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(54) **Appliance for pulse rate and temperature measurement**

(57) A housing 1 adapted to be clasped by the hand has a digital display 2, 3; a press button 7 containing an optical-electrical pulse sensor; a socket 8 for a temperature

sensor 9 to be plugged in via a cable 10; and a switch 6 to select the pulse rate or temperature measurement mode. A measuring circuit comprising a single micro-processor to which the sensors and the switch 6 are connected, and a battery are accommodated in the pocket-size appliance.

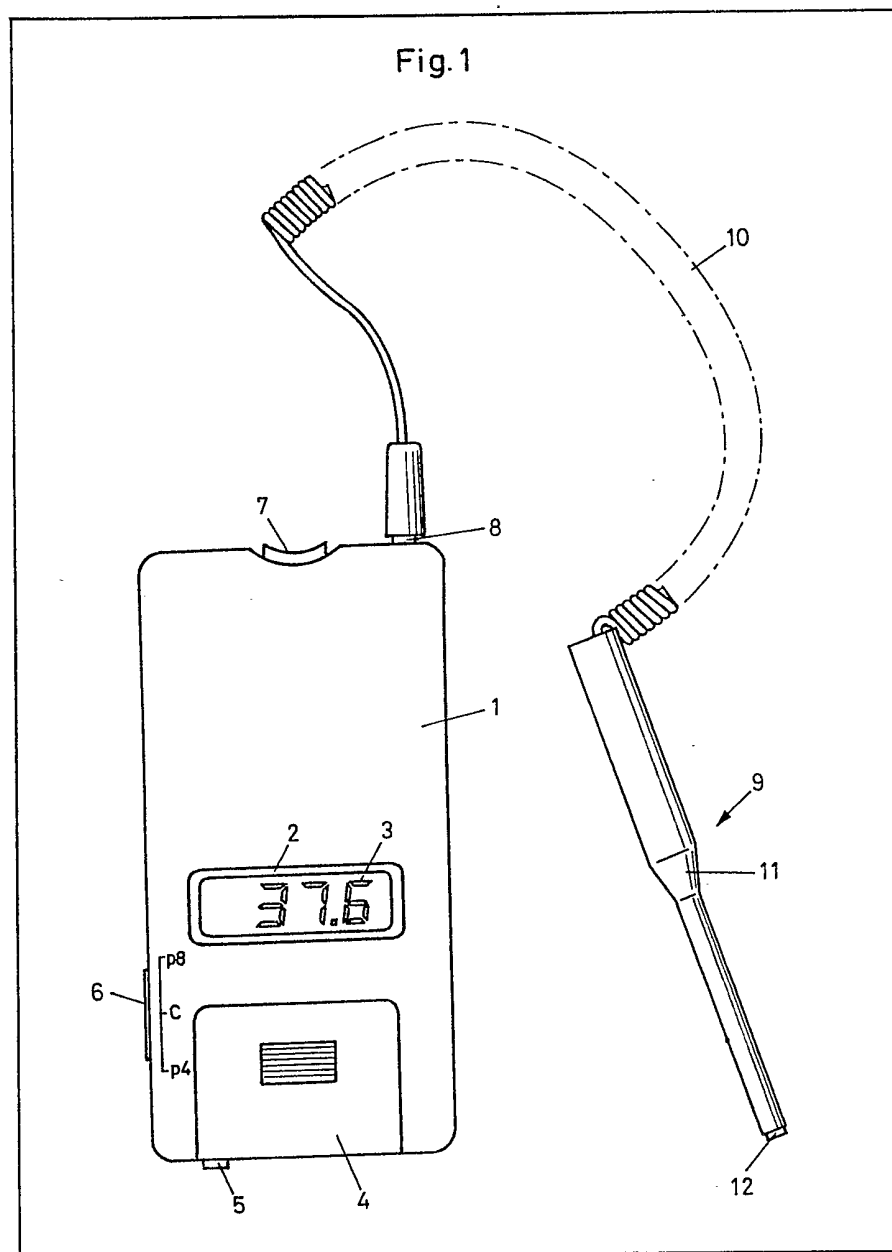


Fig.1

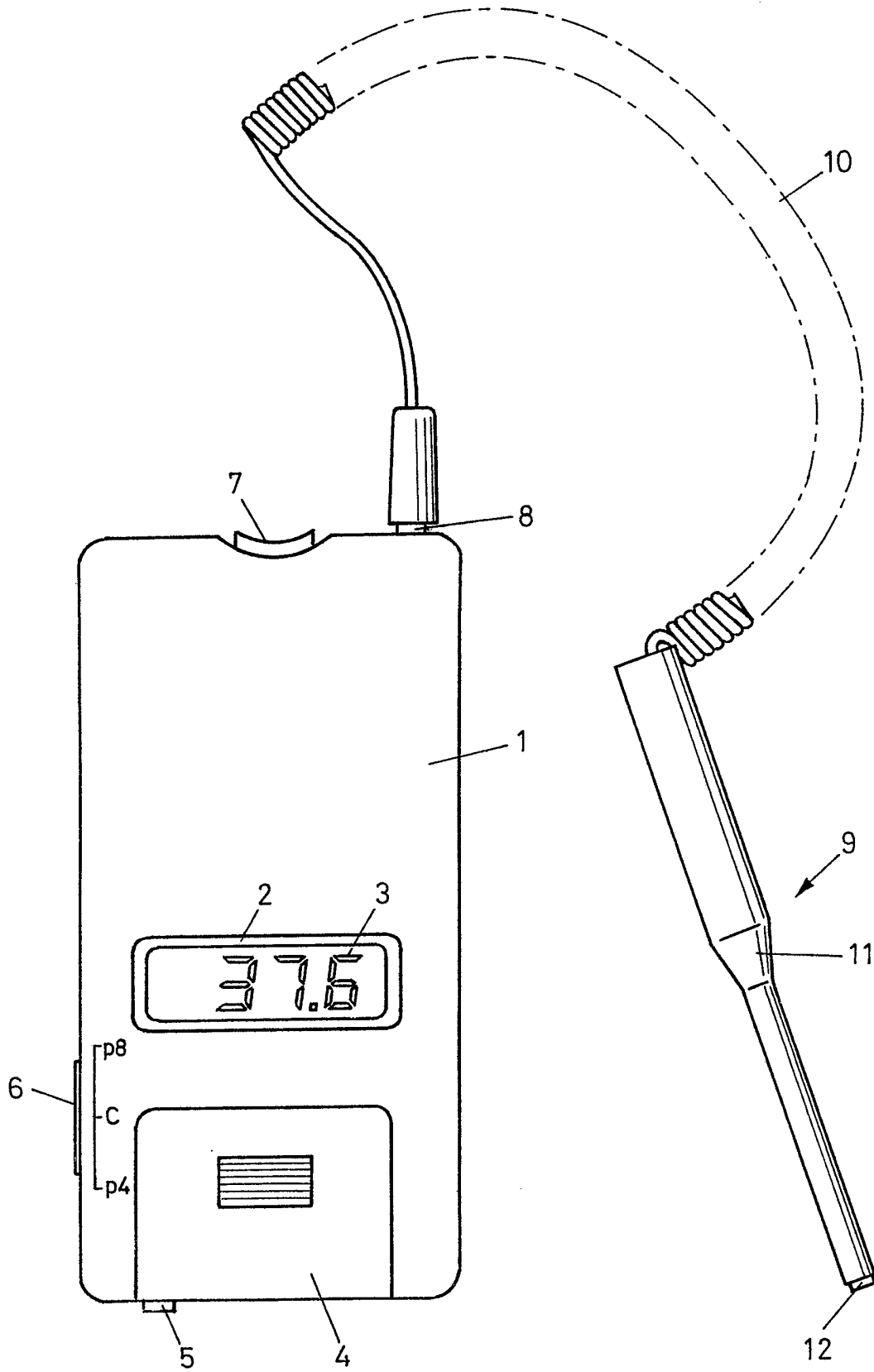


Fig. 2

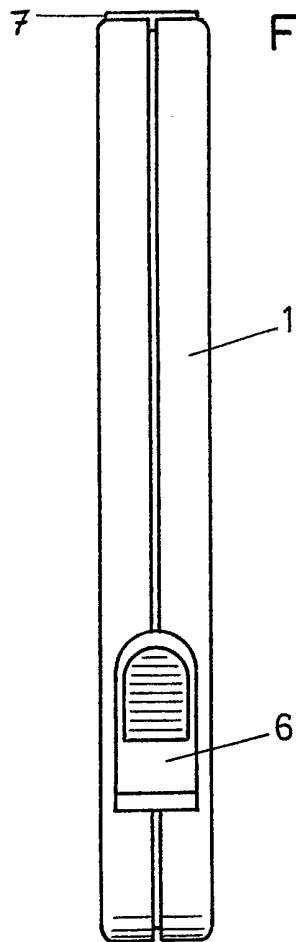


Fig. 3

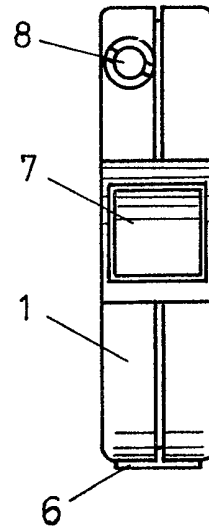
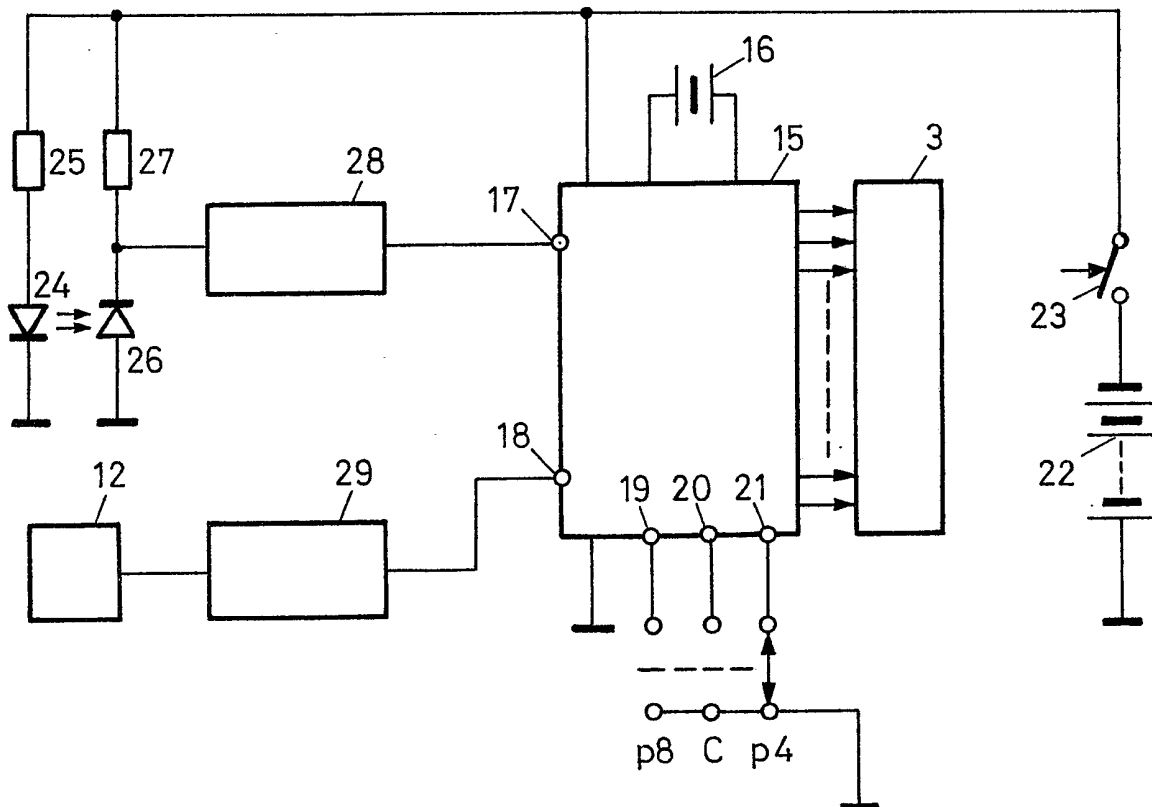


