Jan. 27, 1948. S. S. PRENTISS 2,434,956

LIQUID OXYGEN WALKAROUND UNIT

Filed Nov. 5, 1945

Fig 1

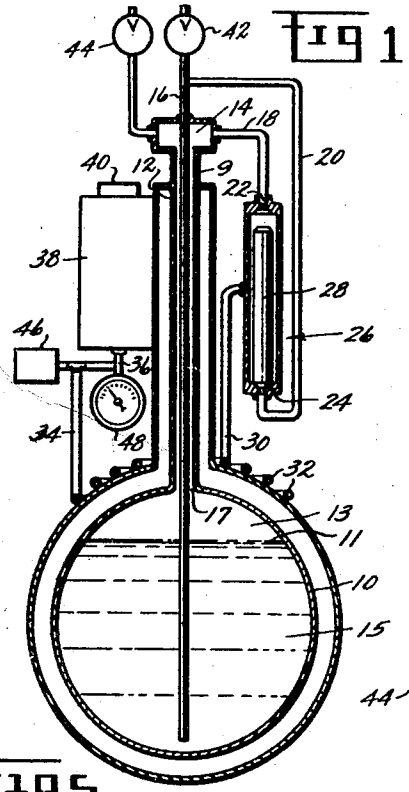


Fig 2

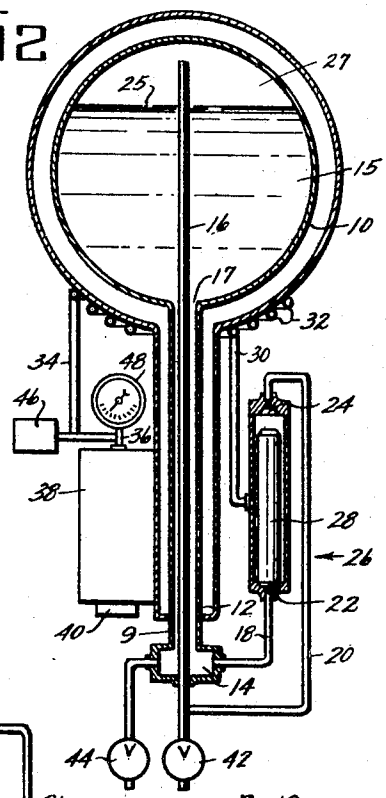


Fig 3

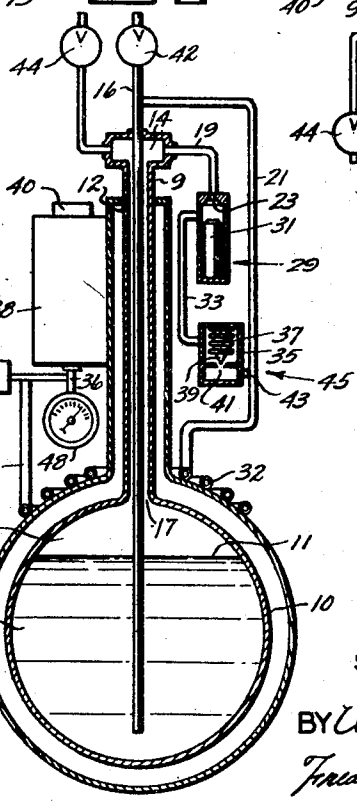


Fig 4

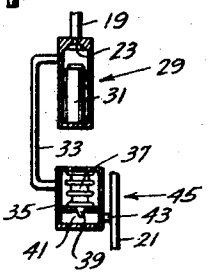
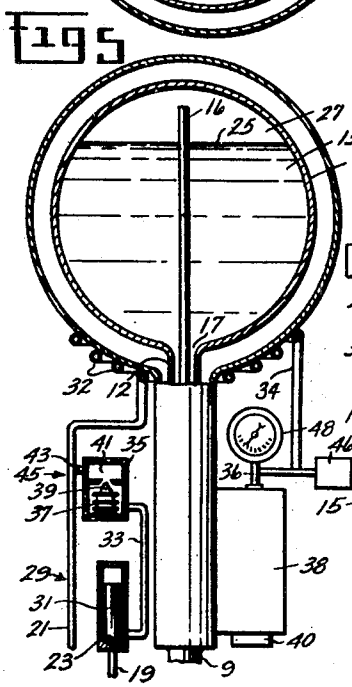


