

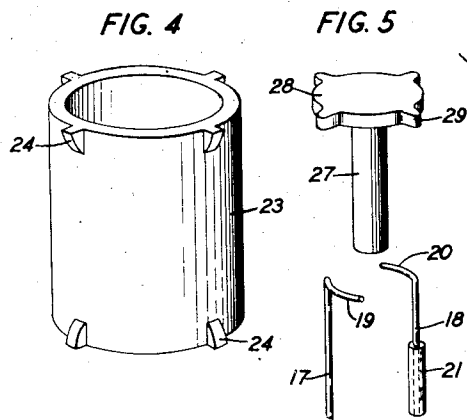
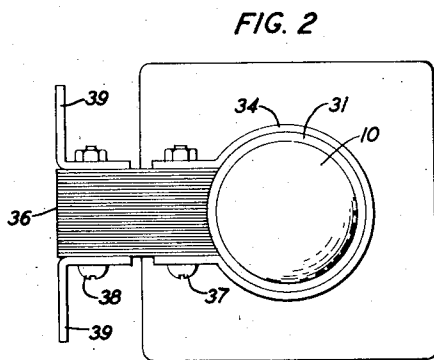
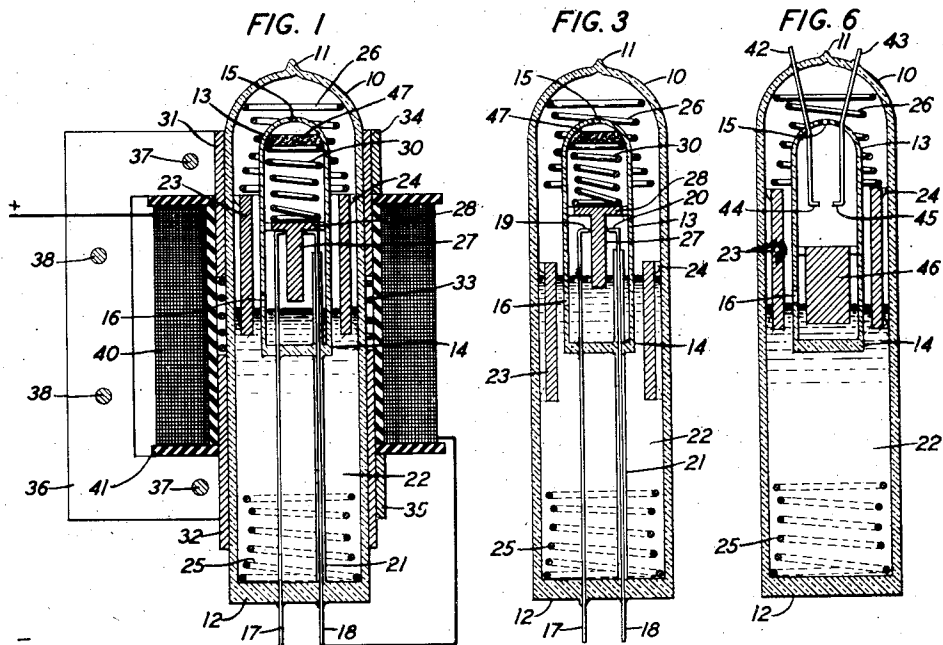
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RELAY

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RELAY

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This invention relates to a time delay relay or circuit controlling device. The object of the invention is to provide a relay, the contacts of which may be opened or closed an appreciable interval after the energization of the relay winding.

It is often desirable in electrical systems to provide for delaying the closing or opening of a circuit for an appreciable interval, for example of several seconds or minutes after the establishment of another circuit or to make and break a circuit periodically at a slow predetermined rate.

In accordance with the present invention a relay having the desired characteristic of delaying the operation of its contacts for a considerable interval after its winding is energized is provided which comprises an electromagnetic field surrounding an envelope within which is a pool of mercury or other fluid having similar characteristics. An annular displacer or core of magnetic material is positioned within the envelope, floated on the mercury pool, and subject to the magnetic field. Centrally positioned in the envelope and inside the annular core is a glass tube partly submerged in the pool of mercury. This tube is closed with the exception of an opening near its base and a restricted vent in its upper end. Extending from outside the envelope into the tube and sealed to both the envelope and tube are two contacts electrically insulated from each other. A float member having a conducting surface is positioned in the tube and subject to the rise and fall of the mercury in the tube for bridging the contacts. This float member may be arranged to normally bridge the contacts and to open the circuit between them when the mercury rises in the tube and lifts the float, or may be arranged to bridge normally open contacts when the mercury rises in the tube, as may be desired.

