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JP 100102541 A JP 080075203 A US 5637040 A
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(71) Applicant(s)
Kleenair Maintenance Services Limited
(Incorporated in the United Kingdom)
Airfield Road, CHRISTCHURCH, Dorset, BH23 3TG,
United Kingdom

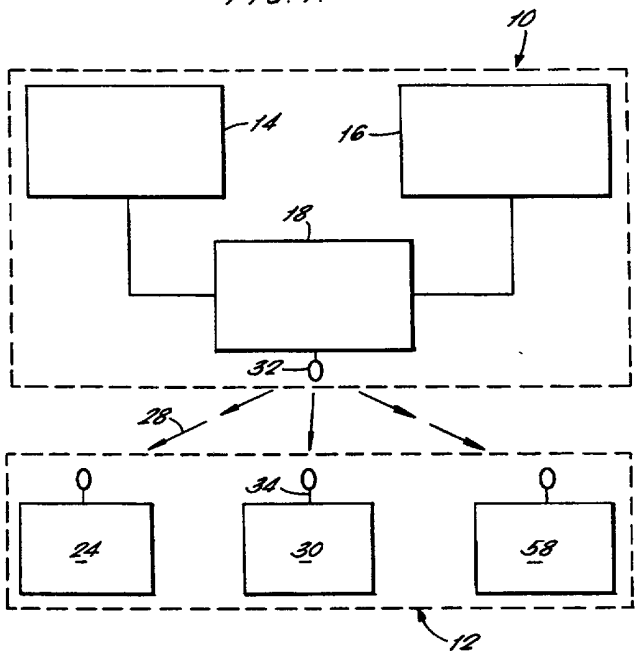
(72) Inventor(s)
Derek Withrington

(74) Agent and/or Address for Service
Boult Wade Tennant
Verulam Gardens, 70 Gray's Inn Road, LONDON,
WC1X 8BT, United Kingdom

(54) Abstract Title
**Device for automatically controlling an air maintenance system**

(57) A device 10 for automatically controlling an air maintenance system 12 is disclosed. The device uses a Passive Infra-Red (PIR) detector 14 to count the number of movements within an enclosed space during a specified time period. Readings from a temperature sensor 16 may also be included. A processor 18 then estimates the number of people within the enclosed space and thereby activates the air maintenance system 12 at a suitable activation level. Preferably, a PIR detector 14 with no latching-on period is provided. Communication between the processor 18 and the air maintenance system is preferably by way of a radio transceiver 32.

FIG. 1.

