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DEVELOPMENT OF A GASEOUS TUBE DIRECTIONAL TAXI-WAY MARKER LIGHT

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DEVELOPMENT OF A GASEOUS TUBE DIRECTIONAL TAXI-WAY MARKER LIGHT

SUMMARY

This report describes the development of a taxi-way marker light designed to indicate to pilots the exact location of the taxi-way without requiring a pilot to see more than one light of an installation at a time.

Twenty of these lights have been installed at Weir Cook Municipal Airport, Indianapolis, Indiana. Operating an average of 12 hours per night, the entire system will consume approximately 10 KWH per night, or in the neighborhood of 30 cents worth of electrical energy per 12-hour period.

This light consists of an elevated unit which stands 21 inches high, has plexiglass windows, and is provided with a frangible base coupling, disconnecting plug and switch. The operation of the latter is governed by the one-piece top, removal of which opens the switch.

Preliminary tests and observations indicate that the light can be readily recognized. Due to their flexibility of structure, when these units are struck by planes, they usually suffer only fractured couplings, broken lamps and some dents. A number of these, carelessly damaged by small planes parked near the taxi strip, were straightened out and put back into service. No damage to the small planes was reported. There were 41 cases reported of lights being hit before one cover was damaged too badly to be straightened out. This matter of breakage is particularly vexing at Indianapolis as many small planes are parked along the taxi strip. Such parking is not a general practice over the country.

INTRODUCTION

At present most taxi-way marker lighting is accomplished by means of standard flush contact or runway lights modified by aviation blue glass color screens so that the unit appears to the pilot as a dim blue light regardless of the angle or position from which the light is observed. Thus, on a dark night or one with restricted visibility, a pilot taxiing his plane along a taxi-way using such lights, with their all-way type of distribution, can easily miss a turn in the pavement, and taxi the plane between a pair of lights on the same side of the taxi-way on to soft ground or mud. Such a mishap can have serious consequences or cause undesirable delay. Furthermore, the blue color screens are inherently inefficient, screening out and wasting a large proportion of the total generated light.

With the gaseous tube directional taxi-way marker light developed at the C.A.A. Experimental Station, it is proposed to use a high current, relatively low voltage, blue fluorescent gaseous tube light source bent into a V-shape and so installed in an elevated lighting fixture that the point of the V is always towards the taxi-way. Thus the pilot will always have a definite indication as to the location of the taxi-way.

EQUIPMENT AND INSTALLATION

After observation of the continued economical and successful performance of relatively high current low voltage gaseous tubes in an experimental boundary lighting system at Aretz Airport, Lafayette, Indiana,[1] it was decided to use the same type of gaseous tube for an experimental taxi-way lighting system.

Consequently a development contract was negotiated with the tube designers, the Leland Electric Company of Dayton, Ohio. Under terms of this contract the Government was furnished 20 of the gaseous tube taxi-way lights complete with tubes and ready for operation. The lighting unit is illustrated in figure 1

A 120-volt multiple distribution system was selected for supplying power to these units, as they are so designed that a relatively wide variation in voltage due to line drop has little effect on the operation. The installation was made with No. 10 and No. 12, 600-volt single-conductor trenchwire plowed in with a cable plow, as illustrated in figure 2.

The lighting unit shown in figure 3 with cover removed, consists of a transformer, fuse block, capacitor for correcting the power factor, safety switch and a blue gas-filled tubular light source which is held in place by fuse clips. The component parts are mounted on a frame-work which is protected by a removable one-piece cover with plexiglass windows. Removal of this cover operates a switch to open the circuit to the transformer during maintenance. The windows are held in place by means of a self-sealing weather-strip developed by the Inland Division of General Motors Corporation.

A polarized plug and receptacle are enclosed in the fracture coupling so that if the unit is struck and knocked off the base, the electrical circuit will be disconnected at the same time without any live high voltage wires left hanging loosely. See figure 4.

Reflectors were originally provided with these lights, but tests showed that with these the effect was that of a lighted area rather than that of a bent line. After the reflectors were removed, the desired sharp, clearly-defined V-appearance resulted.

Although some question has been raised as to whether or not the units could be a little less bright for better results, nothing is being done to reduce the brightness until comments have been received from more pilots. No difficult problem is involved in reducing the brightness if such action is found to be necessary.

The lamp, or tube, shown in figure 5, which is designed for cold

[1] Gilbert, M. S., "A Low Cost Boundary Lighting System For Small Airports," Technical Development Report No. 53, December 1946.

cathode operation, is made of lead glass, 20 mm. diameter, with a 3-inch radius at the 60-degree bend.

The interior of the tube is coated with blue calcium tungstate fluorescent phosphor. At each end are the tungsten filaments which serve as the electrodes. These are especially designed for the desired current characteristics of the tube. During the manufacturing process the tube is exhausted and filled with argon gas at low pressure. To this is added a small amount of mercury which provides the proper spectral radiation for energizing the phosphor.

