

Nov. 21, 1939.

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2,180,631

PORTABLE OXYGEN THERAPY APPARATUS

Filed Aug. 27, 1936

2 Sheets-Sheet 1

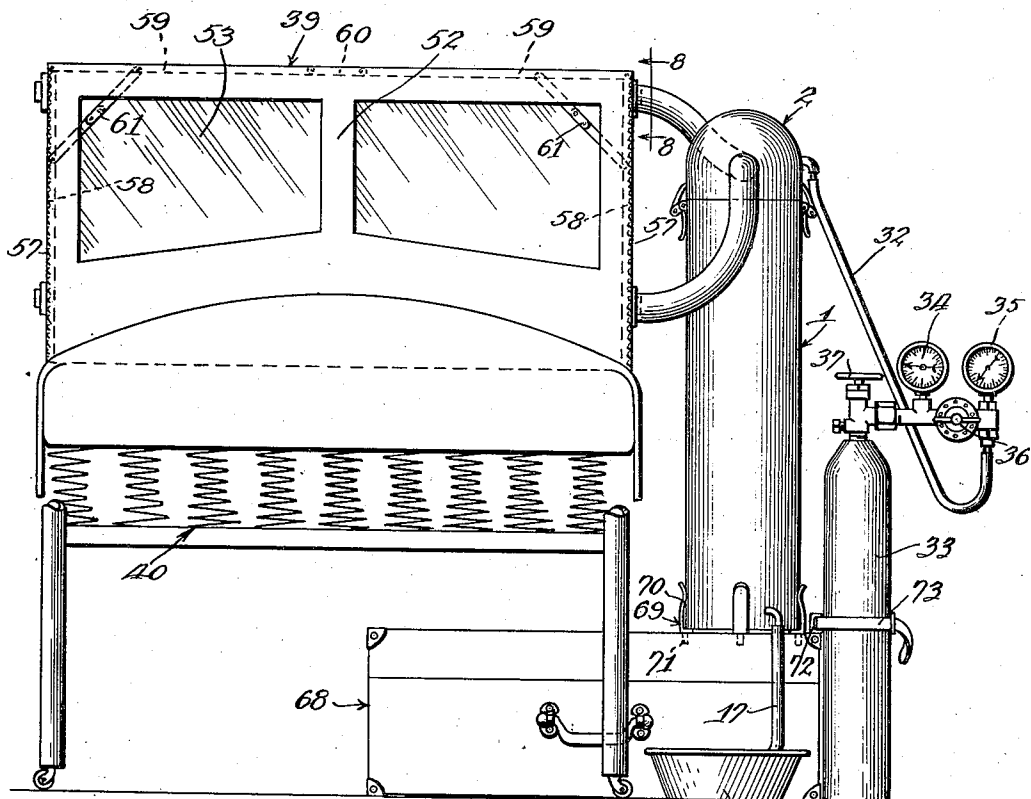


Fig. 1.

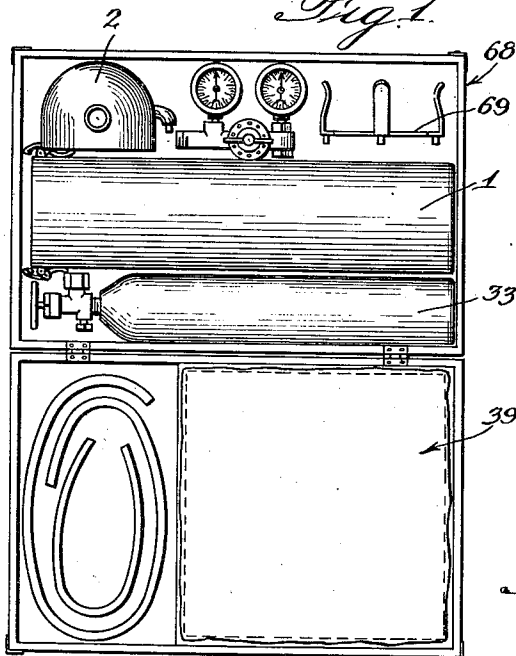


Fig. 2.

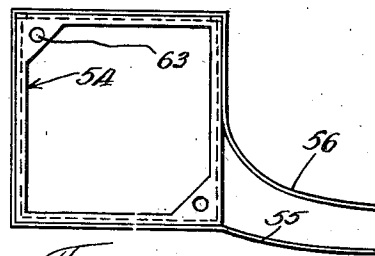


Fig. 3.

