Film-Tech

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SERVICE INSTRUCTIONS

FILMOSOUND® PROJECTORS

(AUTOMATIC THREADING)

MODELS

545	**545EX**	**545T**	**545EXT**
550		**550T**	
552	**552EX**	**552T**	**552EXT**

NOTE: PARTS CATALOG ONLY REVISED JULY 1969

BELL & HOWELL

PHOTO SALES COMPANY
GENERAL SERVICE DEPT.
7100 McCORMICK ROAD
CHICAGO, ILLINOIS 60645

PART NO. 70340 PRINTED IN U.S.A. REVISED JUNE 1968

Design 552 Filmosound Projector

NOTE

The castings for the Automatic Threading projector are magnesium. Adhere to standard shop safety practices when machining or drilling castings.

FACTORY SERVICE ADDRESSES

PRODUCT ONLY

CHICAGO

Bell & Howell Photo Sales Co.
General Service Department
2409 West Howard Street
Evanston, Illinois 60202
Area Code: 312-673-3300

NEW YORK

Bell & Howell Photo Sales Co.
General Service Department
200 Smith Street
E. Farmingdale, L.I., New York 11735
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GLENDALE

Bell & Howell Photo Sales Co.
General Service Department
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PARTS ORDERS AND SERVICE INFORMATION

Bell & Howell Photo Sales Co.
General Service Department
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Chicago, Illinois 60645
Area Code: 312-673-3300

TABLE OF CONTENTS

Introduction

GENERAL.

This Service Manual has been prepared to aid in the repair and adjustment of the Bell & Howell Filmosound Automatic Threading 16-mm motion picture projectors listed in the following Feature Description List. An illustrated Parts Catalog is included at the rear of the manual to identify replacement parts and to aid the serviceman in the disassembly and reassembly of the projector.

All parts in the Parts Catalog illustrations are indexed in a suggested order of disassembly, with attaching parts immediately preceding those parts which they attach. Before proceeding with repairs, operate the projector to verify the customer complaint; then refer to the Troubleshooting Charts for possible causes and suggested remedies for the indicated trouble.

MAINTENANCE PRECAUTIONS.

In addition to the tools normally available in most repair shops, complete projector repair will require the use of the special tools illustrated in Figure A and the Bristol setscrew wrenches listed in the following chart.

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-F1

NOTE: Wrench G165-F3 is required to tighten setscrew in tool handle.

CAUTION: In the current design of all projector models, castings are drilled (but not tapped) to accept swage screws (all with part numbers in the 30800 series). If the swage screw is the same size as the corresponding machine screw used in earlier model castings (with tapped screw holes), the swage screw only is listed in the parts lists and can be used in both early and current model projectors. However, machine screws cannot be used in current model (untapped) castings. Therefore, if any early model casting must be replaced with a current model casting, all machine screws used with that casting must be replaced with the new swage-type screws. Where the thread size of the swage screw differs from that of the corresponding machine screws used in earlier models, refer to the parts lists for the listing of both screws.

FEATURE DESCRIPTION LIST

FEATURE	545A	550A	552A	545EX	552EX
Color	Turquoise				
Projection Lens	2" f/1.6	2" f/1.6	2" f/1.4	2" f/1.6	2" f/1.4
Projection Lamp (120 Volt)					
Rating	750W	750W	1000W	750W	1000W
Lamp Designation	CWA	CWA	CTS	CWA	CTS
Exciter Lamp					
Rating	4V	4V	4V	4V	4V
Lamp Designation	BAK	BAK	BAK	BAK	BAK
Projection Control					
Forward-Reverse	Yes	Yes	Yes	Yes	Yes
Still Projection	No	No	Yes	No	Yes
Still Projection Filter	No	No	Yes	No	Yes
Film Threading	Automatic				
Number of Shutter Blades	3	3	3	2	2
Operating Voltage	117VAC	117VAC	117VAC	117VAC	117VAC
Motor Frequency	60Hz	60Hz	60Hz	50/60Hz	50/60Hz
Automatic Loop Restorer	Yes	Yes	Yes	Yes	Yes

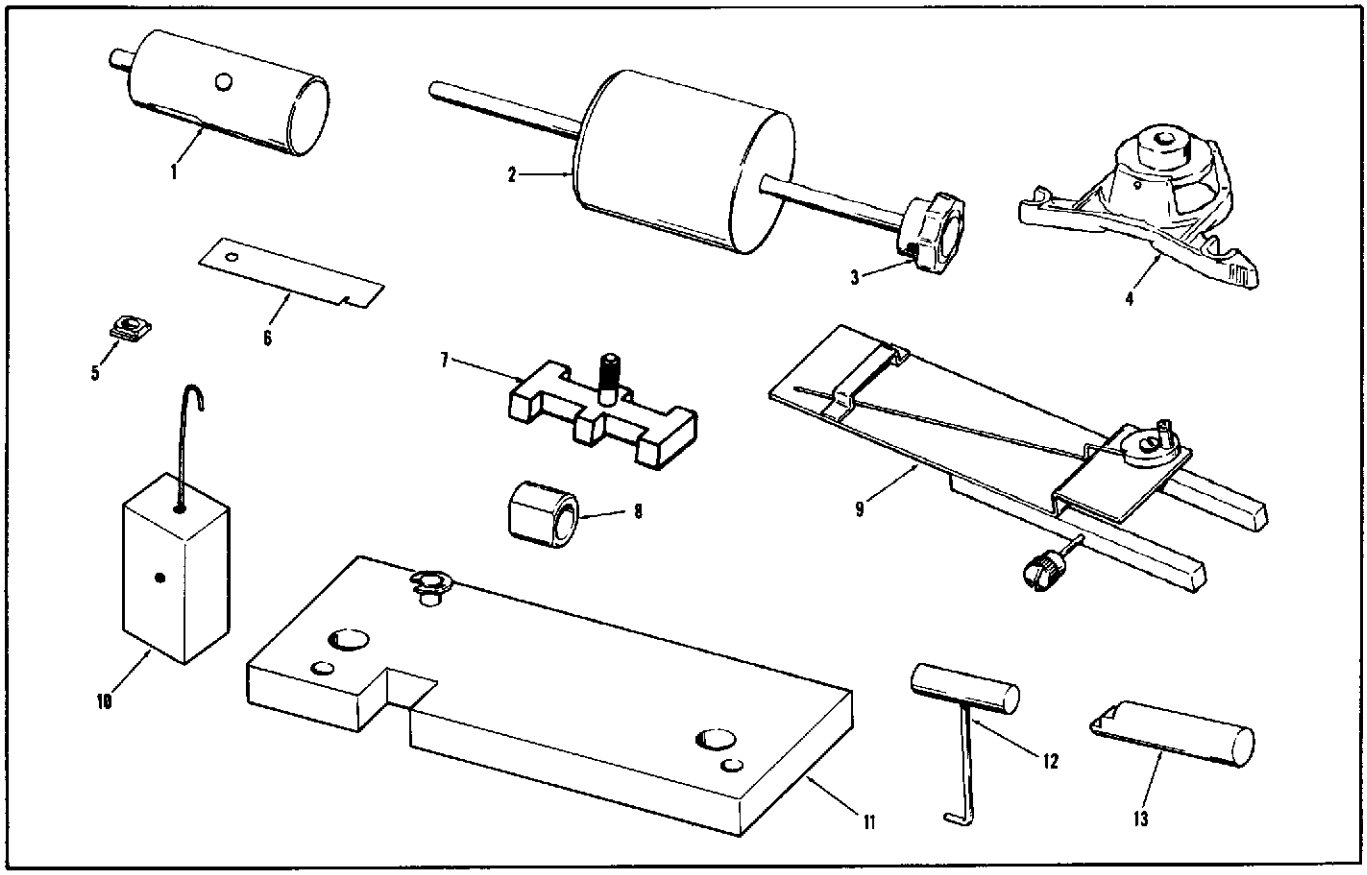


Figure A. Special Service Tools

INDEX NO.	TOOL NO.	TOOL NAME	USE
1	SER-550-2-N5	Lamp Plug	
2	SER-550-2-N1	Lens Plug	
3	SER-550-2-N2	Alignment Rod	Alignment of optical system (see Figure K)
4	SER-550-2-N4	Condenser Plug	
5	SER-550-2-N3	Aperture Plug	
6	SER-550-5-N2	Stroke Gage	Measure shuttle stroke (Fig. L)
7	S-09701-35N2	Shuttle Height Gage	Check shuttle protrusion (Fig. M)
8	SER-552-2-N1	Restorer Positioning Tool	Adjusting the loop restorer (Fig. V)
9	SER-552-4-N1	Shuttle Tension Gage	Adjusting shuttle tension (Fig. N)
10	SER-552-4-N2	Weight for Shuttle Tension Gage	Adjusting shuttle tension (Fig. N)
11	SER-552-1-N1	Timing and Alignment Plate	Timing the sprockets (Fig. V)
12	SER-552-5-N1	Soundhead Locating Gage	Positioning the soundhead (Fig. W)
13	SER-550-8-N1	Alignment Tool	Aligning sound drum and photocell (Fig. R)
	SER-550-5-N1	Shuttle Stroke Target	Measuring shuttle stroke (Fig. P)

Cleaning and Lubrication

1. CLEANING.

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

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

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

2. LUBRICATION.

The following Lubrication Chart lists those items which are to be lubricated during reassembly. Lubricants specified can be ordered from Bell & Howell by part number. Be careful not to over-lubricate. A drop or two of oil and a light film of grease (applied with a brush, if possible) will be adequate. Wipe away excess lubricant with a lint-free cloth.

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

LUBRICATION CHART

PARTS TO BE LUBRICATED	LUBRICANT
Machined surfaces (non-bearing) of all castings	Oil (P/N 070003)
Reel arm clutch ball retainers and shafts (Figure 2) and sprocket shafts (41 and 42, Figure 14)	Oil (P/N 08963)
Framer shaft (27, Figure 17), bearing face of worm gear (24 or 24A, Figure 18), and pin of rewind sprocket (Figure 2)	Oil (P/N 04978)
Felt oil pads in cams and all shafts, sleeve bearings and sliding parts (friction surfaces) not otherwise specified	Oil (P/N 070032)
Slots in outboard bearing assembly (20, Figure 14)	Grease (P/N 070031)
The following items are to be greased sparingly: (1) Teeth of all nylon gears (2) Pin of take-up drive sprocket (Figure 2) (3) Friction surface of lamp release ring (5, Figure 3) (4) Reel arm lock plungers (20, Figure 7) (5) Tilt rack and pinions (Figure 8) (6) Meshing gears in reel arms (Figures 9 and 10) (7) Loop restorer shaft (19, Figure 16) (8) Self centering assembly (current models) (23, Figure 16) (9) Cam wiper and wick (current models) (14 and 15, Figure 17) (10) Shuttle arms and bearings (17, Figure 17) (11) Shuttle link bearings (17A, Figure 17) (12) In-out cam and cam follower (21, Figure 17) (13) Threads of framer shaft (27, Figure 17) (14) Sleeve of condenser holder (5, Figure 18) (15) Mechanism housing (38, Figure 18); film guide pivot posts, sprocket shaft bearings, camshaft bearings (16) Pinion teeth of focus knob (3, Figure 20)	Grease (P/N 070034)

Trouble Shooting

3. MISCELLANEOUS TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Nothing runs	1. Protective switch not operating.	1. Use correct screw in lower left rear corner of case or replace switch if defective.
	2. Damaged power cable.	2. Repair or replace cable.
	3. Loose connections.	3. Repair connections.
Motor hums but does not run	1. Starting circuit open or shorted.	1. Repair loose or transposed connections. Replace defective capacitor and/or relay.
Motor runs but mechanism does not run	1. Damaged switch.	1. Replace switch.
	2. Transposed leads on main switch.	2. Connect leads to proper terminals.
	3. Drive belt off of pulley.	3. Reinstall drive belt.
	4. Motor or driven pulley loose on shaft.	4. Position pulley and tighten setscrews.
	5. Damaged belt.	5. Replace belt.
	6. Animation clutch spring broken (Design 552 and 552EX Only).	6. Replace spring.
Rewind does not operate	1. Rewind clutch not engaging or clutch slipping.	1. Adjust (paragraph 70c).
Take-up does not operate	*1. Clutch balls or spring lost.	1. Replace.
	2. Take-up sprocket damaged.	2. Replace.
Feed spindle does not revolve in reverse	1. Dirt in feed spindle clutch.	1. Clean.
	2. Clutch spring lost.	2. Replace.
Gate will not lock	1. Latch spring set too close to lens mount stop.	1. Adjust latch spring.
	2. Pressure shoe out-of-line.	2. Realign pressure shoe.
Shuttle runs but sprockets do not revolve	1. Animation clutch spring broken or lost (Design 552 and 552EX).	1. Replace spring.

*Early Models Only.

3. MISCELLANEOUS TROUBLES AND REMEDIES (CONT).

TROUBLE	PROBABLE CAUSE	REMEDY
Short lamp life	1. Line voltage in excess of lamp voltage.	1. Use lamp of correct voltage rating.
	2. Blower belt off of pulley.	2. Replace belt.
	3. Dirt in blower.	3. Clean.
Speed changer does not work	1. Knob or shifter crank loose.	1. Tighten setscrew.
Speeds slow	1. Binding in the mechanism.	1. Free binding condition.
	2. Belt slipping.	2. Clean or replace belt.
Runs at speed between 18 and 24 FPS	1. Pulleys out-of-line.	1. Realign pulleys.
	2. Belt shifter out of adjustment.	2. Adjust belt shifter.
	3. Belt shifter toggle spring broken.	3. Replace spring.
	4. Power line frequency other than 60 cycles (except 545EX and 552EX).	4. Use proper voltage and frequency.
*Solenoids buzz	1. Plungers not seating (Design 552 and 552EX).	1. Adjust (paragraphs 67c and 68b).

*Early Models Only.

4. PICTURE TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Film jump	1. Damaged film.	1. Repair or replace.
	2. Loose shuttle.	2. Adjust and tighten (paragraph 65c).
	3. Dirty gate.	3. Clean gate.
	4. Damaged or lost pressure shoe spring.	4. Replace spring.
	5. Pressure shoe misaligned.	5. Realign pressure shoe.
	6. Incorrect shuttle stroke.	6. Adjust (paragraph 65d).
Double image	1. Incorrect shuttle stroke.	1. Adjust (paragraph 65d).
	2. Excessive shuttle protrusion.	2. Adjust (paragraph 65d).
Weave	1. Sticking edge guide.	1. Clean guide.
	2. Guide rail tension spring lost.	2. Replace spring.
	3. Fixed edge guide out of position.	3. Reposition guide.
Poor illumination	1. Optics out-of-line.	1. Realign (paragraph 64).
	2. Fire shutter sticking (Design 552 and 552EX).	*2. Free solenoid or linkage (paragraph 68). Check mechanical linkage for binding.
	3. Front condenser reversed.	3. Reassemble correctly.
Poor focus	1. Dirty lens and/or aperture.	1. Clean lens and/or aperture.
	2. Warped film.	2. Recondition or replace film.
	3. Projector lens mount out-of-line.	3. Realign (paragraph 66).
	4. Pressure shoe spring lost.	4. Replace spring.
	5. Bent pressure shoe.	5. Replace pressure shoe.
	6. Pressure shoe out-of-line.	6. Realign pressure shoe.
Frame line creeps	1. Framer eccentric loose.	1. Align and tighten (paragraph 65e).
Insufficient framing	1. Framer eccentric out of adjustment.	1. Adjust (paragraph 65e).
Trailer ghost	1. Shutter out of time.	1. Reassemble properly.

*Early Models Only.

5. FILM TRANSPORT TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Loss of loops	1. Damaged film.	1. Repair or replace film.
	2. Inadequate shuttle protrusion.	2. Adjust (paragraph 65b).
	3. Inadequate or excessive shuttle stroke.	3. Adjust (paragraph 65d).
	4. Pressure shoe spring lost.	4. Replace spring.
	5. Pressure shoe mounting plate screws loose.	5. Tighten screws.
	6. Sprocket shoe locks not closing.	6. Clean or adjust.
	7. Sprocket drive gear loose on shaft.	7. Retime and tighten.
	8. In-out bracket spring broken.	8. Replace spring.
Shuttle operates but sprockets do not revolve	1. Animation clutch spring broken or lost (Design 552 and 552EX).	1. Replace spring.
Lower loop not restored	1. Loop restorer stroke too short.	1. Adjust (paragraph 76).
	2. Loop restorer does not engage restorer cam.	2. Adjust (paragraph 76).
Film rubs on loop restorer roller	1. Restorer arm out of position.	1. Reposition (paragraph 76).
Excessive film slap	1. Damaged film.	1. Recondition or replace.
	2. Green film.	2. Age or buff film.
	3. Dirty gate.	3. Clean gate.
	4. Pressure shoe rubbing on edge guides.	4. Realign pressure shoe.
	5. Incorrect shuttle stroke.	5. Adjust (paragraph 65d).
Animation clutch does not operate (Design 552 and 552EX)	1. Open circuit.	1. Repair circuit.
	*2. Solenoid plunger set too high or too low.	2. Adjust solenoid plunger.
	3. Stop pawl clearance excessive.	3. Adjust (paragraph 67a).
Animation clutch stops sprocket but shuttle pulls film	1. Insufficient shuttle retraction (Design 552 and 552EX).	1. Adjust (paragraph 67b).
Splices jam in sprocket shoes	1. Bad splices.	1. Replace splices.
	2. Emulsion build-up.	2. Clean (see paragraph 1).

*Early Models Only.

6. SOUND SYSTEM TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Projector runs, tubes do not light	1. Loose connection.	1. Repair connection.
	2. Tube burned out.	2. Replace tube.
	3. Amplifier switch damaged.	3. Replace switch.
	4. Heater series resistor open.	4. Replace resistor.
Tubes light, exciter does not light	1. Exciter lamp cable disconnected.	1. Connect cable.
	2. Wrong exciter lamp used.	2. Replace with correct lamp.
	3. Damaged oscillator tube.	3. Replace tube.
	4. Projector switch open or leads disconnected.	4. Replace switch or connect leads.
Tubes and exciter light, but no sound	1. Speaker jack disconnected or speaker jack switch open.	1. Connect leads. Repair or replace jack.
	2. Photocell cable disconnected or leads reversed.	2. Connect cable. Connect leads to proper terminals.
	3. Damaged tubes.	3. Replace tubes.
	4. Photocell out-of-line.	4. Realign (paragraph 71b).
	5. Dirt on end of photocell.	5. Clean (paragraph 1).
	6. Wrong exciter lamp used.	6. Replace with correct lamp.
Low volume	1. Damaged tubes.	1. Replace tubes.
	2. Wrong exciter lamp used.	2. Replace with correct lamp.
	3. Photocell out-of-line.	3. Realign (paragraph 71b).
	4. Dirt on photocell or slit.	4. Clean (paragraph 1).
	5. Slit misaligned.	5. Realign (paragraph 71d).
	6. Buzz track misaligned.	6. Realign (paragraph 71e).
Distortion at all volume levels	1. Wrong exciter lamp used.	1. Replace with correct lamp.
	2. Inverter or output tubes damaged.	2. Replace tubes.
	3. Open element in one output tube.	3. Replace tube.
Crackling noises	1. Damaged tubes.	1. Replace defective tubes.
	2. Broken ground lead to mechanism or blower housing.	2. Repair leads.
	3. Grounding springs loose, bent or lost.	3. Repair or replace springs.
	4. Buzz track out-of-line.	4. Realign (paragraph 71e).
	5. Broken cable shield.	5. Repair shield.

6. SOUND SYSTEM TROUBLES AND REMEDIES (CONT).

TROUBLE	PROBABLE CAUSE	REMEDY
Wow or flutter	1. Stabilizer guide roller sticking.	1. Clean roller.
	2. Stabilizer guide roller spring broken, unhooked or lost.	2. Repair or replace spring.
	3. Film edge guide (soundhead) out-of-line.	3. Realign (paragraph 71e).
	4. Loose flywheel.	4. Tighten flywheel.
	5. Damaged sound drum bearing.	5. Replace bearing.
	6. Dirt causing guide roller arm pivot bearing to bind.	6. Clean and polish.
	7. Photocell or exciter cable rubbing against flywheel.	7. Reposition photocell.
	8. Chip or dirt in take-up sprocket gear teeth.	8. Remove and clean.
	9. Loop restorer stroke is too short or restorer set too low.	9. Adjust (paragraph 76).
Clicking noises	1. Dirt on sound drum.	1. Clean sound drum.
	2. Broken ground lead to mechanism or blower housing.	2. Repair leads.
	3. Sound drum grounding spring loose, bent or lost.	3. Repair or replace spring.
High frequencies fade (jumps focus)	1. Warped film.	1. Recondition or replace film.
	2. Film edge guide (soundhead) out-of-line.	2. Realign (paragraph 71e).
	3. Dirt on sound drum.	3. Clean sound drum.
Hum	1. Tube shield lost.	1. Replace shield.
	2. Screws holding amplifier base shield to PC board loose or lost.	2. Tighten or replace.
	3. Frame by-pass condenser open or disconnected.	3. Replace or repair condenser.
	4. Amplifier not at same potential as test equipment.	4. Operate amplifier from isolation transformer.
	5. Grounded wiring.	5. Correct grounded condition.

7. TROUBLE SHOOTING THE AUTOLOAD SYSTEM.

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

b. Test Film. The autoload system has been designed to function properly with all films which can be described as being in projectable condition (see Operators Instructions for limits of shrinkage, curl, etc.). Generally, any film which functions properly in other Bell & Howell projectors (such as Designs 399, 540 and 542) can be used for testing the autoload system. Any film which does not thread properly should be inspected. The end of the leader must be properly trimmed and free from sharp bends. All sprocket holes in the first 18 inches of leader must be in good condition. Splices must be properly registered and in good condition. Sprocket holes restricted by cement or splicing tape must be cleared or the splice remade. The repairman is cautioned that it would be a waste of time to adjust or attempt to adjust the autoload system to autothread a film which is in such poor condition as to be incapable of being the source of an uninterrupted film presentation of acceptable quality.

c. Autoload Trouble Shooting Chart.

TROUBLE	PROBABLE CAUSE	REMEDY
Film cannot be inserted into feed sprocket	1. Obstruction below arm of sprocket guard (1, Figure 19).	1. Remove obstruction.
	2. Sprocket guard arm (1, Figure 19) bent or binding.	2. Straighten or replace arm.
	3. Excessive pressure on leaf spring (30, Figure 15).	3. Adjust leaf spring (paragraph 75k).
Film will not pull between feed sprocket and sprocket shoe	1. Entrance guide (11, Figure T) misaligned	4. Realign per paragraph 75h).
	2. Feed sprocket shoe sticking.	2. Clean sprocket shoe pivot.
	3. Feed sprocket shoe spring (37, Figure 14) broken.	3. Replace spring.
	4. Caked emulsion or burr on sprocket shoe film rails.	4. Clean; remove burr with crocus cloth.
Film comes out the side of top sprocket	1. Obstruction in sprocket shoe.	1. Remove obstruction.
	2. Damaged sprocket shoe.	2. Replace sprocket shoe.
	3. Sprocket shoe and sprocket misaligned laterally.	3. Realign.
Film strikes top of aperture plate and begins to pile up	1. Upper loop former (8, Figure U) bent or out of adjustment.	1. Straighten or replace if bent; or readjust per paragraph 75e.
	2. Lower loop former (4, Figure U) set too close to aperture plate.	2. Readjust per paragraph 75c.
Film butts into or goes under top end of aperture plate side tension rail or strikes fixed rail	1. Upper loop former (8, Figure U) bent, causing sidewise deflection of film.	1. Straighten or replace.
	2. Lower loop former (4, Figure U) bent or out of adjustment.	2. Straighten or replace if bent; or readjust per paragraph 75c.

7. TROUBLE SHOOTING THE AUTOLOAD SYSTEM (CONT).

TROUBLE	PROBABLE CAUSE	REMEDY
Film butts into top of film pressure plate (7, Figure 20) or passes over outside of pressure plate	1. Lower loop former (4, Figure U) out of adjustment.	1. Readjust per paragraph 75c.
	2. Pressure shoe not lifting off of aperture plate when film gate is closed.	2. Bent parts need straightening (paragraph 75g) or replacing.
Film ejects between bottom of gate and top of take-up sprocket, or piles up in this area	1. Lower loop former (14, Figure 15) bent or sticking.	1. Straighten, remove bind, or replace as necessary.
	2. Lower loop former (15, Figure 15) broken.	2. Replace spring.
	3. Loop restorer out of adjustment or restorer roller stud bent.	3. Readjust loop restorer (paragraph 76); replace damaged parts.
	4. Obstruction or burr in take-up sprocket upper shoe.	4. Clean; remove burr with crocus cloth.
	5. Sprockets out of time.	5. Time sprockets per paragraph 77.
Film not threading over take-up sprocket	1. Sprocket guard mounting plate (25, Figure 15) out of position.	1. Reposition per paragraph 75b.
	2. Obstruction in upper sprocket shoe.	2. Remove obstruction.
	3. Sprocket shoe spring (37, Figure 14) broken.	3. Replace spring.
	4. Take-up sprocket shaft loose in gear (39, Figure 14).	4. Retime sprockets (paragraph 77) and tighten setscrews (38, Figure 14).
Film piles up ahead of sound drum	1. Insufficient clearance between soundhead threading guides (4 and 5, Figure V).	1. Readjust all guides per paragraph 75.
	2. Back-up bracket (20, Figure 15) bent downward.	2. Straighten bracket.
	3. Exciter lamp cover loose.	3. Tighten cover retaining screw.
	4. Obstruction in gap between sound drum and exciter lamp cover.	4. Remove obstruction.
	5. Not enough clearance between sound drum and cover.	5. Check clearance per paragraph 79.
	6. Edge guide adjusting screw (23, Figure 13) out too far.	6. Adjust per paragraph 71e.
Film ejects ahead of lower take-up sprocket shoe or piles up in this area	1. Insufficient clearance between soundhead threading guides (4 and 5, Figure V).	1. Readjust all guides per paragraph 75.
	2. Soundhead loose or improperly positioned.	2. Reposition per paragraph 78.

7. TROUBLE SHOOTING THE AUTOLOAD SYSTEM (CONT).

TROUBLE	PROBABLE CAUSE	REMEDY
Film ejects ahead of lower take-up sprocket shoe or piles up in this area (cont)	3. Obstruction or burr in lower take-up sprocket shoe.	3. Remove obstruction; remove burr with crocus cloth.
	4. Film guide (6, Figure 13) improperly positioned.	4. Reposition guide.
Film sticks in or is ejected from lower take-up sprocket shoe	1. Obstruction or burr in lower take-up sprocket shoe.	1. Remove obstruction; remove burr with crocus cloth.
	2. Sprocket shoe sticking.	2. Clean sprocket shoe pivot.
	3. Broken sprocket shoe spring (37, Figure 14)	3. Replace spring.
	4. Sprocket shoe and sprocket misaligned laterally.	4. Realign.
	5. Film exit guide (7, Figure 15) bent or improperly positioned.	5. Reposition or straighten guide.
Film piles up ahead of idler roller (9, Figure 15) or is ejected from this area	1. Film exit guide (9, Figure 15) bent or improperly positioned.	1. Reposition or straighten guide.
	2. Idler roller sticking or roller stud loose or bent.	2. Remedy sticking condition; reset locking lever (12, Figure 15).
System will not lock	1. Locking lever (12, Figure 15) binding.	1. Repair or replace lever.
	2. Release spring (18, Figure 15) disengaged or broken.	2. Engage spring with locking lever, or replace spring.
	3. Eccentric pivot (11, Figure 15) improperly adjusted.	3. Readjust pivot per paragraph 75i.
System locks when actuator (13, Figure 14) is pressed	1. Stop screw (13B, Figure 14) below actuator not set high enough (early models only).	1. Reset stop screw per paragraph 75j.
Loop restorer cycles continuously	1. Restorer out of adjustment.	1. Adjust per paragraph 76.
	2. Shuttle retractor pin (40, Figure 17) sticking.	2. Clean and lubricate pin.
	3. Pressure plate (7, Figure 20) binding on aperture plate edge guide.	3. Realign pressure plate.
Slack film in soundhead area	1. Sprocket shoes sticking.	1. Clean sprocket shoe pivots.
	2. Take-up jerking.	2. Check take-up torque and check for binding in take-up reel arm.
	3. Jockey rollers sticking.	3. Clean and lubricate.
	4. Soundhead improperly positioned.	4. Reposition per paragraph 78.
	5. Dirt or obstruction between sound drum and exciter lamp cover.	5. Remove obstruction.

7. TROUBLE SHOOTING THE AUTOLOAD SYSTEM (CONT).

TROUBLE	PROBABLE CAUSE	REMEDY
Film scratches	1. Caked emulsion on film path parts.	1. Clean film path.
	2. Film chips in sprocket shoes.	2. Remove film chips.
	3. Scratches or burrs on film guides, shoes, aperture or pressure plate.	3. Polish with crocus cloth or replace.
	4. Jockey rollers sticking.	4. Clean and lubricate.
Perforations checked	1. Shuttle not retracting.	1. Adjust per paragraph 75f.
	2. Pressure plate not lifting from aperture plate.	2. Adjust per paragraph 75g.
	3. Excessive feed or take-up tension.	3. Adjust tension.
Film dimpled between perforations	1. Sprocket shoes sticking.	1. Clean sprocket shoe pivots.
	2. Shuttle not retracting.	2. Adjust per paragraph 75f.
	3. Sprockets out of time.	3. Retime per paragraph 77.
	4. Inadequate pressure on leaf spring (30, Figure 15).	4. Adjust per paragraph 75k.
	5. End of film leader not cut clean and square.	5. Check film cutter; replace if dull or broken.
Film escape mechanism does not open to permit exit of film	1. Film exit latching is out of adjustment.	1. Readjust per paragraph 75d.
Film escape locking pawl does not seat properly; film exits constantly	1. Torsion spring (9, Figure 16) is disconnected.	1. Connect torsion spring.
	2. Locking pawl (11, Figure 16) out of adjustment.	2. Readjust locking pawl per paragraph 75d.

