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(54) **Parameter controller**

(57) A controller for controlling the value of a parameter, e.g. room temperature, produces a control signal related to the ratio between the error in the actual value of the parameter (as compared with a desired value) and the change in the value of the parameter over a preceding time period. As shown a sensor 5 senses the value of the parameter at any point in time whilst the desired value is set by means of a potentiometer slider 1. The outputs are converted to digital values and held in respective latches 8,4. The actual value is compared in a comparator 10 with the desired value to produce a difference or error signal and is compared in a subtractor 12 with a previous actual value (from a latch 9) to produce a signal indicative of the change in the value of the parameter during a predetermined time period. The ratio of the difference (error) and change signals is then derived by a divider 11 and utilised to control the value of the parameter.

The controller is particularly applicable to the control of temperature, the sensor 5 then being a thermistor and the output signal being used to control a triac and thus an electrical heater or the pumping of water through a radiator.

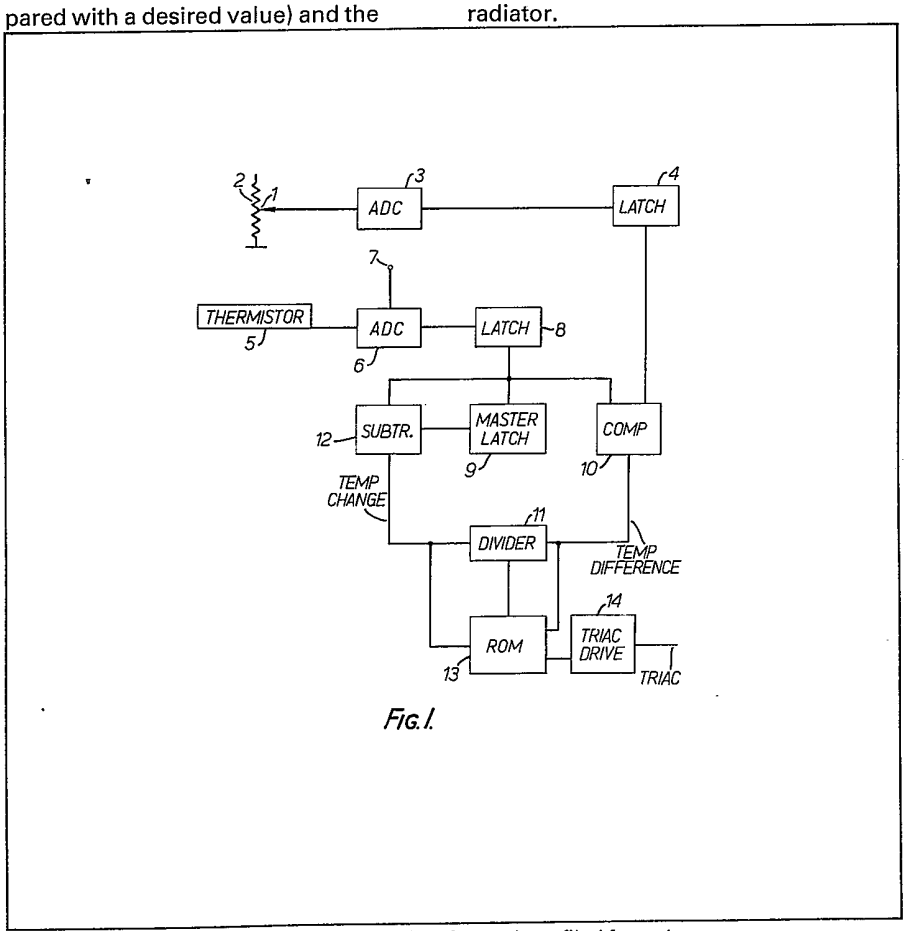

Fig. 1.

