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AVIATION FACILITIES SERVICE  
MANUAL OF OPERATIONS

Qcx-A

MTC 3.4.1.2

MAINTENANCE OF  
AIRWAY BEACON  
FACILITIES

First Edition  
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FEDERAL AVIATION AGENCY

Systems Maintenance Division

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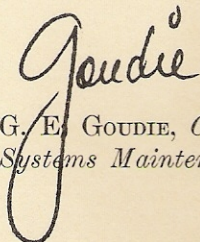
## Foreword

This booklet is one of a series of publications forming the Aviation Facilities Service Manual of Operations. The publications of the Director's office and each Division of the Aviation Facilities Service comprise a Volume of the Manual; each Volume is then subdivided into Parts, the Parts into Chapters, the Chapters into Sections and the Sections into Units. This booklet forms a Unit of the Manual of Operations.

The designation MTC 3.4.1.2 assigned this Unit indicates the Volume; Maintenance (MTC): the Part; Engineering (3): the Chapter; Plant and Structures (4): the Section; General (1): and the Unit; Maintenance of Airway Beacon Facilities (2). The designation MTC 3.4.1.2 shall be used in referring to this publication. By placing a dash (—) after the designation, the number of a particular paragraph will be added to simplify reference thereto.

This Unit of the Manual was written by Messrs. WALTER M. LACHNIT, *Eastern Region*, EMORY C. BRONNER, *Western Region*, and includes comments from their Regional Offices; it was edited by Messrs. FRANK G. HENRY, *AF-134, Chairman*; LEO J. FLEMING, *Western Region*, ROBERT C. HUSS, *Eastern Region*, and WILLIAM L. GILLETTE, *Central Region*. Acknowledgement is also made of assistance given by the many personnel within the Washington Office, Regional Offices, and Field Offices who reviewed drafts, evaluated procedures, made technical suggestions, proof-read, and performed other tasks as necessary to complete this Unit.

This publication is approved as a Unit of the Aviation Facilities Service Manual of Operations, and as such shall govern the activities of all personnel engaged in the maintenance of Airway Beacon Facilities.

  
G. E. GOUDIE, *Chief,*  
*Systems Maintenance Division.*

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VOLUME—MTC SYSTEMS MAINTENANCE

Part 3—MAINTENANCE ENGINEERING

Chapter 4—PLANT AND STRUCTURES

Section 1—GENERAL

## UNIT 2—MAINTENANCE OF AIRWAY BEACON FACILITIES

### 1.0 GENERAL

#### 1.1 Purpose

The purpose of this publication is to provide a manual of operational procedures, technical standards, special methods and techniques to guide technical personnel in the *Maintenance of Airway Beacon Facilities*.

#### 1.2 Scope and Application

This publication contains the necessary information for personnel to obtain optimum performance of *Airway Beacons*. This MANOP Unit augments information available in Instruction Books and General Maintenance MANOP Units.

The instructions contained herein shall supersede previous policy and similar directives where conflict occurs.

#### 1.3 Safety

Personnel shall use care in working on *Airway Beacon* equipment. See applicable section of MANOP V-D-4-20 for a comprehensive discussion of safety.

#### 1.4 Related Publications

MTC 3.4.2.1, "Maintenance of Electrical Systems in Buildings."

MTC 3.4.3.4, "Maintenance of Structures."

MTC 3.4.7.2, "Maintenance of Control Devices for Aviation Lighting."

MTC 3.4.7.4, "Focusing and Lamping Procedures for Aviation Lighting."

FAA-TSO-N7a, dated February 5, 1958 and attached National Standard for Aeronautical Beacons.

#### 1.5 Revisions

The methods used in the revision of Maintenance MANOP Units will depend on the extent of the change involved and will range from the issuance of a new page, to the publication of a new edition. Additionally, minor changes and amplification may be issued in the form of a numbered memorandum. Plant Facility Instruction. When necessary for attainment of Agency objectives, the Regional Offices may issue temporary emergency instructions at variance with the MANOP Units. Copies of all such instructions shall be transmitted with a covering memorandum to the Chief, Systems Maintenance Division not later than the time of issuance to the field.

All field personnel are requested to report any errors in this MANOP and to make suggestions for its improvement, expansion or clarification. These reports and suggestions should be transmitted through regular channels to the Regional Office.

Regional Offices shall forward to the Chief, Systems Maintenance Division their recommendations for changes in the MANOP Unit. These recommendations shall be submitted with a covering memorandum explaining the need for the revision. An attachment in the form of a draft of a revised paragraph, or a Plant Facility Instruction as appears most appropriate, will be provided.

### 2.0 CRITERIA AND POLICY

#### 2.1 Lighted Aids to Air Navigation

The necessity of lighted aids for guiding pilots was recognized when night flying was



first contemplated. It must be remembered that in the early 1920's aircraft flew at under 100 miles per hour and at altitudes of less than 3,000 feet. Radio aids were very scarce and pilots navigated their planes principally by sight, lighted aids and magnetic compass only. To promote safety and provide the visual guidance for pilots, lighted Federal Airways routes were established, connecting principal cities in the United States. An airway can be defined as an imaginary strip five miles wide on either side of a center line, or ten miles overall width. The airways are identified by name, color, and number and are in all cases laid out between two large cities, such as Los Angeles-Amarillo (LA-A), or Kansas City-St. Louis (KC-SL). All airways are designated or identified from West to East and South to North. In recent years, due to the increased speed of modern aircraft and operation at higher altitudes, the airways beacons are gradually becoming less effective as a navigational aid and are largely being replaced with electronic equipment. Airway beacons are still being operated and maintained at airports, in mountainous areas and at strategic locations along the Federal Airways and their importance as a navigational aid should not be minimized. Since most of the beacon sites are remotely located, and maintenance schedules widely spaced, a high standard of maintenance is of utmost importance so as to reduce failures to an absolute minimum.

### 2.2 Operation of Beacons

After a facility has been placed in operation on a commissioned basis, it is the responsibility of the Maintenance Technician to continue the facility in operation. Air Traffic Service personnel on duty shall be advised immediately whenever any condition exists which may limit the reliability of the facility, and also, when the facility is restored to normal operation. Interruptions for construction and/or modernization shall be anticipated and published as far in advance as practical.

## 3.0 TECHNICAL CHARACTERISTICS

### 3.1 Purpose and Function

To promote safety and provide the best possible visual aid for guiding pilots along estab-

lished airways. The physical function of the airways beacon as a lighted aid to air navigation is to collect the rays of the light beams from their sources and project them along a desired path. This produces distinctive characteristics in light which enable them to be readily recognized by pilots. The projected light beam is controlled by the arrangement and design optics in such a manner that several distinctive types of light beams are obtained to meet specific requirements.

### 3.2 Description

All air navigation lighting aids have special characteristics so they may be readily recognized by a pilot and impart specific information to the pilot. For this reason, the lighted aids must, of necessity, be of various heights,

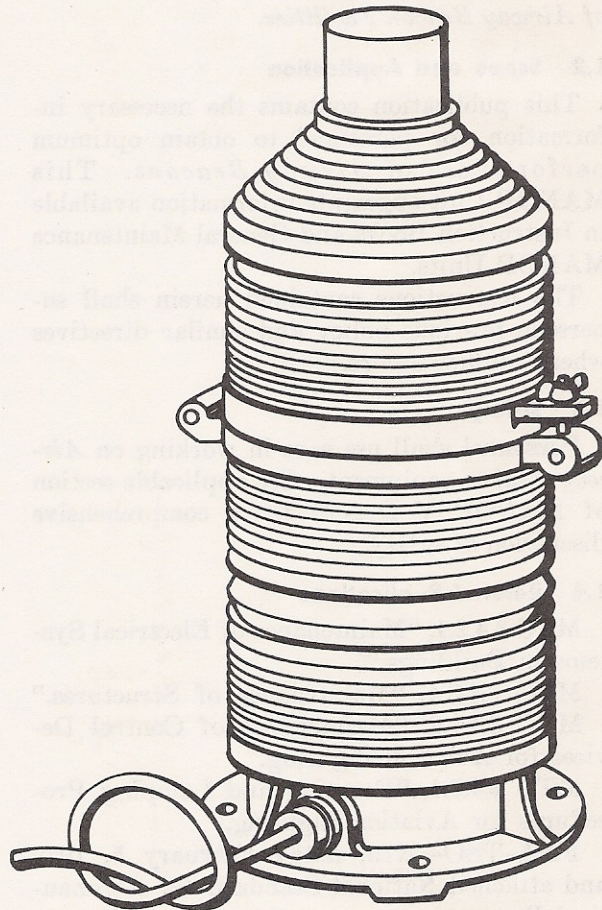


FIGURE 1.—300 mm Electric Code Beacon.



types, and intensity, ranging from 250 to 3,500,000 candle power. The two types of electrified beacons now in general use are the 36-inch, double-ended, 6 rpm, rotating beacon, and the 24-inch, single-ended, 12 rpm, rotating beacon. The three principal manufacturers of the airways rotating beacons are: Westinghouse, General Electric and Crouse-Hinds. All three are similar in construction.

**3.2.1 The 300 mm Electric Code Beacon**

This type beacon (Fig. 1) is used at some locations as an airways beacon and/or marker. However, this code beacon is used primarily as a red flashing hazard marker for major obstructions to air navigation and as a green flashing auxiliary code beacon at airports. The code beacon consists of four Fresnel lens units, arranged to give a definite beam through three-hundred sixty (360) degrees horizontally, from horizontal to the zenith. The light source is two (2) five-hundred (500) watt and/or six-hundred twenty (620) watt lamps which burn simultaneously. The flashing code is obtained

by a motor-driven gear train, which actuates two (2) mercury contacts producing the flashes. For detailed information and/or maintenance procedures on this type beacon see MANOP Units MTC 3.4.2.5 Maintenance of Obstruction Lights, MTC 3.4.7.4 Focusing and Lamping Procedures for Aviation Lighting.

**3.2.2 The 300 mm Acetylene Beacon**

This type beacon (Fig. 2) is presently utilized at very few locations, and is confined to such locations where commercial or other electric power is not available due to prohibitive cost of installation. Maintenance of acetylene lighting equipment requires maintenance methods not applicable in servicing electric-type beacons, therefore, is discussed in detail under separate paragraphs in Section 4.13 of this manual.

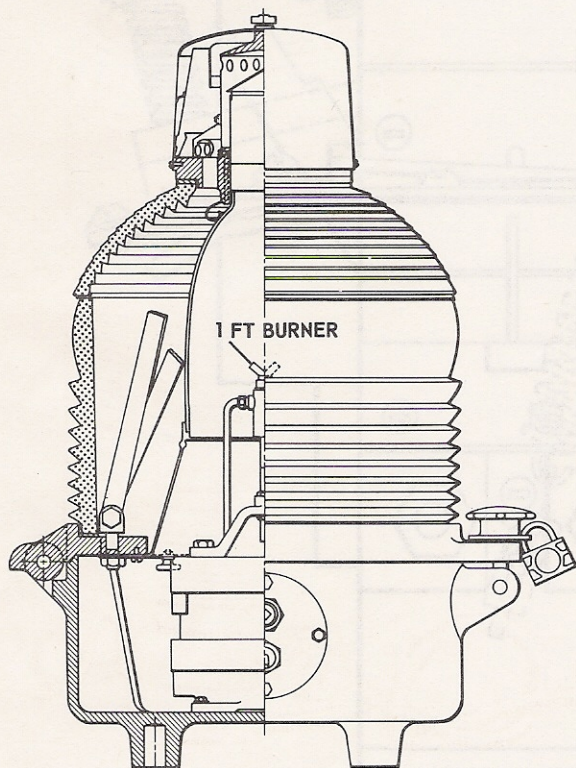


FIGURE 2.—Acetylene Lantern 300 mm.

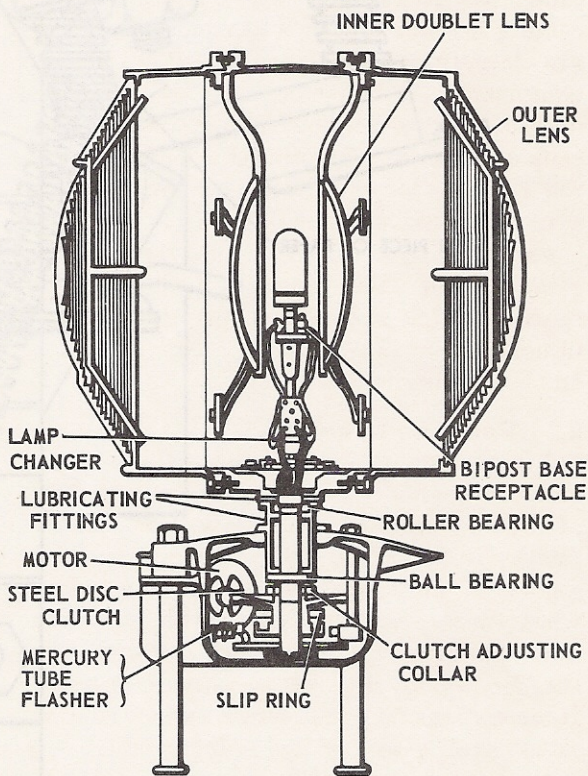


FIGURE 3.—DCB 36" Rotating Beacon.

