INSTRUCTIONS

12

RCA 400 PORTO-ARC 16MM PROJECTOR

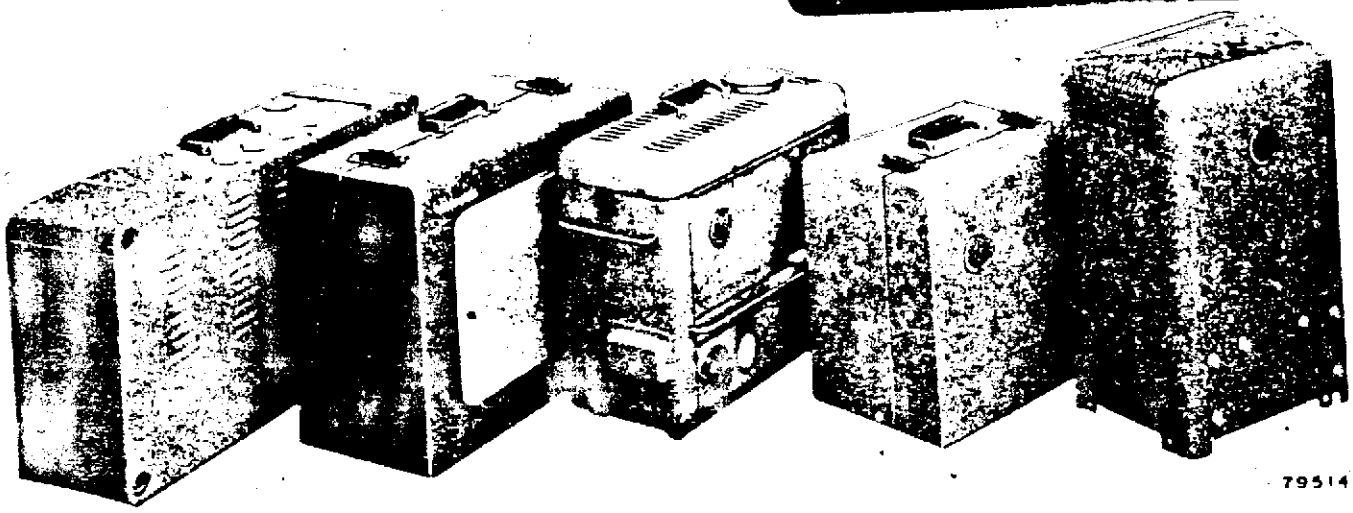

Figure 1 — RCA 400 Porto-Arc 16 mm Projector Equipment

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IMPORTANT: Read these instructions carefully before installing and operating the equipment. This equipment must be operated from an a-c power source of the frequency and voltage specified on the nameplate. If there is doubt concerning the power available, consult the electric-power company.

LIST OF ILLUSTRATIONS

TECHNICAL DATA

NOTE: The instructions contained in this manual also apply to the 50-cycle equipment.

Power Required

105 to 125 volts, 15 amperes
60 cycles (MI-1315, MI-1315-A, MI-1315-B)
50 cycles (MI-1315-F, MI-1315-AF, MI-1315-BF)

Projection Lens

Speed f/1.8
Focal Length: 2½ inches
Coated on all air to glass surfaces

Sound Lamp

¾ ampere, 4-volt prefocused
S-8 double contact
BGB/BGK

Tube Complement

2 RCA 6J7
2 RCA 6L6G
2 RCA 6SL7GT
1 RCA 6V6GT
1 RCA 5U4GB
1 RCA 921 PHOTOTUBE

Amplifier Fuse

2 amperes, Type 3AG, Slo-Blo

Amplifier Output

25 watts

WARNING

Do not operate the equipment on any power frequency other than that specified on nameplate.

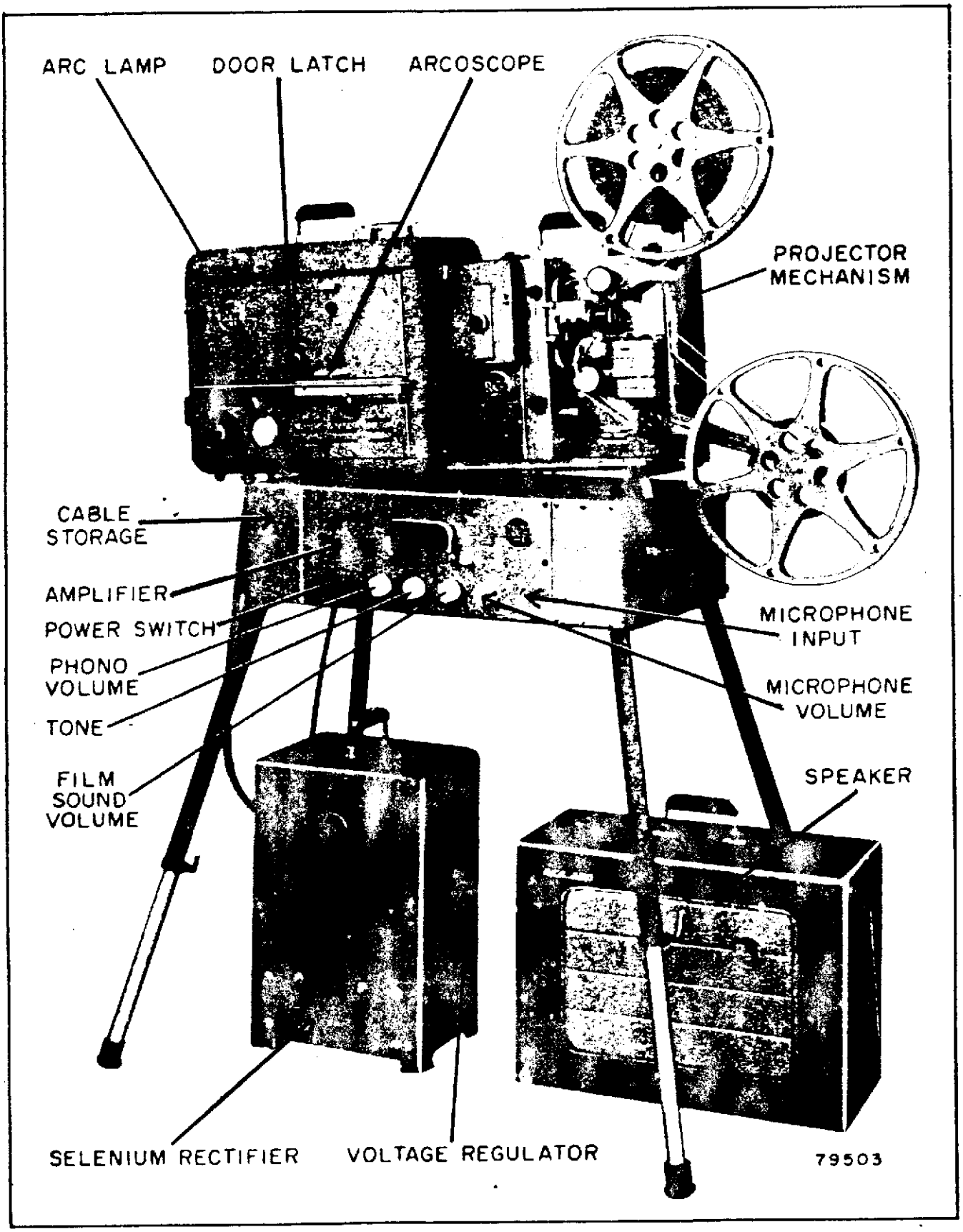

Figure 2 — Equipment Assembled for Operation

DESCRIPTION

Application

The RCA Model 400 Porto-Arc 16mm Motion Picture Equipment is portable deluxe equipment designed for high quality presentation of 16mm sound and silent motion films. It can be set up for operation in any suitable location where power of the required frequency, voltage and current capacity is available — see nameplate on equipment.

This equipment can be used with a microphone or a phonograph for public address either simultaneously with silent pictures or independently of projection. It is also designed to give excellent quality reproduction of full color motion pictures.

Components

The equipment consists of the following five basic units in matching cases or housings:

1. Projector Mechanism (Part 1 of MI-1315, 1315-A, 1315-AF, 1315-B or 1315-BF)

2. Pedestal-Amplifier Assembly (Part 2 of MI-1315, 1315-A, 1315-AF, 1315-B or 1315-BF)

3. Arc Lamp (Part 3 of MI-1315, 1315-A, 1315-AF, 1315-B or 1315-BF)

4. Rectifier (MI-1325, MI-1325-A, MI-1325-B, 30 ampere; or MI-1324, 10 ampere, as ordered)

5. Loudspeaker (MI-1312-A, MI-1312-B or MI-1312-C — one or more when ordered separately)

The Projector Mechanism is equipped with a semi-automatic combination dowser and fire shutter which closes automatically when the film speed of the projector falls for any reason to 14 frames per second, thus preventing accidental film damage. It also includes a condenser lens and a heat filter mounted in a pull-out holder which is locked in place by a small knob. The heat filter is a separate unit and can be removed from the holder by sliding it out of the guide rails. A blower for cooling the condenser lens and film gate assembly is included and is controlled by the projector motor switch. The MI-1315, MI-1315-A and MI-1315-B Mechanisms are designed for 60-cycle operation and the MI-1315-F, MI-1315-AF and MI-1315-BF for 50-cycle operation.

The Pedestal Assembly (combination amplifier carrying case and projector supporting pedestal) has separate compartments to contain its demountable legs and the inter-connecting cables. It also incorporates a tilting mechanism in the front end, which is operated by a fold-in crank. This tilting mechanism allows the picture to be exactly adjusted to the proper position on the screen over a range of about five degrees. In some cases, of course, an "up" projection angle is required and in others a "down" projection angle; these requirements are met by the adjustable length legs which are provided, and they also allow the height of the projector optical axis to be adjusted to suit existing projection room port holes. The same Pedestal Assembly serves for both 50 and 60 cycle equipment.

The amplifier is designed to provide audio power output of 25 watts with film sound, microphone or phonograph input. It can be used to drive a single MI-1312-A, MI-1312-B, MI-1312-C or MI-35014 Loudspeaker, or a number of these P.M. type speakers connected to present an impedance of 4, 8 or 16 ohms to the corresponding amplifier output connections. Connections for impedances of 164 ohms ("70 volt lines") and 500 ohms are also available.

Mounted on the amplifier panel, from left to right, are the following controls and input connectors: Amplifier Power Switch, Phono Volume, Tone Control, Film Sound Volume, Microphone Volume, and Microphone Input, see figure 2. The phonograph input circuit is a high-impedance one, designed to accommodate the crystal-pickup output circuits of standard record players. As supplied, the microphone input circuit is likewise high-impedance, but the amplifier design includes a chassis socket into which an MI-12399 Transformer may be plugged to provide a balanced 250 ohm low-impedance circuit suitable for long microphone lines, say from the auditorium stage.

The Arc Lamp is designed to operate with either the standard Pearlex carbon trim (carbons) which are designed to burn at 30 amperes with a D.C. potential drop of 28-volts across the arc, or with a newly-designed, low current carbon trim which burns at 10 amperes and 50 volts arc drop. The 30 ampere trim with heat filter in place should deliver to the screen approximately 1300 lumens of light. The 10 ampere trim without the heat filter in place (not necessary) should deliver approximately 750 lumens, which is over twice that available from the ordinary incandescent lamp 16mm projector.

For maximum operator safety an interlock switch actuated by the arc lamp door disconnects the arc rectifier from the power supply circuit as the door is opened.

