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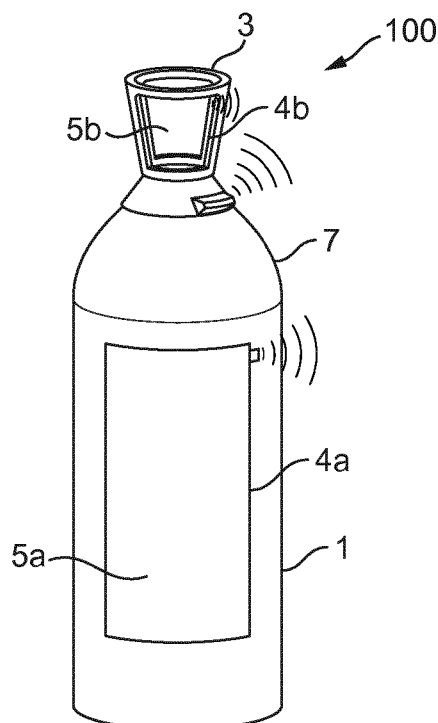
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(54) Title: AN ELECTRONIC SYSTEM FOR A CYLINDER TO PROVIDE STATUS INFORMATION

**FIG. 1A**

(57) Abstract: An electronic display system for a cylinder containing compressible fluid. The display system comprises a cylinder valve which has an information display controller which is configured to receive information describing properties of the valve, the cylinder and/or the compressible fluid. Using this information, an electronic signal is generated for use by a display device to display the status of the valve, cylinder and/or compressible fluid. A local display device receives the electronic signal and displays the status on a display surface. The display surface is provided on the body of the cylinder and/or on the body of a valve guard attached to the cylinder.



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AN ELECTRONIC SYSTEM FOR A CYLINDER TO PROVIDE STATUS INFORMATION

FIELD OF THE INVENTION

5 The present invention relates to an electronic system for a cylinder containing a compressible fluid. The electronic system is arranged to provide status information to a device, such as a local display device configured to display the status on a surface of the cylinder or a valve guard attached to the cylinder.

10

 Although reference is made to a “cylinder”, it will be understood that the invention is applicable broadly to all portable pressurised gas containers whether they are strictly in the form of a cylinder or not.

15 Such cylinders are used to supply gas for a range of applications including welding and cutting hoses and torches, gas packaging machines and laboratory equipment.

BACKGROUND OF THE INVENTION

20 The use of containers, typically cylinders, for storing and dispensing pressurised fluid is ubiquitous. Some notable examples include their use to store and dispense gases for medical purposes, for scientific research or for industrial applications. The cylinders may further be used to transport pressurised fluid between locations, either to be transferred to local storage for later use or to be
25 extracted on demand from the cylinder at the point of use.

 Irrespective of the exact use, it is highly desirable to have knowledge of the status of the containers. This knowledge typically includes information regarding their contents – such as pressure and temperature of the pressurised fluid – as well any hardware associated with them (for example, the open/shut
30 status of shut-off valves, the inlet/outlet pressure settings and tolerances of regulator valves, etc). The reason for monitoring the status of the cylinders can vary, but a common reason is for health and safety; for example, it is wise to

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know at least an indication of the pressure of a compressed fluid inside a cylinder to avoid the risk of an explosion.

The manner in which such information is available to a user of a cylinder is limited. This is due to the manner in which the information is obtained and presented, which is mostly provided on a readout physically attached to a valve of the cylinder. For example, the most common parameter to be measured is pressure of the compressible fluid within the cylinder, collected using a pressure gauge well-known in the art. A pressure gauge is an external piece of equipment that is plugged into a valve to allow fluid communication with the gas, where the pressure is displayed on a display physically attached to the gauge. It is not unusual to have multiple readouts on one system – for example, pressure regulators typically have two pressure gauges, one for input pressure and one for output pressure.

The limitations on physical space mean that limits are imposed on the number of readouts available on a cylinder; it becomes increasingly implausible to simply add multiple readouts to monitor all the parameters as there would not be space to accommodate them, in addition to the result that the more readouts that are provided, the more confusing the overall assembly to the user. In addition, it also results in a compromise being made regarding the size of the readout, resulting in a reduction in size such that the field of view becomes limited, and the display can be hard to read due to the small readout.

Furthermore, current indicators are susceptible to damage and can have varying accuracy. If damage does occur, or the indicator is exposed to damaging conditions (e.g. high temperature), then the warnings of such damage or conditions are limited or non-existent. Limitations are also present in the monitoring of damage to the cylinder itself, such as damage from shock, or over-temperature.

Wireless status indicators are known in the art, and can include a pressure sensor configured to transmit information wirelessly to a computer to allow for analysis of data by a user. However, such a solution has the disadvantage in that the computer may not always be accessible, at a location some distance from the cylinder, or be in the possession of an individual who is not the present

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user of the cylinder. It is preferable to have access to the required wide variety of information at a location nearby the cylinder to any user that is proximate to the cylinder.

The present invention seeks to provide means for a robust electronic component for cylinder valves that allow a user for flexible access to a wide variety of information in an easily-accessible manner, which provides various advantages over those of the prior art.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided an electronic display system for a cylinder containing compressible fluid, the electronic display system comprising a valve for use on the cylinder, the valve comprising an information display controller configured to receive information describing properties of at least one of the valve, the cylinder and the compressible fluid; and, using the received information, generate an electronic signal for use by one or more display devices to display an indication of a status of at least one of the valve, the cylinder and the compressible fluid; and a local display device configured to receive the electronic signal and to display the indication of a status on a display surface, the display surface provided on the body surface of the cylinder and/or the body surface of a valve guard attached to the cylinder. Providing the information at a location proximate to the cylinder allows for the user to monitor the cylinder condition while operating the cylinder.

Advantageously, the electronic display system further comprises the cylinder, wherein the local display device is a flexible screen wrapped around the cylinder. Further advantageously, the electronic display system further comprises the valve guard, wherein the local display device is a flexible screen wrapped around the valve guard. These embodiments take advantage of a large surface area provided on the cylinder and/or valve guard that mean a wide variety of information can be simultaneously provided.

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Further advantageously, the local display device is a projector and the projector is configured to display the status of indication on the display surface by projecting the indication of a status on the display surface. By projecting the image on the cylinder or valve guard rather than another surface means one
5 does not need to consider whether other items in the environment will block the projection beam. Also, by being configured to project the image on the cylinder, valve or guard itself, a projection surface will always be available to display the information.

Further advantageously, the valve further comprises a user input device
10 configured to receive user input by the user and provide information to the information display controller based on that user input. Providing a means for a user to input data provides increased user flexibility in processing of information to generate the electronic signal.

