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(54) Title: METHOD AND APPARATUS FOR PROVIDING PERSONAL AIR-CONDITIONING (57) Abstract According to the invention, air is locally fed in or sucked to the vicinity of the skin along a tubular duct (4), so that by means of the air flowing through the sheathing of the duct, the sweat secreted on the skin and/or the dampness of the clothes is evaporated and thus eliminated.		

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METHOD AND APPARATUS FOR PROVIDING
PERSONAL AIR-CONDITIONING

5 The present invention relates to a method for
providing personal air conditioning, wherein the sweat
secreted on the skin is evaporated and/or the dampened
clothing or the like is dried.

 The invention also relates to a corresponding
apparatus for providing personal air-conditioning.

10 It is common practice to provide rooms and/or
building facilities with air-conditioning. This secures
sufficient ventilation and possibly maintains the
temperature and humidity at a level which enables people
to live and/or work in the said facilities without
15 perspiring or feeling cold. Such air conditioning
arrangements are, however, expensive both as regards
maintenance and building.

 The installation of air-conditioning is
particularly difficult in hot or tropical circumstances.
20 If the temperature of the environment surpasses that of
the skin, and the relative humidity of the surrounding
air is 100%, moisture - i.e. sweat - is not evaporated
from the skin surface, which evaporation would lower the
skin surface temperature and bring a sensation of
25 coolness. This succeeds if the surrounding air is
sufficiently dry, i.e. the relative humidity is clearly
below 100%. Such personal air-conditioning partly takes
place indirectly: the clothing placed next to the skin
is dampened and consequently emanates humidity into the
30 air. As regards those areas of the skin which are bare,
the moisture evaporates directly resulting in a pleasant
feeling in the respective areas.

 The situation becomes problematic particularly
in the case of sitting or lying down: the clothing and
35 the mat or sheet, which remain in between the body or
parts thereof and the bedding, are inevitably dampened.
Evaporation of the moisture helps, but any evaporation

ducts and/or air conditioning is normally not arranged. As regards skinfolds and recesses in between the members of the body, the moisture is not evaporated from there either. This is the normal situation even if the surrounding air were relatively dry, when the temperature is high enough for the secretion of sweat. The position must be constantly changed, which is not pleasant and does not necessarily even bring relief. It is also pointed out that changing of the position is not always possible.

A serious problem in modern nursing is to create a bed environment with the minimum amount of discomfort for the patient. Especially patients who are confined to bed for a long time or permanently and who cannot themselves turn or move their limbs, inevitably get bedsores when lying on ordinary beddings. The bedsores affect the treatment of the patient and among others serve as entry routes for various infections. Bedsores are developed in places where the surface pressure against the skin is continuously higher than 25-35 mmHG and where the skin is damp owing to perspiration. These patients must therefore be turned or their position must be changed every two or three hours by nurses. However, the moving or turning of a multihandicapped patient may in practice be impossible.

In the prior art there are known several bedding and/or bed arrangements where the purpose has been to improve the state and care of the patient. The published Swedish specification SE 376 841 introduces a gas-filled mattress which is placed on the bed, and an auxiliary mattress is placed thereupon. The top surface of the bottom mattress is provided with perforations. The mattress is connected to a pressure gas supply, by means of which an overpressure is maintained in the mattress, and the mattress is kept tensioned irrespective of the continuous gas leakage through the top surface. The auxiliary top mattress is made of some

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porous material. This distributes the gas flowing out through the top surface of the bottom mattress evenly throughout the surface of the auxiliary mattress, which results in a good ventilation and airing of the bed, and the bed is kept dry irrespective of the perspiration of the patient. The pressure of the mattress is also suggested to be adjustable so that the mattress will be soft and resilient, having such characteristics that even out the load on the skin and are required if the formation of bedsores is to be prevented, or if the already appeared bedsores are to be cured.

Among the disadvantages of the mattress arrangement according to the said Swedish specification is the fact that air is conducted to below the patient via the mattress. In that case the top surface of the mattress is either wholly gas-permeable, or it is provided with holes at regular intervals. When the patient is lying down on the mattress and at least partly sinks into it, his body shuts the mattress holes below, so that the air has access to flow only through those holes on the mattress surface which remain outside the body. Consequently the desired air-conditioning of the skin is not achieved. In practice the hygiene and cleaning of the said mattress are also doubtful. And air-impervious sheet or equivalent layer cannot be placed on top of the mattress or below the patient, but on the other hand the various human excretions, such as urine, must not penetrate into the mattress.