Disassembly Procedure

8. GENERAL INSTRUCTIONS.

a. Physical differences in models are clearly shown in parts catalog illustrations and clarified in parts list "Notes." Be sure to review these differences and determine which parts are applicable to your projector.

b. 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.

c. When unsoldering is required to replace electrical parts, care must be used to avoid the application of heat to adjacent parts. Use a heat sink, if necessary, or grip the lead with a pliers to provide additional heat dissipation.

CAUTION: In the current design of all projector models, castings are drilled (but not tapped) to accept swage screws (all with part numbers in the 30800 series). If the swage screw is the same size as the corresponding machine screw used in earlier model castings (with tapped screw holes), the swage screw only is listed in the parts lists and can be used in both early and current model projectors. However, machine screws cannot be used in current model (untapped) castings. Therefore, if any early model casting must be replaced with a current model casting, all machine screws used with that casting must be replaced with the new swage-type screws. Where the thread size of the swage screw differs from that of the corresponding machine screws used in earlier models, refer to the parts lists for the listing of both screws.

9. REMOVING FIGURE 1 PARTS. Remove parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Most labels and nameplates are adhesive backed or cemented in place and should not be removed unless damaged, illegible or defaced.

b. If the rear cover (3) must be replaced on earlier projector models, refer to Note A following the Figure 1 parts list for special instructions.

10. REMOVING REEL ARMS AND CLUTCHES. (See Figure 2.) Various styles of reel arms and clutches, from early models to current styles, are illustrated in Figure 2. In all instances, reel arms can be removed by disassembling the clutch parts from the reel arm shafts; then withdrawing the reel arm and its bronze washer from the projector mechanism plate. If replacement of clutch parts is necessary, note the following special instructions.

a. When repairing clutch systems on rear reel arms, note that certain parts of the wobble plate clutch system (Figure 2A) and the ratchet and cushion clutch system (Figure 2B) will shortly be unavailable. If any of these indicated parts are in need of replacement, the clutch system must then be modified to the new Torrington system shown in Figure 2C. This is accomplished by discarding all of the indicated parts of the earlier system and installing the E-ring (P/N 21736) and the sprocket assembly (P/N 012654) in their place. In addition, the reel arm must be disassembled and the existing reel arm shaft replaced with the latest shaft (P/N 40295).

b. When replacing clutch systems on the front reel arms, note that certain parts of the wobble plate clutch system (Figure 2D) and the interim Torrington clutch system (Figure 2E) will shortly be unavailable. If any of these indicated parts are in need of replacement, the clutch system must then be modified to the new Torrington system shown in Figure 2F. This is accomplished by discarding all of the indicated parts of the earlier system and installing the latest rewind sprocket (P/N 012661) and take-up reverse sprocket (P/N 012662) in their place.

11. REMOVING FIGURE 3 PARTS. Remove Figure 3 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Early style condenser lens (P/N 200454) can be used in both the early and current condenser lens assemblies; however, the current lens (P/N 201611) can be used only in the current lens assembly together with the two retaining springs (P/N 37311 and 37312).

b. When removal of parts requires that leadwires be disconnected or unsoldered, tag the leadwires to facilitate rewiring during reassembly.

12. REMOVING FIGURE 4 PARTS. Remove Figure 4 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Remove the stud (2) at the front end of the film guide (3), thus freeing the spacer (4) located behind the film guide. Remove the idler roller screw (1) and disassemble the film guide and the idler roller (5) from the end of the snubber mounting post (14).

NOTE: Current idler rollers (5 and 8, P/N 41330) are not interchangeable with earlier rollers (P/N 39523) and can be used only with the current snubber roller shaft assembly (10, P/N 012329). If the snubber roller shaft assembly must be replaced, the current shaft assembly will be furnished, together with two of the current idler rollers.

b. Remove the snubber handle (6) and disassemble the idler roller (8) from the snubber shaft assembly (10). Remove the retaining ring (9) and disassemble the snubber shaft assembly (10), snubber spring (11), spring retainer (12), and spring cover (13) from the snubber mounting post (14).

c. If the flywheel (21) must be removed, insert a 1/16-inch punch carefully through the hole in the sound drum shaft housing and into the hole in the sound drum shaft (rotate the shaft until the punch drops into hole). Hold the punch and shaft stationary while loosening the flywheel nut (20). When withdrawing the flywheel, note if there are spacing washers located on the shaft behind the drum. These washers are used on later model projectors where the inner hub of the flywheel was enlarged to eliminate binding against the sound drum. On earlier models, flywheels have a small shoulder on the inner hub which eliminates the need for spacing washers.

d. Support the soundhead assembly (26) while removing the mounting screws (23) and (24) and washers (25), and withdraw the assembly carefully from the projector main plate.

e. The complete mechanism assembly (30) is secured to the main plate with four screws (29). Disengage the rewind timing belt and support the mechanism firmly while removing the mounting screws.

13. REMOVING SOLENOID-OPERATED CLUTCH AND FIRE SHUTTER PARTS — 552 AND 552EX ONLY. The solenoid-operated clutch and fire shutter system (Figure 5) was used in earlier Model 552 and 552EX projectors. Note the following precautions when removing these parts.

a. Make a note of leadwire connections before removing the solenoids (6) or (15). To remove the clutch solenoid (6), first remove the mounting screws (4) and washers (5). Then loosen the setscrew (1) in the upper clutch rod collar (2) and withdraw the collar from the rod. Remove the solenoid, slipping the rod down until it disengages from the hole in the stop pawl (item 31, Figure 17).

b. Disengage the upper end of the fire shutter solenoid rod (11) from the fire shutter. Note the manner in which the ends of the fire shutter spring (12) are engaged, and disassemble the rod and spring from the fire shutter solenoid (15). Remove the screws (13) and washers (14) and disassemble the solenoid (15) from its bracket (17).

14. REMOVING THE MECHANICALLY-OPERATED CLUTCH AND FIRE SHUTTER PARTS — 552 AND 552EX ONLY. The mechanically-operated clutch and fire shutter system (Figure 6) is used in current Model 552 and 552EX projectors. Note the following precautions when removing these parts.

a. The projector drive motor must be removed (paragraph 15) to gain access to the clutch parts.

b. Loosen the setscrew (2) and remove the collar (3) from the lower end of the clutch rod (4). Disassemble the clutch rod from the clutch lever (15).

c. Disengage the short clutch rod (13) from the clutch lever (15) and the Still-Run bracket (18). Remove the retaining ring (14) and withdraw the clutch lever from the clutch lever shaft (6). Make certain that the Still-Run knob (8) has been removed from the camshaft (20).

d. Note the manner in which the springs (12) and (16) are engaged and the cams (21) and (23) are assembled. Remove three screws (17) and withdraw the Still-Run bracket (18) from the projector main plate. Removal of the retaining ring (19) will permit the camshaft assembly (20), cams (21) and (23) and pawl bushing (22) to be disassembled from the bracket (18).

15. REMOVING FIGURE 7 PARTS. Remove Figure 7 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Make a note of leadwire connections before disconnecting or unsoldering leads. Note also the manner in which the flat belt (28) threads around the motor pulley (35) and through the belt shifter (29).

b. Handle the speaker (4) carefully so as not to damage the cone. If damaged, place on a shelf for possible repair.

c. The starting capacitor (8) can be replaced by disconnecting the spade lugs from its terminals; then loosening the screw (5) and sliding the capacitor from its clamp (7).

d. If the motor relay (11) is to be replaced, check the inset in Figure 7 for the style of relay to be used and the manner in which leadwires are connected to relay terminals. The relay is secured to the bracket (13) with two screws (9) and hex nuts (10).

e. The reel arm lock plungers (20) and their springs (19) are retained by the brackets (18). If the plungers are sticking or operating stiffly, remove them and check for burrs, caked lubricant or dirt, broken spring coils, etc. Remove burrs with crocus cloth, clean, re-lubricate and reinstall.

f. Disengage the blower belt (21) from the pulleys on the drive motor and blower motor. As noted in the Figure 7 parts list, projectors with Serial No. 76399 and lower use drive belt P/N 31687, while projectors with Serial No. 76400 and up use the V-type of belt, P/N 40283. Motor pulleys (35) are similarly affected and must be replaced with a pulley of the same identifying color and belt groove as that which was removed.

g. The drive motor (27) can be removed by loosening the screws in the bracket straps (25) and unhooking the straps from the motor mounting brackets (40). It should be noted that the motor discharge spring (26) is used only with earlier motors. Current motors are equipped with a grounding device which automatically

grounds the motor to the main plate when the motor bracket strap (25) is tightened. Note also that motor (P/N 011189) (G.E. #5KCM49GG151) has been discontinued. If the projector being repaired is equipped with such a motor and the motor must be replaced, order motor (P/N 011893) plus one mounting bracket (P/N 31263). The mounting bracket (40) must be used in place of the bracket used at the closed end of the discontinued motor.

16. REMOVING FIGURE 8 PARTS. Remove Figure 8 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. If the rotary switch (4) is in need of replacement the current switch (P/N 41322) will be furnished. This latest switch is internally wired to provide sound cut-off during reverse operation.

b. In all current projector models, the amplifier assembly (12) is secured to the main plate (41) with No. 6-32 swage-type screws (10) in place of the No. 5-40 machine screws used in earlier models. If the main plate and bearing assembly is replaced, be sure to order the necessary swage screws (P/N 30881) and lock washers (P/N 17168) for remounting the amplifier.

c. The complete tilt mechanism assembly (20) can be removed by first disassembling the screw (15) lock washer (16) and tilt bar (17); then removing the two screws (18) that attach the tilt housing (20K) to the main frame. If the tilt housing has countersunk mounting holes, the attaching screws will either be slotted head Sems screws (P/N 36053) or swage-type screws (P/N 30857) used in the most current models. Early style tilt housings were attached with screws (P/N 31694) and lock washers (P/N 600797).

d. Be sure to check the style of interlock switch (27) used in the projector being repaired. As noted in the parts list, the part number of the terminal strip (25), the interlock switch bracket (30) and the projector base (42) will vary depending on the interlock switch being used. Refer to the inset in Figure 8 for the difference in appearance between early and current interlock switches.

e. When replacing the preamplifier (37), note that early projector models required the use of a spacer (37A) behind the lower right mounting hole of the amplifier board.

17. DISASSEMBLING THE FRONT REEL ARM. (See Figure 9.) Remove front reel arm parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. In earlier projector models, the reel arm cover (2) is secured with two machine screws and lock washers. In current projector models, the cover is secured with two swage-type screws (1). If the reel arm cover must be replaced, be sure to order two swage screws (P/N 30879) for cover installation. When the cover is removed, note the presence of any shim washers (3) between reel arm and cover.

b. To remove the spindle parts (5 through 11), drive out the spring pin (4). This pin must be replaced with a new one at reassembly. Withdraw the spindle (10) and its washer (11) from the reel arm, catching the collar (5), torsion spring (7), gear (8) and washers (9), (9A) and (9B) as they are freed.

c. Loosen the setscrews (12) and disassemble the upper gear assembly (13) and clutch spring (14) from the reel arm shaft (29). Remove the two retaining rings (15), the clutch disc assembly (16), the two brass washers (17) and the spring tension washer (17A). The reel arm shaft (29) is now free and can be pressed from the splined bearing (30).

d. Remove the retaining ring (18) and clips (19) and disassemble the nylon spur gears (20) and (20A), the washer (21) and the drive shaft (22) from the reel arm. Inspect the nylon bearings for damage and replace, if necessary.

e. Remove the two retaining rings (24) and disassemble the friction shoe (25), the friction shoe bracket (26), the disc assembly (27), bronze washer (28) and splined bearing (30) from the reel arm. Do not press out the needle bearings (30A, 34A and 34B) unless obviously in need of replacement.

f. Some early model projectors were equipped with an eccentric spacer, or stop, located beneath the brake spring (32). This eccentric serves no purpose and can be eliminated; however, a 5-40 by 3/16 inch fillister head screw (P/N 25837) must then be used to attach the brake spring. The eccentric is not used in current model projectors, and the brake spring is attached with a swage-type screw (P/N 30804). If the reel arm must be replaced, the current (untapped) arm will be furnished and swage screw (P/N 30804) also must be ordered.

18. DISASSEMBLING THE REAR REEL ARM. (See Figure 10.) Remove rear reel arm parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

NOTE: If the rear reel arm clutch system is being converted to the current Torrington style (paragraph 10), the rear reel arm shaft (P/N 31233) (27) must be replaced with shaft (P/N 40295). This can be accomplished by removing the reel arm cover (8) and disassembling only those parts outlined in step c, following.

a. Disconnect and remove the take-up belt (1) and swivel the take-up arm assembly (6), catching the spring (2) as it is released. Remove the screw (3) and disassemble the take-up spindle (4) from the arm. The take-up arm need not be removed from the rear reel arm (29) unless in need of replacement. Note that in some earlier models, a split roll pin (P/N 303188) was used to mount the take-up arm in place of the dowel pin (5) currently used. In such instances, the split roll pin must be used when replacement is necessary.

b. In earlier projector models, the reel arm cover (8) was secured with two machine screws and lock washers. In current projector models, the cover is secured with two swage-type screws (7). If the reel arm cover must be replaced, be sure to order two swage screws (P/N 30879) for cover installation. When the cover is removed, note the presence of any shim washers (P/N 34874) between the reel arm and cover.

c. Remove the retaining ring (9) and clips (10) and remove the nylon gears (11) and (12) and the washer (13) from the drive shaft (22). Loosen the setscrews (24) and disassemble the gear assembly (25), the washers (26) and the reel arm shaft (27) from the reel arm.

d. Remove the retaining ring (14) and withdraw the pulley and gear assembly (15) from the rewind drive shaft (21). Inspect the nylon bearings (16) and the rubber sleeve (30) for damage or wear. The shaft (21) can be removed by loosening the setscrew (20) in the reel arm boss.

e. Withdraw the drive shaft (22) from the cast ears of the reel arm and press out the splined bearing assembly (28). Inspect the nylon bearings (23) for damage or wear. Do not press out the needle bearings (6A) or (28A) unless obviously in need of replacement.

19. DISASSEMBLING THE LAMPHOLDER. (See Figure 11.) Remove the screws (1) and separate the lamp baffle (2) from the lamp socket bracket (8). Disassemble the release lever pin (3), release lever (4) and tension washer (5) from the bracket. Replace the vinyl sleeve (9) if torn or otherwise damaged. The lamp socket (7) is secured to the bracket with two rivets (6). If in need of replacement, the rivets must be drilled out.

20. DISASSEMBLING THE LAMPHOUSE. (See Figure 12.) Remove lamphouse parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. If the nameplate (1) for the Models 550, 552 and 552EX must be replaced, note that the earlier style (P/N 31971) is cemented in place, while the current style (P/N 41112) is adhesive backed and can only be used on the current smooth-surfaced lamp housing (P/N 42208).

b. Disassemble the screws (2), lamp shield (3), washers (4) spacer bushings (5) and heat reflector (6) from the lamphouse. Refer to Note B following the Figure 12 parts list for proper replacement of screws (2) and spacer bushings (5).

c. The lamphouse handle (7) and latch (8) are used in Model 550, 552 and 552EX projectors; the retaining ring (8A) and lamphouse lock screw (8B) are used in Model 545 and 545EX projectors.

d. Early style lamphouse grilles (10) with two drilled holes for mounting are no longer available. Refer to the reassembly instructions for the procedure involved in installing single-hole grilles on early style lamp housings.

21. DISASSEMBLING THE SOUNDHEAD. (See Figure 13.) Remove soundhead parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Make a careful note of leadwire connections before disconnecting or unsoldering leads during disassembly.

b. The optical slit assembly (11) can be removed by loosening the clamping screw (10) and withdrawing the assembly from the housing (36).

c. Remove the retaining ring (12) and unscrew and remove the guide roller adjusting screw (13).

d. In earlier model projectors, the soundhead was tapped for two setscrews (19) which were tightened against the sound drum housing to lock the assembly in place. In later models, the sound drum housing is drilled and tapped to receive two Sems screws (19A). In either case, remove these screws and loosen the locking setscrew (18). Withdraw the sound drum assembly carefully, noting the manner in which the silicon cell assembly (22) and its retainer (21) are assembled into the slot in the sound drum shaft. Wrap the sound drum assembly and silicon cell assembly in tissue to protect them against damage.

e. Stabilizer arm assembly (32) (P/N 09833), has been discontinued and is superseded by stabilizer arm (32A) (P/N 31659). Torsion spring (P/N 31672) (34), is used only with the early arm assembly (32); therefore, if the arm assembly (32) is to be replaced with the current arm, spring (34) also must be replaced with spring (34A) (P/N 39789). The earlier style spring (34) is still available for service.

f. The insets in Figure 13 illustrate the early and current style of exciter lamp retaining pins. Note that the springs are the same in both styles. However, the early style collar and pin are no longer available. If in need of replacement, order a set of current parts consisting of pin (P/N 41321) and bushing (P/N 41320). Refer to the Reassembly section for installation procedures.

g. Early style soundhead housings (with tapped screw holes) are no longer available. If the housing must be replaced, be sure to order the proper quantity of swage-type screws (items 10, 29 and 31) for reassembling parts to the new casting.

22. DISASSEMBLING THE MECHANISM. (See Figure 14.) Remove Figure 14 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Pry out the hinge pins (1) and (2) with a wire cutter or similar tool to free the lens carrier assembly (5). Note that the spring washer (3) is used with the upper pin and the flat washer (4) with the lower pin. Refer to paragraph 28 for lens carrier disassembly procedure.

b. When removing speed change knob parts (items 6 through 11), note the manner in which the spring (10) is installed.

c. All current production models are equipped with the film escape parts (items 4 through 12, Figure 16) and some earlier projectors may have been modified accordingly. This eliminates the need for setscrew (13B, Figure 14) on projectors so equipped.

d. Remove the two retaining rings (18) and withdraw the clutch lever shaft (19). Remove three screws (17) and disassemble the outboard bearing assembly (20) and the rewind clutch lever (21) from the upper sprocket shaft. Check the physical appearance of the clutch lever against the insets in Figure 14 to determine the proper part number for replacement. Withdraw the rewind button (22) and spring (23) from the opening in the mechanism casting.

e. Remove the rewind timing belt (24) and examine it for unusual wear or physical damage. Replace belt if necessary. Remove the retaining rings (25) and disassemble the rewind drive sprocket (26), flat washer (27), spring (28) and spline driver (29) from the upper sprocket shaft. Loosen the setscrews (30) and remove the take-up drive sprocket (31).

f. The sprocket guard assembly (33) is secured with three screws (32) inserted from the rear of the mechanism casting. Refer to paragraph 27 for sprocket guard parts replacement. When removing the remaining sprocket guards (35) and (35A), note the manner in which the torsion springs (37) are assembled. Inspect all rollers (36) for nicks or deep scratches and replace if damaged.

g. Loosen the setscrews (38) and disassemble the gears (39), tension washers (40), sprocket assemblies (41) and (42), the lower sprocket flange (43) and the thrust washers (44) from the mechanism casting. Beginning with March 1968 production models, upper sprocket assembly (P/N 012327) will be used in all projectors. This new assembly has the sprocket pressed onto the shaft, thus differing from previous models in which the sprocket is secured with setscrews (41A). Be sure to check the style of sprocket assembly used, because the timing adjustment is different for each.

h. Only the current (drilled but untapped) mechanism housing will be available for replacement. If the housing must be replaced, be sure to order a sufficient quantity of the swage-type screws (14) and (17) for reinstalling the hood (15) and outboard bearing (20) to the new casting.

23. DISASSEMBLING THE MECHANISM. (See Figure 15.) Remove Figure 15 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Remove the screws (1) and three flanged rollers (2). Inspect the rollers for nicks and deep scratches and replace if damaged.

b. Remove the retaining ring (3) and disassemble the bracket and handle assembly (4) and torsion spring (5) from the shaft of the sprocket guard plate (25). Be sure to note the manner in which the torsion spring is installed.

c. Remove the screw (6) and film exit guide (7). Disassemble the screw (8) and idler roller (9) from the auto thread locking lever (12). Inspect the roller for nicks or deep scratches and replace if damaged. Remove screw (10), pivot (11) and locking lever (12).

d. Note the manner in which torsion spring (15) is assembled. Remove the retaining ring (13) and withdraw the lower loop form (14) and torsion spring (15) from the lower stud of the connecting link assembly (41). Note the manner in which the legs of the release spring (18) are positioned before removing screw (16), bushing (17) and spring (18).

e. Remove the screw (19) and back-up bracket (20). Remove the retaining ring (21) and disassemble the film guide (23) and its washers (22) from the mechanism housing. Remove two screws (24) and the sprocket guard plate assembly (25). Remove the retaining ring (28) and disassemble the toggle lever assembly (26) and upper film guide (27) from the sprocket guard plate.

f. Remove two screws (29) and the leaf spring (30). Remove the retaining ring (33) from the upper stud of the connecting link assembly (41). Loosen the setscrew (31) and disassemble the threading lever (32) and lower loop form assembly (34) from the mechanism housing. Remove two screws (35) and the upper sprocket guard plate assembly (36). Disassemble the screw (37), lock washer (38), flat washer (39), shuttle retractor (40) and connecting link assembly (41) from the mechanism housing.

g. Only the current (drilled but untapped) mechanism housing will be available for replacement. If the housing must be replaced, be sure to order a swage-type screw (16) for reinstalling the release spring (18) to the new casting.

24. DISASSEMBLING THE MECHANISM. (See Figure 16.) Remove Figure 16 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Early model projectors were equipped with an upper loop form and hub assembly (P/N 011949) in place of the film escape components illustrated in Figure 16 (items 4 through 12) and used on all current models. Instructions for modifying projectors to include the film escape mechanism will be found in the Modifications section of this Service Manual. The earlier form and hub assembly is available for service and will be furnished if requested.

b. The complete film escape mechanism (items 4 through 12) can be removed as an assembly. Loosen the setscrews (4) in the hub of the upper kickplate assembly (5) and withdraw the assembly and the washer (6) from the upper loop form shaft assembly (25). Unhook and remove the spring (24) and withdraw the shaft

assembly from the mechanism housing. Note carefully the manner in which the film escape parts are assembled. Remove the locking pawl screw (10); then remove the two retaining rings (7) and disassemble the shaft (8), torsion spring (9) locking pawl (11) and pawl bracket hub (12) from the kickplate (5).

c. Screw (13) is used only to secure one end of the tension spring (15). Screw (13A) secures the cam follower and support assembly (16) to the arm assembly (18). Cam follower parts (16A through 16F) need not be disassembled unless in need of replacement. Loosen the hex head screw (17) and disassemble the arm assembly (18) and lever and shaft assembly (19) from the mechanism housing.

d. Remove the screws (20), lock washers (21), flat washers (22) and the self centering assembly (23). Do not attempt to disassemble this assembly as parts are not available for service.

e. Remove the two screws (26) and lift the aperture plate assembly (27) from the mechanism housing. Refer to paragraph 29 for aperture plate disassembly instructions.

f. Remove the screw (28), lens carrier catch (29) and flat washer (30). The screw (31) serves as an adjustable stop for the lens carrier and need not be removed.

g. Only the current (drilled but untapped) mechanism housing will be available for replacement. If the housing must be replaced, be sure to order one each of swage-type screws (13), (28) and (31) for reassembly of parts to the new casting.

25. DISASSEMBLING THE MECHANISM. (See Figure 17.) Remove Figure 17 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 shuttle shaft. Remove screws (3) and (4) and lift off the fire shutter assembly (5) or the support bracket (5A). The fire shutter assembly is used only on Model 552 and 552EX projectors, and disassembly instructions will be found in paragraph 30. Remove two screws (3) and washers (3A) to free the heat baffle (6).

b. Remove the shutter nut (7), counterbalance weight (8), the shutter (9) or (9A) and the fiber washer (10). On current export moedels only, the two-bladed shutter (9A) is being used. When repairing export models equipped with the three-bladed shutter, the two-bladed shutter should be used for replacement when necessary. (See Note, following.)

NOTE: When stock of early style shutters (P/N 31004) is depleted, it will be necessary to furnish the current shutter (P/N 41308) (3-blade) or (P/N 41309) (2-blade) together with the current pull-down cam (18) (P/N 41307). The current cam and shutters are provided with identification markings (see inset, Figure 17).

c. Unless obviously in need of replacement, do not disassemble the ball and stud assemblies (12) or the shuttle link bearings (17A) from the shuttle arms (17). Inspect the pull-down cam followers (17B) for wear. These followers can be reversed or turned end-for-end if badly worn. In current model projectors, the followers are staked in place in the recess of the shuttle arm. Refer to the Reassembly section for replacement instructions. Unhook the extension spring (13) from the end of each arm (17) and remove the felt wiper (14) and shuttle arms from the assembly. The cam wiper wick (15) is inserted within the coils of the spring (13). If unusually dirty, the wiper and wick should be replaced. Lubricate new wicks as outlined in the Lubrication instructions, paragraph 2.

d. Remove the pull-down cam (18) from the camshaft. Refer to the note following paragraph 25, step b, for pull-down cam and shutter replacement. Remove screws (19) and withdraw the in-out cam (21) and the in-out bracket assembly (22). Note that the in-out follower (22A) and in-out spring (22B) are replaceable.

e. Unscrew the bearing support assembly (23) from the shuttle arm plate assembly (25). Remove two screws (24) and disassemble the shuttle arm plate from the mechanism housing, disengaging the upper forked arm of the plate from the framer shaft assembly (27). Pull out the stop pin (26) and unscrew the framer shaft assembly from the mechanism housing. Remove the screw (38) and disassemble the in-out spring (39) and shuttle retractor pin (40) from the mechanism housing.

f. Models 552 and 552EX Only. Before disassembling the following parts, note the manner in which the legs of torsion spring (30) are engaged. This spring and the clutch stop (36) are used only on Model 552 and 552EX projectors equipped with the solenoid-operated clutch system (Figure 5). Remove the two retaining rings (28) and withdraw the stop pawl shaft (29), the torsion spring (30), and the stop pawl (31). Remove screws (32) and (35) to disassemble the shaft bracket (33) and bearing bracket (37) from the mechanism housing. Press the grommets (34) from the shaft bracket.

g. Only the current (drilled but untapped) mechanism housing will be available for replacement. If the housing must be replaced, be sure to order a sufficient quantity of swage-type screws (items 3, 24, 35 and 38) for reassembly of parts to the new casting.

26. DISASSEMBLING THE MECHANISM. (See Figure 18.) Remove Figure 18 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Models 545, 545EX and 550 Only. Remove the large retaining ring (8). Remove the two screws (9) and the bearing loading spring (10). Loosen setscrew (11) in the loop restorer cam (27) and the two setscrews (24A) in the worm gear (24B). Shift the camshaft (30) to the left until the bearing (12) is forced from its seat. Remove the bearing and the shim washer (12A). Remove retaining ring (28) and slide the camshaft to the right,

forcing out the large bearing (29). Remove the worm gear (24B) and loop restorer cam (27) as the shaft is withdrawn. Loosen the setscrew (32) and unscrew the rewind adjustment stud (33) from the top of the mechanism housing. Remove the screw (34), condenser holder (35), special washer (36) and tension spring (37). Note that only the current (drilled but untapped) mechanism housing will be available for replacement. If the housing must be replaced, be sure to order new swage-type screws (9) and (34) and current bearing loading spring (P/N 42244) (item 10) as well. The No. 4-40 swage screw (P/N 30804) (item 9) cannot be used with earlier mechanism housings, since these screw holes were tapped with a No. 3-48 thread. Machine screws (P/N 31094) (item 9) must be used in earlier castings to secure the bearing loading spring (10).

NOTE: The following steps of disassembly are to be used only when repairing 552 and 552EX projectors.

b. Unscrew and remove the round nut (4), washer (5) and shuttle adjustment bracket (6). Remove the two screws (1) and (2) and washers (3), and lift the animated clutch bracket assembly (7) from the mechanism housing. Remove the three retaining rings (7B) and slide the shaft (7C) from the clutch mounting bracket (7L), removing the slide bumper (7D), flat washer (7E), spring (7F) and clutch slide bar assembly (7G) as the shaft is withdrawn. Remove the screw (7H) and washer (7J) to free the strike (7K) from the clutch slide bar. Note that in current projector models a No. 4-40 hex washer head screw (P/N 41317) (item 7H) is used to hold the strike (7K) more firmly. This screw can only be used with the latest strike (P/N 41318). The earlier strike (P/N 31050) will be furnished until stock is depleted, after which the current strike and screw must be ordered.

c. Remove the large retaining ring (8), the two screws (9) and the bearing loading spring (10). Loosen the setscrew (11) in the loop restorer cam (27) and shift the camshaft (30) to the left until the bearing (12) is forced from its seat. Remove the bearing and the shim washer (12A). Pry retaining rings (16) and (28) from the camshaft and slide the camshaft to the right, forcing out the large bearing (29). Remove the clutch parts (13 through 27) as the shaft is withdrawn, noting the manner in which torsion spring (14) is assembled. Refer to paragraph 31 for further disassembly of the worm gear (24).

d. Camshaft (P/N 31008) (item 30C) used in earlier model projectors will be made from camshaft (P/N 36039) and therefore will have two sets of slots and flats. The relative position of slots and flats of the modified camshaft are shown in the far right-hand inset of Figure 18.

e. Loosen the setscrew (32) and unscrew the rewind adjustment stud (33) from the top of the mechanism housing. Remove the screw (34), condenser holder (35), special washer (36) and tension spring (37).

f. Only the current (drilled but untapped) mechanism housing will be available for replacement. If the housing must be replaced, it also will be necessary to order two swage-type screws (P/N 30804) (item 9), current bearing loading spring (P/N 42244) (item 10) and the swage-type condenser holder screw (P/N 30884) (item 34).

