

Aug. 12, 1930.

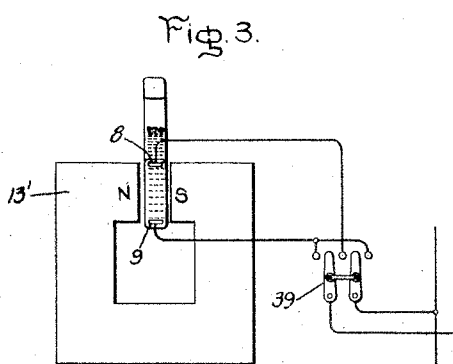
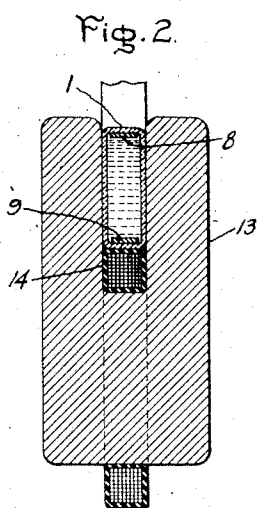
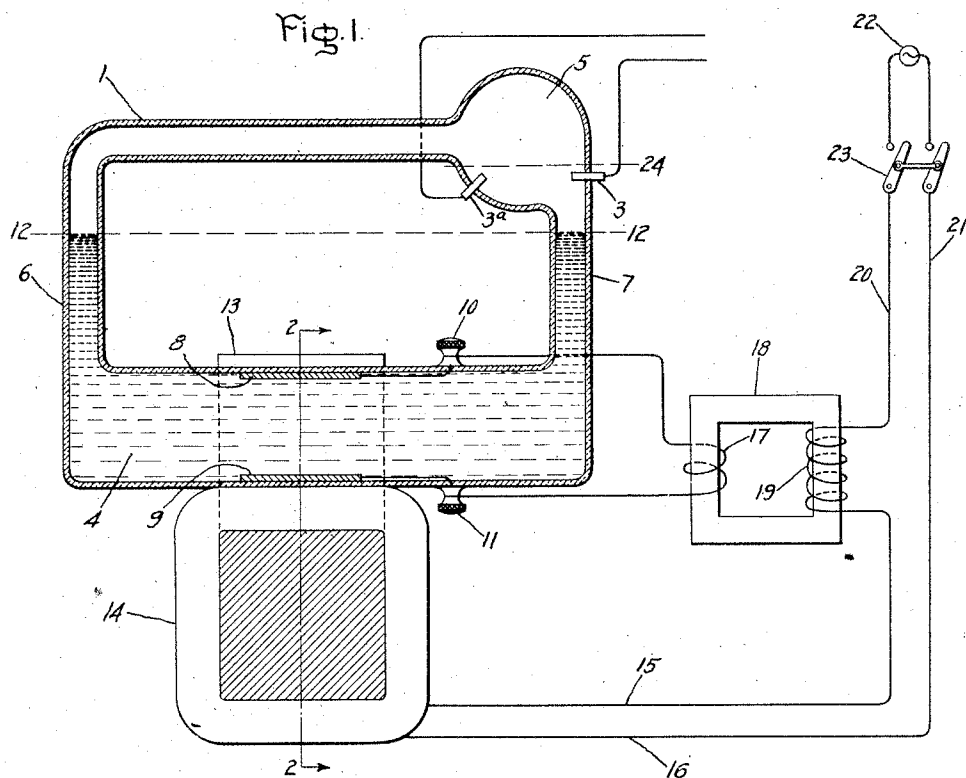
A. S. FITZ GERALD

1,773,036

MERCURY RELAY

Filed Jan. 12, 1928

2 Sheets-Sheet 1



Inventor:
Alan S. Fitz Gerald,
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His Attorney.

