

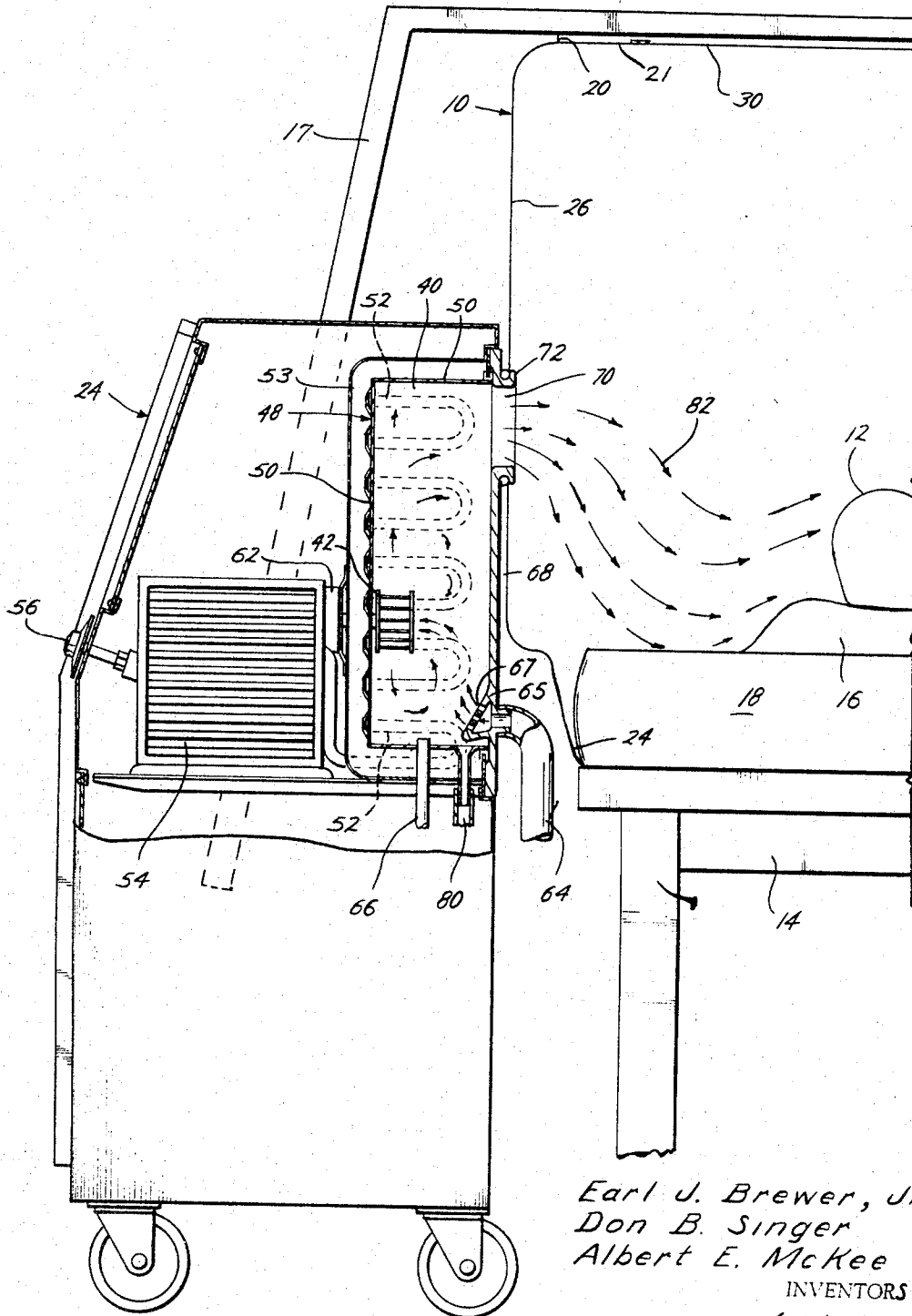
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OXYGEN THERAPY ENCLOSURE WITH COOLING CHAMBER

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OXYGEN THERAPY ENCLOSURE WITH COOLING CHAMBER

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The present invention relates to enclosures for administering oxygen for prolonged periods of time to a patient and more particularly, relates to the provision of a circulation chamber for cooling and separating the turbulent flow of oxygen and/or air-oxygen mixture from the patient enclosure.

It is generally believed that oxygen should be maintained at least fifty volumes percent at all times, have a temperature of 15 degrees to 20 degrees centigrade, a carbon dioxide concentration of less than 1½ volumes percent, and a forty to sixty percent humidity.

