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[54] **RECORDING OR ALARM DEVICES**

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[51] **Int. Cl.** **A61b 5/10**

[58] **Field of Search** ..... 340/279, 272, 278; 128/25, 128/2.05 P, 2.08; 338/114, 100, 99

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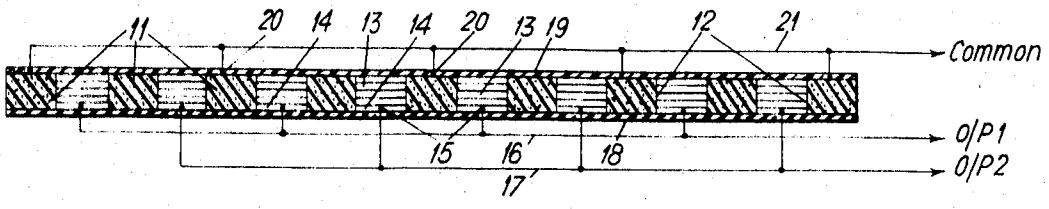
[57] **ABSTRACT**

A mattress for detecting the presence or absence of movement of a living creature resting upon it embodies resilient resistor material connected to electrical circuit leads in such manner that movements of the living creature e.g. breathing, produce output electrical pulses that are transmitted to a monitoring unit. The resilient resistor material is arranged in stacks of separate layers of such material alternated with intervening regions of resiliently deformable support material so that the movements to be detected are transmitted to the resilient resistor material without the latter becoming unduly compressed.

6 Claims, 4 Drawing Figures



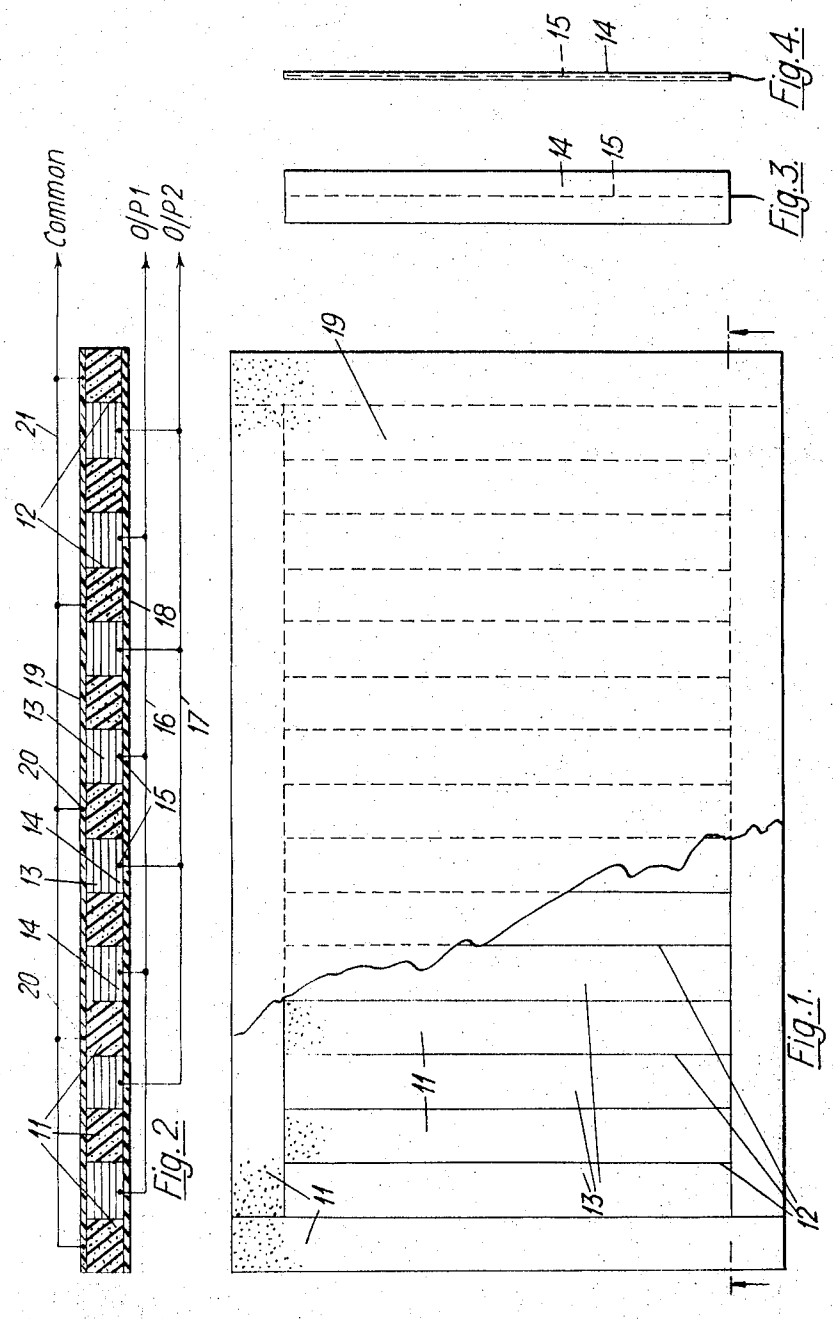


Fig.4.

Fig.3.

Common
O/P1
O/P2

Fig.2

Fig.1.

RECORDING OR ALARM DEVICES

This invention relates to a mattress for detecting the presence or absence of movement of a living creature resting upon it and, more specifically, to an apnoea detector which gives an alarm in the event of a baby failing to breath (and thus ceasing to move for a predetermined period).

It is an object of the invention to provide such a mattress that imposes no more than normal restraints on the positioning or movement of the person resting upon it and is not connected electrically or mechanically to that person.

