

PARTIAL REPRO
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NAVWEPS 50-30GMQ13-1

Handbook

Operation and Service Instructions with Illustrated Parts Breakdown

CLOUD HEIGHT SET

AN/GMQ-13C

(General Instrument)

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

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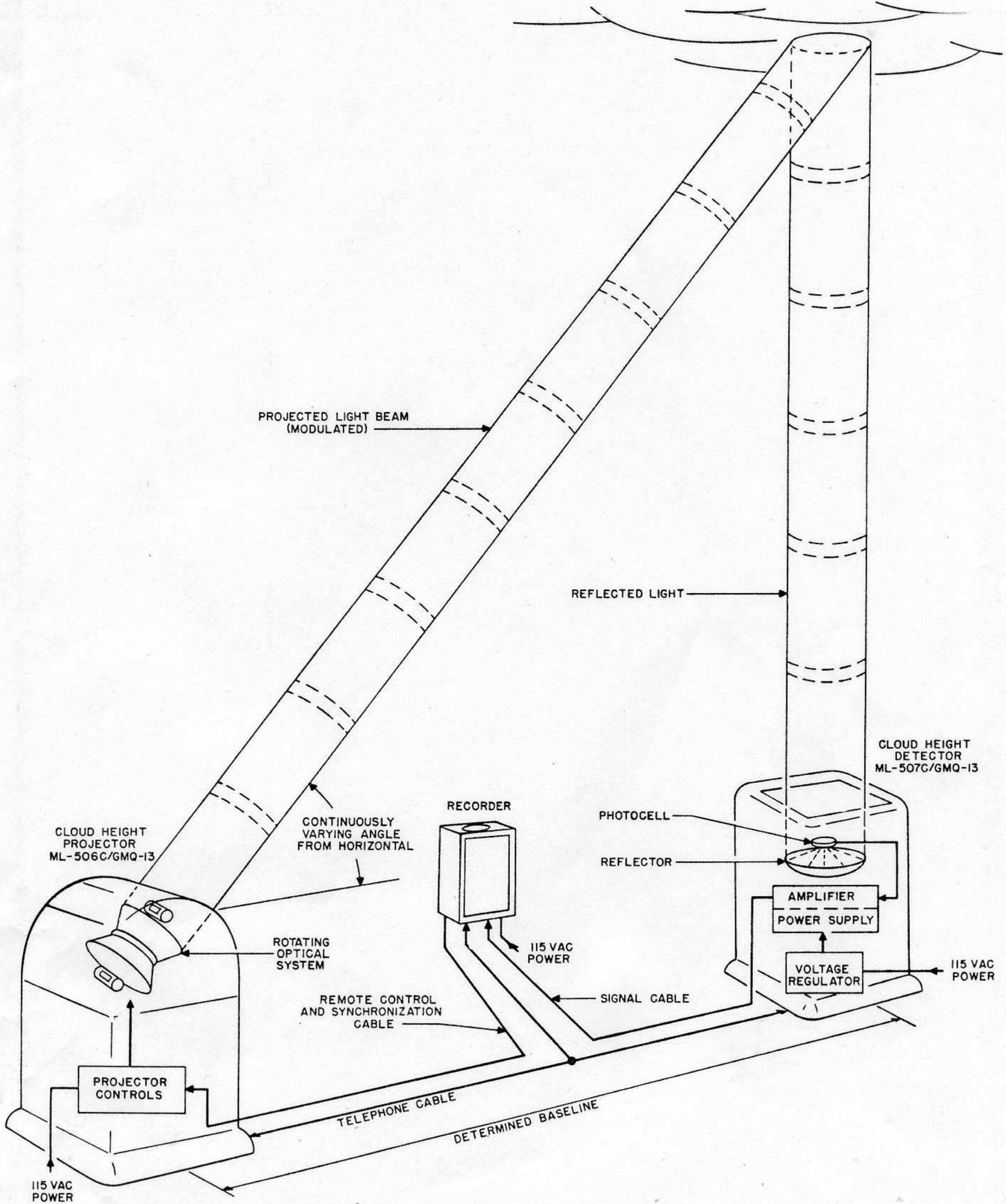


Figure 1-1. Cloud Height Set AN/GMQ-13C, Functional Diagram

INTRODUCTION

1. PURPOSE AND SCOPE OF HANDBOOK.

This publication comprises operation and service instructions, with illustrated parts breakdown, for Cloud Height Set AN/GMQ-13C. It includes a general description of the theory of operation, installation procedures, and field maintenance procedures.

2. PURPOSE AND SCOPE OF SECTIONS.

This handbook is divided into twelve functional sections to provide segregated information as follows:

- a. Section I supplies a description and the leading particulars of the cloud height set, such as physical characteristics and power requirements, and includes a functional explanation of its operation.
- b. Section II describes the test equipment and special tools needed for the disassembly, assembly, and testing of the cloud height set.
- c. Section III contains complete instructions for installation of the cloud height set. It includes selecting

a site, preparation of a foundation, assembly of the equipment for operation, and preparation for reshipment.

- d. Section IV supplies essential information needed to operate the equipment, including a description of controls, sequence of operation, and equipment presentations.

- e. Section V discusses the theory of operation.

- f. Section VI discusses the field maintenance instructions needed to keep the equipment in proper operating condition.

- g. Section VII contains all other drawings required by the maintenance technician, including the schematic and wiring diagrams.

- h. Sections VIII through XII include the introduction to the illustrated parts breakdown, group assembly parts list, numerical index, reference designation index, and Difference data sheets.

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1-1. GENERAL.

1-2. Cloud Height Set AN/GMQ-13C consists of Cloud Height Projector ML-506C/GMQ-13, Cloud Height Detector ML-507C/GMQ-13, and Recorder (designation to be assigned later). The cloud height recorder was not available at the time this handbook was prepared, and is not covered in this initial edition. This publication provides complete operation and service instructions, with illustrated parts breakdown, for the projector and detector components. These components may be installed and made ready for operation, but cannot function as a complete set until the recorder is available. Instructions covering the recorder will be published later, either as a revision to this handbook or as a separate manual.

1-3. PURPOSE OF EQUIPMENT.

1-4. Cloud Height Set AN/GMQ-13C is a fixed ground equipment used for making rapid and accurate measurements of the lowest layer of cloud heights. This equipment is capable of observing cloud heights during the daylight hours as well as at night.

1-5. FUNCTIONAL DESCRIPTION.

1-6. The cloud height set system is comprised of three major components: a projector; a detector; and a recorder. The basic principle involved when making cloud height measurements is one of triangulation. (See figure 1-1.) The projector is comprised of two identical optical systems mounted back-to-back on a rotary mount such that light beams are continuously rotated in the plane of the detector's "field of view." This field of view of the detector, directed vertically upward in the plane defined by the rotating beams of the projector, is located a known distance from the projector. At some point in the rotation, each portion of the detector's field of view, from the top of the detector to the zenith, is illuminated. Any cloud or other reflective obstruction will cause a light spot to occur as the light beams pass. The light spot is collected by a photocell located in the detector. The light variations of the beam cause similar voltage variations to appear at the output of the photocell. These voltage variations are amplified and fed to the recorder; this

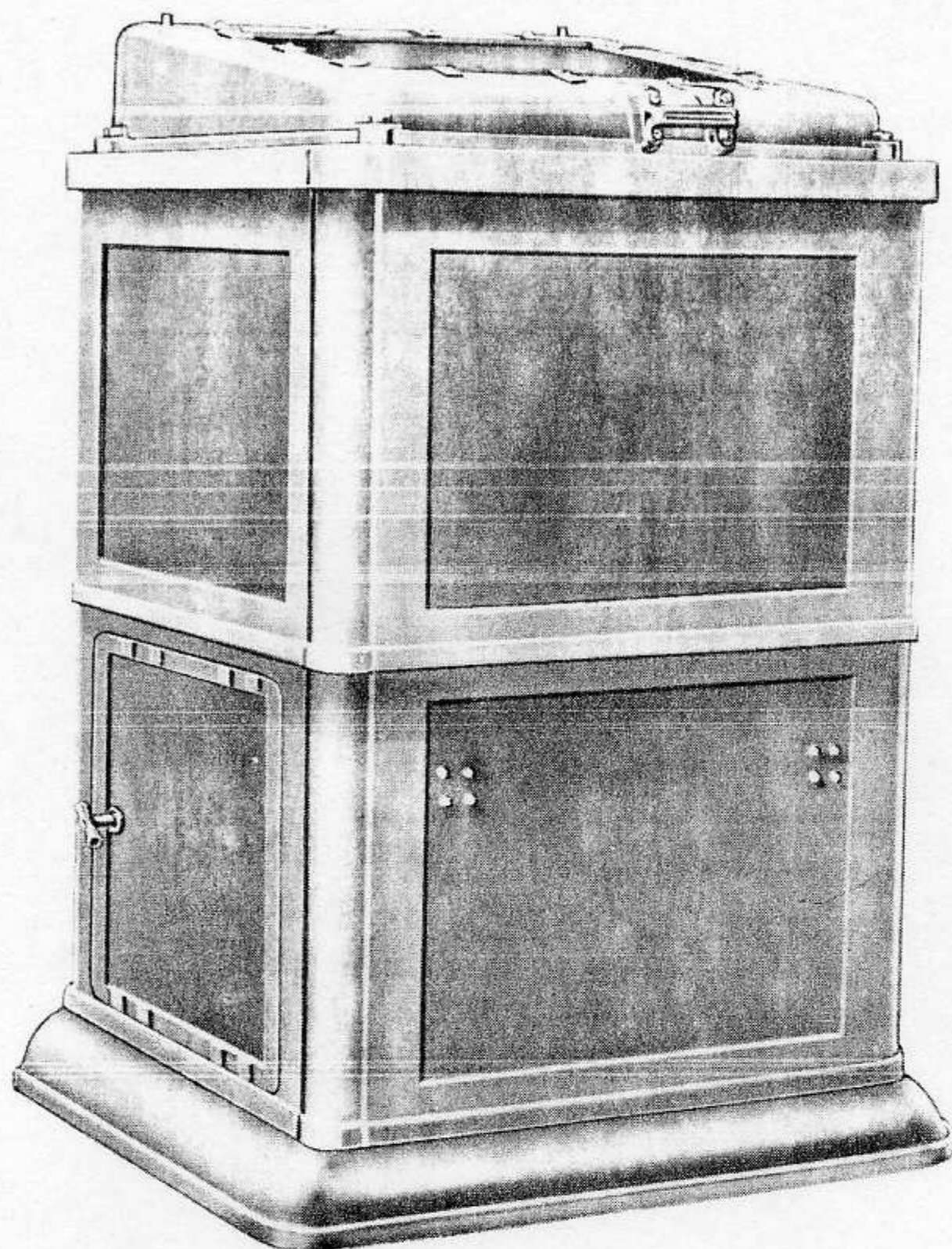


Figure 1-2. Cloud Height Detector ML-507C/GMQ-13

presents the cloud height information graphically, on a chart graduated in angular intervals, from which the cloud height may be determined. Two light beams are used to increase the rate of measurement and to provide a safety factor in case of failure of one optical system. A measuring sweep occurs every six seconds and is three seconds in duration. The cloud height set is used primarily at the end of the instrument runway and is designed for relatively short baselines of 400 to 900 feet. This permits cloud height measurement of approximately 5000 feet maximum, the height range of principal interest to pilots during final approach.

1-7. DESCRIPTION OF COMPONENTS.

1-8. DETECTOR. (See figure 1-2.)

1-9. Components of the detector consist of an optical system, a photoelectric cell, an amplifier-power supply, and a voltage regulator; these are housed in an aluminum cabinet 42 inches square by 62 inches high. All power, control, and signal wiring, and their associated components, are located in the lower part of the cabinet. Entrance to the cabinet is made through three

access doors. The optical system, located in the center section of the cabinet, is comprised of a 24-inch parabolic back-silvered mirror (reflector) with a focal length of 10 inches. Located above the reflector, at the focal point, is a resistive-type photoconductive cell fitted with an infrared transmitting cover glass to eliminate, as much as possible, saturation of the cell and changes in input voltage due to changes in ambient light. The output of the photocell is fed to a high-gain audio amplifier having a tuned frequency of 110 cycles per second and a maximum bandwidth of 100 cycles per second. The combined amplifier-power supply unit and the separate voltage regulator subassembly are located on the floor of the cabinet in a position easily accessible from the housing doors. A cover glass is fitted to the top of the housing; a metal diaphragm, mounted directly below the cover glass, acts to shield the reflector and photocell from stray light. To prevent the accumulation of snow and ice on the top of the detector during winter weather, a deicer assembly, consisting of a 1000-watt space heater element (which

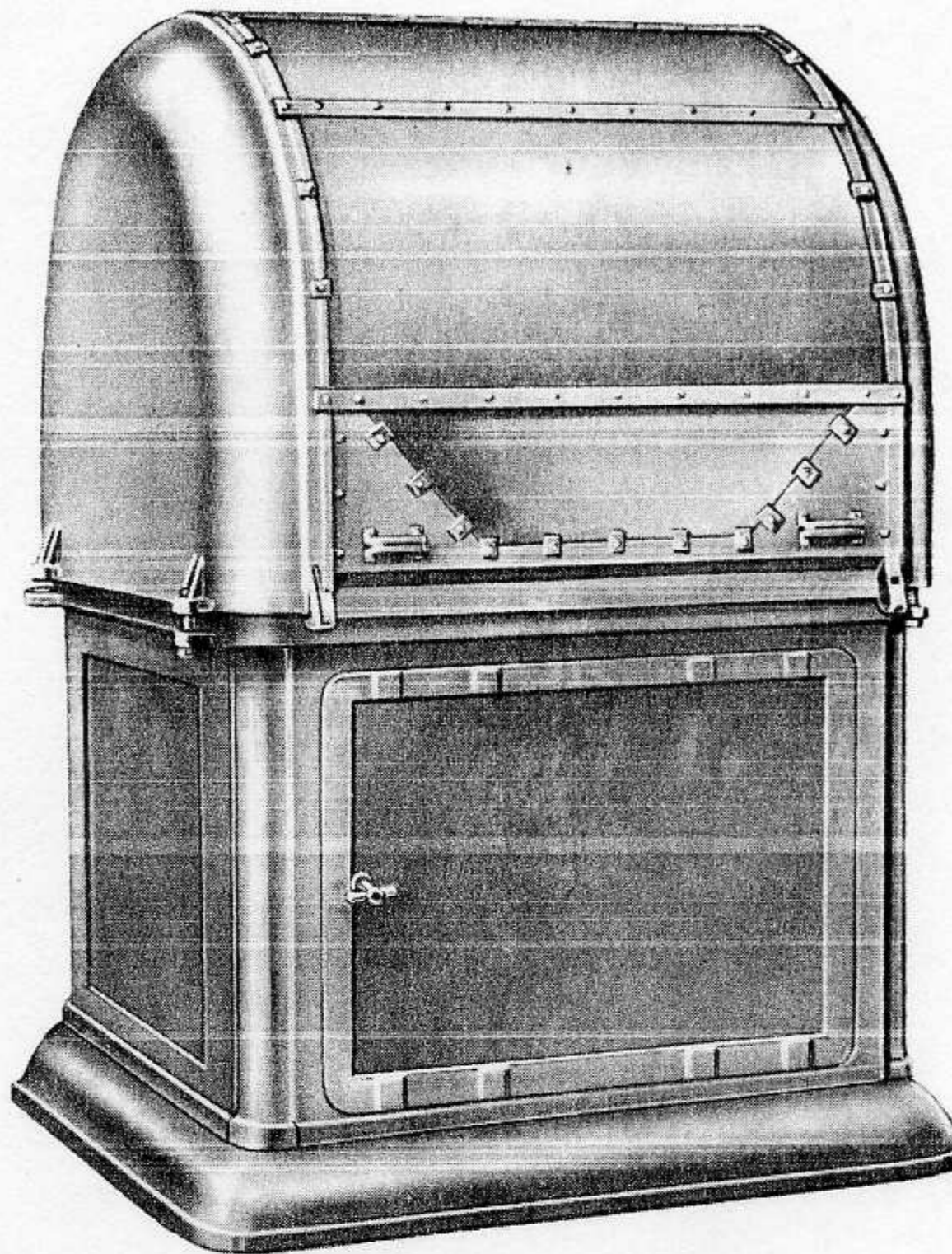


Figure 1-3. Cloud Height Projector ML-506C/GMQ-13

may be replaced by a 500-watt element, if necessary), a thermostat, and a blower, is located in a separate glass-covered housing, mounted to the top of the cabinet.

1-10. PROJECTOR. (See figure 1-3.)

1-11. The components of the projector are: an optical system, a drive assembly, and power and control relays; these are housed in a glass-domed aluminum cabinet, 42 inches square by 60 inches high. All power and control wire terminations, and associated electrical components, are located in the lower part of the cabinet. Entrance to the cabinet is made through two access doors, one on the side nearest the detector and one on the side away from the detector. The projector employs two identical optical systems, each with a high-current incandescent lamp (fitted with an offset-coiled filament) as a light source. Each light source is modulated by a barrel-type shutter driven by a synchronous motor. The shutter is mounted over the lamp so that the light falling on each reflector is interrupted at a rate of 120 obscurations per second. The shutter gives

a minimum of 95 percent modulation to the light beam, making it possible for the detector to identify light received from the projector. Two reflectors, each a back-silvered glass type parabolic mirror with a diameter of 24 inches and a focal length of 10 inches, are housed back-to-back in the rotary mount assembly. Two trunnions and a trunnion shaft support the rotary mount assembly. A timing belt transmission, coupling the synchronous drive motor to the trunnion shaft, serves as a speed reductor, providing a 15-to-1 reduction of revolutions per minute between the synchronous drive motor and the rotary mount assembly. The rotary mount assembly is covered by a glass-domed aluminum top, hinged to the cabinet.

1-12. DIFFERENCE IN MODELS.

1-13. Sections I through XI of this handbook apply to Cloud Height Projector ML-506C/GMQ-13 and Cloud Height Detector ML-507C/GMQ-13, manufactured by General Instrument Corporation, Brooklyn, New York, on Bureau of Aeronautics Order No.

01781 (Weather Bureau Contract Cwb-9177). Additional models will be covered in section XII by the use of Difference data sheets. Service instructions for models included in section XII are the same as the procedures given in section I through XI, except for the specific differences noted by the applicable Difference data sheets.

1-14. EQUIPMENT SUPPLIED.

1-15. Table 1-1 lists the equipment supplied.

1-16. FUSE COMPLEMENT.

1-17. Fuses for the projector and detector are listed in table 1-2.

1-18. TUBE COMPLEMENT.

1-19. The tube complement of the projector and detector is given in table 1-3.

1-20. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

1-21. Table 1-4 lists the equipment required but not supplied for normal operation of the projector and detector. This does not include the foundation material and conduits described in section III, or the cable requirements specified in paragraph 1-22.

TABLE 1-1. EQUIPMENT SUPPLIED

Quantity Per Equipment	Name	Nomenclature
1	Projector	Projector, Cloud Height ML-506C/GMQ-13
1	Detector	Detector, Cloud Height ML-507C/GMQ-13

1-22. CABLE REQUIREMENTS.

1-23. All power, control, signal, and telephone connections between components are shown in figure 3-5. For power cable, #6 AWG conductors will be suitable; larger conductors should be used when necessary. All factors (such as distance, extra equipment, defrosting, etc.) affecting total current and resistance in the conductors should be considered. Where larger conductors are impractical, transformers may be utilized. A four-conductor cable must be provided between the projector and detector, while a six-conductor cable is necessary between the recorder and either the projector

TABLE 1-2. FUSE COMPLEMENT

Reference Designation	Manufacturer's Type	Rating	Function
F201	Fustron MDL-1	1 Amp, slowblow, 250V	Detector amplifier-power supply input a-c line.
F301	Buss W-6	6 Amp	Projector lamp #1.
F302	Buss W-6	6 Amp	Projector lamp #2.

TABLE 1-3. TUBE COMPLEMENT

Reference Designation	Location	Subchassis	Tube Type	Function
V201	Detector	Amplifier-power supply	6072	First two stages of the amplifier.
V202	Detector	Amplifier-power supply	6072	Stages 3 and 4 of the amplifier.
V203	Detector	Amplifier-power supply	5814A	Final two stages of the amplifier.
V204	Detector	Amplifier-power supply	6X4W	Power supply full-wave rectifier.
V205	Detector	Amplifier-power supply	OA2WA	Power supply regulator tube.
V206	Detector	Amplifier-power supply	OA2WA	Power supply regulator tube.
V207	Detector	Photocell mounting plate		Photocell.

TABLE 1-4. EQUIPMENT REQUIRED BUT NOT SUPPLIED

Quantity Per Equipment	Nomenclature		Required Use	Required Characteristics
	Name	Designation		
1	Indicating device or recorder		Visual or recorded indication of cloud height signals.	

or detector, depending on which unit is closer to the recorder. The six-conductor cable provides for the signal, control, and telephone circuits, while the four-conductor cable provides a continuation for the telephone circuit and either the signal or control circuit. Both cables may be #16 AWG.

1-24. POWER REQUIREMENTS.

1-25. A 115-volt, 60-cycle, a-c power source is required for the operation of the projector and detector. Voltages required for the projector and the recorder must have a constant phase relationship for synchronization of the units (the power for each unit must be generated at the same source). It is better to provide for more than minimum power in all stages of planning. The values given hereafter are minimum values.

1-26. DETECTOR POWER REQUIREMENTS.

1-27. Power requirements for the detector vary according to the geographical location and type of installation. For an installation located far enough south to be relatively free from ice and snow, 200 watts is sufficient. The amplifier alone consumes about 50 watts. For an installation located far enough north to require heat to keep the cover glass free from frost, ice, or snow, at least 1200 watts of power is needed. In very severe cases, 1500 or 2000 watts may be required.

1-28. PROJECTOR POWER REQUIREMENTS.

1-29. For normal operation, 1000 watts is sufficient for the projector installation. Each lamp consumes approximately 400 watts. Except in extreme ice and snow conditions, the lamps supply sufficient heat to keep the

cover glass clear. Under such extreme conditions, 500 to 1000 watts of additional power may be required for an auxiliary heater.

1-30. INDICATING UNITS.

1-31. Paragraphs 1-32 and 1-34 describe two types of indicating devices that may be used with the projector and detector.

1-32. CATHODE-RAY TUBE INDICATOR.

1-33. For visual indications of cloud height signals, a cathode-ray tube indicator may be used. The electron beam moves up the vertical axis of the tube in synchronism with the sweep of the projector beam, and widens at a point corresponding to the angle at which the projector light beam strikes the cloud over the detector. The face of the cathode-ray tube is calibrated in degrees, and this angular measurement is converted into height by reference to precomputed scales.

1-34. RECORDER.

1-35. A recorder will normally be used with the projector and detector. Recording is accomplished by electrolytic means on chemically treated paper. Cloud heights are recorded in terms of elevation angles. The horizontal motion of the stylus is synchronized with the rotation of the projector, and the density of the record varies directly with the signal strength.

1-36. PHYSICAL DIMENSIONS OF COMPONENTS.

1-37. Table 1-5 lists the physical dimensions and the weights of the projector and detector.

TABLE 1-5. PHYSICAL DIMENSIONS OF THE PROJECTOR AND DETECTOR

Nomenclature	Height (in.)	Width (in.)	Depth (in.)	Weight (lbs)	Shipping Weight (lbs)
Projector	60	42	42	1000	950
Detector	62	42	42	830	750

SECTION II

TEST EQUIPMENT AND SPECIAL TOOLS

2-1. GENERAL.

2-2. This section lists the test equipment and special tools employed in the installation and maintenance of the cloud height projector and detector components.

2-3. TEST EQUIPMENT REQUIRED BUT NOT SUPPLIED.

2-4. TEST EQUIPMENT RECOMMENDED.

2-5. The equipment recommended for testing the projector and detector mechanical and electrical components is listed in table 2-1.

2-6. SPECIAL TOOLS AND FIXTURES.

2-7. Table 2-2 lists the special equipment used with the projector and detector but not supplied with the units.

TABLE 2-1. TEST EQUIPMENT REQUIRED FOR MAINTENANCE

Name	AN Type Designation	Alternate	Application
Signal Generator	TS-382()/U	Hewlett-Packard Model 200AB	Checking gain and tuning of detector amplifier.
Oscilloscope	AN/USM-24()	Du Mont Type 303	Signal tracing in detector amplifier.
Multimeter	AN/USM-34()	Triplet Model 630-A	General voltage and resistance measurements.
Ammeter (clamp-on type)	Stock No. G6225-284-0855		Checking filament current of projector lamps.
Vacuum Tube Voltmeter	TS-505/U	Hewlett-Packard Model 410B	Checking detector amplifier gain.
Stroboscope		General Radio Type 631-B Strobotac	Checking speed of synchronous motors.
Autotransformer		General Radio Type V-10 variac	Line voltage variation.
Resistor, 500 ohms, 1/2 watt			Detector amplifier load.

TABLE 2-2. SPECIAL TOOLS AND FIXTURES

Figure No.	Name	Application
3-13	Carpenters level	Installation of the projector and detector cabinets.
3-13	Sensitive level	Installation of the projector and detector reflectors.
3-2	Foundation template	Construction of foundations.
6-2	Voltage divider network	Amplifier checking.
	Transit or theodolite	Checking vertical aspect of the detector beam.
	Tape, steel, 300 ft	Measuring base line.

2-8. TEST EQUIPMENT AND TOOLS SUPPLIED.

2-9. Table 2-3 lists the tools and test equipment sup-

plied with the projector and detector units. This equipment is shown in figure 2-1.

TABLE 2-3. TEST EQUIPMENT AND TOOLS SUPPLIED

Figure No.	Part No.	Name	Application
2-1	A-489-120	Focusing device (sight)	Alignment of projector lamps.
2-1	A-489-209	Positioning template	Installation of detector and projector cabinets.
2-1	A-489-311	Focusing device (lamp)	Alignment of photocell.

