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(71) Applicant: **Centro Sicurezza e Qualita di Mammarella Monica Spoltore (IT)**

(72) Inventors:
• **Pompa, Sabatino**
65010 SPOLTRE (IT)
• **Giangiaco, Mario**
66023 FRANCAVILLA AL MARE (IT)
• **Fagioli, Gabriele**
66013 CHIETI SCALO (IT)

(74) Representative: **Jorio, Paolo et al Studio Torta S.r.l.**
Via Viotti 9
10121 Torino (IT)

(54) **POSITION AND OPERATION SIGNALLING APPARATUS FOR FIRE EXTINGUISHERS AND FIRE EXTINGUISHING SYSTEM COMPRISING SUCH AN APPARATUS**

(57) A positioning signalling apparatus (3;3') for fire extinguishers (2) provided with an optical device (16), e.g. a LASER, and an electronic circuit (15,23,24) for powering and controlling the optical device (16). The optical device (16) is configured so as to be placed on a fire extinguisher (2) in the form integrated therewith and so as to generate a focused light beam adapted to produce a luminous image (9) at a distance from the apparatus (3;3'), in order to promote the immediate identification of the fire extinguisher in case of fire.
The apparatus (3;3') is further characterized by comprising wireless communication means to other apparatuses (3;3') in a network of fire extinguishers and to a central monitoring station.

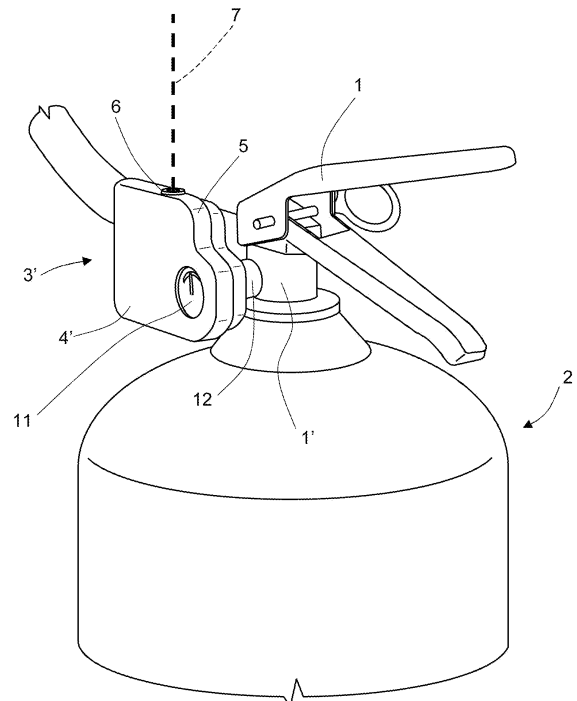


Fig.2

Description

[0001] The present invention relates to a position and operation signalling apparatus for fire extinguishers and to a fire extinguishing system comprising such an apparatus, and more in particular to a position signalling apparatus for fire extinguishers for facilitating the detection of fire extinguisher position in case of fire, and to a fire extinguishing system comprising a wireless communication network between fire extinguishers belonging to the fire extinguishing system itself.

[0002] As known, electric system protections are activated in case of fire, which provide for interrupting the supply of electricity and activating an emergency lighting system. The emergency lighting system has a lower intensity than the normal lighting system; therefore, the visibility is highly reduced. Furthermore, the presence of smoke generated by the fire further worsens visibility in the involved rooms. Under these conditions, it is often very difficult to easily identify where the fire extinguishers are located and reach the closest one. The presence of an extinguisher is currently signalled by means of specific signs affixed on the wall close to the fire extinguisher itself. It is apparent that poor ambient lighting and the concurrent presence of smoke make these signs completely inadequate to be easily identified in order to consequently identify the fire extinguisher.

[0003] It is the object of the present invention to provide a position and operation signalling apparatus for fire extinguishers and a fire extinguishing system comprising such an apparatus which solves the problems of the prior art.

[0004] According to the present invention, a position and operation signalling apparatus for fire extinguishers and a fire extinguishing system comprising such an apparatus are provided as defined in claims 1 and 17.

[0005] For a better understanding of the present invention, preferred embodiments will now be described by way of non-limitative example, only with reference to the accompanying drawings, in which:

- figure 1 shows the outer casing of a position signalling apparatus for fire extinguishers placed on the handle of a fire extinguisher, according to an embodiment of the present invention;
- figure 2 shows the outer casing of a position signalling apparatus for fire extinguishers placed on the base of the handle of a fire extinguisher, according to a further embodiment of the present invention;
- figure 3 shows a fire extinguisher provided with the position signalling apparatus in figure 1 or figure 2 and arranged in a room;
- figure 4 shows an electronic circuit for powering, controlling and commanding the position signalling apparatus for fire extinguishers according to an embodiment of the present invention;
- figure 5 shows another embodiment of the electronic circuit for powering, controlling and commanding the

- position signalling apparatus for fire extinguishers;
- figure 6 shows a pressure detector for fire extinguishers adapted to be used in the circuit in figure 5;
- figure 7 shows a further embodiment of the electronic circuit for powering, controlling and commanding the position signalling apparatus for fire extinguishers;
- figure 8 shows a wireless network of a fire extinguishing system comprising a plurality of position signalling apparatuses of respective fire extinguishers according to the present invention;
- figure 9 shows a coordination device adapted to be interfaced with the position signalling apparatuses belonging to the wireless network in figure 8 and with an operator and/or a control room external to the wireless network; and
- figure 10 shows a maintenance device adapted to be interfaced with the position signalling apparatuses belonging to the wireless network in figure 8 to carry out maintenance operations on the position signalling apparatuses.

[0006] Figure 1 shows a fire extinguisher 2 comprising a handle 1 provided with a signalling apparatus 3 (here seen from the outside) according to an embodiment of the present invention.

[0007] According to such an embodiment, the signalling apparatus 3 comprises a casing 4, made for example of soft plastic material and shaped so as to adapt to the lower handle of the fire extinguisher 2 and be integral therewith. Appropriate fastening means (not shown) may be provided to promote the coupling thereof. Thereby, the grip of the fire extinguisher 2 by a user is not compromised by the presence of the signalling apparatus 3.

[0008] Figure 2 shows a fire extinguisher 2 provided with a signalling apparatus 3' (seen from the outside) according to a further embodiment of the present invention. The signalling apparatus 3' comprises a casing 4', e.g. made of either hard or soft plastic material and provided with fastening means 12 adapted to couple the signalling apparatus 3', by means of the casing 4', to the base 1' of the handle 1 of the fire extinguisher 2. For example, the casing 4' may be integral with a pressure gauge 11 with which all fire extinguishers are provided. Thereby, the fastening means of the casing 4' correspond to the fastening means of the pressure gauge 11 to the fire extinguisher 2. Alternatively, instead of being integral with the pressure gauge 11, the casing 4' may be fixed to the fire extinguisher 2 by means of the same screw for fastening the pressure gauge 11 to the fire extinguisher 2. Or again, the casing 4' may be fixed to the base 1' of the handle 1 by means of an adjustable circular-section ring.

[0009] As known, the pressure tightness between pressure gauge 11 and fire extinguisher 2 is ensured by an o-ring, mounted on the seat of the pressure gauge 11 and which is engaged in the valve (not shown) of the fire extinguisher 2. In order to prevent the sealing capacity of the o-ring from altering upon fastening the signalling

apparatus 3' to the pressure gauge 11, an accessory ring which is fastened by means of a screw nut onto the collar of the valve where the pressure gauge 11 is screwed may be used.

[0010] The following operations may be performed, for example, for mounting the signalling apparatus 3: removing the pressure gauge 11; inserting the nut in the collar of the valve; screwing the pressure gauge 11; coupling the signalling apparatus 3' to the pressure gauge 11 or to the base 1' of the handle 1 of the fire extinguisher 2.

[0011] In both embodiments in figures 1 and 2, the grip of the fire extinguisher 2 by a user is not compromised by the presence of the signalling apparatus 3 or 3'.

[0012] Regardless of the embodiment and coupling of the signalling apparatus 3, 3' to the fire extinguisher 2, the casing 4, 4' has a housing 5, for accommodating one or more batteries (not shown) inside the casing 4, 4' itself, and an opening 6 for emitting a light beam 7 towards the outside of the casing 4, 4'. Such a light beam 7 may be generated by a focused LED or LASER device, as described in greater detail below with reference to figures 4 and 5.

