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(56) Documents Cited:
WO 2018/016935 A1 **WO 2016/146786 A1**
US 9721586 B1 **US 20170323584 A1**
US 20160163175 A1

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INT CL **F17C, G06F**
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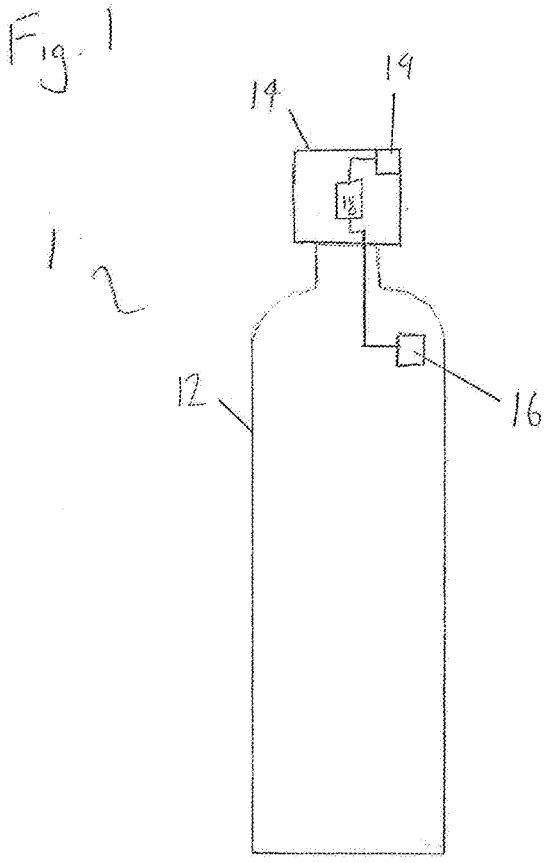
(54) Title of the Invention: **A system**
Abstract Title: **Wireless gas cylinder monitoring system with voice-activated base unit**

(57) A system comprising a gas cylinder 12 having a fill level sensor 16, such as a pressure or temperature sensor which can sense the fill level of the cylinder. The fill level sensor can communicate via a wireless connector 19 to a base station 2, which includes a microphone 26 and a speaker, and may receive a user's voice command and use it to query the fill sensor and relay back the fill level in the form of an audible signal indicative of fill level. The base station may be a commercially available smart speaker.



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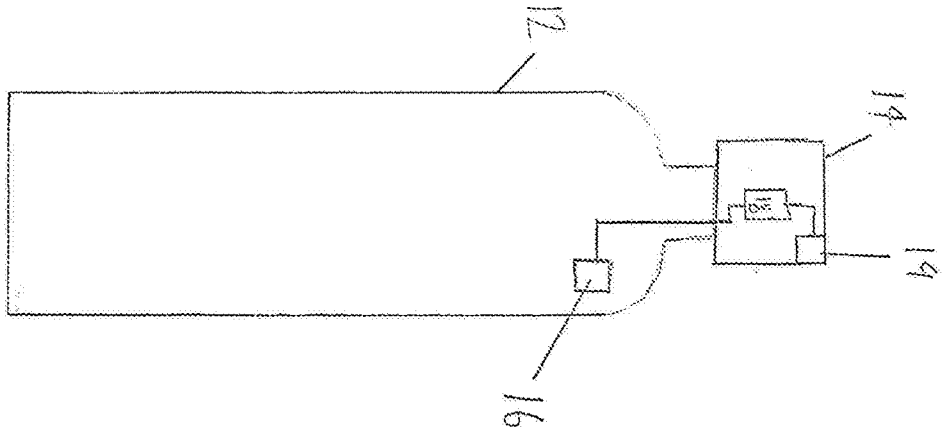
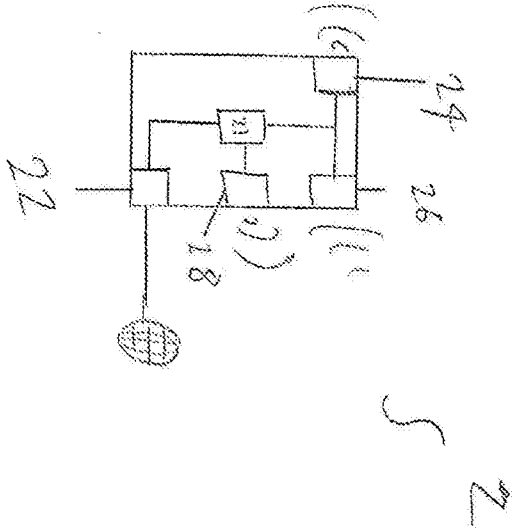