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

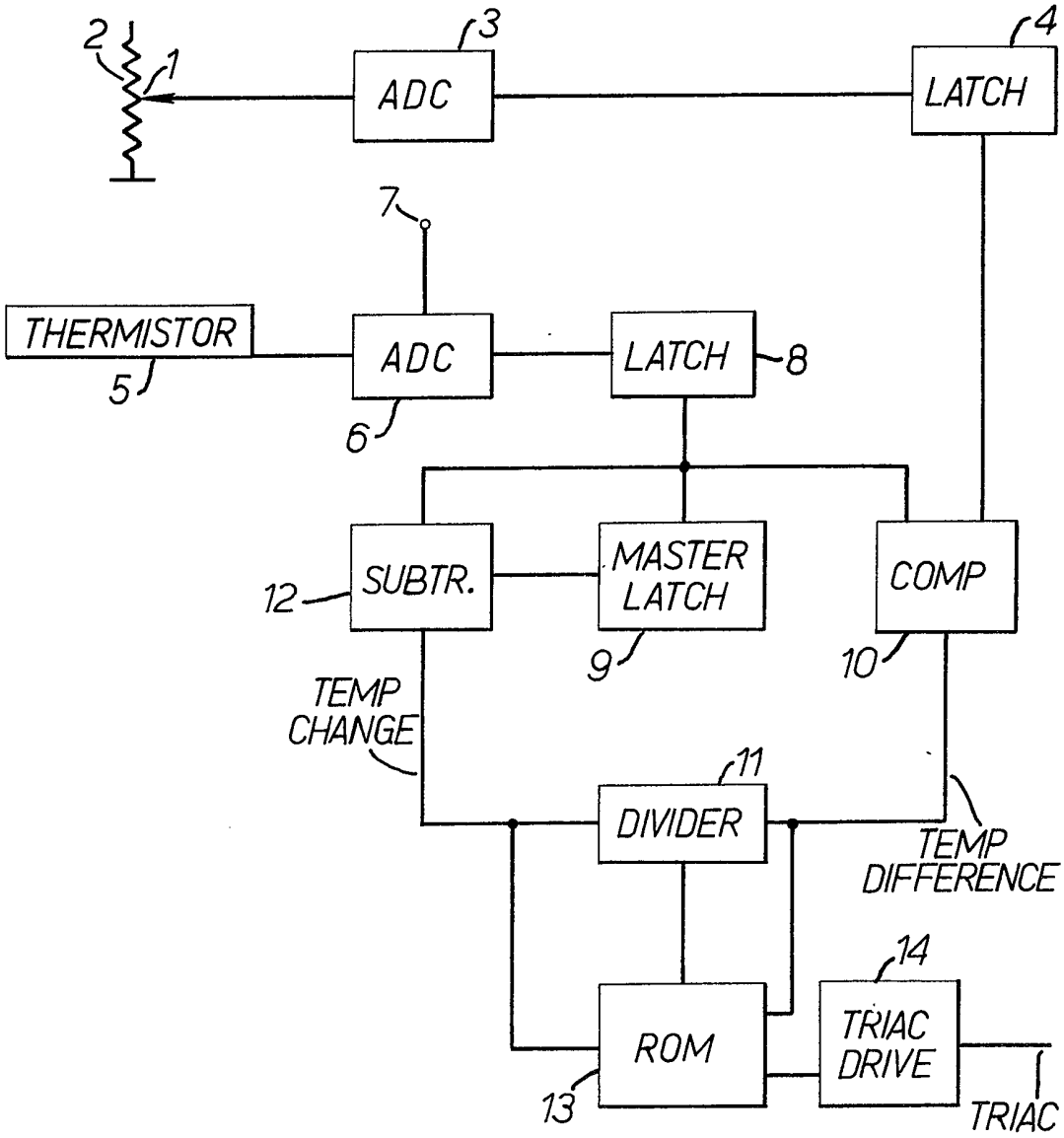
2
1
3
ADC
4
LATCH
7
THERMISTOR
5
ADC
6
LATCH
8
SUBTR.
12
MASTER LATCH
9
COMP
10
TEMP CHANGE
11
DIVIDER
TEMP DIFFERENCE
14
ROM
13
TRIAC DRIVE
TRIAC

FIG. 1.

