T.O. 10D1-2-9-1

TECHNICAL MANUAL

OPERATION AND SERVICE INSTRUCTIONS

PROJECTOR

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

(BELL & HOWELL)

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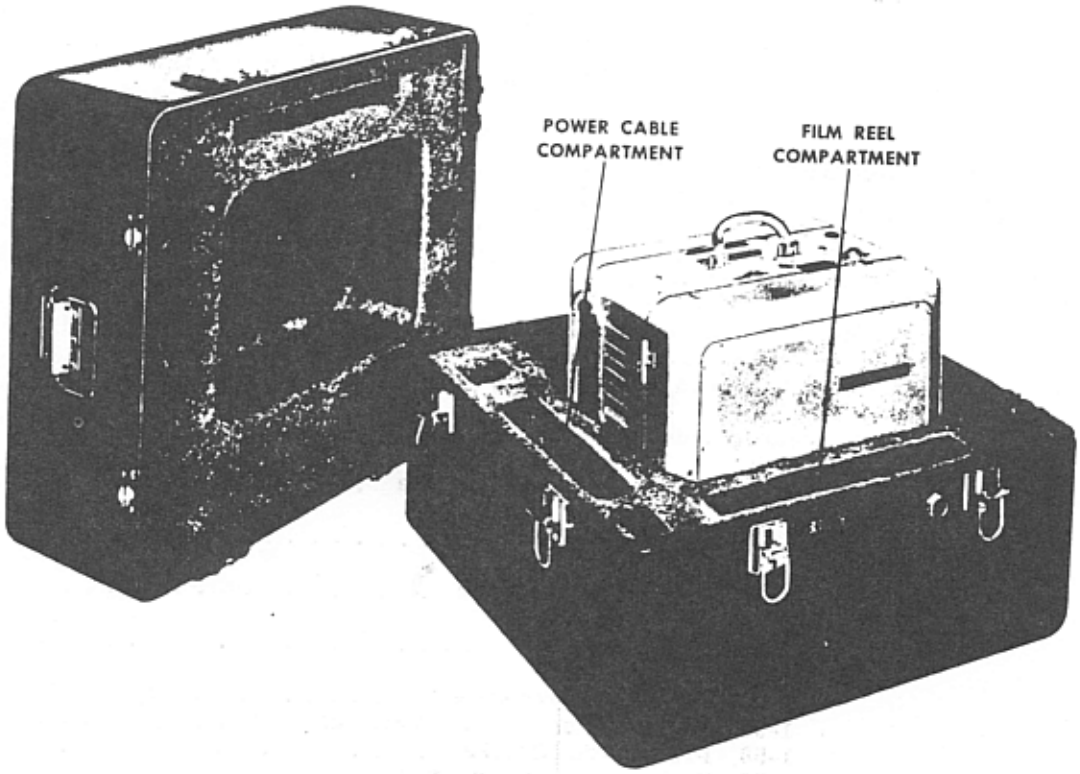

Figure 1-1. Type AQ-2A(1) 16-mm Projector in Carrying Case

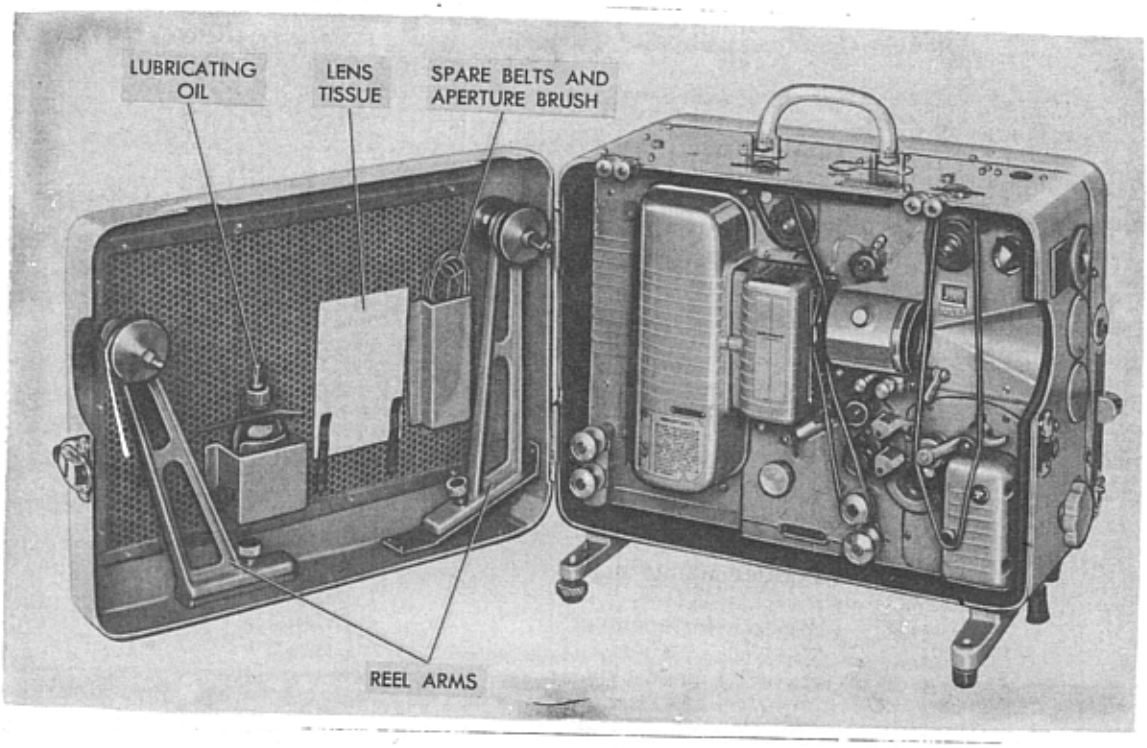

Figure 1-2. Type AQ-2A(1) 16-mm Projector with Case Door Open

creates sound, music or speech through the use of a loudspeaker.

1-37. FILTER SYSTEM OPERATION. The mechanical means utilized to achieve uniformity of film speed at the scanning point is based on the gravity principle. Functioning of the "gravity filter system" is accomplished through the combined efforts of the upper idler roller, lower idler roller, the rotating sound drum, and the flywheel, as well as by the naturally formed film loops shaped by the threading format. The sound drum and rollers are shown in figure 1-5. The sound drum is not driven by the projector mechanism; it is revolved entirely by the friction of the film passing over it. The sound drum is attached to the flywheel by means of a shaft which is supported by ball bearings of high-precision tolerance. Once the flywheel starts to turn, it tends to keep revolving at a smooth and uniform rate, keeping the film motion uniform as well. The upper idler gravity roller rests on the film between the sound sprocket and the sound drum, and the lower idler gravity roller rests on the film between the sound drum and the take-up sprocket. These rollers are mounted on arms so as to allow free vertical movement. The rollers act in such a manner as to stabilize themselves in a balanced condition when the projector has reached operating speed. Since the mass of these rollers and arms is very small in comparison with the mass of the flywheel, any speed irregularity results in displacement of the rollers with no change in the flywheel speed. The "gravity filter system" is unaffected by temperature and comes to a fully balanced condition in less than 4 seconds.

1-38. AMPLIFIER AND SPEAKER OPERATION. The amplifier provides a means of changing the weak, fluctuating current received from the photocell to a current which, while still fluctuating in exactly the same pattern as the photocell current, will nevertheless be strong enough to operate the loudspeaker. Volume and tone controls are provided to adjust the intensity and quality of the sound. A reverse gain of 20 decibles is provided for reproduction of incorrectly recorded sound tracks. The amplifier includes an a-c supply for operation of the vacuum tube heaters and a d-c supply for positive plate and screen potentials and negative grid bias for the power output tubes. The loudspeaker completes the final step in sound reproduction. It provides a means for converting the amplified audio signal from the amplifier into sound energy. The volume of sound obtainable from the loudspeaker is controlled by the maximum output of the amplifier.

1-39. SCREEN SELECTION AND PLACEMENT.

1-40. The efficient use of any screen involves projection that utilizes the entire screen surface. Motion pictures require oblong screens due to the shape of the film images. There are two main types of screen surfaces for motion picture projection: white matte and glass beaded. Each type has certain characteristics of its own in terms of percentage of brightness at various angles of observation.

1-41. Angles of observation are measured from the projection axis, which is a line running from the lens of the projector perpendicular to the center of the screen surface. The best reflection and truest observation of the picture is achieved when the observer views the screen from an angle close to the projection axis. However, since not all observers can be seated close to the projection axis, it is essential that some latitude of observation angle be provided by screen construction. The preferred angles of observation for the beaded screen are approximately 20 degrees on either side of the projection axis. With matte surface screens, the view angle should not exceed 30 degrees. Note, also, that the white matte screen is characterized by a wide angle of reflection, thus affording a more uniform brightness to the entire audience. (See figure 1-10).

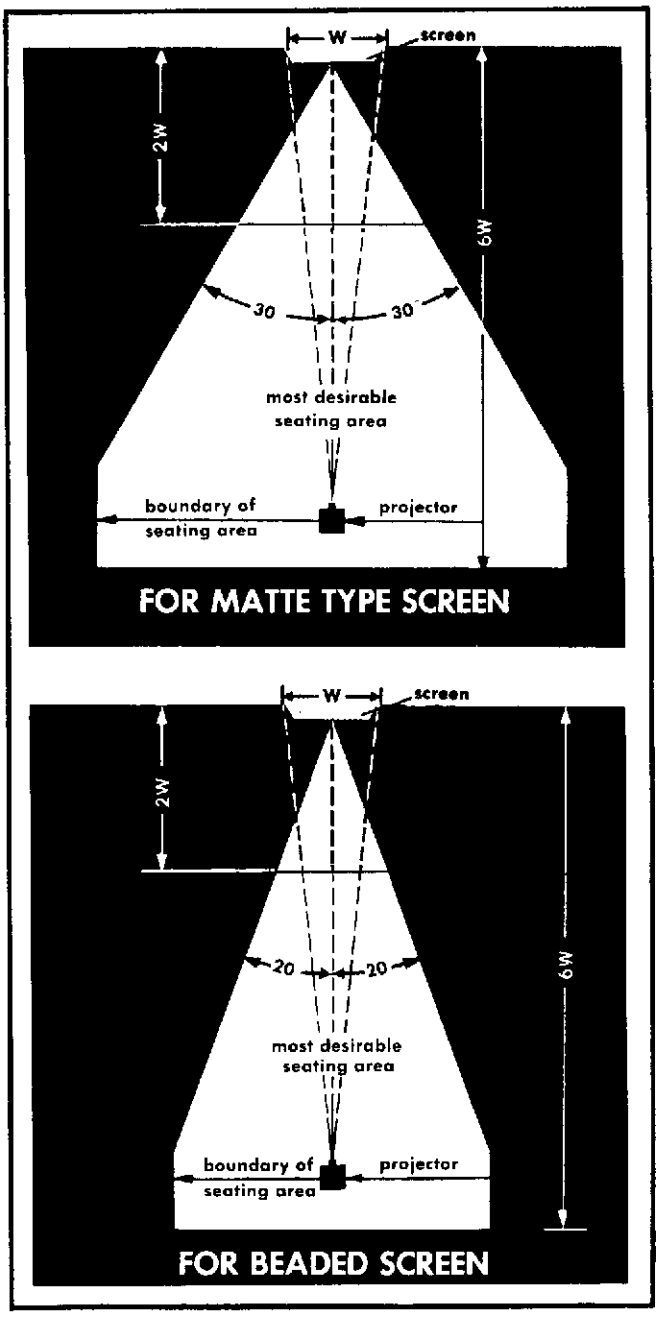

Figure 1-10. Audience Seating — Screen Types

1-42. When a matte screen is used, no one should sit closer to the screen than 2 screen-widths nor farther from it than 6 screen-widths, and no one should sit outside an angle of 30 degrees from the center line.

1-43. When a beaded screen is used, no one should sit closer to the screen than 2-1/2 screen widths, nor farther from it than 6 screen widths. In this case, no one should sit outside an angle of 20 degrees either side of the centerline. Beyond a 20-degree angle, the brightness of the screen falls off rapidly. Also, when a beaded screen is used, the screen should not be raised too far above the heads of the spectators, for those sitting closer to the screen may then view it at an angle greater than 20 degrees in the vertical direction.

1-44. The screen should always be placed at right angles to the lens axis, and at a convenient height for viewing, with the projector placed high enough so that the heads of the audience do not interrupt the light on its way to the screen. The screen height should be such that the lower edge is at least as high as the heads of the audience seated nearest it.

1-45. LENS RELATIONSHIP TO PICTURE SIZE.

1-46. Closely related to screen size is the focal length of the lens being used in the projector, since the lens determines the size of the screen image. The 2-inch lens has been supplied with this projector since this focal length meets most average projection conditions. Frequently, however, it may be necessary to depart considerably from average conditions. Reference to the Projection Chart (Table I) will disclose the relationship between the picture size and projection distance for lenses of different focal lengths.

1-47. The information contained in the Projection Chart is based on the following approximate relation: The focal length (in inches) of the lens is 3/8 of the ratio of the projected distance (in feet) to the width (in feet) of the screen.

As an example, assume that it is desired to determine the focal length of a lens for use in a small room, where the distance between the lens and the screen is 24 feet and the screen is 6 feet wide. The ratio of 24 feet to 6 feet is 4, and 3/8 of 4 is 1-1/2 inches. Therefore, a 1-1/2 inch lens should be used to place a 6-foot picture on the screen from a distance of 24 feet. If a lens of a computed focal length is not available, the lens having the nearest focal length should be used.

1-48. LOCATING THE EQUIPMENT.

1-49. Try to locate the projector as far back in the projection area (room, auditorium, or theater) as possible, so that the audience is well in front of the lens. Whenever possible, there should be at least 6 feet between the last row of seats and the projector. Be sure the projector is located far enough from the screen so that the projected image fills the screen. The nearer the projector is to the screen, the smaller the image, and vice versa.

1-50. Place the projector on a sturdy table or bench. The mounting surface should be of such a height that the centerline of projection is four feet above the floor, so that the beam of projected light will pass above the heads of those who sit directly in front of the projector. The lower edge of the screen should be at least as high as the tops of the heads of the persons sitting nearest the screen.

1-51. USING EXTERNAL LOUDSPEAKER.

1-52. When an external 16-ohm loudspeaker is used, place the loudspeaker on a table or platform at one side of, and on a level with, the center of the screen, or at one side of and just below the screen. Never place the loudspeaker on the floor.

1-53. Make the cabling connections between projector and external louspeaker as shown in figure 1-11. Also, make certain that the loudspeaker selector switch is in the REMOTE SPEAKER ON position. (See figure 1-8).

