SERVICE INSTRUCTIONS

TELEVISION VIDICON FILM-CHAIN PROJECTOR

Commercial JAN

DESIGN 614 EVM

PHOTO PRODUCTS GROUP

BELL & HOWELL

This projector now manufactured by:
INTERNATIONAL CINEMA EQUIPMENT CO.
100 N.E. 39th St.
Miami, Florida 33137
(305) 573-7339
Fax: 305-573-8101

GENERAL SERVICE DEPT.
7100 McCORMICK ROAD
CHICAGO, ILLINOIS 60645

PART NO. 70492 PRINTED IN U.S.A. NOVEMBER 1966

SPARE PARTS KITS

OPERATION SPARES KIT (1 YR. SUPPLY)

40	Projection Lamp #600442
12	Exciter Lamp #613261
24	Feed Reel Belt #620976
24	Take-Up Reel Belt #620975
2	Projector Oil (2 oz. bottle) #067480
5	Amplifier Fuse #620857
3	Amplifier Pilot Lamp #612735
3	Projector Pilot Lamp #613251
6	Control Panel Pilot Lamp #300022

AMPLIFIER TUBE KIT (#067298)

2 - 12AX7 Tubes; 3 - 6AQ5 Tubes; 2 - 6X4 Tubes

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3	Film Shoe Assembly #061997
2	Bronze Washer (for Reel Arms) #613373
2	Take-Up and Rewind Ratchet #611231
6	Bearing Ball (for Take-Up Shaft) #5238

All orders for tools and kits should be addressed to Bell & Howell Company, Professional Equipment Dept. #8729, 7100 McCormick Road, Chicago, Illinois 60645.

LAMPS:

PROJECTION

CXY
CXK 300watt 25hr — Television models 614 ETV, EVM

DDB 750watt 25hr
DFD 1000watt 10hr
DFT 1000watt 25hr
DHT 1200watt 10hr — Incandescent for all other JAN models

BTN 750watt 500hr
BTP 750watt 200hr
BTR 1000watt 250hr — Halogen substitute for above incandescents

SOUND EXCITER

BSL — JAN 614CD, CBVM

BRX 6volt 1 amp 100hr — All other JAN models

NOTE: 1000 watt XENON lamp conversion kit is available for high intensity applications. Call International Cinema Equipment.

Introduction

This instruction book has been prepared as an aid to the television station personnel in the operation, maintenance, and minor repair of the Bell & Howell Design 614EVM 16mm television vidicon film-chain projectors.

The projectors covered in these instructions are specially designed versions of commercial JAN (Design 614) projectors. Parts replacement data and repair procedures common to all Design 614 projectors is found in Instruction Book #70467 dated June 1965.

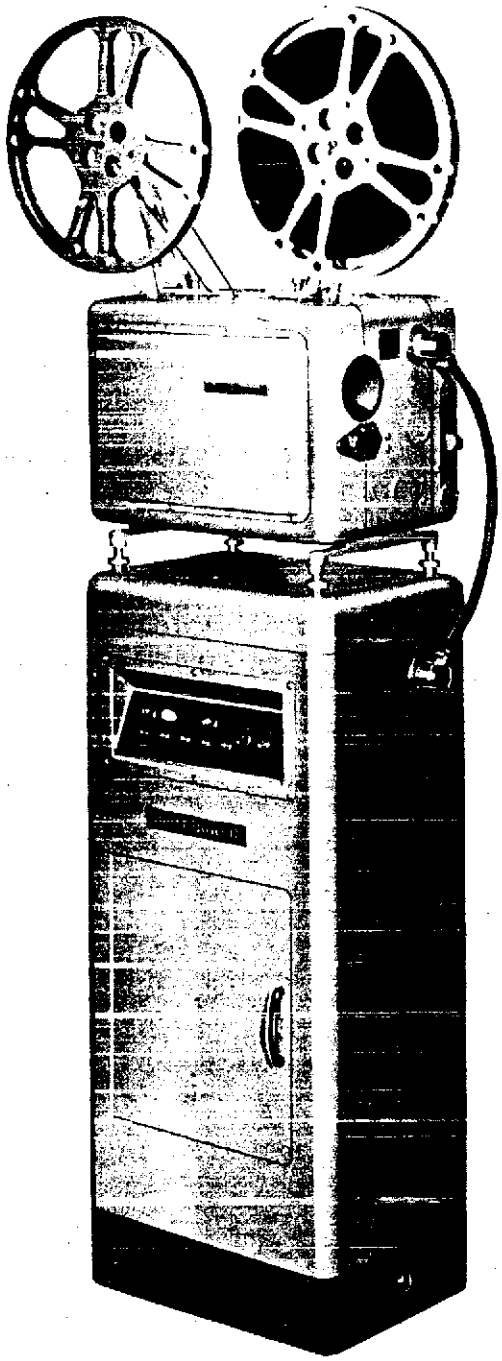

Figure 1. Design 614EVM (16mm) Television Vidicon Film-Chain Projector

Description

1. GENERAL.

The equipment (figure 1) consists of a 16-mm film projector mounted on a pedestal control cabinet, designed to play back both magnetic and optical sound tracks. All three television projectors are basically identical with the only major differences being in the shutter speed and in the electrical power requirements. The 614EVMF operates on 117-volt, 50 cycle alternating current, while the 614EVMR and 614EVMS require 117-volt, 60 cycle alternating current. Shutter speed variations are as follows: 614EVMF, 48 cycles-per-second; 614EVMR, 72 cycles-per-second; 614-EVMS 120 cycles-per-second. Any of these projectors can be equipped with either a 300-watt or a 1000-watt lamp. Both lamps are rated at 25 hours with the 300-watt lamp furnishing a light output of 50 lumens and the 1000-watt lamp providing a light output of 350 lumens.

2. PEDESTAL CONTROL CABINET.

The pedestal control cabinet (figure 1) contains all of the controls for local operation of the projector. A built-in 24-volt D.C. control circuit, consisting of three relays energized by current supplied within the cabinet, affords the remote operation facility. A LOCAL-REMOTE switch on the control panel permits the operator to set up for projection and then surrender the actual operating controls to a remote location. Pilot lamps on both cabinet control panel and remote panel indicate the position of the switching circuits. Four elevating screws, upon which projector mounts on top of the cabinet, are provided for precise leveling and adjustment of the optical axis of projector lens to the standard 48-inch elevation. Latitude of adjustment varies from 47 to 49 inches. Two large shelves inside the cabinet afford ample space for storing spare projection lamps, exciter lamps, and other accessories.

A cable for connecting projector to the control cabinet and a 10-foot audio cable that fits in the projector audio socket are furnished with the equipment.

3. SPECIFICATIONS.

GENERAL DATA:

Projector dimensions:

Height	13-3/4 inches
Length	16-1/4 inches
Width	12-1/8 inches

Pedestal control cabinet dimensions:

Height	38 inches
Length	16-1/4 inches
Width	12-1/8 inches

Projector weight	49 pounds
Control cabinet weight	25 pounds
Film size	16-mm
Film reel capacity	2000 feet
Speed (60-cycle systems)	24 fps
Speed (50-cycle systems)	25 fps
Sound reproduction	Optical and magnetic
Leveling adjustment	Screw-type
Film direction	Forward and reverse
Film protection	Air-cooled aperture, sapphire inserts, undercut sprockets and rollers, 3-tooth Carboloy shuttle
Lubrication	Sealed
Ventilation	Motor driven, 3-inch diameter, 24-blade rotor
Elapsed-time meter	5-digit hour meter
Loopsetting adjustment	Pushbutton

OPTICAL DATA:

Light output (all models):

300-watt, 25-hour lamp	50 lumens
1000-watt, 25-hour lamp	350 lumens

Shutter frequency:

614EVMF	48 cycles-per-second
614EVMR	72 cycles-per-second
614EVMS	120 cycles-per-second

Light application time	Equal to or greater than 30% for that of single television field
Picture steadiness	Vertical jump (maximum) 0.2% picture height; horizontal weave 0.2% picture width maximum
Film framing	Fixed-axis type; no aperture displacement during framing
Projection lens	2 inches f/1.6 standard; accommodates up to 5.4 inch lens
Optical elements	All air-to-glass surfaces of lens and condenser elements coated to reduce reflection losses and increase light transmission of system

ELECTRICAL DATA:

Amplifier:

Power output	Plus 10 dbm (600 ohms) unbalanced or 6 watt (16 ohms)
Harmonic content	Less than 2% total from 100 to 7000 cycles
Frequency response	80 to 8000 cycles-per-second within 1-1/2 db

Signal/noise ratio ..... Optical — 60 db below amplifier rated output; magnetic — 40 db below amplifier rated output
Wow ..... 0.125% maximum
Flutter ..... 0.125% maximum
Band pass .... Total sum of wow and flutter shall not exceed 0.250%
Tube complement .... 12AY7 — magnetic pre-amp
12AX7 — voltage amplifier
12AX7 — voltage amplifier/phase inverter
6AQ5 — r-f oscillator for exciter lamp
6AQ5 (2 required) — push pull power amplifier
6X4 (2 required) — rectifiers

Blower motor ..... Universal
Drive motor ..... Synchronous
Exciter lamp ..... Prefocused, 6 volt, 1 amp
Photocell ..... Silicon type
Power requirement ..... 110 to 120 volts A.C., 50 or 60 cycle

CONTROLS:

Local .... 5 pushbuttons: REVERSE, FORWARD, STOP, RUN, and SHOW
Remote .... Remote control operation possible by providing momentary contact switches (switch in REMOTE position). Remote circuit operates on 24-volts, D.C., from self contained power supply circuit or from station BUS

4. OPERATING THEORY.

The projector shutter frequency is the determining factor that permits the Bell & Howell Design 614 EVM projectors to be efficiently used in vidicon film-chain systems. The shutter used in the 614EVMS operates at 120 cps; that is, each frame of the film is projected five times. The time-cycle graph (figure 2) illustrates the relationship between the television field and frame rate as against the motion-picture film frame rate. The five light pulses in each frame are indicated, and their relationship to the television field and frame can be compared. The pull-down cycle for each film frame is completely masked by the shutter, so that no travel ghost will be evident in the projected picture.

The shutter produces five light pulses at 2770 usec duration for each film frame, four per television frame, or two per television field. The time application for each television field is then 5540 usec.

In the 614EVMF, which operates on 117-volt, 50-cycle current, the film is transported at 25 frames per second. It also should be noted that computations specified in the preceding paragraphs will vary with the 48 cps (614EVMF) and 72 cps (EVMR) shutter.

The image is projected through the multiplexer mirror system onto a field lens. The camera then focuses upon the field lens. Refer to the applicable manufacturers' instructions for a discussion of these components.

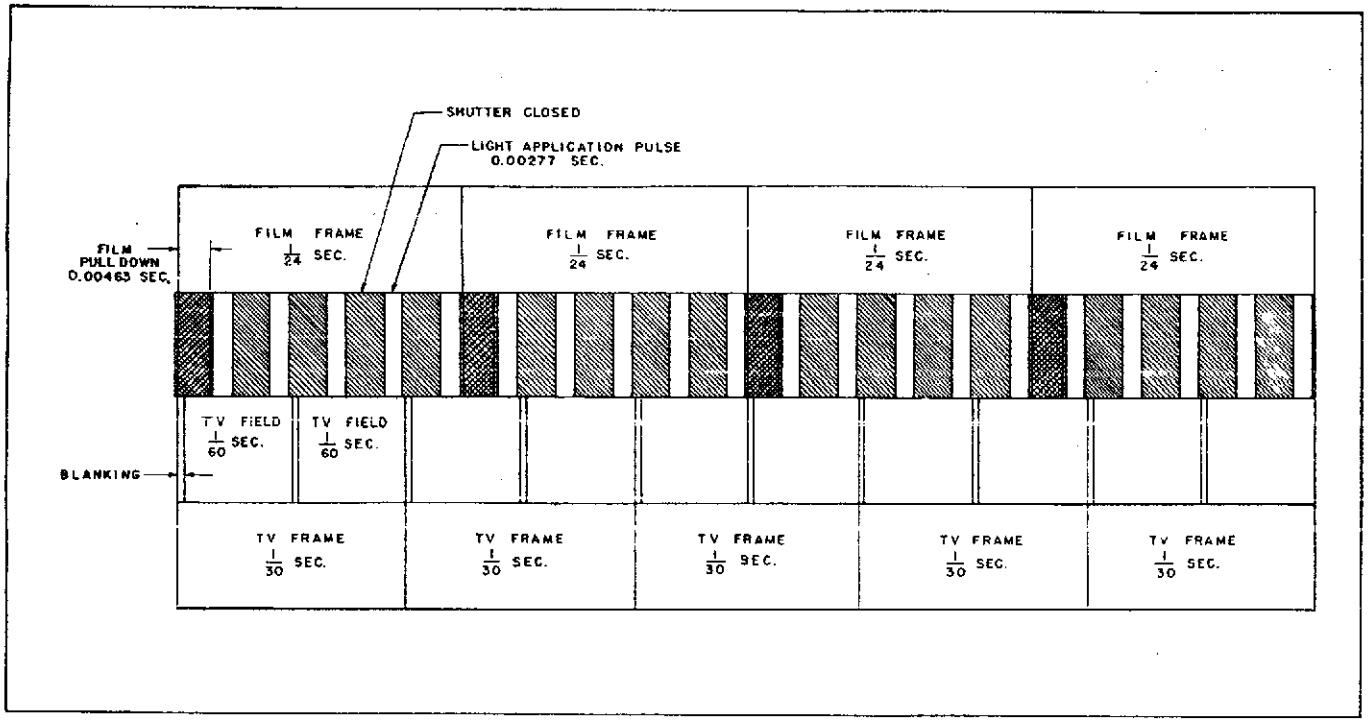

Figure 2. Projector Time Cycle for 60-Cycle Operation

Installation

The main consideration in operating motion picture projectors with a vidicon, multiplexer, and slide projector, is setting up the equipment components so that the optical centerline passes through the exact center of the vidicon lens, the projector lenses, the slide projector lens, and the multiplexer, in both the vertical and horizontal planes.

