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AUTOMATIC SUBMERSIBLE PUMP

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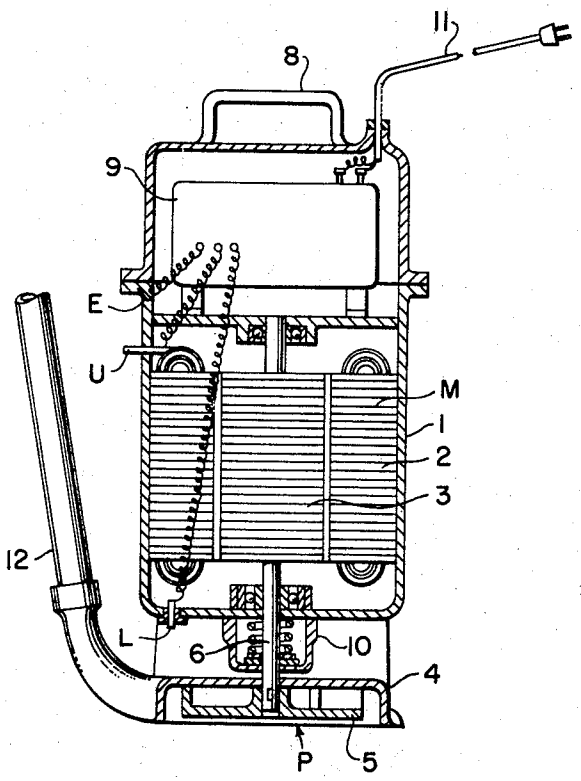


Fig. 1

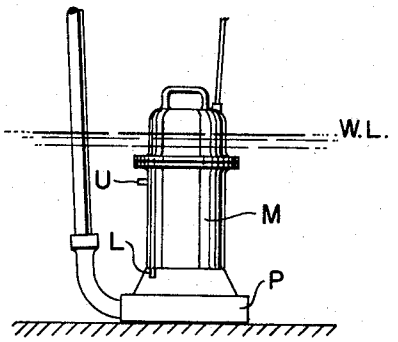


Fig. 3a

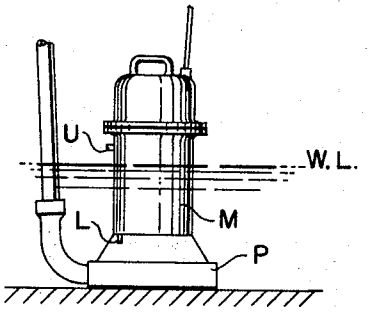


Fig. 3b

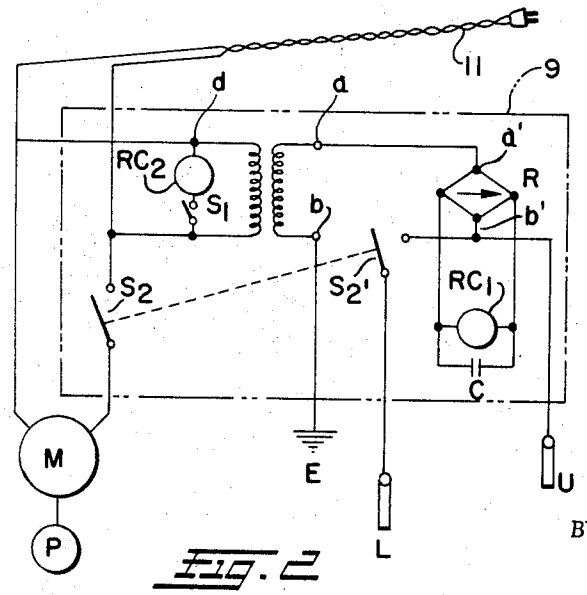


Fig. 2

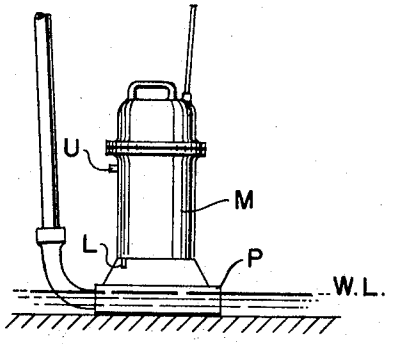


Fig. 3c

INVENTOR
MITSUO INOUE

BY Oberlin, Maky & Donnelly
ATTORNEYS

United States Patent Office

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AUTOMATIC SUBMERSIBLE PUMP

Mitsuo Inoue, Nishinomiya, Japan, assignor to C.D.M. Kabushiki Kaisha, Kishiwada, Osaka, Japan, a corporation of Japan

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ABSTRACT OF THE DISCLOSURE

A submersible pump having an automatic control device including an upper electrode and an earth which when submerged are electrically connected to close the secondary circuit of a transformer and energize a first relay. The first relay when energized closes a switch in series with a second relay for energizing the same which in turn closes another switch in the pump motor circuit to cause actuation of the pump motor. A third switch directly coupled to the motor circuit switch is closed by the closing of the motor circuit switch to connect the upper electrode with a lower electrode, whereby the secondary circuit of the transformer is maintained closed by way of the lower electrode and earth and the pump continues to operate until the water level drops below the lower electrode.

