(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 666 654 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.06.2006 Bulletin 2006/23

(21) Application number: **05110737.3**

(22) Date of filing: **15.11.2005**

(51) Int Cl.:
D06F 33/02 *(2006.01)* ***D06F 39/04*** *(2006.01)*
A47L 15/42 *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **18.11.2004 IT TO20040809**

(71) Applicant: **Indesit Company S.p.A.**
60044 Fabriano (AN) (IT)

(72) Inventors:
- **Aisa Valerio, Valerio**
  60044 Fabriano (AN) (IT)
- **Mariotti Costantino, Costantino**
  06028 Sigillo (PG) (IT)

(74) Representative: **Dini, Roberto**
c/o Metroconsult S.r.l.
Piazza Cavour 3
10060 None (Torino) (IT)

(54) Washing machine

(57) A washing machine is described, which comprises an electronic control unit (10) controlling the operation of said washing machine, a container adaptable to contain a wash liquid, and an element (8) to heat said wash liquid.

The invention consists in the fact that said control unit (10) operates means (9,9',9") adapted to regulate the power drawn by said heating element (8) so that it does not exceed a limit set by the user.

EP 1 666 654 A2

Description

[0001] The present invention relates to a washing machine according to the preamble of claim 1.

[0002] As explained in the following detailed description, the invention is particularly advantageous for a laundry washing machine or a washing/drying machine.

[0003] Nowadays several typologies of washing machines are fitted with a container adapted to contain a wash liquid, typically water and wash additives (detergents, softeners, etc.), which must be heated for different purposes; e.g. in washing machines the wash liquid is heated in order to clean dirty linen, whereas in dishwashers this is required for washing crockery.

[0004] The heating of the wash liquid in the above-mentioned washing machines takes place by means of a heating element, typically an electric resistor, which is connected to a power source as necessary. The electric power drawn by the resistor is yielded in the form of heat to the wash liquid, which is thus heated up.

[0005] Said heating element represents, in most household appliances incorporating it, the main cause of electric power consumption. In washing machines, wherein a large quantity of wash liquid is heated, the resistor can draw a power of 2KWh for quite a long time; in particular, said resistor remains energized until the wash liquid has reached the desired temperature.

[0006] Such high absorptions can give rise to problems in houses wherein a meter, located at the inlet of the domestic network, limits the power absorption from the public mains to a contractual value, typically 3kW.

[0007] As a matter of fact, the simultaneous operation of several household appliances can cause the required electric power to be higher than that available, with a consequent interruption of the electricity supply by the electric meter. It can therefore happen that the washing machine stops during the wash cycle or that the electric oven interrupts the cooking, with evident inconveniences for the user.

[0008] The object of the present invention is to solve the above-mentioned overload problems which arise when several household appliances are connected.

[0009] Patent EP 0727668 B1 describes household appliances equipped with a control unit and a suitable network interface, so that they can use information regarding the instantaneous power drawn by all appliances connected to the network for the purpose of performing a self-regulation. According to said patent, the electric consumption information is made available over an appropriate communication bus, which can be the same electric network, by an external metering device; said external metering device can be incorporated in the energy meter located at the inlet of the domestic network for limiting the distributed power.

[0010] These systems, however, require that the household appliance be equipped with suitable electronic boards which increase the cost of the appliance, and need an additional device for detecting the power drawn on the network and for sending this information to the household appliances.

[0011] Another object of the present invention is therefore to prevent overload problems without having to provide washing machines with costly devices or to install additional devices on the domestic network.

[0012] These and other objects, as detailed below, are achieved according to the present invention through a washing machine incorporating the features of the annexed claims.