**3.2.3 Rotating Beacon, 36-Inch**

This double-ended rotating beacon (Fig. 3) is generally used at airports and intermediate



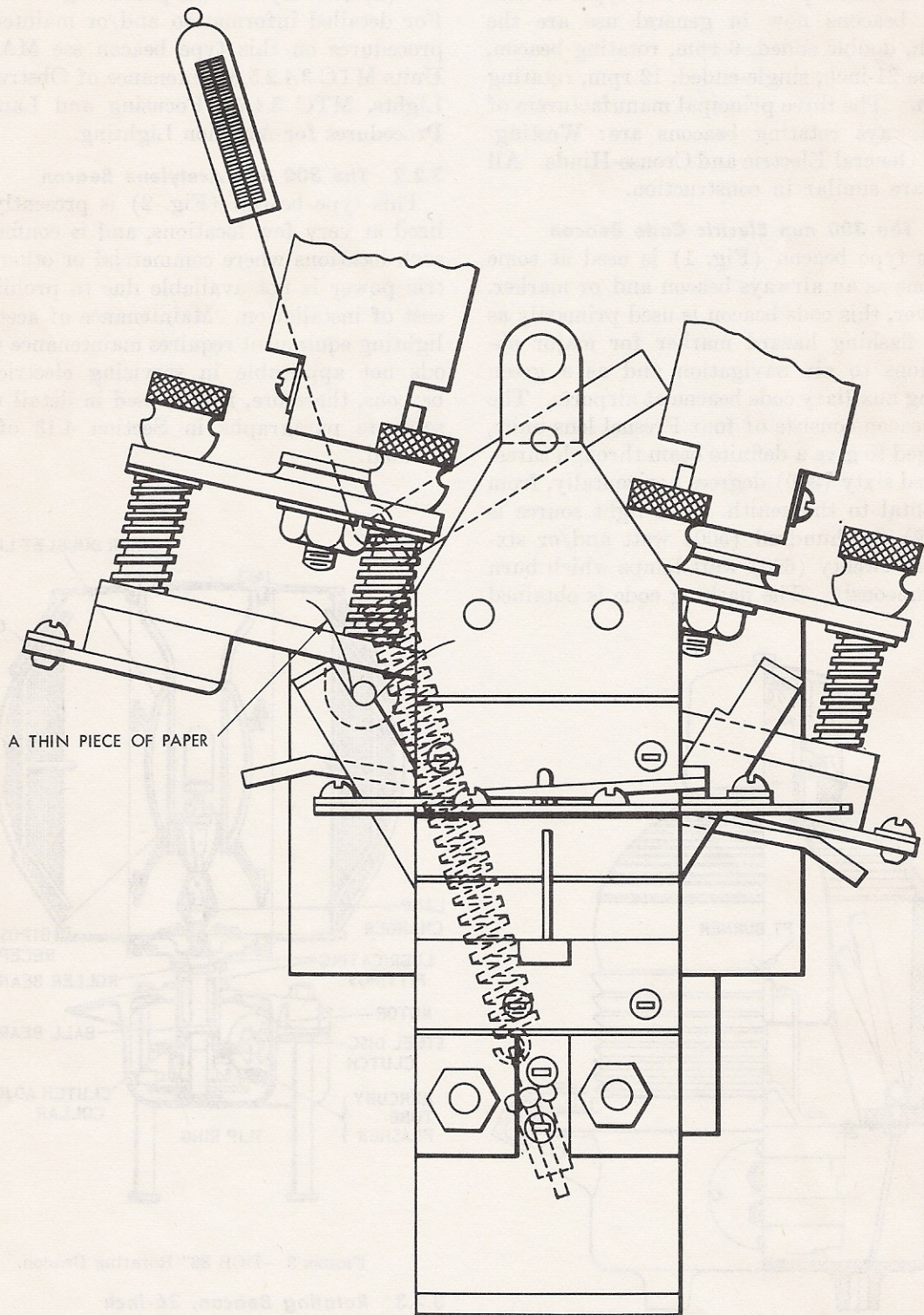


FIGURE 4.—Tilting Type Lamp Changer.



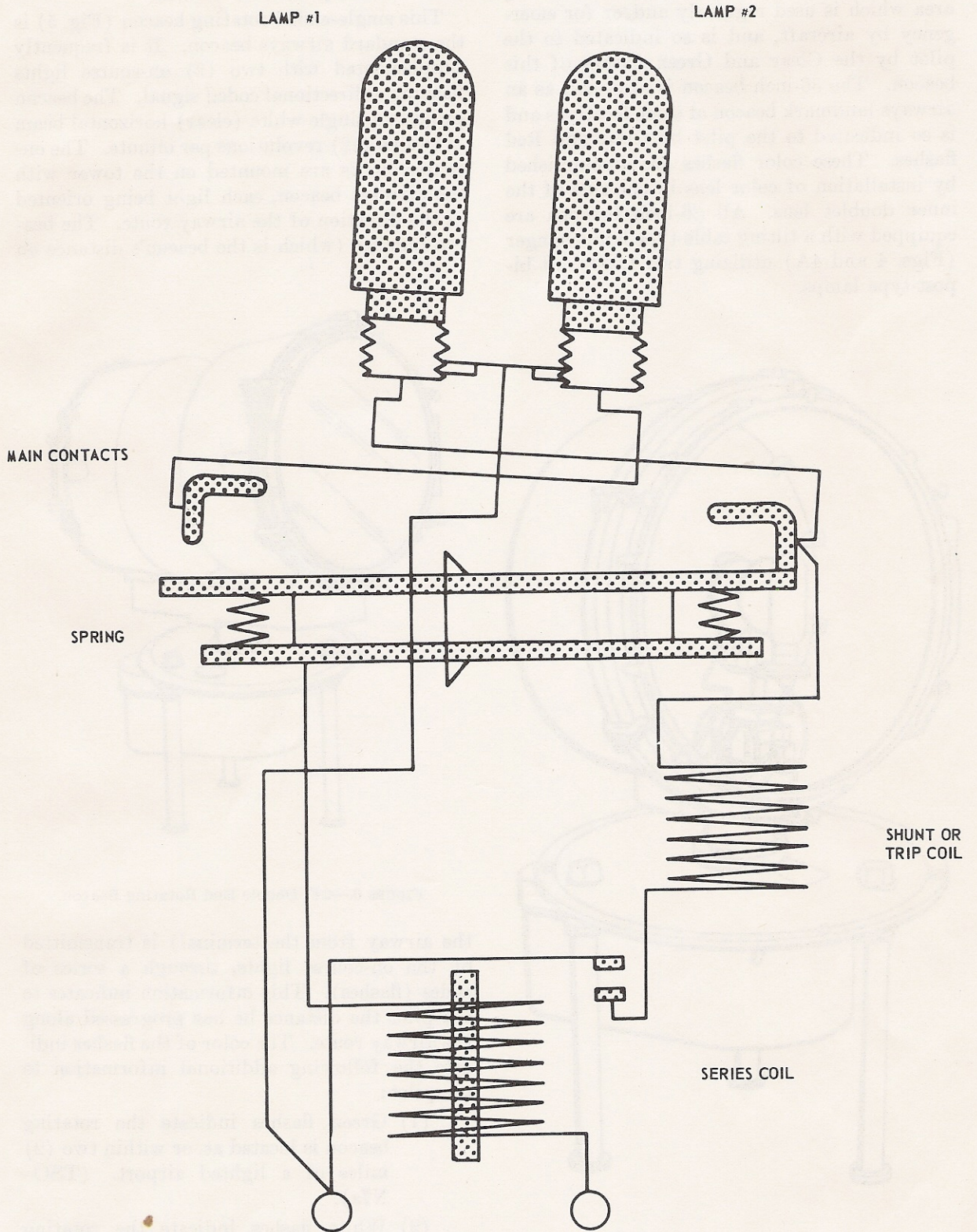


FIGURE 4A.—Wiring Diagram Tilt Type Lamp Changer.



landing fields to identify a suitable landing area which is used regularly and/or for emergency by aircraft, and is so indicated to the pilot by the Clear and Green flashes of this beacon. The 36-inch beacon is also used as an airways landmark beacon at some locations and is so indicated to the pilot by Clear and Red flashes. These color flashes are accomplished by installation of color lens in one side of the inner doublet lens. All 36-inch beacons are equipped with a tilting table-type lampchanger (Figs. 4 and 4A) utilizing two 1,000-watt bi-post-type lamps.

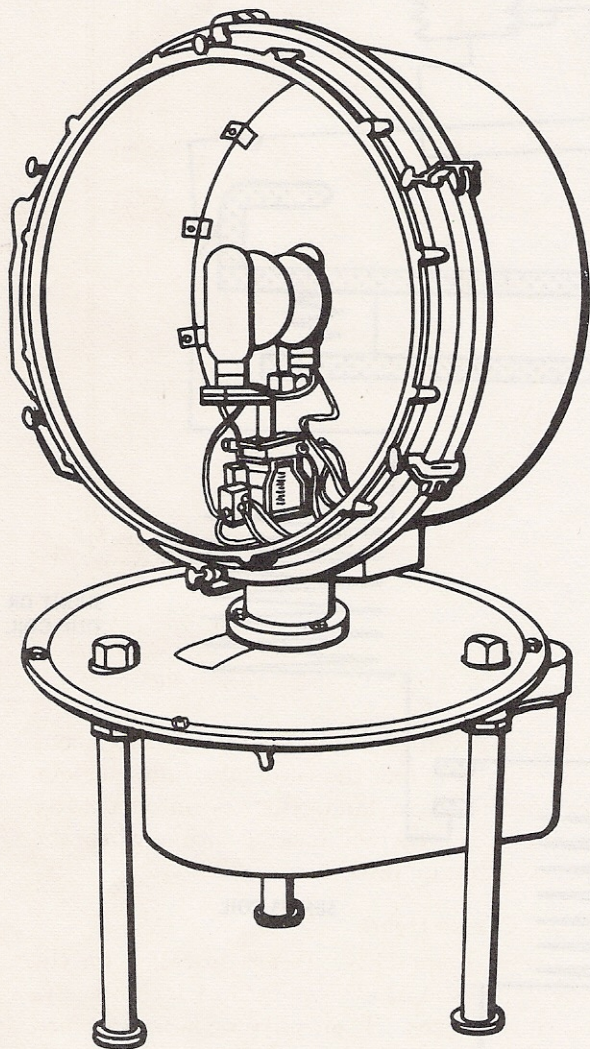


FIGURE 5.—DCB 24" Rotating Beacon.

### 3.2.4 Rotating Beacon, 24-Inch

This single-ended rotating beacon (Fig. 5) is the standard airways beacon. It is frequently supplemented with two (2) on-course lights flashing a directional coded signal. The beacon projects a single white (clear) horizontal beam at twelve (12) revolutions per minute. The on-course lights are mounted on the tower with the airways beacon, each light being oriented in the direction of the airway route. The beacon number (which is the beacon's distance on

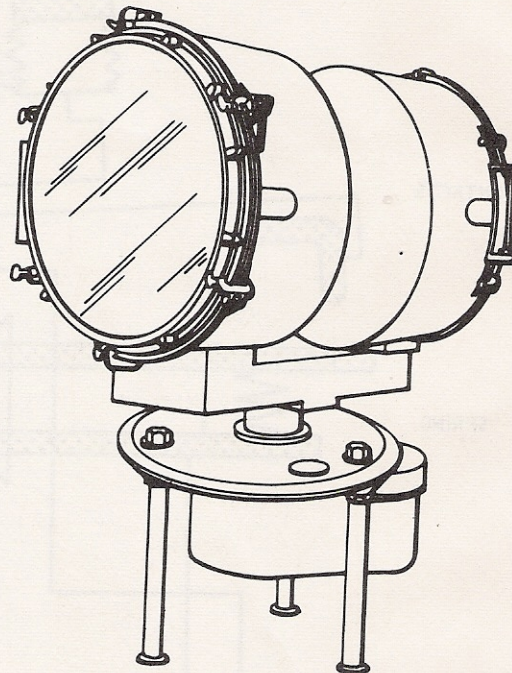


FIGURE 6.—24" Double End Rotating Beacon.

the airway from the terminal) is transmitted by the on-course lights, through a series of codes (flashes). This information indicates to the pilot the distance he has progressed along the airway route. The color of the flashes indicate the following additional information to the pilot:

- (1) Green flashes indicate the rotating beacon is located at, or within two (2) miles of a lighted airport. (TSO-N7a).
- (2) White flashes indicate the rotating beacon is located at, or within two (2)



miles of an unlighted airport. (TSO-N7a).

- (3) Red flashes indicate the rotating beacon is on a Federal Airway and is installed at an isolated location.

**3.2.4.1 Rotating Beacon, 24-Inch, Double-Ended**

This rotating beacon (Fig. 6) is used at some lighted fields in lieu of the 36-inch beacon. It projects beams of light in two horizontal directions, one-hundred eighty (180) degrees apart, and revolves at a speed of six (6) revolutions

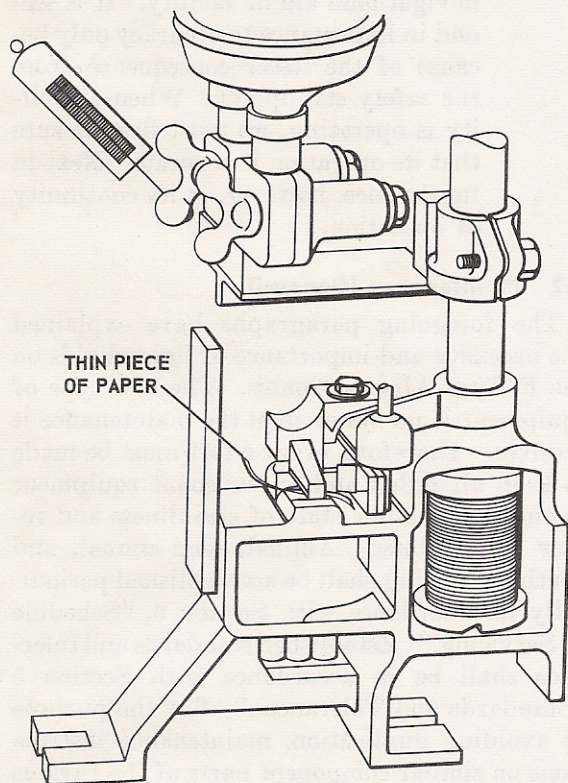


FIGURE 7.—Rotating Type Lamp Changer.

per minute. The primary difference other than the diameter of the lens is that this beacon has a dual light source whereas the 36-inch beacon has a single-light source.