27. DISASSEMBLING THE SPROCKET GUARD. Disassemble the sprocket guard (Figure 19, 19A or 19B) in the indexed order of disassembly, noting the following special precautions.

NOTE: When present service stock is depleted, complete sprocket guard assemblies (P/N 09897, Figure 19) and (012125, Figure 19A) will no longer be available. However, piece parts for these assemblies can be ordered for repair.

a. Early Sprocket Guard (Figure 19). Note the manner in which the torsion spring (2) is assembled. Remove the guard and shaft assembly (1) and torsion spring from the pin of the channel and post assembly (5). Remove rollers (3) from the guard shaft. Remove screw (4) and channel and post assembly (5), screw (6) and cover strike (7).

b. Interim Sprocket Guard (Figure 19A). Note the manner in which torsion spring (5) is assembled. Remove the retaining ring (1) and disassemble the washer (2), rollers (3) and (6), guard and shaft assembly (4) and torsion spring (5) from the pin of the channel and post assembly (10). Remove the rollers (7) from the guard shaft. Remove the screw (8), washer (9) and channel and post assembly (10). Remove screw (11) and cover strike (12).

c. Current Sprocket Guard (Figure 19B). Remove the screw (1), washer (2) and channel and post assembly (3). Remove screw (4) and cover strike (5).

28. DISASSEMBLING THE LENS CARRIER. (See Figure 20.) Remove Figure 20 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Remove the screws (1) and hold-down spring (2) and lift out the focus knob assembly (3).

b. Remove the screws (4), spacers (5) and (6) and springs (8) and disassemble the pressure plate (7) and lever (9) from the lens carrier. Wrap the pressure plate in tissue for protection.

c. Remove screws (10) and adjustment plate (11). Note the difference in screws (10) used in earlier and current projector models. Machine screw (P/N 31905) can be used only with the early tapped lens carriers. Swage-type screws (P/N 30804) are required for current lens carriers (drilled but untapped). Only the current lens carrier will be available for replacement; therefore, if the lens carrier (13) must be replaced, be sure to order four swage-type screws (P/N 30804) for reassembly of the hold-down spring (2) and adjustment plate (11) to the new casting.

29. DISASSEMBLING THE APERTURE PLATE. (See Figure 21.) Remove Figure 21 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. As noted in the Figure 21 parts list, all projectors are now standardizing on chrome rails and spring retaining covers. Be sure to check these notes carefully before ordering replacement parts.

b. The insets in Figure 21 illustrate the early and current methods of mounting the spring retaining cover (4) and film tension rail (6).

c. Note that early model aperture plates were drilled only so that the film guide (11) is attached with a screw (8), hex nut (9) and lock washer (10). The current aperture plate is drilled and tapped, and the film guide is secured with screw (P/N 31978).

30. DISASSEMBLING THE FIRE SHUTTER — MODELS 552 AND 552EX ONLY. (See Figure 22.) Unhook and remove the extension spring (1). Note the manner in which retainer spring (2) is assembled before removing the spring and the filter glass retainer (3). Carefully straighten the retaining ears on the filter arm and remove the fire shutter disc (4) and heat filter (5). Wrap the filter in tissue for protection.

31. DISASSEMBLING THE WORM GEAR — MODELS 552 AND 552EX ONLY. (See Figure 23.) Remove two screws (2), the setscrew (3), and Banc-lok (4) and separate the interlock retainer (1) from the worm gear (5).

32. REPAIRING THE PREAMPLIFIER. (See Figure 24.) Defective electrical parts can be removed by cutting the leads as close as possible to the body of the part or by unsoldering the leads from the terminal posts. When unsoldering, it is advisable to use a heat sink to avoid the direct application of heat to adjacent components. Refer to the NOTE in the schematic wiring diagrams (Figures 27, 29 and 31) for special instructions on replacing resistor R34 (item 2).

33. DISASSEMBLING THE EARLY STYLE BLOWER. (See Figure 25.) Early style blowers (used on projectors with Serial Number 76399 and lower) were equipped with removable bearings. Remove Figure 25 parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. Note that blower pulley (P/N 31586) (item 2) is used on early style blower assemblies. Current pulleys are designed to accept the V-type belt (see inset, Figure 25A).

b. To disassemble the blower, remove the screw (5) and hex nut (6); then drill out the eyelet-type rivets (3) and separate the housing halves (8). Note the location of nylon washers (10, 18 and 20) when disassembling blower parts.

34. DISASSEMBLING CURRENT STYLE BLOWER. (Figure 25A.) Current style blowers are equipped with pressed bearings which are not replaceable. Remove Figure 25A parts, as necessary, in their indexed order of disassembly, noting the following special precautions.

a. If pulley replacement is necessary, be sure to order the proper pulley (2) for the projector being repaired. Current pulleys are designed to accept the V-belt (see inset, Figure 25A).

b. To disassemble the blower assembly, drill out the four eyelet-type rivets (3) and separate the front housing (5) from the rear housing (6). Remove the blower wheel and shaft assembly (9) and the nylon washers (8).

35. REPAIRING THE AMPLIFIER. (See Figure 26.) Using standard electronic shop techniques, check the amplifier for weak or faulty tubes, for continuity and for shorts and grounds. Refer to the proper schematic diagram (Figure 27, 29 or 31) for voltages and ratings of components. Defective solder-secured parts can be removed by cutting the leads as close as possible to the body of the part or by unsoldering the leads from the terminals. When unsoldering, it is advisable to use a heat sink to avoid the direct application of heat to adjacent components.

Reassembly Procedure

36. GENERAL INSTRUCTIONS.

a. When the reassembly procedure includes the staking of rivets or similar parts, all staking and riveting operations should be performed during the early stages of reassembly to avoid damage to other parts. Be sure to support the major part solidly during staking operations.

b. When installing electrical parts, refer to the appropriate wiring diagram (Figures 27 through 32) for proper leadwire connections. When soldering is required, use a heat sink to avoid the direct application of heat to adjacent parts.

c. Parts which require lubrication are listed in paragraph 2 of this Service Manual, together with the specified lubricant. Lubricate sparingly and wipe away excess lubricant with a clean, lint-free cloth. During reassembly, apply a drop of oil to screw holes to facilitate screw installation.

d. Reassembly instructions are not included for the amplifier (Figure 26) or the preamplifier (Figure 24). Refer to step b, above, for special precautions on parts replacement.

e. Many of the nameplates and instruction plates have a protected adhesive backing. Remove the protective paper and brush the adhesive with a mixture of three parts Toluol to one part trichlorethylene. When adhesive is tacky, press the nameplate carefully but firmly in place. Wipe away excess adhesive with a damp cloth.

f. In current projectors, several of the projector castings are drilled (but not tapped) to accommodate swage-type screws. Except where screw sizes were changed, these swage-type screws can be used in both early and current projectors. However, the machine screws used in earlier models cannot be used in current untapped castings. Only the current castings are available for replacement; therefore, should such a casting be replaced, certain of the machine screws used in earlier models also must be replaced. These instances are clearly noted in the reassembly instructions.

37. REASSEMBLING CURRENT STYLE BLOWER. (See Figure 25A.) Current style blowers are equipped with pressed bearings which are not replaceable. Reassemble the blower as follows:

a. Assemble the retaining ring (7) into the groove of the blower wheel shaft. Install a nylon washer (8) on the long end of the blower wheel shaft and insert the short shaft end into the bearing in the rear blower housing (6).

b. Assemble the front housing (5) to the rear housing and secure the assembly with the four eyelet-type rivets (3). Note the location of the leadwire clamp (4) secured by one of these rivets.

c. Install the second nylon washer (8) down over the protruding end of the blower wheel shaft. If the blower pulley (2) was replaced, be sure that the proper pulley is used for the particular blower being repaired. Current pulleys are designed to accept the V-type belt (see inset, Figure 25A).

38. REASSEMBLING THE EARLY STYLE BLOWER. (See Figure 25.) The early style blower (used on projectors with Serial Number 76399 and lower) were equipped with removable bearings. Reassemble the blower as follows:

a. Insert a nylon washer (20) and bearing (19) into the bearing hole in each housing half (8). Install a large nylon washer (18) on each bearing shoulder, and assemble the retaining rings (17) into the housings to hold these parts in place.

b. Assemble the retaining ring (9) and the blower wheel (16) to the shaft (15) and tighten the setscrew (14). Assemble the collar (13) and nylon washer (10) to the shaft and tighten the setscrew enough to hold the collar in place. Assemble the blower wheel shaft into the rear housing bearing.

c. Install a second nylon washer (10) on the shaft and down against the retaining ring (9). Assemble the front housing half to the rear housing half and secure the assembly with three eyelet-type rivets (3) and the screw (5) and hex nut (6). Note the location of the leadwire clamp (4) and lug terminal (7).

d. Working through the large blower opening, loosen the two blower wheel setscrews (14) and shift the blower wheel until it is centered within the housing halves; then tighten the setscrews securely. Loosen the collar setscrew (12) and locate the collar (13) so that the blower shaft has a barely perceptible amount of end play (about 0.005 inch). Tighten the collar setscrew securely.

39. REASSEMBLING THE WORM GEAR — MODELS 552 AND 552EX ONLY. (See Figure 23.) Assemble the interlock retainer (1) to the worm gear (5) with two screws (2). Install Banc-lok (4) and setscrew (3).

40. REASSEMBLING THE FIRE SHUTTER — MODELS 552 AND 552EX ONLY. (See Figure 22.) Clean

the heat filter (5) with lens cleaning fluid and/or lens tissue. Hold the filter by its edge while inserting it into the filter arm. Position the fire shutter disc (4) over the filter and carefully bend the retaining ears on the filter arm to hold these parts in place. Assemble the retainer (3) and retainer spring (2) to the filter arm. Assemble the spring (1) between the ears of the fire shutter as shown in Figure 22.

41. REASSEMBLING THE APERTURE PLATE. (See Figure 21.) Reassemble the aperture plate as outlined in the following paragraphs.

a. As noted in the Figure 21 parts list, all projectors are now standardizing on chrome rails and spring retaining covers. Be sure to check parts list carefully before ordering replacement parts.

b. Early model aperture plates (12) are drilled so that the film guide (11) is attached with a screw (8), hex nut (9) and lock washer (10). Current aperture plates are drilled and tapped, and the film guide is secured with a single screw (8).

c. The insets in Figure 21 illustrate the early and current methods of mounting the film tension rail (6) and spring retaining cover (4). When assembling these parts to the aperture plate, the ends of the spring (7) should rest in the notched out portion of the film tension rail (6) and the center of the spring should bear against the aperture plate stud. Note that in earlier models, washers (5) are used in place of the spacer bushings (5A) used in current models. Tighten the retaining screws (3) securely. Install the film guide rail (2), tightening the two screws (1) securely.

42. REASSEMBLING THE LENS CARRIER. (See Figure 20.) Reassemble the lens carrier parts as outlined in the following paragraphs.

a. Only the current lens carrier (13) with drilled but untapped screw holes is available for replacement. If the lens carrier casting is replaced, swage-type screws (P/N 30804) (items 1 and 10) also must be ordered for reassembling of parts.

b. Assemble the pressure plate (7), springs (8) and pressure plate lever (9) to the lens carrier and install the adjustment plate (11) and two screws (10). Install the spacer bushings (5) and (6) and the screws (4). Both screws tap into the threaded posts of the pressure plate, the upper screw securing the lever (9).

c. Assemble the focus knob assembly (3) to the lens carrier (13), and install the hold-down spring (2) and screws (1).

43. REASSEMBLING THE SPROCKET GUARD. The three variations of sprocket guard are shown in Figures 19, 19A and 19B. The early (Figure 19) and interim (Figure 19A) sprocket guards are no longer available as complete assemblies, but piece parts are available for repairs.

a. Current Sprocket Guard (Figure 19B). Secure the cover strike (5) to the sprocket guard (6) with screw (4). The strike must be adjusted when the sprocket guard is installed. Secure the channel and post assembly (3) to the sprocket guard with the screw (1) and washer (2).

b. Interim Sprocket Guard (Figure 19A). Secure the cover strike (12) to the sprocket guard (13) with screw (11). The strike must be adjusted when the sprocket guard is installed. The spring (5) is assembled on the pin of the channel and post assembly (10) between the ears of the guard and shaft assembly (4), and the spring legs must be positioned so that the small rollers (7) are held in contact with the channel and post roller (10). Assemble items (2 through 6) onto the channel pin and secure with retaining ring (1). Press small rollers (7) onto the guard shaft. Secure this assembly to the sprocket guard with the screw (8) and washer (9).

c. Early Sprocket Guard (Figure 19). Secure the cover strike (7) to the sprocket guard (8) with screw (6). The strike must be adjusted when the sprocket is installed. The spring (2) is assembled on the pin of the channel and post assembly (5) between the ears of the guard and shaft assembly (1), and the spring legs must be positioned so that the small rollers (3) are held in contact with the channel and post roller (5). Press the small rollers (3) onto the guard shaft and assemble the guard and shaft assembly and spring to the channel pin. Secure this assembly to the sprocket guard with the screw (4).

44. REASSEMBLING THE MECHANISM. (See Figure 18.) Reassemble Figure 18 parts as outlined in the following paragraphs. Note that steps a through d apply only to Model 545, 545EX and 550 projectors, with the remaining steps applying only to Model 552 and 552EX projectors.

NOTE: Only the current (drilled but untapped) mechanism housings will be available for replacement. The machine screws used to attach parts to earlier castings cannot be used with the current castings; therefore, if the mechanism housing was replaced, it will be necessary to order swage screws (P/N 30804) (item 9) and (P/N 30884) (item 34) for reassembly of parts to the new casting. Note also that the current bearing loading spring (P/N 42244) (item 10) also must be ordered because of the larger screw hole size.

Models 545, 545EX and 550 Only.

a. Install the condenser holder (35), special washer (36) and spring (37) on the screw (34) and assemble the screw to the mechanism housing (38). Screw the rewind adjustment stud (33) down into the mechanism housing and install the setscrew (32).

b. Lightly grease both bearing holes in the mechanism housing arms. Assemble the washer (12A) and ball bearing (12) into the bearing hole in the mechanism housing. Assemble bearing (29) to the camshaft (30) until the bearing is seated against the shoulder of the shaft. Install retaining ring (28) into the camshaft slot with the convex face of the ring away from the bearing.

c. Insert the end of the camshaft through the right-hand bearing hole in the casting arm and assemble the loop restorer cam (27) and worm gear (24B) to the shaft. Continue pressing the camshaft to the left, inserting the end of the shaft into the left-hand bearing (12) while seating the right-hand bearing (29) in the bearing hole of the cast arm. Install the bearing loading spring (10) with the two screws (9). (See Note preceding step a.) Assemble the large retaining ring (8) into the ring groove of the housing arm, with the convex face of the ring against the bearing (29).

d. Insert a 0.190-inch feeler gage between the loop restorer cam (27) and the cast arm of the housing. Press and hold the cam firmly against the feeler gage while tightening the setscrew (11). Temporarily tighten the worm gear setscrews (24A) until the worm gear can be adjusted in final assembly. Refer to paragraph 76 for loop restorer cam adjustment.

Models 552 and 552EX Only.

e. Assemble the condenser holder parts as outlined in step a and the camshaft bearings as outlined in step b, above.

f. Note that on current projectors the strike (7K) has a larger tapped hole to accept a No. 4-40 hex head screw (7H). Be sure to order the proper parts for replacement. Assemble the strike (7K) to the clutch slide bar assembly (7G) with screw (7H) and washer (7J). Hold the slide bar assembly in position between the ears of the mounting bracket assembly (7L) while inserting the shaft (7C). Slide bumper (7D) must be installed on the shaft between the right-hand ears of the slide bar and the bracket. Assemble the washer (7E) and spring (7F) on the shaft before it is inserted through the two left-hand ears. Install the three retaining rings (7B). The setscrew (7A) must be adjusted at final assembly. Secure the assembled clutch bracket (7) to the mechanism housing with the two screws (1) and (2) and lock washers (3). Assemble the adjustment bracket (6) to the long screw (2) with the washer (5) and round nut (4). Press down firmly on the clutch bracket while tightening the screws (1) and (2).

g. Assemble the three rubber bushings (25) into the holes in the worm gear (24). Assemble the bearing assembly (23) to the worm gear so that the ears of the bearing are aligned with corresponding notches in the worm gear. Insert the ears of the clutch yoke (21) through the slots in the bearing assembly (23) while assembling the spring (22) over the protrusion of the clutch yoke and into the hole in the bearing assembly. Assemble the two shoulder pins (20) to the bearing assembly, pressing them in until they engage the clutch yoke ears. Assemble the trigger (19) and sleeve bearing (18) to the assembled worm gear and bearing assembly.

h. Insert the camshaft, with ball bearing assembled, through the right-hand bearing hole in the casting arm and, to the shaft, assemble the loop restorer cam (27), washer (26) and assembled worm gear group (step g, preceding). Install the spring (14) over the hub of the driven clutch (15), spreading the spring legs so that they straddle the bent ear at the top of the driven clutch. Insert the hub of the driver clutch (13) through the hub of the driven clutch, spreading the legs of spring (14) still further until one of the lugs of the driver clutch is straddled. Install the washer (17) and assembled clutches on the camshaft. The driven clutch (15) must be installed on the camshaft flats so that the bent ear of the clutch is parallel with the flat for the loop restorer cam (27).

i. Continue pressing the camshaft to the left, inserting the end of the shaft into bearing (12) while seating bearing (29) in the bearing hole of the cast arm. Install the two retaining rings (16) in the camshaft grooves, one between washer (26) and cam (27) and the other between washer (17) and clutch (15). Check to make certain that the actuating ear extends beyond the inside edge of the strike (7K). Clutch and loop restorer adjustments will be made after final assembly is completed. Refer to paragraph 67 and 76 respectively.

j. Install the bearing loading spring (10) with the two screws (9). (See Note preceding step a.) Assemble the large retaining ring into the ring groove of the housing arm, with the convex face of the ring against the bearing (29).

k. Insert a 0.190-inch feeler gage between the loop restorer cam and the cast arm of the housing. Press and hold the cam firmly against the feeler gage while tightening the setscrew (11). The clutch adjustment views, Figure Q, illustrate the assembly of clutch parts and can be referred to for assistance during reassembly.

45. REASSEMBLING THE MECHANISM. (See Figure 17.) Reassemble Figure 17 parts as outlined in the following paragraphs. Note that clutch parts (28 through 37) are used only in Model 552 and 552EX projectors. Therefore, disregard step g when repairing 545, 545EX and 550 projectors.

NOTE: Only the current (drilled but untapped), mechanism housings will be available for replacement. The machine screws used to attach parts to earlier castings cannot be used with the current castings; therefore, if the mechanism housing was replaced, it will be necessary to order the required quantity of swage-type screws (items 3, 19, 24, 35 and 38) for reassembly of parts to the new casting.

a. Assemble the shuttle retractor pin (40) and in-out spring (39) and insert the rounded end of the pin into the hole in the long cast arm, just to the right of the camshaft. Secure the loop end of the spring to the housing with screw (38). Screw the bearing support (23) up into the staked nut of the shuttle arm plate assembly (25) turning the support in all the way. Install the framer knob and shaft assembly (27) down into the mechanism housing and press the stop pin (26) into its opening so that the flat on the pin faces the shaft. Engage the fork-like end of the shuttle arm plate framing arm with the cut out of the framer shaft and secure the plate to the cast arm of the housing with screws (24).

b. Loosely assemble the in-out cam (21) to the in-out bracket assembly (22) so that the nylon face of the cam follower (22A) rides against the polished surface of the cam (indicated by arrow, Figure 17). Install this assembled group over the end of the camshaft and fasten the in-out bracket to the mechanism housing with two screws (19).

c. At this point, refer to Figure 16 and install the assembled aperture plate (27) with screws (26). Adjust the aperture plate as instructed in paragraph 64, step a; then return to Figure 17 and continue with reassembly as follows.

d. Make certain that the 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 shuttle arm. Shuttle arm parts (11 through 16) are shown assembled in Figure B. Insert the lubricated cam wiper wick (15) into the coils of the spring (13). Assemble the lubricated felt wiper (14) and the spring (13) to the rear ends of the shuttle arms. Then assemble the ball and stud assemblies (12) to the arms with the hex nuts (11). Carefully insert the front ends of the shuttle arms between the guides of the in-out bracket (22). Assemble the shuttle (16) to the front ends of the shuttle arms so that the shuttle teeth extend through the shuttle slot in the aperture plate and in toward the mechanism housing. Rotate the in-out cam (21), until the tongue on the unpolished face of cam rests down in the notch in the shoulder of the camshaft. Install the pull-down cam (18) on the camshaft spreading the two shuttle arms apart slightly until the cam is in place. The notch in the face of the pull-down cam must engage a mating protrusion on the face of the in-out cam (21). Back out the bearing support (23) until its socket-like nylon pad engages the ball of the ball and stud assembly (12) on the upper arm. The lower stud ball should rest in the socket of the nylon pad mounted on the shuttle arm plate (25). It may be necessary to loosen the hex nuts (11) and shift the ball and stud assemblies (12) until properly aligned. Temporarily install the shutter nut (7).

NOTE: As indicated in the Figure 17 parts list, a new pull-down cam (18) and shutters (9) are being used in current projectors. These new parts are provided with identification markings (see inset, Figure 17) and are interchangeable with the earlier cam and shutter only as a set. When the stock of early style shutters is depleted, it will be necessary to furnish the current shutter (P/N 41308) (3-blade) or (P/N 41309) (2-blade) together with the current pull-down cam (P/N 41307). The 2-blade shutter should be used on all export models (545EX and 552EX) when replacement is necessary.

e. At this point, adjust the shuttle (all projectors) as instructed in paragraph 65, and the clutch mechanism (Models 552 and 552EX only) as instructed in paragraph 67, steps a and b. Then continue with the reassembly procedure as follows.

f. Remove the shutter nut (7) from the camshaft. Install the fiber washer (10) on the camshaft and up against the pull-down cam (18) so that the slot in the washer is aligned with the slot in the cam. Assemble the shutter (9) or (9A) to the camshaft (see Note preceding step e) and install the counterbalance weight (8) so that its pin enters the slots in the shutter and pull-down cam. Install the nut (7) with its shoulder in the center hole of the weight and tighten the nut securely while holding the end of the camshaft with an open-end wrench.

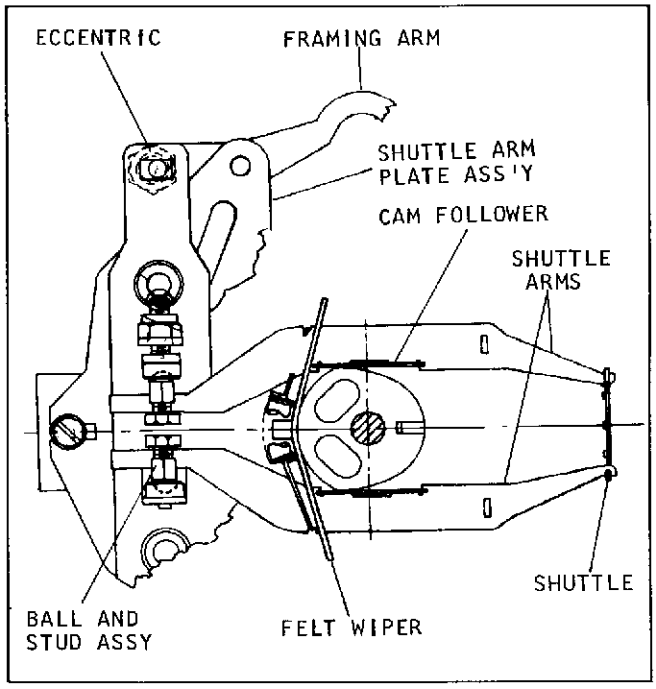


Figure B. Shuttle and Shuttle Arms Assembled

g. Models 552 and 552EX Only. Note that the torsion spring (30) and the clutch (36) are used only in projectors which are equipped with the solenoid-operated clutch and fire shutter system (Figure 5). Assemble the grommets (34) into the bracket (33). Install a retaining ring (28) into the groove nearest the end of the shaft (29) and insert the plain end of the shaft through the bearing bracket (37) and both ears of the stop pawl (31). Loosely attach the bearing bracket (37) to the cast arm of the housing with screws (35). (On projectors with the solenoid-operated clutch system, screws (35) also attach the clutch stop (36), and the torsion spring (30) must be installed on the shaft (29) and up against the left-hand ear of the stop pawl.) Assemble the mounting bracket (33) to the end of the shaft and secure the bracket with screws (32). Tighten screws (32) and (35) securely. Refer to paragraph 67, step a, for stop pawl to trigger clearance adjustment.

NOTE: On projectors with the solenoid-operated clutch system, hook one end of torsion spring (30) over the top edge of the bracket (33) and hook the other end up around the front edge of the stop pawl. When viewed from the spring end of the shaft, the spring must tend to rotate the stop pawl clockwise on the shaft.

h. Insert the rounded end of the heat baffle (6) under the shutter and secure the baffle to the mechanism housing with two screws (3) and flat washers (3A). Install the pulley (2) on the end of the camshaft and tighten the pulley setscrews (1) securely. Note the Model 552 and 552EX projectors are equipped with the fire shutter assembly (5) while the Models 545, 545EX and 550 are equipped with a similarly shaped support bracket (5A). Attach the fire shutter assembly or the bracket to the mechanism housing with two screws (3). Assemble the lower condenser screw (4) into the tapped hole below the heat baffle screws (3).

46. REASSEMBLING THE MECHANISM. (See Figure 16.) Reassemble Figure 16 parts as outlined in the following paragraphs. The aperture plate assembly (27) was installed in paragraph 45. Adjustment views, Figures T through V, show the autoload system parts assembled and will assist in the reassembling of parts.

NOTE: Only the current (drilled but untapped) mechanism housings will be available for replacement. If the mechanism housing was replaced, swage-type screws (items 13, 28 and 31) also must be ordered for reassembly to the new casting.

a. Turn the lens stop screw (31) into the housing until only one thread is visible. Fasten the lens carrier catch (29) and its spacer washer (30) to the casting with screw (28). It may be necessary to adjust this catch at final assembly to insure proper operation of the lens carrier. Adjustment of the lens mount screw is outlined in paragraph 66.

b. Attach the self centering assembly (23) to the casting with two screws (20), lock washers (21) and flat washers (22). Assemble the shaft assembly (19) to the mechanism housing and install the arm assembly (18) on the shaft. The forked finger of the arm must engage the pin of the self centering assembly, between the two large washers. Insert a 0.0015-inch feeler gage between the hub of the arm and the boss of the casting. Hold the shaft and arm firmly together while tightening the hex head screw (17); then remove the feeler gage.

NOTE: Shaft assembly (19), when installed, must be positioned approximately as shown in Figure 16, with the notched out area in its upper edge beneath the lower bearing protruding from the mechanism housing. The roller (2) must not be installed until the lower loop former parts in Figure 15 have been assembled.

c. Assemble the cam follower parts (16A through 16F) in the sequence illustrated in Figure 16. Attach the cam follower assembly to the arm assembly (18) with the screw (13A) and washer (14), tightening the screw just enough to hold the follower. Cam follower adjustment is made in final assembly as instructed in paragraph 76. Engage one end of the spring (15) around the shaft (19) and secure the other end to the casting with the screw (13) and washer (14).

d. The upper loop form and hub assembly (P/N 011949) (see inset, Figure 16) was used only in early model projectors and has been discontinued. Film escape components (5 through 12) are used on all current projectors. If the early loop form assembly is not in need of replacement and the customer does not desire to up-date the projector, insert the shaft (25) through its bearing and install the washer (6) and loop form assembly; tighten the two loop form setscrews (4). Assemble film escape components in the following manner: Assemble the hub assembly (12) to the locking pawl (11) with screw (10). Insert the shaft (8) through one ear of the kickplate assembly (5), install the spring (9) and assembled pawl and hub on the shaft, and insert the shaft through the second ear of the kickplate. Install one retaining ring (7) on the inner end of the shaft and the second retaining ring between the spring (9) and hub assembly (12). Hook one end of the spring over the outer ear of the kickplate and the other end behind the upper finger of the hub assembly so that the hub and locking pawl tend to rotate clockwise around the shaft. Insert the shaft of shaft assembly (25) through its bearing in the housing and install the washer (6) and assembled film escape parts on the shaft. Hold these parts together while tightening the setscrews (4). Hook one end of the spring (24) into the small hole in the link of the shaft assembly (25) and the other end around the lower end of the rewind adjustment stud (33, Figure 18). The film escape mechanism must be adjusted in final assembly as instructed in paragraph 75, step d.

47. REASSEMBLING THE MECHANISM. (See Figure 15.) Reassemble Figure 15 parts as outlined in the following paragraphs. Adjustment views, Figures T through V show the autoload system parts assembled and will assist in reassembling of the parts.

