

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **80303206.9**

(51) Int. Cl.³: **A 47 C 27/10, A 61 G 7/04**

(22) Date of filing: **11.09.80**

(30) Priority: **12.09.79 GB 7931575**

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(43) Date of publication of application: **25.03.81**
Bulletin 81/12

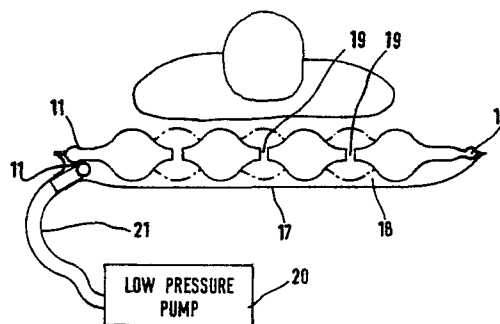
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(84) Designated Contracting States: **AT BE CH DE FR IT LI
NL SE**

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(54) **Support.**

(57) This invention relates to supports e.g. for living bodies and in particular, but not exclusively, to bed pads and mattresses for use with patients confined to bed.
A bed pad comprises an alternating pressure pad 10, constituted by sheets 11, defining two sets of alternately inflatable interdigitated channels 12, 13, a pump 14 for alternately inflating the air channels to support a patient alternately on the two sets of channels and a sheet 17 secured to the underneath of the pad 10 to define a plenum 18, apertures 19, which pass through the pad 10 but are sealed from the air channels 12, 13, and a further low pressure pump for circulating air through the plenum 18 and the apertures 19 and hence between the patient and the pad 10. In other embodiments, an air permeable sheet is provided above the pressure pad 10 to define a plenum, or the pad is provided inside a complete envelope with a permeable upper sheet.



SUPPORT

This invention relates to supports for users, for example body supports for use as mattresses on beds. When
5 a living body is supported by a support for long periods of time, for example in the case of a patient confined to bed or a lorry driver or airline pilot confined by their job to their seat, prolonged contact between the body and the support can cause problems.

10 For example, when patients, who are confined to bed, lie for long periods on traditional mattresses it is found that they suffer from bedsores and other sources of discomfort. It has been known for some time that if such patients are provided with a mattress, or a pad for lying
15 on a traditional mattress, which has interspersed alternately inflatable portions so that the body of the patient can be supported alternately by the different portions, bedsores and other discomfort can be reduced. This is because, with such arrangements, the contact between
20 the patient's body and the support is periodically

relieved and transferred to permit increased bloodflow to the pressure points where the patient's weight is supported.

However, the build-up of moisture between the patient
5 and the pad can still cause bedsores. Moisture build-up is also a general problem using supports other than alternating pressure pads of the kind mentioned above.

It is known to try and reduce this moisture build-up by providing ventilating air between the patient and the
10 supporting pad. However, in the case of alternating pressure pads, this has been achieved hitherto by providing perforations in the pressurised supporting cells of the pad so that air escapes from these portions to ventilate the patient. In order to ensure that the patient is still
15 supported, an oversized pump must be used to make up the air lost through leakage from these perforations. Further, the air escaping from the pressurised cells has a relatively high velocity and this has necessitated the use of a permeable pad inserted between the patient and the
20 alternating pressure pad to diffuse the escaping air.

According to one aspect of the present invention a support for a user comprises an air inflatable alternating pressure pad having two sets of cells which are alternately inflatable and deflatable, a high pressure air supply for
25 inflating the alternating pressure pad whereby the weight

of the user is carried alternately by the two sets of cells, a plenum chamber constituted by upper and lower elements sealed together, the upper element constituting at least a part of an upper surface of the support and
5 being air permeable, and low pressure pumping means for pumping air into said chamber through an inlet for escape through said upper element, or for drawing air into said chamber through said upper element by suction at an outlet. With this arrangement separate air supplies at different
10 pressures are provided to the alternating pressure pad and to the plenum chamber for supply of ventilating air to the patient. The high pressure and low pressure supplies can be optimised for their specific purpose.