5. SET-UP PROCEDURE.

a. Select the site for the multiplexer.

b. Draw two reference chalk lines on the floor intersecting at the center of the multiplexer, 90° apart.

c. Fasten the multiplexer to the floor with its lens surface toward the vidicon position, normal to the reference line. Be sure that it is exactly level and has not been disturbed during installation. Shim up if necessary.

d. Install the vidicon camera along the reference line so that the optical centerline of the camera lens coincides with the center of the optical field lens. Use a plumb bob and levels to insure correct installation.

e. Install the projectors with their pedestal control cabinets so that the optical centers of both projector lenses pass through the center of their respective multiplexer mirrors. Use the elevating screws under the projector to compensate for any floor slope or other unevenness. Check adjustments with plumb bob and levels.

f. A typical telecine room layout is shown in figure 3. When using lenses other than those indicated in the illustration, refer to the 16mm lens data chart (Table I) for image size of different focal length lenses.

6. CABLE LAYOUT.

Figure 4 shows a typical layout for connecting the projector pedestal control cabinets to the 117-volt A.C. power source, projector change-over, remote

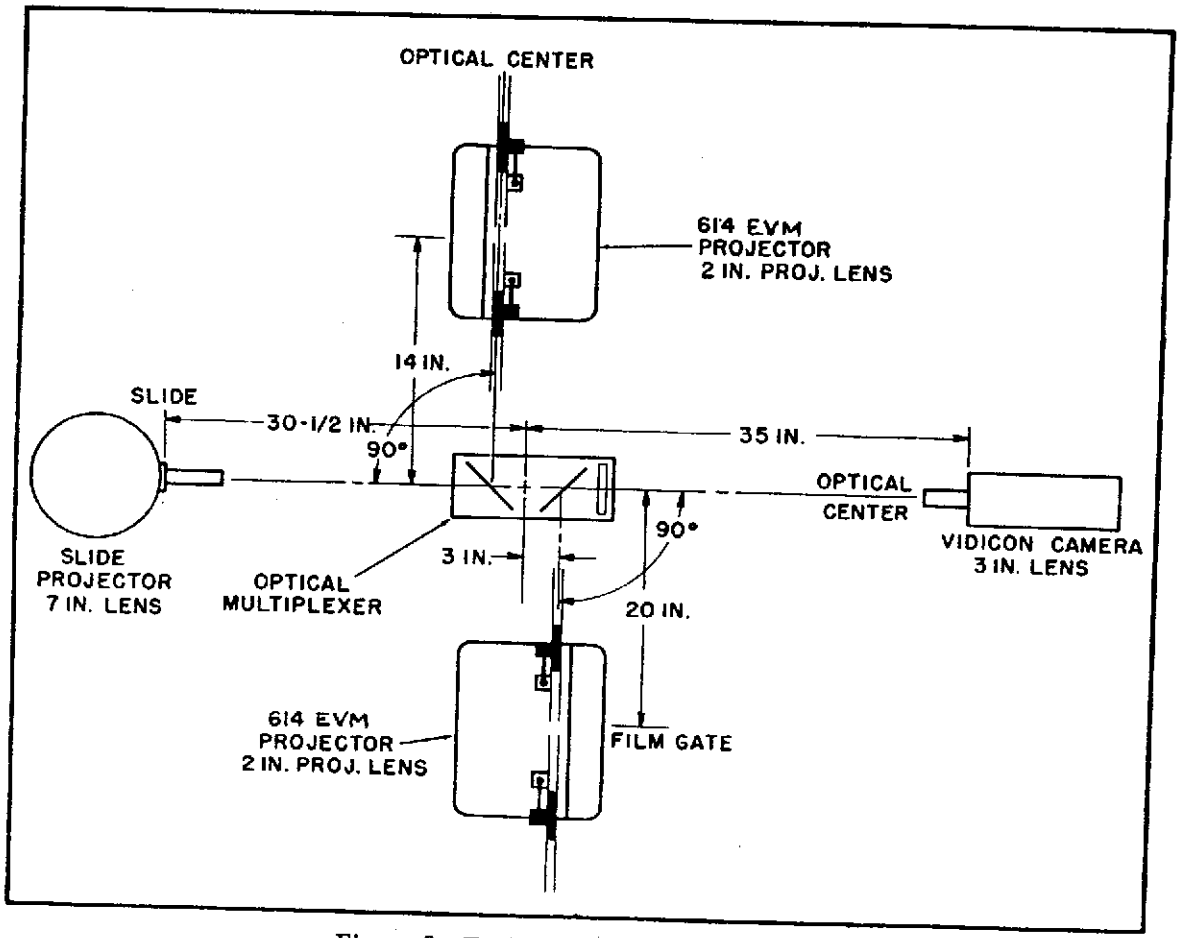

Figure 3. Typical Telecine Room Layout

TABLE I. LENS DATA CHART

Distance - Lens to Screen	16mm Projection Lens Focal Length			
	2 in. f/1.6 B & H #065184	2.5 in. f/1.6 B & H #620757	3 in. f/1.6 B & H #620763	4 in. f/1.6 B & H #620765
12 in.	1.4"h x 1.9"w	1.1"h x 1.5"w	0.8"h x 1.1"w	0.6"h x 0.7"w
18 in.	2.2"h x 3.0"w	1.6"h x 2.2"w	1.2"h x 1.7"w	0.9"h x 1.1"w
24 in.	3.1"h x 4.1"w	2.5"h x 3.4"w	1.9"h x 2.6"w	1.4"h x 1.9"w
30 in.	3.9"h x 5.3"w	3.1"h x 4.1"w	2.5"h x 3.4"w	2.1"h x 2.8"w
36 in.	4.8"h x 6.4"w	3.9"h x 5.3"w	3.1"h x 4.1"w	2.3"h x 3.0"w
42 in.	5.7"h x 7.5"w	4.6"h x 6.2"w	3.6"h x 4.8"w	2.7"h x 3.6"w
48 in.	6.5"h x 8.6"w	5.3"h x 7.1"w	4.2"h x 5.6"w	3.1"h x 4.1"w

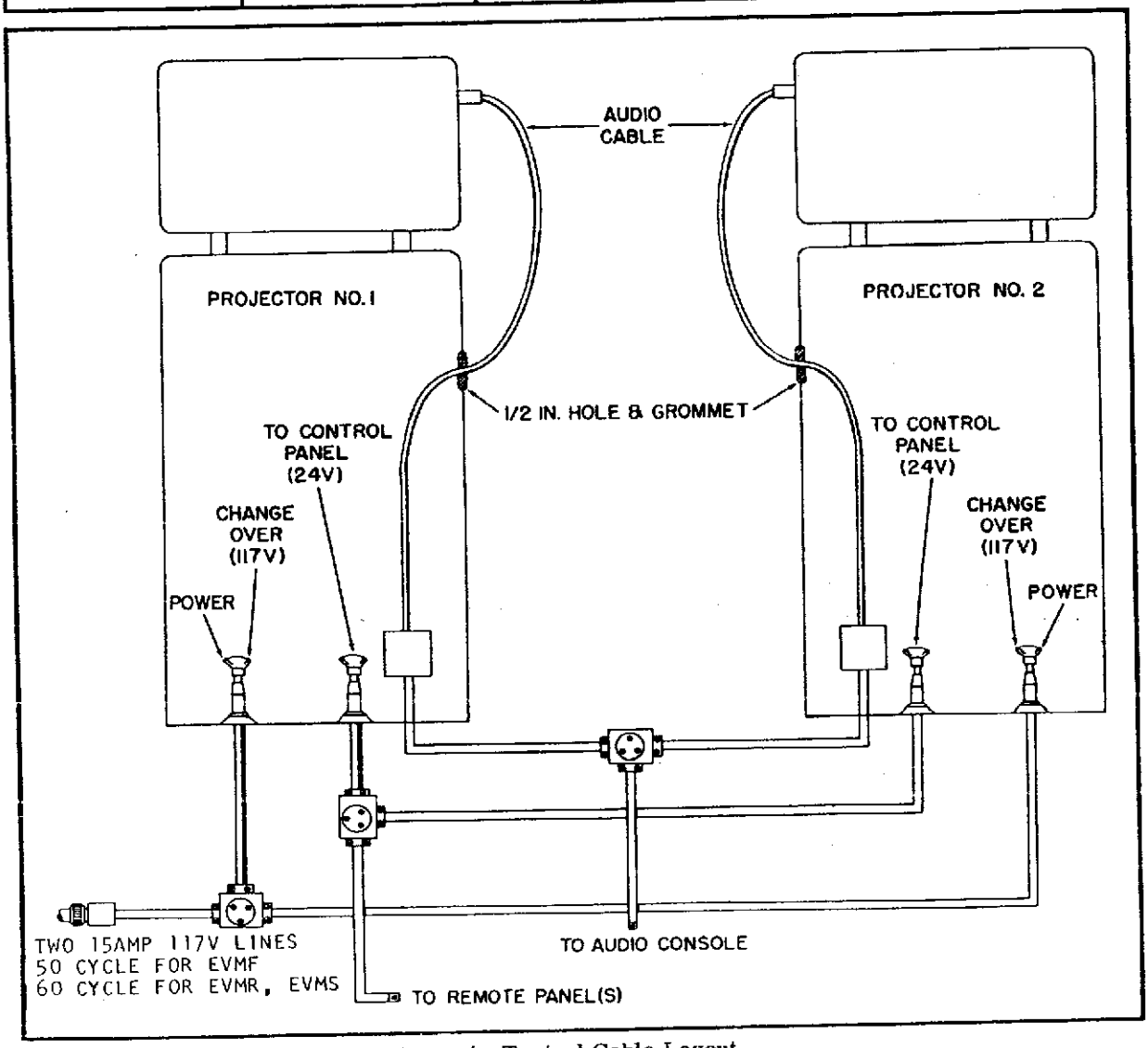

Figure 4. Typical Cable Layout

control, audio line, and projection lamp intensity control. If desirable, these lines could be run in 3/4-inch conduit set beneath the floor level. Stub the ends of the conduit for power, change-over, and remote control, but use a junction box for the audio connection. The three knockouts on the pedestal base may be used for making connections.

a. Connect a separate 117-volt A.C. line to each cabinet (term. 1 and 2 of short terminal strip, figure 5).

b. Connect term. 9, 10, 11 and 12 to projector #2. Run these leads in same conduit with power line.

c. Wire up the remote control panel. (See figure 6.) From one projector, connect terminals 13, 14, 15, 16, 17, 18, 19, 20, and 21 (figure 5) to one remote panel section. Repeat these connections from the second projector to the second remote panel section.

NOTE: Remote panels not furnished by Bell & Howell. A suggested remote panel layout is shown in figure 8.

d. Drill a 1/2-inch hole and install a grommet in each pedestal control cabinet. Run both 10-foot audio cables to their respective junction boxes, through the conduit, and make appropriate connections at the audio console.

e. If projection lamp intensity control is desired, remove the jumper between terminals 3 and 4 on the short terminal strip (figure 5) and connect in a Variac, General Radio Type V5, or equal. Refer to figure 7 for circuit.

NOTE: The magnetic playback head in the projector is susceptible to stray magnetic field pickup. The intensity control Variac should not be mounted in such a fashion that it will induce hum into the magnetic head circuit.

7. OTHER COMPONENTS.

Refer to the applicable equipment manufacturers' instructions for the installation, operation, and service of the vidicon camera, multiplexer, remote panel, audio console, and other related equipment. The foregoing instructions are merely a guide for installation. The equipment manufacturers' recommendations should govern the final installation.

