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SERVICE INSTRUCTIONS

KEN LAYTON
1941 1/2 E. State #8
Olympia, WA 98506
FILMS-ELECTRONICS-SPECIAL EFFECTS

FILMOSOUND PROJECTOR

(MANUAL THREADING)

DESIGN 1535, 1540, 1541

CONSUMER PRODUCTS GROUP



BELL & HOWELL

**GENERAL SERVICE DEPT.
7100 McCORMICK ROAD
CHICAGO, ILLINOIS 60645**

FACTORY SERVICE ADDRESSES

PRODUCT ONLY

CHICAGO

General Service Department
2200 Brummel Place
Evanston, Illinois 60202
Area Code: 312-673-3300

NEW YORK

General Service Department
200 Smith Street
E. Farmingdale, L.I., New York 11735
Area Code: 516-293-8910

GLENDALE

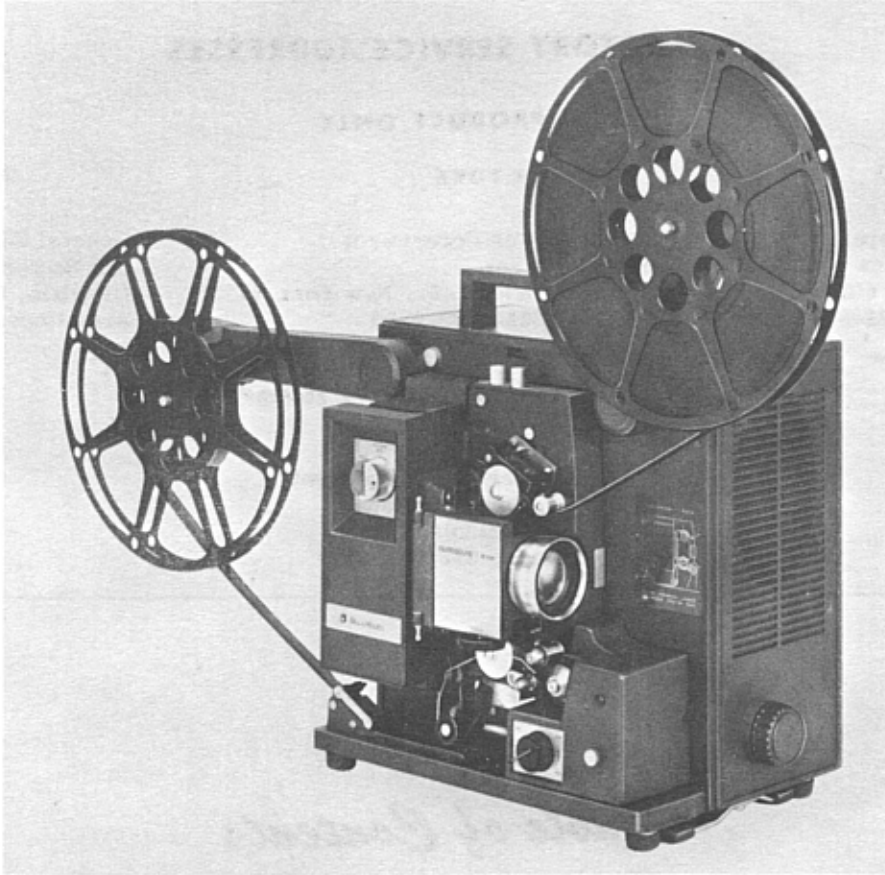
General Service Department
623 Rodier Drive
Glendale, California 91201
Area Code: 213-245-6631

PARTS ORDERS AND SERVICE INFORMATION

General Service Department
7100 McCormick Road
Chicago, Illinois 60645
Area Code: 312-673-3300

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Design 1540 Manual Threading 16-MM Filmosound Projector

FEATURE DESCRIPTION LIST

Color	
Design 1535	..... All charcoal
Design 1540	..... Charcoal and turquoise
Operating Voltage	..... 117 VAC, 60 Hz
Projection Lamp	..... Tungsten-Halogen Type EKS, 250W, 24V EMM (50 HR. ON BRITE, 100 HR. ON NORMAL)
Exciter Lamp	..... Type BAK, 4V 200 HRS (OR BRS - 50 HR)
Projection Lens	..... 2 inch f/1.6
Projection Control	..... Forward and reverse
Film Speeds	..... Silent and sound
Shutter	..... Three-blade
Amplifier	..... Solid-state plug-in type
Output	..... 10 watt (RMS)
Power Consumption (Maximum)	..... 350 watts
Special Features	..... Automatic loop restorer (1540/1541 only) Illuminated control panel Jack for auxiliary speaker

Introduction

GENERAL.

This Service Manual has been prepared to aid in the repair and adjustment of Bell & Howell 1500-series Manual Threading 16-mm Filmosound Projectors. The disassembly, reassembly, adjustment and test procedures in the following sections are presented as they apply, specifically, to the Design 1535A and 1540A projectors. However, with reference to the Replacement Parts lists and illustrations for variations in design features, the basic instructions can be easily adapted to cover all manual thread models listed on page 2 of the Replacement Parts section. Specific differences between models which may require special attention during repairs are noted at the end of this section beginning on page 2A. When repairing projectors other than the basic Design 1535A and 1540A models, be sure to read through these instructions first.

An illustrated Replacement Parts section is included at the rear of this manual. All replacement parts are listed in a suggested order of disassembly, with attaching parts immediately preceding those parts which they attach. Schematic and pictorial wiring diagrams for the projector and amplifier will be found at the end of the Replacement Parts section.

SPECIAL MAINTENANCE PRECAUTIONS.

Before proceeding with repairs, operate the projector to verify customer complaints; then refer to the Trouble Shooting section for possible causes and suggested remedies for the indicated trouble.

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. Special tools and gages necessary for projector alignments and adjustments are illustrated in Figure A and listed in the accompanying chart. Following is a list of Bristol setscrew wrenches required for projector repair.

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.

*3/8" IGNITION WRENCH
FOR ADJUSTING FRAMER
AND 7/16" BOX*

CLEANING INSTRUCTIONS.

All film path areas must be kept free from emulsion build-up to insure trouble-free operation. Use Toluol, and/or an orange stick to remove emulsion from film path areas, being careful not to scratch the surfaces. Be particularly careful when cleaning the soundhead rollers and sound drum.

Do not use trichloroethylene solvents to clean plastic parts. Use a naphtha base cleaning fluid and remember to re-lubricate parts after cleaning. Do not use solvents in critical 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.

LUBRICATION.

Parts which require lubrication are specifically noted in the reassembly instructions. Unless otherwise indicated, use Bell & Howell grease (Spec. No. 1956) and oil (Spec. No. 1543). If recommended Bell & Howell lubricants are not immediately available, use the best grades of ball bearing grease and projector oil obtainable from local commercial outlets.

When repairs are of such a simple nature that reference to disassembly and reassembly procedure is unnecessary, the following lubrication rules should be applied.

(1) Remove old lubricant by immersing the part in a pan of solvent or wiping with a cloth dampened in solvent.

(2) Apply new lubricant sparingly; no more than a drop or two of oil or a thin film of grease applied with a brush.

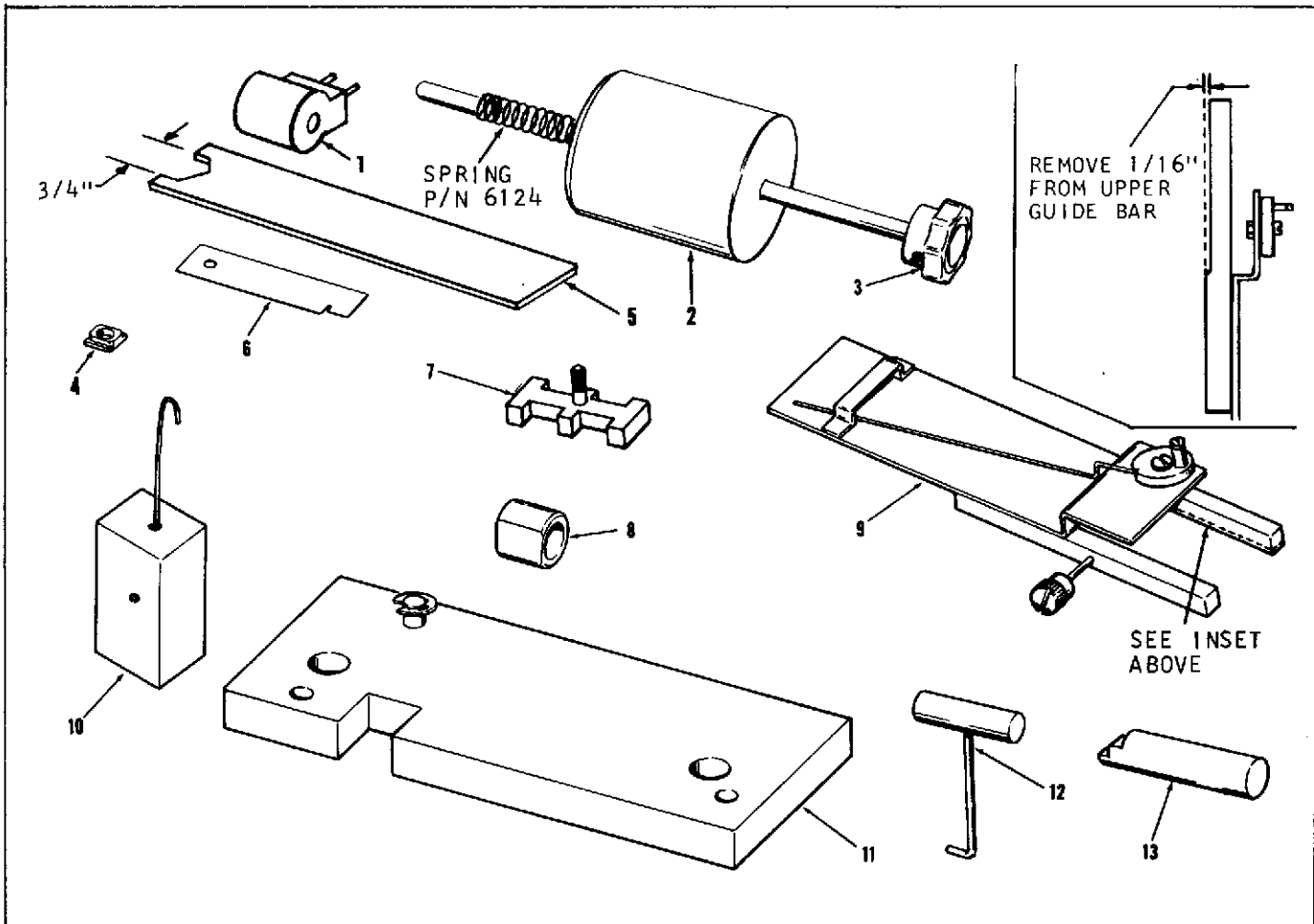
(3) Oil should be used in the following places: machined non-bearing surfaces of all castings and main plate bearings for sprocket shafts.

(4) Grease should be used in the following places: all gear mounting studs, all gear teeth, all shafts which pivot or rotate, friction surfaces of all pivoting plates or levers, and the felt wicks in the shuttle area.

NOTE: The felt wicks can be re-used if cleaned thoroughly in naphtha; then placed in a shallow pan of grease until completely saturated.

DRIVE BELT REPLACEMENT.

Because of the compactness of the design and the direct drive blower system of these projectors, the drive belt is not easily accessible for replacement



INDEX NO.	TOOL NO.	TOOL NAME	USE
1	SER-1552-1-N1	Lamp Plug (1500 SERIES)	} 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

as in previous Filmosound models. The following procedure will enable a serviceman to replace the belt with a minimum of disassembly.

a. Remove the rear cover from the projector. Seven screws (2 through 4, Figure 1) secure the cover.

b. Run the drive belt off of the large mechanism pulley by rotating the pulley by hand; then pull the free end of the belt from the belt shifter loop.

c. Remove the tie strips from around the wiring at both ends of the motor. Then loosen the screws in both motor bracket straps (37, Figure 2) and lift off the straps and tie bar (39B) as a unit.

d. Lift the motor just enough to permit the drive belt to be passed beneath the motor toward the trans-

formers (from right to left). Be very careful not to lift the motor too high, as this could damage the blower fan attached at the right end of the motor shaft.

e. Disconnect the motor leadwire push-on connectors from the terminal lugs of the starting capacitor (10, Figure 2), and remove the crimp-type connector which joins the yellow motor lead to the two white leads. The drive belt can now be removed.

f. Install the new belt by reversing the above order of removal. When rejoining the yellow and white leadwires, use a screw-on type connector (leadwire nut) in place of the crimp-type connector. Also, when reinstalling the motor bracket clamps, make sure that the motor grounding strap (left end of motor) bears on the motor mounting bracket (38, Figure 2).

