This invention relates to electric devices and more particularly to an interrupter which may be used as a gas-filled lamp adapted to automatically emit successive flashes of light or as a make-and-break device.

An object of my invention is the construction of a lamp of the gas-filled type, adapted to automatically interrupt and restore its operating circuit at regular intervals.

Another object of my invention is the production of a unitary flasher-lamp adapted for use in connection with traffic signal posts where a regularly occurring intermittent light is required.

A further object of my invention is the formation of a circuit-interrupting device adapted for actuating flasher warning-lamps, pilot lamps, relays, electric signs and the like.

A still further object of my invention is the provision of intermittent light-flashes by periodically interrupting the circuit in a lamp by moving a self-contained column of a conducting liquid by means of varying gas pressures in the lamp.

Other objects and advantages of the invention will be apparent as the description proceeds.

Various arrangements have been devised for providing warning lamps giving intermittent flashes of light in connection with traffic signal posts and the like. Such arrangements have been cumbersome, complicated and liable to get out of order. Those involving rotating parts for mechanically making and breaking the circuit to the lamp or lamps are subject to mechanical wear and various other forms of deterioration. Those involving thermostatic elements require care to keep the device operating properly, waste a considerable amount of energy because of the non-light-giving resistance elements and are more or less unreliable in operation.

According to my invention, I provide a device of the gas-filled type which may operate to emit regularly, recurring flashes of light, or act as a make-and-break device, is efficient in its operation and requires no attention to keep it working properly as long as the light or heat-emitting element, such as an incandescent filament, is intact. Essentially, my device comprises a gas-filled envelope containing a light or heat-emitting medium, such as a filament, heating coil or separated electrodes, between which an arc or electrical discharge is adapted to be formed, in one chamber thereof. The gas-filling is preferably a relatively inert gas, such as nitrogen or a mixture of inert gases, at a substantial pressure.

The envelope is in two parts or chambers, joined by a contracted portion or tube containing mercury. One leading-in wire enters the chamber containing the filament, if such is used, and includes the filament between sections thereof. The section beyond the filament is extended to make contact with, or dip into, the mercury in the contracted portion. The other leading-in wire is electrically connected to the mercury in any suitable manner. When electrical energy is applied to heat the filament, the gas in the chamber containing the same is also heated and expands against the pressure of the gas in the other chamber and forces the mercury away from the leading-in wire dipping therein. This breaks the circuit, deenergizes the light or heat-emitting element and allows the gas in the chamber containing the same to cool. When the gas has cooled sufficiently to allow the gas which had been compressed in the other chamber to force the mercury column again in contact with the lead extended from the filament, the device is again energized and the cycle is repeated.

In the accompanying drawing illustrating preferred embodiments of my invention, Fig. 1 is a side elevation of a simple form of my device;

Fig. 2 is a side elevation, partly in section, of a modification thereof; and,

Fig. 3 is a side elevation of a device as shown in Fig. 1, with additional devices shown diagrammatically in circuit therewith.

An elementary form of my device is illustrated in Fig. 1 which shows an envelope comprising sealed bulbs or chambers 1 and 2 connected by a tube or contraction 3 of the envelope. These bulbs are filled with a relatively inert gas, such as nitrogen, argon, or a mixture thereof, such as 80% argon and 20% nitrogen, under a substantial pressure which is preferably within the range from an atmosphere to a half-atmosphere, such as 25 inches of mercury, for example. The tube 3 is partially filled with mercury 4, as shown.
The mercury level is so adjusted that, when the filament or other heating means 5 in the bulb 1 is not energized, the lead 6 extended beyond the filament touches the mercury or is immersed therein a small distance.

Leading-in wire 7 supplies electrical energy to the filament 5 from a battery or other suitable source of electrical energy 8, and the circuit may be closed by a switch or other circuit-making device 9. The other leading-in wire 10 may extend through the wall of the bulb 2 into the tube 3 and make contact therein with the mercury or it may extend into the bulb 1 parallel with the leading-in wire extension 6. Such an alternative construction is illustrated in Fig. 2 and later described. Another operative arrangement of the leading-in wire 10 would be to have it extend directly into the tube 3, (see wire 33 in Fig. 3, for example) and make contact with the mercury. In other words, the leading-in wire 10 may make contact with the mercury in any manner, it being immaterial whether it extends into the bulb 1, the bulb 2 or the tube 3.

