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SERVICE INSTRUCTIONS

FILMOSOUND® PROJECTOR

(AUTOMATIC THREADING)

DESIGN 1545, 1550, 1552

1545EX, 1552EX

BELL & HOWELL

GENERAL SERVICE DEPT.
7100 McCORMICK ROAD
CHICAGO, ILLINOIS 60645

PART NO. 72745

PRINTED IN U.S.A.

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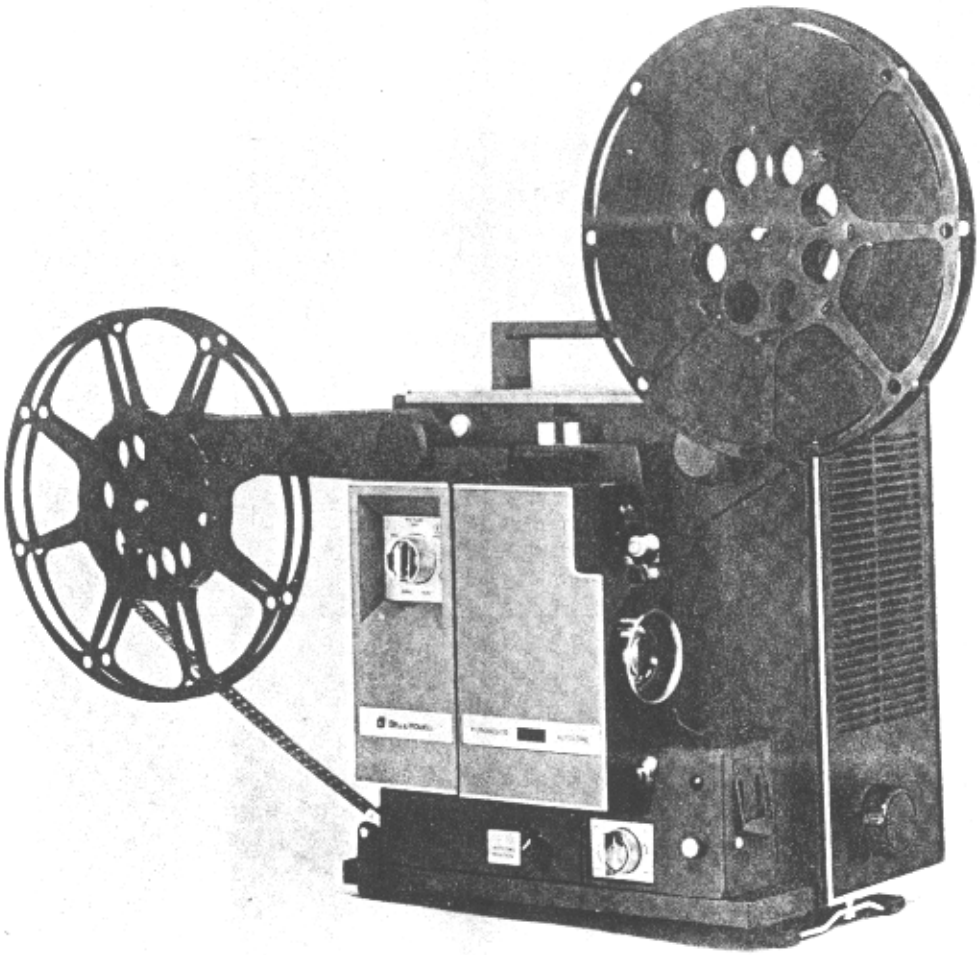

Design 1552 Autoload Projector with 800-Foot Reels

FEATURE DESCRIPTION LIST

Operating Voltage	117 VAC
Film Threading	Automatic
Projection Control	Forward, reverse, and still projection
Projection Lens (Standard)	2 inch f/1.4
Projection Lamp	24-volt, 250 watt, Type EKS
Exciter Lamp	4-volt, Type BAK

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PRODUCT ONLY

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Introduction

GENERAL.

This Service Manual has been prepared to aid in the repair and adjustment of Bell & Howell 1500-series Automatic Threading 16-mm Filmosound Projectors. The disassembly, reassembly, adjustment and test procedures in the following sections are presented as they apply, specifically, to the Design 1552A projector. However, with reference to the parts lists for variations in design, the repairman can easily adapt these instructions to cover all Autoload models listed on page 2 of the Parts Catalog. Specific differences between models which may require special attention are covered on page 3A of this manual. When repairing models other than the basic Design 1552A, read through these instructions first.

The Filmosound projector is completely gear driven with shifting from forward to rewind accomplished by means of a rocker plate-idler gear arrangement. The autoload system consists of a series of guides, loopformers and rollers which, when the system is in the "load" position (closed), the film will be guided through the threading path to the film take-up reel, when the system is in the "open" position, the guides and rollers clear the film path.

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.

SPECIAL MAINTENANCE PRECAUTIONS.

Before beginning repair operations, perform the test procedures outlined in the Final Test section of the manual and check specific customer complaints against the Troubleshooting charts for possible causes and recommended remedies.

The removal and installation of most projector parts can be accomplished with tools normally available in photo equipment repair shops. A pencil-type soldering gun should be available for electrical repairs, and the Bristol wrenches listed in the following chart will also be required. Special tools and gages necessary for projector alignments and adjustments are illustrated and listed in Figure A and its accompanying chart.

BRISTOL SETSCREW WRENCHES REQUIRED FOR MAINTENANCE

Setscrew Size	No. of Flutes	B&H Part No.	
		Handle	Wrench
No. 4-40	6	G1271-F1	G1271-X2
No. 6-32	6	STK3852-B	STK3863-B
No. 8-32	6	G165-F1	G165-X2

NOTE: Wrench G165-F3 is needed to tighten setscrew in tool handles.

CLEANING.

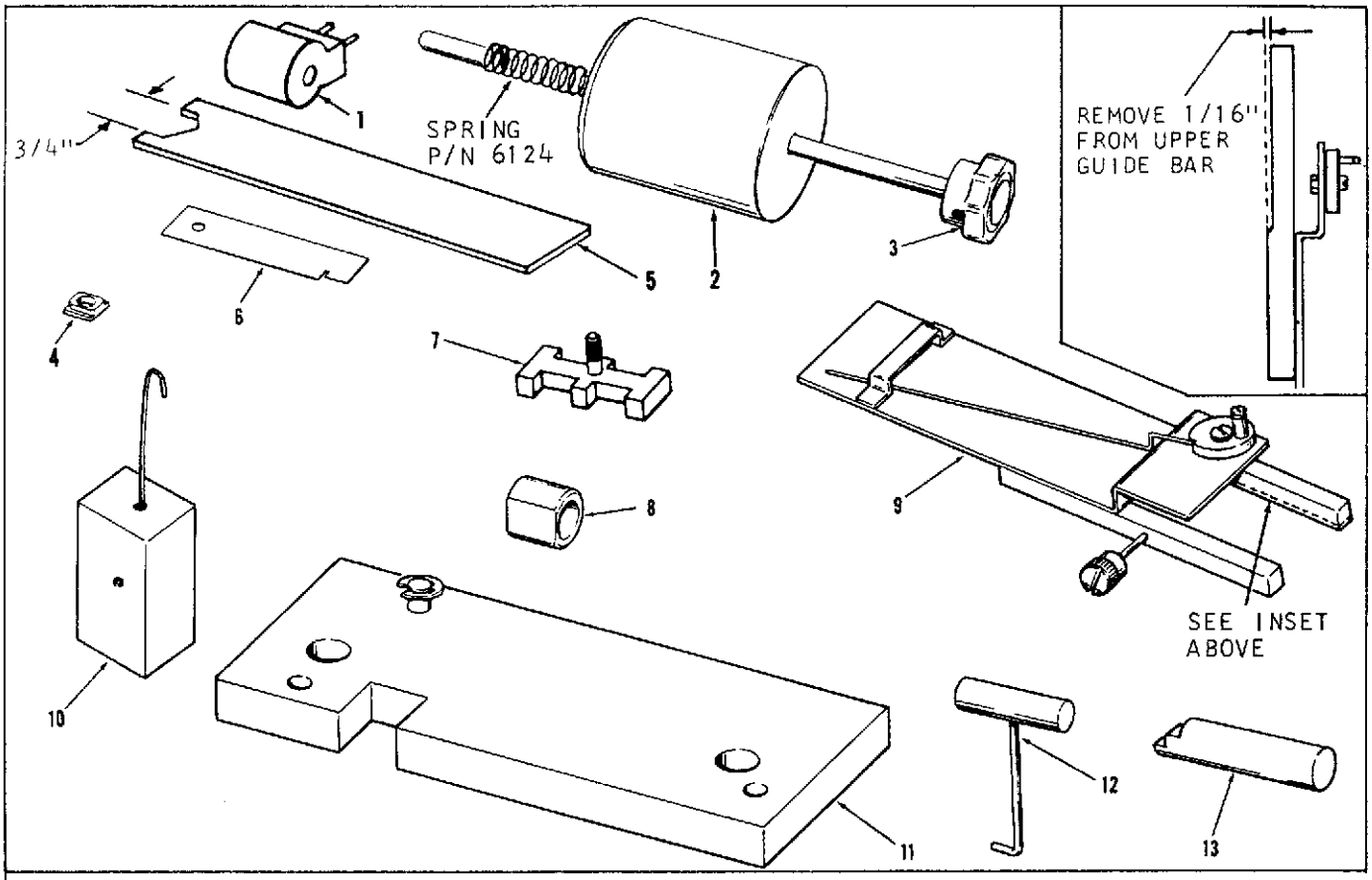
All film path areas must be kept free from emulsion build-up, or film jamming will take place during the automatic threading operation. Use Toluol, and/or an orange stick to remove emulsion from film path areas, being careful not to scratch the surfaces. Pay particular attention to film path parts of the soundhead cover and soundhead.

Do not use trichloroethylene solvents to clean plastic parts. Use a naphtha base cleaning fluid and be sure that grease is NOT wiped off critical areas of lubrication. Do not use solvents on these critical areas, especially in the auto-threading linkage, since lubrication is applied during assembly and it would be difficult to replace without disassembling the linkage. Use a soft lint free cloth when necessary to remove any accumulation of dust or film chips.

During periodic maintenance of the projector, the transport mechanism should be removed and thoroughly cleaned. Brush or blow out all large particles of dirt. Wash all moving parts except "Olite" bearings with any good petroleum solvent. Wash "Olite" bearings and the pull-down cams with naphtha. Wash the cam oilers in naphtha, and replace if not thoroughly cleaned by washing. Discard and replace the cam wiper and cam wiper wick. As soon as parts have been washed and dried, coat with a light film of the specified lubricant.

LUBRICATION.

The following Lubrication Chart lists those items which are to be lubricated during reassembly. Lubricants specified can be ordered from Bell & Howell



INDEX NO.	TOOL NO.	TOOL NAME	USE
1	SER-1552-1-N1	Lamp Plug	Alignment of optical system (Figure E)
2	SER-550-2-N1	Lens Plug	
3	SER-550-2-N2	Alignment Rod	
4	SER-550-2-N3	Aperture Plug	
5	Make in Shop	Torque Wrench	Adjust rewind torque (make from 1/16 by 1-1/4 by 7 inch CRS)
6	SER-550-5-N2	Stroke Gage	Measure shuttle stroke (Figure F)
7	S-09701-35N2	Shuttle Height Gage	Check shuttle protrusion (Figure G)
8	SER-552-2-N1	Restorer Positioning Tool	Adjusting the loop restorer (Figure R)
9	SER-552-4-N1	Shuttle Tension Gage	Adjusting shuttle tension (Figure H)
10	SER-552-4-N2	Weight for Shuttle Tension Gage	Adjusting shuttle tension (Figure H)
11	SER-552-1-N1	Timing and Alignment Plate	Timing the sprockets (Figure R)
12	SER-552-5-N1	Soundhead Locating Gage	Positioning the soundhead (Figure M)
13	SER-550-8-N1	Alignment Tool	Aligning sound drum and photocell (Figure L)
	SER-550-5-N1	Shuttle Stroke Target	Measuring shuttle stroke (Figure J)

Figure A. Special Service Tools

by part number. Be careful not to over-lubricate. A drop or two of oil and a light film of grease (applied with a brush, if possible) will be adequate. Wipe away excess lubricant with a lint-free cloth.

Felt pads and wicks should be placed in a shallow pan of the specified grease or oil and allowed to stand until saturated. Permit the excess lubricant to drain away before installing these felt parts.

LUBRICATION CHART

PARTS TO BE LUBRICATED	LUBRICANT
Machined surfaces (non-bearing) of all castings	Oil (P/N 070003)
Sprocket shafts (17 and 19, Figure 9)	Oil (P/N 08963)
Framer shaft (36, Figure 11) and bearing face of worm gear (24, Figure 12)	Oil (P/N 04978)
Felt oil pads in cams, and all shafts, sleeve bearings and sliding parts (friction surfaces) not otherwise specified	Oil (P/N 070032)
The following items are to be greased sparingly:	Grease (P/N 070034)
Teeth of all nylon gears	
Friction surface of lamp release ring (18, Figure 8)	
Reel arm lock buttons (26, Figure 3)	
Tilt rack and pinions (Figure 5)	
Meshing gears in reel arms (Figures 6 and 7)	
Loop restorer shaft (58, Figure 10)	
Self-centering assembly (63, Figure 10)	
Cam wiper and wick (14 and 15, Figure 11)	
Shuttle link bearings (17A, Figure 11)	
In-out cam and cam follower (21A, Figure 11)	
Mechanism housing (31, Figure 12); film guide pivot posts, sprocket shaft bearings and camshaft bearings	
Pinion teeth of focus knob (5M, Figure 9)	

DRIVE BELT REPLACEMENT

Because of the compactness of the design of the 1552 projector, the drive belt is not easily accessible for replacement. To avoid extensive disassembly at the rear of the projector, the following procedure is recommended. Refer to parts catalog Figure 2.

a. Remove the rear cover (paragraph 2) to expose the drive belt and associated components. Manually run the drive belt off of the large mechanism pulley and pull the free end of the belt from the belt shifter loop.

b. Remove the tie strips from around the wiring at both ends of the motor.

c. Loosen the screws in both motor bracket straps (37, Figure 2) and lift off the straps and tie bar as a group.

d. Lift the motor just enough to permit the belt to be passed beneath the motor toward the transformer. Be very careful not to lift the motor so high as to damage the blower fan at the end of the motor shaft.

e. Disconnect the push-on connectors which connect the motor leads to the motor capacitor (10, Figure 2) and remove the crimp-type solderless connector which joins the grey-yellow motor lead to the three white leads. The belt can now be removed.

f. Install the new belt by reversing the above order of removal. Replace the crimp-type solderless connector with a screw-on type connector and, when securing the motor with the motor bracket straps, make sure that the motor grounding strap (left end of motor) bears on the motor mounting bracket (38, Figure 2).

REPAIR OF MODELS OTHER THAN DESIGN 1552A

GENERAL.

The basic repair instructions in the following sections of this manual apply, specifically, to the Design 1552A projector. However, if you will check the parts lists at the rear of the manual, you will discover that most of the differences between models are simply a matter of part number changes or the elimination of certain features which are basic to the Design 1552 projectors. For example, you will note that the Mechanism Door Assembly (Figure 1, item 14) is not used on Design 1545 projectors (code letters A, B and C). Therefore, when repairing a Design 1545 projector, instructions pertaining to this item can be ignored. Similarly, you will note that the Run-Still linkage mechanism parts in Figure 4 are used only in the Design 1552 projectors (coded F, G and H). Therefore, all repairs and adjustments pertaining to these items can be ignored when repairing Design 1545 and 1550 projectors.

SPEAKER AND STARTING CAPACITOR.

As illustrated in parts list Figure 2, there is a noticeable difference between the speaker/starting capacitor components used in earlier and current Design 1545A, 1550A and 1552A projectors. This difference is easily distinguished by the methods used to mount the capacitor and has no affect on repair instructions. When installing a new speaker (P/N 44225) in earlier models, the new starting capacitor (P/N 45692) and clamp (P/N 44226) also must be installed. All model "B" projectors are equipped with the new speaker and capacitor.

EXPORT MODELS.

Design 1545EX and 1552EX projectors are merely export versions of the basic 1545A and 1552A respectively, adapted for 50Hz operation. Major differences are in the transformer assembly components (Figure 2, items 12 through 22), the motor pulley (item 2-36), the mechanism pulley (item 11-2) and the shutter (item 11-9). Instructions for repair are the same as for the basic models.

MODEL "B" PROJECTORS.

Design 1545B, 1550B and 1552B projectors (coded B, E and G respectively) are the most current production models of the 1500-series Autothread projectors. The most distinguishable feature of the Model "B" projectors is the addition of the "lamp saver" switch mounted on the main plate directly above the soundhead (see parts list Figure 5). This switch provides maximum illumination from the projector lamp when in the BRIGHT position. When set in the NORMAL position, lamp life is increased. The other major change in Model "B" projectors occurs in the reel arm gearing (parts list Figures 3, 6 and 7). Less critical changes will be found in the transformer components and the rotary switch mounting (parts list Figure 2). These differences are covered in the following paragraphs.

a. Lamp Saver Switch. The mounted location of the lamp saver switch is shown in parts list Figure 5 (item -39). To replace this switch, the rivets (item 5-38) must be drilled out and the new switch riveted in place. Wire connections for the lamp switch are shown in the inset of Figure 15.

b. Transformer Assembly (Figure 2, item -12). Three different transformer assemblies are used in the 1500-series projectors and are not interchangeable. The projectors to which each transformer assembly applies are clearly indicated in the "Usable on Code" column. Lamp transformer P/N 014235 must be used in Model "B" projectors, which are equipped with the "lamp saver" switch (see step a, preceding).

c. Rotary Switch (Figure 2, item -4). In Design 1545B and 1550B projectors, the rotary switch P/N 45695 is mounted directly to the projector main plate with the hex nut (item 2-2) and lockwasher (item 2-3). In all other projectors (including the Design 1552B) the rotary switch P/N 44528 is mounted to a bracket assembly (Figure 4, item -15) which, in turn, is fastened to the projector main plate. These two switches are not interchangeable.

d. Reel Arm Gearing. To reduce gear noise, a gearing change has been made in all Model "B" projectors beginning with Serial No. 2314001. Earlier style gears and shafts are still available for replacement, but it is most important that you avoid interchanging gears between the two styles. The differences are as follows.

(1) At the rear end of the rear reel arm shaft (see parts list Figure 3), a gear with pressed bearing P/N 014947 is used in place of spur gear P/N 44369 (item -2) and a washer P/N 34861 (item -2A) is used in place of the retaining key (item -3).

(2) At the rear end of the front reel arm shaft (see parts list Figure 3), clutch and bearing assembly P/N 014949 replaces clutch assembly P/N 014516, spur gear P/N 46534 replaces spur gear P/N 44366 and a flat washer P/N 31237 has been added between the thrust washer (3-13A) and the clutch assembly.

NOTE: If new reel arms P/N 014948 (3-24) and P/N 014946 (3-25) are installed, the new gearing components mentioned in (1) and (2) preceding must also be installed. The installation procedures and adjustments are the same as those for earlier style units.

(3) In the front and rear reel arms (see Figures 5 and 6), the only part affected by the gearing changes mentioned in (1) and (2) is the reel arm shaft (item 14 in Figure 6 and item 31 in Figure 7). The new shafts must be installed if the gearing change mentioned in steps (1) and (2) is made.

NOTE: Both reel arms underwent some gear modification in projector models below Serial No. 2314001. The difference in affected parts is purely dimensional and these dimensions are clearly indicated in the insets in Figures 6 and 7. If any of these parts is in need of replacement, refer to the notes beneath each parts list for proper instructions. In all instances, the change of parts in the reel arms will not affect the reassembly, installation and adjustment procedures.

MODEL 1550L PROJECTOR.

The Design 1550L projector (coded "J" in the parts lists) is a variation of the Design 1550B (coded "E") but without the lamp saver switch. The major difference between this projector and all other 1500-Series Autothread Filmosound projectors involves the projection lamp (Type BHB) which operates directly from line voltage and thus eliminates the need for a separate lamp transformer. The power transformer for the Design 1550L, shown in the inset of Parts Catalog Figure 2, mounts on the projector base in the same position as the lamp/power transformer group of other models. Wiring connections for the Design 1550L are shown at the rear of the Parts Catalog section.

SPECIAL REPAIR PRECAUTIONS.

The Parts Catalog section clearly notes any differences between early and current production models, and these differences must be considered when making projector repairs. Refer to the Notes following each list of parts for specific replacement instructions. In spite of parts differences, the adjustment procedures and specified clearance tolerances for current models are the same as those for earlier models.

Disassembly Procedure

1. GENERAL PRECAUTIONS.

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

b. Cemented or adhesive backed parts are so noted in the parts lists and can be removed by prying up one edge with a knife blade. Be careful not to scratch surrounding areas, and remove traces of old adhesive with solvent.

c. When unsoldering is required to remove electrical parts, it is advisable to tag leadwires or make a rough sketch of leadwire connections to facilitate installation of the parts. Unsolder leads with a pencil type soldering gun, using a heat sink if available, or gripping the lead with a pliers to provide additional heat dissipation.

d. When removing riveted parts for replacement, the old rivet must be drilled out with a drill equal to, or slightly smaller than, the diameter of the rivet to be installed. Refer to the parts lists for the rivet diameter.

