United States Patent

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[54] **HYPERBARIC TREATMENT CHAMBER**
6 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **128/204,** 98/1.5
[51] **Int. Cl.** **A61h 31/00,** B64d 13/00
[50] **Field of Search** 128/204, 297, 298, 30, 28, 203; 98/1.5

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ABSTRACT: A hyperbaric treatment chamber is formed within an elongated tubular hermetically sealable casing having a pressure sealable door at each end and a floor structure therein and supports in the casing for a patient bed or litter. The casing is sized to enclose a patient's entire body in a prone or supine position on the bed or litter while permitting the patient to assume a sitting position. Valve means are associated with the casing for admitting a selected gas, such as oxygen, under a pressure higher than atmospheric into the casing interior to provide a selected stable pressure atmosphere with desired gas, such as up to one hundred percent (100%) oxygen, around the patient's body. A high pressure sprinkler system for quenching possible fires and medical means for examining and treating the patient are contained within the casing.

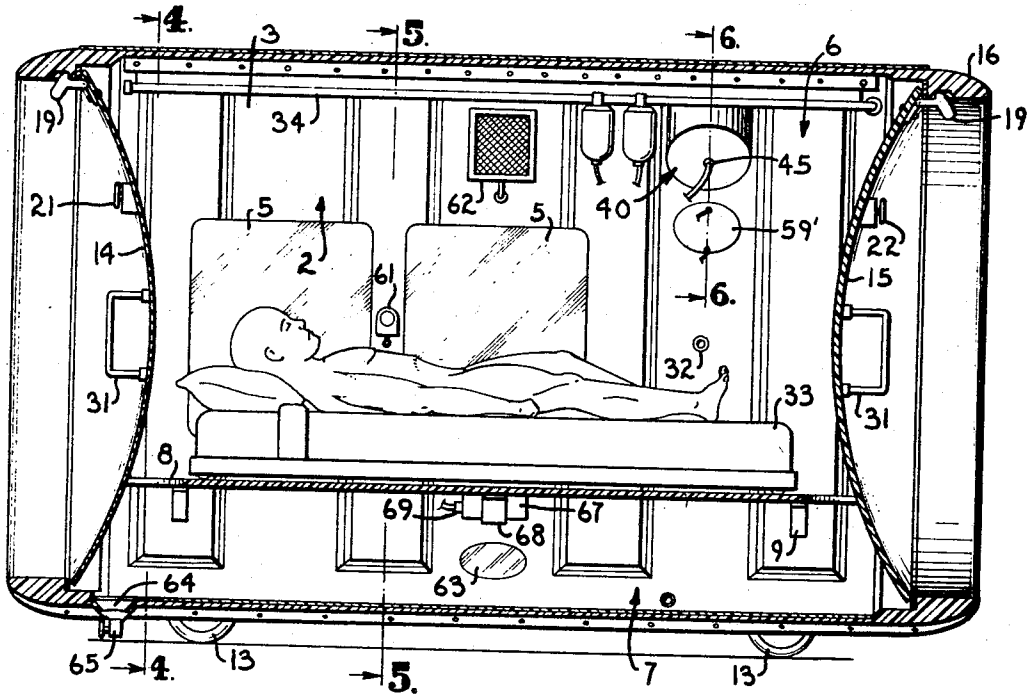


Fig. 1.