All 24-inch beacons are equipped with either a rotating-type lampchanger (Fig. 7) or a tilting-type lampchanger (Fig. 4) utilizing an auxiliary spherical reflector (Fig. 8) with 500-watt medium bipost-type lamps. Both the 24-

and 36-inch rotating beacons consist basically of a rotating drum and a fixed base, which houses the rotating mechanism, clutch, slip rings (collector rings) and flasher mechanism (when used). The beacon drum houses the op-

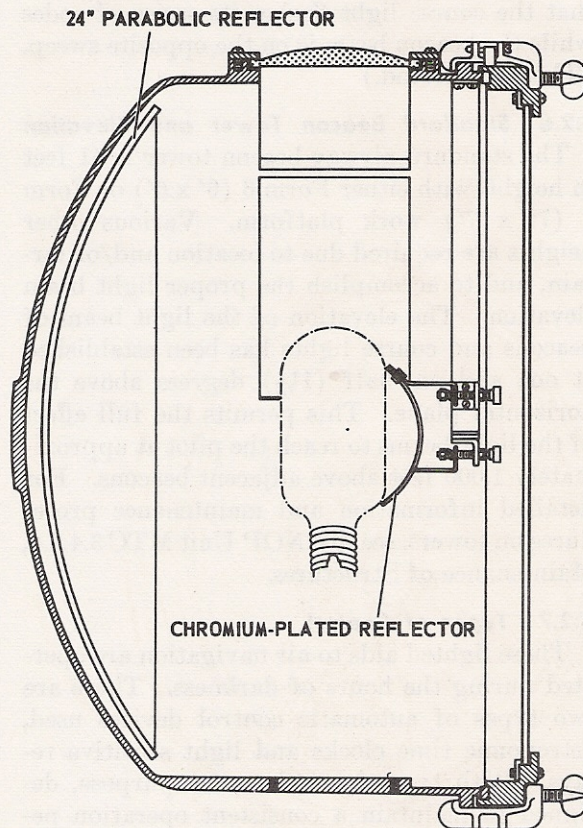


FIGURE 8.—Parabolic and Spherical Reflectors.

tical system which condenses the light to a concentrated beam and the automatic lampchanger provides a spare lamp that is automatically moved to the correct focal position when the operating lamp fails.

**3.2.5 Course Lights**

Course lights (Fig. 9) are installed on the tower platform of all standard 24-inch airways rotating beacons. Their purpose is as described in paragraph 3.2.4. These code flashing lights are eighteen (18) inches in diameter, utilizing the same type 500-watt lamp as used in the 24-inch beacon, and are electrically operated and



controlled by the flashing mechanism code cam located on the bottom of the rotating shaft. The cam moves two actuating arms (one for each course light), each having a mercury tube attached to the actuating arm which makes and breaks the electrical circuit to the course light lamp. The synchronism of the flashes is such that the course light flashes its series of codes while the beacon beam is on the opposite sweep. (The dark period.)

### 3.2.6 Standard Beacon Tower and Elevation

The standard airway beacon tower is 51 feet in height, with either Form 6 (6' x 6') or Form 7 (7' x 7') work platform. Various other heights are required due to location and/or terrain, and to accomplish the proper light beam elevation. The elevation of the light beam of beacons and course lights has been established at one and one-half (1½) degrees above the horizontal plane. This permits the full effect of the light beams to reach the pilot at approximately 1,000 feet above adjacent beacons. For detailed information and maintenance procedures on towers, see MANOP Unit MTC 3.4.3.4, Maintenance of Structures.

### 3.2.7 Types of Control

These lighted aids to air navigation are operated during the hours of darkness. There are two types of automatic control devices used, astronomic time clocks and light sensitive relays. Both types have the same purpose, designed to maintain a consistent operation period in relation to sunset and sunrise. For detailed information and maintenance procedures, see MANOP Unit MTC 3.4.7.2, Maintenance of Control Devices for Aviation Lighting.

### 3.2.8 Electrical Beacons Other Than AC-Type Power

Many existing airway beacons are powered by engine-generated Direct Current (DC). Therefore, the beacon lampchanger coils, time clock coils and beacon drive motor for DC-powered equipment must be designed for use on direct current.

## 4.0 MAINTENANCE PROCEDURES

### 4.1 Maintenance Objectives

The basic objective of all maintenance is to provide for reliability of service of all facilities

under the jurisdiction of the Federal Aviation Agency. The two major factors to be considered in striving for the most reliable service are accuracy and continuity.

- (1) *Accuracy* The word "accuracy" means the accuracy of the information transmitted by a navigational aid or facility as compared to certain established standards. Accuracy is considered of primary importance in all FAA maintenance.
- (2) *Continuity* Continuity can be defined as the uninterrupted performance of a navigational aid or facility. It is second in importance to accuracy only because of the lesser consequence from the safety standpoint. When a facility is operating, we must first be sure that its operation is accurate. Next in importance, however, is its continuity of operation.

## 4.2 Maintenance (General)

The foregoing paragraphs have explained the necessity and importance of lighted aids on the Federal Airways routes. The best type of equipment is no better than the maintenance it receives. Therefore, every effort must be made to keep all lights and appurtenant equipment in the best possible state of cleanliness and repair at all times. Annual, semi-annual, and routine servicing shall be accomplished periodically in accordance with Section 6, "Schedule of Servicing." Established standards and tolerance shall be in accordance with Section 5 "Standards and Tolerances." For the purpose of avoiding duplication, maintenance instructions on similar component parts of the various types of beacons are combined.

## 4.3 Beacon Drums and Course Light Housings

### 4.3.1 Cleaning

Clean the interior of beacon drums and course light housings each time the facility is serviced. The interior of the drums and housings shall be painted flat black. Paint the focusing cross marks white so that they can be readily seen when observed through the focusing peephole.



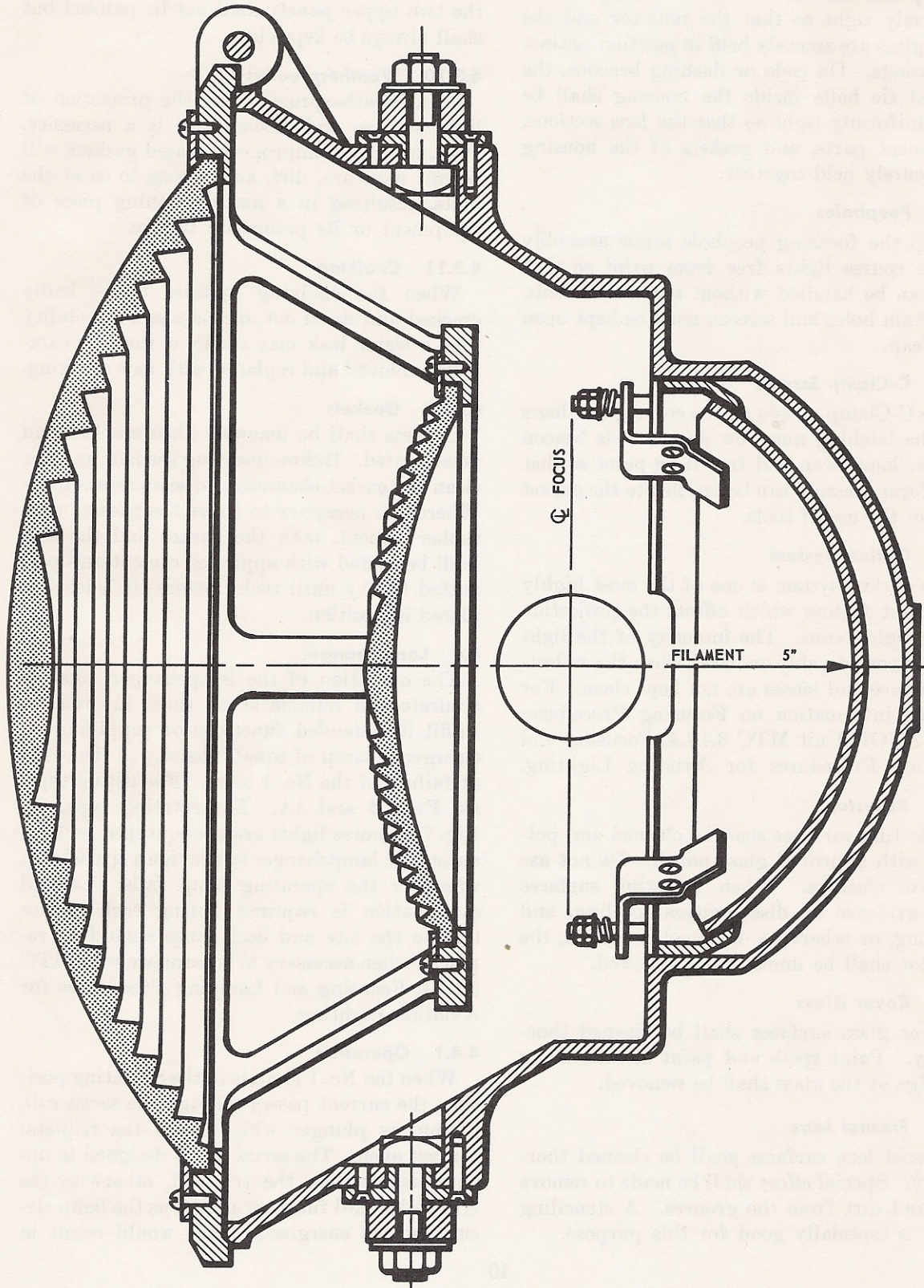


FIGURE 9.—18" Course Light.



#### 4.3.2 Reflector and Cover Screws

Keep the reflector and cover clamp screws uniformly tight so that the reflector and the cover glass are securely held in position against the gaskets. On code or flashing beacons, the vertical tie bolts inside the housing shall be kept uniformly tight so that the lens sections, component parts, and gaskets of the housing are securely held together.

#### 4.3.3 Peepholes

Keep the focusing peephole screw assembly on the course lights free from paint so that they can be handled without the use of tools. The drain holes and screens must be kept open and clean.

#### 4.3.4 C-Clamp Screws

The C-Clamp screws on the cover glass doors and the latching nutscrew on the code beacon shall be kept clean and free from paint so that a uniform pressure can be applied to the gasket without the use of tools.

#### 4.3.5 Optical System

The optical system is one of the most highly important factors which affects the projection of the light beam. The intensity of the light beam is considerably reduced when the reflecting surface and lenses are not kept clean. For detailed information on Focusing Procedures see MANOP Unit MTC 3.4.7.4, Focusing and Lamping Procedures for Aviation Lighting.

#### 4.3.6 Reflector

Reflecting surfaces shall be cleaned and polished with approved glass polish. Do not use abrasive cleaners. When reflecting surfaces show evidence of discoloration, peeling, and checking, or otherwise damaged condition, the reflector shall be immediately renewed.

#### 4.3.7 Cover Glass

Cover glass surfaces shall be cleaned thoroughly. Paint spots and paint streaks along the edge of the glass shall be removed.

#### 4.3.8 Fresnel Lens

Fresnel lens surfaces shall be cleaned thoroughly. Special effort shall be made to remove dust and dirt from the grooves. A stenciling brush is especially good for this purpose.

#### 4.3.9 Zenith Panels

The two lower zenith panels shall be painted; the two upper panels shall not be painted but shall always be kept clean.

#### 4.3.10 Weatherproofing

Good weatherproofing for the protection of light sources and mechanisms is a necessity. Poor, leaky and improperly seated gaskets will permit moisture, dirt, and insects to enter the units, resulting in a malfunctioning piece of equipment or its premature failure.

#### 4.3.11 Caulking

When the caulking appears to be badly cracked and dried out, or there is a possibility that a water leak may occur, it shall be carefully removed and replaced with new caulking.

#### 4.3.12 Gaskets

Gaskets shall be renewed when cracked and deteriorated. Before inserting the new gaskets, clean the gasket channels and seats thoroughly. Where it is necessary to fasten the gaskets with rubber cement, both the gasket and the seat shall be coated with approved cement and permitted to dry until tacky before the gasket is placed in position.

#### 4.4 Lampchanger

The operation of the lampchanger must be accurate and reliable at all times in order to fulfill its intended functions of supplying an emergency lamp of equal intensity in the event of failure of the No. 1 lamp. For tilting type, see Figs. 4 and 4A. For rotating type, see Fig. 7. Course lights are not equipped with an automatic lampchanger to provide a spare lamp whenever the operating lamp fails. Careful examination is required during each service trip to the site and each lamp should be replaced when necessary in accordance with MTC 3.4.7.4, Focusing and Lamping Procedures for Aviation Lighting.

#### 4.4.1 Operation

When the No. 1 lamp is in the operating position, the current passes through the series coil, lifting its plunger which keeps the trip-coil contact open. The series coil is designed to operate faster than the trip-coil, otherwise the trip-coil would function as soon as the lamp circuit became energized. This would result in



the changer being always in the No. 2 position. When the No. 1 lamp fails the series-coil plunger drops and completes the circuit through the contact points to the trip-coil. This raises the trip-coil plunger with sufficient force to release the latch and allow the spring to tilt or rotate the lamp changer into No. 2 position. The No. 2 lamp then becomes the operating lamp, and if properly set and adjusted, will be positioned at the focal point of the optical system.

#### **4.4.2 Clean Contacts**

Main contacts (mechanical) located under the lampchanger table shall be kept clean and polished.

#### **4.4.3 Adjust Main Contacts**

Main contacts (mercury); if necessary adjust the mercury tube holder so that a positive contact is obtained in both the No. 1 and No. 2 positions. This can be accomplished by bending the tube holders the required distance so that the mercury is level at both positions. See that the mercury tube leads are not interfering with the operation of the lampchanger.