Further advantageously, the valve further comprises a memory for storing
15 information, wherein the information display controller is configured to receive information from the memory, wherein generation of the electronic signal additionally uses the received information from the memory. Stored information accessible to the information display controller again increases flexibility. For example, information relating to usage history can be stored, or information
20 relating to compressible fluid properties.

Further advantageously, the valve further comprises a sensor to collect at least part of the information describing properties of at least one of the valve, the cylinder and the compressible fluid. By providing a suitable sensor on the valve, a self-contained system can be envisaged that reduces the complexity for an end
25 user.

Further advantageously, the valve further comprises a transceiver configured to transmit the electronic signal as a wireless signal. Providing a transceiver to transmit wireless signal allows for a wider range of use of the electronic signal by devices, including portable devices. For example, the
30 wireless signal may be at least one of a wi-fi signal; a Bluetooth signal; and a GSM signal.

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Further advantageously, the valve further comprises a transceiver configured to receive information. The feature of a transceiver to receive information allows for greater flexibility in how the information display controller can be configured and used.

5 Further advantageously, the transceiver is an RFID (Radio Frequency IDentification) transceiver and/or an NFC (Near Field Communication) transceiver. Such transceivers can be configured for short range operation to provide a straightforward means for communication – e.g. to be received by a RFID handheld device to monitor cylinder contents during inventory.

10 . Further advantageously, the valve is a primary shut-off valve for the cylinder. By providing the advantageous features described herein on the primary shut-off valve (which is not removed by the end user of the cylinder) rather than secondary valves (which are usually swapped in and out based on user requirements), the cylinder is always provided with means by which a status
15 can be monitored.

In accordance with another embodiment, there is provided a cylinder assembly comprising any electronic display system embodiment described above.

In a second aspect, there is described an electronic display system for use
20 on a cylinder containing compressible fluid, the electronic display system comprising a valve comprising an information display controller configured to receive information describing properties of at least one of the valve, the cylinder and the compressible fluid; and, using the received information, generate an electronic signal for use by one or more display devices to display an indication of
25 a status of at least one of the valve, the cylinder and the compressible fluid. The electronic display system further comprises a projecting display device configured to receive the electronic signal, the display device comprising a projector apparatus to display the indication of a status by projecting the indication on a surface. In this preferred embodiment, the projecting display device is arranged
30 to display the information at a variety of surfaces that are not limited to the cylinder and/or valve guard body. This provides a more flexible user interface.

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Advantageously, the projecting display device is a piece of wearable technology. This has the advantage of providing the projecting means on the user's person, allowing ready access to the information. For example, if the wearable technology is a pair of safety goggles (such as welding goggles), the user is provided with status information without having to turn his/her head toward the cylinder and away from a hazardous task.

Further advantageously, the projecting display device is configured to be attachable to wearable safety equipment such that the projecting apparatus displays the indication of status on a surface of the wearable safety equipment. This provides greater flexibility over a projector integrated into a piece of safety equipment, as it can be readily detached and reattached to different items depending on the task being performed by the user.

Optionally, the projector apparatus may be configured such that the surface can be a surface apart from the cylinder. A user can take advantage of, for example, a blank wall nearby the cylinder to display large amounts of information. This optionally provides the option for large text to be used that can be legible from a distance.

Advantageously, the electronic display system is part of a cylinder assembly, and the projector apparatus is configured to display the indication of a status on a surface of the cylinder assembly.

In a third aspect, there is provided an electronic system for a cylinder containing compressible fluid, the electronic display system comprising a valve assembly for use on the cylinder, the valve assembly comprising an information controller configured to receive information describing properties of at least one of the valve assembly, the cylinder and the compressible fluid; and, using the received information, generate an electronic signal for use by one or more devices to provide to a user an indication of a status of at least one of the valve assembly, the cylinder and the compressible fluid. The information controller is configured to wirelessly transmit the electronic signal to the device, and wherein the valve assembly does not include a display.

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The valve assembly may comprise: the valve; any electronics, sensors, or actuators mounted thereon; any flow regulation devices mounted thereon; and/or the cylinder body on which the valve is mounted.

Without requiring a display on the valve assembly itself, a cylinder
5 assembly including the electronic system is provided with additional space for more components. Furthermore, without a display attached, the valve assembly will be cheaper to produce.

Advantageously, the above described electronic display systems and electronic systems further comprise one or more remote display devices, the one
10 or more remote display devices configured to receive the electronic signal and to display the indication of a status and wherein each of the one or more display devices is selected from the following group: a computer tablet; a smartphone and an item of wearable technology. The variety of display devices that can be used to display the information provides more flexible access to information by
15 the user. Optionally, the above described electronic display systems further comprise a speaker configured to receive the electronic signal and produce a sound related to the indication of a status of at least one of the valve, the cylinder and the compressible fluid. Having a non-visual indication provided means that a user can be alerted to a status without having to look at the cylinder, such as in
20 the case when performing a hazardous task.

Other preferred features of the present invention are set out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

25 Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1A is an illustration of electronic display system embodiments comprising a flexible screen.

Figure 1B is an illustration of an electronic display system embodiment
30 comprising a projector.

Figure 1C is an illustration of another electronic display system embodiment comprising a projector.

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Figure 2 is a schematic illustrating the components of a valve forming part of an embodiment of the electronic display system, and the relationship between those components.

Figure 3 is an illustration of the electronic display system comprising a projector display device, in accordance with advantageous embodiments of the present invention.

Figure 4 is an illustration of the electronic display system comprising one or more remote display devices, in accordance with advantageous embodiments of the present invention.

DETAILED DESCRIPTION

Embodiments of the invention are now provided with reference to the accompanying figures.

Figures 1A – 1C illustrate exemplary embodiments of the present invention. Specifically, Figures 1A - 1C shows an electronic display system 100 for a cylinder 1 containing compressible fluid. The electronic display system 100 comprises a local display device 4 configured to display the indication of a status on a display surface 5, the display surface provided on the body surface of the cylinder 1 and/or the body surface of a valve guard 3 attached to the cylinder 1. The meaning of a 'local' display device is a display device that is in the immediate vicinity to the other features of the electronic display system 100, of which the embodiments illustrated in Figures 1A – 1C are examples.

Figure 1A illustrates the advantageous embodiment of where the electronic display system of claim 1 further comprises the cylinder 1, wherein the local display device is a flexible screen 4a wrapped around the cylinder 1. The flexible screen 4a comprises a display surface 5a for displaying the indication of status, where the flexible screen 4a and consequently the display surface 5a are non-planar and conform to the surface dimensions of a portion of the cylinder.

