July 22, 1941. C. F. WARRICK 2,249,994

RELAY DEVICE

Filed May 18, 1938

Fig. 1.

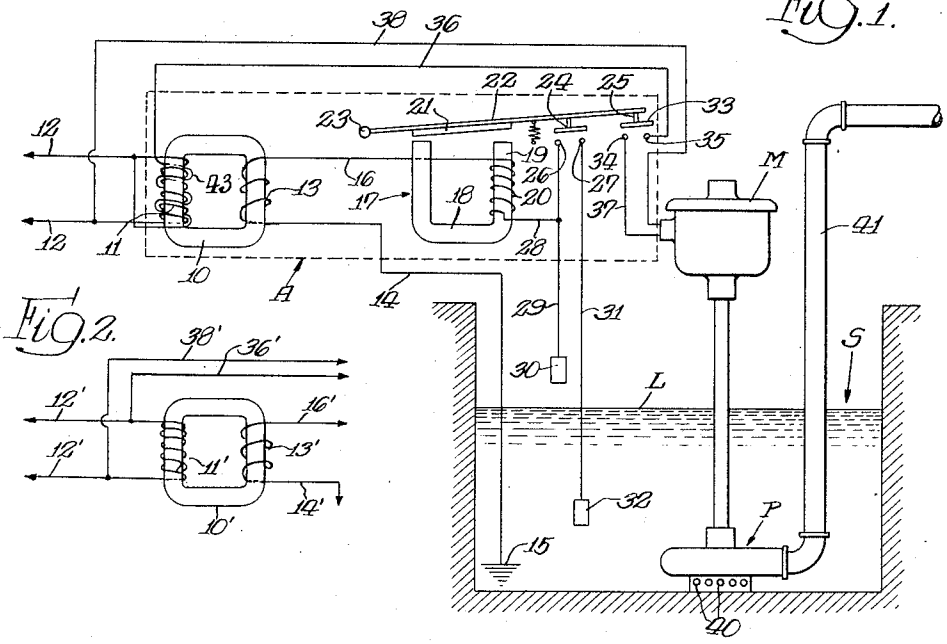


Fig. 2.

INVENTOR.
Charles F. Warrick.
BY Bair & Freeman
ATTORNEYS.

Patented July 22, 1941 2,249,994

UNITED STATES PATENT OFFICE

2,249,994

RELAY DEVICE

Charles Fredericks Warrick, Detroit, Mich., assignor of one-half to Imperial Brass Manufacturing Co., Chicago, Ill., a corporation of Illinois

Application May 18, 1938, Serial No. 208,728

5 Claims. (Cl. 103—25)

My invention relates to electrical controls and particularly magnetic actuated controls suitable for use in a variety of installations. Among the objects of my invention is to provide a new and improved electric control which is positive acting and sufficiently powerful so that movable parts therein of rugged construction can be shifted by a simplified circuit arrangement.

Another object is the provision of a new and improved electric control for an apparatus wherein the circuit operating the controlling portion of the device is insulated from the line circuit.

Another object is the provision of an electromagnetic control device for an electric apparatus which is so constructed that when a sudden additional demand is made on the line circuit due to a change of conditions within the apparatus the power operating the control device is temporarily varied to compensate for unbalanced conditions in the apparatus in order that the control portions of the device may function properly at all times.

Still another object is the provision of an electromagnetic control device responsive to changes in liquid level in a container which is operatively connected to auxiliary attachments in such a manner that as the level of the liquid changes in the container, the auxiliary attachments are set in operation or released therefrom, depending upon the particular liquid level conditions at which the device is adjusted to operate without the use of floats.

A further object is the provision of a new and improved liquid level control which is operable by means of electrodes suspended in the liquid in order to control operations of a pump suitable for changing the level of the liquid in response to the operations of said device.

