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

(11) Publication number: **0 326 048 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **89101046.4**

(51) Int. Cl.[4]: **D06F 58/28**

(22) Date of filing: **20.01.89**

(30) Priority: **25.01.88 IT 4570288**

(43) Date of publication of application:
02.08.89 Bulletin 89/31

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI NL SE

(71) Applicant: **INDUSTRIE ZANUSSI S.p.A.**
Via Giardini Cattaneo 3
I-33170 Pordenone(IT)

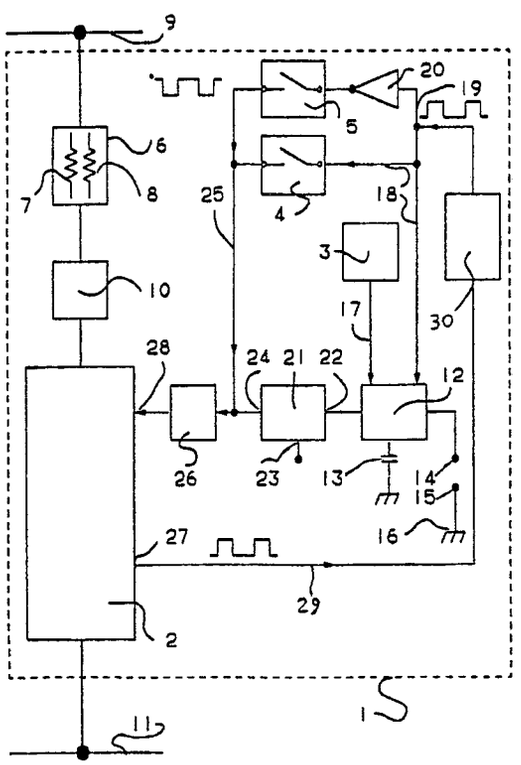
(72) Inventor: **Russo, Fernando**
Via Spallanzani 22
I-33170 Pordenone(IT)
Inventor: **Zanon, Elvio**
Via Frede 8
I-33030 San Vito di Fagagna Udine(IT)

(74) Representative: **Patentanwälte Grünecker, Kinkeldey, Stockmair & Partner**
Maximilianstrasse 58
D-8000 München 22(DE)

(54) Device for controlling the drying of laundry in a laundry drier.

(57) A device for controlling the drying of laundry in a laundry drier comprises a microprocessor (2) adapted to generate an enabling signal for permitting the identification of drying cycles selected by first, second or third selector means (3, 4, 5). The microprocessor (2) is energized from the electric circuit of the machine in series with the heater element (6), and is electrically separated, by means of opto-insulators (26, 30) or the like, from the low-voltage electric components of the device. These components in particular comprise an integrator circuit (12) and a comparator (21) for controlling the drying degree of the laundry.

By the selection of the drying cycles to be performed, the control device permits the automatic execution of the respective cycles with simultaneous control of the laundry drying process.



EP 0 326 048 A2

DEVICE FOR CONTROLLING THE DRYING OF LAUNDRY IN A LAUNDRY DRIER

The invention relates to an electronic control device for a laundry drier adapted to permit the execution of drying cycles for determining the drying of the laundry in a preselected manner.

Known laundry driers are designed to permit the execution of different laundry drying cycles selected in accordance with the type and quantity of the tissues to be dried and with the degree of dryness to be obtained. These drying cycles are adapted to be selected by the preliminary adjustment of a respective program control unit of the machine, which may comprise a conventional electromechanical timer or an electronic microprocessor, or by actuating respective push-button selectors associated to an electronic control device with which the machine is additionally provided for controlling the degree to which the laundry is to be dried.

In particular, the execution of each drying cycle thus selected is automatically controlled by the program control unit by successively energizing and deenergizing the various electric components of the machine, while the pre-selected degree of dryness of the laundry is obtained thanks to the presence of the elctronic control device which is effective, in response to the moisture content of the laundry as detected by means of two detector electrodes disposed in the drum of the machine, to repeatedly energize and deenergize the heater element of the machine.