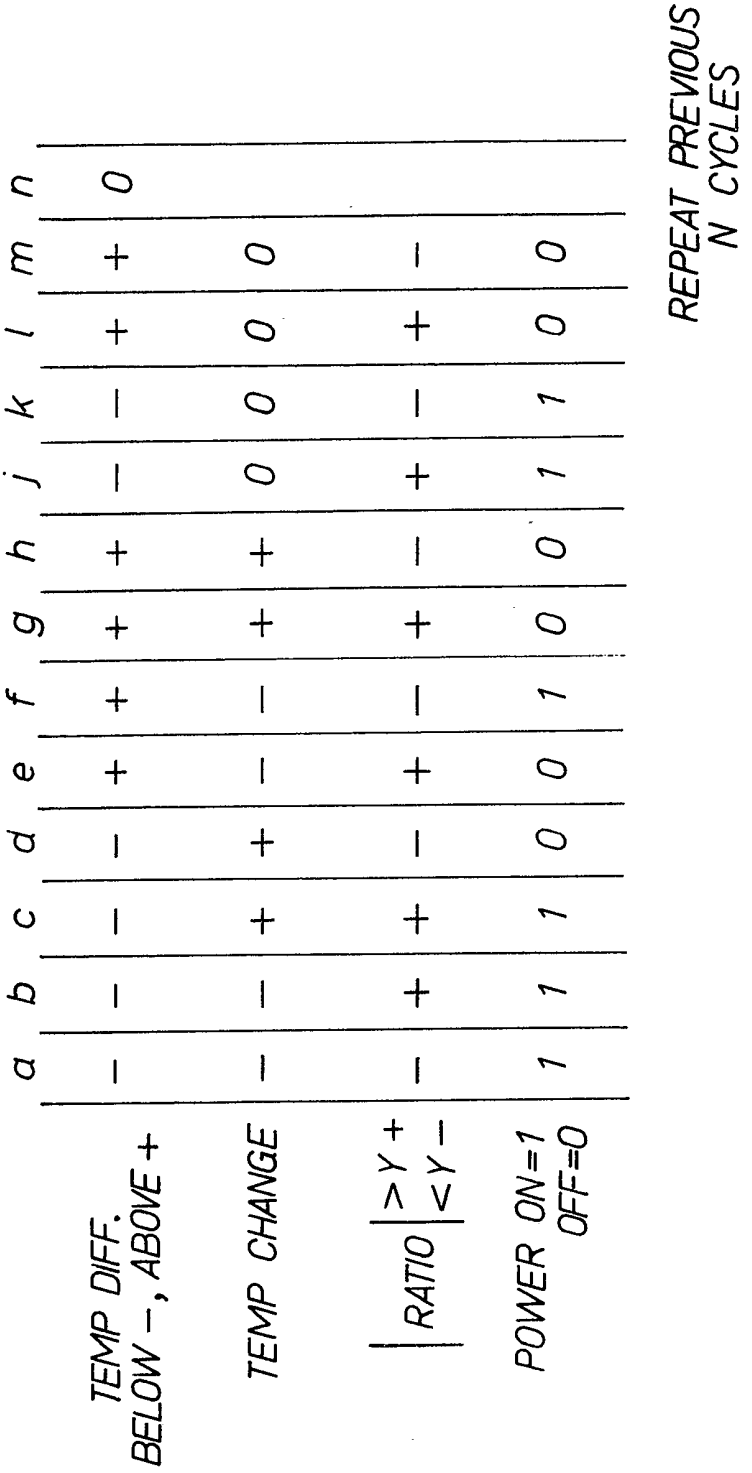
a b c d e f g h j k l m n
TEMP DIFF. BELOW −, ABOVE +
− − − + + + + + − − + + 0
TEMP CHANGE
− − + + − − + + − 0 0 0 0
RATIO > Y +, < Y −
− + + − + − + − + − + − −
POWER ON=1 OFF=0
1 1 1 0 0 1 0 0 1 1 0 0 0
REPEAT PREVIOUS N CYCLES

FIG. 2.

SPECIFICATION

Parameter controller

This invention relates to a parameter controller for controlling the value of a parameter and is, particularly but not exclusively applicable to the control of temperature e.g. the temperature of a room, which is heated by a room heater.

A problem with known temperature controllers is that of enabling a heater to achieve a desired temperature rapidly with a minimum of overshoot.

Controllers which allow rapid heating of an environment often produce considerable overshoot of the desired temperature whilst the avoidance of the overshoot can result in an undesirably long time being taken to achieve the temperature.

This invention seeks to provide a temperature controller in which the above problem is mitigated.

According to this invention there is provided a controller for controlling the value of a parameter, the controller comprising means responsive to a parameter dependent electrical signal derived from a sensor, for providing a first electrical signal representative of the difference between a desired and an actual value of the parameter at a predetermined point in time, and for providing a second electrical signal representative of the change in the value of the parameter during a predetermined time period ending immediately preceding the said point in time, and control means for controlling the value of the parameter in dependence upon the ratio of the values of the first and second electrical signals.