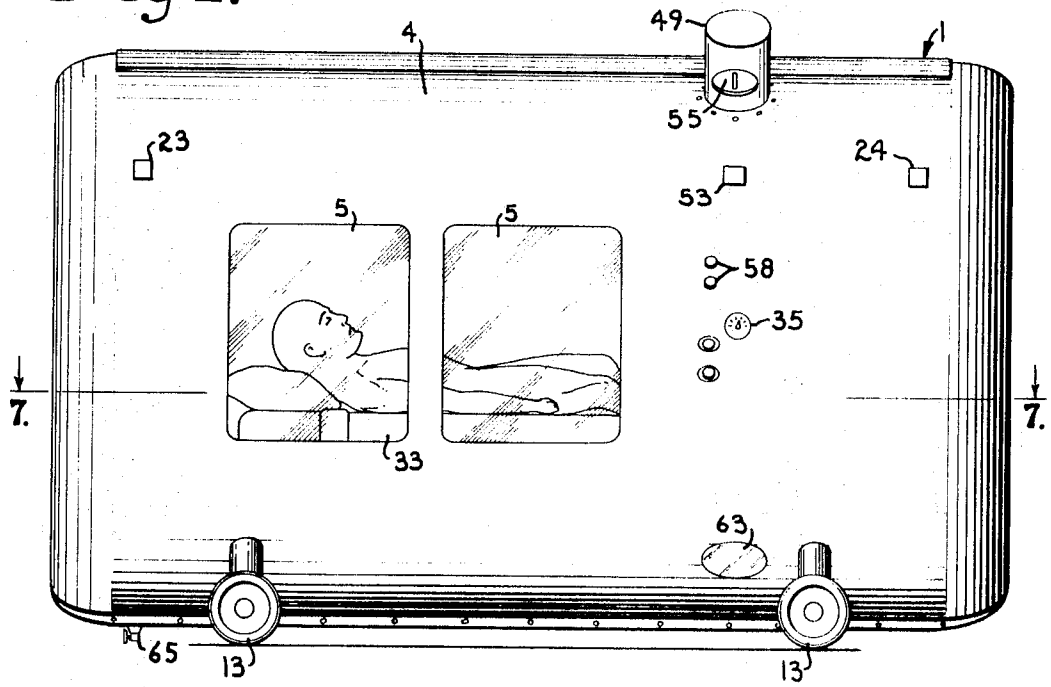
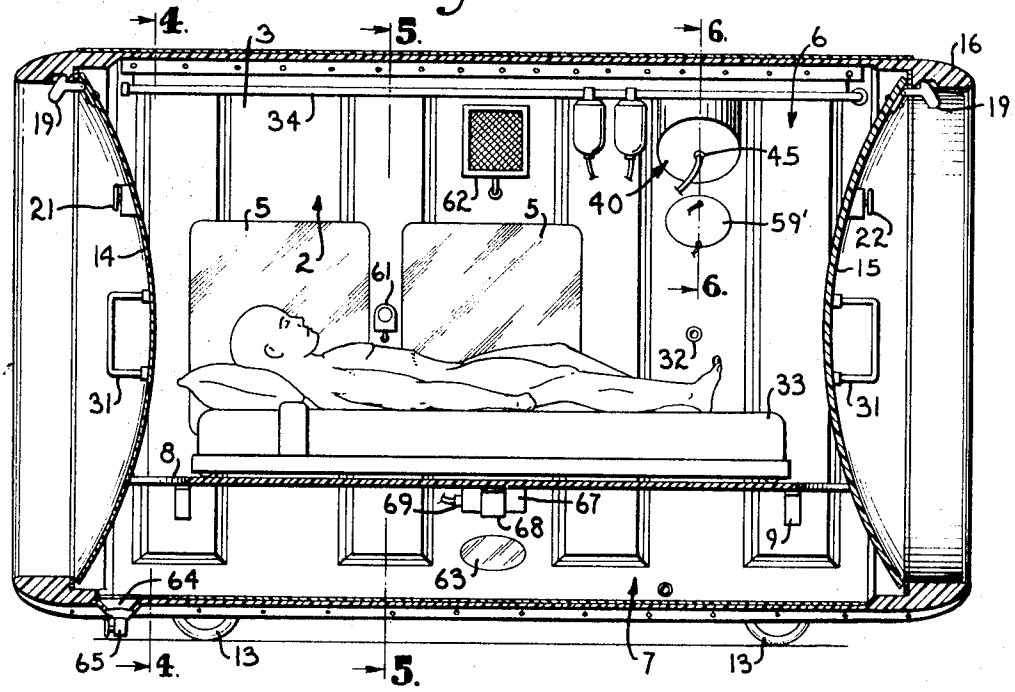


Fig. 3.



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Fig. 2.

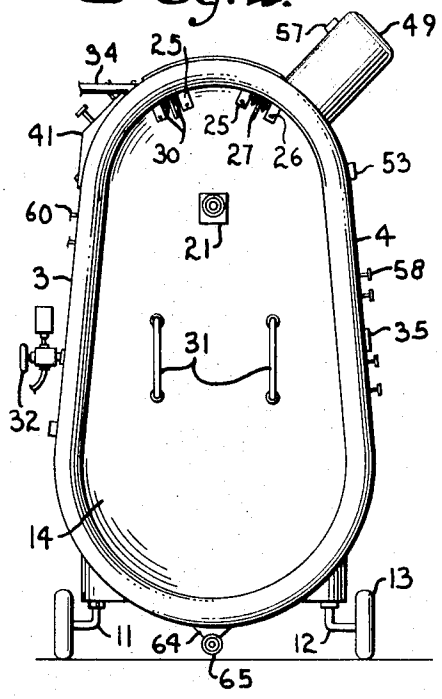


Fig. 4.

