

May 1, 1951

J. A. HEIDBRINK
MEANS FOR COOLING AIR OR OXYGEN ENRICHED
AIR WITHIN AN ENCLOSURE

2,550,810

Filed Feb. 12, 1947

2 Sheets-Sheet 1

Fig. 2

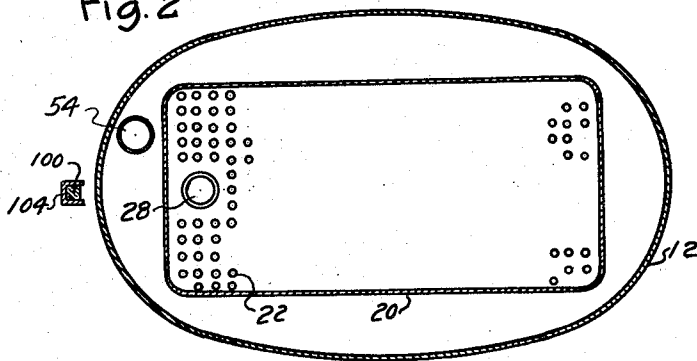
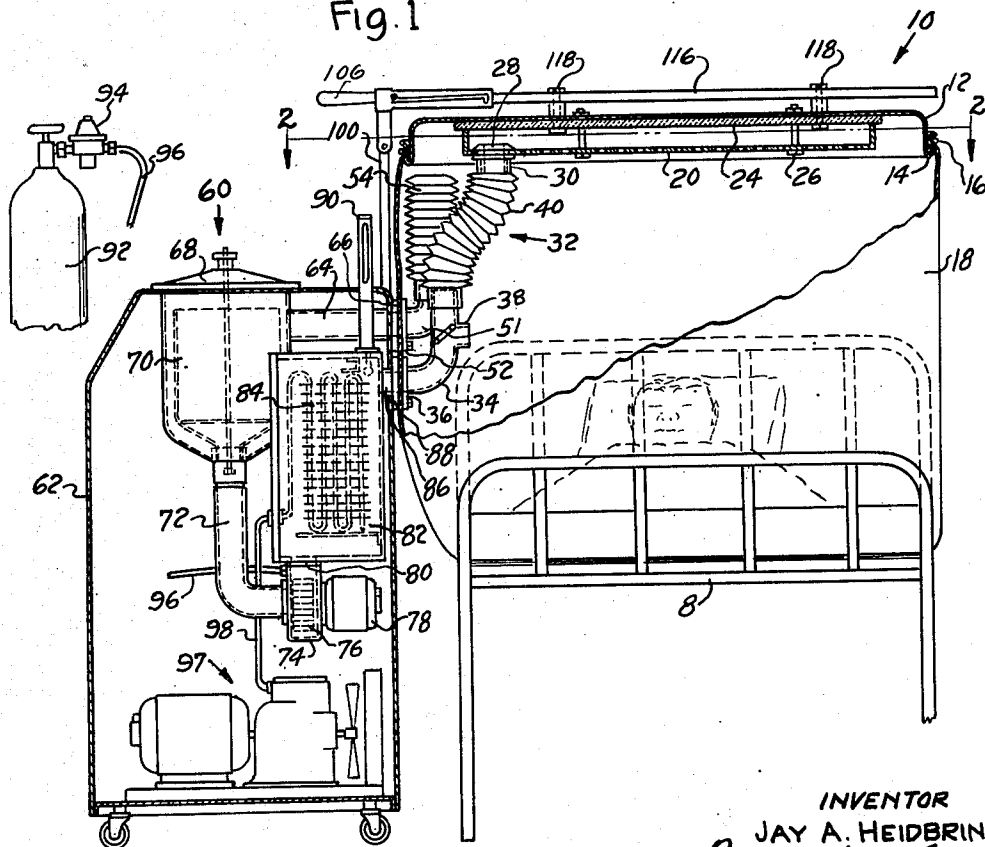


