble the torsion spring (6) and threading arm (4) to the stud in the lower right-hand corner of the mounting plate (21). Check for the presence of the plastic tip (45) on the threading arm. Engage the legs of the spring (6) so that they tend to pivot the threading arm clockwise. Install the retaining ring (3) to secure the arm to the stud.

k. Install the three flanged rollers (2) on their respective studs and secure them with the screws (1).

INSTALLING FIGURE 14 — MECHANISM COMPONENTS

a. Models 2592A Only. Engage the free end of the animation switch lever crank (37) into the hole at the top of the mechanism housing. Replace the switch lever (35) and tighten the setscrews (34). Insert a 0.010-inch feeler gage between the animation switch lever (35) and the mechanism housing and hold the lever against a shim while pressing the crank grip ring (36) in against the mechanism housing. Remove the shim.

b. Rotate and hold the lower loopformer (13, Figure 15A) fully counterclockwise and assemble the film exit guide (32, Figure 14) to the mechanism housing with screw (31).

c. Assemble the sprocket guards (27) and (28), rollers (29) and torsion springs (30) to the tapped mounting posts of the guard mounting plates. The rollers must be assembled as shown in the inset of Figure 14. The inner bent end of each spring is inserted into small spring holes in the mounting plates adjacent to the tapped posts. The outer bent ear of each spring hooks over the outer edge of each sprocket guard (27) and (28). The springs should tend to rotate the free (unmounted) end of the sprocket guard toward the sprocket bearings in the

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mechanism housing. Secure the sprocket guards to their mounting post with the screws (25) and the shim washers (26).

d. Assemble spring (24) to the shaft of the rewind button (23) and insert the shaft down into the opening in the top of the mechanism housing. Depress the button and assemble the retaining ring (22) into the groove at the lower end of the shaft.

e. Assemble the lower sprocket flange (20) and thrust washer (21) onto the shaft of the lower sprocket assembly (19). Spread the two lower sprocket guards and insert the sprocket shaft through the lower bearings in the mechanism housing until the sprocket is fully seated. Release the sprocket guards. Assemble a flat washer (14A), a spring tension washer (14) and the lower sprocket gear (13) to the sprocket shaft, meshing the sprocket gear teeth with the worm gear. Align either setscrew (11) with the groove on the sprocket shaft and tighten both setscrews securely. The sprocket and gear must turn freely but with only a minimum of end play.

f. Assemble the upper sprocket flange (17A) and thrust washer (18) to the shaft of the upper sprocket assembly (17). Lift the free end of the upper sprocket guard (27) and insert the sprocket shaft through the upper bearings in the mechanism housing until the sprocket is fully seated. Release the sprocket guard.

g. Assemble the upper sprocket guard parts (16A through 16D). Slip the assembled sprocket guard (16) up into position beneath the upper sprocket and secure the guard with two screws (15) inserted from the rear of the mechanism housing. Assemble a flat washer (14A), tension washer (14) and the upper sprocket gear (12) to the

sprocket shaft. Align either setscrew (11) with the groove on the sprocket shaft and carefully mesh the sprocket gear with the worm gear. Tighten both setscrews (11) securely. The sprocket and gear must turn freely, but with a minimum of end play.

h. Fasten the hood (10) to the mechanism housing with the two screws (9). Press down and hold the upper loopformer (31, Figure 15A) while assembling the threading lever (7, Figure 14) to the lever shaft. Install the retaining ring (6).

i. Hold the assembled lens carrier (5) between the hinge bosses of the mechanism housing. Insert the flat washer (4) on top of the lower hinge boss and the spring tension washer (3) beneath the upper hinge boss. Press the hinge pins (1) and (2) into place to hold the lens carrier. Adjust the lens carrier catch (38, Figure 15A) so that it holds the lens carrier firmly against the stop screw (18, Figure 15B) in the closed position; yet permits the carrier to be opened easily.

j. Insert the assembled mechanism through the cut-out in the mainplate and install the two screws at the bottom of the mechanism casting. At the top rear portion of the mainplate reinstall the idler gear adjustment bracket securing it to the mainplate with two washers and screws. Replace the rewind clutch and idler gear assemblies on the upper sprocket shaft as shown in Parts Catalog Figure 5. Reassemble the drive belt to the mechanism pulley and replace the drive motor (paragraph 18) and the projection lamp (paragraph 9).

NOTE: At this point, and before reinstalling the end cap and projector covers; all of the final adjustments outlined in the Adjustments section should be made.

ADJUSTMENTS AND TESTS

30. GENERAL INSTRUCTIONS.

The alignment and adjustments covered in this section are necessary to the proper operation of the projector. Even though the projector may not have under-gone a complete overhaul and repair, it is recommended that all adjustments be checked as a routine measure. Routine adjustments such as those applicable to sliding fits, clearances and end play have been covered in the reassembly procedures and are not repeated here except where they directly affect other adjustments or alignments.

The special tools and fixtures required to perform the adjustment procedures are illustrated in Figure B and listed in an accompanying chart. The test films and multi-spline setscrews are listed in separate charts which also will be found in the Introduction section. In addition, special electronic test equipment (voltohmmeter, oscillator and tachometer or Strobotac) are needed to check and adjust the sound system of the projector. For accurate results, connect the projector to a line variable transformer set at 120 volts, 60Hz or rated nominal voltage.

WARNING

Many of the procedures listed in this section require operation with the rear cover removed. To avoid shock hazards, disconnect the power and, if applicable, discharge the motor starting capacitor when not required. The use of an isolation transformer is recommended.

31. OPTICAL ALIGNMENT.

It is important that these alignments be performed in the following listed sequence (steps a and b). All special tools and fixtures required for optical alignment are

shown and listed in Figure B. These items are shown installed in the projector in Figure Q. Be sure to turn the mechanism manually until the shutter blade is clear of the aperture opening, before inserting alignment tools.

a. Aligning the Aperture Plate.

- (1) Remove the projection lens from the lens carrier. Open the lamphouse and remove the projection lamp.
- (2) Swing the lens carrier fully open and disassemble the pressure plate from the lens carrier.
- (3) Loosen the two aperture plate mounting screws just enough to permit movement of the aperture plate, and insert the aperture plug (item 4, Figure B) into the aperture opening.

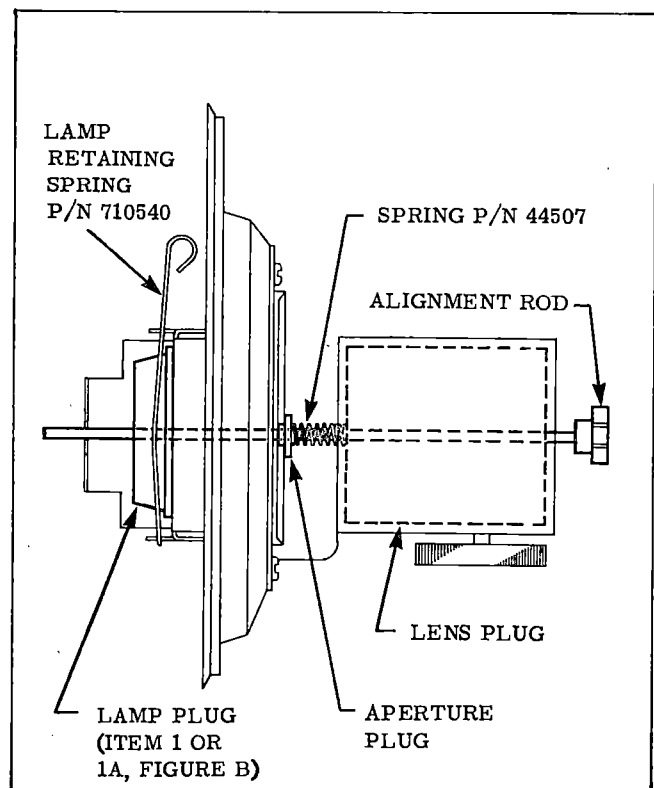


Figure Q. Aligning the Optical System

- (4) Insert the alignment rod (Figure Q) through the lens plug until the rod end protrudes enough to install the spring (P/N 44507). Insert the lens plug into the lens barrel until the tip of the alignment rod engages the aperture plug previously installed. Tip the projector carefully onto its back (lens opening facing up). The alignment rod must slide freely through the aperture plug without binding. If necessary, shift the aperture plate slightly keeping it horizontal (shuttle tooth travel is even from top to bottom) until free rod movement is obtained; then tighten aperture plate screws.

b. Aligning the Lamp.

- (1) Tip the projector back into its normal, upright position and reassemble the pressure plate to the lens carrier. Close the lens carrier.
- (2) To align the lamp, loosen the heat shutter assembly mounting screws just enough to permit movement of the heat shutter assembly. Insert the appropriate lamp plug (Figure Q) into position and secure the lamp retainer spring. Slide alignment rod completely into place until the tip of the rod engages the hole in the lamp plug. Shift the heat shutter assembly as necessary until the rod engages the hole in the lamp plug. Then tighten the screws securely and remove all tools.

NOTE: After alignment has been completed, touch up the aperture area with a flat black paint as required. This will prevent any reflections which may occur from the aperture.

32. ADJUSTING THE INTERMITTENT MECHANISM.

NOTE: All of the following mechanism adjustments must be made with the framer knob in the "center" position.

a. Checking Shuttle Tooth Side Clearance.

Advance the mechanism manually until the shuttle is at the center of its stroke as shown in Figure R. The clearance from the edge of the shuttle slot to the inner end of the shuttle tooth (nearest the aperture opening) should be 0.007-inch (0.178mm) minimum. From the edge of the shuttle slot to the outer end of the shuttle tooth, the distance should be 0.050-inch (1.27mm) maximum. Check these clearances at both the upper tooth and lower tooth. If the clearances vary at the upper and lower teeth and inner clearance is less than 0.007-inch (0.178mm) at either end, the following possible causes should be checked and corrected.

- (1) Aperture plate out-of-alignment. See paragraph 31, step a, for aperture plate alignment.
- (2) Shuttle stroke incorrect. See paragraph 32, step d, for shuttle stroke adjustment.

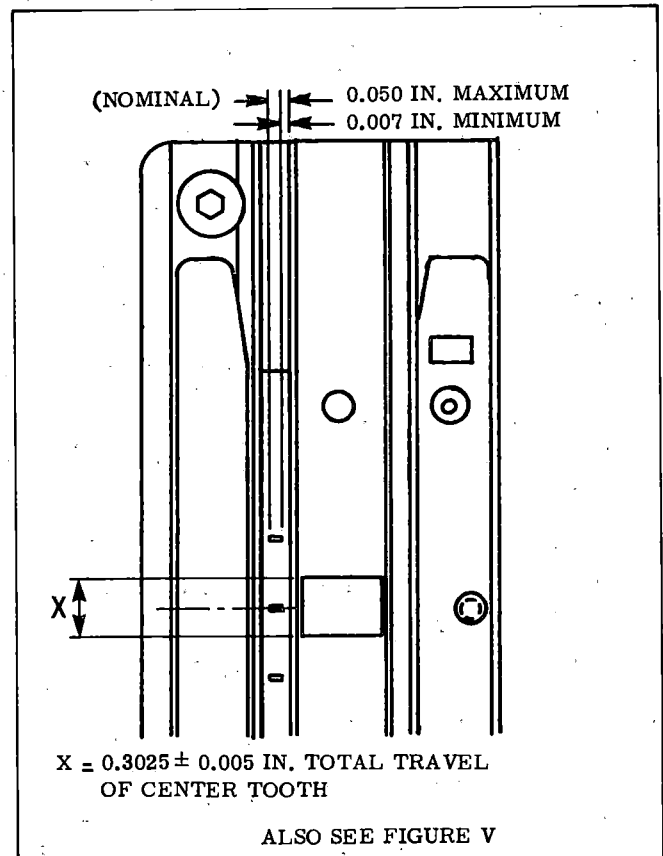


Figure R. Aperture Plate and Shuttle Tooth Clearance

- (3) Link bearing missing from end of shuttle arm. Partial disassembly is required to remove the shuttle arm and replace the link bearing. Refer to Parts Catalog Figure 16.
- (4) The shuttle tooth side clearances can be adjusted by loosening the shuttle plate support nut. Slide the shuttle arm as required to obtain the clearances as specified in Figure R.

NOTE: The assembled intermittent mechanism is shown in Figure S.