2. REMOVAL OF COVERS (Figure 1). Remove the parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Seven screws (items 2, 3 and 4) must be removed to free the rear cover assembly (5). Do not attempt to disassemble the rear cover.

b. To remove the mechanism door assembly (14), swing it open; then press down on the door spring (14D) and lift straight up. The lamphouse assembly (15) pulls straight off from the mechanism plate.

c. To remove the projection lamp (16), press down the retaining spring and pull the lamp straight out from its socket. Do not rock or twist lamp during removal, or the lamp pins may become damaged.

d. As indicated, the decals and nameplates are adhesive backed and need not be removed unless badly defaced or illegible. If replacement is necessary, pry up one edge with a sharp knife. Remove adhesive from the surface to which the part was cemented by wiping with solvent.

3. REMOVAL OF ELECTRICAL PARTS (Figure 2). Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Before removing electrical components, note the manner in which the leadwires are routed and tied. The pictorial wiring diagram at the rear of the Replacement Parts section will assist in the proper reconnection of leadwires.

b. The printed circuit board (7) can be removed by taking out the two screws (5) at the upper end of the board and pulling the board straight up to disengage the board contact pins from the edge connector (6). Do not rock the board to disengage the pins.

c. The assembled transformers (13) and (16) must be removed as a unit. Tilt the case and remove the two rear attaching screws (12) from the underside of the base; then remove the two front attaching screws (11) and lift out the assembled transformers.

d. The drive motor and blower components must be removed as a unit to permit belt replacement or motor and blower repairs. This is accomplished by removing the four motor mounting screws (27) and the four blower housing screws (28). If the drive belt (34) is in need of replacement, it can be cut with a sharp knife. If the belt is in good condition, slip it edgewise down between the mechanism pulley and the casting. Lift the assembled motor and blower from the base. Remove three screws (29) and disassemble the fan housing (30) from the housing cover (33). Loosen the setscrew (31) and disassemble the fan and hub assembly (32) and cover (33) from the motor shaft.

e. The solenoid (46) can be removed by loosening the setscrew (40) in the lower collar (41) and withdrawing the collar from the solenoid actuating rod; then removing the three screws (42) which are inserted through the rubber bushings (44). Be careful not to lose the three spacer washers (43) located behind the solenoid mounting plate (47). Remove the two screws (45) and separate the solenoid (46) from the plate (47).

4. REMOVAL OF GEARS, REEL ARMS AND SOUNDHEAD (Figure 3). Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Retaining ring (1), spur gear (2) and retaining clip (3) must be removed to permit the removal of the rear reel arm assembly (25). Retaining ring (13), reverse take-up clutch assembly (14), gear (15) and retaining clip (16) must be removed to permit the removal of the front reel arm assembly (24). Both reel arms are secured by three screws (22) and a reel arm disc (23). When removing the reel arms,

be careful not to lose the lock buttons (26) and springs (27).

b. If the soundhead (34) is to be removed, it will first be necessary to refer to Figure 2 and remove the starting capacitor (10) and the transformers (13) and (16). Then remove retaining ring (28, Figure 3) and washers (29) and (30), and pull the flywheel (21) from the sound drum shaft, tilting the flywheel (31) from the sound drum shaft, tilting the flywheel to clear the drive motor. Unsolder the leadwires from the Volume-Tone control mounted to the soundhead. Then remove the three screws (32) and washers (33) and carefully disassemble the soundhead from the projector main plate.

5. REMOVAL OF RUN-STILL LINKAGE AND MECHANISM ASSEMBLY (Figure 4). Remove parts, as necessary in their indexed order of disassembly, noting the following special precautions.

a. Loosen the setscrews (1) in the collars (2); then disengage the lower end of the still-run rod (4) from the pivoting link assembly (23) and disassemble the rod, collars and spring (3) from the stop pawl.

b. Loosen the setscrew (5) and remove the collar (6) and spring (7) from the lower end of the fire shutter rod. Disengage the upper end of the rod from the fire shutter and remove the rod.

c. Loosen the setscrew (9) and disassemble the animation switch lever (10) from the end of the animation switch crank (12). Disassemble the rod and its retaining ring (11) from the main plate.

d. Remove two screws (13) and the leadwire clamp (13A) and disassemble the animation switch and bracket assembly (14) and rotary switch bracket (15) from the main plate. Remove the retaining rings (16) and disassemble the still-run arm (17) and switch shaft tube (18) from the main plate.

e. Remove the two shoulder screws (19) and lift the sliding link assembly (20) and the two spacers (21) from the main plate. Remove the pivot screw (22) and disassemble the pivoting link assembly (23), spacer (24), torsion spring (25) and flat washer (26) from the main plate. Remove two retaining rings (27) and lift out the torsion spring (28). Remove the shoulder studs (29), belt shifter bracket (30) and the spacers (31).

f. Hold the mechanism assembly (34) securely while removing the four screws (32) and the idler gear adjustment bracket (33). Carefully withdraw the mechanism assembly from the main plate.

6. REMOVAL OF FILM GUIDES AND TILT MECHANISM (Figure 5). Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Remove the retaining ring (1) from the inner end of the shaft on which the film guide roller (13) is mounted. Remove retaining ring (2) and flat washer (3) from the spring post (6) and remove the spring (4).

b. Remove the adapter shaft (7) and film guide roller (8). Remove the screw (9) and lift out the sliding film guide assembly (10). Remove screw (11) and disassemble the film guide (12) and guide roller (13) from the autothread lever shaft. Remove screw (14) and film guide (15).

c. Remove the screw (16) and lock washer (17) and disassemble the tilt bar (18) from the lower end of the tilt gear rack (23). Loosen the setscrew (20) and withdraw the tilt knob (21) and spring tension washer (22) from the end of the gearshaft (25). Lift out the tilt gear rack (23). Remove the retaining ring (24) and the tilt gearshaft (25). Drive out the spring pin (26) and lift out the tilt worm gear (27).

d. Each end plate (31) and (32) is secured to the projector base (35) with two hex washer head screws (30).

7. DISASSEMBLING THE FRONT REEL ARM (Figure 6). Disassemble the front reel arm in the following manner, noting any special precautions.

a. Remove the two screws (1) and lift the reel arm cover (2) from the front arm (22). Note the shim washers (3) located between the cover and reel arm mounting bosses.

b. Remove the screw (4) and disassemble the feed spindle assembly (5) and shim washer (6) from the front reel arm. If spindle parts are damaged, remove the retaining ring (5A), loosen the setscrews (5B) and remove the gear (5C) and washer (5D) from the spindle (5E).

c. Remove the retaining ring (7) from the spring post in the reel arm to free the end of the torsion spring (10). Loosen the setscrew (8) and lift the gear (9) and torsion spring (10) from the reel arm shaft (14).

d. Remove the two retaining rings (11) and disassemble the reel arm shaft (14) and washers (12) and (13) from the reel arm.

e. Remove the retaining ring (15) and withdraw the upper spur gear (16) from the gearshaft (20). Remove the two gear retaining clips (17), the washer (18) and the lower spur gear (19) and slide the gearshaft (20) from the bearing posts of the reel arm. Inspect the nylon bearings (21) and, if damaged, press them from the bearing posts.

8. DISASSEMBLING THE REAR REEL ARM (Figure 7). Disassemble the rear reel arm in the following manner, noting any special precautions.

a. Remove the two screws (1) and lift the reel arm cover (2) from the rear arm (32). Note the shim washers (3) located between the cover and the reel arm mounting bosses.

b. Press the take-up arm (9) against the reel arm casting and slip the take-up belt (4) from the pulleys. Release the take-up arm slowly and catch the tension spring (5) as it drops free. Remove the screw (6) and disassemble the take-up spindle and pulley assembly (7) and shim washer (8) from the take-up arm. Remove the take-up arm (9) from the mounting pin pressed into the rear arm (32).

c. Remove the retaining ring (10) and large flat washer (11) from the end of the gearshaft (16). Remove the rubber sleeve (12) from the hub of the gear (14). Loosen the gear setscrew (13) and disassemble the gear (14), the shim washer (15) and the gearshaft (16) from the reel arm.

d. Remove the retaining ring (17) from the spring post in the reel arm to free the end of the torsion spring (18) and lift the torsion spring from the hub of the upper face gear (27).

e. Remove the retaining ring (19) and slide the upper spur gear (20) toward the upper face gear (27) until the upper gear retaining clip (21) can be removed. Move the gearshaft (24) down until the upper spur gear (20) and washer (23) can be removed. Remove the lower gear retaining clip (21) and lower spur gear (22), and slide the gearshaft (24) from the bearing posts of the reel arm. Inspect the nylon bearings (25) and, if damaged, press them from the bearing posts.

f. Loosen the setscrew (26) and lift the upper face gear (27) from the reel arm shaft (31). Remove the two retaining rings (28) and disassemble the reel arm shaft (31) and washers (29) and (30) from the reel arm.

9. DISASSEMBLING THE EXCITER LAMP COVER AND SOUNDHEAD (Figure 8). Disassemble the exciter lamp cover and soundhead assembly in the following manner, noting any special precautions.

a. Inspect exciter lamp cover parts (1 through 7) and disassemble only as necessary for replacement.

b. Make a careful note of leadwire connections before disconnecting or unsoldering leads during disassembly of the soundhead. Remove the exciter lamp (8), wipe off fingerprints, and wrap the lamp in tissue paper.

c. Do not loosen the clamping screw (10) or disturb the lateral position of the optical slit assembly (11) unless it has been determined that the optical slit is in need of replacement or adjustment.

d. Unhook and remove the stabilizer arm spring (12). Remove the retaining ring (13) and disassemble the roller adjusting screw (14) and complete stabilizer arm assembly (15) from the soundhead casting. Remove the two screws (15A) and washers (15B) and disassemble the rollers (15C) and (15D) from the stabilizer arm roller shafts. The removal of screws (15E) will free the torsion spring (15G) and stabilizer arms (15F), (15H) and (15J).

e. Remove two screws (16) and disassemble the lamp contact assembly (17) and lamp release ring (18) from the soundhead casting.

f. Loosen the setscrew (19) which bears against the light pipe and photocell retainer (22). Then remove the two screws (20), and carefully withdraw the sound drum assembly (21), retainer (22) and photocell assembly (23) as a group from the soundhead casting. Wrap the sound drum and photocell in tissue paper to protect them from damage. Do not remove the edge guide screw (24).

g. To remove the stabilizer tension adjuster, remove the retaining ring (26) from the adjuster and unscrew the adjuster from the tapped hole in the spring retainer (29). Be careful not to lose friction washer (27) located at the lower end of the adjuster.

10. DISASSEMBLING THE MECHANISM (Figure 9). Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

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. To disassemble the lens carrier, remove the two screws (5A) and remove the pressure plate (5B), bushings (5C) and (5D), springs (5E) and pressure plate lever (5F). The adjustment plate (5H) need not be removed. Pry up the nameplate (5J) with a knife blade. Remove two screws (5K) and disassemble the spring (5L) and the knob and pinion assembly (5M) from the lens carrier (5N).

b. Remove the retaining ring (6) and withdraw the actuating lever (7) from the animation switch actuating rod. Remove the two screws (9) and the hood (10).

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

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.

11. DISASSEMBLING THE MECHANISM (Figure 10). Remove parts, as necessary, in their indexed order

of disassembly, noting the following special precautions.

a. Remove the three screws (1) and flanged rollers (2). Note the manner in which the torsion spring (5) is installed. Remove the retaining ring (3) and withdraw the threading arm (4) and torsion spring (5) from the mounting posts of the guard mounting plates.

b. Note the manner in which the legs of the torsion spring (14) are engaged. Remove the screw (6), idler roller (7), roller stud (8), locking lever bushing (9), torsion spring (10) and autothread lever 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 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.

e. Loosen the locking screw (27) and disassemble the threading lever assembly (28) from the rear end of the upper loopformer (30) shaft. Remove the retaining ring (29) and withdraw the upper loopformer assembly (30). Remove the connecting link and stud assembly (35).

f. The hex head screw (36) is used to adjust the lens carrier and should not be disturbed. Do not remove the lens carrier catch (38) unless damaged and in need of replacement.

g. Remove two screws (40) and the upper guard mounting plate assembly (41). Note the manner in which the legs of the torsion spring (44) are engaged. Loosen two setscrews (42) and disassemble the shaft and link assembly (43), torsion spring (44), flat washer (45) and the loopformer and lock pawl assembly (46) from the mechanism housing. Do not disassemble the loopformer and lock pawl assembly unless parts are damaged and obviously in need of replacement.

h. Remove the screw (49) and flat washer (50) and disengage and remove the tension spring (51). Remove the screw (52) and flat washer (53) and lift out the cam follower and support assembly (54). Do not disassemble unless parts are damaged and in need of replacement. Loosen the hex head locking screw (55) and disassemble the arm assembly (56), flat washer (57) and the lever and shaft assembly (58) from the mechanism housing.

i. Remove the two screws (60), lock washers (61) and flat washers (62) which secure the self-centering assembly (63) to mechanism housing. The self-centering device is furnished only as an assembly.

j. Remove screws (64) and the aperture plate assembly (65). Refer to paragraph 14 for aperture plate disassembly instructions.

12. DISASSEMBLING THE MECHANISM (Figure 11). Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Loosen the two setscrews (1) and withdraw the mechanism pulley (2) from the end of the camshaft. Remove four screws (3) and lift off the fire shutter assembly (4). Inspect fire shutter parts (4A through 4E) and replace if damaged.

b. Remove two screws (5) and the heat baffle (6). Remove the shutter nut (7), counterbalance weight (8), shutter (9) and fiber washer (10).

c. 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. These followers are staked in place in the recess of each shuttle arm and can be reversed or turned end-for-end if badly worn. Unhook the extension spring (13) from the end of each shuttle arm and remove the felt wiper (14) and shuttle arms. The cam wiper wick (15) is inserted within the coils of the spring (13). If the wiper and wick appear especially dirty, discard them.

d. Withdraw the pull-down cam (18) from the camshaft. Remove the two screws (19) and disassemble the in-out cam (20) and cam bracket assembly (21) together from the mechanism housing. Inspect the cam follower (21A) and spring (21B) and replace if damaged. Remove two screws (22) and the shuttle arm plate assembly (23). Inspect the bearing support (24) and replace if damaged.

e. Pull out the stop pin (25) and unscrew the framer knob and shaft (26) from the mechanism housing. Remove the screw (27), the in-out spring (28) and the shuttle retractor pin (29).

f. 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) and stop pawl shaft bracket (36) from the mechanism housing. Inspect the grommets (37) and, if damaged, press them from the bracket (36).

13. DISASSEMBLING THE MECHANISM (Figure 12). Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Remove the round nut (1) and washer (2) and disassemble the shuttle adjustment bracket (3) from the animated clutch bracket assembly. Remove the screws (4) and (5) and lock washers (6) and lift the animated clutch bracket assembly (7) from the mechanism housing. If bracket assembly parts are in need of replacement, proceed as follows. Remove the

three retaining rings (7B) and slide the shaft (7C) from the clutch mounting bracket (7L), removing the slide bumper (7D), washer (7E), spring (7F) and clutch slide bar assembly (7G) from the shaft as it is withdrawn. Remove the screw (7H) and washer (7J) to free the strike (7K) from the clutch slide bar.

b. 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 (30) to the left until the bearing (12) is forced from the mechanism housing. Pull the bearing from the camshaft. Remove retaining rings (16) and (28) from the camshaft and press the camshaft to the right to force the large bearing (29) 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. Inspect worm gear parts (24A through 24D) and, if damaged, disassemble for replacement.

14. DISASSEMBLING THE APERTURE PLATE (Figure 13). Disassemble the aperture plate by removing parts, as necessary, in their indexed order of disassembly. Be very careful not to scratch or nick the rails or aperture plate with the screwdriver when removing screws.

15. TESTING AND REPAIRING THE PRINTED CIRCUIT BOARD ASSEMBLY (Figure 14). Using standard electronic shop test equipment and techniques, check the printed circuit board and its components for continuity and for shorts and open circuits. Refer to the schematic diagram, Figure 15, for voltages and ratings of components and for test points. Defective solder-secured parts can be replaced by cutting the leads as close as possible to the body of the part or by unsoldering the leads from their terminal points. When unsoldering, it is advisable to use a heat sink to avoid the direct application of heat to adjacent components on the board. When replacing parts, note the following special precautions.

a. Each of the three transistors (4) and (5) are furnished with a special lock washer (3) and a mica washer (3A). The lock washer is to be installed beneath the head of the screw (1) with its teeth against the flat washer (2). Apply thermal compound (Bell & Howell Spec. 28-7-001) to both sides of the mica washer and install this washer between the transistor and the metal heat sink bracket. The metal collector plate of the transistor must be toward the heat sink.

b. The integrated circuit (30) must be installed with its polarity mark or notch toward the side of the board indicated by the dashed arrow drawn on the top of the circuit in Figure 14. This arrow is not imprinted on the circuit itself.

Reassembly Procedure

16. GENERAL INSTRUCTIONS.

a. 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.

b. When installing electrical parts, refer to the pictorial wiring diagram at the rear of the Replacement Parts section for the proper connection of leadwires. When resoldering components to the printed circuit board (Figure 14), use a heat sink to avoid the direct application of heat to adjacent components on the board. Refer to paragraph 15 for special instructions regarding transistor and integrated circuit replacement.

c. Most of the nameplates and 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 Tulouol to one part trichloroethylene. When adhesive is tacky, press the nameplate carefully but firmly in place. Wipe away excess adhesive with a cloth dampened with solvent.

d. Lubrication instructions are provided in the Introduction section of this service manual. Do not overlubricate. Apply grease and oil sparingly as indicated, and wipe away 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.

17. REASSEMBLING THE APERTURE PLATE (Figure 13).

a. Assemble the film guide (9) to the aperture plate (10) with the screw (8). The right end of the film guide should be square with the edge of the aperture plate.

b. Assemble the side tension spring (7) and film tension rail (6) to the aperture plate. The ends of the spring should engage the notches in the film tension rail and the center of the spring should bear against the staked pin in the aperture plate. Assemble the spacer bushings (5) and spring retaining cover (4) to the aperture plate and install the two screws (3).

c. Attach the film guide rail (2) to the aperture plate with the two screws (1), tightening the screws securely. Refer to paragraph 19, step d, for installation instructions.

18. REASSEMBLING THE MECHANISM (Figure 12). Reassemble Figure 12 parts as outlined in the following paragraphs.

a. Assemble the strike (7K) to the clutch slide bar assembly (7G) with the screw (7H) and washer (7J). Insert the shaft (7C) part way through the right-hand arm of the mounting bracket assembly (7L) 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 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 clutch bracket assembly (7) to the mechanism housing with the two screws (4) and (5) and lock washers (6), and press down firmly on the bracket while tightening the screws. Assemble the adjustment bracket (3) to the end of the longer screw (5) and install the washer (2) and round nut (1), tightening the nut finger tight.

b. 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 bearing (29) to the camshaft (30) until the bearing is seated against the shoulder of the shaft. Install the retaining ring (28) to the camshaft with the bowed surface of the ring facing away from the ball bearing.

c. 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 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.

d. Insert the end of the camshaft (30), with ball bearing (29) assembled, through the bearing hole in the right-hand cast arm of the mechanism housing. To the shaft, assemble the loop restorer cam (27),

flat 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).

e. Slide the camshaft all the way in place, inserting the end of the camshaft into bearing (12) while seating the large bearing (29) 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). Clutch and loop restorer adjustments will be made after reassembly has been completed.

f. 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 bearing (29).

g. 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.

19. REASSEMBLING THE MECHANISM (Figure 11). Reassemble Figure 11 parts as outlined in the following paragraphs.

a. Assemble the shuttle retractor pin (29) and in-out 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).

b. Screw the framer knob and shaft (26) down into the mechanism housing. Orient the stop pin (25) so that the flat side of the pin is parallel with and facing the framer shaft, and press the pin in place. Screw the bearing support (24) all the way up into the staked nut 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).

c. 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 dash arrow in Figure 11). Install this assembled group over the end of the camshaft and secure the cam bracket assembly to the cast arm of the mechanism housing with the two screws (19).

d. At this point, refer to Figure 10 and install the assembled aperture plate (65) with screws (64). Then return to Figure 11 and continue with reassembly as follows.

e. 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 B). 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 B. 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 face 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.