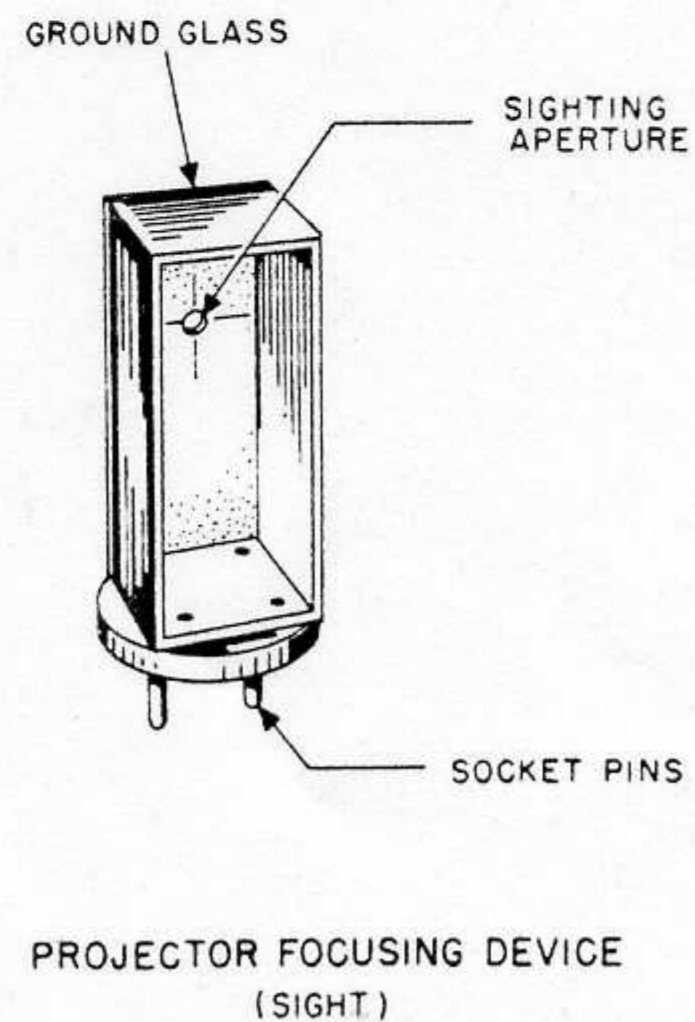
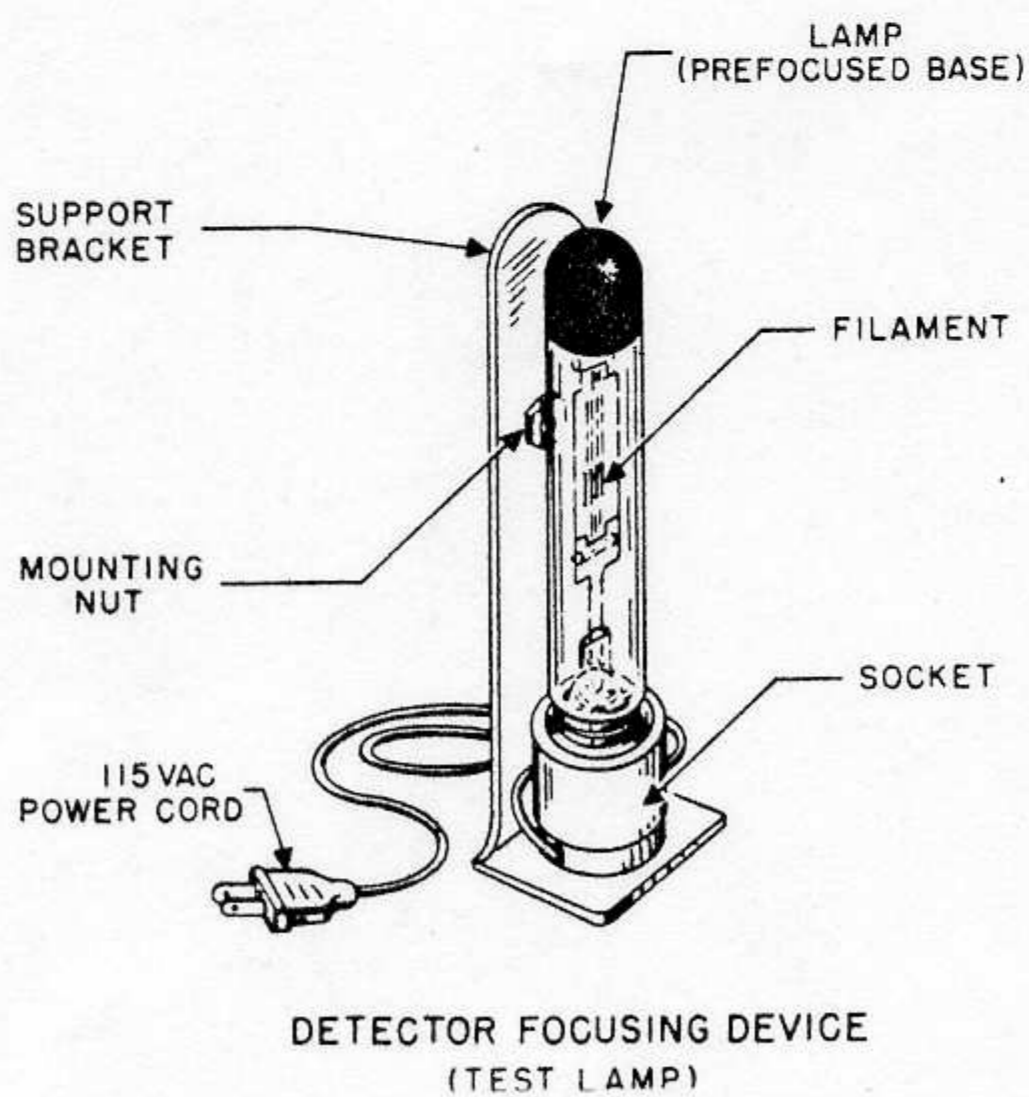
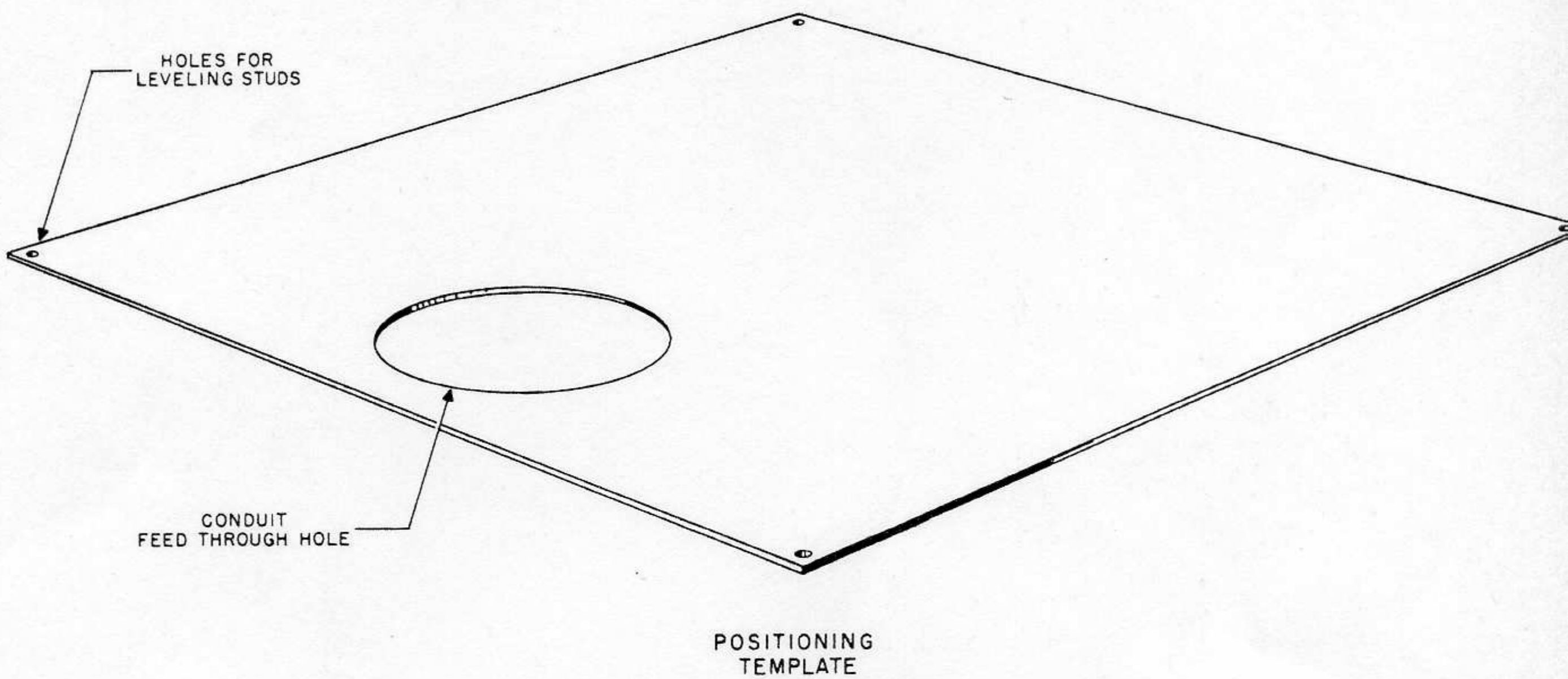


Figure 2-1. Special Equipment Supplied

Level template furnished with the projector (and detector) so that the cable entrance hole in the template is to the right of the centerline when viewed from the rear of the projector (or detector).

2. Place the template over the studs in the leveling feet. Adjust the feet so that the centerline is in line with the center of the opposite foundation.

1. Place the flat washers under the anchor nuts and tighten the nuts securely with the template in place. Leave the template. It can best be stored in this position under the projector (and detector).

3-26. INSTALLATION OF CABLES.

3-27. Figure 3-5 illustrates the minimum cable connections required for a typical installation. Site in the location of the power, control, signal, and telephone cables. Dig a trench wide enough and deep enough for easy burial below the frostline, if possible; put in a layer of screened sand or earth and install the cables. The wires of the cable should be labeled for proper connection to the junction box. See paragraph 1-22 for cable requirements. Pull the cables through the entrance conduits and the hole in the positioning template; leave about 6 feet of cable coiled on top of the template. Cover the cables with 4 inches of screened sand or earth and fill the trench completely with dirt.

3-28. Cable connections are made as follows:

1. Run two cables from the weather station to the nearest field site: the 6-conductor #16 AWG for signal, control, and telephone circuits; and the 2-conductor #6 AWG for power.

2. Run two cables between the projector and detector sites: the 4-conductor #16 AWG; and the 2-conductor #6 AWG.

3. At the site closest to the recorder, pull the 6-conductor and the 4-conductor cables through the 1-1/2 inch conduit. Pull the two #6 power cables through the 1-1/4 inch conduit.

4. At the other site, pull the power cable through the 1-1/4 inch conduit and the 4-conductor cable through the 1-1/2 inch conduit.

5. At the site closest to the recorder, splice together the two pairs of #6 AWG power cables. Leave about 4 feet of wire after the splice for connection to the junction box inside the equipment housing.

6. Splice the 6-conductor and the 4-conductor cables together in the following manner: splice one pair of the 4-conductor cable to one pair of the 6-conductor cable, leaving about 4 feet after the splice for entry to the equipment (this is the telephone line); splice together another pair of the 4-conductor and 6-conductor cables directly (this is the continuation of either the control or signal line from the far site to the recorder and does not enter this equipment). The remaining pair of the 6-conductor cable enters the equipment directly.

CAUTION

Make all splices weatherproof to prevent water seepage under the base from shorting the lines.

g. Push the splices back through the cable entrance hole in the positioning template, leaving enough slack above the template for connection to the equipment junction box, unless it is obvious that the cable bends and splices are small enough to allow the cables to remain above the template without being crimped by the pressure of the cabinet base.

3-29. INSTALLATION OF THE DETECTOR.

3-30. PREPARATION.

3-31. Move the detector to a position adjacent to the detector foundation before removing the crate. Unpack the crates, leaving the skid bases on the larger boxes. Check all parts against the packing list. Check to see that all components are undamaged.

CAUTION

Handle the detector with care; the cast aluminum cabinet may fracture if it receives a hard blow or severe jolt.

3-32. Install the four leveling bushings in the detector base, screwing them nearly all the way in. (See figure 3-4.)

Note

Since cabling must be introduced through the bottom of the detector cabinet, temporarily mount the detector on blocks of wood over the foundation until the wiring is completed.

3-33. POWER AND SIGNAL CABLE ENTRANCE.

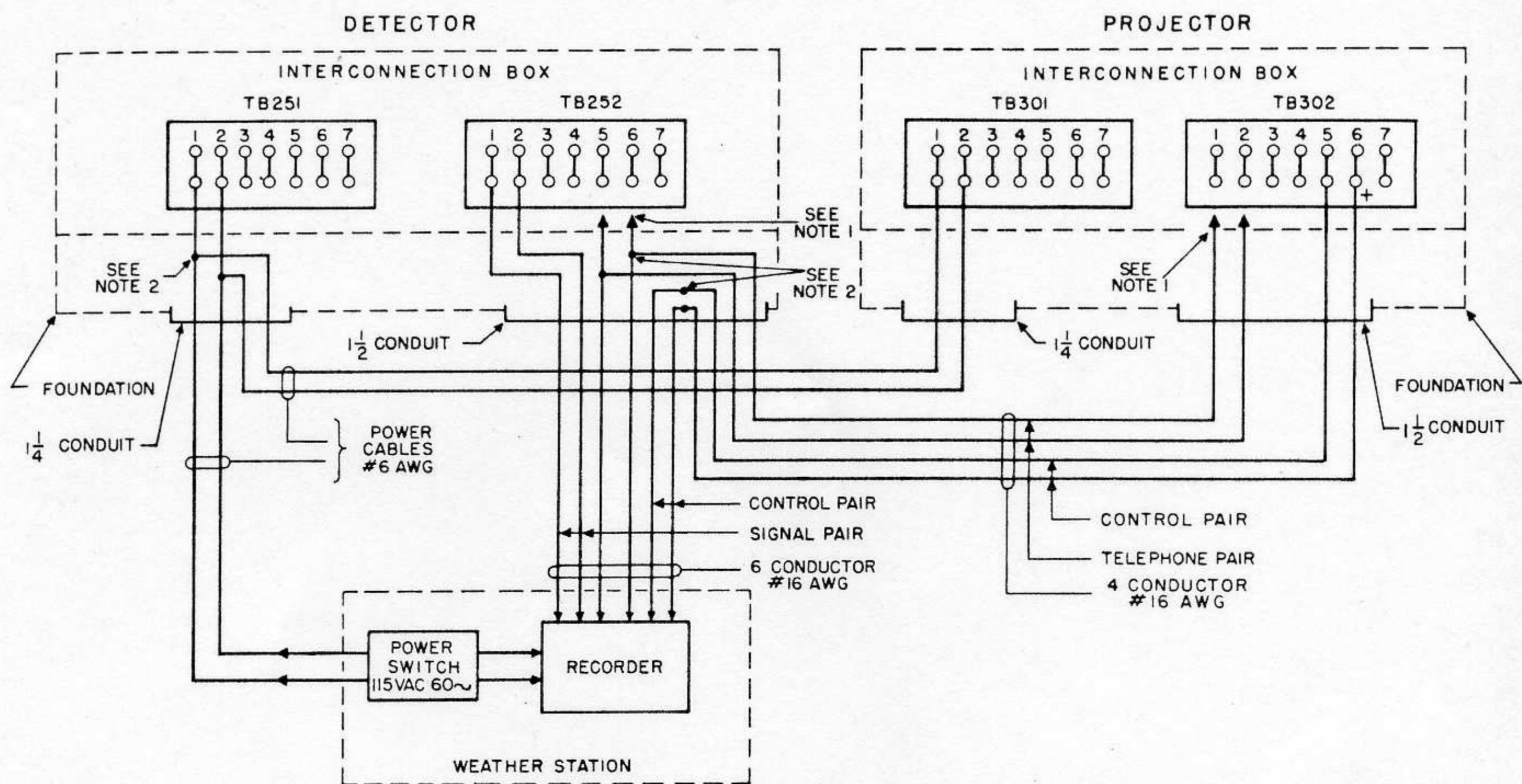
3-34. Entrance to the housing for signal, telephone, and power conductors is made through a 3-1/2 inch opening in the floor of the detector housing. (See figure 3-6.) A cover plate, placed over the 3-1/2 inch opening, secures a 1/2-inch flexible conduit through which the signal and telephone cable is fed, and a 1-inch flexible conduit through which the power cable is fed.

3-35. Follow the procedure outlined below for cable entrance.

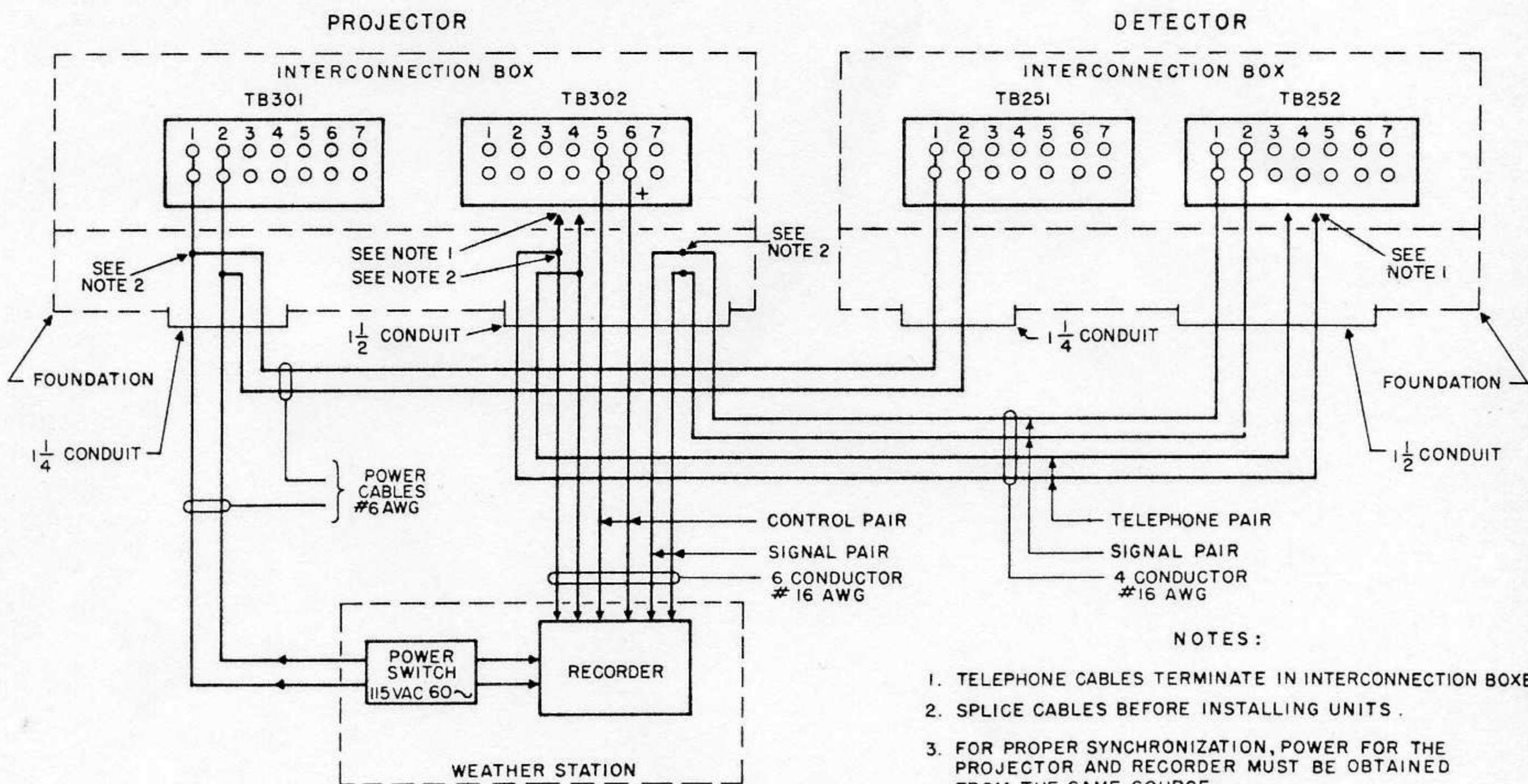
a. Feed the signal and telephone cables through the cover plate and 1/2-inch flexible conduit, into the detector junction box.

b. Feed the power cable through the 1-inch flexible conduit into the junction box.

c. Remove the wooden blocks and lower the detector into place over the leveling studs. The leveling bushings should have been previously installed in the detector base. (See paragraph 3-32.)



(A) (SEE NOTES BELOW)



(B) NOTES:
 1. TELEPHONE CABLES TERMINATE IN INTERCONNECTION BOXES
 2. SPLICE CABLES BEFORE INSTALLING UNITS.
 3. FOR PROPER SYNCHRONIZATION, POWER FOR THE PROJECTOR AND RECORDER MUST BE OBTAINED FROM THE SAME SOURCE.

Figure 3-5. External Cabling Diagram

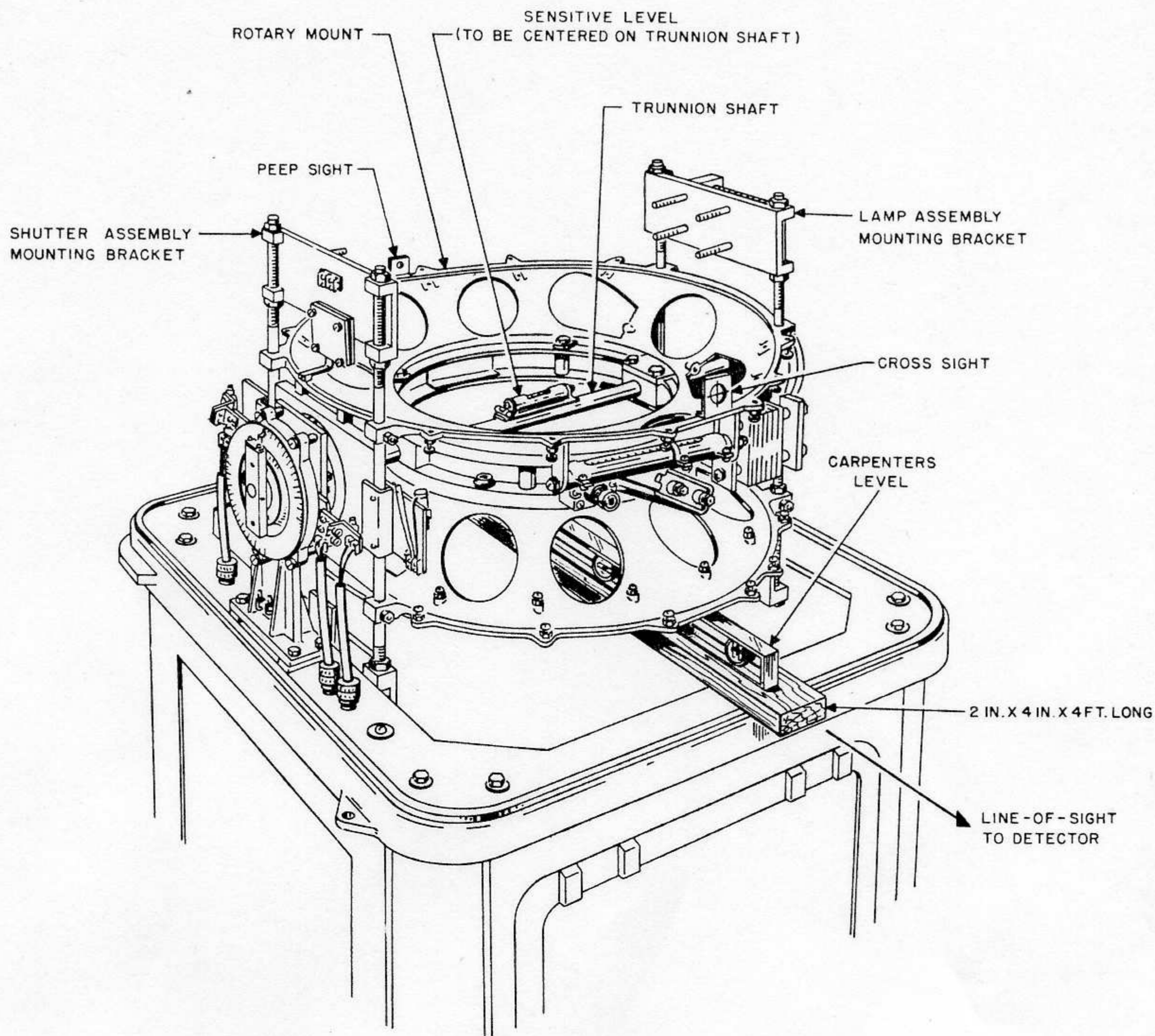


Figure 3-12. Projector Rotary Mount and Trunnion Alignment

c. In order to avoid damage to the leveling studs, raise the projector evenly by lifting one side of the projector and inserting one 1 in. x 4 in. x 6 in. piece under each of the elevated corners.

d. Lift the opposite side and insert two 1 in. x 4 in. x 6 in. pieces under each of the elevated corners.

e. Repeat step d on alternate sides until the projector has four pieces of wood under each of two corners, and complete the raising by placing one piece under each of the remaining corners.

CAUTION

The leveling bushings must not be raised high enough to clear the leveling studs.

f. With the projector well supported, loosen the retaining nuts on the anchor bolts underneath the projector.

g. With a long 2 in. x 4 in. piece through the open door of the projector housing as a lever, rotate the projector as required to perfectly align the projector with the detector as described in paragraph 3-70. Position the feet so that the leveling studs are in the center of the leveling bushings.

h. Tighten the anchor bolt retaining nuts and lower the projector to the foundation by removing two wooden blocks alternately from one side, then the other, until all blocks have been removed.

i. Recheck the alignment as described in paragraph 3-70.

- c. Rotate the carpenters level 45 degrees and repeat step b.
- d. Rotate the carpenters level 90 degrees and repeat step b.
- e. Recheck the level of the reflector by repeating steps b, c, and d.
- f. After the reflector is level, tighten the lower adjusting screw adjacent to one end of the level until the bubble in the sensitive level begins to move.

CAUTION

Use extreme care when tightening adjusting screws. It is possible to fracture the reflector by exerting uneven pressure.

g. Tighten the upper adjusting screw at the same location until the bubble moves back to level. In this initial adjustment the clamp should be firm but not tight.

h. Move to the clamp across the diameter of the reflector and tighten the adjusting screws as in steps f and g. Be careful not to disturb the wedges.

i. Repeat steps f, g, and h, on the other two clamps which are adjacent to the ends of the level, moving across a diameter of the reflector for each successive operation.

j. Rotate the levels to a position between four other clamps and repeat steps f, g, and i.

k. Repeat step i with the remaining four loose clamps. The reflectors should still be perfectly level with all clamps firm.

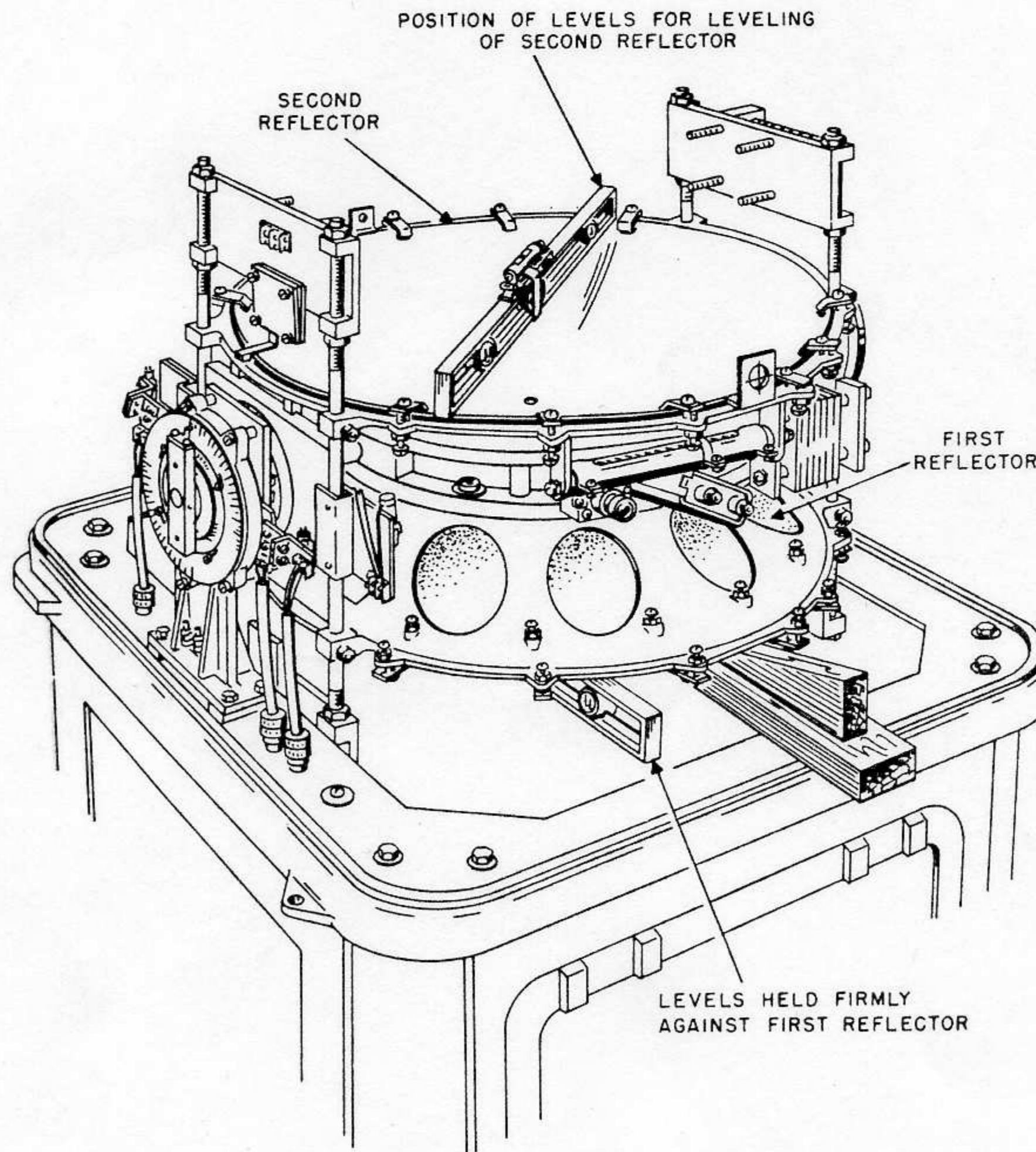


Figure 3-14. Projector Second Reflector Installation

CAUTION

The procedures outlined above for the initial clamping should be repeated one or two more times until all clamps are tight. However, on these final adjustments, since the reflector is firm the slightest displacement of the bubble in the sensitive level will indicate distortion in the reflector. Extreme care must be exercised.

l. When the clamping is completed, the slots on the retaining screws should be on radii of the reflector to facilitate the placement of strings across the diameters of the reflectors, used later in focusing. The upper adjusting screws should be set to accommodate this placement of the slots.

m. Tighten the nuts on the adjusting screws.

n. After the reflector has been clamped, carefully remove the blocking under the lower reflector support ring while restraining the rotary mount by hand. The

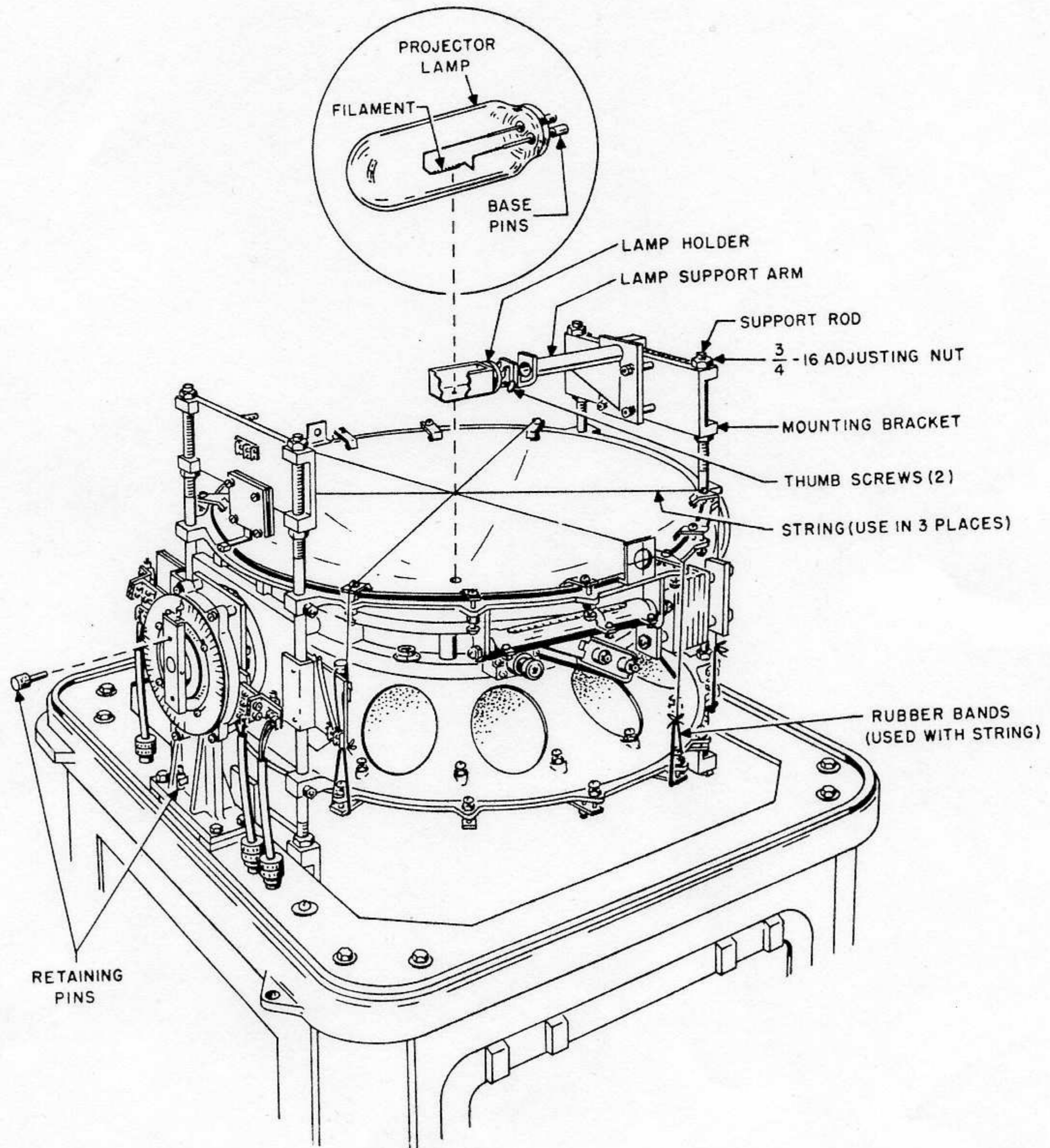


Figure 3-15. Projector Lamp Focusing Diagram

rotary mount will be unbalanced due to the added weight of the installed reflector.

o. Rotate the rotary mount until the installed reflector is facing downward and the second reflector support ring is up. (See figure 3-14.)

p. Block the reflector support ring as described in steps b and c of paragraph 3-84. Place the smooth surface of the wedges up, to allow for finer adjustment of the wedges.

q. Hold the levels (taped together) underneath and against the reflector that is turned down. Adjust the blocking wedges until the plane of the reflector's edge is level. It will be necessary for one person to adjust the wedges and hold the levels against the reflector, while another person views the reflection of the bubble from below, on the reflector inside the cabinet. This leveling is critical; it determines the final aspect of the two light beams.

r. Check to see that the index pointer again reads exactly 90 degrees on the angular scale. If it does not, the reflector installation procedure of paragraph 3-84 will have to be repeated.

s. After the reflector is blocked in a level position, install the second reflector by repeating the procedures given in steps b through m.