The current consumption of the lamp is 105 milliamperes and normal operating voltage is 190. In starting the lamp less than 500 volts are required.

The transformer is rated at 50 volt-amperes and consumes 0.45 amperes at 115 volts. Both 110-volt and 220-volt primary taps are provided.

An 8 mfd. condenser is connected across the transformer to correct the power factor to 85 per cent plus.

Tests made at the National Bureau of Standards show the bare tube to have a brightness of approximately 5 candles, for a 6-inch length. Candlepower of the unit is somewhat higher, as shown in the curve, figure 7.

The color of the lamp is within the specified requirements for aviation blue. See figure 8.

The units were spaced approximately 200 feet apart, some 10 feet from the pavement and some (where the taxi access strips are very narrow) approximately 15 feet away from the pavement. A sketch showing the location of the lighting units and wire is shown in figure 6.

OPERATING COSTS

The operating cost of these taxi-way lights is very low as the power consumption of the individual unit is approximately 44 watts. At the present writing the lights have been operating 12 hours nightly for approximately 60 nights or about 720 hours without any burn-outs. No data is yet available on the life of the tubes, but it is estimated that they will continue to operate for well over 3000 hours without burn-outs. Results of life tests and production costs will of course determine lamp maintenance costs. Such costs should not prove excessive.

CONCLUSION

In view of the results obtained with this experimental type of taxi-way lighting, gaseous tube directional taxi-way lights should be seriously considered for future use on large airports.

They have been easily seen and interpreted by various pilots and are being received with enthusiasm by the airline pilots who have thus far reported.

It has been found that these lights clearly point out the location of the runway and by the nature of their design make it possible to use a pattern of lights requiring fewer units then under the present standard practice.

While experience with this new type of taxi-way light will help in developing a satisfactory pattern, increased production should help in reducing the costs, so that both first cost and maintenance are expected to be well within the budgetary capacity of any airports requiring their use.

