

TECHNICAL MANUAL
OVERHAUL INSTRUCTIONS

PROJECTOR

16-MM SOUND MOTION PICTURE
TYPE AQ-2A (1), TYPE AQ-2A (3)

(BELL & HOWELL)

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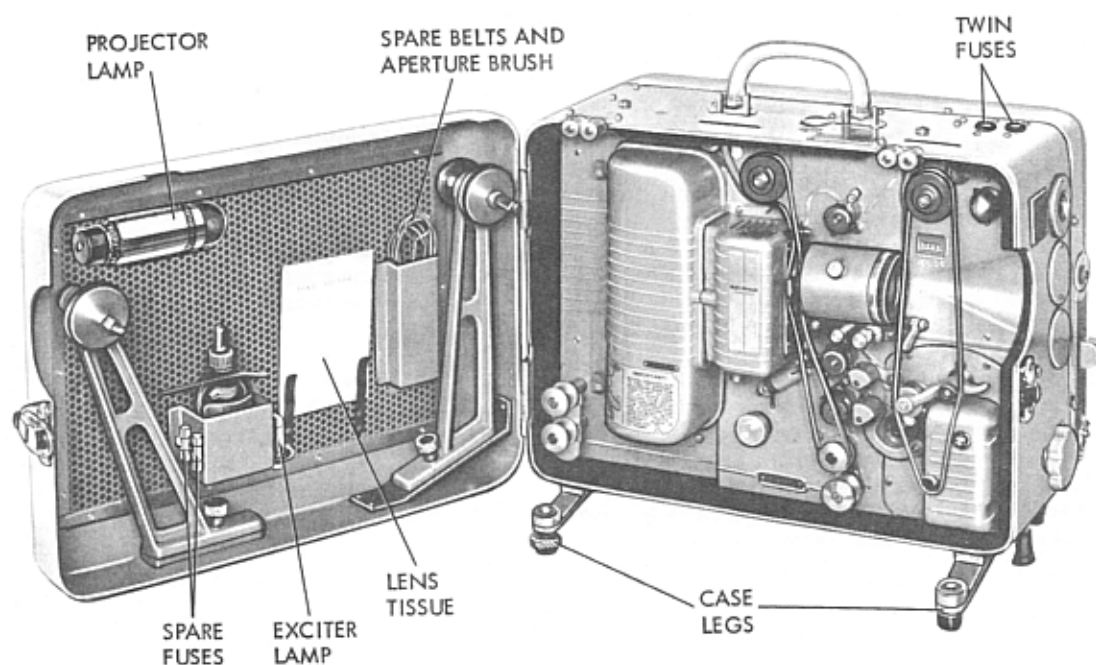


Figure 1-2A. Type AQ-2A(3) 16mm Projector with Case Door Open

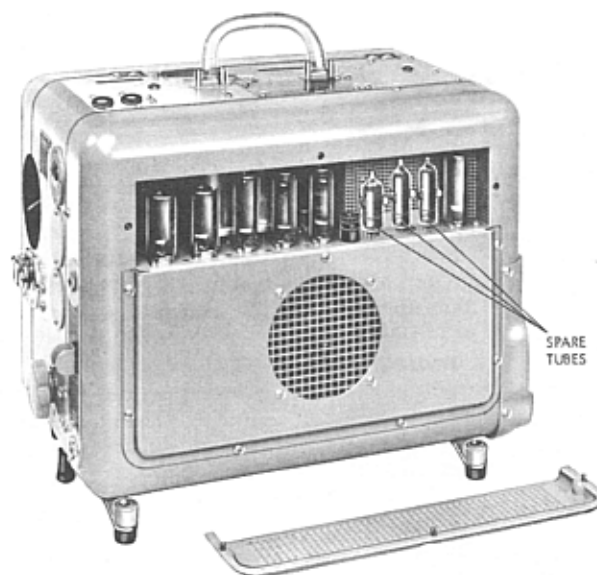


Figure 1-2B. Amplifier Tube Grille Removed-
Type AQ-2A(3) Projector

INTRODUCTION

This handbook provides operating and service instructions for the Types AQ-2A(1) and AQ-2A(3) 16-mm Sound Motion Picture Projectors (figures 1-1, 1-2 and 1-2A). The instructions cover operation, inspection, lubrication and maintenance services which can be performed by operating personnel.

The AQ-2A(1) and AQ-2A(3) projectors are manufactured by the Bell & Howell Company, Chicago, under their designations Design 614DB and 614AD, respectively. This portable equipment projects 16-mm sound motion picture film at a speed of 24 frames per second, and reproduces the sound recorded on the film sound track. The equipment is designed to aid in training, briefing and entertaining Air Force

personnel and may be operated in any average-sized room, small theater, or auditorium where the designated electrical power is available.

These instructions cover two variations of the Type AQ-2A(1) projector, which differ primarily in electrical circuitry (figures 4-9 through 4-12). The latest of these projectors, bearing serial numbers P99000 through P99576, are equipped with an octal plug (P102) and socket (J205) to facilitate conversion to magnetic sound reproduction. The AQ-2A(3) projector is very similar electrically to the latest AQ-2A(1) equipment, but has additional electrical refinements as noted in figures 4-13 and 4-14. Also note, in figure 1-2A, the twin fuses and the altered case leg design.

SECTION I

OPERATION

1-1. DESCRIPTION.

1-2. GENERAL. The projectors consist of a 16-mm sound motion picture projector, an integral amplifier and a 5-inch, 10-watt loudspeaker, all mounted in one portable case. This assembly, for the AQ-2A(1) projector, together with a 16-foot power cable assembly, and the maintenance parts and accessories shown in figure 1-3, are stored in a large carrying case for handling and storage (figure 1-1). For the AQ-2A(3) projector a duck cover is provided instead of the carrying case and the power cord and reel are held in a pocket on the side of this cover. The smooth finish aluminum case of the projector itself houses the projection and sound-optical systems. This case is composed of a main rectangular section with a hinged operating door on the right side. The amplifier-loudspeaker components are mounted on the left side of the projector case by means of nine screws. The carrying handle, tilt mechanism, and AC receptacle are mounted to the main section of the case. The inside of the projector operating door provides storage space for the reel arms, accessories, and various maintenance parts (figures 1-2 and 1-2A).

1-3. PROJECTOR MECHANISM PANELS. All of the mechanical subassemblies are mounted to the front and rear gray enameled aluminum castings. The sound head, film rollers and sprockets, projection lens, condensing lenses, film drive, and intermittent mechanism are mounted on the front mechanism panel casting. The lamphouse, projection lamp, reflector, projection drive motor and ventilating motor are mounted on the rear mechanism panel casting.

1-4. REEL ARMS. When the projector is not in use, the two reel arm assemblies are mounted to the inside of the front projector door as shown in figure 1-2. Both reel arms are provided with a spindle and a lock-latch for holding the reels in place. Friction is applied to the spindle on the feed reel arm to

maintain proper tension of the film as it is being pulled from the reel. The pulley is attached to the spindle as a means of rewinding the film. The pulley attached to the spindle of the take-up reel arm provides a means of taking up the film after it has run through the projector. Friction is applied to the take-up spindle to provide proper tension on the film take-up as the take-up reel becomes loaded with film and the weight of the reel increases.

1-5. DRIVE BELTS. Two drive belts are used in the projector — spring belts in the AQ-2A(1) projector and fabric belts in the AQ-2A(3) projector. The rewind belt rotates the film reel on the feed reel arm during the rewinding operation, and the take-up belt drives the take-up reel during projection. The take-up belt is the longer of the two. On the AQ-2A(3) projector, the small belt pulleys are provided with an eccentric for belt tension adjustment during initial "wear-in" of the belts.

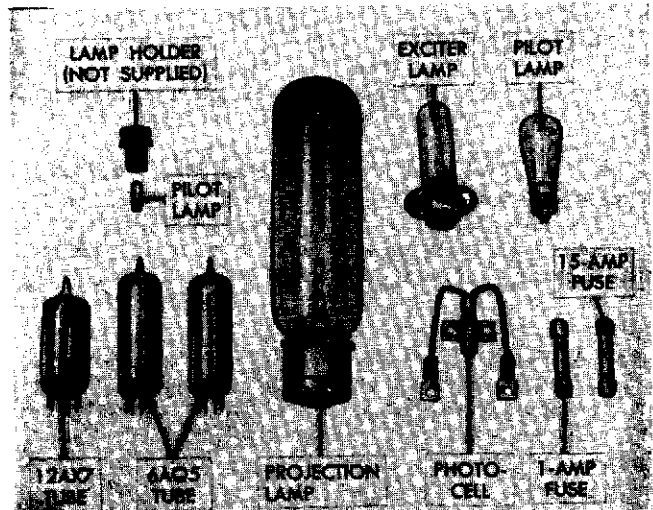
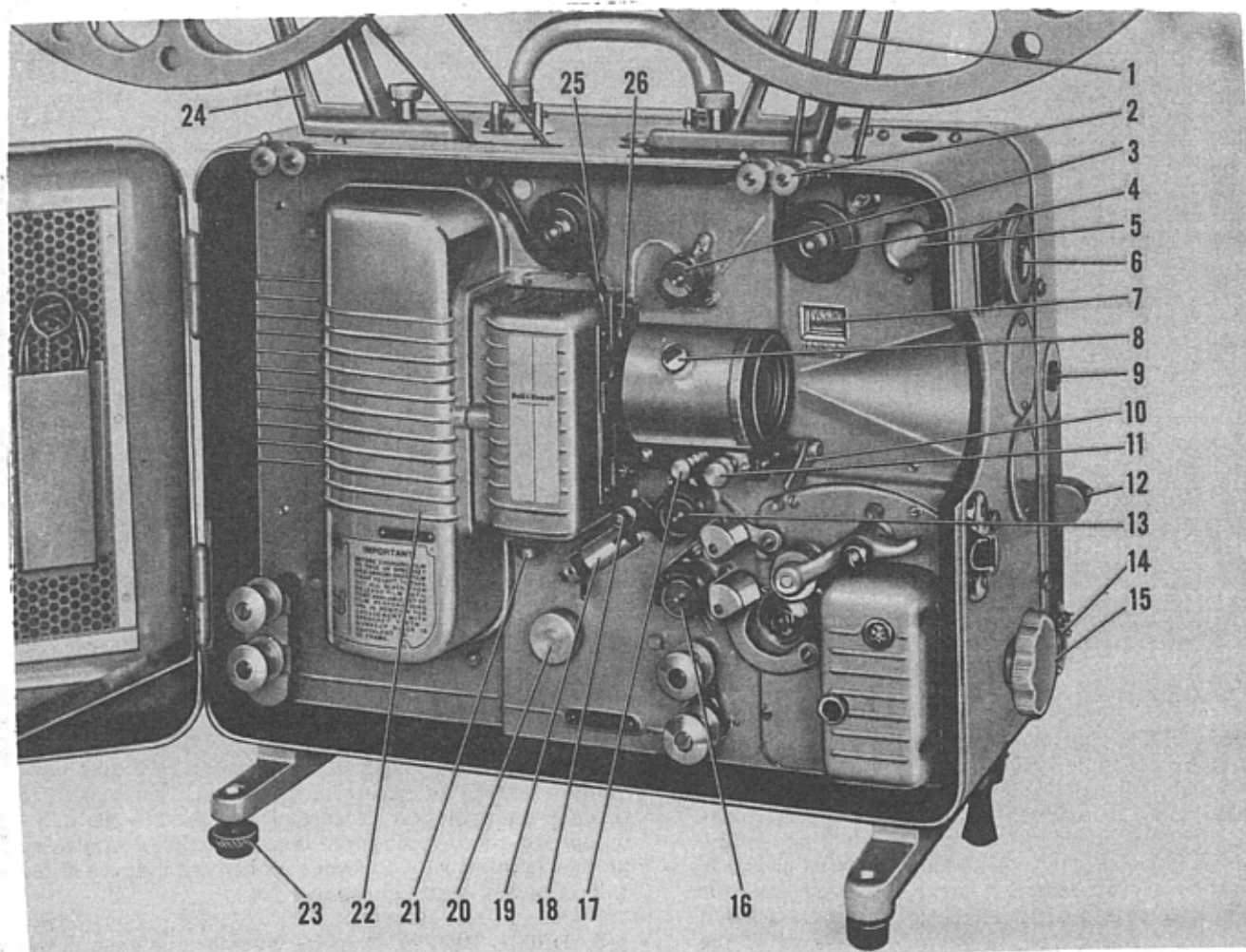


Figure 1-3. Projector Accessories and Spares



- | | | |
|-----------------------------|-----------------------------------|-------------------------------------|
| 1. Feed reel arm | 10. Pressure plate closing handle | 18. Loopsetter roller assembly |
| 2. Film guide rollers | 11. Focusing control knob | 19. Loopsetter positioning assembly |
| 3. Feed sprocket | 12. Loudspeaker selector switch | 20. Threading knob |
| 4. Spring belt drive pulley | 13. Sound sprocket | 21. Framing knob |
| 5. Projector threading lamp | 14. External speaker receptacle | 22. Projector lamphouse door |
| 6. Power receptacle | 15. Tilt control knob | 23. Levelling adjustment screw |
| 7. Hourmeter | 16. Take-up sprocket | 24. Take-up reel arm |
| 8. Lens locking screw | 17. Pressure plate release knob | 25. Aperture plate assembly |
| 9. Microphone input | | 26. Pressure plate assembly |

Figure 1-4. Identification of Parts on Projector Operating Side

1-6. FILM SPROCKETS AND STRIPPERS. Three film sprockets are used in the projector (figure 1-4). All three sprockets turn with a uniform velocity and therefore help move the film at a constant speed. The uppermost sprocket is the feed sprocket, which unwinds the film from the feed reel and maintains a loop of film above the film channel. The center sprocket is the sound-sprocket, which feeds the film to the sound head and maintains a loop of film of proper size below the film channel. The lower sprocket is the take-up sprocket, which moves the film away from the sound-head to the take-up reel. The film stripper rests on the hub of each sprocket where it does not interfere with the film. When film tears, it has a tendency to wrap itself around a sprocket.

The film stripper forces the film away from the sprocket, keeping it from damaging itself against the sprocket teeth.

1-7. SPROCKET SHOES. The sprocket shoes (figure 1-4) lock in position under the feed sprocket and over the sound and take-up sprockets to maintain registration between the film perforations and sprocket teeth. The shoes are designed to afford 140-degree coverage of the sprockets.

1-8. APERTURE PLATE AND APERTURE. The aperture plate assembly is shown in its normal operating position in figure 1-4. This is the film channel through which the film is moved before the aperture,

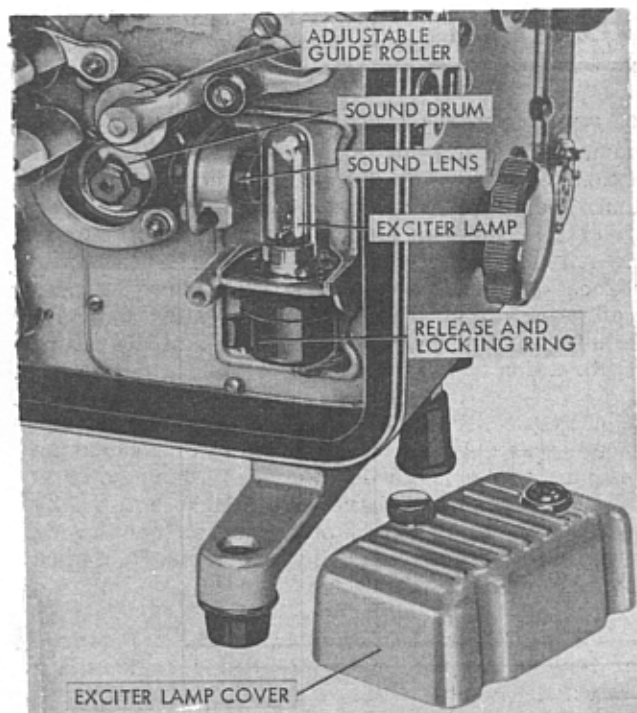


Figure 1-5. Sound Head and Exciter Lamp

1-19. **SOUND OPTICAL UNIT.** Light from the exciter lamp is imaged on the film sound track by the sound-optical unit (sound-lens) in the form of a light line scanning beam. (See figure 1-5.) The special type of sound lens used in this projector is of adequate depth of focus to produce the required frequency response characteristics from either side of the film without adjustment.

1-20. **OPTICAL LIGHT PIPE PRISM.** The optical light pipe prism is not discernible in figure 1-5, since it is positioned behind the sound drum. Its purpose is to concentrate all of the sound light beam into a small area and transmit this concentrated beam to the photo cell without loss.

1-21. **PHOTOCELL.** The AQ-2A(1) projectors are equipped with a lead sulphide photocell; the AQ-2A(3) projector is equipped with a germanium diode photocell. The purpose of the photocell is to convert light variations into variations in electrical currents, which are transmitted to the amplifier and loud-speaker where they are converted to sound energy.

1-22. **ADJUSTABLE FILM GUIDE ROLLER ASSEMBLY.** This assembly (figure 1-5) performs three important functions. First, it provides the proper tension to ensure that the film wraps around the sound drum sufficiently, and thereby prevents it from slipping on the drum. Second, it guides the film over the sound drum smoothly with the sound track protruding over the edge of the sound drum in the correct lateral position in relation to the scanning light beam. Third, it provides an adjustment for correctly positioning the film sound track laterally in relation to the scanning light beam in the event that the sound track is not confined to standardized limits.

1-23. **DRIVE MOTOR.** A universal, series-wound, governor-type motor is used for driving the projector mechanism. This motor guarantees speed constancy over voltage ranges from 100 to 130 volts. This range is especially advantageous where gasoline generator sets, with their varying frequency and voltage characteristics, are the source of power supply for the equipment.

1-24. **COOLING SYSTEM.** A separate motor is used to furnish power for the cooling system. The ventilating motor, with its blower fan or wheel, is in operation at all times when the projector is operating, except when the projector is in REWIND position. A cooling blast of air is blown continuously up around the projection lamp to carry away the heat generated by the lamp. In addition, it cools the condensing lenses, the aperture, and the film itself. Cooling air intakes are provided by the grille in the switch panel and air vents under the lamp house cover, shuttle cover, and in the base of the maintenance door.

1-25. **HOUR COUNTER.** The hour counter assembly is mounted at the rear of the front mechanism casting (figure 1-4) and is viewed from the front of the projector. The counter records up to 99999 hours of operation. It is mechanically coupled to the take-up and rewind drive chain sprocket which turns at constant speed while the projector mechanism operates. The hour counter is specifically useful in keeping track of the number of hours that the equipment has been in use.

1-26. **AMPLIFIER.** The amplifier of the AQ-2A(1) projector has a rated output of 8 watts; that of the AQ-2A(3) projector has a rated output of 7-1/2 watts. Total harmonic distortion does not exceed 2.0% at any frequency from 100 to 7500 cycles. The amplifier mounts at the rear of the projector case by means of nine screws. Ready access to the amplifier

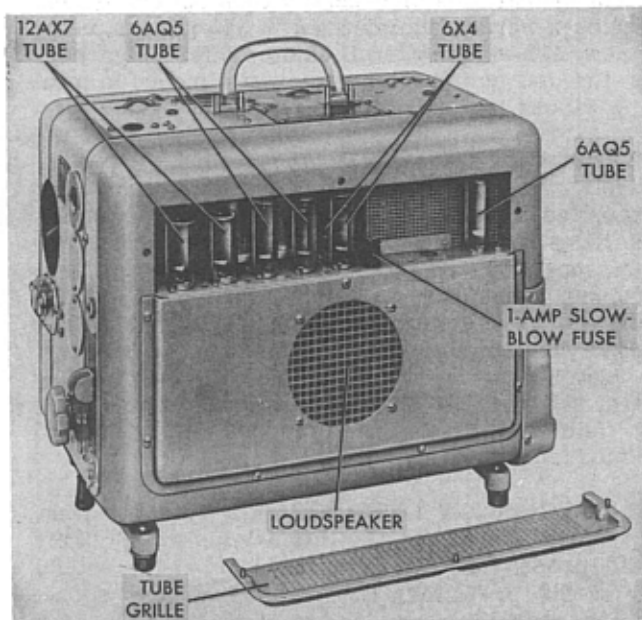


Figure 1-6. Amplifier Tube Grille Removed - AQ-2A(1) Projector

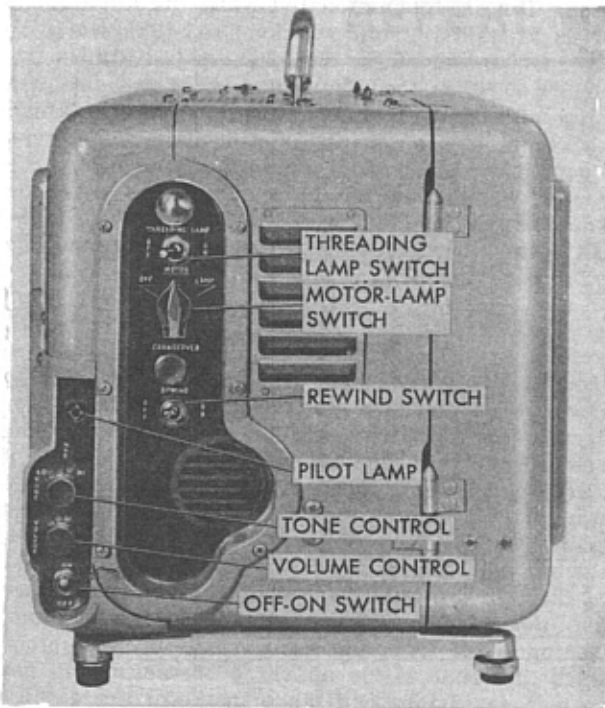


Figure 1-7. Projector - Amplifier Rear Controls

tubes and fuse is obtained by unlocking the three Dzus fasteners which hold the grille in place (figure 1-6). Access to electrical components (capacitors, resistors, switches, etc.) is obtained by removing the six screws holding the loudspeaker mounting cover to the main chassis.

1-27. LOUDSPEAKER. The loudspeaker (figure 1-6) is an integral part of the projector and is mounted to the removable service cover of the amplifier. The loudspeaker is a 5-inch, 10-watt, permanent magnet, moving voice coil type of speaker with an impedance of 8 ohms.

1-28. REAR OPERATING CONTROLS. All of the electrical switches for the projector are located at the rear of the operating switch panel. These switches include the THREADING LAMP, MOTOR-LAMP, and REWIND switches. The space marked CHANGEOVER has a non-functioning blank plug. The amplifier has two sets of operating controls. The control panel at the rear of the case, adjacent to the projector operating switch panel (figure 1-7), includes the following: A power switch (OFF-ON), a VOLUME control, and a TONE control (marked LO-NOR-HI). A pilot light is provided to illuminate these controls.

1-29. FRONT OPERATING CONTROLS. These controls (figure 1-8) include an input jack (marked MICROPHONE) for connecting a high impedance microphone or record phonograph, a loudspeaker selector switch (marked LOCAL SPEAKER ON - REMOTE SPEAKER ON), and an output receptacle (marked REMOTE SPEAKER) for connecting an external 16-ohm loudspeaker.

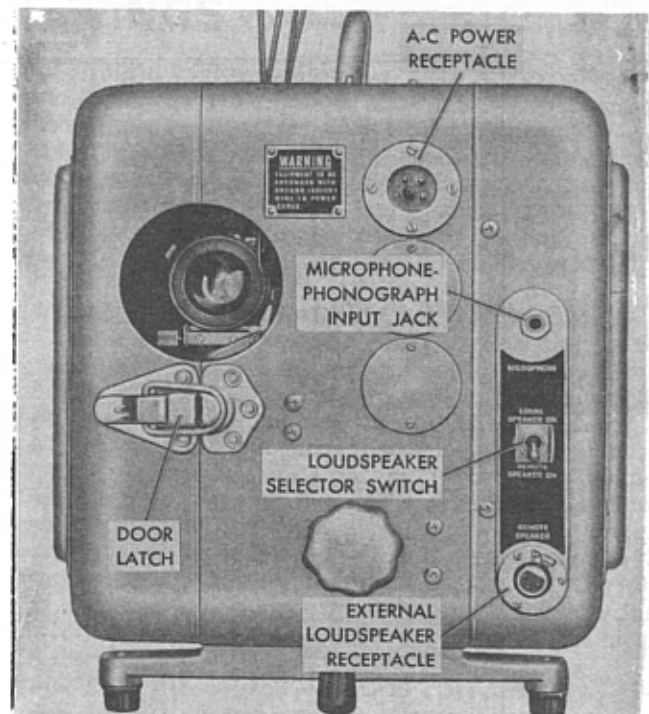


Figure 1-8. Amplifier Front Controls

1-30. TABLE OF LEADING PARTICULARS.

Power supply	105-129 v AC, 50-60 cycle
Power consumption	1050 w with 750 w lamp 1300 w with 1000 w lamp
Projection lens	2-inch, f/1.4
Film speed (sound only).	24 frames per sec.
Reel capacity (max.)	2000 ft. (1600 ft reel supplied)
Projection lamp.	750 w, 115 v, medium pre-focus base, rated 25 hours
Exciter lamp	6 volt, 1 amp, double contact
Threading lamp.	6 w, 120 v, candelabra base
Pilot lamp (projector)	6 w, 120 v, candelabra base
Photocell - AQ-2A(1)	Lead sulphide
Photocell - AQ-2A(3)	Photodiode
Projector fuse	15 amp
Drive motor.	5,554 rpm, with centrifugal governor
Blower motor	3-inch dia., 24-blade rotor
Amplifier output - AQ-2A(1).	8 w, less than 2% distortion
Amplifier output - AQ-2A(3)	7-1/2 w, less than 2% distortion
Input signal (amplifier).	0.180 volts with 20 db reserve gain
Sound head output impedance.	150,000 ohms
Amplifier frequency	$\pm 1-1/2$ db; 80 to 8000 cps
Tone Control:	
"Hi" range accentuation	6db (± 2 db) at 3500 cps
"Hi" range attenuation	10db (± 2 db) at 5000 cps
"Lo" range attenuation	12db (± 2 db) at 100 cps
Tube components	(2) 12AX7 (V201, V202) (3) 6AQ5 (V203, V204, V205) (2) 6X4 (V206, V207)
Pilot lamp (amplifier)	6 to 8 volts
Amplifier fuse - early AQ-2A(1)	1 amp slow-blow
Amplifier fuse - late AQ-2A(1).	0.8 amp slow-blow
all AQ-2A(3)	
Speaker	5-inch, 10 watt, permanent magnet type with 8 ohm impedance

1-31. PRINCIPLES OF OPERATION.

1-32. GENERAL. The principles involved in the making and showing of 16-mm motion picture sound films are not included, since such material is considered fundamental text book information available to all operating personnel. Following is a brief discussion of the actual mechanical process involved in the reproduction of sound and picture as accomplished by the type AQ-2A (1) Projector.

1-33. INTERMITTENT MECHANISM OPERATION. A shuttle and actuating cam arrangement is used to advance and position the film in front of the picture aperture. Each frame of film is held for an instant in front of the aperture, and then pulled away very rapidly. This sequence proceeds at a rate of 24 frames per second. In the film threading process, two loops of film are formed: one above the picture channel, and one below the picture channel. These film loops ensure that the film will pass the aperture intermittently. Also, the lower loop of film, when correctly sized, guarantees proper synchronization of sound and picture.

1-34. AUTOMATIC LOOP FORMING OPERATION. It is essential that a lower loop of film of conventional size be formed immediately below the picture channel (between the intermittent movement and the sound feed sprocket) in order to maintain synchronization between the picture and sound. It is the function of the loopsetter roller and its attached lever arm to control the size of this loop. The loopsetter lower lever arm may be indirectly depressed or operated by the loopsetter pushbutton on top of the projector case. The loopsetter lower lever arm must be limited as to the maximum distance it can be depressed, otherwise a larger than conventional lower loop would be formed and thus result in a loss of synchronization between picture and sound. This is primarily the function of the loopsetter positioning assembly. When this assembly is adjusted correctly, the lower film loop formed will result in a film distance of 26 frames between the picture aperture and sound scanning point. The loop positioning adjustment lever provides a range of adjustment in a ninety-degree movement. Low-shrink

or new film is accommodated when the adjustment lever is at its maximum position away from the projector mechanism plate. Shrunk or old film is accommodated when the adjustment lever is depressed parallel with the mechanism plate. The setting which will accommodate most film is midway between these two positions. After this adjustment is made, the loopsetter pushbutton should be depressed to set the correct length of the lower loop to result in a 26-frame distance between the projected picture and the sound scanning point.

1-35. PROJECTION OPTICAL SYSTEM OPERATION. A typical projection optical system is illustrated in figure 1-9. A high-wattage concentrated filament lamp located behind the film provides the light beam for projecting the film image on the screen. Condensing lenses concentrate the light from the filament of the projection lamp on the picture area, and a reflector placed behind the lamp recovers the light emanating to the rear of the lamp, which otherwise would be lost. The recovered light is directed forward through the optical system. An aperture plate masks the beam of projected light from the lamp, screening it off from all except the film frame positioned in front of the aperture opening. This results in a maximum brilliance in the projected picture. The projection lens, in front of the film, focuses the image of the film frame on the screen. The size of the projected image is determined by the distance of the projector from the screen and by the focal length of the projection lens.

1-36. SOUND OPTICAL SYSTEM OPERATION. The sound motion picture projector has a second optical system in addition to the one used to project the picture onto the screen. It is called the sound-optical system. In running through the projector, the film sound track passes in front of the sound optical unit (sound lens) which focuses a beam of light from the exciter lamp onto the sound track. This beam of light passes through the film and is reflected, by means of a mirror or prism, onto the photo cell. This light beam is called a scanning beam. The variations of light intensity control the volume of electrical impulses to the amplifier, whereas the rapidity of change gives the pitch and tone and thus

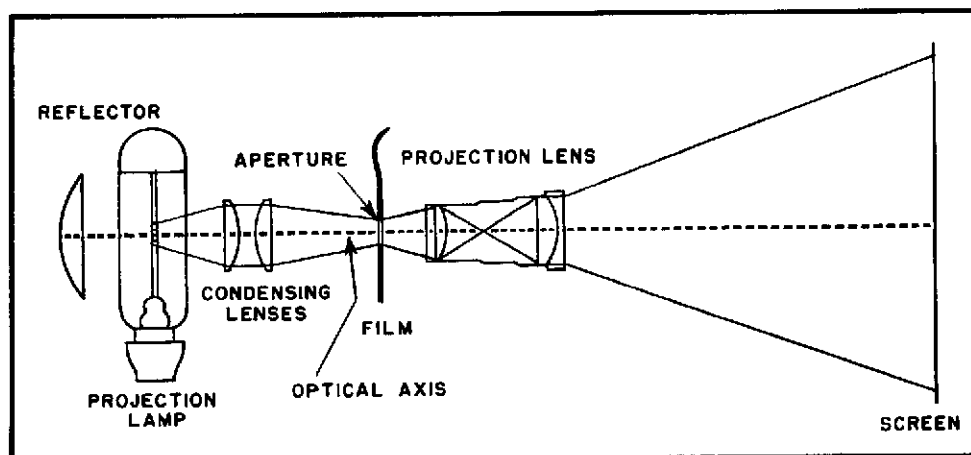


Figure 1-9. Typical Projection Light Optical System

SECTION I
INTRODUCTION

1-1. IDENTIFICATION.

1-2. This handbook provides complete overhaul and testing instructions for the Type AQ-2A(1) 16-mm Sound Motion Picture Projector, manufactured by the Bell & Howell Company, Chicago, under their model designation Design 614-DB. See figure 1-1 for overall view of equipment.

1-3. PURPOSE.

1-4. The projector is designed as an aid in training, briefing and entertaining Military personnel and can be operated in any average-sized room, small theatre, auditorium or aircraft hanger when specified electric power is available.

1-5. ADDITIONAL MODELS.

1-6. Sections I, II and III of this handbook contain overhaul and test instructions for the Type AQ-2A(1) projector set. Overhaul and test instructions for additional models are provided in Section IV by the use of Difference Data Sheets. The additional models included in Section IV are listed in Section IV.

1-7. TABLE OF LEADING PARTICULARS.

Film size	16-mm
Film reel capacity	2000 feet
Film speed	24 frames-per-second
Power supply	105-129 volts, 50-60 cycles
Power consumption	1050 watts
Projection lamp (25 hr. life)	750-watt, 115-volt
Exciter lamp	6-volt, 1-amp
Threading lamp	120-volt, 6-watt
Photocell	Lead sulphide, photo-resistive cell, 80 volts
Projector fuse (1 req'd)	15 amp
Amplifier fuse (1 req'd)	1-amp, slow-blow
Drive motor	Centrifugal governor, universal type
Ventilation	24-blade, motor-driven, 3-inch diameter rotor
Amplifier input	0.4 volts
Power output	8 watts
Sound head output impedance	150,000 ohms
Tube complement	(2) JAN12Ax7, (2) JAN6x4 and (3) JAN6005/6AQ5W/6095
Overall dimensions	14-1/2" high, 12-1/8" wide, 16-1/4" long
Weight	48 lbs.

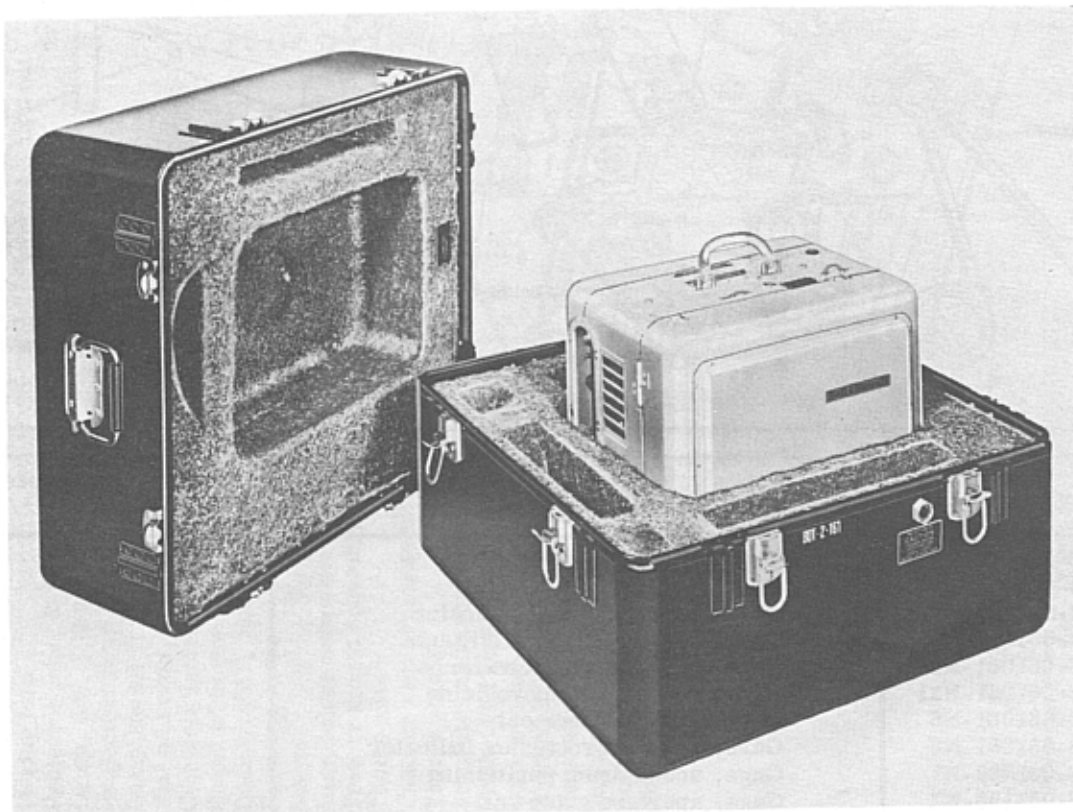


Figure 1-1. Type AQ-2A(1) Projector and Carrying Case

SECTION II

OVERHAUL INSTRUCTIONS

2-1. SPECIAL TOOLS.

2-2. The special tools illustrated in figure 2-1 are required to perform the overhaul procedures outlined in this handbook. Refer to the key to figure 2-1 for proper part number and nomenclature of tools.

2-3. GENERAL OVERHAUL INSTRUCTIONS.

2-4. The following procedures provide for the complete disassembly of the 16-mm projector, with each of its major components treated separately. Before performing all of the steps in the disassembly sequence, first attempt to localize the trouble by analyzing the failure report with reference to the trouble shooting chart (paragraph 3-59), the amplifier trouble analysis chart (Table III) and the equipment characteristics tests (Tables VII, VIII

and IX) at the end of Section III. If a complete overhaul of equipment is indicated, perform the operations specified in the following paragraphs. Obvious disassembly of miscellaneous parts will not be discussed.

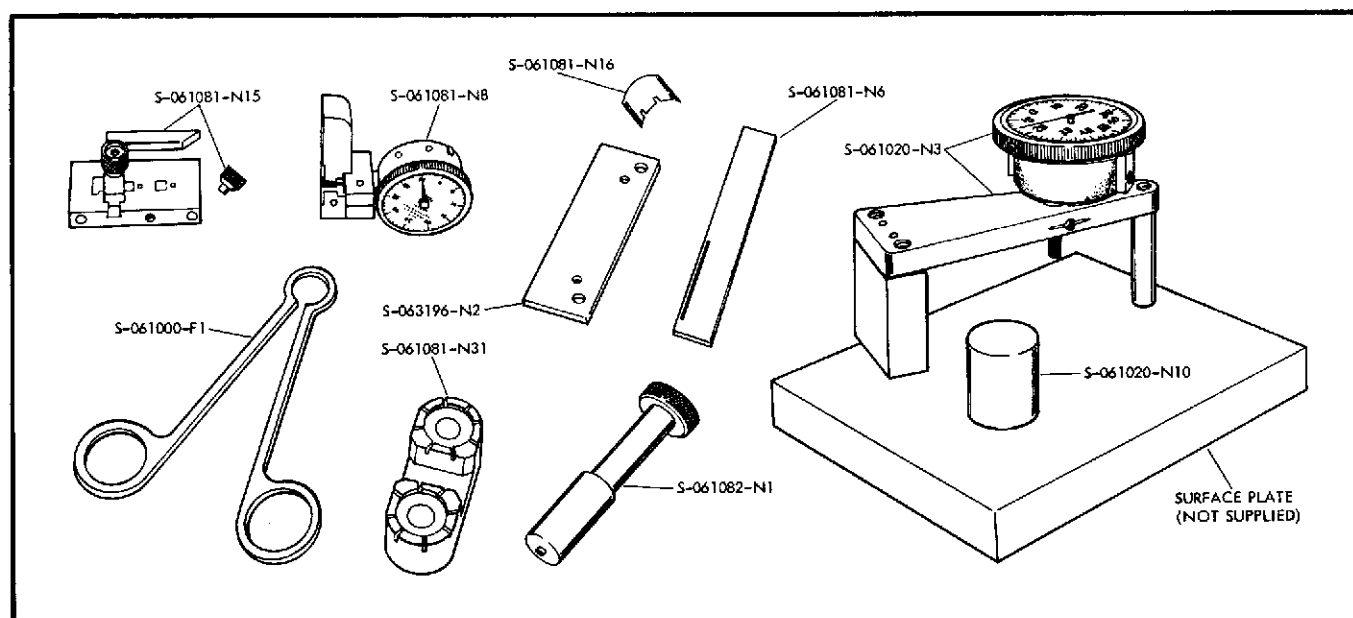
2-5. REMOVAL OF MAJOR COMPONENTS.

2-6. PROJECTION LAMP PARTS. (See figure 2-2.)

a. Open lamphouse door. Press down on projection lamp (9) and twist counterclockwise to remove it from lamp socket (10).

b. If necessary to replace lamp socket (10), remove two screws (11), lift up socket and disconnect lead-wires.

c. The complete lampholder assembly (12) is secured to mechanism plate with two screws (13) and lock washers (14).