NOTE: Only the current (drilled but untapped) mechanism housings are available for replacement. If the mechanism housing was replaced, swage-type screw (item 16) also must be ordered for reassembly of spring (18) to the new housing.

a. Assemble the connecting link assembly (41) and the shuttle retractor (40) with the screw (37) and washers (38) and (39).

b. Attach the upper sprocket guard plate (36) to the mechanism housing with two screws (35), the upper screw being inserted through the half-moon slot of the kickplate assembly (item 5, Figure 17).

c. Attach the leaf spring (30) to the loop form assembly (34) with two screws (29). Assemble the small hole in the film guide (27) over the pin in the lower sprocket guard plate (25) and hold the guide while inserting the shaft of the toggle lever assembly (26) through the guard plate. The guard plate pin must engage the fork-like ears of the toggle lever. Secure the lever with the retaining ring (28).

d. Assemble the loop form assembly (34) on the upper pin of the connecting link (41) and install the retaining ring (33). Insert the shaft of the upper loop form through the upper guard plate (36) and the mechanism housing and install the threading lever (32) on the end of the shaft. Secure the threading lever

with the locking screw (31). Note that early models used a setscrew for locking purposes; in current projectors, a hex head screw is used. Engage the lower pin of the connecting link (41) with the remaining forked end of the toggle lever assembly (26) and secure the lower guard plate (25) to the mechanism housing with screws (24). The film guide (27) must be raised during this operation so that its large pivot hole slides onto the bearing protruding from the housing.

e. Assemble a large washer (22) and film guide (23) over the bearing protruding through the lower guard plate (25), slipping the hole in the arm of the film guide over the lower pin of the connecting link (41). Install the second large washer (22) and secure all parts with the retaining ring (21). Attach the back-up bracket (20) to the lower guard plate with the screw (19). Assemble the loop form (14) and torsion spring (15) over the lower pin of the connecting link (41) and install retaining ring (13). The legs of the spring must be positioned so that they force the loop form (14) to pivot clockwise around the connecting link pin.

f. Assemble the screw (10) and pivot (11) to the locking lever (12). Rotate and hold the loop form (14) counterclockwise while installing the locking lever (12) tightening the screw (10) securely. Again rotate the loop form (14) counterclockwise while installing the film exit guide (7) to the lower guard plate (25) with screw (6). The curved lip of upper loop form (14) must touch the formed curve of exit guide (7). Install bushing (17) into release spring (18) and secure these parts to housing with screw (16). The long leg of the spring must hook behind the rear edge of the locking lever (12) and the short leg must press against the housing casting. This tension will tend to rotate the lever (12) in a counterclockwise direction around the pivot (11).

g. Assemble the bracket and handle assembly (4) and torsion spring (5) to the lower right stud of the guard plate (25). The bent end of the spring hooks behind the small finger at the front of the locking lever (12) and the straight end presses against the flat surface of the bracket (4), thus pivoting the bracket clockwise. Install small rollers (2) with screws (1) and the large roller (9) with screw (8). Then refer to Figure 16 and install the retaining ring (3), the loop restorer roller (2) and screw (1) on the protruding handle of the shaft assembly (19).

h. Refer to paragraphs 74 and 75 for autoload system adjustments to be performed after final assembly.

48. REASSEMBLING THE MECHANISM. (See Figure 14.) Reassemble Figure 14 parts as outlined in the following paragraphs. Adjustment views, Figures T through V show the autoload system parts assembled and will assist in reassembling parts.

NOTE: Only the current (drilled but untapped) mechanism housing is available for replacement. If the mechanism housing was replaced, swage-type screws (items 14 and 17) also must be ordered for reassembly of the hood (15) and outboard bearing assembly (20) to the new housing.

a. Assemble two retaining rings (9) to belt shift crank (11), and insert long end of crank into opening in housing. Install end of the spring (10) with the least amount of coils over end of crank and the opposite end over the spring anchor post (16). The large center coil of the spring must project toward the rear edge of the housing. Secure the spring to the crank and anchor post with the two remaining retaining rings (9).

b. Install a thrust washer (44) over shaft of upper sprocket assembly (41) and insert sprocket shaft through bearing hole in housing until shaft protrudes about 1/8-inch from rear of housing. Install tension washer (40) and sprocket gear (39), aligning either setscrew (38) with flat on sprocket shaft. Carefully mesh the sprocket gear with the worm gear (24, Figure 18), then slide the shaft through the sprocket gear until the sprocket rests against the bearing in the housing. Tighten both setscrews (38). Install the take-up drive sprocket (31) on the shaft, and tighten setscrews (30).

NOTE: As noted in the Figure 14 parts list, production models after March 1968 are equipped with sprocket and shaft assembly (P/N 012327) in which the sprocket is pressed onto the shaft. In the earlier sprocket and shaft assembly (P/N 011228), the sprocket is held to the shaft with setscrews. The method used for timing the upper sprocket (paragraph 77) will depend on the type of sprocket assembly used in the projector.

c. Install rewind button (22) and spring (23). Depress the button while assembling the rewind clutch lever (21) to the mechanism. The small forked end of the lever engages a groove in the button shaft; the large forked end encircles the upper sprocket shaft. Install the spline driver (29) on the sprocket shaft with the spline fitting through the forked end of the clutch lever and meshing with the drive sprocket (31). Install spring (28), washer (27), retaining rings (25) and rewind drive sprocket (26). Install the timing belt (24) over the rewind drive sprocket (26). Assemble the outboard bearing assembly (20) onto the sprocket shaft and install clutch lever shaft (19) and retaining rings (18). Secure the outboard bearing assembly to the mechanism housing with three screws (17).

d. Refer to Figure C. Loosen the locking setscrew and turn the rewind adjusting stud in or out to obtain 0.010-inch clearance between the rewind clutch lever and the spline driver. Then tighten the setscrew securely against the adjusting stud.

e. Assemble flange (43) and thrust washer (44) onto lower sprocket assembly (42) and insert sprocket shaft through bearings in mechanism housing. Install tension washer (40) and sprocket gear (39) onto shaft, meshing teeth of sprocket gear with worm gear. Tighten setscrews (38) securely so that sprocket shaft turns freely but without noticeable end play.

f. Assemble sprocket guards (35) and (35A), rollers (36) and torsion springs (37) to mechanism with screws (34) and shim washers (34A). The inner bent end of each spring inserts into the small spring holes in the guard plates (items 25 and 36, Figure 15). The

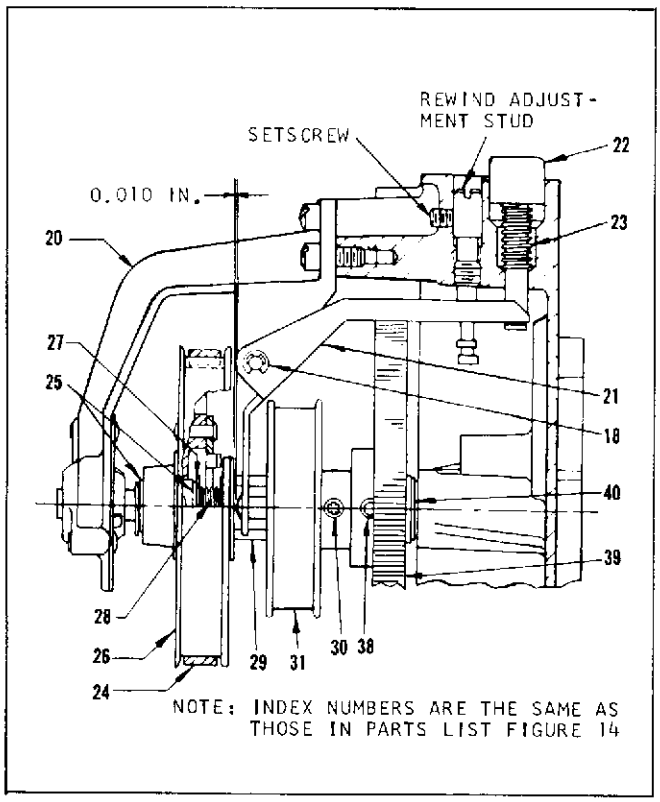


Figure C. Upper Sprocket Gear and Clutch Parts Assembled

outer bent end of each spring hooks over the outer ledge of each sprocket guard (35) or (35A). Spring action will tend to hold the guards around the sprockets. Attach sprocket guard assembly (33) with three screws (32) inserted from rear of mechanism plate. Install actuating assembly (13) on protruding end of upper loop form shaft with retaining ring (12). Attach hood (15) with screws (14). Install speed change knob (7) onto belt crank (11), and hold knob against the mechanism housing while tightening setscrew (6). Hold the knob firmly and push spring (10) toward the sprocket gear; then hold spring in this position and switch the knob to the SILENT setting.

g. Hold the lens carrier (5) between the hinge bosses of the mechanism housing. Insert washers (4) and (3) between the lens carrier hinge ears and mechanism housing hinge bosses and press hinge pins (1) and (2) into place. The lens carrier catch (item 29, Figure 16) must be adjusted as necessary to permit the lens carrier to be opened freely, yet must hold carrier firmly against the stop screw (item 31, Figure 16) in the closed position.

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

49. REASSEMBLING THE SOUNDHEAD. (See Figure 13.) Reassemble Figure 13 parts as outlined in the following paragraphs.

NOTE: Only the current (drilled but untapped) soundhead housing (item 36) is available for replacement. If the housing was replaced, swage-type screws (items 10, 29 and 31) also must be ordered for reassembly of parts to the new housing.

a. As noted in the Figure 13 parts list and insets, exciter lamp mounting pins (36A) in current projectors differ from those used in earlier projector models. The early pin and keeper style has been discontinued; therefore, if pins must be replaced, the current pin (P/N 41321) and its bushing (P/N 41320) must be ordered as a set. Spring (P/N 602339) is used with both styles of pin. Assemble the spring and bushing into the hole in the casting. Insert the pin, forcing the pin into the bushing as shown in Figure 13.

b. Screw the adjusting (edge guide) screw (13) into the housing (36). Insert the shaft of the upper stabilizer arm (35) carefully through the soundhead housing and adjusting screw and install the retaining ring (12). Install the lower stabilizer arm (33) and spring (34) or (34A) on the rear end of the upper arm shaft and secure these parts with the half-moon stabilizer arm (32) or (32A) and two screws (31). Attach spring terminal (30) with screw (29) and hook spring (28) between terminal and ear of lower arm (33).

NOTE: Stabilizer arm (P/N 09833) (item 32) has been discontinued and, if in need of replacement, current arm (P/N 31659) (item 32A) must be ordered together with the current torsion spring (P/N 39789) (item 34A). The early torsion spring (P/N 31672) (item 34) will be available for service on earlier soundheads. Refer to Figure D for torsion spring and stabilizer arm installations.

c. Assemble the silicon cell assembly (22) and its retainer (21) to the sound drum housing (20) and assemble the sound drum assembly carefully into the housing. Hold the sound drum while tightening the setscrew (18) against the retainer (21) just enough to hold all parts in place. In earlier models, two setscrews (19) were tightened down against the sound drum housing to hold it securely. In current models, the sound drum housing is drilled and tapped and two Sems screws (19A) are turned into these holes to secure the assembly.

d. Assemble the contact assembly (15) and lamp release ring (17) to the soundhead housing with screws (14). Insert the optical slit assembly (11) into its opening in the housing and tighten the clamping screw (10) just enough to hold the slit assembly in place. Install the exciter lamp (8) on the lamp pins; press down and rotate clockwise to secure the lamp.

e. Lightly oil the roller shafts of both stabilizer arms (33) and (35) and install the rollers (26) and (27) with screws (24) and washers (25).

f. If the indicating ruby (4) was replaced, cement the new ruby into the exciter lamp cover (7). Attach the film guide (6) to the cover with the screw (5). Assemble the retaining screw (2) to the cover and install the retaining ring (1). Temporarily install the cover

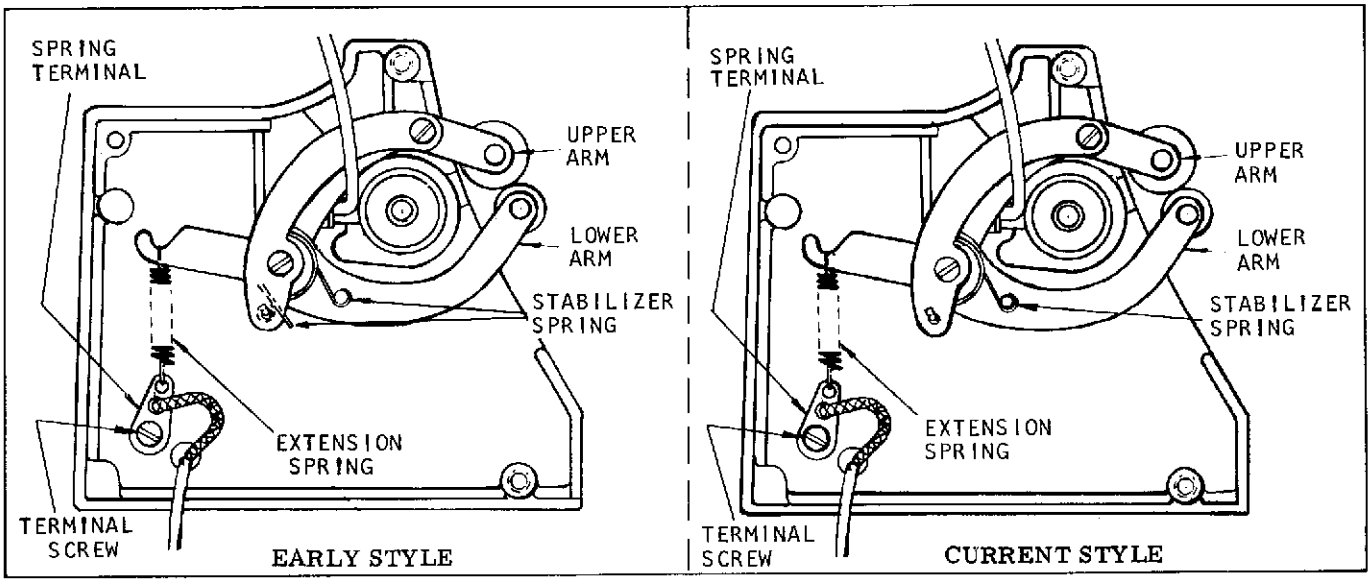


Figure D. Stabilizer Arms and Spring Assembled

to the soundhead housing to protect parts until installation.

g. The soundhead must be adjusted after final assembly. Refer to paragraph 71 for soundhead adjustment procedure and to paragraph 78 for final soundhead positioning.

50. REASSEMBLING THE LAMPHOUSE. (See Figure 12.) Reassemble Figure 12 parts as outlined in the following paragraphs.

a. In earlier model projectors, the lamphouse grille (10) was attached to the lamp housing (12) with two machine screws (9) at the rear corners. In current model projectors, new grilles (P/N 41338 and 41339) and their corresponding housings are provided with a single mounting hole at the center of the rear edge. Two-hole grilles and housings no longer will be available for service. If the earlier two-hole housing is in good condition but the grille was replaced, clamp new grille in place and drill mounting hole with a 1.65 mm (0.066 ± 0.002-inch) drill. Use mounting hole in the grille as a guide. Attach grille with a single rivet (P/N 36100). If the housing was replaced, the old two-hole grille can be redrilled in the same manner, using the mounting hole in the housing as a guide. In addition, however, be sure to order two swage-type screws (P/N 30806) (item 2) for attaching the lamp shield (3) to the new housing.

b. Note that Model 550, 552 and 552EX projectors are equipped with the handle (7) and latch (8), while Models 545 and 545EX use the knurled lock screw (8B) for retaining the lamp screw.

c. As noted in the Figure 12 parts list, the thickness of the spacer bushing (5) will determine which screw (2) is used in reassembly.

51. REASSEMBLING THE LAMPHOLDER. (See Figure 11.) Reassemble Figure 11 parts in the following manner. Lightly grease both faces of the spring tension washer (5) and assemble the release lever (4) and spring washer (5) to screw (3). The convex (bowed) face of the washer must be against the lever. Assemble these parts to the lamp socket bracket (8) so that the releasing finger of the lever is inserted up through the slot in the bracket. Make certain that the lever is seated on the shoulder of the screw so that it can pivot smoothly; then tighten the screw. Fasten the lamp baffle (2) to the bracket with the three screws (1).

52. REASSEMBLING THE REAR REEL ARM. (See Figure 10.) Reassemble Figure 10 parts as outlined in the following paragraphs.

NOTE: If the rear reel arm was disassembled merely as part of the conversion to the current Torrington style clutch system (paragraph 61), only partial disassembly was required and certain of the following steps can be ignored. However, it would be advisable to inspect those parts which remain assembled and to clean and lubricate parts before reassembly.

a. Assemble the needle bearings (6A) and (28A) into the take-up arm assembly (6) and splined bearing assembly (28) respectively. Assemble nylon bearings (16) into the lower pulley and gear assembly (15) and nylon bearings (23) into the drive shaft support arms of the rear arm (29). Place one drop of oil in each nylon bearing and two drops of oil in each needle bearing. Assemble splined bearing (28) into reel arm.

b. Assemble the rubber sleeve (30) to the hub of the lower gear assembly (15). Assemble the retaining ring (19) and lower gear to the rewind drive shaft (21) and install the second retaining ring (14). Install the spring (18) and plunger (17) and hold in place while inserting the shaft (21) into the reel arm. Secure with the setscrew (20).

c. Assemble the lower spur gear (11) to the end of the drive shaft (22) which has one retaining ring slot, and install the retaining clip (10). Insert the opposite end of the drive shaft through both bearings (23) and install the washer (13), retaining clip (10), upper spur gear (12) and retaining ring (9). The lower nylon gear (11) must mesh with the crown gear teeth of the lower gear assembly (15) with a minimum of backlash. Loosen the setscrew (20) and shift the gear (15) and its shaft (21) in or out as necessary; then retighten the setscrew securely.

d. Hold the upper gear assembly (25) in place, its teeth engaging those of the upper nylon gear (12) while inserting the rear reel arm shaft (27). When converting to the current Torrington clutch system, be sure to use shaft (P/N 40295) (shaft (P/N 31233) is used with the early wobble plate clutch system and the interim ratchet and cushion clutch system, both of which have been discontinued). Note the use of brass shims (26) located beneath the gear assembly (25). Use shims, as necessary, to reduce gear backlash to a minimum. When proper shimming has been determined, secure the gear assembly (25) with two setscrews (24).

e. In most earlier model projectors, a straight pin (5) was used to secure the take-up arm (6) to the reel arm. Dowel pin (P/N 41331) is used in current models and will be furnished as a replacement. If you should find, however, that the take-up arm was mounted with a split roll pin (P/N 303188), a new split roll pin must be used in reassembly. Assemble the take-up spindle and pulley assembly (4) to the take-up arm with the socket head screw (3). Hold the take-up arm in place with the belt (1) looped around the pulley assembly and the hub of the lower gear (15). Spring (2) must be inserted into the drilled hole in the take-up arm and the free end of the spring will bear against the reel arm as shown in Figure E. Install the pin (5) to secure the take-up arm to the reel arm.

f. Refer to paragraph 70, step b, for final backlash adjustments and lightly lubricate all gear teeth. Check smoothness of gear train action by rotating the shaft (27). Assemble the reel arm cover (8) to the reel arm with the screws (7), using shims (P/N 34874) as necessary, between the reel arm bosses and cover bosses to eliminate dimpling of the cover as the screws are tightened. Note that only the current (drilled but untapped) cover (P/N 42218) is available for replacement. If the cover was replaced, be sure to order two swage-type screws (P/N 30879) for reassembling the new cover.

53. REASSEMBLING THE FRONT REEL ARM. (See Figure 9.) Reassemble Figure 9 parts as outlined in the following paragraphs.

a. Only the current (drilled but untapped) reel arm (34) and cover (2) are available for replacement. Therefore, if the reel arm was replaced, new swage-type screw (P/N 30804) (item 31A) will be required for attaching the brake spring (32) to the new arm. If the cover was replaced, two swage-type screws (P/N 30879) (item 1) will be required for installing the new cover. Machine screw (P/N 25837) (item 31) must be

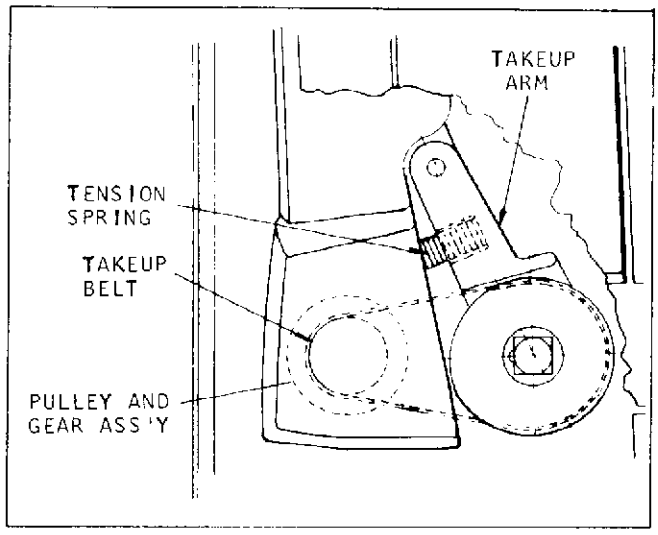


Figure E. Installing Take-Up Arm, Belt and Spring

used to attach the brake spring to earlier (drilled and tapped) reel arms.

b. If, during disassembly, an eccentric washer was found beneath the brake spring (32), this washer can be discarded. The brake spring eliminates the need for this eccentric washer.

c. Assemble needle bearings (34A) and (34B) into the front reel arm (34), needle bearings (30A) into the splined bearing assembly (30) and nylon bearings (23) into the drive shaft support arms of the front reel arm. Place one drop of oil in each nylon bearing and two drops of oil in each needle bearing.

d. Assemble the brake spring (32) to the reel arm with the screw (31) or (31A). Assemble the friction shoe (25) to the pin of the bracket assembly (26) with the retaining ring (24). Assemble the splined bearing assembly (30) into the reel arm (34) and install the large bronze washer (28) and the disc assembly (27). Assemble the bracket assembly (26) to the disc assembly shaft and install the retaining ring (24).

e. Insert the reel arm shaft (29) through the splined bearing (30) and assemble the washers (17) and (17A) and one retaining ring (15) on the shaft. Assemble the clutch disc (16), pin facing out, and the second retaining ring (15) to the shaft.

f. Assemble the lower spur gear (20) to the end of the drive shaft (22) with the retaining clip (19). Insert the shaft through the two nylon bearings (23) and assemble the flat washer (21), retaining clip (19), upper spur gear (20A) and retaining ring (18) to the upper end of the shaft.

g. Loosely assemble the spring (7), lower gear (8) and feed spindle collar (5). One end of the spring is inserted into a hole in the inner face of the gear (8) and the other end hooked beneath the pin (6) in the collar. Add washers (9), (9A) and (9B) to this group and hold up in place while inserting the feed spindle

assembly (10), with washer (11) installed, through the bearing (34A) and the loosely assembled group of parts. Turn the collar (5) until the pin hole in the collar and spindle shaft are aligned; then install spring pin (4) to secure all parts.

h. Assemble the upper gear assembly (13) to the end of the reel arm shaft (29) and install and tighten the setscrews (12). Refer to paragraph 70, step a, for reel arm end play and backlash adjustments. Assemble the reel arm cover (2) to the reel arm with screws (1). Use shims (3), as necessary, between the reel arm bosses and cover bosses to eliminate dimpling of the cover as the cover screws are tightened.

54. REASSEMBLY OF FIGURE 8 PARTS. Reassemble Figure 8 parts as outlined in the following paragraphs.

a. The inset in Figure 8 illustrates the difference in appearance between early and current interlock switches (item 27). Early style switch (P/N 31684) is used in projector base (P/N 33360) (item 42) together with switch bracket (P/N 31695) (30) and terminal strip (P/N 09877) (25). The current switch (P/N 39504) is used in projector base (P/N 42201) (item 42) together with switch bracket (P/N 39517) (30) and terminal strip (P/N 012543) (25). Early and current style parts are not interchangeable individually but only as a set, base included. The early projector base will be stocked for replacement on early model projectors. However, only the latest (drilled but untapped) base is available for current projectors. When replacing the base on current model projectors, be sure to order swage-type screws (24) and (28) for reassembly of the terminal strip and switch bracket to the new base. Refer to the proper wiring diagram (Figure 28, 30 or 32) when wiring the components in the base. Then install the insulator (23) over these components.

b. In early model projectors, the amplifier assembly (12) is attached with No. 5-40 machine screws (10) and No. 5 lock washers (11). In current model projectors, No. 6-32 swage-type screws and No. 6 lock washers are used.

c. In early model projectors, a spacer (37A) was used behind the lower right-hand mounting hole of the preamplifier assembly (37). In current model projectors, a machined boss is located at this point and the spacer is no longer required.

d. Assemble the washer (20J) to the tilt worm gear (20H). Lightly oil the gear shaft and insert it through the bearing holes in the tilt housing (20K). Install the spring washer (20G) on the shaft, bowed face toward the housing; then install flat washer (20F) and retaining ring (20E). Assemble the tilt pinion (20D) into the housing with the large spring pin (20C). Apply a light film of grease to the pinion, the worm gear, and the teeth of the tilt rack (20B). Insert the tilt rack down into the tilt housing and install the two small spring pins (20A).

e. Fasten the tilt mechanism assembly (20) to the projector main plate with screws (18) and the lock washers (19). Refer to the note following Figure 8 parts list for proper screws to be used. Attach the tilt bar (17) to the lower end of the tilt rack (20B) with screw (15) and lock washer (16). Secure the tilt knob (14) to the end of the gear shaft (20H) with the setscrew (13). Rotate the knob to retract the tilt bar up against the base.

f. Secure the blower assembly (8) and air deflector (9) to the main plate with the screws (5), lock washers (6) and brackets (7). Do not tighten the blower mounting screws until all rear mechanism parts are assembled and the blower pulley can be aligned with the drive motor pulley.

g. Be sure to install washer (P/N 28718) on the rotary switch shaft before assembling the rotary switch (4) to the main plate. Refer to the proper wiring diagram (Figure 28, 30 or 32) when making wiring connections to electrical components.

55. REASSEMBLING FIGURE 7 PARTS. Reassemble Figure 7 parts as outlined in the following paragraphs.

a. If the projector being repaired (Models 552 and 552EX only) is equipped with the mechanically-operated clutch and fire shutter parts (Figure 6), those parts must be assembled to the main plate before the drive motor (27, Figure 7) is installed. Note, in the Figure 7 parts list, that the type of motor mounting brackets required is dependent on the type of motor assembly used. Motor (P/N 011189) (G.E. #5KCM49GG151) has been discontinued. When such motors are in need of replacement, order motor (P/N 011893) and an additional mounting bracket (P/N 31263) to replace the bracket originally used at the closed end of motor (P/N 011189). Early drive motors required a separate motor discharge spring (26). This spring is not required on current motors since a built-in grounding device automatically grounds the motor to the frame when the motor bracket strap (25) is locked in place. Proper brackets for use with each motor are listed in Figure 7 parts list notes.

b. If the motor pulley (35) was replaced, be sure to check Figure 7 parts list notes for the proper pulley to be used in the projector being repaired. New type V-belts (21) (P/N 40283) are used in all projectors in the 76400 Serial Number group and up, and, as shown in the insets of Figures 7 and 25A, a new V-groove drive motor pulley and blower pulley are also used.

c. The relationship of belt shifter parts is shown in Figure F. Hold the belt shift stop (33) in place between the arms of the bar stop bracket so that the setscrew (32) is visible in the center hole of the bracket. Insert the leg of belt shifter (29) through the bracket and bar stop. Secure the bar bracket (31) to the end of the belt shifter leg with setscrew (30). Fasten the stop bracket (23) and belt shift spring (24) to the main plate with two screws (22). Move the belt shifter until the edge of stop bracket (23) is approximately 7/32 inch from the bar bracket (31) and tighten setscrew (32).

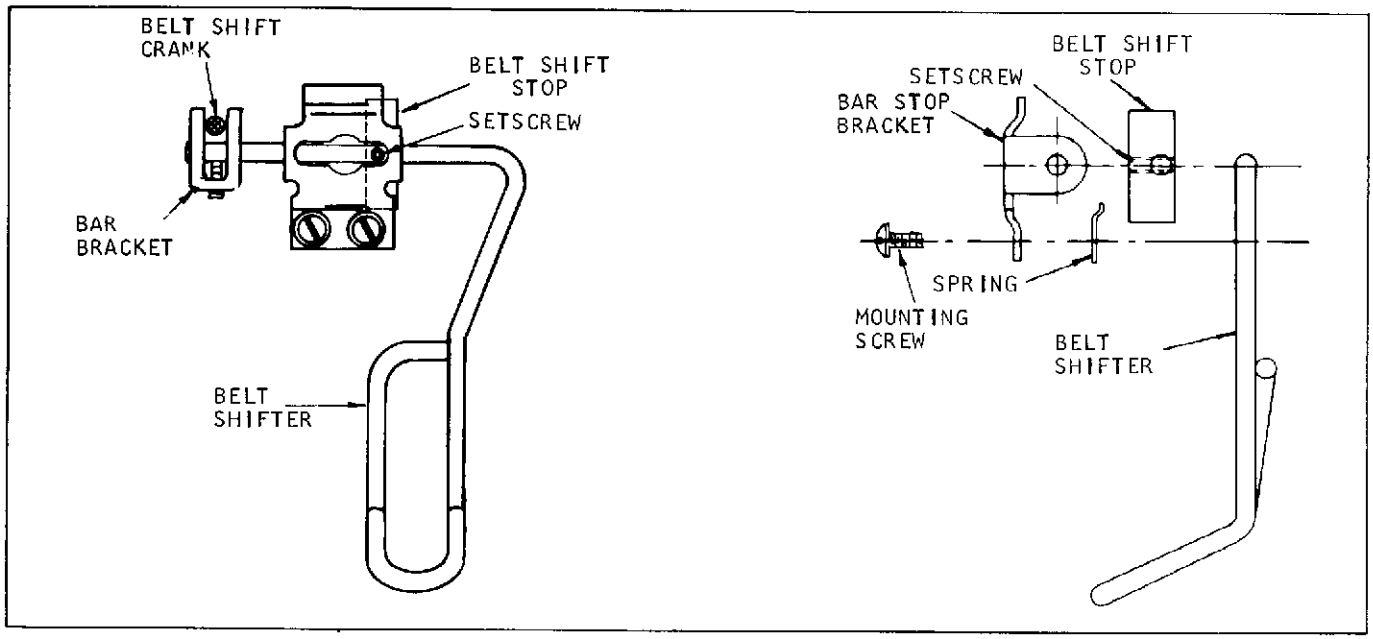


Figure F. Assembling Belt Shifter Parts

d. Temporarily insert the flat belt (28) up through the loop of the belt shifter (29) and engage it over the knurled diameter of the motor pulley (35). Let the belt hang free until the assembled projector mechanism is mounted on the main plate. Loop the blower belt around the blower pulley and the outer belt groove of the motor pulley. Shift the blower assembly until the belt is vertically aligned and tighten the blower mounting screws securely.

e. Reel arm locking parts (17 through 20) should not be installed until the reel arms and clutches are assembled to the main plate (paragraph 61).

f. If rollers (15B) and (16B) were removed or replaced, place a drop of oil on each roller shaft before reassembly. Secure the idler assemblies (15) and (16) to the main plate with screws (14). Refer to paragraph 72 for method of adjusting the idler assemblies in final assembly to provide proper belt tension.

g. Two styles of motor relay (11) are used in projectors (see inset, Figure 7). If in need of replacement, be sure to order the correct relay and make wiring connections to relay terminals as shown.

h. Refer to the appropriate wiring diagram (Figure 28, 30 or 32) for proper leadwire connections to the various electrical components.

