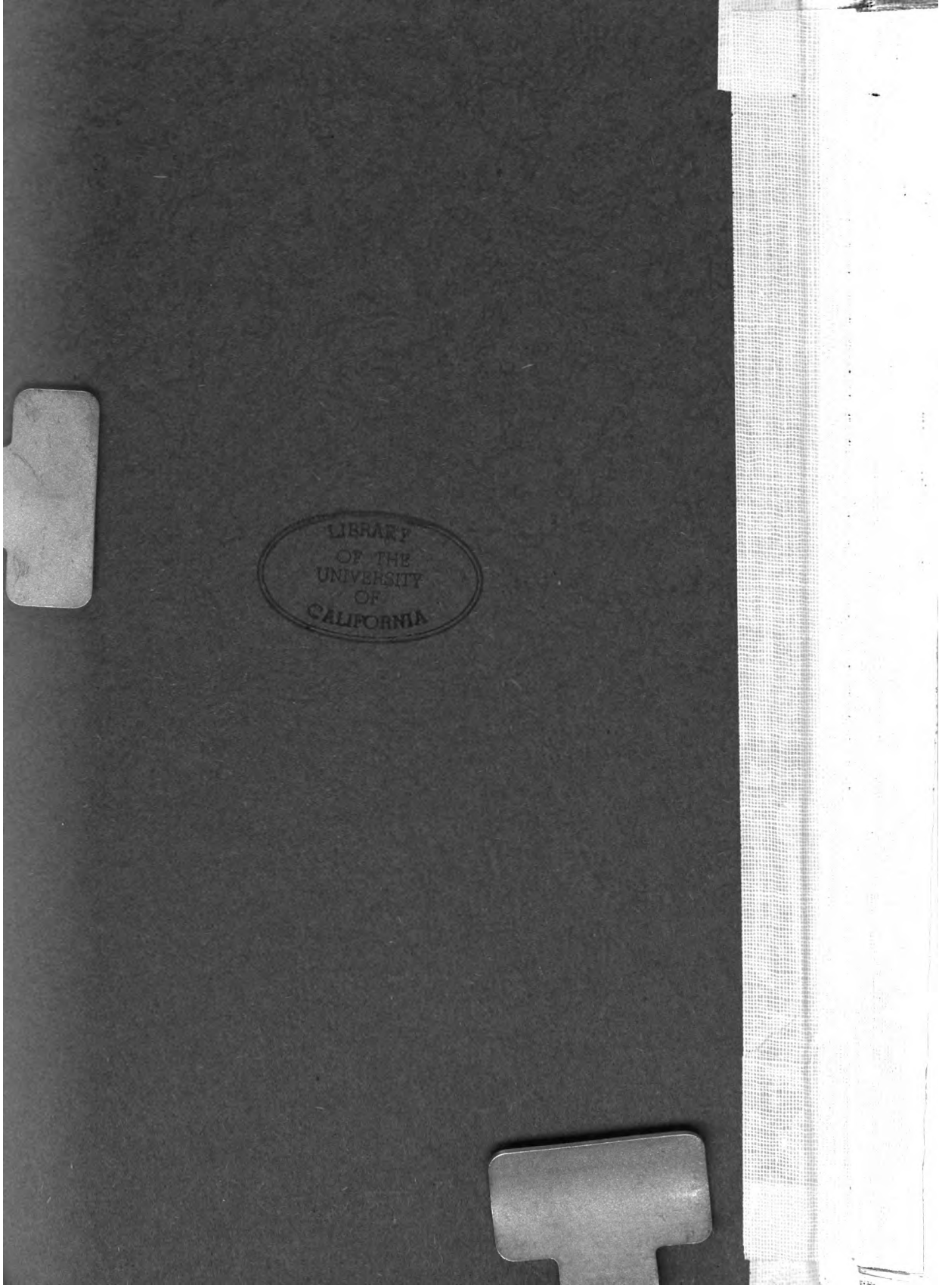


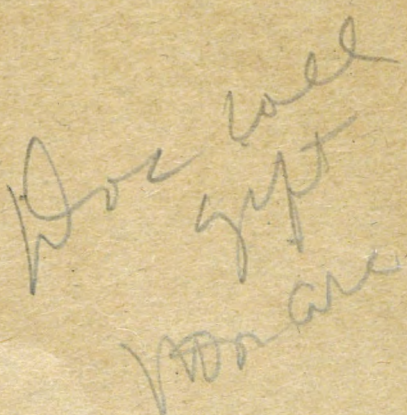
TM 11-401

WAR DEPARTMENT

TECHNICAL MANUAL

TRAINING FILM AND FILM STRIP PROJECTION

March 22, 1943



TECHNICAL MANUAL
No. 11-401

WAR DEPARTMENT,
WASHINGTON, March 22, 1943.

TRAINING FILM AND FILM STRIP PROJECTION

514940°—43——1

CHAPTER 1

GENERAL

1. Purpose of manual.—The purpose of this manual is to provide instruction for the correct use, maintenance, and storage of training film and projection equipment. The 16-mm training film projectors are used in service command libraries, unit headquarters, and replacement training centers to project sound training films prepared for the Army training program.

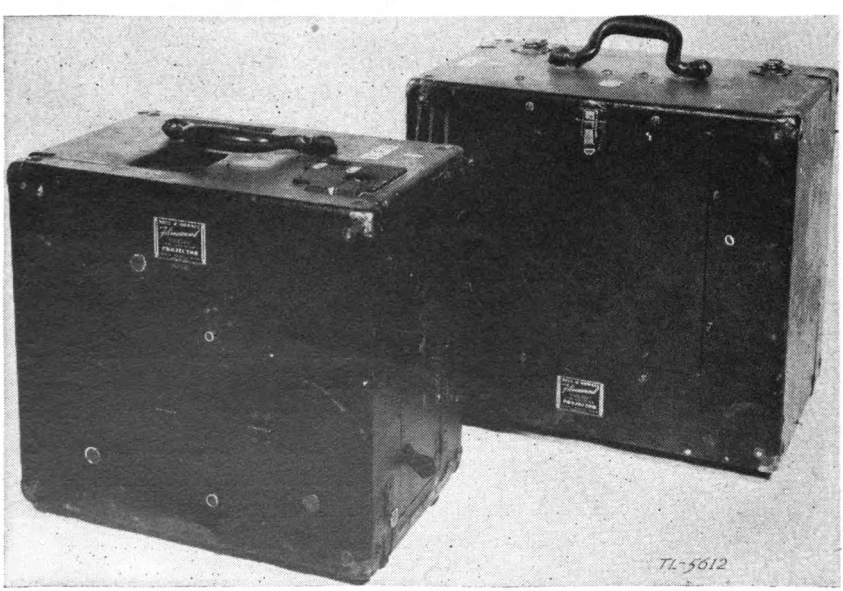


FIGURE 1.—Bell & Howell projector packed for transporting.

CHAPTER 2

TRAINING FILM PROJECTION

SECTION I

EQUIPMENT

2. Types of projectors and screens.—*a.* Four types of 16-mm projectors are used in the Army training program: Ampro YA, Phonofilm, Bell & Howell, and R. C. A. The complete projector usually comes in two cases, a projector case and a speaker case (see fig. 1). The projector case (fig. 2) houses the motor *A*, lens *B*, sprockets C^1, C^2, and C^3, control panel *D*, sound drum *E*, and the projector and exciter lamps. The speaker case houses the speaker, speaker cable *G*, power cable *H*, reel *I*, a tool kit *J*, spare lamps, and extra tubes. (See fig. 3.) The size and weight of the four projector models are shown in the following table:

Model	Projector case size (inches)	Speaker case size (inches)	Weight of both cases (pounds)
Ampro YA	22 x 12 x 18	22 x 14 x 18	82
Phonofilm	10½ x 22 x 16½	20½ x 11½ x 11½	93
Bell & Howell	10½ x 14½ x 16½	12½ x 16½ x 19	79
R. C. A	13½ x 8½ x 21	15½ x 9 x 18½	72

b. The portable screen PH–358 (fig. 4) generally is employed in buildings used only occasionally for film showings. Roller screens, used in semipermanent installations, are suspended from the top edge of a frame and can be rolled up when not in use. Permanent type screens, similar to those used in post theaters, should be em-

ployed whenever possible, as this type of screen produces the best image.

3. Projectionist.—When showing training material, the projectionist must provide conditions favorable for maximum concentration, such as comfort of the audience, proper preparation of projection material, and the elimination of distractions and delays during projection. Therefore, each projectionist should be schooled by

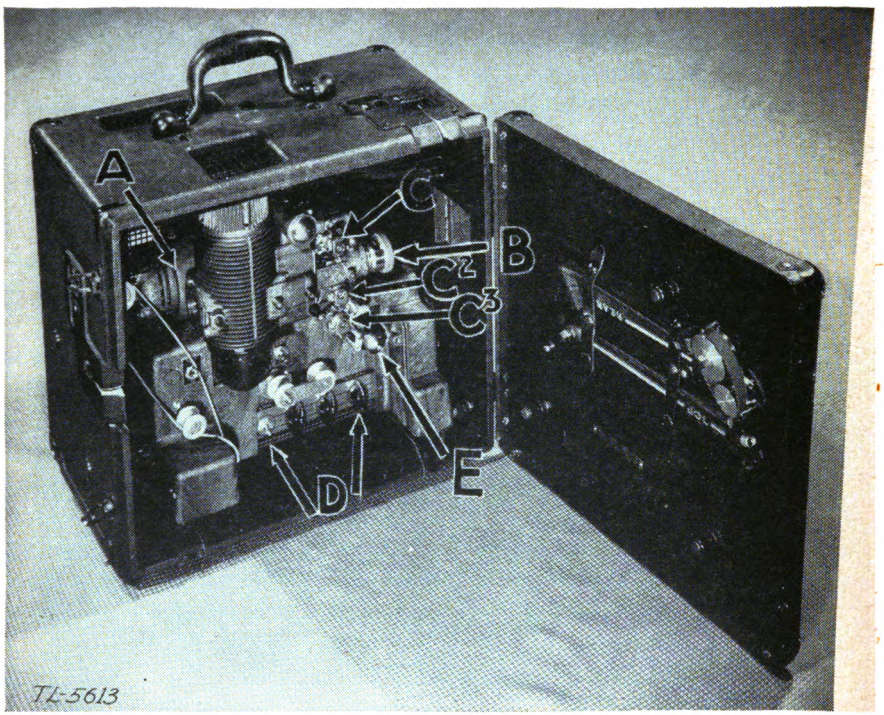


FIGURE 2.—Bell & Howell projector case open showing detachable reel arms in carrying position.

means of a definite training program. Upon satisfactorily completing such a program, he should be given a permit, U. S. Army Projection Operator's Permit (W. D., S. C. Form No. 190). In addition to the duties pertaining to actual exhibiting of film, the projectionist is responsible for the care, storage, and maintenance of both film and equipment.

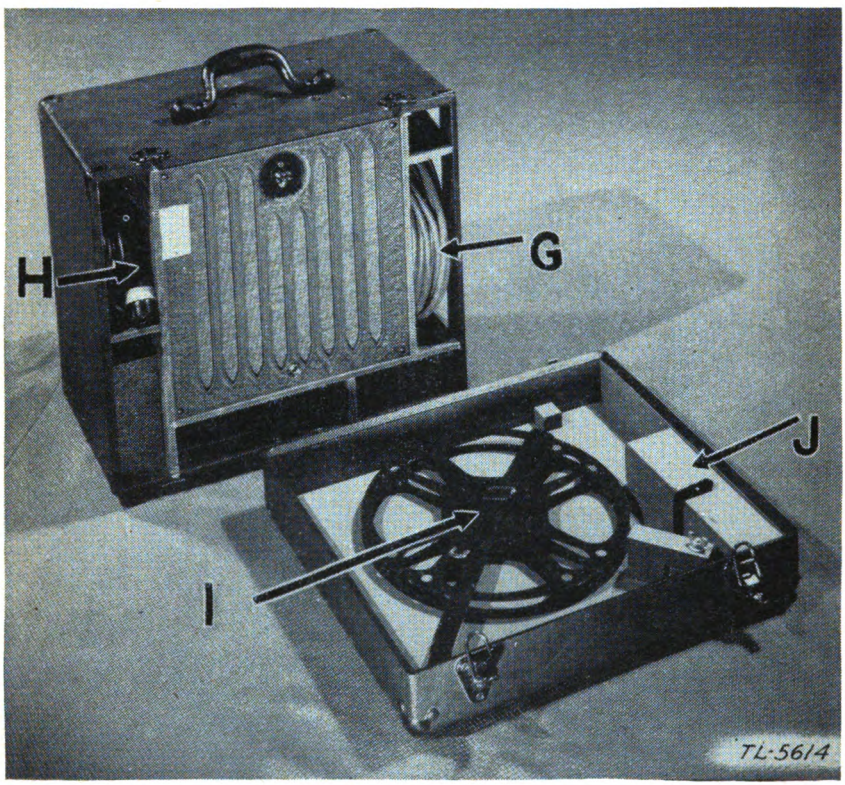


FIGURE 3.—Bell & Howell speaker case open.

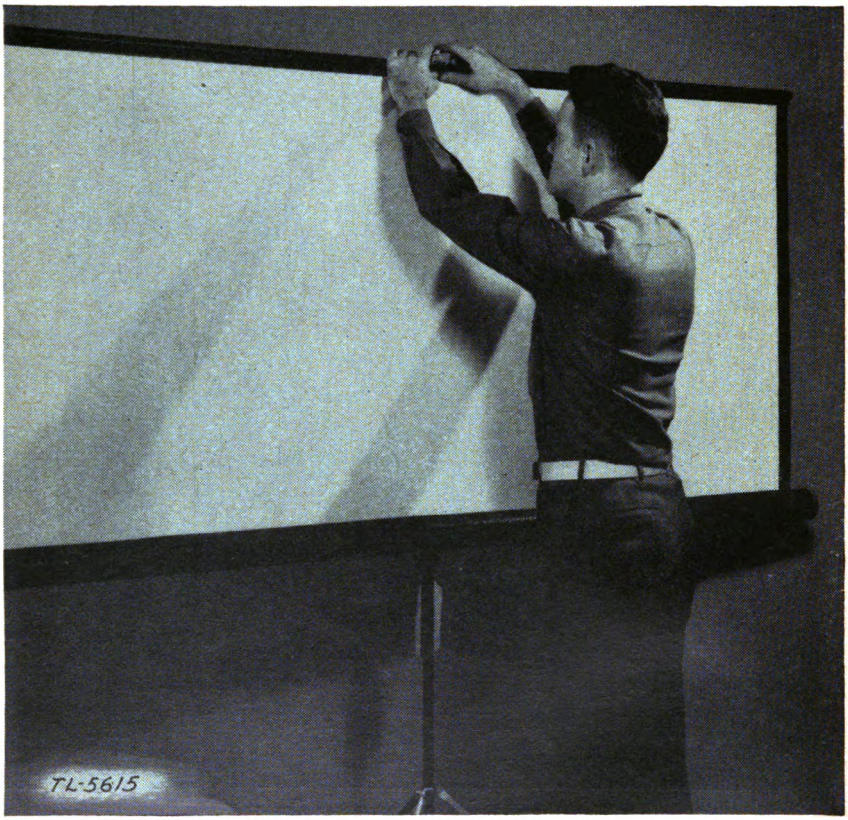


FIGURE 4.—Da-Lite portable screen ready for use.

SECTION II

EMPLOYMENT

4. Placing and unpacking equipment.—If the room to be used for projection is not especially constructed for film showings, the projectionist should survey the room so that the screen and projector may be placed to best advantage in relation to the most feasible seating arrangement for the audience. Provision must be made for covering windows. A power outlet must be located and an extension cord provided if necessary. After these points have been considered, place the speaker and projector at their respective locations.

5. Setting up projector for operation.—*a.* The Phonofilm, Bell & Howell, and R. C. A. projectors are fixed in their cases and are not removed for projection. The Ampro YA must be removed from its case. Following is the procedure for setting up the projector for operation:

(1) *Ampro YA* (fig. 5).—(*a*) Remove the projector from the case.

(*b*) Pull down feed-reel arm *K* and engage retaining pin.

(*c*) Pull down take-up arm *L* and engage retaining pin.

(*d*) Engage feed-pulley belt *M* and take-up belt *N*.

(2) *Phonofilm* (fig. 6).—The Phonofilm projector is prepared for operation in the same manner as the Ampro YA, except that it is not removed from its case.

(3) *Bell & Howell* (fig. 7).—(*a*) Open projector case door and remove feed arm and take-up arm.

(*b*) Place take-up arm *L* and feed arm *K* in position and fasten with thumbscrews O^1 and O^2. The lettering on each arm faces the projectionist's operating position.

(*c*) Engage feed pulley belt *M* and take-up pulley belt *N*.

(*d*) Open lens door.

(4) *R. C. A.* (fig. 8).—(*a*) Remove projector case cover.

(*b*) Open the speaker housing and remove feed arm and take-up arm.

(*c*) Place straight feed arm *K* in position on top of projector and fasten with thumbscrew O^1.

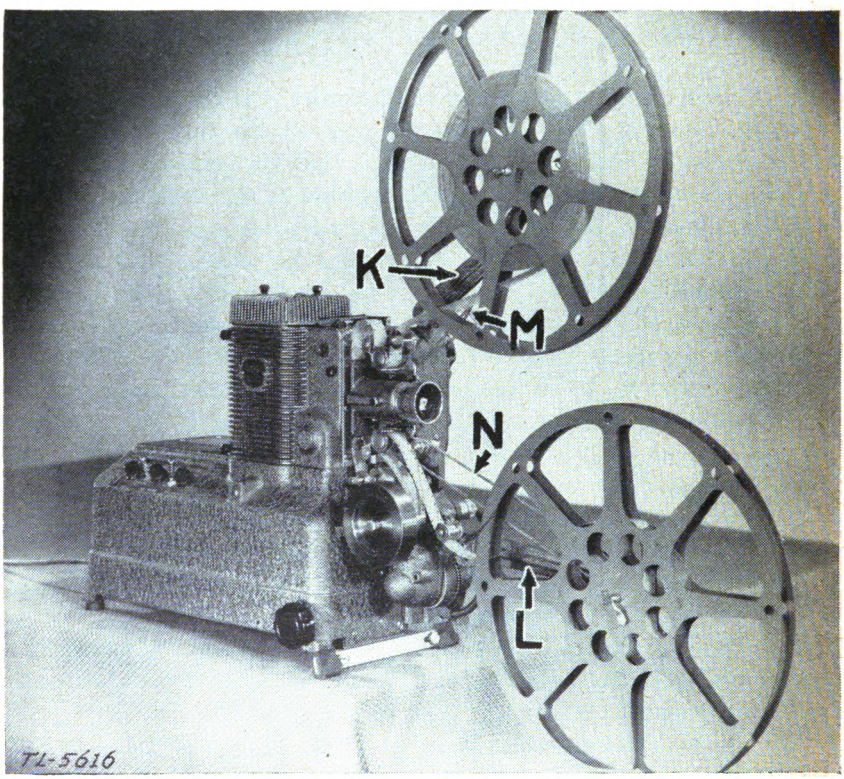


FIGURE 5.—Ampro YA projector ready for operation.

