Film-Tech

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These manuals are designed to facilitate the exchange of information related to cinema projection and film handling, with no warranties nor obligations from the authors, for qualified field service engineers.

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www.film-tech.com

BELL & HOWELL

MODEL 1568 HIGH-INTENSITY 16MM SOUND PROJECTOR

OWNERS AND OPERATORS GUIDE

IMPORTANT:
Please read these instructions carefully before operating this unit

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IMPORTANT SAFEGUARDS

When using your photographic equipment, basic safety precautions should always be followed, including the following:

1. **Read and understand all instructions.**
2. **Close supervision is necessary when any equipment is used by or near children. Do not leave equipment unattended while in use.**
3. **Care must be taken as burns can occur from touching hot parts.**
4. **Do not operate equipment with a damaged cord or if the equipment has been dropped or damaged — until it has been examined by a qualified serviceman.**
5. **Position the equipment in such a way so as not to block any air intake or exhaust openings.**
6. **If an extension cord is necessary, a cord with a suitable current rating should be used. Cords rated for less amperage than the equipment may overheat. Care should be taken to arrange the cord so that it will not be tripped over or pulled.**
7. **Always unplug equipment from electrical outlet when not in use. Never yank cord to pull plug from outlet. Grasp plug and pull to disconnect.**
8. **Let equipment cool completely before putting away. Store the power cord properly in the storage area provided.**
9. **To protect against electrical shock hazards, do not expose this equipment to rain, moisture, or other liquids.**
10. **To avoid electric shock hazard, do not disassemble this equipment, but take it to a qualified serviceman when some service or repair work is required. Incorrect reassembly can cause electric shock hazard when the equipment is used subsequently.**

The serial number of your projector is included on the name plate located at the rear of the machine. Record the serial number in the space provided below.

_____

SAVE THESE INSTRUCTIONS

TABLE OF CONTENTS

YOUR NEW PROJECTOR

Your new Bell & Howell 16mm High-Intensity Sound Projector is a professional device of the highest quality. You can expect years of reliable performance from this equipment.

Model 1568 combines the features most sought after by the professional user in an easy to operate, dependable projector that is equally at home in a small theater, a traveling road show, or a corporate board room. The modern, high output light source assures auditorium quality projection over long distances. The powerful sound system provides faithful sound reproduction for large audiences or can be operated into permanent sound systems. Remote control and tandem operation capability allow the operator maximum convenience and makes possible the most professional showing of motion picture programs.

We are proud of this product which was designed to exacting standards of performance, quality, and durability. The material that follows will help you to use your new projector to the fullest extent of its capability.

SPECIFICATIONS

ILLUMINATION SYSTEM

Lamp. ..... 300 Watt Gas Discharge Arc Lamp with integral Dichroic Reflector.

Shutter. ..... Two Blade (48 interruptions per second)

Standard Lens. .. 2" (50mm) F/1.2 Straw Coated

Optional Lenses. . 1.5" (38mm) F/1.5 Straw Coated
2.5" (64mm) F/1.5 Straw Coated
3" (76mm) F/1.6 Straw Coated
4" (100mm) F/1.6 Straw Coated
Filmovara® Zoom for use with 1.5" (38mm), 2" (50mm), 2.5" (64 mm) and 3" (76mm) lenses. Magnification ratio 0.875 to 1.125.
Anamorphic lens (2X) for use with 1.5" (38mm), 2" (50mm), 2.5" (64mm), 3" (76mm), and * 4" (100mm) lenses.
* Anamorphic lens adapter for 4" (100mm) lens.

Screen Lumens. . 1700 typical

Color Temperature ..... 6000°K Typical

Lamp Life. ..... 75 Hrs. (warranty)

Lumen Maintenance ..... ≥75% of initial @ 40 Hrs.
≥50% of initial @ 75 Hrs.

Lamp Power Supply. ..... Built-in; Solid State

FILM HANDLING CAPABILITIES AND CONTROLS

Reel Arms. ..... Folding; Gear Driven; Weight compensated take-up torque in forward project.

Film Capacity. ... 400 Ft. to 2000 Ft. (120m to 600m)

Framing Control. Fixed Axis; Moves only film

Focus Control. .. Precision Rack and Pinion

Shuttle. ..... Three tooth Stellite

Film Guide Rails. Carbo-Nitride Treated

Elevation Adjustment. .... Knob type; Rack and Pinion

Threading. ..... Automatic

Loop Restorer. .. Automatic, synchronized with shutter

ELECTRICAL MODULAR SYSTEMS

Power. ..... 120VAC, 60Hz (operating range 105 to 132VAC), 8 Amps Max.

Line Cord. ..... 18/3 AWG SJT Non Captive 10 Ft. (3m) length

Protection. ..... Internal via fuses and electronic controls, plus —
1 — 8 Amp Type 3AG Fuse for Lamp Power Supply
1 — 2 Amp Type 3AG Fuse for Control Circuit, Audio Amplifier, Motor Drive Circuit, and Exciter/Blower Power Supplies.

AUDIO SYSTEM

Type. ..... Optical Sound Track

Amplifier Type. ..... Plug-in, all Solid State with safe operating area protection (overload shutdown); pushbutton resettable

Power. ..... Greater than 20 Watts RMS into 8 Ohm load at less than 1% Total Harmonic Distortion (THD). 25 Watts RMS at less than 5% THD

Frequency Response. ..... 50 to 10 KHz

Wow and Flutter. 0.3% Max (peak weighted)

Tone Control. .... 7db boost or cut at 8KHz

Microphone Input ..... ¼" phone jack (with 2mv sensitivity) provided for microphones of 200 Ohms to 50K Ohms impedance. Audio circuit is automatically activated when microphone is plugged in.

Amplifier Output. ..... 2 pin DIN jack for 4-16 Ohm load; operation below 8 Ohms not recommended for best sound quality.

Auxiliary Amplifier Output. ..... 3 pin DIN jack; 0.7V RMS (0dBM) 600 Ohm (minimum) unbalanced line

Speaker Cover. .. 8 Ohm total (2 speakers) included as standard equipment.

EXCITER LAMP

Type. ..... BAK 4V, 0.75 Amp
Approximate Life — 300 Hrs.

FILM TRANSPORT RATE

Forward Project. . 24 Frames/Second ±2%

Reverse Project. . 24 Frames/Second ±4%

Douser System. . Automatic; Shields film from lamp output during stop mode, between forward/reverse modes, and during auto thread mode

Drive System. .... D.C. Servo motor system with integrated timing and control logic

Cooling System. . Single D.C. Blower motor operates in all modes

Control System. . Single digital logic printed circuit board controls all projector functions

Remote Control. . Optional Accessory is fully protected from electrically noisy environments and the effects of static electrical discharges. Low voltage 3 conductor (Class II) Wiring.

SPECIFICATIONS (CONT'D)

Remote Control.. Con't.

Functions Controlled/Indicated —
Lamp On
Lamp Ready
Lamp Off
Forward
Stop
Reverse
Cord length 20 Ft. (6m)
Maximum length recommended 250 Ft. (75m).
50 Ft. (15m) extensions are available
Up to 5 remote control units may be used with each projector provided cumulative length of cord does not exceed 250 Ft. (75m).

Multimedia..... See special section for complete specifications.

Changeover/ Tandem Operation..... On site changeover and/or remotely controlled changeover.

Size..... See Page 34 — Mounting Drawings

Weight..... 38.5 lbs. (17.5 Kg) Complete

Options.....
Remote Control Module
Remote Control Extension Cable
Remote Control Podium Bracket
Tandem Changeover Cable
Microphone
Accessory Lenses
Orchestricon III™ Speaker
Exciter Lamp
Projection Lamp
Pedestal Base

APPROVALS

UL Listed

READ THESE INSTRUCTIONS BEFORE OPERATING THIS EQUIPMENT

CAUTION

This equipment is designed to operate only on 120VAC, 60 Hz current. Operating from any other source may damage the equipment and void the warranty.

Do not attempt to remove the top or metal back cover of the projector; no internal parts are serviceable without specialized equipment and tools. In addition, the high voltage present is hazardous, and especially dangerous to untrained personnel.

Keep the lamp house door closed except as necessary for access to the projection lamp. Do not look directly at the lamp when lighted, nor touch the lamp, lamp base, plug, or socket while the lamp is igniting or lighted. Starting voltage is approximately 15,000 volts.

When using the projector with an auxiliary amplifier, reduce the projector volume and tone controls to "0" and make all volume and tone adjustments on the auxiliary amplifier.

When changing the projection lamp, allow the equipment to cool thoroughly before handling the lamp. Be sure to unplug the power cord from the wall outlet before attempting to remove the lamp plug from its socket.

During normal operation, the projection lamp should remain lit for at least three minutes after ignition whenever possible. Shorter running time will degrade lamp life.

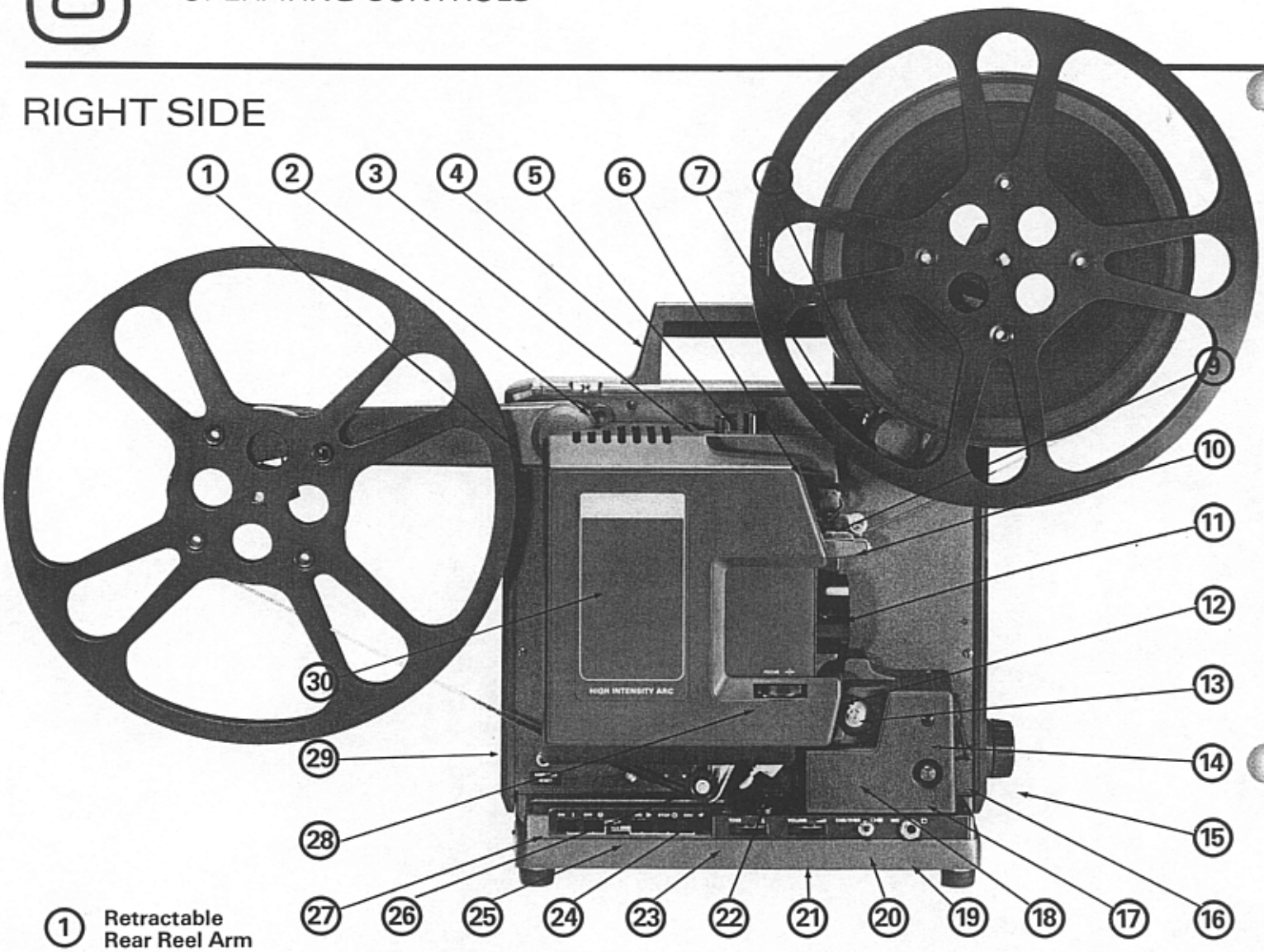
When using a microphone in a system wired for tandem operation, be sure to plug the microphone into the projector that is running. Plugging the microphone into a projector changes the control of the system over to that projector. Changeover cannot be effected to a second projector if the microphone is plugged into the first projector.

When connecting extension speakers to the internal sound amplifier, connect no more than two speakers of 8 ohms each in parallel.

When connecting the projector to a permanent sound system be sure the system is in proper operating condition to avoid possible damage to the projector audio amplifier.

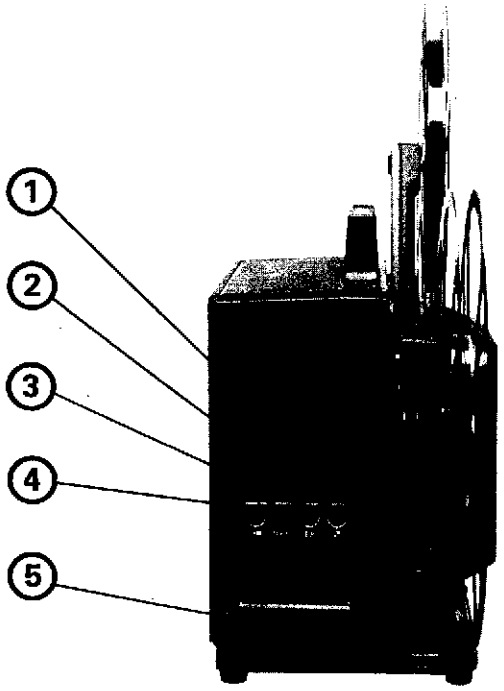
Ground polarity of the system must be observed and the proper plug used to mate with the jack on the projector. See specifications.

RIGHT SIDE



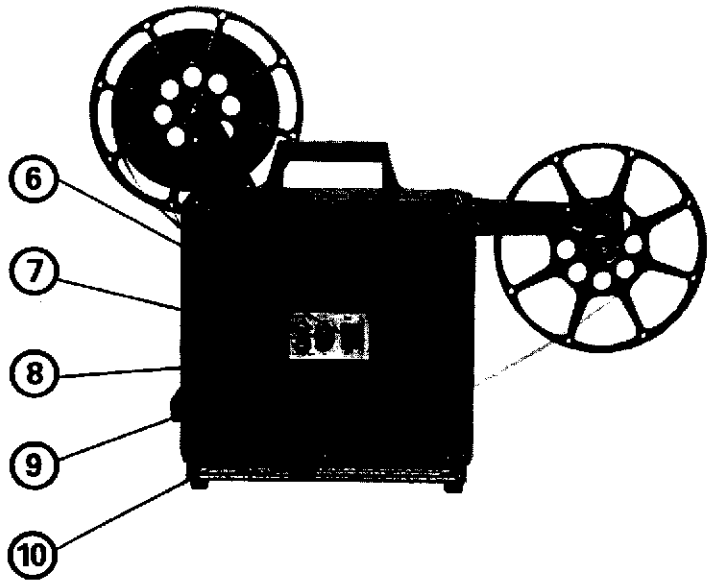
1. Retractable Rear Reel Arm
2. Rear Reel Arm Release Button
3. Framing Knob
4. Carrying Handle
5. High Speed Rewind Button
6. System Restorer
7. Front Reel Arm Release Button
8. Retractable Front Reel Arm
9. Sprocket Guards
10. Film Insert Channel
11. Lens
12. Stabilizing Rollers
13. Sound Drum
14. Exciter Lamp Indicator
15. Tilt Knob
16. Film Cutter Lever
17. Exciter Lamp Cover Screw
18. Exciter Lamp Cover
19. Microphone Jack
20. Changeover Button
21. Volume Control
22. Automatic Loop Restorer
23. Tone Control
24. Automatic Threading Lever
25. Film Forward, Stop, Reverse Buttons
26. Threading System Release Roller
27. Lamp On/Off Buttons
28. Focus Control
29. Amplifier Reset Button
30. Lamp House Cover

REAR



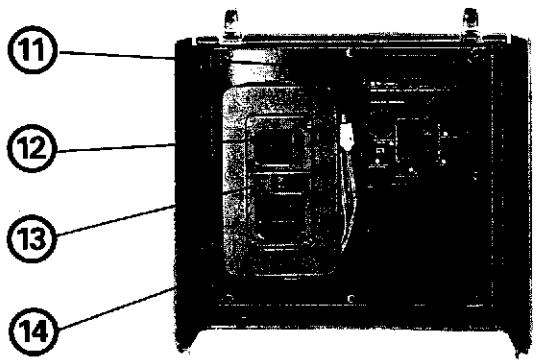
1. Remote Control Jack
2. Auxiliary Amplifier Jack
3. Speaker Jack
4. Changeover Jack
5. Name Plate/Serial Number

LEFT SIDE



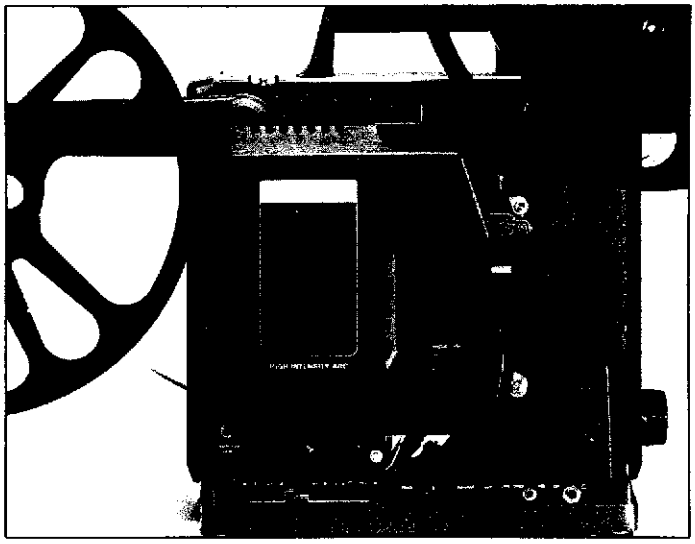
6. Main Power Switch
7. Lamp Fuse
8. Film System Fuse
9. Line Cord Receptacle
10. Multimedia Control Connector

SPEAKER



11. Threading Instructions
12. Exciter Lamp Storage
13. Extension Speaker Jack
14. Speaker Cord Storage

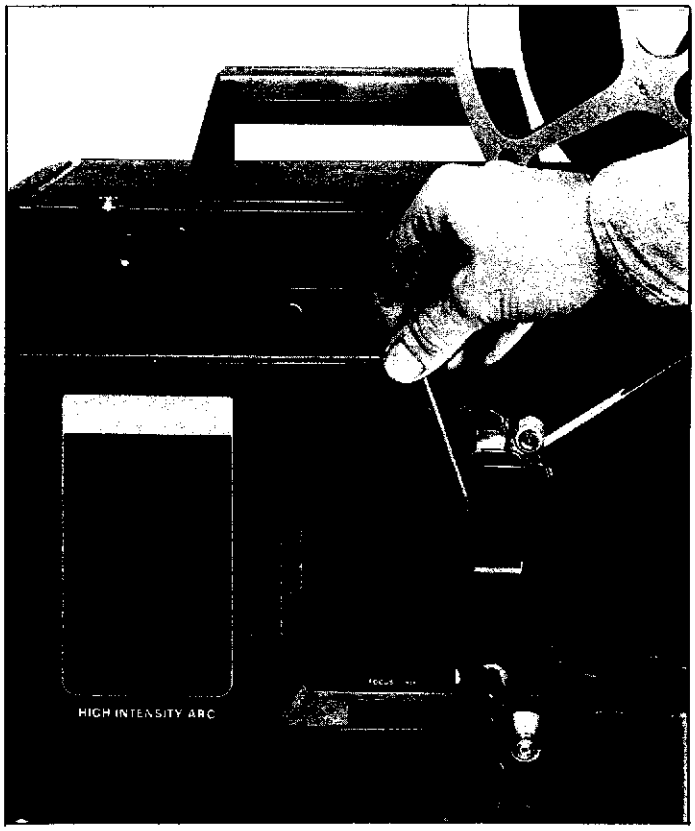
GENERAL FEATURES



The **Carrying Handle** is located atop the projector at a balance point which makes it easy to pick up and move the equipment.

Both **Front** and **Rear Reel Arms** are retractable. Each pivots upward from the storage position and locks in the operating position. To retract an arm, depress the **Reel Arm Release Button** by pressing in toward the projector body while moving the arm downward.

The **Framing Knob** allows the operator to move the film within the aperture to properly fill the screen with the projected image. Turning the knob clockwise raises the projected image in the aperture; counterclockwise lowers the image.



Pressing the **High Speed Rewind Button** after setting the operating controls for rewind allows the projector to rewind at highest speed.

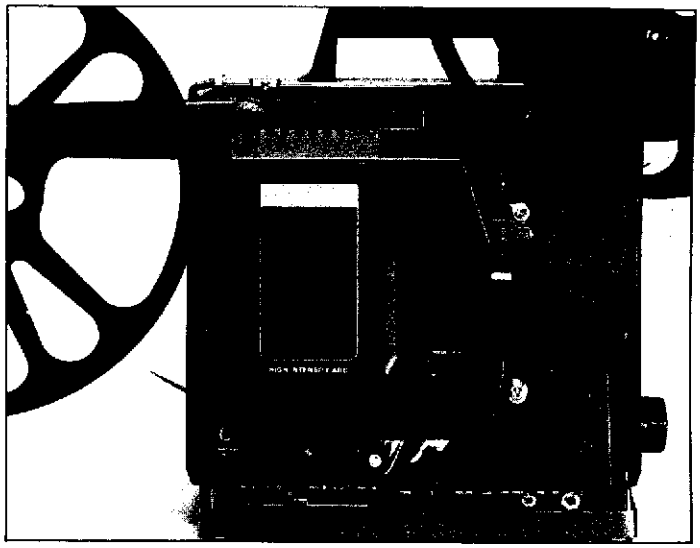
If a large portion of film is damaged and tension is lost around the sound drum, pressing down firmly on the **System Restorer** for at least one second will normally restore the film to the proper threading path.

The **Lamp House Cover** protects the lamp from damage and shields extraneous light from the projection area. To open the compartment door, grasp the cover at the top near the **Framing Knob** and pull away from the body of the projector. The **Cover Door** is hinged at the left side and will swing open easily. A spring clip holds the cover closed.

The **Focus Control** moves the projection lens forward and back.

Various lenses allow the operator to obtain optimum screen image size at any distance. See Page 31 for projection table. Each lens is a high quality, multi-element, Straw Coated device capable of projecting sharp, bright images.

GENERAL FEATURES (CONT'D)

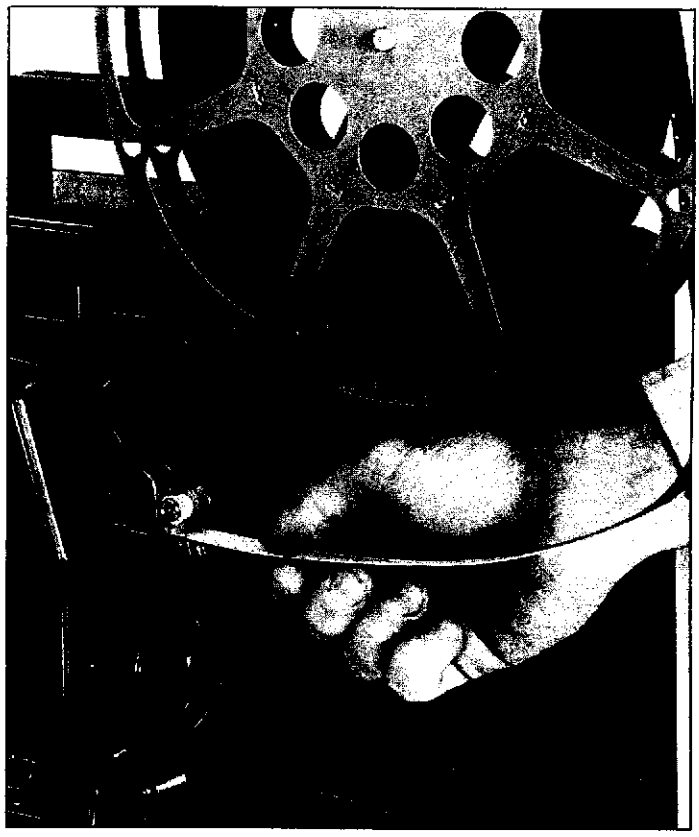


Stabilizing Rollers keep the film in proper relationship with the **Sound Drum** during projection, assuring high quality sound reproduction.

A **Tilt Knob** allows the operator to raise the front of the projector for projection on a screen located above the horizontal axis of the projector. To retain a square projected image, the top of the screen should be tilted toward the projector when the projector is tilted upwards.

An **Exciter Lamp Indicator** monitors the exciter lamp. This convenience device assures the operator that this portion of the sound system is ready for normal operation.

The **Exciter Lamp** cover protects the lamp from damage and shields extraneous light from escaping. The **Exciter Lamp Cover Screw** secures the cover in the closed position.



The **Film Cutter Lever** is used to properly trim the film leader if it is damaged or torn.

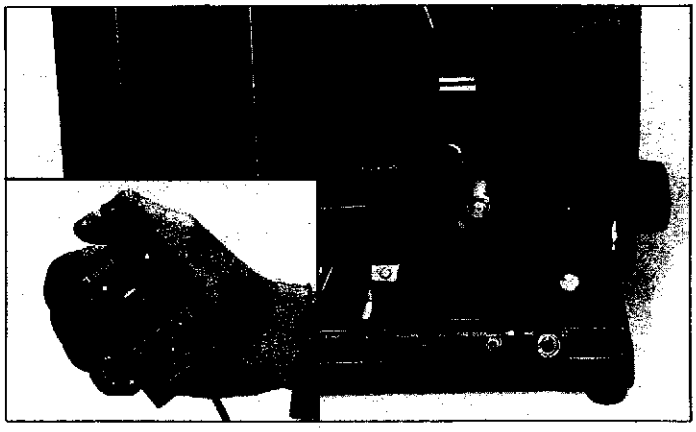
Torn perforations or bad splices will sometimes cause a loss of the lower loop below the film gate. The **Automatic Loop Restorer** will reset the lower loop.

The **Film Insert Channel** is the opening into which the end of the leader is first inserted as a part of the automatic threading procedure. **Sprocket Guards** keep the film on the sprocket.

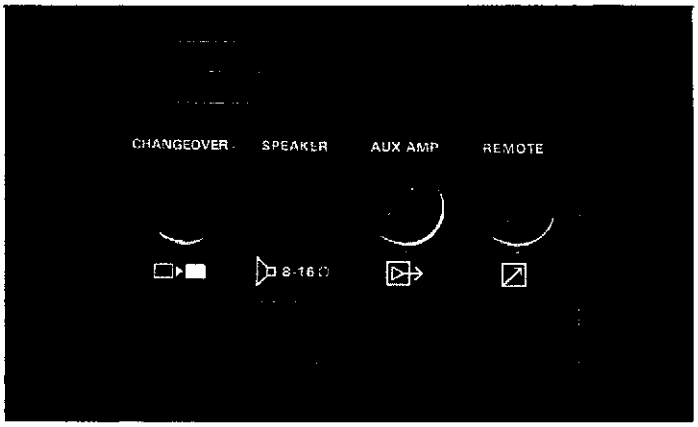
When preparing for Autoloading procedure, the **Automatic Threading Lever** is first moved forward to the Autoload position to ready the mechanism.

GENERAL FEATURES (CONT'D)

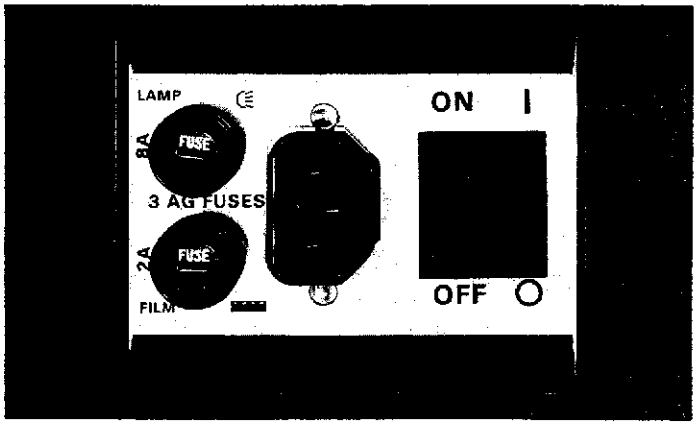
Various operating functions of the projector may be controlled from either the buttons on the machine or from the accessory **Remote Control Module. Lamp On, Lamp Off, Film Forward, Stop, and Film Reverse Buttons** are located on the projector housing and on the accessory **Remote Control Module** to activate the named functions. A **Changeover Button,** for tandem operation, is located on the projector; the accessory **Remote Control Module** may also be used to activate changeover from remote location. See section Page 18. A **Microphone Jack** is included to accept an accessory microphone which can be used with the projector's built-in sound system.



Four jacks are located in the panel at the rear of the projector. These jacks, which accept only DIN plugs, include the **Changeover Jack** for controlling a second projector when tandem operation is desired; **Speaker Jack** for driving the cover speaker from the internal sound amplifier; **Auxiliary Amplifier Jack** for connecting the projector to an external amplifier system; **Remote Control Jack** for use with the accessory **Remote Control Module.**



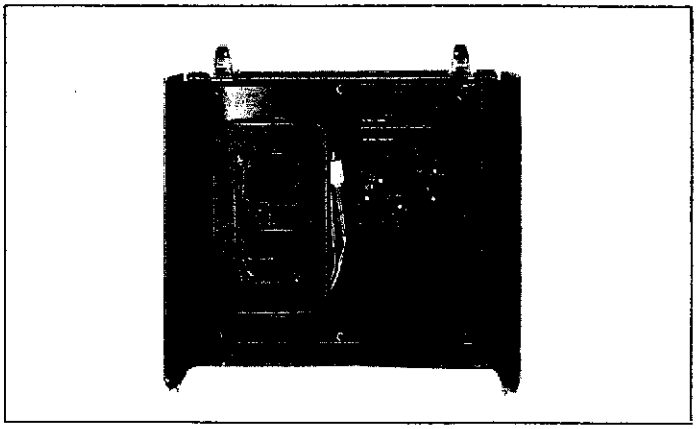
A panel on the left side of the projector includes the **Lamp** and **Film System Fuses,** the **Line Cord Receptacle,** and the **Main Power Switch.**



The Speaker Cover included with the machine contains two speakers for efficient sound reproduction. An additional speaker (8 Ohms minimum) may be plugged into the **Extension Speaker Jack** located on the **Speaker Cover Housing.**

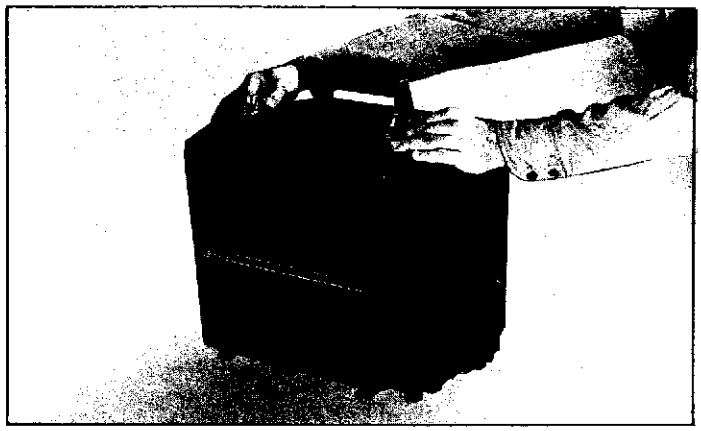
The threading procedure for Autoloading is printed inside the speaker cover for ready reference.

Speaker Cord Storage is provided in the **Speaker Cover** housing. Simply wrap the cord securely around the posts provided. Storage is also provided in the same area for a spare **Exciter Lamp.**

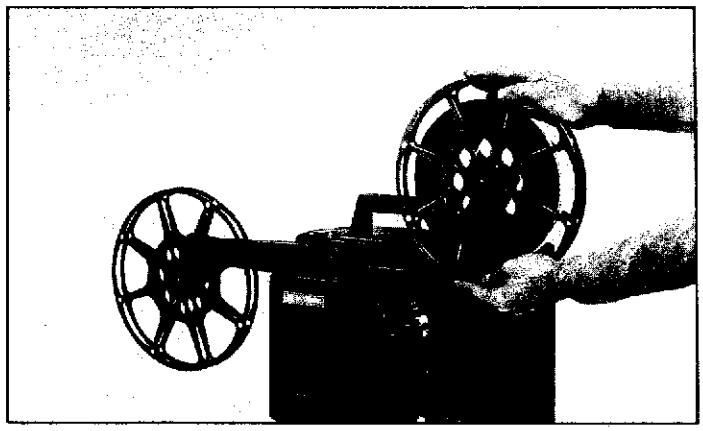


SETTING UP THE PROJECTOR

Place the projector on a sturdy projection stand or a solid table facing the screen. Release the two locking clamps at the top of the projector housing, remove the speaker cover, and place it near the screen. Extend the reel arms; they lock into place with an audible "snap." Select a reel of the same size or larger than the reel of film to be projected and place it on the rear take-up reel arm. Place the reel containing the film to be projected on the front reel arm.



Unwind the speaker cord and plug the cord into the appropriate jack at the rear panel of the projector. Assure that the main power switch is in the OFF position. Connect the main power cord to the projector at the receptacle built into the left side panel. Connect the other end of the power cord into a grounding type 120VAC, 60 Hz outlet.



CAUTION:

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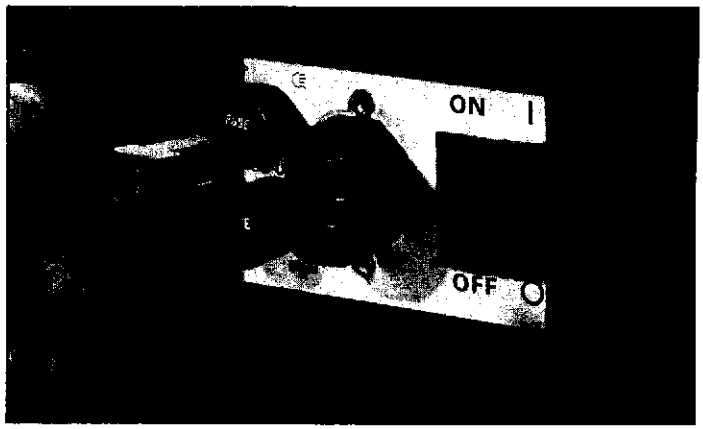
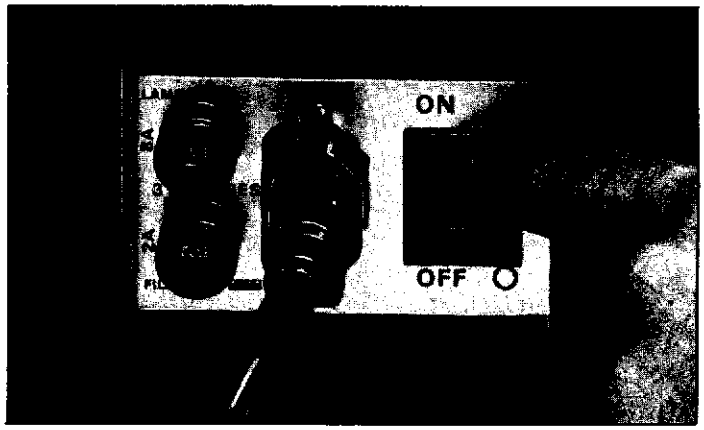


Move the Main Power Switch to ON. The projector fan will immediately start and an audible "clack" of the douser solenoid will be heard. The projector is now in the stand-by mode — both the lamp and motor systems are off. After about five seconds, the motor and lamp systems may be actuated. Test the motor system by pressing the Forward button; the motor should immediately start and the douser will open. The audio system is activated when the projector is in the Forward mode. Press the Stop button to stop the motor, close the douser, and mute the audio system.



SETTING UP THE PROJECTOR (CONT'D)

Ignite the projection lamp by pressing the Lamp On button briefly. (Pressing the Lamp On button for only 50 milliseconds will initiate the lamp starting sequence, although no harm will result from holding the button down for a few seconds.) Complete lamp warm up — full brilliance and proper color temperature — occurs in about three minutes.

CAUTION:

During normal operation, operate the projection lamp for at least three minutes after ignition whenever possible. Shorter running time will degrade lamp life.

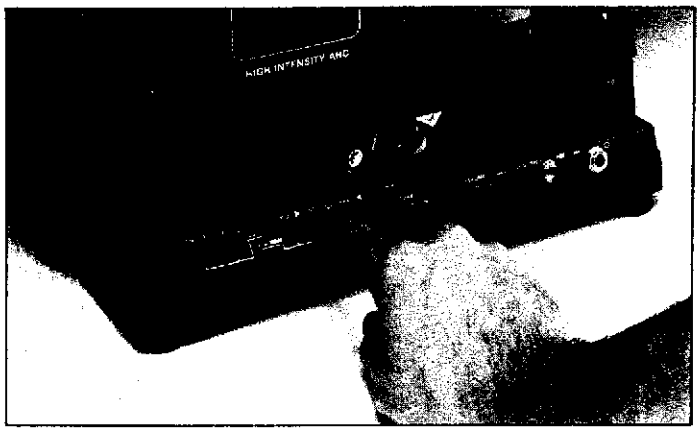
NOTE:

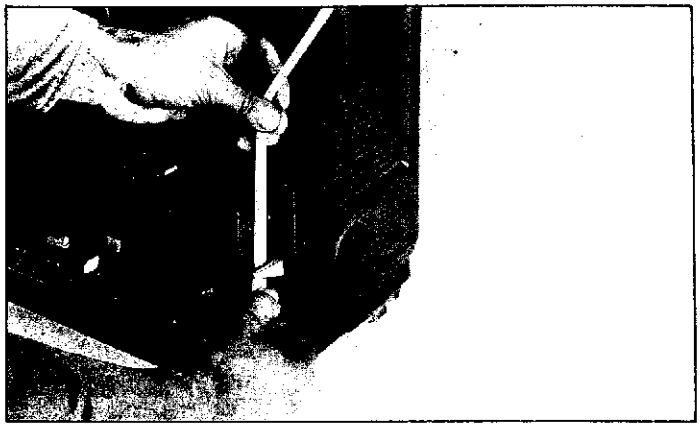
As an operator convenience feature, the Lamp Off button has a built-in time lag to keep the lamp on in case the Off button is pressed inadvertently. The time lag requires that the button be pressed firmly and held down for at least two seconds to turn off the lamp.

Press and hold the Lamp Off button for at least two seconds to turn off the lamp.

Check the leader on the film. The first three feet of film (leader) must be free of any defects. If the tip of the film is damaged or torn, insert it into the film cutter and press film cutter lever to trim the end.

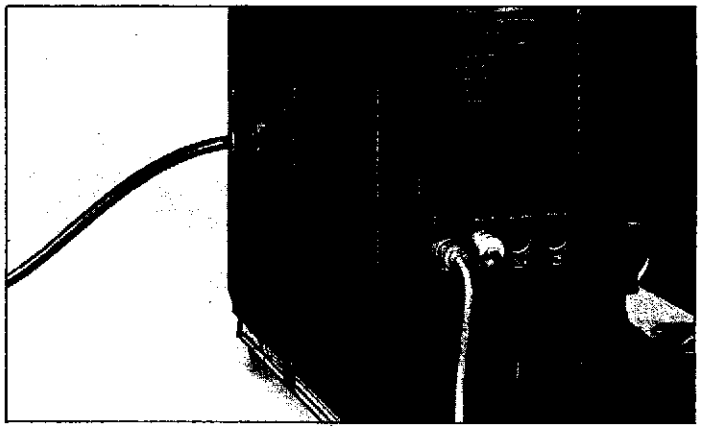
Press the Forward button to start the projector motor. Push the blue threading lever toward the front of the projector, to the Autoload position. Insert the film end into the film channel under the blue roller. Continue pushing the flim in until it engages the sprocket. The autoload mechanism will continue to thread the film through the projector. When the film completes its route through the projector and exits at the rear, catch the end and press the Stop button. Tug on the film to release the autoload mechanism. Wrap the film end around the take-up reel.





PROJECTING THE FILM

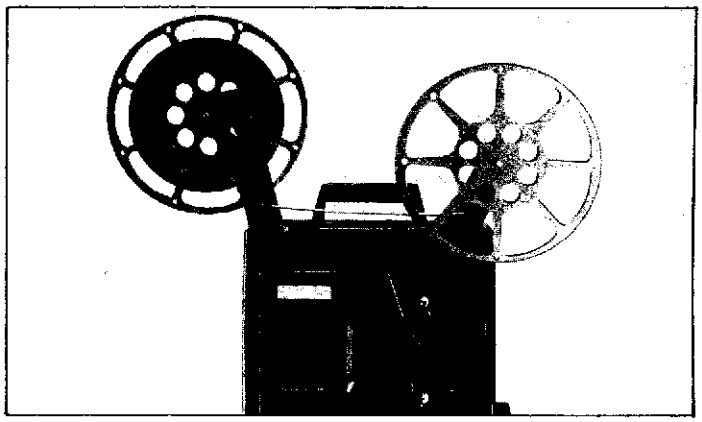
Before the actual showing, whenever possible, the film should be partially projected so that the image may be sharply focused on the screen, the projector aligned with the screen, and the volume and tone controls set for appropriate sound quality. During this preview showing, any additional connections to the projector may be made, such as the remote control module, auxiliary amplifier, tandem machine, or additional speakers. Reverse the film to the starting position before the actual presentation. To begin the actual showing, be certain the projection lamp has ignited and warmed up to full brilliance and correct color temperature. Press the Forward button to start the film. At the end of the film press the Stop button. Push and hold the Lamp Off button for at least two seconds to turn off the lamp.