Fig. 1



A SYSTEM

The present invention relates to an improved system incorporating a gas cylinder assembly and a base unit.

Recent developments have seen many sensing systems, processors and associated servers detecting, processing and storing information regarding the content of compressed gas cylinders. However, this data is frequently in a format which is difficult to access and/or interpret for a lay user. Given that many compressed gas systems are deployed remotely, for example in the home of a patient, where there is not necessarily a technical contact always available there is a need for a simpler method for user interaction.

A system according to the present invention is provided according to claim 1. This system allows a user to easily determine the fill level of a gas cylinder and hence estimate its remaining use and carry out further tasks as necessary. This is particularly useful for a bed-ridden or disabled user of a cylinder. Furthermore, the energy intensive speech recognition and processing is carried out separate to the cylinder.

The system may further comprising a cylinder processor, arranged to determine: a time-averaged consumption rate of gas from the gas cylinder; and a predicted life of the gas cylinder, based upon the fill level and the time-averaged consumption rate, wherein the base processor is further configured to receive the predicted life and transmit a third signal to the sounder to generate the audible signal indicative of the predicted life. This allows prediction about remaining life to influence decisions.

The audible signal may comprise a query for the user to order a replacement or refill for the gas cylinder when the processor determines that the first or second condition is below a threshold value. This allows easy and quick ordering of replacements or refills.

The audible signal may be a spoken word response. This is easy for a user to comprehend.

The processor may be configured to compare the first signal to a security reference signal to determine whether the identity of the spoken word command matches an authorised user. This can ensure that the user has appropriate permissions to view the requested information or take a particular action.

A system according to the present invention is provided according to claim 6. This system allows for easy pairing of the valve and the cylinder.

The present invention will now be described, by way of example only, with respect to the accompanying figures in which:

Figure 1 depicts a schematic of a system.

Figure 1 shows a schematic of a system 100. The system 100 comprises a gas cylinder assembly 1 and a base station 2. The gas cylinder assembly 1 is formed of a gas cylinder 12 with a valve 14 attached thereto. The valve 14 controls the flow of fluid to and/or from the gas cylinder 12. The gas cylinder assembly 1 further comprises a sensor 16. The sensor 16 is arranged to detect a condition of the gas cylinder 12. In particular, the sensor 16 is arranged to detect the fill level of the gas cylinder 12. Additional components may also be provided in the gas cylinder assembly 1 as discussed further below. The sensor 16 may detect the fill level by detecting one or more of the pressure or temperature inside the cylinder 12.

The gas cylinder assembly 1 may further comprise a cylinder processor 18. The cylinder processor 18 is in an electrical communication with the fill level sensor 16 and may be arranged to predict the remaining life of the gas cylinder 12. That is, the amount of time that the gas cylinder 12 can continue outputting gas based upon standard and/or predicted usage rates. Standard usage rates may be predefined and stored in a memory, such as in an algorithm or look-up table. Alternatively, the processor 18 may determine a time-average consumption rate of gas from the gas cylinder 12 and use this time-average consumption rate in combination with the remaining fill level of the gas cylinder 12 to predict the remaining life of the gas cylinder 12. Alternatively, the gas cylinder assembly may directly or indirectly measure the flow rate. This could be achieved with a flow sensor, a positon sensor and/or a pressure sensor.

The processor 18 may calculate the remaining gas supply time based upon a pre-programmed formula or algorithm using different parameters as inputs. For example, the processor 18 may use properties of the gas, the gas volume and/or the gas temperature.