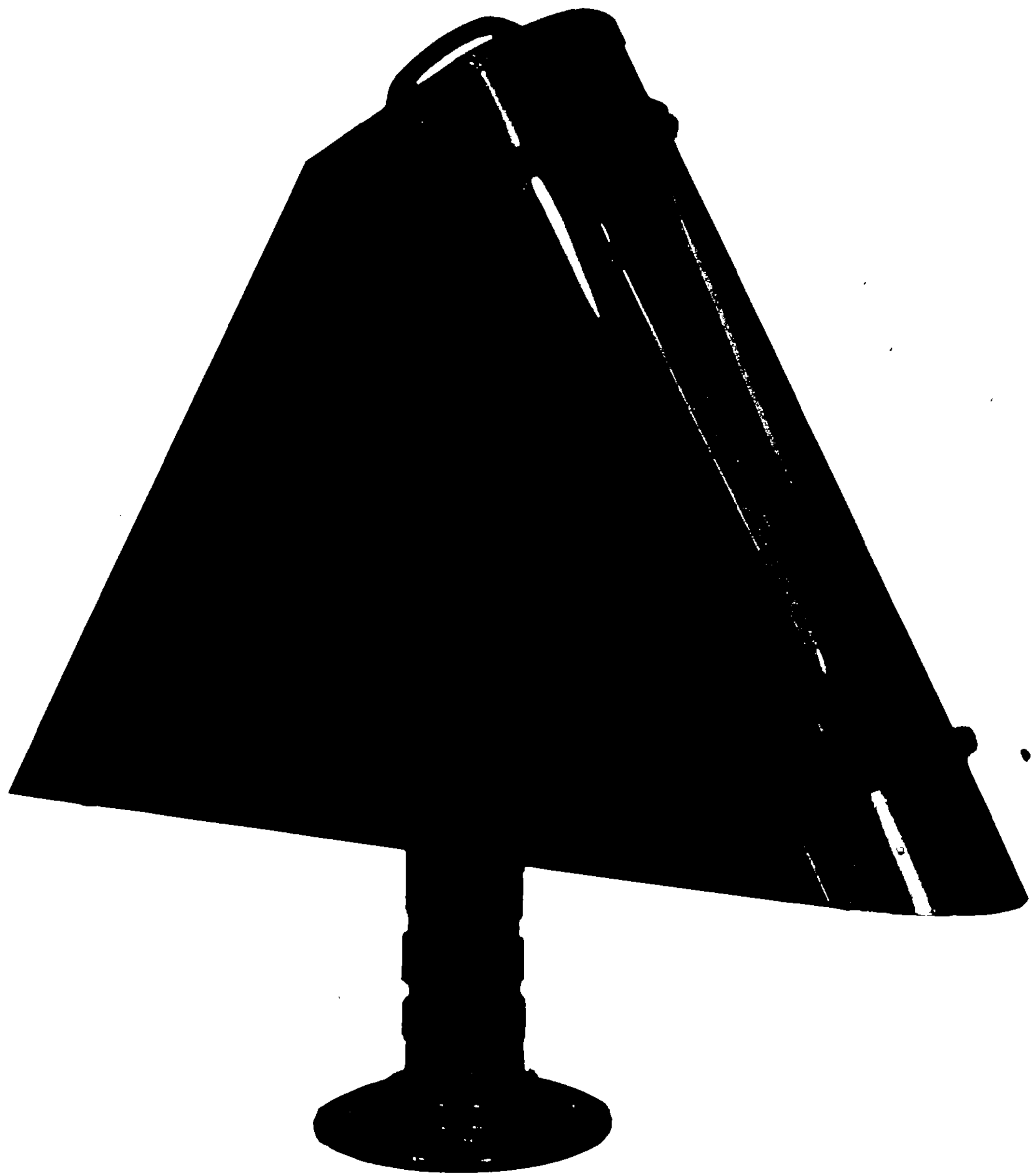

FIGURE 1. GASEOUS TUBE DIRECTIONAL TAXI-WAY MARKER LIGHT

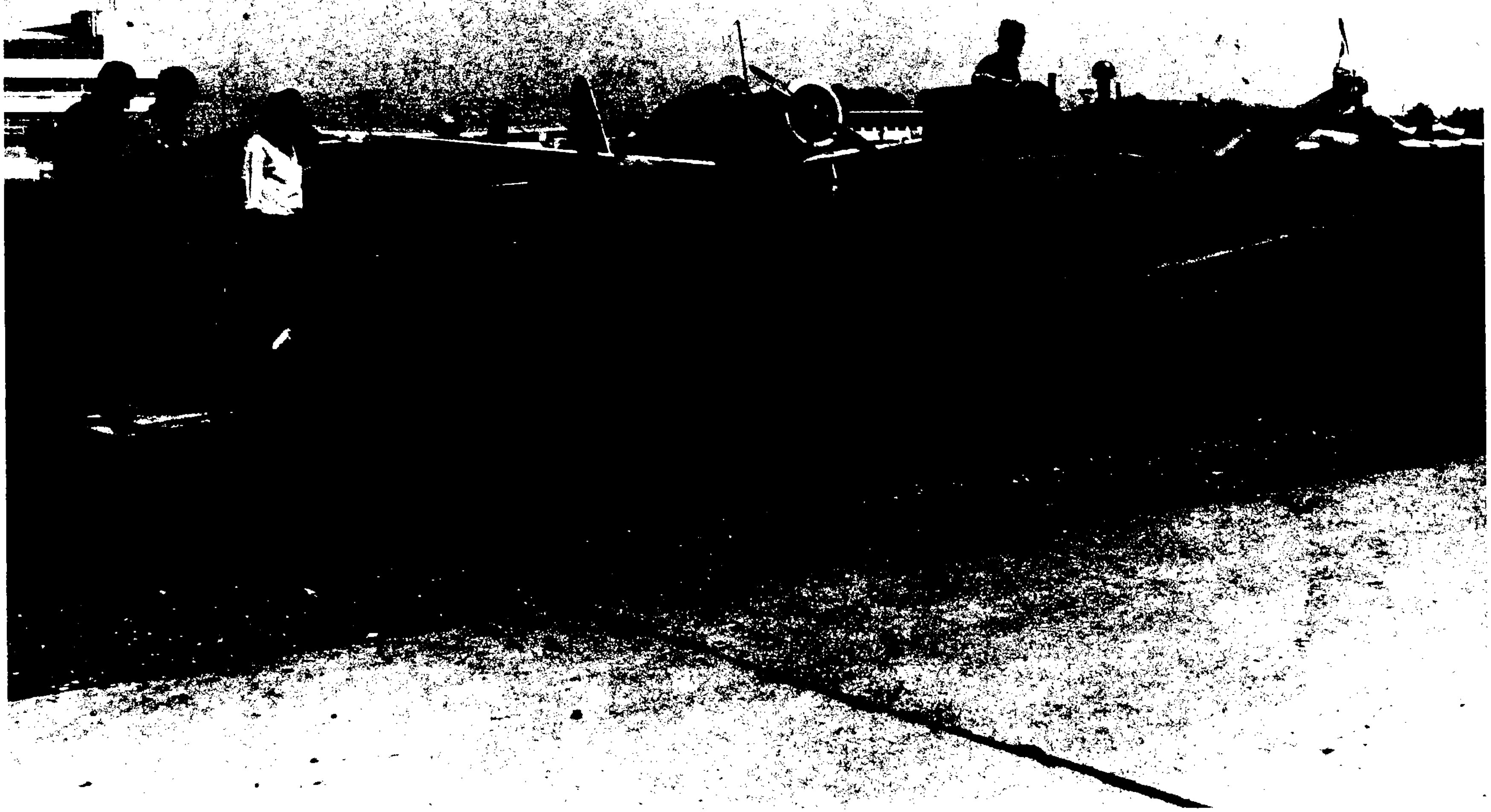

