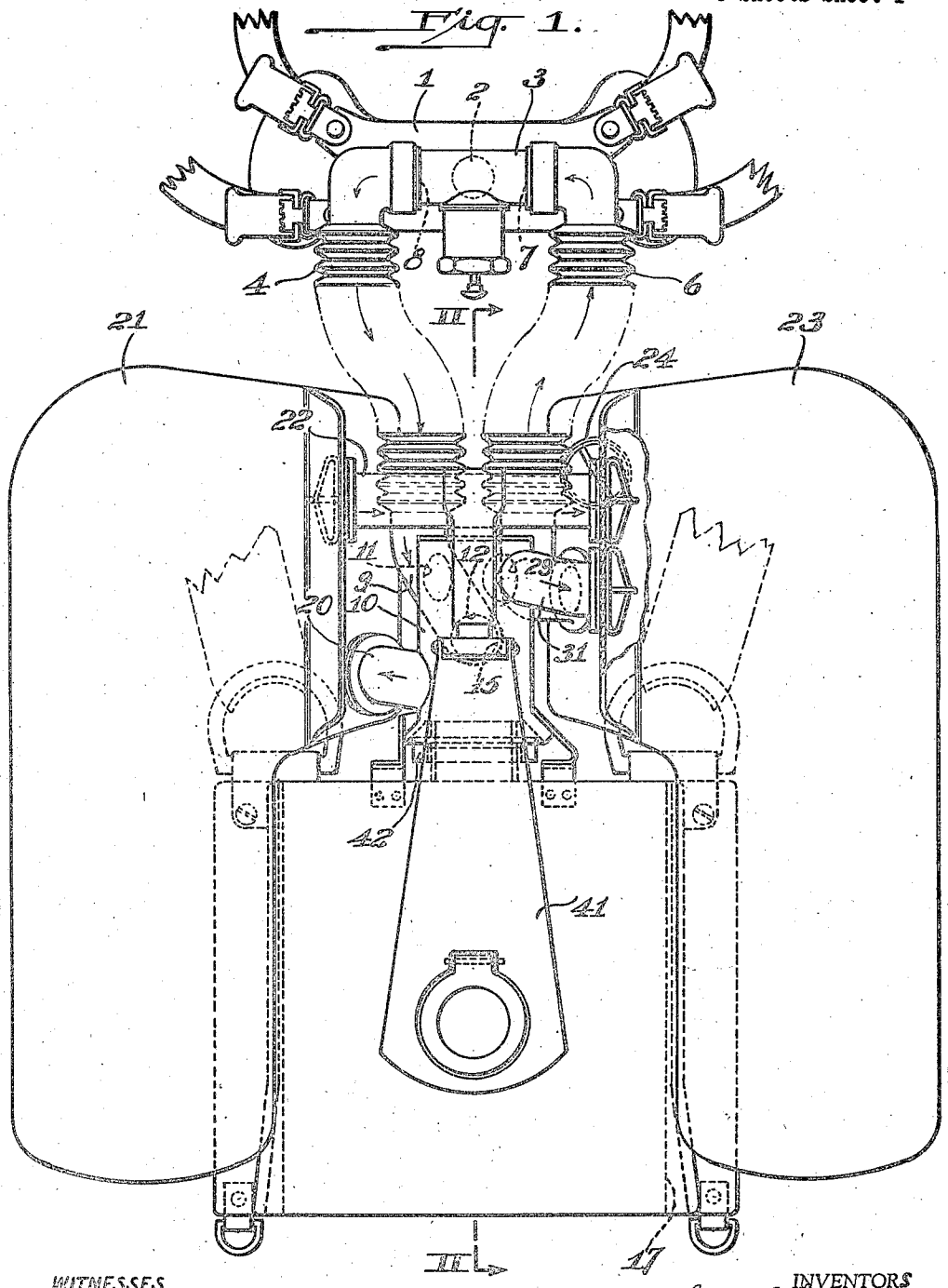
July 16, 1946. C. B. JACKSON ET AL 2,403,981

BREATHING APPARATUS

Filed Nov. 1, 1939 3 Sheets-Sheet 1

Fig. 1.