SPECIAL REPAIR INSTRUCTIONS

GENERAL.

The basic repair instructions in the following sections of this manual are presented as they apply, specifically, to the original Design 1535A and 1540A projectors. Since the issuance of these basic instructions, the following changes and additions in designs have taken place.

(1) The Design 1541A projector was added to the series. This projector includes the "Still-Run" feature, the parts for which are shown in Figures 3A and 10A of the Replacement Parts section. Except for this addition and minor differences in part numbers, the Design 1541A projector is the same as the 1540A projector.

(2) Certain design changes were made to all Model "A" projectors (1535A, 1540A, 1541A) to improve projector performance. The parts involved in these changes are identified in the parts listings as "early models" and "current models" and parts list "notes" explain the availability and usage of the parts involved.

(3) The most current version of the manual thread projectors are the "B" models (1535B, 1540B, 1541B). These models are most easily identified by the presence of a "lamp saver" switch located on the main plate just above the sound head. This addition requires the use of a different lamp transformer as well as minor changes in wiring connections as shown in the inset of Figure 13. It also should be noted that all Model "B" projectors above Serial No. 2314001 have been improved by a reel arm gearing modification. The parts affected by this change are illustrated and identified in Parts Catalog Figure 3 and in reel arm views, Figures 5 and 6.

SPEAKER AND STARTING CAPACITOR.

As illustrated in Parts Catalog Figure 2, there is a noticeable difference between the speaker/capacitor components used in the earlier model "A" projectors and those used in all current models. Although the capacitor mounting method has been altered, repair instructions are not affected in any way except to note that the installation of the new speaker (P/N 44225) will necessitate the installation of the new capacitor (P/N 45692) and clamp (P/N 44226) as well.

REEL ARM GEARING (Model "B" Projectors beginning with Serial No. 2314001).

This gearing change was made to reduce gear noise during operation. Earlier style gearing and shafts are still available for replacement, but it is most important that you avoid interchanging gears between the two styles. The differences are as follows.

(1) On the rear reel arm shaft at the back side of the projector main plate (Parts Catalog Figure 3), a gear with pressed bearing (P/N 014947) is used in place of the plain spur gear (P/N 44363, item 3-2) and a washer (P/N 34861, item 3-2A) is used in place of the retaining key (item 3-3).

(2) On the front reel arm shaft at the back side of the projector main plate (Parts Catalog Figure 3), a clutch and bearing assembly (P/N 014949) is used in place of the clutch assembly (P/N 014516, item 3-14), spur gear (P/N 46534) is used in place of spur gear (P/N 44366, item 3-15), and a flat washer (P/N 31237) has been added between the thrust washer (item 3-13A) and the clutch and bearing assembly.

NOTE: The new parts discussed in steps (1) and (2) cannot be used unless new reel arms P/N 014948 (item 3-24) and P/N 014946 (item 3-25) also are installed or the old reel arms are modified as instructed in step (3), following. All installation procedures and adjustments are the same as those for earlier style projectors (see paragraph 31).

(3) In the front and rear reel arms (Parts Catalog Figures 5 and 6), the only parts affected by the gearing changes mentioned in steps (1) and (2) are the reel arm shafts (item 14 in Figure 5 and item 31 in Figure 6). The new shafts (P/N 46533 and 46530 respectively) must be installed in the reel arms if the gearing changes made in steps (1) and (2) are made.

NOTE: Early front reel arm assemblies P/N 014517, are no longer available for replacement. Therefore, if the complete front reel arm is to be replaced, the new reel arm assembly P/N 014948 must be installed in its place and the gearing and washer changes indicated in step (2) must be made. The adjustments outlined in paragraph 31 still apply.

ROTARY SWITCH AND FUSE.

In all "A" model projectors, the rotary switch (item 4, Figure 2) is assembled to a switch bracket (item 36, Figure 3) which is, in turn, fastened to the main plate of the projector. The fuseholder is an integral part of the switch bracket. In all "B" model projectors, the rotary switch is mounted directly to the main plate, thus eliminating the need for a mounting bracket. However, a separate fuseholder (item 1B, Figure 2) is now required and is mounted to the main plate just to the rear of the rotary switch.

STILL-RUN COMPONENTS — DESIGN 1541 PROJECTORS ONLY. The Design 1541 projectors are the only manual thread models of the 1500 series which are equipped with the "still-run" feature. The parts involved are illustrated in Figures 3A and 10A of the Replacement Parts section. Procedures for repair and/or replacement of these items is as follows.

a. Replacement of Figure 3A Parts. The disassembly and reassembly of parts shown in Figure 3A is a purely mechanical procedure and requires no special tools. Note the following special precautions.

- (1) The upper end of the still-run rod (4) extends through a hole in the lip of the stop pawl, with one collar (2) below the pawl and the spring (3) and second collar above (see View A of Figure A-1, this section).
- (2) The upper end of the fire shutter rod (8) engages the actuating lever of the fire shutter assembly shown in Figure 10A.
- (3) In reassembly, the loops of the torsion spring (20) are assembled to the studs at the rear end of the pivoting link (18) and the lower end of the sliding link (13).

b. Removal of Figure 10A Parts. The Design 1541 projector is equipped with a fire shutter assembly in place of the support bracket (item 4, Figure 10) used in Design 1535 and 1540 projectors. Except for this, the basic disassembly procedures outlined in steps (a) through (e) of paragraph 11 will apply. For the balance of disassembly, disregard step (f) of the basic instructions and proceed as follows.

- (1) Remove the two retaining rings (4) and disassemble the stop pawl shaft (5) and stop pawl (6) from the mechanism casting. Remove screws (7) and (9) and disassemble the bearing bracket (8) and stop pawl shaft bracket (10) from the mechanism casting. Inspect the grommets (11) and, if damaged, press them from the bracket (10).
- (2) Remove the round nut (12) and washer (13) and disassemble the shuttle adjustment bracket (14) from the animated clutch bracket assembly. Remove the two screws (15) and (16) and lock washers (17) and lift the animated clutch bracket assembly (18) from the mechanism casting. Remove the three retaining rings (18B) and slide the shaft (18C) from the bracket (18L), removing the bumper (18D), washer (18E), spring (18F) and slide bar assembly (18G) from the shaft as it is withdrawn. Remove the screws (18H) and washer (18J) to free the strike (18K).
- (3) Remove the retaining ring (19), the two screws (20) and the bearing loading spring (21). Loosen the setscrew (22) in the loop restorer cam (38) and press the camshaft (41) to the left until the bearing (23) is forced from the mechanism casting. Pull the bearing from the camshaft. Remove retaining rings (27) and (39) from the camshaft and press the camshaft to the right to force the large bearing (40) from the mechanism casting. Withdraw the camshaft to the right, removing the clutch, worm gear and cam parts (24 through 38) as the camshaft is withdrawn. Inspect worm gear parts (35A through 35D) and, if damaged, disassemble for replacement.

c. Reassembly of Figure 10A Parts. When repairing Design 1541 projectors, disregard the reassembly procedures outlined in steps (a) through (d) in paragraph 16 of the Reassembly section and reassemble the still-run clutch parts in the following manner.

- (1) Assemble the strike (18K) to the clutch slide bar assembly (18G) with the screw (18H) and washer (18J). Insert the shaft (18C) part way through the right-hand arm of the mounting bracket assembly (18L) and install the bumper (18D) on the end of the shaft. Hold the slide bar assembly (18G) in position between the arms of the bracket assembly and continue to insert the shaft, assembling the