FIGURE 2. PLOWING IN CABLE FOR TAXI-WAY LIGHTING INSTALLATION

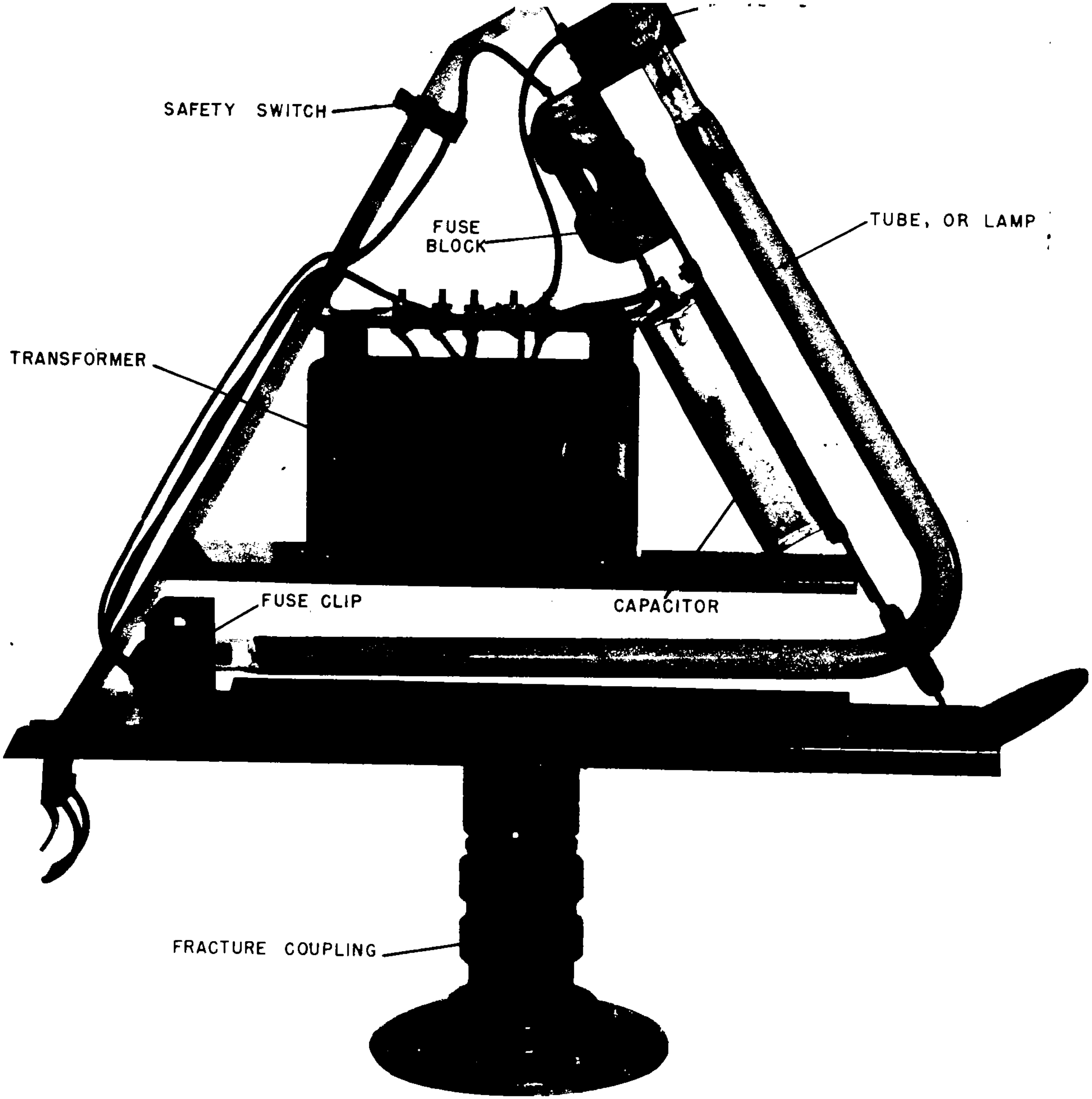

FIGURE 3. TAXI-WAY MARKER LIGHT (COVER REMOVED).