56. REASSEMBLING MECHANICALLY-OPERATED CLUTCH AND FIRE SHUTTER COMPONENTS. (See Figure 6.) Parts shown in Figure 6 are used only in current Model 552 and 552EX projectors. Reassemble Figure 6 parts as outlined in the following paragraphs.

NOTE: If the projector being repaired is equipped with solenoid-operated clutch and fire shutter components, refer to paragraph 57 following for proper reassembly instructions.

a. Assemble the clutch cam and stud assembly (23) to the camshaft assembly (20), with the flanged side of the stud to be facing toward the washer and cam assembly. The stud of the camshaft assembly (20) must locate between the ears of the cam and stud assembly.

B. Assemble the pawl bushing (22) to the camshaft, with the large OD of the bushing toward the cam and stud assembly.

c. Assemble clutch cam (21) onto the large OD of the pawl bushing (22), with the stud of the camshaft assembly (20) located between the two ears of the cam.

d. Assemble the bracket and lever assembly (18) to the camshaft, with the stud of the clutch cam (21) located in the "banana" slot of the bracket. Install the large retaining ring (19) in the groove of the camshaft to hold all the bracket and cam parts (18 through 23) together.

e. Turn the projector belt shift knob to SILENT position. Insert the camshaft through the slot in the main plate casting and through the upper hole in the nameplate assembly (9). Locate the bracket and lever assembly between the motor mounting bosses and install the three screws (17).

f. Assemble the short clutch rod (13) through the hole in the long arm of the clutch lever (15), with the bent tip of the rod assembled from outside the bracket arm. Assemble the long clutch rod (4) through the hole in the formed ear on the opposite side of the clutch lever, with the bent end of the rod assembled from outside of the formed ear.

g. Assemble the free end of the short clutch rod (13) through the hole in the end of the clutch actuating lever of the bracket assembly (18). Turn the belt shift lever to the SOUND position. Carefully assemble the clutch lever (15) onto the protruding end of the clutch lever shaft (6) and onto the stud of the bracket and lever assembly (18), while inserting the free end of the long clutch rod (4) down through the hole in the stop pawl (item 31, Figure 17). Install the retaining ring (14) on the stud of the bracket and lever assembly. Install the collar (3), tapered end upward, on lower end of the long clutch rod and tighten setscrew (2).

h. Install the Still-Run knob (8) on the end of the camshaft (20), tightening the setscrew (7) against the flat on the shaft. Assemble the stop pawl spring (1) by hooking the right angle bent end of the spring around the clutch rod above the stop pawl. The lower bent end will be hooked beneath the terminal lug under the lower right-hand mounting screw of the complete mechanism assembly when that assembly is installed.

i. Rotate the Still-Run knob (8) and depress the clutch lever (15) until full travel of the long clutch rod (4) is attained. While maintaining this lever position, adjust collar (3) until there is a gap of 3/32-inch between top of collar and undersurface of stop pawl. (See Figure Q.)

NOTE: When the clutch lever is depressed, make sure that the stop pawl is not riding on the trigger of the clutch assembly by rotating worm gear.

j. Install overcenter spring (16) by hooking the hook-like legs between the stud on the bracket and lever assembly (18) and the stud on the cam and stud assembly (23). Install fire shutter lever spring (12) with screw (10) and flat washer (11). The bent tip of the spring must rest on the top edge of the fire shutter support bracket. Refer to paragraph 69 for final adjustments.

57. REASSEMBLING SOLENOID-OPERATED CLUTCH AND FIRE SHUTTER COMPONENTS. (See Figure 5.) Parts shown in Figure 5 are used only in early Model 552 and 552EX projectors. Reassemble Figure 5 parts as outlined in the following paragraphs.

a. Secure the fire shutter solenoid bracket (17) to the projector base with the two screws (16). Assemble the spring (12) and fire shutter solenoid (15) to the bracket. The long leg of the spring must be inserted behind the pin in the solenoid plunger and the short bent end into the spring hole in the bracket (17). Install the washers (14) and screws (13), tightening the screws just enough to hold. Assemble the fire shutter rod (11) to the holes in the end of the fire shutter solenoid plunger. The upper end of the rod must be hooked to the fire shutter filter arm after the complete mechanism has been installed.

b. Assemble the rubber grommets (9) into the mounting holes in the clutch solenoid mounting bracket (10). Assemble the clutch solenoid assembly (6) to the bracket with two screws (4) and washers (5). Assemble one collar (2), tapered end up, on the clutch rod, leaving the setscrew loose. Insert the end of the rod up through the hole in the stop pawl (31, Figure 17) and position the solenoid on the mounting hole in the base. Insert metal bushings (8) into the rubber grommets (9) and secure the bracket to the base with screws (7). Install the spring (3) and remaining collar (2), tapered end down, on the upper end of the clutch rod and temporarily tighten the collar setscrew.

c. Raise the clutch solenoid rod until the solenoid plunger protrudes approximately 3/16 inch from the solenoid body. Slide the lower collar up until it makes contact with the underside of the stop pawl (31, Figure 17) and tighten the lower collar setscrew. Loosen the upper collar setscrew and position the upper collar on the rod until the distance between the top of the upper collar and bottom of lower collar is 7/8 inch. Tighten upper collar setscrew.

58. REASSEMBLY OF FIGURE 4 PARTS. Reassemble Figure 4 parts as outlined in the following paragraphs.

a. If repairs to the mechanism assembly (30) required that the mechanism housing be replaced with the current (drilled but untapped) style, new swage-type mounting screws (P/N 30824) (item 29) must be used to mount the mechanism to the main plate. Lift the assembled mechanism up into position against the main plate and install the mounting screws (29). When repairing current Model 552 and 552EX projectors equipped with the mechanically-operated clutch system, the free end of the long tension spring (item 1, Figure 6) must be hooked behind the head of the lower right-hand mounting screw before that screw is tightened. When repairing early Model 552 and 552EX projectors, the upper end of the fire shutter rod (item 1, Figure 5) must be engaged in the hole in the fire shutter filter arm.

b. The cover shield (28) was used only in early model projectors and can be removed from all models and discarded.

c. Lift the soundhead assembly (26) up into position against the main plate. Make certain that all leadwires are behind the main plate and not caught between the plate and soundhead housing. Install and tighten the screws (23) and (24) with their washers (25). Refer to the appropriate wiring diagram (Figure 28, 30 or 32) for proper wiring connections between the soundhead and other components.

d. Install the washer (22) on the sound drum shaft, plus any shim washers removed during disassembly. Carefully guide the flywheel (21) onto the sound drum shaft and install the flywheel nut (20), turning the nut on by hand as far as possible. Insert a 1/16-inch punch through the guide hole in the sound drum shaft housing and hold it lightly while rotating the sound drum shaft. When the punch drops into the hole in the shaft, hold it firmly and tighten flywheel nut with a wrench. Remove the punch. Fasten grounding spring (19) and cable clamp (18) to the base with screw (17). It may be necessary to bend the grounding spring until it applies tension against the end of the sound drum shaft.

e. Install the washer (15) on the snubber mounting post (14) and screw the post into the tapped hole in the main plate. Insert the snubber spring retainer (12) between the last two coils at the inner end of the snubber spring (11) and insert the spring and retainer into the spring cover (13). Assemble these parts over the large diameter of the snubber mounting post (14). Assemble the hub of the snubber roller shaft assembly (10) over the snubber post and inside the spring (11). Before the shaft is fully in place, wind the spring one full turn counterclockwise and engage the bent end of the spring with the small hole in the crank arm of the shaft assembly. Press the shaft all the way in and install the retaining ring (9) to hold these parts in place.

f. Note in the inset of Figure 4 the appearance of current idler rollers (P/N 41330) (items 5 and 8). These rollers are not interchangeable with early style rollers (P/N 39523), which will continue to be available for service. However, when the early style snubber roller shaft assembly (P/N 011222) (item 10) is out-of-stock, the current shaft assembly (P/N 012329) will be supplied, together with two of the current rollers. Early style rollers must then be discarded or placed in stock as service spares. Assemble idler roller (8) to the shaft assembly (10) and install the snubber handle (6). Hold idler roller (5) between the arms of the film guide (3) and assemble these parts to the end of the snubber post (14). Install the screw (1). Lift the free end of the film guide (3) up in line with its mounting hole in the main plate. Insert the mounting stud (2) through the film guide and the spacer (4) and screw the stud tightly into place.

59. REASSEMBLY OF FIGURE 3 PARTS. Reassemble Figure 3 parts as instructed in the following paragraphs.

NOTE: As indicated in the Figure 3 parts list, Model 545 and 545EX projectors are not equipped with the shield assembly (item 1) or pilot lamp (item 17) and use a nameplate bracket (P/N 38456) (item 22) in place of the pilot light bracket assembly (P/N 09822) used in all other models. Note also that only the Models 552 and 552EX are equipped with the selector switch (16).

a. Attach the pilot lamp bracket on nameplate bracket (22) to the main plate with screws (21). Assemble the lamphouse (19) to the bracket with three screws (18) inserted through holes in the bracket hinge and turned into screw holes in the lamphouse. Close the lamphouse and check to make certain that the lamphouse contour matches with that of the mechanism housing. If necessary, loosen the bracket attaching screws (21) and shift the bracket. On Model 550, 552 and 552EX projectors, check to make certain that the lamphouse opens and closes without binding. It may be necessary to adjust the lamphouse latch (item 8, Figure 12) to insure proper latching operation.

b. Models 552 and 552EX Only. Assemble the selector switch (16), with its switch guard and mounting plate, to the switch nameplate (13) and install switch nut and washers. Install the two screws (14) before tightening the switch nut. Assemble the switch nameplate to the pilot lamp mounting bracket (22), threading the selector switch leadwires through the hole in the main plate and guiding the amplifier and relay switch control shafts through the lower two holes in the nameplate. Secure the nameplate to the pilot lamp bracket with three screws (12). Install the knobs (8), (9) and (11), with approximately 1/32-inch clearance between the knobs and the nameplate.

c. Models 545, 545EX and 550 Only. Assemble the switch nameplate (13) to the bracket (22), guiding the amplifier and rotary switch control shafts through the holes in the nameplate. Secure the nameplate to the bracket with the three screws (12). Install the knobs (8), (9) and (11), with approximately 1/32-inch clearance between the knobs and the nameplate.

d. Early and current condenser assemblies (3) are shown in the inset in Figure 3. In early models, a coil spring (P/N 31584) separated the two lenses. In current models, two internal retaining springs (P/N 37311 and P/N 37312) are inserted into the housing (3E) to secure the first condenser (3D) and provide a spacing stop for the second condenser (3B). The second condenser is held in the housing with a third retaining spring (3A). Be sure to clean lenses thoroughly before reassembly and avoid leaving fingerprints on the lens surfaces. Engage the lower notched end of the condenser assembly with the lower mounting screw projecting from the mechanism below the aperture opening; then swing the upper end in toward the projector until the upper notch snaps over the spring-loaded condenser lens holder.

e. Perform optical alignment procedures outlined in paragraph 64 before continuing with reassembly.

NOTE: The Projection Lens Chart following the Figure 3 parts list indicates the projection lenses which are available, together with the appropriate field flattener and retaining ring for each. These field flatteners are available as service parts.

60. INSTALLING FRONT REEL ARM AND CLUTCH PARTS. Note, in the Figure 2 parts lists, that certain parts of the wobble plate clutch system (Figure 2D) and the interim Torrington clutch system (Figure 2E) will shortly be unavailable. If any one of the indicated parts is replaced, the clutch system must be modified to the new Torrington system (Figure 2F). This is accomplished by discarding all of the indicated parts of the old system and replacing those parts with the latest rewind sprocket (P/N 012661) and take-up reverse sprocket (P/N 012662). This installation of the reel arm with each clutch style is covered separately in the following paragraphs.

a. Front Arm and Current Torrington Clutch System. (See Figure 2F.)

(1) Assemble the washer (12) over the spline of the front reel arm and insert the reel arm shaft through the main plate. Assemble the black lock disc (10) over the spline of the reel arm so that the notch in the disc

is approximately at the position shown in Figure G. Install the retaining collar (9) up against the lock disc and tighten its setscrews (8).

(2) Refer to Figure 7 and install lock plunger parts (items 17 through 20) as follows. Lightly oil the lock plunger (20) and assemble the spring (19) and lock plunger to the plunger bracket (18) so that the notch in the bracket straddles the narrow arm of the lock plunger bar. Secure this group of parts to the main plate with two screws (17) so that the narrow arm of the lock plunger bar is located in the notch of the reel arm lock disc (Figure G).

(3) Refer to Figure 2F and continue installation as follows: Apply a light film of oil to the reel arm shaft and install two brass washers (7), a nylon washer (6), reverse take-up sprocket (5), small diameter hub toward the main plate, and a second nylon washer (4) on the reel arm shaft. The rewind timing belt is hanging loose around the large rewind drive sprocket of the mechanism assembly. Loop this belt around the rewind sprocket (3) and slide the sprocket onto the reel arm shaft, slotted hub facing out. Install the locking collar (2) so that its tongue mates with the slot in the rewind sprocket hub. Insert a 0.003-inch feeler gage between nylon washer (6) and brass washer (7), press reel arm and clutch parts together and tighten setscrews (1). Remove feeler gage and refer to paragraph 72 for belt adjustment.

b. Front Arm and Intermediate Torrington Clutch System. (See Figure 2E.) The only difference between the current and intermediate Torrington clutch system is in the improved design of the reverse take-up sprocket (5) and rewind sprocket. The installation procedure is identical to that outlined in step a, above.

c. Front Arm and Wobble Plate Clutch System. (See Figure 2D.)

(1) Install the reel arm (15) and washer (16), the lock disc (14) and retaining collar (13) as outlined in step a (1), above.

(2) Install lock plunger parts as outlined in step a (2), above.

(3) Apply a light film of oil to the reel arm shaft and to the face of the clutch ball retainer (8). Install two brass washers (11), a nylon washer (10) and the reverse take-up sprocket (9), small diameter hub first, onto the reel arm shaft. Install the clutch ball retainer (8), formed ears facing away from sprocket (9), onto the reel arm shaft and into the counterbore of the sprocket.

(4) Install the clutch cam (7) so that the three notches in the cam OD straddle the three ears of the clutch ball retainer (8) and the shallowest end of each notch is at the left (counterclockwise) side. Rotate the cam counterclockwise against the ears of the retainer (8) and insert a steel ball (6) between each pair of retainer ears. Insert the spring (4) into the radial slot of the cam so that the spring tends to rotate the cam in a clockwise direction when released. Install nylon washer (5) on reel arm shaft.

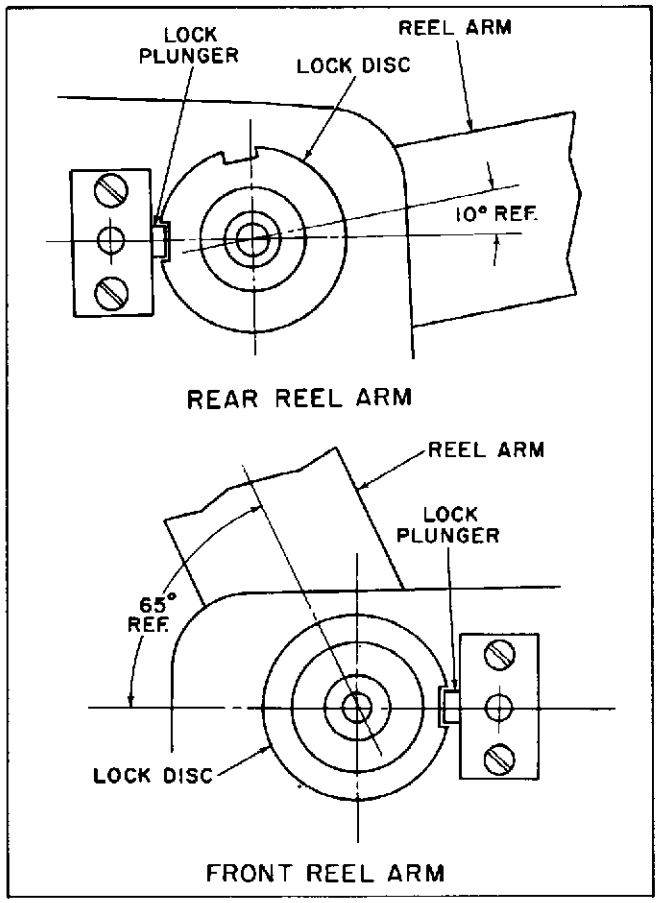


Figure G. Installing Reel Arm Lock Discs and Plungers

(5) The rewind timing belt is hanging loose around the large rewind drive sprocket of the mechanism assembly. Loop this belt around the rewind sprocket (3) and slide the sprocket onto the reel arm shaft, slotted hub facing out. Install the locking collar (2) so that its tongue mates with the slot in the rewind sprocket hub. Insert a 0.003-inch feeler gage between nylon washer (10) and brass washer (11), and press and hold all parts together while tightening the setscrews (1). Remove the feeler gage and refer to paragraph 72 for belt adjustment.

61. INSTALLING REAR REEL ARM AND CLUTCH PARTS. Note, in the Figure 2 parts lists, that certain parts of the wobble plate clutch system (Figure

2A) and the ratchet and cushion clutch system (Figure 2B) will shortly be unavailable. If any one of the indicated parts is replaced, the clutch system must be modified to the new Torrington system (Figure 2C). This is accomplished by discarding all of the indicated parts of the old system, installing a new shaft (P/N 40295) in the rear reel arm (paragraphs 18 and 52), and installing current take-up sprocket assembly (P/N 012654) on the shaft with a retaining ring (P/N 21736). The installation of the reel arm with each clutch style is covered separately in the following paragraphs.

a. Rear Arm and Current Torrington Clutch System. (See Figure 2C.)

(1) Assemble the washer (11) over the spline of the rear reel arm (10) and insert the reel arm shaft through the main plate. Assemble the nickel-plated lock disc (9) over the spline of the reel arm so that the notch in the disc is approximately at the position shown in Figure G. Install retaining collar (8) up against the lock disc and tighten its setscrews (7).

(2) Install lock plunger parts as outlined in paragraph 60, step a (2). Then apply a light film of oil to the reel arm shaft and install two brass washers (6) and nylon washer (5).

(3) Install the take-up timing belt (item 18, Figure 1), looping it beneath the take-up drive sprocket on the mechanism assembly and around the reverse take-up sprocket of the front reel arm. This belt is shown installed in Figure S to aid in installation. Make certain that both idler roller brackets are loose to eliminate tension on the belt. Loop the free end of the timing belt around the rear take-up sprocket (item 4, Figure 2C) and slide the sprocket, the nylon washer (3) and brass washer (2) onto the reel arm shaft. Secure all parts with the retaining ring (1).

(4) Refer to paragraph 72 for belt tension adjustments.

b. Rear Arm and Ratchet-Cushion Clutch System. (See Figure 2B.)

(1) Install the reel arm (10), washer (1), lock disc (9) and retaining collar (8) as instructed in paragraph 61, step a (1), preceding.

(2) Install the lock plunger parts as outlined in paragraph 60, step a (2).

(3) Install the take-up timing belt (item 18, Figure 1), looping it beneath the take-up drive sprocket on the mechanism assembly and around the reverse take-up sprocket of the front reel arm. This belt is shown installed in Figure S to aid in installation. Make certain that both idler roller brackets are loose to eliminate tension on the belt. Loop the free end of the timing belt around the rear take-up sprocket (item 6, Figure 2B) before installing sprocket.

(4) Apply a light film of oil to reel arm shaft. Assemble the take-up sprocket assembly (6) to the shaft with the metal flange of the sprocket toward the main plate. Assemble the felt washer (5), ratchet (4) and cushion (3) to the reel arm shaft and slide the ratchet up against the face of the sprocket. Slide the locking collar (2) up until it just contacts the cushion and tighten the two setscrews (1) securely.

(5) Refer to paragraph 72 for belt tension adjustments.

c. Rear Arm and Wobble Plate Clutch System. (See Figure 2A.)

(1) Install the reel arm (14), washer (15), lock disc (13) and retaining collar (12) as outlined in paragraph 61, step a (1).

(2) Install the lock plunger parts as outlined in paragraph 60, step a (2).

(3) Install the take-up timing belt (item 18, Figure 1), looping it beneath the take-up drive sprocket on the mechanism assembly and around the reverse take-up sprocket of the front reel arm. This belt is shown installed in Figure S to aid in installation. Make certain that both idler roller brackets are loose to eliminate tension on the belt. Loop the free end of the timing belt around the rear take-up sprocket (item 8, Figure 2A) before installing sprocket.

(4) Apply a light film of oil to the reel arm shaft and to the face of the clutch ball retainer (7). Install two brass washers (10), a nylon washer (9) and the take-up sprocket (8), metal flange facing in, over the shaft and up against the collar (12). Install the clutch ball retainer (7), formed ears facing away from the sprocket (8), onto the reel arm shaft and into the counterbore of the sprocket. Install the nylon washer (6).

(5) Install the clutch cam (5) so that the three notches in the cam OD straddle the three ears of the clutch ball retainer (7) and the shallowest end of each notch is at the right (clockwise) side. Rotate the cam clockwise against the ears of the retainer (7) and insert a steel ball (4) between each pair of retainer ears. Insert the spring (3) into the radial slot of the cam so that the spring tends to rotate the cam counterclockwise when released. Install the rear reel arm bearing (2) up against the clutch cam (5) and tighten the setscrews (1) securely.

(6) Refer to paragraph 72 for belt adjustments.

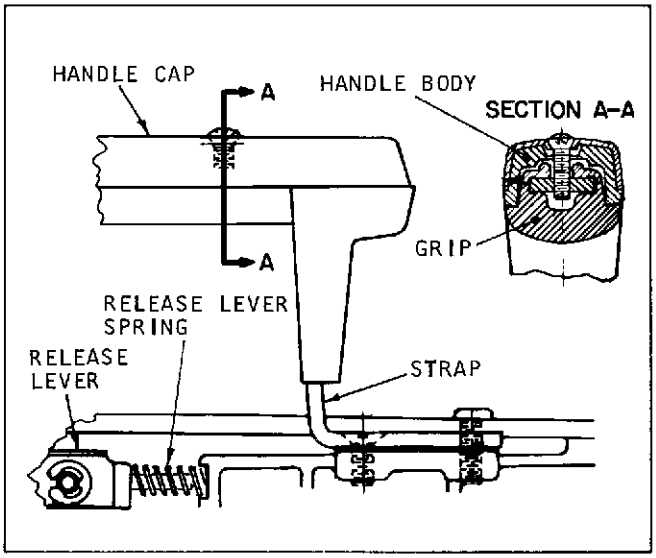


Figure H. Installing the Carrying Handle

62. REASSEMBLY OF FIGURE 1 PARTS. Reassemble Figure 1 parts as outlined in the following paragraphs.

a. Assemble the spring (17) to the spring pin at the right end of the cover release lever (16). Install the cover latch studs (15) and assemble the release lever to the studs. The free end of the spring (17) should be inserted in the recess of the main plate boss immediately to the right of the release lever (see Figure H).

b. When reassembling the carrying handle parts to the main plate, note that only early model projectors require the felt pads (12A). Current rear covers have eliminated the top center mounting hole located directly below the handle on earlier rear covers. Attach the carrying handle strap (12) to the main plate with two each of screws (11) and (11A) (Figure H), and note the spacers (13) must be used on the front two screws between the strap and the main plate mounting bosses. Assemble the rubber grip (10), handle body (9) and cap (8) to the handle strap as shown in Figure H and install the screws (7).

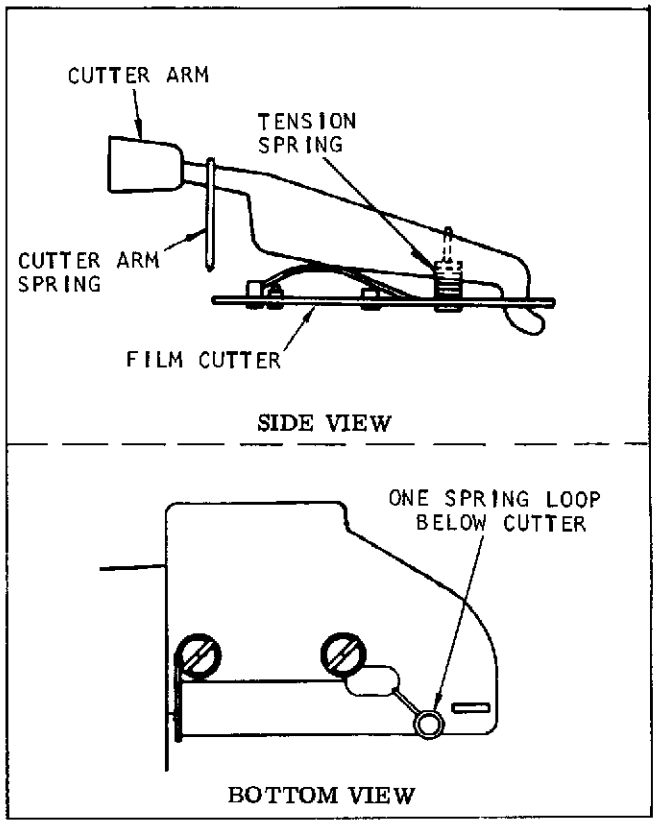


Figure J. Installing Film Cutter Parts

c. Note, in Figure J, the installation of film cutter parts. The film cutter assembly (22) is secured to the base with two screws (20) with the front screw also securing the loop of the cutter arm spring (21). Insert the tail of the film cutter arm (23) into the rectangular slot at the rear of the film cutter, engaging the hook-end of spring (21) over the arm as shown in Figure J. Insert the bent loop end of the tension spring (19) through the elongated hole in the film cutter and with one full coil beneath the cutter (Figure J).

d. Refer to the Adjustments section and perform all adjustments and alignments before installing the projector covers.

Adjustments

63. 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.

64. OPTICAL ALIGNMENT.

It is important that these alignments be performed in the following listed sequence (steps a through d). All special tools and fixtures required for optical alignment are shown in Figure A (items 1 through 5). Except for the aperture plug (item 5), these items are shown installed in the projector in Figure K. Be sure to turn the mechanism manually until the shutter blade is clear of the aperture opening.

a. Aligning the Aperture Plate.

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

(2) Swing the lens carrier fully open and disassemble the pressure plate from the lens carrier. (If necessary, refer to paragraph 28 for disassembly instructions.)

(3) Loosen the two aperture plate mounting screws just enough to permit movement of the aperture plate, and insert the aperture plug (item 5, Figure A) into the aperture opening. Close the lens carrier.

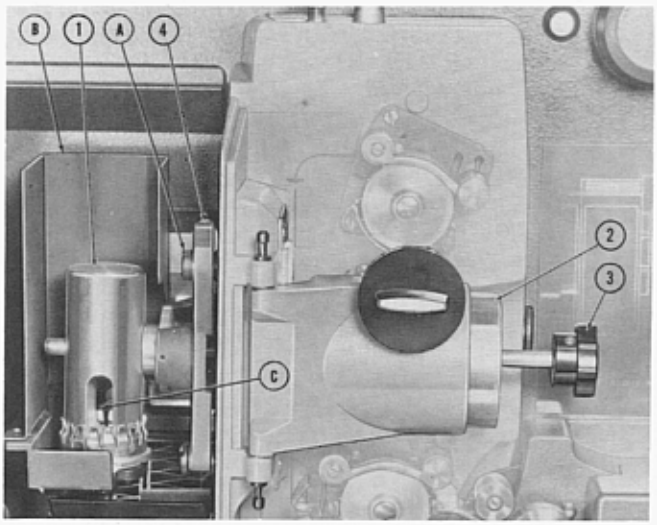


Figure K. Optical Alignment Tools Installed

(4) Tip the projector carefully onto its back (lens opening facing up) and insert the lens plug (item 2, Figure K) down into the lens barrel. Insert the end of the alignment rod (item 3, Figure K) into the center hole of the lens plug and carefully lower the rod. It may be necessary to shift the aperture plate slightly so that the alignment rod enters the hole in the aperture plug. With the alignment rod in place, tighten the two aperture plate mounting screws.

b. Aligning the Condensing Lens.

(1) Withdraw the alignment rod (item 3, Figure K) enough so that the condenser plug (item 4, Figure K) can be installed on the condenser screw and holder protruding from the mechanism housing.

(2) Carefully lower the alignment rod through the aligning hole in the condenser plug. Due to the manner in which the plug is suspended it may shift slightly from side to side as the rod is inserted, but this will not affect alignment. However, if the tip of the rod should strike the top or bottom of the plug aligning hole, tighten or loosen the condenser holder screw (A, Figure K) until the plug is aligned with the rod and the rod slides freely in and out.

c. Aligning the Lamp Socket.

(1) Tip the projector back into its normal, upright position. Loosen the two screws (behind the lamp socket) which secure the lamp holder assembly (B, Figure K) to the projector main plate.

(2) Withdraw the alignment rod enough so that the lamp plug (item 1, Figure K) can be inserted into the lamp socket. Rotate the lamp plug until its aligning hole is in line with the alignment rod.

(3) Slide the rod through the hole in the lamp plug. Grasp the lampholder and lamp plug, with thumb beneath the lamp socket bracket and fingers resting lightly on top of the lamp plug. Do not grip firmly. Press the lamp socket bracket upward until the socket bears lightly but evenly against the bottom of the plug. Do not force the bracket upward. The alignment rod must still move freely, without binding.