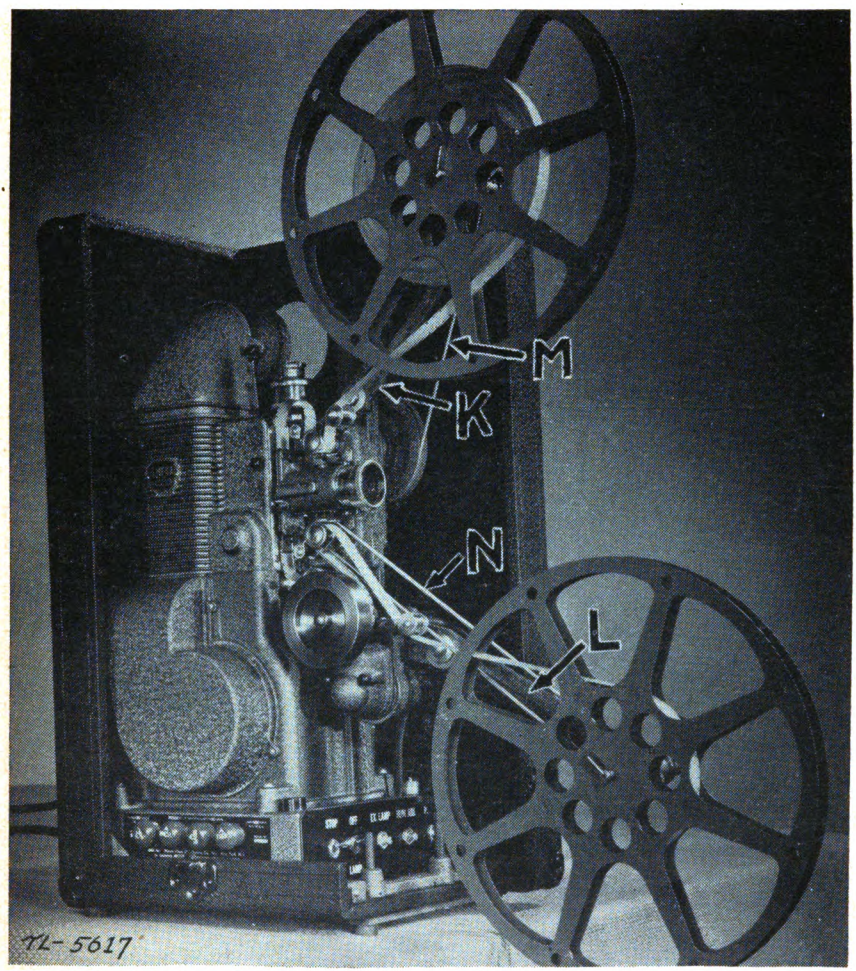


FIGURE 6.—Phonofilm projector ready for operation.

(*d*) Place curved take-up arm *L* in position on bottom of projector and fasten with thumbscrew O^2.

b. Place the projector on a table or stand approximately 4 feet high. It is necessary to place the Ampro YA and Phonofilm projectors on the forward edge of the table to prevent the take-up reel rubbing the table top. Place the projector at a distance which will give the proper image size. Appendix I gives the relation between the image size, distance to screen, and lens focal length.

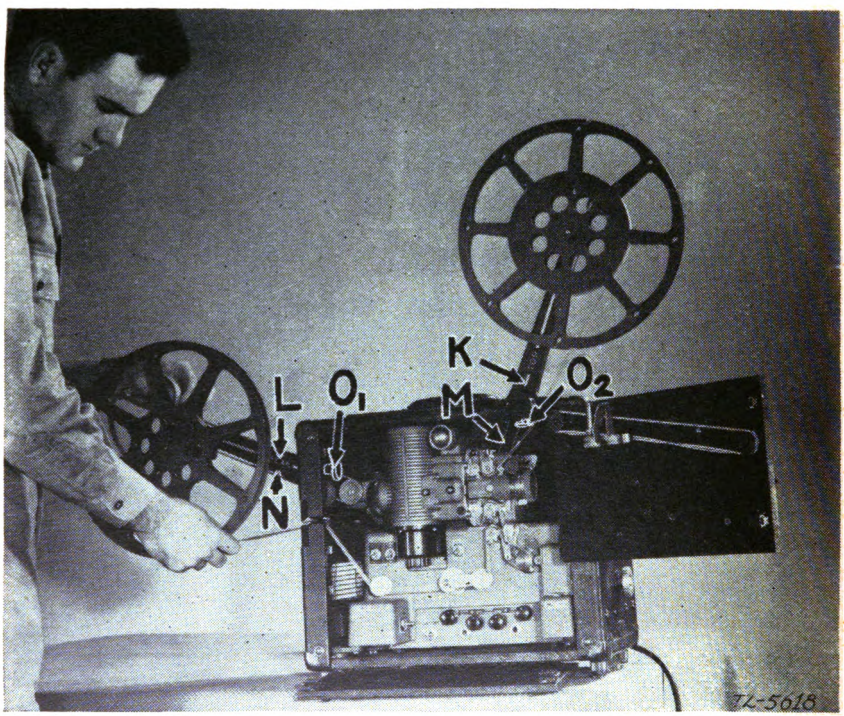


FIGURE 7.—Bell & Howell projector ready for operation.

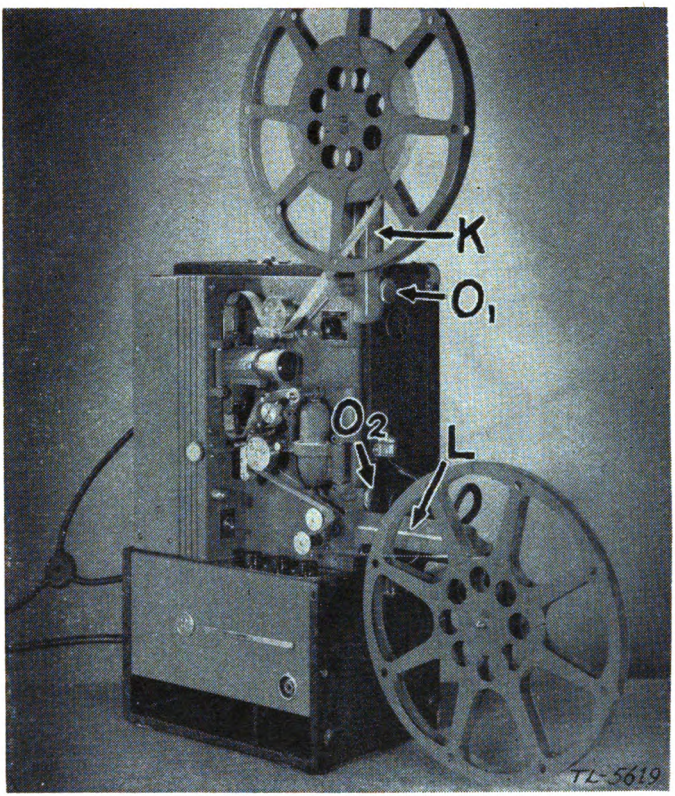


FIGURE 8.—R. C. A. projector ready for operation.

c. Turn elevator knob *G* (figs. 9 and 10) on front of base to raise or lower image on the screen. On the front of the R. C. A. model there are two knobs so that the image may be leveled also.

d. Place the speaker behind and at least 2 feet above the lower edge of the screen. Take off the speaker and grill covers and remove all spare parts from the speaker case.

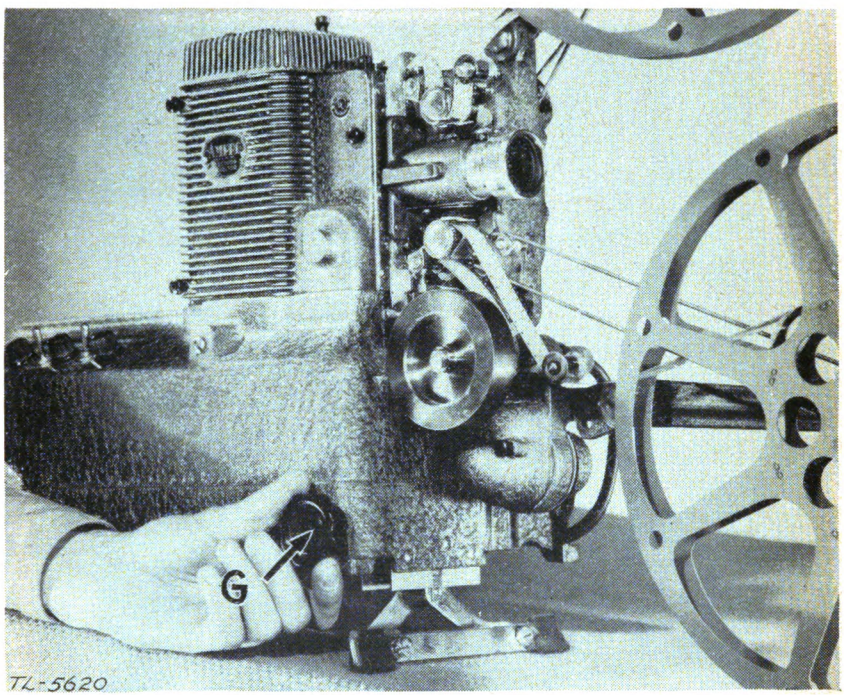


FIGURE 9.—Elevator knob on Ampro YA projector.

6. Electrical connections.—*a. Power.*—A 110-volt, 60-cycle power source must be available for operating the projector. If the power source is 220 volts, a voltage-reducing resistor or transformer must be used to obtain the necessary 110 volts. If the power supply is direct current, a rotary converter must be used to supply the projector with current of the proper voltage and frequency. Any special installations must have the approval of the post electrician.

b. Cables.—Cables should be laid in such a manner that the audience cannot trip over them. Cables may be hung overhead from rafters or tied high on supports with string.

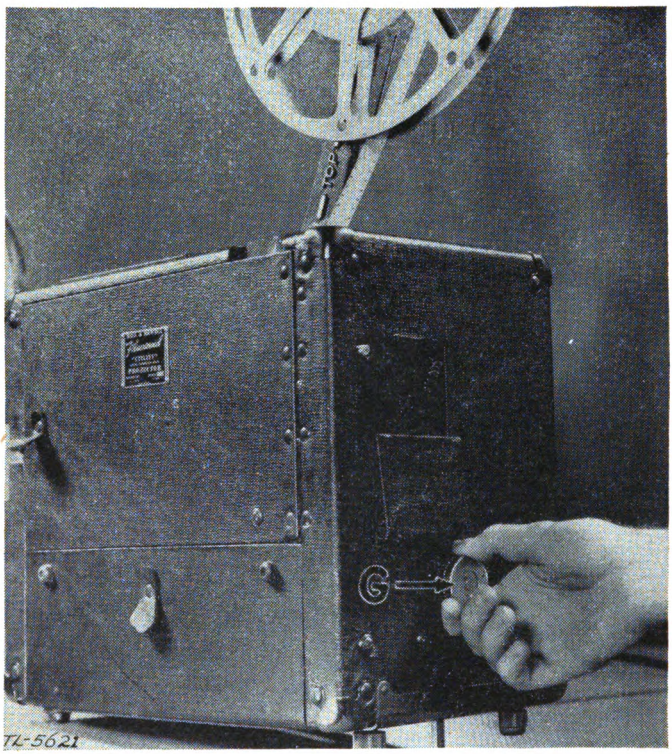


FIGURE 10.—Elevator knob on Bell & Howell projector.

c. Procedure.—The following procedures are for connecting the speakers and the projectors:

(1) *Ampro YA.*—Connect speaker to amplifier by inserting speaker cable plug into receptacle *S* (fig. 11) located at the rear of the projector. Plug the five-prong power cable into receptacle *Q*. Plug the other end of the power cable into power source receptacle.

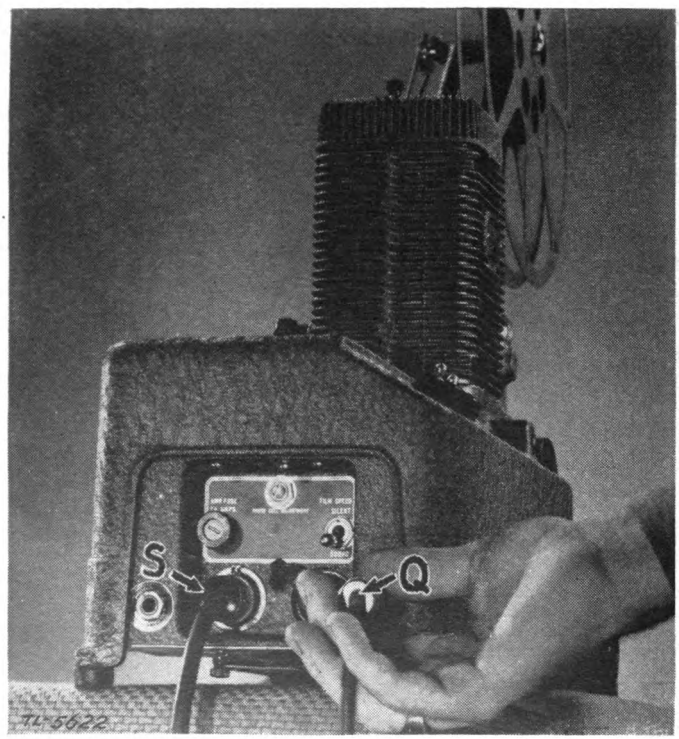


FIGURE 11.—Ampro YA electrical connections.

(2) *Phonofilm.*—The power connections for the Phonofilm are made in the same manner as the Ampro YA. All connections are to be made through nonduplicating plugs, so that the equipment cannot be incorrectly connected.

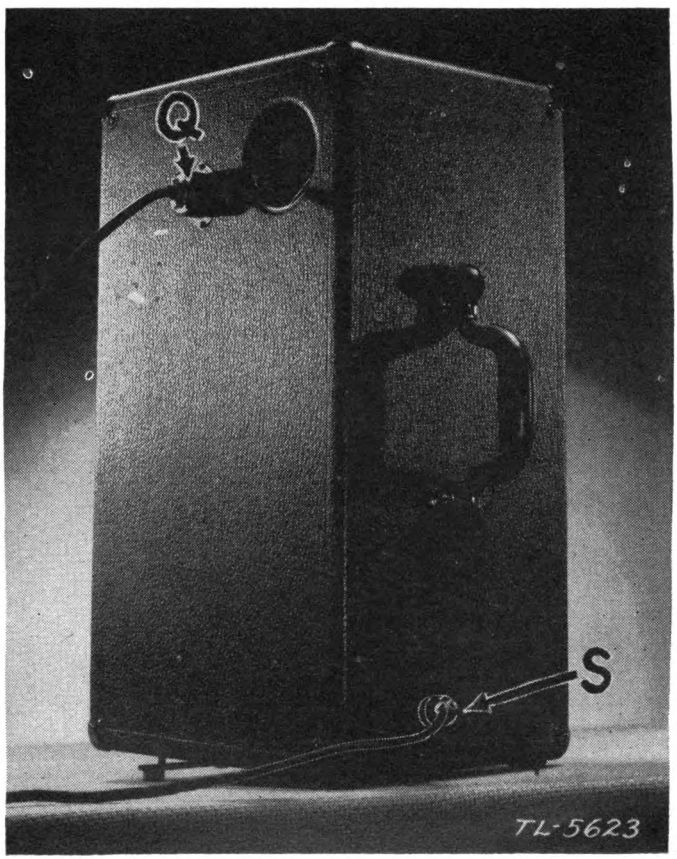


FIGURE 12.—Phonofilm electrical connections.

(3) *Bell & Howell.*—Insert the female plug of the *Y*-power cable in the upper receptacle *Q* (fig. 13). Insert the male plug in the lower (amplifier) receptacle *R*. Connect speaker to projector by inserting the speaker cable plug in receptacle *S* on projector. Insert power plug into power source receptacle.

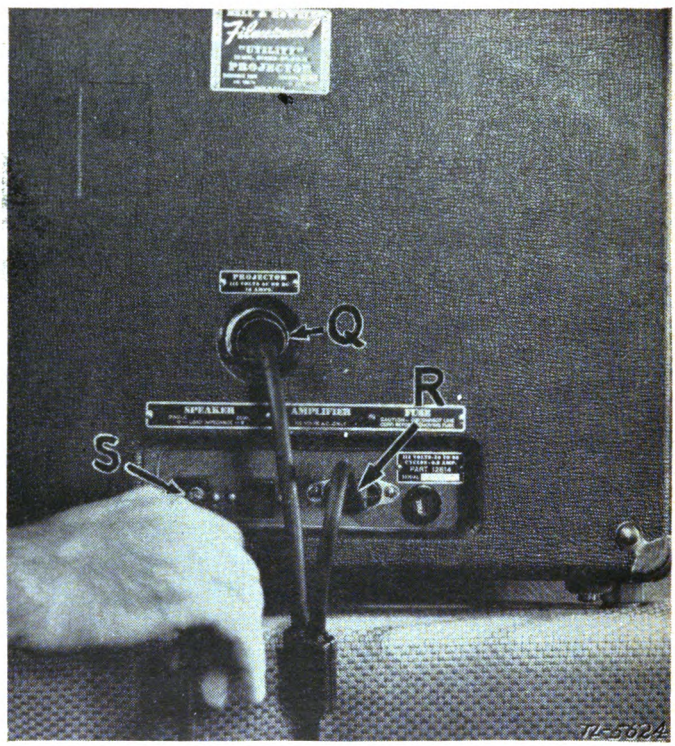


FIGURE 13.—Bell & Howell electrical connections.

(4) *R. C. A.*—Plug the *Y*-ends of the *Y*-power cable into the *Q* (AC–DC) and *R* (AC–ONLY) receptacles (fig. 14) located on the back of the projector. Insert the plug on the other end of the power cable in the power source receptacle. Connect speaker to projector by inserting speaker cable plug in receptacle *S*.

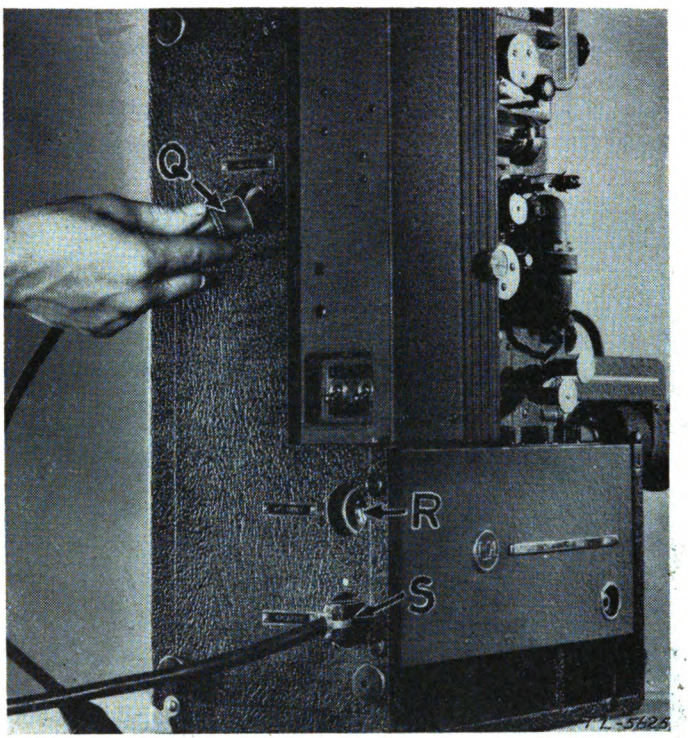


FIGURE 14.—R. C. A. electrical connections.

7. Threading film.—The method of threading film is the same for all projectors, with minor exceptions. Figures 15, 16, 17, and 18 show each projector completely threaded and each part labeled for easy identification. The following procedure is observed in threading each projector:

a. Slip the reel of film to be shown on feed reel arm ***K***, with the emulsion side toward the screen.

b. Reel off enough film to thread the projector. Pass film over roller T_1.

c. Release film guide on sprocket C_1, and engage sprocket teeth in film sprocket holes. Release film guide to retain film on sprocket.