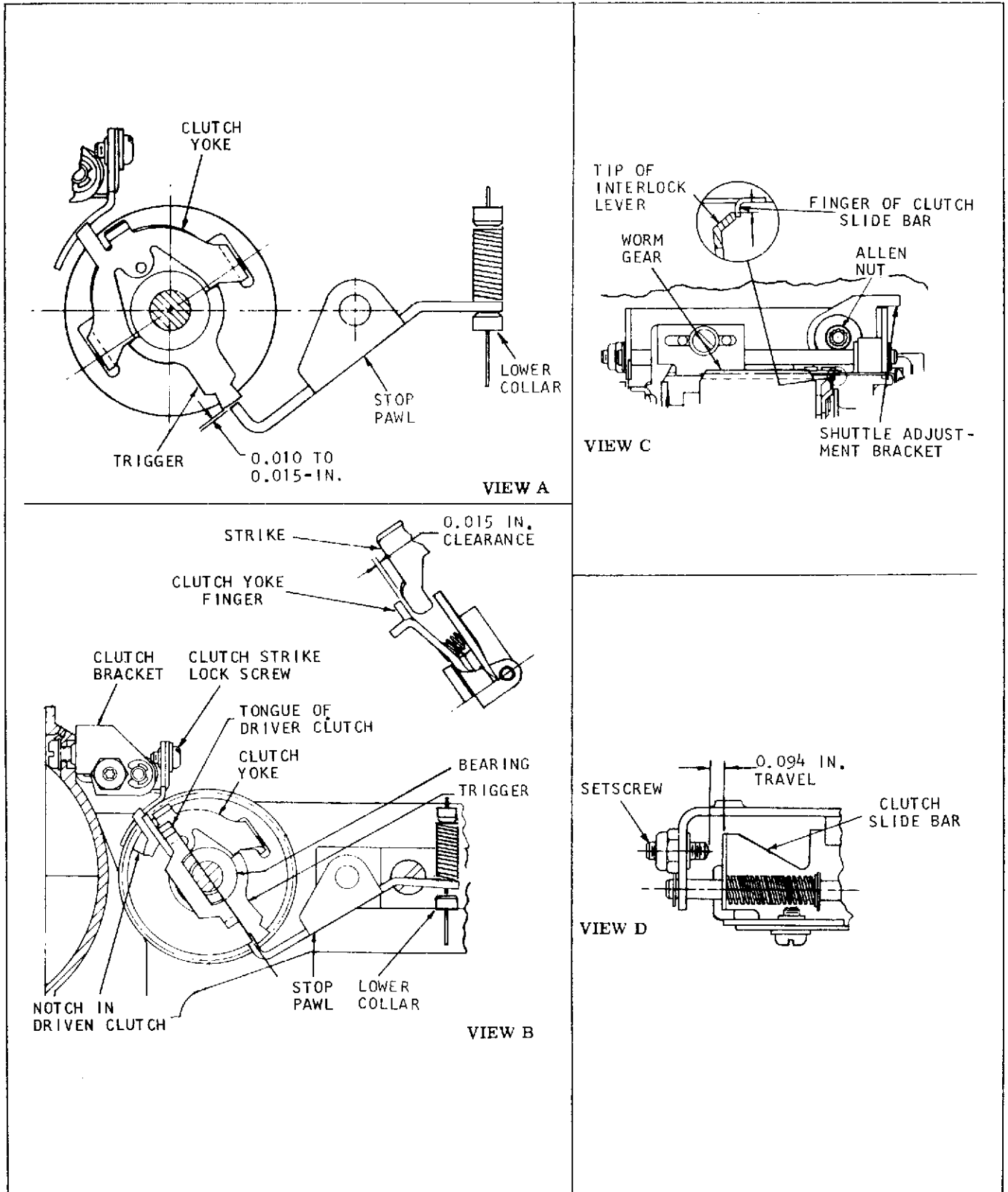


Figure A-1. Still-Run Clutch Adjustments — Design 1541 Only

- flat washer (18E) and spring (18F) on the shaft before it is inserted through the left-hand arms. Install the three retaining rings (18B) with the center ring to the right of the spring and washer. The setscrew (8A) must be adjusted at final assembly to limit slide bar travel. Assemble the complete clutch bracket assembly (18) to the mechanism housing with the two screws (15) and (16) and lock washers (17), and press down firmly on the bracket while tightening the screws. Assemble the adjustment bracket (14) to the end of the longer screw (16) and install the washer (13) and round nut (12) tightening the nut finger tight.
- (2) Lightly grease both bearing openings in the cast arms of the mechanism housing. Press the ball bearing (23) into its bearing opening until fully seated. Assemble the large bearing (40) to the camshaft (41) until the bearing is seated against the shoulder of the shaft. Install the retaining ring (39) to the camshaft with the bowed surface of the ring facing away from the ball bearing.
 - (3) Assemble the three rubber bushings (36) into the corresponding openings in the face of the worm gear assembly (35). Assemble the bearing assembly (34) to the worm gear so that the formed ears of the bearing are aligned with corresponding notches in the worm gear. Insert the bent ears of the clutch yoke (32) through the slots in the bearing assembly, while assembling the spring (33) over the protruding finger of the clutch yoke and into the hole in the bearing assembly. Hold these parts together while assembling the two shoulder pins (31) to the bearing assembly, pressing them in until they engage the bent ears of the clutch yoke. Assemble the trigger (30) to the sleeve bearing (29) and press the bearing through the bearing assembly (34) and into the worm gear.
 - (4) Insert the end of the camshaft (41), with ball bearing (40) assembled, through the bearing hole in the right-hand cast arm of the mechanism housing. To the shaft, assemble the loop restorer cam (38), thrust washer (37) and the assembled worm gear group. Assemble the torsion spring (25) over the hub of the driven clutch (26), spreading the legs of the spring so that they straddle the bent ear at the top of the clutch. Insert the hub of the driver clutch (24) through the hub of the driven clutch, spreading the legs of the torsion spring still further until one of the lugs of the driver clutch is also straddled by the spring legs. Install the washer (28) and the assembled clutches on the camshaft. When installed, the bent ear of the driven clutch (26) must be parallel with the camshaft flat for the loop restorer cam (38).
 - (5) Slide the camshaft all the way in place, inserting the end of the camshaft into bearing (23) while seating the large bearing (40) in the bearing hole of the cast arm. Assemble the two retaining rings (27) to the camshaft, one between washer (37) and loop restorer cam (38); the other between washer (28) and clutch (26). Clutch and loop restorer adjustments will be made after reassembly has been completed.
 - (6) Fasten the bearing loading spring (21) to the cast arm of the mechanism housing with two screws (20). Assemble the large retaining ring (19) into the ring groove of the housing arm, with the bowed face of the ring against the bearing (40).
 - (7) Insert a 0.190-inch feeler gage between the loop restorer cam and the cast arm of the mechanism housing. Hold the cam firmly against the feeler gage while tightening the setscrew (22) against the flat of the camshaft. Remove the feeler gage.
 - (8) Assemble the two grommets (11) into the bracket (10). Install a retaining ring (4) into the ring groove closest to the right end of the stop pawl shaft (5). Insert the opposite end of the shaft through the bearing bracket (8) and both ears of the stop pawl (6) and assemble the second retaining ring (4) into the ring groove of the shaft just inside the right-hand ear of the stop pawl. Loosely attach the bearing bracket (8) to the cast arm of the mechanism housing with the two screws (7). Assemble the bracket (10) to the left end of the shaft and secure the bracket to the mechanism housing with two screws (9). Refer to step d and e following for stop pawl to trigger clearance adjustment.
- NOTE: The balance of the reassembly procedure for Design 1541 projectors is the same as outlined in steps (e) through (m) of paragraph 16 in the basic service instructions except that the fire shutter assembly shown in Figure G is used in place of the support bracket (item 4, Figure 10) used in the Designs 1535 and 1540.
- d. Checking Stop Pawl to Trigger Clearance. With the Still-Run knob in the "RUN" position, rotate the mechanism pulley manually until the finger of the trigger is aligned with the bent inner ear of the stop pawl as shown in View A, Figure A-1. If the trigger fails to clear the stop pawl ear, adjust as follows: Loosen the setscrew in the lower collar of the still-run rod and move the collar upward, thus pivoting the stop pawl counterclockwise. When a clearance of 0.010 to 0.015 inch is obtained between tip of trigger and ear of stop pawl, tighten the collar setscrew securely.

e. Checking Shuttle Retraction. With the Still-Run knob in the "STILL" position, rotate the mechanism pulley manually. The ear of the clutch pawl should latch behind the trigger as shown in View B, Figure A-1. Note also the clearance required between the finger on the clutch yoke and the curved arm of the strike. Adjust shuttle retraction as follows (Still-Run knob in "STILL" position).

- (1) Loosen the clutch strike screw (View B, Figure A-1) to permit the strike to be shifted. Insert a 0.015-inch feeler gage between the clutch yoke finger and the strike arm, and press and hold the strike against the feeler gage while retightening the strike screw. Remove the feeler gage.

- (2) Refer to View C, Figure A-1. Loosen the round Allen nut slightly and shift the shuttle adjustment bracket slowly toward the shuttle (to the right) until the shuttle teeth are retracted below the level of the aperture plate rails. Hold the adjustment bracket securely while retightening the Allen nut.
- (3) Refer to View D, Figure A-1. Adjust the setscrew in or out to obtain a clearance of 0.094 inch between the left-hand ear of the clutch slide bar and the tip of the setscrew.
- (4) The shuttle interlock retainer is secured to the right end of the worm gear. Note, in View C, that the curved lip of this retainer must overlap the downward bent finger of the clutch slide bar. If necessary, bend this finger to obtain positive overlap as shown.

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 to the tapped holes to prevent loss.

b. Cemented or adhesive backed parts are so noted in the parts lists and should not be removed unless defaced or unless their removal is necessary to expose other parts of the projector. Removal of cemented parts can be accomplished by prying up one edge with a knife blade. Be careful not to scratch surrounding areas, and remove traces of old adhesive from the mounting area with a cloth dampened in 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 removing electrical parts, it is advisable to tag leadwires or to make a rough sketch of leadwire connections to facilitate the installation of new 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.

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

a. Swing down the hinged upper door of the rear cover assembly and remove four screws (2), plus the single screw (4) that secures the pivoting cable

latch plate. Loosen the three screws (3) that secure the bottom tabs of the rear cover to the base and lift off the cover.

b. Remove two screws (6) and lift off the top plate assembly (7). The carrying handle (9) is secured to the top plate with four screws (8). The rear cover latch (10) is mounted on a formed tab which is then peened over to secure it in place.

c. The control knobs (12), (13) and (20) are pressed onto their shafts and must be pried off with care. To remove the lamphouse assembly (15), pull it straight from the mechanism plate.

d. To remove the projection lamp (16), swing down the retaining clamp (17B) and pull the lamp straight out from its socket. Do not rock or twist the lamp during removal, or the lamp pins may become damaged. The lamp shield (17A) and lampholder assembly (18) are secured to the projector main plate with screws (17).

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

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

b. The printed circuit board (7) can be removed by taking out the two screws (5A) at the upper end of

SERVICE INSTRUCTIONS

the board and pulling the board straight up to disengage the board contact pins from the edge connector (6). Do not rock or twist the board to disengage the pins.

c. The assembled transformers (12 through 22) must be removed as a unit. Tilt the projector to remove the two rear attaching screws (11) from the underside of the base; then remove the two front attaching screws (11) which are threaded down into tapped holes in the base. Lift out the assembled transformers with their assembled brackets.

d. The drive belt (34) can be replaced by following the "Drive Belt Replacement" instructions in the Introduction section of this manual. Remove the drive motor and blower components (29 through 39) as a unit by removing the four motor mounting screws (27) and the four blower housing and cover screws (28). Remove three screws (29) and disassemble the fan housing (30) from the housing cover (33). Loosen the two setscrews (31) and disassemble the fan and hub assembly (32) and cover (33) from the motor shaft. Loosen two setscrews (35) and withdraw the pulley (36) from the motor shaft.

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

a. Remove the retaining ring (1) and disassemble the spur gear (2) and retaining key (3) from the shaft of the rear reel arm (25). Remove the retaining ring (13) and disassemble the thrust washer (13A), clutch assembly (14), spur gear (15) and retaining key (16) from the shaft of the front reel arm (24). Note that the lock buttons (26) are spring-loaded and will pop out when the reel arms are removed. Remove the three screws (22) which secure each reel arm disc (24) to the main plate, and disassemble the discs and reel arms from the plate.

b. Remove two retaining rings (1) and disassemble the large spur gears (4) and flat washers (5) from the main plate studs.

c. Remove the push-on grip ring (6) and disassemble the spring tension washer (7), thrust washer (7A), large spur gear (8) arm and gear idler assembly (9), retaining key (10), flat washer (11) and rewind clutch (12) from the shaft of the upper sprocket assembly. Remove the retaining ring (9A) and disassemble the spur gear (9B) from the idler arm (9C).

d. Disassemble the retaining ring (17), flat washer (18) and idler gear (19) from the gear stud protruding through the rewind lever (21D). Note the manner in which the ends of the torsion spring (20) are engaged; then lift the lever and gear assembly (21) and torsion spring (20) from the gear stud. Disassemble the retaining rings (21A), flat washers (21B) and spur gears (21C) from the gear studs of the rewind lever (21D).

NOTE: The soundhead assembly (34) cannot be removed (step e) until the starting capacitor and trans-

former group (Figure 2) have been disassembled from the projector.

e. Remove the retaining ring (28) and washers (29) and (30A) from the sound drum shaft. Pull the flywheel (31) from the shaft, tilting it slightly to clear the motor if the motor is still in place. Remove remaining washers (30) and (30A) from the shaft. Support the soundhead assembly (34) while removing the three screws (32) and washers (33); then carefully lift the soundhead from the projector main plate. Refer to paragraph 8 for soundhead disassembly instructions.

f. Remove two retaining rings (37) and disassemble the torsion spring (38) from the rear shoulder stud (39) and the stud protruding from the main plate. Unscrew the two shoulder studs (39) and disassemble the belt shifter bracket (40) and spacers (41) from the main plate.

g. Refer to Figure 4 and disassemble the retaining ring (1) and spring (4) from the shaft behind the snubber roller. Support the mechanism assembly (44, Figure 3) while removing the four screws (42) which secure it to the main plate. The upper two screws also attach the idler gear adjustment bracket.

5. REMOVAL OF FILM GUIDES AND TILT MECHANISM (Figure 4). Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Remove retaining ring (2) and flat washer (3) and lift the spring (4) from the end of spring post (6). The other end of the spring attaches to the snubber lever of the mechanism assembly and has already been disengaged. The spring post (6) is secured to the base with a single screw (5).

b. Unscrew the adapter shaft (7) to free the film guide roller (8). Remove the screw (9) and lift out the sliding film guide assembly (10) from the base. Disassemble the retaining rings (10A) and guide rollers (10B) from the guide bracket (10C).

c. Remove the screw (11) and lock washer (12) and disassemble the tilt bar (13) from the lower end of the tilt gear rack (19). Loosen the setscrew (15) and withdraw the tilt knob (16), spring tension washer (17) and flat washer (18) from the end of the gearshaft (21). Lift out the tilt gear rack and remove the retaining ring (20) and the tilt gearshaft (21). Drive out the spring pin (22) and lift out the tilt worm gear (23).

d. Each end plate (28) and (29) is secured at the bottom with two screws (27) inserted up through the base and at the top by a single screw (27) inserted through the main plate. Four screws (30) secure the main plate (31) to the uprights of the base assembly (34).

6. DISASSEMBLING THE FRONT REEL ARM (Figure 5). Disassemble the front reel arm in the following manner, noting any special precautions.

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

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

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

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

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

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

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

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

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

8. DISASSEMBLING THE EXCITER LAMP COVER AND SOUNDHEAD (Figure 7). Disassemble the exciter lamp cover and soundhead assembly in the following manner, noting any special precautions.

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

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

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

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

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

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

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

9. DISASSEMBLING THE MECHANISM (Figure 8). Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

SERVICE INSTRUCTIONS

a. To remove the lens carrier assembly (5), pry out the hinge pins (1) and (2) with a wire cutter or similar tool and lift the lens carrier from the mechanism. Note that the spring washer (3) is used with the upper pin and the flat washer (4) with the lower pin. To disassemble the lens carrier, remove the two screws (5A) and remove the pressure plate (5B), bushings (5C) and (5D), springs (5E) and pressure plate lever (5F). The adjustment plate (5H) need not be removed. Pry up the nameplate (5J) with a knife blade. Remove two screws (5K) and disassemble the spring (5L) and the knob and pinion assembly (5M) from the lens carrier (5N).

b. 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.

10. DISASSEMBLING THE MECHANISM (Figure 9). 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 12 for aperture plate disassembly instructions.

11. DISASSEMBLING THE MECHANISM (Figure 10). 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).

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 ring groove in the long cast arm of the housing. Remove the two screws (28) and the bearing loading spring (29) and (in Design 1540 projectors only) 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.

