

# **INSTALLATION AND OPERATING INSTRUCTIONS**

## **TODD-AO PROJECTOR**

**CATALOG 3070**



**AMERICAN OPTICAL COMPANY**

*Motion Picture Products Division*

*Southbridge, Massachusetts, U. S. A.*

*Distributed by*

**THE TODD-AO CORPORATION**

**INSTRUCTION BOOK NO. P1955**

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- |                               |   |
|-------------------------------|---|
| 1. Arc lamp                   | 13. Water line connections              |
| 2. Projector head             | 14. Cutout for electrical leads         |
| 3. Upper magazine             | 15. Holes for hold-down bolts           |
| 4. Window                     | 16. Holes for leveling screws           |
| 5. Upper fire trap            | 17. Lower base                          |
| 6. Lens barrel and lens mount | 18. Arc lamp bracket                    |
| 7. Lens mount bracket         | 19. Arc lamp pushbutton switches        |
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| 11. Lower motor               | 23. Connector hole, optical sound cable |
| 12. Upper base                | 24. Lower magazine                      |

*Figure 1. Three-Quarter Front View of Projector.*

*(Legend)*

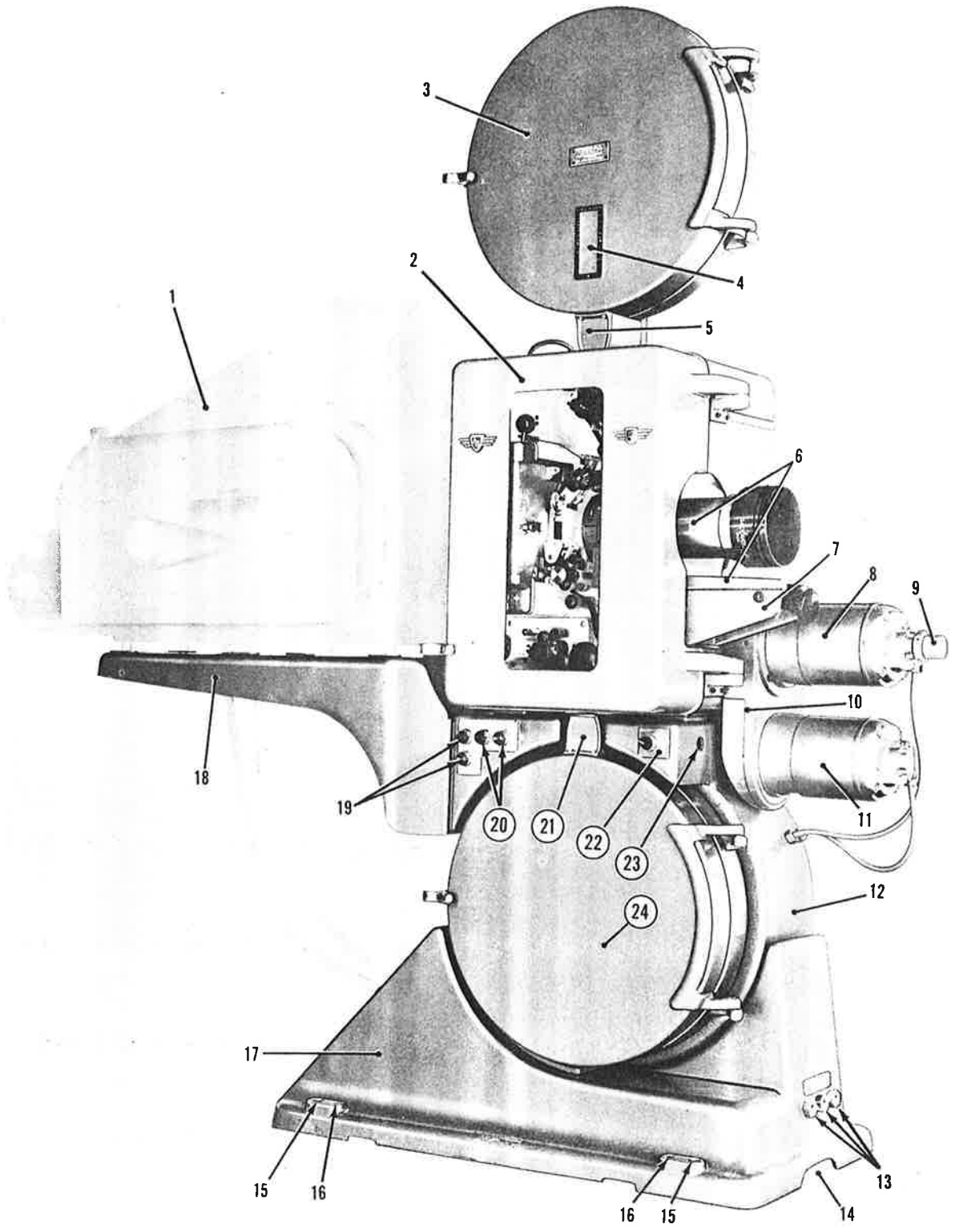
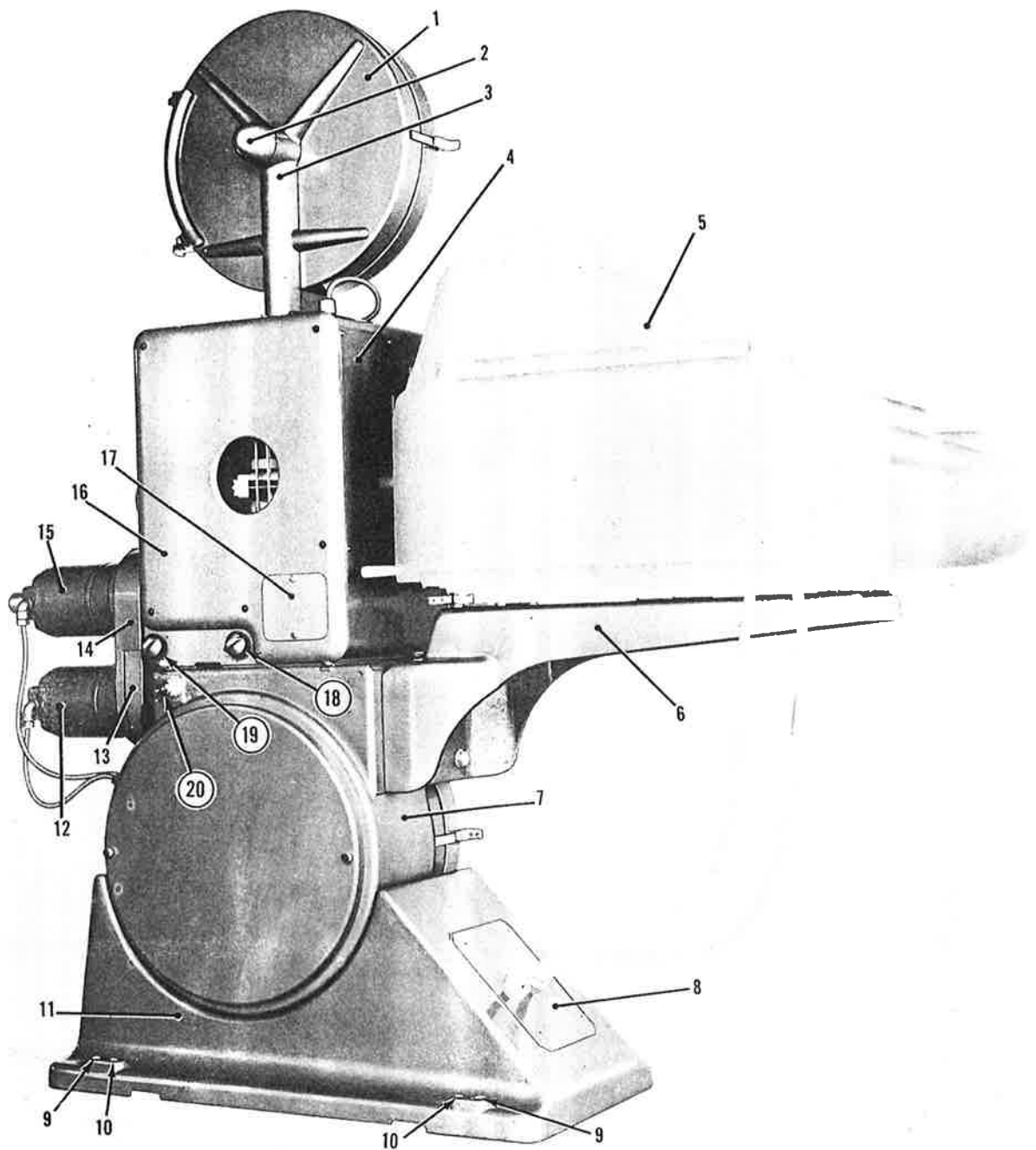


Figure 1. Three-Quarter Front View of Projector.



- |                                    |  |
|------------------------------------|--|
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## Section 1. DESCRIPTION AND PRINCIPLES OF OPERATION

### 1. General

The Todd-AO projector embodies the most advanced design in the motion picture industry. Extensive research by the American Optical Company in the use of wide motion picture film and new concepts in wide angle lens design, together with the outstanding experience of the Phillips Company of Holland has resulted in this achievement. The result of this new, advanced design is at once obvious in the appearance of the projector (Figs. 1 and 2, frontispieces). It is a symmetrically balanced assembly, the only overhanging unit being the arc lamp bracket. The isolation of the bracket permits complete flexibility in the choice of the arc lamp to be used.

Another advantage of Todd-AO design is that it permits the grouping of most of the mechanism in one enclosure . . . the projector head. The drives and gearing for two-speed operation, the magnetic soundhead, and the optical soundhead are all centrally located and easily accessible. This arrangement is in contrast with conventional projector design which places only the mechanism for moving film and the means for holding the lenses in the projector head . . . the mechanism being driven by the optical soundhead which is usually placed under the projector. With the introduction of magnetic sound, another attachment had to be added to conventional projectors. The film was then threaded through this attachment to obtain the magnetic sound pickup. The Todd-AO projector with built-in sound units (both magnetic and optical) makes it possible to isolate effects of unequal reel pressure and prevent their transmission into either the magnetic or the optical sound system.

Throughout the projector, every consideration has been given to service requirements. All components are readily accessible and simplicity of design makes adjustments and replacements easy to accomplish. The manufacturer's high standards of material and workmanship, known throughout the world, have been built into the Todd-AO projector.

#### NOTE

*The instructions in the following pages cover only the projector. For information on the arc lamp, see the arc lamp manufacturer's instruction book. For information on the sound system, see instructions covering the sound system.*

### 2. Lower Base

The sturdy, well balanced lower base (17) (Fig. 1) and (11) (Fig. 2) has a functional contour that provides a solid foundation for the entire projector as well as a cradle for the upper base. This cradle arrangement permits tilting the projector to the desired projection angle with a minimum change in the center of gravity of the whole unit. Two large cap screws (11) (Fig. 9) are used to clamp the upper base in the desired position. The projector may be tilted downward as much as 28° and it may also be tilted upward to meet the requirements of a drive-in theater, or any installation where the booth is lower than the screen. These adjustments are made without altering the angle of the floor on which the projector is mounted.

The bottom of the lower base is open, permitting the electrical leads and water lines to be brought into the lower base directly from the floor if desired. In this instance, the water lines and electrical leads (10) (Fig. 4), with the exception of the 65-volt d-c arc lamp leads, are fed through the center rectangular opening in the lower base into the upper base. The arc lamp leads are fed to the arc lamp through the porcelain bushings in the cover plate (8) (Fig. 2) in the back of the lower base.

As an alternate, it is possible to bring the electrical leads through the cutout (14) (Fig. 1) in the front of the lower base. Water line connections (13) are provided in the front of the lower base. If necessary to comply with the local ordinances, the arc lamp lead may be run directly to the arc lamp from a floor outlet outside of the lower base casting. Holes for leveling screws (16) and hold-down bolts (15) are provided in the four corners of the lower base.

#### NOTE

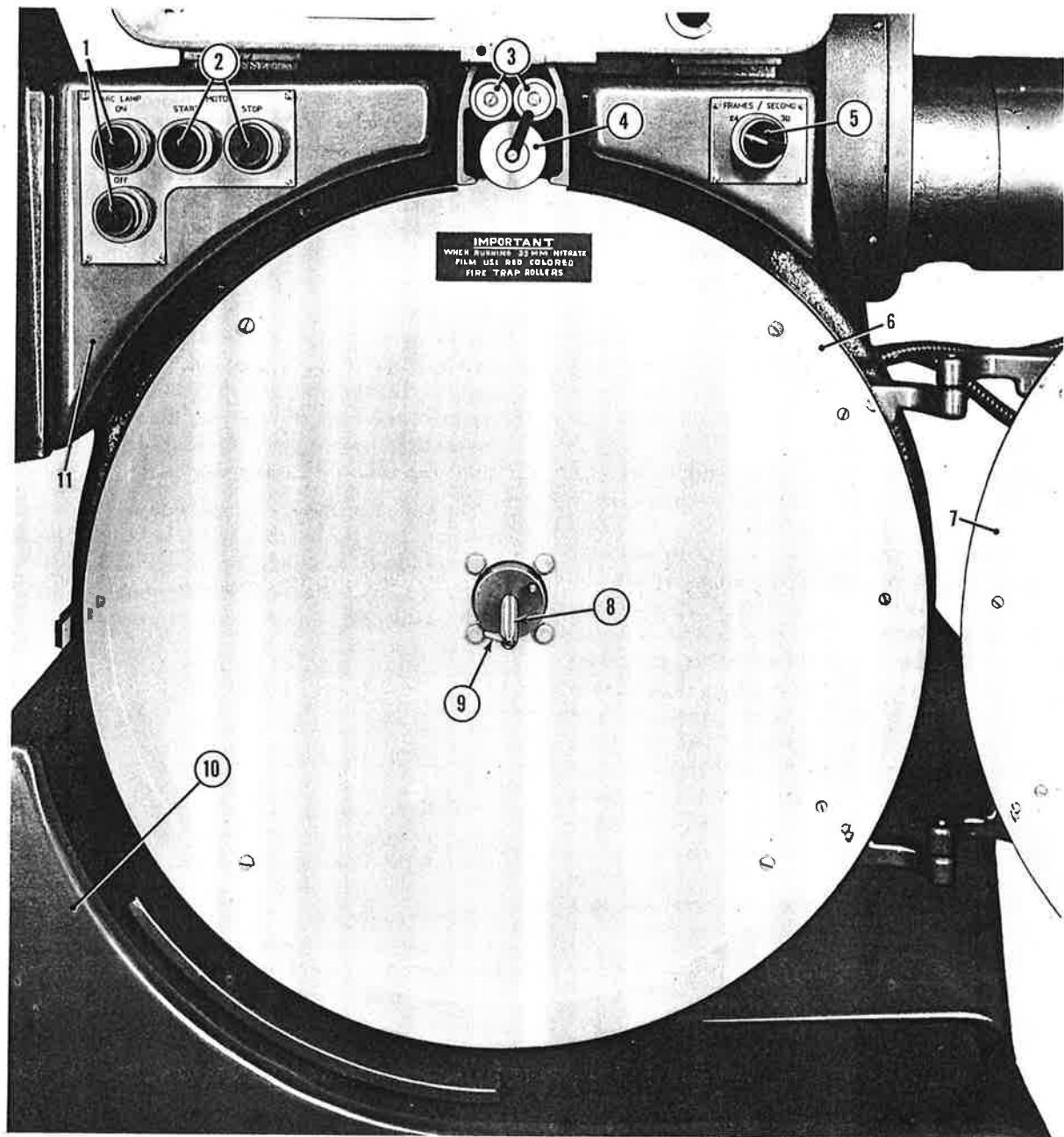
*Before installing the lower base, engaging plates for the leveling screws must be installed. See Paragraph 8b.*

### 3. Upper Base

The upper base (12) (Fig. 1) and (7) (Fig. 2) serves as a support for the projector head and upper magazine and as a housing for the majority of the electrical components. The lower magazine (6) (Fig. 3) is mounted on the right or operator's side of the upper base.

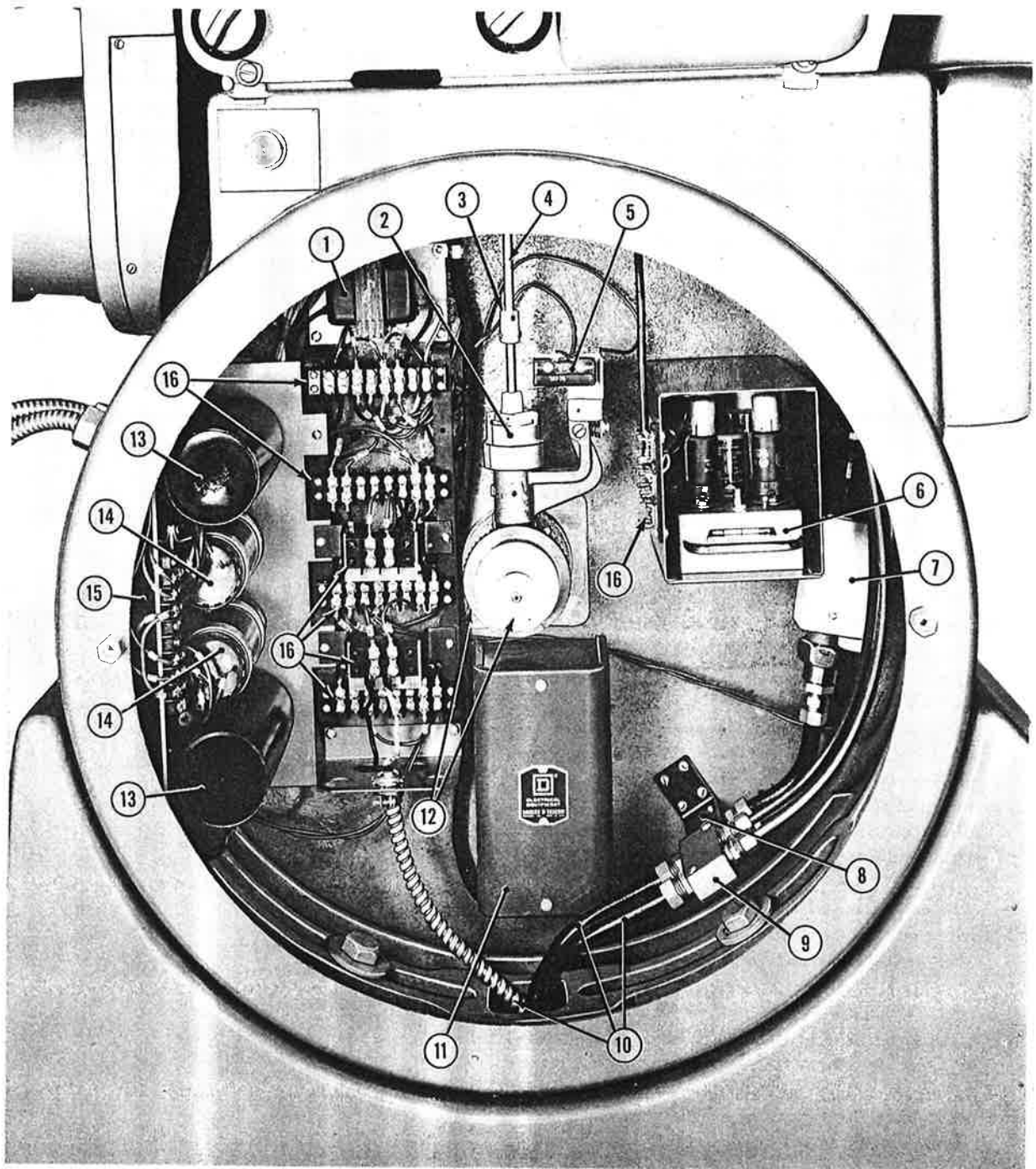
The interior of the upper base is accessible by removing the cover on the left side. The components in the upper base are as follows:

6-volt a-c stepdown transformer (1) (Fig. 4)



1. Arc lamp pushbutton switches
2. Motor pushbutton switches
3. Lower fire trap rollers
4. Guide roller
5. Motor selector switch
6. Lower magazine
7. Lower magazine door
8. Reel shaft
9. Latch
10. Lower base
11. Upper base

*Figure 3. Upper Base, Right Side, Door Open.*



- |                                    |   |
|------------------------------------|---|
| 1. 6-volt a-c stepdown transformer | 10. Electrical leads and water leads                        |
| 2. Centrifugal switch control      | 11. Motor start contactor                                   |
| 3. Main shaft coupling             | 12. Lower reel drive assembly including the friction clutch |
| 4. Coupling shaft                  | 13. Motor run capacitors                                    |
| 5. Minimum speed safety switch     | 14. Motor start capacitors                                  |
| 6. Optical preamplifier            | 15. 90-volt d-c selenium rectifier                          |
| 7. Water flow switch               | 16. Terminal strips   |
| 8. Water inlet manifold            |   |
| 9. Water outlet manifold           |   |

Figure 4. Upper Base, Left Side, Cover Removed.

- Centrifugal switch control (2)
- Main shaft coupling (3)
- Coupling shaft (4)
- Minimum speed safety switch (5)
- Optical preamplifier (6)
- Water flow switch (7)
- Water inlet manifold (8)
- Water outlet manifold (9)
- Electrical and water leads (10)
- Motor start contactor (11)
- Lower reel drive assembly including the friction clutch (12)
- Motor run capacitors (13)
- Motor start capacitors (14)
- 90-volt d-c selenium rectifier (15)
- Terminal strips (16)

The minimum speed safety switch (5) (Fig. 4) is operated by the centrifugal switch control (2). The switch is in series with the dowser solenoid. This solenoid circuit is opened and automatically drops the dowser and blocks the arc lamp beam if the speed of the main shaft is not up to the operating speed of the projector.

The optical preamplifier (6) is a complete plug-in unit and may be quickly removed and replaced.

The water inlet manifold (8) and the water outlet manifold (9) are designed so that the water connections may be made easily.

The water flow switch (7) operates in the arc lamp relay circuit and prevents the arc lamp from operating unless water is circulating through the arc lamp cooling system.

If the arc is controlled by a manually operated switch, a suitable signal device should be installed to indicate when water is flowing.

The motor leads are carried to the motors in flexible conduit from the front of the upper base.

The motor start and stop pushbutton switches (20) (Fig. 1) and the arc lamp start and stop pushbutton switches (19) are located on the right side of the upper base in the upper left corner. The motor selector switch (22) is located in the upper right corner. This switch allows the operator to select either the top motor which runs the film at 30 frames per second or the bottom motor which runs the film at 24 frames per second. A second motor stop pushbutton (20) (Fig. 2) is located on the left side of the upper base in the upper left corner. This arrangement makes it easy for the operator to stop the projector quickly from either side.

#### 4. Projector Head

One of the distinguishing features of the Todd-AO projector head (2) (Fig. 1) and (16) (Fig. 2) is that

it operates with either 35mm magnetic sound, 70mm magnetic sound, or 35mm optical sound. This arrangement provides, for the first time, the means for using either 70mm Todd-AO, 35mm optical sound, or 35mm cinemascope with magnetic sound in one projector. Perspecta sound may also be used if desired. The change from one sound system to another is accomplished by changing the necessary units and threading the film as required for each system. All interchangeable units are installed on referenced machined surfaces and require no installation adjustments. The 70mm units are color coded red and the 35mm units are color coded blue for quick identification. The change from one system to another normally requires about 4 minutes. The main assemblies or units built into the projector head are as follows:

*a. Cooling Plate.* The cooling plate holds the aperture plates for all of the different film systems. The aperture plates (25) (Fig. 5) are latched in place and are quickly changed. One pressure band holder (3) is mounted on the top of the cooling plate, and one is mounted on the bottom. The cooling plate may be released by disengaging the release lever (2) and pulling out the release knob (24), thus making it easy to change the pressure bands and aperture plate. The water cooling lines (6) (Fig. 6), dowser solenoid (5), dowser (7), and release lever (2) (Fig. 5) are mounted on the cooling plate holder.