[0013] Further objects and advantages of the present invention will become apparent from the following detailed description, claims and annexed drawings, supplied by way of non-limiting example, wherein:

- Fig. 1 shows a washing machine, specifically a laundry washing machine or a washing/drying machine, fitted with a container adapted to contain a wash liquid.
- Fig. 2 is a diagram of the wash liquid heating circuit.
- Fig. 3 shows the progress over time of the voltage applied to the heating element and of its power absorption in a washing machine according to the prior art.
- Fig. 4 shows the progress over time of the voltage applied to the heating element versus its power absorption in a washing machine according to an embodiment of the present invention.
- Fig. 5 is a general diagram of the wash liquid heating circuit of a washing machine according to the present invention.
- Fig. 6 is a diagram of the wash liquid heating circuit of a washing machine according to a further embodiment of the present invention.
- Fig. 7 shows a washing machine fitted with means for setting a limit to the power absorbed by the heating element of the same appliance.
- Fig. 8 shows a first advantageous embodiment of a knob for setting the power limit.
- Fig. 9 shows a second advantageous embodiment of a knob for setting the power limit.
- Fig. 10 shows a third advantageous embodiment of a knob for setting the power limit.

[0014] Fig. 1 shows a washing machine (1) comprising a container (4) adapted to contain a wash liquid, typically water and wash additives (detergents, softeners, etc.). In this illustration, the household appliance is a laundry washing machine fitted with a door (2) incorporating a glass bowl (3) for closing the wash tub (4) containing the wash liquid and the laundry.

[0015] The washing machine (1) also comprises means (5,6,7) adapted to set the operation, typically the operating programme, of said household appliance. In the case of a laundry washing machine or washing/drying machine, said machine operation setting means typically comprise a knob (5) and push-buttons (6) for selecting the wash programme; in order to improve the interaction

with the user, there can also be a display (7) for displaying information such as menus.

[0016] Still with reference to laundry washing machines or washing/drying machines provided with automatic or manual selection of the type of wash to be carried out, the user can set the desired temperature of the wash liquid.

[0017] A similar situation is found in dishwashers, wherein the user can set a temperature value for the wash liquid.

[0018] In washing machines according to the prior art, the wash liquid is warmed up by means of a heating element, typically a resistor, which remains energized until the wash liquid has reached the desired temperature.

[0019] Fig. 2 shows an example of a wash liquid heating circuit according to the prior art. The circuit comprises a heating element (8), consisting of a resistor, and a switching device (9) arranged in series with said resistor.

[0020] The electronic control unit (10), typically a microprocessor, operates the switching device to open or close the contact with the supply (V); typically, in washing machines, the closing the switching device causes the wash liquid heating element to be connected directly across the phase and neutral wires of the domestic network.

[0021] Said electronic control unit (10) also receives information from a temperature sensor (T); said information can either refer to the resistor temperature or to the wash liquid temperature, and represents a parameter on the basis of which said electronic control unit (10) operates the switching device (9) for supplying or not the heating element (8).

[0022] Fig. 3 shows the progress over time (t) of the voltage (V) applied to the heating element and of its power absorption (P) in a washing machine according to the prior art. S1 designates the signal sent by the control unit (10) for operating the switching device (8). When S1 is low, the switching device opens the contact between supply and heating element, so that there is no voltage across the heating element e no power is drawn. When the control unit detects the necessity of heating the wash liquid (e.g. through a temperature sensor T), the signal S1 is kept high and the switching device (8) closes the contact with the supply, so that a voltage V, indicated with a continuous line, is applied across the heating element (8), and consequently the heating element absorbs an electric power (P) having an average value P_m; a portion of the absorbed electric power is yielded in the form of heat to the wash liquid, which is thus heated up.

[0023] As shown in Fig. 3, the heating element is supplied for a consecutive series of cycles of the voltage signal, until the control unit detects that the desired temperature has been reached.

[0024] If other household appliances are connected to the electric network when the washing machine is operating, it can happen that the overall power required is higher than the contractual limit agreed upon with the public network authority, typically 3 kW, thus the meter cuts the distribution of electricity.

[0025] In order to avoid this inconvenience, the washing machine according to the invention is characterized in that the control unit (10), besides managing the normal operating programmes of the machine, is also adapted to operating means (9') adapted to regulate the power drawn by said heating element (8), typically a resistor, so that said power does not exceed the limit set by the user.

[0026] Therefore, the following teachings regard both an apparatus and a method, in that they teach how to make a particularly advantageous washing machine as well as a method for a particularly simple, clever and conscious management of electric consumptions.