The alternating pressure pad may constitute one of
15 the elements of the plenum chamber. For example, the alternating pressure pad may form the lower element. In another arrangement the alternating pressure pad forms the upper element and has a plurality of apertures between cells and sealed therefrom, for the escape of air from,
20 or entry into, the plenum chamber.

In a different embodiment, the two elements are separate from the alternating pressure pad, comprising upper and lower sheets forming an envelope containing the pad.

25 Preferably, the upper element has a plurality of apertures for the escape of air from, or entry to, the

plenum chamber. Further, the upper element, when not constituted by the alternating pressure pad, may be made from an air permeable material.

Conveniently, the upper and lower elements are made
5 of thermoplastic sheet material and are sealed together by welding. Further, the upper and lower elements may be sealed together, at least partly, by means of zip-type fasteners.

In a further arrangement, said inlet, or said outlet,
10 of the plenum chamber is at an edge of the support and comprises a rigid air conduit portion extending from outside to inside the chamber and having an outer end adapted for connection thereto of the supply or suction pipe with the pipe axis extending substantially at right angles to the
15 adjacent edge of the support and an inner end having an aperture to the interior of the chamber in a plane substantially at right angles to the adjacent edge of the support. Conveniently, the air conduit portion is T-shaped having the upright of the T extending from the
20 outside to the inside of the chamber perpendicular to said adjacent edge of the support, and the cross-bar of the T communicating with the inner end of the upright and extending parallel to said edge providing a pair of said inner end apertures.

25 Normally, the high pressure supply for the alternating

pressure pad, provides air at between 30 and 90 mm of mercury. In one arrangement, the alternating pressure pad has two interdigitated sets of channels forming said sets of cells. Then each channel may be formed as a
5 series of intercommunicating bubble cells, with the bubble cells of one channel being interspersed between the bubble cells of each adjacent channel.

The low pressure pumping means is preferably arranged to pump air into the said plenum chamber. Then
10 a bacterial filter may be included between said pumping means and the inlet to said plenum chamber. The low pressure pumping means may deliver air at a pressure not more than 5 mm of mercury, typically 0.2 mm to 1 mm of mercury.

In another aspect, the present invention provides a
15 support for a user comprising a support pad for supporting the user, an envelope surrounding the pad, an upper side of the envelope above the support being air permeable and low pressure pumping means for pumping air into said envelope through an inlet for escape through said permeable upper
20 side, or for drawing air into the envelope through said upper side by suction at an outlet.

With this arrangement, an existing support pad, which may be of the alternating pressure type or an ordinary mattress, can be converted for ventilating a user by being
25 enclosed inside the envelope.

The permeable upper side of the envelope may have a plurality of apertures for the escape of air from, or entry of air to, the envelope. Preferably the envelope is formed of upper and lower sheets sealed together. The upper sheet
5 may be made of an air permeable material.

The upper and lower sheets may be made of thermoplastic material and may be sealed together by welding. Preferably, the sheets are sealed together, at least partly, by means of a zip-type fastener.

10 Examples of the present invention will now be described with reference to the accompanying drawings in which :

Figure 1 is a plan view of a support constituting one embodiment of the invention;

15 Figure 2 is a cross-sectional view along the line X-X of Figure 1, and showing a patient in position;

Figure 3 is a cross-sectional view corresponding to that of Figure 2 and showing an alternative embodiment of the invention;

20 Figure 4 is a cross-sectional view showing a further alternative embodiment of the invention;

Figure 5 is a plan view of the embodiment of Figure 4 and,

Figure 6 is an enlarged view showing an inlet for
25 low pressure air to the plenum chambers or envelope provided in any of the embodiments of Figures 1 to 5.

Figures 1 and 2 show a support pad for use as a mattress on a bed. The support is generally indicated at 10, and comprises a pair of overlying plastic sheets 11, which are hermetically sealed together to define two sets of channels 12 which are interdigitated, each channel having a closed end and an open end. Each channel 12 comprises a series of aligned generally spherical bubble-like cells 12a. In this particular embodiment the channels extend in directions transverse to the length of the mattress. The channels 12 extend across the centre portion of the width of the pad, leaving edge portions of sheets 11 extending lengthwise of the mattress and defining two air supply manifolds 13a and 13b, one on each side of the mattress. One set of channels has the open ends of the channel open to manifold 13a and the other set has open ends open to manifold 13b.