1. Cooling plate
2. Release lever
3. Pressure band holder
4. Upper feed sprocket
5. Pad roller
6. Upper fire trap rollers
7. Guide roller
8. Magnetic pick-up head
9. Magnetic soundhead
10. Nylon pressure roller
11. Lens mount
12. Intermediate feed sprocket
13. Film gate
14. Framing indicator
15. Framing knob
16. Lens mount bracket
17. Oil level window
18. Hold-back sprocket
19. Guide roller
20. Lower fire trap rollers
21. Exciter lamp housing
22. Optical soundhead
23. Pressure roller, optical sound
24. Release knob
25. Aperture plate

Figure 5. Projector Head, Right Side, Door Open, Cooling Plate Released (Legend)

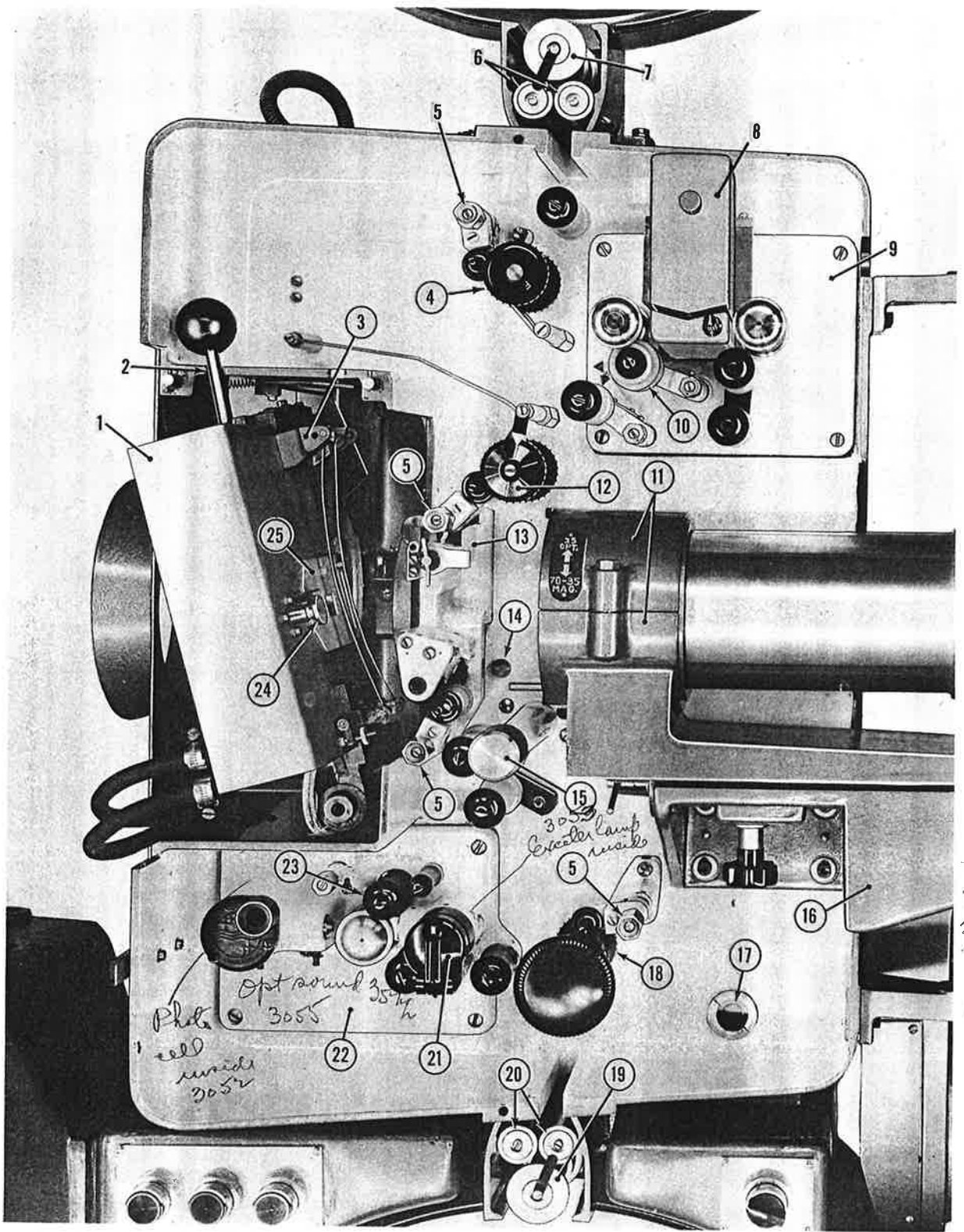
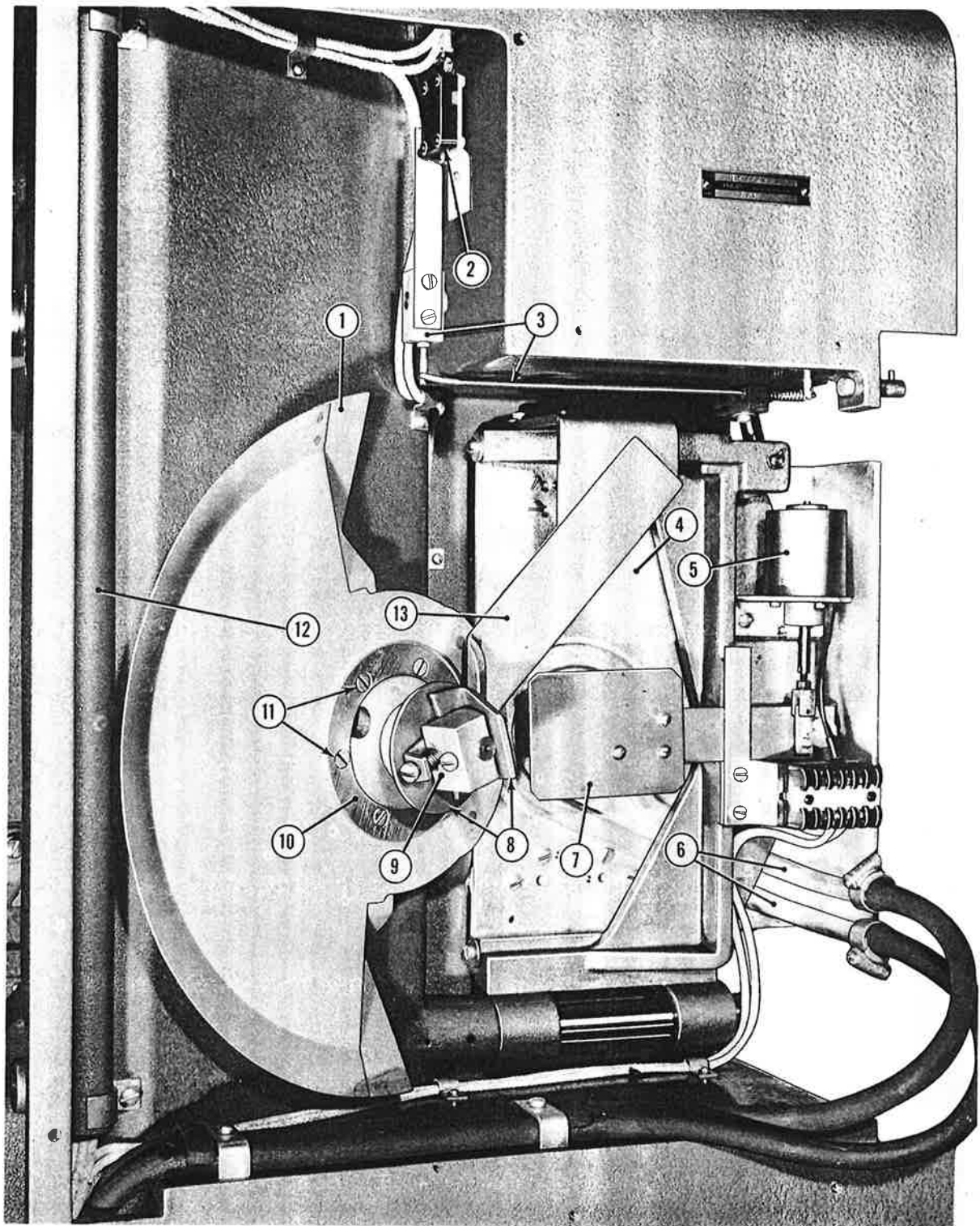


Figure 5. Projector Head, Right Side, Door Open, Cooling Plate Released.

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- |   |                              |                             |
|---|------------------------------|-----------------------------|
| 1. Shutter                              | 6. Water lines               | 11. Clamping ring screws    |
| 2. Film buckle switch                   | 7. Dowser                    | 12. Conduit                 |
| 3. Film buckle switch actuating linkage | 8. Centrifugal stop assembly | 13. Centrifugal locking arm |
| 4. Cooling plate                        | 9. Retaining block           |                             |
| 5. Dowser solenoid                      | 10. Clamping ring            |                             |

Figure 6. Cooling Plate, Rear View.

*b. Main Shaft.* The main shaft (6) (Fig. 7) is mounted in three ball bearing assemblies (3). The upper feed sprocket gear (4), intermediate feed sprocket gear (7), hold-back sprocket gear (12), shutter shaft drive gear, and intermittent are all driven by the main shaft. The oil pump gear (17) is driven by the motor drive shaft (14). The introduction of the upper feed sprocket at a point above that at which the feed sprocket is found on conventional projectors serves to isolate any irregularities in film pull from the upper reel. The design of the main shaft ties in all the synchronized components and reduces the use of intermediate gears that could introduce backlash or cause the shutter to get out of phase with the intermittent mechanism.

*c. Intermittent Mechanism.* The intermittent mechanism (9) (Fig. 7) is mounted in the projector head and is accessible from the left side of the projector. Normally this unit needs no adjustment. In the event of malfunctioning it should be returned to the factory. The intermittent mechanism is automatically lubricated by the oil system.

*d. Shutter and Shutter Shaft Assembly.* The Todd-AO shutter (1) (Fig. 6) differs from conventional projector shutters in that it is single bladed. This shutter cuts the picture twice during each cycle and develops an efficiency of approximately 54 percent. The shutter shaft assembly (8) (Fig. 7) is driven by the main shaft and is mounted in the left side of the projector head. The complete shutter shaft assembly, less the shutter, is removable as a unit.

*e. Oil Pump and Oil System.* The gear type oil pump (15) (Fig. 7) contains a combined gauze and magnetic filter. This filter may be changed by removing the oil filter cap (16) and removing the filter. Oil lines run to the various gear drives in the projector head. The oil level window (17) (Fig. 5) is visible from the right or operator's side of the projector with the door open. The oil filling screw (1) (Fig. 7), oil drain cap (13), and oil pump (15) are installed in the projector head.

*f. Optical Soundhead.* The optical soundhead (22) (Fig. 5) is built as a unit and is installed in the projector head with four screws. An exciter lamp throws a light beam on the film through a light focusing system. A micro objective projects the illuminated spot on the slit via a mirror. A condenser behind the slit concentrates the light beam on the photocell.

*g. Magnetic Soundhead.* The magnetic soundhead (9) (Fig. 5) is mounted in the upper right side of the projector head. Ten sound tracks are incorporated in the pickup head; six of which are used for Todd-AO 70mm film and four for 35mm

film. The magnetic pickup head is mounted on the machined surface on the soundhead.

*b. Film Gate.* Two complete film gate kits are furnished with each projector . . . one for Todd-AO 70mm film, color coded red, and one for 35mm film, color coded blue. The appropriate film gate (13) (Fig. 5) must be installed for the film being used. Two pad rollers (5) are attached to the film gate. The one at the top of the film gate engages the intermediate feed sprocket and the one at the bottom engages the intermittent sprocket. Film edge guide rollers at the top of the film gate align the film with the aperture.

*i. Motor Drive Shaft.* The motor drive shaft (14) (Fig. 7) is located in the lower front of the projector head. This drive shaft is geared directly to the main shaft. The oil pump is mounted on the drive shaft support which in turn is mounted on the projector head housing.

## 5. Upper Magazine

### CAUTION

*Be sure to heed the warning note placed inside the upper magazine just above the upper fire trap. If 35mm nitrate film is to be run, the red fire trap rollers must be used. Do not use these red rollers with 70mm film.*

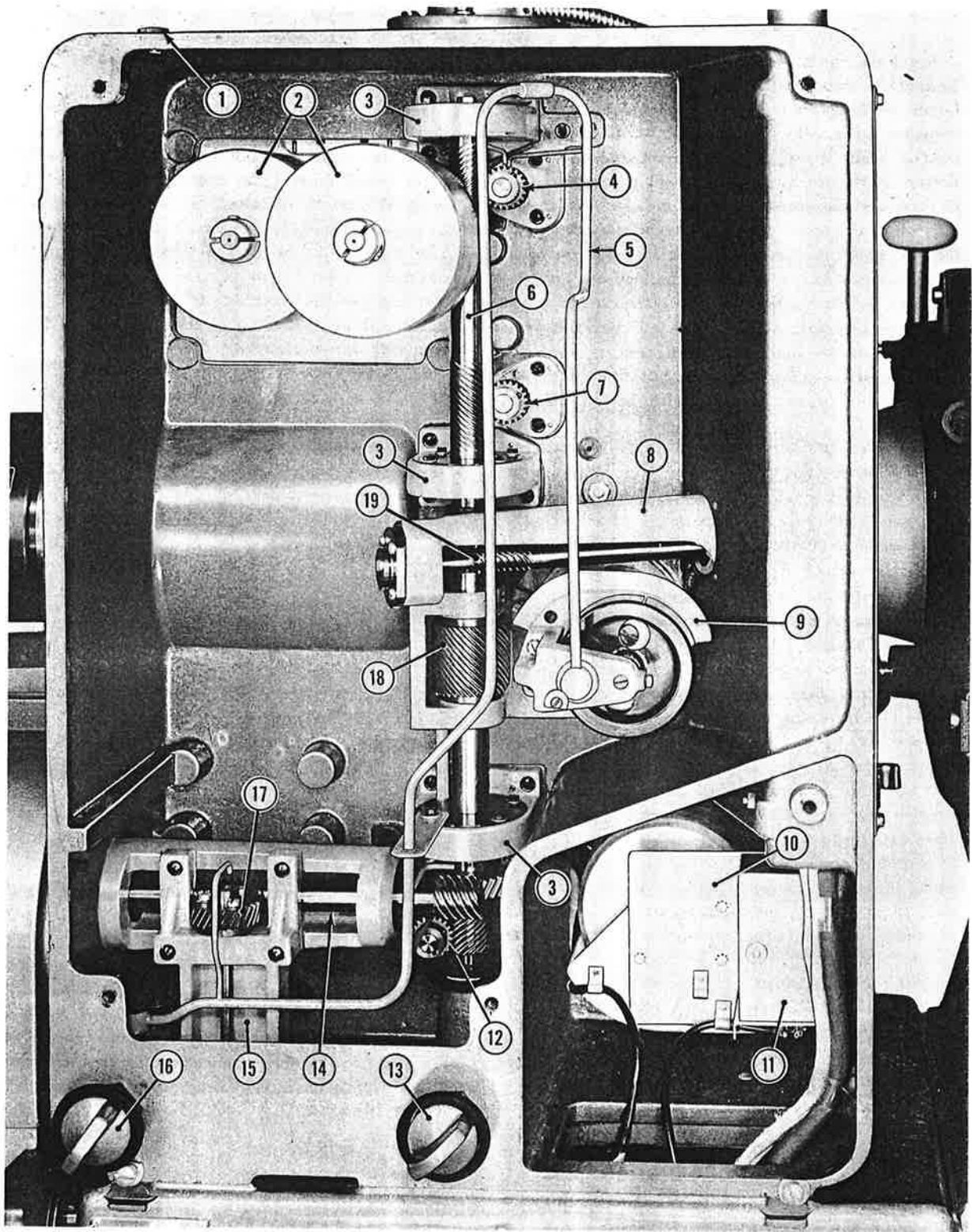
The upper magazine (3) (Fig. 1) and (1) (Fig. 2) consists of the upper magazine support (3) with cap (2), reel shaft, friction brake, magazine and magazine cover. A lamp directly behind the upper magazine window provides the operator with a visual indication of the amount of film left on the upper reel. The upper fire trap (5) (Fig. 1) is attached to the upper magazine and is installed between the upper magazine and the projector head. Even tension is maintained on the film between the upper reel and the upper feed sprocket by the adjustable friction brake operating on the reel shaft in the upper magazine.

## 6. Arc Lamp Bracket

The arc lamp bracket (18) (Fig. 1) and (6) (Fig. 2) is mounted on the upper rear side of the upper base. This bracket is designed to accommodate any standard arc lamp, however, only certain of these are recommended for the Todd-AO process.

## 7. Motor Drive Assembly

The motor drive assembly (8) (Fig. 1), (9), (10), and (11), consists of two ¼-hp, 1800-rpm, 115/230-volt, 60-cycle, single-phase motors which are cou-



- |                                    |   |                             |
|------------------------------------|---|-----------------------------|
| 1. Oil filling screw               | 8. Shutter shaft assembly               | 15. Oil pump                |
| 2. Magnetic soundhead stabilizers  | 9. Intermittent mechanism               | 16. Oil filter cap          |
| 3. Ball bearing assembly           | 10. Optical sound stabilizer mechanism  | 17. Oil pump gear           |
| 4. Upper feed sprocket gear        | 11. Photocell compartment and photocell | 18. Intermittent drive gear |
| 5. Oil line                        | 12. Hold-back sprocket gear             | 19. Shutter shaft gear      |
| 6. Main shaft                      | 13. Oil drain cap                       |                             |
| 7. Intermediate feed sprocket gear | 14. Motor drive shaft                   |                             |

*Figure 7. Projector Head, Left Side, Cover Removed.*



pled by a Gilmer belt and mounted on the projector head by means of the drive housing. The upper motor (8) drives the film at a speed of 30 frames per second. This motor is used only for Todd-AO 70mm film. The lower motor (11) has a pulley ratio which runs the film at 24 frames per second. The upper motor is equipped with a manual inching

knob (9) which permits the operator to turn the projector slowly by hand. The motors are controlled by start and stop pushbutton switches (20) and the motor selector switch (22). There is also a motor stop pushbutton (20) (Fig. 2) on the left side of the projector to enable the operator to stop the projector from either side.

## Section II. UNPACKING, ASSEMBLY, AND INSTALLATION

### 8. General

a. *Method of Packing and Numbering.* The Todd-AO projector is packed and shipped in containers numbered 1 through 6 plus additional cartons for accessories. The main assemblies are packed in these containers as follows:

Container No.	Assembly
1	Lower Base
2	Upper Base
3	Projector Head
4	Upper Magazine
5	Arc Lamp Bracket
6	Motor Assembly

The order in which the containers are numbered is also the order of assembly of the projector. Therefore, open and unpack Container No. 1 first, Container No. 2 second, etc.

#### NOTE

The "right" and "left" sides of the projector as used in these instructions refer to the right and left sides as the operator faces the screen. The right side is therefore, the operator's side.

#### CAUTION

Use care in unloading and unpacking the projector. All of the projector components are precision fitted and some are critically adjusted. Avoid dropping or jarring any of the containers. Do not unpack these components until they are to be assembled unless shipping damage is indicated.

b. *Preparation of Installation Area for Setup.* The location of the electrical and water outlets must be determined before the installation of the lower base. As explained in Paragraph 2, all the electrical leads as well as the water lines may be brought into the projector directly from the floor through the lower base if desired. However, the water lines, electrical leads, and 65-volt arc lamp leads may be brought in through the front of the lower base. A cutout (14) (Fig. 1) for the electrical leads and connections (13) for the water lines are provided for that purpose. Whichever method is used, the outlets must be prepared before the lower base is installed (see Figure 8 for installation dimensions). Metal floor plates must be placed on the floor to engage the leveling screws installed in the holes (16) (Fig. 1) in each corner of the lower base. These floor plates should be not less than approximately  $2\frac{1}{2}$  X  $2\frac{1}{2}$  inches square and

they should be heavy enough to prevent the leveling screws from entering the floor.

#### NOTE

Be sure the floor plates do not cover the point where the hold-down screws are to be installed (see Figure 8 for installation dimensions).

### 9. Lower Base

a. *Unpacking.* The lower base is contained in the shipping case marked "No. 1." Four hold-down bolts with nuts and washers are used to fasten the lower base to the bottom of the shipping case. Unpack and install the lower base as follows:

- (1) Remove the cover from the shipping case.
- (2) Remove the nuts from the hold-down bolts.
- (3) Lift the lower base out of the shipping case.

#### NOTE

The lower base can be lifted out of its shipping case by four men. However, a chain hoist can be used if one is available. In this case, a small iron bar should be placed under the center hole in the top of the casting, and the chain hoist hook should then be hooked to the bar.

b. *Installation.* After the lower base has been removed from the shipping case, make a final check of the installation area to make sure that the electrical outlets, water lines, and floor plates are properly prepared. A final check of measurements should be made to make sure the leveling screws will properly engage the floor plates (see Figure 8). The installation procedure for the lower base is as follows:

- (1) Move the lower base to its operating position.
- (2) Install the leveling screws in the holes (16) (Fig. 1) in preparation for final positioning of the projector.
- (3) Install four hold-down screws in the holes (15) (Fig. 1) in the lower base.
- (4) Smear a coating of heavy grease on the circular surface of the lower base where it supports the upper base. Be sure this is done before the upper base is installed.

#### NOTE

One 8-ounce tube of grease is shipped with each projector. Use this grease as described in (4) above.

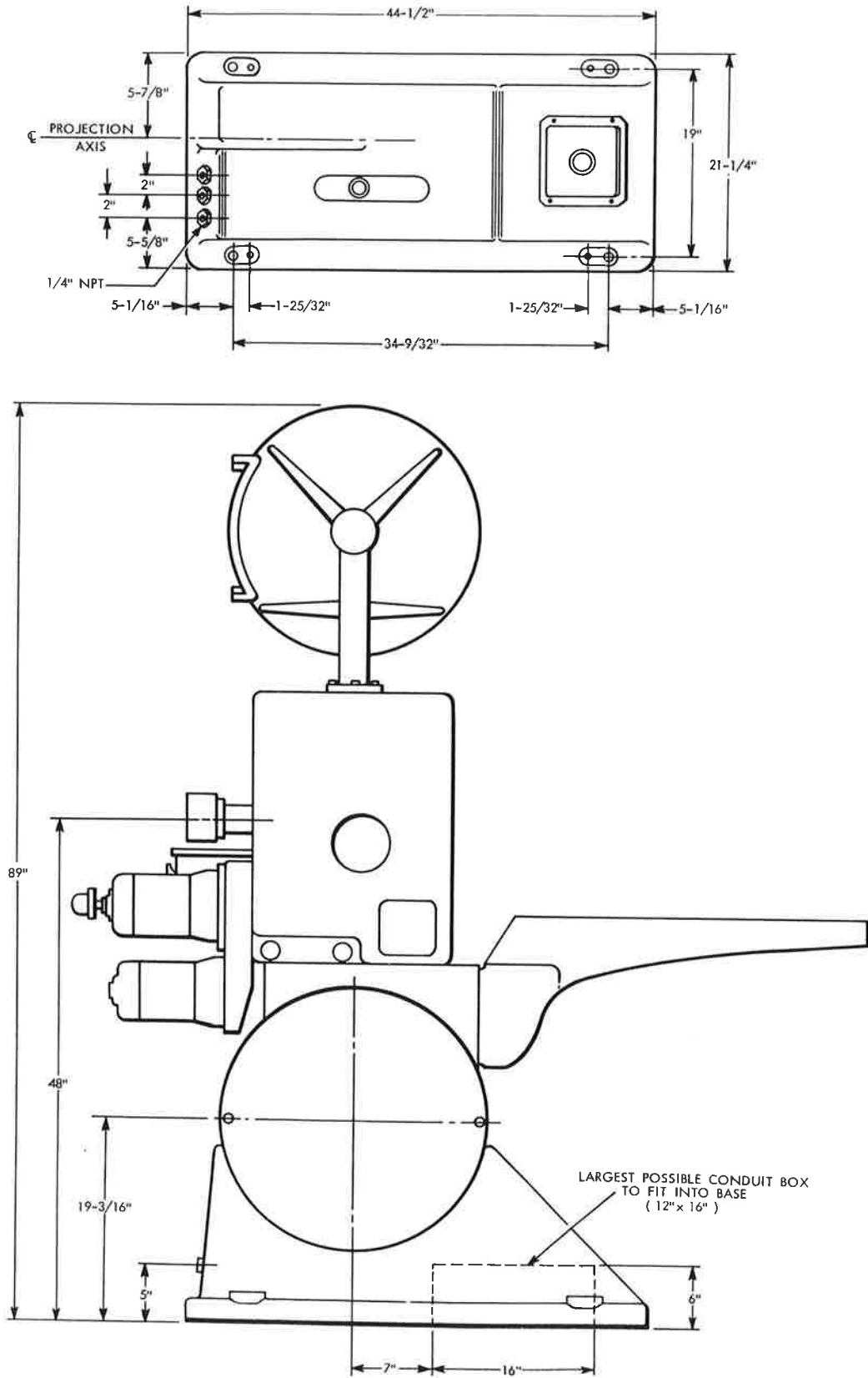


Figure 8. Installation Diagram, Elevation and Plan View Showing Location of Plumbing and A-C and D-C Power Supplies.

## 10. Upper Base

*a. Unpacking.* The upper base is contained in the shipping case marked "No. 2." This unit is packed inverted in its shipping case to facilitate shipping and unpacking. Two large cap screws with flat washers are contained in a cloth bag shipped inside the case. These are the two cap screws (11) (Fig. 9) used to mount the upper base on the lower base. The coupling shaft and four pieces of tubing are also contained in the shipping case for the upper base. The coupling shaft connects the main shaft with the lower reel drive. The tubing is used to make the water connections from the manifolds to the equipment. The procedure for unpacking the upper base is as follows:

- (1) Remove the shipping case cover.
- (2) Remove the wood screws from the shipping wedges and remove the wedges.
- (3) Remove the wood screws from the crosspieces.
- (4) Loosen the nuts on the carriage bolts that hold the crosspieces to the upper base, and then turn the crosspieces lengthwise of the shipping case to facilitate removal of the bolts.

### CAUTION

*Do not let the bolts drop into the upper base. Insert one hand into the upper base and hold the bolts as the nuts are removed.*

- (5) Remove the reel side of the shipping case.
- (6) Remove the two bolts that hold the upper base to the shipping pallet.
- (7) Lift the upper base out of the shipping case.

### CAUTION

*When removing the upper base from the shipping case, be careful not to rest the upper base on the lower fire trap housing, as this may force the fire trap rollers out of line.*

*b. Installation.* Before installing the upper base on the lower base, be sure to smear a coating of heavy grease on the supporting surface of the lower base (Par. 9b (4)). Install the upper base as follows:

- (1) Remove the door (7) (Fig. 3) from the magazine on the right side of the upper base.
- (2) Place the upper base on the lower base with the lower magazine on the right side.

## NOTE

*The electrical leads and water leads (10) (Fig. 4) must be fed up through the center hole in the upper base. Be sure to leave enough slack in the leads and hoses to permit rotation of the upper base on the lower base when adjusting the projection angle.*

- (3) Install the large cap screws (11) (Fig. 9) and flat washers (10) and tighten them with an end wrench.

## 11. Projector Head

*a. Unpacking.* The projector head is contained in the shipping case marked "No. 3." The projector head is removed from the shipping case as follows:

- (1) Remove the top of the shipping case.
- (2) Turn the shipping case containing the projector head upside down.

### CAUTION

*Be sure enough help is present to hold the projector head in place in the shipping case while it is being turned over. Lift on the projector head itself to prevent the projector head from sliding out of the shipping case.*

- (3) Lift the inverted shipping case off the projector head.
- (4) Lay the projector head on its side on two 2 X 4's as shown in Figure 10, with the arc lamp flange in a downward position between the 2 X 4's.

### CAUTION

*Be sure the two 2 X 4's are placed so that the projector head does not rest on the arc lamp flange.*

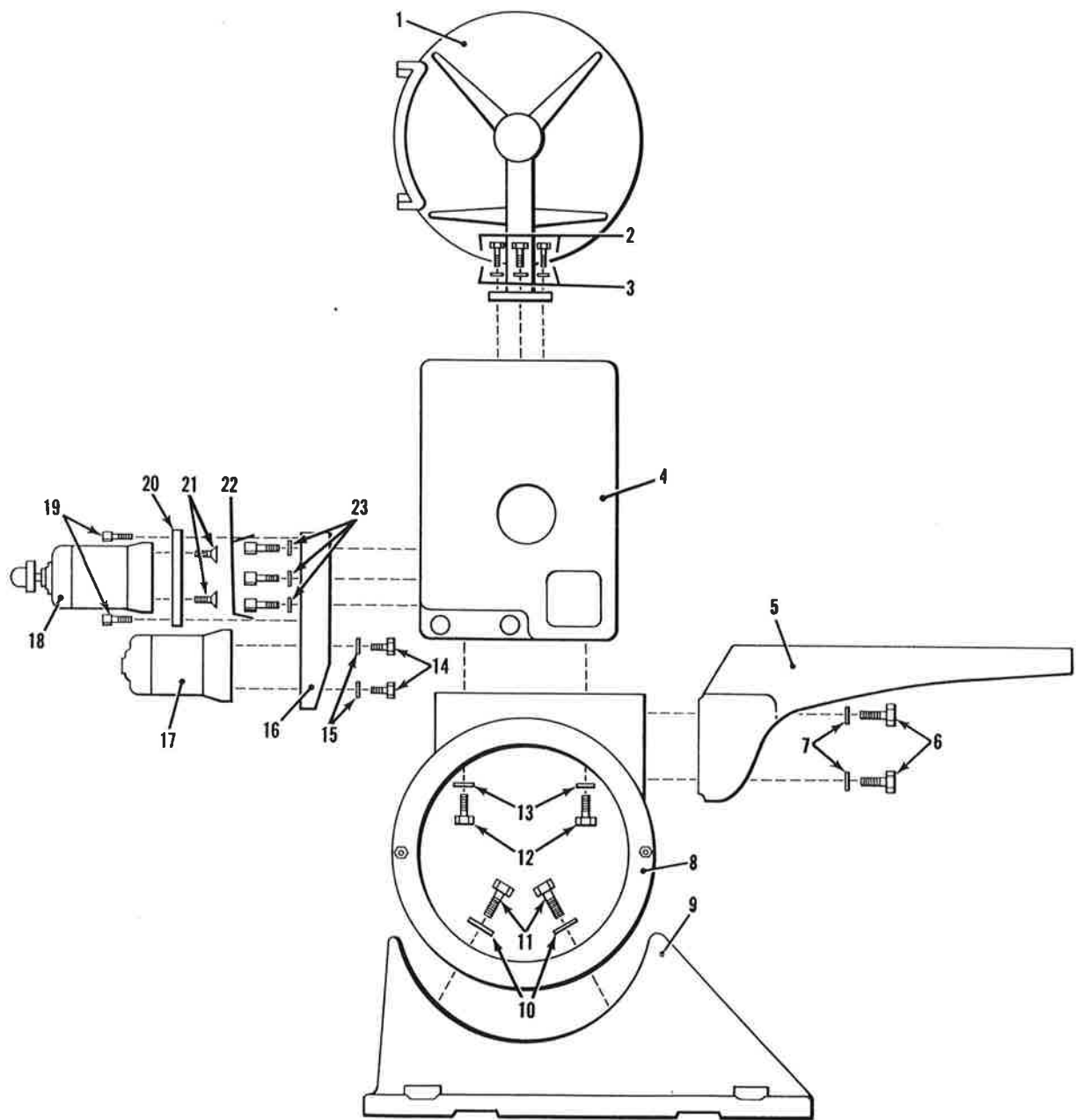
- (5) Remove the two cap screws (5) (Fig. 10) that hold the bottom crating (6) to the bottom of the projector head and remove the bottom crating.