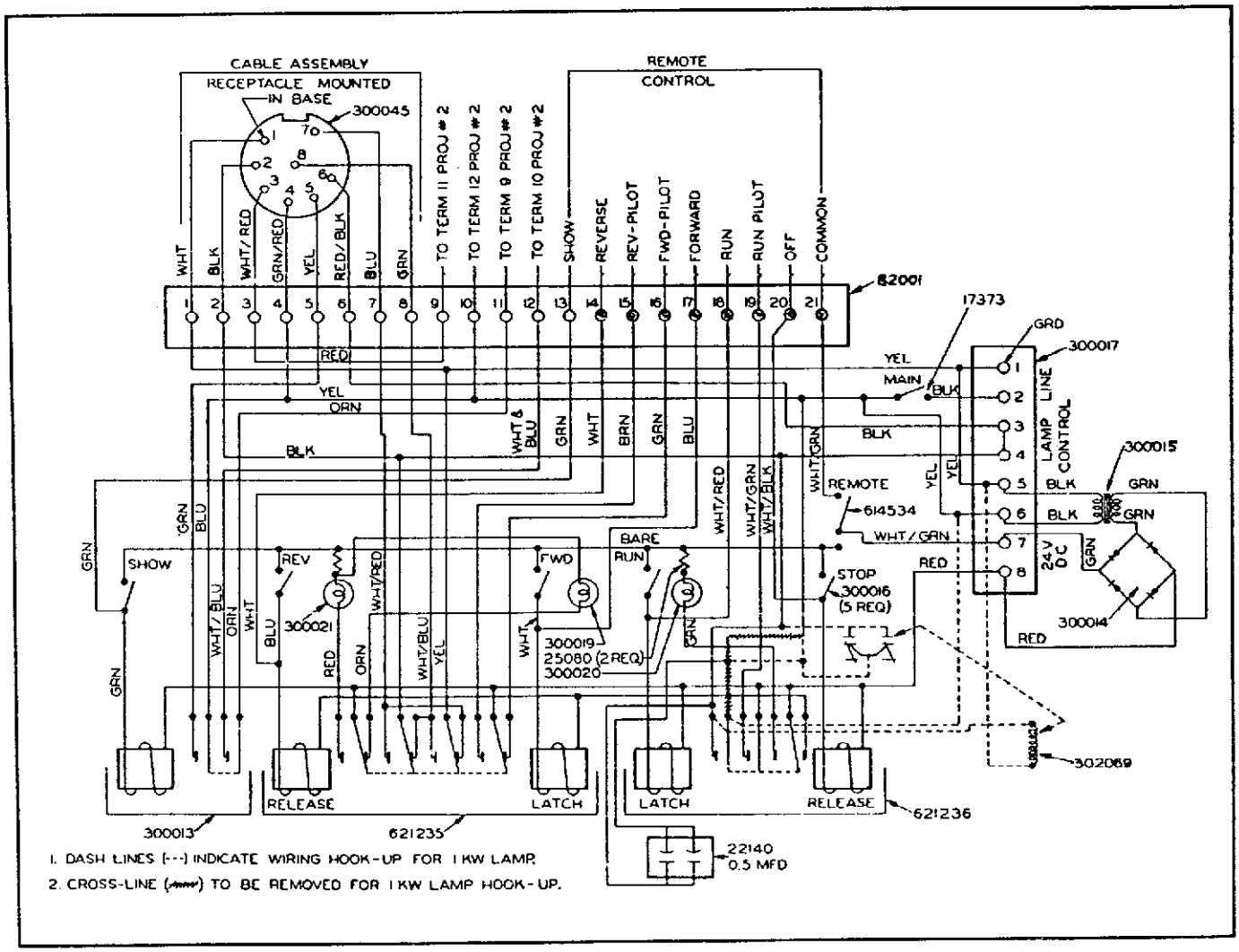

Figure 5. Pedestal Control Cabinet Wiring Diagram

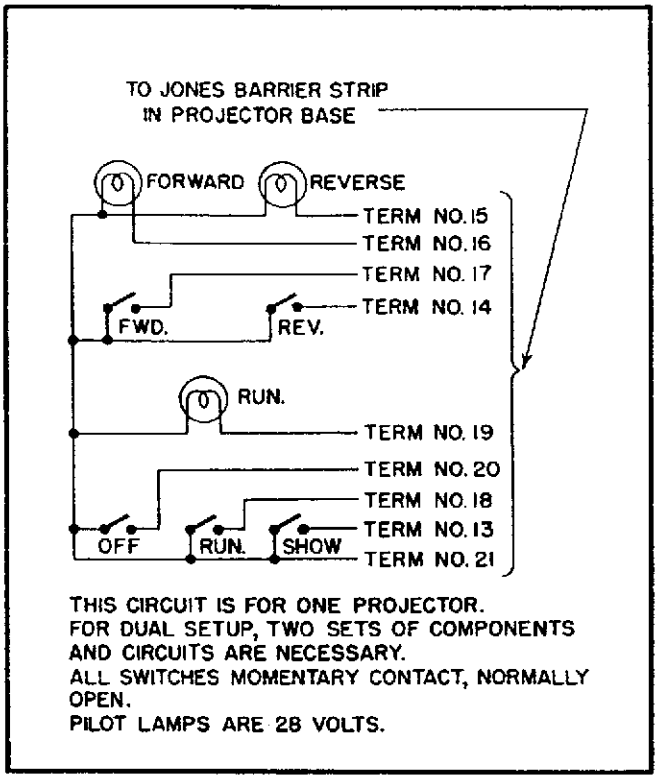

Figure 6. Remote Panel Wiring Diagram

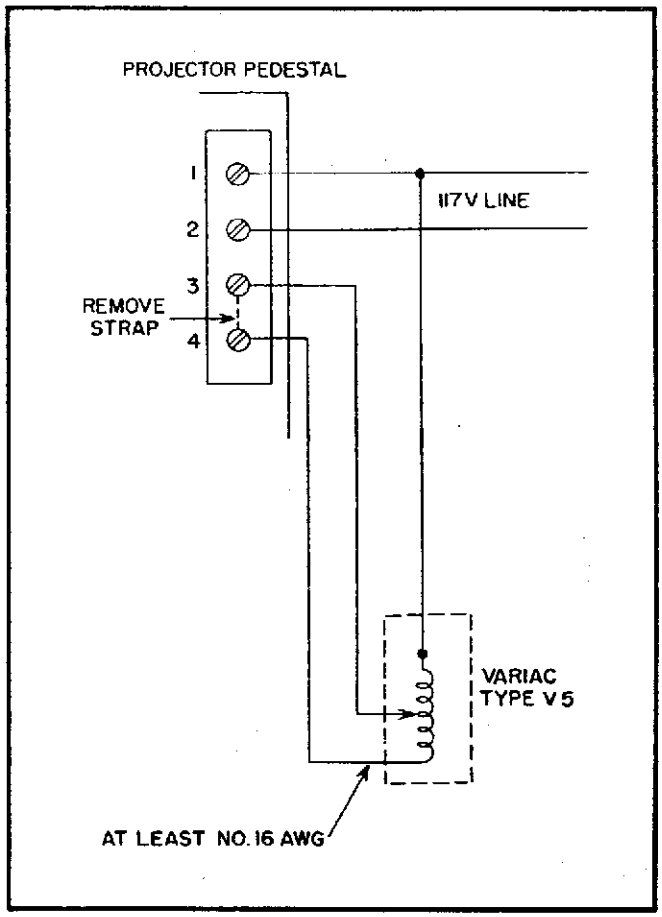

Figure 7. Projection Lamp Intensity Control Circuit

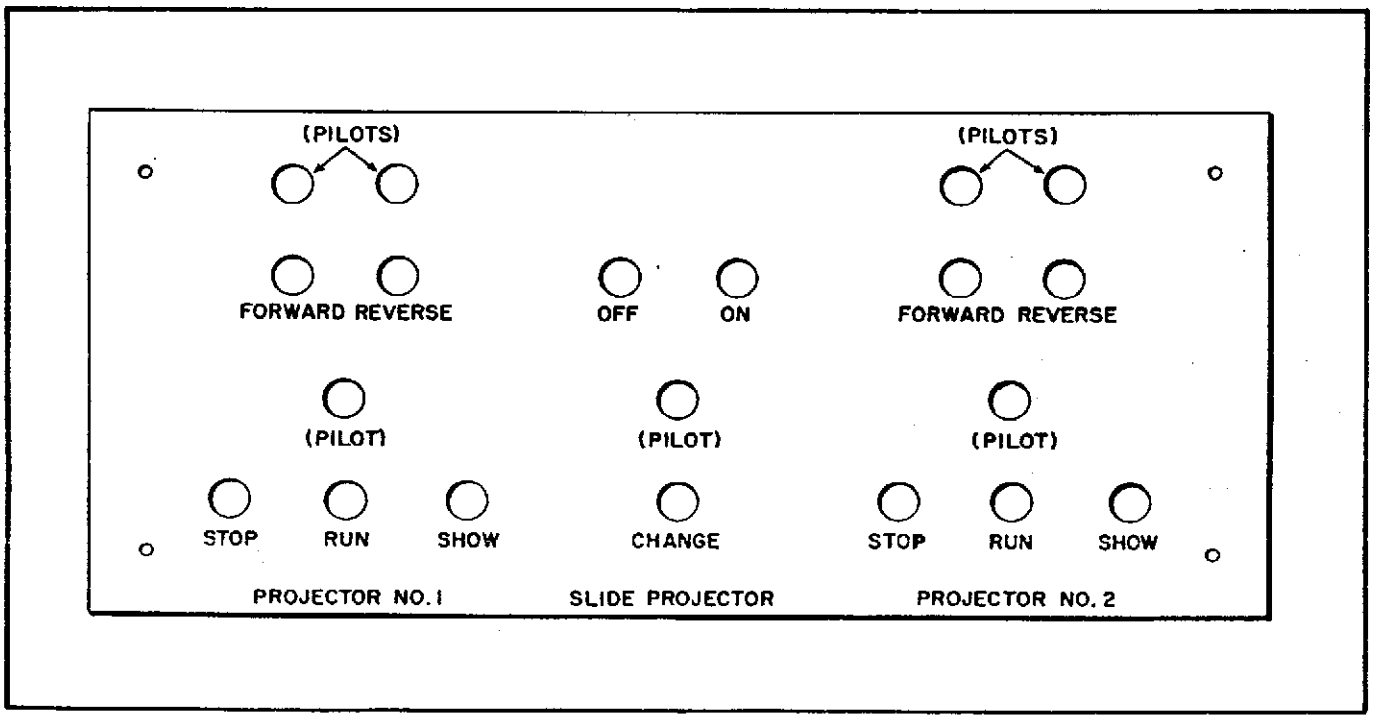

Figure 8. Suggested Layout for Remote Control Panel

Operation

8. REEL ARM INSTALLATION.

a. Mount the take-up reel arm and the feed reel arm to the projector as shown in figure 9. For projection, the rewind mechanism knob on the feed reel arm (figure 10) must be set in the OUT position (engaged in the short slot). This knob is set in the IN position (engaged in long slot) only when rewinding film. Projecting film with the rewind mechanism knob in the IN or rewind position exerts extreme tension on the film at the feed sprocket, a condition which will cause damage to the film.

b. Loop the rewind belt, without a twist, over the pulley on the feed reel arm. Loop the take-up belt, without a twist, over the pulley on the take-up reel arm. Refer to figure 9. Make certain that both belts are looped around their respective pulleys within the projector.

9. PRELIMINARY EQUIPMENT CHECKS.

a. Check to be sure the aperture plate (figure 11) is all the way down. To do this, open the film gate by pulling out the pressure plate release knob. Grasp the handle of the aperture plate and push it down firmly as far as it will go. Close the film gate 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 is removed while the projector is running, the shuttle teeth will break, causing picture jump, loss of lower loop, etc.

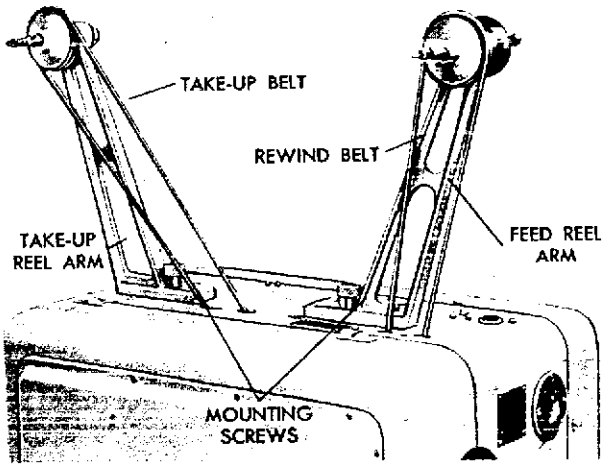

Figure 9. Reel Arms and Spring Belts in Operating Position

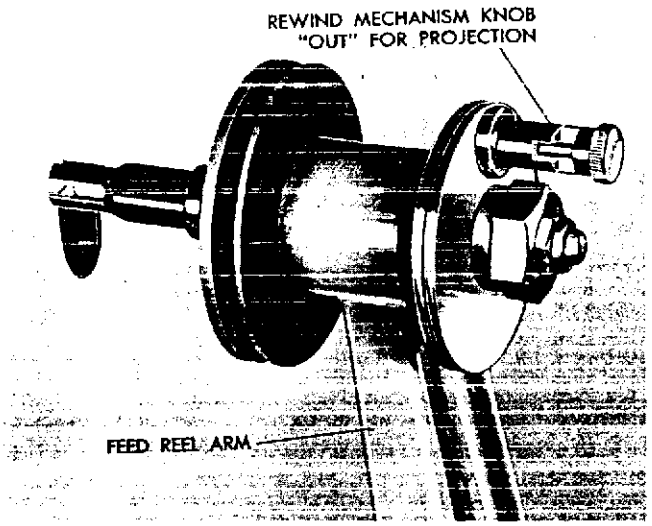

Figure 10. Projection Position of Feed Reel Arm Rewind Knob

b. Be sure the rewind mechanism knob (figure 10) on the projector feed reel arm is in its OUT position and engaged in the short slot.

c. Turn ON-OFF switch on power panel to "ON" position. The motor should start, the take-up belt should run, and the three film sprockets should operate smoothly and quietly.