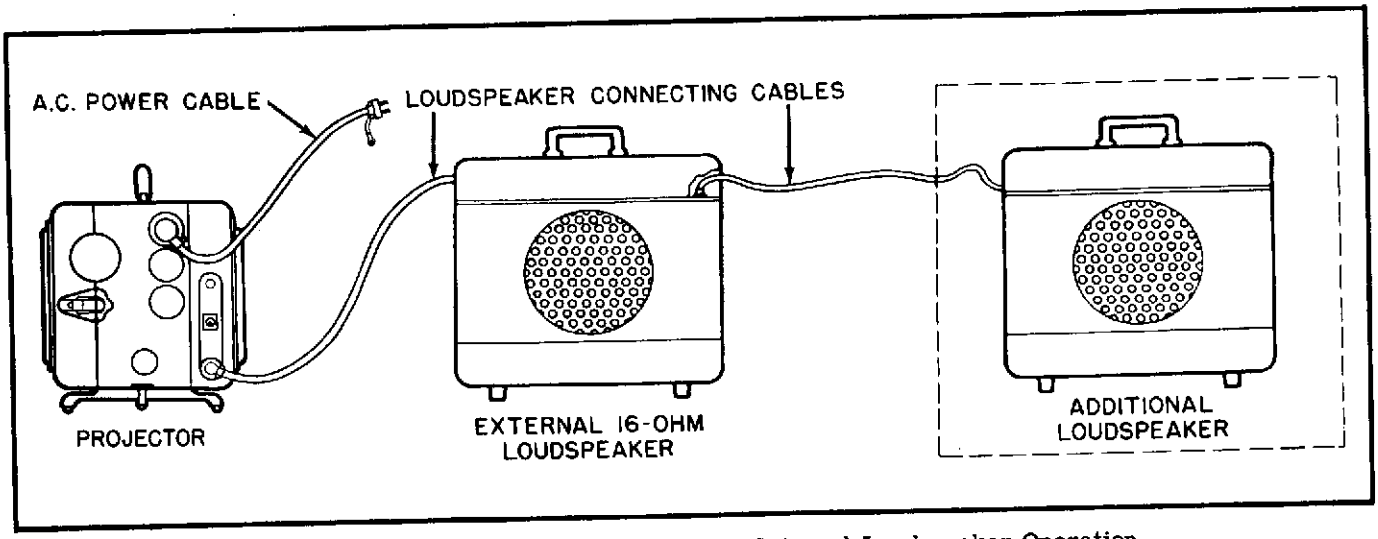

Figure 1-11. Interconnecting Diagram for External Loudspeaker Operation

TABLE I. PROJECTION CHART

Distance	E. F. L. 0.75"	16-mm Projection Lens Focal Length 1.0"	1.5"	2.0"	2.5"	3.0"	3.5"	4.0"	4.5"	5.0"	5.4"	K
5'	2.5	1.9"										1.9
7'	3.1	2.38										2.38
10'	5.0	3.8	2.5									3.8
15'	7.5	5.7	3.8	2.8								5.7
20'	10.0	7.6	5.0	3.8	3.0							7.6
25'	12.4	9.5	6.3	4.7	3.8	3.1						9.5
30'		11.4	7.6	5.7	4.5	3.8	3.2					11.4
35'		13.3	8.8	6.6	5.3	4.4	3.8	3.3				13.3
40'			10.1	7.6	6.0	5.2	4.3	3.8	3.3			15.2
45'			11.4	8.5	6.8	5.7	4.8	4.3	3.8	3.4		17.1
50			12.6	9.5	7.6	6.3	5.4	4.7	4.2	3.8		19.0
55			13.9	10.4	8.3	6.9	5.9	5.2	4.6	4.2		20.9
60			15.2	11.4	9.1	7.6	6.5	5.7	5.0	4.5		22.8
65			16.4	12.3	9.8	8.2	7.0	6.2	5.4	4.9		24.7
70				13.3	10.6	8.8	7.6	6.6	5.9	5.3		26.6
75				14.2	11.4	9.5	8.1	7.1	6.4	5.7		28.5
80				15.2	12.1	10.1	8.6	7.6	6.7	6.1		30.4
85				16.1	12.8	10.7	9.2	8.1	7.1	6.4		32.3
90				17.1	13.6	11.4	9.7	8.5	7.6	6.8		34.2
95					14.4	12.0	10.3	9.0	8.0	7.2		36.1
100					15.2	12.6	10.8	9.5	8.4	7.6		38.0
105					16.0	13.3	11.4	9.9	8.8	8.0		39.9
110					16.7	13.9	11.9	10.4	9.2	8.3		41.8
115					17.4	14.5	12.4	10.9	9.7	8.7		43.7
120						15.2	13.0	11.4	10.1	9.1		45.6
125						15.8	13.5	11.9	10.5	9.5		47.5
130						16.4	14.0	12.3	10.9	9.9		49.4
135							14.6	12.8	11.4	10.2		51.3
140							15.2	13.3	11.8	10.6	9.8	53.2
145							15.7	13.7	12.2	11.0	10.2	55.1
150								14.2	12.6	11.4	10.5	57.0
155								14.7	13.0	11.8	10.9	58.9
160								15.2	13.5	12.1	11.2	60.8
165								15.7	13.9	12.5	11.6	62.7
170								16.1	14.3	12.9	11.9	64.6
175								16.6	14.7	13.3	12.3	66.5
180								17.1	15.2	13.7	12.6	68.4
185								17.5	15.6	14.0	13.0	70.3
190								18.0	16.0	14.4	13.3	72.2
195								18.5	16.4	14.8	13.7	74.1
200								19.0	16.9	15.2	14.0	76.0

Aperture height: .284"
width: .380"

"K" indicates aperture width multiplied by projection distance. To obtain screen width in feet divide by lens focal length; to obtain focal length where desired screen size (width) is known, divide K by screen width.

"E. F. L." indicates effective focal length.

TABLE II. OPERATING CONTROLS

Control	Location	Function
Threading lamp switch	Projector operating panel. See figure 1-7.	Turns on the threading lamp on projector mechanism panel and the pilot lamp on projector switch panel.
Motor-Lamp switch	Projector operating switch panel. See figure 1-7.	Turns projector motor and lamp on and off.
Rewind switch	Projector operating switch panel. See figure 1-7.	Changes movement of projection mechanism from forward to reverse for rewinding film. Can also be used for reversing the direction of film movement.
Knob, rewind mechanism	Feed reel arm. See figure 1-4.	Raises and lowers front end of projector for centering projected image on screen.
Projector tilt control knob	Front of projector case. See figure 1-4.	Raises and lowers front end of projector for centering projected image on screen.
Loop setter push-button	Pushbutton on top of projector case. See figure 1-4.	Adjusts lower loop when threading projector to precise size for synchronization of picture and sound.
Loop setter positioning adjustment lever	Below film channel. See figure 1-4.	Adjustment control that compensates for variation in physical condition of film; prevents complete loss of lower loop of film, eliminates rethreading, and assures uninterrupted film showings.
Framing knob	Protrudes below shutter cover assembly. See figure 1-4.	Centers film frame at aperture so that one complete picture is projected on screen.
Focusing knob	On slide carriage just below lens holder. See figure 1-4.	Critical focusing of pictures on screen while projector is running.
Projection lamp adjustment control levers	Below lamphouse. See figure 4-4.	Centers and focuses projection lamp.
Projection lens	In lens holder. See figure 1-4.	Focuses picture on screen.
Projection leveling screw	Right rear projector leg. See figure 1-4.	To bring projector to level position if operated from stand with uneven surface.
Threading knob	On front mechanism plate of projector. See figure 1-4.	Motivates projection mechanism to engage shuttle tooth with film sprocket hole.
ON-OFF power switch	On rear amplifier operating panel. See figure 1-7.	Turns on and off the electrical power to the amplifier.
VOLUME control	Rear amplifier operating panel. See figure 1-7.	Controls volume of sound output to loudspeaker.
TONE control (marked LO-NOR-HI)	On amplifier operating panel. See figure 1-7.	Affects substantially entire frequency range of amplifier.
Loudspeaker selector switch	On amplifier control panel. See figure 1-8.	Permits selection of built-in loudspeaker or external 16-ohm loudspeaker when this latter type is connected to equipment.

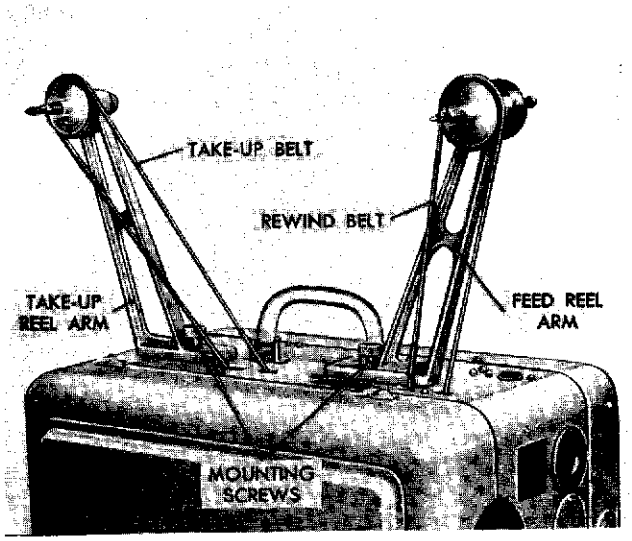

Figure 1-12. Reel Arms and Belts Installed

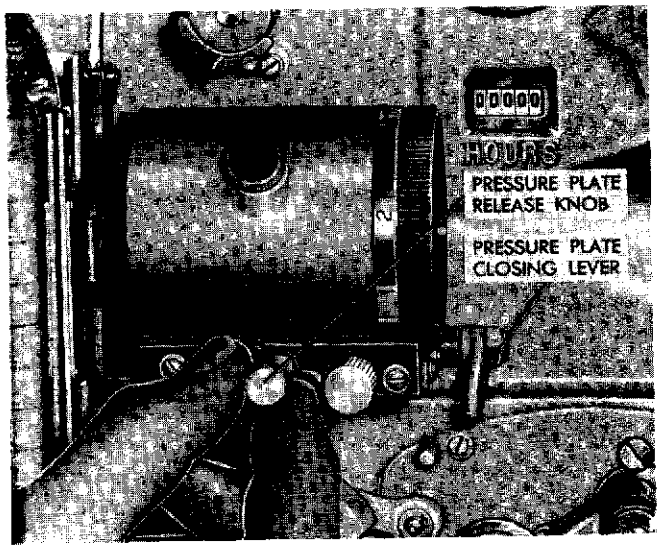

Figure 1-13. Opening the Film Channel

1-54. OPERATING PROCEDURE.

1-55. GENERAL. Before attempting to operate the projector, it is important to become thoroughly familiar with the controls and switches used. The Table of Operating Controls (Table II) lists the name, location, and function of all controls and switches.

1-56. CONNECTION PROCEDURE.

a. Turn the MOTOR-LAMP switch on the projector switch panel to the OFF position.

b. Throw the amplifier OFF-ON power switch to the OFF position.

c. Turn the VOLUME control knob fully counterclockwise.

d. Turn the TONE control knob to the position marked NOR (normal) unless a check of the film or acoustic conditions of the projection area prior to showing indicates that other settings would be more desirable.

e. Connect the power cable. The female end plugs into the three-pin receptacle on the projector case; the male end plugs into the 105 to 129-volt AC, 50 to 60 cycle power source.

CAUTION

The projector is grounded by means of a green grounding wire at the male end of the power cable. Be sure to ground this wire before operating the projector by securing ground wire lug with screw that attaches wall receptacle cover plate.

f. Move the loudspeaker selector switch to the correct position. If the built-in, 5-inch loudspeaker is to be used, this switch must be set in the upward position, LOCAL SPEAKER ON. If an external 16-ohm loudspeaker is to be used, insert the loudspeaker cable connector into the Cannon receptacle marked REMOTE SPEAKER, then move the loudspeaker selector switch to the position marked REMOTE SPEAKER ON. Refer to figure 1-11 for cabling connections when using external loudspeaker.

1-57. INSTALLING REEL ARMS AND BELTS.

a. When not in use, the reel arms are mounted inside the case door (figures 1-2 and 1-2A). Remove the reel arms by loosening the knurled locking screw on each arm. The feed reel arm mounts at the front of the projector case and the take-up reel arm at the rear (figure 1-12).

b. On AQ-2A(1) projectors, the reel arms can be installed and tightened down before looping the spring belts over the reel arm pulleys. Make certain that the belts are engaged in their respective pulleys within the projector and that the belts are not twisted.

c. On AQ-2A(3) projectors, the fabric belts should be engaged with their respective pulleys within the projector and looped over the reel arm pulleys before the reel arms are seated and tightened down. Hold the reel arms in position on the case, but tipped slightly toward front of projector, while looping belts over pulleys. Then seat the reel arm and tighten the knurled screw. Adjust belt tension, if necessary (paragraph 4-19).

1-58. PRE-OPERATION CHECKS.

a. Make certain that the aperture plate is all the way down. To do this, open the film channel by pulling out the pressure plate release knob (figure 1-13). Grasp the handle of the aperture plate and push it down firmly as far as it will go. Close the film channel by pushing the pressure plate closing handle until the pressure plate release knob snaps back in.