3-87. INSTALLATION AND ADJUSTMENT OF THE LAMP SUPPORT BRACKET ASSEMBLY. (See figure 3-15.)

3-88. There are several precautions to take during the installation and adjustment of the lamp support bracket and arm. The lamp support arm must be parallel to the plane of the reflector edge; the support bracket must be adjusted so that the lamp filament is parallel to the axis of rotation, and centered on the optical axis of the reflectors; and finally, the lamp support must be adjusted so that the filament lies in the focal plane of the reflector. All three of these criteria must be met when the lamp support bracket is finally adjusted.

3-89. To achieve the above conditions, install the lamp support bracket and adjust as follows:

a. Install the lamp support on the studs of the mounting plate, using the 5/16-18 nuts to position the bracket.

b. Turn the reflector face up and lock the rotary mount in position with the retaining pins.

c. Install three strings across the reflector as shown in figure 3-15. Each string will lie on a diameter of the reflector, through the slots of the clamp retaining screws which were turned to radii of the reflector (see paragraphs 3-84k and 3-86l). Tie rubber bands to the ends of the strings to keep the strings taut.

d. Install the lamp focusing device (sight, figure 2-1) in the lamp holder, with the frosted surface and cross facing the reflector.

e. Remove the pins that secure the rotary mount to the slip ring support and turn the reflector down until the reflector can be seen conveniently from a point on the optical axis of the reflector.

f. Adjust the nuts on the lamp support so that the center of the hole, the intersection of the strings, and the image of the intersection of the strings coincide. Level the lamp support arm at 0 degrees and at 90 degrees while maintaining coincidence. When the focusing device is replaced by the lamp, the center of the lamp filament will lie on the optical axis of the reflector.

g. Rotate the rotary mount until the reflector is directed at a contrasting cloud (white cloud on a blue sky background) or any other object 1000 feet or more from the projector.

h. Adjust the 3/4-16 nuts above and below the mounting bracket until the cloud or distant object comes into sharp focus on the frosted surface of the focusing device. Recheck the level of the lamp support arm.

Note

Repeat the sharp focus procedure several times to make sure that the best focus is obtained.

i. Tighten the adjusting nuts and remove the lamp focusing device and the strings.

j. Connect the leads from the lamp socket to the 12-volt terminals of the lamp transformer on the rotary mount. Make sure the connectors do not short against the lamp support arm. Secure the cable clamp to the transformer mounting screw.

k. Repeat steps a through j for the second lamp support.

3-90. INSTALLATION AND ADJUSTMENT OF THE SHUTTER ASSEMBLY. (See figure 3-16.)

3-91. Installation and adjustment of the shutter assembly will complete the installation of the projector optical system components. Proper alignment of the shutter is as important as proper alignment of the other components of the optical system. Modulation of the projector beam is greatly affected by the shutter adjustment. Only the modulated portion of the light flux on the cloud is useful for operation of the system. In addition to the required modulation, the shutter mount should be parallel to the plane determined by the edge of the reflector, and centered on the lamp filament for optimum operation.

3-92. To accomplish the above requirements, proceed as follows:

a. Mount the shutter drive motor support on the studs of the mounting bracket, using the 5/16-18 nuts to hold the support in place.

b. Point the reflector up, and pin the rotary mount in this position.

CAUTION

When working over the reflector, cover the reflector with padding or heavy cardboard to avoid chance of breakage.

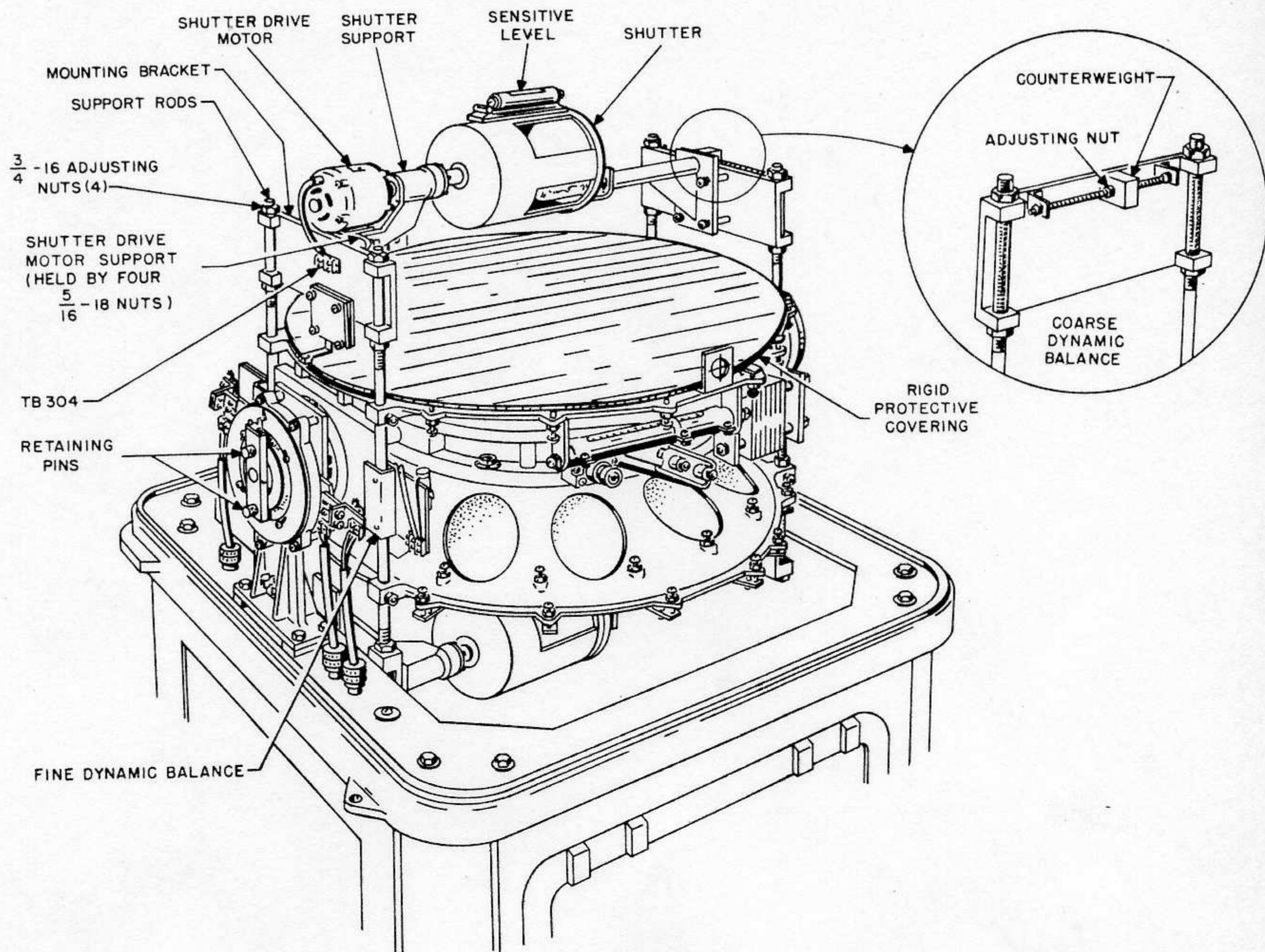


Figure 3-16. Projector Shutter and Rotary Mount Dynamic Balance

c. Place the sensitive level on the shutter as shown in figure 3-16, and adjust the 5/16-18 nuts until the shutter is level. Unpin the rotary mount and turn it until the index pointer reads exactly 0 degrees. Level the shutter in this plane also. Repin the mount at 90 degrees.

d. Connect the shutter drive motor leads to terminal board TB304 (refer to the wiring diagram, figure 7-5).

e. Install a lamp, with the filament offset toward the reflector (figure 3-15).

f. Adjust the 3/4-16 support rod nuts until the shutter is about 1/8-inch from the lamp. Remove the lamp.

g. Repeat steps a through f to install the second shutter assembly. (The shutter drive motor leads are connected to terminal board TB303.)

h. Turn "MAIN LINE" circuit breakers S301 and S302 to "ON" (figure 4-1).

Note

Power to the field lines is controlled from the weather station.

i. Place "LOCAL START" switch S304 to the "ON" position.

j. The shutters should build up to full speed in a few seconds and then run smoothly with little or no vibration. In building up to speed, the shutter may go through one or two periods of oscillation. If properly balanced, not more than two periods of oscillation should be encountered in getting up to speed; the same is true in slowing down.

3-93. If there is any doubt about a shutter being smooth enough to operate, proceed as follows:

a. With all the projector switches in the "OFF" position, place a 5-cent coin (or a slug of about 1/8-inch thickness) on the inside of the shutter below the lamp. Install the lamp in its holder.

b. Raise the shutter assembly slowly with the 3/4-16 shutter rod nuts until the coin lightly touches the lamp. Remove the coin.

CAUTION

Do not operate the shutter with less than 1/16-inch clearance.

c. Place the "MAIN LINE" switches S301 and S302, "MOTOR START" switch S303, and "LOCAL START" switch S304 to the "ON" position, and let the rotary mount revolve as shutter speed increases.

d. Turn S304 to "OFF" and allow the shutter to come to rest, then turn S304 to "ON" again. Let the shutters reach full speed, then turn S304 to "OFF."

e. If, after repeating steps c and d three or four times, the shutter does not touch the lamp, the shutter may be considered satisfactory. This is merely a test for smoothness of shutter operation and is not indicative of the final position of the shutters for normal operation. Place all switches to "OFF" at the end of the test.

3-94. MODULATION ADJUSTMENT.

(See figure 3-17.)

a. Turn the shutter so that an open slot is facing the reflector. Rotate the shutter slowly, until the edge of the opening of the shutter and the image of the filament can both be seen at the extreme lower edge of the reflector. Without changing the position of the shutter opening relative to the reflector, move the rotary mount until the top edge of the reflector can be viewed perpendicularly from the plane of the reflector edge. If the filament and the other edge of the shutter opening are just visible at the extreme top edge of the reflector, the shutter position to obtain 100% modulation of the projector beam is correct.

b. The adjustment in step a may be checked by turning the solid section of the shutter toward the reflector, and checking that the lamp filament is visible only at the extreme edge of the reflector at both the top and bottom of the reflector.

Note

Steps a and b can best be performed after dark with the shutter motor leads disconnected from terminal strips TB303 and TB304 and with the lamps energized ("MAIN LINE" switches S301 and S302, and "LOCAL START" switch S304 in the "ON" position).

c. When making this check with the lamps on, it is necessary to see if the opening in the shutter exposes the entire reflector to the lamp, and if the shadow of the shutter vane covers the entire reflector as shown in

figure 3-17, details A and B. It is not necessary to look into the lighted filament in the afterdark check. Merely examine the reflector to note the extent of the shadow formed by the vane of the shutter.

d. Adjust the support rod nuts to give 100% modulation as shown in figure 3-17, details A and B, and as determined by the checks in steps a and b. Under-modulation and over-modulation are shown in details C and D. Over-modulation will not affect the operation of the detector and projector, but it reduces the clearance between the lamp and shutter and should be avoided.

e. Spin the shutter by hand to make certain that the shutter clears the lamp. Turn the rotary mount by hand while the shutter is spinning, to be sure that the shutter clearance is sufficient during the entire revolution of the rotary mount.

f. Recheck all nuts for tightness.

3-95. ELECTRICAL AND MECHANICAL ADJUSTMENTS OF THE PROJECTOR.

3-96. ADJUSTMENT OF THE ROTARY MOUNT DYNAMIC BALANCE. (See figure 3-16.)

3-97. After all of the assemblies are installed, the rotary mount must be dynamically balanced so it will hold steady in any position when stopped. Counterweights are located on the lamp assembly mounting bracket.

3-98. To adjust dynamic balance, proceed as follows:

a. Remove the timing belt attaching the transfer pulley to the trunnion shaft drive pulley. (See figure 6-7.)

b. Remove the brushes. (See paragraph 6-50 and figure 6-6.)

c. Loosen the brake. (See paragraph 3-110 and figure 3-20.) The rotary mount is now free from all restraining forces and is resting on the support ball bearings.

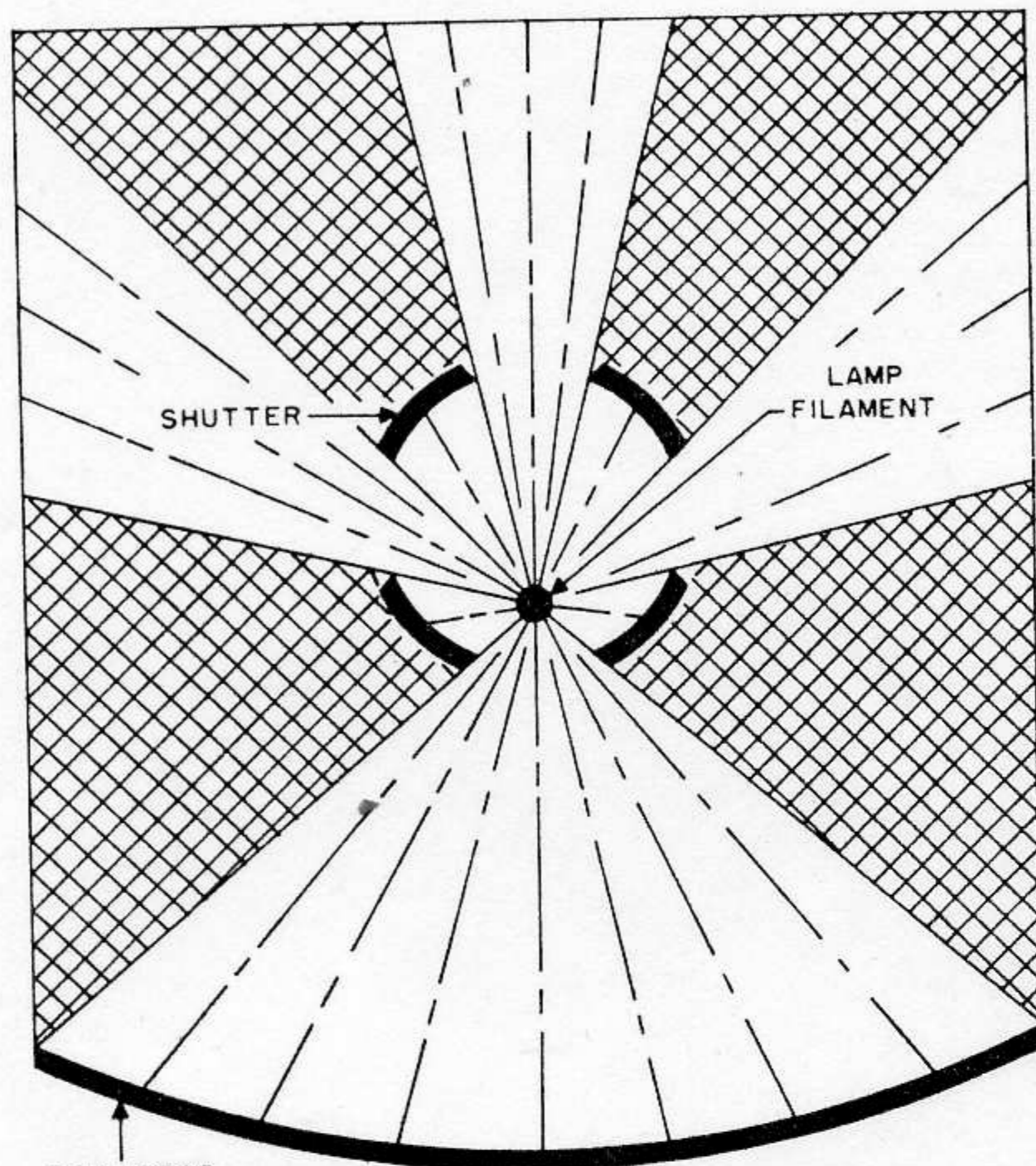
d. Turn the rotary mount by hand until the reflectors are in a horizontal position (index pointer at 90 degrees).

e. Loosen the two nuts on the balancing devices and place the counterweights in the center of the balancing rods. Tighten the nuts.

f. Spin the rotary mount by hand, and let it turn freely. When it stops, it should remain in position. If it begins to roll after stopping, the mount is not properly balanced.

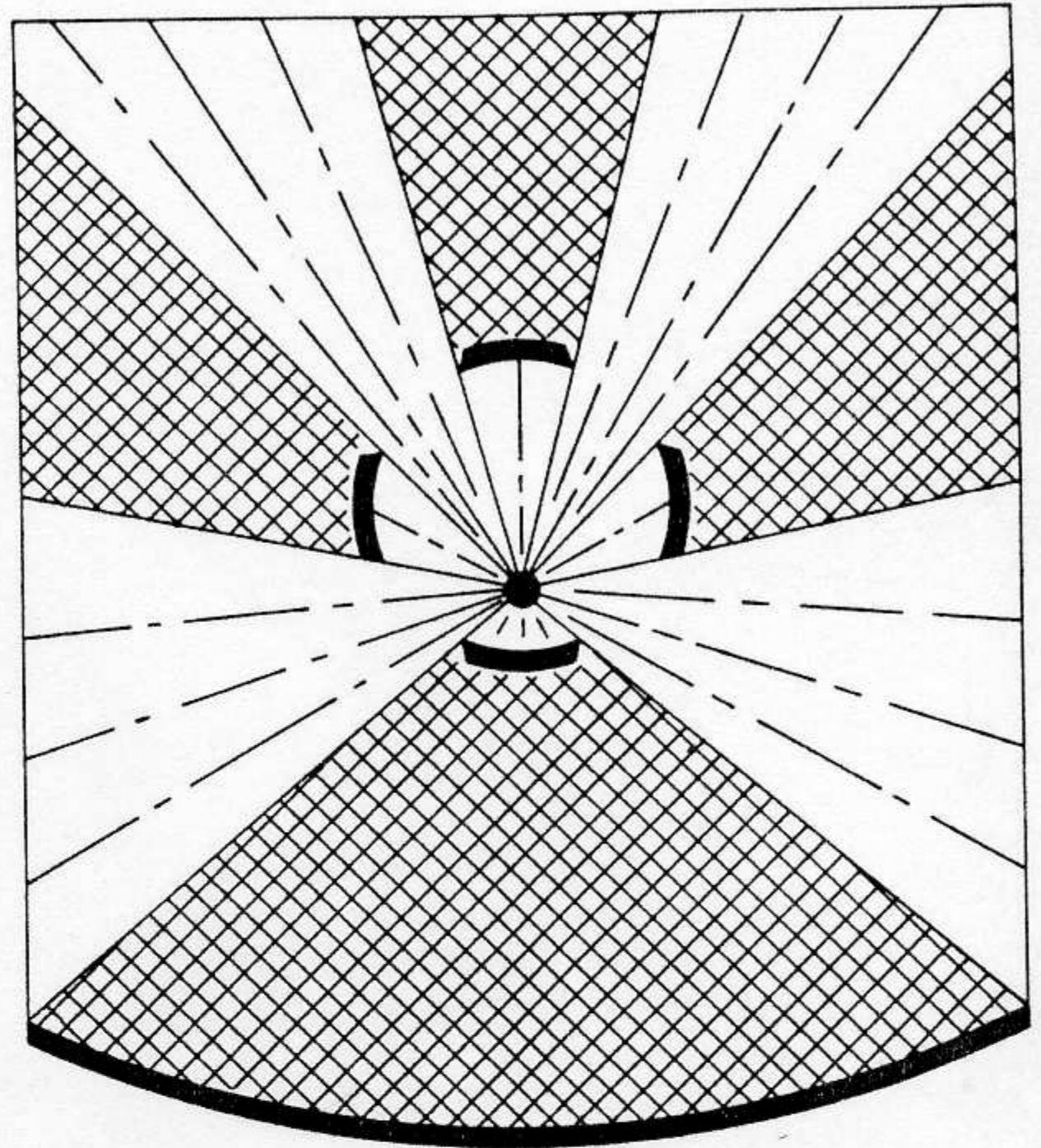
g. Loosen the nuts and slide one or both counterweights (depending upon the degree of misalignment) in a direction opposite to the direction of roll. Tighten the nuts and repeat step f. If the mount continues to roll, repeat the balancing.

h. For fine adjustment of the balancing, move one or both of the mounting plates containing the lamp dimming switches (figure 3-18) up or down on the support rod. The plates are clamped to the support rods and may be moved by loosening the two screws securing the clamp.



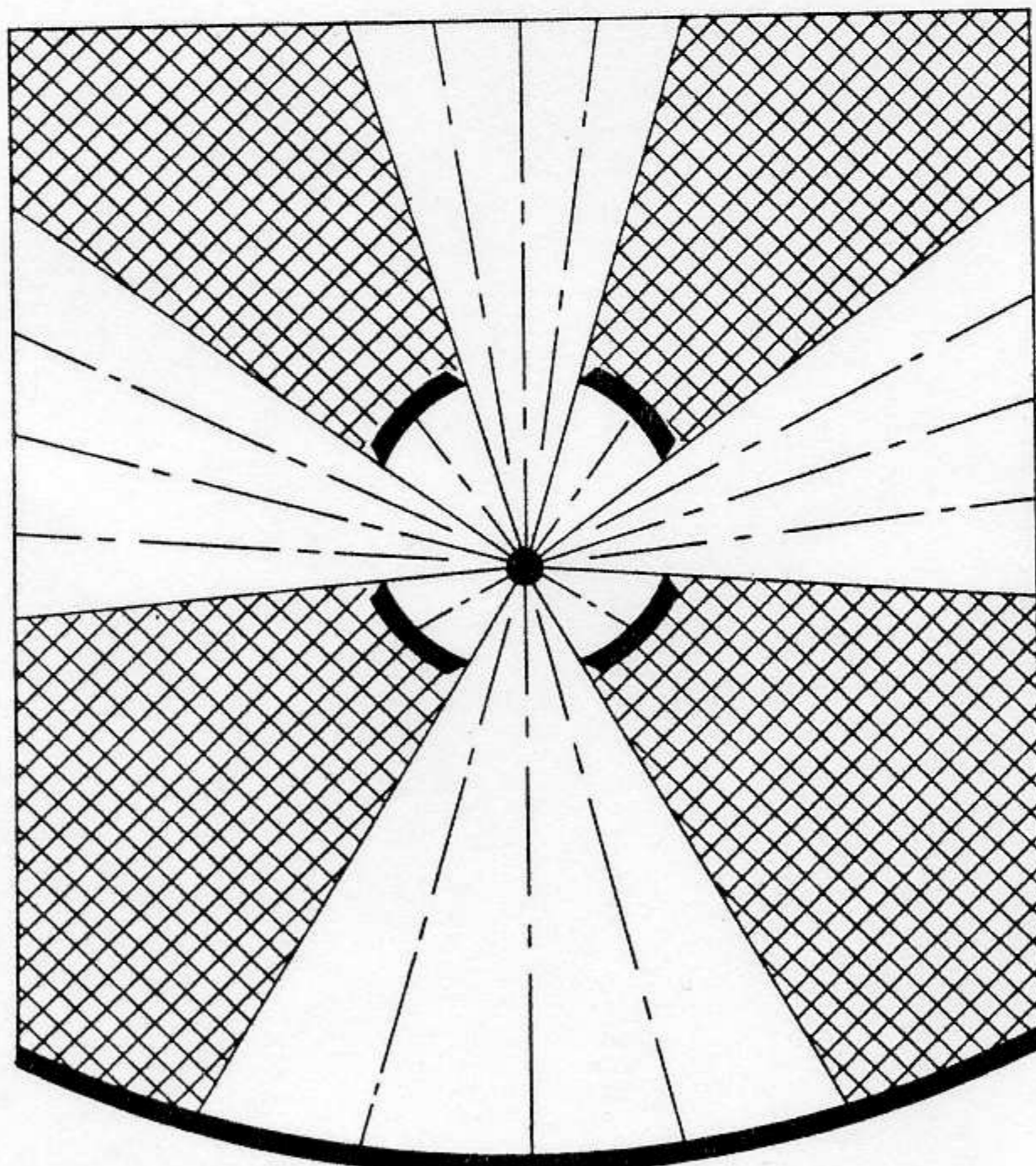
SHUTTER CORRECTLY ADJUSTED

A



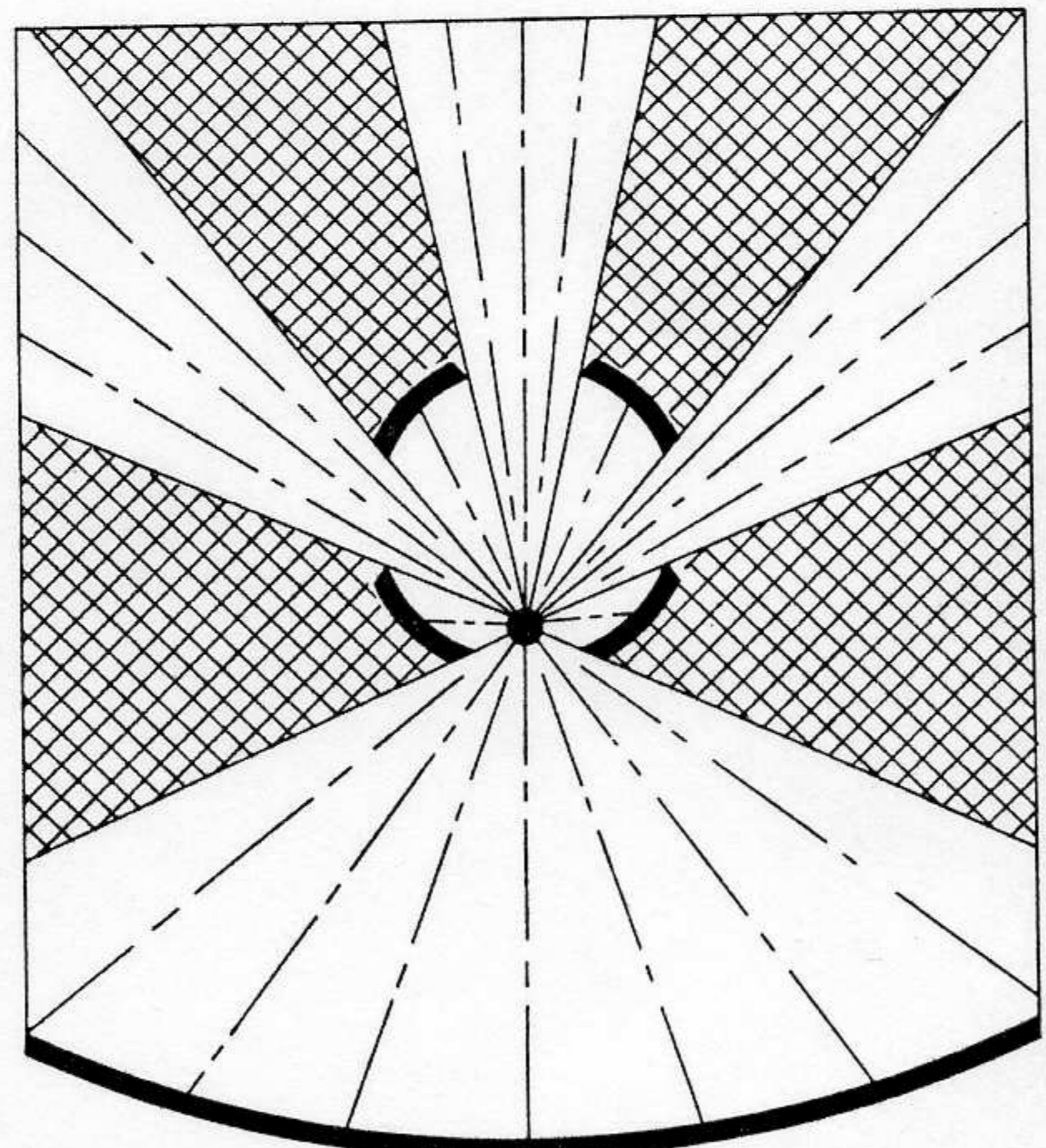
SHUTTER CORRECTLY ADJUSTED

B



SHUTTER TOO FAR FROM LAMP FILAMENT
(UNDER-MODULATED)

C



SHUTTER TOO CLOSE TO LAMP FILAMENT
(OVER-MODULATED)

D

Figure 3-17. Projector Shutter Modulation Adjustment

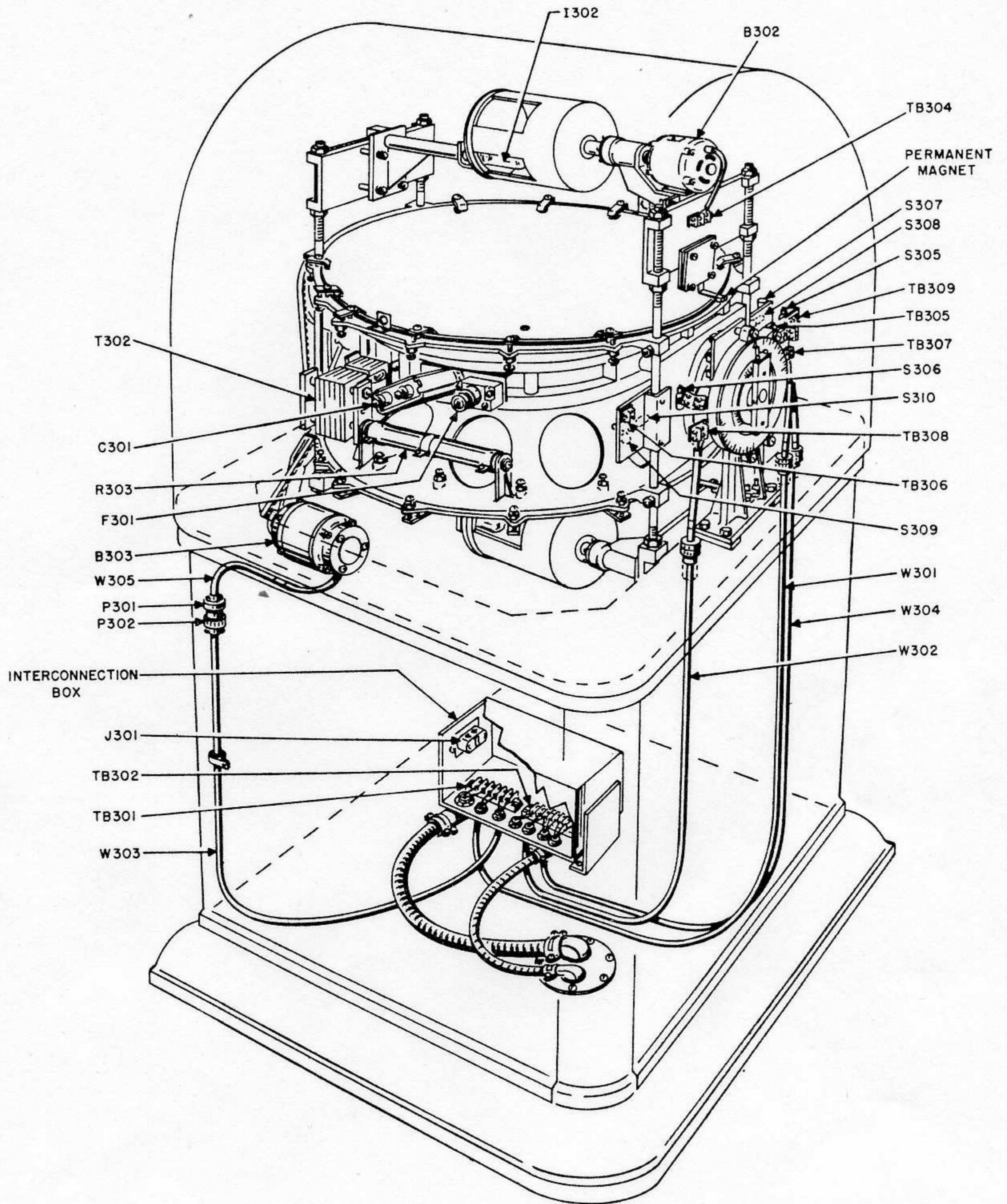


Figure 3-21. Projector Internal Cabling Diagram

SECTION V

THEORY OF OPERATION

5-1. GENERAL SYSTEM OPERATION.