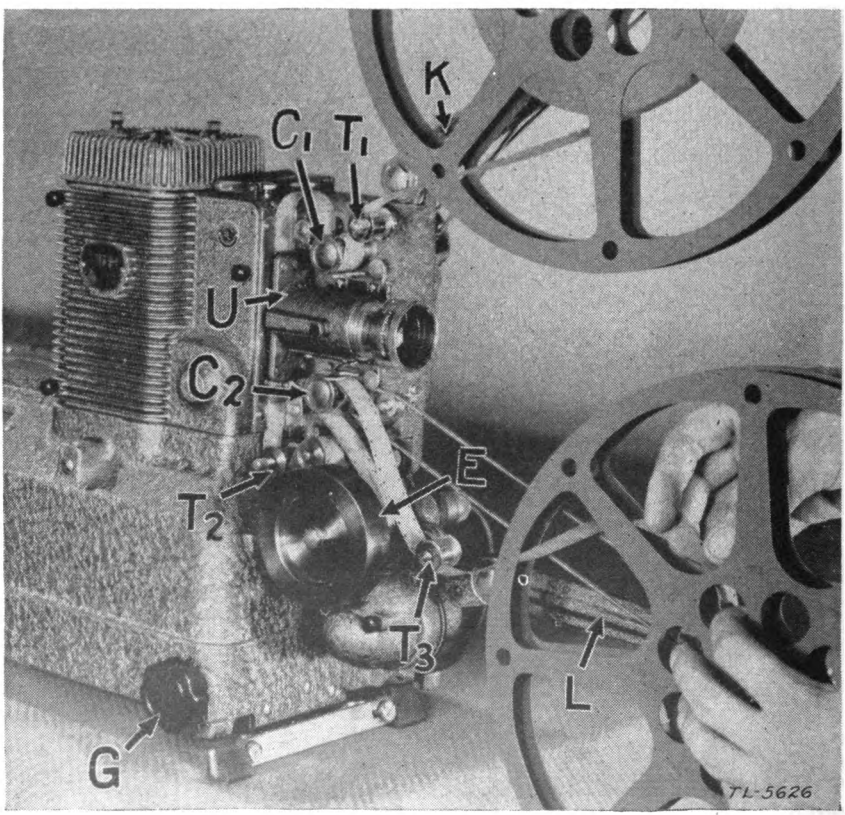


FIGURE 15.—Ampro YA projector with film threaded.

d. Open film gate *U* and, after forming a loop of about seven sprocket holes, place the film in the gate. Aline sprocket holes in film with teeth in gate. Close film gate.

e. Form another loop of about seven sprocket holes, then pass film over roller T_2, sound drum *E*, and through sprocket C_2.

f. Fasten the end of the leader to the take-up reel and rotate the reel to remove slack.

g. Turn the projector mechanism several revolutions by hand to make certain that the film is threaded properly through the sprockets and the film gate. The film loops on each side of the film gate must not be lost during projection.

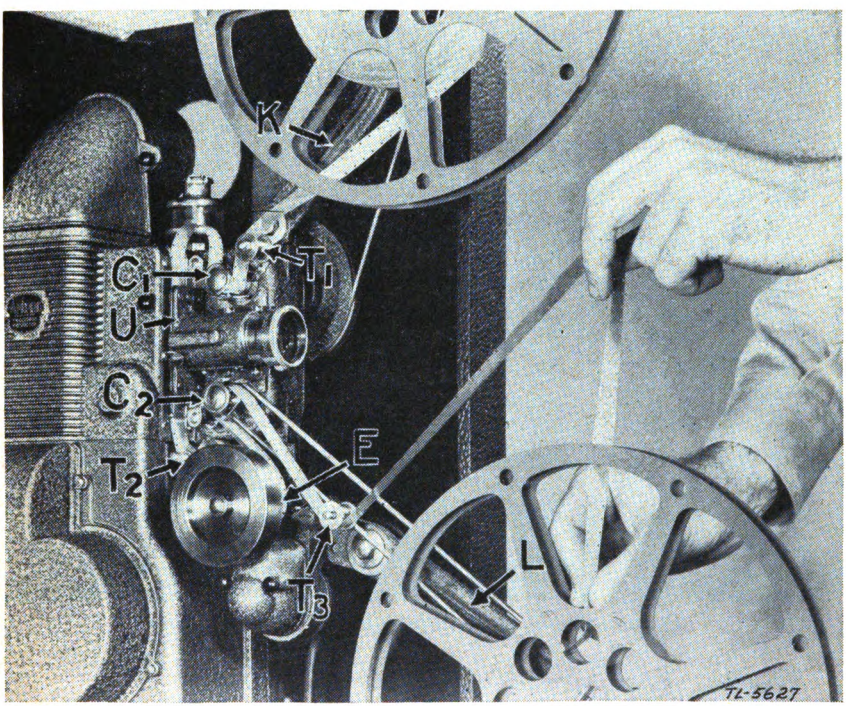


FIGURE 16.—Phonofilm projector with film threaded.

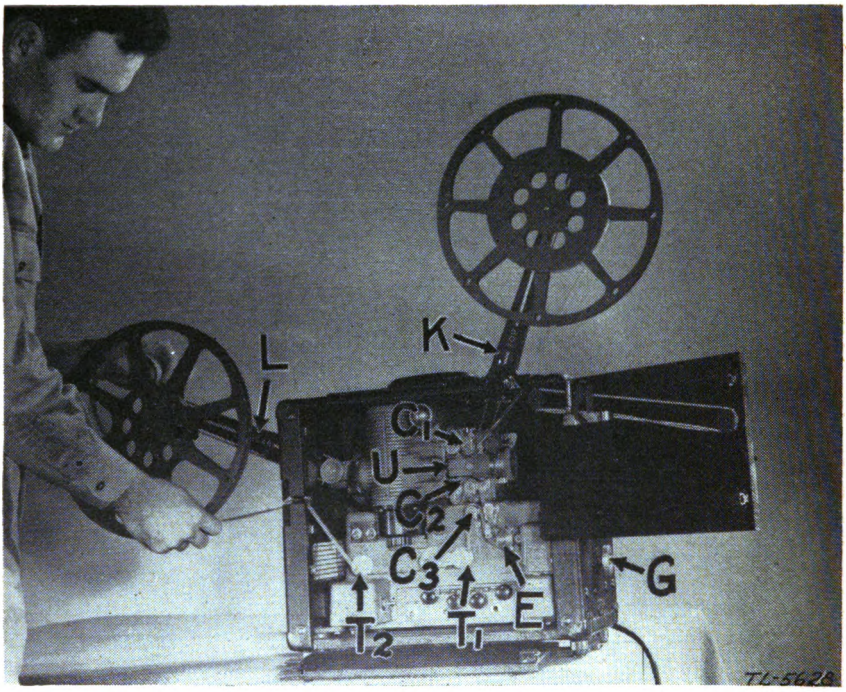


FIGURE 17.—Bell & Howell projector with film threaded.

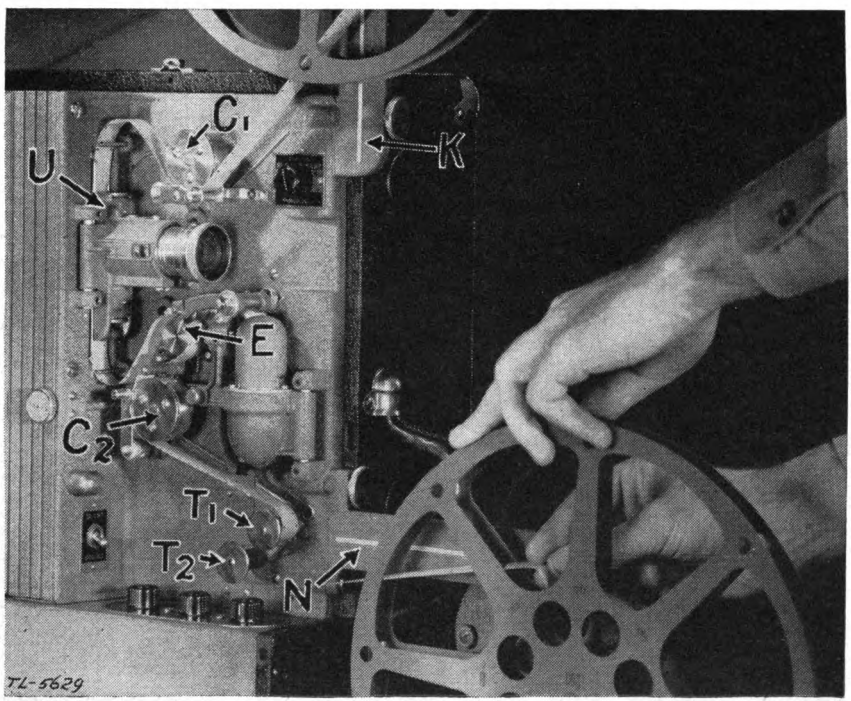


FIGURE 18.—R. C. A. projector with film threaded.

8. Projection.—*a. Preliminary.*—Before starting projection, turn on the amplifier and allow tube filaments 30 seconds to warm. Turn on projector lamp and motor, and gradually turn up sound after picture starts. Focus and frame as outlined in paragraphs 9 and 10. When the projector has been focused and framed, reverse the projector motor and rewind the film back to its beginning. The film is then ready for projection. Check the projector frequently to make certain that the sprocket teeth mesh with the film sprocket holes. Investigation should be made immediately of any strange noise in the projector. Noises are an indication of trouble. Under no condition should the

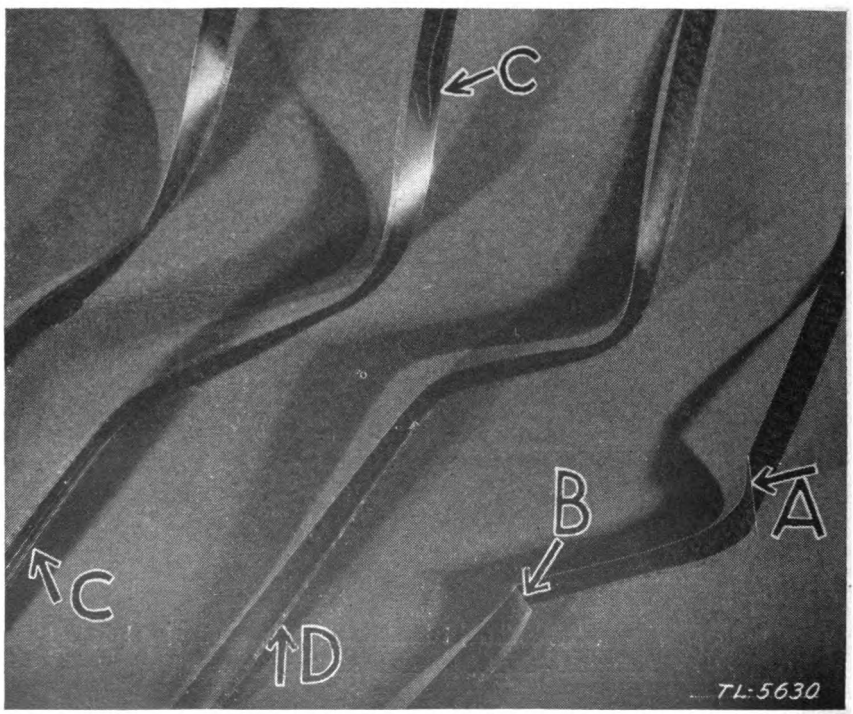


FIGURE 19.—Examples of film damage.

projector be left unattended while in operation. When trouble develops, immediate action is necessary to prevent damage to the film and equipment.

b. Film damage.—Film damage is caused by careless handling and careless projector operation. Figure 19 shows the four most common examples of film damage.

(1) Diagonal creasing *A* (fig. 19) is usually caused by film running over flange of feed sprocket, or by foreign material on sprocket shoe or guide roller.

(2) Horizontal creasing *B* is usually caused by stepping on film. Always be sure that film takes up properly during projection, so that it does not collect on the floor.

(3) Scratches on film *C* are usually caused by dirt in film gate or dragging pawl.

(4) Enlarged sprocket holes *D* are usually caused by dirty sprockets, lost loops, or excessive film gate tension.

(5) Sprocket holes on the sound track are made by incorrect threading or the use of sound film on a silent projector.

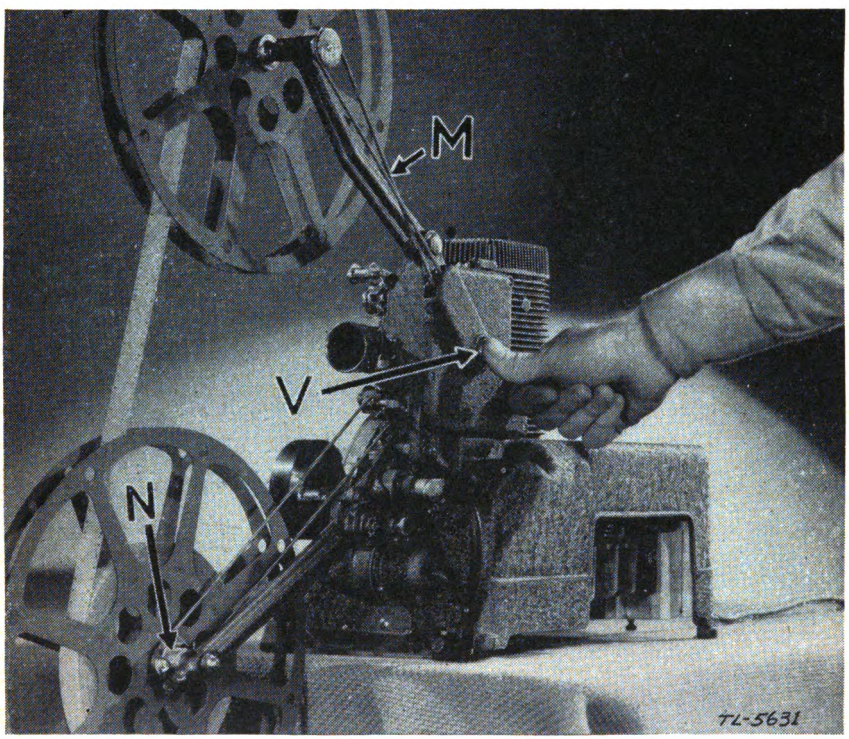


FIGURE 20.—Rewinding Ampro YA projector.

(6) If the film breaks, lap the broken end around the take-up reel, or repair temporarily, using adhesive tape. Mark the break by inserting a small piece of paper in the reel. Splice the film as soon as the showing is finished.

c. Rewinding.—(1) *Ampro YA.*—After completing projection, loop the free end of the film around the empty reel; disengage take-up belt at *N;* cross the belt *M* on the feed reel; hold in the rewind button *V;* and start the projector motor. (See fig. 20.)

(2) *Phonofilm.*—The Phonofilm is rewound in exactly the same manner as the Ampro YA. (See fig. 21.) The rewind button *V* is located on the large pulley, and must be held in during the rewinding operation.

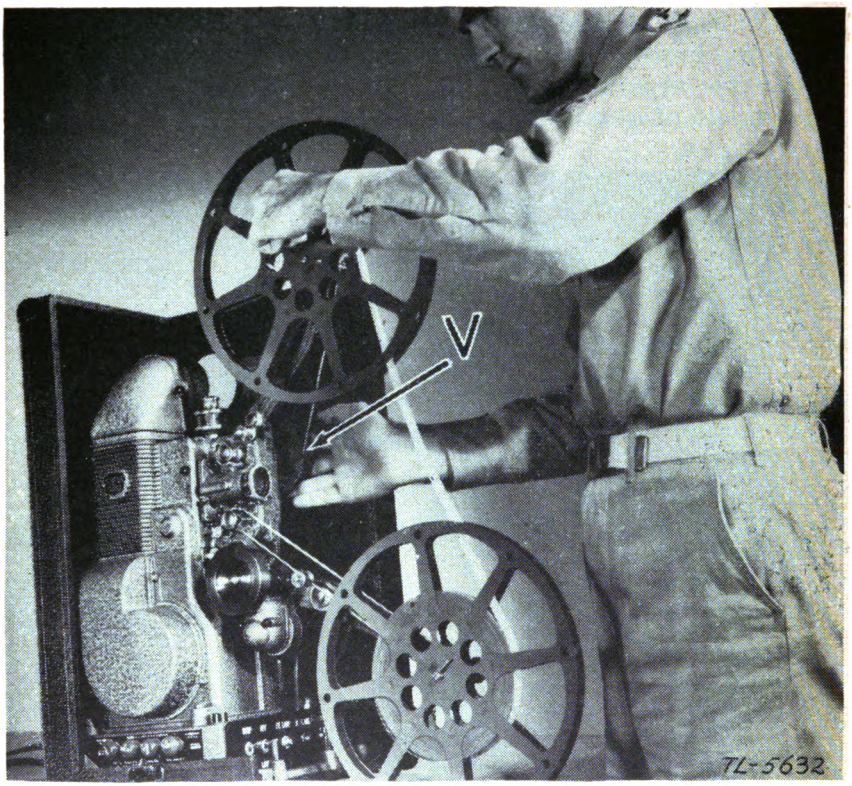


FIGURE 21.—Rewinding Phonofilm projector.

(3) *Bell & Howell.*—To rewind the Bell & Howell projector, change reels, loop the free end of the film around the empty reel, shift the clutch lever *V*, and start projector motor. (See fig. 22.)

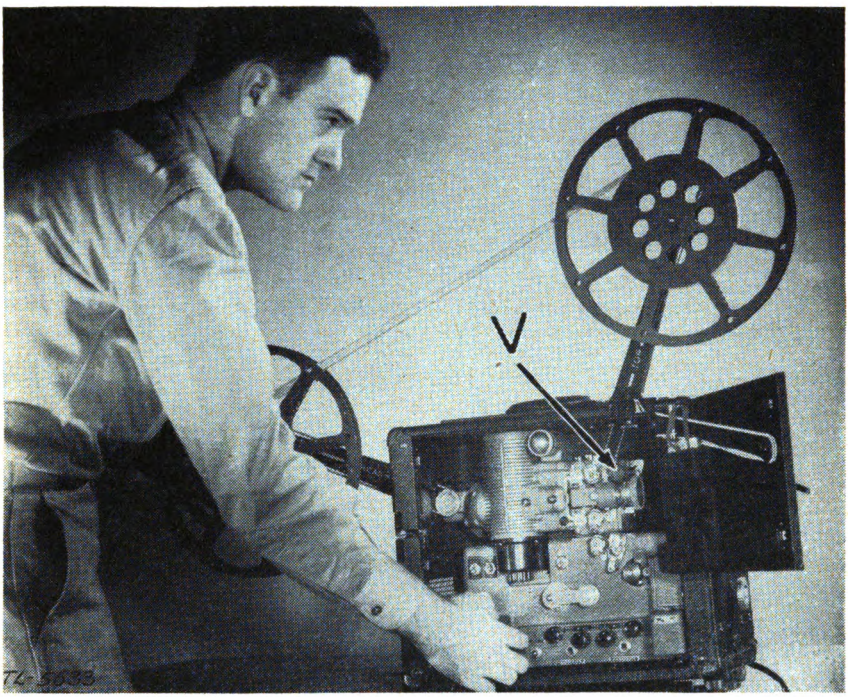


FIGURE 22.—Rewinding the Bell & Howell projector.

(4) *R. C. A.*—To rewind the R. C. A. projector, loop the free end of the film around the feed reel, turn rewind switch *V* to "Rewind" position, and start projector motor. (See fig. 23.)

FIGURE 23.—Rewinding R. C. A. projector.

9. Focusing image.—To focus the projected image on the screen, loosen setscrew *P* (fig. 24) on the lens housing, and rotate lens until the image on the screen is clear. Tighten the setscrew to hold lens in proper position.

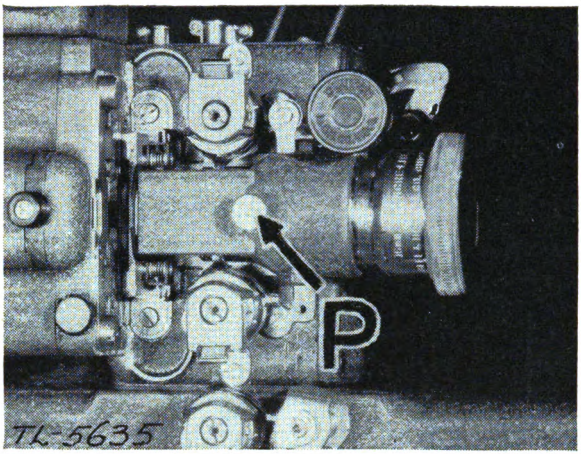


FIGURE 24.—Lens setscrew.

FIGURE 25.—Picture out of focus.

FIGURE 26.—Picture in focus.

