United States Patent

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Chur, Switzerland
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[33] **Germany**
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[54] **SNAP SWITCH**
4 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **200/83,**
200/168, 335/1, 317/99
[51] **Int. Cl.** **H01h 35/40,**
H02b 1/08
[50] **Field of Search** 200/83,
83.9, 153, 168A; 335/1, 185, 192, 203, 15, 28, 29,
49, 53, 162, 186, 188, 194; 317/99, 112

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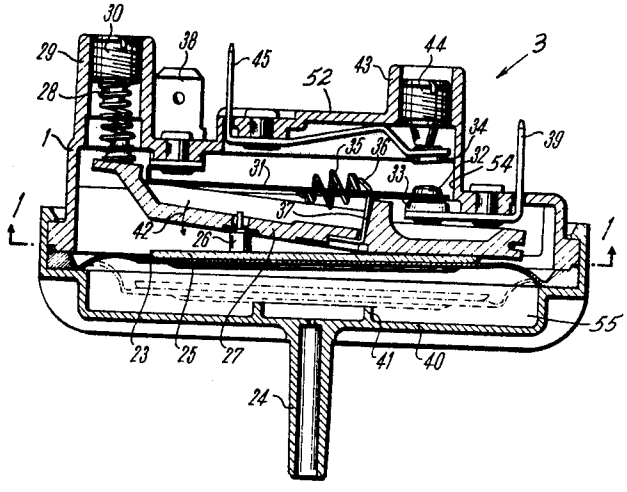
ABSTRACT: A combination of several switch units side by side in one housing includes at least one pressure-controlled switch unit actuated by a diaphragm and at least one electrically controlled switch unit actuated by an electromagnet for controlling the operation of different elements of one machine, for example, a washing machine.



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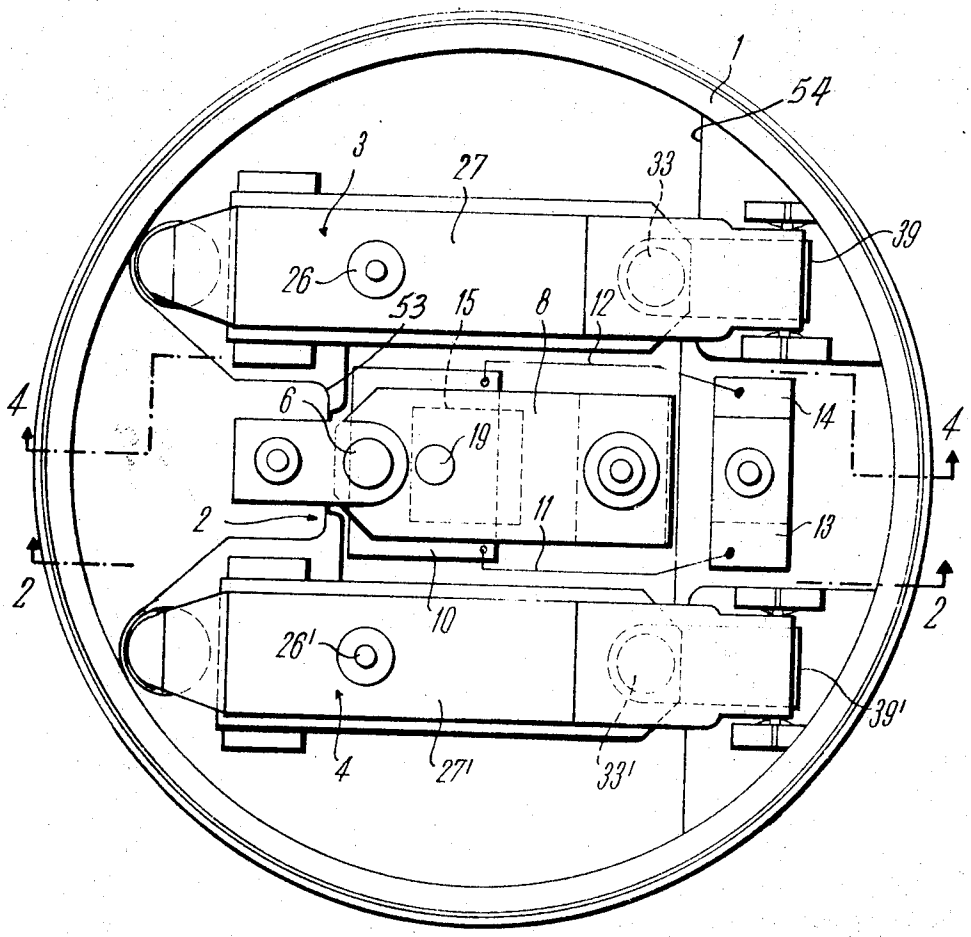