There are known control devices.(German Patent Application n. 2930671) comprising a load circuit substantially composed of a rectangular-pulse generator connected to an electric capacitor through a differentiating element, an amplifier, a diode and a limiting resistor, said capacitor having its terminal connected respectively to ground and to a first detector electrode together with said charge circuit.

The second detector electrode of the machine on its part is electrically insulated from the first detector electrode and is otherwise connected to ground.

Such control devices further comprise an electronic comparator the input terminals of which are connected respectively to the electric capacitor, together with the first detector electrode and said charge circuit, and to a reference voltage source the voltage level of which is adjustable in accordance with the degree of dryness of the laundry to be attained, the output terminal of said comparator being connected to the heater element of the machine through a flip-flop circuit and a control relay.

In this manner the described control device is operable to constantly charge the capacitor to a preselected voltage level through the charge circuit, while the capacitor on its part is partially discharged to ground through the detector electrodes when the latter are short-circuited by the wet laundry contained in the drum of the machine and coming into contact with the electrodes during the rotation of the drum.

The actual charge voltage level of the capacitor is applied to one input of the comparator and continually compared to the reference voltage applied to the other input of the comparator, until the charge voltage is higher than the reference voltage, whereupon there is no output signal at the output terminal of the comparator.

Under these conditions, the comparator causes the heater element of the machine to be maintained in the energized state, with the result that the laundry is progressively dried.

When on the other hand the charge voltage is lower than the reference voltage, indicating that the laundry has been dried to the desired degree of dryness, the comparator supplies a positive signal at its output for causing the heater element to be deenergized through the flip-flop circuit and the control relay.

At this time the program control unit may control the energization of a blower for the laundry cooling phase of the cycle, and for the subsequent termination of the selected drying cycle.

With the above discussed laundry driers it is thus possible to execute the drying of various kinds of fabrics by employing different drying temperatures by subdividing the electric heater element of the machine into several separate sections which may be individually energized or connected to one another in series or in parallel, depending on the required heat output.

It is an object of the present invention to provide an electronic control device for a laundry drier, such control device being of a simple construction and capable of permitting the drying cycles and the drying degree of the laundry to be selected solely by actuating the drying cycle selector push-buttons associated to a microprocessor for controlling the execution of the respective cycles, to thereby permit the formerly provided push-buttons for selecting the degree of dryness to be eliminated, with the resultant simplification of the construction of the drier.

These and other objects are attained according to the invention by an electronic control device for a laundry drier having a rotatable drum for containing the laundry and at least one variable-output heater element, said device comprising at least one microprocessor containing encoded informations

defining the drying cycles capable of being selected and adapted to control the execution of the selected cycles; first, second and third selector means operable respectively to select drying cycles with the rated output and reduced output of the heater element and to maintain said heater element energized for a supplementary period; said devcie further comprising integrator means composed of a plurality of electric capacitors connected in parallel to one another to two sensor electrodes disposed in said drum and adapted to be short-circuited by the moist laundry, and comparator means adapted to control the energization and deenergization of said heater element through said microprocessor in response to the comparison of the charge voltage levels of said integrator means to a predetermined reference voltage.

A control device of this type is characterized according to the invention in that said microprocessor is adapted to identify each drying cycle selected by means of said first, second or third selector means through said integrator means, with the aid of an enabling signal generated by said microprocessor and supplied simultaneously to said integrator means and to said second and third selector means.

The characteristics of the invention will become more clearly evident from the following description, given by way of example with reference to the accompanying drawing, the only figure of which shows an electric circuit diagram of a control device according to the invention for use in a laundry drier.

With reference to the drawing, there is shown an electronic control device 1 for controlling the laundry drying process in a laundry drier, substantially comprising a microprocessor 2 including a memory containing initially stored informations defining all drying cycles which can be executed by the respective drier. Microprocessor 2 is also adapted to automatically control the execution of any drying cycle selected in the manner to be described; the control device further includes first, second and third selector means 3, 4 and 5 in the form of conventional push-button switches mounted in the control panel of the drier and adapted to be manually and separately actuated for selecting respective drying cycles at different drying temperatures.