Part Number	Nomenclature	Procuring Service Stock Number
S-061000-F1	Tool, sound optical	
S-061020-N10	Block, master	
S-061020-N3	Gage, front camshaft indicator	
S-061081-N15	Gage, shutter and intermittent	
S-061081-N16	Gage, sprocket film clearance	
S-061081-N31	Gage, sprocket synchronizing	
S-061081-N6	Gage, shuttle alinement	
S-061081-N8	Gage, shutter protrusion indicator	
S-061082-N1	Gage, sound drum positioning	
S-063196-N2	Gage, aperture guide rail	

Figure 2-1. Special Overhaul Tools for Type AQ-2A(1) Projector

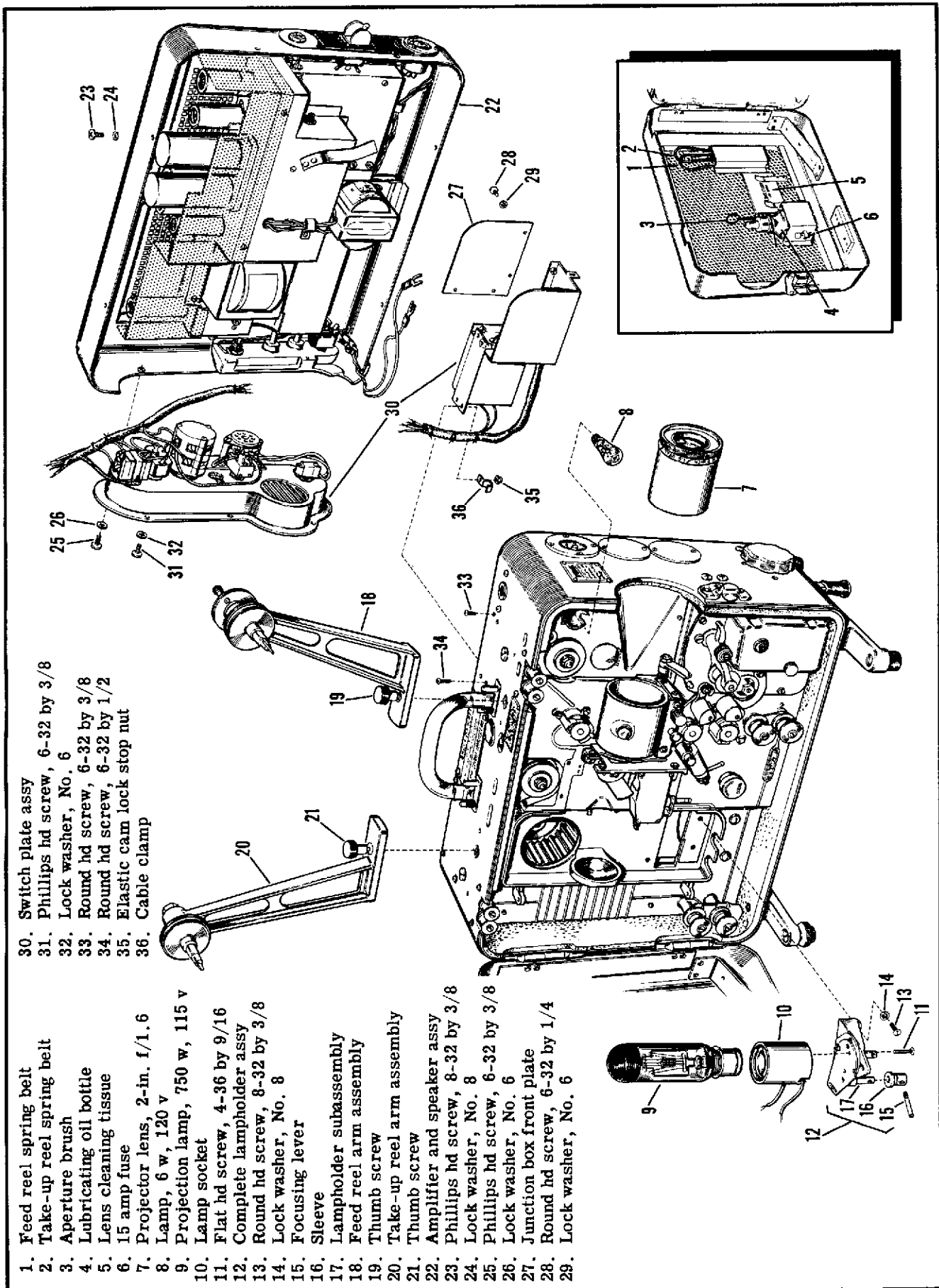


Figure 2-2. Removing Projection Lamp, Reel Arms, Amplifier and Switch Plate

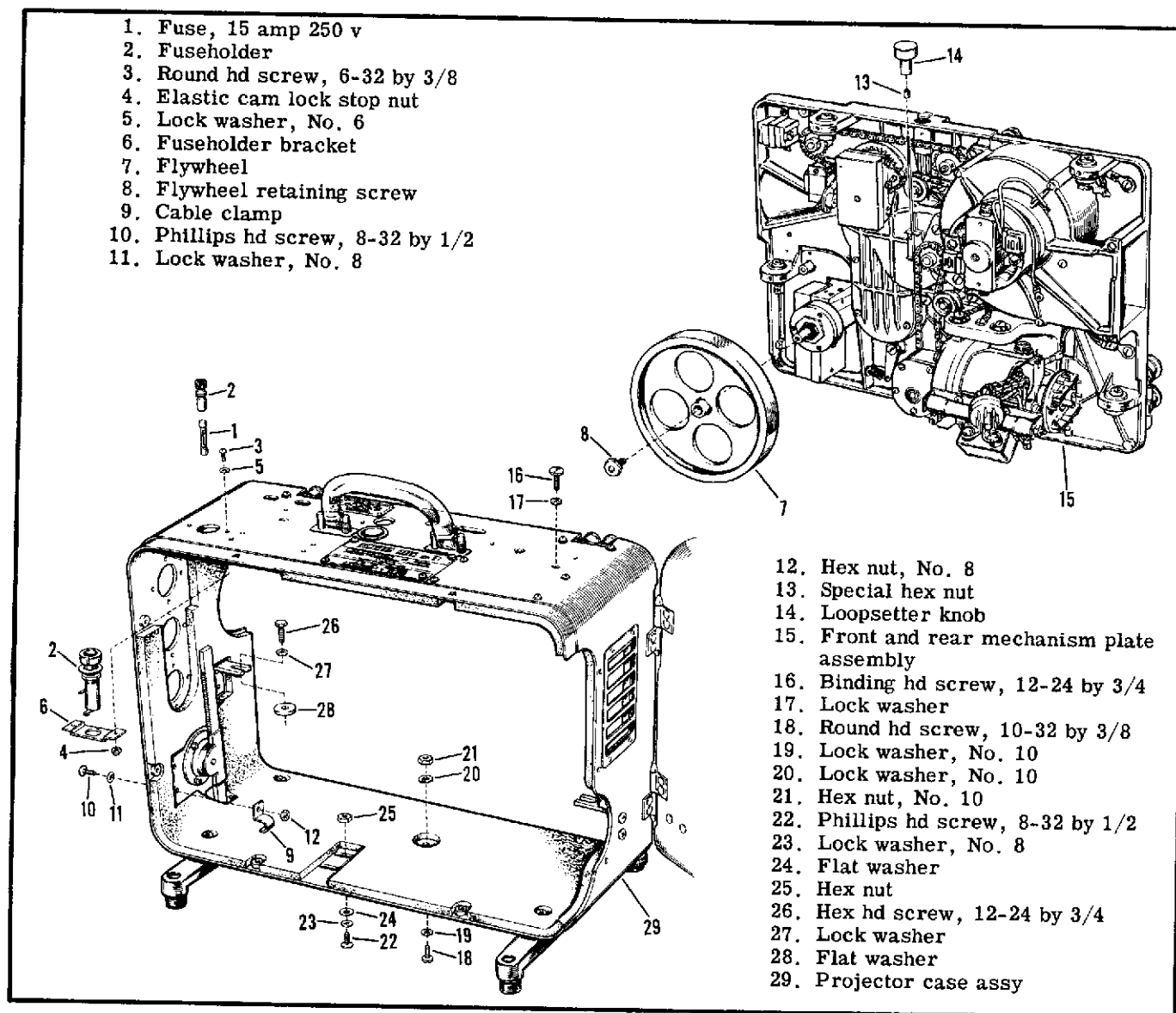


Figure 2-3. Removing Mechanism Plate Assembly from Case.

Key for Figure 2-4

- | | | |
|-------------------------|--------------------------------------|----------------------------------|
| 1. Lamphouse cover | 11. Special screw | 22. Lock washer, No. 10 |
| 2. Heat shield | 12. Lock washer, No. 4 | 23. Plain washer |
| 3. Spacer | 13. Threading knob | 24. Drive chain |
| 4. Speed nut | 14. Set screw, 8-32 by 1/8 | 25. Blower motor and cover assy |
| 5. Light baffle | 15. Ground wire cable | 26. Round hd screw, 6-32 by 3/8 |
| 6. Speed nut | 16. Round hd screw, 10-32 by 1/4 | 27. Lock washer, No. 6 |
| 7. Spacing collar | 17. Lock washer, No. 10 | 28. Rear mechanism plate assy |
| 8. Light baffle | 18. Fillister hd screw, 10-32 by 5/8 | 29. Round hd screw, 10-32 by 1/2 |
| 9. Cover subassembly | 19. Lock washer, No. 10 | 30. Lock washer, No. 10 |
| 10. Sound head assembly | 20. Drive motor assy | 31. Front mechanism plate assy |
| | 21. Round hd screw, 10-32 by 5/8 | |

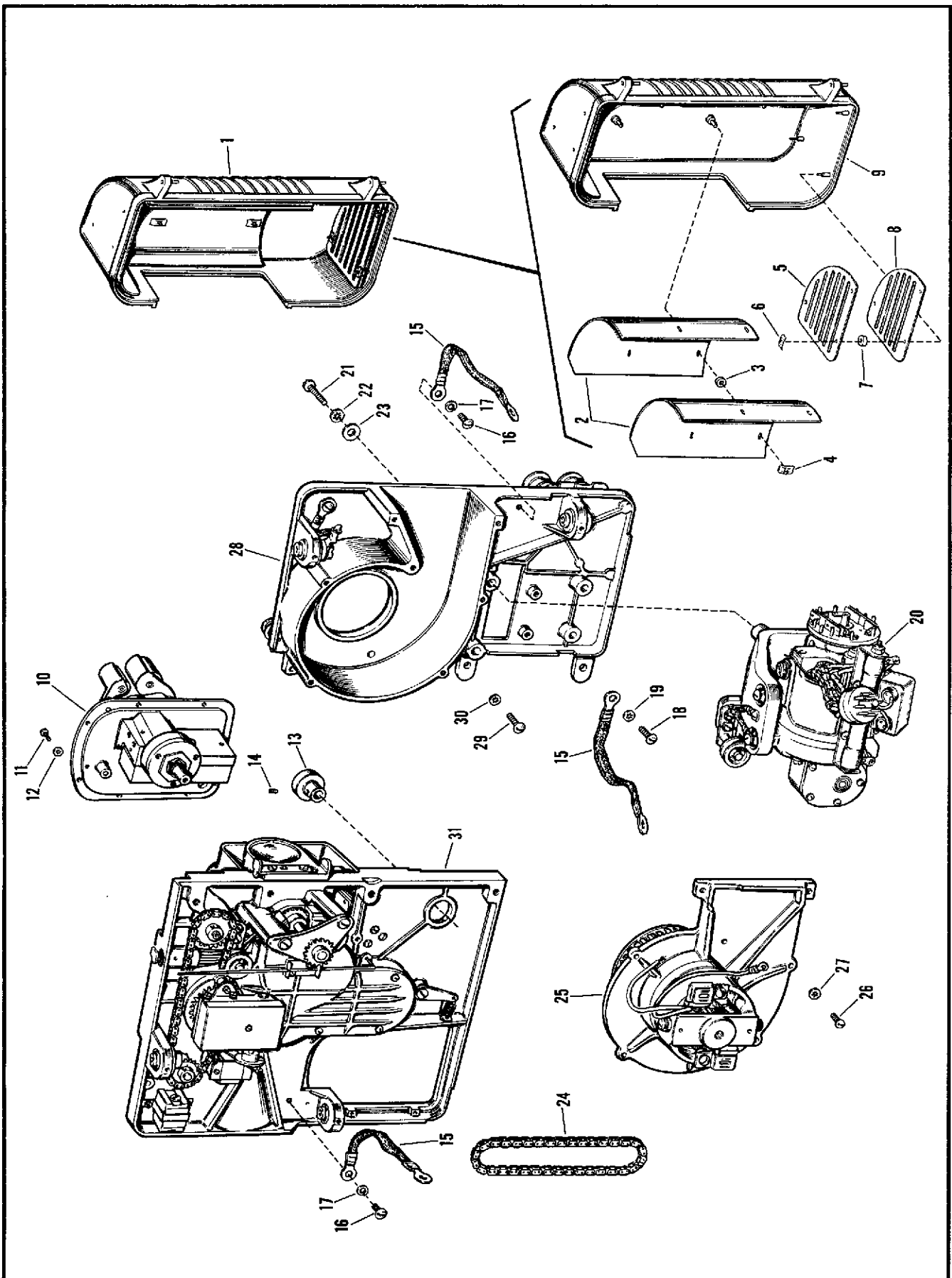


Figure 2-4. Removing Sound Head, Drive Motor and Blower Motor

2-7. FEED AND TAKE-UP REEL ARMS. (See figure 2-2.) The reel arms (18 and 20) are normally stowed in the projector case door when not in use, and are fastened down by means of the thumb screws (19 and 21).

2-8. AMPLIFIER AND SPEAKER ASSEMBLY. (See figure 2-2.) The amplifier housing is secured to the projector case by six screws (23) and lock washers (24) located at the top, front and bottom of the case and three screws (25) and lock washers (26) which also serve to fasten one edge of the switch plate (30) to the amplifier case. Remove these screws and carefully pull the amplifier away from the projector case until the leadwires are exposed. Disconnect leadwires as required, and separate the amplifier assembly from the projector case.

2-9. SWITCH PLATE ASSEMBLY. (See figure 2-2.) Remove screws (28), lock washers (29) and junction box front plate (27). Remove screws (33 and 34), elastic cam lock stop nuts (35) and cable clamp (36) to free junction box. Unsolder fuseholder and receptacle leadwires within the junction box. Note wiring harness connections to various projector components. Two small, shielded wires from sound head assembly must be disconnected at the OFF-MOTOR-LAMP switch and unwound from harness. The ground terminal at one end of large, shielded harness is fastened to mechanism plate just behind projection lamp socket. Two leadwires must be disconnected from the lampholder behind the junction box. The two blower motor leadwires must be disconnected at the OFF-MOTOR-LAMP switch. Remove three switch plate screws (31) and lock washers (32), and carefully lift complete switch plate assembly (30), with wiring harness, from projector.

2-10. FRONT AND REAR MECHANISM PLATE ASSEMBLY. (See figure 2-3.)

- a. Loosen special hex nut (13) and remove loopsetter knob (14) from loopsetter rod.
- b. Remove flywheel retaining screw (8) and carefully remove flywheel (7) from stabilizer shaft.
- c. Check all leadwires and cables, loosening any

cable clamps or freeing any leadwire terminals that might prevent removal of the mechanism plate.

d. Remove two binding head screws (16) and lock washers (17) and two hex head screws (26), lock washers (27) and flat washers (28) that secure the mechanism plate at the four vibration mounts.

e. Remove mechanism plate (15) through the door side of the projector - not through the amplifier opening.

2-11. SOUND HEAD ASSEMBLY. (See figure 2-4.) The sound head assembly (10) is fastened into the mechanism plate with seven special screws (11) and lock washers (12). Remove carefully to avoid damage to the sound drum.

2-12. DRIVE MOTOR ASSEMBLY. (See figure 2-4.) Loosen set screw (14) and remove threading knob (13). Loosen the two screws in the idler roller bracket at the top of the drive motor, and shift bracket to the right to remove tension from drive chain (24). Disengage chain from sprocket above motor. Remove four screws (21), lock washers (22) and plain washers (23), supporting the drive motor to prevent it from falling. Carefully remove drive motor, disengaging drive chain from flexible drive coupling.

2-13. BLOWER MOTOR AND COVER ASSEMBLY. (See figure 2-4.) The blower motor and cover assembly (25) is held in place by seven screws (26) and lock washers (27). Remove this assembly.

2-14. REAR MECHANISM PLATE ASSEMBLY. (See figure 2-4.) The rear mechanism plate assembly (28) is secured to the front mechanism plate assembly (31) with four screws (29) and lock washers (30). Separate the two mechanism plates.

2-15. COUNTER AND COUNTER DRIVE MECHANISM. (See figure 2-5.) Remove two each of screws (9 and 14) and lock washers (10 and 15) and lift assembled counter (8) and counter drive mechanism (13) from mechanism plate. Do not disassemble counter drive arm (11) from counter (8) unless one or the other of these two parts requires replacement.

Key for Figure 2-5

- | | | |
|--------------------------------------|-----------------------------------|---------------------------------|
| 1. Idler pulley | 18. Set screw, 8-32 by 7/8 | 36. Special screw |
| 2. Idler pulley stud | 19. Drive chain | 37. Lock washer |
| 3. Lampholder | 20. Rewind sprocket | 38. Loop setter rod |
| 4. Round hd screw, 4-36 by 3/8 | 21. Set screw, 8-32 by 1/8 | 39. Condenser lens assy |
| 5. Hex nut, No. 4-36 | 22. Feed pulley assy | 40. Pressure plate assy |
| 6. Lock washer, No. 4 | 23. Fiber washer | 41. Aperture plate assy |
| 7. Lamp bracket | 24. Take-up chain sprocket | 42. Lens holder stop plate |
| 8. Ratchet counter | 25. Set screw, 8-32 by 1/8 | 43. Special screw |
| 9. Round hd screw, 4-36 by 3/8 | 26. Take-up pulley assembly | 44. Lock washer, No. 4 |
| 10. Lock washer, No. 4 | 27. Fiber washer | 45. Lens holder assembly |
| 11. Counter drive arm | 28. Idler assembly | 46. Friction button |
| 12. Fillister hd screw, 3-48 by 5/16 | 29. Binding hd screw, 8-32 by 1/2 | 47. Friction spring |
| 13. Counter drive mechanism assy | 30. Flat washer | 48. Guide disc |
| 14. Round hd screw, 6-32 by 1/4 | 31. Lock washer, No. 8 | 49. Lens mounting assy |
| 15. Lock washer, No. 6 | 32. Idler roller | 50. Special screw |
| 16. Mounting stud | 33. Retaining ring | 51. Round hd screw, 4-36 by 1/4 |
| 17. Drive sprocket | 34. Idler arm subassembly | 52. Lock washer, No. 4 |
| | 35. Loop setter bracket | |

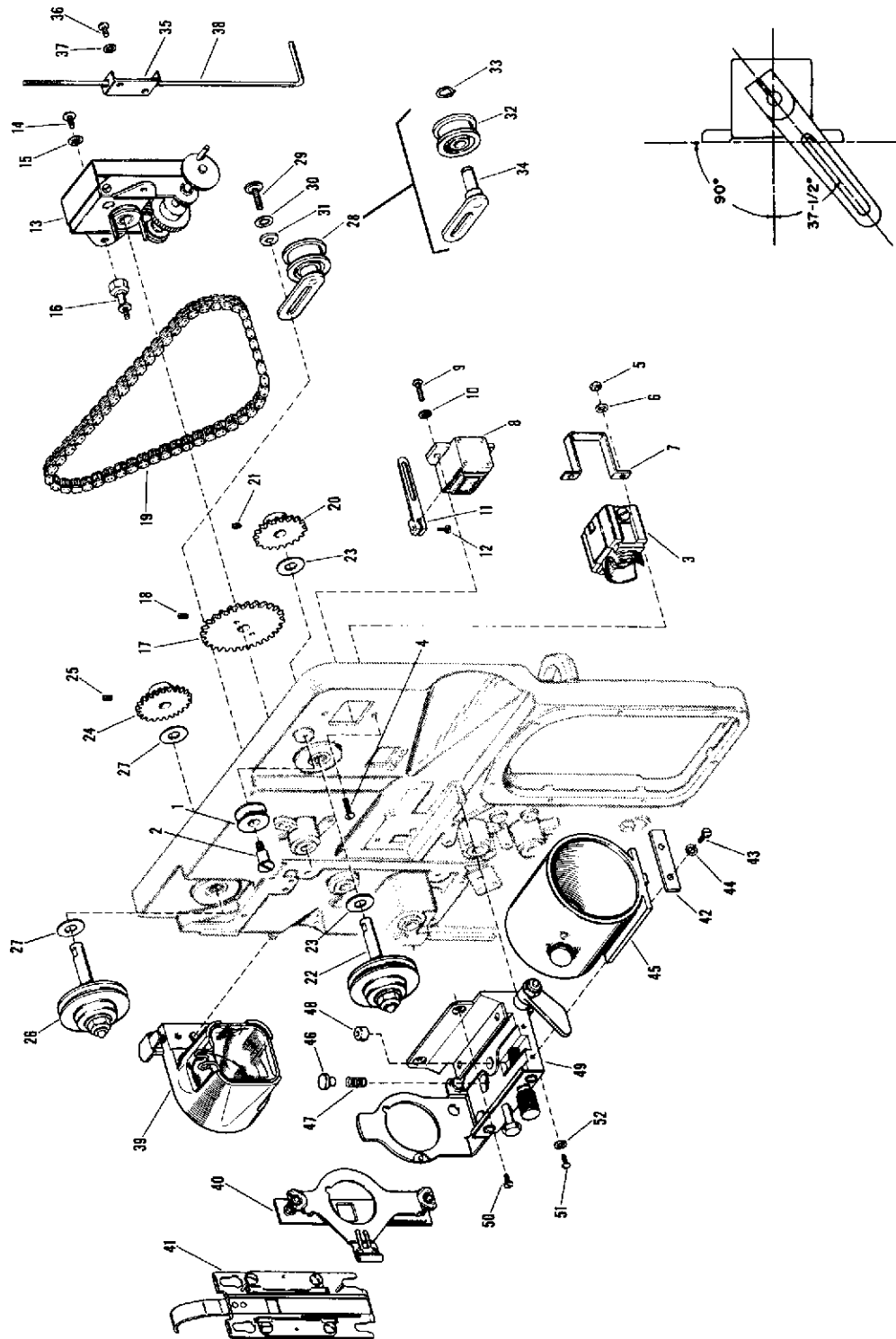


Figure 2-5. Removing Pulleys, Film Counter, Aperture Plate and Pressure Plate

2-16. FEED AND TAKE-UP PULLEY ASSEMBLIES. (See figure 2-5.) Loosen two screws (29) so that idler assembly (28) can be shifted to the right, thereby removing tension from drive chain (19). Slip drive chain from sprockets (17, 20 and 24). Loosen set screws (21 and 25), and remove sprockets (20 and 24), pulleys (22 and 26) and thrust washers (23 and 27) from mechanism plate.

2-17. CONDENSER LENS ASSEMBLY. (See figure 2-5.) Place thumb of left hand on top of condensing lens lock lever and fingers beneath lens housing. Press down on lock lever to compress lock spring and pull condenser lens assembly (39) toward rear edge of mechanism plate until it comes free.

2-18. PRESSURE PLATE ASSEMBLY. (See figure 2-5.) Open film channel by pulling out on pressure plate release knob located on lens mounting assembly (49). Grasp handle of pressure plate (40) and pull outward gently and evenly to remove it from projector.

2-19. APERTURE PLATE ASSEMBLY. (See figure 2-5.) Retract shuttle teeth by manually turning the mechanism drive sprocket on back of mechanism plate. Grasp thumb handle at top of aperture plate

(41) and gently pull upward - then outward - until aperture plate is free of mechanism plate.

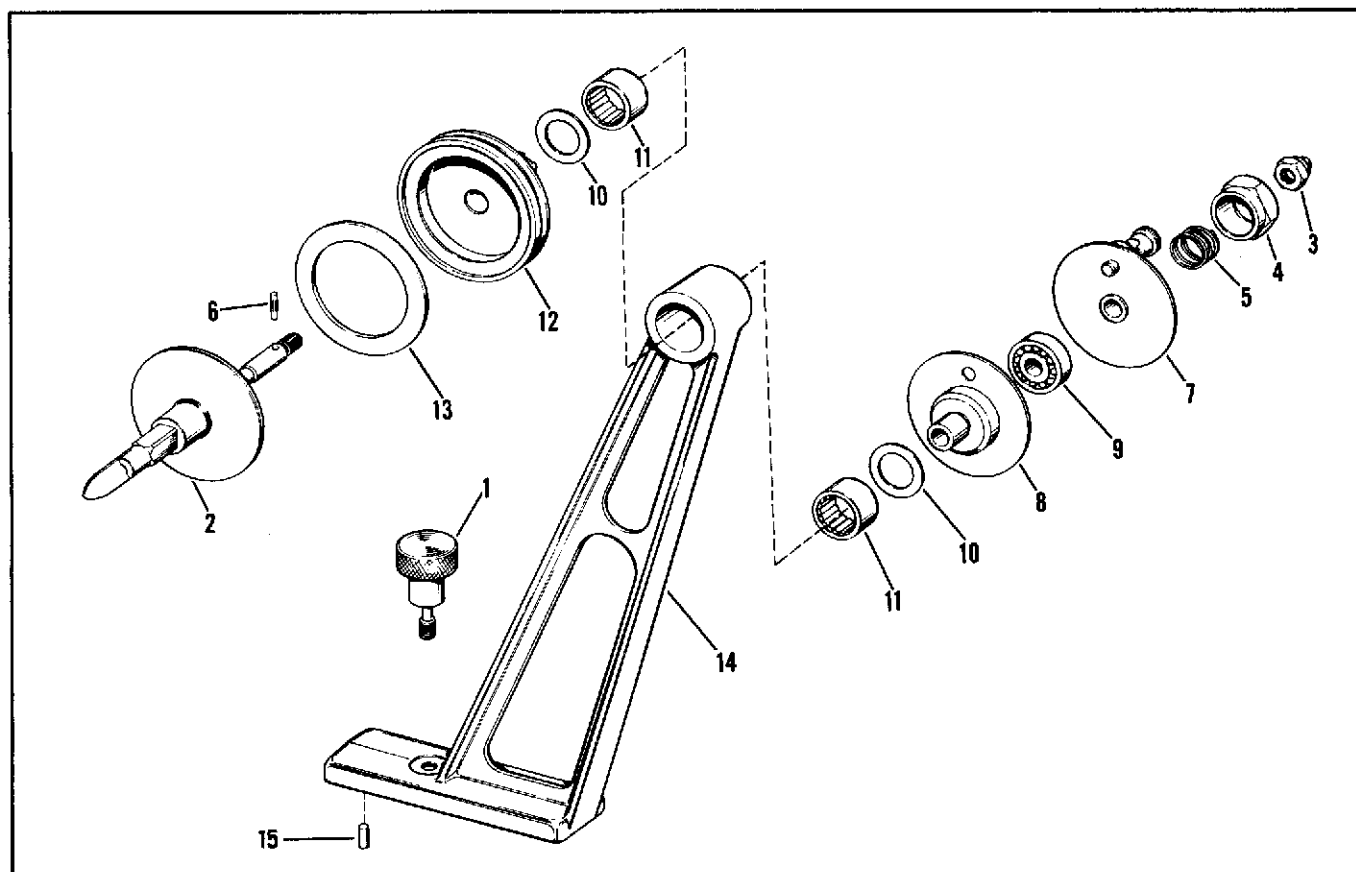
2-20. LENS HOLDER ASSEMBLY. (See figure 2-5.) Remove two screws (43), lock washers (44) and the lens holder stop plate (42). Slowly rack the lens holder assembly (45) forward by turning the knurled focusing knob on the lens mounting assembly (49) until the lens holder assembly is free. Be careful not to lose the friction button (46) and friction spring (47) located in a recess in the mounting assembly.

2-21. LENS MOUNTING ASSEMBLY. (See figure 2-5.) Remove three screws (50 and 51) and one lock washer (52) and lift the lens mounting assembly (49) from the mechanism plate. Invert mounting assembly and permit guide disc (48) to drop into hand.

2-22. FEED REEL ARM ASSEMBLY REPAIR.

2-23. DISASSEMBLY. (See figure 2-6.)

- a. Remove nuts (3 and 4) and spring (5).
- b. Tap out the driving pin (6) and remove spindle clutch assembly (7), clutch plate subassembly (8), and thrust washer (10). If necessary, press ball bearing (9) from clutch plate subassembly.



- | | | |
|---------------------|-----------------------------|---------------------|
| 1. Thumb screw | 6. Driving pin | 11. Thrust bearing |
| 2. Spindle assy | 7. Spindle clutch assy | 12. Spindle pulley |
| 3. Elastic stop nut | 8. Clutch plate subassembly | 13. Friction washer |
| 4. Tension nut | 9. Ball bearing | 14. Arm subassembly |
| 5. Tension spring | 10. Thrust washer | 15. Alining pin |

Figure 2-6. Feed Reel Arm Assembly

c. Remove spindle assembly (2), pulley (12), friction washer (13) and thrust washer (10). If necessary press thrust bearings (11) from arm (14).

2-24. **CLEANING AND INSPECTION.** Clean all parts thoroughly in dry cleaning solvent (Federal Specification P-S-661), and allow parts to dry thoroughly. Inspect parts for actual physical damage; wear is not a vital factor in determining replacement. Press bearings onto wooden dowels of snug fit and spin the bearing, noting any roughness in rotation which would indicate bearing balls or rollers with flat spots.

2-25. **REPAIR OR REPLACEMENT.** Repair of parts is not practicable; replace damaged parts.

2-26. **LUBRICATION.** Apply a very light coating of grease (Military Specification MIL-G-3278) to both sides of thrust washer (10), and to the bearings (9 and 11).

2-27. **REASSEMBLY.** (See figure 2-6.) Reassemble the parts in reverse order of disassembly, noting the following special precautions:

- a. After installing spindle tension nut (4), tighten this nut just enough so that, when the pulley (12) is held, the spindle can be turned manually.
- b. Tighten elastic stop nut (3) up against spindle tension nut (4), but do not overtighten. Spindle (2)

must turn freely and must have approximately 1/32-inch end play (in and out of arm).

2-28. TAKE-UP REEL ARM ASSEMBLY REPAIR.

2-29. **DISASSEMBLY.** (See figure 2-7.)

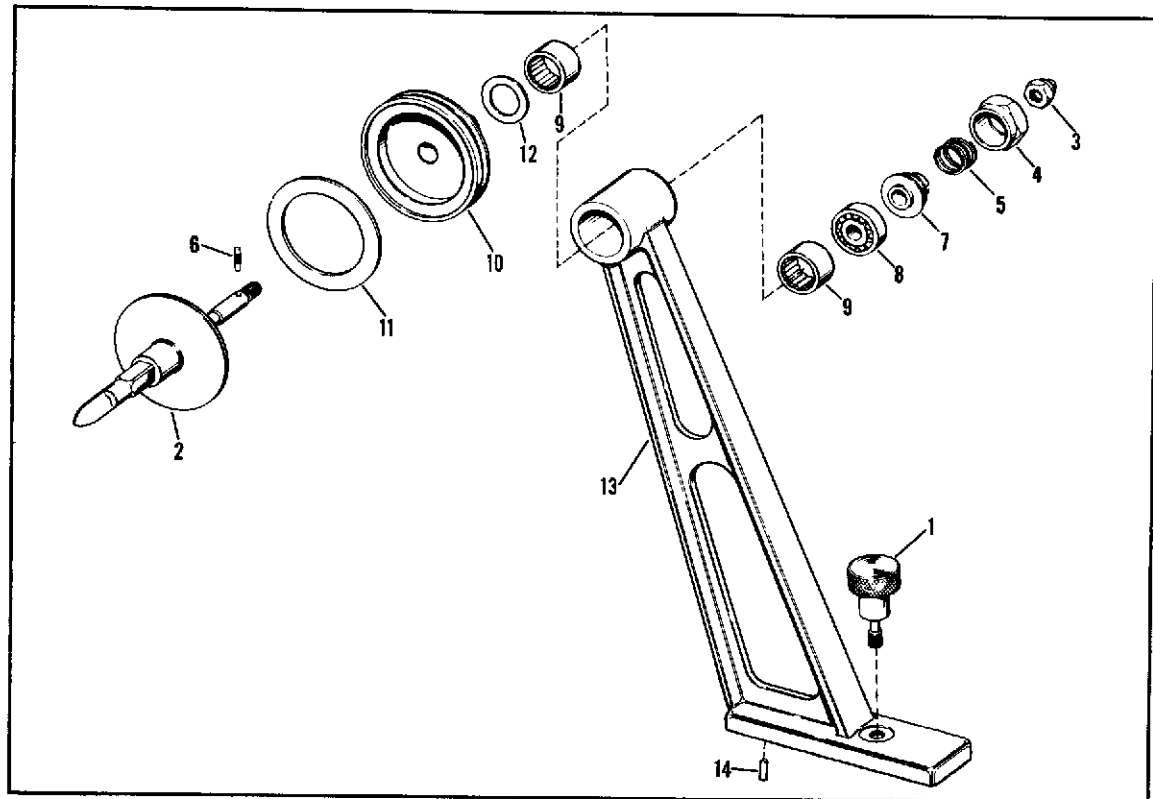
- a. Remove elastic stop nut (3), tension nut (4) and tension spring (5).
- b. Tap out driving pin (6) and disassemble remaining parts from take-up arm (12).

2-30. **CLEANING AND INSPECTION.** Clean all parts thoroughly in dry cleaning solvent (Federal Specification P-S-661) and allow parts to dry. Inspect parts for actual physical damage; wear is not a vital factor in determining parts replacement. Press the bearings onto wooden dowels of snug fit and spin the bearing, noting any roughness in rotation which would indicate bearing balls or rollers with flat spots.

2-31. **REPAIR OR REPLACEMENT.** Repair of parts is not practicable; replace all damaged parts.

2-32. **LUBRICATION.** Apply a very light coating of grease (Military Specification MIL-G-3278) to both thrust bearings (9) and the ball bearing (8).

2-33. **REASSEMBLY.** (See figure 2-7.) Reassemble the parts in reverse order of disassembly, noting the



- | | | |
|---------------------|-------------------|---------------------|
| 1. Thumb screw | 6. Driving pin | 10. Spindle pulley |
| 2. Spindle assembly | 7. Tension plate | 11. Friction washer |
| 3. Elastic stop nut | 8. Ball bearing | 12. Thrust washer |
| 4. Tension nut | 9. Thrust bearing | 13. Arm subassembly |
| 5. Tension spring | | 14. Alining pin |

Figure 2-7. Take-up Reel Arm Assembly

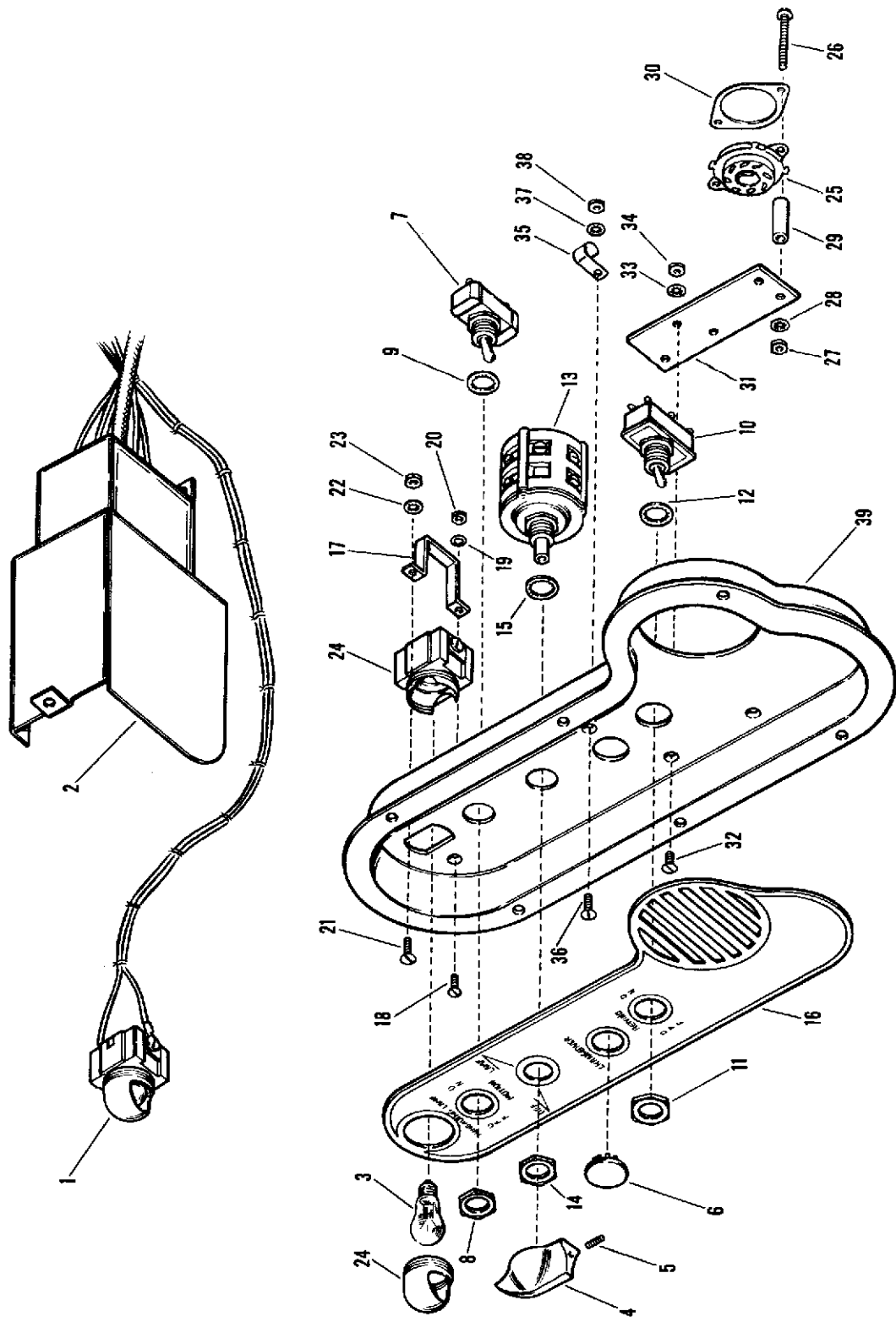


Figure 2-8. Switch Plate Assembly

Key for Figure 2-8

- | | | |
|---------------------------------|-----------------------------------|--------------------------------|
| 1. Lampholder | 14. Nut, hex | 27. Hex nut |
| 2. Filter and junction box assy | 15. Lock washer | 28. Lock washer, No. 6 |
| 3. Lamp, 6w, 120 v | 16. Switch plate | 29. Spacer |
| 4. Knob | 17. Pilot light bracket | 30. Retaining ring |
| 5. Set screw, 8-32 by 3/8 | 18. Flat hd screw, 4-36 by 3/8 | 31. Mounting plate |
| 6. Button plug | 19. Lock washer, No. 4 | 32. Flat hd screw, 6-32 by 3/8 |
| 7. SPST switch | 20. Hex nut | 33. Lock washer, No. 6 |
| 8. Hex nut | 21. Flat hd screw, 6-32 by 1/2 | 34. Hex nut, No. 6-32 |
| 9. Lock washer | 22. Lock washer, No. 6 | 35. Cable clamp |
| 10. D.P.D.T. switch | 23. Small hex nut | 36. Flat hd screw, 6-32 by 1/2 |
| 11. Hex nut | 24. Lampholder | 37. Lock washer, No. 6 |
| 12. Lock washer | 25. Octal tube socket | 38. Small hex nut |
| 13. Rotary snap switch | 26. Round hd screw, 6-32 by 1-1/8 | 39. Switch plate housing |

following special precautions:

- a. After installing spindle tension nut (4), tighten this nut just enough so that, when pulley (10) is held, the spindle can be turned manually.
- b. Tighten elastic stop nut (3) up against spindle tension nut (4), but do not overtighten. Spindle (2) must turn freely and must have approximately 1/32-inch end play (in and out of arm).

2-34. SWITCH PLATE ASSEMBLY REPAIR.

2-35. **DISASSEMBLY.** (See figure 2-8.) Under normal circumstances, complete disassembly of the switch panel will not be necessary. Removal of parts for replacement can be accomplished by reference to figure 2-8.

2-36. **CLEANING AND INSPECTION.** Wipe all parts with a cloth dampened in dry cleaning solvent (Federal Specification P-S-661). Inspect parts and wiring for actual physical damage. Refer to paragraphs 3-1 through 3-14 for descriptive and maintenance test data on the projector electrical circuit.

2-37. **REPAIR OR REPLACEMENT.** Other than the straightening of dents or twists in metal parts, repair is not practicable; replace damaged parts.

2-38. **LUBRICATION.** No lubrication required.

2-39. **REASSEMBLY.** (See figure 2-8.) Reassemble the switch plate assembly by reference to figure 2-8.

2-40. SOUND HEAD ASSEMBLY REPAIR.

2-41. **DISASSEMBLY.** (See figure 2-9.)

- a. Remove retaining rings (2 and 5) and pull jockey roller assemblies (1 and 4) from pivot studs (3 and 6). Refer to paragraph 2-46 for repair instructions for these roller assemblies.
- b. Remove screw (8) and impedance roller assembly (7). Refer to paragraph 2-52 for impedance roller repair instructions.
- c. Loosen set screws (10 and 11) and carefully withdraw stabilizer housing assembly (9). Refer to paragraph 2-58 for repair instructions for housing assembly.
- d. Loosen cover screw (13) and remove lamp cover assembly (12). Move pin release cam (18) to extreme

right-hand position, and lift out the exciter lamp (16). Lamp socket parts can be disassembled by removing lamp socket nut (17), screw (20) and lock washer (21), and three flat head screws (23).

CAUTION

The scanning lens (24) is pre-set by means of precision instruments for maximum efficiency and should not be disturbed unless it has been determined that this item requires replacement. If such is the case, remove screw (25) and withdraw the lens.

e. Loosen knob on P. C. cell cover assembly (26) and lift off the cover. To remove P. C. cell assembly (37), take out screws (38) and lock washers (39) and disconnect cell leadwire lugs from terminal block (30).

f. Remove screws (31 and 34) and lock washers (32) to free terminal block (30). Note spacing collar (33) between terminal block and casting and hexagonal spacer nut (35) at front of terminal block. Disassemble remaining parts as required.

2-42. **CLEANING AND INSPECTION.** Clean sound head casting with a cloth dampened in dry cleaning solvent (Federal Specification P-S-661), being careful not to touch the scanning lens if still assembled. Wipe exciter lamp with clean, dry cloth or lens tissue to remove fingerprints. Clean remaining parts in dry cleaning solvent and allow parts to dry before reassembly. Examine parts for actual physical damage.

2-43. **REPAIR OR REPLACEMENT.** Repair of damaged parts is not practicable; replace all damaged parts. P.C. cell assembly replacement is determined by analyzing the accompanying failure report for the projector and by pre-testing the equipment as instructed in Section III.

2-44. **LUBRICATION.** No lubrication required.

2-45. **REASSEMBLY.** (See figure 2-9.)

- a. Insert the stabilizer housing assembly (9) carefully into and through the mounting plate (43). Adjust position of stabilizer housing so that its light pipe prism will be perpendicular to the scanning lens when lens is installed. The inner face of the sound drum should extend 0.044-inch (± 0.002 -inch) beyond the

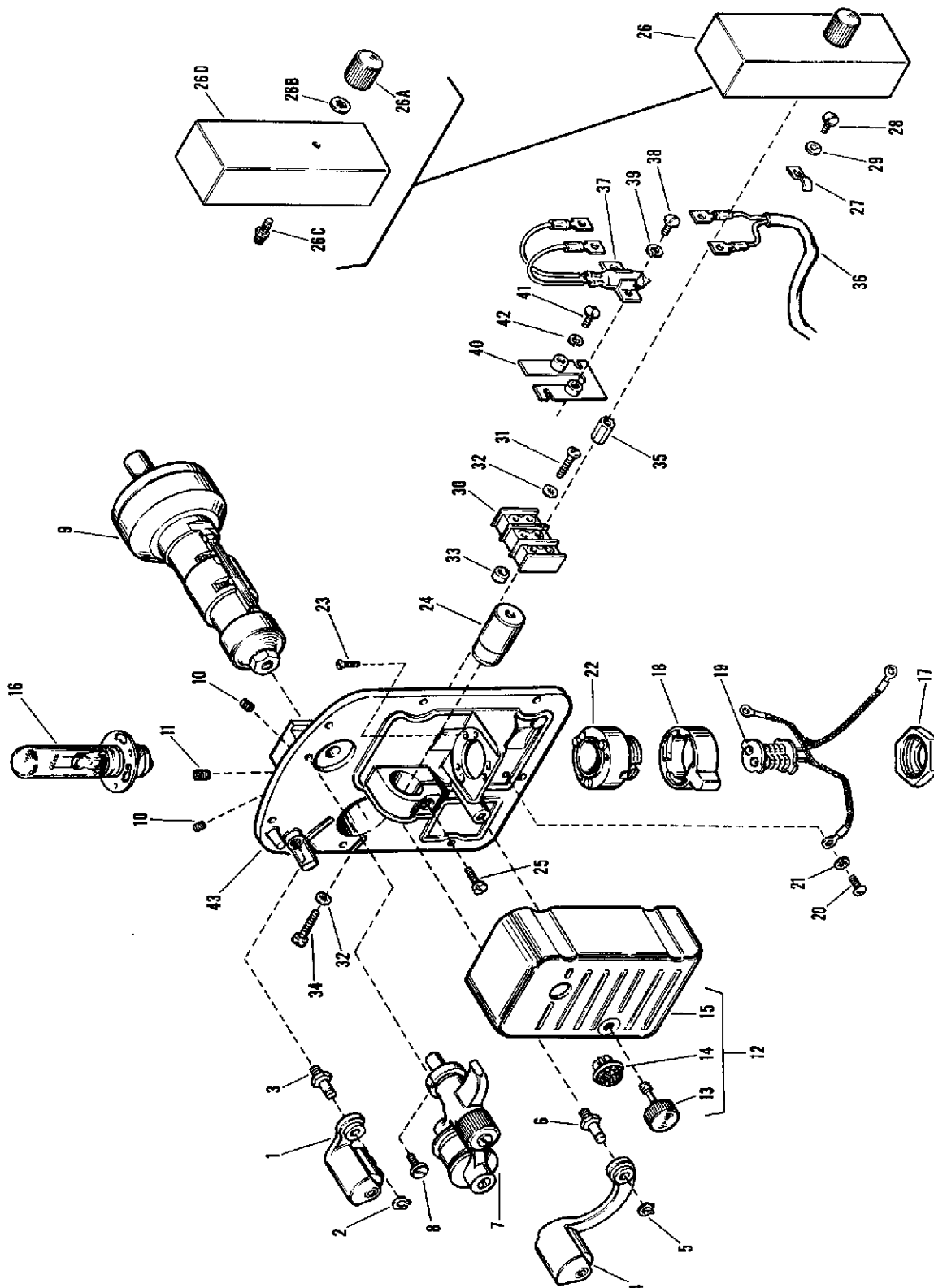


Figure 2-9. Sound Head Assembly

Key for Figure 2-9

- | | | |
|------------------------------|-------------------------------------|-----------------------------------|
| 1. Upper jockey roller assy | 17. Lamp socket nut | 28. Round hd screw, 6-32 by 1/4 |
| 2. Retaining ring | 18. Pin release cam | 29. Lock washer, No. 6 |
| 3. Pivot stud | 19. Socket contact assy | 30. Terminal block |
| 4. Lower jockey roller assy | 20. Round hd screw, 8-32 by 1/4 | 31. Round hd screw, 6-32 by 5/8 |
| 5. Retaining ring | 21. Lock washer, No. 8 | 32. Lock washer, No. 6 |
| 6. Pivot stud | 22. Socket subassembly | 33. Spacing collar |
| 7. Impedance roller assy | 23. Flat hd screw, 2-56 by 5/16 | 34. Round hd screw, 6-32 by 3/4 |
| 8. Special screw | 24. Scanning lens | 35. Spacer nut |
| 9. Stabilizer housing assy | 25. Fillister hd screw, 6-32 by 3/8 | 36. Cable assembly |
| 10. Set screw, 6-32 by 1/8 | 26. P.C. cell cover assy | 37. P.C. cell assembly |
| 11. Set screw, 10-32 by 3/16 | 26A. Knob | 38. Round hd screw, 4-36 by 0.187 |
| 12. Lamp cover assy | 26B. Lock washer, No. 8 | 39. Lock washer, No. 4 |
| 13. Cover screw | 26C. Stud | 40. Mounting plate |
| 14. Ruby jewel | 26D. Cover | 41. Round hd screw, 4-36 by 3/16 |
| 15. Cover | 27. Cable clamp | 42. Lock washer, No. 4 |
| 16. Exciter lamp | | 43. Mounting plate |

centerline of the scanning lens, as shown in figure 2-10. This dimension is obtained by use of the sound drum adjustment gage, Tool Number S-061082-N1 (figure 2-11).

b. Insert sound drum adjustment gage as shown in figure 2-11, and move the stabilizer housing assembly in or out until inner face of sound drum just touches small projection on end of gage. Recheck to make certain that light pipe prism is perpendicular in relation to the scanning lens. Then install and tighten set screws (10 and 11) while maintaining the alignment.

c. Install terminal block (30) with screws (31 and 34) and lock washers (32). Make certain that screw (31) passes through terminal block and spacing collar (33). Install hexagonal spacer nut (35) on end of screw (34).

d. Install P.C. cell mounting plate (40) with screws (41) and lock washers (42), but do not tighten screws. Shift plate until center point of exposed light pipe prism is equidistant from the edges of the opening in mounting plate. While maintaining this alignment, tighten screws (41).

e. Note small round hole on one side of P.C. cell assembly (37). Mount cell assembly to cell mounting plate with small round hole facing light pipe prism. Install screws (38) and lock washers (39). Connect P.C. cell terminal lugs to upper two posts of terminal block. Terminal lugs of cable assembly (36) connect to the lower two posts of terminal block. Install cable

clamp (27) and P.C. cell cover assembly (26).

f. Insert scanning lens (24) into opening in mounting plate with tapered end facing sound drum. Install and tighten screw (25) just enough to hold. Scanning lens must be finally adjusted after projector is reassembled.

g. Install exciter lamp socket parts (17 through 23). With pin release cam (18) in extreme right position, install exciter lamp (16); move pin release cam to the left (locking) position. Wipe fingerprints from lamp with clean cloth. Install the lamp cover assembly (12).

h. Install upper jockey roller assembly (1) and lower jockey roller assembly (4). Insert shaft of impedance roller assembly (7) through mounting plate until assembly is seated against plate. Install screw (8), tightening just enough to hold. This roller assembly should impart a five to six-ounce tension, or pressure, on the film as it passes around the sound drum. Lift roller end of impedance roller assembly with an ounce spring scale, and check the tension. The tension is adjusted by loosening screw (8) and rotating entire roller assembly within the mounting plate. Rotate assembly clockwise to decrease tension and counter-clockwise to increase tension.