Fig. 1

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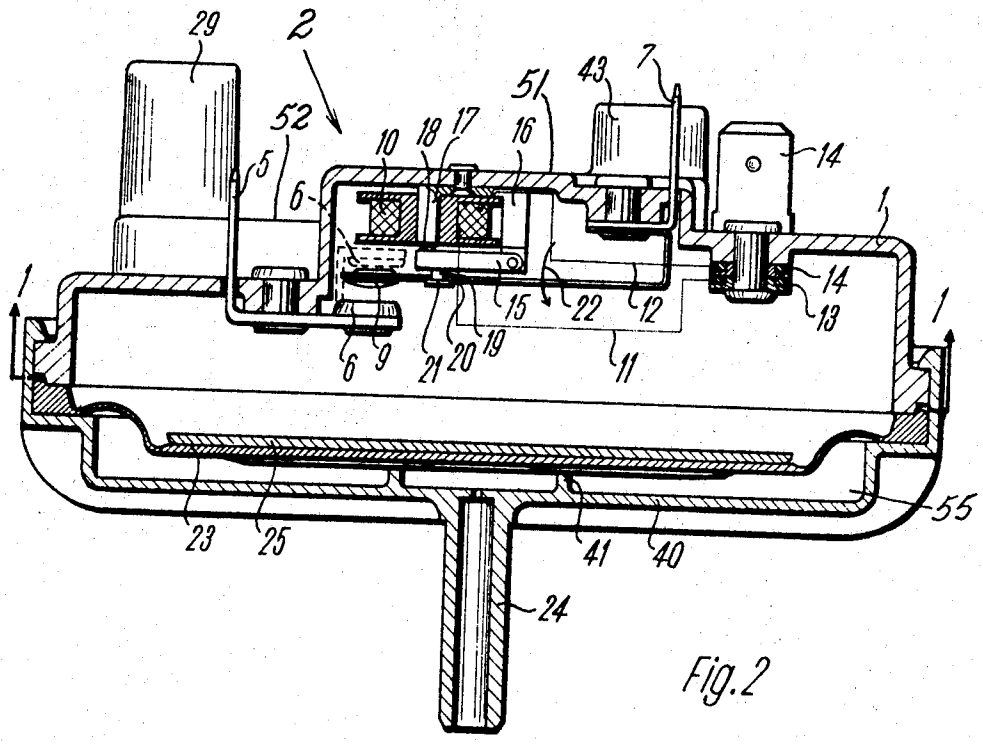