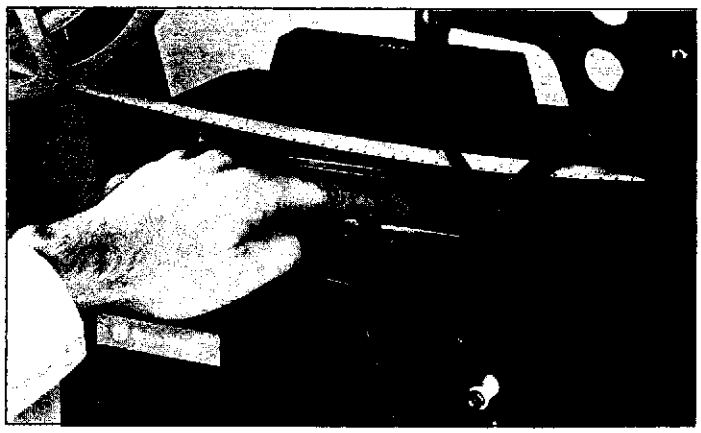


REWINDING THE FILM

Move the rear take-up reel arm to the rewind position by pressing in the reel arm release button while raising the reel arm. Unwind the last few feet of film from the take-up reel and attach the end of the film to the hub of the front film reel. Press the Reverse button to begin rewinding the film; then, press the rewind button above the lens housing to engage the rewind clutch for faster rewinding.

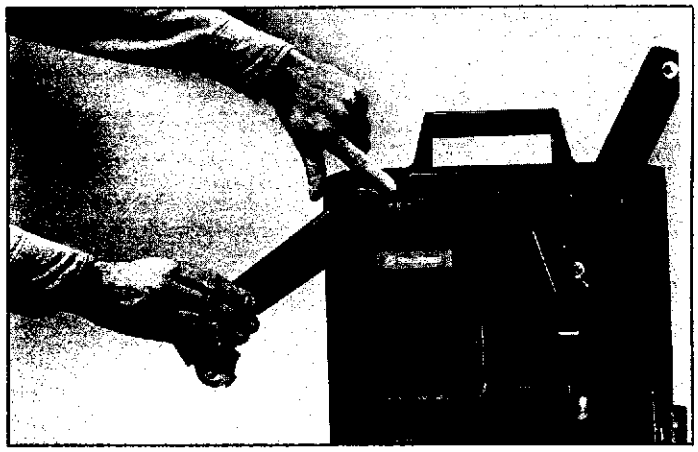
Move the autoload lever forward during rewind to close the douser and prevent light from projecting on the screen. After the film is completely rewound, press the Stop button.

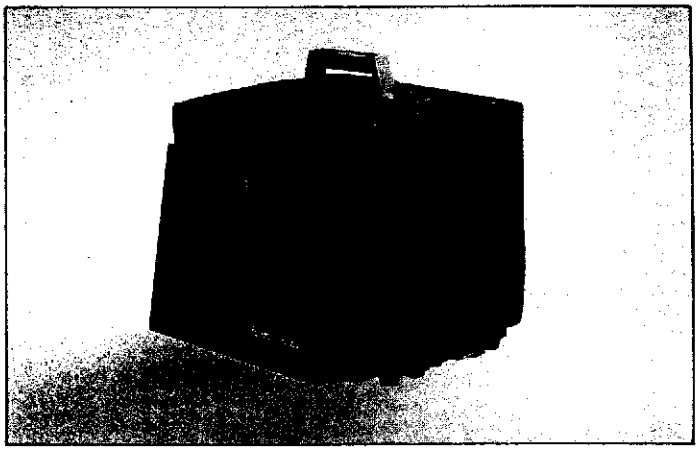




TAKING DOWN THE PROJECTOR

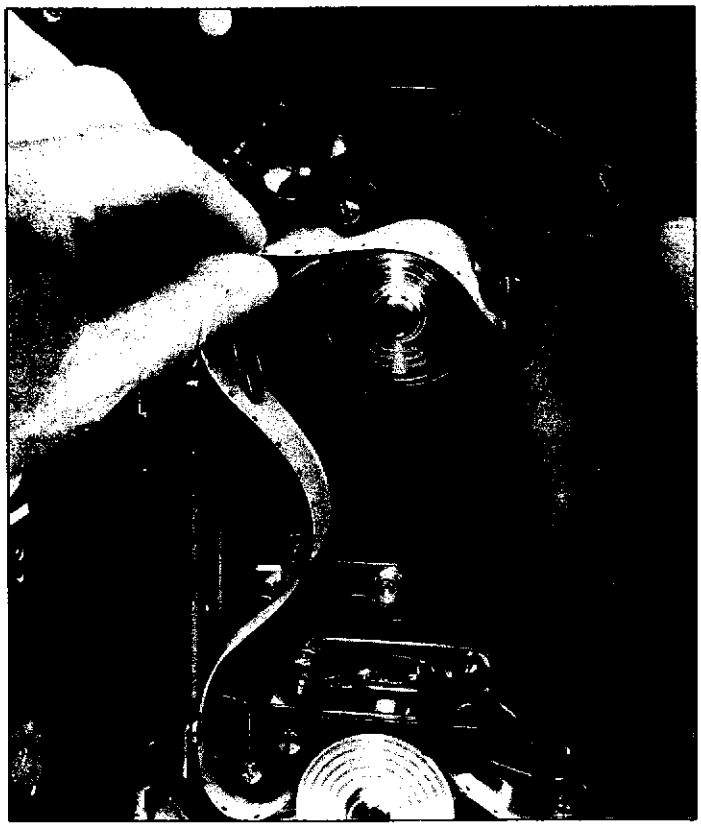
To take down the projector after use or for storage, first disconnect all power and interconnection cables. Then, remove the reels, press in on the reel arm release buttons, and fold in the reel arms. Wind the speaker cord on the storage pins in the speaker cover housing. Store any remaining cables and the reels in an appropriate place. Place the speaker cover on the projector and snap the two locking clamps on top of the projector firmly shut. Cover the projector with the vinyl dust cover.





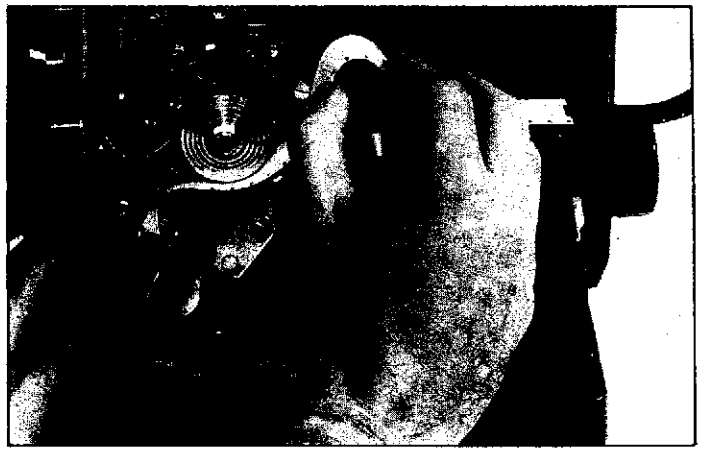
MANUAL UNTHREADING

To remove film in the middle of a reel, be certain threading mechanism door is open. Open hinged lens carriage and all three sprocket guards. Loosen exciter lamp cover screw and remove exciter lamp cover *(for easier unthreading procedure).* Turn feed reel clockwise to provide slack in film. Grasp film with right hand close to black roller and ease film out from under roller.



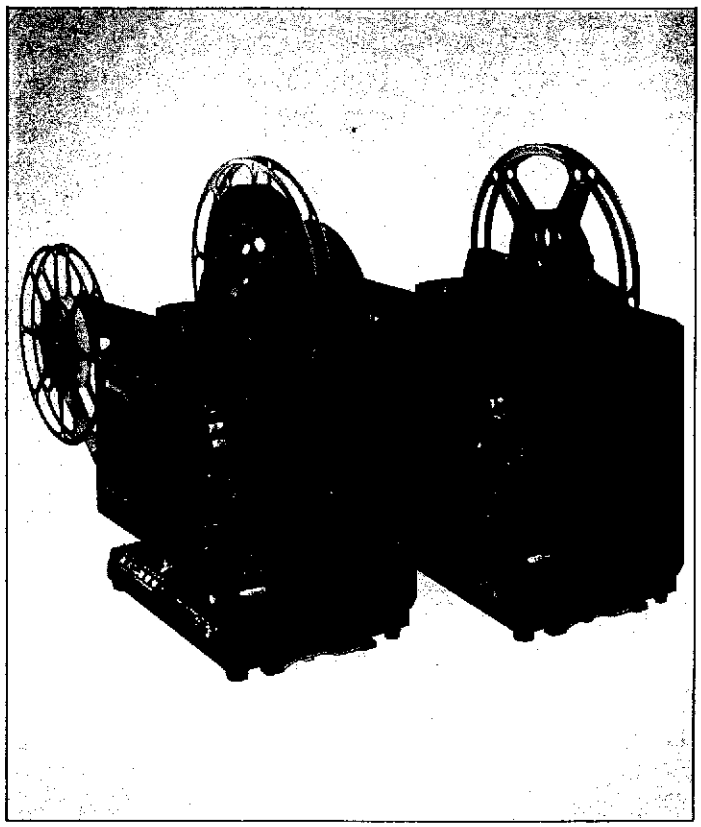
MANUAL UNTHREADING (CONT'D)

Hold film snug against first sprocket guard roller with right hand. Grasp film behind sprocket with left hand and slide film off of top sprocket. Grasp film under loop restorer roller with left hand and slide off of top of lower sprocket. Continue to ease film from under the stabilizing roller and off the sound drum. Hold film with the left hand at the rear of the lower sprocket and with the right hand, ease the film off the sprocket. Slide the film from the casting base and unthread the snubber roller. Leaving the reels on the reel arms, proceed with rewinding as described on Page 13.



TANDEM OPERATION

To show multiple reels without interruption, two Model 1568 projectors can be operated in tandem. Changeover of the projected image and sound is accomplished automatically by pressing the changeover switch located near the front of the projector base. When the switch is pressed, projection and sound will be activated only from the machine on which the switch is pressed.



SETTING UP FOR TANDEM OPERATION

Special set-up consideration should be given when you are planning to use two projectors in tandem for a continuous, professional showing. Both projectors should be lined up on the screen as closely as possible to reduce any shift in image when changing from one projector to the other. Follow this procedure:

1. Plug the power cord of each unit into an appropriate 120VAC grounding type wall outlet. If adapters must be used, be sure the grounding terminals of each adapter are properly secured to the screw on the wall outlet for proper grounding. Have a trained electrician install the adapter and check the outlet wiring to be sure there is no shock hazard. Faulty wiring may cause damage to the equipment and personal injury to the operator.

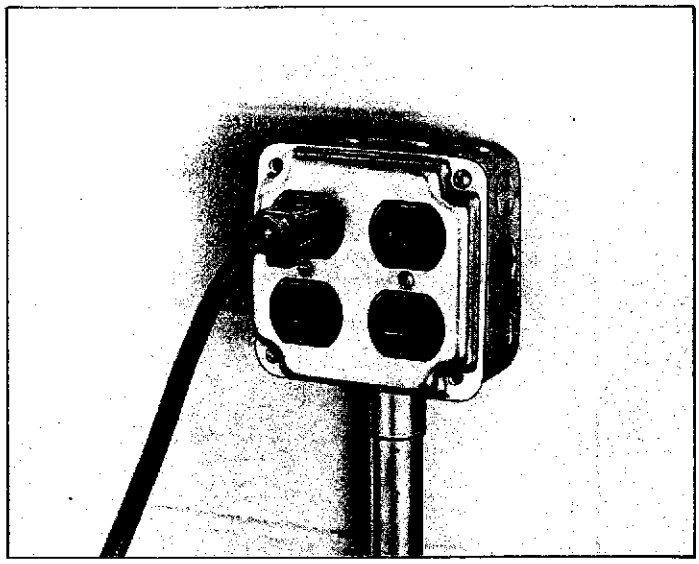
NOTE:

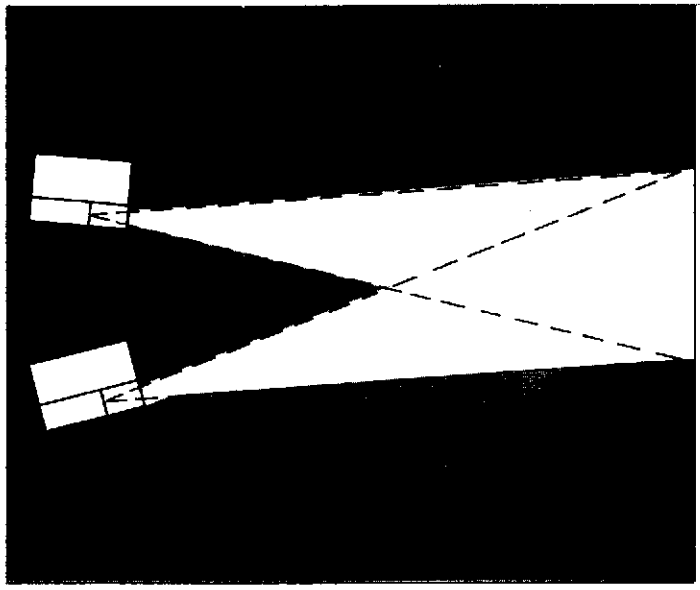
Fused electrical service to the wall outlet must be adequate to provide 8 amps current to **each** projector. Since two projectors will operate together, 20 amps service must be available.

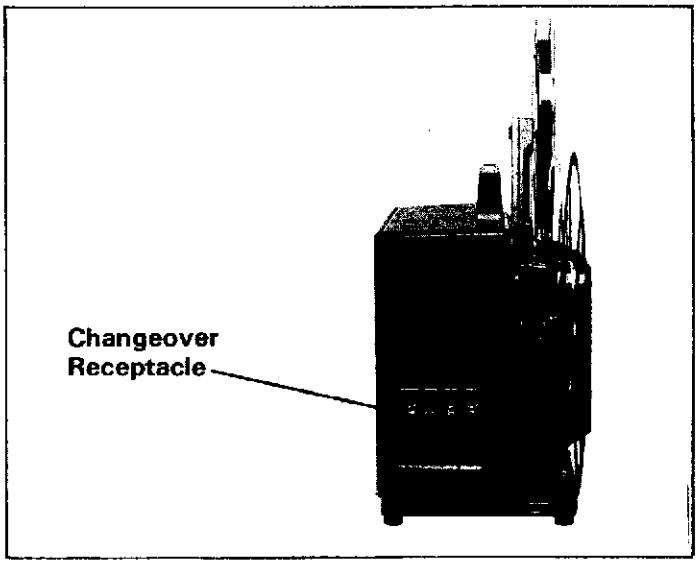
2. Warm up the projectors and press the Lamp On switch of each. Press the Forward project button on one projector; light from that projector will appear on the screen. Center the light and use the tilt knob if necessary. Press the Forward project button on the second projector and align the projected image with the first.

3. Interconnect the two projectors by plugging the changeover cable into the receptacles marked Changeover at the rear of the projectors. Press the "Changeover" button on either projector to douse the projected light on the other projector.

4. Proceed with threading the film and set up for projection. Remember, projection and sound will be activated only from the machine on which the button is pressed.







PROCEDURE FOR TANDEM OPERATION

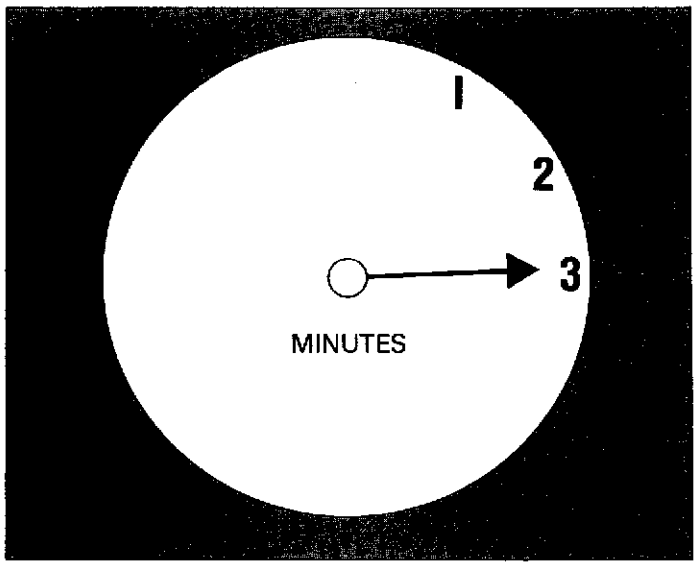
General procedure for tandem operation is the same as for single projection. Volume and tone controls on each projector should be set approximately at the same level and sound quality if projector speakers are used.

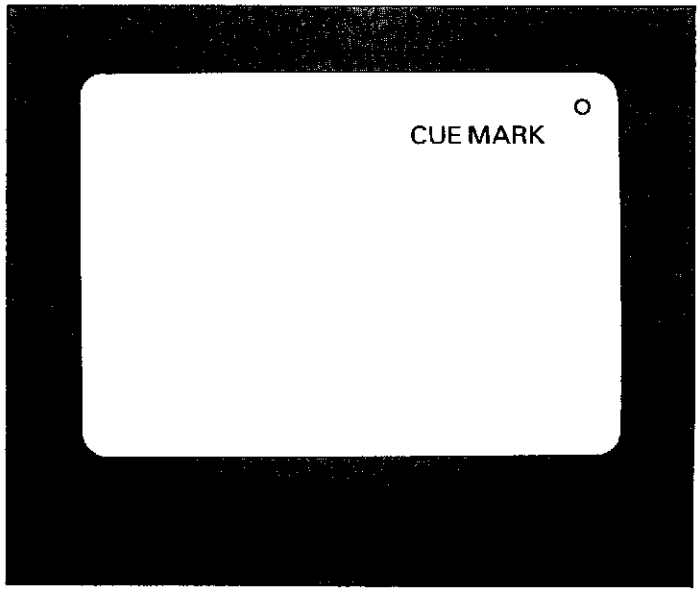
CAUTION:

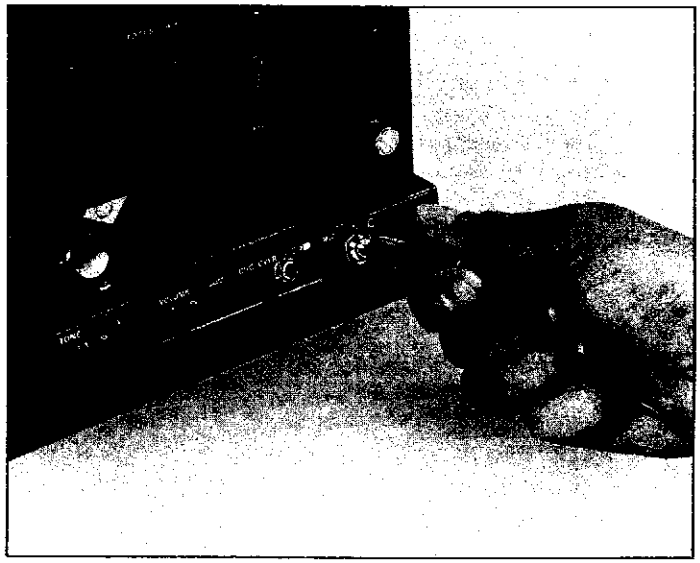
If an auxiliary amplifier is used, reduce the volume and tone controls on the projector to "0," and make all volume and tone adjustments on the auxiliary amplifier. About three minutes before the end of the first reel, press the "Lamp On" button on the second projector. (Be sure to allow approximately three minutes for the lamp to warm-up and come to full brilliance and correct color temperature.) As the film comes to the very end of the first reel watch for the changeover cue mark which appears for an instant in the upper right-hand corner of the screen. When it appears press the Forward project button on the second projector. Approximately six seconds after the first cue mark appears, a second cue mark will appear; on the second cue, press the changeover button on the second projector. Pressing the changeover button automatically opens the douser and transfers the sound to the projector on which the changeover button has been pressed. Remote changeover can be effected with the remote control module. See Page 18. If additional film is to be shown, rewind the film on the first projector, thread up with the next reel, and then follow the described procedure for lamp warm-up and cue marks. To conserve lamp life, turn off the lamp if the projector will not be in use within 30 minutes.

CAUTION:

When using a microphone in a system wired for tandem operation, be sure to plug the microphone into the projector that is running. Plugging the microphone into a projector changes control of the system over to that projector. Changeover cannot be effected to a second projector if the microphone is plugged into the other projector.





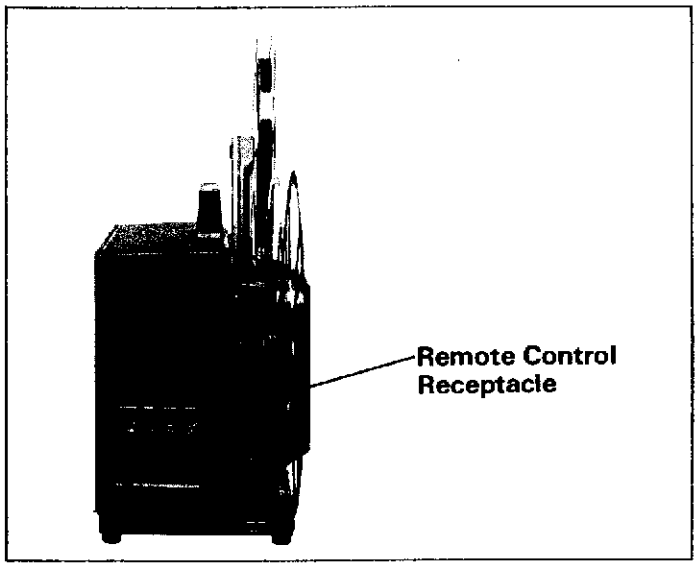


REMOTE CONTROL

Various operating functions of the projector may be controlled from either the built-in buttons or from the accessory remote control module. To use the remote control accessory, connect it to the control panel at the rear of the projector.

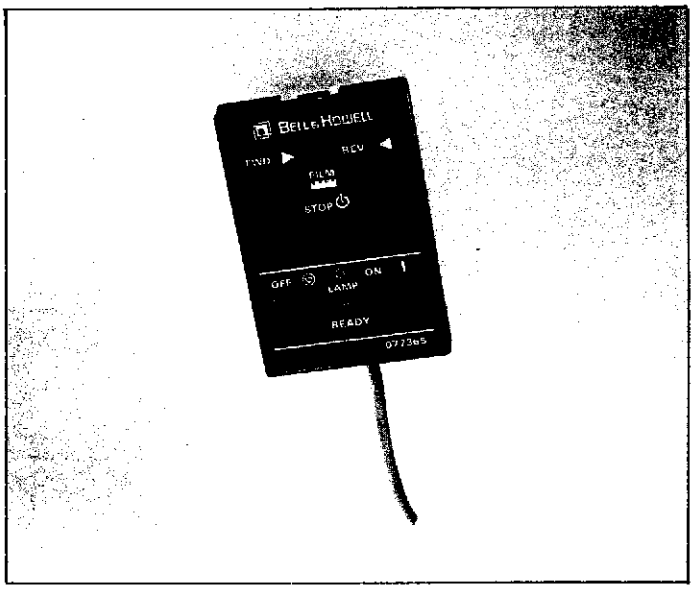
Controls on the module include Lamp On, Lamp Off, Film Forward, Stop, and Film Reverse buttons plus a Lamp Ready indicator.

Two remote modules may be used to perform remote changeover when two projectors are used in tandem. Connect a remote module to each projector. Place the first reel on one projector and the second reel on the other projector and "cue up" for changeover, stopping at this point. During the showing, about three minutes before changeover, press the remote module "Lamp On" button on the **second projector.** When the first cue mark appears on the screen, press the remote module Forward button on the **second projector.** On the second cue, press the remote module Stop button on the **first projector** for automatic changeover.



AUTOMATIC LOOP RESTORER

Torn perforations or bad splices will sometimes cause a loss of the lower loop below the film gate. The automatic loop restorer will reset the lower loop so that projection can continue without interruption. Loop restoration in the reverse projection mode is not possible. If the projector must be unthreaded manually, see instructions on Pages 14 and 15.

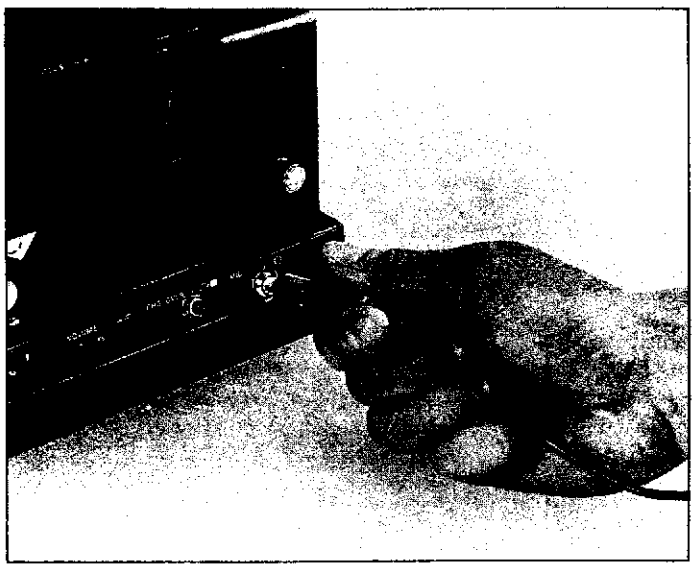


PUBLIC ADDRESS SYSTEM

An accessory microphone may be used with your projector for making announcements any time the projector is operative. Plug the microphone into the jack provided and adjust the volume and tone controls. When a microphone is plugged into the jack, the sound track on the film is silenced.

CAUTION:

When using a microphone in a system wired for tandem operation, be sure to plug the microphone into the projector that is running. Plugging the microphone into a projector changes the control of the system over to that projector. Changeover cannot be effected to a second projector if the microphone is plugged into the other projector.



GENERAL DESCRIPTION

Your Bell & Howell projector has been designed to interface with the most advanced state of the art multimedia programmers. A special connector provides easy access to projector control functions plus motor speed control as well. These function controls, available through the Multimedia Connector, are provided primarily for the professional using sophisticated programming devices with capability for advanced techniques. For the casual multimedia user, a simple but effective means of controlling the projector is described at the close of this section.

FUNCTIONAL DESCRIPTION

A. Functions
1. Motor Drive System
   a. Forward
   b. Stop
   c. Reverse
2. Projection Illumination System
   a. Lamp On
   b. Lamp Off
   c. Lamp Mode Indicator
3. Douser Control
4. Projection Speed Tachometer
5. Analog Motor Speed Control
6. Other Pin Functions

B. Description
1. One receptacle pin is dedicated to the motor drive system.

   Application of positive portion of the control signal will cause the motor to go into forward projection mode. Application of the negative going portion of the control signal will cause the motor to go into reverse projection mode. D.C. levels may also be used to cause the above mode changes. (See specification section.)

   Application of the entire control waveform to this pin will cause the motor drive system to stop.

   It should be noted that instantaneous reponse to any of the above signals (levels) is not to be expected. There are built-in noise rejection timing circuits and system inertial components which delay reaction to the control signals. (See specification section.)

2. One receptacle pin is dedicated to the projection illumination system.

   Application of the positive part of the control signal will cause the projection lamp to extinguish.

   Application of the negative part of the control signal will cause the projection lamp to illuminate. Shortly after lamp ignition, the projection lamp light output will be sensed and the D.C. level on the projection illumination system pin will change to indicate the presence of this light output.

   D.C. levels may also be used to cause the above mode changes. (See specification section.)

3. One receptacle pin is dedicated to controlling the projection system dousing shutter.

   Application of low impedance between this pin and the pin designated as the projector frame ground will cause the dousing shutter to close. (See specification section.)

4. Two pins of the receptacle are dedicated to use as projection speed tachometer nodes. One of these pins is intended to be supplied from a direct current source by the user. The other pin will output the supplied current in a modulated form which will increase from a low value to a high value and return to a low value again one time per each transported film frame, provided the film is presented to the transport mechanism with no more than two succeeding sprocket holes missing. (See specification section.)

5. One pin of the receptacle is dedicated to the projector analog motor speed control.

   Application of voltages (D.C.) to this pin will cause the projector transport system to run faster or slower proportionally to the voltage applied. Approximately $\pm$ 8 percent speed variation can be obtained by the user for the purpose of synchronizing the projector with another device. (See specification section.)

6. Other pin functions include: One pin used to output the projector control signal (square wave) to user equipment.

   One pin used as projector frame ground reference. (See specification section.)

THE RECEPTACLE

RECEPTACLE TYPE: TRW/CINCH TYPE
S308-AB

TO BE USED WITH: TRW/CINCH PLUG
TYPE P308-CCT

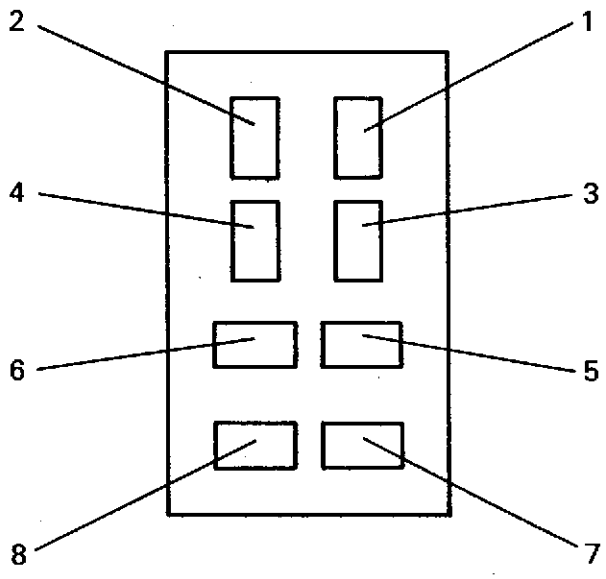
PIN-OUT AND NUMBERING:

VIEWED FROM OUTSIDE
PROJECTOR
(AS USER SEES RECEPTACLE)

PIN 1 = PHOTO TRANSISTOR COLLECTOR (TACHOMETER)
PIN 2 = ANALOG MOTOR SPEED CONTROL INPUT
PIN 3 = PHOTO TRANSISTOR EMITTER (TACHOMETER)
PIN 4 = PROJECTOR FRAME GROUND
PIN 5 = DOUSING SHUTTER CONTROL
PIN 6 = PROJECTOR MOTOR DRIVE SYSTEM CONTROL
PIN 7 = CONTROL SIGNAL OUTPUT (SQUARE WAVE)
PIN 8 = PROJECTOR ILLUMINATION SYSTEM CONTROL

RECEPTACLE LOCATION:

ON REAR PANEL OF PROJECTOR CASE IMMEDIATELY UNDER LINE CORD RECEPTACLE/FUSE PANEL.



SPECIFICATIONS

Pins 1 and 3: Photo-Transistor

A. Becomes low impedance during pull-down of film frame in projection gate.
B. Low impedance (conduction) state: Outputs 2.0 milliamperes minimum with 10 volts Vce (open circuit) applied; recommended load resistance 3300 ohms.
C. High impedance state: Outputs .01 milliampere maximum with 10 volts Vce (open circuit) applied.
D. Rate of transitions: Approximately 500 microseconds rise and fall times at projection speed. Longer at lower speeds.
E. A protection diode is included across this device. Reverse biasing is prohibited. Positive voltage is applied to Pin 1 for proper photo-transistor operation.

Pin 2: Analog Motor Speed Control Input Pin

A. A D.C. bias of approximately 7.4 volts D.C. will be present on the pin.
B. Under no conditions should this pin be subjected to voltages above + 11 VDC or below + 4 VDC.
C. A voltage of + 9.5 volts D.C. applied to this pin will cause the projector to run approximately 8 percent fast (26 frames per second).
D. A voltage of + 6.0 volts D.C. applied to this pin will cause the projector to run approximately 8 percent slow (22 frames per second).
E. A time lag of approximately five frames will be observed while correcting the projector speed by 8 percent. This assumes instantaneous changes in voltage at Pin 2.

Pin 4: Projector Frame Ground

A. This is reference Pin and current return for all other projector referenced pins.
B. This pin is conductively connected to the A.C. line cord ground.
C. Source/link currents appearing on this pin shall be limited to a maximum of 1.0 ampere peak.

Pin 5: Dousing Shutter Control

A. Dousing shutter can be activated by conductively connecting Pin 5 to Pin 4 (frame ground).
B. Open circuit voltage at Pin 5 is approximately 37VDC.
C. Closed circuit current is initially 650 milliamperes decaying to 200 milliamperes steady state about 50 milliseconds after closing of circuit with resistance of less than 3 ohms.

SPECIFICATIONS (CONT'D)

D. Device used to pull-down and maintain Pin 5 in "ON" state must not be allowed to drop more than 1.0 VDC in steady state condition. (1.5 VDC maximum in transition state)
E. Semiconductor devices used to activate Pin 5 will be protected (within the projector) from inductive effects by the presence of a diode shunting the dousing shutter solenoid coil. (See equivalent circuit section.)

Pin 6: Motor Drive System Control Pin
A. Static D.C. level on Pin 6 is + 6.0 volts D.C. (± 0.4 volts D.C.).
B. Apply top portion of control signal (+ 6 volts to + 11 volts) in order to produce forward mode. This signal must be applied for 0.35 seconds minimum.
C. As an alternate, a D.C. level greater than + 7.5 volts D.C. (but less than + 12 volts D.C.) applied to Pin 6 will produce the forward mode.
D. Apply the bottom portion (0 VDC to + 6 volts D.C.) of the control signal to accomplish the reverse function. This signal must be applied for at least 0.35 seconds for the mode change.
E. As an alternate, a D.C. level of less than + 4.5 volts, (but greater than 0 VDC) may be applied to Pin 6 in order to accomplish the reverse function.
F. By applying the entire 11 V.P-P control signal to Pin 6 the motor drive system is given a stop command. This command must be applied for a minimum of 0.35 seconds.
G. With input signals removed, the static D.C. level on Pin 6 is always ± 6.0 VDC (± 0.4 VDC). See equivalent circuit section.

Pin 7: Control Signal Output
A. Amplitude: Approximately 11 volts peak-to-peak.
B. Frequency: 3 to 5 kilohertz
C. Waveform: Nearly squarewave, duty cycle is 51 percent.
D. Use: May be used to supply return signals for activation of motor drive and projector illumination control pins.
E. Caution: Do not attempt to use more than 10 milliamperes peak-to-peak from this source.

Pin 8: Illumination System Control Pin
A. Has static level of 6 volts D.C. bias (± 0.4 volts D.C.)
B. Apply top portion of control signal (+ 6 to + 11 volts) for extinguishing projection lamp. This signal *MUST* be applied for a minimum of 3.0 seconds.
C. A D.C. level greater than + 7.5 volts (but less than + 12 volts D.C.) may be used as an alternate to accomplish the above mentioned mode change.
D. Apply bottom portion of control signal (0 to + 6 volts) for illuminating lamp. This signal must be applied for a minumum of 0.35 seconds.
E. A D.C. level of less than + 4.5 volts (but greater than 0 volts D.C.) may be used as an alternate to accomplish the "Lamp-On" mode.
F. After the projection lamp is turned on, the static voltage level appearing on Pin 8 will change from + 6 volts D.C. to 1.3 volts D.C. (± 0.3 volts). This gives the user an indication that the lamp is operating.
G. In order to turn the lamp off, it will be necessary to "pull-up" a load resistance of approximately 90 ohms to the + 7.5 volt D.C. level. (See equivalent circuit section.)

CAUTION:
If projector is operated at less than 22 frames per second with the douser de-activated (open) your film may be damaged from excessive overheating. Avoid this operating condition.

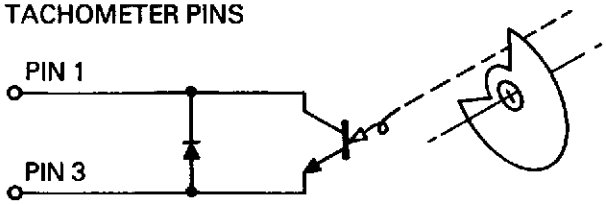
PROJECTOR INTERNAL CIRCUITRY

SCHEMATICS

EQUIVALENT CIRCUITS

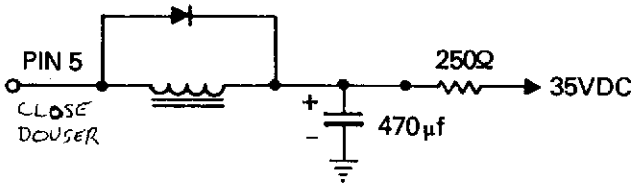
No. 1

PROJECTION SPEED TACHOMETER PINS



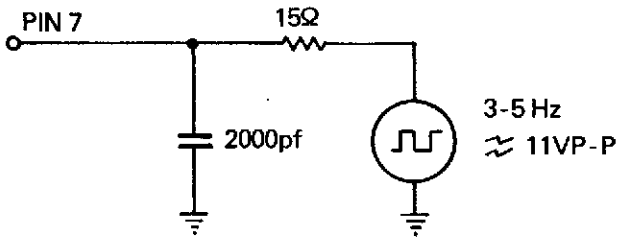
No. 2

DOUSING SHUTTER CONTROL PIN



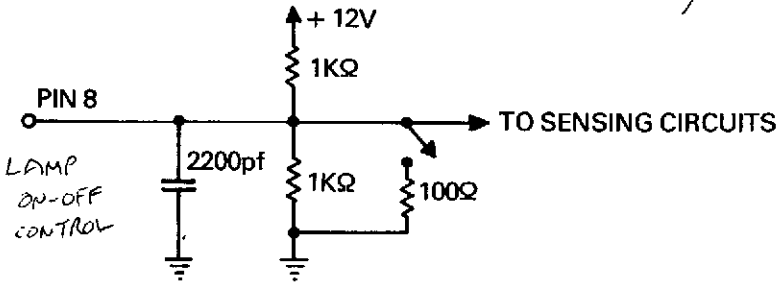
No. 3

SQUARE WAVE CONTROL SIGNAL SOURCE PIN



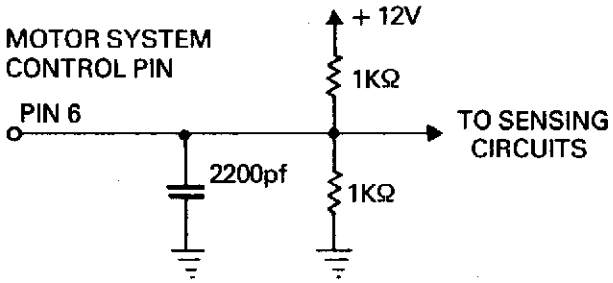
No. 4

ILLUMINATION SYSTEM CONTROL PIN



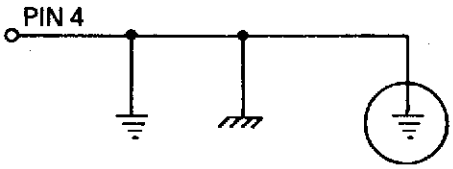
No. 5

MOTOR SYSTEM CONTROL PIN



No. 6

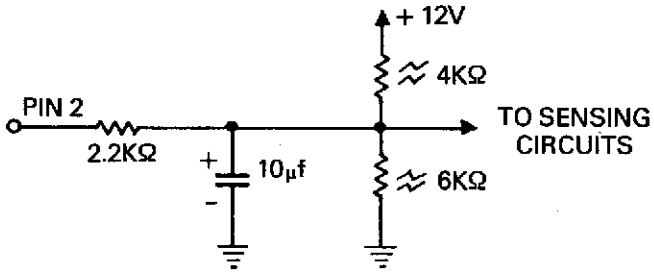
PROJECTOR CHASSIS (FRAME GROUND) PIN



CAUTION:
THIS PIN IS CONNECTED TO PROJECTOR LINE CORD SAFETY GROUND

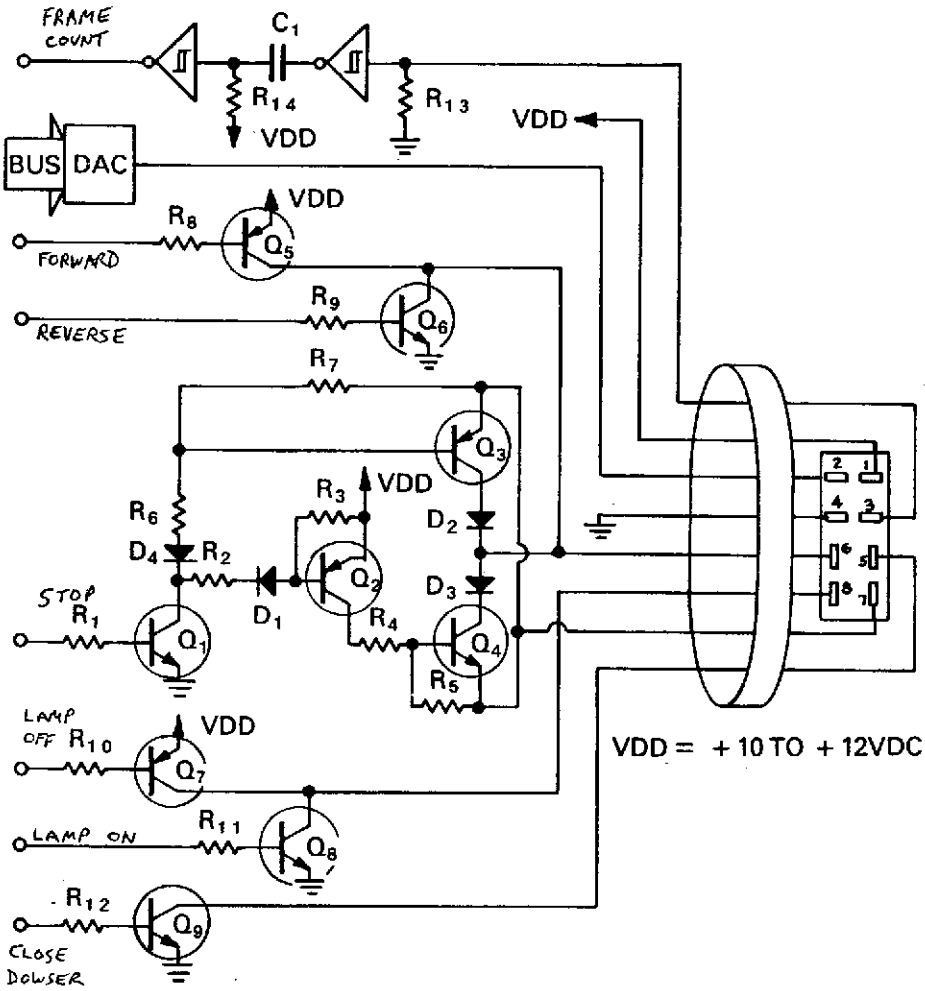
No. 7

ANALOG MOTOR SPEED CONTROL PIN



SCHEMATICS (CONT'D)

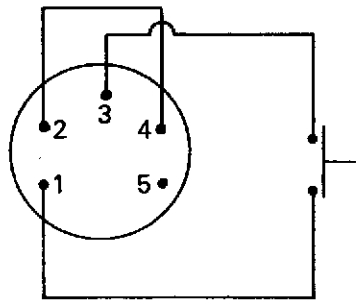
RECOMMENDED INTERFACE



R_1 = 3300Ω
R_2 = 3300Ω
R_3 = 2200Ω
R_4 = 3300Ω
R_5 = 2200Ω
R_6 = 3300Ω
R_7 = 2200Ω
R_8 = 3300Ω
R_9 = 3300Ω
R_{10} = 3300Ω
R_{11} = 3300Ω
R_{12} = 3300Ω
R_{13} = 3300Ω
R_{14} = 33KΩ
C_1 = .001 f
D_1 -D_4 = 1N914
Q_2, Q_3, Q_5, Q_7 = MPS6534
Q_1, Q_4, Q_6, Q_8 = MPS6531
Q_9 = D40K2 (GE)

SIMPLIFIED MULTIMEDIA

The changeover jack at the back of the projector may be used to remotely control the built-in douser for multimedia systems. Under these conditions the film will continue to transport. Additionally, the remote jack at the back of the projector may be used to remotely stop the film transport mechanism which will also close the douser and shut off light to the screen.