#### **4.4.4 Sluggishness**

The movable parts of the lampchanger may become sluggish due to dust or corrosion and will retard its operation to a point where a failure may occur.

#### **4.4.5 Freeness**

Before attempting any adjustment on the spring tension be sure the lampchanger operates freely. If not, disassemble the movable parts, clean them with crocus cloth, apply dry graphite to the cleaned surfaces, and reassemble.

#### **4.4.6 Caution**

Never use lubricant on moving parts as high temperatures in the drum will cause evaporation of the oils leaving a gummy residue.

#### **4.4.7 Spring Tension**

If the lampchanger operation is free and the tension is not sufficient, the tilting or rotating spring should be adjusted so that the lampchanger table will operate with sufficient force to lock in the No. 2 position. Do not set the spring too tightly; this will rotate or tilt the

lampchanger with such force that the lamp filament will be injured and the lamp life considerably shortened. It might also place too much tension on the locking device so that it will not release under the impact of the tripping plunger. When measuring spring tension on tilting table lampchangers, place the table in the No. 1 position. Insert a thin piece of paper between the pawl and the pawl-lock in the latching device. Hook the spring scale directly to the operating arm or table, adjacent to the lampchanger spring. Adjust the spring tension so that the paper previously inserted between the pawl and the latch will release under a seven (7) to eight (8) ounce direct pull applied to the spring scale (Fig. 4).

#### **4.4.8 Latching Device**

Due to frequent operation the notch in the pawl in the No. 1 position of the lampchanger becomes worn and rounded to a point where an involuntary tripping may occur due to vibration. The notch should be squared off with a file and the face and edges smoothed with emery cloth.

#### **4.4.9 Lampchanger Coils and Leads**

Inspect visually coils and leads for damage due to sun reflection. Check all leads for tightness and abrasions; repair or renew as found necessary.

#### **4.4.10 Shunt-Coil Plunger**

Check shunt-coil plunger operation and adjust to proper length, if necessary.

#### **4.4.11 Leads**

It is important that the position of the various leads be adjusted and fastened so that they do not interfere with the lampchanger operation.

#### **4.4.12 Testing**

The lampchanger operation shall be tested by simulating lamp failure at each visit to the site. To accomplish this, remove the single wire from the terminal of the No. 1 lamp socket. Close the circuit to the lampchanger and observe operation. It should be adjusted so that the table will tilt or rotate to the spare position with sufficient force to lock positively.



#### 4.4.13 Adjustments

Special attention should be paid to the adjustment and cleaning of the contact points so that a positive electrical contact is obtained and a proper clearance is maintained. As no mechanical adjustment is provided, the contact arm can be slightly bent to meet the requirement. The importance of this adjustment is stressed because an involuntary contact may occur, due to vibration or line surge, with the result that the lampchanger will prematurely trip to the No. 2 position. Use crocus cloth for cleaning contacts.

#### 4.5 Lamp Servicing

If any lamp, even though still burning, appears to be in a condition which will evidently soon result in failure, such a lamp shall be replaced immediately. Good judgment must be exercised, so that lamps still having useful life are not prematurely replaced.

##### 4.5.1 Lamp Replacement

When examining large-wattage incandescent lamps such as those used in beacons and course lights, special attention shall be given to the following conditions which determine the necessity for their renewal:

- (1) When the interior of the high-wattage lamp has blackened appreciably from the top to about three-fourths of an inch ( $\frac{3}{4}$ "') above the top of the filament. The blackening of the bulk materially decreases the efficiency of the light.
- (2) When the lamp has been blistered by the sun or other causes.
- (3) When the filament is excessively distorted and sagging.
- (4) When the rated lamp life has been attained (see Section 6.0).

##### 4.5.2 Lamp Receptacle

The lamp receptacle for airway beacons and course lights are of the fixed bipost type with one fixed and one floating block. Each block has a wing-head type clamping screw. Before removal of the lamp, the wing-head screws must be loosened sufficiently so that the terminals do not bind when the lamp is removed, thereby causing a possible breakage of the glass.

#### 4.5.3 How to Change Lamp

When replacing the lamp, the screws in the solid block must always be tightened first, then in the floating block. This will eliminate the possibility of cramping the bipost which would result in a broken lamp. When the No. 1 lamp in the beacon is to be renewed, the No. 2 lamp shall be removed from its socket and installed in the No. 1 position. The new replacement lamp shall be inserted in the No. 2 position. Tighten the wing screws by hand, never use pliers or a wrench on them.

##### 4.5.4 Testing

Test the new lamp which has been placed in the No. 2 changer position by tripping lampchanger so that the No. 2 lamp is in burning position and is illuminated for a period of five minutes, in order to ascertain that it is not defective and that it will not result in failure after a few minutes of operation.

##### 4.5.5 Light and Efficiency of Lamps

An appreciable variation (2 volts or more) in the impressed voltage, from the rated voltage of the lamp, will have a very pronounced affect upon the life and luminous efficiency of the lamp (see Section 4.12.3.2).

#### 4.6 Beacon Collector Ring and Brushes

Collector rings must be kept clean and free from arcing. A suitable way of cleaning collector rings is to remove collector ring brushes and run beacon motor only. While beacon is rotating, hold a piece of crocus cloth, treated with a few drops of light oil, against the collector rings. Wipe collector rings with clean rag and replace collector brushes when finished. (Fig. 10.)

##### 4.6.1 Brushes

To prevent severe arcing, the brushes must be properly seated to fit the radius of the collector ring and set to lead or trail at an angle of five (5) to ten (10) degrees, and have sufficient spring tension. At least eighty-five (85) percent of the brush surface areas shall make contact. New brushes can be seated by inserting a piece of light grade sandpaper toward brush, pulling sandpaper back and forth following the contour of the collector ring. Fig. 10 shows method for seating brushes and gauging tension.



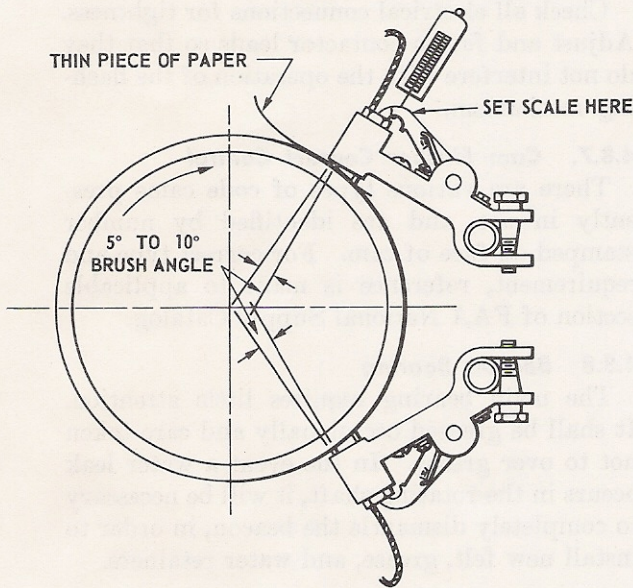


FIGURE 10.—Beacon Collector Ring and Brushes.

**4.6.2 Brush Guides**

Brushholders shall be kept clean so that the brushes and springs are operating freely in the guides. A sticking brush will arc and damage the commutator or collector ring. If brush guides (adjacent to commutator or collector ring) are badly worn, due to side friction of the brush, install new brush guides. Brushes should fit snug in the brush guides without binding. Caution should be exercised when replacing new guides so that they are not reversed as this will prevent removal of brushes for servicing or inspection.

**4.7 Clutch**

The slip clutch is designed to protect the motor and gears from damage in event the drum should not be free to rotate. The tension on all beacon clutches shall be in "foot pounds" drag on the clutch plate.

**4.7.1 Definition**

The drag, foot pounds, is the amount of force required to overcome the friction of the clutch plate when applied one (1) foot from the center of the clutch shaft.

**4.7.2 Tolerance Check**

To check the clutch plate adjustment, the scale should be attached horizontally one (1)

foot out from the center of the beacon shaft (see Fig. 11) and the clutch tolerance adjusted to conform with Paragraph 5.1.5.

**4.7.3 Adjustments**

The following methods describe the appropriate clutch adjustment procedure for the model and type of beacon being serviced.

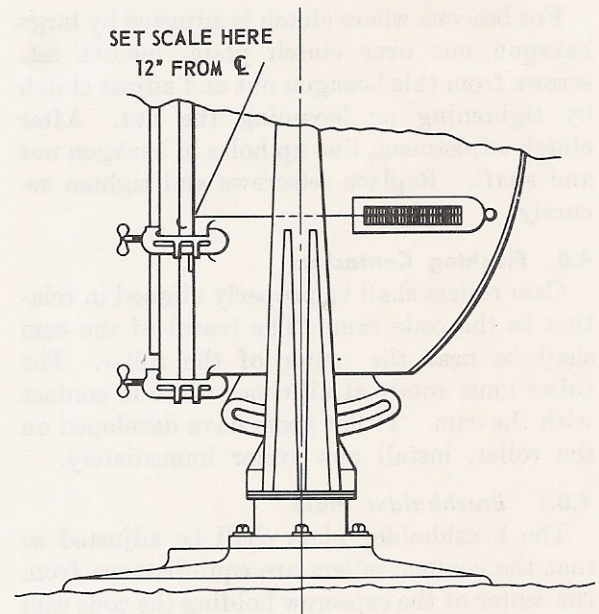


FIGURE 11.—Measuring Clutch Tension.

**4.7.3.1 Method One**

For beacons in which the collector ring support is also the clutch adjusting device, disconnect and remove course light cam, brush holder support plate and collector ring assembly to expose the collector ring support.

*(1) Cleaning before Assembling*

If clutch washer is badly worn, renew. Clean all parts thoroughly. Before assembling the clutch, inspect the wire lugs for tightness; replace lugs if necessary. Tape and shellac wire and terminal lugs. Clean flat portion of terminal lug for good contact.

*(2) Assembly and Adjustment*

Align the adjusting device with holes in the shaft. Insert the set-screws and tighten so that the adjusting device is securely locked. Re-assemble the remaining parts and see that all fastenings are securely tightened.



#### 4.7.3.2 Method Two

For beacons where the clutch is adjusted by a plate under the ring gear, remove the hexagon cap screws located on the top of the ring gear and turn the adjusting plate in the direction necessary for loosening or tightening the clutch. After adjustment is made replace cap-screws.

#### 4.7.3.3 Method Three

For beacons where clutch is adjusted by large hexagon nut over clutch plate, remove setscrews from this hexagon nut and adjust clutch by tightening or loosening the nut. After clutch adjustment, line up holes in hexagon nut and shaft. Replace setscrews and tighten securely.

### 4.8 Flashing Contactors

Cam rollers shall be properly aligned in relation to the code cam. The travel of the cam shall be near the center of the roller. The roller must rotate at all times while in contact with the cam. If flat spots have developed on the roller, install new roller immediately.

#### 4.8.1 Brushholder Plate

The brushholder plate shall be adjusted so that the contact rollers are equi-distance from the center of the capscrew holding the code cam in position.

#### 4.8.2 Mercury Tube Contacts

On mercury tube contacts, adjust the support spring so that a minimum of splashing of the mercury will occur in the tube.

#### 4.8.3 Adjusting the Flashes

Adjust the timing of the flashes so that the course light flashes its code while the beacon beam is on the opposite sweep. (The dark period.)

#### 4.8.4 Brightness

Adjust the contactors so that the filament in the course light lamp reaches its maximum intensity of brilliance for each light period. The eclipse period between the flashes shall be positive without any flickering.

#### 4.8.5 Sign Flasher

Clean sign flasher base, check and maintain oil level in flasher gear case. (Where installed.)

### 4.8.6 Electrical Connections

Check all electrical connections for tightness. Adjust and fasten contactor leads so that they do not interfere with the operation of the flashing mechanism.

#### 4.8.7. Cam Flasher Contact Control

There are various types of code cams presently in use, and are identified by number stamped on face of cam. For correct type and requirement, reference is made to applicable section of FAA National Supply Catalog.

### 4.8.8 Beacon Bearing

The main bearing requires little attention. It shall be greased occasionally and care taken not to over grease. In the event a water leak occurs in the rotating shaft, it will be necessary to completely dismantle the beacon, in order to install new felt, grease, and water retainers.

### 4.9 Motor Servicing

#### 4.9.1 Brushes

On brush type motors, remove brushes and, if worn to  $\frac{1}{3}$  of the original length, new brushes shall be installed.

Before replacing or renewing brushes, polish the surface of the brush, and before installing make sure that the collector ring surface is polished smooth and free from grooves. On D.C. motors, seat the brush to the radius of the armature and, before installing, inspect the armature and mica to insure smoothness and freedom from carbon deposits.

#### 4.9.2 End-Play

Excessive end-play shall be adjusted, depending on the type motor used, as follows:

- (1) To determine the proper tolerance on a ball bearing motor, tighten the thrust-bearing adjustment until a slight drag is felt when the motor shaft is rotated by hand. Then back up the thrust bearing adjustment one-quarter ( $\frac{1}{4}$ ) to one-half ( $\frac{1}{2}$ ) of a turn. This will be the proper clearance.
- (2) On sleeve bearing motors, it will be necessary to hold a small measuring scale against the motor housing adjacent to the drive shaft (worm gear end). Mark a line with a scribe on



the drive shaft, and adjust the end-play of the shaft to one sixty-fourth ( $\frac{1}{64}$ ) of an inch on the scale.

#### 4.9.3 Cleaning

The interior of the beacon drive motor housing will accumulate carbon dust and grease requiring periodic dismantling and cleaning. When cleaning, special attention shall be given to the starting switch, brush-holders and bearings for proper operation. Adjust, clean and renew, if necessary.