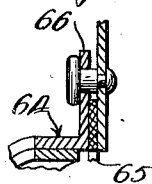


Fig. 4.

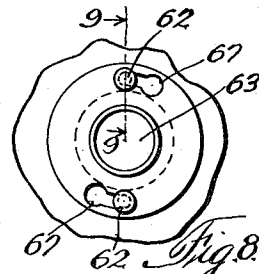


Fig. 5.

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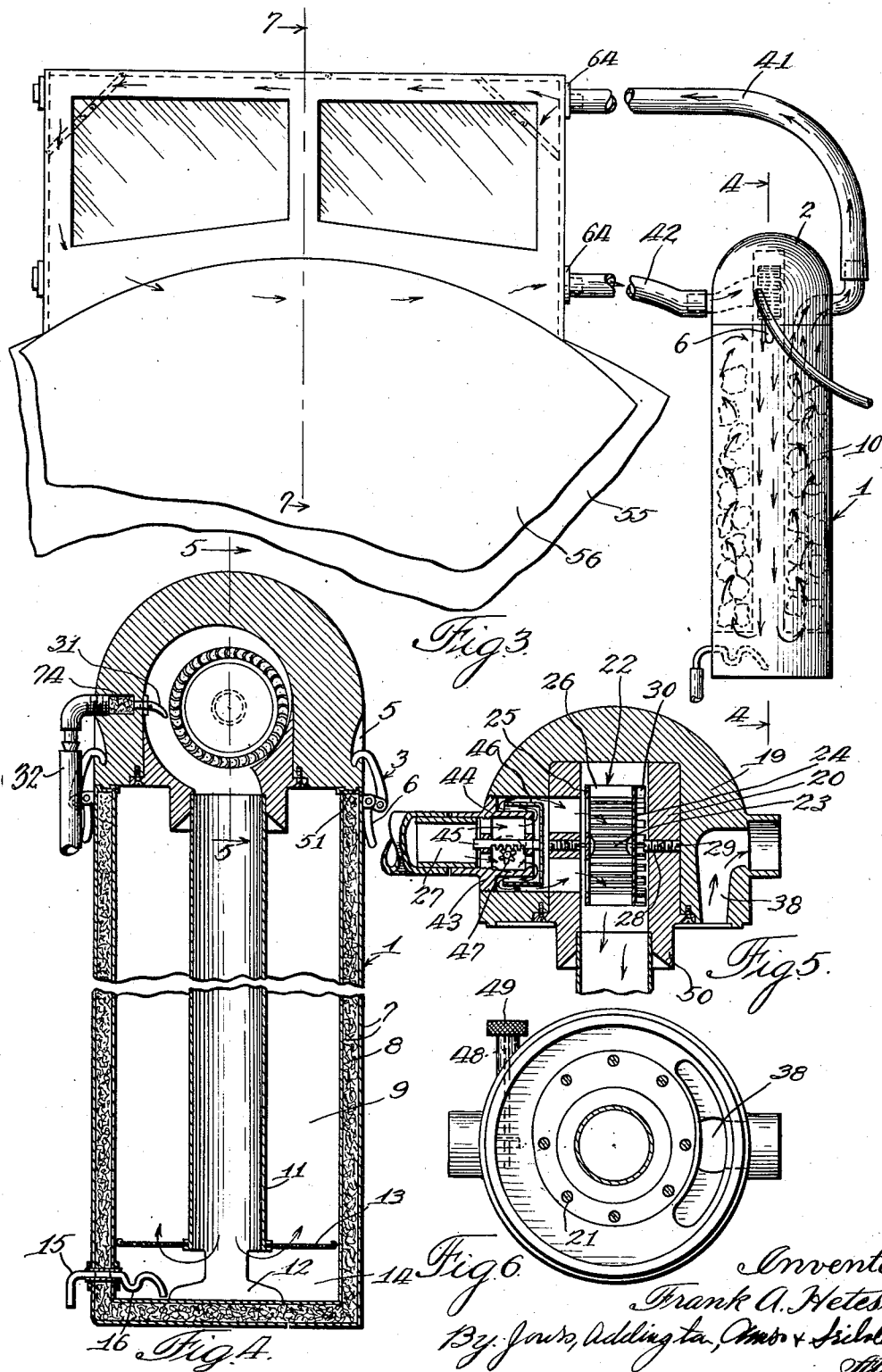
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PORTABLE OXYGEN THERAPY APPARATUS

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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,180,631

PORTABLE OXYGEN THERAPY APPARATUS

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16 Claims. (Cl. 128—203)

This invention relates to oxygen therapy apparatus and particularly to a portable device in which the entire therapy apparatus, including an emergency size tank of high pressure oxygen, may be packed in a small carrying case and easily transported by a physician to the place of application of a therapy treatment.