12. DISASSEMBLING THE APERTURE PLATE (Figure 11). 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.

13. TESTING AND REPAIRING THE PRINTED CIRCUIT BOARD ASSEMBLY (Figure 12). Using standard electronic shop test equipment and techniques, check the printed circuit board and its components for continuity and for shorts and open circuits. Refer to the schematic diagram, Figure 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 dashed arrow drawn on the top of the circuit in Figure 12. This arrow is not imprinted on the circuit itself.

Reassembly Procedure

14. 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 diagrams at the end of the Replacement Parts section for the proper connection of leadwires. When resoldering components to the printed circuit board (Figure 12), use a heat sink to avoid the direct application of heat to adjacent components on the board. Refer to paragraph 13 for special instructions regarding transistor and integrated circuit replacement.

c. Lubrication instructions are provided in the Introduction section of this service manual. Do not over-lubricate. Apply grease and oil sparingly as indicated, and wipe away 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 12). 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.

15. REASSEMBLING THE APERTURE PLATE (Figure 11). Reassemble Figure 11 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 16, step k, for installation instructions.

16. REASSEMBLING THE MECHANISM (Figure 10). Reassemble Figure 10 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

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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, and 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. For Design 1540 projectors only, assemble the loop restorer cam (34) to the end of the camshaft with its hub toward the long cast arm. For all projectors, 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. For Design 1540 projectors only, 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 up 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

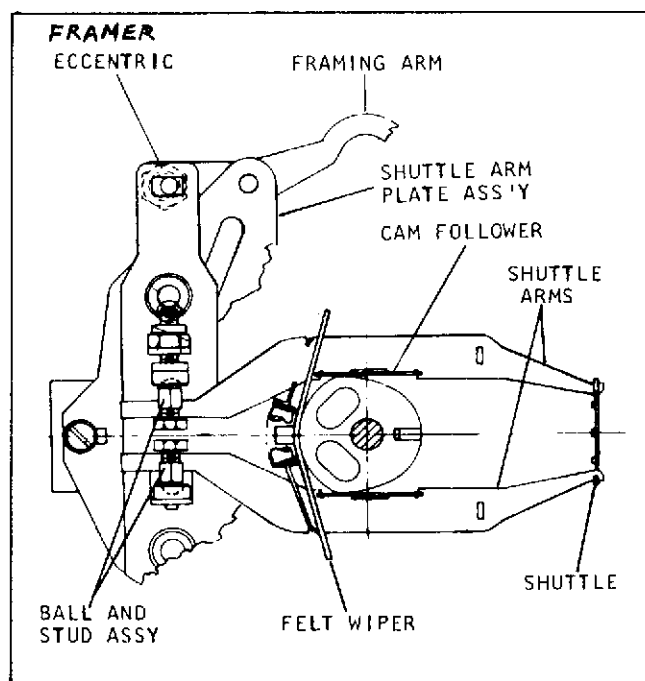


Figure B. Shuttle and Shuttle Arms Assembled

(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 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 9 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 29.

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.

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

a. Design 1540 Only. Assemble the retaining ring (32) into the ring groove in the short shaft of the lever assembly (31). Lightly grease the long shaft of the lever and insert it through the hole directly below the sprocket bearing. Position 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 the self-centering assembly to engage the self-centering shaft. Assemble the screw (28) loosely to the arm assembly. Insert a 0.015-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. 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. Assemble the cam follower parts (27A through 27F) as shown in Figure 9 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, counter-bored end out, and install the screw (20). Refer to paragraph 34 for loop restorer adjustments.

NOTE: The following instructions apply to both the Design 1535 and 1540 projectors.

b. 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.

c. Assemble the lower guard mounting plate (13) over the lower sprocket bearing and align the screw holes with the tapped holes in the housing. When assembling Design 1540 projectors, 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.

d. 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 lens carrier has been installed (paragraph 30).

e. 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).

18. REASSEMBLING THE MECHANISM (Figure 8). Reassemble Figure 8 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) and the gear teeth must mesh with the worm gear assembly previously installed. Set the lower sprocket gear in the following manner.

Design 1535 only: Insert a 0.005-inch shim between the sprocket gear and the tension washer. Press against the gear to hold the shim in place but without flattening the tension washer, and tighten both setscrews (6) securely.

Design 1540 only: Tighten one of the setscrews (6) so that the sprocket shaft turns freely but without noticeable end play. This screw must be loosened and retightened when adjusting film clearance.

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.

19. REASSEMBLING THE LENS CARRIER (Figure 8). Reassemble the lens carrier assembly as outlined in the following paragraphs.

a. Lightly grease the gear teeth of the pinion assembly (5M), the notches in the lens carrier (5N) where the pinion shaft will rest, and the notched ears of the pinion spring (5L).

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

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

d. Assemble the shorter bushing (5C) and its spring (5E) to the pressure plate pin adjacent to the lever (5F). Assemble the remaining bushing (5D) and its spring (5E) to the opposite pressure plate pin.

e. Carefully place the lens carrier (5N) down on the assembled pressure plate and install the adjustment plate (5H). Install and tighten the screws (5A);

then install screws (5G) and tighten them just enough to hold.

f. Insert the lens plug (Figure A) into the lens bore of the carrier with the rectangular boss of the plug fitted into the opening in the pressure plate. Tighten screws (5G) securely and withdraw the lens plug.

g. Clean the nameplate mounting surface of the lens carrier with a cloth dampened with solvent. Remove the backing from the nameplate (5J) and activate the adhesive as instructed in paragraph 14, step e. Assemble the nameplate to the lens carrier and wipe away excess adhesive with a soft cloth dampened with solvent.

h. 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 30 for lens carrier and latch adjustments.

20. REASSEMBLING THE SOUNDHEAD AND EXCITER LAMP COVER (Figure 7). Reassemble the soundhead and lamp cover parts as outlined in the following paragraphs.

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

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

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

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

e. Lightly oil the roller shafts of stabilizer arms (15H) and (15J). Assemble the lower stabilizer arm (15H) over the short shaft end of the upper stabilizer

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

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

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

h. Insert the small end of the stabilizer tension adjuster (28) through the hole in the top of the soundhead casting. Assemble the spring retainer (29) to the adjuster, threading it approximately midway in the threaded area. Before inserting pin end of adjuster into the small hole at the bottom of the casting, assemble the friction washer (27), bowed face up, to the end of the adjuster. Assemble the retaining

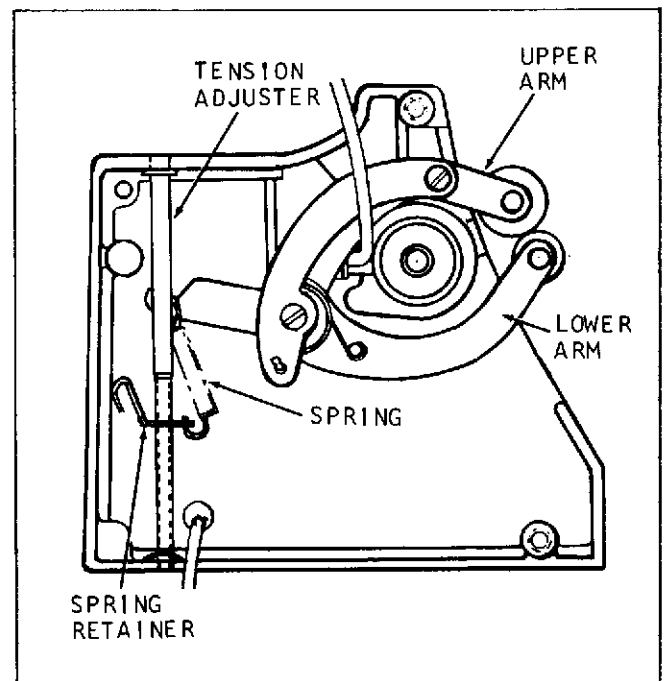


Figure C. Stabilizer Arms Installed on Soundhead

ring (26) into the groove at the upper end of the adjuster. Hook the tension spring (12) between the end of the lower stabilizer arm (15H) and the hole in the spring retainer (29). Install the exciter lamp (8). Refer to paragraph 32 for soundhead adjustments.

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

j. Reassemble the exciter lamp cover as follows. Remove the cloth backing from the light shield (6) and assemble the light shield to the left-hand inside upper wall of the lamp cover (7) so that it is flush with the outer edge of the cover. Remove any excess or overlap with a sharp knife or razor blade. Assemble the cover screw (3) to the cover and install the retaining ring (2). Press the hole plug (5) into the hole in the cover.

21. REASSEMBLING THE REAR REEL ARM ASSEMBLY (Figure 6). 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). Assemble the take-up arm (9) to the mounting pin (33) in the reel arm. Assemble the take-up belt (4) around the spindle pulley and the rubber sleeve of the lower face gear. See Figure D. Insert the tension spring (5) into the recess in the take-up arm and compress the spring with a piece of shim stock while assembling the reel arm cover (2) to the reel arm. Be sure to place a shim washer (3) on each of the reel arm mounting bosses before lowering the cover in place. Install and tighten the two screws (1).

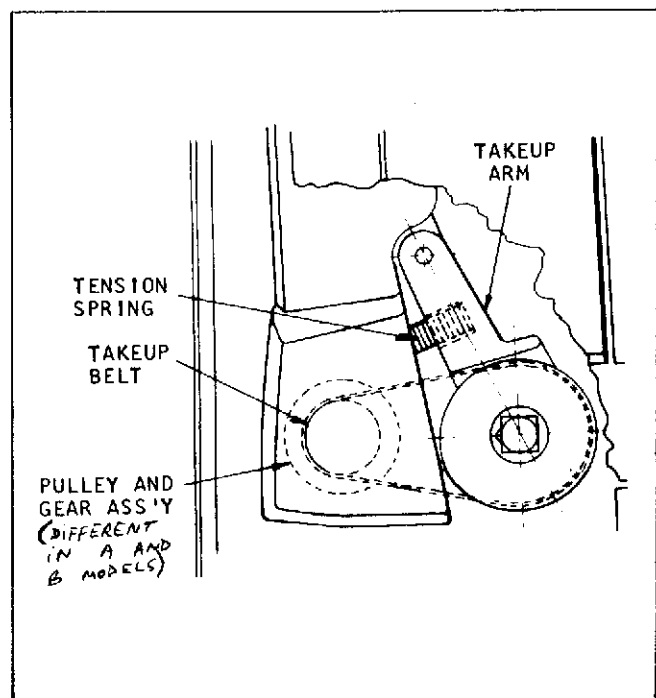


Figure D. Take-Up Arm Assembled

22. REASSEMBLING THE FRONT REEL ARM ASSEMBLY (Figure 5). Reassemble the front reel arm as outlined in the following paragraphs.

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

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

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

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

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

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

23. INSTALLING THE TILT MECHANISM AND FILM GUIDES (Figure 4). Reassemble Figure 4 parts as outlined in the following paragraphs.

a. Lightly grease the teeth of the worm gear (23) and the gear rack (19). Assemble the gear rack into its channel in the end plate (28); then hold the worm gear between the two formed ears, its teeth engaging those of the gear rack, and secure the worm gear with a new spring pin (22). Assemble the gear shaft (21) to the end plate, engaging its gear teeth with those of the worm gear (23), and secure the gear shaft with the retaining ring (20). Lightly speck the gear shaft teeth with grease. Assemble the two washers (17) and (18) and tilt knob (16) to the end of the gear rack (19) and tighten the setscrew (15) securely. Assemble the tilt bar (13) to the end of the gear rack, short leg toward the front of the projector, and install the screw (11) and its lock washer (12). Operate the tilt knob in both directions to check the tilt mechanism for smooth operation.

b. At this point, refer to Figure 3 and carefully assemble the complete mechanism assembly (44) to the projector main plate with the four screws (42). The upper two screws also serve to attach the idler gear adjustment bracket (43).

c. Refer to Figure 4 and 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).

d. 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 install the washer (3) and retaining ring (2) to retain the end of the spring.

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

a. Lightly grease the elongated slot and sliding contact surface of the belt shifter bracket assembly (40) and assemble the spacers (41) and shifter bracket to the tapped bosses of the main plate with the two shoulder studs (39). Assemble one loop of the tension spring to the right-hand shoulder stud and the other loop over the notched ear of the bracket (40) just

above the stud. Install the retaining rings (37) to hold the spring loops in place.

b. Secure the rotary switch bracket assembly (36) to the main plate with the two screws (35).