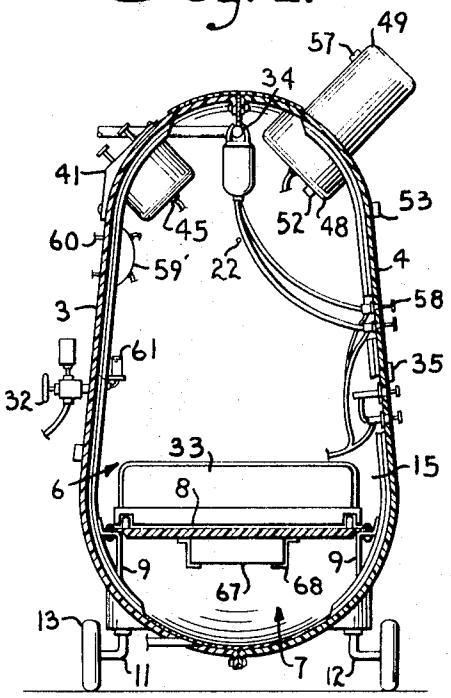
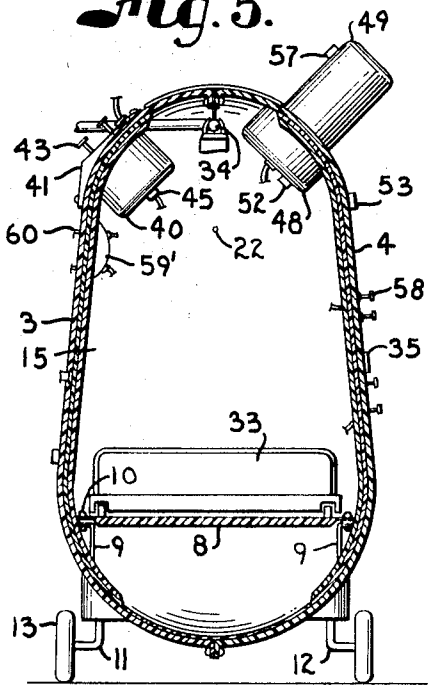


Fig. 5.



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Fig. 7.

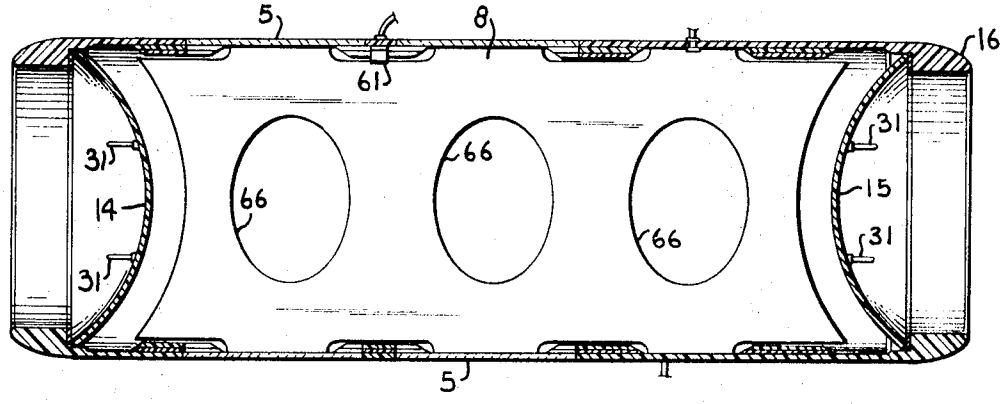


Fig. 6.