Fig. 2

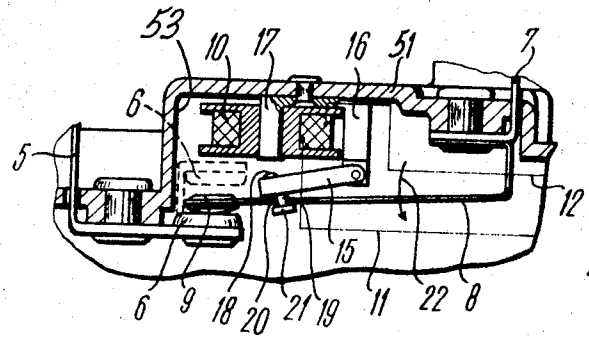

Fig. 3

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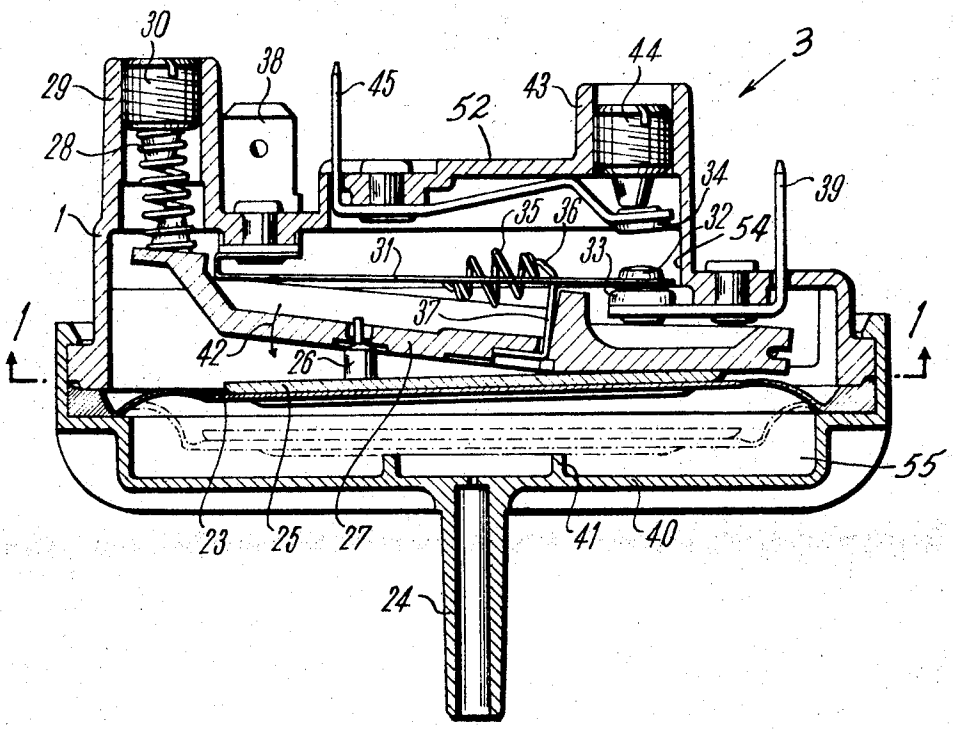

Fig. 4

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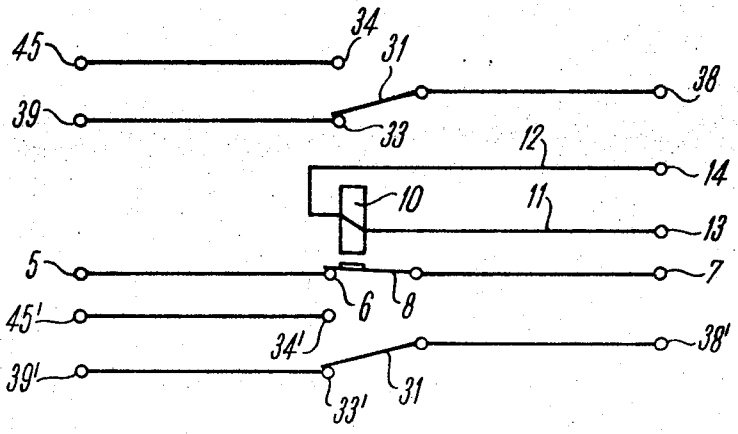