The parameter may be the temperature of a medium, the control means being operative to control the application of heat to the medium.

The means for producing the first and second electrical signals may include a first comparator for comparing, at the predetermined point in time, an electrical signal representative of the desired value of the parameter with an electrical signal representative of the actual value to provide the said first electrical signal.

The means for producing the first, and second electrical signals may include a second comparator for comparing, at the predetermined point in time an electrical signal representative of the actual value at that time, with an electrical signal representative of the value of the parameter, immediately preceding the commencement of the predetermined time period.

A store may be provided for storing, for the duration of the said time period, the electrical signal representative of the value of the parameter immediately preceding the predetermined time period.

A divider may be provided for dividing the first and second electrical signals to produce the said ratio.

The control means for controlling the value of the parameter may also be arranged additionally to control the value in dependence upon the values of the first and second electrical signals.

The control means may include a tabular store for providing an output control signal in dependence upon the value of one or more input signals.

The tabular store may be a read only memory.

An exemplary embodiment of the invention will now be described with reference to the drawings in which,

Figure 1 is a schematic block diagram of a parameter controller in accordance with this invention and,

Figure 2 shows a table in accordance with which the controller of Figure 1 controls a parameter.

For the purposes of explanation consider the parameter to be temperature.

In order to achieve a desired temperature in a medium e.g. the air in a room, the desired temperature is set by means of a slider 1 on a potentiometer 2 to provide an electrical signal which is representative of the desired temperature.

The electrical signal obtained from the slider 1 is converted into a digital signal by means of an analogue-digital converter 3 and the digital value provided by the converter 3 is held in a latch 4.

Actual room temperature is determined by means of a temperature sensor provided in the form of a thermistor 5. The thermistor 5 provides an electrical signal representative of actual room temperature and this is fed to one input of an analogue-digital converter 6 which converts the electrical signals to digital signals at successive points in time, separated by the said predetermined time period, under the control of a control signal fed to a terminal 7 connected to a second input of the converter 6. For example if the predetermined time period is X seconds then the control signal will be fed to the terminal 7 every X seconds and the convertor 6 will make the conversion each time a control signal is applied to the terminal 7.

As each conversion is made by the analogue-digital converter 6 the digital value is stored in a latch 8 whilst the digital value previously stored in the latch 8 obtained from the conversion occurring X seconds previously in time is transferred to a master latch 9.

The digital value stored at any instant in the latch 8 is fed to one input of a first comparator 10 which also receives the digital value stored in the latch 4 representative of the desired room temperature. The comparator 10 compares the two digital values and provides an output signal representative of the temperature difference existing between desired and actual room temperature at predetermined points in time determined by the control signal applied to the terminal 7. The temperature difference signal is fed to one input of an arithmetic divider 11.

The digital value held in the latch 8 is also fed to one input of a second comparator 12 provided in the form of an arithmetic subtractor which subtracts from this digital value the value stored in the master latch 9 representative of the actual room temperature existing X seconds earlier in time. The comparator 12 provides an output signal representative of the temperature change during this time period X and this signal is fed to a second input of the divider 11 which divides the digital output signal provided by the comparator 10 with that provided by the comparator 12.

The result of the division is fed as an output signal

from the divider 11 to one input of a tabular store provided by a read-only memory 13, which also receives the digital output signals provided by the comparators 10 and 12. The read-only memory 13 has stored therein a look-up table and provides an output signal determined by that look-up table in dependence upon the values of the input signals applied to the read only memory. The output signal provided by the read-only memory is a logical 1 or 0 signal representative of the application or not of heating power to the room.

The read-only memory 13 is connected to a triac-drive circuit 14 which, in dependence upon the digital output signal received from the read only memory 13 provides an output control signal for a triac which causes heating power to be applied for a period of X seconds until a new sample of actual room temperature is converted by the analogue-digital converter 6 on the occurrence of the next control signal applied to the terminal 7. In the event of an electrical room heater the triac would control the application of electrical power to the heater whilst in the case of a pumped radiator heating system the triac would control the pumping of heating water through the radiator.

An example of how the read-only memory 13 provides a digital output signal in dependence upon the values of the input signals applied thereto is illustrated with reference to Figure 2 of the drawings.