Fig 5



INVENTOR
SPENCER S. PRENTISS

BY Clarke Coonty AND
Frederick W. Cotterman
-ATTORNEYS-

Patented Jan. 27, 1948 2,434,956

UNITED STATES PATENT OFFICE

2,434,956

LIQUID OXYGEN "WALKAROUND" UNIT

Spencer S. Prentiss, Washington, D. C., assignor to The United States of America, as represented by the Secretary of War

Application November 5, 1945, Serial No. 626,870

9 Claims. (Cl. 62—1)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

The invention described herein may be manufactured and used by or for the Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to a portable oxygen "walkaround" unit having reference to a unit of such weight and capacity as may be carried about on the person to supply the user with breathing oxygen for a period of several hours.

An object of this invention is to provide a unit of this class having storage space for liquid oxygen and having means to convert the liquid oxygen into breathing oxygen as fast as is required.

Another object of the invention is to provide an oxygen unit in which the takeoff will always be connected to that part of the container in which the oxygen is in the gas phase no matter whether the container is upright or inverted.

Another object of the invention is to provide means whereby the normal rate of conversion from the liquid to the gas phase may be augmented at the will of the user.

Another object of the invention is to provide means whereby the normal rate of conversion from the liquid to a gas phase may be augmented automatically to maintain a given preselected gas pressure.

Other objects and advantages will be recognized as the invention is further described with reference to the drawings wherein:

Fig. 1 is a schematic view showing a device embodying my invention in its normal operating condition.

Fig. 2 is a schematic view showing the device in position to increase the normal rate of conversion from the liquid phase to the gas phase.

Fig. 3 shows a modification of the device in the normal operating condition, this modification being provided with automatic means for controlling conversion from the liquid to the gas phase.

Fig. 4 shows the action of the device of Fig. 3 when breathing oxygen is being drawn off faster than the normal conversion rate.

Fig. 5 shows the action of the device of Fig. 3 when it has for any reason been inverted.

Like reference characters refer to like parts throughout the several views.

A vacuum-jacketed vessel 10 which may be of the "Dewar" type of appropriate size, preferably one-half to one litre capacity, has an extension 9 of the neck 12 of the vessel provided with a closure 14. The line 11 indicates the level of the liquid oxygen 15 in the vessel 10 when the device is upright as seen in Fig. 1, the space 13 above

2

the line being filled with oxygen in the gaseous state. A tube 16 enters the top of the closure 14, being pressure-sealed where it enters, thence loosely downward through the neck extension 9 and the neck 12 leaving a space 17 between them, then downward substantially to the bottom of the vessel. Conduit means 18 and 20 connect the closure 14 and the tube 16 respectively to the upper and lower passageways 22 and 24 of a gravity-operated valve 26.

The gravity-operated valve 26 has a weighted valve member 28 which normally rests on and closes the lower passageway 24 but will close the passageway 22 and open the passageway 24 when the device is inverted as shown in Fig. 2 in which the line 25 represents the level of the liquid oxygen 15 in the vessel 10 and the space 27 that part of the contents which is in the gaseous state. The takeoff 30 from the valve 26 proceeds to the inner turn of a warming coil 32 which spirals around the neck 12, the turns lying against the jacket of the vessel 10 to which jacket they may be soldered or similarly secured for mechanical support as well as for thermal conductivity.

The outer turn of the warming coil 32 proceeds by way of a conduit 34 to the input side 36 of a demand regulator. This regulator consists of any of the several commercially available designs which are well known in the art but may preferably be of the diluter type for economy of operation. The output side 40 of the demand regulator is connected to an oxygen mask not shown.

As an alternative, the demand regulator may be replaced by a valve and a constant-flow regulator by using a suitable economizer such as a rubber breather bag or similar device. A filler valve 42 is provided at the outer end of the tube 16 and a vent valve 44 communicates with the closure 14. A safety valve 46 and a pressure gauge 48 are connected to the conduit 34.