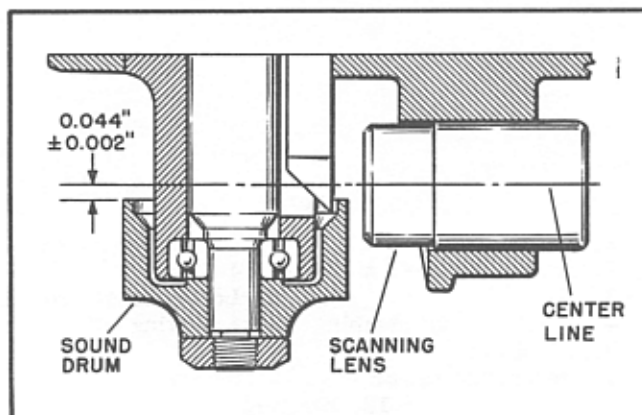


Figure 2-10. Positioning the Sound Drum

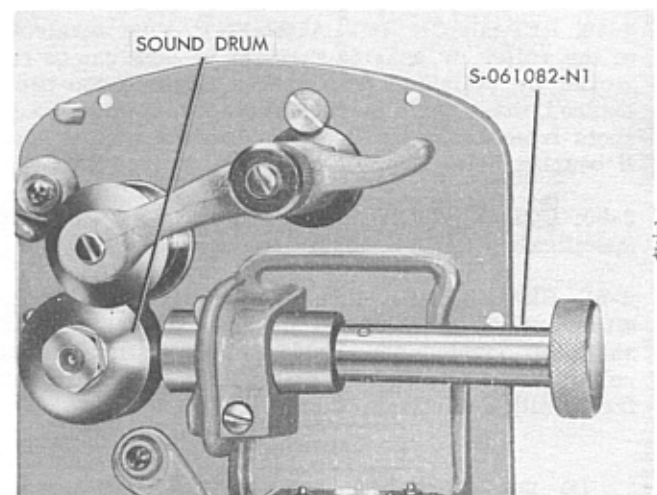
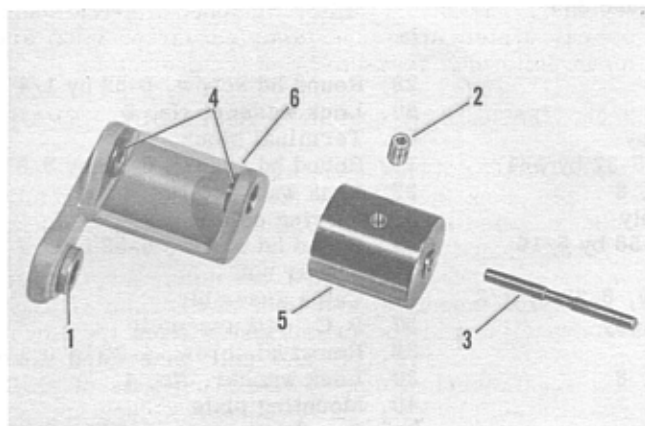
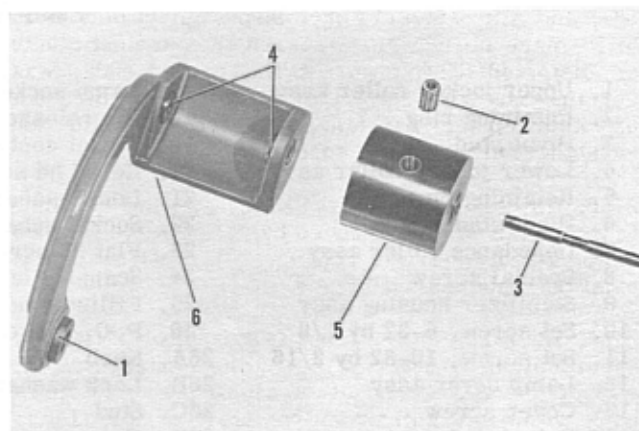


Figure 2-11. Using Adjustment Gage S-061082-N1



- | | |
|--------------------------|-------------------|
| 1. Sleeve bearing | 4. Sleeve bearing |
| 2. Set screw, 5-40 x 1/4 | 5. Roller |
| 3. Roller shaft | 6. Housing |

Figure 2-12. Upper Jockey Roller Assembly



- | | |
|--------------------------|-------------------|
| 1. Sleeve bearing | 4. Sleeve bearing |
| 2. Set screw, 5-40 x 1/4 | 5. Roller |
| 3. Roller shaft | 6. Housing |

Figure 2-13. Lower Jockey Roller Assembly

2-46. JOCKEY ROLLER ASSEMBLY REPAIR.

NOTE

Both the upper jockey roller assembly and lower jockey roller assembly are covered by the following instructions. Except for the difference in roller housings, both assemblies are identical in construction.

2-47. **DISASSEMBLY.** (See figure 2-12 or 2-13.) Loosen set screw (2) and pull out roller shaft (3), thus freeing all parts of assembly. Do not press bearings (1 and 4) from housing (6) unless damaged.

2-48. **CLEANING AND INSPECTION.** Clean all parts in dry cleaning solvent (Federal Specification P-S-661) and allow them to dry before reassembly. Inspect roller for deep scratches, nicks or flat spots. Inspect shaft for bends and make certain that shaft bearing surfaces are not rough. Check housing for rough spots which might interfere with free rotation of roller.

2-49. **REPAIR OR REPLACEMENT.** Fine scratches in the roller or bearing surfaces of shaft can be removed by polishing with crocus cloth. If too badly marred, these parts must be replaced. Remove rough spots from housing with a file. Replace shaft if bent. If bearing holes are out-of-round, replace bearings.

2-50. **LUBRICATION.** Place a drop of oil (Military Specification MIL-O-6085) into each bearing.

2-51. **REASSEMBLY.** (See figure 2-12 or 2-13.) Position roller (5) between bearings (4) and install shaft (3). Tighten set screw (2) just enough to hold roller to shaft. Make certain that roller rotates freely with a minimum of end play.

CAUTION

Do not overtighten set screw (2), as this could bend the shaft and cause the roller to rotate erratically.

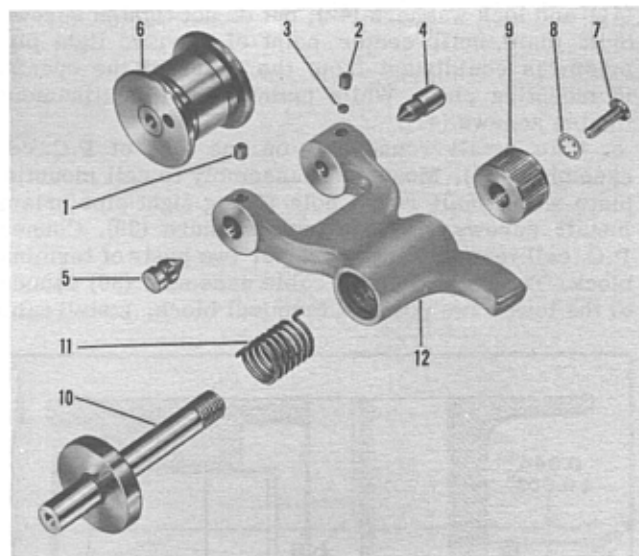
2-52. IMPEDANCE ROLLER ASSEMBLY REPAIR.

2-53. **DISASSEMBLY.** (See figure 2-14.)

a. Loosen set screws (1 and 2) and unscrew the adjustable pivot pin (4). The slug (3) will drop into the housing (12) as pivot pin is withdrawn. Remove plain pivot pin (5) and lift roller (6) from housing.

b. Disassemble parts (7) through (11) from housing (12).

2-54. **CLEANING AND INSPECTION.** Clean all parts with dry cleaning solvent (Federal Specification P-S-



- | | |
|--------------------------|-----------------------|
| 1. Set screw, 5-40 x 1/8 | 7. Binding hd screw, |
| 2. Set screw, 5-40 x 1/8 | 4-40 x 3/8 |
| 3. Slug | 8. Lock washer, No. 4 |
| 4. Pivot pin, adjustable | 9. Adjusting nut |
| 5. Pivot pin | 10. Stud |
| 6. Impedance roller | 11. Spring |
| | 12. Housing |

Figure 2-14. Impedance Roller Assembly

661) and allow them to dry. Inspect pivot pins (4 and 5) to make certain that tapered ends are not blunted or distorted. Check spring for broken ends. Make certain that bearings in roller are free of dirt, dust or other foreign substance. Inspect roller for deep scratches, nicks or flat spots.

2-55. REPAIR OR REPLACEMENT. Fine scratches in the roller can be removed by polishing with crocus cloth; if badly marred, replace roller. All other parts must be replaced if damaged.

2-56. LUBRICATION. Place two drops of oil (Military Specification MIL-O-6085) into the bearings at each end of the roller and allow oil to seep into the felt wick within the roller. Entire shaft of stud (10) and mounting face of adjusting nut (9) must be coated lightly with grease (Military Specification MIL-G-3278) during reassembly.

2-57. REASSEMBLY. (See figure 2-14.)

a. Hold roller (6) in position between arms of housing with 5/32-inch wide roller groove closest to arm with plain (unthreaded) pivot pin hole. Insert pivot pin (5) and install set screw (1) so that cone point of screw engages groove in pivot pin.

b. Screw adjustable pivot pin (4) into place to a point where roller rotates freely with a minimum of end play. Insert slug (3), burr side up, into set screw hole, and install set screw (2). Re-check roller freedom of rotation and end play. End play must be barely perceptible (not in excess of 0.0005-inch). Tighten set screw (2).

c. Insert spring (11) so that bent end engages hole within housing (12). Lubricate stud (10), as instructed in paragraph 2-56, and insert stud through spring and housing. Outer bent end of spring must engage small hole in mounting flange face of stud. Lubricate nut (9), paragraph 2-56, and install nut, screw (7) and lock washer (8). Tighten screw just enough to hold parts

together. This screw will be tightened after the sound optical system alignment tests (paragraph 3-52) are made, following reassembly of the projector.

2-58. STABILIZER HOUSING ASSEMBLY REPAIR.

2-59. DISASSEMBLY. (See figure 2-15.)

a. Hold lock nut (10) with wrench and carefully remove sound drum nut (1). Pull film scanning drum (2) from shaft (14).

b. Remove screws (6) and carefully lift brackets (5), prism mount (8) and light pipe prism (7) from housing (15). Lift the prism gently from the mount.

c. Remove screws (12) and pull assembled shaft (14) from housing. Place wrench on flats of shaft, unscrew self locking nut (9). Unscrew lock nut (10) and remove lock plate (11) and bearing (13) from shaft. Remove bearing (3) and thrust washer (4) from housing.

CAUTION

Avoid placing fingers on ball races of bearing during removal, and do not use any tool that might cause damage to bearing. After removal, wrap bearing in clean cloth or tin foil.

2-60. CLEANING AND INSPECTION. Wash all parts, except prism, in dry cleaning solvent (Federal Specification P-S-661), and allow parts to dry. Prism should be wiped with soft lint-free cloth. Inspect prism for chips, scratches or discoloration. Inspect film scanning drum for nicks or grooves. Make certain that stabilizer shaft is not bent in any way. Check ball bearing rotation; bearings should rotate freely and smoothly.

2-61. REPAIR OR REPLACEMENT. Repair of damaged parts is impracticable. Replace all damaged parts.

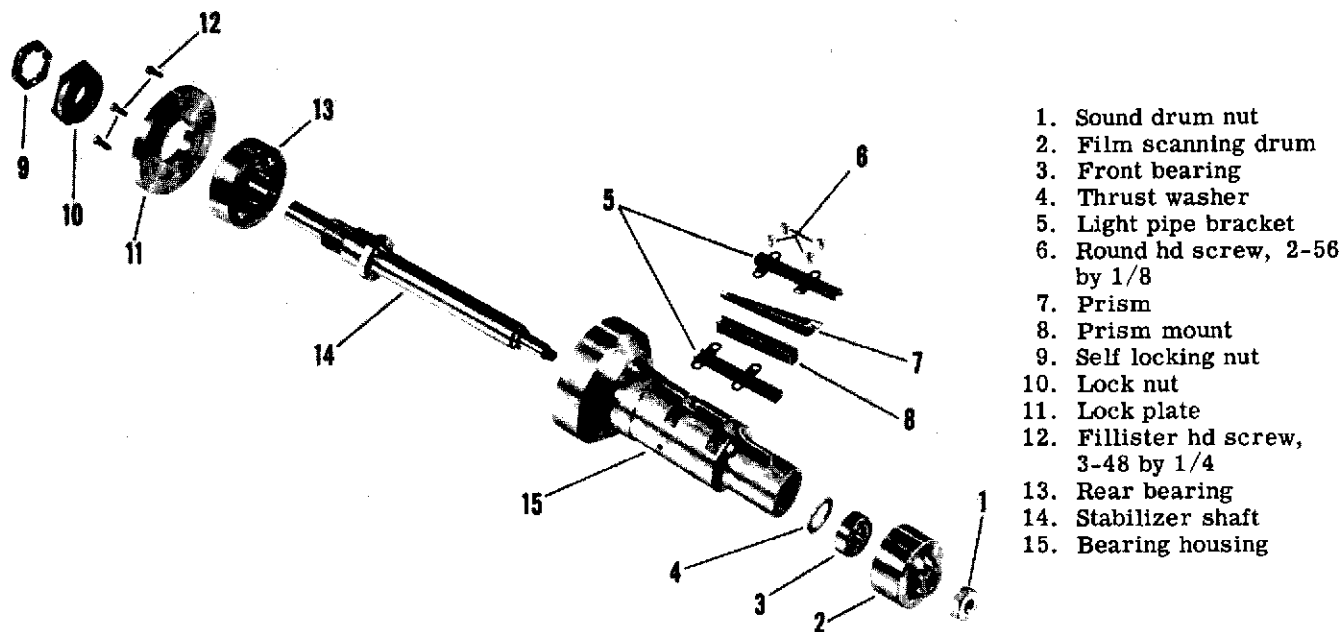


Figure 2-15. Stabilizer Housing Assembly

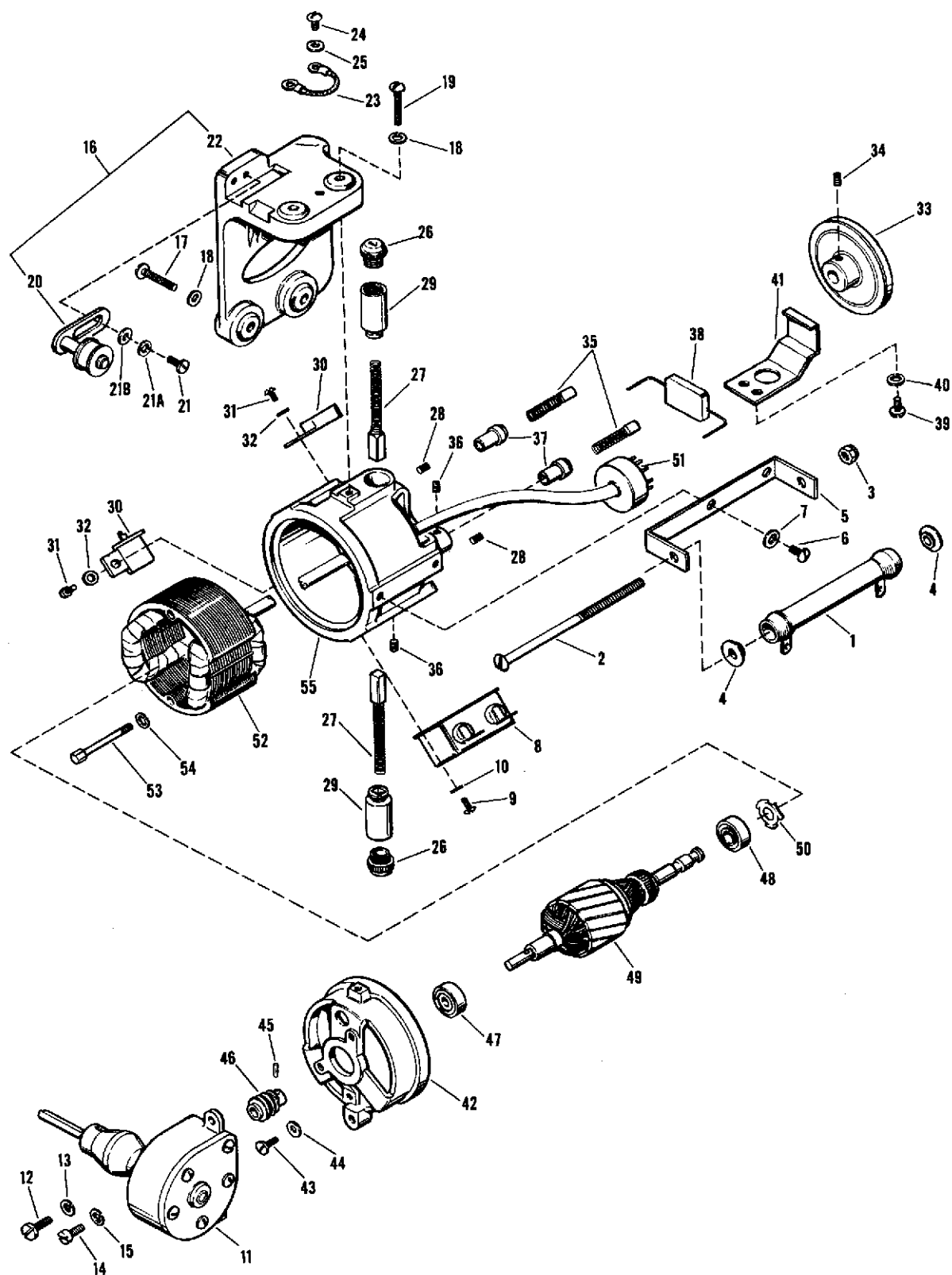


Figure 2-16. Drive Motor Assembly

Key for Figure 2-16

- | | | |
|-------------------------------------|-----------------------------------|-----------------------------------|
| 1. Fixed resistor, 150 ohms | 20. Idler assy | 37. Brush holder |
| 2. Round hd screw, 10-24 by 4-1/2 | 21. Binding hd screw, 8-32 by 1/2 | 38. Fixed capacitor, 0.01 uf |
| 3. Elastic stop nut | 21A. Plain washer | 39. Round hd screw, 8-32 by 5/16 |
| 4. Centering washer | 21B. Lock washer, #8 | 40. Lock washer, #8 |
| 5. Mounting bracket | 22. Bracket subassembly | 41. Bracket |
| 6. Binding hd screw, 8-32 by 1/4 | 23. Ground strap | 42. Rear housing |
| 7. Lock washer, #8 | 24. Round hd screw, 10-32 by 1/4 | 43. Binding hd screw, 6-32 by 1/2 |
| 8. Fixed capacitor, 0.5 uf | 25. Lock washer, #10 | 44. Lock washer, #6 |
| 9. Round hd screw, 6-32 by 1/4 | 26. Brush holder cap | 45. Drive gear pin |
| 10. Lock washer, #6 | 27. Brush and spring | 46. Drive gear |
| 11. Motor gear housing assy | 28. Set screw, 8-32 by 1/4 | 47. Ball bearing |
| 12. Binding hd screw, 8-32 by 5/16 | 29. Motor brush holder | 48. Ball bearing |
| 13. Lock washer, #8 | 30. Fixed capacitor, 10,000 uuf | 49. Armature |
| 14. Fillister hd screw, 8-32 by 3/8 | 31. Round hd screw, 10-32 by 1/4 | 50. Bearing loading spring |
| 15. Lock washer, #8 | 32. Lock washer, #10 | 51. Octal plug |
| 16. Motor mounting bracket | 33. Governor | 52. Motor field assy |
| 17. Round hd screw, 10-24 by 1 | 34. Set screw, 8-32 by 1/8 | 53. Field retaining screw |
| 18. Lock washer, #10 | 35. Brush and spring | 54. Lock washer, #8 |
| 19. Round hd screw, 10-24 by 1-1/2 | 36. Set screw, 8-32 by 3/16 | 55. Front housing |

2-62. LUBRICATION. Apply a light film of grease (Military Specification MIL-G-3278) to the bearing races, the bearing shoulders of the housing, and to the stabilizer shaft during reassembly.

2-63. REASSEMBLY. (See figure 2-15.)

a. Lubricate bearing (13), paragraph 2-62, and press bearing up against shoulder of shaft (14) by hand. Do not exert undue pressure during installation.

b. Install lock plate (11) and lock nut (10), tightening nut by hand. The lock nut holds bearing to shaft and must fit into groove of lock plate. With wrench engaging flats on stabilizer shaft, tighten lock nut (10) securely. Install and tighten self locking nut (9).

c. Lubricate shaft, paragraph 2-62, and insert partially assembled shaft into housing (15). Install three screws (12) just enough to hold lock plate (11) in place.

d. Insert thrust washer (4), concave side toward bearing (3), into front opening in housing (15). Lubricate bearing (3), paragraph 2-62, slide it over end of shaft, and gently press it into stabilizer housing and down against thrust washer (4).

e. Install film scanning drum (2) and nut (1). Hold lock nut (10) with wrench while tightening sound drum nut (1). Tighten the three screws (12) and rotate the shaft. The stabilizer shaft must turn freely with no perceptible binding.

CAUTION

Handle sound drum carefully at all times to avoid damage which might impair sound.

f. Place partially assembled stabilizer housing in a "V" block, and measure the true-running quality of the film scanning drum by rotating it against a true-ness indicator. The total indicator deviation on turned diameter of scanning drum must not exceed 0.0004-inch with the housing held stationary. If deviation exceeds 0.0004-inch, the largest diameter of the stabilizer housing should be accurately located on a lathe steady-rest to maintain the 0.0004-inch concentricity. Seal the prism opening with cotton and tape and drive the stabilizer shaft to fine-turn the drum.

NOTE

Do not turn diameter of scanning drum to a point greater than 0.010-inch of original diameter.

g. Remove tape and cotton from prism opening in stabilizer housing. Be sure that no stray strands of cotton remain in openings. Insert prism (7) into mount (8) with clear areas of prism facing up. Insert mount into one of the brackets (5), again with clear prism areas facing up. Insert assembled parts into stabilizer housing with clear prism areas facing up and widest end of prism extending approximately 0.040-inch under the film scanning drum. Install remaining bracket (5) with four screws (6).

2-64. DRIVE MOTOR REPAIR.

2-65. DISASSEMBLY. (See figure 2-16.)

a. Remove resistor and mounting bracket parts (items 1 through 7) and capacitors (8 and 30) from motor housing, unsoldering leadwires as required.

b. In order to remove motor gear housing assembly (11), it first will be necessary to remove the flexible coupling from the gear housing shaft. This can be done by loosening the coupling set screw closest to the end of the shaft and sliding off the coupling with attached chain sprocket. Take out three screws (12 and 14) and lock washers (13 and 15) and withdraw the complete gear housing. Temporarily assemble coupling to shaft and set this assembly aside. Repair instructions for the gear housing assembly are outlined in paragraph 2-70.

c. Disassemble motor mounting bracket and parts (items 16 through 25).

d. Remove brush holder caps (26) and brush and springs assemblies (27). Brush holders (29) need not be removed.

e. Loosen two set screws (34), and remove governor (33) and governor brush and spring assemblies (35). Brush holders (37) need not be removed.

f. Remove bracket (41) and capacitor (38), unsoldering capacitor leads as required.

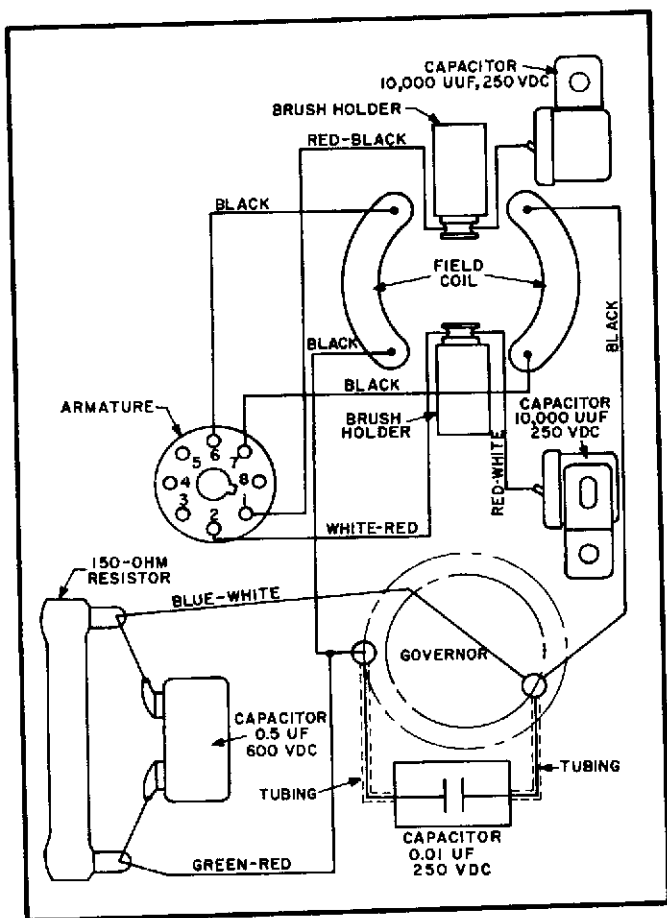


Figure 2-17. Drive Motor Wiring Diagram

- g. Drive out pin (45) and remove drive gear (46). Remove rear housing (42) and armature (49). Be careful not to lose the two bearing loading springs (50) from end of armature shaft.
- h. Disassemble motor field (52) from housing (55). These parts are machined in assembly and must be replaced as an assembly.

2-66. CLEANING AND INSPECTION.

- a. Clean all parts, except electrical components, with dry cleaning solvent (Federal Specification P-S-861). Wipe electrical parts with a dry cloth.
- b. Inspect bearings to make certain that they spin freely and smoothly and that they seat properly in the bearing recesses of the housing. Bearings must not be loose in bearing recess.
- c. Check field coils for continuity.
- d. Check armature for short circuits on a growler. Inspect armature winding for signs of burning, charring, or serious nicks and breaks. Examine commutator for excessive wear or badly burned commutator bars.
- e. Inspect motor brushes for excessive wear (shorter than 3/8-inch) and broken pigtails and springs. Inspect governor brushes for excessive wear (shorter than 3/16-inch) and broken pigtails and springs.
- f. Check slip rings on back of governor for indication of a permanent open or short. Resistance on volt-ohmmeter should read "zero" with governor contacts closed; resistance should be infinite with contacts

held open.

- g. Check capacitors with electronic multimeter for leaks and shorts. Check resistor with volt-ohmmeter for proper resistance (150 ohms).

2-67. REPAIR OR REPLACEMENT. Repair of damaged or worn parts is impracticable. Replace all damaged and excessively worn parts.

2-68. LUBRICATION. Apply a light coating of grease (Military Specification MIL-G-3278) to the bearings (47 and 48) and to the drive gear (46) during re-assembly.

2-69. REASSEMBLY. (See figure 2-16.)

- a. Assemble motor field (52) into housing (55). Lubricate bearings (47 and 48), paragraph 2-68, and assemble them to armature (49). Slip two loading springs (50) onto commutator end of armature shaft with prongs against the bearing (48). Insert this group into front housing (55) until the bearing seats in the bearing recess.
- b. Install rear housing (42) over ball bearing (47) on armature shaft and flush against front housing. Holes for screws (43) must line up with tapped holes in field coil retaining studs, and the tapped bosses on rear housing and front housing, for screws (19), must be aligned. Secure the rear housing. Install drive gear (46) to end of armature shaft with pin (45). Lubricate gear, paragraph 2-68.
- c. Remove flexible coupling from gear housing assembly (11), and install gear housing assembly to rear housing with screws (12 and 14) and lock washers (13 and 15). Note that binding head screw (12) is installed below flexible coupling to allow clearance for drive chain around sprocket. It may be necessary to rotate gear housing shaft until worm gears engage, thus permitting gear housing to seat fully. Armature shaft must turn freely with maximum end play of 0.008-inch.
- d. When installing motor brushes, make certain that concave face of each brush matches diameter of commutator.
- e. Install all electrical components, except the governor, making wiring connections as illustrated in figure 2-17.
- f. Install motor mounting bracket parts (items 16 through 25) by reference to figure 2-16.
- g. Install governor brushes (35) and bracket (41). Place governor (33) on armature shaft. Governor should seat about 1/32-inch from each brush holder. Install and tighten two sets screws (34). The motor speed adjustment will be made just before drive motor is installed to projector (paragraph 2-167).

2-70. DRIVE MOTOR GEAR HOUSING REPAIR.

2-71. DISASSEMBLY. (See figure 2-18.)

- a. Loosen set screw in flexible drive coupling (1) to free the sprocket (2).
- b. Disassemble remaining parts from housing (8).

2-72. CLEANING AND INSPECTION. Clean all parts with dry cleaning solvent (Federal Specification P-S-861), removing all old grease from housing. Dry parts thoroughly. Inspect parts for physical damage - bent shaft, chipped or broken gear teeth, or cracks in the castings.

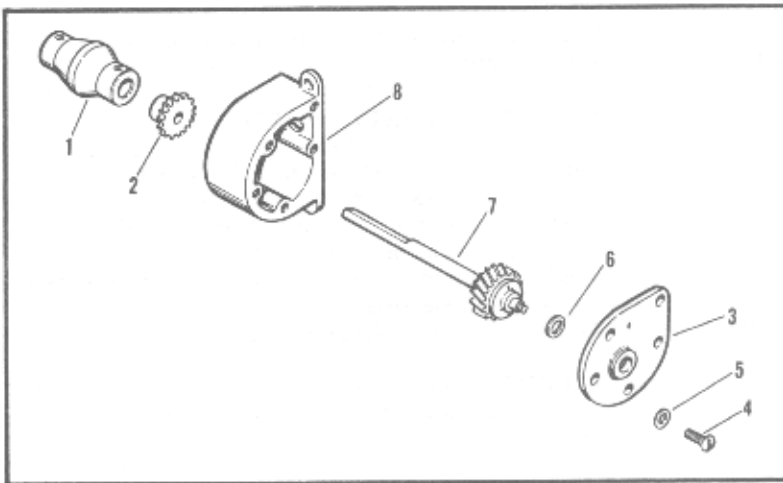


Figure 2-18. Drive Motor Gear Housing Assembly

1. Flexible drive coupling
2. Sprocket
3. Cover
4. Round hd screw, 4-36 by 3/8
5. Lock washer, No. 4
6. Fibre washer
7. Gear and shaft assy
8. Gear housing assy

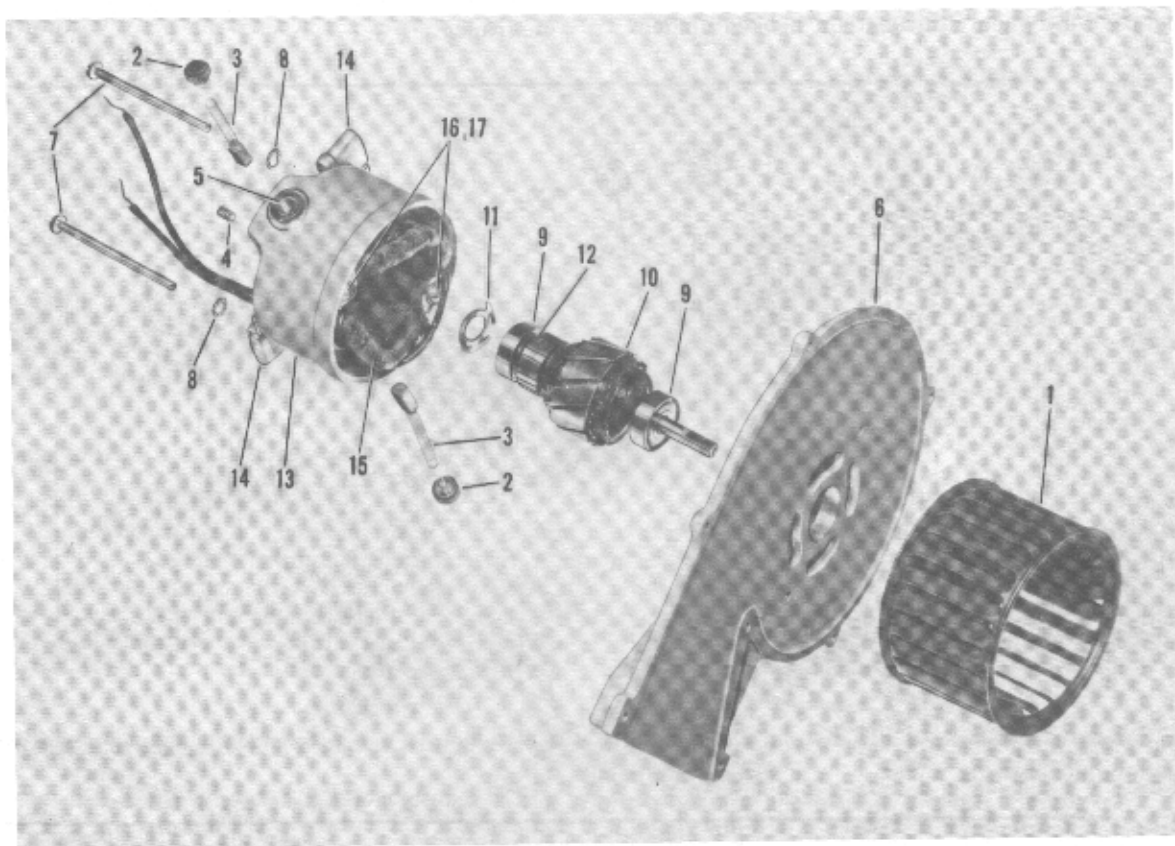
2-73. REPAIR OR REPLACEMENT. Repair of damaged parts is not practicable. Replace all damaged parts.

2-74. LUBRICATION. After the unit is reassembled, fill the gear housing with seven grams of grease (Military Specification MIL-G-3278), or until the

housing is filled to approximately one-third its depth. Also, the shaft bearings in the cover (3) and housing (8) should each be lubricated with four drops of oil (Military Specification MIL-O-6085).

2-75. REASSEMBLY. (See figure 2-18.)

- a. Install fiber washer (6) on shaft (7) and assemble



1. Blower wheel
2. Insulating screw cap
3. Brush and spring
4. Set screw, 8-32 by 1/8
5. Brush holder
6. Cover

7. Round hd screw, 8-32 by 2-1/4
8. Lock washer, No. 8
9. Ball bearing
10. Armature
11. Bearing loading spring

12. Washer
13. Motor housing
14. Fixed capacitor, 0.01 uf
15. Field assy
16. Round hd screw, 8-32 by 1-1/8
17. Lock washer, No. 8

Figure 2-19. Blower Motor Assembly

shaft into housing (8). Install cover (3).

b. Insert hub of sprocket (2) into coupling (1), noting that set screw must bear against flat of sprocket hub. Do not assemble coupling and sprocket to shaft until gear housing is fastened to drive motor (paragraph 2-69, step c).

2-76. BLOWER MOTOR REPAIR.

2-77. **DISASSEMBLY.** (See figure 2-19.) Disassemble the blower motor as shown in figure 2-19. Be careful not to lose the bearing loading spring (11) at the commutator end of the armature (10).

2-78. CLEANING AND INSPECTION.

a. Wipe all electrical parts with a clean, dry cloth. Wipe remaining parts with a cloth dampened in dry cleaning solvent (Federal Specification P-S-661).

b. Inspect motor brushes for broken springs or excessive wear (shorter than 1/4-inch in length).

c. Check field coils for continuity.

d. Inspect winding of armature for signs of burning, charring, serious nicks or breaks. Examine commutator for out-of-round, excessive wear or burned spots.

e. Spin the ball bearings and check for smooth, quiet rotation.

f. Inspect blower wheel for bent or broken blades.

g. Check capacitor (250 volt) with volt ohmmeter for leaks or shorts.

2-79. REPAIR OR REPLACEMENT.

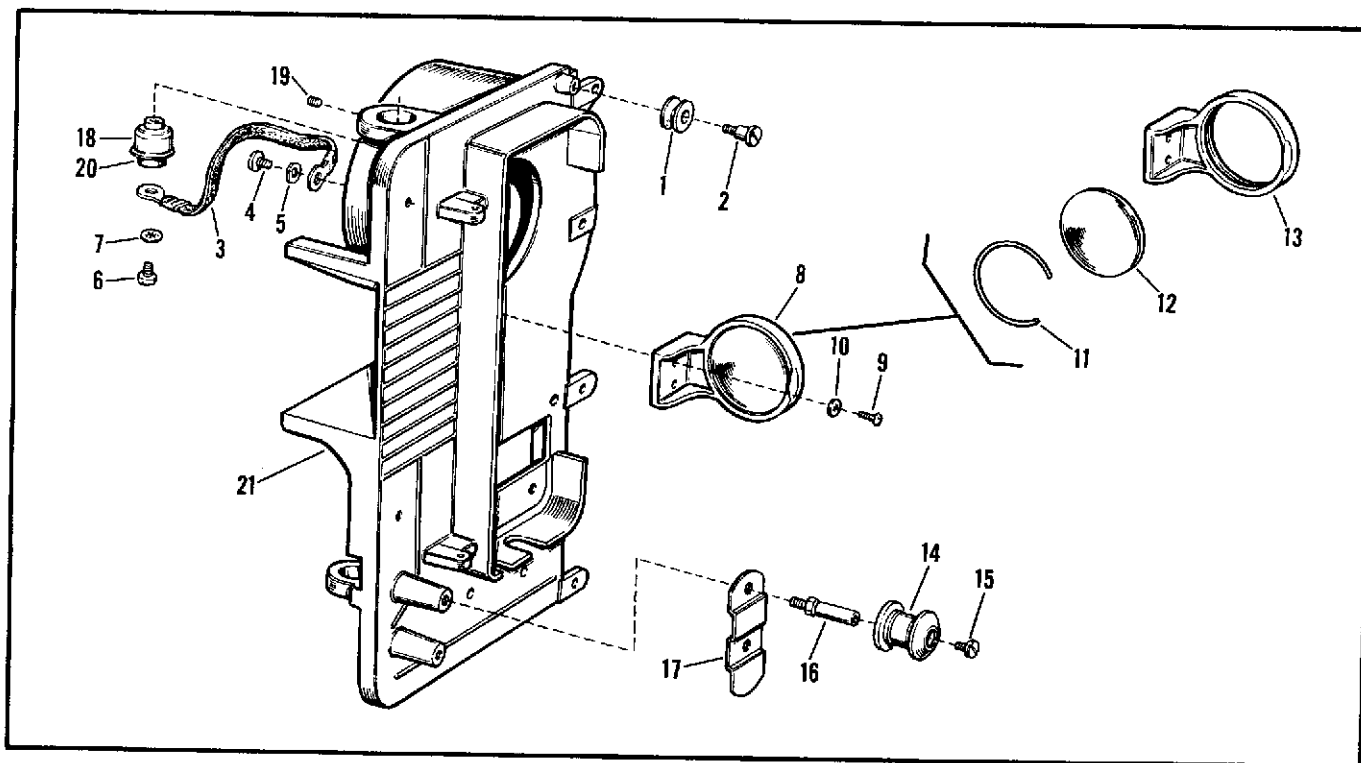
a. If commutator is out-of-round, has high spots or burned spots, it can be turned down in a lathe. Make cut no deeper than necessary. Ends of commutator segments should not be less than 1/16-inch thick after cutting operation.

b. Straighten bent blower wheel blades; replace blower wheel if blades are broken.

c. Replace all other damaged parts.

2-80. **LUBRICATION.** Apply a light coating of grease (Military Specification MIL-G-3278) to the outer diameter of bearings.

2-81. **REASSEMBLY.** (See figure 2-19.) Reassemble the blower motor by reference to figure 2-19. Note that bearing loading spring (11) must be positioned inside the bearing recess of motor housing with the prongs up against the bearing. When assembled, armature must revolve freely with a minimum end play of 0.010-inch. When installing blower wheel (1), maintain an exact clearance of 0.047-inch between blower housing cover (6) and inner face of blower wheel. Tighten blower wheel set screw securely and re-check clearance.



- | | | |
|-------------------------------------|---------------------------------|----------------------------|
| 1. Idler pulley | 8. Reflector assembly | 15. Special screw |
| 2. Idler pulley stud | 9. Round hd screw, 8-36 by 5/16 | 16. Idler shaft |
| 3. Grounding cable | 10. Lock washer, No. 8 | 17. Film guard |
| 4. Round hd screw, 10-32 by 1/4 | 11. Lock ring | 18. Vibration mount |
| 5. Lock washer, No. 10 | 12. Reflector | 19. Set screw, 8-32 by 1/4 |
| 6. Fillister hd screw, 12-24 by 1/4 | 13. Bracket | 20. Spacer |
| 7. Lock washer, No. 12 | 14. Idler roller | 21. Rear plate |

Figure 2-20. Rear Mechanism Plate Assembly

2-82. REAR MECHANISM PLATE REPAIR.