CAUTION

Never remove the aperture plate or pressure plate while the projector is running. If either plate is moved while the projector is in operation the center shuttle tooth may break, causing picture jump, loss of lower loop, etc.

b. Check the REWIND switch on the projector operating panel to be certain that the switch is in the OFF position.

c. Be sure that the reel rewind mechanism knob on the projector feed reel arm is in its OUT position

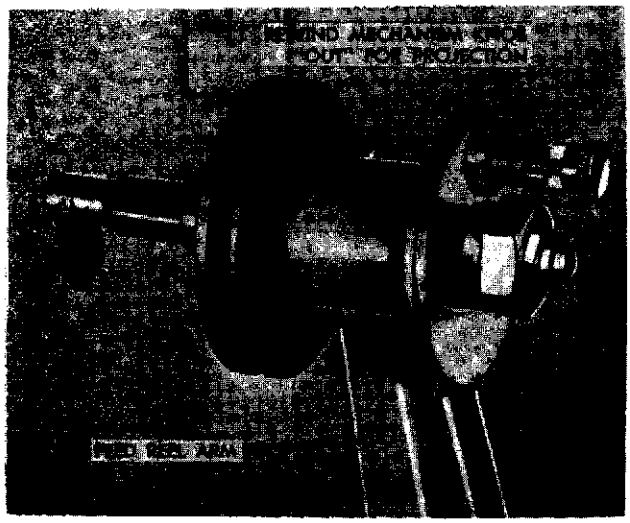

Figure 1-14. Feed Reel Arm Rewind Knob

and engaged in the short slot as shown in figure 1-14. This knob must be set in the IN position (engaged in the long slot) only when rewinding the film.

d. Throw the MOTOR-LAMP switch to the MOTOR position. The motor should start, the take-up belt should run, and the three film sprockets should rotate. The projector mechanism should operate smoothly and quietly.

e. Throw the MOTOR-LAMP switch to the LAMP position. Light should be projected to the screen.

f. While the light is being projected to the screen, turn the amplifier power switch to the ON position. The amplifier pilot lamp should light, indicating that the amplifier is on, and the red exciter lamp indicator on the exciter lamp cover should light up, indicating that the exciter lamp is on.

g. Make certain that the loudspeaker selector switch is set in the proper position for external or local speaker operation.

h. Turn the amplifier VOLUME control clockwise to mid-position. Insert a clean card or piece of paper (about 1 inch wide and 3 inches long) between the sound lens and sound drum (figure 1-5). Move the card back and forth, in this position, to interrupt the light beam from the sound lens to the photocell. If the system is operating satisfactorily, a short thumping sound will be heard in the loudspeaker each time the beam is interrupted. This sound indicates that all electrical connections have been properly made, and that the equipment is in working order.

1-59. PREPARATION FOR THREADING.

a. If the projector is on a table or stand, shift the projector sideways until the light beam points to the screen. If the projector image falls below the screen, raise the projector by turning the tilt control knob (figure 1-8) counterclockwise until the beam of light centers on the screen in a vertical direction.

b. To compensate for any unevenness of the table or stand on which the projector is placed, a leveling device is incorporated into the projector. If the projected image on the screen is not parallel to the horizontal edge of the screen, turn the leveling adjustment screw (figure 1-4) clockwise or counterclockwise, as needed, to attain the proper horizontal position of the image on the screen.

c. With the image of the aperture being projected onto the screen, free the projection lens by unscrewing the lens locking screw (figure 1-4) on the lens carriage. Hold lens shoulder tightly against front of lens holder and tighten lens locking screw. Focus image of aperture on the screen by means of the focusing control knob. Later, when projecting film, critical focusing of the picture will be done as the title appears on the screen, by means of the focusing control knob (figure 1-4). After focusing, turn the MOTOR-LAMP switch to the OFF position.

d. Before starting any film program, it is imperative that film path be absolutely free from dirt, dust, and caked emulsion, and that the optical system be scrupulously clean. In most instances, the aperture brush supplied with the equipment will suffice to remove any dirt or caked emulsion from the film rollers, the aperture and pressure plates, the film sprockets, film shoes, sound drum and film guide adjustment roller. Lens elements can be cleaned with lens tissue. Refer to paragraphs 4-2 through 4-12 for more detailed cleaning instructions.

e. Be sure to inspect bad splices or excessively worn sprocket holes. Make needed repairs to avoid trouble during the program. Check the film to be used to be sure that the sprocket holes are toward the operator and that the picture and titles are upside down in the threaded position of the film. If these conditions are not met, the film is incorrectly wound on the reel and must be rewound before it can be threaded onto the projector.

f. Turn on the amplifier in sufficient time so that the tubes will have reached normal operating temperature by the time you are ready to start the program.

g. If the threading is being done in total or semi-darkness, turn on the threading lamp by throwing the threading lamp switch on the projector operating panel to the ON position. This also lights the pilot lamp on the projector operating panel and facilitates threading the projector.

1-60. THREADING THE PROJECTOR.

a. A leader is spliced at the beginning of each run to protect the film from damage. Note that following the leader, there are numbers starting at "12" and running down to "3," at regular intervals. The threading is done in this area.

b. Unwind about 4 or 5 feet of film leader from the feed reel. Pass the film between the two film guide rollers at the top of the projector case (figure 1-15). Lower the feed sprocket film shoe away from the feed sprocket, and place the film under the feed sprocket. Make certain that the front perforations engage the sprocket teeth. Push up the feed sprocket film shoe to lock the film in place under the feed sprocket.

c. Turn the threading knob to the point where the words "THREADING KNOB" are in a horizontal plane. This will place the shuttle teeth in their maximum position of protrusion for engagement with the film perforations. Open the film channel for threading by pulling out the pressure plate release knob (figure 1-13). Form a proper length of upper film loop as indicated by the loop guide line on the mechanism plate. Place the film flat on the aperture

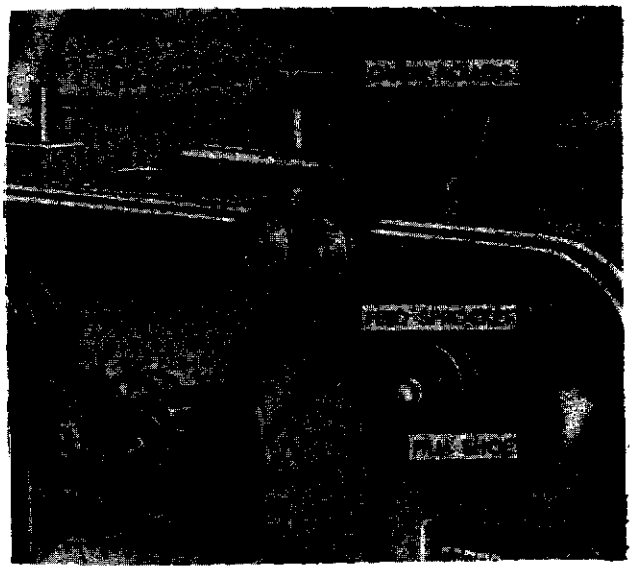

Figure 1-15. Engaging Film with Feed Sprocket

plate as shown in figure 1-16. Make certain that the film is located in the recessed portion of the aperture plate, flat against the aperture opening, and that the shuttle teeth engage with the film perforations. Then, bring the pressure plate against the film by pushing the pressure plate closing handle (figure 1-13) to the left until the pressure plate release knob snaps back in.

d. Turn the threading knob several clockwise revolutions, and watch the action of the film. If the properly sized upper film loop is maintained and the film moves downward through the aperture channel, the shuttle teeth are properly engaging the film perforations. If this does not occur, repeat the preceding threading operation through the aperture channel.

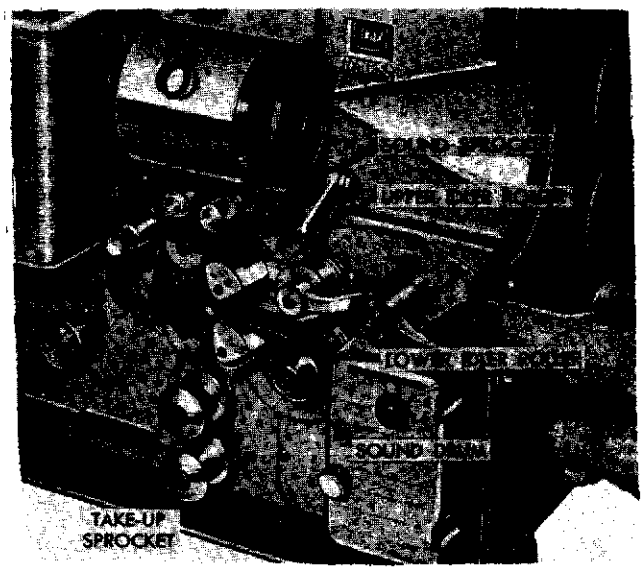

Figure 1-17. Forming the Lower Film Loop

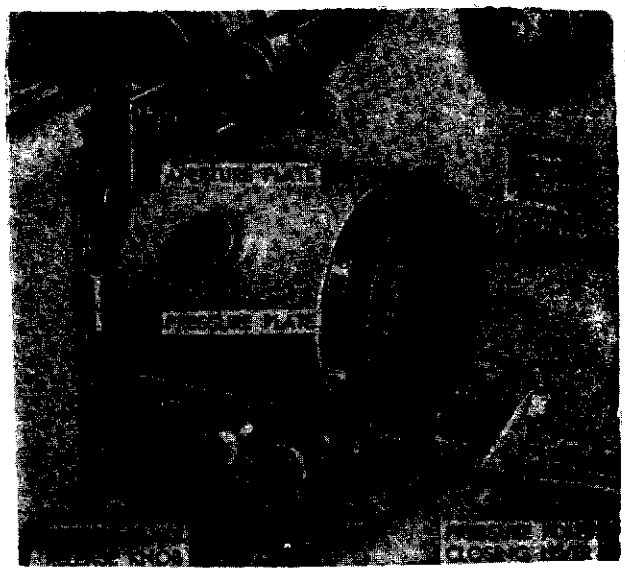

Figure 1-16. Placing Film in Film Channel

e. Lift the sound sprocket film shoe away from the sound sprocket (figure 1-17). Form a lower loop of film of a size to correspond with the loop threading mark on the projector mounting plate. While maintaining the size of the lower loop, pass the film over the sound sprocket, making certain that the film perforations engage the sprocket teeth. Push down on the sound sprocket film shoe to lock the film in place over the sound sprocket.

f. Pass the film under the upper idler roller and around the sound drum, facilitating this procedure by raising the guide roller as shown in figure 1-17. After passing the film around the sound drum, lower the guide roller to its operating position over the sound drum.

g. Lift the take-up sprocket shoe from the take-up sprocket and pass the film under the lower idler roller and over the take-up sprocket (figure 1-18).

h. Before engaging film perforations with the teeth of the take-up sprocket, gently pull the film taut to the left as shown in figure 1-18. Then release the film enough to permit the lower idler roller to pull

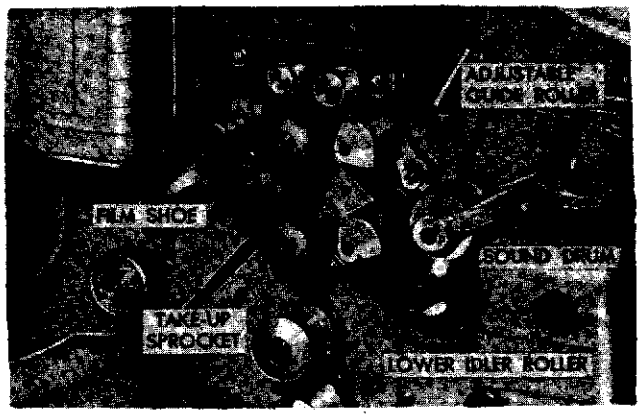

Figure 1-18. Engaging Take-up Sprocket Teeth

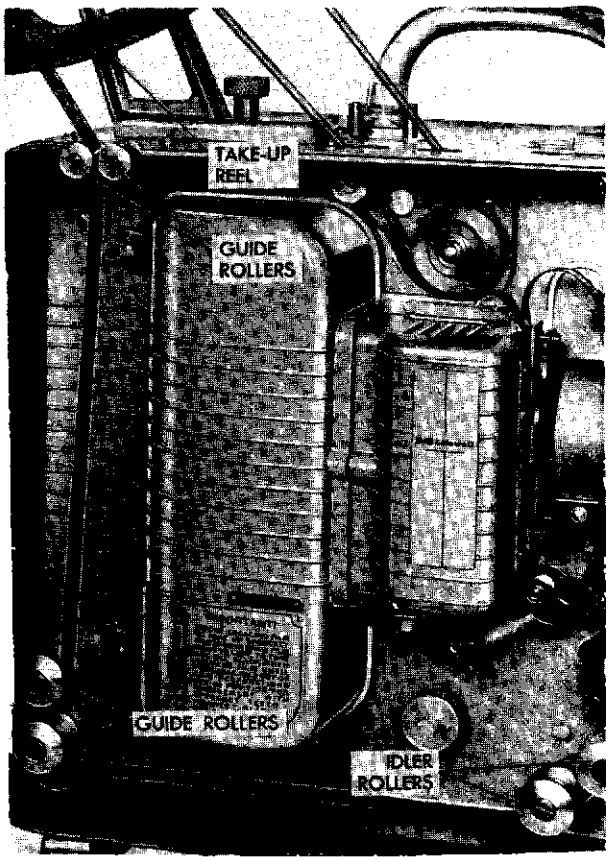

Figure 1-19. Film Path to Take-up Reel

the film back until the first available set of film perforations are in position for engagement with the sprocket teeth. The correct amount of slack at this point is equivalent to one-half frame of film. Push down on the take-up sprocket shoe to lock the film in place over the take-up sprocket.

i. From the take-up sprocket, pass the film around the right side of both floating idler rollers and to the left across the bottom of the case to the two guide rollers (figure 1-19). Pass the film around the left side of the lower film guide roller and around the right side of the upper film guide roller. From here the film is passed upward and between the two film guide rollers at the top of the case, then to the left side of the empty take-up reel. Guide the film up and around the hub of the take-up reel in a clockwise direction and engage the free end of the film securely to the slot in the reel hub. The reel must take up film as it revolves in a clockwise direction.

j. Rotate the take-up reel in a clockwise direction until the film slack has been taken up. This completes the threading of the projector. The complete projector film threading path is shown in figure 1-20 in diagram form.

k. Check the threading by turning the threading knob in a clockwise direction. If the knob turns freely and the film moves continuously on each film sprocket without strain, and if the properly sized upper and lower loops of film are maintained, the projector is properly threaded.

