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

(11) EP 0 924 331 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.06.1999 Bulletin 1999/25

(51) Int. Cl.[6]: **D06F 39/04**

(21) Application number: **98122364.7**

(22) Date of filing: **25.11.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **11.12.1997 DE 19755089**

(71) Applicant: **WHIRLPOOL CORPORATION**
Benton Harbor Michigan 49022 (US)

(72) Inventors:
- **Thumm, Jorge,**
  c/o Whirlpool Europe s.r.l./Pat. Dep
  21025 Comerio (IT)
- **Leins, Guenther,**
  c/o Whirlpool Europe s.r.l./Pat.
  21025 Comerio (IT)
- **Pöttger, Robert,**
  c/o Whirlpool Europe s.r.l./Pat.
  21025 Comerio (IT)

(74) Representative:
Guerci, Alessandro
Whirlpool Europe S.r.l.
Patent Department
Viale G. Borghi 27
21025 Comerio (VA) (IT)

(54) Safety circuit for a heating circuit of a washing machine, dishwasher or drier

(57) The invention relates to a safety circuit for a heating circuit of a washing machine or dishwasher or of a drier, wherein the heating circuit includes a series connection comprising heating switching contact, heating resistor and safety switch, and wherein a monitoring arrangement monitors the heating circuit for faults and, in the event of a fault, causes the heating circuit or the machine to be switched-off. The operational reliability of the heating circuit is easily improved as a result of the potentials at the junctions between the heating switching contact and heating resistor and/or between the heating resistor and safety switch being supplied to a logic circuit which, only when the potential conditions in the heating circuit are correct, issues no fault signal to switch-off the heating circuit or the machine.

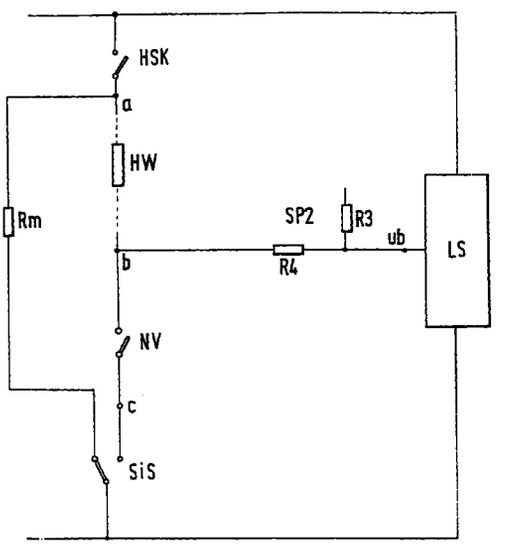

Fig.1

EP 0 924 331 A2

Description

[0001] The invention relates to a safety circuit for a heating circuit of a washing machine, dishwasher or drier, wherein the heating circuit includes a series connection comprising heating switching contact, heating resistor and safety switch, and wherein a monitoring arrangement monitors the heating circuit for faults and, in the event of a fault, causes the heating circuit or the machine to be switched-off.

[0002] Such safety circuits are in fact very important for washing machines, dishwashers or driers, so that, in the event of faults occurring in the heating circuit, the heating means is prevented from overheating, which would cause component parts to be damaged or destroyed, and fires are prevented from being produced. The latter applies, more especially, when flat-tube heater bodies are used.

[0003] As shown in DE 26 47 616 B2, a safety circuit with two level switches is known. The two level switches monitor a lower level and an upper level for the water line and are used to increase the number of possible water lines and to reduce the consumption of energy required for the washing process. However, the two level switches do not provide a high degree of safety to prevent the heating means from overheating.

[0004] As shows, in DE 33 29 744 A1, the heating circuit is normally actuated via a level switch. In such case, a control contact precedes the control motor of the program switch and closes one or two steps in front of the control contact, which actuates the heating circuit. With this circuit, it is ensured that, even if there is no supply of water and no phase connection from the heating side when the machine is connected in a network having the "zero voltage" type of protection, the possibility of overheating is excluded, since the program switch cannot pass into the heating step.

[0005] As shown in DE-0S 19 08 464, a safety circuit is also known, which provides a temperature regulator and a temperature limiter. In such case, a means for safeguarding the electrical heating resistors from overheating is achieved when at least two contacts, which directly actuate the heating means, of the temperature regulator and of the temperature limiter are connected in series with the heating resistors in such a manner that one contact precedes the heating resistors and one contact follows said resistors. Moreover, the contact of a level switch is incorporated in the series connection, but the faulty function thereof is not monitored.