When the switch 9 is closed, an electrical circuit is completed from the battery 8 through leading-in wire 7 extending through the press 11 of bulb 1, filament 5, leading-in wire extension 6, mercury 4, leading-in wire 10 extending through the press 12 of bulb 2 and switch 9 back to the battery 8. When the circuit is closed, the source of light and heat or the source of heat only, such as filament 5, is energized and the heat developed thereby causes the gas in bulb 1 to expand and force the mercury level down against the pressure of the gas in the bulb 2 until the mercury breaks contact with the lead 6, thus opening the circuit through the filament 5. As soon as the gas begins to cool off, the mercury rises in the tube adjacent to bulb 1 until contact is again made with leading-in wire extension 6 and the filament is again energized and the cycle is repeated.

The light flashes are synchronized with the variations in temperature and pressure of the gas in bulb 1. That is, the light is flashed off during the heating and increase in pressure of the gas in bulb 1 and is flashed on during the cooling and reduction in pressure of the gas.

The gas in the bulb 2 serves to balance the pressure of the gas in bulb 1 when the lamp is unlighted and, at the same time, it allows the mercury to move sufficiently when the pressure of the gas in bulb 1 is increased by a small percentage, by the temperature of the filament being raised to incandescence. The gas in bulb 2 also serves to prevent any material changes in the level of the mercury due to changes in the average temperature of the device, as might be encountered when the device is used out of doors.

Another embodiment of my invention is illustrated in Fig. 2. A single containing envelope or bulb 13 is divided into two compartments 14 and 15 by the flare or partition 16 which is sealed into the bulb at 17. The two leading-in wire extensions 18 and 19 are immersed a small distance in the mercury 20 held in a contracted portion 21 in the lower part of the bulb 13. The lower part of the flare 16 comprises a contraction or tube 22 which surrounds the leading-in wire extensions 18 and 19 and dips into the mercury 20 to a distance below that to which said leading-in wire extensions 18 and 19 dip.

A filament or heater 23 is supplied with electrical energy from a battery 24, or other source of electricity, through leading-in wires 25 and 26. When the switch or other circuit-making device 27 is closed, the circuit is completed from the battery 24 through leading-in wire 25, leading-in wire extension 18, mercury 20, leading-in wire extension 19, filament 23, leading-in wire 26, switch 27 and back to battery 24.

The incandescent element 23 will then heat the gas contained in chamber 14, causing it to expand and force the mercury in the tube 22 until contact is broken between the leading-in wire extensions 18 and 19 or one of them and the mercury column. This breaks the circuit to the element 23 which becomes deenergized, and the gas in the chamber 14 cools until the mercury rises again to complete the electrical circuit, when the device is again energized or lighted and the cycle is repeated.

A flasher-lamp or other device similar to that shown in Fig. 1 is shown in Fig. 3 connected up with additional devices. Such additional devices may also be connected to the apparatus shown in Fig. 2, as will be obvious to those skilled in the art. This lamp or make-and-break device comprises a gas-filled envelope consisting of bulbs or chambers 1 and 2 connected by tube 3 containing mercury 4. The electrical circuit to the filament or heating element 5 extends from a battery 8 or other suitable source of electrical energy through a switch 9, leading-in wire 10, mercury 4, leading-in wire extension 6, filament or heating element 5, leading-in wire 7 and back to the battery 8. When the switch 9 is closed, the filament 5, if such is used, may become incandescent and heat the gas in the bulb 1, driving the mercury in the tube 3 toward the bulb 2 until it breaks contact with the leading-in wire extension 6, as described with reference to Fig. 1. The gas in the bulb 1 then cools until the mercury again makes contact with leading-in wire extension 6 and the cycle is repeated.

Additional attachments to the device may comprise a lead made of such length in the
tube 3 that it touches the mercury only when the gas in the bulb 1 is at very nearly the same temperature as that in bulb 2. That is, it will make electrical contact with the mercury only before the lamp is energized by closing the switch 9 or, in case the filament 5 therein became burnt out or otherwise destroyed, because the gas in the bulb 1 is at all times warmer than that in bulb 2 when the lamp is flashing regularly. Thus, a pilot light or other warning device 28 may be connected through a switch 29 to the lead 31, the circuit being closed through a battery 32 and a lead 33 which makes contact with the mercury 4 in the tube 3 at all times.

When the lamp is flashing regularly, the mercury level will be below that of the lead 31, and the pilot light or warning device 28 will not be energized. However, if the filament 5 burns out or the circuit operating this filament becomes broken in any way, so that the filament does not light, the mercury will rise until it touches lead 31, and the warning device 28 will be put in operation to show that a new lamp should be installed or the circuit thereto repaired.

The device may be made to operate as a circuit interrupter to open and close circuits through other apparatus, such as relays, for accomplishing any desired results. For accomplishing this purpose, a lead 34 is placed in such position that the mercury touches it only when the filament 5 is heated. This closes the circuit temporarily through a battery 35 and common lead 33 to mercury 4 and relay or auxiliary apparatus 36 when the switch 37 is closed. After the circuit through filament 5 is broken, the mercury level on the side of the tube connected to bulb 2 falls and the contact with the lead 34 is broken.