## NOTE

*The two cap screws (5) are used to mount the projector head on the upper base.*

## NOTE

*Do not remove the top crating from the projector head until the head is installed on the upper base. Use the top crating as an aid for lifting and turning the projector head.*



- |                           |                            |                                  |
|---------------------------|----------------------------|----------------------------------|
| 1. Upper magazine         | 9. Lower base              | 16. Drive housing                |
| 2. Cap screws (3 req'd)   | 10. Flat washers (2 req'd) | 17. Lower motor                  |
| 3. Flat washers (3 req'd) | 11. Cap screws (2 req'd)   | 18. Upper motor                  |
| 4. Projector head         | 12. Cap screws (2 req'd)   | 19. Allen-head screws (4 req'd)  |
| 5. Arc lamp bracket       | 13. Flat washers (2 req'd) | 20. Adapter plate                |
| 6. Cap screws (4 req'd)   | 14. Cap screws (4 req'd)   | 21. Flat-headed screws (4 req'd) |
| 7. Flat washers (4 req'd) | 15. Flat washers (4 req'd) | 22. Allen-head screws (6 req'd)  |
| 8. Upper base             |                            | 23. Flat washers (6 req'd)       |

Figure 9. Main Assemblies, Exploded View.

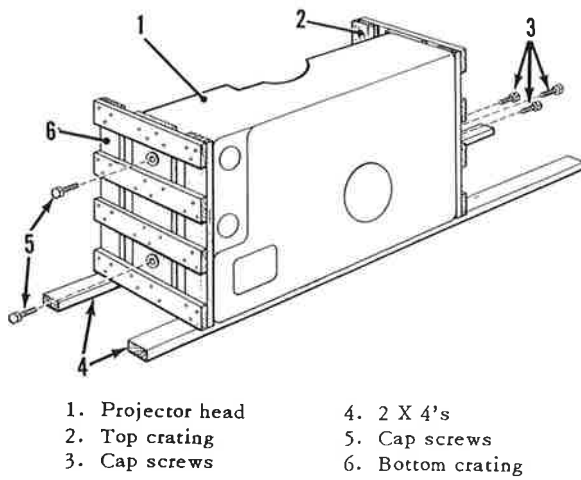


Figure 10. Removing Bottom Crating from Projector Head.

(6) Set the projector head right side up with the top crating still attached.

*b. Installation.*

(1) Place the projector head on the upper base.

**CAUTION**

Be sure the aligning washers (2) (Fig. 11) are not turned down before installing the projector head. Otherwise they may be damaged when lifting the projector head onto the upper base.

(2) After placing the projector head on the upper base, loosen the aligning screws (1) (Fig. 11) that hold the aligning washers (2).

(3) Rotate the washers so that the circular half is in a downward position as shown in Figure

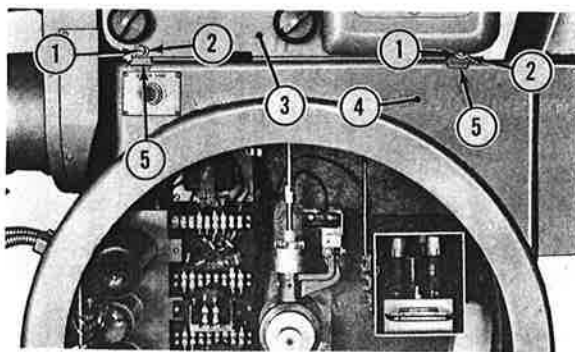


Figure 11. Alignment of Projector Head.

11 and tighten the aligning screws.

(4) Move the projector head into its operating position, aligning the washers (2) and stops (5) as shown in Figure 11.

(5) Insert the coupling shaft (4) (Fig. 4) in the projector head and connect the main shaft coupling (3).

(6) Install the cap screws (12) (Fig. 9) and flat washers (13). Check the forward and backward alignment, being sure the coupling shaft turns freely.

(7) Install the operator's door on the right side of the projector head as follows:

(a) Remove the door and the hinge brackets from the separate cardboard shipping cases accompanying the projector head.

(b) Clean the surfaces of the hinge brackets thoroughly.

(c) Mount the two hinge brackets on the projector head by inserting and tightening three Allen-head screws in each bracket.

(d) Install the door on the hinge brackets.

**NOTE**

If the door does not swing easily, loosen the Allen-head screws to permit the hinges to center properly. Retighten the Allen-head screws and try the door again.

**12. Upper Magazine**

*a. Unpacking.* The upper magazine is contained in the container marked "No. 4." Remove the upper magazine from the container as follows:

(1) Remove the cover from the packing case.

(2) Remove the upper magazine from the packing case.

**NOTE**

The shipping case contains a cloth sack with three 5/16 x 1/4 inch cap screws and lockwashers. These cap screws and lockwashers are used to install the upper magazine support to the top of the projector head (see (2) and (3) (Fig. 9)).

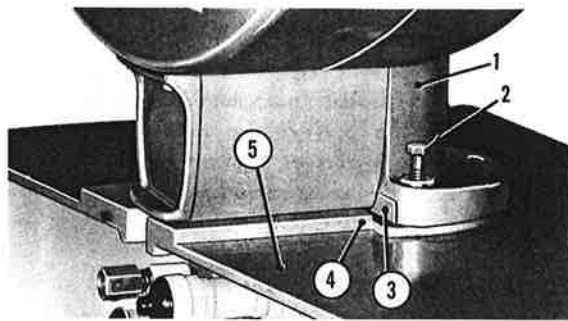
*b. Installation.*

(1) Place the magazine in position on the projector head.

(2) Insert the three cap screws (2) (Fig. 12), leaving them loose.

(3) Make sure that the machined reference surface (3) (Fig. 12) is snug against the machined reference flange (4).

(4) Tighten the three cap screws (2).



1. Upper magazine
2. Cap screw
3. Machined reference surface
4. Machined reference flange
5. Projector head

Figure 12. Alignment of Upper Magazine.

**NOTE**

A decal stating that red fire trap rollers must be used when 35mm nitrate film is run must appear on the inside of the upper magazine, just above the fire trap. Make sure that this decal or an equivalent is present.

(5) Remove the cap (2) (Fig. 2) and check the lubrication of the friction brake. If it is necessary to supply additional lubricant, use a light grease or 600 W oil.

**13. Arc Lamp Bracket**

a. *Unpacking.* The arc lamp bracket is contained in the shipping case marked "No. 5." Remove the arc lamp bracket as follows:

- (1) Remove the shipping case cover.

**NOTE**

The cloth bag attached to the arc lamp bracket contains leveling washers, spacers, nuts, and bolts used in the installation of the arc lamp.

(2) Lift the arc lamp bracket out of the shipping case.

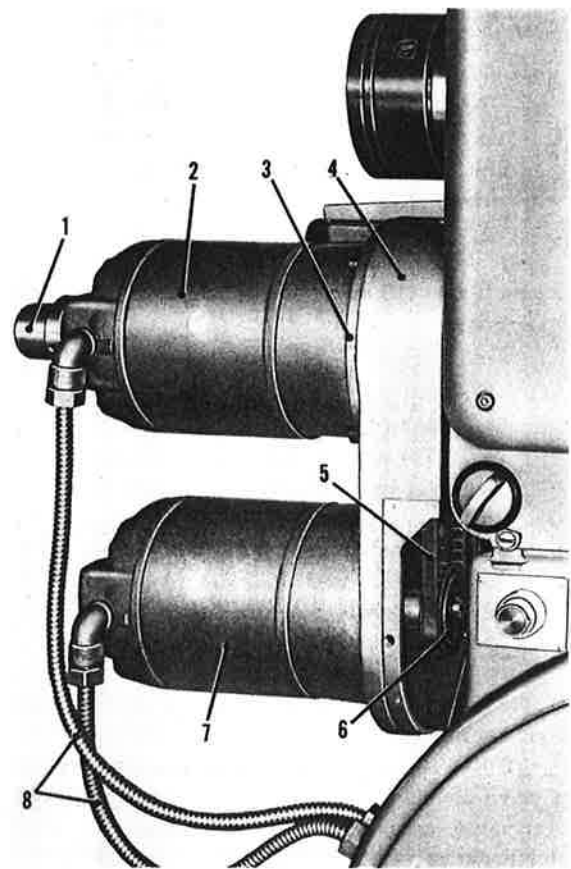
b. *Installation.*

(1) Hold the arc lamp bracket (5) (Fig. 9) in place against the back of the upper base.

(2) Install and tighten the four cap screws (6) and flat washers (7) that hold the arc lamp bracket to the upper base.

**14. Motor Drive Assembly**

a. *Unpacking.* The motor drive assembly, which consists of the upper motor (2) (Fig. 13), lower



- |                  |                       |
|------------------|-----------------------|
| 1. Inching knob  | 5. Gilmer belt        |
| 2. Upper motor   | 6. Lower motor pulley |
| 3. Adapter plate | 7. Lower motor        |
| 4. Drive housing | 8. Motor leads        |

Figure 13. Close-Up of Motor Drive Assembly.

motor (7), adapter plate (3), pulleys, belt, and drive housing (4), is contained in shipping case No. 6. This assembly is unpacked simply by opening the shipping case and removing the components.

b. *Installation.*

(1) Install the drive housing (16) (Fig. 9) on the lower base by installing six Allen-head screws (22) and washers (23).

(2) Install the adapter plate (20) on the upper motor (18) by inserting and tightening four flat-headed screws (21).

(3) Install the Gilmer pulley on the shaft using the key attached to the motor shaft.

**NOTE**

The distance from the face of the upper pulley to the face of the adapter ring must be 1-13/16 inches as shown in Figure 14. Likewise, the distance from the face of the lower pulley to the face of the lower motor must be

1-13/16 inches. It is very important that this clearance be accurate so that the pulleys line up correctly. The upper pulley must not bind on the coupling pins. Figure 14 shows the correct alignment of the Gilmer drive pulleys.

(4) Install the upper motor (18) (Fig. 9) and adapter plate (20) on the drive housing (16) by installing four Allen-head screws (19).

**NOTE**

Be sure to install the Gilmer belt (5) (Fig. 13) on the pulley of the upper motor before attaching the motor to the housing and engaging the drive pins in the pulley. The belt cannot be installed after the motor and pulley are mounted on the Gilmer drive housing.

(5) Install the remaining pulley on the shaft as shown in Figure 14.

(6) Install the lower motor (17) (Fig. 9) on the drive housing (16), making sure the Gilmer belt is engaged properly on both motor pulleys. The belt should run with no slack, but it should not be stretched. Tighten the four cap screws (6) and washers (15).

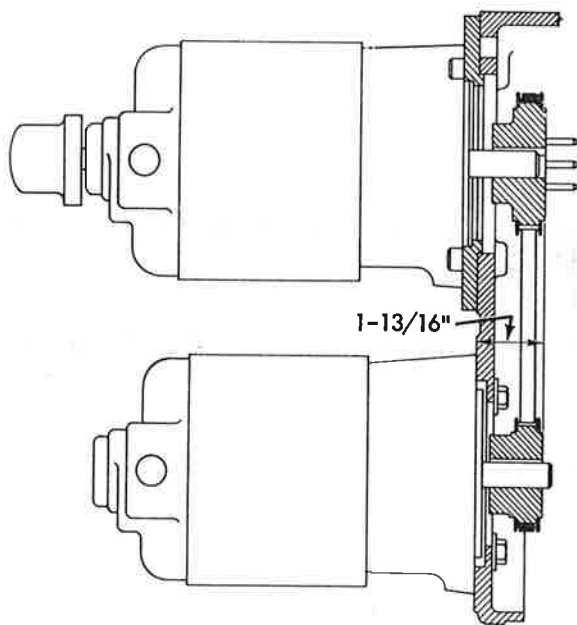


Figure 14. Diagram of Pulley Alignment.

**NOTE**

Do not install the two halves of the motor mount cover until the motors have been test run under power to see if the pulleys are properly aligned with correct tension and that the belt is running smoothly.

**15. Optical Soundhead**

a. *Unpacking.* The optical soundhead is mounted on a wooden shipping block and packed in a small box separate from the projector head.

**CAUTION**

The optical soundhead is a delicate instrument. Handle and unpack with care.

(1) Open the top of the box and remove the optical soundhead and shipping block.

(2) Remove the four flat-headed screws with nuts and washers that hold the optical soundhead on the shipping block and remove the shipping block from the soundhead.

(3) Wipe all shipping grease from the soundhead with a clean, dry cloth.

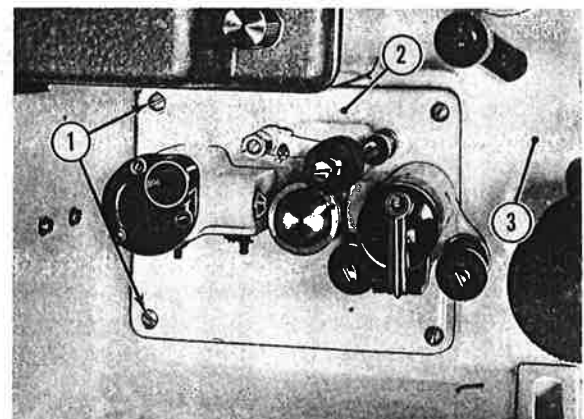
**CAUTION**

When cleaning the soundhead, be careful not to smear the lenses.

b. *Installation.* The optical soundhead (2) (Fig. 15) is mounted in the projector head with four mounting screws (1) shipped inserted in the projector head.

(1) Feed the two optical soundhead wires through the hole behind the soundhead and install the soundhead in its operating position.

(2) Tighten the four mounting screws (1).



1. Mounting screws      3. Projector head  
2. Optical soundhead

Figure 15. Close-Up of Optical Soundhead.



## 16. Magnetic Soundhead Stabilizers

*a. Unpacking.* The magnetic soundhead stabilizers (1) (Fig. 32) are packed in a small box separate from the projector head.

*b. Installation.*

(1) Remove the screws (2) (Fig. 32) from the locking spacers on the shafts (3).

(2) Install the stabilizers (1) on the shafts (3), holding the shafts from the front side to prevent their being pushed through. Tighten the screws removed in (1) above. Hold the stabilizing rollers (4) (Fig. 16) to prevent the shafts from turning when aligning the screws in the shaft.

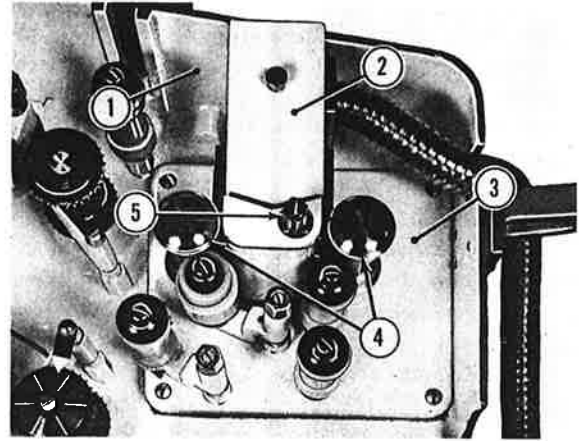
## 17. Lens Mount Bracket

*a. Unpacking.* The lens mount bracket (3) (Fig. 17) is shipped in a separate container.

### NOTE

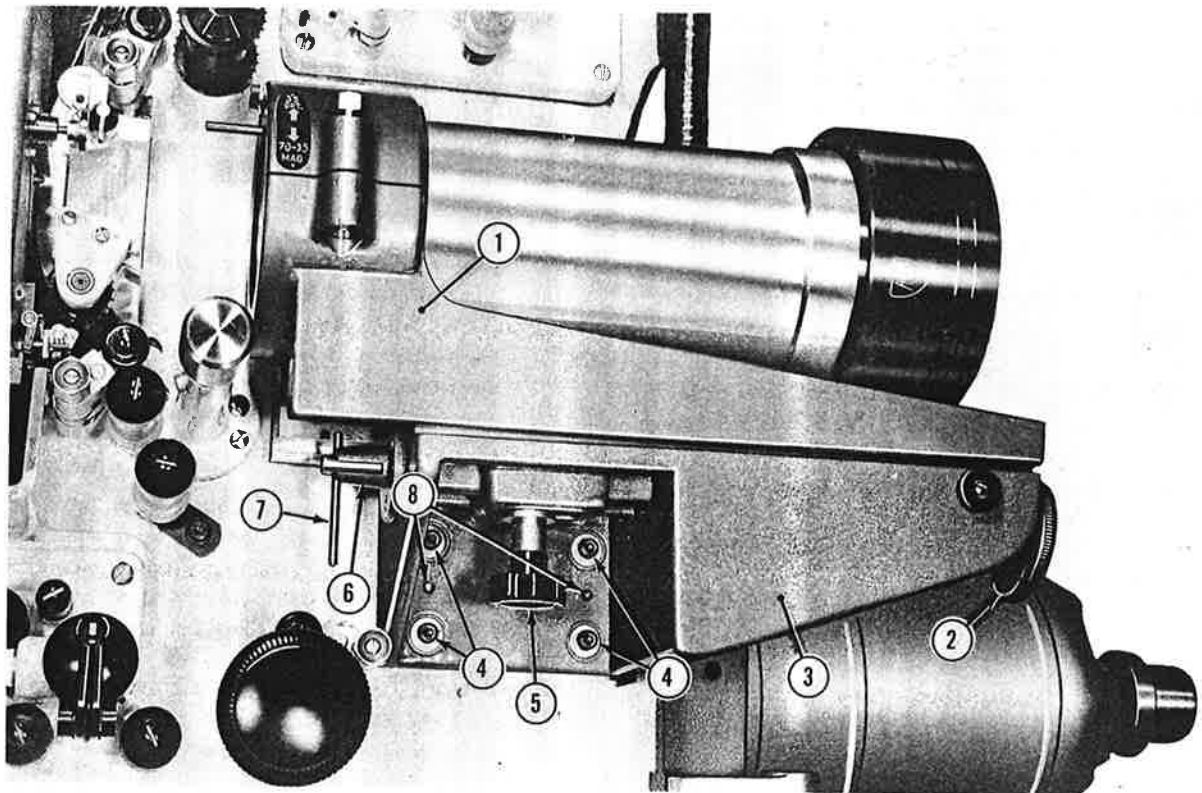
The lens mount hold-down bolt (5), focusing knob (2), and door hinges, and door hinge mounting screws are shipped together in a separate container.

*b. Installation.* Hold the lens mount bracket (3) (Fig. 17) in place and install the four Allen-head screws (4) in the base of the bracket. Make sure the dowel pins (8) (Fig. 17) are properly aligned.



- |                          |                          |
|--------------------------|--------------------------|
| 1. Projector head        | 4. Stabilizing rollers   |
| 2. Magnetic pick-up head | 5. Pressure control knob |
| 3. Magnetic soundhead    |                          |

Figure 16. Close-Up of Magnetic Soundhead.



- |                       |                      |
|-----------------------|----------------------|
| 1. Lens mount         | 5. Hold-down bolt    |
| 2. Focusing knob      | 6. Engaging bushing  |
| 3. Lens mount bracket | 7. Focus spring lock |
| 4. Allen-head screws  | 8. Dowel pins        |

Figure 17. Lens Mount Bracket and Lens Mount.

## 18. Lens Mount

*a. Unpacking.* The lens mount is shipped assembled with the eccentric bushing in a separate container.

*b. Installation.*

(1) Before attempting to install the lens mount, be sure the focus spring lock (7) (Fig. 17) is in the short slot at the end of the engaging bushing (6), and that the focusing knob (2) is backed away sufficiently to allow room for entry of the stop on the bottom of the lens mount.

(2) Place the lens mount in position on the lens mount bracket.

(3) Remove the hold-down bolt (5) from the separate container and install the bolt, but leave it loose enough to allow movement of the lens mount.

(4) Tighten the focusing knob (2) sufficiently to release the focus spring lock (7), and turn the focus spring lock so that it enters the long slot in the engaging bushing (6).

(5) Tighten the hold-down bolt (5).

## 19. Lens

The lens is shipped in a separate container. Handle the lens carefully and assemble it to the lens mount as follows:

*a.* Loosen the lens mount locking bolt (9) (Fig. 25) and remove the eccentric bushing.

*b.* Loosen the two eccentric bushing clamping screws and slide the eccentric bushing onto the 4-inch diameter of the lens as far as it will go, the lens rotating pin (27) (Fig. 25) being toward the rear.

*c.* Tighten the two eccentric bushing clamping screws.

*d.* Insert the lens and eccentric bushing assembly into the lens mount so that the lens rotating pin may rotate through a full 180° on the right-hand side of the lens mount, making sure that the eccentric bushing flange is seated against the front face of the lens mount.

*e.* With the lens rotating pin in correct position, as discussed in Paragraph 33b, tighten the lens mount locking bolt. Do not disassemble the lens itself.

## 20. Optical Preamplifier

The optical preamplifier (6) (Fig. 4) is packed in a separate box and is a complete plug-in unit. Before plugging the unit in, make sure the tubes are secure in their sockets.

## 21. Photocell

Remove the photocell from its container and install it in the photocell compartment (11) (Fig. 7).

## 22. Electrical Connections

### NOTE

*These instructions cover only projector connections . . . see sound system instructions for sound system connections.*

*a. A-C Power Supply.* The 110-volt, 60-cycle, a-c power supply may be brought in through the front of the lower base or directly through the floor underneath the lower base (see Paragraph 2). The a-c leads (numbered "60" and "20" on the wiring diagram (Fig. 18)) are connected to the two center terminal clips of the raised terminal strip at the bottom of the terminal strip panel (Fig. 19).

*b. D-C Power Supply.* The d-c power supply for the arc lamp may be brought in through the lower base or direct to the arc lamp from an outlet in the floor (see Paragraph 2). The location of the d-c connections on the arc lamp may vary according to the type of arc lamp used.

*c. Motor Leads.* The motor leads (8) (Fig. 13) are connected to the motors by opening the junction box on each motor, feeding the leads from the conduit into the junction box, installing the conduit bushings on the junction box, and connecting the leads.

### NOTE

*Both motors must operate in a clockwise direction when facing the projector from the front. Consult the connection diagram on the inside of each conduit box for connection data. See Figure 18 for proper wire identification.*

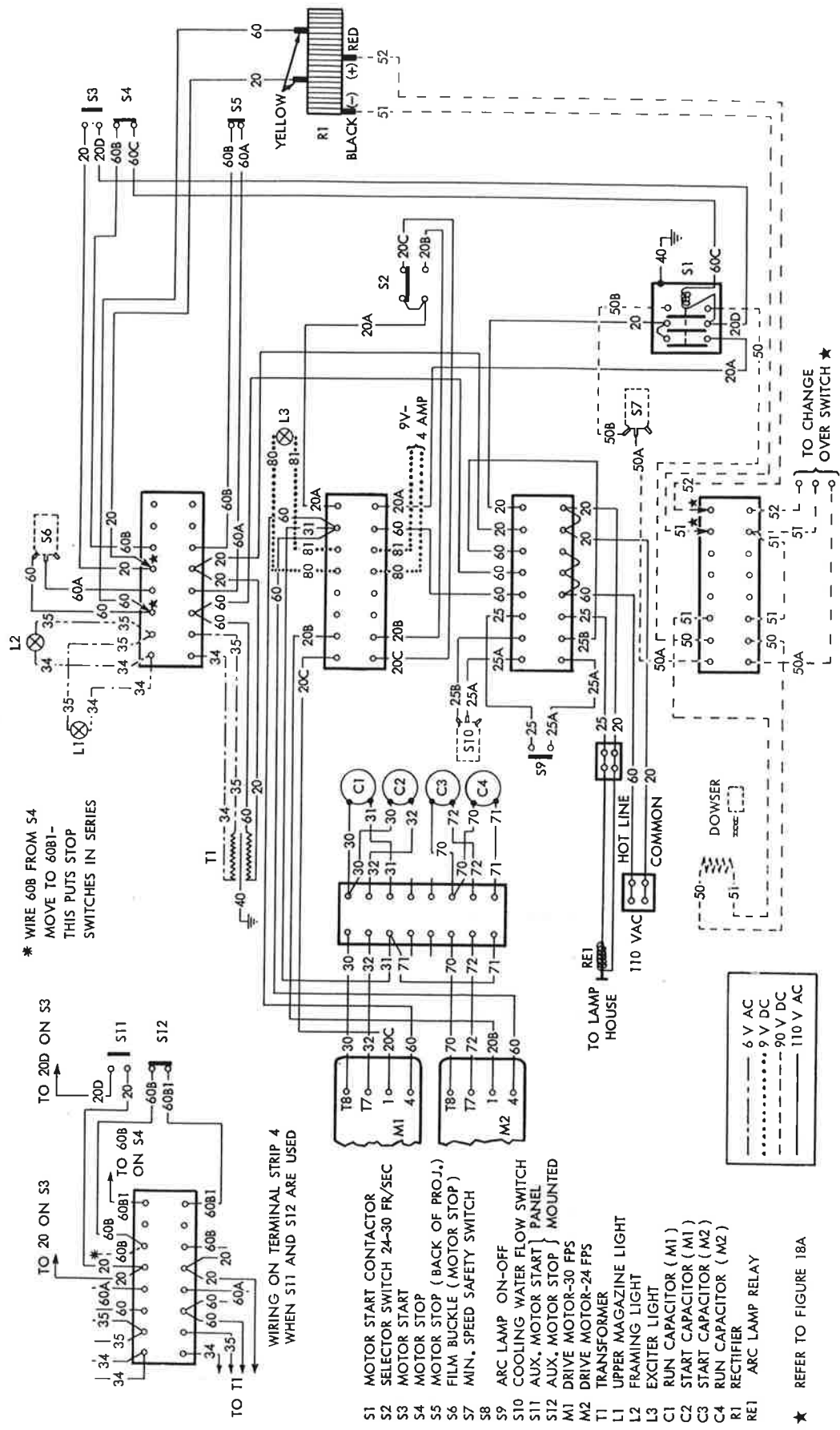
*d. Upper Magazine Lamp Leads.* The projector is shipped with the leads for the upper magazine lamp coiled tightly and tied to the upper magazine bracket. These leads are connected as follows:

(1) Uncoil the leads (Nos. 34 and 35 on the wiring diagram (Fig. 18)).

