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

(11) **EP 2 104 124 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
11.02.2015 Bulletin 2015/07

(51) Int Cl.:
H01H 13/52 *(2006.01)*

(21) Application number: **09250770.6**

(22) Date of filing: **19.03.2009**

(54) **Safety switches**

Schutzschalter

Interrupteurs de sécurité

(84) Designated Contracting States:
DE FR GB

(30) Priority: **20.03.2008 GB 0805181**

(43) Date of publication of application:
23.09.2009 Bulletin 2009/39

(73) Proprietor: **Rockwell Automation Limited**
Milton Keynes
Buckinghamshire MK11 3DR (GB)

(72) Inventor: **Poyner, Julian**
Cheshire SK7 6JS (GB)

(74) Representative: **Williams, Michael David et al**
Marks & Clerk LLP
1 New York Street
Manchester M1 4HD (GB)

(56) References cited:
EP-A- 1 795 676
DE-A1- 10 123 942
DE-A1-102004 038 488

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 2 104 124 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to safety switches, and in particular to a communication arrangement of a safety switch.

[0002] Safety switches are well known, and are typically used to prevent access to, for example, dangerous electromechanical or electrical machinery when that machinery is in operation. In a conventional arrangement, the safety switch is mounted on a doorpost of a machinery guard, and an actuator for the safety switch is mounted on a corresponding door of the machinery guard. When the door is closed the actuator engages with the safety switch, which in turn changes the condition of electrical contacts within the safety switch. For instance, when the door is closed the actuator may cause electrical contacts within the switch to close, therefore allowing electricity to be supplied to machinery within the machinery guard. Such an arrangement ensures that electricity can only be supplied to the machinery when the guard door is shut. When the guard door is opened, the actuator disengages from the safety switch, thereby opening the electrical contacts and preventing the supply of electricity to the machinery. This means that when a user opens the guard door to gain entry to the machinery guard, the machinery is not supplied with electricity, and the risk of injury to the user is reduced or eliminated.

[0003] DE-A-102004038488 discloses a safety switch according to the preamble of claim 1.

[0004] In other embodiments, opening and closing of the guard door does not necessarily allow or prevent the supply of electricity to the machinery within the machinery guard. Instead, opening and closing of the guard door may directly or indirectly result in a change in the operating state of the machinery. For instance, when the door to the machinery guard is opened, the contacts within the safety switch can be configured to ensure that the machinery is changed to an idle state, or to run at a slower speed, for example. Alternatively, the safety switch can be configured to control an intermediate control device which is used to control the operating state of the machinery. Movement of electrical contacts may not be required to change the operating state of the switch, and other arrangements may be used. For instance, solid state, digital or analogue electronics may be used instead of contacts.

[0005] In existing arrangements, one or more safety switches may be in communication with a central processing unit, or central control unit, or the like. For instance, a safety switch may communicate information indicative of its condition (for example, whether or not contacts provided in the safety switch are in an open or closed configuration) to the central processing unit. The central processing unit, may, in turn, communicate with the safety switch in order to control, for example, a latching arrangement. If the safety switch communicates to the central processing unit the fact that its contacts are in an open configuration, this would imply that the door to the machinery guard has been opened. The central processing unit would therefore communicate back with the safety switch and/or the machinery in order to change the operating state of the machinery, for example turning it off.

[0006] In order to maintain high safety standards and reliability, known safety switches are provided with communication arrangements which communicate continuously with the central processing unit. The central processing unit is configured to ensure that any break in a communication is assumed to be a sign that something is wrong with the safety switch. Therefore, the supply of electricity to the machinery is often interrupted as a result of break in communication between the safety switch and the central processing unit. In this way, the entire arrangement is fail-safe. However, communication between the safety switch and the central processing unit may be interrupted even when there is no malfunction of, or problem with, the safety switch. For instance, an object may temporarily block a wireless communications path between the safety switch and the central processing unit This may cause the power to the machinery to be interrupted, even when there is nothing wrong with the safety switch, or the communication arrangement with which it is provided. Such interruption of power to the machinery can occur quite frequently if the communication is also blocked frequently, and can be a nuisance in an environment where machinery downtime reduces throughput, for example. Furthermore continuous communication between the central processing unit and the safety switch requires a continuous supply of power to the safety switch arrangement. In the present environment, where the minimisation of power consumption is desirable in all areas of commerce and industry, this may be undesirable.

[0007] It is therefore an object of the present invention to provide a new or alternative safety switch arrangement which may obviate or mitigate at least one disadvantage of the prior art, whether identified herein or elsewhere.

[0008] According to a first aspect of the present invention, there is provided a safety switch arrangement for affecting the operating state of equipment to which the safety switch is at least indirectly connected, the safety switch comprising: a configuration arranged to change from a first condition to a second condition depending on whether or not an at least indirectly connected, the safety switch comprising: a configuration arranged to change from a first condition to a second condition depending on whether or not an actuator has been engaged with or disengaged from the safety switch; and a communication arrangement arranged to transmit information indicative of a state of the safety switch to a processing unit, the communication arrangement being arranged to transmit information indicative of a state of the safety switch only when the state of the switch changes from a first state to a second state and/or the second state to the first state; and a latching arrangement; the latching arrangement being configured to directly or indirectly latch the actuator

in position relative to the safety switch arrangement; the safety switch arrangement being configured such that, once the actuator is latched in position by the latching arrangement, the actuator is latched in position until the communication arrangement receives a predetermined signal from the processing unit which is at least indicative of a permission to unlatch the actuator.

[0009] The communication arrangement may be arranged to transmit information indicative of a state of the safety switch only when the state of the switch changes from a first state to a second state.

[0010] The latching arrangement may be configured to latch the actuator in position relative to the safety switch arrangement. The safety switch arrangement may be configured such that, once the actuator is latched in position by the latching arrangement, the actuator is latched in position until the communication arrangement receives a predetermined signal. The predetermined signal may be at least indicative of a permission to unlatch the actuator. The latching arrangement may be the configuration that is arranged to change from a first condition to a second condition depending on whether or not the actuator has been engaged with or disengaged from the safety switch. The first condition may be when the latching arrangement has latched the actuator in position relative to the safety switch, and the second condition is when the latching arrangement has not latched the actuator in position relative to the safety switch.

[0011] The change of state of the safety switch from the first state to the second state may be caused by the change in condition of the configuration from the first condition to the second condition.

[0012] The configuration, which is arranged to change from a first condition to a second condition depending on whether or not the actuator has been engaged with or disengaged from the safety switch, may comprise contacts. The first condition may be when the contacts are in an open configuration, and the second condition may be when the contacts are in a closed configuration.

[0013] The safety switches 10, 12 are substantially as described above, in that they at least indirectly control the operating state of the machinery 2 depending on whether the doors 6, 8 are opened or closed. In the Figure, it can be seen that the safety switches 10, 12 are in two-way wireless communication 14 with a central processing unit 16 (which may be a computer, a server, etc). The central processing unit 16 is in turn in wired connection 18 with the machinery 4. Of course, it will be appreciated that the central processing unit 16 may be in wireless communication with the machinery 2. The central processing unit 16 is shown as being located outside of the machinery guard 2. This may be advantageous in that the central processing unit 16 can be maintained, serviced, etc. without having to gain access into the machinery guard 2. However, it will be appreciated that in some circumstances the central processing unit 16 may be located within the machinery guard 2.