- (5) Ball and stud assembly loose on shuttle arm. With rear cover removed, reposition ball and stud assembly (Figure S) and tighten stud nut securely.

b. Checking Shuttle Tooth Height. Unscrew the handle from the shuttle tooth height gage (item 8, Figure B). Carefully place the projector on its rear end cap with the front of the projector facing you, and disengage and remove the pressure plate. The steps at either end of the gage are the height gages

and are marked "GO" and "NO GO." Insert the gage, "GO" end first, into the film channel between the rails of the aperture plate and slide it to the right. The "GO" step should pass over the shuttle teeth without catching. Repeat this inspection with the "NO GO" end of the gage. The "NO GO" step must not pass over the shuttle teeth. If the shuttle teeth are too high or too low, adjust height as follows:

NOTE: To perform the adjustments with the mechanism assembly installed on the main-plate, the lamphouse, projection lamp and heat shutter assembly must be removed.

- (1) Remove the belt from the mechanism pulley. Turn the mechanism drive pulley manually until the access hole in the shutter and the setscrew on the in-out bracket are aligned (Figure T).
- (2) Move the still-run lever to the "still" position. Insert a No. 4 spline wrench through the access opening and engage it in the socket of the in-out cam follower screw.

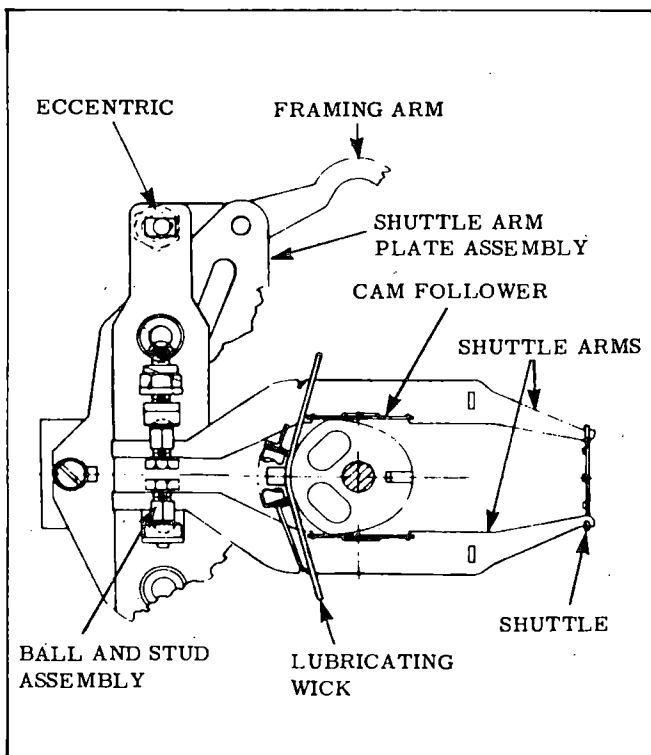


Figure S. Shuttle Arms and Cam Assembly

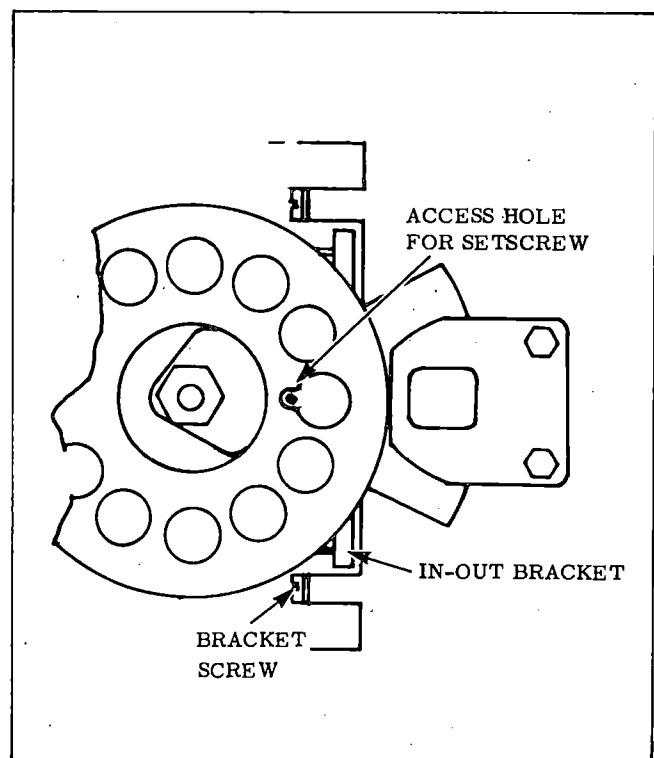


Figure T. Adjusting Shuttle Tooth Height

- (3) If the shuttle teeth were too low ("NO-GO" step passes over the shuttle teeth), turn the cam follower screw counterclockwise to increase tooth height. If the shuttle teeth were too high ("GO" step catches against shuttle teeth), turn the adjusting screw clockwise. Recheck shuttle tooth height and continue to adjust the follower screw until the proper height is obtained.
- (4) If only one tooth cannot be brought into tolerance, it may be necessary to loosen the screws which secure the in-out bracket (Figure T) and adjust the bracket slightly. Then retighten the mounting screws and adjust shuttle tooth height as outlined in paragraph 32, step b, above.

NOTE: Upon completion of shuttle tooth height adjustment, reassemble the heat shutter assembly, projection lamp and lamp-house. Realign the lamp as outlined in paragraph 31, step b.

c. Checking Fit of Shuttle Arms to Pull-Down Cam (See Figure U). Disconnect the projector line cord and remove the rear cover (paragraph 11) and the drive motor (paragraph 18).

NOTE: If the projector has just been lubricated, run for two or three minutes before proceeding with this adjustment.

- (1) Open the lens carrier and turn the projector mechanism by hand until the shuttle teeth are retracted and have moved downward to approximately the center of the stroke (center tooth approximately on horizontal center line of aperture). Tighten the upper bearing support assembly to the point of having a slight binding or ratcheting feeling while turning the camshaft. Turn the upper bearing support assembly counterclockwise approximately 1/16 turn. This will allow the cam to turn freely without binding.

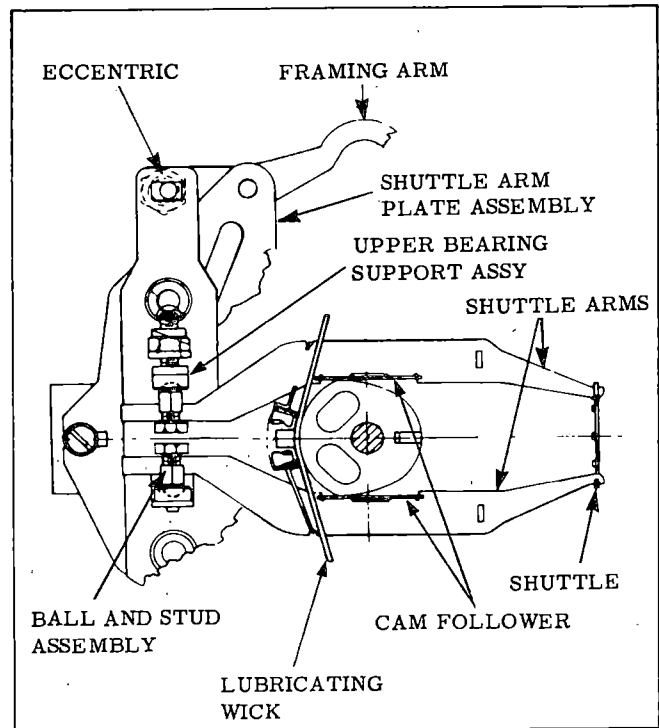


Figure U. Adjusting Fit of Shuttle Arms to Pull-Down Cam

CAUTION

Do not tighten shuttle arms more than is specified in an attempt to remove cam noise. Excessive tightening of shuttle arms for the purpose of reducing other noises will reduce life of cam, cam shoes and possible use of excess current by loading the motor or affecting the speed.

d. Checking and Adjusting Shuttle Stroke (Figures R and V). Shuttle stroke (vertical travel on down stroke) is set at the factory at 0.3025 ± 0.005 inch. Therefore, the procedures for checking and adjusting shuttle stroke are required only when the shuttle arm plate assembly or arms have been moved. Before starting these procedures, make sure the mechanism is assembled correctly.

- (1) Procedure for Checking Shuttle Tooth Stroke. If the shuttle arm plate assembly or arms have been disturbed, the pivot point must be checked for proper alignment. Turn the framer

knob until the bottom edge of the center tooth is aligned with the top edge of the aperture opening as shown in Figure V. Check proper setting of the shuttle stroke, side-to-side shuttle tooth clearance and protrusion as shown in Figure R.

NOTE: Before proceeding to step (2) following, return the framer knob to the center position and verify the results of the aperture plate and aperture alignment (paragraph 31), shuttle tooth side clearance and shuttle tooth height (paragraph 32, steps a and b).

- (2) Turn the framer knob until the teeth move to the upper position (down stroke). Remove the drive belt from the mechanism pulley. Turn the pulley until the center tooth is at the extreme top of the pull down stroke. The bottom edge of the center tooth is now in line with the top edge of the aperture opening. Rotate the camshaft until the center tooth is at the bottom of the pull down stroke. In this position the top edge of the center tooth should be in line with the bottom of the aperture opening as shown in Figure V. Shuttle stroke (vertical travel) is now placed in a close proximity of the factory setting at 0.3025 ± 0.005 inch without tooling. Replace the drive belt on the mechanism pulley and return the framer knob to the center position.

(3) Procedure for Adjusting Shuttle Stroke. Loosen the two shuttle plate mounting screws just enough to permit movement of the shuttle arm plate.

- (a) To lengthen the stroke, shift the shuttle arm plate toward the pull-down cam.
- (b) To shorten the stroke, shift the shuttle arm plate assembly away from the pull-down cam.

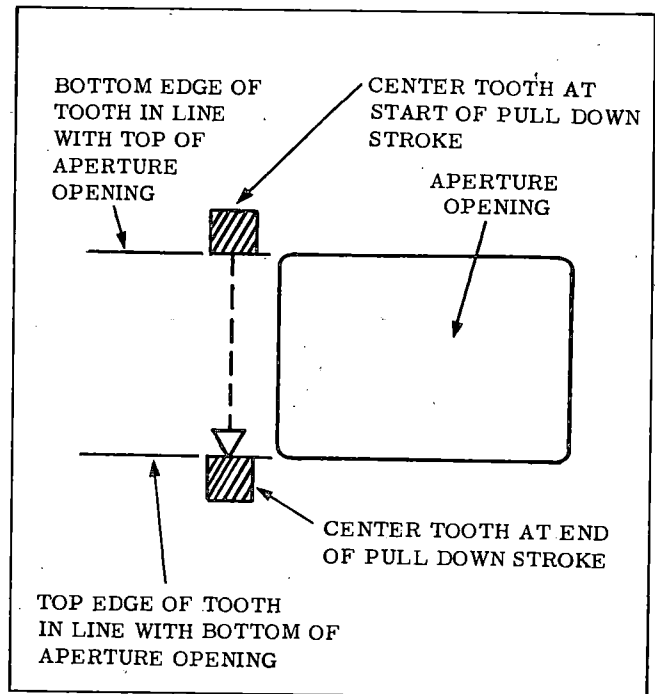


Figure V. Center Shuttle Tooth Travel Adjustment

- (c) After adjusting stroke, recheck shuttle tooth side clearance as instructed in paragraph 32, step a, and readjust the shuttle arms for proper tooth side clearance.

CAUTION

Do not attempt to eliminate film slap by setting stroke outside established tolerance. This will produce double image and/or jump with films having different shrink or stretch and a clicking noise from the shuttle teeth hitting the pressure plate.

e. Framing Adjustment. Thread the projector with test film TFL-1580 NX2. Project the film and turn framing knob from one limit to the other. If at one limit a frame line is not visible, loosen the nut on the framing eccentric located at the top of the shuttle arm plate assembly (Figure S) and turn the eccentric until the frame line appears. Hold the eccentric while tightening the nut.