Fig. 1



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Fig. 4

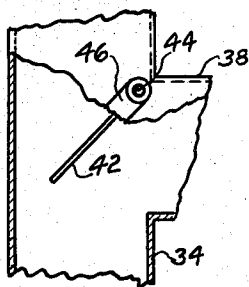
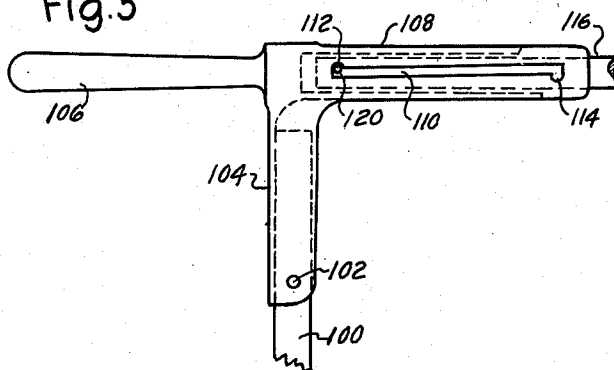
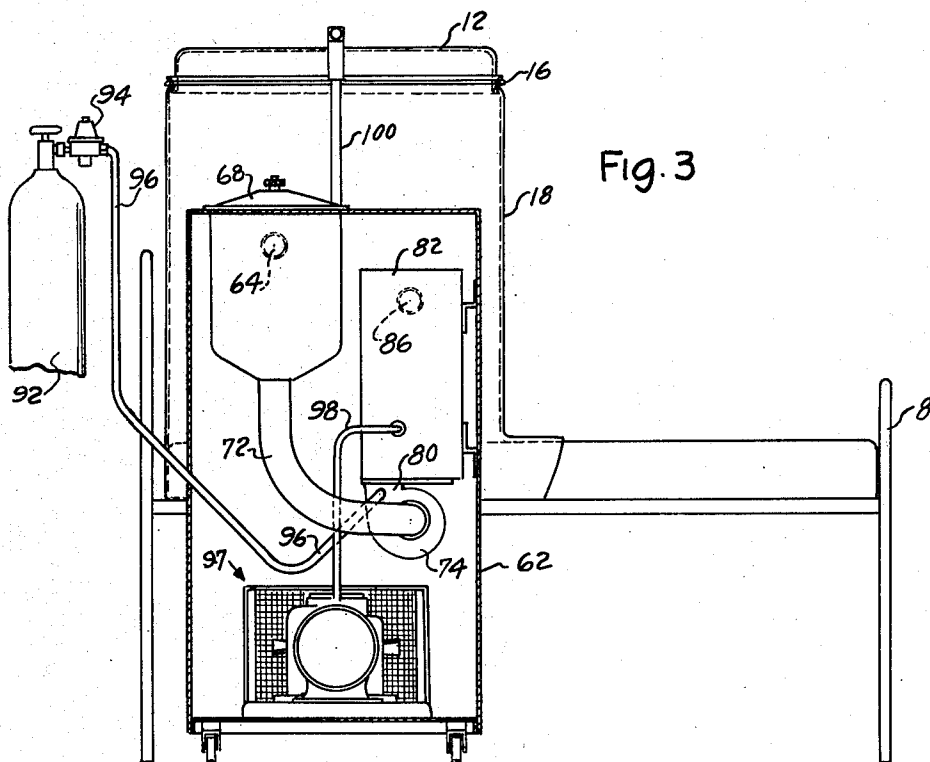


Fig. 5



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UNITED STATES PATENT OFFICE

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MEANS FOR COOLING AIR OR OXYGEN
ENRICHED AIR WITHIN AN ENCLOSUREJay A. Heidbrink, Minneapolis, Minn., assignor to
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5 Claims. (Cl. 98—33)

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My invention relates to a means for cooling air or oxygen enriched air within an enclosure which is adapted to surround a bed. In particular it relates to means for cooling the atmosphere within an enclosure when the atmospheric temperature surrounding the enclosure is excessively high. On administering oxygen therapy to a patient it is essential that the air which surrounds the head of the patient should be enriched with oxygen and it should be cooled to a point below what is regarded as normal room temperature, and should preferably be to about 65° F., as the lowered temperature tends to inhibit bacterial activity. The particular advantage of the present invention is that when the temperature of the air surrounding the enclosure is excessively warm, as for example near or above 90° F., room temperature, the air mixture supplied to the patient can be maintained at the desired lower temperature.