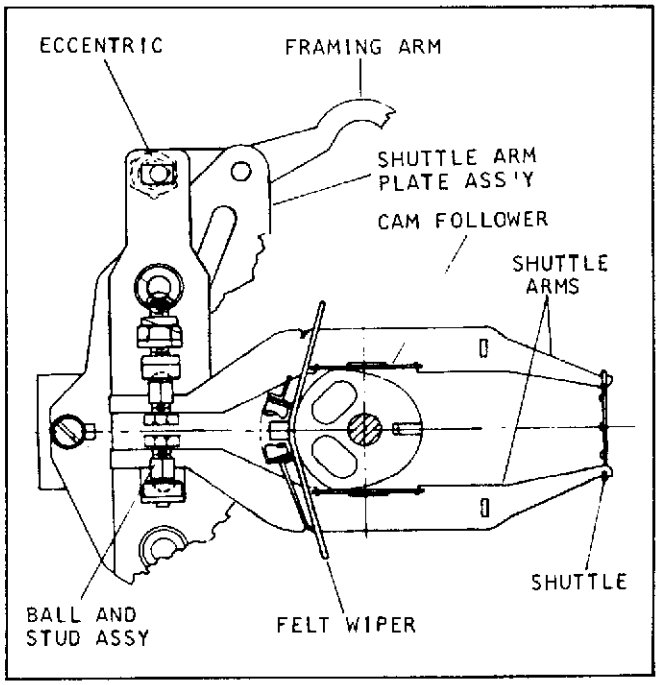


Figure B. Shuttle and Shuttle Arms Assembled

f. Install the fiber washer (10) on the camshaft and up against the pull-down cam (18) so that the slot in the washer 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.

g. Assemble the grommets (37) into the bracket (36). Assemble a retaining ring (30) into the groove nearest the end of the stop pawl shaft (31) and insert the opposite end of the shaft through the shaft hole in the bearing bracket (34) and both ears of the stop pawl (32). Loosely attach the bearing bracket to the cast arm of the mechanism housing with two screws (33). Assemble bracket (36) to the opposite end of the shaft and fasten the bracket to the mechanism housing with screws (35). Tighten screws (33) and (35) securely. Assemble the second retaining ring (30) into the groove of the shaft so that the right-hand ear of the stop pawl is held against the bearing bracket (34).

h. Insert the rounded end of the heat baffle (6) up under the shutter and secure the baffle with the two screws (5). Fasten the fire shutter assembly (4) to the mechanism housing with four screws (3). Install the pulley (2) on the end of the camshaft, and tighten the pulley setscrews (1) down on the flats of the shaft.

20. REASSEMBLING THE MECHANISM (Figure 10). Reassemble Figure 10 parts as outlined in the following paragraphs.

a. Attach the self centering assembly (63) to the mechanism housing with the two screws (60), lock washers (61) and flat washers (62). Assemble the lever and shaft assembly (58) to the mechanism housing and install the washer (57) and arm assembly (56) 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 (57) and the machined boss of the housing. Grip the shaft (58) and arm (56) to hold the feeler gage while tightening the hex head screw (55); then remove the feeler gage. Assemble the retaining ring (59) to the shaft assembly (58).

NOTE: The shaft assembly (58), when installed, must be positioned approximately as shown in Figure 10, 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 (54A through 54F) as shown in Figure 10. Attach this assembled group to the arm assembly (56) with the screw (52) and washer (53). Tighten the screw just enough to hold the follower group. Hook one end of the spring (51) around the end of the lever shaft (58) and secure the other end to the mechanism housing with the screw (49) and washer (50).

c. Assemble the film escape mechanism components (46A through 46G) in the following manner. Assemble the hub assembly (46F) to the locking pawl (46E) with the screw (46D). Insert the shaft (46B) through one ear of the upper loopformer assembly (46G) and install the spring (46C) 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 (46A) to the shaft, with the center ring between the spring (46C) and hub assembly (46F). 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 (46F). The spring should tend to rotate the hub and locking pawl in a clockwise direction.

d. Install the torsion spring (44), short leg first, on the shaft of the shaft and link assembly (43) 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 (45) and the film escape mechanism parts (step c, above) to the protruding end of the shaft (43) and temporarily tighten the setscrews (42).

e. Attach the upper sprocket guard mounting plate (41) to the mechanism housing with two screws (40), the upper screw being inserted through the half-moon slot in the upper loopformer (46G).

f. Attach the lens carrier catch (38) and its flat washer (39) to the mechanism housing with the screw (37). Turn the hex head lens stop screw (36) 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.

g. Assemble the shuttle retractor (34) to the link and stud assembly (35) with the screw (31), lock washer (32) and flat washer (33). Assemble the upper loopformer assembly (30) to the upper end of the connecting link (35) and install the retaining ring (29). Slip the pin end of the threading lever (28) up behind the link (43), engaging the pin with the rectangular slot in the link. Insert the shaft of the upper loopform through the mounting plate (41) 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 loopform with two screws (25).

h. 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 (35) 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.

i. 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 (35) 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).

j. Fasten the back-up bracket (16) to the mounting plate (21) with the screw (15). Assemble the loopform (13) and the torsion spring (14) onto the lower pin of the connecting link (35) and install the retaining ring (12). The legs of the spring must bear against the underside of the loopform in such a manner that they will force the loopform to pivot clockwise around the connecting link pin.

k. Assemble the autothread lever (11) and bushing (9) to the mounting plate (21) with the threaded stud (8). The loopform (13) must be pivoted counterclockwise and held in that position while installing these parts. Again hold the loopform (13) in counterclockwise rotation while securing the idler roller (7) to the mounting plate with the screw (6). Release the loopform (13). Assemble the torsion spring (10), short leg first, to the bushing (9). Hook the short leg of the spring into the hole in the mechanism housing above and to the left of the bushing (9). Hook the long leg of the spring in the V-like notch along the left edge of the lever (11).

l. Assemble the torsion spring (5) and threading arm (4) to the stud in the lower right-hand corner of the mounting plate (21). Engage the legs of the spring so that they tend to pivot the threading arm clockwise. Install the retaining ring (3) to secure the arm to the stud.

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

21. REASSEMBLING THE LENS CARRIER (Figure 9). Reassemble the lens carrier assembly as outlined in the following paragraphs.

a. Lightly grease the gear teeth of the pinion assembly (5M), the pinion slots of the carrier (5N) and the notches of the pinion spring (5L).

b. Assemble the spring (5L) into the two grooves of the pinion assembly (5M) and assemble the pinion into the grooves of the carrier (5N). Fasten the spring securely with the two screws (5K). Check to make certain that the knob rotates smoothly.

c. Place the pressure plate (5B) on the work surface, polished surface down and the forked end of the plate to the left. Assemble the pressure plate lever (5F) to the pressure plate with the small extrusion of the lever fitted into the corresponding hole in the pressure plate. Assemble the bushings (5C) and (5D) into the springs (5E) and assemble these parts and the adjustment plate (5H) to the pressure plate, with the shorter bushing located at the lever (5F). Install and tighten the two screws (5A).

d. Slip the adjustment plate, with pressure plate assembled, into place within the lens carrier and loosely install the two screws (5G). Insert the lens plug (Figure A) into the lens bore of the carrier with the rectangular boss of the plug fitted into the opening in the pressure plate. Tighten screws (5G) securely and withdraw the lens plug.

e. Clean the nameplate area of the lens carrier with a cloth dampened with solvent. Remove the backing from the nameplate (5J) and activate the adhesive as instructed in paragraph 16, step c. Assemble the nameplate to the lens carrier and wipe away excess adhesive with a soft cloth dampened with solvent.

22. REASSEMBLING THE MECHANISM (Figure 9). Reassemble Figure 9 parts as outlined in the following paragraphs.

a. Rotate and hold the lower loopform (13, Figure 10) fully counterclockwise and assemble the filter exit guide (32, Figure 9) to the mechanism housing with the screw (31).

b. 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 9. 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 end 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 mechanism housing. Secure the sprocket guards to their mounting posts with the screws (25) and shim washers (26).

c. Assemble the 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.

d. Assemble the 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 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 flat on the sprocket shaft and tighten both setscrews securely. The sprocket and gear must turn freely but with only a minimum of end play.

e. Assemble the 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.

f. Assemble the sprocket guard parts (16A through 16F) tightening the screw (16D) finger tight. Slip the assembled sprocket guard (16) up into position beneath the upper sprocket and secure the guard with two screws inserted from the rear of the mechanism housing. Assemble a spring tension washer (14) and the upper sprocket gear (12) to the sprocket shaft. Align either setscrew (11) with the flat 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.

g. Fasten the hood (10) to the mechanism housing with the two screws (9). Press down and hold the upper loopformer (30, Figure 10) while assembling the actuating lever (7, Figure 9) to the lever shaft. Install the retaining ring (6).

h. 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 10) so that it holds the lens carrier firmly against the stop screw (36, Figure 10) in the closed position; yet permits the carrier to be opened easily.

i. All critical adjustments are to be made during the final assembly of the projector and are covered in the Adjustments section of this service manual.

23. REASSEMBLING THE SOUNDHEAD AND EXCITER LAMP COVER (Figure 8). Reassemble the soundhead and lamp cover parts as outlined in the following paragraphs.

a. If exciter lamp mounting pin parts (32A through 32C) were replaced, assemble the spring (32C) and bushing (32B) into the opening in the casting and insert the mounting pin (32A), forcing the end of the pin carefully through the bushing.

b. Fasten the terminal (31) to the soundhead casting with the screw (30). The free end of the terminal should be approximately at the 5 o'clock position. Loosely assemble the optical slit locking screw (10), the setscrew (19) and the edge guide screw (24) to the soundhead casting. Leave approximately three threads of the guide screw exposed.

c. Apply ahesive (B&H Spec. 1761-34) to the end four threads of the roller adjusting screw (14) and assemble the screw to the soundhead, leaving approximately two threads exposed.

d. Assemble the light pipe and photocell assembly (23) and light pipe retainer (22) to the sound drum and shaft assembly (21) and insert the sound drum shaft carefully through the opening in the soundhead casting. Hold the sound drum while tightening the setscrew (19) against the retainer (22) just enough to hold all parts in place. Install the two screws (20), turning them down in the tapped holes in the sound drum housing.

e. Lightly oil the roller shafts of stabilizer arms (15H) and (15J). Assemble the lower stabilizer arm (15H) over the short shaft end of the upper stabilizer arm (15J). Assemble the torsion spring (15G), straight leg first, over the tapped hub of the lower stabilizer arm (15H). Assemble the stabilizer arm (15F) to the tapped hubs of the upper and lower arms and install the two screws (15E). Hook the bent end of the spring (15G) through the small hole near the end of stabilizer arm (15F). Wind the straight leg of the spring one full turn clockwise and hook it behind the small post in the lower arm (15H). Assemble the rollers (15C) and (15D) to their respective roller studs. Roller (15D) must be installed with its narrow flange nearest the shoulder of the stud. Secure both rollers with the screws (15A) and washers (15B). Insert the shaft of the upper stabilizer arm carefully through the soundhead casting and the adjusting screw (14) and install the retaining ring (13). Position the retaining ring for 0.0005 to 0.005 inch end play of the stabilizer arm shaft. See Figure C for stabilizer and installation.

f. Lightly grease both surfaces of the lamp release ring (18) and assemble the release ring and the lamp contact assembly (17) to the soundhead casting with the two screws (16).

g. Insert the optical slit assembly (11) into its opening in the soundhead casting and tighten screw (10) just enough to hold the slit in place.

h. Insert the small end of the stabilizer tension adjuster (28) through the hole in the top of the soundhead casting. Assemble the spring retainer (29) to

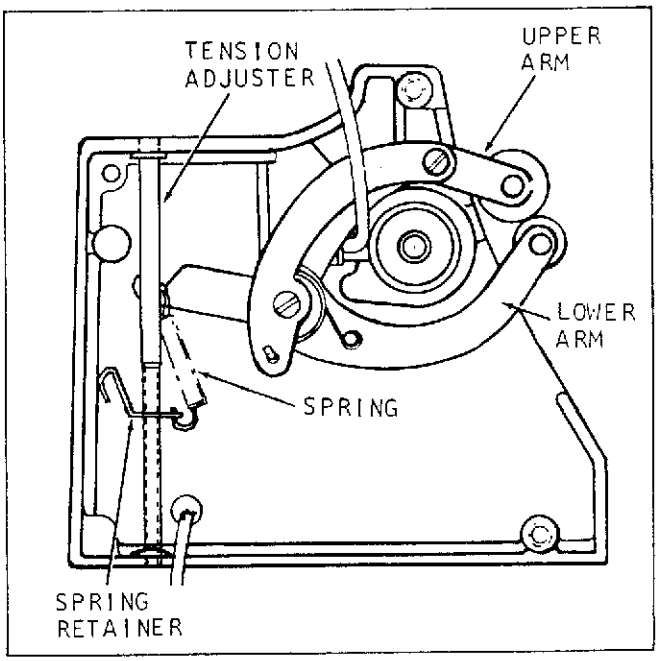


Figure C. Stabilizer Arms Installed on Soundhead

the adjuster, threading it approximately midway in the threaded area. Before inserting pin end of adjuster into the small hole at the bottom of the casting, assemble the friction washer (27), bowed face up, to the end of the adjuster. Assemble the retaining ring (26) into the groove at the upper end of the adjuster. Hook the tension spring (12) between the end of the lower stabilizer arm (15H) and the hole in the spring retainer (29). Install the exciter lamp (8). Refer to paragraph 38 for soundhead adjustments.

i. Assemble the Volume-Tone control (25) to the soundhead casting, tightening the mounting nut (furnished with control) securely. The solder terminals of the control should be pointed toward the lamp socket side of the casting.

j. Reassemble the exciter lamp cover as follows. Remove the cloth backing from the light shield (6) and assemble the light shield to the left-hand inside upper wall of the lamp cover (7) so that it is flush with the outer edge of the cover. Remove any excess or overlap with a sharp knife or razor blade. Assemble the cover screw (2) to the cover and install the retaining ring (1). Press the hole plug (5) into the hole in the cover. Position the film guide (4) over the tapped holes in the cover with the flange of the guide wrapped around the front of the cover, and loosely install the screws (3). Insert a 0.020-inch spacer between the guide flange and the cover, press the flange against the spacer, and tighten the screws (3) securely. Remove the spacer.

24. REASSEMBLING THE REAR REEL ARM ASSEMBLY (Figure 7). Reassemble the rear reel arm as outlined in the following paragraphs.

a. Apply one drop of oil to the unflanged end of the bearing in the rear reel arm (32). Assemble one retaining ring (28) to the rear reel arm shaft (31) in the groove nearest the two narrow flats on the shaft. Assemble the thrust washer (30) over the long end of the shaft and down against the retaining ring. Insert the shaft through the reel arm bearing and install the spacer washer (29) and the second retaining ring (28). Assemble the face gear (27) to the reel arm shaft (31), gear teeth facing up, and tighten setscrew (26) against flat of shaft.

b. Assemble the nylon bearings (25) into the cast bearing arms of the rear reel arm, engaging the key tabs of the bearings with the cross-slots of the bearing holes. Assemble the lower gear (22) to that end of the gear shaft (24) where the flats are nearest the end. The gear face with the square recess must face away from the cast bearing boss. Install the gear retaining clip (21). Insert the gear shaft through both nylon bearings (25). Assemble the washer (23) and gear retaining clip (21) to the end of the gear shaft. Install the upper gear (20), square recess facing inward to engage clip (21), and assemble the grip ring (19) to the end of the shaft. Insert a 0.010 inch feeler gage between the upper gear (20) and washer (23) and press the grip ring (19) in against the gear. Remove feeler gage.

c. Assemble the rubber sleeve (12) to the hub of the face gear (14). The sleeve must rest down against the shoulder of the gear. Insert the small diameter end of gear shaft (16) up through the hole in the lower end of the reel arm. Hold the shaft in place and assemble the washer (15), the face gear (14) and the large washer (11) to the gear shaft. Secure these parts with the retaining ring (10).

d. Install the setscrew (13) into the tapped hole in the reel arm casting near the lower end of gear shaft (16). Do not tighten the setscrew. Move the gear shaft (16) to engage the teeth of the face gear (14) with the lower spur gear (22) and tighten the setscrew (13). Rotate the face gear in both directions to check backlash. There should be approximately 0.005 to 0.018 inch backlash around the total gear circumference. If necessary, loosen the setscrew (13) and remesh gear teeth until proper backlash is obtained; then tighten setscrew securely.

e. Apply a light film of grease to all gear teeth and to the hub of the upper face gear (27). Assemble the torsion spring (18) to the hub of face gear (27) with the loop of the spring over the casting boss near upper spur gear (20). Secure the spring loop to the boss with the retaining ring (17). Rotate the upper face gear in both directions to make certain that the retaining ring does not restrict move of the spring loop on boss. Reposition retaining ring if necessary.

f. Apply one drop of oil to the mouth of the bearing in the take-up arm assembly (9). Assemble the washer (8) to the shaft of the take-up spindle (7) and insert the shaft through the take-up arm bearing. Install and tighten the screw (6). Assemble the take-up arm (9) to the mounting pin (33) in the reel arm. Assemble the take-up belt (4) around the spindle pulley and the rubber sleeve of the lower face gear. See Figure D. Insert the tension spring (5) into the

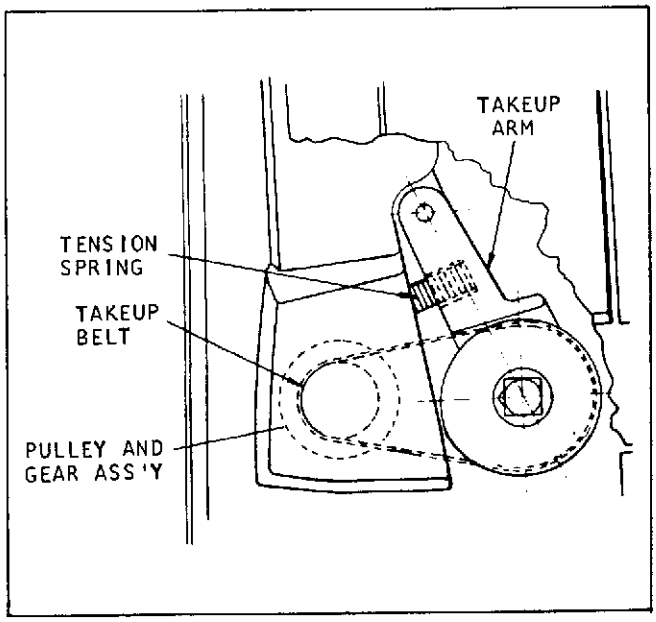


Figure D. Take-Up Arm Assembled

recess in the take-up arm and compress the spring with a piece of shim stock while assembling the reel arm cover (2) to the reel arm. Be sure to place a shim washer (3) on each of the reel arm mounting bosses before lowering the cover in place. Install and tighten the two screws (1).

25. REASSEMBLING THE FRONT REEL ARM ASSEMBLY (Figure 6). Reassemble the front reel arm as outlined in the following paragraphs.

a. Assemble the washer (5D) and then the face gear (5C) down against the shoulder of the feed spindle (5E). Install but do not tighten the two setscrews (5B). Assemble the retaining ring (5A) to the groove in the spindle shaft.

b. Place the reel arm (22) on the bench with the lower (spindle) end of the arm at your left. Assemble the nylon bearings (21) into the cast bearing bosses of the reel arm, engaging the key tabs of the bearings with the cross slots in the bearing bosses. Insert the gear shaft (20) through the nylon bearings from right to left, make sure that the end with the flats furthest from the tip of the shaft is at the right (upper end of the reel arm). Assemble the lower spur gear (19) to the left end of the shaft. The gear face with the square recess must face away from the cast bearing boss. Install the gear retaining clip (17) to the flats of the gear shaft. Assemble the washer (18) and the second gear retaining clip to upper end of the gear shaft (20). Assemble the upper spur gear (16) to the shaft, with the square recess of the gear engaging the retaining clip. Install the grip ring (15) on the end of the shaft. Insert a 0.010-inch feeler gage between the upper spur gear (16) and washer (18), and press the grip ring in against the gear. Remove the feeler gage.

c. Assemble the retaining ring (11) into the ring groove nearest the two flats of reel arm shaft (14). Assemble the washer (12) onto the shaft and down against the retaining ring. Place a drop of oil at the unflanged end of the reel arm upper bearing. Insert the long end of the shaft (14) through the upper bearing and install the spacer washer (13) and the second retaining ring (11). Make certain that the setscrew (8) is not protruding into the shaft hole of the face gear (9). Apply a light coat of grease to the gear teeth and to the hub of the face gear (9). Assemble the torsion spring (10) to the hub of the gear with the loop end of the spring furthest from the gear teeth. Assemble the face gear to the reel arm shaft while engaging the loop end of the spring over the spring boss of the reel arm. Secure the loop with the retaining ring (7), and tighten the gear setscrew (8) securely. The retaining ring (7) must not be so tight as to restrict movement of the spring loop when the face gear is rotated.

d. Apply one drop of oil at the flanged end of the reel arm lower bearing. Assemble the washer (6) onto the shaft of the feed spindle assembly (5), and insert the shaft down through the reel arm bearing. Install and tighten the screw (4) securely.

e. Rotate face gears (5C) and (9) in both directions to check backlash. There should be approximately 0.005-to 0.018 inch backlash around the total circumference of each gear. By the trial and error method, loosen the gear setscrews (5B) or (8) and reposition the engagement of face gears with spur gears until proper backlash is obtained. Then tighten setscrews securely.

f. Place a shim washer (3) on each of the reel arm mounting bosses and carefully assemble the cover (2) to the reel arm. Install and tighten the two screws (1).