[0027] According to a preferred embodiment, said power regulating means (9') comprise an electric switching device (9) arranged in series with said resistor (8) and operated by the control unit (10), which regulates the power drawn by said resistor by adjusting the opening (t_1) and closing (t_2) intervals of said switching device.

[0028] Compared to the prior art, this solution has the same circuit elements, but it allows, through an intelligent control of the switching device, to obtain an advantageous embodiment of a washing machine.

[0029] Once the user has set the limit to the power which can be drawn by said heating element, the electronic control unit (10) will adjust the opening and closing intervals of said switching device appropriately. In Fig. 4, the signal for operating the switching device varies between two levels, i.e. high and low, corresponding to commands for closing or opening the contact between the heating element and the supply, respectively.

[0030] The same illustration also shows the voltage signal (V) across the heating element and its power absorption (P); as it can be seen, the opening of the switching device causes an interruption of the voltage signal and thus of the power drawn by the heating element. On the whole, it follows that the power absorbed during one cycle of the voltage signal is reduced. This power absorption reduction is highlighted by indicating with a bold line the average value of the power drawn in one cycle of the voltage signal (P_m); a dashed line indicates the average power drawn in each half-cycle (P_{ms}) of the voltage signal.

[0031] As an alternative, instead of varying the switching times of the switching device, one can use a second heating element sized for drawing less power.

[0032] In Fig. 6, the washing machine is equipped with a first resistor (8) and a second resistor (11) being suitably sized for drawing less power than said first resistor (8).

[0033] When the user decides to limit the power drawn by the wash liquid heating element, the control unit switches the switching device (9") from a position (12), wherein current flows through said first heating resistor (8) and no current flows through said second resistor (11), to a second position (13), wherein no current flows through said first heating resistor (8) and current flows through said second resistor (11). When the washing ma-

chine (1) does not require the wash liquid to be heated, the switching device (9") is brought to an rest position (14), wherein neither heating element (8,11) is connected to the supply.

[0034] In another advantageous embodiment, the switching element (9') of Fig. 6 can be of the sliding type, so that by changing its operating position it is possible to choose whether to switch on only the first resistor, only the second resistor, both or none; in this way, several combinations are available, which allow the user to choose among a number of power settings.

[0035] Another aspect of the invention relates to how the user sets the limit of the average power that the heating element can draw.

[0036] According to the invention, the washing machine comprises means adapted to set said power limit, such means being distinct from the means used for setting the operation, typically the operating programme, of said household appliance.

[0037] According to an embodiment, such means for setting said limit can consist of a push-button or a touch-button (touch control), which when pressed signals the control unit that it is necessary to limit the power drawn by the heating element, e.g. by controlling the opening and closing intervals of the switching device, Fig. 4, or by selecting a heating element being appropriately sized for drawing less power, Fig. 6.

[0038] In this case, therefore, the household appliance is programmed to reduce the absorbed power value to a predefined value being lower than the rated value and selected by the user by means of said push-button or touch-button.

[0039] According to a preferred embodiment, the user can directly set the limit of the power drawn by the heating element, i.e. the user can select, within a discrete or continuous scale of values, the value of the power drawn by the heating element.

[0040] Thus different types of operation can be conceived, such as "half power" or "minimum power", etc.

[0041] To this end, the power limit setting means can comprise a knob (15) or a menu or a menu item through which said power limit can be set.

[0042] According to an advantageous embodiment, the user sets the absorbed power limit by choosing a non-electric parameter, e.g. a number or a graphic symbol.

[0043] By turning the knob through different positions, represented by a numerical scale (Fig. 10), or by choosing a menu item, the user can adjust the absorption level of said heating element.

[0044] According to a further advantageous embodiment, the indication of the power level can be provided through a graphic symbol, e.g. a graduated scale (Fig. 9); in this case, the user sets the average power absorbed by said heating element by turning said knob within a range defined by a minimum absorption position and a maximum absorption position.

[0045] In order to make the power limit setting system even more user-friendly, the numbers or the graduated scale can be replaced with different graphic symbols (Fig. 8), in particular representing one or more household appliances, e.g. dishwashers, electric irons, refrigerators, etc.

[0046] In this way, the user sets said power limit based on the number of household appliances that he/she wants to use at the same time.