(4) While still holding the socket lightly against the bottom of the lamp plug, slide the lampholder and plug forward toward the lens until the lamp plug just touches the condenser plug. One of the lampholder mounting screws is accessible through the vertical slot (C, Figure K) in the lamp plug. Insert a screwdriver and tighten this screw securely without disturbing the position of the lampholder and lamp plug. Withdraw the alignment rod, remove the lamp plug, and tighten the remaining lampholder mounting screw.

d. Final Alignment Check.

(1) Reinstall the lamp plug in the lamp socket and rotate the plug until its aligning hole is in line with the alignment rod.

(2) Slide the alignment rod back and forth through all three plugs. Since the rod is a lapped fit in the aligning holes, a light resistance should be felt. However, if obvious binding is noted, determine the point at which the rod binds and realign accordingly.

(3) Make sure that the lamp plug does not rise, even slightly, from the lamp socket as the rod passes in and out. If it does, realign the lamp socket as outlined in step c, above.

(4) Tip the projector onto its back (lens opening facing up) and remove the alignment rod, lens plug, condenser plug and lamp plug. Swing open the lens carrier and remove the aperture plug from the aperture opening.

(5) Reassemble the pressure plate to the lens carrier as instructed in paragraph 42. Install the condenser lens assembly and projection lamp and close the lamp housing. Close the lens carrier and install the projection lens.

65. 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 L. 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 64, step a, Aligning the Aperture Plate.

(2) Shuttle stroke incorrect. See paragraph 65, 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 paragraph 25 and Figure B).

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

b. Checking Shuttle Tooth Height. Swing open the lens carrier and advance the mechanism manually until the shuttle is at the center of its stroke as shown in Figure L. Hold the shuttle tooth height gage (item

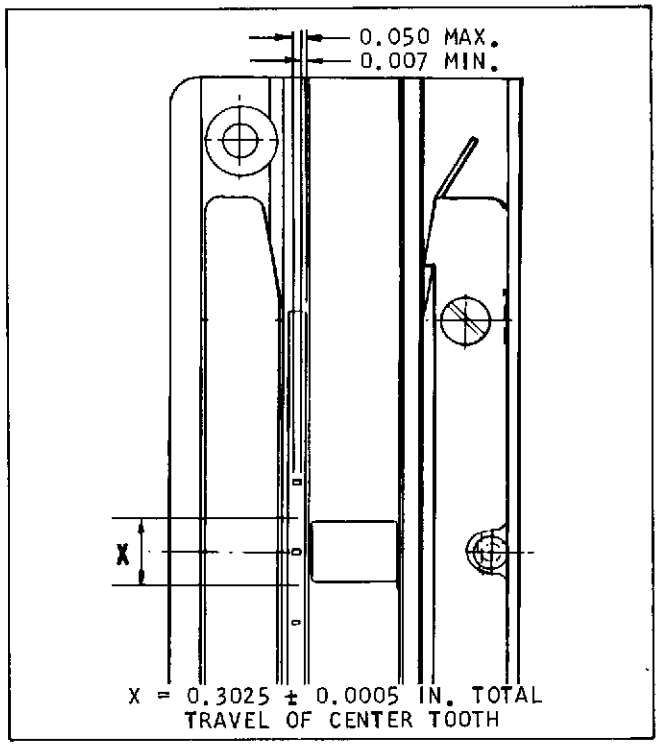


Figure L. Aperture Plate and Shuttle Tooth Clearances

7, Figure A) by its knurled handle and place it against the aperture plate between the rails. The center cars, on either side of the gage handle, are the height gages. Slowly slide the gage downward. The "Go" car should pass over the shuttle tooth without catching. Rotate the gage so that the "No-Go" ear is over the shuttle slot and once more slide the gage downward. The "No-Go" ear must not pass over the shuttle teeth. If the shuttle teeth are too high or two low, adjust height as follows.

NOTE: If the mechanism assembly is installed on the main frame, it will be necessary to open the lamphouse and remove the projection lamp (2, Figure 3), the condenser assembly (3), the lampholder (5) and the pulley shield (7) before proceeding.

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

(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.

(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 M) and shift the bracket slightly. Tighten the mounting screws securely and check and adjust shuttle tooth height as outlined above.

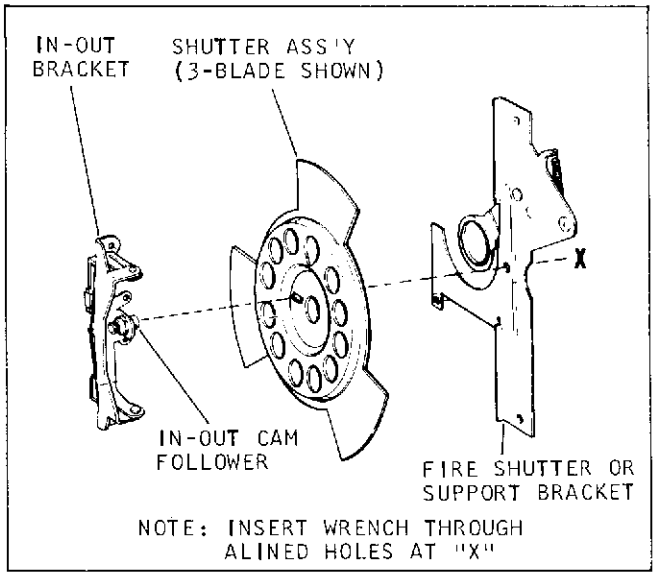


Figure M. Adjusting Shuttle Tooth Height

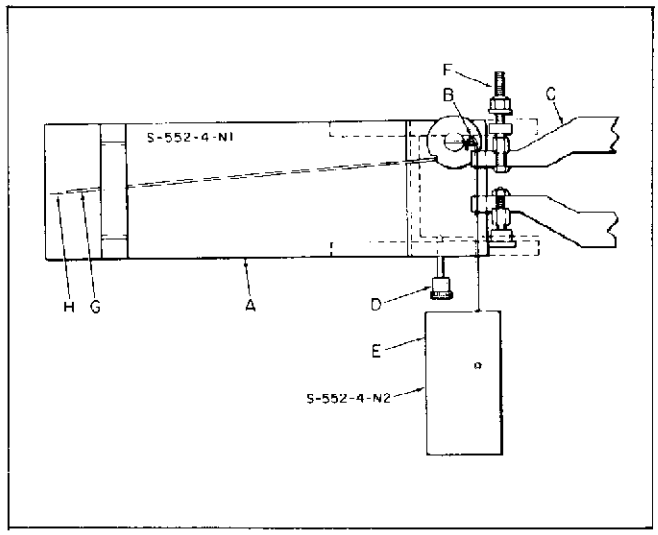


Figure N. Adjusting Fit of Shuttle Arms to Pull-Down Cam

c. Checking Fit of Shuttle Arms to Pull-Down Cam. (See Figure N.) Remove rear cover, projection lamp and blower belt.

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

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

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

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

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

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

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

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

(a) Remove pressure plate assembly (paragraph 28), condensing lens assembly and the motor drive belt (item 28, Figure 7).

(b) Reinstall blower belt and set framer at the mid-point of its over-all travel.

(c) Suspend 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) 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 film gate.

(f) Turn on the projector lamp and focus 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 P).

(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.

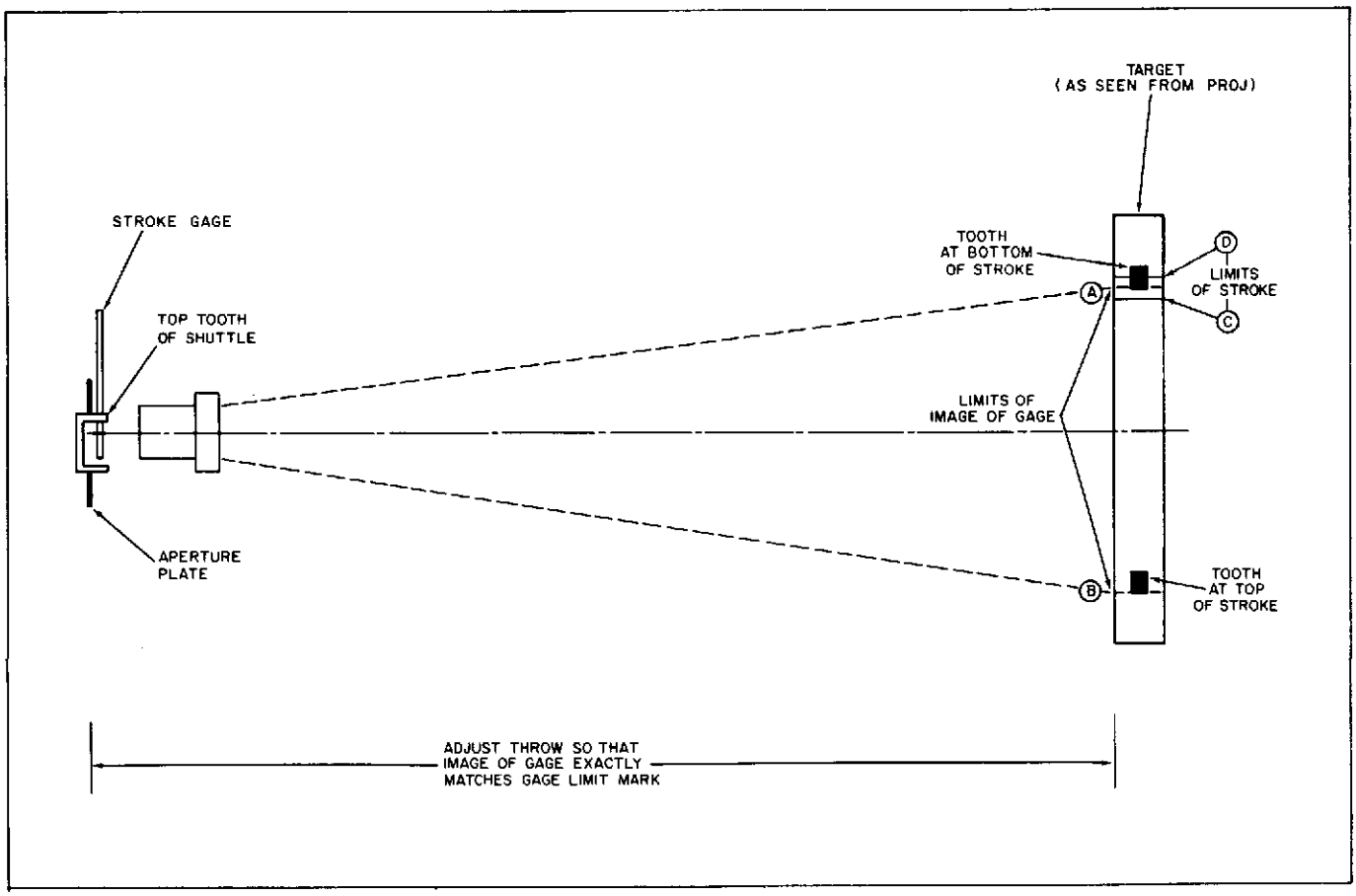


Figure P. Checking and Adjusting Shuttle Stroke with Target

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 P). 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 screws (Figure B) 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 65, 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 the 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.

66. LENS CARRIER ADJUSTMENT. Angular relationship between the lens carrier and the aperture plate is controlled by lens mount stop screw (item 31, Figure 16). 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. Note: 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.

67. ADJUSTING THE ANIMATION CLUTCH (MODELS 552 AND 552EX ONLY).

a. Checking Stop Pawl to Trigger Clearance. Rotate the mechanism by hand until the finger of the trigger is adjacent to the inner bent ear of the stop pawl as shown in View A, Figure Q. If the trigger fails to clear the stop pawl ear, adjust as follows.

(1) On projectors equipped with the solenoid-operated clutch and fire shutter system, loosen the clutch stop screws (item 35, Figure 17) and shift the clutch stop (item 36, Figure 17) up or down, as necessary, to obtain approximately 0.010 to 0.015-inch clearance between the stop pawl ear and the end of the trigger; then tighten the two clutch stop screws securely.

(2) On projectors equipped with the mechanically-operated clutch and fire shutter system, loosen the setscrew in the clutch rod collar (Figure Q, View A) and slide the collar upward, thus pivoting the stop pawl counterclockwise. When a clearance of 0.010 to 0.015-inch is obtained between the stop pawl ear and the end of the trigger, tighten the collar setscrew securely.

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

(1) Loosen the clutch strike screw (View B, Figure Q) 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 Q. Loosen the round Allen nut slightly and shift the shuttle adjustment bracket slowly toward the shuttle (to the right) until the shuttle teeth are retracted below the level of the aperture plate rails. Retighten the Allen nut.

(3) Refer to View D, Figure Q. Adjust the setscrew in or out to obtain a clearance of 0.094 inch between the left-hand ear of the clutch slide bar and the end of the setscrew.

(4) The shuttle interlock retainer is secured to the right end of the worm gear. Note, in View C, that the curved lip of this retainer must overlap the downward bent finger of

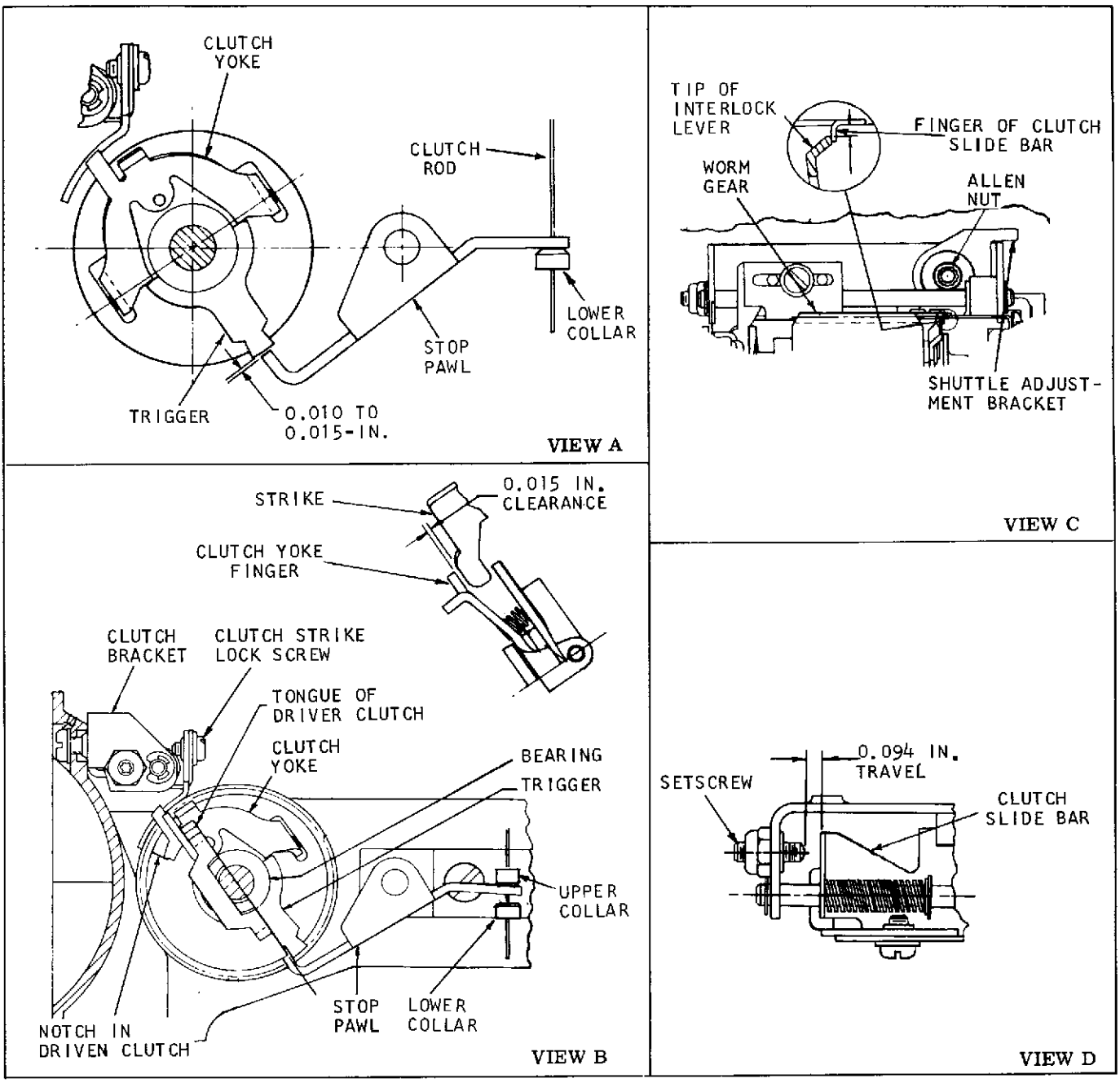


Figure Q. Animation Clutch Adjustments

the clutch slide bar. If necessary, bend this finger to obtain positive overlap as shown.

c. Adjusting Clutch Solenoid Linkage (Early Models). Refer to Figure 5 in the parts list section for the following adjustment procedure. The clutch stop pawl must be disengaged as shown in Figure Q, View A.

(1) Loosen the collar setscrews (1) so that both collars (2) are free on the clutch solenoid rod.

(2) Lift the clutch solenoid rod until the top of the solenoid plunger (6) is raised approximately 3/16 inch out of the solenoid frame. Hold in this position and slide the lower collar up against the stop pawl. Tighten the collar setscrew securely.

(3) Position upper collar so that distance from its top surface to bottom of lower collar is approximately 7/8 inch. This should provide sufficient compression of the spring (3) to prevent rattling.

(4) Start the projector and check the operation of the clutch. If the solenoid pulls in sluggishly, the plunger is set too high. Hold the solenoid rod and lower collar while loosening the collar setscrew. Lower the collar a fraction of an inch on the rod and retighten the setscrew. Then recheck clutch operation. If the solenoid produces a buzzing noise it is set too high (lower the bottom collar) or the spring is compressed too much (loosen upper collar setscrew and raise collar slightly). If the plunger seats fully but the stop pawl ear does not engage behind the trigger, the plunger is either set too low or the spring is not sufficiently compressed. Reset the collars accordingly.

d. Checking Clutch Mechanical Linkage (Current Models). Refer to Figure 6 in the parts list section for the following adjustment procedure.

(1) Rotate the projector Still-Run knob to the Run position and press down fully on the forward edge of the clutch lever (15) so that the clutch lever rod (4) moves downward to the limit of its travel.

(2) While holding the clutch lever depressed, rotate the mechanism knob and check to make certain that the ear of the stop pawl clears the trigger as shown in View A, Figure Q.

(3) Continue holding the clutch lever depressed and adjust the collar (3) beneath the stop pawl to obtain a clearance of 3/32-inch between the top of the collar and the underside of the stop pawl. Tighten the setscrew (2) securely.

(4) Rotate the Still-Run knob from Run to Still and back to Run, checking to see that the ear of the stop pawl engages behind the trigger in the Run position (View B, Figure Q) and clears the trigger in the Still position (View A, Figure Q).

68. ADJUSTING THE SOLENOID-OPERATED FIRE SHUTTER (EARLY MODEL 552 AND 552EX PROJECTORS). If the Model 552 or 552EX projector being repaired is equipped with the solenoid-operated fire shutter system, refer to parts list Figure 5 and adjust as follows.

a. Linkage Clearance. Turn mechanism pulley until one blade of interrupter shutter is adjacent to fire shutter rod (11). Check that rod clears interrupter shutter by at least 3/32 inch. If clearance is less than 3/32 inch, remove solenoid (15) and loosen two bracket retaining screws (16). Shift bracket to provide minimum link clearance of 3/32 inch, then tighten retaining screws securely and reinstall the solenoid.

b. Alignment. Open film gate and turn mechanism pulley until interrupter shutter clears aperture. Loosen two screws (13) which secure solenoid (15) to bracket (17). Place thumb of right-hand against outer end of solenoid frame and index finger on clevis at end of solenoid plunger. Note: Be sure to press on clevis, not on the linkage. Press solenoid against plunger. While looking straight into the aperture, position solenoid so that fire shutter covers aperture; then tighten screw (13) at outer end of solenoid bracket enough to hold solenoid in place. Release solenoid plunger and raise and lower the rod several times to make sure that the plunger slides freely in solenoid. Tip solenoid if necessary to free plunger, then tighten both retaining screws (13) securely.

69. ADJUSTING THE MECHANICALLY-OPERATED FIRE SHUTTER (CURRENT MODEL 552 AND 552EX PROJECTORS). When the projector has been completely assembled, install the projection lamp and lens and run the projector "forward" with the lamp on. Turn the Still-Run knob to the Still position and focus the image of the aperture on the screen. Check for full pattern of the fire shutter disc on the screen (image must show perforations of disc throughout). Note that a bent ear on the fire shutter bracket limits the travel of the fire shutter filter arm. If unfiltered light appears at the top or bottom of the aperture image, it will be necessary to bend this stop ear so that the amount of filter arm travel is increased or decreased accordingly.

70. ADJUSTING REEL ARMS AND REWIND CLUTCH.

a. Front Reel Arm Adjustment. (See Figure 9.) Adjust end play of drive shaft (22) to 0.008 inch ± 0.003 inch by positioning retaining ring (18) against an 0.008 inch shim. The backlash on the lower gear assembly (8) should be between 0.005 inch minimum and 0.018 inch maximum. Adjust by assembling, as required, a combination of 0.010 inch washers (9) and 0.005 inch washers (9B) on feed spindle assembly (10). Greater thickness in washer combinations reduces backlash.

b. Rear Reel Arm Adjustment. (See Figure 10.) Adjust end play of drive shaft (22) to 0.008 inch ± 0.003 inch by positioning retaining ring (9) against an 0.008 inch shim. The backlash on the upper gear assembly (25) should be 0.015 inch ± 0.003 inch. Adjust by increasing or decreasing a build-up of 0.005 inch and 0.0025 inch washers (26), as required, beneath the upper gear assembly (25). Greater thickness in washer combinations reduces backlash.

c. Rewind Clutch Adjustment. The rewind clutch system must be adjusted to produce a supply spindle torque of 5-1/2 to 6 inch-ounces 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 5-1/2 and 6 inch-ounces of torque. All clutch systems (Figures 2D, 2E and 2F) are adjusted in the same manner, by tightening (to increase torque) or loosening (to decrease torque) the hex adjusting nut on the outer end of the rewind sprocket (item 3). Hold the sprocket firmly and adjust the nut with an open-end wrench.

71. ADJUSTING THE SOUNDHEAD.

a. Removal. Due to the ease with which the soundhead can be removed and the greater accessibility thereby obtained, time will be saved by removing the soundhead if major work is required. Remove the soundhead as follows.

(1) Remove the projection lens from the projector. Note that the rear lens element is held in place with a retaining ring and can be replaced if necessary. Wrap lens in tissue paper.

(2) Disconnect photocell and exciter lamp cable from amplifier and release cables from retaining clips.

(3) Remove grounding spring (19, Figure 4). Insert the end of an Allen wrench or short steel pin in hole in sound drum bearing housing directly behind the flywheel until wrench or pin drops through hole in sound drum shaft. Hold the pin firmly and remove flywheel retaining nut (20, Figure 4), flywheel (21) and washer (22).

(4) With a sharp pencil, draw a line on the main frame where the front edge of the soundhead meets the frame. This will provide a reference mark with reassembling.

(5) Remove the three screws (23 and 24, Figure 4) which tap into the soundhead from rear of main plate, and carefully withdraw the soundhead.

b. Photocell Alignment. Early projector models were equipped with the photodiode type of photocell which is no longer available. Current projectors use the silicon photocell. The adjustment procedure for each is essentially the same and requires that the setscrews (items 18 and 19, Figure 13) be loosened and exciter lamp (8) and optical slit assembly (11) be removed.

(1) Silicon Photocell. Insert the alignment tool (item 13, Figure A) into the optical slit mounting hole as shown in Figure R, View A. Press the sound drum in until the inner face of the drum just contacts the first step of the alignment tool and tighten the sound drum screws (19 or 19A, Figure 13) securely. Withdraw the alignment tool and, while looking into the optical slot mounting hole, shift the photocell assembly until its forward tip is flush with inner face of the sound drum as shown in Figure R, View B. Tighten setscrew (18, Figure 13) securely. Reinstall the optical slit and exciter lamp.

(2) Photodiode Photocell. Insert the alignment tool (item 13, Figure A) into the optical slit mounting hole as shown in Figure R, View A. Press the sound drum in until inner face of the drum just contacts the first step of the alignment tool and tighten sound drum screws (19 or 19A, Figure 13) securely. Shift the photocell until its inner edge makes contact with the second step of the alignment tool. Tighten setscrew (18, Figure 13) securely and withdraw the alignment tool. Reinstall the optical slit and exciter lamp.

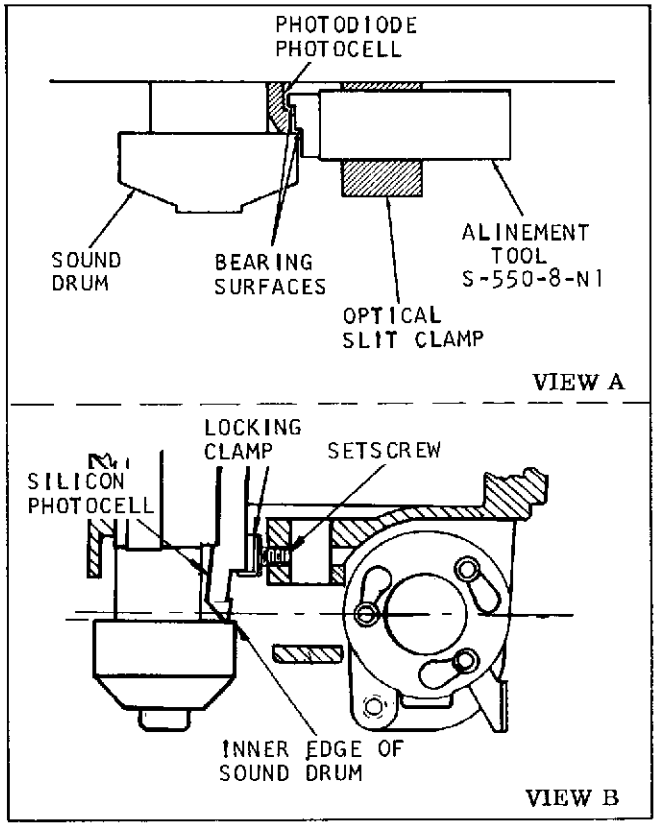


Figure R. Positioning the Sound Drum and Photocell (Both Styles)

c. Roller Arm Tension Adjustment. (See Figure 13). The arms upon which rollers (26 and 27) are mounted are linked by torsion spring (34 or 34A). Therefore the roller arms move as a pair. Counterbalance spring (28) offsets the weight of the rollers and arms. Place soundhead on a level surface and move roller arms (as a set) to various positions. If spring tension is incorrect, roller arms will not remain in the position in which placed. If roller arms swing downward, loosen retaining screw (29) and move spring terminal downward until weight of arms is counterbalanced. If roller arms move upward, move terminal upward to reduce counterbalancing force.

d. Optical Slit Adjustment. (See Figure 13.)

(1) Loosen the clamping screw (10). If the optical slit does not slide freely in its holder, insert a bit of a small screwdriver in the clamp slot and wedge clamp open to free optical slit assembly. Thread projector with 7000 CPS optical setting film and connect a 16-ohm, 10-watt load resistor and output meter to 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.

(2) 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.

e. Buzz Track Adjustment. The lateral position of the film in the soundhead is controlled by the flanged roller (26) and edge guide screw (23). Unless the adjustment has been disturbed, it is not probable that the edge guide screw (23) will require resetting. Thread the projector with buzz track film and adjust volume control to a suitable listening level. Turn adjusting screw (13) 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 (23) 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.

f. Installing the Soundhead (Figure 4). Lift the soundhead assembly up into place against the main plate, making certain that the cables are threaded through the hole and behind the plate. Loosely install the soundhead mounting screws (23) and (24). Align the front edge of the soundhead casting with the pencil mark drawn on the main plate prior to removal and tighten the mounting screws securely. Assemble the flat washer (22) and flywheel (21) on the sound drum shaft and install the flywheel nut (20) finger-tight. Insert a small diameter pin through the hole in the sound drum housing and rotate the drum until the pin drops into a similar hole in the shaft. Hold the pin securely and tighten the flywheel nut with an open-end wrench. Install the grounding spring (19). Check soundhead positioning as outlined in paragraph 78.

72. ADJUSTING TIMING BELT TENSION. Both timing belts are adjusted by means of the idler assemblies shown in Figure S. Although belt tension is not critical, excessive tension will reduce belt life. Loosen the rewind idler bracket screws (Figure S) and position the rewind belt idler until the rewind timing belt can be depressed at mid-point approximately 1/8-inch with light thumb pressure. Tighten the idler bracket screws securely. Loosen the take-up idler bracket screws and position the take-up belt idler until the belt can just touch the motor relay mounting bracket when light thumb pressure is applied to the belt. Tighten idler bracket screws securely.