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BREATHING APPARATUS

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Fig. 2.

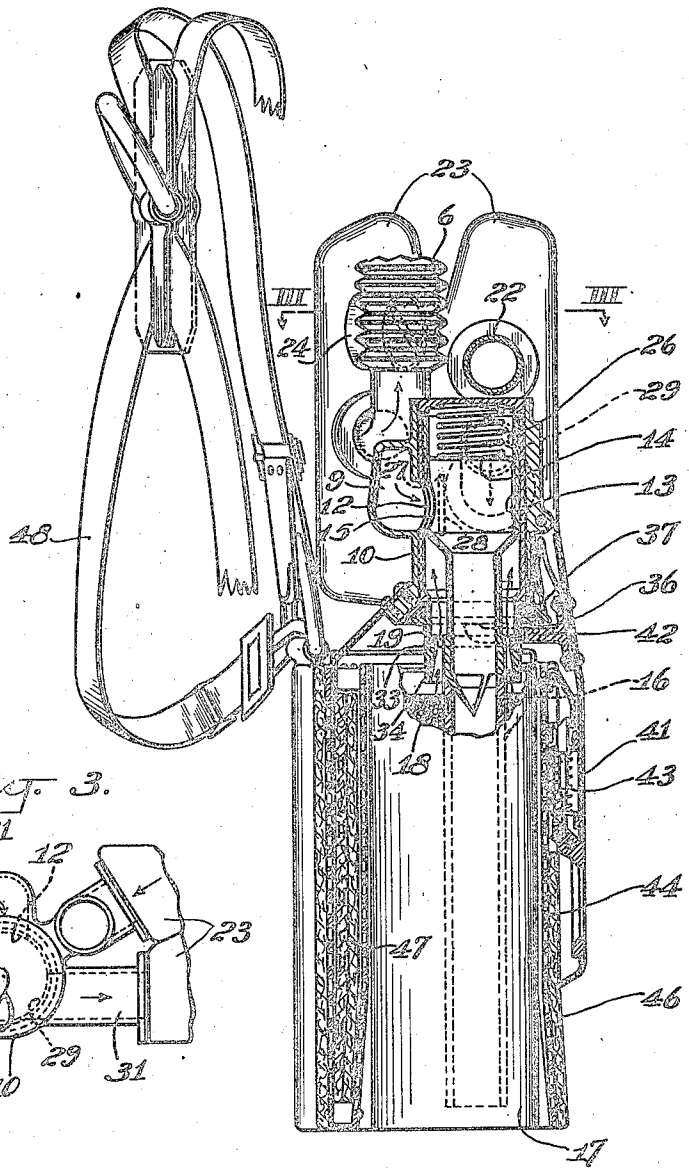
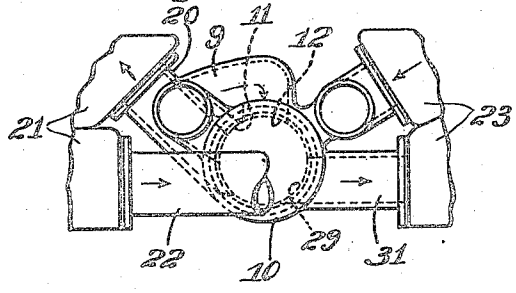


Fig. 3.