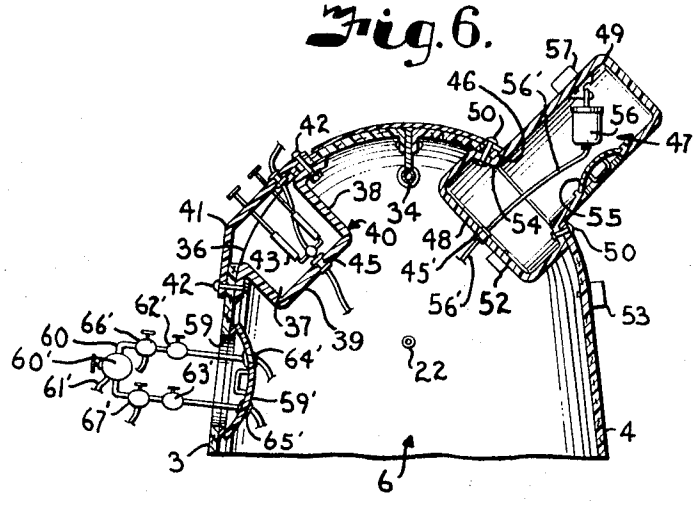
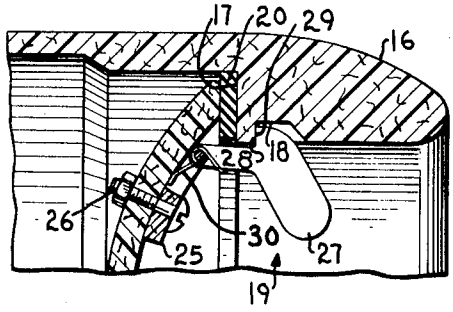


Fig. 8.



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HYPERBARIC TREATMENT CHAMBER

The present invention relates to improvements in treatment chamber apparatus and more particularly hyperbaric treatment chambers for the reception of a single human patient's entire body for subjecting same to gas pressure higher than atmospheric and medically examining and treating same therein.

The principal objects of the present invention are: to provide a hyperbaric treatment chamber adapted to examine and treat a single patient while in a horizontal position, either a prone or a supine position, and a sitting position within an atmosphere of up to and including one hundred percent (100 percent) oxygen at pressures up to or higher than two (2) atmospheres absolute; to provide such a treatment chamber formed of noncorrosive material which is substantially free from acquiring and releasing static electrical charges; to provide such a treatment chamber wherein the chamber has access openings in the form of removable and pressure sealable doors for closing same whereby the patient may remain within the chamber for several days during critical periods when movement must be avoided and intermittent hyperbaric treatment is prescribed; to provide such a treatment chamber having sound communication means in the form of a continuously open microphone and speaker inside the chamber for voice communication to and from the patient; to provide such a treatment chamber having pneumatic and electrical connections for ECG. EEG, blood pressure, humidity, temperature monitoring devices and other necessary devices for patient care; and to provide such a hyperbaric treatment chamber which is economical to manufacture, safe and efficient in operation, and particularly well suited for the proposed use.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example certain embodiments of this invention.

FIG. 1 is a side elevational view of a hyperbaric treatment chamber embodying features of the present invention.

FIG. 2 is an end elevational view of the hyperbaric treatment chamber.

FIG. 3 is a longitudinal sectional view taken on line 3–3, FIG. 2.

FIG. 4 is a transverse sectional view taken on line 4–4, FIG. 3.

FIG. 5 is a transverse sectional view taken on line 5–5, FIG. 3.

FIG. 6 is a fragmentary sectional view taken on line 6–6, FIG. 3, showing a medical therapy unit.

FIG. 7 is a horizontal sectional view taken on line 7–7, FIG. 1, showing a floor structure for supporting a patient bed or litter.

FIG. 8 is an enlarged fragmentary detail of mounting for doors in opposite ends of the chamber.

Referring more in detail to the drawings:

The reference numeral 1 generally designates an elongated tubular or hollow casing which is adapted to be hermetically sealable to form a hyperbaric treatment chamber 2 sized to enclose a patient's entire body while in a horizontal position, such as prone or supine. The casing 1 preferably is of greater length than width in a horizontal position wherein it has sidewalls 3 and 4 of which at least a portion of each is transparent material, thereby defining observation windows 5, for viewing the patient within the tubular casing 1.

It is extremely desirable to prevent or substantially reduce any possible feeling of claustrophobia on the part of the patient, therefore, it is desirable to position the observation windows 5 so that a conscious patient may also observe activities outside the tubular casing 1. To further reduce any possible feeling of claustrophobia, it is desirable to size the tubular casing 1 to permit the patient to assume a sitting position therein while the casing is hermetically sealed.

The tubular casing 1 is generally elliptical in cross section having an upper patient portion 6 and a lower portion 7 separated by a floor structure 8 which is supported on the casing sidewalls 3 and 4. In the illustrated structure, continuous support brackets 9 are mounted in facing relation on the opposite sidewalls 3 and 4 and extend between the opposite ends of the casing for supporting opposite edges of the floor structure 8, as by a plurality of longitudinally spaced bolts 10.

