June 20, 1967 L. R. PHILLIPS 3,326,212

BREATHING APPARATUS

Filed July 3, 1963 2 Sheets-Sheet 1

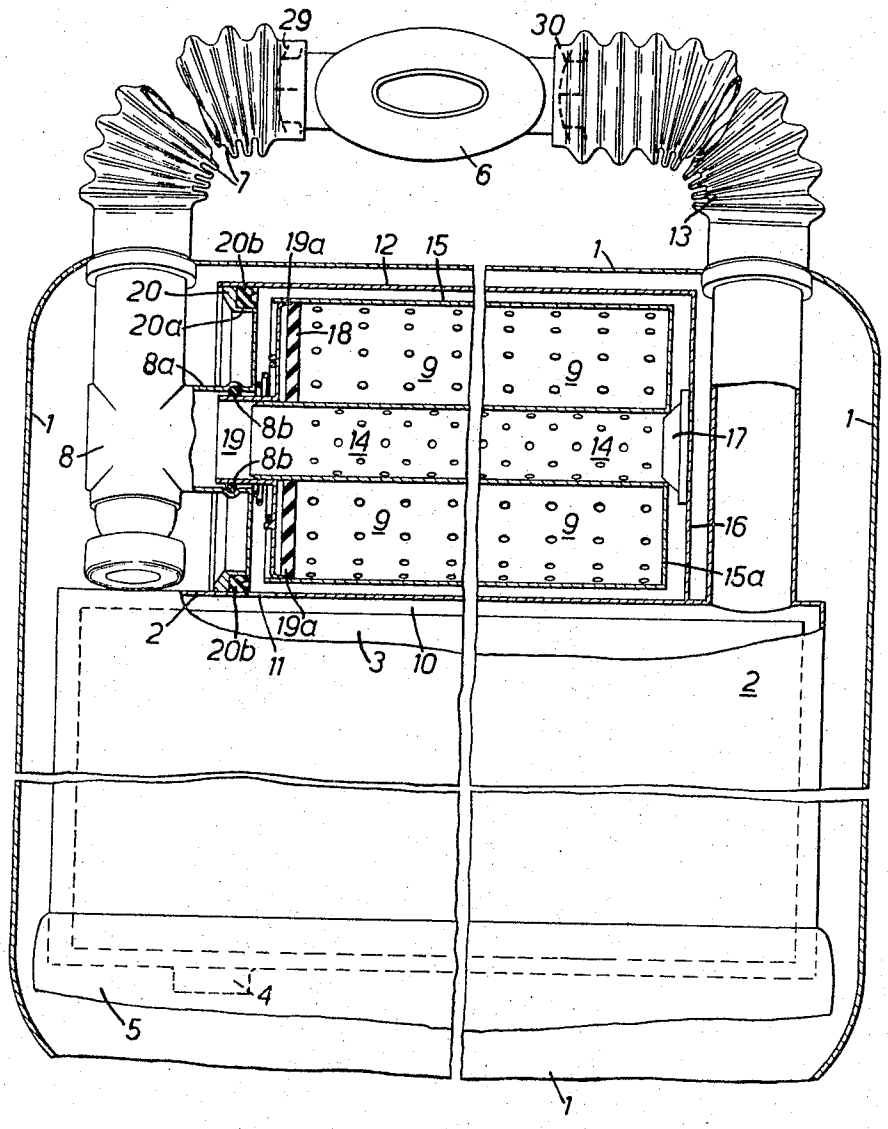


FIG. 1.