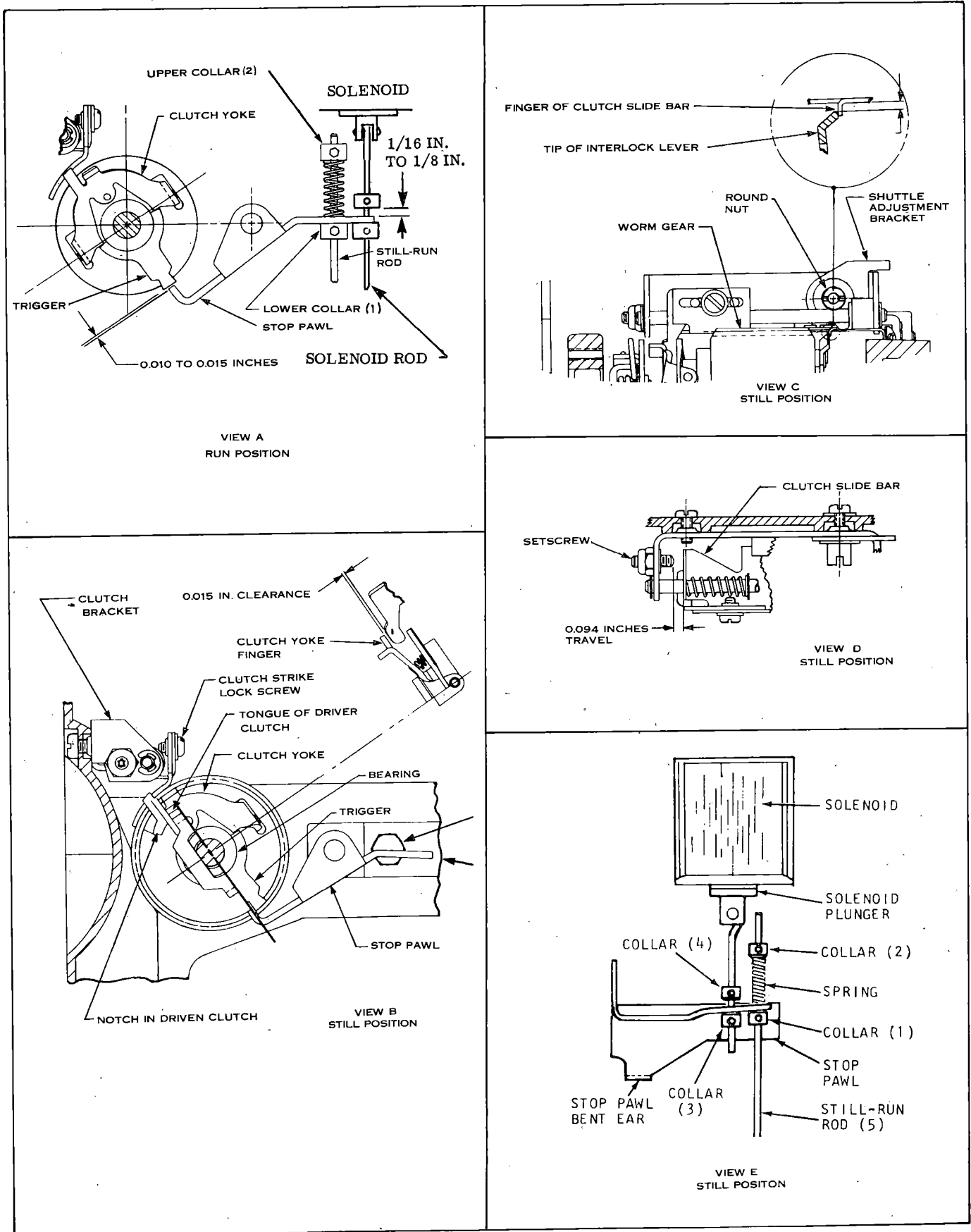


Figure W. Still-Run Clutch Adjustments

f. Check the adjustment by again turning the framing knob from limit to limit while observing the picture. When the eccentric is properly adjusted, either frame line can be projected and movement of film should be approximately equal at top and bottom of framer travel.

33. LENS CARRIER ADJUSTMENT.

Angular relationship between the lens carrier and the aperture plate is controlled by the lens mount stop screw. Thread the projector with roll title or target film TFL-55 NX1 having sharp images in the corners and project a picture approximately 30 inches high onto a matte surface. The projector must be square with the screen. Focus the picture and compare resolution of the two sides of the image when viewed from a distance of approximately twice the width of the picture. If one side appears to be soft, refocus to sharpen that edge of the picture and note whether the lens is moved toward or away from the aperture. For example, if image at the right-hand edge of the screen is soft until the lens is moved toward the aperture, then the lens stop screw is set too far forward and should be turned clockwise.

CAUTION

This adjustment is critical. Lens stop screw should be turned only a few degrees between tests for sharpness.

34. STILL-RUN CLUTCH ADJUSTMENT (ALL 2592 MODELS).

NOTE: The following procedural steps (a through d) also include adjustments for units equipped with the animation feature. Refer to Figure W and perform the adjustments as follows.

a. Checking Stop Pawl to Trigger Clearance. Disconnect the line cord and place the still-run lever in the "run" position. Rotate the mechanism by hand until the finger of the trigger is adjacent to the inner bent ear of the stop pawl as shown in View A. If the trigger fails to clear the stop pawl ear, adjust as follows. Loosen

the bearing bracket screws (View E) and shift the bearing bracket up or down, as necessary, to obtain approximately 0.010 to 0.015-inch clearance between the stop pawl ear and the end of the trigger; then tighten the two screws securely. Refer to paragraph 34, step c(4) for stop bracket adjustment.

b. Checking Shuttle Retraction. Turn the mechanism pulley by hand while pressing down on the clutch pawl at a point where the clutch rod passes through it. The ear of the clutch pawl should latch against the trigger as shown in View B. Note also the clearance required between the finger on the clutch yoke and the curved arm of the strike. Adjust as follows:

- (1) Loosen the clutch strike screw (View B) to permit the strike to be shifted. Insert a 0.015-inch feeler gage between the clutch yoke finger and the strike arm, and press and hold the strike against the feeler gage while retightening the strike screw. Remove the feeler gage.
- (2) Refer to View C and loosen the round Allen nut slightly and shift the shuttle adjustment bracket slowly toward the shuttle (clockwise) until the shuttle teeth are retracted below the level of the aperture plate rails. Retighten the Allen nut.
- (3) Refer to View D and adjust the setscrew in or out to obtain a clearance of 0.094 inch between the left-hand ear of the clutch slide bar and the end of the setscrew.
- (4) The shuttle interlock retainer is secured to the right end of the worm gear. Note, in View C, that the curved lip of this retainer must overlap the downward bent finger of the clutch slide bar. If necessary, bend this finger to obtain positive overlap as shown.

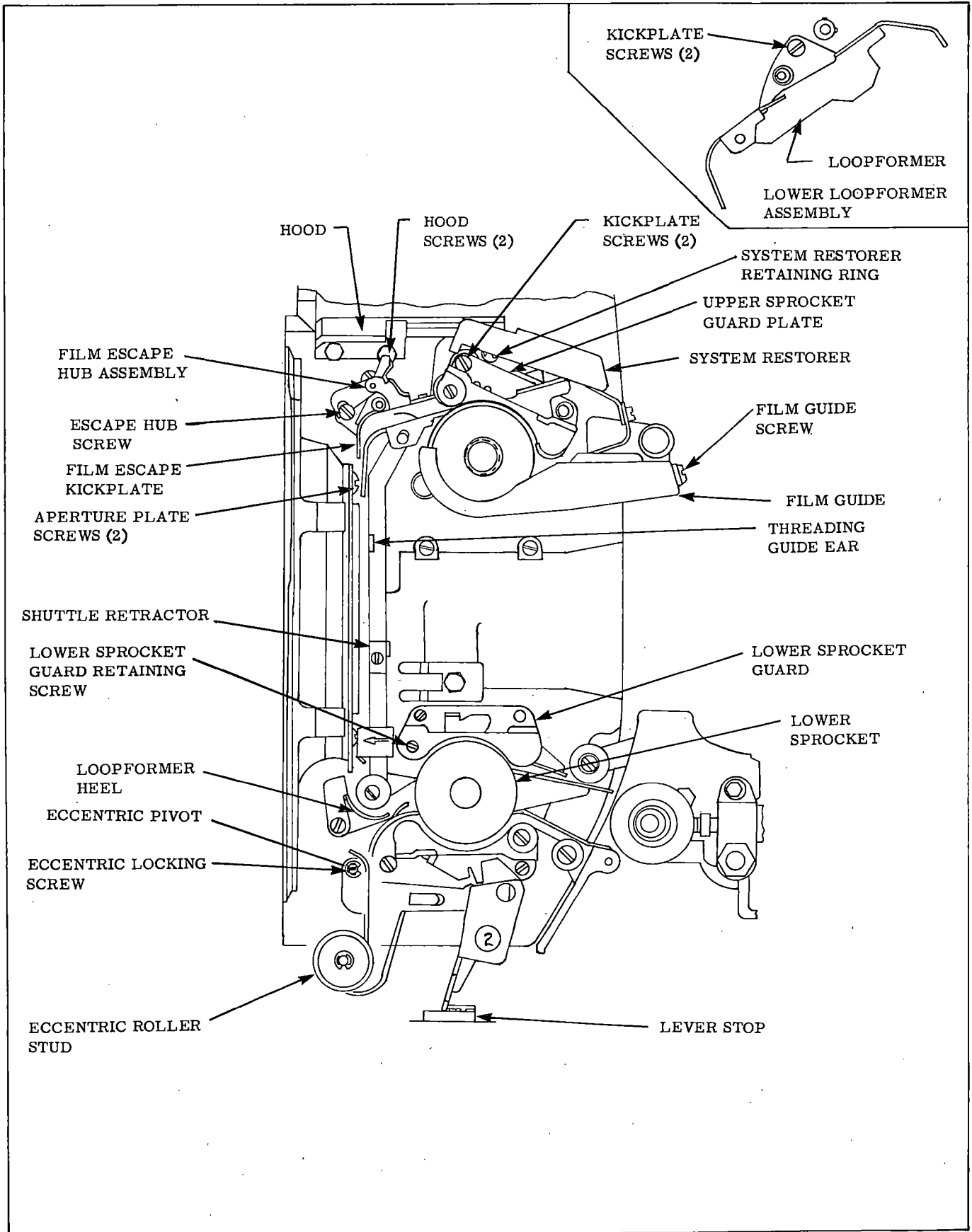


Figure X. Automatic Loading System Adjustments

c. Adjusting the Still-Run and Animated Switch Solenoid Linkages. Rotate the mechanism by hand until the finger of the stop pawl is centered at the tip of the trigger as shown in View A, and place the still-run lever in the "run" position.

- (1) Refer to View E and loosen the setscrews in collars (1) and (2) and press lower collar (1) up against the underside of the stop pawl until a clearance of 0.010 to 0.015 inch is obtained between stop pawl finger and tip of trigger. Tighten collar (1) setscrew.
- (2) With the tip of an appropriate spring gage, press down on upper collar (2) until gage indicates a spring pre-load of 5 ounces; then tighten upper collar (2) setscrew.
- (3) Loosen setscrews in collars (3) and (4). Use a suitable clamp to hold the solenoid plunger up to its seat; then raise lower collar (3) until it just touches the stop pawl and tighten the collar setscrew. Position the upper collar (4) so that there is 1/16 to 1/8 inch clearance between collar and stop pawl and tighten upper collar setscrew.
- (4) Loosen the bearing bracket screw retaining the stop bracket and set the stop bracket to touch the stop pawl preventing over-ride. Retighten screw securely.

d. Checking Still-Run Rod Linkage.

NOTE: Disconnect the line cord and discharge the motor capacitor before attempting the following adjustments.

- (1) Move the projector still-run lever to the "run" position so that the still-run rod moves up to the limit of its travel.
- (2) Rotate the motor pulley and check to make certain that the ear of the stop pawl clears the trigger as shown View A.

NOTE: The animation feature will not operate properly unless the lamp is on. Place the main switch in the "forward project" or "bright project" position. For reverse animation place the projector in the "reverse project" position.

- (3) Operate the projector and move the still-run lever to the "still" position. The stop pawl is engaged with the trigger mechanically. Press the animation lever and the trigger will momentarily be disengaged electrically by the animation switch solenoid. If the pre-load tension of the still-run rod spring (View E) is set too low, the stop pawl may not engage the trigger properly and a chattering will result. If set too high, the spring tension (or solenoid) may not be able to disengage the stop pawl from the trigger. (Note that if spring tension is too high it will also cause the animation switch to be inoperative.) Readjust spring tension until proper operation is obtained.

35. AUTOMATIC LOADING SYSTEM
ADJUSTMENTS — GENERAL.

a. The automatic loading system consists of a series of guides and rollers which, when the system is in the load position, are so located as to guide the film through the threading path. When the system is in the load position, the guides and rollers allow clearance for film threading.

b. The guides are connected by mechanical linkage. The system is actuated by a cocking lever at the lower end of the linkage and the movement is stopped at the top end of the linkage. The clearances must be checked with the system in the load position. If the need for adjustments is detected, it is important that the repairman proceed in the sequenced list in this section. The sprocket timing and the locating of the soundhead may be done without disturbing the film guide adjustments.