#### 4.9.4 Noisy Motor

If motor is noisy, check ball bearings, raceways and balance of armature (33828 G.E. motors). Usually, a chipped ball bearing or scored raceway is the cause. Ball bearings should be cleaned in a solvent to remove old, hardened grease, and repacked with proper grade of grease. When repacking ball bearings, the bearing shall be filled to no more than one-half ( $\frac{1}{2}$ ) its capacity with grease. Clean and polish commutator or collector rings. If necessary, undercut mica, clean with sand paper, and finish by polishing with crocus cloth. When the motor is reassembled, care must be exercised that the endbells are properly aligned. Improper alignment of the endbells can affect both the air gap between the armature and field poles and bearing alignment.

#### 4.9.5 Lubrication

The oil groove on sleeve type motors shall be cleaned to permit the oil to flow freely around the motor shaft. Examine the oil wick to determine if it is soft and pliable and will absorb oil. Wash wick in solvent or replace if necessary.

#### 4.9.6 Alignment

The alignment of the motor worm gear with beacon ring gear must be correctly adjusted to prevent excessive wear and noisy operation, as follows:

- (1) The vertical alignment of the worm gear with the ring gear should be accurately adjusted by either adding or removing proper sized shims between the motor base and the bosses in the beacon base.

- (2) There should be a few thousandths of an inch clearance between the worm gear and the ring gear around the entire perimeter of the ring gear.
- (3) A fairly close check of the alignment can be obtained by removing all grease from a few sections of the ring gear. The area so cleaned should be approximately 2 inches in length, and the sections should be spaced about 45 degrees apart. Rotate the motor shaft by hand and observe closely the imprint left by the worm gear on the cleaned sections of the ring gear. Raise or lower the motor until the imprint of the worm gear is equally distributed over the gear face on the ring gear.
- (4) Keep the collar and nut which secure the worm gear to the motor shaft tightened, so that no backlash or play will occur at this point.

#### 4.9.7 Level

Check the level of the beacon by placing a level on the levelling boss. Remove all paint or other material so that a true level can be obtained. Loosen the hold-down bolts and insert or remove spacer-washers as required for proper level. Check level of beacon in four directions. Tighten down the base.

#### 4.10 Worm and Ring Gears

There are various types of gear combinations required for longer life and quieter operation in the rotating mechanism of the various types of airway beacons, i.e., bronze worm gear for use with micarta ring gear, etc. Therefore, for correct type and requirement, see applicable section FAA National Supply Catalog.

#### 4.11 Cabinets, Fuses, Wiring, Conduits, Service

The interior of the "T" and "G" cabinets shall be kept clean and painted flat black. When interior of cabinet requires painting, care must be exercised that no paint is smeared on the switches or other electrical components inside of the cabinet. Old knock-outs and screw holes which have been left open from previous equipment alterations, shall be plugged to exclude insects and dirt. Door



hinges and locking devices shall be oiled or greased occasionally, so that when the door is closed it will compress the gasket securely and evenly.

#### 4.11.1 Padlocks

Padlocks shall be lubricated with dry graphite powder.

#### 4.11.2 Electrical

Check operation of electrical switch blades and clips for good contact. Switches should have sufficient tension between the blades and hinges, and yet allow freedom of operation. Loose fitting hinges or clips will cause overheating and deterioration of the switch part. Severe overheating can usually be detected by a bluish color of the switch part affected.

#### 4.11.3 Fuses

Fuses shall be checked for good electrical connections in their receptacles, and for correct fusing of circuits. There shall be no fuses in the neutral or grounded circuits.

All circuits shall be fused in accordance with MANOP MTC 3.4.2.1 Maintenance of Electrical Systems in Buildings.

##### 4.11.3.1 Tight Connections

Clean receptacles and fuse body with abrasive cloth to insure a tight electrical connection.

##### 4.11.3.2 Tight Fuses

On renewable cartridge fuses, the component parts of the fuse should be checked for tightness.

#### 4.11.4 Wiring in G-Cabinet

Wiring in G-cabinet shall be maintained in accordance with Drawing D-1965-1.

#### 4.11.5 Wiring

Inspect visually and check for abrasions, breaks, and loose connections. Repair or renew wiring when necessary. All repair patches shall be covered with a suitable insulating cement. Check the position of the wiring and, if necessary, tape several leads together so that they will maintain a neat appearance and will not become jammed in cabinet doors and covers.

#### 4.11.6 Terminal Lugs

Check terminal lugs for tight electrical connection. The cable insulation near the terminal lugs should be wrapped with friction or plastic tape, extending slightly over the lugs. The completed job shall then be covered with insulating cement. The flat portion of the lug shall be cleaned so that a good electrical connection is made. Check visually and renew bushings and insulators if cracked or broken.

#### 4.11.7 Conduit

Inspect the conduit visually for loose supports. If necessary, replace broken fastenings with Wraplock.

##### 4.11.7.1 Traps

Open up water traps that may be plugged with paint or dirt. Standing water in the conduit will soon damage the wire insulation to a point where trouble will occur.

#### 4.11.8 Lightning Rod and Arrestor

Lightning rod and arrestor shall be serviced in such a manner that the minimum possible resistance to ground is maintained at all times.

#### 4.11.9 Approved Methods of Measuring Ground Resistance

For checking lightning protection equipment, resistance of ground rods, etc, the maintenance technician shall follow one of the methods as outlined in MANOP MTC 3.4.2.2, Maintenance of Electrical Distribution Systems.

##### 4.11.10 Installation

Lightning rod and arrestor shall be installed in accordance with Figure 12.

#### 4.12 Power Service

No maintenance of watt-hour meter is required as it is generally the property of the power company servicing the site. However, it should be observed for creeping under no load, as this indicates a faulty meter or a ground in the circuit. In the event this condition is noted, check wiring to busbar and if clear request the power company to repair or replace the meter.

##### 4.12.1 Meter Leads

Check the leads to the meter for tightness and keep the outside of the meter clean.







#### 4.12.2 Voltage Check

The voltage of each lamp assembly shall be carefully checked at the receptacle, under full load operating conditions, each semi-annual servicing period or oftener if conditions warrant. The lamps' rated voltages shall correspond as nearly as possible to the impressed socket voltage. (See Paragraph 5.0)

#### 4.12.3 Power Lines

In many instances, due to long transmission factors and peculiar local conditions, the voltage regulation may be poor and cause voltage variations from 5 to 15 or more volts at the site. Maintenance personnel shall measure the socket voltage under load at 6-month intervals, while the aids are actually in operation and maintain a running record at the facility of the readings obtained.

##### 4.12.3.1 Variations

Where voltage variations are constantly and excessively abnormal, a recording voltmeter should be installed for a period of several days, thereby accurately ascertaining the extent of such variations. Power companies in many instances will gladly make such recordings gratis. Should the voltage variations be excessive (greater than 3 volts, plus or minus) the technicians should make every effort to have the power company remedy this condition. In the event the power company is unable to comply with such a request, the Regional Office should be informed of all pertinent facts in the case so that other corrective action can be taken.

##### 4.12.3.2 Arbitrary Voltage Value

When voltage variations are unavoidable and cannot immediately be corrected, an arbitrary voltage value should be chosen which will be a compromise or middle point between the two extremes of the voltage variations. A lamp rated for this voltage should be used. For example, where the voltage varies from 110 volts to 117 volts, and is usually around 114 volts, a 115 volt lamp should be used. When selecting a lamp to meet the varying conditions, it should be noted that it is more desirable from an outage standpoint, to have a lamp burning most of the time a few volts under

its rated voltage than a few volts over its rated voltage.

##### 4.12.3.3 Engine Generator Power Supply

Voltage fluctuations at these sites are very slight, no more than a few volts, caused by the course light flashing.

##### 4.12.3.4 Engine Generators

Engine generators shall be regulated to deliver 115 volts at the beacon lamp receptacle under load. All adjustments shall be made when the engine and generator have reached their normal operating temperatures; otherwise an incorrect adjustment will be the result.

#### 4.13 Acetylene Code and Route Beacon

The basic assembly of acetylene lighting equipment consists of a lantern with flasher mechanism, sunvalve, a system of piping, including manifold, valves, pressure gauge and acetylene cylinders (accumulators).

##### 4.13.1 Accumulators

The acetylene cylinders (accumulators) provide the energy source for acetylene-operated aids to air navigation.

##### 4.13.2 Accumulators Capacity

Six or more 225 cubic foot, or 300 cubic foot acetylene cylinders are installed in a small 4-by-5 or 5-by-5 foot storage shed, located at the base of the airway tower. Normally, six cylinders are connected through a manifold and pressure gauge to a single feed line (high-pressure, copper-covered steel tubing) up the tower to the lantern.

##### 4.13.3 Sunvalve

The sunvalve is a light actuated and temperature compensated device whereby the main burner supply is turned off in daylight and turned on again at the approach of darkness. When daylight strikes the sunvalve a black cylinder absorbs the light, causing a slight expansion to take place which, through a system of levers, operates a valve controlling the passage of acetylene to the main burner. At installations where the sunvalve is used, a savings of acetylene gas consumption from 20 to 40 percent is obtained.



#### 4.13.4 *Lantern*

The lantern consists of a base, light apparatus and optical element.

##### 4.13.4.1 *Base*

The base houses the light apparatus, filter, supports the optical, and provides for mounting of the sunvalve. Keep the interior of the unit clean; do not allow residue from the burner and pilot light to accumulate and adhere to the metallic interior of the base. Keep the tiebolts and other fastenings uniformly tight.

##### 4.13.4.2 *Optical Element*

The optical element consists of an upper and lower lens. It is hinged to the base to provide access to the interior of the lantern for lighting, testing and regulating. Due to the low intensity light source in acetylene lanterns, it is very important that the optics be kept as clean as possible, in order to derive maximum benefit from the light. Lenses shall be cleaned thoroughly with an approved glass cleaner. Remove paint spots and paint along the edges of the lenses.

##### 4.13.4.3 *Color Screen (Chimney)*

Clean color screen with approved glass cleaner. All scum and soot which has adhered to the interior glassware must be removed. See that the color screen is properly secured.

##### 4.13.5 *Ventilation*

Natural ventilation is provided through screened openings located at the top and in the base. Clean the upper and lower ventilating screens thoroughly so that the lantern is properly ventilated at all times. Lack of sufficient ventilation will smoke up the interior of the lantern and prematurely carbonize the burners.

##### 4.13.5.1 *Light Apparatus*

The light apparatus consists of the flasher mechanism, main burner and pilot burner.

##### 4.13.5.2 *Flasher Mechanism*

The flasher regulator assembly serves the dual purpose of reducing the gas pressure in the storage cylinders (to approx. 100 mm. of water), and releasing the gas to the burners in puffs which correspond to the flashes of

light. The pilot burner is supplied with gas direct from the regulator at an unvarying pressure of 100 mm. (water column).

##### 4.13.5.3 *Flashing Period*

The flashing period is the ratio of light and darkness. The correct proportion is one part light and nine parts eclipse. At this rate, the light is burning only one tenth of the time the beacon is operating.

##### 4.13.5.4 *Regulation*

The rate of flow of the gas to the flasher is regulated by the density of a cotton or asbestos wick. The adjustment of this is by means of a screw or a small hexagon head stud, located on the outside of the beacon housing. The rate-of-flash adjustment is similar, but is located on the outside of the flasher body and operates a lever which regulates the flashes per minute.

##### 4.13.6 *Diaphragm*

In both the flasher and regulator the diaphragms consist of soft pieces of leather which in time will stretch out of shape, become brittle, and crack adjacent to the flasher housing. When this occurs, no proper adjustment of the flasher or regulator is possible.

To correct a condition such as described above, new diaphragms must be installed. Before installation, they shall be well kneaded with neats-foot oil until they are thoroughly pliable.

##### 4.13.6.2 *Filter Assembly*

Filters and screens will in time become clogged due to impurities in the acetylene gas and shall be inspected once a year and renewed if necessary. New screens and filters shall always be installed when diaphragms are renewed.

##### 4.13.7 *Pilot Burner*

The purpose of the pilot light is to ignite the acetylene gas from the main burner, at the termination of each eclipse period. The adjustment of the pilot light is one of the most important adjustments on the beacon and should be made with extreme care. Improper adjustment can cause excessive fuel consumption and blackening of the lantern glassware, which reduces the light output of the beacon.



The pilot flame should be as large as possible, without being luminous. If luminous and high, it will carbonize rapidly and restrict the pilot burner openings to a point where the pilot light may be extinguished due to lack of sufficient acetylene. If too low, it may fail to light the main burner. Either of these two maladjustments would cause the failure of the entire facility.

#### 4.13.7.1 Adjustment

Before satisfactory pilot light adjustment can be made it will be necessary to drain the system of all air. To accomplish this, loosen the pipe connections at the lantern, open the wall mounted shut-off valve and purge all air from the system. Allow flow to continue a few minutes until it is determined that the acetylene has reached the burners and all air expelled from the system.

Light the lantern and observe for a time to be sure that all air is expelled from the system. The presence of air is indicated by a distinct popping of the flame. Turn the regulating screw to the left until a luminous spot appears. (This is an over adjustment). Turn the screw slowly to the right until the luminous spot just disappears. (This is the correct adjustment). In the event of bright daylight or high wind, cover the beacon to prevent over adjustment.

#### 4.13.7.2 Cleaning

To remove pilot burner for cleaning, carefully open clips fixing it to the main burner and gently lift it straight up. Scrape or brush accumulated carbon out of pilot burner socket. Place a small amount of white lead on the pilot burner tube before replacing it. Wipe the surplus white lead off so that it will not clog the pilot tube.

#### 4.13.8 Main Burner

The main burner supplies the gas to the pilot light flame and when ignited, produces the light source for the beacon. The flame should be flat, bright, and have a fishtail shape. All air must be out of the system before the flame will assume its proper shape. (See Figure 13).

