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RADIO AND ELECTRICAL ENGINEERING DIVISION

A TRANSISTORIZED DAYLIGHT SWITCH FOR BUOYS

H. R. SMYTH

OTTAWA

SEPTEMBER 1956

NRC NO. 4167

ABSTRACT

Normally, battery-operated buoy lights function continuously. A device employing transistors and a photoelectric cell is described, which renders the buoy light inoperative during daylight hours, thereby effecting a considerable saving in battery cost. The device would also be useful with unattended battery-operated shore beacons.

A TRANSISTORIZED DAYLIGHT SWITCH FOR BUOYS

- H. R. Smyth -

INTRODUCTION

Battery-operated buoy lights used as aids to navigation, normally require replacement batteries during a season. Attempts have been made to conserve batteries during daylight hours by using various types of switches that are operated by differential expansion of metals heated by the sun. These switches have proved unreliable owing to poor sensitivity to daylight, and also because of the fluttering of contacts as the buoy moves under the motion of the sea. A practical daylight switch is described in this report.

METHOD OF OPERATION

A conventional three-stage d-c amplifier, using three type-2N130 germanium transistors, is controlled by a type-B2M Sun Battery (see Fig.1). During daylight hours the photocell (PC) produces a bias of 0.25 volts on the control transistor T_1 , causing it to draw current through R_1 . This produces a positive bias on the base of transistor T_2 , reducing the collector current to zero, and thus causing the base potential of T_3 to reach -6 volts. The collector T_3 then draws 1 milliampere of current through the relay solenoid and opens the buoy battery circuit. (The relay is normally closed in order to fail safely.)

At dusk, when daylight intensity has fallen to a value of approximately 10 foot-candles, the photocell output falls to 0.1 volts, reducing the collector current of T_1 to a low value. The resulting negative bias on the base of T_2 causes the collector to draw maximum current, thus biasing T_3 to cutoff. This releases the relay, closing the contacts in the buoy light circuit.