36. ADJUSTING THE LOADING GUIDES.
(Figure X).

a. Swing open the lens carrier to expose the lower sprocket guard and remove the lower sprocket guard retaining screw.

b. Remove the retaining ring that secures the system restorer and lock the automatic loading system. Place a 0.015 inch feeler gage between the film support rails of the aperture plate and the rear surface of the lower loopformer assembly (see inset, Figure X). This surface should touch the feeler gage just as the heel of the loopformer strikes the shoulder on the mounting stud for the entrance guide roller. To adjust, loosen the two kickplate screws which attach the upper sprocket guard plate. Press downward on the front end of the loopformer assembly and rotate the upper sprocket guard plate until heel of loopformer strikes the shoulder of the stud and the rear surface clears the aperture rails by 0.015-inch. Then tighten the kickplate screws securely.

NOTE: Depress and hold the lower loopformer assembly and check, at rear of mechanism, to see that the pin in the threading lever clears the bottom of the elongated slot in the loopformer shaft link by approximately 1/64 inch. (See Figure Y.) If necessary, loosen the hex head screw that secures the threading lever and rotate the lever to obtain the proper clearance; then retighten the hex head screw.

c. Check operation of the film escape mechanism by leaving the automatic threading system open. Manually advance the film and push it in the upper channel. The film should fold and flow out through the film escape kickplate in the loopformer. If the kickplate does not release, the arm of the hub assembly is not striking the hood properly. The hood can be moved slightly and the hub assembly should be adjusted accordingly. When the automatic threading system is activated and the kickplate does not lock in position, loosen the escape hub screw holding the hub assembly to the locking pawl and adjust the hub assembly until

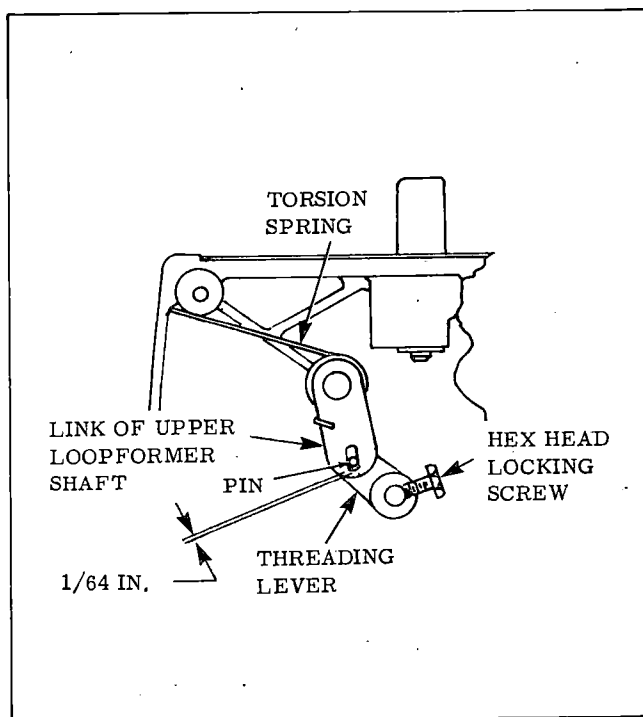


Figure Y. Threading Lever Clearance Adjustment

the top of the bracket touches the upper curved surface of the loopformer. This will lock the kickplate in position.

d. Again depress the loopformer assembly and check to make certain that there is 0.012 to 0.015 inch clearance between the top surface of the lower loopformer and the bottom surface of the kickplate. To adjust, remove the two screws which attach the hood. Loosen the two kickplate screws and move the kickplate to obtain desired clearance. Tighten the kickplate screws and reinstall the hood. Before tightening the hood retaining screws, press the hood toward the rear of the projector.

e. With the automatic loading system locked, and the film gate open, check to make certain that the shuttle teeth do not protrude through the slot in the aperture plate. If shuttle teeth protrude, loosen the shuttle retractor screw and carefully raise the shuttle retractor until teeth are retracted; then tighten the shuttle retractor screw securely.

f. Close the film gate while observing to see that the film pressure plate does not contact the aperture plate. If the pressure plate remains in contact with the aperture plate, either the pressure plate lift-off ear or the ear on the threading guide linkage is bent. Reform ear, or ears, as necessary.

g. Loosen the film guide screw and align the film guide so that film will feed squarely to the sprocket; then retighten the film guide screw.

h. Loosen the eccentric locking screw, lock the system, and check to make certain that the loopformer heel is bearing on the shoulder of the roller stud. If necessary, rotate the eccentric pivot with a wire pick or pin punch until the heel bears against the stud shoulder. When the loopformer is pressed downward, there must be no clearance between the heel and the stud shoulder.

i. Recheck clearance between the rear of the loopformer and the aperture rails (step c, preceding). Also, make certain that the end of the upper loopformer is tangent to or slightly ahead of the plane of the aperture plate film support rails. If readjustment is necessary, refer to steps c through e, preceding.

j. Lock the system and try to insert film into the feed sprocket. If film slips in too freely, loosen the two leaf spring screws and move the leaf spring downward to increase pressure on the film. If film buckles as it is inserted, move leaf spring upward to reduce pressure; then tighten the leaf spring screws.

37. CHECKING AND ADJUSTING LOOP RESTORER.

The automatic response of the loop restorer should be checked by means of two test film strips, TFS-D550 NX1 and TFS-D550 NX5. The first provides a test for damaged perforations; the second for elongated perforations. Run each test strip through the projector in "forward" and observe the reaction of the loop restorer as the damaged and elongated perforations pass through the film

gate. The lower loop should be automatically restored within five or six frames. To adjust the loop restorer, refer to Figure Z and proceed as follows.

a. Slip loop restorer roller gage (item 12, Figure B) small notch end first over the loop restorer roller with the point on the tool facing the aperture plate at the rear end of the sprocket guard. The tool should just touch the guide roller lightly. To adjust spacing between the loop restorer roller and guide roller, loosen the mounting screws in the self-centering assembly (View B) and raise or lower self-centering assembly until the proper spacing is obtained. Then tighten the mounting screws securely. Be sure that the ear of the loop restorer arm is positioned between the two spring-loaded keeper plates of the self-centering assembly.

b. Rotate the mechanism pulley until the setscrew in the loop restorer cam is at the bottom, directly below the camshaft (View B). The clearance between the upper tip of the cam follower blade and the face of the cam should be 0.015-inch. To adjust this clearance, loosen the cam follower support mounting screw and rotate the support accordingly; then retighten the screw securely. Now check the clearance between the upper end of the cam follower and the small diameter of the loop restorer cam (View C). This clearance should be 0.040-inch (± 0.005 -inch). Be sure that the cam setscrew is still positioned at the bottom of the cam, below the camshaft. To adjust this clearance, loosen the two cam follower screws (View B) and raise or lower the cam follower blade as necessary; then retighten the two cam follower screws securely.

c. Recheck the clearance between the loop restorer roller and sprocket guard as outlined in step a. Remove the loop restorer roller gage and once more check loop restorer operation with the test films.

38. TIMING THE SPROCKETS.

a. Open the film gate and turn the framer shaft clockwise as far as it will go. Then turn the mechanism pulley manually until

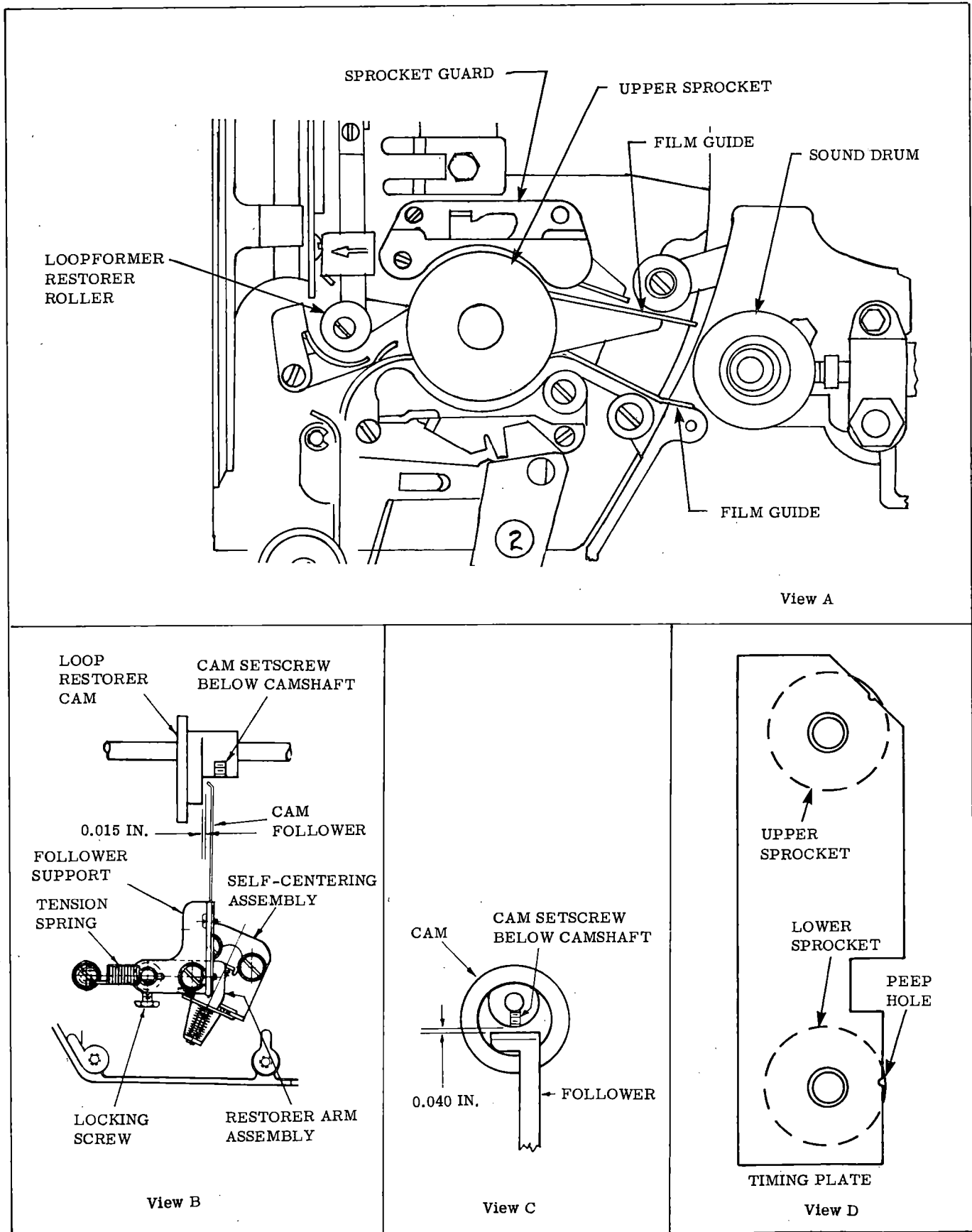


Figure Z. Adjusting the Loop Restorer

the shuttle is at the bottom of the stroke (teeth protruding) and the edge of the shutter blade bisects the aperture opening.

b. Push upward on the underside of the worm gear and check to make certain that the tongue on the driver clutch bears against the edge of the notch in the driven clutch (see Figure W, View B). Remove excess play.

c. Open the sprocket guards and place the timing and alignment plate (item 11, Figure B) over the sprocket hubs as shown in View D, Figure Z). The teeth on the sprocket should be in a direct line of sight with the edge drill holes. If the teeth do not align with the edge of each drill hole, the sprockets are out-of-time. Note the direction in which each sprocket must be rotated to bring the teeth back in line with the peep holes, then proceed with step d.

d. To retune the sprockets, the rear cover of the projector must be removed to expose the large sprocket gears at the rear of the mechanism assembly. Hold the sprocket gear stationary while loosening its setscrews; then, still holding the gear stationary, carefully rotate the sprocket and shaft assembly in the proper direction until the tooth is aligned with the center of the drill hole in the gage. Tighten the gear setscrews securely while retaining the gear on the sprocket. Use a drop of sealant or paint on the setscrews to prevent slipping.

39. ADJUSTING THE REEL ARMS AND REWIND CLUTCH (Figure AA).

a. Front Reel Arm Adjustment. Adjust end play of the shaft to 0.008 inch \pm 0.003 inch by positioning the front reel arm shaft retaining ring against an 0.008 inch shim. The backlash for both face gears should be between 0.005-inch (minimum) and 0.016-inch (maximum). Adjustment is made by loosening the face gear setscrews and repositioning the face gears as necessary.

b. Rear Reel Arm Adjustment. Adjust end play of the shaft to 0.008 inch \pm 0.003 inch by positioning the rear reel arm shaft retaining ring against an 0.008 inch shim.