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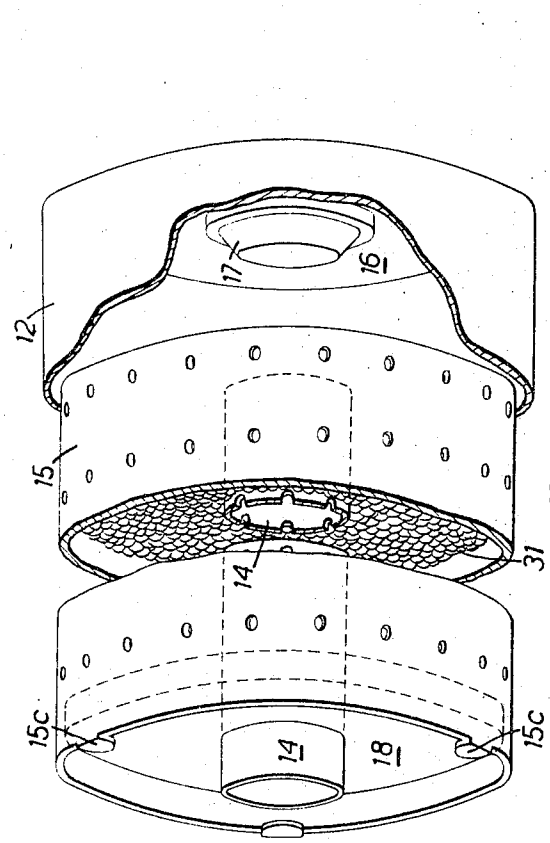


FIG. 2.

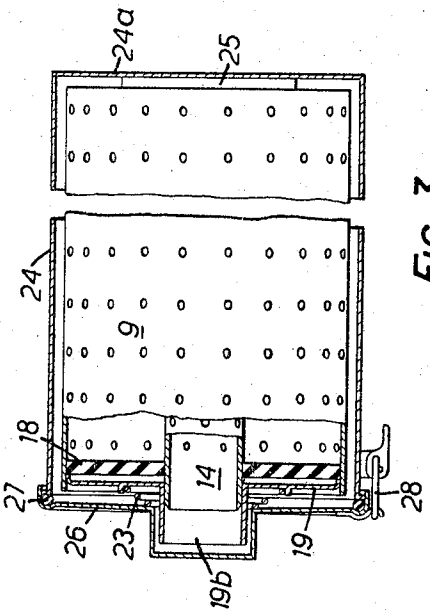
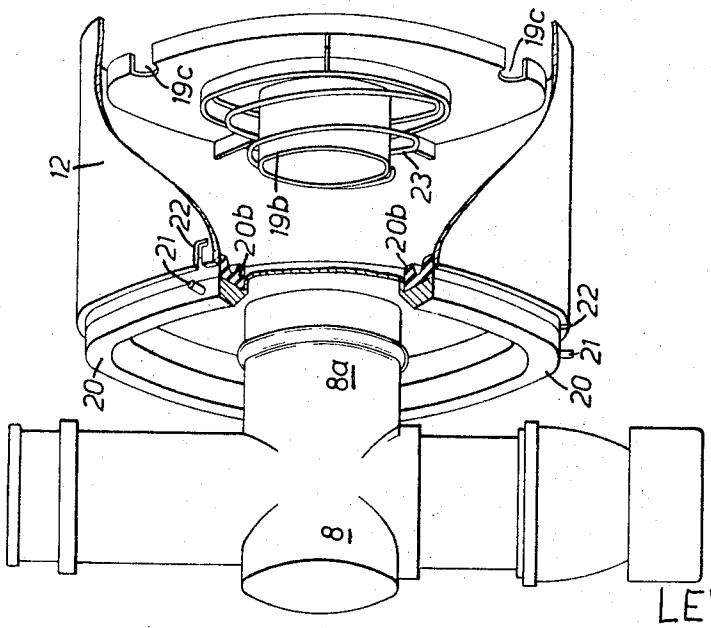


FIG. 3.



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United States Patent Office 3,326,212
Patented June 20, 1967

3,326,212

BREATHING APPARATUS

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Filed July 3, 1963, Ser. No. 292,523
Claims priority, application Great Britain, July 7, 1962, 26,153/62
3 Claims. (Cl. 128—147)

This invention relates to carbon dioxide trapping means for use with breathing apparatus, e.g. breathing apparatus of the kind known as self-contained oxygen breathing apparatus, in which a chemical charge is contained in a housing usually in the form of a canister, the carbon dioxide being removed from the air exhaled by the user by passing it through the chemical charge, which is gas adsorbent.