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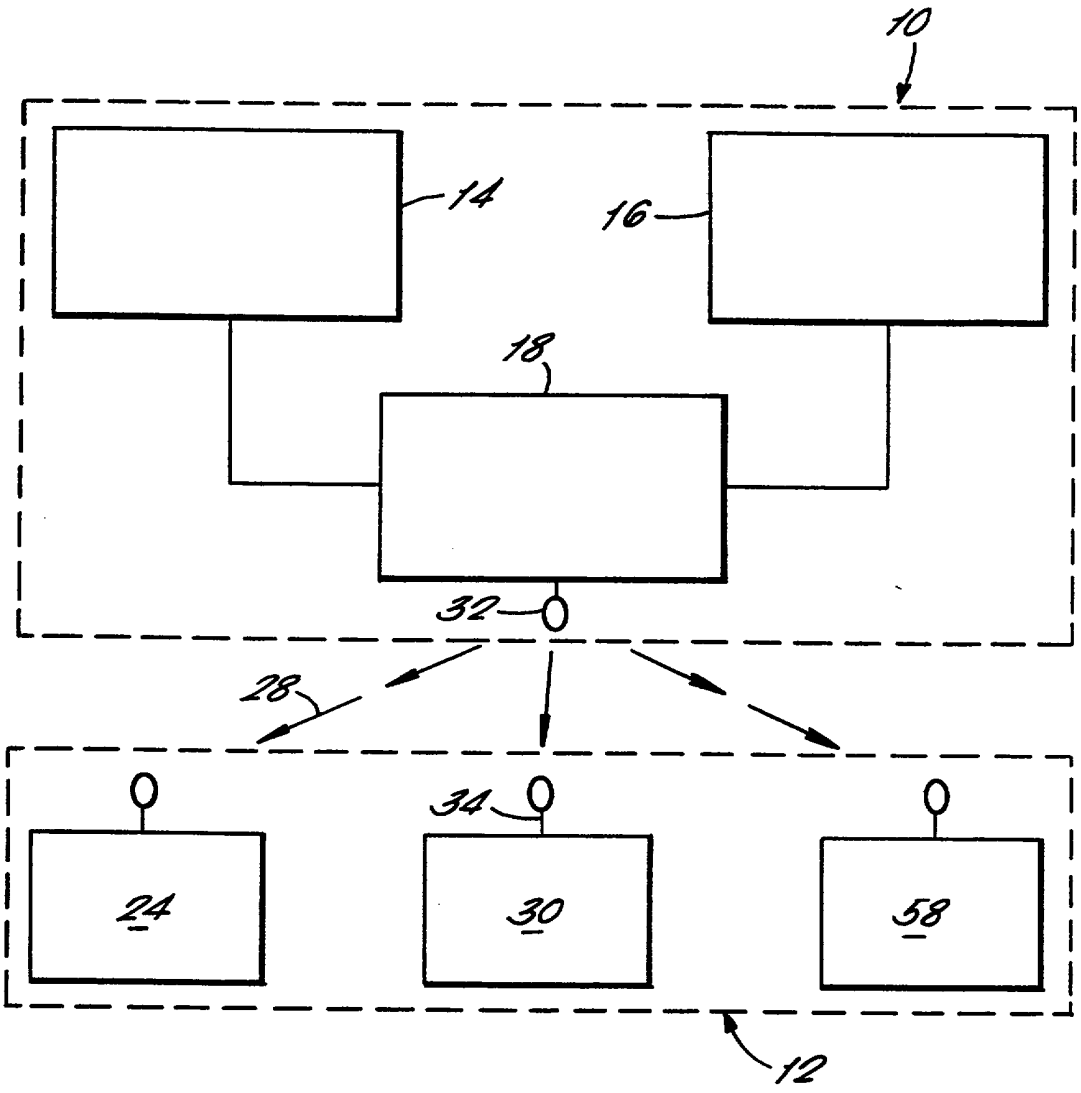
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1.