It is desirable that the tubular casing 1 be easily movable with or without the patient therein, therefore, a pair of axles 11 and 12 are mounted on the exterior surface of the lower portion 7 adjacent the opposite ends of the casing 1. Freely rotatable wheels 13 are mounted on opposite ends of each of the axles 11 and 12, to thereby permit the casing and patient to be movable between various treatment areas and to allow the patient to remain within the casing for several days during critical periods when movement must be avoided and intermittent hyperbaric treatment is prescribed.

Pressure sealable doors 14 and 15 are positioned at each end of the elongated casing 1. It is desirable to use the pressure within the casing 1 to facilitate the seal of the doors 14 and 15 in the opposite ends of the casing 1, thereby providing a hermetically sealed chamber adapted for hyperbaric treatment of the patient.

In the illustrated structure, each end of the elongated casing 1 has an enlarged portion 16 extending inwardly and each of the enlarged portions 16 has a shoulder or abutment surface 17 which is positioned substantially normal to the sidewalls 3 and 4 of the casing 1 and is inwardly facing. Each of the enlarged end portions 16 also has a plurality of recesses 18 in an inner periphery thereof to receive a latch structure 19, as later described. A continuous seal member 20 is mounted on the shoulder or abutment surface 17 of each of the enlarged end portions 16 for engagement with the respective doors 14 or 15.

In the illustrated structure, the doors 14 and 15 are generally concave-convex members with the peripheral edges thereof engaging the respective seal member 20, and each of the doors 14 and 15 are positioned within the tubular casing 1 whereby when pressure above atmospheric is introduced into the casing 1, the doors are urged outwardly or toward the opposite ends of the casing 1, to thereby provide a positive seal between their respective peripheral edges and the seal member mounted on the inwardly facing shoulder or abutment surface 17.

Particularly for critical patients, it may be necessary to have quick access to the patient, therefore, the doors 14 and 15 must be easily removable. Manual pressure release valves 21 and 22 are mounted in the doors 14 and 15 respectively to exhaust the pressure within the treatment chamber 2 thereby removing sealing force urging the doors 14 and 15 into engagement with the respective seal member 20. It has been found that rapid reductions of pressure will not cause "Bends" in patients being treated in an atmosphere of one hundred percent (100 percent) oxygen and at pressures above atmospheric, therefore, pressure release valves 23 and 24 are mounted in one of the sidewalls, for example sidewall 4, adjacent the opposite ends of the casing 1 to increase the speed of exhausting the pressure within the treatment chamber.

It is desirable that each latch structure 19 be mounted on the concave surface of each of the doors 14 and 15 adjacent an upper edge thereof. The latch structure 19 is illustrated as including a pair of spaced mounting arms 25 suitably secured to an exterior surface of the respective door 14 or 15, as by a plurality of bolts or screws 26 and a latching arm 27 which is pivotally mounted on the mounting arm 25 and has an enlarged portion forming a shoulder 28 adapted to engage an outwardly facing surface 29 within the recess 18 of the respective enlarged end portion 16. A suitable resilient member, such as a spring 30 which has outwardly biased arms engaging facing surfaces of the respective door 14 or 15 and latching arm 27, urges the latching arm 27 into engagement with the respective surface 29. One arm of the spring 30 engages the door surface and the other arm thereof engages the latching arm 27 to urge same away from the door surface and into the recess 18.

Each of the doors 14 and 15 include at least one hand bar 31 mounted on the exterior surface thereof for maneuvering the respective door during installation or removal thereof. It is desirable to provide quick access to the patient within the casing 1, therefore, the doors 14 and 15 must be quickly removable. It is a simple matter to move the latching arm 27 out of engagement with the respective recess 18 and push the door inwardly and twist same sufficiently to remove the door from the respective end of the casing. It is noted that opposite ends of the floor structure 8 are recessed from the respective enlarged end portions 16 to provide maneuvering room for the respective doors 14 or 15 during installation or removal thereof.

Hyperbaric chambers are particularly adapted to treat patients at pressures above atmospheric and in a standard air atmosphere, a one hundred percent (100 percent) oxygen atmosphere or an atmosphere having an oxygen percentage in an amount therebetween, therefore, suitable valve and gauge means 32 are mounted on the exterior surface of one of the sidewalls, preferably sidewall 3, and are adapted to admit a selected gas or gas mixtures under suitable conditions from a suitable source (not shown) at a controlled temperature and at a pressure higher than atmospheric into the casing 1 having the doors 14 and 15 positioned closing the opposite end thereof.