2-83. DISASSEMBLY. (See figure 2-20.) Disassemble the rear mechanism plate, as required, by reference to figure 2-20.

2-84. CLEANING AND INSPECTION. Clean all parts, except reflector (12), with dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly before reassembly. Remove dust and dirt from reflector by blowing air across the surface with a syringe bulb. Remove stains with cleaning tissue. If necessary, use a drop or two of denatured alcohol (Military Specification MIL-A-6091) to remove oil film or fingerprints. Inspect all parts for physical damage.

2-85. REPAIR OR REPLACEMENT. Repair of damaged parts is impracticable. Replace damaged parts.

2-86. LUBRICATION. Place a drop or two of oil (Military Specification MIL-O-6085) on the roller bearing surface of the idler pulley stud (2) and on each of the idler shafts (17) during reassembly.

2-87. REASSEMBLY. (See figure 2-20.) Reassemble the rear mechanism plate by reference to figure 2-20.

Be sure to perform required lubrication (paragraph 2-86) and avoid leaving fingerprints on the reflector (12).

2-88. COUNTER DRIVE MECHANISM REPAIR.

2-89. DISASSEMBLY. (See figure 2-21.)

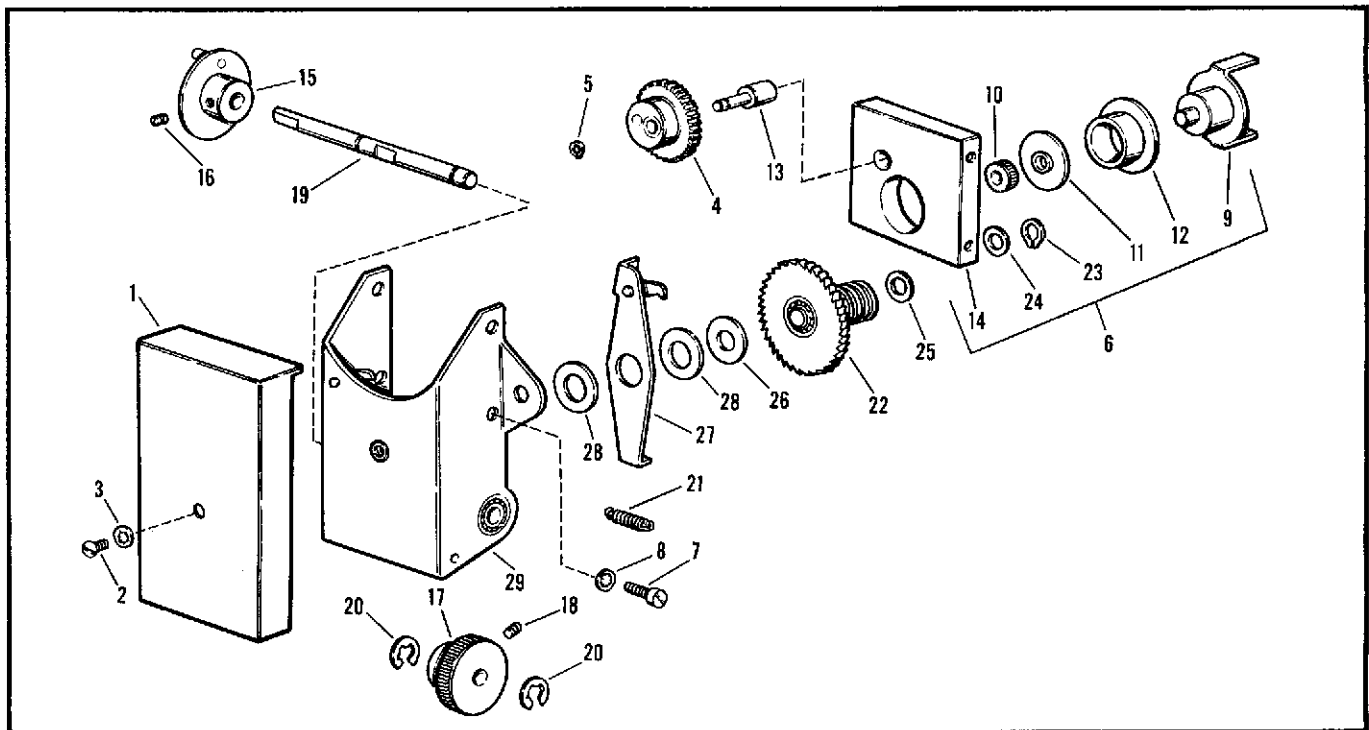
a. Remove screw (2), washer (3) and cover (1).
b. Remove four screws (7) and lock washers (8) and separate gear train plate assembly (6) from housing (29).

c. Remove retaining ring (5) and cam and gear assembly (4) from cam gear stud (13). If necessary, drive stud from plate (14). Pry pinion (10) carefully from pinion hub assembly (9) and remove hub and shoulder washer (11). If necessary, press sleeve bearing (12) from plate (14).

d. Loosen set screw (16) and remove drive disc (15).

e. Loosen set screw (18) so that ratchet worm gear (17) is loose on shaft (19) within the housing (29). Pry retaining rings (20) from grooves in shaft, and pull shaft from housing, catching gear (17) as it falls free.

f. Unhook and remove spring (21). Remove remaining parts (22 through 28) from housing as shown in figure 2-21.

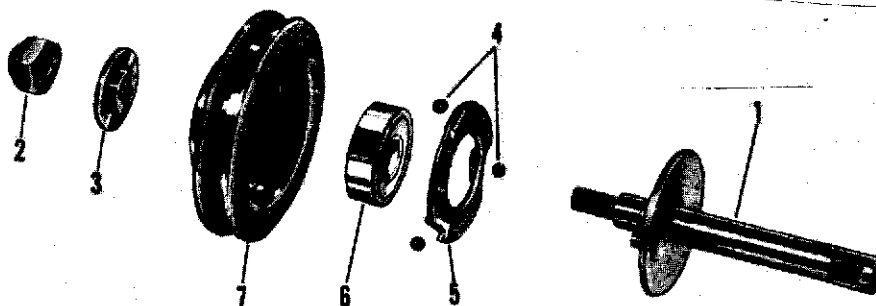


- | | | |
|------------------------------------|----------------------------|--------------------|
| 1. Cover | 11. Shoulder washer | 20. Retaining ring |
| 2. Round hd screw, 3-56 by 3/16 | 12. Sleeve bearing | 21. Spring |
| 3. Lock washer, No. 3 | 13. Cam gear stud | 22. Ratchet wheel |
| 4. Cam and gear assy | 14. Mounting plate | 23. Retaining ring |
| 5. Retaining ring | 15. Drive disc | 24. Spacer |
| 6. Gear train plate assy | 16. Set screw, 5-40 by 1/8 | 25. Fiber washer |
| 7. Fillister hd screw, 5-40 by 1/4 | 17. Ratchet worm gear | 26. Shim |
| 8. Lock washer, No. 5 | 18. Set screw, 5-40 by 1/8 | 27. Ratchet arm |
| 9. Pinion hub assy | 19. Output shaft | 28. Flat washer |
| 10. Pinion | | 29. Housing assy |

Figure 2-21. Counter Drive Mechanism Assembly

Figure 2-22. Feed and Take-up Pulley Assemblies

1. Take-up and rewind shaft
2. Elastic stop nut, 8-32
3. Extruded washer
4. Bearing ball
5. Pulley ratchet
6. Ball bearing
7. Pulley



2-90. **CLEANING AND INSPECTION.** Clean all parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly before reassembly. Inspect all parts for actual physical damage—stripped screw threads, chipped or broken gear teeth, bent shafts, and so forth.

2-91. **REPAIR OR REPLACEMENT.** Repair of damaged parts is not practicable. Replace damaged parts.

2-92. **LUBRICATION.** During reassembly, apply a light coating of grease (Military Specification MIL-G-3278) to all gear teeth and to the bearing surfaces of the pinion hub assembly, cam gear stud and output shaft. Remaining lubrication is outlined in the reassembly procedure.

2-93. **REASSEMBLY.** (See figure 2-21.)

a. Apply a very light film of oil (Military Specification MIL-O-6086) on the mounting stud which will receive the ratchet wheel (22). Install parts (22) through (28) on the stud within the housing (29). Place two drops of oil between washer (25) and ratchet wheel (22). Note that the quantity of shims (26) must be determined to limit ratchet wheel end play to 0.001 to 0.003-inch.

b. Hook spring (21) between hole in housing (29) and hole in lower end of ratchet arm (27).

c. Insert output shaft (19) into housing, installing gear (17) on shaft while doing so. Install retaining rings (20) on shaft inside housing to prevent shaft from sliding out. Center the teeth of gear (17) with worm of ratchet wheel (22) and tighten set screw (18) against flat of shaft (19). Install drive disc (15) on end of shaft, tightening set screw (16) against flat of shaft. Place four drops of oil (Military Specification MIL-O-6086) at the two points where output shaft protrudes through housing, allowing oil to run down into the housing.

d. Press sleeve bearing (12) and cam gear stud (13) into mounting plate (14). Bearing flange must be flush against mounting plate. Large diameter of stud (13), at base of gear shaft portion, must protrude 3/64-inch ($\pm$ 0.010-inch) above surface of plate. Insert pinion hub (9) through sleeve bearing (12) and install shoulder washer (11), with shoulder facing out, and pinion (10) on pinion hub. Pinion hub must turn freely with the pinion pressed in place.

e. Install cam and gear assembly (4) on gear shaft of stud (13), securing with retaining ring (5). While pressing lower end of ratchet arm (27) toward drive disc (15), assemble the gear train plate assembly (6) to housing (29) and install screws (7) and lock washers (8). Upper finger on ratchet arm must bear

against cam hub of gear (4). Place one or two drops of oil between ratchet arm finger and cam hub.

f. Make certain that ratchet fingers (riveted to housing and ratchet arm) are engaging teeth of ratchet wheel. Install cover (1), screw (2) and lock washer (3).

2-94. **FEED AND TAKE-UP PULLEY REPAIR.**

2-95. **DISASSEMBLY.** (See figure 2-22.) Disassemble the feed and take-up pulleys by reference to figure 2-22, being careful not to lose the bearing balls (4).

2-96. **CLEANING AND INSPECTION.** Clean all parts, except bearing, in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly before reassembly. Inspect ears of pulley ratchet for excessive wear. Check bearing for smooth, free rotation. Inspect shaft for distortion or excess wear.

2-97. **REPAIR OR REPLACEMENT.** Repair of damaged parts is impracticable. Replace damaged parts. If ears of ratchet are grooved, replace ratchet. If shaft is worn to less than 0.247 inch in diameter, replace shaft.

2-98. **LUBRICATION.** No lubrication required.

2-99. **REASSEMBLY.** (See figure 2-22.)

CAUTION

The ears of pulley ratchet (5) must face inward in the take-up pulley assembly and outward in the feed pulley assembly.

a. Press bearing (6) into pulley (7). Place ratchet (5) within pulley with ratchet ears facing outward and place a bearing ball (4) into each of the three notches formed by bending the ratchet ears.

b. Carefully insert threaded end of shaft (1) through pulley until large diameter flange of shaft presses firmly against ratchet. The pin on the flange must engage the hole in the ratchet. Invert this assembled group and install washer (3) and stop nut (2).

c. The shaft must turn freely in one direction and lock in the other, after nut (2) is tightened.

2-100. **CONDENSER LENS ASSEMBLY REPAIR.**

2-101. **DISASSEMBLY.** (See figure 2-23.) Condensers (1 and 3) are held in place by means of lock springs (2 and 4). Be careful not to scratch glass surfaces during removal of springs.

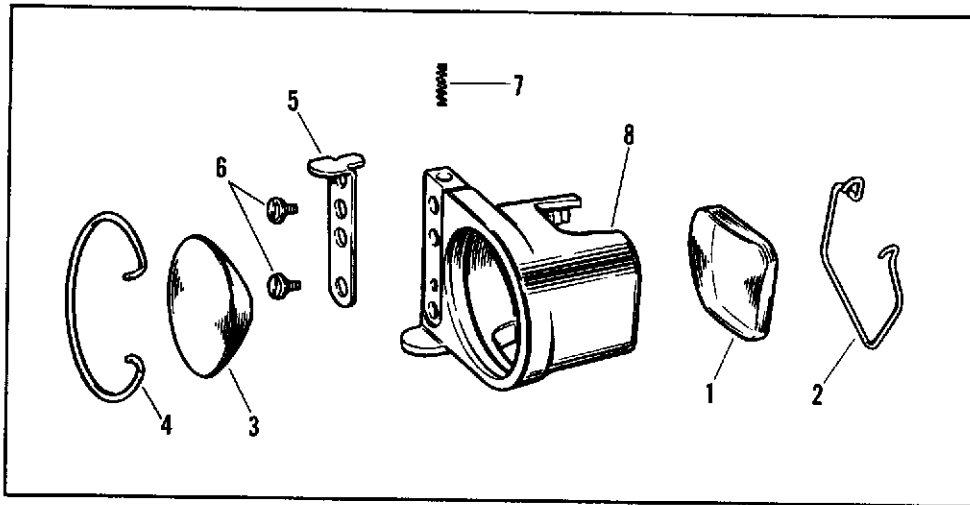


Figure 2-23. Condenser Lens Assembly

1. Front condenser
2. Lock spring
3. Rear condenser
4. Lock spring
5. Lock lever
6. Lens bracket screw
7. Lock lever spring
8. Lens bracket

2-102. **CLEANING AND INSPECTION.** Clean the condensers by blowing away the dust and dirt with syringe bulb, then wiping with lens cleaning tissue. If necessary, use a few drops of denatured alcohol (Military Specification MIL-A-6091) on glass surface to remove fingerprints and oil or other residue. Clean remaining parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly. Inspect condensers for scratches, chips or cracks.

2-103. **REPAIR OR REPLACEMENT.** Repair of damaged parts is impracticable. Replace all damaged parts.

2-104. **LUBRICATION.** No lubrication required.

2-105. **REASSEMBLY.** (See figure 2-23.) Reassemble parts by reference to figure 2-23. Avoid leaving fingerprints on condensers.

2-106. **PRESSURE PLATE ASSEMBLY REPAIR.**

2-107. **DISASSEMBLY.** (See figure 2-24.) Disassemble as shown in figure 2-24 for replacement of springs (3).

2-108. **CLEANING AND INSPECTION.** Clean all parts with denatured alcohol (Military Specification MIL-A-6091), making certain that hardened film emulsion is completely removed. Inspect pressure plate for scratches or grooves, nicks, distortion or excessive wear.

2-109. **REPAIR OR REPLACEMENT.** Repair of damaged or worn parts is impracticable. If pressure plate film surface is scratched or nicked, if plate is bent, or if pressure plate rails are worn to a point where picture area and sound track area of film contact the metal surface of the plate, the plate must be replaced. Fine scratches can be removed by polishing with crocus cloth.

2-110. **LUBRICATION.** No lubrication required.

2-111. **REASSEMBLY.** (See figure 2-24.) Reassemble as shown in figure 2-24.

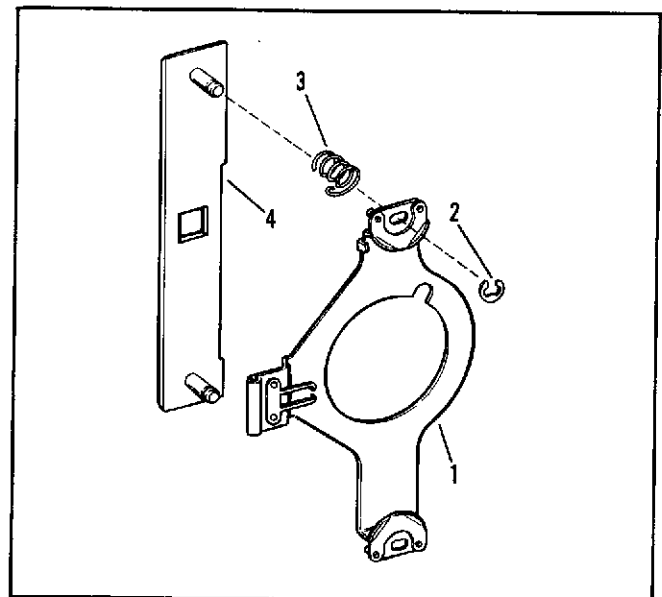
2-112. **APERTURE PLATE ASSEMBLY REPAIR.**

2-113. **DISASSEMBLY.** (See figure 2-25.)

- a. Remove screws (2) and film rail (1).
- b. Remove screws (4), film floating rail (3) and bracket spring (5). Washers (6) will drop free when rail (3) is removed.

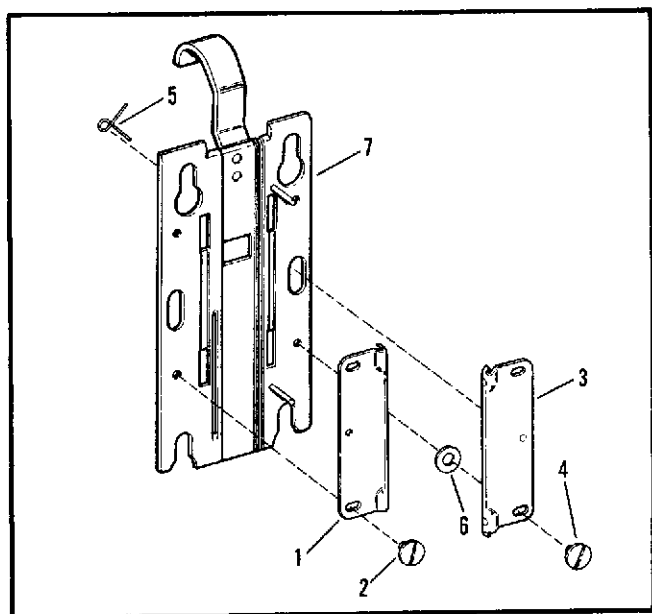
2-114. **CLEANING AND INSPECTION.** Clean aperture plate subassembly with aperture brush. To remove caked film emulsion, use a few drops of denatured alcohol (Military Specification MIL-A-6091). Inspect sapphire jewel insets in rails for chipping. Inspect aperture plate subassembly for excessive wear at the plate rails.

2-115. **REPAIR OR REPLACEMENT.** Repair of damaged parts is impracticable. Replace spring if broken.



1. Pressure plate clip
2. Retaining ring
3. Compression spring
4. Plate and stud assembly

Figure 2-24. Pressure Plate Assembly



- | | |
|-------------------------------|-------------------|
| 1. Film rail subassy | 4. Bracket screw |
| 2. Film guide screw | 5. Bracket spring |
| 3. Film floating rail subassy | 6. Bracket washer |
| 7. Aperture plate subassy | |

Figure 2-25. Aperture Plate Assembly

Replace film rails if sapphire jewel insets are chipped or broken. Replace plate subassembly if rails show signs of grooving.

2-116. LUBRICATION. No lubrication required.

2-117. REASSEMBLY. (See figure 2-25.)

a. Secure film rail (1) to plate subassembly (7) with screws (2), tightening screws just enough to hold. The rail must be free to move. Place guide rail gage (Tool No. S-063196-N2) on aperture plate as shown in figure 2-26. Press down firmly on gage so that the two alignment pins on back of gage fit snugly into aperture plate mounting holes. Press gage upward (toward aperture plate handle) to lock the pins into mounting holes. Hold film rail up flush against the gage and tighten screws (2) securely.

b. Lay washers (6) over floating guide rail mounting holes in aperture plate, and place rail (3) on top of washers so that pin on underside of rail protrudes through hole in aperture plate. Install and tighten screws (4).

c. Invert aperture plate and place loop of spring (5) over floating film rail pin. Engage straight ends of spring in slots in under side of aperture plate.

2-118. LENS HOLDER REPAIR.

2-119. DISASSEMBLY. (See figure 2-27.) Disassemble as shown in figure 2-27.

2-120. CLEANING AND INSPECTION. Clean all parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly. Inspect fiber button on end of lens lock screw for good condition. Inspect gear rack for broken teeth. Check machined mounting

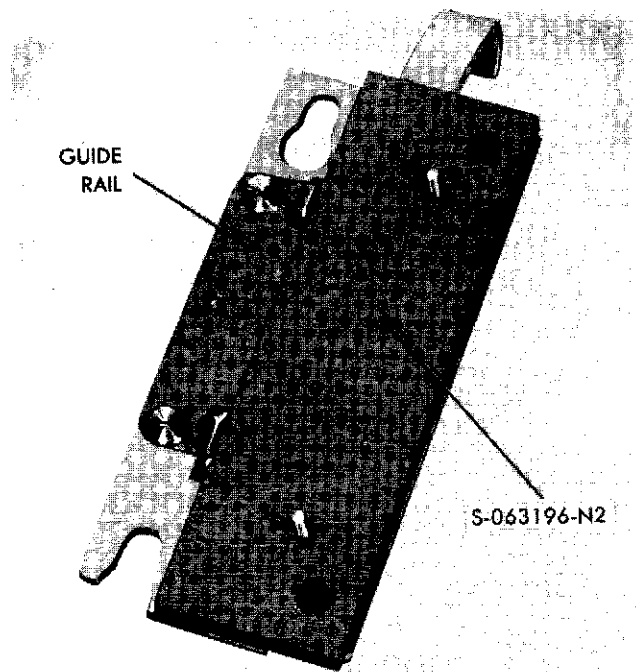


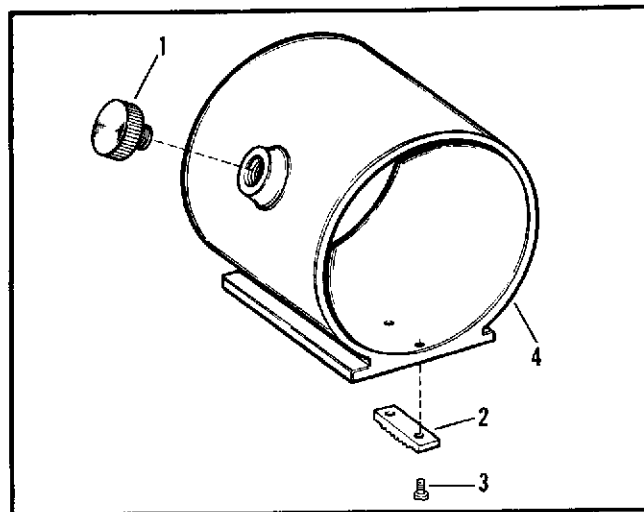
Figure 2-26. Adjusting Fixed Film Guide Rail

surface of lens holder for wear and rough spots.

2-121. REPAIR OR REPLACEMENT. If necessary, remove rough spots from machined mounting surface of lens holder with crocus cloth or a very fine-cut file. If surface is worn unevenly, replace holder. Replace lens locking screw if fiber tip is worn or frayed. Replace gear rack if any teeth are broken.

2-122. LUBRICATION. Lubricate gear rack teeth with film of grease (Military Specification MIL-G-3278).

2-123. REASSEMBLY. (See figure 2-27.) Reassemble as shown in figure 2-27.



- | | |
|----------------------------|--------------------|
| 1. Lens lock screw assy | 3. Gear rack screw |
| 2. Lens focusing gear rack | 4. Lens holder |

Figure 2-27. Lens Holder Assembly

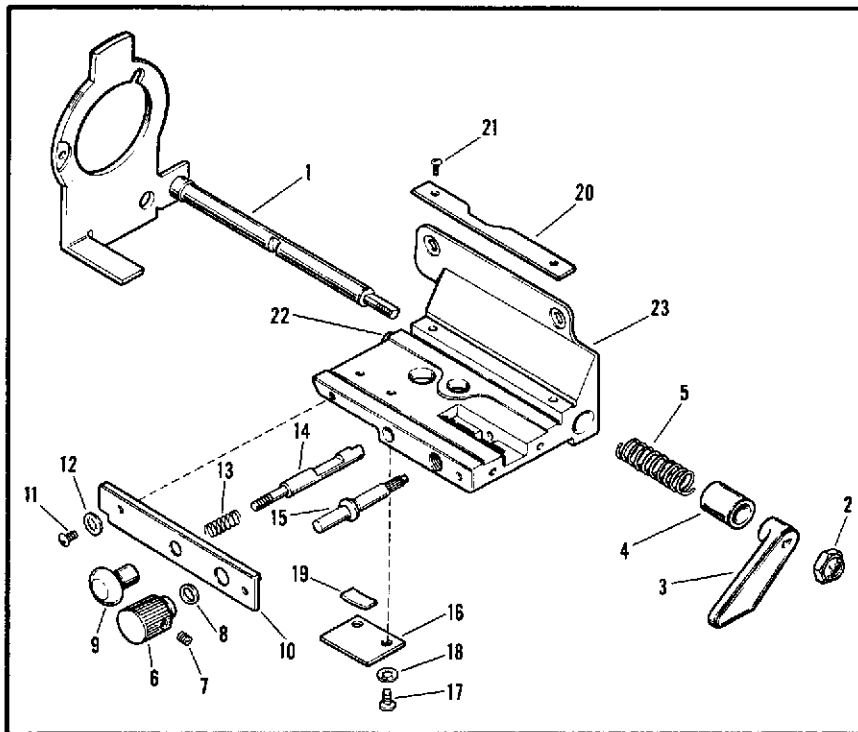


Figure 2-28. Lens Mounting Assembly

1. Pressure plate holder assy
2. Elastic stop nut, 10-32
3. Holder rod push arm
4. Holder rod collar
5. Compression spring
6. Focusing knob
7. Setscrew, 5-40 by 1/8
8. Spring washer
9. Release rod knob
10. Side rail
11. Round hd screw, 4-36 by 0.187
12. Lock washer, No. 4
13. Compression spring
14. Release rod
15. Focusing pinion
16. Retaining plate
17. Round hd screw, 4-36 by 0.187
18. Lock washer, No. 4
19. Flat spring
20. Top rail
21. Round hd screw, 4-36 by 1/8
22. Stop stud
23. Lens holder mounting

2-124. LENS MOUNTING ASSEMBLY REPAIR.

2-125. DISASSEMBLY. (See figure 2-28.) Disassemble by following the sequence outlined in figure 2-28.

2-126. CLEANING AND INSPECTION. Clean all parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly before reassembly. Inspect focusing pinion (15) for chipped or broken teeth. Inspect sliding track of lens holder mounting (23) for rough spots. Examine springs for breaks in coils.

2-127. REPAIR OR REPLACEMENT. Remove rough spots from sliding track of lens holder mounting with a very fine-cut file. Repair of any other damage is impracticable. Replace all damaged parts.

2-128. LUBRICATION. During reassembly, apply a light film of grease (Military Specification MIL-G-3278) to the teeth of pinion (15) and the sliding track of lens holder mounting (23).

2-129. REASSEMBLY. (See figure 2-28.)

- a. Fasten top rail (20) to mounting (23) with screws (21).
- b. Invert mounting, place flat spring (19) in recess, and install retaining plate (16) with screws (17) and lock washers (18). Concave side of spring (19) must face into the recess.
- c. Lubricate teeth of pinion (15), paragraph 2-128, and insert pinion into mounting. Install spring (13) on release rod (14) and insert rod into mounting. Install side rail (10) with screws (11) and lock washers (12).
- d. Insert shaft of pressure plate holder assembly (1) through mounting. Install spring (5), collar (4) and push arm (3) onto end of shaft and secure parts with elastic stop nut (2).
- e. Screw knob (9) onto release rod. Install washer

(8), concave face against rail (10), onto focusing pinion shaft. Press knob (6) onto shaft and tighten set screw (7).

2-130. SPROCKET, FILM SHOE AND GEAR REPAIR.

2-131. DISASSEMBLY. (See figure 2-29.)

NOTE

The following procedure outlines the disassembly of only such parts as require special instructions. Purely mechanical disassembly procedures are not included.

- a. Remove screw (2 and 3) and lock washers (4) and lift off gear cover (1) to expose gears.
- b. Remove retaining ring (7) and spacer (8) and pull double idler gear (6) from gear stud (9). Remove retaining ring (11) and pull single idler gear (10) from gear stud (12). Pull sleeve (13) from shaft of gear (17).
- c. To remove sprockets (14), loosen set screws (15) and pull sprockets and fiber washers (16) from gear shafts. Withdraw gears (17, 18 and 19) from rear of mechanism plate. Be careful not to lose film stops (20).
- d. Film strippers (21) and film shoes (24) can be removed by taking out attaching parts (22 and 23) and (25 and 26), respectively. If necessary, disassemble film shoes (items 27 through 31) as shown in illustration.
- e. Unhook spring (34) from rear arm (36), loosen set screw (37) and disassemble rear arm and loop-setter assembly (38) from mechanism plate.
- f. Remove three screws (40) and lock washers (41) at rear of mechanism plate and lift off film slack adjusting assembly (39). Refer to paragraph 2-136 for repair instructions.
- g. Removal of remaining parts is purely mechanical and can be accomplished by reference to figure 2-29.

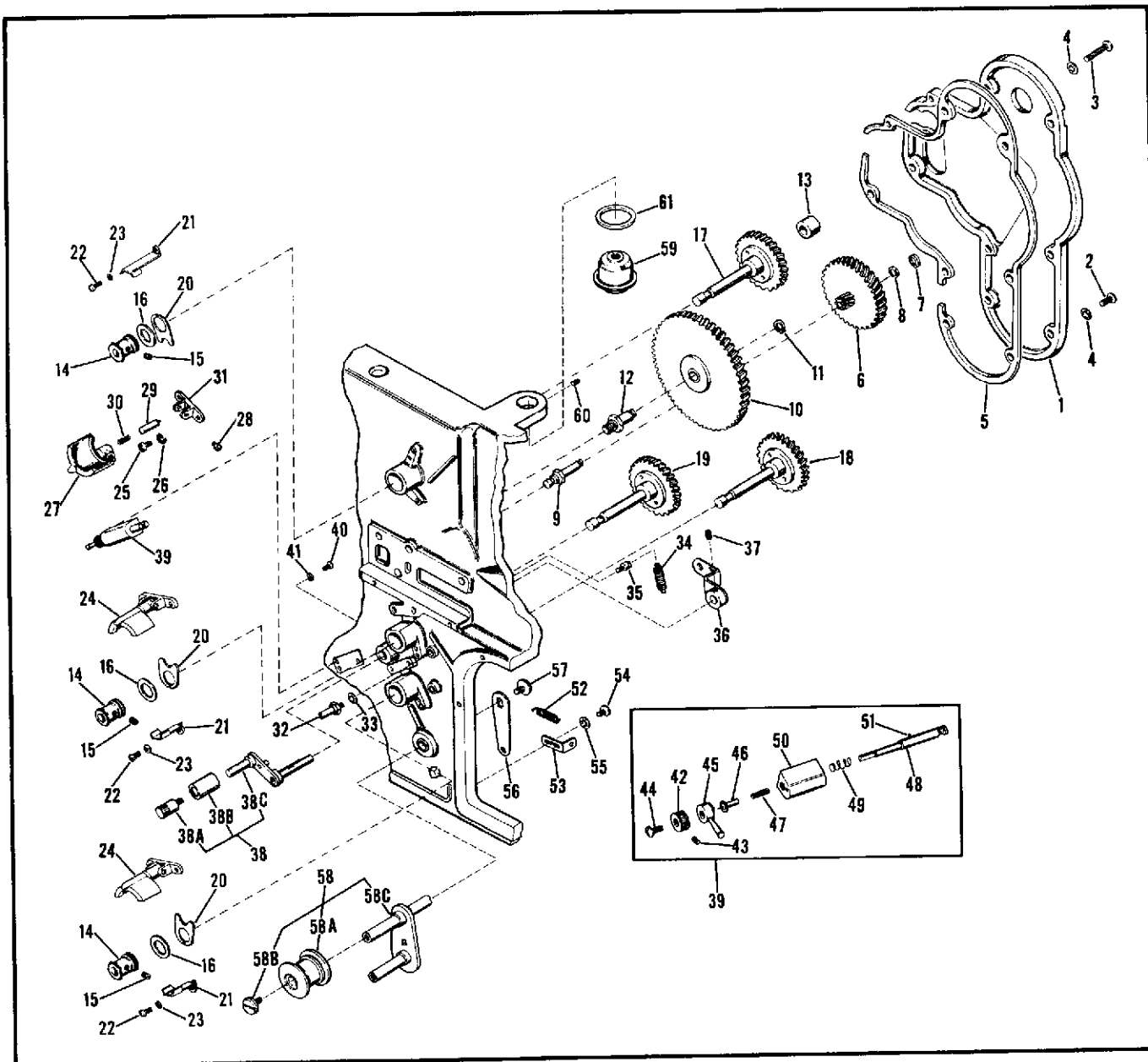


Figure 2-29. Removing Sprockets, Film Shoes and Gears

2-132. CLEANING AND INSPECTION.

a. Clean parts which contact film with denatured alcohol (Military Specification MIL-A-6091), being sure to remove all traces of hardened film emulsion. Clean remaining parts with dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly.

b. Inspect gears and sprockets for chipped or broken teeth.

c. Examine film contacting surfaces of sprockets and rollers for grooves, deep scratches, nicks and rough or flat spots.

d. Inspect film contacting surfaces of film shoes and film strippers for rough spots.

e. Examine all springs for breaks in coils.

f. Inspect grooves of pivot bracket (31), in which the point of the locking rod (29) rides, for excessive wear

and breaks. Inspect point of locking rod for excessive bluntness due to wear.

2-133. REPAIR OR REPLACEMENT. Repair of damaged parts is impracticable. Replace damaged parts.

2-134. LUBRICATION. During reassembly, perform the following lubrication procedures:

a. Apply a light film of grease (Military Specification MIL-G-3278) to all gear teeth.

b. Apply a very light film of oil (Military Specification MIL-O-6086) to all gear shafts, gear studs and film roller shafts.

c. After reassembly of projector, make certain that oil well cup at top of projector mechanism plate is filled with oil (Military Specification MIL-O-6086).

Key for Figure 2-29

- | | | |
|-------------------------------------|-----------------------------------|---------------------------------|
| 1. Gear cover | 23. Lock washer, No. 3 | 43. Setscrew, 5-40 by 1/8 |
| 2. Round hd screw, 6-32 by 3/8 | 24. Film shoe assy | 44. Truss hd screw, 3-48 by 1/4 |
| 3. Round hd screw, 6-32 by 3/4 | 25. Special screw | 45. Film slack adjusting collar |
| 4. Lock washer, No. 6 | 26. Lock washer, No. 4 | 46. Stop pin |
| 5. Cover gasket | 27. Film shoe | 47. Stop pin spring |
| 6. Double idler gear | 28. Pivot screw | 48. Film slack adjusting rod |
| 7. Retaining ring | 29. Locking rod | 49. Compression spring |
| 8. Spacer | 30. Compression spring | 50. Housing |
| 9. Idler gear stud | 31. Pivot bracket | 51. Driv-lock pin |
| 10. Single idler gear | 32. Jockey roller stop stud | 52. Spring |
| 11. Retaining ring | 33. Lock washer, No. 6 | 53. Bracket |
| 12. Idler gear stud | 34. Tension spring | 54. Special screw |
| 13. Sleeve | 35. Spring stud | 55. Lock washer, No. 4 |
| 14. Film sprocket | 36. Rear arm assy | 56. Tension lever |
| 15. Setscrew, 8-32 by 1/8 | 37. Setscrew, 5-40 by 1/8 | 57. Special screw |
| 16. Fiber washer | 38. Loopsetter assy | 58. Floating idler assembly |
| 17. Feed sprocket gear assy | 38A. Knob | 58A. Idler roller |
| 18. Sound sprocket gear assy | 38B. Roller | 58B. Special screw |
| 19. Take-up sprocket gear assy | 38C. Loopsetter subassembly | 58C. Floating idler subassembly |
| 20. Film stop | 39. Film slack adjusting assembly | 59. Vibration mounting |
| 21. Film stripper | 40. Round hd screw, 4-36 by 1/4 | 60. Setscrew, 8-32 by 1/4 |
| 22. Fillister hd screw, 3-48 by 1/4 | 41. Lock washer, No. 4 | 61. Spacer |
| | 42. Film slack retaining roller | |

2-135. REASSEMBLY. (See figure 2-29.)

NOTE

If front mechanism plate is to be completely disassembled, the repair procedures outlined in paragraphs 2-142 through 2-153 must be accomplished before the following reassembly steps are begun.

- Assemble mounting (59) and spacer (61) into mechanism plate; install and tighten set screw (60).
- Assemble rollers (58A) and screws (58B) to shafts of idler subassembly (58C). Assemble floating idler assembly (58) and tension lever (56) to mechanism plate with screw (57). Install bracket (53) with screw (54) and lock washer (55). Do not tighten screw. Hook spring (52) between bracket (53) and lower end of lever (56). Adjust bracket so that all slack is removed from spring, and tighten screw (54) securely.
- Attach reassembled film slack adjusting assembly (39) to mechanism plate with screws (40) and lock washers (41). Assemble loopsetter assembly (38) and insert its shaft through mechanism plate. Install arm (36) on end of loopsetter shaft, tightening set screw (37) down against flat on end of shaft. Hook one end of spring to mechanism plate with spring stud (35).
- Apply a very light film of grease (Military Specification MIL-G-3278) to locking rod (29), spring (30) and the lock rod point grooves in the bracket (31). When assembling film shoe into bracket, these two grooves should be at top of bracket (toward open face of shoe). Install and tighten pivot screws (28). Press bracket down so that lock rod hole in shoe is accessible, and insert spring (30) and rod (29) into hole. Hold lock rod down with screwdriver while snapping bracket back up into position.
- Install film stops (20) on flange of bearings in mechanism plate so that U-shaped edge of stop is centrally located in regard to film shoe mounting

holes. Install gears (17, 18 and 19) and install washers (16) and sprockets (14) on gear shafts. Securely lock each sprocket with two set screws (15). Sprockets and shafts must turn freely with a maximum end play 0.0005-inch.

f. Mount film shoes (24) either under or over sprocket as required, with two screws (25) and lock washers (26). Do not tighten screws. Raise film shoe away from sprocket and insert film clearance gage (Tool Number S-061081-N16) between sprocket and shoe as shown in figure 2-30. Close film shoe against gage and tighten screws (25) securely. Open film shoe and remove gage. Repeat procedure for all three film shoes. Attach film strippers (21) with the screws (22) and

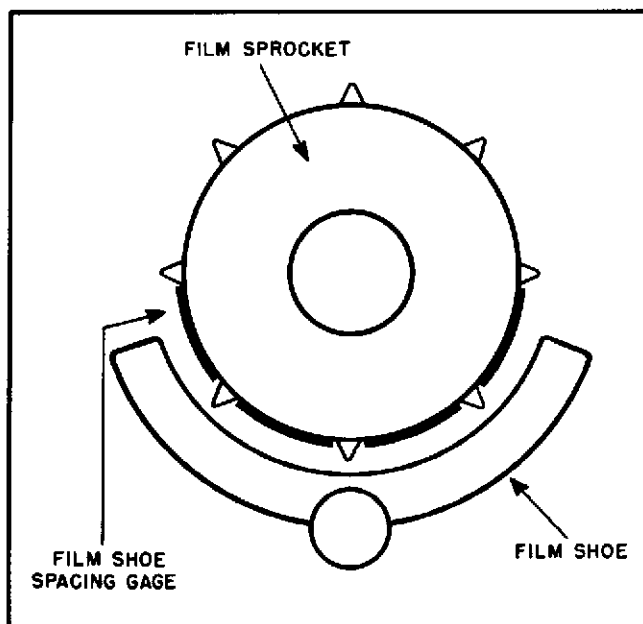


Figure 2-30. Using Film Clearance Gage

lock washers (23).

g. Install sleeve (13) on protruding shaft of gear (17). Mount gears (6 and 10) to gear studs with retaining rings (7 and 11). Be sure spacer (8) is in place on gear stud (9).

h. Check to make certain that all shafts turn freely with no perceptible end play. Lubricate all gear teeth (paragraph 2-134) and install gear cover (1) and its gasket (5) with six screws (2 and 3) and lock washers (4). If a new gasket (5) is being used, a one-inch section must be cut from it to provide movement clearance for the arm (36) as it protrudes from the casting. The two long screws (3) are installed through the holes closest to the blower motor mounting location.

2-136. FILM SLACK ADJUSTING ASSEMBLY REPAIR.

2-137. DISASSEMBLY. (See figure 2-29.) Remove screw (44), loosen set screw (43), and disassemble all parts (45 through 49) from housing (50).

2-138. CLEANING AND INSPECTION. Clean all parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly. Inspect adjusting collar for broken teeth and small end of stop pin for excessive wear. Check springs for broken coils.

2-139. REPAIR OR REPLACEMENT. Repair of damaged parts is impracticable. If pin end of stop pin (46) is rounded excessively or broken, replace both pin and adjusting collar. Replace other parts which are damaged. If pin (51) is broken off, replace adjusting rod and pin.

2-140. LUBRICATION. No lubrication required.

2-141. REASSEMBLY. (See figure 2-29.)

a. If adjusting rod (48) was replaced, new pin (51)

must be pressed in 0.046-inch below outer diameter of shaft. Place spring (49) on rod and insert rod into housing (50). The pin (51) must engage the approximate center of the slot in housing and the notch-out in end of rod must face toward curved radius of housing.

b. Insert spring (47) and stop pin (46) into small hole in housing and install adjusting collar (45) on shaft in such a manner that tip of pin engages teeth of collar.

c. Place retaining collar (42) on shaft and install, but do not tighten, set screw (43). Apply pressure to both ends of assembly until pin (51) is in center of slot in housing. Hold in this position while tightening set screw (43) against flat of shaft. Install screw (44).

2-142. SHUTTER AND SHUTTLE MECHANISM REPAIR.

