

FILM-TECH

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SERVICE TOOLS AND SUPPLIES CHART

Figure A Index No.	Tool No.	Tool Description	Tool Usage
1	S-078175-6-F1	Lamp Plug	Optical system alignment(Fig.B)
2	S-550-2-N1	Lens Plug	Optical system alignment(Fig.B)
3	S-550-2-N2	Alignment Rod	Optical system alignment(Fig.B)
4	S-550-2-N3	Aperture Plug	Optical system alignment(Fig.B)
5	P/N 20044507	Compression Spring	Optical system alignment(Fig.B)
6	Make in Shop	Torque Wrench	Adjust rewind torque(par.23).
7	P/N 20710365	Rewind Torque Reel	Adjust rewind torque(par.23).
—	Purchase	Push-Pull Torque Scale (Chatillon#LP-72, Master Gage Co., Chicago, IL 60622)	Adjust rewind torque(par.23).
8	S-09701-35-N2	Shuttle Height Gage	Check shuttle protrusion (par.19,step b).
9	Make in Shop	Alignment Tool	Align sound drum (Fig.J).
10	S-552-1-N1	Timing and Alignment Plate	Timing the sprockets (par.26-2)
11	S-552-2-N1	Loop Restorer Roller Gage	Adjust loop restorer (par.25-1).
12	P/N 20048478	Cleaning Pad	Clean film path.
	G1271-F1	Setscrew Wrench and Handle	For 4-40 Bristol type setscrews.
	G1271-X2	Setscrew Wrench	For 4-40 Bristol type setscrews.
	STK3852-B	Setscrew Wrench and Handle	For 6-32 Bristol type setscrews.
	STK3863-B	Setscrew Wrench and Handle	For 6-32 Bristol type setscrews.
	G165-F1	Setscrew Wrench and Handle	For 8-32 Bristol type setscrews.
	G165-F3	Special Setscrew Wrench	For setscrews in wrench handles.
	P/N 30070030	Lubricating Oil	See Parts Catalog illustrations.
	P/N 30078215	Lubricating Oil	See Parts Catalog illustrations.
	P/N 30070034	General Purpose Grease	See Parts Catalog illustrations.
	P/N 30070043	Special Grease	See Parts Catalog illustrations.
	P/N 30070047	Special Grease	See Parts Catalog illustrations.
	P/N 20070507	Adhesive	See paragraph 7, step b.
	TFL-55-NX1	Test Film Loop	Adjust centering and framing.
	TFL-37-NX1	Test Film Loop	Check buzz track
	TFL-2575-NX2	Test Film Loop	Check 7000Hz azimuth.
	TFL-2698-FX1	Test Film Loop	Magnetic head adjustments.

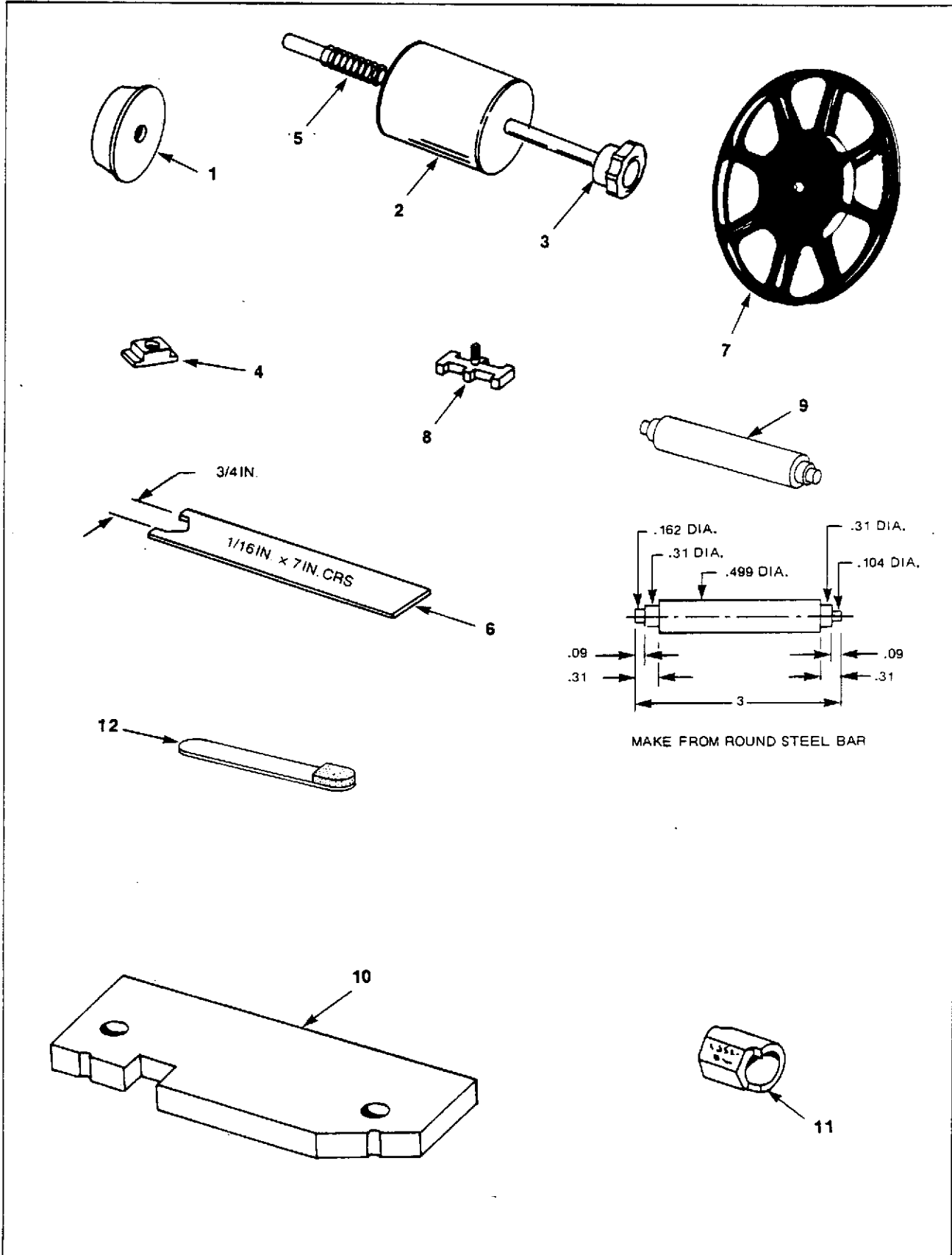


Figure A. Service Tools

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INTRODUCTION

1. SPECIAL MAINTENANCE PRECAUTIONS.

Refer to projector's serial number nameplate for correct model number and suffix letter to be used with code charts throughout the parts catalog.

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

The drive motor is supported on insulated brackets to protect it from electrical ground. When servicing adjacent parts such as the belt shifter, transformer and magnetic shields use special care to restore the air space between them and the motor and motor fasteners. Reduced clearances may result in electric shock hazards.

2. CLEANING INSTRUCTIONS.

Use isopropyl alcohol and the special cleaning pad (Figure A-12) to remove hardened emulsion, and be careful not to scratch the surfaces that contact the film. Pay particular attention to the sound drum and the soundhead rollers.

Use isopropyl alcohol to clean plastic parts and be careful not to remove lubricants from critical areas, especially in the film threading linkage. Blow away dust and film chips with a low-pressure jet of compressed air and wipe with a soft, lint-free cloth.

3. LUBRICATIONS INSTRUCTIONS.

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

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

4. GENERAL REPLACEMENT DATA.

The rear cover is secured to the projector base with three screws and to the end caps with two screws each. When these seven screws have been removed, carefully work the cover free from the projector to the limit of the interconnecting leadwires. The rear cover may be completely separated from the projector by dis-

connecting the input line at the power transformer module. The covers on the underside of the base can be removed to expose the amplifier and its controls.

5. FUSE REPLACEMENT.

a. The amplifier power input circuit and exciter supply is protected by two 2.0A Slo-Blo fuses which are located on the printed circuit assembly. The bottom cover must be removed to gain access to the fuse.

b. The electrical system of these projectors is protected against overheating by special thermal fuses. Fuses are installed in the drive motor windings and in the power transformer and can not be replaced. In the event a thermal fuse opens, repair cause of overheating and replace defective item.