The object of the present invention is, among other things, to eliminate or to alleviate the aforementioned drawbacks and to realize such a general method and apparatus for providing personal air-conditioning which is simple, easily replaceable and hygienic for instance in hospital surroundings. This is achieved so that a narrow, elongate area, which is part of a sheathing of a tubular member or duct, is installed to proceed in the vicinity of the skin, and that via the

said member and through this area there is arranged a gas flow, whereby the sweat secreted on the skin and/or the dampness of the clothes is evaporated and eliminated. This is realized by supplying gas, particularly air, to the vicinity of the skin topically along a line-like path and through a suitable tubular member, and by providing this member with a number of outlets for the gas near the said path in such a fashion that most of the gas is discharged against the skin. Alternatively air can be sucked in, topically to the vicinity of the skin, along the line-like path and through a suitable duct, where the suction inlets for air are arranged near the said path so that the major part of the air is sucked into the duct from the vicinity of the skin. By means of this method, the air-conditioning is directed especially to the areas where it is needed: to the vicinity and surface of the skin, most advantageously underneath the clothing, where the air flow conforms to the skin surface and cools the skin by evaporating moisture.

The duct is advantageously arranged in the vicinity of those parts or areas of the body which lie against some other part of the body or against the bedding. In practice this means that the airing is arranged in between the underlay, such as a seat, and the corresponding part of the body, such as the buttocks. Thus the excess moisture can be evaporated from the exact spot where it is being created.

The duct can be arranged either in clothing or in the bedding. For example in a bed the duct is advantageously arranged in the sheet or some equivalent structure which is placed on top of the bedding proper. Thus the airing can be arranged either as portable along with the person, or as connected to the bedding. The duct can be provided for instance in a shirt, in which case working in hot conditions becomes possible with a suitable pressure air supply such as an air bottle.

Alternatively the duct can be provided in any type of underlay which is widely used - for example in a car seat or in a bed, as was already pointed out. The duct conforming to the line-like path can be formed into a separate unit, which, when desired, can be attached to a piece of clothing, to the bedding or the like. Thus any kind of garment or underlay which is much used can be provided with personal air-conditioning. Such unit can be replaceable when necessary.

10 The characteristic novel features of the apparatus of the present invention are apparent from the appended patent claims 9-19.

 Among the advantages of the apparatus according to the invention, the following are pointed out. The apparatus is simple in structure and economical to manufacture, and if necessary easily replaceable as well as hygienic. It can also be made disposable or connected to a disposable product such as a disposable sheet. The apparatus uses little energy. It is operated with small amounts of air and with a slight over- or underpressure of gas. By means of the apparatus the gas, such as air, is fed to or sucked from the exact spot where it is most useful and effective.

 The invention and its additional advantages are described in detail below, with reference to the appended drawings, where

 Figure 1 illustrates the apparatus of the present invention as installed in a bed;

 Figures 2A, 2B and 2C illustrate possible cross-sections along the line A-A of the apparatus of figure 1;

 Figure 3 illustrates a detail of the apparatus of figure 2A;

 Figure 4 illustrates another embodiment of the invention, seen from the top;

 Figure 5 illustrates the apparatus of figure 4, seen in cross-section along the line B-B;

Figure 6 illustrates the duct employed in the apparatus of figure 4;

Figure 7 illustrates the coupling clutch for connecting the duct to an air supply hose.

5 The apparatus 1 is formed as a sheet 2 or equivalent replaceable element, as is seen in figure 1. This is placed in between the patient and the bedding. The bedding may be an ordinary mattress 3, or a water-bed or an air-bed. The duct is connectable to an
10 overpressure source such as a pressure gas source 6 or the like such as an air pump, compressor etc., for example via a hose 7 or a pipe, and a faucet 18. The duct 4 is advantageously installed in the longitudinal direction of the sheet 2 or the like and of the person,
15 for instance the patient, lying in the bed, along the line C-C, in the middle area of the sheet, i.e. in the vicinity of such parts or areas of the body that are placed against the bedding. The top surface 5 of the duct 4 is made of a porous gas-permeable material.
20 Alternatively the top surface 5 of the duct 4 is provided with small holes 10, so that the air flows mainly towards the skin of the person lying in the bed. At least one end of the duct 4 is closed, in which case the hose 7 is connected to the opposite end.
25 Alternatively the hose 7 can be connected to some other part of the duct, in which case both ends of the duct are closed. The duct can also be realized so that the width of the said duct is larger than that of the elongate air-permeable area.
30 The cross-section of the apparatus of figure 1 may vary, as is illustrated in the examples of figures 2A, 2B and 2C. In the embodiment of figure 2A, under the sheet 2, in the longitudinal direction thereof, there is attached a compact gas-impermeable band or
35 strip 8, which may be manufactured of some suitable plastic material. This strip is attached, for instance glued, to the sheet 2 at the edges 8a, 8b. In the

