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(54) **Heated or cooled cushion pad**

Beheiztes oder gekühltes Polster

Coussin avec système de chauffage et de refroidissement

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Description

BACKGROUND

1. Field of the Invention

[0001] The present invention relates to a cushion, such as for use as a mattress or seat and backrest, for example, which presents an outer surface of selectively variable temperature and apparatus therefor including a heat pump for reducing cushion temperature operating on a Stirling cycle.

2. Description of Related Art

[0002] There are many situations in which it is desirable that a cushion, such as a seat and backrest in an automotive vehicle, for example, be capable of being selectively cooled or heated for the comfort of someone sitting or resting against the cushion. In the colder climates, it would be desirable, particularly in the winter time, to obtain relatively instant heating of the seat cushions to warm an individual sitting or leaning on them prior to normal actuation of the auto heating system which typically relies upon the engine coolant being brought up to a sufficiently high temperature for satisfactory operation. In warm seasons, these same vehicles which have conventional air conditioning systems that direct cool air directly on the front of passengers and into the vehicle interior generally, undesirably leave those portions of the individual directly facing and contacting the seat and backrest cushions at an undesirably elevated temperature and in the case of high humidity, this results in even more discomfort for the vehicle occupant. In both situations, warming or cooling, as the case may be, of the cushions themselves will increase the comfort level of the individual.

[0003] Because of believed deleterious effect upon the environment, certain of the more efficient chemical materials (e.g., Freon) are being forced into retirement from use in air conditioning systems. At the present time, all other substitute materials known for this purpose do not possess the same high level of efficiency and are, in truth, substantially inferior in normal operation to those being eliminated. Also, there is the increasing problems that future automotive vehicles may be required to operate on less and less power in order to conserve basic fuels as well as reduce harmful byproducts, and this will, of necessity, leave a lesser proportion of available power for use by air conditioning or heating equipment.

[0004] In U.S. Patent 5,002,336, by Steve Feher, there is disclosed a seat and backrest especially constructed for being cooled or heated as desired where the heat pump utilized for this purpose is a thermoelectric unit which accomplishes the desired function with a substantially lower energy requirement than is utilized where the full interior of the vehicle is conditioned in accordance with conventional air conditioning techniques. However, even though considered a substantial improvement over other known and conventional techniques, there is still believed to be room for improvement especially in increasing overall efficiency of operation.

[0005] In EP-A-0811340 there is disclosed an example of known variable temperature cushion apparatus wherein an upholstery material comprises woven tubes of thermo plastic threads arranged parallel to one another and held together to form a pad by gluing or by securing them with separate woven structure.

[0006] In the US Patent 5,002,336, there is described a variable temperature cushion apparatus according to the preamble of claim 1.

[0007] In the '336 patent, the seat and backrest construction includes a plenum for receiving temperature conditioned air, which construction is formed alternatively from either metal wire spring coils or relatively rigid plastic tubes with sidewall openings. To function properly the seat construction must readily allow conditioned air to pass throughout the plenum not close off air flow to a significant extent from the weight of an individual sitting or leaning on the seating, and at the same time be comfortable.

[0008] Still further, automotive seat manufacturer's consider it undesirable that internal supports (e.g., spring coils) should produce a visible surface impression and in that way destroy design esthetics. It has been found in this regard to be self defeating to merely increase the thickness of a comfort layer located over wire springs or rigid plastic tubes since this reduces heat transference and thus overall operational efficiency.

[0009] It is against the background, and the limitations and problems associated therewith, that the present invention has been developed.

[0010] It is accordingly a primary aim and object of this invention to provide a cushion for variable temperature use which includes an internal plenum for receiving selectively variable temperature air where plenum is so formed as not to close off during use and yet is not uncomfortable to the touch, does not give external signs of the plenum forming means, and does not require a relatively thick outer comfort layer which would create a prohibitive reduction in the level of heat transference.

[0011] To achieve this, the variable temperature cushion apparatus of the invention is characterized by the features claimed in the characterizing part of claim 1.