(2) Push the conduit (12) (Fig. 6) up through the top of the projector enough to permit installation of the lamp conduit bushing.

### CAUTION

*Do not push the conduit too far as it may shear the buckle switch leads inside the projector head.*



- S1 MOTOR START CONTACTOR
- S2 SELECTOR SWITCH 24-30 FR/SEC
- S3 MOTOR START
- S4 MOTOR STOP
- S5 MOTOR STOP (BACK OF PROJ.)
- S6 FILM BUCKLE (MOTOR STOP)
- S7 MIN. SPEED SAFETY SWITCH
- S8 ARC LAMP ON-OFF
- S9 COOLING WATER FLOW SWITCH
- S10 AUX. MOTOR START PANEL
- S11 DRIVE MOTOR-30 FPS
- S12 DRIVE MOTOR-24 FPS
- M1 MOTOR
- M2 TRANSFORMER
- T1 UPPER MAGAZINE LIGHT
- L1 FRAMING LIGHT
- L2 EXCITER LIGHT
- L3 MOTOR START
- C1 RUN CAPACITOR (M1)
- C2 START CAPACITOR (M1)
- C3 START CAPACITOR (M2)
- C4 RUN CAPACITOR (M2)
- R1 RECTIFIER
- RE1 ARC LAMP RELAY

Figure 18. Wiring Diagram.

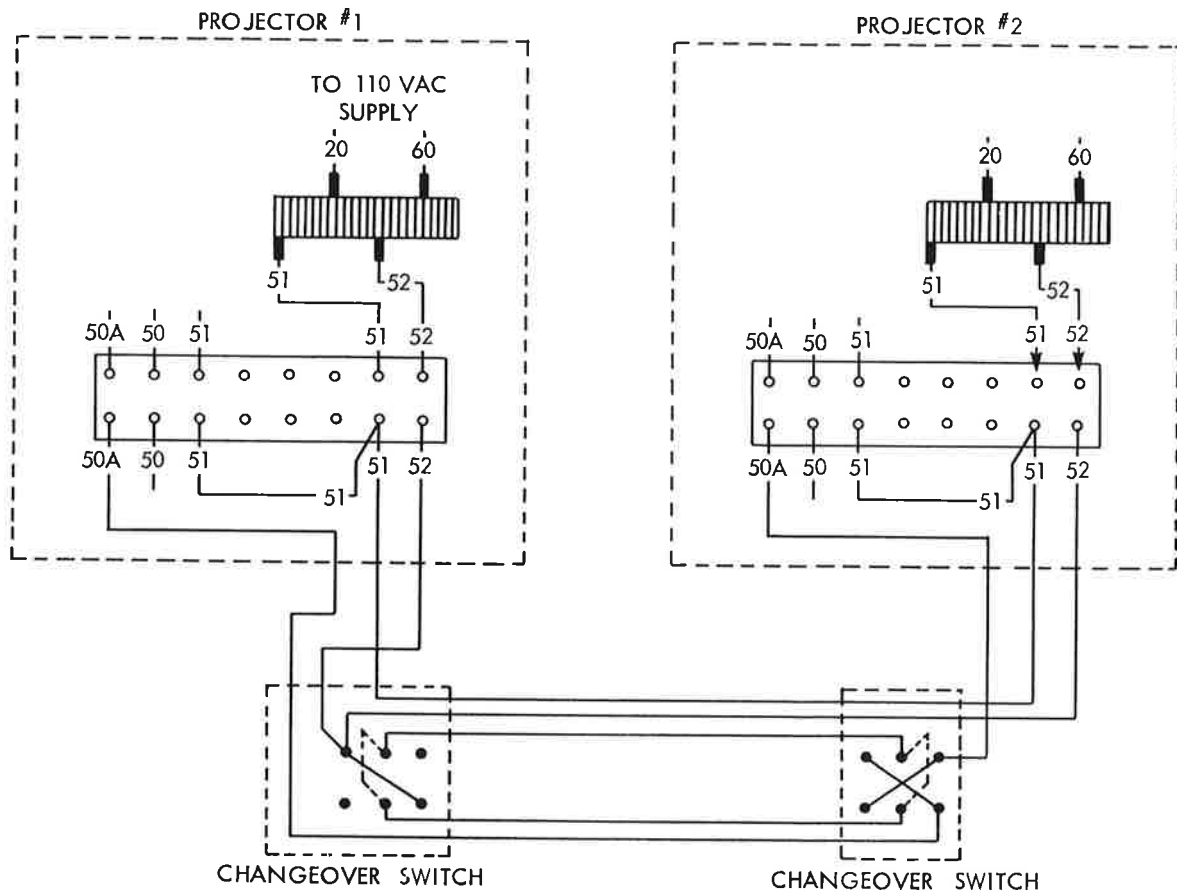


Figure 18A. Dowser Changeover Wiring Diagram.

(3) Pass the leads down through the conduit into the upper base.

(4) Connect the upper magazine lamp leads to terminals 1 (1) (Fig. 18) and 2 (2) of the top terminal strip.

(5) Install the conduit bushing and tighten the small Allen-head screw in the rear of the bushing.

*e. Exciter Lamp Leads.* The black casing from the optical soundhead contains the exciter lamp leads (Nos. 80 and 81 on the wiring diagram (Fig. 18)). Connect these leads to the fifth terminal (5) (Fig. 19) and the sixth terminal (6) of the second terminal strip from the top.

*f. Photocell Leads.* The shielded cable from the photocell (11) (Fig. 7) should be connected as follows:

(1) Solder the center wire to the terminal marked "PEC+" on the terminal strip mounted on the side of the preamplifier compartment.

(2) Make a pigtail of the shielding and solder it to the terminal marked "PEC-" on the same terminal strip.

*g. Framing Lamp Leads.* Connect these leads (Nos. 34 and 35 on the wiring diagram (Fig. 18)) to terminals 1 (1) (Fig. 19) and 2 (2) of the top terminal strip.

*b. Film Buckle Switch Leads.* Connect these leads (Nos. 60 and 60A on the wiring diagram (Fig. 18)) to terminals 3 (3) and 4 (4) of the top terminal strip.

*i. Dowser Solenoid Leads.* These leads are numbered "50" and "51" on the wiring diagram (Fig. 18). Connect the lead numbered "50" to the lower half of the second terminal (9) (Fig. 19) of the lower terminal strip. Connect the lead marked "51" to the upper half of the third terminal (8) (Fig. 19) of the bottom terminal strip.

*j. Arc Lamp Relay.* The arc lamp relay leads may be brought in through the front of the lower base or directly through the floor underneath the lower base (see Paragraph 2). The arc lamp relay leads (numbered "20" and "25" on the wiring diagram (Fig. 18)) are connected to the two center clips of the raised terminal strip at the center-of the terminal strip panel (10) (Fig. 19).

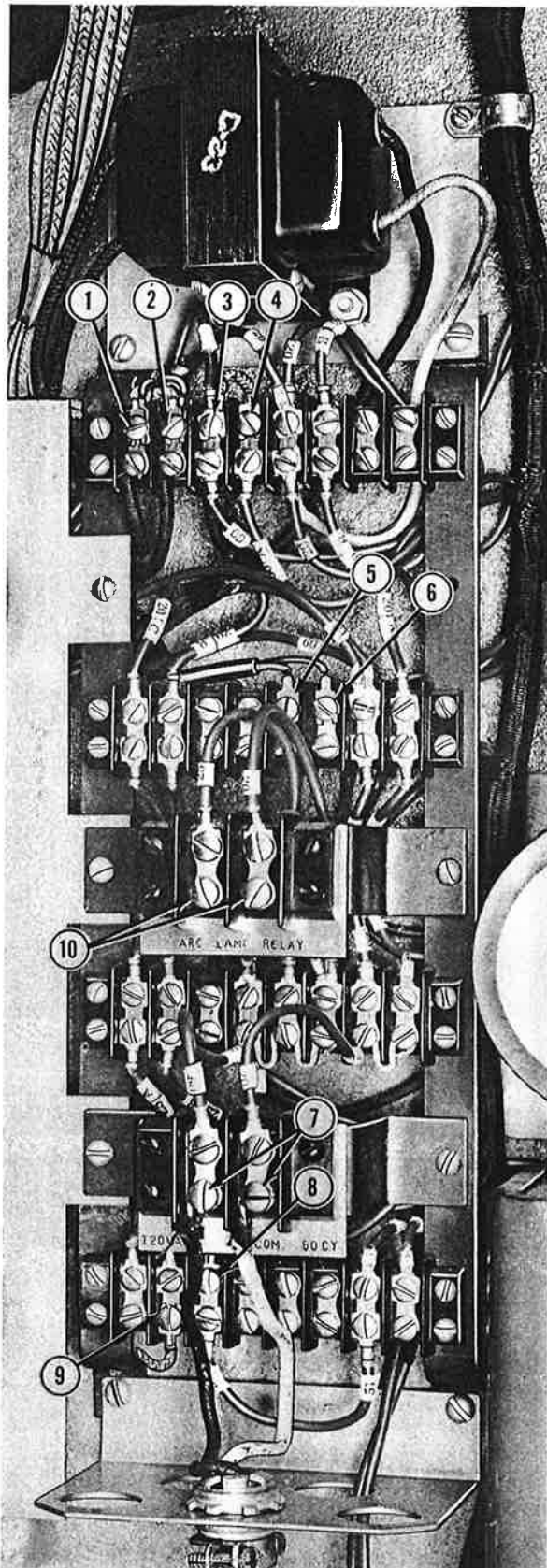


Figure 19. Terminal Strip Panel.

1. Magazine lamp lead and framing lamp lead
2. Magazine lamp lead and framing lamp lead
3. Film buckle switch lead
4. Film buckle switch lead
5. Exciter lamp lead
6. Exciter lamp lead
7. A-C power input leads
8. Dowser solenoid lead
9. Dowser solenoid lead
10. Arc lamp relay leads

Figure 19. Terminal Strip Panel (Legend)

*k. Auxiliary Panel-Mounted Motor Start and Stop Switches.*

(1) Connect the auxiliary motor start switch (S-11) (Fig. 18) in parallel with the motor start switch (S-3) as shown on the wiring diagram (Fig. 18).

(2) Connect the auxiliary motor stop switch (S-12) in series with the motor stop switch (S-4) as shown on the wiring diagram (Fig. 18).

*l. Exciter Light Power Leads.* Connect the 9-volt dc, 4 amp exciter light power supply from the sound unit to terminals 80 and 81 (Fig. 18). These two leads can be part of the cable from the sound unit that enters the projector through a 1-1/8" dia. hole in the front of the upper base.

*m. Dowser Changeover Switches.* Interconnect two double-pole, double-throw changeover switches as shown in Figure 18A. Run three-wire cables to each projector, either through the floor or through the front of the lower base as discussed in Paragraph 2, and connect the wires to terminals 50A, 51, and 52 as shown on Figure 18 and Figure 18A. At this time also connect the input and output of the selenium rectifier in *one* projector only as shown on the wiring diagram (Fig. 18).

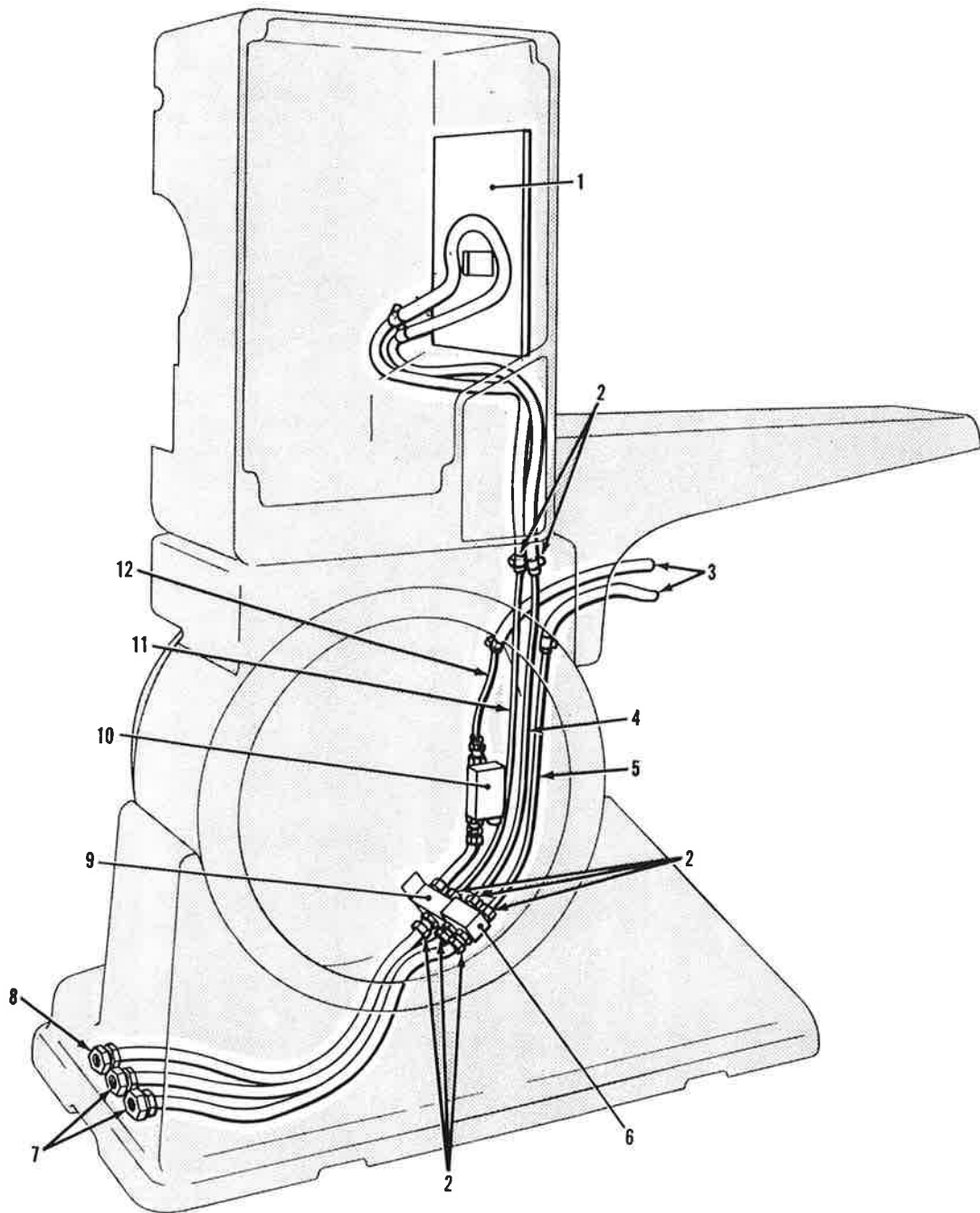
**NOTE**

Connect the rectifier in the other projector for emergency power supply only.

**23. Plumbing Connections**

*a. Outside Connections.* There are three outside water connections (13) (Fig. 1) on the lower base. One of these connections is marked "IN" and the remaining two are marked "OUT." Connect the outside water supply and the drain to these three connections.

*b. Inside Connections.* Nine inside connections must be made for the water cooling system. The tubing and hose clamps for these connections are packed in the shipping case for the upper base. The nine connections are shown in Figure 20.



- |  |   |
|--|---|
| 1. Cooling plate                                     | 7. Outlet connectors                                |
| 2. Upper base hose connections                       | 8. Inlet connector                                  |
| 3. Lines to arc lamp                                 | 9. Inlet manifold                                   |
| 4. Tube connecting return line<br>from cooling plate | 10. Water flow switch                               |
| 5. Tube connecting return line<br>from arc lamp      | 11. Tube connecting supply<br>line to cooling plate |
| 6. Outlet manifold                                   | 12. Tube connecting supply<br>line to arc lamp      |

*Figure 20. Practical Diagram of Water Supply and Drain.*

### Section III. PREOPERATIONAL SERVICES

#### 24. Cleaning

*a. Overall Check for Cleanliness.* Before operating the projector, go over the entire assembly with a clean, dry cloth to remove any grease or dirt present as a result of shipping, assembling, and installing.

*b. Magazines.* Wipe out the inside of the magazines first with a cloth dampened with a petroleum solvent and then with a clean, dry cloth.

*c. Fire Trap Rollers.* Remove the upper and lower fire trap rollers and clean them with a cloth dampened with a petroleum solvent.

#### CAUTION

*The fire trap rollers are permanently lubricated. Do not immerse the rollers in cleaning fluid, as this may dissolve the lubricant.*

*d. Film Compartment.* Wipe out the inside of the film compartment with a clean, dry cloth. Use a small brush to clean the pad rollers and sprockets and then wipe them with a cloth dampened with a petroleum solvent. Clean the film gate and all surfaces contacted by the film with a cloth dampened with a petroleum solvent.

#### CAUTION

*Always be careful not to smear the optics of the optical soundhead and the lenses in the lens mount.*

*e. Lenses.* Clean the lenses carefully by the accepted method used in cleaning precision optics. Do not disassemble the lenses.

#### 25. Lubrication

*a. Automatic Oil System.* Before filling the oil reservoir with special Todd-AO projector oil, make sure the oil drain cap (13) (Fig. 7) is tight. Also check the oil filter to be sure it is clean and that the oil filter cap (16) is tightly installed. If the projector is to be tilted forward or backward at any angle up to 20°, the oil level in the oil level window (17) (Fig. 5) must be even with the top of the red circle. If the projector is to be tilted forward at any angle greater than 20°, the oil level must be even with the bottom of the red circle.

#### NOTE

*Clean the oil filters and change the oil in the projector head after 20 hours of operation. Wash the filters and change the oil again after 50*

*hours, 100 hours, and every 250 hours thereafter. Wash the filter with a petroleum solvent.*

*b. General Check of Lubrication Points.* In addition to filling the oil reservoir as described above, all lubrication points of the projector should be checked. Refer to Paragraph 36 for complete lubrication data.

#### 26. Water System

*a.* Before operating the projector, the water supply should be turned on and allowed to run long enough to discover any leaks that may occur in the outside connections, inside connections, or piping.

*b.* Adjust the water flow switch (10) (Fig. 20) so that it will respond to whatever water system is used. (The pressure of a water recirculating system differs from that of a city water system.) Make the adjustment by removing the cover from the water flow switch and turning the adjusting screw so that the switch operates when the water stops circulating. Make sure that the arc lamp will not start unless water is circulating through the system and that the arc lamp is automatically shut off when the water is turned off.

#### CAUTION

*Never operate the projector when the water is turned off. Both the arc lamp and the cooling plate are water-cooled.*

#### 27. Test Run Without Film Installed

#### CAUTION

*Using the inching knob (9) (Fig. 1), turn the projector through several cycles by hand to see that all working parts are operating freely and properly.*

*a. Motor Switches.* After hand-operating the projector as described above, set the motor selector switch (22) (Fig. 1) for the 30 frames per second motor and press the motor start pushbutton (20). Allow the projector to operate for a few seconds, then press the motor stop pushbutton located next to the motor start pushbutton. Repeat this procedure, but this time stop the projector by pressing the motor stop pushbutton (20) (Fig. 2) on the left side of the projector. Next, set the motor selector switch (22) (Fig. 1) for the 24 frames per second motor and repeat the procedure, thus testing

all of the motor pushbutton switches and the motor selector switch. Do not operate selector switch while projector is running.

*b. Oil Pump.* After testing the motor switches as described in *a* above, start the projector and check the operation of the oil pump. Oil should flow from the ends of all the pipeline outlets onto the several gears located in the left side of the projector head.

*c. Framing Light and Upper Magazine Light.*

During the test run, check to see if the framing light and upper magazine light are lighted.

*d. Dowser and Buckle Switch.* Before installing film in the projector, check the operation of the dowser (7) (Fig. 6) by manually tripping the film buckle switch actuating lever while the projector is running. The operation of the dowser and the minimum speed safety switch may also be checked by grasping the inching knob with a gloved hand and slowing the speed of the motor.



## Section IV. OPERATING INSTRUCTIONS

### 28. General

The Todd-AO projector is designed to accommodate Todd-AO 70mm film with magnetic sound, 35mm film with magnetic sound, or 35mm film with optical sound. When changing from Todd-AO 70mm film with magnetic sound to 35mm film with magnetic sound, or vice versa, it is necessary to change the pad rollers (3) (Fig. 25) and (10), nylon pressure roller (5), film gate (25), aperture plate (20), and pressure bands (21).

#### NOTE

Pressure bands for 35mm film are  $\frac{1}{4}$ -inch wide; the bands for 70mm film are  $\frac{3}{8}$ -inch wide.

Also, when 35mm nitrate film is to be used, special red fire trap rollers (2) and (11) must be installed. An adapter kit containing all of the interchangeable parts, including the special red fire trap rollers, is furnished with each projector. Always check to see if the right parts are mounted before starting to thread the projector. New projectors are delivered with parts mounted for Todd-AO 70mm film. See Paragraph 29 for instructions covering removal and installation of interchangeable parts. Operating procedure is covered in Paragraph 33. Operating instructions for the Todd-AO theater sound unit are covered in Section VIII. Operating instructions for the automatic focus drift compensator are covered in Section IX.

### 29. Removal and Installation of Interchangeable Parts

*a. Pad Roller.* The upper pad rollers (3) (Fig. 25) and the lower pad rollers (10) are removed, installed, and adjusted as follows:

#### (1) Removal.

(a) Push the pad roller (6) (Fig. 21) away from the sprocket (5).

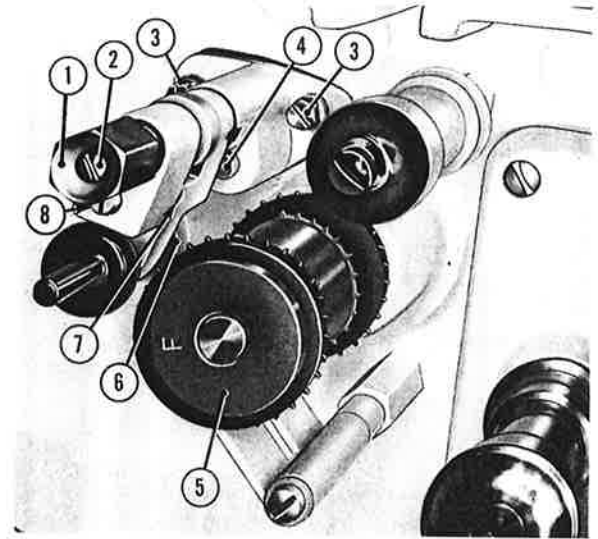
(b) Loosen the two mounting screws (3) that hold the pad roller assembly to the projector head and remove the pad roller assembly.

#### (2) Installation.

(a) Place the pad roller assembly in position, making sure it is properly seated.

(b) Tighten the two mounting screws (3) (Fig. 21).

(3) *Adjustment.* The spring tension of the pad roller is adjusted by loosening the screw (2) (Fig. 21), turning the knob (1) as required, and tightening the screw (2). The clearance of the pad roller (6) against the sprocket (5) is adjusted by loosening the lock screw (7) and turning the clearance ad-



1. Release and tension adjusting knob
2. Locking screw
3. Mounting screw
4. Conical adjusting point
5. Sprocket
6. Pad roller
7. Lockscrew
8. Clearance adjusting screw

Figure 21. Close-Up of Pad Roller Assembly.

justing screw (8). The clearance adjusting screw (8) changes the relationship of the conical adjusting points (4). The clearance adjustment is made as follows:

(a) Place two thicknesses of film over the sprocket (5) and turn the pad roller (6) by hand; it must turn freely.

(b) Add a third thickness of film to the sprocket. With the third thickness of film added, the pad roller (6) should rub lightly against the film.

(c) If the clearance is not correct, loosen the lock screw (7) and turn the adjusting screw (8) in or out as necessary to obtain the clearance described in (b) above.

*b. Nylon Pressure Roller.* The nylon pressure roller (5) (Fig. 25) is removed and installed by removing the slotted cap at the end of the roller. Adjustment of spring tension is made in the same manner as described in a(3) above. In this case, however, the two rollers should contact each other lightly with no clearance between them.

#### *c. Film Gate.*

(1) *Removal.* Before attempting to remove the film gate, turn the inching knob (9) (Fig. 1)

until the open shutter indicator (3) (Fig. 22) is accurately aligned. Remove the film gate as follows:

(a) Pull the release lever (1) (Fig. 22) and open the cooling plate (7).

(b) Loosen the thumbscrew (5) (Fig. 23) that holds the film gate (6) to the projector head.

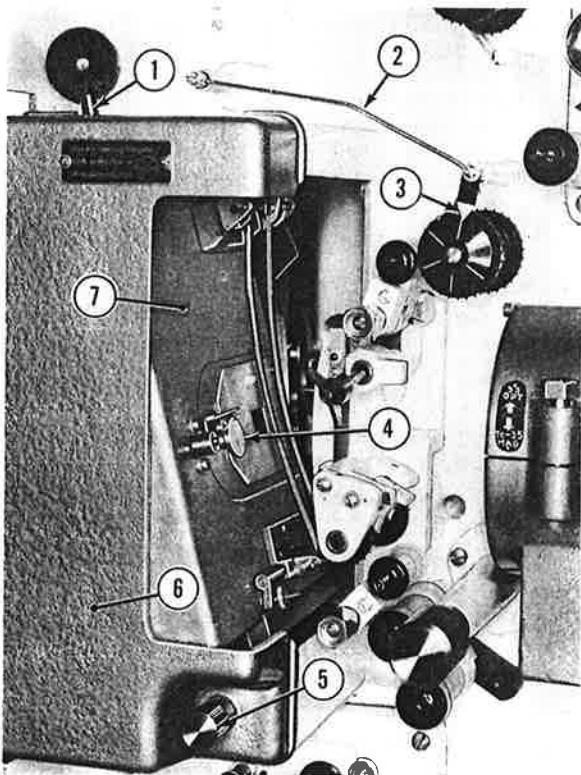
(c) Open the pad rollers (3) and (7) as shown in Figure 23.

(d) Grasp the film gate as shown in Figure 24, making sure the filmstripper (1) (Fig. 24) is held away from the intermittent sprocket with the little finger of the right hand.

(e) Pull the film gate straight out away from the projector head.

#### CAUTION

*When removing the film gate, be sure it does not hit the teeth on the intermittent sprocket.*



1. Release lever
2. Film buckle switch lever
3. Open shutter indicator
4. Cooling plate release knob
5. Knurled holding knob
6. Cooling plate cover
7. Cooling plate

*Figure 22. Projector Prepared for Film Gate Removal.*

#### (2) Installation.

(a) Hold the film gate as shown in Figure 24.

(b) Push the film gate into position by moving it directly toward the projector head.

#### CAUTION

*When installing the film gate, be sure it is held properly. Move the film gate into position slowly and carefully, making sure that the filmstripper (1) (Fig. 24) clears the intermittent sprocket (2) and that the film gate clears the pressure bands on the aperture plate. Always be sure the film gate is properly seated before tightening the thumbscrew.*

(c) When the film gate is properly seated, tighten the thumbscrew (5) (Fig. 23).

d. *Aperture Plate.* Several sizes of aperture plates are furnished with the adapter kit shipped with each projector. Be sure the correct aperture plate is selected for the type of film to be run. Remove and install the aperture plate as follows:

#### (1) Removal.

(a) Turn the latch that holds the aperture plate 90° to release the aperture plate.