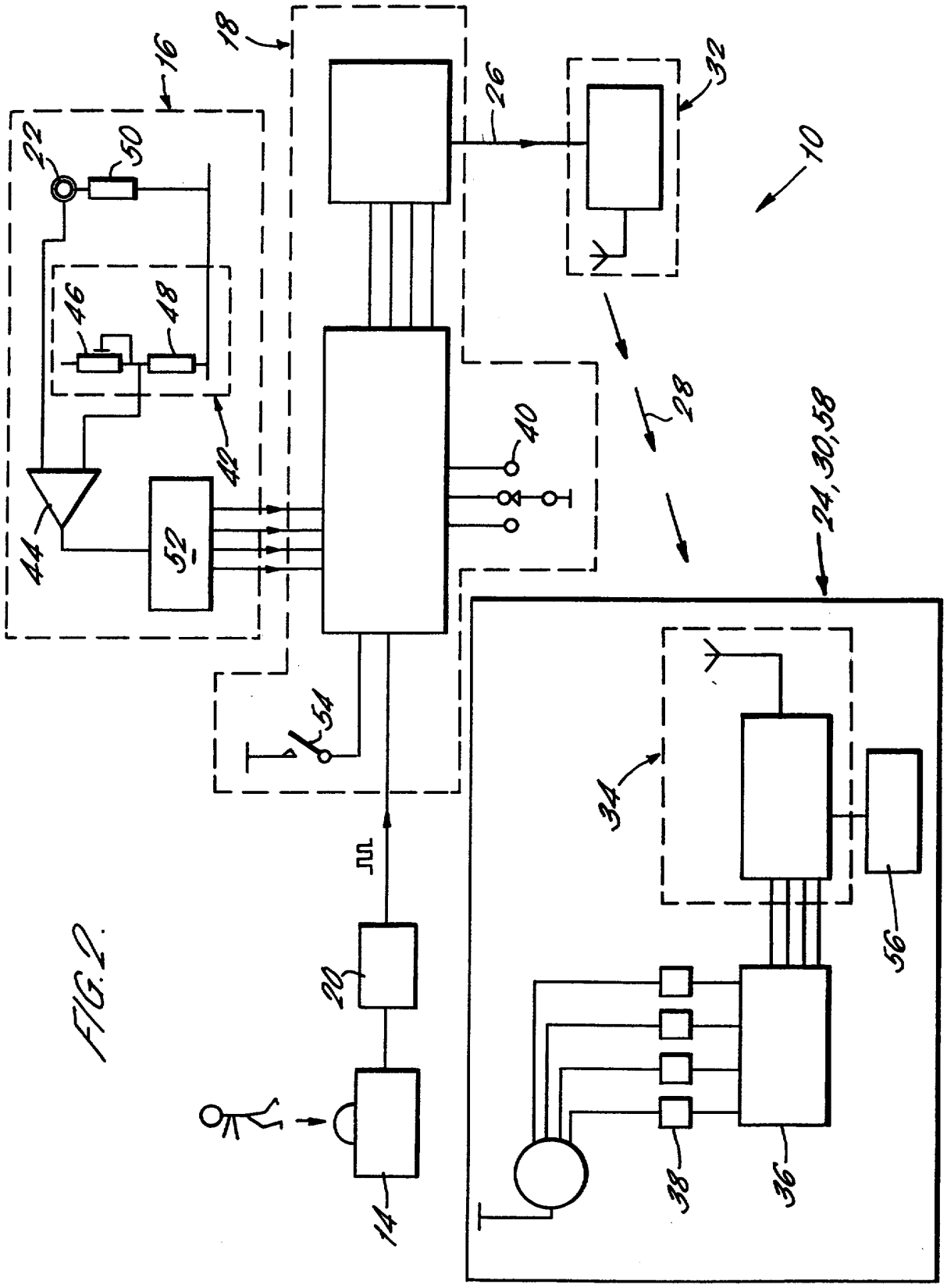



FIG. 2.

**Statement of Invention**

According to the present invention there is provided a device for automatically controlling an air maintenance system, the device comprising: sensor means for detecting at least one parameter within an enclosed space; and processor means, having at least one input connectable to said sensor means for receiving data from said sensor means, and having at least one output; wherein said sensor means comprises at least one motion sensor means which can sense a number of individual movements within the enclosed space; the device being characterised in that said processor means is provided to record the number of movements sensed by said at least one motion sensor means within the enclosed space during a specified time period and to provide an output for controlling the air maintenance system when connected thereto.

In a preferred embodiment of the invention, said at least one motion sensor means comprises a Passive Infra-Red (PIR) detector which may provide an output for each movement sensed within the enclosed space with no latching-on period. Said sensor means may further comprise at least one temperature sensor.

Said processor means can interpret said data received from said sensor means and can select an appropriate activation level for the air maintenance system. Said processor means can generate an output signal which is dependent upon the interpretation of said data received from said sensor means and the output signal provides a control signal which can be supplied to the air maintenance system to control its operation.