In particular, for obtaining different drying temperatures the heater element 6 of the drier may be conventionally subdivided into several separate sections (in the present case two sections 7 and 8 adapted to be connected in parallel to one another). These heater element sections may be energized separately or in combination as required for generating the heat energy required for the drying process.

Heater element 6 on its part is connected to a power supply conductor 9 of the drier, and its energization is controlled by microprocessor 2 through a switch element 10 in the form for instance of a triac, a relay or the like, microprocessor 2 being otherwise connected to the other power supply conductor 11 of the drier.

First and second selector means 3 and 5 are both operable to select conventional drying cycles for cotton fabrics and resistant synthetics to be executed with the maximum heat output, to which purpose all sections of heater element 6 are interconnected for obtaining a predetermined degree of dryness of the laundry; in the second case, heater element 6 is maintained in the energized state for a predetermined supplementary period so as to determine the complete drying of the laundry (these drying cycles are denoted as "extra dry cycles").

Second selector means 4 on its part is operable to select drying cycles with reduced heat output for drying delicate synthetic fabrics, providing for the energization of only one section of heater element 6 for a sufficient period for attaining the preselected degree of dryness of the laundry (these drying cycles are referred to as "acrylic drying cycles"). The present control device further comprises an integrator circuit 12 composed of a plurality of electric capacitors 13 connected, in parallel to one another, to limiter resistors, diodes and other per se known electronic components (all of which are now shown), and to two sensor electrodes 14 and 15 disposed in the rotating drum (not shown) of the drier adapted to contain the moist laundry to be dried, sensor electrodes 14 and 15 being connected respectively to integrator circuit 12 and to ground 16 and adapted to be short-circuited by the moist laundry to be dried.

Integrator circuit 12 is energized at a low voltage and adapted, in response to the selection of respective drying cycles by means of first, second and third selector means 3, 4 and 5, corresponding to predetermined degrees of dryness of the laundry, to vary the time constant of capacitors 13.

To this purpose integrator circuit 12 is connected to first and second selector means 3 and 4, respectively, via respective conductors 17 and 18, and to third selector means 5 via a conductor 19 itself connected to conductor 18 and to a logic inverter 20 of conventional type, the function of which will become evident as the description proceeds.

The present control device finally comprises an electronic comparator 21 having its input terminals 22 and 23 connected respectively to integrator circuit 12 and to a fixed-level reference voltage source, and its output terminal 24, to a further conductor 25 adapted to connect second and third selector means 4 and 5 in parallel, and to micro-

processor 2 through an optoinsulator 26 or a similar insulating element provided for electrically separating microprocessor 2, which is energized with the mains voltage through the respective conductors 9 and 11, from the components energized at low voltage (and comprising integrator circuit 12, selector means 3, 4 and 5, and electronic comparator 21).

Comparator 21 serves the purpose of comparing the charge voltage level of capacitors 13 of integrator circuit 12 as preselected by first, second or third selector means 3, 4 or 5, to the predetermined reference voltage level, for thus controlling, in response to the result of the comparison, the energization and deenergization of heater element 6 through microprocessor 2 and switch element 10 in the manner to be described.

For permitting microprocessor 2 to identify each drying cycle selected in the manner described, microprocessor 2 is arranged to furnish at its output 27 a continuous enabling signal of rectangular shape to be applied to an associated input 28 of microprocessor 2 and simultaneously to integrator circuit 12 and second and third selector means 4 and 5, to which purpose output 27 is connected to conductors 18 and 19 through conductor 29 and a further optoinsulator 30 or a similar insulating element provided for electrically separating microprocessor 2 from the low-voltage elements defined above.

To this purpose microprocessor 2 is responsive to the absence or presence at output 24 of comparator 21 of said enabling signal when a drying cycle to be executed has been selected by actuating first or second selector means 3 or 4, respectively, and of an enabling signal identical but complementary to the first-named signal, when a drying cycle has been selected by actuating third selector means 5. In the first case, particularly, the absence of the enabling signal at output 24 of comparator 21 results from the fact that different voltage levels are applied to the two inputs 22 and 23 of comparator 21. In the second case, the presence of the enabling signal at output 24 of comparator 21 results from the actuation of second selector means 4. In the third case, finally, the complementary enabling signal is obtained as a result of the presence of logic inverter 20 connected in series with third selector means 5.