##### 4.13.8.1 Adjustment

The method of obtaining the correct sequence of light and eclipse is as follows:

- (a) Slow the rate of flash down to two (2) per minute by use of the adjustment for rate of flash.
- (b) Check the duration of the light period and the eclipse period. The light should burn for three (3) seconds and then be out for twenty-seven (27) seconds. This can be accomplished by the rate of flow adjustment, after which no further regulation in the rate of flow of gas should be made.
- (c) Increase the rate of flashing to conform to the FAA standard characteristic of forty (40) flashes per minute. It takes an appreciable time for the characteristic to reach a constant after an adjustment has been made. The rate of flash shall be checked at each regular visit to the site.

#### 4.13.9 Cleaning

Do not ream holes in burner; this will affect the shape of the flame. Use an instrument for cleaning smaller than the diameter of burner hole. Install new burners when they are badly carbonized, or cracked.

##### 4.13.9.1 Main Burners

Main burners must be carefully handled so that the lava tips are not damaged. In removing main burners, be sure to use a wrench on the boss of the burner tube.

##### 4.13.9.2 Installment

When installing burner, apply white lead to threads. Wipe surplus white lead off so that it will not clog the acetylene tube. Replace the burner in the same manner it was removed. Where two or more burners are used, adjust angle of burners to form a symmetrical pattern. The angle of burners must be such that the pilot light burners will slip snugly into place without forcing.

##### 4.13.10 Sunvalve Maintenance

The sunvalve requires a minimum of maintenance except periodic cleaning of the exterior surfaces and adjustment. Should it be necessary to remove the sunvalve, the sunvalve bypass valve shall be turned to "closed." The lantern will then operate continuously. The sunvalve piping must also be removed and the openings closed with blind plugs.



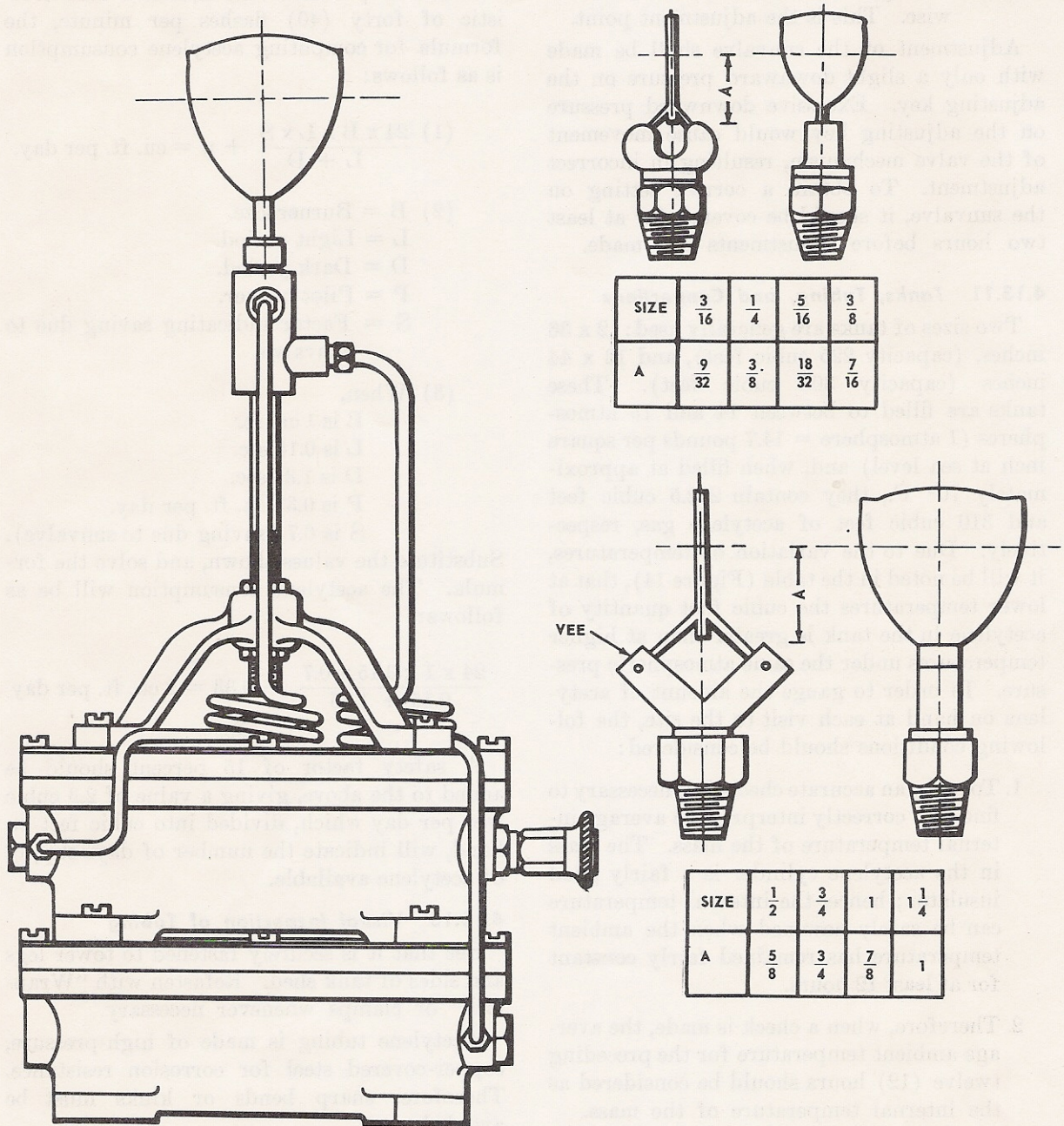


FIGURE 13.—Focal Height of Acetylene Burners.

**4.13.10.1 Adjustment**

With the light operating, proceed with the following adjustments:

- (1) Turn the dial pointer to the right, clockwise, to a point where the light stops operating.
- (2) Turn the pointer an additional forty-five (45) degrees to the right, clockwise.
- (3) Turn the pointer to the left, counter clockwise, until the light just operates. This is the critical point.



- (4) Turn the pointer an additional 15 to 20 degrees to the left, counter-clockwise. This is the adjustment point.

Adjustment of the sunvalve shall be made with only a slight downward pressure on the adjusting key. Excessive downward pressure on the adjusting key would cause movement of the valve mechanism, resulting in incorrect adjustment. To obtain a correct setting on the sunvalve, it should be covered for at least two hours before adjustments are made.

#### 4.13.11 Tanks, Tubing, and Connections

Two sizes of tanks are generally used: 12 x 36 inches, (capacity 225 cubic feet), and 12 x 44 inches (capacity 300 cubic feet). These tanks are filled to between 14 and 15 atmospheres (1 atmosphere = 14.7 pounds per square inch at sea level) and, when filled at approximately 70° F., they contain 232.5 cubic feet and 310 cubic feet of acetylene gas, respectively. Due to the variation of temperatures, it will be noted in the table (Figure 14), that at lower temperatures the cubic foot quantity of acetylene in the tank is greater than at higher temperatures under the same atmospheric pressure. In order to gauge the amount of acetylene on hand at each visit to the site, the following conditions should be considered:

1. To make an accurate check, it is necessary to find and correctly interpret the average internal temperature of the mass. The mass in the acetylene cylinder is a fairly good insulator; hence, the internal temperature can be safely assumed when the ambient temperature has remained fairly constant for at least 12 hours.
2. Therefore, when a check is made, the average ambient temperature for the preceding twelve (12) hours should be considered as the internal temperature of the mass.
3. As an example, using the table shown on Figure 14, the gauge indicates three (3) atmospheres. It is assumed that the temperature for the preceding twelve (12) hours has averaged 50° Fahrenheit. There are six (6) acetylene cylinders connected up. This indicates that there are 282 cubic feet of acetylene gas on hand.

#### 4.13.12 Acetylene Consumption Formula

Based on present FAA standard characteristic of forty (40) flashes per minute, the formula for computing acetylene consumption is as follows:

$$(1) \frac{24 \times B \times L \times S}{L + D} + p = \text{cu. ft. per day.}$$

- (2) B = Burner size.  
L = Light period.  
D = Dark period.  
P = Pilot burner.  
S = Factor indicating saving due to sunvalve.

- (3) When,  
B is 1 cu. ft.  
L is 0.15 sec.  
D is 1.35 sec.  
P is 0.33 cu. ft. per day.  
S is 0.7 (saving due to sunvalve).

Substitute the values shown, and solve the formula. The acetylene consumption will be as follows:

$$\frac{24 \times 1 \times 0.15 \times 0.7}{0.15 + 1.35} + 0.33 = 2 \text{ cu. ft. per day}$$

A safety factor of 15 percent should be added to the above, giving a value of 2.3 cubic feet per day which, divided into cubic feet on hand, will indicate the number of days supply of acetylene available.

#### 4.13.13 Visual Inspection of Tubing

See that it is securely fastened to tower legs and sides of tank shed. Refasten with "Wrap-lock" or clamps whenever necessary.

Acetylene tubing is made of high-pressure, copper-covered steel for corrosion resistance. Therefore, sharp bends or kinks must be avoided.

Connections shall be tested for leaks with soap suds, particularly after new tanks have been installed, or the position of the tubing has been disturbed.

Whenever a connection has been broken or disturbed, new aluminum washers must be used in the connector before it is reassembled and tightened. Apply a thin coating of white lead



Available Acetylene Gas in Cylinders (Cubic Feet at Various Temperatures)

Atmospheric Pressures and Temperatures F.	Type of cylinders	12" x 36"—225 cu. ft.							12" x 44"—300 cu. ft.						
	Number of cylinders	1	2	3	4	5	6	8	1	2	3	4	5	6	8
	Atmos. Fahr.														
2	90	14	28	41	55	69	82	110	19	37	55	73	92	109	147
	70	18	37	55	73	92	110	146	24	49	72	97	123	147	195
	50	24	47	71	94	118	142	188	32	63	95	125	157	189	251
	30	30	60	91	121	151	182	242	40	80	121	161	201	243	323
	10	40	81	121	162	202	242	324	53	108	161	216	269	323	432
3	90	29	58	87	115	143	174	230	39	77	116	153	191	232	307
	70	37	74	110	147	184	220	294	49	99	147	196	245	293	392
	50	47	94	141	188	237	282	376	63	125	188	251	316	376	501
	30	60	120	180	240	300	360	480	80	160	240	320	400	480	640
	10	81	161	242	322	403	484	644	108	215	323	429	537	645	859
4	90	42	85	128	170	213	256	340	56	113	171	227	284	341	453
	70	55	111	165	221	277	330	442	73	148	220	298	369	440	589
	50	71	143	214	286	357	428	572	95	191	285	381	476	571	763
	30	89	179	268	357	447	536	714	119	239	357	476	596	715	952
	10	120	239	359	478	597	718	956	160	319	479	637	796	957	1,275
5	90	57	115	173	230	287	346	460	76	153	231	307	383	461	613
	70	73	147	221	294	367	442	588	97	196	295	392	489	589	784
	50	92	184	276	368	460	552	736	123	245	368	491	613	736	981
	30	120	239	359	478	597	718	956	160	319	479	637	796	957	1,275
	10	157	315	473	630	788	946	1,260	209	420	631	840	1,050	1,261	1,680
6	90	73	146	220	293	366	440	586	97	195	293	391	488	587	781
	70	91	182	273	364	455	546	728	121	243	364	485	607	728	971
	50	115	230	345	460	578	690	920	153	307	460	613	770	920	1,227
	30	149	298	447	596	745	894	1,192	199	397	596	795	993	1,192	1,589
	10	197	394	591	788	985	1,182	1,576	263	525	789	1,054	1,313	1,576	2,101
7	90	87	174	261	348	435	522	696	116	232	348	464	580	696	928
	70	110	220	330	440	550	660	880	147	293	440	587	733	880	1,173
	50	139	278	417	556	695	834	1,112	185	371	556	741	927	1,112	1,483
	30	178	356	534	712	890	1,068	1,424	237	475	712	949	1,187	1,424	1,899
	10	234	468	702	936	1,170	1,404	1,872	312	624	936	1,248	1,560	1,872	2,496
8	90	100	200	300	400	500	600	800	133	267	400	533	667	800	1,067
	70	127	254	381	508	635	762	1,016	169	339	508	677	847	1,016	1,355
	50	160	320	480	640	800	960	1,280	213	427	640	853	1,067	1,280	1,707
	30	205	410	615	820	1,025	1,230	1,640	273	547	820	1,093	1,367	1,640	2,187
	10	271	542	813	1,084	1,355	1,626	2,168	361	723	1,084	1,445	1,807	2,168	2,891
9	90	114	228	342	456	570	684	912	152	304	456	608	760	912	1,216
	70	143	286	429	572	715	858	1,144	191	381	572	763	953	1,144	1,525
	50	182	364	546	728	910	1,092	1,456	243	485	728	971	1,213	1,456	1,941
	30	234	468	702	936	1,170	1,404	1,872	312	624	936	1,248	1,560	1,872	2,496
	10	306	612	918	1,225	1,531	1,836	2,450	408	816	1,224	1,633	2,041	2,448	3,267
10	90	128	256	384	512	640	768	1,024	171	341	512	683	853	1,024	1,365
	70	160	320	480	640	800	960	1,280	213	427	640	853	1,067	1,280	1,707
	50	204	408	612	816	1,020	1,224	1,632	272	544	816	1,088	1,360	1,632	2,176
	30	261	522	783	1,044	1,305	1,566	2,088	348	696	1,044	1,392	1,740	2,088	2,784
	10	341	682	1,023	1,364	1,704	2,046	2,728	455	909	1,364	1,819	2,273	2,728	3,637
11	90	141	282	423	564	705	846	1,128	188	376	564	752	940	1,128	1,504
	70	176	352	528	704	880	1,056	1,408	235	469	704	939	1,173	1,408	1,877
	50	223	446	669	894	1,115	1,338	1,788	297	595	892	1,192	1,487	1,784	2,384
	30	287	574	861	1,148	1,435	1,722	2,296	383	765	1,148	1,531	1,913	2,296	3,061
	10	375	750	1,125	1,500	1,875	2,250	3,000	500	1,000	1,500	2,000	2,500	3,000	4,000
12	90	153	306	459	612	765	918	1,224	204	408	612	816	1,020	1,224	1,632
	70	191	382	573	764	955	1,146	1,528	255	509	764	1,019	1,273	1,528	2,037
	50	244	488	732	976	1,220	1,464	1,952	325	651	975	1,301	1,627	1,952	2,603
	30	314	628	942	1,256	1,570	1,884	2,512	419	837	1,256	1,675	2,093	2,512	3,349
	10	408	816	1,224	1,632	2,040	2,448	3,264	540	1,080	1,620	2,160	2,700	3,240	4,320
13	90	165	330	495	660	825	990	1,320	220	440	660	880	1,100	1,320	1,760
	70	208	416	624	832	1,040	1,248	1,664	277	555	832	1,109	1,387	1,664	2,219
	50	265	530	795	1,060	1,325	1,590	2,120	353	707	1,060	1,413	1,767	2,120	2,827
	30	340	680	1,020	1,360	1,700	2,040	2,720	453	907	1,360	1,813	2,267	2,720	3,627
	10	448	896	1,344	1,792	2,240	2,688	3,584	584	1,168	1,752	2,336	2,920	3,504	4,672
14	90	178	356	534	712	890	1,068	1,424	237	475	712	949	1,187	1,424	1,898
	70	222	444	666	888	1,110	1,332	1,776	296	592	888	1,184	1,480	1,775	2,368
	50	283	566	849	1,132	1,415	1,698	2,264	377	755	1,132	1,509	1,887	2,264	3,019
	30	362	724	1,086	1,448	1,810	2,172	2,896	483	965	1,448	1,931	2,413	2,896	3,861
	10	476	952	1,428	1,896	2,364	2,832	3,776	616	1,232	1,848	2,464	3,080	3,760	4,944
15	90	189	378	567	756	945	1,134	1,512	252	504	756	1,008	1,260	1,512	2,016
	70	237	474	711	948	1,185	1,422	1,896	316	632	948	1,264	1,580	1,896	2,528
	50	300	600	900	1,200	1,500	1,800	2,400	400	800	1,200	1,600	2,000	2,400	3,200
	30	396	792	1,188	1,584	1,980	2,376	3,168	520	1,040	1,560	2,080	2,600	3,120	4,160
	10	512	1,024	1,536	2,048	2,560	3,072	4,096	656	1,312	1,968	2,624	3,280	3,936	5,248
16	90	199	398	597	796	995	1,194	1,592	265	531	796	1,061	1,327	1,592	2,123
	70	250	500	750	1,000	1,250	1,500	2,000	333	667	1,000	1,333	1,667	2,000	2,667
	50	319	638	957	1,276	1,595	1,914	2,552	425	851	1,276	1,701	2,127	2,552	3,403
	30	425	850	1,275	1,700	2,125	2,550	3,400	560	1,120	1,680	2,240	2,800	3,360	4,480
	10	550	1,100	1,650	2,200	2,750	3,300	4,400	710	1,420	2,130	2,840	3,550	4,400	5,860
17	90	208	416	624	832	1,040	1,248	1,664	277	555	832	1,109	1,387	1,664	2,219
	70	261	522	783	1,044	1,305	1,566	2,088	348	696	1,044	1,392	1,740	2,088	2,784
	50	336	672	1,008	1,344	1,680	2,016	2,688	448	896	1,344	1,792	2,240	2,688	3,584
	30	448	896	1,344	1,792	2,240	2,688	3,584	584	1,168	1,752	2,336	2,920	3,504	4,672
	10	584	1,168	1,752	2,336	2,920	3,504	4,672	744	1,488	2,232	2,976	3,720	4,464	5,952