Alternatively, or in addition, some or all of the processing may be carried out remotely. For example, this may be carried out on a cloud-based server. The base unit 2 would transmit the data (raw or having undergone a first pass processing) to the cloud-based server for further processing.

Typically, power is supplied to the components of the gas cylinder assembly 1 from a locally connected battery. Alternatively, or in addition, energy harvesting techniques or devices could be used.

The base unit (or base station) 2 generally comprises a network connector 22 for connecting to the internet. In particular, this may connect to a cloud-based proprietary area. This may be a wired or wireless connection. A local connector 24 is provided for communication with the gas cylinder assembly 1. In particular, with a gas cylinder local connector 19 provided on the gas cylinder assembly 1. The local connectors 24, 19 may use any known wired or wireless technology to transmit information and data. For example, the local connectors 24, 29 may use Bluetooth. The base unit 2 further comprises a microphone or array of microphones 26 for receiving a spoken word instruction, and a sounder or array of sounders 28 for generating an audible signal. In particular the sounder 28 may be a speaker or beeper. In preferable embodiments, the sounder 28 may be suitable to generate an audible response signal, in particular a spoken word signal. The base unit 2 further comprises a processor 21 which is in electrical communication with the above-noted components of the base unit 2.

In use, the microphone 26 will receive a first audible instruction signal which is a spoken word signal form a user. The microphone 26 will then generate an electric signal indicative of this spoken word command which is transmitted to the base processor 21. The base processor 21 then processes this signal and interprets this command to determine the content thereof. In particular, if this command is an enquiry as to the fill level of the gas cylinder 12. The base unit 2 will then communicate with the gas cylinder assembly 1 via the local connector 24 and the gas cylinder local connector 19 to request communication of the fill level. The processor 21 will then further communicate with the sounder 28 to generate an audible signal indicative of the fill level.

Alternatively, or additionally, the predicted life of the gas cylinder 12 may also be communicated from the gas cylinder local connector 19 to the processor 21 and then on to the user.

In addition to any audible output from the base unit 2, a corresponding visual output may also be generated. This could be on a screen of the base unit 2, or on any other suitably connected device.

The remaining life calculated by the processor may further be transmitted to the base unit 2 and the base unit processor 21 may also generate a third signal to transmit to the sound which generates a further audible response which is indicative of the predicted life of this cylinder 12.

The user may, in response to the returned information from the base unit 2, decide to take a further action. This further action may include placing an order for refill or replacement of the gas cylinder 12.

The base unit processor 21 may further carry out an identification of the user to ensure that they are authorised to view information about the system or submit an order a replacement or refill. In certain embodiments, different users may have different authorisation levels which permit them to carry out different acts in relation to the system 100. In order to achieve this, the processor 21 may be configured to compare the signal received from the microphone 26 to a security reference signal. This may allow voice recognition to be carried out in order to determine the identity of the spoken word command. Alternatively, or additionally, any other recognition and authorisation technique or method may be used. For example, a companion mobile application on a user's mobile phone could be used to identify the user.

In practice, the base unit 2 may be a commercially available "smart speaker" or other household management devices. Examples of which include an Amazon Echo, Apple HomePod, Google Home or any other similar devices. Alternatively, the base unit 2 may be a proprietary system. This allows smart functionality to be imparted in a household system to a cylinder assembly 1 which is only required to have a local connector 19. As a result, the cylinder assembly 1 does not require more complex components than already incorporated to sense the data. Furthermore, the energy consuming steps of voice

recognition and processing can be carried out by the base unit 2 which is typically mains connected, thereby extending the life of the battery of the gas cylinder assembly 1. A specialised package of vocabulary related to the system 100 may need to be installed on the base unit 2.

In a further use of the present system 100, the base unit 2 may be used to generate a "pairing action" between a gas cylinder 12 and a valve for controlling the flow from the gas cylinder. Typically, the valves and gas cylinders 12 are produced separately and in smart systems must be paired together. This allows the valve to identify the content (i.e. what fill gas is inside the cylinder 12) as well as the total capacity of any given cylinder 12. This may be achieved by the valve having a sensor for ready a corresponding identifier on the gas cylinder. This identification may be triggered by an instruction from the use to the base unit which is then transmitted to the gas cylinder assembly 1.