In this manner, and depending on the selected drying cycle, microprocessor 2 operates to initiate the respective cycle by causing heater element 6 to be energized in accordance with the required heat output and to subsequently control in an automatic manner the execution of the selected cycle for the full duration thereof.

During the execution of the drying cycle, capacitors 13 of integrator circuit 12 are progressively charged when the enabling signal applied to integrator circuit 12 is at a high level, and are partially discharged to ground 16 via sensor electrodes 14, 15, as they are short-circuited by the moist laundry, when the enabling signal is at a low level.

As long, moreover, as the charge voltage and the reference voltage applied to inputs 22 and 23 of comparator 21 are at different levels, there appears no signal at output 24 of comparator 21, indicating that the laundry has not yet been dried to the selected degree, so that heater element 6 is maintained in the energized state by microprocessor 2. As soon, on the other hand, as these voltages are at the same level, comparator 21 furnishes a signal at output 24, causing heater element 6 to be deenergized by the action of microprocessor 2 and switch element 10.

Subsequently microprocessor 2 may initiate the cooling phase by causing the blower (not shown) of the drier to be energized to thereby cool the laundry and the metallic parts of the drum and the housing of the drier as the conclusion of the selected drying cycle.

The advantages of the present control device are thus fully evident.

As a matter of fact, this device permits to contemporaneously obtain, during the selection of the drying cycle to be executed by the actuation of first, second or third selector means 3, 4 or 5, respectively, the identification and subsequent control of the selected cycle by microprocessor 2, and the adjustment of the degree of dryness required for the respective laundry by the variation of the time constant of capacitors 13 of integrator circuit 12 due to the presence of the enabling signal furnished by the microprocessor. In comparison to known solutions, the present control device is of a simple construction eliminating the need of expensive electromechanical devices for controlling the execution of the drying cycles, thanks to the fact that these operations are directly controlled by the microprocessor which is energized from the electric circuit of the drier and electrically separated by opto-insulators 26 and 30 from the low-voltage electrical components of the control device itself.