[0047] It is clear that many variations can be made to the present invention by those skilled in the art; for example, the means (9') for regulating the power drawn by the heating element can be adapted to reduce the amplitude of the current absorbed by and/or voltage applied to said heating element. These current/voltage amplitude reducing means also comprise, for the purposes of the present invention, means for limiting the amplitude of voltage and/or current signals, such as circuits cutting the voltage and/or current above a certain threshold, or transformers as well.

Claims

1. Washing machine comprising an electronic control unit (10) controlling the operation of said washing machine, a container adapted to contain a wash liquid and an element (8) to heat said wash liquid, **characterized in that** said control unit (10) is adapted to drive means (9,9',9") adapted to regulate the power drawn by said heating element (8) so that it does not exceed a limit set by the user.

2. Washing machine according to claim 1, **characterized in that** said limit is set directly by the user.

3. Washing machine according to claim 1 or 2, **characterized in that** said washing machine comprises means (15) for setting said limit.

4. Washing machine according to claim 3, **characterized in that** said washing machine comprises means (5,6,7) adapted to set the operation, typically the operating programme, of said washing machine, said operation setting means being distinct from said limit setting means (15).

5. Washing machine according to claim 4, **characterized in that** said distinct means correspond to menus or menu items being distinct from those for programming the operation of the machine.

6. Washing machine according to one of the previous claims, **characterized in that** said heating element (8) is a resistor.

7. Washing machine according to claim 6, **characterized in that** said regulating means (9,9',9") comprise an electric switching device (9,9") arranged in series

with said resistor (8).

8. Washing machine according to claim 7, **characterized in that** said control unit (10) regulates the power drawn by said resistor (8) by adjusting the opening (t_1) and closing (t_2) intervals of said switching device (9,9").

9. Washing machine according to claim 6 or 7, **characterized in that** said regulating means (9,9',9") comprise a second heating resistor (11).

10. Washing machine according to claim 9, **characterized in that** said control unit is adapted to switch said switching device from a position (12), wherein current flows through said heating resistor (8) and no current flows through said second resistor (11), to a second position (13), wherein no current flows through said heating resistor (8) and current flows through said second resistor (11).

11. Washing machine according to claim 9, **characterized in that** said control unit is adapted to switch said switching device to several operating positions, so as to connect one, none or both of said resistors (8,11) to the electric network.

12. Washing machine according to one of claims 1 to 6, **characterized in that** said regulating means (9') reduce the amplitude of the current absorbed and/or the voltage applied to said heating element (8).

13. Washing machine according to claim 12, **characterized in that** said regulating means (9') comprise amplitude limiting means.

14. Washing machine according to one of claims 3 to 13, **characterized in that** said power limit setting means comprise a push-button.

15. Washing machine according to one of claims 3 to 13, **characterized in that** said power limit setting means comprise a knob (15).

16. Washing machine according to one of claims 3 to 13, **characterized in that** said power limit setting means comprise a touch-button.

17. Washing machine according to one or more of claims 14 to 16, **characterized in that** said limit setting means comprise an electronic display.

18. Washing machine according to one of the previous claims, **characterized in that** the user sets said limit by choosing a non-electric parameter.

19. Washing machine according to claim 18, **characterized in that** said parameter is a number.

20. Washing machine according to claim 17, **characterized in that** the user sets the average power drawn by said heating element by choosing a menu item.

21. Washing machine according to claim 15, **characterized in that** the user sets the average power drawn by said heating element by turning said knob within a range defined by a minimum absorption position and a maximum absorption position.

22. Washing machine according to claim 18, **characterized in that** said parameter is indicated through graphic symbols.

23. Washing machine according to claim 22, **characterized in that** said graphic symbols represent household appliances.

24. Washing machine according to one of the previous claims, **characterized in that** said washing machine is a laundry washing machine or a washing/drying machine.