6. LAMP REPLACEMENT.

CAUTION: Turn projector off and disconnect the line cord before removing lamps.

a. **Projection Lamp.** Press in on the top of the lamp retainer spring to release the lamp from its holder. Pull the lamp straight out from its socket (do not twist or wiggle the lamp during removal). Assemble the new lamp into the socket, position lamp in the lamp holder and clamp in place with the retainer spring.

b. **Exciter Lamp.** Note position of the orientation notch in the lamp base. Rotate lamp release ring (Figure 11-25). Twist the lamp counterclockwise and lift it from the contact pins. Position the new lamp on the lamp socket pins with notch oriented as above and twist clockwise to set in place. Return lamp release ring to original position.

c. Remove finger prints from the lamp with lens tissue or a lint-free cloth.

DISASSEMBLY/ REASSEMBLY PROCEDURES

7. GENERAL PRECAUTIONS.

a. Cemented or adhesive-backed parts are so noted in the parts lists and can be removed by carefully prying up one edge. Be careful not to scratch surrounding areas and remove traces of old adhesive with solvent before installing new labels or nameplates. If the new item is to be cemented in place, use Bell & Howell Company P/N 20070507 cement. If the new item is adhesive-backed, peel off the protective tissue and smooth the item in place.

Service Instructions

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

8. DRIVE BELT REPLACEMENT.

a. If the drive belt is badly worn or frayed and in need of replacement, cut the belt and remove it. Clean both belt pulleys with isopropyl alcohol.

b. Unplug the motor leads from the connector located atop the power transformer module. Remove the motor bracket strap from each end of the drive motor. Starting from the end of the motor nearest to the power transformer module, loop the new drive belt around the motor onto the motor pulley. Engage the upper end of the belt around the upper (mechanism) pulley with as little stretching as possible.

c. Reassemble the motor bracket straps and insert the motor leads connector.

9. INTERNAL SPEAKER REPLACEMENT.

When reattaching wire leads to the speaker refer to wiring diagram for proper connection to color coded terminal.

10. POWER TRANSFORMER REPLACEMENT.

Use care when positioning the transformer to avoid pinching wire leads against the platform. Position the transformer to attain a minimum gap where the connectors panel (Figure 10-16) passes through the rear cover.

11. DRIVE MOTOR REPLACEMENT.

The drive motor in model 2698 must be rotated in its cradel to select optimum position for minimum hum in the magnetic sound mode.

12. REEL ARM REPLACEMENT.

a. Be prepared for sudden pop-out of the lock button (Figure 4-29 and 4-30) and compression spring (Figure 4-31) when removing either reel arm. The lock button cups (Figure 4-32) may be removed by applying finger pressure to the cup from the gear side of the mainplate.

13. AMPLIFIER REPAIR.

NOTE: Amplifier circuit board repairs are not recommended except as an emergency measure and then only if qualified electronics personnel and test equipment are available. Using standard electronic shop test equipment and techniques, check the amplifier assembly and its components for continuity and for shorts and open circuits. Refer to the appropriate wiring diagram for voltages and ratings of

components and for test points. If a faulty condition is tracked to the amplifier, replace the complete assembly (Figure 6-12).

14. MAIN PLATE REMOVAL.

A main plate holding fixture, illustrated in Figure A, should be made so that the main plate can be set in an upright position while performing inspection and maintenance procedures.

The main plate is secured to the base with four screws (Figure 7-8). Before removing the main plate it will be necessary to unsolder the leads at the exciter lamp socket (Figure 11-24) and , in the model 2698, the mag/opt selector switch (Figure 13-7). Also disconnect the photocell (Figure 11-30) from the amplifier. Remove the soundhead assembly (Figure 7-4) to gain access to two of the four screws. A free hanging connector, located near the blower, is provided to disconnect the projection lamp socket (Figure 2-17).

15. SOUNDHEAD REPLACEMENT.

The center-to-center distance (2.391 inches) from the lower sprocket to the sounddrum is critical and if improperly set will affect sound reproduction. The sprocket/sounddrum distance is precisely set with a gage at the factory. Before removing the soundhead trace the outline of the soundhead onto the mainplate. When reassembling, hold the soundhead within that outline while securing the screws.

16. MECHANISM REPLACEMENT.

The mechanism (Figure 7-7) is secured to the main plate with four screws (Figure 7-5). To gain access to the two lower screws it will be necessary to remove or raise the drive motor (Figure 3-14).

Take care when moving the mechanism through the main plate opening to avoid bending sheet metal parts such as the shutter (Figure 21-5), and, in models 2692 and 2698 the safety shutter rod (Figure 5-8).

17. 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 a complete overhaul and repair, it is recommended that all adjustments be checked as a routine measure.

All special tools, test films and fixtures required to perform the adjustment procedures are illustrated and listed in Figure A. In addition, special electronic test equipment (voltohmmeter, oscillator and tachometer or Strobotac) are needed to check and adjust the sound system of the projector. For accurate results, connect the projector to a line variable transformer set to match the setting of the voltage selector switch in the cord wrap panel.

WARNING

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

18. OPTICAL ALIGNMENT (Figure B).

It is important that these alignments be performed in the following listed sequence (steps a and b). Be sure to turn the mechanism manually until the shutter blade is clear of the aperture opening, before inserting alignment tools.

a. Aligning the Aperture Plate (Figure B).

- (1) Remove the projection lens and the projection lamp.
- (2) Disassemble the pressure plate from the lens carrier.
- (3) Loosen the two aperture plate mounting screws just enough to permit movement of the aperture plate, and insert the aperture plug (Figure A-4) into the aperture opening.
- (4) Insert the alignment rod (Figure B) through the lens plug until the rod end protrudes enough to install the spring (Figure A-5). Insert the lens plug into the lens carrier until the tip of the alignment rod engages the aperture plug previously installed. Tip the projector carefully onto its rear end cap (lens

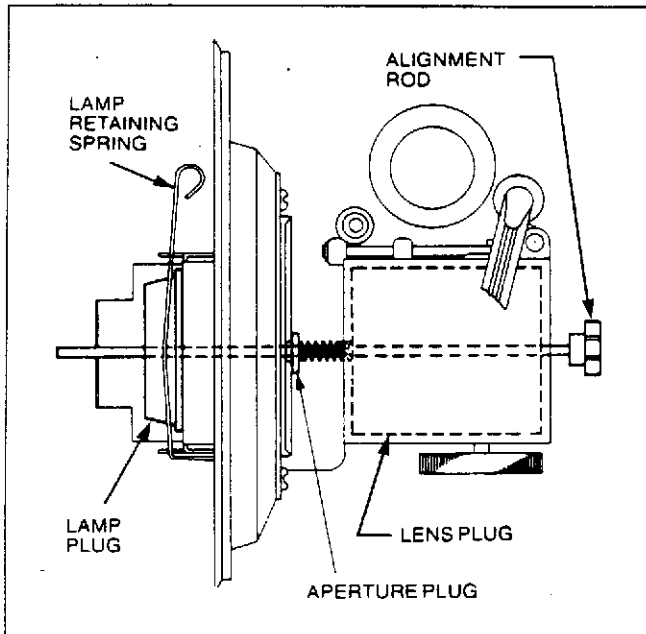


Figure B. Aligning the Optical System

opening facing up). The alignment rod must slide freely through the aperture plug without binding. If necessary, shift the aperture plate slightly keeping it horizontal (shuttle tooth travel is even from top to bottom) until free rod movement is obtained; then tighten aperture plate screws.

b. Aligning the lamp.

- (1) Loosen the heat shutter assembly mounting screws just enough to permit movement of the heat shutter assembly. Insert lamp plug (Figure A-1) into lamp position and secure the lamp retainer spring. Insert the lens plug (Figure A-2) into the lens carrier. Slide the alignment rod completely into place until the tip of the rod engages the hole in the lamp plug. Shift the heat shutter assembly as necessary until rod slides freely in the lamp plug hole. Then tighten the screws securely.

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

19. ADJUSTING THE INTERMITTENT MECHANISM.

NOTE: All of the following mechanism adjustments must be made with framer knob in the "center" position. After each adjustment, manually rotate the cam shaft to "SEAT" the adjusted component and recheck the adjustment.

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

- (1) Aperture plate out-of-alignment:
See paragraph 18, step a, for aperture plate alignment.
- (2) Shuttle stroke incorrect:
See paragraph 19, step d, for shuttle stroke adjustment.
- (3) Link bearing missing from end of shuttle arm:
Partial disassembly is required to remove and replace the shuttle arm. Refer to Parts Catalog Figure 21.