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BREATHING APPARATUS

Filed Nov. 1, 1939 3 Sheets-Sheet 3

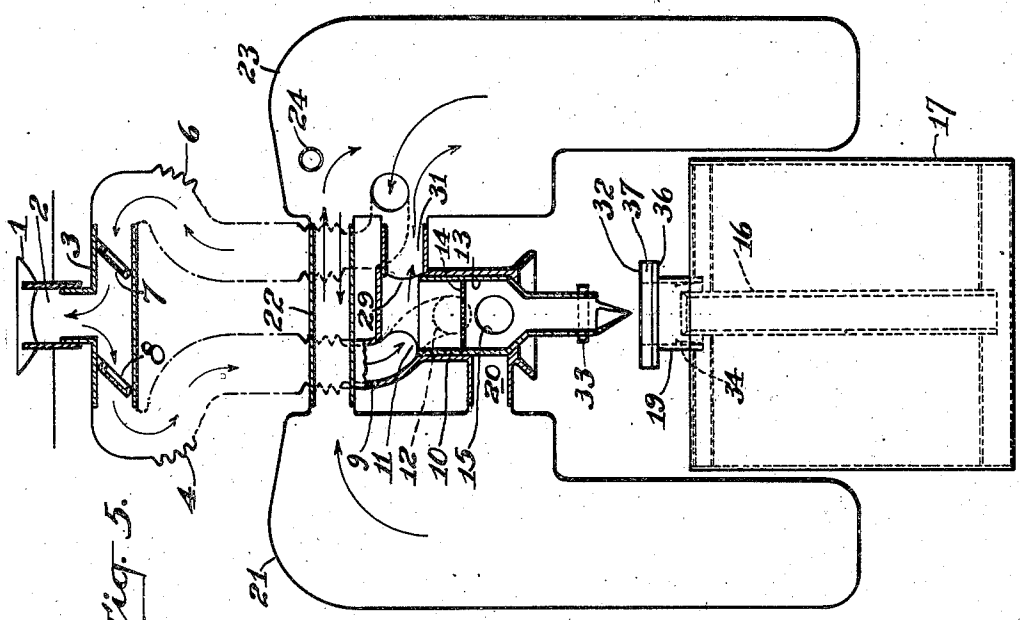


Fig. 5.

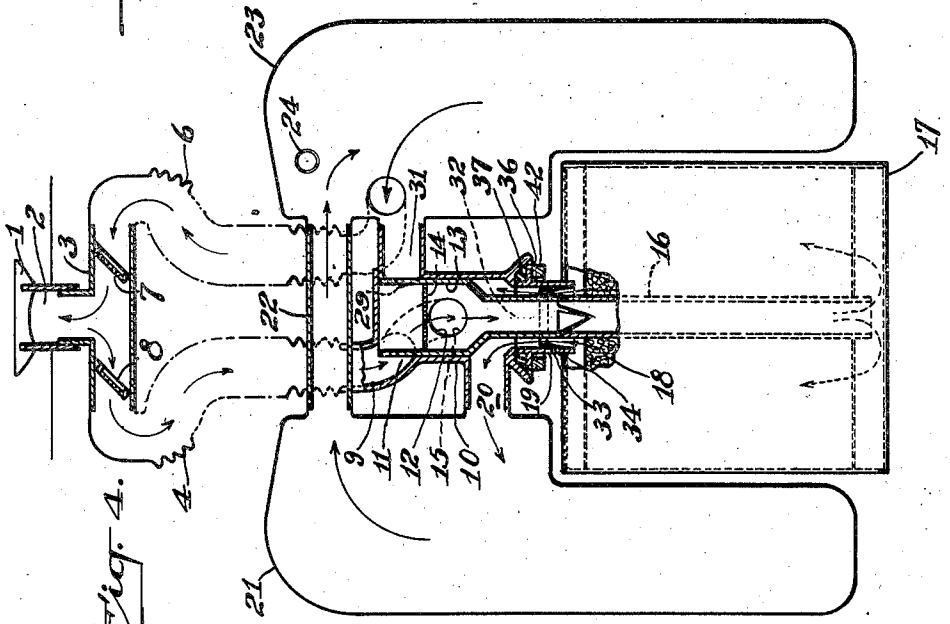


Fig. 4.