A preferred embodiment of the present invention further comprises a radio transmitter means having at least one channel and wherein the control signal can be communicated to the air maintenance system by the radio transmitter means under the control of the processor

means, for the purpose of controlling the operation of the air maintenance system. In a preferred embodiment, said radio transmitter means is arranged to transmit the control signal to the air maintenance system, when connected thereto, at substantially regular intervals under the control of the processor means, for the purpose of adjusting the operation of the air maintenance system.

The invention may further comprise receiving means for receiving the transmitted control signal when the device is in operation, these receiving means preferably comprising radio receiver means. The radio receiver means is connectable with the air maintenance system in order to control the operation thereof.

A preferred embodiment of the present invention further comprises interpreting means, connectable to an output of the radio receiver means, in order to interpret the control signal and to provide an output for controlling the operation of the air maintenance system. Preferably, said interpreting means is further connectable to switching means of or for the air maintenance system, whereby electrical power can be supplied thereto.

In a preferred embodiment of the present invention, said sensor means is manually adjustable and said processor means is manually configurable.

A further embodiment of the present invention provides an air maintenance system comprising at least one air maintenance unit for controlling the atmospheric parameters in an enclosed space and comprising a device as herebefore described.

In a further embodiment, the or each at least one air maintenance unit is selected from air cleaners, ventilation units and/or temperature control units.

**Brief description of the Figures**

There now follows a detailed description, which is to be read with reference to the accompanying drawings, of several embodiments of the present invention which have been selected for description to illustrate the invention by way of example and not be way of limitation.

Fig. 1 shows a preferred embodiment of the invention in a schematic form.

Fig. 2 shows an example schematic circuit diagram of a preferred embodiment of the invention.

**Detailed Description of the Preferred Embodiments**

With reference to Figures 1 and 2, a preferred embodiment of the present invention provides a device 10 for automatically controlling an air maintenance system 12. The device comprises sensor means 14,16 for detecting at least one parameter within an enclosed space; and processor means 18, having at least one input for receiving data from said sensor means 14,16, and having at least one output. In the embodiment depicted in the Figures, the sensor means is provided by only two sensors 14,16 and the processor means by a single processor 18, but it will be appreciated that a large enclosed space or a building containing a number of rooms may require many individual sensors which may be controlled by one or several processors.

Each said sensor means comprises at least one motion sensor means 14 which can sense a number of individual movements within the enclosed space. In the embodiment shown in the Figures, the motion sensor 14 is a Passive Infra-Red (PIR) detector 14, but it will be

appreciated that other motion sensors are well known to a skilled person and may easily be substituted for the PIR detector 14 shown.

The PIR detector 14 may be of a standard design but, in a preferred embodiment, a modified PIR detector, i.e. with no latching-on period, is provided. When a standard PIR detector senses movement it 'latches on' for a period of about 3 seconds. During the latching-on period, the detector provides a single output signal regardless of the number of movements sensed during that period. Whereas this may be acceptable in an enclosed space where sudden surges in people are not expected, it would not be suitable for use in many public buildings such as cinemas and theatres. In these buildings, tightly gathered groups of people may enter the enclosed space simultaneously and a standard PIR detector may only provide a single output pulse. The modified PIR detector 14 used in a preferred embodiment of the present invention, not having a latching-on period, would output a large number of signals in this situation and give an indication of the number of people within the group. This may have drawbacks should a single person stand very close to the modified PIR detector 14. Were this to happen, the PIR would indicate that an erroneously high number of movements were being made. This can easily be overcome by mounting the PIR detector away from areas accessible to the public or on the ceiling, but preferably there is a provided a pulse limiter or 'one shot device' 20 situated between the PIR detector 14 and the processor 18 to limit the number of pulses outputted by the PIR detector 14 in any given time period. The one shot device may, for example, comprise a multi-vibrator.

The processor 18 is provided to record the number of movements sensed by the or each motion sensor 14 within the enclosed space during a specified time period. The number of movements sensed by the PIR

detector 14 and recorded by the processor 18 is related to the number of people within the enclosed space and the processor 18 is arranged to interpret data received from the PIR detector 14.