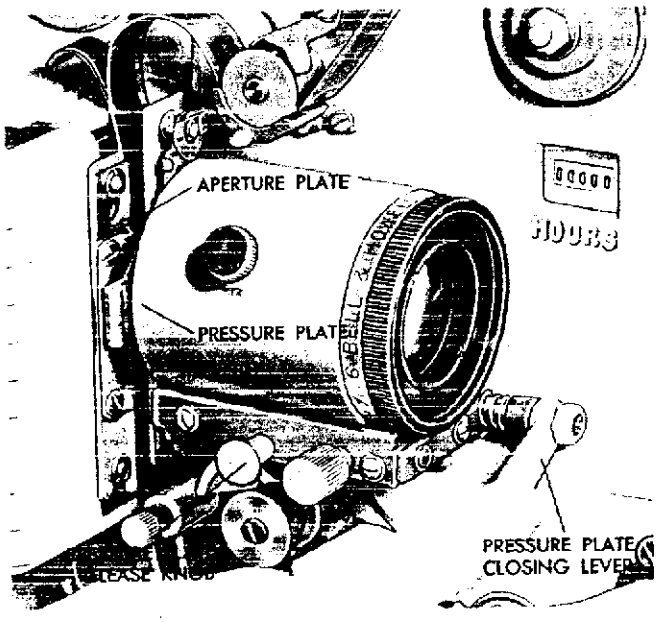

Figure 11. Controls for Opening and Closing Film Gate

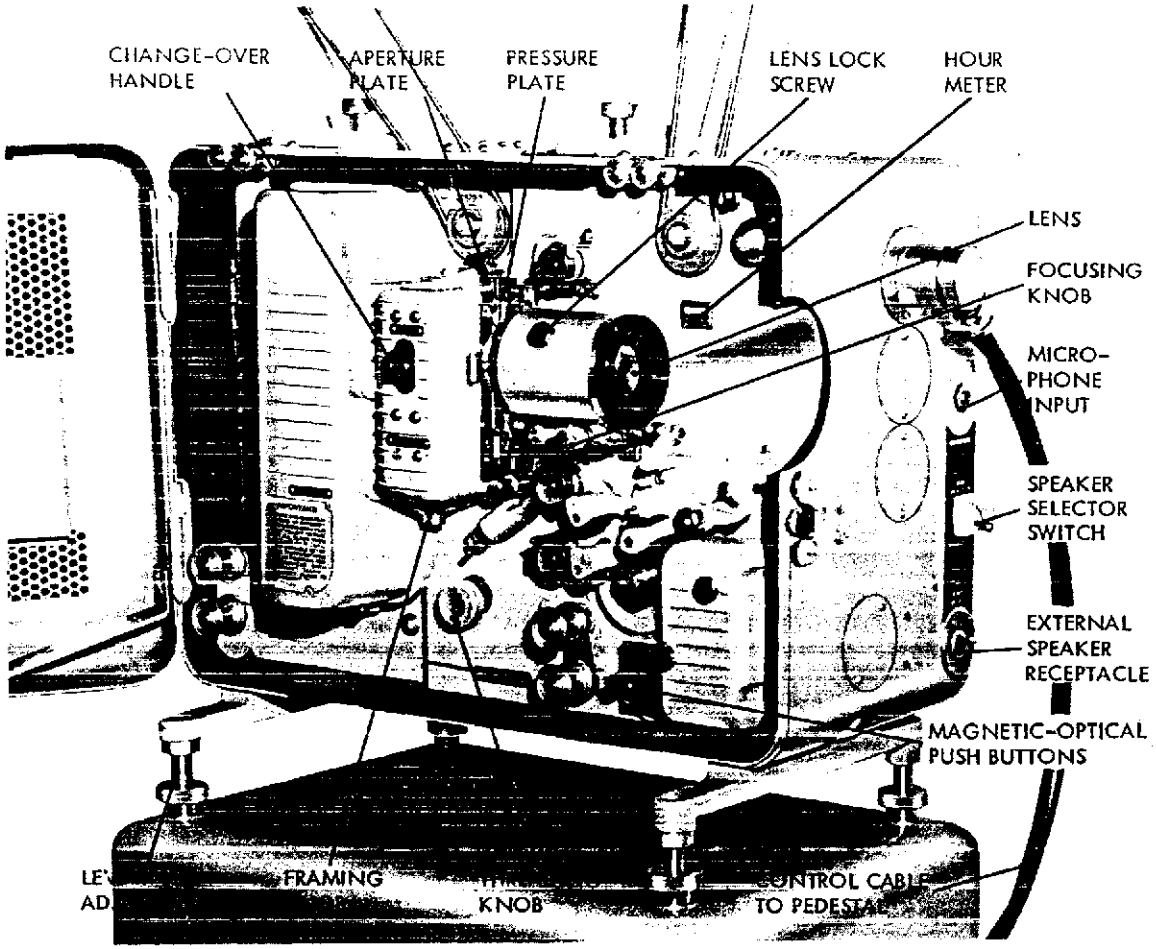

Figure 12. Projector Operating Controls

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

NOTE: Operating controls for the equipment are illustrated in figures 12, 13 and 14.

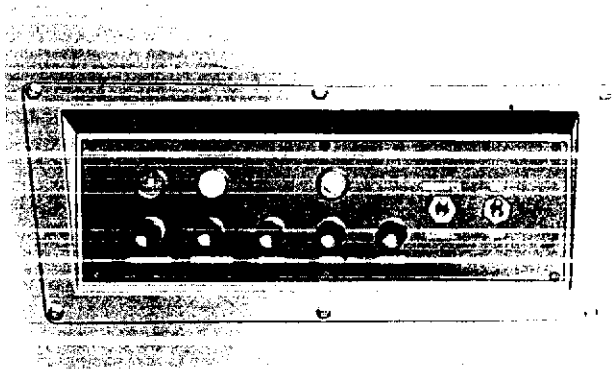

Figure 13. Pedestal Control Panel

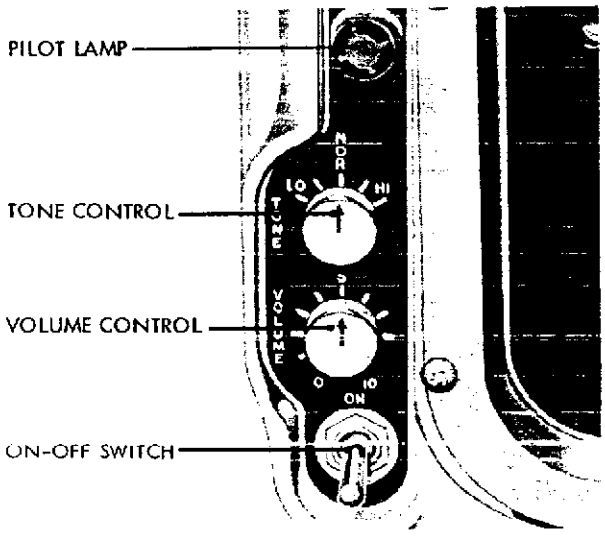

Figure 14. Amplifier Control Panel

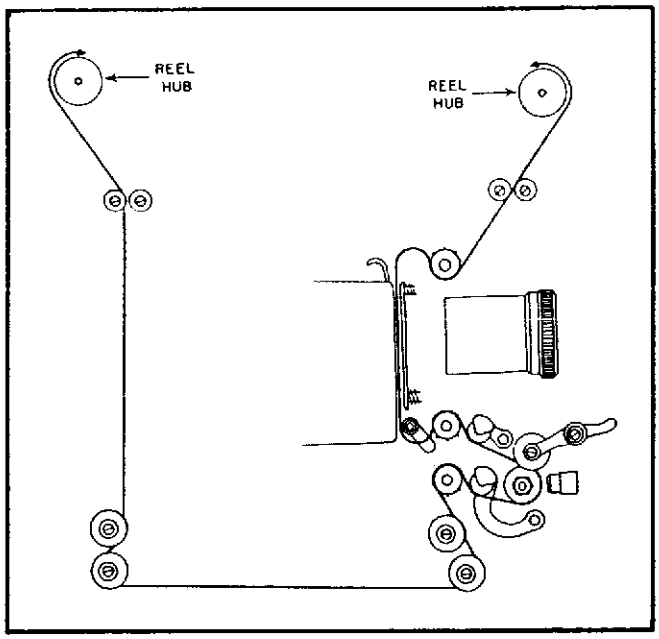

Figure 15. Projector Threading Diagram

10. PROJECTOR THREADING PROCEDURE.

a. Refer to figure 15. Unwind about four to five feet of film leader. Pass the film between the two film guide rollers at the top of the projector case. Lower the feed sprocket film shoe away from the feed sprocket and place film under the feed sprocket, making sure that the film perforations engage the sprocket teeth. Push up the feed sprocket film shoe to lock film in place under the feed sprocket.

b. Turn the threading knob (figure 12) to the point where the words "THREADING KNOB" are in a horizontal plane. This will place the shuttle teeth in their maximum protrusion position for engagement with the film perforations. Open the film gate by pulling the pressure plate release knob (figure 11). Form a proper length of upper film loop. (Film loop must be of the size indicated by the loop guide line on the mechanism plate.) Place the film flat on the aperture plate. Be sure 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 moving the pressure plate release handle toward the lens and to the left as far as it will go without forcing.

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

d. Lift the sound sprocket film shoe away from the sound sprocket. 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 sure that the film perforations engage the sprocket teeth. Push down on the sound sprocket film shoe to lock film in place over the sound sprocket.

e. Pass the film under the upper idler roller and around the sound drum, facilitating this procedure by raising the guide roller. After passing the film around the sound drum, lower the guide roller to its operating position over the sound drum.

f. 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.

g. Before engaging film perforations with the teeth of the take-up sprocket, gently pull the film taut to the left. Then release the film just enough to permit the lower idler roller to pull the film back until the first available set of film perforations are in position for engagement with the sprocket teeth. Correct slack at this point is equivalent to one-half frame of film. Push down on the take-up sprocket shoe to lock film in place over the take-up sprocket.

h. From the take-up sprocket, pass the film over the right side of both floating idler rollers and to the left across the bottom of the case to the two guide rollers. 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 upwards in between the two film guide rollers at the top of the case and to the left side of the empty take-up reel. Place the film between the flanges of the reel and engage the free end of the film securely in the slot in the hub of the take-up reel so that the reel will take up the film as it revolves in a clockwise direction.

i. Hold the take-up reel stationary and pull the take-up belt downward a few times to take up the film slack. This completes the threading of the projector. Figure 15 shows the complete threading path in diagram form.

j. Turn the threading knob (figure 12) in a clockwise direction. If it turns freely and the film moves continuously on each film sprocket without strain, and if the proper sized upper and lower loops of film are maintained, the projector is threaded properly.

11. ADJUSTMENTS BEFORE OPERATING.

a. Figure 16 identifies the loop setter positioning assembly. When this mechanism is adjusted properly with the film to be projected, it performs two important functions: (1) it assures an uninterrupted film program by preventing the complete loss of the lower loop of film (when film with perforation damage is being used), and (2) it measures the correct size of lower loop of film, thus insuring perfect synchronization of the picture and the sound.

b. Normally, the adjustment of the loop setter positioning assembly is performed by the operator

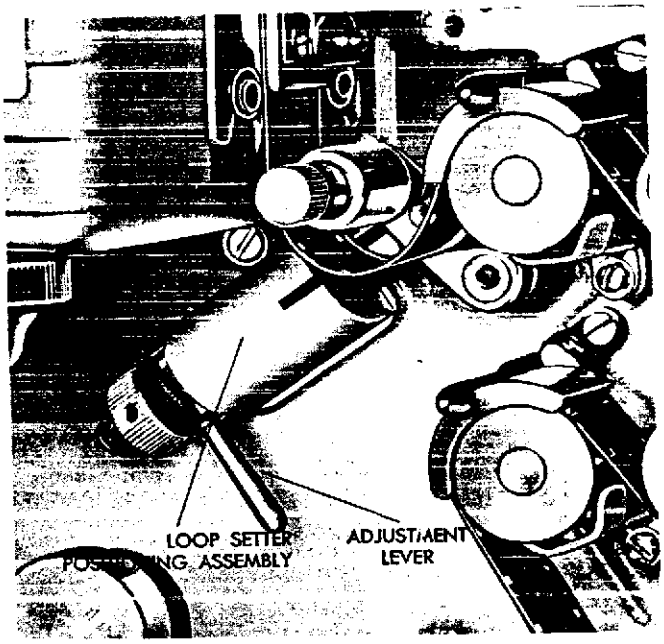

Figure 16. Loopsetter Positioning Adjustment

while he is previewing the film, prior to its showing. It is included here, immediately following the instructions on threading, as a logical step in the instructions on the equipment. Once the operator becomes familiar with threading, the adjustment should be made, as mentioned above, during the preview run of the film. All films vary in their physical condition. If the film has shrunk, the proper adjustment of the loop setter positioning assembly will compensate for this shrinkage. If the film is stretched, the proper adjustment of the loop setter positioning assembly will compensate for the slack in the film. Because of the variances in films, it is recommended that the adjustment of the loop setter positioning assembly be made for every reel of film shown.

c. Check to be sure that the aperture plate is down all the way. Turn on the projection lamp and frame the picture on the monitor screen. Place the index finger under the upper loop of film and gently pull up on the film, meanwhile watching the projected picture on the monitor screen. If the projected image remains entirely visible and steady, no adjustment of the loop setter positioning assembly is required. However, if the picture is not steady but moves in a rapid jerky manner so as not to be visible, and if the projector makes a clicking noise, turn the film positioning adjustment lever (figure 16) gradually upward or downward, one notch at a time, until the picture is visible and the clicking noise is stopped. Then gently press the loop setter push button on top of the projector case down all the way and release it quickly. Do not force this button down. This will (1) set the lower loop to the precise size required for synchronization of the picture and sound and (2) assure an uninterrupted program by preventing the complete loss of the lower loop of film.