5 PIN DIN PLUG
(CHANGEOVER JACK)

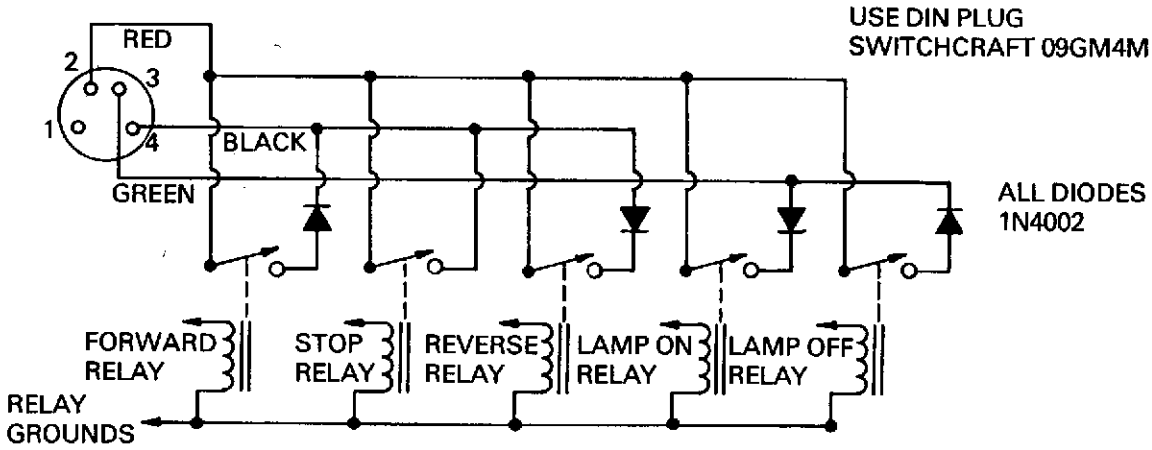
USE 5 PIN DIN PLUG
SWITCHCRAFT 12GM5M.
WIRE AS SHOWN.

CLOSE SWITCH TO
CLOSE DOUSER

SCHEMATICS (CONT'D)

OTHER FUNCTIONS
THROUGH REMOTE JACK

The circuit below may be used to interface your projector into a multimedia system to provide a variety of functions. Relays must be provided with the proper actuation time for proper projector operation. A delay generator, see below, TYPICAL PROGRAMMER, may be used with this system, also.



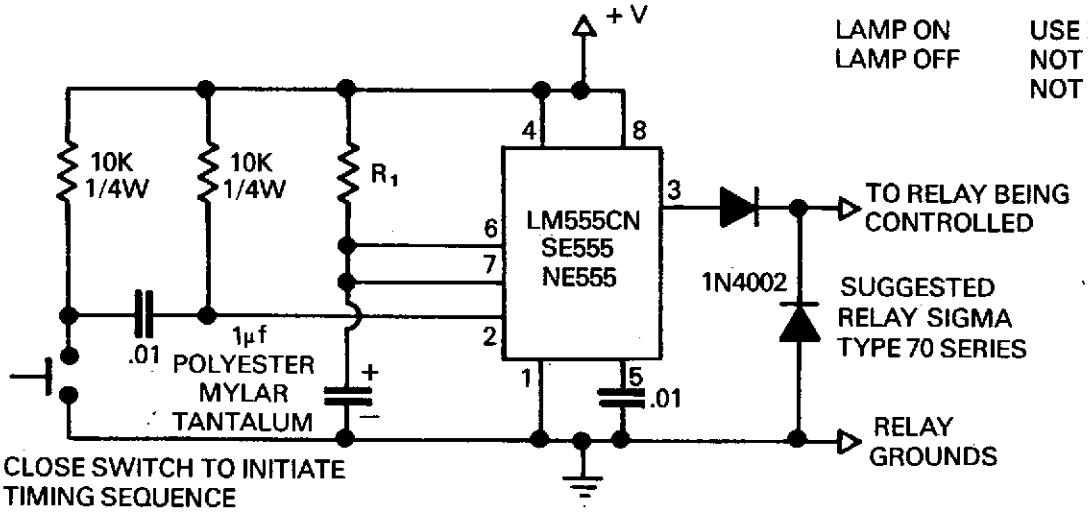
TYPICAL PROGRAMMER

A delay generator is required when using the remote jack to control various functions. For Forward, Reverse, Stop, and Lamp On, relay closure time must be not less than 350 milliseconds nor more than 1 second. For Lamp Off, relay closure time must be not less than 3 seconds nor more than 5 seconds. Use one of the circuits described below for each function you wish to control, with the appropriate resistor value for the function.

USE ONE OF THESE CIRCUITS FOR EACH FUNCTION YOU WISH TO CONTROL. USE APPROPRIATE VALUE FOR R1.

RECOMMENDED TIMING FOR RELAYS:

FORWARD REVERSE STOP	USE RELAY CLOSURE TIME OF NOT LESS THAN 350 MILLISECONDS: NOT MORE THAN 1 SECOND.
LAMP ON LAMP OFF	USE RELAY CLOSURE TIME OF NOT LESS THAN 3 SECONDS: NOT MORE THAN 5 SECONDS.



R_1 = 330K OHMS ± 5% FOR
FORWARD
REVERSE
STOP

R_1 = 3.3 MEGOHMS ± 5% FOR
LAMP OFF

MAINTENANCE AND CLEANING

Your Bell & Howell projector has been designed and engineered for long, trouble-free service with a minimum of maintenance. Factory lubrication is built-in; you'll never need to oil this projector. Permanently lubricated bearings mean extended service and longer life. Many parts which normally wear are adjustable, eliminating the need for frequent replacement.

Periodic maintenance is required, including cleaning and occasional replacement of some parts. Instructions for simple procedures follow. We recommend that you seek factory approved service from your Bell & Howell Approved Service Station periodically to assure that your equipment remains in first-class operating condition.

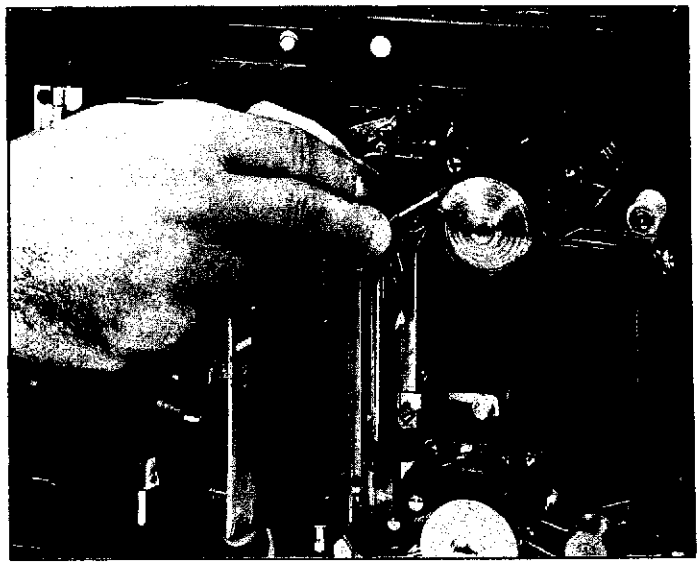
LAMP POWER SUPPLY

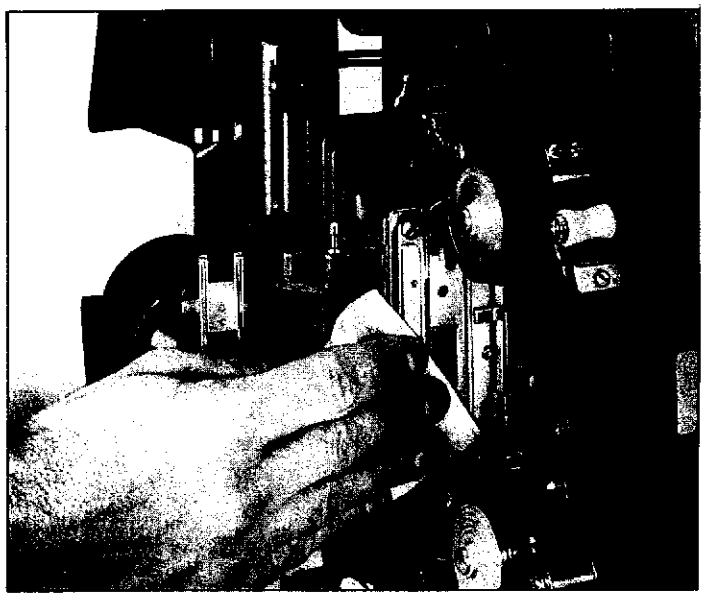
CAUTION:

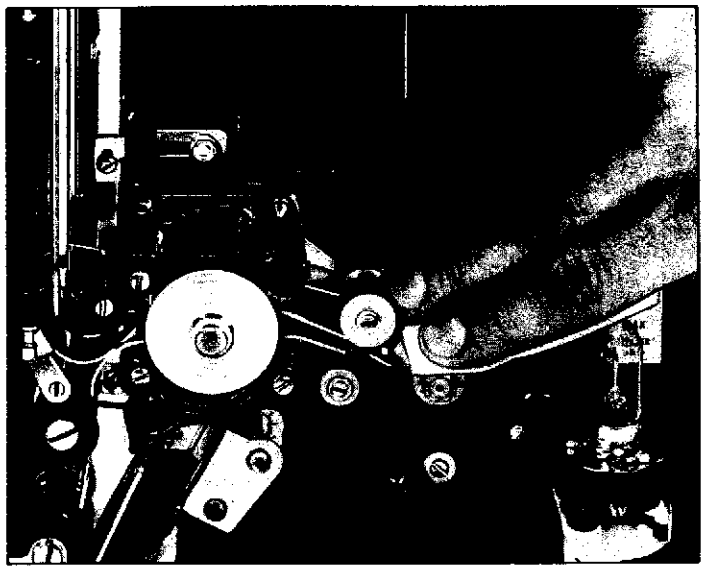
Do not attempt to remove the top or metal back cover of the projector; no internal parts are serviceable without specialized equipment and tools. In addition, the high voltage present is hazardous, and especially dangerous to untrained personnel.

CLEANING THE FILM PATH

To prevent damage to the film, all surfaces that contact the film must be cleaned frequently. To reach the film path, open the Lamp House Cover. Wipe all threading guides with a soft cloth or brush which has been moistened with any naphtha based agent such as lighter fluid. Remove the exciter lamp cover (see section on replacement of exciter lamp) to clean the sound drum, and the film guide that is part of the exciter lamp cover. Gently clean both sound drum stabilizing rollers. Remove any loose particles that may have become lodged in the film path.







CLEANING THE APERTURE AND PRESSURE PLATES

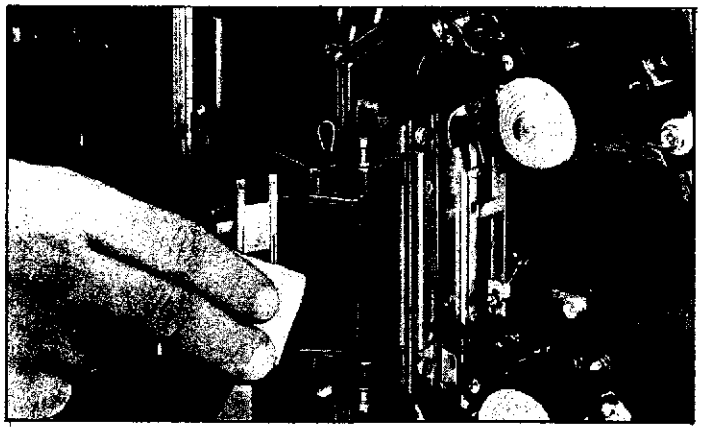
Swing open the lens carriage by pulling outward on the lens barrel. Gently wipe the aperture and the pressure plate with a cloth moistened with lighter fluid or naphtha based solvent to remove accumulated dirt or emulsion. Also clean the aperture side tension rail and the aperture opening. Be sure to press in on the side tension rail and clean the area of the aperture plate behind the side tension rail. Gently swing back the lens carriage into position; be sure the pressure plate seats properly. Snap the lens carriage closed.

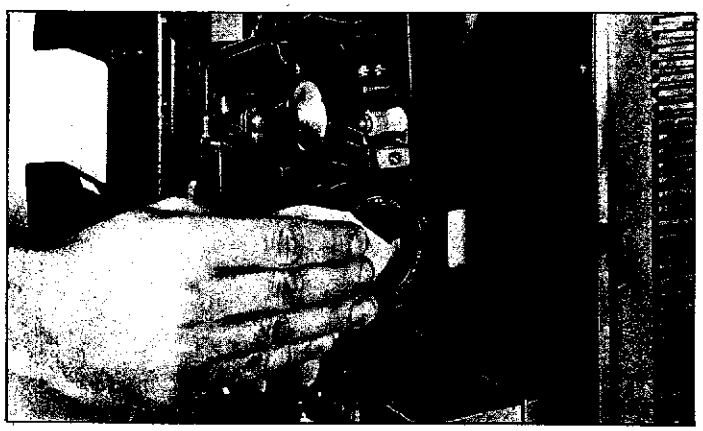
CLEANING THE LENS

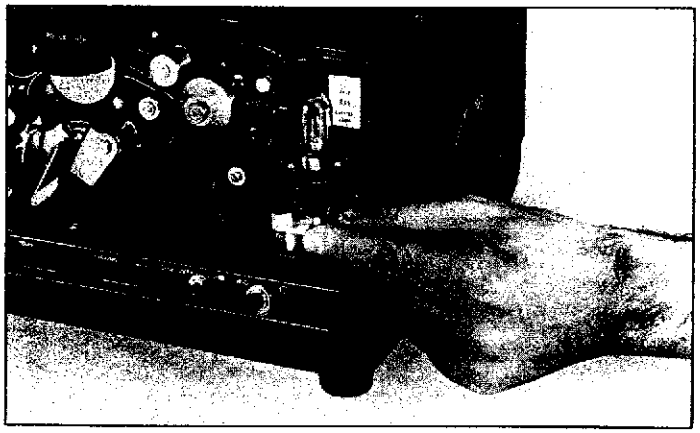
Swing open the lens carriage. The lens need not be removed from the lens barrel for cleaning. Use a lens tissue or soft cloth moistened with lens cleaner to wipe dust and fingerprints off front and rear lens elements. After cleaning, close the lens carriage, as described above.

REPLACING THE EXCITER LAMP

Before attempting to replace the exciter lamp, be sure the main power switch is in the Off position. Loosen the thumb screw which holds the exciter lamp cover in place, pull the cover straight out without tilting to remove. Note the registration pins which align the cover. Swing the exciter lamp lock lever counterclockwise about 90° to release the lamp. Rotate the lamp until it can be lifted off the guide pins. Place the new lamp over the guide pins and rotate the lamp clockwise. Rotate the exciter lamp lock lever clockwise to lock the exciter lamp into position. Replace the exciter lamp cover; be sure to match the two registration pins to the holes to align the cover. When the cover is firmly seated in place, hold it securely and tighten the thumb screw.

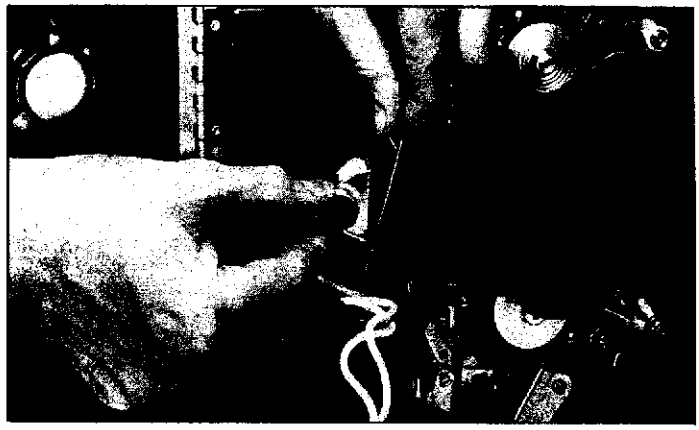


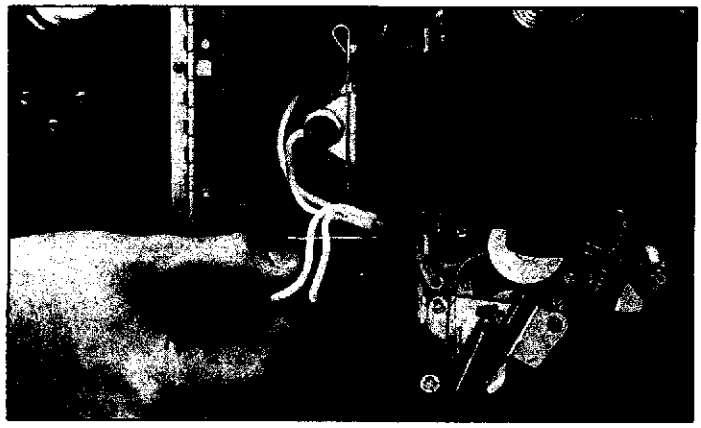


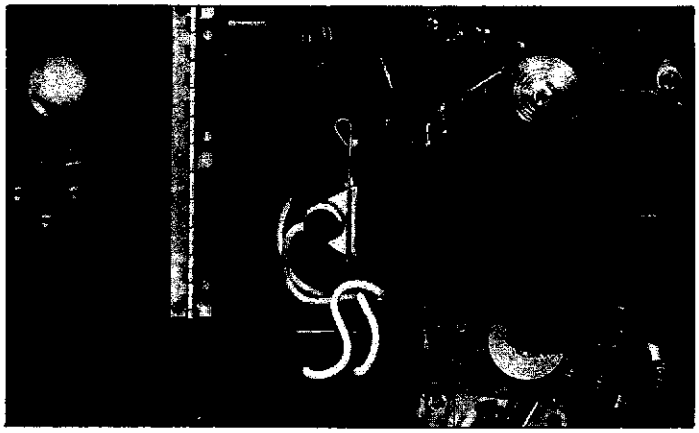


REPLACING THE PROJECTION LAMP

When changing the projection lamp, allow the equipment to cool thoroughly before handling the lamp. Be sure to unplug the power cord from the wall outlet before attempting to replace the projection lamp. Open the lamp house cover door. Unplug the lamp plug from the socket. Press in on the top of the lamp retaining spring clip to unlock, and then swing the clip around to release the tension on the lamp. Remove the lamp by hand (if the lamp is still warm to the touch, use a cloth or wear a glove). Place the new lamp in position, with the longer ceramic insulator pointing inward and the wires hanging down toward the socket. Handle the lamp only by the outer reflector shell. Be certain it is seated properly; it fits snugly in place in exact alignment with the projector housing. Apply pressure on the lamp with the retaining spring clip and lock the top of the clip in place to secure the lamp in position. Insert the lamp plug into the socket, note that the plug and socket are polarized and will fit only one way. Route the wires as shown in the bottom photograph. Lamp replacement information is given inside the lamp house cover. Close the door after lamp replacement.







TROUBLE SHOOTING

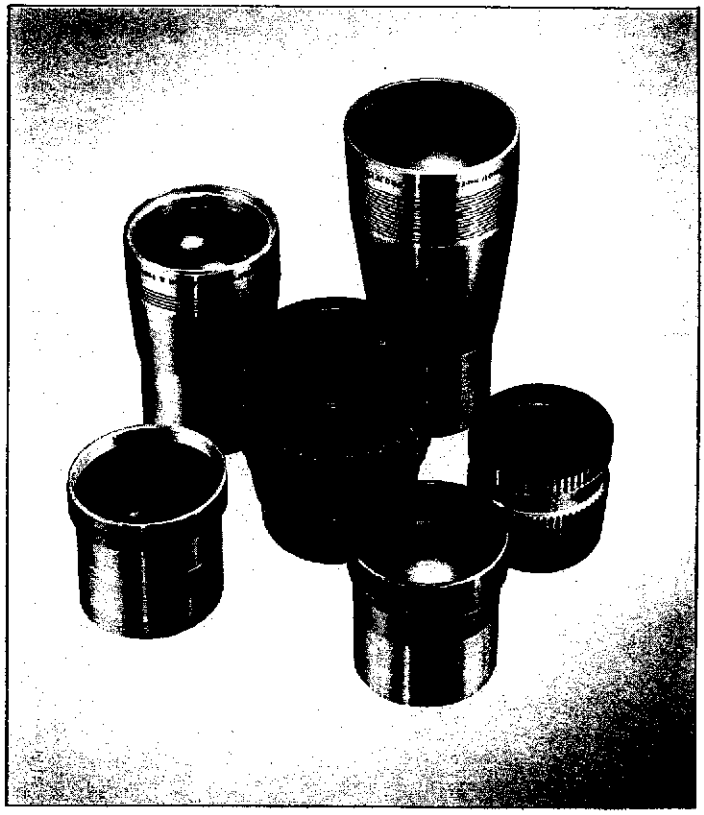
The following information includes a variety of symptoms, a test which will pinpoint the nature of the trouble, the cause of the trouble, and a remedy. Many of the symptoms described may not ever be encountered during the life of the projector; this information is provided as a guide should the condition ever exist.

SYMPTOM	TEST	CAUSE	REMEDY
Projector completely inoperative (no blower, no exciter lamp).	Is main power cord plugged in? Is main power switch in ON position? Is 2 amp (film) fuse burned out?	If yes to all tests, internal power supply is not working.	Unplug main power cord and replace 2 amp fuse. If new fuse burns out, return projector to service station.
No film transport, but blower and exciter lamp operate.	Disconnect all cables from rear panel, except speaker. Press film forward or reverse button.	If operation resumes, look for defect in remote control module. If no film transport, internal control module is not working.	Return projector to service station.
No lamp operation (blower and exciter lamp operative).	Unplug main power cord. Open lamp house cover door and assure lamp plug is firmly plugged into the socket.	Plug is loose.	Reinsert plug into socket.
	Turn on main power switch. Press Lamp On button for one second. Listen for clicks.	If no clicks, power to lamp circuit incomplete.	Check 8 amp fuse; If fuse burned out, replace. Repeat test. If fuse burns out again, return projector to service station. If fuse not burned out but symptom continues, return projector to service station.
		If clicks at rate of about 2 per second, lamp is inoperative.	Replace lamp with known good lamp. Repeat test. If symptom continues, return projector to service station.
Sound fails during show	Check to see if exciter lamp is on.	If connection tight, amplifier load may be excessive or output shorted.	Remove plug from speaker jack. Push amplifier reset button. If exciter lights and stays on, check speaker wire for short circuits or excessive loading (less than 4 ohms). Decrease number of speakers on line to 2 or less. Check speaker cable for shorts or replace with known good cable.
		If no, bad exciter lamp.	Replace lamp.
		If yes, speaker cable or auxiliary amplifier cable may be loose.	Tighten connection.
		Internal failure.	Return projector to service station.
Lamp goes off during show.	Listen for blower noise; if no noise and exciter lamp is lit.	Blower failure.	Return projector to service station.
Lamp lights but color is violet or blue.	Wait 5 minutes for full warm-up. Is color still blue?	End of lamp life.	Replace projection lamp.

ACCESSORY LENSES

A variety of accessory projection lenses are available to give sharp, brilliant movies for every audience or location. Ranging from 1.5" (38mm) through 4" (100mm) in discrete lenses, and including Filmovara® Zoom, and Anamorphic attachments, virtually every screen size can be filled at projection distances up to 200 feet. It is best to have a lens of the right focal length to fill the screen. The focal length required will vary according to screen size and distance between the projector and screen. The projection table which follows will show the relationship between lens focal length, screen size, and distance. It is best to have the projector located as far toward the rear of the room as possible to avoid obstructing the view of your audience.

Due to the optical characteristics of the illumination system in this product, using a lens with a focal length of less than 1.5" (38mm) is not recommended as non-uniform illumination will result.

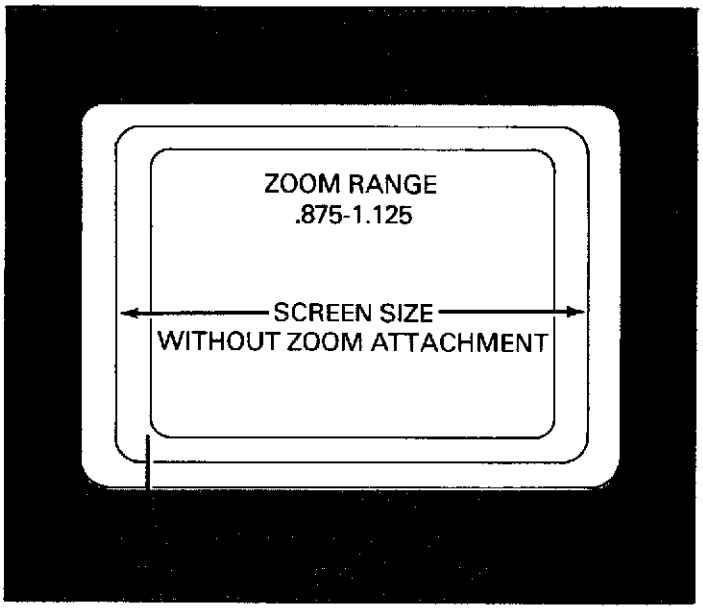


FILMOVARA® ZOOM

The Filmovara zoom attachment will enable you to project a variety of image sizes with a single lens. The Filmovara can be used with the following lenses:

1.5" (38mm) F/1.5
2" (50mm) F/1.2 (standard lens)
2.5" (64mm) F/1.5
3" (76mm) F/1.6

The magnification ratio ranges from .875 to 1.125. See the projection table for the span of screen size/distances you can achieve with this attachment. To use the Filmovara attachment, screw it onto the front of the projection lens. (It screws on with clockwise rotation). Revolve the rear, black, knurled collar of the attachment until your image fills the width of the screen at the selected projection distance. Clockwise rotation of the ring decreases picture size; counterclockwise rotation increases picture size. Sharpen the image with the projector focus knob as with any other lens.



ANAMORPHIC LENS (2X)

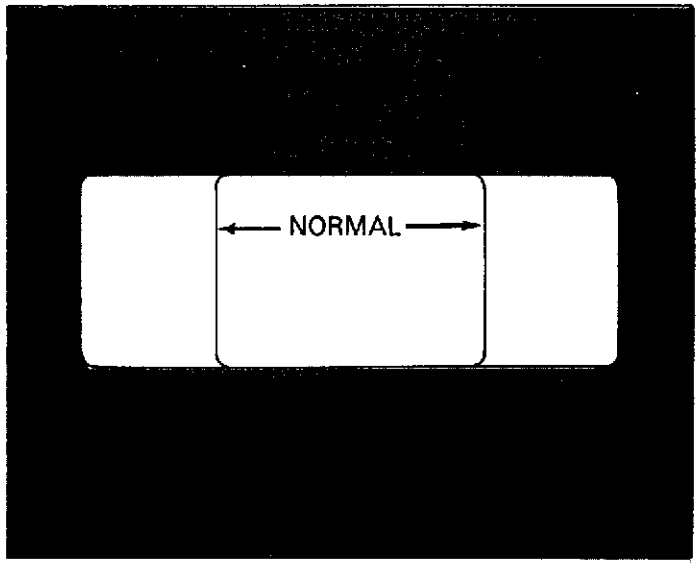
The Anamorphic lens will enable you to show wide-screen 16mm films. This lens doubles the width of the projected image without altering the height. This accessory fits the following lenses without an adapter:

1.5" (38mm) F/1.5
2" (50mm) F/1.2 (standard lens)
2.5" (64mm) F/1.5
3" (76mm) F/1.6

With an accessory adapter, the Anamorphic lens may be used with:

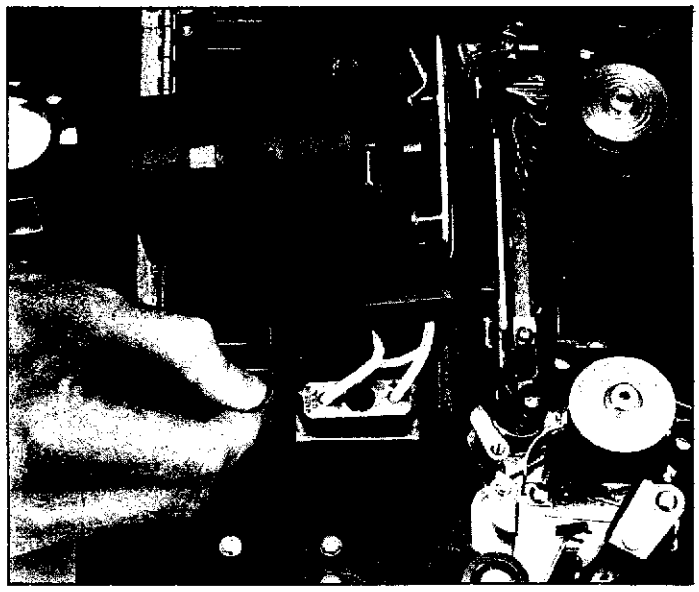
4" (100mm) F/1.6

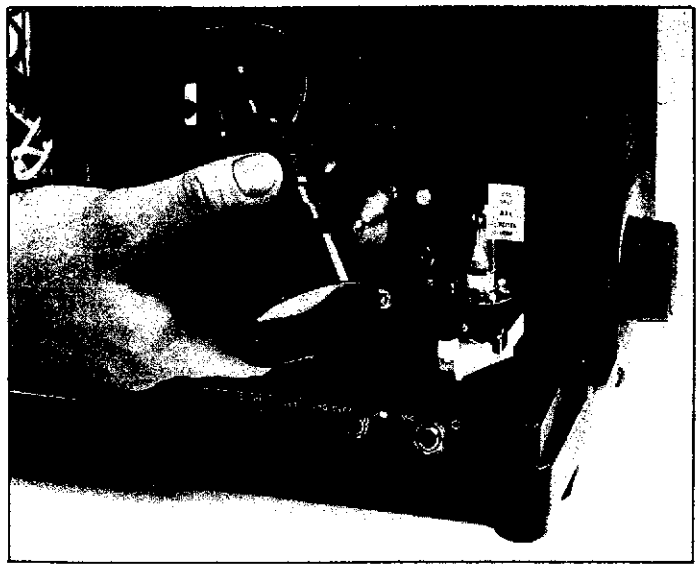
To use the Anamorphic lens, screw it into the front of the projection lens. (It screws on with clockwise rotation.) Position the projector to fill the width of the screen by rotating the lens assembly. Preset the projection distance on the Anamorphic lens barrel, then sharpen the image with the projector focus knob as with any other lens.



CHANGING LENSES

This projector is equipped with a lens locking system to discourage unauthorized removal of the projection lens. The locking system consists of an Allen screw and wrench supplied with the projector. The Allen screw is installed in the threaded hole on the underside of the lens housing. The screw should be installed when the lens is focused all the way in. To remove the lens, back out the screw with the wrench; turn the focus knob until the lens is racked out as far as it will go, then grasp the lens barrel and remove it from the housing. To replace lens, insert it into the housing, rack the focus knob to engage the lens, move the lens all the way in and retighten the Allen screw.



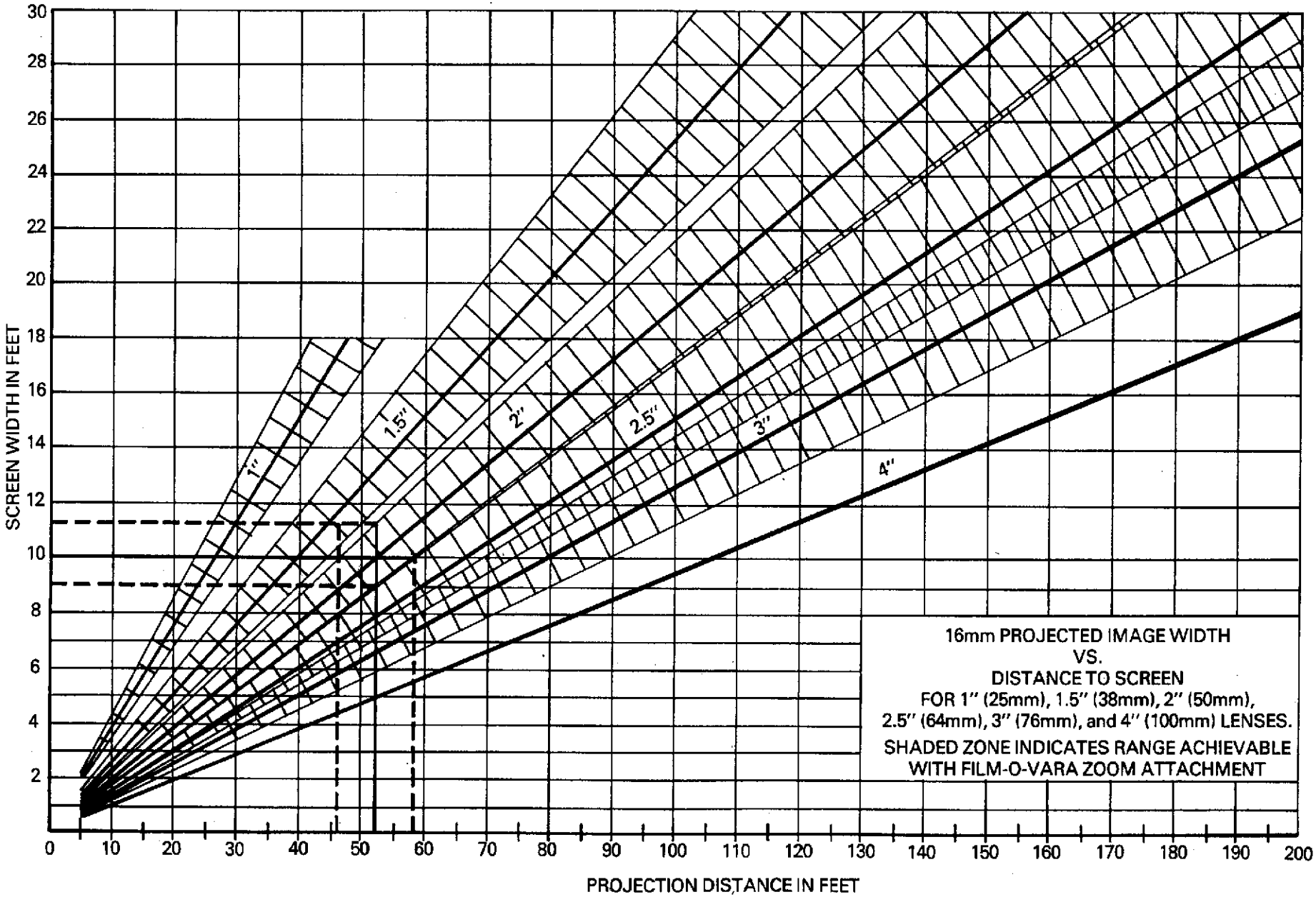


PROJECTION TABLE

This table shows the relationship between lens focal length, screen size and distance. It is based on the equation:

$$\text{Screen Width (feet)} = \frac{.38 \times \text{Projection Distance (feet)}}{\text{Focal Length (inches)}}$$

For example: a 10 foot wide screen used with a 2" (50mm) lens requires a projection distance of 52 feet. When Filmovara® Zoom attachment is used, the projection distance can vary from 46 feet to 58 feet. Or, the Filmovara attachment could be used to adjust the image width from 9 feet to 11.2 feet at a fixed projection distance of 52 feet.



ACCESSORIES

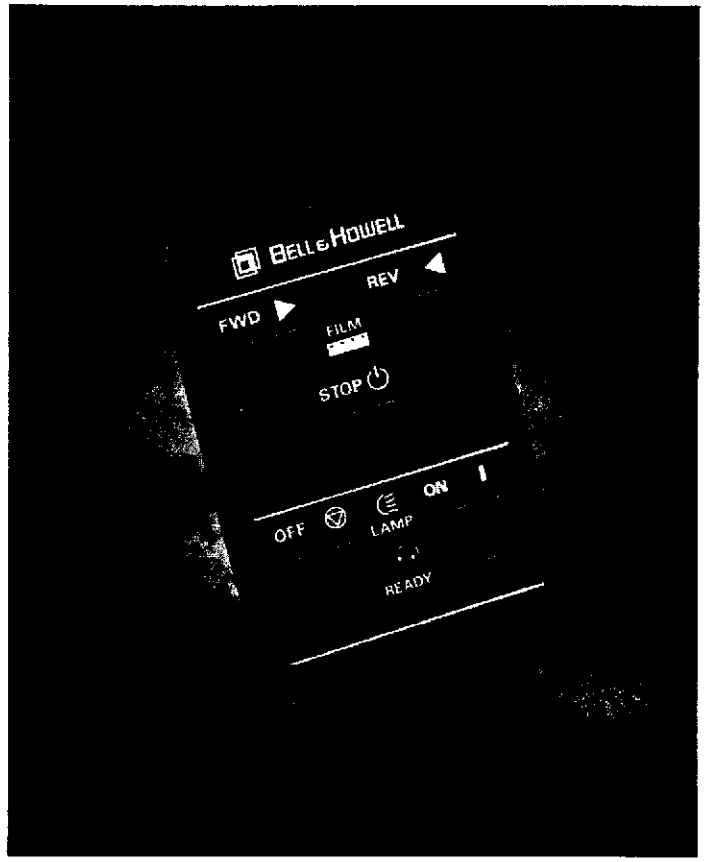
REMOTE CONTROL MODULE
Bell & Howell Part No. 077365
Allows control of the projector operating functions from a remote location. For ultimate convenience and versatility, up to five remote control modules may be used with a single junction box. Attached cord 20' (6M)

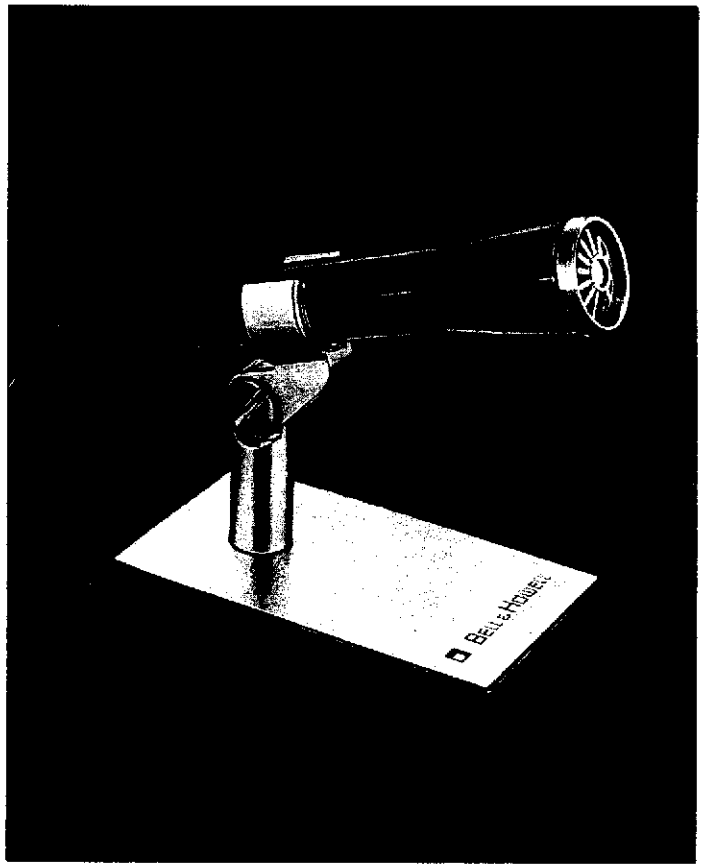
REMOTE CONTROL MODULE EXTENSION CABLE
Bell & Howell Part No. 709941
One or more extension cords of 50' (15M) length can extend the possible distance between remote control module and the projector. Extensions can be added to a cumulative maximum of 250' (75M) of cable.