Also shown in Figure 1A is the advantageous embodiment of where the electronic display system 100 further comprises the valve guard 3, wherein the local display device is a flexible screen 4b wrapped around the valve guard 3.

The flexible screen 4b comprises a display surface 5b, where the flexible screen 4b and consequently the display surface 5b are non-planar and conform to the surface dimensions of a portion of the valve guard. While Figure 1A illustrates the flexible screens being provided on cylindrical portions of the cylinder 1 and valve guard 3, it is to be understood that the flexible screens may be provided on a body surface portion of the cylinder 1 or valve guard 3 that are non-cylindrical, for example, the screen may be provided proximate to the cylinder shoulder 7. It is to be understood that flexible screens can be provided on the valve guard 3 and the cylinder body in combination, or independently. In the embodiment where a flexible screen 5a is attached to the cylinder 1 and a flexible screen is attached to the valve guard 3, the electronic display system 100 comprises both the valve guard 3 and the cylinder 1.

Figures 1B and 1C illustrate an advantageous embodiment where the local display device is a projector 4c, the projector 4c being configured to display the status of indication on the display surface 5 by projecting the indication of a status on the display surface 5. In the exemplary embodiment of Figure 1B, the display surface 5 is a surface 5c of the valve guard 3, and the projector 4c displays the indication of status by projecting an image 6 on the surface 5c to indicate the status. In the exemplary embodiment of Figure 1C, the display surface 5 is a surface 5d of the cylinder 1, and the projector 4c displays the indication of status by projecting an image 6 on the surface 5d to indicate the status. Figure 1C illustrates the image 6 being projected on the surface of the shoulder 7 of the cylinder 1, but it is understood that the projector 4c may be arranged with respect to the cylinder 1 to project on any suitable surface of the cylinder 1.

In the preferred embodiment of the present invention, the electronic display system 100 comprises a valve 2, the valve 2 for use on a cylinder 1 containing a compressible fluid 10 and an embodiment of the valve 2 is illustrated in Figure 2. The valve comprises an inlet 11 arranged to receive the compressible fluid 10 from the cylinder 1, an outlet 12 arranged to provide an output to an external environment, and a sealing element 15 arranged to block flow between the inlet 11 and the outlet 12. The sealing element 15 has an

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electronic output, which outputs an electronic 'valve on/off signal' 16 that provides an indication the sealing element 15 is closed, open or partially open and the extent of that opening.

In the preferred embodiment of the present invention, the valve further
5 comprises an information display controller (IDC) 13. The IDC 13 is electronic, and in the exemplary embodiment includes a processor 18 to interpret and process information that is received by the IDC 13. The IDC 13 is configured to receive information describing properties of at least one of the valve 2, the cylinder 1 and the compressible fluid 10. For example, in the exemplary
10 embodiment of Figure 2, the valve on/off signal 16 is provided from the sealing element 15 to the IDC 13. Figure 2 illustrates further additional components that are arranged to provide at least part of the information describing properties of at least one of the valve, the cylinder and the compressible fluid to be received by the IDC 13. For example, the valve comprises sensors 20 arranged to collect
15 data from the compressible fluid 10 flowing through the valve inlet 11, to provide information regarding properties of the compressible fluid 10 to the IDC 13. The sensors 20 may include, but are not limited to a pressure sensor to sense pressure of the fluid, a temperature sensor to sense temperature and a flow sensor to sense rate of flow. Additionally, while not illustrated in Figure 2,
20 sensors can be provided to collect data from the outlet valve 12 in the same manner as data is collected from input valve 11. The sensors 20 may be internal to the valve, or provided in the form of attachable components that can be mounted and dismounted from the inlet 11 and/or outlet 12 of the valve 2.

Further information regarding the properties of the compressible fluid can
25 be provided by cylinder sensors 21, which are configured to collect information from the cylinder 1. This information is provided as 'cylinder sensor information' 22 to the IDC 13. These sensors may be similar sensors to those described above with respect to valve sensors 20. The cylinder sensors 21 can also be configured to provide information regarding the cylinder to the IDC 13. For
30 example, the cylinder sensors 21 may comprise piezoelectric elements to measure strain or force on the cylinder 1, or temperature sensors to measure the internal and external temperature of the cylinder 1. Additionally, and although not

shown in Figure 2, there may be provided sensors on the valve 2 that extend within the cylinder 1 to provide information about the cylinder 1 to the IDC 13. The operation of these valve sensors to provide information to the IDC 13 is as described above with respect to cylinder sensors 21.

5 Additionally, the IDC 13 can be configured to receive information from a device external to the valve, including display devices, as discussed below, but also hardware device that is connected to the valve 2 so as to receive the compressible fluid 10. An example would be a device connected at the valve outlet 12, such as welding equipment. Advantageously, and as illustrated in the
10 exemplary embodiment of Figure 2, the valve 2 comprises a transceiver 23 configured to receive information such as the information from the external device, and provide that information to be used by the IDC 13.

 The valve may comprise further means for providing information to be received by the IDC 13. As illustrated in Figure 2, the valve may comprise a user
15 input device 24 configured to receive a user input 25 from the user and provide information to the IDC 13 based on that user input 25. Examples of user inputs may be a touch screen, a plurality of switches or a port such as a USB.

 Also illustrated in Figure 2 is the advantageous feature of a memory 26 for storing information, wherein the IDC 13 is configured to receive information from
20 the memory 26. The memory may be configured so as to receive and store information, such as information received through the transceiver 23 or from the user input device 24.

 Using the received information, the IDC 13 generates an electronic signal 14. While reference is made to electronic signal 14 in the singular, it is
25 understood that the IDC 13 can be configured to produce a plurality of electronic signals for targeted use. This generation includes the processing of the received information into a format suitable for use with software programs to calculate properties of the cylinder. The software programs may be provided prior to installation, or can be provided to the IDC 13 by a user of the cylinder 1 as part of
30 in-situ customisation.

 The status of the valve 2, cylinder 1 and compressible fluid 10 can be determined by the IDC 13 through suitable use of the received information

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describing properties of the valve 2, cylinder 1 and compressible fluid 10. This can be done from a single input; for example, the received valve on/off signal 16 can be used by the IDC 13 to determine whether the valve is open or closed. Thus the IDC 13 can generate the electronic signal 14 such that when received
5 by a display device, the electronic signal 14 is suitable for use by that display device to display an indication of whether the valve 2 is open or closed.