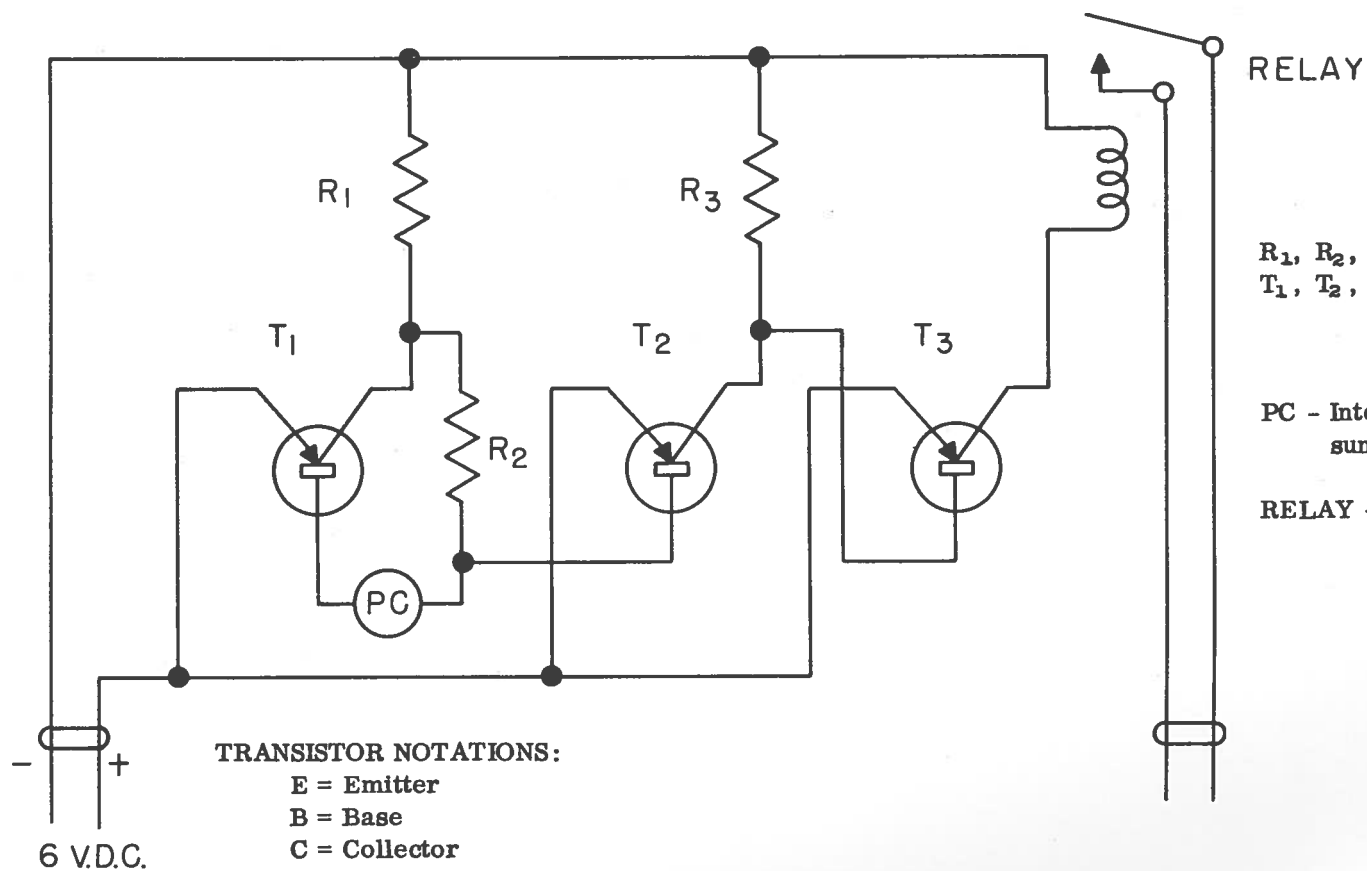
Component values were chosen so that the switch operates about one-half hour before a buoy light would usually be required for safe navigation at dusk.

The switch operates entirely from the 6-volt battery normally supplied for operation of buoy light flashers and unattended shore beacons. The current drawn by the switch amounts to 3 milliamperes in daylight and falls to 1 milliampere at night.

COMMENTS

It is desirable that the switch be enclosed in a casting attached to the housing of the buoy flasher unit, below the light, so that the flash cannot shine on the photocell.

Several units have been in operation in the laboratory for a one-year period without failure, and three units have been in service on buoys for several months.



PARTS LIST

R_1, R_2, R_3 - $10k, \frac{1}{2}w$
 T_1, T_2, T_3 - Raytheon
 Type-2N130
 Transistors

PC - International Rectifier Corp.
 sun battery type-B2M

RELAY - Potter and Brumfield
 type-SS5D with coils
 in parallel to give
 resistance of 2500 ohms