An "arcoscope" having two calibrated lines scribed on a white screen for correct positioning of the burning carbons with respect to the lamp optical system is provided on the outside of the arc lamp door. Windows having filter glasses suitable for direct observation of the arc and carbon positions are also provided in the door. To provide for the differences in carbon

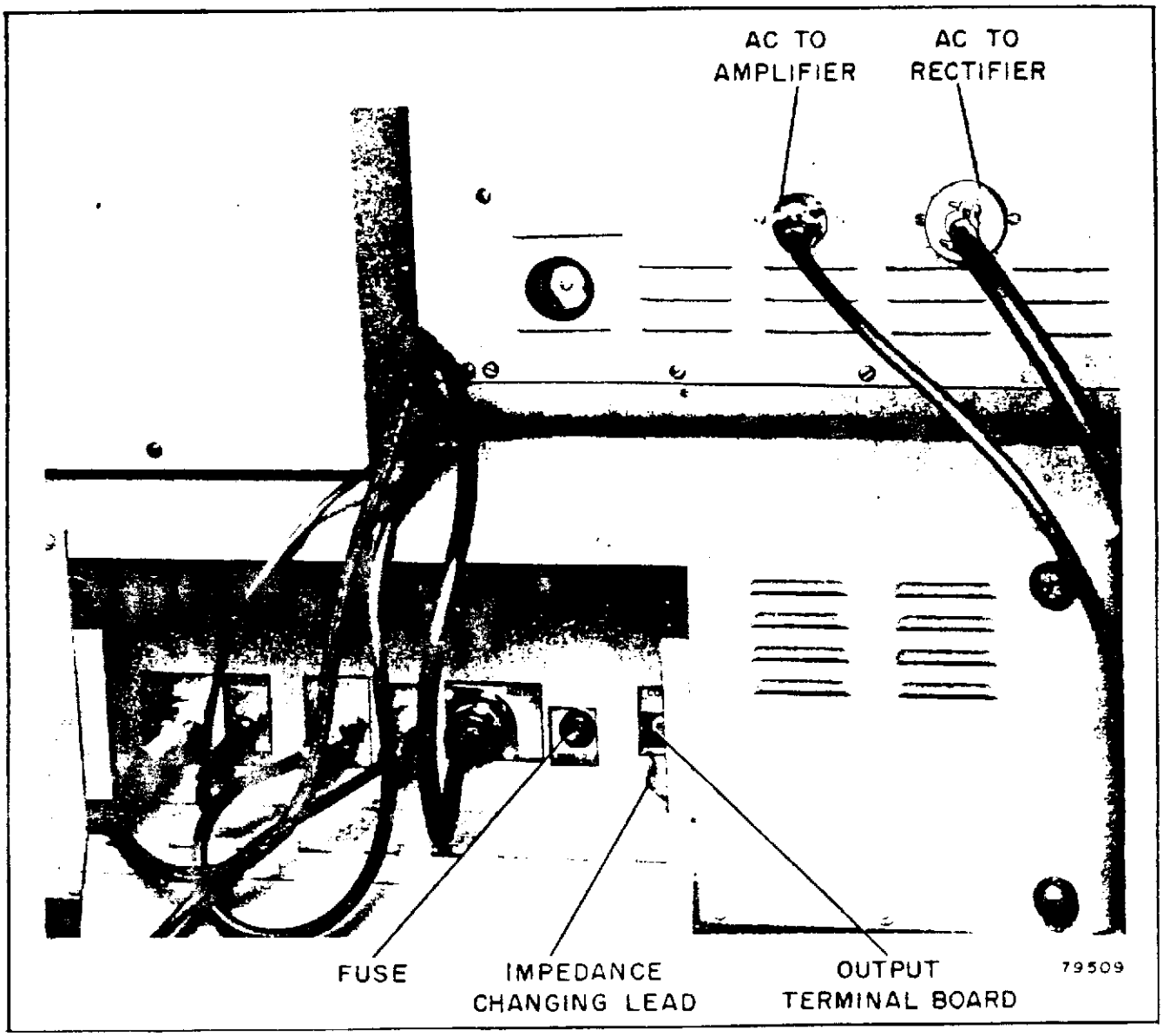

Figure 3 — View of Nonoperating Side of Amplifier with Cables Connected

feed rates between the 30 and 10 ampere carbon trims, a speed changing device is included at the rear of the arc lamp. The carbon feed mechanism ceases feeding when the carbon stubs burn down to approximately two inches in length, and the feeding mechanism does not start until the arc is struck, thus preventing accidental damage to the carbon holders.

An elliptical reflector approximately seven and one-half inches in diameter is mounted on a vertical baffle within the arc lamp by a three-point, spring-seated suspension. The center of the mirror is almost three inches in back of the arc to reduce fogging tendencies from arc gases. Two control knobs extending to the back of the arc lamp from the reflector's spring-mounted frame provide tilt and training adjustments for uniform illumination of the projector mechanism aperture.

The Arc Rectifiers, MI-1324, MI-1325, MI-1325-A, and MI-1325-B are used to convert alternating current from the power line to direct current required for proper operation of the arc. The MI-1325 Rectifier uses two 15 ampere tubes to supply 30-ampere output. The MI-1325-A and MI-1325-B, 30-Ampere Rectifiers, are selenium type full wave rectifiers, the MI-1324, 10-Ampere Rectifier, uses two 6 ampere tubes. All rectifiers are provided with primary tap switches to accommodate varying line voltage and load conditions.

MI-1312-A, 1312-B or 1312-C Speaker Carrying Case includes a powerful 10" cone speaker of the permanent magnet type with a voice coil impedance of six ohms. The MI-35014 Auxiliary Speaker Carrying Case includes a P.M. speaker with 16 ohms voice coil impedance.

ASSEMBLING AND CONNECTING EQUIPMENT

Setting Up

Assemble and connect the equipment in the following manner:

1. Turn the latches with a coin and open the door in the rear end of the amplifier case; remove the legs from the storage compartment.

Screw the legs all the way into the sockets provided for them on the bottom of the amplifier case, which with legs attached, comprises the arc lamp and projector supporting pedestal. Make certain that the legs are seated firmly in their sockets, and adjust the lengths of the legs to obtain the correct projection angle and the desired machine height. Rotate the clamping collars so the leg clamping levers are turned inward, and not protruding outward from the legs in a hazardous manner. Tighten the leg clamps securely by hand so there will be no danger of the legs collapsing as the additional weight of the projector and lamp are added.

2. Unfold the elevating crank on the front of the amplifier case and turn it clockwise until the elevating pins protrude approximately one-half (1/2) inch above the top surface of the housing. This will facilitate locating the projector mechanism in proper engagement with the pins. Remove the front cover from the projector mechanism and set it in place so that the brackets on its lower front surface engage the elevating pins. Open the door in the amplifier carrying case, on the nonoperating side or on the side opposite the amplifier control panel, by turning the two locks with a coin; connect the plugs of the three connection cables from the projector mechanism to their mating receptacles within this compartment, see figure 3. The plugs and receptacles are aranged so that they cannot be incorrectly connected. The screw-type holding rings on the two shielded cable connectors should be screwed on with reasonable firmness to insure good electrical connection of the cable shields.

3. Assemble the arc lamp to the projector mechanism in the following manner: crank the elevating pins downward so that the brackets at the front of the projector mechanism rests on the top of the amplifier case. Set the arc lamp on the amplifier case to the rear of the projector mechanism so the pins in the nickel-plated bracket at its lower front edge drop into the corresponding holes in the rear edge of the projector mechanism base. Crank up the elevating mechanism to bring the long cowl-type fastening pin just above the projector picture gate into alignment with the corresponding socket in the front of the arc lamp housing. Engage the pin in the socket and turn the pin's handle one-half turn clockwise to firmly lock the lamp and mechanism together.

4. Withdraw the connecting cables from the pedestal-amplifier's rear storage compartment. They have been provided with suitable plugs to prevent incorrect connections. The longest cable having a twistlock female plug in one end and a parallel blade plug on the other is the main 117 volts ac power supply cable to the equipment. This should be connected by #12 wire or larger extension cable (or permanently installed wiring) to a circuit of the building wiring capable of supplying at least 15 amperes at 117 volts, 60 cycle, or 50 cycle. Consult the nameplate on the projector to determine the correct frequency. Fuses or breakers to protect the circuit must be of at least 15 ampere rating, slo-blow or timelag type. Refer to figures 4 and 5.

There are two sockets on the under side of the arc lamp at the rear end. Insert the female plug of the 117 volts ac power cable in its mating socket at the left (viewed from the rear end of the arc lamp). The large diameter cable having twist-lock plugs at each end is used to carry direct current from the rectifier to the arc lamp. Connect its female plug to the right hand socket underneath the arc lamp, and connect the male plug at the opposite end of the cable to its corresponding socket on the rectifier. The small diameter cable with plugs at each end is used to carry alternating current from the arc lamp to the rectifier. See figure 3. Connect the male plug on this cable to the socket on the nonoperating side of the arc lamp, and connect the female plug to its mating socket on the rectifier. To protect the operator, the alternating current for the rectifier is passed through door-operated mercury switches within the arc lamp so that the current is interrupted and the rectifier ceases to supply direct current as soon as the arc lamp door is opened. Refer to figure 4. Insert the parallel blade plug, which is attached to the permanently connected short cable coming from the amplifier, in the mating socket on the nonoperating side of the arc lamp.

5. The door on the nonoperating side of the pedestal-amplifier case provides access to the amplifier's output jack and terminal board, see figure 3. The sound output jack and the impedance changing screw terminals are in parallel to accommodate either permanent or portable speaker connections.

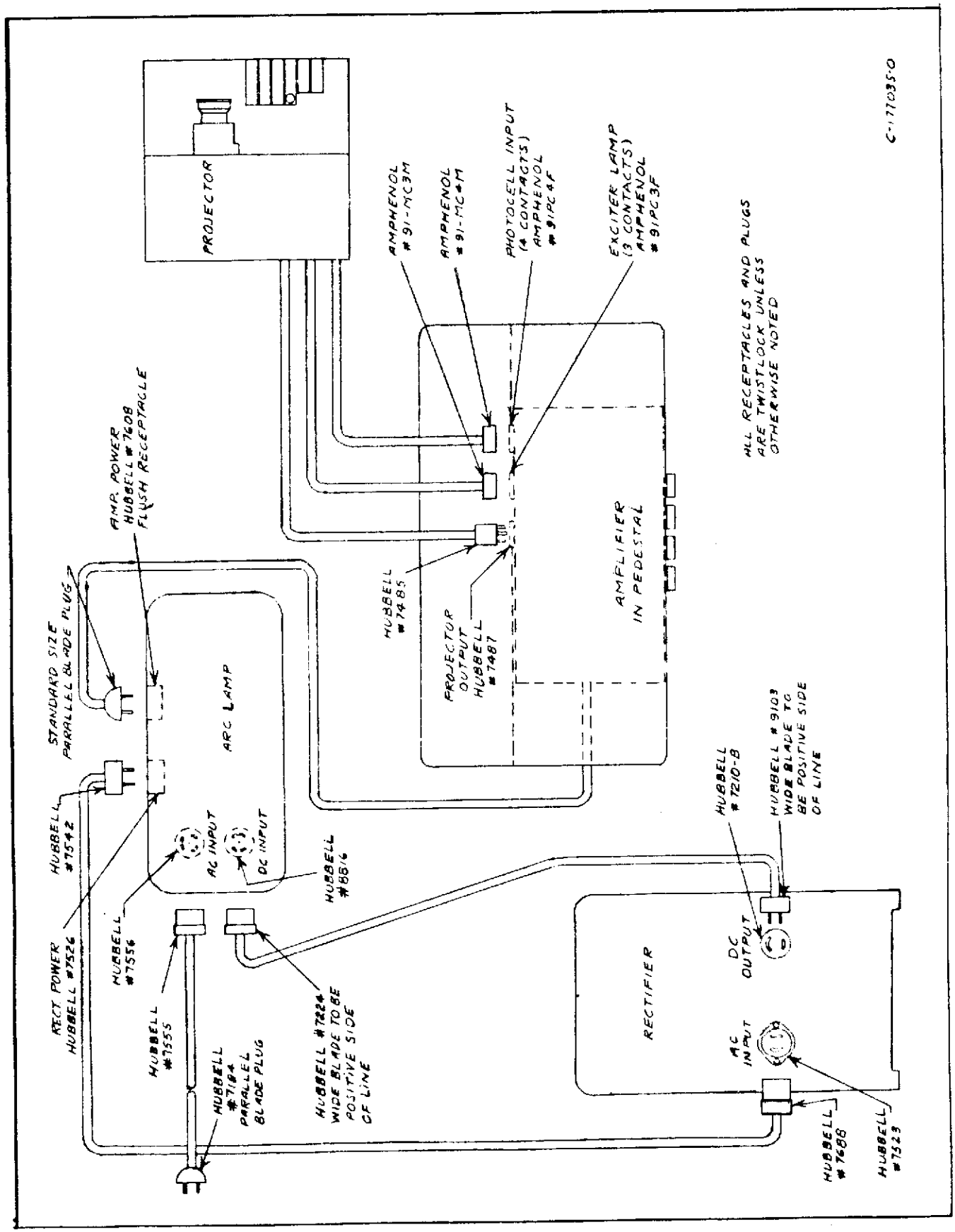

Figure 4 — Interconnection Diagram

One end of each of the amplifier's output transformer secondaries (low and high impedance) is grounded and is also connected to the jack frame as well as to the "COM" terminal of the impedance changing terminal board, see figure 16. Three taps on the lower impedance secondary are connected to the next three terminals (left to right) on the impedance changing terminal board, providing output impedances of 4, 8 and 15 ohms. The higher impedance secondary provides a 500 ohm output circuit suitable for connection to certain types of stage loudspeaker equipment, and it is tapped at 164 ohms to provide a nominal "70 volt line" for feeding modern distributed speaker systems. The flexible lead associated with the impedance changing terminal board is used to select the desired output circuit, see figure 3.