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UNITED STATES PATENT OFFICE

2,403,981

BREATHING APPARATUS

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Application November 1, 1939, Serial No. 302,358

5 Claims. (Cl. 128—191)

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This invention relates to breathing apparatus, and more particularly to a self-contained type of apparatus with which the wearer breathes in a closed fluid circuit.

A major disadvantage of self-contained breathing apparatus is that an exothermic chemical reaction in an air-purifying canister raises the temperature of the air to be breathed to the point where it is very uncomfortable to breathe. Another disadvantage is that whenever a canister requires replacement, the removal of the canister in the fluid circuit opens the circuit to the surrounding vitiated atmosphere, wherefore the wearer must return to pure air every time he needs to replace a canister. This materially limits the uninterrupted time that can be spent in a noxious or poisonous atmosphere, which may seriously interfere with the work being done.

It is among the objects of this invention to provide breathing apparatus in which the wearer breathes in a closed circuit, in which a single canister absorbs carbon dioxide and liberates oxygen, in which the purified air is cooled before inhalation, in which the air-purifying canister can be quickly removed and replaced without interfering with the breathing cycle in the closed circuit, and in which the wearer continues to breathe in a closed circuit while the canister is removed.

In accordance with this invention a face-piece is connected by an exhalation tube to a canister that contains chemicals suitable for removing carbon dioxide from exhaled air and for evolving oxygen. The outlet of the canister is connected by one or more breathing bags, preferably two, to an inhalation tube that leads back to the face-piece. These breathing bags serve as a reservoir for air and also cool the air from the canister. The canister is detachably locked in position so that it may be removed when the materials therein are spent. To prevent the wearer from breathing poisonous or noxious air while the canister is being replaced, means is provided for automatically closing the passages to and from the canister when it is removed and for maintaining a closed breathing circuit.

The preferred embodiment of the invention is illustrated in the accompanying drawings in which Fig. 1 is a front view of my breathing apparatus; Fig. 2 is a vertical section taken on the line II—II of Fig. 1; Fig. 3 is a fragmentary horizontal view taken on the line III—III of Fig. 2; Fig. 4 is a diagrammatic view illustrating the breathing circuit when the air-purifying canister is in place; and Fig. 5 is a similar diagrammatic view showing the breathing circuit while the canister is removed.

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Referring to Figs. 1, 4 and 5 of the drawings, a face-piece 1 is shown which fits over only the mouth of the wearer so that his nose must be closed by a clamp (not shown), but it is apparent that a face-piece may be used which is large enough to cover both nose and mouth. The center of the face-piece is provided with a breathing opening 2 to the outer end of which is connected a rigid horizontal breathing tube 3 that terminates in two downwardly extending flexible tubes 4 and 6. Exhalation takes place through only tube 4 because a check valve 7 mounted in the opposite end of rigid tube 3 prevents air from passing out through tube 6 which serves as an inhalation tube. A check valve 8 at the other end of the rigid tube prevents inhalation through tube 4. At the center of tube 3 there is a downwardly extending saliva trap 5 from which saliva can be released at will.

The exhalation tube is connected to a passage 9 (Figs. 2 and 3) that enters the back of an open bottom vertical cylinder or valve casing 10 near its top at 11 (Figs. 1 and 3) and also about halfway down at inlet 12. As shown in Fig. 2, slidably disposed in this cylinder is a slide valve or hollow plunger 13 that has a solid partition 14 near its upper end, a reduced tubular lower portion provided with a piercing end 25, and an opening 15 in its side wall that registers with inlet 12 when the valve is in its raised position. The open lower end of this plunger is seated in the top of a central vertical tube 16 in an air-purifying canister 17 below it so that exhaled air will pass down through this tube, out of its bottom and up through a carbon dioxide absorbing and oxygen liberating chemical 18 in the canister. The respirable air leaving the canister passes upwardly between its neck 19 and the plunger and into the lower part of cylinder 10 from which a short conduit 20 extends into a flexible breathing bag 21, shown in all but Fig. 2. The upper part of this bag is connected by a horizontal conduit 22 to the upper portion of a similar breathing bag 23 disposed at the opposite side of the apparatus. Air from this second bag is conducted back to the face-piece through inhalation tube 6. Thus a breathing circuit closed to the atmosphere is defined and includes a passage through the canister. To prevent undue air pressure from building up in this apparatus, bag 23 is provided with a relief valve 24.

