Aug. 8, 1944. H. ABRAMSON ET AL 2,355,256

LIGHT SENSITIVE DEVICE

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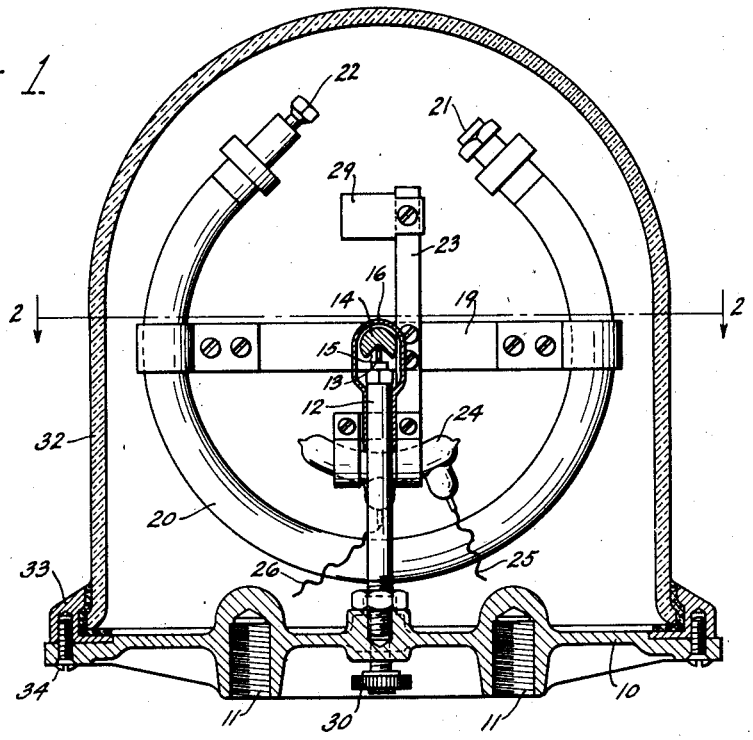
Fig. 1.



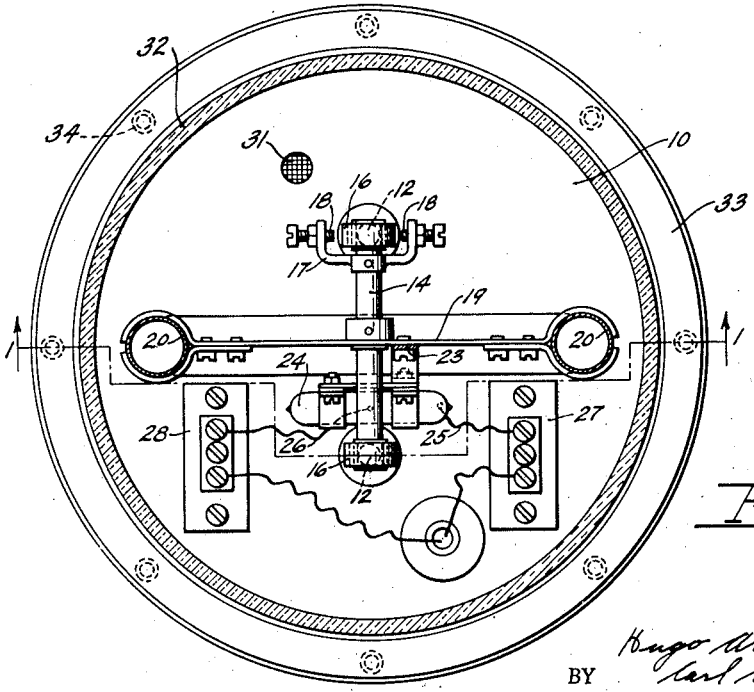


Fig. 2.

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LIGHT SENSITIVE DEVICE

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4 Claims. (Cl. 200—140)

Our invention relates to improvements in light sensitive devices for controlling the operation of any desired apparatus, such as lightbuoy, beacon, street illumination system or the like.