For operation of a single MI-1312-A, -B or -C Speaker use the 8-ohm output, or use the same tap for four of the same speakers connected in series-parallel. Use the 15-ohm tap for two MI-1312-A, -B or -C Speakers connected in series, or a single MI-35014 an excellent combination for portable operation since several hundred feet of regular #16 two-conductor speaker cable can be used at this impedance without encountering excessive cable power losses. Permanently installed circuits between projection rooms and stages are normally run with at least #14 wire having relatively small losses; when these circuits are available, the amplifier output impedance may be selected to most nearly agree with the connected impedance of the stage loudspeaker system. Avoid the combination of low impedance speaker loads and long, small-conductor cables leading to them. Even though such loads may work well enough connected to the amplifier's lowest output impedance circuit when the cable lengths are short the results via a few hundred feet of flexible small conductor speaker cable may be poor due to high cable losses.

Remove the front cover of the projector. Remove the accessories contained in the cover and place them nearby the projector. Then carry the speaker to the projection screen and place it on a chair or other suitable elevated support. Place the speaker at approximately ear level height, and pointed at the center of the audience.

CAUTION: Do not place anything on top of the rectifier. Ventilation openings must not be obstructed.

Run the speaker cable in the most convenient manner, preferably around the edge of the room, where it will be out of the way of the audience. See section titled "*Projection Practice.*"

Mounting Reel Arms

Attach the reel arms to the projector and put the spring belts on their pulleys in the following manner:

Fasten the reel arms, see figure 7, in place with the thumbscrews and pull out the spring belts and put them over the pulleys on the arms. Make sure the belts are not twisted.

ARC LAMP OPERATION

Installing Carbons

Refer to figures 2 and 5. Open the lamp house door by turning the latching knob on the door a quarter turn to the left, and lifting the door up until the stop rests against the lamp house, in which position it will remain until pulled down. Make certain that the circuit breaker switch on the rear end of the lamp below the feed change cover is in its OFF position, and that the control lever for the projector mechanism's combination dowser and fire shutter is all the way in and latched downward. The knob on this control is horizontal and located just to the rear of the regular framing knob on the mechanism, see figure 6.

Two control knobs, used to change the position of the carbon holders, are mounted in slots in the lamp housing just below the door. Turn the right hand knob clockwise so that the positive carbon holder is moved as far as it will go towards the front of the lamp. Turn the left hand knob counterclockwise to move the negative carbon holder completely to the rear of the lamp. Remove one pair of carbons from their container and insert the larger of the two carbons into the positive carbon holder at the front of the lamp. (The carbons are marked positive and negative.) The carbon should fit snugly in the holder, but if it does not do so, adjust the tension screw to properly space the carbon holder jaws. Insert the small carbon in the negative carbon holder at the back of the lamp, and if necessary adjust its tension screw, near the front of the holder, for a snug fit. The proper tension adjustment is one which will just allow a hot carbon stub to be easily pulled from its holder using pliers. Excessive tension will cause carbon breakage and stripping of tension screw threads. Insufficient tension may cause arc instability due to poor contact between jaws and carbons, and ultimately, burning of the jaws.

With the carbons in place, turn the two control knobs to position the tips of the carbons within one-quarter (¼") inch of each other, so that the gap between them is approximately centered between the guides which support the carbons near their tips. Refer to figure 5.

6

CAUTION: Never turn the ARC POWER switch to "ON" without first checking carbons. If they are accidentally in contact, line fuses may blow.

If the arc is struck with the gap near one guide or the other, the guide may be destroyed. With the carbons properly positioned the lamp is ready for striking or starting the arc. Turn the ARC POWER, or circuit breaker, switch on the lamp to ON and close the door of the lamp, which will close the switch of the 10 ampere rectifier supplying power to the primary of the transformer and blower of the 30 ampere rectifier. The carbon feed motor will not advance the carbons until the arc is actually struck, since the lamp circuits include a relay which prevents the motor from operating until arc current is actually being drawn. The rectifier may be left operating indefinitely with the lamp house door closed, with no danger of the carbons feeding together and blowing line fuses.

To strike the arc, turn the left hand or negative carbon control knob clockwise to bring the negative carbon momentarily into contact with the tip of the positive carbon, but do not use force to jam the carbons together. Immediately the carbon tips touch, reverse the negative travel to separate the two carbon tips about one-quarter (¼") inch. If this operation is performed too slowly, the arc will draw excessive current, and the circuit breaker will cut out. (This feature was built into the equipment to prevent blowing the line fuse.) In the event this occurs, reset the circuit breaker and again strike the arc after the carbon tips have cooled for about 30 seconds. As a rule there will be a small amount of sputtering until the tips of the carbon reach operating temperature. After the arc is burning steadily, observe the images of the carbon tips on the small white arcoscope screen on the lamp house door, see figure 2. By manipulating the carbon position control knob carefully, bring the image of the positive carbon tip in line with the left hand scribed line on the arcoscope, and bring the image of the negative carbon tip in line with the right hand scribed line. These operations must be performed simultaneously to avoid drawing the carbon tips so far apart that the arc is broken.

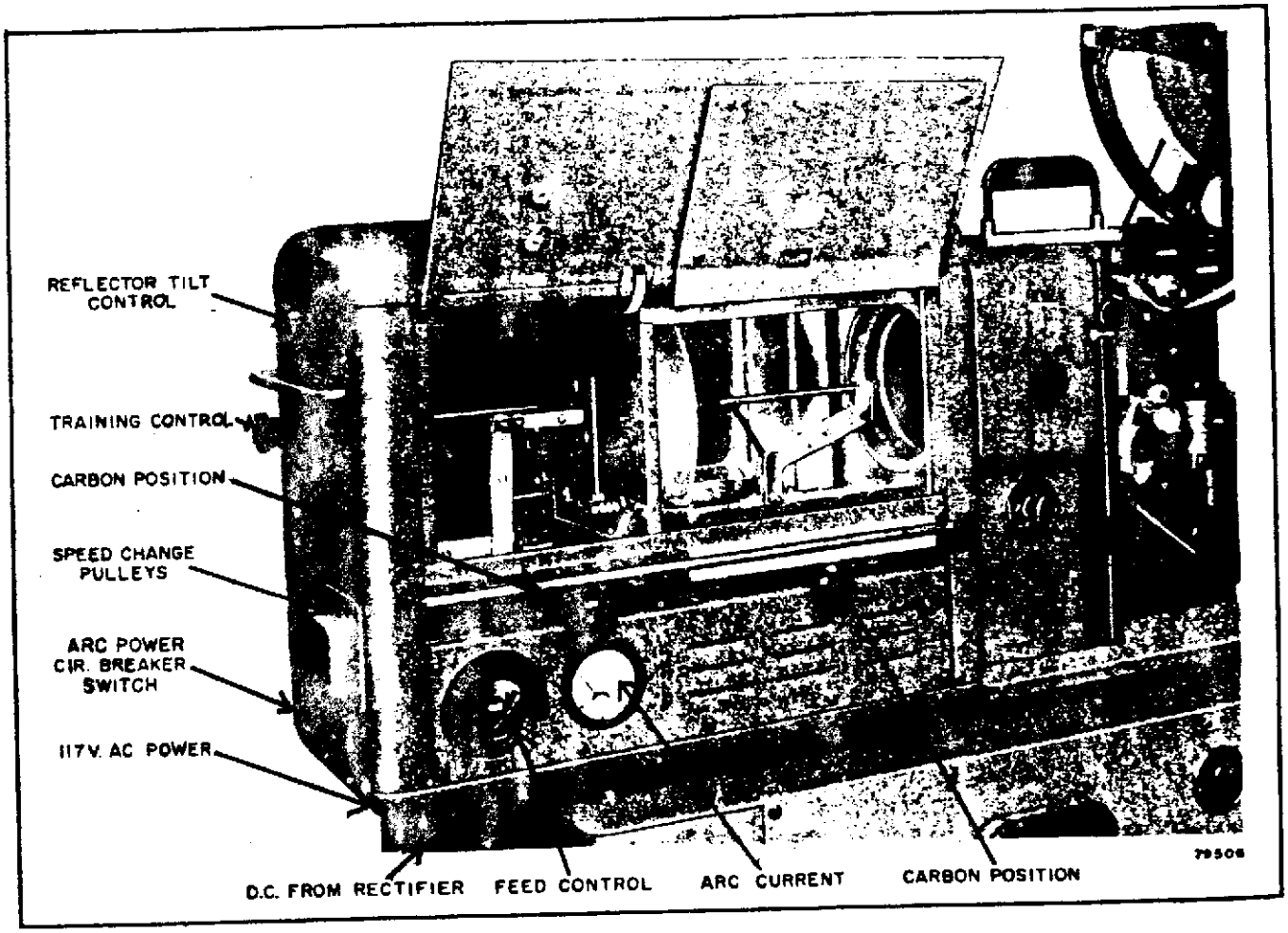

Figure 5 — Operating Side of Arc Lamp

Arc Current Adjustments

With the arc gap adjusted to the proper operating length as noted, the arc current ammeter just to the right of the feed motor control should indicate approximately 30 amperes for the 30 ampere Pearlex carbon trim and approximately 10 amperes for the low-current carbon trim mentioned. If the current reading is high, the voltage being delivered by the rectifier is also high and should be reduced. This voltage is controlled by the tap switch on the side of the rectifier. The voltage is increased by turning the tap switch control knob clockwise and decreased by turning it counterclockwise. For the best contact life the tap switch should not be operated with the arc burning, except where it becomes necessary to change the setting during the show. The arc may be extinguished before changing the switch setting by merely momentarily opening the arc lamp door.

If the arc current is low when the arc gap is adjusted to the indicated length, or if the arc cannot be maintained as the carbon tips are separated this distance, the rectifier output voltage is too low, and its tap switch setting should be increased one step at a time. Reasonable degrees of low AC line voltage can be compensated in this manner. Very high required switch settings on the rectifier are an indication of inadequate power supply to the equipment, and the condition should be remedied since it may also affect amplifier and drive motor performance. Such conditions may result from the use of long, small-conductor power supply circuits to the projector from the building electrical distribution panel, or may be due to the use of plugs and connectors of inadequate rating to carry the required current resulting in excessive heating and voltage drop. It also may be due to a poor receptacle causing a high resistance connection. All such items used should have a minimum rating of 15 amperes. Do not confuse the AC line current values with the *DC arc* currents indicated by the lamp house ammeter.

The actual objective of the arc current adjustments outlined is to establish both the rated current through the arc and the rated DC voltage drop across it. These values must be correct for the carbon trim being used if the rated light output and carbon burning rates are to be realized. The arc voltage drop is a function of both the arc current and the spacing between the burning carbon tips (the "arc gap"). To simplify field adjustments, the correct gap length for the rated drop at the rated current is determined by measurement during arc lamp testing at the factory, and is indicated by the scribed lines on the arcoscope screen. With this factor fixed, it becomes possible to establish correct burning conditions merely by adjusting the rectifier output to produce the rated arc current at this spacing. As will be explained in more detail later, having the image of the positive carbon tip aligned with its scribed line also establishes the burning arc at the right position with respect to the lamp optical elements for proper illumination of the projector aperture. Before making the feed adjustments outlined in the following section, allow the arc to burn a sufficient length of time to form a good crater on the end of the positive carbon.

Carbon Feed Adjustments

As soon as the arc is struck a current-operated internal relay starts the DC carbon feed motor, which moves the carbon holders toward each other by a geared speed reducer, a variable ratio, spring belt pulley combination, and longitudinal feed screws. The average speed of the feed motor is set by the rheostat, see figure 5, at the rear end of the lamp's control panel; the motor is so compounded and provided with an auxiliary series arc current winding as to act as a stabilizer for the burning arc. For example, if the arc gap tends to increase in length for some reason, the motor speeds up and brings the carbon tips closer together until the average conditions are restored, and vice versa. Burning rate variations due to line voltage changes within the control range, and to non-uniform carbon characteristics are thus compensated to a considerable degree.

In general, the positive carbon is consumed at a faster rate than the negative, particularly at the higher currents. The pair of double-grooved pulleys under the small cover at the rear of the arc lamp housing compensates for this varying ratio. For 30 ampere operation the spring belt must be in the pulley grooves nearest the housing; for 10 ampere operation the belt is moved to the rear grooves. Normally the machines are shipped with the belt in the 30 ampere operating position but the point should be checked prior to making feed rate adjustments.

The approximate setting for the feed control rheostat using the "Pearlex" 30 ampere carbon trim is with the control knob arrow horizontal and pointing forward. The corresponding setting for the 10 ampere, low-current trim is with the arrow horizontal and pointing to the rear. The actual setting required in any given case must be determined by observation of the carbon feeding action over a period of some minutes. If the images of both carbon tips tend to draw apart from their respective scribed lines on the arcoscope screen, increase the average feed rate by turning the control knob slightly clockwise. Conversely, if they tend to draw together, with consequent increase in arc current, slightly decrease the

feed rate. With proper setting of the rheostat and reasonably steady line voltage, it should be possible to burn an entire carbon trim with no more than occasional checks on the arc status.

