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SERVICE INSTRUCTIONS

FILMOSOUND PROJECTOR

(MANUAL THREADING)

DESIGN 1574/ 1579

KMR ELECTRONICS DATE 09/25/91
PO# 108
Replacement part for MFG BH2
QUN 1 P/N 73584
KMR Electronics (714) 979-0400

BELL & HOWELL

GENERAL SERVICE DEPT.
7100 McCORMICK ROAD
CHICAGO, ILLINOIS 60645

PART NO. 73584 PRINTED IN U.S.A. AUGUST 1975

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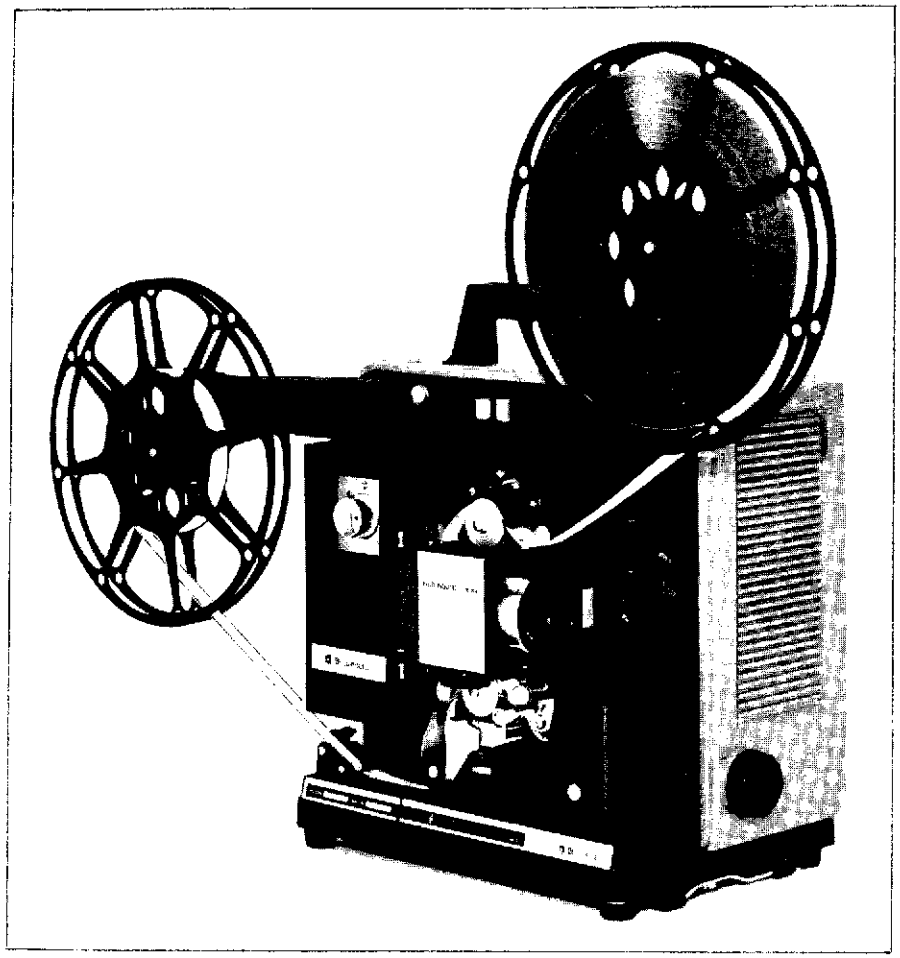


Design 1579 Manual Thread Filmosound Projector

FEATURE DESCRIPTION LIST

Operating Voltage	117VAC, 60Hz (50/60Hz motor available)
Film Threading	Manual
Projector Control	Forward and reverse projection only
Projection Lens (Standard)	2-inch f/1.4
Projection Lamp . EMM/EKS	25 hour, 250 watt P/N 47431
Exciter Lamp	4-volt Type BAK P/N 34884
Amplifier	Solid state with integrated circuit; output, 10 watts RMS
Total Power Consumption	350 watts

Introduction

GENERAL.

This Service Manual has been prepared to assist in the repair and adjustment of Bell & Howell Manual Threading Filmosound Projectors, Design 1574 and 1579. Design specifications are listed in the Feature Description List on the preceding page. An illustrated Parts Catalog is included at the rear of the manual to identify replacement parts and to aid the serviceman in the disassembly and reassembly of the projector. Parts differences between models are indicated by the use of code letters in the "Usable on Code" column of the parts lists, with the coding system explained on page 2 of the Parts Catalog.

DESCRIPTION.

The only difference in these two projectors is in the color. The Design 1574 projector has light grey and black covers and castings, while the Design 1579 is turquoise and charcoal. For both projectors, the film must be threaded manually through the system to the take-up reel.

These projectors are completely gear-driven, with shifting from forward to rewind accomplished by means of a rocker plate and idler gear arrangement. All functions are electrically controlled by a single rotary switch knob on the lamphouse.

SPECIAL MAINTENANCE PRECAUTIONS.

Before beginning repair operations, check specific customer complaints against the Trouble-shooting 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.

CLEANING.

All film path areas must be kept free from emulsion build-up to insure trouble-free operation. Use Tuoluol, and/or an orange stick to remove emulsion from the film path areas, being careful not to scratch the surfaces. Pay particular attention to the film path parts of the soundhead cover and soundhead.

BRISTOL SETSCREW WRENCHES REQUIRED FOR MAINTENANCE

Setscrew Size	No. of Flutes	B&H Part No.	
		Handle	Wrench
No. 4-40NC	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.

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 in cricical areas of lubrication where disassembly would be required in order to re-lubricate. 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 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.

DRIVE BELT REPLACEMENT.

Because of the compactness of design of these projectors, 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 3.

a. Remove the rear cover (item 7, Figure 1) 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 (26, Figure 3) and lift off the straps and stabilizer bracket (27) as a group.

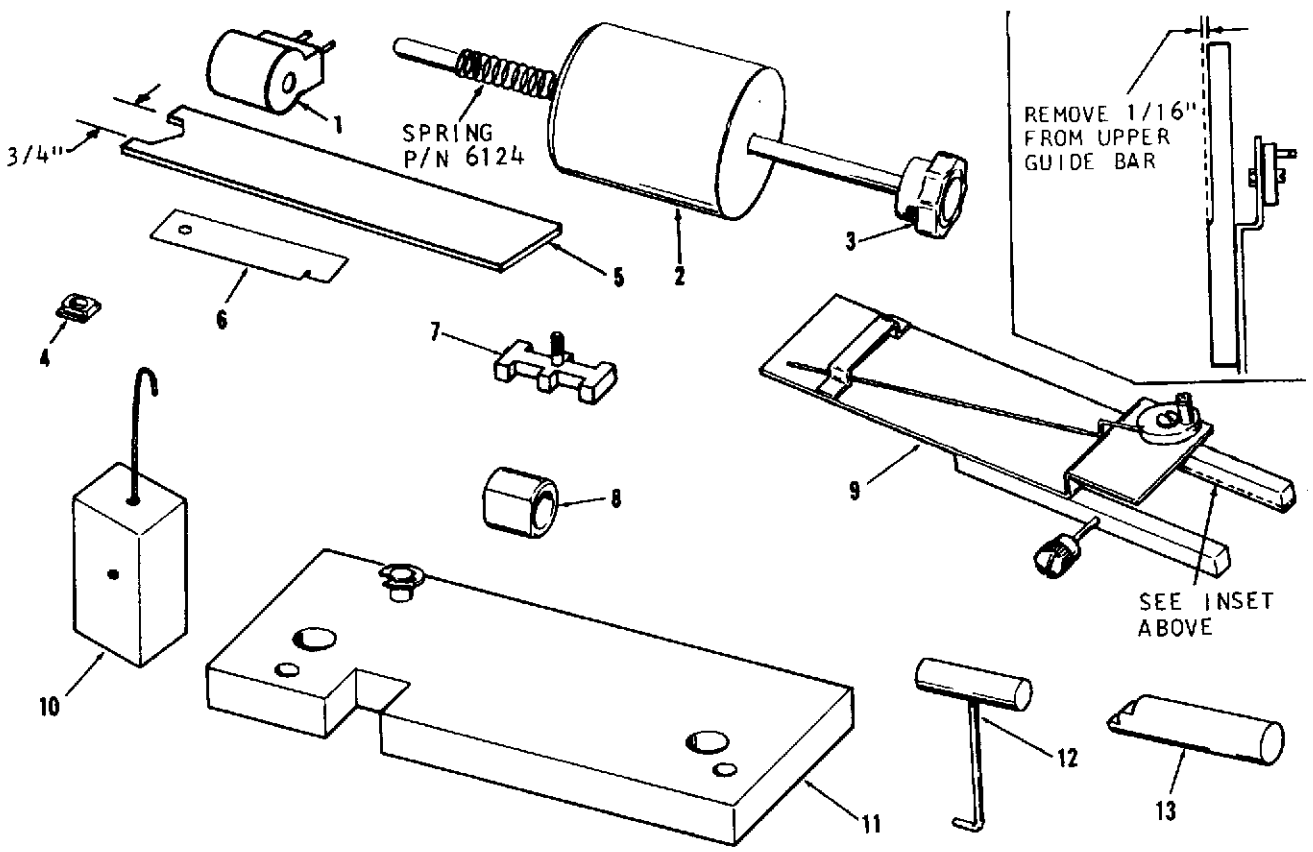
d. Raise the motor just enough to permit the belt to be passed beneath the motor toward the transformer. Be very careful not to lift the motor so high as to damage the blower fan at the end of the motor shaft.

e. Disconnect the push-on connectors which connect the motor leads to the starting capacitor (item 7C, 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 from the projector.

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 (27, Figure 3).

LUBRICATION CHART

PARTS TO BE LUBRICATED	LUBRICANT
Machined surface (non-bearing) of all castings	Oil (Part Number 070003)
Sprocket shafts (16 and 17, Figure 9)	Oil (Part Number 08963)
Framer shaft (26, Figure 11) and bearing face of worm gear (33, Figure 11)	Oil (Part Number 04978)
Felt oil pads in cams, shafts and sliding parts (friction surfaces) not otherwise specified	Oil (Part Number 070032)
The following items are to be greased sparingly:	
Friction surface of lamp release ring (18, Figure 8)	Grease (Part Number 070034)
Reel arm lock buttons (30, Figure 4)	
Tilt rack and pinions (Figure 5)	
Meshing gears in reel arms (Figures 6 and 7)	
Loop restorer shaft (31, Figure 10)	
Self-centering assembly (36, 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 11); film guide pivot posts, sprocket shaft bearings and camshaft bearings	
Pinion teeth of focus knob (56, Figure 9)	



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 M)
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 N)
12	SER-552-5-N1	Soundhead Locating Gage	Positioning the soundhead (Figure L)
13	SER-550-8-N1	Alignment Tool	Aligning sound drum and photocell (Figure K)
	SER-550-5-N1	Shuttle Stroke Target	Measuring shuttle stroke (Figure J)

Figure A. Special Service Tools

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 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.

d. 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. Refer to Figure 14 for leadwire connections.

e. Do not attempt to repair the amplifier assembly (Figure 13) as the field replacement of circuit board components can often do more harm than good. If electrical troubles are traced to the amplifier, replace the complete amplifier assembly.