13. CHANGE-OVER OPERATION.

a. While film is running through the first (outgoing) projector, mount the second reel of film to the feed reel arm and the empty reel to the take-up arm of the second (incoming) projector. Press the FORWARD button on the local panel for the incoming projector. Thread the incoming projector and set its changeover handle (figure 12) in the CLOSED position. As the first projector nears the end of its reel, watch for the cue dot which appears for an instant in the upper right corner of the screen. When it appears, press the RUN button for the incoming projector. Another cue dot will appear in same position on the screen approximately six seconds after the first one. When this dot appears, press the SHOW button on the remote control panel of the incoming projector pedestal stand (figure 13). Then turn off the outgoing projector. Pressing the SHOW button opens the douser of the incoming projector, and the picture is projected on the screen accompanied by sound. The picture and sound are cut out from the outgoing projector.

14. REWINDING FILM.

It is recommended that a rewinding device be used for the rewinding; however, rewinding can be done with the projector. Refer to projector operator's booklet for rewinding instructions.

NOTE: Return the rewind mechanism knob on the feed reel arm to the OUT position for projection. Failure to do this will cause damage to the next film run through the projector.

Preventive Maintenance

15. DAILY INSPECTION.

a. Inspect the projection lens for dust, dirt or oil vapor deposits. Clean the lens if necessary.

b. Open the lamphouse cover and inspect the projection lamp reflector and exposed surface of the condensing lens for dust or oil vapor deposits. Clean if necessary and avoid leaving fingerprints on lamp or lens. If the projection lamp is badly smoked so that the blackened areas extend below the level of the lamp filaments, replace the lamp.

CAUTION: Never attempt to replace a lamp when it is hot without adequate protection for your hands.

c. Inspect the aperture plate assembly, and pressure plate assembly for dirt and caked film emulsion on the surfaces which come in contact with the film. Clean if necessary.

d. Inspect the sprocket film guards for collection of dirt and caked film emulsion on the surfaces which come in contact with the film. Clean if necessary.

e. Inspect the film sprockets for dirt, caked film emulsion and nicks on the sprocket teeth. Clean if necessary.

f. Inspect the floating film roller assembly and all film guide rollers for collection of dirt and caked film emulsion on the surfaces which come in contact with the film. All rollers must turn freely. Clean if necessary.

g. Inspect the sound drum for collection of dirt and film emulsion on the surface which comes in contact with the film. Be sure to check the edge of the sound drum optical slit and the magnetic pick-up heads for collection of lint or emulsion. Clean if necessary.

h. Inspect the fabric take-up and rewind belts for accumulated dirt and for cuts. Wipe belts with a clean, dry cloth. Replace if damaged.

i. Inspect the sound lens. This 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 lens with a syringe bulb. Remove any remaining dust or dirt with a camel's hair brush; then wipe the lens surfaces clean with lens tissue.

CAUTION: Do not disrupt the setting of the sound lens by attempting to remove it or by taking the lens apart. It is necessary only to clean the external surfaces of the lens.

16. WEEKLY INSPECTION.

a. Perform the inspection procedures outlined in paragraph 15 and proceed as directed below.

b. Inspect the exciter lamp. After the exciter lamp nears the end of its life (100 hours), the inside of the bulb becomes darkened and the efficiency of the lamp is reduced. It is advisable to replace the exciter lamp when it becomes excessively dark and thereby avoid the possibility of an interruption of the sound during a film program due to the burning out of the exciter lamp.

17. 300 HOUR INSPECTION.

After every 300 hours of operation, remove the shutter cover and shuttle cover from the projector and clean any accumulation of emulsion and dirt from the shuttle and cams. Saturate the felt pad on the inside of the shuttle cover with projector oil before reinstalling the covers.

18. MONTHLY INSPECTION.

a. Perform the inspection procedures outlined in paragraphs 15 through 17 and continue as directed below.

b. Open the lamp house cover and inspect the projection lamp reflector. If cracked or chipped, reflector should be replaced. Remove dust or dirt as instructed in paragraph 15, step b.

c. Remove the condensing lens assembly from the projector, and clean the glass surfaces of both lenses. It is not necessary to disassemble the condensing lens for cleaning purposes.

d. Rotate all film guide rollers to see that they turn freely. Remove rollers which do not turn freely and inspect for dirt or wear. Clean or replace as necessary.

e. Inspect inner surfaces of all three sprocket guards for burrs, nicks and scratches. If present, remove by rubbing scratched surface with crocus cloth. If nicks or scratches are too deep, replace the complete sprocket guard assembly.

f. With a magnifying lens, examine all three sprockets for nicks, burrs or other damage. If burrs are present, remove with crocus cloth. If impossible to repair, replace and adjust sprocket(s).

g. Operate the equipment and check all switches and controls to make certain that they perform properly. Replace any switch or control found to be defective.

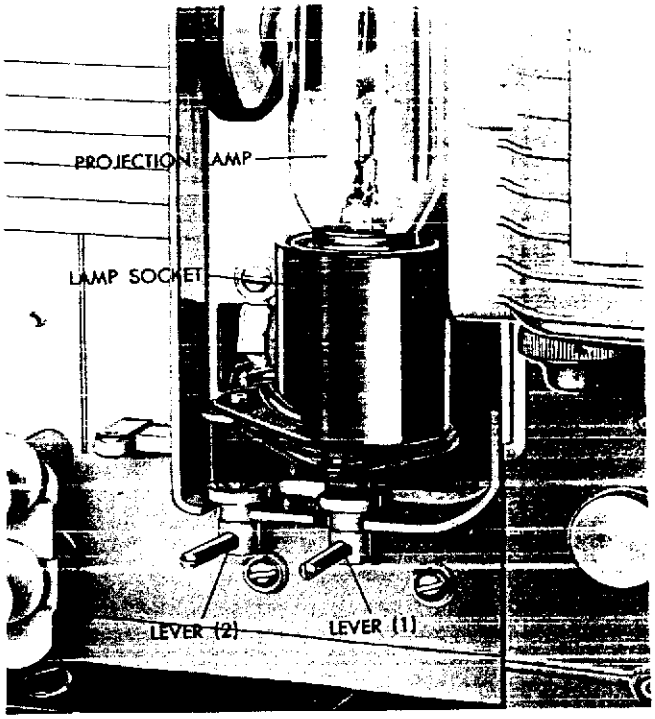

Figure 17. Projection Lamp Adjustment Levers

19. PROJECTION LAMP FILAMENT ADJUSTMENT.

CAUTION: Never attempt to replace a lamp when it is hot without adequate protection for your hands.

a. After a projection lamp has been used for two-thirds of its rated life, the filaments may sag so that vertical bands appear on the screen. This condition can be corrected by using the lamp adjustment levers below the projection lamp socket (figure 17).

b. With the lamp on, focus the picture on the monitor screen and manipulate the two lamp adjustment levers until the screen is evenly illuminated and is free from intensity.

20. LUBRICATION INSTRUCTIONS.

a. The sealed lubrication system of all 614EVM projectors is designed to provide proper, regulated lubrication to all intermittent mechanism parts for 1000 hours of normal operation. This lubricating system is illustrated in figure 18, and oil wicks should be installed as shown. When lubricated wicks are in place remove the inspection hole setscrew. While observing the camshaft wick through this hole, adjust the setscrew underneath the casting until the wick just contacts the front camshaft. Do not force the wick against the camshaft so that it bends or spreads. With the tip just touching the camshaft, tighten the lock nut and install the inspection hole setscrew.

b. Apply a drop of projector oil to each film guide roller shaft every 100 hours of operation or at least every two months. Apply a drop of oil to the two film guide adjustment roller connecting shafts every 250 hours of operation. Apply a drop of oil to the two chain idler rollers every 500 hours of operation.

21. CHECKING PROCEDURE WITH TEST FILM.

a. Use S.M.P.T.E. Service Test Film, TV Film, and Magnetic Sound Test Film to check for possible projector and amplifier operating defects.

b. With results obtained from the film tests, make the necessary repairs or adjustments. Refer to Instruction Book #70467 for repair procedures.

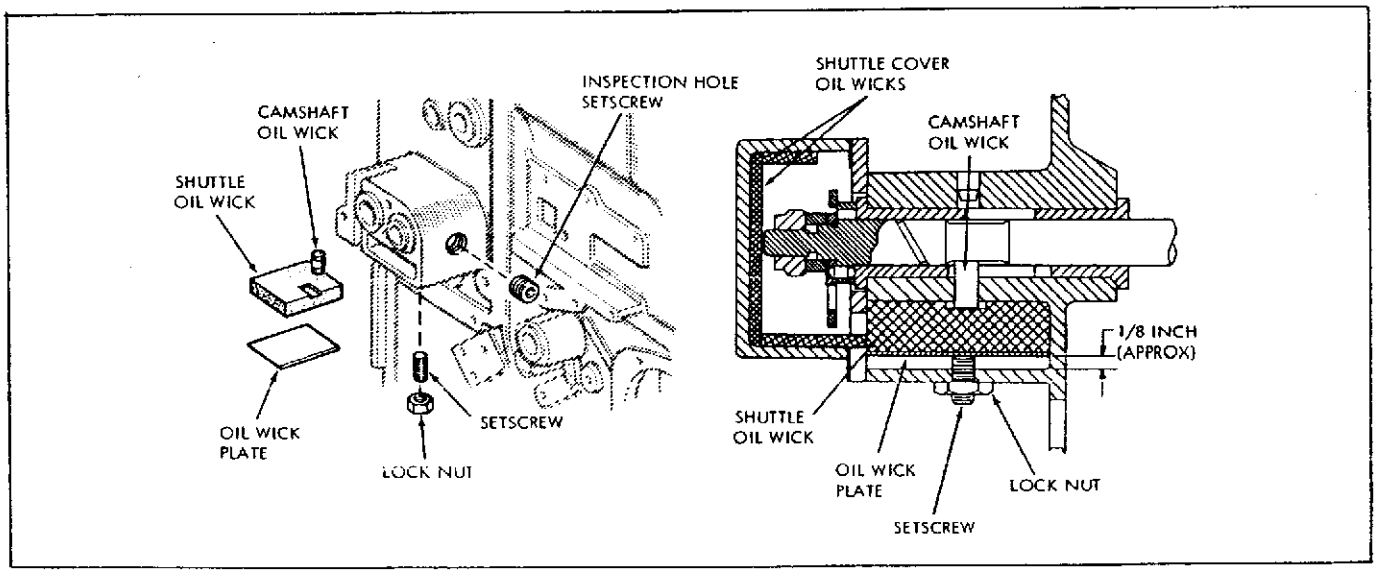

Figure 18. Sealed Lubrication System for Intermittent Mechanism

NOTE: REFER TO INSTRUCTION BOOK NO. 70467 FOR 614EVM REPLACEMENT PARTS

Corrective Maintenance

22. TROUBLE SHOOTING CHART.

Trouble	Probable Cause	Remedy
1. Projector motor does not run, projection lamp does not light, amplifier does operate.	a. No A.C. voltage to projector.	a. Check A.C. voltage.
	b. Faulty motor-lamp relay, amplifier OFF-ON switch.	b. Check relay and switch; repair or replace.
2. Projector motor runs, projection lamp lights, but amplifier does not operate (no sound).	a. Amplifier not turned on.	a. Turn amplifier OFF-ON switch to ON position.
	b. Amplifier fuse blown.	b. Replace fuse.
	c. Defective tube(s).	c. Check and replace defective tubes.
	d. Exciter lamp burned out.	d. Replace exciter lamp.
	e. Photocell cable not connected.	e. Connect cable to photocell receptacle.
	f. Internal amplifier trouble.	f. Check circuit; repair or replace defective parts.
	g. Push button on sound head not depressed completely.	g. Press proper button.
3. Projector lamp lights, motor will not run.	a. Loose connection in motor circuit, or open circuit.	a. Check all connections to motor and repair as necessary.
	b. Faulty motor-lamp relay (run).	b. Repair or replace relay.
	c. Defective motor.	c. Replace motor.
4. Motor operates but projection lamp does not light.	a. Lamp burned out.	a. Replace lamp.
	b. Lamp not seated correctly in socket.	b. Check to see that lamp is inserted properly.
	c. Motor-Lamp relay contact defective.	c. Replace relay.
	d. Defective projector wiring.	d. Check projector wiring circuit; repair defects.
5. Motor runs, mechanism does not.	a. Drive chain not engaged on motor chain sprocket or main drive chain sprocket.	a. Engage chain on sprockets.
	b. Drive chain sprocket loose on shaft.	b. Tighten chain sprocket to shaft.
6. Motor speed varies.	a. Defective motor.	a. Replace motor.
7. Picture not framed.	a. Film itself out of frame.	a. Check projector with film with proper frame line.