Data from the PIR detector 14 is further combined with that from a corresponding one or more temperature sensors 16, each of which may comprise a thermistor 20 as well as other components. Although these are the only types of sensor shown in the Figures, others may be suitable for measuring the parameters within the enclosed space. A noise sensor, for example, may also be used to estimate the number of people present, or a smoke detector may sense the need to activate a ventilation unit 22. Once data from the sensors 14,16 has been interpreted by the processor 18, the processor 18 can then select an appropriate activation level for the air maintenance system 12 and generate an output signal 24 which is dependent upon the interpretation of said data received from said sensor means 14,16. The output signal 26 provides a control signal 26 which can be supplied to the air maintenance system 12 to control its operation. It will be apparent that the processor 18 can be programmable with the details of the air maintenance system 12 and of the sensors 14,16 present within the building. For example, a basic algorithm for a device 10 comprising only two sensors, a PIR detector 14 and a temperature sensor 16, controlling an air maintenance system 12 comprising only two air maintenance units, an air cleaner 28 and a ventilation unit 24 may be:

| **Processor Inputs** | **Processor Outputs** |
|---|---|
| No strikes by PIR for 20 minutes | . . . Both units off |
| Low level strikes by PIR | . . . . . Both units low |
| High level strikes by PIR and low temperature | . . . . . Air cleaner high, Ventilation unit low |
| Low level strikes by PIR and high temperature | . . . . |

. . . . . Air cleaner low, Ventilation unit high
High level strikes by PIR and high temperature
. . . . . Both units high

A preferred embodiment of the invention further comprises a radio transmitter means 30 having at least one channel and wherein the control signal 28 can be communicated to the air maintenance system 12 by the radio transmitter means 32 under the control of the processor 18, for the purpose of controlling the operation of the air maintenance system 12. Although the Figures show a radio transmitter 32, it will be understood that other forms of communication, such as by direct wire transmission, may be used. Furthermore, in an embodiment where the radio transmitter 32 has more than one channel, it may be possible to transmit different control signals 28 to different parts of the air maintenance system 12 such that different parts of a large building may be controlled independently from single processor 18.

A preferred embodiment has the radio transmitter 32 arranged to transmit the control signal 28 to the air maintenance system 12 at substantially regular intervals under the control of the processor 18. This feature enables the quick reset of errors due to interference between the radio transmitter 32 and the air maintenance system 12, or due to device response failure of the air maintenance system 12.

A preferred embodiment of the present invention further provides receiving means 32 for receiving the control signal 28 when the device is in operation. In a preferred embodiment, said receiving means 34 comprises radio receiver means 34, although other possibilities, such as direct wire communication, may be envisaged and implemented. The radio receiver means 34 is further connectable with the air maintenance system 12 in order to control the operation thereof.

An embodiment of the present invention further provides interpreting means 34, connectable to an output of the radio receiver means 34, in order to interpret the control signal 28 and to provide an output for controlling the operation of the air maintenance system 12. These interpreting means 36 may comprise a decoder 36 for decoding the control signal 28.

The interpreting means 36 may further be connected to switching means 36 of or for the air maintenance system 12, for supplying power thereto. Many prior air maintenance systems already comprise control switches to which the interpreting means 36 of the present invention may be connected such that the air maintenance system may be activated at an appropriate level as directed by the processor 18. It may be necessary to hard wire the interpreting means 36 directly to the control switches of the air maintenance system, or simple connectors may be available. If neither of these possibilities is practicable, the present invention may further provide at least one relay 38 for supplying power to the air maintenance system at an appropriate level as directed by the processor 18.

So that the present invention may be suitable for use in many different enclosed spaces, a preferred embodiment of the present invention further provides sensors 14,16 which is manually adjustable and a processor 18 which is manually configurable.