5-2. The projector and detector, two of the major components of the cloud height set, use the basic principle of triangulation to measure cloud heights. (See figure 1-1.) The projector unit directs a beam of light to the clouds at a measurable angle; light signals reflected from the clouds, or other objects within the vertical sector over the detector, are detected and amplified by that unit. The known angle of projection, and the known fixed distance between projector and detector, furnish the basis for accurate measurement of cloud heights over the detector unit. These data are then transmitted over land lines to a recorder situated in the weather station. There are several factors which affect the accuracy of cloud height measurements. A knowledge of these factors will aid in securing optimum operation and in determining capabilities of this equipment. These factors are divided into two basic groups, fixed and variable.

5-3. FIXED FACTORS.

5-4. The length of the base line determines, to a large extent, the maximum height that clouds can be measured with any degree of accuracy. From purely geometric considerations it is evident that, for any given base line, the accuracy of the system decreases as the angle of the projector beam increases; the system accuracy is greatest when the angle of the rotating beam is near zero degrees. For example, with a base line of 500 feet, a 1-degree change at an angle of 30 degrees over the detector results in a change in height of 2 feet. However, at an angle of 60 degrees, a 1-degree change results in a change in height of 37 feet. A greater possibility of inaccuracy exists at the larger angle. Shortening the base line to less than 400 feet decreases the accuracy in the measurement of higher clouds. Increasing the base line improves the accuracy of the higher cloud measurements; however, for base lines of 1000 feet or longer, other limiting factors appear. These include light beam cut-off by low hanging cloud fragments, attenuation of the beam by fog or other obstructions to vision, and aerosol angular-scatter functions (diffusion of light beam by cloud droplets). A satisfactory compromise is obtained with a base line of 400 feet, the most commonly used length. Preferred and alternate locations of the equipment are shown in figure 7-1.

5-5. The gain of the detector amplifier is subject to change over a long period of time, but may generally be considered fairly constant in terms of short periods

of time. Changes in gain are due to variations in gain control setting, or result from changes in component values with age.

5-6. The alignment of the optical systems, the alignment of the projector to the detector, and the cleanliness of the optical systems are slow changing factors. The latter (cleanliness) may vary from week to week, but for any given series of cloud measurements may be considered constant.

5-7. Condition of the optical system will vary with age. Under optimum conditions, each reflector unit produces a beam intensity of about 3,000,000 candlepower. As the lamps age, their brightness decreases due both to a black deposit of tungsten on the inner surface of the lamp envelope (which reduces the light flux) and an increase in filament resistance (which decreases the current flow through the filament).

5-8. VARIABLE FACTORS.

5-9. In addition to the fixed factors described above, there are several others which vary rapidly and are equally important to cloud height measurement. These variable factors are, in general, inherent in this type of equipment.

5-10. The sensitivity of the lead sulfide semiconductor photocell used in the detector changes over a rather wide range, under the varying conditions of temperature and ambient light to which the cell must necessarily be exposed. Sensitivity and signal-to-noise ratio decrease with an increase in each of these parameters.

5-11. Another major factor affecting the sensitivity of the photocell is the quantity of light flux received from the background or sky. Photocell resistance, which determines sensitivity, decreases rapidly with increase in light flux. Thus, greater sensitivity is realized at night than during the daylight hours. This makes difficult the measurement of single-layer thin clouds, or otherwise bright cumulus-type clouds which are usually rich in infrared radiation during the daytime. In order to minimize the saturation effects of the ambient light on the photocell, a near infrared band-pass filter is employed as a cover glass for the cell. This filter eliminates most of the visible light, while allowing approximately 90 percent transmission of the radiation to which the cell is now sensitive. This high degree of infrared radiation which reaches the cell from the clouds reduces its resistance (sensitivity) and, therefore, reduces the effect of the reflected signal from the projector.

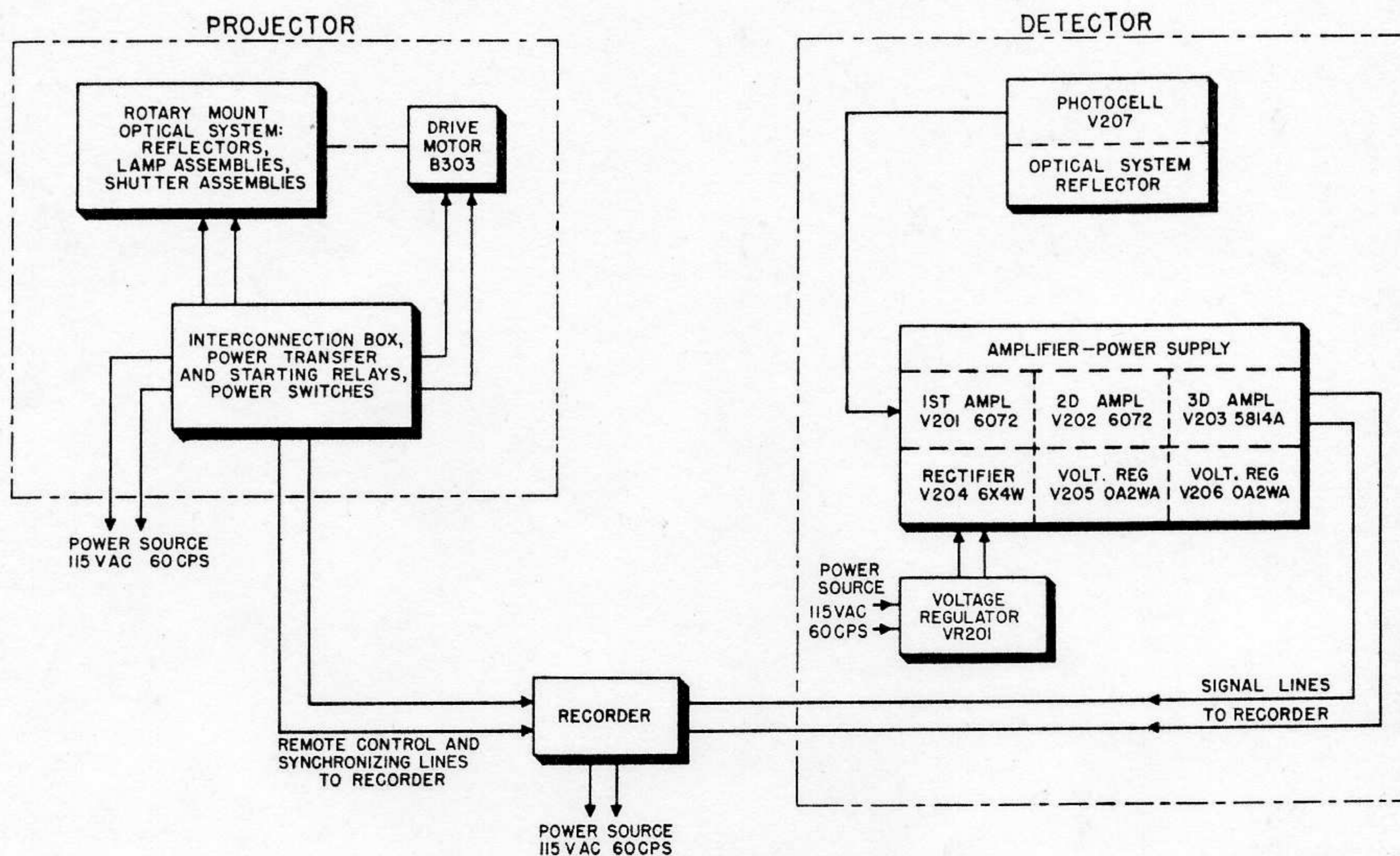


Figure 5-1. Cloud Height Set, Simplified Block Diagram

5-12. BLOCK DIAGRAM ANALYSIS.

5-13. Figure 5-1 illustrates, in block diagram form, the components and signal paths of the projector and detector. The function of each component is described in the following paragraphs.

5-14. PROJECTOR.

5-15. The projector junction box distributes a-c power to the lamp assemblies, motors, and other electrical components of the projector optical system. The junction box contains the switches and relays used in operating the projector from the recorder site or locally from the projector site. After the projector has been placed in standby condition, it can be turned on and off from the recorder by means of control lines from the recorder to the starting relay in the projector junction box.

5-16. The projector optical system consists of a rotary mount support for the reflectors, lamp assemblies with shutters to modulate the light beams, motors to rotate the shutters, and slip rings to transfer the a-c power from the junction box to the lamps and motors on the rotating mount. The rotary mount drive motor B303 turns the projector optical system described above at a rate of 5 rpm.

5-17. DETECTOR.

5-18. The detector optical system contains a reflector and photocell which collect the reflections of light from cloud bases; these signals are coupled to the detector amplifier.

5-19. The detector incorporates a three-tube low-noise amplifier which boosts the signals to a value suitable for use by the associated recorder (paragraph 5-20). The amplifier includes a full-wave rectifier power supply to develop filament and plate voltages for the amplifier stages. A separate magnetic voltage regulator furnishes regulated input line voltage to the amplifier-power supply.

5-20. The output signal from the detector amplifier is fed through land lines to the associated recorder. Cloud heights are recorded in terms of elevation angles. The horizontal motion of the recorder stylus is synchronized with the rotation of the projector, and the density of the record varies directly with the signal strength.

5-21. DETAILED ANALYSIS OF ELECTRICAL AND MECHANICAL COMPONENTS.

5-22. The following paragraphs provide a detailed description and theory of operation of the electrical

and mechanical components of the projector and detector.

5-23. ELECTRICAL CHARACTERISTICS.

5-24. The electrical circuits of the projector and detector are comprised of those components associated with the projection of light beams, the detection and amplification of light reflection, and its conversion to signal voltages suitable for use by the recorder. The components consist of a modulated light source in the projector, a sensitive photocell to absorb the light reflections, and a tuned amplifier to increase the strength of the signal to a level needed for the associated recorder.

5-25. MECHANICAL CHARACTERISTICS.

5-26. The mechanical components of the projector and detector are comprised of a drive system to scan the "field of view" of the detector, two motor-driven shutters which modulate the light beams, and a system for synchronizing the projector with the recorder.

5-27. PROJECTOR COMPONENTS.

5-28. GENERAL. The projector incorporates two identical light sources, complete with optical systems, rotating shutters to modulate the light beams, and power and control circuits which coordinate the operation of the projector with the other units of the system. The light beams successively sweep the vertical "field of view" of the detector (from detector top to zenith) and illuminate any cloud or other obstruction in the sector. The light scattered downward from the cloud is collected by the light-sensitive photocell of the detector, and the amplified pulse which results is applied to the recorder. Provision is made for synchronizing recorder operation with the rotation of the projector light beams.

5-29. OPTICAL SYSTEM. Each optical system of the projector is composed of a reflector, projector lamp, lamp transformer, lamp dimming switches, and shutter assembly. Except for reference symbols, the systems are identical. The components of the optical systems are shown in figure 6-8.

5-30. REFLECTORS. The projector reflectors are back-silvered precision-ground parabolic mirrors, with a 10-inch focal length. The reflectors concentrate the light from the projector lamps into a narrow beam.

5-31. PROJECTOR LAMPS. Projector lamps I301 and I302, located at the focal points of the reflectors, operate at approximately 35 amperes (full brightness) with 12 volts applied to the filaments. Leads from the lamp transformers to the lamp sockets (asbestos covered No. 8 AWG stranded wire) are designed to withstand high heat and high current. Each lamp has a filament offset to within 1/2 inch of the lamp envelope on the side adjacent to the reflector. The offset filament permits the use of a large bulb for better cooling and still provides optimum modulation of the light beam with a relatively small shutter. A medium bi-post base is used with the lamp.

5-32. LAMP TRANSFORMERS. Transformers T301 and T302 furnish the power for lamp operation. The transformer primaries are tapped to match the a-c line voltage, in order to provide proper current for lamp operation.

5-33. LAMP DIMMING CIRCUIT. (See figure 7-3.) To prolong the life of the projector lamps, the filament current is reduced during that portion of the optical system rotation when the lamp is not scanning the detector field of view. Dimming the lamps has two advantages: it reduces the length of time the lamps are operating at full brightness, and it protects the filaments against breakage which would result from the excessive cooling and heating effects of on-off operation. Dimming for lamp I301 is accomplished in the following manner.

5-34. As the reflector assembly containing lamp I301 turns through its scanning range, from just below zero degrees to just beyond 90 degrees, mercury tilt switches S307 and S308 are closed. The full primary voltage is applied to lamp transformer T301 and a current of 35 amperes flows through the lamp. This is the full bright condition.

5-35. When the reflector passes 90 degrees, switch S308 opens as the mercury runs out of the bulb. This places resistor R302 in series with the transformer primary, effectively reducing the voltage across the primary. A filament current of 14 amperes now flows through the lamp. This is the dim condition.

5-36. Sometime during the remainder of the cycle, from 90 degrees to approximately 15 degrees below zero, switch S307 will open and switch S308 will close. Since the switches are in series, the lamp will continue to be dim as long as one of the switches is open.

5-37. At approximately 15 degrees below zero, switch S307 will close also, shorting out resistor R302, and applying the full primary voltage to the transformer. Full-bright current now flows through the lamp again, and the cycle repeats. The 15-degree lead time at the zero position is provided so the lamp will be at full brightness by the time the reflector reaches zero.

5-38. Lamp I302 is dimmed in the same manner. Resistor R303 is placed in series with the primary of T302. Switch S309 controls the zero position, and S310 controls the 90-degree position.

5-39. SHUTTER ASSEMBLIES. The light beams are modulated by means of shutters mounted on motor shafts. The shutters, rotated by motors B301 and B302, respectively, are cylinders having four rectangular openings alternated with four rectangular vanes, or solid portions, of equal size. One base of the cylinder is open, so the shutter can fit over the lamp. The shutters are rotated at 1800 rpm and interrupt the light beam 120 times a second. The beam modulation is obtained by adjusting the shutters with respect to the lamp filaments. When properly adjusted for 100% modulation, the shutters will allow the lamp filaments

to "see" the entire reflector but no more than the reflector. Likewise, when a vane of the shutter obscures the reflector, it will obscure the reflector only and the shadow of the vane will not extend beyond the reflector. Figure 3-17 shows the shutters correctly and incorrectly adjusted. There is no loss when the light beam is over modulated; however, this condition may produce insufficient clearance between the lamp and the shutter.

5-40. **DRIVE SYSTEM.** The projector drive system consists of rotary mount drive motor B303, and its associated mechanical components. The rotation of the optical system is accomplished through a series of belts and pulleys, shown in figure 6-7. The rotary mount drive motor is of the synchronous type, with an internal speed reduction of 200 to 1, resulting in an output of 75 rpm. Capacitor C303 and resistor R301 are the phase splitting components for the motor.

5-41. **TIMING BELT TRANSMISSION.** The timing belt transmission reduces the speed of the rotary mount optical system from the motor speed of 75 rpm to 5 rpm. The transmission consists of a driven pulley, a driver timing belt, and an idler timing belt pulley, with a total reduction of 15 to 1.

5-42. **ROTARY MOUNT BRAKE AND DYNAMIC BALANCE.** To insure uniform movement and balance of the optical system during operation, a brake and two balancing devices are provided on the rotary mount assembly. The brake consists of a spring-loaded, asbestos-lined brake shoe that rides against the brake drum surface of the driven pulley (figure 3-20). Brake pressure can be adjusted from 0 to 5 lbs. The brake serves to dampen vibrations in the rotating optical system and to eliminate backlash in the drive system. Two types of balancing devices contribute to the smoothness of operation. Counterweights, located on the rear of the lamp mounting plates (figure 3-16), provide a coarse adjustment of the balance; fine adjustment is obtained by sliding the plates containing the lamp-dimming mercury switches (figure 3-18) up or down on the support rods. A tapped hole is provided on these plates to which additional weights may be added, if necessary.

5-43. **POWER AND CONTROL CIRCUITS.**
(See figure 7-2.)

5-44. Application of line voltage to the projector (and detector) is controlled from the weather station. The field lines to the projector are connected to terminals 1 and 2 of TB301. Duplex receptacle J301 is connected across the line, ahead of the projector controls, to provide an auxiliary power outlet (for test equipment, soldering iron, etc.).

5-45. Power to the projector circuits is controlled by a pair of thermal circuit breakers, "MAIN LINE" switches S301 and S302, each rated at 20 amperes. For normal (remote) operation of the projector, these switches, and "MOTOR START" switch S303 must be

placed in the "ON" position, and "LOCAL START" switch S304 in the "OFF" position.

5-46. When the recorder's projector control switch is operated, voltage is applied through terminal 6 of TB302 to the solenoid of relay K302. The ground return is through zero switch S305 (normally closed) and terminal 5 of TB302, back to the recorder.

5-47. When relay K302 energizes, it transfers the 115-volt ac to the solenoid of relay K301. K301 energizes, and remains energized due to the parallel application of voltage from two sources: the first is the original energizing voltage transferred from K302; the second is the voltage applied to the solenoid through protective switch S306 (normally closed) and the holding contacts of K301.

5-48. When relay K301 energizes, it applies the a-c voltage through S303 to the rotary mount drive motor (B303) and also to the slip ring assembly, to energize the lamps (I301 and I302) and shutter drive motors (B301 and B302). The timing belt drive (paragraph 5-20) turns the mount at 5 rpm. During that 90-degree portion of the cycle in which a lamp scans the detector's field of view, its mercury tilt switches (S307 and S308 for I301, S309 and S310 for I302) are closed to permit the full current of 35 amperes to flow through the lamp. During the remainder of the cycle the switches are open, and the dimming resistor (R302 or R303) limits the lamp current to 14 amperes. The lamp shutters interrupt the light reaching the reflectors at the rate of 120 times per second.

5-49. When the No. 1 reflector (designation arbitrarily assigned at installation to aid identification; see paragraph 3-70) reaches the zero position as indicated on the angular scale, a permanent magnet on the rotary mount opens switch S305 and permits it to close again at 2 degrees. This 2-degree break in the circuit has no effect on projector operation, since K301 is still energized through S306, but it provides the synchronizing pulse required by the recorder to coordinate its operation with the scanning of the projector. S305 is called the zero switch.

5-50. Approximately 30 degrees before the magnet on reflector No. 1 opens zero switch S305, another magnet on reflector No. 2 momentarily opens protective switch S306 as it passes. There is no effect on projector operation as long as K302 remains energized by the voltage from the recorder. Switch S306 performs its protective function when the projector is being stopped. When the projector control at the recorder is turned off, K302 is deenergized. The projector continues to operate because K301 is still energized through S306. As soon as the rotary mount turns to a position where the magnet on the No. 2 reflector opens S306, there is no longer an energizing path for the solenoid of K301 and this relay drops out, removing the voltage from the lamps, the shutter drive motors, and the rotary mount drive motor. Due to the action of the brake, the rotary mount will coast to a stop within 20 degrees. In this

position, neither reflector will be pointed into the sun. The second, and perhaps the most important, feature of the protective switch and brake combination, is that the mount does not stop with the No. 1 reflector positioned between 0 and 2 degrees. If this were to happen, the magnet would hold switch S305 open and it would not be possible to start the projector from the recorder again. It would then become necessary to turn the mount by hand until S305 closes, to complete the circuit for relay K302.

5-51. When the projector is operated locally, "LOCAL START" switch S304 bypasses K302 to apply the line voltage to K301.

5-52. DETECTOR COMPONENTS.

5-53. GENERAL. The detector components include an optical system, an amplifier with power supply, a voltage regulator, and a deicer. The optical system of the detector is directed vertically upward. As light beams from the associated projector sweep a cloud base or other obstruction within this field of view, the reflected light is collected by the detector optical system. The modulation component of the light is amplified and directed to the recorder, that has been calibrated to indicate the height of the obstruction.

5-54. OPTICAL SYSTEM. The optical system of the detector consists of a reflector (identical to those used in the projector unit) and a light-sensitive photocell.

The system is carefully adjusted so that light beams, parallel to the optical axis of the reflector, will converge at the photocell. In order that simple trigonometric principles may be used, the detector optical system must be directly perpendicular to the baseline between the projector and detector. (See figure 1-1.) The components of the optical system are described in paragraphs 5-26 through 5-28.

5-55. DETECTOR PHOTOCELL. Photocell V207 is mounted in the focal plane of the reflector on the optical axis. The lead-sulfide protoconductive cell is a low-noise, non-microphonic cell having a nominal dark resistance of 1 to 3 megohms. As light strikes the sensitive surface, the resistance of the cell decreases. The cell response is very rapid and easily follows the 120-cycle pulsating light received from the projector. The photocell serves to provide a signal source for the detector amplifier. As shown in figure 5-2, the cell is connected as the bottom leg of a series bleeder across the B+ supply. Changes in the intensity of the light striking the photosensitive surface of the cell result in changes in the resistance in the bottom leg of the series bleeder. This causes a corresponding change in voltage drop across the photocell, and produces a varying voltage on the grid of V201. This varying voltage may be either a signal voltage or a noise voltage depending upon the source of light. If the light causing the voltage variation results from the pulsating light

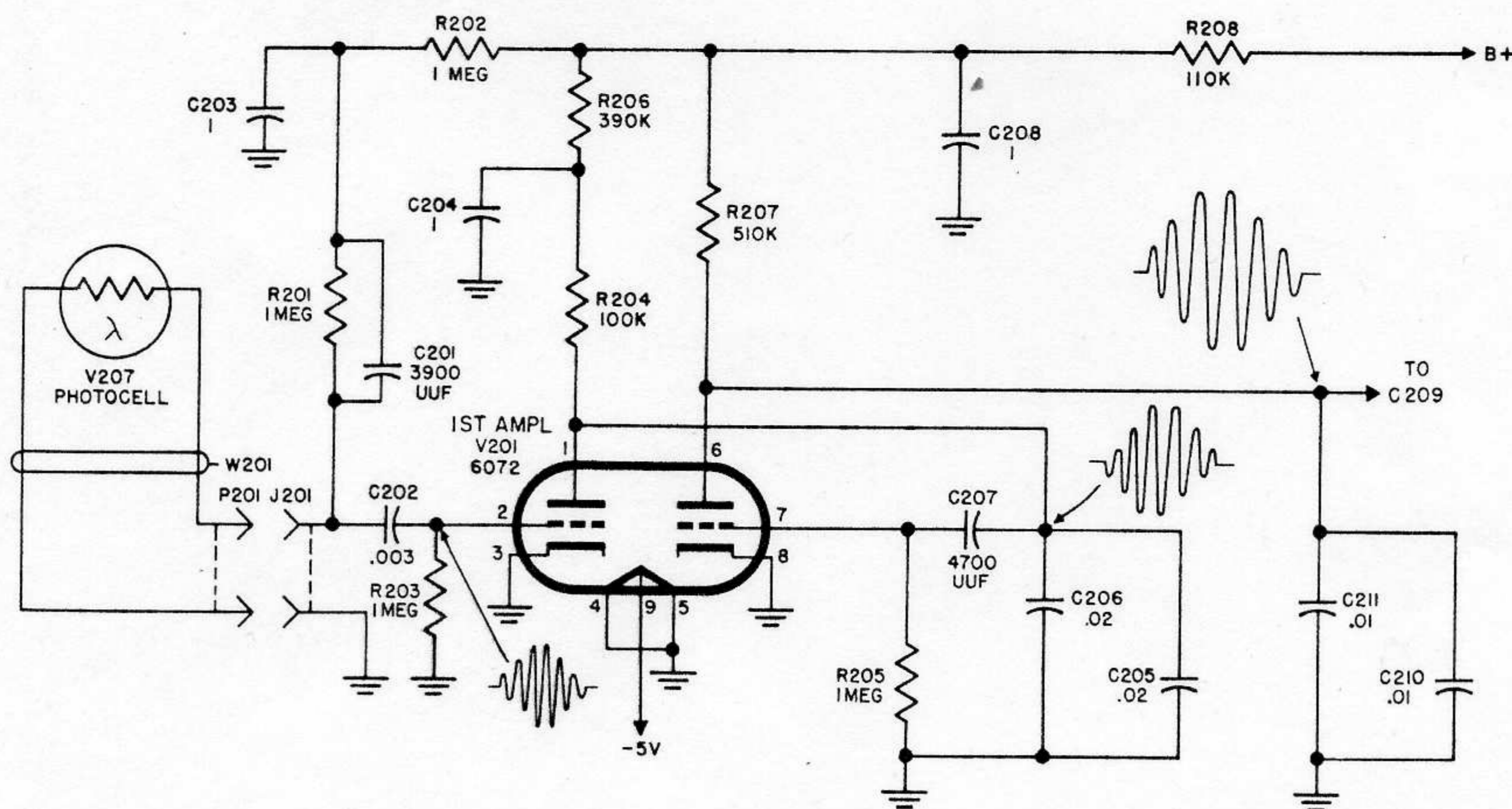


Figure 5-2. Detector Photocell and First Amplifier Stage, Simplified Schematic Diagram

of the projector beam, it is called signal voltage. From any other source, a varying voltage is a noise voltage.

5-56. NOISE VOLTAGES. There are two types of noise voltage common to the projector and detector:

a. The noise due to changes in ambient light intensity received by the photocell, as well as noise generated by the cell itself, is inherent in this equipment and is usually of random phase and magnitude.

b. Other noise voltages, due to line pickup, nearby strong modulated lights, and similar causes, are usually of fixed phase and of a frequency that will cause a continuous reaction at the recorder. These voltages must be eliminated if satisfactory operation is to be obtained.

5-57. PHOTOCELL FILTER. A band-pass filter is placed between the photocell and the reflector to eliminate, as much as possible, saturation of the cell and changes in input voltage due to ambient light changes. The filter (figure 3-9) allows energy of long wavelengths (1 to 2 microns) to pass but excludes the shorter wavelengths, including most visible light.

5-58. AMPLIFIER. The detector amplifier is a three-tube, class A audio amplifier. It is tuned to the lower

band of audio frequencies by proper selection of capacitors and resistors throughout the coupling and decoupling networks. The band width of the amplifier is approximately 92 cps, from about 78 cps to 170. (See figure 6-3.) The amplifier utilizes long-life, low-noise tubes and selected low-noise components.