With these and other objects in view my invention consists in the construction, arrangement and combination of the various parts of my device whereby the objects contemplated are attained as hereinafter more fully set forth and pointed out in my claims and illustrated in the accompanying drawing in which:

Figure 1 is a diagrammatic view showing the control elements and a pump controlled thereby, positioned in a sump.

Figure 2 is a diagram of a transformer used in the control showing a modified primary wiring.

In the construction of electric control devices which must be made of such a rugged construction that they are suitable for throwing heavy switches for actuating alarms and like activities, it is necessary to construct the actuating portions in such a manner that they can be supplied with a current strong enough to do the work desired without that current being so great as to jeopardize the safety of any person coming in contact therewith. By providing a positive acting relay of this character the construction can be kept extremely simple so that an electrician with no more than a fundamental grounding in his art is capable of making adjustments and repairs without it being necessary to send the entire instrument back to the factory. The extremely simple construction of my device also permits it to be built quickly and cheaply without sacrificing any fineness of adjustment in its operation and insures a product which can be sold to the public at a price commensurate with its usefulness.

By the use of electrodes as herein set forth, the control device is readily operable in a conductive liquid in containers under pressure since no mechanical connection other than an insulated electric wire is needed between inside and outside of the container, a condition not true of floats. Moreover the device is operable even though a sheet of ice forms on the surface of a conductive liquid such as water for example, when immersed in the conductive liquid underneath.

My device in general consists of a transformer, or in some instances a condenser, having the primary side directly and permanently connected to a source of alternating current. The secondary side of the transformer includes a circuit necessarily insulated from the primary circuit and operable to actuate a magnetic relay, the armature of which is pivoted so that when actuated it is capable of throwing a heavy switch or other similar functions requiring movement of an actuator arm with considerable force.

In the embodiment of my invention shown in Figure 1, the electrical control device A is shown within the dotted line connected to a motor M which is set up so as to drive a sump pump P located at the bottom of the sump S. The electric control device includes a transformer 10 having a primary side 11 which is connected by line wires 12 to a source of alternating current. The secondary side 13 of the transformer has one connection 14 to a ground which may be at the point 15 in the sump or elsewhere connected to the ground. Another connection 16 from the secondary coil leads to a magnetic relay 17.

The relay 17 includes a core member 18, one pole portion 19 of which is wound with a coil of wire 20 connected to the secondary circuit wire 16. An armature 21 is provided mounted upon an extension 22 pivotally supported at a point 23.

The extension is adapted to jointly operate a pair of switches 24 and 25, the detailed operation of which will be presently described.

Switch 24 which for illustrative purposes may be called the relay switch has a pair of terminal points 26 and 27. The point 26 is connected by means of a lead 28 to an end of the relay coil 20 opposite from the end connected with wire 16 leading to the transformer secondary coil. The same point 26 is likewise connected through a lead 29 to an electrode 30 which is suspended in the sump at an upper level. The other terminal point 27 is connected by means of a lead 31 directly to an electrode 32 which is suspended in the sump at a level lower than the electrode 30.

The switch 25 carried by the extension which for descriptive purposes will be termed the motor switch, includes a contact arm 33 adapted to close the circuit between terminal points 34 and 35. A wire 36 from the point 35 is connected with one of the line wires 12 while a wire 37 connects the other terminal point 34 to the pump. A parallel wire 38 connects the pump directly with the other of the line wires 12 thereby connecting the pump into the same circuit which supplies the transformer 10. A description of the operation follows:

As has been noted the transformer 10 at its primary side is permanently connected to a source of alternating current which thereby tends to continuously set up a current in the secondary coil which may be a step down in voltage as indicated in Figure 1 by any proportionate ratio, or if desired in some instances a step up ratio may be used. One of the terminals of the secondary coil is permanently connected with a ground.