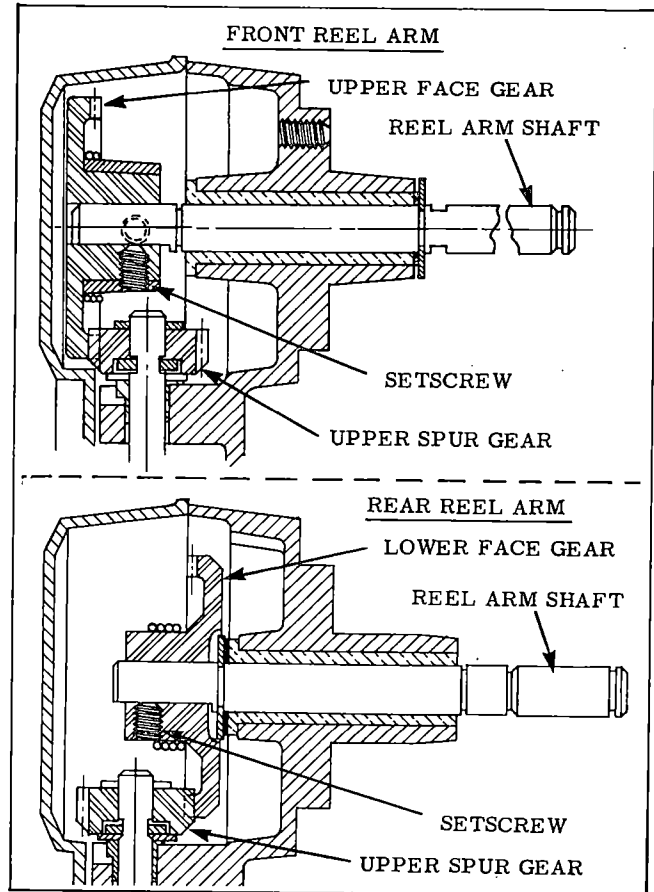


Figure AA. Adjusting Reel Arms

The backlash for both face gears should be between 0.005-inch (minimum) and 0.018-inch (maximum). The upper gear is adjusted by loosening its setscrew and repositioning the gear as necessary. The lower gear is adjusted by loosening the setscrew in the tapped hole of the arm and shifting the shaft in and out as necessary.

c. Rewind Clutch Adjustment. The rewind clutch system must be adjusted to produce a supply spindle torque of 35 to 55 inch-ounces when the rewind button is pressed during rewind operation. Install an empty 1200 foot reel on the supply spindle and wrap several turns of film around the reel hub. Hook a spring scale to the free end of the film strip. Place the projector in "reverse" and turn on the projector. Press and release the rewind button at the top of the mechanism housing. The spring scale must register between 14 to 22 ounces when the rewind clutch system begins to slip. Rewind

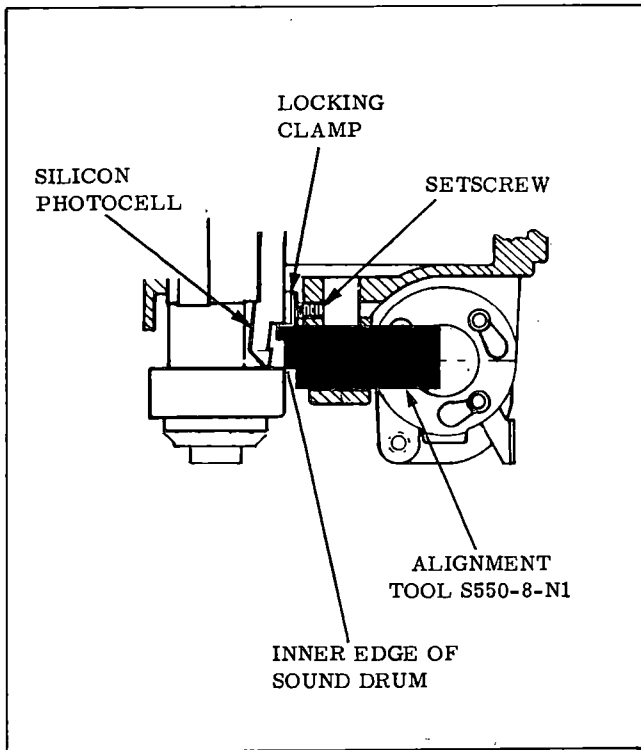


Figure AB. Positioning the Sound Drum and Silicon Photocell

torque (also 14 to 22 ounces) is adjusted by means of the rewind clutch assembly. This clutch is installed with the adjusting grip ring facing inward toward the main-plate and a special wrench (item 6, Figure B) must be used for the adjustment.

40. ADJUSTING THE SOUND SYSTEM.

a. Photocell Alignment (Figure AB).

- (1) Loosen the photocell setscrew, clamping screw and the two sound drum mounting screws. Remove the exciter lamp and the optical slit.
- (2) Insert the sound drum alignment tool (item 9, Figure B) into the optical slit opening as shown in Figure AB.
- (3) Press the sound drum in until its inner face just makes contact with the first step, or bearing surface, of the alignment tool, and maintain this contact while tightening the two screws securely.

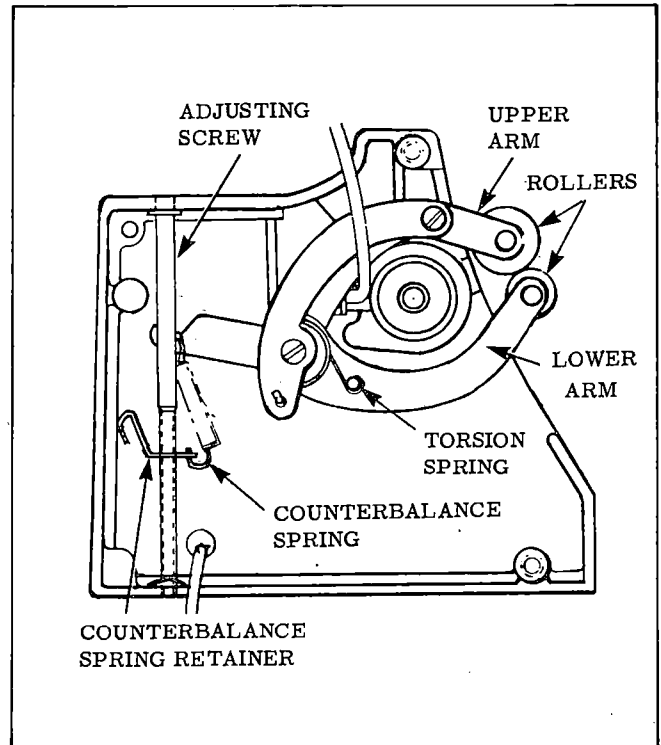


Figure AC. Stabilizer Roller Adjustment

- (4) Withdraw the alignment tool and, while looking into the optical slit mounting hole, shift the photocell until its forward tip is flush with the inner face of the sound drum. Maintain this position while tightening the setscrew.

b. Stabilizer Roller Adjustment (Figure AC). The roller arms are linked by a torsion spring and, therefore, will move as a pair. The counterbalance spring must be adjusted to offset the weight of the rollers and the roller arms. Place the soundhead on a level surface and move the roller arms (as a set) to various positions. If the roller arms fail to remain in the set positions, engage the slotted head of the tension adjuster with a screwdriver and turn the adjuster clockwise or counterclockwise until proper counterbalance is obtained.

c. Optical Slit Adjustment (Figure AB).

- (1) Insert the optical slit into its opening in the soundhead. The adjusting holes in the barrel of the slit must be at top center.

- (2) Insert a 0.050-inch (1.27mm) feeler gage between the tip of the optical slit and the sound drum and press the optical slit in against the feeler gage. Hold in this position while tightening the clamping screw just enough to hold the slit in place. Replace the exciter lamp.
- (3) Thread the projector with 7000Hz optical setting film TFL-26 NX3 and connect a 16-ohm, 10-watt load resistor and voltmeter to the speaker jack.

NOTE: A pair of hairpin tongs approximately 6 inches long and formed with the ends turned inward and tapered to engage holes in end of slit barrel are very useful in adjusting the optical slit. They can be made from 20 to 26 gage music wire or 1/16 inch diameter drill rod.

- (4) Set the volume control at approximately mid-position and start the projector. Move slit toward or away from film, as required, to obtain an output reading. Rotate the slit to obtain peak reading and simultaneously move in or out until maximum output is obtained from both sides of the film loop. Move the slit toward the film until output is within 1 to 2 DB. Tighten the slit clamping screw securely to lock the adjustment.

d. Buzz Track Adjustment. The lateral position of the film in the soundhead is controlled by the flanged roller (see item 15C, Figure 13) and the edge guide screw (item 24, Figure 13). Unless the adjustment has been disturbed, it is not probable that the edge guide screw will require resetting. Thread the projector with buzz track test loop TFL-37 NX1 and adjust the volume control to a suitable listening level. Turn the roller adjusting screw (item 14, Figure 13) to move the flanged roller laterally.

NOTE: Originally two types of buzz track were in use. On one, the track spacing exceeds the length of the scanning beam. This track can be positioned so that little or no signal is reproduced. On the other

type of track, spacing is less than the length of the beam. This track should be positioned so that both tones are reproduced at approximately the same volume level. If, after adjustment of guide roller position, signal levels cannot be balanced (or eliminated on wide track), or level of tones fluctuates, adjust the edge guide screw to clear up the condition. If the edge guide screw is far out of adjustment, turn it clockwise until it clears the edge of the film, adjust rollers and then set the guide screw to stop weave of film.

41. PROJECTOR SPEED CHECKS.

Speed of the projector is not adjustable. Therefore, speed checks are primarily for the purpose of determining that the equipment is operating properly and as a means of detecting excessive mechanism loads, damaged drive belt or similar conditions.

a. Methods of Measurement. Various devices and procedures can be used to check projector speed. The most common ones are as follows:

- (1) Photocell and Frequency Meter. Used to measure the number of pulsations of the projection beam per second. Pulsations per second is then converted to projector speed. This method is quite practical in large volume shops.
- (2) Strobatac or Similar Strobe Light. Usually synchronized with interrupter shutter of shuttle. Shutter makes one revolution per frame. Shuttle makes one stroke per frame.
- (3) Tachometer (Preferably Having a Speed Range with a Maximum Speed of 150-200 RPM). Used to measure RPM of the sprocket.
- (4) Strobe Disc. Attached to the sprocket by means of suction cup or rubber foot. For viewing with light from 60Hz source, disc should have 70 dots for sound speed, 93 dots for silent speed. Count number of apparent revo-

lutions of pattern for one minute. If pattern drifts in direction of rotation, add to design speed to obtain true speed. If pattern drifts against rotation, subtract from design speed to obtain true speed.

- (5) Timed Loop. Make loop of exactly 120 frames. Splice will pass aperture 12 times per minute plus or minus the permissible variation in speed and the timing error.

b. Speeds at 120 Volts AC, 60Hz.

Sound Speed - 24 FPS $\pm 2\%$
 Shutter - 1440 RPM $\pm 2\%$
 Sprocket - 102.86 RPM $\pm 2\%$

Silent Speed - 18 FPS $\pm 5\%$
 Shutter - 1080 RPM $\pm 5\%$
 Sprocket - 77.1 RPM $\pm 5\%$

42. CHECKING CLEARANCE FOR THE EXCITER LAMP COVER.

Since the film must pass between the sound drum and the exciter lamp cover, the clearance between these two items should be checked. Insert a #77 drill or a straight piece of #25 wire into the channel between the drum and the cover. The gage should enter the channel with slight friction but without forcing. If clearance is inadequate, straighten the exciter lamp cover locating pins to obtain proper clearance.

43. GEAR SHIFT TENSION ADJUSTMENT.

When shifting from forward to reverse, or vice versa, the idler gear arm (Figure AD) should pivot smoothly to effect the engagement of the idler gear with gear "A" or gear "B." This can be checked by rotating the drive belt pulley manually, first in one direction and then the other. If the pivoting action seems hesitant, increase the tension on the arm assembly by pressing the retaining ring more firmly on the spur gear shaft until the bowed washer (Figure AD) is flattened against the face of the gear.