It is desirable to have a supply system (not shown) adapted to supply chemically pure oxygen to the treatment chamber 2 at an excellent balance of ambient conditions within the chamber, such as having the relative humidity controlled within selected limits, such as 60 percent to 70 percent, to provide a selected stable nonfluctuating pressure atmosphere around the entire patient's body. A cryogenic system or other supply may be used for the purpose. It has been found that the body tissues absorb substantially more oxygen at super atmospheric pressures, therefore, in certain physical conditions, such as myocardial infarctions, carbon monoxide poisoning, gas gangrene, pedicle skin grafts, burns, severe trauma, brain surgery, thoracic surgery and lung complications, it is desirable to expose the patient to an atmosphere of one hundred percent (100 percent) oxygen at pressures higher than atmospheric, such as in the nature of two to three atmospheres absolute.

The valve and gauge means 32 are adapted to maintain a selected pressure within selected limits. The valve and gauge means 32 are also connected to a suitable source of hydrocarbon free compressed air for flushing the casing 1 prior to opening the doors 14 and 15 after the pressure has been lowered to one atmosphere absolute to remove the danger of electrical sparking.

Fatal fires are a constant danger in atmospheres of one hundred percent (100 percent) oxygen, therefore, it is desirable to form the structure of the casing 1, floor structure 8 and doors 14 and 15, of a noncorrosive material which is substantially free from acquiring and releasing static electrical charges, such as plastic, Fiberglas, or metal encased within suitable insulators, such as cork or rubber. It is noted that the patient's clothing and the bedding for a bed or litter 33 should be preferably of a material free from acquiring and releasing static electrical charges, such as cotton. It is also noted that certain cosmetics and hair preparations are subject to spontaneous combustion within a pressurized atmosphere of one hundred percent (100 percent) oxygen, and it is, therefore, desirable to completely remove same from the patient's body before introducing the oxygen into the interior of the casing 1.

As an added safety precaution, high pressure sprinkler means 34 are positioned within the casing 1 and extend longitudinally between the opposite ends thereof and are positioned within the upper portion 6, preferably adjacent an upper surface thereof. It is desirable to have suitable control means (not shown) outside the casing 1 and operatively connected to and responsive to suitable temperature sensitive means 35 within the casing 1, for activating the high pressure sprinkler means 34 in the event of a fire or a temperature above a selected control level within the upper portion 6 of the casing 1 or if smoke is detected within the casing 1.

In addition to exposing the entire body of the patient to a hyperbaric oxygen atmosphere, it may be desirable to treat or examine or both treat and examine the patient during the hyperbaric treatment, therefore, suitable medical means, as later described, are contained within the casing 1 for examining and treating the patient.

In the illustrated structure, a port or aperture 36 extends through an upper portion of the sidewall 3 within the upper patient portion 6. A therapy chamber 37 is defined by sidewalls 38 and an end wall 39 of support structure 40 mounted on the interior surface of the sidewall 3. A removable cover 41 is suitably mounted on the exterior surface of the casing 1 to close the port or aperture 36, as by a plurality of bolts or screws 42, which also suitably secure the support structure 40 to the sidewall 3. Suitable medical treatment means, such as a medicinal therapy unit 43, is mounted in the therapy chamber 37 and communicates with a suitable intravenous catheter placement unit (not shown) within the casing 1. The medicinal therapy unit 43 is operative to supply selected medicament, such as intravenous feedings or fluid supply, to restore fluid balance in the respective patient within the casing 1. A suitable check valve 45 is removably mounted in the end wall 39 of the therapy chamber 37. The medicinal therapy unit 43 and the catheter unit within the chamber 2 are connected to the valve 45 by suitable flexible tubes or hoses whereby the medicinal therapy unit 43, the catheter unit, and the valve 45 may be removed for cleaning.

A port or aperture 46 extends through an upper portion of the sidewall 4. A pressure chamber 47 extends through the port or aperture 46 and has a lower portion 48 extending into the casing 1 and an exterior or upper portion 49 extending into the casing 1 and an exterior or upper portion 49 extending outwardly from the casing 1. Suitable bolts or screws 50 secure the pressure chamber 47 to an interior surface of the sidewall 4. A pressure valve 52 is mounted on the lower portion 48 and is adapted to equalize pressure within the pressure chamber 47 and the casing 1 in response to operation of a suitable control member 53 mounted on the casing 1 adjacent the pressure chamber 47 to adjust the pressure within the chamber 47.

