April 18, 1939. D. H. REEVES 2,154,638

AIR CONDITIONING APPARATUS

Original Filed July 12, 1935 2 Sheets-Sheet 1

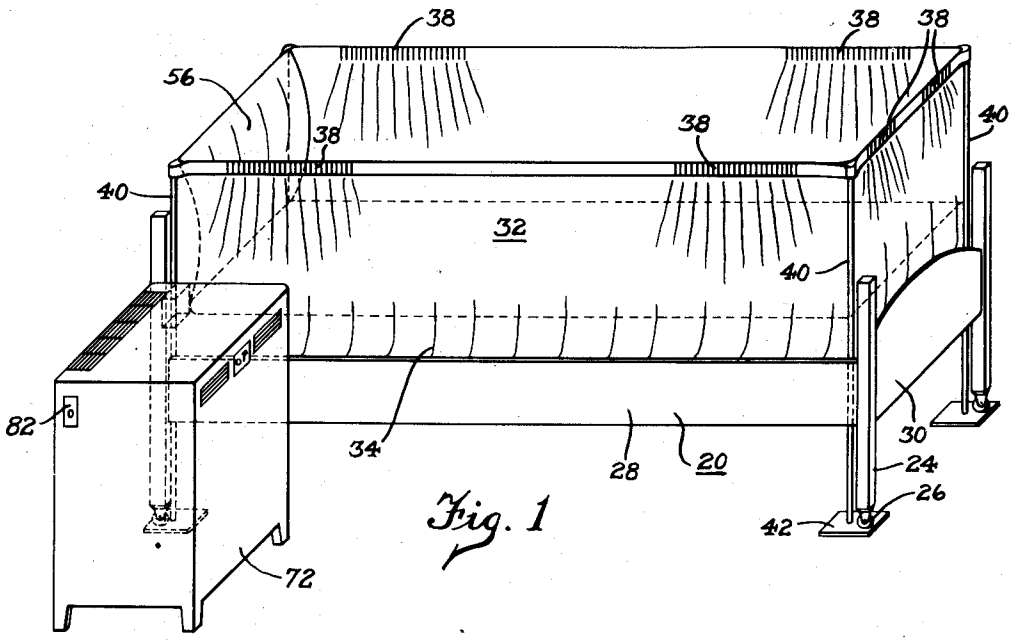


Fig. 1

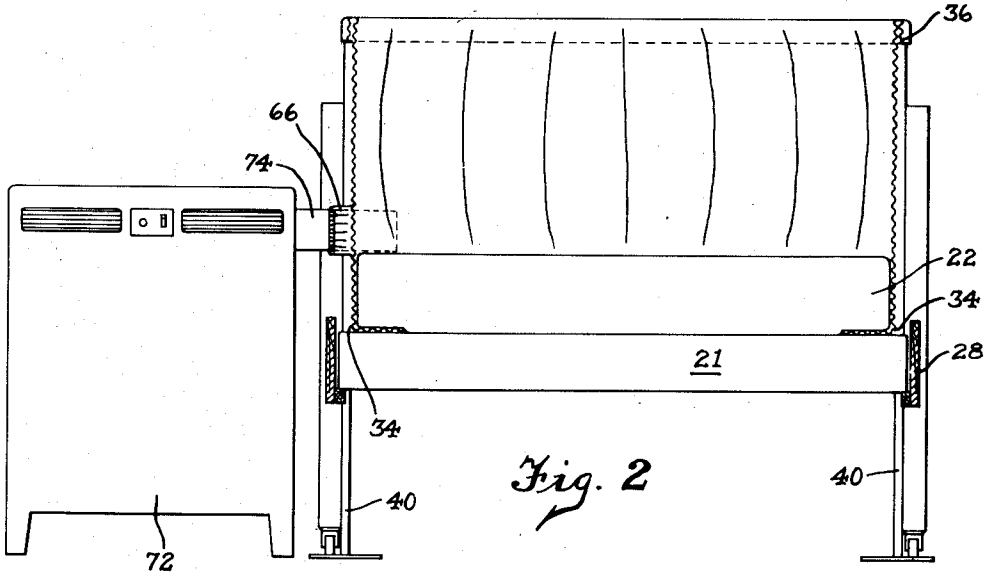


Fig. 2

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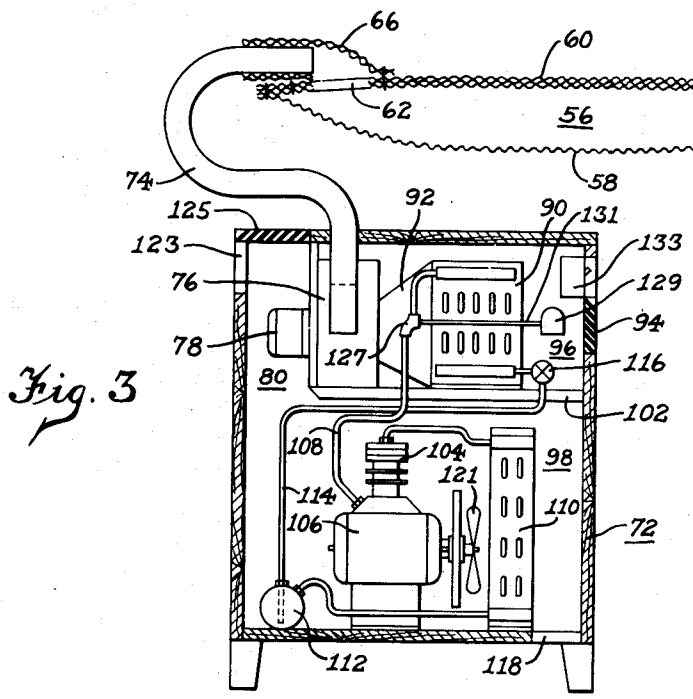


Fig. 3

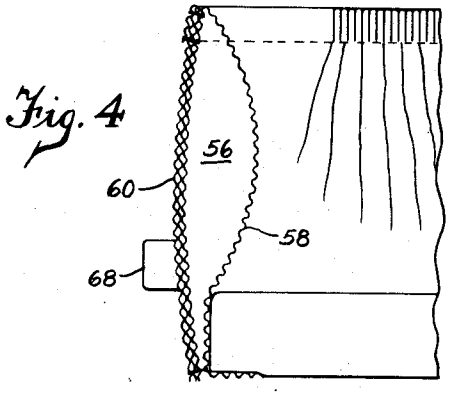


Fig. 4

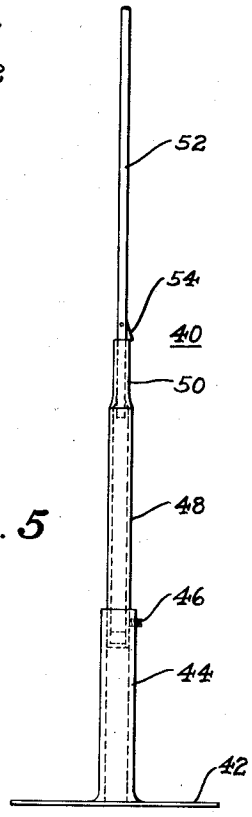


Fig. 5

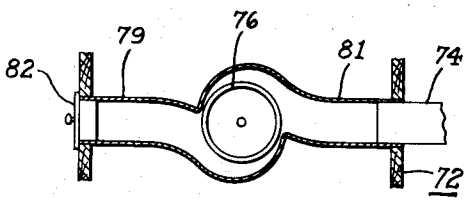


Fig. 6

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UNITED STATES PATENT OFFICE

2,154,638

AIR CONDITIONING APPARATUS

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Application July 12, 1935, Serial No. 31,067
Renewed March 10, 1938

9 Claims. (Cl. 98—1)

This invention relates to refrigerating apparatus and more particularly to bed coolers.