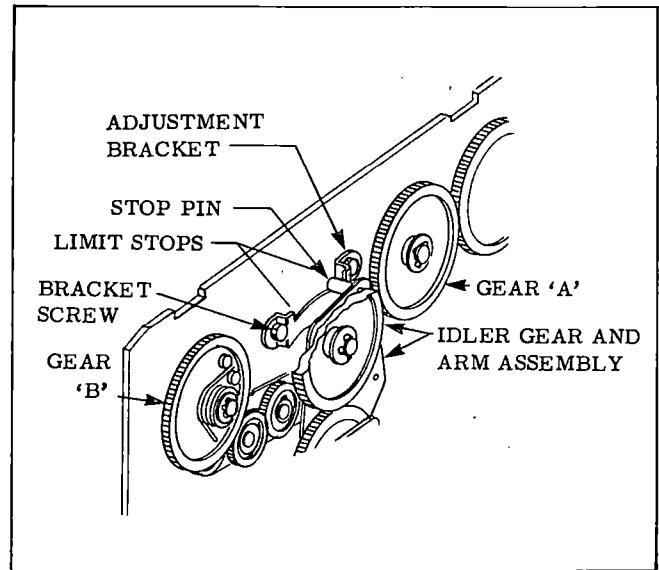


Figure AD. Adjusting Gear Shift Tension and Backlash

44. IDLER GEAR BACKLASH ADJUSTMENT.

In both the forward and reverse positions, there must be a perceptible amount of backlash between the idler gear and gears "A" and "B," Figure AD. As the idler arm pivots, a stop pin protruding at the upper end of the arm rides the slightly curved rim of the adjustment bracket from one limit stop to the other. Check gear backlash at both limit stops. If there is no backlash at one stop and too much at the other, loosen the adjustment bracket screws and shift the bracket slightly to balance the backlash in both positions.

45. CIRCUIT EXPLANATION FOR THE 20 WATT AMPLIFIER (WITH OR WITHOUT DUAL TONE CONTROL).

To adequately discuss the 20 watt amplifier, the unit has been divided into seven basic stages. Each stage will be discussed in the following order:

- (1) Optical Pre-Amplifier Stage
- (2) Tone Control Network Stage
- (3) Pre-Drive IC Stage
- (4) Driver Transistor Stage
- (5) Power Output Transistor Stage
- (6) Overload Protection Stage
- (7) Exciter Lamp Power Supply Stage

(1) Optical Pre-Amplifier Stage.

The optical pre-amplifier stage converts optical signal inputs to electrical outputs. The operational amplifier (half of IC1) gets its signal from the modulated output of the photo diode (optical pick-up). This output signal has an order of magnitude in the 1mV range. R18 acting as a DC load on the photo diode, stabilizes the photo diode so that it works into a relatively small DC load and also stabilizes the gain of IC1 in the event that the photo diode becomes completely cut-off from light (such as when the exciter lamp is extinguished). C1 and C14 block DC current from upsetting the bias on IC1 inputs. R26 returns the non-inverting (+) input of IC1 to ground to set the output of IC1 at 0 volt DC with respect to ground. Dual purpose resistor R1 returns the inverting input (-) of IC1 to a DC voltage which looks like ground (that is the output of IC1) and provides stabilizing feedback to the inverting input. As signal appears on the photo diode its impedance changes proportionally to the signal generated. This means that for higher signal output levels more feedback is applied to the IC1 optical pre-amplifier stage. The constantly changing feedback produces a linearizing effect on the output of the photo diode to reduce the system distortion. Since the photo diode is connected between the inverting and non-inverting inputs, any noise generated on the wires of the photo diode will be in phase at these inputs and cancelled by the common mode rejection ratio of IC1. Completing this stage is capacitor C2 which is non-polar due to the fact that the output pin of IC1 is at 0 volt DC level and goes plus and minus about 1 volt around this level (ground).

(2) Tone Control Network Stage.

Two types of tone controls are used with the 20 watt amplifier; a single tone control and a dual tone control. The dual tone control is located on a separate PC board that is connected to the 20 watt amplifier.

a. Single Tone Control. The single high frequency boost/cut control forms a high pass filter to the tone control arm or a high pass filter to ground. When the tone control arm is advanced toward the high end of the control, higher frequency signal components are routed through C15 and fed forward into the next stage. As the arm of the tone control is advanced toward the low side of the control, a high pass network is formed between the signal source and ground, thus shunting the higher frequency components of the signal to ground and away from the next stage. This results in a simple treble boost and cut control with the center position being considered the flat position.

b. Dual Tone Control. The dual tone control is a dual and treble control assembly using both IC1A and IC1B. Pin 1 of IC1A is connected to pin 2 thus making IC1A a voltage follower. Pin 3 (the non-inverting input) of this IC is tied to ground to efficiently disable this unused op-amp stage. The other half of IC1 (IC1B) is used as the amplifier stage for the dual tone control.

There is less than 1dB of loss in this active feedback, dual tone control network, due to the amplification of IC1B (shown in assembly 078561). The signal from the photo-cell is amplified by the optical sound pre-amplifier and outputted from the main amplifier board through terminal 6. A shielded cable brings this signal to pin 3 on connector J2 of the dual tone control PC board. Pin 3 is connected to the top of the volume control (R22). The attenuated signal at the arm of the volume control follows two paths to the inverting input (pin 6) of IC1B: First through R17 and the parallel combination of the plus side of the bass control and C12, then through R18; the other path is through R19 in series with the plus side of the treble control and through C14. Opposing the input signal is a signal from the output of IC1B which is out of phase (180°) with the input signals. This allows the user to select more feedback in the frequency range desired by moving the treble or bass controls to the minus side (producing bass and treble cut conditions) or, to select more

signal by moving the treble and bass controls toward the plus side (producing bass or treble boost conditions). The bass and treble tone circuits have a design center frequency of 700Hz. Maximum bass boost or cut effect is at 70Hz, while the maximum treble boost or cut effect is at 7000Hz. In other words, two selective filter networks have been incorporated in the feedback path of IC1B. By advancing either the treble or bass control to the positive side more signal is introduced to the inverting input of IC1B to obtain the boost characteristic. By moving the bass or treble control toward the minus side, more negative feedback is introduced to attenuate certain frequencies and produce the cut conditions. The output of IC1B is fed to the pre-driver op-amp stage on the main amplifier board through pin 4 of J2.

Both IC1A and IC1B are fed voltages from the ± 14 volts supply on the main amplifier. Except for the ± 14 volts supplies on the dual tone control assembly all other DC voltages on this board are 0 volt ± 50 millivolts.

c. Trouble Shooting the Dual Tone Control PC Board Assembly.

- (a) If the dual tone control board assembly has attenuation, the fault is probably in the IC1B. Any excessive DC offsets at pin 7 of IC1B can be traced either to a defective IC or the lack of balanced ± 14 volts DC supplies to this board.
- (b) Defective AC signal paths on this board can be found by noting the frequency at which the board deviates from specification. If there is deviation in the low frequency (lower than 350Hz range) the problem is most likely due to a defect in R20, C13, C12, R17 or the bass control itself. A defect in higher frequencies (3500Hz and up) will be found in the treble side of the system. Look for defects in R19, R21, C14 or the treble control itself.

- (c) In some instances a crackling sound may be heard in the audio output as the bass control is rotated; this indicates a defective wiper in the bass control. The bass control has a DC current path from the output of IC1B back to the inverting input (the treble control will not produce the same kind of scratchy effect if defective).

(3) Pre-Driver IC Stage.

Utilizing the second half of IC1, this stage provides amplification and control of the audio signal for presentation to the driver and power output stages of the amplifier. The large open loop gain of IC1 allows it to clean-up the signals presented to the driver and output stages. This stage also compares the output signal applied to the speaker with the input signal coming from the tone control stage. The pre-driver corrects any non-linearity in the output waveform so that it resembles, as close as possible, the input waveform from the tone control stage. Thus, any non-linearities in the driver transistors or power output transistors are removed from the system.

Main parts comprising the pre-driver IC stage are: second half of IC1, C3, C11, C5, R4, R5 and R23. C3 couples the signal from the tone control stage to the non-inverting input of the pre-driver IC and also provides DC isolation of the non-inverting input. R5 references the non-inverting input to the DC ground potential (0 volt). The resistance of R5 is equal to the resistance of R23 to insure that the DC offset voltage appearing at the IC output pin (pin 7) is held as nearly as possible to 0 volt DC. The power amplifier circuit is designed to be used without capacitor coupling between the output of the power amplifier and speaker; so the DC output voltage must be kept as close as possible to ground. R23 provides a direct connection from the output of the power amplifier to the inverting input of the pre-driver stage. C11 DC isolates the inverting input pin from ground.

Therefore, the DC voltage appearing at the inverting input (pin 6) is exactly equal to the power amplifier output offset voltage. Since the lower end of resistor R5 is tied to ground, the DC output voltage for the entire power amplifier is 0 volt with respect to ground. Resistor R23 forms a divider with R4 for AC signals. The ratio of R23 to R4 sets the AC (signal) gain of the power amplifier stage. That is, if R23 is 330K ohms and R4 is 3.3K ohms the power amplifier voltage gain is 330 divided by 3.3; this equates to a voltage gain of 100.

The pre-driver output feeds the driver transistor stage.

(4) Driver Transistor Stage.

The driver transistor stage has two functions; (1) to boost the output current of the pre-driver sufficiently to drive the output transistor, and (2) to set the quiescent operating current of the output transistors. Q2 and Q3, the driver transistors, are maintained in a slightly conductive (on-state) condition when no signal is being applied to the amplifier. R9 and R10 source a small amount of current through D13 and D14. The D13 and D14 diode drops maintain Q2 and Q3 in the slightly "on" condition. Trimmer pot P2 adjusts the amount of voltage available to the bases of Q2 and Q3 to limit their base currents. The emitter-collector conduction of Q2 and Q3 is limited, thus limiting the base currents of Q4 and Q5. One of the small heat sinks on Q2 and Q3 is a formed aluminum part which cradles D13 and D14. This part transmits the heat developed in the driver transistor to the two diodes. As the temperatures of the driver transistors rise, these transistors tend to be "turned on" more fully. The thermal feedback to the diodes allows the diode junction to track the driver transistor junction so that a stable quiescent base current is maintained throughout the projector's operating temperature range. By controlling the collector-emitter resistance of the driver transistors, the on-state of Q4 and Q5 is also controlled.

(5) Power Output Transistor Stage.

The power output transistors Q4 and Q5 share a common heat sink with the exciter lamp series regulator Q7. These two transistors directly drive the load (speaker) while being controlled and fed signal from the driver transistors Q2 and Q3. Two pairs of resistors (R16, R12 and R17, R13) form local DC feedback networks from the power output transistor to the driver transistor. The driver transistor/power output transistor pair has a gain set by the associated feedback resistors. If R16 is 240 ohms and R12 is 15 ohms the stage gain is 240 divided by 15 which is approximately 16. That means the output of the power amplifier to the speaker should be approximately 16 times greater than the output of the pre-driver IC. This voltage gain is based on the output voltage swing of the pre-driver IC. Because the pre-driver IC is driven from a ± 14 VDC source, the maximum output voltage swing at pin 7 is approximately 22 volts peak-to-peak. If the output waveform is a sine wave, 22 volts peak-to-peak equals approximately 7.75 volts RMS. To obtain 15 watts output into an 8 ohm load, approximately 11 volts RMS must be produced across the load. This means some voltage gain is needed in the driver and power output stages; and the voltage gain of approximately 16 does not require an excessive amount of drive from the pre-driver IC. The overall gain of the pre-driver, driver, and power output stages is set by the ratio of R23 to R4, but the local voltage gain of 16 is not additive to the gain of the entire amplifier because the pre-driver IC gets its control feedback directly from the output of the power amplifier stage. R22 and C4 form a cell to allow the amplifier to work a relatively low impedance load at high frequencies (above 30KHz). R20 and R21 act as local feedback sources to linearize the outputs of Q4 and Q5.

(6) Overload Protection Stage.

Transistor Q1 senses the emitter current of Q5. Q1 is driven from a half-wave rectifier stage comprised of D9, R6 and C10.

As the power amplifier sources current to the speaker, the voltage drop across R20 (also functional above) increases.

NOTE: Because Q5 conducts only on the positive half of the output sine wave, the voltage wave form across R20 will look like the positive half of the output sine wave. As the voltage drop across R20 increases past 0.6 volt, D9 begins to conduct on the peaks. If the peak voltage across R20 increases above 1.0 volt, there will be sufficient voltage developed on C10 to turn on the base emitter junction of Q1. This voltage must remain present on repetitive peaks or R11 will discharge C10 and no action at the base emitter junction of Q1 will take place.