The carbon feed control system tends to stabilize the arc current and the arc gap *dimensions* as noted, and so long as the voltage delivered by the rectifier remains constant, it obviously also tends to maintain the arc in the correct *position* with respect to the lamp optical system. The relative burning rates of the positive and negative carbons are affected not only by the arc current but also by the arc voltage drop, so any considerable change in line and rectifier output voltages will cause the burning arc to drift away from its correct position even though the proper gap dimensions and current are being maintained by the feed control system.

This situation is easily corrected by manually adjusting the burning carbon tips to their correct positions as observed on the arcoscope screen, and then checking the arc current ammeter reading. If the reading is above normal, drop the rectifier tap switch setting one point; if it is sub-normal, increase the switch setting one point. In either case, watch the feed and control action for several minutes before re-checking the current and making any needed further adjustments. As previously stated, such adjustments should not be necessary unless the prevailing line voltage is notably unstable, and provided the initial adjustments were carefully made as outlined after the equipment was in operation long enough to reach stable operating temperatures.

As stated under "DESCRIPTION," the design of the carbon feed mechanisms is such that the feeding action ceases when carbon stubs burn down to about 2 inches in length, thus protecting the guides and holders. Remaining burning time may be estimated from the burning time indicator located above the knob on the front panel of the arc lamp. Short lengths may be saved and used for short reels in accordance with theatre practice.

A considerable amount of heat is dissipated within the lamp house and its internal parts become hot, particularly when operating with the 30-ampere carbon trim. Care should be used in touching any of these parts after the lamp has been in operation, and pliers should be used in removing carbon stubs from the holders.

Optical Adjustments

The remaining arc lamp adjustments invlove having the projector mechanism in operation without film and with the projected light beam properly aligned and focused on a screen.

As previously mentioned, the operating control for the projector mechanism's combination dowser and fire shutter is the small horizontal knob to the left of the framing knob. The knob is attached to a notched arm or lever. Lifting the knob up and pulling it outward opens the combination dowser and fire shutter. It will not stay open, however, unless the projector mechanism is running and up to normal film operating speed, and it will not open when the projector is started until the arm is manually unlatched and pulled out by the knob. This allows the projector to be started and the film leader and any other unwanted material at the beginning of the film to pass down through the projector before the picture is projected on the screen. Stopping the machine causes the fire shutter to close automatically and to lock in the closed position.

Strike the arc lamp, and after it is operating steadily, start the projector motor by throwing the PROJECTOR switch on, see figure 7. Turn the SPEED SELECTOR upward to SILENT, or downward to SOUND, as required. Unlatch the dowser-fire shutter and align and focus the aperture outline on the screen.

Loosen the lens lock. Focus by moving the projection lens back and forth in the picture gate for rough adjustment and by rotating it for fine adjustment until the outline of the lighted area on the screen is well defined. Tighten the lens lock.

Adjust the distance between the projector and the screen until the width of the lighted area is slightly greater than the width of the white portion of the screen, and then center the light vertically with the tilting control.

NOTE: When the picture is slightly larger than the white portion of the screen the edges of the picture will be clean cut.

Unless the projector is set up to project at least a 15 to 20 ft. wide picture, considerable flicker will be evident on the screen with no film in the projector gate. This is so because the projectors are intended only for use in projecting such large pictures, and hence normally incorporate two-blade shutters for maximum light transmission. Flicker perceptibility is well known to be more or less directly proportional to the reflected light intensity, and inversely proportional to the flicker rate. Even though arc projectors deliver far more light than incandescent lamp projectors, they are normally used with such large screens that the resulting reflected light intensities are low enough to permit the advantageous use of the two-blade shutter. If arc projection light quality is desired

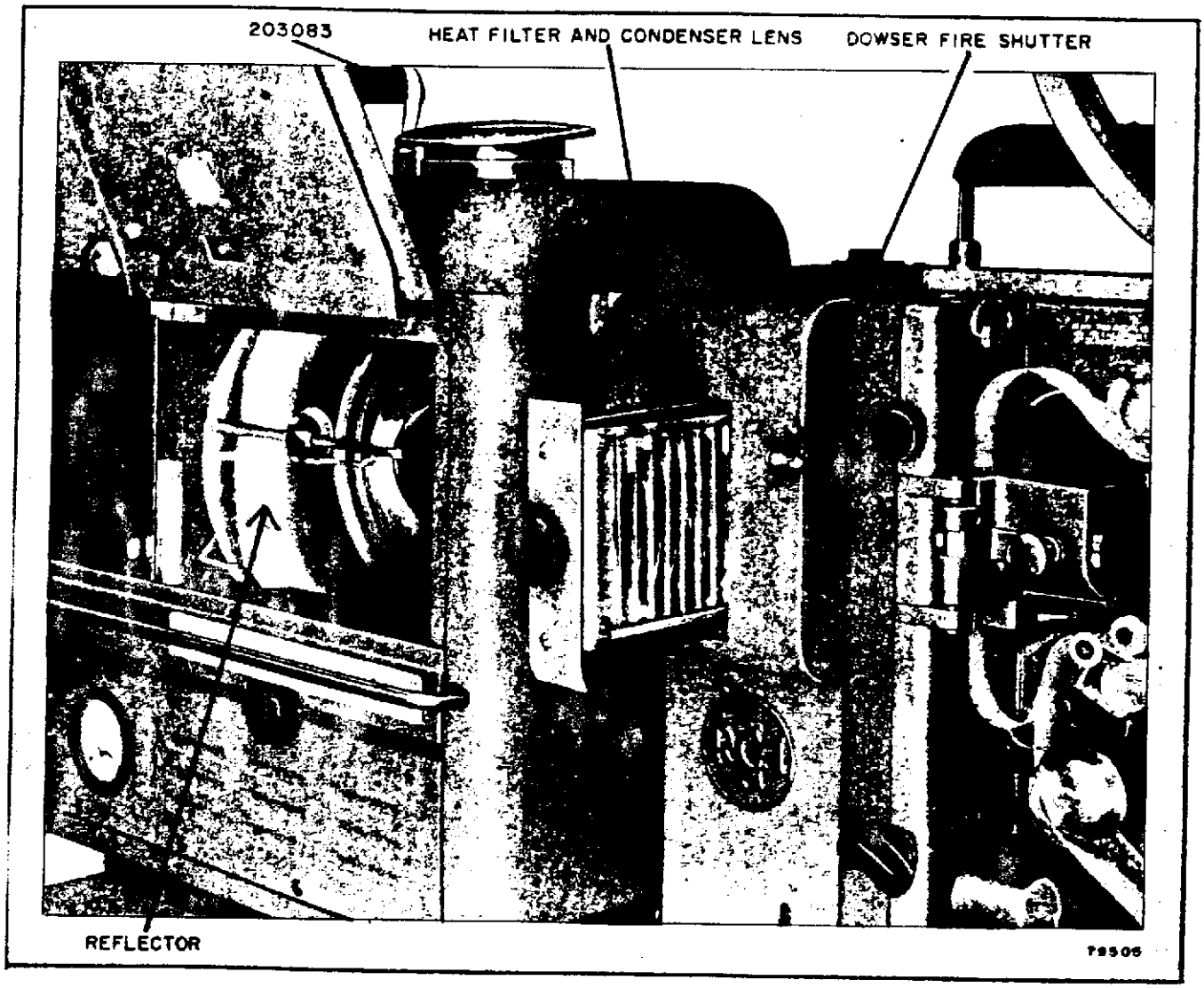

Figure 6 — View of Condenser Lens and Heat Filter

on small screens, or if 16 frame "silent" pictures are to be run in any quantity, it is a simple job to substitute a three-blade shutter for the two-blade shutter originally supplied.

Assuming the image of the positive carbon tip to be properly aligned with its scribed position line on the arcoscope screen, and assuming that the lamp's reflector tilting and training adjustments have not been disturbed since final factory testing, the aperture image on the screen should be brightly and evenly illuminated. The corners and edges of the image should be at least 75 to 80 percent as bright as the center, and no brownish or bluish color casts should be evident in these areas.

If the observed image does not meet these specifications, first check the reflector adjustments, refer to figure 5. Turn the tilt control knob (top of rear surface of lamp housing) to equalize the top and bottom brilliance of the image. Turn the training control knob (below the tilt control knob) to equalize the right and left sides of the image. With the reflector thus properly aligned with the projector aperture, again check the color quality and brilliance distribution of the screen image, first making certain that the positive carbon tip image on the arcoscope screen is exactly on its scribed line.

Any failure of the aperture screen image to meet the specified performance characteristics under such conditions is an indication that some component of the projector's optical system is out of alignment. Make certain that the reflector is properly seated in its bracket and that no parts appear to be damaged or misplaced, then try displacing the positive carbon tip

image on the arcoscope screen first one way and then the other from the scribed line position, at the same time observing the aperture image on the screen. It may be possible in this manner to find a position which produces satisfactory screen image quality. If such a position is found, scribe a new reference line on the arcoscope screen in pencil; measure the distance between the original positive and negative lines carefully, and then scribe in pencil a new negative reference line the same distance from the pencil positive line.

It should be noted that the position of the positive carbon tip with respect to the mirror which produces best color quality and the 75-80% side-to-center distribution is *not* the position for maximum image center brightness. Most of the light comes from the extremely hot crater in the tip of the positive carbon. By bringing the hottest spot to focus exactly at the film plane the screen image center is brightest, but the total light output falls and the picture quality is poor due to the resulting large differences in brilliance between the center "hot spot" and the picture edges.

Condenser Lens and Heat Filter

The pull-out holder for the arc lamp's condensing lens, which also holds the heat filter is located in the projector mechanism case, see figure 6. The pullout holder is locked in place by an internal latch operated by a small knob; turning this knob one-half turn counterclockwise releases the latch so the assembly may be pulled out for inspection and cleaning. The heat filter assembly slides out of its guide rails in the holder.

The *beat filter* is never required when operating the arc lamp with its 10 ampere carbon trim. It may be required, however, when operating at 30 amperes if the prints being run are black and white and are relatively dense so that a considerable portion of the heat energy in the light beam is stopped and absorbed by the film. The heat filter is seldom required with color films which are relatively transparent to the infra-red (heat) energy in the beam. The necessity for using the filter may be determined by inspection of the film as it leaves the lower sprocket. If there is no sign of buckling or embossing and if the film does not feel excessively warm to the touch, there may be no need to use the heat filter. The filter reduces the overall light transmission by a factor of approximately 30% and obviously it is desirable to use it only when it is necessary. It reduces the heat at the picture aperture, however, by a factor of almost 50%.

PROJECTOR OPERATION

Threading

Refer to figure 7 and thread the projector in the following manner:

1. Place an empty reel on the lower reel arm and a reel of film on the upper.

2. Unwind the film until the picture or title frames are reached and examine the film to see whether it is ready for threading. To do this, consider yourself in the position of the arc lamp and look through the film toward a light. With the end of the film downward, the pictures or titles should be upside down and reversed, and the sprocket holes on sound film should be toward your right. If these conditions are met, the film is ready for threading.

3. Make sure the REWIND-OPERATE lever is in the OPERATE position.

4. Hold the film about four feet or more from the end and press down on the upper sprocket shoe with the right-hand thumb.

5. Slide the film under the upper sprocket. Make sure that the sprocket teeth engage the sprocket holes. Release the sprocket shoe.

6. Open the picture gate — by pulling the lens lock — and place the film on the aperture plate, between the guide rails and the side shoe. Form the upper loop of film above the aperture plate so that the film follows the white guide line on the projector frame. Close the picture gate with your thumbs, while holding the film in position.

7. Form the lower loop of film below the picture gate as indicated by the white guide line and finger stop.

8. Run the film over the guide roller, under the rubber pressure roller, clockwise around the sound drum, and over the tension roller.

9. Thread the film to the left of and under the lower sprocket.

10. Next run the film under the snubber roller to the lower reel.

11. Insert the end of the film in the slot in the hub of the lower reel, or attach it to the hub with a piece of adhesive tape.

12. Rotate the reel clockwise by hand to take up film slack. Lift the reel slightly to equalize belt tension. This will prevent the reel from rolling backwards when it is released.