5-59. FIRST AMPLIFIER V201. (See figure 5-2.) Photocell V207, described in paragraph 5-26, is located in the input circuit as the bottom leg of a series bleeder, which includes R201 and R202, connected from B+ to ground. The detected 120-cycle signal (originated by the projector, and reflected from a cloud base) is fed through a coupling network, C202 and R203, to the grid of V201. V201 is a type 6072 twin triode, chosen because of its inherent low noise characteristics. V201 utilizes contact bias developed by space charge in the tube and grid leakage through R203. Capacitors C201, C203, and C204 are decoupling capacitors which produce high frequency cut-off. From the plate of V201, the signal is coupled to the grid of the second half of the tube, through coupling network C207 and R205. Capacitors C205, C206, C208, C210, and C211 serve as high frequency decoupling

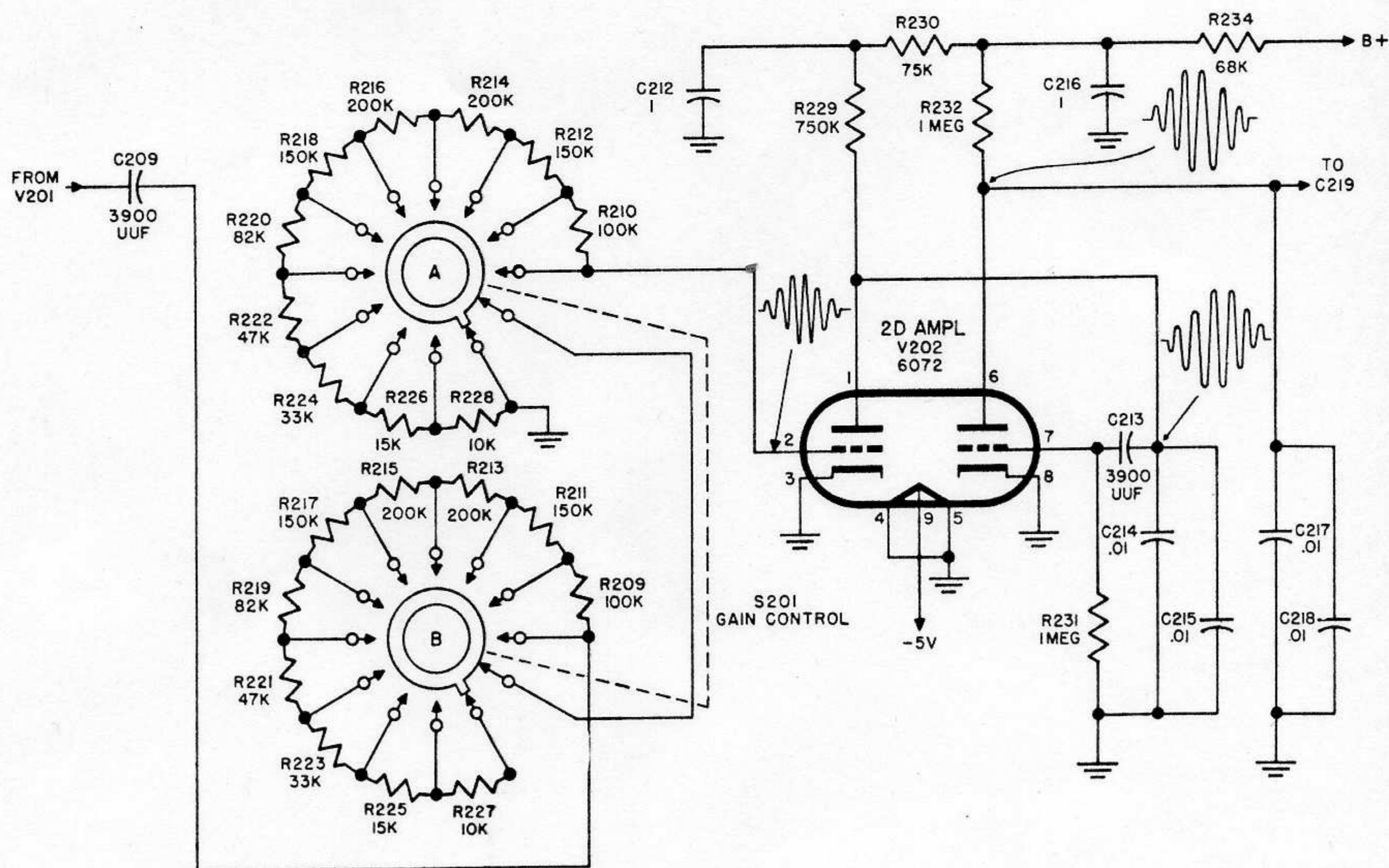


Figure 5-3. Detector Second Amplifier Stage, Simplified Schematic Diagram

components. Filament voltage for V201 is supplied from a filtered d-c source, to minimize ripple in the output. Filament and plate voltages are reduced to take full advantage of the low noise characteristics. From the plate (pin 6) of V201, the signal is coupled, via C209, to "GAIN" control S201.

5-60. AMPLIFIER "GAIN" CONTROL. (See figure 5-3.) Amplifier "GAIN" control S201 is an eleven-position control designed to attenuate the amplifier output in 6-db steps. It is installed between the first and second stages of the amplifier. The maximum attenuation is obtained when the control is fully

5-62. THIRD AMPLIFIER V203. (See figure 5-4.) The final stage of the detector amplifier is a type 5814A medium-mu twin triode employed as a power amplifier. The signal from the plate of V202 is coupled through C219 and R233 to the grid of the first section. This stage is biased at 5 volts, using cathode self-bias (R236 and C221A). From the plate of the first section, the signal is coupled through C222 and R237 to pin 7 of the second section. The amplification factor of V203 is approximately 20. The plate of the second section drives the primary of T202. C228 serves as a high frequency bypass capacitor. Output transformer T202 is chosen to match the high impedance of V203, and the

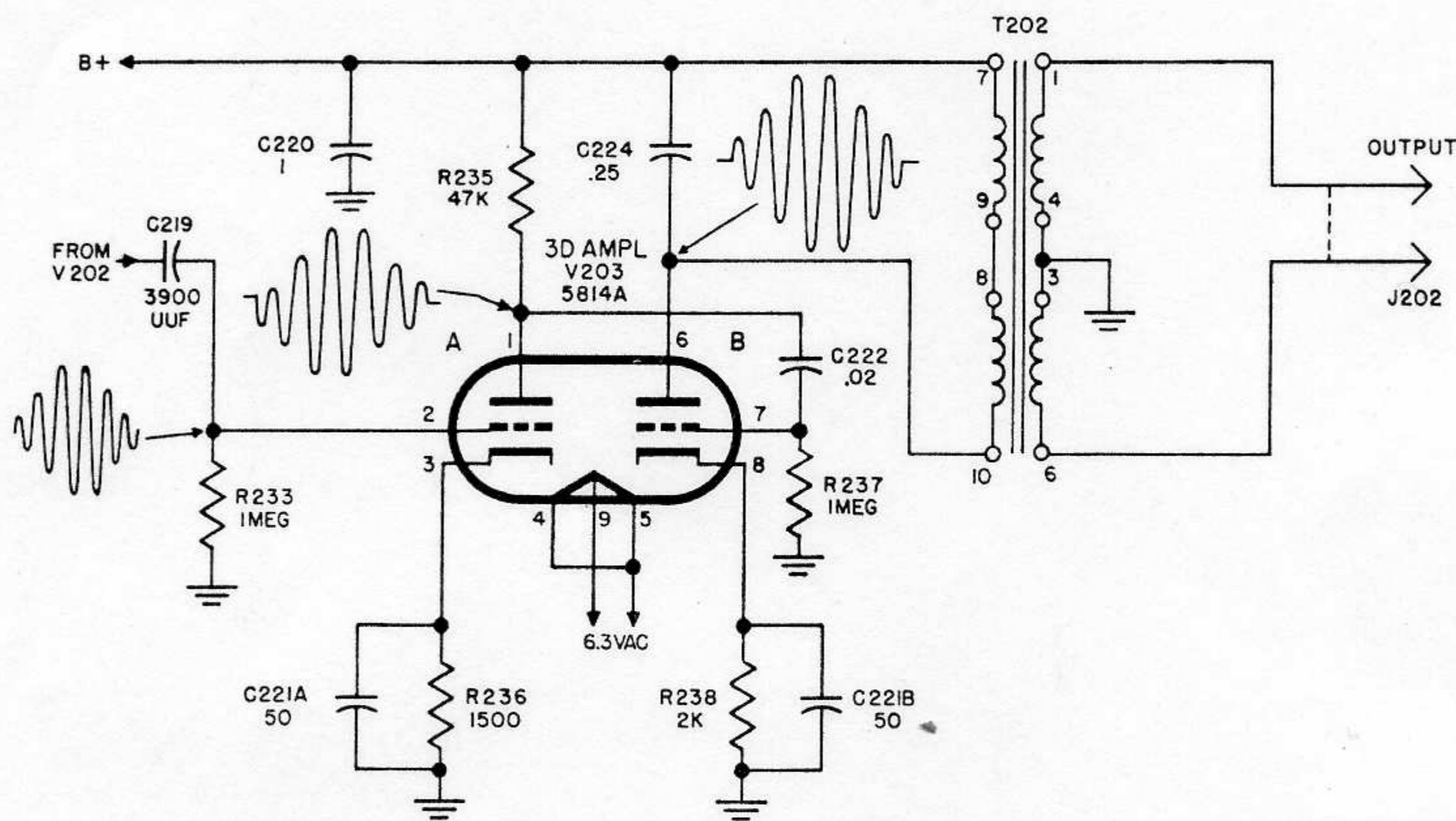


Figure 5-4. Detector Third Amplifier Stage, Simplified Schematic Diagram

counterclockwise. Upon installation of the detector amplifier, the "GAIN" control is set to a level that will prevent saturation of the stages of the amplifier.

5-61. SECOND AMPLIFIER V202. (See figure 5-3.) With the gain control in a position above minimum gain, input signals from V201 are coupled to the grid of V202, which performs the second stage of amplification. V202 is a type 6072 twin triode, with coupling and decoupling circuits identical to those of V201. The signal is passed from the plate of the first section to the grid of the second section; from the plate of the second section the signal is coupled through C219 to the grid of V203 in the output circuit.

secondary is used to match an output impedance of 500 ohms. The secondary of T202 is center tapped to produce a balanced output and cancel any 60-cps a-c pick-up in the line. The output signal at T202 is fed to the recorder.

5-63. AMPLIFIER POWER SUPPLY. (See figure 5-3.) A-c voltage is supplied through P202 to the primary of power transformer T201. V204 is a type 6X4W, connected in a full-wave rectifier circuit with a two section pi filter composed of L201, L202, C226, C228, and C230. Resistor R240 limits the rectifier current. V205 and V206, type 0A2WA voltage regulator tubes, are connected in series to supply the amplifier with a regulated 300 volts dc. Amplifier stages V201

Section V
Paragraph 5-67

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5-67. DEICER ASSEMBLY. The deicer prevents the accumulation of snow and ice on top of the detector cover glass during severe winter weather. The deicer consists of a 1000-watt space heater, HR251, and blower B251 which circulates the warm air throughout the area under the cover glass. Power for the heater

and blower is obtained from the junction box, and controlled by thermal circuit breakers S251 and S252. Thermostat S253 may be adjusted to compensate for weather conditions, and permits power to be applied to the deicer when local temperature drops below the operating point.

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WARNING

Voltages dangerous to life exist in this equipment. Use care when servicing power circuits.

6-19. TROUBLESHOOTING CHART.

6-20. Table 6-4 lists the projector and detector test points and control positions, the test equipment control positions, and the indications of normal and abnormal behavior of the equipment components. The chart shows the steps necessary to localize equipment malfunction to a specific component or components, with the aid of test points. Checks are made at, or between, three types of test points: a major test point is designated with a star-enclosed Arabic numeral; an intermediate test point is designated with an encircled capital letter; and a minor test point with an encircled letter and arabic numeral. These points are identified in figures 7-3 and 7-4. Make the checks in the sequence shown; each step presumes satisfactory completion of the previous step.

6-21. PROJECTOR POWER AND CONTROL CIRCUIT TROUBLESHOOTING. (See figure 7-2.)

6-22. If there is a power failure at the projector, make the preliminary inspection outlined in table 6-2. If the trouble cannot be located by this method, check the voltages and resistances at terminal boards TB301, TB302, TB307, and TB308. Proceed with steps 1 through 8 of table 6-4.

6-23. PROJECTOR OPTICAL SYSTEM TROUBLESHOOTING.

6-24. If the power and control circuits check satisfactory and the optical system does not operate, check the voltages and resistances at terminal boards TB309, TB304, TB305, and TB306. After isolating the trouble

to the faulty section, proceed with steps 9 through 17 of table 6-4.

6-25. DETECTOR TROUBLESHOOTING.

6-26. The following paragraphs describe the procedures for localizing detector malfunctions to specific components. Steps 18 and 19 of table 6-4 deal with the primary power to the detector.

6-27. DEICER CIRCUIT. (See figure 6-10.) After completing the preliminary inspection outlined in table 6-2, check the voltage and resistance readings at TB251. Proceed with the troubleshooting procedures in table 6-4, steps 20 through 22.

6-28. VOLTAGE REGULATOR. (See figure 7-4.) Check the connections to and from the voltage regulator. Check the output voltage in accordance with step 23 of table 6-4.

6-29. PHOTOCELL. Step 24 of table 6-4 describes the method of checking the dark resistance of the photocell.

6-30. TROUBLESHOOTING THE AMPLIFIER-POWER SUPPLY.

6-31. If the preliminary inspection procedure of table 6-2 does not reveal the cause of abnormal operation, the amplifier-power supply should be removed from the detector cabinet and tested in accordance with steps 25 through 41 of table 6-4. The recommended bench test set-up is shown in figure 6-1, and described in paragraph 6-33. The voltage divider network required for the tests must be fabricated locally. Fabrication instructions are given in paragraph 6-34; a schematic diagram of the voltage divider network is shown in figure 6-2.

6-32. Because the signals are random, and the amplifier gain is variable and high (100,000 is minimum gain), both the attenuation factor of the voltage divider network and the maximum gain of the amplifier must be known. The procedure for calculating

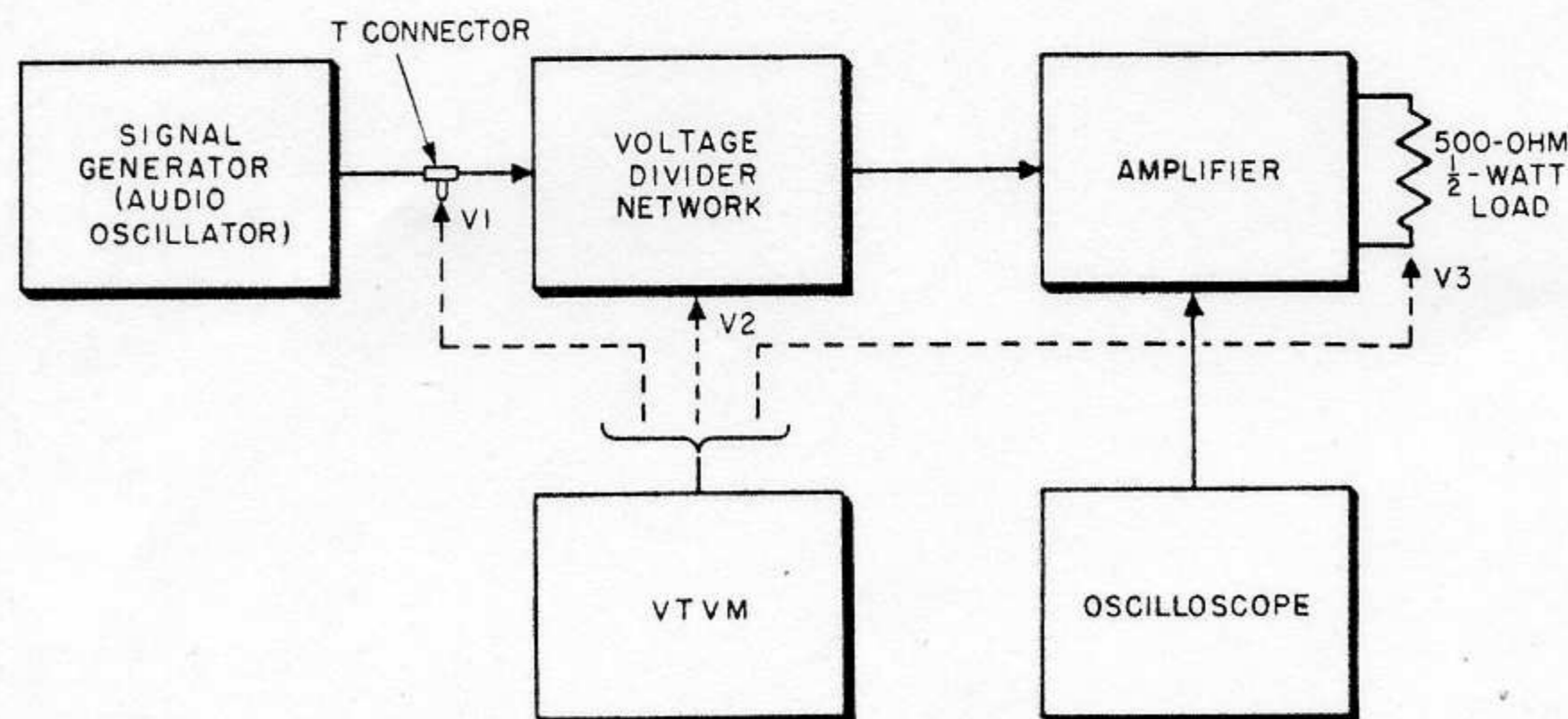


Figure 6-1. Detector Amplifier-Power Supply, Test Equipment Interconnection Diagram

these factors is given in paragraph 6-35. When the maximum gain is determined, the "GAIN" control may be set to give a desired output level. The oscilloscope may then be used to check the stage gains of the amplifier (see table 6-4, steps 29 through 40). Simplified schematic diagrams of the amplifier stages are given in figures 5-2 through 5-4.

6-33. AMPLIFIER BENCH TEST SET-UP.

(See figure 6-1.)

a. Connect the output of the signal generator to the center arm of the T-connector, and the voltage divider network input cable to one branch.

b. Connect the output of the voltage divider network to the input jack of the amplifier.

c. Connect the 500-ohm resistive load across the output terminals of the amplifier.

d. Connect the amplifier-power supply to a 118-volt (maximum) a-c source. Lower line voltage will increase the gain of the amplifier. For the most accurate measurements, the line voltage should be the same amplitude as that at which the amplifier normally operates.

e. Allow all equipment to warm up for at least 15 minutes before making measurements.

Note

The amplifier is extremely sensitive to 60-cycle pickup. Shield all unused jacks. Do not remove the bottom cover from the chassis when making the gain measurement. When making stage gain measurements, shield the bottom as carefully as possible after connecting the oscilloscope probe.

6-34. CONSTRUCTION OF THE VOLTAGE DIVIDER NETWORK. (See figure 6-2.)

a. The components for the voltage divider network are identified in figure 6-2. They should be enclosed in a small shield can. Run solder around all open edges of the can, to reduce stray pickup as much as possible.

b. Interconnecting cables should be kept as short as possible. Use coaxial cable. Make sure there is continuity in the cable shield between the generator and the amplifier.

6-35. CALCULATING ATTENUATION AND GAIN.

a. Connect the equipment as shown in figure 6-1. Set the signal generator output to 110 cycles.

b. Connect the vtvm to the second output jack of the voltage divider. Set the signal generator output level to obtain a reading of no more than 0.1 volt on the vtvm (assume a reading of 0.05 volt as an example). Record this reading as V2.

c. Remove the vtvm and shield the output jack of the voltage divider. Measure the voltage into the divider network (at the T-connector). Record this reading as V1 (assume 16 volts).

d. The attenuation factor is V1 divided by V2. (For the above assumed values, the attenuation factor is 16 divided by 0.05, or 320.)

e. Connect the vtvm between one end of the resistive load and ground. Adjust the signal generator output level to obtain a reading of 2 volts on the vtvm (amplifier "GAIN" control set to maximum). This is V3.

f. Measure the new V1 at the output of the signal generator (assume 0.01 volt).

g. The maximum gain of the amplifier is V3 times 2 times the attenuation factor, divided by V1. (For the above assumed values, the maximum gain is 2 times 2 times 320, divided by 0.01, or 128,000.)

6-36. VOLTAGE AND RESISTANCE MEASUREMENTS. (See figure 7-7.)

6-37. Table 6-5 gives the average voltage and resistance measurements at the tube sockets of the detector amplifier-power supply. Unless otherwise noted, all voltages are dc, and are measured with respect to ground.

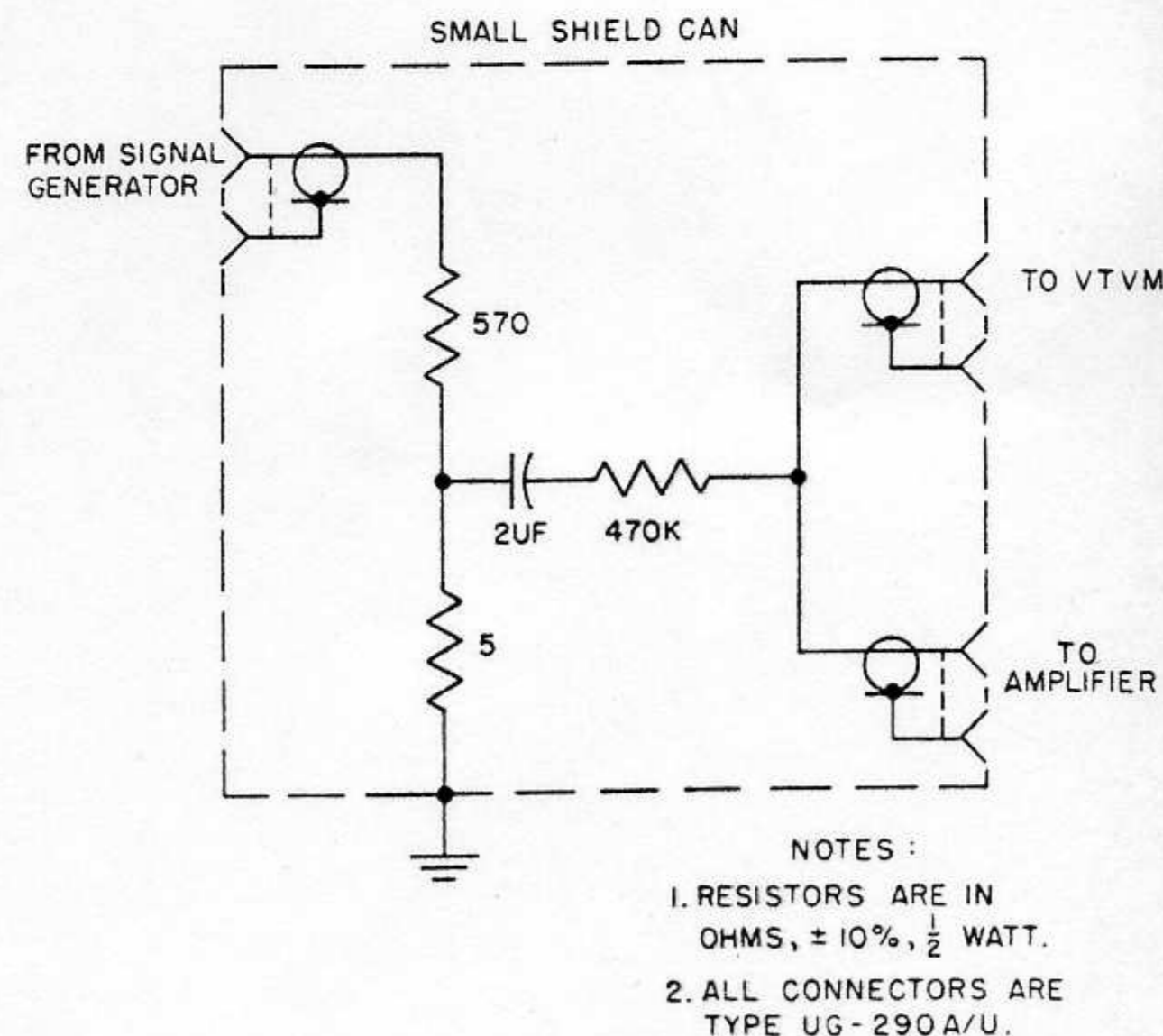


Figure 6-2. Voltage Divider Network Construction, Schematic Diagram

TABLE 6-5. DETECTOR AMPLIFIER TUBE SOCKET VOLTAGES AND RESISTANCES

Tube	Pin Number	Voltage	Resistance to Ground (ohms)	Tube	Pin Number	Voltage	Resistance to Ground (ohms)
V201 (6072)	1	28 V	Infinite	V204 (6X4W)	1	440 V ac	300
	2	-0.45 V	1 meg		2	NC	NC
	3	0	0		3 to 4	6.3 V ac	10
	4	0	0		4		10
	5	0	0		5	NC	NC
	6	29 V	Infinite		6	440 V	300
	7	-0.45 V	1 meg		7	465 V	Infinite
	8	0	0	V205 (0A2WA)	1	300 V	Infinite
	9	-5 V	0		2	150 V	Infinite
V202 (6072)	1	30	Infinite		3	NC	NC
	2	-0.45 V	1 meg		4	150 V	Infinite
	3	0	0		5	300 V	Infinite
	4	0	0		6	NC	NC
	5	0	0		7	150 V	Infinite
	6	31 V	Infinite	V206 (0A2WA)	1	150 V	Infinite
	7	-0.45 V	1 meg		2	0	0
	8	0	0		3	NC	NC
	9	-5 V	0		4	0	0
V203 (5814A)	1	130 V	Infinite		5	150 V	Infinite
	2	0	1 meg		6	NC	NC
	3	600 V	1500		7	0	0
	4 to 9	6.3 V ac	10				
	5 to 9	6.3 V ac	10				
	6	300 V	Infinite				
	7	0	1 meg				
	8	13 V	200				
	9		10				

6-38. ALIGNMENT AND ADJUSTMENTS.

6-39. After maintenance has been performed on the equipment, alignment or adjustment checks should be made. The alignment and adjustment procedures for the projector and detector components are located in section III.

6-40. DETECTOR AMPLIFIER TUNING.

(See figure 6-3.)

6-41. The amplifier is a fixed-tuned device, with a frequency response centered about 110 cycles per second. Be sure to use the specified components when replacing parts in the amplifier circuits, to prevent a change in the response. The frequency versus gain characteristics of the amplifier are shown in figure 6-3.

6-42. REMOVAL AND REPLACEMENT OF PROJECTOR ASSEMBLIES AND SUBASSEMBLIES.

6-43. The following paragraphs describe the procedures necessary to remove and replace components of

the projector. They are arranged in the required order of disassembly for the rotary mount.

WARNING

Voltage dangerous to life exists in this equipment. Make sure all power has been removed before attempting removal or replacement of components.

6-44. DOME COVER ASSEMBLY. (See figure 6-4.)

6-45. Remove the projector dome cover assembly in the following manner:

- Remove the two hex nuts and bolts locking the dome cover to the lower cabinet.
- Open the dome cover, and remove the slip loops of the cable assemblies from the washers.
- Close the dome cover, and remove the four cotter pins holding the pin hinges.
- Remove the pin hinges.

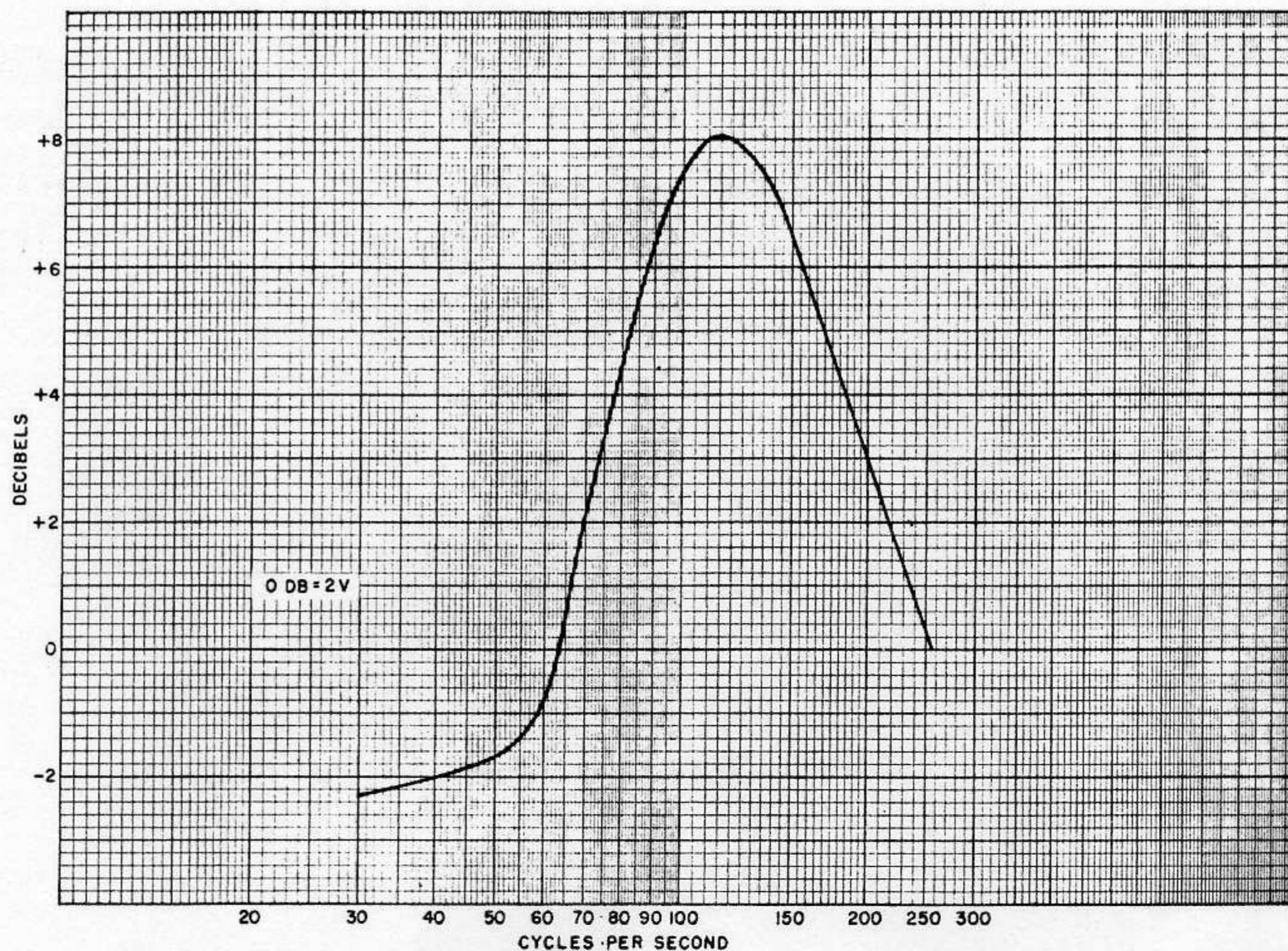


Figure 6-3. Amplifier Frequency Response

CAUTION

At least four men are required to lift the dome cover high enough to clear the internal components. After the cover is detached (unless it is to be serviced), remove it to a safe distance, to avoid accidental damage to the dome cover plate glass.

e. Remove the glass panels from the dome cover by removing the crossbars. Break the plastic seal by feeding a bare copper wire underneath the crossbar at one end, and pulling it across to the other. Remove the inner crossbars in the same manner. Take away the holding clamps. With one man working inside, and one on the outside, proceed to break the seal of each glass panel. Hold each glass panel firmly while the seal is being broken.

CAUTION

Do not attempt to break the plastic seal by using a screwdriver or chisel. Removal of the seal with a blunt instrument may result in damage to the glass panel.

f. As each section of the glass panel is replaced, reseal with plastic weatherproofing compound.