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embodiment of figure 2C, the strip 8 is replaced by a sheet-size layer 9 attached to the sheet, which layer is impermeable both to gas and to liquid. This embodiment is particularly suited to chronic patients, in which case the apparatus also serves as an effective cover for the mattress. In the embodiment of figure 2B, the duct 4 is formed of a tubular member 11, which is advantageously attached under the sheet 2. The tubular member 11 is made of some gas-impermeable material such as plastic. The top part thereof is provided, at least partly, with holes 10. The strip 8, the tubular member 11 or the layer 9 can also be realized of some slightly gas-permeable material.

When the duct 4 is made of a material which is impermeable, or only slightly permeable, to air or gas, it is provided with holes 10. Accordingly the top surface 5 of the duct must also be provided with an additional layer 12 made of some porous material, as is seen in figure 3. This layer can be formed of a sheet 2, as is illustrated in the embodiments of figures 2A, 2B and 2C, or of a separate porous layer, which is installed on top of the top part of the duct.

The permeability to air or gas of the top surface 5 of the duct 4 may be adjusted. This is carried out so that either the size of the holes 10 or their density per unit area is arranged to change while proceeding from the first end D of the duct to the second end E. It is advantageous that at the first end D of the duct, i.e. at the head of bed, the size of the holes 10 is larger or their density higher than at the second end E of the duct, i.e. at the foot of the bed. Consequently more air flows in under the top part of the patient's body than under the legs. Thus the airing is made more effective in the area of the back and the buttocks, which areas are remarkably sensitive to the formation of bedsores.

The duct 4 can be formed as a separate device

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which can be attached to the sheet 2, or to the bed or the like. This modification of the present invention is illustrated in the preferred embodiments of figures 4, 5 and 6. Here, as in the embodiment of figure 1, the duct 4 is placed in the longitudinal direction of the sheet and the patient, along the line C-C, in the middle area of the sheet. The duct 4 is made of one or several thin pipes 13; 13a, 13b, which are at least partly permeable to air. The pipes 13 are installed on top of the band-like, elongate bottom surface 16. Around the pipes or on top of them there is provided an at least partly air-permeable layer 14a, advantageously a band 14, which is broader than the pipe and parallel to it. In between the bottom surface 16 and the layer 14, at the sides of the pipes 13, there are provided advantageously resilient slopes 14, 14b, which are triangular in cross-section and suitably prevent the pipes 13 from pressing uncomfortably against the skin for instance when the weight of the patient presses the duct 4 against the bedding. These slopes can be made of some porous, gas-permeable material.

The layer 14a, 14 is provided with an adhesive surface 15 or the like, whereby the duct 4 can be attached to the underlay such as the sheet 2 or the like, either permanently or replaceably. The layer 14a may be of the same width as the whole sheet, as is illustrated by the dotted lines in figure 4. The width of the air-permeable section in the layer 14a or in the band 14 is at least the width of the pipe 13, so that air can be discharged through the holes 10 of the pipe or through the porous cover further out of the duct.

On its opposite side with respect to the layer 14a, 14, the pipe 13 is provided with a compact, gas-impermeable layer 16, i.e. an underneath surface, as is seen in figures 5 and 6. The said layer prevents air from flowing through the sheet or the like, away from the patient. This layer is not always necessary,

because the bedding may in itself be impermeable to gas or to air. On the other hand, the layer 16 does not necessarily have to be gas-proof; in most cases it suffices that the underneath layer is less permeable to gas than the top surface, i.e. the surface 14a, 14.

The diameter of the pipe 13 falls for instance within the range of 3 to 7 mm, and is advantageously made of some resilient material such as plastic. In that case its cover is provided with holes 10. If the pipe 13 is made of some porous gas-permeable material such as a suitable fabric, the holes 10 are not necessarily needed.