Commercial air conditioning has now become an established thing and widespread application has been made in commercial establishments. Air conditioning as applied to residences has not been exploited to any material extent because of the relatively high cost thereof. However, the cooling of beds has been considered a distinct possibility, since it is in attempting to sleep upon hot humid nights that the discomfort of summer weather is manifested. The loss of sleep is the worst result of hot weather. Therefore, considerable development work has been done upon bed cooling, but in most cases, the bed coolers or devices are elaborate and expensive and are of such a character that few persons would desire to have them in their bed room. Some of these bed coolers have undesirable cold drafts, some cool the feet too much and the head too little, and nearly all are of a distinctly undesirable appearance.

It is an object of my invention to provide an improved bed cooler which will have such an aspect that it will be eagerly accepted by the public and which will maintain the sleeper in a comfortable environment during warm weather.

It is another object of my invention to provide an improved bed cooler which will maintain the body at a comfortable temperature and provide a supply of cool, fresh, filtered air without drafts for the head.

It is a further object of my invention to provide a self-contained bed cooler which will blend with the furniture normally found in a bed room, which will require no exposed connecting ducts or lines and be of such a character that it will fit in any ordinary bed room.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a perspective view of a bed cooler embodying my invention;

Fig. 2 is a front view, partly in section, of the bed cooler shown in Fig. 1;

Fig. 3 is a vertical sectional view through the air cooling device connected in a diagrammatic way to a horizontal sectional view of the air distributing device;

Fig. 4 is a vertical sectional view through the air distributing device;

Fig. 5 is a view in elevation of one of the curtain posts; and

Fig. 6 is a sectional view of the centrifugal fan of the air cooling device and its two outlets.

The general principle I employ in cooling a bed is to form a pool of circulated, cooled air within a low curtain surrounding the bed as shown in Fig. 1. As cool air is heavier than warm air, it will drop so that such an enclosure, though open at the top, will retain any cool air that is introduced into it, just as a pail will retain any water poured into it. In like manner, if a continuous supply is provided, such water will eventually overflow and in the case of the bed, the cooled air after being warmed by its contact with the occupant or other heat giving source will eventually rise and flow over the top. The air which is introduced within the curtain enclosure is cooled and dehumidified by means of a refrigerant evaporating unit and forced into an envelope of muslin which forms the wall or curtain portion extending across the head of the bed.

This envelope is made of four thicknesses of muslin and the air is introduced between the innermost sheet portion of muslin and the next innermost sheet portion of muslin so that substantially all of the air passes with very little resistance through the innermost sheet of muslin which acts as a filter for removing particles in the air. This air passes through the single thickness of muslin at a relatively low rate and as explained above, passes over the pillow and the head of the person using the pillow and fills the space within the curtain enclosure with cooled, dry, filtered air. The warm air is naturally forced out of the enclosure by the cool air being supplied. By making it possible to sleep in such an environment, much of the distress caused by hot weather is eliminated.

Referring now more particularly to the drawings, there is shown in Figs. 1 and 2 an ordinary bed **20** provided with box springs **21**, a mattress **22** and legs **24** at each corner of the bed shown provided with ordinary castors **26**. The bed has the usual side rails **28** and head board and a foot board **30**. Extending around the mattress is a curtained enclosure **32** which has its lower edges tucked beneath the mattress, specifically between the lower edge of the mattress and the top of the springs **21** as shown by the reference character **34**. This tucking under, therefore, makes a seal between the bottom of the curtain and the mattress and completes the substantially air tight receptacle which is thereby formed by the mattress which forms the bottom of the receptacle and the curtained enclosure which forms the walls of the receptacle. The curtained enclosure

may be made of any suitable fabric which will prevent the air from escaping, preferably a tightly woven, washable material and if desired one or several thicknesses of some material such as ordinary muslin or bed sheeting may be used. Preferably this fabric is bleached muslin made from unbleached muslin having a thread count of about sixty-eight by seventy-two threads per inch and having a weight of about 4.75 square yards per pound. This provides for each square inch of the fabric about four thousand nine hundred tiny openings between the threads. These openings, however, are so tiny that air will not pass through these openings unless there is at least a slight pressure to force the air through.