[0014] In order to control the operating state of the machinery 4, communication between the safety switches 10, 12 and the central processing unit 16 is undertaken continuously. For instance, the safety switches 10, 12 may continuously (e.g. every second or half-second) transmit to the central processing unit 16 information at least indicative of whether or not the doors 6, 8 to which the safety switches 10, 12 are attached are open or closed. If the safety switches 10, 12 determine (or are in a state or condition that indicates) that the doors 6, 8 are not closed, or not locked or latched in position, the communication with the central processing unit 16 may change from comprising a first signal to comprising a second signal. For instance, when the doors 6, 8 to the machinery guard 2 are closed, and/or latched or locked in position, the safety switches 10, 12 may transmit to the central processing unit 16 a signal which indicates that electricity may be supplied to the machinery 4. The central processing unit 16 will in turn control the machinery 4 via wired connection 18 such that electricity may be supplied to the machinery 4. If, on the other hand, the doors 6, 8 to the machinery guard 2 are not closed, or locked or latched in position, the safety switches 10, 12 may change the signal which they communicate to the central processing unit 16, such that the signal indicates that electricity should not be supplied to the machinery 4. Once again, the central processing unit 16 controls machinery 4 by the wired connection 18 to effect this control - i.e. the central processing unit 16 prevents the supply of electricity to the machinery guard 4.

[0015] The arrangement shown in Figure 1 often works satisfactorily. However, there are disadvantages associated with this arrangement.

[0016] Figure 1b illustrates a disadvantage of the continuous communications arrangement shown in and described with reference to Figure 1a, Figure 1b shows that a person 20 is blocking communication 14 between the first safety switch 10 and the central processing unit 16. For safety reasons, if communication is not possible between the first safety switch 10 (or the second safety switch 12) and the central processing unit 16, the central processing unit 16 will configured to 'assume' that there is something wrong with the safety switch 10. The central processing unit 16 will default to a fail-safe situation, in that, because it is not provided with information regarding the state of the first door 6 to the machinery guard 2 (e.g whether it is opened or closed), it will prevent the supply of electrical power to the machinery 4, or at least change its operating state to a slower or idle state.

[0017] In many circumstances, this fail-safe configuration is a very safe and very thorough approach to a breakdown in communication between the first safety switch 10 and the central processing unit 16. However, if the breakdown in communication between the first safety switch 10 and the central processing unit 16 occurs frequently, for example each time a person walks in-between the first safety switch 10 and the central processing unit 16, the electrical power to the machinery 4 may be interrupted just as frequently. This may mean that the

machinery 4 is out of operation frequently, when there is nothing at an wrong with the machinery 4, the first door 6 to the machinery guard 2, or the safety switch 10. This may result in an unnecessary reduction of throughput of a process or the like which uses the machinery 4. This is clearly undesirable.

[0018] It will be appreciated that the safety switches 10, 12 can communicate with the central processing unit in any convenient manner. For example, wireless communication can be undertaken, or the continuous communication can be undertaken in a wired manner. The wireless or wired transmission and reception of data to and from a central processing unit is known in the art, and will therefore not be described in detail here.

[0019] It has been found that one or more problems associated with prior art communication arrangements and principles can be overcome by providing a safety switch arrangement which communicates with, for example, a central processing unit only when the state of the safety switch changes (in other words, the transmission of a signal from the safety switch being triggered by a change in state of the switch). For instance, by only undertaking communication when the state of the switch changes, less power is used by a communications arrangement provided in the safety switch. Furthermore, because communication will be less frequent, the number of times that the supply of electrical power to the machinery is interrupted without a genuine cause or reason may be reduced. These advantages, and how they are implemented, will be described in Figures 2 to 4.

[0020] Figure 2a depicts a safety switch arrangement in accordance with an embodiment of the present invention. The Figure shows a safety switch 30. The safety switch 30 is provided with a cam arrangement 32. A moveable plunger 34 is biased against a surface of the cam arrangement 32 by a spring 36. It can be seen that the moveable plunger 34 is latched in position by two pivotable latching members 38. The pivotable latching members 38 are attached to a sliding member 40 which is retractable into a solenoid 42. The solenoid 42 is in communication with a communications arrangement 46 via a wired connection 44. An input to the communications arrangement 46 is provided on the outside of the safety switch in the form of a button 48.

[0021] It can be seen that an actuator 50 is engaged with the cam arrangement 32. The actuator 50 may be attached to, for example, a door 52 or the like. The actuator 50 can only be disengaged from the cam arrangement 32 if the cam arrangement 32 is allowed to rotate. The cam arrangement 32 is not allowed to rotate when the pivotable latching members 38 are engaged with, and prevent movement of, the moveable plunger 34.

[0022] When there is no input to the communications arrangement 46 via the button 48, the communications arrangement 46 does not transmit any information. In other words, and in contrast with the prior art, the communications arrangement 46 does not communicate or transmit information continuously.

[0023] Figure 2b shows the situation when, a user, for example, depresses the button 48 when the user wishes to disengage the actuator 50 from the safety switch 30 to, for example, gain access to a machinery guard.

[0024] When the button 48 is depressed, the state of the safety switch 30 changes from one state to another. Specifically, the safety switch 30 changes from an idle state to a state in which disengagement of the pivotable latching members 38 is requested. When the button 48 is depressed, the communications arrangement 46 wirelessly transmits (or in another example, transmits in a wired manner) to a central processing unit or the like a request for the pivotable latching members 38 be disengaged from the moveable plunger 34.

[0025] Figure 2c shows the communications arrangement 46 receiving a transmission from the central processing unit which gives permission for the pivotable latching members 38 to be disengaged from the moveable plunger 34. It can be seen that the communications arrangement 46 has effected this disengagement by controlling the solenoid 42. The solenoid 42 is energised, causing retraction of the sliding member 40 into the solenoid 42, which in turn causes the pivotable latching members 38 to pivot and be disengaged from notches 54 provided in the moveable plunger 34. The moveable plunger 34 is no longer latched in position, meaning that the cam arrangement 32 is now rotatable.

[0026] Before or during transmission of a signal to the communications arrangement 46 from the central processing unit, the central processing unit may change the operating state of the machinery, for example interrupting its power supply or changing the state of the machinery to a slower or idol state making it safer for a user to enter the machinery guard once the pivotable latching members 38 have been disengaged from the moveable plunger 34.

[0027] When the pivotable latching members 38 have been disengaged from the moveable plunger 34, a light or sound may be provided so that the user of the safety switch 30 is now aware that the actuator 50 can be disengaged from the safety switch 30 so that for example, the door 52 to a machinery guard may be opened. When the user has been provided with an indication that the pivotable latching members 38 have been disengaged from the plunger 34, the user will know that the actuator 50 can be disengaged from the safety switch 30. Figure 2d shows that the user can therefore pull on the door 52 which in turn causes disengagement of the actuator 50 from the cam arrangement 32. This is because the cam arrangement 32 is now able to rotate, since the moveable plunger 34 is no longer latched in position.

[0028] Figure 2d also shows the communications arrangement 46 transmitting a signal to the central processing unit. The signal is indicative of a change of state of the safety switch. In one example, the signal may be transmitted when the pivotable latching members 38 have been disengaged from the plunger 34, so that the central processing unit is aware of the fact that the door

52 may now be opened. Alternatively or additionally, the signal may be transmitted when one or more of the moveable plunger 34. cam arrangement 32 or actuator 50 moves by an amount which is indicative of the actuator being disengaged from the cam arrangement 32 and safety switch 30, so that the central processing unit is aware of the fact that the actuator 50 is disengaged and the door 52 has been opened.