[0012] According to the present invention, there Is provided a variable temperature cushion apparatus characterized in that the plenum is constructed of synthetic-monofilament fibers intermeshed and interwoven to form a plurality of generally parallel open- weaved tubes arranged side by side in single plane, with first and second monofilament open-weave layers being arranged on opposite sides of the plane of parallel tubes and being interwoven therewith, whereby the parallel tubes are unitarily secured together, the walls of the tubes being open weave so that pressurized conditioned air received into the plenum can move along a relatively low back-pres-

sure path lengthwise of the tubes and along a higher back-pressure path transversely of the tube longitudinal axes, said tubes having sufficient transverse rigidity so as to be free from closing off to any significant extent during use.

[0013] Features of the preferred embodiments are set out in the appendant claims.

[0014] In describing the present invention in its various aspects, the term "cushion" will refer to a seat, a backrest or mattress-like item that has its temperature conditioned in accordance with and by use of the apparatus described. When either a "seat", "backrest" or "mattress pad" is specifically referred to, those terms will be used.

[0015] As a first embodiment of a cushion, filaments of a strong and flexible synthetic resin material are used to form a plurality of loosely woven tubes held between a pair of similarly woven sheathe made from the same material. In this manner, a flexible porous and air permeable pad is provided which will be sufficiently rigid to resist closing off of the tubular chambers by someone leaning, sitting or lying on them and, in that way, enable conditioned air to pass along the tubular portions and outwardly through the woven walls to condition the surrounding area of the so-formed plenum within the cushion. Although the tubes are constructed of woven plastic filaments, the filaments are not secured to one another at crossover points, but instead the filaments are free to slide across one another which results in more comfort to a user.

[0016] The cushion pad provided has air impermeable bottom and lateral sides while a loose woven textile top cover provides air permeability. For additional flexibility and comfort, a layer of foam of low to medium density and of open cell variety is inserted between the textile covering and the cushion plenum structure described in the immediately preceding paragraphs. The foam layer must be so constructed as to provide good air and vapor permeability.

[0017] A conditioned air inlet duct is affixed to the cushion rear edge and is formed to transmit the air along a predetermined number of separate channels into the cushion. Where a pair of cushions (e.g., seat and backrest) are to be provided with conditioned air, the duct provides separate multi-channel air streams to each cushion.

[0018] A cushion constructed of the referenced air permeable woven tubes can be sized to served as a mattress or pad to be placed over a conventional mattress of similar dimensions.

[0019] A heat pump preferably including a Stirling cycle conditioner is utilized for selectively reducing the temperature of pressurized air moved along a flexible hose to the cushion inlet duct. In practice, a Stirling cycle conditioner can be shown to be 5-6 times more efficient than a thermoelectric cooling device, and less expensive to manufacture. Also, for a given amount of heat pumped, a Stirling pump is smaller than a corresponding thermoelectric unit and approximately the same in weight per unit heat pumped.

[0020] The Stirling heat pump preferably is a sealed free-piston unit including a pair of helical coil springs coaxial with a balancing mass for reducing undesirable vibration.

[0021] A ceramic or resistive PTC heater mounted to the conditioner warms the air during heating mode with the cooling parts of the conditioner maintained inoperative. The heater has a heat exchanger constructed of pins or posts promoting more universally directed heat transference with the ambient air.

[0022] Condensate that collects on the cooling conditioner is allowed to follow a gravity path into a receiving trap, and then along a conduit to fall onto a felt pad. An electrical heater evaporates the condensate from the felt into the ambient air.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a side elevational, partially sectional view of a temperature modifiable seat cushion as described;

FIG. 2 is an enlarged sectional, partially fragmentary view of the seat cushion;

FIG. 3 is an elevational view of a cushion and inlet duct;

FIG. 4 is an elevational, partially sectional view of a heat pump;

FIG. 5 is a sectional view of a free-piston Stirling cycle device for use in the heat pump of FIG. 4;

FIG. 6 is a schematic view of condensation elimination means for use with the heat pump of FIG. 4;

FIG. 7 is a perspective, partially sectional view of a flexible conduit interconnecting with the cushion inlet duct;

FIG. 8 shows an isometric partially sectional view of an alternative version of cushion for use as a sleeping pad;

FIG. 9 is a side elevational view of the invention shown with the condensation handling means of FIG. 6;

FIG. 10 is a side elevational sectional view of the cushion of FIG. 8 shown assembled to a mattress;

FIG. 11 is an enlarged partially sectional view of plenum forming means of the invention;

FIG. 12 is a sectional view of an alternative form of Stirling heat pump for use with the invention; and

FIG. 13 depicts an alternative form of heating apparatus for use with the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0024] Turning now to the drawings and particularly FIG. 1, the invention is shown and described in connection with a pair of cushions 10 and 12 which are manufactured in accordance with the principles of the invention and are particularly adaptable for use in an automotive

vehicle where the cushion 10 comprises a seat and the cushion 12 is a backrest. Construction of the two cushions 10 and 12 is identical, therefore, only the construction of cushion 10 will be given in detail.