Heretofore it has been proposed to provide a device of this type which includes a pair of connected containers which are partially filled with liquid with vapor trapped above the liquid in each vessel. One of these vessels is arranged to absorb heat at a faster rate than the other, whereby the vapor trapped therein expands and forces some of the liquid into the other vessel. The vessels are pivotally mounted in such a way that the unbalance resulting from displacement of the liquid from one vessel to the other causes the vessels to pivot and thus operate a controlling member, such as a mercury switch. However, devices of this nature have had the drawback that a substantial amount of work was required to force the liquid from one chamber to the other and such displacement of the liquid shifted the center of gravity of the pivoted containers with the result that a substantial amount of the force produced by the unbalance was not available for actuating the controlling member.

In accordance with our present invention the containers are constructed in the form of a portion of a torus. The upper part of the torus is interrupted and sealed. The torus is pivotally mounted in a vertical plane about an axis which coincides with the geometrical center of the torus. Also, the interior diameter of the torus is uniform throughout, thereby reducing to a minimum the resistance to the flow of liquid therethrough. In addition, the torus and associated parts which pivot with it are balanced about the axis of rotation in such a way that the center of gravity always coincides with the axis. Consequently, the only force required to pivot the container is that necessary to overcome friction in the bearing and the slight friction between the flowing liquid and the interior and the torus.

Further objects and advantages of my invention will be apparent from the following description considered in connection with the accompanying drawing, which form a part of this specification and of which:

Fig. 1 is a side view, partially in cross-section, of a device in accordance with our invention; and

Fig. 2 is a top view, partially in cross-section, of the device shown in Fig. 1.

Referring to the drawing, reference character 10 designates a base plate which is provided with threaded bores 11 for securing the plate in place on any suitable standard. The base plate carries a pair of upright members 12 which are provided at their upper ends with knife-edge supports 13. A shaft 14 is supported by the knife edges, which engage V-shaped recesses 15 formed in the shaft. A strap 16 is secured to each of the members 12 and surrounds the shaft 14 in order to prevent accidental displacement of the shaft from the knife edges. A pair of arms 17 is rigidly secured to the shaft 14 and is provided with adjustable stops 18 which may contact one of the uprights 12 so as to limit the pivotal movement of the shaft.

A member 19 is secured at its center to the shaft and at its ends to a tubular member 20 which is in the form of approximately three-quarters of a torus. As is clear from Fig. 1, this torus is interrupted at the upper part thereof, and the ends of the tube are sealed by means of plugs 21 and 22. The geometrical center of the torus coincides with the center of rotation of the shaft 14.

The tube 20 is preferably made of stainless steel having a small wall thickness of, for instance, 0.5 mm. The right hand half of the torus, as viewed in Fig. 1, is painted black or otherwise given a high coefficient of heat absorption, while the other half is given a lower coefficient, as by being chromium plated or highly polished. The tubular member 20 is about half filled with a suitable liquid. The vapor of this liquid should have a high coefficient of expansion, the liquid should not attack the stainless steel tube, it should have a low freezing point (not above —50° C.) if the device is to be used outdoors, and its critical temperature should not be below 70° C. We have found that sulphur dioxide has all of these characteristics. However, before placing the sulphur dioxide in the tubular member 20, the latter should be heated so as to expel all moisture and as much air as possible in order to prevent the formation of sulphuric acid.

Secured at right angles to the member 19 is an arm 23, the lower end of which carries a mercury switch 24. The glass tube of this switch is preferably arcuate with its center coinciding with the center of rotation of shaft 14. Flexible leads 25 and 26 connect the terminals of the switch with the terminal blocks 27 and 28, respectively, which are secured to the base plate 10.

The upper end of the arm 23 carries an adjustable counter-weight 29 which is so dimensioned and positioned on the arm as to exactly balance all of the elements carried by the shaft

14. In order words, the center of gravity of the pivoted structure coincides with its center of rotation.

A screw 30 extends through a threaded bore in the base plate located just below the bottom of the torus. This screw may be advanced upwardly so as to contact the torus and lift the shaft 14 from the knife edges and clamp it against the straps 16 to prevent pivoting of the structure during shipment. The base plate is preferably provided with a ventilation hole 31 covered by a wire mesh screen, and a transparent dome 32 is secured thereto by means of a ring 33 fastened to the base plate by bolts 34. The dome protects the device from dust and the action of the weather while exposing the torus to light and radiant heat.