Additionally, the IDC can determine a status that is related to a single input – for example, a pressure measurement of the compressible fluid received by the IDC 13 can be used not only to determine the pressure, but also a status that can
10 be inferred from the pressure, such as volume of compressible fluid remaining. In the embodiment where a memory 26 is provided, it is understood that generation of the electronic signal 14 additionally uses the received information from the memory 26. For example, this may be information such as the specific compressible fluid being stored in the cylinder 1, or specific parameters used for
15 comparison to readings from the sensors 20 (e.g. a pressure tolerance level/threshold, a temperature threshold, etc).

The IDC 13 being configured to receive information from a plurality of sources and about a plurality of parameters has an advantage. In particular, the IDC 13 can utilise more than one input to produce a status that may not be
20 available from a single input. For example, the IDC 13 can receive pressure information and temperature information from cylinder sensors 21, and process these pieces of information in combination having regard to their interdependence (on a rudimentary level, the ideal gas equation). This could produce a more accurate estimate of the amount of fluid remaining, or serve as
25 an early warning indication of a build-up of dangerous pressure levels.

Optionally, in one embodiment the IDC 13 is configured to receive information regarding properties of at least one of the valve, cylinder and compressible fluid, and use that received information to generate an electronic signal for use by a display device to display an indication of a status of a different
30 one of the valve, cylinder and compressible fluid. For example, information received regarding the cylinder can be used to infer a status of the compressible fluid.

Advantageously, the valve 2 is a primary shut-off valve for the cylinder 1. The term 'primary shut-off valve' is understood to be a master valve attached to the cylinder used to have overriding control of any contents leaving the cylinder. Cylinders for compressible fluids are typically employed with customisable
5 components attached to the primary shut-off valve, such as a regulator to control the pressure of compressible fluid that is dispensed from the cylinder. If the valve of the present invention is provided on such a removable component, then the user would lose the associated advantageous features if required to modify or replace a setup attached to the valve – e.g. replacement of a regulator.

10 Additionally, in embodiments where information is stored on the valve, if the valve can be swapped around between cylinders then status information may become inaccurate. In contrast, the primary shut off valve is not a component that is removed or replaced by the user in situ and there would be no possibility for the user to remove, swap or replace the valve. This means that when a cylinder is
15 employed with a primary-shut off valve according to this embodiment of the present invention, the user will be assured access to status information regarding the cylinder, valve or compressible liquid stored in the valve.

The electronic signal 14 generated by the IDC 13 is suitable for use by one or more display devices to display an indication of a status 6 of at least one of the
20 valve 2, the cylinder 1 and the compressible fluid 10. For example, contained within the electronic signal 14 is data suitable to be processed by the one or more display devices to generate the image, similar to the manner in which information is provided to a computer monitor. It is understood that the electronic signal 14 is suitable to be received by the display devices to be used to display information,
25 but the electronic signal 14 may be used by other apparatus to serve other purposes. For example, the electronic signal could be provided to a centralised system used to track and record information on the cylinders, or routed to a customer service desk to allow for prompt service in connection with the cylinder 1 (such as replenishment). Advantageously, the electronic signal can be
30 provided to a central alarm system for use by the central alarm system to sound an alarm.

The information that can be displayed by the display devices includes, but is not limited to, (1) information relating to the compressible fluid 10 stored in the cylinder such as pressure, flow rate, temperature, composition and material data safety sheets; (2) information to show legislative compliance or information; (3) information related to any devices connected to the cylinder, such as welding equipment; (4) information regarding predicted timescales, such as predicted time until the contents of the cylinder 1 is exhausted and/or predicted time until completion of a task (this may, for example, be calculated from the cylinder contents divided by the rate of flow of the fluid from the cylinder); (5) information relating to the comparison of other information, such as a comparison of the time left until the contents of the cylinder 1 is exhausted against the time that is still required for completion of a task; (6) information relating to an indication of whether the valve is open or closed; (7) information regarding cylinder usage patterns and/or history; (8) advertising; and (9) information relating to warnings, such as safety hazards.

As described above, an exemplary embodiment of the valve 2 comprises a transceiver 23. This transceiver 23 may be further configured to transmit the electronic signal 14 as a wireless signal, which can then be received by suitable equipment installed on one or more display devices, or any other equipment that is configured to receive and use the electronic signal (such as the central alarm system described previously). The transceiver 23 may also be used to receive a wireless signal from the one or more display devices or other pieces of equipment, so as to provide information from the one or more display devices or other pieces of equipment to the IDC 13. The wireless signal may be a wireless signal known in the art, such as a wi-fi signal; a Bluetooth signal; and a GSM signal.

The exemplary embodiment describes a transceiver 23, but it is understood that instead of a transceiver, the valve may alternatively employ a transmitter and/or receiver to perform the tasks transmitting and receiving tasks respectively, as described herein.

In an advantageous embodiment, the transceiver 23 is an RFID transceiver and/or an NFC transceiver, configured to transmit and/or receive information from RFID/NFC tags or transceivers located nearby.

Optionally, the valve comprises an alarm 27, and the IDC 13 is configured
5 to generate an electronic signal to be provided to the alarm 27 to trigger the alarm. The alarm may, for example, be visual and/or audible.

In a preferred embodiment of the present invention, and as shown in Figures 1A -1C, the electronic display system 100 further comprises a local display device 4. The local display device 4 is configured to receive the
10 electronic signal 14. The local display device 4 is further configured to display the indication of a status by projecting the indication on a surface 5, as described above with respect of Figures 1A – 1C.

In the optional embodiment described above with respect to Figures 1B-1C where the local display device is a projector 4c, the surface is a surface that is
15 part of a cylinder assembly comprising the cylinder and the valve guard. This has the advantage that a projection surface will always be provided wherever the cylinder is located. However, in an alternative preferred embodiment of the present invention, in place of a local display device that is physically attached to the other components of the electronic display system 100, there is provided a
20 projecting display device configured to receive the electronic signal, the display device comprising a projector apparatus to display the indication of a status by projecting the indication on a surface. The surface is thus not limited to a surface on said cylinder assembly. This embodiment provides greater flexibility to the surfaces that a projected image 6 can be displayed upon.

25 Figure 3 illustrates exemplary embodiments. For example, the projector apparatus may be configured such that the surface can be a surface apart from the cylinder. The surface may be a nearby wall 39 or a nearby ceiling. This configuration may be achieved in several suitable ways; for example, the apparatus may be configurable to have an adjustable imaging element that may
30 be rotatable to point at different surfaces or, alternatively or in combination, the apparatus may be configured to detect the distance to a nearby surface (e.g. through use of monitoring reflected light) and calculate an appropriate focal

length to ensure that the projected image is legible to a user. In one embodiment, the projecting apparatus is a short-throw projector.