The present trend is to completely enclose the apparatus to protect it, and recharging of the chemical-containing canister after the charge has become too contaminated for further use has hitherto entailed the removal of the housing or canister from the apparatus so that it can be emptied, cleaned and recharged. Hereinafter, the term "canister" will be used to identify the housing, but it should be understood that any suitable compartment which may be used in the same manner as hereinafter described is contemplated under the term "canister," and in this connection, the present invention is also concerned with cartridges charged with the said chemical and particularly adapted for use with the canister of a form of the present invention.

According to the present invention, breathing apparatus includes a canister for containing the said chemical and is characterised in that the canister has opposed end wall parts one of which is formed with an inlet for the exhaled air, the other end wall part being adapted to afford a seating for one end of a cartridge charged with the said chemical and insertable in and removable from the canister, one end wall being adapted to serve as a closure lid for the canister and being displaceable relative to the remainder of the canister to permit of insertion and removal of the cartridge.

Further, in accordance with the present invention, breathing apparatus comprises a canister, a compartment adapted to contain a liquid oxygen evaporator, means to support within the canister a cartridge containing the chemical charge for absorbing carbon dioxide, said supporting means being adapted to locate the cartridge in perimetrically spaced relationship relative to the canister and to seal the exhaled air inlet of said cartridge from the space between the cartridge and canister, said space communicating with an air passage leading to said compartment, a pair of end walls with said canister, one of which is fixed relative to the canister, a seating with said latter end wall for the end of the cartridge remote from the end admitting exhaled air to the cartridge, the other end wall comprising a removable lid for the canister and provided with means to seal the exhaled air inlet of the cartridge from said space and to connect such end of the cartridge to the exhaling conduit of the apparatus.

Still further, in accordance with the present invention, breathing apparatus comprises a cartridge in the form of a receptacle charged with carbon dioxide absorbing material, a compartment containing a liquid oxygen evaporator, a canister into which the cartridge is loaded, a conduit extending axially along the interior of the cartridge and between which and the surrounding wall of the cartridge is loaded with said material, a relatively fixed end wall with said canister, a seating with said end wall for an opposed end of the cartridge, a removable lid to close the other end of the canister and formed with a central tubular part adapted to mate with one end of said conduit and connect such conduit to an exhaled air conduit, resilient means loading said lid axially with the opposed end of the cartridge and sealing means in said latter end of the cartridge to seal said material from the lid receiving end of the canister, said loading of the cartridge being transmitted to the cartridge from said resilient means via the said lid, sealing means and material, said cartridge being spaced perimetrically from the canister and its said conduit and its perimetrical wall being reticulated, the space between the perimeter of the cartridge and the canister communicating with the compartment containing the liquid oxygen evaporator.

Desirably, as an accessory of the present invention, a special container for storing a cartridge prior to loading it into the said canister is provided, such container including means to seal the interior of the cartridge from harmful atmospheric conditions. Briefly, such a container comprises a casing dimensioned approximately to the dimensions of the said canister and having a removable lid sealing an open end of the container through which the cartridge is removed. This lid is provided with resilient means applying an axial load to the cartridge in substantially the same manner as adopted by the lid of the canister of the breathing apparatus.

As the inner container may be charged and stored in its outer storage container, the invention provides a pre-filled disposable cartridge if it is made from a cheap material, or a pre-filled refillable cartridge if made from a more durable material, for example metal.

The invention may be performed in various ways, but one specific embodiment in which the canister is to be included in a closed circuit self-contained oxygen breathing apparatus will now be described with reference to the accompanying drawings, wherein:

FIGURE 1 is a broken part sectional elevation view showing a closed circuit self-contained breathing apparatus with a cartridge loaded therein.