A constantly increasing number of physicians are prescribing oxygen therapy which involves the use of high concentrations of oxygen under closely controlled conditions. Devices for this purpose and fulfilling all necessary requirements are not universally available and are not easily portable. For this reason, proper treatment is often delayed until too late to be effective. It is well known that positive results by the use of oxygen therapy can only be obtained by instituting the treatment in the first occurrence of symptoms of suboxygenation of blood and tissues and administering sufficient dosage under proper conditions to dissipate such symptoms. The treatment should be immediately applied at the time of diagnosis and this is usually impossible except when the patient is at a properly equipped hospital.

The present invention is particularly intended to provide a small portable oxygen therapy apparatus which may be carried by the physician to the patient and, if the diagnosis suggests the necessity for oxygen treatment, it may be applied without delay. If the necessity for oxygen treatment is indicated, this treatment cannot begin too soon. In fact, in cases of pneumonia, the treatment should not be withheld until the signs of oxygen deficiency in blood and tissues occur, but should be started as soon as diagnosis is made.

Usually when a physician is called to a patient and the diagnosis indicates the necessity for oxygen treatment, it is necessary for the physician to call up a renting agency or a hospital and request that the equipment be provided. As previously stated, oxygen treatment should be given immediately upon diagnosis and the necessary delay in delivering the equipment is very often disastrous to the patient. It is, therefore, an object of the invention to provide an easily portable device which may be quickly set up by a physician or nurse and which will provide sufficient oxygen to supply the necessary treatment until more oxygen may be delivered.

A further object is the provision of a portable apparatus of the character described in which a very small cooling chamber in the circulating system will provide great cooling efficiency.

Some oxygen therapy devices control the circulation by means of oxygen pressure through an injector, while others provide a motor driven blower. In such devices the necessarily small passages in the injector are apt to become clogged and the device fails to function in the proper manner. The motor driven devices cannot be used except where power is available. These difficulties have been overcome in the present invention and it is an object to provide a new and novel means operable by oxygen pressure for freely circulating the gases in a closed circulating system.

A further object is to provide a knock-down portable device of comparatively few parts, of small size in which all of the parts may be quickly and easily assembled without the necessity of securing them together by bolts or nuts or other devices requiring the use of tools; also, in which all parts and surfaces are easily accessible for sterilizing.

A further object is the provision of a portable apparatus capable of maintaining a comfortable atmosphere with a high concentration of oxygen or combination of gases necessary to breathing therapy, and which is arranged to maintain the circulation in accordance with the oxygen flow, in combination with means independent of the oxygen flow for controlling circulation and temperature. The latter may be a combined muffler and circulation control.

Further objects will be apparent from the specification and the appended claims.

In the drawings:

Figure 1 is a front elevation of one embodiment of the invention assembled for use and including the application of the so-called tent to a bed;

Fig. 2 is a top view of the carrying case in open position and with all of the parts including the tent packed therein;

Fig. 3 is a diagrammatic view of the cooling cylinder and tent and illustrates the direction of flow of the gases therethrough;

Fig. 4 is a vertical section through the cooling chamber, taken on a line substantially corresponding to line 4—4 of Fig. 3;

Fig. 5 is a sectional view through the combined cylinder cover and blower head and taken on a line substantially corresponding to line 5—5 of Fig. 4;

Fig. 6 is a bottom view of the blower head illustrated in Fig. 5;

Fig. 7 is a transverse section through the tent

and is taken on a line substantially corresponding to line 7-7 of Fig. 3;

Fig. 8 is a section through the inlet conduit leading to the tent and taken on line 8-8 of Fig. 1; and

Fig. 9 is a detail sectional view taken on a line substantially corresponding to line 9-9 of Fig. 8.