In another advantageous embodiment, the projecting display device is a piece of wearable technology. An example of such wearable technology may be a pair of glasses 40 with a projecting element 40a configured to project an image on the surface of a lens of the glasses, or may be a watch configured to project an image onto the arm or hand of a user, or may be a piece of wearable safety equipment (e.g. a welding mask or safety goggles) with a projecting element configured to project an image on a surface of the wearable safety equipment. In another optional embodiment, the projecting display device is a device 41a configured to be attachable to wearable safety equipment 41 such that the projecting apparatus displays the indication of status on a surface of the wearable safety equipment. For example, the device 41a may clip on to the wearable safety equipment 41 to project an image 41b onto a surface of the wearable safety equipment 41.

It is also to be appreciated from the above described advantageous embodiments described in connection with the projecting apparatus that the projection surface need not be flat, and with suitable programming of the projector and electronic components of the valve, a legible image can be projected onto a non-planar surface. It is also to be understood that these embodiments are not mutually exclusive with the embodiments described in connection with Figures 1B and 1C; advantageously, the projector apparatus is configured to display the indication of a status on a surface of a cylinder assembly that comprises the electronic display system 100. For example, the cylinder assembly may comprise the valve guard 3 and/or the cylinder 1.

The above described embodiments are in relation to an electronic system that is an electronic display system 100, understood to be suitable for providing an electronic signal to devices that can provide the indication of status to a user in a visual format, such as in the examples provided of a projector or a flexible screen. However, it is to be understood that the generated electronic signal 14 may also be suitable for use by other devices that are not necessarily display devices, such as a speaker for producing sound.

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In another preferred embodiment of the present invention, it is not necessary for the information to be provided to a user in a visual format. In this embodiment, there is provided an electronic system for a cylinder containing compressible fluid, the electronic display system 100 comprising a valve for use
5 on the cylinder, the valve comprising an information controller configured to receive information describing properties of at least one of the valve, the cylinder and the compressible fluid. In this embodiment, the information controller operates in the same manner as the IDC 13 described above, including how it is configured to receive information from multiple sources (e.g. valve sensors 20,
10 memory 26). However, in this preferred embodiment, the information controller is configured to use the received information to generate an electronic signal for use by one or more devices to provide to a user an indication of a status of at least one of the valve, the cylinder and the compressible fluid. Notably, the electrical signal is suitable for use by display devices and/or devices that are not
15 display devices. Additionally, the information controller is configured to wirelessly transmit the electronic signal to the device, and wherein the valve does not include a display. It is to be understood that in an optional embodiment, the information controller has identical functionality to the IDC 13, in that the electrical signal 14 is suitable for use by one or more display devices. However, in this
20 advantageous embodiment the valve itself, or the valve assembly (including components fixed to or mounted on the valve), does not include a display or display device.

It is to be understood that the word 'valve' can be understood to mean not only a single valve (such as a shut-off valve), but also valve assembly that
25 comprises multiple connected valve components, such as an assembly of a shut-off valve connected to a regulator valve and a pressure release valve. Thus in an advantageous embodiment, there is no display physically connected to the valve, either directly or through other valve components.

In an optional embodiment, the electronic display system 100 (and
30 electronic system) of the above described embodiments as described above may comprise one or more remote display devices, the one or more remote display devices configured to receive the electronic signal and to display the indication of

a status and wherein each of the one or more display devices is selected from the following group: a computer tablet; a smartphone and an item of wearable technology. Figure 4 illustrates examples of wearable technology, including eyewear 42, such as google glass, which will display information in an area 43 in the user's field of vision. Another example of wearable technology is a wrist device 43, such as the apple iWatch, with a screen for displaying the information to the user. Other examples of wearable technology are envisaged, such as industry-specific safety equipment (e.g. a mask worn when welding).

10 In a further optional embodiment, the electronic display system 100 (and electronic system) of the above-described embodiments may further comprise a speaker configured to receive the electronic signal and produce a sound related to the indication of a status of at least one of the valve, the cylinder and the compressible fluid.

15 Although preferred embodiments of the invention have been described, it is to be understood that these are by way of example only and that various modifications may be contemplated.

CLAIMS

1. An electronic display system for a cylinder containing compressible fluid, the electronic display system comprising:

5 a valve for use on the cylinder, the valve comprising an information display controller configured to:

receive information describing properties of at least one of the valve, the cylinder and the compressible fluid; and

10 using the received information, generate an electronic signal for use by one or more display devices to display an indication of a status of at least one of the valve, the cylinder and the compressible fluid; and

15 a local display device configured to receive the electronic signal and to display the indication of a status on a display surface, the display surface provided on the body surface of the cylinder and/or the body surface of a valve guard attached to the cylinder.

2. The electronic display system of claim 1, further comprising the cylinder, wherein the local display device is a flexible screen wrapped around the cylinder.

20

3. The electronic display system of claim 1, further comprising the valve guard, wherein the local display device is a flexible screen wrapped around the valve guard.

25 4. The electronic display system of claim 1, wherein the local display device is a projector, the projector configured to display the status of indication on the display surface by projecting the indication of a status on the display surface.

30 5. The electronic display system of any preceding claim, further comprising a user input device configured to receive user input by the user and provide information to the information display controller based on that user input.

– 20 –

6. The electronic display system of any preceding claim, further comprising a memory for storing information, wherein the information display controller is configured to receive information from the memory, wherein generation of the electronic signal additionally uses the received information from the memory.

5

7. The electronic display system of any preceding claim, further comprising a sensor to collect at least part of the information describing properties of at least one of the valve, the cylinder and the compressible fluid.

10 8. The electronic display system of any preceding claim, further comprising a transceiver configured to transmit the electronic signal as a wireless signal.

9. The electronic display system of any preceding claim, further comprising a transceiver configured to receive information.

15

10. The electronic display system of claim 8 and claim 9, wherein the transceiver is an RFID transceiver and/or an NFC transceiver.

11. The electronic display system of claim 8, wherein the wireless signal is at least one of a wi-fi signal; a Bluetooth signal; and a GSM signal.

20

12. The electronic display system of any preceding claim, wherein the valve is a primary shut-off valve for the cylinder.

25 13. An electronic display system substantially as herein described with reference to Figures 1 – 4 of the accompanying drawings.

14. A cylinder assembly comprising the electronic display system of any preceding claim.

30

15. An electronic display system for use on a cylinder containing compressible fluid, the electronic display system comprising:

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a valve comprising an information display controller configured to:

receive information describing properties of at least one of the valve, the cylinder and the compressible fluid; and

using the received information, generate an electronic signal for use by one or more display devices to display an indication of a status of at least one of the valve, the cylinder and the compressible fluid;

a projecting display device configured to receive the electronic signal, the display device comprising a projector apparatus to display the indication of a status by projecting the indication on a surface.