2-143. DISASSEMBLY. (See figure 2-31.)

a. Loosen set screws (2) and remove framer knob (1). Remove screws (4), lock washers (5) and shutter cover assembly (3). If shutter cover requires repairs, refer to figure 2-32 for disassembly procedure.

b. Remove screws (7 and 7A) and lock washers (8) and lift off the cover (6). Disengage spring (9). Disassemble items (10) through (23) from mechanism plate. Note that parts (17) through (23) are furnished as a complete kit and must be replaced as a complete kit if any one part is damaged.

c. Loosen set screw (25) and remove sprocket (24). Remove screws (27), lock washers (28) and bracket (26). Remove screw (30) and lock washer (31) and disassemble parts (29), (32), (33), (34) and (35) from mechanism plate. Tie the shims (33) and (35) in groups and mark them so the same quantity can be installed during reassembly.

d. Loosen two set screws (37) and disassemble gear

Key for Figure 2-31

1. Framer knob	26. Drive shaft bracket subassy	49B. Shutter screw
2. Set screw, 8-32 by 1/4	27. Round hd screw, 10-32 by 1/2	49C. Shutter shaft
3. Shutter cover assy	28. Lock washer, No. 10	50. Locking collar
4. Special screw	29. Front cam gear assy	51. Set screw, 5-40 by 3/16
5. Lock washer, No. 4	30. Special screw	52. Shaft bracket
6. Cover subassembly	31. Lock washer, No. 5	53. Fillister hd screw, 3-56 by 1/4
7. Round hd screw, 2-56 by 5/8	32. Front cam gear lock ring	54. Lock washer, No. 3
7A. Round hd screw, 2-56 by 3/4	33. Shim	55. Pivot bar assy
8. Lock washer, No. 2	34. Front camshaft	56. Bar mounting screw
9. Shuttle spring	35. Flat shim washer	57. Bar spring washer
10. Special nut	36. Rear cam gear assy	58. Friction washer
11. Front cam counterweight	37. Set screw, 8-32 by 3/16	59. Framer shaft
12. Lubricating disc	38. Rear camshaft assy	60. Oil reservoir
13. Shuttle cams and pivot kit assy	39. Mounting plate subassy	61. Spring and wick assy
14. Elastic stop nut, 4-40	40. Flat hd screw, 2-56 by 3/16	62. Oil reservoir adapter
15. Elastic cam lock stop nut	41. Thrust collar	63. Mounting bracket assy
16. Retaining washer	42. Set screw, 8-32 by 1/8	64. Mounting bracket screw
17. Rear cam, horizontal motion	43. Drive gear assy	65. Lock washer, No. 10
18. Front cam, vertical motion	44. Set screw, 8-32 by 3/16	66. Flat washer
19. Bushing washer	45. Hub washer	67. Oil cup assembly
20. Outer spacer	46. Drive shaft	68. Oiling system assy
21. Pivot bushing	47. Shutter gear assy	68A. Oil reservoir cap
22. Inner spacer	48. Set screw, 8-32 by 1/8	68B. Oil retaining pad
23. Shuttle assy	49. Shutter assy	68C. Oil guide wire
24. Rewind sprocket	49A. Shutter	68D. Oiling system subassembly
25. Set screw, 8-32 by 1/8		69. Plate and insert subassembly

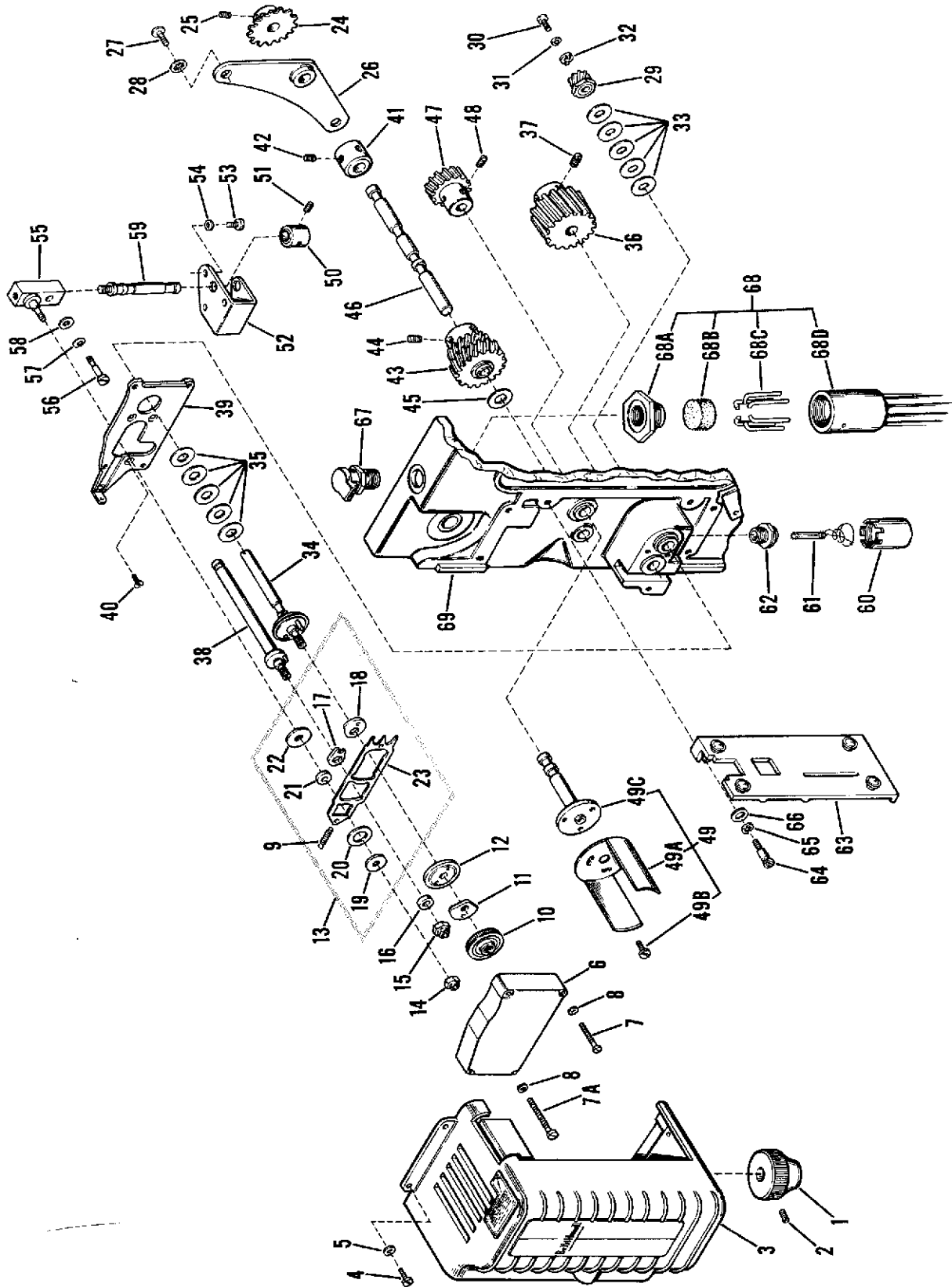
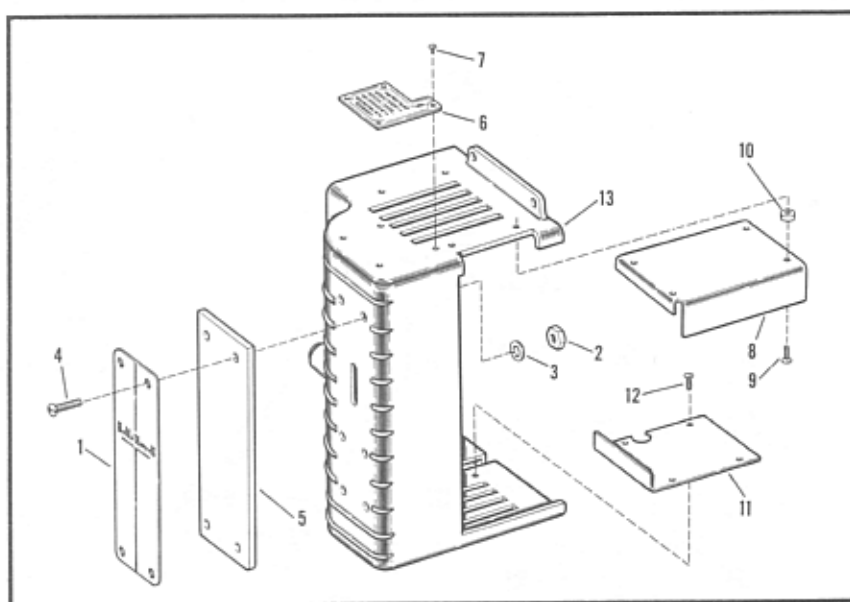


Figure 2-31. Removing Shutter and Shuttle Mechanism Parts

Figure 2-32. Shutter Cover Assembly

1. Nameplate
2. Hex nut, 5-40
3. Lock washer, No. 5
4. Round hd screw, 5-40 by 1/2
5. Cover plate
6. Warning plate
7. Drive screw, No. 00 by 1/8
8. Upper shield
9. Drive screw, No. 00 by 1/8
10. Spacer
11. Lower shield
12. Drive screw, No. 00 by 1/8
13. Shutter cover



(36) and rear camshaft (38) from mechanism plate. Press drive shaft (46) from mechanism plate, and disassemble thrust collar (41), hub washer (45) and drive gear (43) from shaft. Remove screws (40) and plate (39).

e. Loosen set screw (48) and remove shutter gear (47) and shutter assembly (49) from mechanism plate. Disassemble shutter only if necessary for parts replacement.

f. Loosen set screws (51) in locking collar (50). Remove three screws (53) and lock washers (54) and withdraw bracket (52) and collar (50) from shaft (59). Remove screw (56), spring washer (57) and friction washer (58) to free the pivot bar (55). Unscrew shaft (59) from pivot bar.

g. Remaining disassembly can be accomplished by reference to figure 2-31.

2-144. CLEANING AND INSPECTION. Clean all parts in dry cleaning solvent (Federal Specification P-S-

661) and dry thoroughly before reassembly. Inspect all parts for unusual wear or damage. The shuttle kit parts should be examined very closely for wear. Check gears for chipped or broken teeth. Made certain that shutter blades are not bent or twisted. Check camshafts to see if they are bent or otherwise distorted. Inspect oil wick to see if it is clogged with old oil.

2-145. REPAIR OR REPLACEMENT. Repair of damaged parts is impracticable. All damaged parts must be replaced. Note in figure 2-31 that shuttle parts (17) through (23) must be replaced as a complete kit if any one part is damaged or excessively worn. Replace oil wick if clogged or thick with old oil.

2-146. LUBRICATION. During reassembly, apply a light film of grease (Military Specification MIL-G-3278) to all gear teeth and one or two drops of oil (Military Specification MIL-O-6086) to the bearing

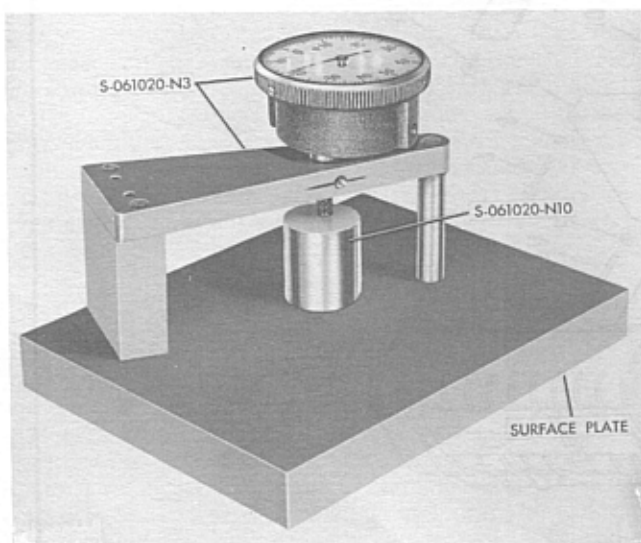


Figure 2-33. Setting the Camshaft Indicator Gage

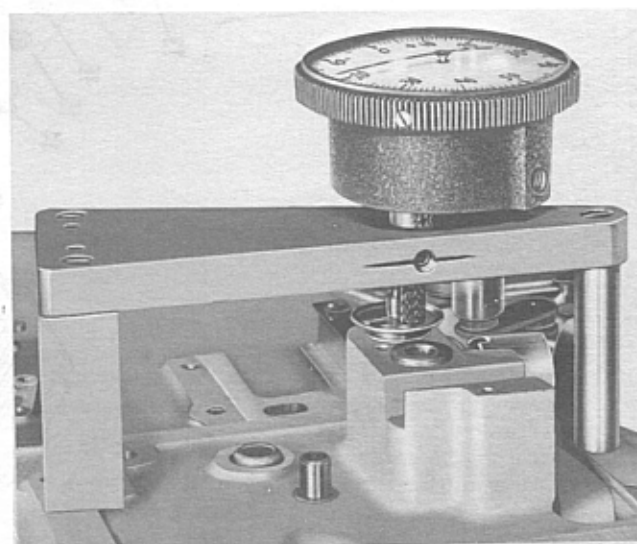


Figure 2-34. Setting Camshaft with Gage

surface of each shaft. Also, place one drop of oil on the pivot bar stud (55), front cam (18) and rear cam (17).

2-147. REASSEMBLY. (See figure 2-31.)

NOTE

If the mechanism plate is to be completely disassembled, follow repair procedures outlined under paragraph 2-148 before proceeding with reassembly.

a. Assemble lubricating parts (60, 61, 62, 67 and 68) to mechanism plate. Felt wick (61) and oil pad (68B) should be saturated with oil (Military Specification MIL-O-6086) before reassembly.

b. Screw shaft (59) into pivot bar (55) and attach bar to mechanism plate with screw (56) and washers (57 and 58). Spring washer (57) must be installed with cup face toward bar. Hold collar (50), beveled face up, in place between arms of bracket (52) and slide bracket and collar up onto shaft (59). Secure bracket with screws (53) and lock washers (54). Slide collar up until it touches bracket and tighten set screws (51).

c. Fasten bracket (26) to mechanism plate with screws (27) and lock washers (28). Do not tighten screws. Insert drive shaft (46) through bracket and into bearing in mechanism plate. Make certain that drive shaft is aligned squarely in both bearings, shifting bracket (26) if necessary. Then tighten screws (27). Withdraw shaft from mechanism plate to permit installation of collar (41), gear (43), and washer (45) on shaft. Press shaft back into mechanism plate until end of shaft is flush with front face of mechanism plate bearing. Press gear and washer toward mechanism plate until washer bears against flange of bearing. Tighten two set screws (44) securely. Move collar (41) until it touches bearing in bracket (26) and tighten its set screws (42) securely. Shaft should turn freely with a minimum end play of 0.003-inch. Secure sprocket (24) to shaft with set screw (25).

d. Fasten mounting plate (39) to mechanism plate with three screws (40). Install shim washers (35) on front camshaft (34) and insert camshaft through its bearing in the mechanism plate. Place master block (Tool No. S-061020-N10) on a surface plate with front camshaft indicator gage (Tool No. S-061020-N3) positioned above it as shown in figure 2-33. With stem of gage just touching the master block, adjust indicator until pointer reads "zero". Place indicator gage on machined surface of mechanism plate as shown in figure 2-34. With stem of gage just touching end of front camshaft, indicator should read "zero". Add or remove shims (35) on front camshaft until condition is met.

e. Install shims (33) and gear (29) on front camshaft, aligning slot in gear with slot in camshaft. Assemble lock ring (32) into slot in gear and camshaft and install screw (30) and lock washer (31). Camshaft must revolve freely with no noticeable end play. If necessary, shim washers (33) must be added or removed until these conditions are met.

f. Assemble rear camshaft (38) and gear (36) to mechanism plate. Hub of gear must face away from mechanism plate. Tighten set screws (37) just enough

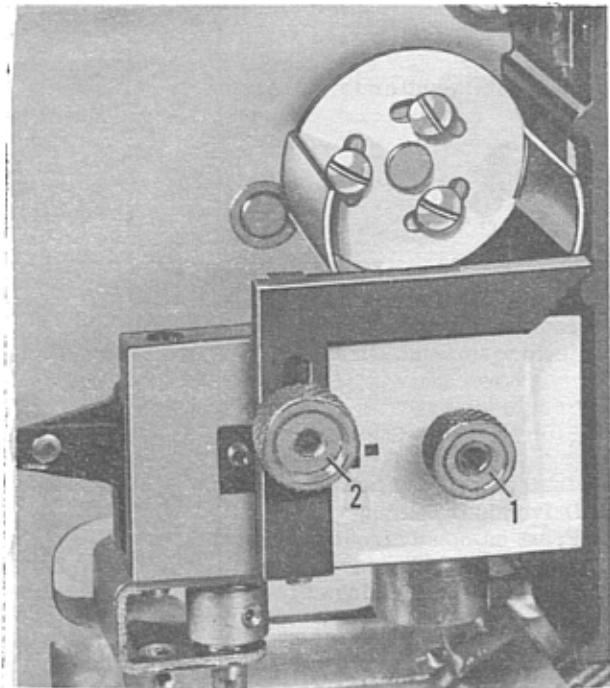


Figure 2-35. Synchronizing the Shutter and Intermittent Mechanism

to hold the gear.

g. Before installing shutter (49), check to make certain that heads of screws (49B) are centrally located in their elongated slots and are tightly screwed in place. Install shutter and shutter gear (47), tightening set screws (48) just enough to hold. Hub of gear must face mechanism plate.

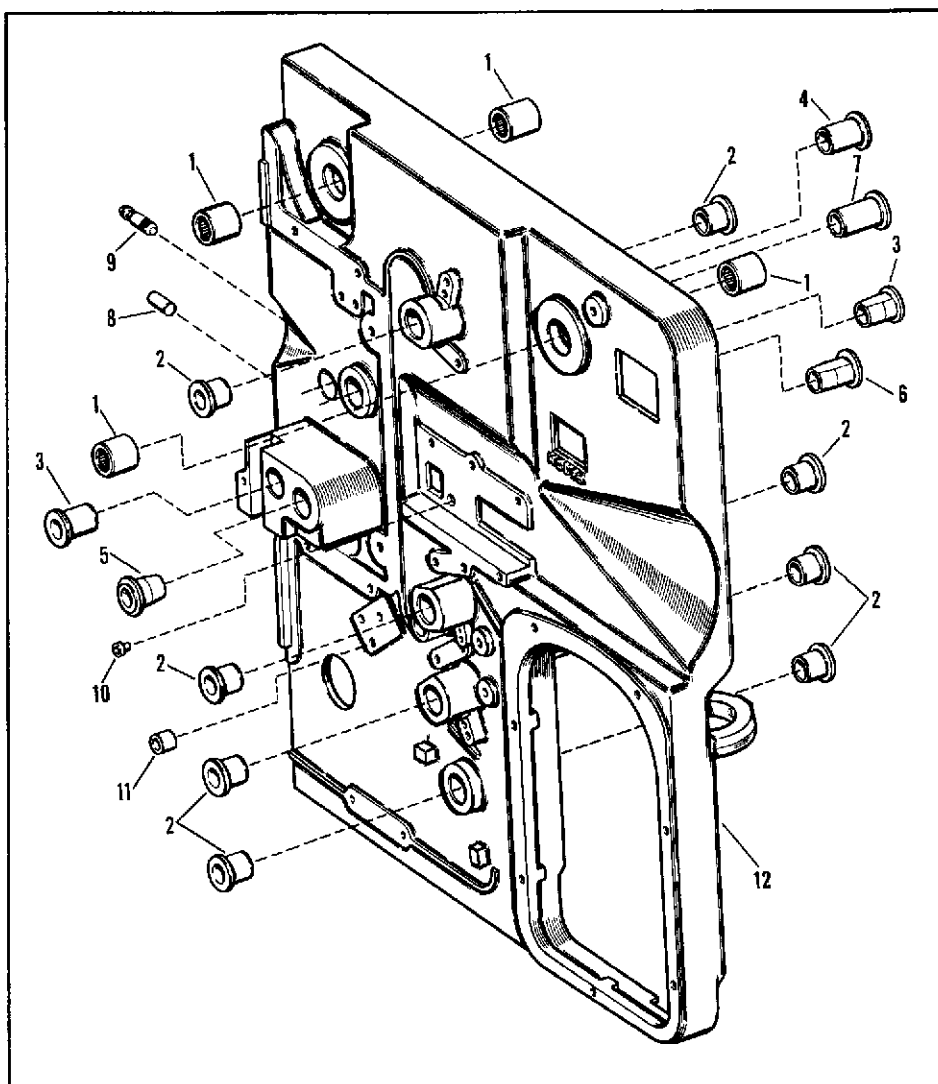
h. Turn front camshaft (34) and rear camshaft (38) until the registration pin is to the right of the shaft (when facing mechanism plate). Rotate the shutter until the shutter blades form a parentheses () above the camshafts. Install shutter and intermittent gage (Tool No. S-061081-N15) as shown in figure 2-35, and lock gage in place by installing knurled nut (1) on front camshaft. Loosen knurled nut (2) and raise the gage bar up against shutter blades. Tighten knurled nut (2) to hold gage bar in this position. Tighten set screws (37 and 48) securely, remembering that both camshafts and the shutter must revolve freely but with a maximum end play of 0.0005-inch. Remove the gage.

i. Fasten mounting bracket (63) to mechanism plate with screws (64), lock washers (65) and flat washers (66). Do not tighten screws until aperture plate mounting bracket has been aligned (paragraph 2-169).

j. Install front cam (18) on front camshaft (34). Install rear cam (17), retaining washer (16) and cam lock stop nut (15) on rear camshaft (38). Install spacer (22) and bushing (21) on shaft of pivot bar (55). Hook spring (9) into hole in end of shuttle (23) and install shuttle over cams and pivot bushing. Sapphire jewel inset in center shuttle tooth must be on bottom of tooth when shuttle is installed. Hook free end of spring (9) into hole in bent arm at rear of mounting plate (39). Install spacer (20) over outer diameter of pivot bushing (21) and install washer (19) up against

Figure 2-36. Removing Front Mechanism Plate Bearings

1. Needle bearing
2. Film sprocket shaft bearing
3. Rear camshaft front bearing
4. Rear camshaft rear bearing
5. Drive shaft bearing
6. Front camshaft front bearing
7. Front camshaft rear bearing
8. Shutter shaft bearing
9. Dowel pin
10. Stud
11. Film gate lock seat
12. Pivot shaft
13. Front plate and bushing assy



bushing. Secure these parts with elastic stop nut (14). Install lubricating disc (12) to front camshaft, with pin in camshaft entering small hole in disc. Install counterweight (11), inserting its pin into large hole in disc (12). Secure these parts with special nut (10). Place one drop of oil (Military Specification MIL-O-6086) on each cam and on parts mounted to pivot bar (55). Do not install covers (6 and 3) or knob (1) until the shuttle has been properly adjusted (paragraph 2-169).

2-148. MECHANISM PLATE BEARING REPLACEMENT.

2-149. DISASSEMBLY. (See figure 2-36.) All bearings are shown removed in figure 2-36. However, bearings should not be disassembled from mechanism plate unless inspection indicates a need for replacement, because new bearings must be broached to size after installation.

2-150. CLEANING AND INSPECTION. Without removing them from mechanism plate, clean all bearings with dry cleaning solvent (Federal Specification P-S-661). Wipe entire mechanism plate with a cloth

dampened in solvent. Inspect all bearings for out-of-round and for signs of scoring or unusually great wear.

2-151. REPAIR OR REPLACEMENT. Repair of parts is not practicable. Bearings must be replaced in pairs.

2-152. LUBRICATION. Place a drop or two of oil (Military Specification MIL-O-6096) on the rollers of the four needle bearings.

2-153. REASSEMBLY. (See figure 2-36.)

a. Needle bearings (1) must be installed with lettered ends of bearings toward outside of casting. Lettered face of each bearing must be 0.010-inch below surface of casting.

b. Install eight sprocket shaft bearings (2) and line-broach inner diameter of bearings to 0.2502 (-0.0004) inch.

c. The cut-out of bearing (6) must line up with the hole in the casting when installed. Line-broach inner diameter of bearings (3) and (4) to 0.2502 (-0.0004) inch; bearings (6) and (7) to 0.1870 (+0.0005) inch.

d. Line-broach the inner diameter of bearings (5) and (8) to 0.2502 (-0.0004) inch. Line-broach inner diameter of bearings (12) to 0.1870 (+0.0005) inch.

e. If dowel pin (9) required replacement, it must be pressed in until pin extends 1/8-inch beyond edge of plate. Stud (10) must extend 0.437-inch beyond edge of plate. Gate lock seat (11) must be pressed in flush with casting.

2-154. INSTALLATION OF MAJOR COMPONENTS.

2-155. LENS MOUNTING ASSEMBLY.

(See figure 2-5.)

a. Make certain that lens holder rails of mounting are free from dirt and grit and that they are lubricated with a film of grease (Military Specification MIL-G-3278).

b. Attach lens mounting assembly (49) to mechanism plate with two screws (50) and the screw (51) and lock washer (52). Insert guide disc (48), spring (47) and friction button (46) into proper holes in lens mounting.

2-156. LENS HOLDER ASSEMBLY. (See figure 2-5.)

a. Install lens holder assembly (45) on lens mounting assembly and slide holder in about halfway. Press down on friction button (46) and slide lens holder inward as far as it will go.

b. Turn focusing knob to engage pinion teeth with focusing rack on underside of lens holder. Press the side rail (item 10, figure 2-28) flush against the assembly and tighten the side rail mounting screws securely. Turn focusing knob back and forth; lens holder should move freely without excess slack.

c. Loosen set screw in focusing knob, press knob in against its spring washer, and tighten set screw. With lens holder racked all the way into the mounting, attach lens holder stop plate (item 42, figure 2-5) with screws (43) and lock washers (44).

2-157. APERTURE PLATE ASSEMBLY. (See figure 2-5.) Pull outward on the release rod knob of the lens mounting to open the film gate, and install the aperture plate assembly (41) in its normal operating position.

2-158. PRESSURE PLATE ASSEMBLY. (See figure 2-5.) With the release knob pulled outward, slide the pressure plate (40) into place on the pressure plate holder of the lens mounting.

2-159. CONDENSER LENS ASSEMBLY. (See figure 2-5.) With thumb of left hand on top of lens mounting lock lever and fingers at bottom of housing, press down on lock lever and slide condenser lens assembly (39) into place on mounting pins in mechanism plate. Release the lock lever.

2-160. FEED AND TAKE-UP PULLEYS. (See figure 2-5.)

a. Apply a very light film of grease (Military Specification MIL-G-3278) to both sides of washers (23 and 27) and assemble pulleys (22 and 26) and their washers to mechanism plate.

b. Install sprockets (20 and 24) on pulley shafts, hubs facing outward, and secure with set screws (21 and 25) turned down tightly against flats on pulley shafts. Each group should rotate freely with a minimum (not more than 0.0005-inch) of end play. Engage drive chain (19) with teeth of both sprockets.

c. Install drive sprocket (17) to feed sprocket shaft,

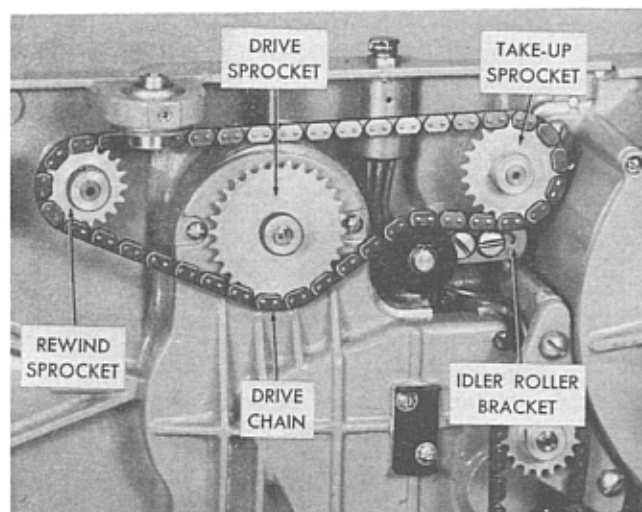


Figure 2-37. Drive Chain and Sprockets Installed

hub facing outward, and secure with set screws (18).

d. Fasten assembled drive chain idler assembly (28) loosely to mechanism plate with screws (29), flat washers (31) and lock washers (30). Adjust position of idler roller bracket so that there is a small amount of slack in drive chain, and tighten screws (29) securely. Proper installation of chain and sprockets is shown in figure 2-37.

e. Apply a coating of grease (Military Specification MIL-G-3278) to entire length of drive chain.

2-161. COUNTER AND COUNTER DRIVE MECHANISM. (See figure 2-5.)

a. With the exposed numbers of the counter (8) in perfect alignment, the counter drive arm (11) must be installed to the ratchet shaft of the counter at the angle shown in the inset of figure 2-5. Tighten locking screw (12) securely.

b. Install counter drive mechanism (13) to tapped studs (16) in mechanism plate with screws (14) and lock washers (15). Arms on pinion hub of counter drive mechanism must enter holes in the drive sprocket (17).

c. Install counter (8) with screws (9) and lock washers (10), engaging long slot in drive arm (11) with pin in counter mechanism drive disc.

NOTE

Lampholder (3) should not be installed until after mechanism plate is assembled into case.

2-162. REAR MECHANISM PLATE. (See figure 2-4.) Attach rear mechanism plate assembly (28) to front mechanism plate assembly (31) with attaching screws (29) and lock washers (30).

2-163. BLOWER MOTOR AND COVER ASSEMBLY. (See figure 2-4.) Fasten the blower motor and cover assembly (25) to rear mechanism plate with seven screws (26) and lock washers (27). Wiring connections will be made after all major components have been installed.

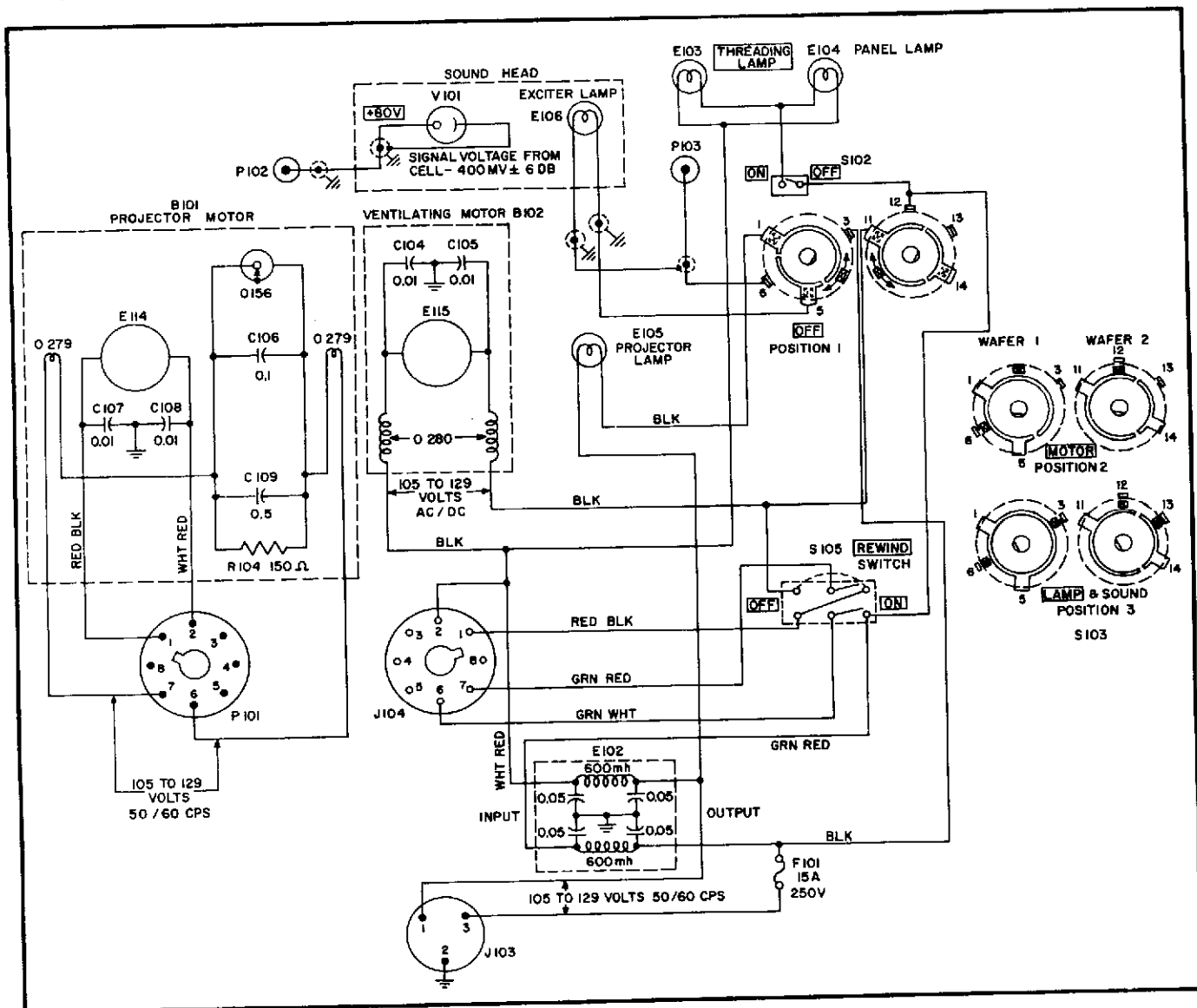


Figure 2-38. Type AQ-2A(1) Projector Schematic Wiring Diagram

2-164. SOUND HEAD ASSEMBLY. (See figure 2-4.)

a. Insert assembled sound head (10) into its mounting on the mechanism plate and secure in place with seven screws (11) and lock washers (12). The upper and lower jockey rollers should be held in a raised position during insertion of sound head assembly so that they will rest on their respective stop studs after installation.

b. Wiring connections will be made after all major components are installed.

2-165. FRONT AND REAR MECHANISM PLATE INSTALLATION. (See figure 2-3.)

a. Carefully insert the partially assembled front and rear mechanism plate (15) into the projector case (29). Vibration mounts at top of mechanism plate must be aligned with two screw holes in top of case so that screws (16) can be installed. Mounts at front and rear edges of mechanism plate must be positioned below brackets within projector case so that hex head screws (26) can be installed.

b. Install all hardware parts (18 through 28) and make certain that all shielded ground wire cables (item 15, figure 2-4) are properly connected.

c. Secure the flywheel (7, figure 2-3) to the sound head stabilizer shaft with screw (8).

d. Install fuseholder (2) and fuse (1).

e. Install special nut (13) and knob (14) on upper end of loopsetter rod. Knob should extend about 3/32-inch above surface of case. Tighten nut up against bottom of knob.

f. Install lampholder (item 3, figure 2-5).

2-166. SWITCH PLATE ASSEMBLY. (See figure 2-2.)

a. Install switch panel casting of switch plate assembly (30) to rear edge of projector case with three screws (31) and lock washers (32).

b. Thread the heavy shielded cable properly within the projector case near the top of the mechanism plate. Proper wiring connections are shown in the schematic wiring diagram, figure 2-38.

c. Note that one branch of the heavy shielded cable,

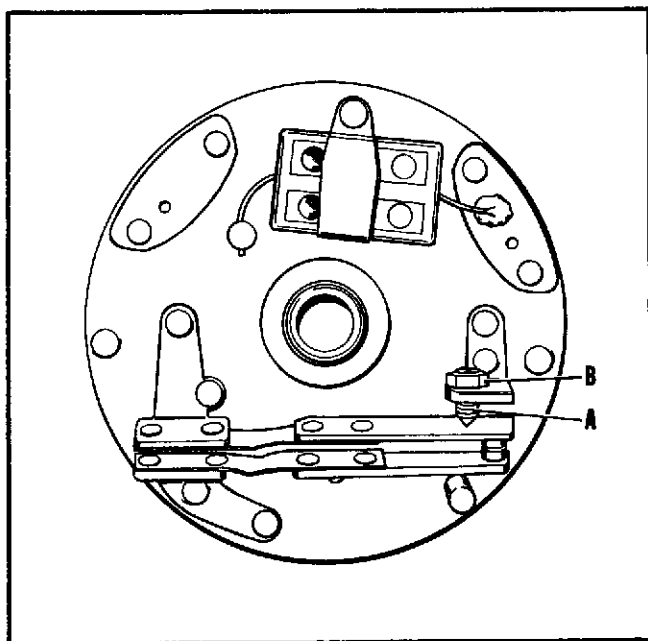


Figure 2-39. Drive Motor Governor Adjustment

containing two black leadwires, must emerge through the projection lamp socket opening on the front side of the mechanism plate. The shielding, at this point, is grounded to the mechanism plate just above the opening by a screw, flat washer and lock washer. Also, make the connections to the lampholder in the upper left-hand corner of the mechanism plate (see figure 2-38) and intertwine the small shielded wires from the sound head around the heavy shielded cable and over to the switch panel. Connect blower motor leadwires as shown in figure 2-38.

d. Install the projection lamp parts (10 through 14), making wiring connections as shown in figure 2-38.

e. Install the condenser bracket portion of the switch plate assembly (30) with the screws (33 and 34) and lock nuts (35). Make the wiring connections to the fuseholder and the pins of the power receptacle (figure 2-38). Recheck all wiring connections against the schematic wiring diagram to make certain that they are correct.

2-167. DRIVE MOTOR ASSEMBLY. (See figure 2-4.)

a. Connect projector power cable between power receptacle and 105 to 129-volt AC power source.

b. Connect motor plug to its receptacle on inside of switch plate assembly, and turn OFF-MOTOR-LAMP switch to MOTOR position.

c. With motor running, check the motor speed by means of a tachometer on the motor armature shaft. Motor speed should be 5554 revolutions-per-minute. To adjust motor speed, loosen adjustment nut (B), figure 2-39, on the governor. Turn adjustment screw (A) clockwise to increase speed or counterclockwise to decrease speed. Tighten nut (B) securely after adjustment has been made. Turn switch to OFF position.

d. Disconnect motor plug, and install motor (20, figure 2-4) to mechanism plate with four screws (21), lock washers (22) and plain washers (23). While motor is being installed into place, drive chain (24) should be hooked around sprocket on motor gear housing

shaft and the sprocket to the right of loopsetter rod. There should be a small amount of slack in the drive chain. This slack is obtained by positioning the motor properly and by adjusting the position of the idler pulley bracket at the top of the motor casting. Be sure to tighten all screws securely after adjustment.

e. Install threading knob (13) with set screw (14). With the shuttle tooth at maximum protrusion position, the words "THREADING KNOB" should be in a horizontal plane. Reconnect motor plug.

2-168. AMPLIFIER AND SPEAKER ASSEMBLY. (See figure 2-2.)

a. Lift assembled amplifier and speaker assembly (22) as close as possible to projector to permit connection of jack plug to photocell input connector and leadwire spade lugs to proper projector terminals. See amplifier schematic wiring diagram, figure 3-1.

b. Lift amplifier and speaker assembly carefully up into position and press into place against projector case. Install six screws (23) and lock washers (24) at top, front and bottom of amplifier, and three screws (25) and lock washers (26) at rear edge of switch panel casting.

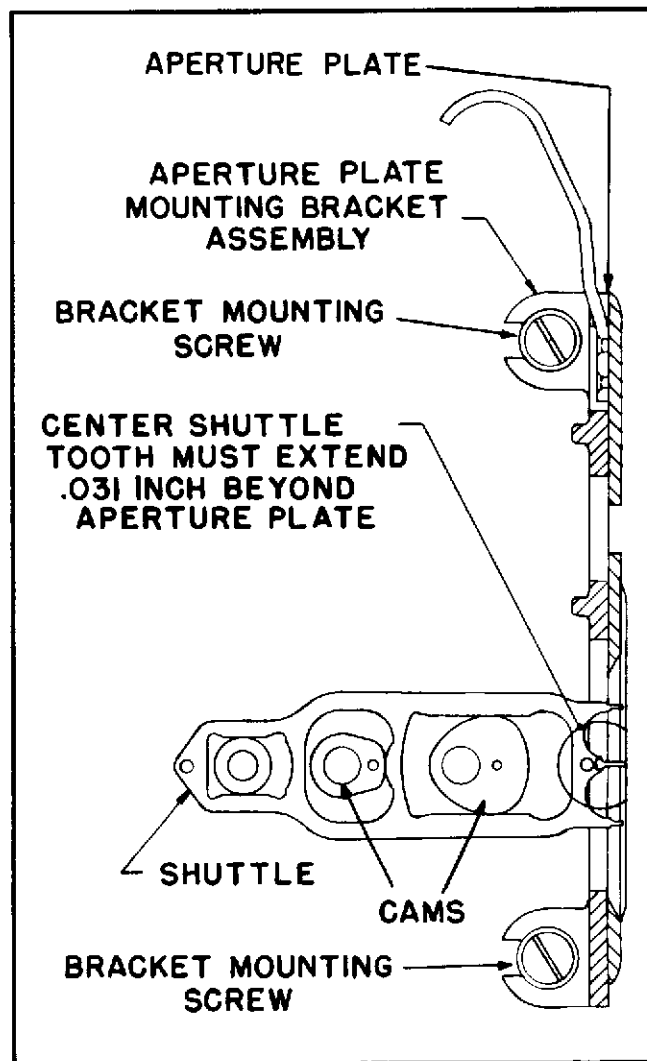


Figure 2-40. Horizontal Position of Shuttle and Cams

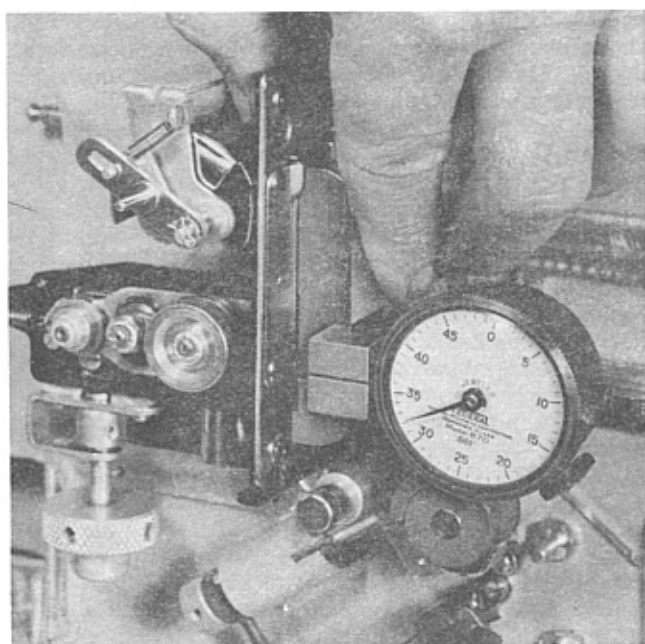


Figure 2-41. Checking Shuttle Tooth Protrusion

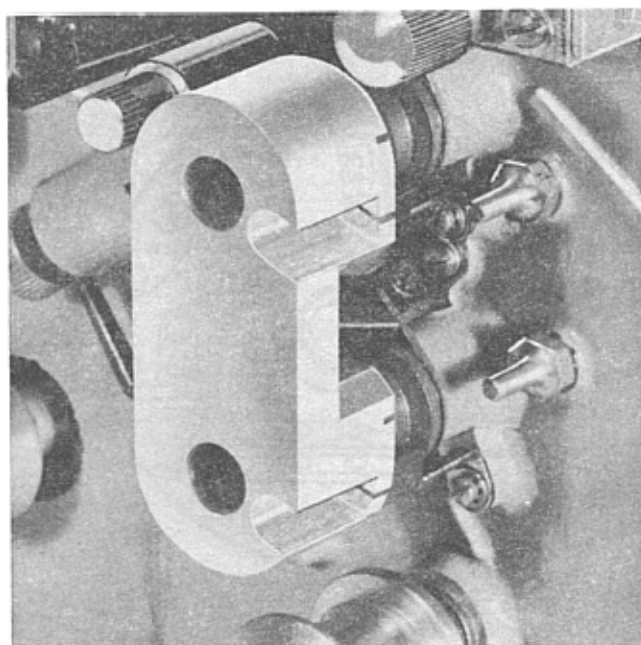


Figure 2-42. Using Sprocket Synchronizer Gage

2-169. ADJUSTING SHUTTLE AND APERTURE PLATE MOUNTING BRACKET.

a. For proper operation, the center tooth of the shuttle must protrude 0.031-inch (+ 0.002, - 0.001-inch) beyond the surface of the aperture plate. Attainment of this precise dimension requires that the aperture plate mounting bracket (item 63, figure 2-31) be aligned in a straight perpendicular plane in relation to the horizontal position of the shuttle. In order to perform this adjustment, it is necessary to remove the lens holder assembly (paragraph 2-20) and lens mounting assembly (paragraph 2-21) from the mechanism plate. Leave the aperture plate in the projector.

b. Turn threading knob clockwise until the center shuttle tooth is at its maximum protrusion position. The cams should be parallel to the shuttle as shown in figure 2-40.

c. Place shuttle alinement gage (Tool No. S-061081-N8, figure 2-1) on a surface plate with gage plunger contacting the plate. If necessary, loosen gage dial set screw and rotate dial until indicator points exactly to "zero" reading. Then tighten dial set screw.

d. As indicated in figure 2-41, place gage against aperture plate with gage plunger contacting center shuttle tooth. The gage indicator reading should not be less than 30 nor more than 33 (indicating a protrusion of 0.030 to 0.033-inch).

e. To adjust shuttle tooth protrusion, the aperture plate mounting bracket must be moved back (away from the lens) to increase the amount of protrusion or forward (toward the lens) to decrease the amount of protrusion. Before tightening aperture plate mounting bracket screws, check by eye to make certain that bracket is perpendicular to horizontal line through cams and shuttle.

f. After tightening screws, recheck shuttle tooth protrusion with indicator gage to make certain that the proper dimension has been maintained.

g. Before reinstalling lens holder and mounting,

adjust the shuttle for proper film perforation clearance as instructed in paragraph 2-170.