NOTE: Connections between electrical components and the amplifier are made through the edge connector (item 18, Figure 5). Therefore, when replacing electrical components which are so interconnected, the edge connector must be exposed so that the appropriate leadwires can be disconnected. This is accomplished as instructed in paragraph 6, step c.

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

a. Unlatch and remove the front cover assembly (1). If latches are to be replaced, the rivets (1B) must be carefully drilled out.

b. The back cover (7) is secured by seven screws (6), three along the bottom edge and two at each side. Use a thin-wall socket wrench to remove these screws, grinding it down, if necessary, so that it can fully engage the screw heads.

c. Remove two screws (8) near the top of the mainplate to free the top cover assembly (9). Remove the four screws (9A) and disassemble the carrying handle (9B) and brackets (9C) from the cover. The latch plates (9F) and spacers (9G) are secured with rivets (9E).

d. Remove the lamphouse assembly (11) by pulling it straight out from the projector mainplate. If the latch (11D) is to be replaced, the rivet (11A) must be drilled out.

e. To remove the exciter lamp cover assembly (13), loosen the captive thumbscrew and lift the cover from the soundhead assembly. Refer to paragraph 9 for lamp cover disassembly instructions.

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

a. Loosen the setscrew (1) and disassemble the tilt knob assembly (2) from the tilt shaft.

b. Replacement of the speaker (6B) and starting capacitor (7C) can be accomplished without disassembling the end caps (6) and (7) from the projector. However, if the end caps are damaged and in need of replacement, proceed as follows: Tilt the projector so that the four screws (3) which secure the end caps (6) and (7) to the base can be removed. Then set the projector upright and remove the remaining four screws (4) which are inserted through the front side of the mainplate. Be careful not to lose the speed nuts (5) assembled to the mounting bosses of the end caps.

c. To remove the projection lamp (12), press down the lamp retaining spring and pull the lamp straight out from its socket. Do not rock or twist the lamp during removal, or the lamp pins may be damaged. The lamp shield (14) and lampholder (15) are secured to the mainplate with two screws (13).

4. REMOVAL OF ELECTRICAL PARTS (Figure 3). Before removing electrical components, note the manner in which the leadwires are routed and tied. The pictorial wiring diagram at the rear of the Parts Catalog will assist in the proper reconnection of leadwires.

a. The transformers (6) and (10) are more easily serviced if they are removed from the base as an assembled unit (2). Since the two mounting screws (1) closest to the mainplate are assembled from the underside of the base, the amplifier cover (16,

Figure 5) must be removed for access to those screws. Refer also to the NOTE following paragraph 1 for instructions pertaining to leadwire connections to the edge connector. Disassemble transformers, as necessary, for replacement or repair.

b. 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 (13) and the four blower housing screws (14). If the drive belt (21) 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 (15) and disassemble the fan housing (17) from the housing cover (20). Loosen the setscrew (18) and disassemble the fan and hub assembly (19) and cover (20) from the motor shaft.

c. Remove the two screws (31) which secure the switch bracket (32) to the mainplate and disassemble the nut (33), lockwasher (34) and rotary switch (35) from the bracket. Remove the screw (36) and the fuseholder (37).

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

a. To remove the rear reel arm assembly (29) for repair or replacement, disassemble the retaining ring (1), washer (3), spur gear (4) and a second retaining ring (1) from the end of the reel arm shaft. Note the manner in which the reel arm disc (27) is positioned before disassembling the screws (26) and disc (27) from the mainplate; then carefully withdraw the reel arm assembly, catching the lock button (30) and spring (31) as they pop free.

b. To remove the front reel arm assembly (28) for repair or replacement, disassemble the gear and clutch parts (15) through (20) from the end of the reel arm shaft. Note the manner in which the reel arm disc (27) is positioned before disassembling the screws (26) and disc (27) from the mainplate. Carefully withdraw the reel arm assembly, catching the lock button (30) and spring (31) as they pop free.

c. To remove the soundhead assembly (40) for repair or replacement, it first is necessary to remove the amplifier cover (item 16, Figure 5) so that the soundhead leads can be unsoldered from the edge connector terminals (refer to NOTE following paragraph 1). Assuming that the transformer assembly has already been removed (paragraph 4), refer to Figure 4 and disassemble the retaining ring (32), flywheel (35) and washers (33) and (34) from the end of the sound drum shaft. Then remove three screws (36) and washers (37) and carefully lift the soundhead assembly from the mainplate.

d. No special instructions are required for removal of the drive gearing in Figure 4 except to note in which direction the gear hubs are facing. Inspect all gears for chipped or broken teeth and replace if necessary. Clean and relubricate all reusable gears.

e. Remove two retaining rings (42) and lift out the torsion spring (43). Remove the shoulder studs (44), belt shifter bracket (45) and the spacers (46).

f. Hold the mechanism assembly (49) securely while removing the four screws (47) and the idler gear adjustment bracket (49). Carefully withdraw the mechanism assembly from the mainplate.

6. REMOVAL OF BASE COMPONENTS (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 to which the roller (8) is mounted and disengage that end of the snubber spring. Disassemble the retaining ring (2), flat washer (3) and spring (4) from the top of the spring post (6).

b. Remove the adapter shaft (7) and lift out the film guide roller (8). Remove the screw (9) and lift the film guide assembly (10) from the flanges on the base. Disassemble the guide assembly, if necessary, for replacement of damaged parts.

c. To expose the amplifier assembly (20) and edge connector assembly (18), remove the five screws (15) and the cover (16). Remove the four screws (17) and (19) and lift out both assemblies. When separating the edge connector from the amplifier pull them straight apart without wriggling or twisting them and thus distorting the pins. Note the spacers (21) located beneath the amplifier screw heads.

d. Remove the four screws (22) and the cover (23) to expose the volume and tone control assembly (25). Four screws (24) secure the control assembly into the base. Replace parts as necessary.

e. Remove the screw (26) and lockwasher (27) and disassemble the tilt bar (28) from the lower end of the tilt gear rack (39). Remove two screws (37) and disassemble the adapter (38) and gear rack (39) from the base. Remove the retaining ring (40) and lift out the tilt gearshaft (41) and spring tension washer (42). Drive out the spring pin (43) and lift out the tilt worm gear (44).

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 washers (5D) and (5E) from the spindle (5F).

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 setscrews (8) and (8A) and lift the gear (9) and torsion spring (10) from the reel arm shaft (14). If damaged, disassemble the plastic sleeve (9A) from the gear hub.

d. Remove the two retaining rings (11) and disassemble the reel arm shaft (14) and washers (12) and (13) from the reel arm (22).

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 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. The take-up arm and rear reel arm are replaceable only as an assembly (32).

c. Remove the retaining ring (10) and large flat washer (11) from the end of the gearshaft (16). Do not remove the rubber sleeve (12) from the hub of the gear (14) unless in need of replacement. 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 4) and disassemble only as necessary for replacement of damaged parts.

b. Make a careful note of leadwire connections before disconnecting or unsoldering leads during disassembly of the soundhead. Remove the exciter lamp (5), wipe off fingerprints, and wrap the lamp in tissue paper.

c. Do not loosen the clamping screw (7) or disturb the lateral position of the optical slit assembly (8) unless it has been determined that the optical slit is in need of replacement or adjustment.

d. Unhook and remove the stabilizer arm spring (9). Remove the retaining ring (10) and disassemble the roller adjusting screw (11) and complete stabilizer arm assembly (12) from the soundhead casting. Remove the two screws (12A) and washers (12B) and disassemble the rollers (12C) and (12D) from the stabilizer arm roller shafts. The removal of screws (12E) will free the torsion spring (12G) and stabilizer arms (12F), (12H) and (12J).

e. Remove two screws (13) and disassemble the lamp contact assembly (14) and lamp release ring (15) from the soundhead casting.

f. Loosen the setscrew (16) which bears against the light pipe and photocell retainer (19). Then remove the two screws (17), and carefully withdraw the sound drum assembly (18), retainer (19) and photocell assembly (20) 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 (21).

g. To remove the stabilizer tension adjuster, remove the retaining ring (22) from the adjuster (24), and unscrew the adjuster from the tapped hole in the spring retainer (25). Be careful not to lose the friction washer (23) 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), washers (5C), springs (5D) and pressure plate lever (5E). The adjustment plate (5H) need not be removed. Pry up the nameplate (5H) with a knife blade. Remove two screws (5J) and disassemble the spring (5K) and the knob and pinion assembly (5L) from the lens carrier (5M).

b. Loosen the two setscrews (6) in each sprocket gear (7), and withdraw the gears and the spring tension washers (8) from the sprocket shafts (16) and (17). Remove two screws (9) and the sprocket guard (10). Snap open the three spring-loaded sprocket guards (13) and withdraw the sprocket assemblies (16) and (17) from the mechanism housing sprocket bearings. Remove the thrust washer (19) from each sprocket shaft and withdraw the sprocket flange (18) from the lower sprocket shaft.

c. Remove the screws (11) and spacing washers (12) and disassemble the sprocket guards (13), guide rollers (14) and torsion springs (15) from the studs of the guard mounting plates. The stop bracket (29) is secured to the lower right-hand stud with one of the screws (11) and to the lower guard mounting plate with screw (28).

d. Depress the rewind button (21) while removing the retaining ring (20) from the lower end of the shaft; then lift the rewind button and its spring (22) from the mechanism housing.

e. Remove the screw (23) and washer (24) and slip the roller (25) from the roller post (27). Disassemble the split bearings (26) from the rollers. The roller post (27) is screwed into a tapped hole in the mechanism housing.

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 disassemble the rollers (2) from the posts of the guard mounting plates (13) and (19). Disassemble the screw (3) and roller (4) from the shaft of the snubber lever (7). Remove the screw (5) and lift the bushing (6) and snubber lever (7) from the mechanism housing.

b. Remove the screw (8) and film exit guide (9). Remove two screws (10) and the washer (11) and disassemble the film threading guide (12) and lower guard mounting plate (13) from the mechanism housing. The upper guard mounting plate (19) is also secured with two screws (18).

c. The hex head screw (14) is used to align the lens carrier in the closed position and should not be removed. Do not remove the lens carrier catch (16) unless damaged and in need of replacement.

d. Remove the screw (22) and flat washer (23) and disengage the tension spring (24). from the loop restorer shaft (31). Remove the screw (25) and flat washer (26) and lift the cam follower assembly (27) from the mechanism housing. Do not disassemble the cam follower assembly unless parts are damaged and in need of replacement.

e. Loosen the hex head locking screw (28) and disassemble the arm assembly (29), flat washer (30) and the lever and shaft assembly (31) from the mechanism housing. Remove two screws (33), lock washers (34) and flat washers (35) which secure the self-centering assembly (36) to the mechanism housing.

f. Remove screws (37) and lift the aperture plate assembly (38) from the mechanism housing. Refer to paragraph 13 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 support bracket (4). Do not lose the spacing washers (3A).