When using the control for controlling the water level in a sump a change in level L of the liquid contained in the sump is utilized for actuating the electric control device. To accomplish this the electrodes 30 and 32 as previously noted are suspended at different levels in the sump. Assuming that it is the purpose of the invention to draw water from the sump so that the level is lowered the electrode 32 is suspended well down in the sump. Since as a practical matter it is preferred not to have the motor start and stop too often, the second electrode 30 is suspended at a relatively high level in the sump in order that the interval between the two may represent a considerable quantity of liquid. As the liquid level rises in the sump contact is first made with the lower electrode 32, but since the relay switch 24 is open there is no change in the condition of the circuit even though there is a potential short circuit between the ground 15 and the electrode 32. As the level continues to rise the liquid eventually comes into contact with the electrode 30. At this point a contact is made which completes the circuit through the transformer secondary coil and simultaneously the relay coil defined by the wires 29, 28, 16, 13 and 14. The relay coil thus excited sets up a magnetic field which draws the armature 23 downward thereby closing both the relay switch and the motor switch. It is to be noted that since the magnetic flux around the armature is felt only when the secondary circuit is closed there can be no flux induced therein by continuous excitation of the primary side of the transformer.

When the motor switch closes the motor is started and the pump acts to draw liquid from the sump into the intake apertures 40 of the pump and thence drives it upward through an outlet pipe 41 to a suitable sewer or drain. As the liquid level is lowered it breaks contact with the electrode 30 but since it remains in contact with the electrode 32 the circuit through the relay coil and transformer secondary remains closed, thereby continuing to excite the magnetic field produced by the relay coil holding the armature in place and holding the motor switch closed. Eventually the liquid level will be lowered to a point out of contact with the lower electrode 32 thereby breaking the circuit through the relay coil and transformer secondary. With the circuit thus broken the armature 21 will be released and will be sprung upwards opening both switches thereby shutting off operation of the pump and at the same time resetting the relay switch 24 to its initial position ready for a succeeding operation. By this arrangement the pump is never dry thereby increasing its efficiency of operation. Moreover, the frequency of its operation will be determined by the quantity of water contained in the sump between the electrodes 30 and 32 which under normal drainage conditions will mean that the motor and pump by operating only occasionally has a greatly increased life.

On occasions when the electric control device is used with apparatus in the nature of a motor and pump such as is shown in Figure 1, the initial starting torque of the motor might be so great as to temporarily lower the line current. If this lowering were sufficiently great as it might be at the end of a line the induced current in the secondary coil of the transformer might be low enough so as to prevent or at least render more inefficient the operation of the relay coil, a condition which might fail to properly lower the armature and close the switches. To obviate this, one of the wires 38 connecting the pump with the line circuit 12 may be wound around the primary side of a transformer 10 in the form of a coil 43. In a transformer wound in this manner when an apparatus such as a motor reduces the line current operative upon the primary coil 11 of the transformer the coil 43, acting as a step up coil, adds to the magnetic flux on the primary side, thereby inducing a greater current in the secondary coil 13 to compensate for the temporary reduction. Therefore the current in the secondary circuit remains great enough to actuate the relay and promote efficient operation thereof.

A modified type of device is shown in Figure 2, wherein the series coil 45 has been omitted. In this device line wires 12' supply current to the primary coil 11 wound on the transformer core 10'. A secondary coil 13' has leads 14' and 16' from it to a relay mechanism similar to that described in connection with Figure 1. Wires 36' and 38' may be directly connected to a motor circuit.

Some changes may be made in the construction and arrangement of my device without departing from the real spirit and purpose of my invention and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

I claim as my invention:

1. In an electric control device comprising a transformer having a primary side and a secondary side, said primary side having a coil thereon connected to a continuous source of alternating current, an electric apparatus subject to control by said device connected to said source

of current, an auxiliary coil on one side of said transformer connected in series with said apparatus, a coil on the secondary side of said transformer adapted to be excited by the primary coil and a relay actuable by said secondary coil to control operation of the apparatus, said auxiliary coil being operable upon a change in the power load due to a change in operating conditions in said apparatus to temporarily vary the current supplied to said relay in order to counter-balance the change in the transformer resulting from a variable demand by the apparatus.