However, in the past most oxygen tents have employed forced circulation or blow and air-oxygen mixture directly into the tent. However, in addition to causing an undesirable draft in the canopy, this forced type of circulation under normal operating conditions has been unable to sustain the fifty volume percent oxygen concentration required in the tent. In the conventional open bottom canopies presently used in hospitals the forced circulation of the oxygen mixture forced the oxygen out the bottom, through the seams, and bed clothes. Nor could forced circulation be used in open top oxygen canopies, as the blower fan would cause considerable turbulence in the canopy and would blow the refrigerated oxygen out of the top of the open canopy. For example, in using the standard open bottom canopies and following the prescribed practice of providing a flow rate of 15 liters of oxygen per minute for 20 minutes with a maintenance of 10 liters per minute the required fifty volumes percent oxygen concentration is not obtained.

In addition to the forced type of circulation, previous tents have been utilized which operated on the principle of convection circulation. While these tents were capable of maintaining the required oxygen concentration, they were unsatisfactory or uneconomical in that their sources of refrigeration required ice, liquid oxygen or Dry Ice, all of which had certain disadvantages.

The present invention is generally directed to providing an auxiliary or circulation cooling chamber which holds the oxygen and/or air-oxygen mixture adjacent the patient enclosure wherein the excess oxygen and/or air-oxygen mixture in the chamber spills over and flows into the patient enclosure or canopy proper with a minimum of turbulence thereby providing a relatively quiescent flow into the tent or canopy proper so that the oxygen will not be lost out the top, if an open top canopy is used, nor will it be lost out the bottom of a loosely tucked open bottom type canopy.

Yet a still further object of the present invention is the provision of an auxiliary or circulation cooling chamber which includes an oxygen inlet for receiving and cooling oxygen with the chamber being in communication with the canopy whereby the oxygen that is introduced to the chamber spills out into the canopy and in the event that more cooling in the canopy is desired a volume of air as high as fifty percent may be supplied to the chamber for mixing with the oxygen.

It is therefore an object of the present invention to provide an auxiliary or circulation cooling chamber adjacent an oxygen enclosure by which an effective concentration of oxygen is mixed with air, refrigerated, and may be passed with a minimum of turbulence to the patient enclosure tent proper so that there is a minimum of loss of oxygen and in which other substances such as medica-

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tion or additional cooling air may be added in the auxiliary chamber as required for the treatment of the patient, regardless of type of canopy utilized.

A further object of the present invention is the provision of an oxygen therapy enclosure which includes a circulation cooling chamber communicating with the patient enclosure proper including an opening between the chamber and said enclosure whereby the major circulation of refrigerated air-oxygen mixture occurs in the circulation chamber and a volume of refrigerated air-oxygen equal to that introduced into the chamber spills or flows into the patient enclosure to provide a refrigerated air-oxygen mixture to the patient with a minimum of loss and turbulence thus providing draftless semi-convection circulation of a cooled oxygen rich mixture about the patient's head.

A further object is the provision of an insulated and refrigerated circulation cooling chamber having an opening in communication with an oxygen enclosure at a vertical position just above the head of a patient positioned in the enclosure, and a rotary fan in the chamber but spaced from the opening whereby the air-oxygen mixture is cooled and overflows into the enclosure turbulence and because the refrigerated mixture is heavier than the warmer mixture in the enclosure it will stratify near the bottom of the enclosure and adjacent the patient.

Other and further objects, features and advantages of the present invention will be apparent from the following description of a presently preferred embodiment of the invention, given for the purpose of disclosure, and taken in conjunction with the accompanying drawings, where like character references designate like parts throughout the several views, and where,

The drawing is a fragmentary side elevational view, partly in cross-section, illustrating a circulation cooling chamber in communication with an oxygen enclosure according to the present invention.

Referring now to the drawing, a conventional patient enclosure or canopy is generally indicated by the reference numeral 10 and is shown as being disposed about the head of the patient 12 who is in the bed 14, and on the usual pillow 16 and mattress 18. The enclosure 10 may include any suitable frame 17, and may include supporting straps 20 which are secured to the frame 17 for suitably supporting the canopy or enclosure 10. While any suitable type of enclosure may be utilized such as the open bottom type canopies which are tucked beneath the patient's mattress, the preferable enclosure 10 is completely enclosed on the bottom 24, sides 26 and includes preferably a detachable top 30.

Refrigeration of the air-oxygen mixture in the canopy 10 is desirable both for the comfort of the patient and for the reduction of cardiac work load. Therefore, a suitable oxygen refrigeration unit 24 may be provided.