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

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

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

f. Assemble the spur gears (21C), hubs inward, to the gear studs of the rewind lever assembly (21D). Place a washer (21B) on the gear stud nearest the end of the lever, and secure the gears with the retaining rings (21A). Hook the bent end of the long leg of the spring (20) through the hole in the upper lip of the rewind lever (21D) and assemble the spring loop and the rewind lever to the gear stud of the main plate (located near the upper left-hand corner of the cut-out for the mechanism assembly). Wind the short leg of the spring one full turn counterclockwise and hook the bent end behind the edge of the cut-out. Assemble the idler gear (19), hub inward, and the washer (18) to the protruding gear stud, meshing gear (19) with gears (21C). Install retaining ring (17).

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

h. Assemble the gear (9B), long hub out, to the gear stud of the arm assembly (9C) and install the retaining ring (9A). Assemble the rewind clutch assembly (12) and flat washer (11) to the upper sprocket shaft and assemble the gear retaining clip (10) to the flats of the shaft. Assemble the large hole in the idler arm over the inner shoulder of the spur gear

(8) and install these parts on the upper sprocket shaft. Slide the gear (8) inward until the square recess in its face engages the square clip (10). The staked pin of the idler arm must be inserted into the triangular cut-out in the rewind lever (21D). Install the spring tension washer (7), bowed face out, and grip ring (6).

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

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

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

a. Be sure to install the washer (43) over the threaded boss of the speaker jack (42) before assembling the jack, the nameplate (41) and the locking nut (40) to the projector end plate.

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

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

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

e. Assemble the mounting brackets (21) and (22) to the lamp transformer (13) with two screws (18) and Sems nuts (17). Assemble the power transformer brackets (19) and (20) to the top of the lamp transformer with the remaining two screws (18) and Sems nuts (17). Position the power transformer (16) on top of the lamp transformer, between the two brackets (19) and (20), and install the two screws (15) and Sems nuts (14). Position the transformer group over the mounting holes in the projector base. Insert the two screws (11) up from beneath the base and thread them partially into the rear holes in the brackets (21) and (22). Insert screws (11) down through the front holes in the brackets and into the base. Tighten all screws securely.

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

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

h. Insert the shaft of the rotary switch (4) through the mounting hole in the switch mounting bracket. Assemble the lock washer (3) and mounting nut (2) on the shaft before continuing to insert the shaft through the long switch tube. When viewed from the rear of

the projector, switch terminal 2A must be at the upper left corner of the switch. Secure the switch to the mounting bracket by tightening the locking nut up against the inside surface of the bracket.

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

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

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

b. Assemble the "Fwd-Rev-Lamp" knob (20) to the shaft of the rotary switch, pressing it in until fully seated.

c. Assemble the "Tone" control knob (13) to the control shaft protruding from the soundhead, engaging the key lugs of the knob with the slots in the outer shaft. Install the "On-Volume" control knob (12) on the shaft so that the spring insert of the knob bears against the flat on the inner shaft.

d. Assemble the carrying handle (9) to the top plate (11) with the four screws (8).

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

Adjustments

27. 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.

28. OPTICAL ALIGNMENT.

Align the aperture plate before attempting to align the lamp socket. 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 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.

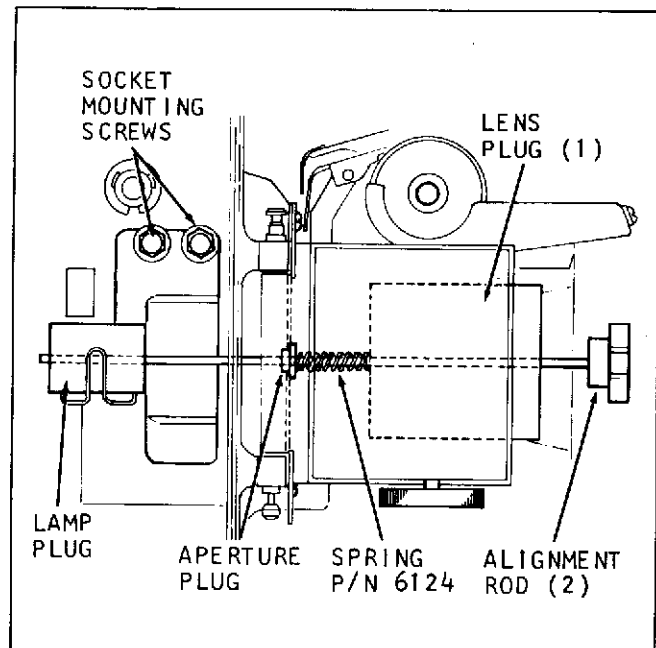


Figure E. Aligning the Optical System

- (4) Insert the alignment rod (item 3, 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.

29. 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 28, step a, Aligning the Aperture Plate.
- (2) Shuttle stroke incorrect. See paragraph 29, 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.

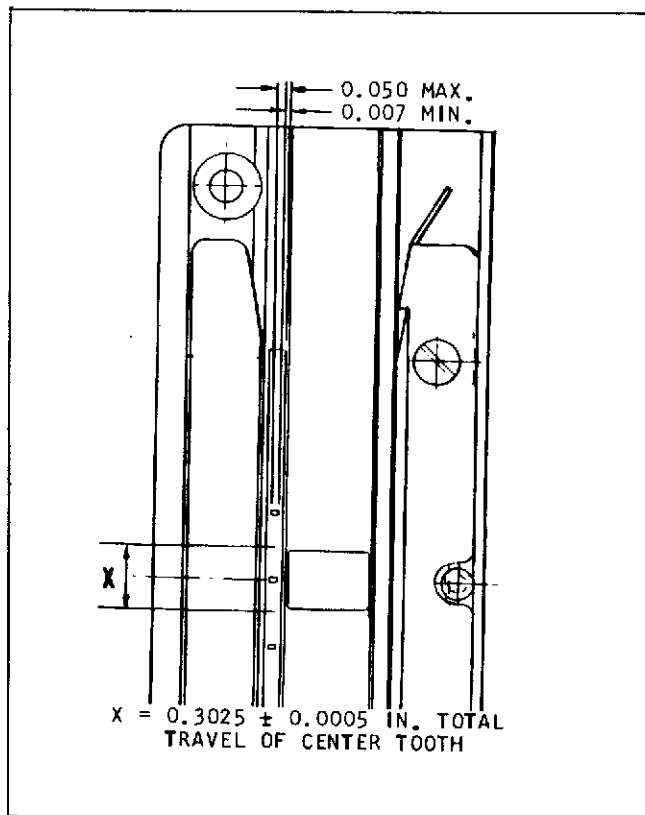


Figure F. Aperture Plate and Shuttle Tooth Clearance

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 lamp-holder 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.

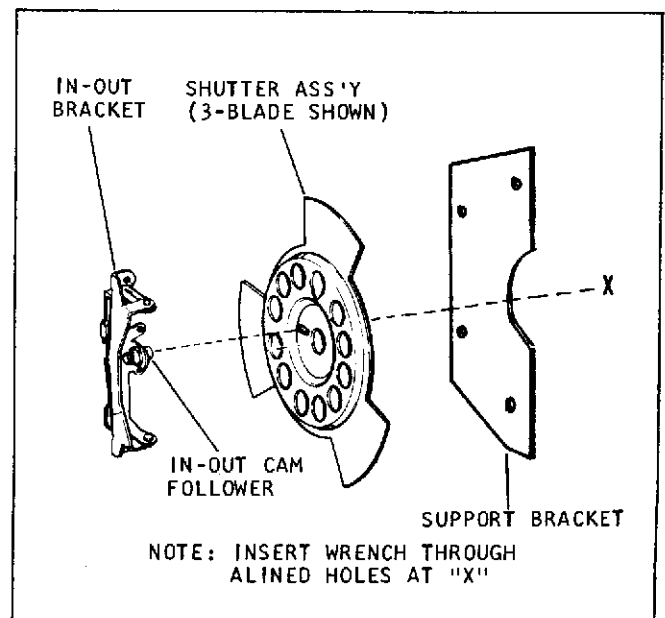


Figure G. Adjusting Shuttle Tooth Height

- (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 S-552-4-N1 over casting to which shuttle mounting plate is attached (Figure H). When tool (A) is positioned so that stud (B) can bear on shuttle arm (C), tighten thumbscrew (D) just enough to hold tool in position. Engage hook of tool S-552-4-N2 in slot of stud (B) as shown, and allow weight (E) to swing downward. Tilt projector, if required, so that the weight does not rub on any stationary parts.

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

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

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

CAUTION: Do not tighten shuttle arms more than is specified in an attempt to remove cam noise. Excessive tightening of shuttle arms for the purpose of reducing other noises will reduce life of cam and cam shoes.

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 comparator. 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

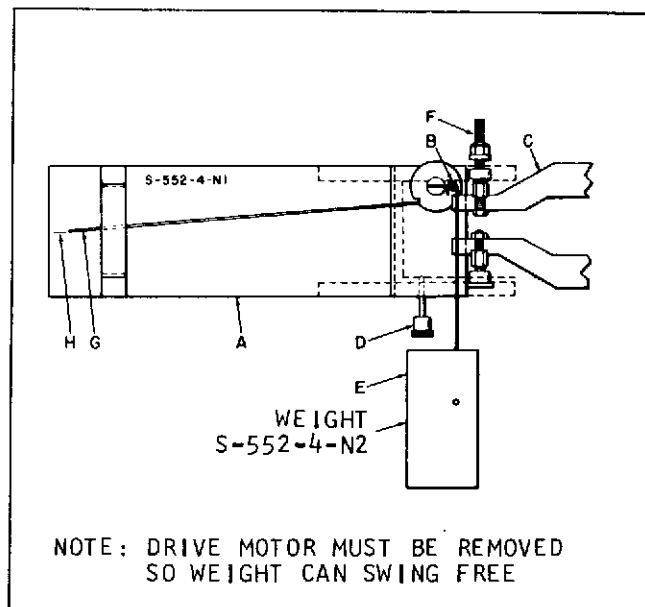


Figure H. Adjusting Fit of Shuttle Arms to Pull-Down Cam

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).

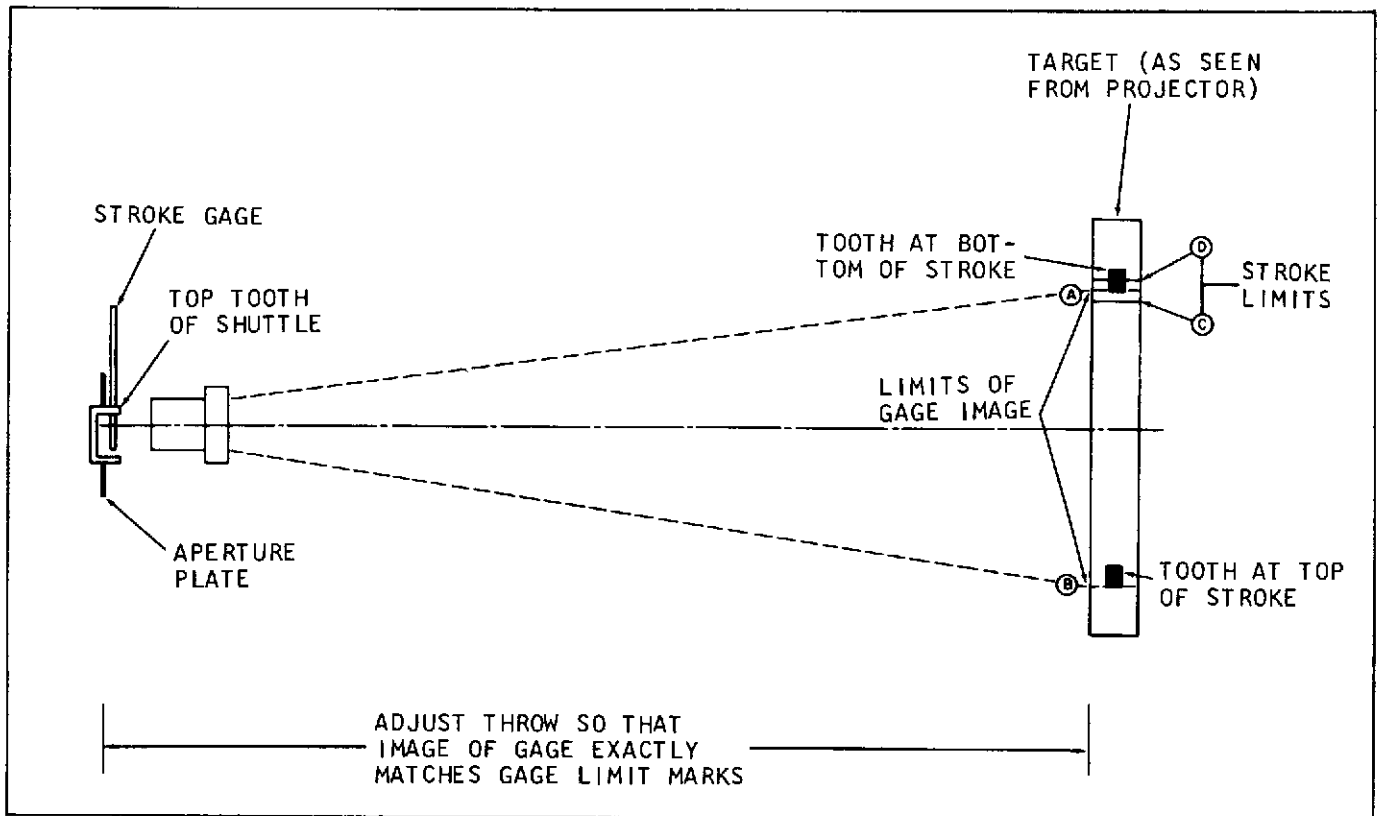


Figure J. Checking and Adjusting Shuttle Stroke with Target

- (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 29, 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.