A second relay or other device 38 may be energized after device 36 by the common battery 35 when the mercury rises further until it touches the lead 39 when the switch 41 is in closed position. When the mercury again falls, 38 and 36 will be deenergized in the reverse order. Similarly, the relay or other device 42, which is normally energized by battery 43 or other source of electricity through resistance 44, will be short-circuited when mercury in the tube 3 contacts with the lead 45, as a short circuit will then be formed from battery 43 through resistance 44, lead 38, mercury 4, lead 45 back to battery 43. The use of relays or other auxiliary electrical devices is too well known in the art to require elaboration, but reference may be had, for example, to German Patents Nos. 235,434 and 291,140.

When the device is used merely for making and breaking circuits in auxiliary apparatus, it is evidently unnecessary for the filament, if such is used, to be heated to a high temperature or to incandescence, and a heating coil or other device emitting heat only may be used instead of an incandescent filament.

The time required to complete each cycle of the operation and the distance through which the mercury travels depend on the rate at which heat is developed in the heating or lighting element, the size of the bulbs, the diameter of the tube, the rate at which heat is radiated from the gas in tube 1 and other factors which may be controlled within limits.

It is obvious that the device may be so constructed as to make and break any desired number of auxiliary circuits and that the lengths of, and the intervals between, the on and off periods in the various circuits may be controlled by the proper choice of the factors mentioned above.

While I have described in detail what I now consider to be the preferred embodiments of my invention, it is to be understood that the same are merely illustrative and that many modifications may be made therein without departing from the spirit and scope of the appended claims.

What is claimed is:
1. A flasher-lamp comprising two chambers connected by a contracted portion, mercury in said contracted portion, a gas at a substantial pressure in said chambers, a heating element in one chamber, an electric circuit for said heating element including said mercury, conductors in the heating element containing chamber extending from said element and electrically connected with said mercury and constituting part of said circuit, said mercury moving to break said circuit upon the expansion of the gas heated by said heating element.
2. A flasher-lamp comprising two chambers connected by a contracted portion, mercury in said contracted portion, a gas at a substantial pressure in said chambers, an incandescent filament in one of said chambers, conductors supported in the chamber having the filament, said conductors being electrically connected with said mercury, said filament being connected to one of said conductors.
3. A flasher-lamp comprising a bulb enclosing a filament, a flare dividing the bulb into two compartments and comprising a contracted portion extending to the lower part of the bulb, mercury contained in said lower part and extending above the lower edge of said contracted portion of the flare, leading-in wires extending into the bulb, extensions on said leading-in wires and disposed in the contracted portion of the flare to make contact with the mercury in the tube, one of said leading-in wires being electrically connected to the filament in the bulb, the other leading-in wire and its extension serving as a portion of an electrical circuit for
the passage of energy to said filament through said mercury.

4. A gas-filled electrical device comprising a container divided into upper and lower compartments by a partition, mercury in the lower compartment, a tube extending from the partition and dipping below the surface of the mercury and connecting the two compartments, a heating element in the upper compartment surrounded by a gas filling and suitably energized by means of a circuit to a source of electricity, the electrical circuit from said source including a portion of said mercury so that the circuit through the heating element is broken when the gas pressure in the upper compartment is increased a predetermined amount and displaces the mercury from the circuit.

5. A gas filled lamp comprising a sealed envelope divided into two compartments by a flare and containing an incandescent filament connected to a source of electrical energy, a restricted portion at the bottom of said envelope filled with mercury, a tube extending from the flare and dipping below the surface of the mercury, a leading-in wire for supporting said filament and having an extension making contact with the mercury, a second lead wire spaced from said extension and dipping into said mercury and connected to said source of energy to make a complete circuit for the passage of electrical energy through said filament.

6. The combination of a make-and-break device comprising a bulb, a gas at a substantial pressure in said bulb, a partition dividing said bulb into two compartments and including a contracted portion extending to the lower part of the bulb, mercury contained in said lower part and extending above the lower edge of said contracted portion, a heating element in one chamber suitably energized from a source of electricity, a circuit for supplying electrical energy to said heating element, said circuit including said mercury so that said circuit is intermittently broken by an increase gas pressure in the compartment containing the heating element forcing the mercury away to break the circuit and permitting a return of the mercury when the gas in the compartments equalizes to again make the circuit.

In testimony whereof, I have hereunto subscribed my name this 16th day of June, 1922.

PAUL THORNE WEEKS.