16. The electronic display device of claim 15, wherein the projecting display device is a piece of wearable technology.

17. The electronic display system of claim 15, wherein the projecting display device is configured to be attachable to wearable safety equipment such that the projecting apparatus displays the indication of status on a surface of the wearable safety equipment.

18. The electronic display system of claim 15, wherein the projector apparatus may be configured such that the surface can be a surface apart from the cylinder.

19. The electronic display system of any preceding claim, further comprising one or more remote display devices, the one or more remote display devices configured to receive the electronic signal and to display the indication of a status and wherein each of the one or more display devices is selected from the following group: a computer tablet; a smartphone and an item of wearable technology.

20. The electronic display system of any preceding claim, the electronic display system further comprising a speaker configured to receive the electronic

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signal and produce a sound related to the indication of a status of at least one of the valve, the cylinder and the compressible fluid.

21. A cylinder assembly comprising the electronic display system of claim 15, wherein the projector apparatus is configured to display the indication of a status on a surface of the cylinder assembly.

22. An electronic system for a cylinder containing compressible fluid, the electronic system comprising:

10 a valve assembly for use on the cylinder, the valve assembly comprising an information controller configured to:

receive information describing properties of at least one of the valve assembly, the cylinder and the compressible fluid; and

15 using the received information, generate an electronic signal for use by one or more devices to provide to a user an indication of a status of at least one of the valve assembly, the cylinder and the compressible fluid;

20 wherein the information controller is configured to wirelessly transmit the electronic signal to the device, and wherein the valve assembly does not include a display.

23. The electronic system of claim 22, further comprising one or more remote display devices, the one or more remote display devices configured to receive the electronic signal and to display the indication of a status and wherein each of the one or more display devices is selected from the following group: a computer tablet; a smartphone and an item of wearable technology.

24. The electronic system of claim 22, the electronic display system further comprising a speaker configured to receive the electronic signal and produce a sound related to the indication of a status of at least one of the valve assembly, the cylinder and the compressible fluid.