It is essential in providing a satisfactory oxygen enclosure to prevent turbulence into the canopy or enclosure proper. As previously mentioned a forced circulation system could not be used in the open top type oxygen enclosure as the turbulence would cause the refrigerated oxygen to merely blow out the top of the enclosure, and in the open bottom type enclosure since the heavier colder oxygen settles to the bottom of the enclosure the pressure caused by forced circulation blowing into the enclosure proper would cause a loss of oxygen through the bottom. In order to overcome these disadvantages, regardless of the type of enclosure used, the present invention is directed specifically to the provision of a circulation cooling chamber 40 which is in communication with the enclosure 10.

The chamber 40 is a "cold box" into which oxygen and air is circulated and cooled, and in which the excess air-oxygen mixture flows out or spills out into the enclosure

10 as additional oxygen is introduced into the chamber 40. The preferred embodiment of a circulation chamber 40 and its use in combination with enclosure 10 is best seen from the drawing. In this embodiment the evaporator unit 48 of the refrigeration unit is in the form of plates 50 forming sides of the reservoir or chamber 40 to cool the chamber 40. The cooling action is provided by a plurality of tubes 52 flowing about the plates 50 and containing the refrigeration coolant and suitably insulated by insulation 53. The evaporator plates 50 and tubes 52 are connected to a conventional refrigeration system including the condenser 54, and a temperature control dial 56 which is connected to a refrigeration system which is conventional and no further description is believed necessary. It is particularly noted that the evaporator plates 50 enclose and form a portion of the circulation chamber 40. A blower wheel such as squirrel cage rotor 42 is provided in the chamber 40 which is rotated by a conventional motor 62. It is to be particularly noted that the blower 42 is a small fan for the purpose of circulating the incoming oxygen and air aspirating from the canopy over the cooling surfaces provided, but is not a recirculating fan and is not sized or positioned to circulate and cool the entire air-oxygen mixture in the enclosure 10. Nor is the refrigeration unit required to cool the entire mixture in the enclosure 10, only the mixture in the chamber 40. A suitable inlet tube 64 is provided into the chamber 40 for the admission of oxygen which is drawn into the interior of the blower 42 and blown against the cooling plates 50 and cooled. A diffuser 65 having a plurality of openings 67 is provided at end of the oxygen inlet conduit 64 to diffuse and direct the oxygen to blower 42. If desired, an inlet tube 66 may be provided for the admission into the circulation chamber 40 of additional air and/or suitable medication which may be mixed with the incoming oxygen and which may be used in the treatment of the patient, to control the humidity or to provide additional cooling. Thus, it is noted that the circulating chamber 40 is sized sufficient to contain substantially the entire circulation of the refrigerated air-oxygen mixture from the fan 42 and thus contain the concentration of turbulent flowing mixture which is being cooled and mixed in preparation for administration to a patient. Thus, the chamber or refrigerated oxygen reservoir 40 provides that most of the circulation or turbulence occurs in the chamber 40 and provides a relatively quiescent flow or spilling of refrigerated air-oxygen mixture into the enclosure proper 10 as additional oxygen flows into chamber 40 from the inlet 64. Thus, a refrigerated air-oxygen mixture is not blown out of the enclosure 10 but instead the excess mixture merely spills out as additional oxygen is introduced into the chamber 40 from inlet 64.

Preferably, the circulation chamber includes a partition 68 between the enclosure proper 10 and the chamber 40 limiting the fluid communication between the chamber 40 and the enclosure 10 through an opening 70 in the chamber 40. Thus, the partition 68 insures that the chamber 40 contains the major portion of the turbulent circulating refrigerated mixture which then flows quiescently from the chamber 40 into the canopy 10 as indicated by the arrows. It is also particularly noted that the blower 42 is positioned in the chamber 40 and spaced from the opening 70 so that the output of the blower 42 blows against the cooling plates 50, but not directly against the opening 70. And, as oxygen enters chamber 40 from inlet 64, the excess oxygen will flow into the canopy proper 10 by overflow, but will not primarily be blown out into enclosure 10 by the blower 42.

The enclosure 10 may be suitably connected to and receives the spill over or overflow of the air-oxygen mixture from the chamber 40 through the opening 70. For example, the replaceable patient enclosure 10 may be secured to flanges 72 about the opening 70.

Referring to the arrows 82, it is noted that the flow of the refrigerated mixture spills through the opening 70

into the lower portion of the enclosure 10. Since the refrigerated air-oxygen mixture is at a very cold temperature, preferably about 38 degrees, it will be much heavier than the ambient gas in the canopy 10 and will tend to hug the bottom of the enclosure 10. Thus, the cooled concentrated mixture will be positioned adjacent the head of the patient 12. When the patient exhales, the temperature of his exhalation will be 95 degrees or higher and this radical difference in temperature will cause a convection which will, in effect, shoot the exhaled air up and out the open top 30 of the canopy. It is also to be noted that a lip 21 extends inwardly around the top of the enclosure 10. This lip prevents the warmed exhalation of the patient which rises from creating a convection circulation that would suck warm air down the outside edge of the canopy 10 and then venting it out towards the center of the canopy where the patient was exhaling. However, since the concentrated mixture is much heavier than the exhaled air, it will not be expelled from the canopy. In addition, in the present apparatus, it is not necessary to take the heat exhaled by the patient, transfer it to the cooling coils and then to the condenser and recirculate it. The present apparatus, therefore, is not a recirculation type system and allows the use of much smaller refrigeration compressors.