If the relay is of such a character that the float normally closes the contacts with the magnetic field unenergized, the core floats on the pool of mercury and the level of the pool is such that the float is unaffected thereby. When the field is energized, however, the core is submerged into the mercury pool raising the level of the pool so that mercury is displaced through the opening in the lower end of the tube and raises the float thereby opening the circuit between the contacts. The rate at which the pool of mercury rises in the tube is determined by the size of the restricted vent in the upper end of the tube and therefore, by proportioning the size of the vent, the operating time of the relay may be deter-

mined. When the magnetic circuit is deenergized the core rises quickly and the level of the mercury drops at once thereby again bridging the contacts.

Should it be desired to delay the closure of normally open contacts the relay could be constructed in the same general manner except that the contacts would be positioned above the float and would be closed only after the float has been lifted by the rising column of mercury in the tube.

For a clearer understanding of the invention reference may be had to the following detailed description taken in connection with the accompanying drawing of which:

Fig. 1 is a vertical section through the relay showing the relay in its unoperated condition with its contacts closed;

Fig. 2 is a top plan view of the relay;

Fig. 3 is a section similar to Fig. 1 with the magnet yoke and winding omitted showing the relay in its operated condition with its contacts open;

Fig. 4 is a perspective view of the displacer or core of the relay;

Fig. 5 is a perspective view of the float and upper ends of the contacts of the relay shown in Fig. 1; and

Fig. 6 is a sectional view of a relay similar to Fig. 2 but modified to enable the closure of normally open contacts when the relay winding is energized.

In the several figures 10 designates a glass envelope in the form of a cylinder sealed off at 11 and having a thickened base 12. Centrally positioned within the envelope is a second glass tube 13 having a thickened base 14 and provided at its upper end with a restricted vent 15. This vent is made very minute for the purpose of restricting the flow of gas from the tube into the envelope. A small opening 16 is also provided in the side wall of the tube 13 for a purpose to be later described.

As disclosed in Figs. 1 and 2 two terminal wires 17 and 18 extend upwardly through the base 12 of the envelope 10 and through the base 14 of the tube 13 and terminate in arcuate contact portions 19 and 20 extending at right angles therefrom. The terminal wire 17 is sealed into the bases of the envelope and tube and the terminal wire 18 extends through a glass sleeve 21 which extends substantially the entire length of the wire and is sealed to the base 12 of the envelope and to the base 14 of the tube thereby effectively insulating wire 18 from wire 17. The wires 17

and 18 also serve to rigidly support the tube 13 within the envelope.

The envelope is partially filled with mercury 22 until the level has been raised to a desired amount. Positioned within the envelope 10 and surrounding the tube 13 is an annular displacer or solenoid core 23 of magnetic material having high permeability and low residual magnetism. This core as most clearly disclosed in Fig. 4 is provided with outwardly extending projections 26 for guiding the core in its vertical movement within the envelope. These projections are of small contact area for the purpose of reducing to a minimum the frictional contact thereof with the inside wall of the envelope and to permit the free flow of gas or mercury between the inside wall of the envelope and the outside wall of the core. The core 23 normally floats on the mercury 22 in the position shown in Fig. 1, the level of the mercury being such that with the core floating thereon it just reaches to the lower side of the opening 16 in the tube 13.

A spring 25 is positioned in the lower portion of the envelope 10 and a second spring 26 is positioned in the upper end of the envelope, these springs being of non-magnetic material and serving to protect the envelope against shock in shipping and handling. The lower spring 25 may be suitably anchored to the base 12 of the envelope to prevent it from floating upwardly in the mercury although anchoring is not necessary since no harm would be done if it should float upwardly into engagement with the lower edge of the core 23.

A float member 27 is provided within the tube 13 having a disc-shaped head 28 provided with teeth 29 for guiding the float in its vertical movement within the tube. These teeth are of small contact area for the purpose of reducing to a minimum the frictional contact thereof with the inside wall of tube 13 and to permit the free flow of gas past the edge of the head. The float is made of metal having good conductivity, tungsten being suitable for the purpose. Normally it rests upon the contact portions 19 and 20 of the terminal wires 17 and 18 thereby establishing a conducting bridge therebetween. In this position its lower end is out of contact with the upper surface of the mercury pool. For insuring a good contact with the contact portions 19 and 20 a light coiled spring 30 is inserted between the upper face of the head 28 of the float and the upper end of the tube 13. The spring 30 also serves to hold the float 27 in position to prevent damage to the tube 13 during shipping and handling.