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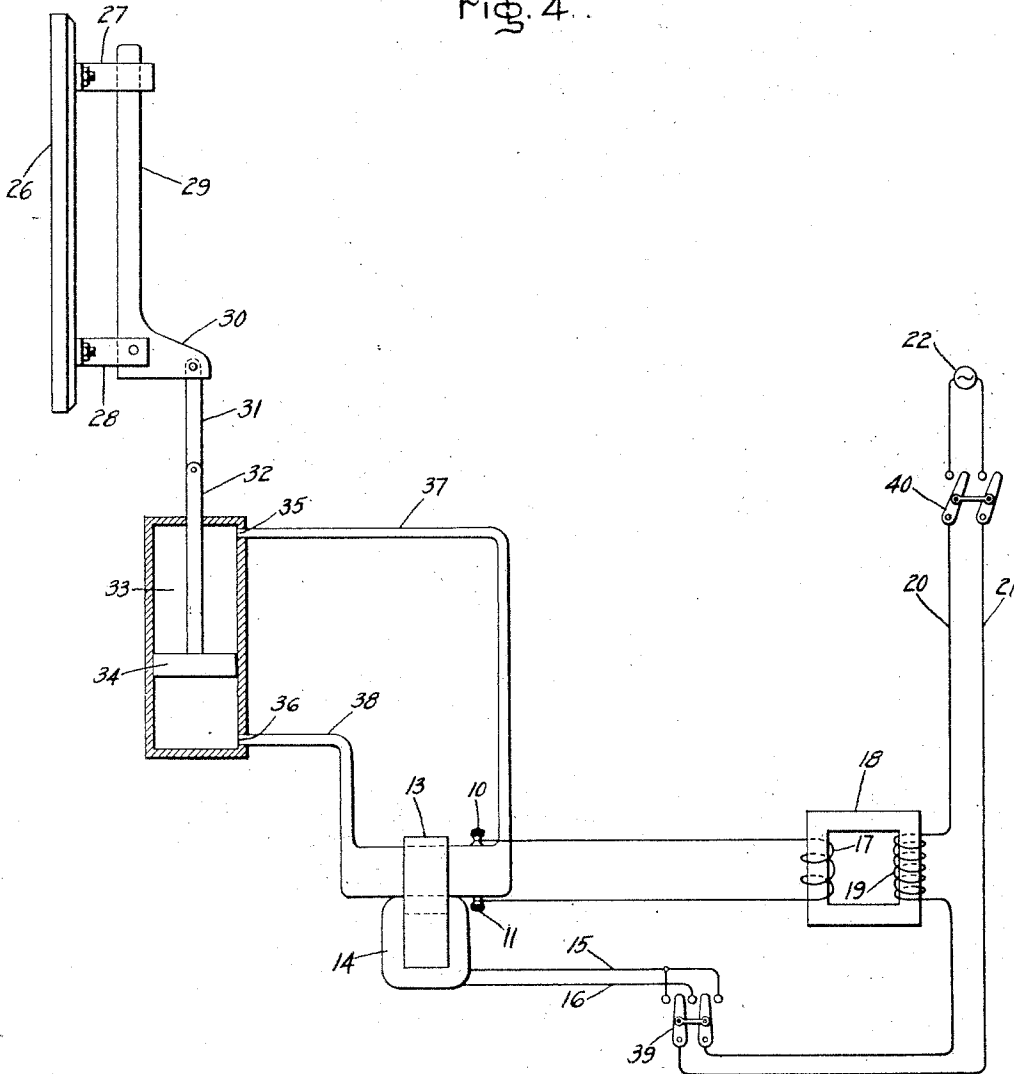
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2 Sheets-Sheet 2

Fig. 4.



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UNITED STATES PATENT OFFICE

ALAN S. FITZ GERALD, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

MERCURY RELAY

Application filed January 12, 1928. Serial No. 248,317.

My invention relates to circuit controller of the liquid contact type and more particularly to such controllers of large current carrying capacity. The advantages peculiar to liquid contact controllers, such as sealed mercury contact switches, are well known in the art. By the use of these controllers in circuits which must be opened or closed frequently, the burning of contacts and consequent maintenance which is an incident to the use of metallic contacts may be avoided, and the life of the controller increased.

In the mercury contact switch heretofore in general use, the mercury and contacts have been enclosed within a sealed tube pivoted to permit a limited rocking motion. While this arrangement has been more or less satisfactory where the current carrying capacity of the switch was small, and the operating forces available to tilt the tube were ample, such switches are not suitable for controlling large currents because of the difficulty of providing connections sufficiently flexible to avoid hindering the operations of the mercury tube while at the same time having suitable current carrying capacity and sufficient strength to withstand ordinary handling.

It is an object of my invention to overcome the above mentioned difficulties by substituting for the pivoted mercury tube, a stationary vessel and causing the mercury therein to be displaced by electro-magnetic influence to close the contacts.

Another object of the invention is to provide a liquid contact electric switch of a relatively large current carrying capacity which may be operated with a comparatively small amount of power.

The preferred embodiments of my invention, as illustrated in the accompanying drawing will now be described, and the features which I believe to be new and patentable will be pointed out in the appended claims.

In the drawing, Fig. 1 is a schematic diagram of the preferred embodiment of my invention in a mercury contact switch. Fig. 2 is a cross-sectional view of the electromagnet shown in Fig. 1, taken on the line 2—2. Fig. 3 shows a modification of my invention in

which the electromagnet is replaced by a permanent magnet. Fig. 4 illustrates an application of the same principle with the interposition of mechanical means between the mercury chamber and the switch which is illustrated as a disconnecting switch of a well known type, though it is obvious that it might be applied to any other type of switch.

Referring now to Fig. 1 of the drawing, I have illustrated a mercury contact switch comprising a vessel 1, containing the main switch contacts 3 and 3^a. This vessel is preferably of glass and hermetically sealed, although any other suitable material which may be readily formed in the desired shape may be used. It is not necessary to the operation of this device that the vessel be sealed, although in practice, it is usually desirable. The contacts 3 and 3^a are also sealed into the vessel in case a sealed vessel is used, and they must be insulated from the vessel if it is made of electrically conductive material. This vessel comprises a main mercury chamber 4 and a contact chamber 5, in which are mounted the contacts 3 and 3^a, connected together by means of the tubes 6 and 7, and is preferably as thin as possible in a direction normal to the plane of the drawing.