[0006] The above-described safety circuits basically have the following disadvantages:

[0007] The failure of a safety element is not noticed in each case. In consequence, the redundancy of the respective system is reduced by one stage from the time of the failure.

[0008] The reaction time of the temperature limiters or thermostats respectively limits the effectiveness. Serious damage or fires may occur, more especially when plastics materials are used in the vicinity of the heating resistors, before the safety elements respond. Furthermore, the effectiveness cannot be ensured over the entire depth of the appliance by any inclined containers.

[0009] In addition, it should not be ignored that so-called flat-tube heater bodies may burn out when they become overheated; for example, a partial earth short circuit is formed in the event of overheating or as a result of corrosion. This type of fault is not reliably detected by temperature limiters or thermostats.

[0010] DE 195 15 902 C1 shows a safety circuit without temperature limiters and thermostats. Provision is made therein for two level switches to monitor the normal water position and to control a switching element in series connection; for the switching element to trigger the control motor; and for the control motor to connect the heating resistor in parallel with the switching element via control contacts after a prescribed time has passed in the stimulating and washing phase following the water supply phase.

[0011] The actuation of the heating means is prepared only when both level switches indicate and connect the normal level of the water line, and the heating means is actuated via control contacts of the control motor after a time prescribed by the control. However, this known safety circuit still requires considerable outlay and does not detect any faults in the heating circuit, such as a short circuit or a disconnection of component parts.

[0012] It is an object of the invention to provide a safety circuit of the initially mentioned type, which requires no temperature limiters and thermostats and detects all permissible and non-permissible potential conditions in the heating circuit in a simple manner without a considerable time delay and, in the event of a fault, induces a switching-off of the heating circuit or machine.

[0013] This object is achieved, according to the invention, when the potentials are supplied to a logic circuit at the junctions between heating resistor and safety switch and/or heating switching contact and heating resistor, said logic circuit issuing no fault signal to switch-off the heating circuit or the machine only when the potential conditions in the heating circuit are correct.

[0014] With this electrical safety circuit, the potential conditions occurring in the heating circuit can be detected without considerable outlay and evaluated, via the logic circuit, as to whether there is a correct or faulty switching state of the heating circuit. Upon ascertaining a faulty potential distribution in the heating circuit, the logic circuit can immediately induce the switching-off of the heating circuit or the machine.

[0015] For level-regulated washing machines or dishwashers, the safety circuit can be extended in such a manner that a level switch is incorporated in the heating circuit between the heating resistor and the safety switch, and an additional potential is supplied to the logic circuit at the junction between the level switch and the safety switch. Provision is therefore made for the heating switching contact and the level switch to be con-

figured as working contacts, and for the level switch to be closed if the water line in the machine is adequate.

[0016] If provision is additionally made for the safety switch (e.g. relay) to be configured as a switchover contact, and for the junction between heating switching contact and heating resistor to be connected to the inoperative contact of the safety switch via a measuring resistor, a specific potential condition at the control inputs of the logic circuit can be achieved if there is no actuation of the safety switch by the logic circuit, even in the initial state when all of the switches are to be open. For such purpose, the embodiment is also such that a voltage divider, formed from resistors, is connected to at least one junction of the heating circuit, and the potentials at the pick-up points of the voltage dividers are supplied to the control inputs of the logic circuit as control potentials.

[0017] The heating circuit can then be checked for the presence of the correct initial state before and possibly after the heating process. In such case, the heating switching contact, and possibly the level switch and the safety switch, must be open or respectively be in their initial switching position. In consequence, a blocked air trap/kinked hose and therefore closed level switch contacts can also be detected.

[0018] The logic circuit preferably includes a microprocessor, which detects the potentials present at its control inputs; it logically links such and compares such with prescribed desired value combinations, which correspond to correct switching states of the heating circuit.

[0019] The invention is explained more fully with reference to embodiments illustrated in the drawings. In the drawings:

Fig. 1 illustrates a heating circuit with heating switching contact, heating resistor, switch NV (e.g. level switch) and safety stitch, which is monitored for its potential conditions at one location; and

Fig. 2 illustrates a heating circuit with heating switching contact, heating resistor, switch NV (e.g. level switch) and safety switch, which is monitored for its potential conditions at three locations.

[0020] In the embodiment of Fig. 1, the heating circuit comprises a series connection of heating switching contact HSK, heating resistor HW, switch NV and safety switch SiS, which is connectable to a supply voltage. The connection may be effected in known manner via a program switch, which determines the actuation of the heating means during the course of the washing or rinsing process. In such case, the supply voltage may be derived from the mains voltage.