REMOTE CONTROL PODIUM BRACKET
Bell & Howell Part No. 710241
Allows remote control module to be firmly attached to podium. Assures operator of complete control, and protects module from damage through mishandling.

TANDEM CHANGEOVER CABLE
Bell & Howell Part No. 709934
Connects two projectors together for uninterrupted showing of multi-reel features.

MICROPHONE
Bell & Howell Part No. 043591
Wide frequency range 600 ohm dynamic microphone with adjustable stand.





ACCESSORIES (CONT'D)

ACCESSORY LENSES
1.5" (38mm) F/1.5
Bell & Howell Part No. 204441
2.5" (64mm) F/1.6
Bell & Howell Part No. 204442
3" (76mm) F/1.6
Bell & Howell Part No. 204443
4" (100mm) F/1.6
Bell & Howell Part No. 201004

FILMOVARA® ZOOM
Bell & Howell Part No. 204665
For use with 1.5" (38mm), 2" (50mm), 2.5" (64mm), and 3" (76mm) lenses.
Magnification ratio .875 to 1.125.

ANAMORPHIC LENS (2X)
Bell & Howell Part No. 204440
For use with 1.5" (38mm), 2" (50mm), 2.5" (64mm), 3" (76mm), and *4" (100mm) lenses.

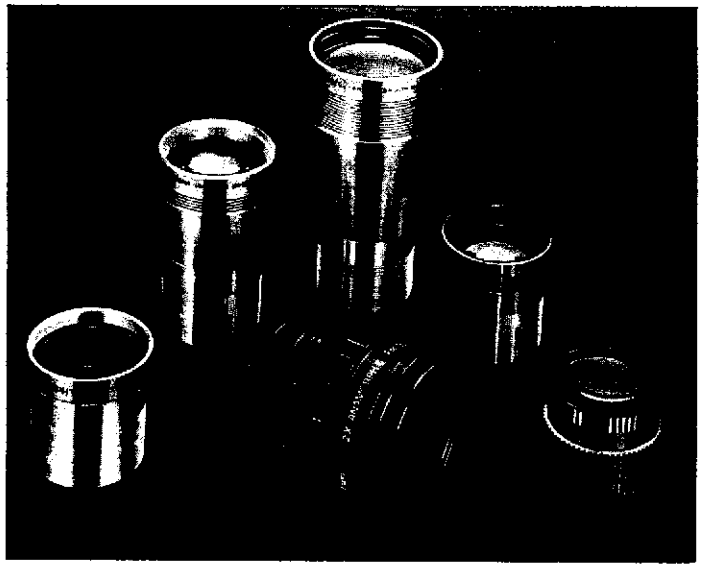
***ANAMORPHIC LENS ADAPTER**
Bell & Howell Part No. 204287
Required with 4" (100mm) lens.

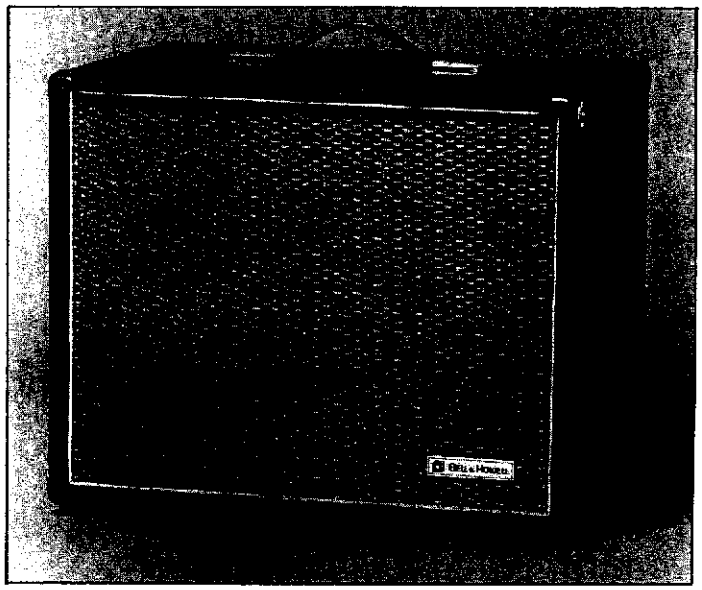
ORCHESTRICON III™ SPEAKER
Bell & Howell Part No. 077799
Remote 12" (30cm) speaker complete with 50' (15M) cord.

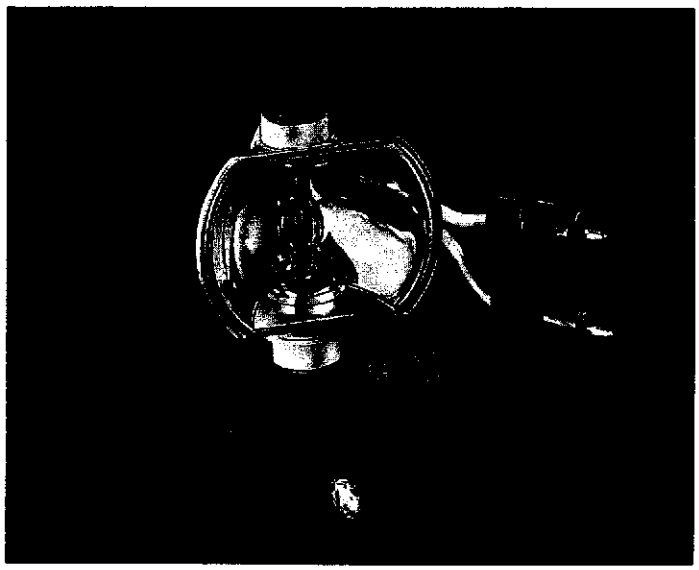
PROJECTION LAMP
Bell & Howell Part No. 710875

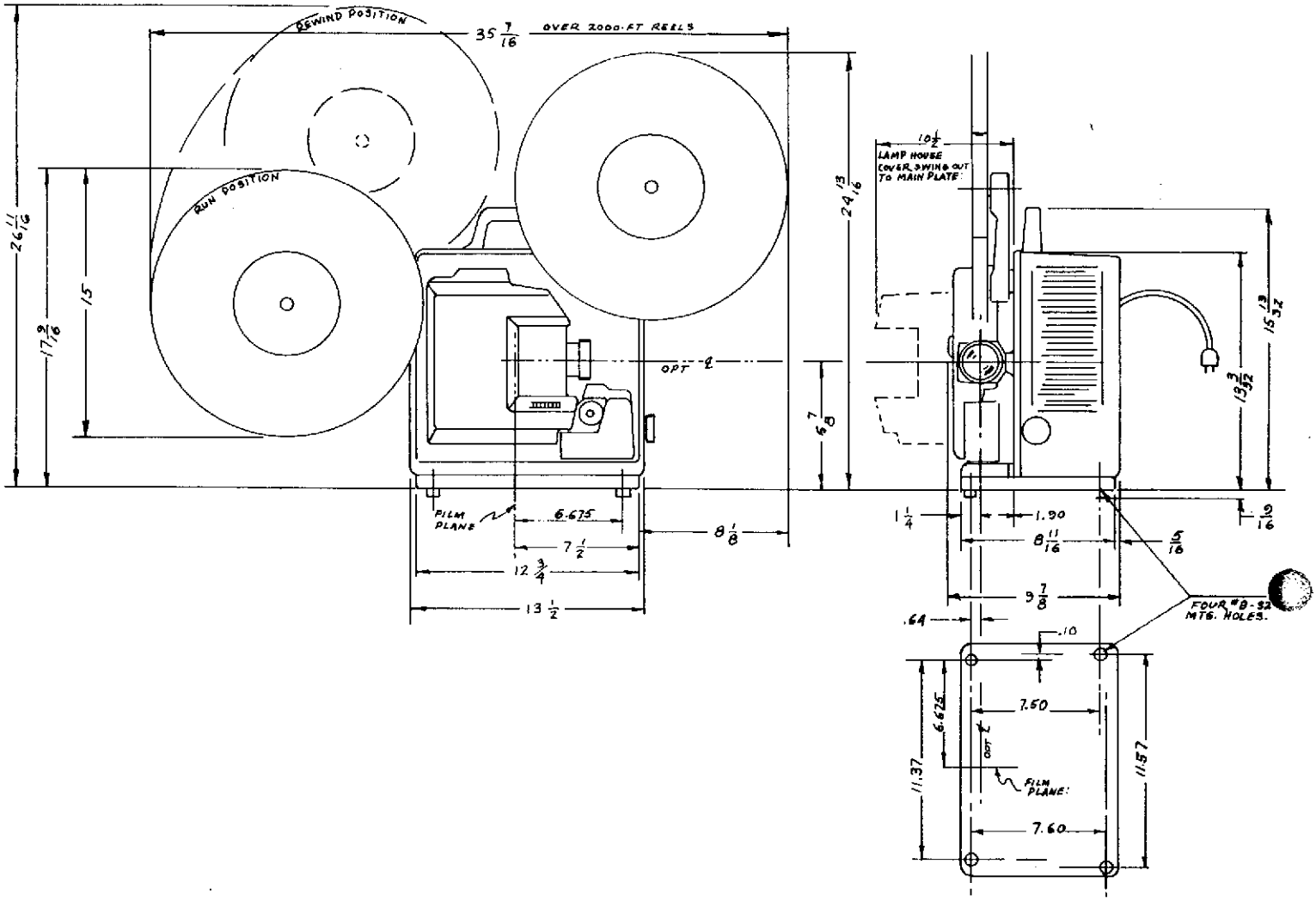
EXCITER LAMP
Bell & Howell Part No. 34884
BAK 4V 0.75 Amp.

PEDESTAL BASE
Bell & Howell Part No. 077797
For permanent installations, with built-in height adapter.









DRILLING DIAGRAM

For permanent installations, your projector can be mounted on the accessory pedestal stand or another solid surface. The drilling diagram that follows gives the key installation dimensions to allow complete clearance for all operating controls. When making a permanent installation, use adequate mounting hardware and install the required electrical outlets to handle one or more projectors.

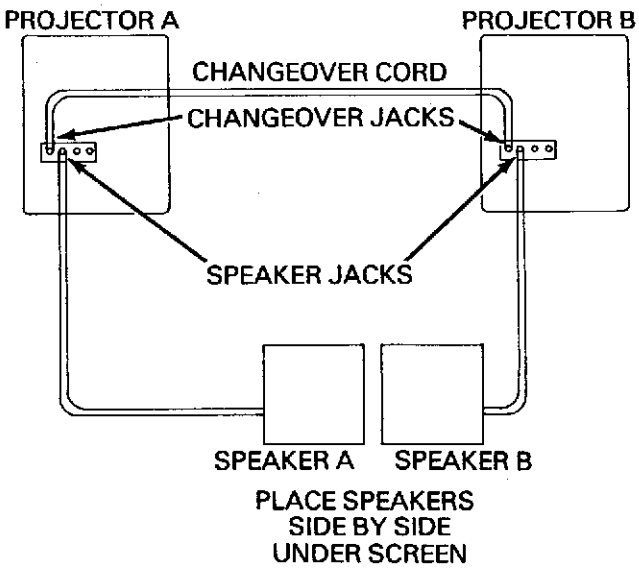
CAUTION:

To assure proper cooling, DO NOT REMOVE RUBBER FEET FROM THE PROJECTOR BASE. Use screws long enough to pass through mounting surface and rubber feet, and securely fasten to the projector base.

TANDEM CHANGEOVER WITH TWO SPEAKER SYSTEM

(This is the preferred system)
Sequence of installation:

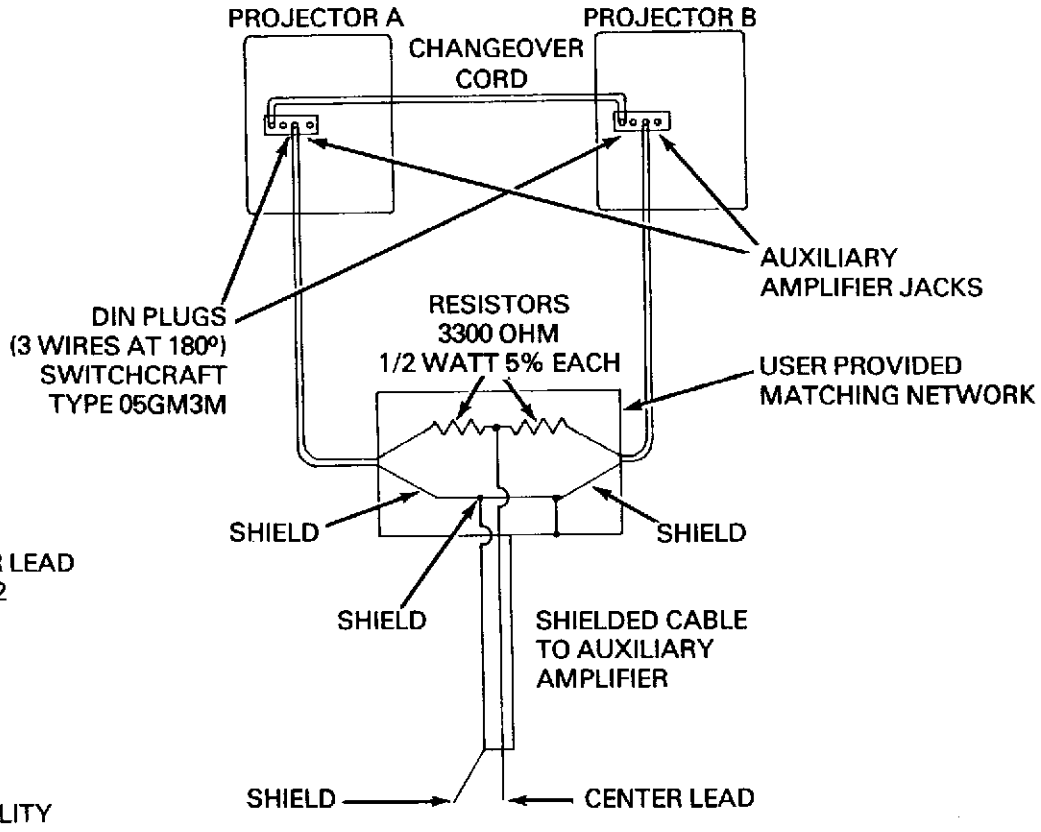
1. Connect the two projectors with the accessory changeover cable.
2. Plug one speaker cord into each projector.
3. Turn on both projectors.
4. Prepare for the show.

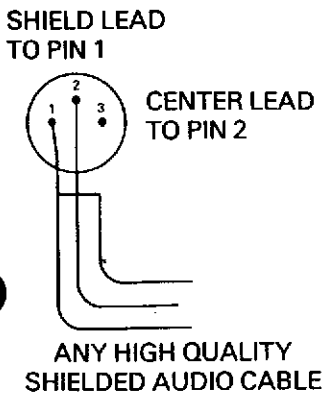


TANDEM CHANGEOVER WITH AUXILIARY AMPLIFIER

This system allows two projectors to operate in tandem when interfaced with an auxiliary sound system. The output from the matching circuit described below is approximately -4dbM (450MV RMS).

NOTE:
The auxiliary amplifier system must have an input impedance of more than 10K ohms for use with tandem projectors.





BELL & HOWELL

AUDIO-VISUAL PRODUCTS

7100 N McCormick Road Chicago, IL 60645 (312) 262-1600

Specifications subject to change without notice.

Form No. 16796-381 Part No. 950-079 Printed in U.S.A.

SERVICE INSTRUCTIONS

HI-INTENSITY 16mm SOUND PROJECTOR

MODEL 1568

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BELL & HOWELL

GENERAL SERVICE DEPT.
7100 McCORMICK ROAD
CHICAGO, ILLINOIS 60645

PART NO. 74411 PRINTED IN U.S.A. JULY 1979

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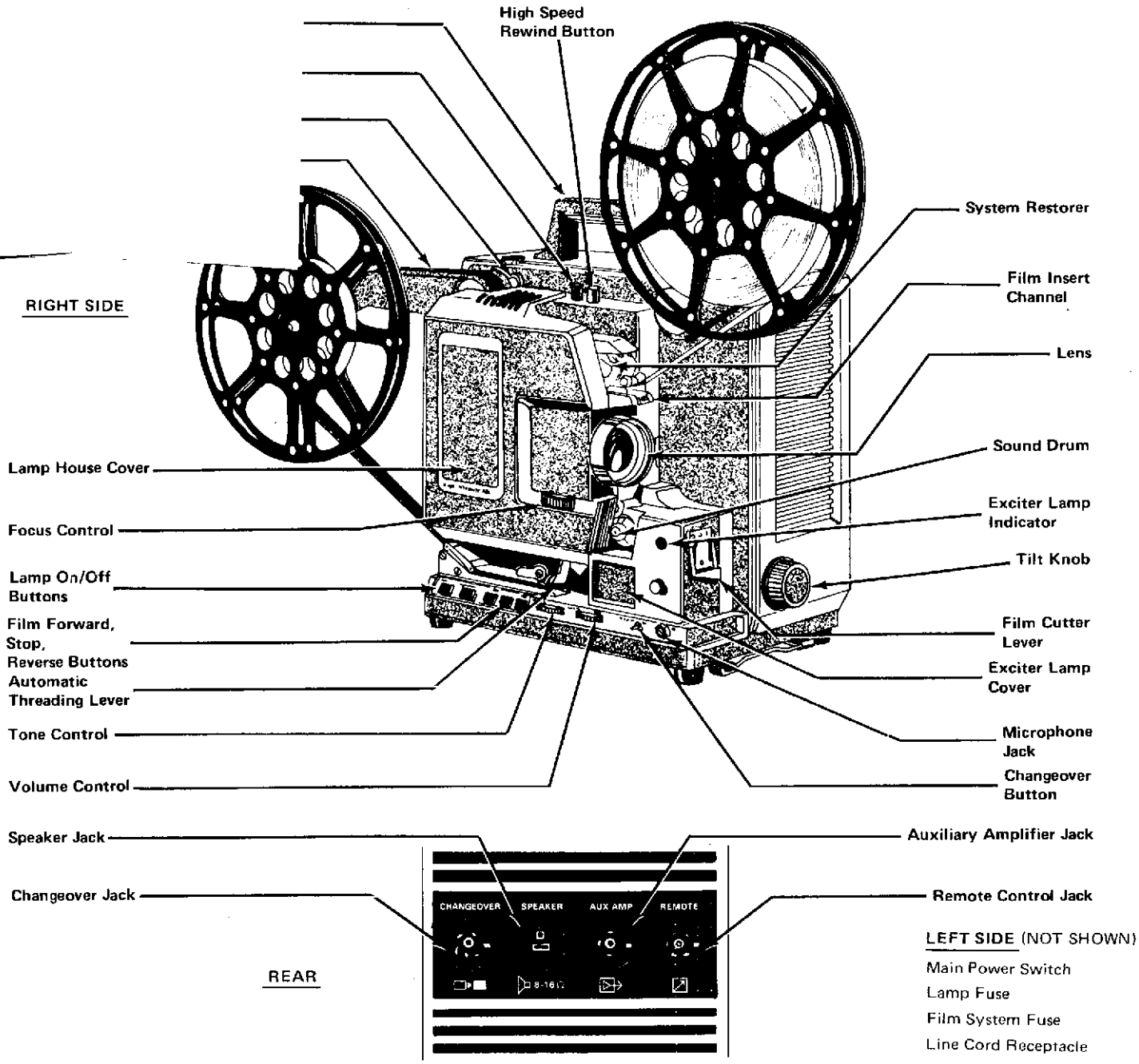


Model 1568 High-Intensity 16mm Sound Motion Picture Projector

FEATURE DESCRIPTION LIST

Operating Voltage	120VAC/60Hz, 8 Amps maximum
Film Threading	Fully automatic
Projector Operating Control	Forward and reverse projection only
Standard Lens	Straw-coated 2-inch (50mm) f/1.2
Projection Lamp	300-Watt gas discharge arc-type
Picture Speed	24 Frames-per-second with two blade shutter
Exciter Lamp	4-Volt Type BAK
Amplifier	Solid state with integrated circuit; more than 20 watts RMS into 8 ohm load
Audio System	Optical sound track

FACTORY SERVICE RECEIVING ADDRESS
Bell & Howell Company
General Service Department
2200 Brummel Place
Evanston, Illinois 60202
(312) 273-5820

FOR PARTS, ORDERS AND SERVICE INFORMATION
Bell & Howell Company
General Service Dept.
7100 McCormick Road
Chicago, IL 60645
(312) 273-5820

TABLE OF CONTENTS

INTRODUCTION

GENERAL.

This Service Manual has been prepared to assist in the maintenance, repair and adjustment of the Model 1568 Automatic Threading 16MM Sound Projector. Model specifications are listed in the Feature Description List. An Illustrated Parts Catalog at the rear of the manual serves to identify replacement parts of the projector and as an aid to the serviceman in the disassembly and reassembly of the projector. Only those parts and subassemblies listed in the Parts Catalog are recommended for replacement, and further disassembly or repair of projector components should not be attempted.

DESCRIPTION.

This automatic threading 16mm sound projector is completely gear driven, with shifting from forward to rewind accomplished by means of a rocker plate/idler gear arrangement. The automatic loading system consists of a series of guides, loopformers and rollers which, when the system is in the loading mode (closed), will automatically guide the film through the threading path to the film take-up reel. When the film path system is in the "open" position, the film guides and rollers are clear of the film path.

The upper and lower film guides are connected by a mechanical linkage with a locking lever at the lower end to actuate (close) the system. A film escape mechanism is included at the upper end of the linkage to prevent the film from being damaged due to unexpected jamming at that point. If a film jam should occur, the film will simply fold up and flow out through a "kickplate" of the escape mechanism. This will permit the operator to stop the projector before any real film damage has occurred.

CAUTION

Do not try to repair either the Control Circuit Board Assembly (item 17, Figure 2) or the Lamp Power Supply Assembly (item 26, Figure 2). Any attempt to repair these assemblies will automatically void their Bell & Howell Company warranties.

If service troubles are traced to the Control Circuit Board Assembly (P/N 077451) or the Lamp Power Supply Assembly (P/N 077597) remove the faulty assembly and send it to the "Factory Service Receiving Address" shown on the first page of this manual. The faulty assembly will be replaced with a rebuilt/exchange unit.

NOTE: When shipping the Control Circuit Board Assembly it must be packed in an anti-static bag (B&H P/N 710579). The Lamp Power Supply Assembly may be shipped in its replacement unit container.

SPECIAL MAINTENANCE PRECAUTIONS.

This service manual is intended for use by professional service personnel with appropriate expertise and tools; it is supplemental information to qualified training and is not to be used by untrained personnel.

All safety precautions included in this service manual (as well as those for any electrical mechanical device) should be followed.

The removal and installation of most projector parts can be accomplished with the tools normally available in most photo equipment repair shops. A quality pencil-type soldering iron should be available for electrical repairs, and it is very important that you make a note of wire color coding when

moving any electrical component. Wiring diagrams are included at the rear of the Parts Catalog to assist you in making electrical parts replacements.

Most of the protective covers (rear cover, end caps, etc.) are secured with "tamper-proof" screws so that owners will not unwisely remove these covers and thus expose themselves to possible injury. A special screwdriver bit (see Figure A, item 15) is available to service stations for the removal of these screws. The wrenches listed in the Bristol Setscrew Wrenches chart also should be available for repairs. These wrenches, plus the various tools and gages illustrated and listed in Figure A are available from the Bell & Howell Company or can be made in your repair shop.

CLEANING INSTRUCTIONS.

All film path areas must be thoroughly cleaned of film emulsion build-up, or film jamming may eventually occur during automatic threading operations. Use Toluol and/or an orange stick (or toothpick) to remove emulsion build-up from film path parts. You must be very careful not to scratch surfaces over which the film will travel and be particularly attentive to the film threading components of the sound cover and sound drum.

Do not use trichloroethylene solvents to clean plastic parts. Use a naphtha base cleaning fluid and make certain that lubricant is NOT removed from critical friction areas. Do not use solvents on these critical areas (gears, sliding parts, etc.), particularly in the automatic threading linkage. A lubricant is applied as the linkage is assembled and will be difficult to replace without completely disassembling the linkage from the projector. In these areas, simply use a soft, lint-free cloth or low pressure jet of compressed air to remove the accumulation of dust or film chips.

Periodically, the complete transport mechanism assembly should be removed, thoroughly cleaned and relubricated. Instructions for removal and installation of mechanism assembly can be found in the Disassembly and Reassembly sections of this manual. Use a camel's hair brush or low pressure jet of compressed air to remove large particles of dust and dirt. Clean all moving parts except Oilite bearings and pull-down cams with any good quality petroleum solvent. Oilite bearings and pull-down cams should be cleaned with naphtha.

Discard and replace the felt cam wiper and cam wiper wick. Instructions for lubricating felt pads and wicks are contained in the paragraphs under LUBRICATION. When all critical parts have been cleaned and dried, relubricate as instructed in the Lubrication Chart.

LUBRICATION.

The Lubrication Chart lists those items which are to be lubricated during reassembly of the projector. The lubricants specified in this chart are available from the Bell & Howell Company under the indicated part number. It is very important that you do not apply too much lubricant. Only a drop or two of oil or a thin film of grease (applied by a brush) will be necessary. Be very careful not to accidentally apply lubricants to neighboring parts (such as the drive belt or motor pulley), which could cause inefficient projector operation. Always wipe away excess lubricant with a lint-free cloth.

The felt cam wiper and wick in the shuttle mechanism should be replaced if they appear to be dirty (gritty) or dry. Place the new felt parts in a shallow pan of the specified grease (B&H P/N 070034) until they have become saturated. Remove the felts from the pan and wipe away excess lubricant before installing them.

The most efficient way to lubricate the gear drive mechanism of the projector is to "speck" the gear teeth with grease during reassembly. Then, when the projector is reassembled and operable, run the projector for a few minutes to distribute the grease evenly through the entire system. Again, you are cautioned not to over-lubricate. Wipe away excess lubricant with a lint-free cloth.

LUBRICATION CHART

Parts To Be Lubricated	Lubricant
Machined surfaces (non-bearing) of all castings	Oil (P/N 070030)
Sprocket shafts (17 and 18, Figure 9)	Oil (P/N 078215)
Framer shaft (28, Figure 12)	Oil (P/N 04978)
The following items are to be greased sparingly:	
Teeth of all nylon gears	Light Yellow Grease (P/N 070034)
Friction surface of lamp release ring (18, Figure 8)	
Reel arm lock buttons (25, Figure 3)	
Tilt rack and pinions (Figure 15)	
Meshing gears in reel arms (Figures 6 and 7)	
Loop restorer shaft (22, Figure 11)	
Self-centering assy (27, Figure 11)	
Cam wiper and wick (17 and 18, Figure 12)	

Parts To Be Lubricated	Lubricant
The following items are to be greased sparingly:	
Shuttle link bearing (20A, Figure 12)	Light Yellow Grease (P/N 070034)
In-out cam and cam follower (24A, Figure 12)	
Mechanism housing (43, Figure 12); film guide pivot posts, sprocket shaft bearings and camshaft bearings	
Pinion teeth of focus knob (10, Figure 13)	
Sprocket gears (12 and 13, Figure 9) and worm gear (39, Figure 12)	Dark Yellow Grease (P/N 070043)
Reverse clutch and gear (18 and 19, Figure 3)	Blue Grease (P/N 070047)
Torsion springs (10, Figure 6) and (18, Figure 7)	
Rewind clutch friction washers (8 and 11, Figure 4)	
Reel arm take-up disc (22, Figure 3) and reel arm surfaces (23 and 24, Figure 3)	

TEST FILM CHART

Test Film Part No.	Purpose
TFL-55-NX1	Centering and framing test loop
TFL-37-NX1	Buzz track test loop
TFL-26-NX3	7KHz azimuth test loop
TFL-23-NX1	400Hz power output test loop
TFR-D550-NX5	Audio-centering-framing test roll
TFS-D550-NX1	Loop restorer test strip (bad holes)
TFS-D550-NX5	Loop restorer test strip (elongated holes)

BRISTOL SETSCREW WRENCHES REQUIRED FOR MAINTENANCE

Setscrew Size	No. of Flutes	B&H Part No.	
		Handle	Wrench
No. 4-40	6	G1271-F	G1271-X2
No. 6-32	6	STK3852-B	STK3863-B
No. 8-32	6	G165-F1	G165-X2

NOTE: Wrench G165-3 is needed to tighten setscrew in tool handles.

INDEX NO.	TOOL NO.	TOOL DESCRIPTION	USE
1	S-1568-2-1F1	Lamp Plug	Alignment of optical system (Fig. E)
2	S-550-2-N1	Lens Plug	
3	S-550-2-N2	Alignment Rod	
4	S-550-2-N3	Aperture Plug	
5	Make in Shop	Torque Wrench	Adjust rewind torque (check torque with Chatillion #LP-72 (0 to 72 oz.) push-pull scale, Master Gauge Co. Chicago 60622)
6	S-550-5-N2	Stroke Gage	Measure shuttle stroke (Fig. F)
7	S-09701-35N2	Shuttle Height Gage	Check shuttle protrusion (Fig. G)
8	S-552-2-N1	Restorer Positioning Tool	Adjusting the loop restorer (Fig. Q)
9	S-552-4-N1	Shuttle Tension Gage	Adjusting shuttle tension (Fig. H)
10	S-552-4-N2	Weight for Shuttle Tension Gage	Adjusting shuttle tension (Fig. H)
11	S-552-1-N1	Timing and Alignment Plate	Timing the sprockets (Fig. Q)
12	S-552-5-N1	Soundhead Locating Gage	Positioning the soundhead (Fig. L)
13	S-550-8-N1	Alignment Tool	Aligning sound drum and photocell (Fig. K)
14	S-550-5-N1	Shuttle Stroke Target	Measuring shuttle stroke (Fig. J)
15	STK-11978	Tamper Proof Screw Bit	Remove tamper proof screws
16	Make in Shop	Rewind torque reel (use P/N 014570)	Torque adjustments
17	Purchase	Push-Pull Scale (Chatillon #LP-72 (Master Gauge Co., Chicago 60622)	Torque adjustments

Figure A. Special Service Tools

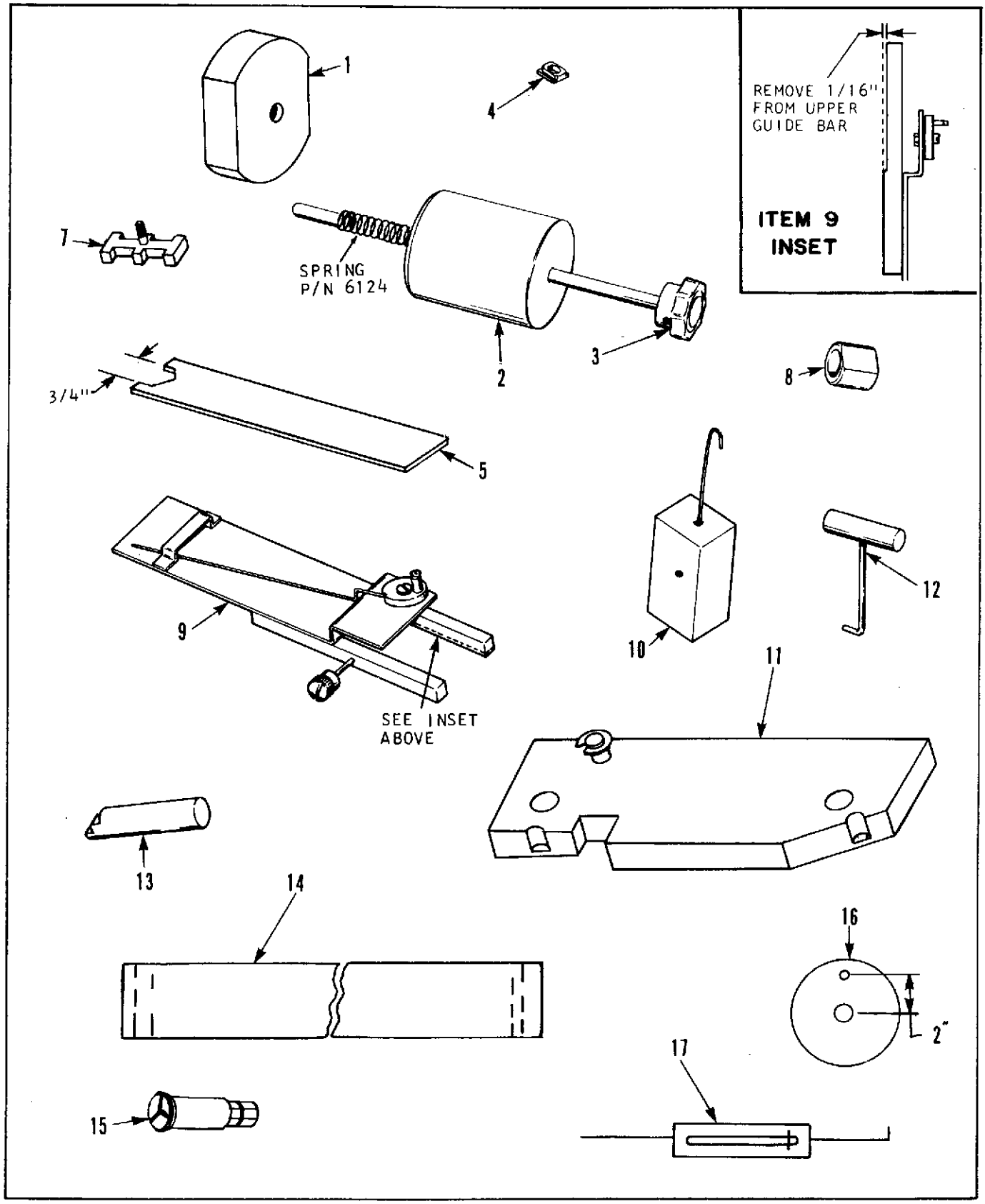


Figure A. Special Service Tools (Continued)

DISASSEMBLY PROCEDURES

1. GENERAL PRECAUTIONS.

a. Be sure to use the proper size tools for disassembly and reassembly procedures. After removing attaching parts (screws, nuts, etc.), loosely reinstall these parts to the removed part or tapped holes to prevent loss.

b. Cemented or adhesive backed parts are so noted in the parts lists and can be removed by prying up one edge with a knife blade. Be careful not to scratch surrounding areas. Remove traces of old adhesive with solvent.

c. When removing electrical parts, it is advisable to tag leadwires or make a rough sketch of leadwire connections to facilitate installation of the parts. Unsolder leads with a pencil type soldering iron, using a heat sink if available, or gripping the lead with a pliers to provide additional heat dissipation.

d. When removing riveted parts for replacement, the old rivet must be drilled out with a drill equal to, or slightly smaller than, the diameter of rivet to be installed. Refer to parts lists for the rivet diameter.

CAUTION

To prevent damage, do not allow metal chips to fall into the mechanism.

WARNING

There is high voltage (in excess of 10,000 volts, 7 amps) present on the Lamp Power Supply Assembly. Do not touch this assembly or take any measurements when the power is on.

Before proceeding to disassemble the projector turn off the power and remove the line cord from the electrical outlet.

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

a. Unlatch and remove the front cover and speakers assembly (1) from the projector. If speaker repair or replacement is required, refer to Figure 15 for parts replacement information.

b. Three screws (10) and (11) secure the lamphouse cover assembly (13) to the mainplate. The lower screw also attaches the air baffle (12). No special instructions are necessary for disassembling the lamphouse cover components.

c. The rear cover assembly (8) is held by eight "tamper-proof" screws (4), (5) and (6) and three lockwashers (7). A special screwdriver bit (item 15, Figure A) is required to remove these screws.

d. Remove the two screws (17) located near the upper corners of the mainplate to free the top cover assembly. No special instructions are necessary for disassembling the top cover components.

3. REMOVAL OF THE END CAPS, CIRCUIT BOARDS AND PROJECTION LAMP (Figure 2). Remove parts, as necessary, in their indexed order of disassembly, noting any special precautions.

a. Remove the screw (1) and tension washer (2) and disassemble the tilt bar (3) from the projector. The rubber feet (4) are secured to the tilt bar with adhesive (3M Co. #1711). Loosen the setscrews (5) and withdraw the tilt knob (6) from the tilt shaft.

NOTE: Removal of the control circuit board, jack plate and lamp power supply assemblies cannot be accomplished without first removing the end caps from the projector. Proceed as follows:

b. Carefully tilt the projector so that the underside of the base is exposed. The front end cap (10) is secured to the base with two screws (7) and one sleeve spacer (8). The rear end cap (21) uses only two screws (19). Set the projector upright and remove the four remaining attaching screws (9) and (20) which are inserted through the front side of the mainplate into the front and rear end caps respectively. Be careful not to lose the speed nuts (11) and (18) assembled to the mounting bosses of the end caps.

c. The four screws (13) that attach the jack plate assembly (15) are located under the nameplate (12). A screw (14) also secures the ground lead to the blower housing. If any of the riveted jacks (15E), (15F) or (15G) needs replacing, drill out the rivets. The new jack can be attached by means of the screws (15B) and nuts (15A) as are used to attach the speaker jack (15C).

d. The fuse, switch and jack assembly (23) is attached with three screws (22). The fuseholders (23B) can be removed by slitting the insulating sleeve (23A), disconnecting the wire leads and unscrewing the toggle nut (24). If the jack (23D) must be replaced, drill out the rivets (23C) and install the new jack with two hex nuts (15A) and two screws (15B). The on-off switch (23B) can be removed by simply pressing on the four clips which retain it.

e. The control circuit board assembly (17) is attached to the end cap with six screws (16). Remove the screws and carefully pull the five connectors away from the board. Care must be used when handling this board as it contains CMOS/IC's.

WARNING

There is high voltage (in excess of 10,000 volts, 7 amps) present on the Lamp Power Supply Assembly. Do not touch this assembly or take any measurements when the power is on.

f. To remove the lamp power supply assembly (26), first disconnect all snap-on connectors and wire leads from the board and transformers, noting where each is connected. Then remove the four attaching screws (25).

CAUTION

Do not try to repair either the control circuit board assembly (17) or the lamp power supply assembly (26). Any attempt to repair these assemblies will automatically void their Bell & Howell Company warranties.

If service troubles are traced to the Control Circuit Board Assembly (P/N 077451) or the Lamp Power Supply Assembly (P/N 077597) remove the faulty assembly and send it to the "Factory Service Receiving Address" shown on the first page of this manual. The faulty assembly will be replaced with a rebuilt/exchange unit.

NOTE: When shipping the Control Circuit Board Assembly it must be packed in an anti-static bag (B&H P/N 710579). The Lamp Power Supply Assembly may be shipped in its replacement unit container.

g. To remove the projection lamp (29), press in and to the left on the lamp retaining spring until the lamp can be withdrawn from the lampholder. The lamp connector assembly (31) is secured to the mainplate with two screws (30). Do not rock or twist the connector during its removal or the lamp socket pins may become damaged.

4. REMOVAL OF POWER DRIVE COMPONENTS AND REEL ARMS (Figure 3). Remove parts, as necessary, in their indexed order of disassembly, noting any special precautions.

NOTE: When removing electrical components, be sure you make a note of every wiring connection. No special instructions are required for the replacement of the fuses (31) and (32) or the fuse board assembly (34). Do not attempt to replace any of the items mounted on the fuse board assembly. This board must be replaced as an assembly.

a. Four screws (1) secure the transformer (2) to its two mounting brackets (4). The brackets need not be removed.

b. Four screws (5) attach the blower assembly (6) to the projector base. No special instructions are necessary for disassembling the blower assembly. The blower fan (6E) is exposed by removing the left-hand housing (6C). After removing the fan, support the motor (6G) while removing its mounting screws (6F).

NOTE: The blower fan and blower motor can be replaced without removing the blower assembly from the housing. Simply remove only the left-hand housing (6C), and then remove the fan and motor as instructed in step b, above.

c. The drive belt (7) can be slipped to the right from around the motor pulley (9), which is secured to the motor shaft with two setscrews (8). To disconnect motor connector, the two latches must be in and held while the connector is disengaged. The rubber shock mount tabs should be reassembled into the detents on the motor mounts.

d. To remove the rear reel arm assembly (24), the retaining ring (13), the gear and bearing assembly (14) and shims (15) must be removed from the rear end of the reel arm shaft. Remove the reel arm disc (22) by removing its screws (21). The lock button (25) is held under tension by spring (26) and may pop out as the reel arm is withdrawn from the mainplate. Be careful not to lose these parts. For rear reel arm repairs, refer to paragraph 8.

e. To remove front reel arm assembly (23), the retaining ring (16), rewind clutch bearing assembly (17), clutch gear (18), rewind gear (19) and retaining clip (20) must be removed from the rear end of the reel arm shaft. Note the position of the orientation notch in the rim of reel arm disc (22) before removing its screws (21). The lock button (25) is held under tension by spring (26) and may pop out as the reel arm is withdrawn from the mainplate. Be careful not to lose these parts. For front reel arm repairs, refer to paragraph 7.

5. REMOVAL OF GEAR DRIVE AND THE SOUNDHEAD (Figure 4). Remove parts, as necessary, in their indexed order of disassembly, noting any special precautions.

NOTE: The removal of these parts is relatively simple and requires no special instructions. However, these are the areas which require lubrication to insure proper projector operation. Therefore, it is most important that these areas be inspected carefully for insufficient lubricant or for lubricants which have lost their ability to perform as specified. The proper lubricants required are listed in the chart in the Introduction section as well as the instructions for cleaning and lubricating such parts.

a. The removal and replacement of gear drive components will pose no problem if you follow the exploded view illustrations and the cleaning and lubrication instructions in the Introduction section of this manual. No special instructions are required for the replacement of these items.

b. To remove the soundhead assembly (26), the flywheel (20) must first be disassembled from the projector. This is accomplished by removing the retaining ring (18) and washers (19) from the flywheel shaft. Be very careful not to nick or scratch the flywheel (20) when disassembling. Temporarily wrap in soft cloths, for example, to prevent that from happening.