USE 3/8" IGNITION WRENCH AND 7/16" BOX

30. 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 9). 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 9) 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.

31. ADJUSTING REEL ARMS AND REWIND CLUTCH.

a. Front Reel Arm Adjustment (See Figure 5). Adjust end play of drive shaft (14) to 0.008 inch \pm 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 6). Adjust end play of drive shaft (31) to 0.008 inch \pm 0.003 inch by positioning retaining ring (28) against an 0.008 inch shim. The backlash for both face gears should be between 0.005-inch (minimum) and 0.018-inch (maximum). The upper gear (27) is adjusted by loosening its setscrew (26) and repositioning the gear as necessary. The lower gear is adjusted by loosening the setscrew (13) in the tapped hole of the arm and shifting the shaft (16) in and out as necessary.

c. Rewind Clutch Adjustment. The rewind clutch system must be adjusted to produce a supply spindle torque of 2-1/2 to 4-1/2 in.-lbs when the rewind button is pressed during operation. Install an empty reel on the supply spindle and wrap several turns of a ten-inch film strip around the reel hub. Hook a spring scale to the free end of the film strip. Turn on the projector and press the rewind button. The spring scale must measure between 2-1/2 to 4-1/2 in.-lbs of torque. To adjust reverse take-up torque, grip the flats of the clutch disc (of clutch assembly 14, Figure 3) with a wrench and tighten or loosen the hex nut on the clutch disc shaft as necessary. To adjust rewind torque (2-1/2 to 4-1/2 in.-lbs), use the special wrench (item 5, Figure A) to grip the flats of the rewind clutch (12, Figure 3) as shown in Figure P.

32. ADJUSTING THE SOUNDHEAD.

a. Soundhead Removal.

- (1) Remove the projection lens from the lens carrier and wrap it in tissue or a soft cloth.
- (2) Remove the Volume and Tone control knobs from the control shaft and remove the exciter lamp cover from the soundhead. Unscrew the mounting nut from the threaded Volume control bushing.
- (3) Remove the rear cover (paragraph 2) from the projector. Remove the assembled power transformer and lamp transformer (paragraph 3) from the projector base, being careful not to place undue strain on the transformer leads. Remove the flywheel (31, Figure 3) from the sound drum shaft.
- (4) Unsolder the black ground wire from the tip of the terminal at the lower left-hand corner of the soundhead housing. Disconnect the flag terminal of the exciter lamp leadwire from terminal 1L1 of the main switch.
- (5) With a sharp pencil or scribing tool, scribe a line on the projector main plate along the front edge of the soundhead casting. This will provide a reference mark for locating the soundhead during installation.
- (6) Remove the three screws (32, Figure 3) and flat washers (33) and carefully withdraw the soundhead assembly from the projector main plate, disengaging the Volume control shaft from its opening in the soundhead housing.

b. Photocell Alignment (Figure 7).

- (1) Loosen the setscrew (19) and the two housing screws (20). Remove the exciter lamp (8) and the optical slit (11).
- (2) Insert the sound drum alignment tool into the optical slit opening as shown in Figure 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 (20) securely.
- (4) Withdraw the alignment tool and, while looking into the optical slit mounting hole, shift the photocell until its forward tip is flush with the inner face of the sound drum. Maintain this position while tightening the setscrew.

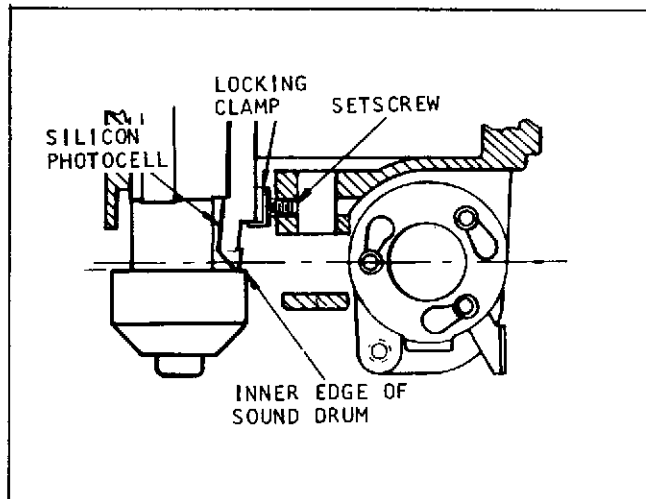


Figure K. Positioning the Sound Drum and Silicon Cell

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 (32, Figure 3) with their washers (33) from the rear of the main plate and tighten the screws finger tight. Shift the soundhead until the forward edge of the soundhead housing is aligned with the scribe or pencil mark on the main plate and maintain this position while tightening the three screws securely.
- (3) Connect the flag terminal of the exciter lamp leadwire to terminal 1L1 of the main switch. Resolder the black ground lead to the tip of the terminal in the lower left-hand corner of the soundhead housing.
- (4) Assemble the washers (29, 30 and 30A, Figure 3) and flywheel (31) to the sound drum shaft and secure these parts with the retaining ring (28).

- (5) Reinstall the assembled power transformer and lamp transformer to the projector base (paragraph 25).
- (6) Temporarily install the Volume and Tone control knobs on the control shaft.

e. Optical Slit Adjustment (Figure 7).

- (1) Insert the optical slit (11) into its opening in the soundhead. The adjusting hole in the barrel of the slit must be at top center.
- (2) Insert a 0.050-inch feeler gage between the tip of the optical slit and the sound drum and press the optical slit in against the feeler gage. Hold in this position while tightening the locking screw (10) just enough to hold the slit in place.
- (3) Thread the projector with 7000 CPS optical setting film and connect a 16-ohm, 10-watt load resistor and output meter to the speaker jack.

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

- (4) Set the volume control at approximately 12 o'clock position and start projector. Move slit toward or away from film, as required, to obtain an output reading. Rotate the slit to obtain peak reading and simultaneously move in or out until maximum output is obtained. If film was threaded with emulsion toward the optical slit, move slit toward film until output drops 1-1/2 to 2 DB. If emulsion is toward sound drum, move slit away from film to obtain 1-1/2 to 2 DB drop in output. Tighten slit clamping screw (10) securely to lock the adjustment.

f. Buzz Track Adjustment (Figure 7). The lateral position of the film in the soundhead is controlled by the flanged roller (15C) and edge guide screw (24). Unless the adjustment has been disturbed, it is not probable that the edge guide screw (24) will require resetting. Thread the projector with buzz track film and adjust volume control to a suitable listening level. Turn adjusting screw (14) to move flanged roller laterally.

NOTE: There are two types of buzz track in use. On one, the track spacing exceeds the length of the scanning beam. This track can be positioned so that little or no signal is reproduced. On the other type of track, spacing is less than the length of the beam. This track should be positioned so that both tones are reproduced at approximately the same volume level. If, after adjustment of guide roller position, signal levels cannot be balanced (or eliminated on wide track), or level of tones fluctuates, adjust edge guide screw (24) to clear up the condition.

If the edge guide screw is far out of adjustment, turn it clockwise until it clears the edge of film, adjust rollers and then set guide screw to stop weave of film.

g. Positioning the Soundhead.

- (1) Lock the autoloader system in the load position and loosen the three soundhead mounting screws (32, Figure 3) just enough to permit the soundhead to be shifted.
- (2) Hold the soundhead locating gage (Figure A) by its handle and insert the gage carefully between the sound drum and take-up sprocket as shown in Figure L. Position the gage so that one end bears against the supporting ribs for the sound track edge of the film and with the round body of the gage in contact with the rear sprocket flange, as shown.
- (3) Tilt the gage so that it lies on a centerline between the take-up sprocket and sound drum. Shift the soundhead toward the take-up sprocket until the sound drum bears lightly against the end of the gage, and tighten the soundhead attaching screws securely.

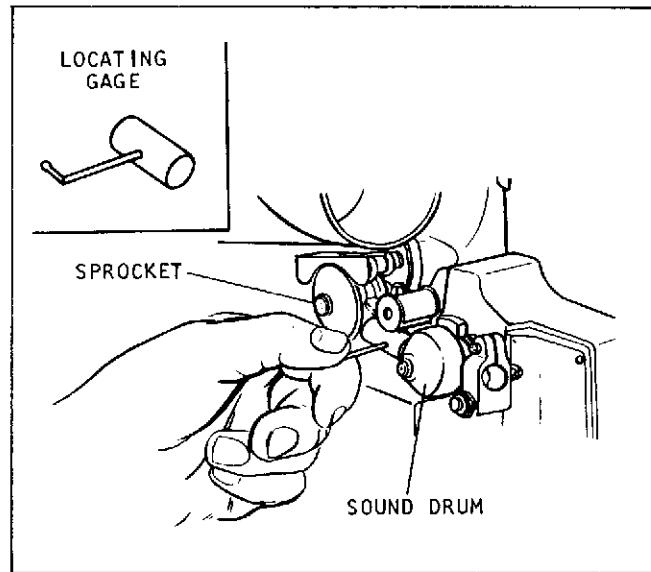


Figure L. Positioning the Soundhead

33. **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.

- (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 \pm 2%).**
Shutter - 1440 RPM \pm 2%
Sprocket - 102.86 RPM \pm 2%
- (2) **Silent Speed (18 FPS \pm 5%).**
Shutter - 1080 RPM \pm 5%
Sprocket - 77.1 RPM \pm 5%

34. **CHECKING AND ADJUSTING LOOP RESTORER (Design 1540 Only).** 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 9) 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

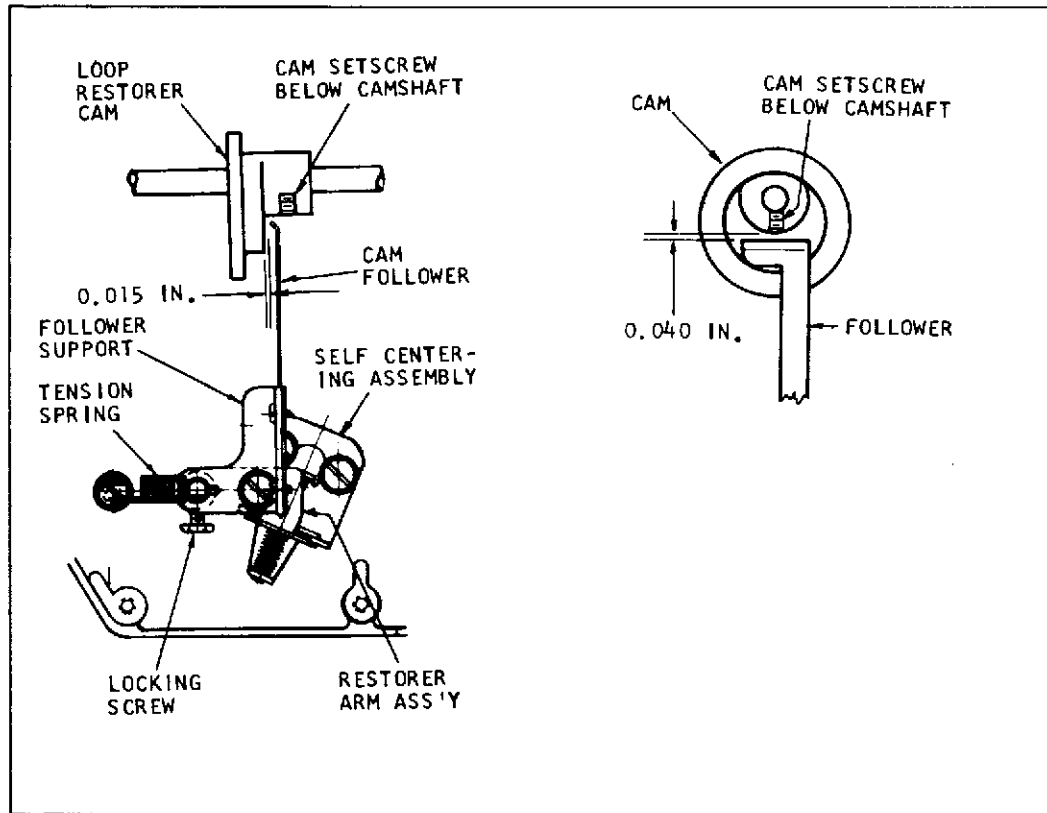


Figure M. Adjusting the Automatic Loop Restorer (Design 1540 Only)

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.