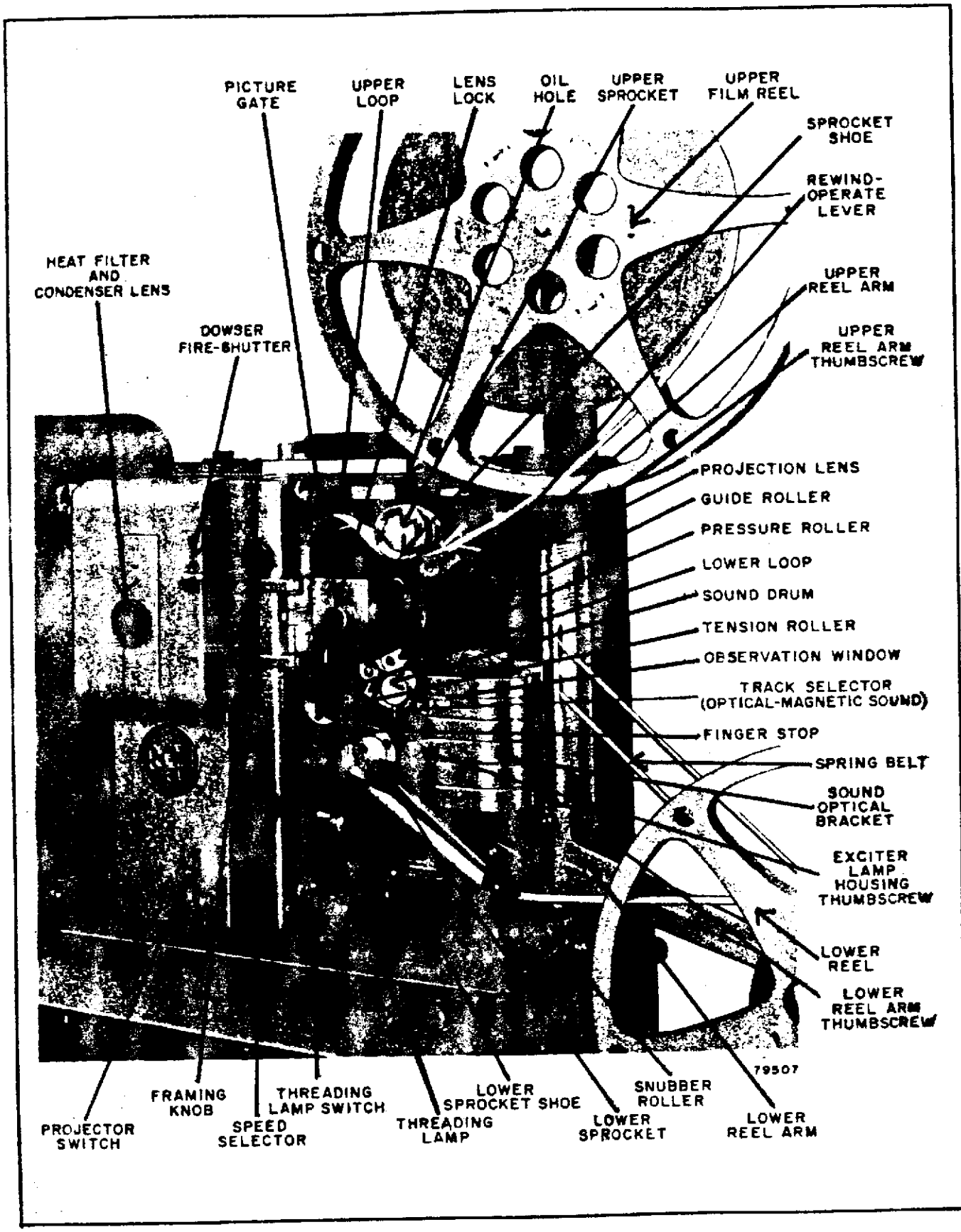

Figure 7 — Operating View of Projector

Operating an Optical Sound Projector

Sound Pictures

When sound pictures are to be projected proceed as follows:

1. Throw the POWER switch on the amplifier to on, see figure 2.

NOTE: The sound lamp lights within 15-30 seconds after the amplifier power switch has been turned on. It can be observed through the observation window, see figure 7, in its housing.

2. Turn the FILM SOUND VOLUME control to "O," and the TONE control to the midway position, see figure 2.

3. Strike the arc lamp (previously adjusted as instructed under *ARC LAMP OPERATION),* and then throw the PROJECTOR switch on, and the SPEED SELECTOR downward to SOUND.

4. Loosen the lens locking thumbscrew and focus by rotating the projection lens until the picture is clear and distinct. Titles or other printed portions of the picture make excellent subjects on which to focus. Lock the lens barrel in the focused position.

5. Turn the FILM SOUND VOLUME control clockwise until the desired volume is obtained.

6. Frame the picture, if necessary, by turning the FRAMING knob until one complete picture shows on the screen.

7. Adjust the TONE control for the most pleasing effect.

8. When the last picture has appeared on the screen, and before all the film has passed through the projector, extinguish the ARC by throwing the ARC POWER switch to the OFF position.

9. Turn the FILM SOUND VOLUME control to "O" as soon as the sound ceases.

10. Finally, return the PROJECTOR switch to the off position.

NOTE: Occasionally, damaged film may prevent the intermittent pull-down claw from properly engaging the sprocket holes in the film. This may result in the loss of the lower loop. When this happens, the picture on the screen is blurred. The difficulty can be remedied immediately, without stopping the machine, by placing a finger above the film as it emerges from the lower end of the picture gate and quickly pulling down on the film until the finger strikes the finger stop, see figure 7.

The THREADING LAMP can be turned on with the THREADING LAMP switch when light is needed during a show, thus eliminating the necessity for turning on the room lights. The cover of this lamp can be rotated to direct the light where required.

Silent Pictures

Proceed as for showing a sound picture, with the following exceptions:

1. Turn the speed selector upward to SILENT. This decreases the speed of the projector to that appropriate to silent pictures.

2. Leave the POWER switch on the amplifier in the off position. Omit any adjustment of volume or tone, unless the public address feature is to be used.

Public Address and Record Playing

When it is desired to use sound input from a microphone, or a phonograph pickup, a shielded cable and a shielded standard telephone plug will be required for connecting either device. Assemble the cable and plug and connect the cable to the microphone, or to the phonograph pickup. Insert the microphone cable plug in the MICROPHONE JACK on the front of the amplifier, see figure 2. Insert the phonograph cable plug in the PHONO jack, on the nonoperating side of the amplifier, see figure 3. Set the POWER switch on the amplifier in the on position. Adjust the TONE and VOLUME controls to obtain the most pleasing tone and a suitable volume of sound. (Separate controls identified as MICROPHONE VOLUME and PHONO VOLUME are mounted on the amplifier control panel, see figure 2.) Use the appropriate control for the device in use.

NOTE: Plugging into the PHONO JACK automatically cuts off the film sound.

For suitable microphones, phonograph pickups, cables and plugs consult your dealer. The following types of shielded two-conductor plugs, or any plugs similar to them, may be used: Carter #PG-52, Switchcraft #70 or Mallory #75N.

Operating a Magnetic Sound Projector

To operate a projector which has been converted for magnetic sound reproduction, it is only necessary to perform the following operations:

1. Plug the connector at the end of the magnetic sound cable into the PHOTO-CELL jack, on the nonoperating side of the amplifier, see figure 16.

2. Thread the magnetic sound track film in the manner described under *Threading* above.

3. Turn the TRACK SELECTOR to MAGNETIC, see figure 7, and operate the projector in the manner described under *Operating an Optical Sound Projector,* above.

Rewinding

Film should be rewound immediately after projection. Rewinding is done quickly with only the pro-

jector mechanism in operation (carbons not burning), as follows:

1. Bring the end of the film from the lower reel directly to the hub of the upper reel, without twisting the film, and attach it. Give the upper reel a few turns counter clockwise by hand to take up film slack.

2. Turn the REWIND-OPERATE lever to REWIND.

3. Put the PROJECTOR switch in the on position and let the projector run until the film is rewound.

4. Turn the speed selector downwards toward SOUND.

When two or more reels are to be shown, it may be desirable to postpone rewinding until all the reels have been shown, since this shortens the delay between successive reels. As a result, the question may arise as to whether or not a reel has been rewound. This may easily be determined by examining the film as explained in step 2 of the section titled *Threading*. If the film is not in the position specified there, it requires rewinding.

Packing Up after the Show

When the show is over, in order to pack up proceed as follows:

1. Disconnect the equipment from the 117 V.A.C. power service. Disconnect all cables and replace (all but the speaker and projector cables) in the storage compartment in the end of the amplifier case.

2. A small tray is mounted under the arc to catch copper drippings from the carbons. Empty the tray and clean the interior of the lamp house. Remove the chimney from the lamp house and wash the white dust off it by holding it under a cold water faucet. Close the lamp house door.

3. Turn the handle of the cowl-type fastening pin, connecting arc lamp to projector, one-half (½) turn counter clockwise to release the pin. Remove pin from socket on arc lamp. Crank down the projector elevator.

4. Disengage the arc lamp from the projector mechanism, by raising the arc lamp and lifting the pins in the bracket on the front of the lamp out of the holes in the projector base. Remove the lamp from the amplifier.

5. Remove the reels and the reel arms from the projector mechanism and replace the reel arms in the projector cover, see figure 8.

6. Bring the three cables attached to the projector around to the operating side of the projector (four

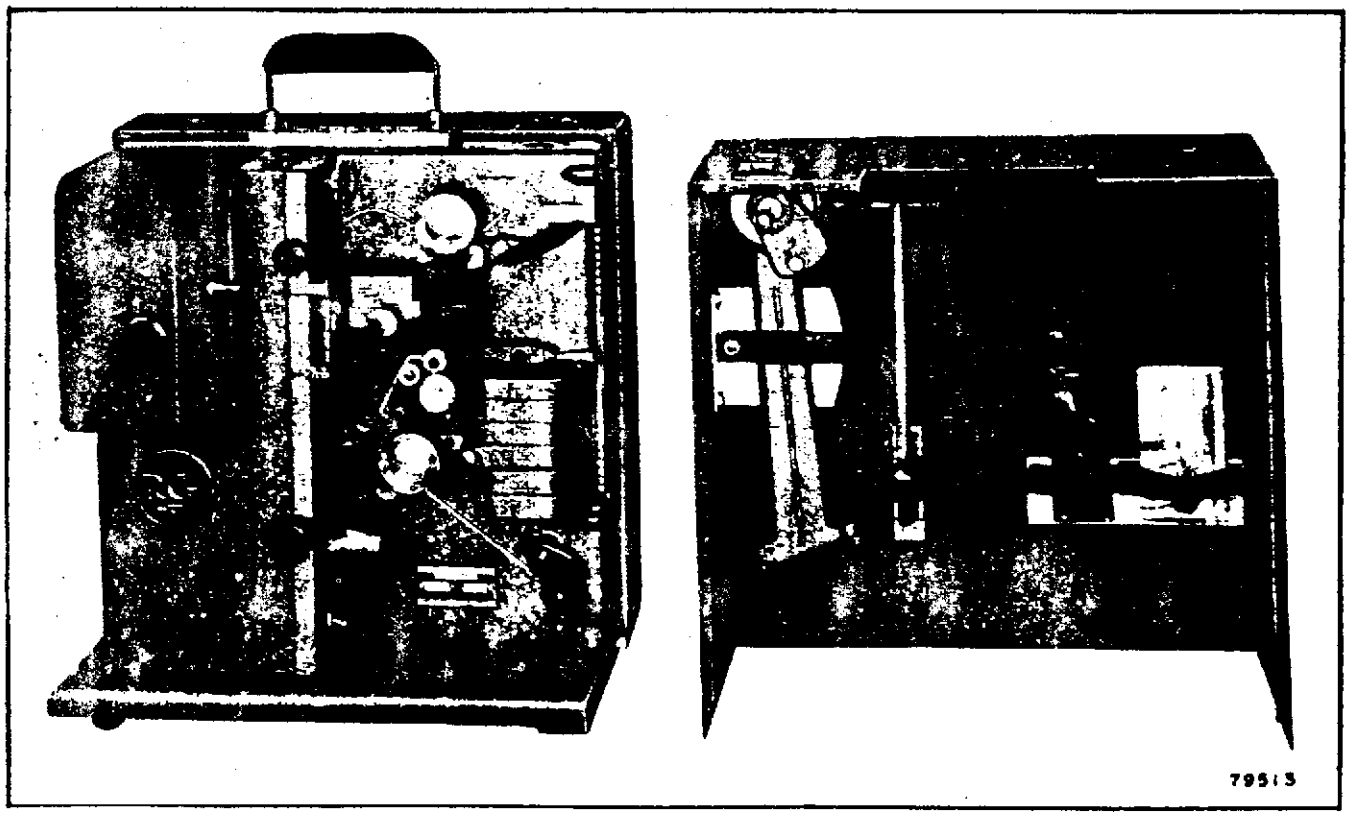

Figure 8 — View of Projector Packed Away

on a magnetic sound projector), coil them up, and push them into the space below the lower sprocket, between the threading lamp and snubber roller.

7. Push the spring belts back into the projector case, by holding one side of the belt stationary and pushing in the other side. Replace the cover on the projector.

8. Roll up the speaker cable and replace it in the speaker case. Close the case.

9. Fold up the elevator crank on the amplifier. Release the leg clamping collars and unscrew the legs from the amplifier. Replace the legs in the storage compartment, after telescoping them.