The operation of the device shown in Figs. 1 and 2 is substantially as follows:

The filler valve 42 is connected to a source of liquid oxygen under several p. s. i. pressure and opened, the vent valve 44 being simultaneously opened and left open until liquid oxygen flows therefrom showing that the device is completely filled with the liquid. Both of the valves 42 and 44 are then closed and disconnection of the valve 42 from the supply source is effected and the apparatus placed in a upright position until it is to be used.

When thus filled and stored, the pressure will

build up at a rate of not more than several p. s. i. per hour, so that no oxygen will be wasted for several hours, that is, not until the pressure builds up to the value at which the safety valve 46 is set, which value may preferably be about 125 p. s. i. In use the device may be attached to the user by means of a standard clothes clip, a small spring scale being interposed between the clip and the device to indicate the state of the charge. When the wearer's mask is attached to the demand regulator, oxygen taken from the demand regulator may be replenished by flow from the space 13, through the space 17 between the inside of the neck 12 and the tube 16, through the extension 9 into the closure 14, thence through the conduit 18, gravity valve 26, conduit 30, warming coil 32 and conduit 34 into the demand regulator. This path may hereinafter be referred to as the primary fluid channel.

Gas phase oxygen will usually be used faster than the normal conversion rate, thereby lowering the pressure and consequently lowering the boiling point. When the pressure approaches a minimum value for satisfactory operation of the demand regulator, as may be evidenced by the gauge 48 or by the resistance to breathing, the apparatus may be inverted for a short period of time as in Fig. 2. It is noted that the higher the pressure at which the safety valve 46 is set, the less frequently the device must be inverted for a given oxygen consumption.

When the device is inverted as in Fig. 2, the member 28 of the gravity valve 26 drops, thereby opening the passageway 24 and closing the passageway 22. Moreover, the gas space, which in Fig. 1 was at 13 above the line 11, will, in Fig. 2, be at 27 above the line 25. Furthermore, in the normal position Fig. 1, the space 17, extension 9, closure 14 and conduit 18 were filled with gas phase oxygen, and the pipe 16 and conduit 20 contained liquid, while in the inverted position of Fig. 2, the space 17, extension 9, closure 14, and conduit 18 contained liquid and the pipe 16 and conduit 20 contained gas.

It follows that, when the device is inverted as shown in Fig. 2, the extension 9, closure 14 and conduit 18, being without heat insulation, warm the liquid, thereby raising its boiling point and increasing the pressure for more rapid conversion, the converted gas phase oxygen passing down through the tube 16 and through the conduit 20, passageway 24, gravity valve 26, conduit 30, warming coil 32, conduit 34 to the demand regulator. This path may hereinafter be referred to as the secondary fluid channel. When the gauge 48 indicates that the pressure has again reached the desired value, the device may be returned to the upright position.

In the modification shown in Figs. 3 to 5, the same "Dewar" container 10, pressure gauge 48, safety valve 46, closure 14 and demand regulator 38 may be used in the same way hereinbefore described. The gravity valve 29 of the modified device, however, is operative only when the apparatus is inverted as shown in Fig. 5 where the valve member 31 has closed the passageway 23.

The device, Figs. 3 through 5 is further modified by the addition of a pressure controlled "sylphon"-operated bypass valve 45 which comprises a casing 35 in which a "sylphon" 37 has the upper end secured to the top of the casing, the inside of the "sylphon" having been filled with air or other suitable gas at a predetermined pressure and sealed, and the lower end being provided with a valve member 39 which is forced by expansion of the "sylphon" to close the passageway 41 which prevents fluid flow through the passageway 43 into the conduit 21. By providing the inside of the "sylphon" with a preselected initial pressure when the valve 39 is in closed position, the pressure at which the gas phase oxygen around the "sylphon" will keep the valve 39 off its seat 41, may be selectively controlled. For purposes of illustration let it be assumed that it is required to maintain the gas phase oxygen around the outside of the "sylphon" at a pressure of approximately 16 p. s. i. to keep the valve 39 open, 16 p. s. i. being about as low as will safely operate the demand regulator. A conduit 33 connects the gravity-operated valve 29 to the "sylphon"-operated valve 45. The conduit 21 connects the tube 16 to the inside turn of the warming coil 32. The conduit 19 connects the closure 14 to the passageway 23 into the gravity valve 29.