(b) Slide the aperture plate out of its position in the cooling plate, being careful not to damage the pressure bands.

#### NOTE

*The aperture plates are made with a slight lengthwise curvature to provide tension against the holding latch. Do not attempt to straighten the aperture plates.*

#### (2) Installation.

(a) Insert the aperture plate in the cooling plate. Be sure the aperture plate is centered on the centering pin.

(b) Hold the aperture plate firmly against the face of the cooling plate and turn the holding latch 90° to lock it in position.

#### e. Pressure Bands.

(1) *Removal.* Before removing the pressure bands, open the cooling plate as shown in Figure 23. Use the special tool contained in the adapter kit to unhook the pressure bands (10) (Fig. 23).

#### CAUTION

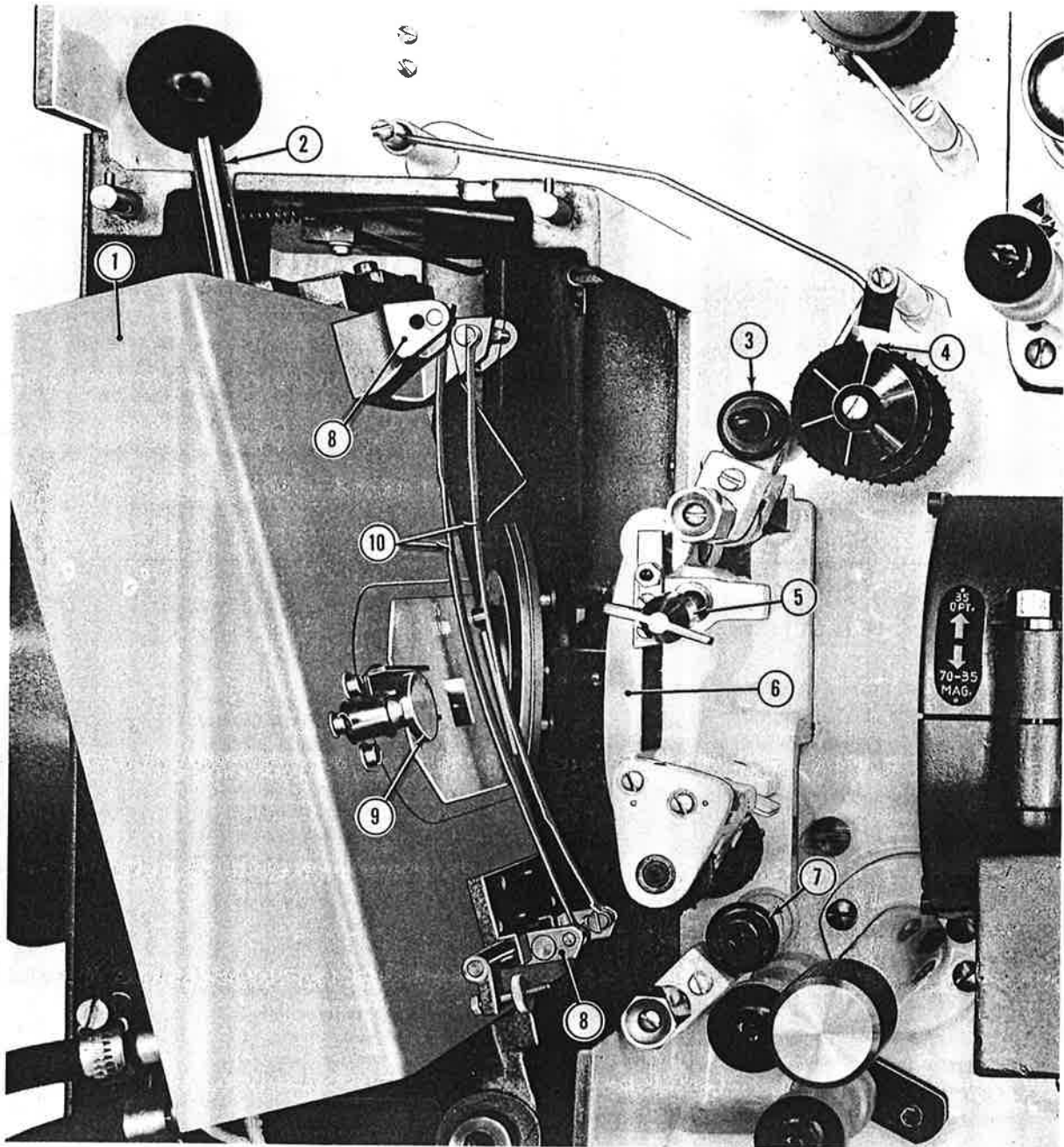
*Never try to remove the pressure bands by pulling them from the center. This will damage the engaging ends*

of the pressure bands and prevent them from holding the film properly.

(2) *Installation.* Hold the pressure band at the end and push it onto the pressure band holder.

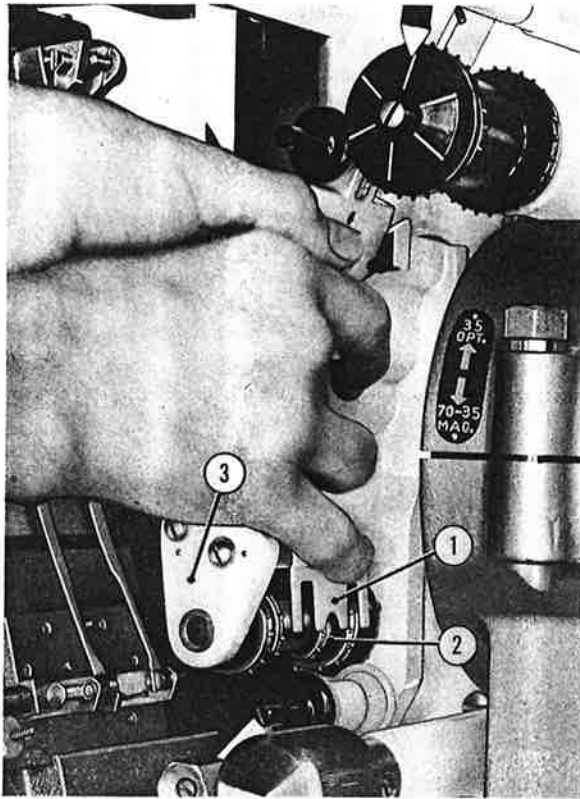
#### CAUTION

The pressure bands must be installed so that the cutout portions nearest the end of the bands are on the lower inside position, facing each other.



- |  |                         |
|--|-------------------------|
| 1. Cooling plate                             | 6. Film gate            |
| 2. Release lever                             | 7. Pad roller           |
| 3. Pad roller for intermediate feed sprocket | 8. Pressure band holder |
| 4. Open shutter indicator                    | 9. Release knob         |
| 5. Thumbscrew                                | 10. Pressure bands      |

Figure 23. Projector Prepared for Pressure Band Removal.



1. Filmstripper
2. Intermittent sprocket
3. Film gate

Figure 24. Method of Holding Film Gate.

### 30. Setup For Todd-AO 70mm Film With Magnetic Sound (Fig. 25)

a. *General.* Figure 25 shows the setup and threading for Todd-AO 70mm film with magnetic sound. Interchangeable parts are identified in Paragraphs 28 and 29. All interchangeable parts used with Todd-AO 70mm film are color coded red. See Paragraph 33 for complete operating procedure.

b. *Lens Mount Pin.* The lens mount pin (27) (Fig. 25) must be in the "down" position for Todd-AO 70mm film. To change the position of the lens mount pin, first loosen the lens mount clamping bolt (9).

c. *Threading Todd-AO 70mm Film.* Before starting to thread the projector, set the framing indicator (14) (Fig. 5) in the center position by turning the framing knob (15) as necessary. By setting the framing indicator in the center position, later framing adjustments may be made in either direction.

- (1) Open the cooling plate (1) (Fig. 23).
- (2) Open all of the pad rollers.

(3) Install the loaded reel in the upper magazine and pull out enough film to permit full length

threading and anchoring in the take-up reel in the lower magazine.

(4) Thread the film over the guide roller (1) (Fig. 25) and through the fire trap rollers (2) in the upper fire trap. Be sure this is done as shown in Figure 25.

(5) Thread the film through the magnetic soundhead as shown in Figure 25, through the film gate, and all the way down to the hold-back sprocket (13) (Fig. 25), leaving all of the pad rollers open.

(6) Set the film so that it is properly framed and close the pad roller on the intermittent sprocket (19).

(7) Set the upper loop (22).

#### CAUTION

*The method of threading described in these instructions is the minimum loop method. This means that the projector is pulled down for threading when it is at its minimum loop phase in its cycle of operation. This is when the intermittent has just pulled the film down and the shutter has turned 90° to reach its open (vertical)*

1. Upper fire trap guide roller
2. Upper fire trap rollers
3. Upper pad roller
4. Upper feed sprocket
5. Nylon pressure roller
6. Red tension indicator
7. Pivoting guide roller
8. Adjustable guide roller
9. Lens mount clamping bolt
10. Lower pad roller
11. Lower fire trap rollers
12. Lower fire trap guide roller
13. Hold-back sprocket
14. Optical soundhead
15. Sound drum
16. Pressure roller
17. Guide roller
18. Pad roller for intermittent sprocket
19. Intermittent sprocket
20. Aperture plate
21. Pressure band
22. Upper loop
23. Intermediate feed sprocket
24. Pad roller for intermediate feed sprocket
25. Film gate
26. Lower loop
27. Lens mount pin
28. Exciter lamp housing

Figure 25. Setup for Todd-AO Film with Magnetic Sound and 35mm Film with Magnetic Sound (Minimum Loop Setting) (Legend).

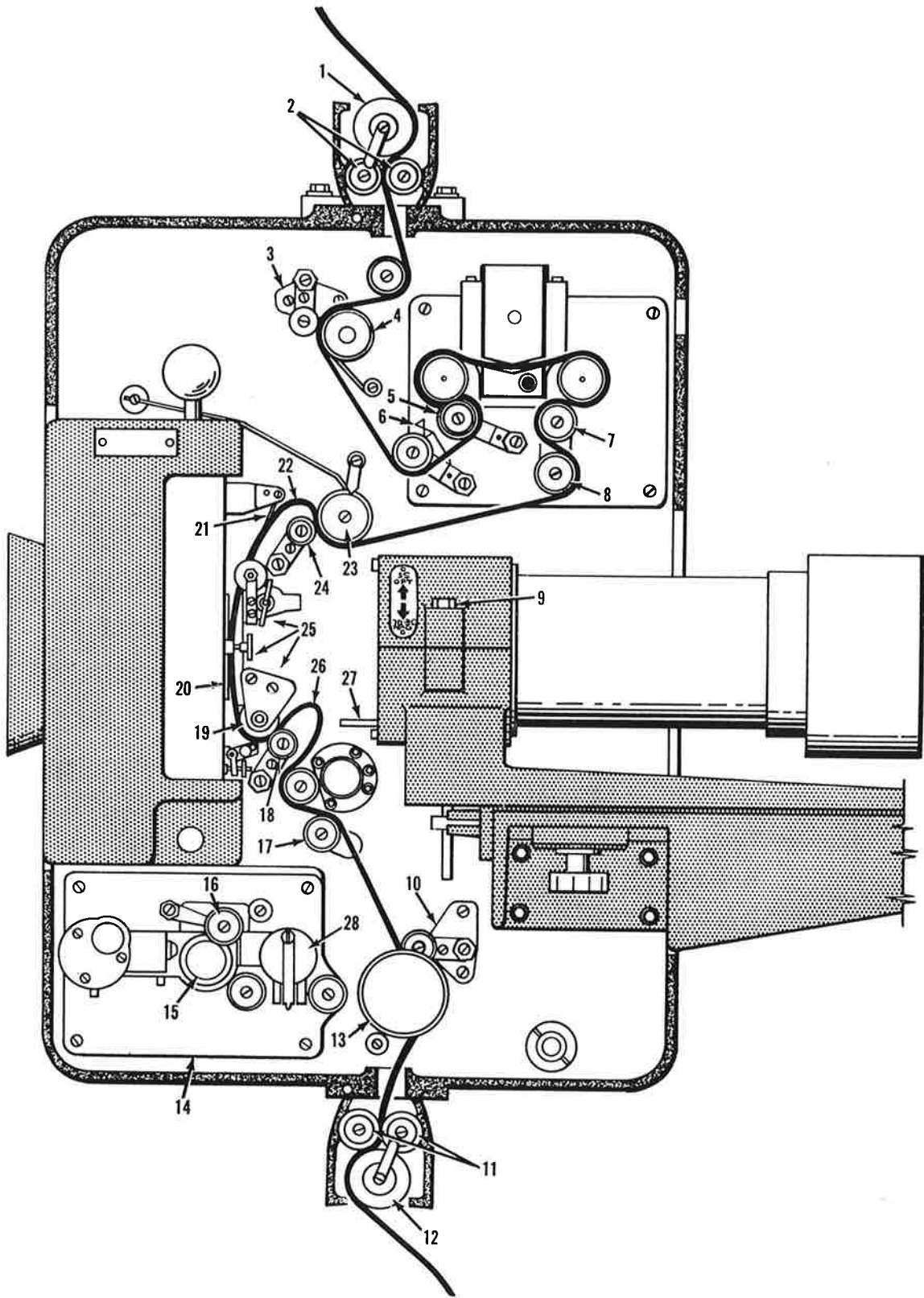


Figure 25. Setup for Todd-AO 70mm Film with Magnetic Sound and 35mm Film with Magnetic Sound (Minimum Loop Setting).

position. At this point the open shutter indicator must be aligned as shown in Figure 22. When setting the upper loop by the minimum loop method, the film should lie closely over the pad roller (24) (Fig. 25) leaving only enough slack for the framing adjustment. Be sure the projector is in the correct phase of its cycle before setting the upper loop. Otherwise, unnecessary film breakage may occur.

#### NOTE

If the operator prefers to thread the projector by the maximum loop method, the projector must be pulled down for threading at the last point when the shutter is open just before the intermittent begins its pull down movement. In this case the open shutter indicator (3) (Fig. 22) must be set to indicate an open shutter at this point. When the projector is threaded by the maximum loop method, the upper loop should be approximately  $1\frac{1}{4}$  inches above the pad roller (24) (Fig. 25) when the pad roller is closed. If the maximum loop method is used, the lower loop must be set at its minimum.

(8) After setting the upper loop, close the pad roller (24) against the intermediate feed sprocket (23).

(9) Thread the film through the magnetic soundhead and over the upper feed sprocket (4).

#### NOTE

For proper sound synchronization, the film must measure 24 frames from the magnetic pick-up head to the frame that is over the aperture. If the film does not measure 24 frames, it may be adjusted by removing the guide roller (7), loosening the nut on the guide roller bracket, and pivoting the roller (8) inward or outward as required.

(10) Obtain the proper tension through the magnetic soundhead by tightening or loosening the film until the red tension indicators (6) are aligned.

#### NOTE

The function of the small knob (5) (Fig. 16) at the bottom of the mag-

netic pick-up head is to press the film against the magnetic pickup with the proper amount of pressure. For Todd-AO 70mm film the knob should be set at zero or 70. For 35mm film the knob should be set at 35. Be sure to set the knob at zero when removing the cover from the magnetic pick-up head.

(11) Close the pad roller against the upper feed sprocket.

(12) Set the lower loop (26).

#### NOTE

At this point in the cycle of operation of the projector the lower loop is at its maximum. The top of the loop should extend about  $\frac{3}{4}$  of an inch above the pad roller (18). Minimum loops result in quieter operation.

(13) Close the pad roller on the hold-back sprocket.

#### NOTE

The loops should be as small as possible without causing film breakage. Large loops are inclined to flap during operation and cause undesirable noise in the projector.

(14) At this point, recheck the framing of the film in the aperture plate. This is done by turning the inching knob and observing the film as it passes the aperture plate. The film, in its stopped position, must frame accurately in the aperture plate. If the framing adjustment is out by less than one sprocket hole, the correction may be made by turning the framing knob (15) (Fig. 5). One frame range in adjustment is available, but is not recommended as standard practice.

(15) After checking the framing, thread the film through the lower fire trap rollers (11) (Fig. 25), over the guide roller (12) into the lower magazine, and anchor it on the take-up reel.

### 31. Setup For 35mm Film With Magnetic Sound (Fig. 25)

Figure 25 also shows the setup and threading for 35mm film with magnetic sound. The threading for 35mm film with magnetic sound is the same as it is for the Todd-AO 70mm film with magnetic sound except that the 35mm film runs on the inner sections of the stabilizers and the picture should precede the sound by 28 frames instead of 24 frames. However, the setup for 35mm film requires

that all interchangeable parts for 35mm film be installed. These parts are color coded blue.

#### NOTE

*Pressure bands for 35mm film are 1/4-inch wide.*

Refer to Paragraph 29 for instructions on the removal and installation of interchangeable parts. With the exceptions mentioned above, Paragraph 30 covers the threading instructions for 35mm film with magnetic sound. See Paragraph 33 for complete operating procedure.

### 32. Setup For 35mm Film With Optical Sound

*a. General.* Figure 26 shows the setup and threading for 35mm film with optical sound. As in the case of 35mm film with magnetic sound, all the interchangeable parts are color coded blue. The lens mount pin (27) (Fig. 26) must be in the "up" position. Prepare the projector for threading in the same manner described in Paragraph 30c (1) through (3). See Paragraph 33 for complete operating procedure.

#### *b. Threading 35mm Film with Optical Sound.*

(1) Thread the film through the upper fire trap as described in Paragraph 30c(4) and shown in Figure 26.

(2) Pass the film directly to the intermediate feed sprocket (23) (Fig. 26), bypassing the magnetic soundhead.

(3) Thread the film through the film gate (25) and optical soundhead (14) as shown in Figure 26, leaving the pad rollers open.

(4) Set the film so that it is properly framed and close the pad roller (18) on the intermittent sprocket (19).

(5) Set the upper loop (22) as described in Paragraph 30c(7).

(6) After setting the upper loop, close the pad roller (24) against the intermediate feed sprocket (23).

(7) Set the lower loop by holding the forefinger on the pad roller (18) and passing the film over the forefinger.

(8) After setting the lower loop and removing the slack in the film, close the lower pad roller (10) on the hold-back sprocket (13).

#### NOTE

*For proper synchronization of optical sound, the sound takeoff precedes the picture by 20 frames.*

(9) Thread the film through the lower fire trap rollers (11), over the guide roller (12) and into the

lower magazine. Anchor the film on the take-up reel.

### 33. Operating Procedure (all films)

*a. Projector Setup.* Be sure that the proper interchangeable parts are installed for the type of film to be run. Interchangeable parts for Todd-AO 70mm film are color coded red and parts for 35mm film are color coded blue. See Paragraph 29 for instructions for the removal and installation of interchangeable parts.

*b. Lens Mount Pin.* The lens mount pin must be in the "down" position for Todd-AO 70mm film and 35mm film with magnetic sound, and in the "up" position for 35mm film with optical sound. To change the lens mount pin, first loosen the clamping bolt (9) (Fig. 25). The correct position of the lens mount pin for each setup is shown in Figures 25 and 26.

*c. Framing Indicator.* Before starting to thread the projector, set the framing indicator (14) (Fig. 5) in the center position by turning the framing knob (15) as necessary. By setting the framing indicator in the center position later framing adjustments may be made in either direction.

*d. Motor Selector Switch.* Set the motor selector switch (5) (Fig. 3) for either 30 frames per second (Todd-AO 70mm film) or 24 frames per second (35mm film) as required.

*e. Water Cooling System.* Open the intake valve of the water cooling system.

#### NOTE

*The intake valve of the water cooling system is located outside of the projector. Consequently, this valve does not appear in any of the illustrations in this instruction book.*

*f. Threading.* Threading for the different types of film is shown in Figures 25 and 26. However, before any threading is attempted, the following procedure must be followed:

(1) Open the cooling plate (see Paragraph 29c(1)).

(2) Open all of the pad rollers.

(3) Install the film in the upper magazine and pull out enough film to permit full length threading and anchoring in the take-up reel in the lower magazine.

(4) Refer to Paragraphs 30, 31, and 32 for instructions for threading the different types of film.

*g. Test Run with Film Installed.* After the projector is threaded, check all pad rollers to see if they are closed. Turn the projector through several cycles by hand to see if it runs smoothly. When it is certain that the projector is working properly,



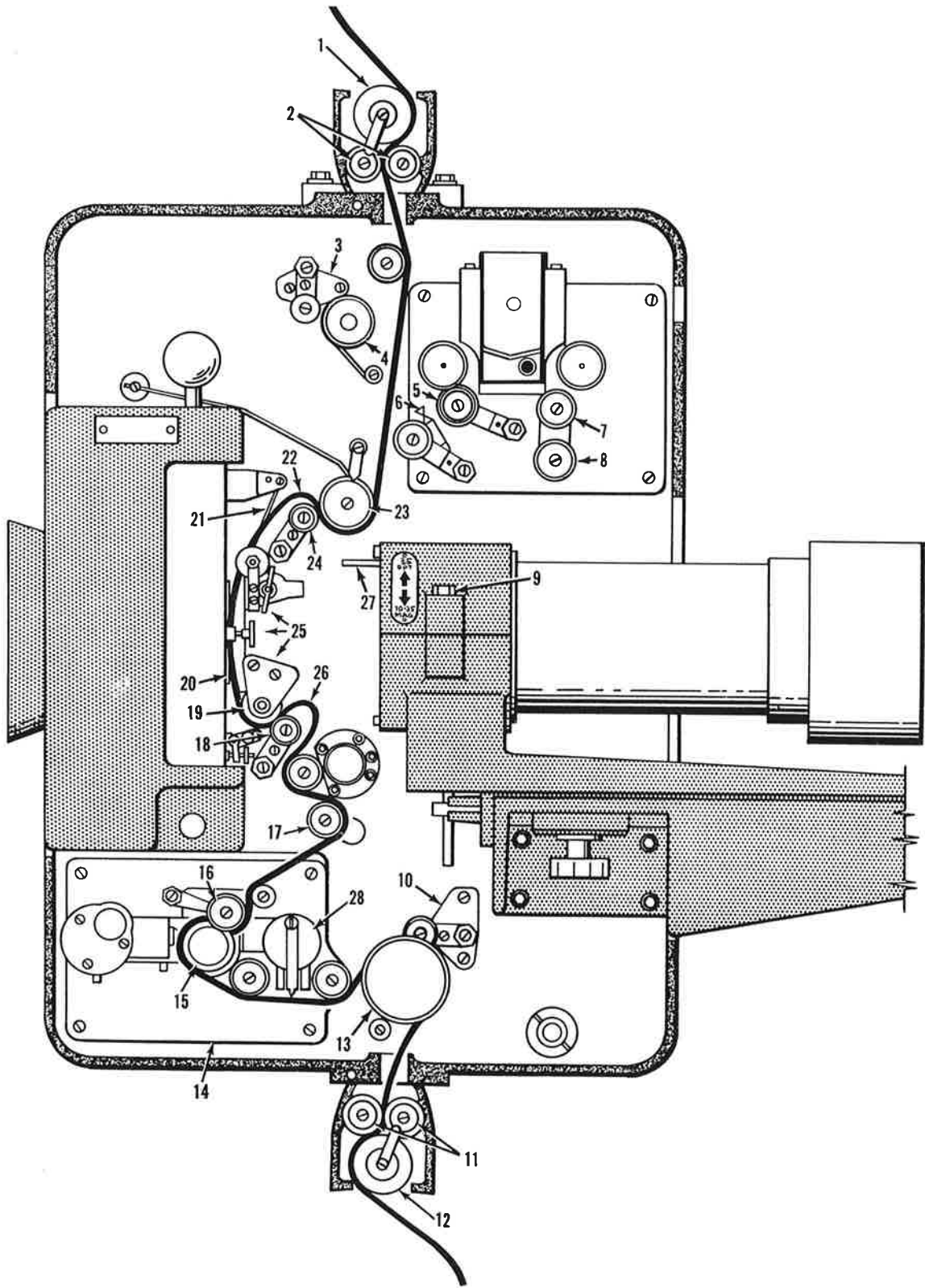


Figure 26. Set-up for 35mm Film with Optical Sound (Minimum Loop Setting).



1. Upper fire trap guide roller
2. Upper fire trap rollers
3. Upper pad roller
4. Upper feed sprocket
5. Nylon pressure roller
6. Red tension indicator
7. Pivoting guide roller
8. Adjustable guide roller
9. Lens mount clamping bolt
10. Lower pad roller
11. Lower fire trap rollers
12. Lower fire trap guide roller
13. Hold-back sprocket
14. Optical soundhead
15. Sound drum
16. Pressure roller
17. Guide roller
18. Pad roller for intermittent sprocket
19. Intermittent sprocket
20. Aperture plate
21. Pressure band
22. Upper loop
23. Intermediate feed sprocket
24. Pad roller for intermediate feed sprocket
25. Film gate
26. Lower loop
27. Lens mount pin
28. Exciter lamp housing

*Figure 26. Setup for 35mm Film with Optical Sound (Minimum Loop Setting) (Legend).*

start the projector and check the following:

(1) *Picture Focus.* The focusing point for the Todd-AO projector is not the center of the screen, but a point one-third of the distance from either end of the screen. The picture is properly focused when it is sharpest at this point.

(2) *Framing.* If the film is threaded correctly, improper framing may be corrected by turning the framing knob (15) (Fig. 5) as required.

(3) *Pressure Band Tension.* With the projector in operation, turn the pressure band tension adjusting knob (4) (Fig. 28) in a counterclockwise direction until the picture becomes unsteady; then retighten the knob until the picture is steady.

## Section V. OPERATIONAL MAINTENANCE

### 34. Cleaning

*a. Pad Rollers.* During operation the pad rollers tend to accumulate a coating of wax. Remove the rollers at least once each week and clean them thoroughly with a cloth dampened with a petroleum solvent.

*b. Film Gate.* Remove the film gate (Par. 29c) at least once each week and clean it with a cloth dampened with a petroleum solvent. Be sure all wax is removed.

*c. Fire Trap Rollers.* Remove the fire trap rollers (2) (Fig. 25) and (11) at least once each week and clean them thoroughly with a cloth dampened with a petroleum solvent.

#### CAUTION

*The fire trap rollers are permanently lubricated and should not be immersed in the cleaning solvent as this may dissolve the lubricant.*

*d. Interior of Projector Head.* At least once each week wipe out the entire interior of the projector head with a cloth dampened with a petroleum solvent.

*e. Exterior of Projector.* Clean the exterior of the projector periodically with a petroleum solvent. Remove any excess grease, oil, or accumulated dirt.

*f. Interior of Magazines.* Wipe out the interior of the magazines at least once each week with a cloth dampened with a petroleum solvent.

*g. Oil Filter.* At least once each week remove the oil filter cap (19) (Fig. 2) and remove the oil filter and clean it thoroughly with a petroleum solvent having a high flash point.

*b. Lenses.* Clean the lenses in the approved method.