If the device is to be responsive to sun-light, it is preferably positioned with the plane of the torus extending in a north and south direction and with the heat absorbing portion of the torus to the south. In this position the heat absorbing portion will always be exposed to the sunlight and will never be in a shadow cast by the uprights 12 or the other portion of the torus. The above positioning is correct, if the device is located in the Northern Hemisphere, but obviously if it is used in the Southern Hemisphere it should be turned around, inasmuch as the sun shines from the north.

At night, when the torus is not exposed to radiant heat, both portions thereof will have approximately the same temperature and the vapor above the liquid in each end of the torus will occupy the same volume. Consequently, the torus and other pivotal structure occupies the position shown in Fig. 1 and the liquid mercury within the switch 24 bridges the contacts and closes the circuit so as to light the buoy or other apparatus which the device is employed to control. However, during daylight when the torus is exposed to the radiant heat of the sun, the right hand portion of the torus, which is blackened, absorbs more heat than does the left hand polished portion. This causes the vapor above the liquid in the right hand portion to expand more than the vapor in the other portion, which in turn causes liquid to be displaced from the right to the left hand portion. This results in a pivoting of the torus in a counter-clockwise direction, whereby the mercury in the switch runs to the left hand end of the tube and opens the circuit through the switch.

Due to the fact that the geometrical center of the torus coincides with its center of rotation, and the center of the torus coincides with its center of rotation, the center of gravity of the device is not shifted by the above described displacement of the liquid, but always coincides with the center of rotation. Moreover, due to the fact that the internal diameter of the torus is uniform throughout, it offers a minimum resistance to flow of liquid from one portion of the torus to the other. Thus, practically all of the force resulting from the unbalance caused by the liquid displacement is available for shifting the switch. Due to the fact that the tube of the switch is arcuate with its center coinciding with the center of rotation, the shifting of the liquid mercury therein does not disturb the center of gravity of the entire device.

While we have shown the device as used to operate an electric switch, it is obvious that it could also be used to open and close a valve for controlling flow of gas or other fluid fuel. It is to be understood that the embodiment described is for the purpose of illustration only and that the scope of our invention is not to be limited thereby, but is to be determined by the appended claims.

What we claim is:

1. In a device of the class described, a container in the shape of a torus interrupted at its upper part, means for pivotally mounting said torus about an axis coinciding with its geometric center, said torus being partially filled with a liquid and opposite portions of said torus having different light absorbing characteristics, and a control member actuated by pivoting of said torus.

2. In a device of the class described, a container in the shape of a torus interrupted at its upper part, means for pivotally mounting said torus about an axis coinciding with its geometric center, the portions of said torus on opposite sides of said center having different light absorbing characteristics, said torus being partially filled with a liquid and having a uniform cross-sectional area whereby liquid may flow from one portion to the other with a minimum of resistance, and a control member actuated by pivoting of said torus.

3. In a device of the class described, a container in the shape of a torus interrupted at its upper part, means for pivotally mounting said torus about an axis coinciding with its center, said torus being partially filled with a liquid and opposite portions of said torus having different light absorbing characteristics, a control member connected to said torus and actuated by tilting thereof, and means for counterbalancing said torus and associated parts so that the center of gravity thereof coincides with said axis.

4. In a device of the class described, a container forming approximately three-quarters of a torus and being interrupted at its upper part, means for pivotally mounting said torus in a vertical plane about an axis coinciding with its geometrical center, the portions of said torus on opposite sides of said center having different light absorbing characteristics, said torus being partially filled with a liquid and having a uniform cross-sectional area whereby liquid may flow from one portion to the other with a minimum of resistance, a control member operable by tilting connected to said torus so as to be tilted by the pivoting thereof, and a counter-weight secured to said torus for causing the center of gravity of said torus and associated parts which are tiltable therewith to coincide with said axis.

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