Disclosure

This invention relates to an automatic submersible pump equipped with an automatic operation control device inside the housing. Ordinary small-size pumps directly coupled with water-tight motors and immersed in water for lifting or discharging of water tend to run idle unless they are tended by an operator, as they continue to operate even in the absence of water due to the drop of the water level. Such idling results not only in a waste of power but in considerably shortened machine life. In order to overcome the defect, the use of a float switch or the like which shuts off the power supply upon the drop of the water level below a predetermined value has been proposed. However, such an accessory increases the pump size correspondingly, and gives great inconvenience to the handling of portable pumps, though it may not be objectionable for stationary pumps. Furthermore, portable pumps are in most cases used for civil engineering works, and rough handling inevitably causes trouble or damage to float switches which comprise movable parts.

In the light of the foregoing difficulties, the present invention has for its object provision of a small-size and compact portable underwater pump incorporating an automatic operation control device which is trouble-free in rough handling.

According to the invention, in an automatic submersible pump having an automatic control device to control its operation in response to changes in the water level around it, said pump comprising a pump body, a driving motor casing above the pump body and a sealed compartment for the automatic control device in the top of the motor casing, upper and lower electrodes are provided which are adapted to be electrically connected to an earth of the control device by conduction through water in which the pump is immersed, a transformer being provided the primary of which is adapted to be connected to a power supply and the secondary terminals of which are connected respectively to one input terminal of a rectifier and to the earth, the other input terminal of the rectifier being connected to the upper electrode, a relay coil and a condenser being connected in parallel across the rectifier output and a second relay coil, and a switch closed by energisation of the first relay coil, being connected in series across the transformer primary, the second relay coil, when energised closing a switch in the motor circuit and moving a change-over switch to make a connection between the said lower electrode and the input terminal of the rectifier which is also connected to the upper electrode.

The invention is described hereunder in further detail with reference to the accompanying drawings in which:

FIG. 1 is a sectional side view of an automatic submersible pump according to the present invention;

FIG. 2 is a connection diagram of a control circuit for automatic operation of the pump in FIG. 1; and

FIGS. 3*a*, 3*b* and 3*c* illustrate the relations between the submersible pump according to the invention and different water levels.

Referring to the drawings, the symbol M in FIG. 1 indicates a motor consisting of a casing **1**, stator **2** and rotor **3**, and P indicates a pump comprising a casing **4** and impeller **5**. The impeller **5** of the pump P is mounted securely on the rotor shaft **6** of the motor M, and the casings **1** and **4** are directly coupled with each other. On the top of the casing **1**, a cover **7** provided with a handle **8** is mounted, and inside said cover **7** an automatic operation control device **9** according to the present invention is incorporated in a water-tight manner. The numeral **10** indicates a shaft seal, **11** cabtyre cord for power supply, and **12** discharge a pipe for the pump. On the upper and lower portions of the casing **1**, an upper electrode U and a lower electrode L are arranged, respectively, insulated and slightly exposed from the casing **1**. An earth E is for the control device **9** attached to the casing **1**, if the casing itself is a good electric conductor. If, on the contrary, the casing **1** is a poor conductor such as a synthetic resin, the earth E is posed from the casing and connected to two additional electrodes protruding from the casing one adjacent each of the upper and lower electrodes U and L. The automatic operation control device **9** has such internal connection as illustrated in FIG. 2. The secondary terminals *a* and *b* of the transformer T are connected, respectively, with an input terminal *a'* of a rectifier R and the earth E, while another input terminal *b'* of the rectifier R is connected with the upper electrode U. To the output end of the rectifier R, a relay coil RC_1 is connected, and a condenser C is connected in parallel with the relay coil RC_1. On the primary side of the transformer T, another relay coil RC_2 is connected in series with a normally opened switch S_1. Another normally opened switch S_2 connected by wiring to the feeder of the motor M and a switch S_2' coupled with the switch S_2 are so arranged that they operate as the relay coil RC_1 is energised to close the switch S_1 thereby applying the energizing current to the relay coil RC_2. The terminal *b* and the lower electrode L are connected by a circuit normally closed by the switch S_2', and the upper electrode U and the lower electrode L are so arranged as to form a closed connection as the switch S_2' works.