#### NOTE

*Do not remove the lenses from the lens barrel. Clean only the exterior surface of the outer lenses.*

### 35. Lubrication

*a. Oil System.* All of the main shaft drive bearings are lubricated by the automatic oil system. Consequently, these points need no attention from the operator. All that is necessary is to be sure the oil system is working properly. The oil filter should be checked periodically for cleanliness. Whenever a filter becomes damaged or difficult to clean, replace it with a new filter. When replacing the oil filter, be sure the knurled end of the filter

is out toward the filter cap. The oil should be changed whenever it appears discolored or seems to be losing its lubricating quality. Special Todd-AO projector oil must be used. (See Paragraph 25a for instructions for filling the oil reservoir.) Figure 27 shows the lubrication points of the projector.

*b. Film Gate Edge Guide Bearings.* Apply a drop of projector oil to the film gate edge guide bearings (14) (Fig. 27) once each day and whenever the gate is changed.

*c. Intermittent Sprocket Bearing.* Apply a drop of projector oil to the intermittent sprocket bearing (12) once each day and whenever the gate is changed.

*d. Pad Rollers.* Remove the pad rollers (10) once each week and apply one drop of projector oil to each pad roller shaft.

*e. Guide Rollers and Pressure Rollers.* Remove the rollers (11) from their respective shafts at least once each week and apply one drop of projector oil to each roller shaft.

*f. Friction Brake Disk.* Place several drops of gear oil on the friction brake disk (1) once each month. Use enough oil to penetrate the entire disk, but not enough to cause dripping.

*g. Friction Clutch Disk.* Lubricate the friction clutch disk (6) in the same manner as the friction brake disk (see *f* above).

*b. Drive Shaft Bushing.* Apply a small amount of bearing grease to the drive shaft bushing (4) when the projector is installed.

*i. Lower Reel Drive Gear.* Apply a small amount of gear grease to the lower reel drive gear (5) when the projector is installed and once every three months thereafter.

*j. Film Buckle Switch Levers.* Apply one drop of projector oil to all pivot points of the film buckle switch levers (2) once each month.

### 36. Adjustments

*Drive Belt.* Check the drive belt once each month for proper tension. The belt should run with no slack, but it should not be stretched.

- |                              |  |
|------------------------------|--|
| 1. Friction brake disk       | 9. Oil lines                           |
| 2. Film buckle switch levers | 10. Pad rollers                        |
| 3. Oil drain cap             | 11. Guide rollers and pressure rollers |
| 4. Drive shaft bushing       | 12. Intermittent sprocket bearing      |
| 5. Lower reel drive gear     | 13. Oil level window                   |
| 6. Friction clutch disk      | 14. Film gate edge guide bearings      |
| 7. Oil filter cap            |  |
| 8. Oil pump                  |  |

Figure 27. Lubrication Chart (Legend).

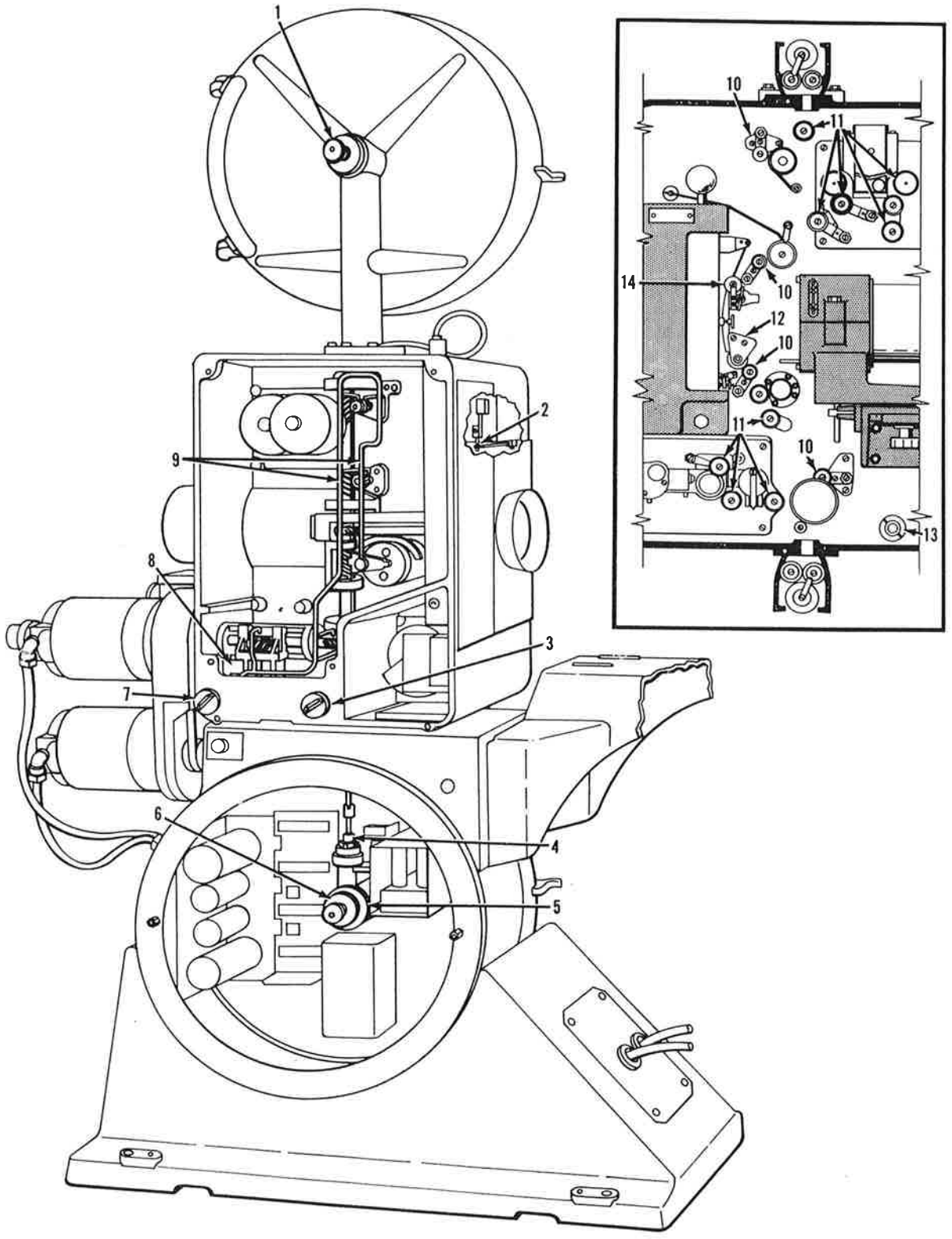


Figure 27. Lubrication Chart.

## Section VI. TROUBLE SHOOTING

### 37. General

The Todd-AO projector is designed to operate with minimum service requirements. Nevertheless, emergencies may sometimes arise which require the operator to diagnose the reason for unsatisfactory operation or failure of the projector or any of its

components. To assist the operator, this section lists various symptoms, each of which is followed by a list of probable causes of the trouble. A possible remedy is described opposite the probable cause.

### 38. Projector Motors Fail To Start

<i>Probable cause</i>	<i>Possible remedy</i>
a. Open circuit to projector motor.	Check 115-volt supply through motor start contactor.
b. Film buckle switch tripped.	Check the film buckle switch lever action.
c. Faulty motor start capacitor (14) (Fig. 4).	Replace the motor start capacitor (Par. 53).
d. Faulty start switch or selector switch.	Check all switch contacts for proper operation.

### 39. Recurring Film Breakage

<i>Probable cause</i>	<i>Possible remedy</i>
a. Loops too small	Check size of upper loop and lower loop (see Paragraph 30c (7) and (12)).
b. Pad roller or guide roller does not run freely.	Check the operation of all pad rollers and guide rollers.
c. Damaged or broken sprocket.	Replace any defective sprockets.

### 40. Picture and Sound not Synchronized

<i>Probable cause</i>	<i>Possible remedy</i>
a. Wrong number of frames from the soundhead to the frame in the aperture plate.	With Todd-AO 70mm film, the picture precedes the sound by 24 frames. With 35mm film with magnetic sound, the picture precedes the sound by 28 frames. With 35mm film with optical sound, the sound precedes the picture by 20 frames. (See NOTE following Par. 30c (9)).
b. Film incorrectly threaded.	Check the appropriate threading diagram (Fig. 25 or 26) and make any necessary changes.

#### 41. Projector Noisy in Operation

*Probable cause*

- a. Loops too large.
- b. Faulty lubrication.

*Possible remedy*

Check the size of the loops (Par. 30c (7) through (13)).

Make sure the automatic oil system is working properly and that all lubrication points are lubricated (Par. 35).

#### 42. Shutter Tailing

*Probable cause*

Shutter not adjusted correctly.

*Possible remedy*

Make sure the shutter cuts off the arc lamp beam just before the intermittent sprocket starts to move the film. Loosen the clamping ring screws (11) (Fig. 6) and set the shutter in the proper position.

## Section VII. REMOVAL AND INSTALLATION OF REPLACEABLE UNITS

### 43. Cooling Plate Holder

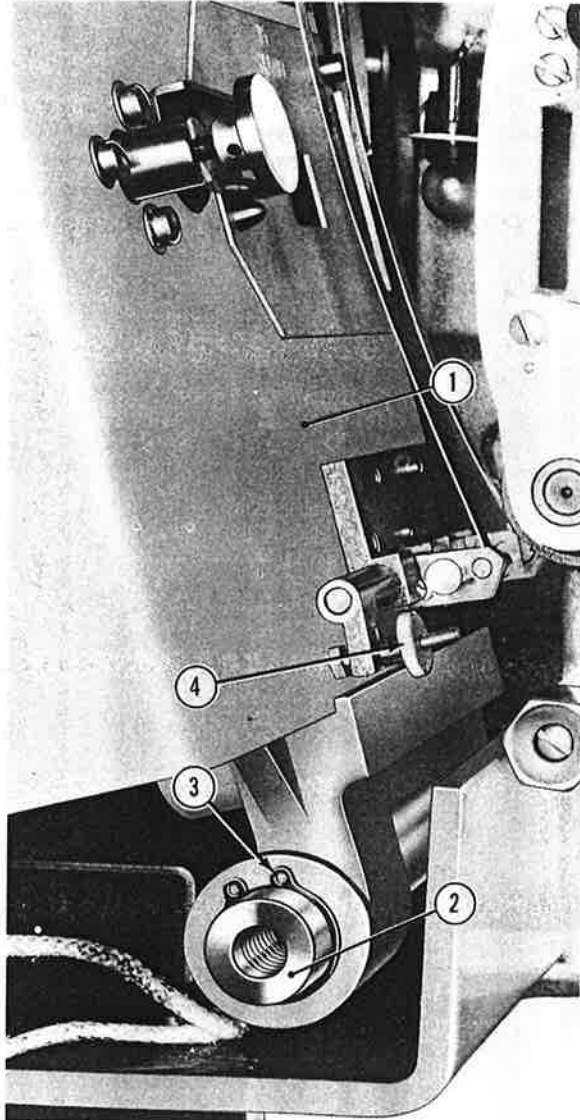
*a. Removal.* Be sure the cooling plate is opened before attempting removal of the cooling plate holder (Par. 29c(1) (a)).

(1) Remove the retaining ring (3) (Fig. 28) at the end of the cooling plate holder hinge stud (2).

(2) Disconnect the electrical leads (3) (Fig. 29) from the terminal strip (2).

(3) Disconnect the water lines (4).

(4) Pull the cooling plate holder from the hinge stud (2) (Fig. 28).



1. Cooling plate
2. Cooling plate hinge stud
3. Retaining ring
4. Pressure band tension adjusting knob

Figure 28. Cooling Plate in Position for Removal.

### *b. Installation.*

(1) Install the cooling plate holder on the hinge stud (2) (Fig. 28) and install the retaining ring (3).

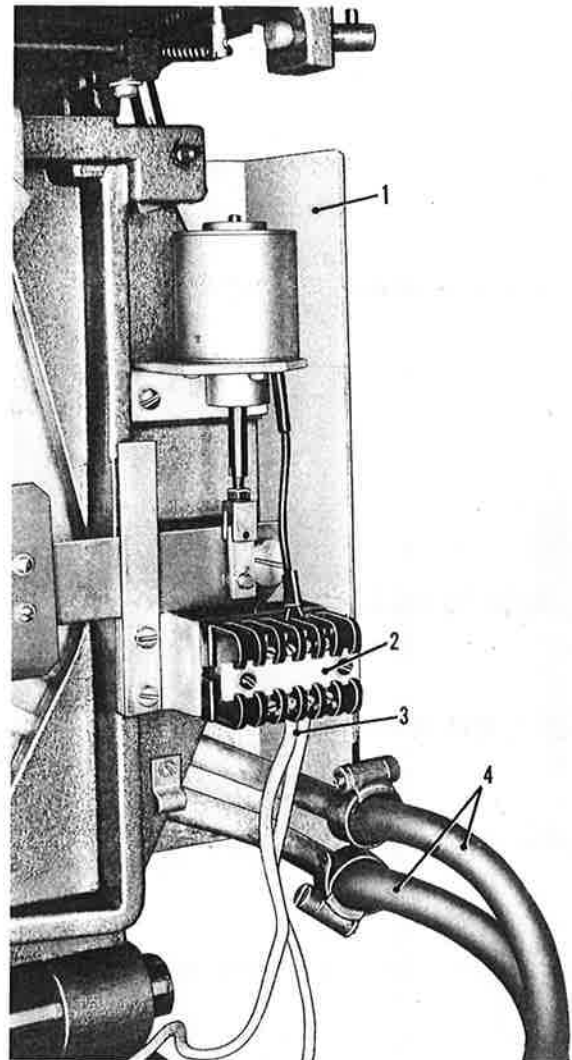
(2) Connect the electrical leads (3) (Fig. 29) to the bottom third and fourth terminals of the terminal strip (2).

(3) Connect the water lines (4).

### 44. Intermittent Mechanism

#### *a. Removal.*

(1) Remove the cover from the left side of the projector head.



1. Cooling plate
2. Terminal strip
3. Electrical leads
4. Water lines

Figure 29. Cooling Plate, Rear View.

(2) Remove the oil feeder line from the intermittent mechanism.

(3) Remove the film gate (Par. 29c) and the intermittent sprocket.

(4) Turn the framing knob (4) (Fig. 30) as far as it will go in a clockwise direction.

(5) Remove the screw (1) through the hole in the projector head wall.

(6) Turn the framing knob (4) as far as it will go in a counterclockwise direction and remove the second screw (1).

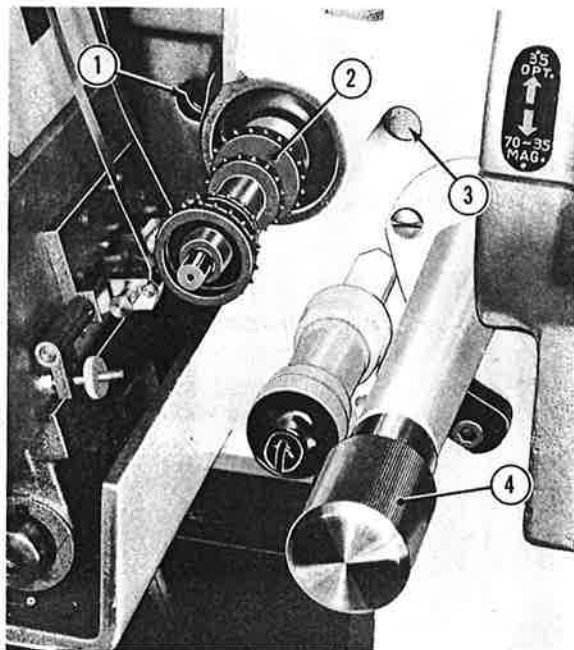
(7) Return the framing knob to the center position with the horizontal line through the center of the framing reference hole (3). The reference marks on the intermittent flywheel and housing on the left side of the projector head must now be opposite each other as shown in Figure 31.

(8) Remove the intermittent mechanism from the left side of the projector head.

#### CAUTION

*Pull the intermittent mechanism out carefully to avoid damaging the gears.*

*b. Installation.* Install the intermittent mechanism in the reverse order of removal (*a* above), making sure the reference marks are in the position shown in Figure 31.



1. Screw
2. Intermittent sprocket and shaft
3. Framing reference hole
4. Framing knob

Figure 30. Removing the Intermittent Mechanism.

#### NOTE

*Be sure to tighten the screw that locks the intermittent sprocket (2) (Fig. 30) to the shaft.*

#### 45. Lens Mount

*a. Removal.* Before removing the lens mount, loosen the lens mount clamping bolt (9) (Fig. 25) and remove the lens barrel from the lens mount.

(1) Loosen the hold-down bolt (5) (Fig. 17).

(2) Turn the focusing knob (2) in until the turnbuckle handle (7) is released at the end of the engaging bushing (6).

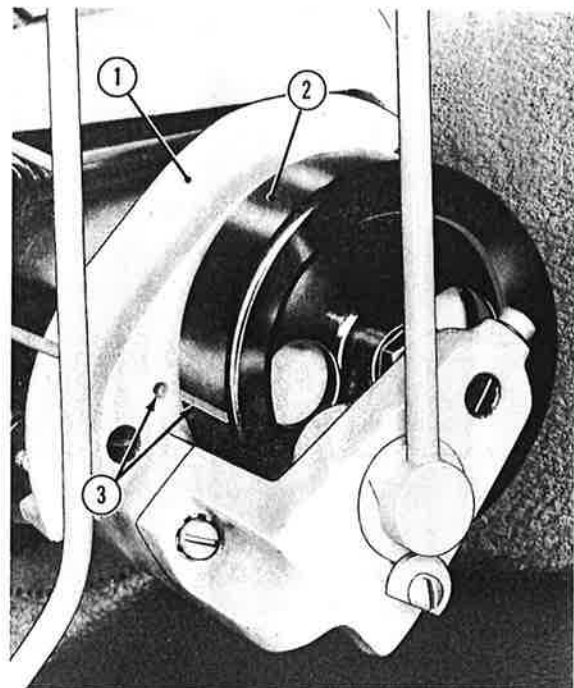
(3) Place the turnbuckle handle (7) in the shorter slot of the engaging bushing and turn the focusing knob (2) in the opposite direction until the turnbuckle handle is seated in the engaging bushing (6).

(4) Remove the hold-down bolt (5) and remove the lens mount.

*b. Installation.* Refer to Paragraph 18 for installation instructions for the lens mount.

#### 46. Lens Mount Bracket

*a. Removal.* Before removing the lens mount bracket, remove the lens mount (Par. 45). To remove the lens mount bracket, remove the four Allen-head screws (4) (Fig. 17).



1. Intermittent housing
2. Flywheel
3. Reference marks

Figure 31. Reference Marks, Intermittent Mechanism.

*b. Installation.* To install the lens mount bracket, install the Allen-head screws (4), being sure the dowel pins are in place.

#### 47. Magnetic Soundhead

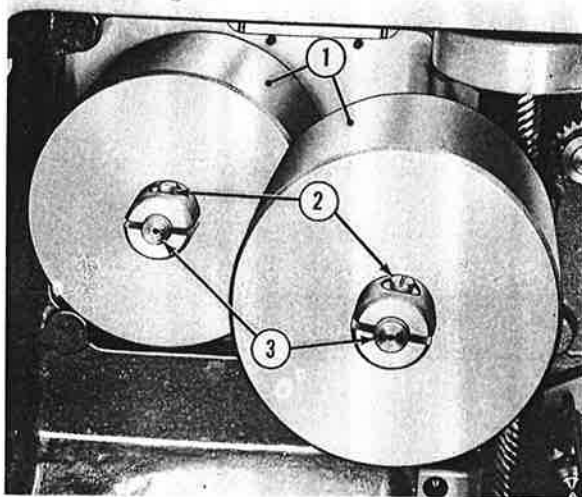
##### *a. Removal.*

(1) Disconnect the plug on the magnetic pick-up.

(2) Remove the two screws (2) (Fig. 32) that hold the stabilizers (1) to their respective shafts and remove the stabilizers.

(3) Remove the four mounting screws (2) (Fig. 33) and remove the magnetic soundhead.

*b. Installation.* Install the magnetic soundhead in the reverse order of removal (*a* above).



- 1. Stabilizers
- 2. Screws
- 3. Shafts

Figure 32. Stabilizers, Magnetic Soundhead.

#### 48. Magnetic Pick-up Head

##### *a. Removal.*

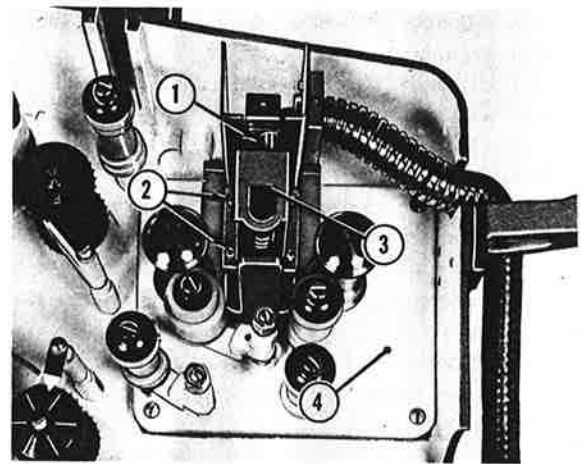
(1) Disconnect the terminal box (1) (Fig. 33) from the top of the magnetic pick-up head (3) and remove the cover from the magnetic pick-up head.

##### **NOTE**

*Be sure the pressure knob at the bottom of the magnetic pick-up head is set at zero before removing cover.*

(2) Remove the four mounting screws and remove the magnetic pick-up head (3) from the magnetic soundhead (4).

*b. Installation.* Install the magnetic pick-up head in the reverse order of removal (*a* above).



- 1. Terminal box
- 2. Mounting screws
- 3. Magnetic pick-up head
- 4. Magnetic soundhead

Figure 33. Magnetic Pick-up Head, Cover Removed.

#### 49. Optical Soundhead

##### *a. Removal.*

(1) Disconnect the optical soundhead leads and the photocell lead from the terminal strips in the lower base.

(2) Remove the four mounting screws (1) (Fig. 15) and remove the optical soundhead from the projector head.

*b. Installation.* Refer to Paragraph 15*b* for instructions covering installation of the optical soundhead. Refer to Paragraph 22*e* for instructions covering connection of the optical soundhead electrical leads.

#### 50. Exciter Lamp, Optical Soundhead

The optical soundhead exciter lamp is contained in the exciter lamp housing (28) (Fig. 25). This housing is equipped with a snap cover and the exciter lamp can be removed and installed simply by opening the snap cover.

#### 51. Lower Reel Drive Assembly

##### *a. Removal.*

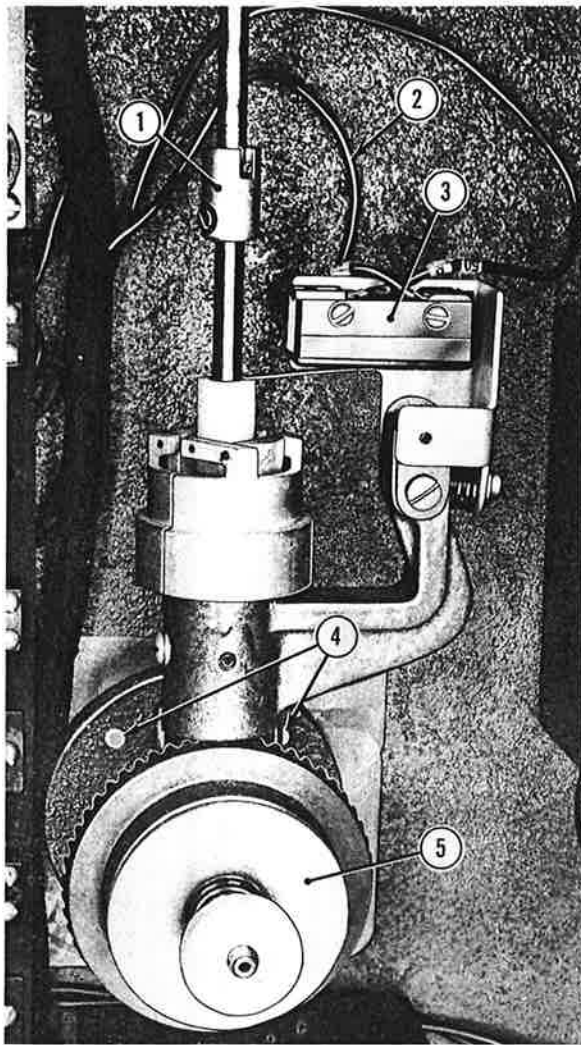
(1) Disconnect the main shaft coupling (1) (Fig. 34).

(2) Remove the minimum speed safety switch from the switch bracket.

(3) Remove the four mounting bolts that hold the lower reel drive assembly to the upper base wall.

*b. Installation.* Install the lower reel drive assembly in the reverse order of removal (*a* above).





1. Main shaft coupling
2. Electrical leads
3. Minimum speed safety switch
4. Mounting bolts
5. Lower reel drive assembly

Figure 34. Lower Reel Drive Assembly.

## 52. Motor Drive Assembly

### a. Removal.

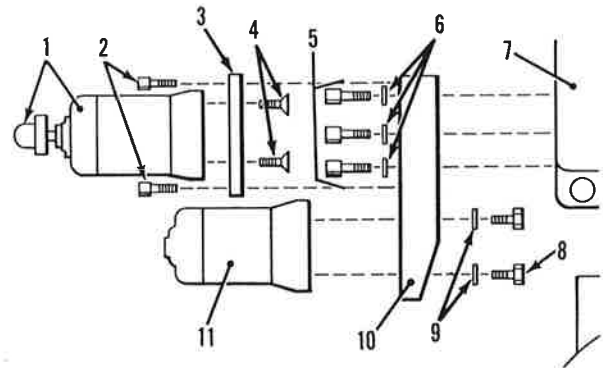
(1) Disconnect the electrical conduit from the motors.

(2) Remove the four cap screws (8) (Fig. 35) and washers (9) and remove the lower motor (11).

(3) Remove the four Allen-head screws (2) and remove the upper motor (1) and adapter plate (3) from the drive housing (10).

(4) Remove the Gilmer belt from the upper motor.

(5) Remove the six Allen-head screws (5) and washers (6) and remove the drive housing.



1. Upper motor and inching knob
2. Allen-head screws
3. Adapter plate
4. Flat-headed screws
5. Allen-head screws
6. Flat washers
7. Projector head
8. Cap screws
9. Flat washers
10. Drive housing
11. Lower motor

Figure 35. Motor Drive Assembly, Partial Exploded View.

(6) If necessary, remove the four flat-headed screws (4) and remove the adapter plate (3) from the upper motor (1).

b. *Installation.* Refer to Paragraph 14b for instructions covering installation of the motor drive assembly.

## 53. Motor Start Capacitors and Motor Run Capacitors

### CAUTION

Capacitors sometimes carry a dangerous accumulated electrical charge. Always ground the capacitor terminals before starting removal by touching a wire to each terminal and to the projector frame. Use an insulated wire with bare ends.