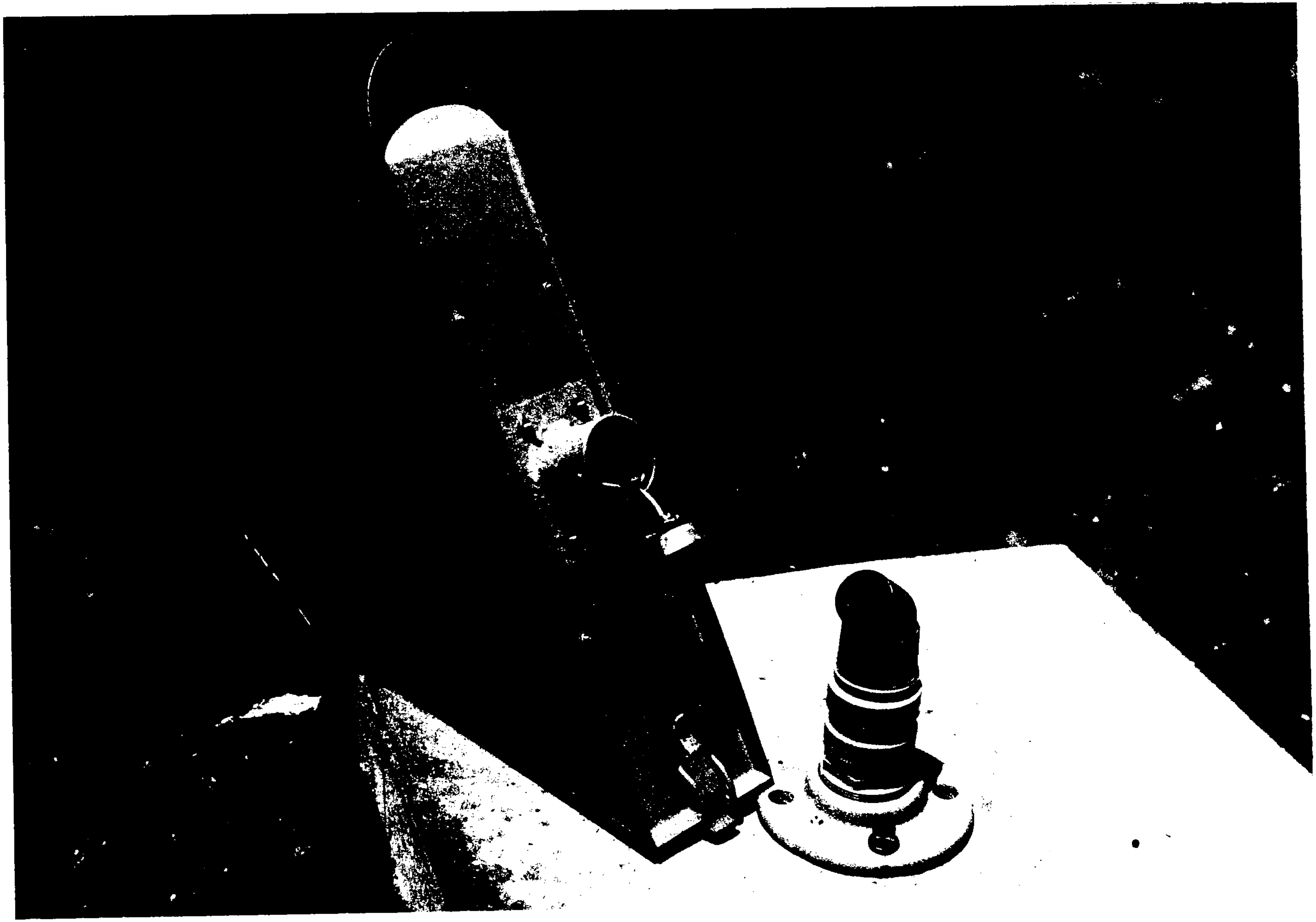

FIGURE 4. TAXI-WAY MARKER LIGHT (UNCOUPLED TO SHOW DISCONNECTING PLUG).