After the assembly of the elements above described within the envelope 10 and the insertion of the mercury pool and before the upper end of the envelope is sealed off at 11, the envelope is evacuated and charged with an inert gas, such as helium, argon, hydrogen or the like.

The envelope 10 is fitted loosely within two metal sleeves 31 and 32 preferably of magnetic material and held in position by the friction of a coil spring 33 wrapped closely around the envelope and bearing against the adjacent ends of the sleeves. This spring is of non-magnetic material such as phosphor bronze. The sleeves 31 and 32 are clamped by clips 34 and 35 to a laminated yoke 36 of soft iron or other suitable magnetic material. Bolts 37 serve to fasten the clips to the yoke and to clamp the laminations of the yoke together. Other bolts 38 pass through the yoke and serve to further clamp the laminations of the yoke together and to secure mounting brackets 39 to the yoke.

A solenoid coil 40 is wound on an insulating spool 41 which surrounds the magnetic sleeves 31 and 32 between the arms of the yoke 36. As disclosed in Fig. 1 the operating circuit for coil 40 extends from one terminal of a source of electrical energy through the coil, over terminal wire 18 and the contact portion 20 thereof, bridging disc 20 of the float member 27, contact portion 19 of terminal wire 17 to the other terminal of the source of energy whereby a self-interrupting circuit for the coil 40 is provided. It is to be understood, however, that this is only illustrative of one manner in which the relay may be used. It will be obvious that the circuit through the coil 40 and the circuit over the terminal wires 17 and 18 may be entirely separate whereby the energization of the coil over one circuit will control the interruption of a second independent circuit.

In Fig. 6 a modification of the relay is disclosed which is essentially the same as that disclosed in Figs. 1 and 2 with the exception that whereas in Figs. 1 and 2 a relay is disclosed which upon operation opens normally closed contacts, the relay of Fig. 6 is arranged to close normally open contacts. For this purpose the terminal wires 42 and 43 are extended downwardly through the upper ends of the envelope 10 and tube 13 and terminate in horizontal arcuate contact portions 44 and 45 positioned above the float member 46. These terminal wires are sealed into the envelope and tube and serve as supports for the tube. The float 46 is similar to the float 27 disclosed in Fig. 5 and establishes a bridge across the contact portions 44 and 45 when it is floated upwardly by the mercury.

It will be assumed that the relay is connected as disclosed in Fig. 1 for interrupting its own operating circuit and that it is in its normal condition with the core 23 floating on the mercury, the level of the pool of mercury extending just below the opening 16 in the tube 13 and the float member 27 resting on the contact portions of the terminal wires 17 and 18. If now electrical energy is applied to the relay the coil 40 will become energized and will draw the core 23 downwardly into the pool of mercury until it assumes the position shown in Fig. 3. As the core moves downwardly it will displace mercury which will rise in the envelope. Some of the mercury will flow through the opening 16 of tube 13 until when it rises above the upper edge of the opening 16 the tube 13 will be sealed except for the restricted vent 15 in its upper end.

The mercury which has been displaced by the core 23 will continue to seek a stable level by continuing to rise in the tube 13 but the rate at which it is permitted to flow into the tube will now be delayed by the pressure of the gas trapped in the tube. However, as the gas escapes slowly through the vent 15 the mercury level in the tube will slowly rise until it engages and lifts the float member 27 against the tension of spring 30. When the mercury level has risen sufficiently the float member will be raised until its head portion 28 is disengaged from the contact portions 19 and 20 of the terminal wires thereby opening the circuit through the coil 40 as disclosed in Fig. 2.

The coil 40 now being deenergized the core 23 will at once float upwardly in the mercury and the mercury level will drop in the envelope 10 permitting the mercury in the tube 13 to flow out of the tube through the opening 16 thereby lowering the float member 27 until its disc-

shaped head 28 is again forced into engagement with the contact portions of the terminal wires by the spring 30. The circuit through the coil 40 will again be made and the relay will thus intermittently operate at a predetermined rate so long as it is connected to the source of energy.

To prevent mercury vapor formed by the making and breaking of the relay contacts from rising and collecting in the upper end of the tube 13 about the vent 15, which might cause a variation in the flow of gas through the vent and thus cause a variance in the delay period of the relay, a small quantity of asbestos fiber, felt, steel wool or the like 47 is packed lightly in the upper end of the tube which will intercept the particles of mercury vapor and preserve the normal gas flow.