Trouble	Probable Cause	Remedy
8. Fuzz projecting in picture area.	a. Dirt in aperture opening.	a. Clean aperture using brush supplied. NOTE: Projector must be stopped.
9. Picture not sharp on monitor screen. One side or entire picture may not be sharp.	a. Improperly focused.	a. Focus projector lens. (Also check camera lens focus.)
	b. Projection lens dirty, oily, or finger-spotted.	b. Clean lens with lint-free tissue and alcohol.
	c. Pressure plate and/or aperture plate worn.	c. Replace defective plates.
	d. Pressure plate not seated firmly against film in aperture channel.	d. Check seating, push pressure plate closing handle.
	e. Defective projection lens.	e. Replace lens.
	f. Insufficient pressure plate tension.	f. Clean or replace pressure plate, if required.
10. Picture indistinct, illumination low.	a. Projection lamp old, black and ready to burn out.	a. Replace lamp.
	b. Dirty reflector, condenser lenses, projector lens.	b. Clean these optical elements.
	c. Projection lamp position adjustment incorrect.	c. Adjust lamp socket position for maximum light (paragraph 19).
11. 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. Broken take-up belt.	b. Replace with new belt.
	c. Slippage in take-up ratchet pulley assembly.	c. Disassemble and repair take-up ratchet pulley assembly.
	d. Two lock nuts on take-up arm too tight or too loose.	d. Adjust accordingly.
	e. Film not attached to hub of reel.	e. Attach film securely to hub.
	f. Take-up reel bent and jammed on arm.	f. Replace reel.
	g. Oilite bronze washer in take-up assembly is worn.	g. Replace washer.
12. Projector fails to rewind properly.	a. Knob on feed reel arm set in improper position.	a. Knob should be IN for rewinding.
	b. Belt disengaged from pulley.	b. Loop belt over pulley.
	c. Two lock nuts on feed reel arm too tight or too loose.	c. Adjust accordingly.
	d. Slippage in rewind ratchet pulley assembly.	d. Disassemble and repair rewind ratchet pulley assembly.
	e. Broken rewind belt.	e. Replace with new belt.

Trouble	Probable Cause	Remedy
12. Projector fails to rewind property (cont).	f. Oilite bronze washer in feed reel arm assembly is worn.	f. Replace washer.
	g. Defective Forward-Reverse relay.	g. Repair or replace defective relay.
13. Picture unsteady; jump or weave.	a. Worn film, defective perforations.	a. Rethread film.
	b. Pressure plate not seated firmly against film in picture channel.	b. Check alignment of aperture and pressure plates.
	c. Poorly made splices.	c. Check film, remake splice(s).
	d. Sprocket shoes fit too loosely, causing film to jump off.	d. Adjust clearance between shoe and sprocket to tolerance of two thicknesses of film.
	e. Insufficient pressure plate tension.	e. Clean or replace pressure plate.
14. Film scratched.	a. Dirt or emulsion on aperture and/or pressure plate.	a. Clean, using aperture brush furnished, or alcohol and toothpick.
	b. Dirt or emulsion on film shoes, sprockets, film rollers.	b. Clean, using aperture brush furnished, or alcohol and toothpick.
	c. Worn film handling parts; pressure plate, aperture plate, shoes, rollers.	c. Replace worn parts.
	d. Sticking or binding film rollers.	d. Remove rollers and clean shaft with alcohol and rag. If worn, or if they still bind, replace roller and/or shaft.
	e. Nicks and scratches on contact surfaces of film path: film rails, rollers, sound drum, pressure plate, film shoes.	e. Rub part with crocus cloth. If nick or scratch is deep, replace parts.
15. Excessive film wear. Torn or damaged film splices. Damaged or torn perforations.	a. Film guards fit too snugly around sprockets.	a. Adjust clearance between inner shoulder of shoe and inner edge of sprocket shoulder to 0.015-inch (two film thicknesses).
16. Excessively noisy projector operation.	a. Film slap due to improper pressure plate tension.	a. Clean or replace pressure plate.
17. Shutter bar appears on screen.	a. Projector running slow.	a. Check speed at threading knob — speed should be 1440 RPM. If not, check line voltage and frequency. Check mechanism for binding.
18. Picture satisfactory, sound weak or distorted.	a. Sound optical system or magnetic pickup dirty.	a. Clean optical or magnetic pickup as necessary. (Pipe cleaner and alcohol.)
	b. Amplifier tubes defective.	b. Check and replace defective tubes.

Trouble	Probable Cause	Remedy
18. Picture satisfactory, sound weak or distorted (cont).	c. Photocell defective.	c. Check photo-cell output. Replace if necessary.
	d. Defective exciter lamp.	d. Replace lamp.
19. Picture satisfactory, but no sound.	a. Exciter lamp burned out.	a. Replace lamp.
	b. Amplifier tubes defective.	b. Check tubes, especially the 6AQ5 exciter lamp oscillator tube. Replace defective tubes.
	c. Photo cell defective.	c. Replace photo cell assembly. Check photo cell output.
	d. Wrong button depressed.	d. Check buttons.
20. Flutter or wow.	a. Lost lower picture loop.	a. Set with loop restorer.
	b. Dirt on sound drum and rollers in sound head assembly.	b. Clean sound drum, clean all rollers.
	c. Film guide rollers sticky or jammed.	c. Examine rollers to see that they turn freely; if not, remove rollers and clean bearings and shafts. Make necessary replacements.
	d. Obstruction rubbing on flywheel.	d. Remove obstruction.
21. Distorted sound reproduction.	a. Defective tubes.	a. Check and replace bad tubes.
	b. Defective exciter lamp.	b. Replace lamp.
	c. Bad connections in projector or amplifier wiring.	c. Sectionalize and localize trouble and repair.
	d. Defective amplifier.	d. Localize trouble, repair or replace defective parts.
	e. Sound optical system or magnetic pickup out of adjustment.	e. Check adjustment of sound optical system and magnetic pickup. If defective on magnetic and optical reproduction remove and return to factory.
22. Amplifier fuse blows.	a. Shorted tube(s).	a. Check and replace defective tube(s).
	b. Defective amplifier wiring, or component parts.	b. Localize trouble; repair or replace defective parts.
	c. Incorrect fuse.	c. Correct fuse size. (0.8 amp. Slo-Blow.)

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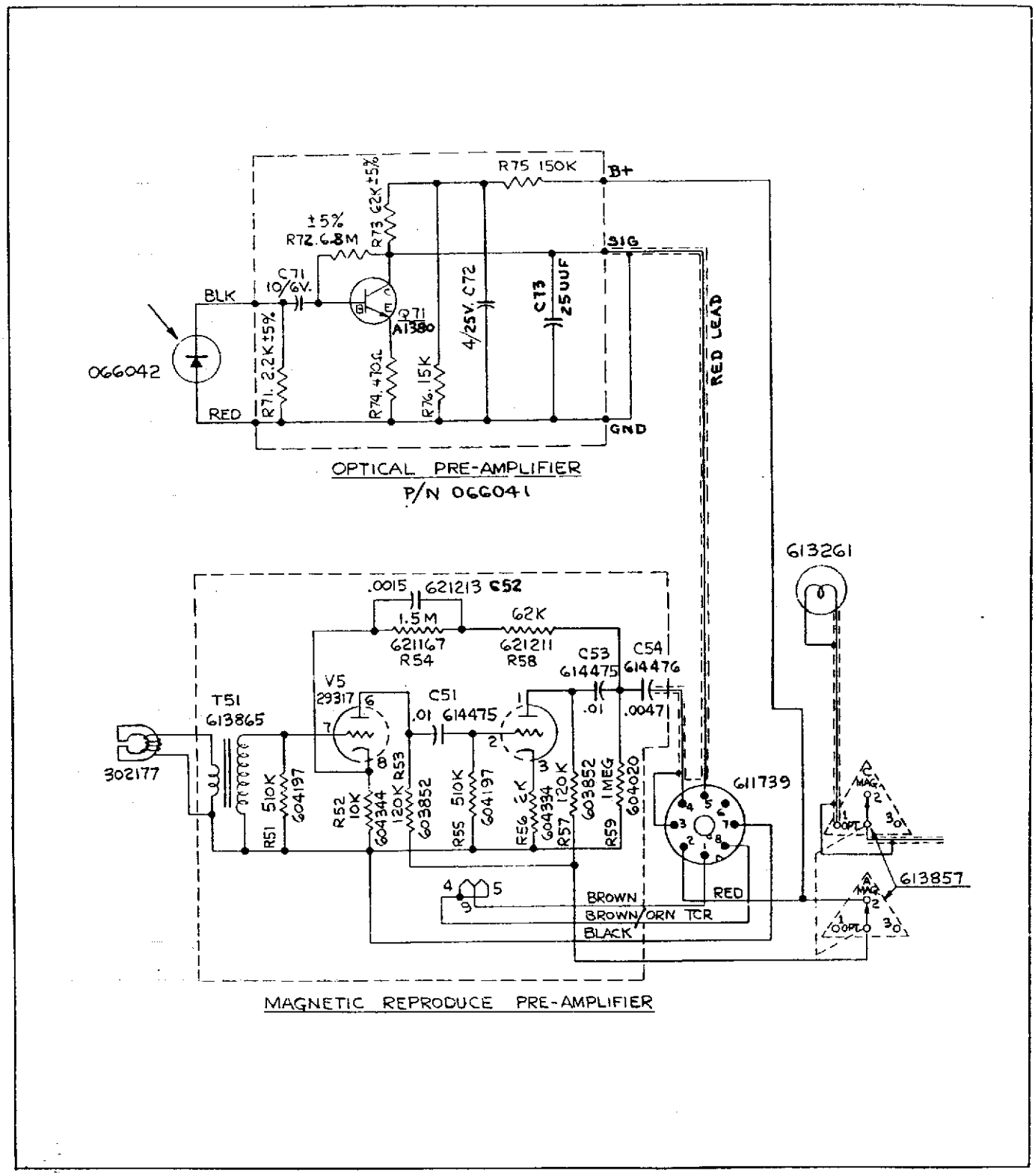