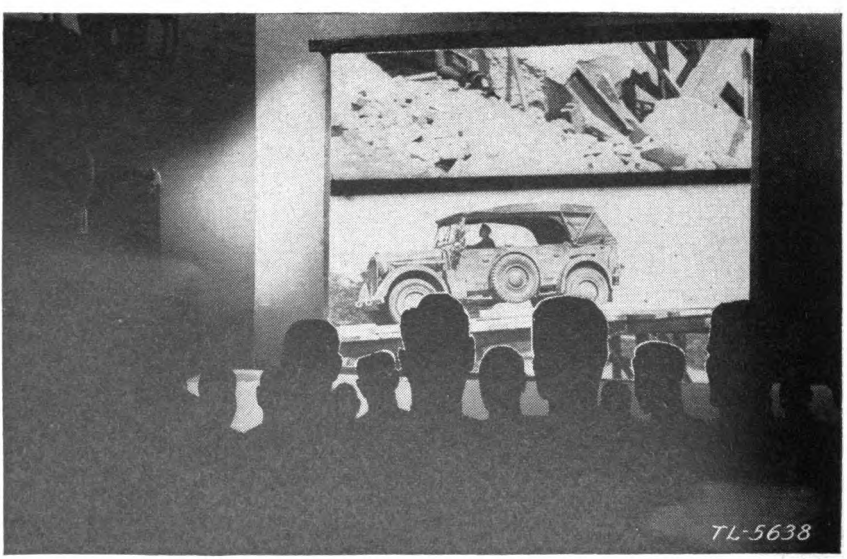


FIGURE 27.—Picture improperly framed.

10. Framing image.—For correct framing, each individual frame of the film must be centered properly at the film gate. When improperly framed, the image on the screen appears divided. To frame the image on the Bell & Howell and Phonofilm projectors, move the framing lever *Q* (fig. 28) up or down until the image appears nor-

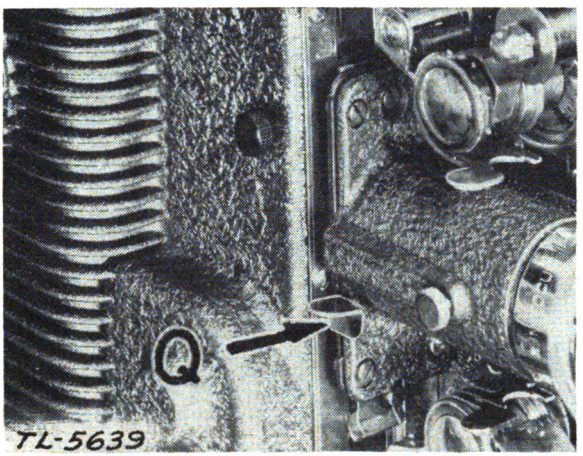


FIGURE 28.—Phonofilm framing lever.

mal. The Ampro YA and R. C. A. projectors are equipped with a framing screw *Q* (figs. 29 and 30) mounted on the projector mechanism body. To frame these projectors, turn screw until image appears normal.

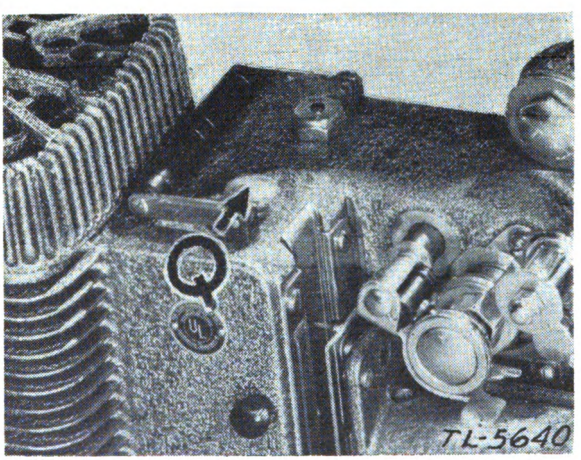


FIGURE 29.—Ampro YA framing screw.

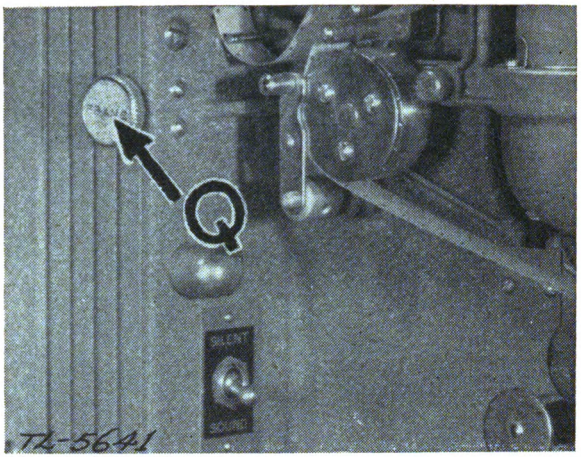


FIGURE 30.—R. C. A. framing screw.

11. Screening.—Rooms prepared for training film projection are shown in figures 31, 32, 33, and 34. Buildings in use as barracks make poor film theaters. Although seats are located in front, stoves interfere with projection and the acoustics are bad.

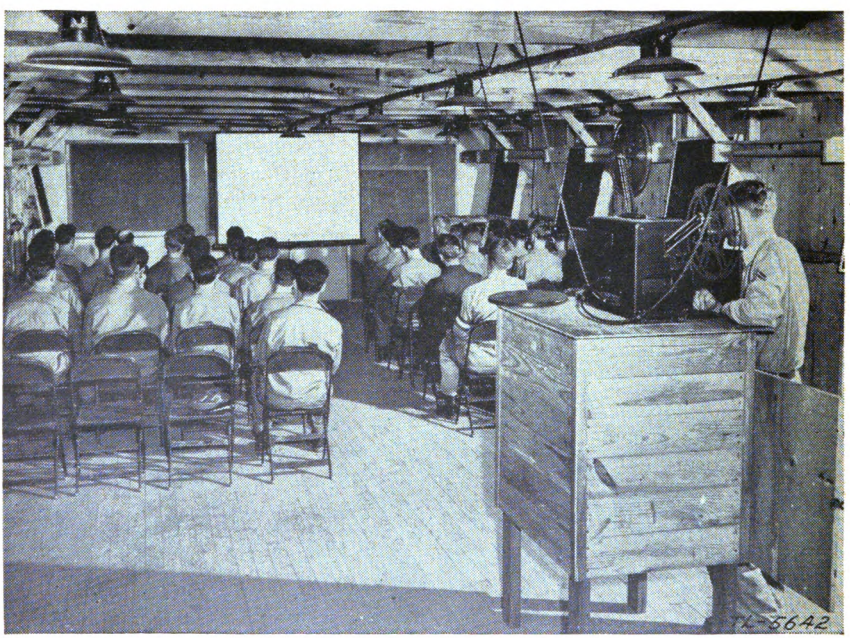


FIGURE 31.—Room prepared for projection.

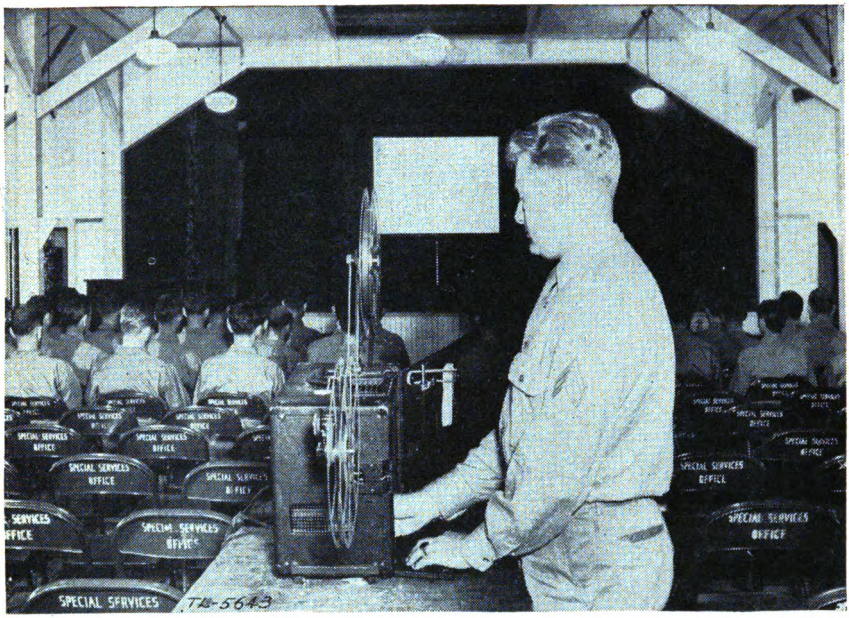


FIGURE 32.—Post theater ready for projection (from projectionist's position).

FIGURE 33.—Post theater ready for projection (from instructor's position).

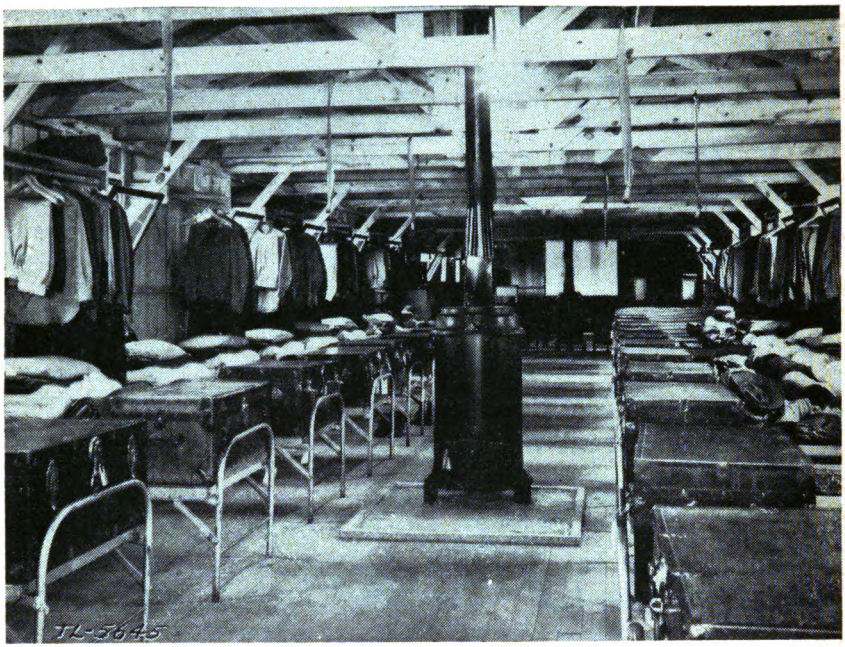


FIGURE 34.—Barracks used as theater.

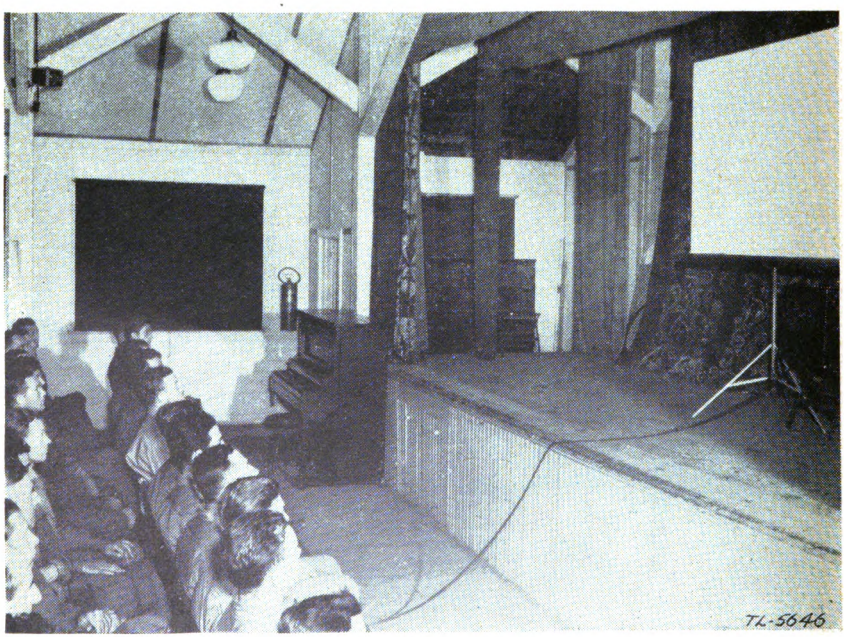


FIGURE 35.—Theater with properly placed screen.

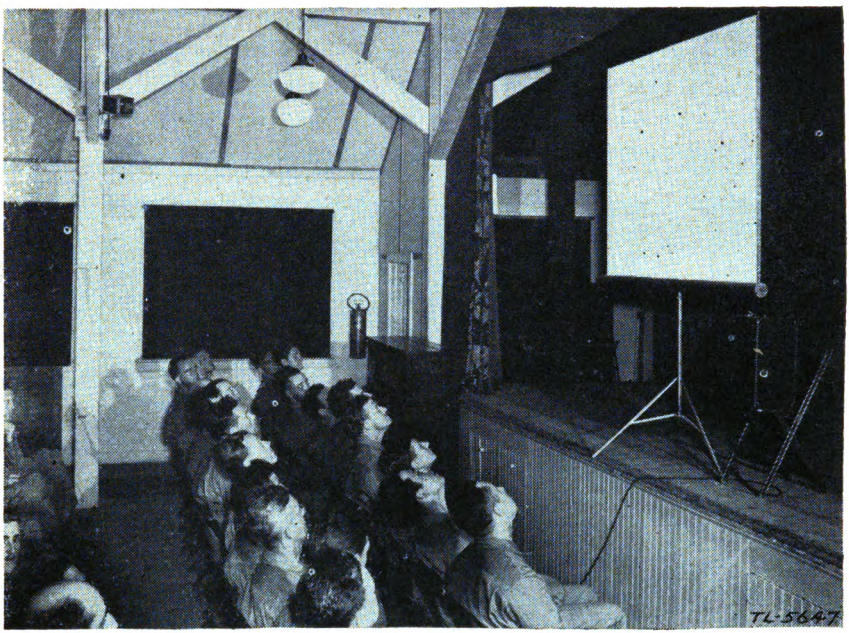


FIGURE 36.—Theater with improperly placed screen.

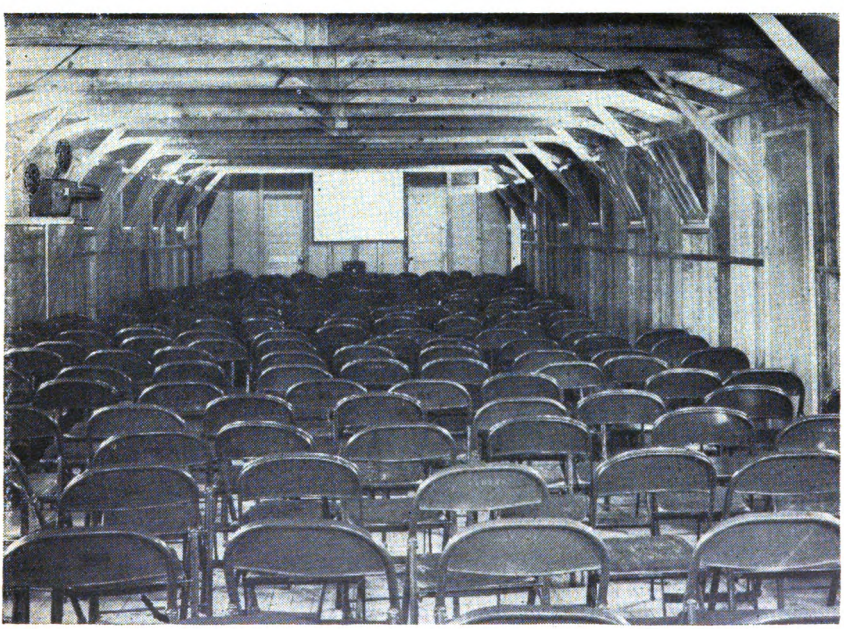


FIGURE 37.—Classroom used for projection.

514940°—43——3

a. Screen.—The screen should be at least 6 feet from the front row of seats and high enough to be seen easily by the entire audience.

(1) In barracks with low ceilings, the screen is visible to only a portion of the audience. The projector may be mounted on a side shelf when aisle arrangement is not practicable. (See fig. 37.)

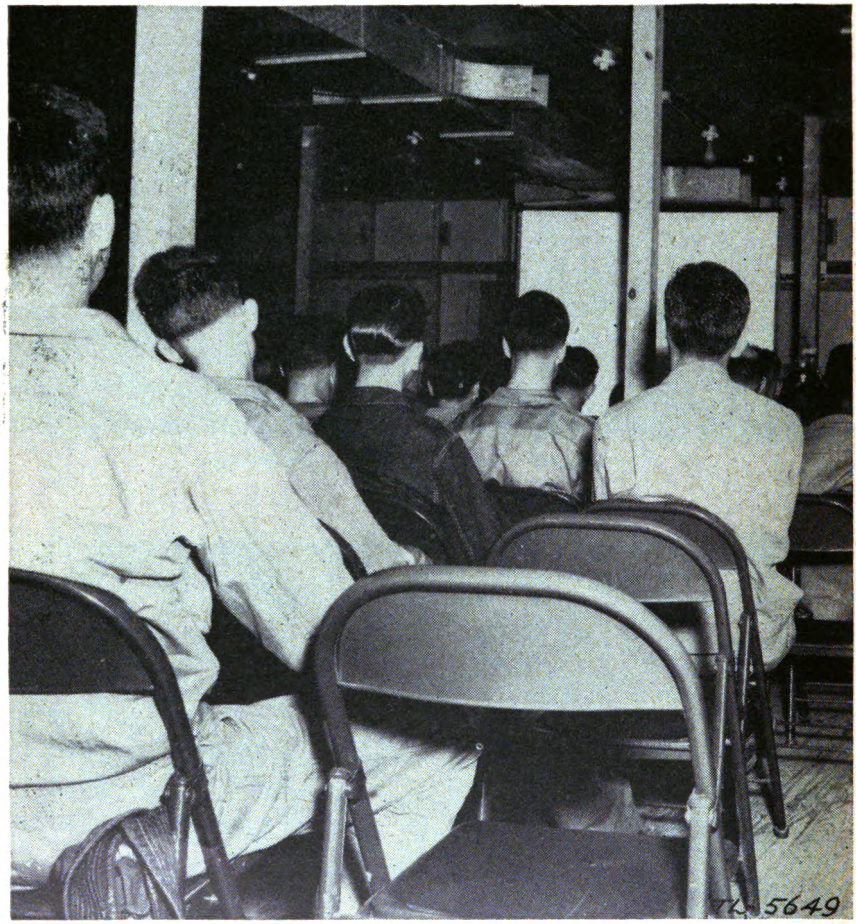


FIGURE 38.—Posts obstruct view of screen.

(2) In rooms containing posts, the seats outside the line of posts should not be used. Posts block the view from side seats. (See fig. 38.)

b. Window shading.—(1) Blackout curtains, canvas, or blankets may be used to shade windows temporarily. Rooms used permanently for film showings may be darkened by painting the windows black. Rear windows need not be shaded. Windows hinged at the

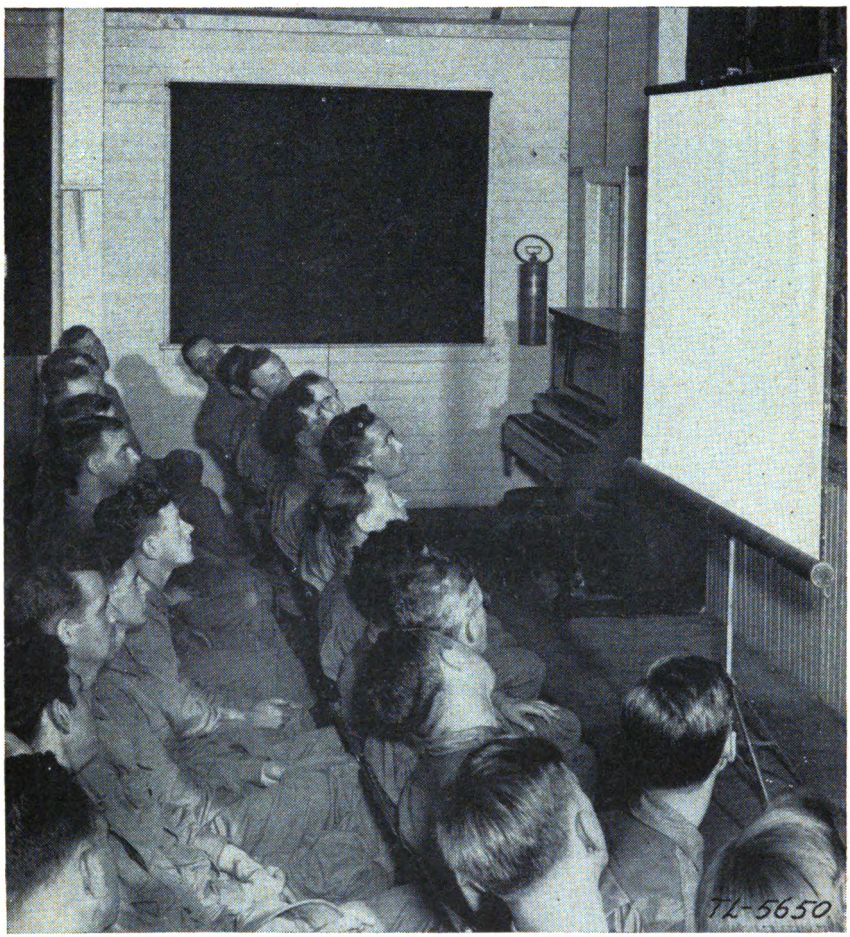


FIGURE 39.—Men on row ends must twist their heads to see the screen.

bottom may be opened for ventilation if triangular blinders are attached to the casement and ceiling space immediately overhead is painted black to prevent light reflection. (See fig. 42.)