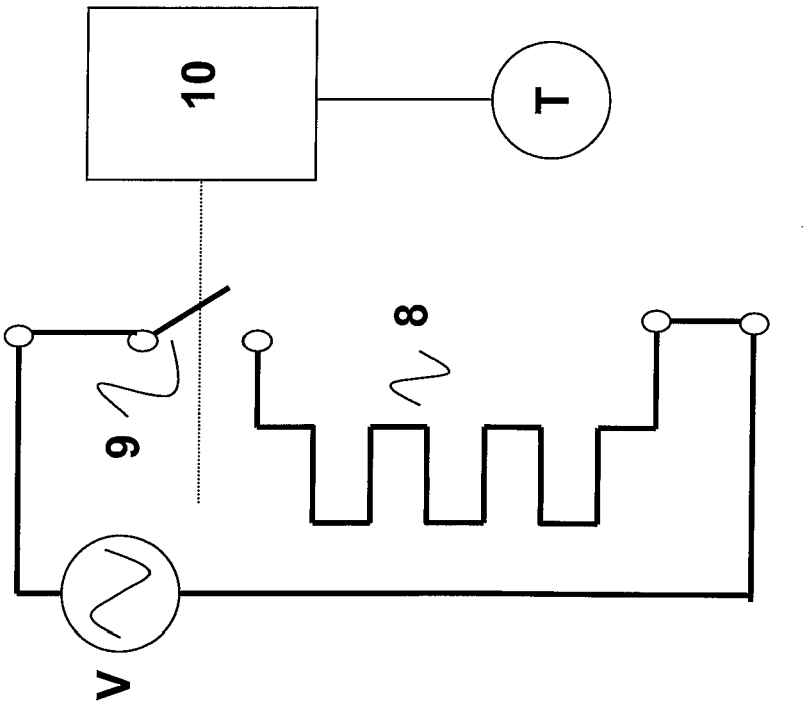

Fig. 2

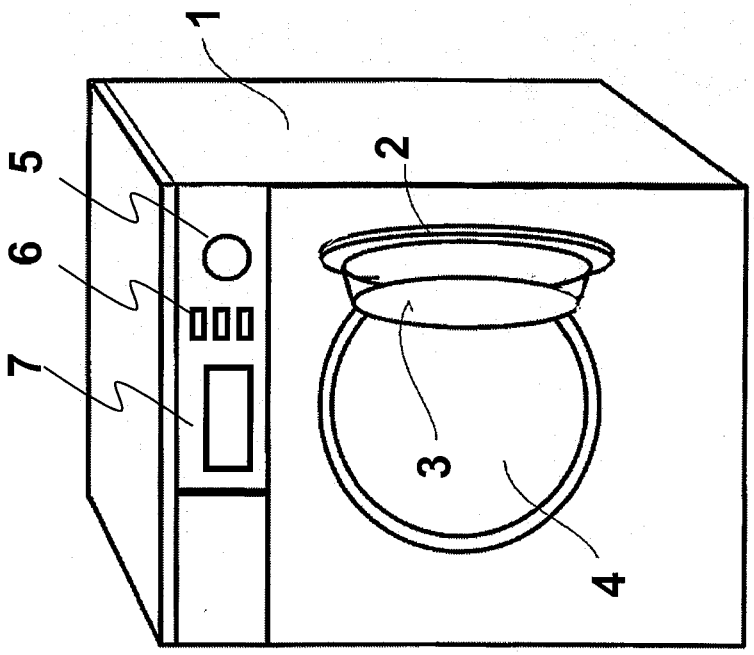