Fig. 5

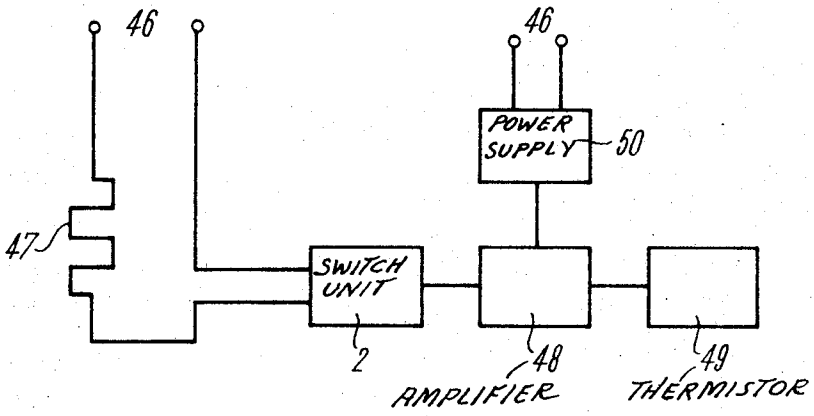

Fig. 6

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SNAP SWITCH

The present invention relates to a multipole snap switch which is especially adapted for being employed in a laundering or dish-washing machine or the like whose individual switch units are equipped with contact springs for making and breaking one or more circuits.

The switch systems of such multipole switches are generally controlled by means of a diaphragm responsive to a pressure which depends upon the level of the liquid contained in the respective machine and acts upon spring-loaded control levers operating the contact springs. Such pressure-controlled switches are frequently employed for carrying out a switching operation when a predetermined pressure is reached. A switch of this type may also be controlled by a temperature gauge which converts the temperatures acting thereon into pressures. Owing to their design and functions, the switches controlled by such temperature-pressure converters do, however, not operate at very specific temperatures and pressures but within relatively large temperature and pressure ranges. For this reason electronic temperature sensors known as thermistors are often preferred which not only operate more accurately but may also be easily separated from the actual switches since they are connected thereto merely electrically, in contradistinction to the temperature-pressure converters mentioned above.

It is an object of the present invention to provide a multipolar snap-action switch of the type mentioned above which is responsive to changes in pressure and may in addition be used for carrying out switching operations in response to conditions or parameters independent of pressures.

According to the invention, this object is attained by designing the switch so that the operations of at least one of the switch units thereof may be controlled by an electrically controlled switch element, while the operations of at least one further switch unit may be controlled by a switch element which is responsive to a pressure determined, for example, by the level of a liquid in a container or machine. This combination of two different switch systems has the particular advantage that the different switching operations can be performed by a single multipolar switch which is of reliable construction and also operates accurately at all times even though it has to comply with different requirements.

According to one preferred embodiment of the invention, the control element of the electric switch unit of the multipolar switch is in the form of an electromagnet with a pivotable armature whose free end is connected to a contact spring so as to pivot the same into or out of engagement with a fixed contact.

This electrically controlled switch unit, which may be located between two pressure-controlled switch units and could be exchanged, if desired, for another pressure-controlled switch unit, may also be connected to and actuated by an electronic control system which is responsive, for example, to a temperature value which is determined by an electronic sensor or thermistor.

These and additional features and advantages of the present invention will become further apparent from the following detailed description thereof which is to be read with reference to the accompanying drawing in which:

FIG. 1 shows a cross section of the switch taken along the line 1–1 of FIG. 2;

FIG. 2 shows an axial section taken along the line 2–2 of FIG. 1;

FIG. 3 shows an enlarged view of a part of the switch illustrated in FIG. 2;

FIG. 4 shows an axial section taken along the line 4–4 of FIG. 1;

FIG. 5 shows a diagram of the electric circuitry the switch; and

FIG. 6 shows a diagrammatic illustration of the electrically controlled switch unit together with an electronic control system therefor.

As illustrated in the drawing, the multipole switching device according to the invention comprises a housing 1 in which, as shown particularly in FIG. 1, three switch units are mounted side-by-side, namely a central switch unit 2 which is electrically controlled and two outer switch units 3 and 4 each of which is pressure-controlled.