The duct 4 according to figures 5 and 6 can be manufactured longitudinally by the meter. This kind of uniform, elongate duct can be cut into pieces of desired lengths and installed, when necessary, to a sheet or some other suitable underlay underneath the person, or to a garment near the skin, when the drawbacks of perspiration are desired to be prevented. The adhesive surface 15 is advantageously provided with protection 19, which is removable when the duct 4 is attached to its underlay, as is illustrated in figure 6.

The apparatus of the invention is connected, via the duct 4, by means of the pipe or hose 7, to a suitable gas supply such as an air pump, as is illustrated in figures 1 and 4. When necessary, the apparatus can also be provided with a suitable heating and/or cooling device 17, which is located outside the apparatus proper. The heating device can be used when the room temperature is low, whereas the cooling device is used when the temperature of the surroundings is high, for instance in tropical climates.

In figures 1 or 4, the apparatus of the present invention is operated as follows. When for instance the patient p suffers from perspiration or bedsores, the apparatus of the invention is installed underneath him, on top of a normal mattress or some

suitable special mattress. The installation is carried out so that the duct 4 is placed under the patient, roughly along the central line C-C of his body, as is seen for example in figure 4. The duct 4 is connected, by means of the hose 7, to a suitable pressure gas supply 6, such as a pressure air supply, and the supply of air into the duct is adjusted to be suitable for instance by aid of the faucet 18. This means that the pressure in the duct 4, for instance inside the pipe 13 in figure 5, is such that air or some other gas can be discharged through the porous layer 14, via the holes 10, to beneath the patient and made to proceed, in between the patient and the sheet 2, towards the edges of the bed, from the pipe 13 outwards. The air currents according to the arrows F illustrated in figure 5 cool off the patient's skin and evaporate the moisture formed on the skin surface (539 kCal/liter of water), thus preventing both the bedding and the patient's clothing from dampening with sweat.

The duct 4 is connected to the hose 7 by means of a suitable coupling device. This is advantageously a bayonet clutch, which can be employed without any separate pressing means. Figure 7 illustrates an advantageous coupling device for connecting the duct 4 to the air hose 7. The clutch 20 is formed to be a flat and planewise conical piece, or a piece widening planewise in some corresponding fashion. In the middle of of the piece, in the direction of its longitudinal axis, there is located the hole 21 which connects the duct 4 to the hose 7. The diameter of the stem 20a of the clutch 20 is larger than that of the duct 4. Thus the clutch 20 can be fitted in a gas-proof fashion in the duct 4. The hose 7 is directly connectable to a suitable coupling sleeve 22 of the clutch 20. The hose 7 is attached to the coupling sleeve 22 advantageously by means of friction coupling, or it can be fastened to place by employing a suitable fastening means so that

the hose and the fastening means together form a uniform, compact coupling.

5 The modifications of the present invention explained above are connected to a method where air or some other gas is introduced to the vicinity of the skin from an overpressure supply. Many of the specified modifications can also be operated as connected to an underpressure supply such as a suction pump or the like, in which case the operation, as regards the air
10 currents, takes place in the opposite direction. These modifications are noteworthy in cases where the spreading of dust or bacteria from the bed or some similar underlay to the immediate surroundings of people should be prevented. This applies for instance to
15 people who are allergic to dust, and in general to hospital surroundings. Moreover, in general the suction of air in connection with the apparatus may be more easily arranged than the feeding of pressurized air.

In the above specification the invention has
20 been explained mainly with reference to a few preferred embodiments only, but it is obviously clear that the invention can be modified in many ways without departing from the scope of the appended patent claims. For instance the width of the duct may vary between 2 and 10
25 cm, or it may even be equal to the width of the bed so that the width of the air-permeable area falls within the said range, whereas the width of a corresponding duct, when a tubular duct is employed, can be something within the range of a few millimeters. In addition to
30 this, instead of only one duct, several ducts can be employed, which ducts are either parallel or their location varies according to the modification in question. Apart from the treatment of patients confined to bed, or apart from beds in general, the apparatus of
35 the present invention can also be used as an aid in the treatment of patients in wheelchairs or the like. In that case the size of the

apparatus is naturally smaller than above, in the
embodiments of figures 1 or 4. The essential point is
that the duct, through which the air or gas is fed or
sucked for instance in between the patient's buttocks and
5 the underlay, such as the seat of a wheelchair, is
suitably installed underneath the patient.