NOTE: Before removing soundhead assembly, scribe reference line as outlined in paragraph 42a.(1).

c. Removal of the soundhead assembly (26) is critical. Extreme care must be used not to allow this assembly to be damaged in any way during its removal and after it has been lifted free of the projector. If necessary, wrap the soundhead assembly in clean, lint-free cloths and set it aside until more detailed repair facilities are available. The repair of the soundhead assembly components is covered in paragraph 9 of this manual.

d. The removal of the complete mechanism assembly (29) is equally critical. Herein are mounted most of the parts which assure the reliability of the film transport system and the sensitivity of the optical system. The repair of this assembly is covered in more detail in paragraphs 10 through 13 of this section.

6. REMOVAL OF BASE-MOUNTED CONTROLS (Figure 5). The removal of most mechanical items located within and around the projector base will not be a problem. Even most of the electrical items located within the base require only that you make a note of wiring connections so that reassembly of repaired or new components can be accomplished with a minimum of difficulty. The replacement of the more critical of these items is covered in the following paragraphs.

a. If you are servicing the automatic threading components mounted on the base (items 4 through 11), make certain that these items are thoroughly cleaned and relubricated (if required) during reassembly.

b. Removal of the cover plates (16) and (19) will expose the critical electrical components for inspection and replacement. The volume/tone cover plate (16) is secured by four screws (15); the amplifier cover plate (19) by five screws (18).

c. The servo amplifier (27) and the projector amplifier assembly (35) both are exposed for inspection and replacement when the amplifier cover plate (19) is removed. The servo amplifier (27) is secured to the base with two screws (26). When the screws have been removed, pull the servo amplifier straight away from its connector. Do not twist or wiggle the servo amplifier to disengage it from the connector, for this may damage the pins. The projector amplifier (35) is secured to the base with three screws (34). This assembly also is tied to the sound system by means of an edge connector (33) and the disengagement of connecting pins must be made by pulling straight out between the two units.

d. For replacement of additional parts of the projector base, refer to Parts Catalog, Figure 16.

7. DISASSEMBLING THE FRONT REEL ARM (Figure 6). Remove parts, as necessary, in their indexed order of disassembly, noting any special precautions.

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

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

c. Remove the retaining ring (7) from the spring post in the reel arm to free the end of the torsion spring (10). Loosen the setscrews (8) and (8A) and lift the gear (9) and torsion spring (10) from the reel arm shaft (14). If damaged, disassemble the plastic sleeve (9A) from the gear hub.

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

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

8. DISASSEMBLING THE REAR REEL ARM (Figure 7). Remove parts, as necessary, in their indexed order of disassembly, noting any special precautions.

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

b. Press the take-up arm against the reel arm casting and slip the take-up belt (4) from the pulleys. Release the take-up arm

slowly and catch the tension spring (5) as it drops free. Remove the screw (6) and disassemble the take-up spindle and pulley assembly (7) and shim washer (8) from the take-up arm. The take-up arm and rear reel arm are replaceable only as an assembly (32).

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

d. Remove the retaining ring (17) from the spring post in the reel arm to free the end of the torsion spring (18) and lift the torsion spring from the hub of the upper face gear (27).

e. Remove the retaining ring (19) and slide the upper spur gear (20) toward the upper face gear (27) until the upper gear retaining clip (21) can be removed. Move the gearshaft (24) down until the upper spur gear (20) and washer (23) can be removed. Remove the lower gear retaining clip (21) and lower spur gear (22), and slide the gearshaft (24) from the bearing posts of the reel arm. Inspect the nylon bearings (25) and, if damaged, press them from the bearing posts.

f. Loosen the setscrew (26) and lift the upper face gear (27) from the reel arm shaft (31). Remove the retaining ring (28) and disassemble the reel arm shaft (31) and washers (29).

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

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

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

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

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

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

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

g. To remove the stabilizer tension adjuster, remove retaining ring (25) from the adjuster (27), and unscrew the adjuster from the tapped hole in spring retainer (28). Be careful not to lose friction washer (26) located at the lower end of the adjuster.

h. Remove two screws (29) and one washer (30) and disassemble threading safety switch (32) and its bracket (31) from the soundhead casting. Make a note of wiring connections before disassembling switch leadwires.

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

a. To remove the lens carrier assembly (5), pry out the hinge pins (1) and (2) with a wire cutter or similar tool and lift the lens carrier from the mechanism. Note that the spring washer (3) is used with the upper pin and the flat washer (4) with the lower pin. For lens carrier parts repair and replacement, refer to paragraph 14 and Figure 13.

b. Remove the retaining ring (16) and withdraw the threading lever (7). Remove the two screws (9) and the hood (10).

c. Loosen two setscrews (11) in each sprocket gear (12) and (13) and remove the gears, tension washers (14) and flat washers (14A) from the sprocket shafts. Remove two screws (15) and the upper sprocket guard assembly (16), and withdraw the upper sprocket assembly (17) and its thrust washer (19) from the mechanism housing. Disassemble the lower sprocket assembly (18) and flange (21) from the mechanism housing.

d. Remove the retaining ring (22) from the lower end of the rewind button shaft, and lift the rewind button (23) and its spring (24) from the top of the mechanism housing.

e. When removing sprocket guards (27) and (28), note the manner in which the torsion springs (30) are assembled so that they may be properly reinstalled.

11. DISASSEMBLING THE MECHANISM (Figure 10). Remove parts, as necessary, in their indexed order of disassembly, noting any special precautions.

a. Remove the three screws (1) and flanged rollers (2). Note the manner in which the torsion spring (5) is installed. Remove the retaining ring (3) and withdraw the threading arm (4) and torsion spring (5) from the mounting posts of the guard mounting plate (21).

b. Note the manner in which the legs of the torsion spring (14) are engaged. Remove the retaining ring (6), film guide (7), roller stud (8), locking lever eccentric (9) the tension spring (11) and the automatic threading lever assembly (10).

c. Note the manner in which the legs of the torsion spring (14) are engaged. Remove the retaining ring (12) and lift off the lower loopformer (13) and the torsion spring (14).

d. Remove the screw (15) and back-up bracket (16). Remove the large retaining ring (17) and lift off the lower film guide (19) and two washers (18). Remove two screws (20) and the lower guard mounting plate (21). Remove the retaining ring (21A) and disassemble the toggle lever and pivot assembly (21B) and lower film guide (22) from the mounting plate.

e. Loosen the locking screw (25) and disassemble the threading lever assembly (26) from the rear shaft end of the upper loopformer (27B). Remove the retaining ring (27A) and withdraw the upper loopformer assembly. Remove the connecting link and stud assembly (27G).

12. DISASSEMBLING THE MECHANISM (Figure 11). Remove parts, as necessary, in their indexed order of disassembly, noting any special precautions.

a. The hex head screw (1) is used to adjust the lens carrier and should not be disturbed. Do not remove the lens carrier catch (3) unless it is to be replaced.

b. Remove two screws (4) and the upper guard mounting plate assembly (5). Note the manner in which the legs of the torsion spring (8) are engaged. Loosen two setscrews (6) and disassemble the shaft assembly (7), torsion spring (8), flat washer (9) and the loopformer and lock pawl assembly (10) from the mechanism housing. Do not disassemble the loopformer and lock pawl group (10) unless visual inspection indicates a need for parts replacement.

c. Remove screw (13) and washer (14) and disengage and remove the torsion spring (15). Remove screw (16) and washer (17) and lift the cam follower and support assembly (18) from the mechanism casting.

d. Remove two screws (24) and washers (25) and (26) and disassemble the self-centering assembly (27). Do not attempt to disassemble this assembly.

e. Remove screws (28) to free the aperture plate assembly (29). Refer to paragraph 15 and Figure 14 for aperture plate parts replacement.

13. DISASSEMBLING THE MECHANISM (Figure 12). Remove parts, as necessary, in their indexed order of disassembly, noting any special precautions.

a. Loosen the two setscrews (1) and withdraw the mechanism pulley (2) from the end of the camshaft.

b. Remove four screws (3) and washers (4) and lift the douser assembly (5) from the mechanism. Check for presence and condition of the tension spring (5A).

c. Remove the two screws (6), heat baffles (7) and (9) and spacers (8). Unscrew the shutter nut (10) and remove the counterbalance weight (11), shutter (12) and fiber washer (13).

d. Unless obviously in need of replacement, do not disassemble the ball and stud assemblies (15) or the shuttle link bearing (20A) from the shuttle arms (20). Inspect the pull-down cam follower (20B) for wear. Badly worn shuttle arms should be replaced. Unhook the extension spring (16) from the end of each shuttle arm and remove the shuttle arms and the felt wiper (17). The felt wick (18) is inserted within the coils of the spring (16). If either of these felts seem unusually dirty, they should be replaced. New felts should be lubricated as covered in the Introduction section under LUBRICATION.

e. Withdraw the pull-down cam (21) from the camshaft. Remove the two screws (22) and lift the in-out cam (23) and cam bracket assembly (24) from the mechanism. Inspect the cam follower (24A) and tension spring (24B) and replace if damaged. Remove the two screws (25) and the shuttle arm plate assembly (26). Inspect the bearing support assembly (26A) and replace if worn or damaged.

f. With a sharp-nose pliers, pull out the framer shaft stop pin (27). Unscrew the framer shaft (28) from the mechanism housing (43). An adhesive-backed decorative disc is located in the recess at the top of framer knob (28). Remove the screw (29), the in-out spring (30) and the shuttle retractor pin (31).

g. Remove the screws (32) and the bearing loading spring (33). Loosen the setscrews (34) and (37) so that the worm gear (39) and loop restorer cam (40) are free on the shaft. Remove the two retaining rings (36) and (41) and press the camshaft (38) to the left to force bearing (35) from its seat in the housing. Then press the camshaft to the right to force bearing (42) from its seat. Remove the worm gear (39) and loop restorer cam (40) as the camshaft is withdrawn from the housing.

14. DISASSEMBLING THE LENS CARRIER (Figure 13). Remove parts, as necessary, in their indexed order of disassembly, noting any special precautions.

a. Remove the two screws (1) and disassemble the pressure plate (2), washers (3), springs (4) and pressure plate lever (5) from the lens carrier. The adjustment plate (7) need not be removed unless inspection shows that it is badly nicked or scratched.

b. If the nameplate has not already been removed from the lens carrier, pry it up with a sharp knife blade to expose the two screws (8). Remove these screws and disassemble pinion spring (9) and knob and pinion assembly (10) from the lens carrier.

15. DISASSEMBLING THE APERTURE PLATE (Figure 14). No special instructions are required for the removal of aperture plate parts. Be very careful not to scratch or nick the rails or aperture plate with the screwdriver when removing the screws.

16. DISASSEMBLING THE FRONT COVER AND SPEAKERS (Figure 15). No special instructions are required for disassembling the front cover components. Be sure to make a careful note of leadwire connections when removing electrical items.

17. DISASSEMBLING TILT MECHANISM FROM BASE (Figure 16). No special instructions are required for disassembling the tilt mechanism parts from the projector base. Remove parts in their indexed order and replace those which are damaged or badly worn.

18. TESTING AND REPAIR OF CIRCUIT BOARD ASSEMBLIES.

a. Control Circuit Board and Lamp Power Supply Assemblies.

CAUTION

Do not try to repair either the Control Circuit Board Assembly (item 17, Figure 2) or the Lamp Power Supply Assembly (item 26, Figure 2). Any attempt to repair these assemblies will automatically void their Bell & Howell Company warranties.

If service troubles are traced to the Control Circuit Board Assembly (P/N 077451) or the Lamp Power Supply Assembly (P/N 077597) remove the faulty assembly and send it to the "Factory Service Receiving Address" shown on the first page of this manual. The faulty assembly will be replaced with a rebuilt/exchange unit.

NOTE: When shipping the Control Circuit Board Assembly it must be packed in an anti-static bag (B&H P/N 710579). The Lamp Power Supply Assembly may be shipped in its replacement unit container.

b. Audio Amplifier and Servo Amplifier Circuit Board Assemblies.

NOTE: Unless the service station is equipped with adequate audio test equipment and trained electronics personnel, it is recommended that the printed circuit board assembly be replaced if faulty.

Components of the printed circuit board can be inspected and checked without removing the board completely from the chassis assembly. With the circuit board exposed, remove the mounting screws. Grip the circuit board only by its edges to avoid touching the board components and carefully lift the circuit board away from the chassis. Refer to Figure 17 in the Parts Catalog section for circuit board component identification and schematic wiring.

Use a pencil-type solder iron for soldering operations. Be careful to use only the minimum heat necessary when soldering and unsoldering component leads. The use of a heat sink is recommended to avoid the direct application of heat to the adjacent components.

If the circuit board is to be removed completely for replacement, make a careful note of wiring harness connections to the board. Do not alter the wiring layout when installing the new circuit board and be sure to dress all leadwires so that they do not interfere with moving mechanical parts.

REASSEMBLY PROCEDURES

19. GENERAL PRECAUTIONS.

a. Before reassembling parts, be sure to clean them thoroughly. Metal parts can be immersed in a pan of non-flammable solvent or wiped with a cloth dampened with solvent; then blown dry with a low pressure jet of compressed air or dried with a lint-free cloth. Do not clean plastic or electrical components with solvent. Simply wipe plastic and electrical components with a clean, dry cloth. Clean optical parts with a good quality lens cleaner and lens tissue or a lint-free cloth.

b. When reasembly procedures include staking or riveting operations, it is wise to perform these operations before assembling other parts. Be sure to support the major casting or plate solidly during staking operations to avoid distorting the casting or plate.

NOTE: In many instances, you will find that you can install previously riveted items with screws and nuts. These are mentioned in the reassembly instructions.

c. When installing electrical components, refer to the wiring diagrams at the rear of the Parts Catalog for the proper connection of leadwires. Refer to paragraph 18 for special instructions regarding testing and replacement of the circuit board assemblies.

d. Most of the nameplates and the instruction plates are provided with an adhesive backing. Make certain that the area to which such parts are to be secured is thoroughly clean by wiping with a cloth dampened with solvent. Remove the protective paper backing and brush the adhesive with a mixture of three parts Toluol to one part of trichloroethylene. When the adhesive is tacky, press the nameplate carefully but firmly in place. Wipe away any excess adhesive with a cloth dampened with solvent.

e. Lubrication instructions are provided in the Introduction section of this service manual. Do not over-lubricate. Apply grease and oil sparingly as indicated, and wipe away any excess lubricant with a lint-free cloth. Gears should be lubricated by specking the gear teeth and then running the projector for a few moments to distribute the grease. Where oil is indicated, a drop or two will usually suffice.

20. REASSEMBLING TILT MECHANISM (Figure 16). Reassemble tilt mechanism parts to the base as follows.

a. Lightly grease teeth of worm gear (9), gearshaft (5) and gear rack (3). Assemble tension washer (7) to gearshaft (5) with the bowed face toward the gear. Insert the shaft through the hole in the base and assemble retaining ring (4) to the groove in gearshaft.

b. Fasten tilt adapter (2) loosely to the base with screw (1). Assemble gear rack (3) and worm gear (9) into the base, holding the worm gear between the two formed ears of the base with all gear teeth (worm gear, gearshaft and gear rack) engaged. Secure the worm gear with a new spring pin (8).

c. Position tilt adapter (2) so that the gear rack does not bind in the rectangular cut-out and tighten adapter screw (1) securely.

21. REASSEMBLING FRONT COVER AND SPEAKERS (Figure 15). No special instructions are required for reassembling the front cover and speakers. Be sure to check all wiring connections carefully before making the final reassembly steps.

22. REASSEMBLING APERTURE PLATE (Figure 14). Reassemble aperture plate parts as follows.

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

b. Assemble the side tension spring (7) and the film tension rail (6) to the aperture plate. The ends of the spring should engage the notches in the film tension rail and the center of the spring should bear against the staked pin in the aperture plate. Assemble the spacer bushings (5) and spring retaining cover (4) to the aperture plate and install the two screws (3).

c. Attach the film guide rail (2) to the aperture plate with the two screws (1), tightening the screws securely. Refer to paragraph 25 for installation instructions.

d. If the black paint on the aperture has been scratched or worn away, touch up the area with flat black paint and allow to dry.

23. REASSEMBLING THE LENS CARRIER (Figure 13). Reassemble the lens carrier parts as follows.

a. Lightly grease the gear teeth of the pinion assembly (10), the pinion slots of the carrier (11) and the notches of the pinion spring (9).

b. Assemble the pinion into the grooves of the carrier (11). Assemble the spring (9) into the two grooves of the pinion assembly (10). Fasten the spring securely with the two screws (8). Check to make certain that the knob rotates smoothly.

c. Place the pressure plate (2) on the work surface, polished surface down and the forked end of the plate to the left. Assemble the pressure plate lever (5) to the pressure plate with the small extrusion of the lever fitted into the corresponding hole in the pressure plate. Assemble the flat washers (3), springs (4) and the adjustment plate (7) to the pressure plate. Install and tighten the screws (1).

d. Slip the adjustment plate, with pressure plate assembled, into place within the lens carrier and loosely install the two screws (6). Insert the lens plug (item 2, Figure A) into the lens bore of the lens carrier with the rectangular boss of the plug fitted into the opening in the pressure plate. Tighten screws (6) securely and withdraw lens plug.

e. Clean the nameplate area of the lens carrier with a cloth dampened with solvent. Remove the backing from the nameplate (item 5A, Figure 9) and activate the adhesive as instructed in paragraph 19, step d. Assemble the nameplate to the lens carrier and wipe away excess adhesive with a soft cloth dampened with solvent.

f. Refer to paragraph 27, step h, for lens carrier installation instructions.

24. REASSEMBLING THE MECHANISM (Figure 12). Reassemble Figure 12 mechanism parts as follows.

a. Lightly grease both bearing openings in the cast arms of the mechanism housing. Press the ball bearing (35) into its bearing opening until fully seated. Assemble the large bearing (42) to the camshaft (38) until the bearing is seated against the shoulder of the shaft. Install the retaining ring (36) to the camshaft with the concave surface of the ring facing away from the ball bearing.

b. Insert the long end of the camshaft through the bearing hole in the long cast arm of the mechanism housing. As the shaft end protrudes through the cast arm, assemble the loop restorer cam (40) and worm gear (39) to the shaft. Continue sliding the shaft to the left, inserting the end of the shaft into the left-hand bearing (35) while seating the large bearing (42) in the bearing opening of the right-hand cast arm. Make certain that both bearings are fully seated; then install the bearing loading spring (33) to the left-hand cast arm with the two screws (32). Assemble the large retaining ring (41) into the inner ring groove in the right-hand bearing opening. The bowed surface of the ring must face the large bearing (42).

c. Insert a 0.190 inch feeler gage between the loop restorer cam and the cast arm of the mechanism housing. Hold the cam firmly against the feeler gage while tightening its setscrew against the flat of the camshaft. Remove the feeler gage. Tighten the worm gear setscrew enough to hold until final adjustment can be made.

d. Assemble the shuttle retractor pin (31) and in-out spring (30) and insert the rounded end of the pin into the hole in the long cast arm, just to the right of the camshaft. Secure the loop end of the spring to the casting with the screw (29).

e. Screw the framer knob and shaft (28) down into the mechanism housing. Press the stop pin (27) in place. Screw the bearing support (26A) all the way up into the staked nut of the shuttle arm plate assembly (26). Engage the fork-like end of the shuttle arm plate framing arm with the cut-out at the lower end of the framer shaft, and fasten the plate to the cast arm of the mechanism housing with the two screws (25).

f. Loosely assemble the in-out cam (23) to the cam bracket assembly (24) so that the nylon face of the cam follower (24A) rides against the polished surface of the cam (indicated by the dash arrow in Figure 12). Install this assembled group over the end of the camshaft and secure the cam bracket assembly to the cast arm of the mechanism housing with the two screws (22).

NOTE: At this point, refer to Figure 11 and install the assembled aperture plate (29) with screws (28). Then return to Figure 12 and continue with reassembly as follow.

g. Make certain that the shuttle link bearings (20A) are firmly pressed into the notches at the front end of each shuttle arm (20) and that the cam followers (20B) are assembled into the center notched section of each arm (see Figure B). Insert the lubricated cam wiper wick (18) into the coils of the extension spring (16). Assemble the lubricated felt wiper (17) and the extension spring (16) to the shuttle arms as shown in Figure B. Assemble the ball and stud assemblies (15) to the ends of the arms with the hex nuts (14), tightening the nuts only fingertight. Carefully insert the front ends of the shuttle arms between the guides of the in-out bracket assembly (24). Assemble the shuttle (19) to the front ends of the shuttle arm so that the shuttle teeth extend through the shuttle slot in the aperture plate and face in toward the mechanism housing. Rotate the in-out cam

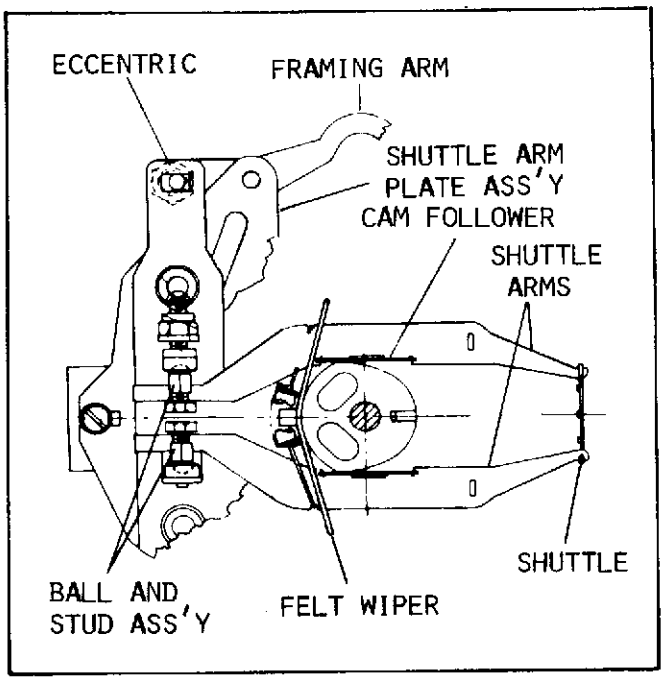


Figure B. Shuttle and Shuttle Arms Assembled

(23) until the tongue protruding from the unpolished surface of the cam rests down in the notch in the shoulder of the camshaft. Assemble the pull-down cam (21) to the camshaft, spreading the shuttle arms lightly until the cam is fully in place. The notch in the inner face of the pull-down cam must engage a mating protrusion on the face of the in-out cam. Back out the bearing support (26A) until its socket-like nylon pad engages the ball of the upper stud assembly (15). The ball of the lower stud assembly should rest in the socket of the nylon pad mounted on the shuttle arm plate assembly (26). It may be necessary to loosen the hex nuts (14) and shift the ball and stud assemblies (15) until proper alignment is obtained.

h. Install the fiber washer (13) on the camshaft and up against the pull-down cam (21) so that the slot in the washers is aligned with the slot in the cam. Assemble the shutter (12) to the camshaft and install the counterbalance weight (11) so that its pin engages the slots in the shutter and the pull-down cam. Install the shutter nut (10) with its shoulder in the center hole of the counterweight. Grip the flats at the end of the camshaft with an open-end wrench and tighten the nut (10) securely.

i. Assemble the heat baffles (7) and (9) with spacer washers (8) and secure this group of parts to the mechanism housing beneath the shutter with the two screws (6). Attach the douser (5) to the mechanism housing with two screws (3) and washers (4). Assemble the pulley (2) to the end of the camshaft and tighten the setscrews (1) down on the flats of the shaft.

25. REASSEMBLING THE MECHANISM (Figure 11). Reassemble Figure 11 mechanism parts as follows.

a. Attach the self-centering assembly (27) to the mechanism housing with the two screws (24), lock washers (25) and flat washers (26). Assemble the lever and shaft assembly (22) to the mechanism housing and install the washer (21) and arm assembly (20) on the end of the shaft. The fork-like finger of the arm assembly must engage the pin of the self-centering assembly between the two large washers. Insert a 0.0015-inch feeler gage between the washer (21) and the machined boss of the housing. Grip the shaft (22) and arm (20) to hold the feeler gage while tightening the hex head screw (19); then remove the feeler gage. Assemble the retaining ring (23) to the shaft assembly (22).

NOTE: The shaft assembly (22), when installed, must be positioned approximately as shown in Figure 11, with the notched area in its upper edge positioned beneath the lower sprocket shaft bearing of the mechanism housing.

b. Assemble the cam follower parts (18A) through (18F) as shown in Figure 11. Attach this assembled group to the arm assembly (20) with the screw (16) and washer (17). Tighten the screw just enough to hold the follower group. Hook one end of the spring (15) around the end of the lever shaft (22) and secure the other end to the mechanism housing with the screw (13) and washer (14).

c. Assemble the film escape mechanism components (10A) through (10G) in the following manner. Assemble the hub assembly (10F) to the locking pawl (10E) with the screw (10D). Insert the shaft (10B) through one ear of the upper loopformer assembly (10G) and install the spring (10C) and the assembled hub and pawl on the shaft. Then engage the end of the shaft with the second ear of the loopformer. Assemble the retaining rings (10A) to the shaft, with the center ring between the spring (10C) and hub assembly (10F). Hook one end of the spring over the outer ear of the loopformer and hook the other end behind the upper finger of the hub assembly (10F). The spring should tend to rotate the hub and locking pawl in a clockwise direction.

d. Install the torsion spring (8), short leg first, on the shaft of the shaft and link assembly (7) and insert the shaft through the bearing in the mechanism housing. Hook the long leg of the spring beneath the tapped mounting boss in the upper left-hand corner of the mechanism housing. Hook the short, bent end of the spring behind the left edge of the link. Assemble the washer (9) and the film escape mechanism parts (step c, above) to the protruding end of the shaft (7) and temporarily tighten the setscrews (6).

e. Attach the upper sprocket guard mounting plate (5) to the mechanism housing with two screws (4), the upper screw being inserted through the half-moon slot in the upper loopformer (10G).

f. Attach the lens carrier catch (3) to the mechanism housing with the screw (2). Turn the hex head lens stop screw (1) into the tapped hole in the housing until only one thread is visible. It may be necessary to adjust the catch and stop screw at final assembly to insure proper operation of the lens carrier.

26. REASSEMBLING THE MECHANISM (Figure 10). Reassemble Figure 10 mechanism parts as follows.

a. Assemble the shuttle retractor (27F) to the connecting link assembly (27G) with the screw (27C) lock washer (27D) and flat washer (27E). Assemble the upper loopformer assembly (27B) to the upper end of the connecting link (27G) and install the retaining ring (27A). Slip the pin end of the threading lever (26) up behind the link (item

7, Figure 11), engaging the pin with the rectangular slot in the link. Insert the shaft of the loopformer assembly through the mounting plate (item 5, Figure 11), and mechanism housing, and into the hub of the threading lever (26). Tighten the hex head locking screw (25) securely. Attach the leaf spring (24) to the upper loopformer with two screws (23).

b. Assemble the small hole in the film guide (22) over the pin in the lower sprocket guard mounting plate (21) and hold the film guide in place while inserting the shaft of the toggle lever assembly (21B) through the guard plate. The forked end of the toggle lever must straddle the film guide mounting pin. Secure the toggle lever to the mounting plate with the retaining ring (21A). Engage the remaining forked end of the toggle lever with the pin at the lower end of the connecting link (27G) and secure the lower mounting plate (21) to the mechanims housing with the two screws (20). The film guide (22) must be lifted slightly during this operation so that its large pivot hole slides over the sprocket shaft bearing in the housing.

c. Assemble one large washer (18) and the lower film guide (19) over the lower sprocket bearing, at the same time inserting the pin at the lower end of the connecting link (27G) through the hole in the arm of the film guide (19). Install the second large washer (18) and secure these parts with the retaining ring (17).

d. Fasten the back-up bracket (16) to the mounting plate (21) with the screw (15). Assemble the loopformer (13) and the torsion spring (14) onto the lower pin of the connecting link (27G) and install the retaining ring (12). The legs of the spring must bear against the underside of the loopformer in such a manner that they will force the loopformer to pivot clockwise around the connecting link pin.

e. Secure the flanged roller (10C) and film guide (10B) to the automatic threading lever (10D) with the retaining ring (10A).

f. Assemble the automatic threading lever (10) and eccentric (9) to the mounting plate (21) with the threaded stud (8). The loopformer (13) must be pivoted counterclockwise and held in that position while installing these parts. Assemble the tension spring (11), short leg first, to the eccentric (9). Hook the short leg of the spring into the hole in the mechanism housing along and to the left of the eccentric (9). Hook the long leg of the spring in the V-like notch along the left edge of the lever (10).

g. Assemble the torsion spring (5) and threading arm (4) to the stud in the lower right-hand corner of the mounting plate (21). Engage the legs of the spring so that they tend to pivot the threading arm clockwise. Install the retaining ring (3) to secure the arm to the stud.

h. Install the rollers (2) on their respective studs and secure them with the screws (1).

27. REASSEMBLING THE MECHANISM (Figure 9). Reassemble Figure 9 mechanism parts as follows.

a. Rotate and hold the lower loopformer (13, Figure 10) fully counterclockwise and assemble the film exit guide (32, Figure 9) to the mechanism housing with the screw (31).

b. Assemble the sprocket guards (27) and (28), rollers (29) and torsion springs (30) to the tapped mounting posts of the guard mounting plates. The rollers must be assembled as shown in the inset of Figure 9. The inner bent end of each spring is inserted into small spring holes in the mounting plates adjacent to the tapped posts. The outer bent end of each spring hooks over the outer edge of each sprocket guard (27) and (28). The springs should tend to rotate the free (unmounted) end of the sprocket guard toward the sprocket bearings in the mechanism housing. Secure the sprocket guards to their mounting post with the screws (25) and the shim washers (26).

c. Assemble spring (24) to the shaft of the rewind button (23) and insert the shaft down into the opening in the top of the mechanism

housing. Depress the button and assemble the retaining ring (22) into the groove at the lower end of the shaft.

d. Assemble the lower sprocket flange (21) and thrust washer (19) onto the shaft of the lower sprocket assembly (19). Spread the two lower sprocket guards and insert the sprocket shaft through the lower bearings in the mechanism housing until the sprocket is fully seated. Release the sprocket guards. Assemble a flat washer (14A), a spring tension washer (14) and the lower sprocket gear (13) to the sprocket shaft, meshing the sprocket gear teeth with the worm gear. Align either setscrew (11) with the groove on the sprocket shaft and tighten both setscrews securely. The sprocket and gear must turn freely but with only a minimum of end play.

e. Assemble the upper sprocket flange (20) and thrust washer (19) to the shaft of the upper sprocket assembly (17). Lift the free end of the upper sprocket guard (27) and insert the sprocket shaft through the upper bearings in the mechanism housing until the sprocket is fully seated. Release the sprocket guard.

f. Assemble the upper sprocket guard parts (16A) through (16D). Slip the assembled sprocket guard (16) up into position beneath the upper sprocket and secure the guard with two screws inserted from the rear of the mechanism housing. Assemble a flat washer (14A), tension washer (14) and the upper sprocket gear (12) to the sprocket shaft. Align either setscrew (11) with the groove on the sprocket shaft and carefully mesh the sprocket gear with the worm gear. Tighten both setscrews (11) securely. The sprocket and gear must turn freely, but with a minimum of end play.

g. Fasten the hood (10) to the mechanism housing with the two screws (9). Press down and hold the upper loopformer (27B, Figure 10) while assembling the threading lever (7, Figure 9) to the lever shaft. Install the retaining ring (6).

h. Hold the assembled lens carrier (5) between the hinge bosses of the mechanism housing. Insert the flat washer (4) on top of the lower hinge boss and the spring tension washer (3) beneath the upper hinge boss. Press the hinge pins (1) and (2) into place to hold the lens carrier. Adjust the lens carrier catch (3, Figure 11) so that it holds the lens carrier firmly against the stop screw (1, Figure 11) in the closed position; yet permits the carrier to be opened easily.

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

28. REASSEMBLING THE SOUNDHEAD AND EXCITER LAMP COVER (Figure 8). Reassemble the soundhead and exciter lamp cover parts as follows.

a. If exciter lamp mounting pin parts (35A) through (35C) were replaced, assemble the spring (35C) and bushing (35B) into the opening in the casting and insert the mounting pin (35A), forcing the end of the pin carefully through the bushing.

b. Assemble the switch (32) to the bracket (31) and attach the switch bracket to the soundhead casting with two screws (29) and one washer (30). The wiring connection will be made after soundhead installation.

c. Fasten the terminal (34) to the soundhead casting with the screw (33). The free end of the terminal should be approximately at the 5 o'clock position. Loosely assemble the optical slit locking screw (10), the setscrew (19) and the edge guide screw (24) to the soundhead casting. Leave approximately three threads of the guide screw exposed.

d. Apply screw sealant to the end four threads of the roller adjusting screw (14) and assemble the screw to the soundhead, leaving approximately two threads exposed.

e. Assemble the photocell assembly (23) and retainer (22) to the sound drum and shaft assembly (21) and insert the sound drum shaft carefully through the opening in the soundhead casting. Hold the sound drum while tightening the setscrew (19) against

the retainer (22) just enough to hold all parts in place. Install the two screws (20), turning them down in the tapped holes in the sound drum housing.

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

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

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

i. Insert the small end of the stabilizer tension adjuster (27) through the hole in the top of the soundhead casting. Assemble the spring retainer (28) to the adjuster, threading it approximately midway in the threaded area. Before inserting pin end of adjuster into the small hole at the bottom of the casting, assemble the friction washer (26), bowed face up, to the end of the adjuster. Assemble the retaining ring (25) into the groove at the upper end of the adjuster.

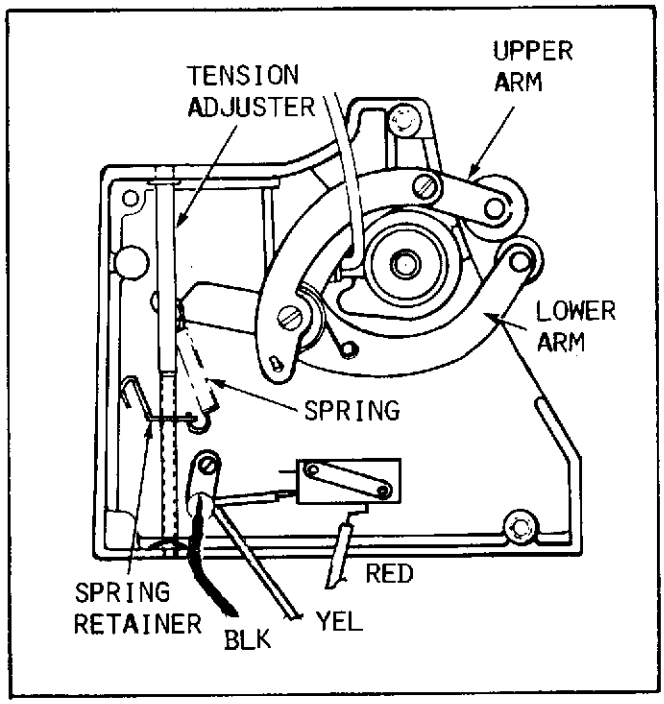


Figure C. Stabilizer Arms Installed on Soundhead

Hook the tension spring (12) between the end of the lower stabilizer arm (15H) and the hole in the spring retainer (28). Install the exciter lamp (8). Refer to paragraph 42 for soundhead adjustments.

j. Reassemble the exciter lamp cover as follows. Remove the cloth backing from the light shield (6) and assemble the light shield to the left-hand inside upper wall of the lamp cover (7) so that it is flush with the outer edge of the cover. Remove any excess or overlap with a sharp knife or razor blade. Assemble the cover screw (2) to the cover and install the retaining ring (1). Press the hole plug (5) into the hole in the cover. Position the film guide (4) over the tapped holes in the cover with the flange of the guide wrapped around the front of the cover, and loosely install the screws (3). Insert a 0.020-inch spacer between the guide flange and the cover, press the flange against the spacer, and tighten the screws (3) securely. Remove the spacer. Refer to paragraph 32 for soundhead installation.

29. REASSEMBLING THE REAR REEL ARM ASSEMBLY (Figure 7). Reassemble the rear reel arm parts as follows.

a. Apply one drop of oil to the unflanged end of the bearing in the rear reel arm (32). Assemble the retaining ring (28) to the rear reel arm shaft (31) in the groove nearest the two narrow flats on the shaft. Assemble the thrust washer (29) over the long end of the shaft and down against the retaining ring. Insert the shaft through the reel arm bearing. Assemble the face gear (27) to the reel arm shaft (31), gear teeth facing up, and tighten setscrew (26) against flat of shaft.

b. Assemble the nylon bearings (25) into the cast bearing arms of the rear reel arm, engaging the key tabs of the bearings with the cross-slots of the bearing holes. Assemble the lower gear (22) to that end of the gear shaft (24) where the flats are nearest the end. The gear face with the square recess must face away from the cast bearing boss. Install the gear retaining clip (21). Insert the gear shaft through both nylon bearings (25). Assemble the washer (23) and gear retaining clip (21) to the end of the gear shaft. Install the upper gear (20), square recess facing inward to engage clip (21), and assemble grip (19) to the end of the shaft. Insert a 0.030 inch feeler gage between upper gear (20) and washer (23) and press grip ring (19) in against the gear. Remove feeler gage.

c. Assemble the rubber sleeve (12) to the hub of the face gear (14). The sleeve must rest down against the shoulder of the gear. Insert the small diameter end of gear shaft (16) up through the hole in the lower end of the reel arm. Hold the shaft in place and assemble the washer (15), the face gear (14) and the large washer (11) to the gear shaft. Secure these parts with the retaining ring (10).

d. Install the setscrew (13) into the tapped hole in the reel arm casting near the lower end of gear shaft (16). Do not tighten the setscrew. Move the gear shaft (16) to engage the teeth of the face gear (14) with the lower spur gear (22) and tighten the setscrew (13). Rotate the face gear in both directions to check backlash. There should be approximately 0.005 to 0.018-inch backlash around the total gear circumference. If necessary, loosen the setscrew (13) and remesh gear teeth until proper backlash is obtained; then tighten the setscrew securely.

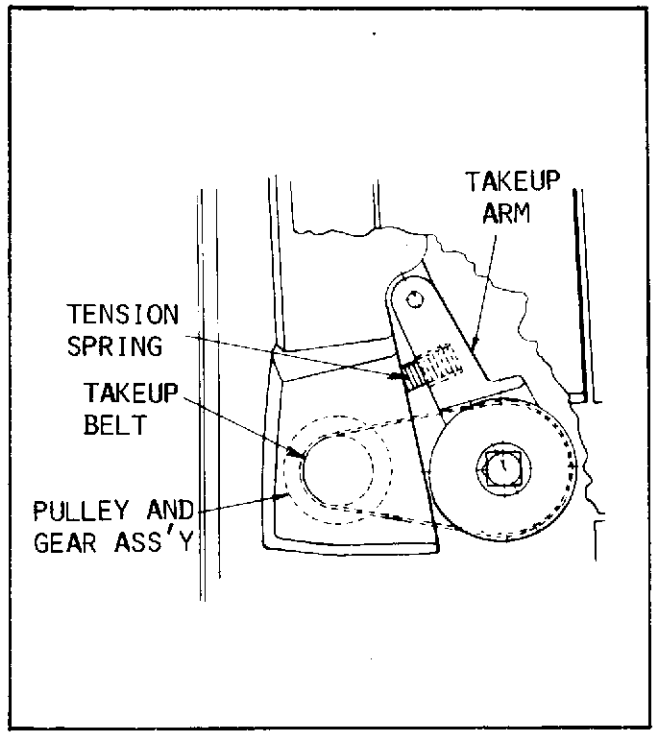


Figure D. Take-Up Arm Assembled

e. Apply a light film of grease to all gear teeth and to the hub of the upper face gear (27). Assemble the torsion spring (18) to the hub of face gear (27) with the loop of the spring over the casting boss near upper spur gear (20). Secure the spring loop to the boss with the retaining ring (17). Rotate the upper face gear in both directions to make certain that the retaining ring does not restrict movement of the spring loop on the boss. Reposition retaining ring if necessary.

f. Apply one drop of oil to the mouth of the bearing in the take-up arm assembly. Assemble the washer (8) to the shaft of the take-up spindle (7) and insert the shaft through the take-up arm bearing. Install and tighten the screw (6). Assemble the take-up arm to the mounting pin in the reel arm. Assemble the take-up belt (4) around the spindle pulley and the rubber sleeve of the lower face gear. See Figure D. Insert the tension spring (5) into the recess in the take-up arm and compress the spring with a piece of shim stock while assembling the reel arm cover (2) to the reel arm. Install and tighten the two screws (1). Refer to paragraph 33 for reel arm installation.

30. REASSEMBLING THE FRONT REEL ARM ASSEMBLY (Figure 6). Reassemble the front reel arm parts as follows.

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

b. Place the reel arm (22) on the bench with the lower (spindle) end of the arm at your left. Assemble nylon bearings (21) into the cast bearing bosses of the reel arm, engaging the key tabs of the bearings with the cross slots in the bearing bosses. Insert gear shaft (20) through the nylon bearings from right to left, make sure that the end with the flats furthest from the tip of the shaft is at the right (upper end of the reel arm). Assemble lower spur gear (19) to the left end of the shaft. The gear face with the square recess must face away from the cast bearing boss. Install gear retaining clip (17) to the flats of the gear shaft. Assemble washer (18) and the second gear retaining clip to upper end of gear shaft (20). Assemble upper spur gear (16) to the shaft, with the square recess of the gear engaging the retaining clip. Install grip ring (15) on the end of the shaft. Insert a 0.030-inch feeler gage between the upper spur gear (16) and washer (18), and press the grip ring in against the gear. Remove the feeler gage.

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

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

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

f. Carefully assemble the cover (2) to the reel arm. Install and tighten the two screws (1). Refer to paragraph 33 for reel arm installation.