FIGURE 2 is an exploded side elevation view in perspective showing the canister, cartridge and junction unit for connecting the canister to the exhaled air circuit, some of the parts being broken away for clarity.

FIGURE 3 is an axial section showing a cartridge loaded in a storage container.

Referring to FIGURE 1 of the drawings, the outer casing which is provided with the usual harness for carrying it on the person, is indicated by the reference numeral 1, the compartment therein for the liquid oxygen evaporation and its evaporator by the reference numerals 2 and 3 respectively, it being understood that the compartment 2 at its base communicates as at 4 with the usual breathing bag 5. The air exhaled by the user is from the mouthpiece 6 via a hose 7, junction T-piece 8 into a cartridge, indicated generally by the reference numeral 9, from the cartridge to the narrow space 10 in the compartment 2 surrounding the evaporator 3 via an outlet 11 in a canister 12 into which the cartridge is loaded. The cartridge 9 contains the granular chemical charge 31 (see FIGURE 2) by which the carbon dioxide is absorbed, the purified

air then being re-circulated back to the mouthpiece **6** via a hose **13** after having negotiated the space **10**. Desirably the cartridge **9** is of the radial flow type, the chemical charge being arranged in the form of an annulus between a perforated tube **14** and the cylindrical wall **15** of the cartridge, this wall being reticulated for the passage of purified air into the canister **12**. Thus, the exhaled air flows radially outwardly through the granular charge, the carbon dioxide being absorbed on the surface of the granules and the cleaned air being tapped off from the outer surface of the cartridge.

It will be understood that the ends of the mouthpiece **6** which receives the appropriate ends of the hose members **7** and **13** are provided with the usual non-return exhale and inhale valves **29** and **30** respectively.

The canister **12** (also see FIGURE 2) in which the chemical charge is loaded comprises a main substantially cylindrical body integral with or fixed alongside the compartment **2**. One end of the canister is closed by an end wall plate **16** provided with a concentric conical rubber seating **17** which abuts in the opposed end of the tube **14**, about the other ends of which is fitted a cellular annular rubber sealing member **18** between which and the closed end wall **16**, the charge of chemical material **31**, e.g. soda-lime, is placed under axial pressure. The tube **14** is integral with an end wall **15***a* of the cartridge casing.

The other end of the cartridge casing is open for loading it with the chemical charge, and when charged it is closed by means of a removable wall **19** which is in the form of a dished lid, the flange **19***a* of which mates in the cartridge wall **15** and abuts against and desirably partly overlaps, the annual sealing member **18**. Formed integrally with the removable wall **19** is a concentric hollow boss **19***b* which mates as a close plug fit in the tubular limb **8***a* of the T-piece **8**. A sealing ring **8***b* is provided in the limb **8***a* to isolate the canister **12** from the intake end of the tube **14**, the limb **8***a* being formed with a flange **20** provided with radial pins **21** which engage in bayonet slots **22** in the appropriate end of the canister **12**.

The wall or lid **19** has in its periphery semi-circular cutouts **19***c* which line up with semicircular lugs **15***c* bent inwards from the rim of the cartridge casing **15**, so that when wall or lid **19** is placed in cartridge **15** and rotates a few degrees it will be secured firmly in position.

Interposed between the wall **19** closing the open end of the cartridge casing **15** and the flange **20** is an involute compression spring **23**, so that when the flange **20** is locked by the bayonet joint in the canister **12** the spring **23** is compressed to load the wall or lid **19** and cellular rubber member **18** against the charge of chemical material to maintain it in a compacted condition.

The flange **20** is stepped as at **20***a* to carry a sealing ring **20***b*, desirably of the chevron or channel section type as shown, and the outer diameter part of such flange, with the sealing ring **20** makes a gas-tight joint with the open end of the canister **12**. Thus it will be seen that in order to remove the cartridge for replacement thereof, it is only necessary to impart a slight twist to the T-piece **8** to disengage the pins **21** from the slots **22**, and free the end assembly **8** and **20** from the canister **12** to leave the cartridge loose for removal.