6-46. SHUTTER AND LAMP ASSEMBLIES.
(See figures 3-15, 3-16, and 6-5.)

CAUTION

Cover the reflector with a stiff protective material when removing assemblies, to prevent damage from falling hardware.

6-47. The procedures for removing the lamp and shutter assemblies are described in paragraphs 3-79 through 3-82. Before removing either assembly, remove the lamp from the socket by loosening the two thumbscrews securing the base pins. To disassemble the shutter assembly, loosen the two set screws holding the flexible coupling to the motor shaft, and remove the four motor mounting screws. To remove the shutter, unscrew the 3/8-16 nut which holds it to the shaft.

6-48. REFLECTORS. (See figures 3-13 and 3-14.)

6-49. The reflectors can be removed by releasing the 12 retaining clamps around the circumference of each. The procedures for replacing reflectors are described in paragraphs 3-83 through 3-86.

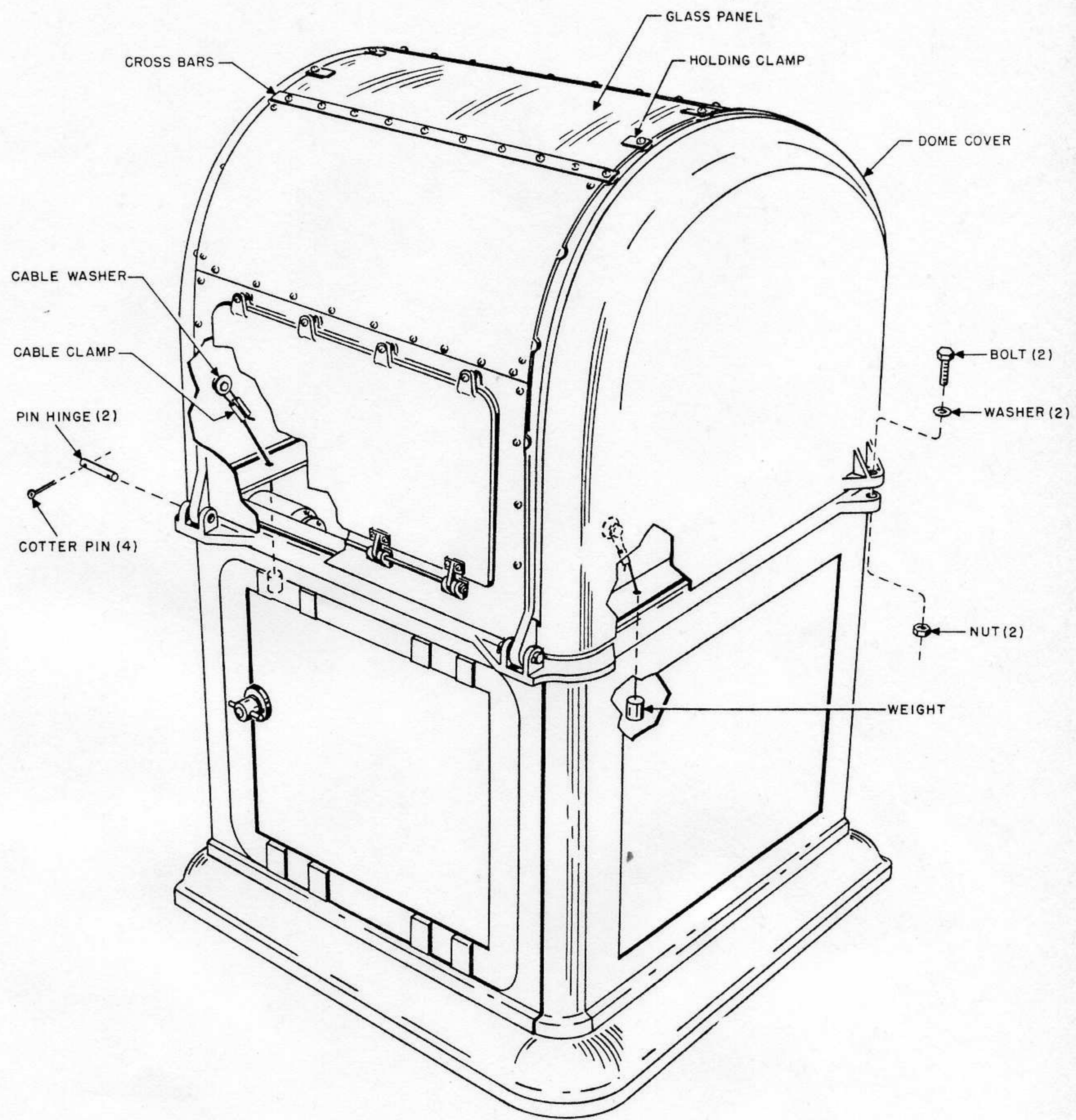


Figure 6-4. Projector Cabinet, Assembly View

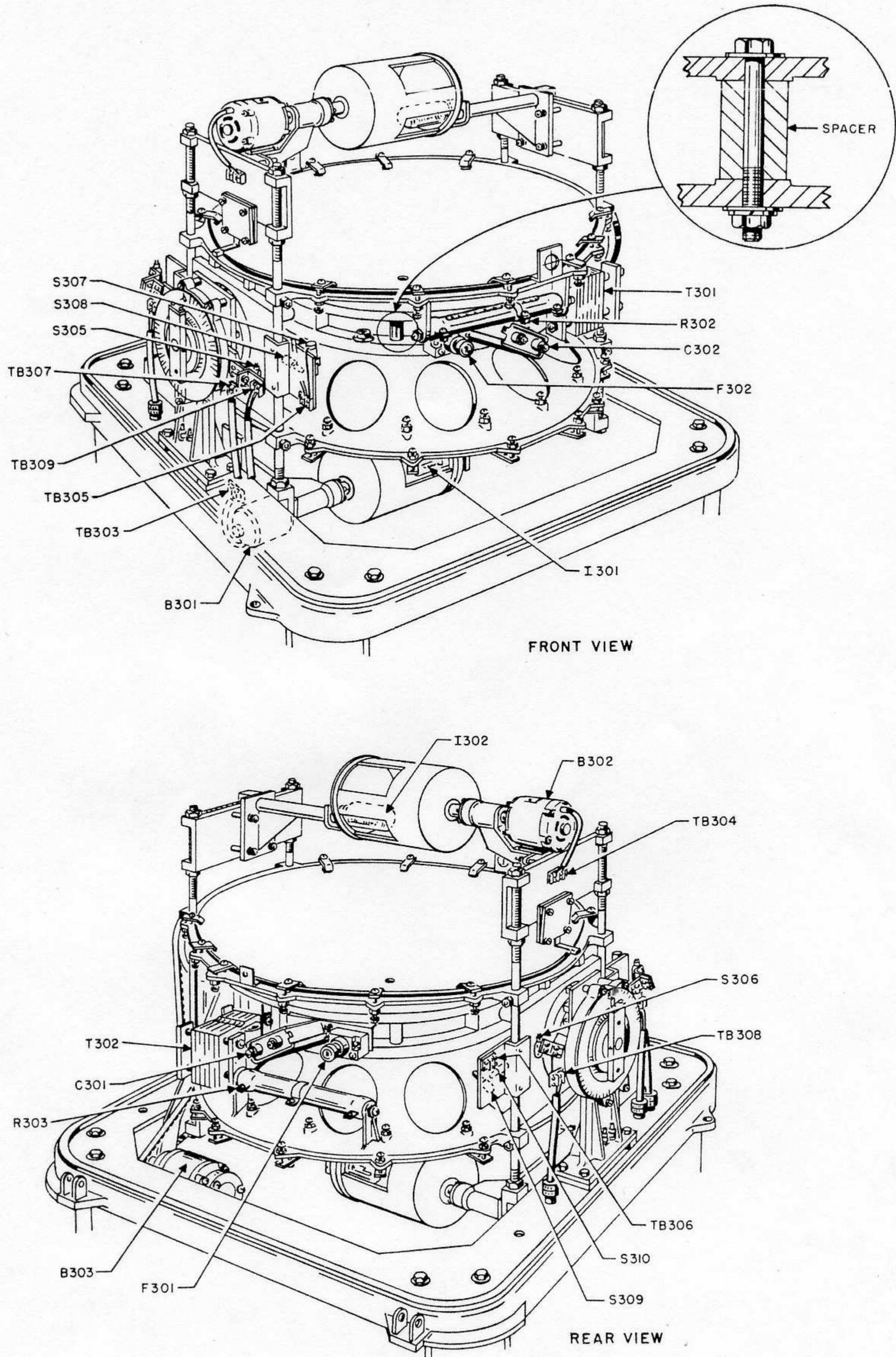
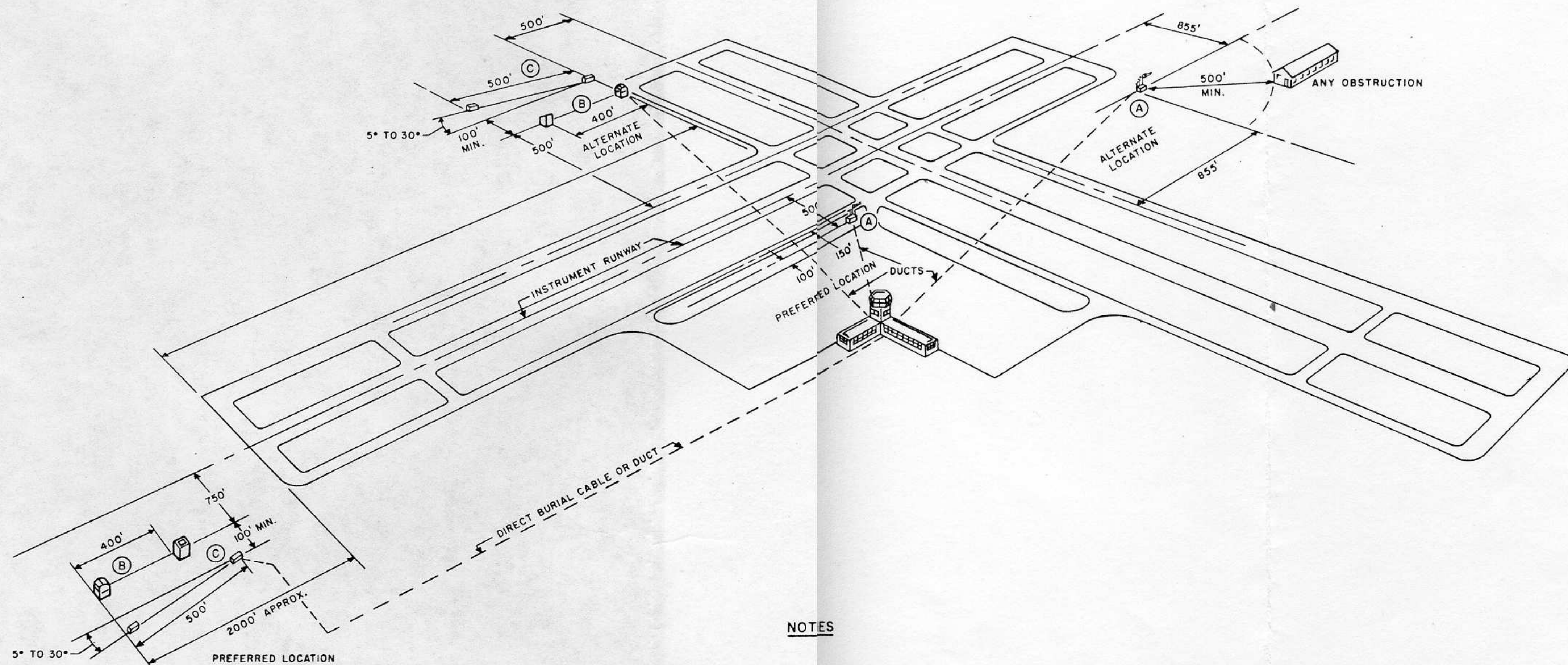


Figure 6-8. Projector Rotary Mount, Parts Location Diagram



NOTES

(A) WIND MEASURING SET AN/UMQ-5()-TRANSMITTER (RUNWAY TEMPERATURE SENSOR AT THE SAME LOCATION) (REFER TO HANDBOOK NAVAER 50-30FR-525).

1. PREFERRED LOCATION:

- a. NOT LESS THAN 500 FEET FROM RUNWAY CENTERLINE.
- b. NOT LESS THAN 150 FEET FROM TAXIWAY CENTERLINE.
- c. NOT LESS THAN 100 FEET FROM EDGE OF PARKING APRON.
- d. NOT LESS THAN 400 FEET FROM AREAS OF PROP OR JET BLAST.

2. ALTERNATE LOCATION:

- a. 855 FEET FROM RUNWAY CENTERLINE(S).
- b. 500 FEET FROM OBSTRUCTION(S) TO FREE AIR FLOW.
- c. PLUS OTHER RESTRICTIONS AS ABOVE.

3. PROVIDE 105-125 VOLTS, 60 CYCLE, SINGLE PHASE AC POWER TO TRANSMITTER SITE.

4. AT THE PREFERRED LOCATION, WIND MEASURING SET SHALL BE MOUNTED BY MEANS OF A FRANGIBLE COUPLING.

(B) CLOUD HEIGHT SET AN/GMQ-13 (CEILOMETER)-PROJECTOR AND DETECTOR (REFER TO HANDBOOK NAVAER 50-30GMQ13-1).

1. PREFERRED LOCATION - PROJECTOR AND DETECTOR SHALL BE PLACED IN THE APPROACH ZONE, 400 FEET APART, PARALLEL TO THE RUNWAY CENTERLINE EXTENDED AND A MINIMUM OF 750 FEET FROM IT, SO THAT THE FURTHEST PIECE OF EQUIPMENT WILL BE APPROXIMATELY 2000 FEET FROM THE APPROACH END OF THE INSTRUMENT RUNWAY.

2. ALTERNATE LOCATION - PROJECTOR AND DETECTOR SHALL BE PLACED 400 FEET APART, PARALLEL TO THE INSTRUMENT RUNWAY, SO THAT NEITHER WILL BE CLOSER THAN 500 FEET FROM ANY RUNWAY CENTERLINE, 150 FEET FROM ANY TAXIWAY CENTERLINE, OR 100 FEET FROM THE EDGE OF AN AIRCRAFT PARKING APRON.

3. PROVIDE 117 VOLT, 60 CYCLE AC POWER FROM ONE SOURCE FOR PROJECTOR AND DETECTOR.

4. POWER AT NORTHERN LOCATIONS WILL NORMALLY REQUIRE 1000 WATTS FOR DEICING FOR BOTH PROJECTOR AND DETECTOR (FOR SEVERE ICING, USE 2000 WATTS). AT SOUTHERN LOCATIONS, PROVIDE 1000 WATTS FOR PROJECTOR AND 200 WATTS FOR DETECTOR (NO HEAT REQUIRED FOR DEICING).

(C) TRANSMISSOMETER AN/GMQ-10-PROJECTOR AND RECEIVER (REFER TO HANDBOOK NAVAER 50-30GMQ10-501).

1. PREFERRED LOCATION - PROJECTOR AND RECEIVER SHALL BE PLACED IN THE APPROACH ZONE, 500 FEET APART, SO THAT THE NEAREST PIECE OF EQUIPMENT TO THE RUNWAY CENTERLINE EXTENDED SHALL BE 850 FEET (100 FEET OUTBOARD OF THE CEILOMETER), WITH THE FURTHEST PIECE APPROXIMATELY 2000 FEET FROM THE APPROACH END OF THE INSTRUMENT RUNWAY.

2. ALTERNATE LOCATION - PROJECTOR AND RECEIVER SHALL BE PLACED 500 FEET APART, A MINIMUM OF 100 FEET FROM THE CEILOMETER, AND OUTBOARD FROM THE INSTRUMENT RUNWAY SO THAT NEITHER INSTRUMENT WILL BE CLOSER THAN 500 FEET FROM ANY RUNWAY CENTERLINE, 150 FEET FROM ANY TAXIWAY CENTERLINE, OR 100 FEET FROM THE EDGE OF AN AIRCRAFT PARKING APRON.

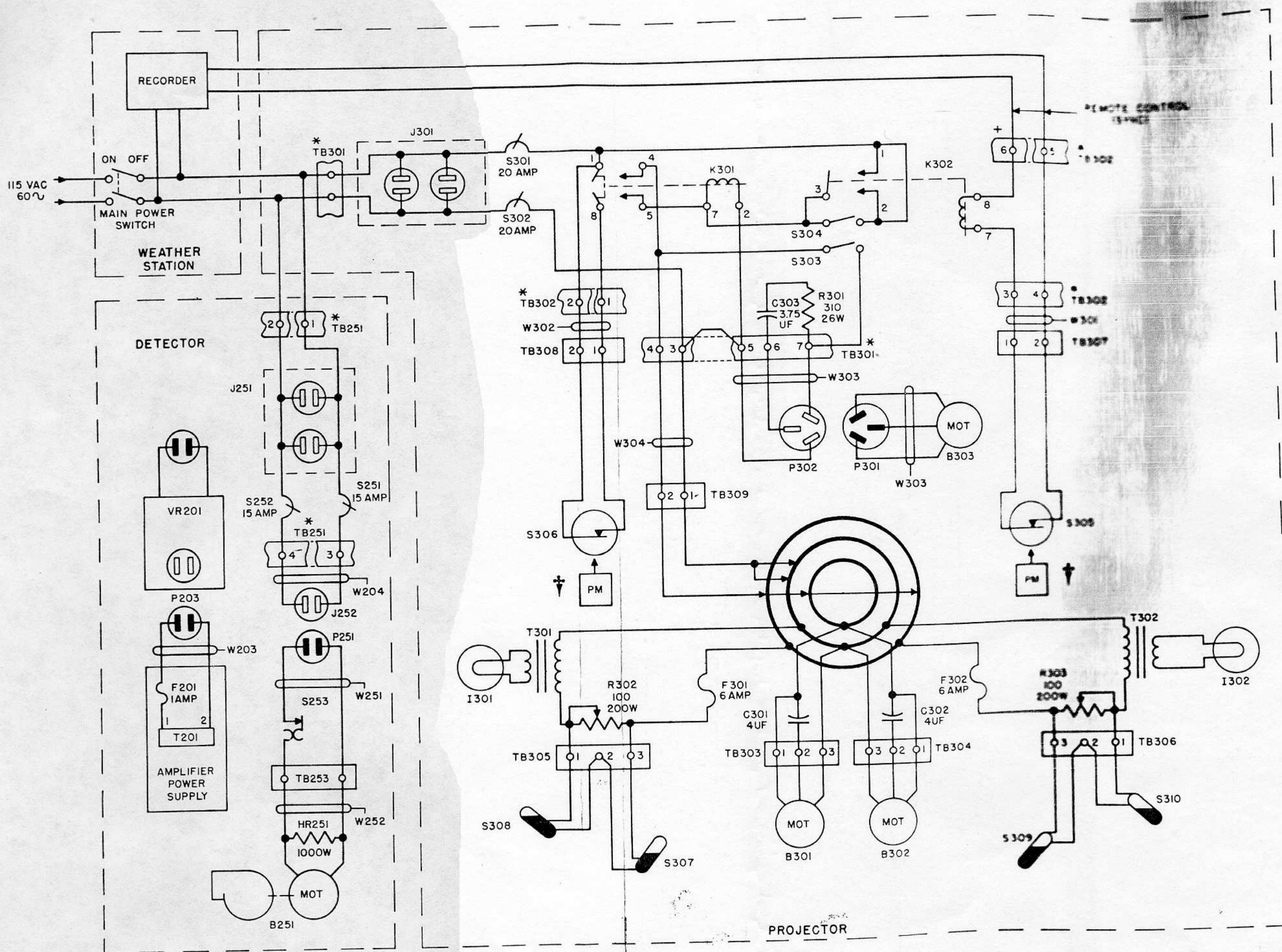
3. ORIENTATION SHALL BE - RECEIVER TO PROJECTOR SO THAT LINE OF SIGHT IS MORE THAN 25 DEGREES FROM EAST OR WEST AND SHALL BE TOWARD A NEARBY TERRESTRIAL BACKGROUND TO THE SOUTH (REVERSE THIS ORIENTATION TO WITHIN 45 DEGREES OF NORTH IF RECEIVER SEES A SKY OR DISTANT TERRESTRIAL BACKGROUND).

4. LINE OF SIGHT SHALL BE 6 TO 10 FEET ABOVE THE GROUND, AND 5 TO 30 DEGREES FROM THE CENTERLINE (OR CENTERLINE EXTENDED) OF THE RUNWAY.

5. PROVIDE 115 ± 10 VOLTS, 60 ± 3 CYCLES, SINGLE PHASE AC FOR PROJECTOR AND RECEIVER.

6. PROJECTOR AND RECEIVER SHALL BE MOUNTED BY MEANS OF FRANGIBLE COUPLINGS.

Figure 7-1. Standard Layout Installation



- NOTES:
1. (*) PARTS SO MARKED ARE SECTIONS OF LARGER COMPONENTS.
 2. † PERMANENT MAGNETS LOCATED ON ROTARY MOUNT.

Figure 7-2. Power and Control Circuit, Schematic Diagram

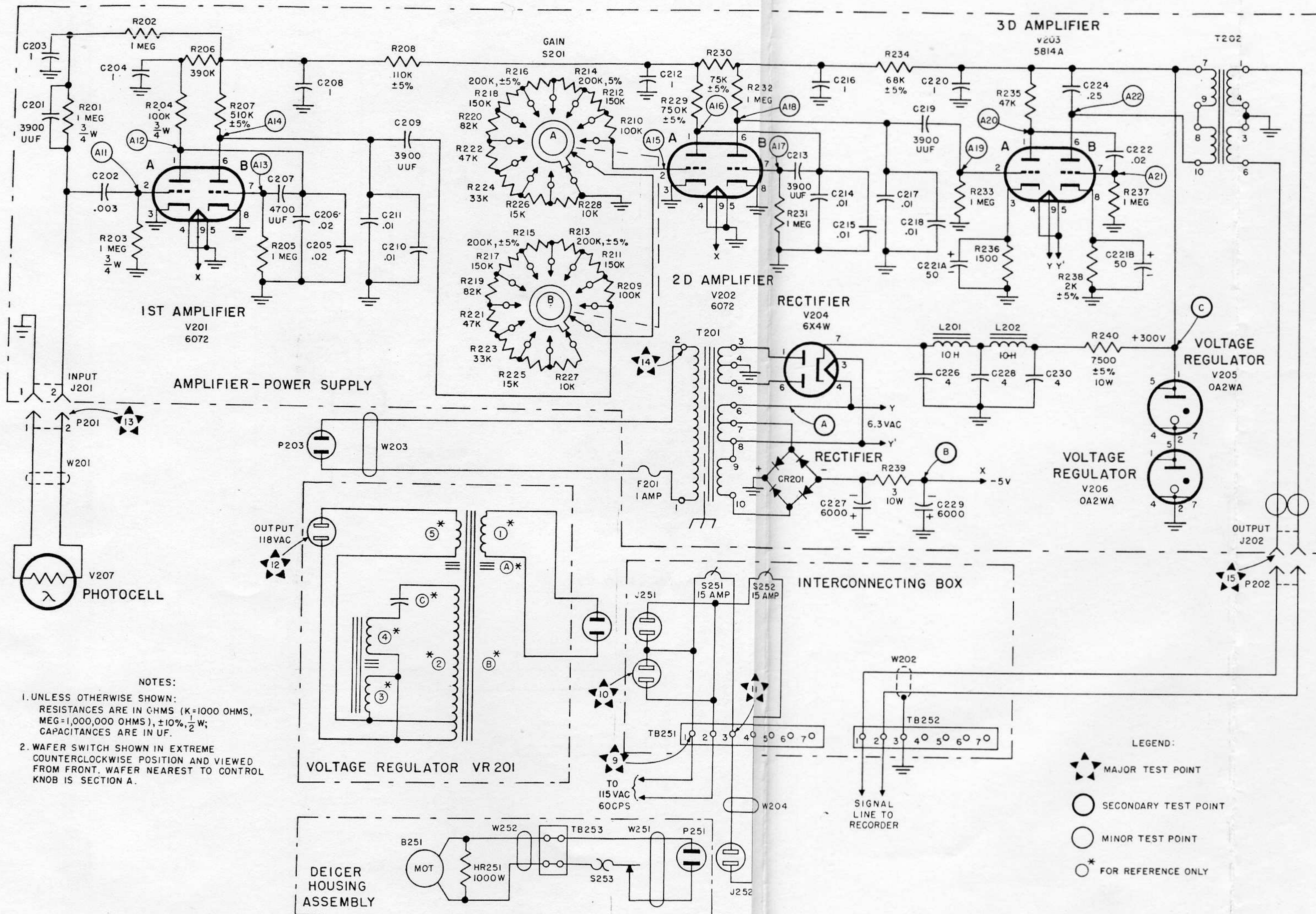


Figure 7-4. Detector, Schematic Diagram

SECTION VIII

INTRODUCTION TO ILLUSTRATED PARTS BREAKDOWN

8-1. GENERAL.

8-2. The Illustrated Parts Breakdown describes and lists the assemblies, subassemblies, and component parts of Cloud Height Projector ML-506C/GMQ-13 and Cloud Height Detector ML-507C/GMQ-13, components of Cloud Height Set AN/GMQ-13C. The Illustrated Parts Breakdown supplements the information furnished for this equipment in the operating and service instruction sections of this handbook. The following paragraphs describe the sections of the Illustrated Parts Breakdown.

8-3. GROUP ASSEMBLY PARTS LIST.

8-4. The Group Assembly Parts List, section IX, contains the exploded views and parts lists for each of the assemblies in the equipment. Index numbers are assigned to the parts in the exploded views, and the listings associated with each illustration are arranged in the numerical sequence of the index numbers. The parts lists are tabular in form. The "FIG. & INDEX NO." column locates each part in the illustration in which it appears. The "PART NO." column identifies each part by manufacturers' part number. When no such number is applicable, "No Number" appears in this column. The designation "COMM" in this column applies to standard hardware procurable in the open market. The "DESCRIPTION" column lists the basic names of the parts, and any additional information required to complete the identification of the part. Manufacturers are indicated by code designations, explained and listed in paragraph 8-11. The description column also establishes, by means of a system of indentation, the relationship of parts to a next higher assembly, and a logical order of disassembly. The "UNITS PER ASSY" column shows the quantity of each part required for one assembly or subassembly.

8-5. ILLUSTRATIONS. The illustrations for the Group Assembly Parts List are a series of exploded views which show the physical appearance and the location of each part or assembly. The illustrations are numbered consecutively. When it is not feasible to explode an entire assembly in one illustration, a portion of it is carried over to another figure for complete illustration and listing. If the unexploded portions are complete subassemblies, the exploded view of the subassembly and the parts list for it may be located conveniently by noting the cross-referencing of the figure numbers in the "DESCRIPTION" column. Parts or assemblies drawn with dashed lines are fully illustrated and listed elsewhere. Each part illustrated in

solid outline on an illustration, and given an index number, will be found on the parts list for that figure.

8-6. FIGURE AND INDEX NUMBERS. The first two parts of the number listed for a part in the "FIGURE & INDEX NO." column is the figure number of the illustration in which the part is shown. The portion of the number following the second hyphen is the index number; this number identifies the part in the illustration. For example, the combination "9-3-18" indicates that the part listed is shown in figure 9-3, specifically pointed out by index 18.

8-7. PART NUMBERS. The numbers listed in this column are either Radio Receptor, Government Standard, or manufacturers' part numbers.

8-8. "COMMERCIAL" ITEMS AND "NO NUMBER" PARTS. Hardware items procurable from normal commercial sources, but having no assigned part numbers, are listed as "COMM" in the "PART NO." column. The term "NO NUMBER" is used to list parts when they have no assigned numbers, or when the assigned numbers do not fully describe the part. In both cases, the information necessary for procurement purposes is given in the "DESCRIPTION" column.

8-9. NOMENCLATURE. The identification arrangement of the "DESCRIPTION" column under numbers "1" through "7" is used to show the relationship of parts and subassemblies to assemblies. For instance, a part of subassembly listed in indentation "3" will be a component of the assembly listed above it in indentation "2."

8-10. MANUFACTURERS' CODES. When a number listed is not a Radio Receptor, AN (Army-Navy), JAN (Joint Army-Navy), or AF (Air Force) part number, a code denoting the manufacturer from whom the part can be procured is shown in the "DESCRIPTION" column, following the description of the item. A list of manufacturers' codes appearing in this section, and the manufacturer to which each applies, is as follows:

MANUFACTURERS CODE LIST

Code Number	Name and Address
00656	Aerovox Corp., New Bedford, Mass.
00779	Aircraft Marine Products, Inc., Harrisburg, Pa.

MANUFACTURERS CODE LIST (Cont)

Code Number	Name and Address
02660	Amphenol Electronics Corp., Chicago, Ill.
04850	Permag Corp., Brooklyn, N. Y.
05828	General Instruments Corp., Defense Products Division, New York, N. Y.
09922	Burndy Engineering Co., Inc., New York, N. Y.
19139	Eastman Kodak Co., Rochester, N. Y.
24446	General Electric Co., Schenectady, N. Y.
24457	General Electric Co., Wire and Cable Department, Bridgeport, Conn.
25244	Globe—Union Inc., Centralab Division, Milwaukee, Wis.
37942	P. R. Mallory and Co., Inc., Indianapolis, Ind.
39709	Mercoide Corp., The Chicago, Ill.
42498	National Co., Inc., Malden, Mass.
43334	New Departure Division of General Motors Corp., Bristol, Conn.
44655	Ohmite Manufacturing Co., Chicago, Ill.
46859	Philco Corp., Philadelphia, Pa.
49367	Pyle National Co., The Chicago, Ill.
49956	Raytheon Manufacturing Co., Waltham, Mass.
55814	Sola Electric Co., Cicero, Ill.
57448	Stephens Adamson Manufacturing Co., Aurora, Ill.
57771	Stimpson, Edwin B., Co., Inc., Brooklyn, N. Y.
59730	Thomas and Betts Co., Elizabeth, N. J.