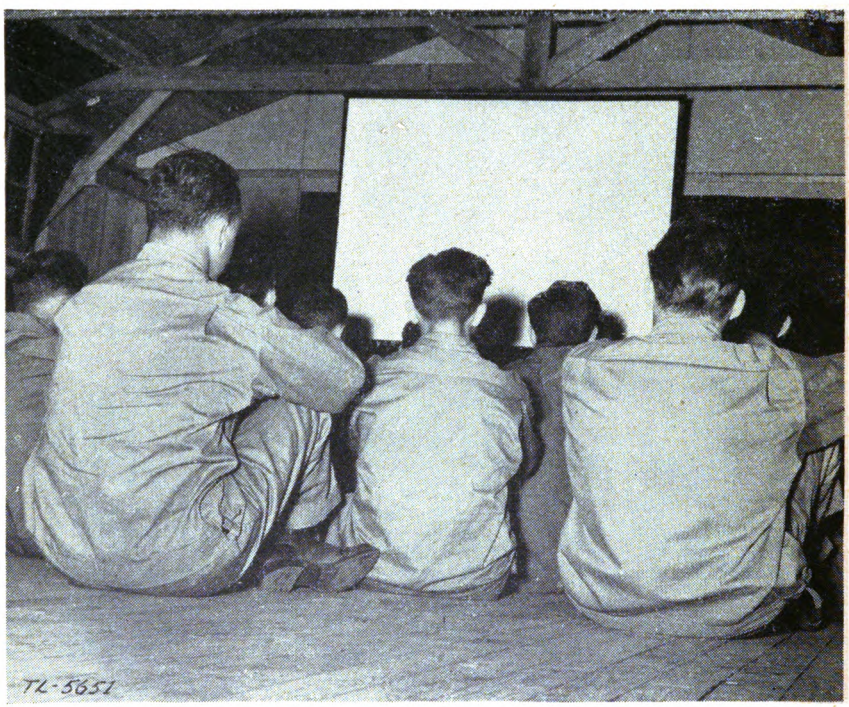


FIGURE 40.—Sitting on floor is uncomfortable and view of the screen is blocked.

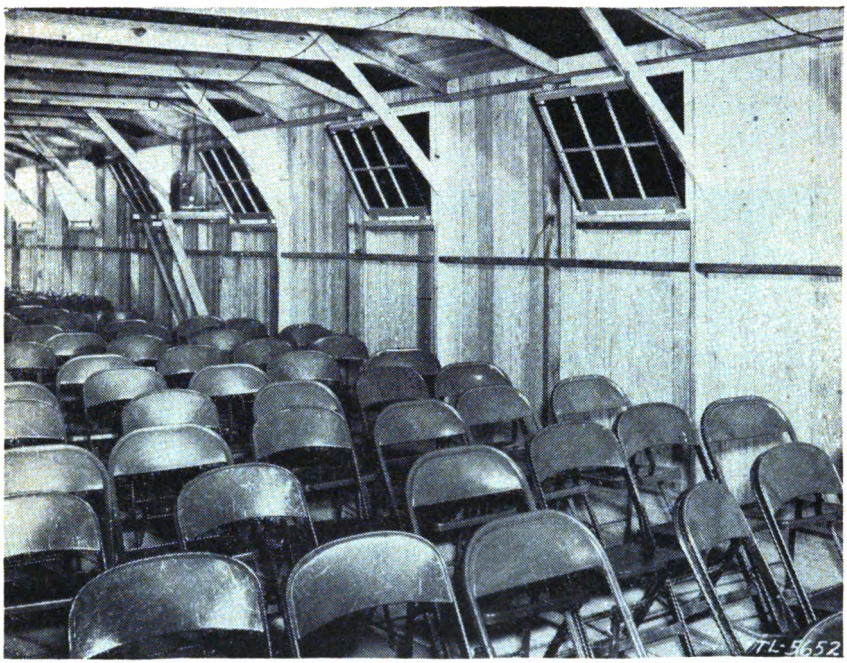


FIGURE 41.—Windows painted black to exclude light.

FIGURE 42.—Painted windows with ventilation blinders.

(2) When rooms are not permanently set up for screening, detachable frames with shades of tar paper or other opaque material may be made. (See figs. 43, 44, and 45.) A cleat and slot are used for attaching shade to window frame. Opening at the bottom of a shade provides ventilation.

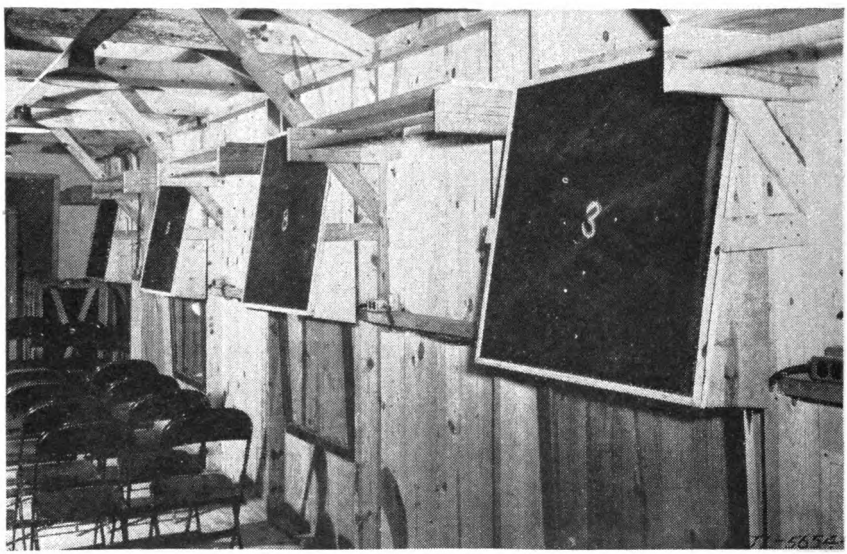


FIGURE 43.—Tar paper shades.

(3) Detachable plywood panels that slide in horizontal slots will shade windows effectively, but shut off ventilation which must be provided from some other source. (See fig. 45.)

(4) Ordinary window shades may be used if weighted or fastened at the bottom to prevent blowing.

c. Acoustical adjustments.—Large rooms may require acoustical adjustments to reduce resonance. Blankets placed against large flat walls reduce reverberation. Sound values and tone qualities will differ for empty and full rooms.

FIGURE 44.—Attaching tar paper shades.

FIGURE 45.—Plywood shade.

Section III

CARE, HANDLING, AND MAINTENANCE

12. Packing and moving equipment.—*a.* Careful handling of the equipment, when packing, unpacking, and installing it, is the greatest single factor in trouble-free operation.

b. When a showing is completed, the projectionist should pack all equipment and accessories neatly and orderly in their carrying cases. Power and speaker cables should be coiled and not folded.

c. Care must be exercised in lifting, stowing in vehicles, and transporting equipment.

13. Storing film.—Proper storage facilities are essential to assure long life for film. Metal or wooden racks, vaults, or open cases are suitable for storing film. Figures 49 to 52, inclusive, show the various methods and equipment used in storage.

14. Cleaning.—*a.* Use soft, lintless cloth or lens tissue to keep lens free from dust or dirt. (See fig. 53.)

b. Use a brush and cleaning fluid to free film channels, rollers, and sprockets of oil, gum, and dirt. Knives or other metal objects should not be used in cleaning.

c. The projector should be cleaned thoroughly by qualified technicians at least once a year.

15. Oiling.—Lubrication is most essential to proper operation of the projector. Each projector has an adequate oiling system and should be lubricated with the oil specified by its manufacturer. Lubricate sprockets and roller bearings with one drop of oil after every 4-hour period of operation. Do not use too much oil. Do not oil a projector when it is loaded with film.

a. Ampro YA.—Lubricate point *A* (fig. 56), rewind-button oil hole, and reel shafts after each 4 hours of use. Use *one* drop of oil at each point.

b. Phonofilm.—Keep oil reservoir *A* (fig. 57) at least half full at all times. This provides complete lubrication for the projector.

c. Bell & Howell.—Place one drop of oil in cups A^1 and A^2 (fig. 58) after every 4-hour period of operation. Oil A^3 with one drop every 16 hours. Saturate sprocket felts B^1, B^2, and B^3 every 3 months.

FIGURE 46.—Packing equipment for moving.

FIGURE 47.—Handle projection equipment with care.

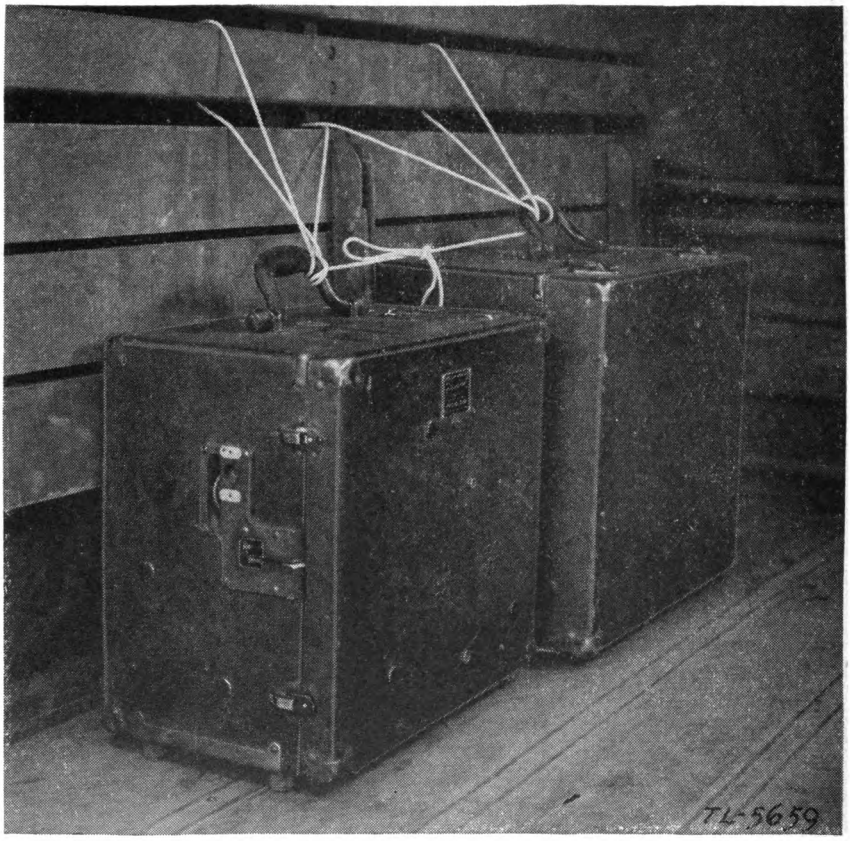


FIGURE 48.—To prevent damage, tie equipment level and orderly in truck.

FIGURE 49.—Special metal racks for storing film.

FIGURE 50.—Wooden cases for storing film.

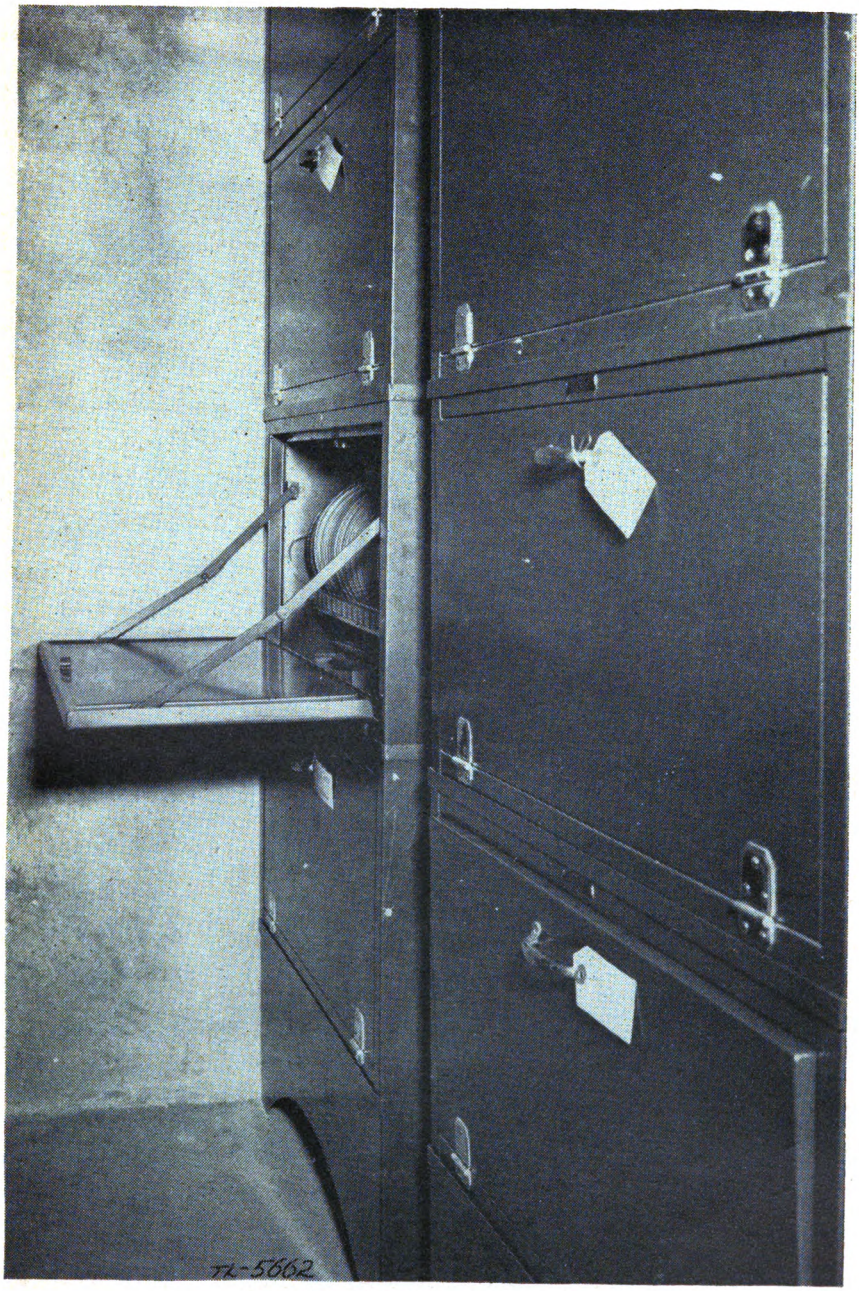


FIGURE 51.—Metal film storage vaults.

FIGURE 52.—Wooden racks for storing film.

FIGURE 53.—Cleaning lens with tissue.

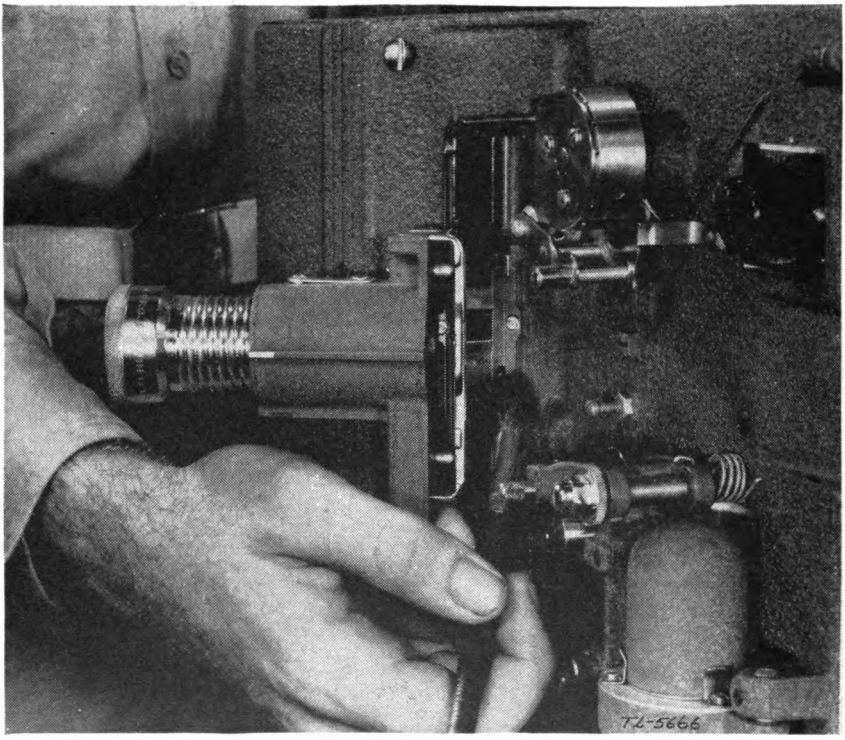


FIGURE 54.—Cleaning the film gate.

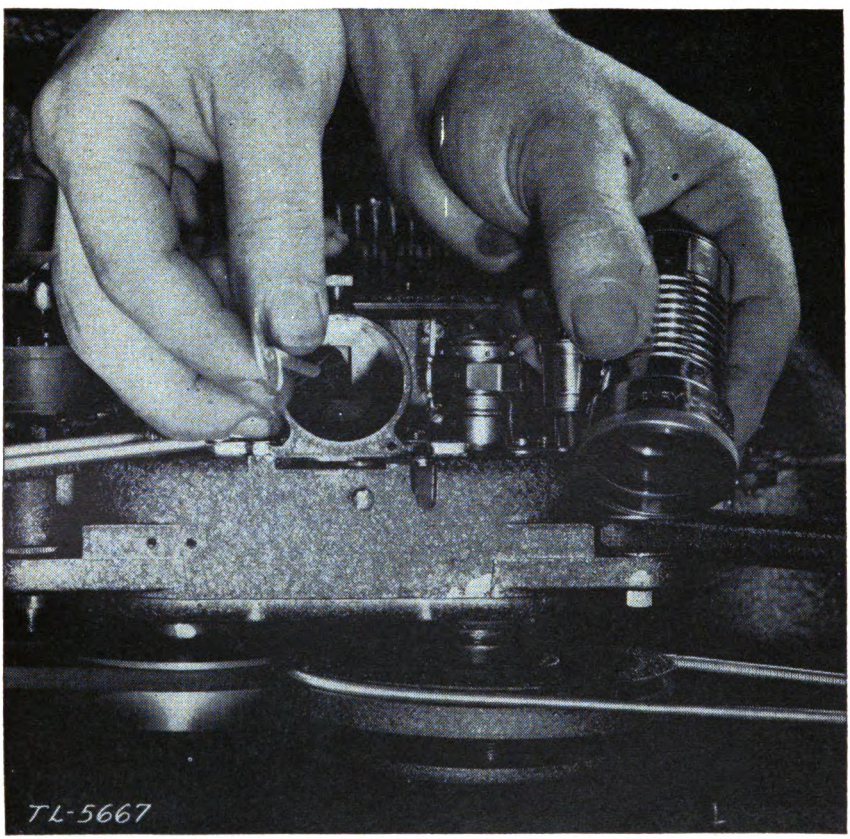


FIGURE 55.—Cleaning the aperture.