Fig. 1

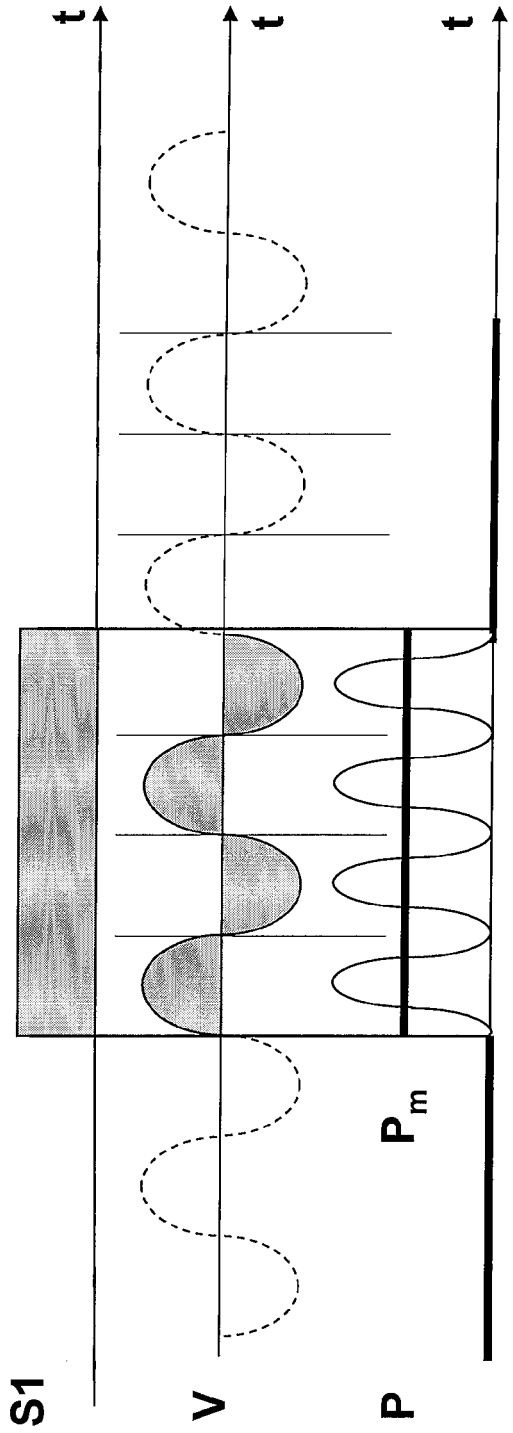

Fig. 3

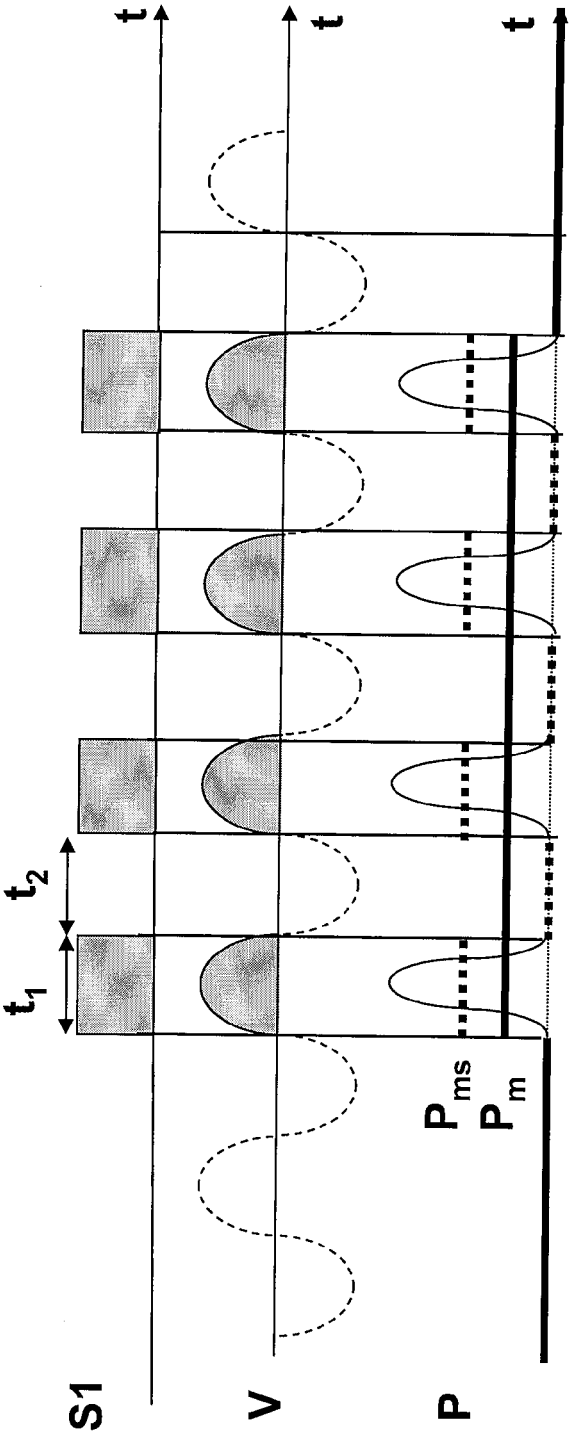