1 / 4

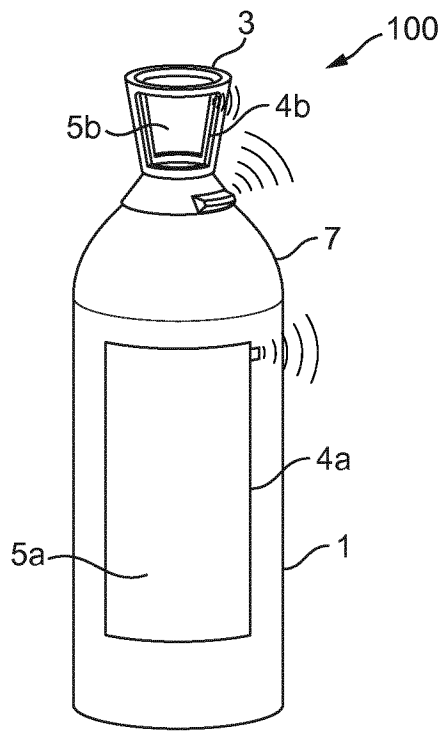


FIG. 1A

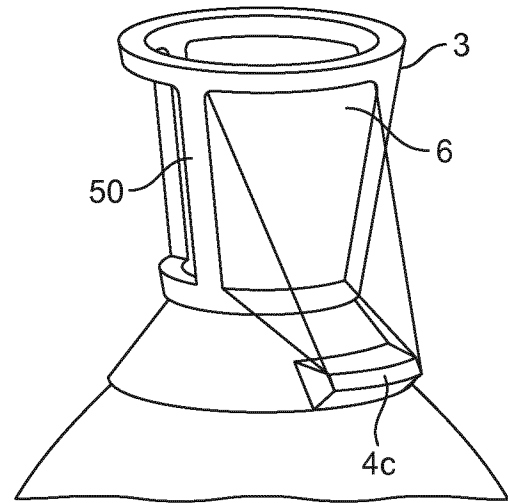


FIG. 1B

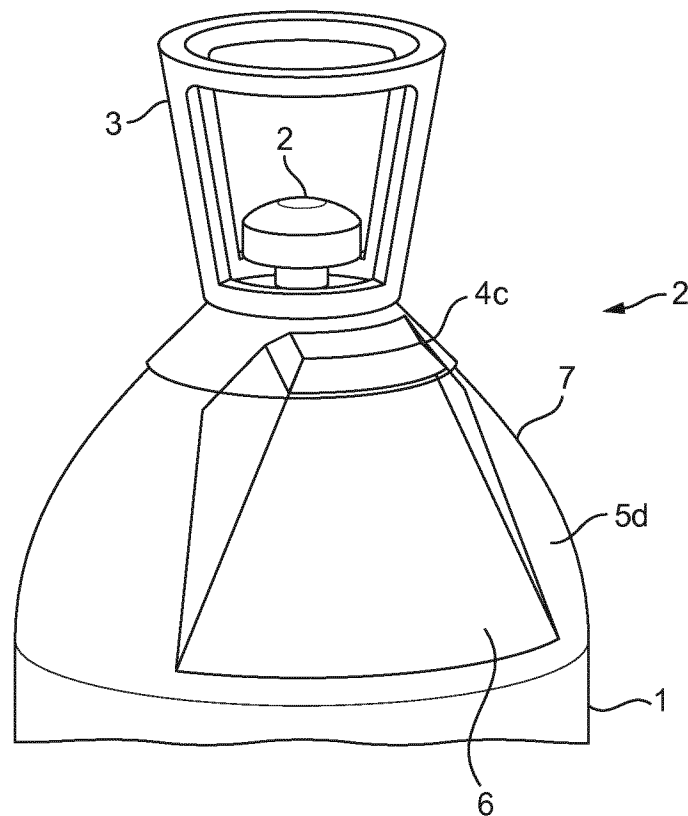


FIG. 1C

2 / 4

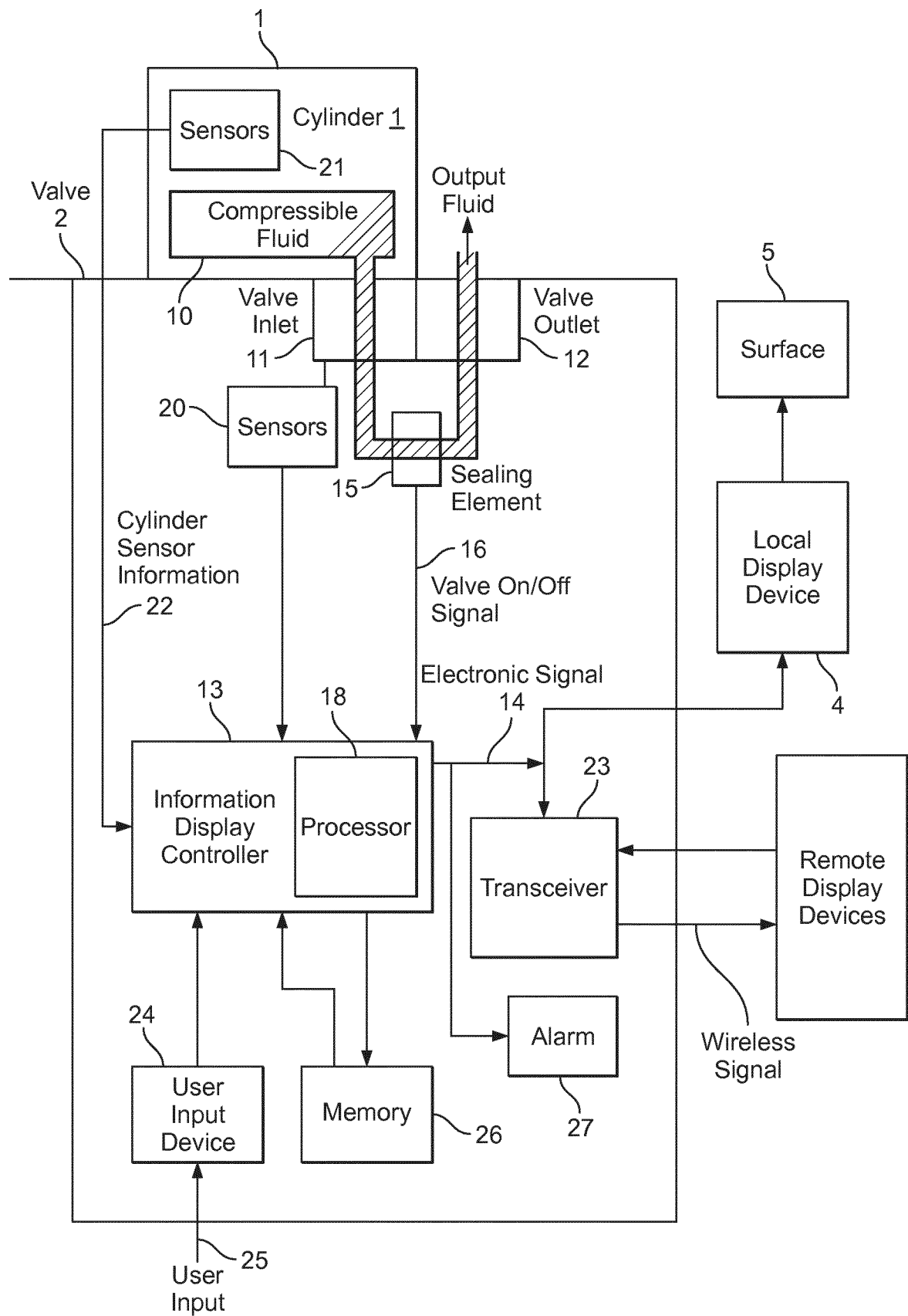


FIG. 2

3 / 4

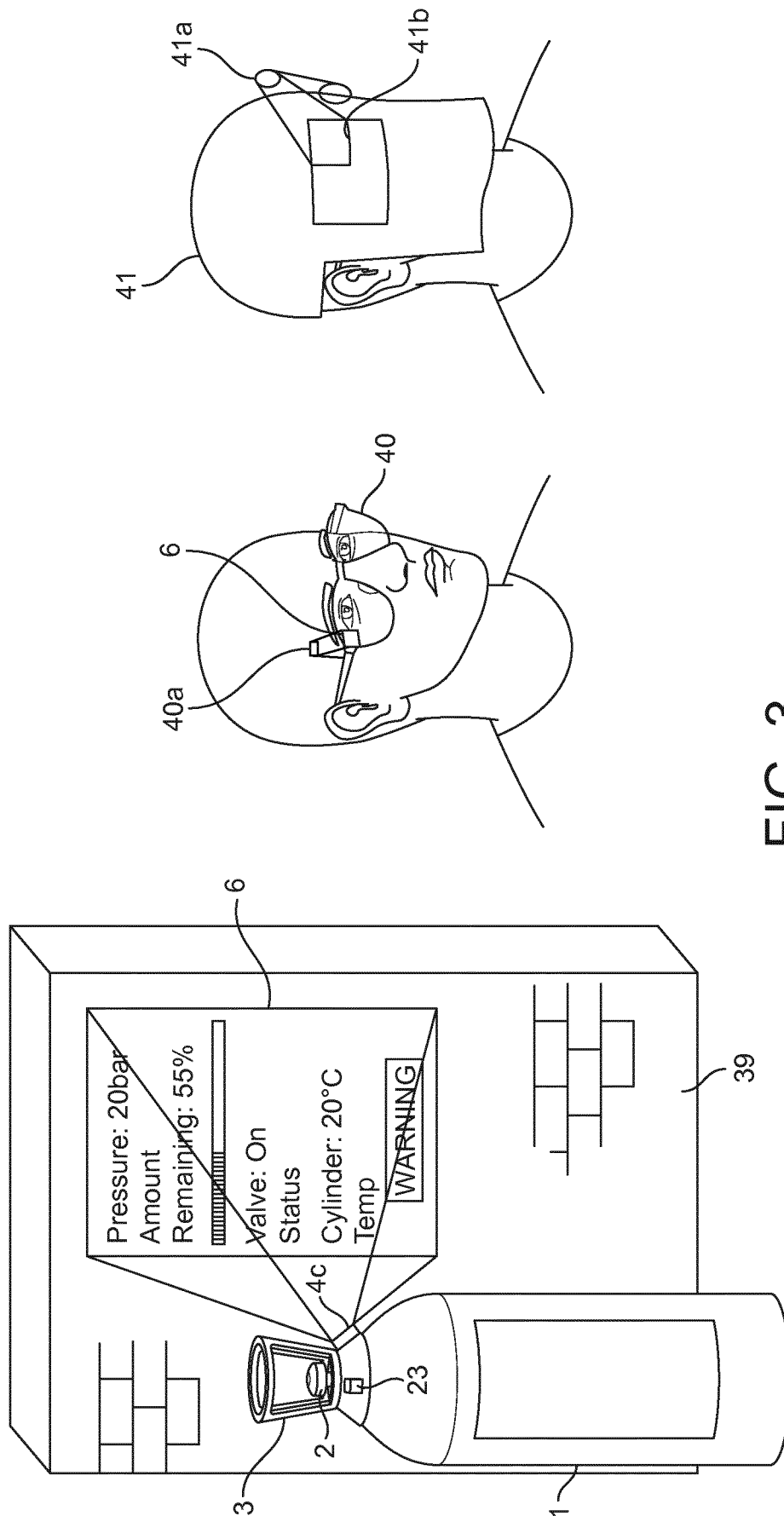


FIG. 3

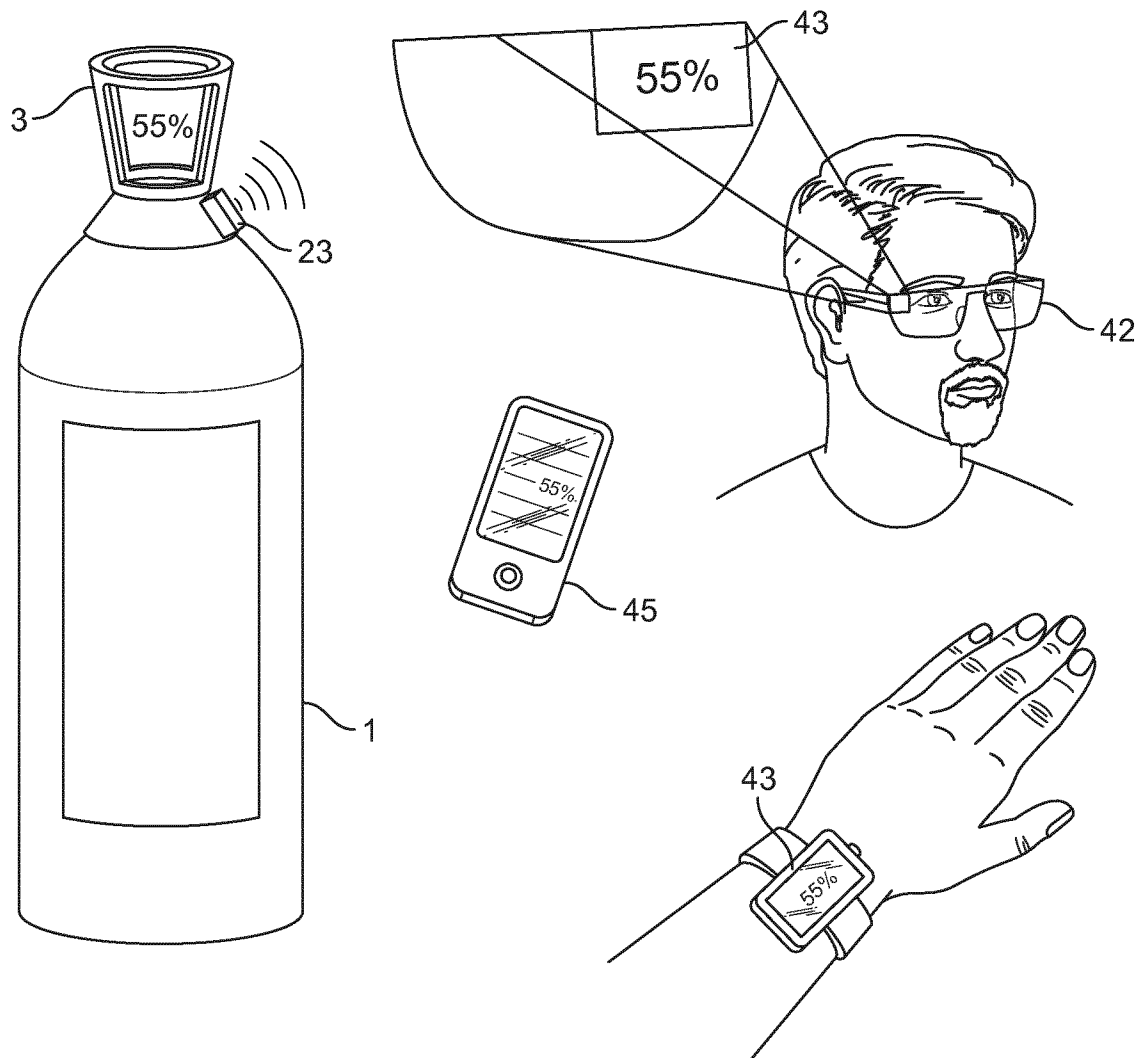


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/055887

A. CLASSIFICATION OF SUBJECT MATTER

INV. F17C13/02 F17C13/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F17C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 339 222 A2 (LINDE AG [DE]) 29 June 2011 (2011-06-29)	1,4-7, 12-15, 20,21
Y	columns 3-6; figures 1-4	2,3,5, 8-11,20
Y	----- US 2008/150739 A1 (GAMARD STEPHAN C F [US]) 26 June 2008 (2008-06-26)	8-11
A	paragraphs [0010], [0027] -----	1-3
X	US 2012/226451 A1 (BACOT PATRICK [FR] ET AL) 6 September 2012 (2012-09-06)	1-4, 6-14,18, 19,21
Y	pages 2,3; figure 1 -----	2,3,5,20
X	US 2014/214341 A1 (ROGERS JR DAVID DUANE [US]) 31 July 2014 (2014-07-31) page 1; claims 1,7; figure 9 -----	1-21



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

18 May 2016

Date of mailing of the international search report

09/08/2016

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/055887