31. REASSEMBLING THE BASE CONTROLS (Figure 5). Reassemble the base controls parts as follows.

a. Assemble edge connector (33) to the amplifier assembly (35) and position these components carefully within the projector base (38). Assemble spacers (36) with heat sink compound (P/N 70910) between the amplifier and base and loosely install the three screws (34); then install the two edge connector screws (32) and tighten all five screws securely. Be sure that all leadwire harnesses are properly dressed within the base.

b. Assemble volume/tone control assembly (31) into the projector base with the knurled knobs protruding into the rectangular cut-outs in the base. Install mounting screws (28) and (29) and spacer (30). Make certain that the knobs are not binding in the cut-outs. Refer to the wiring diagram for leadwire connections.

c. Assemble servo amplifier (27) into the base and install mounting screws (26). (Use heat sink compound P/N 70910.) Refer to the wiring diagram for proper leadwire connections.

d. When assembling changeover switch (21A) and microphone jack (21B) to the control bracket (21), be sure washers (22), (23) and (24) are assembled to the switch and jack shafts as indicated. Insert the assembled control bracket assembly into the base and secure with the two screws (20). Refer to the wiring diagram for proper leadwire connections.

e. Make a final inspection of all leadwire connections; then install amplifier cover plate (19) with its screws (18) and the volume/tone control cover plate (16) with its screws (15). Secure the rubber feet (13) and washers (14) to the corners of the base with the screws (12).

f. Turn the base right-side up and assemble the mainplate assembly (9) to the uprights of the base with four screws (8).

NOTE: At this point, refer to Figure 4 and carefully assemble the complete mechanism assembly (29) to the mainplate with the four screws (27), the upper two screws also serving to attach the idler gear adjustment bracket (28). Check for the presence of the rubber tip (30) on the end of the threading arm. See paragraph 33, step a, for solenoid and douser adjustment. Return to Figure 5 for the balance of reassembly as follows.

g. Assemble a roller (7C) and the adapter (7D) to the shaft at the squared end of film guide bracket (7B). Assemble the second roller (7C) to the shaft at the rounded end of the film guide bracket and install both retaining rings (7A). Engage the free end of the adapter (7D) with the guide rails of the film guide which is assembled to the lower rear corner of the mechanism assembly. Lower the rear end of the film guide assembly (7) so that the ears of the adapter (7D) are between the cast ears of the base. Hold the guide roller (5), large diameter facing out, between the ears while installing the adapter shaft (4) through the cast ears and roller. Install screw (6) to secure the assembly.

h. Assemble automatic threading arm stop (11) to the base with screw (10). Before tightening the screw, insert a 0.060-inch shim between the arm stop pin and snubber lever of the mechanism assembly. Rotate the stop until the stop pin just touches the shim and hold the stop securely while tightening screw (10). Remove the shim.

32. DRIVE GEARS AND SOUNDHEAD (Figure 4). Reassemble the drive gears and soundhead parts as follows.

NOTE: The complete mechanism assembly (29) was installed as part of the Figure 5 reassembly procedure (paragraph 31).

a. Carefully assemble the soundhead assembly (26) to the mainplate while guiding the sound drum shaft and leadwires through the opening. Hold the soundhead securely while installing and tightening the three mounting screws (23) and washers (24). Refer to the wiring diagram for proper leadwire connections.

b. Assemble flat washer (22) and tension washer (21) to the sound drum shaft. The bowed face of the tension washer must face the mainplate. Install flywheel (20) and flat washer (19) to the shaft and press in on the flywheel until retaining ring (18) can be installed. Spin the flywheel to make certain that all parts operate smoothly.

c. Assemble gears (17C), hubs inward, to the gear studs of rewind lever (17D). Secure the gears with washers (17B) and retaining rings (17A). Hook the bent end of the long leg of torsion spring (16) through the hole in the upper lip of the rewind lever (17D) and assemble the spring loop and the rewind lever to the gear stud of the mainplate (located near the upper left-hand corner of the cut-out for the mechanism assembly). Wind the short leg of the spring (16) one full turn counterclockwise and hook the bent end behind the edge of the cut-out. Assemble idler gear (15), hub facing inward, and washer (14) to the protruding gear stud, meshing gear (15) with both gears (17C). Secure gear (15) with retaining ring (13).

d. Lubricate per lubrication instructions and then assemble the idler gear (9B) to the gear stud of arm assembly (9C) with the long gear hub facing out and secure with retaining

ring (9A). Assemble rewind clutch assembly (12) and washer (11) to upper sprocket shaft and assemble retaining clip (10) to the flats of the shaft. Assemble the large hole of idler arm (9) over the inner shoulder of spur gear (7) and install these parts and washer (8) on the upper sprocket shaft. Slide gear (7) in until its square recess engages retaining clip (10). The staked pin of the idler arm must be inserted into the triangular cut-out in the rewind lever (17). Install tension washer (5), bowed face out, and retaining ring (4).

e. Install washers (3) and spur gears (2) hubs out, on their respective gear studs and secure them with retaining rings (1). Speck all gear teeth sparingly with grease. After the projector is assembled and operable, lubricant can be distributed by running the projector briefly.

33. POWER DRIVE COMPONENTS AND REEL ARMS (Figure 3). Reassemble the power drive and reel arm parts as follows.

NOTE: When reassembling electrical components to the projector, refer to the wiring diagram for proper leadwire connections. Be sure to dress leadwires so they do not interfere with the projectors moving parts.

a. Assemble amplifier reset switch (30) to the mainplate in the bottom left-hand (rear) corner with its mounting nut. Connect leadwires as necessary. Attach solenoid assembly (28) at the rear of the mainplate with two screws (27). Connect upper end of solenoid link rod to the douser. Place the plunger in the solenoid. Loosely assemble the screws to the solenoid. Adjust douser by moving solenoid up or down accordingly. Tighten screws. See paragraph 40 for final adjustment.

b. Insert a coil spring (26) and lock button (25) into the opening to the right of the rear reel arm mounting hole in the mainplate. Hold the button in while assembling the rear reel arm (24) to the mainplate. When the arm is fully in place, withdraw the shim stock and assemble the reel arm disc (22) over the protruding shoulder of the reel arm. The bent fingers of the disc should point away from the mainplate. Align the screw holes in the disc with those in the reel arm and install and tighten the screws (21). Install the front reel arm components in the same manner.

c. Assemble retaining clip (20), gear (19), clutch gear (18) and rewind clutch bearing assembly (17) to the front reel arm shaft and secure all parts with retaining ring (16). Assemble shim washer (15) and gear assembly (14) to the rear reel arm shaft and secure with retaining ring (13). Speck all gear teeth lightly with grease and rotate gears to distribute the lubricant.

d. Assemble drive motor (12) and its mounting brackets (11) to the projector base with screws (10). When installing the motor pulley (9), align its grooves visually with the mechanism pulley above before tightening the two pulley setscrews (8). Loop the drive belt (7) between the two pulleys.

e. Secure the fuseboard assembly (34) with the standoff (35) and screws (33). Press the fuses (31) and (32) into their fuse clips.

f. No special instructions are necessary for reassembling blower assembly parts (6), except to make certain that fan assembly (6E) does not strike against the blower housing. The housing enclosures are secured to the projector base with the screws (5).

g. Assemble transformer assembly (2) to its two mounting brackets (4) and secure the transformer with four mounting screws (1).

34. END CAPS AND CIRCUIT BOARDS (Figure 2). Reassemble the end caps and circuit boards as follows.

a. Secure lamp connector assembly (31) to the mainplate with screws (30).

b. Dress lamp leadwires carefully when assembling projection lamp (29) into its lamp holder. Swing the retaining spring to lock the lamp in position.

c. Attach power supply support bracket (28) to the mainplate with two screws (27). Secure lamp power supply assembly (26) to the support bracket with screws (25).

d. Assemble fuse, switch and jack assembly (23) to the projector with screws (22). Connect leadwires as indicated in the projector wiring diagram.

e. Check rear end cap (21) to make certain that all nuts (18) are in position. Lift the end cap up into position and loosely install the two screws that are inserted through the mainplate into the end cap nuts (18). Install the front end cap (10) in like fashion, using screws (9). Carefully lower the projector onto its front face so that the base is exposed. Through the base and into each end cap, install screws (19) into the rear end cap and screws (7) into the front end cap. Note that a spacer (8) is required at the front end cap. Tighten all screws securely.

j. Assemble tilt knob assembly (6) to the end of the tilt shaft with two setscrews (5). Be sure to position the knob so that the tilt mechanism operates freely. If rubber feet (4) are to be replaced secure them to the tilt bar (3) with 3M Co. #1711 adhesive. Assemble the tilt bar to the projector with washer (2) and screw (1).

k. When assembling the printed circuit boards to the projector, be sure that all wiring connections have been properly and securely made. Refer to Figure 1 and attach the lamphouse.

35. PROJECTOR COVERS (Figure 1). Reassemble the projector covers as follows.

a. Attach the lamphouse cover assembly (13) and air baffle (12) with screws (10) and (11) and actuate the cover to make certain that it swings easily from closed to open positions.

b. All adhesive-backed data plates and nameplates are to be installed as instructed in step d, paragraph 19.

c. No special instructions are required for the installation of the various projector covers. Use the exploded view illustrations to orient and install these covers. The fuses (2) and (3) can be installed at any time.

d. Do not install the rear cover assembly (8) until all final tests and adjustments have been made. Using the special screwdriver bit (item 15, Figure A) attach the rear cover to the projector with the eight "tamperproof" screws (4), (5) and (6) and three lockwashers (7). Upon completion of all tests and adjustments, reinstall all covers.

ADJUSTMENTS AND TESTS

36. GENERAL INSTRUCTIONS.

The alignment and adjustments covered in this section are necessary to the proper operation of the projector. Even though the projector may not have under gone complete overhaul and repair, it is recommended that all adjustments be checked as a routine measure. Routine adjustments such as those applicable to sliding fits, clearances and end play have been covered in the reassembly procedures and are not repeated here except where they directly affect other adjustments or alignments.

CAUTION

Do not attempt to make adjustments to the Control Circuit Board or the Power Supply Assembly. The policy regarding these items is covered in paragraph 18.

All special tools and fixtures required to perform the adjustment procedures are listed and illustrated in Figure A. In addition, special test films and electronic test equipment (vacuum tube voltmeter, volt-ohmmeter, oscillator and tachometer or Strobotac) are needed to check and adjust the sound system of the projector. The test films are listed in the Introduction section.

WARNING

Many of the procedures listed in this section require operation with the rear projector cover removed. To avoid shock hazards, disconnect the power cord except when actual operating tests are being performed. Unless you are checking the lamp circuit also remove the "Lamp" fuse (item 23B, Figure 2). This will disable the lamp power supply.

37. OPTICAL ALIGNMENT.

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

NOTE: It may be necessary to remove the mechanism assembly from the projector to make the shuttle adjustments outlined in paragraph 38.

a. Remove the projection lens from the lens carrier. Open the lamphouse and remove the projection lamp and the condensing lens assembly.

b. Swing the lens carrier fully open and disassemble the pressure plate from the lens carrier.

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

d. Insert the alignment rod (Figure E) through the lens plug until the rod end protrudes enough to install the spring (P/N 6124). Insert the lens plug into the lens barrel until the tip of the alignment rod engages the aperture plug previously installed. Tip the projector carefully onto its back (lens opening facing up). The alignment rod must slide freely through the aperture plug without binding. If necessary, shift the aperture plate slightly until free rod movement is obtained; then tighten aperture plate screws.

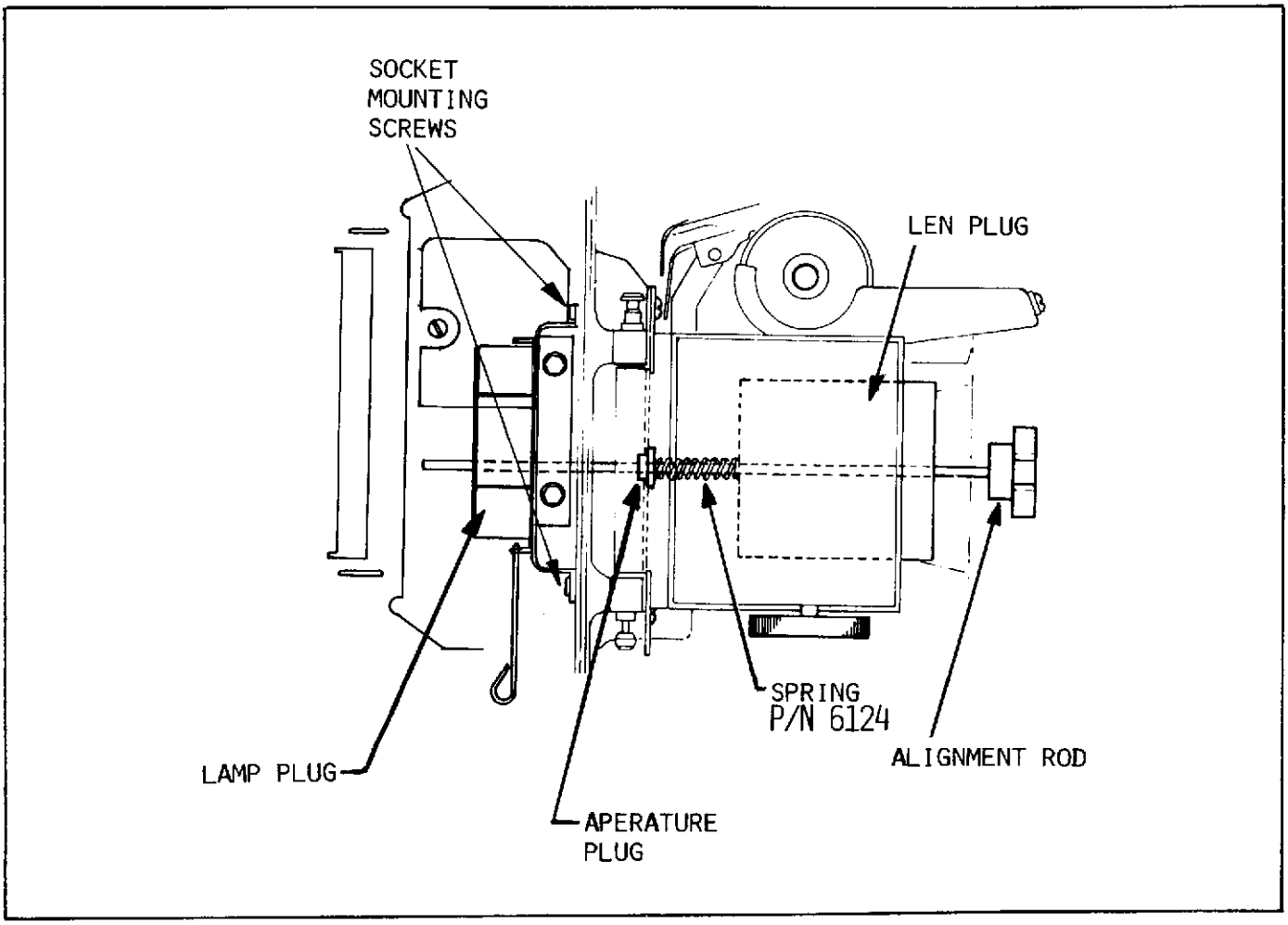


Figure E. Aligning the Optical System

NOTE: If the paint on the aperture or pressure plate is badly worn or scratched, touch up with flat black paint. This will insure that reflections are not projected on the screen.

38. ADJUSTING THE INTERMITTENT MECHANISM.

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

(1) Aperture plate out of alignment. See paragraph 37.

(2) Shuttle stroke incorrect. See paragraph 38, Shuttle Stroke Adjustment.

(3) Link bearing missing from end of shuttle arm. Partial disassembly required to remove shuttle arm and replace link bearing (refer to Disassembly section).

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

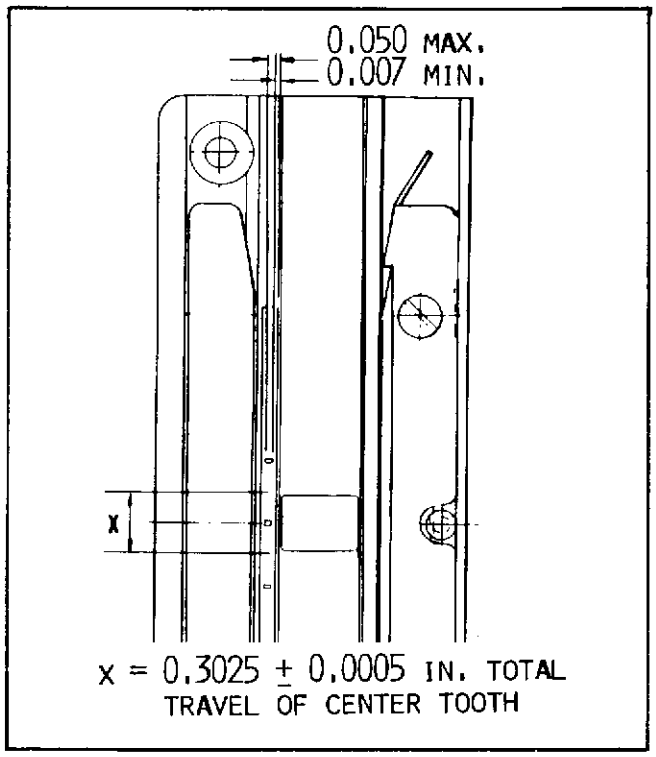


Figure F. Aperture Plate and Shuttle Tooth Clearance

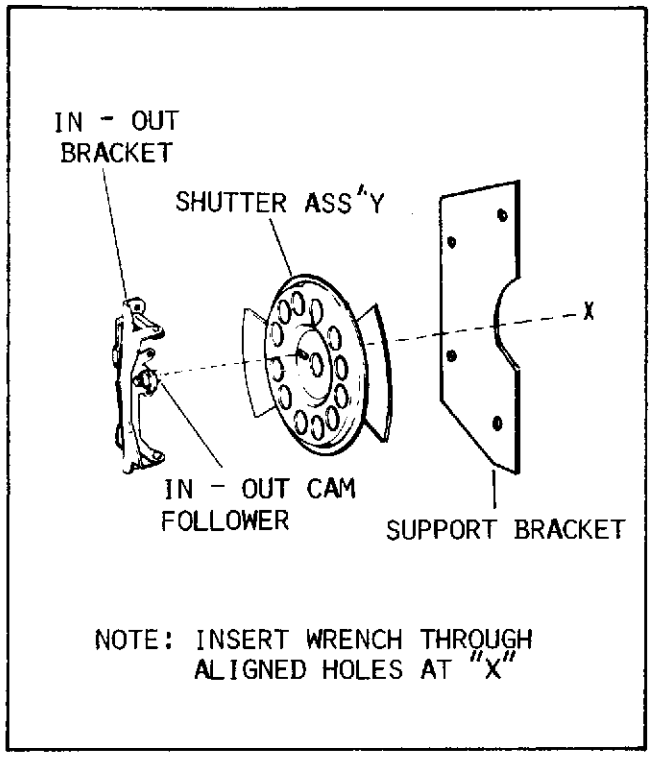


Figure G. Adjusting Shuttle Tooth Height

b. Checking Shuttle Tooth Height. Swing open the lens carrier and advance the mechanism manually until the shuttle is at the center of its stroke as shown in Figure F. Hold the shuttle tooth height gage (item 7, Figure A) by its knurled handle and place it against the aperture plate between the rails. The center ears, on either side of the gage handle, are the height gages. Slowly slide the gage downward. The "Go" ear should pass over the shuttle tooth without catching. Rotate the gage so that the "No-Go" ear is over the shuttle slot and once more slide the gage downward. The "No-Go" ear must not pass over the shuttle teeth. If the shuttle teeth are too high or too low, adjust height as follows.

NOTE: If the mechanism assembly is installed on the mainframe, it will be necessary to remove the lamphouse and the projection lamp before proceeding.

(1) Turn the mechanism drive pulley by hand until the access holes in the shutter and the douser bracket are aligned (see Figure G).

(2) Insert a No. 4 Bristol Wrench into these access openings and engage it in the socket of the in-out cam follower screw.

(3) If the shuttle teeth were too low ("No-Go" ear passes over shuttle teeth), turn the cam follower screw counterclockwise to increase shuttle tooth height. If the shuttle teeth were too high ("Go" ear catches against shuttle teeth), turn the cam follower screw clockwise. It may be necessary to recheck shuttle tooth height with the gage several times before the proper height has been obtained.

(4) If one of the teeth cannot be brought into tolerance by the above method, it may be necessary to loosen the screws which attach the in-out bracket (Figure G) and then shift the bracket slightly. Tighten the mounting screws securely and check and adjust shuttle tooth height as outlined above.

c. Checking Fit of Shuttle Arms to Pull-Down Cam (See Figure H). Remove rear cover and the projection lamp.

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

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

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

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

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

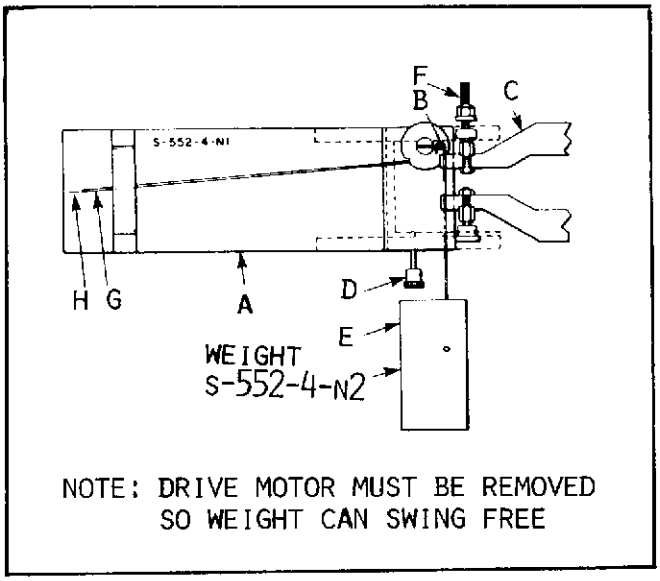


Figure H. Adjusting Fit of Shuttle Arms to Pull-Down Cam

CAUTION

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

d. Checking Shuttle Stroke. Normal shuttle stroke (vertical travel of shuttle teeth) is 0.3025 inches (Figure F). The most convenient means of measuring the stroke is to use the projector as an optical comparator. The step on the stroke gage (item 6, Figure A) is the length of the nominal stroke. When it is inserted in the aperture and projected, it provides a reference dimension with which the actual stroke can be compared. A sketch of a target is shown in Figure J. The A to B section is a 100 to 1 enlargement of the gage. The C and D lines represent 10 to 1 enlargements of the limits of tolerance.

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

(a) Remove pressure plate assembly from the lens carrier.

(b) Set the framer knob at the mid-point of its over-all travel.

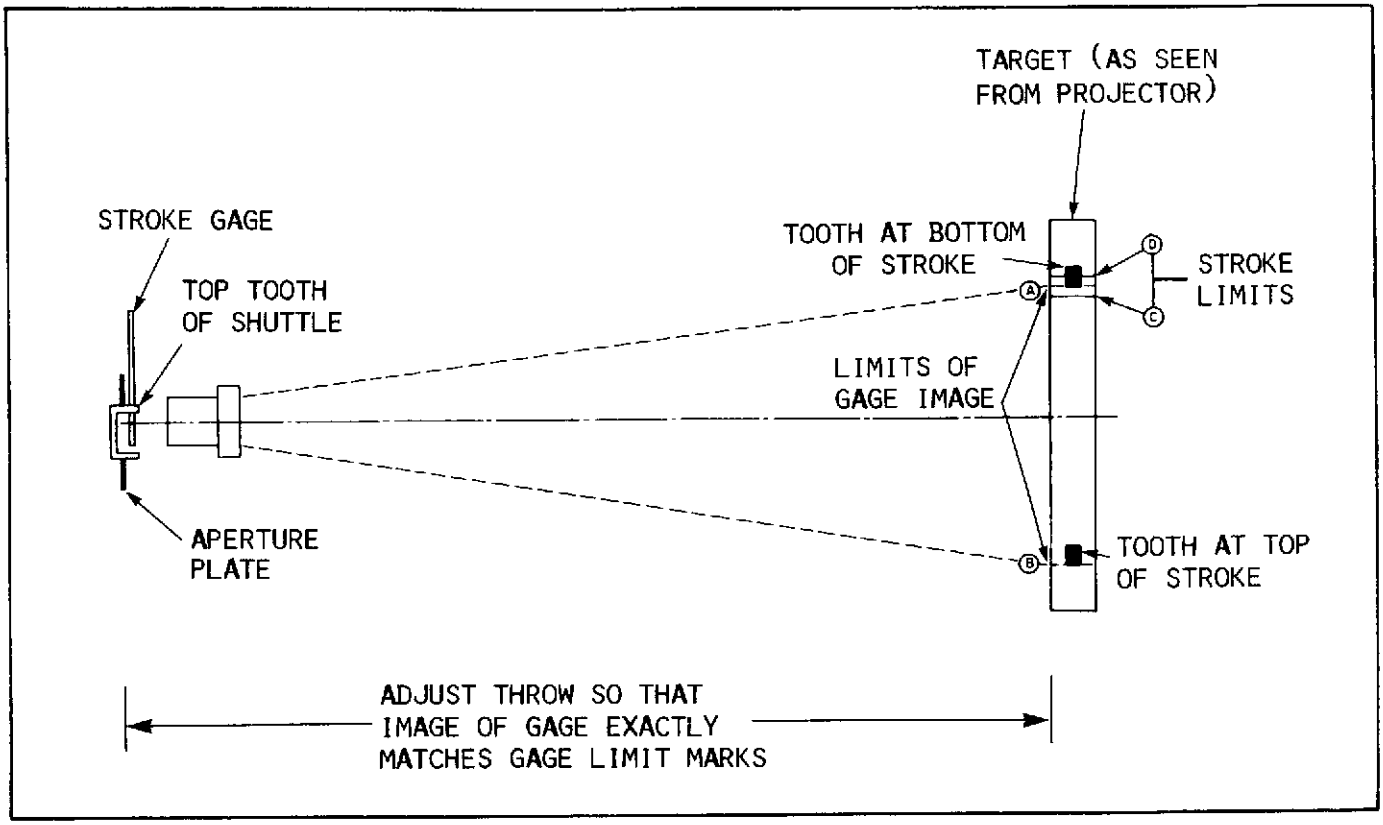


Figure J. Checking and Adjusting Shuttle Stroke with Target

(c) Suspend the target approximately 18 feet from the projector with center of target on same horizontal line as optical axis of projector. If room arrangement necessitates tilting projector, target must also be tilted so that angle between the target and optical axis is 90 degrees. If this is not done, "Keystone" error will result.

(d) Open the lens carrier and turn the projector mechanism by hand until shuttle is at bottom of stroke and shutter just clears aperture.

(e) Insert stroke gage (S-550-5-N2) in the aperture plate and lightly press it down against the top tooth of the claw. Close the lens carrier.

(f) Turn on the projector lamp and focus the image of the shuttle slot on the target. Move projector toward or away from the target until a sharply focused image of the step at end of stroke gage just reaches from line A to line B (Figure J).

(g) Slide the stroke gage up out of field-of-view and turn mechanism pulley until center tooth of shuttle is at top of stroke indicated by image of tooth near line A. Adjust framer, if required, until projected image of edge of tooth just touches line A.

(h) Turn mechanism pulley until center tooth of shuttle reappears at top of target. Rock mechanism pulley to find top of shuttle stroke. Edge of tooth used as reference in step (g) must fall between lines (C) and (D) (Figure J). If image falls between (C) and (A), stroke is too short. If image falls beyond (D), stroke is too long.

(2) Procedure for Adjusting Shuttle Stroke. Loosen the two shuttle plate mounting screws just enough to permit movement of the shuttle arm plate.

(a) To lengthen the stroke, shift the shuttle arm plate toward the pull-down cam.

(b) To shorten the stroke, shift the shuttle arm plate assembly away from the pull-down cam.

(c) After adjusting stroke, recheck shuttle tooth side clearance as instructed in paragraph 38, step a, and readjust if necessary.

CAUTION

Do not attempt to eliminate film slap by setting stroke outside established tolerance. This will produce double image and/or jump with films having different shrink or stretch.

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

39. LENS CARRIER ADJUSTMENT. Angular relationship between the lens carrier and the aperture plate is controlled by lens mount stop screw (item 1, Figure 11). Thread projector with roll title or target film having sharp images in corners and project a picture approximately 30 inches high onto a matte surface. The projector must be square with the screen. Focus the picture and compare resolution of the two sides of the image when viewed from a distance of approximately twice the width of the picture. If one side appears to be soft, refocus to sharpen that edge of the picture and note whether the lens is moved toward or away from the aperture. Loosen the lens carrier catch screw. Adjust the lens carrier catch accordingly and tighten screw.

40. ADJUSTING THE DOUSER.

When the projector has been completely assembled, install the projection lamp and lens. With the lamp on and the projector in the stop position, there should be no light leak through the lens. Note that a bent ear on the douser bracket limits the travel of the shutter arm. If light appears at the top or bottom of the aperture image, it will be necessary to adjust the solenoid so that the amount of arm travel is increased or decreased accordingly.

41. ADJUSTING THE REEL ARMS AND REWIND CLUTCH.

a. Front Reel Arm Adjustment (See Figure 6). Adjust end play of the shaft (14) to 0.008 inch ± 0.003 inch by positioning retaining ring (11) against an 0.008 inch shim. The backlash for both face gears should be between 0.005-inch (minimum) and 0.016-inch (maximum). Adjustment is made by loosening the face gear setscrews (5A), (8) and (8A) and repositioning the face gears (5B) and (9) as necessary.

b. Rear Reel Arm Adjustment (See Figure 7). Adjust end play of the shaft (31) to 0 .008 inch ± 0.003 inch by positioning retaining ring (28) against an 0.008 inch shim. The backlash for both face gears should be between 0.005-inch (minimum) and 0.018-inch (maximum). The upper gear (27) is adjusted by loosening its setscrew (26) and repositioning the gear as necessary. The lower gear (14) is adjusted by loosening the setscrew (13) in the tapped hole of the arm and shifting the shaft (16) in and out as necessary.

c. Rewind Clutch Adjustment. The rewind clutch system must be adjusted to produce a supply spindle torque of 35 to 55 inch-ounces when the rewind button is pressed during operation. Install an empty 1200 foot reel on the supply spindle and wrap several turns of film around the reel hub. Hook a spring scale to the free end of the film

strip. Turn on the projector to "Reverse" and press and release the rewind button at the top of the mechanism housing. The spring scale must register between 14 to 22 ounces when the rewind clutch system begins to slip. Rewind torque (also 14 to 22 ounces) is adjusted by means of the rewind clutch assembly (item 12, Figure 4). This clutch is installed with the adjusting nut facing inward toward the mainplate, and a special wrench (item 5, Figure A) must be used for the adjustment.

42. ADJUSTING THE SOUNDHEAD.

a. Soundhead Removal.

(1) Remove the projection lens from the lens carrier and wrap it in tissue or a soft cloth.

(2) Loosen the cover thumbscrew and remove the exciter lamp cover from the soundhead.

(3) Remove the rear cover (Figure 1) from the projector. Remove power transformer (Figure 3) from the projector base, being careful not to place undue strain on the transformer leads. Remove flywheel (20, Figure 4) from the sound drum shaft.

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

(5) With a sharp pencil or scribing tool, scribe a line on the projector mainplate along the front edge of the soundhead casting. This will provide a reference mark for locating the soundhead during installation.

(6) Remove the three screws (23, Figure 4) and flat washers (24) and carefully withdraw the soundhead assembly from the projector mainplate.

b. Photocell Alignment (Figure 8).

(1) Loosen the setscrew (19) and the two housing screws (20). Remove the exciter lamp (8) and the optical slit (11).

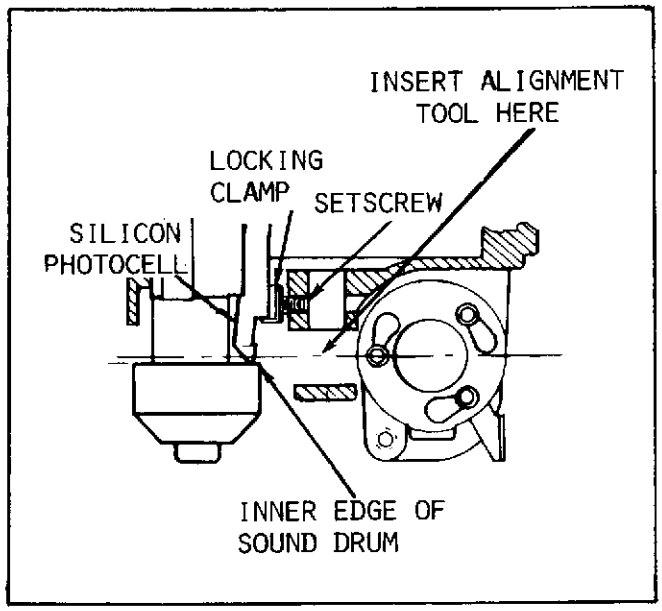


Figure K. Positioning the Sound Drum and Silicon Photocell

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

(3) Press the sound drum in until its inner face just makes contact with the first step, or bearing surface, of the alignment tool, and maintain this contact while tightening the two screws (20) securely.

(4) Withdraw the alignment tool and, while looking into the optical slit mounting hole, shift the photocell until its forward tip is flush with the inner face of the sound drum. Maintain this position while tightening setscrew (19).

c. Roller Tension Adjustment (Figure C). The roller arms are linked by a torsion spring and, therefore, will move as a pair. The counterbalance spring must be adjusted to offset the weight of the rollers and the roller arms. Place the soundhead on a level surface and move the roller arms (as a set) to various positions. If the roller arms fail to remain in the set positions, engage the slotted head of the tension adjuster with a screwdriver and turn the adjuster clockwise or counterclockwise until proper counterbalance is obtained.

NOTE: The following adjustments must be made with the soundhead installed and the projector threaded with special test film.

d. Soundhead Installation.

(1) Carefully assemble the soundhead assembly to the projector mainplate.

(2) Install the three screws (23, Figure 4) with their washers (24) from the rear of the mainplate and tighten the screws fingertight. Shift the soundhead until the forward edge of the soundhead housing is aligned with the scribe or pencil mark on the mainplate and maintain this position while tightening the three screws securely.

(3) Refer to the wiring diagram at the rear of the Parts Catalog section and reconnect or resolder all soundhead leadwires.

(4) Assemble the spring tension washer (21, Figure 4), flywheel (20) and the flat washers (19) and (22) to the sound drum shaft and secure these parts with the retaining ring (18).

(5) Reinstall the power transformer (Figure 3) to the projector base.

e. Optical Slit Adjustment (Figure 8).

(1) Insert the optical slit (11) into its opening in the soundhead. The adjusting hole in the barrel of the slit must be at top center.

(2) Insert a 0.050-inch feeler gage between the tip of the optical slit and the sound drum and press the optical slit in against the feeler gage. Hold in this position while tightening the locking screw (10) just enough to hold the slit in place.

(3) Thread the projector with audio framing test film TFR-D550-NX5 and connect a 16-ohm, 15-watt load resistor and output meter to the speaker jack.

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

(4) Set the volume control at the number 5 position and start projector. Move slit toward or away from film, as required, to obtain an output reading. Rotate the slit to obtain peak reading and simultaneously move in or out until maximum output is obtained. If film was threaded with emulsion toward the optical slit, move slit toward film until output drops 1-1/2 to 2 DB. If emulsion is toward sound drum, move slit away from film to obtain 1-1/2 to 2 DB drop in output. Tighten slit clamping screw (10) securely to lock the adjustment.

f. Buzz Track Adjustment (Figure 8). The lateral position of the film in the soundhead is controlled by the flanged roller (15C) and edge guide screw (24). Unless the adjustment has been disturbed, it is not probable that the edge guide screw (24) will require resetting. Thread the projector with buzz track test loop TFL-37-NX1 and adjust volume control to a suitable listening level. Turn adjusting screw (14) to move flanged roller laterally.

NOTE: Originally two types of buzz track were in use. On one, the track spacing exceeds the length of the scanning beam. This track can be positioned so that little or no signal is reproduced. On the other type of track, spacing is less than the length of the beam. This track should be positioned so that both tones are reproduced at approximately the same volume level. If, after adjustment of guide roller position, signal levels cannot be balanced (or eliminated on wide track), or level of tones fluctuates, adjust edge guide screw (24) to clear up the condition. If the edge guide screw is far out of adjustment, turn it clockwise until it clears the edge of film, adjust rollers and then set guide screw to stop weave of film.

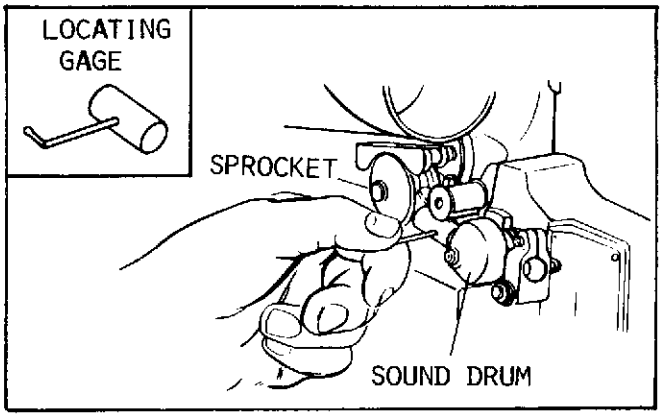


Figure L. Positioning the Soundhead

g. Positioning the Soundhead.

(1) Lock the automatic threading system in the load position and loosen the three soundhead mounting screws (23, Figure 4) just enough to permit the soundhead to be shifted.

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

(3) Tilt the gage so that it lies on a centerline between take-up sprocket and sound drum. Shift the soundhead toward the take-up sprocket until the sound drum bears lightly against the end of the gage, and tighten the soundhead attaching screws securely.

43. PROJECTOR SPEED ADJUSTMENT. The speed of the projector (frames per second) can be adjusted in the following manner. Lay the projector carefully on its back and remove the hole plug (item 37, Figure 5) to expose the servo amplifier pot. With the projector in the "forward" position and the lamp on, adjust the speed by turning resistor R17 located on the servo board. When turned to the right (clockwise), speed is increased, when turned to the left, speed is decreased. The value will depend upon which of the following methods of measurement is used. The end result must produce a film speed of 24 frames per second.

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

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

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

(3) Tachometer. Use a tachometer having a speed range with a maximum speed of 150 to 200 RPM to measure RPM of the sprocket.

(4) Strobe Disc. Attached to sprocket by means of suction cup or rubber foot. For viewing with light from 60Hz source, disc should have 70 dots for sound speed. Count number of apparent revolutions of pattern for one minute. If pattern drifts in direction of rotation, add to design speed to obtain true speed. If pattern drifts against rotation, subtract from design speed to obtain true speed.

(5) Time Loop. Make a loop of exactly 120 frames. At sound speed, splice will pass aperture 12 times per minute plus or minus the permissible variation in speed and the timing error.

b. Speeds at 120VAC, 60Hz.

(1) Picture Speed - 24 FPS ±2%
Shutter Speed - 1440 RPM ±2%
Sprocket Speed - 102.86 RPM ±2%
Shutter Frequency - 48 CPS ±2%

44. AUTOMATIC THREADING SYSTEM ADJUSTMENTS.

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

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

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

45. ADJUSTING THE THREADING GUIDES.

a. Swing open the lens carrier upper take-up sprocket guard (1, Figure M) and remove the retaining screw (2, Figure M).

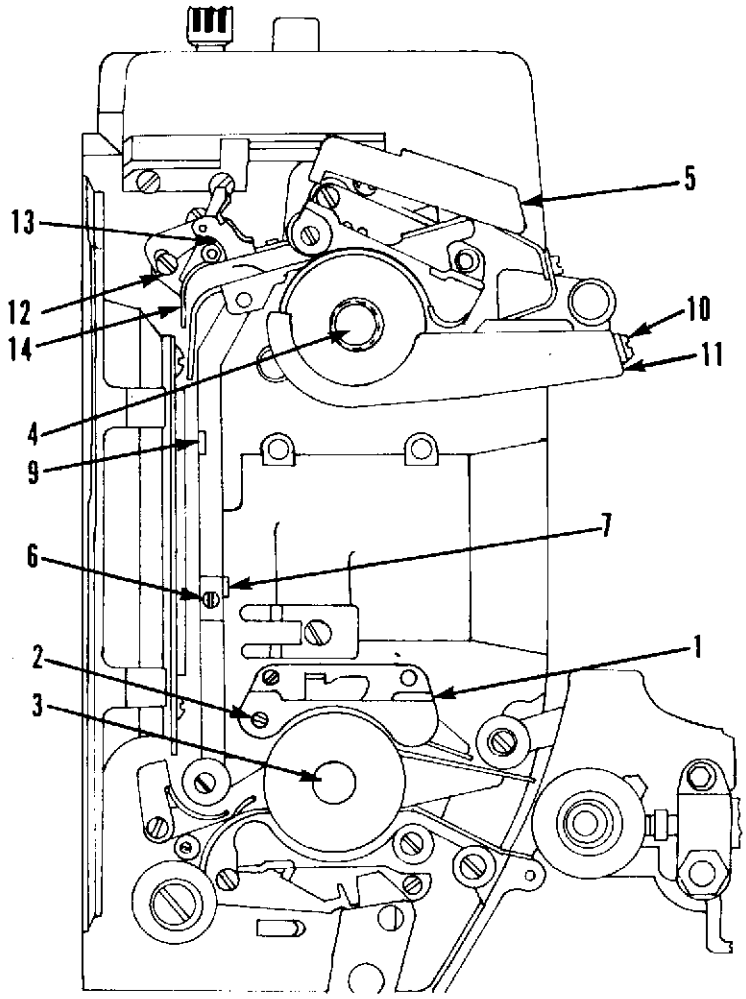
b. Place the timing plate (S-552-1-N1) over the sprocket hubs (3 and 4, Figure M). The timing plate locating pin should enter the counterbore from which screw (2, Figure M) was removed. If the locating pin does not enter the counterbore, loosen the three sprocket guard plate attaching screws (1, Figure N) and rotate lower guard plate (2, Figure N) until pin enters hole. Then tighten the three screws securely. Remove retaining ring that secures the actuating assembly (5, Figure M) and lock the automatic threading system.

c. Refer to Figure N and place a 0.015 inch feeler gage between the film support rails of the aperture plate and the rear surface of the lower loopformer assembly (4). This surface should touch the feeler gage just as the heel of the loopformer (5) strikes the shoulder on the mounting stud for the entrance guide roller (6). To adjust, loosen two screws (7) which attach the upper sprocket guard plate. Press downward on front end of loopformer assembly and rotate upper sprocket guard plate until heel of loopformer strikes shoulder of stud and rear surface clears aperture rails by 0.015 inch. Then tighten screws (7).