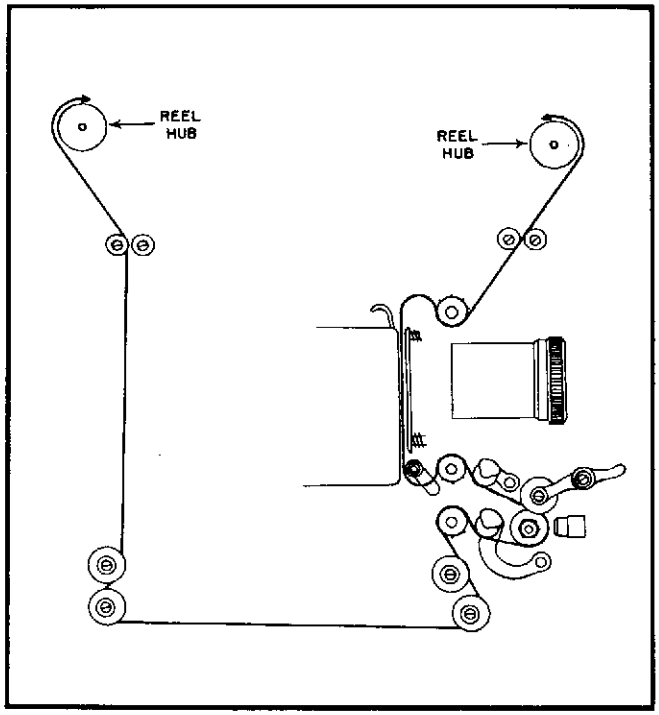

Figure 1-20. Projector Film Threading Diagram

1-61. LOOP-SETTING ADJUSTMENT.

a. The loopsetter positioning assembly, when properly adjusted, will compensate for stretched or shrunken film. Before proceeding with the adjustment, check to be certain that the aperture plate is drawn all the way in position. Then turn on the projection lamp and frame the picture on the screen.

b. Place the index finger under the upper loop of film and gently pull upward on the film, meanwhile watching the projected picture on the screen. If the projected picture remains entirely visible and steady, no other adjustment of the loopsetter positioning assembly is required. However, if the picture is not steady but moves in a rapid, uneven manner, so as not to be visible, and the projector makes a clicking noise, turn the front positioning adjustment lever (figure 1-21) upward or downward one notch at a time until the picture is visible and the clicking noise is stopped.

c. Gently press the loopsetter pushbutton (on top of the case) down all the way and release it quickly. Do not force this button down. The loopsetter pushbutton sets the lower loop to the precise size required for synchronization of picture and sound.

1-62. FINAL CHECKS.

a. Make certain that the amplifier OFF-ON switch is in the ON position. It takes about 45 to 60 seconds for the tubes to reach normal operating temperature.

b. Check the film channel to be sure that it is fully closed. If not, push the pressure plate closing handle (figure 1-13) until the pressure plate release knob snaps back in.

c. Check the TONE control knob. Unless a check of the film or acoustic conditions of the projection area prior to the showing indicated that another setting would be more desirable, this control should

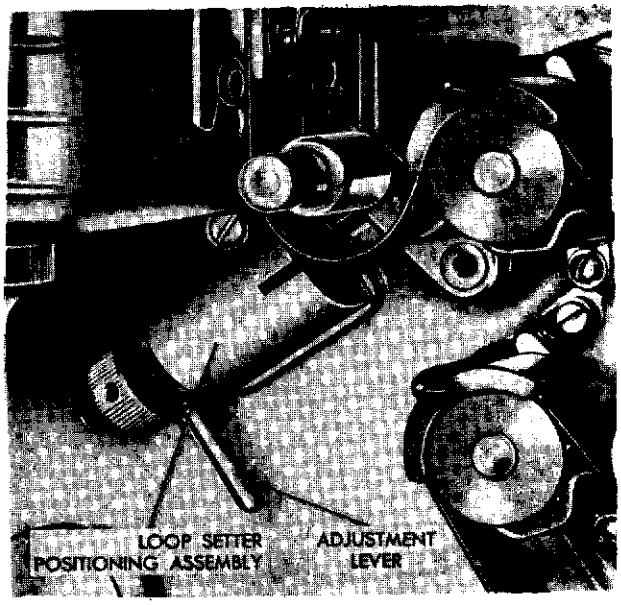

Figure 1-21. Loopsetter Positioning Assembly

be in the position marked NOR (normal).

d. Make certain that the loudspeaker selector switch (figure 1-8) is in the proper position for local or external loudspeaker operation.

1-63. STARTING THE PROJECTOR.

a. Turn the projector MOTOR-LAMP switch to the MOTOR position. For training films, as soon as the end of the film leader passes the picture aperture, turn the MOTOR-LAMP switch to the LAMP position; at the same time, turn up the amplifier VOLUME control knob to the required setting for proper sound volume.

NOTE

On 16-mm entertainment films, following the leader, there are numbers on the film starting at "12" and ending at "3" at regular intervals. When projecting this type of film, turn on the lamp after the last number passes the picture aperture.

b. Adjust the focusing control knob (figure 1-4) to bring the projected image on the screen into its sharpest focus.

c. Frame the picture on the screen, if necessary, with the framing knob (1-4).

d. During operation, stand by for possible readjustments. Constantly watch the focus of the picture as the film itself may not always be in sharp focus. Listen to the volume and tone of the sound and be ready to make adjustments due to variations in the sound recording. Watch the take-up reel to see that it is taking up film properly. If the film breaks during the show, quickly stop the projector and turn down the volume. Film splicing will hold up the program for too long a period. Therefore, remove the film from the projection mechanism, and, by hand, loop the two free ends of the film around the film on the hub of the take-up reel. Start the projector to make certain that the film is being taken up properly. Stop the projector. Rethread the projector and continue the program. The film can be spliced after the program has been completed.

1-64. STOPPING THE PROJECTOR.

a. On each reel of film there is an end-title, indicating the end of the reel. As soon as the sound or the end title has faded out, perform the following operations in rapid sequence: (1) Turn the MOTOR-LAMP switch to the MOTOR position. (2) Turn the VOLUME control to its most counterclockwise position. (3) Allow the remaining film to run through the projector; then turn off the MOTOR-LAMP switch.

b. If additional reels are to be shown, proceed as follows: (1) Remove the take-up reel (full reel of film) from the take-up spindle. (2) Place the new reel of film on the feed reel spindle and rethread the projector (paragraph 1-60). Operate the controls as before to project the picture accompanied by sound. Properly rewind all film after the show.

1-65. REWINDING THE FILM.

a. It must be cautioned that rewinding the film on the projector will not permit checking of film condition.

b. To rewind the film on the projector, unwind about three feet of film from the take-up reel and pass the film directly from the bottom of the take-up reel to the right side of the empty reel (figure 1-22). Engage the free end of the film in the slot of the empty reel hub. Rotate the empty reel one or more turns in a counterclockwise direction to make certain that the film has engaged the reel properly. Both the full reel of film and the empty reel of film should turn in a counterclockwise direction. No twisting, changing or removing of the belt is necessary.

NOTE

Make certain that the film between both reels is not sagging excessively as the sudden start of rewinding may snap the film.

c. Set the rewind mechanism knob on the front reel arm (figure 1-14) to the "IN" or closed position. Turn the REWIND switch on the projector switch panel to the ON position. This will start the motor.

d. Allow the film to run until all of the film is re-

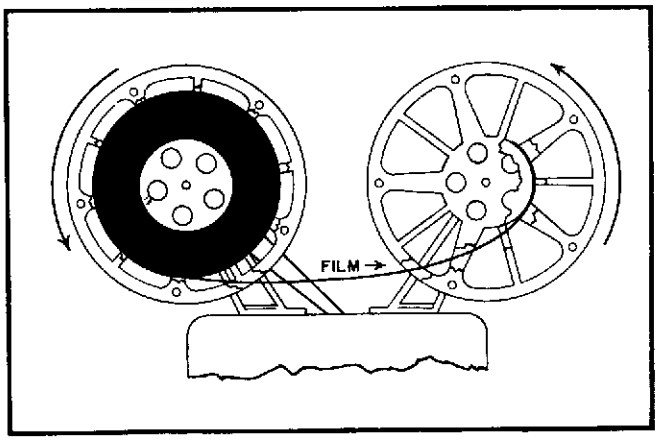

Figure 1-22. Film Threaded for Rewinding

wound, then turn the REWIND switch to the OFF position.

e. As soon as rewinding has been completed, return the rewind mechanism knob on the feed reel arm to the "OUT" position for projection.

CAUTION

Failure to do this will cause damage to the next film run through the projector.

1-66. OPERATING WITH MICROPHONE. Although not included with the projector, a high-impedance microphone may be used with the equipment. The output impedance of the microphone should be 150,000 ohms. When using a microphone, proceed as follows:

a. Connect power cable to AC power receptacle (figure 1-8) on the projector and into the 115-volt AC power supply. Be sure to ground the cable.

b. Make certain that the loudspeaker selector switch is in the proper position for local or external loudspeaker operation.

c. Turn the amplifier ON-OFF switch to the ON position. Allow 45 to 60 seconds for the tubes to warm up.

d. Set the VOLUME control in the extreme counterclockwise position.

e. Connect the microphone to the input marked MICROPHONE (figure 1-8).

f. Adjust the VOLUME and TONE control (figure 1-7) for the best sound reproduction.

1-67. OPERATING WITH TURNTABLE. Although not included with the projector, a high-impedance turntable may be used with the equipment. The input receptacle marked MICROPHONE (figure 1-8) will accept a connecting plug of the turntable cable.

a. Connect the power cable to the AC power receptacle (figure 1-8) and into the 115-volt AC power source.

b. Connect the turntable cable into the input marked MICROPHONE (figure 1-8).

c. Set the amplifier VOLUME control to the extreme counterclockwise position.

d. Turn the amplifier power switch to the ON position. Allow 45 to 60 seconds for the tubes to warm up.

e. Make certain that the loudspeaker selector switch is in the proper position for local or external loudspeaker operation.

f. Operate the turntable and make sound adjustments with the VOLUME control and TONE control until the sound is satisfactory.

SECTION II

SPECIAL SERVICE TOOLS

NOTE

No special tools or equipment items are required for the maintenance services delegated to operating personnel. It is recommended that operating personnel do not proceed beyond the maintenance procedures outlined in Sections III and IV of this instruction book.

SECTION III

PERIODIC INSPECTION AND LUBRICATION

3-1. PERIODIC INSPECTION.

Component	Nature of Inspection	Inspection Time
Projection lens	Clean external glass surfaces. Examine for cracks, scratches or chipping.	Daily
Projection lamp reflector	Clean glass reflecting surface. Examine for dents, chips or other damage.	Daily
Condensing lens	Clean exposed glass surface.	Daily
Sound optical unit	Clean external glass surfaces.	Daily
Sound drum	Clean surface that contacts film.	Daily
Aperture plate	Inspect and clean.	Daily
Pressure plate	Inspect and clean.	Daily
Projection lamp	Inspect and clean. Replace if exceptionally black or burned out. See paragraph 4-14.	Daily
Film sprocket shoes	Inspect and clean.	Daily
Take-up and rewind belts	Check and replace if necessary.	Daily
Film sprockets	Inspect and clean.	Daily
Take-up pulleys	Inspect; clean if necessary.	Daily
Rewind pulleys	Inspect; clean if necessary.	Daily
Exciter lamp	Check lamp. Replace if bulb is exceptionally dark. See paragraph 4-16.	50 Hours
Lubrication system	Check per paragraph 3-2.	100 Hours
Film sprockets	Inspect for burrs. Remove burrs if present.	100 Hours
Feed and take-up reel spindles	Inspect for smooth running operation.	100 Hours
Film rollers	Inspect and clean. Check for free rolling.	100 Hours
Condensing lenses	Inspect inner glass surfaces; clean.	100 Hours
Motor and governor brushes	Inspect, replace if necessary.	300 Hours
Exciter lamp	Inspect and replace if necessary.	300 Hours
Connecting cables	Make continuity test, inspect terminals.	300 Hours
Electron tubes	Inspect. Test, replace if necessary.	300 Hours
Feed and take-up reel spindles	Inspect; clean.	25 Hours

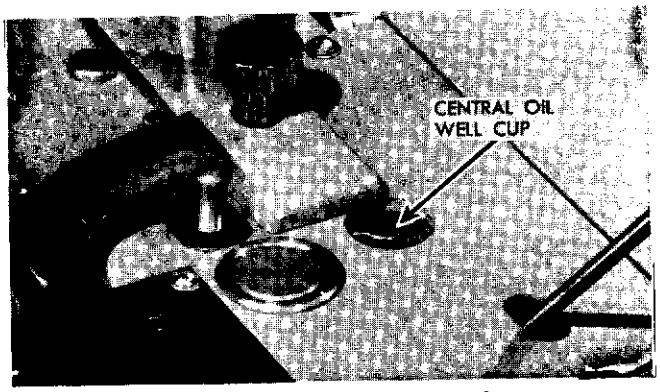

Figure 3-1. Central Oil Well Cup — AQ-2A(1) Projectors

3-2. LUBRICATION.

3-3. LUBRICATION OF INTERNAL PARTS. Internal lubrication for the AQ-2A(1) projectors is supplied through a one-point feed lubrication system. Oil is applied to the central oil well cup (figure 3-1) on top of the projector case and is fed through oil tubing to all internal mechanism bearings and to the intermittent mechanism reservoir. On AQ-2A(3) projectors, the oil well cup and tubing have been eliminated. A felt pad below the shutter and shuttle camshafts is saturated with oil and feeds all parts of the intermittent mechanism through a system of felt wicks. All projectors should be lubricated only with oil bearing Military Symbol 2135H. It will not be necessary to lubricate these wicks in the fields. Wicks should be replaced at the 1000-hour overhaul of equipment.

CAUTION

Over-oiling should be avoided. Never permit excess oil to reach parts of the machine other than those designed for lubrication. Oil in the wrong places may cause damage, blurred pictures, and distorted sound.

3-4. LUBRICATION OF EXTERNAL PARTS. Use only Military Symbol 2135H oil for lubrication. On AQ-2A(1) projectors, apply a drop of oil at each of the following points at the times indicated. (1) Film guide roller sets every 100 hours of operation or every 60 days. (2) Film guide roller shafts every 250 hours of operation. (3) Chain idler rollers every 500 hours of operation. Except for the belt idler pulleys, all AQ-2A(3) rollers are equipped with oilite bearings and need be lubricated only every 500 hours unless removed for cleaning or unless the projector is overhauled.

SECTION IV

MAINTENANCE

4-1. TROUBLE SHOOTING.

Trouble	Probable Cause	Remedy
Motor operates but projection lamp does not light.	a. MOTOR-LAMP switch not turned to LAMP position.	a. Turn MOTOR-LAMP switch to LAMP position.
	b. Projection lamp not seated correctly in socket, contact poor.	b. Check to see that lamp is inserted properly.
	c. Projection lamp burned out.	c. Replace with new lamp. Refer to paragraph 4-14.
	d. MOTOR-LAMP switch defective or wiring defective.	d. Return to overhaul depot for repair.
Picture indistinct, illumination low.	a. Projection lamp improperly seated in socket.	a. Reinsert lamp correctly.
	b. Projection lamp old, black and ready to burn out.	b. Replace lamp. Refer to paragraph 4-14.
	c. Dirty reflector, condenser lenses, projection lens.	c. Clean these optical elements. (Paragraphs 4-3 to 4-5.)
	d. Projection lamp position adjustment incorrect.	d. Adjust lamp socket position for maximum light. Refer to paragraph 4-15.
	e. Dirty or poor quality screen.	e. Wash dirty screen. If canvas screen, replace with matte white screen material.
	f. Low line voltage.	f. Check line voltage.