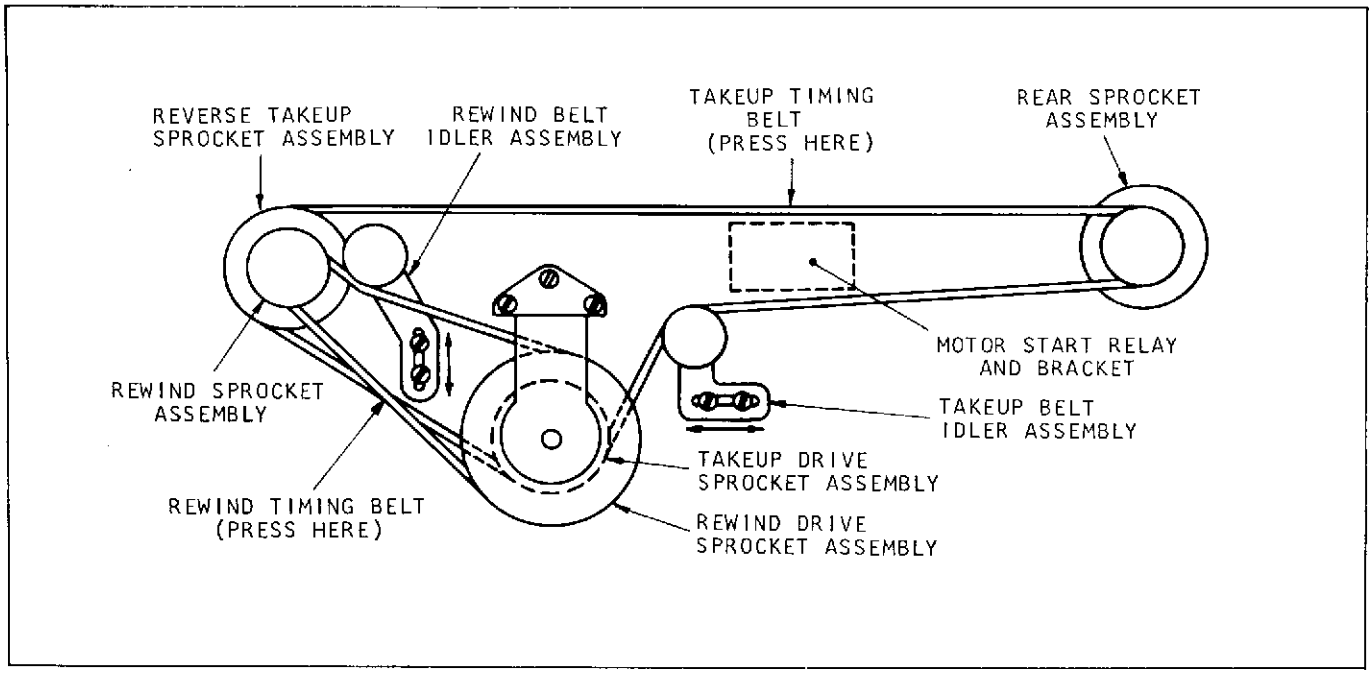


Figure S. Adjusting Timing Belt Tension

73. 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 ± 2%).
Shutter - 1440 RPM ± 2%
Sprocket - 102.86 RPM ± 2%

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

74. AUTO-LOAD SYSTEM ADJUSTMENTS — GENERAL.

a. The auto-load system consists of a series of guides and rollers which, when the system is in the load position, are so located as to guide the film through the threading path. When the system is in the open position, the guides and rollers clear the film path.

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

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

75. ADJUSTING THE LOADING GUIDES.

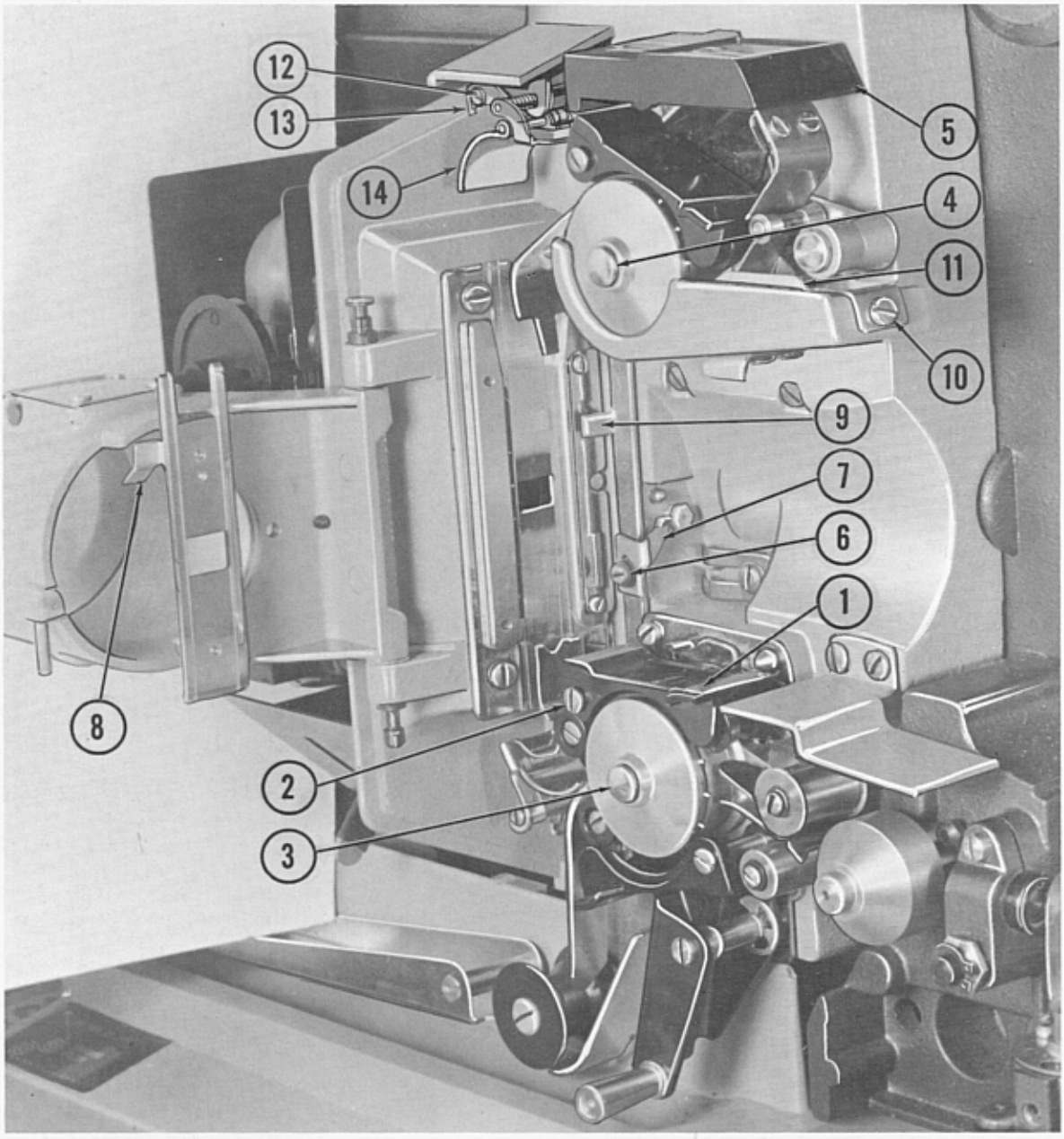
a. Open the film gage and upper take-up sprocket shoe (1, Figure T) and remove the retaining screw (2).

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

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

NOTE: Depress and hold the lower loop form assembly (4, Figure U) and check, at rear of mechanism, to see that the pin in the threading lever clears the bottom of the elongated slot in the loop form shaft link by approximately 1/64 inch. (See inset A below Figure T). If necessary, loosen the hex head screw that secures the threading lever and rotate the lever to obtain the proper clearance; then retighten the hex head screw.

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



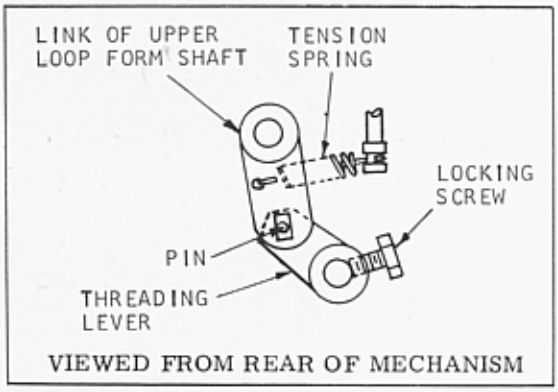


Figure T. Autoload System Adjustments — View I

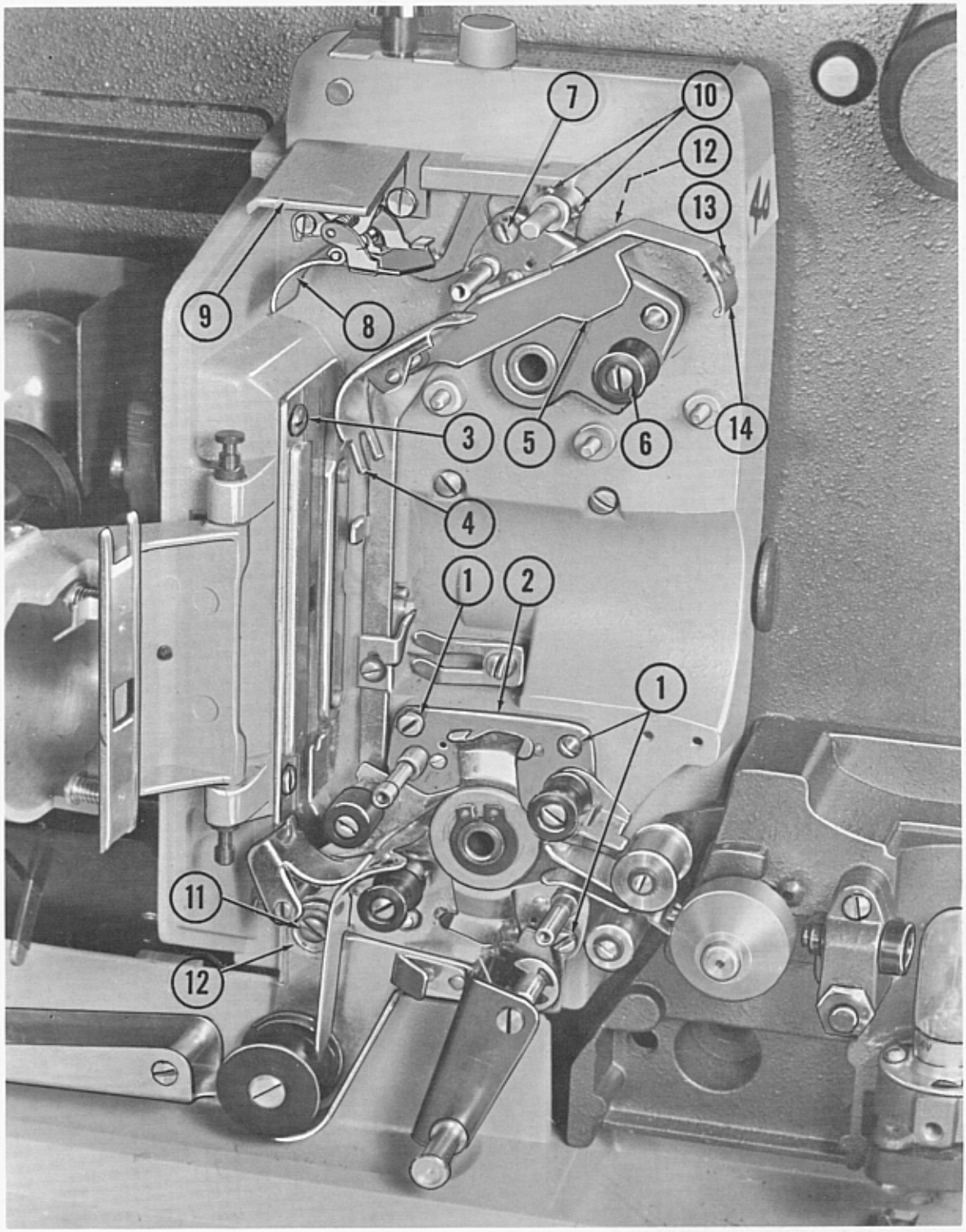


Figure U. Autoload System Adjustments — View II

screw (12, Figure T) holding the hub assembly to locking pawl and adjust the hub assembly until the tip of the bracket touches the upper curved surface of the loop former. This will lock kickplate in position.

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

f. With the auto-load system locked and film gate open, check to make certain that the shuttle teeth do not protrude through the slot in the aperture plate. If shuttle teeth protrude, loosen screw (6, Figure T) and carefully raise the shuttle retractor (7) until teeth are retracted; then tighten screw (6) securely. Caution: The top end of the shuttle retractor must not strike the casting.

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

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

i. Loosen screw (11, Figure U), lock the system, and check to make certain that loop form heel (5) is bearing on shoulder of roller stud (6). If necessary, rotate the eccentric pivot (12) with a wire pick or pin punch until heel bears against stud shoulder. When loop form is pressed downward, there must be no clearance between heel and stud shoulder. Recheck clearance between rear of loop form and aperture rails (step c, preceding). Also, make certain that end of upper loop form (8) is tangent to or slightly ahead of the plane of the aperture plate film support rails. If readjustment is necessary, refer to steps c through e, preceding.

j. Install actuating assembly (5, Figure T) and press it down to make certain that system does not lock. If system locks when actuating assembly is depressed, remove the assembly and raise the setscrew protruding up from boss in casting. This setscrew acts as a stop for the actuating assembly. When the height of the setscrew is properly adjusted, seal setscrew with shellac or cement and reinstall actuating assembly with retaining ring. This setscrew is provided only on those projectors not equipped with the film escape mechanism.

k. Lock the system and try to insert film into the feed sprocket. If film slips in too freely, loosen the two screws (13, Figure U) and move leaf spring (14) downward to increase pressure on the film. If film buckles as it is inserted, move leaf spring upward to reduce pressure; then tighten screws (13).

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

a. Slip the loop restorer position tool (item 8, Figure A) over the loop restorer roller (1, Figure V) with the flat on the tool facing the guide roller at the rear end of the upper sprocket shoe (6, Figure V). The flat of the tool should just touch the guide roller lightly. To adjust spacing between loop restorer roller and guide roller, loosen the mounting screws in the self-centering assembly (inset A, Figure V) and raise or lower that assembly until the proper spacing is obtained. Then tighten the mounting screws securely. Be sure that the ear of the loop restorer arm is positioned between the two spring-loaded keeper plates of the self-centering assembly.

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

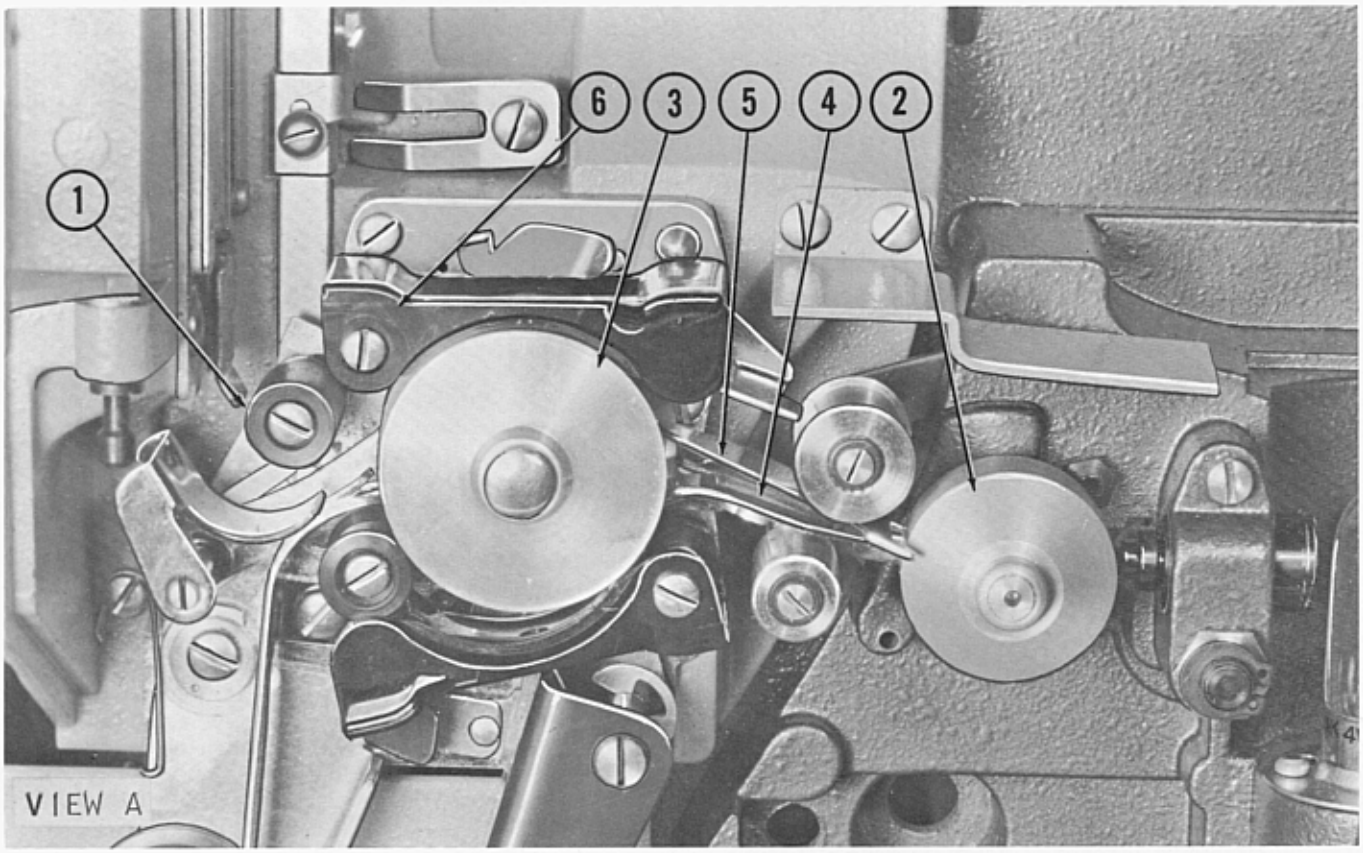
77. TIMING THE SPROCKETS.

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

c. Open the film sprocket shoes and place the timing plate (item 11, Figure A) over the sprocket hubs (see inset C, Figure V). 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 teeth back in line with peep holes; then proceed as follows:

NOTE: In the most recent projectors, the upper sprocket is pressed on the sprocket shaft and is retimed in the same manner as the lower (take-up)



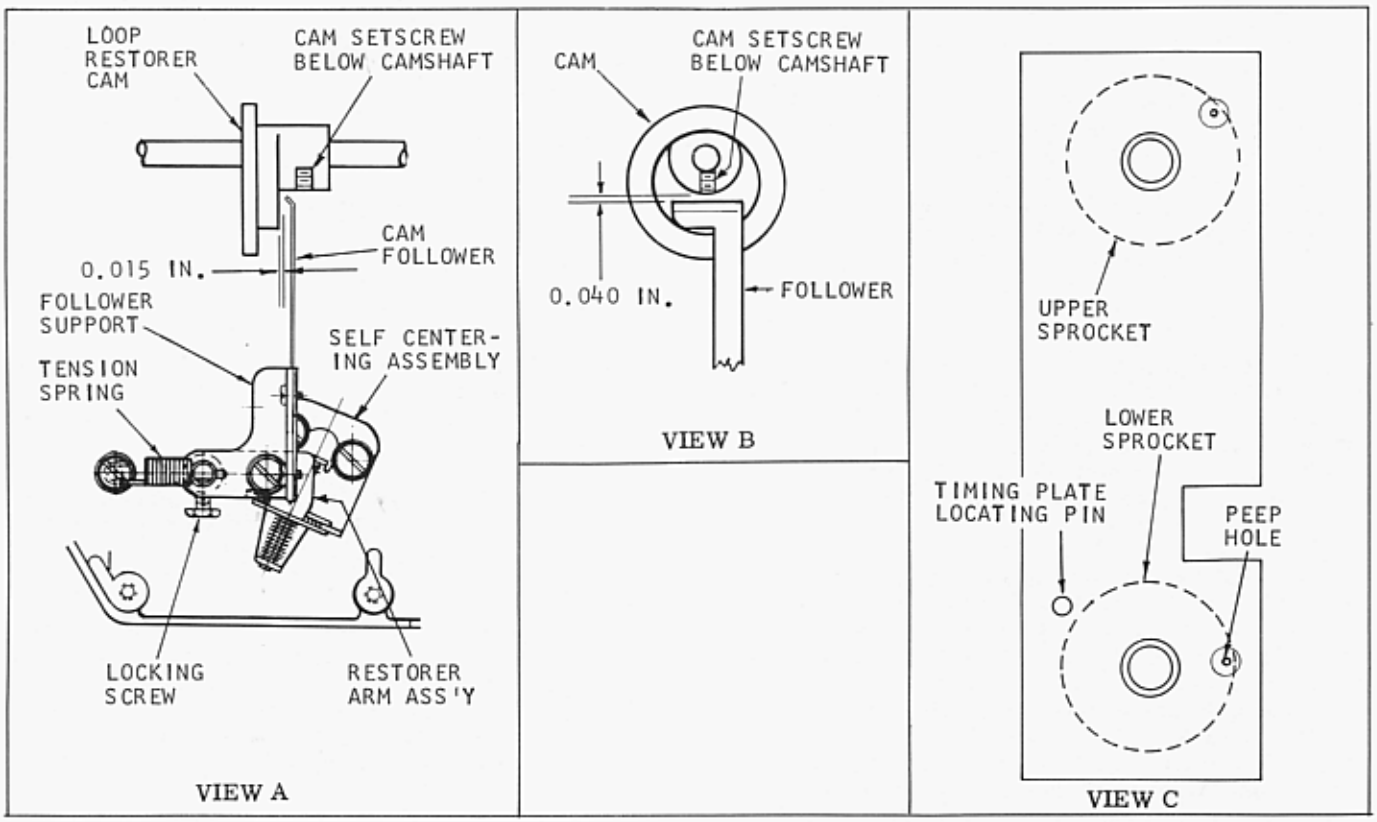


Figure V. Autoload System Adjustments — View III

sprocket (step e, following). In earlier projectors, the upper sprocket is secured to the shaft with two setscrews and these setscrews, in turn, are locked with two more setscrews. Retiming of this earlier sprocket is covered in step d, following.

d. To retime the feed (upper) sprocket on earlier models, remove the sprocket shoe. Remove the two sprocket setscrews to expose the inner setscrews and loosen the inner setscrews. Rotate the sprocket until the pencil mark appears in the upper peep hole. Then tighten all four setscrews securely.

e. To retime the feed (upper) sprocket on the latest models (see Note following step c, above), hold the large sprocket gear at the rear of the upper sprocket shaft stationary while loosening its setscrews; then carefully rotate the upper sprocket until the pencil mark appears in the center of the upper peep hole. Tighten the sprocket gear setscrews securely. To retime the take-up (lower) sprockets on all projectors, hold the lower sprocket gear stationary and loosen its setscrews; then rotate the lower sprocket until its pencil mark appears in the center of the lower peep hole and tighten the sprocket gear setscrews securely.

78. POSITIONING THE SOUNDHEAD.

a. Lock the system in the "thread" position and loosen the three screws (23 and 24, Figure 4) which attach the soundhead to the main frame casting.

b. Hold the soundhead locating gage (item 12, Figure A) by its handle and insert the gage carefully between the sound drum and take-up sprocket as shown in Figure W. The gage must be between the sound drum threading guides. Position the gage so that one end bears against the supporting ribs for the sound track edge of the film and with the round body of the gage in contact with the rear sprocket flange, as shown.

c. 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.

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

80. TESTING THE AMPLIFIER. Amplifier test points locations are indicated in Figure X. Observe the following test conditions during the tests.

TEST CONDITIONS:

Line voltage 120V 60 CPS

Oscillator generating 400 CPS, properly loaded and coupled to photocell input thru a 0.5 mfd capacitor.

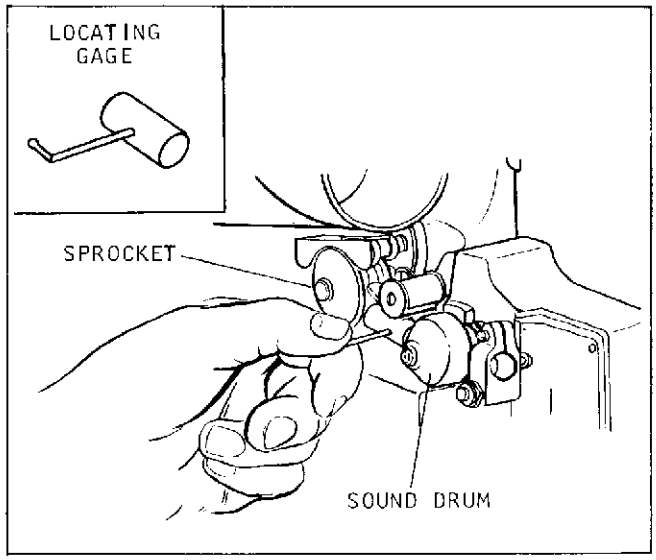


Figure W. Positioning the Soundhead Assembly

Input voltage at photocell terminals 0.1V R.M.S.

Volume control set to produce 7.5 volts (approximately mid-point) across 16 ohm load.

All signal voltages measured with high impedance VTVM.

All voltages measured to B - (Amplifier Ground).

Tone control in "Normal" position.

Tube	Pin Number and Voltages							
	1	2	3	4	5	6	7	8
V-1	0.12	0.09	0.09	-	-	4.85	*	0.02
V-2	7.65	0.12	0.97	-	-	7.35	*	7.9
V-3	0.12	-	-	-	7.2	-	61	-
V-4	0.12	-	-	-	7.3	-	61	-

*Essentially equal to voltage at preceding plate.

Voltage measured should be within approximately ± 20 percent of values shown on chart.

81. CORRECTING FOR REDUCED VOLUME FROM THE AMPLIFIER. When customer complaint indicates a gradual reduction of amplifier volume, it may be due to deterioration or weakness in the Type 25C5 tubes. On earlier projector models, this trouble usually can be corrected by replacing the 590 K-ohm grid resistors R18 and R20 with 220 K-ohm resistors P/N 34840, or by installing a 470 K-ohm resistor in parallel with each of the existing resistors. See Figure Y for the location of these resistors on the amplifier.

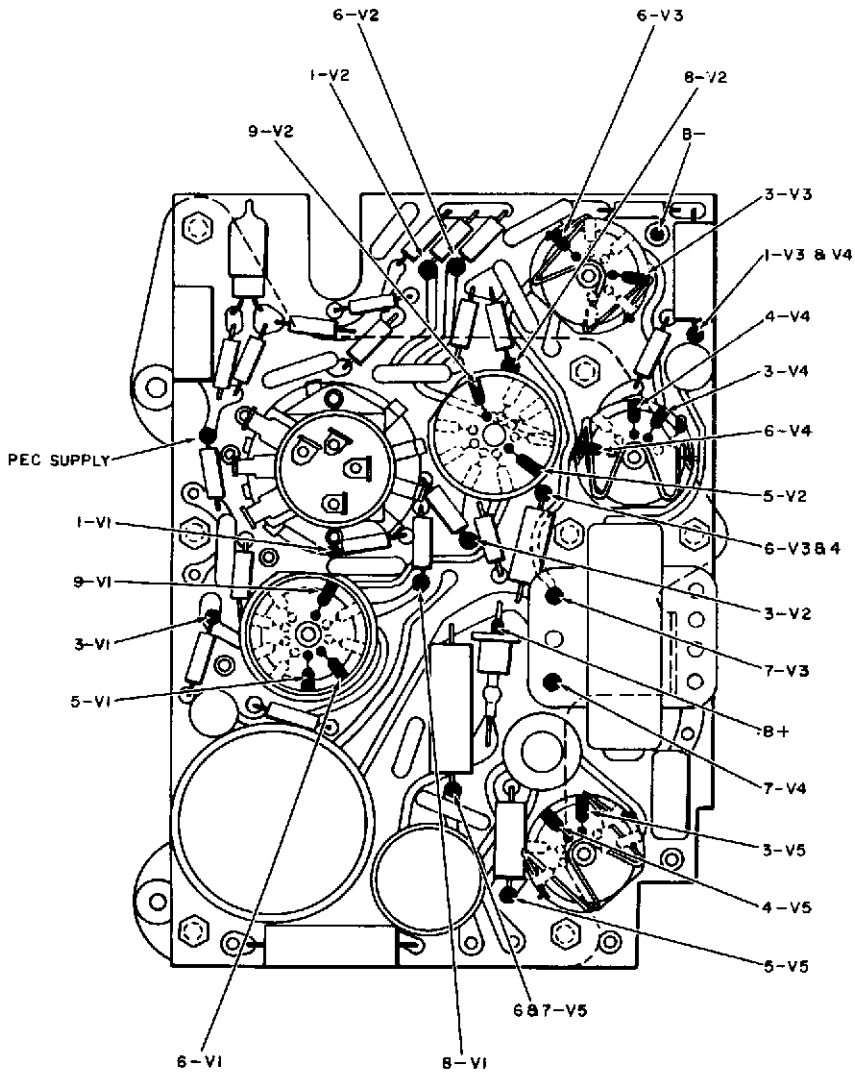


Figure X. Location of Amplifier Test Points

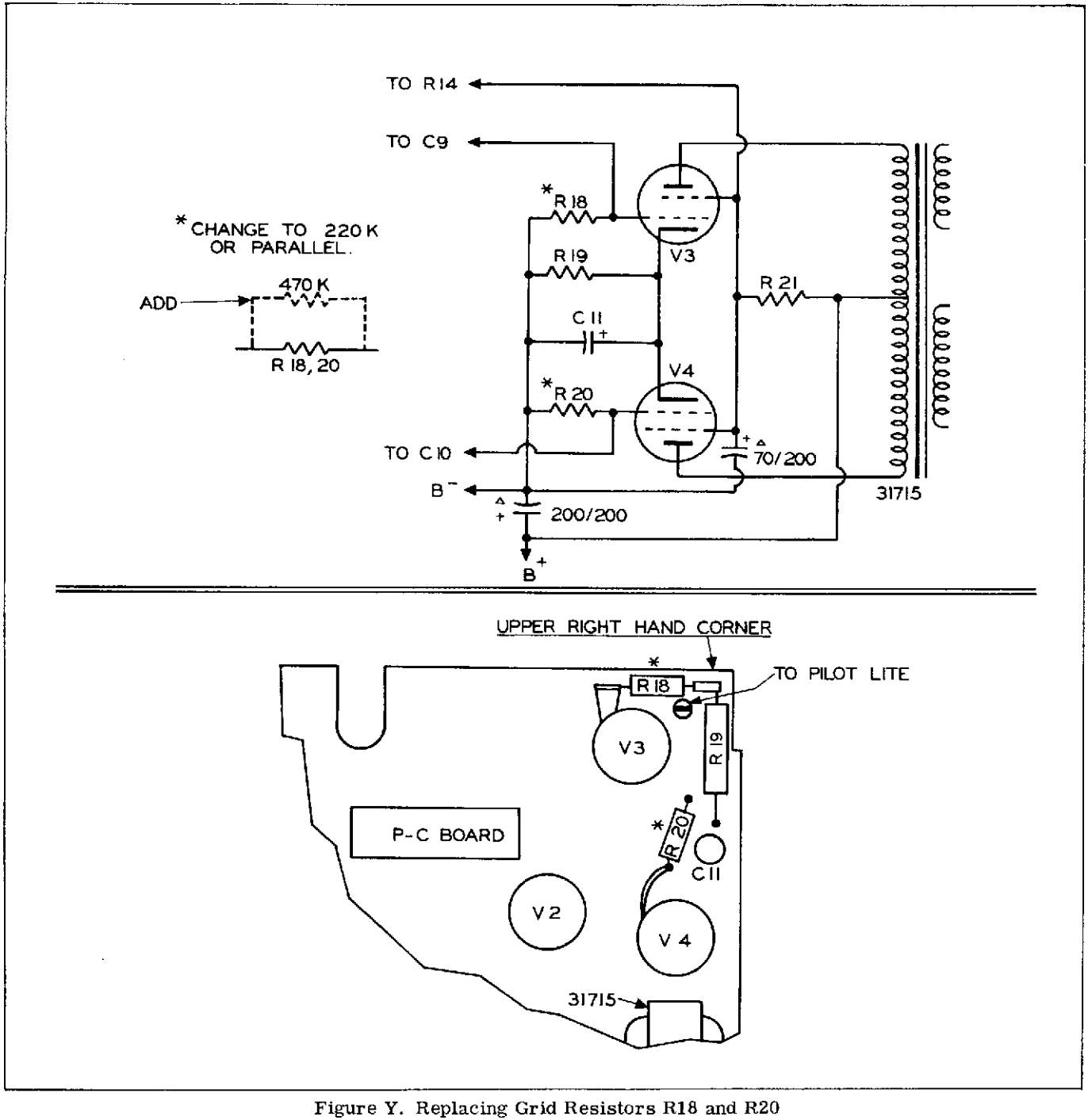


Figure Y. Replacing Grid Resistors R18 and R20

Modifications

82. INSTALLING MIC-PHONO ADAPTER KIT.

The Mic-Phono Adapter Kit can be installed on Filmosound Projectors equipped either with the germanium photodiode or with the silicon photocell and its associated preamplifier. Preliminary installation procedures (paragraph 83) and final installation procedures (paragraph 86) are applicable to all Filmosound Projectors. Special wiring procedures for projectors equipped with the germanium photodiode are covered in paragraph 84, while those for silicon photocell projectors are covered in paragraph 85. Therefore, for projectors equipped with the germanium diode photocell, follow the procedures outlined in paragraphs 83, 84 and 86; for those equipped with the silicon photocell, follow paragraphs 83, 85 and 86.