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 felt 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.

f. Remove the large retaining ring (27) from the ring groove in the long cast arm of the housing. Remove the two screws (28), the bearing loading spring (29) and loosen the setscrew (30) in the loop restorer cam (34). Press the camshaft (37) to the left, forcing the bearing (31) from its seat.

Remove the small retaining ring (35) from the camshaft and loosen the setscrews (32) in the worm gear (33). Press the camshaft to the right, forcing the large bearing (36) from its seat, and remove the worm gear as the camshaft and bearing are disassembled from the housing.

13. DISASSEMBLING THE APERTURE PLATE (Figure 12). Place a soft cloth on the work surface to protect the aperture plate from scratches during disassembly. When removing screws, be careful not to scratch the rails or aperture plate with the screwdriver.

14. TESTING AND REPAIRING THE PRINTED CIRCUIT BOARD ASSEMBLY (Figure 13). 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 wiring diagram, Figure 14, 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 arrow drawn on the top of the circuit in Figure 13. This arrow is not imprinted on the circuit itself.

Reassembly Procedure

15. 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.

b. When installing electrical parts, refer to the wiring diagram at the end of the Replacement Parts section for the proper connection of leadwires. When resoldering components to the printed circuit board (Figure 13), use a heat sink to avoid the direct application of heat to adjacent components on the board. Refer to paragraph 14 for special instructions regarding transistor and integrated circuit replacement.

c. 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.

d. Reassembly instructions are not included for the printed circuit board (Figure 13). Refer to step b, above, for special precautions on parts replacement.

e. 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.

16. REASSEMBLING THE APERTURE PLATE (Figure 12). Reassemble Figure 12 parts as outlined in the following paragraphs.

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

b. Assemble the side tension spring (7) and film tension rail (6) to the aperture plate, engaging the ends of the spring in the notches in the film tension rail and with the center of the spring contacting the pin near the edge of the aperture plate. Hold these parts in place while assembling the spacer bushings (5) and spring retaining cover (4) to the aperture plate and install the two screws (3).

c. Secure the film guide rail (2) to the aperture plate with the two screws (1). Refer to paragraph 17, step k, for installation instructions.

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

a. Lightly grease the two large bearing holes in the cast arms of the mechanism housing (38). Press

the ball bearing (31) into the short cast arm and assemble the loading spring (29) to the arm with its lugs contacting the bearing. Secure the loading spring with the two screws (28).

b. Assemble the large bearing (36) to the camshaft (37) from the end which is not threaded, pressing the bearing in place until it is seated against the shoulder of the camshaft. Install the retaining ring (35) into the ring groove of the camshaft to hold the bearing against the shoulder. Be sure that the convex face of the ring is away from the bearing.

c. Insert the long (unthreaded) end of the camshaft through the bearing hole in the long cast arm. Assemble the loop restorer cam (34) to the end of the camshaft with its hub toward the long cast arm. Assemble the worm gear (33) to the camshaft with its hub facing away from the long cast arm. Guide the end of the camshaft into the bearing (31) in the short cast arm until the large bearing (36) begins to enter the bearing hole in the long cast arm. Slip a two-inch piece of metal sleeve or tubing over the protruding end of the camshaft so that the end of the sleeve is against the bearing; then rap the opposite end of the sleeve with a rubber mallet until the bearing (36) is fully seated in the long cast arm. Assemble the large retaining ring (27) over the camshaft with its convex face toward the large bearing, and press the ring into the ring groove in the mechanism housing.

d. Loosely assemble the two setscrews (32) to the hub of the worm gear (33). Position the worm gear on the camshaft so that the hub of the gear is 0.610 inch from the bearing in the short cast arm, and tighten the two setscrews securely. Insert a 0.190-inch feeler gage between the loop restorer cam (34) and the long cast arm. Press the cam against the feeler gage while tightening the setscrew (30) against the flat of the camshaft. Remove the feeler gage.

e. Lightly grease the threads and pilot diameter of the framer shaft (26) and assemble the framer shaft into the mechanism housing. Orient the stop pin (25) so that the flat side of the pin is facing the framer shaft, and press the pin into the mechanism housing. Check the framer shaft for freedom of rotation.

f. Screw the bearing support (24) all the way into the staked nut of the shuttle arm plate assembly (23). Assemble the shuttle arm plate to the long cast arm of the housing, engaging the forked framing arm with the cut-out at the lower end of the framer shaft (26). Fasten the plate to the cast arm of the mechanism housing with the two screws (22).

g. Lightly oil the two pivots of the cam bracket assembly (21) and 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. Assemble these parts over the protruding end of the camshaft and secure the cam bracket assembly to the two tapped holes at the base of the long cast arm of the mechanism housing with the two screws (19).

h. Rest the mechanism housing on the work surface with the camshaft pointing up. 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). Lightly grease the two nylon ball sockets of the shuttle arm plates (23) and the two shuttle guide shoe slots of the cam bracket assembly (21). Saturate the felt wiper (14) and wicks (15) with grease and insert the felt wick (15) into the coils of the extension spring (13) and assemble the long 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, tightening the nuts (11) only fingertight. Lightly grease the link bearing ends of the shuttle arms and assemble the shuttle arms to the mechanism by guiding the link bearing ends through the guide shoe slots of the cam bracket assembly (21) until the stud balls (12) are engaged in the nylon sockets of the plate assembly (23). Assemble the shuttle (16) to the front ends of the shuttle arm so that the shuttle teeth will extend through the shuttle slot in the aperture plate (not yet installed) and back in toward the camshaft.

i. 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, so that the groove near the elongated holes fits over the small protrusion of the in-out cam. Shift the ball and stud assemblies (12) until the balls are properly seated in the sockets of the nylon pads of the plate assembly (23) and tighten the hex nuts (11). Adjust (screw down) the bearing support (24) to apply a light pressure on the shuttle arms. Make certain that the tab of the felt

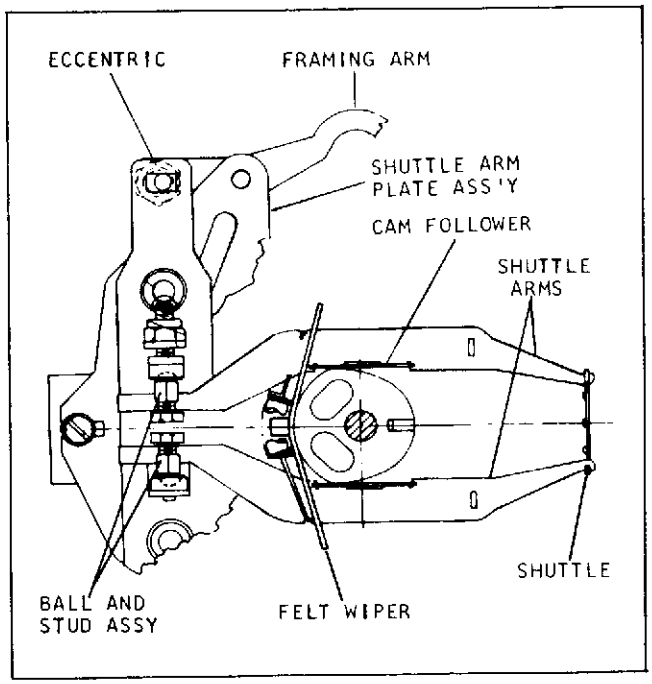


Figure B. Shuttle and Shuttle Arms Assembled

wiper (14) is lying flat against the in-out cam, and pack a small amount of grease between this wiper and the pull-down cam.

j. Install the fiber washer (10) to 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 with the smallest concave diameter against the pull-down cam. Assemble the counterbalance weight (8) to the camshaft with the small protrusion engaging the slots of the shutter and pull-down cam. Install the shutter nut (7) with the shoulder of the nut fitting into the countersunk hole of the counter weight. Engage a torque adapter with the flats at the end of the camshaft and tighten the shutter nut to 20 inch-pounds of torque minimum.

k. At this point, refer to Figure 10 and assemble the aperture plate (item 38) loosely to the mechanism housing with the two screws (37). Be careful to position the shuttle slot of the plate over the shuttle teeth before turning down the screws fingertight. Then, before continuing with reassembly, perform the intermittent mechanism adjustments outlined in paragraph 31.

l. Position the heat baffle (6) on the two tapped bosses located behind the aperture surface of the mechanism housing, and fasten it in place with the two screws (5). Manually rotate the shutter to make certain that the shutter does not rub against the baffle. If necessary, adjust baffle by bending slightly. Apply a thin coat of adhesive to the four tapped bosses of the mechanism housing to which the support bracket (4) will be mounted, and carefully position a spacer washer (3A) on each of these bosses. Secure the support bracket with the four screws (3).

m. Loosely assemble the two setscrews (1) to the mechanism pulley (2), and install the pulley on the end of the camshaft, hub toward the shutter. Insert a 0.010 inch feeler gage between the pulley hub and shutter nut and press against the pulley while tightening the two setscrews securely. Remove the feeler gage.