Trouble	Probable Cause	Remedy
Picture not sharp on screen. One side or entire picture may not be sharp.	a. Improperly focused.	a. Focus lens.
	b. Projection lens dirty, oily or finger-spotted.	b. Clean lens with lens tissue. Refer to paragraph 4-3.
	c. Pressure plate not seated firmly against film in aperture channel.	c. Push pressure plate closing handle.
	d. Film loops too short.	d. Rethread projector with proper sized loops.
	e. Bad film. Insufficient pressure plate tension.	e. Check projector with good film.
	f. Defective projection lens.	f. Replace lens.
	g. Pressure plate and/or aperture plate worn.	g. Return to overhaul depot for repair.
Fuzz projecting in picture area.	a. Dirt in aperture opening.	a. Clean aperture using brush supplied. CAUTION: Projector must be stopped.
Picture unsteady; jump or weave.	a. Improper threading.	a. Rethread projector correctly.
	b. Pressure plate not seated firmly against film in picture channel.	b. Push pressure plate closing handle.
	c. Many consecutive film perforations damaged excessively.	c. Remove damaged section of film and splice.
	d. Poorly made splices.	d. Check film, remake splices.
	e. Improper slitting of film; poor filming of picture.	e. Check with film known to be in good condition.
	f. Projector requires general overhaul for replacement of worn parts.	f. Return to overhaul depot for repair.
Picture travel ghost. Vertical lines observed on screen above and/or below white objects.	a. Defective projection lamp.	a. Replace lamp. Refer to paragraph 4-14.
	b. Projection lamp out of adjustment.	b. Adjust. Refer to paragraph 4-15.
	c. Shutter out of time with intermittent mechanism.	c. Adjust shutter to synchronize with intermittent. Refer to paragraph 4-26.
Picture satisfactory, but no sound.	a. Amplifier ON-OFF switch not in ON position.	a. Turn switch to ON position.
	b. Loudspeaker selector switch in wrong position.	b. Place switch in correct position.
	c. Loudspeaker not connected.	c. Connect loudspeaker to amplifier.
	d. Photocell amplifier cable defective or disconnected.	d. Check cable.
	e. Exciter lamp burned out.	e. Replace exciter lamp. Refer to paragraph 4-16.

Trouble	Probable Cause	Remedy
Picture satisfactory, but no sound (cont).	f. Amplifier tubes defective.	f. Check tubes, especially the 6AQ5 exciter lamp oscillator tube V205. Replace all defective tubes. Refer to paragraph 4-21.
	g. Defective speaker.	g. Replace speaker. Refer to paragraph 4-25.
	h. Damaged photocell or defective amplifier.	h. Replace photocell (par. 4-26) or return to overhaul depot for repair.
Inadequate sound volume.	a. VOLUME control not turned up sufficiently.	a. Turn up VOLUME control.
	b. Defective amplifier tube (s).	b. Check, replace defective tube (s). Refer to paragraph 4-21.
	c. Dirt or oil partly obstructing sound optical system.	c. Clean sound optical elements. Refer to paragraph 4-10.
	d. Dirty or defective exciter lamp.	d. Clean lamp. Refer to paragraph 4-9. If trouble persists replace exciter lamp (paragraph 4-16).
	e. Low line voltage.	e. Check line voltage.
	f. Defective photocell.	f. Replace photocell as instructed in paragraph 4-26.
Popping noise from speaker when operating with film.	a. Dirt on back edge of sound drum.	a. Clean thoroughly. Refer to paragraph 4-6.
	b. Dirt on sound lens or light pipe.	b. Clean thoroughly. Refer to paragraph 4-10.
	c. Dirty sound track.	c. Clean film.
	d. Poor sound track on film.	d. Check by reproducing film of known sound quality.
Microphonics — denoted by continuous bell or string-like noises.	a. Defective tube.	a. Check and replace as needed. Refer to paragraph 4-21.
	b. Defective exciter lamp.	b. Replace with new lamp. Refer to paragraph 4-16.
Distorted sound reproduction.	a. Defective tubes.	a. Check, replace bad tubes. Refer to paragraph 4-21.
	b. Defective exciter lamp.	b. Replace exciter lamp. Refer to paragraph 4-16.
	c. Bad sound track.	c. Adjust tone control, if trouble persists, check and/or replace film.
	d. Worn film sprockets.	d. Return to overhaul depot for repair.
	e. Defective amplifier loudspeaker or wiring. Sound optical system out of adjustment.	e. Return to overhaul depot for repair.

Trouble	Probable Cause	Remedy
Projector fails to take up film properly.	a. Belt off pulley on take-up arm or off take-up ratchet pulley in projector.	a. Loop belt on pulley (s).
	b. Bent or stretched take-up belt.	b. Replace with new belt. Refer to paragraph 4-19.
	c. Film not attached to hub of reel.	c. Attach film securely to hub.
	d. Take-up reel bent and jammed on arm.	d. Replace reel.
	e. Take-up reel slipping on spindle.	e. Latch reel securely.
	f. Two lock nuts on take-up arm too tight or too loose.	f. Adjust accordingly.
	g. Slippage in take-up ratchet pulley assembly.	g. Return to overhaul depot for repair.
Projector fails to rewind film properly.	a. Plunger on feed reel arm set in improper position.	a. Plunger should be IN for rewinding.
	b. Spring belt off pulley.	b. Loop belt over pulley.
	c. Bent or stretched rewind belt.	c. Replace with new belt. Refer to paragraph 4-19.
	d. Two lock nuts on feed reel arm too tight or too loose.	d. Adjust accordingly.
	e. Slippage in rewind ratchet pulley assembly.	e. Return to overhaul depot for repair.
	f. Oilite bronze washer in feed reel arm assembly is worn.	f. Return to overhaul depot for repair.
Motor speed varies or projector runs too fast.	a. Governor or governor wiring troubles.	a. Return to overhaul depot for repair.
Projector does not function.	a. Projector fuse blown.	a. Replace fuse.
	b. Faulty electrical wiring or components.	b. Return to overhaul depot for repair.

4-2. CLEANING INSTRUCTIONS.

4-3. PROJECTION LENS. Remove the projection lens by loosening the lens locking screw and withdrawing the lens from its carriage. If only a slight amount of dust has accumulated on the lens surface, remove the dust with lens cleaning tissue, a camel's hair brush, or by blowing air across the surface with a syringe bulb. If wiping does not remove the dust, breathe on the lens and polish with lens cleaning tissue. If, however, fingerprints, oil, grease or other accumulations of dirt are present, place a drop or two of pure grain alcohol on the glass surface and follow with a thorough polishing with lens cleaning tissue. Fingerprints should be removed at once, otherwise they may become etched in the lens. Wipe surfaces dry and avoid leaving fingerprints or lint. Do not attempt to take the lens apart. It is necessary only to clean the external surfaces of the lens element.

4-4. PROJECTION LAMP REFLECTOR. The reflector (figure 4-1) is accessible for cleaning without removal from the projector. Open the lamphouse cover and remove dust or dirt from the reflector by using a camel's hair brush or by blowing air across its surface with a syringe bulb. Remove all stains, if present, with lens cleaning tissue. If necessary, use a drop or two of pure grain alcohol, to dissolve the oil, and wipe the reflector surface dry. Avoid leaving fingerprints.

4-5. CONDENSING LENS ASSEMBLY. The condensing lens assembly must be removed from the projector for cleaning. Open the lamphouse cover and remove the projection lamp by pressing the lamp well downward, turning it 90 degrees in a counterclockwise direction as far as it will go, and lifting the lamp free of its socket. Place the thumb of the left hand on top of the condensing lens lock lever (figure 4-1) and

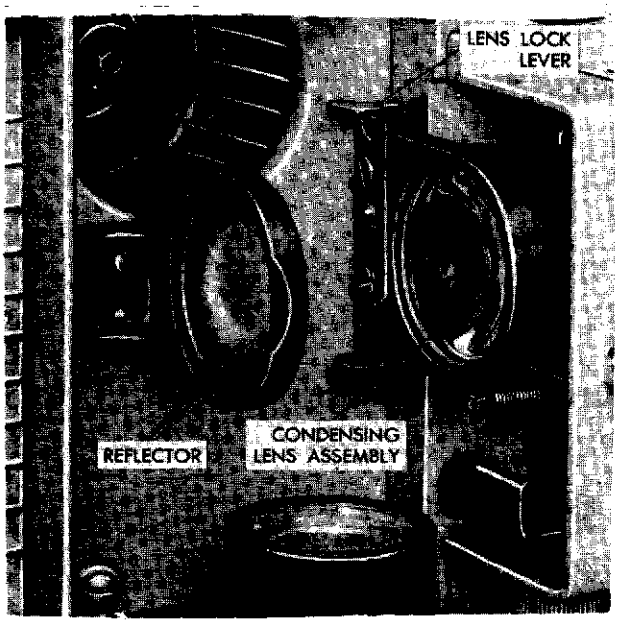

Figure 4-1. Reflector and Condensing Lens

forefinger on the lower end of the housing. Apply pressure to depress the lock spring; then pull the entire assembly toward the reflector until it is free. Remove the front lens lock spring and separate the lens from the housing as shown in figure 4-2. Clean the glass surfaces of both lenses with a camel's hair brush or lens cleaning tissue. If necessary, place a drop or two of pure grain alcohol on the lenses; clean thoroughly and wipe dry. After cleaning, reinstall the front lens with the lens lock spring. Be careful to avoid leaving fingerprints. Press down on the condensing lens lock lever and insert the complete assembly back into its opening in the projector. Reinstall the lamp and close the lamphouse cover.

4-6. SOUND DRUM. The sound drum must be handled very carefully because the bearings are delicate. Any damage to them will result in excessive sound flutter. While rotating the sound drum with the forefinger, remove all dirt and lint from its surface with a clean, soft, lint-free cloth. If any foreign substances remain on the drum, they may be removed by rubbing gently with a cloth dampened in pure grain alcohol. Be sure to remove any traces of lint on the inner edge of the drum, as this will cause a regular popping noise from the loudspeaker each time a piece of lint or dirt passes the scanning beam.

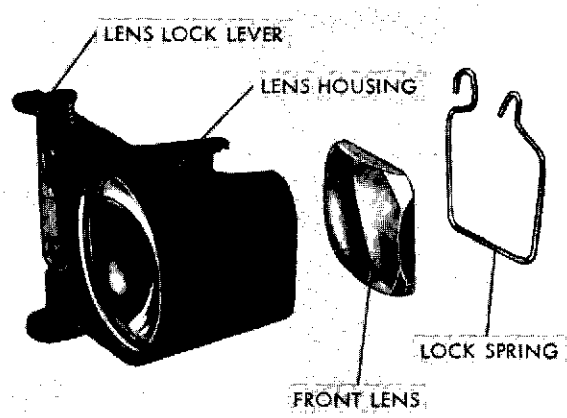

Figure 4-2. Condensing Lens, Partial Disassembly

CAUTION

When cleaning with alcohol, use alcohol sparingly to avoid the danger of washing foreign material off the drum and onto the various neighboring parts of the projector.

4-7. FILM SPROCKETS AND SHOES. Clean all three film sprockets and shoes with the aperture brush furnished with the equipment, or with a bristle brush (such as a toothbrush) moistened with pure grain alcohol. The alcohol will soften the dirt and emulsion for easier removal. Be sure to remove all traces of dirt or caked emulsion. To facilitate the cleaning procedure, move the film shoes away from the sprockets and run the projector while cleaning the sprockets. Stop the projector and clean the film shoes thoroughly, removing dirt and caked emulsion with the aperture brush. The film shoes must be perfectly clean, otherwise film may be damaged during operation of the projector.

4-8. FILM GUIDE ROLLERS. Each film guide roller should be rotated and all dirt, lint, and film emulsion removed from it with the aperture brush. If necessary, use pure grain alcohol to soften the dirt and emulsion for easier removal.

4-9. PROJECTION AND EXCITER LAMPS. The projection lamp is accessible through the lamphouse cover. Never clean this lamp while it is hot. Wipe the lamp with a clean, soft, lint-free cloth or lens tissue. Avoid leaving fingerprints on the clear areas of the lamp, as fingerprint smudges will decrease the illumination. Remove the exciter lamp cover to expose the exciter lamp. Clean this lamp with a clean cloth or lens tissue. Avoid leaving fingerprints.

4-10. SOUND LENS. Remove the exciter lamp cover. The sound lens, with one face exposed toward the exciter lamp and the other face exposed toward the sound drum, should be cleaned by blowing air across the two external surfaces of the lamp with a syringe bulb. Remove any remaining dust or dirt with camel's hair brush, then wipe the lens surface clean with lens tissue.

CAUTION

Do not disrupt the setting of this lens or attempt to remove the lens from the projector. Such a procedure requires special training and precision instruments. It is necessary only to clean the external surfaces of the lens. After cleaning, replace the exciter lamp cover.

4-11. PRESSURE PLATE. Do not remove pressure plate while projector is running. Open the film channel by pulling out the pressure plate release knob (fig-

ure 1-13). Grasp the pressure plate handle and pull the pressure plate toward you until it is free of the projector. Clean the film handling surface of the plate with the aperture brush. Remove caked emulsion by softening it with pure grain alcohol and rubbing the emulsion from the pressure plate with a smooth stick or toothpick. Be sure to remove all dirt from the edges of the rectangular opening in the pressure plate.

CAUTION

Never use a metal object to clean the pressure plate. When returning the pressure plate to its proper operating position, be sure that it seats properly on the clip and that it is pushed all the way into position.

4-12. APERTURE PLATE. Do not attempt to remove the aperture plate while the projector is running. First remove the pressure plate as instructed in paragraph 4-10. Retract the shuttle by turning the threading knob (figure 1-4). Then remove the aperture plate by grasping the thumb handle at the top of the assembly and pulling upward, then outward, until the aperture plate is free of the mechanism (figure 4-3). With the aperture brush, remove all traces of dirt or caked emulsion from the entire film-contacting surface of the plate. If the aperture brush does not remove every particle of caked emulsion, pour a few drops of pure grain alcohol on a clean cloth and rub the cloth over the aperture plate surface. The alcohol will soften the caked emulsion and make it easier to remove with the aperture brush or with a small stick or toothpick. Be sure to remove accumulated dirt or dust from under the edges of the aperture.

CAUTION

Under no circumstances should a metal object be used in cleaning the aperture plate. Such a metal object could scratch the highly polished surfaces of the aperture plate and cause later damage to the film. When reinstalling the aperture plate, place the retaining slots of the plate over the guides on the aperture plate mounting brackets. Push the plate downward as far as it will go. It is very important that the aperture plate be down all the way.