Since R20 is 0.33 ohms, 1.2 volts is developed with 3.64 amps peak emitter current flowing through Q5. This amount of current will flow from the amplifier only when a load of less than 3 ohms (a fault condition or short circuit) is connected to the output of the amplifier. As this or a greater amount of current flows, the voltage on C10 will build-up in a short period of time. When the voltage on capacitor C10 rises above 0.6 volt DC, Q1 turns on and directs current to flow from the positive terminal of the power supply into the gate of SCR Q8. Anytime more than 200 microamps of current flows into the gate of SCR Q8, the SCR will be turned on (go into its low impedance conduction state from anode to cathode) and when Q8 turns on, the ± 14 VDC sources are removed from the pre-driver IC (and the optical pre-amp IC as well). The SCR latches in the "on" state until the current flowing through it is reduced to near 0. Its operation sequence is as follows:

- 1: Amplifier senses extremely low impedance at its output.
- 2: Voltage drop on R20 exceeds 1.2 volts.
- 3: Q1 turns on.
- 4: SCR turns on and latches.
- 5: No sound is output from the system.
- 6: User notices sound is off, shuts down the projector.

7: User locates source of problem and corrects.

8: User turns projector back on again.

When the projector is off for more than 10 seconds, the current through the SCR decays to the point where the SCR is brought out of its latched condition. If the projector is turned back on at this time, it will not operate normally unless the cause of the problem has been cleared.

(7) Exciter Lamp Power Supply Stage.

The Type BAK exciter lamp has a normal rating of 4.0 volts at approximately 700 milli-amperes current. Actually, the exciter lamp source is a negative DC (-3.9 volts DC set at the factory) with respect to the projector chassis frame ground. The exciter lamp voltage must be well regulated and virtually free of any noise which could degrade both the signal-to-noise ratio and dynamic range of the projector amplifier system. This dual function is handled by a voltage regulator/filter comprised of transistors Q6 and Q7, incorporated on the projector amplifier PC board.

D1 through D4 are connected in a conventional bridge system with capacitive input filter (C9). Q6 is connected as an emitter follower stage to control the base current of Q7. Q7 is located on the amplifier heat sink assembly so it can dissipate approximately 3.9 watts under normal operating conditions. The base of Q6 is connected to a variable voltage source which is divided down from the regulated -14 volts supply of the projector amplifier. The voltage at the arm of P1 should be approximately -4.6VDC with respect to projector frame ground. C12 filters any audio voltage components which would appear at the base of Q6. R41 and C6 prevent Q6 from becoming a common base oscillator. With the proper setting of pot P1, Q6 conducts just enough to maintain a constant voltage on the exciter lamp by controlling the base current to Q7. Q7 conducts only enough to maintain the exciter lamp at the proper -3.9 volts with less than 10 millivolts peak-to-peak noise.

TROUBLE SHOOTING

46. MISCELLANEOUS TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Nothing runs	<ol style="list-style-type: none"> 1. Defective main switch. 2. Damaged line cord. 3. Loose connections. 4. Blown thermal fuse. 5. Blown power input fuse or fuseboard fuse(s) (multi-line voltage models) 	<ol style="list-style-type: none"> 1. Replace main switch (para. 17). 2. Repair or replace line cord. 3. Repair connections. 4. Replace thermal fuse; check drive motor for proper operation. 5. Check for proper voltage selector knob setting; see schematic wiring diagrams for proper fuse(s) values and replace blown fuse(s).
Motor hums but does not run	<ol style="list-style-type: none"> 1. Starting circuit open or shorted. 2. Defective capacitor or drive motor. 3. Voltage selector knob in wrong setting (multi-line voltage models). 	<ol style="list-style-type: none"> 1. Replace loose or transposed connections. 2. Replace defective capacitor or drive motor (para. 18). 3. Place voltage selector knob at correct setting.
Motor runs but mechanism does not run	<ol style="list-style-type: none"> 1. Drive belt broken or unhooked from pulley. 2. Motor pulley loose on shaft. 3. Still-run clutch spring lost or broken (2592 models). 	<ol style="list-style-type: none"> 1. Reinstall or replace drive belt (para. 12). 2. Reposition motor pulley and tighten setscrews. 3. Replace still-run clutch spring (item 14, Figure 17).
Rewind does not operate	<ol style="list-style-type: none"> 1. Rewind gears not engaging or clutch slipping. 2. Projector in "still" position (2592 models). 	<ol style="list-style-type: none"> 1. Adjust rewind clutch (para. 39, step c) and/or gears (para. 43). 2. Place still-run lever in "run" position.
Take-up does not rotate	<ol style="list-style-type: none"> 1. Idler arm not functioning. 2. Defective gear and bearing assembly. 3. Defective take-up belt. 	<ol style="list-style-type: none"> 1. Clean idler arm and adjust. 2. Replace defective gear and bearing assembly (item 2, Figure 5). 3. Replace take-up belt (item 3, Figure 12).

46. MISCELLANEOUS TROUBLES AND REMEDIES (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Feed spindle does not rotate	<ol style="list-style-type: none"> 1. Defective take-up clutch and bearing assembly. 2. Idler arm not functioning. 3. Loose setscrews in front reel arm face gears. 	<ol style="list-style-type: none"> 1. Replace defective take-up clutch assembly (item 16, Figure 5). 2. Clean idler arm and adjust. 3. Tighten face gear setscrews.
Gate will not lock	<ol style="list-style-type: none"> 1. Latch spring set too close to lens mount stop. 2. Pressure plate out-of-line. 	<ol style="list-style-type: none"> 1. Adjust latch spring. 2. Align pressure plate.
Shuttle runs but sprockets do not revolve	<ol style="list-style-type: none"> 1. Still-run clutch spring lost or broken (2592 models). 	<ol style="list-style-type: none"> 1. Replace still-run clutch spring (item 14, Figure 17).
Short lamp life	<ol style="list-style-type: none"> 1. Line voltage too high. 2. Dirt and lint clogging blower housing. 3. Blower fan loose on drive motor shaft. 4. Contacts burned in lamp connector. 5. Voltage selector knob in wrong setting (multi-line voltage models only). 	<ol style="list-style-type: none"> 1. Check for proper lamp use. 2. Clean blower housing. 3. Tighten or replace blower fan setscrew (para. 16). 4. Replace lamp connector. 5. Place voltage selector knob at correct setting.
Projector speed slow	<ol style="list-style-type: none"> 1. Binding in mechanism. 2. Drive belt slipping. 3. Defective capacitor or motor. 4. Voltage selector knob in wrong setting (multi-line voltage models only). 	<ol style="list-style-type: none"> 1. Free binding condition. 2. Clean or replace drive belt (para. 12). 3. Replace defective component. 4. Place voltage selector knob in correct setting.
Projector runs at speed between 18 and 24 FPS	<ol style="list-style-type: none"> 1. Pulleys out-of-line. 2. Belt shifter bent. 3. Power line frequency other than 60 cycles. 	<ol style="list-style-type: none"> 1. Realign pulleys. 2. Straighten belt shifter or replace. 3. Use proper voltage and frequency.

47. PICTURE TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Film jump	<ol style="list-style-type: none"> 1. Damaged film. 2. Loose shuttle arms. 3. Dirty film aperture. 4. Damaged or lost pressure plate spring. 5. Pressure plate misaligned. 6. Incorrect shuttle stroke. 7. Lost loop in entire system. 	<ol style="list-style-type: none"> 1. Repair or replace. 2. Adjust and tighten (para. 32, step c). 3. Clean film aperture. 4. Replace pressure plate spring. 5. Realign pressure plate. 6. Adjust (para. 32, step d). 7. Open and close automatic load lever; check for damaged sprocket holes.
Double image	<ol style="list-style-type: none"> 1. Incorrect shuttle stroke. 2. Excessive shuttle protrusion. 	<ol style="list-style-type: none"> 1. Adjust (para. 32, step d). 2. Adjust (para. 32, step b).
Weave (due to faulty aperture plate)	<ol style="list-style-type: none"> 1. Side tension spring missing. 2. Sticking edge guide. 3. Fixed edge guide out of position. 	<ol style="list-style-type: none"> 1. Replace side tension spring. 2. Clean edge guide. 3. Reposition edge guide.
Poor illumination	<ol style="list-style-type: none"> 1. Optics out-of-line. 2. Projection lamp wearing out. 3. Improper voltage setting (multi-line voltage models only). 	<ol style="list-style-type: none"> 1. Realign (para. 31). 2. Replace projection lamp. 3. Place voltage selector knob in correct setting.
Poor focus	<ol style="list-style-type: none"> 1. Dirty lens and/or aperture. 2. Warped film. 3. Pressure plate spring lost. 4. Bent pressure plate. 5. Pressure plate out-of-line. 6. Defective lens. 	<ol style="list-style-type: none"> 1. Clean lens and/or aperture. 2. Recondition or replace film. 3. Replace pressure plate spring. 4. Replace pressure plate. 5. Realign pressure plate. 6. Replace lens.
Frame line creeps	<ol style="list-style-type: none"> 1. Framer eccentric loose. 	<ol style="list-style-type: none"> 1. Align and tighten (para. 32, step e).
Insufficient framing	<ol style="list-style-type: none"> 1. Framer eccentric out-of-adjustment. 	<ol style="list-style-type: none"> 1. Adjust (para. 32, step e).
Trailer ghost	<ol style="list-style-type: none"> 1. Shutter out-of-alignment. 	<ol style="list-style-type: none"> 1. Reassemble properly.

48. FILM TRANSPORT TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Loss of loops	<ol style="list-style-type: none"> 1. Damaged film. 2. Inadequate shuttle protrusion. 3. Inadequate or excessive shuttle stroke. 4. Pressure plate spring lost. 5. Pressure plate mounting screws loose. 6. Sprocket guards not closing. 7. In-out bracket spring broken. 8. Sprocket drive gear loose on shaft. 9. Supply reel too small. 	<ol style="list-style-type: none"> 1. Repair or replace film. 2. Adjust (para. 32, step b). 3. Adjust (para. 32, step d). 4. Replace pressure plate spring. 5. Tighten pressure plate mounting screws. 6. Clean and adjust sprocket guards. 7. Replace in-out bracket spring. 8. Retime sprockets (para. 38, step d) and tighten setscrews. 9. Use 400 foot reel with hub 2-1/2 inches in diameter (minimum).
Excessive film slap	<ol style="list-style-type: none"> 1. Damaged film. 2. Green film. 3. Dirty pressure plate. 4. Pressure plate rubbing on aperture plate guide rails. 5. Incorrect shuttle stroke. 	<ol style="list-style-type: none"> 1. Recondition or replace film. 2. Age or buff film. 3. Clean pressure plate. 4. Realign pressure plate. 5. Adjust (para. 32, step d).
Still-run clutch does not operate (2592 Models)	<ol style="list-style-type: none"> 1. Open in animation switch circuit. 2. Solenoid plunger not set properly. 3. Excessive stop pawl clearance. 	<ol style="list-style-type: none"> 1. Repair animation switch circuit or replace switch. 2. Adjust solenoid plunger (para. 34, step c). 3. Adjust stop pawl clearance (para. 34, step a).
Still-run clutch stops sprocket but shuttle pulls film (2592 Models)	<ol style="list-style-type: none"> 1. Insufficient shuttle retraction. 	<ol style="list-style-type: none"> 1. Adjust shuttle retraction (para. 34, step b).
Splices jam in sprocket shoes	<ol style="list-style-type: none"> 1. Bad splices. 2. Emulsion build-up on film path components. 	<ol style="list-style-type: none"> 1. Replace splices. 2. Clean film path components.

49. SOUND SYSTEM TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Projector runs, no voltage at PC board	<ol style="list-style-type: none"> 1. Loose connection. 2. Blown fuse(s) on fuseboard (multi-line voltage models). 3. Amplifier switch damaged. 	<ol style="list-style-type: none"> 1. Repair connection. 2. Replace blown fuse(s); see schematic wiring diagrams for proper fuse values. 3. Replace circuit board (para. 23); (see Figure 7 for circuit board replacement policy).
Projector runs, voltage at PC board, but exciter lamp does not light	<ol style="list-style-type: none"> 1. Exciter lamp cable disconnected. 2. Wrong exciter lamp used. 3. Projector main switch open or leads disconnected. 4. Defective amplifier. 5. Shorted speaker or shorted speaker jack wires. 	<ol style="list-style-type: none"> 1. Reconnect exciter lamp cable. 2. Replace with correct lamp. 3. Replace main switch (para. 17) or connect leads. 4. Repair per para. 45 or replace circuit board (para. 23); (see Figure 7 for circuit board replacement policy). 5. Repair or replace speaker (para. 14).
Voltage at PC board, exciter lamp lights, but no sound	<ol style="list-style-type: none"> 1. Speaker jack disconnected or speaker jack switch open. 2. Photocell cable disconnected. 3. Photocell out-of-line. 4. Dirt on end of photocell. 5. Wrong exciter lamp used. 6. Defective amplifier. 	<ol style="list-style-type: none"> 1. Connect leads. Repair or replace jack. 2. Connect cable. Connect leads to proper terminals. 3. Realign (para. 40, step a). 4. Clean photocell. 5. Replace with correct lamp. 6. Repair per para. 45 or replace circuit board (para. 23); (see Figure 7 for circuit board replacement policy).
Low volume	<ol style="list-style-type: none"> 1. Trouble in amplifier PC board. 2. Wrong exciter lamp used. 3. Photocell out-of-line. 4. Dirt on photocell or slit. 5. Optical slit misaligned. 	<ol style="list-style-type: none"> 1. Repair per para. 45 or replace circuit board (para. 23); (see Figure 7 for circuit board replacement policy). 2. Replace with correct lamp. 3. Realign (para. 40, step a). 4. Clean photocell and slit. 5. Realign optical slit (para. 40, step c).