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PATENT CLAIMS

1. A method for providing personal air-conditioning, wherein the sweat secreted on the skin is evaporated and/or the dampened clothes or the like are dried, characterized in that a narrow, elongate area, which is part of a sheathing of a tubular member or duct (4) is installed to proceed in the vicinity of the skin, and that via the said member and through this area there is arranged a gas flow whereby the sweat secreted on the skin and/or the dampness of the clothes is evaporated and eliminated.

2. The method of claim 1, characterized in that some gas, air in particular, is fed locally to the vicinity of the skin along a line-like path and through a suitable tubular duct (4), and that a number of outlets (10) for the gas to flow out of the duct is arranged near the said line so that the major part of the gas is discharged against the skin.

3. The method of claim 1, characterized in that air is sucked locally to the vicinity of the skin, along a line-like path and via a suitable tubular duct (4), and that a number of inlets (10) for air to flow into the duct is arranged in the duct near the said line, so that the major part of the air is sucked in from the vicinity of the skin towards the duct (4).

4. The method of claim 1, 2 or 3, characterized in that the duct (4) is arranged in the vicinity of those parts or areas of the body which are in immediate contact with some other part of the body or with some type of underlay (3).

5. The method of claim 1, 2, 3 or 4, characterized in that the duct (4) is arranged in a piece of clothing.

6. The method of claim 4, characterized in that the duct (4) is arranged in the

underlay (3).

7. The method of claim 4 or 6, c h a r a c -
t e r i z e d in that the duct (4) is arranged in a
sheet (2) or some similar member to be placed on the
5 underlay (3) proper.

8. The method of any of the preceding claims,
c h a r a c t e r i z e d in that the duct (4) is
formed as a separate unit which is, when desired,
connectable to a garment, to the underlay or the like.

10 9. An apparatus for providing personal air-
conditioning, whereby the sweat secreted on the skin is
evaporated and/or the dampened clothes or the like are
dried, c h a r a c t e r i z e d in that the apparatus
comprises at least one elongate tubular duct (4), which
15 is placed in the vicinity of the skin, the surface (5)
of the said duct being at least partly gas-permeable,
particularly as regards the side which falls against the
skin, and which duct is connected to an overpressure or
underpressure supply (6) or equivalent.

20 10. The apparatus of claim 9, c h a r a c -
t e r i z e d in that the duct is formed as a separate
device, which is connectable to clothing and/or to an
underlay or the like.

25 11. The apparatus of claim 10, c h a r a c -
t e r i z e d in that the duct (4) is formed to be a
replaceable device.

30 12. The apparatus of claim 10 or 11, c h a -
r a c t e r i z e d in that the duct (4) is provided
with an adhesive surface (15) or the like, and that the
adhesive surface in turn is provided with protection
(19) which is removable when the duct is attached to the
underlay.

35 13. The apparatus of claim 8, 9, 10, 11 or
12, c h a r a c t e r i z e d in that the underneath
surface (16) of the duct (4), which falls further from
the skin than the other parts of the duct but is located
in the vicinity of the skin, is made to be poorly

permeable at least to gas.

14. The apparatus of claim 8, 9, 10, 11, 12 or 13, characterized in that the duct (4) forms part of a sheet (2) or the like.

5 15. The apparatus of claim 14, characterized in that the duct (4) is placed in the longitudinal direction (C-C) of both the sheet (2) and the patient, in the middle area of the sheet.

10 16. The apparatus of any of the preceding claims 8-14, characterized in that the top surface (5) of the duct is provided with some porous, gas-permeable fabric (2, 12).