The operation of the modified apparatus shown in Figs. 3 through 5 is substantially as follows:

The device should first be filled with liquid oxygen at several p. s. i. pressure as described with reference to Fig. 1. It is noted that when the vessel is being filled, the valve part 39 will be on the seat 41. When conversion has thereafter proceeded until the valve part 39 rises from the seat 41, oxygen under at least 16 p. s. i. will pass through the primary fluid channel which includes the space 17, container 14, conduit 19, gravity valve 29, conduit 33 "sylphon"-operated valve 45, coil 32 and conduit 34, to the demand regulator.

If no oxygen is immediately used, the pressure may build up to a point where the safety valve 46 opens, which may be assumed for illustrative purposes, to be at about 45 p. s. i. This low safety valve setting is practicable in this exemplification of the invention where recharging is automatic, whereas, in the first exemplification described, a higher safety valve setting is desirable to lessen the number of times that the user must give his attention to inverting the device for recharging. On the other hand, if oxygen is used faster than the normal conversion rate, the pressure in the casing 35 around the "sylphon" 37 will fall until the "sylphon" valve 45 closes as seen in Fig. 4, whereupon liquid oxygen 15 will be taken from the bottom of the container 10 and passed through the secondary fluid channel which includes the tube 16, conduit 21, coil 32 and conduit 34, to the demand regulator 38. Since the conduits 21 and 34 and coil 32 are exposed to the atmosphere, pressure will build up rapidly within the container 10, neck 12, closure 14 and "sylphon"-valve 45 and again open the valve for normal operation as in Fig. 3.

From the foregoing it will be seen that, because of movement of oxygen through a secondary channel when more is used than is normally converted, the entire charge may be expended without attention by the user.

Should the device for any reason become inverted and the gravity valve 29 thereby closed as seen in Fig. 5, liquid oxygen will extend into a part of the primary channel which includes the neck extension 9, closure 14, and conduit 19, to be warmed for conversion, and gas phase oxygen will flow from the space 27 above the line 25 through the secondary channel which includes the tube 16, conduit 21, coil 32 and conduit 34 to the demand regulator. Discharge by way of the safety valve 46 will occur if the apparatus is left in the inverted condition, Fig. 5, for too long a period.

Having shown and described several forms of my invention, I claim:

1. In a device for storing liquid oxygen to be carried on the person and for converting it into breathing oxygen and delivering it to a demand regulator as fast as needed, a heat insulated container adapted to hold the liquid oxygen, said container having an opening in the top, a hollow closure for said opening whereby the inside of said container is connected to the hollow of said closure, a vent valve connected to the hollow of said closure, a tube extending pressure tight through the top of said closure to a point near the bottom of said container, a warming coil having its turns lying on and secured to the outer surface of said container and around said opening, a conduit connecting said tube at a point above said closure to the inner turn of said warming coil, a second conduit connecting the outer turn of said warming coil to said demand regulator, a safety valve and a pressure gauge connected to said second conduit, a gravity valve operative to be open when the device is upright and closed when the device is inverted, a pressure operated valve operative to be open when the pressure within the device is above a predetermined value and closed when said pressure is below said predetermined value, and passageways connecting the hollow of the closure to the inlet side of said gravity valve, the outlet of said gravity valve to the inlet of said pressure operated valve, and the outlet of said pressure operated valve to the first said conduit.

2. In a device for storing liquid oxygen to be carried on the person and for converting it into breathing oxygen and delivering it to a demand regulator as fast as needed, a heat insulated container adapted to hold the liquid oxygen, said container having an opening in the top, a hollow closure for said opening whereby the inside of said container is connected to the hollow of said closure, means to vent the hollow of said closure, a tube extending pressure tight through the top of said closure to a point near the bottom of said container, a warming coil having its turns lying on the outer surface of said container and around said opening, a conduit connecting said tube at a point above said closure to one end of said warming coil, a second conduit connecting the other end of said warming coil to said demand regulator, a gravity valve operative to be open when the device is upright and closed when the device is inverted, a pressure operated valve operative to be open when the pressure within the device is above a predetermined value and closed when said pressure is below said predetermined value, and passageways connecting the hollow of the closure to the inlet side of said gravity valve, the outlet of said gravity valve to the inlet of said pressure operated valve, and the outlet of said pressure operated valve to the first said conduit.