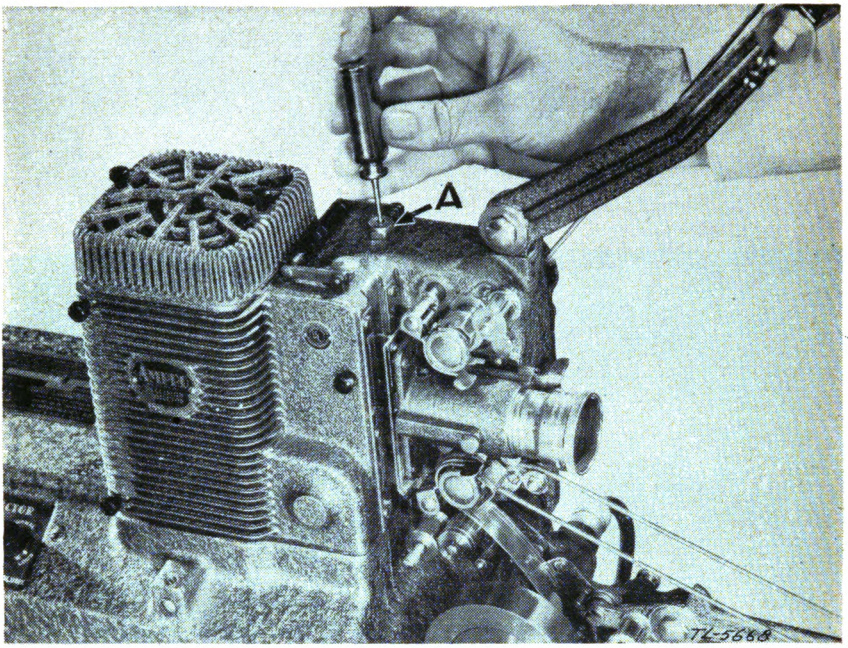


FIGURE 56.—Oiling system of Ampro YA projector.

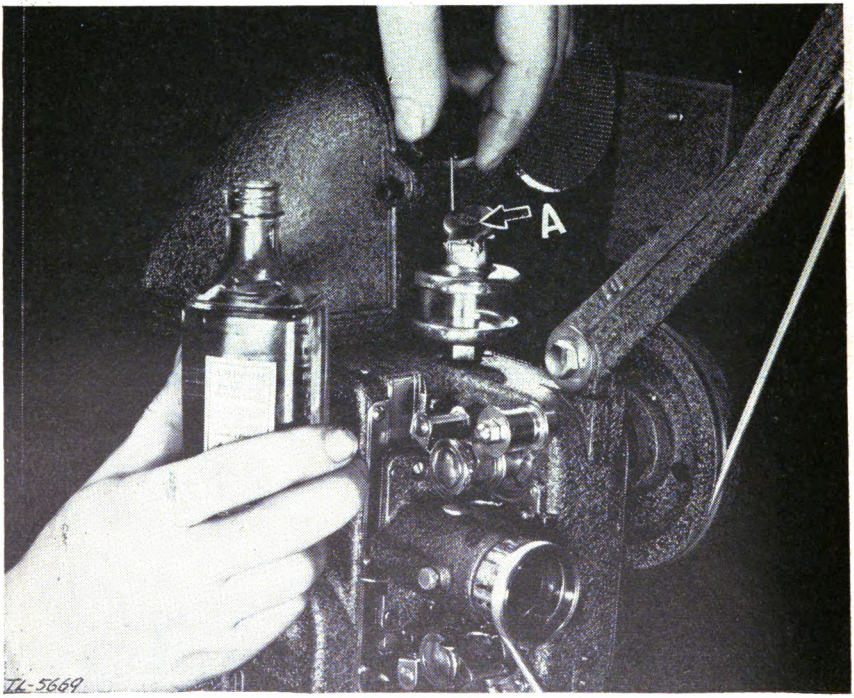


FIGURE 57.—Oiling system of Phonofilm projector.

d. R. C. A.—Before each showing, place five drops of oil in channel *A*. This provides complete lubrication for all moving parts. (See fig. 59.)

16. Replacing and repairing.—Replace projector lamps when they burn out or when the screen image becomes dim. Exciter lamps have a long life and will usually require replacement only if damaged by rough treatment or overvoltage.

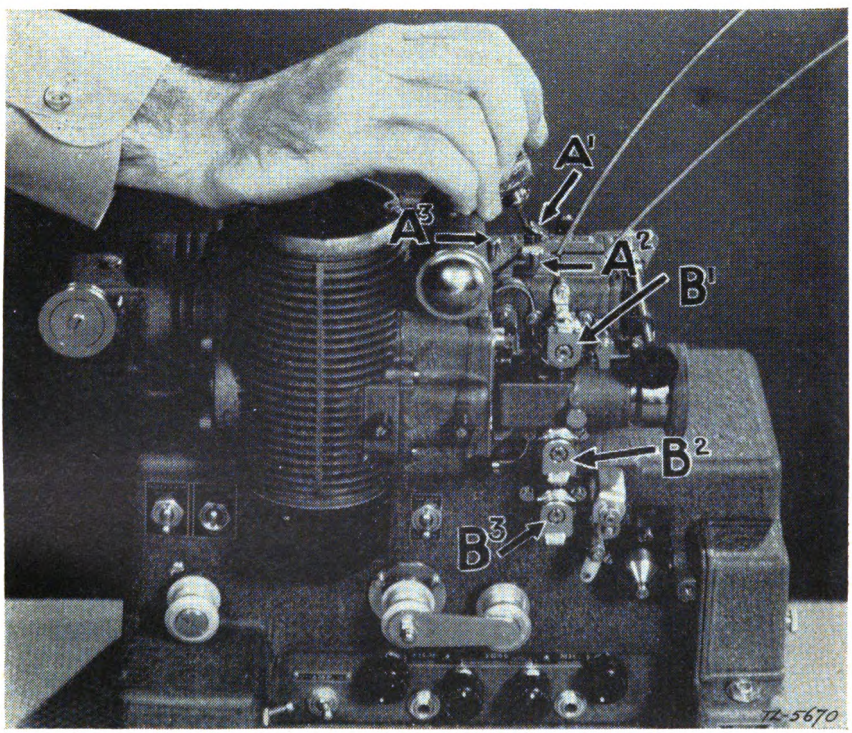


FIGURE 58.—Oiling system of Bell & Howell projector.

a. Ampro YA.—(1) To replace the projector lamp, remove the two cover nuts and lift off the housing cover. Rotate the lamp to the left and lift out. Wipe fingerprints from the new lamp and position the new lamp and the cover. (See fig. 60.)

(2) To replace the exciter lamp, remove the two cover nuts and the lamp cover. Rotate the lamp to the left and remove. Position the new lamp and the cover. (See fig. 61.)

b. Phonofilm.—Use the same procedure as in *a* above in replacing lamps in the Phonofilm. (See figs. 62 and 63.)

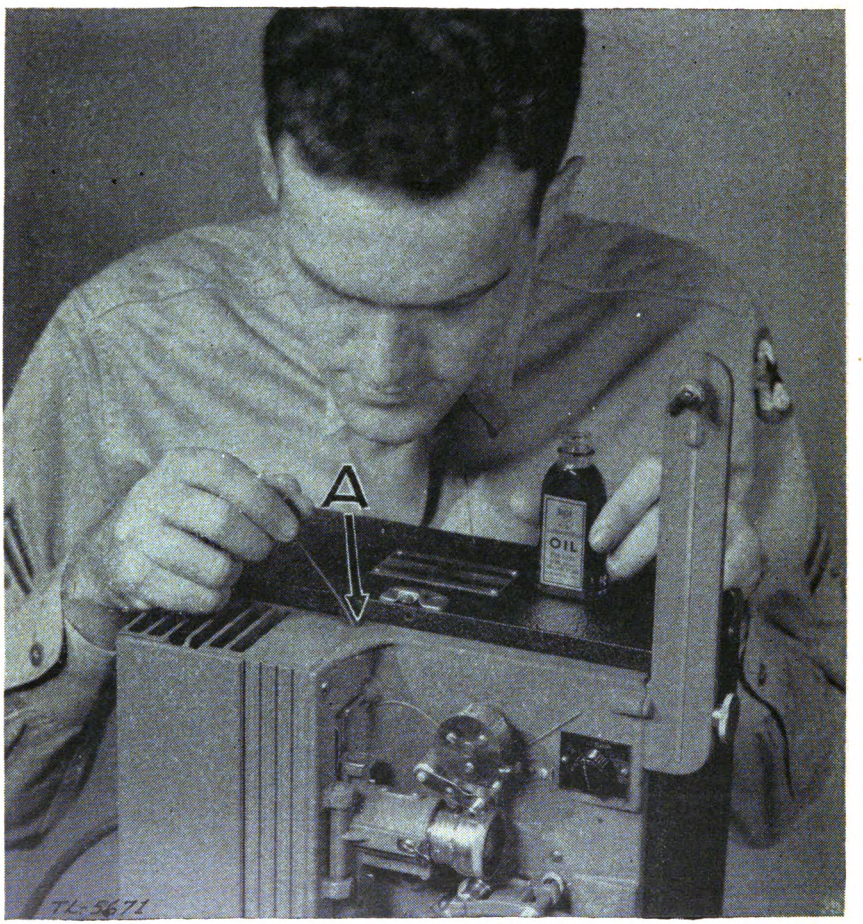


FIGURE 59.—Oiling system for R. C. A. projector.

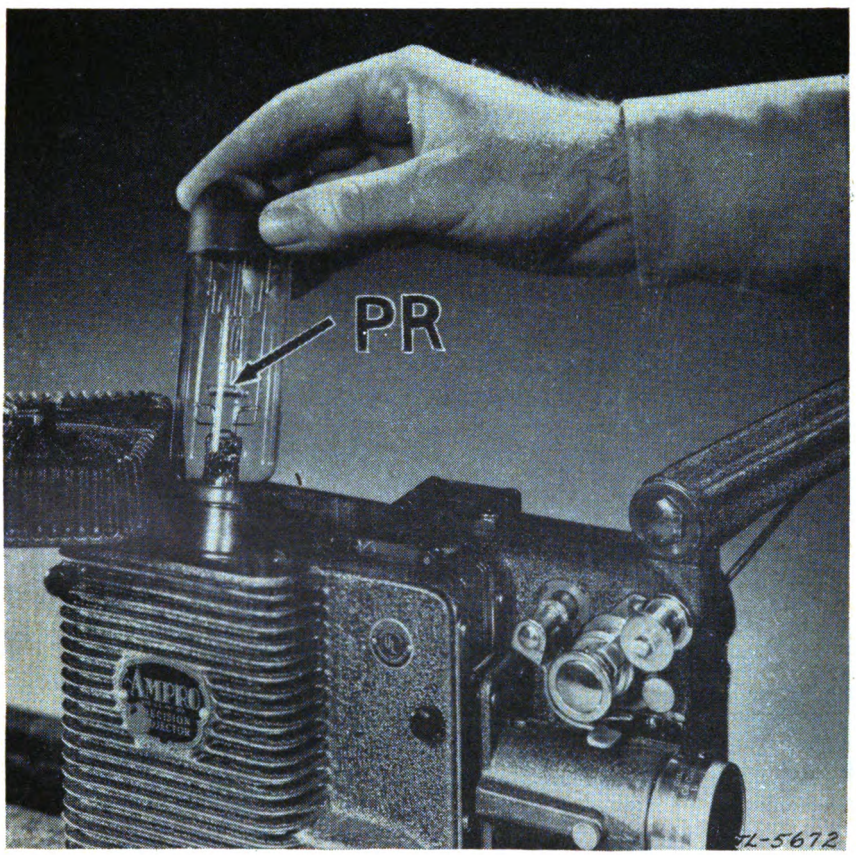


FIGURE 60.—Removing Ampro YA projection lamp.

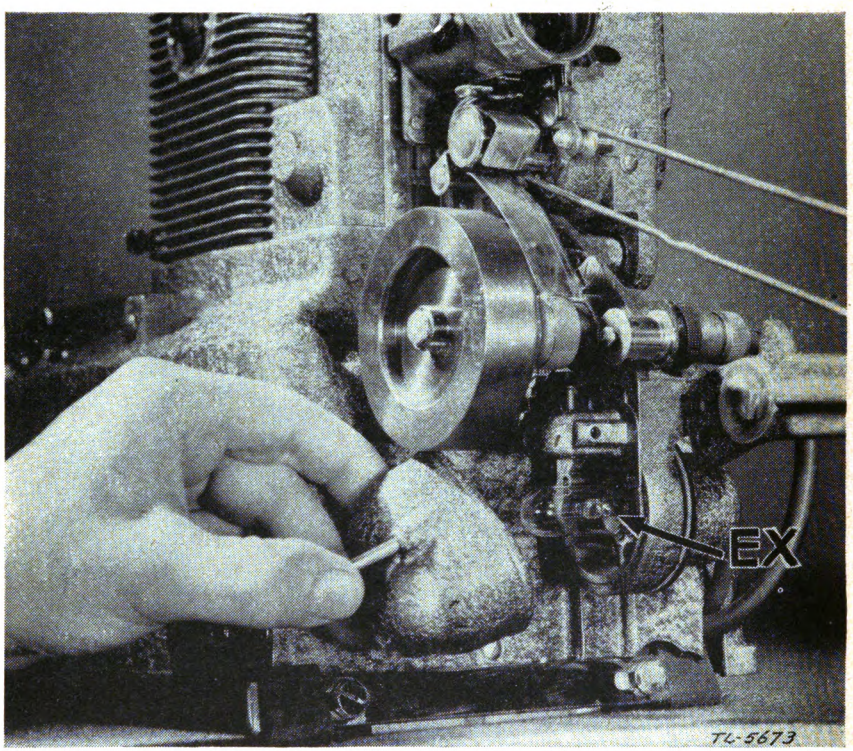


FIGURE 61.—Removing Ampro YA exciter lamp.

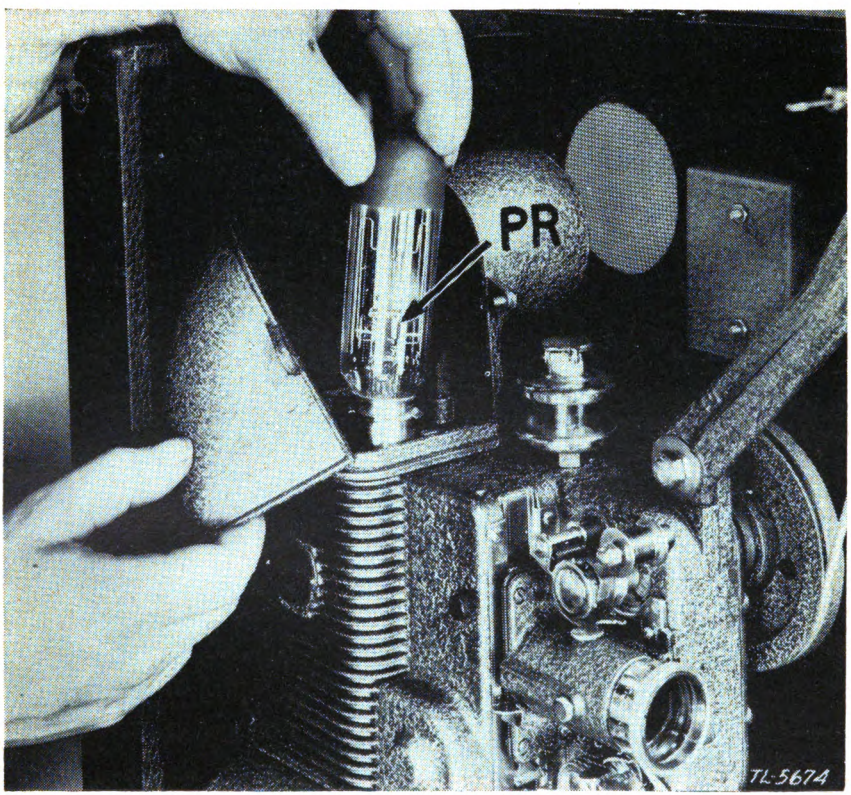


FIGURE 62.—Removing Phonofilm projector lamp.

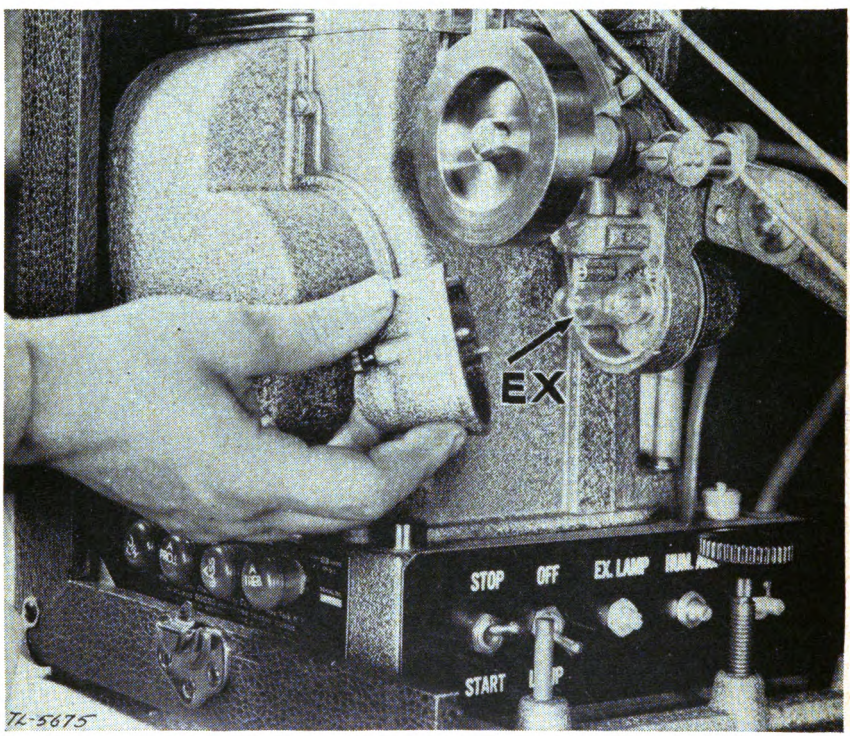


FIGURE 63.—Removing Phonofilm exciter lamp.

c. Bell & Howell.—(1) To replace the projector lamp, unscrew the cap at bottom of lamp house, allowing lamp to slide out (fig. 64). Screw centering ring on new lamp, and with centering tongue forward, raise lamp into position. Replace retaining cap.

(2) To replace the exciter lamp, loosen thumbnut and remove lamp cover (fig. 65). Lift off lamp shield. Press down on lamp, rotate to the left, and lift out. Replace with new lamp.

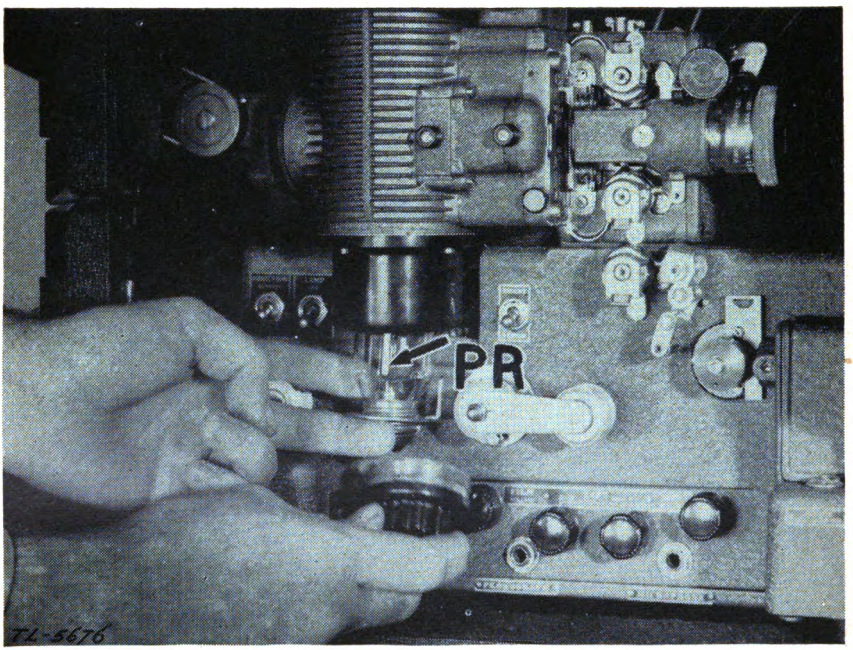


FIGURE 64.—Removing Bell & Howell projector lamp.

d. R. C. A.—(1) To replace the projector lamp, place finger in groove at top of lamp house (fig. 66) and pull top of lamp house door outward. Slip off the metal shield and unscrew the old lamp. Replace with new lamp.