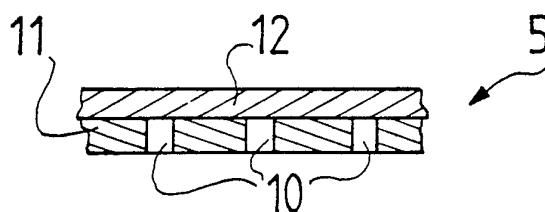
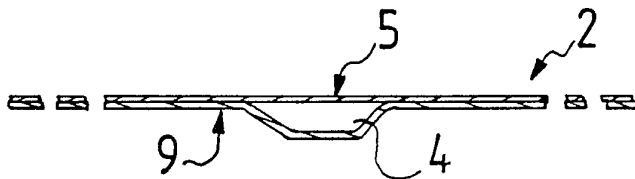
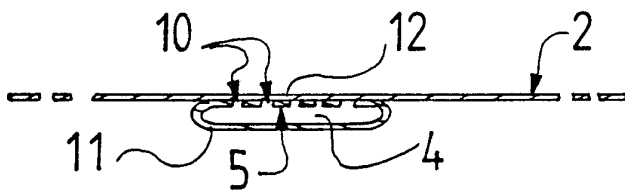
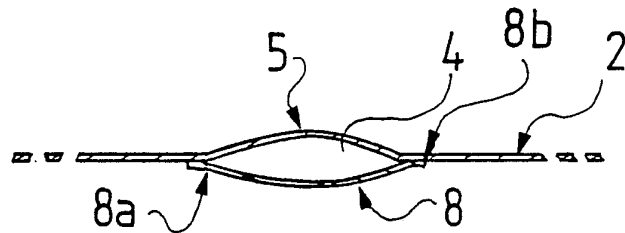
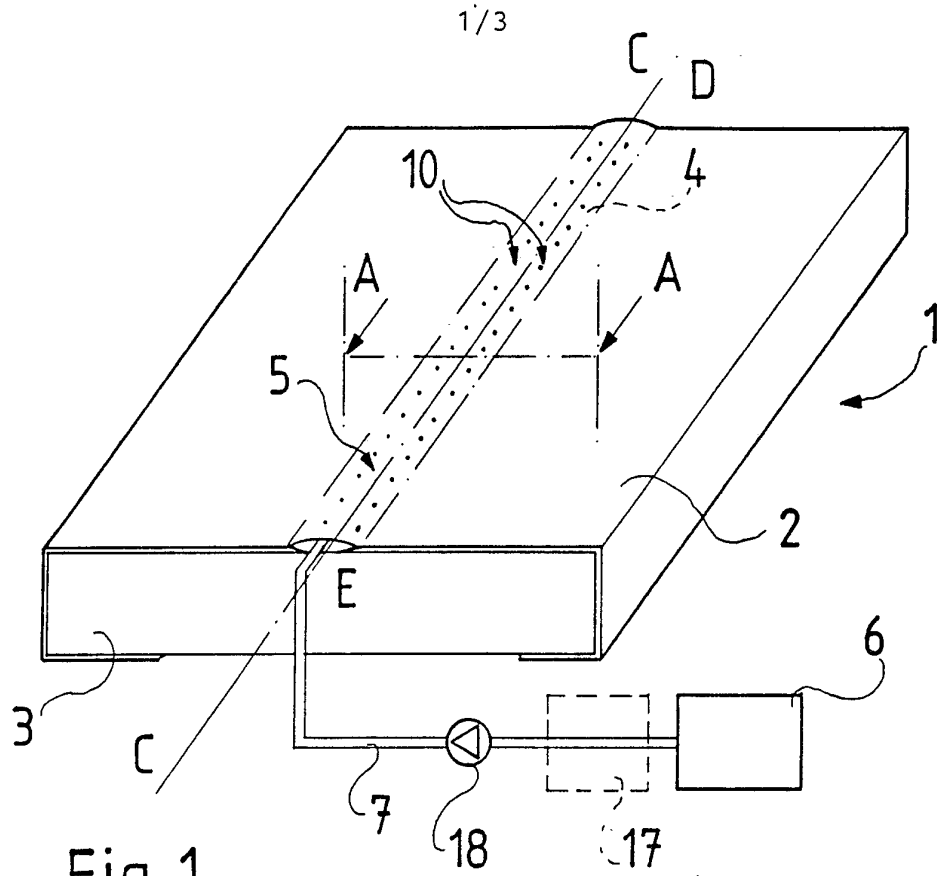
15 17. The apparatus of any of the preceding claims 8-15, characterized in that the duct (4) is formed of one or several flexible pipes (13).

20 18. The apparatus of any of the preceding claims 9 - 17, characterized in that the duct (4) is connected to a pressure gas supply (6) by means of a hose (7), the end whereof is provided with a flat and planewise conical coupling clutch (20), which can be fitted into the duct (4) in a gas-proof fashion.

25 19. The apparatus of any of the preceding claims 9 - 18, characterized in that an apparatus which is connected to a pressure gas supply (6), also includes a heating and/or cooling device (17) for the gas such as air.