According to this invention there is provided a mattress for detecting movement or absence of movement, e.g., apnoea, in a human or animal lying thereon, which mattress embodies resilient resistor material that is varyingly loaded as the human or animal moves whereby changes in its electrical resistance occur giving rise to electrical output signal pulses that are monitored in a detector circuit. The detector circuit may then deliver a warning signal should the interval between pulses or the amplitude of the pulses differ from a pre-determined pattern.

By this arrangement, the movement of a person on the mattress is communicated to the mattress solely by changes in the pressure, area or location of contact. The amplitude of the electrical signal depends on the rapidity or magnitude of movement and the monitor circuit detecting these signals can, if desired, be set so as to neglect signals below a predetermined level.

The device may utilise a number of layers of the resilient resistor material, which may be resilient plastic foam incorporating an electrically conductive material such as graphite, so that movement of one layer relative to a contiguous layer changes the contact resistance, these changes being detected by a suitable electrical circuit.

In one form of the device, movement sensing areas are alternated with support areas consisting of slightly deformable resilient material such as neoprene rubber foam. The support material is chosen in thickness and strength according to the weight of the person resting on the mattress and must allow movement to be transmitted to the resilient resistor material while ensuring that the resilient resistor material is not greatly compressed. In this form of the device stacks of layers of resilient resistor material may be used to increase the total contact resistance and to obtain greater sensitivity to movement.

One embodiment of the invention will now be described by way of example, with reference to the accompanying drawings in which:

FIG. **1** is a plan view of an apnoea detecting mattress with the cover removed and an upper sheet broken away,

FIG. **2** is a longitudinal section through the mattress, and

FIGS. **3** and **4** are a plan and side view, respectively, of a layer of resilient resistor material from the mattress which embodies an electrode wire.

The mattress is built up from bolsters of resilient neoprene rubber foam each of rectangular cross section and arranged two along the sides, two across the ends, and seven more laid crosswise parallel to the end bolsters at equal intervals along the length of the mattress, the seven intermediate crosswise bolsters being spaced

from one another and from the end bolsters by channels **12** of substantially the same width as the bolsters. The channels **12** are filled with stacks of layers **13** of resilient resistor material, which may be resilient plastic foam embodying an electrically conductive material, e.g., powdered graphite.

The bottom layer **14** of the stack of layers **13** of resilient resistor material in each channel **12** has threaded through it a fine flexible copper wire **15** plated with a conductive protective material such as tin. These wires form electrodes; alternate ones of these electrode wires are connected to a first output lead **16** while the intervening wires are connected to a second output lead **17**. The mattress is closed underneath by a neoprene rubber sheet base **18** underlying the stacks **13** of resilient resistor foam and bolsters **11** and bonded to the latter.

An upper sheet **19** of the mattress, overlying and bonded to the bolsters **12**, and in contact with the top layers of the resilient resistor stacks **13**, is also of resilient resistor material and has threaded through it at intervals a series of electrode wires **20**, like the wires **15**, that are connected to a common lead **21**. Above the upper sheet **19** is placed a layer of non-electrically-conducting plastic foam (not shown) to help distribute the forces resulting from movement of the person resting on the mattress. A thin welded sterilisable plastics cover (not shown) encloses the mattress.

A movement of a person on the top of the mattress causes a redistribution of pressure amongst the resilient resistor stacks **13**, or even a displacement of the electrode layer material **19**, resulting in changes of contact resistance between two or more of the resilient resistor layers. This, in turn, produces a differential signal pulse between the output leads **16, 17**.

Further forms of the device with alternative sizes, configurations and numbers of movement sensing areas and support areas may be used in the monitoring of human or animal patients in the conscious or unconscious conditions after illness, injury, treatment or in the post-operative state. The requirement may be to provide an alarm if movement reduces below a desired level (or ceases), or alternatively if increased activity occurs.

Each signal output pulse is detected by an electronic circuit and if it exceeds a pre-determined amplitude, resets a timer. When detecting absence of movement an alarm is given if a pre-determined period elapses without resetting of the timer. Increased activity may be detected if a pre-determined period is not achieved without resetting and the occurrence of this condition exceeds a pre-determined frequency. An increase in the violence of activity may be ascertained by the presence of large amplitude pulses.

I claim:

1. A mattress for detecting movement or absence of movement, e.g., apnoea, in a living being lying thereon, said mattress including resilient resistor material that is varyingly loaded as said living being moves whereby changes in its electrical resistance give rise to varying electrical output signals, said mattress comprising movement-sensing regions taken along a length of said mattress of resilient resistor material alternated with support regions of resiliently-deformable electrically insulating supportive material, said supportive material having sufficient resilience to allow movement of said living being to be transmitted to said resilient resistor

material, but having also sufficient firmness to support said living being.

2. A mattress according to claim **1**, wherein said resilient resistor material is resilient plastic foam incorporating graphite.

3. A mattress according to claim **1**, wherein said resilient resistor material in each of said regions is disposed in contiguous layers one upon another to form stacks, whereby changes in load distribution cause changes in the contact resistance between contiguous ones of said layers in said stacks.

4. A mattress according to claim **3**, wherein a lower layer of each of said stacks and an upper layer of each of said stacks contain embedded metallic electrodes, and means connecting said electrodes to external electrical leads.

5. A mattress according to claim **4**, including means connecting said electrodes in said lower layers of alternate ones of said stacks to one output lead, and means connecting said electrodes in said lower layer of the intervening ones of said stacks are connected to a second output lead.

6. A mattress according to claim **5**, wherein is provided a single layer of resilient resistor material overlying all said stacks, a series of electrodes embedded in said single layer of resilient resistor material, and means connecting said last named electrodes in common to a third lead.

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