35. 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:

d. To retime the sprockets, the rear cover of the projector must be removed to expose the large sprocket gears at the rear of the mechanism assembly. Hold the sprocket gear stationary while loosening its setscrews; then, still holding the gear stationary, carefully rotate the sprocket and shaft assembly in the proper direction until the pencil alignment mark appears in the center of the timing plate peep hole. Tighten the gear setscrews securely without retaining the gear or the sprocket.

36. 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

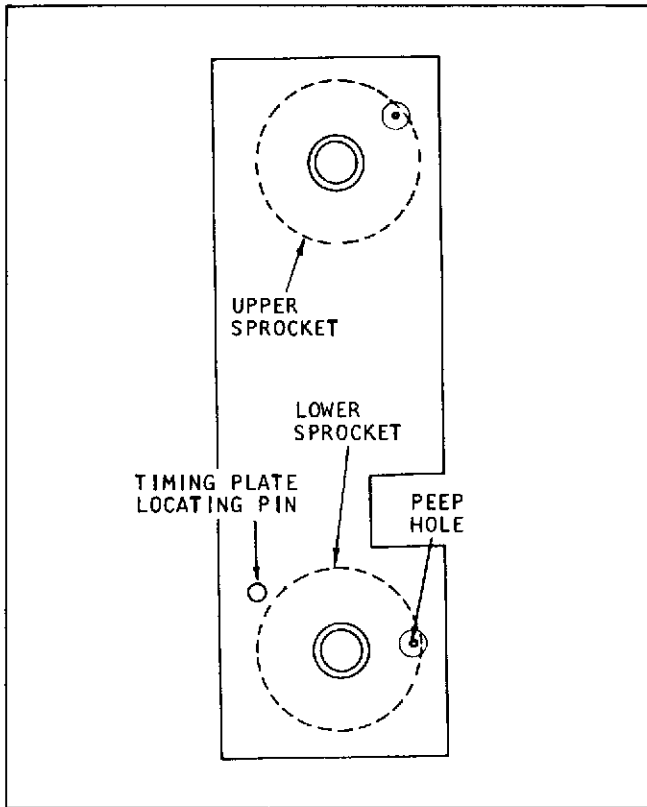


Figure N. Timing the Sprockets

#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.

37. 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

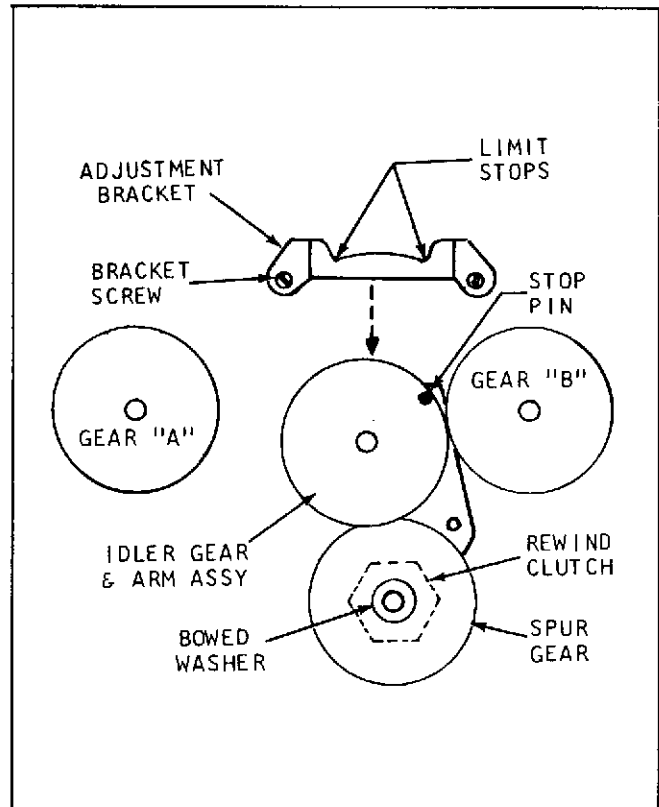


Figure P. Adjusting Gear Shift Tension and Backlash

the retaining ring more firmly on the spur gear shaft until the bowed washer (Figure P) is flattened against the face of the gear.

38. 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

39. MISCELLANEOUS TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Nothing runs	1. Defective On-Off switch. 2. Damaged power cable. 3. Loose connections.	1. Replace switch. 2. Repair or replace cable. 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. 2. Transposed leads on main switch. 3. Drive belt broken or unhooked from pulley. 4. Motor pulley loose on shaft. 5. Animation clutch spring broken.	1. Replace switch. 2. Connect leads to proper terminals. 3. Replace or reinstall drive belt. 4. Position pulley and tighten setscrews. 5. Replace spring.
Rewind does not operate	1. Rewind clutch not engaging or clutch slipping.	1. Adjust (paragraph 31c).
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.
Gate will not lock	1. Latch spring set too close to lens mount stop. 2. Pressure plate out-of-line.	1. Adjust latch spring. 2. Realign pressure plate.
Shuttle runs but sprockets do not revolve	1. Animation clutch spring broken or lost.	1. Replace spring.
Short lamp life	1. Line voltage in excess of lamp voltage. 2. Drive belt broken or disengaged. 3. Dirt and lint clogging blower housing.	1. Use lamp of correct voltage rating. 2. Replace or re-engage belt. 3. Clean.
Projector speed slow	1. Binding in the mechanism. 2. Belt slipping.	1. Free binding condition. 2. Clean or replace belt.
Runs at speed between 18 and 24 FPS	1. Pulleys out-of-line. 2. Belt shifter bent. 3. Power line frequency other than 60 cycles.	1. Realign pulleys. 2. Straighten belt shifter. 3. Use proper voltage and frequency.

SERVICE INSTRUCTIONS

40. PICTURE TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Film jump	<ol style="list-style-type: none"> 1. Damaged film. 2. Loose shuttle. 3. Dirty film aperture. 4. Damaged or lost pressure plate spring. 5. Pressure plate misaligned. 6. Incorrect shuttle stroke. 	<ol style="list-style-type: none"> 1. Repair or replace. 2. Adjust and tighten (paragraph 29c). 3. Clean film aperture. 4. Replace spring. 5. Realign pressure plate. 6. Adjust (paragraph 29d).
Double image	<ol style="list-style-type: none"> 1. Incorrect shuttle stroke. 2. Excessive shuttle protrusion. 	<ol style="list-style-type: none"> 1. Adjust (paragraph 29d). 2. Adjust (paragraph 29b).
Weave (due to faulty aperture plate)	<ol style="list-style-type: none"> 1. Sticking edge guide. 2. Replace tension spring lost. 3. Fixed edge guide out of position. 	<ol style="list-style-type: none"> 1. Clean guide. 2. Replace spring. 3. Reposition guide.
Poor illumination	<ol style="list-style-type: none"> 1. Optics out-of-line. 2. Fire shutter sticking. 	<ol style="list-style-type: none"> 1. Realign (paragraph 28). 2. Checking mechanical linkage for binding.
Poor focus	<ol style="list-style-type: none"> 1. Dirty lens and/or aperture. 2. Warped film. 3. Projector lens mount out-of-line. 4. Pressure plate spring lost. 5. Bent pressure plate. 6. Pressure plate out-of-line. 	<ol style="list-style-type: none"> 1. Clean lens and/or aperture. 2. Recondition or replace film. 3. Realign (paragraph 30a). 4. Replace spring. 5. Replace pressure plate. 6. Realign pressure plate.
Frame line creeps	<ol style="list-style-type: none"> 1. Framer eccentric loose. 	<ol style="list-style-type: none"> 1. Align and tighten (paragraph 29e).
Insufficient framing	<ol style="list-style-type: none"> 1. Framer eccentric out of adjustment. 	<ol style="list-style-type: none"> 1. Adjust (paragraph 29e).
Trailer ghost	<ol style="list-style-type: none"> 1. Shutter out-of-line. (TIME) 	<ol style="list-style-type: none"> 1. Reassemble properly.
Film scratches	<ol style="list-style-type: none"> 1. Caked emulsion on film path parts. 2. Film chips in sprocket guards. 3. Scratches or burrs on film guides, guards, aperture or pressure plate. 4. Jockey rollers (soundhead) sticking. 	<ol style="list-style-type: none"> 1. Clean film path. 2. Remove film chips. 3. Polish with crocus cloth or replace. 4. Clean and lubricate.
Film dimpled between perforations	<ol style="list-style-type: none"> 1. Sprocket shoes sticking. 	<ol style="list-style-type: none"> 1. Clean sprocket shoe pivots.

41. FILM TRANSPORT TROUBLES AND REMEDIES.

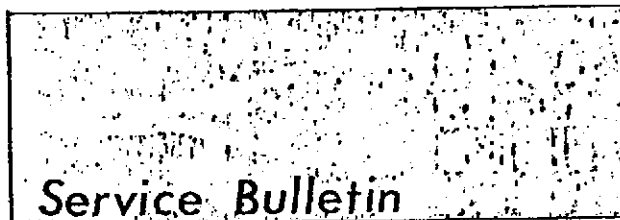
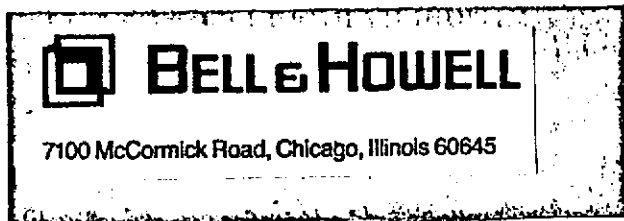
TROUBLE	PROBABLE CAUSE	REMEDY
Loss of loops	<ol style="list-style-type: none"> 1. Damaged film. 2. Inadequate shuttle protrusion. 3. Inadequate or excessive shuttle stroke. 4. Pressure plate spring lost. 5. Pressure mounting plate screws loose. 6. Sprocket guards not closing. 7. Sprocket drive gear loose on shaft. 8. In-out bracket spring broken. 	<ol style="list-style-type: none"> 1. Repair or replace film. 2. Adjust (paragraph 29b). 3. Adjust (paragraph 29d). 4. Replace spring. 5. Tighten mounting screws. 6. Clean or adjust. 7. Retime (paragraph 35) and tighten setscrews. 8. Replace spring.
Shuttle operates but sprockets do not revolve	<ol style="list-style-type: none"> 1. Animation clutch spring broken or lost. 	<ol style="list-style-type: none"> 1. Replace spring.
Lower loop not restored (Design 1540 only)	<ol style="list-style-type: none"> 1. Loop restorer stroke too short. 2. Loop restorer does not engage restorer cam. 	<ol style="list-style-type: none"> 1. Adjust (paragraph 34). 2. Adjust (paragraph 34).
Film rubs on loop restorer roller (Design 1540 only)	<ol style="list-style-type: none"> 1. Restorer arm out of position. 	<ol style="list-style-type: none"> 1. Reposition (paragraph 34).
Excessive film slap	<ol style="list-style-type: none"> 1. Damaged film. 2. Green film. 3. Dirty pressure plate. 4. Pressure plate rubbing on aperture plate guide rails. 5. Incorrect shuttle stroke. 	<ol style="list-style-type: none"> 1. Recondition or replace. 2. Age or buff film. 3. Clean pressure plate. 4. Realign pressure plate. 5. Adjust (paragraph 29d).
Splices jam in sprocket shoes	<ol style="list-style-type: none"> 1. Bad splices. 2. Emulsion build-up. 	<ol style="list-style-type: none"> 1. Replace splices. 2. Clean film path components.
Automatic loop restorer cycles continuously (Design 1540 only)	<ol style="list-style-type: none"> 1. Restorer out of adjustment. 2. Pressure plate (5B, Figure 8) binding on aperture plate edge guide. 	<ol style="list-style-type: none"> 1. Adjust per paragraph 34. 2. Realign pressure plate.
Slack film in soundhead area	<ol style="list-style-type: none"> 1. Sprocket guards sticking. 2. Take-up jerking. 3. Jockey rollers (soundhead) sticking. 4. Soundhead improperly positioned. 5. Dirt or obstruction between sound drum and exciter lamp cover. 	<ol style="list-style-type: none"> 1. Clean sprocket shoe pivots. 2. Check take-up torque and check for binding in take-up reel arm. 3. Clean and lubricate. 4. Reposition per paragraph 32g. 5. Remove obstruction.