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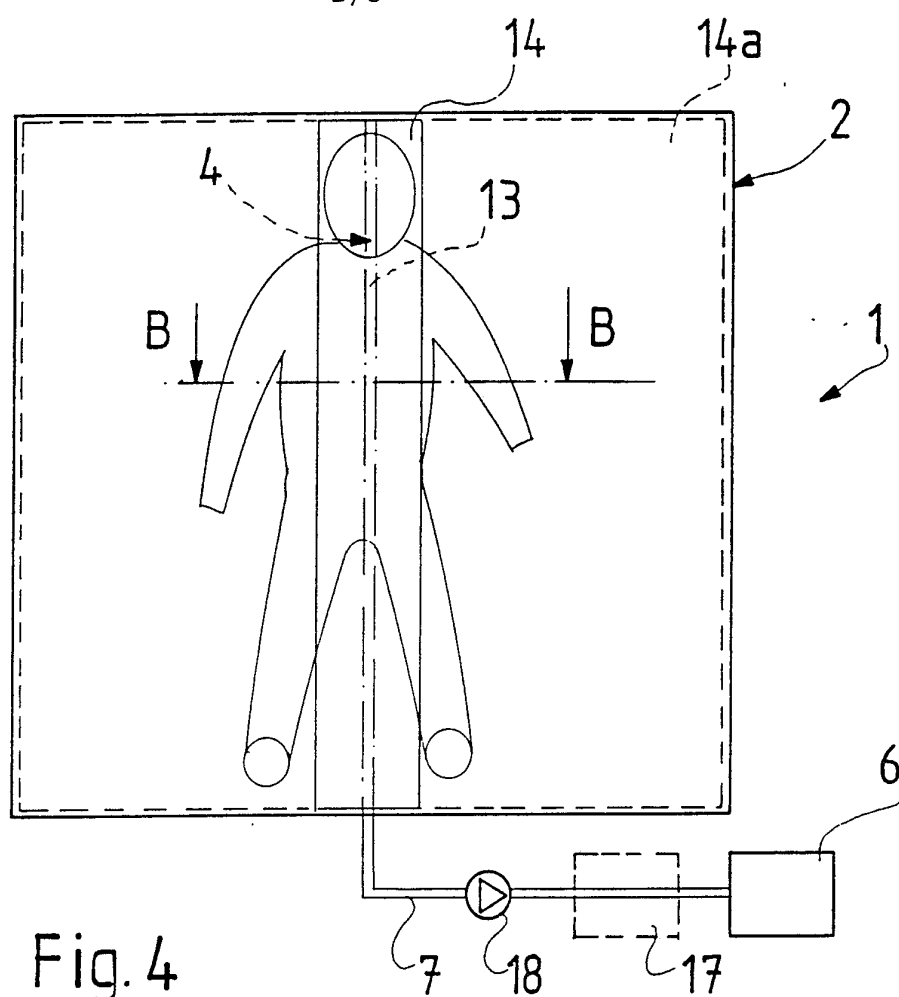