Fig. 4



SPECIFICATION

An appliance for pulse rate and temperature measurement

This invention relates to an appliance for pulse rate and temperature measurement, more particularly on the human body, comprising an optical electrical pulse sensor for a part of the body, a measuring circuit connected to the pulse sensor, and a display for the pulse rate, and comprising a temperature sensor, a measuring circuit connected to the temperature sensor and a display for the measured temperature, a housing adapted to be clasped in the hand being provided, for the pulse rate measurement, with a button containing the optical electrical pulse sensor and adapted to be pressed by one finger of the hand.

Pulse rate measuring appliances are known in which the reflection of an illuminated part of the body varying with each pulse beat as a result of the dilating blood vessels is utilized to form corresponding measuring pulses, the intervals between the pulse beats being electronically measured and the number of beats per minute being indicated as a number. More particularly, small-size appliances of this kind are known which can be held in one hand, a finger of the same hand being scanned for the pulse beat in the manner described.

Small-size electronic thermometers are also known in which the temperature detected by a temperature sensor is displayed in digital form.

The object of this invention is to provide an appliance of this kind which enables pulse rate and body temperature to be rapidly and accurately measured and displayed with minimum outlay in terms of apparatus and with simple handling.

According to the invention, there is provided an appliance for pulse rate and temperature measurement, more particularly on the human body, comprising an optical electrical pulse sensor for a part of the body, a measuring circuit connected to the pulse sensor, and a display for the pulse rate, and comprising a temperature sensor, a measuring circuit connected to the temperature sensor and a display for the measured temperature, a housing adapted to be clasped in the hand being provided, for the pulse rate measurement, with a button containing the optical electrical pulse sensor and adapted to be pressed by one finger of the hand, and in which the housing is provided with a connection for the temperature sensor, and the housing contains a single micro-processor connected to the pulse sensor and the temperature sensor, to which micro-processor there is connected a single display and a selector switch for selecting the pulse rate measurement or temperature measurement mode.

One exemplified embodiment of the subject of the invention is explained hereinafter with reference to the drawing wherein:

Figure 1 is a front view of an appliance embodying the invention, with the temperature sensor plugged in,

Figure 2 is a side elevation of the appliance of Figure 1 showing the mode selector switch, Figure 3 is a plan view of the top narrow end of the appliance of Figure 1, and

Figure 4 is a block diagram of the measuring circuit of the appliance of Figure 1.

The appliance illustrated comprises a rectangular plastics housing 1, the width and thickness of which are approximately the same as a conventional packet of cigarettes and the height of which is approximately half as much again as that of a packet of cigarettes. The front of the housing 1 (Figure 1) is formed with a window 2, behind which there is disposed a display 3 for numbers, letters and other symbols, preferably a liquid crystal display. The bottom part of the housing 1 contains a battery compartment 4 accommodating a 9 V battery for example. A plug socket 5 is provided on the bottom narrow side of the housing for connection of a miniature charger where a chargeable battery is used.

A sliding switch 6 is provided on one of the narrow longitudinal sides of the housing 1 (Figure 2) for selection of one of the different types of operation of the appliance. When switch 6 is in a first position p4 in Figure 1, the appliance is ready to operate for pulse rate measurements, each pulse beat being detected and the pulse rate being determined by comparison with the previous pulse beat, whereupon the average of the four last measurements is displayed on the display 3. When the switch 6 is in the other end position p8, the pulse beats are again detected but on each pulse beat the average of the pulse rate over the last eight beats is determined and displayed. When the switch 6 is in the middle position C the appliance is in the state of operation for temperature measurements.