Figure 19. Optical-Magnetic Soundhead Schematic Wiring Diagram

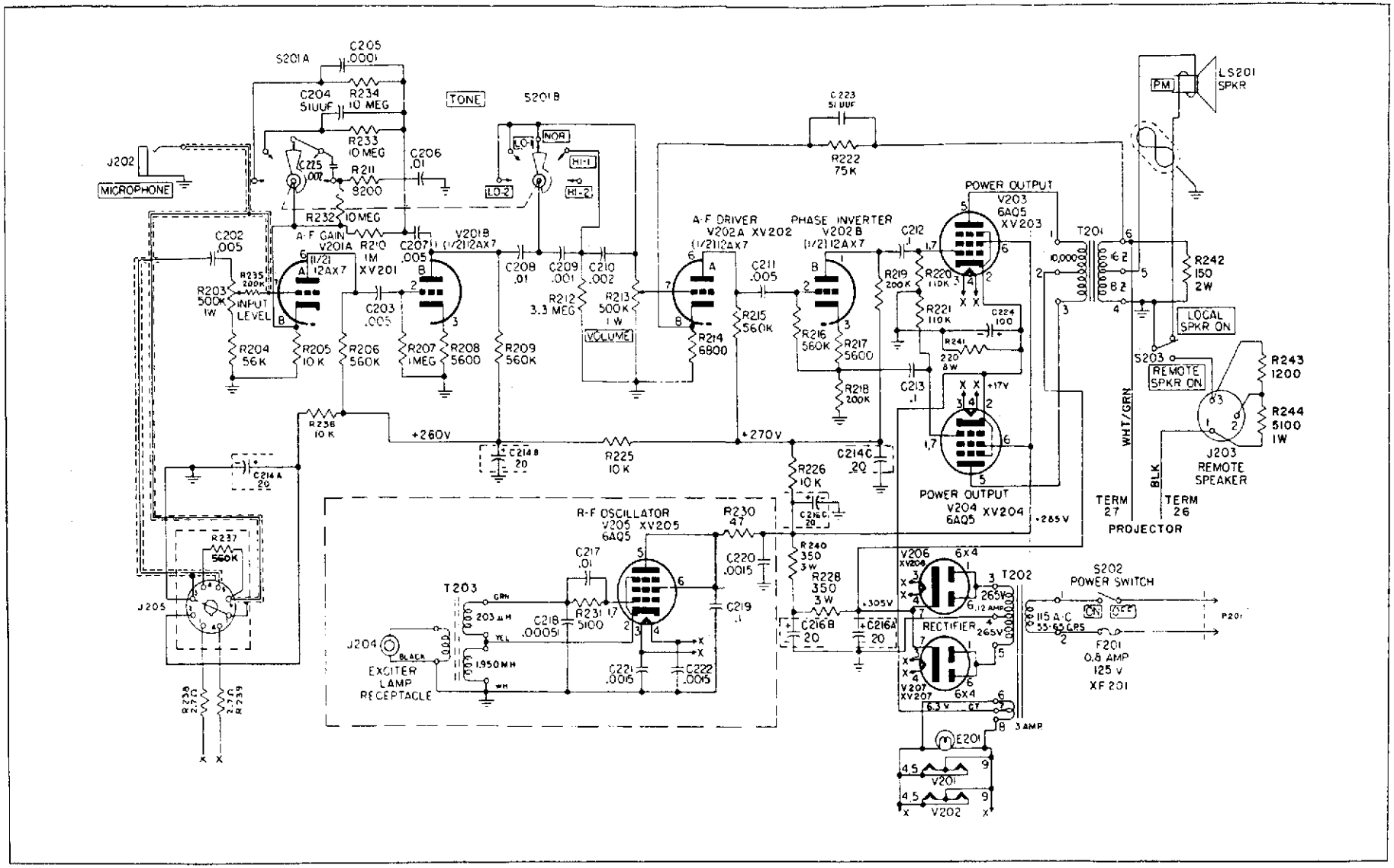


Figure 20. Projector Amplifier Schematic Wiring Diagram

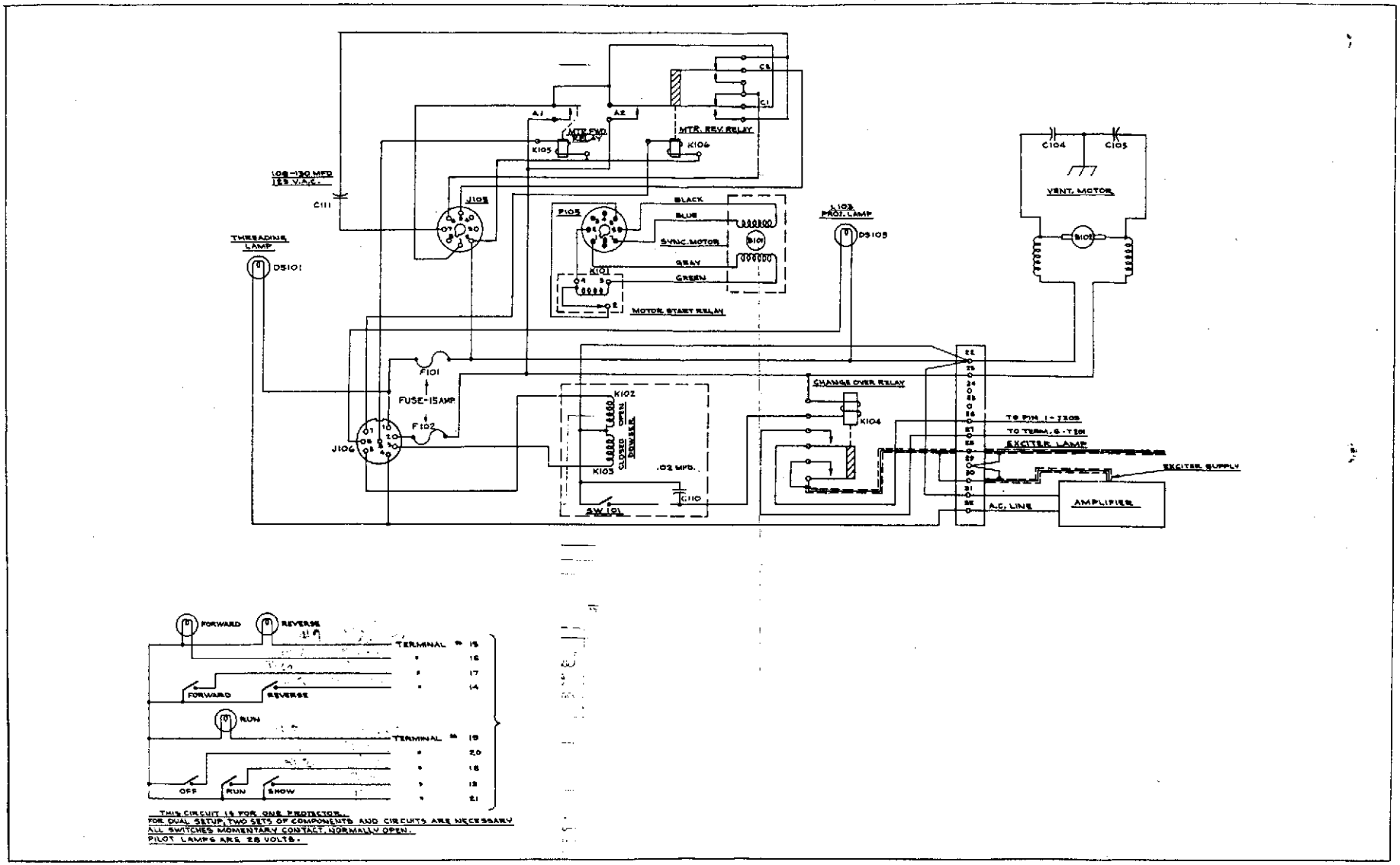


Figure 21. Projector Assembly Schematic Wiring Diagram

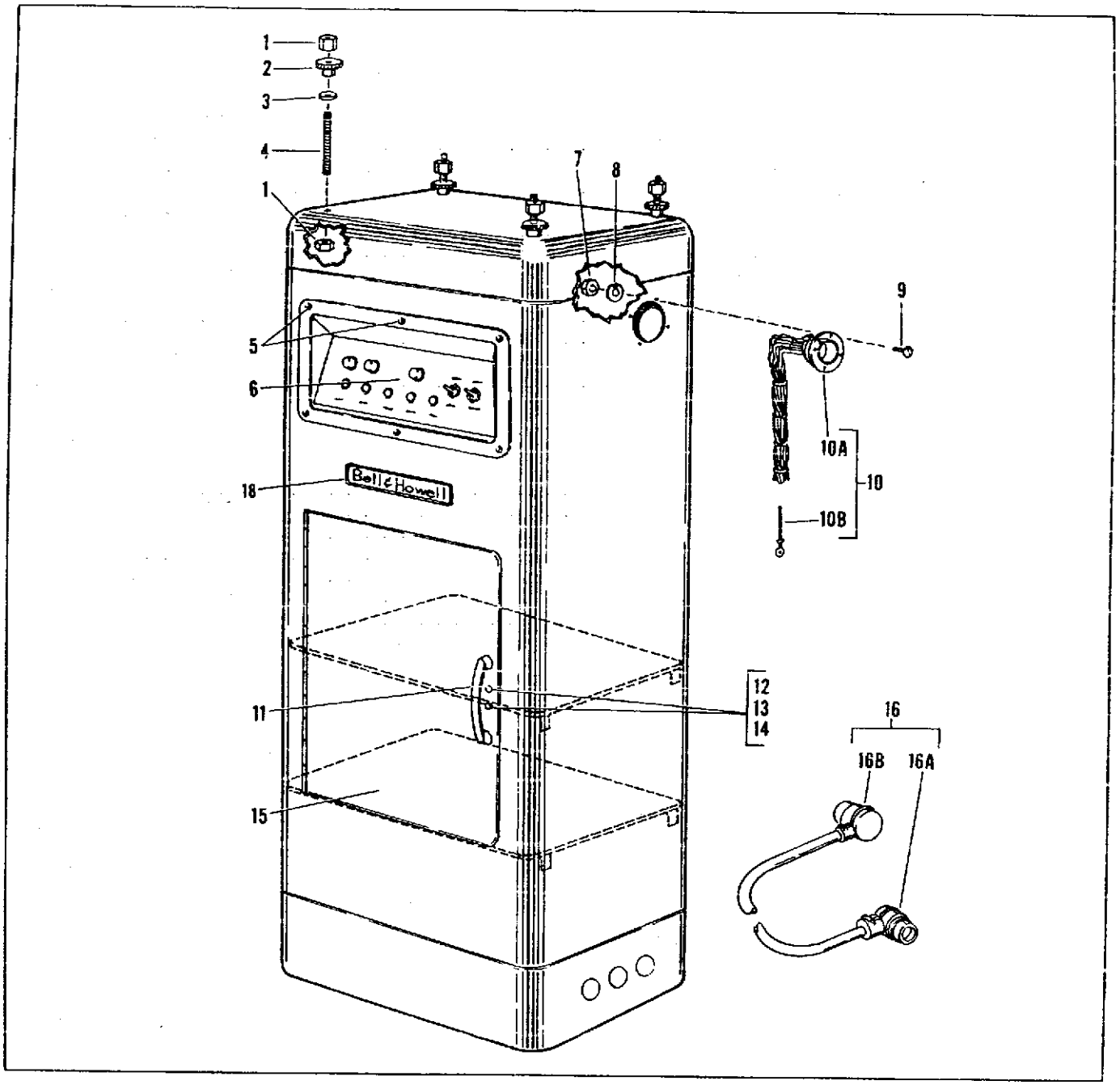


Figure 38. Pedestal Control Cabinet Replacement Parts (Models 614EVMF, 614EVMR, and 614EVMS)

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		PEDESTAL CONTROL CABINET		
38-	067527	BASE ASSEMBLY, Projector	1	EFG
-1	300049	. NUT, Hex	8	EFG
-2	300007	. NUT, Lock (special)	4	EFG
-3	7470	. WASHER	4	EFG
-4	300006	. SCREW, Elevating	4	EFG
-5	620042	. SCREW, Phillips truss head	6	EFG
-6	067526	. CHASSIS ASSEMBLY (See figure 39 for detail parts)	1	EFG
-7	81847	. NUT, Hex	4	EFG
-8	19481	. WASHER, Lock	4	EFG
-9	24394	. SCREW, Oval head	4	EFG
-10	030020	. CABLE ASSEMBLY, 8-pin receptacle	1	EFG
-10A	300045	. . RECEPTACLE, Female	1	EFG
-10B	612474	. . TERMINAL, Leadwire	8	EFG
-11	300005	. HANDLE (With attaching screws)	1	EFG
-12	600981	. NUT, Hex	2	EFG
-13	620044	. SCREW, Phillips truss head	2	EFG
-14	23426	. CATCH, Door	1	EFG
-15	300003	. SHELF, Plywood	2	EFG
-16	030004	CABLE ASSEMBLY, Amplifier	1	EFG
-16A	613995	. PLUG	1	EFG
-16B	300010	. PLUG, Male, 8-pin	1	EFG
-17	300001	. BASE, Television projector	1	EFG
-18	27451	NAMEPLATE, Bell & Howell	1	EFG

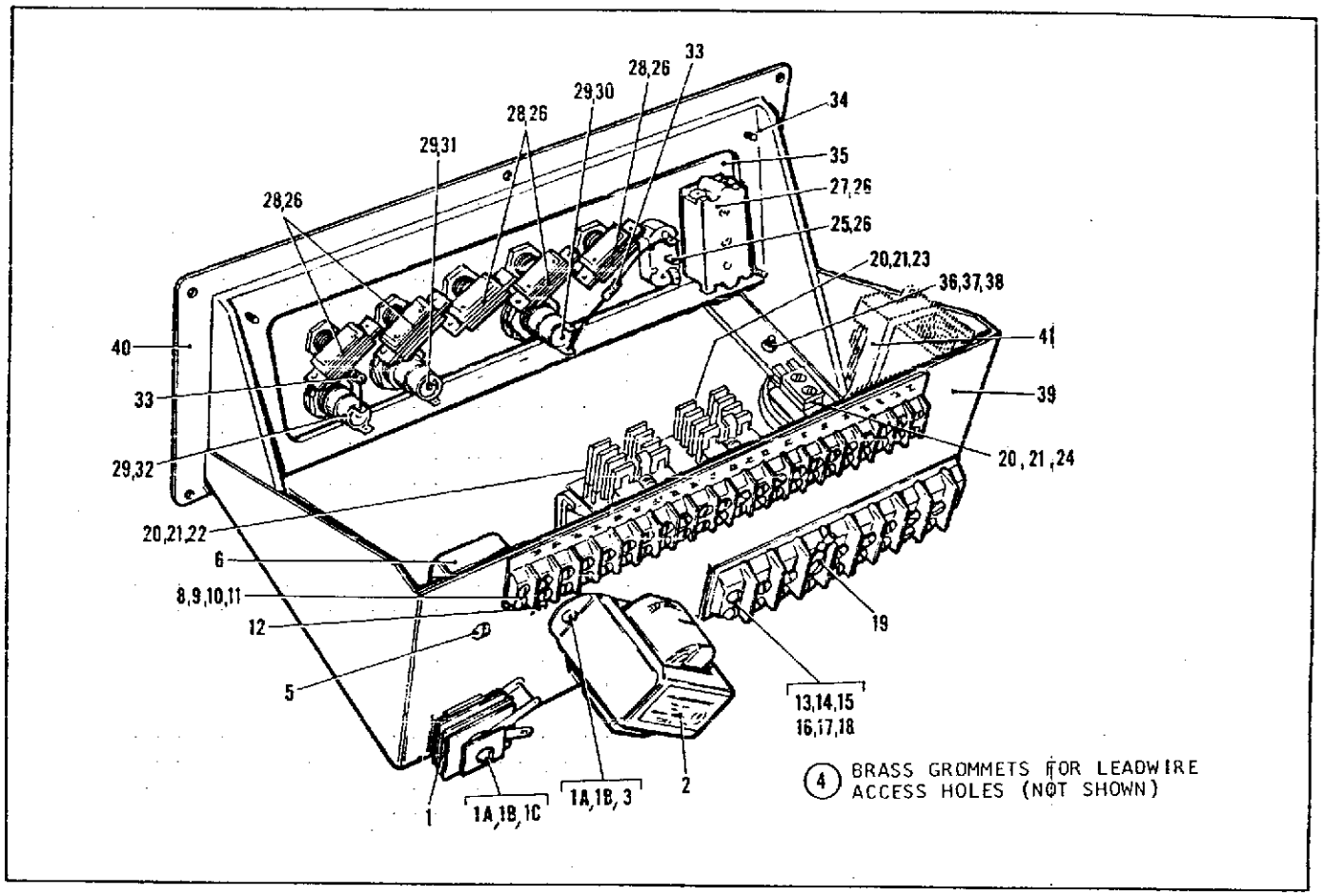


Figure 39. Control Chassis Replacement Parts (Models 614EVMF, 614EVMR, and 614EVMS)