PROJECTION PRACTICE

Choice of Focal Length of Lens

The focal length of the lens supplied with the RCA Model 400 Arc Projectors is 2½ inches. This is a value which meets average arc projection conditions. However, in some instances, lenses of different focal lengths may be required. For example, it may be required to project a picture of given size from different distances. Table 1 below gives the relationship between picture size and projection distance for lenses of six different focal lengths. Standard lenses and anamorphic lenses may be obtained from authorized RCA Audio-Visual Equipment dealers and distributors.

TABLE I PROJECTION DATA

Projection Distance Feet	Picture Width				
	2" lens	2½" lens	3" lens	3½" lens	4" lens
10	1'10"	1'7¼"	1'4½"	1'½"	0'11"
15	2'9"	2'5"	2'1"	1'7"	1'4½"
20	3'8"	3'½"	2'9"	2'1"	1'10"
25	4'7"	4'0"	3'5½"	2'7½"	2'3½"
30	5'6"	4'10"	4'2"	3'2"	2'9"
35	6'5"	5'7½"	4'10"	3'8"	4'2½"
40	7'4"	6'5"	5'6"	4'2"	3'8"
50	9'2"	8'0"	6'11"	5'3"	4'7"
60	11'0"	9'8"	8'4"	6'3½"	5'6"
70	12'10"	11'3"	9'8"	7'4"	6'5"
80	14'8"	12'10"	11'0"	8'4"	7'4"
90	16'6"	14'6"	12'6"	9'7"	8'3"
100	18'4"	16'0"	13'10"	10'6"	9'2"
115	21'10"	18'4"	16'0"	12'1"	10'6"
130	....	20'10"	18'0"	13'7"	11'11"
145	....	....	20'0"	15'3"	13'3"
160	....	....	22'0"	16'9"	14'8"
175	....	....	....	18'4"	16'0"

NOTE: Picture height is ¾ of picture width, except when Anamorphic lenses or special apertures are used.

TABLE II 16MM LENSES

* RELATIVE LIGHT TRANSMISSION PERCENTAGES

Focal Length	Speed	Percent
½"	f 2.4	44.5%
⅝"	f 2.0	64%
1"	f 2.0	64%
1½"	f 1.6	100%
2"	f 1.6	100% Reference
2½"	f 1.8	79%
3"	f 2.0	64%
3½"	f 2.5	41%
4"	f 2.8	32.6%

Choice of Screens

A white matte screen should be used whenever a sufficiently bright picture can be obtained, for it presents a more uniform brightness to the entire audience. A beaded screen appears brighter than a matte screen along the line from the center of the screen to the projector, but its brightness falls off rapidly as the observer moves away from this line.

Securing Cables

In order to avoid interruptions and disturbances of sound and picture during a show, the power and speaker cables should be secured so that they cannot

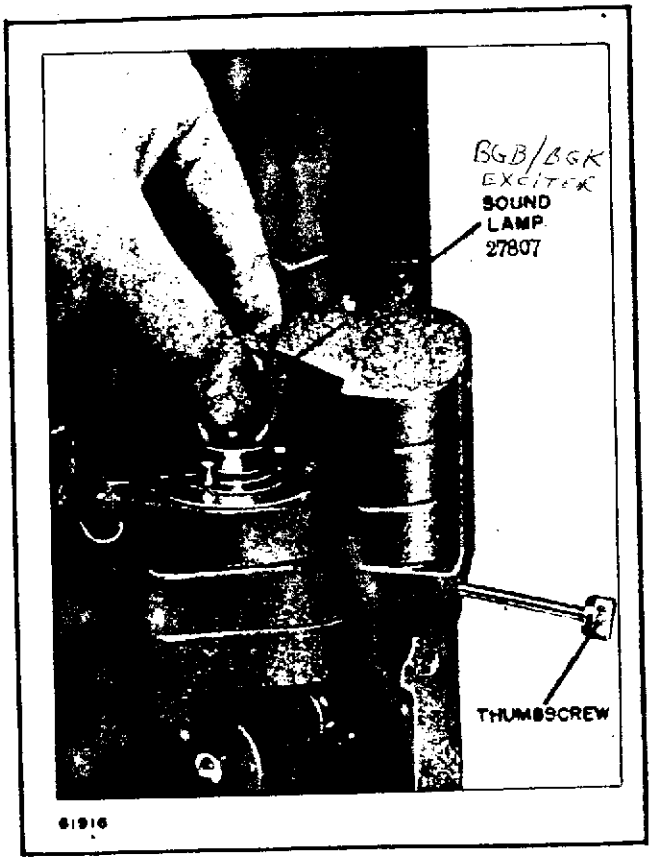

Figure 9 — Replacement of Sound Lamp

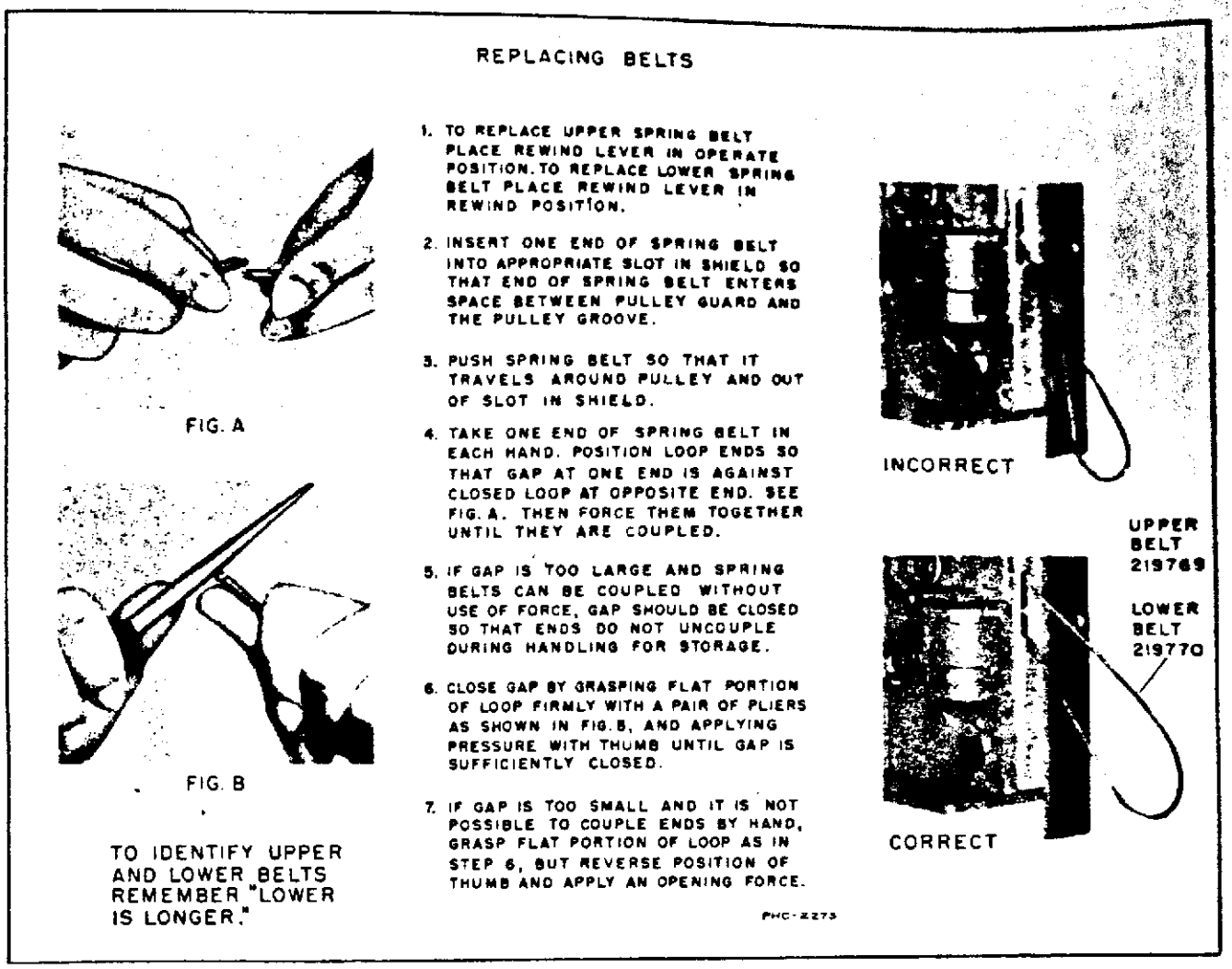

Figure 10 — Replacing Belts

become disconnected accidentally by persons stumbling over them.

Previewing Pictures

An experienced operator will preview films he plans to show in order to acquaint himself with their peculiarities and thus be ready to make changes in volume, tone, and focus whenever they are required.

Care of Film

Film should be handled carefully lest it be scratched, torn or otherwise damaged. Film is easily scratched by winding it too tightly on the reel so that adjacent turns of film grind against each other. Scratches on film are very noticeable on the screen and it is costly and difficult to remove them. Film should be handled by the edges as much as possible, and touching the picture or sound track area should be avoided. Occasionally, film should be inspected for broken sprocket holes and other defects. Necessary repair should be performed promptly.

When film is dirty it should be cleaned by passing it between folds of lint-free cloth moistened with carbon tetrachloride, or some other cleaner suggested by the dealer. Consult the dealer regarding a humidor for storing film when it is not in use.

Running Time

The running time of reels of given length for 16mm film depends on whether the film is sound or silent, because sound film runs 24 frames per second and silent film only 16 frames. Exact knowledge of the running time of various films will help the operator in planning a show. Table III below gives the running time in minutes of 16mm films of various footages.

TABLE III

RUNNING TIME OF 16MM FILM

Footage	Time in Minutes	
	Sound	Silent
400 ft.	11	14.8
600 ft.	17	22.2
800 ft.	22	29.6
1000 ft.	28	37.
1200 ft.	33	44.4
1400 ft.	39	51.8
1600 ft.	44	59.2
1800 ft.	50	66.6
2000 ft.	56	74.

MAINTENANCE OF ARC LAMP

Chimney, Tray and Housing

The removable chimney on the top of the lamp house serves two functions. It properly ventilates the interior of the arc housing and it also acts as a collector for the white dust which results from the burning of the Pearlex carbons. This dust should be washed off the chimney by holding it under a cold water faucet. Other than this, the chimney and the rest of the arc lamp require very little maintenance. The tray located under the arc to catch copper drippings should be emptied after each showing and the interior of the arc lamp housing should be kept clean at all times.

Reflector

The reflector should be carefully wiped off with lens tissue or with a soft dry, clean cloth before each period of operation. At 30 ampere operation some carbon dust will deposit near its upper edge; it should be cleaned off after each reel.

When reflectors begin to show disentegration of the silver coating, pitting, or a grayish color, loss in projected light will have become excessive, and they