[0013] With combined reference to figures 1-3, the light beam 7 is advantageously projected towards a ceiling 8 of a room 10 in which the fire extinguisher 2 is placed, and forms a luminous image 9 on the ceiling 8. The luminous image 9 may be of various shapes and sizes, e.g. it may be a luminous spot or circle or it may form a letter "E" standing for the word "Extinguisher". Thereby, a user 11 looking for the fire extinguisher 2 in an assumed poorly lit room 10 (with emergency lighting) and/or with the presence of smoke is facilitated in searching the fire extinguisher 2 itself because the luminous image 9 may be located with a gaze from various angles. Indeed, in an environment full of smoke, a simple lamp would be poorly visible due to the scattering of light rays by the suspended particles, while the visibility of a beam generated by focused LED or LASER is, on the contrary, increased precisely because of such a scattering phenomenon. Furthermore, the light beam 7 being projected at a distance from the fire extinguisher 2, possible obstacles present close to the fire extinguisher 2, which could obstruct the sight of an operator looking for the fire extinguisher 2, are not a significant hindrance to the visual location of the fire extinguisher itself 2.

[0014] Figure 4 schematically shows an electronic power, control and command circuit 15 of a LASER device 16 configured to generate the light beam 7. In an first embodiment thereof, the electronic circuit 15 comprises a battery 20, e.g. adapted to generate a 3V voltage, a microprocessor circuit 21 and a pilot switch 22, e.g. a MOSFET device serving the function of switch. The battery 20 supplies the power needed for their operation to the microprocessor circuit 21 and to the LASER device 16. A small-size, rechargeable lithium battery adapted to be placed inside the housing 5 (shown in figure 1 or 2) is advantageously used.

[0015] The LASER device 16 is controlled by the elec-

tronic circuit 15, in order to generate a pulse on timing (intermittent on/off operation of the LASER device 16). The microprocessor circuit 21 alternatively controls the pilot switch 22, which in turn controls the LASER device 16 on/off, to either conduct or cut-off stages.

[0016] The pulse on timing serves a three-fold function. Firstly, it allows to minimize current consumption and to preserve the energy of the battery 20; then, it promotes the visual perception of the luminous image 9 by the human eye which, as known, is particularly sensitive to image variations more than to a fixed image; and finally it reduces up to eliminating the problem of danger of possible accidental pointing of the light beam 7 towards the human eye.

[0017] For example, an on/off timing of the LASER device 16, with 10 ms in on-state and 900 ms in off-state, is used; these values ensure an optimal persistence time for the human eye, and the frequency may be further automatically varied according to the operating conditions of the fire extinguisher 2. For example, an excessively low value of the inner pressure of the fire extinguisher 2 may be signalled by varying the on/off timing of the LASER device 16, i.e. by controlling it for 10 ms in on-state and 300 ms in off-state.

[0018] In order to maximize the energy saving, the voltage supplied by the battery 20 to the LASER device 16 is modulated by means of PWM (Pulse Width Modulation) for allowing to minimize the energy dissipation while maintaining a maximum illumination during the whole discharge time of the battery 20.

[0019] The PWM modulation of input current to the laser device 16 may be managed by the microcontroller circuit 21.

[0020] The advantage of using PWM modulation is first the drastic reduction of power dissipated by the electronic circuitry, because the electronic power devices of known type (MOSFET, IGBT, etc.) minimize the energy dissipation when they work under two conditions of saturation or interdiction only.

[0021] Figure 5 shows an electronic circuit 23 according to a further embodiment. Like that shown in figure 4, the electronic circuit 23 in figure 5 comprises a battery 20, a microprocessor circuit 21 and a pilot switch 22, but differs from the electronic circuit 15 in figure 4 for the additional presence of an energy converter 19, adapted to convert the light energy possibly present in the environment (e.g. the room 10, figure 3) into electricity to charge the battery 20 and/or to directly power the microprocessor circuit 21; a sensor/indicator block 26 connected to the microprocessor circuit 21, comprising at least one pressure sensor 27 used for acquiring a pressure value inside the fire extinguisher 2; a sound generator 30 connected to the microprocessor circuit 21, e.g. a piezoelectric buzzer, for generating an alarm sound signal; and a communication interface 31 (e.g. a radio type interface), powered by the battery 20 and connected to the microprocessor circuit 21, for transmitting fire alarm signals or operating fault signals of the fire extinguisher 2

to a control room and/or to a maintenance operator (not shown) remotely located with respect to the fire extinguisher 2 itself. The control room and/or operator may be indifferently located either close to the room 10 or far from the room 10 itself, e.g. in another building, to monitor all the possible alarms or operating faults of all the fire extinguishers (provided with the signalling apparatus 3, comprising the electronic circuit 23 provided with a communication interface 31) present in a residential dwelling or workplace.

[0022] The sensor block 26 may further comprise other sensor types, such as, for example, a light sensor 28, used for measuring luminosity in the room 10 and/or a temperature sensor 29 and/or an accelerometer 32 or even other sensors.

[0023] The accelerometer 32 is preferably of the triaxial type and is adapted to detect unauthorized movements of the fire extinguisher 2 (e.g. theft) and to send an unauthorized movement signal to the microprocessor 21, which in turn controls the communication interface 31 to send an unauthorized movement signal of the fire extinguisher 2 to a control room and/or an operator.

[0024] The pressure sensor 27 may be advantageously either connected to the original pressure gauge with which all powder fire extinguishers are provided, e.g. as an extension or fitting of the original pressure gauge, or may be connected to a pressure indicator mounted instead of the original pressure gauge (e.g. of the type shown in figure 6 and described with reference to such a figure).

[0025] The microprocessor circuit 21 periodically diagnoses the fire extinguisher 2 by acquiring the pressure value inside the reservoir of the fire extinguisher 2 from the pressure sensor 27. If the pressure in the reservoir drops below a minimum threshold value expected for a correct operation, the microprocessor circuit 21 controls the sound generator 30 in order to generate faulty operation sound signals of the fire extinguisher 2 which may be heard by people in transit or residing close to the fire extinguisher 2 itself. These signals are generated with the purpose of attracting attention and prompting people in transit to inform the operators in charge of fire extinguishing system maintenance to restore the correct operation of the fire extinguisher 2. Alternatively or additionally to the sound signalling, in case of anomalous pressure in the reservoir of the fire extinguisher 2, the microprocessor circuit 21 further controls the communication interface 31 in order to transmit operating fault signals of the fire extinguisher 2 to a control room and/or to an operator in charge of maintenance.

[0026] A pressure indicator 39 adapted for the illustrated purposes, installable instead of or by the side of the original pressure gauge of the fire extinguisher 2, is schematically shown in figure 6. The pressure indicator 39 comprises a pressure indicator needle 40 including in turn a magnetic element 41. The magnetic element 41, e.g. made of neodymium, may be integrated in the pressure indicator needle 40, or applied to the pressure indi-

cator needle 40 by means of appropriate fastening means (e.g. glued or screwed) or alternatively the whole pressure indicator needle 40 may be made of magnetic material and thus it may be the magnetic element 41 itself. The pressure indicator 39 further comprises a reed bulb 42, of known type. The reed bulb 42 comprises first and second ferromagnetic foils 42' and 42'', generally made of iron and nickel tightly sealed in a glass casing. The ferromagnetic foils 42', 42'', electrically polarized in a convenient manner, overlap apart from one another inside the casing and, under rest conditions, are not conducting because they are separated by a small gap. However, when subjected to an appropriate magnetic field (in the example shown, generated by the magnetic element 41), the first and second foils 42' and 42'' come in direct contact with each other and an electric signal crosses the terminals (not shown) of the reed bulb 42. The reed bulb 42 is inserted into the pressure indicator 39 and spatially arranged in correspondence of at least one anomalous operating zone 43', 43'', indicating an anomalous operation of the fire extinguisher 2 (excessively high or excessively low pressure), in all cases beyond a correct operating zone 44 indicating a correct operation of the fire extinguisher 2.

[0027] When the pressure indicator needle 40 comprising the magnetic element 41 is outside the correct operating zone 44, the reed bulb 42 is activated thus causing the direct contact of the first foil 42' with the second foil 42''. The state of the reed bulb 42 (open contact or closed contact) may be monitored either constantly or at regular intervals by the microprocessor 21 which, if the reed bulb 42 is active and conducting, may signal the event by means of an anomalous operating sound signalling (by means of the sound generator 30) or by sending a message to the control room or to an operator (by means of the communication interface 31).

[0028] It is apparent that two reed bulbs may be inserted (in a manner not shown in the figure) into the pressure sensor 39, one at the anomalous operating zone 43', indicating an excessively low pressure, and one at the anomalous operating zone 43'', indicating an excessively high pressure, on the left and on the right of the correct operating zone 44.

[0029] Alternatively to the use of a reed bulb 42 of the described type, a reed bulb may be used in which the first foil 42' and the second foil 42'' are in electric contact with each other under the normal operating condition of the fire extinguisher 2, and the activation of a malfunction state or alarm (i.e. when the magnetic element 41 is beyond the correct operating zone 44) is subjected to the detachment between the first foil 42' and the second foil 42'', caused by an appropriate magnetic field.