FIGURE 14



to the connector threads, wipe the surplus off so that the tubing will not get clogged.

all times. Always air out any confined space. Acetylene is detectable by a characteristic odor. A three percent mixture is explosive.

4.13.14 Caution

Never use an open flame to check for leaks. See that adequate ventilation is maintained at

5.0 STANDARDS AND TOLERANCES

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0
1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0



5.1 Tabulation of Standards and Tolerances

ITEM	NOMINAL	OPERATING
5.1.1 Beacon Drums -----	(a) Revolutions per minute, 36-inch beacon ----- (b) Revolutions per minute, 24-inch beacon -----	6-RPM. 12-RPM.
5.1.2 Lampchanger -----	(a) Contacts, with series coil energized ----- (b) Spring tension, tilting table ----- (c) Spring tension, rotating table ----- (d) Trip-coil (shunt coil), adjustment -----	$\frac{3}{32}'' \pm \frac{1}{32}''$ . 7½ oz. ± ½ oz. 1 lb., 3 oz. ± ½ oz. (As required.)
5.1.3 Collector Ring -----	(a) Brush, percent of contact area ----- (b) Brush-holder, clearance to rings, where adjustable ----- (c) Brush tension, carbon ----- (d) Brush tension, metite ----- (e) Brush replacement -----	85% minimum. $\frac{3}{32}''$ . 12 oz. ± 2 oz. 2½ lbs. ± ½ lb. (When worn to ⅓ of original length.)
5.1.4 Motor -----	(a) End-play, maximum on ball bearing motors ----- (b) End-play, maximum on sleeve bearing motors -----	0.003-inch. 0.012-inch.
5.1.5 Clutch -----	(a) Clutch-drag, 36-inch and 24-inch beacon, foot-pounds --	13 f.p. ± 2 f.p.
5.1.6 Flashing Contactor --	(a) Mercury tube contacts, (adjusted to minimum splashing of mercury)	(As required.)
5.1.7 Electrical -----	(a) Terminal lugs, where replacement is required, the use of currently approved type connectors shall be used. (b) Voltage, variations in operating voltage under load shall not exceed.	(As required.) 3 volts ±.

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**6.0 MAINTENANCE SCHEDULE OF SERVICING**

For maximum reliability of service, schedules for the performance of maintenance should be on the basis of experience and/or rated lamp life expectancy i.e., 1000 watt lamp, type IM/T20BP, common to 36-inch beacons, 500 hour lamp life; the 500 watt lamp type T-20/13-120, common to 24-inch beacons and course lights, 500 hour lamp life. However, the rated lamp life can be expected only under ideal conditions and upon exact determination of the number of hours of operation. Ideal conditions are seldom, if ever, encountered and hours of operation cannot readily be determined as not all beacons are operated nightly from 15 minutes before sunset to 15 minutes after sunrise. In areas where conditions of poor visibility are frequent, it is sometimes desirable to operate beacons during day light hours as well as at night. Beacons so operated are equipped with light-sensitive photocell devices and adjusted so that the lamps will burn when the north sky light intensity level falls to approxi-

mately 35 foot-candles, and turn off at north sky light intensity level of 58 foot-candles. In other instances, beacons are equipped with Astronomic Time Switches which regulate the hours of operation.

Therefore, in lieu of lamp life expectancy, the Service Schedules set forth herein are based on average conditions and experience.

**6.1 Service Schedule**

The Service Schedules are divided between the Commercial Power, (A Type), airways beacon and the Prime Power, (B, BR, BRA, type) airways beacon facilities. This means that all Commercial Power Beacon facilities shall be serviced at forty-five (45) day intervals and the Prime Power Beacon facilities serviced at thirty (30) day intervals during engine-generator scheduled service.

All items covered under Maintenance Procedures in this Unit shall be accomplished during each servicing period, except those items indicated as semi-annual and annual.



Equipment	Routine 30/45 Day	Semi- Annual	Annual
Beacon Drums and Course Light Housing, para. 4.3.1 through para. 4.3.4 -----	X		
Optical System, para. 4.3.5 through para. 4.3.9 -----	X		
Weatherproofing, para. 4.3.10 through para. 4.3.12 -----	X		
Lampchanger, para. 4.4 through para. 4.4.13 -----	X		
Lamp Servicing, para. 4.5 through para. 4.5.5 -----	X		
Beacon Collector Rings and Brushes, para. 4.6 through para. 4.6.2 -----	X		
Clutch, para. 4.7 through para. 4.7.3.5 -----	X		
Flashing Contactors for Course Light, para. 4.8 through para. 4.8.7 -----	X		
Beacon Bearings, para. 4.8.8 -----			X
Motor, brush type, A.C. and D.C., para. 4.9, 4.9.1, 4.9.2, 4.9.6 ----	X		
Check Level of Beacon Base -----		X	
Cabinets, (G and T type), para. 4.11 through para. 4.11.3 ----	X		
Cabinets, (G and T type), para. 4.11 through para. 4.11.6 ----		X	
Conduit and Traps, para. 4.11.7 and para. 4.11.7.1 -----		X	
Lightning Rod Arrestor, para. 4.11.8 (Replace as required) ----	X		
Lightning Rod and Arrestor, para. 4.11.8 through para. 4.11.10 --			X
Power Service, para. 4.11.12 and para. 4.11.12.1 -----	X		
Voltage Check, para. 4.11.13 through para. 4.12.2 -----		X	
Acetylene Code Beacon, para. 4.13 through 4.13.14. Except para. 4.13.6.2 -----	X		
Filter Assembly, para. 4.13.6.2 -----			X
Electric Code Beacon, all applicable items -----	X		

**6.2 Working Equipment**

Miscellaneous small hand tools which can be used in the maintenance of an Airway Beacon facility. These include but are not restricted to:

- Screwdriver assortment.
- Set of small open end wrenches, (midget).
- Set of open end and box wrenches (up to 7/8 inch).
- Wrenches, adj., 6", 8", 10".
- Bearing puller (small size).
- Long nose pliers.
- Diagonal cutting pliers.
- Grease gun (small size).
- Can, oiler (small size).
- Knife, electricians.
- Spanner wrenches.

(a) Crouse-Hinds No. HL232, for DCB24" Beacon.

(b) Crouse-Hinds No. HL-P591, for DCB36" Beacon.

- Bag, tool, canvas or leather.
- Brushes, paint, 1" and 3".
- Hammer, ball-pein, 8 oz.
- Pliers, combination, slip joint, 6".
- Weed cutter.
- Flashlight, Cell, Eveready #950, or similar.
- Fuse puller and tester (small size).

**6.3 Test Equipment**

Miscellaneous test equipment which can be used in the maintenance of Airway Beacon facility. These include but are not restricted to:

- Voltmeter, clamp-on type, (small).
- Voltmeter, AC-DC, 2 scale, 0-150-300v w/case and leads.
- Scales, pull, 0-25 lbs., graduated in lbs.
- Scales, pull, 0-32 oz., Teletype Corp. Part #2727.



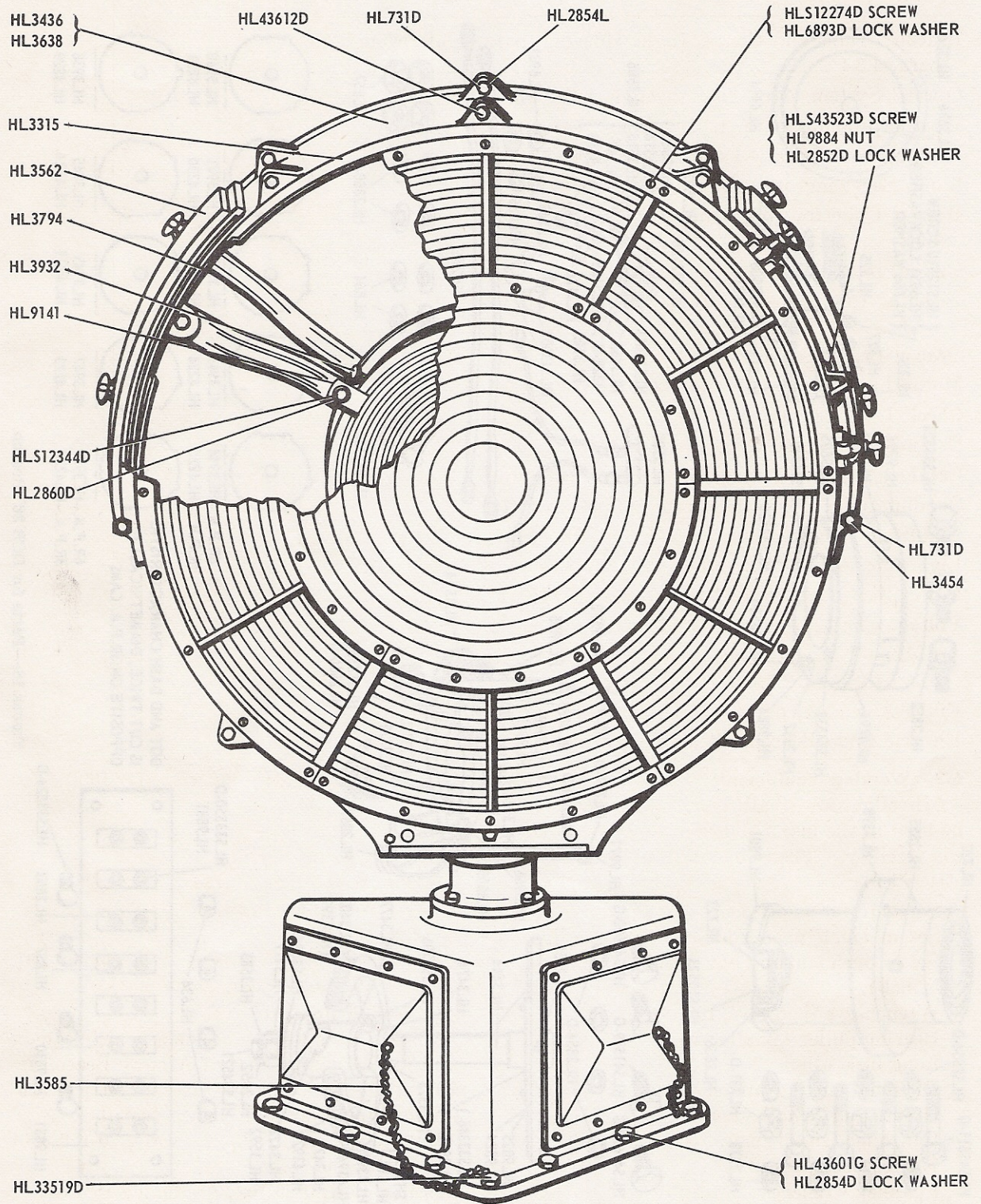


FIGURE 15.—Parts for DCB 36" Beacon.