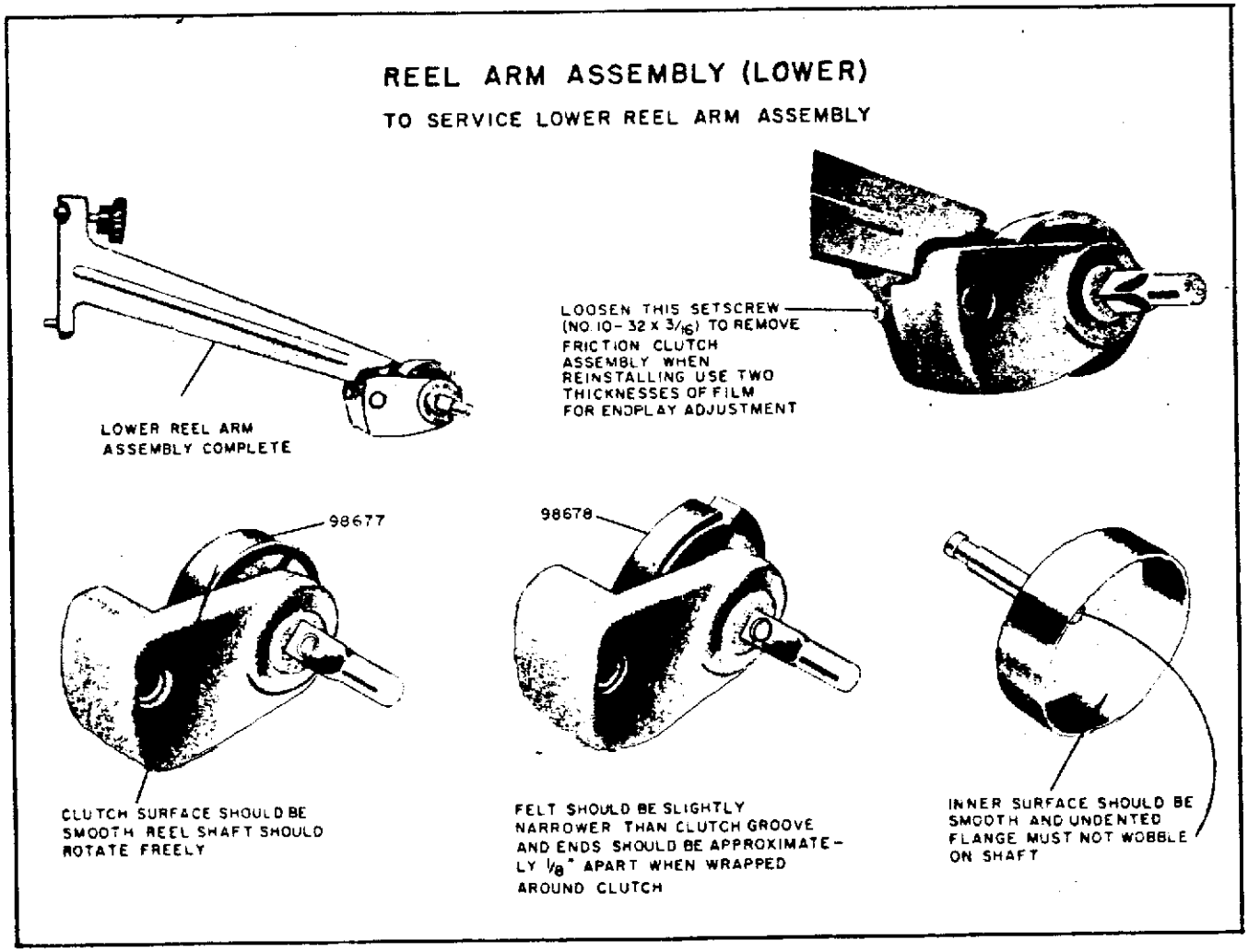

Figure 11 — Lower Reel Arm Assembly

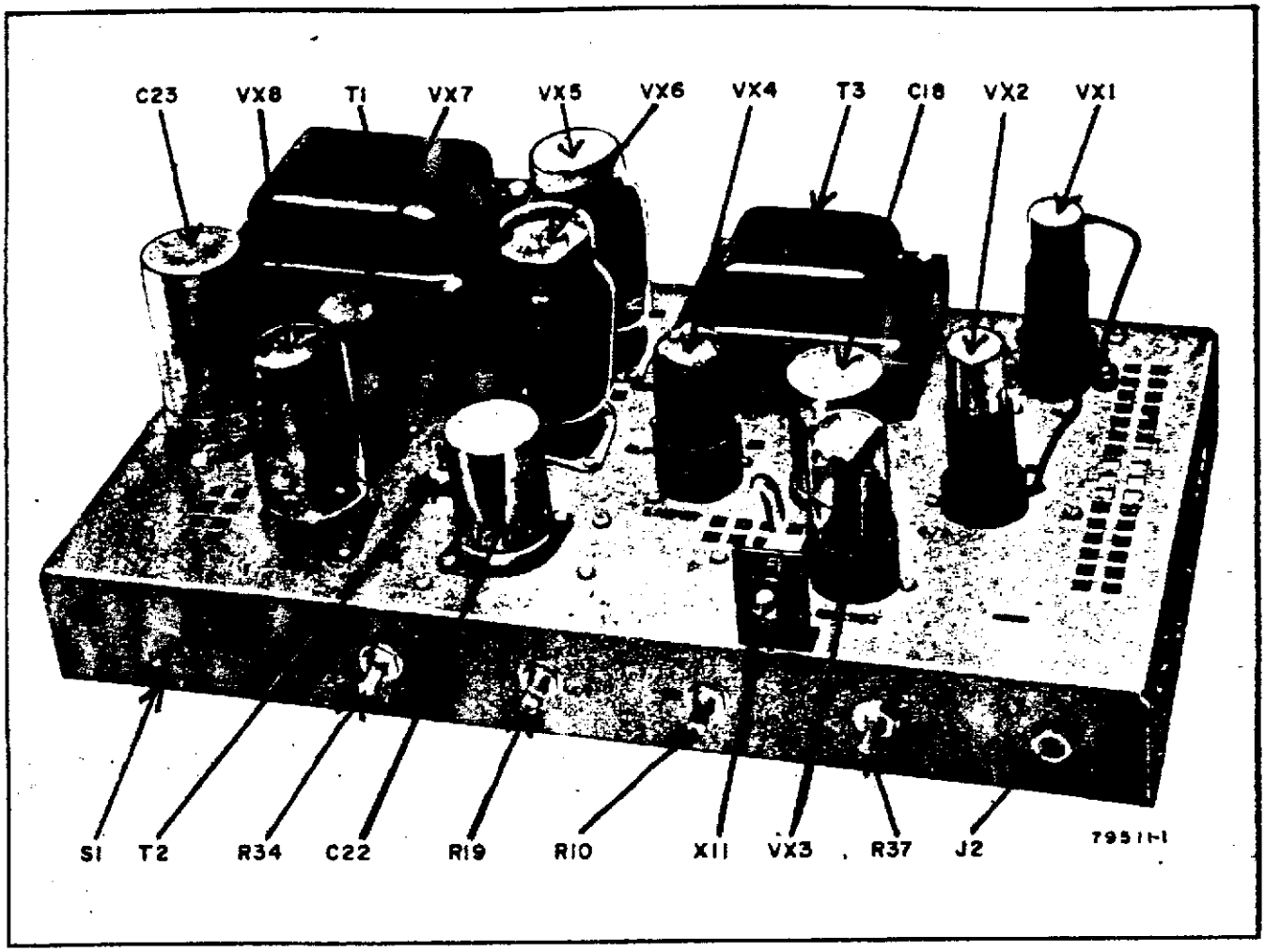

Figure 12 — Top View of Amplifier — Location of Parts

should be replaced. Replacing of the reflector sometimes requires realignment and remarking of the arcoscope.

MAINTENANCE OF PROJECTOR MECHANISM

Lubrication

It is important that the projector mechanism be properly lubricated. Refer to the *LUBRICATION CHART*.

Cleaning

In order that the equipment will give consistently good performance it must be kept clean. Dust, oil, particles of emulsion, carbon dust, and other dirt should be removed. To clean the equipment proceed as follows:

1. *Cleaning lenses.* Clean all optical surfaces by gently wiping them with lens tissue. *Do not use carbon tetrachloride or alcohol on the lenses.* Use a good lens cleaning fluid, preferably obtained from your dealer. Apply the cleaner to the lens and gently wipe dry with a lens tissue. Discard the tissue and polish with a fresh tissue. With the possible exception of the condensing lens all optical surfaces should be cleaned before use, each time the equipment is to be put into service.

a. *Condensing Lens and Heat Filter.* The condensing lens should be cleaned frequently, but not necessarily each time the equipment is operated. Refer to figure 6. Pull out the lens holder, and — if in use — lift the heat filter up and out of the holder to obtain access to the front of the lens. Clean the heat filter when it is in use. Avoid touching either the condensing lens on the heat filter with anything damp while they are hot.

b. *Projection Lens.* Refer to figure 7. Loosen the lens lock and pull the lens out of the picture gate.

Clean and replace the lens, taking care not to touch the lens surface with the fingers.

c. *Sound Optical Unit (lens tube).* Refer to figures 7 and 9. This unit is mounted in the clamp portion of the SOUND OPTICAL BRACKET. Unscrew the EXCITER LAMP HOUSING THUMBSCREW and swing the assembly outward. Remove the sound lamp (exciter lamp) from its socket. Refer to REPLACEMENTS-SOUND LAMP, below. Clean the exposed front and rear glass elements of the sound optical unit. Do not loosen the clamp or remove the optical unit from its mounting; proper positioning of the unit for optimum sound quality requires tools and test facilities available only in the factory or in qualified repair shops. Replace the exciter lamp after cleaning the optical unit. Remove any finger marks from the lamp surface after replacing the lamp.

d. *Sound Lamp.* Refer to figure 9. Open the sound optical bracket and clean the lamp in place.

2. *Cleaning Mechanical Members.* Film dirt will collect on the aperture plate, the film pressure shoe (which presses the film against the aperture rails), the sprockets, the sound drum pressure roller, and on the sound drum. *Do not use a knife or any other metal instrument, for removing the dirt.* A wooden toothpick or similar tool, may be used to dislodge hardened film emulsion particles.

a. *Aperture Plate.* Open the picture gate and wipe the aperture plate with a soft cloth to remove dirt. Use a toothpick, if necessary, to remove dirt from corners. Clean the two side pressure shoes with the bristle brush supplied with the projector. Clean the film pressure shoe in the same manner as the aperture plate. A small amount of thinner or cleaning fluid may be used to soften caked emulsion for easier removal. After all visible dirt and emulsion have been removed, inspect and feel the film contracting surfaces of both the aperture plate and the film pressure shoe