Fig. 4

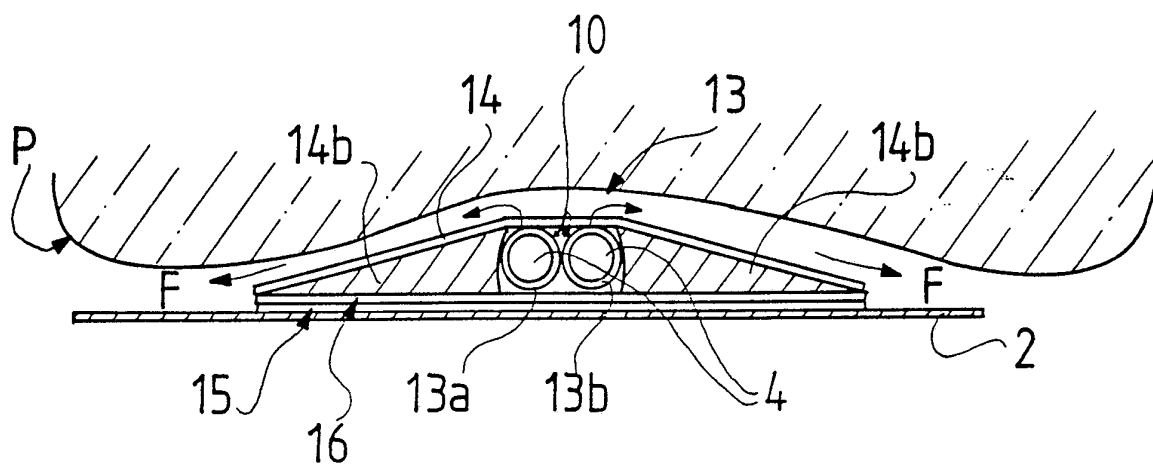


Fig. 5

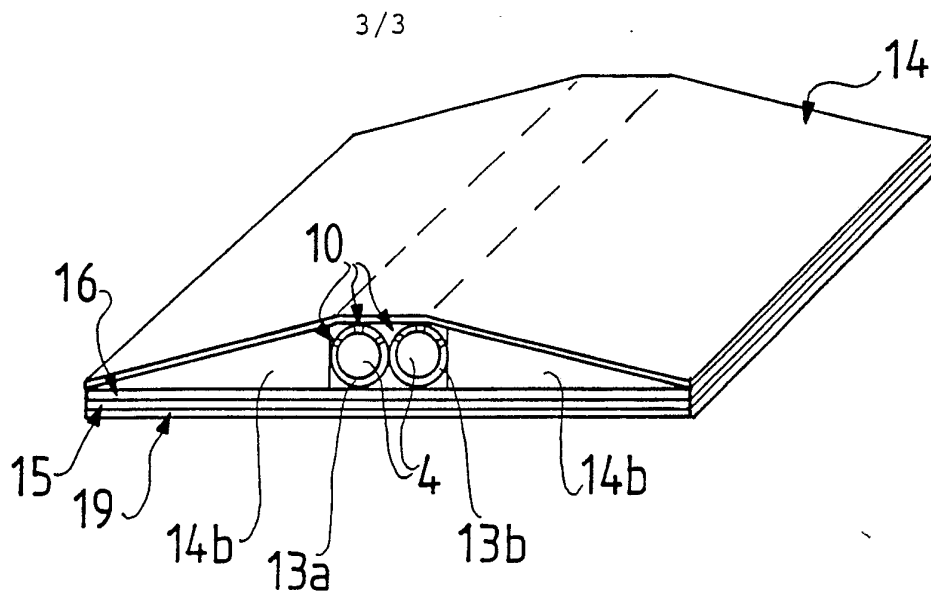


Fig. 6

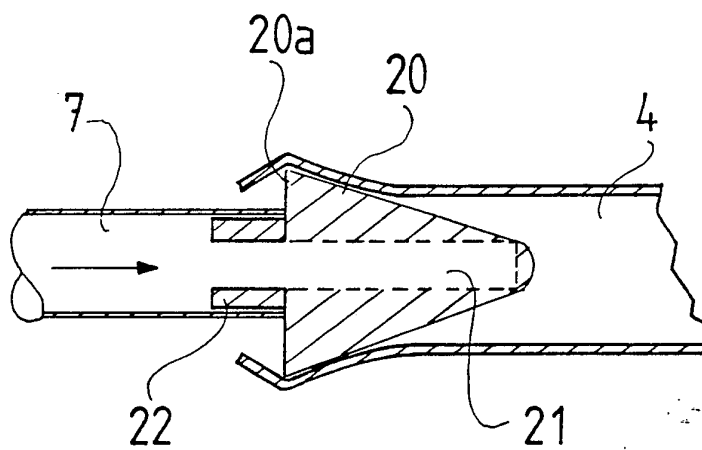
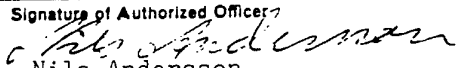


Fig. 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/FI87/00172

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC ⁴		
A 61 G 7/04 // A 47 C 21/04		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC 4	A 47 C 7/72, /74, 21/00, /04; A 61 G 7/04	
US C1	5: 284, 347, 421-423; 297: 180, 453	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁸		
Category ⁹	Citation of Document, ¹¹ with Indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	DE, A1, 1 654 384 (SCHIRNEKER H-L) 11 March 1971	1-4, 9, 16, 19
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<p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
1988-02-18	1988-03-11	
International Searching Authority	Signature of Authorized Officer ⁷	
Swedish Patent Office	 Nils Andersson	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
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Y	US, A, 4 125 911 (MOERTEL) 21 November 1978 DE, 2819769 JP, 53141749 CA, 1080448 GB, 1583018	1, 9, 15
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