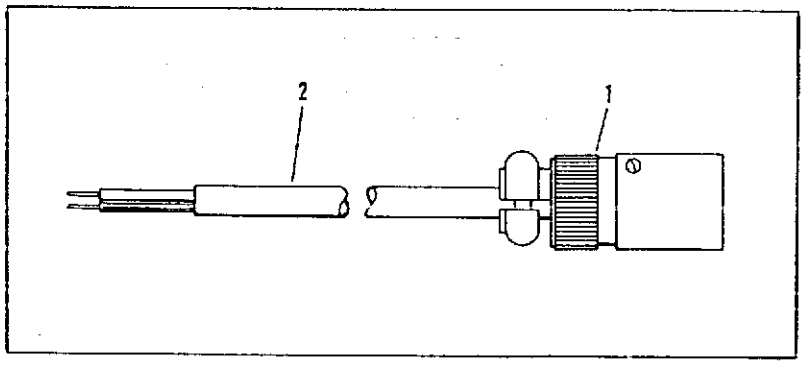
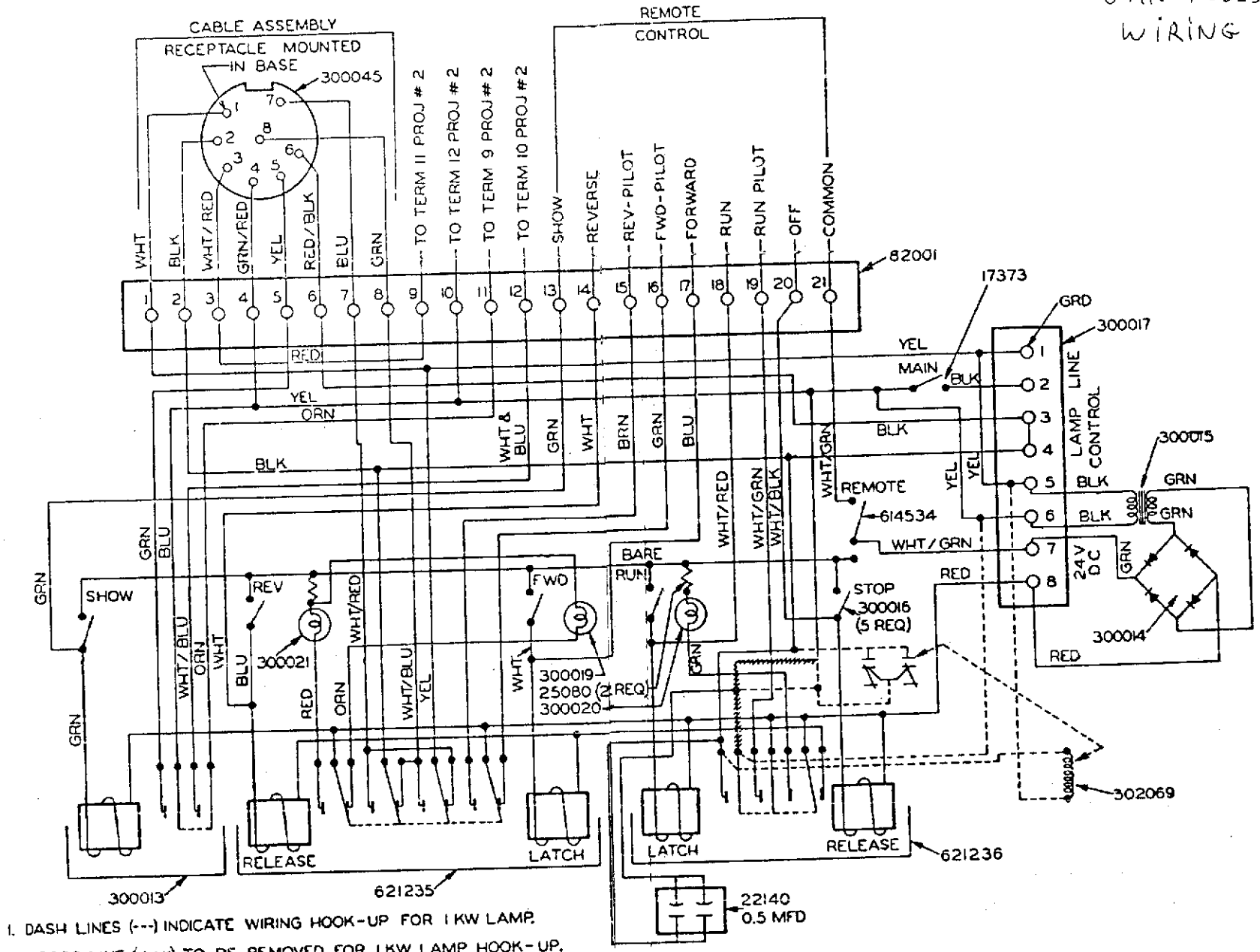


Figure 40. Audio Output Cable Assembly (Models 614EVMF, 614EVMR, and 614EVMS)

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		CONTROL CHASSIS		
39-	067526	CHASSIS ASSEMBLY, Projector base	1	EFG
-1	300014	. RECTIFIER, Selenium	1	EFG
-1A	19037	. NUT, Hex	3	EFG
-1B	25266	. WASHER, Lock	3	EFG
-1C	22233	. SCREW, Round head	1	EFG
-2	300015	. TRANSFORMER, Filament	1	EFG
-3	600802	. SCREW, Round head	2	EFG
-4	614442	. GROMMET, Brass (not shown in view)	4	EFG
-5	80947	. SCREW, Round head SEMS	2	EFG
-6	22140	. CAPACITOR	1	EFG
-8	600789	. WASHER, Lock	4	EFG
-9	620110	. SCREW, Fillister head	4	EFG
-10	82001	. STRIP, Terminal (long)	1	EFG
-11	82005	. MARKER, Terminal strip	1	EFG
-12	612474	. TERMINAL	AR	EFG
-13	3123	. NUT, Hex	4	EFG
-14	600735	. WASHER, Lock	4	EFG
-15	600809	. SCREW, Fillister head	4	EFG
-16	12122	. WASHER	4	EFG
-17	300017	. STRIP, Terminal (short)	1	EFG
-18	300018	. MARKER, Terminal strip	1	EFG
-19	612427	. TERMINAL	AR	EFG
-20	600806	. SCREW	AR	EFG
-21	600735	. WASHER, Lock	AR	EFG
-21	19327	. NUT, Hex	AR	EFG
-22	621236	. RELAY, Latching type, 3 contacts	1	EFG
-23	621235	. RELAY, Latching type, 4 contacts	1	EFG
-24	300013	. RELAY, 2 contacts	1	EFG
-25	614534	. SWITCH, Toggle (with attaching nuts)	1	EFG
-26	611735	. WASHER, Lock, internal teeth	7	EFG
-27	17373	. SWITCH, Toggle (with attaching nuts).	1	EFG
-28	300016	. SWITCH, Pushbutton	5	EFG
-29	300022	. BULB, Pilot lamp	3	EFG
-30	300019	. LAMPHOLDER, Pilot (with amber jewel)	1	EFG
-31	300020	. LAMPHOLDER, Pilot (with green jewel)	1	EFG
-32	300021	. LAMPHOLDER, Pilot (with red jewel)	1	EFG
-33	25080	. RESISTOR	2	EFG
-34	99466	. SCREW, Switch panel attaching	6	EFG
-35	300004	. PLATE, Control switch	1	EFG
-36	19037	. NUT, Hex	6	EFG
-37	25266	. WASHER, Lock	6	EFG
-38	24215	. SCREW, Pan head	6	EFG
-39	300009	. CHASSIS	1	EFG
-40	300002	. HOUSING, Chassis and switch plate	1	EFG
-41	302069	. RELAY (Used only with 1000-watt lamp)	1	EFG
		AUDIO OUTPUT CABLE ASSEMBLY		
40-	030005	CABLE ASSEMBLY, Audio output	1	EFG
-1	612984	. CONNECTOR, Cable	1	EFG
-2	300036	. CABLE, Power	1	EFG

JAN PEDESTAL WIRING



1. DASH LINES (---) INDICATE WIRING HOOK-UP FOR 1 KW LAMP.
2. CROSS-LINE (⁄⁄⁄⁄⁄) TO BE REMOVED FOR 1 KW LAMP HOOK-UP.

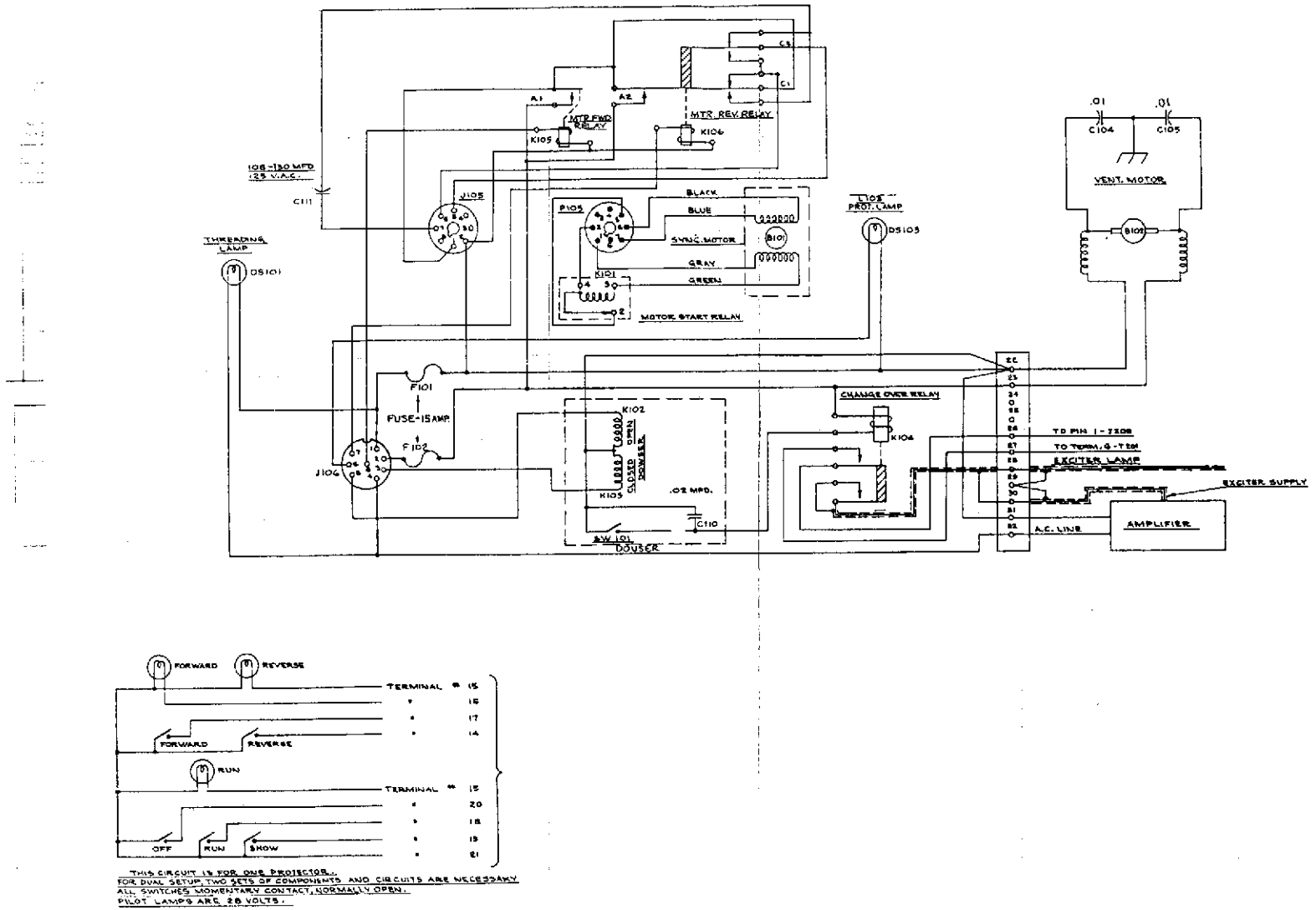


Figure 45. Projector Wiring Diagram (614EVMF, EVMR and EVMS)
OPTICAL AND MAGNETIC PLAY WITH SYNC MOTOR AND CHANGEOVER