MANUFACTURERS CODE LIST (Cont)

Code Number	Name and Address
59899	Thordarson Electric Manufacturing Co., Inc., Chicago, Ill.
61463	United States Rubber Co., New York, N. Y.
63743	Ward Leonard Electric Co., Mount Vernon, N. Y.
65083	Westinghouse Lamp Division of Westinghouse Electric Corp., Bloomfield, N. J.
65586	Weigand, Edwin L., Co., Pittsburgh, Pa.
70309	Allied Control Co., Inc. New York, N. Y.
70318	Allmetal Screw Products Co., Inc., Garden City, N. Y.
70494	American Hardware Corp., Corbin Cabinet Lock Division, New Britain, Conn.
70892	Bead Chain Manufacturing Co., Bridgeport, Conn.
70903	Belden Manufacturing Co., Chicago, Ill.
71279	Cambridge Thermionic Corp., Cambridge, Mass.
71400	Bussman Manufacturing Co., St. Louis, Mo.
71482	C. P. Clare and Co., Chicago, Ill.
71700	Cornish Wire Co., New York, N. Y.
72619	Dial Light Co. of America, New York, N. Y.
72699	General Instrument Co., Inc., Newark, N. J.
72765	Drake Manufacturing Co., Chicago, Ill.
72962	Elastic Stop Nut Corp. of America, Union, N. J.
73674	Durakool Inc., Elkhart, Ind.
73693	Electric Indicator Co., Glenbrook, Conn.
73842	Goodyear Tire and Rubber Corp., Akron, Ohio

Section VIII
Introduction to I.P.B.

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MANUFACTURERS CODE LIST (Cont)

Code Number	Name and Address
74193	Heinemann Electric Co., Trenton, N. J.
74200	Heinze Electric Co., Lowell, Mass.
74389	Ulanet, George, Co., Newark, N. J.
74545	Hubell, Harvey, Inc., Bridgeport, Conn.
74887	Insuline Corp. of America, Long Island City, N. Y.
74970	Johnson, E. F., Co., Waseca, Minn.
75382	Kulka Electric Manufacturing Co., Inc., Mt. Vernon, N. Y.
76005	Lord Manufacturing Co., Erie, Pa.
76433	Micamold Radio Corp., Brooklyn, N. Y.
76487	Millen, James, Manufacturing Co., Inc., Malden, Mass.
77464	Presstite Engineering Co., St. Louis, Mo.
77638	Radio Receptor Co., Brooklyn, New York
78290	Struthers Dunn Inc., Philadelphia, Pa.
78467	Tiebout, W. and J. New York, N. Y.
78497	Standard Coil Products Co., Chicago, Ill.
78553	Tinnerman Products, Inc., Cleveland, Ohio
79136	Waldes Koh-I-Noor, Inc., Long Island City, N. Y.
79555	White, S. S., Dental Manufacturing Co., Philadelphia, Pa.
79963	Zierick Manufacturing Corp., New Rochelle, N. Y.
80035	Winchester Electronics Co., New York, N. Y.
80223	United Transformer Co., New York, N. Y.

MANUFACTURERS CODE LIST (Cont)

Code Number	Name and Address
81922	Square D Co., New York, N. Y.
82084	Geier & Bluhm, Troy, N. Y.
82091	American General Thermostat Corp., New York, N. Y.
89946	Westinghouse Electric Corp., Beaver, Pa.
91506	Augat Bros. Inc., Attleboro, Mass.
91767	Helicoil Corp., Danbury, Conn.
91796	American Chain & Cable Co., Inc., Wire Rope Sling Department, Wilkes Barre, Pa.
93983	Transitron, Inc., New York, N. Y.
96214	Texas Instruments, Inc., Dallas, Texas
96768	C E M Co., Danielson, Conn.
96904	Natvar Corp., Woodbridge, N. J.
97965	Chicago Standard Transformer Co., Chicago, Ill.

8-11. UNITS PER ASSEMBLY. The number appearing in this column is the total quantity of the listed part required in its immediate assembly; total quantity per equipment appears in the "QTY PER ART." column of the Numerical Index, section X. The letters "Ref" (Reference) call attention to a detailed breakdown of the assembly or subassembly which can be found in a previous listing or one which follows.

8-12. NUMERICAL INDEX.

8-13. Section X is a numerical index arranged in alphabetical-numerical order to serve as an index to the Group Assembly Parts List. The following order is used: letters "A" through "Z" and then numerals "0" through "9"; alphabetic "O's" are considered as numerical zeros; spaces or dashes in a number take precedence over letters. Every part number that appears in the Group Assembly Parts List will appear in the Numerical Index.

8-14. Items that are designated as "COMM" and "No Number" in the "PART NO." column of the Group

Assembly Parts List are listed in the above sequence by the principal identifying noun of the nomenclature.

8-15. The figure and index numbers shown in the Numerical Index, for Government Standard parts and Radio Receptor standard hardware, are only for the first occurrence of that part in the Group Assembly Parts List. For all other parts, the figure and index numbers for each use of the part are given.

8-16. The quantity listed in the "QTY PER ART." column is the total number used in all the assemblies within the cloud height set.

8-17. REFERENCE DESIGNATION INDEX.

8-18. Reference designations have been assigned to all electrical parts which appear on schematic diagrams in the operation and service sections of the handbook. Section XI lists the reference designations in alpha-numerical sequence, with the corresponding figure and index numbers. The electrical parts have been assigned reference symbol numbers by series, which indicates the physical location of the parts within the assembled equipment. The tabulation which follows will be helpful in identifying the location of parts when the reference symbol number is known.

REFERENCE SYMBOL NUMBERS

<i>Series No.</i>	<i>Component</i>
200	Detector
300	Projector

8-19. HOW TO USE THE ILLUSTRATED PARTS BREAKDOWN.

8-20. TO FIND THE ILLUSTRATION AND NOMENCLATURE OF A PART, WHEN THE PART NUMBER IS KNOWN.

- a. Locate the part in the projector or detector por-

tion of the Numerical Index (section X). Refer to the "FIG. & INDEX NO." column; note the figure number which contains the part, and the index number of the part.

- b. Locate the illustration in the Group Assembly Parts List (section IX).

- c. Verify the part in the illustration by means of the index number.

- d. Determine the nomenclature of the part from the Group Assembly Parts List for that illustration.

8-21. TO DETERMINE THE PART NUMBER AND THE NOMENCLATURE OF A PART, WHEN THE PART NUMBER IS NOT KNOWN.

- a. Refer to the Table of Contents to find the illustration of the major operating assembly of which the part is known or thought to be a component.

- b. Turn to the illustration and scan it.

- c. Locate the part, and determine its index number. Refer to the description corresponding to the index number.

- d. If the part is not shown as a unit, but is shown assembled to other parts, the "DESCRIPTION" column of the parts list will refer to another illustration where the part will be shown as a unit.

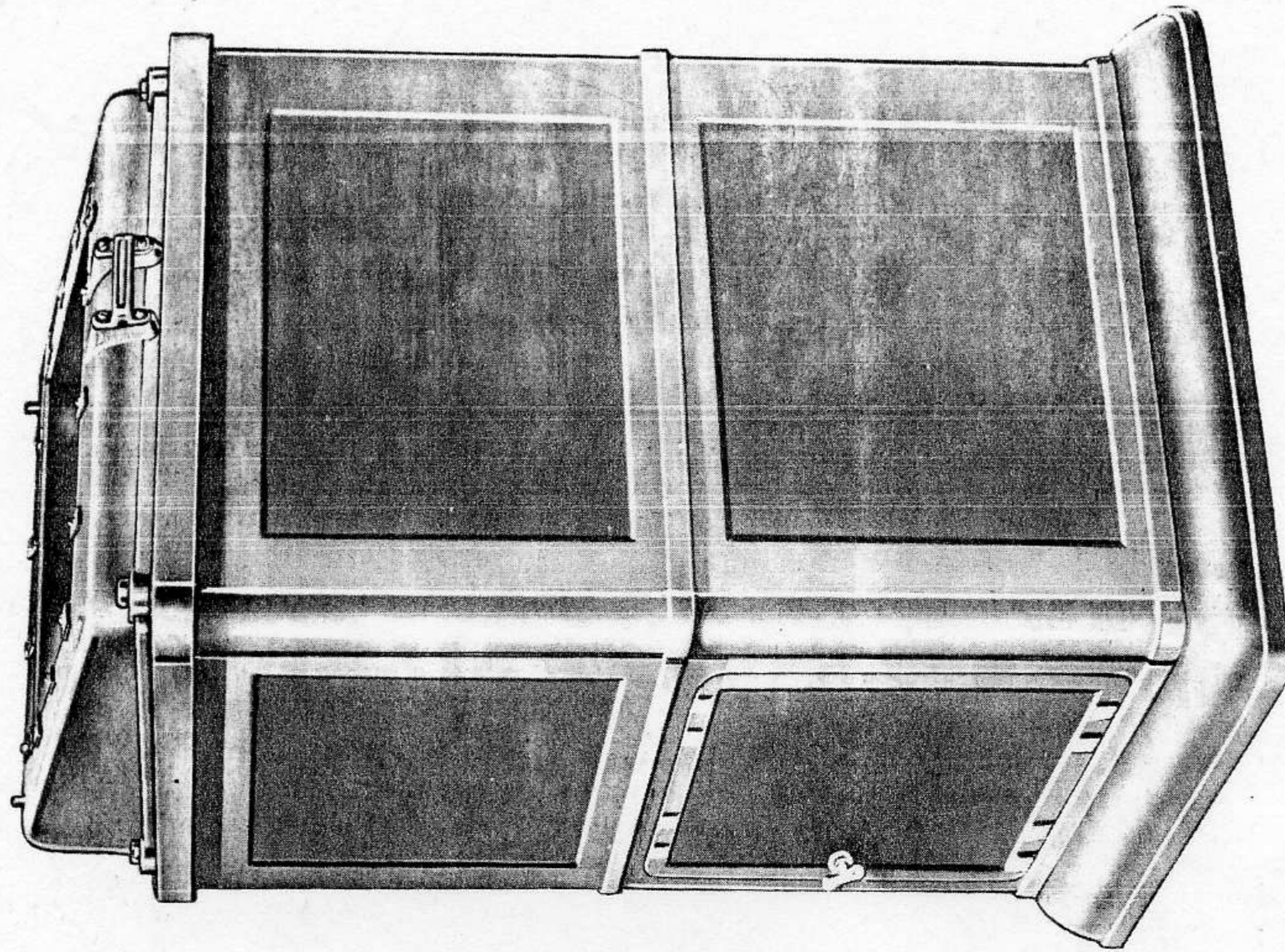
8-22. TO FIND THE ILLUSTRATION, PART NUMBER, AND NOMENCLATURE OF A PART, WHEN THE REFERENCE DESIGNATION IS KNOWN.

- a. Locate the reference designation in the index (section XI). Note the location in the "Figure & Index No." column.

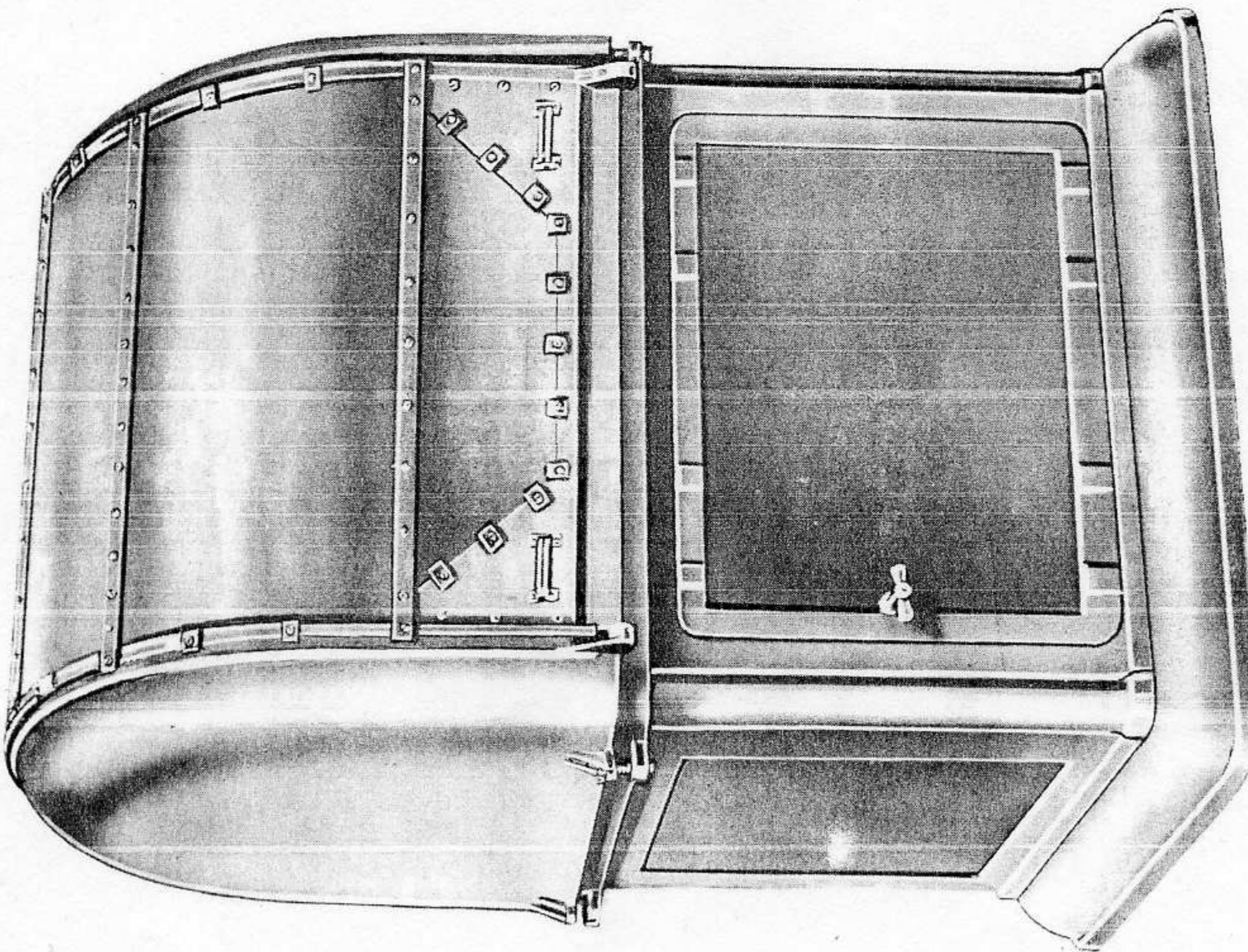
- b. Turn to the illustration in the Group Assembly Parts List.

- c. Locate the part in the illustration by means of the index number.

- d. Determine the part number and the nomenclature from the Group Assembly Parts List for that illustration.



CLOUD HEIGHT DETECTOR
ML-507C/GMQ-13
(SEE FIGURE 9-14)



CLOUD HEIGHT PROJECTOR
ML-506C/GMQ-13
(SEE FIGURE 9-2)

Figure 9-1. Cloud Height Set AN/GMQ-13C

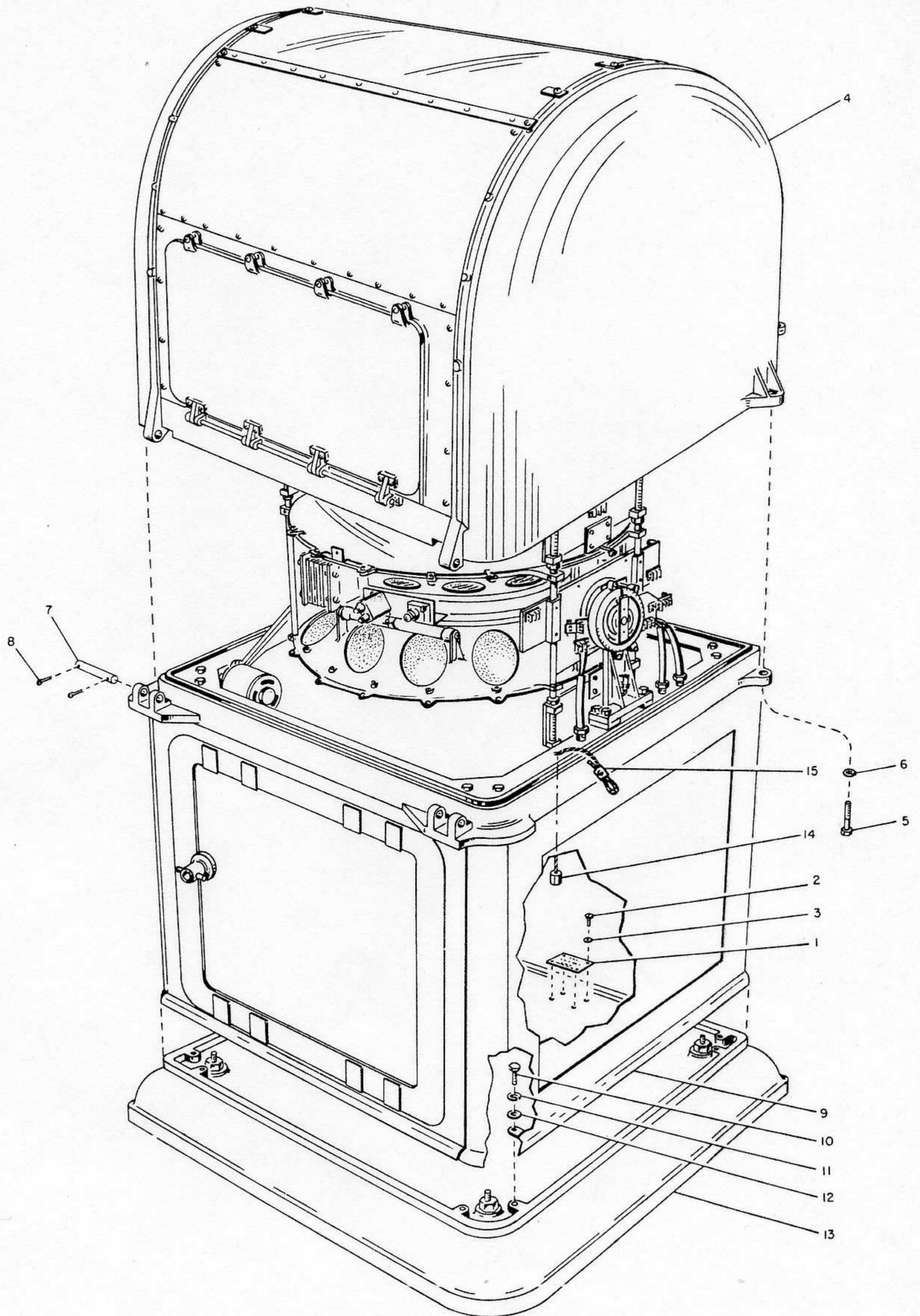


Figure 9-1. Cloud Height Set AN/GMQ-13C

Figure 9-2. Main Assembly, Cloud Height Projector ML-506C/GMQ-13

FIG. & INDEX NO.	PART NO.	DESCRIPTION							UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5	6	7		
9-8-2	489-116-1	.	LAMPHOLDER					1	
	489-116-2	.	LAMPHOLDER					1	
-3	489-121-1	.	RETAINER SUBASSY, FIXED, Steel, 1-15/16 in. h, 2-1/4 in. w						1	
-4	489-121-2	.	RETAINER SUBASSY, ADJUSTABLE, Steel, 1-15/16 in. h, 2-1/4 in. w						1	
(ATTACHING PARTS)										
-5	COMM	.	NUT, PLAIN, HEX, Brs ni pl, No. 12-24, 7/16 in. across flats, 1/8 in. thick						4	
-6	COMM	.	WASHER, LOCK, SPLIT, Phos brz ni pl, No. 12 med						4	
-7	COMM	.	WASHER, FLAT, Brs ni pl, 1/2 in. od, 0.230 in. id, 0.047 in. thick						4	
-8	489-180	.	BEARING, SLEEVE, Brs ni pl, 21/64 in. lg, 0.312 in. od, 0.045 in. thick						1	
-9	COMM	.	STUD, CONTINUOUS THREAD, Brs, No. 12-24 by 1-1/4 in.						2	
			-----*-----							
-10	489-181	.	INSULATOR, LAMPHOLDER, Mica, 2-11/16 in. lg, 1-5/8 in. w, 1/4 in. thick						1	

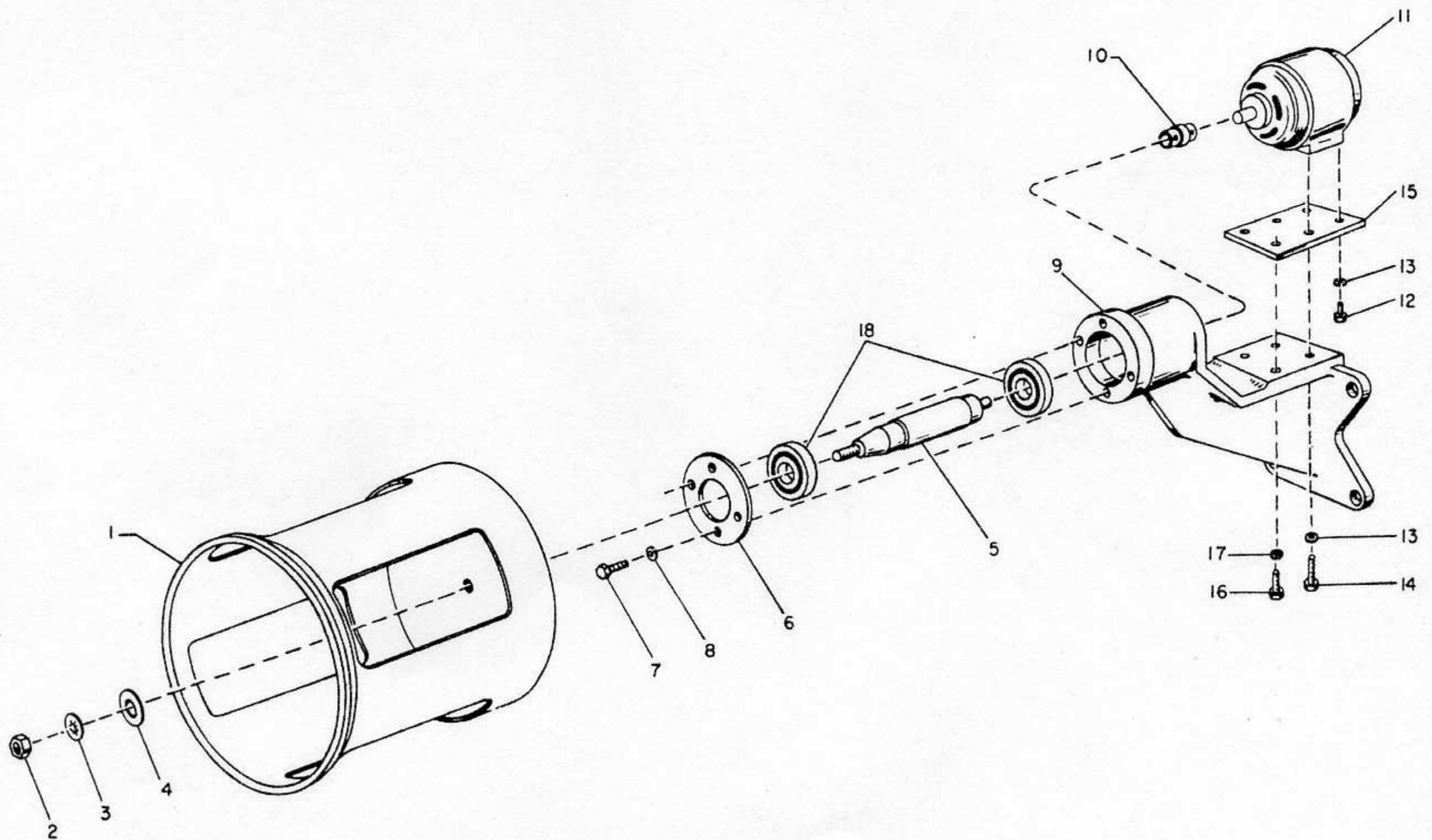


Figure 9-7. Shutter Assembly

Section IX
Group Assembly Parts List

NAVAER 50-30GMQ13-1

FIG. & INDEX NO.	PART NO.	DESCRIPTION							UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5	6	7		
9-6-13	273	.	BOX CONNECTOR, ELECTRICAL, 90 deg squeeze (Mfd by 59730.)						1	
-14	489-129-2	.	INTERCONNECTING BOX (See figure 9-12 for detail breakdown.)						1	
			(ATTACHING PARTS)							
-15	COMM	.	SCREW, CAP, HEX HD, Cres, No. 3/8-16 by 1/2 in.						4	
-16	COMM	.	WASHER, LOCK, SPLIT, Cres, No. 3/8 med						4	
			-----*							
-17	COMM	.	CONDUIT, METAL FLEXIBLE, 1/2 in. dia, 1-1/2 ft lg (Mfd by 65073.)						1	
-18	COMM	.	CONDUIT, METAL FLEXIBLE, 1 in. dia, 2 ft lg (Mfd by 65073.)						1	
-19	422	.	BUSHING, ELECTRICAL CONDUIT (Mfd by 59730.)						2	
-20	424	.	BUSHING, ELECTRICAL CONDUIT (Mfd by 59730.)						2	
9-7-	489-113-1*		SHUTTER ASSEMBLY (See figure 9-4 for next higher assembly.) ...						Ref	
	489-113-2*		SHUTTER ASSEMBLY (See figure 9-4 for next higher assembly.) ...						Ref	
-1	489-65	.	SHUTTER, LAMP, Barrel type, 6-3/4 in. od, 6 in. id, 7-1/8 in. lg (ATTACHING PARTS)						1	
-2	COMM	.	NUT, PLAIN, HEX, Cres, No. 3/8-16, 5/8 in. across flats, 5/16 in. thick						1	
-3	COMM	.	WASHER, LOCK, Internal tooth, cres, No. 3/8 med						1	
-4	COMM	.	WASHER, FLAT, Cres, 1 in. od, 7/16 in. id, 1/16 in. thick						1	
			-----*							
-5	489-154	.	SHAFT, SHUTTER, Cres, 0.750 in. od, 4-3/4 in. lg						1	
-6	489-156	.	SUPPORT, BEARING, Al, 2-1/4 in. od, 1-3/16 in. id, 1/8 in. thick (ATTACHING PARTS)						1	
-7	COMM	.	SCREW, CAP, HEX HD, Slotted, cres, No. 10-32 by 1-1/2 in.						4	
-8	COMM	.	WASHER, LOCK, SPLIT, Cres, No. 10 light						4	
			-----*							
-9	489-86	.	SUPPORT, SHUTTER, Al, 7 in. lg, 5-13/16 in. w, 3-3/4 in. deep						1	
-10	489-532	.	COUPLING, FLEXIBLE, 0.250 in. bore dia						1	
-11	4501-25	.	MOTOR, ALTERNATING CURRENT, Shutter drive, 1/50 hp, 50/60 cycles, 1800 rpm (ATTACHING PARTS)						1	
-12	COMM	.	SCREW, MACHINE, FIL HD, Cres, No. 10-32 by 1/2 in.						2	
-13	COMM	.	WASHER, LOCK, SPLIT, Cres, No. 10 light						4	
-14	COMM	.	SCREW, CAP, HEX HD, Cres, No. 10-32 by 13/16 in.						2	
			-----*							
-15	489-295	.	PLATE, SUPPORT, MOTOR, Al, 2-3/8 in. lg, 1-7/8 in. w, 0.187 in. thick (ATTACHING PARTS)						1	
-16	COMM	.	SCREW, CAP, HEX HD, Slotted, Cres, No. 10-32 by 5/8 in.						2	
-17	COMM	.	WASHER, LOCK, SPLIT, Cres, No. 10 light						2	
			-----*							
-18	77R10XIE	.	BEARING, BALL (Mfd by 43334.)						2	
9-8-	489-123-1**		LAMP SUPPORT ASSEMBLY (See figure 9-4 for next higher assembly.)						Ref	
	489-123-2**		LAMP SUPPORT ASSEMBLY (See figure 9-4 for next higher assembly.)						Ref	
-1	489-207-1	.	SUPPORT, LAMP, Crs, 6-7/8 in. lg, 4-3/4 in. w, 4 in. deep						1	
	489-207-2	.	SUPPORT, LAMP, Crs, 6-7/8 in. lg, 4-3/4 in. w, 4 in. deep						1	

* Shutter assemblies are identical except for shutter motor reference symbols screened on motor support plate (item 15).
** Lamp support assemblies are identical except for a difference in reference symbols.