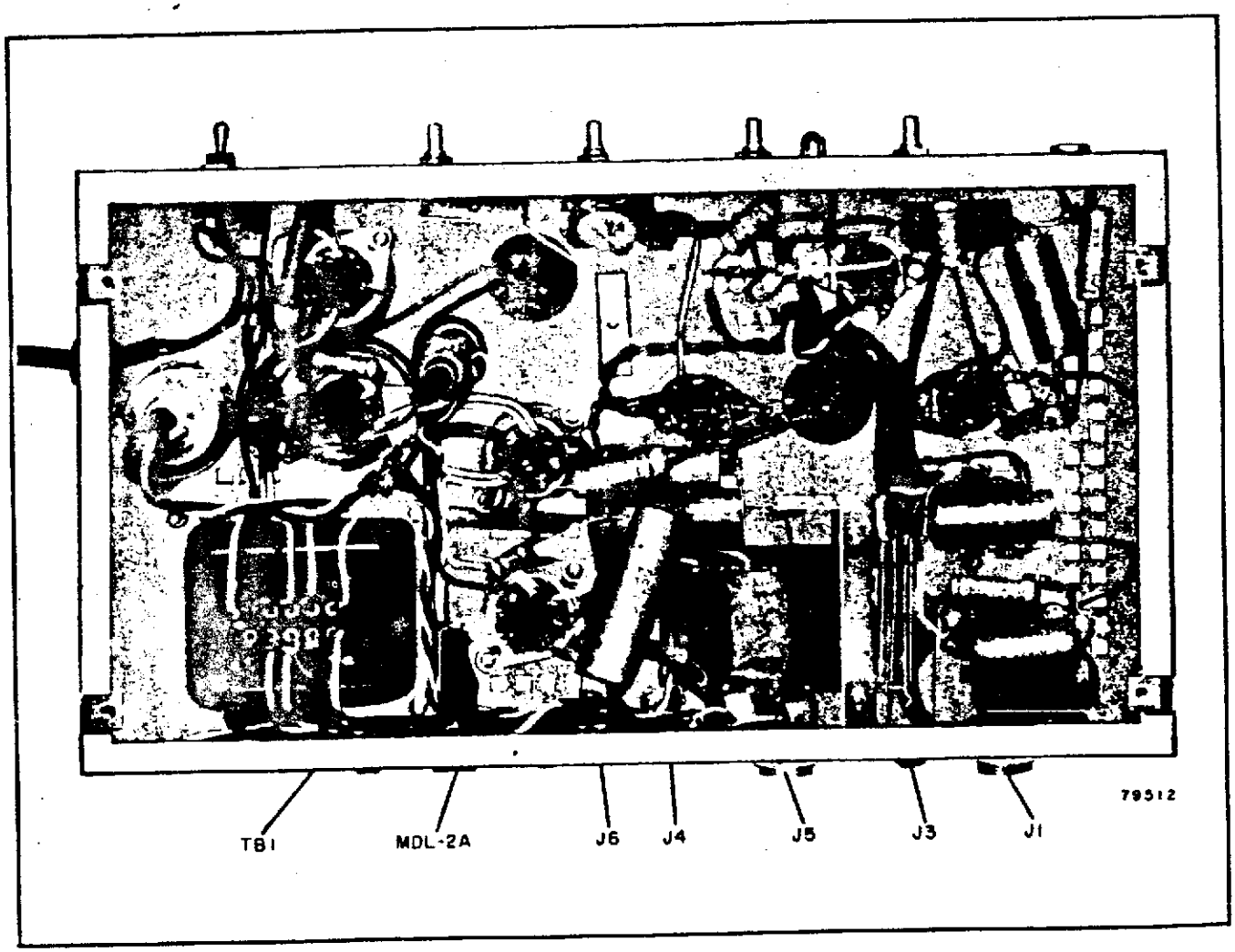

Figure 13 — Bottom View of Amplifier — Location of Parts

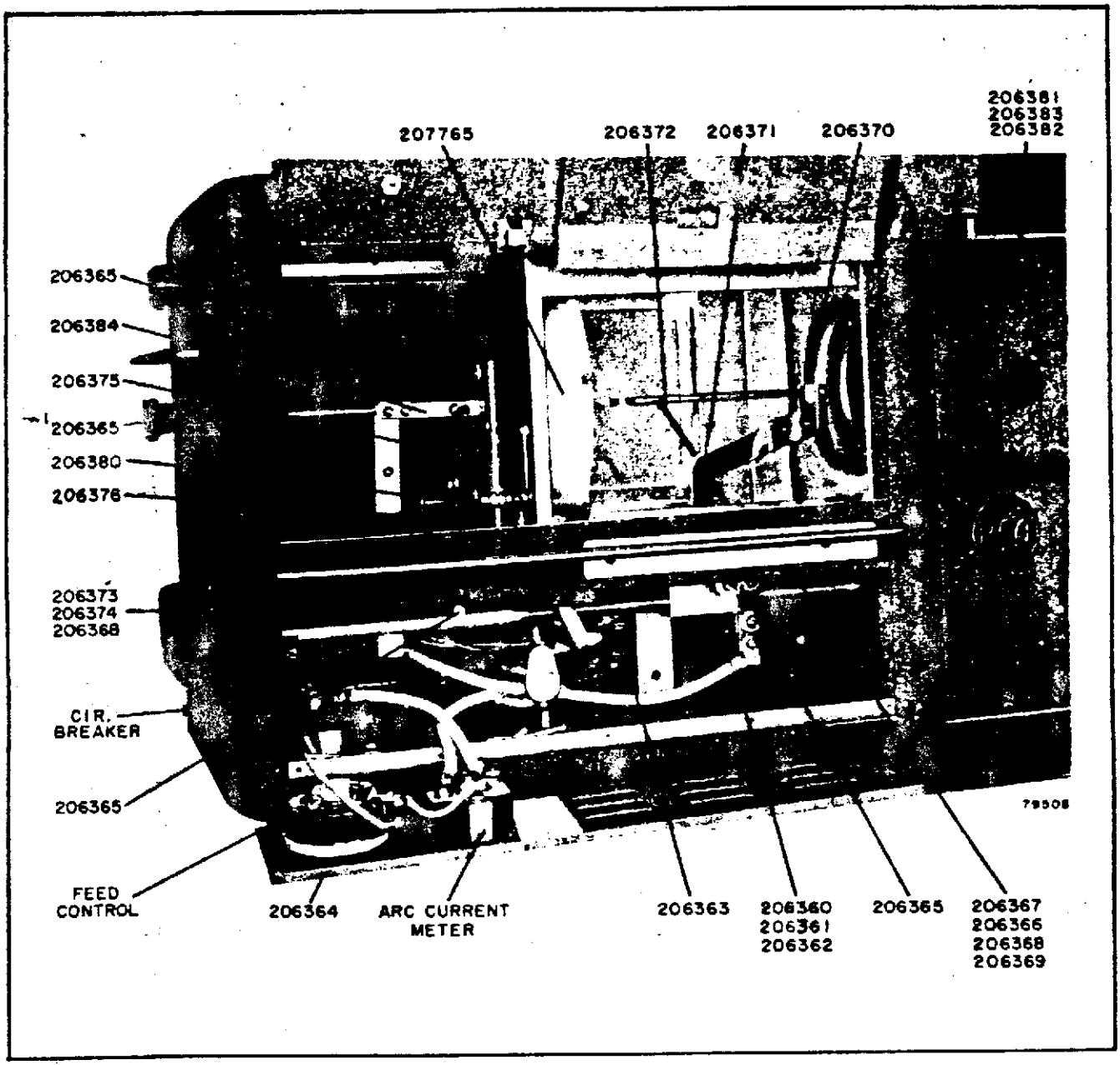

Figure 14 — Interior of Lamp House — Location of Parts

to make sure they are smooth and free from all foreign material, scratches and pits. The presence of scratches or pits may ultimately call for replacement of the part involved, since film emulsion piling up and hardening in such depressions cause film scratching.

b. *Sprockets.* Clean the sprockets with a bristle brush or toothbrush. Be sure that all dirt is removed from the teeth.

c. *Sound Drum Pressure Roller.* Wipe clean with a soft cloth moistened with carbon tetrachloride. Rotate the roller while cleaning.

d. *Sound Drum.* Clean the sound drum in the same manner as the pressure roller. Be sure to clean the back edge of the drum where the film sound tracks overhang. Wrap a clean cloth around the left forefinger and insert the finger between the guide roller and the tension roller. Hold the cloth against the back edge of the drum and rotate the drum with the right forefinger. Cleaning the back edge of the sound drum from the left side in this manner minimizes the possibility of disturbing the small mirror behind the drum on the right, which reflects the light beam from the sound optical unit into the phototube.

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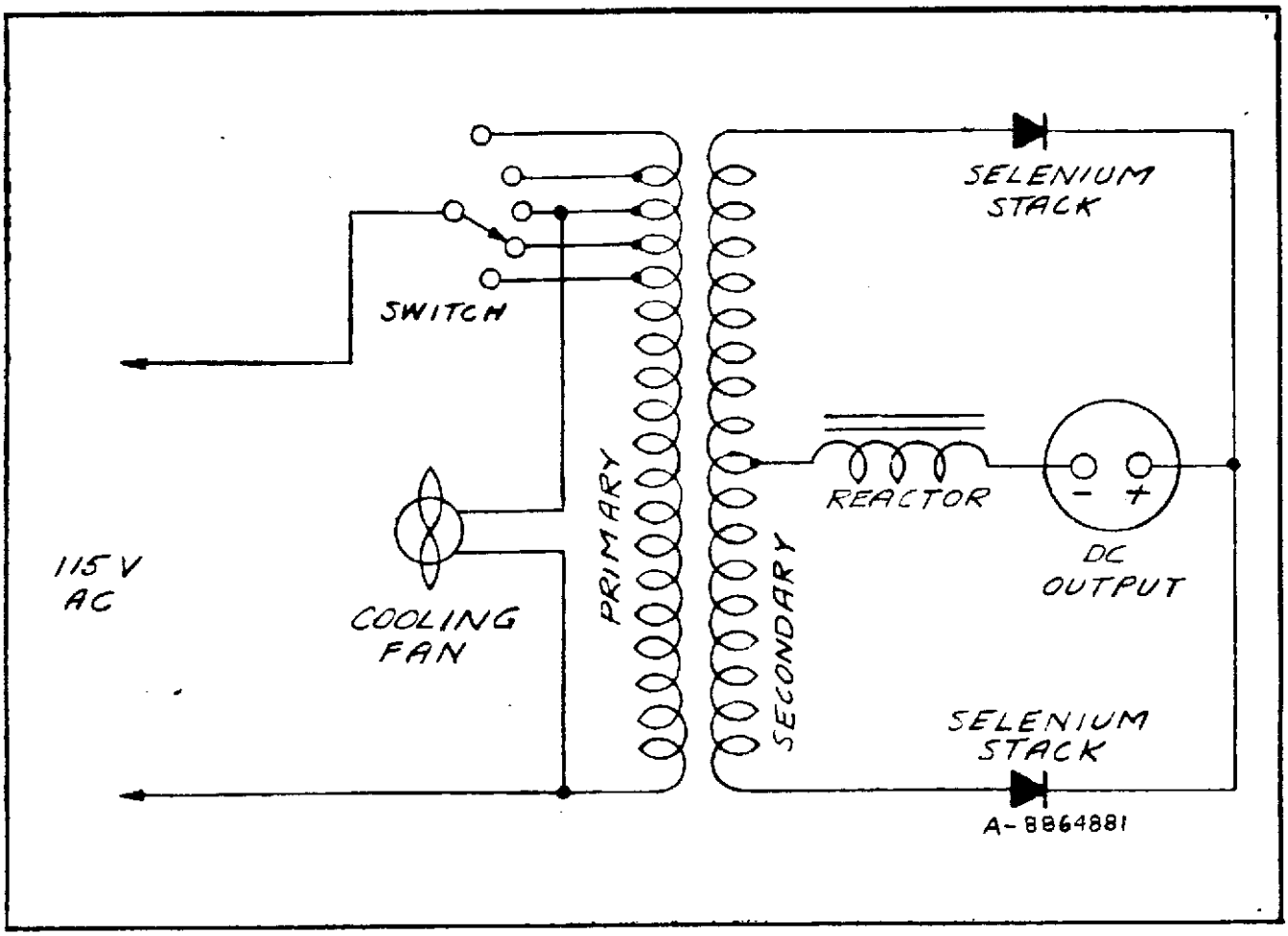

Figure 15 — Schematic Diagram of Selenium Rectifier

Replacements

1. *Sound Lamp.* The sound lamp is the most likely component to require replacement during a show. Spare lamps should be kept conveniently at hand. Open the sound optical bracket, see figure 9. Grasp the sound lamp with the left hand as shown, lift it slightly and turn it counter clockwise to disengage the socket pins. To install the new lamp, line up the notch in its flange with the small hole in the socket plate, and drop the flange over the socket pins. Push it down against the socket base and turn the lamp clockwise until it snaps into place. (Clean finger marks.)

2. *Fuse.* The fuse is mounted on the nonoperating side of the amplifier, see figure 3. When replacing a blown fuse, make sure that the replacement fuse is of the same type and rating (2 ampere, type 3AG), as the one furnished with the amplifier. To use a fuse of higher rating, for replacement purposes, will needlessly endanger the windings of the power transformer. If the fuse burns out repeatedly, check the tubes and amplifier components for the cause.

3. *Belts.* Remove and replace belts according to the instructions in figure 10.

4. *Reel Arm.* Refer to figure 11 for maintenance information on the lower reel arm assembly.

Service and Replacement Parts

If the equipment, due to damage or long use, should require service beyond the scope of the operations outlined in the "MAINTENANCE" section of these instructions, it should be sent or taken to an Authorized RCA Audio-Visual Equipment Dealer or Distributor. In general these RCA representatives maintain complete servicing facilities and adequate stocks of component parts.

The following parts list is included to provide identification when ordering replacement parts. Refer to the REPLACEMENT PARTS ordering instructions in the back of this book for ordering procedure details.

RCA - CARBON ARC

TROUBLE LOCATION AND REMEDY CHART

Description of Trouble	Possible Cause	Remedy
a. Loses lower loop	(1) Dirty aperture plate (2) Defective film	Clean Cut out defective part and splice
b. Picture motion unsteady	(1) Loss of loops	Restore loops
c. Picture indistinct or illumination low	(1) Dirty projection lens (2) Dirty condenser lens	Clean both ends Clean
d. Film being scratched	(1) Film pressure shoe dirty (2) Sound pressure roller dirty (3) Aperture plate dirty	Clean Clean Clean
e. Sound weak; picture normal	(1) Volume control not set properly (2) Defective tube	Adjust Check amplifier tubes
f. No sound; picture normal	(1) Amplifier POWER switch in off position (2) Loudspeaker not connected (3) VOLUME control not set properly (4) Sound lamp burned out (5) Defective tube	Snap switch ON Connect Adjust Replace Replace tube
g. Reproduction noisy	(1) Back edge of sound drum dirty (2) Dirty film (3) BAD TUBE	Clean drum Clean REPLACE TUBE
h. Sound on MIC; no sound from film	(1) Sound lamp burned out (2) Defective phototube	Replace Replace

LUBRICATION CHART

Points of	Type of Lubrication	Lubrication at Time of General Overhaul	Periodic Lubrication
Intermittent Cam	Sta-put heavy oil E.F. Houghton Co. Phila. 370 (Supplied in oil can with projector)	Saturate felts with oil, not to point of dripping. If contact point between felt and cam is worn, replace felt.	Ten drops in oil hole every 500 hrs. or twice a year, whichever comes first
Motor	SAE 30 Motor Oil	Five drops in each hole	Five drops in each hole every 1000 hrs. or once a year, whichever comes first
Guide Roller	SAE 10 Motor Oil	One drop in shaft hole in roller	Clean, then apply only if roller sticks or squeaks
Snubber Roller	Soft lead pencil, micro-fine graphite or Molykote powder	Apply smudge on shafts (must be free of oil)	Clean, then apply only if roller sticks or squeaks
Shoe, side pressure shoe	Soft lead pencil, micro-fine graphite or Molykote powder	Apply smudge on shoe before assembly (must be free of oil)	
Pin, film shoe	SAE 10 Motor Oil	Smudge on each pin	

LUBRICATION CHART (Continued)

Points of	Type of Lubrication	Lubrication at Time of General Overhaul	Periodic Lubrication
Pressure Roller	SAE 10 Motor Oil	One drop in shaft hole in roller	
Oilite bearings such as sprocket shaft, worm shaft, etc.	SAE 30 Medium Motor Oil	A few drops in bearing and on shaft	
Oilite bushings such as intermittent gear, shutter gear, rewind gears, etc.	SAE 30 Medium Motor Oil	A few drops in bushing and on shaft	
All gear teeth, including worm	Light grease, RCA Stock #205148, Esso Castroleum #3 or equivalent	Apply lightly to all teeth	