[0021] A measuring resistor Rm branches-off at the junction a between the heating switching contact HSK and the heating resistor HW, said measuring resistor being connected to the inoperative side of the safety switch SiS, which is configured as a switchover contact, and, in consequence, has a specific potential of the supply voltage at the junction a in the initial state (HSK open, SiS in its initial position) of the heating circuit.

[0022] At least one voltage divider SP2, which is formed from resistors (e.g. R3 and R4), is connected at the junctions a, b and c between the heating switching contact HSK and the safety switch SiS. The control voltage ub for the control input B of a logic circuit LS, which occurs in view of the potential u2, is picked-up at the pick-up point e of the voltage divider SP2 and is compared with prescribed potential conditions. These prescribed potential conditions are stored in the logic circuit LS, which is possibly provided with a microprocessor, and they correspond to potential conditions which correspond to the correct switching states of the heating circuit (e.g. initial position and operative state). If a fault occurs in the heating circuit, e.g. a short circuit or a disconnection, a defective heating switching contact and/or a defective safety switching contact, then the logic circuit LS detects a deviation from the permissible potential conditions and issues a switch-off signal AS, which may be used to switch-off the heating circuit or the machine. In consequence, the safety of the heating circuit is substantially increased without temperature limiters or thermostats being used therefor.

[0023] The safety circuit, together with the monitoring of the potential conditions at various locations of the heating circuit and with the control of permissible potential combinations in the logic circuit LS, can also be achieved with the reverse connection of the heating circuit to the supply voltage and any desirable supply voltages for the voltage divider SP2.

[0024] As Fig. 1 illustrates, the voltages u1, u2 and u3 at the junctions change in the heating circuit depending on the switching state and faults in the heating circuit with its component parts, as does the control circuit ub for the logic circuit LS. The control voltage ub is then decisive for the state of the heating circuit and forms the basis for the comparison with the permissible potential combinations, stored in the logic circuit LS, for the control voltage u2.

[0025] As Fig. 2 illustrates, the monitoring of the heating circuit can be effected at two/three locations, whereby the voltages u1, u2 and u3 determine the control voltages ua, ub and uc, which are compared with prescribed, permissible two/three potential combinations. In consequence, all of the component parts of the heating circuit, incl. level switch, pump, air trap, are again monitored jointly, and an improved operational reliability is achieved in the heating circuit.

Claims

1. Safety circuit for a heating circuit of a washing machine, dishwasher or drier, wherein the heating circuit includes a series connection comprising heating switching contact, heating resistor and

safety switch, and wherein a monitoring arrangement monitors the heating circuit for faults and, in the event of a fault, causes the heating circuit or the machine to be switched-off, characterised in that the potentials (u2 and possibly u1 and/or u3) are supplied to a logic circuit (US) at the junctions (b and possibly a and/or c) between heating resistor (HW) and safety switch (SiS) and/or between heating switching contact (HSK) and heating resistor (HW), said logic circuit issuing no fault signal. to switch-off (AS) the heating circuit or the machine only when the potential conditions in the heating circuit are correct.

2. Safety circuit according to claim 1, characterised in that a switch (NV), which may also be a level switch, is incorporated in the heating circuit between the heating resistor (HW) and the safety switch (SiS), and in that a third potential (u3) is supplied to the logic circuit (US) at the junction (c) between the switch (NV), which may also be a level switch, and the safety switch (SiS).

3. Safety circuit according to claim 1 or 2, characterised in that the heating switching contact (HSK) and the switch (NV), which may also be a level switch, are configured as working contacts, and in that the switch (NV) is closed in the normal case in the machine.

4. Safety circuit according to one of claims 1 to 3, characterised in that the safety switch (SiS) is configured as a switchover contact which, if there is no actuation by the logic circuit (LS) in the initial state, connects a measuring resistor (Rm) to the junction (a) between heating switching contact (HSK) and heating resistor (HW) in the event of an interrupted heating circuit.

5. Safety circuit according to one of claims 1 to 4, characterised in that a voltage divider (SP1, SP2, SP3), formed from resistors (e.g. R1 and R2, R3 and R4, R5 and R6), is connected to each of the junctions (a,b,c) of the heating circuit, and the potentials (ua, ub, uc) at the pick-up points (d,e,f) of the voltage dividers (SP1, SP2, SP3) are supplied to the control inputs (A,B,C) of the logic circuit (LS) as control potentials.