In the mercury chamber 4 are mounted two electrodes 8 and 9 connected to terminals 10 and 11, sealed into the vessel. This mercury chamber 4 is filled with mercury which rises in the tubes 6 and 7 to a level 12 substantially below the contacts 3 and 3^a. Contacts 3 and 3^a might be placed normally below the mercury level if intended to be normally closed.

Surrounding the mercury chamber 4 in the position in which the electrodes 8 and 9 are mounted is a C-shaped electromagnet 13 having a winding 14 terminating in the leads 15 and 16. That is, the portion of the mercury chamber containing the electrodes 8 and 9 is arranged in the air gap of the electromagnet 13, which is preferably made only long enough to receive the vessel so that a maximum flux may be obtained for a given magnetomotive force.

Current of low voltage but high amperage is supplied to the electrodes 8 and 9, through binding posts 10 and 11 mounted in the main

mercury chamber 4 from the secondary winding 17 of a transformer 18. The primary winding 19 of this transformer is energized in series with the exciting winding 14 of the electromagnet 13. By this means the current flowing between the electrodes 8 and 9 is kept substantially in phase with the flux set up by the electromagnet 13. The primary of the transformer 18 and the winding 14 are energized through the leads 20 and 21 from a suitable source of alternating current 22. In this circuit may be placed a suitable switch 23 which may be an ordinary push-button switch, or the contacts of a relay or control device upon which the operation of this switch is to depend.

The operation of this device is as follows: Upon closing the switch 23, the transformer 18 and the exciting windings 14 are energized by an alternating current. The winding 14 sets up a powerful magnetic field in the air gap of the electromagnet 13; at the same time, the secondary winding 17 supplies a current of high intensity which flows between the electrodes 8 and 9 through the mercury as a conductor. This mercury which is carrying the greater part of the current is in the air gap of the electromagnet 13 and is acted upon in the same manner as the armature conductors of an electric motor. This electromagnetic force propels the mercury to the right, and the mercury rises in the contact chamber 5 to the level 24 and falls in the tube to the left until the difference in hydrostatic head just balances the propulsive force acting on the mercury.

As the mercury rises in the chamber 5, the circuit is completed between the main contacts 3 and 3*. This circuit will be maintained closed as long as the switch 23 is closed to energize the transformer 18 and exciting winding 14, but will be opened as soon as they are deenergized.

In Fig. 3, I have represented a further modification of my invention where the magnet 13' is an ordinary permanent magnet and the electrodes 8 and 9 are connected to a direct current source through a reversing switch 39. This modification may be used where the change in level of the mercury is small.

Fig. 4 illustrates an application of the same principle involved in the apparatus just described to the operation of a disconnecting switch or to operate any other movable device. In this figure the disconnecting switch comprises a base 26 on which are mounted the split contact 27 and the split finger 28 in which is pivoted the disconnect blade 29. The disconnect blade has a projecting arm 30 to which is pivoted the operating link 31. The operation of the switch is similar in principle to that described in connection with Fig. 1, with the exception that the difference in head of the two columns of mercury in the

tubes 37 and 38 is impressed upon a piston 34 operating in a cylinder 33. The piston 34 is connected by means of a link 32 to the operating link 31. In addition, a double pole double throw switch 39 is provided in the circuit of the exciting winding for reversing the current therein. This reversing of current in the exciting winding 14 relative to that between the electrodes causes a reversal in the direction of displacement of the mercury, which, in turn, may be utilized to open and close the disconnecting switch 29. A switch 40 is provided in the supply leads 20 and 21 to control the operation of the disconnecting switch. The switch 40 is shown as a manually operated device, though obviously it may consist of contacts of some relay or other control device. Where desired the switch 40 may be omitted and the switch controlled entirely by the switch 39.

While I have shown and described only the preferred embodiments of my invention, it is not limited to the structure disclosed but obviously includes other modifications such as the use of a single electromagnet with a shading coil such as is well known in the art as applied to the induction disc relay, in place of the electromagnetic means illustrated; or in place of a sealed vessel, an open vessel of proper form might be used; or in place of the glass vessel with sealed electrodes a metallic vessel might be used with the contacts 3 and 3* properly insulated.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In combination, an electromagnet, a transformer having a primary winding connected in series with said electromagnet, and a secondary winding; a vessel arranged in the air gap of said electromagnet containing spaced contacts, an electrically conductive liquid, and electrodes connected to the secondary winding of said transformer for supplying an electric current to said liquid; and a source of alternating current for energizing said electromagnet in series with said transformer whereby said liquid is displaced from its normal position to control a circuit between said contacts.

2. In combination, an electromagnet, a transformer having a primary winding connected in series with said electromagnet, and a secondary winding, a vessel arranged in the air gap of said electromagnet, containing an electrically conductive liquid and electrodes connected to the secondary winding of said transformer for supplying an electric current to said liquid, and a source of alternating current for energizing said electromagnet in series with said transformer whereby said liquid is actuated.

In witness whereof, I have hereunto set my hand this 11th day of January, 1927.

ALAN S. FITZ GERALD.