When an automatic submersible pump according to the invention comprising the above structure is immersed in water as shown in FIG. 3*a*, the upper electrode U, the lower electrode L, and the earth E are communicated with one another via water as a conductor, and the secondary circuit of the transformer T is closed, and hence an energizing current runs through the relay coil RC_1. Then, the energized relay coil RC_1 closes the switch S_1, with the result that a sufficient current is applied to the di-circuit including the relay coil RC_2 and the switch S_1, and that the relay coil RC_2 is energized to close the switch S_2, thereby to actuate the motor M for the pumping operation. At this time, the switch S_2' connects the upper electrode U with the lower electrode L, so that, if the water level drops below the upper electrode U as indicated in FIG. 3*b*, the secondary circuit of the transformer T will

remain closed and the pump P will continue its operation as long as the lower electrode L is conductively connected to the earth E through the medium of water. If the water level indicated in FIG. 3c, the connection between the lower electrode L and the earth E via water will be cut off, and the secondary circuit of the transformer T will be opened, whereby the relay coil RC_1 will be deenergized to open the switch S_1 and the relay coil RC_2 will also be deenergized to open the switch S_2 and thus to stop the motor M. As the switch S_2' is coupled at this time with the switch S_2 and returns to the position where it connects the lower electrode L to the earth E, the operation of the pump will not be resumed unless the water level reaches again the level of the upper electrode U.

As will be understood from the foregoing description, the automatic submersible pump according to the present invention is automatically operated as the water level rises above the upper electrode U, and is automatically stopped as the water level drops below the lower electrode L, and thus the pumping operation is carried out quite positively and entirely automatically without the need of any operator and with no possibility of idling. The automatic operation control device **9** is compactly built inside the top cover **7** of the casing **1**. It has many advantages: for example, it can naturally be reduced in size as compared with the conventional float-type devices, and is so rugged in construction that it is trouble-free in rough handling, and always operates positively, even if the pump is not in a vertical position, so long as there is a vertical difference between the positions of the electrodes U and L. The automatic submersible pump of the invention incorporating such an automatic operation control device is extremely suitable for water lifting and discharging operations in civil engineering and other construction works.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States is:

1. In combination, a submersible pump, a motor for driving said pump, and an automatic control device mounted on said pump for controlling the operation of said pump motor in response to changes in the water level around said pump, said automatic control device comprising vertically spaced upper and lower electrodes which when submerged are adapted to be electrically connected to an earth of said control device by conduction through the water in which the pump is immersed, a transformer having a primary circuit which is adapted to be connected to a power supply and a secondary circuit, a rectifier having one input terminal connected to one terminal of said secondary circuit and the other input terminal connected to said upper electrode, the other terminal of said secondary circuit being connected to the earth, a first relay coil connected across the output terminals of said rectifier, a second relay coil, a first switch closed by energization of said first relay coil, said first switch being connected in series with said second relay coil across the transformer primary circuit for energizing said second relay coil when said first switch is closed, said second relay coil, when energized, closing another switch in the motor circuit to actuate said pump motor, and a change-over switch means directly coupled to said motor circuit switch operative to make a connection between said lower electrode and the input terminal of said rectifier which is also connected with said uppper electrode in response to the closing of said motor circuit switch, whereby said transformer secondary circuit will remain closed and said pump motor will continue to operate as long as said lower electrode is conductively connected to the earth through the water in which the pump is emerged.

2. The combination of claim **1** further comprising a condenser connected in parallel with said first relay coil.

3. The combination of claim **1** wherein said pump motor is contained in a casing of good electrical conductivity and the earth of said control device is connected thereto, said upper and lower electrodes being insulated from and protruding outwardly through said casing adjacent the top and bottom thereof, respectively.

4. The combination of claim **1** wherein said pump motor is contained in a casing of poor electrical conductivity and the earth of said control device is connected to two additional electrodes protruding from said casing one adjacent each of said upper and lower electrodes.

5. The combination of claim **1** wherein said pump motor is contained in a casing, and there is a sealed compartment for said automatic control device mounted on top of said casing.

References Cited

UNITED STATES PATENTS

2,424,657	7/1947	Goodman	103—25
2,834,845	5/1958	Nielsen	103—25
3,019,764	2/1962	Schilling	103—25
3,030,890	4/1962	Galik	103—25
3,118,391	1/1964	Ciabattari	103—25
3,252,420	5/1966	Sorensen	103—25

FOREIGN PATENTS

595,750	12/1947	Great Britain.

DONLEY J. STOCKING, *Primary Examiner.*

WILLIAM L. FREEH, *Examiner.*