An air pump 14 has outputs 15 and 16. Output 15 is connected to manifold 13a by input tube 15a and output 16 is connected to manifold 13b by input tube 16a. Valve means 116 are provided in the pump to supply air under pressure from the pump alternately to the two manifolds 13a and 13b and hence to cause adjacent channels 12 to be inflated and deflated alternately. The valve means are arranged so that the channels of one set are inflated or at least partially inflated before the channels of the other set are deflated.

The two sets of channels 12 thus form an air pad giving support to a user and in which the weight of the user is carried alternately on discrete regions defined by the two sets of channels.

5 An air impermeable sheet 17 is affixed to the lower side of the interconnected sheets 11 to form a plenum 18 therebelow. A series of apertures 19 are formed through the interconnected sheets 11 of the air pad, such that these apertures are sealed from the channels 12. A low
10 pressure pump 20, typically a fan or blower supplying air at a pressure of 0.2 mm of mercury is connected by a tube 21 to the plenum chamber 18. This pump is operated continuously to maintain a low pressure in the plenum chamber the pressure being lower than that employed
15 in the air pad supplied by the pump 14 and insufficient to support the weight of a user on the mattress.

The upper side of the pad 10 may be covered by a normal cotton bed sheet or other air permeable sheet.

In use the channels 12 are alternately inflated by
20 the pump 14, which is controlled by a pressure regulator, (not shown) which enables adjustment to be made of the air pressure supplied to the channels 12 in accordance with the weight and shape of the patient. This pressure is typically between 30 and 90 mm of mercury and such that
25 the weight of the user is carried on the inflated cells holding the patient away from the deflated cells.

This ensures that the regions of contact between the user and the support change alternately with the alternate inflation of the two sets of channels.

Instead of blowing air into the plenum chamber 18
5 and hence out of the apertures 19, the pump 20 may be arranged to suck air from chamber 18 and hence cause air to flow from the environment through apertures 19 into plenum 18. Either way, air at a suitable pressure is passed between the pad and the user to ventilate the regions of
10 contact between pad and user. Further the pressure of the ventilating air is not dependent on the pressure in channels 12 and hence the weight or shape of the patient and therefore the pressure of the ventilating air can be selected solely on the basis of achieving correct
15 ventilation. The low pressure air ventilation for the patient operates continuously. The amount of ventilation is controlled by the output of the pump 20 and is wholly independent of the pressure of the air supply to the pressure pad channels 12; the latter can be adjusted independently
20 in accordance with requirements, e.g. the weight of the patient.

It will be appreciated that different arrays of apertures will be required depending on the use of the pad. However for ventilation of the user to occur at least some
25 of the apertures must be formed in a part of the pad which

lies beneath the user but is spaced from the user during at least one part of the cycle of pump 14. The size of the apertures will depend on the capacity of the low pressure pump 20 and the number of apertures, but the pump capacity and the aperture size should be chosen to be sufficient to achieve ventilation of the user without over inflation of the plenum 18, and to avoid excessive ventilation and chilling of the user.

In the arrangement illustrated in Figure 2, the alternating pressure pad 10 constitutes the upper element defining the plenum chamber 18 with the sheet 17 forming the lower element. In the alternative arrangement illustrated in Figure 3, the pressure pad 10 itself forms the lower element of a plenum chamber defined between the support 10 and an upper sheet 22 sealed about the edge of the support 10. The upper sheet 22 is made air-permeable, for example by providing apertures 23 through the sheet. In this example, the alternating pressure pad 10 is itself made impermeable, that is to say, the apertures 19 are omitted. Low pressure air is supplied from the pump 20 via a pipe 21 to the chamber 24 above the pad 10.

Referring now to Figures 4 and 5, a further embodiment of the invention is illustrated. In this embodiment, a plenum chamber 24 is formed by upper and lower sheets 25 and 26 sealed together to form an envelope

27 containing the supporting pad 28. The envelope 27 is separate from the pad 28 and is supplied with low pressure air as before via a pipe 21 from a pump 20. The air in the envelope 27 can flow around the edges of the pad 28 and
5 escape from the envelope via apertures 29 in the upper sheet 25. As shown in Figure 4, the support pad 10 may be for example an alternating pressure pad of the sort described above. Thus, this embodiment of the invention enables existing alternating pressure pads to be converted
10 to enable ventilating air to be supplied to the user, by inserting such a pad inside the envelope 27.