42. SOUND SYSTEM TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Projector runs, no voltage at P.C. board	<ol style="list-style-type: none"> 1. Loose connection. 2. Amplifier switch damaged. 	<ol style="list-style-type: none"> 1. Repair connection. 2. Replace switch.
Projector runs, voltage at P.C. board, but exciter lamp does not light	<ol style="list-style-type: none"> 1. Exciter lamp cable disconnected. 2. Wrong exciter lamp used. 3. Projector main switch open or leads disconnected. 	<ol style="list-style-type: none"> 1. Connect cable. 2. Replace with correct lamp. 3. Replace main switch or connect leads.
Voltage at P.C. board, exciter lamp lights, but no sound	<ol style="list-style-type: none"> 1. Speaker jack disconnected or speaker jack switch open. 2. Photocell cable disconnected or leads reversed. 3. Photocell out-of-line. 4. Dirt on end of photocell. 5. Wrong exciter lamp used. 	<ol style="list-style-type: none"> 1. Connect leads. Repair or replace jack. 2. Connect cable. Connect leads to proper terminals. 3. Realign (paragraph 32b). 4. Clean photocell. 5. Replace with correct lamp.
Low volume	<ol style="list-style-type: none"> 1. Trouble in printed circuit board. 2. Wrong exciter lamp used. 3. Photocell out-of-line. 4. Dirt on photocell or slit. 5. Slit misaligned. 6. Buzz track misaligned. 	<ol style="list-style-type: none"> 1. Check out the circuit board. 2. Replace with correct lamp. 3. Realign (paragraph 32b). 4. Clean photocell and slit. 5. Realign (paragraph 32e). 6. Realign (paragraph 32f).
Distortion at all volume levels	<ol style="list-style-type: none"> 1. Wrong exciter lamp used. 2. Trouble in printed circuit board. 	<ol style="list-style-type: none"> 1. Replace with correct lamp. 2. Check out the circuit board.
Crackling noises	<ol style="list-style-type: none"> 1. Broken ground lead to main frame. 2. Buzz track out-of-line. 3. Broken cable shield. 	<ol style="list-style-type: none"> 1. Replace defective lead. 2. Realign (paragraph 32f). 3. Repair shield or replace cable.
Wow or flutter	<ol style="list-style-type: none"> 1. Soundhead stabilizer guide roller sticking. 2. Stabilizer guide roller spring broken, unhooked or lost. 3. Film edge guide (soundhead) out-of-line. 4. Loose flywheel. 5. Damaged sound drum bearing. 	<ol style="list-style-type: none"> 1. Clean roller and roller shaft. 2. Repair or replace spring. 3. Realign (paragraph 32f). 4. Tighten flywheel. 5. Replace sound drum.

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

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.
	9. Loop restorer stroke is too short or restorer set too low (Design 1540 only).	9. Adjust (paragraph 34).
Clicking noises	1. Dirt on sound drum.	1. Clean sound drum.
	2. Broken ground lead to main frame.	2. Replace lead.
High frequencies fade (jumps focus)	1. Warped film.	1. Recondition or replace film.
	2. Film edge guide (soundhead) out-of-line.	2. Realign (paragraph 32f).
	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.
EXCITER LAMP NOT LIT OR DIM OR FLICKERS	1. DEFECTIVE LAMP.	1. REPLACE LAMP.
	2. DEFECTIVE ROTARY SWITCH.	2. REPLACE SWITCH.
	3. Q6 AND/OR Q7 ON PC BOARD BAD	3. TEST AND REPLACE IF NECESSARY.
	4. DIODES D11, D12, D13, D14 MAY BE BAD.	4. TEST AND REPLACE IF NECESSARY.
DISTORTED OUTPUT	1. CHECK TRANSISTORS Q2, Q3, Q4, Q5 FOR SHORTS, OPENS, OR EXCESSIVE LEAKAGE.	1. TEST AND REPLACE IF NECESSARY.



A-73-179 (Revised)

Subject: 1500 SERIES PROJECTOR AMPLIFIERS (#014583) Date: 3-18-74

Reference: Service Manuals #72774 (Manual) and #72745 (Autoload)

Model 1500 Series Projectors coming in for service must be examined for proper heat transfer between the amplifier and end plate bosses.

Remove the amplifier and examine the three bosses for any traces of paint. If surfaces are painted or appear rough, they should be filed. To do so, lay projector amplifier side down. Use a double cut flat file and draw file back and forth, exerting pressure with your fingers on file surface above the bosses. It is important that bosses be filed flat. All three bosses must be filed level to each other. Use a metal straight edge to check flatness.

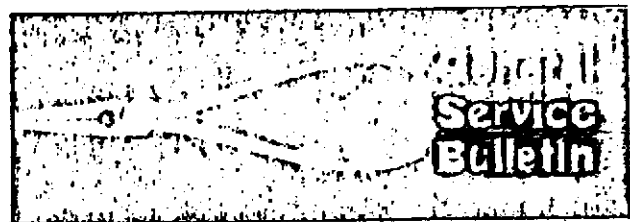
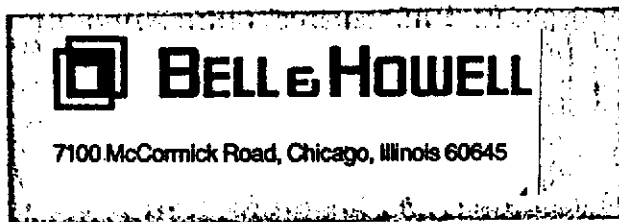
Inspect that no burrs exist at the threaded hole in the end bosses of the side casting. Burrs will prevent intimate contact between heat-sink and mounting surfaces. Remove burrs with a drill manually held in hand.

The original mounting screws (#30808 or 30833) Figure 2 Index 5 or 5A have been changed. The amplifier heat sink plate should be mounted to the heat sink bosses with a #47974 spacer and #30810 hex head screw. Slide spacers onto screws and then position the amplifier. Tighten screws securely 8 in. lb. The purpose of the spacer is to insure that an adequate clearance exists between transistor and screw head.

Be sure to reapply silicon heat transfer grease before remounting power output transistors.

The improved heat sink remounting of the amplifier should be made on all warranty repairs or when amplifier repairs are made on customer's equipment out of warranty. Projectors manufactured after 1973 (Serial #4001001 and up) have the new heat sink screws and spacers.

The screws (#30810) and spacers (47974) can be ordered in the usual manner on a Service Parts Order Form #878.



A-74-194

Subject: EXCITER LAMP WIRING - 1500 SERIES PROJECTORS

Date: 4-15-74

Reference: Service Manual #72745 (Autoload) & #72774 (Manual Load)

The exciter lamp in currently manufactured 1500 series projectors is wired differently than models produced earlier. The exciter lamp secondary of the power transformer is now switched on and off by the main switch. This improvement provides more reliable operation of the exciter lamp circuit.

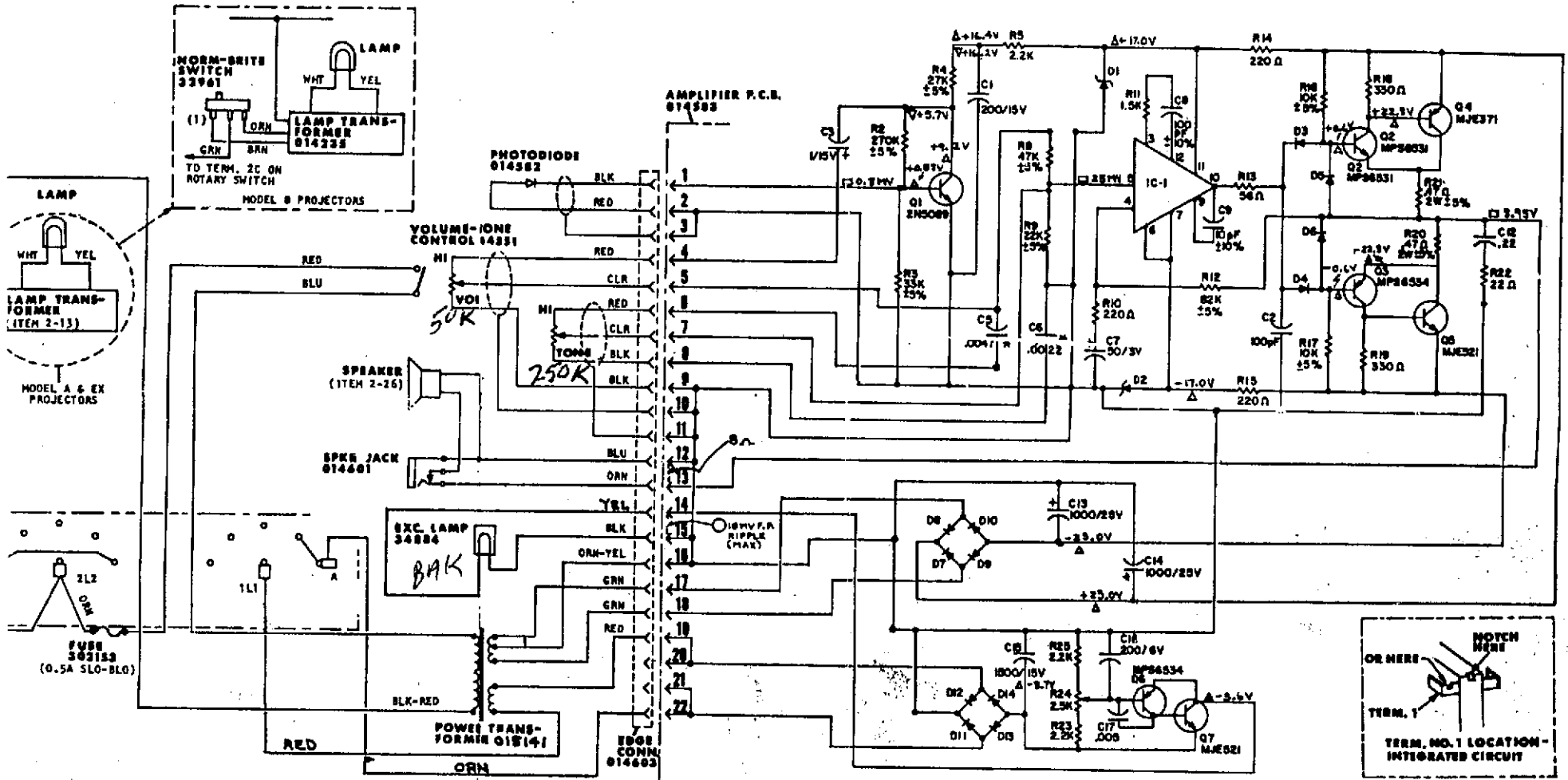
If exciter lamp current surges have caused exciter lamp power transistor (Q7) to blow, the exciter lamp should be rewired. Currently manufactured or rewired projectors will have the orange wire from terminal "1L1" on main switch soldered to terminal "Z-22" on the P.C. board connector (terminal nearest the rear cover).

The procedure for rewiring the exciter lamp is as follows:

1. Remove the rear cover and move out of the way.
2. Unsolder the orange wire that connects to terminal "R-14" on the P.C. board connector.
3. Unsolder the red power transformer wire from terminal "Z-22" on connector.
4. Solder the orange wire to terminal "Z-22" on connector.
5. Solder and crimp a flag terminal lug (#32093) to the red transformer wire.
6. Disconnect the yellow wire from terminal "1L1" on the main switch and connect the red transformer wire (new flag terminal lug) to terminal "1L1".
7. Cut the lug off the yellow wire. Strip and tin the wire (1/2 inch) and solder to terminal "R-14" on the P.C. board connector.

NOTE: When resoldering wires to the connector terminals, take caution not to burn other wires with the solder iron or short terminals together with solder.

8. Reassemble the rear cover and check out the projector for proper operation.



OR HERE NOTCH HERE
TERM. 1
TERM. NO. 1 LOCATION - INTEGRATED CIRCUIT