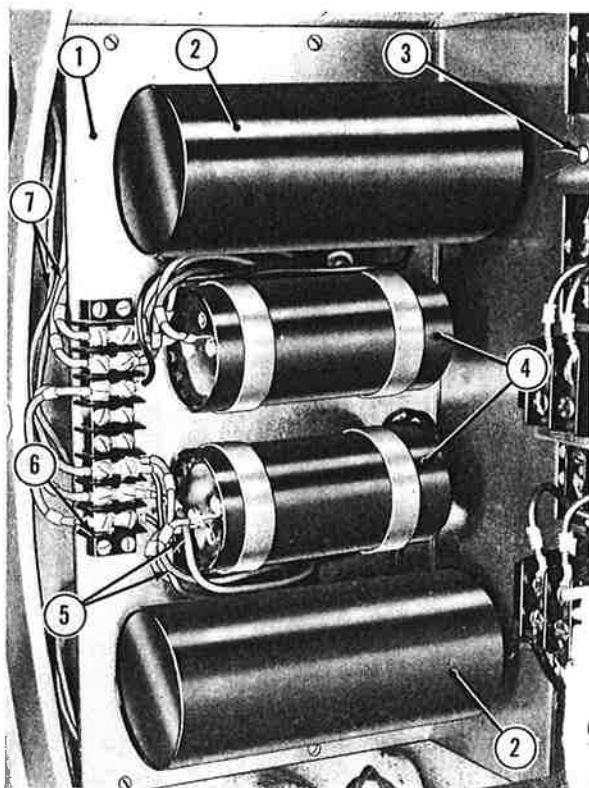
### a. Removal.

(1) Disconnect the capacitor leads (5) (Fig. 36) from the terminal strip (6).

### NOTE

The capacitor mounting screws are located between the capacitors and cannot be seen in Figure 36.

(2) Using a thin screwdriver, remove the ca-



1. Capacitor mounting plate
2. Motor run capacitor
3. Mounting screw
4. Motor start capacitors
5. Capacitor leads
6. Terminal strip
7. Motor leads and power input leads

Figure 36. Capacitors and Capacitor Mounting Plate.

pacitor mounting screws and remove the capacitor.

*b. Installation.* Install the capacitor in the reverse order of removal (*a* above).

#### 54. 90-Volt Selenium Rectifier

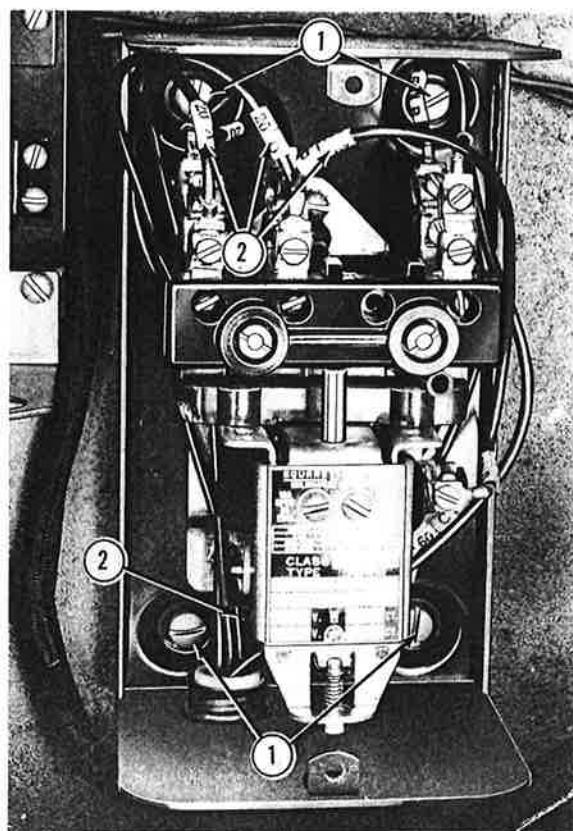
*a. Removal.* The 90-volt selenium rectifier is mounted on the back of the capacitor mounting plate (1) (Fig. 36). Before removing the rectifier from the capacitor mounting plate, remove the plate from the upper base. Proceed as follows:

(1) Disconnect the motor leads and power input leads (7) from the terminal strip (6).

(2) Remove the three mounting screws (3) from the capacitor mounting plate (1) and remove the plate.

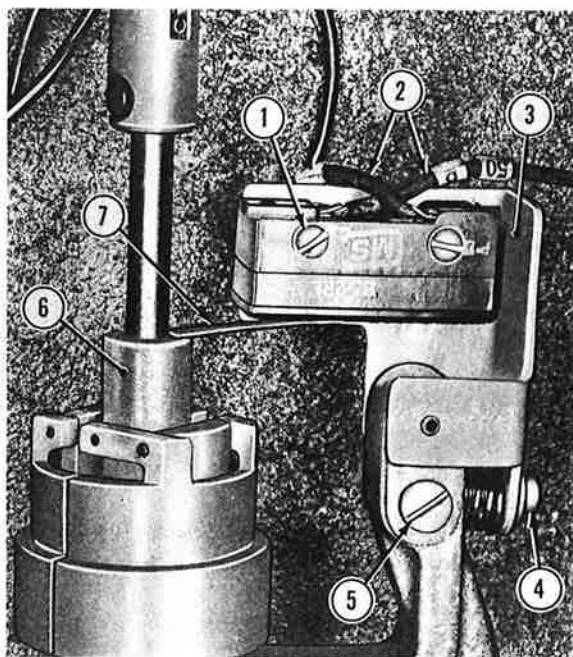
(3) Remove the four screws that hold the rectifier to the mounting plate and remove the rectifier.

*b. Installation.* Install the rectifier in the reverse order of removal (*a* above).



1. Mounting screws
2. Electrical leads

Figure 37. Motor Start Contactor, Cover Removed.



1. Mounting screw
2. Electrical leads
3. Bracket
4. Adjusting screw
5. Locking screw
6. Bushing
7. Actuating lever

Figure 38. Minimum Speed Safety Switch.

## 55. Motor Start Contactor

### a. Removal.

(1) Remove the two screws that hold the cover on the motor start contactor and remove the cover.

(2) Disconnect the electrical leads (2) (Fig. 37).

(3) Remove the four mounting screws (1) (Fig. 37) that hold the contactor to the wall of the upper base and remove the contactor.

b. *Installation.* Install the motor start contactor in the reverse order of removal (a above).

## 56. Minimum Speed Safety Switch

### a. Removal.

(1) Disconnect the electrical leads (2) (Fig. 38).

(2) Remove the two mounting screws (1).

b. *Installation.* Install the switch in the reverse order of removal (a above).

c. *Adjustment of Minimum Speed Safety Switch.* The switch must be set so that the switch actuating lever (7) (Fig. 38) operates the switch at approximately one half the travel distance of the bushing (6). Adjust the switch as follows:

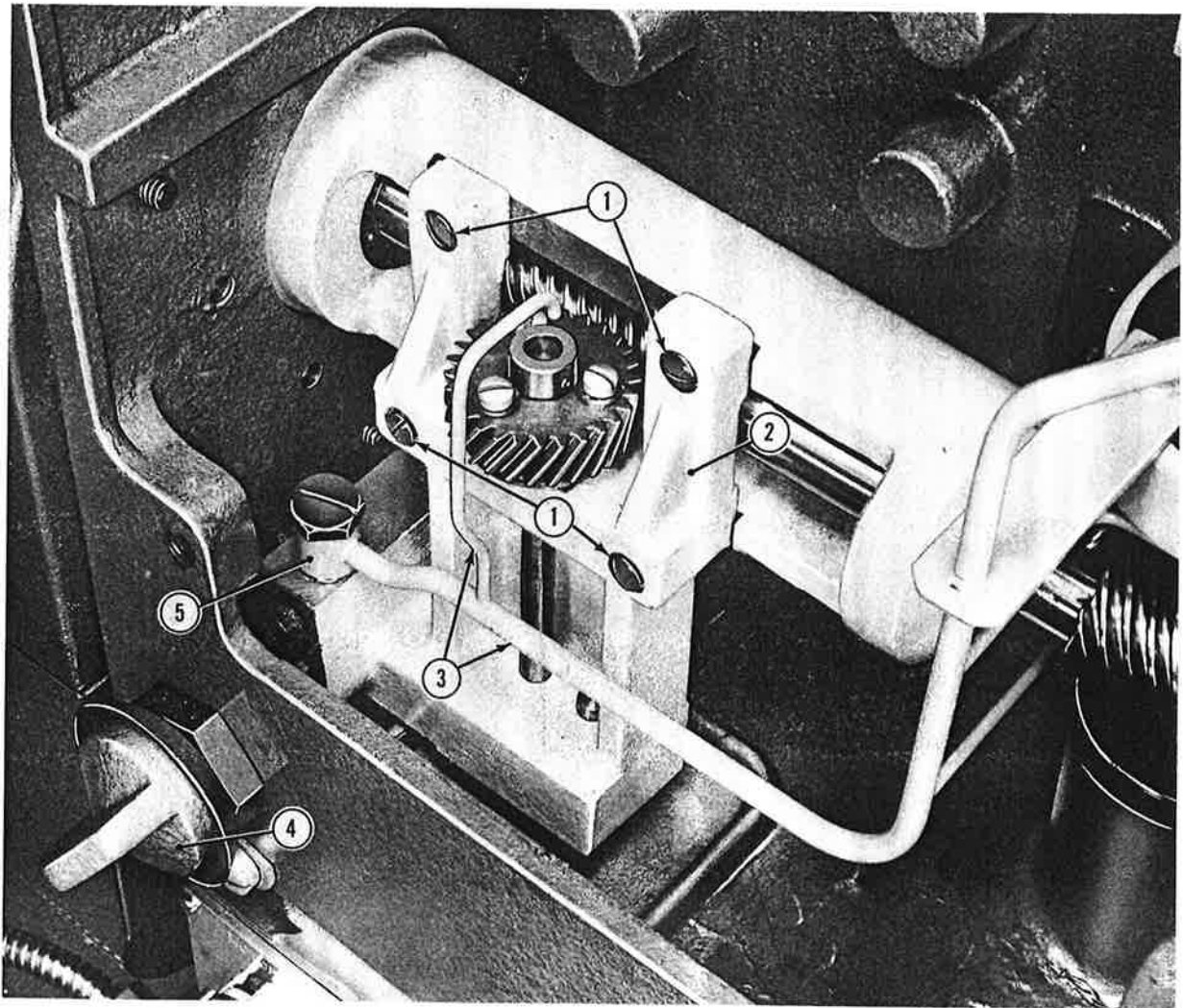
(1) Loosen the locking screw (5).

(2) Using an offset screwdriver, turn the adjusting screw (4) until the desired position of the switch is obtained.

(3) Tighten the locking screw (5).

## 57. Oil Pump

a. *Removal.* Before removing the oil pump, be sure the oil system is drained as completely as possible.



- |                    |                             |
|--------------------|-----------------------------|
| 1. Mounting screws | 4. Oil filter cap           |
| 2. Oil pump        | 5. Oil line connecting plug |
| 3. Oil line        |                             |

Figure 39. Oil Pump.

(1) Disconnect the oil line (3) (Fig. 39) by removing the oil line connecting plug (5).

(2) Remove the oil filter cap (4) and the oil filter.

(3) Remove the four mounting screws (1) and remove the oil pump (2).

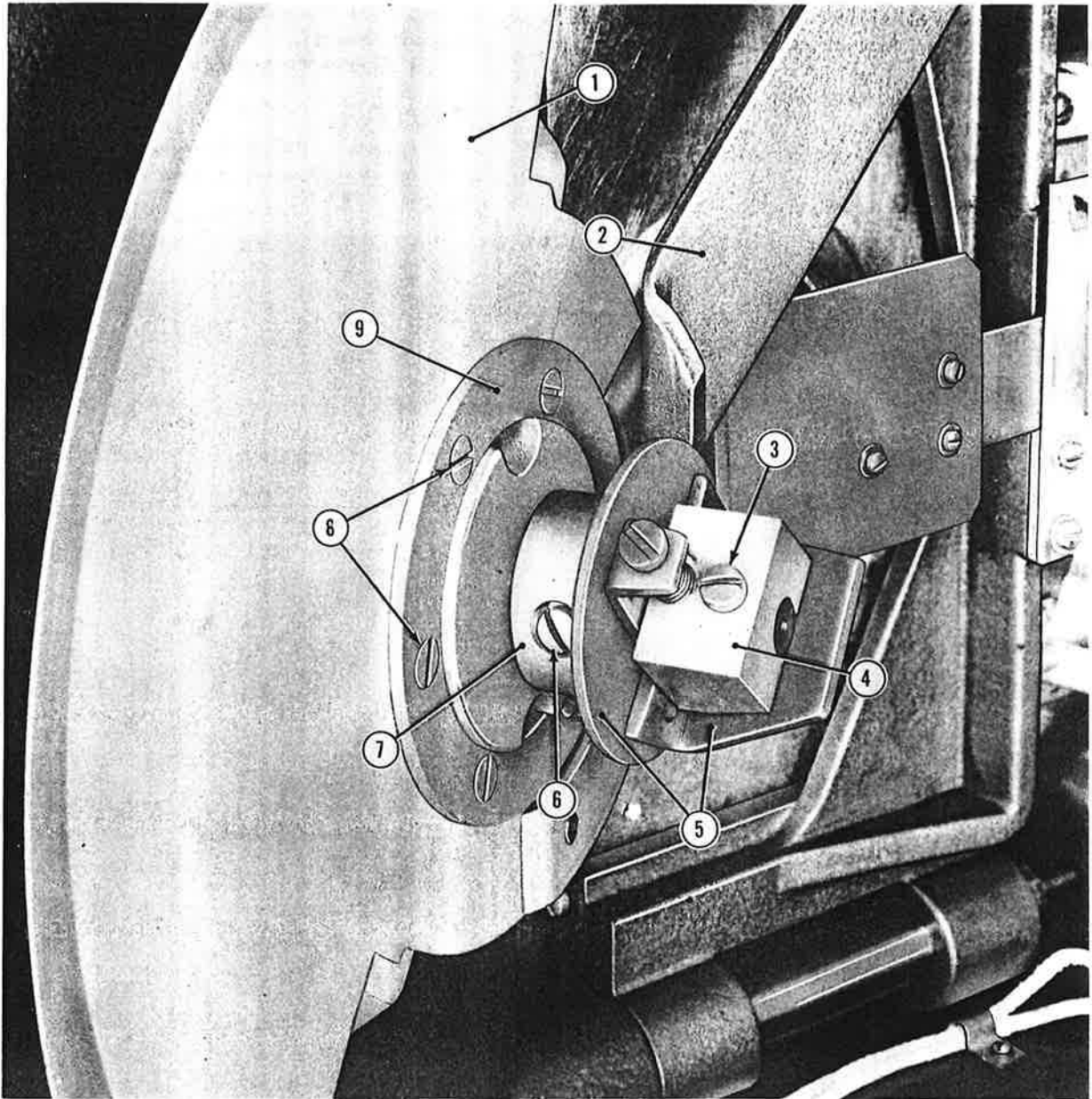
*b. Installation.* Install the oil pump in the reverse order of removal (*a* above).

## 58. Photocell

The photocell is installed in the photocell compartment (11) (Fig. 7). The photocell is removed after removing the compartment cover.

## 59. Optical Preamp

The optical preamplifier (6) (Fig. 4) is a plug-in unit which can be removed simply by pulling it out of the preamplifier case. When installing the pre-



- |                              |                            |
|------------------------------|----------------------------|
| 1. Shutter                   | 6. Setscrew                |
| 2. Centrifugal locking arm   | 7. Hub                     |
| 3. Locking screw             | 8. Shutter mounting screws |
| 4. Retaining block           | 9. Clamping ring           |
| 5. Centrifugal stop assembly |                            |

*Figure 40. Shutter Removal.*

amplifier, be sure all tubes are properly installed and that the unit is completely plugged in and seated properly.

## 60. Shutter and Shutter Shaft Assembly

*a. Removal.* Before removing the shutter and shutter shaft assembly, disconnect the oil line (5) (Fig. 7) and move the oil feeder away from the worm of the shutter shaft assembly. In addition to moving the oil line feeder, remove the cooling plate holder (Par. 43) and the projector head panel covering the shutter compartment.

(1) Remove the locking screw (3) (Fig. 40) and remove the retaining block (4).

(2) Remove the setscrew (6) from the hub (7) and remove the hub.

(3) Remove the shutter mounting screws (8) and remove the shutter (1).

(4) Remove the four mounting screws (2) (Fig. 41) and remove the shutter shaft assembly (3) through the hole in the projector head wall (1).

*b. Installation of the Shutter Shaft Assembly.* Install the shutter shaft assembly in the reverse order of removal (*a* above).

*c. Installation and Adjustment of the Shutter.*

(1) Install the shutter on the hub shoulder of the shutter shaft assembly.

### CAUTION

*Be sure the shutter is properly seated on the hub shoulder of the shutter shaft assembly before installing the clamping ring (9) (Fig. 40) and mounting screws (8). If the mounting screws (8) are tightened on the shutter when it is improperly seated, the shutter may be forced out of shape.*

(2) Install the clamping ring (9) and mounting screws (8), leaving the screws just loose enough to allow the shutter to turn on the hub shoulder without turning the shutter shaft.

(3) Turn the inching knob (9) (Fig. 1) until the intermittent just starts the pull-down movement. At this point, the shutter must close the aperture.

(4) Tighten the shutter mounting screws (8) (Fig. 40).

### NOTE

*The shutter must be set accurately in relation to the movement of the intermittent sprocket. If necessary, loosen the shutter mounting screws and readjust the shutter until it is set accurately.*

(5) Install the hub (7) (Fig. 40) on the shutter shaft, leaving the setscrew (6) loose.

(6) Install the centrifugal stop assembly (5) on the shutter shaft so that it clears the centrifugal locking arm (2) by approximately one-eighth of an inch and is parallel to the straight edge of the shutter blade.

(7) Tighten the locking screw (3).

(8) Insert one thickness of film between the hub and the centrifugal stop assembly and tighten the setscrew (6). The centrifugal stop assembly should be just loose enough to move outward without binding.

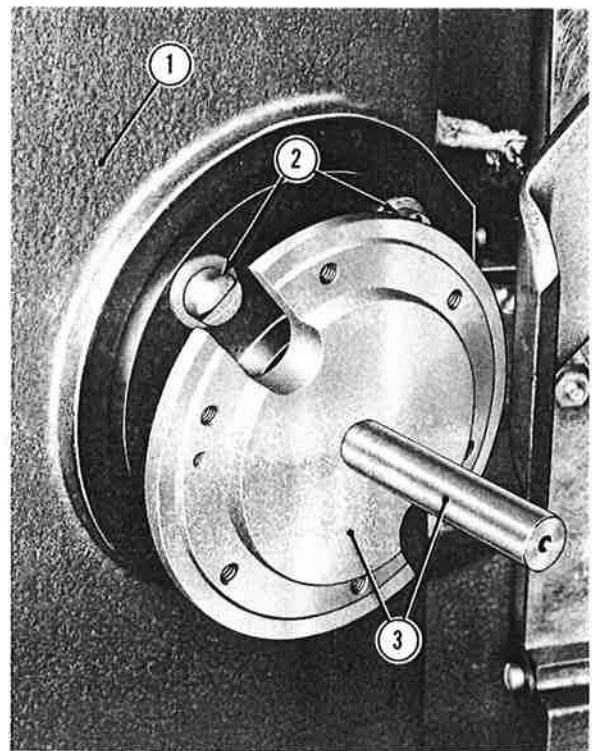
## 61. Water Flow Switch

The water flow switch (7) (Fig. 4) is mounted on a bracket installed in the upper base.

*a. Removal.*

(1) Disconnect the unions at the top and bottom of the flow switch.

(2) Using an Allen-head wrench, remove the two Allen-head screws at the right rear of the flow switch.



1. Projector head wall
2. Mounting screws
3. Shutter shaft assembly

Figure 41. Shutter Shaft Assembly, Shutter Removed.

#### **NOTE**

*The Allen-head screws mentioned in (2) above are accessible between the right side of the water flow switch and the outside wall of the upper base. If the water lines prevent removal of the Allen-head screws, disconnect the water lines and move them out of the way.*

*b. Installation.* Install the water flow switch in the reverse order of removal (*a* above).



## 62. General

The Todd-AO theater sound unit has been specially designed to meet the requirements of efficient changeover when using either Todd-AO 70mm film with magnetic sound, 35mm film with magnetic sound, or 35mm film with optical sound. Perspecta sound may also be added if required.

## 63. Control Rack

The control rack (Fig. 42), as furnished, includes the following equipment:

- 2 Banks of magnetic amplifiers (1) through (7) including six active and one spare preamplifier (7) and one cinemascope switcher amplifier (8).
- 1 Switch relay equalizer panel (25) for machines No. 1 and No. 2.
- 1 Switch relay equalizer panel for machine No. 3 (not included with a two-machine installation).
- 1 Master gain control panel (24).
- 1 Monitor selector and volume control panel (23).
- 1 Stereo amplifier regular-emergency switching panel (22).
- 1 Dual high voltage dc and low voltage ac power supply panel (21).
- 1 Low voltage dc power supply panel (20).

## 64. Preamplifiers

Reading from left to right, on Figure 42, preamplifiers No. 1 through No. 4 are located in the top bank. No. 5, No. 6, No. 7, which is the spare, and No. 8, the cinemascope switcher amplifier, are located in the lower bank. The preamplifiers are of the plug-in type so that in case of trouble the spare (7) (Fig. 42) may be used to replace any of the others except the cinemascope switcher amplifier.

## 65. Switch Relay Equalizer Panel For Machines No. 1 and No. 2

a. This panel (25) (Fig. 42) includes manually operated switches for switching between cinemascope and Todd-AO magnetic head sections and their associated equalizers. These switches operate changeover relays and the system transfer relay. The Perspecta Sound on-off switch (10) is also installed on this panel.

b. There are two changeover switches (9) for each machine. Each switch has two positions, one position is marked "Cinemascope" and the other is marked "Todd-AO." One switch of each pair controls the magnetic head selection and the other controls the equalizer circuits. Both switches of either pair must be positioned to either Cinemascope or Todd-AO, depending on the film being run.

When the switches are in the position marked "Cinemascope," they complete the switcher amplifier circuit. If during the run of the show both Cinemascope and Todd-AO film are included, the switches should be preset to their correct positions before changeover. Likewise, on change of show, if a different product from that previously run is to be used, the switches should be properly preset.

c. The Perspecta Sound on-off switch should be left in the "off" position at all times except when a Perspecta Sound integrator is installed in operation.

## 66. Switch Relay Equalizer Panel For Machine No. 3

This panel is included only with a three-machine installation. When installed, it includes, for the No. 3 machine, facilities and functions as described in Paragraph 65.

## 67. Master Gain Control Panel

This panel (24) (Fig. 42) includes an auditorium speaker control (11) and a stage speaker control (12) appropriately marked. These controls are used for adjustment of sound volume in the theater when running either a Cinemascope or Todd-AO product.

## 68. Monitor Selector and Volume Control Panel

This panel (23) (Fig. 42) is normally used with an external monitor amplifier. A monitor volume control (14) is included and a selector switch (13) has positions for monitoring channels No. 1 through No. 6 and "ALL."

## 69. Stereo Amplifier Regular-emergency Switching Panel

This panel (22) (Fig. 42) mounts six switches (15) designated 1 through 6 with positions marked "NOR-BUS." In the NOR position each stereo amplifier is connected to its normal channel and speakers. Switching is used so that if the amplifiers for any of the channels 1 through 5 fail, the amplifier for channel 6 may be substituted. To accomplish this, throw the switch for the channel number of the defective amplifier to "BUS" and the channel 6 switch to "BUS."

## 70. Dual High Voltage DC and Low Voltage AC Power Supply Panel

This panel (21) (Fig. 42) mounts the throw-over switch (17) for the power supply which furnishes the "B" voltage for all the preamplifiers in the unit, the 6.3-volt a-c heater voltage for the optical amplifier located in the projector base, one set of

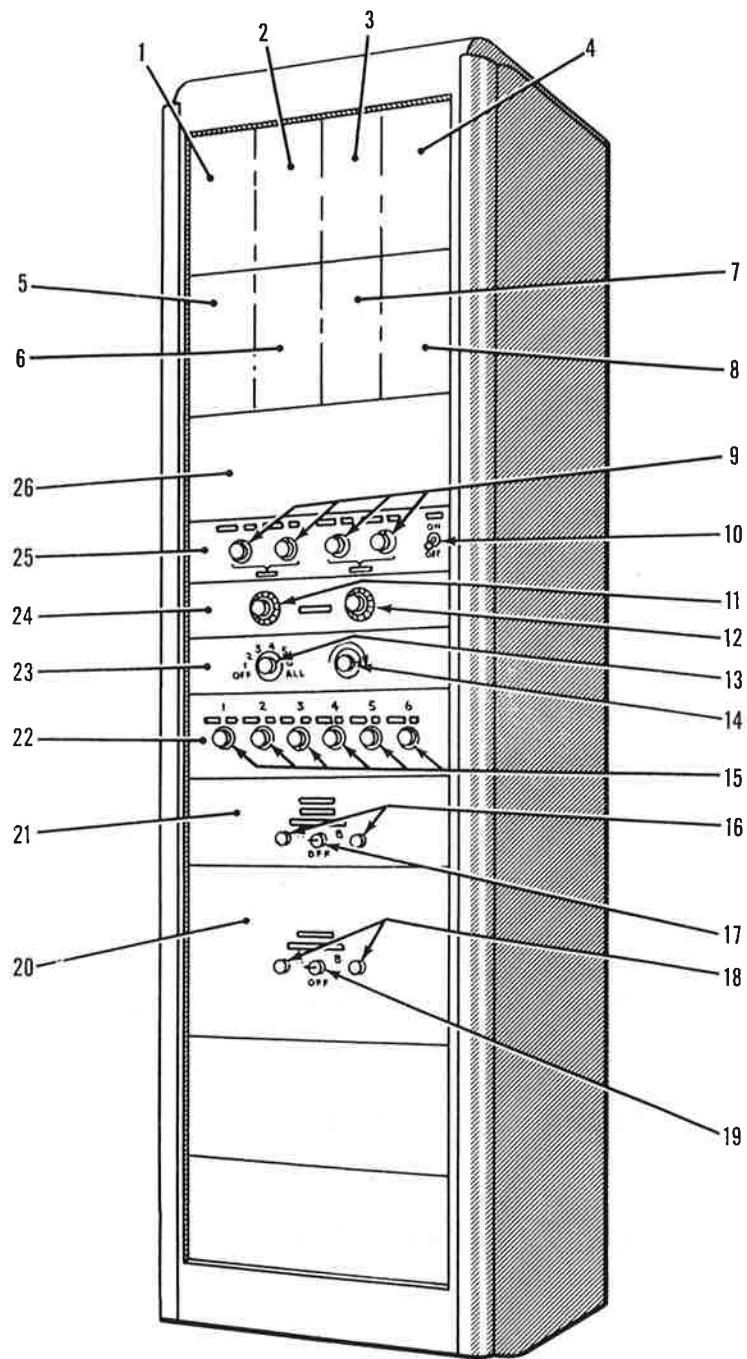


Figure 42. Todd-AO Special Theater Sound Unit Control Panel.