[0030] Furthermore, in order to be certain that the reed bulb 42 of the pressure indicator 39 correctly works, a capacitor (not shown) 39 may be inserted into the pressure indicator 39, connected in parallel to the reed bulb 42, having a low capacity value (e.g. 100 pF), so as not to compromise the normal operation of the pressure in-

indicator 39. Such a capacitor may be used during the step of diagnosing, thus allowing to check the correct connection of the parts. For this purpose, the microprocessor 21 checks the correct operation by sending a short voltage step and then analyzing the received reply. If the line returns to the rest state with a delay longer than a predetermined interval (e.g. $\geq 1 \mu\text{s}$), it means that the connection is correct, otherwise if the connection returns to the rest state in a shorter time than the aforementioned threshold, the connection is interrupted (the reed bulb 42 is not correctly working). Also in this case, the microprocessor 21 may signal the event by means of an anomalous operation sound signalling or by sending an appropriate message to the control room or to an operator. During the step of installing, diagnosing the contact will help the installer to understand if the mounting correctly occurred. Subsequently, it is used to confidently known that no faults or possible tampering have occurred.

[0031] Alternatively to a reed bulb 42, a pressure indicator 39 may be made, in which the activation of a malfunction event or alarm is generated by a direct mechanical contact between the pressure indicator needle 40 and an abutting element (not shown). The mechanical contact may, for example, cause the activation of an appropriate signal or, if the pressure indicator needle 40 and the abutting element are made of conducting material and appropriately polarized, may enable a flow of electric current between the abutting element and the pressure indicator needle 40. Such a current may be monitored either constantly or at regular intervals by the microprocessor 21 which, if active and conducting, may indicate the event by means of an anomalous operating sound signalling (by means of the sound generator 30) or by sending a message to the control room or to an operator (by means of the communication interface 31).

[0032] The pressure sensor 27 and the pressure indicator 39 may be prepared by the supplier/assembler of the fire extinguisher 2 during the assembly (for new fire extinguishers) or during the step of overhauling (for fire extinguishers already on the market).

[0033] Figure 7 shows an electronic circuit 24 similar to the electronic circuit 23 in figure 5. Elements in common of the electronic circuit 24 and the electronic circuit 23 will not be described in further detail.

[0034] In addition to the elements in common to the electronic circuit 23, the electronic circuit 24 comprises a memory 25, connected to the microprocessor circuit 21 and adapted to store information which allow to univocally identify the fire extinguisher 2 to which the electronic circuit 24 is mounted. By way of example, these information may be limited to a registration number of the fire extinguisher; or may further comprise one or more of: the safety system owner's name, the address, the city, the building floor, the number or name of the room where the fire extinguisher 2 is located.

[0035] These information may be communicated to the control room and/or to the operator in charge of maintenance in case of incorrect operation alarm of a fire extin-

guisher 2. The communication interface 31 may communicate with the control room and/or or with the operator by means of a wireless or wired LAN network or by means of the cellular network (e.g. GSM, GPRS, UMTS, etc.), or other.

[0036] Because each fire extinguisher 2 is equipped with its own signalling apparatus 3 or 3', comprising the electronic circuit 24 in turn including a communication interface 31, a wireless network may be made, e.g. of the mesh type, between a plurality of fire extinguishers 2 present in a given place, e.g. in a same plant or office or other.

[0037] Figure 8 shows a fire extinguishing system 50 comprising a plurality of fire extinguishers 2, each comprising in turn a signalling apparatus 3, 3' including the electronic circuit 24 of the type shown in figure 5. General reference to a fire extinguisher 2 will be made hereinafter in the description, understanding that this comprises a respective signalling apparatus 3, 3'.

[0038] The fire extinguishing system 50 further comprises at least one coordinator device 51, configured to be interfaced with one or more signalling apparatuses 3, 3' of respective fire extinguishers 2, for reading and writing data. The coordinator device 51 is interfaced with a public network 52 (of known type, e.g. GSM, UMTS, WIMAX, or wired network, or the Internet, or other) outside the fire extinguishing system 50, for sending information related to one or more fire extinguishers 2, belonging to the fire extinguishing system 50, to a mobile device 53 of an operator in charge of maintenance or to a control room (described in greater detail below).

[0039] Figure 9 schematically shows a coordinator device 51 useable in the fire extinguishing system 50 in figure 8. The coordinator device 51 comprises a video 55, a microcontroller 56, a modem 57 (e.g. a GSM modem), a wireless transceiver 58, a memory 59, a housing for a SIM card 60, a GPS receiver 62 and a battery 61.

[0040] Some of the main activities of the coordinator device 51 are: storing operating parameters of the fire extinguishing system 50; maintaining an occurred event history (alarm situations, malfunctions, maintenance); delivering a network synchronism signal to the fire extinguishers 2 belonging to the fire extinguishing system 50; receiving and storing information (e.g. alarm or malfunction signals) transmitted by the fire extinguishers 2; querying the fire extinguishers 2 to evaluate the operation; modifying and/or acquiring operating parameters of each fire extinguisher 2 of the fire extinguishing system 50 (e.g. acquiring and modifying the blinking frequency of the LASER device 16, acquiring and modifying the blinking intensity of the LASER device 16, activating/deactivating the sound generator 30, acquiring the temperature of a fire extinguisher 2, etc.); checking that all fire extinguishers 2 of the fire extinguishing system 50 are actually present; sending alarm or malfunction signals to a predetermined telephone number, e.g. belonging to an operator in charge of maintenance of the fire extinguishing system 50; sending alarm or malfunction signals to a con-

trol room outside the fire extinguishing system 50; and, if a high safety level is required, protect the signals send and/or received by means of encryption key.

[0041] More in detail, the video 55 is used to display a plurality of information, e.g. the operating state of coordinator device 51 and fire extinguishing system 50 (e.g. configuration parameters, possible alarm state of one or more fire extinguishers 2 belonging to the fire extinguishing system 50, charge level of the battery of the signalling apparatuses 3, 3' with which the fire extinguishers 2 belonging to the fire extinguishing system 50 are provided, charge level of the battery of the coordinator device 51 itself, maintenance state in progress, etc.). On radio level, two simultaneously active radio connections are present: a wireless connection managed by the wireless transceiver 58, adapted to communicate in transmission/reception with all the fire extinguishers 2 of the fire extinguishing system 50, e.g. using a 2.4GHz frequency connection and a wireless LAN protocol of known type; and a wireless connection managed by the modem 57, e.g. on mobile telephone network, to alert an operator in charge of safety/maintenance of the fire extinguishers 2 in real time. The modem 57 may advantageously send communications (e.g. an SMS text message) on GSM, UMTS or other telephony network (by using a SIM card accommodated in the SIM card housing 60) or an email message via the Internet.

[0042] The memory 59 may contain a plurality of information, e.g. the name of the owner of the fire extinguishing system, the address, the city and for each fire extinguisher 2 present in the fire extinguishing system 50, the registration number of the fire extinguisher 2 associated to data related to the location of the fire extinguisher 2 in the building (e.g. the building floor, the number or name of the room where the fire extinguisher 2 is located).

[0043] Information related to the place in which the coordinator device 51 is located may be stored in the memory 59 or may be acquired by the GPS signal receiver 62 and processed by an appropriate software (e.g. of the type used for GPS navigation) residing in the memory 59.

[0044] The power of the coordinator device 51 is supplied by the battery 61, of rechargeable type, which in turn may be powered/recharged by an external AC/DC power unit (not shown) connected to network voltage. If the network voltage is absent, service continuity is ensured for a few days by the battery 61.

[0045] The consumption of the battery in case of prolonged network voltage absence or the failure of the battery 61 may be signalled to the operator in charge of the maintenance of the fire extinguishing system 50 (e.g. by means of SMS text messages).

[0046] Again with reference to figure 8, the fire extinguishers 2 communicate to one another using the respective communication interfaces 31. Each fire extinguisher 2 communicates with one or more fire extinguishers 2 within radio range, thus in fact creating a cooperative-type wireless communication network (or mesh network). Furthermore, the fire extinguishers 2 within the

radio range from the coordinator device 51 communicate with the latter. When a fire extinguisher 2 is faulty (e.g. in case of excessively low or excessively high internal pressure), the faulty fire extinguisher 2 transmits an alarm message.

[0047] In order to deliver the alarm message to the operator and/or to the control room, the faulty fire extinguisher 2 will firstly send such an alarm message to the coordinator device 51, which forwards it to the operator's mobile device 53 and/or the control room through the public network 52. Before forwarding such an alarm message, the coordinator device generates a data packet adapted to be transmitted according to the communication protocol used by the public network 52 with which it is interfaced, in order to make it compatible therewith, and may add or remove information. For example, each fire extinguisher 2 may generate an alarm message containing its own registration number and the indication of the fault type (e.g. in the form of numeric code known by both the fire extinguisher 2 and the coordinator device 51). Prior to transmission, the coordinator device 51 may complete such an alarm message with information related to the place where the operator has to intervene.