The upper edge of the curtained enclosure is turned outwardly to form a hem as indicated by the reference character **36** all the way around the upper edge. At the points indicated by the reference character **38**, beneath this turned-over edge, that is within the hem, there is provided strips of ordinary elastic in a stretched condition fastened at either end within the hem so as to form gathers between the points of fastening. That is, the ends of the elastic are fastened to the hem at each end of the gathers. These elastic gathered portions **38** hold the curtain in place and permit the ready entrance to and exit from the bed merely by depressing or pushing down the curtain at the place it is desired to enter or leave the bed. These elastic portions also permit the enclosure to conform to different sizes and shapes of beds. Adjacent the corners of the curtained enclosure, this turned-over upper edge or hem is not fastened down, but forms pockets which fit over the upper ends of the vertical supporting rods or standards **40** which support the upper edge of the curtained enclosure. These rods or standards **40** extend downwardly inside the side rails and the head and footboards and the legs, but outside the mattress and springs. At the lower end, these rods are each provided with a sheet metal base **42** upon each of which rest one of the castors **26** at the bottom of the legs **24** or the leg itself if castors are not used. The castor preferably rests upon the outermost corner of the base **42** so that the weight of the bed can be used most effectively in preventing the rods **40** from being pulled inwardly by the elastic portions **38** of the curtained enclosure.

Referring now more particularly to Fig. 5 for a detailed view of a suitable form a rod or standard for supporting the curtained enclosure, there is shown a socket **44** extending upwardly from the base **42** and provided with a set screw **46** for holding a hollow rod **48** having a solid bottom padded by a rubber cushion and provided at its upper end with a necked-in portion **50** for receiving the lower end of the solid rod **52** provided with a spring catch **54** which engages the upper edge of the hollow rod **48**. The spring catch **54** may be pushed inwardly and the solid rod may be pushed down all the way to the bottom of the hollow rod when the curtain is not in use. The hollow rod **48** may be moved upwardly or downwardly within the socket **44** and held in any desired position by the set screw **46** in order to hold the upper edge of the curtained enclosure **32** at the desired height above the mattress, regardless of the height of the bed.

The head end of the curtained enclosure **32** is provided by an envelope **56** made up of four sheets of muslin or other suitable porous fabric as best shown in Figs. 3 and 4. Preferably, this muslin has substantially the same specifications as that given for the muslin of the curtains and is sufficiently porous to permit air to pass through a single thickness with very little resistance. In this envelope, there is provided an inner sheet **58** which forms the wall of the envelope through which the air passes into the curtained enclosure and three outer sheets designated by the reference character **60** which in reality form the head wall portion of the curtained enclosure as well as form the outer wall of the envelope. This envelope extends entirely across the head end of the bed and is provided with inlets **62** and **64** in either side of the wall portion **60** of the envelope, each of which is provided with a neck of a double thickness of muslin or other material so as to be substantially air tight, the neck for the inlet **62** being designated by the reference character **66** and the neck for the inlet **64** being designated by the reference character **68**. The neck **68**, however, is closed by a clamp or string and cooled air is supplied to the envelope **56** by a duct **74**, shown diagrammatically in Fig. 3, which connects to the neck **66**. By providing an inlet neck on each side, the air cooler may be placed on either side of the bed as desired.