FIG.1 CIRCUIT DIAGRAM OF DAYLIGHT SWITCH

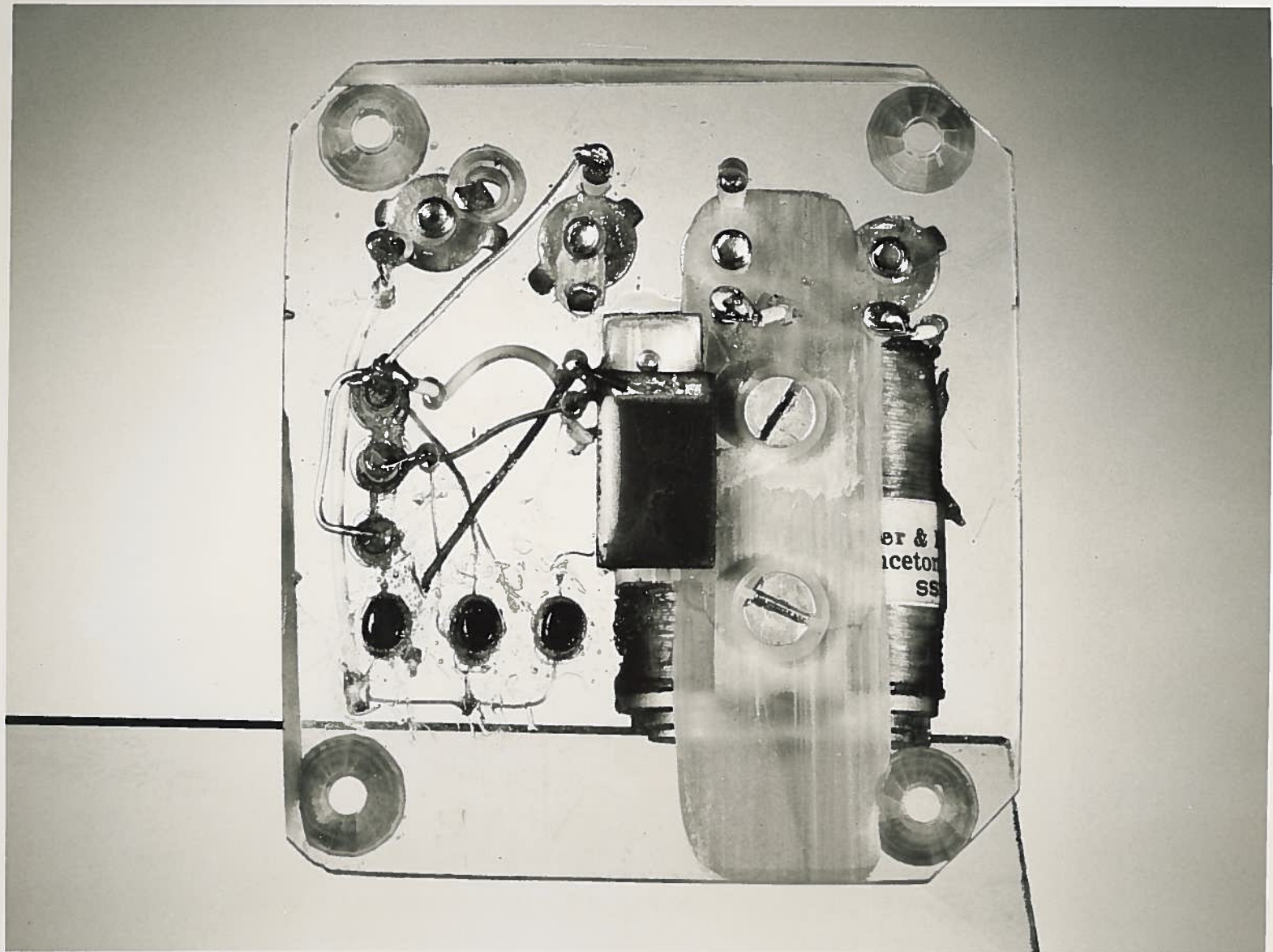


PLATE I PROTOTYPE OF DAYLIGHT SWITCH ASSEMBLY, FRONT VIEW

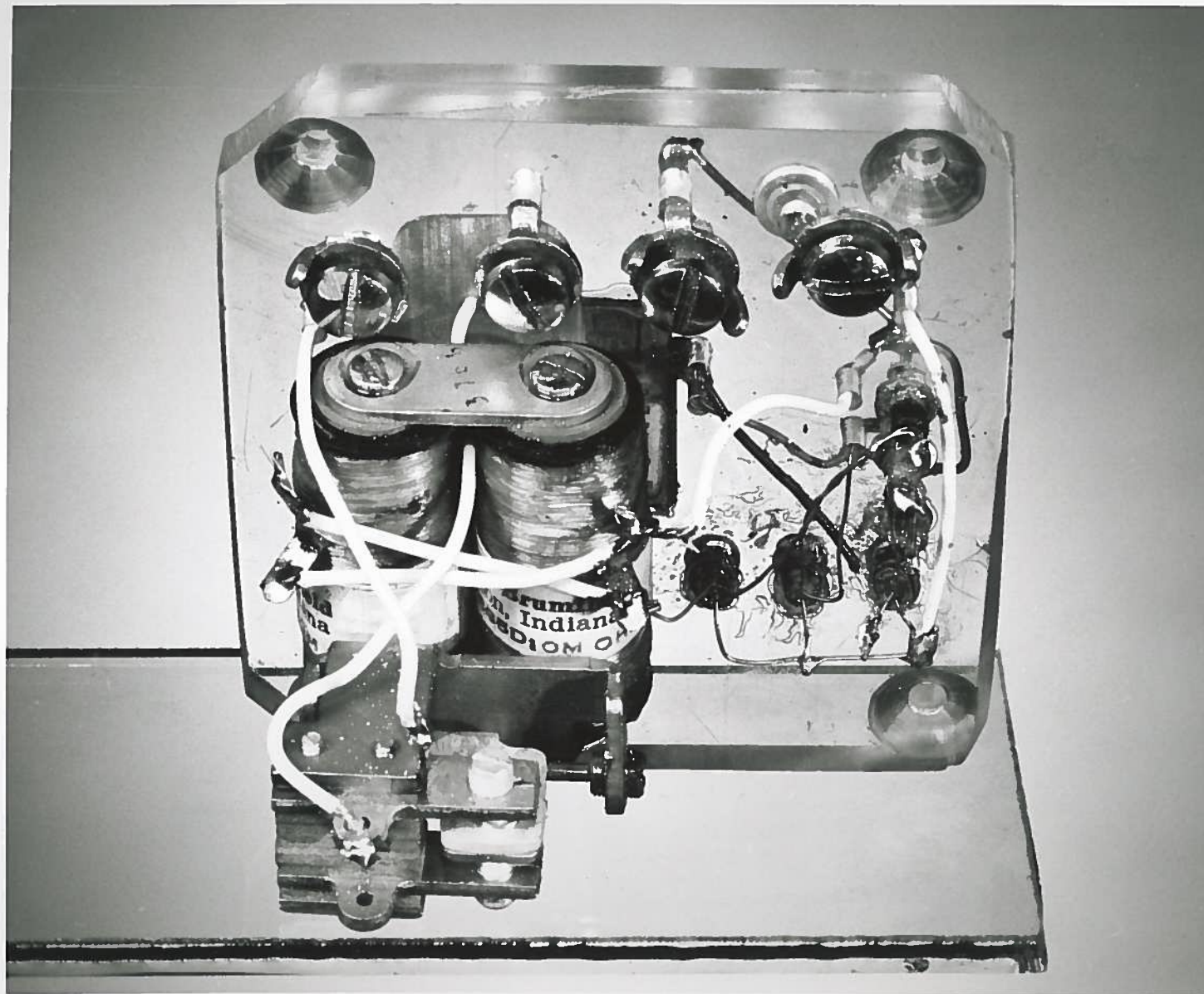