[0029] It will of course be appreciated that the communications principles mentioned above are equally applicable when the actuator 50 is engaged with the cam arrangement 32 and safety switch 30 (i.e. when the door 52 is closed). For instance, when the safety switch changes from a first state to a second state, the communications arrangement 46 may communicate this change (or information indicative of this change) to the central processing unit. The central processing unit may then change the operating state of machinery within a machinery guard in response to the change of state of the switch 30. The change of state of the switch may be when the actuator 50 engages with the safety switch 32, and causes the pivotable latching members 38 to engage with the moveable plunger 34.

[0030] Figure 2e shows that when the actuator 50 is engaged with the safety switch 30, and the state of the safety switch is not changed from one state to another, the communication arrangement 46 does not send (or in other words transmit) any information. Similarly, Figure 2f shows that when the actuator 50 is disengaged from the safety switch 30, the communication arrangement 46 again does not transmit any information. This is in stark contrast to the prior art, where the communications arrangement would continuously transmits information to, for example, a central processing unit or the like irrespective of a change of state of the switch.

[0031] Figure 3a is a graph depicting communication principles of a known safety switch arrangement. It can be seen that signals 60 are transmitted in a continuous and periodic manner over a period of time. Figure 3b shows that between a time T_1 and a time T_2 a body or other object is blocking transmission of the signals 60 from the communications arrangement to, for example, a central processing unit This means that during this period there is effectively a gap 62 in the transmission which the central processing unit may determine as an error. In response to the gap or break in communications, the central processing unit may default to a fail-safe situation and interrupt the supply of electrical power to machinery located within machinery guard.

[0032] Figure 4a depicts communication principles in accordance with an embodiment of the present invention. It can be seen that signals 64 are not transmitted continuously, but are instead transmitted only when the state of the safety switch continues from one state to another state. In other words, the changing of the state of the safety switch triggers transmission of a signal 64. This means that in comparison with the prior art arrangement where signals are continuously transmitted, an embodiment of the present invention uses far less power to transmit the signals.

[0033] Figure 4b shows that between the time T_1 and the time T_2, transmission from the communications arrangement is blocked, leading to a period 66 where the central processing unit does not receive any information from the communications arrangement of the safety switch. However, and in contrast with the prior art arrangement, the arrangement in accordance with an embodiment of the present invention is configured such that the central processing unit does not look for and monitor a continuously and periodically generated signal. Instead, the central processing unit only acts upon signals which it receives. Thus, the fact that there is a period 66 for which the central processing unit cannot receive any information does not matter, since for the same period 66 the central processing unit cannot communicate with the safety switch. This means that the communications arrangement cannot transmit an unlatch request to the central processing unit, and/or the central processing unit cannot transmit an unlatch permission to the safety switch. When transmission between the communications arrangement of the safety switch and the central processing unit is blocked, the actuator cannot be disengaged from the safety switch. This means that a door provided with the actuator cannot be opened, meaning that a user cannot enter a machine guard of which the door forms a part. In short, the arrangement is fail-safe. Furthermore, it can be seen that due to the fact that signals are only generated when the state of the safety switch changes from a first state to a second state, there are far less signals to be blocked by a body located in between the safety switch arrangement and the central processing unit. This reduces or eliminates the possibility of the central processing unit unnecessarily interrupting supply of electrical power to the machinery within the machinery guard.

[0034] In the prior art arrangements, continuous communication between the safety switch and the central processing unit is desirable so that it is always known whether the safety switch has detected (or in other words is in a state which reflects) an opening or closing of a door, or the like. In the present invention, since continuous communication is not undertaken, such continuous monitoring is not undertaken. Therefore, it is preferable that the central processing unit can assume that the safety switch is maintained at a state until it receives information indicative of a change in the state of the switch. Therefore, it may be preferable to incorporate a latching arrangement in the safety switch to ensure that the safety switch is indeed maintained in a given state until the central processing unit receives information of a change in that state (for example, a request to unlatch the latching arrangement, or information indicating that the latching arrangement has been unlatched). The central processing unit can then receive and act upon this information.

[0035] It will be appreciated that a latching arrangement as described above in relation to Figures 2a to 2f

is not essential. For instance, as soon as an actuator disengages from the safety switch, the communications arrangement may communicate this fact to a central processing unit, which can then in turn change the operating state of machinery within a machinery guard. Similarly, when the actuator is engaged with a safety switch, the communications arrangement can communicate this fact to the central processing unit, for example allowing electricity to be supplied to machinery within the machinery guard. A latching arrangement may be preferred, however, to ensure that the safety switch remains in a certain state, for example where the actuator is latched in position. A latching arrangement may also be included to introduce a delay between changing the operating state of machinery within the machinery guard and allowing the user to disengage the actuator from the safety switch and enter the machinery guard. This delay may be sufficient for the machinery to slow down by a desired amount, or come to a stop. In other words, the safety switch may be configured such that, once the actuator is latched in position by the latching arrangement, it is latched in position until the communication arrangement receives a predetermined signal. The predetermined signal may at least be indicative of a permission to unlatch the actuator.

[0036] In the described embodiments, solenoids have been stated as forming part of the latching arrangement. This is not essential, and may not be preferred. This is because it may be necessary to energise a solenoid for a long period of time in order to ensure that a bolt or plunger (etc.) is retracted within the plunger for a long period of time. To energise a solenoid for a long period of time requires the solenoid to be supplied with electricity for a long period of time. Instead of using a solenoid, it may therefore be preferable to use a component which is moveable in-between stable states (e.g. state which do not require a power supply to be maintained). For instance, a stepper motor or linear actuator may be preferable, since they can be moved to positions (or states) which do not require the supply of electricity to be maintained. Any suitable latching arrangement can be employed, for example an arrangement comprising a sliding bolt, pivotable latching members, a screw thread arrangement, or any other suitable arrangement. The latching arrangement may directly or indirectly latch the actuator in position relative to the safety switch. Direct latching may include bringing one or more members into contact with the actuator to latch it in position. Indirect latching may include bringing one or more members into contact with an element other than the actuator, in order to latch the actuator in position. For instance, the latching arrangement shown in and described with reference to Figures 2a to 2f is an example where indirect latching of the actuator is undertaken.

[0037] In the forgoing embodiments, an actuator has been described. The actuator has been described and shown protruding from a door and which can be, for example, moved into and out of a safety switch. It will be appreciated that such an actuator is not essential, and neither is the movement of an actuator into and out of the safety switch. In some embodiments, the actuator could comprise a magnet, and engage and disengage with the safety switch using a magnetic field. In other embodiments, the actuator could be the finger, thumb or another body part of a user. The actuator could be attached to a door, gate, or the like, form part of the door, gate or the like, or actually be the door, gate or the like.

[0038] In the forgoing embodiments, the terms 'latching', 'latched', 'latching arrangement' and 'latched in position' have been used. It will be appreciated that these terms are synonymous with the terms 'locking, 'locked, 'locking arrangement' and 'locked in position'.

[0039] As described above, a safety switch arrangement is provided for affecting the operating state of equipment to which the safety switch is at least indirectly connected. The safety switch is at least indirectly connected to the equipment, in so far as that the safety switch could be connected to the equipment in a wireless manner, or via another piece of equipment which may provide a control or further control functions. The safety switch may of course be directly connected to the equipment, and it will be understood that the term 'at least indirectly connected' includes directly connected.