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

a. Assemble the retaining ring (32) into the ring groove in the short shaft of the loop restorer lever assembly (31). Lightly grease the long shaft of the lever and insert it through the hole directly below the sprocket bearing. Assemble the lever so that it is pointing at the aperture plate. Position the self-centering assembly (36) over the two tapped holes at the rear of the mechanism housing, just to the right of the lower sprocket bearing. Secure the assembly with the two screws (33), lock washers (34) and flat washers (35). Tighten the screws fingertight. Assemble the washer (30) and arm assembly (29) to the protruding end of the loop restorer shaft (31), inserting the forked finger of the arm assembly between the two plates of self-centering assembly (36) to engage the self-centering shaft. Assemble the screw (28) loosely to the arm assembly. Insert a 0.0015-inch shim between the washer (30) and the machined boss of the housing. Grip the arm assembly and loop restorer lever with the fingers to hold the shim in position while tightening the screw (28) securely against the flat on the loop restorer shaft; then withdraw the shim.

b. With a vise pliers, grip the two self-centering plates as close as possible to the self-centering shaft and secure the vise pliers to lock the assembly in place. Then tighten the screws (33) securely. When releasing the vise pliers, note the reaction of the self-centering bars. If the bars appear to be spring-loaded away from the bracket, loosen the two screws (33), re-engage the vise pliers and reset the assembly as before.

c. Assemble the cam follower parts (27A through 27F) as shown in Figure 10 and install this assembly on the loop restorer shaft and up against the arm assembly (29). Fasten in place with the screw (25) and washer (26), tightening the screw fingertight. Loosely fasten the elongated loop of the spring (24) to the tapped hole of the housing located below and to the left of the lower sprocket bearing with the screw (22) and flat washer (23). Hook the round loop of the spring over the end of the loop restorer shaft; then tighten screw (22) securely. Assemble the roller (21) to the short shaft of the loop restorer lever, counterbored end out, and install the screw (20). Refer to paragraph 36 for loop restorer adjustments.

d. Secure the upper guard mounting plate (19) to the mechanism housing with the two screws (18). Rotate the mounting plate clockwise against the screws before tightening them.

e. Assemble lower guard mounting plate (13) over the lower sprocket bearing and align screw holes with the tapped holes in the housing. The loop restorer lever assembly (31) must be pivoted counterclockwise so that the roller (21) is to the left of the mounting plate. Loosely install a screw (10) through the upper left-hand mounting hole. Assemble the washer (11) and threading guide (12) to the second screw and assemble this screw through the right-hand mounting hole approximately one inch down from the top edge of the plate. Rotate the mounting plate clockwise against the screws before tightening them. Check to make certain that there is a slight clearance (0.013 inch) between the threading guide (12) and the sprocket sleeve.

f. Assemble the lens carrier catch (16) and the flat washer (17) to the screw (15). Fasten the catch to the tapped boss just above the lower guard mounting plate (13). The forked end of the catch must straddle the formed rectangular protrusion of the mechanism casting. Temporarily install the lens carrier stop screw (14) into the tapped hole in the mechanism housing. The catch and stop screw will be adjusted after the lens carrier has been installed (paragraph 32).

g. Secure the film exit guide (9) to the mechanism housing with the screw (8). Assemble the bushing (6) to the snubber lever assembly (7) and secure these parts to the mechanism housing with the screw (5). Secure the roller (4) to the snubber lever post with the screw (3). Assemble a roller (2) to the right-hand post of the upper mounting plate (19) and to the upper right-hand and lower left-hand posts of the lower mounting plate (13). The counterbored end of the rollers must be away from the mounting plates. Secure the rollers to the posts with the three screws (1).

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

a. Apply adhesive to the threads of the roller post (27) and screw the post into the tapped hole in the mechanism housing to the right of the upper sprocket bearing. Assemble a split bearing (26) to each end of the roller (25) and install the roller on the roller post with the grooved end of the roller toward the mechanism housing. Secure the roller to the post with the screw (23) and washer (24).

b. Assemble the spring (22) to the shaft of the rewind button (21) and insert the shaft down through the hole in the top of the mechanism housing. Hold the rewind button depressed while assembling the retaining ring (20) to the shaft.

c. Secure the sprocket guard (10) to the mechanism housing just below the upper sprocket bearing with two screws (9). The three torsion springs (15) are to be installed with the short leg in toward the mechanism housing; install one spring on the roller post above and to the left of the upper sprocket bearing, one spring on the roller post above and to the left of the lower sprocket bearing, and one spring on the roller post below and to the right of the lower sprocket bearing.

d. Install the sprocket guards (13) and their rollers (14) on the roller posts to which the springs (15) were installed. The tapered end of the rollers must face in toward the mechanism housing, and the long end of each spring must be outside of the sprocket guards. Assemble the stop bracket (29) to the roller post below and to the right of the sprocket bearing and secure the inner (slotted) end of the bracket to the tapped hole in the lower guard mounting plate with the screw (28). Align the stop bracket vertically before tightening the screw. Assemble the screws (11) into the tapped holes of the roller posts and tighten the rollers securely. All rollers must rotate freely and with some noticeable end play. If "squeaking" is noted as rollers are rotated, add a washer (12) beneath the head of the screw (11). Rotate the short (inner) leg of each spring (15) in a clockwise direction around the roller post and engage the bent end in the small hole adjacent to the post.

e. Loosely assemble two setscrews (6) to each of the sprocket gears (7), and "open" the sprocket guards (13). Assemble the sprocket flange (18) to the shaft of the lower sprocket assembly (17), with the smallest diameter of the flange toward the sprocket. Assemble a thrust washer (19) to the sprocket shaft and lightly oil the end of the shaft. Insert the shaft through the lower sprocket bearing and assemble a tension washer (8) and a sprocket gear (7) to the shaft. The sprocket gear hub must face out (away from the housing). Align either setscrew (6) with the flat at the end of the sprocket shaft and carefully mesh the sprocket gear (7) with the worm gear. Tighten both setscrews securely. The sprocket and sprocket gear must turn freely, but there must be a minimum of end play in the sprocket shaft.

f. Assemble a thrust washer (19) to the shaft of the upper sprocket assembly (16) and lightly oil the end of the shaft. Insert the shaft through the upper sprocket bearing until the end of the shaft protrudes approximately 1/8 to 1/4 inch and assemble a tension washer (8) to the shaft. Hold the upper sprocket gear (7), hub facing out, in place with the gear teeth meshing with the worm gear, and press the sprocket assembly fully into place. Insert a 0.005-inch shim between the sprocket gear and tension washer and, while holding all parts together to eliminate end play, tighten the two setscrews (6) securely. "Close" all sprocket guards.

20. 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 (5L), the notches in the lens carrier (5M) where the pinion shaft will rest, and the notched ears of the pinion spring (5K).

b. Engage the notched ears of the spring (5K) with the grooves in the pinion assembly (5L) and assemble these parts to the lens carrier (5M). Fasten the spring securely to the lens carrier with the two screws (5J) and check to make certain that the knob and shaft rotate smoothly.

c. Place the pressure plate (5B) on the work table, polished surface down and the forked end of the plate to the left. Assemble the pressure plate lever (5E) to the pressure plate with the small extrusion of the lever engaging the mating hole in the aperture plate.

d. Assemble the spacer washers (5C) to the two screws (5A) and secure the springs (5D) and the adjustment plate (5G) to the tapped posts of the pressure plate.

e. Slip the assembled adjustment plate and pressure plate into place within the lens carrier and loosely install the two adjustment plate mounting screws (5F). Insert the lens plug (see Figure A) into the lens bore of the carrier while manipulating pressure plate until the boss at the inner end of plug seats in the aperture opening of pressure plate; then tighten screws (5F) securely and withdraw lens plug.

f. Clean the nameplate mounting surface of the lens carrier with a cloth dampened with solvent. Remove the backing from the nameplate (5H) and activate the adhesive as instructed in paragraph 15, step e. Assemble the nameplate to the lens carrier and wipe away excess adhesive with a soft cloth dampened with solvent.

g. Hold the assembled lens carrier (5) in position between the hinge bosses of the mechanism housing. Insert a spring tension washer (3) between the upper hinge boss of the lens carrier and the hinge boss of the housing, and press the upper hinge pin (1) into place until fully seated. Insert a flat washer (4) between the lower hinge boss of the lens carrier and the hinge boss of the housing, and press the lower hinge pin (2) up into place until fully seated. Refer to paragraph 32 for lens carrier and latch adjustments.

21. 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 (28A through 28C) were replaced, assemble the spring (28C) and bushing (28B) into the opening in the casting and insert the mounting pin (28A), forcing the end of the pin carefully through the bushing.

b. Fasten the terminal (27) to the soundhead casting with the screw (26). The free end of the terminal should be approximately at the 5 o'clock position. Loosely assemble the optical slit locking screw (7), the setscrew (16) and the edge guide screw (21) 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 (11) and assemble the screw to the soundhead, leaving approximately two threads exposed.

d. Assemble the light pipe and photocell assembly (20) and light pipe retainer (19) to the sound drum and shaft assembly (18) and insert the sound drum shaft carefully through the opening in the soundhead casting. Hold the sound drum while tightening the setscrew (16) against the retainer (19) just enough to hold all parts in place. Install the two screws (17), turning them down in the tapped holes in the sound drum housing.

e. Lightly oil the roller shafts of stabilizer arms (12H) and (12J). Assemble the lower stabilizer arm (12H) over the short shaft end of the upper stabilizer arm (12J). Assemble the torsion spring (12G), straight leg first, over the tapped hub of the lower stabilizer arm (12H). Assemble the stabilizer arm (12F) to the tapped hubs of the upper and lower arms and install the two screws (12E). Hook the bent end of the spring (12G) through the small hole near the end of stabilizer arm (12F). Wind the straight leg of the spring one full turn clockwise and hook it behind the small post in the lower arm (12H). Assemble the rollers (12C) and (12D) to their respective roller studs. Roller (12D) must be installed with its narrow flange nearest the shoulder of the stud. Secure both rollers with the screws (12A) and washers (12B). Insert the shaft of the upper stabilizer arm carefully through the soundhead casting and the adjusting screw (11) and install the retaining ring (10). Position the retaining ring for 0.0005 to 0.005 inch end play of the stabilizer arm shaft. See Figure C for stabilizer arm installation.

f. Lightly grease both surfaces of the lamp release ring (15) and assemble the release ring and the lamp contact assembly (14) to the soundhead casting with the two screws (13).

g. Insert the optical slit assembly (8) into its opening in the soundhead casting and tighten screw (7) just enough to hold the slit in place.

h. Insert the small end of the stabilizer tension adjuster (24) through the hole in the top of the soundhead casting. Assemble the spring retainer (25) to 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 (23), bowed face up, to the end of the adjuster. Assemble the retaining ring (22) into the groove at the upper end of the adjuster. Hook the tension spring (9) between the end of the lower stabilizer arm (12H) and the hole in the spring retainer (25). Install the exciter lamp (5). Refer to paragraph 34 for soundhead adjustments.

i. Reassemble the exciter lamp cover as follows. Assemble the cover screw (2) to the cover (4) and install the retaining ring (1). Press the jewel (3) into the hole in the cover.

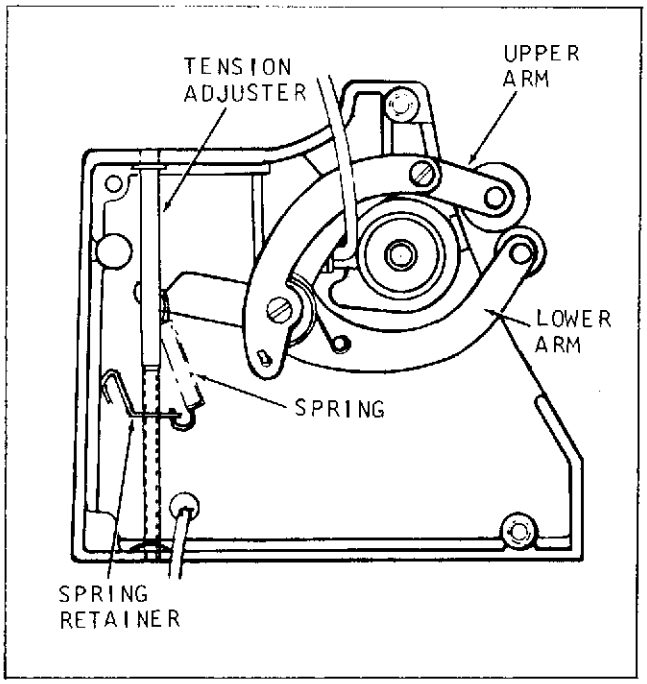


Figure C. Stabilizer Arms Installed on Soundhead

22. 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 movement of the spring loop on the boss. Reposition the 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). Insert the tension spring (5) into the recess in the take-up arm and compress the spring while assembling the take-up belt (4) around the spindle pulley and the rubber sleeve of the lower face gear. See Figure D. Assemble 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).