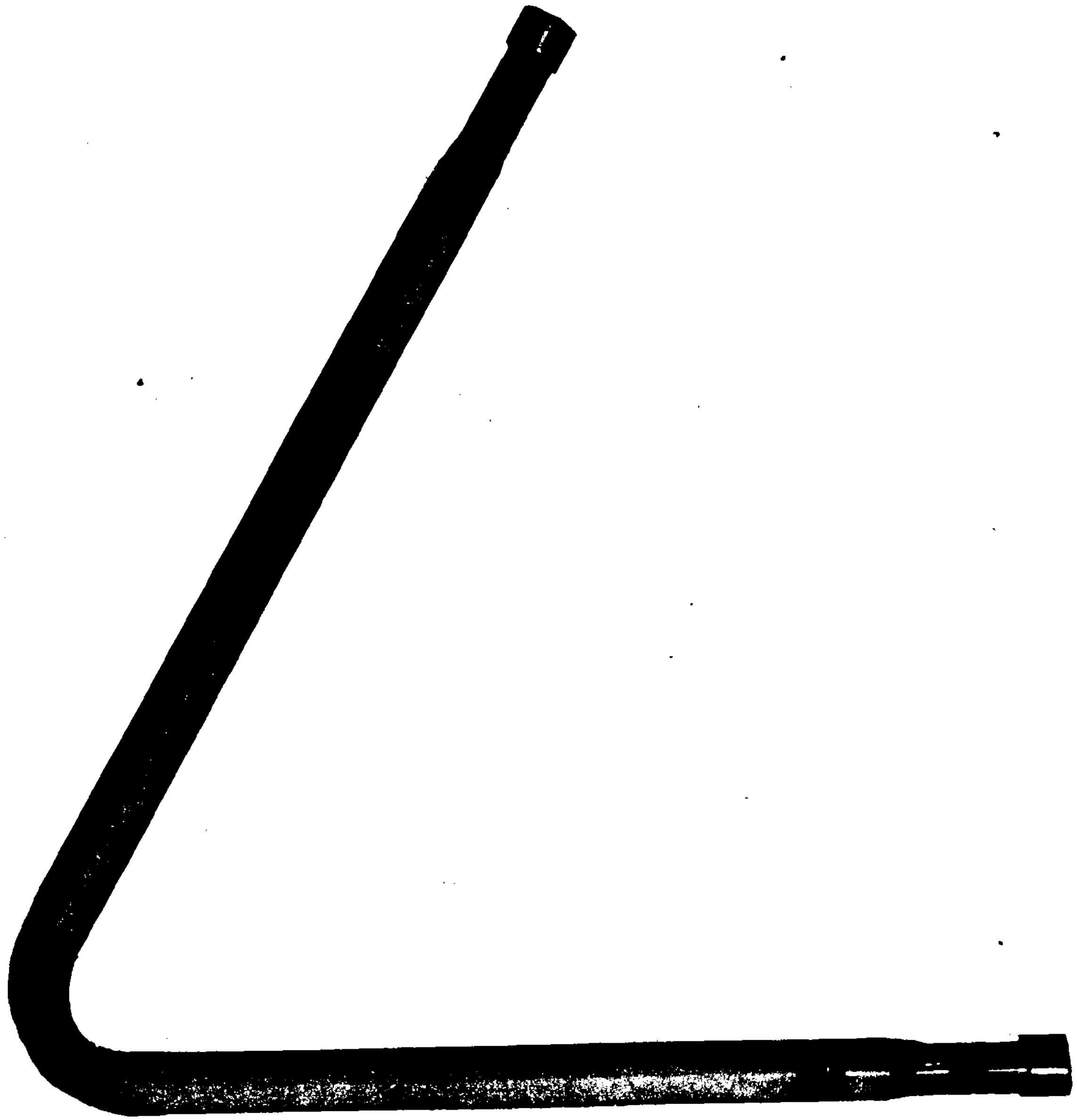

FIGURE 5. LAMP OR TUBE FOR TAXI-WAY MARKER LIGHT

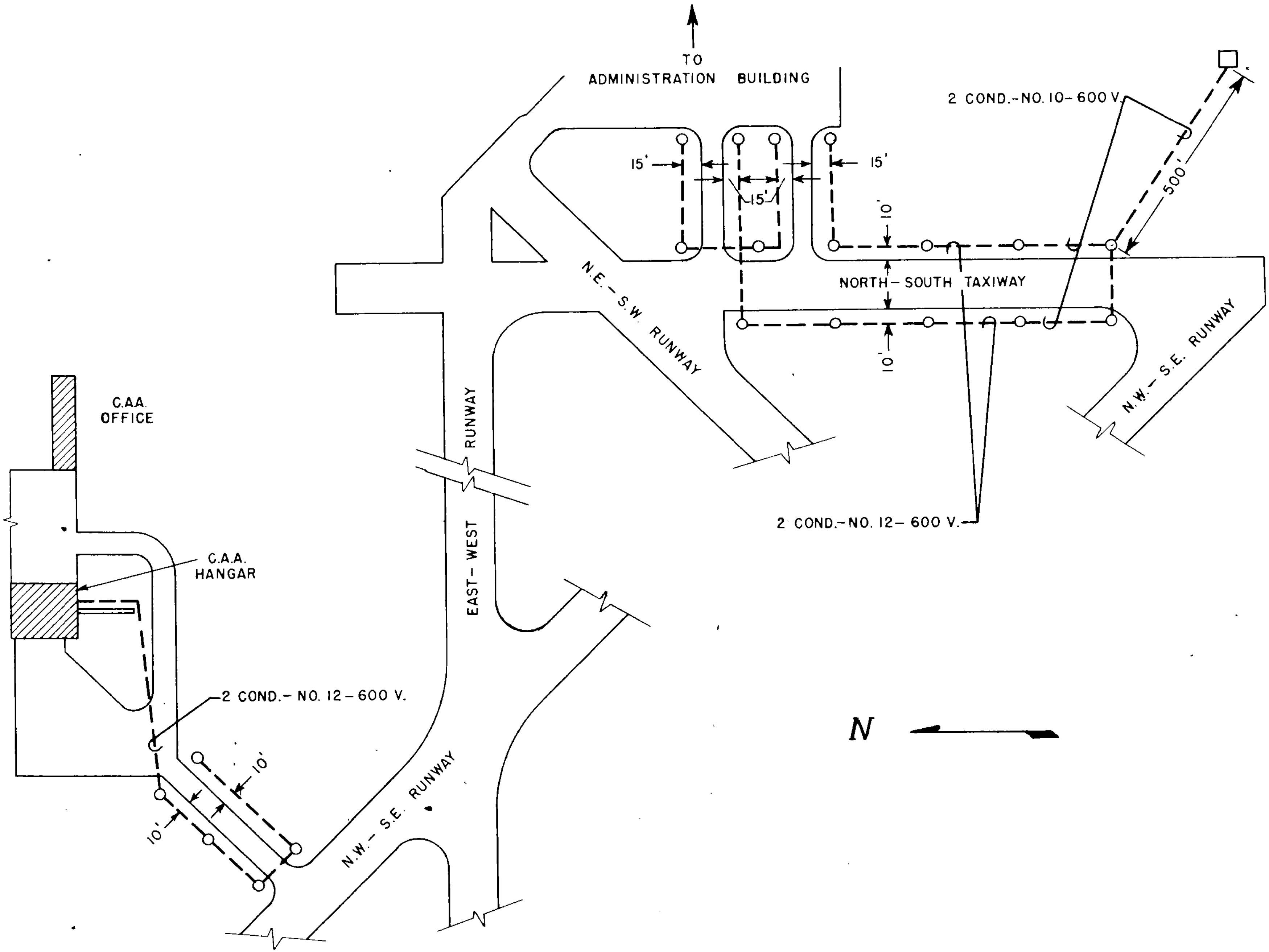

FIGURE 6. WIRING DIAGRAM AND LAYOUT OF EXPERIMENTAL TAXI-WAY LIGHTING INSTALLATION