2-170. ADJUSTING SHUTTLE FILM PERFORATION CLEARANCE.

a. Place the shuttle alinement gage (Tool No. S-061081-N6, figure 2-1) flat against the aperture plate with the opening in the gage at the bottom and away from mechanism plate. Gage should rest flush against the fixed film guide rail of the aperture plate.

b. Turn threading knob clockwise slowly, and check movement of shuttle teeth. All three teeth should enter the opening in the gage without striking either side of the opening.

c. If shuttle teeth strike the gage, remove the aperture plate and adjust position of fixed guide rail as instructed in paragraph 2-117. Reinstall aperture plate in projector and repeat gage check (step b, above). If shuttle teeth continue to strike gage, the front camshaft adjustment (paragraph 2-147, step d) was not made properly during reassembly.

d. Refer to figure 2-31. Install shuttle cover (6) with screws (7 and 7A) and lock washers (8). Note that the one long screw (7A) is inserted in lower left-hand corner of shuttle cover. Install shutter cover (3) with screws (4) and lock washers (5). Secure framer knob (1) to shaft (59) with set screws (2).

2-171. SYNCHRONIZING LOWER FILM SPROCKETS.

a. Turn threading knob clockwise until center shuttle tooth is at its maximum protrusion position.

b. Loosen the set screws in each of the lower film sprockets until sprockets can be turned. Rotate both film sprockets until one of the set screws in each is accessible at the right side of the sprocket.

c. Place sprocket and shuttle synchronizer gage (Tool No. S-061081-N31, figure 2-1) over sprockets as shown in figure 2-42. Teeth on both sprockets must enter grooves in the gage, and the gage must be in exact perpendicular position as shown in figure 2-42.

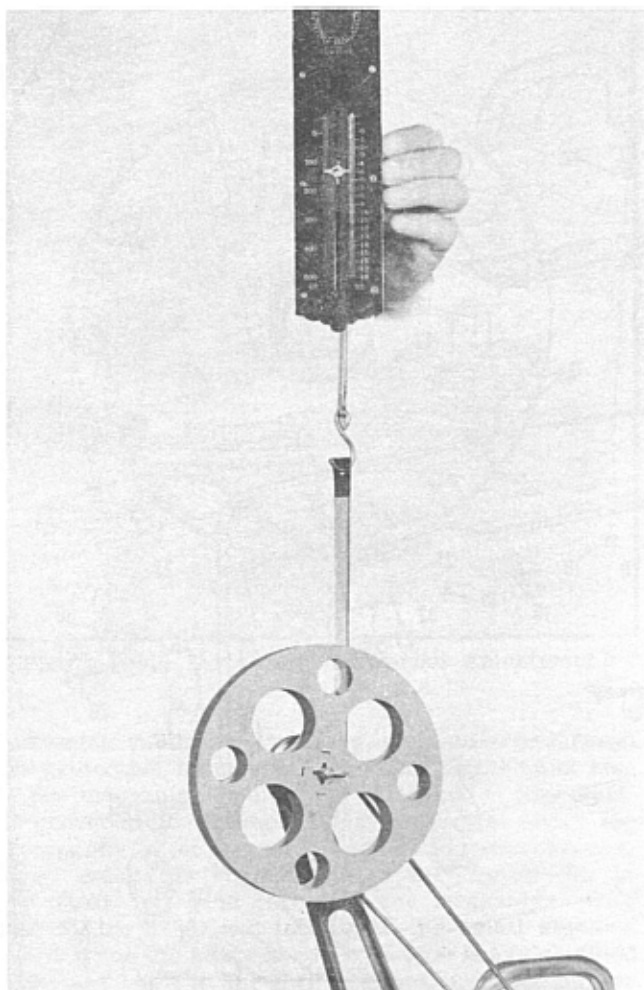


Figure 2-43. Spring Scale Adjustment for Film Take-up Tension

d. With gage held in proper engaging position, tighten accessible set screw in each sprocket. Remove gage and tighten remaining set screws. Check sprocket end play; end play must not exceed 0.0005-inch.

2-172. FILM TAKE-UP TENSION ADJUSTMENT.

NOTE

In the event that the take-up spindle (2, figure 2-7), pulley (10) or friction washer (11) were replaced, a run-in period of 15 to 16 hours will be required before the film take-up adjustment can be performed.

a. Mount the feed and take-up reel arms to the projector by means of their thumb screws, and attach the spring belts to both reel arm pulleys.

b. Wrap three feet of 16-mm film around the hub of an empty 400-foot film reel and install reel on take-up arm spindle. Tighten elastic stop nut on end of take-up spindle against the tension nut and attach hook-end of 18-ounce spring scale to end of film as shown in figure 2-43.

c. Start motor and read the scale. Tension exerted

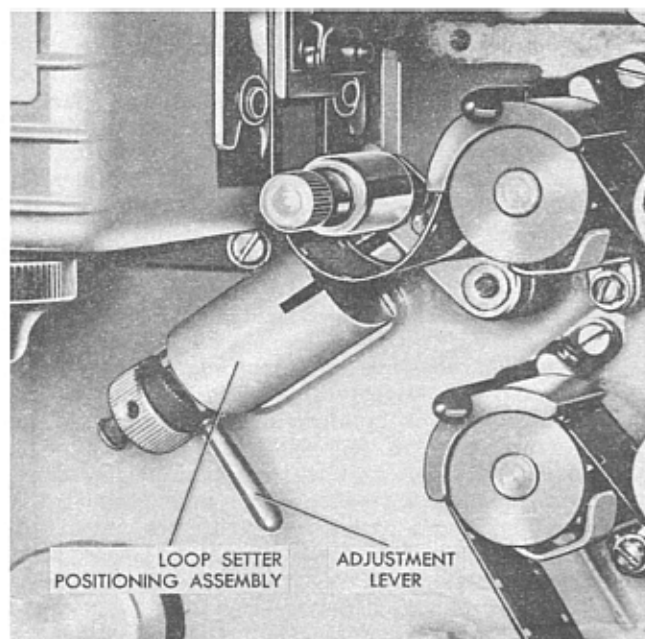


Figure 2-44. Film Slack Lever Adjustment

on film should be 8 ounces. If necessary, adjust the tension nut on take-up spindle by tightening the elastic stop nut until correct reading is obtained.

d. Stop the motor and remove scale and film, but leave the film reel installed. Tie the reel to reel arm with string or wire to apply tension to take-up arm during run-in period. Start projector and let it run for a period of at least 16 hours. Remove wire or string from reel and arm after run-in period.

e. Wrap the three-foot length of film around hub of empty 400-foot film reel on take-up spindle and attach hook-end of scale to end of film (figure 2-43). Tighten or loosen elastic stop nut and tension nut on spindle until reading on scale is 8 ounces maximum. The tension now is set to accommodate all size film reels from 400-foot to 2000-foot capacity.

2-173. FILM SLACK ADJUSTING ASSEMBLY ADJUSTMENT. (See figure 2-44.)

a. Move the film slack adjusting collar (45, figure 2-29) over its entire course and observe the action of the loopsetter assembly (38). The loopsetter assembly should move up and down. If movement does not occur, proceed as follows:

b. Insert a screwdriver between retaining collar (42) and truss head screw (44) and apply pressure against head of screw. Loosen set screw (43) while holding the screwdriver in this position. Ease up on the pressure of the screwdriver so that the adjusting rod (48) moves upward approximately 3/64-inch; then tighten the set screw (43) securely.

2-174. PROJECTOR CASE REPAIR.

2-175. DISASSEMBLY. (See figure 2-45.) Disassembly of projector case parts can be accomplished by referring to figures 2-45 through 2-48.

2-176. CLEANING AND INSPECTION.

a. Clean removed parts with dry cleaning solvent

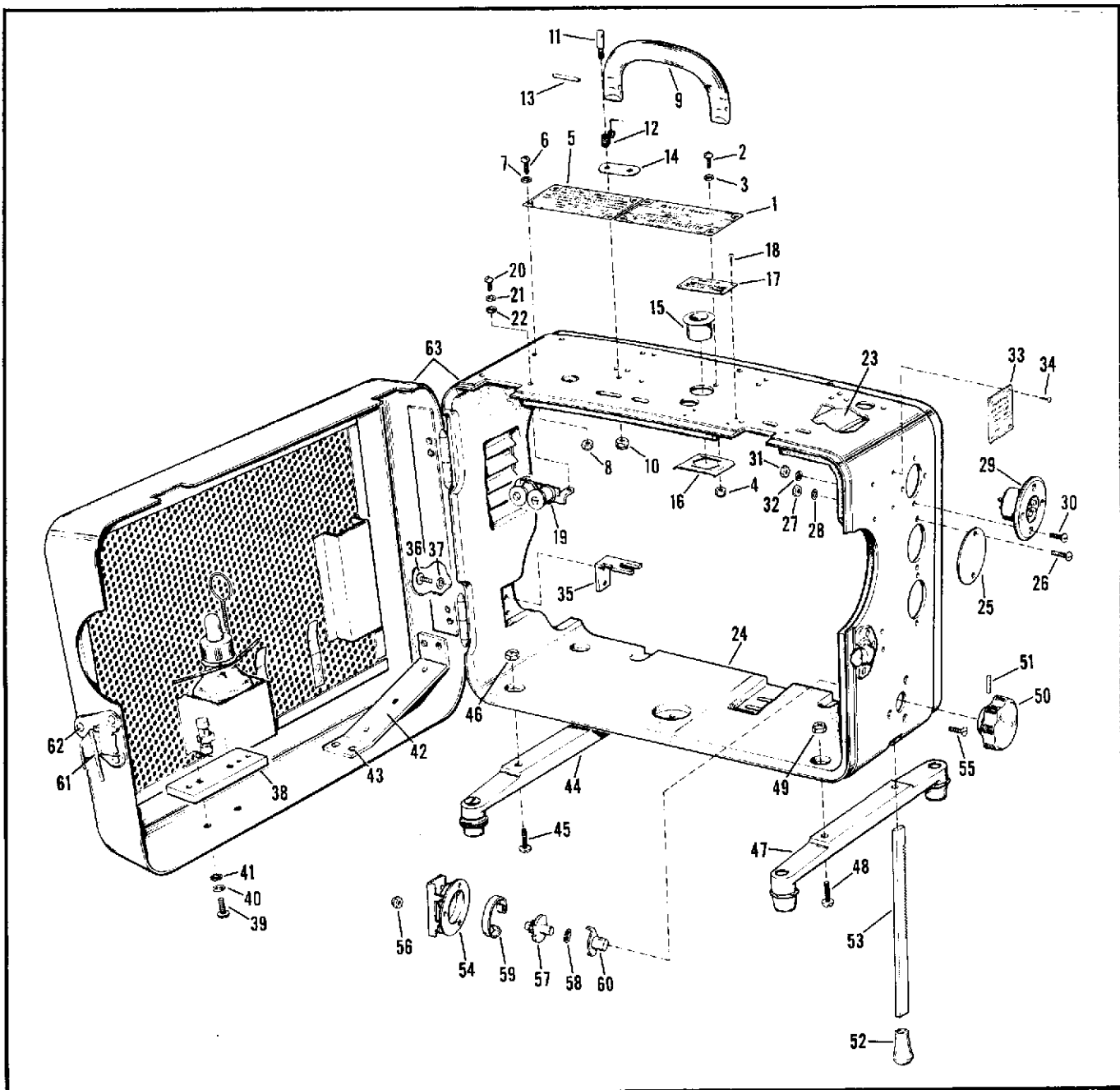


Figure 2-45. Projector Case Assembly Exploded

(Federal Specification P-S-661) and allow parts to dry before reassembly.

- b. Inspect tilt jack rack and pinion for broken teeth.
- c. Inspect rubber tips on legs and tilt rack jack for damage.
- d. Inspect cork lining in tilt jack housing for oil saturation or fraying.
- e. Inspect film rollers for flat spots.

2-177. REPAIR OR REPLACEMENT. Repair of damaged parts is impracticable. Replace damaged parts.

2-178. LUBRICATION. During reassembly, apply a light film of grease (Military Specification MIL-G-

3278) to teeth of tilt jack rack and pinion. Place a drop or two of oil (Military Specification MIL-O-6086) on each film roller shaft.

2-179. REASSEMBLY. (See figure 2-45.)

- a. Insert rack (53) through slot in housing (54). Depress friction spring (59) and insert spring into housing, being careful not to damage cork lining.
- b. Insert pinion (57) into housing, engaging the spring (59) with slot in pinion. Teeth of pinion and rack must engage.
- c. Install thrust washer (58) on shaft of pinion. The tilt jack arm (60) must fit onto pinion and into the friction spring.

Key for Figure 2-45

- | | | |
|----------------------------------|------------------------------------|---------------------------------|
| 1. Identification plate | 22. Flat washer | 43. Rivet |
| 2. Round hd screw, 6-32 by 3/8 | 23. Cork pad | 44. Rear projector leg assy |
| 3. Lock washer, No. 6 | 24. Acoustic filter | 45. Round hd screw, 8-32 by 3/4 |
| 4. Hex nut | 25. Cover | 46. Elastic stop nut, No. 8-32 |
| 5. Lubrication plate | 26. Round hd screw, 4-36 by 3/8 | 47. Front projector leg assy |
| 6. Round hd screw, 6-32 by 3/8 | 27. Hex nut, No. 4-36 | 48. Round hd screw, 8-32 by 3/4 |
| 7. Lock washer, No. 6 | 28. Lock washer, No. 4 | 49. Elastic stop nut, No. 8-32 |
| 8. Hex nut | 29. Receptacle | 50. Tilt jack knob |
| 9. Clear handle | 30. Oval hd screw, 4-36 by 7/16 | 51. Straight pin |
| 10. Elastic stop nut, 8-32 | 31. Hex nut, No. 4-36 | 52. Tilt jack leg (rubber) |
| 11. Handle post | 32. Lock washer, No. 4 | 53. Tilt jack rack |
| 12. Tension spring | 33. Warning plate | 54. Tilt jack housing |
| 13. Pin | 34. Drive screw, No. 2 by 3/16 | 55. Flat hd screw, 5-40 by 5/16 |
| 14. Handle plate | 35. Support bracket | 56. Elastic stop nut, No. 5-40 |
| 15. Loopsetter rod knob stop | 36. Phillips hd screw, 8-32 by 3/8 | 57. Tilt jack pinion |
| 16. Speed nut | 37. Lock washer, No. 8 | 58. Thrust washer |
| 17. Rewind warning plate | 38. Storage bracket | 59. Friction spring |
| 18. Drive screw, No. 2 by 3/16 | 39. Phillips hd screw, 8-32 by 3/8 | 60. Tilt jack arm |
| 19. Bracket and roller assy | 40. Lock washer, No. 8 | 61. Case clamp |
| 20. Round hd screw, 5-40 by 5/16 | 41. Flat washer | 62. Rivet |
| 21. Lock washer, No. 5 | 42. Storage bracket | 63. Case |

d. Insert assembled mechanism up into position within projector case and secure with three screws (55) and elastic stop nuts (56). Secure knob (50) to tilt jack arm (60) with straight pin (51).

e. Assemble any remaining parts to projector case as shown in figure 2-45.

2-180. AMPLIFIER AND SPEAKER REPAIR.

2-181. Actual physical replacement of amplifier and

speaker parts can be accomplished by removing the amplifier and speaker assembly (paragraph 2-8) and referring to figures 2-49 through 2-52 for identification of replacement parts. To determine which electronic parts require replacement, it first will be necessary to perform a complete trouble shooting check and circuit analysis of the amplifier and speaker as instructed in Section III. Replace all faulty components.

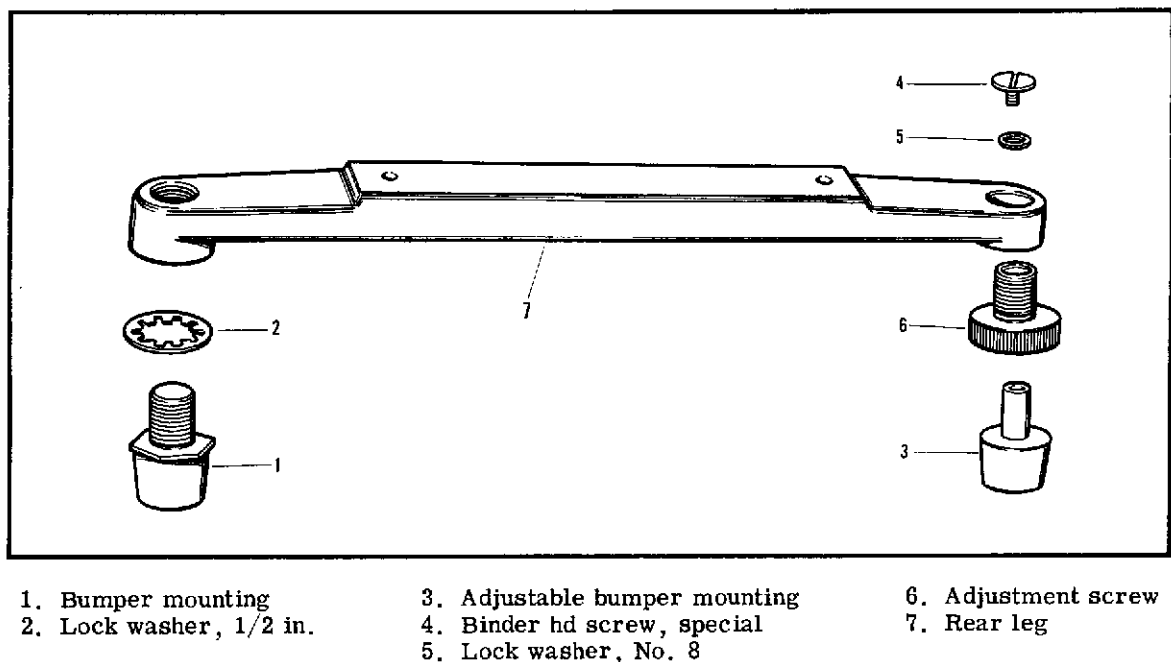
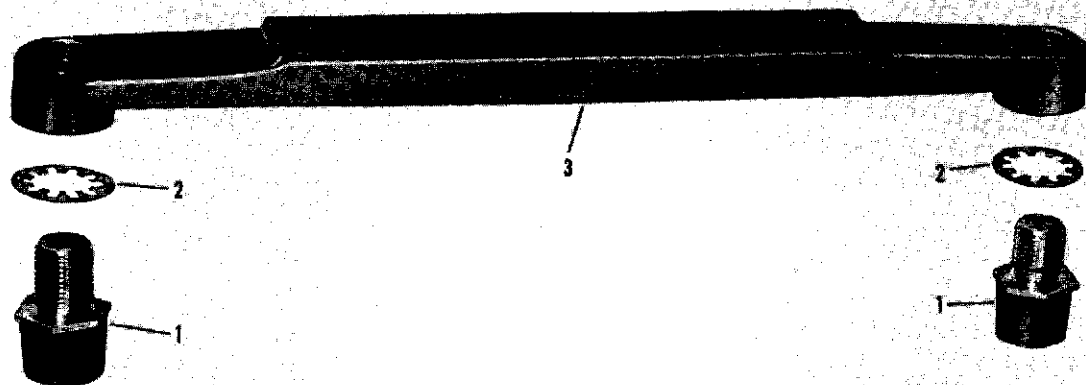


Figure 2-46. Rear Projector Leg Assembly



1. Bumper Mounting

2. Lock washer, 1/2 in.

3. Case front leg

Figure 2-47. Front Projector Leg Assembly

Key for Figure 2-48

1. Film guide roller bracket
2. Roller shaft screw
3. Hex nut, No. 4-32
4. Lock washer, No. 4
5. Film guide roller

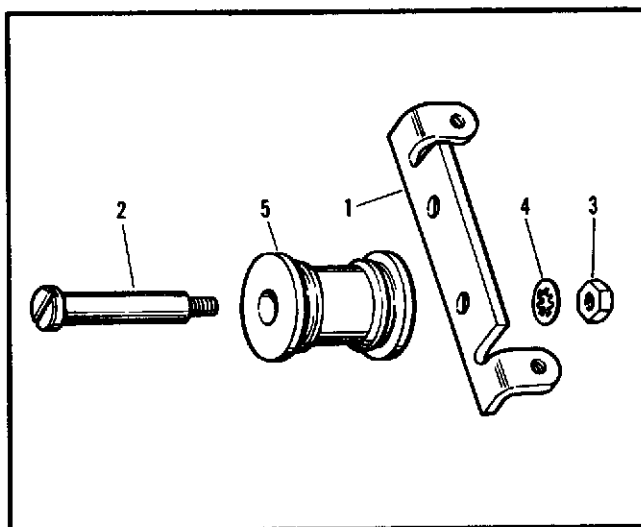
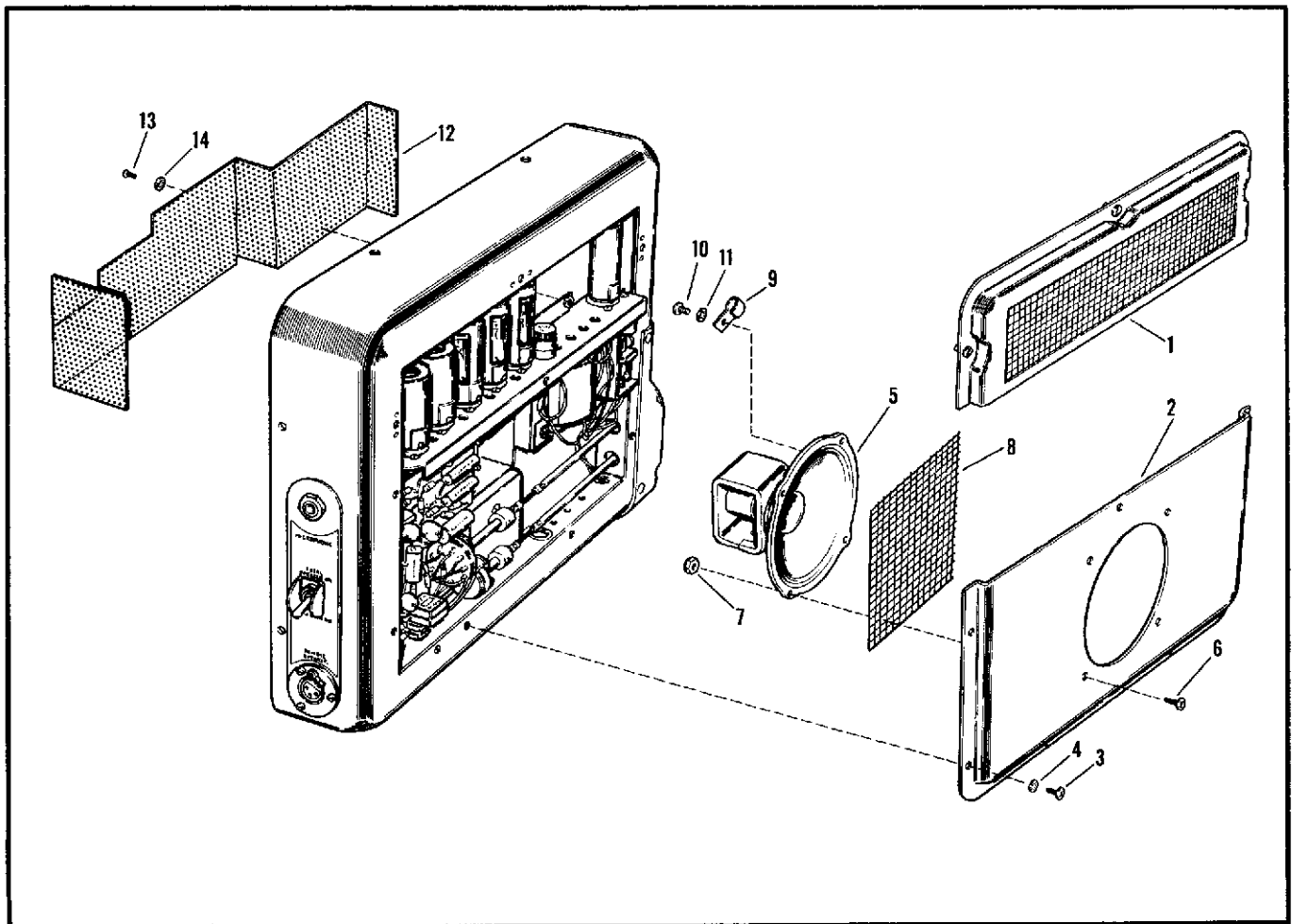
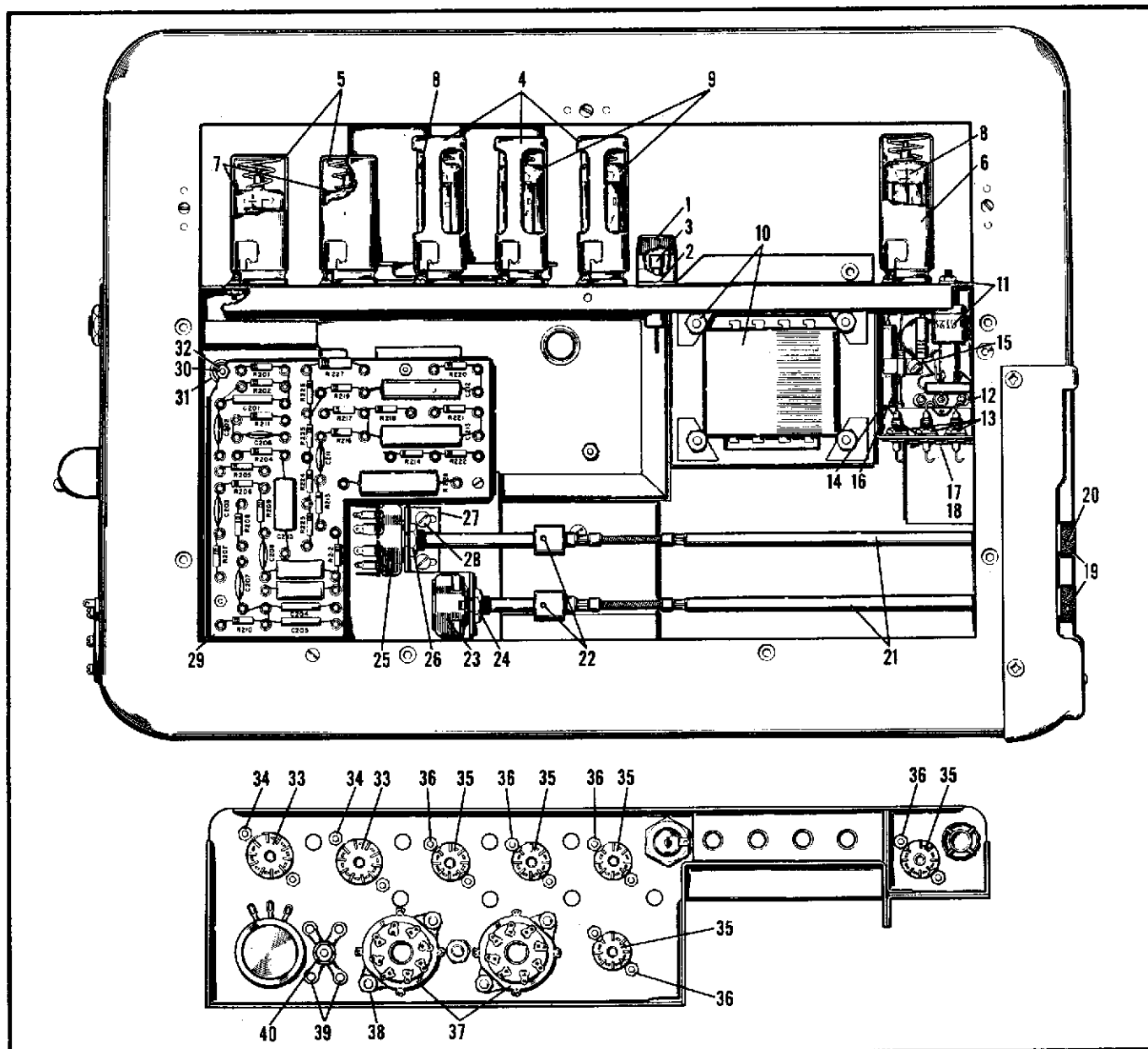


Figure 2-48. Bracket and Roller Assembly



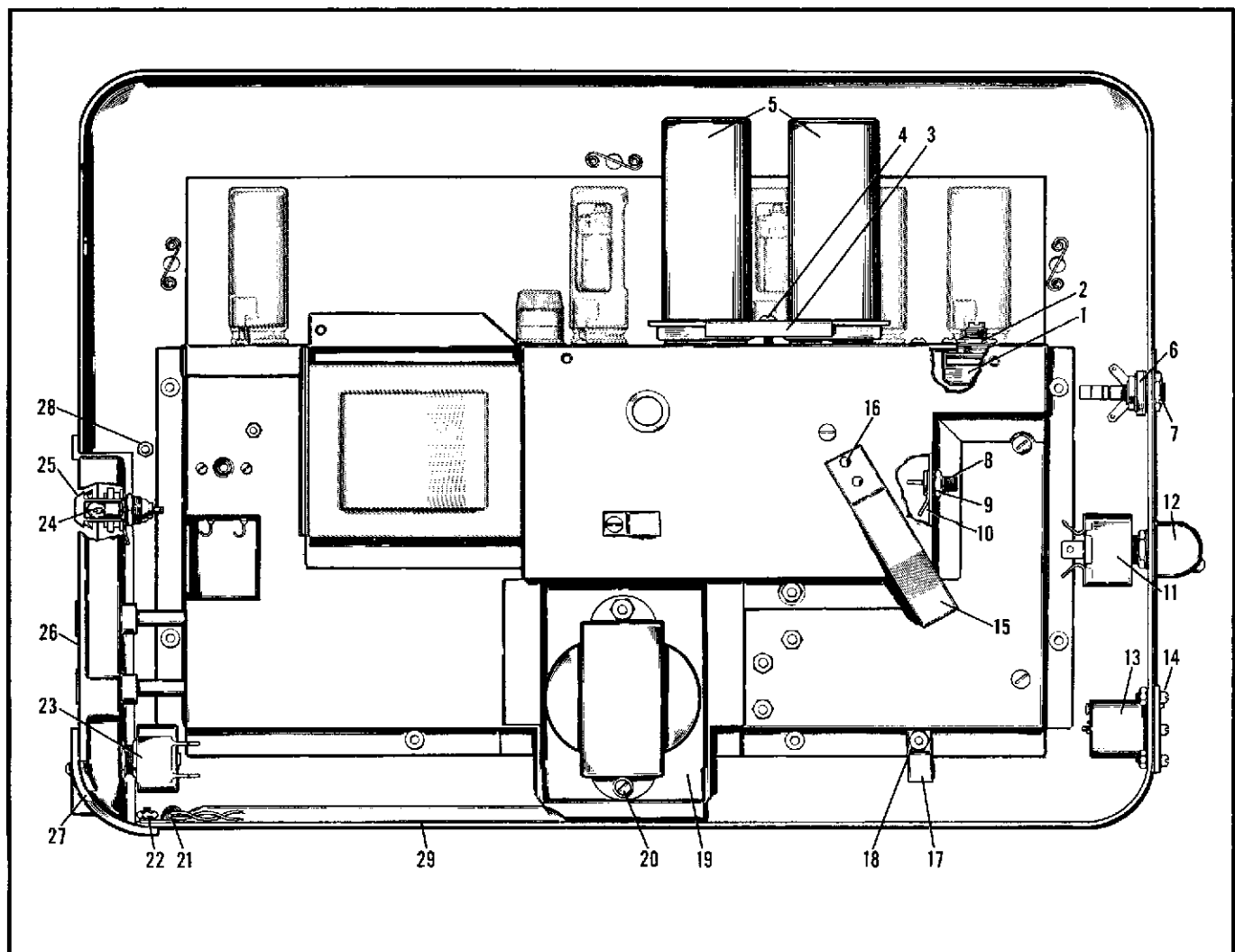
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|-----------------------------------|-----------------------------------|----------------------------------|
| 1. Tube vent grille | 6. Phillips hd screw, 6-32 by 1/2 | 10. Round hd screw, 8-32 by 1/4 |
| 2. Speaker panel | 7. Elastic cam lock stop nut | 11. Lock washer, No. 8 |
| 3. Phillips hd screw, 6-32 by 3/8 | 8. Speaker grille | 12. Rear screen |
| 4. Lock washer, No. 6 | 9. Cable clamp | 13. Round hd screw, 6-32 by 5/16 |
| 5. Loudspeaker, 5 inch | | 14. Lock washer, No. 6 |

Figure 2-49. Removing Loudspeaker and Grilles



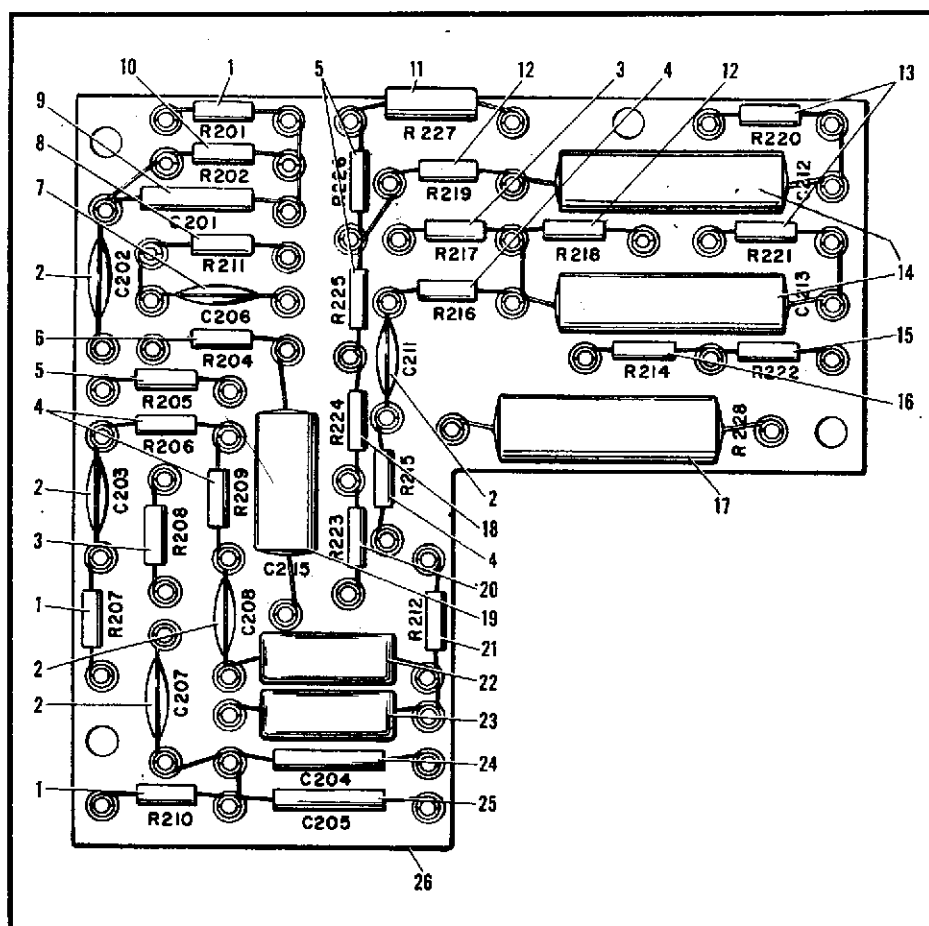
- | | | |
|--|---|---|
| 1. Fuse holder | 15. Rd hd screws, hex nuts and lock washers | 29. Resistor-capacitor strip assy |
| 2. Spacer | 16. Resistor (47 ohm) | 30. Elastic stop nuts, rd hd screws and spacers |
| 3. Fuse (1 amp, 125v) | 17. Terminal lug | 31. Resistor (160 ohms) |
| 4. Tube shield | 18. Rd hd screws and hex nuts | 32. Elastic stop nut, rd hd screw, insulating washer and insulating plate |
| 5. Tube shield | 19. Control knob | 33. Tube socket |
| 6. Tube shield | 20. Setscrew, 8-32 by 3/16 | 34. Rd hd screw, hex nut and special washer |
| 7. Tube, 12AX7 | 21. Control shaft assembly | 35. Tube socket |
| 8. Tube, 6AQ5 | 22. Setscrew, 6-32 by 1/8 | 36. Rd hd screw, hex nut and special washer |
| 9. Tube, 6X4 | 23. Potentiometer | 37. Octal socket |
| 10. Transformer, hex nuts and lock washers | 24. Hex nut, plain washer and lock washer | 38. Rd hd screw, hex nut and lock washer |
| 11. Oscillator coil, hex nuts and lock washers | 25. Tone control switch | 39. Terminal lug |
| 12. Receptacle, rd hd screws, hex nuts and washers | 26. Hex nut, plain washer and lock washer | 40. Rd hd screw and hex nut |
| 13. Capacitor (1500 uf), hex nuts and lock washers | 27. Mounting bracket | |
| 14. Capacitor (0.1 uf) | 28. Rd hd screw, hex nut and lock washer | |

Figure 2-50. Amplifier Tubes and Sockets



- | | | |
|--------------------------------|-------------------------------------|------------------------------------|
| 1. Potentiometer | 11. Toggle switch | 20. Hex nut, No. 8-32 |
| 2. Hex locking nut, 3/8-32 | 12. Switch guard | 20. Lock washer, No. 8 |
| 2. Plain washer | 13. Receptacle | 21. Cable clamp |
| 2. Lock washer, 3/8 in. | 14. Fillister hd screw, 4-36 by 3/8 | 22. Flat hd screw, 6-32 by 1/2 |
| 3. Retaining clamp | 14. Hex nut, No. 4-36 | 22. Hex nut, No. 6-32 |
| 4. Round hd screw, 8-32 by 3/4 | 14. Special washer | 22. Lock washer, No. 6 |
| 5. Capacitor, 20 uf | 15. Contact spring | 23. SPST switch |
| 6. Receptacle | 16. Rivet | 24. Lamp |
| 7. Hex nut | 17. Cable clamp | 25. Lampholder |
| 7. Phenolic washer | 18. Flat hd screw, 6-32 by 1/2 | 26. Control panel plate |
| 7. Extruded washer | 18. Hex nut, No. 6-32 | 27. Control panel housing |
| 8. Receptacle | 18. Lock washer, No. 6 | 28. Phillips hd screw, 6-32 by 3/8 |
| 9. Hex nut | 19. Output transformer | 28. Hex nut, No. 6-32 |
| 9. Lock washer | 20. Round hd screw, 8-32 by 3/8 | 28. Lock washer, No. 6 |
| 10. Soldering lug | | 29. Amplifier chassis subassembly |

Figure 2-51. Amplifier Capacitors, Switches and Receptacles



- | | | |
|---------------------------|----------------------------|----------------------------|
| 1. Resistor, 1 meg | 10. Resistor, 750,000 ohms | 18. Resistor, 470,000 ohms |
| 2. Capacitor, 0.005 uf | 11. Resistor, 15,000 ohms | 19. Capacitor, 0.1 uf |
| 3. Resistor, 5600 ohms | 12. Resistor, 110,000 ohms | 20. Resistor, 270,000 ohms |
| 4. Resistor, 560,000 ohms | 13. Resistor, 200,000 ohms | 21. Resistor, 3.3 megohms |
| 5. Resistor, 10,000 ohms | 14. Capacitor, 0.1 uf | 22. Capacitor, 1000 uuf |
| 6. Resistor, 56,000 ohms | 15. Resistor, 75,000 ohms | 23. Capacitor, 2200 uuf |
| 7. Capacitor, 0.01 uf | 16. Resistor, 6800 ohms | 24. Capacitor, 51 uuf |
| 8. Resistor, 8200 ohms | 17. Resistor, 500 ohms | 25. Capacitor, 100 uuf |
| 9. Capacitor, 200 uuf | | 26. Mounting strip |

Figure 2-52. Resistor - Capacitor Strip Assembly

SECTION III

TEST PROCEDURE

3-1. DESCRIPTION OF PROJECTOR ELECTRICAL CIRCUIT. (See figure 2-38.)

3-2. GENERAL. The projector electrical system is divided into three major sections: motor and lamp circuits, exciter lamp supply from amplifier, and photo cell output to amplifier. All three are described in the following paragraphs with reference to figure 2-38.

3-3. MOTOR AND LAMP CIRCUITS.

3-4. The projector drive motor, ventilating motor and projection lamp receive power through receptacle J103. The entire power circuit is protected by fuse F101. An R-F filter E102 in series with the line to the drive motor, ventilating motor and threading lamps minimizes radio frequency radiation. Surge current in the projection lamp prevents the use of such a filter in its line; therefore, the wiring from J103 to E105 is shielded and as short as practicable.

3-5. The threading lamps E103 and E104 receive power through the pilot lamp switch S102.

3-6. The ventilating motor receives its power through terminals 11 and 12 of the motor lamp switch, S103. These terminals make contact on the first clockwise position from "OFF" of S103. Capacitors C104 and C105 are connected between the armature brushes and ground to prevent radio-frequency radiation.

3-7. The projector drive motor is a series wound motor, being able to drive the projector at line voltages as low as 85 volts. The speed of the motor is controlled by a centrifugal governor mounted on the armature shaft. When the motor speed is low, the switch closes, shorting out resistor R104 which increases the current through the circuit. As the speed increases, the switch opens, inserting the additional resistance which in turn reduces the speed. Capacitors C106 across the centrifugal governor and

C109 across R104 minimize radio-frequency radiation.

3-8. Additional radio-frequency suppression is provided by capacitors C107 and C108 connected from the drive motor armature to ground.

3-9. The drive motor wiring is connected to the power supply through plug P101 and receptacle J104, allowing rapid replacement of the entire motor assembly, if necessary.

3-10. When the rewind switch S105 is in the "OFF" position, drive motor operation is normal and is controlled by the motor-lamp rotary switch S103. In the "REWIND" position of switch S105 the motor-lamp rotary switch S103 is by-passed, thus allowing rewinding without ventilating motor and projection lamp operation.

3-11. The projection lamp E105 receives its power through terminals 1 and 3 of motor-lamp switch S-103. These terminals make contact on the extreme clockwise position of the motor-lamp switch.

3-12. EXCITER LAMP CIRCUIT. Exciter lamp power is supplied by the integral 8-watt amplifier through receptacle P103 and terminals 13 and 14 of the S103. Shielded cable is used throughout this circuit to prevent radiation of the 112,000-cycle exciter current.

3-13. AUDIO FREQUENCY SIGNAL. This signal is generated by the lead sulphide photo conductive cell V101. The proximity of the amplifier makes possible the direct connection of the cell to the input of the amplifier through receptacle P102. The photo cell wiring assembly, carrying the signal, is shielded to prevent noise pickup and is short to reduce high frequency losses.

3-14. PROJECTOR CIRCUIT VOLTAGES. Voltages for normal operation, measured at various points, are given in Table I, following.

TABLE I. PROJECTOR CIRCUIT VOLTAGES

Test Point	Symbol (Figure 2-38)	Name of Part	Measure across Terminals	Correct Voltage
1	E103	Threading lamp	Socket	120 v ac
2	E104	Threading lamp	Socket	120 v ac
3	E105	Projection lamp	Socket	120 v ac
4	E102	R-F line filter	R-F line filter	120 v ac
5	J104	Drive motor receptacle	1-2	35 v ac
6	J103	Power receptacle	6-7	85 v ac
7		Ventilating Motor	1-3	120 v ac
			Term. 11 of S103 to top lug of threading lamp socket	120 v ac

3-15. DESCRIPTION OF AMPLIFIER ELECTRICAL CIRCUITS. (See figure 3-1.)

3-16. GENERAL. The amplifier is designed to deliver 8 watts of audio power at less than 2% distortion from 100 to 6000 cycles per second into the speaker load with an input signal of 0.40 volts into the photo cell input J201. A reserve gain of 20 decibels is provided for reproduction of incorrectly recorded sound tracks. The operation of the amplifier is described in paragraphs 3-17 through 3-30, following, with reference to figure 3-1.

3-17. AMPLIFIER POWER SUPPLY. The power requirements for the amplifier include: (1) An a-c supply for operation of the vacuum tube heaters, and (2) a d-c supply for positive plate and screen potentials and negative grid bias for the power output tubes.