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

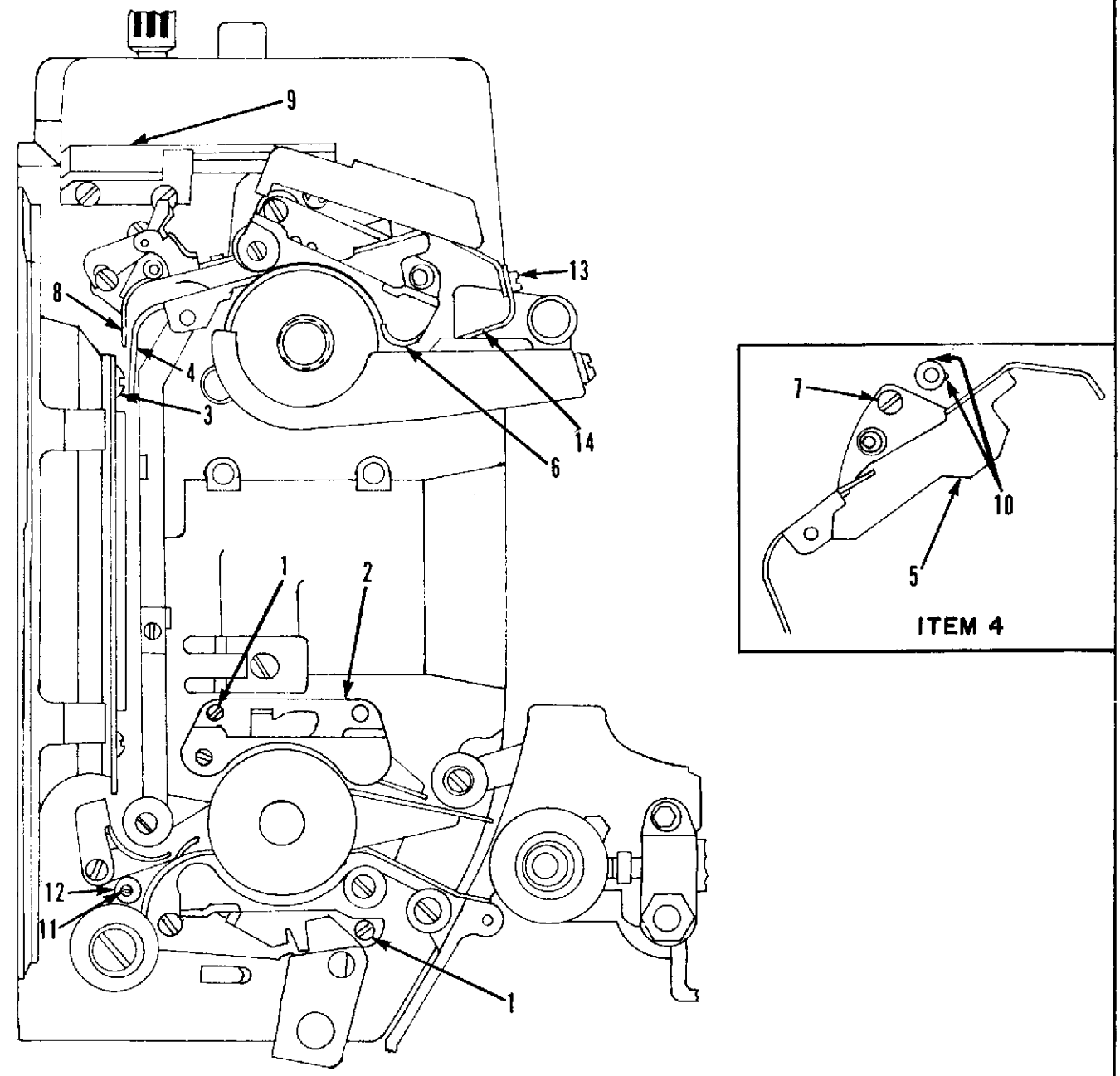
d. Check operation of the film escape mechanism by leaving the automatic threading system open. Manually advance the film and jam it in the upper channel. The film should fold and flow out through the kickplate in the loopformer (14, Figure M). If the kickplate does not release, the arm of the hub assembly (13, Figure M) is not striking the hood (9, Figure N) properly. The hood can be moved slightly and the hub assembly should be adjusted accordingly. When the automatic threading system is activated and the kickplate does not lock in position, loosen the screw (12, Figure M) holding the hub assembly to locking pawl and adjust the hub assembly until the top of the bracket touches the upper curved surface of the loopformer. This will lock the kickplate in position.

e. Referring to Figure N again depress the loopformer assembly (4). Check to make certain that there is 0.012 to 0.015 inch clearance between the top surface of the lower loopformer (4) and the bottom surface of the kickplate (8). To adjust, remove the two screws which attach the hood (9). Loosen two setscrews (10) and rotate the kickplate (8) to obtain desired clearance. Tighten setscrews and reinstall hood. Before tightening hood retaining screws, press hood toward rear of the projector.



1. Sprocket guard
2. Guard retaining screw
3. Lower sprocket hub
4. Upper sprocket hub
5. Actuating assembly
6. Shuttle retractor screw
7. Shuttle retractor
8. Pressure plate lift-off ear
9. Connecting link ear
10. Film guide screw
11. Film guide
12. Escape hub screw
13. Film escape hub
14. Loopformer

Figure M. Automatic Threading System Adjustments — View I



1. Guard plate attaching screw
2. Sprocket guard plate
3. Aperture plate screw
4. Lower loopformer assembly
5. Heel of lower loopformer
6. Entrance guide roller
7. Upper guard plate screws
8. Film escape kickplate
9. Hood
10. Kickplate setscrews
11. Eccentric pivot screw
12. Eccentric pivot
13. Leaf spring screw
14. Leaf spring

Figure N. Automatic Threading System Adjustments — View II

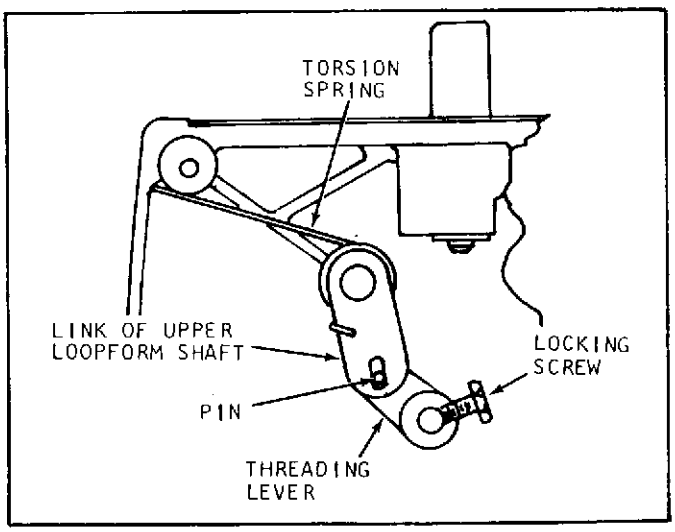


Figure P. Threading Lever Clearance Adjustment

f. With the automatic threading system locked and film gate open, check to make certain that the shuttle teeth do not protrude through the slot in the aperture plate. If shuttle teeth protrude, refer to Figure M and loosen screw (6), and carefully raise the shuttle retractor (7) until teeth are retracted; then tighten screw (6) securely.

CAUTION

The top end of the shuttle retractor must not strike the casting.

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

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

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

j. Lock the system and try to insert the feed sprocket. If film slips in too freely, loosen the two screws (13, Figure N) and move leaf spring (14) downward to increase pressure on the film. If film buckles as it is inserted, move leaf spring upward to reduce pressure; then tighten screws (13). For Threading Interlock (Douser) Switch Adjustment see paragraph 50A.

46. CHECKING AND ADJUSTING THE LOOP RESTORER. The automatic response of the loop restorer should be checked by means of test films TFS-D550-NX1 and TFS-D550-NX5. The first provides a test for damaged perforations; the second for elongated perforations. Run each test film through the projector in "Forward" and observe the reaction of the loop restorer as the damaged and elongated perforations pass through the film gate. The lower loop should be automatically restored within five or six frames. To adjust the loop restorer, refer to inset B, Figure Q and proceed as follows.

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

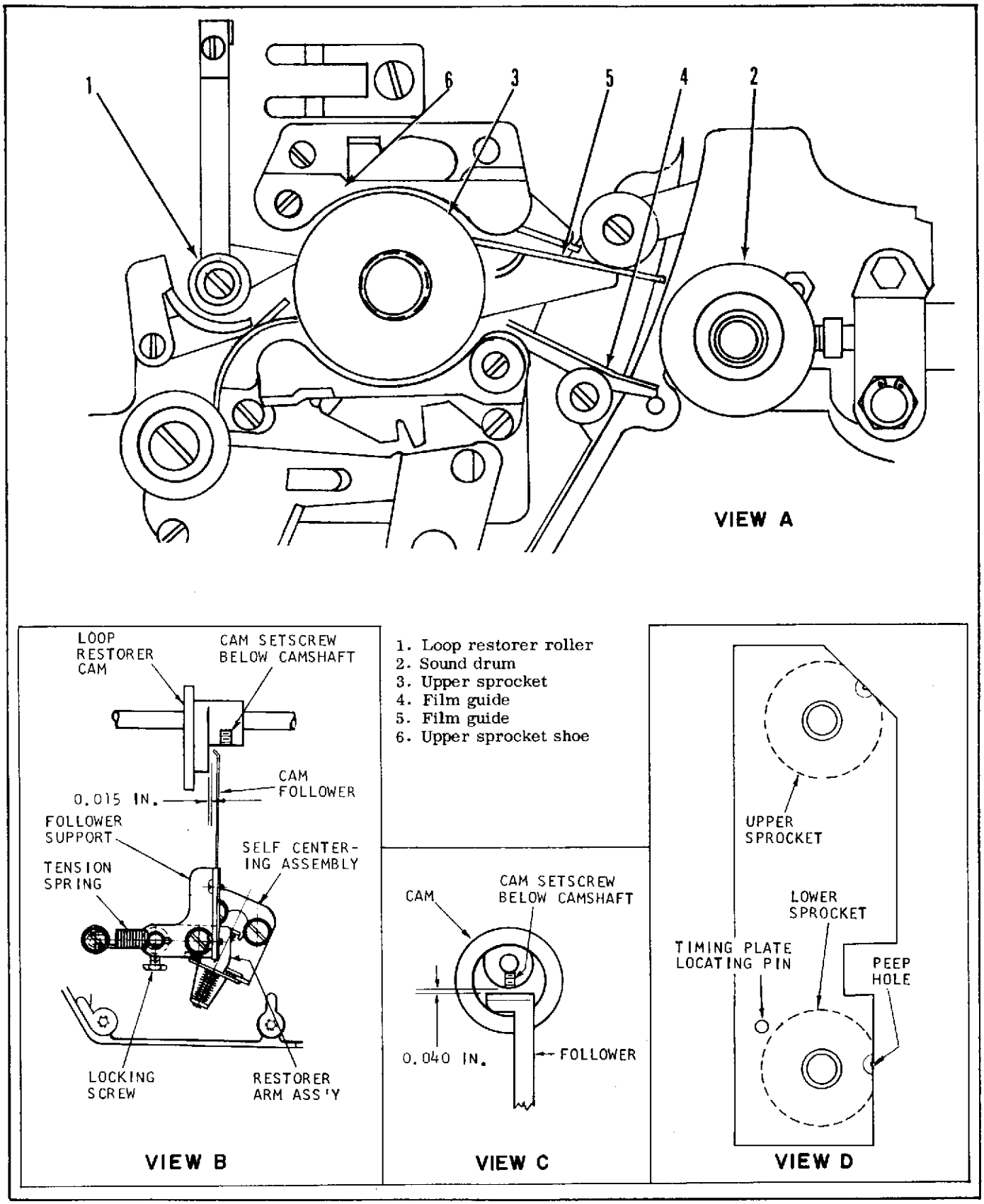


Figure Q. Automatic Threading System Adjustments — View III

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

c. Recheck the clearance between the loop restorer roller and uppper sprocket shoe guide roller as outlined in step a, above. Remove the restorer positioning tool and once more check loop restorer operation with the test films.

47. TIMING THE SPROCKETS.

a. Open the film gate and turn down the framer shaft as far as it will go. Then turn mechanism manually until the shuttle is at the bottom of the stroke (teeth protruding) and the edge of the shutter blade bisects the aperture opening.

b. Open the film shoes and place the timing plate (item 11, Figure A) over the sprocket hubs (View D, Figure Q). Dip the end of a straightened paper clip in red lacquer and insert it down through the peep holes to mark the face of each sprocket. Remove timing plate and place a light pencil mark on the face of each sprocket in line with the teeth nearest the red dot. If this pencil mark does not align with the red dot, the sprockets are out-of-time. Note the direction in which each sprocket must be rotated to bring the teeth back in line with the peep holes; then proceed as follows:

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

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

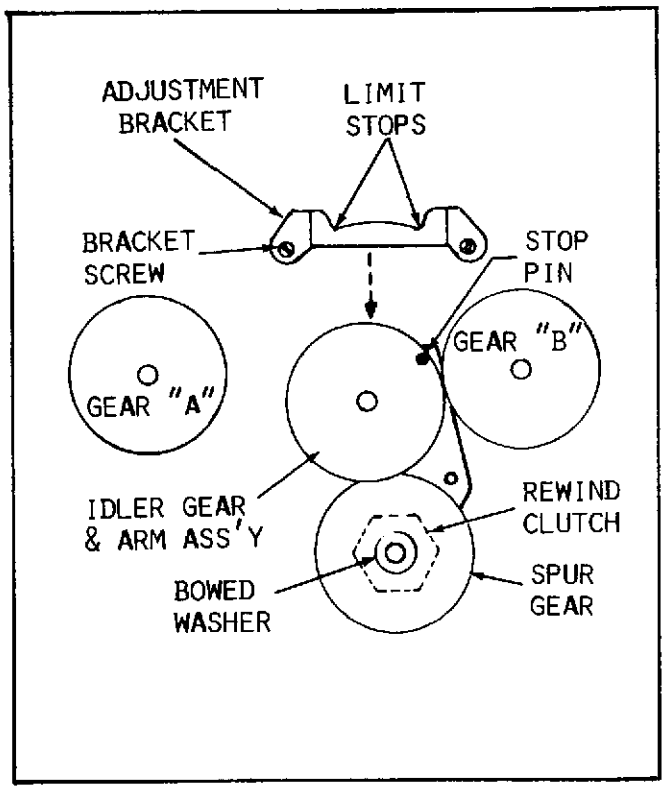


Figure R. Adjusting Gear Shift Tension and Backlash

49. GEAR SHIFT TENSION ADJUSTMENT. When shifting from forward to rewind, or vice versa, the idler gear arm (Figure R) should pivot smoothly to effect the engagement of the idler gear with gear "A" or gear "B." This can be checked by rotating the drive belt pulley manually, first in one direction and then the other. If the pivoting action seems hesitant, increase the tension on the arm assembly by adding a 0.010 shim and pressing the retaining ring more firmly on the spur gear shaft until the bowed washer (Figure R) is flattened against the face of the gear.

50. IDLER GEAR BACKLASH ADJUSTMENT. In both the forward and rewind positions, there must be a perceptible amount of backlash between the idler gear and gears "A" and "B," Figure R. As the idler arm pivots, a stop pin protruding at the upper end of the arm rides the slightly curved rim of the adjustment bracket from one limit to the other. Check gear backlash at both limit stops. If there is no backlash at one stop and too much at the other, loosen the adjustment bracket screws and shift the bracket slightly to balance the backlash in both positions.

50A. THREADING INTERLOCK (DOUSER) SWITCH ADJUSTMENT. With the power ON, activate threading arm (4, Figure 10). Remove exciter lamp cover (7, Figure 8) and loosen the two douser switch mounting screws (29, Figure 8) at the soundhead. Push upward on the screw (with washer under it's head) until the douser (5, Figure 12) is activated. Torque the switch mounting screws to 4 inch-pounds. When the threading arm is deactivated, the douser must open. Reassemble the exciter lamp cover.

TROUBLE SHOOTING

51. ISOLATING CAUSES OF SYSTEMS FAILURES.

a. Testing the Projector for Normal Operating Modes. Before beginning the following tests make sure the projector is plugged into a 120VAC, 60Hz power source. Then press the main power switch on the back of the projector. The projector fan should immediately start and the "clack" of the douser solenoid will be heard. The projector should now be in the stand-by mode with the lamp and motor systems off. After approximately five seconds in the stand-by mode, it is possible to actuate the motor and the lamp systems.

(1) Motor System Test. Test the motor system by pressing the "Forward" button. The motor should go forward at projection speed about 150 milliseconds after the "Forward" button is pressed. At this time (if the speaker is plugged into the projector), the audio system will be enabled and producing sound and the douser solenoid should be open. Now press the "Stop" button. The projector should stop with audio muted and the douser closed.

(2) Lamp System Test. Test the lamp system by pressing the "Lamp On" button. A 150 millisecond press of the "Lamp On" button will initiate the lamp starting sequence, which consists of pulses at about a 2-per-second-rate until the lamp ionizes. In most projectors, lamp ionization will occur on the first pulse from supply. Now press the "Forward" button. As the lamp warms up, its color will turn from violet through blue to white. It has now been determined that the lamp and its power supply are functioning properly.

(3) Motor Interface Circuitry Test. To test the motor circuitry and place the projector in the reverse mode, press the "Reverse" button. In the following sequence the projector will: get a stop command, close the douser, mute the audio, come to a stop, flip a relay, start in the reverse direction and come back up to projection speed. As the motor returns to projection speed the douser will again be opened. Note that the audio is still muted in the reverse project mode. Now press the "Stop" button; the douser should close and the projector stop.

NOTE: If the projector has done all of the above in the listed sequences, its motor and lamp systems are operating properly. If not operating properly refer to paragraph 52, and the trouble shooting charts for correction of specific projector troubles.

b. Testing the Remote Control Unit. After it has been determined that the projector operates properly in the normal modes, the remote control unit may be tested. Insert the remote control plug into the appropriate jack on the end cap. Press the "Forward," "Lamp On" and "Reverse" buttons in the listed sequence described in steps (1), (2) and (3) above. All operations should occur as before with the addition of the remote control lamp indicator glowing when the lamp turns on. (Note: there is a slight delay built into the lamp indicator turn-on.)

c. Testing the Douser System. Test the douser system during threading by pressing the threading lever forward until it latches. The douser should now prevent light getting to the screen. In this mode it is safe to thread the projector with the lamp on.

d. Dual Projector Set-Ups. In dual projector set-ups the changeover feature can be utilized. Plug the changeover cord into

the proper jack on each projector. Turn both projector lamps on. It will be evident that when one projector is put into the forward mode, the other projector's douser will be locked closed. If the non-showing projector is put into the forward mode and its changeover button is pressed, it will begin to show and will close and lock the other projector's douser. Audio is similarly transferred from one projector to the other (even through the line output jacks).

e. It is possible with the Model 1568 projector to perform a "remote" changeover function (with changeover cord attached). If two remote cords are attached (one to each projector) it is possible for the operator to "set-up" both projectors for show, then show the first reel and, remotely, start and transfer the show to the second projector. To do this all the operator need do is: (1) Start the first projector showing. (2) Cue the second projector but leave it stopped at its cue point. (3) Wait during the show and start the lamp on the second projector about two minutes prior to changeover. (4) As the first spot on the screen passes, the operator presses the "Forward" button on the second projector. (5) To get remote changeover all the operator need do at the recognition of the second screen spot, is push the "Stop" button on the first projector and the rest is automatic.

f. The Model 1568 projector is equipped with a microphone jack on the front panel. Any microphone of 200 to 50,000 ohm impedance may be used. As the 1/4-inch phone plug of the microphone is inserted into the jack, the audio for the projector is enabled (no matter what the present operating mode is) and the operator may use the projector as a public address system. (Note: film audio is not heard during this time.)

CAUTION

In changeover (dual projector) systems, control of what appears on the screen during microphone use will go to the projector into which the microphone plug is inserted.

52. ELECTRONIC TROUBLE SHOOTING. The following paragraphs describe electronic troubles that may occur and how to correct them. It is very important that you make a note of wire color coding when moving any electrical component. The wiring diagrams at the rear of the Parts Catalog will assist you in making electrical parts replacements.

CAUTION

No attempt should be made to repair the Control Circuit Board Assembly (item 17, Figure 2) or the Lamp Power Supply Assembly (item 26, Figure 2). Any attempt to repair these assemblies will automatically void their Bell & Howell Company warranties.

If service troubles are traced to the Control Circuit Board Assembly (P/N 077451) or the Lamp Power Supply Assembly (P/N 077597) remove the faulty assembly and send it to the "Factory Service Receiving Address" shown on the first page of this manual. The faulty assembly will be replaced with a rebuilt/exchange unit.

NOTE; When shipping the Control Circuit Board Assembly it must be packed in an anti-static bag (B&H P/N 710579). The Lamp Power Supply Assembly may be shipped in its replace unit container.

53. USER ACCESSIBLE FUSE(S) BLOWN. The user accessible fuse(s) (lamp power supply fuse, Type 3AG, 8 Amp, and the projector electronics supply fuse Type 3AG, 2 Amp, are located on the rear panel of the projector. If you suspect either one of these fuses to be the cause of the projector trouble, replace it with a new fuse of the proper type and try the projector again. To correct a blown fuse situation, however, proceed with the following paragraphs.

a. Blown Lamp Power Supply Fuse (Type 3AG, 8 Amp). Open the projector and visually check the wiring to the power supply sub-chassis. Carefully check the black wire and if found pinched to ground, in contact

with other parts or not properly placed on the board, correct the problem. Replace the blown fuse and retest.

b. If the black wire was not the cause of the problem, replace the blown fuse and disconnect the black wire from the supply terminal and retest. If the fuse blows again check the wiring between the fuse and the end of the black wire. If the new fuse did not blow, with the black wire removed, replace the Lamp Power Supply Assembly.

c. Blown Projector Electronics Supply Fuse (Type 3AG, 2 Amp). Remove the yellow, brown, brown and blue wires from fuseboard points 9, 2, 7, 3. (Do not let these wires touch each other or the frame.) Replace the blown fuse and turn on the projector. If the fuse blows again replace the power transformer.

d. If the replaced fuse did not blow in step c above, then excessive secondary current is being drawn and tests for normal currents must be performed.

NOTE: Currents in the following tests have non-sinusoidal waveforms, therefore, it is recommended that a true RMS voltmeter be used.

e. Test F1, F2, F3 and F4 for normal currents as follows:

(1) In F1 (Drive System) — 3A. Peak-to-Peak stopped (22MV across 0.1 ohm). 10A. P-P motor running (115MV across 0.1 ohm).

(2) In F2 (Amplifier) — No signal — 55MA P-P (5.0MV across 0.1 ohm).

(3) In F3 (Blower/Exciter) — 3.5A. P-P (150MV across 0.1 ohm).

(4) In F4 (Amplifier) — No signal — 55MA P-P (5.0MV across 0.1 ohm).

f. After tests have been performed, investigate source of excessive current condition by checking the affected board.

54. INTERNAL FUSE(S) BLOWN. Internal fuses F1, F2, F3 and F4 are part of the fuseboard assembly (item 34, Figure 3). If upon inspection one of these fuses is found blown, check for the cause of the blow-out in the following paragraphs.

a. Blown Drive Motor System Fuse F1. Refer to Motor/Drive System trouble shooting, paragraph 57.

b. Blown Amplifier Fuses (F2 and/or F4). Visually check the condition of resistors R20 and R21 on the amplifier board and if burned, replace the amplifier board.

c. Due to the fact that the control circuit board assembly receives its power from the amplifier (+ of C7) you can check the + supply to the amplifier by noting if the drive motor is in a stopped condition just after power-up. If it is, then the + supply is not the cause of the problem. If the motor powers-up in the run mode, remove the wire from the amplifier board that leaves the board through the pin located next to the + lead of C7.

(1) If removal of this wire allows fuses F2 and F4 to live through power-up the control board assembly should be replaced. However, first check the routing of this wire to the control board.

(2) If fuses F2 and/or F4 clear with the above wire removed, the trouble is localized in the amplifier.

(3) Check pin 15 (the amplifier output) for abnormal DC offset or excessive loading and correct the condition or replace the amplifier.

d. Blown Exciter/Blower Fuse F3. Both the exciter lamp and blower are operated from this power supply. Check for a condition that would stall the blower motor. For example: if the blower motor is locked or stalled, F3 will clear in less than 5 minutes. If F3 clears fast, the trouble is probably a shorted blower motor (motor wiring) or exciter supply short circuit problem.

55. POWER-UP TROUBLES (Abnormal Operation Immediately After Turning Projector Power On). The Model 1568 projector powers-up in a stopped position. Power-up problems can occur in the motor system, douser, audio or lamp systems. The following charts will assist you in solving and correcting power-up troubles. These charts, as well as those in paragraph 56, are set-up for step-by-step tests and solutions. To use them effectively, each test/check step must be performed in sequence. For example: find the Trouble you want to correct in the Trouble column. Then proceed to the Test/Check Step column and perform the test listed noting the result. Finally, compare the result of the test with the instructions listed in the Solution/Procedure column for the solution of the trouble or the next procedure to follow.

NOTE: All tests listed in these trouble shooting charts will be performed on the control circuit board assembly unless otherwise stated.

We again caution you not to attempt repair of the Control Circuit Board or the Lamp Power Supply Assemblies. When instructed to replace these assemblies; refer to paragraph 52 of this section for specific replacement instructions.

TROUBLE	TEST/CHECK STEP	SOLUTION/PROCEDURE
	MOTOR SYSTEM POWER-UP TROUBLES	
Motor powers-up in the forward-run or reverse-run mode (with controlled speed)	1. After power-up, test pin 2 on the servo amplifier. Voltage should be 0.6VDC (or slightly greater).	a. Voltage is more than 0.6VDC, proceed to paragraph 57, Motor/Drive System Trouble Shooting.
		b. Voltage is less than 0.6VDC; proceed to Test/Check Step 2.
	2. Check line to pin C1.	a. No line problem; replace control circuit board.
Motor powers-up in the forward-run or reverse-run mode (with uncontrolled speed)	1. Replace servo amplifier.	a. Proceed to paragraph 57, Motor/Drive System Trouble Shooting.
	DOUSER POWER-UP TROUBLES	
Douser solenoid does not pull-in	1. Check to see if motor running after power-up.	a. Motor running; replace control circuit board.
Douser solenoid does not pull-in but drive motor powers-up stopped	1. Use a DC meter to test pin B7 to frame ground for 25VDC.	a. Voltage is more than 25VDC: proceed to Test/Check Step 2.
		b. Voltage is less than 25VDC; proceed to Test/Check Step 3.

TROUBLE	TEST/CHECK STEP	SOLUTION/PROCEDURE
Douser solenoid does not pull-in but drive motor powers-up stopped (continued)	2. Press and hold "Stop" button for two seconds. Then meter pin B6 for voltage of less than 2VDC.	a. Voltage is more than 2VDC; replace control circuit board. b. Voltage is less than 2VDC; check solenoid and its wiring to the control circuit board. Proceed to Test/Check Step 3.
	3. Check for obstruction to solenoid travel. If none found, disconnect connector "B" and test resistance between pins B5 and B7. Resistance should be 250 ohms ±10%.	a. Resistance not within 250 ohms ±10% tolerance; replace control circuit board.
	AUDIO POWER-UP TROUBLES	
No audio mute after power-up at the speaker jack	1. Test voltage at pin B5 for over 25VDC.	a. Voltage is less than 25VDC; check voltage source on the fuseboard to find the cause. b. Voltage over 25VDC; proceed to Test/Check Step 2.
	2. Press "Forward" button on projector and observe operation of relay K2, then press "Stop" button.	a. Relay K2 not actuating; replace control circuit board. b. Relay K2 actuating; proceed to Test/Check Step 3.
	3. Remove connector "C" (motor will run at this time - this is normal). Test resistance between terminals C7 and C6 for "zero" ohms.	a. Resistance not "zero" ohms; replace control circuit board.
No audio mute after power-up at the auxiliary amplifier jack	1. Muting is accomplished by shorting the auxiliary amplifier jack output to ground. Check connector pin E3 to frame ground for "zero" resistance. Now test voltage at pin 5 for over 25VDC.	a. Voltage is less than +25VDC; check voltage source on the fuseboard to find the cause. b. Voltage over +25VDC; proceed to Test/Check Step 2.
	2. Press "Forward" button on the projector and observe operation of relay K2; then press "Stop" button.	a. Relay K2 not acutating; replace control circuit board. b. Relay K2 actuating; proceed to Test/Check Step 3.
	3. Remove connector "E." Test resistance between pins E1 and E3 for 0 to 0.5 ohm.	a. Resistance above 0 to 0.5 ohm; replace control circuit board.

TROUBLE	TEST/CHECK STEP	SOLUTION/PROCEDURE
	LAMP POWER-UP TROUBLES	
	WARNING There is high voltage (in excess of 10,000 volts, 7 amps) present on the Lamp Power Supply. Do not touch or measure when power is ON.	
Projector powers-up with the lamp "on"	1. Disconnect the control connector on lamp power supply.	a. Lamp stays lit; replace lamp power supply assembly. b. Lamp goes out; proceed to Test/Check Step 2.
	2. Disconnect connector "A." Short pin A3 to pin A4. Power-up projector and measure DC voltage at A3 to ground. Voltage should be 12VDC ±1VDC).	a. Voltage is less than 12VDC (±1VDC); replace control circuit board. b. Voltage is within 11VDC to 13VDC; check the wiring from A3 to control connector for short to ground.

56. ABNORMAL PROJECTOR OPERATION (After Power-Up Successfully Accomplished).

TROUBLE	TEST/CHECK STEP	SOLUTION/PROCEDURE
	FORWARD AND/OR REVERSE TROUBLES	
Projector fails to go forward when "Forward" button pressed	1. Test pin D5 for voltage of 6VDC (±0.5VDC).	a. 6VDC (±0.5VDC) not found; replace control circuit board. b. 6VDC (±0.5VDC) found; proceed to Test/Check Step 2.
	2. Test for waveform at pin D5 for 6V (P-P) starting at 6VDC and rising to about 12VDC.	a. Waveform found; replace control circuit board. b. Waveform not found; check diode (on switchboard) connected to "Forward" button. Also check the wiring between pin D5 and switchboard for shorts and opens.
Projector fails to go into reverse when "Reverse" button is pressed	1. Test pin D5 for 6VDC (±0.5V).	a. 6VDC (±0.5V) found; proceed to Test/Check Step 3. b. 6VDC (±0.5V) not found; proceed to Test/Check Step 2.
	2. Remove connector "D" and test resistance from remote socket pin 4 to ground.	a. Resistance more than 1 megohm; replace control circuit board. b. Resistance less than 1 megohm; check wiring and MOV at pin 4.
	3. Test waveform at pin D5 for 6V(P-P) starting at "zero" volts and rising to about 6V.	a. Waveform not found; check the switchboard diode connected to "Reverse" button. Also check wiring between switchboard and pin D5 for shorts and opens. b. Waveform found; proceed to Test/Check Step 4.
	4. Test for presence of over 25VDC at pin B5. If present look at relay K1 and alternately press "Forward" and "Reverse" buttons.	a. Relay K1 does not actuate when "Reverse" button is pressed; replace control circuit board.

TROUBLE	TEST/CHECK STEP	SOLUTION/PROCEDURE
Projector does nothing when the "Forward" or "Reverse" button is pressed (after being powered-up for 10 seconds)	1. Test pin D3 for 11 volt (P-P) 4KHz (±2KHz) square wave.	a. Square wave found; proceed to Test/Check Step 4. b. Square wave not found; proceed to Test/Check Step 2.
	2. Test for +12VDC at pin D8.	a. Low or no voltage; proceed to Test/Check Step 3. b. +12VDC found; proceed to Test/Check Step 4.
	3. Test pin D1 for 22VDC (±3VDC).	a. 22VDC (±3VDC) found; replace control circuit board. b. 22VDC (±3VDC) not found; investigate amplifier positive voltage supply.
	4. Check continuity of red wire to remote jack from pin D3 to switchboard on front of the projector.	a. Red wire open, replace wire. b. Red wire okay; proceed to Test/Check Step 5.
	5. Remove connector "D" and test for more than 1 meg-ohm resistance from pins 3 and 4 to ground on the remote jack.	a. Resistance more than 1 meg-ohm; replace control board. b. Low voltage (not over 1 meg-ohm); investigate remote jack wiring and in particular the MOV's around remote jack pins 3 and 4. Trouble may also be found in a pinched or shorted lead to switchboard on the front of the projector

LAMP ON/OFF TROUBLES

Lamp comes on almost immediately after projector power is turned on	1. Check instructions in Power-Up Troubles chart under "Lamp Power-Up Troubles."	
Lamp fails to go out when "Lamp Off" button is pressed and held for more then two seconds	1. Measure voltage at pin D4. Voltage should be 6V (±0.5V) while lamp is off; and 1V (±0.2V) after lamp has warmed-up.	a. 6V (±0.5V) present with lamp off; proceed to Test/Check Step 2. b. 6V (±0.5V) not present with lamp off; proceed to Test/Check Step 3.

TROUBLE	TEST/CHECK STEP	SOLUTION/PROCEDURE
Lamp fails to go out when "Lamp Off" button is pressed and held for more than two seconds	2. Disconnect Q5 (phototransistor) and start the lamp. Allow the lamp to warm-up and try pressing "Lamp On" button.	a. Lamp extinguishes; replace phototransistor Q5. b. Lamp stays on; replace the control circuit board.
	3. Remove phototransistor Q5 from its socket and test for 6V (±0.5V) again.	a. Voltage without Q5 (6V ±0.5V); replace phototransistor Q5. b. Voltage still less than 6V (±0.5V); proceed to Test/Check Step 4.
	4. Check voltage at pin A1.	a. Voltage more than 0.8 volts; look for a short to positive voltage in the wiring to Q5 socket. If not shorted out; replace control circuit board.
Lamp does not start when the "Lamp On" button is pressed (after 10 seconds of power-up	1. Test pin D3 for a 11V (P-P) 4KHz (±2KHz) square wave.	a. Square wave found; proceed to Test/Check Step 6. b. Square wave not found; proceed to Test/Check Step 2.
	2. Test for +12VDC at pin D8.	a. Low or no voltage; proceed to Test/Check Step 3. b. +12VDC found; proceed to Test/Check Step 4.
	3. Test pin D1 for 22VDC (±3VDC).	a. 22VDC (±3VDC) found; replace control circuit board. b. 22VDC (±3VDC) not found; investigate amplifier positive voltage supply.
	4. Check continuity of red wire to remote jack from pin D3 to switchboard on front of the projector.	a. Red wire open, replace wire. b. Red wire okay; proceed to Test/Check Step 5.
	5. Remove connector "D" and test for more than 1 megohm resistance from pins 3 and 4 to ground on the remote jack.	a. Resistance more than 1 megohm; replace control board. b. Resistance is low (not over 1 megohm); investigate remote jack and in particular MOV's around remote jack pins 3 and 4. Trouble may also be found in a pinched or shorted lead to switchboard on the front of the projector.

TROUBLE	TEST/CHECK STEP	SOLUTION/PROCEDURE
Lamp does not start when the "Lamp On" button is pressed (after 10 seconds of power-up)	6. Disconnect connector "A" and short A3 to A4. Press "Lamp On" button. DC voltage from A3 to ground should be 12VDC before "Lamp On" button is pressed then voltage should drop to less than 2VDC.	a. A3 voltage is not 12VDC; replace control circuit board. b. A3 voltage 12VDC; proceed to Test/Check Step 7.
	7. Reinstall connector "A" and measure DC voltage from pin A4 to ground. With the projector in the power-up mode the voltage of A4 should be +12VDC. Press the "Lamp On" button and A4 voltage should be less than 3 volts but not less than 1 volt.	a. A4 voltage is within range or less than 1 volt; replace lamp power supply assembly. b. A4 voltage is not in 1 to 3 volt range; look for an open in the control lines to the lamp power supply. Check thermostat for continuity.
	STOP TROUBLES	
Projector fails to stop when the "Stop" button pressed	1. Check for a defective stop switch. Plug in remote jack and see if projector stops from remote.	a. Projector stops in remote; replace stop switch. b. Projector continues to run on remote; proceed to Test/Check Step 2.
	2. Test for square wave at pin D5.	a. Square wave not found; check remote jack and wiring from pin D3 to pin D5. b. Square wave found; proceed to Test/Check Step 3.
	3. Test C1 for ±0.6VDC.	a. Voltage at C1 ±0.6VDC or over; see paragraph 57, Motor/Drive System Trouble Shooting. b. 0 volts present at C1; replace control circuit board.
Projector goes into forward or reverse when "Stop" button pressed	1. Check for presence of square wave at full amplitude (11V P-P) at pin D5.	a. Square wave present; replace control circuit board. b. Square wave not present; check wiring to switchboard and MOV's on pins 2 and 4 of the remote jack (MOV's may be breaking down at low voltage; 3 to 12 volts).

TROUBLE	TEST/CHECK STEP	SOLUTION/PROCEDURE
Projector goes into stop when "Forward" or "Reverse buttons pressed	1. Check for shorted diodes on the switchboard.	a. Replace diode if short is found.
Projector fails to mute or close the douser when "Stop" button is pressed	1. Check the instructions in the Power-Up Troubles chart under "Douser Power-Up Troubles."	
MICROPHONE TROUBLES		
No microphone operation	1. Check to see that relay K2 is released from mute when mike plug is inserted with projector stopped.	a. Relay K2 released from mute; check microphone jack wiring and wiring to amplifier. b. Relay K2 not released from mute; check pin B1 for DC voltage, should be "zero" with microphone plug inserted.
CHANGE-OVER TROUBLES		
No change-over	1. Test change-over jack pins 1 and 2 to check diode in optocoupler OC-1.	a. Diode normal; proceed to Test/Check Step 2. b. Diode bad; replace control circuit board.
	2. Test resistance between pins B5 and B8 to determine if R43 is of proper value.	a. R43 out of proper value range; replace control circuit board. b. R43 of proper value; proceed to Test/Check Step 3.
	3. Test for good ground (less than 10 ohms) at pin C4 while projector is running forward. Check change-over switch to ground.	a. Good ground present; replace control circuit board. b. Pin C4 high; impedance to ground check pin E3 to ground. If good ground present; replace control circuit board.

57. MOTOR/DRIVE SYSTEM TROUBLE SHOOTING.

The motor drive system consists of seven elements. These are:

1. Power Transformer Winding.
2. Fuse and Rectifier System.
3. Servo Amplifier Printed Circuit Board
4. Forward/Reverse Relay
5. Control Logic
6. Motor/Tachometer
7. Interconnecting Wires/Jacks/Plugs

NOTE: The douser/relay system in the Model 1568 projector also receives its power from the motor power supply. Suitable references to the douser/relay system will be found throughout the motor system trouble shooting information.

See definition of normal operating modes (paragraph 51, step a(1) for correct motor system operation.

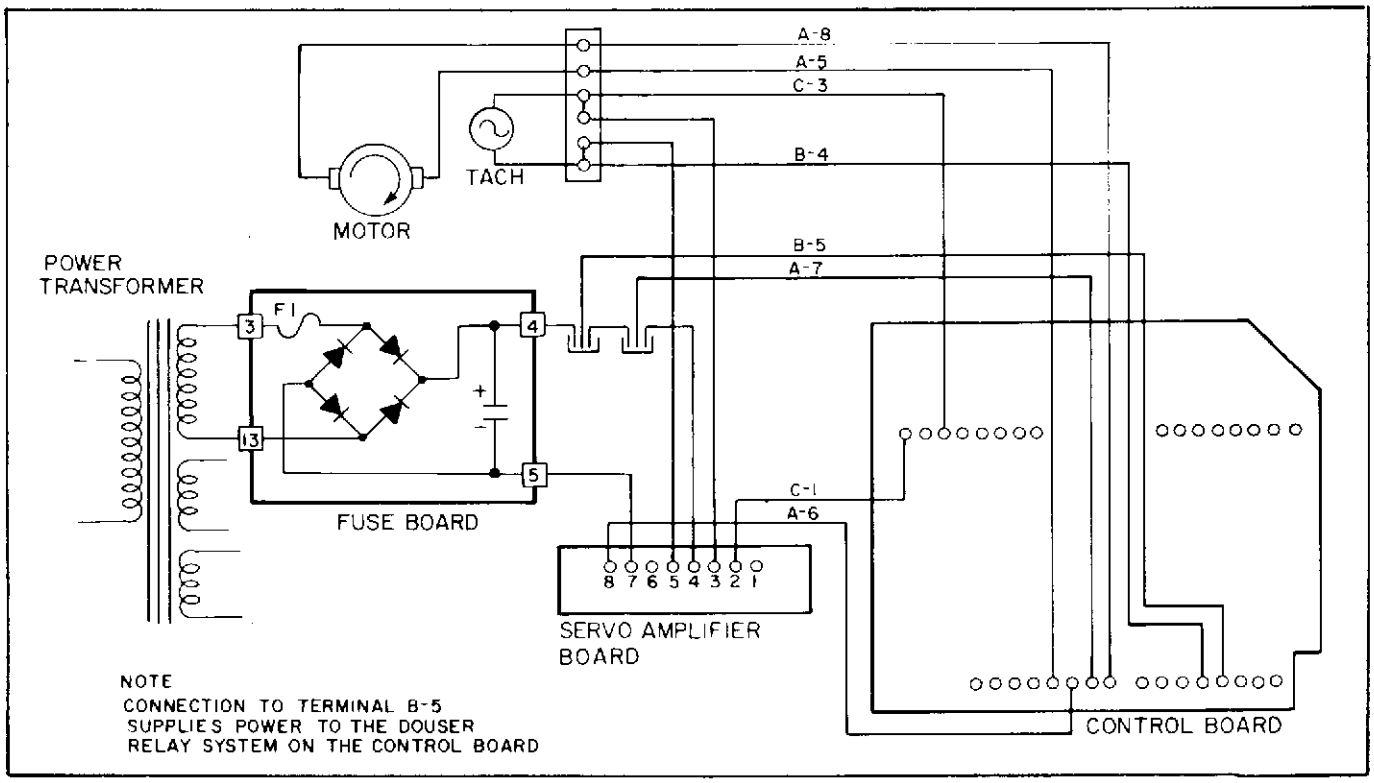
Following is an explanation of each of the seven elements listed above.