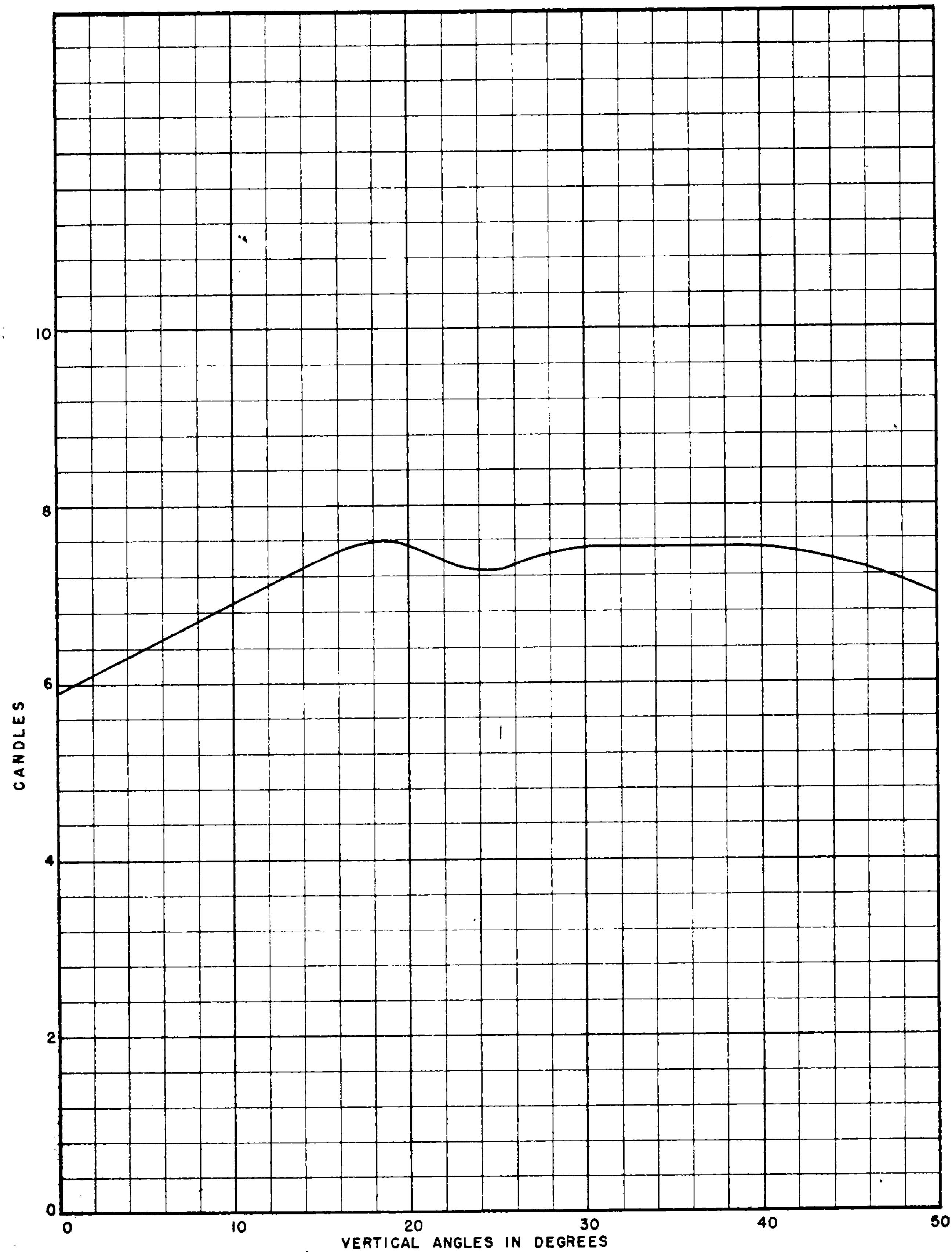

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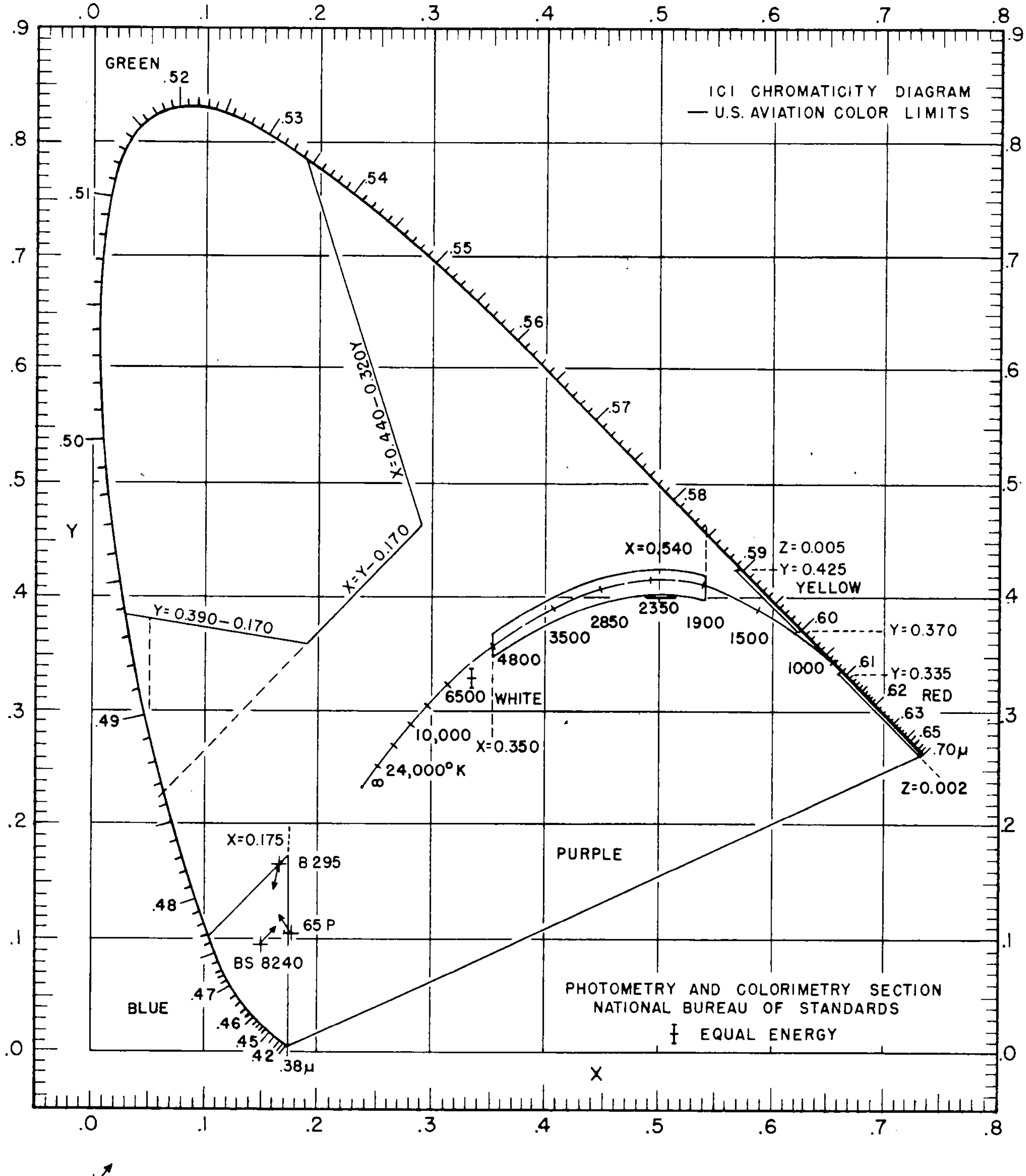
FIGURE 7. CANDLEPOWER DISTRIBUTION CURVE FOR DIRECTIONAL TAXI-WAY MARKER LIGHT



CHROMATICITY OF FILTER AND DIRECTION TO CHROMATICITY OF TEST LAMP

NBS TEST 43A– 15/47

FIGURE 8. ICI CHROMATICITY DIAGRAM FOR TAXI-WAY MARKER LIGHT