4-12A. BELT PULLEYS. Belt pulleys must be cleaned of accumulated dirt, oil, grease, or belt particles, whenever required. Clean channels of both take-up and both rewind pulleys with a lint free cloth and solvent cleaner, Federal Spec. No. TT-T-548.

4-13. PROJECTOR MAINTENANCE.

4-14. PROJECTION LAMP REPLACEMENT.

a. Open the lamphouse cover and remove the lamp by pressing down firmly and turning the lamp 90 degrees in a counterclockwise direction until it is released from its socket.

CAUTION

To avoid severe burns never attempt to remove the projection lamp while it is hot wihout adequate protection to the fingers such as a glove or cloth.

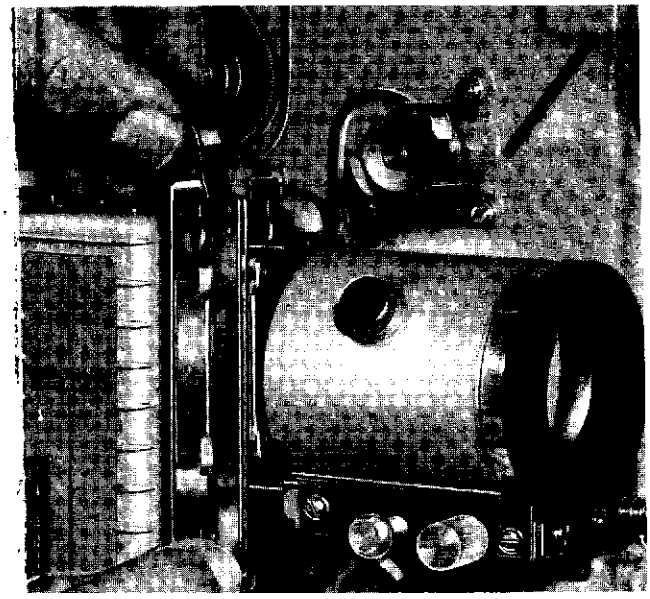

Figure 4-3. Removing the Aperture Plate

b. When installing a new projection lamp, line up the wide and narrow flanges on the base of the lamp with the lamp socket slots and insert the lamp into the socket. Press the lamp down firmly and turn it in a clockwise direction until it locks in place. Wipe the clear portion of the lamp with a clean cloth or lens tissue to remove fingerprints.

c. After installing the new lamp, project the light on the screen and focus the image of the aperture. Should the light be uneven, adjust the position of the lamp as directed in paragraph 4-15.

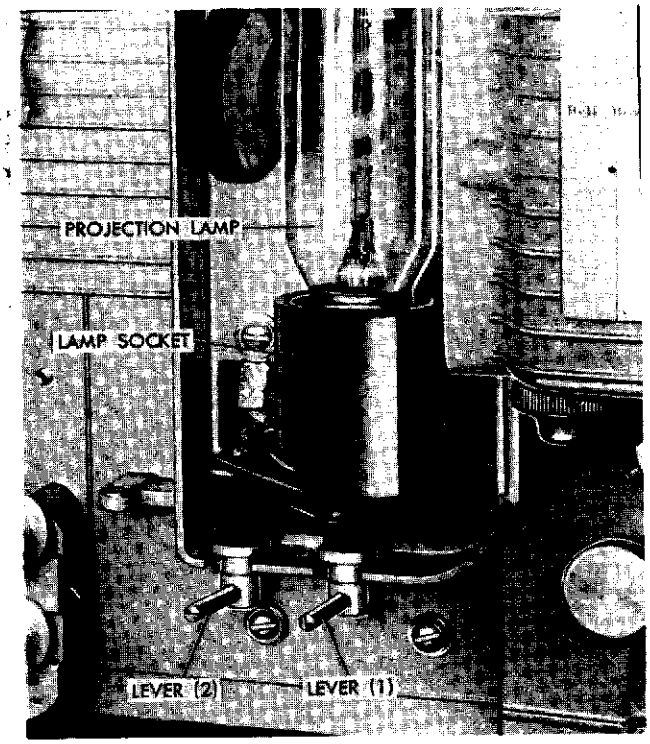

Figure 4-4. Projection Lamp Adjusting Levers

4-15. PROJECTION LAMP ADJUSTMENT.

a. Adjustment levers (figure 4-4) are used to adjust the projection lamp to the most uniform illumination. Lamp adjustment lever (1) moves the lamp socket in and out. Lamp adjustment lever (2) moves the lamp socket backward and forward.

b. Manipulate the two adjustment levers until the image of the aperture on the screen is uniform and most brilliantly illuminated. Correct adjustment should produce a uniform brilliance.

c. If adjustment does not produce uniform brilliance on the screen, the new lamp is unsatisfactory and should be replaced with another lamp.

4-16. EXCITER LAMP REPLACEMENT.

a. Make certain that the power to the projector has been disconnected. Then remove the exciter lamp cover by turning the knurled thumbscrew in a counterclockwise direction until the cover can be lifted from the projector.

b. Move the exciter lamp release and locking ring (figure 4-5) to its extreme right hand position. This will release the registration pins and permit the lamp to be lifted from the socket.

c. When installing a new exciter lamp, place the lamp base openings over the appropriate registration pins and turn the exciter lamp release and locking ring to its extreme left hand position. This will seat the lamp firmly in place.

d. Wipe the exciter lamp with a clean cloth or with lens cleaning tissue to remove fingerprints. The exciter lamp is prefocused and no adjustment of this lamp or its socket is required. Reinstall the exciter lamp cover.

4-17. PILOT LAMP REPLACEMENT. The projector is provided with two pilot lamps. The pilot lamp on the projector mechanism panel serves as a threading lamp, while the pilot lamp on the projector switch panel serves to illuminate the switch panel plate. Both lamps are provided with a standard candelabra screw base. To remove either lamp, unscrew the lamp shield; then unscrew the lamp.

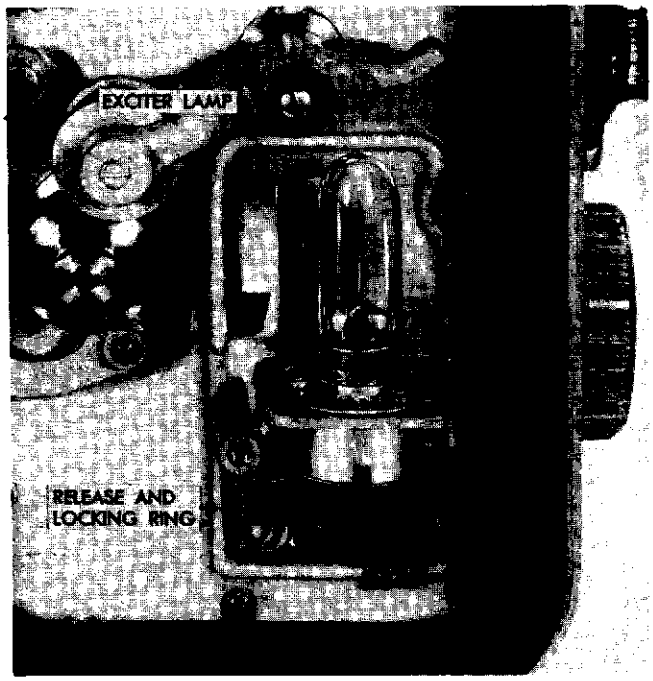

Figure 4-5. Exciter Lamp Exposed

4-18. FUSE REPLACEMENT. Make certain that the projector power cable has been disconnected from the power source before attempting to remove a projector fuse. Remove fuse by unscrewing the fuse post with a screwdriver. Never replace a fuse with one of a higher rating than the fuse supplied with the projector. One projector fuse is used on Type AQ-2A(1) projectors and two are used on Type AQ-2A(3) projectors.

4-19. BELT REPLACEMENT.

a. On AQ-2A(1) projectors, replace the spring belt as follows: Insert the smaller threaded end of the new spring belt down through the belt opening in the top of the projector case. Pass it around its belt drive pulley and up through the other belt opening in the projector case, making certain that the belt is not crossed. While holding the larger, female end of the spring belt in the left hand, twist the formed threaded end of the belt toward you (counterclockwise) the same number of turns as there are formed threads on the end of the belt. This method of belt installation will leave the belt without any tendency to curl or twist. (See figure 4-6.)

b. The AQ-2A(3) projector is equipped with fabric belts. Engage lower end of the replacement belt with its proper pulley, and bring the belt up through the slot in the top of the projector case. With the reel arm thumb screw unscrewed and the locating pins disengaged from the holes in the case, hold the reel arm in position, but with the top tilted forward. Loop the fabric belt over the reel arm pulley and lower the arm back down into place on the projector case, making certain that the locating pins engage their holes. Tighten the thumb screw. Proper belt tension is maintained by loosening the idler pulley screw and rotating the pulley eccentric. When properly adjusted, it should be possible to hold the take-up reel and the belt should continue to drive the clutch. To check feed reel belt adjustment, touch the reel intermittently during rewind. The belt should not slow down or falter when the reel is touched.

4-19A. MOTOR BRUSH REPLACEMENT. Drive motor and blower motor brushes can be inspected and, if necessary, replaced by removing the complete amplifier assembly from the projector (paragraph 4-24) to expose the motors. Remove brush caps with a screwdriver. On Type AQ-2A(3) projectors, a plugged hole in the bottom of the projector case permits access to the lower drive motor brush. Inspect brushes for wear. If drive motor brushes are worn to less than 7/16-inch in length or blower motor brushes are worn to less than 5/16-inch in length, brushes should be replaced. New brushes should be seated with a brush seating hone. When reinstalling original brushes, make sure that the brush is installed with the arc at the tip of the brush matching the curve of the commutator.

4-20. AMPLIFIER MAINTENANCE.

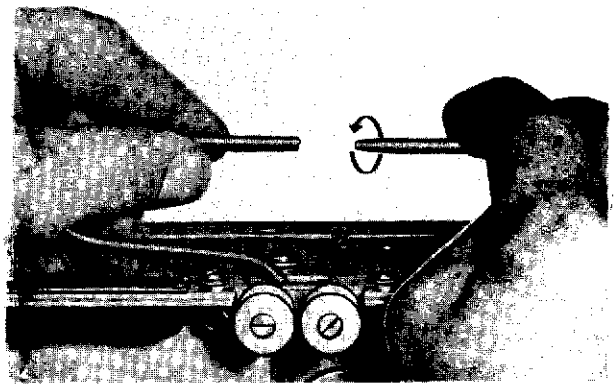

Figure 4-6. Spring Belt Replacement

4-21. TUBE REPLACEMENT. Loosen the three Dzus fasteners and remove the tube grille (figures 1-2B and 1-6). Note the spare tubes (figure 1-2B) for AQ-2A(3) projectors. If possible, extract tube by a direct upward pull. Rock it gently, if it does not release easily. Jiggling the tube in its socket during removal will spread the tube socket contacts unnecessarily.

4-22. PILOT LAMP REPLACEMENT. The pilot lamp illuminates the amplifier switch panel. Unscrew the lamp and shield from the switch panel opening. Twist the shield slightly and remove the lamp from the shield.

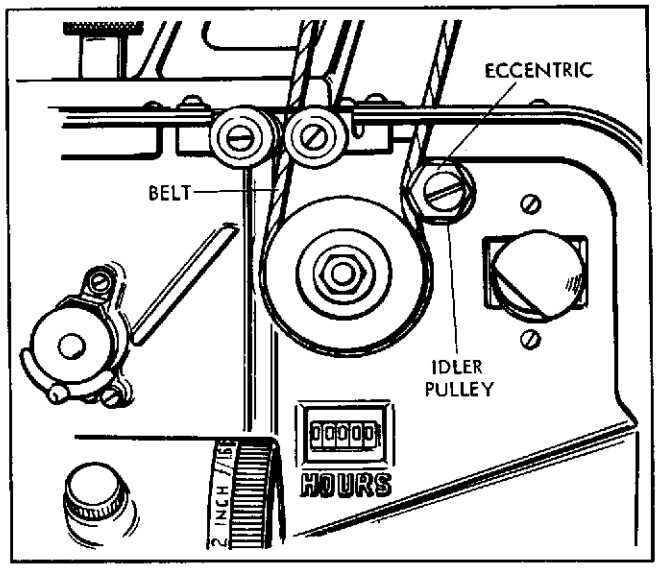

Figure 4-6A. Fabric Belt Replacement

4-23. FUSE REPLACEMENT. To remove the fuse (see figure 1-6) twist the fuse holder cap counter-clockwise one-half turn. Never replace the fuse with one of higher rating (1-amp slow-blow for AQ-2A(1), 0.8-amp slow-blow for AQ-2A(3)).

4-24. COMPLETE AMPLIFIER REPLACEMENT.

a. Remove the six screws and lockwashers that attach the top, front and bottom of the edge of the amplifier to the projector case.

b. Carefully lift the complete amplifier away from the projector case. Do not remove the amplifier too far away, since many of the cables and leadwires are still connected between the projector and amplifier.

c. Remove the three screws and lockwashers that attach the projector switch housing to the amplifier housing.

d. Brace or block the amplifier securely while disconnecting all leadwires and plugs. Label these plugs and leadwires for later reinstallation.

e. Hold or block the replacement or repaired amplifier as close to the projector as possible so that the leadwires can be reconnected to their proper terminals.

f. Carefully slide the amplifier into position against the projector case, aligning the screw holes in the case and amplifier housing. Install the three screws and lockwashers that fasten the projector switch panel housing to the rear edge of the amplifier housing. Install the six screws and lockwashers into the holes in the top, front and bottom of the amplifier housing.

4-25. LOUDSPEAKER REPLACEMENT.

a. Remove the six screws and lockwashers that fasten the speaker panel to the amplifier housing. Carefully lower panel to expose speaker and cable.

b. Disconnect the speaker plug from the receptacle in the amplifier housing.

c. Remove the four screws and nuts that fasten the speaker to the panel.

d. Lift the defective speaker from the panel and install the new speaker with the four screws and nuts. Plug the speaker cable into its receptacle and fasten the speaker panel to the amplifier case with the seven screws and lockwashers.