The electric switch system 2 as illustrated in detail in FIGS. 2 and 3 comprises a fixed contact 6 connected to a terminal 5, and a contact spring 8 which is connected to another terminal 7 and carries on its free end a contact 9 which, under the biasing stress of contact spring 8, normally engages the fixed contact 6. Above this contact spring 8, the housing 1 carries an electromagnet 10 connected by conductors 11 and 12 to two terminals 13 and 14 which are electrically insulated from each other and through which the control current is supplied to the electromagnet 10. This electromagnet 10 is provided with an armature 15 which is pivotably mounted on the free end of a bracket 16 adjacent to the electromagnet and has a contact projection 18 on its side facing the core 17 of the electromagnet. On its opposite, lower side, the pivotable armature 15 carries a pin 19 which projects through a longitudinal slot 20 in the contact spring 8 and terminates in a head 21 of a width larger than that of the slot 20.

The mode of operation of this electrically controlled switch unit 2 is as follows: When the electromagnet 10 is energized by a control current which is supplied thereto from the terminals 13 and 14 through the conductors 11 and 12, the armature 15 is attracted to its closed position as shown in FIG. 2 in which it has lifted the contact spring 8 to its open position. If the control current is then interrupted and the electromagnet is deenergized, contact spring 8 is swung back by its inherent stress in the direction of the arrow 22 so that its contact 9 engages the fixed contact 6 as shown in FIG. 3 and thereby interconnects the two terminals 5 and 7 to close the circuit of the switch unit 2. This return swing of contact spring 8 also draws the armature 15 to its open position as shown in FIG. 3. Switch unit 2 then remains in its closed position until another current impulse is supplied to the electromagnet 10 whereupon the attraction of armature 15 moves the contact spring 8 against its biasing stress to its open position.

Instead of being inherently biased, contact spring 8 may also be acted upon by a pressure or draw spring. It is also possible to mount the fixed contact at the other side of the movable contact 9 in the manner indicated in FIGS. 1 and 2 in dotted lines, in which case the circuit of the electric switch unit 2 will always be closed when a control current traverses the electromagnet 10 and the armature 15 is in its attracted position. As soon as the control current is then interrupted, contact spring 8 is returned by its own bias or by the action of a separate spring to its open position.

Which of the two different arrangements of the fixed contact 6 is to be employed depends upon the particular use of the switch. If the fixed contact 6 is located underneath the contact spring 8, the electromagnetic attraction of contact spring 8 will cause the contacts to be quickly separated so that any arc will also be quickly extinguished. If, however, the control current acting upon the electromagnet 10 is interrupted, the switch unit 2 (which may control, for example, the circuit of an electric heating apparatus) will be closed so that its load will also operate continuously. If, however, the fixed contact 6 is located above the contact spring 8, an interruption of the control current of the electromagnet 10 will also cause the switch unit 2 to be switched off. This advantage will, however, be offset by the disadvantage that the contact spring 8 will then return rather slowly to its open position which will cause stronger arcing of the contacts.

FIG. 4 illustrates the assembly 5 representative of the two pressure controlled switch units 3 and 4 which are located at both sides of the electrically controlled switch unit 2 as previously described. Switch unit 3 is controlled by a diaphragm 23 responsive to the pressure of a liquid or gas which enters the lower part of the housing 1 underneath diaphragm 23 through an inlet 24. This diaphragm 23 acts by a tappet 26, mounted

on a diaphragm plate 25 upon a control lever 27 which is pivotable about one end and acted upon by an adjusting spring 28 whose other end engages a setscrew 30 which may be adjusted to different levels in a socket 29 in the switch housing 1.

The control lever 27 is operatively associated with a contact spring 31, fixedly clamped at one end, which is provided with an aperture through which an extension 37 of the control lever 27 may swing and with a contact 32 on its free end located between two fixed switch contacts 33 and 34 the latter of which is adjustable to different levels by a setscrew 44 in a socket 43. Between this contact spring 31 and the control lever 27 a snap spring 35 is provided which engages with one end the edge of the aperture in contact spring 31 and with its other end the projecting end 36 of the extension 37 of control lever 27.