There may be a plurality of cylinders 12, each of which has the features described above. These plurality of cylinders 12 may be in communication with a single base station 2. In this system 100 each cylinder 12 may have an identifier, such as a name or description or MAC address, which the base station 2 receives as a part of the user audible input in order to determine which cylinder 12 is being queried.

The base unit 2 may collect and aggregate information about the plurality of cylinders 12. This aggregated information may be collectively queried. For example, a user may enquire how many of a the plurality are empty.

A companion mobile application on a mobile device may also be provided in the system 100. This companion application may connect to either the gas cylinder assembly 1 or the base unit 2. Alternatively, the mobile device may be the base unit 2. The mobile device may allow for written commands to be received and transmitted.

CLAIMS:

1. A system comprising:

a gas cylinder assembly, comprising:

a gas cylinder;

a valve for controlling flow of fluid from the gas cylinder;

a sensor configured to generate a signal indicative of the fill level of the gas cylinder; and

a gas cylinder local connector configured to receive the signal from the sensor,

a base unit in communication with the gas cylinder assembly, the base unit comprising:

a network connector for connecting to the internet;

a base local connector for communication with the gas cylinder local connector;

a microphone for receiving a spoken-word command;

a sounder for generating an audible signal; and

a base processor in electrical communication with the network connector, the base local connector, the microphone and the sounder,

wherein the base processor is configured to:

receive a first signal from the microphone indicative of the spoken-word command;

interpret the first signal as an inquiry as to the fill level of the gas cylinder;

communicate with the gas cylinder local connector via the base local connector to enquire as to the fill level; and

transmit a second signal to the sounder to generate the audible signal indicative of the fill level.

2. The system of claim 1, further comprising a cylinder processor, arranged to determine:

a time-averaged consumption rate of gas from the gas cylinder; and

a predicted life of the gas cylinder, based upon the fill level and the time-averaged consumption rate,

wherein the base processor is further configured to receive the predicted life and transmit a third signal to the sounder to generate the audible signal indicative of the predicted life.

3. The system of claim 1 or 2, wherein the audible signal comprises a query for the user to order a replacement or refill for the gas cylinder when the processor determines that the first or second condition is below a threshold value.

4. The system of any preceding claim, wherein the audible signal is a spoken word response.

5. The system of any preceding claim, wherein the processor is configured to compare the first signal to a security reference signal to determine whether the identity of the spoken word command matches an authorised user.

6. A system comprising:

a gas cylinder assembly, comprising:

a gas cylinder having a capacity and a fill gas, the gas cylinder comprising an identifier indicative of the capacity and fill gas;

a valve for controlling flow of fluid from the gas cylinder, the valve comprising a sensor for reading the identifier to read the capacity and fill gas; and

a gas cylinder local connector,

a base unit in communication with the gas cylinder assembly, the base unit comprising:

a network connector for connecting to the internet;

a base local connector for communication with the gas cylinder assembly

a microphone for receiving a spoken-word command;

a base processor in electrical communication with the network connector, the base local connector, the microphone and the sounder,

wherein the base processor is configured to receive a first signal from the microphone indicative of the spoken-word command, interpret the first signal, and communicate with the gas cylinder assembly via the base local connector to instruct the sensor to read the identifier.

Intellectual Property Office

Application No:	GB1820575.7	**Examiner:**	Mr Michael Shaw
Claims searched:	1-6	**Date of search:**	6 June 2019

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-6	US 2017/323584 A1 [DANIEL et al.] see figure 4, abstract paragraphs [0027]-[0030]
Y	1-6	US9721586 B1 [AMAZON TECH INC] see figure 1, "background," section
Y	1-6	WO 2016/146786 A1 [HILTON et al.] see figures, WPI abstract accession no
Y	1-6	WO 2018/016935 A1 [ROSALES] see figures, especially figure 2 abstract
Y	1-6	US 2016/163175 A1 [JENKINS] see figures, abstract

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

F17C; G06F

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI, Patent Fulltext

International Classification:

Subclass	Subgroup	Valid From
F17C	0013/02	01/01/2006