[0048] If the faulty fire extinguisher 2 is not in direct radio connection with the coordinator device 51, each fire extinguisher 2 belonging to the fire extinguishing system 50 may act as a repeater for the fire extinguishers 2 within the radio range therefrom, so that the alarm message is delivered to the coordinator device 51.

[0049] The coordinator device 51 serves the function of synchronizing the circuits mounted to the fire extinguishers, e.g. by outputting a synchronization signal at established intervals so as to allow the resynchronization of the these circuits if these go out of synchronism, and to control the fire extinguishers 2 belonging to the fire extinguishing system 50, and furthermore it acts as an interface towards public networks 52 operating in the territory where the fire extinguishing system 50 is located.

[0050] If the public network 52 is a GSM network, when an alarm message is received by a fire extinguisher 2, the coordinator device 51 may forward such an alarm message as an SMS text message to an intended cellular telephone number. Furthermore, the coordinator device 51 may send the alarm message to a specific service centre where such an alarm message may be stored, processed and read.

[0051] The alarm message which is sent contains all the information for unequivocally identifying and locating the faulty fire extinguisher 2. By way of example, such an alarm message may contain: the registration number of the fire extinguisher, the fire extinguishing system owner's name, the address, the city, the building floor and the number or name of the room where the faulty fire extinguisher 2 is located.

[0052] The alerted operator who goes to the place where the faulty fire extinguisher is located may then restore the operation of the fire extinguisher 2.

[0053] During maintenance interventions, the operator

may have a maintenance device 70 of the type shown in figure 10.

[0054] The maintenance device 70 is of the portable type and comprises a video 71, an alphanumeric keyboard 72, a transceiver 73, a microcontroller 74, a rechargeable battery 75 and interface connectors 76.

[0055] The maintenance device 70 acts as an interface and is used by the operator to access the memory 25 of the fire extinguishers 2, and more in general all parameters of the circuits 15, 23 and 24. It may be used both during the steps of installing the fire extinguishing system 50 and later for updates and/or maintenance.

[0056] The network of the fire extinguishing system 50 may advantageously be accessed in a safe mode by entering the user name and password, defined by the operator when the fire extinguishing system 50 is installed, and then freely editable.

[0057] The maintenance device 70 is designed to communicate with each extinguisher 2 and with the coordinator device 51. In order to simplify the operation of the fire extinguishing system 50, the maintenance device 70 may use the same protocol and frequencies defined for the fire extinguishing system 50 (e.g. a Wireless LAN protocol), but system data editing may be enabled according to one or more safety conditions, e.g. it may only occur if the level of the received signal is higher than a predetermined threshold. Thereby, only the fire extinguisher 2 or the coordinator device 51 which is a few tens of centimetres away from the maintenance device 70 may have a signal strong enough to allow the communication activation. At the same time, the communication becomes robust because it can overcome possible strong intensity, interfering signals.

[0058] The alphanumeric keyboard 72 and the video 71 of the maintenance device 70 serve the function of entering data into the memory 25 of the electronic circuit 24 and/or into the memory 59 of the coordinator device 51, respectively, and of displaying the information contained in these memories 25, 59 or the parameters of the fire extinguishing system 50 (signal power, transmission frequency, etc.).

[0059] The interface connectors 76 may comprise, for example, a power connector and a USB connector. Both may be used for recharging the battery 75. The first is used for recharging the battery 75 from an external AC/DC power source connectable to the electric network, the second is used for connecting the maintenance device 70 to a computer for saving acquired maintenance data and/or for recharging the battery 75 through the USB port.

[0060] Furthermore, the USB connector may be used for connecting a reading device 80, outside the maintenance device 70, such as for example an RF tag reader, or a bar code reader. In this case, the memory 25 of the electronic circuit 24 present on the fire extinguishers 2 is an RF tag or a barcode, containing identifying information of the fire extinguisher 2 (e.g. the registration number of the fire extinguisher 2).

[0061] Alternatively, the reading device 80 may be integrated inside the maintenance device 70.

[0062] Furthermore, the maintenance device 70 may store the performed maintenance intervention history or only the maintenance interventions which have not yet been billed.

[0063] When billing, the data are taken from the maintenance device 70 and stored in a computer (not shown) to be appropriately printed.

[0064] Furthermore, by means of the maintenance device 70, the data present in the memory 25 of the electronic circuit 24 of each fire extinguisher 2 may be edited to store information related to the performed maintenance intervention (if the memory so allows and is of the rewritable type). Storing maintenance data in the memory 25 ensures traceability over time.

[0065] During the maintenance operations, the fire extinguisher 2 undergoing the maintenance informs the coordinator device 51 that maintenance is in progress. After maintenance, the fire extinguisher 2 informs the coordinator device 51 of the performed intervention type and its operativeness. In turn, the coordinator device 51 may store the type of intervention in its memory 59.

[0066] During maintenance, generally once every six months, the operator in charge of maintenance replaces the battery 20 of the electronic circuit 24, carries out possible maintenance operations and, by means of the maintenance device 70, records the type of maintenance carried out in the memory 25 of the fire extinguisher 2.

[0067] Replacing the battery 20 once every six months is sufficient to ensure the good operation of the signalling apparatus 3, 3', particularly if consumption is optimized by turning on/off both the LASER device 16 and the communication interface 31 at regular intervals (e.g. with on/off state timing of 100 to 1). For example, for each long interval 1s, the LASER device 16 lights up for 10ms. Similarly, the communication interface 31 is turned on and off. The reception and transmission intervals are modulated by periods of rest in which the circuits are set to minimum consumption. Thereby, the battery 20 (under optimal conditions) reaches a duration of about six months, i.e. equal to the maximum maintenance time which is contemplated by many laws regarding the maintenance of fire extinguishers.

[0068] The advantages of the present position signalling apparatus for fire extinguishers and fire extinguishing system comprising such an apparatus are the following.

[0069] The difficulty of finding the fire extinguisher from as soon as the initial alarm starts in obviously unexpected situations is considerably reduced. Indeed, concomitant events often negatively affect the timeliness of interventions, with a consequent increase of damages or even impossibility to extinguish the fire before it takes uncontrollable proportions.

[0070] Since the LASER 16 device which emits the light beam 7 is integral with the fire extinguisher 2, the identification of the fire extinguisher 2 itself is facilitated even if the fire extinguisher 2 is removed from its original

position indicated by means of the wall signs currently provided and used.

[0071] In all cases, under poor visibility conditions, the luminous image 9 is more visible than the signs on the wall, thus helping to save time during the minutes of first response to extinguish the fire. The generation of light beam 7 and luminous image 9 may be independent from the environmental conditions where the fire extinguisher is located or may be automatically activated when the ambient light drops below a predetermined threshold value (e.g. because it is dark, because the emergency lighting system has been activated and/or because of the presence of smoke), detected by means of the light sensor 28 (when present).

[0072] Furthermore, in the presence of smoke, the light beam 7, in addition to the luminous image 9, also becomes particularly well visible.

[0073] Again, the presence of sound generator 30 and pressure sensor 27 promotes the maintenance of the fire extinguisher 2 under optimal conditions of use, thus allowing to detect possible operating faults and to restore the optimal conditions of use in a timely manner.

[0074] Furthermore, because the signalling device 3, 3' is directly mounted to the fire extinguisher, in an integrated form with the latter, possible wires coupling or connecting it to a fixed resting station are absent, thus avoiding the risk of creating hindrance for a user of the fire extinguisher 2 and/or of forming sparks which, in a gas saturated environment, could cause an explosion.

[0075] Finally, the possibility of creating a wireless communication network between the fire extinguishers and with an external control room and/or an operator allows an immediate intervention by a maintenance operator who may restore the correct operation of the fire extinguisher which indicated the fault if even only one fire extinguisher signals a fault event.

[0076] It is apparent that changes and variants may be made to the position signalling apparatus for fire extinguishers and to the fire extinguishing system herein described and illustrated without therefore departing from the scope of protection of the present invention.

[0077] For example, several LASER devices 16 (or several LED devices) may be present. Furthermore, any other type of optical or optical-electronic device may be used.

[0078] The electronic circuit 15, 23, 24 may indifferently comprise all or only some of the energy converter 19, the sensor/indicator block 26, the sound generator 30 and the communication interface 31; similarly, the sensor block 26 may indifferently comprise only one or more of the pressure sensor 27, the light sensor 28, the temperature sensor 29 and the accelerometer 32.

[0079] Furthermore, the sound generator 30, when used to generate faulty operation sound signals of the fire extinguisher 2, may be installed by the side of an optical faulty operation indicator (e.g. a LED, not shown) to support the sound signalling with an optical signalling.