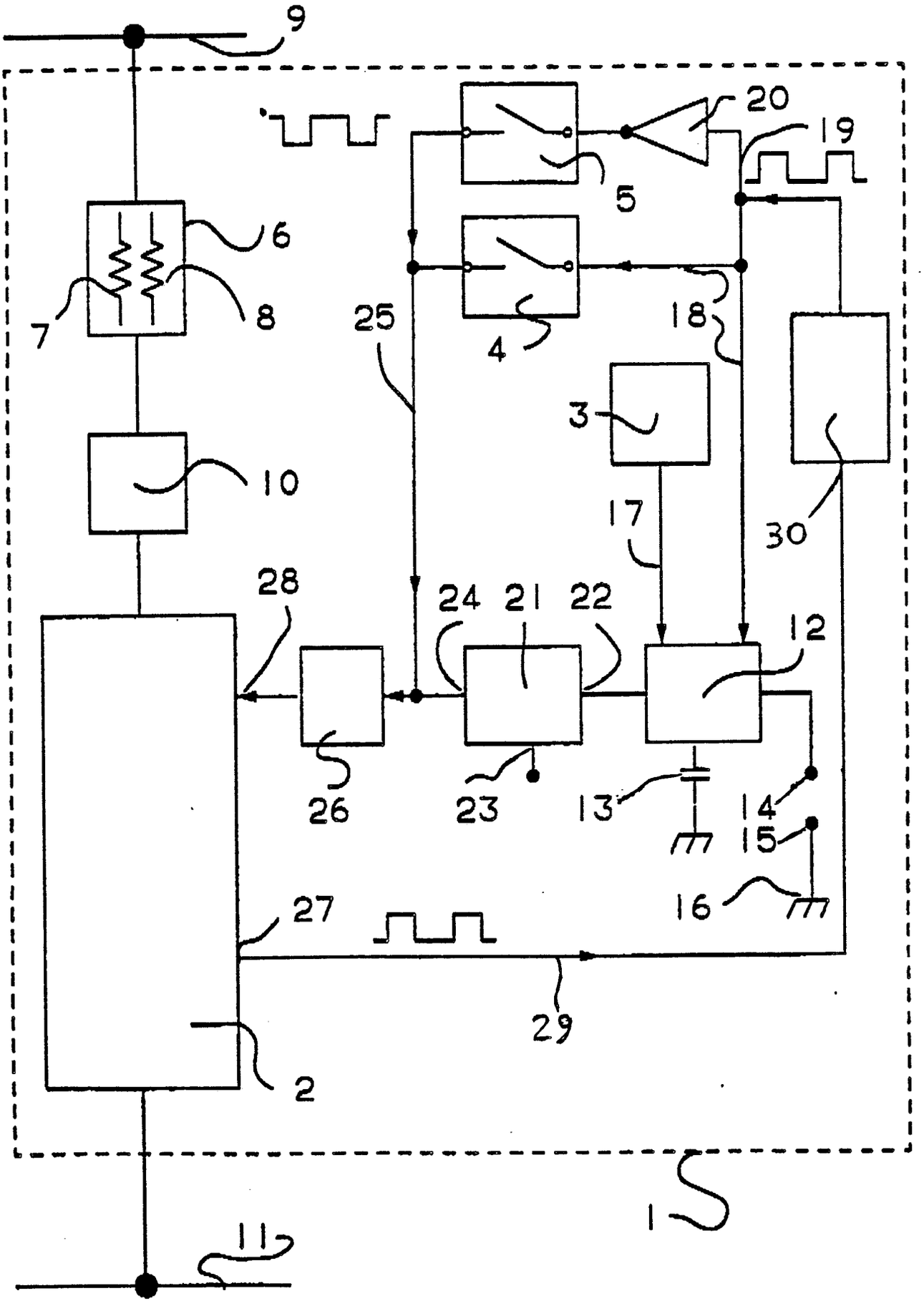
This device also permits a combined selection of the drying cycle and of the desired degree of dryness to take place by solely acting on selector means 3, 4 and 5, thus eliminating the need of separate push-button actuators for selecting the degree of moisture (or of dryness) of the laundry as required in previous solutions, with the resultant simplification of the overall construction of the laundry drier.

Claims

1. An electronic control device for a laundry drier having a rotary drum for containing the laundry and at least one variable-output heater element, said device comprising at least one microprocessor containing encoded informations relating to drying cycles to be selected and adapted to control the execution of the selected cycles, first, second and third selector means operable respectively for selecting drying cycles at the rated output and reduced heat output of said heater element and for maintaining said heater element in the energized state for a supplementary period, said device further comprising integrator means composed of a plurality of electric capacitors connected in parallel to one another to two sensor electrodes disposed in said drum and adapted to be short-circuited by the moist laundry, and comparator means adapted to control the energization and deenergization of said heater element via said microprocessor in response to the comparison between the levels of the charge voltage of said integrator means and of a predetermined reference voltage,
characterized in that said microprocessor (2) is adapted to identify each drying cycle selected by means of said first, second or third selector means (3, 4, 5) via said integrator means (12) with the aid of an enabling signal generated by said microprocessor (2) and simultaneously applied to said integrator means (12) and to said second and third selector means (4, 5).

2. A control device according to claim 1, characterized in that said microprocessor (2) is connected to the power supply conductors (9, 11) of the drier in series with said heater element (6) through per se known switching means (10), and has an output (27) for said enabling signal and in input (28) for the identification of said signal, said output (27) and said input (28) being connected via respective electric insulation means such as optoinsulators (26, 30) or the like, to said integrator means (12) and to the output (24) of said comparator means (21).

3. A control device according to claim 2, characterized in that said first selector means (3) is connected to said integrator means (12), and that said second selector means (4) is connected, in parallel to a circuit composed of said third selector means (5) and, in series therewith, inverter means (20) adapted to generate a complementary enabling signal, to said integrator means (12) and to said output (24) of said comparator means (21).



p.p. Industrie Zanussi S.p.A.