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

a. Assemble the washers (5D) and (5E) and then the face gear (5C) down against the shoulder of the feed spindle (5F). 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)

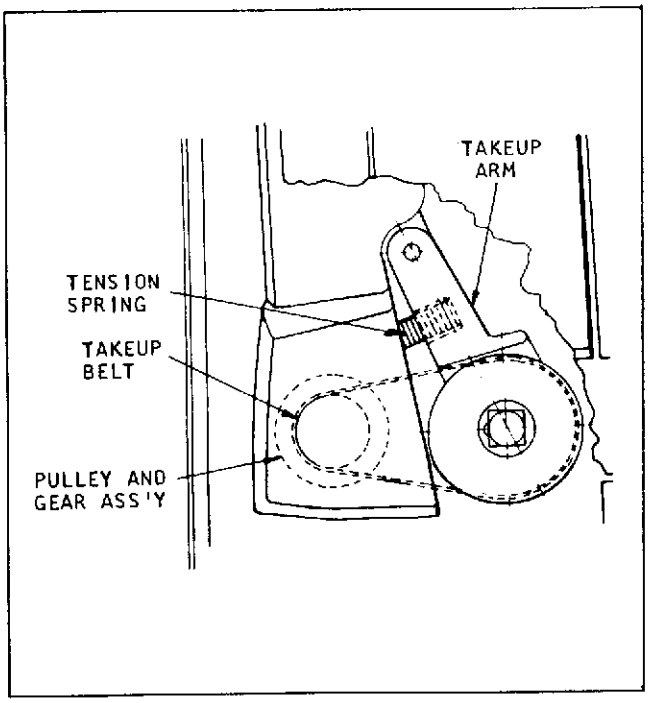


Figure D. Take-Up Arm Assembled

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 setscrews (8) and (8A) are not protruding into the shaft hole of the face gear (9) and that the sleeve (9A) is in place on the hub of the gear. Apply a light coat of grease to the gear teeth. 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).

24. REASSEMBLING THE BASE COMPONENTS (Figure 5). Reassemble Figure 5 parts as outlined in the following paragraphs.

a. Lightly grease the teeth of the worm gear (44), tilt gearshaft (41) and gear rack (39). Assemble spring washer (42) to the tilt gearshaft (41), bowed surface toward the worm gear. Insert the shaft through the hole in the base and secure it with the retaining ring (40). Fasten the tilt adapter (38) loosely to the base with the screw (37). Assemble the gear rack (39) and worm gear (44) into the base, holding the worm gear between the two formed ears of the base with all gear teeth (worm gear, gearshaft and tilt rack) engaged. Secure the worm gear with a new spring pin (43). Position the tilt adapter (38) so that the gear rack does not bind in the rectangular cut-out and tighten the screw (37) securely.

b. Assemble the rubber feet (31) and flat washer (32) to the base with the four screws (30). Assemble the tilt bar (28) to the lower end of the gear rack (39) with the screw (26) and lock washer (27). The short leg of the tilt bar must be toward the front (operating side) of the base. New rubber feet (29) are cemented to the tilt bar.

c. Assemble the volume and tone control assembly (25) into the base and secure with the four screws (24). Check to make certain that the control knobs are not binding in the cut-outs of the base before tightening the four screws. Do not install the cover (23) until all wiring connections and adjustments have been made.

d. Assemble the edge connector (18) to the amplifier circuit board (20), but do not attach these parts or the cover (16) to the base until all external wiring connections to the edge connector have been made. See NOTE following step e, paragraph 26.

e. Turn the base right side up and, if the mainplate (35) had been removed for any reason, assemble the mainplate to the uprights of the base with the four screws (34).

NOTE: At this point, refer to Figure 4 and carefully assemble the complete mechanism assembly (49) to the mainplate with the four screws (47), the upper two screws also serving to attach the idler gear adjustment bracket (48). Then refer to Figure 5 for balance of reassembly as follows.

f. Assemble the rollers (10B) to the shafts of the film guide bracket (10C). Install both retaining rings (10A). Assemble the film guide assembly (10) to the cast ears at the left side of the projector base. Hold the film guide assembly in place while assembling the screw (9) through the cast ears and into the tapped hole in the bracket (10C). 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 (10C).

g. 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 pin behind the mechanism snubber lever and install the retaining ring (1) on the pin to secure the spring. Hook the other end of the spring to the snubber spring post (6) and secure with the washer (3) and retaining ring (2).

25. INSTALLING THE SOUNDHEAD REEL ARMS AND GEARS (Figure 4). Reassembly Figure 4 parts as outlined in the following paragraphs.

a. Light grease the elongated slot and sliding contact surface of the belt shifter bracket assembly (45) and assemble the spacers (46) and bracket assembly (45) to the tapped bosses of the projector mainplate with the two shoulder studs (44). Assemble one loop end of the torsion spring (43) to the right-hand shoulder stud (44) and the other loop end to the bent ear of the bracket assembly just above the shoulder stud. Install the retaining rings (42) to retain the spring loops.

b. Carefully assemble the soundhead assembly (40) to the projector mainplate. Be sure that all leadwires are pulled through behind the mainplate so as not to be pinched between the mainplate and the soundhead. Hold the soundhead while installing and tightening the three screws (36) and their washers (37). Refer to the wiring diagram at the rear of the Parts Catalog for proper wiring connections between the soundhead and other projector components.

c. Assemble the bowed washer (34) and the flywheel (35) to the sound drum shaft, with the bowed face of the washer against the flywheel. Install the flat washer (33) and retaining ring (32) on the end of the sound drum shaft. Spin the flywheel to make certain that the shaft rotates smoothly.

d. Insert a spring (31) and a reel arm lock button (30) into the opening to the right of the rear reel arm mounting hole in mainplate. Hold the button in with a piece of shim stock while assembling the rear reel arm (29) to the mainplate. Assemble the reel arm disc (27) over the shoulder of the reel arm, with the bent fingers of the disc pointing away from the mainplate. Align the screw holes in the disc with those in the reel arm and install and tighten the screws (26). Install the front reel arm assembly (28) in the same manner.

e. Assemble the spur gears (25C), hubs inward, to the gear studs of the rewind lever assembly (25D). Place a washer (25B) on the gear stud nearest the end of the lever, and secure the gears with the retaining rings (25A). Hook the bent end of the long leg of the spring (24) through the hole in the upper lip of the rewind lever (25D) and assemble the spring loop and the rewind lever to the gear stud of the mainplate (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 (23), hub inward, and the washer (22) to the protruding gear stud, meshing gear (23) with gears (25C). Install the retaining ring (21).

f. Assemble the gear retaining key (20) to the flats of the front reel arm shaft. Assemble the spur gear (19) to the shaft so that the square recess in the face of the gear engages the retaining key (20). Assemble the reverse take-up clutch assembly (18) to the shaft and install the washers (17) and (16) and retaining ring (15).

g. Assemble the gear (11B), long hub out, to the gear stud of the arm assembly (11C) and install the retaining ring (11A). Assemble the rewind clutch assembly (14) and flat washer (13) to the upper sprocket shaft and assemble the gear retaining key (12) to the flats of the shaft. Assemble the large hole in the idler arm over the inner shoulder of the spur gear (9) and install these parts and washer (10) on the upper sprocket shaft. Slide the gear (9) inward until the square recess in its face engages the key (12). The staked pin of the idler arm must be inserted into the triangular cut-out in the rewind lever (25D). Install the spring tension washer (7) bowed face out, and the grip ring (6).

h. 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 washer (3) and the spur gear (2) to the shaft and install the retaining ring (1). Refer to paragraphs 39 and 40 for gear clearance adjustment.

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

26. INSTALLING ELECTRICAL COMPONENTS (Figure 3). Install Figure 3 parts as outlined in the following paragraphs. Refer to the wiring diagram at the rear of the Parts Catalog for proper connection of leadwires between components.

a. Attach the fuseholder (37) with the screw (36). Assemble the switch (35) to the switch bracket (32) with the locking nut (33) and lockwasher (34). Lift the bracket up into position against the mainplate while guiding the switch shaft through the mainplate and secure the bracket with the two screws (31). Assemble the fuse (30) to the fuseholder.

b. Assemble the motor mounting brackets (28) and motor bracket straps (26) with stabilizer bracket (27) to the motor end caps. When mounted to the projector base, the motor should be positioned so that the nameplate can be easily read. Install the motor pulley (25) on the motor shaft, small pulley diameter toward the motor. If the pulley was replaced, be sure to use the same color of pulley as the one which was removed. Position the pulley so that its inner face is approximately 1/4-inch from the rubber mounting ring of the motor and temporarily tighten the setscrews (24).

c. Assemble the strain relief (32) to the jacket of the line cord (23) and assemble the strain relief into the center hole in the stabilizer bracket (27). Loop the drive belt (21) around the motor pulley and insert the end of the motor shaft through the blower fan housing cover (20). Assemble the blower fan (19) to the end of the motor shaft, with the fan hub containing the setscrews facing toward the motor. Position the fan on the shaft so that the end of the shaft is approximately 1/16-inch below the face of the outer fan hub and tighten the two setscrews (18). Assemble the fan housing (17) to the cover with the three screws (15). Note the location

of the leadwire clamp (16). Manually rotate the motor pulley to make certain that the fan is not striking the cover or housing.

d. Lift the assembled motor and blower group into position on the projector base, threading the drive belt through the loop of the belt shifter bracket assembly (item 45, Figure 4). Guide the belt edgewise upward and around the large mechanism pulley. Align the motor and blower mounting holes with those in the base, and install and tighten the eight mounting screws (13) and (14). Refer to the wiring diagram at the end of the Parts Catalog section and make the necessary wiring connections.

e. Assemble the brackets (10C) and (10D), mounting flanges facing inward, to the lamp transformer (10E) with the screws (10B) and hex nuts (10A). Assemble the brackets (8) and (9) to the lamp transformer (10) with two screws (4) with lockwashers (5) and two hex nuts (3). Position the power transformer (6) on top of the lamp transformer and secure the lower ends of the brackets (8) and (9) to the lamp transformer with two screws (7B) and hex Sems nuts (7A). Position the complete transformer assembly (2) on the projector base and install the two front mounting screws (1) finger tight. Tip the projector to expose the underside of the base and install the two innermost screws (1) from below. Tighten all four screws securely. Refer to the wiring diagram at the end of the Parts Catalog section for proper wiring connections.