Service Instructions

- (4) Ball and stud assembly loose on shuttle arm: Reposition the shuttle arm (Figure D) and tighten stud nut securely.
- (5) The shuttle tooth side clearances can be adjusted by loosening the ball and stud assembly nuts. Slide the shuttle arms as required to obtain the clearances as specified in Figure C. This adjustment may cause the shuttle to exceed the stroke limits.

b. Checking Shuttle Tooth Height. Carefully place the projector on its rear end cap with the front of the projector facing you. The steps at either end of the shuttle tooth height gage (Figure A-8) are the height limits and are marked "GO" and "NO-GO." Insert the gage into the film channel between the rails of the aperture plate and attempt to slide it over the shuttle teeth. The "GO" step should pass over the shuttle teeth without catching. The "NO-GO" step must not pass over the shuttle teeth. If the shuttle teeth are too high or too low, adjust height as follows:

- (1) Remove the belt from the mechanism pulley. Turn the mechanism drive pulley manually until the access hole in the shutter and setscrew (Figure 21-17A) on the in-out bracket are aligned (Figure E).

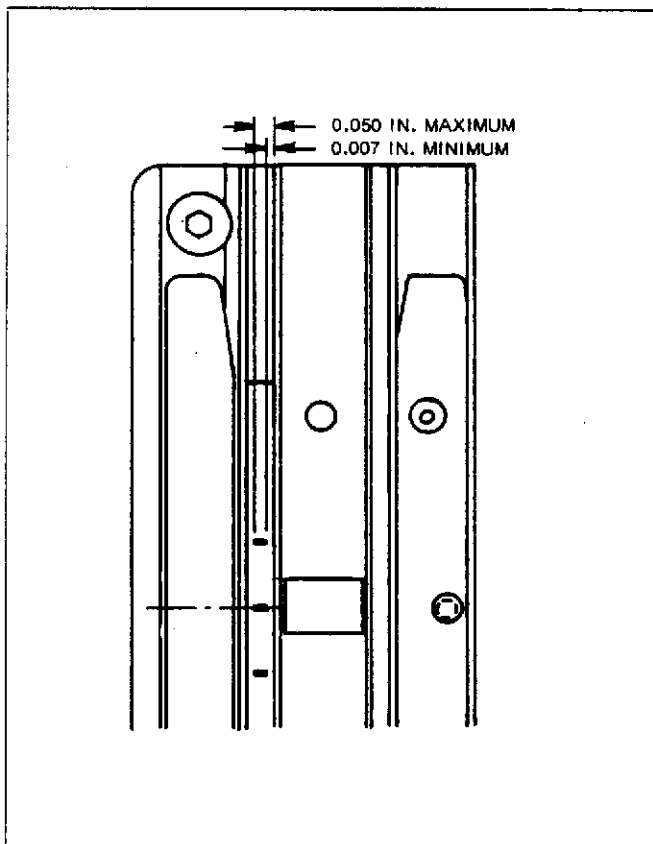


Figure C. Shuttle Tooth Clearance

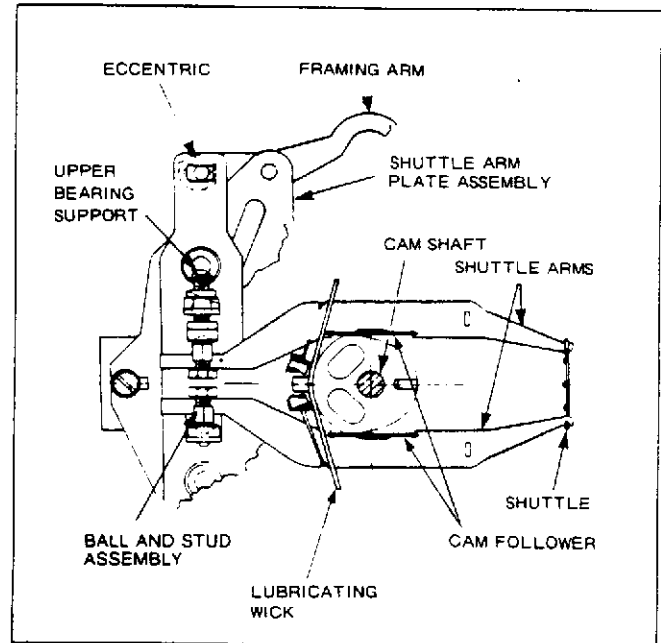


Figure D. Shuttle Arms and Cam Assembly

- (2) If the shuttle teeth were too low ("NO-GO" step passes over the shuttle teeth), turn the cam follower screw counter-clockwise to increase tooth height. If the shuttle teeth were too high ("GO" step catches against shuttle teeth), turn the adjusting screw clockwise. Recheck shuttle tooth height and continue to adjust the follower screw until the proper height is obtained.
- (3) If only one tooth cannot be brought into tolerance, it may be necessary to loosen the screws (Figure 21-15) which secure the in-out bracket (Figure E) and adjust the bracket slightly. Then retighten the mounting screws and adjust shuttle tooth height as outlined above.

c. Checking Fit of Shuttle arms to Pull-Down Cam.

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

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

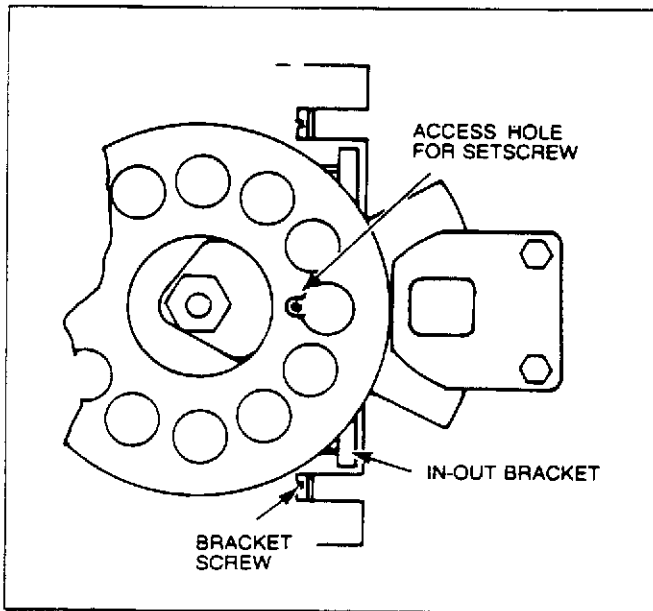


Figure E. Adjusting Shuttle Tooth Height

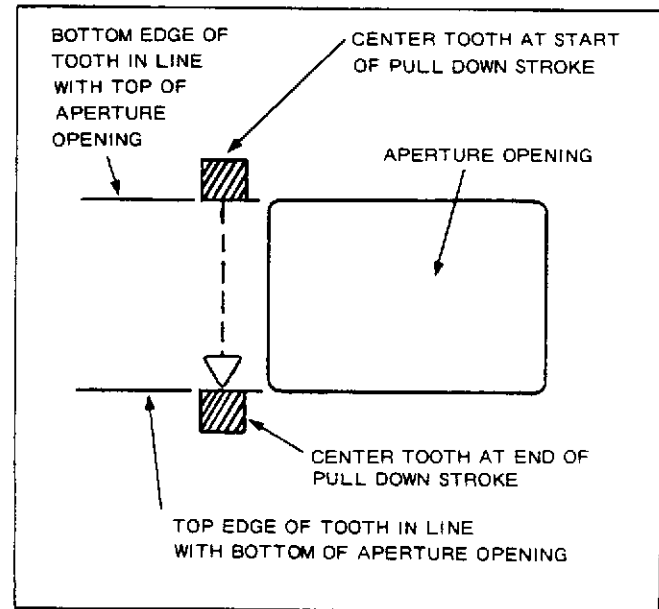


Figure F. Shuttle Stroke Adjustment

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 affect speed, reduce life of cam, cam shoes and possible use of excess current by loading the motor.

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

- (1) Procedure for Checking Shuttle Tooth Stroke. Check for proper setting of the shuttle tooth side clearance (paragraph 19, step a), shuttle tooth height (paragraph 19, step b) and fit of the shuttle arms (paragraph 19, step c).