However, it is not essential for the pad 28 to be of the alternating pressure type. Any support pad of the kind commonly used for supporting a user, e.g. a mattress,
15 can be provided or inserted in the envelope 27. By using the envelope 27 with a supply of low pressure air from the pump 20, ventilating air can be supplied to the user supported on the pad.

A plan view of the envelope 27 is illustrated in
20 Figure 5. The upper and lower sheets 25 and 26 of the envelope are in this example made from a thermoplastic sheet material and are welded together along the side edges 30 and one end edge 31. The opposite end edge 32 is provided with closure means for example a zip-fastener
25 33 by which the end can be closed as required after fitting

the envelope around a supporting pad. The upper and lower sheets 25 and 26 may be extended at each end of the envelope beyond the end edges 31 and 32 to form flaps 34 and 35 respectively which can be used for locating and
5 holding the complete envelope and enclosed supporting pad in position when in use, e.g. by tucking under an existing mattress on a bed.

A pair of grommetted holes 44 may be provided through top sheet 25 to allow the supply tubes 15a and 16a from
10 pump 14 to be connected to an alternating pressure pad 10 in the envelope 27.

Preferably, the upper and lower sheets 25 and 26 in the example of Figures 4 and 5, and also the undersheet 17 and oversheet 22 of the examples of figures 2 and 3 of the
15 invention are made of polyvinyl chloride sheet material, in which case these sheets are impermeable except for apertures punched through them, e.g. apertures 23 and 29. Instead, however, the upper sheets 22 in Figure 3 and 25 in Figure 4 may be made of an air permeable material to
20 allow air to migrate through the material from the plenum chamber supplied with low pressure air from the pump 20.

The sheets 22 and 25 may be formed of an elastic material. This may be especially useful for the sheet 22 in Figure 3, in which case the sheet 22 is stretched when
25 the pad 10 is inflated to avoid any wrinkling of the sheet 22 when the pad is partially inflated.

Figure 6 illustrates a preferred inlet arrangement for the low pressure air delivered from the pump 20 to the plenum chamber formed in any of the examples shown in
30 Figures 2 to 5. A T-shaped conduit member 36 is formed of a relatively rigid material, so as not to be crushed

during normal use of the support pad. The upright 37 of the T passes through an aperture 38 provided in a side edge 39 of the envelope and is sealed to the border of the aperture 38 of the material of the envelope by any known means, such as by clamping as illustrated. Then, the supply pipe 21 is connected to the outer end 40 of the upright 37 of the conduit 36 and extends as shown, at least initially, substantially at right angles to the adjacent edge 39 of the envelope. Air supplied along the pipe 21 enters the envelope and is emitted from the conduit 36 from the two ends 41 of the cross-bar 42 of the T and is thus emitted from the conduit 36 through apertures which lie in planes also at right angles to the edge 39. This arrangement minimises the risk of the opening from the connector 36 into the interior of the plenum chamber of being occluded by the material of the chamber or enclosed supporting pad.

A bacterial filter 43 (Figure 5) may be included between the low pressure pump 20 and the inlet to the plenum chamber, for example conduit 36. This ensures that when ventilation is provided by pumping air into the plenum chamber for escape therefrom, the risk of infection being caused by the ventilating air is minimised.

It may be desirable and means may be provided for controlling the temperature of the ventilating air supplied to the plenum chamber or envelope.

Also, it will be appreciated that the above-described constructions can be used to form a mattress to support the

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whole body of the user or alternatively to form any other kind of support, for example a driving seat for a lorry or other road vehicle, airline seats, or seats for aeroplane pilots.