[0080] Furthermore, the sound alarm signal may also

be generated during the fire to further facilitate finding the fire extinguisher 2.

[0081] Moreover, the coordinator device 51 may be made in the form of an integrated board adapted to be interfaced with a computer (e.g. by means of a PCI slot, a USB interface or other). In this case, the coordinator device 51 is directly powered by the computer and the video 55 is the monitor of the computer itself.

[0082] Finally, each fire extinguisher 2, comprising a signalling apparatus 3, 3' including an electronic circuit 24 of the type shown in figure 7, and belonging to a fire extinguishing system 50 of the type shown and described with reference to figure 8, may store in the memory 25 a history of alarm events occurred in the fire extinguishing system 50. As all fire extinguishers 2 belonging to the fire extinguishing system 50 communicate with one another by means of the signalling apparatus 3, 3', possible alarm and/or malfunction messages related to a fire extinguisher 2 may be transmitted to all signalling apparatuses 3, 3' of the other fire extinguishers 2. Thereby, the alarm history may be retrieved for later analyses of the alarms and/or malfunctions which occurred, even in case of malfunction of the coordinator device 51 or of some signalling apparatuses 3, 3' of the fire extinguishers 2 belonging to the fire extinguishing system 50.

[0083] The position signalling apparatus for fire extinguishers according to the present invention may be placed on new and old generation fire extinguishers present in industrial buildings, hospitals, schools and in all places specified by the law or regulations of every respective country.

Claims

1. A position signalling apparatus (3; 3') for fire extinguishers (2), **characterized by** comprising at least one optical device (16) and an electronic circuit (15; 23; 24) for powering and controlling the optical device, the optical device (16) being configured to be located on a fire extinguisher (2) in a form integrated therewith and to generate a focused light beam (7) forming a luminous image (9) at a distance from the apparatus (3; 3').
2. An apparatus according to claim 1, wherein the optical device (16) is a LASER device.
3. An apparatus according to claim 1 or 2, wherein said processing circuit (15, 23, 24) comprises at least one communication interface (31) configured for sending/receiving an alarm and/or operation fault signal of the respective fire extinguisher (2).
4. An apparatus according to claim 3, wherein said communication interface (31) of each fire extinguisher (2) is configured to create a wireless network (50) with other communication interfaces (31) of other fire

extinguishers (2).

5. An apparatus according to claim 4, wherein said communication interface (31) of each fire extinguisher (2) is configured to communicate with respective communication interfaces (31) of other fire extinguishers (2) belonging to the same wireless network (50).
6. An apparatus according to any one of the claims 3-5, wherein said alarm and/or operation fault signal comprises at least one of: a registration number of the respective fire extinguisher (2), the name of an owner of the respective fire extinguisher (2), the address of the respective fire extinguisher (2), a number and/or name of the room where the respective fire extinguisher (2) is located.
7. An apparatus according to any one of the preceding claims, wherein the electronic circuit (15, 23, 24) comprises a switch (22) suitable for being operated to alternately switch on and off and connected to the optical device (16) to generate a flashing luminous image (9).
8. An apparatus according to any one of the preceding claims, wherein said optical device (16) is powered by a power signal with pulse width modulation (PWM).
9. An apparatus according to any one of the preceding claims, further comprising a casing (4; 4') for housing and protecting the optical device (16) and the electronic circuit (15, 23, 24), said casing (4; 4') being configured so that it can be fixed integrally with a handle of the fire extinguisher (2) or with a pressure gauge (11) of the fire extinguisher (2).
10. An apparatus according to any one of the preceding claims, wherein said electronic circuit (15, 23, 24) further comprises a power supply unit (20) and a processing circuit (21) for the command and control of the optical device (16) connected to said power supply unit (20).
11. An apparatus according to claim 10, wherein said processing circuit (21) is a microprocessor.
12. An apparatus according to any one of the preceding claims, wherein the electronic circuit (15; 23; 24) further comprises a memory (25), said memory being chosen from: magnetic memories, tapes, disks, solid state memories, radiofrequency labels, bar codes.
13. An apparatus according to any one of the claims 6-10, wherein the electronic circuit (15; 23; 24) further comprises at least one optoelectronic converter (19) connected to said power supply unit (20) and

able to absorb light energy, transform it into electrical energy and supply it to said power supply unit (20).

14. An apparatus according to any one of the claims 10-13, wherein the electronic circuit (15; 23; 24) further comprises at least one buzzer (30) and a sensor block (26) connected to said processing circuit (21), the sensor block (26) comprising an alarm sensor chosen among at least a pressure sensor (27), a light sensor (28), a temperature sensor (29) and a movement sensor (32).
15. An apparatus according to claim 14, wherein said alarm sensor is configured to generate an alarm signal for the processing circuit (15, 23, 24), and the processing circuit (15, 23, 24) is configured to provide an activation signal from said buzzer (30) upon reception of said alarm signal.
16. An apparatus according to claim 14 or 15, wherein the pressure sensor (27) is connected to a pressure gauge (39), said pressure gauge comprising a pressure indicator needle (40) at least partially made of magnetic material and configured for moving on a graduated scale (43, 44), and a magnetic sensor (42) configured to generate a malfunction signal of the fire extinguisher (2) when said pressure indicator needle (40) is positioned over said magnetic sensor (42).
17. A fire extinguishing system (50) comprising a plurality of fire extinguishers (2) including a respective position signalling apparatus (3; 3') according to any one of the claims 2-17, said fire extinguishing system (50) further comprising a first coordinator device (51) including a first transceiver (58) configured to communicate with the position signalling apparatus (3; 3') of each fire extinguisher (2) for receiving alarm and/or operation fault signals from said fire extinguisher (2), said position signalling apparatuses (3; 3') being furthermore in reciprocal wireless communication to form a communication network and being configured to receive, by means of the communication interface (31) thereof, alarm and/or operation fault signals from position signalling apparatuses (3; 3') of fire extinguishers (2) belonging to the same communication network and to retransmit, by means of the communication interface (31) thereof, said alarm and/or operation fault signals towards further position signalling apparatuses (3; 3') belonging to the same communication network or towards said first transceiver (58) of the coordinator device (51).
18. A fire extinguishing system according to claim 17, wherein said alarm and/or operation fault signals are encoded signals.
19. A system according to claim 17 or 18, wherein said

coordinator device (51) comprises a memory (59) configured to store at least one of: an alarm and/or operation fault signal history, identification references of all fire extinguishers (2) belonging to the system (50), one or more telephone numbers to be contacted in case of reception of an alarm and/or operation fault signal, one or more recipients of a control room to be contacted in case of reception of an alarm and/or operation fault signal from a fire extinguisher (2).

20. A system according to claim 19, wherein said coordinator device (51) further comprises a battery (61) configured to power the coordinator device (51); a SIM telephone card reader (60) configured to accept a SIM telephone card; a second transceiver (57) configured to access a public telephone network, preferably a cellular telephone network, in transmission and/or reception; a video (55); a GPS receiver, configured to acquire information related to the position of the coordinator system (51); and a microcontroller (56) configured to manage the operations of said first and second transceivers, said memory of the coordinator device and said SIM telephone card reader.
21. A system according to any one of the claims 17-20, further comprising a maintenance device (70) including a respective transceiver device (73) configured to communicate with the communication interface (31) of each fire extinguisher (2) for carrying out at least one operation from: transmitting and/or receiving identification references of a fire extinguisher, transmitting and/or receiving a history of performed maintenance interventions, receiving possible active alarm states, receiving possible active operation faults of the fire extinguisher.
22. A system according to claim 21, wherein said transceiver (73) of the maintenance device (70) is further configured to communicate with the coordinator device (51) to carry out at least one operation from: transmitting and/or receiving the company name or name of the owner of said fire extinguishers, transmitting and/or receiving position information of said coordinator device (51), transmitting and/or receiving identification parameters of fire extinguishers belonging to the system (50), transmitting and/or receiving at least one telephone number, transmitting and/or receiving a network address, transmitting encoding codes, receiving possible active alarm states, receiving possible active operation faults.
23. A system according to claim 21 or 22, wherein said maintenance device (70) further comprises at least one reading device (80) freely chosen from a bar code reader and an RFID label reading and/or writing device.