1. Power Transformer Winding. The power transformer supplies an open circuit voltage of about 30 volts RMS (AC) to the fuseboard to power the motor circuits.

2. Fuse and Rectifier System. The transformer and secondary circuits of the motor system are protected by fuse F1 (a 20mm medium time lag type). Also located on the fuseboard is a bridge rectifier system and capacitor filter. The output of this system is about 40VDC with no load on the capacitor. Note: The douser/relay system on the control circuit board also operates from this supply.

3. Servo Amplifier Printed Circuit Board. The servo amplifier is of new design utilizing switching techniques instead of a level senstitive analog servo system.

The tachometer of the motor puts out an open circuit waveform which is sinusoidal and has a 13 volt peak-to-peak amplitude at 4000 RPM. This waveform is introduced to the base of transistor Q2 through a current limiting resistor R19. Due to the large amp-



Motor System Connection Diagram

litude of the waveform, diode D2 is necessary to protect the B-E junction of Q2 from large reverse voltages.

On positive waveform excursions, Q2 goes deep into saturation; its collector voltage swings to ground. On negative input waveform excursions, Q2 is cut-off allowing the collector voltage to swing positive to the regulated voltage present at the top of R3. (This voltage is 24.3V ±5%.) The Q2 collector swing is coupled to the rest of the servo amplifier through capacitor C3 and diode D3 whose functions will be discussed later.

Transistors Q3 and Q4 form a monostable multivibrator circuit. The cut-off time of Q4 is controlled by the discharge time of capacitor C4 through resistor R6. This is a known circuit parameter due to the tight control we have on the values of C4 and R6. (For reference purposes this time is approximately 500 microseconds.)

Transistor Q4 is driven into cut-off by the negative-going pulse developed at the collector of Q3 after it is coupled through differentiating capacitor C3 and steering diode D3. Q4 is held off due to the highly negative charge on C4 coupled to Q4's base through reverse protection diode D4. As C4 discharges through R6 the voltage at the base of Q4 eventually reaches +0.6V and Q4 returns to its conductive state. Q4's conductive state pulls the Q4 collector to (or near) ground thus cutting-off Q3. The next pulse from the differentiating capacitor C3 can now affect Q4's base directly. The cut-off time of Q4 is made short purposely so as not to extend into the next positive input waveform excursion. On the next positive excursion, Q2 turns on and we have the next negative pulse from the differentiating capacitor C3.

Q4's collector is coupled through resistor R9 to capacitor C5. This network forms an integrator. It can now be seen that the voltage across C5 is proportional to the amount of charge-discharge time to which C5 is subjected. Since the charge time is known (500 microseconds as previously discussed) we need only determine the discharge path (and time). C5 discharges through R9 back into the collector of Q4 when Q4 goes into its conduction state.

To put this all another way, Q4 is cut-off during the first 500 microseconds of all input waveform positive excursions. During this time C5 charges to some voltage. For the remainder of the input waveform cycle Q4 conducts. C5 at this time discharges. Its voltage decays at a rate proportional to input cycle frequency. With high motor RPM there is a large voltage on capacitor C5.

The voltage on this capacitor is compared against that set as a reference (by means of the speed control pot). IC-1 makes a "decision" as to whether or not Q5 should be turned on to increase the motor speed. If the "decision" is yes, the motor is turned on for 1 input waveform cycle and the "decision" is made again.

Capacitors C6 and C7 and resistors R12 and R13 control the gain of IC-1 and its response to fast changes in input and output. These parts stabilize IC-1. R14 limits the base current to Q5. D5 absorbs the output offset of IC-1 because both inputs of IC-1 are tied to DC voltages above ground.

A metal oxide varistor (VR1) and the R-C combination of R1 and C1 act to protect the regulator circuit consisting of Q1, D1 and R2. VR1 protects the entire servo amplifier from fast line transients and high frequency spiking produced by the motor.

4. Forward/Reverse Relay. The forward/reverse relay is located on the control circuit board. This relay merely reverses the motor wires to the +40 volt supply and pin 4 on the servo amplifier board. This effectively reverses the motor direction. Control of the forward/reverse relay is an internal operation of the control circuit board.

5. Control Logic. Transistor Q6 is the control transistor on this servo amplifier board. Because Model 1568 projector uses remote control functions, there is no switch on the unit to electrically disconnect the motor from the servo amplifier. Transistor

Q6 acts to shut-off transistor Q5 to perform the stop function. Q6 turns on to pull the base of Q5 to ground when the control line (pin 2) is supplied with current from the control circuit board.

6. Motor/Tachometer. The motor/tachometer is the same as that previously used in Model 1692 projector. (A DC brush type motor with 12 pole tachometer generator.)

7. Interconnecting Wires / Jacks / Plugs. There is a multiple (6) pole connector at the motor that allows the motor to be removed from the projector as a module. Wire routing from the servo amplifier board to the motor goes through the control circuit board as shown in the system connecting diagram. The tachometer winding supplies both the servo amplifier board and the control circuit board. See system connection diagram for terminations.

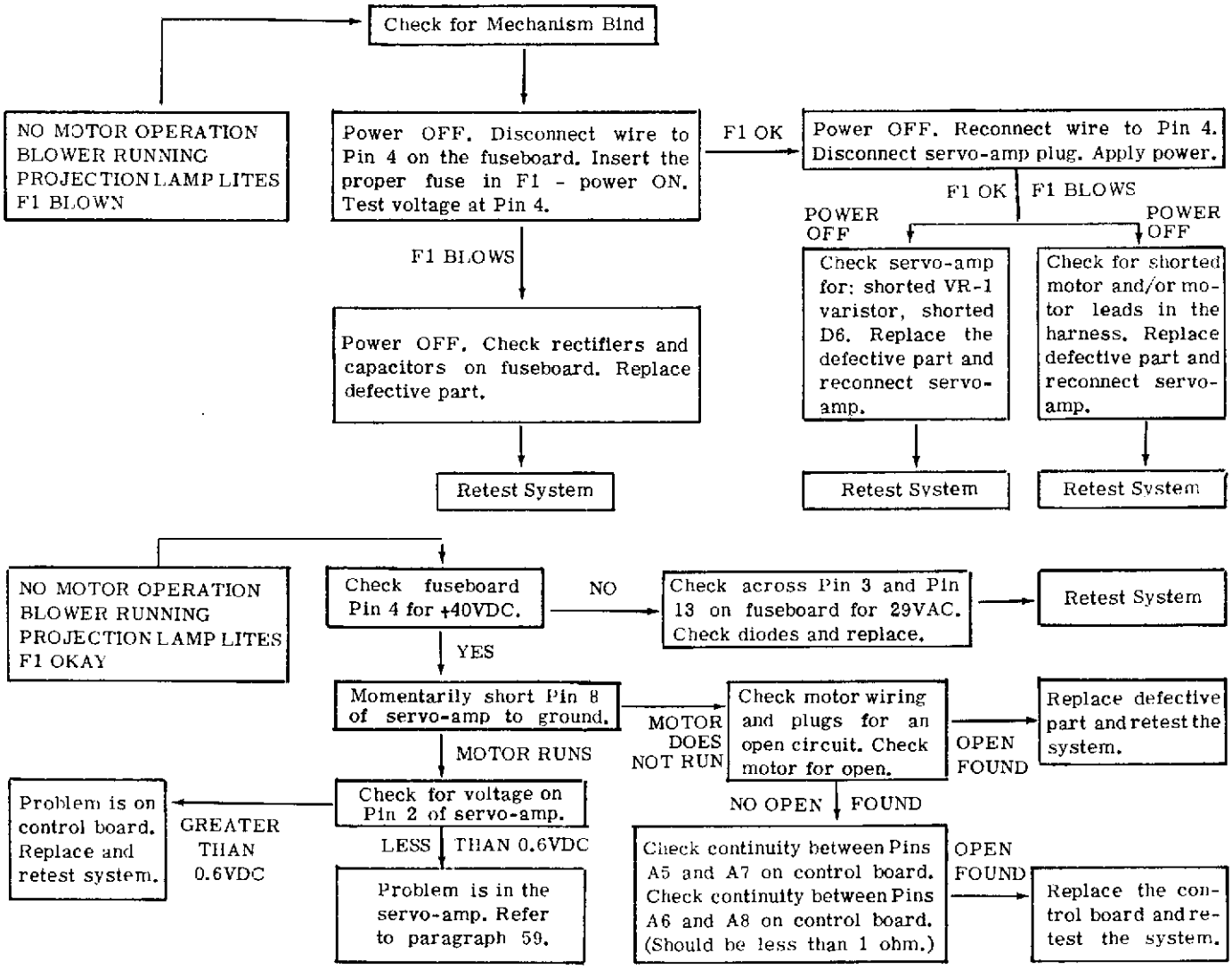
The trouble shooting check list that follows requires the following Test Equipment.

A DC VTVM (see NOTE) with resistance scales.

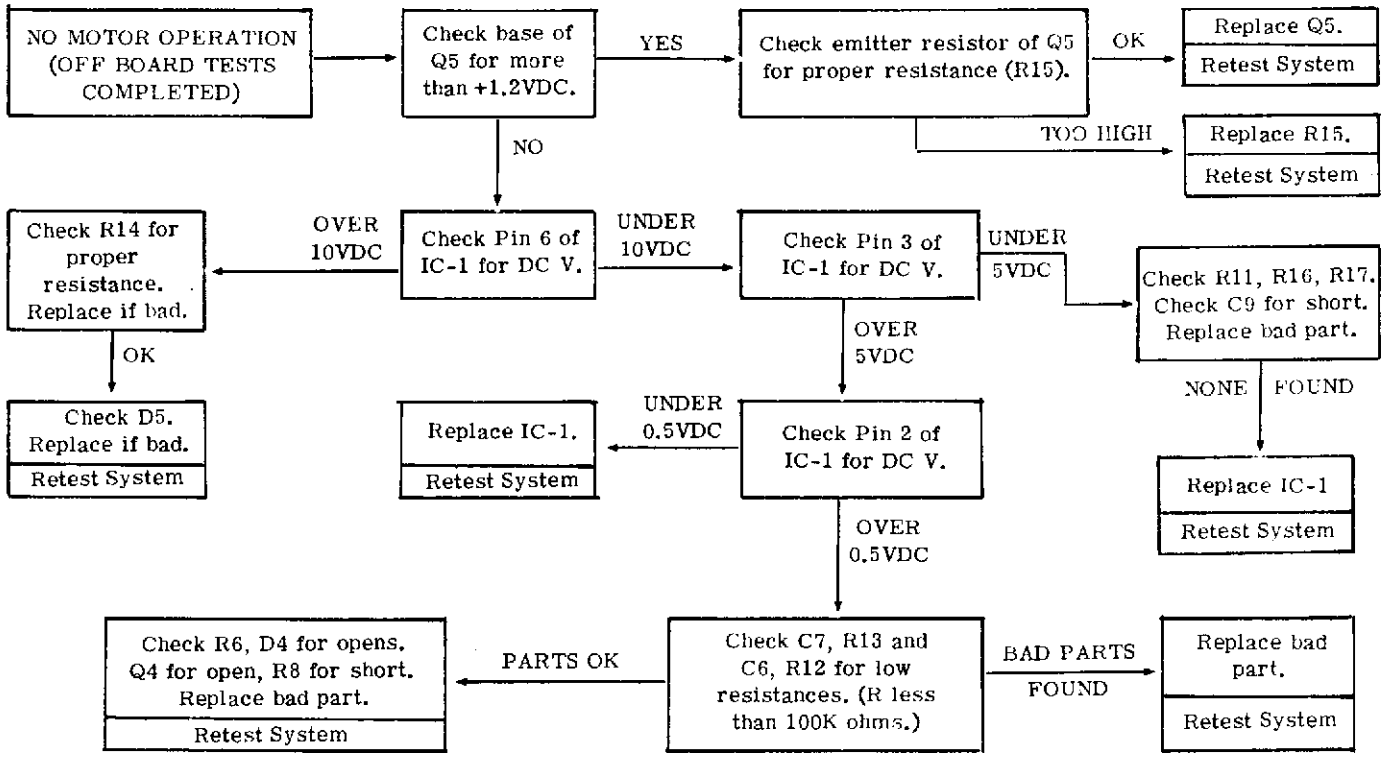
An audio oscilloscope capable of displaying a DC coupled waveform of at least 50 volts P-P.

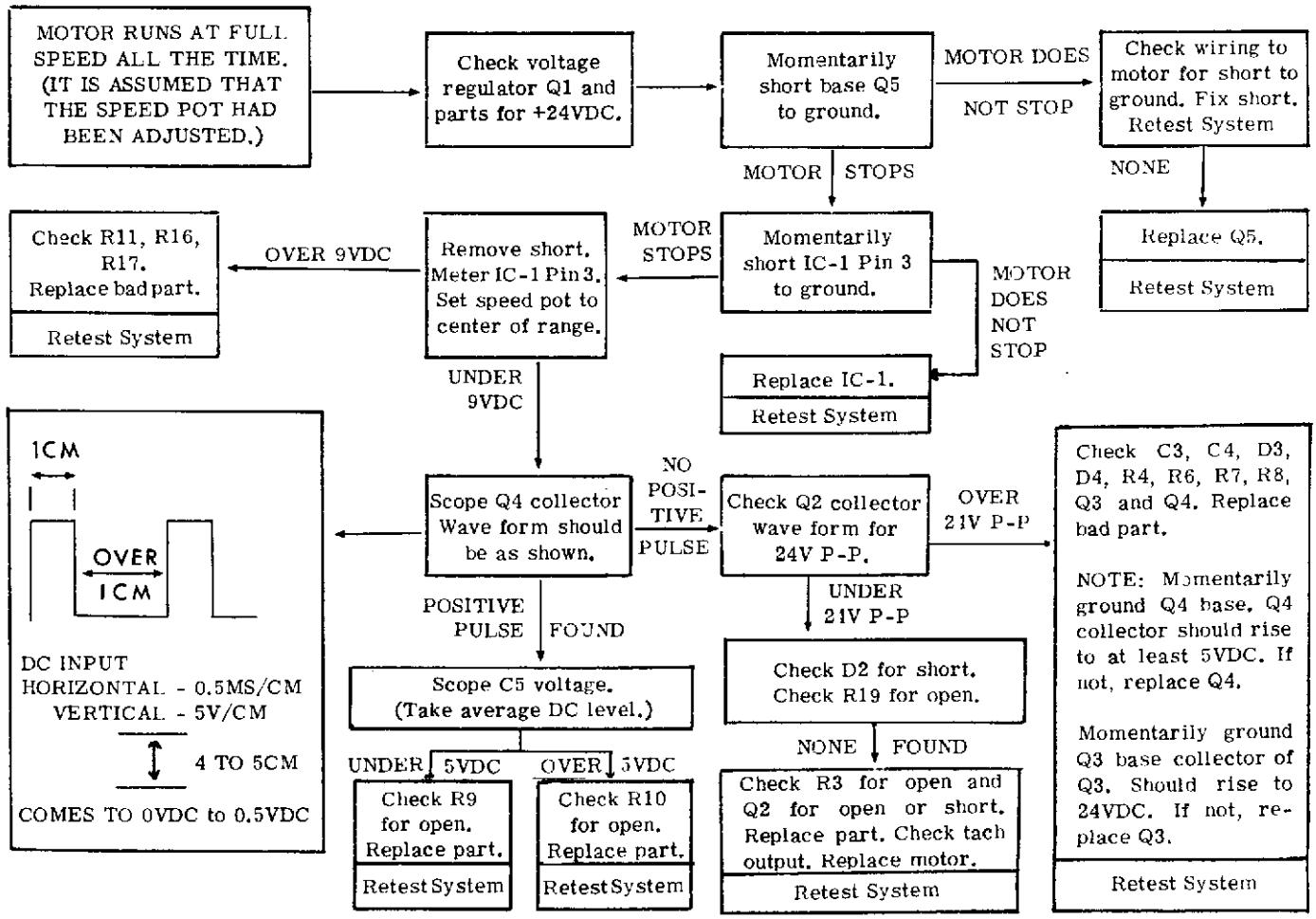
NOTE: Any meter used to test the following voltages in the check lists is assumed to have greater than 5 megohms input impedance.

58. MOTOR SYSTEM CHECK LIST.

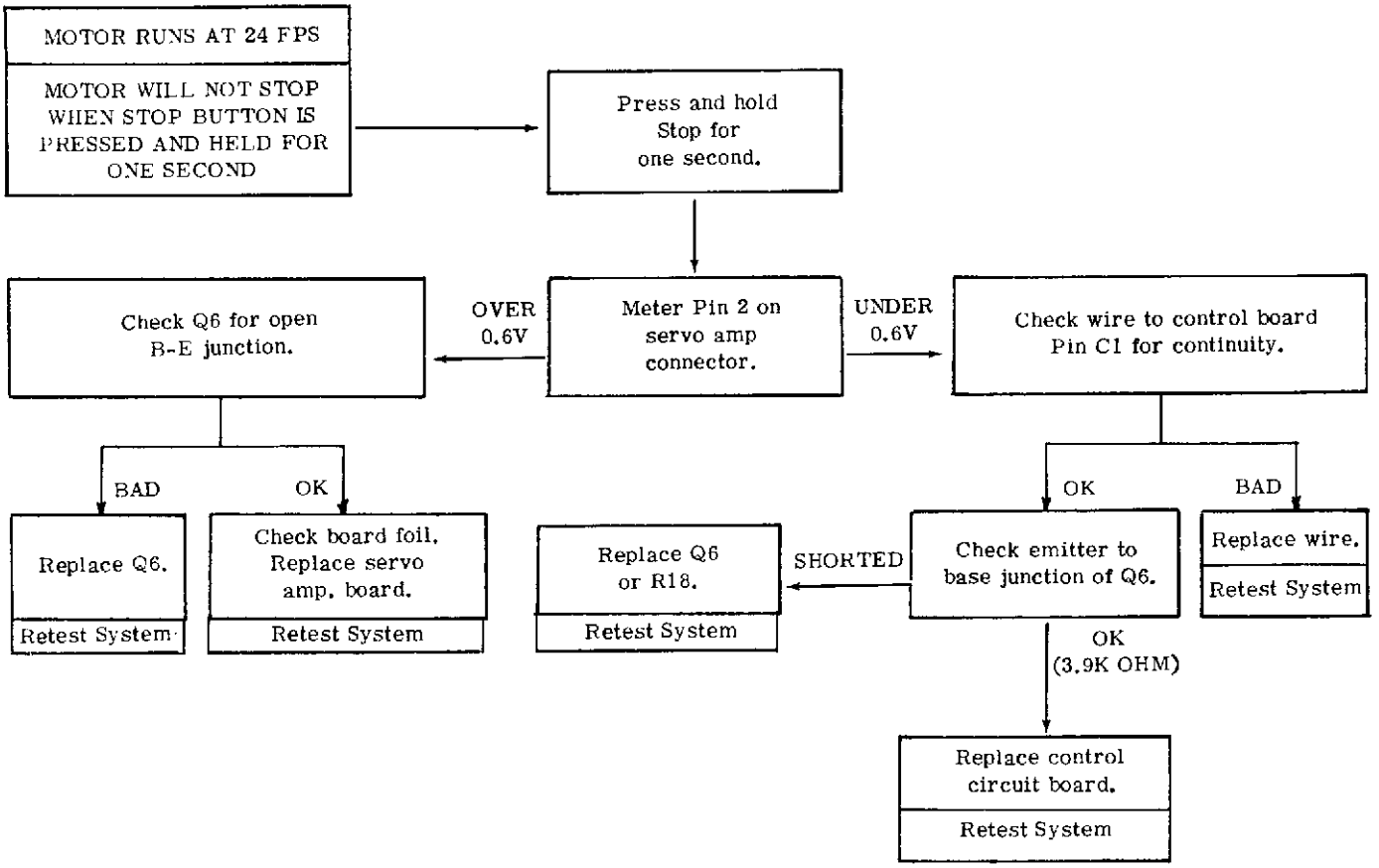


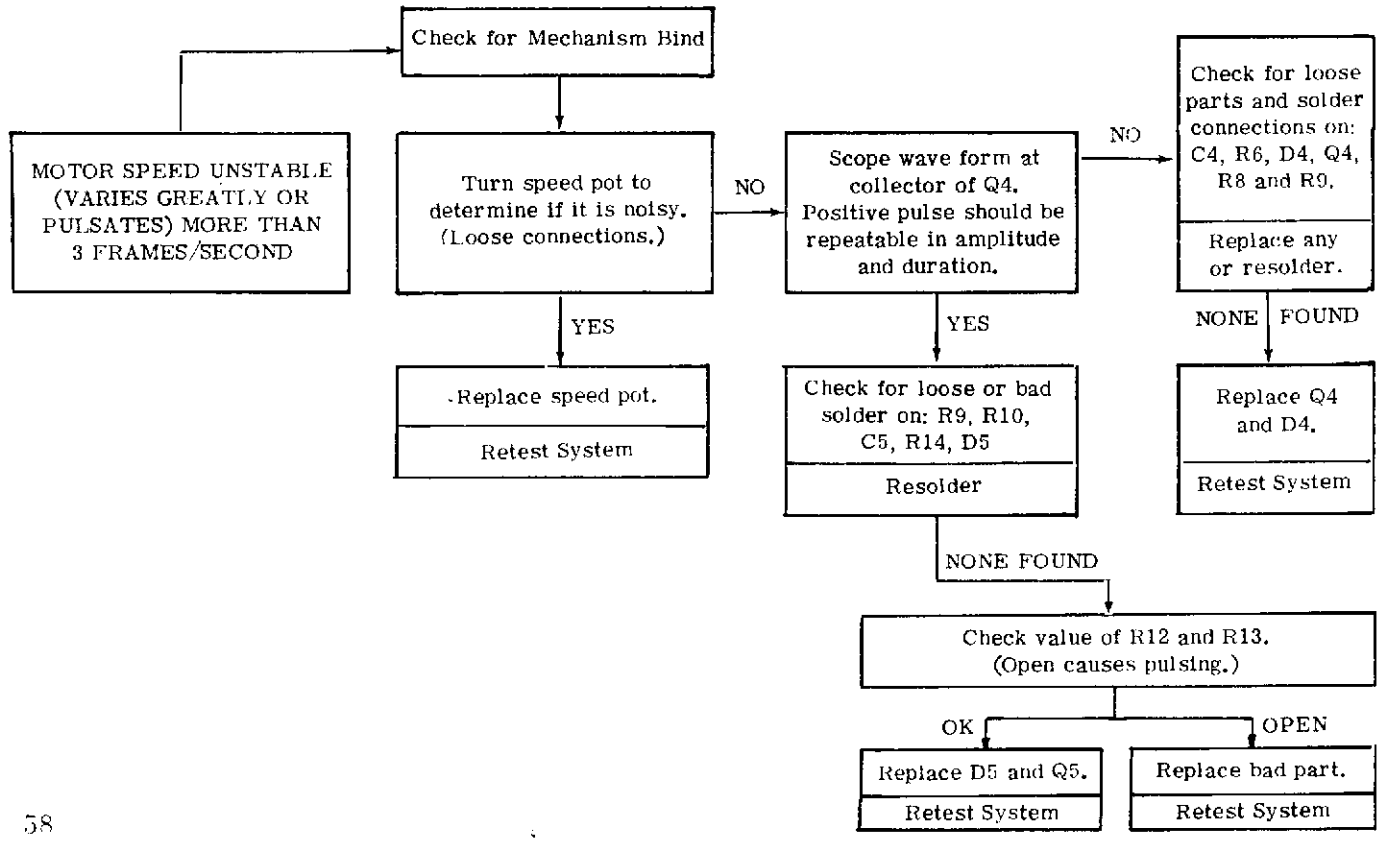
59. SERVO AMP BOARD CHECK LIST.





60. MOTOR CHECK LIST.





61. MISCELLANEOUS TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Nothing runs	1. Defective On-Off switch. 2. Damaged power cable. 3. Loose connections. 4. Line fuse blown. 5. Transformer open.	1. Replace switch. 2. Repair or replace cable. 3. Repair connections. 4. Replace line fuse. 5. Replace transformer.
Motor runs but mechanism does not run	1. Drive belt broken or unhooked from pulley. 2. Motor pulley loose on shaft.	1. Replace or reinstall drive belt. 2. Position pulley and tighten setscrews.
Rewind does not operate	1. Rewind clutch not engaging or clutch slipping.	1. Adjust (para. 41, step c).
Take-up does not operate	1. Take-up sprocket damaged. 2. Defective reel arm belt. 3. Damaged rubber sleeve in arm.	1. Replace sprocket. 2. Replace belt. 3. Clean arm/replace sleeve.
Feed spindle does not rotate	1. Dirt in reverse take-up clutch.	1. Clean clutch.
Gate will not lock	1. Latch spring set too close to lens mount stop. 2. Pressure plate out-of-line.	1. Adjust latch spring. 2. Realign pressure plate.
Lamp starts and warms up in standard fashion but shuts off after several minutes of operation	1. Cooling system failure.	1. Check F3, insure proper blower operation, or remove obstructions from blower duct.
Projector speed slow	1. Binding in the mechanism. 2. Belt slipping. 3. Check motor speed (para. 43).	1. Free binding condition. 2. Clean or replace belt. 3. Adjust (para. 43).

62. PICTURE TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Film jump	1. Damaged film.	1. Repair or replace.
	2. Loose shuttle.	2. Adjust and tighten (para. 38, step c).
	3. Dirty film aperture.	3. Clean film aperture.
	4. Damaged or lost pressure plate spring.	4. Replace spring.
	5. Pressure plate misaligned.	5. Realign pressure plate.
	6. Incorrect shuttle stroke.	6. Adjust (para. 38, step d).
Double image	1. Incorrect shuttle stroke.	1. Adjust (para. 38, step d).
	2. Excessive shuttle protrusion.	2. Adjust (para. 38, step b).
Weave (due to faulty aperture plate)	1. Sticking edge guide.	1. Clean guide.
	2. Replace tension spring lost.	2. Replace spring.
	3. Fixed edge guide out of position.	3. Reposition guide.
Poor illumination	1. Optics out-of-line.	1. Realign (para. 37).
	2. Douser sticking.	2. Check mechanical linkage for binding.
Poor focus	1. Dirty lens and/or aperture.	1. Clean lens and/or aperture.
	2. Warped film.	2. Recondition or replace film.
	3. Projector lens mount out-of-line.	3. Realign (para. 39).
	4. Pressure plate spring lost.	4. Replace spring.
	5. Bent pressure plate.	5. Replace pressure plate.
	6. Pressure plate out-of-line.	6. Realign pressure plate.
Film scratches	1. Caked emulsion on film path parts.	1. Clean film path.
	2. Film chips in sprocket guards.	2. Remove film chips.
	3. Scratches or burrs on film guides, guards, aperture or pressure plate.	3. Polish with crocus cloth or replace.
	4. Jockey rollers (soundhead) sticking.	4. Clean and lubricate.
Perforations checked	1. Shuttle not retracting.	1. Adjust (per para. 45, step f).
	2. Pressure plate not lifting from aperture plate.	2. Adjust (per para. 45, step g).
	3. Excessive feed or take-up tension.	3. Adjust tension.

TROUBLE	PROBABLE CAUSE	REMEDY
Film dimpled between perforations	1. Sprocket shoes sticking.	1. Clean sprocket shoe pivots.
	2. Shuttle not retracting.	2. Adjust (per para. 45, step f).
	3. Sprockets out-of-time.	3. Retime (per para. 47).
	4. Inadequate pressure on leaf spring (24, Fig. 10).	4. Adjust (per para. 45, step j).
	5. End of film leader not cut clean and square.	5. Check your film cutter, replace if dull or broken.
Film escape mechanism does not open to permit exit of film	1. Film exist latching is out-of-adjustment.	1. Readjust (per para. 45, step d).
Film escape locking pawl does not seat properly; film exists constantly	1. Torsion spring (10C, Fig. 11) is disconnected.	1. Connect torsion spring.
	2. Locking pawl (10E, Fig. 11) out-of-adjustment.	2. Readjust locking pawl per para. 45, step d.
Frame line creeps	1. Framer eccentric loose.	1. Align and tighten (para. 38, step e).
Insufficient framing	1. Framer eccentric out-of-adjustment.	1. Adjust (para. 38, step e).
Trailer ghost	1. Shutter out-of-line.	1. Reassemble properly.

63. FILM TRANSPORT TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Loss of loops	1. Damaged film.	1. Repair or replace film.
	2. Inadequate shuttle protrusion.	2. Adjust (para. 38, step b).
	3. Inadequate or excessive shuttle stroke.	3. Adjust (para. 38, step d).
	4. Pressure plate spring lost.	4. Replace spring.
	5. Pressure mounting plate screws loose.	5. Tighten mounting screws.
	6. Sprocket guards not closing.	6. Clean or adjust.
	7. Sprocket drive gear loose on shaft.	7. Retime (para. 47) and tighten setscrews.
	8. In-out bracket spring broken.	8. Replace spring.

TROUBLE	PROBABLE CAUSE	REMEDY
Lower loop not restored	1. Loop restorer stroke too short.	1. Adjust (para. 46).
	2. Loop restorer does not engage restorer cam.	2. Adjust (para. 46).
Film rubs on loop restorer roller	1. Restorer arm out-of-position.	1. Reposition (para. 46).
	2. Loop restorer does not engage restorer cam.	2. Adjust (para. 46).
Excessive film slap	1. Damaged film.	1. Recondition or replace.
	2. Green film.	2. Age or buff film.
	3. Dirty pressure plate.	3. Clean pressure plate.
	4. Pressure plate rubbing on aperture plate guide rails.	4. Realign pressure plate.
	5. Incorrect shuttle stroke.	5. Adjust (para. 38, step d).
Splices jam in sprocket shoes	1. Bad splices.	1. Replace splices.
	2. Emulsion build-up.	2. Clean film path components.

64. SOUND SYSTEM TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
Projector runs, no voltage at audio amplifier P. C. B.	1. Loose connection.	1. Repair connections.
	2. Audio amplifier P. C. B. defective.	2. Repair audio amplifier P. C. B.
Projector runs, voltage at audio amplifier P. C. B. but exciter lamp does not light (even after amplifier reset button has been pressed)	1. Exciter lamp cable disconnected.	1. Connect cable.
	2. Wrong exciter lamp used.	2. Replace with correct lamp.
	3. Exciter lamp burned out.	3. Replace with correct lamp.
	4. Overload shutdown circuit on audio amplifier P. C. B. defective.	4. Replace audio amplifier P. C. B.

TROUBLE	PROBABLE CAUSE	REMEDY
Voltage at audio amplifier P.C.B., exciter lamp lights, but no sound	1. Speaker jack disconnected or speaker jack switch open.	1. Connect leads. Repair or replace jack.
	2. Photocell cable disconnected or leads reversed.	2. Connect cable. Connect leads to proper terminals.
	3. Photocell out-of-line.	3. Realign (para. 41, step b).
	4. Dirt on end of photocell.	4. Clean photocell.
	5. Wrong exciter lamp used.	5. Replace with correct lamp.
	6. Projector in mute mode.	6. Place projector in "Forward."
	7. Mute relay defective.	7. Replace defective relay.
Low volume	1. Trouble in audio amp. P.C.B.	1. Replace audio amp. P.C.B.
	2. Wrong exciter lamp used.	2. Replace with correct lamp.
	3. Photocell out-of-line.	3. Realign (para. 41, step b).
	4. Dirt on photocell or slit.	4. Clean photocell and slit.
	5. Slit misaligned.	5. Realign (para. 42, step e).
	6. Buzz track misaligned.	6. Realign (para. 42, step f).
Distortion at all volume levels	1. Wrong exciter lamp used.	1. Replace with correct lamp.
	2. Trouble in audio amp. P.C.B.	2. Replace audio amp. P.C.B.
Crackling noises	1. Broken ground lead to main frame.	1. Replace defective lead.
	2. Buzz track out-of-line.	2. Realign (para. 42, step f).
	3. Broken cable shield.	3. Repair shield or replace cable.
Wow or flutter	1. Soundhead stabilizer guide roller sticking.	1. Clean roller and roller shaft.
	2. Stabilizer guide roller spring broken, unhooked or lost.	2. Repair or replace spring.
	3. Film edge guide (soundhead) out-of-line.	3. Realign (para. 42, step f).
	4. Loose flywheel.	4. Tighten flywheel.
	5. Damaged sound drum bearing.	5. Replace sound drum.
	6. Dirt causing guide roller arm pivot bearing to bind.	6. Clean and polish.
	7. Photocell or exciter cable rubbing against flywheel.	7. Reposition cables.
	8. Chips or dirt in take-up sprocket gear teeth.	8. Remove and clean sprocket gear.
	9. Loop restorer stroke is too short or restorer set too low.	9. Adjust (para. 46).

TROUBLE	PROBABLE CAUSE	REMEDY
Clicking noises (audible through speaker)	1. Dirt on sound drum. 2. Broken ground lead to main frame.	1. Clean sound drum. 2. Replace lead.
High frequencies fade (jumps focus)	1. Warped film. 2. Film edge guide (soundhead) out-of-line. 3. Dirt on sound drum.	1. Recondition or replace film. 2. Realign (para. 42, step f). 3. Clean sound drum.
Hum	1. Ground wiring. 2. Trouble in audio amplifier P. C. B.	1. Correct grounded condition. 2. Replace or repair the P. C. B.

65. TROUBLE SHOOTING AUTOMATIC THREADING SYSTEM.

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

b. Test Film. The automatic threading system has been designed to function properly with all films which can be described as being in projectable condition (see Operators Instructions for limits of shrinkage, curl, etc.). Generally, any film which functions properly in other Bell & Howell Company projectors (such as Models 1585 and 1592) can be used for testing the automatic threading system. Inspect any film which does not thread properly. The leader end must be properly trimmed and free from sharp bends. All sprocket holes in the first 18 inches of leader must be in good condition. Splices must be properly registered and in good condition. Sprocket holes restricted by cement or splicing tape must be cleared or the splice remade. Repairmen are cautioned that it is a waste of time to attempt to adjust the automatic threading system to a film which is in such poor condition as to be incapable of being the source of an uninterrupted film presentation of acceptable quality.

TROUBLE	PROBABLE CAUSE	REMEDY
Film cannot be inserted into feed sprocket	1. Obstruction below roller of channel (16C, Fig. 9). 2. Roller channel (16C, Fig. 9) bent or binding. 3. Excessive pressure on leaf spring (24, Fig. 10).	1. Remove obstruction. 2. Straighten or replace assembly. 3. Adjust leaf spring (para. 45, step j).

TROUBLE	PROBABLE CAUSE	REMEDY
Film will not pull between feed sprocket and sprocket shoe	1. Entrance guide (11, Fig. M) misaligned. 2. Feed sprocket guard sticking. 3. Feed sprocket guard spring (30, Fig. 9) broken. 4. Caked emulsion or burr on sprocket shoe film rails.	1. Realign (per para. 45, step h). 2. Clean sprocket shoe pivot. 3. Replace spring. 4. Clean; remove burr with crocus cloth.
Film comes out the side of top sprocket	1. Obstruction in sprocket guard. 2. Damaged sprocket guard. 3. Sprocket guard and sprocket misaligned laterally.	1. Remove obstruction. 2. Replace sprocket shoe. 3. Realign.
Film strikes top of aperture plate and begins to pile up	1. Upper loopformer (8, Fig. N) bent or out of adjustment. 2. Lower loopformer (4, Fig. N) set too close to aperture plate.	1. Straighten or replace if bent; readjust per para. 45, step e. 2. Readjust (per para. 45, step e.
Film butts into or goes under top end of aperture plate side tension rail or strikes fixed rail	1. Upper loopformer (8, Fig. N) bent causing sidewise deflection of film. 2. Lower loopformer (4, Fig. N) bent or out-of-adjustment.	1. Straighten or replace if bent; readjust per para. 45, step e. 2. Straighten or replace if bent; readjust per para. 45, step c.
Film butts against top of film pressure plate or passes over outside of pressure plate	1. Lower loopformer (4, Fig. N) out-of-adjustment. 2. Pressure plate not lifting off of aperture plate when film gate is closed.	1. Readjust (per para. 45, step c. 2. Bent parts need straightening (para. 45, step g) or replacing.
Film ejects between bottom of gate and top of take-up sprocket, or piles up in this area	1. Lower loopformer (13, Fig. 10) bent or sticking. 2. Lower loopformer (14, Fig. 10) spring broken. 3. Loop restorer out-of-adjustment or restorer roller stud bent. 4. Obstruction or burr in take-up sprocket upper guard. 5. Sprockets out-of-time.	1. Straighten remove bind or replace as necessary. 2. Replace spring. 3. Readjust loop restorer (para. 46); replace damaged parts. 4. Clean; remove burr with crocus cloth. 5. Time sprockets (per para. 47).

TROUBLE	PROBABLE CAUSE	REMEDY
Film not threading over take-up sprocket	1. Sprocket guard mounting plate (21, Fig. 10) out-of-position.	1. Reposition (per para. 45, step b).
	2. Obstruction in upper sprocket guard.	2. Remove obstruction.
	3. Sprocket guard spring (30, Fig. 9) broken.	3. Replace spring.
	4. Take-up sprocket shaft loose in gear (13, Fig. 9).	4. Retime sprockets (para. 47) and tighten setscrews (11, Fig. 9).
Film piles up ahead of sound drum	1. Insufficient clearance between soundhead threading guides (4 and 5, Fig. Q).	1. Readjust all guides per para. 45.
	2. Back-up bracket (16, Fig. 10) bent downward.	2. Straighten bracket.
	3. Exciter lamp cover loose.	3. Tighten cover retaining screw.
	4. Obstruction in gap between sound drum and exciter lamp cover.	4. Remove obstruction.
	5. Not enough clearance between sound drum and cover.	5. Check clearance per para. 48.
	6. Edge guide adjusting screw (24, Fig. 8) out too far.	6. Adjust per para. 42, step f.
Film ejects ahead of lower take-up sprocket shoe or piles up in this area	1. Insufficient clearance between soundhead threading guides (4 and 5, Fig. Q).	1. Readjust all guides per para. 45.
	2. Soundhead loose or improperly positioned.	2. Reposition per para. 42, step g.
	3. Obstruction or burr in lower take-up sprocket guard.	3. Remove obstruction; remove burr with crocus cloth.
	4. Film guide (4, Fig. 8) improperly positioned.	4. Reposition guide.
Film sticks in or is ejected from lower take-up sprocket	1. Obstruction or burr in lower take-up sprocket guard.	1. Remove obstruction; remove burr with crocus cloth.
	2. Sprocket guard sticking.	2. Clean sprocket guard pivot.
	3. Broken sprocket guard spring (30, Fig. 9).	3. Replace spring.
	4. Sprocket guard and sprocket misaligned laterally.	4. Realign.
	5. Autothread lever (10, Fig. 10) bent or improperly positioned.	5. Reposition or straighten lever.

TROUBLE	PROBABLE CAUSE	REMEDY
Film piles up ahead of idler roller (10D, Fig. 10) or is ejected from this area	1. Automatic threading lever (10D, Fig. 10) bent or improperly positioned. 2. Idler roller sticking or roller stud loose or bent.	1. Reposition or straighten lever. 2. Remedy sticking condition; replace automatic threading lever (10D, Fig. 10).
System will not lock	1. Automatic threading lever (10D, Fig. 10) binding. 2. Release spring (11, Fig. 10) disengaged or broken. 3. Eccentric bushing (12, Fig. N) improperly adjusted.	1. Repair or replace lever. 2. Engage spring with locking lever, or replace spring. 3. Readjust bushing per para. 45, step i.
Loop restorer cycles continuously	1. Restorer out-of-adjustment. 2. Shuttle retractor pin sticking. 3. Pressure plate binding on aperture plate edge guide.	1. Adjust (per para. 46). 2. Clean and lubricate pin. 3. Realign pressure plate.
Slack film in soundhead area	1. Sprocket guards sticking. 2. Take-up jerking. 3. Jockey rollers (soundhead) sticking. 4. Soundhead improperly positioned. 5. Dirt or obstruction between sound drum and exciter lamp cover.	1. Clean sprocket shoe pivots. 2. Check take-up torque and check for binding in take-up reel arm. 3. Clean and lubricate. 4. Reposition per para. 42, step g. 5. Remove obstruction.
Douser opens, closes and re-opens during initiation of forward project mode	1. Improper adjustment of threading interlock switch.	1. Adjust per para. 50A.
Douser fails to close in thread mode	1. Improper adjustment of threading interlock switch.	1. Adjust per para. 50A.