3-18. ALTERNATING-CURRENT SUPPLY. The 115 volt a-c supply voltage is obtained from the projector electrical system. One side of the amplifier a-c line is connected to the top lug of the threading lamp socket E104 through a one-ampere slow-blow fuse F201. A single-pole, single-throw switch S202 is in series with the other line which is connected to the No. 12 terminal of the motor-lamp rotary switch S103. The power transformer T202 has two secondary windings; the first winding (terminals 3, 4 and 5, center tap 4) supplies 265 volts (each side of center tap) to the plates of the two 6X4 rectifier tubes V206 and V207. The second winding (terminals 6, 7 and 8, center tap 7) supplies 6.3 volts to the pilot lamp E201 and the filaments of all tubes.

3-19. DIRECT-CURRENT SUPPLY. The d-c requirement of the amplifier is met by rectification and filtering of the a-c voltage appearing across winding (1), terminals (3 and 4, and 4 and 5) of power transformer T202. Full wave rectification of this voltage is accomplished by the two 6X4 rectifier tubes V206 and V207. The plates of each rectifier tube are paralleled to conduct the current safely. The ripple components of the resulting d-c voltage are removed by the RC Pi-section filter composed of input capacitor C216(A), resistor R228, and terminating capacitor C216(B). Center tap (4) of the high-voltage secondary winding is grounded through resistor R229, thus providing a negative bias voltage of 16 volts for the power amplifier tubes. Grounding center tap (7) of the filament winding in a similar manner biases the heaters at -16 volts, thus reducing hum generated within the amplifier.

3-20. D-C POWER DISTRIBUTION. Direct current for the amplifier tube requirements is distributed in the following manner. The center tap, terminal (2), of the output transformer T201 is connected to the input of the power supply filter at C216(A), furnishing plate voltage for the 6AQ5 power amplifier tubes V203 and V204 through the primary winding. Screen grid excitation for the output tubes V203 and V204 is obtained at the output of the power supply filter at C216(B), with additional filtering action being provided by resistor R227 and bypass capacitor C214(A). Resistor R226 and capacitor

C214(C) are the filtering and decoupling elements which supply the plate voltage to tube V202. Plate voltage for tube V201 is obtained through R225, with capacitor C214(B) providing filtering action. Final voltage division and filtering is accomplished by resistors R224 and R223 and capacitor C215, whose function it is to supply the positive bias voltage for the photo cell in the projector. Refer to paragraph 3-13 for photo cell operation.

3-21. PROJECTOR EXCITER LAMP OSCILLATOR. The exciter lamp requires a 6-volt, 1-ampere, direct-current power supply or its equivalent in alternating current. An equivalent a-c source must be at a frequency high enough so that the thermal inertia of the lamp will prevent the exciting current from modulating the output of the photo cell. To satisfy this requirement a frequency of 112,000 cycles-per-second is used, furnished by the oscillator V205. The output voltage of the oscillator is stepped down through the secondary winding of the oscillator coil L201 in order to obtain the low-voltage, high-current power required by the exciter lamp. This output is fed to the projector by means of a shielded cable, the outer conductor of which is grounded and connected to one side of the exciter lamp. The inner conductor is connected to No. 13 terminal of the rotary motor-lamp switch S103 in the projector.

3-22. POWER OUTPUT STAGE. The output stage delivers a normal rated audio output of 8 watts at less than 2% distortion over a frequency range of from 100 to 6000 cycles per second. It consists of two 6AQ5 beam power pentodes, V203 and V204, connected in class AB push-pull. The output impedance of these tubes is matched to the loudspeaker by the output transformer T201. The secondary winding of the transformer is tapped to provide an 8-ohm winding for the local speaker load (terminals 4 and 5), and a 16-ohm winding for the remote loudspeaker load (terminals 4 and 6). The speaker is connected to the output transformer by means of a shielded two-wire cable, the shield of which is grounded. Provision is made for the use of an external 16-ohm speaker connected to receptacle J203. A single-pole, double-throw switch S203 is used to select the desired speaker. Resistors R220 and R221 are grid load resistors connected to a common source of fixed negative bias obtained from the power supply. Capacitors C212 and C213 are grid coupling capacitors to the phase inverter stage.

3-23. PHASE INVERTER STAGE. The second section of V202 is cathodyne or split-load phase inverter. Phase splitting is accomplished by driving V203 from the plate circuit and V204 from the cathode circuit. The gain of the stage under these circumstances is less than one. Component functions are as follows: C211 is the grid coupling capacitor from the first triode section of V202; R216 is the gridload resistor; R219 is the plate load resistor across which the signal for V203 is developed; R218 is the cathode load resistor across which the signal for V204 is developed; and R217 is the cathode bias resistor. Resistors R218 and R219 are of equal value so as to impress signals of equal amplitude on the grids of the power output tubes.

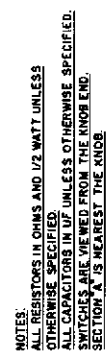


Figure 3-1. Amplifier Schematic Wiring Diagram

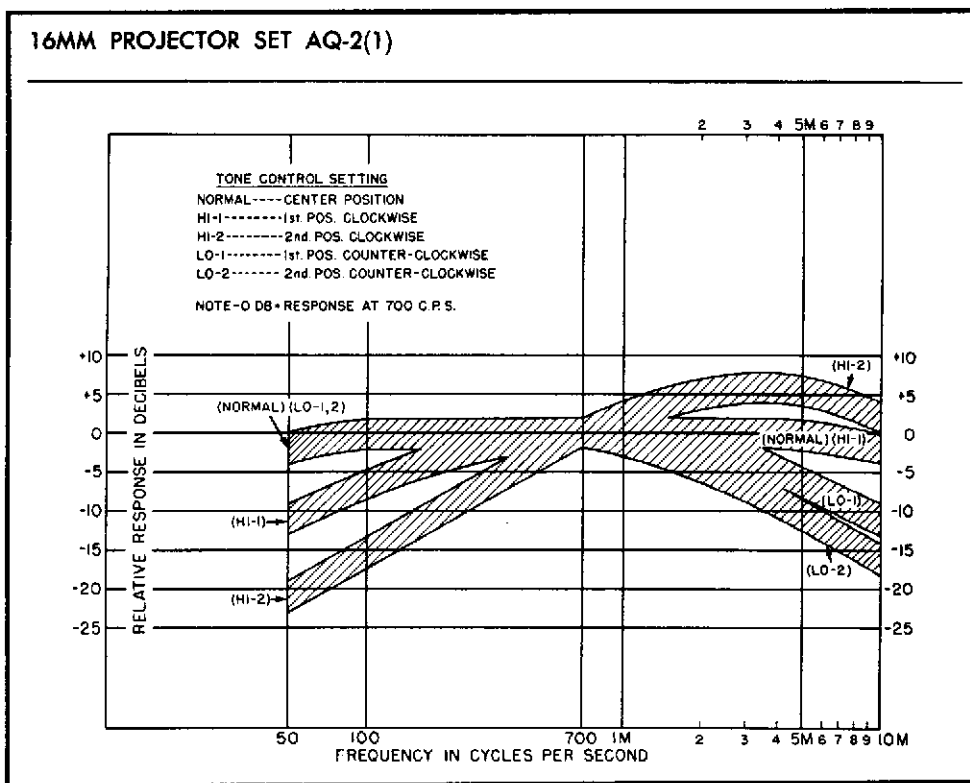


Figure 3-2. Tone Control Frequency Response Characteristics

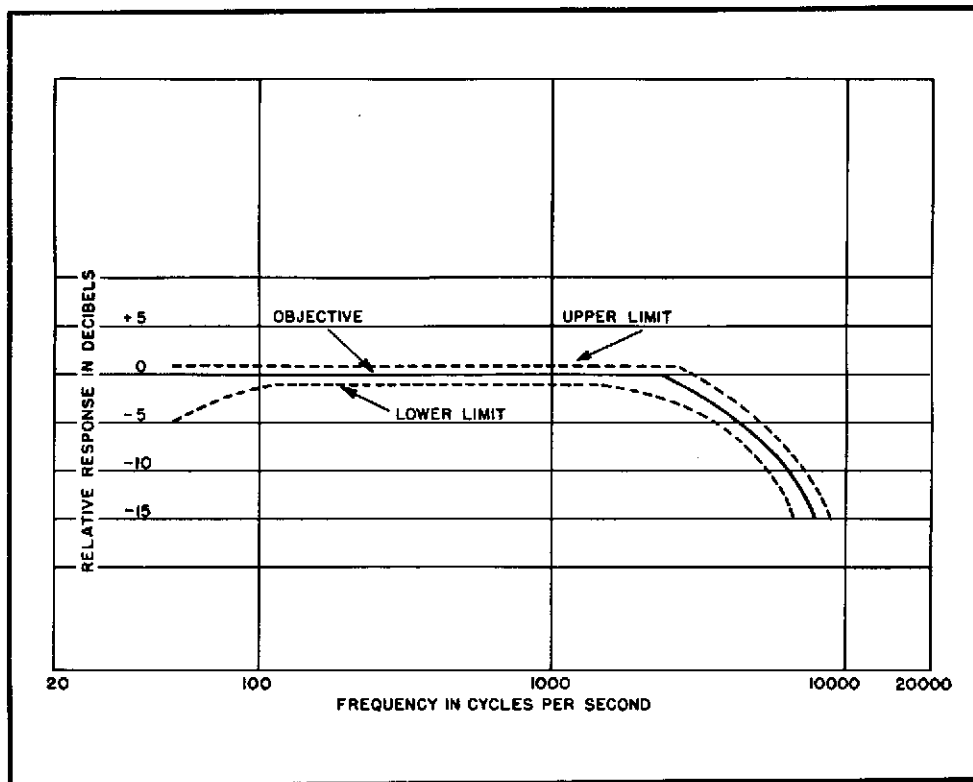


Figure 3-3. Projector Frequency Response Characteristics

3-24. VOLUME CONTROL AND FEEDBACK VOLTAGE STAGE. The first section of V202 is a voltage amplifier stage, the signal impressed on its grid being a function of the position of the volume control potentiometer R213. Negative feedback of 10 decibels is applied to this stage through resistor R222, which is connected between terminal (6) of the output transformer T201 and the cathode of tube V202(A). The feedback loop improves the stability and frequency response of the amplifier, and at the same time reduces distortion. Component functions are as follows: resistor R215 is the plate load resistor; resistor R214 is the cathode bias resistor; and resistor R213 is the grid load resistor and volume control.

3-25. TONE CONTROL. Control over the frequency response characteristics of the amplifier is achieved by means of a two-circuit, five-position rotary switch S201. The switch section S201(A) to the left on the schematic diagram varies the amount of negative feedback applied to the first triode section of tube V201. The feedback components are non-linear with respect to frequency, causing the gain of the stage to vary with frequency in the specified manner. The switch section S201(B) to the right on the schematic diagram varies the frequency response characteristics of the coupling network between the second triode section of tube V201 and the first triode section of tube V202, thereby varying the signal amplitude as a function of frequency.

3-26. HIGH FREQUENCY ACCENTUATION AND LOW FREQUENCY ATTENUATION. In the first clockwise position from normal of the tone control switch, frequencies below 700 cps are attenuated due to the reduced coupling capacity to the grid of tube V202(A) by the insertion of capacitor C210 in series with capacitor C208. This low frequency attenuation is increased in the second clockwise position by the insertion of capacitor C209 in series with capacitors C208 and C210. In addition, capacitor C206 and resistor R211 are shunted across the cathode bias resistor R205 which accentuates frequencies above 700 cps by reducing the cathode degeneration. The second clockwise position from normal of the tone control switch provides 12 decibels (± 2 db) of attenuation at 100 cps and 6 decibels (± 2 db) of accentuation at 3500 cps. The tone control frequency response characteristic curve is shown to figure 3-2.

3-27. HIGH FREQUENCY ATTENUATION. The first counterclockwise position from normal connects capacitor C204 in parallel with feedback resistor R210, thus increasing the negative feedback for frequencies above 700 cps. The second position increases the capacity across resistor R210, further attenuating the high frequencies. This provides 10 decibels (± 2 db) of attenuation at 5,000 cps.

3-28. FUNCTION OF NON-TONE CONTROL COMPONENTS. The function of components not directly related to tone control are as follows: C208 is the grid coupling capacitor between V201(B) and V202(A); R209 is the plate load resistor for the second triode section of V201; R208 is the cathode bias resistor for V201(B). For the first triode section, R206 is the plate

load resistor; R205 is the cathode bias resistor; R203 and R204 are the grid load resistors; and C202 is the grid coupling capacitor. Resistor R210 in series with capacitor C207 is the basic feedback network between the plate of V201(B) and the cathode of V201(A). Resistors R232, R233, and R234 suppress "click" as the tone control switch is rotated.

3-29. INPUT CIRCUIT. The audio voltage generated by the lead sulphide photo conductive cell is developed across the cell load resistor R201. Capacitor C201 and resistor R202 act as an RC filter to attenuate the low frequencies, thus compensating for film scanning high frequency response losses. The resulting projector-amplifier frequency response is in accord with the specifications. Capacitor C202 is a coupling capacitor, blocking the d-c cell bias from the grid of tube V201(A). The grid load resistor is composed of R203 and R204 in series, resistor R203 being a potentiometer whose contact arm is connected to the grid of the input tube V201(A), thereby permitting adjustment of the input signal to prevent over-loading of the amplifier and to insure a 20 decibel amplification reserve.

3-30. MICROPHONE INPUT. An input jack J202 is provided which allows use of the amplifier with any external high impedance sound device such as microphones, phonographs, etc.

3-31. LOCALIZING SOUND TROUBLES.

3-32. GENERAL. The following is a systematic approach to the problem of trouble shooting in the event of equipment failure during operation. It is intended to serve as a guide for rapid location of troubles.

3-33. PROJECTOR MOTOR AND PROJECTION LAMP FUNCTIONING NORMALLY BUT NO SOUND. With film properly threaded in the projector, the following control settings and conditions must be established for sound operation:

- a. ON-OFF amplifier toggle switch in the ON position.
- b. Speaker selector switch in the LOCAL position, if an external speaker is not being used.
- c. Volume control in the mid-position.
- d. OFF-MOTOR-LAMP switch in the LAMP position.

NOTE

If the above mentioned operating conditions have been established and no sound is present, proceed as directed in paragraph 3-34.

3-34. CHECKING THE PROJECTOR TO LOCATE SOUND FAILURE. The projector sound system consists of the exciter lamp, photocell and associated light path elements. The method for checking is as follows:

- a. When the OFF-MOTOR-LAMP switch of the projector is rotated to the LAMP position, the exciter lamp should light. This may be determined by the jewel opening on the exciter lamp cover. If the lamp does not operate replace it with one known to be good. If the new lamp does not light, replace the 6AQ5 oscillator tube V205 in the amplifier.
- b. With no film in the projector and the volume

control at the mid-position, insert a piece of cardboard or heavy paper between the sound drum and sound lens, obstructing the optical light path. This should produce a "plop" in the speaker. Failure to do so may be the result of a bad photo cell, an open or shorted photo cell cable, misalignment of the light path, an improperly functioning amplifier or loud-speaker, or an obstruction such as oil, dirt, or a piece of broken film. Photo cell V101 should last at least three years with normal use.

c. Failure to obtain sound after the above checks indicates the trouble is in the amplifier or loud-speaker. Proceed as directed in paragraph 3-35.

CAUTION

Never attempt to remove or adjust the scanning lens of the sound optical system unless special adjusting equipment and trained personnel are available.

3-35. CHECKING THE AMPLIFIER AND LOUD-SPEAKER. If the amplifier pilot lamp does not operate, this indicates that either the lamp is defective or that no filament power is present at the amplifier. If the tubes do not heat-up after allowing approximately one minute for warm up, no a-c power is being delivered to the amplifier. The fuse (F201) should be checked or replaced to eliminate it

as a possible source of the trouble. If the pilot lamp and tube filaments are operating normally but no sound is available, proceed as follows:

a. With no film in the projector and with the OFF-MOTOR-LAMP switch in the MOTOR position, and with the volume control fully clockwise, move the 6AQ5 output tube V204 in and out of its socket. Noise from the speaker as the tube pins make and break contact with the socket is an indication that the speaker and output tube are operating.

b. Repeat step a with the 6AQ5 output tube V203. Noise as heard above indicates that tube is good.

c. If no noise was heard when either output tube was moved check the speaker connections and speaker selector switch. If the connections are intact and the switch is in the proper position, replace the 6X4 rectifier tubes V206 and V207.

d. If noise was heard in steps a and b, repeat step a with the 12AX7 driver tube V202. A similar noise of greater intensity should be heard. Failure to produce noise at this point would indicate a bad 12AX7 driver tube. Repeat the same procedure with the 12AX7 input tube V201.

3-36. AMPLIFIER TROUBLE IDENTIFICATION.

3-37. TEST EQUIPMENT REQUIRED. The following test films and test equipment are required for thorough testing of the Type AQ-2A(1) projector.

PROJECTOR TEST EQUIPMENT

Nomenclature	Function	Type
Volt-ohmmeter	A-C, D-C and resistance measurements	20,000 ohms-per-volt
Vacuum tube voltmeter	A-C signal voltage measurement	Hickok 209A or equal
16-ohm, 10-watt resistor	Amplifier load resistor	
400 cycle test film	A-C signal voltage source	Navy Stock #H18SMP-99F-1632
Oscillator	To supply test frequencies	Hewlett Packard #200B or equal
Oscilloscope	Checking distortion	Dumont Type #208 or equal
Distortion analyzer	Measuring distortion	Hewlett Packard #330B or equal
Flutter bridge	Measuring speed variation	RCA Type #MI976BA or equal
A-C voltmeter	Measures a-c signal in amplifier accurately	Ballantine Model #300 or equal
Voltage divider	To supply calibrated voltages	G.R. #546-B or equal
Multi-frequency film	To provide means of making complete system frequency response measurements	Navy Stock #H18SMP-99F1627
3000 cycle film	To measure steadiness of speed of projector at sound head (flutter)	Navy Stock #H18SMP-99F1628
Scanning uniformity film	To check uniformity of scanning beam illumination	Two types available
Scanning beam focusing film	Focus and azimuth adjustment of sound lens	Two types available
Buzz track film	To check correct location of sound track for scanning	Navy Stock #H18SMP-99F1629

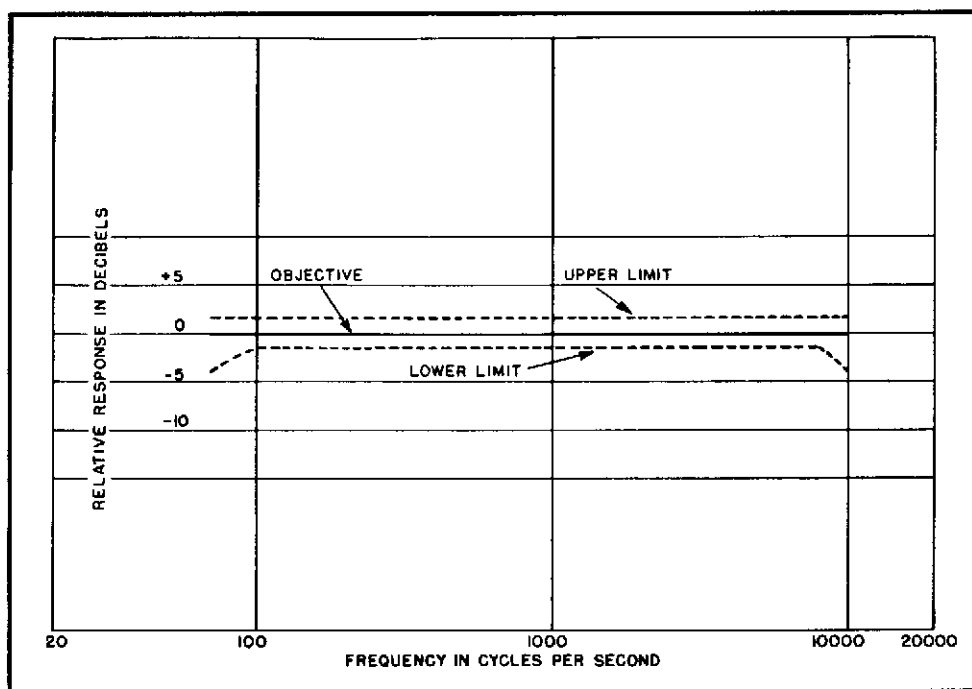


Figure 3-4. Amplifier Frequency Response Characteristics

3-38. **TESTING PRECAUTIONS.** When performing tests, the following points must be observed in order to insure correct measurements.

a. A 20,000 ohm-per-volt meter must be used for d-c measurements. Lower resistance instruments will result in significantly lower readings.

b. All voltage and resistance readings are to be made between circuit ground and voltage point referred to on amplifier schematic wiring diagram, figure 3-1.

c. Measurements of input signal voltage must be carefully made. Parasitic pick-up of hum, etc., will cause erroneous readings.

d. Particular attention must be paid to common grounding of the oscillator and distortion analyzer when distortion measurements are made.

e. All measurements should be made with the amplifier operating from 115-volt, 60-cycle supply, otherwise readings shown in figure 3-4 will be erroneous.

3-39. **AUDIO FREQUENCY MEASUREMENTS.** Performance of the amplifier, with respect to the audio frequency signal, cannot be determined without a steady amplitude input signal. This may be supplied from three different sources;

a. When a projector, known to be operating satisfactorily, is available, 400-cycle test film may be used to supply the audio frequency signal for all amplifier emergency audio frequency performance measurements. The film can be used in the form of a loop about 3 feet in length, if desired.

b. When a complete malfunction of the audio channel exists, this same 400-cycle film can supply the test tone essential for point to point checkings.

c. In the absence of 400-cycle test film, a normal 16-mm print of good quality will do. Definite audio frequency measurements cannot be made with such film, however.

3-40. **OVERALL FREQUENCY RESPONSE MEASUREMENTS.** Measurements of the overall frequency response of the system, including the projector, cannot be made without multi-frequency test film. This measurement should be made whenever the sound system is repaired, and the overall response should never exceed limits shown in figure 3-3.

3-41. Color prints may be released for use with the emulsion on either side of the film base. Reproduction must be the same in either position for best intelligibility. Frequency response curves should be made by running the film normally, and then reversing the test film and running it through the projector. In both cases, the resulting curves should fall within the limits shown in figure 3-3.

3-42. **AUDIO FREQUENCY CHARACTERISTICS AND DISTORTION MEASUREMENTS.** The amplifier audio frequency characteristics and distortion measurements cannot be made without an audio frequency signal generator of low distortion and an audio frequency distortion analyzer of good quality. All amplifier characteristics tests may be conducted with this equipment.

3-43. After a major overhaul, or for periodic performance checks, perform all tests listed in Table VIII, Amplifier Characteristics Tests.

3-44. When measuring the performance of the tone control, the amplifier output power should be set at a level of 2 watts at 700 cycles (5.67 volts across 16-ohm load); otherwise, the amplifier power output stage will be overloaded and erroneous readings result.

3-45. **TUBE VOLTAGE MEASUREMENTS.** This data

is given in Table II near the end of Section III. It includes all pertinent normal voltage and resistance conditions involved in the correct functioning of the amplifier. Measurements are made with correctly functioning tubes. It is necessary, therefore, that all of the tubes be checked prior to installation in the amplifier, otherwise readings taken may be erroneous. Conversely, if means of checking tubes are not available, voltage readings (taken at points indicated in Table II) could be used for determining tube condition in a correctly functioning amplifier. Note the following precautions.

a. A-C signal voltages must be measured with a high impedance vacuum tube voltmeter, otherwise readings will be in error.

b. The amplifier should be terminated in a correct value load resistor (16 ohms) in lieu of the external loudspeaker for making output power measurements.

3-46. AMPLIFIER SCHEMATIC VOLTAGE DATA.

The following data serves to clarify the voltage data given on the amplifier schematic diagram, figure 3-1.

a. The d-c power supply points for measurement are given for points which would not appear on the tube terminal test points chart. See Table IV, D-C Supply Voltage Drop.

b. Circuit malfunctions are rapidly identified by measuring the voltage drop occurring across the individual resistors in the direct current power distribution network. A higher voltage drop than given in the voltage drop table indicates either increased resistance or an abnormally increased current flowing through that portion of the circuit.

3-47. LOUDSPEAKER TROUBLE ANALYSIS.

3-48. GENERAL. The loudspeaker component, which is an integral part of Projector Set AQ-2(1), is a 5-inch, dynamic loudspeaker containing a permanent magnet and a moving voice coil. Audio frequency energy is transmitted from the amplifier to the loudspeaker through its connecting cable, thereby setting the voice coil in motion. Movement of the coil within the air gap and magnetic field causes vibration of the conical diaphragm attached to the voice coil. This diaphragm then sets a large volume of air into motion through vibration. These vibrations are produced at the proper frequency for correct sound transmission.

3-49. LOCALIZING LOUDSPEAKER TROUBLES.

a. Remove loudspeaker by reference to figure 2-49. The length of the speaker cable will permit the speaker mounting panel to be placed on a bench for service. Disassemble speaker from mounting panel.

b. Check the loudspeaker cone for holes or cracks. Apply equal pressure to all sides of the cone and gently push the cone with the fingers to make sure that the voice coil is not rubbing in the air gap. Be careful that this inspection of itself does not further damage the loudspeaker.

c. Unsolder the connection from the terminals of the loudspeaker. Check loudspeaker resistance with an ohmmeter. The d-c resistance of the voice coil should read approximately 8 ohms.

3-50. PROJECTOR SET CHARACTERISTIC TESTS.

3-51. After major overhaul, or after disassembly and repair, the Type AQ-2A(1) projector should meet all of the performance characteristic tests outlined in paragraph 3-52 (sound optical system alinement tests) and in Tables VII, VIII and IX at the end of this section. When making these tests, the following precautions should be noted.

a. All tests should be made at 115 volts ac, 60 cycles, unless otherwise specified.

b. All test films and test equipment required for the performance characteristic tests should be in accordance with, or equivalent to, those specified in paragraph 3-37. Be sure to observe the testing precautions outlined in paragraph 3-38.

3-52. SOUND OPTICAL SYSTEM ALINEMENT TESTS.

3-53. PRELIMINARY SYSTEM CHECK.

a. Connect the equipment as for normal operation. Be sure all components are in operating condition. Turn the GAIN (Volume) control on amplifier panel to an intermediate position and turn the TONE control to NORMAL. Turn amplifier switch to the ON position. Turn OFF-MOTOR-LAMP switch to LAMP position. The red jewel on the exciter lamp cover should glow, indicating that the exciter lamp is operating.

b. Make the thump test by inserting a clean white card approximately one inch wide between the sound optical unit (sound lens) and the sound drum. Move card back and forth in this position to interrupt the scanning light beam from the sound optical unit to the photo conductive cell. If the sound system is operating satisfactorily, a thumping sound will be heard in the loudspeaker.

c. If thumping sound is not heard then the alinement of the sound optical prism or the sound drum were not made in accordance with the directions given in paragraphs 2-45 and 2-63. Recheck these alinements. Repeat thump test until thumping sound is heard in the loudspeaker and continue with the following adjustment procedures.

3-54. BUZZ-TRACK TEST FILM ADJUSTMENT.

a. This adjustment determines if the film guide adjustment roller (figure 3-5) is in proper lateral position in relation to the scanning beam. Thread projector with three-foot loop of buzz-track test film. The emulsion side of the film should face the exciter lamp. Operate the equipment as for regular film. Be sure the amplifier and loudspeaker are connected. Turn up the amplifier volume control about half-way. Set tone control in position marked NORMAL. Turn OFF-MOTOR-LAMP switch to the LAMP position.

b. If the position of the film guide adjustment roller is in proper lateral position in relation to the scanning beam, the low signal (300 cycle) and the high signal (1000 cycle) will (1) not be heard in the loudspeaker, or (2), there will be a faint reproduction of equal intensity from both the low signal (300 cycle) and the high signal (1000 cycle).

c. If the low signal (300 cycle) is reproduced strongly,

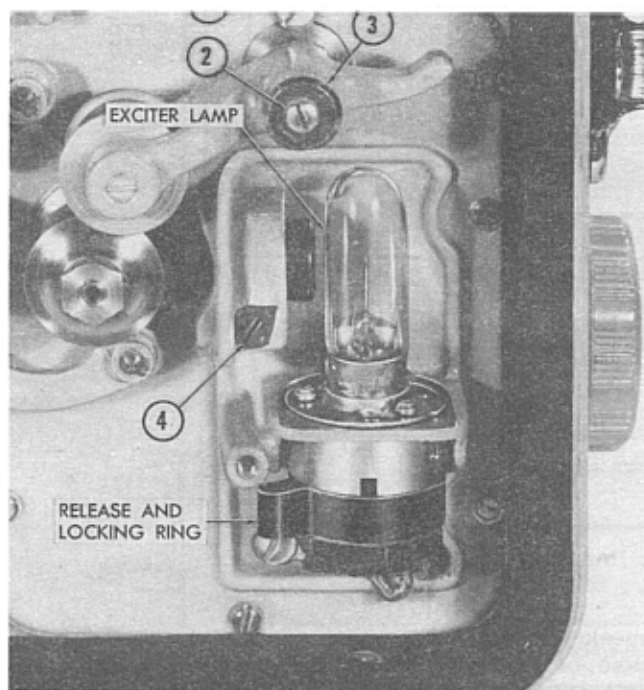


Figure 3-5. Projector Sound Head Alinement Adjustments

loosen the binder head screw (2), figure 3-5 and turn the knurled scanning adjustment nut (3) in a counter-clockwise direction until the signal is very faint or is not heard.

d. If the high signal (1000 cycle) is reproduced strongly, loosen the binder head screw (2), figure 3-5 and turn the knurled scanning adjustment nut (3) in a clockwise direction until the signal is very faint or is not heard.

e. Stop projector and remove the loop of test film.

3-55. ADJUSTMENT FOR UNIFORMITY OF SCANNING BEAM ILLUMINATION.

a. Thread projector with a loop of test film for determining uniformity of scanning beam illumination (1000 cycle). There are two types of this test film; field type and laboratory type.

b. Connect a "volume indicator" or "output" meter, preferably carrying a decibel or "VU" scale, across the output terminals of the amplifier to read the output level of the 1000-cycle tone. Usually, the most convenient point for making the connection is at the loudspeaker. Turn OFF-MOTOR-LAMP switch to the LAMP position. The position of the sound track, relative to the ends of the light beam at any instant, is shown by the animated diagram appearing in the picture area of the film. Read the output level of the 1000-cycle tone. As long as the variation does not exceed ± 1.5 db, the projector has satisfactory uniformity of scanning beam illumination.

d. Greater variations than ± 1.5 db in the output may be caused by dirt on the exciter lamp, the sound optical unit or the optical light pipe prism, or by deformation of the exciter lamp filament, or by misplacement caused by a bent or loose socket, etc. Clean the sound optical elements and make repairs or replacements as needed to correct the unevenness

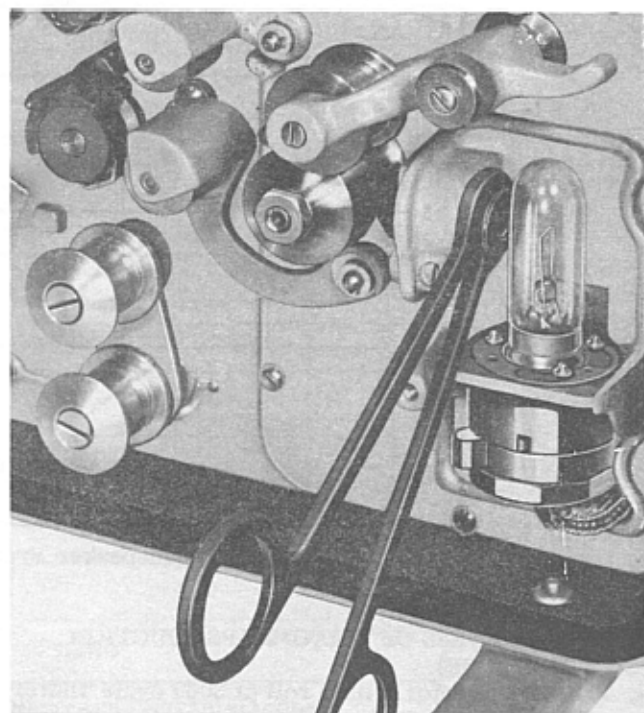


Figure 3-6. Focusing the Scanning Lens

of the scanning beam illumination so as to bring the variation within the ± 1.5 db limit.

3-56. FOCUS AND AZIMUTH ADJUSTMENT (PRECISION ALINEMENT).

a. Thread projector with a loop of precision type (7000 cycle) film for scanning beam focusing and azimuth adjustment. Emulsion side of film should face the exciter lamp. Replace loudspeaker with an 8-ohm non-inductive resistor. Connect oscilloscope across the output circuit of amplifier. Remove exciter lamp cover and exciter lamp. Place the sound optical unit adjustment tool (Tool No. 061000-F1, figure 2-1) over the sound optical unit as shown in figure 3-6. Remount the exciter lamp in its socket.

b. Loosen the fillister head screw (4), figure 3-5. Set tone control in position marked NORMAL. Turn volume (GAIN) control to an intermediate point, position marked 4. Turn OFF-MOTOR-LAMP switch to LAMP position.

c. Using the adjustment tool, adjust the position of the sound optical unit by moving it closer to, or farther away from the exciter lamp, and then by rotating the sound optical unit until a reading of maximum output and minimum distortion is obtained on the meter. Be sure that the true maximum point of output is reached. There are several points where the output will increase and then decrease again, but there is only one true optimum point of maximum output and minimum distortion.

d. When the sound optical unit is properly adjusted, tighten fillister head screw (4, figure 3-6) carefully, and make sure that the reading on the meter does not decrease during the process.

e. Repeat operation with shiny side of 7000 cycle film facing exciter lamp. Reading should be the same as in the first test.

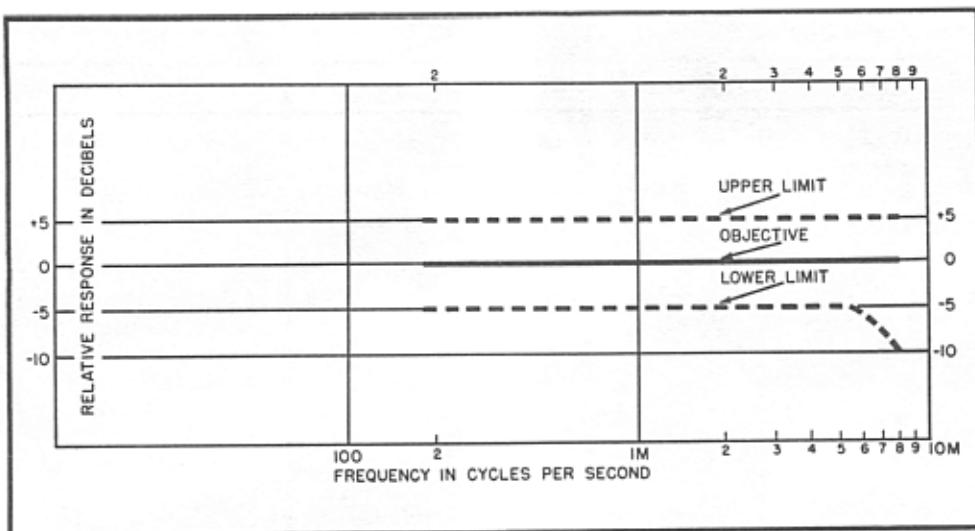


Figure 3-7. Loudspeaker Frequency Response Characteristics

3-57. STEADINESS OF SOUND REPRODUCTION (FLUTTER).

- Thread projector with a roll of 3000 cycle flutter test film. Connect flutter indicator to output of amplifier. Set tone control in position marked NORMAL and volume (GAIN) control in an intermediate position.
- Turn OFF-MOTOR-LAMP switch to LAMP position. Calibrate flutter indicator. Needle of flutter indicator should read at calibrate position on meter.
- With OFF-MOTOR-LAMP switch in LAMP position, read the flutter indicator as soon as 6 feet of film has passed through the projector. The total flutter should be less than 0.25 percent.
- The cause for excessive flutter may be in the sound mechanism, the picture mechanism, the take-up mechanism or the motor assembly.

3-58. CHECKING PHOTOCELL OUTPUT.

- Operate the projector with 400-cycle signal level test film, terminating the amplifier with a 16-ohm, 10-watt, non-inductive resistor in place of the loud-

speaker. This wire-wound resistor is used for the sake of convenience. If an 8-ohm, 10-watt, wire-wound resistor were used, it would be necessary to substitute this resistor for the built-in loudspeaker.

- When the 16-ohm resistor is connected to receptacle J203 (pins 1 and 3), be sure to set the loudspeaker selector switch to the position marked REMOTE SPEAKER ON.

- With TONE control in the normal position (NOR), turn the VOLUME control fully clockwise. With a screwdriver, adjust the control shaft of R203 (figure 3-9) so that 8 watts of audio power is being delivered to the 16-ohm resistive load (11.3 volts rms).

- Reduce the output power by 20 db (decibels) by rotating the VOLUME control counterclockwise until the voltage across the 16-ohm load is 1.13 volts.

- Return the power output to 8 watts (11.3 volts) by adjusting the control shaft of R203.

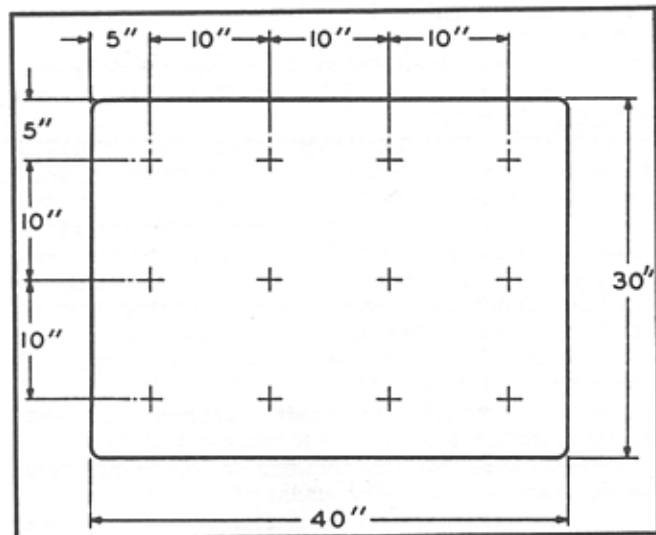


Figure 3-8. Light Measurement Diagram

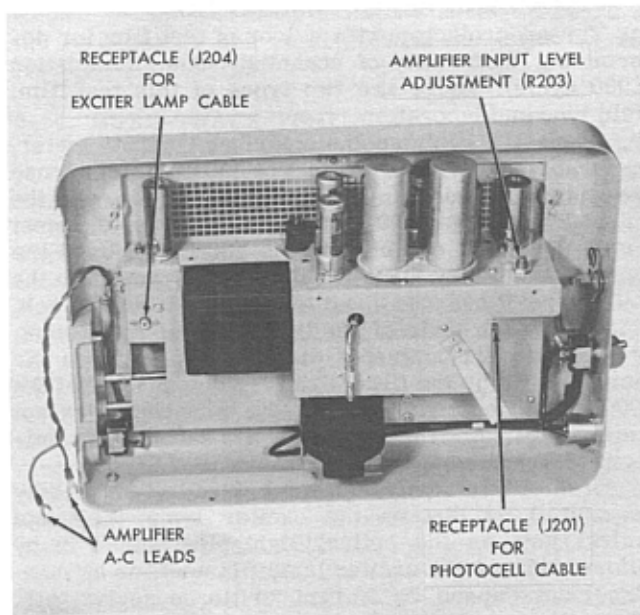


Figure 3-9. Rear View of Amplifier

3-59. TROUBLE SHOOTING CHART

Trouble	Probable Cause	Remedy
1. Amplifier operates, but projector motor does not run, projection lamp does not light.	1. Projector fuse blown. 2. Faulty OFF-MOTOR-LAMP switch or amplifier OFF-ON switch.	1. Replace fuse. 2. Check switches; repair or replace.
2. Projector motor runs, projection lamp lights, but amplifier does not operate (no sound from loud-speaker).	1. Amplifier not turned on. 2. Amplifier fuse blown. 3. Defective tube(s). 4. Exciter lamp burned out. 5. Photo-cell cable not connected from projector to amplifier. 6. Internal amplifier trouble.	1. Turn amplifier OFF-ON switch to ON position. 2. Replace with good fuse. 3. Check and replace defective tube(s). 4. Replace exciter lamp. 5. Connect cable to receptacle J204. 6. Check circuit (para. 3-36); repair or replace defective parts.
3. Projection lamp lights, motor will not run.	1. Loose connection in motor circuit, or open circuit. 2. Worn out or sticking motor brushes. 3. Dirty governor points. 4. Worn out or sticking governor brushes. 5. Faulty OFF-MOTOR-LAMP switch. 6. Defective governor. 7. Defective motor wiring. 8. Defective motor. 9. Dirty commutator.	1. Check all connections to motor and repair as necessary. 2. Remove brushes and clean; replace if necessary. 3. Clean governor points with ignition file. 4. Remove brushes and clean; replace if necessary. 5. Repair or replace with new switch. 6. Repair or replace. 7. Check continuity of wiring and replace broken or defective wires. 8. Remove motor and replace. 9. Clean with crocus cloth.
4. Motor operates but projection lamp does not light.	1. Lamp burned out. 2. Switch not turned to lamp position. 3. OFF-MOTOR-LAMP switch defective. 4. Lamp not seated correctly in socket, contact poor. 5. Defective projector wiring.	1. Replace with new lamp. 2. Turn OFF-MOTOR-LAMP switch to LAMP position. 3. Replace defective switch with new one. 4. Check to see that lamp is inserted properly. 5. Check projector wiring circuit, repair defective wires.

Trouble	Probable Cause	Remedy
5. Motor runs, mechanism does not.	1. Drive chain not engaged on motor chain sprocket or main drive chain sprocket. 2. Drive chain sprocket loose on shaft.	1. Engage chain on sprockets. 2. Tighten chain sprocket to shaft.
6. Motor speed varies or projector runs too fast.	1. Governor not adjusted. 2. Governor points pitted or not making good contact. 3. Electrical wiring.	1. Adjust governor to give correct motor speed. (para. 2-167). 2. Clean with ignition file. Replace with new governor if badly worn or not making good contact. 3. Check motor governor circuit; replace faulty parts.
7. Picture not framed.	1. Framing control not adjusted properly. 2. Film itself out of frame.	1. Turn framing control until picture is in frame. 2. Check projector with film with proper frame line.
8. Fuzz projecting in picture area.	1. Dirt in aperture opening.	1. Clean aperture using brush supplied. CAUTION: Projector must be stopped.
9. Picture not sharp on screen. One side or entire picture may not be sharp.	1. Improperly focused. 2. Projection lens dirty, oily or finger-spotted. 3. Pressure plate and/or aperture plate worn. 4. Pressure plate not seated firmly against film in aperture channel. 5. Defective projection lens. 6. Film loops too short. 7. Insufficient pressure plate tension.	1. Focus lens. 2. Clean lens. 3. Replace defective plates. 4. Push pressure plate closing handle. 5. Replace lens. 6. Rethread projector with proper sized loops. 7. Replace with new pressure plate.
10. Picture indistinct, illumination low.	1. Line voltage lower than lamp rating. 2. Lamp improperly seated in socket. 3. Lamp old, black and ready to burn out. 4. Dirty reflector, condenser lenses, projection lens. 5. Lamp position adjustment incorrect. 6. Film underdeveloped; opaque.	1. Use lamp with voltage equal to voltage of line supply. 2. Reinsert lamp correctly. 3. Replace lamp. 4. Clean these optical elements. 5. Adjust lamp socket position for maximum light. 6. Recommend print be withdrawn from circulation.