26. INSTALLING THE TILT MECHANISM AND FILM GUIDES (Figure 5). Reassemble Figure 5 parts as outlined in the following paragraphs.

a. Lightly grease the teeth of the worm gear (27) and the gear rack (23). Assemble the gear rack into its channel in the end plate (31); then hold the worm gear between the two formed ears, its teeth engaging those of the gear rack, and secure the worm gear with a new spring pin (26). Assemble the gearshaft (25) to the end plate, engaging its gear teeth with those of the worm gear (27), and secure the gearshaft with the retaining ring (24). Lightly speck the gearshaft teeth with grease. Assemble the spring tension washer (22) and tilt knob (21) to the end of the gear rack (23) and tighten the setscrew (20) securely. Assemble the tilt bar (18) to the end of the gear rack, short leg toward the front of the projector, and install the screw (16) and its lock washer (17). Operate the tilt knob in both directions to check the tilt mechanism for smooth operation.

b. At this point, refer to Figure 4 and carefully assemble the complete mechanism assembly (34) to the projector main plate with the four screws (32). The upper two screws also serve to attach the idler gear adjustment bracket (33). Refer to Figure 5.

c. Assemble the film guide (15) to the autothread lever in the lower corner of the mechanism assembly, tightening the screw (14) finger tight. Assemble the roller (13) and film guide (12) to the autothread lever shaft, and install and tighten the screw (11) securely.

d. Assemble a roller (10C) and the adapter (10B) to the shaft at the squared end of the film guide bracket (10D). Assemble the remaining roller to the shaft at the rounded end of the bracket and install both retaining rings (10A). Assemble the film guide assembly (10) to the cast ears at the left side of the projector base, engaging the free end of the adapter (10B) with the guide rails of the film guide (12). Hold the film guide assembly (10) in place while assembling the screw (9) through the cast ears and into the tapped hole in the bracket (10D). Hold the roller (8), large diameter end toward the front of the projector, between the cast ears, and assemble the adapter shaft (7) through the cast ears and roller and into the tapped hole in the bracket (10D).

e. Assemble the snubber spring post (6) to the projector base with the screw (5). Hook one end of

the snubber lever spring (4) into the groove in the shaft behind guide roller (13) and install the retaining ring (1) on the shaft to secure the spring. Hook the other end of the spring to the snubber spring post (6) and install the washer (3) and retaining ring (2) to retain the end of the spring.

27. INSTALLING THE RUN-STILL LINKAGE (Figure 4). Reassemble Figure 4 parts as outlined in the following paragraphs.

a. Lightly grease the elongated slot and sliding contact surface of the belt shifter bracket assembly assembly (30) and assemble the spacers (31) and bracket assembly (30) to the tapped bosses of the projector main plate with the two shoulder studs (29). Assemble one loop end of the torsion spring (28) to the right-hand shoulder stud (29) and the other loop end to the bent ear of the bracket assembly just above the shoulder stud. Install the retaining rings (27) to retain the spring loops.

b. Assemble one loop of the torsion spring (25) over the shoulder stud of the pivoting link assembly (23). Assemble the large washer (26) down against the shoulder. Position the link assembly against the projector main plate, with the end of the stud engaged in the rectangular opening just below the projection lamp socket area, add the other end on the tapped boss of the main plate. Insert the spacer (24) between the link assembly and the tapped boss and install the pivot screw (22).

c. Engage the remaining loop of the torsion spring (25) with the pin at the lower end of the sliding link assembly (20) while assembling the spacers (21) and sliding link to the projector main plate. Install and tighten the two shoulder screws (19).

d. Assemble a retaining ring (16) into the ring groove closest to the slotted end of the switch shaft tube (18) and insert the short end of the tube through the main plate from the front. Assemble the run-still arm assembly (17) over the protruding end of the tube (18), engaging the key lugs of the arm in the slot of the tube and the slot in the end of the arm with the staked pin at the upper end of the sliding link assembly (20). Install the second retaining ring (16) into the ring groove at the end of the tube (18).

e. Loosely assemble the animation switch and bracket assembly (14) and the leadwire clamp (13A) to the rotary switch bracket assembly (15) with the two screws (13). Assemble these parts to the main plate, tightening the screws just enough to hold the brackets in place. Assemble the retaining ring (11) over the flatted end of the switch crank (12) and insert the flatted end through the hole at the top of the mechanism housing. The opposite end of the crank should rest on a bent ear of the animation switch bracket (14) with the bent leg just below the toggle of the animation switch. Assemble the animation switch lever (10) to the protruding end of the crank (12) and tighten the setscrew (9) securely. Insert a 0.010 inch feeler gage between the lever (10) and the mechanism housing, and hold the lever and crank firmly while pressing the retaining ring (11) in against the casting. Remove the feeler gage.

f. Insert the long straight end of the fire shutter rod (8) down behind the pivoting link assembly (23) and through the hole in the bent ear of the link. Engage the upper end of the rod with the hole in the fire shutter filter arm. Assemble the spring (7) and collar (6), small diameter up to the lower end of the rod, and tighten the collar setscrew (5).

g. Assemble a collar (2), small diameter up, to the still-run rod (4). Insert the straight end of the still-run rod up through the hole in the tip of the stop pawl of the mechanism assembly. Hook the bent end of the rod through the hole in the long arm of the pivoting link assembly (23). Assemble the spring (3) and the second collar (2), small diameter down, to the upper end of the rod. Slide the lower collar up against the underside of the stop pawl and compress the spring slightly with the upper collar. Tighten both collar setscrews (1) securely.

28. INSTALLING THE SOUNDHEAD, REEL ARMS AND GEARS (Figure 3). Install Figure 3 parts as outlined in the following paragraphs.

a. Carefully assemble the soundhead assembly (34) to the projector main plate. Be sure that all leadwires are pulled through behind the main plate so as not to be pinched between the main plate and the soundhead. Hold the soundhead while installing and tightening the three screws (32) and their washers (33). Refer to the wiring diagram at the rear of the Replacement Parts section for proper wiring connections between the soundhead and other projector components.

b. Assemble the bowed washer (30) and the flywheel (31) to the sound drum shaft, with the bowed face of the washer against the flywheel. Install the flat washer (29) and retaining ring (28) on the end of the sound drum shaft. Spin the sound wheel to make certain that the shaft rotates smoothly.

c. Insert a spring (27) and a reel arm lock button (26) into the opening to the right of the rear reel arm mounting hole in main plate. Hold the button in with a piece of shim stock while assembling the rear reel arm (25) to the main plate. Assemble the reel arm disc (23) over the shoulder of the reel arm, with the bent fingers of the disc pointing away from the main plate. Align the screw holes in the disc with those in the reel arm and install and tighten the screws (22). Install the front reel arm assembly (24) in the same manner.

d. Assemble the spur gears (21C), hubs inward, to the gear studs of the rewind lever assembly (21D). Place a washer (21B) on the gear stud nearest the end of the lever, and secure the gers with the retaining rings (21A). Hook the bent end of the long leg of the spring (20) through the hole in the upper lip of the rewind lever (21D) and assemble the spring loop and the rewind lever to the gear stud of the main plate (located near the upper left-hand corner of the

cut-out for the mechanism assembly). Wind the short leg of the spring one full turn counterclockwise and hook the bent end behind the edge of the cut-out. Assemble the idler gear (19), hub inward, and the washer (18) to the protruding gear stud, meshing gear (19) with gears (21C). Install the retaining ring (17).

e. Assemble the gear retaining clip (16) to the flats of the front reel arm shaft. Assemble the spur gear (15) to the shaft so that the square recess in the face of the gear engages the square clip (16). Assemble the reverse take-up clutch assembly (14) to the shaft and install the retaining ring (13).

f. Assemble the gear (9B), long hub out, to the gear stud of the arm assembly (9C) and install the retaining ring (9A). Assemble the rewind clutch assembly (12) and flat washer (11) to the upper sprocket shaft and assemble the gear retaining clip (10) to the flats of the shaft. Assemble the large hole in the idler arm over the inner shoulder of the spur gear (8) and install these parts on the upper sprocket shaft. Slide the gear (8) inward until the square recess in its face engages the square clip (10). The staked pin of the idler arm must be inserted into the triangular cut-out in the rewind lever (21D). Install the spring tension washer (7), bowed face out, and grip ring (6).

g. Install the washers (5) and spur gears (4), hubs in, on their respective gear studs, and secure them with the retaining rings (1). Assemble the gear retaining clip (3) to the flats of the rear reel arm shaft. Assemble the spur gear (2) to the shaft, engaging the square recess in the face of the gear with the square clip. Install the retaining ring (1).

h. Speck all gear teeth sparingly with grease. After the projector is completely assembled, grease can be distributed by running the projector briefly.

29. INSTALLING ELECTRICAL COMPONENTS (Figure 2). Install Figure 2 parts as outlined in the following paragraphs. Refer to the wiring diagram at at the rear of the Replacement Parts section for proper connection of leadwires between components.

a. Be sure to install the washer (51) over the threaded boss of the speaker jack (50) before assembling the jack, the nameplate (49) and the locking nut (48) to the projector end plate.

b. Place the solenoid assembly (46) on the work bench surface with the rod pointing toward you and the tapped holes in the solenoid bracket facing up (leadwires at the right). Position the mounting plate (47) over the tapped holes, with the leg containing the single mounting hole toward you and at the left. Install and tighten the two screws (45). Assemble the three rubber bushings (44), small diameter first, into the mounting holes of the mounting plate. Install a collar (41), large diameter first, on the solenoid rod, up against the yoke, and tighten its setscrew (40). Assemble the solenoid group to the support plate mounted to the long cast arm of the mechanism assembly, while guiding the solenoid rod down through the hole in the tongue of the stop pawl. Fasten the mounting plate (47) to the support plate with the three screws (42), inserting the spacer washers (43) between the rubber bushings (44) and the support plate. Temporarily install the remaining collar (41) on the lower end of the solenoid rod and tighten its setscrew (40).

c. Assemble the motor brackets (38) and motor bracket straps (37) to the motor (39). When mounted to the projector base, the motor nameplate should be up so that it can be easily read. Install the pulley (36), small diameter hub toward the motor, on the motor shaft. If the pulley was replaced, be sure to use the same color pulley (red, black or plain anodized) as was removed. Position the pulley with the small end approximately 1/4-inch from the rubber mounting ring of the motor and temporarily tighten the setscrews (35). Loop the drive belt (34) over the pulley. Insert the end of the motor shaft through the blower fan housing cover (33) and install the blower fan assembly (32). The fan hub containing the setscrews should be toward the motor. Position the fan so that the end of the motor shaft is approximately 1/16-inch below the face of the outer fan hub, and tighten the fan setscrews (31) securely. Assemble the blower fan housing (30) to the cover (33) and install the three screws (29). Manually rotate the motor pulley to make certain that the blower fan is not striking the housing or cover.

d. Lift the assembled motor and blower group into position on the projector base, threading the drive belt through the belt shifter. Guide the drive belt edgewise up and around the mechanism pulley. Position the motor mounting brackets over the mounting holes in the base. Check to make certain that the motor nameplate is at the top of the motor. If necessary, loosen the clamp screws in the motor bracket straps (37) and rotate the motor slightly; then retighten the clamp screws. Secure the mounting brackets to the base with the four screws (27). Position the blower cover and housing over the mounting holes in the base and install and tighten the four screws (28).

e. Lift the speaker (26) up into position against left-hand end plate of the projector and secure it in place with the four screws (23). The lower left screw also serves to attach the cable clamp (24) which retains the projector line cord assembly. Secure the green (ground) lead of the line cord with the screw (23).

f. Assemble the mounting brackets (21) and (22) to the power transformer (13) with two screws (18) and Sems nuts (17). Assemble the lamp transformer brackets (19) and (20) to the top of the power transformer with the remaining two screws (18) and Sems nuts (17). Position the lamp transformer (16) on top of the power transformer, between the two brackets (19) and (20), and install the two screws (15) and Sems nuts (14). Position the transformer group over the mounting holes in the projector base. Insert the two screws (12) up from beneath the base

and thread them partially into the rear holes in the brackets (21) and (22). Insert screws (11) down through the front holes in the brackets and into the base. Tighten all screws securely.

g. Assemble the capacitor (10), leads down, into the loop of the capacitor clamp (9), and fasten the clamp to the tapped holes in the speaker magnet frame with the two screws (8). The blue and orange speaker leads must be threaded up through the gap between the capacitor and the right-angle bend of the clamp.

h. If the edge connector and bracket assembly (6) was removed for replacement or to facilitate the unsoldering of leadwires from the terminals, it is suggested that all soldering connections be made before mounting the bracket assembly to the right-hand end plate of the projector with the two screws (5). Carefully guide the pins of the printed circuit board assembly (7) down into the pin sockets of the edge connector (6) and press down firmly until the pins are seated. Fasten the upper end of the board to the end plate with the remaining two screws (5).

i. Insert the shaft of the rotary switch (4) through the mounting hole in the switch mounting bracket. Assemble the lock washer (3) and mounting nut (2) on the shaft before continuing to insert the shaft through the long switch tube. When viewed from the rear of the projector, switch terminal 2A must be at the upper left corner of the switch. Secure the switch to the mounting bracket by tightening the locking nut up against the inside surface of the bracket.

j. Make all leadwire connections as indicated in the wiring diagram at the rear of the Replacement Parts section. Check to be certain that no leads interfere with moving projector parts. Gather together the cross-over leadwires (left to right side of projector) and secure them with suitable ties. Insert the yellow and white lamp leads through the hole in the projector main plate adjacent to the large mechanism pulley.

30. INSTALLING LAMPHOLDER AND CONTROL KNOBS (Figure 1). Install the lampholder and control knobs as outlined in the following paragraphs. The lamphouse, covers, and mechanism door can be reassembled, but need not be installed until all adjustments have been made.

a. Connect the yellow and white lamp leads to the terminals of the lampholder (18) and secure the lampholder to the projector main plate with the two screws (17). Engage the pins of the projection lamp (16) with the pin sockets of the lampholder and press the lamp in fully. Swing the lamp retaining arm up into place to secure the lamp.

b. Assemble the setscrew (20) into the "Fwd-Rev-Lamp" knob (21) until the head of the screw is flush or slightly below the hub of the knob. Assemble knob (21) into the "Still-Run" knob (22) and align the access hole in knob (22) with the setscrew (20). Install both knobs on the rotary switch shaft and tighten the setscrew (20) securely.

c. Assemble the "Tone" control knob (12) to the control shaft protruding from the soundhead, engaging the key lugs of the knob with the slots in the outer shaft. Install the "On-Volume" control knob (11) on the shaft so that the spring insert of the knob bears against the flat on the inner shaft.

NOTE: Perform all adjustments and alignments outlined in the Adjustments section, following, before installing the balance of Figure 1 parts.

Adjustments

31. 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 undergone 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.

All special tools and fixtures required to perform the adjustment procedures are illustrated in Figure A. In addition, special test films and electronic test equipment (vacuum tube voltmeter, volt-ohmmeter, oscillator and tachometer or Strobotac) are needed to check and adjust the sound system.

WARNING

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

32. OPTICAL ALIGNMENT.

It is important that these alignments be performed in the following listed sequence (steps a through d). All special tools and fixtures required for optical alignment are shown in Figure A. Except for the aperture plug (item 1), these items are shown installed in the projector in Figure E. 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 and the condensing lens assembly.

(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 5, Figure A) into the aperture opening. Close the lens carrier.

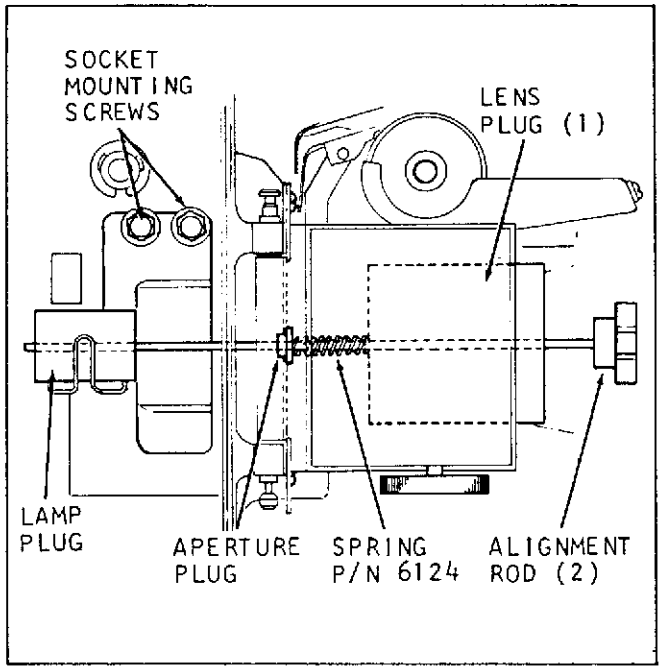


Figure E. Aligning the Optical System

(4) Insert the alignment rod (item 2, Figure E) through the lens plug (item 1) until the rod end protrudes enough to install the spring (P/N 6124). 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 until free rod movement is obtained; then tighten aperture plate screws.

b. Aligning the Lamp Socket.

(1) Tip the projector back into its normal, upright position and reassemble the pressure plate to the lens carrier. Close the lens carrier.

(2) Loosen the two lampholder mounting screws just enough to permit movement of the lampholder. Insert lamp plug (1, Figure A) into lamp socket and secure the lamp spring.

Slide alignment rod completely into place until tip of rod engages the hole in lamp plug. Shift socket as necessary until rod slides freely in the lamp plug hole. Then tighten the screws securely and remove all tools.

33. ADJUSTING THE INTERMITTENT MECHANISM.

a. Checking Shuttle Tooth Side Clearance. Advance the mechanism manually until the shuttle is at the center of its stroke as shown in Figure F. 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 minimum. From the edge of the shuttle slot to the outer end of the shuttle tooth, the distance should be 0.050-inch 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 at either end, the following possible causes should be checked and corrected.

(1) Aperture plate out of alignment. See paragraph 32, step a, Aligning the Aperture Plate.

(2) Shuttle stroke incorrect. See paragraph 33, step d, Shuttle Stroke Adjustment.

(3) Link bearing missing from end of shuttle arm. Partial disassembly required to remove shuttle arm and replace link bearing (refer to Disassembly section).

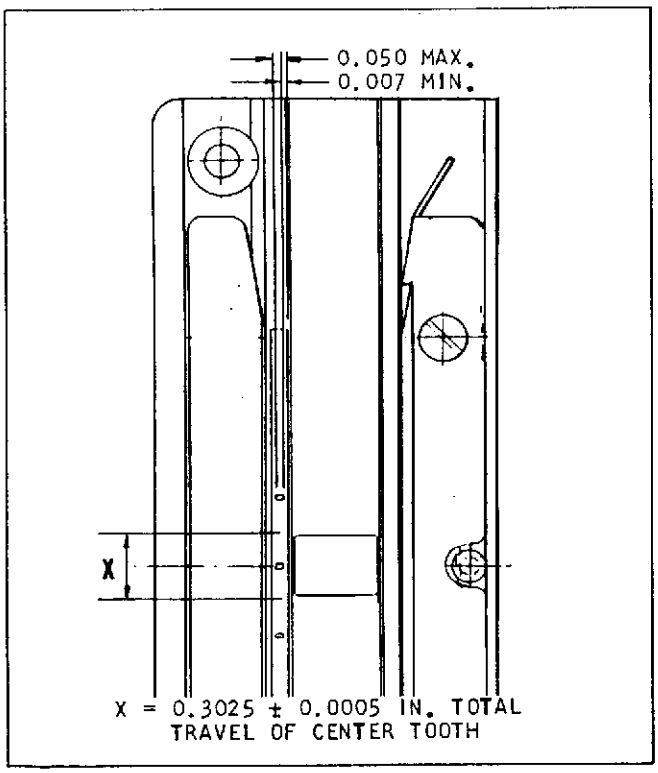


Figure F. Aperture Plate and Shuttle Tooth Clearances

(4) Ball and stud assembly loose on shuttle arm. Reposition ball and stud assembly (Figure B) and tighten stud nut securely.

b. Checking Shuttle Tooth Height. Swing open the lens carrier and advance the mechanism manually until the shuttle is at the center of its stroke as shown in Figure F. Hold the shuttle tooth height gage (Figure A) by its knurled handle and place it against the aperture plate between the rails. The center ears, on either side of the gage handle, are the height gages. Slowly slide the gage downward. The "Go" ear should pass over the shuttle tooth without catching. Rotate the gage so that the "No-Go" ear is over the shuttle slot and once more slide the gage downward. The "No-Go" ear must not pass over the shuttle teeth. If the shuttle teeth are too high or two low, adjust height as follows.

NOTE: If the mechanism assembly is installed on the main frame, it will be necessary to remove the lamphouse, the projection lamp and the lampholder before proceeding.

(1) Turn the mechanism drive pulley by hand until the access holes in the shutter and the fire shutter bracket are aligned as shown in Figure G.

(2) Insert a No. 4 Bristol Wrench into these access openings and engage it in the socket of the in-out cam follower screw.

(3) If the shuttle teeth were too low (No-Go ear passes over shuttle teeth), turn the cam follower screw counterclockwise to increase shuttle tooth height. If the shuttle teeth were too high (Go ear catches

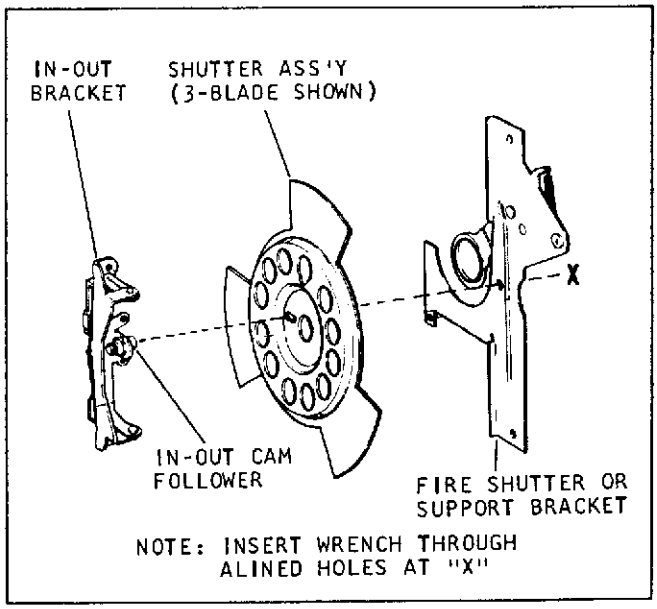


Figure G. Adjusting Shuttle Tooth Height

against shuttle teeth), turn the cam follower screw clockwise. It may be necessary to re-check shuttle tooth height with the gage several times before the proper height has been obtained.