In the past, the general practice relating to this subject matter was to introduce cooled air through the side walls of the enclosure that surrounds the patient at a point spaced above the patient's head and in such a manner that the incoming air was directed toward the walls of the enclosure so as to avoid a direct draft on the patient's face. In this manner the cooled air initially came into contact with the walls of the enclosure from which it was deflected in a turbulent manner above the patient's head. Under conditions of reasonably moderate temperatures the prior art arrangement was satisfactory, but difficulty arose when the temperature surrounding the enclosure became excessively high, for under these conditions the cooled air absorbed so much heat from the walls of the enclosure that it could not be maintained at the desired lowered temperature. It was the practice when atmospheric temperatures were high to increase the rate of air flow into the enclosure to compensate for the gain in heat but this was not satisfactory because it created an intolerable draft on the patient and failed to keep the air properly cooled.

My invention is directed to means used in combination with an air conditioning apparatus and an enclosure positioned with relation to a bed so as to surround the head of a person reclining thereon, and is constructed in such a manner as to direct the flow of cooled air in a quiescent manner with virtually no turbulence in a downward direction and around the head of the person. Means are also provided for withdrawing the warmer air from within the top of the en-

closure so as to create cyclic passage of air through the enclosure.

The principal value of the distributor is for diffusing the incoming air without turbulence and with a minimum absorption of heat. For this reason, the connection between it and the air cooling apparatus is as short as possible and is situated principally within the enclosure where it will be subject to a cooler exterior temperature and will, therefore, absorb less heat. Furthermore, the distributor is carefully heat insulated from the enclosure and is arranged in spaced relation to the side walls to cause the cooled air leaving the distributor to descend in a central column within the enclosure until it reaches the surface of the bed, after which it spreads out and ascends in the form of an annulus. Also the distributor is constructed with such large area of discharge openings that the air leaves it at a reduced velocity and free of turbulence. The cyclic travel of the air is brought about by heat transfer which occurs through the side walls of the enclosure since it is a natural tendency for air to rise when heated, and to aid in this action the means for withdrawing the air from within the enclosure is situated preferably to open adjacent its upper portion.

However, when the temperature of the atmosphere surrounding the enclosure is not excessively high, and may for example be less than about 85° F., the cyclic distribution of air, through the absence of a rapid transfer of heat, will tend to create an excessively cooled condition within the enclosure. Under these conditions, means are provided for diverting the flow of incoming air from the distributor and directing it against the walls of the enclosure to create a turbulent condition and to bring the incoming air quickly into contact with the walls so as to create a more rapid transfer of heat and thus prevent the air within the enclosure from being excessively cooled. Thus the cooling within the enclosure is maintained substantially constant with considerable variations of surrounding room temperature.

An object of my invention is to provide means for cooling the air within an enclosure which is adapted to surround a bed.

Another object is to provide means used in combination with air conditioning apparatus for cooling the atmosphere within an enclosure so as to maintain the air entering the enclosure cooled when the atmospheric temperature surrounding the enclosure is excessively high.

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Another object is to provide in combination with an air conditioning apparatus, means for introducing cooled air into an enclosure which is subject to a relatively higher temperature on its exterior surface, in such a manner as to form a central column of descending non-turbulent cooled air which is separated from the walls of the enclosure by an ascending annulus of warm air.

Another object is to provide in combination with an air conditioning apparatus and an enclosure having an air distributing means therein, a conduit forming a short connection between the apparatus and the distributing means for conducting the cooled air thereto, which is situated within the enclosure and subject to the temperature of the atmosphere within the enclosure.