The upper portion 49 has a smaller diameter than the lower portion 48 and is connected thereto by a wall portion 54 and the port or aperture 46 is only slightly larger than the upper portion 49 whereby the pressure chamber 47 is removable as a unit by lowering same through the port 46 into the chamber 2. The pressure chamber 47 is secured to the casing 1 by the bolts 50 extending through the wall portion 54 and through the sidewall 4.

The upper portion 49 has a pressure sealable access door 55 to provide access to the interior of the upper or exterior portion 49 for installation and replacement of bottles 56 containing fluids to be administered to the patient within the hyperbaric treatment chamber 2. A pressure release valve 57 is mounted on the upper or exterior portion 49 to exhaust the chamber 47 to thereby permit the access door 55 to be opened.

The bottles 56 communicate with the patient within the chamber 2 by means of suitable tubes 56' which are connected to a suitable check valve 45' removably mounted in one of the walls defining the lower portion 48.

A plurality of sealed passageways 58 extend through the casing sidewall 4 to provide pneumatic and electrical connections for ECG, EEG, blood pressure, humidity and temperature monitoring devices, and other necessary devices for patient care and examining the patient during hyperbaric oxygen treatment. It is desirable to thoroughly shield all electrical equipment within the casing 1 to prevent any sparking or hazardous transmission of electrical energy.

A plurality of apertures 59 extend through the sidewall 3 and are closed by doorlike members 59' similar to the access door 55. A pipe 60 extends through each of the doorlike members 59' in a U-shaped path with the free ends of the pipe 60 extending into the chamber 2 and a control valve 60' positioned in the pipe 60 so as to be accessible from the exterior of

the casing 1 for controlling supply of medicament to medical treatment means within the casing 1, such as for blood transfusions, intravenous fluid administration, nasogastric tube feeding and the like. The doorlike member 59', pipe 60 and valve 60' are removable as a unit for cleaning, as in an autoclave, and replacement. A fluid is delivered to the control valve 60' by a suitable tube 61' and the control valve 60' is operative to selectively direct the fluid into either leg or arm of the U-shaped pipe 60. Valves 62' and 63' are mounted in the respective legs or arms of the U-shaped pipe 60 for controlling pressure of fluid delivered to the patient or to other devices (not shown) within the chamber 2. Suitable check valves 64' and 65' are mounted in the doorlike member 59' to prevent reverse flow of the fluid. It is desirable to drain the U-shaped pipe 60 of fluid before changing fluids or removing same for cleaning, therefore, suitable drain valves 66' and 67' are mounted in the respective legs or arms of the U-shaped pipe 60.

Sound or voice communications are provided between the patient and personnel outside the casing 1 to further reduce any feeling of claustrophobia and to permit communication of information to the patient and from the patient to the personnel outside the casing 1. In the illustrated structure, sound communication means in the form of a continuously open microphone 61 is mounted within the casing 1 and a speaker 62 is positioned adjacent one end of the casing 1 and at a level with a patient's head when in the supine or prone position on the bed or letter 33.

Sealable portholes 63 are positioned in the sidewalls 3 and 4 below the floor structure 8 to provide access to the lower portion 7 of the casing 1, for cleaning same. A sump 64 having a drain valve 65 is provided adjacent one end of the lower portion 7 to collect and remove fluids accumulating therein and to collect and remove fluids used to clean the interior of the casing 1.

The floor structure 8 has a plurality of apertures 66 therethrough to provide for equal pressures and temperatures in the upper and lower portions 6 and 7 respectively, and to provide for flow of fluids through the apertures 66 into the sump 64.

A removable container 67 is supported by a bracket 68 depending from the floor structure 8. The container 67 is adapted to receive and collect body fluids, such as urine, nasogastric fluids, and the like, from a prone or supine patient. Suitable flexible tubing extends from the patient and is connected to a suitable check valve 69 mounted in the container 67. The container 67 is preferably positioned adjacent one of the portholes 63 for easy installation and removal.