Fig. 4

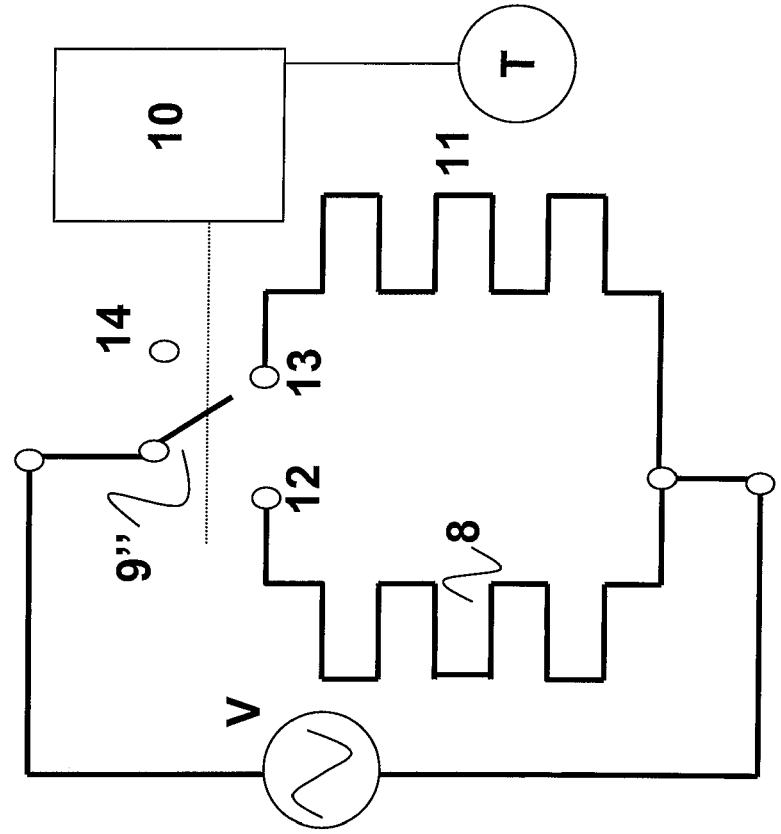

Fig. 6

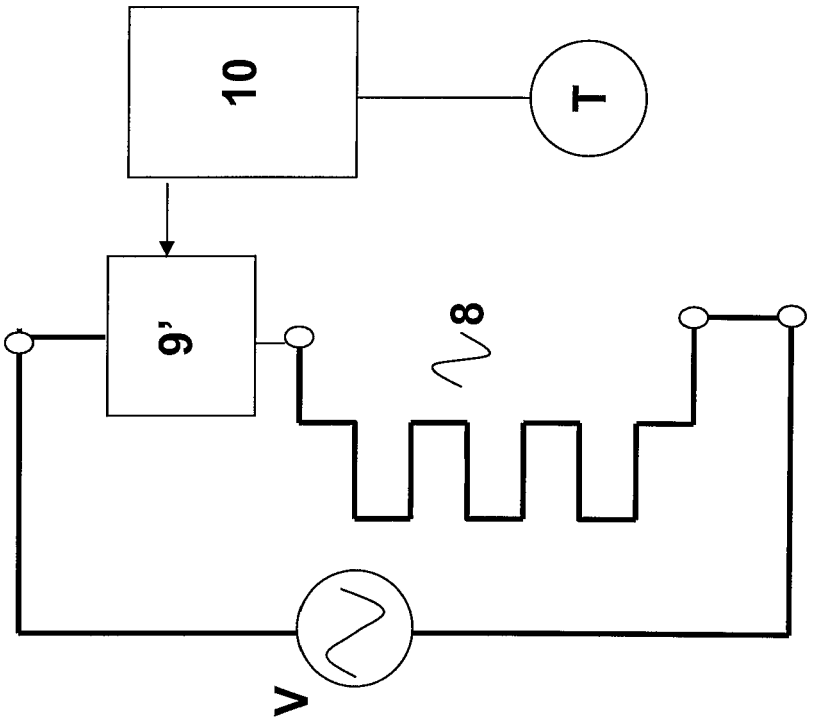