(4) If one of the teeth cannot be brought into tolerance by the above method, it may be necessary to loosen the screws which attach the in-out bracket (Figure G) and shift the bracket slightly. Tighten the mounting screws securely and check and adjust shuttle tooth height as outlined above.

c. Checking Fit of Shuttle Arms to Pull-Down Cam (See Figure H). Remove rear cover and the projection lamp.

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

(1) Open film gate and turn projector mechanism by hand until shuttle teeth are retracted and have moved downward to approximately the center of the stroke (center tooth approximately on horizontal center line of aperture). Slip guide bars of tool SER-552-4-N1 over casting to which shuttle mounting plate is attached (Figure H). When tool (A) is positioned so that stud (B) can bear on shuttle arm (C), tighten thumbscrew (D) just enough to hold tool in position. Engage hook of tool SER-552-4-N2 in slot of stud (B) as shown, and allow weight (E) to swing downward. Tilt projector, if required, so that the weight does not rub on any stationary parts.

(2) Loosen upper bearing support assembly (F) approximately one turn. Rotate projector framer knob so that pointer (G) moves above witness mark (H). Then turn framer knob in the opposite direction until pointer (G) moves back down in line with mark (H).

NOTE: If adjustment of framer knob does not permit movement of pointer (G) as specified, it may be necessary to rotate the camshaft slightly to bring cam into proper position.

(3) Carefully tighten upper bearing support assembly (F) while observing alignment of pointer (G) with witness mark (H). The instant that pointer (G) starts to move upward, stop turning support assembly (F). This is the proper adjustment.

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 and cam shoes.

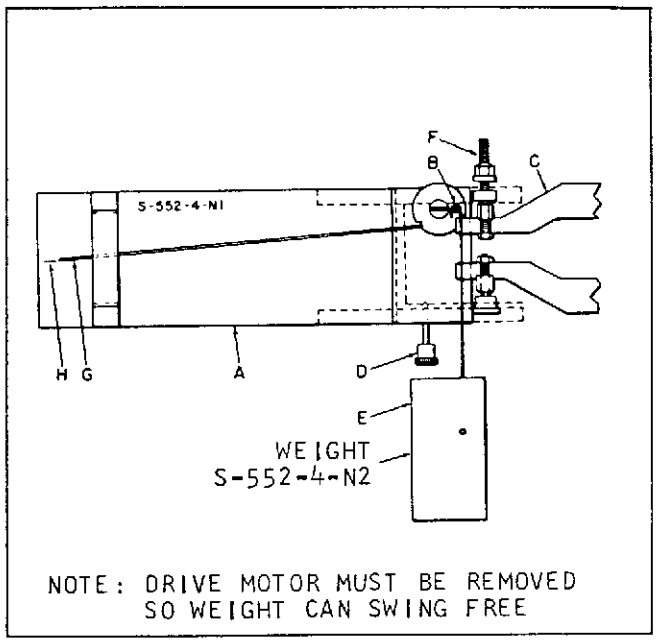


Figure H. Adjusting Fit of Shuttle Arms to Pull-Down Cam

d. Checking Shuttle Stroke. Normal shuttle stroke (vertical travel of shuttle teeth) is 0.3025 inches (Figure F). The most convenient means of measuring the stroke is to use the projector as an optical comparitor. The step on the stroke gage (item 6, Figure A) is the length of the nominal stroke. When it is inserted in the aperture and projected, it provides a reference dimension with which the actual stroke can be compared. A sketch of a target is shown in Figure J. The A to B section is a 100 to 1 enlargement of the gage. The C and D lines represent 100 to 1 enlargements of the limits of tolerance.

(1) Procedure for Measuring Shuttle Stroke. (See Figure J.)

(a) Remove pressure plate assembly from the lens carrier.

(b) Set the framer knob at the mid-point of its over-all travel.

(c) Suspend the target approximately 18 feet from the projector with center of target on same horizontal line as optical axis of projector. If room arrangement necessitates tilting projector, target must also be tilted so that angle between target and optical axis is 90 degrees. If this is not done, "Keystone" error will be produced.

(d) Open the lens carrier and turn the projector mechanism by hand until shuttle is at bottom of stroke and shutter just clears aperture.

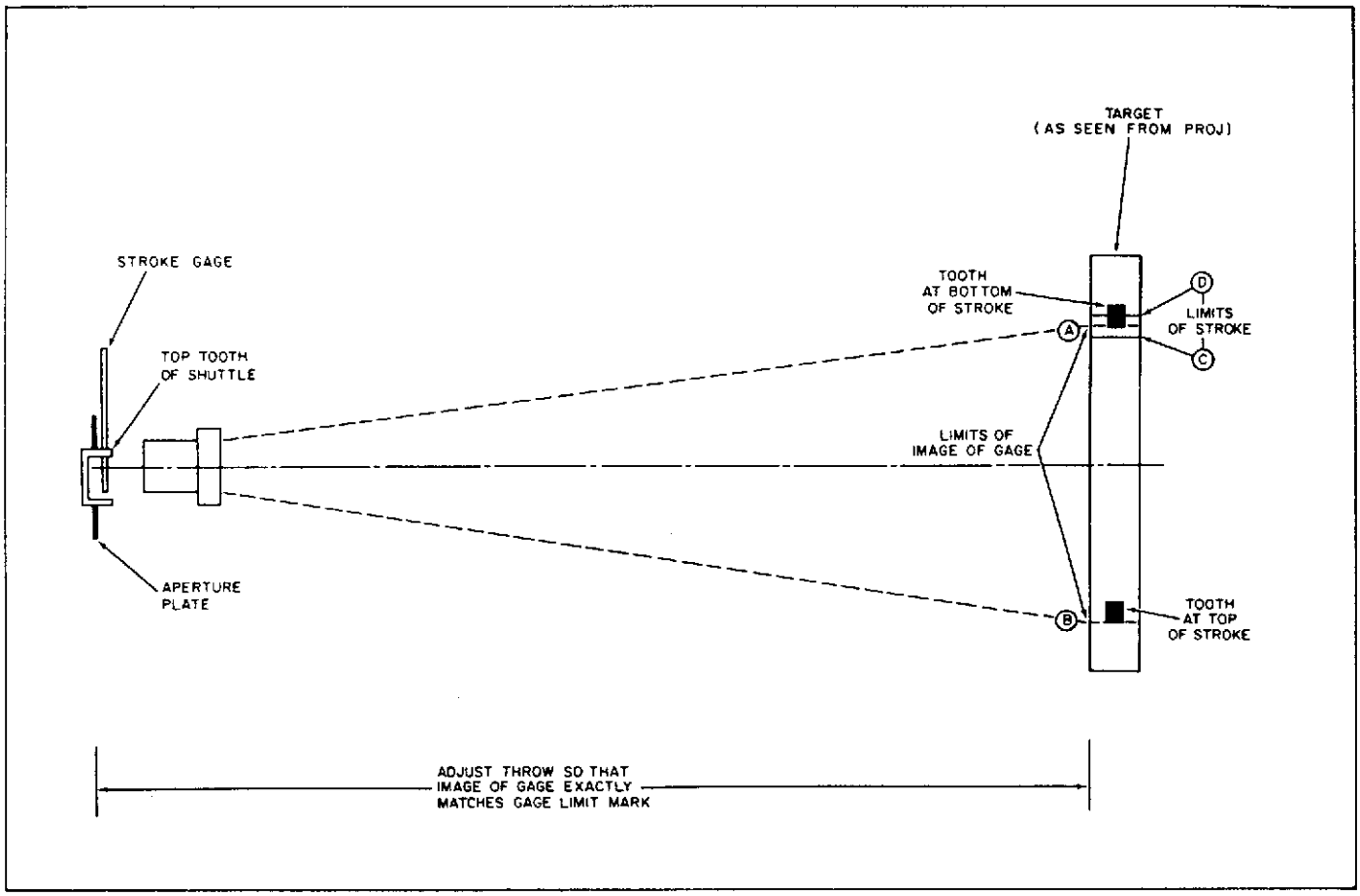


Figure J. Checking and Adjusting Shuttle Stroke with Target

(e) Insert stroke gage (SER-550-5-N2) in the aperture plate and lightly press it down against the top tooth of the claw. Close the lens carrier.

(f) Turn on the projector lamp and focus the image of the shuttle slot on the target. Move projector toward or away from the target until a sharply focused image of the step at end of stroke gage just reaches from line A to line B (Figure J).

(g) Slide the stroke gage up out of field-of-view and turn mechanism pulley until center tooth of shuttle is at top of stroke indicated by image of tooth near line A. Adjust framer, if required, until projected image of edge of tooth just touches line A.

(h) Turn mechanism pulley until center tooth of shuttle reappears at top of target. Rock mechanism pulley to find top of shuttle stroke. Edge of tooth used as reference in step (g) must fall between lines (C) and (D) (Figure J). If image falls between (C) and (A), stroke is too short. If image falls beyond (D), stroke is too long.

(2) 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.

(c) After adjusting stroke, recheck shuttle tooth side clearance as instructed in paragraph 33, step a, and readjust if necessary.

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.

e. Framing Adjustment. Thread projector with film having proper frame line position. Project film and turn framing knob from one limit to the other. If at one limit a frame line is not visible, loosen nut on the framing eccentric located at top of shuttle arm plate assembly (Figure B) and turn eccentric until

the frame line appears. Hold eccentric while tightening nut. Check adjustment by again turning framing knob from limit to limit while observing 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.

34. LENS CARRIER ADJUSTMENT. Angular relationship between the lens carrier and the aperture plate is controlled by lens mount stop screw (item 36, Figure 10). Thread projector with roll title or target film having sharp images in 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 right-hand edge of screen is soft until lens is moved toward aperture, then 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.

35. ADJUSTING THE ANIMATION CLUTCH.

a. Checking Stop Pawl to Trigger Clearance. 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, Figure K. If the trigger fails to clear the stop pawl ear, adjust as follows. Loosen the bearing bracket screws (item 33, Figure 11) and shift the bearing bracket (item 34, Figure 11) 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.

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 behind the trigger as shown in View B, Figure K. 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, Figure K) 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, Figure K. Loosen the round Allen nut slightly and shift the shuttle adjustment bracket slowly toward the shuttle (to the right) until the shuttle teeth are retracted below the level of the aperture plate rails. Retighten the Allen nut.

(3) Refer to View D, Figure K. 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.

c. Adjusting Clutch Solenoid Linkage. Refer to Figure K for the following adjustment procedure. Rotate the mechanism by hand until the finger of the stop pawl is centered at the tip of the trigger as shown in Figure K, View A, and place Still-Run knob in "Run."

(1) Refer to Figure K, View E. Loosen 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 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.

d. Checking Still-Run Linkage. Refer to Figure K, View E in this section for the following adjustment procedure.

(1) Rotate the projector Still-Run knob to the Run position so that the still-run rod (5) moves downward in the limit of its travel.

(2) Rotate the mechanism knob and check to make certain that the ear of the stop pawl clears the trigger as shown in View A, Figure K.

(3) Operate the projector and switch from "Run" to "Still" position. The stop pawl is engaged with the trigger mechanically and is disengaged electrically (by the solenoid). If the preload tension of the spring (paragraph c, step 2, preceding) is set too low, the stop pawl may not engage the trigger properly and a chattering will result. If set too high, the solenoid may not be able to overcome spring tension to disengage the stop pawl from the trigger. Readjust spring tension until proper operation is obtained.

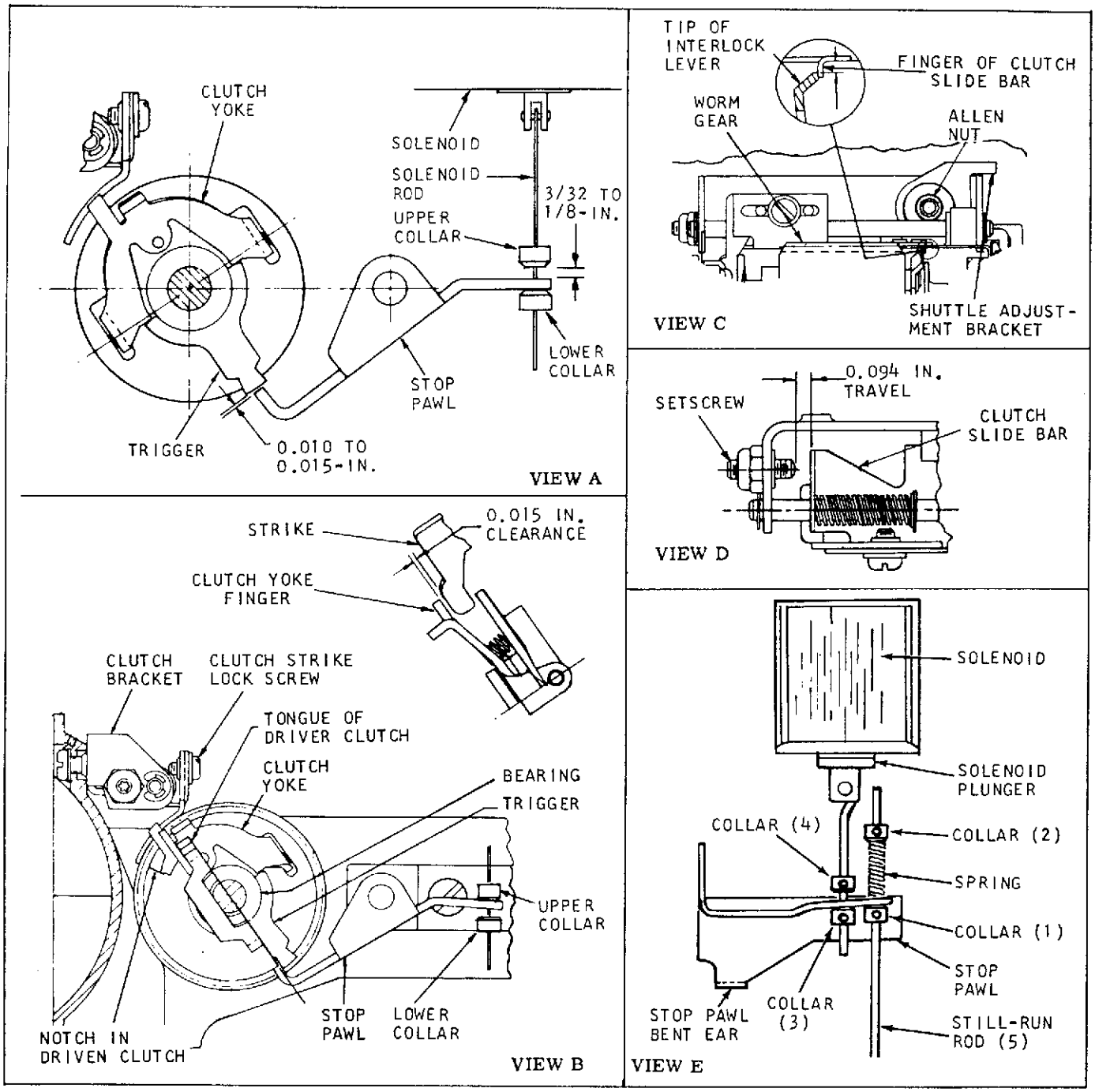


Figure K. Animation Clutch Adjustments

36. ADJUSTING THE FIRE SHUTTER. When the projector has been completely assembled, install the projection lamp and lens and run the projector "forward" with the lamp on. Turn the Still-Run knob to the Still position and focus the image of the aperture on the screen. Check for full pattern of the fire shutter disc on the screen (image must show perforations of disc throughout). Note that a bent ear on the fire shutter bracket limits the travel of the fire shutter filter arm. If unfiltered light appears at the top or bottom of the aperture image, it will be necessary to bend this stop ear so that the amount of filter arm travel is increased or decreased accordingly.

37. ADJUSTING REEL ARMS AND REWIND CLUTCH.

a. Front Reel Arm Adjustment (See Figure 6). Adjust end play of drive shaft (14) to 0.008 inch ± 0.003 inch by positioning retaining ring (11) 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 (5B) and (8) and repositioning the face gears (5C) and (9) as necessary.

b. Rear Reel Arm Adjustment (See Figure 17). Adjust end play of drive shaft (31) to 0.008 inch ± 0.003 inch by positioning retaining ring (28) against an 0.008 inch shim. The backlash for both face gears should be between 0.005-inch (minimum) and 0.018-inch (maximum). The upper gear (27) is adjusted by loosening its setscrew (26) and repositioning the gear as necessary. The lower gear is adjusted by loosening the setscrew (13) in the tapped hole of the arm and shifting the shaft (16) in and out as necessary.

c. Rewind Clutch Adjustment. The rewind clutch system must be adjusted to produce a supply spindle torque of 2-1/2 to 4-1/2 inch-lbs. when the rewind button is pressed during operation. Install an empty reel on the supply spindle and wrap several turns of a ten-inch film strip around the reel hub. Hook a spring scale to the free end of the film strip. Turn on the projector and press the rewind button. The spring scale must measure between 2-1/2 to 4-1/2 inch-lbs. of torque. To adjust reverse take-up torque, grip the flats of the clutch disc (of clutch assembly 12, Figure 3) with a wrench and tighten or loosen the hex nut on the clutch disc shaft as necessary. To adjust rewind torque (2.5 to 4.5 inch-pounds), use the special wrench (item 5, Figure A) to grip the flats of the rewind clutch shown in Figure S, page 32.

38. ADJUSTING THE SOUNDHEAD.

a. Soundhead Removal.

(1) Remove the projection lens from the lens carrier and wrap it in tissue or a soft cloth.

(2) Remove the Volume and Tone control knobs from the control shaft and remove the exciter lamp cover from the soundhead. Unscrew the mounting nut from the threaded Volume control bushing.

(3) Remove the rear cover (Figure 1) from the projector. Remove the assembled power transformer and lamp transformer (Figure 2) from the projector base, being careful not to place undue strain on the transformer leads. Remove the flywheel (31, Figure 3) from the sound drum shaft.

(4) Unsolder the black ground wire from the tip of the terminal at the lower left-hand corner of the soundhead housing. Disconnect the flag terminal of the exciter lamp leadwire from terminal 1L1 of the main switch.

(5) With a sharp pencil or scribing tool, scribe a line on the projector main plate along the front edge of the soundhead casting. This will provide a reference mark for locating the soundhead during installation.

(6) Remove the three screws (32, Figure 3) and flat washers (33) and carefully withdraw the soundhead assemby from the projector main plate, disengaging the Volume control shaft from its opening in the soundhead housing.

b. Photocell Alignment (Figure 8).

(1) Loosen the setscrew (19) and the two housing screws (20). Remove the exciter lamp (8) and the optical slit (11).

(2) Insert the sound drum alignment tool into the optical slit opening as shown in Figure L.

(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 (20) securely.

(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.

c. Roller Tension Adjustment (Figure C). 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 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.

NOTE: The following adjustments must be made with the soundhead installed and the projector threaded with special test film.

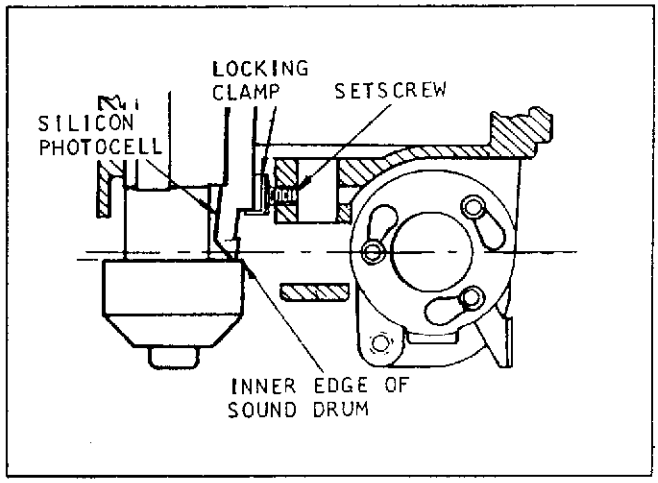


Figure L. Positioning the Sound Drum and Silicon Cell

d. Soundhead Installation.

(1) Carefully assemble the soundhead assembly to the projector main plate, while inserting the Volume control shaft through the soundhead casting. Install and tighten the Volume control mounting nut.

(2) Install the three screws (32, Figure 3) with their washers (33) from the rear of the main plate and tighten the screws finger tight. Shift the soundhead until the forward edge of the soundhead housing is aligned with the scribe or pencil mark on the main plate and maintain this position while tightening the three screws securely.

(3) Connect the flag terminal of the exciter lamp leadwire to terminal 1L1 of the main switch. Resolder the black ground lead to the tip of the terminal in the lower left-hand corner of the soundhead housing.

(4) Assemble the bowed washer (30, Figure 3), flywheel (31) and flat washer (29) to the sound drum shaft and secure these parts with the retaining ring (28).

(5) Reinstall the assembled power transformer and lamp transformer (Figure 2) to the projector base.

(6) Temporarily install the Volume and Tone control knobs on the control shaft.

e. Optical Slit Adjustment (Figure 8).

(1) Insert the optical slit (11) into its opening in the soundhead. The adjusting hole in the barrel of the slit must be at top center.