The modified form of relay disclosed in part in Fig. 6 functions in a similar manner. When the core 23 is depressed into the mercury pool 22 by the energization of the relay coil, mercury is displaced and its level rises in the envelope, a part of the mercury flowing through the opening 16 in the tube 13. As the level of the mercury continues to rise in the tube 13 as permitted by the escape of trapped gas through the restricted vent 15, the float member 46 is raised until it engages and bridges the contact portions 44 and 45 of the terminal wires 42 and 43. When the relay coil is deenergized the core 23 at once floats upwardly in the mercury and the mercury level drops in the envelope 10 permitting the mercury in the tube 13 to flow out through the opening 16 thereby lowering the float member 46 and opening the bridge across the contact portions of the terminal wires.

It will be obvious from the disclosure that the length of the time delay when breaking or making an electrical circuit may be varied within limits by increasing or reducing the size of the vent 15.

What is claimed is:

1. In a relay, a sealed envelope, a solenoid coil, a pool of fluid in said envelope, an annular core within said envelope and floated on said fluid, a tube supported in said envelope having an opening communicating with said pool of fluid and a restricted vent in the upper end thereof, a pair of terminals extending into said tube and insulated from each other, and a float in said tube for bridging said terminals and operable when the fluid rises in said tube in response to the submersion of said core in said fluid upon the energization of said coil.

2. In a relay, a sealed envelope, a solenoid coil, a pool of mercury in said envelope, an annular core within said envelope and floated on said mercury, a tube supported in said envelope having an opening communicating with said pool of mercury and a restricted vent in the upper end thereof, a pair of terminals extending into said tube and insulated from each other, and a float in said tube for bridging said terminals and operable when the mercury rises in said tube in response to the submersion of said core in said mercury upon the energization of said coil.

3. In a relay, a sealed envelope, a solenoid coil, a pool of mercury in said envelope, an annular core within said envelope and floated on said mercury, a tube supported in said envelope having

an opening communicating with said pool of mercury and a restricted vent in the upper end thereof, a pair of terminals extending into said tube and insulated from each other, and a float in said tube normally bridging said terminals and movable out of contact therewith when the mercury rises in said tube in response to the submersion of said core in said mercury upon the energization of said coil.

4. In a relay, a sealed envelope, a solenoid coil surrounding said envelope, a pool of mercury in said envelope, an annular core within said envelope floated on said mercury and within the field of said coil, a tube supported in said envelope having an opening communicating with said pool of mercury and a restricted vent in the upper end thereof, a pair of terminals extending into said tube and insulated from each other, and a float in said tube normally bridging said terminals and movable out of contact therewith when the mercury rises in said tube in response to the submersion of said core in said mercury upon the energization of said coil.

5. In a relay, a sealed envelope, a solenoid coil, a pool of mercury in said envelope, an annular core within said envelope and floated on said mercury, a tube supported in said envelope having an opening communicating with said pool of mercury and a restricted vent in the upper end thereof, a pair of terminals extending into said tube and insulated from each other, a float in said tube, and a spring for normally holding said float in bridging engagement with said terminals, said float movable out of engagement with said terminals when the mercury rises in said tube in response to the submersion of said core in said mercury upon the energization of said coil.

6. In a relay, a sealed envelope, a solenoid coil, a pool of mercury in said envelope, an annular core within said envelope floated on said mercury, a tube supported in said envelope, partially submerged in said mercury, having an opening in the wall thereof just above the normal level of said mercury pool and a restricted vent in the upper end thereof, a pair of terminals extending upwardly through the bases of said envelope and tube and insulated from each other, and a float in said tube normally resting on the upper ends of said terminals forming a conducting bridge between them and movable out of contact therewith when the mercury rises in said tube in response to the submersion of said core in said mercury upon the energization of said coil.

7. In a relay, a sealed envelope, a solenoid coil, a pool of mercury in said envelope, an annular core within said envelope floated on said mercury, a tube supported in said envelope, partially submerged in said mercury, having an opening in the wall thereof just above the normal level of said mercury pool and a restricted vent in the upper end thereof, a pair of terminals extending downwardly through the upper ends of said envelope and tube, and a float in said tube normally out of contact with said terminals and movable into bridging contact therewith when the mercury rises in said tube in response to the submersion of said core in said mercury upon the energization of said coil.

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