3. In a device for storing liquid oxygen and for converting it into gaseous oxygen and controlling its delivery to a demand regulator, a heat insulated container adapted to hold the liquid oxygen, said container having an opening in the top, a hollow closure for said opening whereby the inside of said container is connected to the hollow of said closure, a tube extending pressure tight through the top of said closure to a point near the bottom of said container, a warming coil having its turns lying on the outer surface of said container, a conduit connecting said tube at a point above said closure to one end of said warming coil, a second conduit connecting the other end of said warming coil to said demand regulator, a valve adapted to be open when the device is upright and closed when the device is inverted, a second valve operative to be open when the pressure within the device is above a predetermined value and closed when said pressure is below said predetermined value, and passageways connecting the hollow of the closure to the inlet side of the first said valve, the outlet of the first said valve to the inlet of said second valve, and the outlet of said second valve to the first said conduit.

4. In a device for storing liquid oxygen and for controlling its conversion into gaseous oxygen and its delivery to a demand regulator, a heat insulated container adapted to hold the liquid oxygen, a tube extending into said container to a point near the bottom, said container being sealed against leakage around said tube, a warming coil, a fluid conducting means connecting said tube at a point outside said container to said warming coil, a second conduit connecting said warming coil to said demand regulator, a valve operative to be open when the device is upright and closed when the device is inverted, a second valve operative to be open when the pressure within the device is above a predetermined value and closed when said pressure is below said predetermined value, and passageways connecting the top of the container to the inlet side of the first said valve, the outlet of the first said valve to the inlet of said second valve, and the outlet of said second valve to the first said conduit.

5. In a device for storing liquid oxygen and controlling its conversion into gas phase oxygen, a heat insulated container, a warming coil outside said container, a primary fluid channel from the inside of said container at the top thereof to said warming coil, a secondary fluid channel from the inside of said container at the bottom thereof to said warming coil, and two means in said primary channel, one operative to automatically close said primary channel whenever the device is inverted, and the other operative automatically to close said primary channel whenever the pressure in said primary channel falls below a predetermined value.

6. In a device for storing liquid oxygen and controlling its conversion into gas phase oxygen, a heat insulated container, a warming coil outside said container, a normally open primary fluid channel from the inside of said container at the top thereof to said warming coil, a normally closed secondary fluid channel from the inside of said container at the bottom thereof to said warming coil, and gravity actuable means to close the primary fluid channel and open the secondary fluid channel whenever said device is inverted.

7. In a device for storing liquid oxygen and controlling its conversion into gas phase oxygen, a heat insulated container, a warming coil outside said container, a primary fluid channel from the inside of said container at the top thereof to said warming coil, a secondary fluid channel from the inside of said container at the bottom thereof to said warming coil, and a gravity actuable valve, operative when the device is upright, to open said primary fluid channel and close said secondary fluid channel, and operative when the device is inverted, to close said primary fluid channel and open said secondary fluid channel.

8. In a device for storing liquid oxygen and controlling its conversion into gas phase oxygen, a heat insulated container, a warming coil out-

side said container, a primary fluid channel from the inside of said container at the top thereof to said warming coil, a secondary fluid channel from the inside of said container at the bottom thereof to said warming coil, and gravity actuated means associated with said primary fluid channel automatically operating when the device is inverted to close said primary fluid channel, whereby fluid may flow only through the secondary fluid channel.

9. In a device for storing liquid oxygen and controlling its conversion into gas phase oxygen, a heat insulated container, a warming coil outside said container, a primary channel from the inside of said container at the top thereof to said warming coil, a secondary channel from the inside of said container at the bottom thereof to said warming coil, and means associated with said primary channel automatically operative when the device is inverted to close said primary fluid channel, whereby fluid may flow only through said secondary fluid channel.

SPENCER S. PRENTISS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,505,095	Heylandt	Aug. 19, 1924

FOREIGN PATENTS

Number	Country	Date
622,756	Germany	Dec. 5, 1935