(2) Insert a 0.050-inch 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 locking screw (10) just enough to hold the slit in place.

(3) Thread the projector with 7000 CPS optical setting film and connect a 16-ohm, 10-watt load resistor and output meter 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 12 o'clock position and start 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. If film was threaded with emulsion toward the optical slit, move slit toward film until output drops 1-1/2 to 2 DB. If emulsion is toward sound drum, move slit away from film to obtain 1-1/2 to 2 DB drop in output. Tighten slit clamping screw (10) securely to lock the adjustment.

f. Buzz Track Adjustment (Figure 8). The lateral position of the film in the soundhead is controlled by the flanged roller (15C) and edge guide screw (24). Unless the adjustment has been disturbed, it is not probable that the edge guide screw (24) will require resetting. Thread the projector with buzz track film and adjust volume control to a suitable listening level. Turn adjusting screw (14) to move flanged roller laterally.

NOTE: There are two types of buzz track 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 edge guide screw (24) to clear up the condition. If the edge guide screw is far out of adjustment, turn it clockwise until it clears the edge of film, adjust rollers and then set guide screw to stop weave of film.

g. Positioning the Soundhead.

(1) Lock the autoload system in the load position and loosen the three soundhead mounting screws (32, Figure 3) just enough to permit the soundhead to be shifted.

(2) Hold the soundhead locating gage (Figure A) by its handle and insert the gage carefully between the sound drum and take-up sprocket as shown in Figure M. The gage must be between the sound drum threading guides. Position the gage so that one end bears against the supporting ribs for the sound track edge of the film and with the round body of the gage in contact with the rear sprocket flange, as shown.

(3) Tilt the gage so that it lies on a centerline between the take-up sprocket and sound drum. Shift the soundhead toward the take-up sprocket until the sound drum bears lightly against the end of the gage, and tighten the soundhead attaching screws securely.

39. 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.

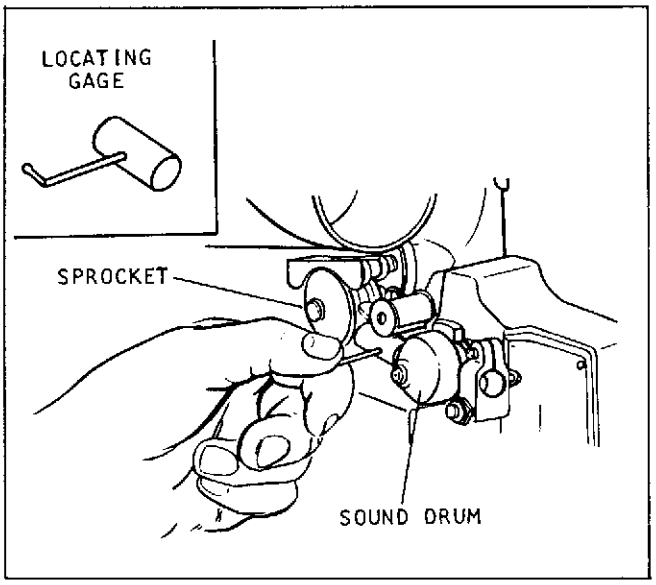


Figure M. Positioning the Soundhead

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 sprocket by means of suction cup or rubber foot. For viewing with light from 60 CPS source, disc should have 70 dots for sound speed, 93 dots for silent speed. Count number of apparent revolutions 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. At sound speed 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, 60 CPS AC.

(1) Sound Speed (24 FPS ± 2%)
Shutter - 1440 RPM ± 2%
Sprocket - 102.86 RPM ± 2%

(2) Silent Speed (18 FPS ± 5%)
Shutter - 1080 RPM ± 5%
Sprocket - 77.1 RPM ± 5%

40. AUTO-LOAD SYSTEM ADJUSTMENTS — GENERAL.

a. The auto-load 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 open position, the guides and rollers clear the film path.

b. When the system is in the open position, the location of the guiding parts is not critical. Therefore, adjustments to assure proper location of the guiding parts are made with the system in the load position.

c. 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 specified 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 sequence listed in this section. The sprocket timing and the locating of the soundhead may be done without disturbing the film guide adjustments.

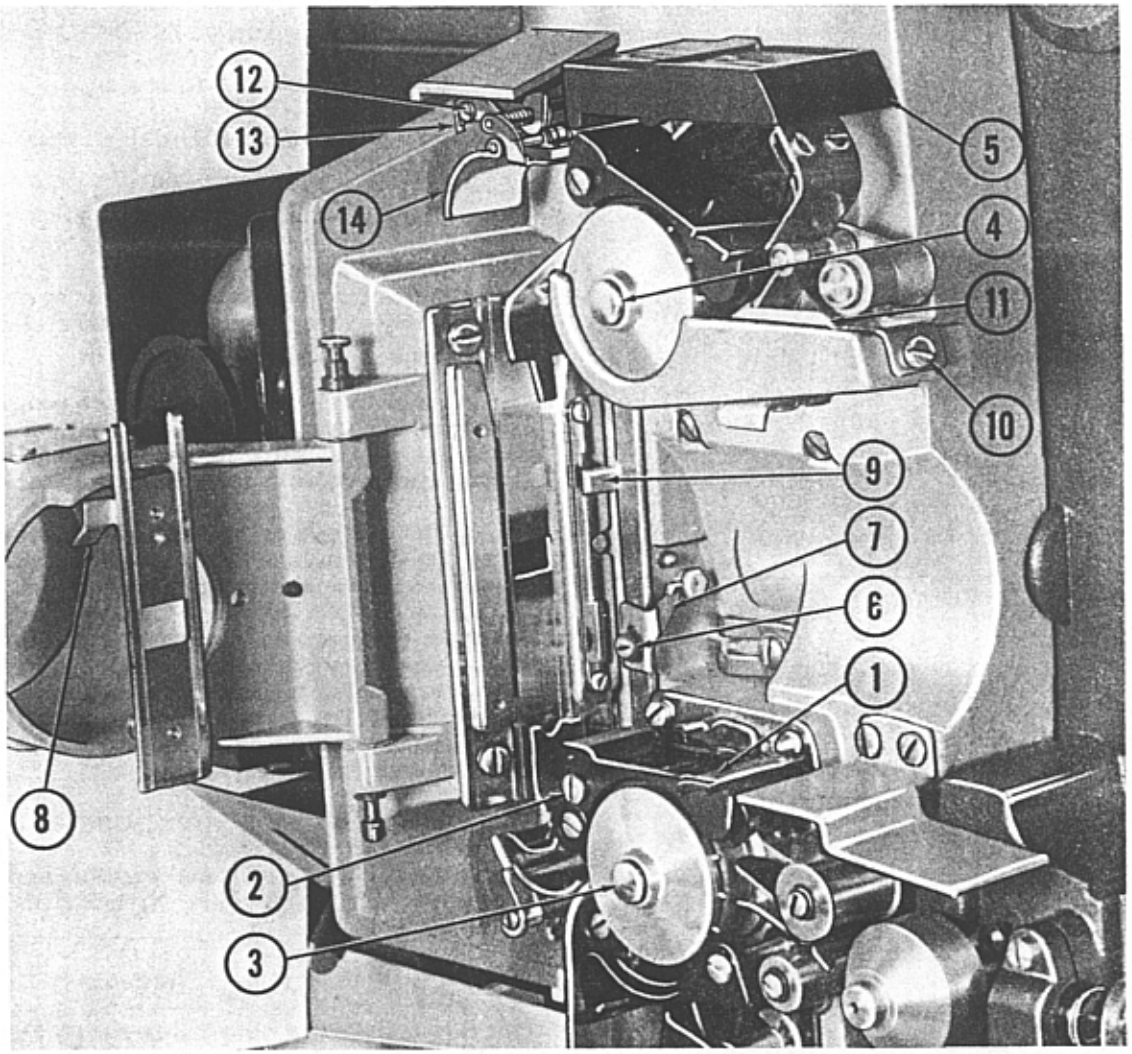
41. ADJUSTING THE LOADING GUIDES.

a. Swing open the lens carrier upper take-up sprocket guard (1, Figure N) and remove the retaining screw (2).

b. Place timing plate (SER-552-1-N1) over the sprocket hubs (3 and 4, Figure N). The timing plate locating pin should enter the counterbore from which screw (2) was removed. If the locating pin does not enter counterbore, loosen three sprocket guard plate attaching screws (1, Figure P) and rotate the lower guard plate (2) until pin enters hole. Then tighten the three screws securely.

c. Remove retaining ring that secures the actuating assembly (5, Figure N) and lock the auto-load system. Place a 0.015 inch feeler gage between the film support rails of the aperture plate and the rear surface of the lower loop form assembly (4, Figure P). This surface should touch the feeler gage just as the heel of the loop form (5, Figure P) strikes the shoulder on the mounting stud for the entrance guide roller (6, Figure P). To adjust, loosen two screws (7, Figure P) which attach the upper sprocket guard plate. Press downward on front end of loop form assembly and rotate upper sprocket guard plate until heel of loop form strikes shoulder of stud and rear surface clears aperture rails by 0.015 inch. Then tighten screws (7, Figure P) securely.

NOTE: Depress and hold the lower loop form assembly (4, Figure P) and check, at rear of mechanism, to see that the pin in the threading lever clears the bottom of the elongated slot in the loop form shaft link by

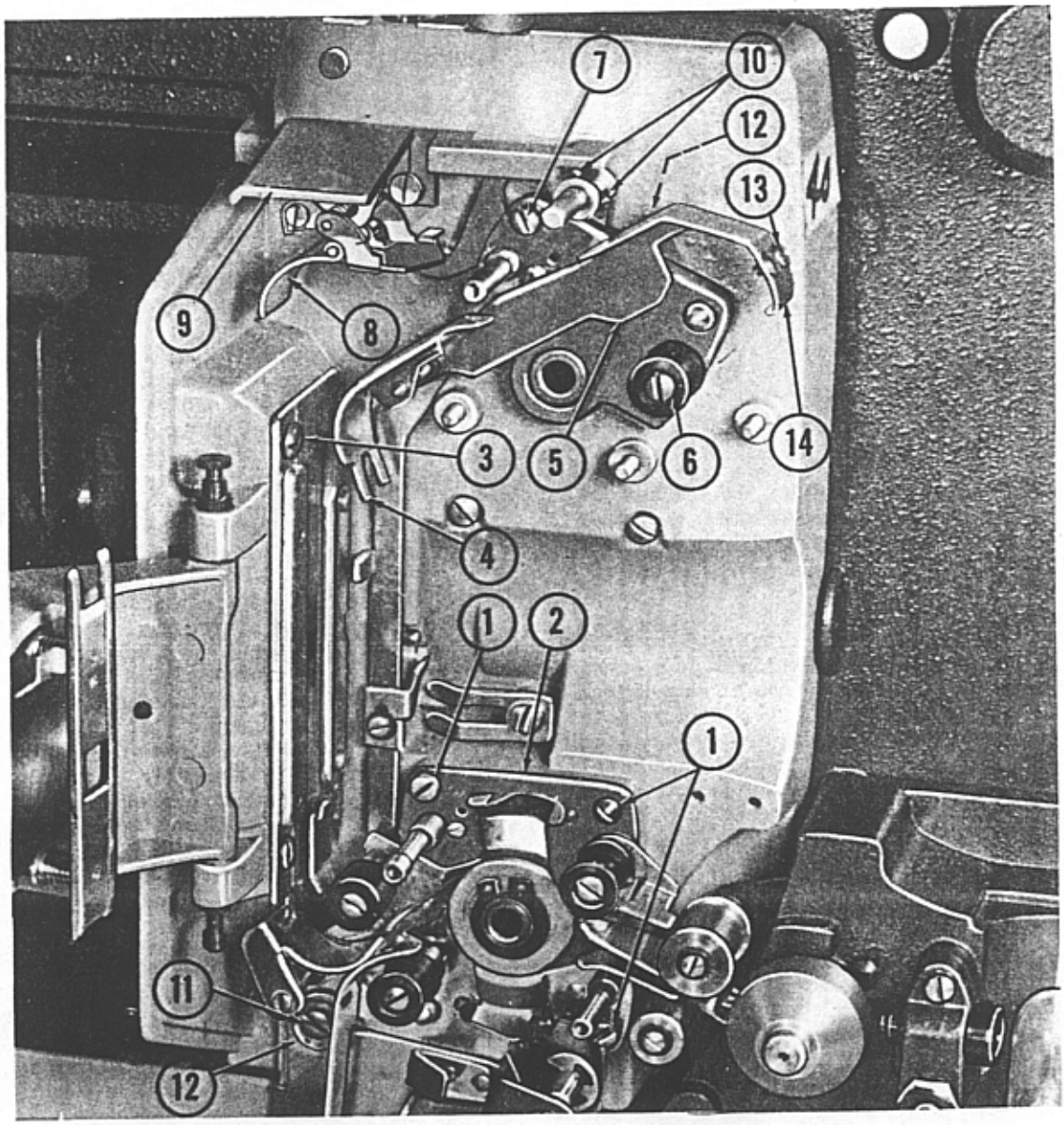


1. Sprocket guard
2. Guard retaining screw
3. Lower sprocket hub
4. Upper sprocket hub
5. Actuating assembly
6. Shuttle retractor screw
7. Shuttle retractor
8. Pressure plate lift-off ear
9. Connecting link ear
10. Film guide screw
11. Film guide
12. Escape hub screw
13. Film escape hub
14. Loopformer

Figure N. Autoload System Adjustments — View I

approximately 1/64 inch. (See Figure Q.) 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.

d. Check operation of the film escape mechanism by leaving the auto-thread system open. Manually advance the film and jam it in the upper channel. The film should fold and flow out through the kickplate in the loop former (14, Figure N). If the kickplate does not release, the arm of the hub assembly (13) is not striking the hood (9, Figure P) properly. The hood can be moved slightly and the hub assembly should be adjusted accordingly. When the auto-thread system is activated and the kickplate does not lock in position, loosen the screw (12, Figure N) holding the hub as-



1. Guard plate attaching screw
2. Sprocket guard plate
3. Aperture plate screw
4. Lower loopform assembly
5. Heel of lower loopform
6. Entrance guide roller
7. Upper guard plate screws
8. Film escape kickplate
9. Hood
10. Kickplate setscrews
11. Eccentric pivot screw
12. Eccentric pivot
13. Leaf spring screw
14. Leaf spring

Figure P. Qutoload System Adjustments — View II

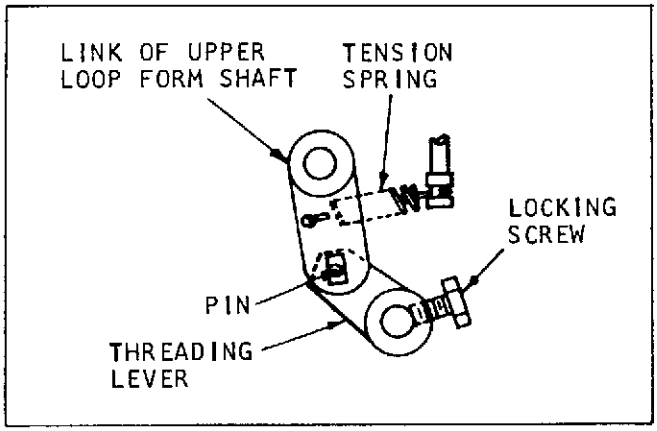


Figure Q. Threading Lever Clearance Adjustment

sembly to locking pawl and adjust the hub assembly until the tip of the bracket touches the upper curved surface of the loop former. This will lock kickplate in position.

e. Again depress the loop form assembly (4, Figure N) and check to make certain that there is 0.012 to 0.015 inch clearance between the top surface of the lower loop form (4, Figure N) and the bottom surface of the kickplate (8, Figure P). To adjust remove the two screws which attach the hood (9). Loosen two setscrews (10) and rotate kickplate (8) to obtain desired clearance. Tighten setscrews and reinstall hood. Before tightening hood retaining screws, press hood toward rear of the projector.

f. With the auto-load system locked and 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 screw (6, Figure N) and carefully raise the shuttle retractor (7) until teeth are retracted; then tighten screw (6) securely. CAUTION: The top end of the shuttle retractor must not strike the casting.

g. Close film gate while observing to see that the film pressure plate does not contact the aperture plate. If pressure plate remains in contact with aperture plate, either the pressure plate lift-off ear (8, Figure N) or the ear (9) on the threading guide linkage is bent. Reform ear, or ears, as necessary.

h. Loosen the screw (10, Figure N) and align the film guide (11) so that film will feed squarely to the sprocket; then retighten screw (10).

i. Loosen screw (11, Figure P), lock the system, and check to make certain that loop form heel (5) is bearing on shoulder of roller stud (6). If necessary, rotate the eccentric pivot (12) with a wire pick or pin punch until heel bears against stud shoulder. When loop form is pressed downward, there must be no clearance between heel and stud shoulder. Recheck clearance between rear of loop form and aperture rails (step c, preceding). Also, make certain that end of upper loop form (8) 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 screws (13, Figure P) and move leaf spring (14) downward to increase pressure on the film. If film buckles as it is inserted, move leaf spring upward to reduce pressure; then tighten screws (13).

42. CHECKING AND ADJUSTING LOOP RESTORER. Check the operation of the loop restorer by threading the projector with a loop of test film in which two or three successive perforations have been purposely enlarged at points approximately one foot apart. The first set of damaged holes should be located about two feet from the aperture. Run the projector in "forward" and observe the action of the loop restorer as the enlarged perforations run through the film gate. The lower loop should be automatically restored within five or six frames. To adjust the loop restorer, refer to Figure R and proceed as follows:

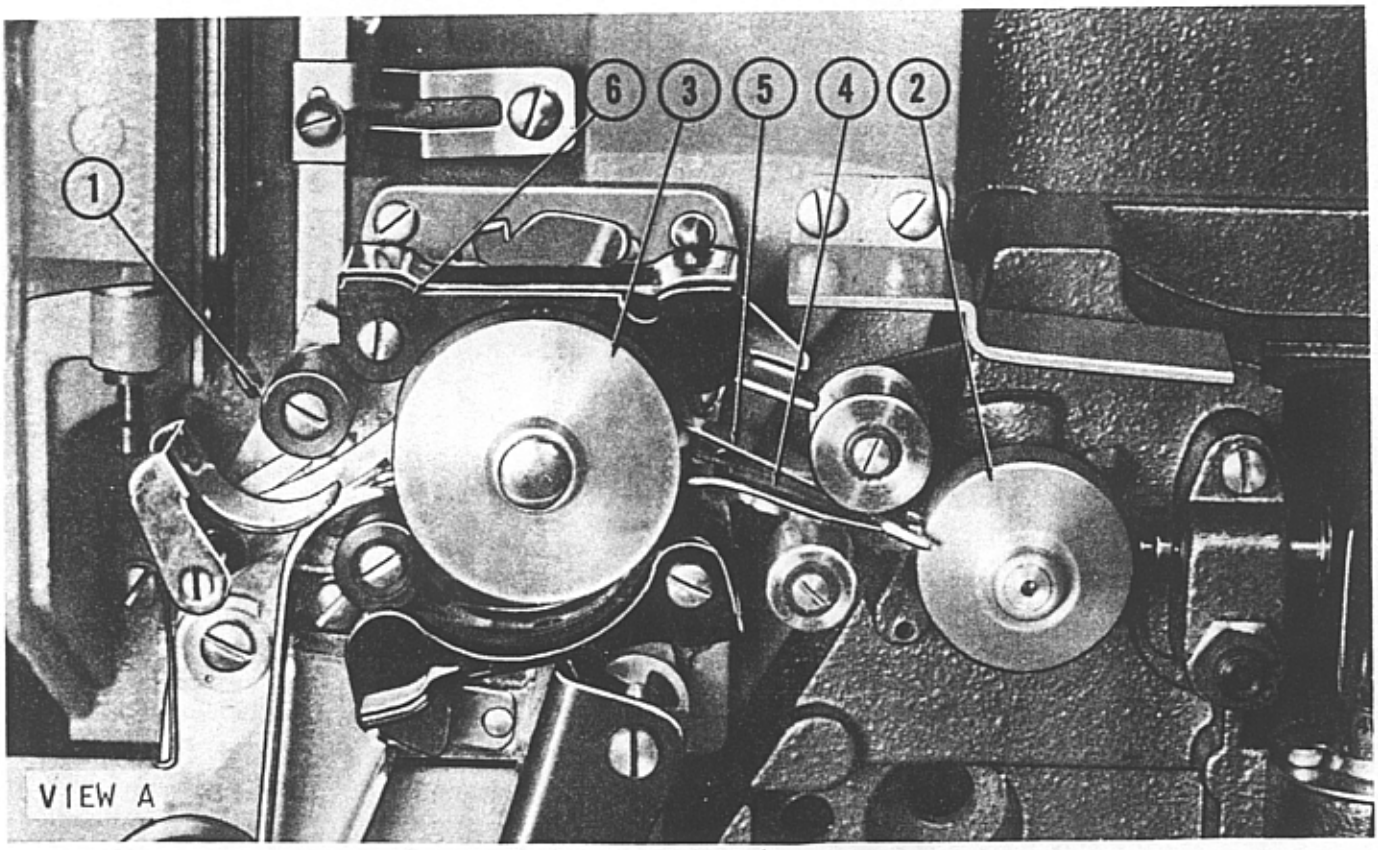
a. Slip the loop restorer position tool (Figure A) over the loop restorer roller (1, Figure R) with the flat on the tool facing the guide roller at the rear end of the upper sprocket shoe (6, Figure R). The flat of the tool should just touch the guide roller lightly. To adjust spacing between loop restorer roller and guide roller, loosen the mounting screws in the self-centering assembly (inset B, Figure R) and raise or lower that 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, diretly below the camshaft (see inset B, Figure R). 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 (inset B) 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 (inset 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 follower screws (inset B) and raise or lower the cam follower blade as necessary; then retighten the two screws securely.

c. Recheck the clearance between the loop restorer roller and upper sprocket shoe guide roller as outlined in step a, above. Remove the restorer positiong tool and once more check loop restorer operation with the loop of test film.