CLAIMS:

1. A support for a user comprising an air inflatable
alternating pressure pad having two sets of cells which
5 are alternately inflatable and deflatable, a high pressure
air supply for inflating the alternating pressure pad
whereby the weight of the user is carried alternately by
the two sets of cells, a plenum chamber constituted by upper
and lower elements sealed together, the upper element con-
10 stituting at least a part of an upper surface of the support
and being air permeable, and low pressure pumping means for
pumping air into said chamber through an inlet for escape
through said upper element, or for drawing air into said
chamber through said upper element by suction at an outlet.

15

2. A support as claimed in claim 1 wherein the
alternating pressure pad constitutes one of the elements.

3. A support as claimed in claim 2 wherein the
20 alternating pressure pad forms the lower element.

4. A support as claimed in claim 2 wherein the
alternating pressure pad forms the upper element and
has a plurality of apertures between cells and sealed
25 therefrom, for the escape of air from, or entry into, the

plenum chamber.

5. A support as claimed in claim 1 wherein the two elements are separate from the alternating pressure pad, comprising upper and lower sheets forming an envelope
5 containing the pad.

6. A support as claimed in any of claims 1, 3 or 5 wherein the upper element has a plurality of apertures for the escape of air from, or entry to, the plenum chamber.
10

7. A support as claimed in any of claims 1, 3, 5 or 6 wherein the upper element is made from an air permeable material.

8. A support as claimed in any preceding claim, wherein the upper and lower elements are made of thermoplastic sheet material and are sealed together by welding.
15

9. A support as claimed in any preceding claim, wherein the upper and lower elements are sealed together, at least partly, by means of zip-type fasteners.
20

10. A support as claimed in any preceding claim wherein said inlet, or said outlet of the plenum chamber is at an edge of the support and comprises a rigid air
25

conduit portion extending from outside to inside the chamber and having an outer end adapted for connection thereto of a supply or suction pipe with the pipe axis extending substantially at right angles to the adjacent
5 edge of the support and an inner end having an aperture to the interior of the chamber in a plane substantially at right angles to the adjacent edge of the support.

11. A support as claimed in claim 10 wherein the
10 air conduit portion is T-shaped having the upright of the T extending from the outside to the inside of the chamber perpendicular to said adjacent edge of the support, and the cross-bar of the T communicating with the inner end of the upright and extending parallel to said edge providing
15 a pair of said inner end apertures.

12. A support as claimed in any preceding claim wherein the high pressure supply provides air at between 30 and 90 mm. Hg.

20

13. A support as claimed in any preceding claim wherein the alternating pressure pad has two interdigitated sets of channels forming said sets of cells.

25

14. A support as claimed in claim 13 wherein each

channel is formed as a series of inter-communicating bubble cells, with the bubble cells of one channel being interspersed between the bubble cells of each adjacent channel.

5

15. A support as claimed in any preceding claim wherein the low pressure pumping means is arranged to pump air into said plenum chamber.

10

16. A support as claimed in claim 15 and including a bacterial filter between said pumping means and the inlet to said plenum chamber.

17. A support as claimed in claim 15 or claim 16 wherein the low pressure pumping means delivers air at a pressure not more than 5 mm Hg.

18. A support for a user comprising a support pad for supporting the user, an envelope surrounding the pad, an upper side of the envelope above the support being air permeable and low pressure pumping means for pumping air into said envelope through an inlet for escape through said permeable upper side, or for drawing air into the envelope through said upper side by suction at an outlet.

25

19. A support as claimed in claim 18 wherein the permeable upper side of the envelope has a plurality of apertures for the escape of air from, or entry of air to, the envelope.

5

20. A support as claimed in claim 18 or claim 19 wherein the envelope is formed of upper and lower sheets sealed together.

10 21. A support as claimed in claim 20 wherein the upper sheet is made of an air permeable material.

22. A support as claimed in claim 20 or claim 21, wherein the upper and lower sheets are made of thermoplastic
15 material and are sealed together by welding.

23. A support as claimed in claim 22, wherein the sheets are sealed together, at least partly by means of a zip-type fastener.

20

24. A support as claimed in any of claims 18 to 23 wherein the low pressure pumping means is arranged to pump air into the envelope.

25

25. A support as claimed in claim 24 and including a bacterial filter between said pumping means and the inlet to the envelope.