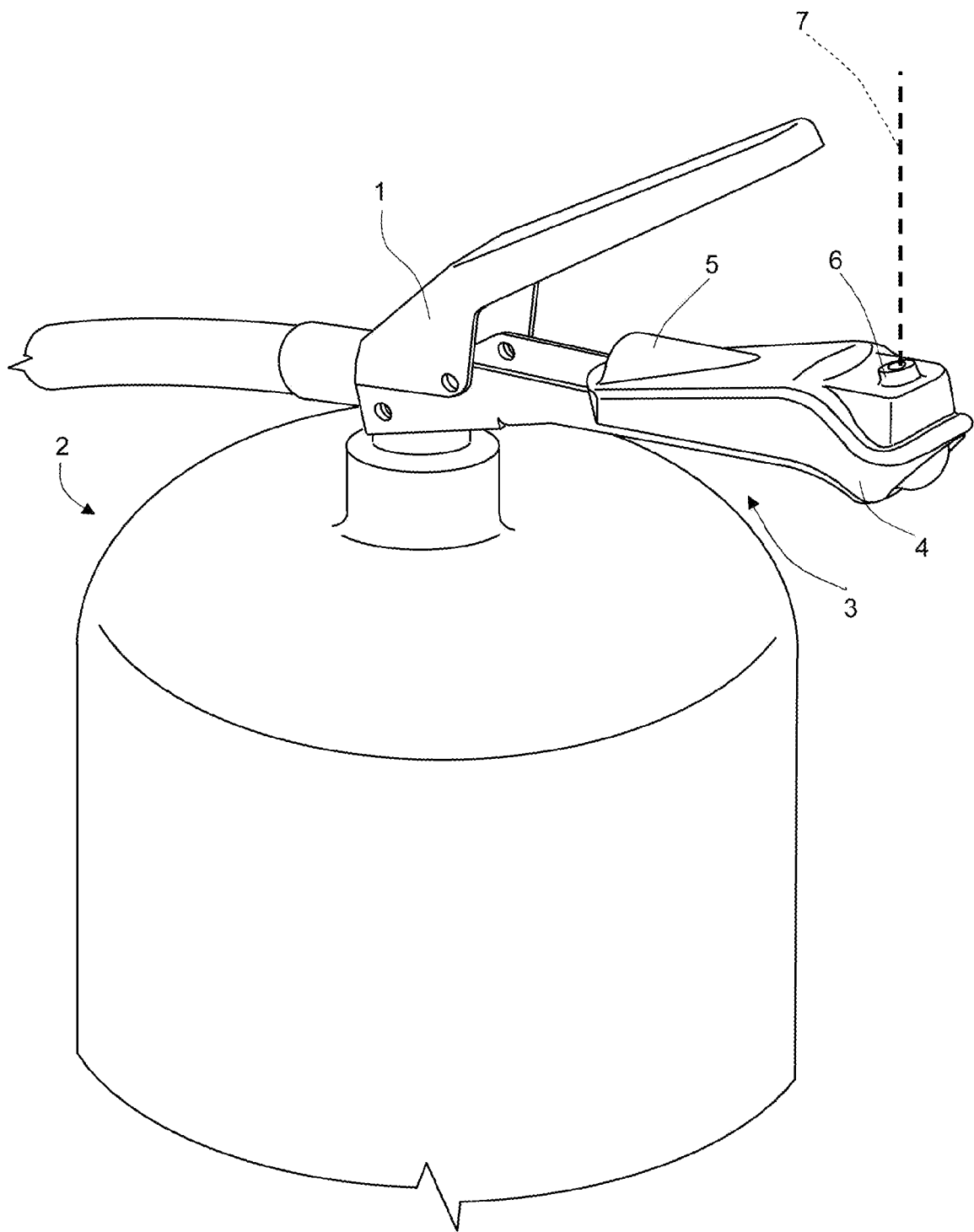


Fig.1

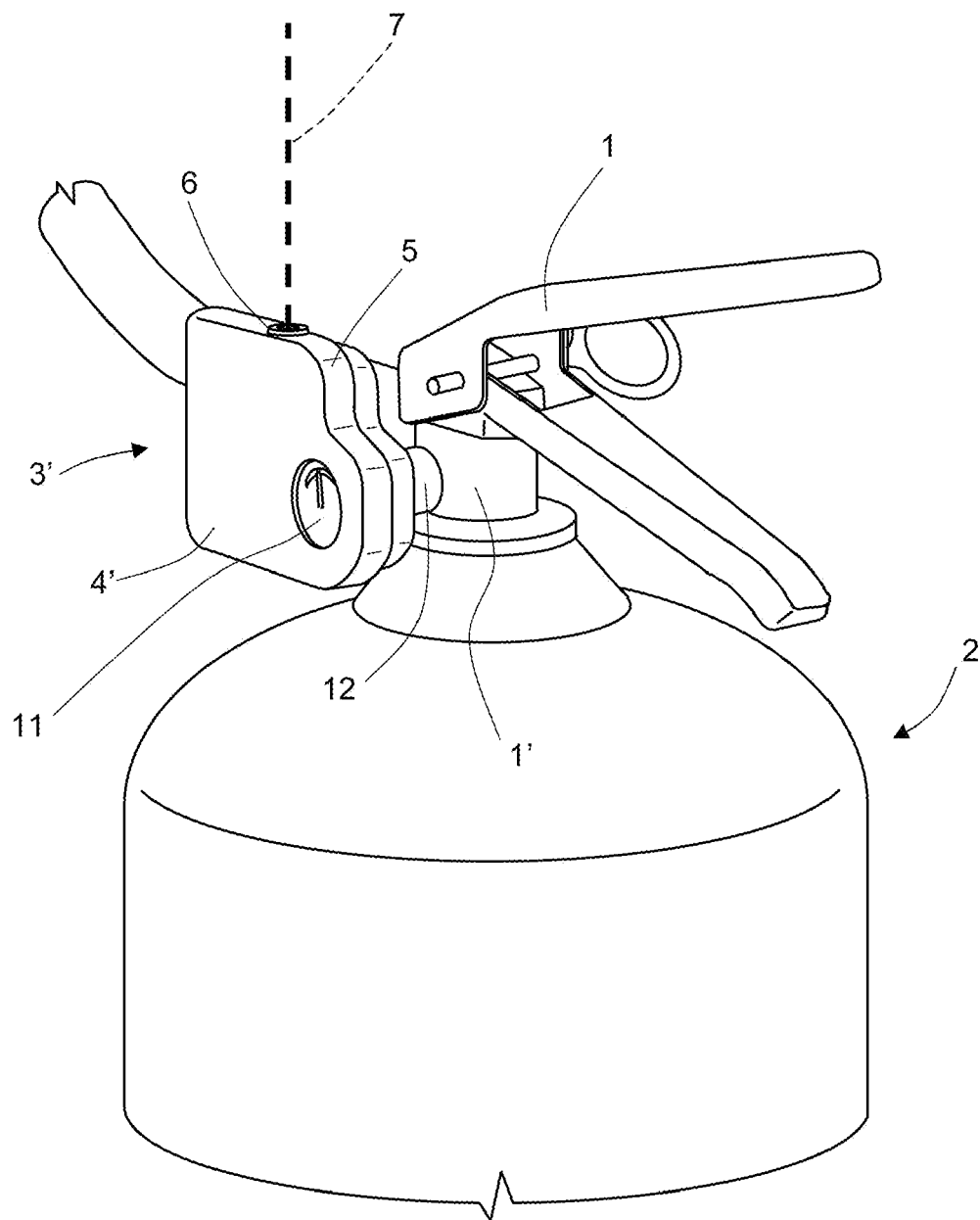


Fig.2

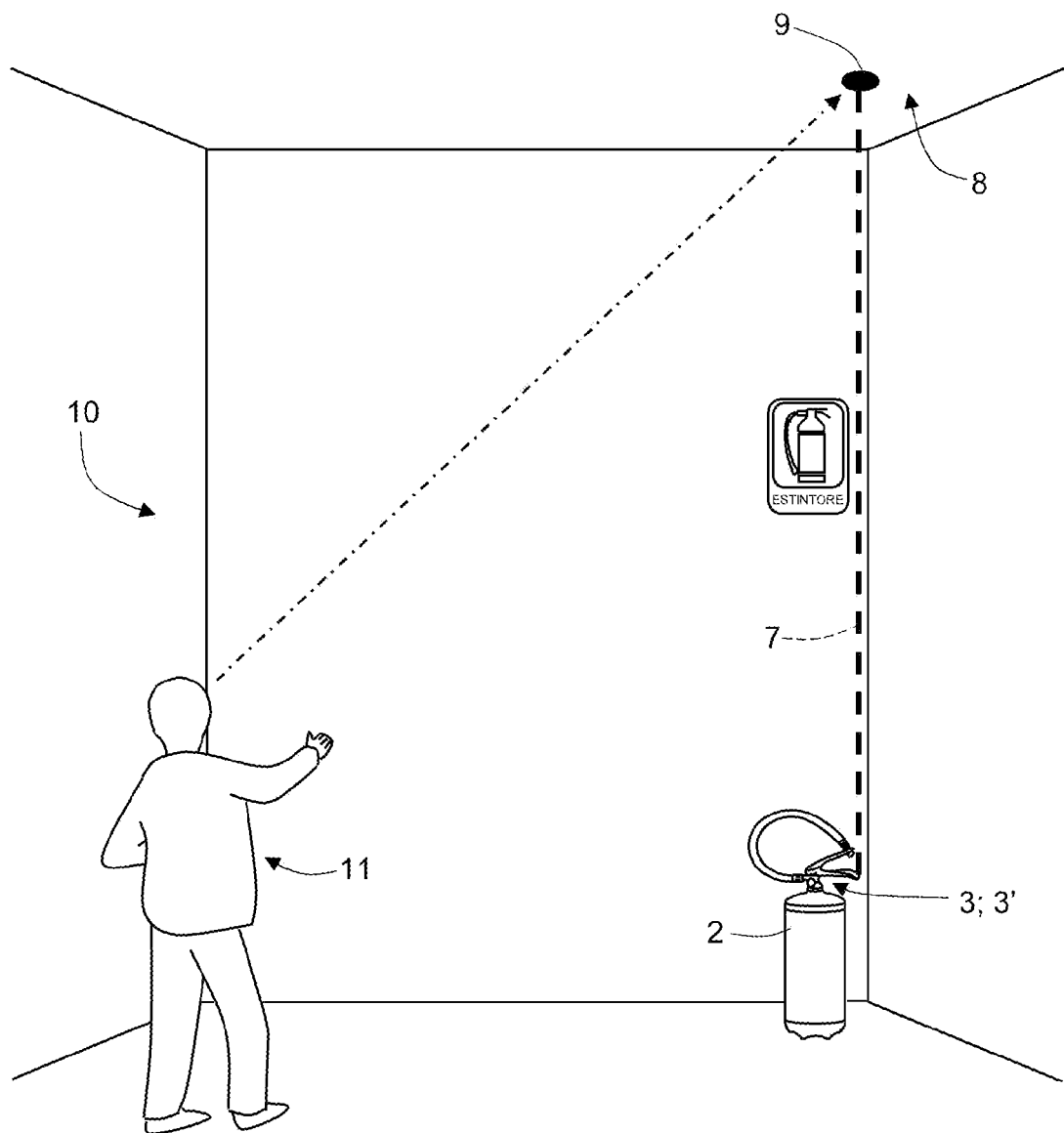


Fig.3

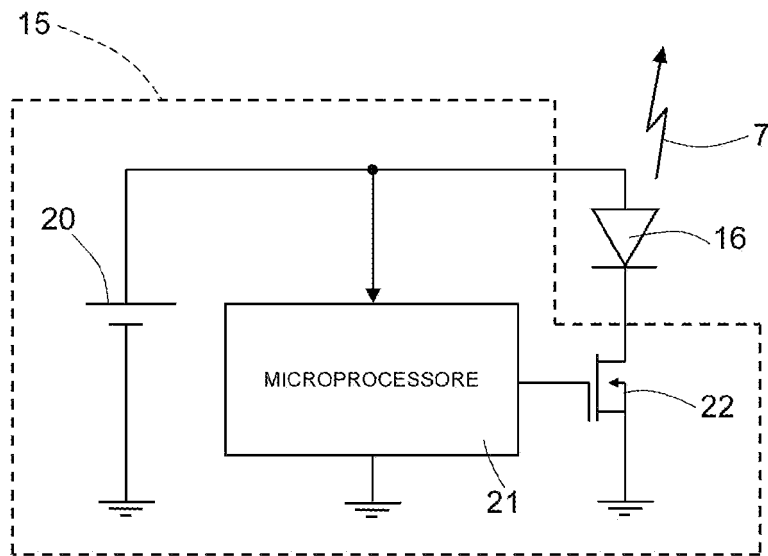


Fig.4

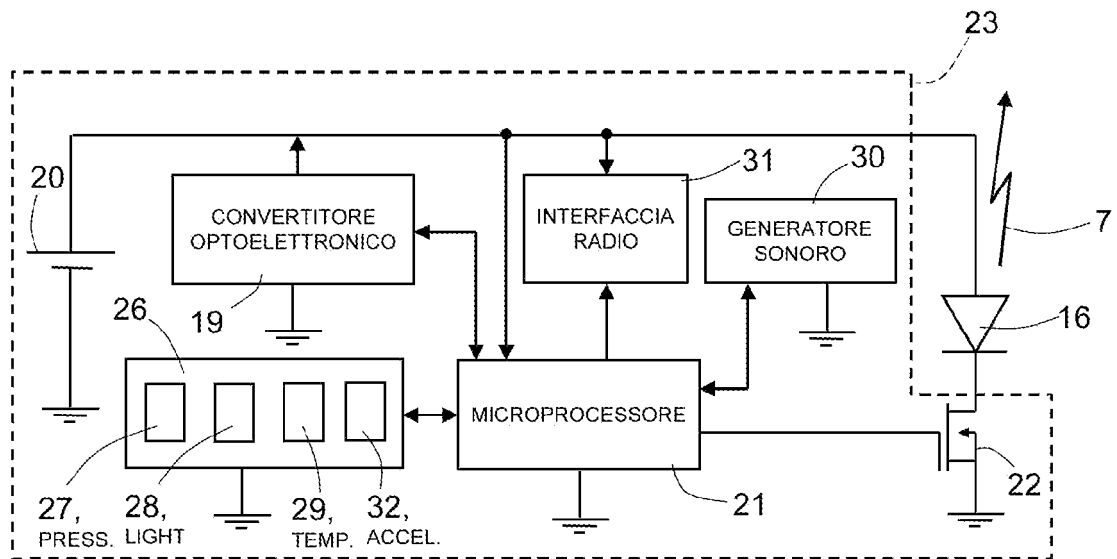


Fig.5

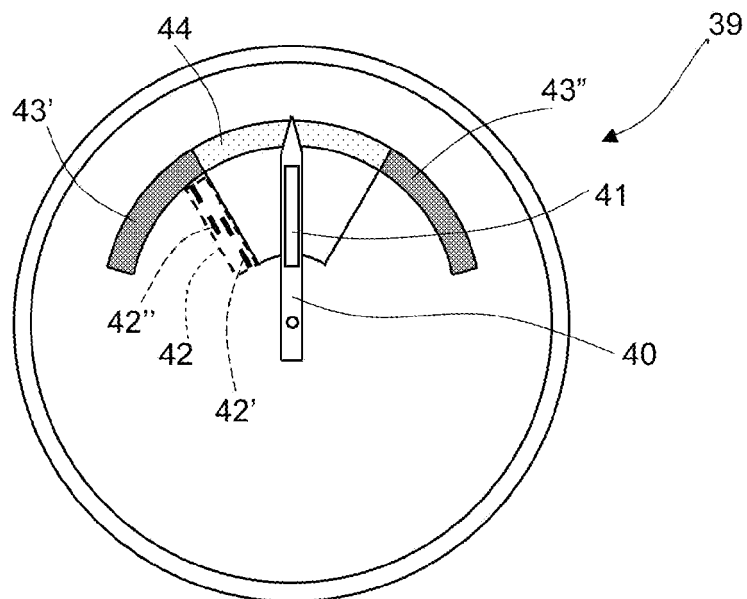


Fig. 6

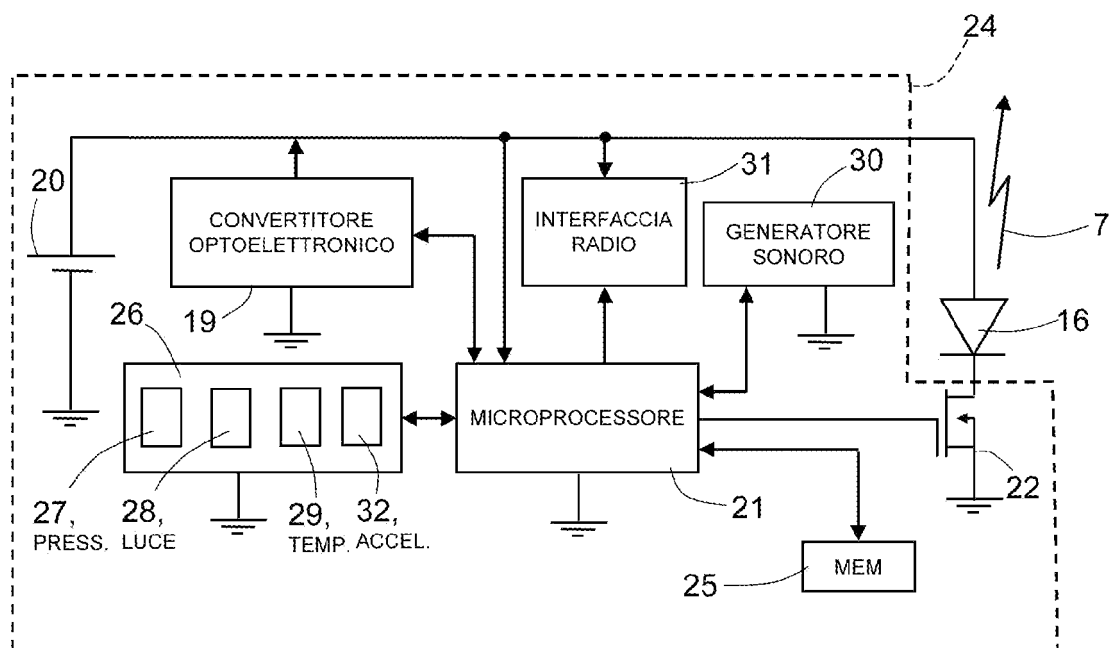


Fig. 7

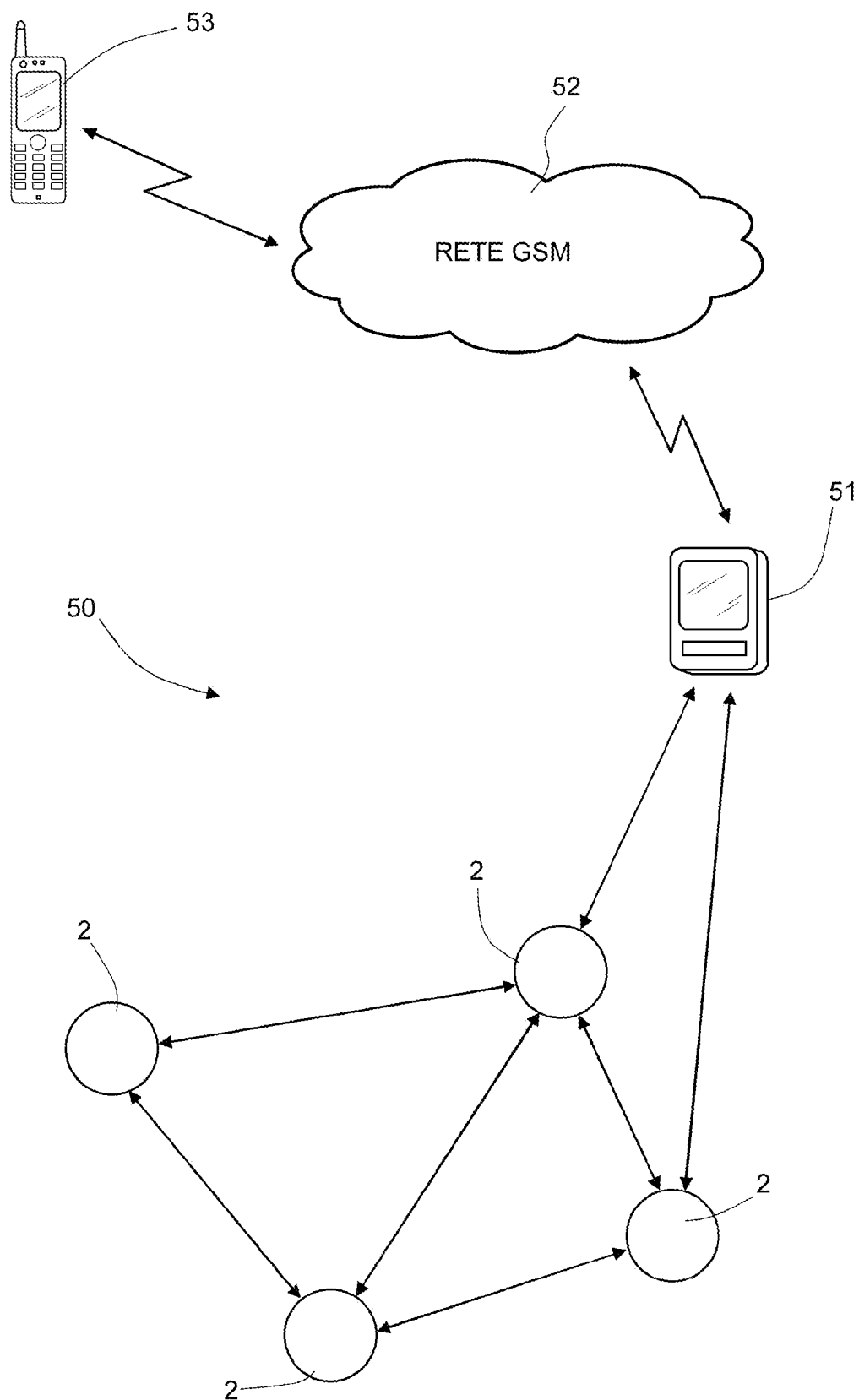


Fig.8