Elements of unit 4 visible in FIG. 7 bear the same designations, with the addition of a prime mark, as corresponding elements of unit 3.

When the switch unit 3 or 4 is in the position as shown in FIG. 4, diaphragm 23 is in its raised operative position in which the control lever 27 is pivoted upwardly against the action of the adjusting spring 28 and the contact 32 of contact spring 31 engages the fixed contact 33 so that the terminals 38 and 39 are electrically interconnected. When diaphragm 23 returns, however, to its inactive position as shown in dot-dash lines in FIG. 4, and settles on the supporting rim 41 on the inner side of the cover 40 of housing 1, control lever 27 carries out a pivoting movement in the bottom portion or direction of the arrow 42 so that toggle spring 35 snaps over to the other side with the result that contact spring 31 swings in the opposite direction and its contact 32 engages the other contact 34. Terminal 38, fixed end of spring 31, is then in circuit with another terminal 45.

The electric circuits of the switching system according to the invention are illustrated diagrammatically in FIG. 5, in which the terminals and contacts are designated by the same reference numerals as in the preceding FIGS. Here again, the reference numerals for the switch unit 4 differ from those used for the switch unit 3 by the addition of a prime mark.

FIG. 6, finally, shows a diagrammatic illustration of an electronic control of the electrical switch unit 2 which, in turn, controls the supply of current to an electric heating device 47 connected to the current source 46. This electronic circuit comprises an amplifier 48 one side of which is connected to a temperature sensor or thermistor 49, such as a temperature-responsive resistance, while its other side is connected to a power-supply unit 50 energized by electric mains 46.

From FIGS. 1—3 it will be noted that the diaphragm 23 with its reinforcing plate 25 extends across the entire dished housing bottom 40, underneath switch units 2, 3 and 4, even though only the latter two units (flanking the unit 2) are actuated by this diaphragm through the intermediary of their levers 27 and 27' upon admission of pressure fluid into the chamber 55 beneath it. It will also be seen that the opposite housing portion, overlying the diaphragm, is formed with a superstructure 51, 52 which defines a recess bounded by edges 53, 54 to accommodate parts of the units 2, 3 and 4, thereby keeping the elements of unit 2 clear of diaphragm 23 in any position of the latter while affording enough room for the operation of the diaphragm-controlled levers of units 3 and 4.

From the above description and the drawing it is evident that this particular switch is in effect a two-level control switch, for example, of a washing machine, which by means of its electrically controlled switch unit is additionally able to control the operation of an electric heating unit of the machine. By thus combining two different switch systems into one structural unit it is possible to omit a separate additional switch as well as separate contactors.

Although my invention has been illustrated and described with reference to the preferred embodiment thereof, I wish to have it understood that it is in no way limited to the details of such embodiment but is capable of numerous modifications within the scope of the appended claims.

I claim:

1. A switching device comprising a housing with a dished bottom portion, a diaphragm spanning said bottom portion within said housing and forming a pressure chamber with said bottom portion, fluid-supply means opening into said chamber for raising and lowering said diaphragm, said housing also having a recessed top portion overlying said diaphragm, and a plurality of switch units above said diaphragm partly accommodated in said recessed top portion, said switch units including a first unit with fluid-controlled actuating means responsive to movement of said diaphragm and a second unit with electrically controlled actuating means positioned sufficiently remote from said diaphragm to be unaffected by such movement.

2. A switching device as defined in claim 1 wherein said switch units include a third unit substantially identical with said first unit, said second unit being flanked by said first and third units and lying at the center of said housing.

3. A switching device as defined in claim 1 wherein said second unit comprises electromagnetic means substantially completely withdrawn into said recessed top portion, contact means between said electromagnetic means and said diaphragm, and armature means for said electromagnetic means coupled with said contact means.

4. A switching device as defined in claim 1 wherein said first unit comprises lever means bearing upon said diaphragm, a toggle mechanism linked with said lever means, and contacts alternately openable and closable by said toggle mechanism.