5 26. A support as claimed in claim 24 or claim 25 wherein the low pressure pumping means delivers air at a pressure not more than 5 mm Hg.

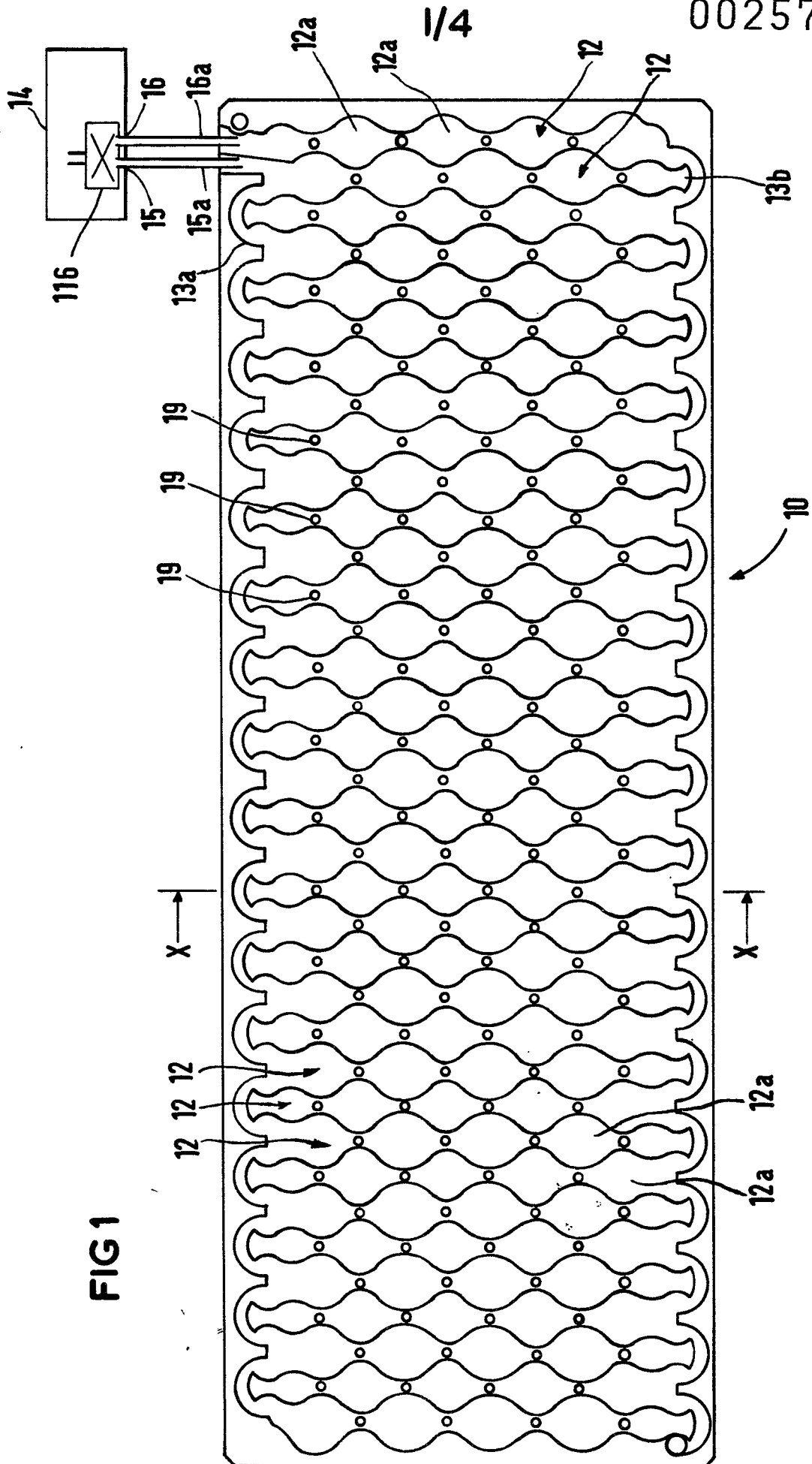
**FIG 1**

FIG 2

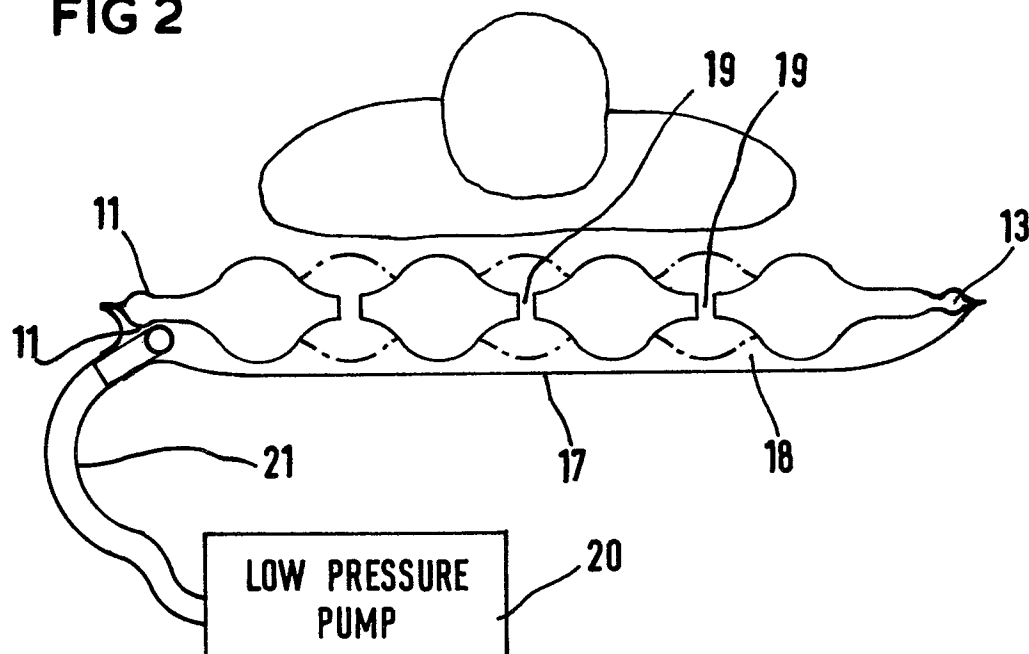


FIG 3

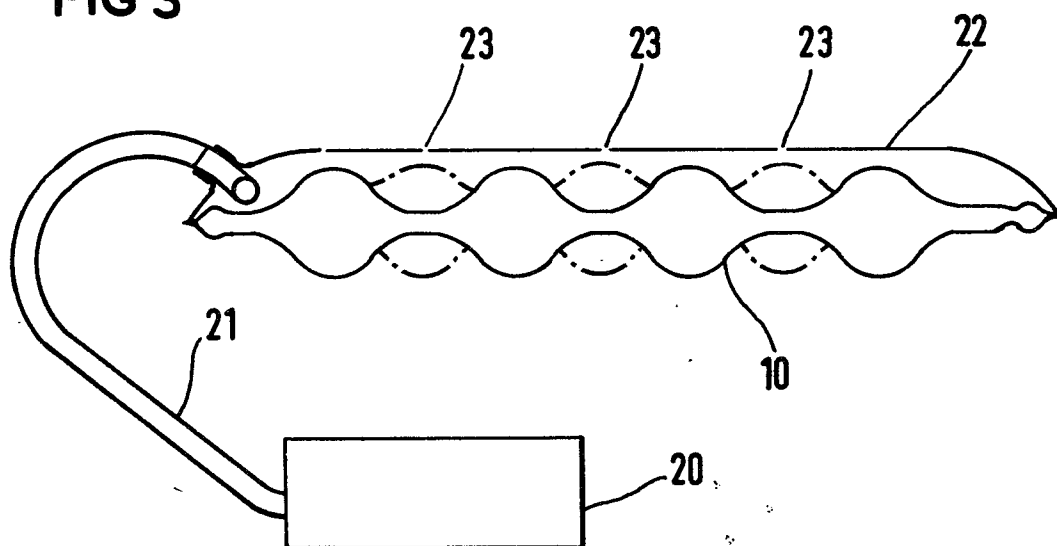


FIG 4