[0025] With additional reference to FIG. 2, cushion 10 is seen to include an outer lower layer 14 covering the cushion bottom, two lateral sides and rear side which can be made of any of a number of different materials with the primary physical characteristic being that it is impermeable to the passage of air and moisture therethrough. An internal portion 16 to be more particularly described later forms a plenum for receiving temperature conditioned air and at the same time providing comfort and possessing necessary rigidity to prevent closing off all or any portion of the plenum during use.

[0026] Over the top surface of the plenum portion 16 there is located a relatively thin foam layer 19 of low to medium density and open cell construction enabling good air and vapor permeability. The foam layer provides additional comfort to the user. Over the foam layer 19 there is located a woven textile cover or layer 20 which is sufficiently open-weave as to permit air and vapor to pass readily therethrough.

[0027] From the cushion construction just described, it is clear that the lateral sides, rear side and bottom of the cushion are impermeable to air while the top and front edge surface facing towards the legs of a user are highly permeable to both air and vapor. Accordingly, in effect, the seat cushion forms a plenum which in a way to be described receives pressurized conditioned air that exits through the permeable portions of the cushion not covered by the body of the user for warming or cooling, as the case may be.

[0028] For the ensuing detailed description of cushion construction, reference is made particularly to FIG. 2. As noted, the cushion 10 includes the impermeable layer 14 which covers the bottom surface and lateral sides of the cushion except for the front side. Similarly, there is outermost top textile layer 20, and an underlying foam pad 19. The plenum interior between the foam pad 19 and the impermeable layer 14 is substantially filled with a tubular pad 32 including a plurality of tubular elements 34 extending parallel to each other and generally parallel to the foam pad 19 with the axial directions of each of the tubular elements extending from a rear side surface to the front side surface of the cushion for a purpose to be described. More particularly, the tubular elements are woven from resilient plastic filaments 36 and are arranged in edge contacting relationship forming a generally planar sheet of tubes. The individual tubular elements are unitarily secured together by first and second open-weave layers 38 and 40 which can be constructed of the filaments 36 and are positioned on opposite sides of the tubular element plane and interwoven therewith. In this way, there is a unitary construction in which air can move transversely through the walls of both the tubular elements as well as the open weave sheets on each side against only modest back pressure, and air flow is restricted by very low back pressure on moving along the axial direction through the tubular elements themselves. In use, the tubular pad 32 just described provides not only a flexible and relatively soft layer upon which an individual can sit or lean against, but also one which will not have its tubular passages closed off during use. Moreover, the woven filament construction does not "mark" the top layer 20 giving an external appearance of the underlying coils.

[0029] An important aspect of the woven construction of the tubes and interconnected layers 38 and 40 is that the filaments are not sealed to one another at crossover points and can move when submitted to pressure (FIG. 11), which feature is believed to add to the softness-to-touch aspect during cushion use. On the other hand, the woven construction and natural physical characteristics of the fibers are such that the tubes do not close off to any significant extent during use despite the relative filament movement when experiencing pressure.

[0030] A suitable material from which a tubular pad 32 can be made is manufactured by Tetko, Inc., Briarcliff Manor, New York and sold under the trade designation "Tubular Fabric".

[0031] FIG. 3 shows an air inlet duct 42 for use in conducting and distributing temperature conditioned air to both a seat and backrest cushions 10 and 12 from a single heat pump 44, the latter to be described in detail later. When viewed in plan, it is seen that the duct is broken into four separate channels 46, 48, 49 and 50 for distribution into both the seat and the backrest at correspondingly different points measured across the width of the respective cushions. In addition, the duct has a separation wall 52 such that the multiple channel delivery for the back rest is separate from the multiple channel delivery to the seat cushion (FIG. 1).

[0032] More particularly, a flexible multiple channel conduit 53 has one end 54 which interconnects with the heat pump 44 for receiving a supply of conditioned air and an opposite end provided with a fitting 55 for releasably connecting with the duct 42. In this way the duct 42 has each of its channels provided with an individual supply of conditioned air.