At the top narrow end of the housing 1 the appliance has a trough-shaped press button 7 (Figures 1 and 3). The housing shown in Figure 1 is adapted to be clasped by the user's hand, one finger, preferably the index finger, fitting over the press button 7. The latter has two functions: when depressed by the finger, the measuring and display circuit contained in housing 1 is connected to the said battery so that the appliance can carry out the measurement determined according to the position of the switch 6. This ensures that the battery is required to deliver current only during the actual measuring time. The appliance or battery is switched on in known manner by a contact actuated by means of the press button 7. The second function of the press button 7 is to record the pulse beat by the finger pressure applied to the press button. The interior of the press button 7 contains in known manner a light source, e.g. an infra-red emitting diode, and a light sensor, e.g. a photo-diode or a photo-transistor, so that the light projected on to the applied finger by the light source is reflected on to the light sensor by the blood vessels dilating in time with the pulse beat.

Another plug socket 8 (Figures 1 and 3) is provided on the top narrow side of the housing 1

to receive a temperature sensor 9 via a cable 10. The pin-shaped temperature sensor 9 comprises a thermally insulating sensor housing 11 and a metallic sensor element 12 at its end. The temperature sensor 9 can without difficulty be brought into contact with any suitable part of the body for measuring the body temperature, the shape of the housing 11 and element 12 readily enabling heat to be radiated and taken from the part of the body concerned, thus obviating incorrect temperature measurement. In addition, the temperature sensor illustrated can be satisfactorily cleaned without any difficulty.

Figure 4 shows the basic circuit diagram for the pulse rate and temperature measuring circuit contained in the housing 1 in Figure 1. The measuring circuit comprises a single micro-processor 15, to which a quartz oscillator 16 is connected to produce the higher-frequency counting pulses required for the measurement. Micro-processor 15 comprises a first data input 17 for pulses corresponding to the pulse beats, and a second data input 18 for pulses corresponding to the temperature. It also has three control inputs 19, 20 and 21 which can be optionally earthed by means of the said sliding switch 6 to produce one of the three types of operation described, p4, p8 or C. The micro-processor 15 also drives in known manner the display 3, the display elements of which are light emitting diode segments or liquid crystal segments. The voltage supplied by battery 22 is fed to micro-processor 15 and other parts of the circuit via the said switch contact 23 actuated by the press button 7.

The infra-red emitting diode 24 accommodated in press-button 7 is fed via a resistor 25, while the photo-diode 26 receiving light reflected by the applied finger is also fed via a resistor 27. Instead of ordinary resistors 25, 27 it is advantageous to use a voltage or current stabilizing circuit to obviate any fluctuations in the voltage of battery 22. The pulse fed to the photo-diode 26 by the pulse beat is fed to a pulse shaper 28, which from the supplied pulse of varying shape and amplitude forms a defined pulse edge, e.g. a falling pulse edge. This is fed to the data input 17 of micro-processor 15.

The sensor element 12 of temperature sensor 9 delivers a current proportional to the temperature at the sensor element 12. A voltage-frequency converter 29 generates pulses of a frequency proportional to the current of the sensor element 12. These pulses are fed to the data input 18 of micro-processor 15.

The latter is so programmed in known manner as first to determine whether pulse rate measurement or temperature measurement is to be carried out depending upon the position of switch 6.

For pulse rate measurement, the micro-processor first provides a -P- display for a short period (e.g. 1 second) to confirm that pulse rate measurement has been started as a result of the position of the switch 6 and application of the

finger. The micro-processor then determines whether the pulse edges are available for pulse shaper 28. If so, a micro-processor register is charged with a number of pulses corresponding to the time spacing between two consecutive pulse edges of the same inclination. If switch 6 is in position p4, the numbers of pulses of four consecutive intervals are totalled and the average is formed. The same applies if the switch 6 is in position p8. To form the measurement showing the "number of pulse beats per minute" the number 60 000 is divided by the fixed interval length or the corresponding number of pulses in a register of the micro-processor. The latter then determines whether the pulse rate thus formed is within a specific range, e.g. about 20 beats per minute and below 200 beats per minute. If so, the micro-processor shows the determined number of beats on the display 3 in decimal form. If not, a special symbol is displayed, e.g. -L- for less than 20 beats per minute and -H- for more than 200 beats per minute. The cycle then starts afresh, the micro-processor showing the presence of the next pulse edge.