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Group Assembly Parts List

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FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5 6 7		
		(ATTACHING PARTS)		
9-11-4	COMM	. SCREW, MACHINE, FIL HD, Brs ni pl, No. 6-32 by 1/4 in.	4	
-5	COMM	. WASHER, LOCK, SPLIT, Phos brz ni pl, No. 6 med	4	
-6	COMM	. WASHER, FLAT, Brs ni pl, 5/16 in. od, 0.147 in. id, 0.032 in. thick -----*-----	4	
-7	22U15B	. MAGNET, PERMANENT, Rectangular u, type b (Mfd by 73200.)	2	
		(ATTACHING PARTS)		
-8	COMM	. SCREW, MACHINE, FIL HD, Brs, No. 4-40 by 7/16 in. -----*-----	2	
-9	489-261-1	. PLATE, RETAINING, Magnet holder, crs, 3-3/4 in. lg, 2-3/4 in. w, 3/16 in. thick	2	
-10	489-260	. PLATE, SPACER, Magnet holder, crs, 3-3/4 in. lg, 3/4 in. w, 1/16 in. thick	2	
-11	489-262	. BRACKET, ANGLE-MAGNET HOLDER, Brs, 2-3/16 in. lg, 1-29/64 in. w, 1/16 in. thick	2	
-12	489-261-2	. PLATE, RETAINING, Magnet holder, Crs, 3-3/4 in. lg, 2-3/4 in. w, 1/8 in. thick	2	
		(ATTACHING PARTS)		
-13	COMM	. SCREW, MACHINE, FIL HD, Brs ni pl, No. 1/4-20 by 1/2 in.	4	
	COMM	. WASHER, LOCK, SPLIT, Cres, No. 1/4 med	4	
-14	COMM	. SCREW, MACHINE, FIL HD, Brs ni pl, No. 1/4-20 by 3/4 in.	4	
-15	COMM	. WASHER, LOCK, SPLIT, Cres, No. 1/4 med	4	
		-----*-----		
-16	489-286	. WEIGHT, BALANCE, Crs, 2 in. lg, 1 in. w, 2 in. h	2	
		(ATTACHING PART)		
	COMM	. NUT, PLAIN, HEX, Brs ni pl, No. 1/4-20, 7/16 in. across flats, 3/16 in. thick -----*-----	2	
-17	489-533	. STUD, CONTINUOUS THREAD, Brs, No. 1/4-20 by 8-3/8 in. ...	2	
		(ATTACHING PARTS)		
-18	COMM	. NUT, PLAIN, HEX, Brs ni pl, No. 1/4-20, 7/16 in. across flats, 3/16 in. thick	8	
-19	COMM	. WASHER, LOCK, SPLIT, Phos brz ni pl, No. 1/4 med	4	
		-----*-----		
-20	489-288	. BRACKET, ANGLE, Crs, 1-5/16 in. lg, 1 in. w	4	
		(ATTACHING PARTS)		
-21	COMM	. SCREW, MACHINE, FIL HD, Brs ni pl, No. 8-32 by 5/16 in.	8	
-22	COMM	. WASHER, LOCK, SPLIT, Cres, No. 8 med	8	
		-----*-----		
-23	489-206-1	. PLATE, MOUNTING, LAMP ASSY, Crs, 11-3/4 in. lg, 3-1/16 in. h incl. studs, 4 in. deep (Ref. to figure 9-8.)	2	
		(ATTACHING PARTS)		
	COMM	. NUT, PLAIN, HEX, Cres, No. 3/4-16, 1-1/8 in. across flats, 27/64 in. thick -----*-----	8	
-24	489-60	. REFLECTOR, LIGHT, Back-silvered glass, 24 in. dia, focal length of 10 in.	2	
		(ATTACHING PARTS)		
-25	489-138	. REFLECTOR CLAMP SUBASSY	24	
-26	489-243	. CLAMP, RIM CLENCHING, Crs, 2-11/16 in. lg, 3/4 in. w, 9/16 in. deep, 3/16 in. thick	1	
-27	COMM	. SCREW, MACHINE, FIL HD, Cres, No. 12-24 by 1 in.	3	
-28	COMM	. WASHER, LOCK, SPLIT, Cres, No. 5/16 med	1	
-29	COMM	. NUT, PLAIN, HEX, Cres, No. 12-24, 7/16 in. across flats, 5/32 in. thick	1	
-30	489-245	. ASBESTOS STRIP, COMPRESSED, Gasket tape, 1 in. lg, 1 in. w, 1/8 in. thick -----*-----	1	
		(ATTACHING PARTS)		
-31	489-139	. REFLECTOR SUPPORT SUBASSY	24	
-32	489-244	. SUPPORT, REFLECTOR, 1 in. lg, 1 in. w, 1/8 in. thick	1	
	489-245	. ASBESTOS STRIP, COMPRESSED, Gasket tape, 1 in. lg, 1 in. w, 1/8 in. thick	1	
-33	489-216	. SIGHT, CROSS-LINE, Crs, 0.031 in. dia steel wire, 2-1/16 in. lg, 2 in. w, 9/16 in. h, 1/16 in. thick	1	

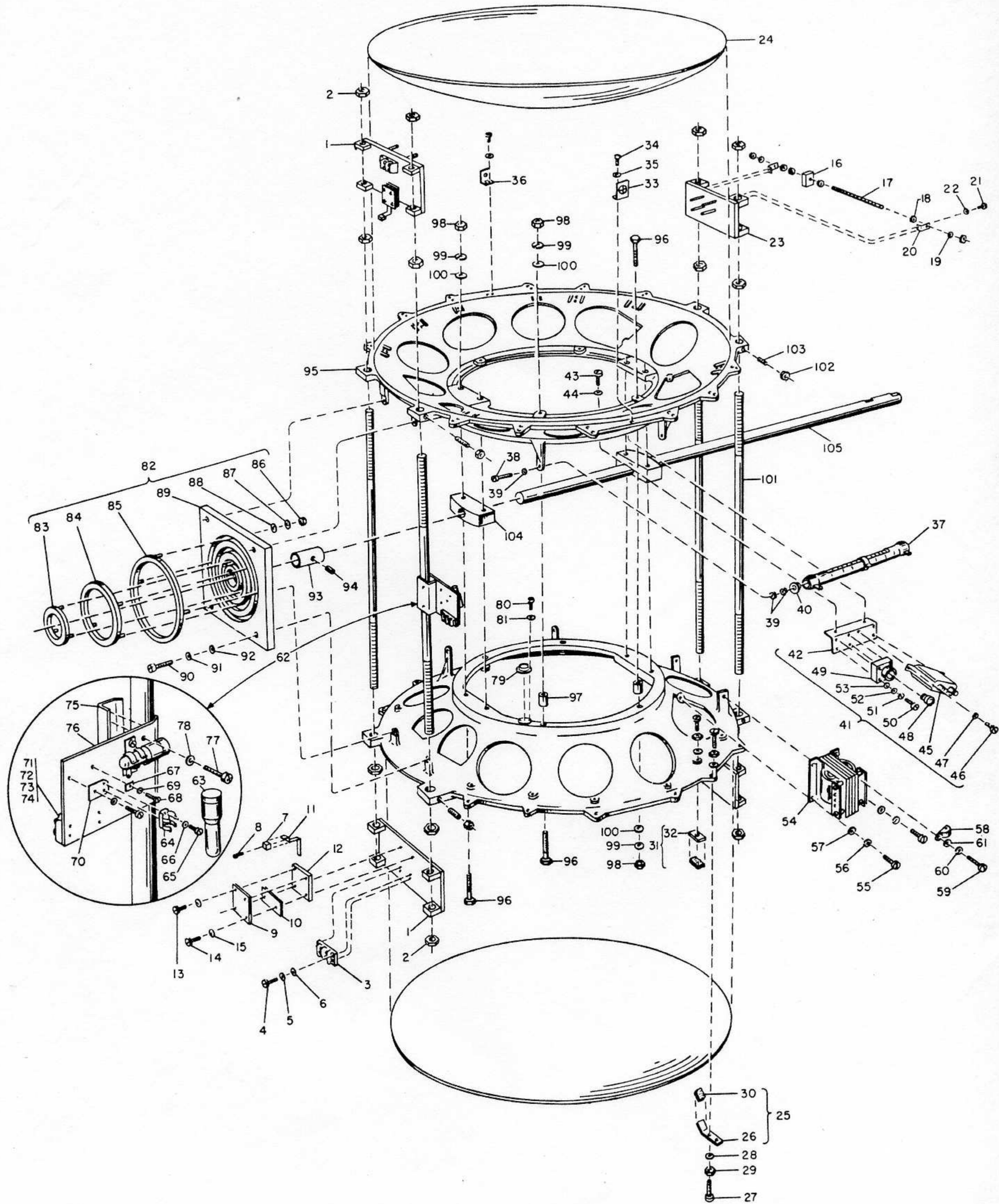


Figure 9-11. Rotary Mount Assembly

Section IX
Group Assembly Parts List

NAVAER 50-30GMQ13-1

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE							
					1	2	3	4	5	6	7
9-16-	No Number	MAIN ASSEMBLY, DETECTOR (See figure 9-14 for next higher assembly.)	Ref								
-1	No Number	. OPTICAL ASSEMBLY (See figure 9-19 for detail breakdown.) ..	1								
		(ATTACHING PARTS)									
-2	COMM	. SCREW, MACHINE, HEX HD, Cres, No. 3/8-16 by 1-1/4 in.	8								
-3	COMM	. WASHER, LOCK, DOMED, Cres, No. 3/8	8								
-4	COMM	. WASHER, LOCK, SPLIT, Cres, No. 3/8 med	8								
-5	COMM	. NUT, PLAIN, HEX, Cres, No. 3/8-16, 5/8 in. across flats, 0.257 in. thick	8								
		-----*-----									
-6	489-313-2	. AMPLIFIER-POWER SUPPLY ASSY (See figure 9-20 for detail breakdown.)	1								
-7	489-271-1	. SHOCK PAD, Rubber, cellular, 18 in. lg, 8 in. w, 2 in. thick	1								
-8	489-314	. INTERCONNECTING BOX, DETECTOR (See figure 9-21 for detail breakdown.)	1								
		(ATTACHING PARTS)									
-9	COMM	. SCREW, CAP, HEX HD, Cres, No. 3/8-16 by 1/2 in.	4								
-10	COMM	. WASHER, LOCK, SPLIT, Cres, No. 3/8 med	4								
		-----*-----									
-11	COMM	. CONDUIT, METAL FLEXIBLE, 1/2 in. dia, 1-1/2 ft. lg (Mfd by 65073.)	1								
-12	COMM	. CONDUIT, METAL FLEXIBLE, 1 in. dia, 2 ft. lg (Mfd by 65073.)	1								
-13	422	. GROMMET, PLASTIC, 1 in. (Mfd by 59730.)	2								
-14	424	. GROMMET, PLASTIC, 1/2 in. (Mfd by 59730.)	2								
-15	23-13-060	. VOLTAGE REGULATOR SUBASSY, 95-130 v pri, 60 cycles, 118 v sec, 0.508 amp, 60 va (Mfd by 55814.)	1								
-16	489-271-2	. SHOCK PAD, Rubber, cellular, 9 in. lg, 8 in. w, 2 in thick	1								
9-17-	No Number	HOUSING, MAIN ASSEMBLY (See figure 9-14 for next higher assembly.)	Ref								
-1	489-304-2	. COVER SUBASSY, HOUSING	1								
		(ATTACHING PARTS)									
-2	COMM	. SCREW, CAP, HEX HD, Cres, No. 3/8-16 by 1-7/8 in.	8								
-3	COMM	. WASHER, LOCK, SPLIT, Cres, No. 3/8 med	8								
-4	COMM	. WASHER, FLAT, Cres, 7/8 in. od, 0.391 in. id, 0.064 in. thick	8								
		-----*-----									
-5	489-162-1	. . WINDOW, COVER SUBASSY, Plate glass, polished, 26-1/2 in. lg, 26-1/2 in. w, 1/4 in. thick	1								
		(ATTACHING PARTS)									
-6	489-305-2	. . . RETAINER, WINDOW, Crs, 1-3/8 in. lg, 3/4 in. w, 3/32 ..	1								
-7	489-278	. . . RETAINER, WINDOW, Cres, 1-3/8 in. lg, 3/4 in. w, 3/32 in. thick	1								
-8	489-164	. . . ASBESTOS STRIP, COMPRESSED, Gasket tape, 3/4 in. lg, 3/8 in. w, 1/8 in. thick	1								
-9	COMM	. . SCREW, MACHINE, FIL HD, Cres, No. 12-24 by 2-1/8 in.	4								
-10	COMM	. . SCREW, MACHINE, FIL HD, Cres, No. 12-24 by 5/8 in.	8								
-11	COMM	. . SCREW, MACHINE, FIL HD, Cres, No. 12-24 by 2-1/2 in.	4								
-12	COMM	. . NUT, PLAIN, HEX, Cres, No. 12-24, 7/16 in. across flats, 5/32 in. thick	8								
-13	COMM	. . WASHER, LOCK, SPLIT, Cres, No. 12 med	24								
-14	COMM	. . WASHER, FLAT, Cres, 1/2 in. od, 0.230 in. id, 0.047 in. thick	12								
		-----*-----									
-15	489-87	. . WINDOW SUPPORT-HOUSING COVER, A1, 37 in. lg, 37 in. w, 3-1/4 in. h	1								
-16	489-169	. . DIAPHRAGM, DETECTOR, Cres, 29-16 in. sq, 1.421 in. h, 0.047 in. thick	1								

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Group Assembly Parts List

NAVAER 50-30GMQ13-1

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5 6 7		
9-18-3	COMM	. STUD, CONTINUOUS THREAD, Cres, No. 1/2-13 by 4-1/4 in.	4	
-4	489-94-2	. BASE, HOUSING, A1, 42 in. lg, 42 in. w, 5-5/16 in. h	1	
-5	COMM	. WASHER, FLAT, Cres, 1-3/8 in. od, 9/16 in. id, 7/64 in thick	4	
-6	489-209	. TEMPLATE, POSITIONING, Cres, 30-7/8 in. square, 0.1046 in. thick	1	
-7	COMM	. NUT, PLAIN, HEX, Cres, No. 1/2-13, 7/8 in. across flats, 1/2 in. thick	4	
-8	489-84	. BASE LEVELING FOOT, A1, 5-7/8 in. lg, 3-3/8 in. h, 2-1/16 in. w	4	
-9	489-220	. PLATE, COVER, CONDUIT, Crs, 5 in. od, 1/16 in. thick	1	
		(ATTACHING PARTS)		
-10	COMM	. SCREW, MACHINE, FIL HD, Cres, No. 10-32 by 5/16 in.	6	
-11	COMM	. WASHER, LOCK, SPLIT, Cres, No. 10 med	6	
		-----*		
-12	3300-901	. PLATE, IDENTIFICATION, Nomenclature	1	
		(ATTACHING PARTS)		
-13	COMM	. SCREW, MACHINE, BIND HD, Cres, No. 4-40 by 1/4 in.	4	
-14	COMM	. WASHER, LOCK, SPLIT, Cres, No. 4 med	4	
		-----*		
9-19-	No Number	OPTICAL ASSEMBLY, DETECTOR (See figure 9-16 for next higher assembly.)	Ref	
-1	489-303	. PHOTOCCELL AND HOUSING ASSEMBLY	1	
		(ATTACHING PARTS)		
-2	COMM	. SCREW, MACHINE, FIL HD, Brs ni pl, No. 1/4-20 by 7/16 in.	1	
-3	COMM	. WASHER, LOCK, SPLIT, Cres, No. 1/4 med	1	
-4	489-214	. WASHER, SPECIAL PURPOSE, Photocell support, Crs, 1-1/2 in. od, 9/32 in. id, 1/16 thick	1	
-5	COMM	. SCREW, MACHINE, HEX HD, Cres, No. 3/8-16 by 1 in.	1	
-6	COMM	. WASHER, LOCK, SPLIT, Cres, No. 3/8 med	1	
-7	COMM	. WASHER, FLAT, Cres, 7/8 in. od, 0.406 in. id, 0.062 in. thick	1	
-8	489-215	. WASHER, SPECIAL PURPOSE, Photocell centering, crs, 3-1/2 in. od, 13/32 in. id, 1/8 in. thick	1	
		-----*		
-9	489-81	. . . BODY, HOUSING, PHOTOCCELL, A1, 3-3/8 in. od, 1-3/16 in. h	1	
-10	489-80	. . . CAP, HOUSING, PHOTOCCELL, A1, 3-9/16 in. od, 15/16 in. h	1	
-11	489-281	. . . WASHER, FLAT, Thrust, A1, 3-1/8 in. od, 2-3/4 in. id, 0.032 in. thick	1	
-12	489-274	. . . GASKET, SYNTHETIC RUBBER, 3-1/8 in. od., 2-3/4 in. id, 1/16 in. thick	2	
-13	489-202	. . . COVER, PHOTOELECTRIC CELL, Glass, infrared, 3-1/8 in. od, 4-5 mm thick	1	
-14	4651-1	. . . PHOTOELECTRIC CELL, 2 meg ±1% @ 70°F, 1-3 meg dark res, lead sulfide type, 20 x 4 mm sensitive surface (Mfd by 19139.)	1	
-15	489-273	. . . DISK, PHOTOELECTRIC CELL, Mica stained, 1-1/4 in. w, 0.008 in. thick	1	
-16	135-500	. . . INSULATOR, STANDOFF, Cone, steatite, supplied w/cork .. cushion (Mfd by 74970.)	2	
		(ATTACHING PARTS)		
-17	COMM	. . . SCREW, MACHINE, FLAT HD, Cres, No. 6-32 by 7/16 in. . . .	4	
		-----*		
-18	COMM	. . . LUG, Soldering, No. 6	3	
		(ATTACHING PARTS)		
-19	COMM	. . . WASHER, FLAT, Brs ni pl, 3/8 in. od, 0.149 in. id, 1/32 in. thick	6	
-20	COMM	. . . WASHER, LOCK, Internal tooth, phos brz ni pl, No. 6 light	9	
-21	COMM	. . . SCREW, MACHINE, ROUND HD, Brs ni pl, No. 6-32 by 3/16 in.	3	
		-----*		

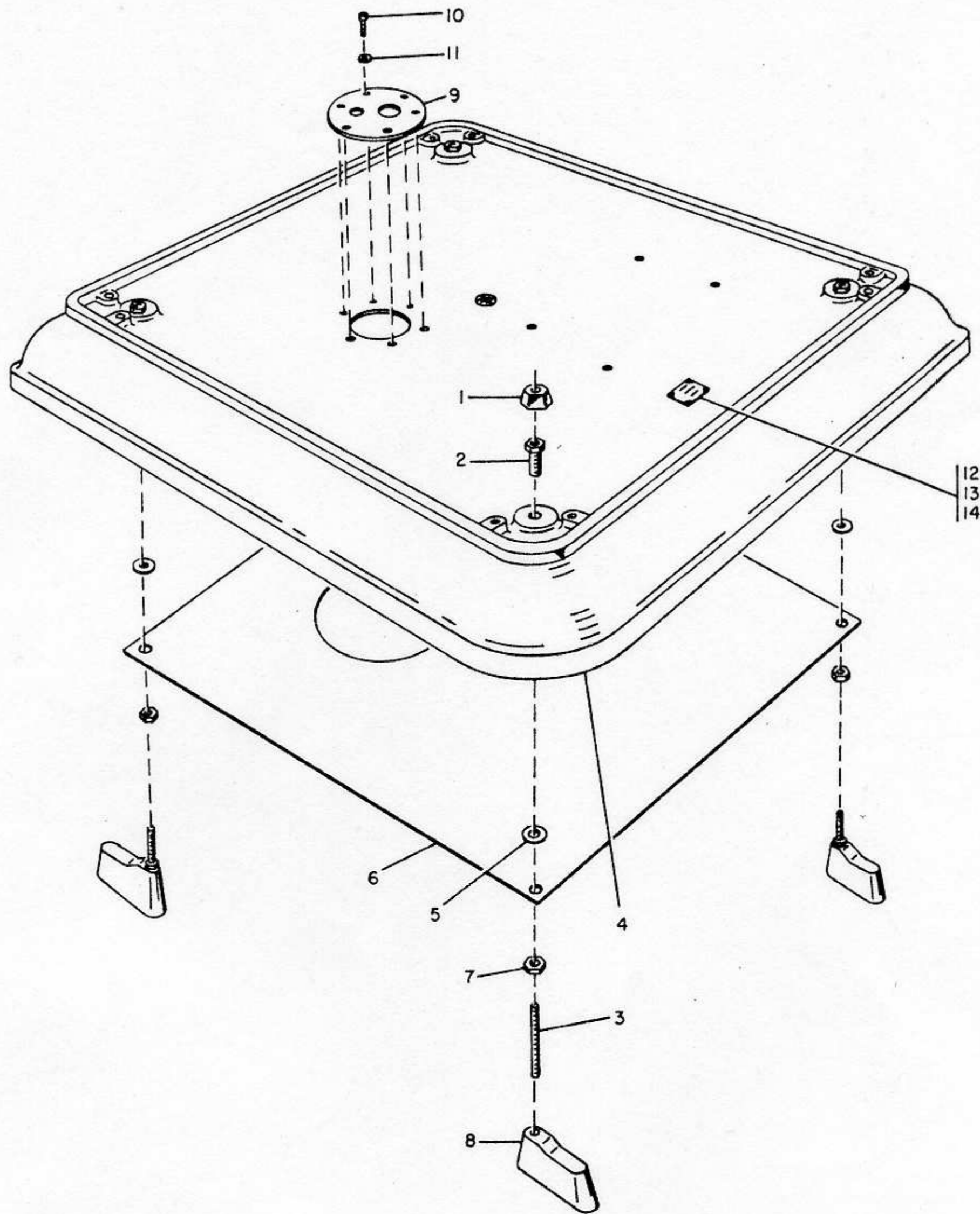


Figure 9-18. Housing Base, Main Assembly, Detector

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE		
					1	2
9-19-22	489-212	. ROD, THREADED END, Photocell tie rod, crs, "Z" shaped, 11-13/16 in. lg, 8-5/8 in. w, 5/16 in. od, No. 5/16-18 threaded each end, 1-1/2 in. lg	2			
		(ATTACHING PARTS)				
-23	COMM	. NUT, PLAIN, HEX, Brs ni pl, No. 5/16-18, 9-16 in across flats, .. 0.225 in. thick	8			
-24	COMM	. WASHER, LOCK, SPLIT, Phos brz ni pl, No. 5/16 med	4			
		-----*-----				

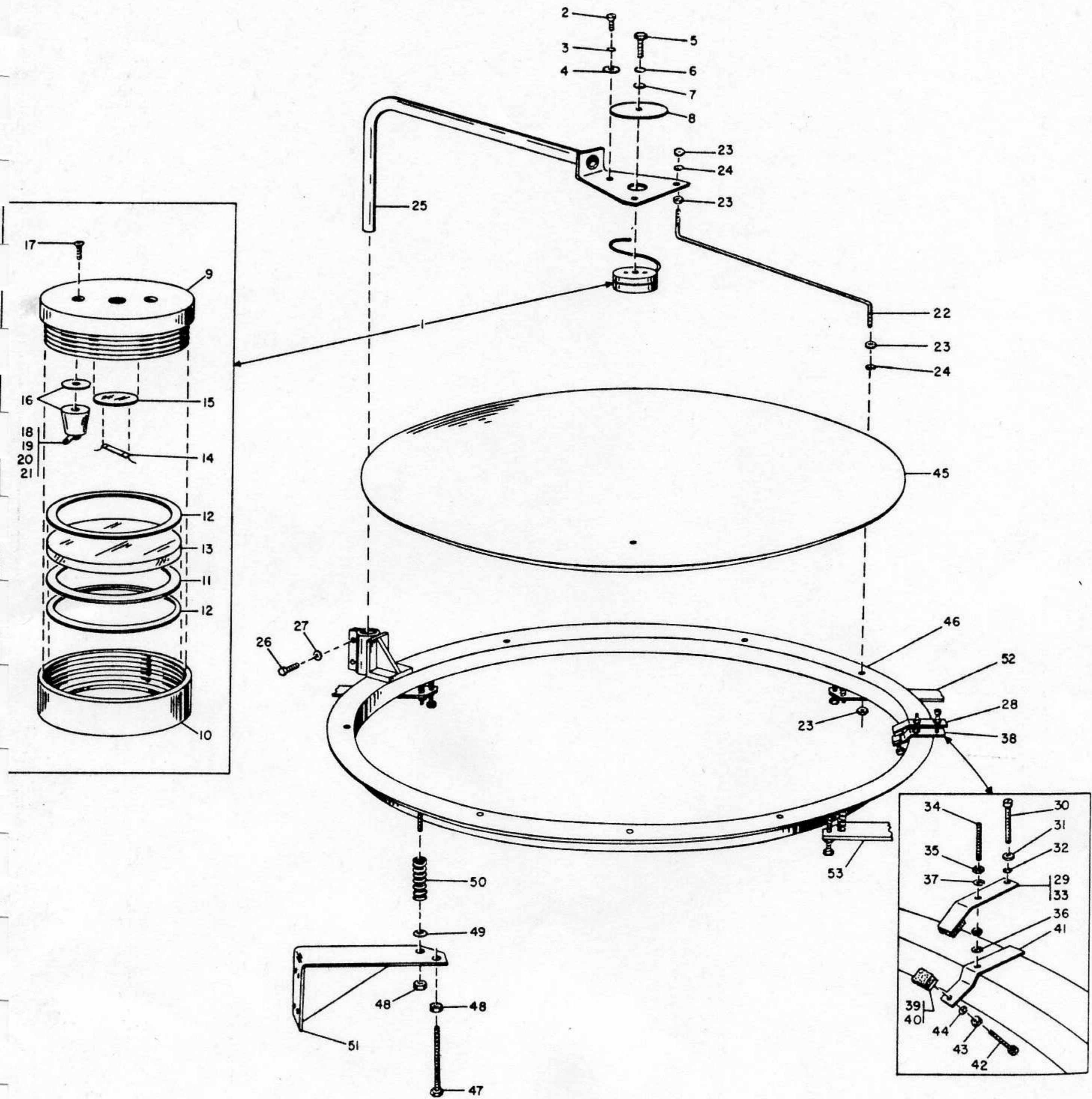


Figure 9-19. Optical Assembly, Detector

REFERENCE DESIGNATION	FIGURE INDEX	CLASS CODE	PART NO.
S310	9-11-63	5930	3237-2
T201	9-20-31	5950	2945-20
T202	9-20-21	5950	2968-3
T301	9-11-54	5950	2943-13
T302	9-11-54	5950	2943-13
TB251	9-21-6	5940	S-7-9080
TB252	9-21-6	5940	S-7-9080
TB253	9-15-21	5940	601-2
TB301	9-12-11	5940	S-7-9080
TB302	9-12-11	5940	S-7-9080
TB303	9-11-3	5940	600-3
TB304	9-11-3	5940	600-3
TB305	9-11-71	5940	600-3
TB306	9-11-71	5940	600-3
TB307	9-9-41	6660	489-205
TB308	9-9-41	6660	489-205
TB309	9-9-41	6660	489-205
V201	9-20-39	5960	6072

REFERENCE DESIGNATION	FIGURE INDEX	CLASS CODE	PART NO.
V202	9-20-39	5960	6072
V203	9-20-38	5960	5814A
V204	9-20-8	5960	6X4W
V205	9-20-26	5960	OA2WA
V206	9-20-26	5960	OA2WA
V207	9-19-1	6660	489-303
W201	9-22-1	6660	489-318
W202	9-22-5	6660	489-319
W203	9-22-13	6150	489-323
W204	9-22-16	6660	489-321-2
W251	9-22-21	6660	489-316
W252	9-22-26	6660	489-317
W301	9-13-1	6660	489-142-1
W302	9-13-6	6660	489-142-2
W303	9-13-11	6660	489-144
W304	9-13-16	6660	489-142-3
W305	9-13-21	6660	489-145

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS	USABLE
			PER ASSY	ON CODE
9-19-25	489-210	. SUPPORT, PHOTOCELL HOUSING, Crs, 17-1/2 in. lg, 4-5/8 in. w, 10 in. h (ATTACHING PARTS)	1	
-26	COMM	. SCREW, MACHINE, HEX HD, Cres, No. 5/16-18 by 3/4 in.	2	
-27	COMM	. WASHER, LOCK, SPLIT, Phoz brz ni pl, No. 5/16 med	2	
		-----*		
-28	489-315	. CLAMP SUBASSY, REFLECTOR	6	
-29	489-247	. . CLAMP, RIM CLENCHING, Crs, 4 in. lg, 1 in. w, 1-1/16 in. h	1	
-30	COMM	. . SCREW, MACHINE, FIL HD, Cres, No. 12-24 by 1-1/4 in. ..	1	
-31	COMM	. . NUT, PLAIN, HEX, Cres, No. 12-24, 7/16 in. across flats, 5/32 in. thick	1	
-32	COMM	. . WASHER, LOCK, SPLIT, Cres, No. 12 med	1	
-33	489-246	. . ASBESTOS STRIP, COMPRESSED, Gasket tape, 13/16 in. lg, 9/16 in. w, 1/8 in. thick (ATTACHING PARTS)	1	
-34	489-534	. STUD, CONTINUOUS THREAD, Cres, No. 1/4-20 by 1-3/4 in. ..	6	
-35	COMM	. NUT, PLAIN, HEX, Cres, No. 1/4-20, 7/16 in. across flats, 0.193 in. thick	12	
-36	COMM	. WASHER, LOCK, SPLIT, Cres, No. 1/4 med	6	
-37	COMM	. WASHER, FLAT, Cres, 5/8 in. od, 0.281 in. id, 0.050 in. thick	6	
		-----*		
-38	489-139	. SUPPORT SUBASSY, REFLECTOR	6	
-39	489-245	. . ASBESTOS STRIP, COMPRESSED, Gasket tape, 1 in. lg, 1 in. w, 1/8 in. thick	1	
-40	489-248	. . SUPPORT, REFLECTOR, Crs, 3-1/2 in. lg, 1 in. w, 1-1/4 in. h	1	
-41	489-244	. . SUPPORT, REFLECTOR, Crs, 1 in. lg, 1 in. w, 1/8 in. thick	1	
		(ATTACHING PARTS)		
-42	COMM	. . SCREW, MACHINE, FIL HD, Cres, No. 12-24 by 1 in.	1	
-43	COMM	. . NUT, PLAIN, HEX, Cres, No. 12-24, 7/16 in. across flats, 5/32 in. thick	1	
-44	COMM	. . WASHER, LOCK, SPLIT, Cres, No. 12 med	1	
		-----*		
-45	489-60	. REFLECTOR, LIGHT, Back-silvered glass, 24 in. dia, focal length of 10 in.	1	
-46	489-213	. RING, SUPPORT, REFLECTOR, Hrs, 29 in. od, 25-3/4 in. id, 2-1/4 in. h (ATTACHING PARTS)	1	
-47	COMM	. SCREW, MACHINE HEX HD, Slotted, cros, No. 3/8-16 by 2 in. ..	4	
-48	COMM	. NUT, JAM, HEX, Cres, No. 3/8-16, 5/8 in. across flats, 0.257 in. thick	8	
-49	COMM	. WASHER, FLAT, Cres, 7/8 in. od, 0.406 in. id, 0.062 in. thick	4	
-50	489-221	. SPRING, HELICAL, COMPRESSION, Cres, 1-7/16 in. free length, 7/16 in. id (ATTACHING PARTS)	4	
		-----*		
-51	489-211-1	. BRACKET, ANGLE, Right, hrs, 9 in. lg, 5-1/4 in. h, 2 in. deep	2	
-52	489-211-2	. BRACKET, ANGLE, Left, hrs, 9 in. lg, 5-1/4 in. h, 2 in. deep, with 7/16 in. dia hole	1	
-53	489-211-3	. BRACKET, ANGLE, Left, hrs, 9 in. lg, 5-1/4 in. h, 2 in. deep	1	
9-20-	489-313-2	AMPLIFIER—POWER SUPPLY ASSEMBLY (See figure 9-16 for next higher assembly.)	Ref	
-1	489-250	. CHASSIS, AMPLIFIER—POWER SUPPLY, Crs, 17 in. lg, 5 in. w, 3-7/32 in. deep, 0.059 in. thick	1	
-2	489-251	. COVER, CHASSIS, Crs, 16-55/64 in. lg, 2-15/16 in. w, 4-55/64 in. h, 0.059 in. thick (ATTACHING PARTS)	1	
-3	COMM	. SCREW, MACHINE, FIL HD, Brs ni pl, No. 6-32 by 5/16 in.	16	