In order to permit a spent canister to be replaced by a fresh one without shutting off the

breathing circuit or opening it to the atmosphere, slidably mounted plunger 13 is urged downwardly in cylinder 10 by a coil spring 26 (Fig. 2) compressed between the top of the cyinder and valve partition 14. The plunger is prevented from rotating by means of a pin 27 which projects into a vertical slot 28 in the cylinder wall. When the canister is removed spring 26 forces the plunger downwardly in the cylinder and thereby closes inlet 12 and conduit 20 and uncovers inlet 11 in the upper portion of the cylinder. At the same time the plunger uncovers an outlet 29 in the side of the cylinder which is connected by a short conduit 31 to breathing bag 23, and the tapered central portion of the plunger closes the bottom of the cylinder, as indicated in Fig. 5. Consequently, this action of the plunger closes off the breathing circuit from the atmosphere and establishes communication through cylinder inlet 11 and outlet 29 between exhalation tube 4 and conduit 31 leading to bag 23 and inhalation tube 6.

To mount a new canister in this apparatus it is moved upwardly against the pointed lower end of the plunger which punctures the metal foil 32 sealing the canister neck and enters the upper end of canister tube 16 to the extent that engaging surfaces of the canister and plunger form a joint therebetween. An annulus 33 on the plunger centers the plunger in the canister neck and engages a shoulder 34 whose upward movement pushes the plunger back up into the valve casing until inlet 12 and passage 20 are opened and inlet 11 and passage 31 are closed, thereby connecting the canister into the closed breathing circuit. Above a flange 36 the top of the canister neck is encircled by a gasket 37 that engages the flaring lower end of cylinder 11 to seal the space between them, as shown in Figs. 2 and 4. This flaring lower end guides the canister and centers it relative to the cylinder.

To detachably lock the canister in operative position a lever 41, which is hinged at its upper end to the front of valve casing 11, is provided with a rearwardly extending bifurcated arm 42 that straddles the canister neck when swung inwardly by the lever and forces flange 36 upwardly to press gasket 37 against the bottom of the valve casing. This lever is held in open and closed positions by a suitable spring-actuated locking device 43 (Fig. 2), part of which is mounted on the front of the open bottom canister receptacle 44 that is rigidly suspended from the valve casing. This receptacle is enclosed in heat-insulating material 46 because the chemical reactions that take place in the canister generate considerable heat. For the same purpose the body-engaging side of the receptacle is provided interiorly with spacing members 47 by which the canister is spaced from its rear wall. The carrying harness 48 for this apparatus is connected to the canister receptacle.

The breathing circuit can be better understood by reference to Figs. 4 and 5. In normal use when the canister is in place, as in Fig. 4, exhaled air passes out of the face-piece through exhalation tube 4 and into the valve plunger through registering openings 12 and 15. The exhaled air passes on down through the hollow plunger and canister tube 16 to the bottom of the canister, and then is purified and supplied with oxygen as it passes up through the chemical. The respirable air leaves the canister through the space between its neck and the valve plunger and enters the bottom of the valve casing which it immediately leaves through passage 20 opening into breathing bag 21. From this bag the air passes

through conduit 22 to breathing bag 23 and then through inhalation tube 6 back to the face-piece.

A feature of this invention is that sufficient air in the circuit can come in contact with a sufficient amount of breathing bag surface area to adequately cool the air for breathing. Two bags are preferred to one large bag because they make the apparatus less bulky and also because more air apparently comes in contact with the inner surfaces of the bags for they more effectively cool it than one large bag.