The cabinet of the air cooling unit is constructed of plywood with a walnut surface and is designed and finished in such a way as to resemble and to be capable of being used as a night table. The air cooling unit, generally designated by the reference character **72**, is located to one side of the head of the bed as best shown in Figs. 1 and 2 and has a straight rectangular air duct **74** leading directly from its upper side to the neck **66** of the envelope **56** so as to supply cool air to the curtained enclosure **32**. My air cooler is provided with a centrifugal fan **76** driven by an electric motor **78** located in an air passage **80**. As best shown in Fig. 6, this fan is in a double scroll housing which is provided with two outlets **79** and **81**, one of which extends directly to the duct **74** and the other of which extends to an outlet which is shown closed by a removable cover plate **82**. The outlet **79** closed by the cover plate **82** may, if desired, be connected by a duct to a second similarly equipped bed situated directly adjacent this outlet so that such a unit may serve twin beds. However, when this cooling unit is used for only one bed, this outlet is closed by a removable cover plate such as the cover plate **82** so that all of the air from the fan **76** is delivered to the envelope **56**. This arrangement makes it possible to place the cooler on either side of the bed.

The curtained enclosure **32** preferably extends about eighteen inches above the top of the mattress. For a single bed, the envelope **56** is about eighteen inches high and about two feet, eight inches long, giving it an area of about four square feet. The fan will deliver to the envelope from forty to sixty cubic feet per minute of air to this envelope so that from ten to fifteen cubic feet per minute of air passes through each square foot of muslin forming the exposed inner wall of the envelope **56**. For a double bed, the envelope **56** is about eighteen inches high and about four feet long, giving it an area of about six square feet through which the cooled air passes. To the envelope of a double bed, I deliver about forty-five to sixty-five cubic feet per minute so that from seven and one-half to eleven cubic feet per minute of air passes through each square foot of the muslin air filter. I find that from seven and one-half to fifteen cubic feet per minute per square foot of area of this muslin is the desirable rate for supplying air to the enclosure. At this

rate, no objectionable drafts are felt and yet the sleeper is provided with a continuous supply of fresh, cool, dry air. It is known by experience that when sleeping in a cold room in the winter that the head can stand the greatest amount of cooling and that the greatest amount of invigoration is felt when cool air is breathed. It is for this reason that in my improved bed cooler I introduce the cooled air at the head of the bed so that the head will get the greatest amount of cooling. The feet which usually need the least amount of cooling are in the warmest portion of the enclosure. This greatly aids in making the prospective sleeper or occupant feel cool and comfortable.

While my improved bed cooler is extremely quiet in operation, starting and stopping might awaken the occupant of the bed. I, therefore, allow my cooler to run continuously. Authorities point out that a steady low sound is conducive to sleep. Instead of controlling the cooling by starting and stopping the refrigerating system, the amount of cooling is automatically controlled by reducing the capacity of the refrigerating system as the room temperature drops and increasing the capacity as the room temperature rises so as to keep an approximately uniform temperature within the bed. The temperature which will be maintained within the bed can easily be adjusted by the occupant. When operating with reduced capacity, the current required by the cooler is also reduced.

The refrigerating system of the cooler includes a refrigerant evaporating means 90 surrounded by and provided with a casing 92 connected to the inlet of the blower 76 so that cool air from the room may be cooled by the evaporating means before being conducted and forced into the bed. The air from the room enters the cabinet through an ornamental grille 94 in the front of the cabinet and enters a compartment 96 containing the evaporating means and the blower 76. This compartment is separated from the compressor compartment 98 by insulated partition-walls 102. The evaporator 90 is maintained at some suitable temperature above freezing and is sufficiently cool that during hot humid weather it will condense a considerable amount of moisture out of the air so that cool, dry, comfortable air is supplied to the bed enclosure. Evaporated refrigerant is withdrawn from the evaporating means and liquid refrigerant is supplied to the evaporating means by a compressor 104 driven by an electric motor 106 for compressing the refrigerant withdrawn from the evaporating means through the return conduit 108 and for forwarding the compressed refrigerant to an air cooled condenser 110 where the compressed refrigerant is liquefied and collected in a receiver 112. The liquid refrigerant is conducted from the receiver through a liquid supply conduit 114 to an expansion valve 116 located in the upper evaporating compartment and connected to the evaporating means to control the flow of liquid refrigerant into the evaporating means and to maintain a proper evaporating pressure and temperature within the evaporating means.