[0040] The safety switch described above can generically be described as being provided with a configuration arranged to change from a first condition to a second condition depending on whether or not an actuator has been engaged with or disengaged from the safety switch. The configuration could be moveable contacts, or solid state electronics, or any suitable configuration. The first condition may be such that the supply of electricity to the equipment is allowed, and the second condition may be such that the supply of electricity to the equipment is prevented. The first condition may be such that the equipment is arranged to operate at a first speed, and the second condition may be such that the equipment is arranged to operate at a second speed. The first condition may be such that movement of at least a part of the equipment is allowed, and the second condition may be such movement of the equipment is prevented. The safety switch as a whole (or the latching arrangement with which it may be provided) may be changeable from a first state to a second state. For instance, in a first state an actuator may be latched in position relative to (e.g. by) the safety switch or latching arrangement. In a second state, the actuator may not be latched in position relative to (e.g. by) the safety switch or latching arrangement. If the actuator is attached to a door, for example of an enclosure in which equipment is located, latching or not latching of the actuator may have the effect of latching the door closed, or allowing it to be opened.

[0041] As described above, a change of state of the Safety switch is arranged to trigger the transmission of a signal from the communications arrangement. The change of state may be when an input is provided to the switch (for example, by a user depressing a button), or

when a configuration (e.g. a cam arrangement, latching arrangement, or contacts) with which the switch is provided changes from one condition to another.

[0042] The communication arrangement described above can be configured to transmit and/or receive information (or in other words a signal) in a wireless or wired manner. The information transmitted will be indicative of a state of the safety switch. The use of the term information does not imply any degree of complexity. The information can be a high or low signal, or an on or off signal. Alternatively or additionally, the information may comprise machine code or other readable instructions, etc. A wireless manner may encompass any form of wireless communication, including any form or electromagnetic, electrical, magnetic or pressure wave, pulse or signal. A wireless manner of communication may be preferable, since the number of cables or wires to and from the safety switch may be reduced, making installation and location of the safety switch easier. A wired manner may encompass any form of wired communication, for example through a wire, cable, etc. The communications arrangement may be any suitable device or collection of devices, for example comprising one or more antennae or signal generating means. Since communications arrangements are well known, they will not be described in detail here. As described above, a change of state of the safety switch is arranged to trigger the transmission of a signal from the communications arrangement. The change of state can be provided to the communication arrangement, or the communication arrangement may be configured to detect such a change in state.

[0043] It will be appreciated that the above embodiments have been described by way of example only. It can be further appreciated that various modifications may be made to the described and indeed other embodiments without departing from the invention as defined by the claims that follow.

Claims

1. A safety switch arrangement (30) for affecting the operating state of equipment to which the safety switch (30) is at least indirectly connected, the safety switch (30) comprising:

   a configuration (32, 34) arranged to change from a first condition to a second condition depending on whether or not an actuator (50) has been engaged with or disengaged from the safety switch (30);

   a communication arrangement (46) arranged to transmit information indicative of a state of the safety switch (30) to a processing unit (16), the communication arrangement (46) being arranged to transmit information indicative of a state of the safety switch (30) only when the state of the switch (30) changes from a first state to a second state and/or the second state to the first state, **characterised in that** it further comprises a latching arrangement (38, 40, 42);

   the latching arrangement (38, 40, 42) being configured to directly or indirectly latch the actuator (50) in position relative to the safety switch arrangement (30);

   the safety switch arrangement (30) being configured such that, once the actuator is latched in position by the latching arrangement (38, 40, 42), the actuator (50) is latched in position until the communication arrangement (46) receives a predetermined signal from the processing unit (16) which is at least indicative of a permission to unlatch the actuator (50).

2. The safety switch arrangement (30) as claimed in claim 1, wherein the latching arrangement (38, 40, 42) is the configuration that is arranged to change from a first condition to a second condition depending on whether or not the actuator (50) has been engaged with or disengaged from the safety switch (30).

3. The safety switch arrangement (30) as claimed in claim 2, wherein the first condition is when the latching arrangement (38, 40, 42) has latched the actuator (50) in position relative to the safety switch (30), and the second condition is when the latching arrangement (38, 40, 42) has not latched the actuator (50) in position relative to the safety switch (30).

4. The safety switch arrangement (30) as claimed in any preceding claim, wherein the change of state of the safety switch (30) from the first state to the second state is caused by the change in condition of the configuration (32, 34) from the first condition to the second condition.

5. The safety switch arrangement (30) as claimed in any preceding claim, wherein the configuration, which is arranged to change from a first condition to a second condition depending on whether or not the actuator (50) has been engaged with or disengaged from the safety switch (30), comprises contacts.

6. The safety switch arrangement (30) as claimed in claim 5, wherein the first condition is when the contacts are in an open configuration, and the second condition is when the contacts are in a closed configuration.

7. The safety switch arrangement (30) as claimed in any of claims 1 to 6, wherein the configuration, which is arranged to change from a first condition to a second condition depending on whether or not the actuator has been engaged with or disengaged from the safety switch (30), comprises a moveable plung-

er (34) or a cam arrangement (32).

8. The safety switch arrangement (30) as claimed in claim 7, wherein the second condition is when the cam arrangement (32) or moveable plunger (34) has moved by an amount which is indicative of the actuator (50) being disengaged from the safety switch (30), and the first configuration is when the cam arrangement (32) or moveable plunger (34) has moved by an amount which is not indicative of the actuator (50) being disengaged from safety switch (30).

9. The safety switch arrangement (30) as claimed in any preceding claim, wherein the communication arrangement (46) is configured to transmit information in a wireless manner.

10. The safety switch arrangement (30) as claimed in any preceding claim, wherein the communication arrangement (46) is configured to transmit information in a wired manner.

Patentansprüche

1. Schutzschalteranordnung (30) für das Bewirken des Betriebszustandes der Anlage, mit der der Schutzschalter (30) mindestens indirekt verbunden ist, wobei der Schutzschalter (30) aufweist:

eine Konfiguration (32, 34), die ausgebildet ist, um sich von einem ersten Zustand in einen zweiten Zustand in Abhängigkeit davon zu verändern, ob ein Betätigungselement (50) mit dem Schutzschalter (30) in Eingriff oder außer Eingriff gebracht wurde oder nicht;
eine Kommunikationsanordnung (46), die ausgebildet ist, um Informationen, die einen Zustand des Schutzschalters (30) anzeigen, zu einer Prozessoreinheit (16) zu übermitteln, wobei die Kommunikationsanordnung (46) ausgebildet ist, um die Informationen, die einen Zustand des Schutzschalters (30) anzeigen, erst zu übermitteln, wenn sich der Zustand des Schalters (30) von einem ersten Zustand in einen zweiten Zustand und/oder der zweite Zustand in den ersten Zustand verändert hat, **dadurch gekennzeichnet, dass** sie außerdem aufweist:

eine Verriegelungsanordnung (38, 40, 42), wobei die Verriegelungsanordnung (38, 40, 42) ausgebildet ist, um das Betätigungselement (50) direkt oder indirekt in Position relativ zur Schutzschalteranordnung (30) zu verriegeln,
wobei die Schutzschalteranordnung (30) so ausgebildet ist, dass, sobald das Betätigungselement in Position durch die Verriegelungsanordnung (38, 40, 42) verriegelt ist, das Betätigungselement (50) in Position verriegelt wird, bis die Kommunikationsanordnung (46) ein vorgegebenes Signal von der Prozessoreinheit (16) empfängt, das mindestens eine Erlaubnis anzeigt, das Betätigungselement (50) zu entriegeln.

2. Schutzschalteranordnung (30) nach Anspruch 1, bei der die Verriegelungsanordnung (38, 40, 42) die Konfiguration ist, die ausgebildet ist, um sich von einem ersten Zustand in einen zweiten Zustand in Abhängigkeit davon zu verändern, ob das Betätigungselement (50) mit dem Schutzschalter (30) in Eingriff oder außer Eingriff gebracht wurde oder nicht.