When the canister is removed for replacements, as shown in Fig. 5, the valve plunger closes the bottom of the cylinder or valve casing and communication between openings 12 and 15 is likewise cut off. However, when the plunger drops it opens inlet 11 and outlet 29 so that the exhalation tube is now connected by the upper portion of the valve casing with passage 31 leading to bag 23. Bag 21 is connected with the other bag only by conduit 22, so air flows in and out of bag 21 through that conduit while passage 20 is closed. There is sufficient air in the two bags to permit normal breathing for a period long enough for changing canisters. Consequently, the wearer does not have to return to an atmosphere of respiratory air for the change. Insertion of a new canister raises the valve plunger and again establishes the breathing circuit shown in Fig. 4.

According to the provisions of the patent statutes, we have explained the principle and method of practicing our invention and have illustrated and described what we now consider to represent its best embodiments. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. Self-contained breathing apparatus comprising a face-piece, an exhalation tube connected thereto, a removable air-purifying canister having an inlet communicating with said tube and having an outlet, a check valve in said tube, a breathing bag connected to the canister outlet, an inhalation tube connected to the face-piece, a second breathing bag connecting to said first bag and inhalation tube, a check valve in said inhalation tube, and means operable upon removal of the canister for cutting off communication between the exhalation tube and first bag and the canister and connecting said second bag with said exhalation tube.

2. Self-contained breathing apparatus comprising a face-piece, an exhalation tube connected thereto, a removable canister having an inlet communicating with said tube and having an outlet, a check valve in said tube, carbon dioxide absorbing and oxygen liberating material in the canister, a breathing bag connected to the canister outlet, an inhalation tube connected to the face-piece, a second breathing bag connecting to said first bag and inhalation tube, a check valve in said inhalation tube, said second bag being provided with an auxiliary inlet, and means normally closing said auxiliary inlet, said means being automatically displaced when the canister is removed for cutting off communication between the exhalation tube and canister and establishing communication between the exhalation tube and said auxiliary inlet.

3. Self-contained breathing apparatus comprising a face-piece, exhalation and inhalation tubes connected thereto, a check valve in each tube, a removable air-purifying canister having

a neck surrounded by a flange and serving as an inlet and an outlet, a valve member provided with a portion projecting into said neck, a breathing bag connected to said inhalation tube and said neck around said projecting portion, said valve member having a passage therethrough connecting said exhalation tube and canister, means operative upon removal of the canister for moving said valve to close said passage, said valve establishing communication between the exhalation tube and said bag when the canister is removed, and detachable means for engaging the bottom of said flange to support the canister.

4. Self-contained breathing apparatus comprising a face-piece, exhalation and inhalation tubes connected thereto, a check valve in each tube, a removable air-purifying canister provided with substantially concentric inlet and outlet ports, and a valve communicating with said tubes and said ports, said valve being formed for actuation by engagement with the canister whereby to establish communication through the valve between said tubes and ports, and said valve being formed for shutting off communication between it and the atmosphere when the canister is removed.

5. Self contained breathing apparatus com-

prising a face piece, inhalation and exhalation conduits each provided with check valves and communicating with said face piece, a removable air-purifying canister provided with substantially concentric inlet and outlet ports, and a valve for selectively interconnecting said conduits with said canister ports or interconnecting said conduits with each other in response to the operative juxtapositioning and removal of said canister respectively, said valve comprising a casing provided with ports communicating with said conduits and an aperture arranged to coapt the outer canister port, a valve element in said casing having a tubular portion apertured to coapt the inner canister port, said tubular portion projecting through said aperture in the casing and movable in the casing axially of said apertures and having ports and channels so arranged therein with respect to the casing as to provide intercommunication between said conduits and respective canister ports at an inner position thereof and to provide intercommunication between said conduits while occluding all channels to the canister coapting apertures at an outer position thereof.

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