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2339222	A2	29-06-2011	AR 079568 A1 01-02-2012
		AU 2010257296 A1 07-07-2011	
		BR PI1006084 A2 30-10-2012	
		CA 2725702 A1 21-06-2011	
		DK 2339222 T3 28-09-2015	
		EP 2339222 A2 29-06-2011	
		ES 2547275 T3 05-10-2015	
		NZ 590086 A 25-05-2012	
		PT 2339222 E 13-10-2015	
		US 2011309076 A1 22-12-2011	
		ZA 201009142 B 30-11-2011	

US 2008150739	A1	26-06-2008	NONE

US 2012226451	A1	06-09-2012	CN 102597720 A 18-07-2012
		EP 2499470 A1 19-09-2012	
		FR 2952432 A1 13-05-2011	
		JP 5951493 B2 13-07-2016	
		JP 2013510327 A 21-03-2013	
		US 2012226451 A1 06-09-2012	
		WO 2011058258 A1 19-05-2011	

US 2014214341	A1	31-07-2014	CN 103930708 A 16-07-2014
		EP 2753862 A2 16-07-2014	
		US 2014214341 A1 31-07-2014	
		WO 2013036243 A2 14-03-2013	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2016/055887

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-21

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-21

An electronic display system having a valve and a displaying device.

2. claims: 22-24

An electronic system having a valve and a device for wireless receiving the status of the valve, the cylinder or the compressible fluid.