Manually rotate the cam shaft to position the shuttle at the extreme top of its movement. Turn the framer knob as required until the bottom edge of the center shuttle tooth is in line with the top edge of the aperture opening (Fig.F). Rotate the cam shaft until the shuttle is at the extreme bottom of its stroke. In this position the top edge of the center shuttle tooth should be in line with the bottom edge of the aperture opening for a close proximity of the factory setting without the use of special gages.

To further check the shuttle stroke, project a trial length of film. The projected image should be steady and there should be no noise as the shuttle teeth penetrate the film perforations. If these conditions are not present proceed to step 2.

- (2) Procedure for Adjusting Shuttle Stroke. Loosen the two shuttle plate mounting screws (Figure 21-18) 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 19, step a, and readjust the shuttle arms for proper tooth side clearance.

e. Framing Adjustment. Thread the projector with test film TFL-55-NX1. Project the film and turn framing knob from one limit to the other. If at one limit a frame line is not visible, loosen the nut on the framing eccentric located at the top of the shuttle arm plate assembly (Figure D) and turn the eccentric until the frame line appears. Hold the eccentric while tightening the nut. Check the adjustment by again turning the framing knob from limit to limit while observing the picture. When the eccentric is properly adjusted, either frame line can be projected and movement of film should be approximately equal at top and bottom of framer travel.

20. LENS CARRIER ADJUSTMENT.

Angular relationship between the lens and the aperture plate is controlled by the lens mount stop screw (Figure 20-20). Thread the projector with roll title or target film TFL -55-NX1 having sharp images in the corners and project a picture approximately 30 inches high onto a matte surface. The projector must be square with the screen. Focus the picture and compare resolution of the two sides of the image when viewed from a distance 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 the screen is soft until the lens is moved toward the aperture, then the lens stop screw is set too far forward and should be turned clockwise.

CAUTION

This adjustment is critical. Turn the lens stop screw only a few degrees between tests for sharpness.

21. ADJUSTING THE RUN-STILL CLUTCH (Figure G).

a. Checking Stop Pawl to Trigger Clearance. Move the run-still lever to the run position. Rotate the mechanism by hand until the finger of the trigger is adjacent to the inner bent ear of the stop pawl as shown in view A, Figure G. Clearance between the stop pawl and trigger should be approximately .010 to .015-inch. To adjust, move the lower collar up or down, as required, on the still-run rod. The upper collar should be approximately .09-inch from the top of the still-run rod. Move the run-still lever to the still position. Rotate the mechanism worm by hand until the trigger is against the stop pawl. The stop pawl should move into the notch in the flange adjacent to the trigger as in View B. Adjust position of upper collar as required to seat the stop pawl in the notch.

b. Checking Shuttle Retraction. When the still-run clutch is in the still mode the slide bar assembly (Figure 22-7) must move the in-out assembly (Figure 21-17) so that the in-out follower is held .010 away from the high dwell of the in-out cam. Adjust as follows:

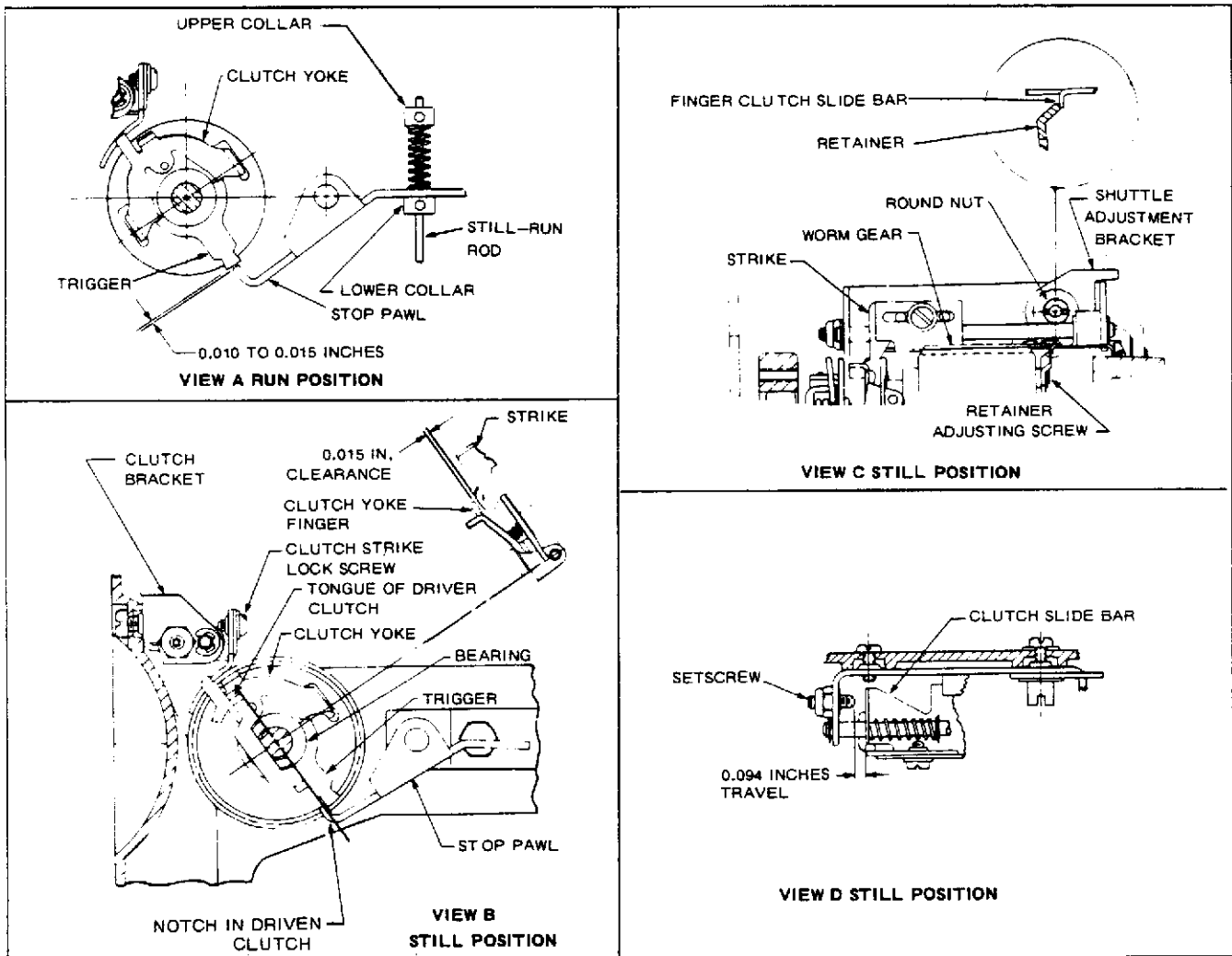


Figure G. Run-Still Clutch Adjustments

- (1) Move the run-still lever to the run position. Rotate the mechanism pulley and observe the vertical clearance between the finger of the clutch slide bar and the retainer (View C). Bend the finger up or down as required to set to .030 clearance.
- (2) Move the run-still lever to the still position. Rotate the worm until the stop pawl drops into the notch of the driven clutch (View B). Move the slide bar (View D) until its finger moves over the retainer as shown (View C). Loosen the round nut and temporarily move the shuttle adjustment bracket forward.
- (3) Turn the retainer adjusting screw (View C) clockwise to move the in-out follower away from the in-out cam and counterclockwise to allow it to move closer. Turn the screw $\frac{1}{4}$ to $\frac{1}{2}$ revolution, rotate the shutter and then inspect for .010 clearance between the in-out follower and the high dwell of the in-out cam. Move the shuttle adjustment bracket back allowing .015 clearance between it and the leaf spring of the slide bar and fasten the round nut securely.
- (4) Loosen the strike screw and adjust the .015 clearance between the strike and the clutch yoke (View B). Retighten the strike screw. Adjust the depth of the set screw (View D) so that it provides .094 travel for the slide bar.

22. ADJUSTING THE REEL ARM GEARS. (Figure H)

Only the upper face gears of the reel arms are shown in Figure H; however, the lower face gears are adjusted in a similar manner. With the reel arm cover removed, check the backlash between the face gear and its mating spur gear through a full 360-degree rotation of the gears. Gear backlash should be a minimum of 0.005-inch (0.127mm) and a maximum of 0.018-inch (0.460mm). To adjust the backlash of either face gear in the front reel arm and the upper face gear only in the rear reel arm, loosen the set screws in the face gear hubs and shift the gears as necessary. To adjust the lower face gear in the rear reel arm, loosen the set screw (Fig. 15-12) in the tapped hole in the reel arm casting and move the lower gear shaft back and forth.