The embodiment illustrated comprises a collapsible tent, a combined cooling cylinder and circulation control, and an emergency tank of high pressure oxygen, together with a carrying case on which the cooling chamber may be supported when in use and in which it may be packed when disassembled. The oxygen tank is provided with a flexible tube outlet leading to the cover of the cooling cylinder. A rotatable fan is mounted in the cover and this fan is located in the circulation conduit and is provided with a set of vanes for maintaining circulation. The fan is also provided at one end with a set of small turbine blades against which a jet of oxygen is directed whereby the fan is rotated to maintain a circulation through the cooling chamber and suitable conduits leading to and from the tent.

Referring to the drawings in detail, an elongated, small diameter cooling cylinder 1 is provided having a blower head 2 thereon, the latter forming a removable cover for the cooling cylinder. The cylinder is provided with releasable latches 3 (Fig. 4) which are engaged in notches 5 in the cover. The latches 3 may be of the usual type, such as ordinarily used on trunks, and may be released by means of handles 6 so that the combined blower head and cover may be easily removed from the cooling cylinder. Practically all of the metal parts of the device are preferably made of aluminum, and the cylinder comprises spaced sheet metal shells 7 having suitable insulating material 8 therebetween. These shells provide a chamber 9 for containing ice, as indicated at 10 in Fig. 3.

The cooling cylinder 1 is provided with a removable coaxial tube 11 arranged to provide a downwardly-extending passage therein from the blower head. The tube 11 is formed at the bottom to provide supports 12 and is open at the sides adjacent the bottom to provide a passage for the gas from the blower, as indicated by the arrows. A screen 13 is removably mounted adjacent the bottom of the cylinder to support the ice and to provide a lower chamber 14 for the accumulation of water from the ice. This chamber 14 is provided with a drain pipe 15 terminating adjacent the bottom of the chamber, as shown, and provided with a trap 16 to prevent the escape of gas from the chamber. When the device is assembled, the drain pipe 15 may be provided with an extension such as a rubber hose 17 (Fig. 1) to direct the water into a pan or other receptacle 18.

The cover 2 preferably comprises a dome-shaped base 19 having an opening therein to receive a fan support 20, which latter is removably supported in the base 19 by means of screws 21 extending through a suitable flange and secured in the base. The member 20 supports a combined turbine and blower 22. This blower may be made of suitable sheet metal and in the embodiment shown comprises an axle 23 on which is secured side plates 24 and 25. Horizontal blower vanes 26 are secured between these side plates and the side plate 25 is perforated as illustrated to enable the passage of gas therethrough from an inlet 27. The axle 23 is preferably arranged for pivotal mounting in suitable bearings,

and these bearings may comprise pivot screws 28 and lock screws 29.

One side of the blower is provided with comparatively small turbine blades 30, and an oxygen inlet nozzle 31 is mounted in the base 19 and arranged to direct a jet of oxygen against the turbine blades as illustrated in Fig. 4. The nozzle is preferably flattened to direct a jet the entire width of the blades. A conduit 32 is connected to this oxygen nozzle and to a suitable oxygen container 33 (Fig. 1), whereby oxygen may be delivered through the nozzle and against the turbine blades to operate the blower. The oxygen tank 33 is provided with a pressure gauge 34, a flow meter 35 and a suitable pressure reducing valve 36, as well as the usual control valve 37.

The central tube 11 of the cooling chamber communicates with the blower chamber as illustrated in Figs. 4 and 5 and it will be apparent that when the oxygen pressure is permitted to rotate the blower, a circulation will be provided through the entire system from the blower inlet 27, through the blower housing 20, the vertical tube 11, the lower chamber 14, then upwardly through ice chamber 9, and through a suitable outlet 38 in the blower head.

A collapsible tent 39 is provided, which may be mounted in the usual manner on a bed 40, as illustrated, and flexible conduits 41 and 42 are provided from the blower head as illustrated; that is, the conduit 41 is connected to the outlet 38 of the blower head and to the upper portion of the tent, as illustrated, and provides an inlet to the tent. The conduit 42 provides an outlet from the lower portion of the tent and to the inlet of the blower head. It will therefore be apparent that when the device is in operation, free circulation will be provided from the tent through the blower and the ice chamber and back to the tent, as illustrated by the arrows in Fig. 3.