The sensor adjusting means may comprise a PIR range switch 38 connected to the processor 18. In the exemplary embodiment of Figure 2, the PIR range switch 40 comprises a three way switch with each of the outputs going to the processor 18 and activating different control functions programmed therein. It can be seen, however, that the PIR range switch may have any number of outputs dependent upon the amount of control required by the user. Alternatively a PIR range switch 40 may be attached directly to the PIR detector 14 for controlling

the sensitivity to movement of the PIR detector 14.

Alternatively, or in addition, the adjusting means may provide means for adjusting the sensitivity of the temperature sensor 16. Where the temperature sensor comprises, for example, a thermistor, the sensitivity may be controlled by way of an adjustable voltage divider 40 and operational amplifier 42. The adjustable voltage divider 42 comprises an adjustable resistor 44 and a first scaling resistor 46. The outputs from the thermistor 22 and the adjustable voltage divider 42 could each be fed into one of the inputs to the operational amplifier 44. The thermistor should be connected to a second scaling resistor 48, which has a resistance chosen to enable the adjustable resistor 42 in conjunction with the first scaling resistor 48 to be marked with a temperature scale. Thus any difference between the output voltage of the thermistor 22 and of the adjustable voltage divider 42 would reflect a difference between the selected temperature and the actual temperature of the enclosed space. The op-amp 44 would amplify and output this voltage difference into a level detector 50 which may detect simply that the enclosed space is too hot or too cold, or the adjustment means may comprise further components such that the amount by which the measured temperature is different from the selected temperature is indicated. The level detector 52 would pass information on whether the enclosed space is too hot or too cold to the processor 18, in order that the processor 18 may interpret the data and activate the air maintenance system 12 at an appropriate level. Other thermostatic control devices may be suitable for use with the present invention.

The processor configuring means may allow the user to change the way in which the processor 18 interprets the data provided by the sensors 14,16, such that the control signal 28 is transmitted under different conditions.

Preferably, the sensors 14,16 are housed in separate boxes which should be small and easy to fix onto a wall or ceiling. This feature keeps the sensors 14,16 discrete and easy to install. Alternatively, the sensors 14,16 may be housed inside (or proximate to) each air maintenance unit such that each unit is independently controlled without the need for radio communication.

Another preferred feature, illustrated in Figure 2, is a reset switch 52 connected to the processor 18. This allows the user to reset the system in the event of a malfunction, or to turn it off altogether and allow manual control of the air maintenance system 12. Also shown in Figure 2 is a shutdown timer 54 attached to the air maintenance system 12 which shuts the system 12 down after a predetermined period of time: 5 minutes, for example. This may be necessary if the device 10 malfunctions such that the control signal 28 is no longer transmitted to the air maintenance system 12.

A preferred system according to the present invention provides an air maintenance system 12 comprising at least one air maintenance unit 24,30,56, only one of which is shown in Figure 2, for controlling the atmospheric parameters in an enclosed space and comprising a device 10 substantially as described herein.

In the preferred system, the or each at least one air maintenance unit 24,30,54 is any one of an air cleaner 30, a ventilation unit 24 or a temperature control unit 58. The temperature control unit 58 may consist of several sub units such as heaters, ceiling fans or air conditioning devices.

**Claims:**

1. A device for automatically controlling an air maintenance system, the device comprising:

sensor means for detecting at least one parameter within an enclosed space; and

processor means, having at least one input connectable to said sensor means for receiving data from said sensor means, and having at least one output;

wherein said sensor means comprises at least one motion sensor means which can sense a number of individual movements within the enclosed space; and

wherein said processor means is provided to record the number of movements sensed by said at least one motion sensor means within the enclosed space during a specified time period and to provide an output for controlling the air maintenance system when connected thereto.

2. A device as claimed in Claim 1 wherein said at least one motion sensor means comprises a Passive Infra-Red (PIR) detector.