I prefer to use difluoro-dichloro-methane as a refrigerant since it is non-toxic and non-inflammable. Preferably, the expansion valve maintains an evaporating temperature between 35 and 40° F. An inlet opening 118 is provided in the bottom of the cabinet through which air is drawn by a fan 121 driven by the electric motor 106 which draws the air through the condenser 110 and discharges it over the motor and compressor and thence up the outlet passage 80 to the outlet opening 123 at the back of the cabinet and the grille 125 which forms a part of the rear portion of the top of the cabinet.

The capacity of the refrigerating system is controlled by a throttling valve 127 located in the suction line 108. This throttling valve 127 is preferably controlled by an adjustable thermostatic bulb 129 connected to the valve by a tube 131. This thermostatic bulb and fluid system preferably contain an oil or other suitable liquid providing pure liquid expansion so that it may be unaffected by pressures within the refrigerating system. The thermostatic bulb 129 has an adjusting means to vary its capacity for holding oil so that the temperature maintained in the bed may be raised or lowered according to individual preference. This is normally set so that throttling begins to take place at about 95° F. room temperature and the throttling valve completely closes at about 82° F. room temperature. The adjustment is capable of raising or lowering these points about 6° F. In order to shut off the unit, or to start it in operation when desired, there is provided a tumbler type switch means 133 on the front of the cabinet. A removable pan may be provided beneath the cabinet for receiving the moisture condensed and collected by the evaporating means.

The first step in preparing a bed for use with my improved bed cooler is to place the four standards or vertical rods in position as shown in Fig. 1 so that they are held in place by the legs of the bed. If these are placed on a very soft rug, it may be necessary to insert a few thicknesses of thin material underneath the base of the standards directly under the point where the leg rests upon in order that the standard will be vertical. With the upper section 52 of the standard dropped, the top should be approximately flush with the top of the mattress. This can be adjusted by loosening the set screw 46 in the socket 44 of the base and adjusting the height of the hollow rod 48 and retightening the set screw.

After the four standards or rods are in place, the curtained enclosure can be hung on them. The curtain should be arranged so that the four thicknesses of muslin form the envelope at the head of the bed. The four pockets at the corners of the curtained enclosure should be fitted over the upper end of the solid rods 52 when they are in the raised position. After the curtained enclosure is thus hung upon the vertical standards or curtain rods, the lower edge of the curtains must be tucked under the mattress all the way around as shown in Figs. 1, 2 and 4, in order that none of the cooled air will escape between the curtain and the mattress.

Next, the cabinet should be located beside the head of the bed on whichever side is more convenient at approximately one inch between the side of the bed and the side of the cabinet and with the small covered opening in the side of the cabinet immediately in front of the head of the bed as shown in Fig. 1. To connect the cabinet to the curtain, the cover plate is removed from the side of the cabinet next to the bed and the straight rectangular connecting duct 74 is inserted in the opening. Then the inlet neck 66 is slipped over the opening end of the tube and tied by means of the cord provided. The other inlet neck opening 68 should be tied shut by means of its cord. The electric cord is then

plugged into any convenient socket and the cooler is then ready for use.

After the bed has been prepared as previously described, it is now only necessary to turn on the switch in order to make it ready for use. Due to the fact that on a hot day, the entire bed will get too warm for comfort, it is best to turn on the cooler an hour or so before the bed is to be occupied so as to reduce the temperature of the pillow, sheet and top of the mattress to a more comfortable point. In order to get into or out of the bed, the curtain can be depressed at either side by reason of the elastic portions **38** provided therefor which permits it to be depressed to the level of the mattress. On a cool night, the curtain can be removed from the standards and the upper edge stretched around the mattress and the upper section or solid rod **52** of the standards dropped by pushing in the catch **54** and any desired bed clothing can be used. It is not necessary to disconnect the neck **66** or any part of the enclosure from the cabinet in order to do this. During the day, the curtain can be dropped as just explained, the standards dropped and a spread put on the entire bed in the regular way.