To make the adaption, the following parts must be ordered from the Bell & Howell General Service Dept.

Part No.	Description	Qty
011931	Mic-Phono Adapter Assembly	1
011932	Cover and Mounting Plate Assembly	1
31928	Screw, Binding head	3
32099	Connector, Dual, spade type	1
36505	Screw, Hex head self-tapping	4
36519	Nameplate	1
31666	Soldering lug	2

83. PRELIMINARY INSTALLATION PROCEDURES.

a. Remove the projector rear cover and discharge the motor start capacitor. This must be done to avoid possible injury from electrical shock.

b. Refer to the proper projector wiring diagram (Figures 28, 30 or 32) and make the following wiring changes to the switch (right center of diagram).

(1) Disconnect the red lead from terminal 2L1.

(2) Disconnect the black lead (coming from the 100-ohm heater dropping resistor) from terminal 2C.

(3) Install the push-on type dual connector from the adapter kit on terminal 2C so that the dual terminals point inward. It may be necessary to straighten the other connector on terminal 2C in order to obtain the necessary clearance for the dual connector.

(4) Reconnect the black lead to one of the dual connector terminals and the red lead to the other dual connector terminal. There now should be two black leads and one red lead connected to terminal 2C.

c. Remove the sound drum grounding spring and the flywheel from the projector. Note: If spacing washers have adhered to the hub of the flywheel, transfer them to the shaft and reinstall the flywheel retaining nut to prevent their loss.

d. Remove the cable retaining clip located on the projector base directly below the speaker, and save the clip for future use.

NOTE: If your projector is equipped with the germanium photodiode, complete the mic-phono adapter installation by following the instructions in paragraphs 84 and 86. If your projector is equipped with the silicon photocell, follow the instructions in paragraphs 85 and 86.

84. SPECIAL WIRING PROCEDURES FOR GERMANIUM PHOTODIODE PROJECTORS.

a. Note the terminal of the photodiode to which the pigtail from the photocell cable shield is attached and place a minus (-) mark adjacent to that terminal. Disconnect and remove the photocell cable.

b. Locate resistor R3 by referring to the proper amplifier schematic diagram. Remove this resistor by cutting its leads with a long-jaw, end-cutting pliers (Klein #204-6-C, Krauter #CG1650, or equal).

c. Note, in Figure Z, that the adapter wiring consists of a yellow lead, a red lead, a long shielded lead and a short shielded lead. The short shielded lead is equipped with spade-type connectors which must be replaced by the lug type terminals (part no. 31666) supplied with the kit. Cut the pigtail of the shield (A) to a length of 3/4-inch and the core wire (B) to a length of 1/2 inch and install the lug type terminals. Connect this shielded lead to the photodiode terminals.

NOTE: The shield pigtail must be connected to the terminal marked minus (-) in step a, and the lead must be positioned so that the pigtail cannot touch other projector parts.

d. Temporarily disconnect the white lead from the top terminal of the volume control switch and push the lead back over the blower housing. Solder the red adapter lead to the amplifier terminal which serves as a junction for resistors R1 and R2 (this is the terminal from which the upper lead of R3 was detached in step b). Reconnect the white lead to the top terminal of the volume control switch and dress

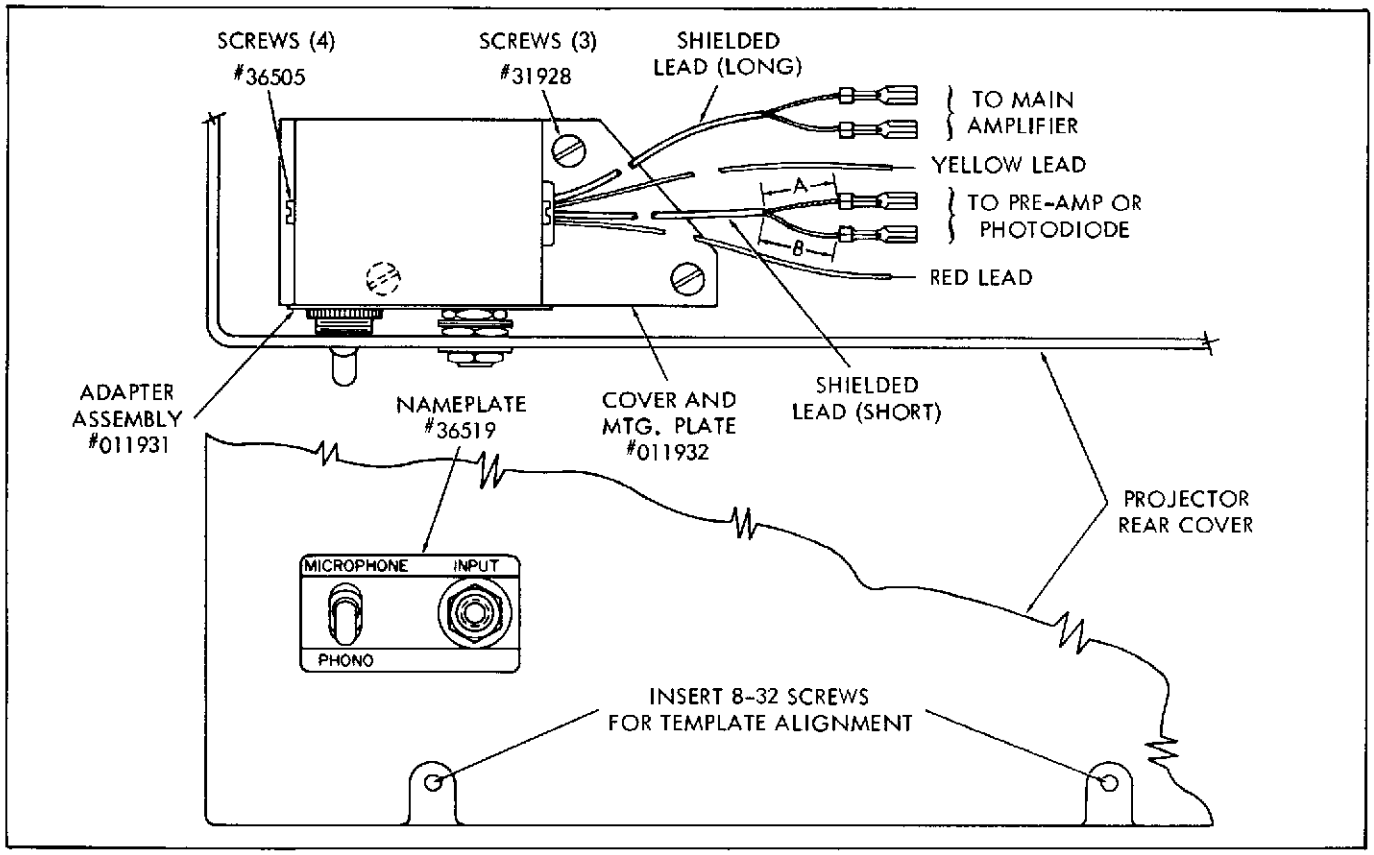


Figure Z. Mic-Phono Modification, Parts Installed

the red lead down along the rear end of the blower housing.

e. Remove the 25C5 tube located directly above the output transformer and the 12AX7 tube which is adjacent to the 25C5. Dress the yellow lead to the adapter up along the rear end of the blower housing and pass it between the main projector switch and the tone control switch. Solder this lead to the tone control switch terminal to which another yellow lead already is attached. Reinstall the two tubes.

f. Connect the remaining (longer) shielded lead of the adapter to the amplifier photocell input. Be sure to observe proper polarity.

g. Secure long shielded lead and red and yellow leads to the projector base with the cable clamp located adjacent to the blower housing. Then complete the installation as instructed in paragraph 86.

85. SPECIAL WIRING PROCEDURES FOR SILICON PHOTOCELL PROJECTORS.

a. Disconnect and remove the shielded lead which connects the preamplifier to the input of the main amplifier.

NOTE: The pigtail from the shield of the photocell cable is soldered to the ground connector of this preamplifier-to-main amplifier lead. Carefully separate the ground connector from the preamplifier terminal. Hold pigtail with a long nose pliers while unsoldering pigtail of photocell lead from ground connector.

b. Note, in Figure Z, that the adapter wiring consists of a yellow lead, a red lead, a long shielded lead and a short shielded lead. The red lead can be removed and discarded, since it is not required for installation in silicon photocell projectors.

c. The short shielded lead of the adapter must be connected to the output terminals of the preamplifier. Before making these connections, tin a spot on the shank of the ground connector referred to in the Note following step a, preceding. Press the lead connectors onto the output terminals of the preamplifier; then loop the pigtail of the photocell cable shield around the shank of the ground connector and spot solder the pigtail securely. Hold the ground connector with a long nose pliers to prevent over-heating.

d. Connect the spade type terminals of the longer shielded adapter lead to the input terminals of the main amplifier. Be sure to observe proper polarity.

e. Remove the 25C5 tube located directly above the output transformer and the 12AX7 tube which is adjacent to the 25C5. Dress the yellow lead of the adapter up along the rear end of the blower housing and pass it between the main projector switch and the tone control switch. Solder this lead to the tone control

switch terminal to which another yellow lead already is attached. Reinstall the two amplifier tubes.

f. Secure the long shielded lead and yellow lead to the projector base with the cable clamp located adjacent to the blower housing. Then complete the installation as instructed in paragraph 86.

86. FINAL INSTALLATION PROCEDURES.

a. Reinstall the projector flywheel and flywheel nut.

b. Remove the cover and mounting plate assembly from the adapter kit and position it over the three holes in the projector base. Dress the leads to the soundhead and to the preamplifier (or to the germanium photodiode, as the case may be). The leads must lie flat on the projector base (no crossovers permitted) and must pass between the front and rear stand-off bushings of the adapter cover and mounting plate assembly.

NOTE: Carefully pull the speaker cable outward so that it will not be under the cover and mounting plate assembly.

c. Install one of the three kit screws (part no. 31928), through the stand-off bushing marked "A" in Figure AA, and tighten screw finger-tight. Slip the mounting foot of the sound drum grounding spring between the rear stand-off bushing and the hole marked "B" and install the second screw. Install the cable clip (removed in paragraph 83, step d) on the last screw and install this screw in the remaining stand-off bushing. The clip should point toward the projector mechanism plate. Carefully align the adapter cover and mounting plate assembly with the rear edge of the projector base and tighten all three screws securely.

d. Insert the adapter assembly (part no. 011931) into the cover and mounting plate assembly and secure it in position with the four screws (part no. 36505). Dress all leads away from the flywheel, with the speaker cable running across the top of the cover and mounting plate assembly and down the side of the cover to join the adapter leads. Secure all leads against the projector base by bending over the cable clip installed in step c, preceding.

e. Before proceeding, check the installation at this stage to make certain that all wiring connections have been properly made. This can be done as follows:

(1) Temporarily install the long case cover screw to activate the projector safety switch. Then connect the projector to the power supply and turn on the projector volume control.

(2) Press the adapter toggle switch upward (to MICROPHONE position) and plug a high impedance microphone (such as the Bell & Howell part no. 29316) into the input jack.

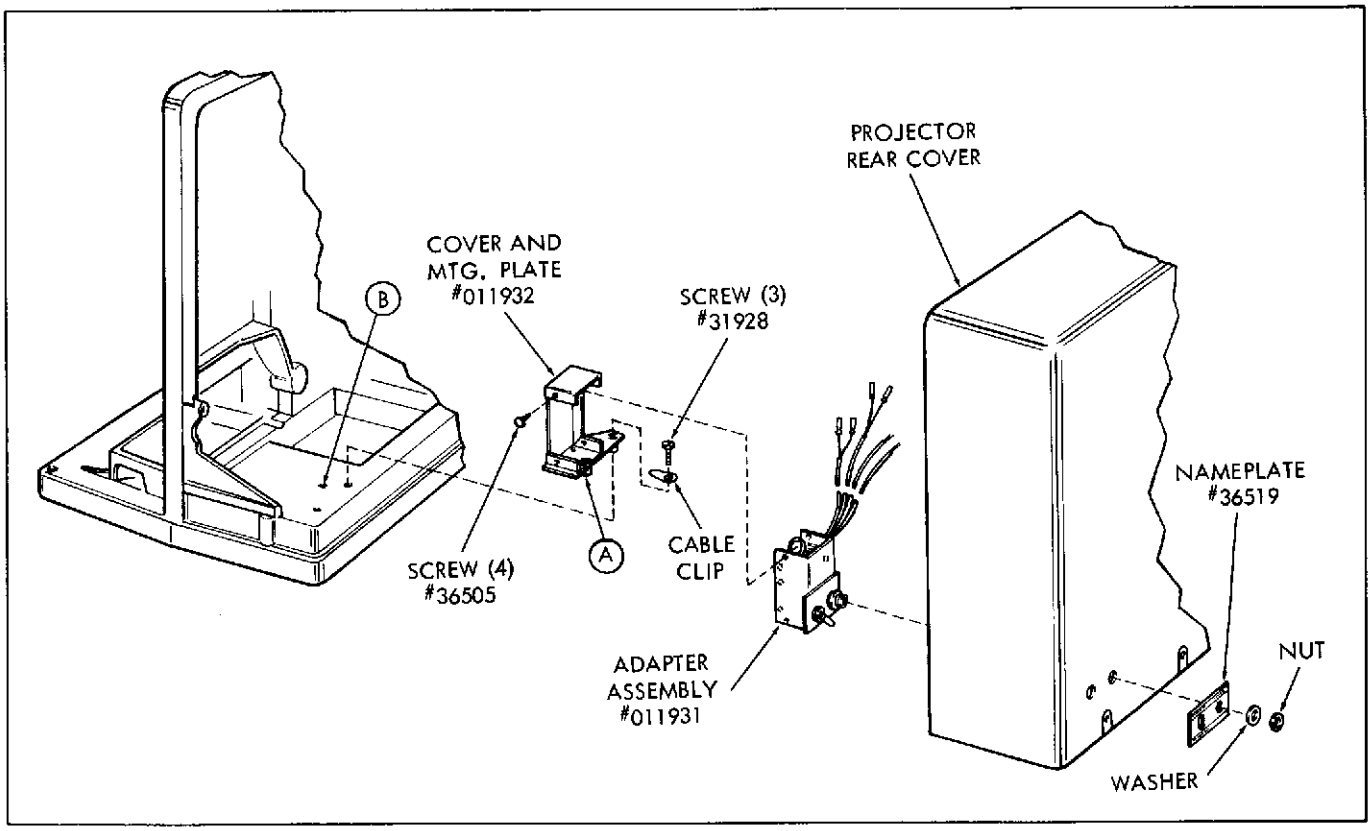


Figure AA. Location of Adapter and Cover on Base

Hold or place the microphone at a spot five to six feet away from the projector speaker and gradually advance the projector volume control. Depending upon the sensitivity of the microphone and its relative position with respect to the speaker, acoustical feedback should occur when the volume control is somewhere between 9 and 2 o'clock.

(3) Press the adapter toggle switch downward to PHONO position) and continue to advance the projector volume control. Acoustical feedback now should occur near the maximum volume position.

(4) If the system checks out as noted above, disconnect the microphone and projector power cord and remove the long case cover screw used to activate the safety switch. Then discharge the motor starting capacitor. If the system does not perform in the prescribed manner, recheck all connections (Figure AB) for possible shorts and grounds.

f. Insert two 8-32 by 3/4-inch machine screws through the two mounting holes in the rear projector cover (see Figure Z), with the screw heads on the inside of the cover. Install two 8-32 nuts finger-tight so that the screws do not wobble.

g. Remove the drilling template (Figure AC). Push the point of a pencil through the centers of the two small holes in the template, rotating the pencil carefully until the holes are enlarged to the size of the printed circles. Carefully install the template on the two 8-32 machine screws installed in step f, preceding. Smooth the template down against the surface of the rear cover and, with a center punch, mark the centers of the two larger holes in the template.

NOTE: If Service Stations anticipate several of these installations, it may be convenient to make a sheet metal template. Drill the two smaller holes with a #19 drill and install two 8-32 by 3/4-inch screws to serve as alignment pins. Use a #40 or #50 drill (depending on the thickness of the sheet metal) to drill the center-punch holes for the larger two holes in the template.

h. Remove the template and the 8-32 screws and nuts from the rear cover and drill the two 1/2-inch diameter holes in the rear cover. Remove the top nut and washer from the jack in the adapter assembly and install the rear projector cover. Check to make certain that the jack protrudes through its hole in the cover and that the adapter toggle switch does not strike the edge of its hole in either position. If interference is encountered, remove the projector rear cover and loosen the three screws that secure the adapter mounting plate to the projector base. Shift the mounting plate to eliminate the interference and retighten the screws.

i. Install the rear cover with its attaching screws. Activate the adhesive on the back of the adapter nameplate (part no. 36519) with toluol and install the nameplate so that its bottom edge is parallel with the bottom of the rear cover. Install the washer and hex nut on the adapter jack.

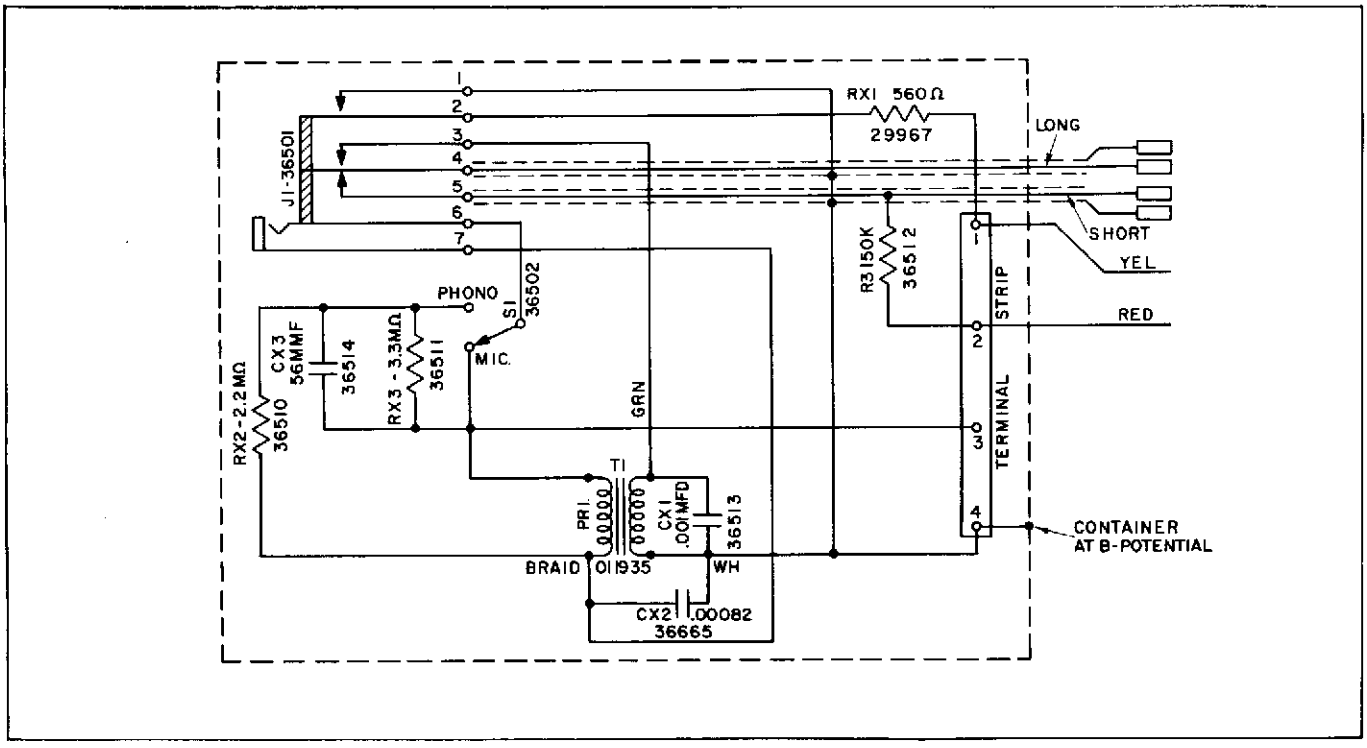


Figure AB. Mic-Phono Modification Wiring Diagram

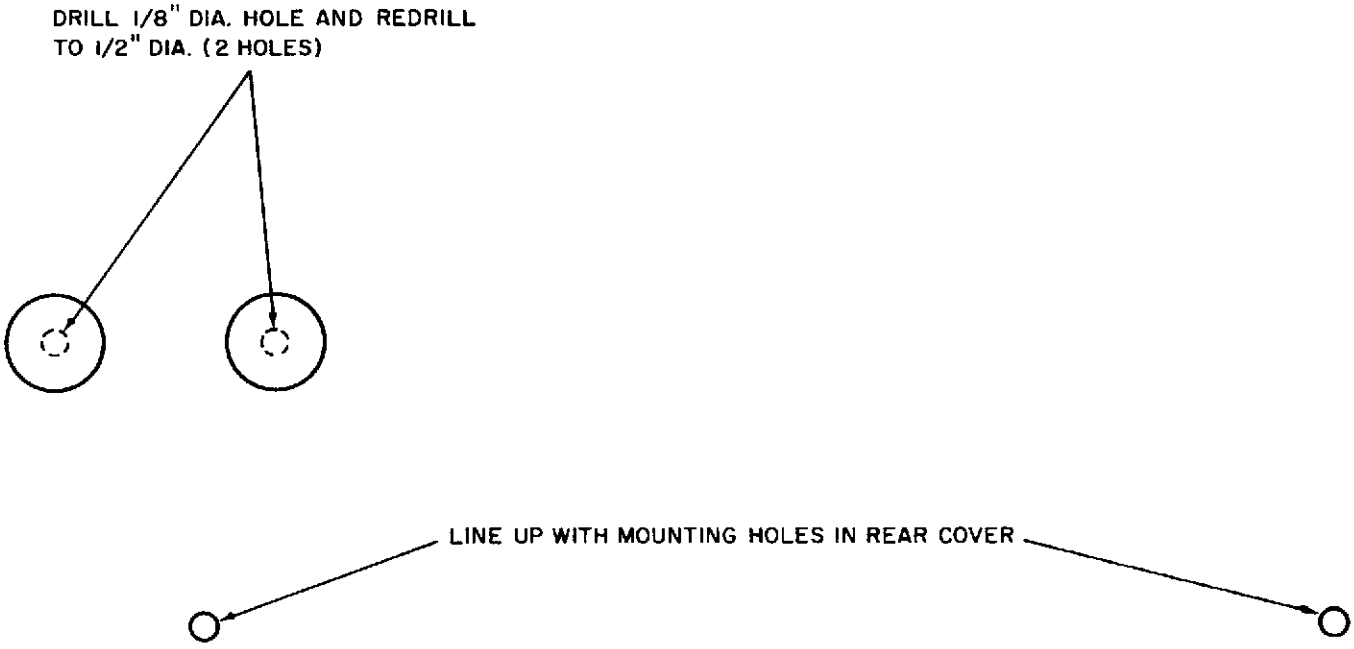


Figure AC. Template for Drilling Rear Cover Holes

j. Connect projector to the power supply and check with microphone to make certain that the system operates properly. Also, check operation with film.

87. MODIFYING PROJECTORS WITH FILM ESCAPE MECHANISM.

This modification requires the complete disassembly of the upper film sprocket area in order to remove the existing upper loop form and replace it with the new loop form and associated parts. The installation of the film escape mechanism is earlier model Filmosound projectors is a major service operation and requires one each of the following parts.

Film loop exit assembly (part no. 012563) (items 4 through 12, Figure 16).

Actuator Assembly (part no. 012135) (item 13, Figure 15).

Hood (part no. 42232) (item 15, Figure 15).

a. Remove the complete mechanism assembly (item 30, Figure 4) as instructed in paragraph 12.

b. Refer to Parts Catalog Figure 14. Remove three screws (17) that attach the outboard bearing assembly (20) to the mechanism casting. Remove the two retaining rings (18), withdraw the clutch lever shaft (19) and lift off the outboard bearing assembly. Remove the retaining rings (25) from the upper sprocket shaft and withdraw the rewind drive sprocket (26), flat washer (27), spring (28) and spline driver (29) from the shaft. Disconnect the forked end of the rewind clutch lever (21) from the rewind button (22) and remove the button and spring (23).

c. Loosen two setscrews (30) and withdraw take-up drive sprocket (31) from the shaft. Remove two screws (32) and disassemble the sprocket guard assembly from the mechanism casting. Remove the retaining ring (12) and lift off the actuating assembly (13). Remove two screws (14) and the hood (15). The actuating assembly and hood will be replaced by new parts and can be discarded or stocked for future repairs.

d. Inspect the upper sprocket guard (35), noting the manner in which the torsion spring (37) is installed. Remove the sprocket guard (35), roller (36) and spring (37). Loosen upper sprocket gear setscrews (38) and remove the sprocket gear (39) and washer (40). Rotate the sprocket until the notch in its rear flange clears the film guide on the lower loop form assembly (item 34, Figure 15) and remove the sprocket assembly (item 41, Figure 14) and its thrust washer (44).

e. Refer to Parts List Figure 15. Remove the screw (1) and upper guide roller (2) from the sprocket guard plate (36).

f. Refer to Parts List Figure 16. Loosen the setscrews (4) that secure the early style loop form (part no. 011949) to the shaft assembly (25). Withdraw the shaft assembly slightly without disconnecting the spring (24).

g. Refer to Parts List Figure 15. Loosen the screw (31) in the threading lever (32), and remove the lower

loop form retaining ring (33). Remove the threading lever (32) and partly withdraw the lower loop form (34) from the upper shaft of the connecting link assembly (41). Remove the screws (35) and raise the sprocket guard plate (36) until the early style upper loop form assembly can be removed. This loop form can be discarded.

h. Install the new film loop exit assembly (part no. 012563) onto the shaft assembly (25, Figure 16) and tighten the setscrews (4) just enough to hold. Refer to Figure 15 and refasten the sprocket guard plate (36) with its screws (35). Press the shaft of the lower loop form (34) into the casting with the ears of the loop form over the upper shaft of the connecting link (41). Install the retaining ring (33) and secure the threading lever (32) to the flat of the loop form shaft with the screw (31). Be sure that the pin of the threading lever engages the slot in the shaft and link assembly (25, Figure 16). Install the film roller (2, Figure 15) and screw (1).

i. Refer to paragraph 48 and Parts List Figure 4 for reassembly of sprocket, sprocket guards, gears, and sprocket parts.

j. Refer to paragraph 58 for instructions regarding reassembly of the complete mechanism to the projector. Then perform the following alignments and adjustments.

(1) Clutch linkage (paragraph 67).
(2) Fire shutter (paragraph 68).
(3) Rewind clutch (paragraph 70, step c).
(4) Timing belt idler (paragraph 72).
(5) Autoload system (paragraph 74).
(6) Loading guides (paragraph 75).
(7) Sprocket timing (paragraph 77).