It is desirable that devices of this type should operate as quietly as possible and therefore the inlet to the blower head comprises a plug 43 preferably threaded into the head and provided with an inwardly extending tubular portion 44. This portion is provided with transverse arms arranged to support a longitudinally movable rack 45 on the inner end of which is mounted a cup-shaped baffle 46. This baffle provides a tortuous passage for the gas passing through the inlet to the blower and effectively muffles any noise which might otherwise be generated. A pinion 47 is mounted on a shaft 48 which shaft extends outwardly and is provided with a thumb nut 49 whereby the pinion 47 may be operated to move the muffler 46 to vary the size of the inlet opening. The muffler 46 therefore acts as a combined muffler and damper. Adjustment of this damper to control the circulation will not affect the flow of the oxygen but when moved to restrict the circulation will raise the temperature in proportion as the circulation is restricted.

An important feature of the invention is the use of a small-diameter, comparatively long, cooling cylinder, together with a central tube 11 around which the ice is packed. The circulation of the air and oxygen downwardly through this tubular member and upwardly through the ice makes a very long cooling passage in proportion to the size of the device, and the tube 11 acts as a condenser for surplus water vapor exhaled by the patient as well as providing a cooling surface.

The blower support 20 extends downwardly below the lower surface of the cover, as indicated in Fig. 5, to provide a socket 15 for the upper end 75

of the vertical tube 11. The lower end of this socket may be countersunk, as illustrated, so that the end of the tube 11 will easily enter therein when the cover is applied to the cylinder. The upper edge of the cylinder 1 is preferably provided with a groove 51 to receive a corresponding sealing and aligning rib on the cover and the groove may be provided with a suitable gasket.

The tent 39 comprises a collapsible frame having a removable cover 52, preferably of rubberized fabric, with the usual windows 53, preferably of fireproof cellulosic material. The cover is easily slipped over a collapsible framework 54 and the bottom portion forms an elongated forwardly extending flap 55. The bottom may be releasably secured to the sides by means of snaps or eyelets and is intended to lie flat on the mattress. The front wall of the cover is also provided with a flap portion 56, and the patient's head is placed on the bottom flap 55. The front wall and flap 56 are lowered and these flaps provide a suitable seal. The zippers 57 provide convenient means whereby the front of the tent may be released and raised when desired.

The tent support comprises rectangular frame-like end members 58 and top frame members 59 to which the end frames are hinged. These top frames are hinged together by an elongated hinge member 60 which is centrally located so that when the end frames are folded inwardly, the entire structure may be folded together in the middle in a comparatively flat form. The end frames are provided with folding braces 61 and are substantially the same width as the inside of the carrying case. Therefore, when the tent is completely folded, it may be easily packed within the case.

Each of the end frames is provided at opposite upper and lower corners with suitable means whereby the conduits 41 and 42 may be quickly and easily connected and disconnected. One of the connecting members is illustrated in Figs. 8 and 9 and comprises studs 62 disposed on opposite sides of the frame opening 63. A connector 64 having a suitable gasket 65 associated therewith is provided on each of the conduits and the outwardly extending flanges 66 of these connectors are provided with keyhole slots 67. It will therefore be apparent that the conduits 41 and 42 may be quickly attached to either end of the tent. The openings on the end of the tent which is not connected may be closed by means of suitable caps similar to the connectors and having similar keyhole slots. These connectors and caps are all interchangeable.

In order that comparatively short conduits may be used leading from the cooling chamber to the tent, the cooling cylinder 1 is preferably supported upon the carrying case 58, as illustrated in Fig. 1. A sheet metal supporting member 69 is provided with upwardly extending spring fingers 70 for engaging the sides of the cylinder when it is placed thereon. The member 69 is also provided with downwardly extending lugs 71 arranged to engage in suitable openings or sockets provided in the cover of the carrying case as illustrated. In order to support the oxygen tank 33 when in use, a member 72 is removably supported in the cover of the carrying case in the same manner as the cylinder support and is provided with a strap 73 for securing the oxygen cylinder in position.