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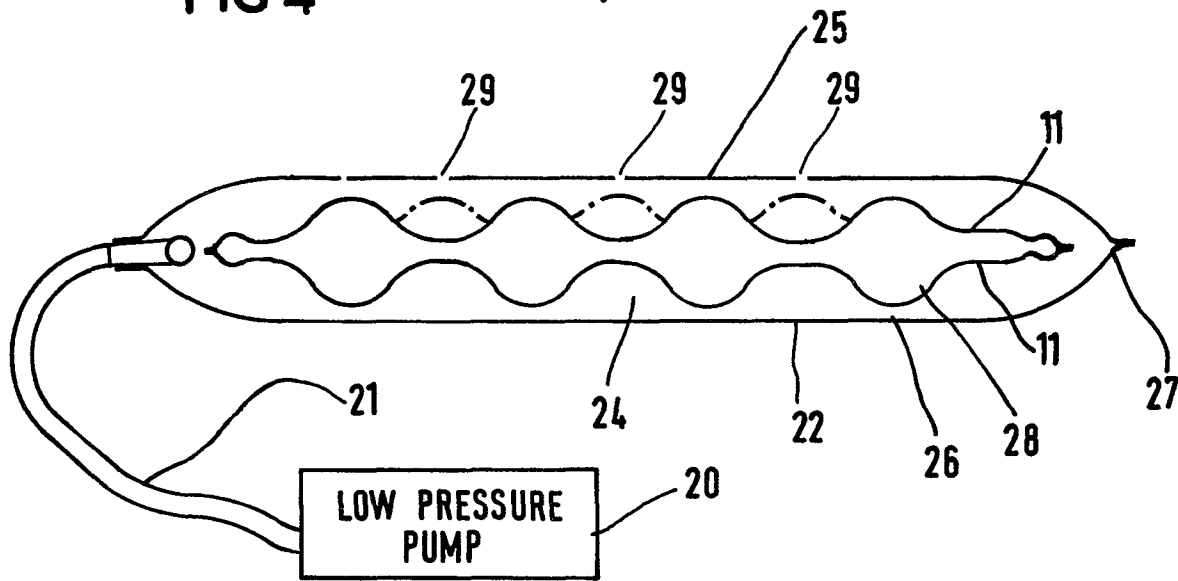


FIG 6

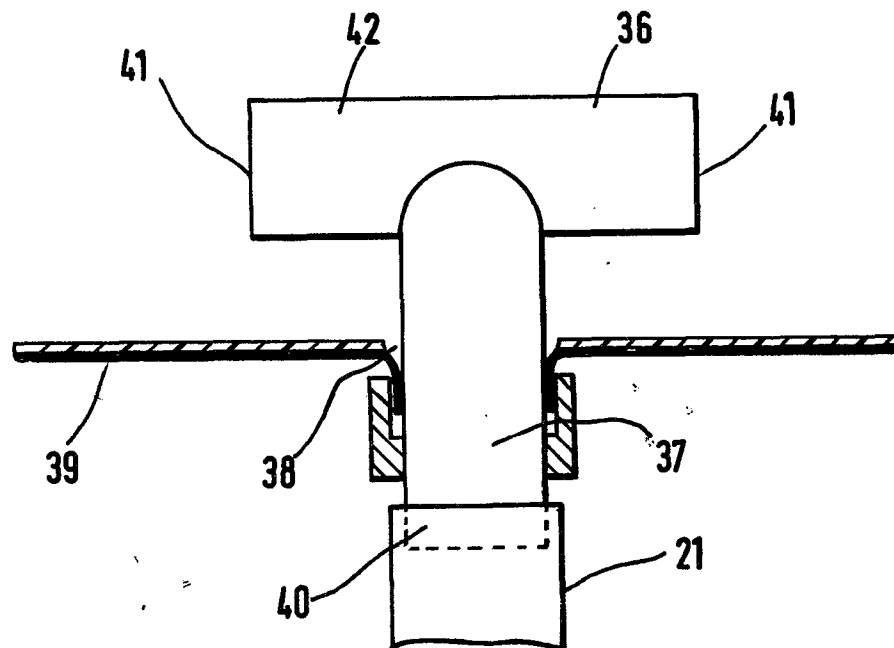


FIG 5