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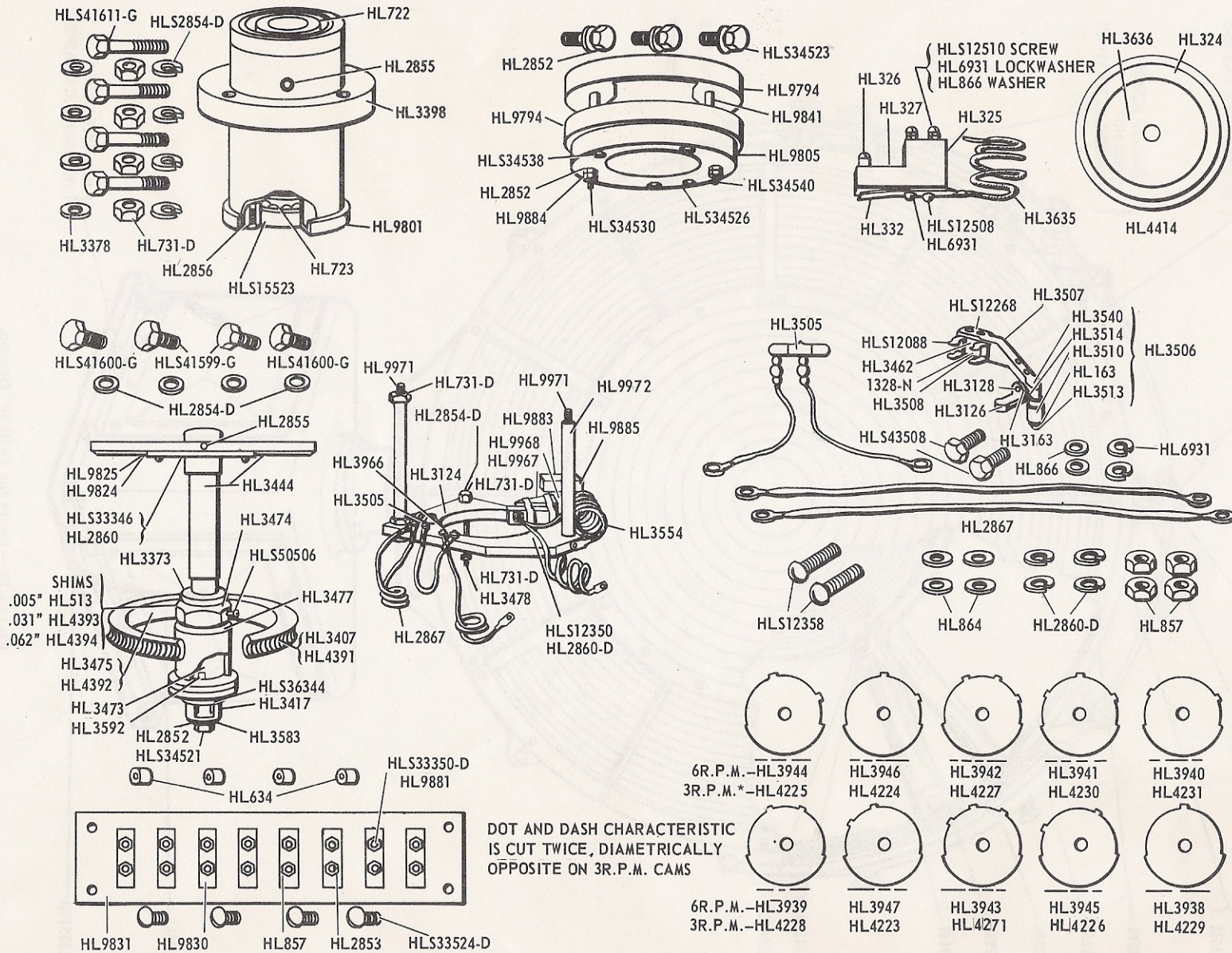
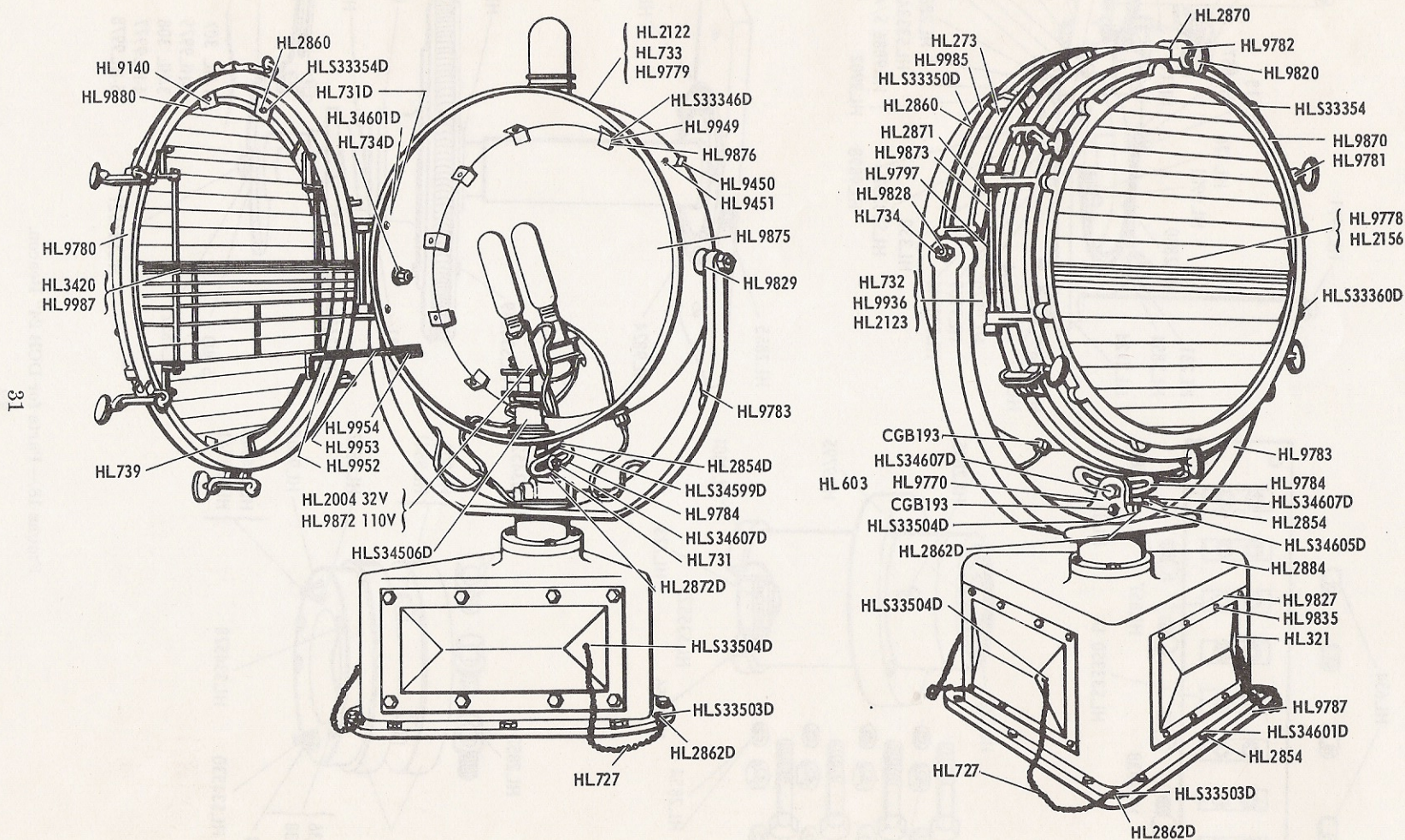


FIGURE 16.—Parts for DCB 36" Beacon.





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FIGURE 17.—Parts for DCB 24' Beacon.



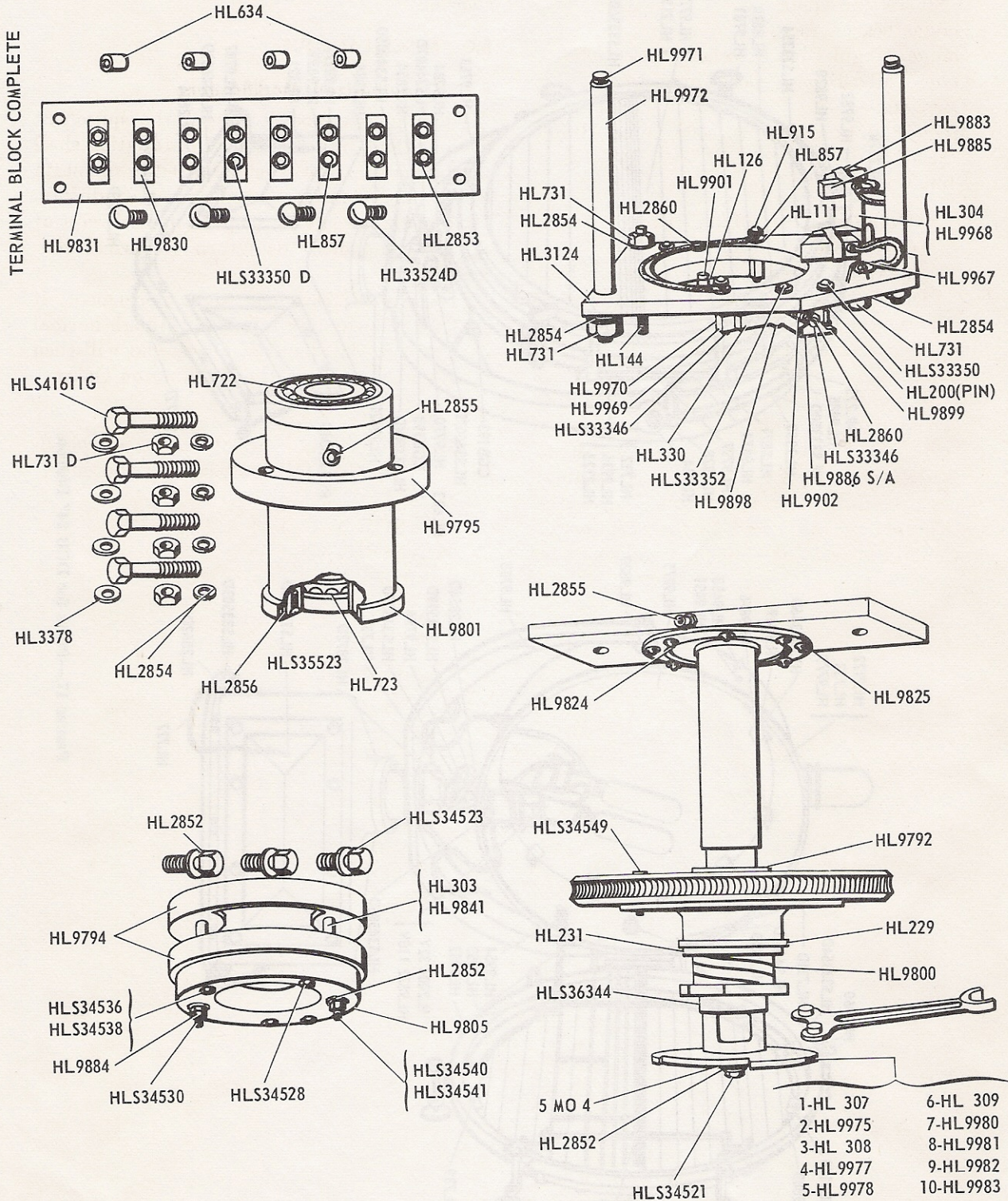


FIGURE 18.—Parts for DCB 24" Beacon.



- Gauge, feeler, 5-inch, .0015-015, (8 leaf), Starrett or equal.
- Gauge, beacon focusing, w/case.
- Gauge, Mogul Bipost, socket pre-set.
- Gauge, Med-Bipost, socket pre-set.
- Level, abney 6".
- Megger, ground tester, 0-300 ahms, Biddle #563.
- Stop watch.

**7.0 PREVENTIVE OR CORRECTIVE MAINTENANCE**

Preventive or corrective maintenance is basically defined as all maintenance performed to prevent equipment failure. Good maintenance practice demands that prompt and effective action be taken to correct any condition which may detract from the efficiency and reliability of a navigational aid. For the purpose of avoiding duplication of maintenance instructions, reference shall be made to the Maintenance procedures section of this Unit. Also see Figures 15, 16, 17 and 18 for parts breakdown and illustrations of major components for

the older type 36-inch and 24-inch airway beacons.

**8.0 MISCELLANEOUS**

**8.1 Unauthorized Modifications**

Unauthorized modifications to the equipment or deviations from the initial installation shall not be made except when required to maintain service due to failure or emergency conditions. Modifications shall be removed upon receipt of correct components or return to normal conditions.

If the modification is to be permanent, it shall be immediately referred, through normal channels, to the Regional Office who will then obtain a waiver from the Washington Office.

**8.2 Recisions**

The following is a list of the known publications this MANOP Unit cancels and supercedes:

- MANOP V-D-4-11
- MANOP V-D-4-14



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