[0033] It is important to note that the conditioned air inlet duct 42 is so arranged with respect to the cushions that an external entrance fitting 56, to which the flexible conduit fitting 55 for conducting conditioned air is connected, is located adjacent a lateral side of the cushion. This enables interconnection to the heat pump via the flexible hose in a manner that does not interfere with positioning of the seat and has been found highly convenient in use. Also, many of the present day automotive vehicles have a strip of cloth sewn into the bightline between the backrest and the seatrest and the asymmetrical positioning of the air inlet duct fitting reduces the possibility of interference on installation in that case.

[0034] In general operation of the cushions and associated apparatus described to this point, the conditioned air flow is pressurized from the heat pump 44 along the

flexible conduit hose to the air inlet duct 42 where it is separated by the intervening wall 52 into two substantially equal parts for transmission and distribution to the seatrest and backrest cushions. Finally, the conditioned air is broken into four substantially equal portions for each of the cushions and distributed along the cushion to the forward end in the case of the seat, and upwardly in the case of the backrest. In addition to warming or cooling the cushion material surface which faces the user, construction as described permits ready transfer of the conditioned air via convection through the cushion to play in relatively even and very small air streams onto an individual using the cushions.

[0035] Although other heat pumps may be usefully employed for producing conditioned air to the described cushions, the heat pump found most advantageous for present purposes in view of its relatively high At operation and corresponding high efficiency of operation as compared to apparatus relying upon a thermoelectric device (e.g., Peltier), has been a Stirling cycle pump with a free-piston located within a sealed chamber (FIG. 5). In its general aspects, the Stirling cycle heat pump 44 produces a "cold" end 58 while at the same time exiting air containing waste heat at a second or "hot" end 60 (FIG. 4). The cold end 58 of the heat pump is seen to be enclosed by a plenum 61 also surrounding main heat exchanger fins 62 secured to the outermost surface of the cold end 58 in a good heat conducting relationship (e.g., brazing). A main blower 64 consisting of a fan driven by an electric motor is affixed to the outer end of plenum 61 and pulls air away from the heat exchanger fins 62 which have been cooled by the heat pump and pressurizes the air for delivery via the flexible hose 66 to the cushions. At this same time, an auxiliary fan (not shown) is located within a further plenum in surrounding relationship to the "hot end" 60 of the heat pump. The purpose of the auxiliary fan is to remove waste heat that accumulates at the hot end and direct it externally of the heat pump (arrows, FIG. 4).

[0036] Although use of the heat pump has been described in the cooling mode, it is also desirable that means be provided for heating the air during cold or inclement days. For this purpose, heat from the Stirling engine hot end could be channeled to the cushions instead of the cooler air , however, this is not fully satisfactory in that the apparatus would be of necessity be prohibitively bulky and expensive. Instead of using the Stirling cycle pump in a heating mode, it has been found preferable that a ceramic or resistive heater 70 of the positive temperature coefficient category be located on the cold end 58 of the heat pump internally of the heat exchanger plenum 61. For use in the heating mode, a sufficient amount of electric current (e.g., 100-150 watts) is passed through the heater 70 to raise the air stream temperature into the cushions to approximately 110° F. during which time the operation of the Stirling heat pump is suspended. Accordingly, the main blower 64 then receiving heat from the heater 70 passes the heated air along the flexible hose 66 into the cushions along the same path as when used in the cooling mode.

[0037] Although other heat pumps operating on the Stirling cycle principle may be found useful, applicant in a practical construction of the invention has achieved superior results with a free piston, linear, electric motor driven heat pump identified by the trade designation mode M223, made and marketed by Sunpower, Inc., Athens, Ohio. Where the air temperature being added to a cushion is approximately 40° F. below ambient, 2.5 watts of refrigeration are obtained for every watt of input to the Stirling pump.

[0038] FIG. 5 shows in sectional view the major parts of a Stirling device 44 useful in practicing the present invention. The device includes a housing 72 enclosing a hermetically sealed chamber 74 filled with gas within which all of the moving parts are located. A free piston 76 is resiliently mounted to the housing by spring 77 for movement toward and away from an internal orifice 78. A magnet 80 and coil 82 surround the piston for driving the same on electric energization via leads 84 and 86. On the opposite side of the orifice 76 there is provided a displacer 88 resiliently mounted by a spring 90 for restricted gas pressure induced movement toward and away from the orifice 78.