PLATE II PROTOTYPE OF DAYLIGHT SWITCH ASSEMBLY, REAR VIEW

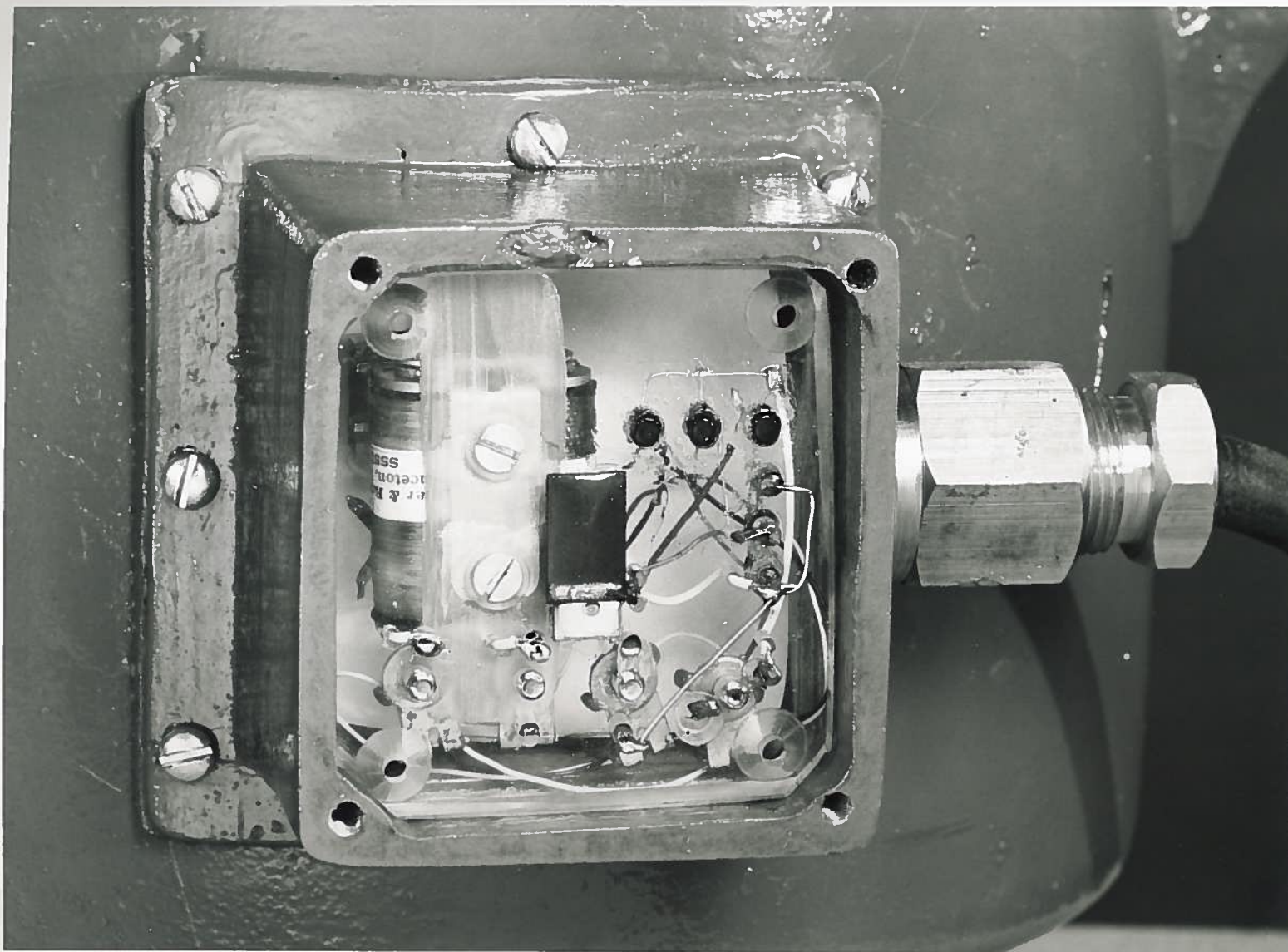


PLATE III PROTOTYPE OF DAYLIGHT SWITCH ASSEMBLY MOUNTED IN CASTING ON BUOY



PLATE IV DAYLIGHT SWITCH ASSEMBLY INSTALLED ON 200-mm BUOY LIGHT



PLATE V DAYLIGHT SWITCH ASSEMBLY FOR CONTROL
OF BATTERY-OPERATED SHORE BEACONS