6. Safety circuit according to one of claims 1 to 5, characterised in that, before and after the closing of the heating switching contact (HSK) and/or after the heating process when the water is drained, the heating circuit is checked for the presence of the potential conditions (ua, ub, uc), which are prescribed by the voltage dividers (SP1, SP2, SP3) and prevail when the heating switching contact (HSK) is open and closed, when the switch (NV), which may also be a level switch, is open and possibly closed, and when the safety switch (SiS) is open and closed.

7. Safety circuit according to one of claims 1 to 6, characterised in that the logic circuit (LS) includes a microprocessor, which detects the existing potentials (ua, ub, uc); it logically links such and compares such with prescribed desired value combinations, which correspond to correct switching states of the heating circuit.

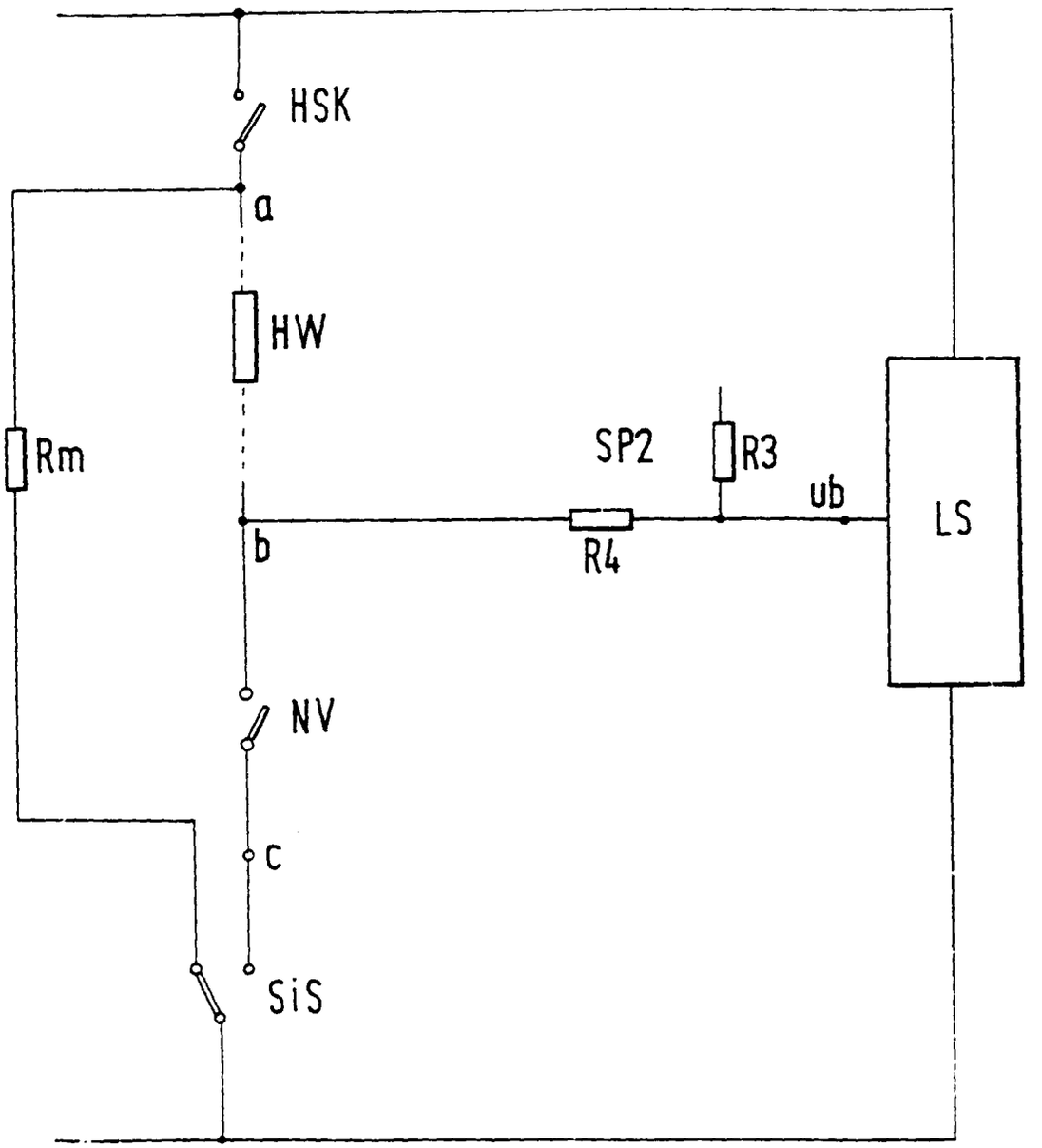

Fig.1

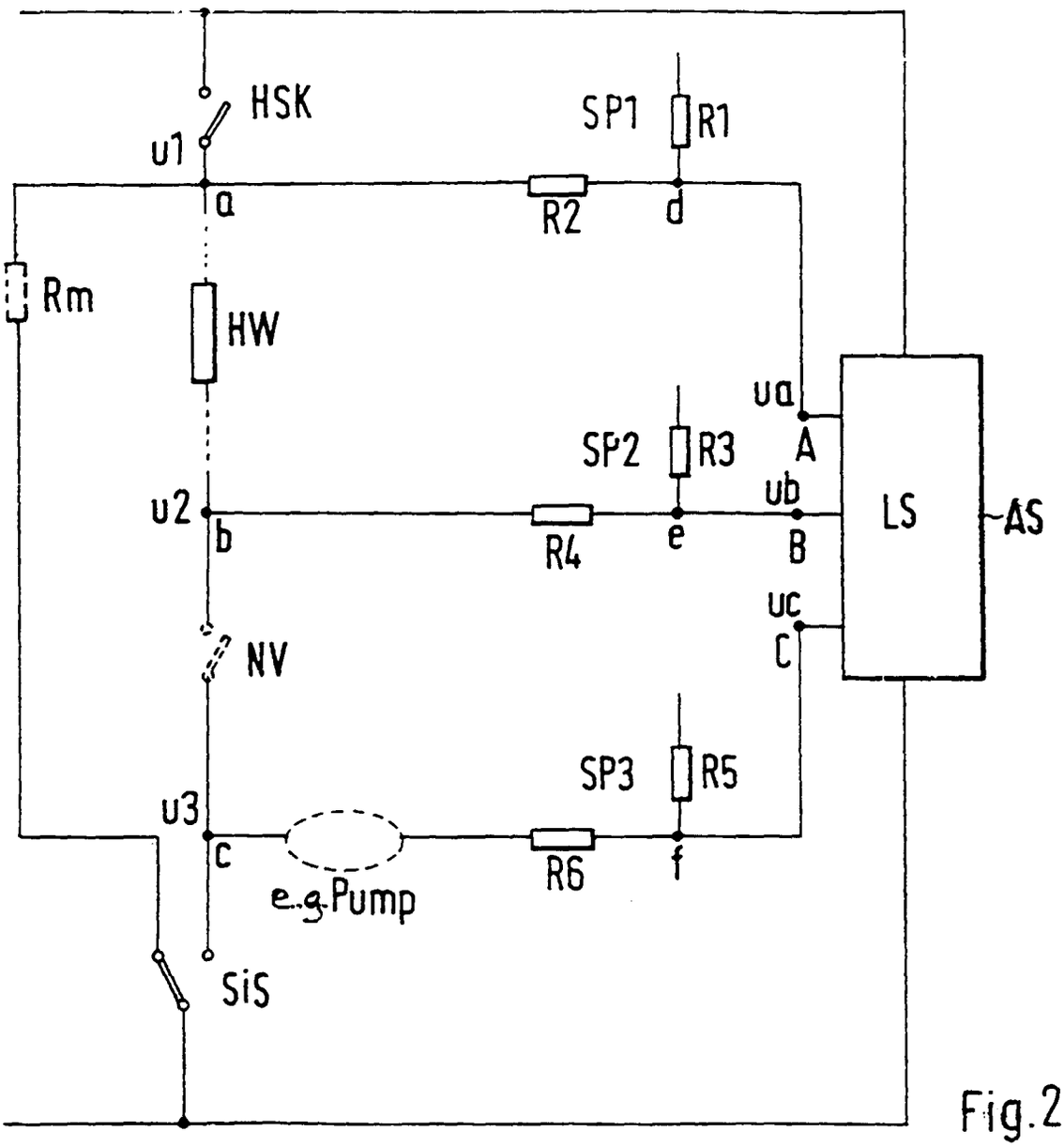
HSK
u1
a
SP1
R1
R2
d
Rm
HW
ua
A
SP2
R3
u2
b
ub
LS
AS
R4
e
B
uc
C
NV
SP3
R5
u3
c
R6
f
e.g.Pump
SiS

Fig.2