23. ADJUSTING THE REWIND CLUTCH.

The rewind clutch must be adjusted to produce a supply spindle torque for the rewind mode of operation. Install an empty reel (Figure A-7) on the supply spindle and wrap several turns of a short film strip around the reel hub. Hook a spring scale to the free end of the film strip, turn the control knob to "REVERSE" and press the rewind button. The spring scale must register between 28 and 44 ounces at the point when the rewind clutch begins to slip.

A special wrench (Figure A-6) must be used for adjusting the rewind clutch (Fig. 4-14). Tighten or loosen the hex nut on the clutch hub.

24. ADJUSTING THE LOOP FORMERS.

a. Loosen the two set screws (Figure 19-38) that secure the upper loop former (Figure 20-1G). Loosen the entrance channel screw (Figure 19-33). Loosen the screws that secure the upper and lower sprocket plates (Figure 19-37 and 19-25C). Close the threading system with the threading arm (Figure 19-4) and hold in this position while retightening the screws to secure the lower sprocket plate. Hold the guide bracket (Figure 19-20) counterclockwise and retighten its screw. Remove the retaining ring (Figure 19-7) and film guide (Figure 19-8). Loosen the film guide stud (Figure 19-12) and rotate the locking lever eccentric (Figure 19-13) so that the Autoload latch assembly (Figure 19-14) holds the loop formers in the position described above. Attempt to slide a .015 inch thick feeler gage between the aperture rails and the loop former (Figure 19-31B). It should enter the space freely. A .025 inch thick feeler gage should not enter the space.

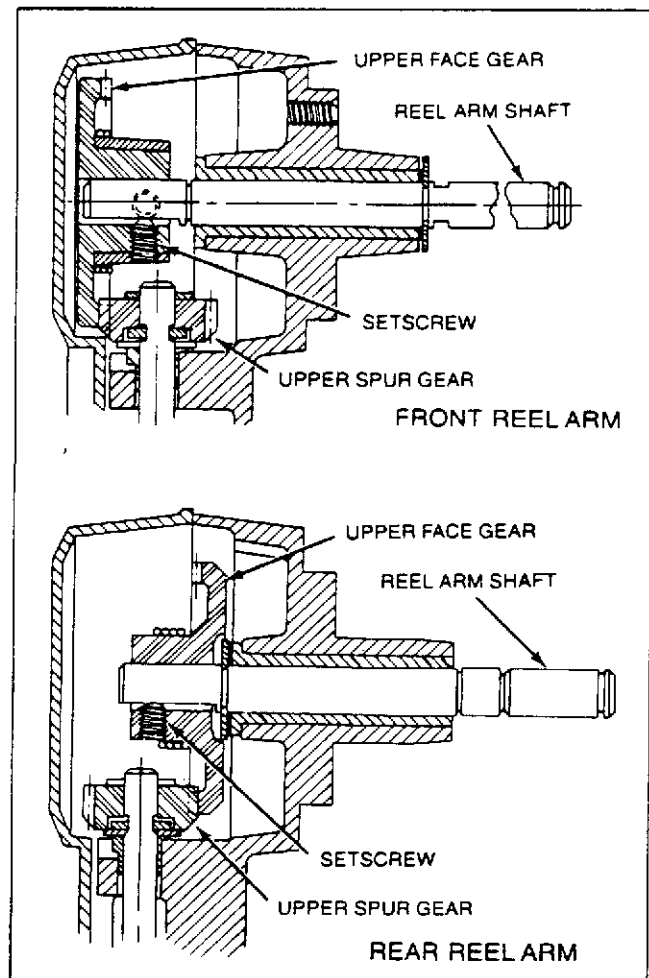


Figure H. Adjusting Reel Arms

Service Instructions

b. Close the threading system. Move the upper loop former (Figure 20-1) so that its inside surface overhangs the aperture rails by .005(+.005) inch. This overhang is to prevent the leading edge of the film from stubbing the upper edge of the aperture plate during threading. Retighten the two set screws in the loop former hub.

c. Place a short strip of film between the upper sprocket and its guard and in the entrance channel. Hold the guard against the film and retighten the upper sprocket plate screws. Close the threading system and retighten the entrance channel screw.

d. Loosen the shuttle retractor screw (Figure 19-31C). Close the threading system. Move the shuttle retractor so that it holds the shuttle below the aperture rails. Retighten the screw.

e. With the threading system latched for threading, try to lift the escape hatch of the loop former (Figure 20-1G). If it opens, the locking pawl (Figure 20-1E) does not have sufficient engagement in the loop former. Adjust by loosening the screw (Figure 20-1D) and repositioning the pawl as required. Release the autoloader latch allowing the system to snap open. The locking pawl should exit the loop former as its bracket strikes the underside of the hood (Figure 18-8). Shift or bend the hood as required to assist release of the locking pawl.

25. ADJUSTING THE AUTO LOOP RESTORER.

a. Open the threading system. Check the loop restorer cam (Figure 22-27) to be sure that it is secured against the shoulder of the cam shaft toward the shutter and the set screw (Figure 22-11) is on the flat of the shaft. Place the loop restorer gage (Figure A-11) over the loop restorer roller. The gage should touch the adjacent sprocket guard roller (Figure 18-25) without putting any load on the roller. To adjust the position of the loop restorer roller loosen the two screws (Figure 20-11) and move the self centering assembly (Figure 20-14) as required. Be sure that the two flat strips in the self centering assembly lay flat against the bracket faces.

b. With the threading system open, the cam follower (Figure 20-7E) should be centered in the space between the long tang of the cast housing and the first face of the loop restorer cam. To adjust, loosen the screw (20-5) and move the cam follower supply as required.

c. The clearance between the formed edge of the cam follower and the cylindrical part of the cam where the set screw enters should be .060 inch. To adjust, loosen the two screws (Figure 20-7A) and move the cam follower as required.

NOTE: Timing of the sprockets and shuttle is essential to loop restorer function.

26. TIMING THE SPROCKETS.

a. Turn the framer knob (Figure 21-21) CW as far as it will go. Manually turn the mechanism pulley in the forward transport direction until the shuttle is at the bottom of the stroke with its teeth fully protruding and the trailing edge of the shutter blade bisects the aperture opening. If the projector is equipped with a still clutch, push upward on the underside of the worm to remove excess play.

b. Place the timing and alignment plate (Figure A-10) over the sprocket hubs. A sprocket tooth should be in a direct line of sight with the notch in the plate at both the upper and lower sprocket. To adjust, loosen the sprocket gear set screws (Figure 18-9) without disturbing the radial position of the gears. Rotate the sprocket as required and retighten the set screws.

27. DRIVE BELT TRACKING/SHIFTING.

The drive belt should run in the center of the belt shifter and each pulley crown. Move the mechanism pulley and/or the motor pulley as required to accomplish proper tracking and shifting. If pulley positioning alone does not cause the belt to track in the center of the pulleys, raise the front or rear of the motor by placing shims as required between the motor bracket and the projector base.

28. ADJUSTING THE SOUND SYSTEM.

a. Photocell and Sound Drum Alignment.

- (1) Loosen the photocell set screw (Figure 11-26) clamping screw (Figure 11-14) and the two sound drum mounting screws (Figure 11-27). Remove the exciter lamp and the optical slit.
- (2) Insert the sound drum alignment tool (Figure A-9) into the optical slit opening as shown in Figure J. Use end having .104 diameter for Models 2685 and 2692. Use end having .162 diameter for Model 2698.