It will be apparent that the device may be easily transported by means of the carrying case and may also be easily and quickly assembled for

use as illustrated in Fig. 1 and the emergency tank will provide sufficient oxygen until a larger tank may be obtained, which latter may be supported in the same way as the emergency tank. The valves may be adjusted to furnish the required amount of oxygen at a predetermined pressure and the circulation and temperature may be easily controlled. For instance, with the muffler valve in a fixed position, increasing the pressure of the oxygen will increase the circulation and simultaneously lower the temperature. In the particular embodiment illustrated, the temperature decreases substantially one degree with one liter per minute added flow. Adjustment of the damper to reduce circulation does not affect the flow of the oxygen but raises the temperature proportionately to the adjustment. The damper control may be provided with an index finger or properly graduated dial, if desired. An oxygen filter 74 (Fig. 4), preferably of fibrous material, may be provided in the oxygen inlet passage to prevent any dust or dirt from entering the circulation system.

Although the device is particularly intended for use in oxygen therapy and is so described, the claims are not intended to be specifically construed except as required by the prior art, and the terms used comprehend a proper range of equivalents, e. g., the term "oxygen" including any suitable gas for breathing therapy.

Having thus described this invention, what is claimed and desired to be secured by Letters Patent is:

1. In an oxygen therapy apparatus having a closed circulating system, an inlet for oxygen under pressure, a combined turbine and blower unit for maintaining constant circulation and operable by said incoming oxygen, said unit comprising a single freely rotatable rotor in the path of circulation.

2. An oxygen therapy device comprising a closed gas circuit, an inlet for oxygen under pressure, movable means operable by said incoming oxygen to maintain circulation in said circuit, and means independent of said circulation maintaining means for varying the rate of circulation.

3. An oxygen therapy device comprising a closed gas circuit, an inlet for oxygen under pressure, movable means operable by said incoming oxygen to maintain circulation in said circuit, means for controlling the pressure of said oxygen jet, means for controlling the volume of oxygen flow, and means independent of the circulation maintaining means for varying the rate of circulation.

4. An oxygen therapy device comprising a closed gas circuit, an inlet for oxygen under pressure, movable means operable by said incoming oxygen to maintain circulation in said circuit, and a combined muffler and damper movable to vary the rate of circulation with any predetermined oxygen flow and without varying the oxygen flow.

5. A therapeutic device comprising a tent, a cooling cylinder, conduits between said cooler and said tent to form a closed circuit therebetween, said cooler comprising a comparatively small diameter cylinder having a return passage therethrough forming a part of said closed circuit, said passage being arranged to contain a cooling medium, a blower rotor in said circuit and adjacent one end of said return passage, and means for directing a jet of oxygen against said rotor to cause circulation through said cooling medium.