Trouble	Probable Cause	Remedy
10. Picture indistinct, illumination low. (cont)	7. Old, dirty, or wrong type of screen.	7. Wash dirty screen. If canvas screen, replace with matte white screen material.
11. Projector fails to take-up film properly.	1. Belt off pulley on take-up arm or off take-up ratchet pulley in projector. 2. Bent or stretched take-up belt. 3. Slippage in take-up ratchet pulley assembly. 4. Two lock nuts on take-up arm too tight or too loose. 5. Film not attached to hub of reel. 6. Take-up reel bent and jammed on arm. 7. Take-up reel slipping on spindle. 8. Oilite bronze washer in take-up assembly is worn.	1. Loop belt on pulley(s). 2. Replace with new belt. 3. Disassemble and repair take-up ratchet pulley assembly (para. 2-94). 4. Adjust accordingly. 5. Attach film securely to hub. 6. Replace reel. 7. Latch reel securely. 8. Replace washer.
12. Projector fails to rewind film properly.	1. Plunger on feed reel arm set in improper position. 2. Spring belt off pulley. 3. Two lock nuts on feed reel arm too tight or too loose. 4. Slippage in rewind ratchet pulley assembly. 5. Bent or stretched rewind belt. 6. Oilite bronze washer in feed reel arm assembly is worn. 7. Defective rewind switch.	1. Plunger should be IN for rewinding. 2. Loop belt over pulley. 3. Adjust accordingly. 4. Disassemble and repair rewind ratchet pulley assembly (para. 2-94). 5. Replace with new belt. 6. Replace washer. 7. Repair or replace defective switch.
13. Picture unsteady; jump or weave.	1. Improper slitting of film; poor filming of picture. 2. Improper threading. 3. Pressure plate not seated firmly against film in picture channel. 4. Many consecutive film perforations damaged excessively.	1. Check with film known to be in good condition. 2. Rethread projector correctly. 3. Push pressure plate closing handle. 4. Remove damaged section of film and splice.

Trouble	Probable Cause	Remedy
13. Picture unsteady; jump or weave. (cont)	5. Poorly made splices. 6. Sprockets not turning properly. 7. Sprocket shoes fit too loosely causing film to jump off. 8. Worn parts in intermittent mechanism; broken shuttle tooth or last tooth slapping film. 9. Center shuttle tooth not protruding far enough through aperture plate. 10. Insufficient pressure plate tension. 11. Worn sprocket teeth. 12. Caked emulsion excessive on aperture and/or pressure plate.	5. Check film, remake splice(s). 6. Check screws holding sprockets. Tighten if necessary. Check sprocket gears for defects. Replace defective gears. 7. Adjust clearance between shoe and sprocket, to tolerance of two thicknesses of film (para. 2-135, step f). 8. Replace defective parts. 9. Adjust mechanism as directed in paragraph 2-169. 10. Replace pressure plate. 11. Replace defective sprocket. 12. Remove caked emulsion with aperture brush; piece of wood, alcohol.
14. Film scratched.	1. Dirt or emulsion on aperture and/or pressure plate. 2. Dirt or emulsion on film shoes, sprockets, film rollers. 3. Worn film handling parts; pressure plate, aperture plate, film sprockets, shoes, rollers. 4. Sticking or binding film rollers. 5. Nicks and scratches on contact surfaces of film path; film rails, rollers, sound drum, pressure plate, sprockets, film shoes.	1. Clean, using aperture brush furnished; alcohol, toothpick. 2. Clean, using aperture brush furnished; alcohol, toothpick. 3. Replace worn parts with new ones. 4. Remove rollers and clean shaft. If worn or if they still bind, replace with new ones. 5. Rub part with crocus cloth. If nick or scratch is deep replace parts with new ones.
15. Excessive film wear. Torn or damaged film splices. Damaged or torn perforations.	1. Film shoes fit too snugly around sprockets. 2. Worn or damaged shuttle teeth. 3. Sprocket teeth badly worn.	1. Adjust clearance between inner shoulder of shoe and inner edge of sprocket shoulder to .015 inch; two film thicknesses (para. 2-135, step f). 2. Examine shuttle teeth for undercut surfaces; if badly worn, replace with new shuttle. (Rotate 180°) 3. Examine sprocket teeth for undercut surfaces. Replace sprocket if badly worn.

Trouble	Probable Cause	Remedy
16. Excessively noisy projector operation.	1. Film clicking resulting from badly worn sprocket teeth. 2. Film slap due to improper pressure plate tension. 3. Inherent mechanical noise.	1. Examine sprocket for excessive wear. If wear is noticeable replace with new sprocket. (Rotate 180°) 2. Replace pressure plate. 3. Examine intermittent mechanism for defective parts. Check gears and rotating parts for nicks or worn surfaces. Replace defective parts if needed.
17. Picture travel ghost. Vertical lines observed on screen above and/or below white objects.	1. Defective projection lamp. 2. Projection lamp out of adjustment. 3. Shutter out of time with intermittent mechanism.	1. Replace lamp. 2. Adjust lamp to maximum brilliance with lamp adjustment levers. 3. Adjust shutter to synchronize with intermittent (para. 2-147, step h).
18. Picture satisfactory, sound weak.	1. Volume control not tuned up or defective. 2. Sound optical system dirty. 3. Amplifier tubes defective. 4. Photo cell out of adjustment, loose or defective. 5. Exciter lamp defective. 6. Power transformer defective. 7. Loudspeaker cable defective. 8. Loudspeaker defective. 9. Poor film sound track.	1. Turn up volume; if control is defective, replace. 2. Clean. 3. Check tubes, replace defective tubes. 4. Correct adjustment; tighten. If still defective replace with new photo cell. To check photo-cell output see paragraph 3-58. 5. Replace exciter lamp. 6. Repair or replace. 7. Check cable, repair or replace. 8. Check loudspeaker, correct defects or replace loudspeaker unit. 9. Turn up volume, adjust tone control to compensate as much as possible for poor film.
19. Picture satisfactory, but no sound.	1. Amplifier switch not in ON position. 2. Loudspeaker not connected. 3. Loudspeaker selector switch in wrong position. 4. Photo-cell amplifier cable defective or disconnected.	1. Turn switch to ON position. 2. Connect loudspeaker to amplifier. 3. Place switch in correct position. 4. Check cable.

Trouble	Probable Cause	Remedy
19. Picture satisfactory, but no sound. (cont)	5. Exciter lamp burned out.	5. Replace exciter lamp.
	6. Amplifier tubes defective.	6. Check tubes, especially the 6AQ5 exciter lamp oscillator tube V205. Replace defective tubes.
	7. Speaker defective.	7. Check speaker, replace if needed.
	8. Photo-cell defective.	8. Replace photo cell assembly. Check photo-cell output, paragraph 3-58.
	9. Internal amplifier trouble.	9. Check amplifier circuit.
	10. Motor-Lamp switch has loose connections or is defective.	10. Check, repair or replace switch.
	11. Absence of sound record on film. Silent picture.	11. Check film to be sure it has sound track.
20. Sound is wavy. (Flutter)	1. Improper threading.	1. Correct threading.
	2. Dirt on sound drum, and rollers in soundhead assembly.	2. Clean sound drum, clean all rollers.
	3. Film guide rollers sticky or jammed.	3. Examine rollers to see that they turn freely. If not, remove rollers and clean bearings and shafts. If they stick after cleaning replace with new ones.
	4. Damaged sound drum.	4. Replace stabilizer housing.
	5. Sound drum binds.	5. Check for defective bearings and replace if necessary.
	6. Improper tension of film around sound drum.	6. Adjust tension of impedance roller in soundhead (para. 2-45, step h).
	7. Flywheel improperly balanced. (Damaged)	7. Replace flywheel.
	8. Sound drum shaft bent.	8. Replace if defective.
	9. Unsteady speed of motor.	9. Check motor and governor. Repair or replace.
	10. Misalignment of film rollers.	10. Check lateral alignment of film rollers to determine if they are causing binding or buckling of the film. Replace defective parts.
	11. Overwidth film.	11. Check with film known to be good.

Trouble	Probable Cause	Remedy
21. Distorted sound reproduction.	1. Bad sound track. 2. Defective tubes. 3. Worn film sprockets. 4. Sound film guide adjustable roller out of alignment. 5. Defective exciter lamp. 6. Bad connections in projector or amplifier wiring. 7. Defective amplifier. 8. Defective loudspeaker. 9. Sound optical system out of adjustment. 10. Overwidth film	1. Adjust tone control, if trouble persists, replace film. 2. Check, replace bad tubes. 3. Replace defective sprocket. 4. Check adjustment of roller with buzz-track test film. 5. Replace exciter lamp. 6. Sectionalize and localize trouble, and repair. 7. Localize trouble, repair or replace defective parts. 8. Check loudspeaker for damaged cone. Replace defective parts; replace loudspeaker if defective. 9. Check adjustment of sound optical system. (para. 3-52). 10. Check with good film.
22. Microphonics—Denoted by continuous bell or string-like noises.	1. Defective tube. 2. Defective exciter lamp. 3. Defective photo electric cell.	1. Check and replace as needed. 2. Replace with new lamp. 3. Replace with new photo-conductive cell.
23. Popping noise from speaker when operating with film.	1. Dirt on back edge of sound drum. 2. Dirt on sound lens or light pipe. 3. Poor sound track on film. 4. Dirty sound track.	1. Clean thoroughly. 2. Clean thoroughly. 3. Check by reproducing film of known sound quality. 4. Return to film exchange.
24. Crackling or frying noise in loudspeaker.	1. Governor contact points badly pitted. 2. Governor brushes arcing. 3. Motor brushes defective. 4. Defective volume and tone control.	1. Burnish governor contact points, with ignition file. 2. Examine governor brushes to see that pigtails are not broken and that brushes are long enough. Replace defective brushes. 3. Examine motor brushes as in 2, above. 4. Rotate control, if noise appears and disappears, replace controls.

Trouble	Probable Cause	Remedy
25. Excessive hissing and buzzing sounds in loud-speaker.	1. Film badly scratched. 2. Speaker loose. 3. Speaker cone cracked or has holes in it. 4. Defective photo cell.	1. Adjust tone controls. 2. Tighten speaker. 3. Replace speaker. 4. Replace photo cell assembly.
26. Excessive hum in loud-speaker.	1. Defective tube(s). 2. Defect in amplifier circuit, bad condenser, etc. 3. Stray light penetrating inside exciter.	1. Check, replace defective tubes. 2. Check circuit and repair as needed (para. 3-36). 3. Lock exciter lamp cover securely.
27. Inadequate volume.	1. Volume control not tuned up sufficiently. 2. Poorly recorded sound track. 3. Dirt or oil partly obstructing sound optical system. 4. Defective amplifier tube(s). 5. Defective photo cell. 6. Dirty or defective exciter lamp. 7. Low line voltage. 8. Photo-cell potentiometer R203 out of adjustment.	1. Turn up volume control. 2. Equipment cannot adjust. 3. Clean sound optical elements. 4. Check, replace defective tube(s). 5. Replace photo-cell. 6. Clean lamp; if trouble persists replace exciter lamp. 7. Check line voltage. 8. Adjust R203 for correct photo-cell output (para. 3-58).
28. Tone unsatisfactory.	1. Tone control not adjusted properly for film being shown. 2. Film itself may be at fault. 3. Defect in amplifier. 4. Poor acoustic conditions.	1. Adjust tone control. 2. Check by reproducing film of known sound quality. 3. Check and replace defective tubes and other parts. 4. Attenuate lows to help cut down reverberation.
29. Sound O. K. from film, silent from microphone.	1. Defective microphone.	1. Check microphone connector plug and cable.
30. Ringing noises from loud-speaker when amplifier volume control is at low volume position.	1. Defective tube.	1. Check, replace defective tube.
31. Ringing noises from loud-speaker when volume control is at high level position.	1. Defective exciter lamp.	1. Replace exciter lamp.

Trouble	Probable Cause	Remedy
32. Amplifier fuse blows.	1. Shorted tube or tubes. 2. Defective amplifier wiring, or component parts. 3. Loose fuse terminals.	1. Check and replace defective tubes. 2. Localize trouble; repair and replace defective parts. 3. Secure terminals.
33. Projector fuse blows.	1. Defective projector wiring, including power cable. 2. Short-circuited lamp or lamp socket. Blows fuse only after lamp has been turned on.	1. Check continuity of electrical wiring in projector for short circuits or grounds. Repair or replace defective units. 2. Check continuity of electrical wiring. Replace defective units. If lamp is defective, replace projection lamp.

TABLE II. TUBE AND OUTPUT TRANSFORMER MEASUREMENTS

NOTE: All d-c voltages should be measured with a 20,000 ohms-per-volt d-c meter with no signal. All a-c voltages should be measured with a vacuum tube voltmeter. In either case, the negative probe must be connected to the chassis, which is common ground for the amplifier. Connect a 16-ohm, 10-watt resistor across pins 1 and 3 of receptacle J203 to take the place of the remote loudspeaker, and turn the loudspeaker selector switch to the position marked REMOTE SPEAKER ON. For the a-c measurements, the sensitivity of the amplifier is checked; therefore, a 400-cps signal voltage of 18 mv is fed to the amplifier through the microphone jack J202 with the volume control fully clockwise. Resistance measurements are made with no power applied to the amplifier. If measurements do not meet requirements shown, refer to Table III (Amplifier Trouble Analysis Chart) for the probable cause of trouble. Whenever a d-c voltage reading is a value lower than that given in the table, other d-c voltages should be checked to make sure that the condition is not general. If a generally low d-c voltage condition exists, refer to Table IV (D-C Supply Voltage Drop) to localize the d-c power supply default.

Tube	Test Point	Pin	D-C Volts	A-C Volts	Resistance
V201 (12AX7)	1	1	110	1.3	1.5 Meg.
	2	2	0	0.056	1.0 Meg.
	3	3	1.2	0.037	5600
	4	4	—16	3.1*	160
	5	5	—16	3.1*	160
	6	6	140	0.058	1.5 Meg.
	7	7	0	0.018	56K-556K†
	8	8	1.5	0.017	10K
	9	9	—16	3.1*	160

TABLE II. TUBE AND OUTPUT TRANSFORMER MEASUREMENTS (cont)

Tube	Test Point	Pin	D-C Volts	A-C Volts	Resistance
V202 (12AX7)	10	1	210	9.8	1 Meg.
	11	2	13	10	670K
	12	3	35	10	115K
	13	4	—16	3.1*	160
	14	5	—16	3.1*	160
	15	6	125	9.8	1.5 Meg.
	16	7	0	1.1	500K
	17	8	1.4	1.1	6200
	18	9	—16	3.1*	160
V203 (6AQ5)	19	1	—11	9.8	500K
	20	2	0	0	0
	21	3	—16	3.1*	160
	22	4	—16	3.1*	160
	23	5	260	160	1 Meg.
	24	6	250	0	1 Meg.
	25	7	—11	9.8	500K
V204 (6AQ5)	26	1	—11	9.8	500K
	27	2	0	0	0
	28	3	—16	3.1*	160
	29	4	—16	3.1*	160
	30	5	260	160	1 Meg.
	31	6	250	0	1 Meg.
	32	7	—11	9.8	500K
V205 (6AQ5)	33	1	—35	150RF	5100
	34	2	0.5	110RF	15
	35	3	—16	3.1*	160
	36	4	—16	3.1*	160
	37	5	250	1.1RF	1 Meg.
	38	6	250	1.1RF	1 Meg.
	39	7	—35	150RF	5100
V206 (6X4)	40	1	—20	265	260
	41	2	0	0	Inf.
	42	3	—16	3.1*	160
	43	4	—16	3.1*	160
	44	5	0	0	Inf.
	45	6	—20	265	260
	46	7	280	8	1 Meg.
V207 (6X4)	47	1	—20	265	260
	48	2	0	0	Inf.
	49	3	—16	3.1*	160
	50	4	—16	3.1*	160
	51	5	0	0	Inf.
	52	6	—20	265	260
	53	7	280	8	1 Meg.
T201	54	5	0	8	0.60
	55	6	0	11.3	1.0

*These voltages must be measured with a high impedance voltmeter (vacuum tube type) with a large capacitor in series with the meter lead to block the d-c component of the voltage. A reading under any other circumstances will be meaningless.

†Resistance from this pin to ground will depend upon setting of R203 and therefore the resistance reading may be anywhere within the limits given.

TABLE III. AMPLIFIER TROUBLE ANALYSIS CHART

NOTE: This chart is coordinated with the tube and output transformer measurements (Table II), and the test points listed below are the same as the test points listed in Table II. For example, if a check of test point 1 in accordance with the tube and output transformer measurements table should show a d-c measurement of zero volts instead of 110 volts, an a-c measurement of zero volts instead of 1.3 volts, and an infinite resistance measurement instead of 1.5 megohms, a reference to test point 1 in the table below will indicate that resistor R209 is open. High voltage or resistance is any measurement from above normal to infinity; low voltage or resistance is any measurement from zero to below normal.

Test Point	Test Condition Indicating Trouble	Capacitors		Resistors Open	Misc.
		Open	Short		
1	D-C voltage high and Resistance normal-----			R208, R207	
	D-C voltage low and A-C voltage low and Resistance low-----		C214b, c		
	D-C voltage low and A-C voltage low and Resistance high-----			R209	
2	A-C voltage low-----	C203			
	D-C voltage high-----	C203			
	Resistance high-----			R207	
3	D-C voltage high and Resistance high-----			R208	
6	D-C voltage high and A-C voltage low and Resistance normal-----			R203, R204, R205	
	D-C voltage low and A-C voltage low and Resistance low-----		C214b, c		
	D-C voltage low and A-C voltage low and Resistance high-----			R206, R225, R226	
7	D-C voltage high-----	C202			
	A-C voltage low-----	C202			
	Resistance high-----			R203, R204	
8	D-C voltage high-----	C207		R205	
	Resistance high-----			R205	
10	D-C voltage high and A-C voltage low-----			R216, R217 R218	
	D-C voltage low and A-C voltage low and Resistance low-----		C214c		
	D-C voltage low and A-C voltage low and Resistance high-----			R219, R226	
11	A-C voltage low-----	C211			
	D-C voltage high-----	C211			
	Resistance high-----			R216, R218	
12	D-C voltage high and Resistance high-----			R217, R218	

TABLE III. AMPLIFIER TROUBLE ANALYSIS CHART (cont)

Test Point	Test Condition Indicating Trouble	Capacitors		Resistors Open	Misc.
		Open	Short		
15	D-C voltage high and A-C voltage low-----			R214	
	D-C voltage low and A-C voltage low and Resistance low-----		C214c		
	D-C voltage low and A-C voltage low and Resistance high-----			R215, R226	
16	A-C voltage low-----	C208			
	D-C voltage high-----		C208		
	Resistance high-----			R213	
17	D-C voltage high and Resistance high-----			R214	
	A-C voltage high-----			R222	
19, 25	A-C voltage low-----	C212			
	D-C voltage low-----		C216c		
	Resistance high and increased D-C voltage-----			R220	
	Decreased neg. D-C or positive D-C voltage-----		C212		
23	D-C voltage high and A-C voltage low-----			R220	
	D-C voltage low and A-C voltage low and Resistance low-----		C216a		
	D-C voltage low and A-C voltage low and Resistance normal-----		C216c	R228	
	D-C voltage low and A-C voltage low and Resistance high-----				T201 Open
24	D-C voltage low and Resistance low-----		C214a		
	D-C voltage high and Resistance high-----			R226	
	D-C voltage low and Resistance high-----			R227	

TABLE III. AMPLIFIER TROUBLE ANALYSIS CHART (cont)

Test Point	Test Condition Indicating Trouble	Capacitors		Resistors Open	Misc.
		Open	Short		
26,32	A-C voltage low-----	C213			
	D-C voltage low-----	C216c			
	Resistance high and incr. D-C voltage-----			R221	
	Decr. neg. D-C or Pos. D-C voltage-----	C213			
30	D-C voltage high and A-C voltage low-----			R221	
	D-C voltage low and A-C voltage low and Resistance low-----	C216a			
	D-C voltage low and A-C voltage low and Resistance high-----				T201 Open
	D-C voltage low and A-C voltage low and Resistance normal-----	C216c		R228	
31	D-C voltage low and Resistance low-----	C214a			
	D-C voltage high and Resistance high-----			R226	
	D-C voltage low and Resistance high-----			R227	
33,39	D-C voltage low and Resistance low and RF voltage low-----	C217			
	D-C voltage low and Resistance high and RF voltage low-----			R231	
	D-C voltage low and Resistance normal and RF voltage low-----	C218			
34	Resistance high and RF voltage low-----				L201 Open
37,38	D-C voltage low and Resistance low-----	C219, C220			
	D-C voltage low and Resistance high-----			R230, R228	
40,45	A-C voltage low and Resistance high-----				T202 Open Secondary

TABLE III. AMPLIFIER TROUBLE ANALYSIS CHART (cont)

Test Point	Test Condition Indicating Trouble	Capacitors		Resistors	Misc.
		Open	Short	Open	
46	D-C voltage low and A-C voltage low and Resistance low-----		C216a		
	D-C voltage low and A-C voltage low-----		R229		
47,52	A-C voltage low and Resistance high-----				T202 Open Secondary
53	D-C voltage low and A-C voltage low and Resistance low-----		C216a		
	D-C voltage low and A-C voltage low-----		R229		

NOTE: The following test points are for checking filament voltages:

4, 5, 9, 13, 14, 18, 21, 22,
28, 29, 35, 36, 42, 43, 49, 50 } A-C voltage low----- C221, C222

TABLE IV. D-C SUPPLY VOLTAGE DROP

Circuit Element	Normal Voltage Drop ($\pm 10\%$)
R228-----	20
R229-----	16
R227-----	10
R226-----	15
R225-----	5
R224-----	155
R223-----	85

TABLE V. D-C RESISTANCES

NOTE: The following chart lists the d-c resistances of the various transformers and inductors used in the amplifier.

Symbol	Part	Measure Between Terminals	Resistance in Ohms
T201	Output Transformer	1-2	450
		2-3	370
		4-5	0.6
		5-6	0.4
T202	Power Transformer	1-2	4.5
		3-4	64
		4-5	68
		6-7	0.09
		7-8	0.08
L201	Oscillator Coil	Gr-ye	5
		Ye-Blk	0.3
		Secondary	0.085

TABLE VI. A-C VOLTAGES

NOTE: The following chart lists the 60 cycle alternating current voltages as appearing at various terminals within the amplifier.

Symbol	Part	Measure Between Terminals	Approx. A-C Voltage
V201	12AX7 tube	4-9	6.3
		5-9	6.3
V202	12AX7 tube	4-9	6.3
		5-9	6.3
V203	6AQ5 tube	3-4	6.3
V204	6AQ5 tube	3-4	6.3
V205	6AQ5 tube	3-4	6.3
V206	6X4 tube	3-4	6.3
V207	6X4 tube	3-4	6.3
R201	Pilot Lamp	Not Marked	6.3
T202	Power Transformer	1-2	115
		3-4	265
		4-5	265
		3-5	530
		6-7	3.1
		7-8	3.1
		6-8	6.3

TABLE VII. PROJECTOR CHARACTERISTICS TESTS

NOTE: All tests to be made at 115 volts ac, 60 cycles, with 750-watt, 115-volt projection lamp.

Test	Procedure	Correct Indication
1. Uniformity of screen illumination.	1. With new 750-watt lamp inserted in projector operate projector on 115 volt, 60 cycle, ac without film. OFF-MOTOR-LAMP switch in LAMP position. 2. Focus aperture on screen so that the projected image of aperture is 40 inches wide and 30 inches high. 3. With illumination meter (employing one photo-electric cell) measure illumination at center of screen and at four corners (2 inches from edge of screen). 4. Compute average illumination of four corners.	1. Light appears on screen. 2. Edges of aperture appear sharp. No patches or bands showing variation of color or brightness appear. 3. At no corner should illumination be less than 60 per cent of illumination at center of screen. 4. Average illumination at four corners should be not less than 70 per cent of illumination at center of screen.
2. Light output.	1. This test should be performed following the test for uniformity of screen illumination. 2. Divide illuminated area into 12 equal squares. Mark centers of these squares. 3. With illumination meter (employing one photo-electric cell) measure illumination at all 12 points. Complete average illumination (sum of measurements divided by 12). 4. Multiply above result by area of projected image of aperture (8.33 sq. ft.).	1. Light appears on screen in sharp focus. 2. Figure 3-8, Page 54, shows layout for light measurements. 3. Average screen illumination in foot candles. 4. Light output should be not less than 320 lumens.
3. Picture unsteadiness.	1. Focus aperture on screen so that projected image of aperture is 40 inches wide. Be sure projector is mounted on vibration free base. 2. Thread projector with reel containing at least 80 ft. of picture-unsteadiness test film (target film). Turn OFF-MOTOR-LAMP switch to LAMP position. 3. With a 6-inch scale, measure at the screen the vertical displacement of the image of the hole in the picture-unsteadiness film. 4. Measure the horizontal displacement of the image of the hole in the unsteadiness test film.	1. Image of aperture on screen should be absolutely motionless. 2. Image of picture-unsteadiness test film should be focused sharply on screen. 3. Vertical unsteadiness of a period shorter than one second should not exceed 0.2 per cent of the picture width in a new projector. It should not exceed 0.25 per cent of the picture width on a projector having been operated for 500 hours. 4. Horizontal unsteadiness having any period whatsoever should not exceed 0.2 per cent of the picture width either in new projectors or projectors operated for 500 hours.

TABLE VII. PROJECTOR CHARACTERISTICS TESTS (cont)

Test	Procedure	Correct Indication
4. Framing mechanism.	1. With projector running with picture-unsteadiness film, as above, operate the framing mechanism so that the picture is framed correctly on the screen. 2. Turn the framing knob as far as it will go clockwise. Measure displacement of image on screen. 3. Turn framing knob counterclockwise until image is framed properly. 4. Turn framing knob as far as it will go counterclockwise. Measure displacement of image on screen.	1. Framing lines on picture should be at edge of image. 2. Image of hole should move up 2-5/8 inches or more. Edge of projected image, as defined by aperture, should not move at all. 3. Framing lines on picture should be at edge of image. 4. Image of hole should move down 2-5/8 inches or more. Edge of projected image, as defined by aperture, should not move at all.
5. Travel Ghost	1. Thread and operate projector with travel ghost test film. Projector should be focused at a distance to give a picture image 40 inches wide. Operator should view image on a matte white screen, at a distance of 6-1/2 feet.	1. There should be no appearance of light streaks or vertical tails added to the projected images of the transparent areas on the test film.
6. Film speed	1. Turn OFF-MOTOR-LAMP switch to MOTOR position. Check speed of feed sprocket with tachometer.	1. Speed should not be less than 178.2 and not more than 181.8 rpm.
7. Film tension	1. Be sure OFF-MOTOR-LAMP switch is in the OFF position. Place empty 2000 ft. reel on spindle of take-up arm. 2. Attach strip of film to reel hub. Wind several turns of film around hub. 3. Place the hook end of a spring scale through the film strip. Turn on the motor. 4. Turn off the motor. Place empty 2000 ft. reel on feed reel arm. 5. Attach strip of film and spring scale as in 2 and 3 above.	1. Reel should be firmly latched on spindle. 2. Film should be wrapped securely on reel. 3. Scale should read not more than 8 ounces, not less than 6 ounces. 4. Reel should be firmly latched on spindle. 5. Scale should read not more than 8 ounces.
8. Film life	1. In a room well protected from dust, thread the projector with a 12 ft. loop of newly processed and lubricated sound and picture film in good condition, having a shrinkage not greater than 0.3 per cent. Film should be supported in its return path, in as near a normal position as possible, by free running rollers of such construction as to have a negligible tendency to damage the film. 2. With a 750 watt lamp in projector, turn OFF-MOTOR-LAMP to the LAMP position. 3. Allow loop of film to pass through picture mechanism 2000 times. After this, observe the quality of the projected picture and sound.	1. Film should be touching all parts of the projector mechanism that it touches in normal operation. 2. Projector should run. 3. Quality of projected image and the sound should not be affected.

TABLE VII. PROJECTOR CHARACTERISTICS TESTS (cont)

Test	Procedure	Correct Indication
8. Film life (cont)	4. Examine film perforations. 5. Splices will be replaced as may be necessary during the test. The life of 10 well made splices will be noted, and the average number of passages of the 10 splices will be computed.	4. Perforations should not show evidence of excessive wear. 5. The average life of the splice should be more than 1000 passages through the projector mechanism, with light source energized (750 watt lamp).
9. Tilt mechanism.	1. Turn tilt knob counterclockwise as far as it will go. 2. Turn tilt knob clockwise to an intermediate position. 3. Turn tilt knob clockwise as far as it will go.	1. Projector should be tilted 10 degrees from horizontal. 2. Angle of tilt should decrease and projector should remain securely in position. 3. Projector should return to horizontal position and remain there.
10. Noise of projector mechanism.	1. Mount projector in a substantially free space on a small stand. Mount the sound level meter so that the microphone is 3 feet from the vertical axis, passing through the picture aperture and in a horizontal plane with the aperture. Take readings at 45 degree intervals beginning with position in front of the projector. Operate projector with newly processed sound and picture film with the meter at curve setting "A." Read the sound level. Make these measurements in a very quiet room.	1. The noise should be less than 60 decibels.
11. Lateral positioning of film scanning light beam (accuracy of buzz track adjustments).	1. Thread projector with buzz track test film. With loudspeaker connected to amplifier, turn GAIN (Volume) control on full. Operate the equipment.	1. No sound of a 300 cycle or 1000 cycle note shall be heard in the loudspeaker, or the 300 and 1000 cycle note shall be reproduced at an equally faint intensity.
12. Uniformity of scanning beam illumination.	1. Thread projector with a loop of uniformity of sound track test film (100 cycle). Measure the output of projector with an output meter.	1. If variation in output is not more than ± 1.5 db, projector has satisfactory scanning beam illumination.
13. Focus and azimuth adjustment of scanning light beam (quick adjustment). (precision adjustment)	1. Thread projector with sound-focusing test film, field type (5000 cycles). Operate projector as for a normal sound film. Adjust sound optical unit. 2. Thread projector with sound focusing test film, precision type (7000 cycles) so that emulsion side faces exciter lamp. Connect output meter to output of amplifier. Turn tone controls to NORMAL. Turn GAIN (Volume) control until a reading is obtained on output meter. Adjust sound optical unit.	1. Loudness of tone in loudspeaker indicates correct adjustment. 2. Focus and azimuth adjustment correct when maximum reading on output meter is obtained.

TABLE VII. PROJECTOR CHARACTERISTICS TESTS (cont)

Test	Procedure	Correct Indication
14. Steadiness of sound reproduction (flutter)	1. Thread the projector with a reel of 3000 cycle flutter test film. Connect flutter indicator to output of amplifier. Operate equipment. Calibrate flutter indicator. 2. Turn off the motor. Turn flutter indicator switch to READ. 3. Turn on the motor. Read the flutter indicator as soon as practicable after 6 feet of film has passed through the projector.	1. Needle of flutter indicator should be read at calibrate point on meter. 2. None. 3. Total flutter should be less than 0.25 per cent.
15. Projector electrical frequency response characteristic test.	1. With scanning light beam properly focused, set treble and bass tone controls at "Normal." Terminate the amplifier in an 8 ohm non-inductive resistor. Operate projector with a multi-frequency test film. Measure the output level at each frequency noted. 2. Repeat test with sound track on other side of film.	1. The response frequency characteristic should be between the dotted limits shown on Figure 3-3. 2. Result should be as in 1 above.
16. Line voltage and frequency variation test.	1. Turn the OFF-MOTOR-LAMP switch to the MOTOR position and to the OFF position 20 times at a line voltage of 108 volts (55 cycles). 2. Repeat operation as in 1 above but at a line voltage of 122 volts (65 cycles). 3. Run projector with sound picture film at line voltage of both 108 and 122 volts, using a 750 watt lamp.	1. Motor should start each time. 2. Motor should start each time. 3. Light output and sound quality should be satisfactory.

TABLE VIII. AMPLIFIER CHARACTERISTICS TESTS

NOTE: Refer to figure 3-4 for Amplifier Frequency Response Characteristics

Test	Procedure	Correct Indication
1. Adequacy of Reserve Amplification.	1. Run projector with a 400 cycle test film. Set amplifier tone control to NOR (NORMAL) and the VOLUME control at a point 20 decibels below maximum output (Mid-Position). Connect 16 ohm, non-inductive resistor to remote loudspeaker receptacle J203, pins 1 and 3.	1. Amplifier should deliver 8 watts of audio power to load resistor (11.3 volts rms across 16 ohm load).
2. Electrical Power Output and Distortion.	1. Disconnect the photo cell input plug from J201. Using the Hewlett-Packard 200B oscillator (or equivalent) as a source of signal, inject a 180 mv. signal into J202. With the same volume control setting as in test (1) measure the harmonic content of the amplifier output with a Hewlett-Packard 330B Distortion Analyzer at frequencies of 100, 400, 1000, 2000, 3500, 5000, and 6000 cycles per second. The input impedance of the Hewlett-Packard 330B Distortion Analyzer is high enough (600 ohms) so as not to disturb the 16 ohm load on the amplifier.	1. The amplifier should develop 8 watts of audio power and the total distortion should not exceed 2.0% at any of the frequencies tested.

TABLE VIII. AMPLIFIER CHARACTERISTICS TESTS (cont)

Test	Procedure	Correct Indication
3. Frequency Response Characteristics.	1. At rated gain, (volume control setting of tests (1) and (2)), vary the input frequency from 70 to 8000 cps, keeping the amplitude of the input signal at 18 mv.	1. The output of the amplifier should fall within the limits of Figure 3-4 for any frequency tested, providing that the input signal is held constant with respect to amplitude and that the amplifier is terminated in a 16 ohm non-inductive load. The measured response should have a slope approximating the slope of the desired curve.
4. Output Voltage Regulation.	1. Inject a 1000 cycle sine wave as in test (2), resulting in 8 watts being delivered to the 16 ohm resistive load (11.3 volts). Remove the load.	1. Removal of the load should not cause the output voltage to increase in excess of 4 db. (Open circuit voltage should not exceed 17.9 volts at rated gain with 180 mv. on grid of V201a.)
5. Noise Test.	1. Reconnect the photo cell cable plug P102 to J201. With the projector running without film, set the tone control to "NOR" and the volume control to Maximum (Fully clockwise). Measure the voltage appearing across the 16 ohm resistor load at the output of the amplifier.	1. The voltage measured is the total electrical noise generated by the projector and amplifier and should be at least 40 db below the rated output of 8 watts. (40 db below 8 watts across 16 ohms corresponds to a voltage of 0.113 volts).
6. Tone Control Action.	1. With an input signal of 18 mv into the microphone jack (J202) and the volume control adjusted for 2 watts of power output across the 16 ohm load resistor (5.67 volts), determine the frequency response curve by varying the input frequency. The curve will be a plot of output in decibels vs frequency. 2. Rotate the tone control fully counterclockwise and obtain a new response curve as above. 3. Rotate the tone control in a clockwise direction and obtain another response curve.	1. The resulting response curve must approximate the design objective, Fig. 3-2 (within ± 2 db). 2. The new response curve should show attenuation of frequencies above 700 cycles with an attenuation of 10 db (± 2 db) at 5000 cycles at maximum position of the control. Fig. 3-2. 3. Accentuation of frequencies above 700 cycles should result in the form of a broadly tuned peak with a boost of 6 db (± 2 db) at 3500 cycles when the control is fully clockwise. In addition, frequencies below 700 cycles shall be attenuated with an attenuation of 12 db (± 2 db) at 100 cycles. Fig. 3-2.
7. Dielectric Test.	1. Disconnect the power leads to the amplifier. Remove all tubes. Connect one lead of the 900 volt dielectric test set to one power lead. Connect other end of dielectric tester to any metal part of amplifier. Turn ON set for one minute.	1. No short circuits or breakdowns should be indicated in the amplifier.

TABLE IX. LOUDSPEAKER CHARACTERISTICS TESTS

Test	Procedure	Correct Indication
1. Sound Output Pressure	1. Set up loudspeaker under free field conditions and impress an 8 watt warble signal across the input taps. Measure the sound output pressure on the loudspeaker axis at a distance of 10 feet employing a signal warbled over band from 800 to 1250 cps. The signal shall be warbled with a linear change of frequency on a logarithmic scale with respect to time.	1. The loudspeaker shall be capable of producing a minimum output pressure of 88 decibels (Ref. 0.002 dyne per cm)
2. Frequency Response Characteristics.	1. Set up loudspeaker under free field conditions and impress a constant voltage signal (of such value as to deliver 2 watts at 800-1250 cps. warble) across the input terminals at a frequency varied from 80 to 8000 cps. Measure the sound output pressure on the loudspeaker axis at a distance of 10 feet.	1. The frequency response characteristics should fall within the limits of Figure 3-7. Sharp peaks and dips may extend beyond these limits providing the width of these peaks and dips at the limits is less than 1/10 octave with no more than one such extension per octave. The sound output pressure over the 800-1250 cycle warble band will not necessarily be the zero reference on Fig. 3-7.
3. Load Characteristic test.	1. Set up loudspeaker under free field conditions and impress an 800-1250 cps warble frequency across the terminals. Vary the amplitude of this signal from zero to 8 watts. Measure the sound output pressure for each value of test voltages on the speaker axis at a distance of 10 feet and the power input to the speaker (volts & amperes) as the amplitude is varied.	1. The load characteristics (sound pressure output versus volt-ampere input) plotted on logarithmic scales should be essentially a straight line. The maximum deviation from a straight line should be 1.5 db at 8 watts.

16-MM PROJECTOR

Serial No. P99000 and Higher

Type AQ-2A(1)

THE INSTRUCTIONS CONTAINED IN PRECEDING SECTIONS OF THIS HANDBOOK
APPLY EXCEPT FOR THE DIFFERENCES LISTED IN THIS DATA SHEET.

LEADING PARTICULARS. Same as for basic Type AQ-2A(1).

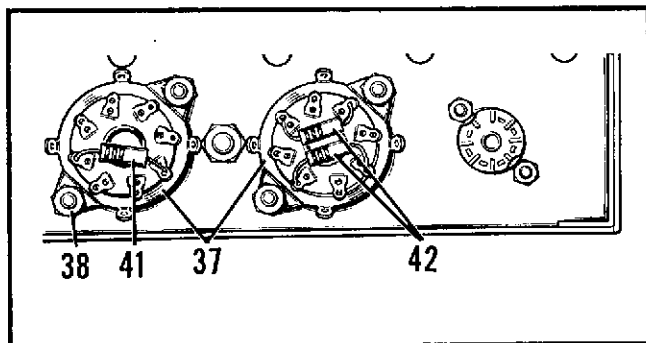
SPECIAL TOOLS. Same as for basic Type AQ-2A(1).

DISASSEMBLY. Same as for basic Type AQ-2A(1), except as noted in the following paragraphs.

a. The sound head assembly for Type AQ-2A(1) projectors bearing serial numbers P99000 and higher is equipped with a photocell cable (36, Figure 2-9), which has an octal plug at one end. This octal plug connects with a mating receptacle mounted in the amplifier in place of the jack-type receptacle used in the basic Type AQ-2A(1) projector.

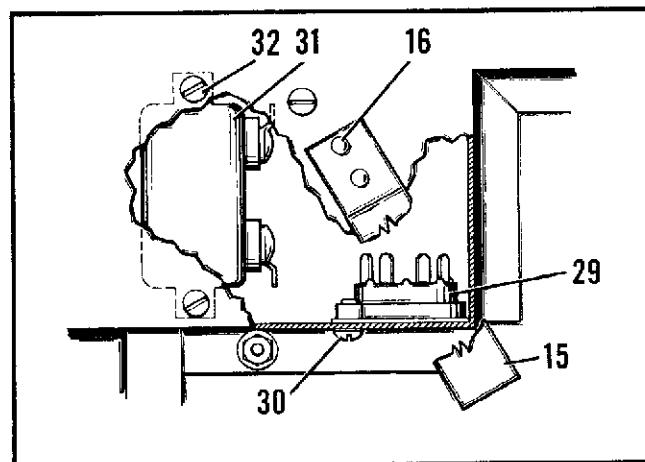
b. The amplifier assembly for Type AQ-2A(1) projectors bearing serial numbers P99000 and higher differs slightly from the amplifier assembly for the basic Type AQ-2A(1) projector. Resistors have been added across terminals of the octal sockets (index 37, Figure 2-50) as shown in Figure 4-1. An octal-type receptacle replaces the jack-type receptacle (index 8, Figure 2-51) used in the basic Type AQ-2A(1) projector, and an electrolytic capacitor has been added to the circuitry. Both the octal receptacle and capacitor are illustrated in Figure 4-2. Changes in some components of the resistor-capacitor strip assembly (see Figure 4-3) have been made to improve over-all performance of the amplifier.

c. A new style power cable is supplied with Type AQ-2A(1) projectors bearing serial numbers P99000 and higher. This cable is equipped with a 3-bladed connector plug (Figure 4-4) of the self-grounding type, with a disconnect pull-chain provided.



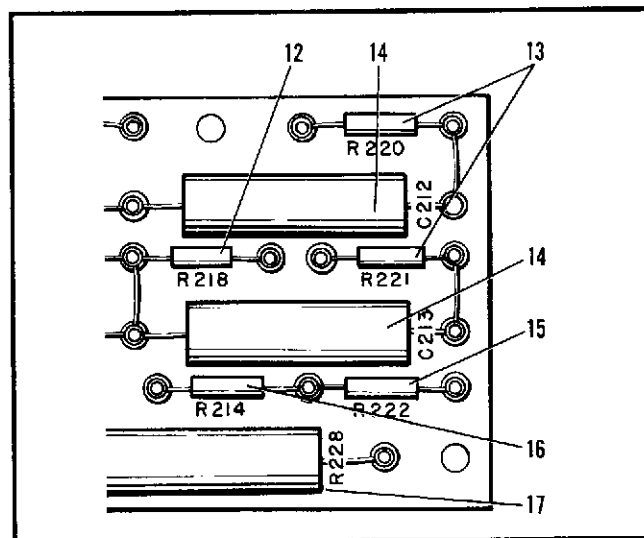
- 37. Octal socket
- 38. Screw, nut and washer
- 41. Resistor, 1/2w 10,000 ohm
- 42. Resistor, 1/2w 2.7 ohm

Figure 4-1. Underside View of Amplifier Chassis Showing Added Resistors



- 15. Contact spring
- 16. Tubular rivet
- 29. Octal receptacle
- 30. No. 6 screw and washer
- 31. Capacitor, 10 uf electrolytic
- 32. No. 6 screw, nut, washer

Figure 4-2. Photocell Input Receptacle and Capacitor



- 12. Resistor, 1/2w 200K ohms
- 13. Resistor, 1/2w 110K ohms
- 14. Capacitor, 0.1 uf 400 wvdc
- 15. Resistor, 1/2w 75K ohms
- 16. Resistor, 1/2w 6800 ohms
- 17. Resistor, 5w 500 ohms

Figure 4-3. Revised Resistor-Capacitor Strip Assembly

CLEANING. Same as for basic Type AQ-2A(1).

INSPECTION. Same as for basic Type AQ-2A(1).

TESTING (during overhaul). Same as for basic Type AQ-2A(1).

REPAIR OR REPLACEMENT. Same as for basic Type AQ-2A(1).

LUBRICATION. Same as for basic Type AQ-2A(1).

REASSEMBLY. Same as for basic Type AQ-2A(1), with changes noted in DISASSEMBLY, preceding.

TEST PROCEDURE (after overhaul). Same as for basic Type AQ-2A(1).

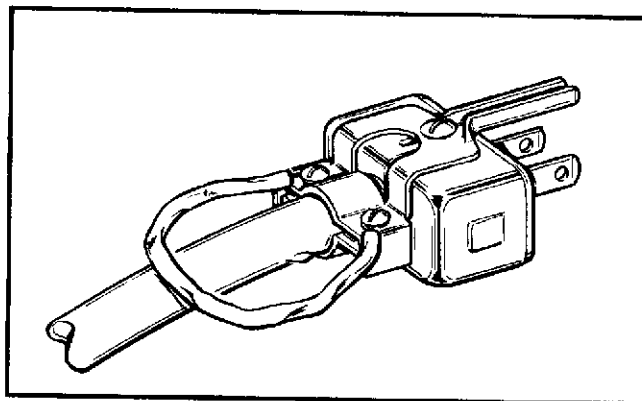


Figure 4-4. Connector Plug for
New Power Cable