43. TIMING THE SPROCKETS.

a. Open the film gate and turn down the framer shaft as far as it will go. Then turn the mechanism manually until the shuttle is at the bottom of the stroke



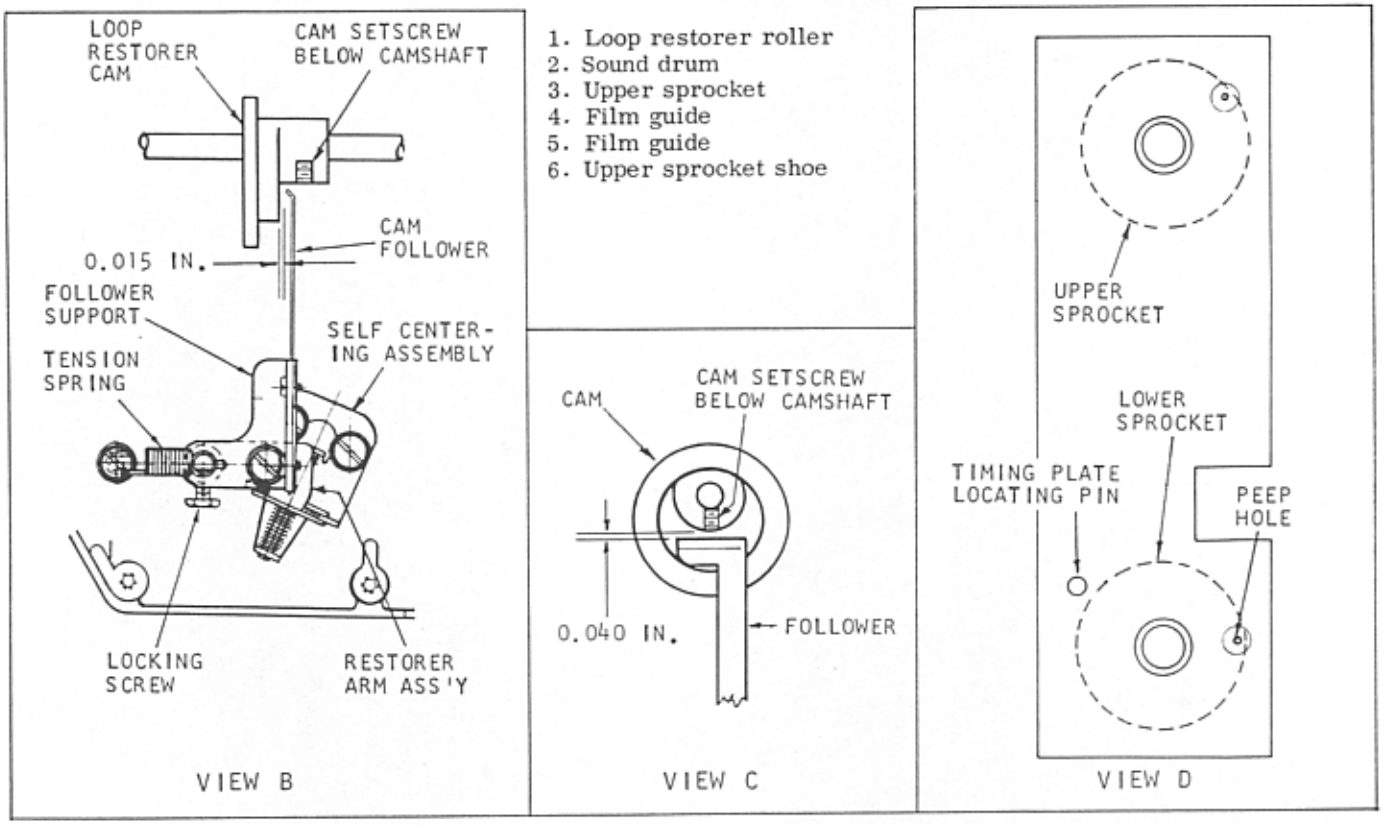


Figure R. Autoload System Adjustments — View III

(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 edge of notch in driven clutch (see Figure K, View B).

c. Open the film shoes and place the timing plate (item 11, Figure A) over the sprocket hubs (View D, Figure K). Dip the end of a straightened paper clip in red lacquer and insert it down through the peep holes to mark the face of each sprocket. Remove timing plate and place a light pencil mark on the face of each sprocket in line with the teeth nearest the red dot. If this pencil mark does not align with the red dot, 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 as follows:

d. To retime 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 pencil alignment mark appears in the center of the timing plate peep hole. Tighten the gear setscrews securely without retaining the gear or the sprocket.

44. CHECKING THE EXCITER LAMP COVER CLEARANCE. Since the film must pass between the sound drum and 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 cover. Gage should enter channel with slight friction but without forcing. If clearance is inadequate, straighten the exciter cover locating pins to obtain proper clearance.

45. GEAR SHIFT TENSION ADJUSTMENT. When shifting from forward to rewind, or vice versa, the idler gear arm (Figure S) 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

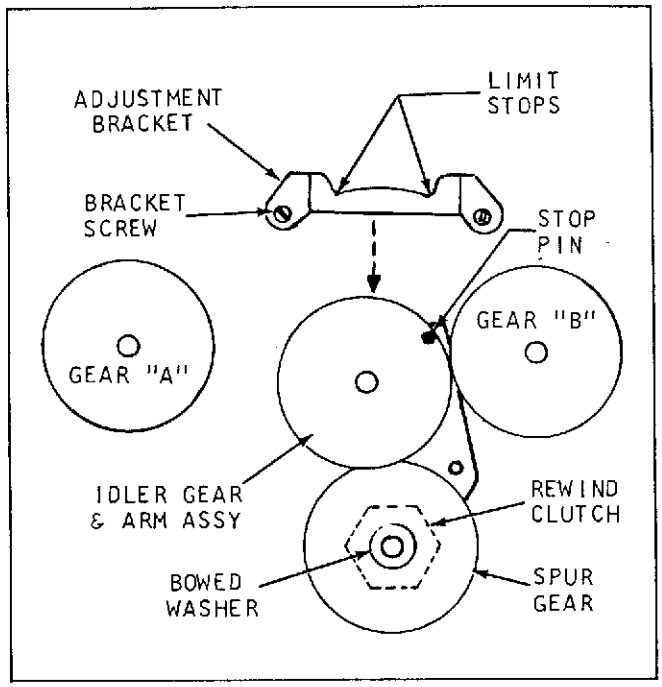


Figure S. Adjusting Gear Shift Tension and Backlash

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 S) is flattened against the face of the gear.

46. IDLER GEAR BACKLASH ADJUSTMENT. In both the forward and rewind positions, there must be a perceptible amount of backlash between the idler gear and gears "A" and "B," Figure S. 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.

Trouble Shooting

47. MISCELLANEOUS TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Nothing runs	1. Defective On-Off switch.	1. Replace switch.
	2. Damaged power cable.	2. Repair or replace cable.
	3. Loose connections.	3. Repair connections.
Motor hums but does not run	1. Starting circuit open or shorted.	1. Repair loose or transposed connections Replace defective capacitor and/or relay.
Motor runs but mechanism does not run	1. Damaged switch.	1. Replace switch.
	2. Transposed leads on main switch.	2. Connect leads to proper terminals.
	3. Drive belt broken or unhooked from pulley.	3. Replace or reinstall drive belt.
	4. Motor pulley loose on shaft.	4. Position pulley and tighten setscrews.
	5. Animation clutch spring broken.	5. Replace spring.
Rewind does not operate	1. Rewind clutch not engaging or clutch slipping.	1. Adjust (paragraph 37c).
Take-up does not operate	1. Take-up sprocket damaged.	1. Replace sprocket.
Feed spindle does not REVOLVE IN REVERSE	1. Dirt in reverse take-up clutch.	1. Clean clutch.
Gate will not lock	1. Latch spring set too close to lens mount stop.	1. Adjust latch spring.
	2. Pressure plate out-of-line.	2. Realign pressure plate.
Shuttle runs but sprockets do not revolve	1. Animation clutch spring broken or lost.	1. Replace spring.
Short lamp life	1. Line voltage in excess of lamp voltage.	1. Use lamp of correct voltage rating.
	2. Drive belt broken or disengaged.	2. Replace or re-engage belt.
	3. Dirt and lint clogging blower housing.	3. Clean.
Projector speed slow	1. Binding in the mechanism.	1. Free binding condition.
	2. Belt slipping.	2. Clean or replace belt.
Runs at speed between 18 and 24 FPS	1. Pulleys out-of-line.	1. Realign pulleys.
	2. Belt shifter bent.	2. Straighten belt shifter.
	3. Power line frequency other than 60 cycles.	3. Use proper voltage and frequency.

48. PICTURE TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Film jump	1. Damaged film.	1. Repair or replace.
	2. Loose shuttle.	2. Adjust and tighten (paragraph 33c).
	3. Dirty film aperture.	3. Clean film aperture.
	4. Damaged or lost pressure plate spring.	4. Replace spring.
	5. Pressure plate misaligned.	5. Realign pressure plate.
	6. Incorrect shuttle stroke.	6. Adjust (paragraph 33d).
Double image	1. Incorrect shuttle stroke.	1. Adjust (paragraph 33d).
	2. Excessive shuttle protrusion.	2. Adjust (paragraph 33d).
Weave (due to faulty aperture plate)	1. Sticking edge guide.	1. Clean guide.
	2. Replace tension spring lost.	2. Replace spring.
	3. Fixed edge guide out of position.	3. Reposition guide.
Poor illumination	1. Optics out-of-line.	1. Realign (paragraph 32).
	2. Fire shutter sticking.	2. Checking mechanical linkage for binding.
Poor focus	1. Dirty lens and/or aperture.	1. Clean lens and/or aperture.
	2. Warped film.	2. Recondition or replace film.
	3. Projector lens mount out-of-line.	3. Realign (paragraph 34).
	4. Pressure plate spring lost.	4. Replace spring.
	5. Bent pressure plate.	5. Replace pressure plate.
	6. Pressure plate out-of-line.	6. Realign pressure plate.
Frame line creeps	1. Framer eccentric loose.	1. Align and tighten (paragraph 33e).
Insufficient framing	1. Framer eccentric out of adjustment.	1. Adjust (paragraph 33e).
Trailer ghost	1. Shutter out-of-line.	1. Reassemble properly.

49. FILM TRANSPORT TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Loss of loops	1. Damaged film.	1. Repair or replace film.
	2. Inadequate shuttle protrusion.	2. Adjust (paragraph 33b).
	3. Inadequate or excessive shuttle stroke.	3. Adjust (paragraph 33d).
	4. Pressure plate spring lost.	4. Replace spring.
	5. Pressure mounting plate screws loose.	5. Tighten mounting screws.
	6. Sprocket guards not closing.	6. Clean or adjust.
	7. Sprocket drive gear loose on shaft.	7. Retime (paragraph 43) and tighten setscrews.
	8. In-out bracket spring broken.	8. Replace spring.
Shuttle operates but sprockets do not revolve	1. Animation clutch spring broken or lost.	1. Replace spring.
Lower loop not restored	1. Loop restorer stroke too short.	1. Adjust (paragraph 42).
	2. Loop restorer does not engage restorer cam.	2. Adjust (paragraph 42).
Film rubs on loop restorer roller	1. Restorer arm out of position.	1. Reposition (paragraph 42).
Excessive film slap	1. Damaged film.	1. Recondition or replace.
	2. Green film.	2. Age or buff film.
	3. Dirty pressure plate.	3. Clean pressure plate.
	4. Pressure plate rubbing on aperture plate guide rails.	4. Realign pressure plate.
	5. Incorrect shuttle stroke.	5. Adjust (paragraph 33d).
Animation clutch does not operate	1. Open in animation clutch circuit.	1. Repair circuit.
	2. Solenoid plunger set too high or too low.	2. Adjust solenoid plunger (paragraph 35).
	3. Stop pawl clearance excessive.	3. Adjust (paragraph 35a).
Animation clutch stops sprocket but shuttle pulls film	1. Insufficient shuttle retraction.	1. Adjust (paragraph 35b).
Splices jam in sprocket shoes	1. Bad splices.	1. Replace splices.
	2. Emulsion build-up.	2. Clean film path components.

50. SOUND SYSTEM TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Projector runs, no voltage at P.C. board	1. Loose connection.	1. Repair connection.
	2. Amplifier switch damaged.	2. Replace switch.
Projector runs, voltage at P.C. board, but exciter lamp does not light	1. Exciter lamp cable disconnected.	1. Connect cable.
	2. Wrong exciter lamp used.	2. Replace with correct lamp.
	3. Projector main switch open or leads disconnected.	3. Replace main switch or connect leads.
Voltage at P.C. board, exciter lamp lights, but no sound	1. Speaker jack disconnected or speaker jack switch open.	1. Connect leads. Repair or replace jack.
	2. Photocell cable disconnected or leads reversed.	2. Connect cable. Connect leads to proper terminals.
	3. Photocell out-of-line.	3. Realign (paragraph 38b).
	4. Dirt on end of photocell.	4. Clean photocell.
	5. Wrong exciter lamp used.	5. Replace with correct lamp.
Low volume	1. Trouble in printed circuit board.	1. Check out the circuit board.
	2. Wrong exciter lamp used.	2. Replace with correct lamp.
	3. Photocell out-of-line.	3. Realign (paragraph 38b).
	4. Dirt on photocell or slit.	4. Clean photocell and slit.
	5. Slit misaligned.	5. Realign (paragraph 38e).
	6. Buzz track misaligned.	6. Realign (paragraph 38f).
Distortion at all volume levels	1. Wrong exciter lamp used.	1. Replace with correct lamp.
	2. Trouble in printed circuit board.	2. Check out the circuit board.
Crackling noises	1. Broken ground lead to main frame.	1. Replace defective lead.
	2. Buzz track out-of-line.	2. Realign (paragraph 38f).
	3. Broken cable shield.	3. Repair shield or replace cable.
Wow or flutter	1. Soundhead 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. Film edge guide (soundhead) out-of-line.	3. Realign (paragraph 38f).
	4. Loose flywheel.	4. Tighten flywheel.

50. SOUND SYSTEM TROUBLES AND REMEDIES (CONT'D).

TROUBLE	PROBABLE CAUSE	REMEDY
Wow or flutter (cont'd)	5. Damaged sound drum bearing.	5. Replace sound drum.
	6. Dirt causing guide roller arm pivot bearing to bind.	6. Clean and polish.
	7. Photocell or exciter cable rubbing against flywheel.	7. Reposition cables.
	8. Chips or dirt in take-up sprocket gear teeth.	8. Remove and clean sprocket gear.
	9. Loop restorer stroke is too short or restorer set too low.	9. Adjust (paragraph 42).
Clicking noises	1. Dirt on sound drum.	1. Clean sound drum.
	2. Broken ground lead to main frame.	2. Replace lead.
High frequencies fade (jumps focus)	1. Warped film.	1. Recondition or replace film.
	2. Film edge guide (soundhead) out-of-line.	2. Realign (paragraph 38f).
	3. Dirt on sound drum.	3. Clean sound drum.
Hum	1. Ground wiring.	1. Correct grounded condition.
	2. Trouble in printed circuit board.	2. Check out the circuit board.

51. TROUBLE SHOOTING AUTOLOAD SYSTEM.

a. General. Any obstruction in the film path, such as caked emulsion, film chips or splicing tape can be expected to interfere with proper threading. Time will be saved by cleaning the threading path and, at the same time, making a visual inspection of all shoes and guides before attempting to localize the trouble. Do not use metal tools to remove material adhering to guides or rollers. Use an orange stick, plastic rod or toothpick whenever scraping is necessary. Pipe cleaners dampened with toluol, naphtha or isopropyl-alcohol are very convenient for cleaning in restricted areas. Do not use trichloroethylene or carbon tetrachloride as cleaning solvents as they might damage or stain plastic parts. Do not use excessive amounts of solvents, or lubricants will be removed from linkage pivots, slides, etc., and will have to be replenished.

b. Test Film. The autoload system has been designed to function properly with all films which can be described as being in projectable condition (see Operators Instructions for limits of shrinkage, curl, etc.). Generally, any film which functions properly in other Bell & Howell projectors (such as Designs 399, 542 and 552) can be used for testing the autoload system. Any film which does not thread properly should be inspected. The end of the leader must be properly trimmed and free from sharp bends. All sprocket holes in the first 18-inches of leader must be in good condition. Splices must be properly registered and in good condition. Sprocket holes restricted by cement or splicing tape must be cleared or the splice remade. The repairman is cautioned that it would be a waste of time to adjust or attempt to adjust the autoload system to autothread a film which is in such poor condition as to be incapable of being the source of an uninterrupted film presentation of acceptable quality.

c. Autoload Trouble Shooting Chart.

TROUBLE	PROBABLE CAUSE	REMEDY
Film cannot be inserted into feed sprocket	1. Obstruction below roller of channel (16c, Figure 9).	1. Remove obstruction.
	2. Roller channel (16c, Figure 9) bent or binding.	2. Straighten or replace assembly.
	3. Excessive pressure on leaf spring (26, Figure 10).	3. Adjust leaf spring (paragraph 41k).
Film will not pull between feed sprocket and sprocket shoe	1. Entrance guide (11, Figure N) misaligned.	1. Realign per paragraph 41h).
	2. Feed sprocket guard sticking.	2. Clean sprocket shoe pivot.
	3. Feed sprocket guard spring (30, Figure 9) broken.	3. Replace spring.
	4. Caked emulsion or burr on sprocket shoe film rails.	4. Clean; remove burr with crocus cloth.
Film comes out the side of top sprocket	1. Obstruction in sprocket guard.	1. Remove obstruction.
	2. Damaged sprocket guard.	2. Replace sprocket shoe.
	3. Sprocket guard and sprocket misaligned laterally.	3. Realign.
Film strikes top of aperture plate and begins to pile up	1. Upper loop former (8, Figure P) bent or out of adjustment.	1. Straighten or replace if bent; or readjust per paragraph 41e.
	2. Lower loop former (4, Figure P) set too close to aperture plate.	2. Readjust per paragraph 41c.
Film butts into or goes under top end of aperture plate side tension rail or strakes fixed rail	1. Upper loop former (8, Figure P) bent causing sidewise deflection of film.	1. Straighten or replace.
	2. Lower loopformer (4, Figure P) bent or out of adjustment.	2. Straighten or replace if bent; or readjust per paragraph 41c.
Film butts against top of film pressure plate or passes over outside of pressure plate	1. Lower loop former (4, Figure P) out of adjustment.	1. Readjust per paragraph 41c.
	2. Pressure plate not lifting off of aperture plate when film gate is closed.	2. Bent parts need straightening (paragraph 41g) or replacing.
Film ejects between bottom of gate and top of take-up sprocket, or piles up in this area	1. Lower loopformer (13, Figure 10) bent or sticking.	1. Straighten, remove bind, or replace as necessary.
	2. Lower loop former spring (14, Figure 10) broken.	2. Replace spring.
	3. Loop restorer out of adjustment or restorer roller stud bent.	3. Readjust loop restorer (paragraph 42); replace damaged parts.
	4. Obstruction or burr in take-up sprocket upper guard.	4. Clean; remove burr with crocus cloth.
	5. Sprockets out of time. BOTTOM SPROCKET	5. Time sprockets per paragraph 43.

TROUBLE	PROBABLE CAUSE	REMEDY
Film not threading over take-up sprocket	1. Sprocket guard mounting plate (21, Figure 10) out of position.	1. Reposition per paragraph 41b).
	2. Obstruction in upper sprocket guard.	2. Remove obstruction.
	3. Sprocket guard spring (30, Figure 9) broken.	3. Replace spring.
	4. Take-up sprocket shaft loose in gear (13, Figure 9).	4. Retime sprockets (paragraph 43) and tighten setscrews (11, Figure 9).
Film piles up ahead of sound drum	1. Insufficient clearance between soundhead threading guides (4 and 5, Figure R).	1. Readjust all guides per paragraph 41.
	2. Back-up bracket (16, Figure 1) bent downward.	2. Straighten bracket.
	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 cover.	5. Check clearance per paragraph 44.
	6. Edge guide adjusting screw (24, Figure 8) out too far.	6. Adjust per paragraph 38f.
Film ejects ahead of lower take-up sprocket shoe or piles up in this area	1. Insufficient clearance between soundhead threading guides (4 and 5, Figure R).	1. Readjust all guides per paragraph 41.
	2. Soundhead loose or improperly positioned.	2. Reposition per paragraph 38g.
	3. Obstruction or burr in lower take-up sprocket guard.	3. Remove obstruction; remove burr with crocus cloth.
	4. Film guide (4, Figure 8) improperly positioned.	4. Reposition guide.
Film sticks in or is ejected from lower take-up sprocket guard	1. Obstruction or burr in lower take-up sprocket guard.	1. Remove obstruction; remove burr with crocus cloth.
	2. Sprocket guard sticking.	2. Clean sprocket guard pivot.
	3. Broken sprocket guard spring (30, Figure 9).	3. Replace spring.
	4. Sprocket guard and sprocket misaligned laterally.	4. Realign.
	5. Autothread lever (11, Figure 10) bent or improperly positioned.	5. Reposition or straighten lever.
Film piles up ahead of idler roller (13, Figure 5) or is ejected from this area	1. Autothread lever (11, Figure 10) bent or improperly positioned.	1. Reposition or straighten lever.
	2. Idler roller sticking or roller stud loose or bent.	2. Remedy sticking condition; replace autothread lever (11, Figure 10).
System will not lock	1. Autothread lever (11, Figure 10) binding.	1. Repair or replace lever.
	2. Release spring (10, Figure 10) disengaged or broken.	2. Engage spring with locking lever, or replace spring.
	3. Eccentric bushing (9, Figure 10) improperly adjusted.	3. Readjust bushing per paragraph 41i.