4-26. PHOTOCELL REPLACEMENT.

a. Remove the amplifier from the projector as instructed in paragraph 4-24.

b. Remove flywheel screw (figure 4-7) and pull the flywheel from the projector. Handle the flywheel with care and place it where it will not become damaged in any way. Excessive flywheel damage will result in impaired sound quality.

c. Remove the seven special screws and inner cut lockwashers that secure the sound head assembly to the mechanism plate, and carefully withdraw the complete sound head assembly from the projector until the photocell cover is exposed.

d. Loosen the knob on the photocell cover and remove the cover, exposing the photocell.

e. Disconnect the terminal lugs of the photocell leadwires from the terminal block. Note the manner in which the photocell mounts in place. Then remove the two round head screws and spring lockwashers that fasten the photocell in place.

f. When installing the new photocell, make sure that the flat face of the integral bracket is resting against the bosses of the photocell adjustment plate. Then install the attaching screws and lockwashers. Reconnect photocell leadwires.

g. Fasten photocell cover back in place and reinstall the sound head assembly. When inserting the sound head assembly into the opening in the mechanism plate, the two roller assemblies at the left must be raised so that they will rest on their respective studs when the assembly is in place. Tighten the seven attaching screws securely.

h. Install the flywheel onto the stabilizer shaft and secure it with the special screw. Then reinstall the amplifier assembly to the projector as instructed in paragraph 4-24.

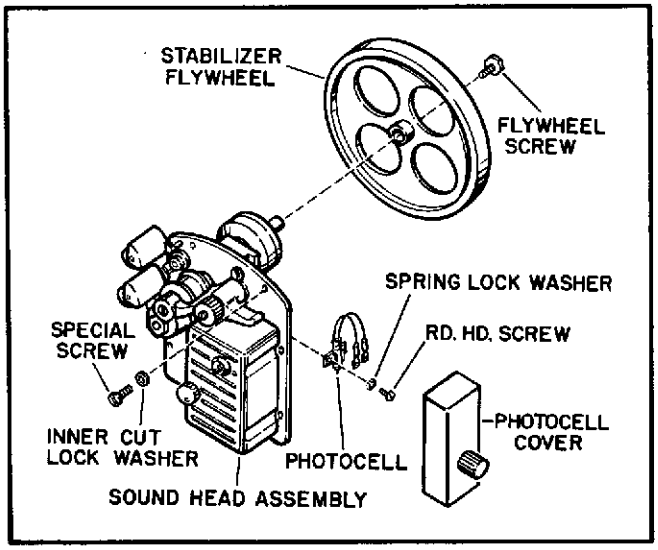

Figure 4-7. Photocell Replacement

4-27. CORRECTING TRAVEL GHOST.

a. Travel ghost, which consists of white vertical streaks at the top or bottom of the picture, indicates that the shutter blades do not completely shut off the light while the film is moving. This condition is most noticeable on titles. Correction is made by synchronizing the shutter with the intermittent mechanism (shuttle and cams).

b. If travel ghost is seen at the top of the picture, the shutter is lagging behind the intermittent mechanism. To correct this condition, loosen the three binder head screws holding the shutter to the shutter shaft (figure 4-8) and rotate the blades slightly in a clockwise direction. Tighten screws after adjustment.

c. If travel ghost is seen at the bottom of the picture, the shutter is slightly in advance of the intermittent mechanism. To correct this condition,

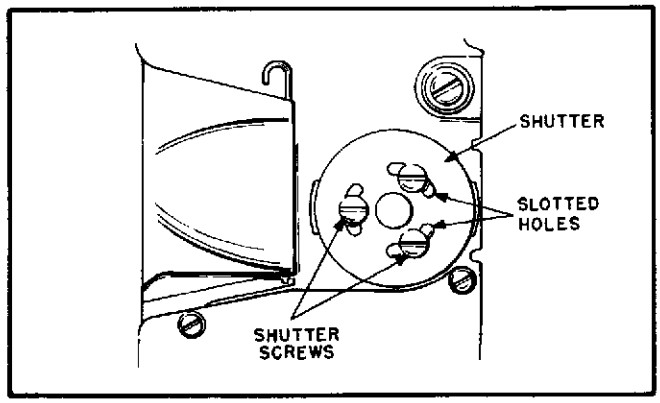

Figure 4-8. Correcting Travel Ghost

loosen the three binder head screws holding the shutter to the shutter shaft, and rotate the blades slightly counterclockwise. Tighten the screws securely after adjustment.

4-28. TESTING THE EQUIPMENT.

4-29. FILM TENSION TEST.

a. Place a 400-foot reel with ten feet of film on the feed reel and attach a 3-ounce weight to the end of the film. The braking action on the feed reel should be just great enough to permit the weight to pull the film downward. If necessary, adjust the large hex nut at the rear end of the feed reel spindle until the braking action is correct; then tighten the spindle cap nut securely.

b. Place a fully-loaded 2000-foot reel on the take-up reel spindle and thread film through the projector (paragraph 1-60). Hook a calibrated spring scale (0 to 18 ounces) to the free end of the film and turn on the projector motor. The take-up should subject the film to not more than 8 ounces nor less than 2 ounces after the projector stabilizes (runs smoothly). If necessary, adjust the large hex nut at the rear end of the take-up reel spindle to meet the requirement. Then tighten the spindle cap nut securely.

c. Place a 400-foot reel with 10 feet of film on the take-up reel spindle, and hook the spring scale to the free end of the film. Turn on the projector motor and note the tension. Tension should be between 2 and 8 ounces after the projector stabilizes.

4-30. OPERATING TEST.

a. Without film in the projector, project light on the screen to check illumination. Focus the aperture on the screen so that the projected image is approximately 40 inches wide by 30 inches high. The edges of the aperture should appear sharp, and patches or bands (indicating variations of color or brightness) should not appear on the screen.

b. Thread the projector with film (paragraph 1-60), and start the projector. Check the steadiness of the projected picture and note the framing. Framing lines should be at the edge of the image and can be adjusted with the framing knob.

c. With the projector running, listen for any unusual noises or sounds which might indicate worn or damaged gears, insufficient lubrication, bent or distorted drive chains, and so forth.

d. Check sound reproduction by operating the amplifier TONE and VOLUME controls.

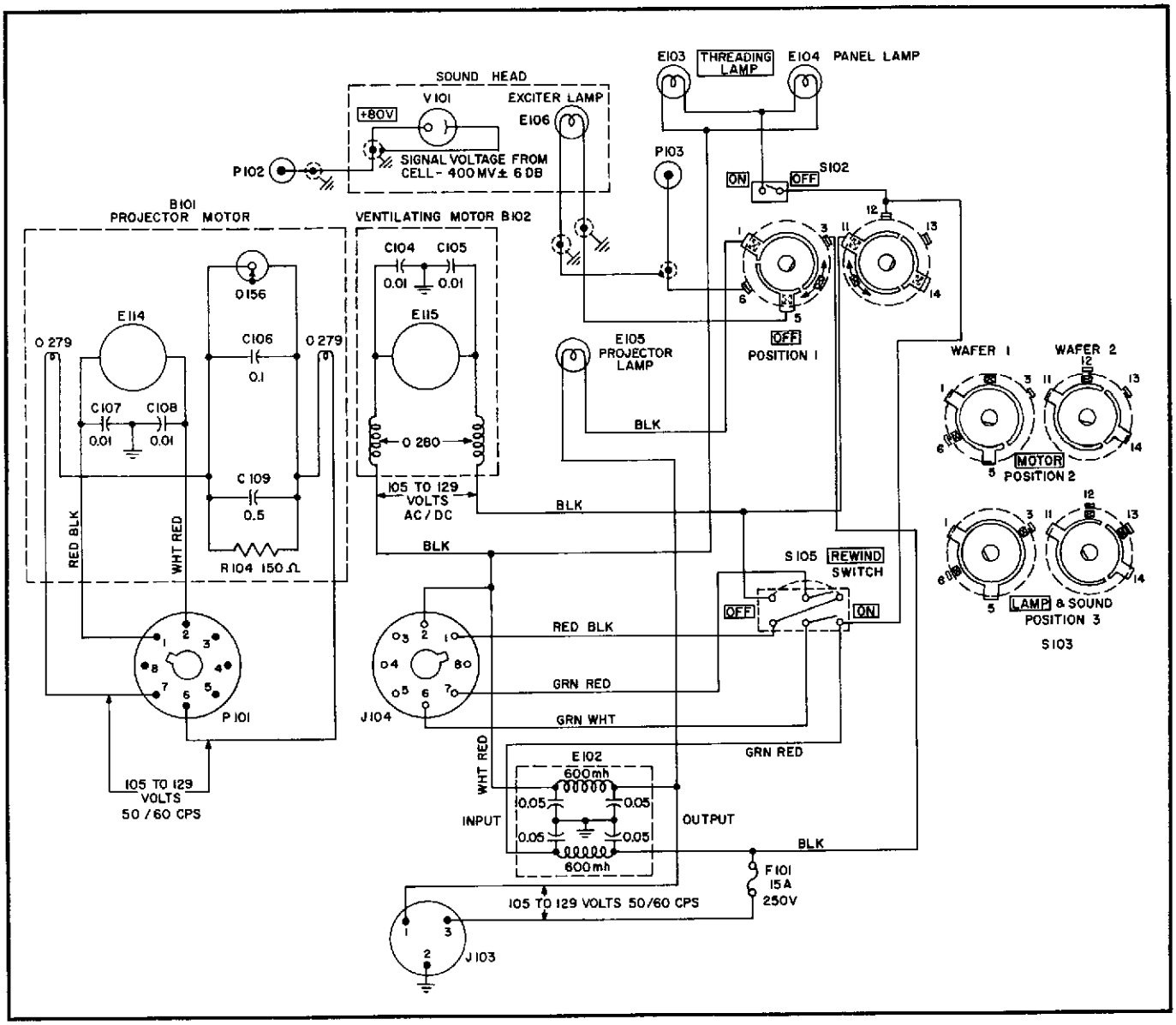

Figure 4-9. Projector Schematic Diagram (up through Serial No. P98999)

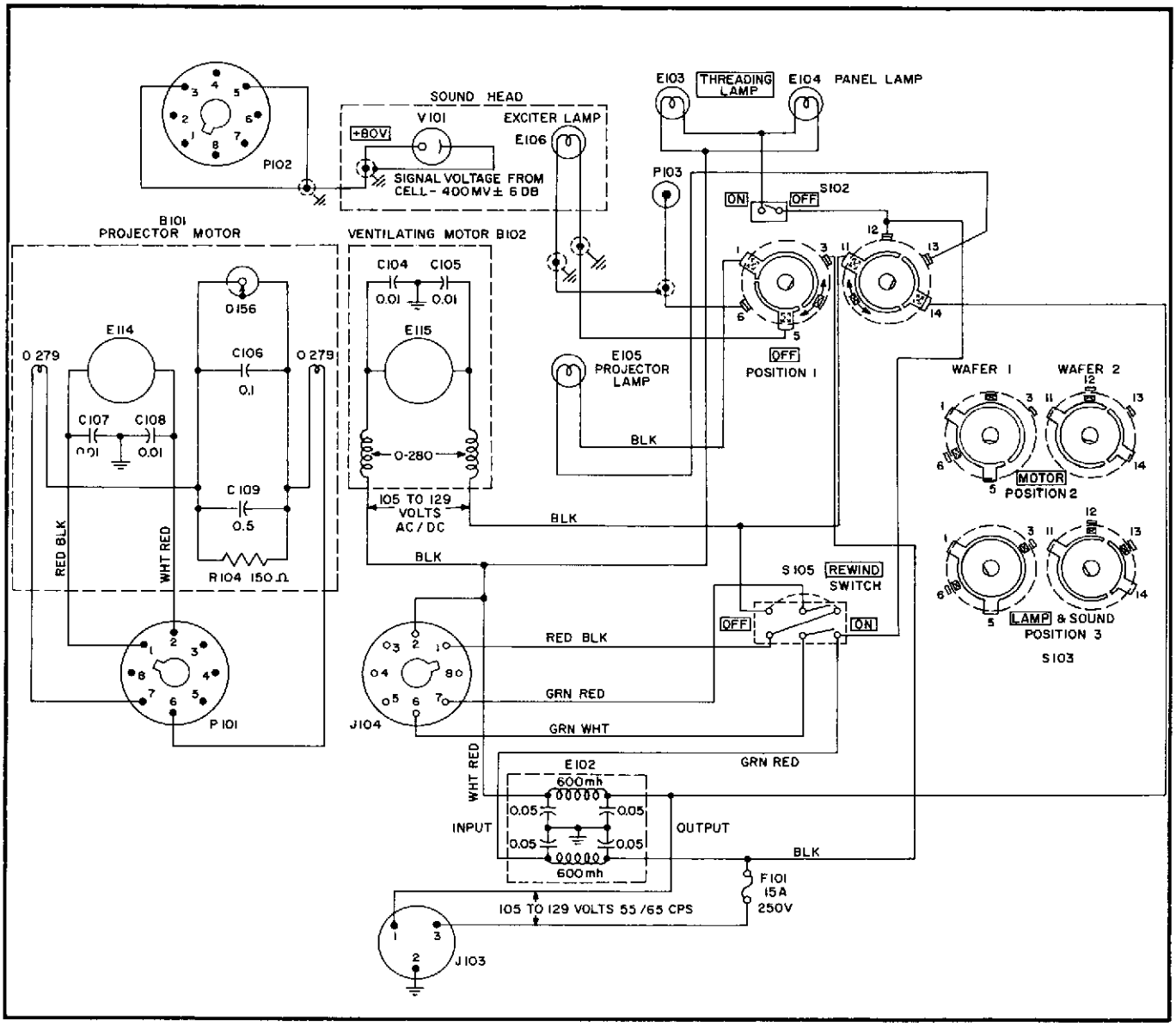

Figure 4-10. Projector Schematic Diagram (Serial No. P99000 through P99576)