NOTE: After all wiring connections have been made and checked against the wiring diagram, Figure 14, refer to Figure 5 and assemble the edge connector (18) and amplifier assembly (20) into the base as follows: Loosely fasten the edge connector at the tilt leg end of the base with the two screws (17). Assemble the spacers (21) to the two amplifier screws (19). When securing the amplifier assembly to the base, make certain that the heat sink plate at the transistor end of the circuit board is flush against the heat sink boss of the plate. Install the screws (19) with spacers and tighten all four screws securely.

27. REASSEMBLING END CAPS AND LAMP COMPONENTS (Figure 2). Reassemble Figure 2 parts as outlined in the following paragraphs.

a. Pull the lamp leads through the access hole in the mainplate and connect them to the terminals of the lampholder (15). Secure the lampholder and the lamp shield (14) to the mainplate with the two screws (13), and pull excess lamp leads back behind the mainplate. Assemble the projection lamp (12) into the lamp socket and swing the lamp retaining spring up into place.

b. Assemble the control knob (11) to the end of the rotary switch shaft.

c. Assemble the axuiliary speaker jack (9) and its insulating washer (10) to the rear end cap (7) with the hex locking nut (8). Reassemble the rear end cap components (7A) through (7E). The starting capacitor (7C) is mounted with its terminals up and the top end of the capacitor approximately 1/8-inch above the top edge of the capacitor clamp (7B). Secure the clamp to the rear end cap with two screws (7A).

d. Assemble the speaker (6B) over the four molded pins of the front end cap (6C) and install the four Keps nuts (6A). Speaker should be installed with the terminals at the top.

e. Make certain that all twelve speed nuts (5) are in place on the formed mounting ears of the two end caps. Position the front end cap assembly (6) on the base with mounting holes aligned and, from beneath the base, install the two base-to-end cap mounting screws (3) finger tight; then install two screws (4) through the mainplate and into the speed nuts on the front mounting ears of the end cap. Tighten all four screws securely. Install the rear end cap assembly (7) in the same manner.

f. Assemble the tilt knob (2) to the protruding end of the tilt shaft and tighten the setscrew (1) securely. Rotate the tilt knob to check the tilting mechanism.

g. Refer to the wiring diagram at the end of the Parts Catalog section for proper wiring connections.

28. REASSEMBLING LAMPHOUSE AND COVERS (Figure 1). No special instructions are necessary for the reassembly of the lamphouse or cover components. These items need not be installed until after all adjustments have been made (see the following section).

Adjustments

29. 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.

30. 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. These tools 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 the alignment tools.

a. Aligning the Aperture Plate.

(1) Remove the projection lens from the lens carrier. Open the lamphouse and remove the projection lamp.

(2) Swing the lens carrier fully open and disassemble the pressure plate from the lens carrier.

(3) Loosen the two aperture plate mounting screws just enough to permit movement of the aperture plate, and insert the aperture plug (item 4, Figure A) into the aperture opening. Close the lens carrier.

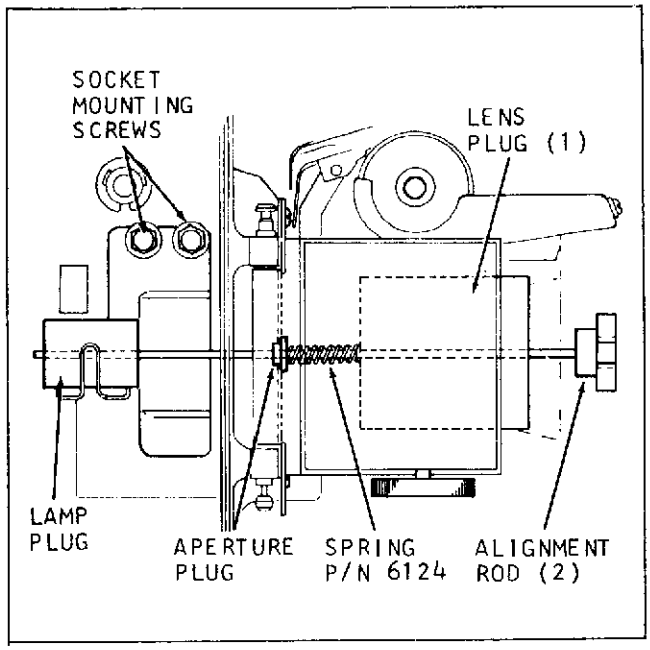


Figure E. Aligning the Optical System

(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.

31. 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 30, step a, Aligning the Aperture Plate.

(2) Shuttle stroke incorrect. See paragraph 31, 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).

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

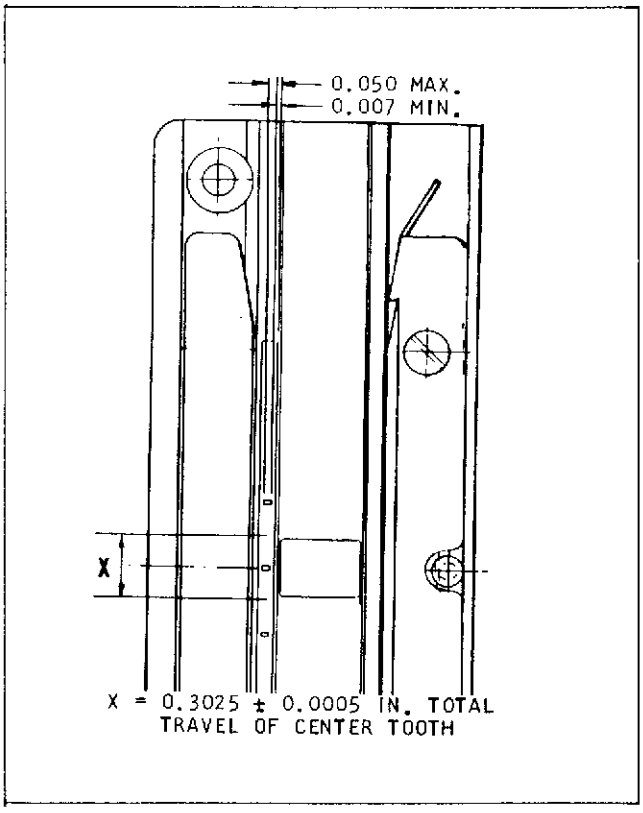


Figure F. Aperture Plate and Shuttle Tooth Clearance

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 too 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 support 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 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.

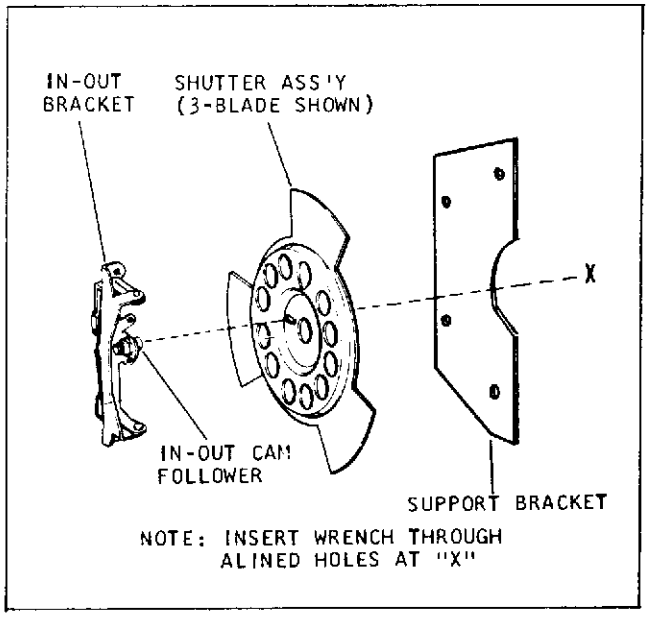


Figure G. Adjusting Shuttle Tooth Height

(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 weight SER-552-4-N2 in slot of stud (B) as shown, and allow weight (E) to swing downward. Tilt projector, if required so that 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.

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

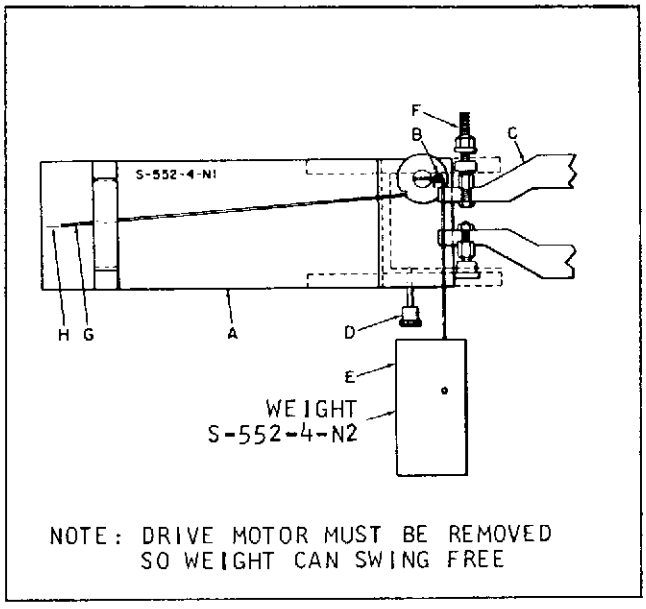


Figure H. Adjusting Fit of Shuttle Arms to Pull-Down Cam

section is a 100 to 1 enlargement of the gage. The C and D lines represent 10 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.

(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).