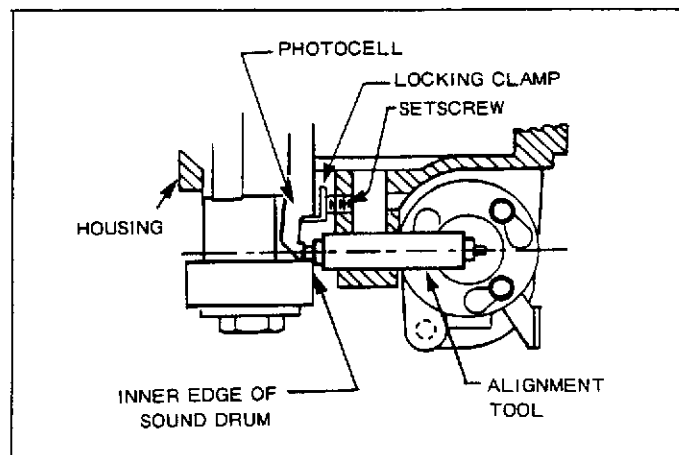


Figure J. Photocell and Sound Drum Alignment

- (3) Press the sound drum in until its inner face just makes contact with the first step (.104 dia. or .162 dia.) of the alignment tool, and maintain this contact while tightening the two sound drum mounting screws securely.
- (4) Move the photocell so that its T-shaped face is flush with the face of the housing. Move the locking clamp against the T-shaped face of the photocell and tighten the set screw.

b. Stabilizer Roller Tension Adjustment. Thread the projector with film and run with projection lamp on. Turn the adjusting screw (Figure 11-33) until the tension on the counter-balance spring is equalized and holds the rollers at equal distance from the threading guides. Finer adjustment will be made in the next step.

c. Optical Slit Adjustment.

- (1) Insert the optical slit into its opening in the soundhead. The adjusting hole in the barrel of the slit must be at top center.
- (2) Insert a 0.050-inch (1.27mm) feeler gage between the tip of the optical slit and the sound drum and press the optical slit in against the feeler gage. Hold in this position while tightening the clamp screw just enough to hold the slit in place.
- (3) Thread the projector with 7000Hz optical setting film TFL-2575-NX2 (film emulsion toward slit lens) and connect an 8-ohm, 50-watt load resistor and voltmeter to the speaker jack.

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

- (4) Set the volume and tone controls at approximately midposition and start the projector. Move slit toward or away from film, as required, to obtain an output reading. Rotate the slit to obtain peak reading and simultaneously move in or out until maximum output is obtained. Tighten slit clamping screw securely to lock the adjustment. Fine tune the stabilizer roller adjustment for minimum flutter.

d. Buzz Track Adjustment. The lateral position of the film at the "soundhead" location is controlled by the flanged roller (Figure 11-17) and the edge guide screw (Figure 11-31). Turn the edge guide screw in or out for precise lateral positioning of the optical sound track in front of the optical slit.

- (1) Connect a voltmeter with 8-ohm load to the speaker jack output, and thread the projector with buzz track test film TFL-37-NX1.
- (2) Run the projector with the projection lamp on and adjust for minimum output on the voltmeter. Disconnect the voltmeter and adjust

the volume control to a suitable listening level. Then check centering by listening to audio.

- (3) Reconnect the voltmeter and adjust the lateral position of the edge guide until the minimum voltage output reading is obtained. Remove buzz track film and voltmeter.

e. Magnetic Head Adjustments. Model 2698 only. Degauss the magnetic head before making these adjustments. Place the Mag/Opt selector in the MAG mode.

- (1) Loosen the screw (Figure 11-11) and move the adjustment bracket (Figure 11-13) so that the magnetic head protrudes approximately .010-inch below the sound drum. Retighten the screw.
- (2) Rotate the eccentric (Figure 12-7) so that the curvature of the magnetic head is concentric with the curvature of the sound drum.
- (3) Rotate the adjustment nut (Figure 11-7) to provide .010-inch clearance between the magnetic head and the rear edge of the sound drum.
- (4) Load Magnetic Test Film Loop TFL-2698-FX1 into the projector and run projector forward. During 400Hz signal adjust the loudness control (Figure 6-12D) for 0db reference level on the 1-volt range of the voltmeter. Set maximum amplitude during 12K Hz signal by adjusting 2 screws (Figure 12-1) for azimuth and perpendicularity and adjust the eccentric (Figure 12-7). Difference between 0db reference level and 12K Hz signal after adjustment should be -4db max.
- (5) Loosen the 2 motor strap (Figure 3-13) screws just enough to permit moving the motor. Assemble the exciter lamp cover (Figure 1-18) to the projector. Run the projector with the projection lamp on. Set the loudness control to 6 and the tone control to 0.
- (6) **CAUTION:** Potential electrical shock hazard. Rotate the motor in its cradle as required to attain -50db hum level. Retighten the 2 motor straps.

29. 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.

Speeds at Nominal Voltage:

Sound Speed	24FPS +/-2%
Shutter	1440RPM +/-2%
Sprocket	102.86RPM +/-2%

TROUBLESHOOTING

30. MISCELLANEOUS TROUBLES AND REMEDIES.

Trouble	Probable Cause	Remedy
Nothing runs	<ol style="list-style-type: none"> 1. Main switch off. 2. Defective switch. 3. Damaged line cord. 4. Loose connections. 5. Blown thermal fuse. 	<ol style="list-style-type: none"> 1. Press main switch to ON. 2. Determine which switch is defective and replace. 3. Repair or replace line cord. 4. Repair connections. 5. Replace drive motor and check for proper operation.
Motor hums but does not run	<ol style="list-style-type: none"> 1. Starting circuit open or shorted. 2. Defective capacitor or drive motor. 3. Foreign object(s) in mechanism. 	<ol style="list-style-type: none"> 1. Replace loose or transposed connections. 2. Replace defective capacitor or drive motor. 3. Locate and remove.
Motor runs but mechanism does not run	<ol style="list-style-type: none"> 1. Drive belt broken or unhooked from pulley. 2. Motor pulley loose on shaft. 3. In Still mode. 	<ol style="list-style-type: none"> 1. Reinstall or replace drive belt (para. 8). 2. Reposition motor pulley and tighten setscrews. 3. Reposition Run/Still lever to run position.
Rewind does not operate/stalls.	<ol style="list-style-type: none"> 1. Rewind gears not engaged. 2. Clutch slipping. 3. Projector in "still" position. 	<ol style="list-style-type: none"> 1. Press rewind button. 2. Adjust (para.23). 3. Place still/run lever in "run" position.
Rear spindle does not rotate for take-up.	<ol style="list-style-type: none"> 1. Take-up belt worn/broke. 2. Take-up sleeve slipping. 3. Override clutch slipping or improperly installed. 4. Idler arm (Fig.4-11C) not functioning. 	<ol style="list-style-type: none"> 1. Replace belt. 2. Replace take-up sleeve (Fig.15-11). 3. Check installation. Replace Clutch & Gear Assembly (Fig.4-2). 4. Clean idler arm and adjust.

30. MISCELLANEOUS TROUBLES AND REMEDIES. (Continued)

Trouble	Probable Cause	Remedy
Short lamp life	<ol style="list-style-type: none"> 1. Voltage at lamp too high. 2. Dirt and lint clogging blower housing. 3. Blower fan loose on drive motor shaft. 4. Contacts burned in lamp connector. 	<ol style="list-style-type: none"> 1. a) Check for proper lamp use. b) Check voltage selector for proper setting. 2. Clean blower housing. 3. Tighten or replace blower fan setscrew. 4. Replace lamp connector.
Projector speed slow.	<ol style="list-style-type: none"> 1. Voltage at motor too low. 2. Binding in mechanism. 3. Drive belt slipping. 4. Defective capacitor or motor. 	<ol style="list-style-type: none"> 1. Check voltage selector for proper setting. 2. Free binding condition. 3. Clean or replace drive belt (para.8). 4. Replace defective component.
Projector runs fast or slow	<ol style="list-style-type: none"> 1. Drive belt incorrectly tracking on pulley. 	<ol style="list-style-type: none"> 1. Align and adjust pulleys (para.27).

31. PICTURE TROUBLES AND REMEDIES.

Film jump	<ol style="list-style-type: none"> 1. Damaged film. 2. Loose shuttle arms. 3. Dirty film aperture. 4. Damaged or lost pressure plate spring. 5. Pressure plate misaligned. 6. Incorrect shuttle stroke. 	<ol style="list-style-type: none"> 1. Repair or replace. 2. Adjust and tighten (para.19, step c). 3. Clean film aperture. 4. Replace spring. 5. Realign pressure plate. 6. Adjust (para.19, step d).
Double image	<ol style="list-style-type: none"> 1. Incorrect shuttle stroke. 2. Excessive shuttle protrusion. 	<ol style="list-style-type: none"> 1. Adjust (para.19, step d). 2. Adjust (para.19, step b).
Weave (due to faulty aperture plate)	<ol style="list-style-type: none"> 1. Side tension spring missing. 2. Sticking edge guide. 3. Fixed edge guide out of position. 	<ol style="list-style-type: none"> 1. Replace spring (Fig.23-7). 2. Clean edge guide. 3. Reposition edge guide.