For temperature measurements, the micro-processor first briefly confirms this by means of a corresponding symbol -C-. The micro-processor then checks whether a pulse is available from the voltage-frequency converter 29, e.g. by reference to the pulse edge. If so, the micro-processor charges a register with the number -273150 corresponding to absolute zero, because the current from sensor element 12, which is proportional to the temperature, rises from that reference point by the display is to be in °C. The micro-processor then counts the pulses delivered by the converter 29 into the said register in positive form for a specific period, e.g. 4 seconds. The register contents are then displayed by the micro-processor in the display 3 in decimal form and with the decimal point. A special symbol again can be used to display whether the temperature is below or above a specific range, whereupon the measuring cycle starts afresh.

It will be clear that the appliance combines the functions of pulse rate measurement and temperature measurement in a very simple manner in respect of construction and handling. Since cheap micro-processors have storage capacities in excess of the approximate 250 words required, for example, for the pulse rate measurement, the additional use of the same micro-processor for the temperature measurement, which requires about 200 words, means that the micro-processor does not have to be more powerful and more expensive.

In the temperature measuring mode, of course, temperatures other than body temperatures can be rapidly and accurately measured provided they are within the temperature range (e.g. 0 to 100°C) covered by the appliance. The combined use of the appliance by individuals or doctors is particularly advantageous.

To change over the appliance from the pulse rate measuring mode to the temperature

measuring mode, the sliding switch 6 may be dispensed with and the socket 8 be provided with a switch contact actuated by insertion of a temperature sensor cable 10 so that the
5 corresponding control input 20 of micro-processor 15 is earthed. In such cases, however, unless another selector switch is used, the pulse rate measurement can be carried out only with a single average value being formed via the pulse intervals
10 detected, preferably eight. However, this is no disadvantage in practice. On the contrary, to obtain even simpler handling and more reliable results, the appliance shown in Figures 1 and 4 may advantageously be provided with a sliding
15 switch 6 having just two positions, one for pulse rate measurement with averaging over eight pulse intervals, and the other for temperature measurements.

CLAIMS

20 1. An appliance for pulse rate and temperature measurement, more particularly on the human body, comprising an optical electrical pulse sensor for a part of the body, a measuring circuit connected to the pulse sensor, and a display for
25 the pulse rate, and comprising a temperature sensor, a measuring circuit connected to the temperature sensor and a display for the measured temperature, a housing adapted to be clasped in the hand being provided, for the pulse
30 rate measurement, with a button containing the optical electrical pulse sensor and adapted to be pressed by one finger of the hand, and in which the housing is provided with a connection for the temperature sensor, and the housing contains a
35 single micro-processor connected to the pulse sensor and the temperature sensor, to which

micro-processor there is connected a single display and a selector switch for selecting the pulse rate measurement or temperature
40 measurement mode.

2. An appliance according to claim 1, in which the press-button means is provided with a switch for switching on the supply voltage delivered by a battery accommodated in the housing, and in
45 which the supply voltage terminals of the micro-processor, the display, and all other parts of the circuit between the pulse sensor and the micro-processor and between the temperature sensor and the micro-processor, are connected to the
50 switch.

3. An appliance according to claim 1 or 2, in which the housing is provided with a socket for plugging in the temperature sensor.

4. An appliance according to claim 3 wherein
55 the temperature sensor has a connecting cable leading from the sensor to a plug for plugging into said socket.

5. An appliance according to any one of claims 1 to 4, in which the micro-processor has a first
60 data input for pulses derived from the output signal of the pulse sensor, a second data input for pulses derived from the output signal of the temperature sensor, and at least two control inputs adapted to be connected optionally to a
65 reference potential, such as earth potential, by means of the selector switch to determine the mode of operation.

6. An appliance for pulse rate and temperature measurement substantially as hereinbefore
70 described with reference to, and as shown in, the accompanying drawings.

7. Any novel feature or combination of features described herein.