TROUBLE	PROBABLE CAUSE	REMEDY
Loop restorer cycles continuously	1. Restorer out of adjustment.	1. Adjust per paragraph 42.
	2. Shuttle retractor pin (29, Figure 11) sticking.	2. Clean and lubricate pin.
	3. Pressure plate (5B, Figure 9) binding on aperture plate edge guide.	3. Realign pressure plate.
Slack film in soundhead area	1. Sprocket guards sticking.	1. Clean sprocket shoe pivots.
	2. Take-up jerking.	2. Check take-up torque and check for binding in take-up reel arm.
	3. Jockey rollers (soundhead) sticking.	3. Clean and lubricate.
	4. Soundhead improperly positioned.	4. Reposition per paragraph 38g.
	5. Dirt or obstruction between sound drum and exciter lamp cover.	5. Remove obstruction.
Film scratches	1. Caked emulsion on film path parts. ON PLASTIC AND METAL	1. Clean film path.
	2. Film chips in sprocket guards.	2. Remove film chips.
	3. Scratches or burrs on film guides, guards, aperture or pressure plate.	3. Polish with crocus cloth or replace.
	4. Jockey rollers (soundhead) sticking.	4. Clean and lubricate.
Perforations checked	1. Shuttle not retracting.	1. Adjust per paragraph 41f.
	2. Pressure plate not lifting from aperture plate.	2. Adjust per paragraph 41g.
	3. Excessive feed or take-up tension.	3. Adjust tension.
Film dimpled between perforations	1. Sprocket shoes sticking.	1. Clean sprocket shoe pivots.
	2. Shuttle not retracting.	2. Adjust per paragraph 41f.
MOST LIKELY	3. Sprockets out of time.	3. Retime per paragraph 43.
	4. Inadequate pressure on leaf spring (26, Figure 10).	4. Adjust per paragraph 41k.
	5. End of film leader not cut clean and square.	5. Check your film cutter; replace if dull or broken.
Film escape mechanism does not open to permit exit of film	1. Film exit latching is out of adjustment.	1. Readjust per paragraph 41d.
Film escape locking pawl does not seat properly; film exits constantly	1. Torsion spring (46c, Figure 10) is disconnected.	1. Connect torsion spring.
	2. Locking pawl (46e, Figure 10) out of adjustment.	2. Readjust locking pawl per paragraph 41d.

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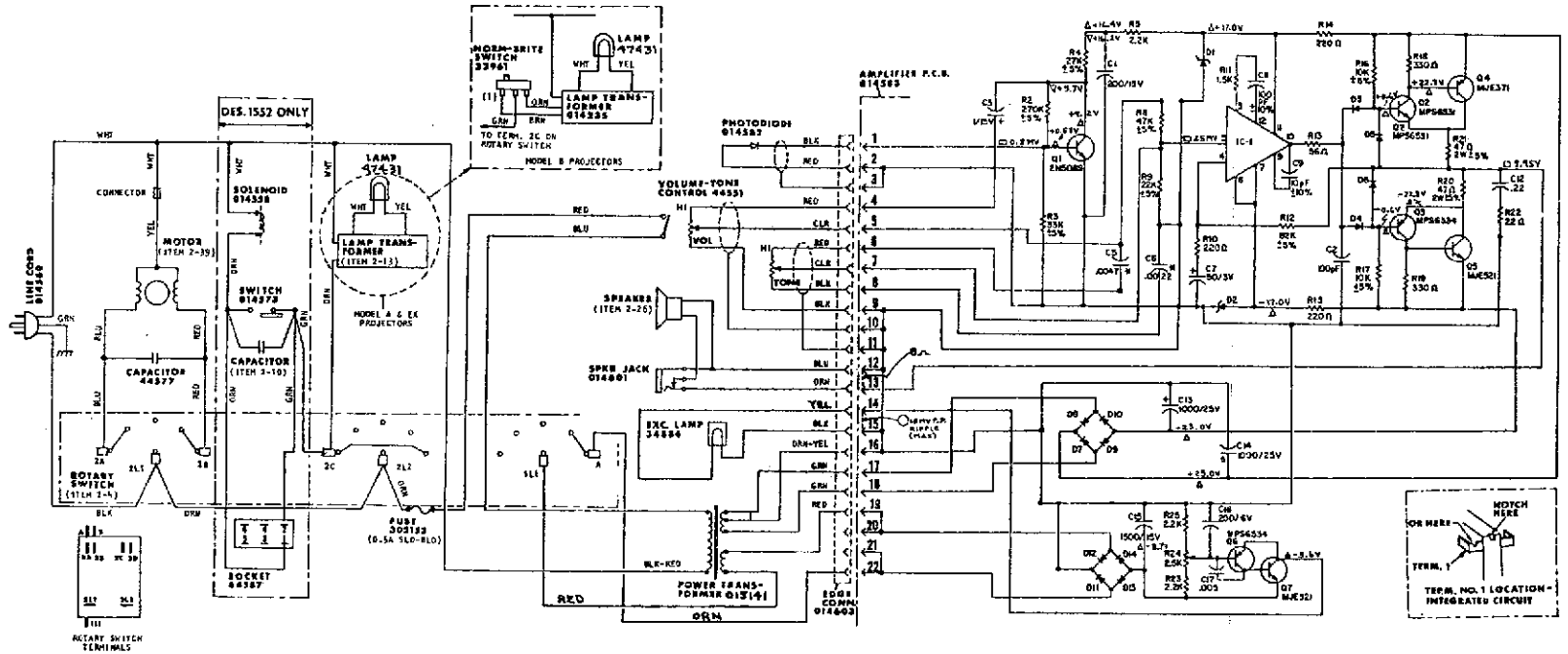

NOTES:

ALL RESISTORS 1/2 WATT ±10% UNLESS OTHERWISE INDICATED

ALL CAPACITOR VALUES IN MFD UNLESS OTHERWISE INDICATED

ALL MEASUREMENTS MADE WITH 120V 60HZ LINE

△ INDICATES DC VOLTAGE MEASURED TO GROUND USING ELECTRONIC VOLTMETER: NO SIGNAL, EXCITER LAMP ON, PHOTOCELL ILLUMINATED (±10% TOLERANCE)

▽ INDICATES DC VOLTAGE WITH PHOTOCELL DARK

□ INDICATES SIGNAL VOLTAGE MEASURED TO GROUND USING ELECTRONIC VOLTMETER: VOLUME CONTROL AT MAX., 10 WATTS (8.95V) OUTPUT INTO 8-OHM RESISTIVE LOAD AT 1000 HZ (±10% TOLERANCE)

○ MEASURED WITH OSCILLOSCOPE OR P.P. ELECTRONIC VOLTMETER

REF	PART NO.	REF	PART NO.	REF	PART NO.	REF	PART NO.
C1	44556	C16	41395	Q5,Q7	41178	R12	88884
C2,C8	44496	C17	41393	R2	41191	R13	41193
C3	88654	D1,D2	43210	R3	41190	R14,R15	36074
C5	44562	D3-D6	41173	R4	41189	R16,R17	765286
C6	44561	D7-D14	41174	R5,R23	31743	R18,R19	36316
C7	41394	IC1	41180	R8	38187	R20,R21	44498
C9	44497	Q1	41175	R9	41188	R22	41194
C12	43910	Q2	41176	R10	41186	R24	44559
C13,C14	44557	Q3,Q6	41177	R11	31732	R25	31743
C15	44558	Q4	41179				

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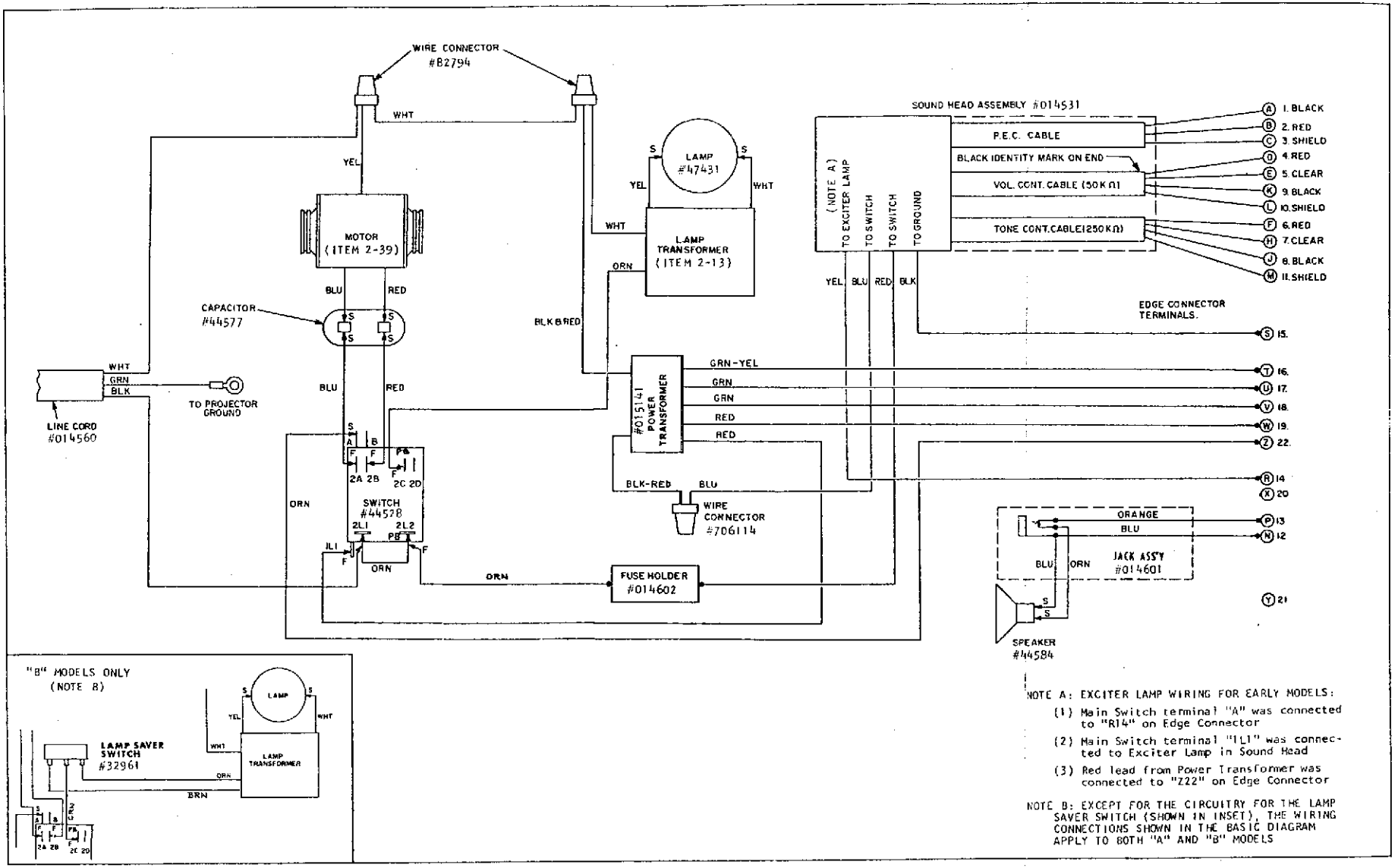
Figure 15

PROJECTOR-AMPLIFIER WIRING DIAGRAMS FOR 1500-SERIES PROJECTORS

DATE	SERVICE	DRAWN J W M
REV 4-15-74	DATA	APPVD

014583 AMPLIFIER PCB ASSEMBLY FOR 1535, 1540, 1545, 1550, 1552 SERIES

SEE ALSO SERVICE BULLETINS # A-73-179 (REVISED) AND # A-74-194



NOTE A: EXCITER LAMP WIRING FOR EARLY MODELS:

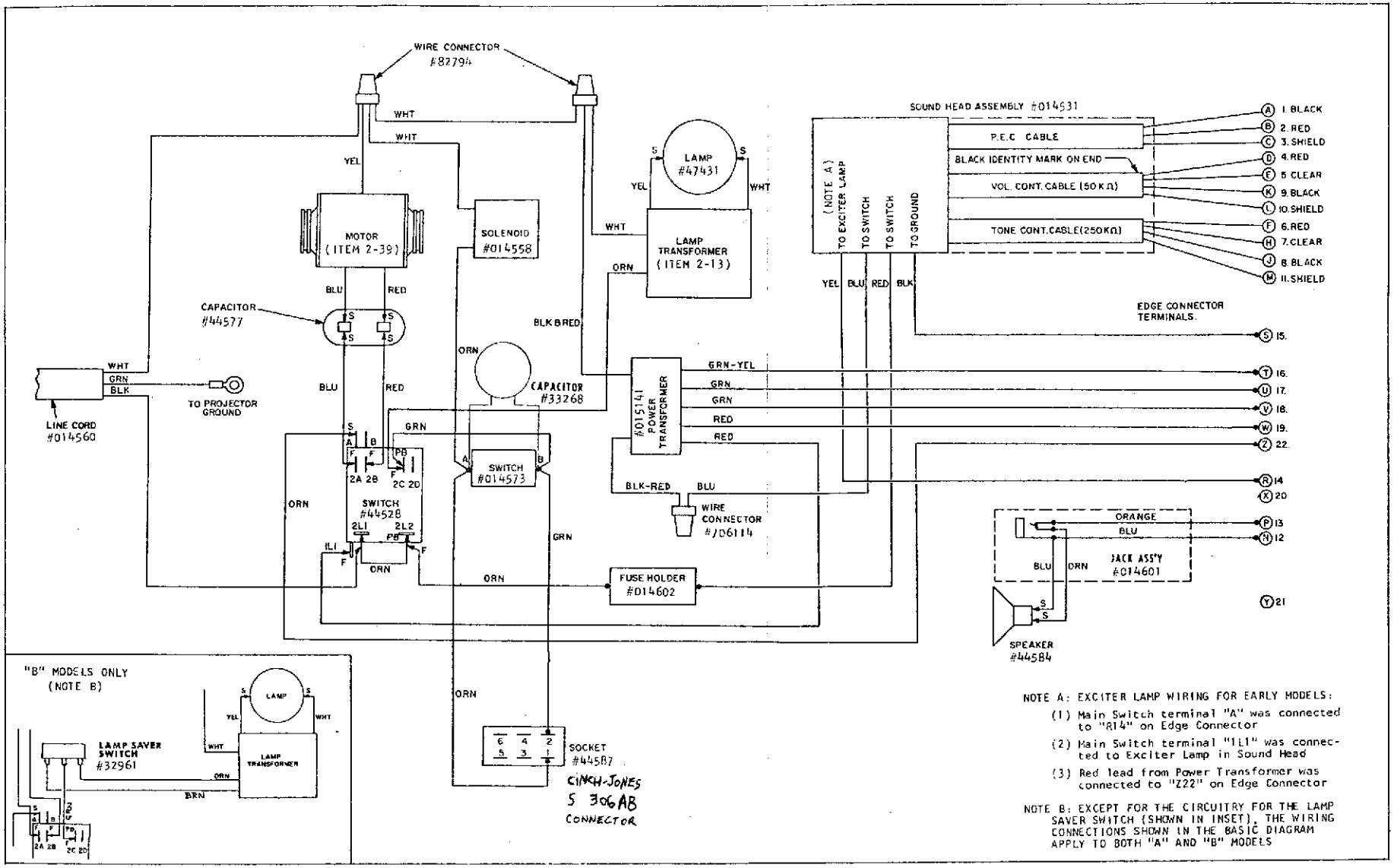
(1) Main Switch terminal "A" was connected to "R14" on Edge Connector

(2) Main Switch terminal "IL1" was connected to Exciter Lamp in Sound Head

(3) Red lead from Power Transformer was connected to "Z22" on Edge Connector

NOTE B: EXCEPT FOR THE CIRCUITRY FOR THE LAMP SAVER SWITCH (SHOWN IN INSET), THE WIRING CONNECTIONS SHOWN IN THE BASIC DIAGRAM APPLY TO BOTH "A" AND "B" MODELS

Figure 16. Projector Pictorial Diagram
(Designs 1545 and 1550)



NOTE A: EXCITER LAMP WIRING FOR EARLY MODELS:

(1) Main Switch terminal "A" was connected to "R14" on Edge Connector

(2) Main Switch terminal "1L1" was connected to Exciter Lamp in Sound Head

(3) Red lead from Power Transformer was connected to "Z22" on Edge Connector

NOTE B: EXCEPT FOR THE CIRCUITRY FOR THE LAMP SAVER SWITCH (SHOWN IN INSET), THE WIRING CONNECTIONS SHOWN IN THE BASIC DIAGRAM APPLY TO BOTH "A" AND "B" MODELS

Figure 17. Projector Pictorial Diagram (Design 1552)

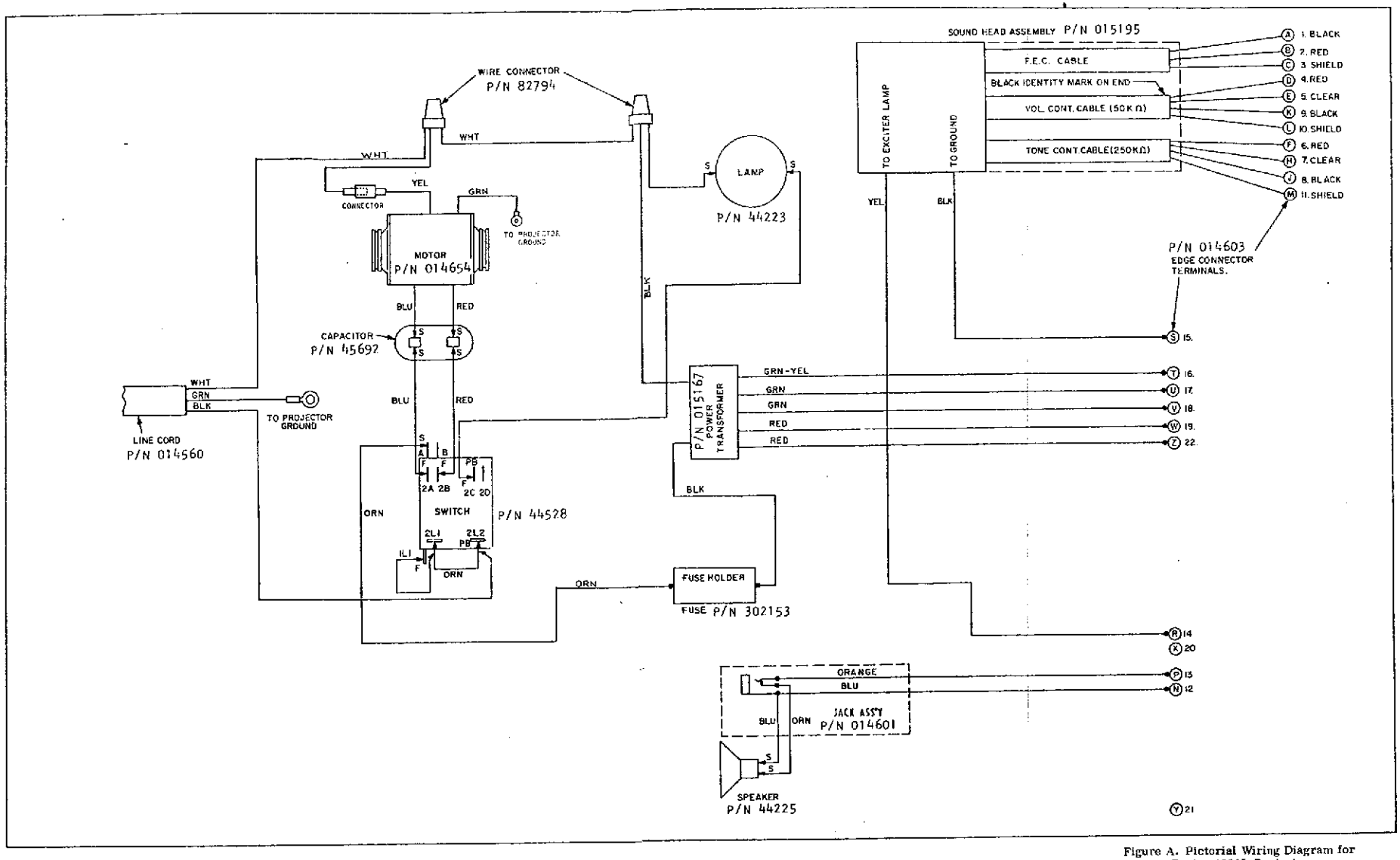


Figure A. Pictorial Wiring Diagram for Design 1550L Projector

ECONOMY MODEL 1550-L