3. Schutzschalteranordnung (30) nach Anspruch 2, bei der der erste Zustand der ist, wenn die Verriegelungsanordnung (38, 40, 42) das Betätigungselement (50) in Position relativ zum Schutzschalter (30) verriegelt hat, und der zweite Zustand der ist, wenn die Verriegelungsanordnung (38, 40, 42) das Betätigungselement (50) in Position relativ zum Schutzschalter (30) nicht verriegelt hat.

4. Schutzschalteranordnung (30) nach einem der vorhergehenden Ansprüche, bei der die Veränderung des Zustandes des Schutzschalters (30) vom ersten Zustand in den zweiten Zustand durch die Veränderung des Zustandes der Konfiguration (32, 34) vom ersten Zustand in den zweiten Zustand hervorgerufen wird.

5. Schutzschalteranordnung (30) nach einem der vorhergehenden Ansprüche, bei der die Konfiguration, die ausgebildet ist, um sich von einem ersten Zustand in einen zweiten Zustand in Abhängigkeit davon zu verändern, ob das Betätigungselement (50) mit dem Schutzschalter (30) in Eingriff gebracht wurde oder nicht, Kontakte aufweist.

6. Schutzschalteranordnung (30) nach Anspruch 5, bei der der erste Zustand der ist, wenn sich die Kontakte in einer offenen Konfiguration befinden, und der zweite Zustand der ist, wenn sich die Kontakte in einer geschlossenen Konfiguration befinden.

7. Schutzschalteranordnung (30) nach einem der Ansprüche 1 bis 6, bei der die Konfiguration, die ausgebildet ist, um sich von einem ersten Zustand in einen zweiten Zustand in Abhängigkeit davon zu verändern, ob das Betätigungselement mit dem Schutzschalter (30) in Eingriff gebracht wurde oder nicht, einen beweglichen Stößel (34) oder eine Nockenanordnung (32) aufweist.

8. Schutzschalteranordnung (30) nach Anspruch 7, bei

der der zweite Zustand der ist, wenn sich die Nockenanordnung (32) oder der bewegliche Stößel (34) um ein Maß bewegt hat, das anzeigt, dass das Betätigungselement (50) vom Schutzschalter (30) außer Eingriff gebracht wurde, und die erste Konfiguration die ist, wenn sich die Nockenanordnung (32) oder der bewegliche Stößel (34) um ein Maß bewegt hat, das nicht anzeigt, dass das Betätigungselement (50) vom Schutzschalter (30) außer Eingriff gebracht wurde.

9. Schutzschalteranordnung (30) nach einem der vorhergehenden Ansprüche, bei der die Kommunikationsanordnung (46) ausgebildet ist, um Informationen in einer drahtlosen Weise zu übermitteln.

10. Schutzschalteranordnung (30) nach einem der vorhergehenden Ansprüche, bei der die Kommunikationsanordnung (46) ausgebildet ist, um Informationen in einer verdrahteten Weise zu übermitteln.

Revendications

1. Agencement formant interrupteur de sécurité (30) permettant d'affecter le statut de fonctionnement d'un équipement auquel l'interrupteur de sécurité (30) est raccordé au moins indirectement, l'interrupteur de sécurité (30) comprenant :

une configuration (32, 34) agencée pour passer d'un premier état à un second état en fonction du fait qu'un actionneur (50) a été ou non mis en prise ou mis hors de prise par rapport à l'interrupteur de sécurité (30) ;
un agencement de communication (46) agencé pour émettre des informations indicatrices d'un statut de l'interrupteur de sécurité (30) vers une unité de traitement (16), l'agencement de communication (46) étant agencé pour émettre les informations indicatrices d'un statut de l'interrupteur de sécurité (30) seulement lorsque le statut de l'interrupteur (30) passe d'un premier état à un second état et/ou du second état au premier état, **caractérisé en ce qu'**il comprend en outre
un agencement de verrouillage (38, 40, 42) ;
l'agencement de verrouillage (38, 40, 42) étant configuré pour verrouiller de manière directe ou indirecte l'actionneur (50) en position par rapport à l'agencement formant interrupteur de sécurité (30) ;
l'agencement formant interrupteur de sécurité (30) étant configuré de telle sorte que, une fois que l'actionneur est verrouillé en position par l'agencement de verrouillage (38, 40, 42), l'actionneur (50) est verrouillé en position jusqu'à ce que l'agencement de communication (46) reçoive de l'unité de traitement (16) un signal prédéterminé qui est au moins indicateur d'une permission de déverrouiller l'actionneur (50).

2. Agencement formant interrupteur de sécurité (30) selon la revendication 1, dans lequel l'agencement de verrouillage (38, 40, 42) représente la configuration qui est agencée pour passer d'un premier état à un second état en fonction du fait que l'actionneur (50) a été ou non mis en prise ou mis hors de prise par rapport à l'interrupteur de sécurité (30).

3. Agencement formant interrupteur de sécurité (30) selon la revendication 2, dans lequel le premier état correspond à celui dans lequel l'agencement de verrouillage (38, 40, 42) a verrouillé l'actionneur (50) en position par rapport à l'interrupteur de sécurité (30), et le second état correspond à celui dans lequel l'agencement de verrouillage (38, 40, 42) n'a pas verrouillé l'actionneur (50) en position par rapport à l'interrupteur de sécurité (30).

4. Agencement formant interrupteur de sécurité (30) selon l'une quelconque des revendications précédentes, dans lequel le changement de statut de l'interrupteur de sécurité (30) du premier statut vers le second statut est provoqué par le changement de l'état de la configuration (32, 34) du premier état au second état.

5. Agencement formant interrupteur de sécurité (30) selon l'une quelconque des revendications précédentes, dans lequel la configuration, qui est agencée pour passer d'un premier état à un second état en fonction du fait que l'actionneur (50) a été ou non mis en prise ou mis hors de prise par rapport à l'interrupteur de sécurité (30), comprend des contacts.

6. Agencement formant interrupteur de sécurité (30) selon la revendication 5, dans lequel le premier état correspond à celui dans lequel les contacts sont dans une configuration ouverte, et le second état correspond à celui dans lequel les contacts sont dans une configuration fermée.

7. Agencement formant interrupteur de sécurité (30) selon l'une quelconque des revendications 1 à 6, dans lequel la configuration, qui est agencée pour passer d'un premier état à un second état en fonction du fait que l'actionneur a été ou non mis en prise ou mis hors de prise par rapport à l'interrupteur de sécurité (30), comprend un piston mobile (34) ou un agencement formant came (32).

8. Agencement formant interrupteur de sécurité (30) selon la revendication 7, dans lequel le second état correspond à celui dans lequel l'agencement formant came (32) ou le piston mobile (34) s'est déplacé

d'une valeur indiquant que l'actionneur (50) est hors de prise par rapport à l'interrupteur de sécurité (30), et la première configuration correspond à celle dans laquelle l'agencement formant came (32) ou le piston mobile (34) s'est déplacé d'une valeur qui n'indique pas que l'actionneur (50) est hors de prise par rapport à l'interrupteur de sécurité (30).

9. Agencement formant interrupteur de sécurité (30) selon l'une quelconque des revendications précédentes, dans lequel l'agencement de communication (46) est configuré pour émettre des informations de manière non filaire.

10. Agencement formant interrupteur de sécurité (30) selon l'une quelconque des revendications précédentes, dans lequel l'agencement de communication (46) est configuré pour émettre des informations de manière filaire.