Another object is to provide in combination with an enclosure having a cool air conduit entering therein, means for distributing the cool air in said enclosure in a non-turbulent descending column.

Another object is to provide in combination with an air conditioning apparatus and an enclosure a first means of distributing cooled air within the enclosure when the temperature of the air surrounding the enclosure is relatively high, and a second means of distributing the air within the enclosure when the temperature of the air surrounding the enclosure is relatively moderate.

A further object is to provide in combination with oxygen therapy equipment a means of providing a therapeutic air within an enclosure which is adapted to surround the head of a person reclining on a bed by providing means for diffusing the therapeutic air within the enclosure in a quiescent manner and wherein the diffuser is situated with relation to the side walls of the enclosure so as to provide a central column of descending cool air which when it comes into contact with the bed will spread out and rise by virtue of heat absorbed from the side walls, the bed, and the enclosure, and preferably be removed from a point adjacent the top of the enclosure.

Other and further objects may become apparent from the following description and claims and from the appended drawings in which:

Fig. 1 is a side elevation of the invention with some parts broken away and others shown in cross-section;

Fig. 2 is a plan view taken on the lines 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a side elevation of the structure shown in Fig. 1 as seen from the left side thereof.

Fig. 4 is an enlarged detailed view of a part of one of the conduits shown in Fig. 1; and

Fig. 5 is an enlarged detailed view of a portion of the supporting structure shown in Fig. 1.

Referring now to the drawings, the invention will be described in detail.

Referring now to Fig. 1, reference numeral 8 indicates a bed, which is here shown as a hospital bed over which is suspended a hood indicated by the general reference numeral 10. Hood 10 is intended to be positioned with relation to bed 8 so as to surround the head of a patient reclining thereon. Hood 10 has a top portion 12 which is oval in shape as shown in plan view in Fig. 2. About the lower edge of top portion 12 is a rim or beading 14. Secured about outer periphery of top portion 12 above beading 14 by a drawstring 16, is a curtain 18. Curtain 18 may be formed of a transparent plastic such as

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"Vinylite," and because it is relatively thin will readily transfer heat to its inside surface. Situated in the under surface of the top portion 12 is an air distributor 20 which has a plurality of small regularly spaced apertures 22 on its lower surface as shown in Fig. 2. Distributor 20 which is in the form of a shallow pan is heat insulated from top portion 12 by a layer of insulation 24 and is secured to top portion 12 by a plurality of fastening means 26 which extend through insulation 24. Distributor 20 is provided with an enlarged aperture 28 at one end of its lower surface which receives a metal end portion 30 of a conduit indicated by the general reference numeral 32. The combined area of the apertures 22 is greatly in excess of the area of inlet opening 28.

Conduit 32 is provided for supplying air to distributor 20 and is formed of a lower portion 34 having at one end thereof a flange 36 which extends to an open branch 38. Portion 34, above branch 38 is connected to portion 30 by a length of flexible corrugated rubber tube 40. As more clearly shown in Fig. 4, branch 38 extends at right angles to portion 34 and is provided with a damper 42 which is pivoted at 44 and controlled by a manually operable lever 46.

Also situated within hood 10, is a second conduit 50 formed of an elbow 51 having a flanged end portion 52. Extending upwardly from elbow 51 is a flexible corrugated rubber tube 54 which is open at its top portion and which extends upwardly within hood 10 adjacent curtain 18 terminating at a point adjacent one side of distributor 20, as clearly shown in Figs. 1 and 2.