Service Instructions

31. PICTURE TROUBLES AND REMEDIES. (Continued)

Trouble	Probable Cause	Remedy
Poor illumination	<ol style="list-style-type: none"> 1. Optics out-of-line. 2. Projection lamp wearing out. 3. Dirt on projection lens. 4. Low voltage at lamp. 	<ol style="list-style-type: none"> 1. Realign (para.18). 2. Replace projection lamp. 3. Clean front and rear elements. 4. Check voltage selector for proper setting.
Poor focus	<ol style="list-style-type: none"> 1. Dirty lens and/or aperture. 2. Warped film. 3. Pressure plate spring lost. 4. Bent pressure plate. 5. Pressure plate out-of-line. 6. Defective lens. 	<ol style="list-style-type: none"> 1. Clean lens and/or aperture. 2. Recondition or replace film. 3. Replace pressure plate spring. 4. Replace pressure plate. 5. Realign pressure plate. 6. Replace lens.
Frame line creeps	<ol style="list-style-type: none"> 1. Framer eccentric loose. 	<ol style="list-style-type: none"> 1. Align and tighten (para.19, step e).
Insufficient framing	<ol style="list-style-type: none"> 1. Framer eccentric out-of-adjustment. 	<ol style="list-style-type: none"> 1. Adjust (para.19, step e).
Trailer ghost	<ol style="list-style-type: none"> 1. Shutter out-of-alignment. 	<ol style="list-style-type: none"> 1. Reassemble properly.
Loss of loops	<ol style="list-style-type: none"> 1. Damaged film. 2. Inadequate shuttle protrusion. 3. Inadequate or excessive shuttle stroke. 4. Pressure plate spring lost. 5. Pressure mounting plate screws loose. 6. Sprocket guards not closing. 7. In-out bracket spring broken. 8. Supply reel too small. 9. Excessive film tension. 	<ol style="list-style-type: none"> 1. Repair or replace film. 2. Adjust (para.19, step b). 3. Adjust (para.19, step d). 4. Replace spring. 5. Tighten mounting screws. 6. Clean and adjust. 7. Replace in-out bracket spring. 8. Use 400 foot reel with hub 2-1/2 inches in diameter (minimum). 9. Replace holdback spring (Fig. 16-11).

32. FILM TRANSPORT TROUBLES AND REMEDIES. (Continued)

Trouble	Probable Cause	Remedy
Excessive film slap	<ol style="list-style-type: none"> 1. Damaged film. 2. Green film. 3. Dirty pressure plate. 4. Pressure plate rubbing on aperture plate guide rails. 5. Incorrect shuttle stroke. 	<ol style="list-style-type: none"> 1. Recondition or replace film. 2. Age or buff film. 3. Clean pressure plate. 4. Realign pressure plate. 5. Adjust (para.19, step d).
Splices jam in sprocket shoes	<ol style="list-style-type: none"> 1. Bad splices. 2. Emulsion build-up. 	<ol style="list-style-type: none"> 1. Replace splices. 2. Clean film path components.
Shuttle runs but sprockets do not revolve	<ol style="list-style-type: none"> 1. Worn loose on cam shaft. 2. Run-still clutch torsion spring defective. 	<ol style="list-style-type: none"> 1. Tighten set screws. 2. Replace spring (Figure 22-14).
Run/still clutch will not operate.	<ol style="list-style-type: none"> 1. Excessive stop pawl clearance. 2. Run/still lever spring missing or defective. 	<ol style="list-style-type: none"> 1. Adjust stop pawl clearance (para.21, step a). 2. Replace spring (Figure 5-18).
Run/still clutch stops the sprocket but shuttle continues to pull film	<ol style="list-style-type: none"> 1. Shuttle not retracting properly. 	<ol style="list-style-type: none"> 1. Adjust shuttle for proper retraction (para.21, step b).

33. SOUND SYSTEM TROUBLES AND REMEDIES.

Projector runs, no voltage at PC board	<ol style="list-style-type: none"> 1. Loose connection or connector. 2. Blown fuses on PC assembly. 	<ol style="list-style-type: none"> 1. Repair connection. 2. Replace blown fuses.
Projector runs, voltage at PC board, but exciter lamp does not light	<ol style="list-style-type: none"> 1. Exciter lamp cable disconnected. 2. Exciter lamp fuse open. 3. Wrong exciter lamp used. 4. Defective amplifier. 	<ol style="list-style-type: none"> 1. Connect cable. 2. Replace fuse. 3. Replace with correct lamp. 4. Repair or replace (para.13).

Service Instructions

33. SOUND SYSTEM TROUBLES AND REMEDIES. (Continued)

Trouble	Probable Cause	Remedy
Voltage at PC board, exciter lamp lights, but no sound	<ol style="list-style-type: none"> 1. Speaker jack disconnected or speaker jack switch open. 2. Opt/mag switch in wrong mode. 3. Photocell cable disconnected. 4. Photocell out-of-line. 5. Dirt on end of photocell. 6. Defective amplifier. 	<ol style="list-style-type: none"> 1. Connect leads. Repair or replace jack. 2. Set switch for type of sound track on film. 3. Connect cable. Connect leads to proper terminals. 4. Realign (para.28, step a). 5. Clean photocell. 6. Repair or replace (para.13).
Low volume	<ol style="list-style-type: none"> 1. Trouble in amplifier PC board. 2. Photocell out-of-line. 3. Dirt on photocell or slit. 4. Slit misaligned. 5. Buzz track misaligned. 	<ol style="list-style-type: none"> 1. Check out the circuit board; replace if faulty (para.13). Circuit trace with schematic using test points 1, 2, 3, 4 etc. 2. Realign (para.28, step a). 3. Clean photocell and slit. 4. Realign (para.28, step c). 5. Realign (para.28, step d).
Distortion at all volume levels	<ol style="list-style-type: none"> 1. Trouble in amplifier PC board. 2. Improper film loops. 	<ol style="list-style-type: none"> 1. Repair or replace (para.13). Circuit trace with schematic using test points 1, 2, 3, 4 etc. 2. Rethread film.
Crackling noises	<ol style="list-style-type: none"> 1. Buzz track out-of-line. 2. Broken cable shield. 3. Defective amplifier. 	<ol style="list-style-type: none"> 1. Realign (para.28, step d). 2. Repair shield or replace cable. 3. Repair or replace (para.13). Circuit trace with schematic using test points 1, 2, 3, 4 etc.

33. SOUND SYSTEM TROUBLES AND REMEDIES. (Continued)

Trouble	Probable Cause	Remedy
Wow or flutter	1. Stabilizer roller sticking.	1. Clean roller and roller shaft.
	2. Stabilizer roller spring broken, unhooked or lost.	2. Repair or replace spring.
	3. Loose flywheel.	3. Replace tension washer (Fig.4-33).
	4. Damaged sound drum bearing.	4. Replace sound drum (para.28).
	5. Dirt causing stabilizer roller arm pivot bearing to bind.	5. Clean pivot shaft bearing.
	6. Photocell cable rubbing against flywheel.	6. Reposition cable.
	7. Chips or dirt in take-up sprocket gear teeth.	7. Remove and clean sprocket gear.
	8. Bent take-up reel.	8. Replaces take-up reel.
	9. Dirt on sound drum.	9. Clean sound drum.
	10. External drags on flywheel.	10. Repair and adjust as required.
Clicking noises	1. Dirt on sound drum.	1. Clean sound drum.
High frequencies fade (jumps focus)	1. Warped film.	1. Recondition or replace film.
	2. Dirt on sound drum.	2. Clean sound drum.
	3. Slit lens out-of-focus or dirty.	3. Clean and/or adjust.
	4. Dirt on magnetic head.	4. Clean with alcohol and Q-tip.
Hum	1. Ground wiring.	1. Correct grounded condition.
	2. Trouble in amplifier PC board.	2. Repair or replace (para.13).
	3. Broken cable shield.	3. Repair or replace cable shield.
	4. High ripple on D.C. supply.	4. Circuit trace and correct. Could be CR3, CR4, CR23, CR24, etc.
	5. Magnetic head open.	5. Replace magnetic head (Figure 12-2).
	6. Exciter lamp cover loose or missing.	6. Assemble cover (Figure 1-18) securely.
	7. Magnetic hum wand out of position.	7. Adjust position of wand (Figure 11-2) for minimum hum.
	8. Drive motor improperly secured.	8. Adjust position of motor (para.25, section e, step 5-6).