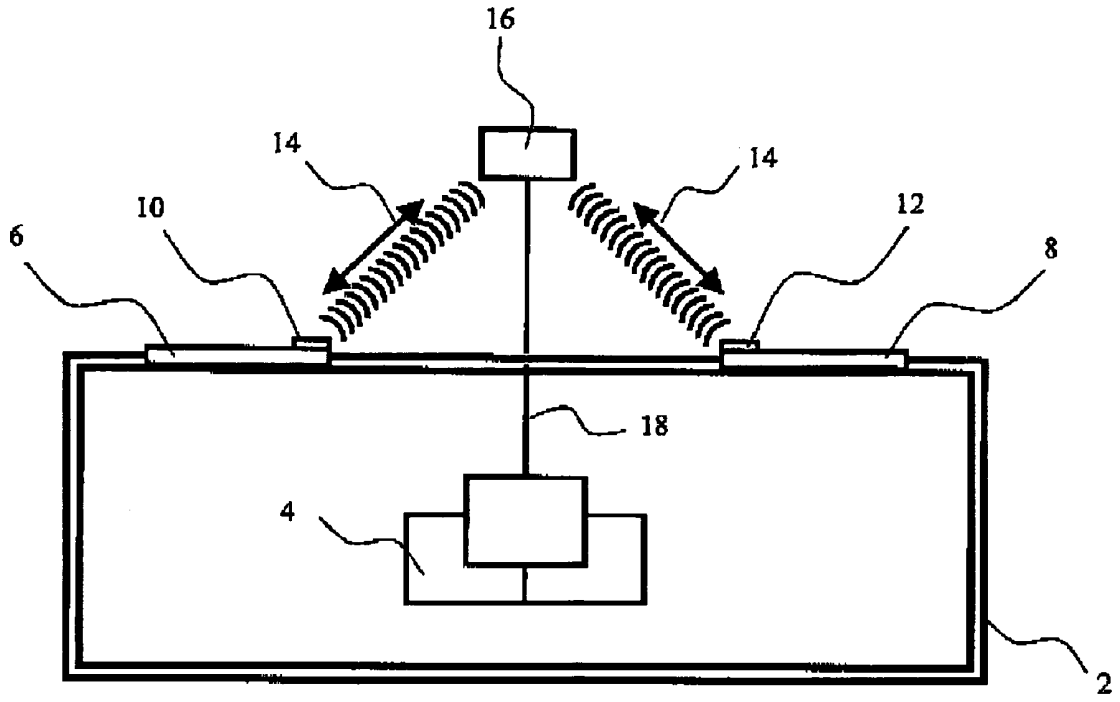


FIG. 1a

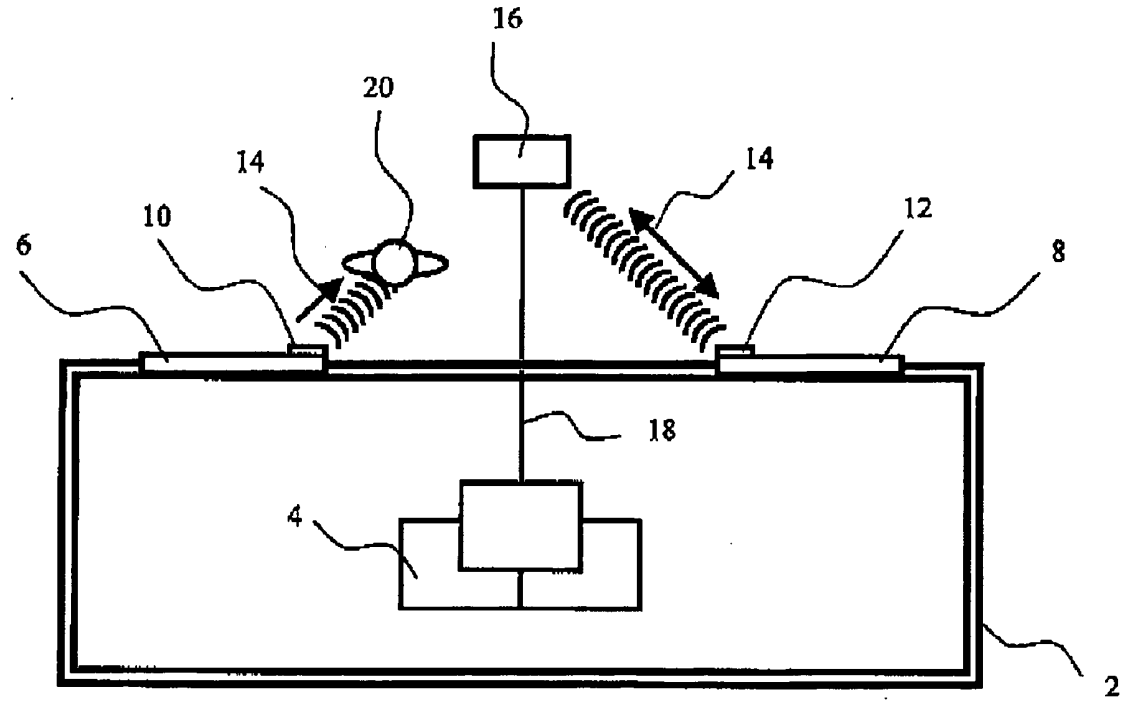


FIG. 1b

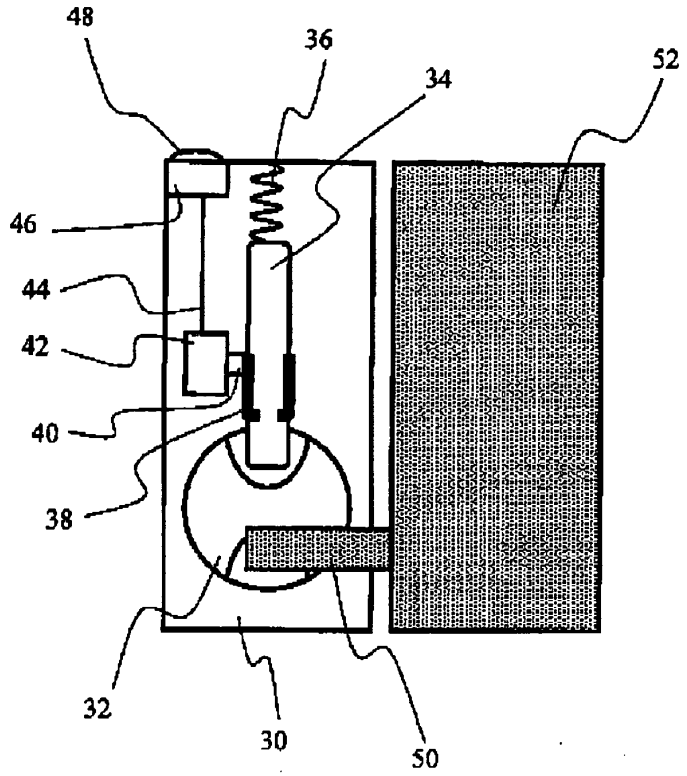


FIG. 2a

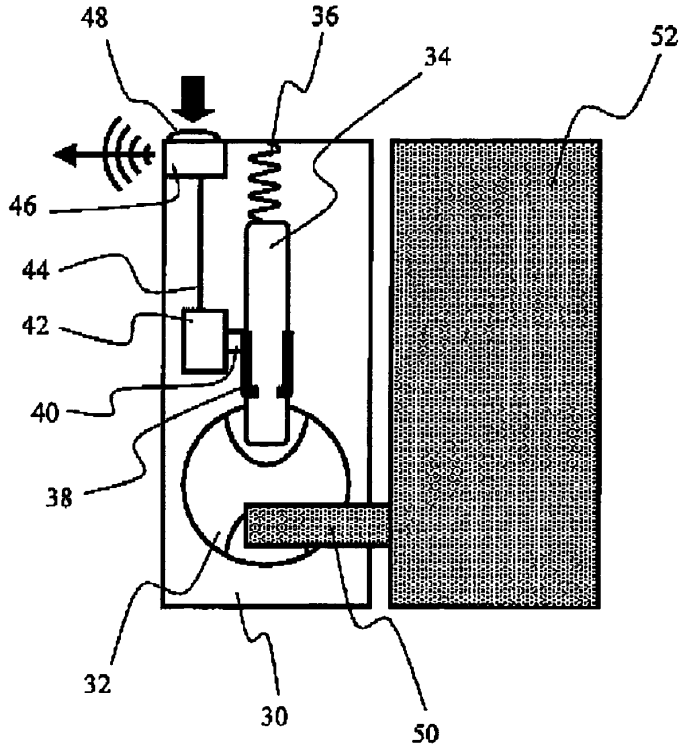


FIG. 2b

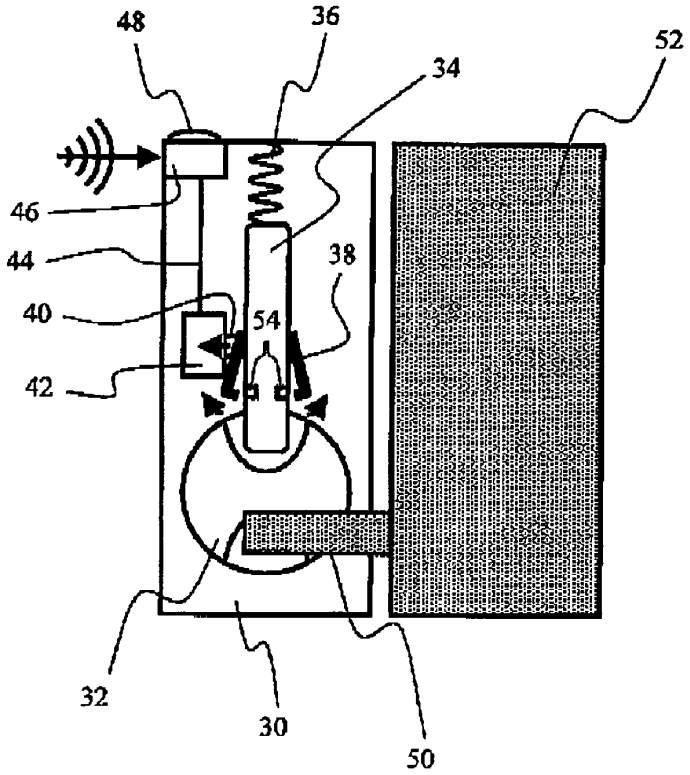

48
36
34