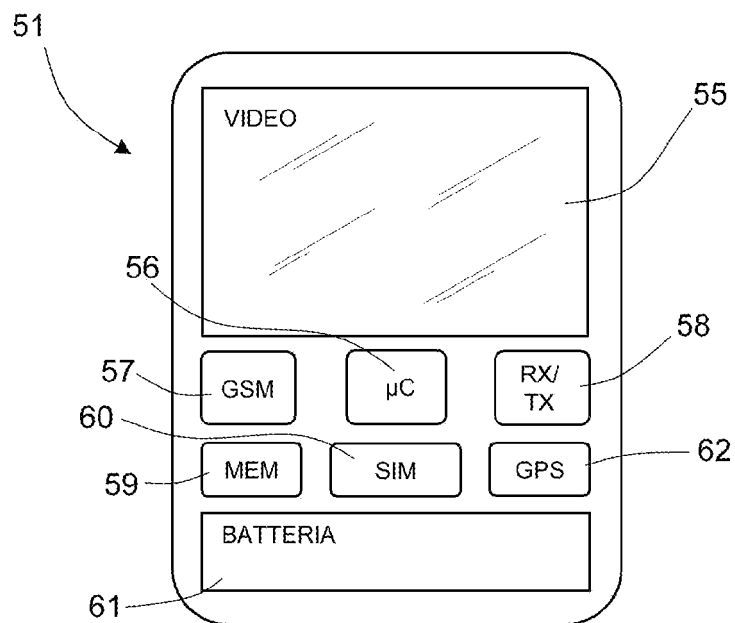


Fig.9

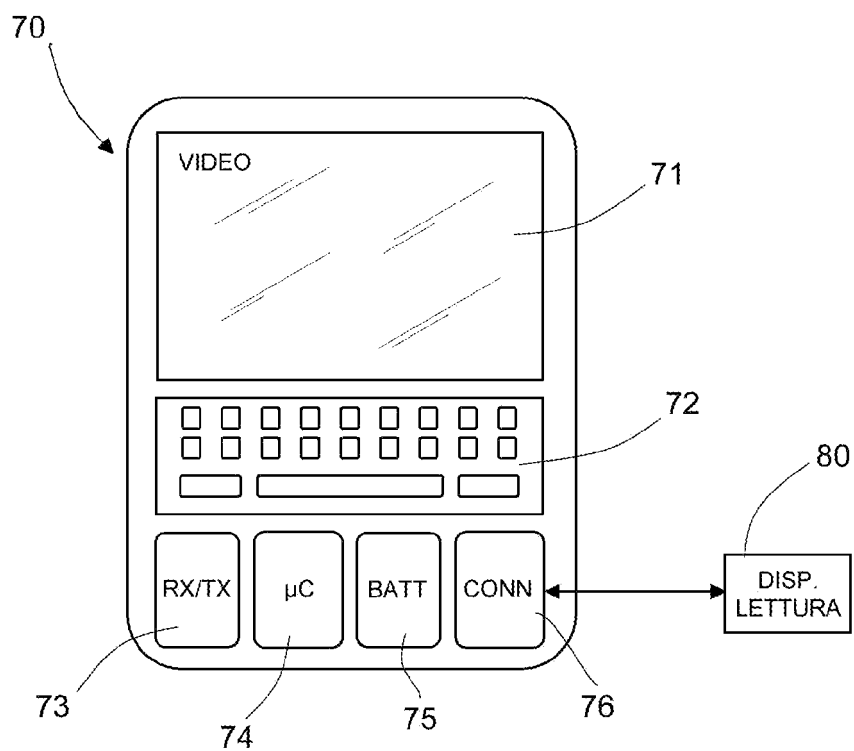


Fig.10



EUROPEAN SEARCH REPORT

Application Number
EP 09 16 8565

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* page 2, line 4 - page 3, line 5 * * page 3, lines 14-18 * * page 4, lines 13-28 * * page 5, lines 15-20,25-29 *	3-6,12, 16-23	A62C13/76 G08B25/10
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 22 October 2009	Examiner Fagundes-Peters, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503.03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 09 16 8565

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The members are as contained in the European Patent Office EDP file on
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22-10-2009

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