Service Instructions

34. AUTOMATIC THREADING SYSTEM TROUBLES AND REMEDIES.

Any obstruction in the film patch, such as caked emulsion, film chips or splicing tape interfere with the proper threading of the projector. Before attempting to localize the trouble, brush or blow away all accumulations of dirt and film chips with a low-pressure jet of compressed air. Inspect all threading guides, shoes and rollers. Clean the film path of emulsion with isopropyl alcohol and the special cleaning pad (Figure A-12).

Trouble	Probable Cause	Remedy
Film cannot be inserted into the feed sprocket	<ol style="list-style-type: none"> 1. Obstruction below roller of channel (see inset, Figure 19). 2. Roller channel bent or binding. 3. Excessive pressure on leaf spring. 	<ol style="list-style-type: none"> 1. Remove obstruction. 2. Straighten or replace channel and roller assembly. 3. Adjust leaf spring (Figure 19-28).
Film will not pull between feed sprocket and sprocket shoe	<ol style="list-style-type: none"> 1. Entrance channel misaligned. 2. Feed sprocket guard sticking. 3. Feed sprocket guard spring broken. 	<ol style="list-style-type: none"> 1. Realign (para.24, step c). 2. Clean sprocket shoe pivot. 3. Replace sprocket guard spring.
Film comes out the side of the top sprocket.	<ol style="list-style-type: none"> 1. Obstruction in sprocket guard. 2. Damaged sprocket guard. 	<ol style="list-style-type: none"> 1. Remove obstruction. 2. Replace sprocket guard.
Film strikes top of aperture plate and begins to pile-up	<ol style="list-style-type: none"> 1. Upper loopformer bent or out of adjustment. 2. Lower loopformer set too close to aperture plate. 	<ol style="list-style-type: none"> 1. Straighten or replace if bent; readjust (para.24, step b). 2. Readjust (para.24, step a).
Film butts into or goes under top end of aperture plate side tension rail or strikes fixed rail	<ol style="list-style-type: none"> 1. Upper loopformer bent causing sidewise deflection of film. 2. Lower loopformer bent or out of adjustment. 	<ol style="list-style-type: none"> 1. Straighten or replace if bent; readjust (para.24). 2. Straighten or replace if bent; readjust (para.24).
Film butts against top of film pressure plate or passes over outside of pressure plate	<ol style="list-style-type: none"> 1. Lower loopformer out of adjustment. 2. Pressure plate not lifting off of aperture plate. 	<ol style="list-style-type: none"> 1. Readjust (para.24, step a). 2. Bent parts (Figure 18-4C and/or 19-31G) need straightening or replacement.
Film ejects between bottom of film gate and top of take-up sprocket or piles up in this area	<ol style="list-style-type: none"> 1. Lower loopformer bent or sticking. 2. Lower loop former spring broken. 3. Obstruction in take-up sprocket upper guard. 4. Sprockets out-of-time. 	<ol style="list-style-type: none"> 1. Straighten, remove bind or replace lower loopformer (Figure 19-17). 2. Replace lower loopformer spring (Figure 19-18). 3. Remove obstruction. 4. Time sprockets (para.26).

34. AUTOMATIC THREADING SYSTEM TROUBLES AND REMEDIES. (Continued)

Trouble	Probable Cause	Remedy
Film not threading over take-up sprocket	<ol style="list-style-type: none"> 1. Obstruction in take-up sprocket guard. 2. Sprocket guard spring broken. 3. Take-up sprocket shaft loose in gear. 	<ol style="list-style-type: none"> 1. Remove obstruction. 2. Replace sprocket guard spring (Figure 18-26). 3. Retime sprocket (para.26) and tighten gear setscrews.
Film piles up ahead of sound drum	<ol style="list-style-type: none"> 1. Back-up bracket bent downward. 2. Exciter lamp cover loose. 3. Obstruction in gap between sound drum and exciter lamp cover. 4. Edge guide adjusting screw out too far. 	<ol style="list-style-type: none"> 1. Straighten back-up bracket (Figure 19-20) 2. Tighten cover retaining screw. 3. Remove obstruction. 4. Adjust buzz (para.28 step d).
Film ejects ahead of lower take-up sprocket shoe or piles up in this area	<ol style="list-style-type: none"> 1. Obstruction in lower take-up sprocket guard. 2. Film guide improperly positioned. 	<ol style="list-style-type: none"> 1. Clear out obstruction. 2. Reposition film guide (Figure 8-5).
Film sticks in or is ejected from lower take-up sprocket guard	<ol style="list-style-type: none"> 1. Obstruction in lower take-up sprocket guard. 2. Sprocket guard sticking. 3. Broken sprocket guard spring. 	<ol style="list-style-type: none"> 1. Clear out obstruction. 2. Clean sprocket guard pivot. 3. Replace sprocket guard spring (Figure 18-26).
Film piles up ahead of flanged roller (Figure 19-11) or is ejected from this area	<ol style="list-style-type: none"> 1. Auto-thread lever bent or its roller shaft loose. 2. Idler roller sticking. 	<ol style="list-style-type: none"> 1. Straighten or replace auto-thread lever (Figure 19-14). 2. Remedy sticking condition.
Automatic loading system will not lock	<ol style="list-style-type: none"> 1. Auto-thread lever binding. 2. Release spring disengaged or broken. 3. Eccentric pivot improperly adjusted. 	<ol style="list-style-type: none"> 1. Repair or replace auto-thread lever (Figure 19-14). 2. Engage spring (Figure 19-15) with locking lever, or replace spring. 3. Readjust pivot (para.24, step a).

Service Instructions

34. AUTOMATIC THREADING SYSTEM TROUBLES AND REMEDIES. (Continued)

Trouble	Probable Cause	Remedy
Loop restorer cycles continuously	<ol style="list-style-type: none"> 1. Shuttle retractor pin sticking; restorer out-of-adjustment. 2. Pressure plate binding on aperture plate edge guide. 	<ol style="list-style-type: none"> 1. Clean and lubricate pin. Adjust loop restorer (para.25). 2. Realign pressure plate.
Slack film in soundhead area	<ol style="list-style-type: none"> 1. Sprocket guards sticking or take-up jerking. 2. Soundhead jockey rollers sticking. 3. Soundhead improperly positioned. 	<ol style="list-style-type: none"> 1. Clean sprocket shoe pivots; check take-up torque and check for binding in take-up reel arm. 2. Clean and lubricate. 3. Reposition (para.15).
Film scratches	<ol style="list-style-type: none"> 1. Caked emulsion on film path parts. 2. Film chips in sprocket guards. 3. Scratches or burrs on film guides, guards, aperture or pressure plate. 4. Soundhead jockey rollers sticking. 	<ol style="list-style-type: none"> 1. Clean film path. 2. Remove film chips. 3. Polish with crocus cloth to remove burrs; replace part(s) if necessary. 4. Clean and lubricate.
Perforations checked	<ol style="list-style-type: none"> 1. Shuttle not retracting. 2. Excessive hold-back tension. 	<ol style="list-style-type: none"> 1. Adjust (para.24, step d). 2. Check for binding in front reel arm and correct.
Film dimpled between perforations	<ol style="list-style-type: none"> 1. Sprocket shoes sticking. 2. Shuttle not retracting. 3. Sprockets out-of-time. 4. Not enough pressure on leaf spring. 5. End of film leader not cut clean and square. 	<ol style="list-style-type: none"> 1. Clean sprocket shoe pivots. 2. Adjust (para.24, step d). 3. Retime (para.26). 4. Adjust spring (Figure 19-28). 5. Check film cutter; replace if dull or broken.
Film escape mechanism does not open to permit exit of film	<ol style="list-style-type: none"> 1. Film escape latching is out-of-adjustment. 	<ol style="list-style-type: none"> 1. Readjust (para.24, step e).
Film escape locking pawl does not seat properly, film exits constantly	<ol style="list-style-type: none"> 1. Torsion spring disconnected. 2. Locking pawl out-of-adjustment. 	<ol style="list-style-type: none"> 1. Reconnect torsion spring (Figure 20-10). 2. Readjust locking pawl (para.24, step e).