(2) To replace the exciter lamp (fig. 67), lift off metal cover and unscrew lamp. Install new lamp and replace cover.

e. A check should be made every 2 weeks for worn or loose parts. The projector should be completely overhauled at least once a year by qualified technicians.

17. Records.—A film-showing schedule should be prepared so that the projectionist can prepare in advance the room, equipment, and film.

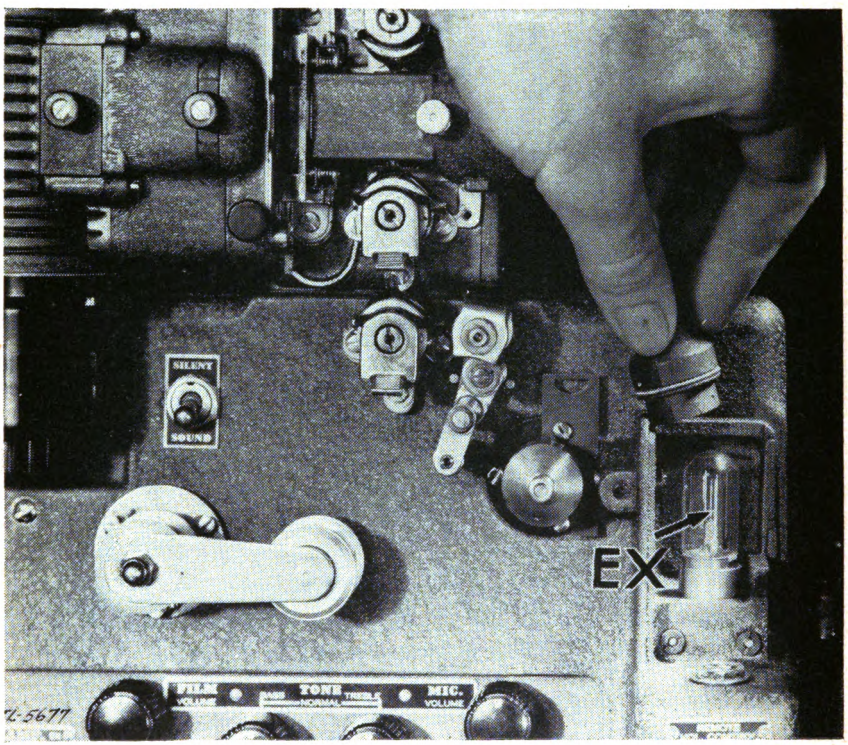


FIGURE 65.—Removing Bell & Howell exciter lamp.

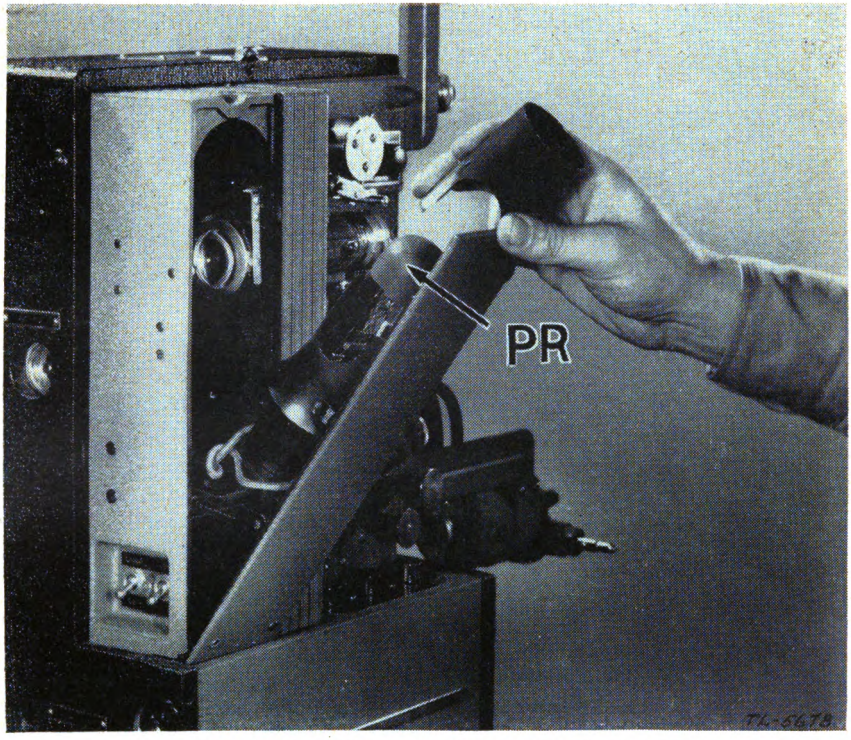


FIGURE 66.—Removing R. C. A. projection lamp.

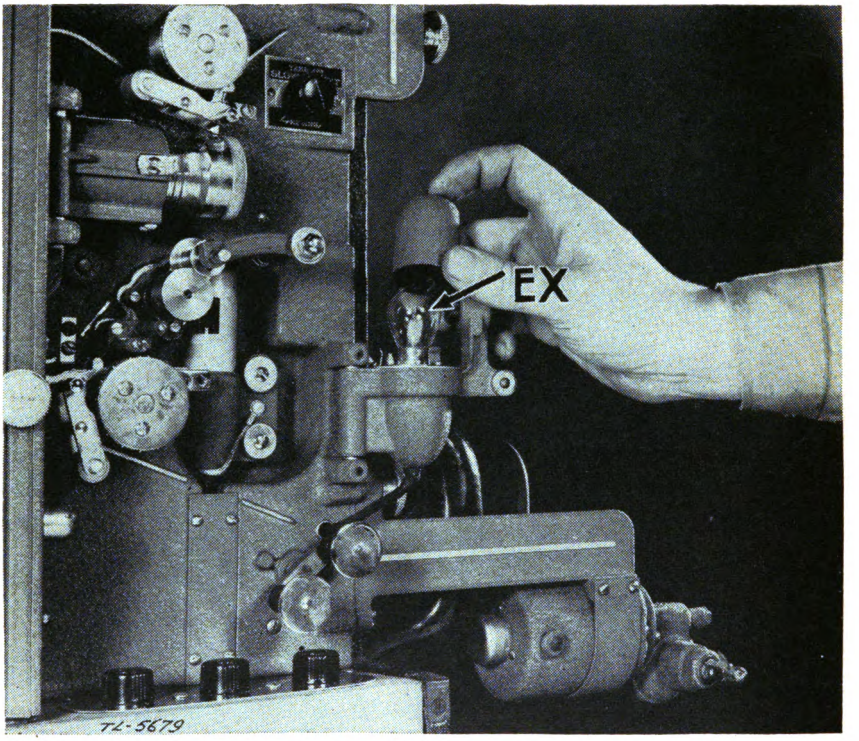


FIGURE 67.—Removing R. C. A. exciter lamp.

a. Regular reference to a record of lamp replacement will help to eliminate delays in projection service. Each projector lamp is rated at 25 hours effective life. To eliminate burn-outs, the lamp should be replaced after being used 25 hours. The following record is suggested for accurate logging of projection time:

Type_____ Make_____ Model_____

Lamp	Date installed	Date of service	Minutes of service	Date removed	Total hours of use	Name of operator

b. A record of cleaning, oiling, and repairing should be kept so that the projector will be ready for use at all times. The following form is suggested for this record:

Type_____ Make_____ Model_____

Part	Date inspected	Date cleaned	Date oiled	Date adjusted	Repair ordered	Name of inspector

CHAPTER 3

FILM STRIP PROJECTOR

SECTION I

GENERAL

18. Use.—The projector PH–222 is used in service command libraries, unit headquarters, and replacement training centers to project film strips prepared for the Army training program.

19. Setting up for operation.—*a.* Projector PH–222 is issued complete in a single case (fig. 68).

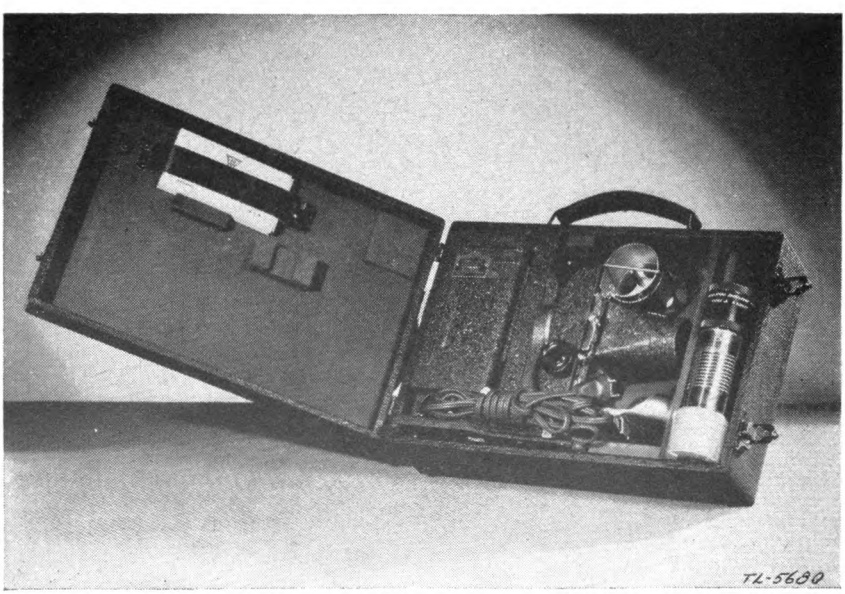


FIGURE 68.—Projector PH–222—encased.

b. To prepare projector for operation, remove from case and place on a stand or table. Insert lens in the lens housing. Do not plug power cord into power receptacle until projector is ready for focusing.

c. The distance between the projector and the screen is one of the factors governing the size of the screen image. (See app. II.)

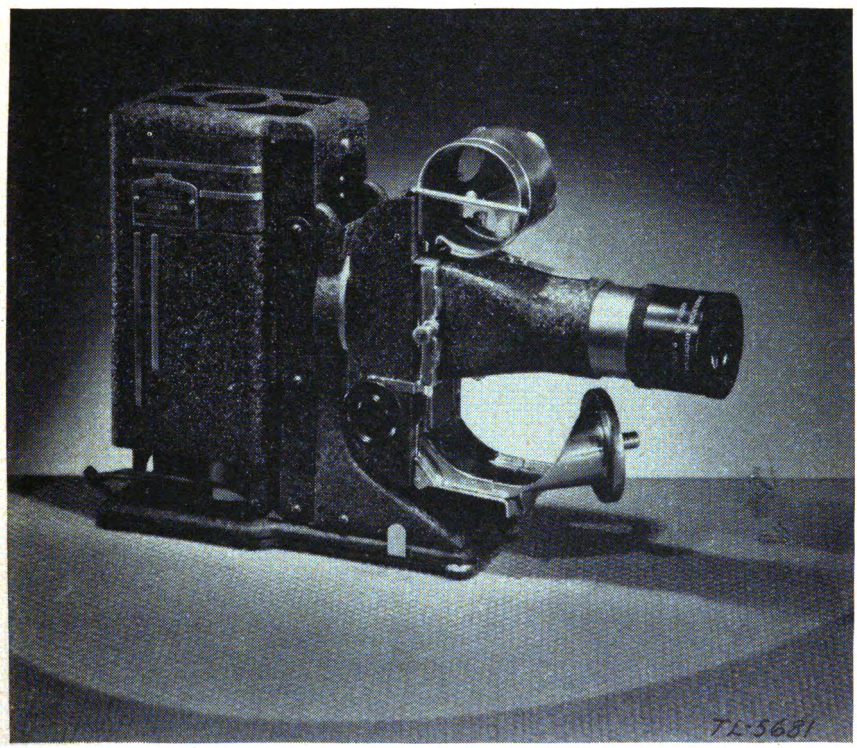


FIGURE 69.—Projector PH–222—assembled.

SECTION II

OPERATION

20. Threading.—*a.* Place the take-up can *A* (fig. 70) in position by inserting stud *B* of the can in the bearing hole *C* at front end of take-up. Push can in until a slight snap is heard.

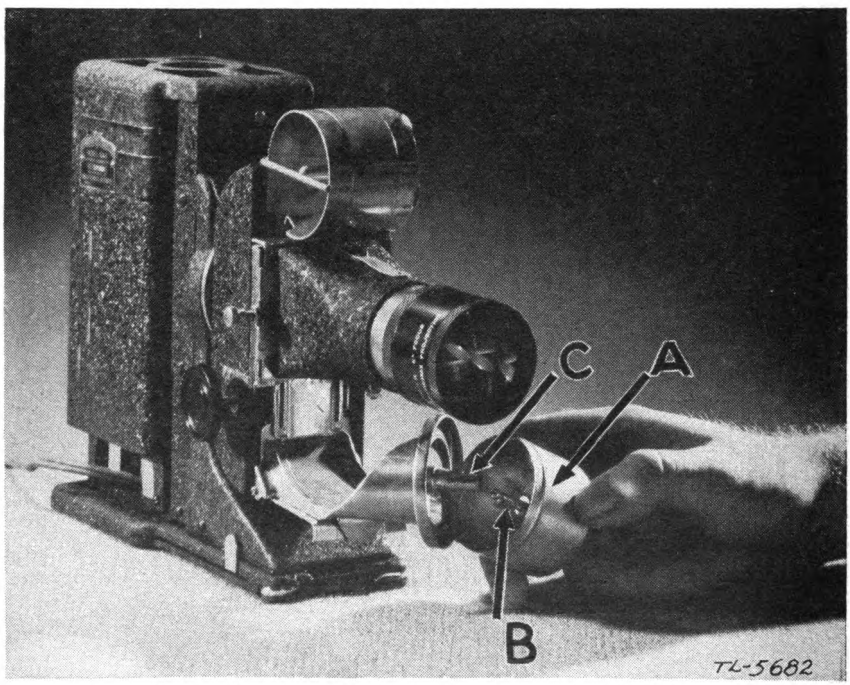


FIGURE 70.—Installing take-up can on projector PH–222.

b. Open film gate by releasing catch spring *D* (fig. 71) and swinging lens barrel *E* to the left.

c. Unwind about 4 inches of film strip and allow it to hang free. Raise the retaining bar *F* and insert free end of film in slot, with emulsion (dull) side toward lamp.

d. Place roll of film on axis bar *G* of film magazine and pull down retaining bar.

e. Place sprocket holes in loose end of film over sprocket teeth and hold in position while closing film gate.

f. Lead loose end of film into take-up can, making certain that it is secured firmly under the guide ledger and that it does not bind.

21. Focusing.—*a.* Plug connecting cord into power outlet and turn on switch at rear of projector. Pull out lens about 2 inches and turn operating knob until image appears on screen. Rotate lens clockwise or counterclockwise until a sharp image appears on the screen.

b. As film is being advanced, make certain that take-up can starts to rotate. To insure proper take-up, give the take-up can a slight turn

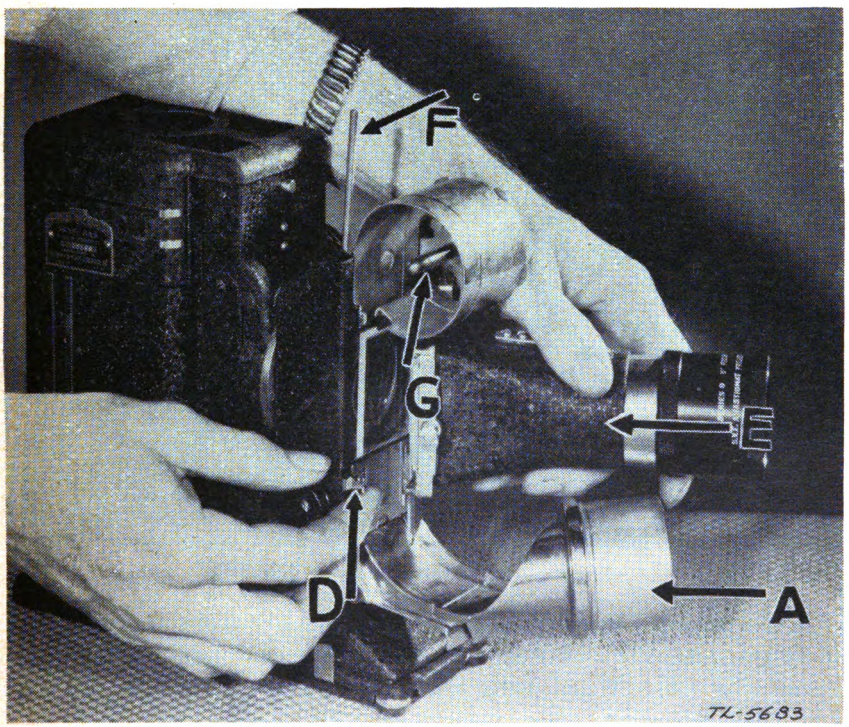


FIGURE 71.—Projector PH–222—showing film gate.

in the same direction as the take-up. This allows for automatic rewind and prepares the film for the next showing.

22. Framing.—*a.* To frame the image properly on the screen, push in the operating knob *H* (fig. 72) and turn clockwise. When the image is properly framed, release the knob.

b. To reverse the direction, or to repeat a picture, turn operating knob counterclockwise. Do not reverse film unless absolutely necessary.

c. Raise or lower framed picture on screen by moving tilting lever *I* (fig. 73) at base of machine. Never tilt projector more than lever will allow, as lamp filament will break if operated at too great an angle. Set projector on a higher base if more elevation is desired.

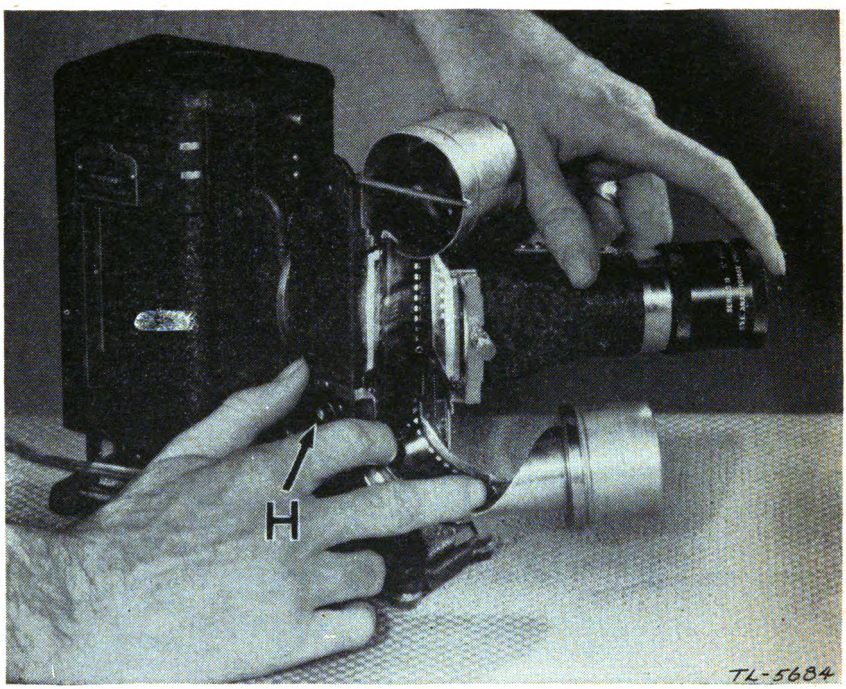


FIGURE 72.—Threading projector PH–222.

d. To project double-frame film strips, remove front aperture mask *J* by grasping the metal edge and sliding it completely out of mask frame (fig. 74). When using horizontal pictures, turn the projector head 90°.

23. Use of slide carrier.—*a.* For projecting 2- by 2-inch slides, open the film gate and remove front aperture mask frame by pulling knob *M* (fig. 74) on frame to right and away from film gate.

b. Remove rear aperture glass *K* (fig. 74) by grasping its sides and lifting lower end from trough.

c. Place semiautomatic slide changer *L* (fig. 75) in film gate by inserting small pin on slide changer in the receiving hole and closing gate.

d. Revolve head of projector 90° and the slide carrier then will be ready for operation. Hold up operating handle and insert slide on front of slide changer. Push down operating handle all the way to

unseat the slide. The image will not be visible until handle is pulled up. Remove each side as it is ejected when the feeding tongue is withdrawn to its upper position. Slides will jam if not removed.