49. SOUND SYSTEM TROUBLES AND REMEDIES (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Low volume (continued)	6. Buzz track misaligned.	6. Realign buzz track (para. 40, step d).
	7. Low exciter lamp voltage.	7. Adjust (para. 45).
Distortion at all volume levels	1. Wrong exciter lamp used.	1. Replace with correct lamp.
	2. Trouble in amplifier PC board.	2. Repair (para. 45) or replace (see Figure 7 for replacement policy).
	3. Improper film loops.	3. Check sprocket holes for dam- age. Readjust loops.
Crackling noises	1. Buzz track out-of-line.	1. Realign buzz track (para. 40, step d).
	2. Broken cable shield.	2. Repair shield or replace cable.
	3. Defective amplifier.	3. Repair (para. 45) or replace (see Figure 7 for replacement policy).
	4. Poor exciter lamp contact.	4. Clean contacts or replace exciter lamp.
Wow or flutter	1. Stabilizer guide roller sticking.	1. Clean roller and roller shaft.
	2. Stabilizer guide roller spring broken, unhooked or lost.	2. Repair or replace spring.
	3. Loose flywheel.	3. Tighten flywheel.
	4. Damaged sound drum bearing.	4. Replace sound drum.
	5. Dirt causing guide roller arm pivot bearing to bind.	5. Clean and polish.
	6. Photocell or exciter cable rubbing against flywheel.	6. Reposition cables.
	7. Soundhead out-of-position.	7. Reposition soundhead (para. 25).
	8. Loop restorer stroke too short or set too low.	8. Adjust loop restorer (para. 37).

49. SOUND SYSTEM TROUBLES AND REMEDIES (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Wow or flutter (continued)	9. Chips or dirt in take-up sprocket gear teeth.	9. Remove and clean sprocket gear.
	10. Bent take-up reel.	10. Replace take-up reel.
	11. Dirt on sound drum or impedance roller.	11. Clean sound drum and impedance roller.
	12. External drags on flywheel such as braking rollers or reverse drive roller.	12. Repair and adjust as required.
Clicking noises	1. Dirt on sound drum.	1. Clean sound drum.
	2. Broken ground lead to mainplate.	2. Replace ground lead.
High frequencies fade (jumps focus)	1. Warped film.	1. Recondition or replace film.
	2. Dirt on sound drum.	2. Clean sound drum.
	3. Optical slit lens out-of-focus or dirty.	3. Clean and/or adjust.
Hum	1. Ground wiring.	1. Correct grounded condition.
	2. Trouble in amplifier PC board.	2. Repair (para. 45) or replace (see Figure 7 for replacement policy).
	3. Broken cable shield.	3. Repair or replace cable shield.

50. TROUBLE SHOOTING THE AUTOMATIC LOADING SYSTEM.

Any obstruction in the film path, such as caked emulsion, film chips or splicing tape interfere with the proper threading of the projector. Before attempting to localize the trouble, brush or blow away all accumulations of dirt and film chips with a low-pressure jet of compressed air. Inspect all threading guides, shoes and rollers. Clean the film path areas with isopropyl alcohol and the special cleaning pad (P/N 48478) being careful not to remove lubricants from the film threading linkages.

The automatic loading system has been designed to function properly with all 16mm films which are in projectable condition. Films that function properly in other Bell & Howell Company projectors can be used for testing the automatic loading system. Inspect the condition of the test film before attempting to adjust the automatic loading system. Check that the film leader end is properly trimmed. Then inspect the sprocket holes in the first 18 inches of leader for good condition and for restrictions such as cement or splicing tape. Finally check the condition of the tape splices and for proper tape splice registration.

50. AUTOMATIC LOADING SYSTEM TROUBLES AND REMEDIES (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Film cannot be inserted into the feed sprocket	<ol style="list-style-type: none"> 1. Obstruction below roller of channel (see inset, Figure 14). 2. Roller channel bent or binding. 3. Excessive pressure on leaf spring. 	<ol style="list-style-type: none"> 1. Remove obstruction. 2. Straighten or replace channel and roller assembly. 3. Adjust leaf spring (para. 36, step j).
Film will not pull between feed sprocket and sprocket shoe	<ol style="list-style-type: none"> 1. Entrance guide misaligned. 2. Feed sprocket guard sticking. 3. Feed sprocket guard spring broken. 4. Caked emulsion or burr on sprocket shoe film rails. 	<ol style="list-style-type: none"> 1. Realign per para. 36, step g). 2. Clean sprocket shoe pivot. 3. Replace sprocket guard spring. 4. Clean; remove burr with crocus cloth.
Film comes out the side of the top sprocket	<ol style="list-style-type: none"> 1. Obstruction in sprocket guard. 2. Damaged sprocket guard. 3. Sprocket guard and sprocket misaligned laterally. 	<ol style="list-style-type: none"> 1. Remove obstruction. 2. Replace sprocket guard. 3. Realign.
Film strikes top of aperture plate and begins to pile-up	<ol style="list-style-type: none"> 1. Upper loopformer bent or out of adjustment. 2. Lower loopformer set too close to aperture plate. 	<ol style="list-style-type: none"> 1. Straighten or replace if bent; readjust per para. 36. 2. Readjust per para. 36.
Film butts into or goes under top end of aperture plate side tension rail or strikes fixed rail	<ol style="list-style-type: none"> 1. Upper loopformer bent causing sidewise deflection of film. 2. Lower loopformer bent or out of adjustment. 	<ol style="list-style-type: none"> 1. Straighten or replace if bent; readjust per para. 36. 2. Straighten or replace if bent; readjust per para. 36.
Film butts against top of film pressure plate or passes over outside of pressure plate	<ol style="list-style-type: none"> 1. Lower loopformer out of adjustment. 2. Pressure plate not lifting off of aperture plate when film gate is closed. 	<ol style="list-style-type: none"> 1. Readjust per para. 36. 2. Bent parts need straightening (para. 36, step f) or replace pressure plate and/or aperture plate.

50. AUTOMATIC LOADING SYSTEM TROUBLES AND REMEDIES (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Film ejects between bottom of film gate and top of take-up sprocket or piles up in this area	1. Lower loopformer bent or sticking.	1. Straighten, remove bind or replace lower loopformer (item 13, Figure 15A).
	2. Lower loopformer spring broken.	2. Replace lower loopformer spring (item 14, Figure 15A).
	3. Loop restorer out-of-adjustment or restorer roller stud bent.	3. Readjust loop restorer (para. 37); replace any damaged parts.
	4. Obstruction or burr in take-up sprocket upper guard.	4. Clean; remove burr with crocus cloth.
	5. Sprockets out-of-time.	5. Time sprockets per para. 38.
Film not threading over take-up sprocket	1. Sprocket guard mounting plate out of position.	1. Reposition sprocket guard mounting plate per para. 36, step b).
	2. Obstruction in upper sprocket guard.	2. Remove obstruction.
	3. Sprocket guard spring broken.	3. Replace sprocket guard spring (item 30, Figure 14).
	4. Take-up sprocket shaft loose in gear.	4. Retime sprockets (para. 38) and tighten gear setscrews.
Film piles up ahead of sound drum	1. Insufficient clearance between soundhead threading guides.	1. Readjust all guides per para. 36.
	2. Back-up bracket bent downward.	2. Straighten back-up bracket (item 16, Figure 15A).
	3. Exciter lamp cover loose.	3. Tighten cover retaining screw.
	4. Obstruction in gap between sound drum and exciter lamp cover.	4. Remove obstruction.
	5. Not enough clearance between sound drum and exciter lamp cover.	5. Check clearance per para. 42.
	6. Edge guide adjusting screw out too far.	6. Adjust per para. 40, step d.

50. AUTOMATIC LOADING SYSTEM TROUBLES AND REMEDIES (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Film ejects ahead of lower take-up sprocket shoe or piles up in this area	<ol style="list-style-type: none"> 1. Insufficient clearance between soundhead threading guides. 2. Soundhead loose or improperly positioned. 3. Obstruction or burr in lower take-up sprocket guard. 4. Film guide improperly positioned. 	<ol style="list-style-type: none"> 1. Readjust all guides per para. 36. 2. Reposition per para. 25. 3. Remove obstruction; remove burr with crocus cloth. 4. Reposition film guide per para. 36, step g.
Film sticks in or is ejected from lower take-up sprocket guard	<ol style="list-style-type: none"> 1. Obstruction or burr in lower take-up sprocket guard. 2. Sprocket guard sticking. 3. Broken sprocket guard spring. 4. Sprocket guard and sprocket misaligned laterally. 5. Autothread lever bent or improperly positioned. 	<ol style="list-style-type: none"> 1. Clear out obstruction; remove burr with crocus cloth. 2. Clean sprocket guard pivot. 3. Replace sprocket guard spring (item 30, Figure 14). 4. Realign. 5. Reposition or straighten autothread lever (item 11, Figure 15A).
Film piles up ahead of flanged roller (item 11C, Figure 15A) or is ejected from this area	<ol style="list-style-type: none"> 1. Autothread lever bent or improperly positioned. 2. Idler roller sticking or roller stud loose or bent. 	<ol style="list-style-type: none"> 1. Reposition or straighten autothread lever (item 11, Figure 15A). 2. Remedy sticking condition; replace autothread lever (item 11, Figure 15A).
Automatic loading system will not lock	<ol style="list-style-type: none"> 1. Autothread lever binding. 2. Release spring disengaged or broken. 3. Eccentric pivot improperly adjusted. 	<ol style="list-style-type: none"> 1. Repair or replace autothread lever (item 11, Figure 15A). 2. Engage spring (item 10, Figure 15A) with locking lever, or replace spring. 3. Readjust pivot per para. 36, step h.
Loop restorer cycles continuously	<ol style="list-style-type: none"> 1. Shuttle retractor pin sticking; restorer out-of-adjustment. 2. Pressure plate binding on aperture plate edge guide. 	<ol style="list-style-type: none"> 1. Clean and lubricate pin. Adjust loop restorer per para. 37. 2. Realign pressure plate.

50. AUTOMATIC LOADING SYSTEM TROUBLES AND REMEDIES (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Slack film in soundhead area	1. Sprocket guards sticking or take-up jerking.	1. Clean sprocket shoe pivots; check take-up torque and check for binding in take-up reel arm.
	2. Soundhead jockey rollers sticking.	2. Clean and lubricate.
	3. Soundhead improperly positioned.	3. Reposition per para. 25.
	4. Dirt or obstruction between the sound drum and the exciter lamp cover.	4. Remove obstruction.
Film scratches	1. Caked emulsion on film path parts.	1. Clean film path (para. 5).
	2. Film chips in sprocket guards.	2. Remove film chips (para. 5).
	3. Scratches or burrs on film guides, guards, aperture or pressure plate.	3. Polish with crocus cloth to remove burrs; replace part(s) if necessary.
	4. Soundhead jockey rollers sticking.	4. Clean and lubricate.
Perforations checked	1. Shuttle not retracting.	1. Adjust per para. 36, step e.
	2. Pressure plate not lifting from aperture plate.	2. Adjust per para. 36, step f.
	3. Excessive feed or take-up tension.	3. Adjust for proper tension.
Film dimpled between perforations	1. Sprocket shoes sticking.	1. Clean sprocket shoe pivots.
	2. Shuttle not retracting.	2. Adjust per para. 36, step e.
	3. Sprockets out-of-time.	3. Retime per para. 38.
	4. Not enough pressure on leaf spring.	4. Adjust per para. 36, step j.
	5. End of film leader not cut clean and square.	5. Check film cutter; replace if dull or broken.
Film escape mechanism does not open to permit exit of film	1. Film escape latching is out-of-adjustment.	1. Readjust per para. 36, step c.
Film escape locking pawl does not seat properly, film exists constantly	1. Torsion spring disconnected.	1. Reconnect torsion spring (item 1C, Figure 15B).
	2. Locking pawl out-of-adjustment.	2. Readjust locking pawl per para. 36, step c.