I claim:

1. A hyperbaric treatment chamber comprising:

a. an elongated tubular open ended casing having sidewalls defining a chamber sized to receive a patient's entire body therein while same is in a horizontal position, said casing having a generally elliptical opening at each end thereof defined by casing end portions having an inwardly directed face;

b. an elongated floor structure mounted within said casing and defining upper and lower portions of said casing, said floor structure being supported on said sidewalls and having a plurality of apertures therethrough and spaced between opposite ends thereof, said opposite ends of said floor structure being spaced from respective end portions of said casing;

c. a removable pressure sealable door for each end of said elongated casing, each door being within said casing and shaped to correspond to said respective elliptical openings and having marginal portions engageable with the respective inwardly directed face, said doors each being movable into sealing engagement with respective end portions of said casing in response to super atmospheric pressure within said casing to close said open ends and hermetically seal said casing, said doors each having portions extending above and below said floor structure and being maneuverable within respective spaces between said floor structure and respective end portions of said casing for removal from said casing; and

d. valve means for admitting a selected gas under a pressure higher than atmospheric into the casing interior to provide a selected stable pressure atmosphere around the patient's body and for exhausting the pressure atmosphere to permit removal of said doors.

2. A hyperbaric treatment chamber as set forth in claim 1 including:

a. high-pressure sprinkler means within said casing for quenching possible fires therein, said high-pressure sprinkler means being within an upper portion of said casing and extending longitudinally between opposite ends thereof;

b. control means outside the casing and operatively connected to said high-pressure sprinkler means for activating same; and

c. smoke and temperature sensitive means operatively connected to said control means for activating same to thereby activate said high-pressure sprinkler means.

3. A hyperbaric treatment chamber as set forth in claim 1 including medical means within said casing for examining and treating a patient therein and comprising:

a. a port through an upper portion of one of said sidewalls of said casing;

b. wall portions defining a pressure chamber extending through said port and having a lower portion within said casing and an upper portion extending outwardly from said casing, said upper portion of said pressure chamber having an aperture through one of said wall portions;

c. means engaging said casing sidewall and said pressure chamber for mounting same in said port;

d. a removable pressure sealable door for said aperture through one wall portion of said upper portion of said pressure chamber, said door being within said pressure chamber and having marginal portions engageable with the wall portion of said pressure chamber adjacent said aperture to seal same;

e. a fluid container within said pressure chamber and means for communicating the contents thereof with the patient within said casing;

f. valve means in one of said wall portions of said lower portion of said pressure chamber and connected to said fluid communicating means for controlling the supply of fluid to the patient; and

g. controlled valve means for equalizing pressure within said pressure chamber and said casing and for exhausting the pressure within said chamber to permit removal of said chamber door.

4. A hyperbaric treatment chamber as set forth in claim 1 wherein:

a. said selected gas is oxygen; and

b. said casing and floor structure and doors are formed of noncorrosive material free from acquiring and releasing static electrical charges, said material having nonmetallic exposed surfaces.

5. A hyperbaric treatment chamber as set forth in claim 1 wherein means for mounting and removing each of said doors includes:

a. a plurality of recesses in an inner periphery of each casing end portion, each recess having a shoulder with an outwardly facing surface;

b. a seal member engaging the inwardly directed face of each casing end portion for engagement with the outer marginal portions of said respective door;

c. latch means for each of said recesses in said casing end portions and mounted on each of said doors and adapted to be engageable within said respective recess to releasably hold said respective door, each latch means having a mounting portion secured to an exterior surface of said respective door and a latching portion pivotally mounted on said mounting portion, said latching portion

having an enlarged portion forming a shoulder engageable with the outwardly facing surface of the recess in the respective casing end portion;

d. resilient means engaging the exterior surface of the door and the latching portion for urging same into engagement with the outwardly facing surface of the recess in the respective casing end portions; and

e. said valve means for exhausting the pressure atmosphere being mounted in each of said doors.

6. A hyperbaric treatment chamber as set forth in claim 1 including:

a. a port through an upper portion of one of said sidewalls of said casing;

b. a chamber for containing medical treating means therein and mounted on an interior surface of said one sidewall and having an open end substantially aligned with said port therethrough;

c. a removable cover mounted on an exterior surface of said casing for closing said port and said open end of said chamber;

d. means within said chamber for containing medicament for a patient within said casing; and

e. valve means in one wall of said chamber and means communicating said medicament containing means with said valve means and with the patient for supplying the medicament thereto, said valve means and medicament containing means and medicament communication means being removable for cleaning.