52
46
44
38
40
54
42
32
30
50

FIG. 2c

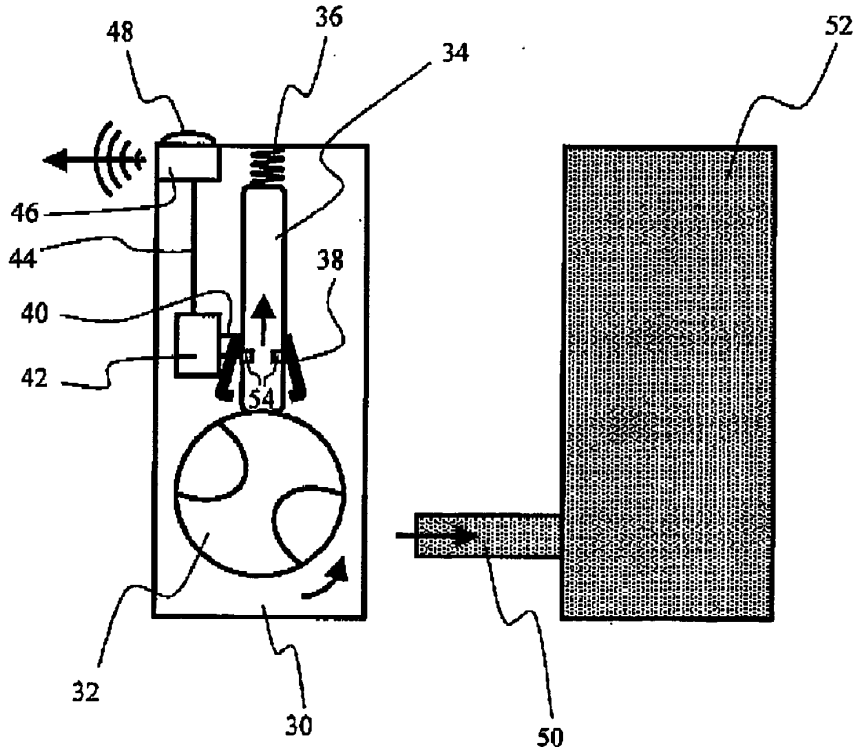

48
36
34
52
46
44
38
40
42
54
32
30
50

FIG. 2d

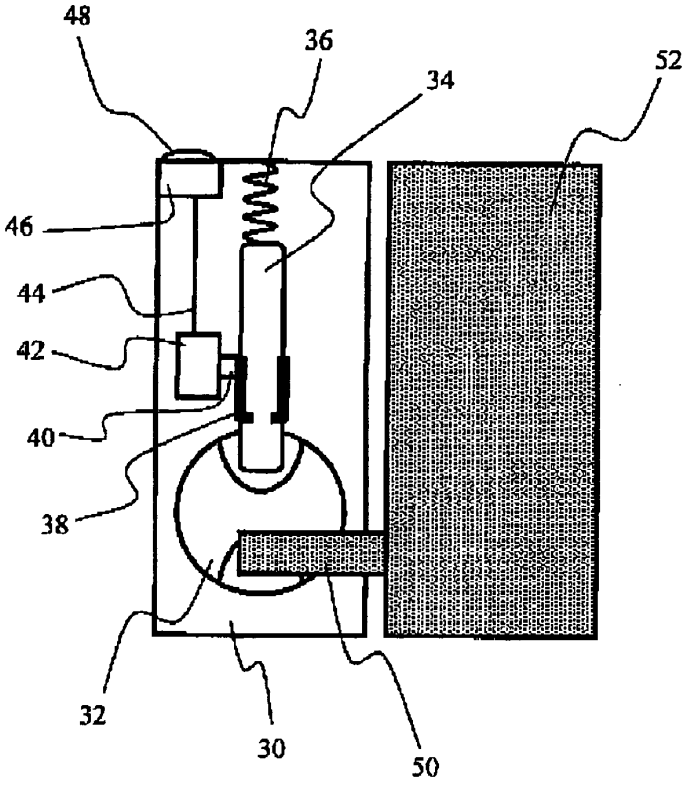


FIG. 2e

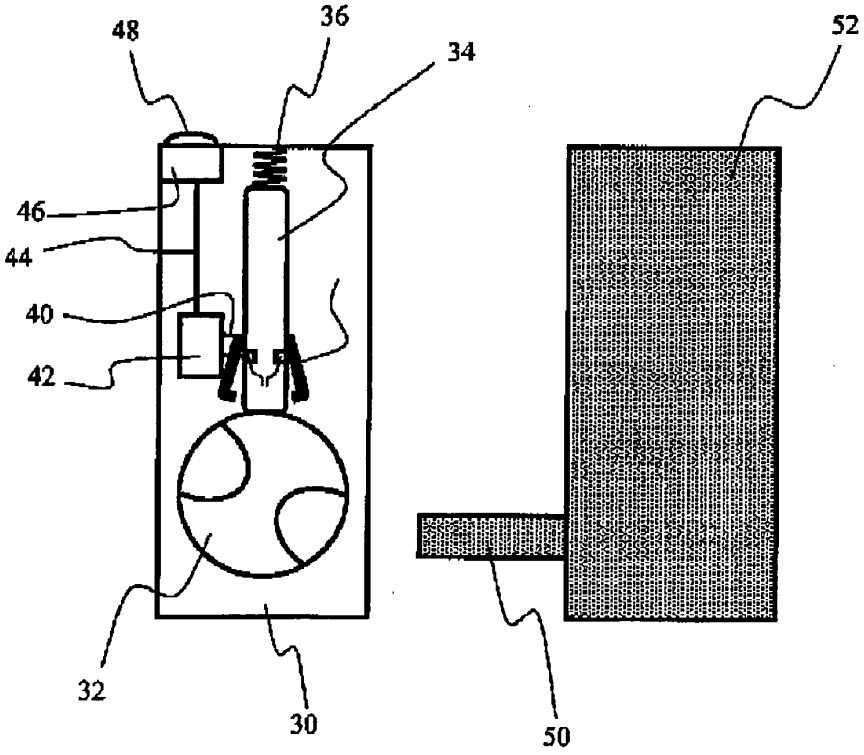


FIG. 2f

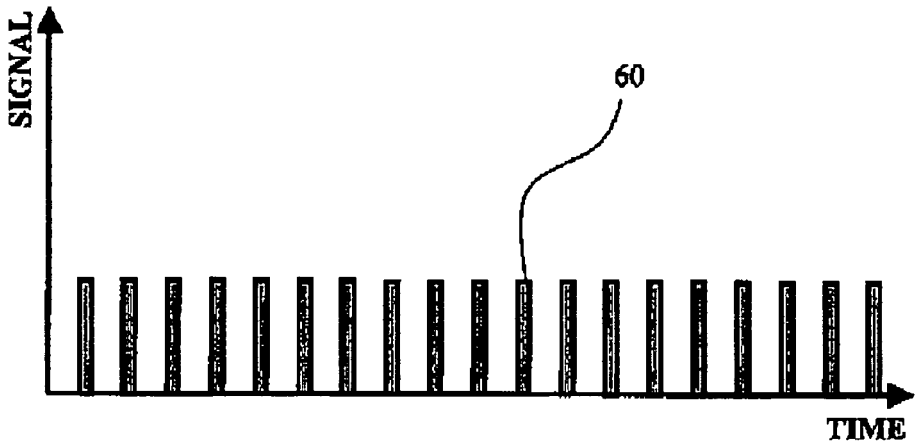