While this bed is suitable for all persons desiring a more comfortable, cooler and dry atmosphere during warm weather, it is particularly valuable and healthful to those who suffer from hay fever, since the air is maintained cool and dry and since the pollen which causes hay fever is filtered out of the air by the moist surfaces upon the evaporating means **90** into which the air supply to the cooler comes into contact and the pollen is also caught in passing through the muslin sheet **58** which distributes the air into the bed. Inasmuch as the enclosure is relatively small, only a small size refrigerating machine is required. Since the condenser is air cooled, no refrigerant ducts, external plumbing connections or special wiring is required.

It is believed this cooler forms an excellent vehicle for introducing air conditioning into the home.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A ventilating device for a bed provided with a mattress comprising a wall means extending around the bed upwardly from the mattress to form an air receptacle, said wall means having a flexible porous portion formed as a part thereof, and means for forcing air through said porous portion to provide a diffused discharge of air into the air receptacle.

2. A ventilating device for a bed provided with a mattress comprising a wall means extending around the four sides of the bed upwardly from the four edges of the mattress to form an air receptacle, said wall means having a vertical porous portion extending vertically above an entire edge portion of the mattress, and means for forcing air through said porous portion into said receptacle.

3. A ventilating device for a bed provided with a mattress comprising a wall means extending around the four sides of the bed upwardly from the four edges of the mattress to form an air receptacle, said wall means having a vertical flexible porous portion extending vertically above an entire edge portion of the mattress, and means for forcing air at the rate of 10 to 15 cubic feet per minute through each square foot of said porous portion.

4. A ventilating device for a bed provided with a mattress comprising a flexible wall means extending around the bed vertically upwardly from the mattress to form an air receptacle, a portion of said flexible wall having an inner lining of a porous material, and means for forcing air between said inner lining and said flexible wall and through said porous material into the air receptacle.

5. A ventilating device for a bed provided with a mattress comprising a wall means extending around the bed vertically upwardly from the mattress to form an air receptacle, said wall having a flexible porous material extending between opposite sides thereof within the receptacle, and means for forcing air through said porous material into the receptacle.

6. A ventilating device for a bed provided with a mattress comprising a flexible wall means extending around the bed vertically upwardly from the mattress to form an air receptacle, said flexible wall having flexible means forming a hollow portion, said means forming the hollow portion including a porous material separating the hollow portion from the interior of the receptacle, and means for forcing air into the hollow portion, inflating the hollow portion and forcing air through the porous material into the receptacle.

7. A ventilating device for a bed provided with a body supporting means comprising a flexible wall means extending around the bed upwardly from the body supporting means to form an air receptacle, said flexible wall means having a porous portion formed as a part thereof, said porous portion having more than one thousand tiny openings per square inch of area, and means for forcing air through said porous portion to provide a diffused discharge of air into the air receptacle.

8. A ventilating device for a bed provided with a body supporting means comprising a flexible wall means of woven fabric extending upwardly from the body supporting means to form an air receptacle, said flexible woven fabric wall means having a porous portion of woven fabric formed as a part thereof, and means for forcing air through said porous portion of woven fabric to provide a diffused discharge of air into the air receptacle.

9. A ventilating device for a bed provided with a body supporting means comprising a flexible wall means extending upwardly from the mattress to form an air receptacle, said flexible wall means having a porous portion of woven fabric formed as a part thereof, and means for forcing air through said porous portion of woven fabric to provide a diffused discharge of air into the air receptacle.

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