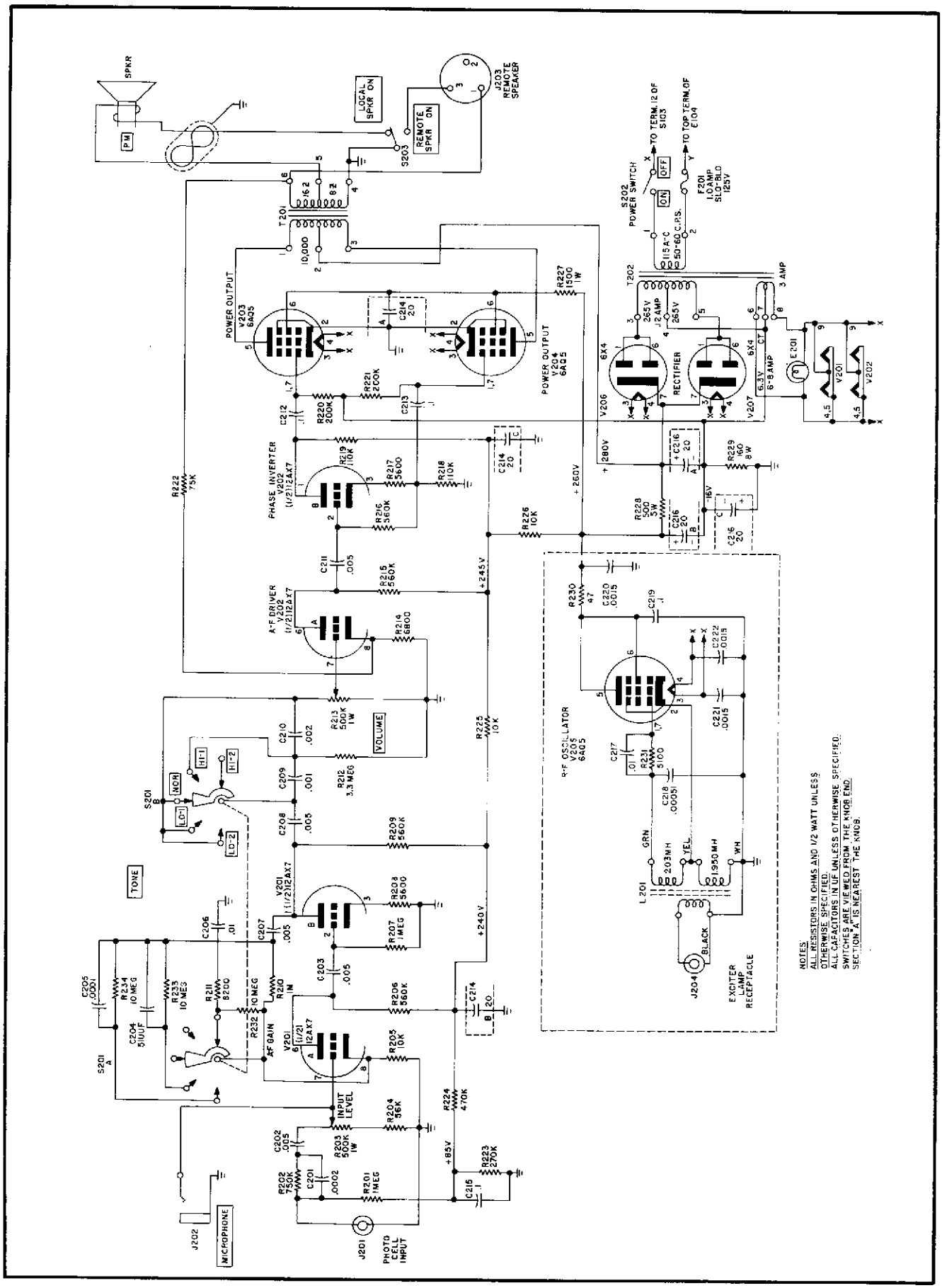

Figure 4-11 Amplifier Schematic Diagram (up through Serial No. P98999)

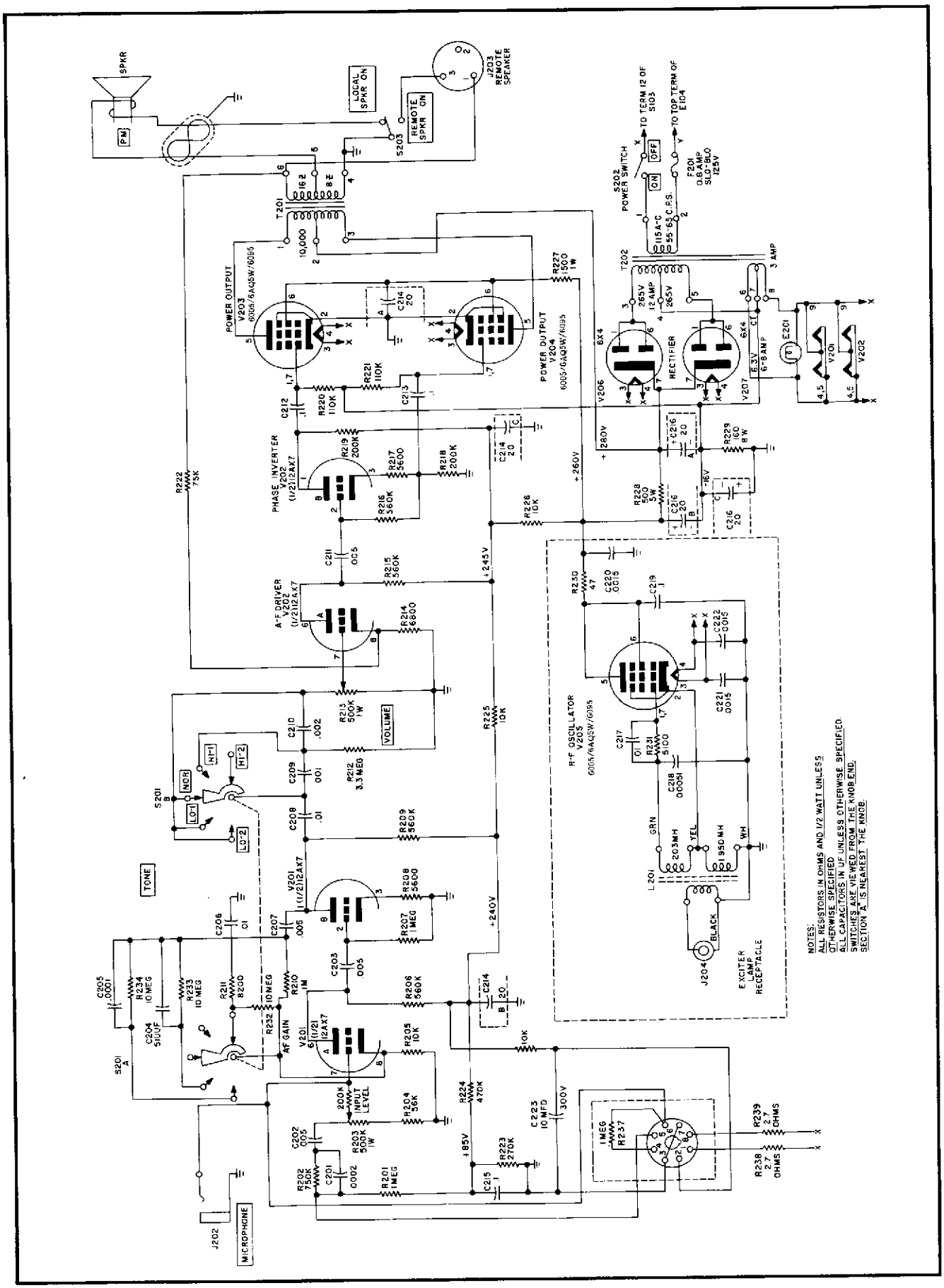

Figure 4-12. Amplifier Schematic Diagram (Serial No. P99000 through P99576)

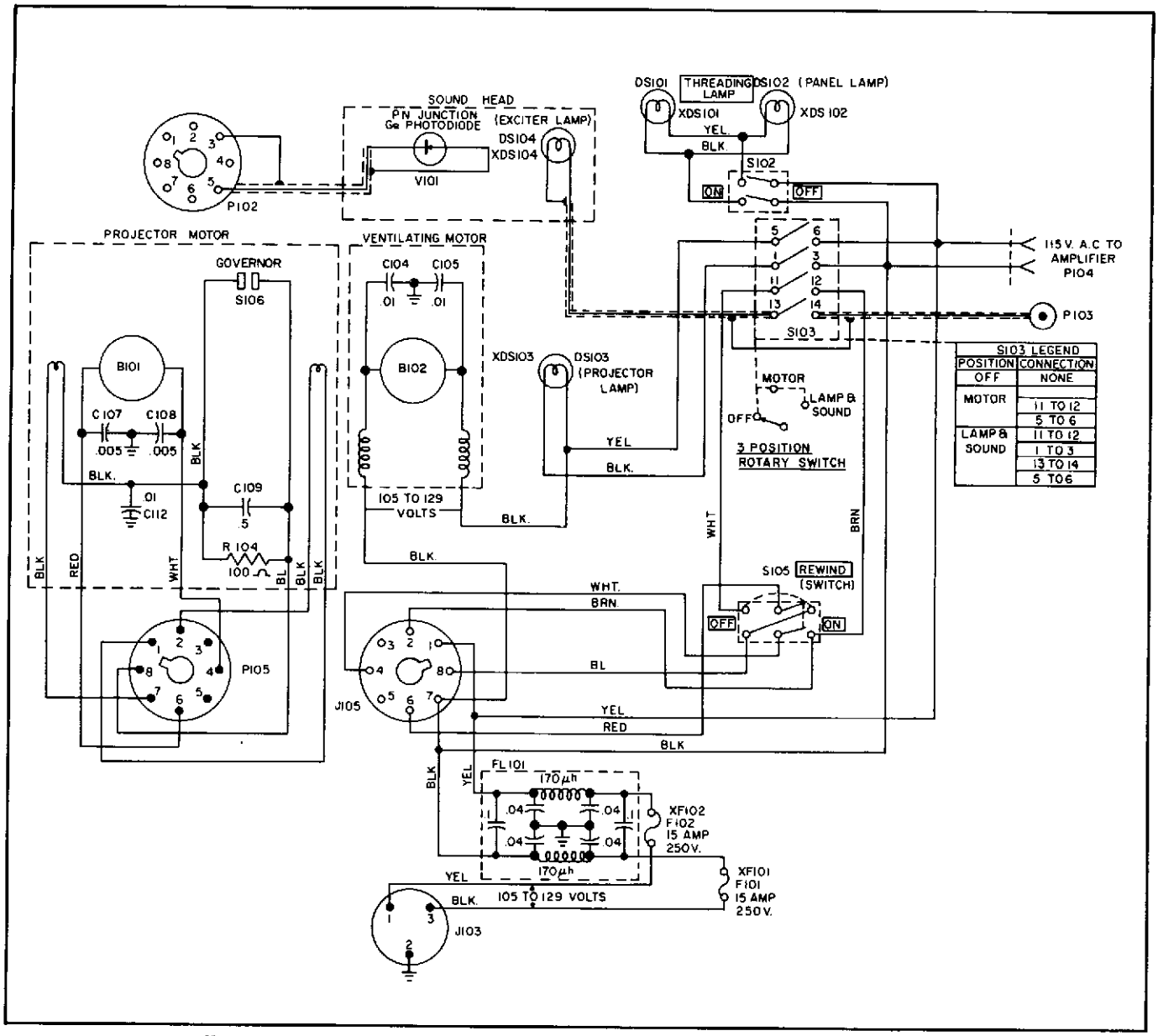

Figure 4-13. Projector Schematic Diagram — Type AQ-2A(3) Projectors

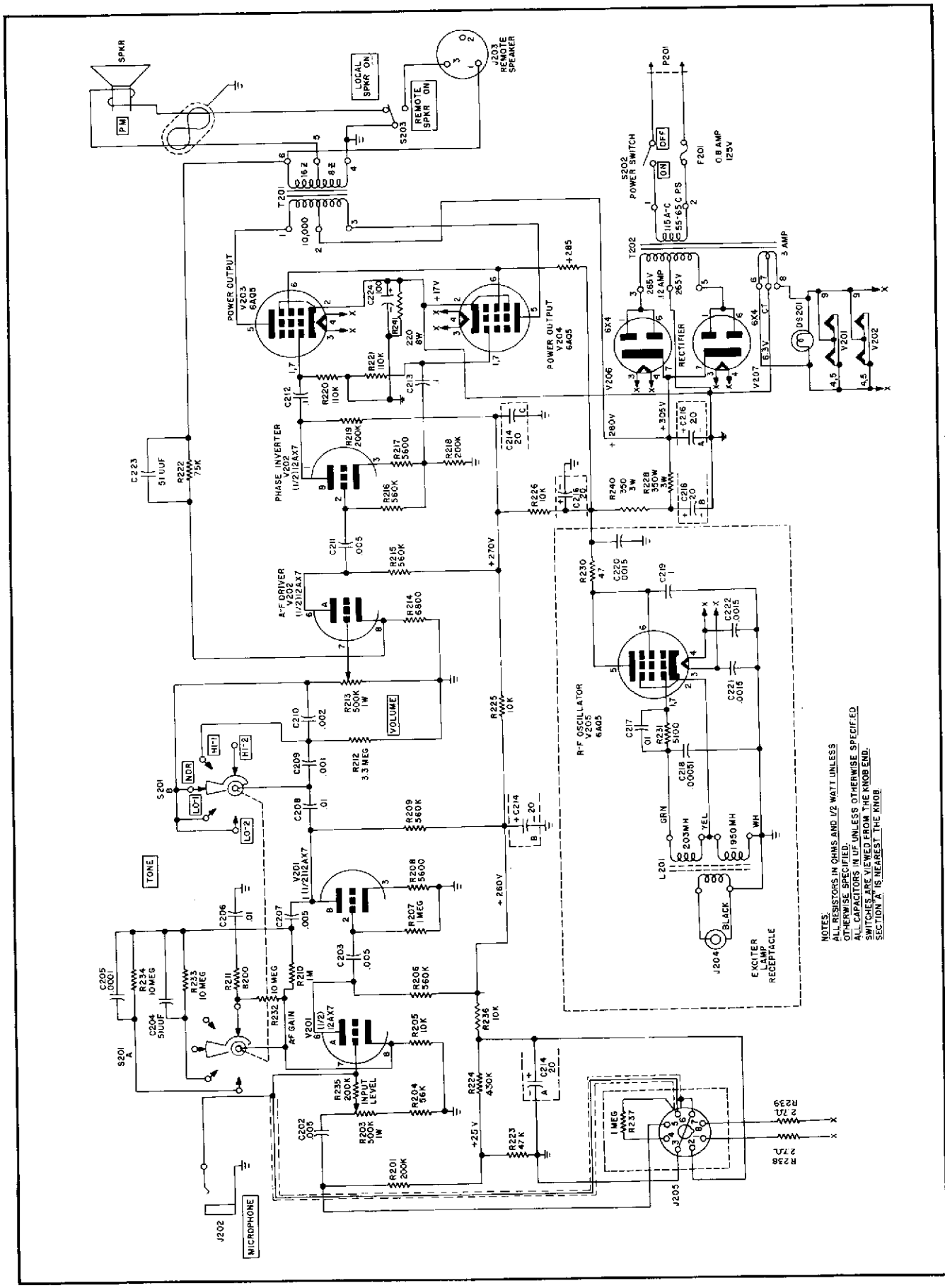

Figure 4-14. Amplifier Schematic Diagram — Type AQ-2A(3) Projectors