Fig. 5

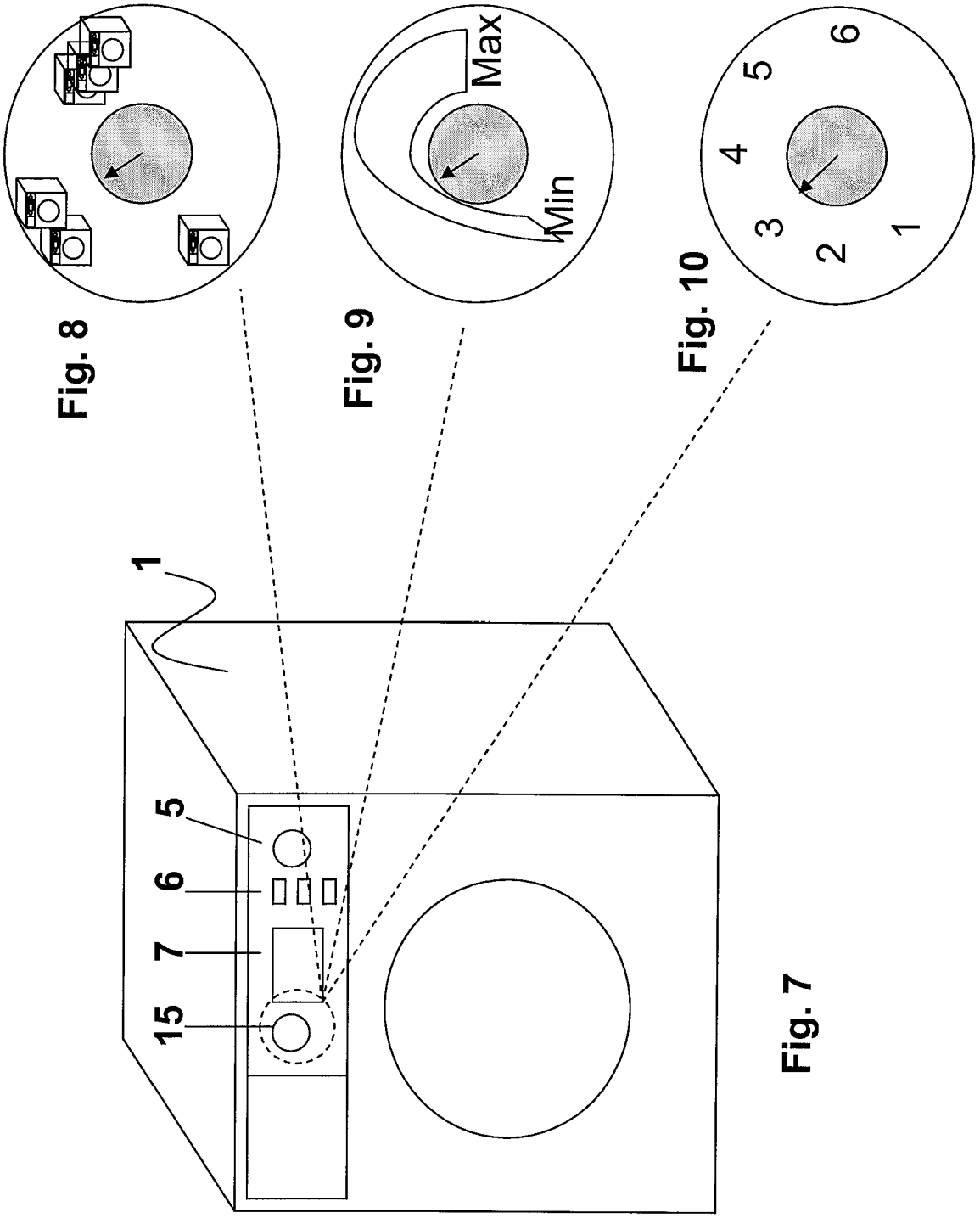

Fig. 8

Fig. 9

Fig. 10

Fig. 7