Indicated by general reference numeral 60 is an air conditioning apparatus which is used in combination with hood 10 to withdraw the air therefrom and purify and cool the air before returning it to the hood. Apparatus 60 consists of a casing 62 which has extending from an upper side portion, a conduit 64 having a flanged portion 66 which is joined by a plurality of fastenings to flanged portion 52 of elbow 51 on either side of an aperture extending through curtain 18. Conduit 64, within casing 62, terminates in a container 68, which within its interior, is provided with a portion 70 that contains a quantity of soda lime. A conduit 72 extends from the lower portion of container 68 and enters one side of centrifugal pump 74, whose impeller 76, is controlled by a motor 78 to withdraw the air from hood 10 through the connection previously mentioned and drive the air through an outlet 80. The outlet 80 of pump 74 is connected to a refrigeration evaporator 82 which contains a cooling coil 84. Evaporator 82 has extending from its upper portion a short conduit 86 having on its exterior end a flange 88 which is joined to flange 36 of conduit 32 through an aperture in curtain 18. A thermometer 90 indicates the temperature of the air leaving evaporator 82 through conduit 86 and will in general be indicative of the temperature of air passing into hood 10.

A cylinder 92 containing compressed, pure oxygen, supplies additional oxygen to the circulated atmosphere through a control valve 94 and a conduit 96 which extends into connection 80 between pump 74 and evaporator 82.

In order to provide refrigeration for evaporator 82, a conventional motor-operated refrigeration compressor indicated by the general reference numeral 97 is connected by a conduit 98 to refrigeration coil 84 to provide fluid refrigerant therefor. In place of the air-cooling means

above described, other air-cooling means such as ice may be used.

As shown in Figs. 1, 3 and 5, hood 10 is supported by apparatus 60. A shaft 100 which is mounted on one side of casing 62 has adjacent its upper portion a pivot 102 on which is pivotally mounted a hinged portion 104. Hinged portion 104 has extending from one side a handle 106 by which portion 104 may be pivotally rotated on pivot 102. Extending in the same plane as handle 106 and forming an angular part of portion 104 is an upper portion 108 which has on one side thereof a slot 110 having an upwardly extending terminal portion 112 at one end and a downwardly extending terminal portion 114 at the other end. Tubular portion 108 is adapted to receive one end of a rod 116, which through brackets 118 supports hood 10 from its top portion 112. A pin 120 is positioned on one end of rod 116 and slidably engages slot 110. Hood 10 is, under certain conditions, adapted to be folded alongside of apparatus 60 and to accomplish this, rod 116 is lifted at its outer end to disengage pin 120 from the terminal portions 112 of slot 110, thereafter rod 116 may be moved outwardly permitting pin 120 to slidably move along slot 110 until it is turned and engaged in a terminal portion 114 of slot 110, whence hood 10 will be folded in a vertical position alongside of apparatus 60.

In operation, the invention performs in the following manner. With the hood 10 surrounding a portion of bed 8 so as to enclose the head and upper part of the patient reclining thereon, it is necessary to continuously supply oxygen-enriched air to the hood which must be at a temperature lower than that surrounding the exterior of the hood.

Assuming the temperature of the air surrounding hood 10 to be about 85° to 90° F. or higher, damper 42 will be adjusted by handle 46 so as to direct the flow of air entirely into distributor 20. With apparatus 60 in operation, the air within hood 10 will be in continuous circulation through the various elements of apparatus 60, and cooled air will be transmitted through conduit 32 to distributor 20. It will be noted that conduit 32 is positioned within hood 10 and forms a relatively short connection between evaporator 82 and distributor 20. Because of its large area and the great number of apertures 22 on its lower surface, the air entering distributor 20 loses its velocity and descends into hood 10 without turbulence and with no appreciable force. As clearly shown in Fig. 2, distributor 20 is centrally disposed in hood 10 in spaced relation to curtain 18 so that the cool air emanating from apertures 22 will descend without coming into contact with curtain 18, and being free of turbulence, will form a cool central core within hood 10 until it reaches the surface of the bed. On contacting the bed the cool air spreads out in a mushroom-like fashion and moves towards curtain 18. With the temperature on the outer surface of curtain 18 being relatively high, the curtain will form a radiating surface and as the air contacts the curtain it will absorb heat and rise in the form of an annulus adjacent the curtain. As the warm air rises within hood 10 it will be withdrawn near the upper portion of the hood through the upper open end of rubber tube 54. Thus the cooled air entering the hood is insulated from the heat being radiated from the curtain by the ascending annulus of warmer air and because conduit

32 is comparatively short in length and is situated within the hood the incoming air reaches the patient at a comparatively low temperature even though a much higher temperature exists in the area surrounding the hood.