2. In an electric control device comprising a transformer including a magnetic core having a primary winding permanently connected to a continuous source of alternating current, an electric apparatus subject to control by said device connected to said source of current, a step-up coil on the primary side of said transformer connected in series with said apparatus, a secondary coil in said transformer continuously excited by the primary coil and a relay comprising a separate stationary magnetic core and a coil of wire thereon actuable by said secondary coil to start operation of the apparatus, said step-up coil being operable upon an increase in the power load due to the starting of said apparatus to temporarily increase the current supplied to said relay in order to counter-balance the loss in the transformer resulting from an increased starting demand by the apparatus.

3. In a liquid level control device including a container for liquid, a pump and an electric motor for driving said pump having connections to a continuous source of alternating current, the combination of an electric control for the motor operable by the liquid comprising a transformer having a closed magnetic core adapted to have the primary side permanently connected to said continuous source of alternating current for continuously exciting an alternating current in a secondary coil, a ground connection for one end of the secondary coil, a relay device comprising a separate intermittently closed magnetic core bearing a coil of wire having one end connected to another end of the secondary coil and an armature having a motor switch for controlling actuation of the motor, a holding circuit connected to the other end of the relay coil including a holding switch actuated by said armature and a pair of electrodes connected respectively with opposite holding switch points and suspended independently in the container at different levels, the upper of said electrodes being directly connected with the secondary transformer coil through the relay and operable when contacted by the liquid to complete the circuit through the relay causing actuation thereof to operate the switches, the lower of said electrodes being operable to maintain the relay circuit closed as the liquid lever lowers below the upper liquid level until the lowering of said level breaks the electric connection with the lower of said electrodes.

4. An electric control comprising a member forming a closed magnetic circuit, a primary winding on one side of said member connected to a continuous source of alternating current and a secondary winding on another side subject to a continually induced current from the primary side having one end thereof connected with the ground, a relay member having a stationary core forming a portion of an intermittently closed magnetic circuit independent of said first magnetic circuit including a pivoted armature forming when pivoted to one position another portion of the second closed magnetic circuit, a winding on the stationary portion of said relay core having one end connected to the other end of the secondary winding, a holding circuit connected to the other end of said relay winding including a pair of spaced electrodes, a switch having two contact points connected one to each of said electrodes respectively, an external conductor adapted to initially connect both electrodes with said one end of the secondary circuit operable after disconnection from one electrode to maintain a closed secondary circuit until the other of said electrodes becomes disconnected therefrom, and an electric actuated device having a switch controlled by said armature connected with means for shifting said external conductor between said positions into and out of contact with said electrodes.

5. In a liquid level control device including a container for liquid, a pump and an electric motor for driving said pump having connections to a continuous source of alternating current, the combination of an electric control for the motor operable by the liquid comprising a transformer having a core comprising a closed magnetic circuit having the primary coil permanently connected to said continuous source of alternating current and a secondary coil, a ground connection for one end of the secondary coil, a relay device including a core comprising a separate magnetic circuit bearing a coil of wire having one end connected to another end of the secondary coil and an armature having a motor switch for controlling actuation of the motor, a holding circuit connected to the other end of the relay coil including a holding switch actuated by said armature and a pair of electrodes connected respectively to opposite holding switch points and suspended independently in the container at different levels, the upper of said electrodes being directly connected with the secondary transformer coil through the relay and operable when contacted by the liquid to complete the circuit through the relay energizing said relay and causing actuation of the armature to operate the switches, the lower of said electrodes being operable to maintain the relay circuit closed after the liquid level recedes below the upper electrode until the liquid breaks the electric connection with the lower of said electrodes, and an intermediate coil surrounding the primary side of the transformer connected in series with one of the motor terminals operable on initial starting of the motor when the motor circuit is closed to modify the electric output of the transformer resulting from the sudden additional load imposed by the motor on the source of electric current.

CHARLES FREDERICKS WARRICK.