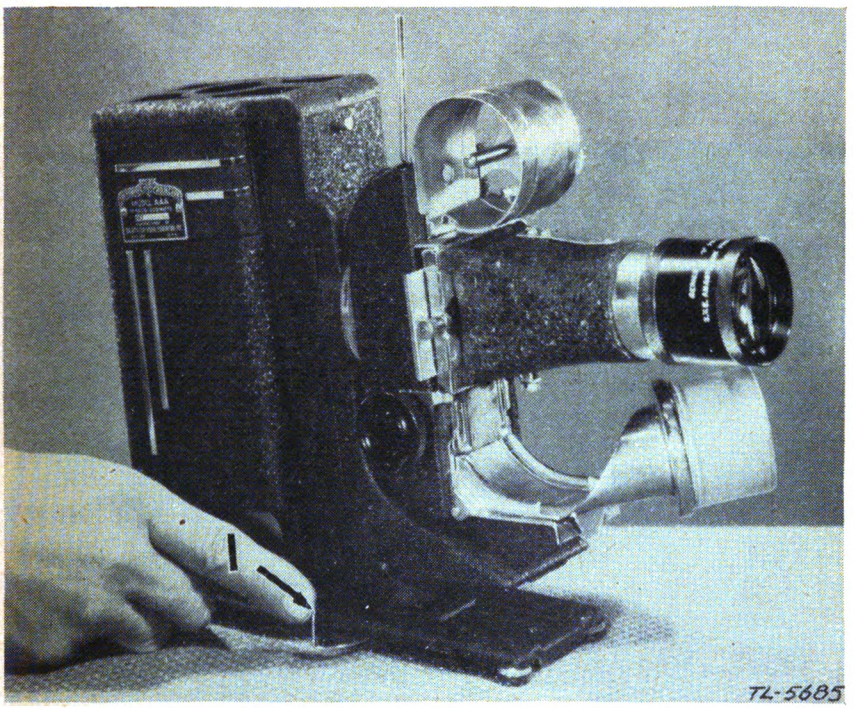


FIGURE 73.—Screening the image with tilting lever.

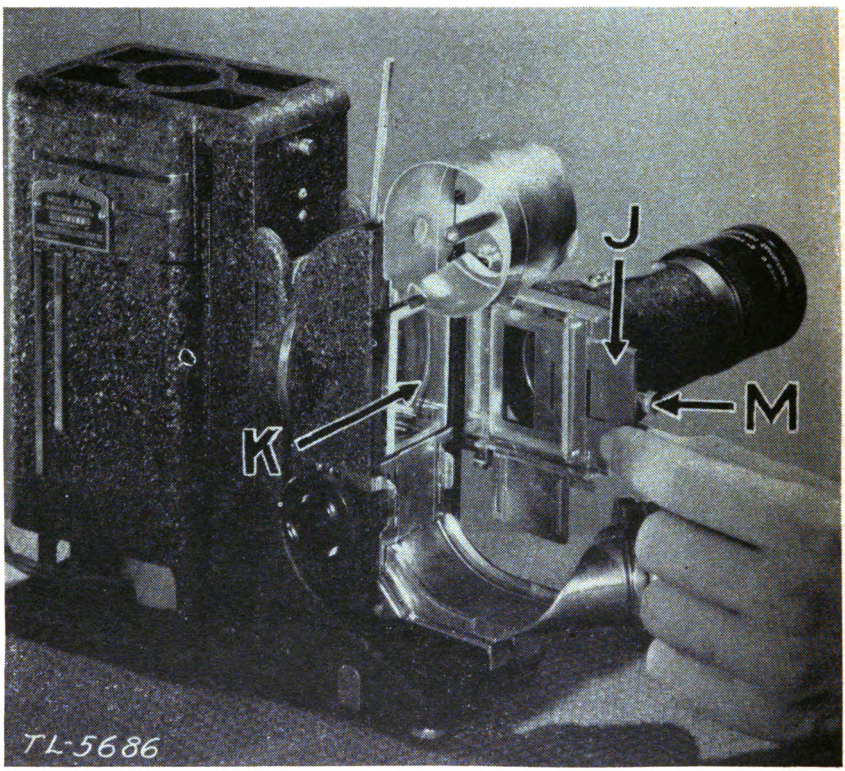


FIGURE 74.—Removing front aperture gate.

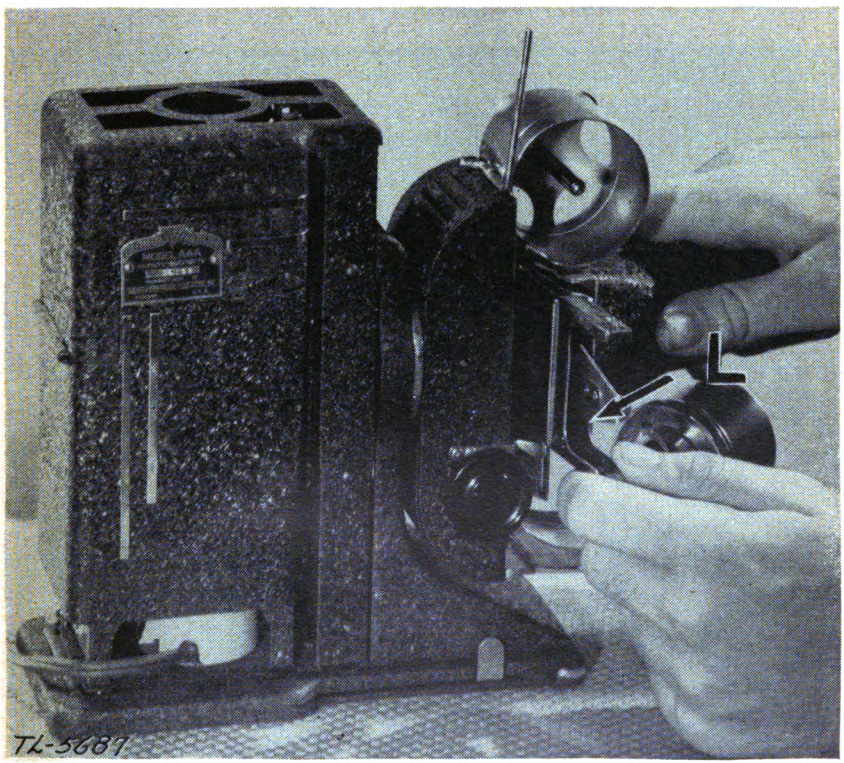


FIGURE 75.—Installing automatic slide changer.

SECTION III

REPLACEMENT OF PARTS

24. Lamp.—To remove projector lamp *O* (fig. 76), push the lamp down in its socket, rotate counterclockwise, and lift out. Reverse the procedure to replace. Lamp switch must be turned off during removal.

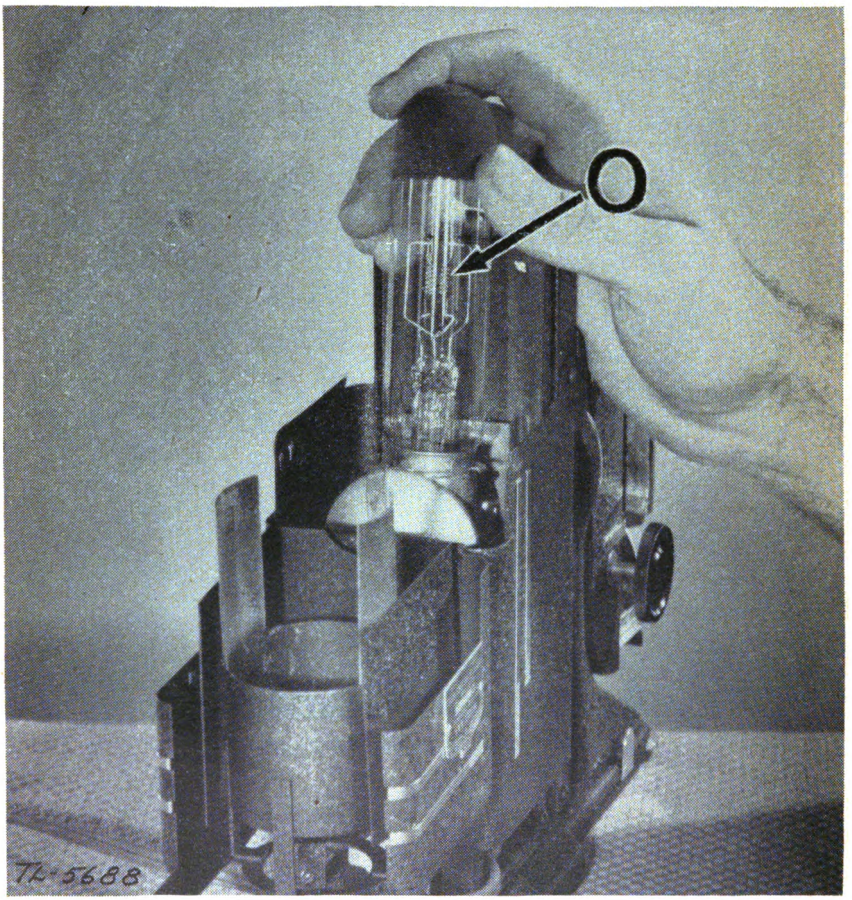


FIGURE 76.—Replacing projector lamp.

25. Heat ray filter.—In case of burning or buckling of film, remove and check the heat ray filter which is mounted between the last condensing lens and the main lens. Any obvious defect in the filter will require replacement to prevent further damage to film.

APPENDIX I

SCREEN TABLE FOR 16-MM PROJECTORS

(Upper dimension is height of picture. Lower dimension is width of picture)

Lens focal length	Distance from screen (in feet)														
	5′	7′	10′	15′	20′	25′	30′	35′	40′	45′	50′	60′	75′	100′	125′	150′
¾″	1′ 10″ 2′ 6″	2′ 8″ 3′ 6″	3′ 9″ 5′ 0″	5′ 7″ 7′ 6″	7′ 6″ 10′ 0″	9′ 4″ 12′ 6″										
1″	1′ 5″ 1′ 11″	2′ 0″ 2′ 8″	2′ 10″ 3′ 9″	4′ 3″ 5′ 8″	5′ 7″ 7′ 6″	7′ 0″ 9′ 4″	8′ 6″ 11′ 4″	9′ 9″ 13′ 1″								
1½″	0′ 11″ 1′ 3″	1′ 4″ 1′ 9″	1′ 10″ 2′ 6″	2′ 10″ 3′ 9″	3′ 9″ 5′ 0″	4′ 8″ 6′ 3″	5′ 7″ 7′ 6″	6′ 7″ 8′ 9″	7′ 6″ 10′ 0″	8′ 4″ 11′ 2″	9′ 4″ 12′ 6″					
2″			1′ 4″ 1′ 10″	2′ 1″ 2′ 10″	2′ 10″ 3′ 9″	3′ 6″ 4′ 8″	4′ 1″ 5′ 6″	4′ 10″ 6′ 6″	5′ 6″ 7′ 5″	6′ 3″ 8′ 5″	7′ 0″ 9′ 4″	8′ 4″ 11′ 2″	10′ 5″ 14′ 0″	14′ 0″ 18′ 9″	17′ 10″ 23′ 5″	21′ 0″ 28′ 1″
2½″			1′ 2″ 1′ 6″	1′ 7″ 2′ 1″	2′ 3″ 3′ 0″	2′ 10″ 3′ 9″	3′ 4″ 4′ 6″	3′ 11″ 5′ 3″	4′ 6″ 6′ 0″	5′ 1″ 6′ 9″	5′ 7″ 7′ 6″	6′ 9″ 9′ 0″	8′ 5″ 11′ 3″	11′ 2″ 15′ 0″	14′ 8″ 19′ 8″	16′ 9″ 22′ 5″
3″						2′ 4″ 3′ 1″	2′ 10″ 3′ 9″	3′ 3″ 4′ 4″	3′ 9″ 5′ 0″	4′ 3″ 5′ 8″	4′ 8″ 6′ 3″	5′ 7″ 7′ 6″	7′ 0″ 9′ 4″	9′ 4″ 12′ 6″	11′ 7″ 15′ 7″	13′ 11″ 18′ 8″
3½″						2′ 0″ 2′ 8″	2′ 4″ 3′ 2″	2′ 10″ 3′ 9″	3′ 2″ 4′ 3″	3′ 6″ 4′ 10″	4′ 0″ 5′ 4″	4′ 8″ 6′ 3″	6′ 0″ 8′ 0″	7′ 11″ 10′ 8″	9′ 11″ 13′ 4″	11′ 11″ 16′ 0″
4″						1′ 9″ 2′ 4″	2′ 1″ 2′ 10″	2′ 2″ 3′ 3″	2′ 10″ 3′ 9″	3′ 2″ 4′ 3″	3′ 6″ 4′ 8″	4′ 1″ 5′ 6″	5′ 3″ 7′ 0″	7′ 0″ 9′ 4″	8′ 8″ 11′ 8″	10′ 5″ 14′ 0″

Appendix II

SCREEN TABLES FOR 35-MM PROJECTORS

The size of the screen image is governed by the equivalent focal length of the lens and the distance from the projector to the screen. The tables show the size of pictures obtained on the screen with a lens of given focal length at a given distance, using horizontal frames. (The proportions are reversed when showing vertical frames.)

Distance from machine to screen	35-mm single frame film				35-mm double frame film				
	Focal length of lens				Focal length of lens				
	3″	4″	5″	6″	3″	4″	5″	6″	7″
10′:									
Height of picture	2. 3	1. 7	1. 3	1. 1	3. 0	2. 3	1. 8	1. 5	1. 3
Width of picture	3. 0	2. 3	1. 8	1. 5	4. 6	3. 4	2. 6	2. 2	1. 9
15′:									
Height of picture	3. 4	2. 5	2. 0	1. 7	4. 5	3. 4	2. 7	2. 3	1. 9
Width of picture	4. 5	3. 4	2. 7	2. 3	6. 8	5. 0	4. 0	3. 4	2. 9
20′:									
Height of picture	4. 5	3. 4	2. 7	2. 3	6. 0	4. 5	3. 6	3. 0	2. 6
Width of picture	6. 0	4. 5	3. 6	3. 0	9. 0	6. 8	5. 4	4. 6	3. 9
25′:									
Height of picture	5. 7	4. 4	3. 5	2. 9	7. 6	5. 8	4. 6	3. 8	3. 3
Width of picture	7. 6	5. 8	4. 6	3. 8	11. 4	8. 8	7. 0	5. 8	4. 9
30′:									
Height of picture	6. 8	5. 1	4. 0	3. 4	9. 1	6. 8	5. 4	4. 5	3. 9
Width of picture	9. 1	6. 8	5. 4	4. 5	13. 6	10. 2	8. 0	6. 8	5. 9
35′:									
Height of picture	7. 9	5. 9	4. 8	4. 0	10. 5	7. 9	6. 4	5. 3	4. 5
Width of picture	10. 5	7. 9	6. 4	5. 3	15. 8	11. 8	9. 6	8. 0	6. 8
40′:									
Height of picture	9. 1	6. 8	5. 5	4. 6	12. 1	9. 1	7. 3	6. 1	5. 2
Width of picture	12. 1	9. 1	7. 3	6. 1	18. 2	13. 6	11. 0	9. 2	7. 8
45′:									
Height of picture	10. 2	7. 6	6. 2	5. 1	13. 6	10. 2	8. 2	6. 8	5. 8
Width of picture	13. 6	10. 2	8. 2	6. 8	20. 4	15. 2	12. 4	10. 2	8. 7
50′:									
Height of picture	11. 2	8. 4	6. 8	5. 6	14. 9	11. 2	9. 0	7. 5	6. 4
Width of picture	14. 9	11. 2	9. 0	7. 5	22. 4	16. 8	13. 6	11. 5	9. 6

Appendix III

TROUBLE CHART FOR 16-MM PROJECTORS

SYMPTOMS OF TROUBLE	Causes of trouble*																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
No sound			X	X	X	X			X	X	X	X			X			X			X			X		X
Impaired sound	X		X		X	X			X	X	X	X	X	X	X		X	X	X	X	X		X	X		
Impaired volume																										
No picture							X				X										X				X	
Poor picture	X						X	X	X							X					X	X	X		X	
Hum or other noise	X	X	X		X	X			X			X	X						X	X				X		
Slow or fast sound																					X					
Irregular motor	X	X										X					X		X	X	X					

*Causes of trouble:

1. Low line voltage.
2. High line voltage.
3. Speaker not connected or improperly connected.
4. Amplifier not on.
5. Amplifier tubes burned out or defective.
6. Exciter lamp out or impaired.
7. Projector lamp burned out or old.
8. Projector lamp out of focus.
9. Film incorrectly threaded.
10. Volume control not on or advanced.
11. Fuse burned out.
12. Projector cable broken or loose.
13. Defective motor belts.
14. Poor room acoustics.
15. Dirty sound lens.
16. Dirty projection lens and reflectors.
17. Speed rheostats wrong position.
18. Film channels dirty.
19. Lack of or too much oil.
20. Motor governor brushes or commutator dirty or damaged.
21. Poor contact in line cord.
22. Poor screen or extraneous light.
23. Defective or dirty film.
24. Line polarity or plugs switched.
25. Lamp projector burning out or blackened.
26. Microphone switch on.

NOTE.—Find the cause of trouble by referring to the X squares opposite the symptom.

APPENDIX IV

PARTS LIST

Component parts and accessories most likely to need replacement are listed below.

Training film projection equipment

Name	Description	Function	Manufacturer	Equipment No.
Projector and speaker.	16-mm sound	Projection and sound.	Ampro	PH-399.
			Phonofilm	PH–402.
			Bell & Howell	PH-131.
			R. C. A	PH-398.
Cord	10′	Power line	(With all models and equipment numbers.)	
Cord	10′ Y	Power line	Bell & Howell	PH-131.
Cable	50′	Speaker extension.	(With all models and equipment numbers.)	
Reels	400′ 1200′ 1600′		(With all models and equipment numbers.)	
Brush	Circular, wire	Aperture cleaning.		
Oil can and oil.		Lubrication		
Lamp	750W, 115V	Projection	(With all models and equipment numbers.)	
Lamp	4V, .75 amp	Exciter	(With all models and equipment numbers.)	
Fuse	1½ amp	General	Ampro	PH-399.
Fuse	5–6 amp	Master	Phonofilm	PH-402.
Fuse	2 amp	General	Bell & Howell	PH-131.
Fuse	2 amp		R. C. A	PH-398.
Diagram		Sound circuit	(With all models and equipment numbers.)	
Instruction Manual.		Instruction	(With all models and equipment numbers.)	
Tube	6J7, 6N7, 6V6, 5Z4.	Amplification	Ampro	PH–399.
Tube	7C5, 5U4G, 7N7, 6N7.	Amplification	Phonofilm	PH–402.
Tube	6J7, 6SC7, 6V6GT, 5Z4.	Amplification	Bell & Howell	PH–131.
Tube	6J7, 6J5, 6N7, 6L6, 5U4G, 6Fc.	Amplification	R. C. A	PH 398.

Film strip projection equipment

Name	Description	Function	Manufacturer	Equipment No.
Projector	35-mm	Projection	Society for Visual Education.	PH–222.
Lamp	300W, 115V 300W, 230V	Projection	Society for Visual Education.	PH–222.
Slide carrier		Slides		

Screen

Screen, case, and tripod.	52″ x 72″ Challenger.	Picture image	Da-Lite Screen Co.	(With all numbers.)

APPENDIX V

MANUFACTURERS AND THEIR ADDRESSES

Ampro Corporation	2839 Northwestern Ave	Chicago, Ill.
The Phonofilm Co	1667 No. McCadden Pl	Hollywood, Calif.
Bell & Howell Co	1801 Larchmont Ave	Chicago, Ill.
R. C. A. Manufacturing Co.		Camden, N. J.
Society for Visual Education.	100 East Ohio St	Chicago, Ill.
Da-Lite Screen Co	2711–2723 No. Crawford Ave.	Chicago, Ill.

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G. C. MARSHALL,
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(For explanation of symbols see FM 21-6.)

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