The air entering apparatus 60 has its carbon dioxide content removed by the soda lime in container 68 and its oxygen supply enriched by pure oxygen from cylinder 92. The evaporator 82 cools and conditions the air before it is returned to conduit 32.

When the temperature of ambient air surrounding hood 10 is within a more moderate range, as for example in the range of under 85° F., the non-turbulent cycle previously disclosed will tend to cause the air surrounding the patient to become excessively cooled because of the slower rate of heat transfer through curtain 18. Under these conditions, damper 42 is moved to divert the flow of air from distributor 20, through the branch opening 38 into the area of hood 10 above the patient's body and in the direction of curtain 18. This will terminate the thermal cycle and cause a turbulent agitation of the air so that all of the air within hood 10 is brought into contact with curtain 18 to cause a more rapid rate of heat transfer and thus raise the temperature within hood 10 and maintain it at a higher level.

If the temperature produced by distributing the air through distributor 20 is excessively low and the temperature resulting from distributing all of the air through branch 38 is excessively high, damper 42 may be positioned at an intermediate position to distribute a portion of the air through distributor 20 and a portion through branch 38, so that a range of temperatures within hood 10 may be obtained by regulating the position of damper 42.

The principal advantage of my invention is that a suitable lowered temperature may be maintained within an enclosure when the exterior temperature is very high by providing for the cooled incoming air to descend in a non-turbulent central core within the enclosure in such a manner that the central core is insulated from the walls of the enclosure by a rising annulus of warmer air. On the other hand, when the ambient temperature is in a more moderate range, the air within the enclosure may be agitated in varying degrees to prevent it from becoming excessively cooled.

Another advantage is that by providing a relatively short connection between the air-cooling means and the distributor, which connection is situated substantially entirely within the enclosure, the air passing from the cooling means to the distributor will not be subjected to atmospheric temperature existing on the outside of the connection and will, therefore, be relatively cool when it reaches the distributor.

Also the practice of removing the warmer air from a point near the top of the enclosure facilitates the cyclic travel of air within the enclosure and will tend to draw the warmer air out of the enclosure in the form of an annulus, adjacent the side walls of the enclosure.

Furthermore, because the air distributor has a relatively large area and a great many small apertures for emitting the cool air, the combined area of which is considerably in excess of the area of the connection to the distributor, the force of the air leaving it is greatly diminished so that the air descends within the enclosure principally by virtue of its lowered temperature.

As numerous changes may be apparent to those

skilled in the art, my invention is not limited to the single illustration, but is defined in the terms of the appended claims.

I claim:

1. In an air conditioning system, in combination, an enclosure for surrounding a portion of a bed and formed of a top wall and side walls, an outlet conduit connected to said enclosure for conducting air from within the enclosure, air conditioning means connected to said conduit and being operative to continuously withdraw and cool the air from within said enclosure, an air distributor consisting of a shallow member supported within the interior of the enclosure beneath the top wall and extending over the major portion of the interior of the enclosure and having its outer edges spaced inwardly from the side walls, the lower surface of said distributor having a plurality of substantially regularly spaced openings, a second conduit connecting said air conditioning means and said distributor to return conditioned air to the interior of said enclosure, said second conduit having an opening therein which is spaced beneath and at one side of the lower surface of the air distributor, and a damper associated with the opening in said second conduit for venting a portion of return air from said second conduit in a substantially lateral direction with respect to the openings in the lower surface of the air distributor.