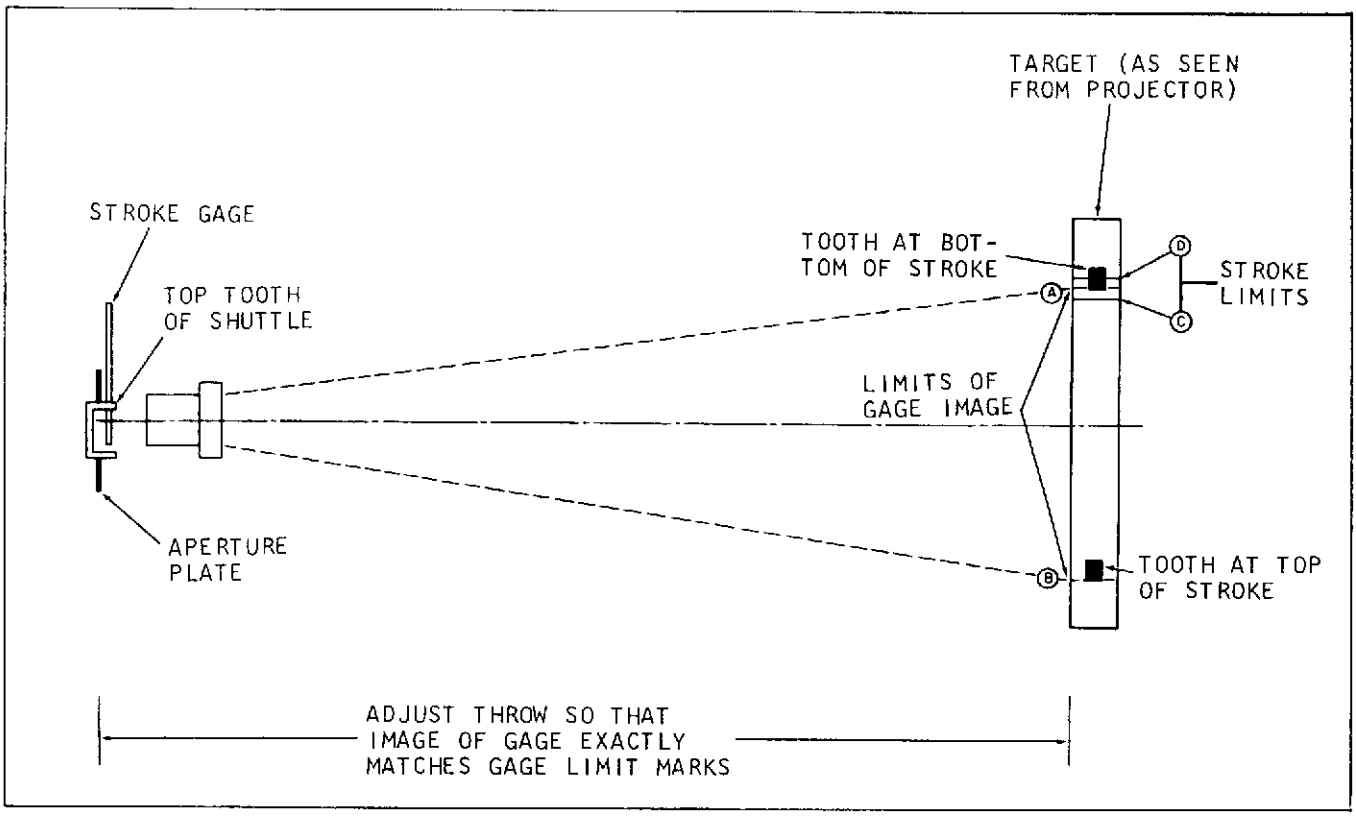


Figure J. Checking and Adjusting Shuttle Stroke with Target

(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 31, 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.

32. LENS CARRIER ADJUSTMENT.

a. Lens Mount Stop Screw. Angular relationship between the lens carrier and the aperture plate is controlled by lens mount stop screw (item 14, 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.

b. Lens Carrier Catch. The lens carrier catch (item 16, Figure 10) should be positioned so that a force of 3-1/2 pounds minimum to 9 pounds maximum is required to pull open the lens carrier. Loosen the screw which fastens the catch to the mechanism housing just enough to permit the catch to be shifted. Moving the catch toward the aperture plate will decrease the force required to pull open the lens carrier; moving the catch away from the aperture plate will increase the required force. Tighten the screw securely after the adjustment has been made.

33. 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 7). 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 (14) 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 in.-lbs when the rwind 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, rotate the "Motor-Lamp" switch to "Reverse" and press and release the rewind button at the top of the mechanism housing. The spring scale must register between 2.5 and 4.5 in.-lbs. When the rewind clutch system begins to slip, take-up torque is adjusted by means of the take-up clutch assembly (item 18, Figure 4). Grip the flats on the inner face of the clutch with a wrench while loosening or tightening the nut on the clutch hub. Rewind torque (also 2.5 to 4.5 in.-lbs.) is adjusted by means of the rewind clutch assembly (item 14, Figure 4). This clutch is installed with the adjusting nut facing inward toward the mainplate, and a special wrench (item 5, Figure A) must be used for the adjustment.

34. 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 back cover (7, Figure 1) and the amplifier cover (16, Figure 5) from the projector. Two of the screws (1, Figure 3) which secure the assembled power/lamp transformer group (2, Figure 3) are assembled from the underside of the base. Taking care not to place too much strain on transformer leads, shift the transformer group enough to permit the flywheel (35, Figure 4) to be removed from the sound drum shaft.

(4) Refer to the wiring diagram at the rear of the Parts Catalog section and disconnect or unsolder soundhead leadwires as necessary.

(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 (36, Figure 3) and flat washers (37) and carefully withdraw the soundhead assemby from the projector main plate,

b. Photocell Alignment (Figure 8).

(1) Loosen the setscrew (16) and the two housing screws (17). Remove the exciter lamp (5) and the optical slit (8).

(2) Insert the sound drum alignment tool (13, Figure A) into the optical slit opening as shown in Figure K.

(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 (17) securely.

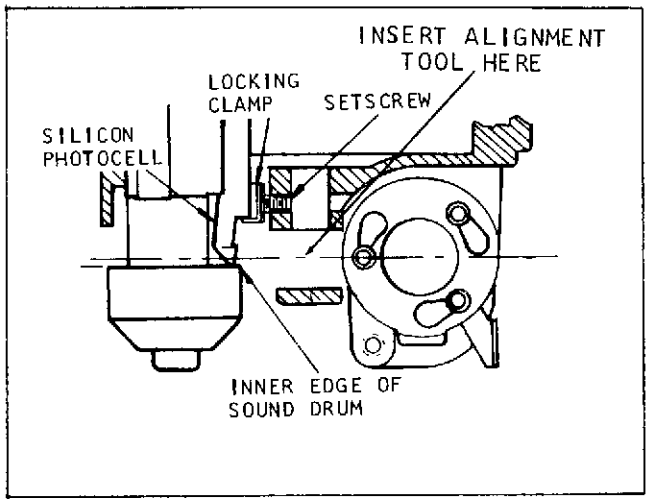


Figure K. Positioning the Sound Drum and Silicon Cell

(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 (16).

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.

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 (36, Figure 3) with their washers (37) 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) Refer to the wiring diagram at the rear of the Parts Catalog section and reconnect or resolder all soundhead leadwires.

(4) Assemble the bowed washer (34, Figure 4) and flywheel (35) and flat washer (33) to the sound drum shaft and secure these parts with retaining ring (32).

(5) Reinstall the assembled power/lamp transformer group (Figure 3) to the projector base and reinstall the back cover and amplifier cover.

e. Optical Slit Adjustment (Figure 8).

(1) Insert the optical slit (8) 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 (7) 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 (7) 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 (12C) and edge guide screw (21). Unless the adjustment has been disturbed, it is not probable that the edge guide screw (21) will require resetting. Thread the projector with buzz track film and adjust volume control to a suitable listening level. Turn adjusting screw (11) 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 (21) 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) Loosen the three soundhead mounting screws (36, Figure 3) just enough to permit the soundhead to be shifted.

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

(3) Tilt gage so that it lies on a centerline between the take-up sprocket and sound drum. Shift 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.

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

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

(1) Photocell and Frequency Meter. Used to measure the number of pulsations of the projection beam per second. Pulsations per second is then converted to projector speed. This method is quite practical in large volume shops.

(2) Strobatac or Similar Strobe Light. Usually synchronized with interrupter shutter of shuttle. Shutter makes one revolution per frame. Shuttle makes one stroke per frame.

(3) Tachometer (Preferably Having a Speed Range with a Maximum Speed of 150-200 RPM). Used to measure RPM of the sprocket.

(4) Strobe Disc. Attached to 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.

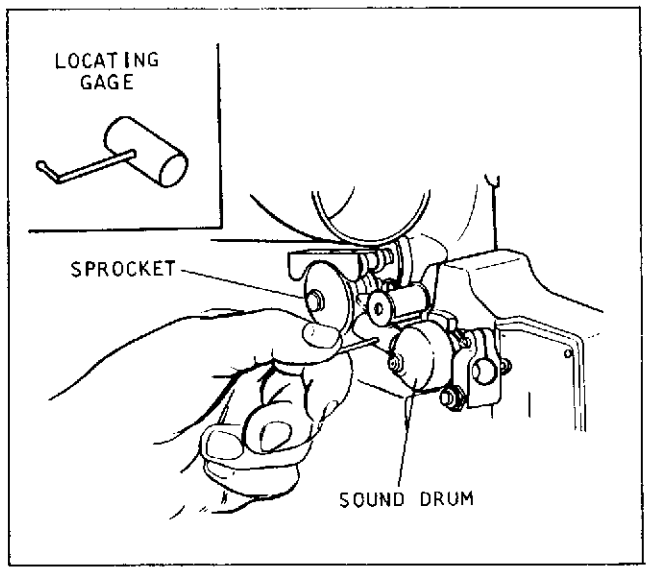


Figure L. Positioning the Soundhead

(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%

36. CHECKING AND ADJUSTING THE 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 M and proceed as follows:

a. Slip the loop restorer position tool (Figure A) over the loop restorer roller (21, Figure 10) with the flat on the tool facing the guide roller at the rear end of the upper sprocket shoe (at approximately one o'clock position). 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 (Figure M) 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

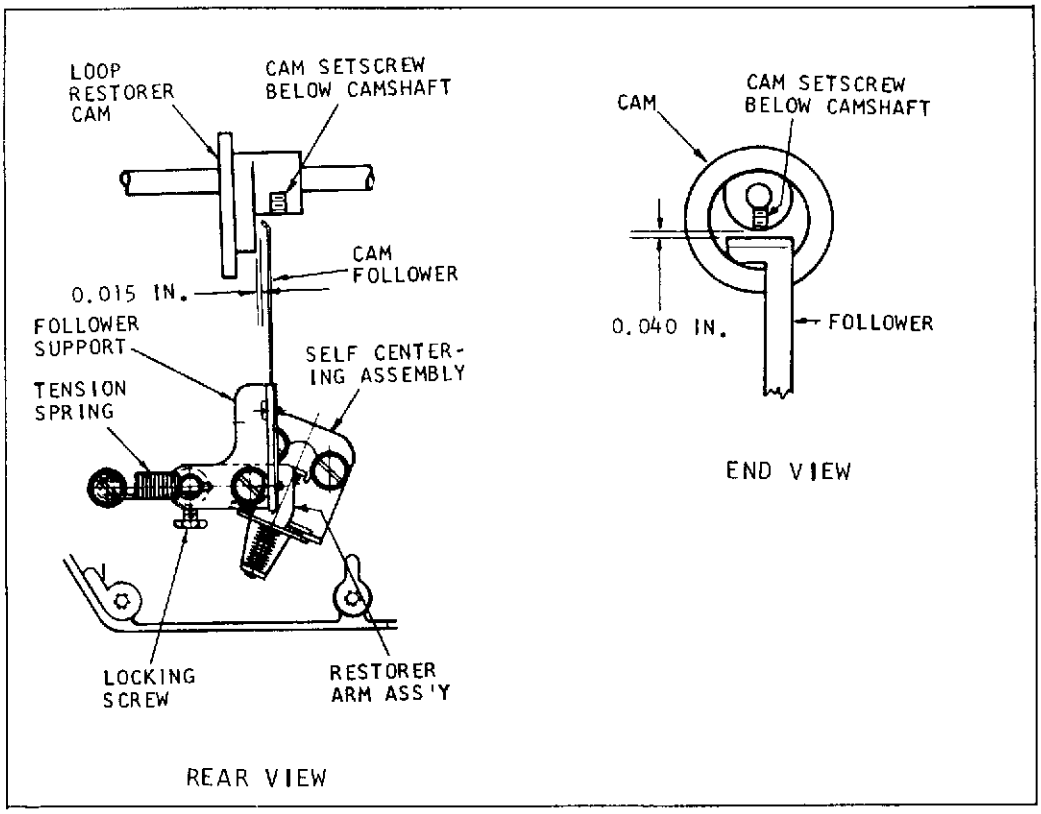


Figure M. Adjusting the Automatic Loop Restorer

spring-loaded keeper plates of the self-centering assembly.

b. Rotate the mechanism pulley until the setscrew in the loop restorer cam is at the bottom, directly below the camshaft (Figure M). 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 locking screw and rotate the support accordingly; then retighten the screw securely. Now check the clearance between the upper end of the cam follower and the small diameter of the loop restorer cam (Figure M). 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 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 positioning tool and once more check loop restorer operation with the loop of test film.