6. A therapeutic device comprising a tent, a cooling cylinder, conduits between said cooler and said tent to form a closed circuit therebetween, said cooler comprising a comparatively small diameter cylinder having a return passage there-through forming a part of said closed circuit, said passage being arranged to contain a cooling medium, a blower rotor in said circuit and adjacent one end of said return passage, means for directing a jet of oxygen against said rotor to cause circulation through said cooling medium, and means adjustable independently of the oxygen flow to vary said circulation.
7. An oxygen therapy apparatus comprising a closed circulating system having a cooling cylinder therein arranged to contain a cooling medium and having an inlet and an outlet, means for injecting oxygen under pressure into said closed circulation system, and means controlled by the incoming oxygen to direct the circulation through said cylinder and through the cooling medium contained therein and to said outlet.
8. An oxygen therapy apparatus comprising a closed circulating system having a cooling cylinder therein arranged to contain a cooling medium and having an inlet and an outlet, means for injecting oxygen under pressure into said closed circulation system, means controlled by the incoming oxygen to direct the circulation through said cylinder and through the cooling medium contained therein and to said outlet, and means independent of the oxygen pressure and flow to control the rate of circulation.
9. In a portable oxygen therapy apparatus having a closed circulating system, an elongated small diameter cooling cylinder, said cylinder comprising a tubular casing open at the top and having a vertical tube therein, said tube being open adjacent the bottom of said cylinder to enable circulation downwardly through said tube and upwardly through said cylinder outside said tube, a foraminated partition in said cylinder above said open lower end, said cylinder being arranged to provide an ice chamber above said partition, a removable cover on said cylinder, said cover having an inlet passage communicating with said tube and an outlet communicating with said ice chamber, movable means in said inlet to cause a circulation from said inlet through said outlet, and a nozzle arranged to direct a jet of oxygen under pressure to operate said circulation means.
10. A cooling cylinder for a portable oxygen therapy apparatus comprising an insulated casing forming an ice chamber, a foraminated partition forming a drain chamber at the bottom of said cylinder, a self-sealing drain pipe leading from said drain chamber, a removable cover on said cylinder and having an inlet communicating with said tube and an outlet communicating with said ice chamber, a freely rotatable fan in said inlet, said cover being provided with a nozzle to direct oxygen under pressure to operate said fan to cause circulation from said inlet through said tube and ice chamber to said outlet.
11. A cooling cylinder for a portable oxygen therapy apparatus comprising an insulated casing forming an ice chamber, a foraminated partition forming a drain chamber at the bottom of said cylinder, a self-sealing drain pipe leading from said drain chamber, a removable cover on said cylinder and having an inlet communicating with said tube and an outlet communicating with said ice chamber, a freely rotatable fan in said inlet, said cover being provided with a nozzle to direct oxygen under pressure to operate said fan to cause circulation from said inlet through said tube and ice chamber to said outlet, and adjustable means to vary the circulation independently of the oxygen flow.
12. A cooling cylinder for a portable oxygen therapy apparatus comprising an insulated casing forming an ice chamber, a foraminated partition forming a drain chamber at the bottom of said cylinder, a self-sealing drain pipe leading from said drain chamber, a removable cover on said cylinder and having an inlet communicating with said tube and an outlet communicating with said ice chamber, a freely rotatable fan in said inlet, said cover being provided with a nozzle to direct oxygen under pressure to operate said fan to cause circulation from said inlet through said tube and ice chamber to said outlet, an adjustable muffler in said inlet, and means accessible from outside said cover to adjust said muffler to vary the circulation independently of the oxygen flow.
13. A portable knock-down oxygen therapy apparatus comprising a collapsible tent, a cooling cylinder having a return passage therein arranged to contain a cooling medium for the passage of gas therethrough and having an inlet and an outlet adjacent one end and a self-sealing drain adjacent the other end, removable conduits communicating between said inlet and outlet respectively and said tent to form a closed circulation passage through said cylinder and said tent, an emergency oxygen tank having a pressure control valve and a flow meter and a pressure meter associated therewith, a removable conduit from said tank for directing a jet of oxygen into said circulation passage adjacent the cylinder inlet, means in said circulation passage and operable by said oxygen jet to maintain a rate of circulation in accordance with the pressure and flow, and a carrying case, all of said apparatus being constructed and arranged to be quickly and easily assembled or disassembled whereby it may be readily packed in said carrying case.
14. A portable knock-down oxygen therapy apparatus comprising a collapsible tent, a cooling cylinder having a return passage therein arranged to contain a cooling medium for the passage of gas therethrough and having an inlet and an outlet adjacent one end and a self-sealing drain adjacent the other end, removable conduits communicating between said inlet and outlet respectively and said tent to form a closed circulation passage through said cylinder and said tent, an emergency oxygen tank having a pressure control valve and a flow meter and a pressure meter associated therewith, a removable conduit from said tank for directing a jet of oxygen into said circulation passage adjacent the cylinder inlet, means in said circulation passage and operable by said oxygen jet to maintain a rate of circulation in accordance with the pressure and flow, a carrying case arranged to provide a support for said cylinder, and removable means on said case to retain said cylinder thereon, all of said apparatus being constructed and arranged to be quickly assembled and disassembled whereby it may be readily packed in said carrying case.
15. In a portable oxygen therapy apparatus having a closed circulating system, a cooling cylinder comprising an insulated casing having a removable coaxial tube therein extending from the top of said cylinder and terminating short of the bottom thereof, a removable screen spaced from the bottom of said cylinder and positioned to support ice in the chamber formed between

34 said tube and the walls of said cylinder for the circulation of gas therethrough, a self-sealing drain adjacent the bottom of said cylinder, a removable cover for said cylinder and said tube and having an inlet and an outlet communicating with the top of said tube and said ice chamber respectively, releasable means for retaining said cover, a removable means in said cover and forming a passage between said tube and said inlet and a blower supported in said passage, and means for directing a jet of oxygen to operate said blower.

16. The method of operating an oxygen therapy apparatus having a closed circulating system and movable circulation maintaining means and a cooling medium in said circulation system, which method comprises introducing oxygen under pressure into said system and utilizing the force of the incoming oxygen to operate the movable means and direct circulation in opposition to the normal thermal flow from said cooling medium.

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