In normal use, the cartridge is refilled with soda-lime, the rubber pad **18** placed in position and flange or end wall **19** inserted and rotated to a locked position. The cartridge is then placed inside canister **12** and the T-piece **8** and flange **20** then fitted, making gas-tight joints by the seals **8***b* and **20***b* simultaneously. The main purpose for including the rubber pad **18** is to prevent a possible uninterrupted gas path across the end of the cartridge.

Each cartridge may be provided with its own end wall **19** carrying the spring **23**, and pending use of a cartridge it may be stored in a cylindrical casing **24** as shown in FIGURE 3.

The cartridge storage casing is closed at one end by an integral wall **24***a* provided with a rubber pad **25** against which the appropriate end of the cartridge is loaded by the compression of the spring **23** between the wall **19** and a lid **26** fitted onto the casing **24** and provided with a sealing ring **27**, any suitable form of fastening means, e.g. snap action latches **28** being provided to retain the lid **26** in position.

I claim:

1. In a closed circuit liquid air or liquid oxygen breathing apparatus, a container for the liquid air or liquid oxygen, a cartridge charged with carbon dioxide absorbing material, a canister accommodating and spaced about the cartridge, an intake tube for exhaled air extending along said cartridge, a compartment spaced about and accommodating the said container for the liquid air or liquid oxygen, said canister and compartment being united as a unitary structure and communicating directly one with the other, a breathing bag united directly to said compartment, a mouthpiece, an exhale conduit connecting said mouthpiece to one end of said intake tube of the cartridge, an inhale conduit extending directly to the mouthpiece from the space between the said compartment and the container for liquid air or liquid oxygen, means connecting said latter space directly to the breathing bag, said intake tube of the cartridge communicating with the said space between the canister and cartridge via the said material in the cartridge, an end wall closing one end of said canister and fixed relative to the canister and joined to said compartment, means securing the cartridge detachably on said canister and sealing said intake tube from direct communication with the said space between the canister and cartridge, said latter means including a lid mated removably in the end of the canister remote from said end wall of the canister.

2. A closed circuit breathing apparatus according to claim **1**, in which the side walls of the said canister and compartment are formed in continuity with each other, and in which the breathing bag has its upper end secured closely about the base of the said compartment, the end walls of the said canister being stepped inwardly relative to the end walls of the said compartment, the inhale conduit at its end remote from the mouthpiece being rigidly joined to the said compartment at one of the steps and thereby extending upwardly alongside the adjacent end wall of the canister, said exhale tube extending closely alongside the other end wall of said canister so as to lie axially in opposition to the other of said steps, an outer casing enclosing the canister, compartment and breathing bag and the parts of the inhale and exhale conduits located alongside the ends of the canister.

3. In a closed circuit liquid air, or liquid oxygen, breathing apparatus provided with a container for the liquid air or liquid oxygen, and with a cartridge charged with carbon dioxide absorbing material, a tube extending axially along and surrounded by said material, a canister accommodating the said cartridge and spaced about the cartridge, a compartment spaced about and accommodating the said container, the said canister and compartment being united as a unitary structure, a breathing bag united directly to said compartment, an outlet in said canister establishing direct communication between the space around the cartridge and the space between the compartment and the liquid air or liquid oxygen container accommodated in said compartment, a mouthpiece, an exhale conduit connecting said mouthpiece to one end of said tube, said tube being perforated to release radially therefrom exhaled air derived from said exhale conduit into said material, a relatively fixed end wall closing one end of said canister and the other end of said tube, an outer wall of said cartridge being perforated so as to release radially throughout its length the purified air from the said material into said space in the canister surrounding the cartridge, an inhale conduit extending directly from said space in said compartment to the mouthpiece, means connecting the said latter space di-

rectly to the breathing bag, and a removable lid closing the other end of the canister and formed with a central tubular part mating with the said one end of the said tube.

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