It is also particularly noted that the opening 70 is vertically positioned relative to the top 30 of the enclosure 10 and the patient 12 to obtain optimum results. That is, the opening 70 is sufficiently below the top 30 so that in the event the top 30 of the enclosure 10 is open the mixture overflowing from chamber 40 will not flow out the open top. The opening 70 is positioned to diffuse the flowing oxygen adjacent the head 12 of the patient. By way of example, the opening 70 is positioned approximately nine inches above the mattress 18 and 18 inches below the top 30 of the enclosure 10.

A condensate drain 80 is provided connected to the bottom of chamber 40 to drain any liquids therefrom which might have condensed therein.

In use, enclosure 10 is placed about the patient 12 and may be closed to prevent the loss of oxygen out of the enclosure 10. If the enclosure 10 were of the open bottom type, it would be carefully tucked under the mattress 18 to reduce losses as much as possible. Oxygen is admitted to the circulation chamber 40 through the oxygen supply inlet 64 and diffuser 65 and refrigerated therein by being blown by the blower 42 against the cooling plates 50. Thus, refrigerated oxygen circulates in the chamber 40 and is mixed with air and the mixture flows in a relatively quiescent manner into the enclosure 10 and forms layers of refrigerated air-oxygen mixture which because of its weight falls to the bottom of the enclosure and adjacent the head 12 of the patient. With the use of the barrier 68 the turbulent flow is isolated in the chamber 40 and can flow only through the opening 70 into the enclosure 10 and adjacent the head of the patient 12. And it is noted that the blower 42 is positioned and directed with reference to the opening 70 so as to contain any turbulence in the chamber 40 and to provide that the mixture overflow to enclosure 10 is primarily a result of excess oxygen in the chamber 40 due to inflow from inlet 64 instead of being blown out of the chamber 40 by fan 42. The flow through the inlet 64 is quite small, for example, one-half cubic foot of oxygen per minute, therefore, it is obvious that the amount flowing out the opening 70 will not cause a draft or sufficient turbulence in the enclosure 10 to upset the oxygen stratification therein. Thus, conversation and treatment of the patient may be provided through the detachable top 30 of the enclosure 10 with a minimum loss of oxygen concentration.

The use of the circulation chamber 40 isolates the turbulent flow from the enclosure 10 and insures that the desired oxygen concentration of fifty volumes percent is maintained in the canopy proper with a minimum oxygen flow rate.

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In addition, suitable medication may be introduced into the chamber 40 through the inlet tube 66 for mixing with the oxygen for being conveniently and suitably administered to the patient 12.

In addition, if additional cooling in the enclosure 10 is desired, additional air may be introduced into the chamber 40 such as through the inlet 66 up to an amount equal to the volume of oxygen which would mean that double the volume of cool gas is flowing from the chamber 40 into the enclosure 10 thereby increasing the cooling effect. Since the normal concentration of oxygen prescribed is fifty percent, this dilution of the oxygen will not be detrimental.

The present invention is therefore well adapted and suited to attain the objects and has the advantages and features mentioned as well as others inherent therein. While a presently preferred embodiment of the invention has been given for the purpose of disclosure, numerous changes in the details of construction and arrangement of parts may be made which are within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. The improvement in an oxygen therapy enclosure which includes a canopy adapted to be disposed about the head of a patient comprising,
 - a cooling chamber having an opening which is connected to said canopy, said opening being adapted to be positioned above and adjacent the patient,
 - a refrigeration system including evaporator plates forming a portion of said chamber,
 - a blower fan in said chamber in which the blower outlet is directed against the evaporator plates,

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an oxygen inlet leading into said chamber and into the blower inlet whereby the oxygen is directed against the evaporator plates and cooled, said opening positioned out of the directed path of the blower fan output whereby the turbulent circulating oxygen is contained in said cooling chamber and the flow from the chamber is limited to cooled oxygen caused by and equal to the flow of oxygen from the oxygen inlet.

2. The invention of claim 1 including, a second fluid inlet connected to said chamber and directed to the blower inlet whereby air may be admitted to said chamber and cooled with the oxygen to increase the cooling of the canopy.
3. The invention of claim 1 including, a medication inlet to the chamber for administering medication to the patient.

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