1. Magnetic preamplifier, plug-in, mounted
2. Magnetic preamplifier, plug-in, mounted
3. Magnetic preamplifier, plug-in, mounted
4. Magnetic preamplifier, plug-in, mounted
5. Magnetic preamplifier, plug-in, mounted
6. Magnetic preamplifier, plug-in, mounted
7. Magnetic preamplifier, plug-in, mounted spare, heater elements only connected
8. Switching amplifier cinemascope, 4th track
9. Cinemascope . . . Todd-AO changeover switches
10. Perspecta Sound on-off switch
11. Auditorium speaker control
12. Stage speaker control
13. Selector switch
14. Monitor volume control
15. Emergency substitute amplifier switches
16. On-off indicator lights, high voltage dc and low voltage ac
17. High voltage dc and low voltage ac throw-over switch
18. On-off indicator lights, low voltage dc
19. Low voltage dc throw-over switch
20. Dual low voltage dc power supply panel
21. Dual high voltage dc and low voltage ac power supply panel
22. Stereo amplifier regular-emergency switching panel
23. Monitor selector and volume control panel
24. Master gain control panel
25. Switch relay equalizer panel for machines No. 1 and No. 2
26. System switching and relays

*Figure 42. Todd-AO Special Theater Sound Unit Control Panel (Legend).*

coils of the magnetic-optical system transfer relay, and the optical system changeover relays. It is a dual supply of which only one section is used at any one time. Switchover between sections, in case of trouble or any other reason, may be accomplished by means of the throw-over switch (17) located on the front of the panel and marked "A-B."

#### **71. Dual Low Voltage DC Power Supply Panel**

This panel (20) (Fig. 42) mounts the throw-over switch (19) and the indicator lights (18) for the dual low voltage d-c power supply. This power supply furnishes the 6.3-volt d-c heater supply for the magnetic preamplifiers and 6-7-volt dc for the balance of the relays used in the equipment. Each section of the dual supply is selected by means of the throw-over switch (19) marked "A-B" on the front of the panel.

#### **72. Accessories – Changeover Cabinets (Not Shown in Figure 42)**

a. The optical reproducer system includes one changeover cabinet for each machine. When changing over from magnetic sound to optical sound or from optical sound to optical sound, it is necessary to press the button in the cabinet associated with the incoming machine. A pilot light and individual machine volume control, used for optical reproduction only, is supplied in each cabinet.

b. The magnetic reproducer system includes one pushbutton station for each machine. Changeover from optical sound to magnetic sound or from magnetic sound to magnetic sound is accomplished by operating the lever switch on the station associated with the incoming machine.

## Section IX. AUTOMATIC FOCUS DRIFT COMPENSATOR

### 73. Description and Theory of Operation

To solve the problem of focus drift that exists when using high intensity arc lamps, a simple accessory is provided for the Todd-AO projector. This accessory is called the automatic focus drift compensator and when installed on the Todd-AO projector it automatically shifts the focus of the projection objective at a predetermined rate, thus compensating for the physical changes in the lens caused by the heat introduced by the arc lamp. The device takes over when the dowser is opened and automatically makes the required adjustment in focus, resetting to the start position at the end of each reel.

The main assemblies and the items that comprise them are as follows:

#### Drive Unit

- Electric motor (17) (Fig. 44)
- Camshaft (10) and main cam (18)
- Worm (19) and worm gear (23)
- Overriding clutch (22)

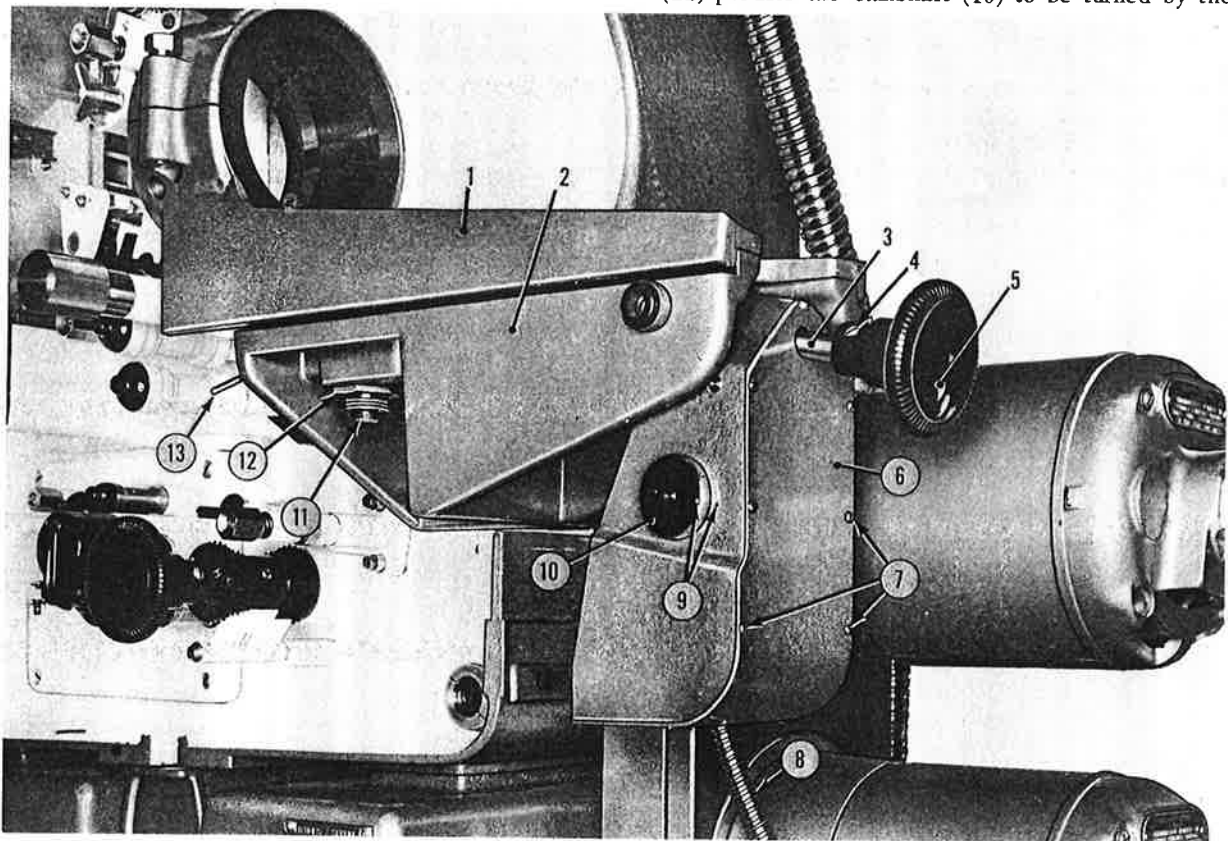
- Actuating lever (6)
- Pivot shaft (7)
- Manual adjusting knob (21)
- Microswitches (8) and (9)
- Collars (12) and (13)
- Focusing screw (5)

#### Control Unit

- Control unit mount (2) (Fig. 45)
- Motor start capacitor (not shown)
- Terminal strip (1)
- Relays (3) and (4)

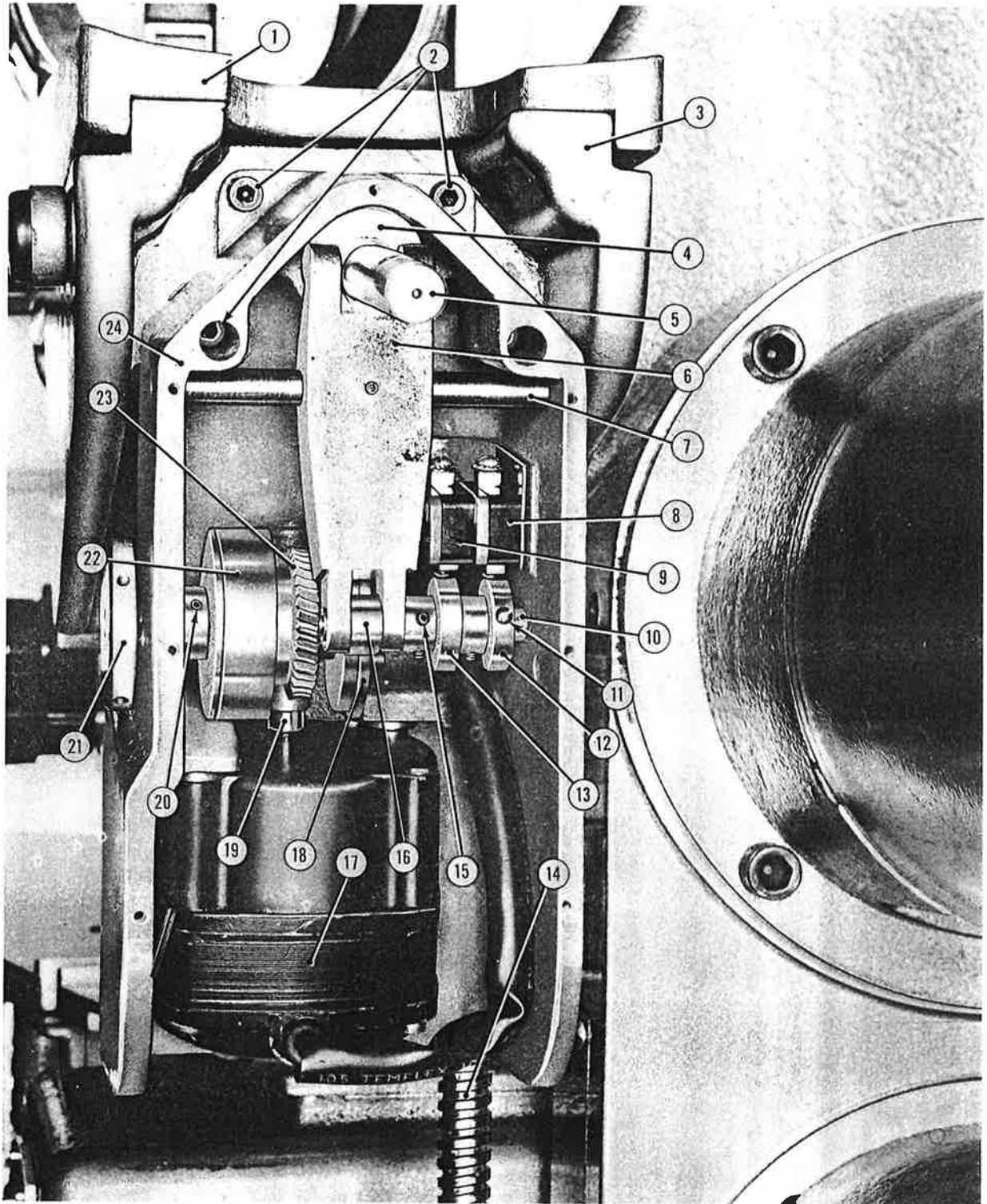
The control unit (2) (Fig. 45), including the motor start capacitor (not shown), terminal strip (1), and relays (3) and (4), is installed on the projector capacitor cover (9) in the upper base. The remainder of the components are assembled in the drive unit housing (24) (Fig. 44) which is mounted on the front of the lens mount bracket (2) (Fig. 43).

The camshaft (10) (Fig. 44) is driven by a worm (19) and worm gear (23). The overriding clutch (22) permits the camshaft (10) to be turned by the



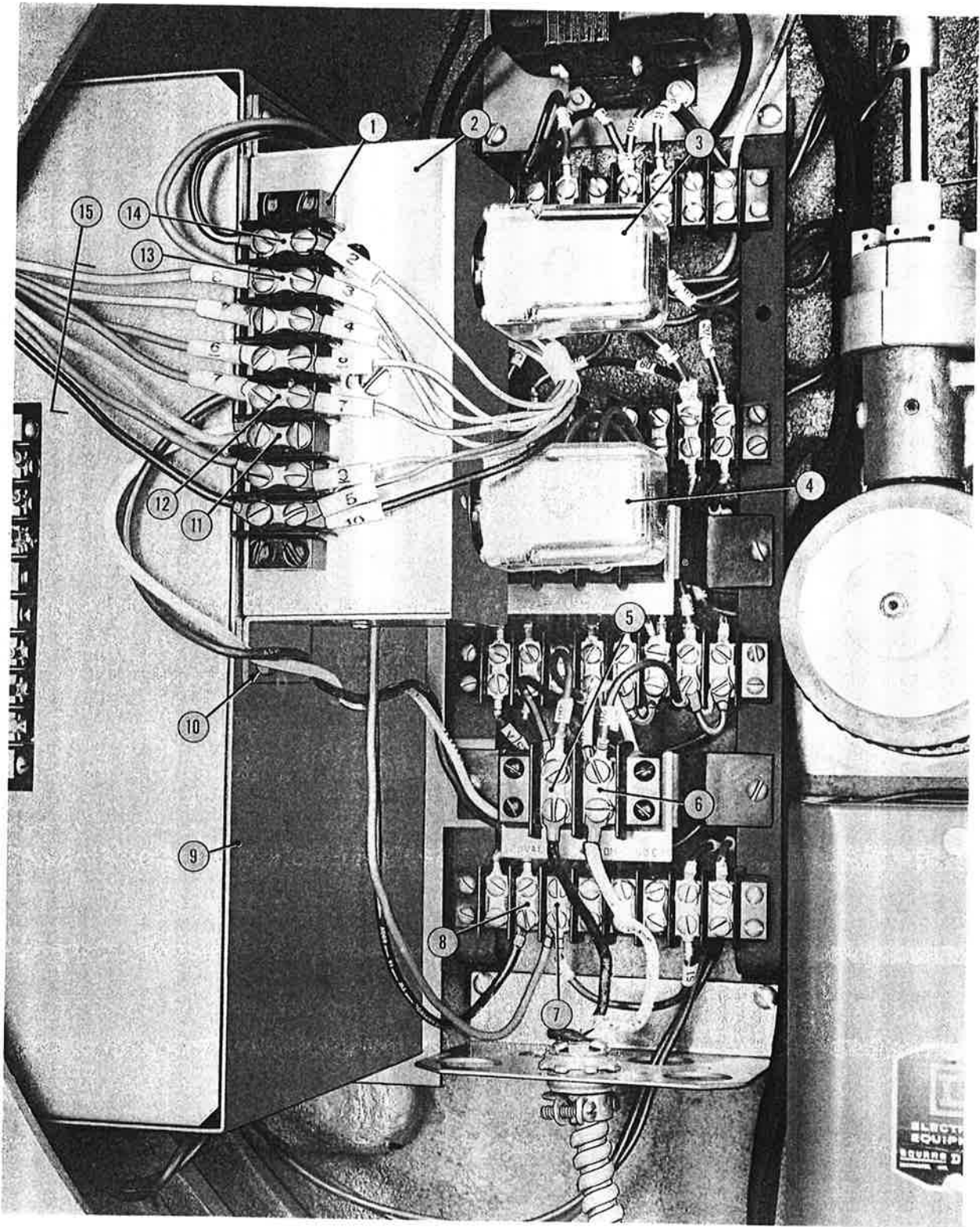
- |                         |                              |
|-------------------------|------------------------------|
| 1. Lens mount           | 8. Conduit                   |
| 2. Lens mount bracket   | 9. Reference dots            |
| 3. Focusing screw       | 10. Manual adjusting knob    |
| 4. Setscrew             | 11. Lens mount clamping stud |
| 5. Manual focusing knob | 12. Locknut                  |
| 6. Drive unit cover     | 13. Focus spring lock        |
| 7. Screws               |                              |

Figure 43. Drive Unit, Installed View.



- |  |                                 |                           |
|--|---------------------------------|---------------------------|
| 1. Lens mount                            | 9. Reset microswitch            | 17. Motor                 |
| 2. Mounting screws, Allen-head (4 req'd) | 10. Camshaft                    | 18. Main cam              |
| 3. Lens mount bracket                    | 11. Microswitch actuating screw | 19. Worm                  |
| 4. Focusing screw bushing                | 12. Collar                      | 20. Clutch setscrew       |
| 5. Focusing screw                        | 13. Collar                      | 21. Manual adjusting knob |
| 6. Actuating lever                       | 14. Conduit                     | 22. Overriding clutch     |
| 7. Pivot shaft                           | 15. Setscrew, Allen-head        | 23. Worm gear             |
| 8. Motor stop microswitch                | 16. Cam roller                  | 24. Drive unit housing    |

Figure 44. Drive Unit with Cover and Manual Focusing Knob Removed.



- |                          |                              |                           |
|--------------------------|------------------------------|---------------------------|
| 1. Terminal strip        | 6. 110-volt a-c terminal     | 11. 110-volt ac           |
| 2. Control unit mount    | 7. 98-volt d-c terminal      | 12. 110-volt ac           |
| 3. Relay                 | 8. 98-volt d-c terminal      | 13. 98-volt dc            |
| 4. Relay                 | 9. Projector capacitor cover | 14. 98-volt dc            |
| 5. 110-volt a-c terminal | 10. Sheet metal screws       | 15. Leads from drive unit |

*Figure 45. Control Unit, Installed View.*

manual adjusting knob (21). The manual focusing knob (5) (Fig. 43) permits manual focusing of the projector when the automatic focus drift compensator is installed. Suitable cams are provided to match the characteristics of a given projection lens and arc lamp.

The microswitches (8) and (9) (Fig. 44) are operated by actuating screws (11) mounted in the outer periphery of the collars (12) and (13). These collars and screws function as cams.

## 74. Installation

*a. General.* The lens mount bracket (2) (Fig. 43) furnished with each Todd-AO projector is adapted for the installation of the automatic focus drift compensator. A hole in the upper base is also provided for the conduit (8) which carries the electrical leads from the drive unit to the control unit in the upper base. A special lens mount clamping stud (11) and locknut (12) are provided to replace the hold-down bolt (5) (Fig. 17) furnished with each projector as standard equipment. A special focusing screw (5) (Fig. 44) is also provided to replace the standard screw. Install the automatic focus drift compensator as follows:

### *b. Lens Mount Clamping Stud and Locknut.*

(1) Remove the hold-down bolt (5) (Fig. 17) from the lens mount bracket (3) (see Paragraph 45a) and remove the lens mount from the projector.

(2) Install the lens mount clamping stud (11) (Fig. 43) as shown in Figure 46, observing the correct distance from the end of the stud to the under side of the lens mount. This stud has a

special oversize  $\frac{1}{2}$  in. - 13 NC thread on one end so that it fits very tightly in the lens mount.

(3) Replace the lens mount on the projector and install the locknut (12) (Fig. 43). Tighten the locknut so that the lens mount will slide freely, but not loosely, on the lens mount bracket. The lens mount must not bind on the lens mount bracket.

### *c. Drive Unit.*

(1) Remove the focusing knob (2) (Fig. 17) and focusing screw from the lens mount bracket.

(2) Remove the focusing screw bushing from the lens mount bracket.

(3) Remove the cover (6) (Fig. 43) from the drive unit.

(4) Install the drive unit by installing four Allen-head screws (2) (Fig. 44). Install the shorter screws in the top holes and the longer screws in the bottom holes.

### *d. Special Focusing Screw.*

(1) Transfer the focusing knob from the standard focusing screw to the special focusing screw furnished with the compensator.

(2) Install the special focusing screw (5) (Fig. 44) in the bushing (4), turning it in until it just comes in contact with the stop on the bottom of the lens mount.

*e. Control Unit.* The relays (3) and (4) (Fig. 45) and the terminal strip (1) are installed on the outside of the control unit mount (2). The motor start capacitor (not shown) is located inside the control unit mount (2). Install all of these items as an assembly by installing four sheet metal

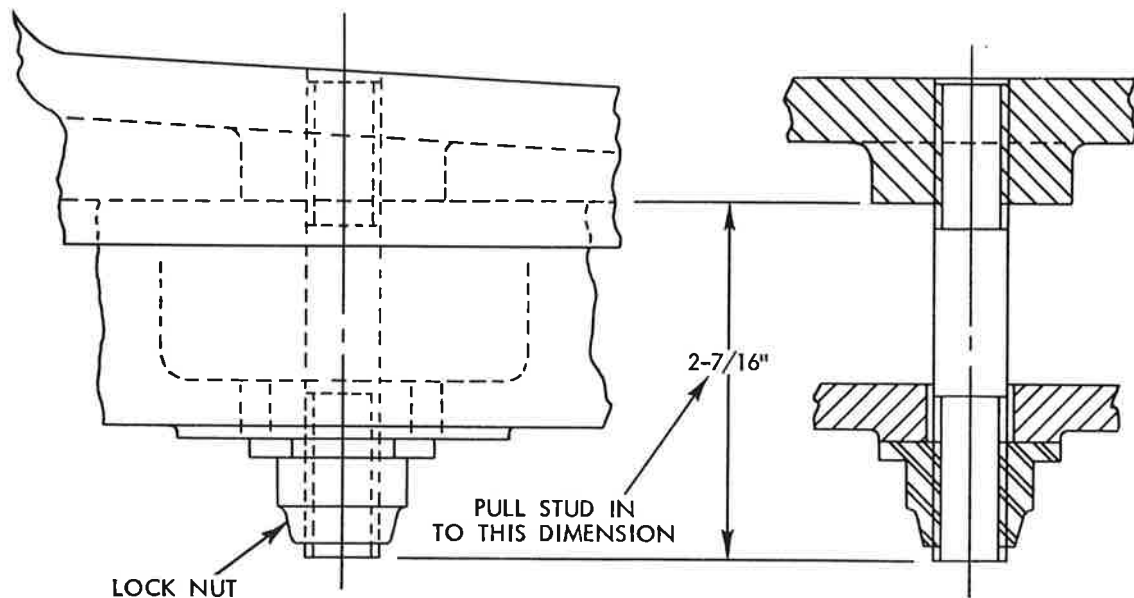


Figure 46. Lens Mount Clamping Stud, Installation Diagram.

screws (10) (Fig. 45).

*f. Electrical Connections.* Make electrical connections as follows:

(1) *Leads from the Drive Unit.* Connect the leads from the drive unit (15) (Fig. 45) to the terminal strip (1) (Fig. 45) as shown on the wiring diagram (Fig. 47).

(2) *98-Volt D-C Supply.* Connect jumper wires from terminals (13) and (14) (Fig. 45) to terminals (7) and (8) (Fig. 45) as shown on the wiring diagram (Fig. 47).

(3) *120-Volt A-C Supply.* Connect jumper wires from terminals (11) and (12) (Fig. 45) to terminals (5) and (6) (Fig. 45) as shown on the wiring diagram (Fig. 47).

## 75. Operation and Adjustment

*a. Test Run.* Before installing the cover (6) (Fig. 43) on the control unit, start the projector and run it through a one-reel cycle. When the projector starts and the dowser is raised, observe the compensator motor to see that it is running. Also check the motor to see that it stops after the focus drift compensation has been made, and that it starts again and runs to the start position when the projector stops at the end of a reel.

*b. Cycle of Operation.* The cycle of operation of the compensator starts with the reference dots (9) (Fig. 43) aligned as shown.

(1) *Compensation.* After the projector has been started and the dowser has been raised, the

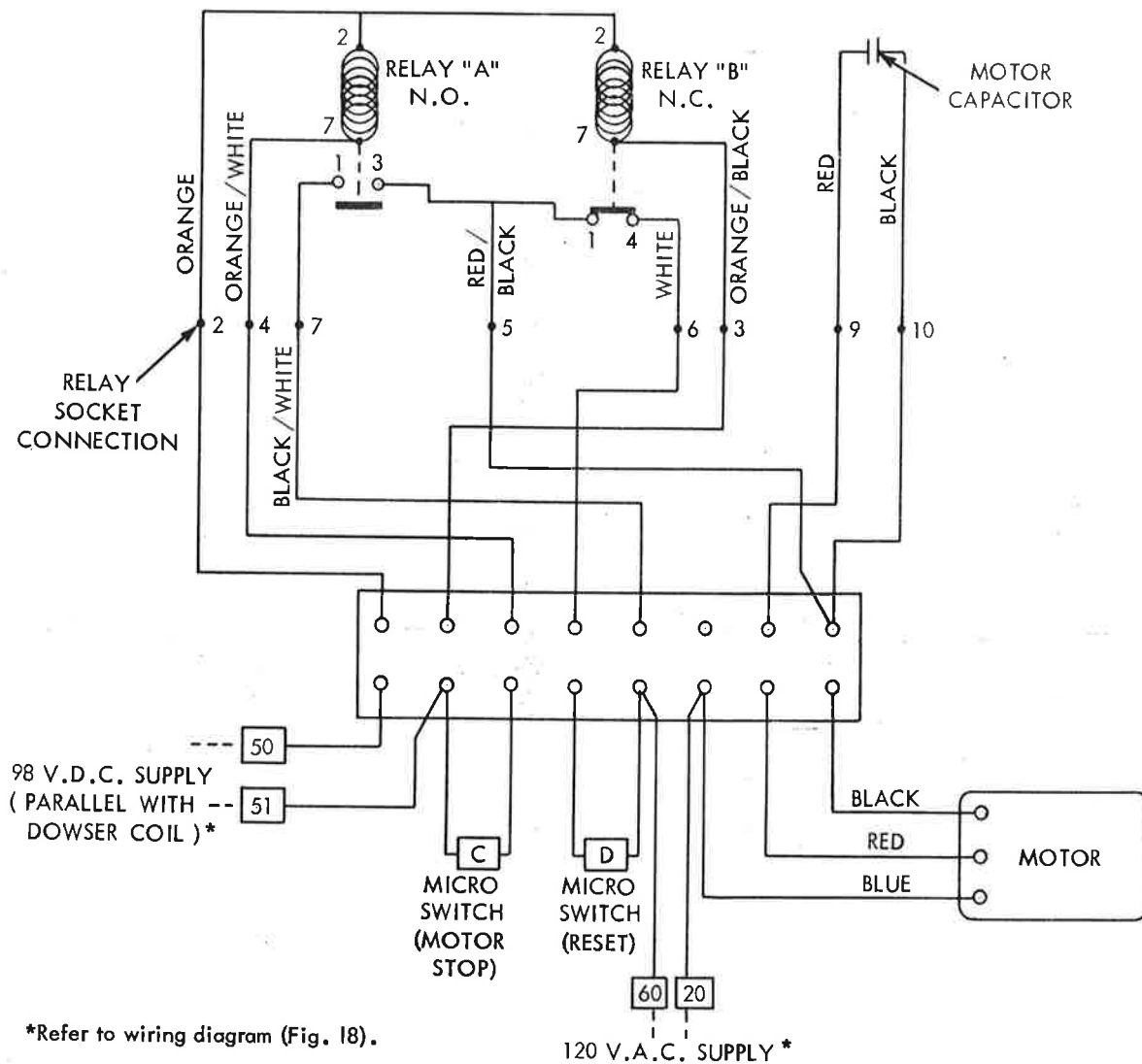


Figure 47. Wiring Diagram, Automatic Focus Drift Compensator.

compensator motor will run until the necessary compensation in focus has been made. At this time the motor stop microswitch (8) (Fig. 44) and (C) (Fig. 47) is actuated by the screw (11) (Fig. 44) in the collar (12). This stops the compensator motor.

(2) *Reset.* The compensator motor remains in the stopped position described in (1) above until the dowser is dropped at the end of the reel, thus deenergizing relay "B" (Fig. 47). This closes the circuit to the compensator motor and it runs until the reset microswitch (9) (Fig. 44) and (D) (Fig. 47) is opened, thus breaking the circuit to the compensator motor and stopping it. The drive unit has

now returned to the start position with the reference dots (9) (Fig. 43) aligned.

c. *Adjustment.* The collars and screws that act as cams are carefully set at the factory to operate the microswitches as described above and field adjustments are not recommended. However, if necessary the timing may be adjusted by loosening the setscrews in the collars and rotating the collars to the proper position. Also, if more or less microswitch lever travel is required, it may be obtained by turning the actuating screws (11) (Fig. 44).