37. 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 (teeth protruding) and the edge of the shutter blade bisects the aperture opening.

b. Open the film shoes and place the timing plate (item 11, Figure A) over the sprocket hubs (Figure N). 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:

c. 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.

38. 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

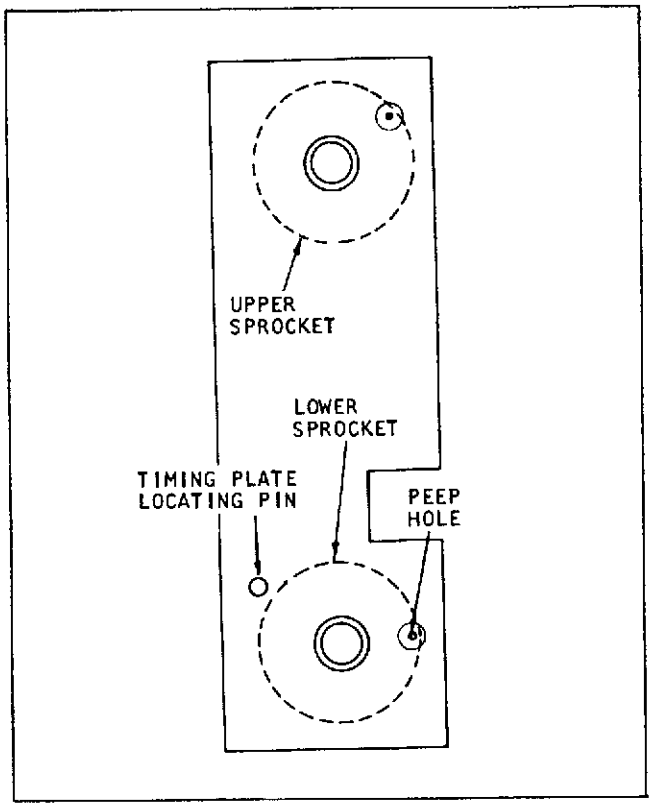


Figure N. Timing the Sprockets

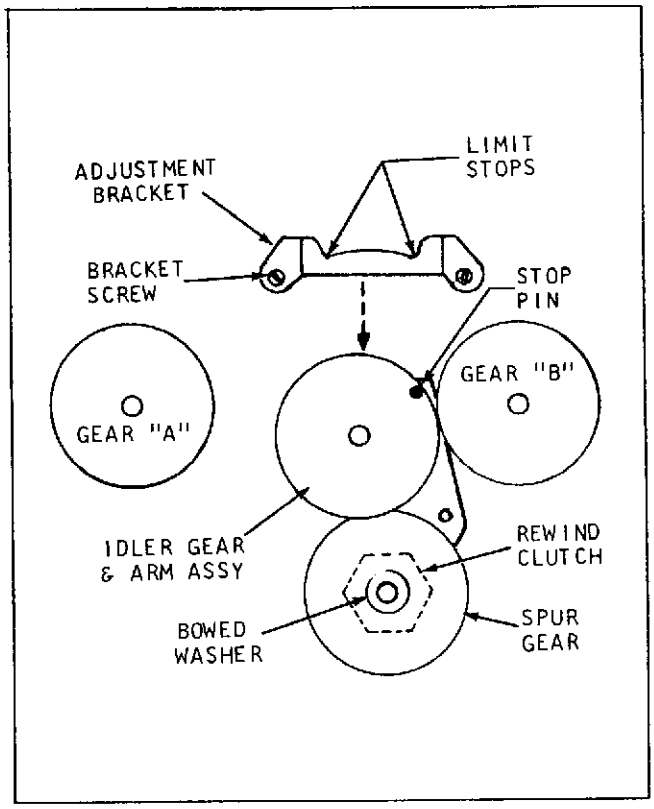


Figure P. Adjusting Gear Shift Tension and Backlash

#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.

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

40. 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 P. 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

41. 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. Align pulley and tighten setscrews.
Rewind does not operate	1. Rewind clutch not engaging or clutch slipping.	1. Adjust (paragraph 33, step c).
Take-up does not operate	1. Take-up sprocket damaged.	1. Replace sprocket.
Feed spindle does not operate	1. Dirt in reverse take-up clutch.	1. Clean clutch.
Lens carrier will not latch	1. Latch spring set too close to lens mount stop.	1. Adjust latch spring (paragraph 32, step b).
	2. Pressure plate out-of-line.	2. Realign pressure plate (paragraph 20, step e).
Shuttle runs but sprockets do not revolve	1. Animation clutch spring broken or lost.	1. Replace spring.
Short lamp life	1. Improper lamp being used.	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.

42. 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 31, step c).
	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 (paragraph 20, step e).
	6. Incorrect shuttle stroke.	6. Adjust (paragraph 31, step d).
Double image	1. Incorrect shuttle stroke.	1. Adjust (paragraph 31, step d).
	2. Excessive shuttle protrusion.	2. Adjust (paragraph 31, step b).
Weave (due to faulty aperture plate)	1. Sticking edge guide.	1. Clean guide.
	2. Tension spring missing.	2. Replace spring.
	3. Fixed edge guide out of position.	3. Reposition guide.
Poor illumination	1. Optics out-of-line.	1. Realign (paragraph 30).
	2. Fire shutter sticking.	2. Check 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 carrier out-of-line.	3. Realign (paragraph 32, step a).
	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 (paragraph 20, step e).
Frame line creeps	1. Framer eccentric loose.	1. Align and tighten (paragraph 31, step e).
Insufficient framing	1. Framer eccentric out of adjustment.	1. Adjust (paragraph 31, step a).
Trailer ghost	1. Shutter out-of-line.	1. Adjust (paragraph 31).
Film scratches	1. Caked emulsion on film path parts.	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.
Film dimpled between perforations	1. Sprocket shoes sticking.	1. Clean sprocket shoe pivots.

43. 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 31, step b).
	3. Inadequate or excessive shuttle stroke.	3. Adjust (paragraph 31, step d).
	4. Pressure plate spring lost.	4. Replace spring.
	5. Pressure mounting plate screws loose.	5. Tighten mounting screws; align pressure plate (paragraph 20, step e).
	6. Sprocket guards not closing.	6. Clean or adjust.
	7. Sprocket drive gear loose on shaft.	7. Retime (paragraph 37) and tighten setscrews.
	8. In-out bracket spring broken.	8. Replace spring.
Lower loop not restored	1. Loop restorer stroke too short.	1. Adjust (paragraph 36).
	2. Loop restorer does not engage restorer cam.	2. Adjust (paragraph 36).
Film rubs on loop restorer roller	1. Restorer arm out of position.	1. Reposition (paragraph 36).
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 (paragraph 20, step e).
	5. Incorrect shuttle stroke.	5. Adjust (paragraph 31, step d).
Splices jam in sprocket shoes	1. Bad splices.	1. Replace splices.
	2. Emulsion build-up.	2. Clean film path components.
Automatic loop restorer cycles continuously	1. Restorer out of adjustment.	1. Adjust per paragraph 36.
	2. Pressure plate (5B, Figure 9) binding on aperture plate edge guide.	2. Realign pressure plate (paragraph 20, step e).
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 (paragraph 33).
	3. Jockey rollers (soundhead) sticking.	3. Clean and lubricate.
	4. Soundhead improperly positioned.	4. Reposition per paragraph 34, step g.
	5. Dirt or obstruction between sound drum and exciter lamp cover.	5. Remove obstruction.

44. 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 amplifier assembly.
Projector runs, voltage at P.C. board, but exciter lamp does not light	1. Exciter lamp cable disconnected.	1. Connect cable (see Figure 14).
	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. External speaker jack disconnected.	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 34, step b).
	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; if faulty, replace complete amplifier assembly.
	2. Wrong exciter lamp used.	2. Replace with correct lamp.
	3. Photocell out-of-line.	3. Realign (paragraph 34, step b).
	4. Dirt on photocell or slit.	4. Clean photocell and slit.
	5. Slit misaligned.	5. Realign (paragraph 34, step e).
	6. Buzz track misaligned.	6. Realign (paragraph 34, step f).
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; if faulty replace complete amplifier assembly.
Crackling noises	1. Broken ground lead to mainframe.	1. Replace defective lead.
	2. Buzz track out-of-line.	2. Realign (paragraph 34, step f).
	3. Broken cable shield.	3. Repair shield or replace cable.
Wow or flutter	1. Soundhead stabilizer guide roller sticking (Figure 8).	1. Clean roller and roller shaft.
	2. Stabilizer guide roller spring broken, unhooked or lost (Figure 8).	2. Repair or replace spring.
	3. Film edge guide (soundhead) out-of-line.	3. Realign (paragraph 34, step f).
	4. Loose flywheel.	4. Tighten flywheel.
	5. Damaged sound drum bearing.	5. Replace sound drum.

44. SOUND SYSTEM TROUBLES AND REMEDIES (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Wow or Flutter (Cont'd)	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; retime sprockets (paragraph 36).
	9. Loop restorer stroke is too short or restorer set too low.	9. Adjust (paragraph 36).
Clicking noises	1. Dirt on sound drum.	1. Clean sound drum.
	2. Broken ground lead to mainframe.	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 34, step f).
	3. Dirt on sound drum.	3. Clean sound drum.
Hum	1. Grounded wiring.	1. Correct grounded condition.
	2. Trouble in printed circuit board.	2. Check out the circuit board; if faulty replace complete amplifier assembly.