FIG. 3a

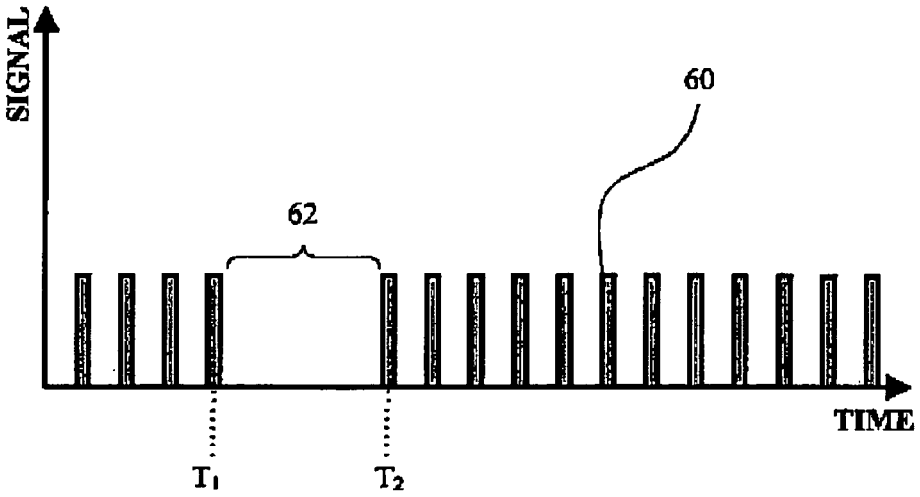


FIG. 3b

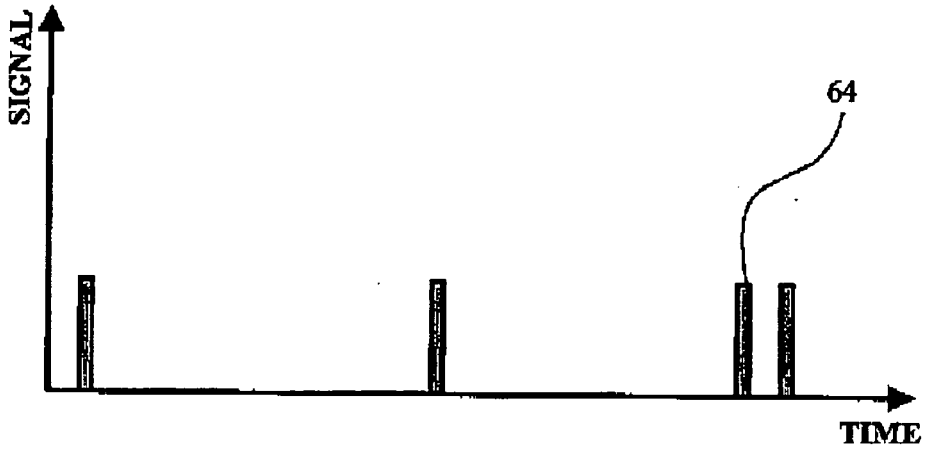


FIG. 4a

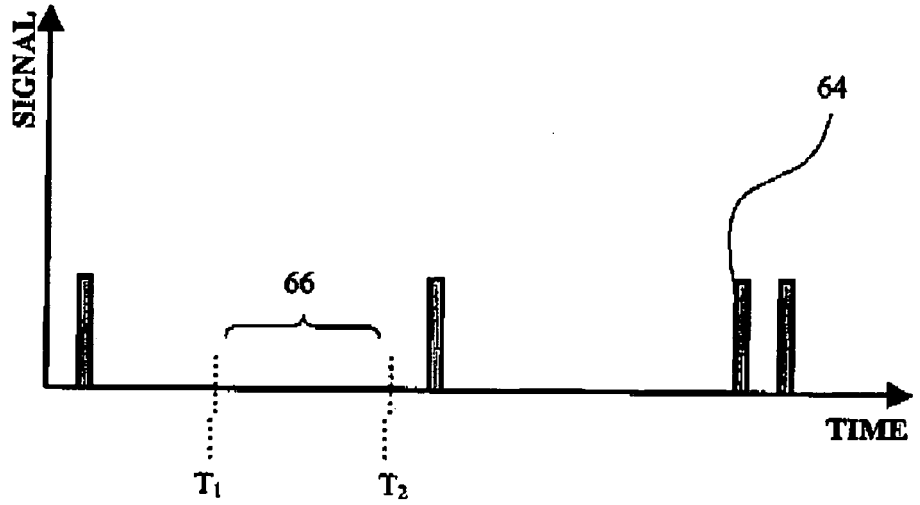


FIG. 4b

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 102004038488 A **[0003]**