2. In an air conditioning system, in combination, an enclosure for surrounding a portion of a bed and formed of a top wall and side walls, air conditioning means for supplying cooled conditioned air to the interior of said enclosure, and an air distributor consisting of a shallow member wholly contained within the interior of the enclosure beneath the top wall, said distributor having an inlet opening connected to said air conditioning means for receiving cooled conditioned air, the lower surface of said distributor having a multiplicity of small substantially regularly spaced outlet openings, the total area of the outlet openings being substantially greater than the area of the inlet opening to reduce to substantially nil the velocity of air leaving the distributor, said distributor extending over the major portion of the interior of the enclosure and having its outer edges spaced inwardly from the side walls of the enclosure, whereby the cooled conditioned air leaving the distributor forms a quiescent descending column within a central area of the enclosure.

3. In an air conditioning system, in combination, an enclosure for surrounding a portion of a bed and formed of a top wall and side walls, an air distributor consisting of a shallow member supported beneath the top wall and extending over the major portion of the interior of the enclosure and having its lateral edges spaced inwardly from the side walls, the lower surface of said distributor having a multiplicity of substantially regularly spaced outlet openings for distributing air downwardly within the enclosure, said distributor having an inlet opening, air cooling means positioned in close relationship to the enclosure and having an outlet opening for cooled air extending in the direction of a side wall of the enclosure, and a conduit extending through the side wall of the enclosure and connecting the outlet opening of the air cooling means with the inlet opening in said distributor, said conduit having substantially its entire linear portion within the enclosure and in contact with the cooled air passing from the entire linear

portion within the enclosure and in contact with the cooled air passing from the distributor to minimize the gain in temperature of the cooled air as it passes from the air cooling means to the distributor.

4. In combination with an enclosure including side walls adapted to surround a portion of the bed, a top secured to the side walls, an outlet conduit connected to said enclosure for withdrawing air adjacent an upper peripheral portion of the top of said enclosure, air conditioning means connected to said conduit and being operative to continuously withdraw and cool the air within said enclosure, and an air distributor supported by the top and wholly contained within the interior of the enclosure and connected to said air conditioning means to return cooled air to said enclosure, the peripheral limits of said distributor being spaced inwardly from the side walls of the enclosure, said distributor having an inlet opening and a multiplicity of downwardly projecting outlet openings, the combined area of the outlet openings being substantially greater than the area of the inlet opening so that the cooled air leaving the distributor is in a quiescent condition and is spaced inwardly from the side walls of the enclosure to form a central descending column that displaces the air within the central part of the enclosure and causes the same to rise in the form of an annulus surrounding the descending column and extending continuously between the descending column and the surrounding walls of the enclosure.

5. In an air conditioning system, in combination, a hood having a top, a flexible fabric curtain formed of material having a relatively high heat transfer capacity depending from the top and adapted to surround a portion of a bed, a conduit extending from a source of cooled air and penetrating the fabric curtain, a hollow box-like air distributor wholly contained within the fabric curtain and supported by the top, the peripheral limits of said air distributor being spaced inwardly from the fabric curtain, said distributor being connected to the other end of said conduit, said distributor having a multiplicity of small openings in its lower surface, the total area of said openings being substantially less than the area of a cross dimension of the conduit for reducing to substantially nil the velocity of air leaving the distributor, whereby the cooled air descends in a central column within the interior of the fabric curtain, and a controllable opening in said conduit within the interior of the fabric curtain for directing a portion of the cooled air into contact with the descending central column to agitate the air within said enclosure.

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REFERENCES CITED

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

UNITED STATES PATENTS

65	Number	Name	Date
	2,087,171	Szostek	July 13, 1937
	2,090,271	Taylor	Aug. 17, 1937
	2,104,024	Conboie	Jan. 4, 1938
	2,105,108	Crosley, Jr.	Jan. 11, 1938
70	2,159,741	Kettering et al.	May 23, 1939
	2,172,944	Norris	Sept. 12, 1939
	2,210,458	Keilholtz	Aug. 6, 1940
	2,235,642	Lintern et al.	Mar. 18, 1941
	2,288,538	Morrison	June 30, 1942
75	2,310,222	Deverall	Feb. 9, 1943