3. A device as claimed in Claim 2 wherein said PIR detector provides an output for each movement sensed within the enclosed space with no latching-on period.

4. A device as claimed in any one of Claims 1 to 3 wherein said sensor means further comprises at least one temperature sensor.

5. A device as claimed in any one of the preceding Claims wherein said processor means can interpret said data received from said sensor means.

6. A device as claimed in Claim 5 wherein said processor means can select an appropriate activation level for the air maintenance system.

7. A device as claimed in either one of Claim 5 and Claim 6 wherein said processor means can generate an output signal which is dependent upon the interpretation of said data received from said sensor means.

8. A device as claimed in Claim 7 wherein the output signal provides a control signal which can be supplied to the air maintenance system to control its operation.

9. A device as claimed in Claim 8 further comprising radio transmitter means having at least one channel and wherein the control signal can be communicated to the air maintenance system by the radio transmitter means under the control of the processor means, for the purpose of controlling the operation of the air maintenance system

10. A device as claimed in Claim 9 wherein the radio transmitter means is arranged to transmit the control signal to the air maintenance system, when connected thereto, at substantially regular intervals under the control of the processor means for the purpose of adjusting the operation of the air maintenance system.

11. A device as claimed in either one of Claim 9 and Claim 10 and further comprising receiving means for receiving the transmitted control signal when the device is in operation.

12. A device as claimed in Claim 11 wherein said receiving means comprises radio receiver means.

13. A device as claimed in Claim 12 wherein the radio receiver means is connectable with the air maintenance system in order to control the operation thereof.

14. A device as claimed in Claim 13 further comprising

interpreting means, connectable to an output of the radio receiver means, in order to interpret the control signal and to provide an output for controlling the operation of the air maintenance system.

15. A device as claimed in Claim 14 wherein said interpreting means is connectable to switching means of or for the air maintenance system, whereby electrical power can be supplied thereto.

16. A device as claimed in any one of the preceding Claims wherein said sensor means is manually adjustable.

17. A device as claimed in any one of the preceding Claims wherein said processor means is manually configurable.

18. A device for automatically controlling an air maintenance system, substantially as hereinbefore described and illustrated with reference to the accompanying drawings.

19. An air maintenance system comprising at least one air maintenance unit for controlling the atmospheric parameters in an enclosed space and further comprising a device according to any one of Claims 1 to 18.

20. A system as claimed in Claim 19 wherein the or each at least one air maintenance unit is selected from air cleaners, ventilation units and/or temperature control units.

21. A system for controlling the atmospheric parameters in an enclosed space, substantially as hereinbefore described and illustrated with reference to the accompanying drawings.

**Application No:** GB 0007091.2 **Examiner:** Dave Mobbs
**Claims searched:** 1-21 **Date of search:** 14 July 2000

# Patents Act 1977
# Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): G3N NGCA, NG2.

Int Cl (Ed.7): F24F 11/00.

Other: ONLINE: EPODOC, JAPIO, WPI.

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| Y | US 5,637,040 | (SAMSUNG ELECTRONICS CO., LTD.) - see particularly column 3 lines 48-50. | 1-2, 5-17, 19-20. |
| Y | US 5,634,846 | (SAMSUNG ELECTRONICS CO., LTD.) - see particularly column 3 line 66 - column 4 line 4. | 1-2, 5-17, 19-20. |
| X | US 5,331,825 | (SAMSUNG ELECTRONICS CO., LTD.) - see particularly column 6 line 37 et. seq. | 1-2, 5-17, 19-20. |
| X | JP 100102541 | (HITACHI CONSTRUCTION MACHINERY CO., LTD.) - cited from the abstract. | 1, 5-8. |
| X, Y | JP 080075203 | (MATSUSHITA DENKI SANGYO KK) - cited from the abstract. | X: 1, 19-20; Y: 2, 5-17. |

| | | | |
|---|---|---|---|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
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