In the table shown in Figure 2 possible values of the temperature difference, temperature change and ratio signals provided respectively by the comparator 10, the comparator 12 and the divider 11, are indicated in respective rows of the table. In the temperature difference row a minus sign indicates that the currently existing temperature is below the pre-set temperature whilst a plus sign indicates conversely that the existing temperature is above the pre-set temperature.

In the temperature change row a minus sign indicates a fall in temperature over a predetermined time period of X seconds whilst a plus sign indicates a rise in temperature over that same period. A zero sign indicates no change in temperature.

In the ratio column a minus sign indicates that the ratio determined by the divider 11 is less than a predetermined value Y whilst a plus sign indicates that the ratio is greater than a predetermined value Y.

The table is also divided into columns each column containing one value each of the temperature difference, temperature change and ratio, together with a digital 1 or O value indicating the output condition of the read only memory for the three values in the column. The output condition values of the read only memory constitute a third row of the table.

To illustrate the application of the table the columns of the table have been lettered a - n. Assume that at a predetermined point in time the values of column C of the table apply. At this instant the temperature difference output provided by the comparator 10 is negative indicating that the actual room temperature is below the desired set temperature. The temperature change value provided by the comparator 12 is positive indicating that the actual temperature has risen during the preceding X seconds and the ratio value provided by the divider 11 is also positive indicating that this ratio is greater than a predetermined value Y. Under these conditions column C indicates a logical 1 for the output state of the read-only memory 13 indicating that further application of heating to the room heater is required during the next X seconds. This logical 1 output is fed to the drive circuit 14 which provides a drive signal to control the triac to apply heating power.

When the conditions shown at column G apply in which the temperature difference indicates that the actual temperature is above the desired temperature, the room temperature has increased during the preceding X seconds and the ratio provided by the divider 11 is greater than the value Y, the read only memory 13 will give a logical O output indicating that during the next X seconds power is not to be applied and no further heating of the room occurs.

Column n shows the case when the output signal from the comparator 10 indicates that the room has reached exactly the desired temperature. In this case the output conditions indicated by the read only memory 13 during the preceding n cycles, each of X seconds, as the actual temperature closely approached the desired temperature, are caused to be repeated to maintain the desired temperature.

The invention has been described by way of example and modifications may be mede without departing from the scope of the invention for example, the invention is not only applicable to the control of room temperature but may be used to control any parameter, the temperature sensor 5 then being replaced by a sensor for sensing the value of the parameter.

By controlling temperature in dependence upon the ratio of the temperature difference and temperature change signals provided by the comparators 10 and 12 respectively, a desired temperature may be achieved with minimum wastage of energy.

CLAIMS

1. A controller for controlling the value of a parameter the controller comprising means responsive to a parameter dependent electrical signal derived from a sensor, for providing a first electrical signal representative of the difference between a desired and an actual value of the parameter at a predetermined point in time, and for providing a second electrical signal representative of the change in the value of the parameter during a predetermined time period ending immediately preceding the said point in time, and control means for controlling the value of the parameter in dependence upon the ratio of the values of the first and second electrical signals.

2. A controller as claimed in Claim 1 in which the parameter is the temperature of a medium, the control means being operative to control the application of heat to the medium.

3. A controller as claimed in Claim 1 or 2 in which the means for producing the first and second

electrical signals includes a first comparator for comparing, at the predetermined point in time, an electrical signal representative of the desired value of the parameter with an electrical signal representative of the actual value to provide the said first electrical signal.

4. A controller as claimed in Claim 3 in which the means for producing the first and second electrical signals includes a second comparator for comparing at the predetermined point in time an electrical signal representative of the actual value at that time with an electrical signal representative of the value of the parameter immediately preceding the commencement of the predetermined time period.

5. A controller as claimed in Claim 4 in which a store is provided for storing for the duration of the said time period the electrical signal representative of the value of the parameter immediately preceding the predetermined time period.

6. A controller as claimed in any preceding claim in which a divider is provided for dividing the first and second electrical signals to produce the said ratio.

7. A controller as claimed in any preceding claim in which the control means for controlling the value of the parameter is also arranged additionally to control the value in dependence upon the values of the first and second electrical signals.

8. A controller as claimed in any preceding claim in which the control means includes a tabular store for providing an output control signal in dependence upon the value of one or more input signals.

9. A controller as claimed in Claim 8 in which the tabular store is a read only memory.

10. A controller for controlling the value of a parameter substantially as herein described with reference to and as illustrated in Figure 1 or Figures 1 and 2 of the drawings.

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