[0039] During use, the coil 82 is electrically pulsed to produce reciprocal movement of the piston 76 which, in turn, moves pressurized gas through the orifice 78 to drive the displacer into the expansion space 92. Between driving pulses the piston is returned by spring 77 and the displacer is similarly returned by spring 90. By the described reciprocal action, the housing end adjacent the expansion space 92 experiences a temperature reduction whereas the opposite housing end has its temperature increased.

[0040] A continuing troublesome matter has been the elimination of condensate that collects in the heat exchanger fins 62 area in the main heat exchanger during operation in the cooling mode. Most car manufacturers appear to be of the opinion that it is not feasible or desirable to try to remove condensate by draining the excess condensation through the vehicle floor since the drain opening could become clogged or obstructed resulting in undesirable concentrate accumulation on the vehicle floor. To solve this problem in the present invention, there is provided a condensation elimination means 94 (FIGS. 6 and 9) having a condensate trap 96 which includes an aluminum plate 98 onto a major surface of which a felt pad 100 is secured. A ceramic or resistive heater 102 (preferably of the positive temperature coefficient variety which reduces the possibility of overheating) is located on the upper surface of the aluminum plate and interconnected with a suitable electric power source (not shown). A conduit 104 connected to the heat pump and leading to the seat cushion and backrest, for example, has a loop 106 located substantially under the main exchanger heat fins so as to receive condensate dropping thereon along a gravity path. A drain means 108 (alternatively, a felt

wick) interconnected with the interior of the loop or trap also feeds along a gravity path to empty the condensate directly onto the felt pad 100. In operation, condensate obtained by the trap and fed along the drain means to moisten the felt pad is then evaporated by the heater 102 so as to return the condensate to the ambient air.

[0041] With reference now to FIG. 8, there is shown a cushion 110 of overall size sufficient that one or more individuals may lie on it. Specifically, the cushion 110 is constructed identically to the prior described cushion construction shown in detail in FIG. 2 in having a tubular pad 112, an overlying foam pad 114 with permeable upper layer 116, and impermeable outer layer sides and bottom 118, optionally, the foam pad 114 may be eliminated entirely.

[0042] The cushion 110 may be used as a separate and individual mattress or preferably as a pad that is placed on a conventional mattress 120 as shown in FIG. 10. More particularly, in this embodiment the cushion 110 is centrally located on a textile covering 122 such as a fitted sheet, for example, and fixedly secured in this position by layer 124 which is sewn or otherwise affixed to the covering 122. In the region of the cushion which would be opposite the feet of someone lying on it, the cushion is enclosed by a further layer 125 of material which would reduce the cooling effect in that area. The cushion assembly is secured onto the mattress by use of an elastic band, sewing or other conventional securing means. Such a cushion is believed to be especially advantageous for medical use with bedridden patients. Conditioned air is provided to cushion 110 from a Stirling heat pump (not shown) via a suitable conduit in the same manner as in the previously described embodiments (FIG. 8).

[0043] In FIG. 12, there is shown in sectional view an alternative version of Stirling cycle heat pump 130 having a vibration and noise retarding means 132. In normal operation a Stirling cycle heat pump including a free-acting piston is accompanied by a certain amount of vibration and noise which desirably is kept to a minimum where, as in the present invention, the heat pump is to be located within an automotive vehicle closely adjacent say, the front seat. More particularly, a cylindrical mass 134 having first and second axial extensions 136 and 138, respectively, held within first and second helical springs 140 and 142 is mounted within the heat pump outer housing 44, such that the extensions 136 and 138 are coaxial with the heat pump piston (not shown) path of movement. In operation, vibratory movement and noise induced by operation of the pump piston is damped by counter inertial action of the mass 134.

[0044] FIG. 13 shows a modification of the "cold" end of the heat pump 44 to include a set of pinlike fins 146 serving to act as a further heat exchanger which has been found to be especially advantageous in improving efficiency of operation during heating by the PTC ceramic/resistor 70. The pinlike shape is believed superior to normal flat fin shapes of conventional heat exchangers in more efficiently accommodating pressurized air moving therepast.

[0045] Although the present invention has been described in connection with preferred embodiments, it is understood that those skilled in the appertaining arts may make modifications that come within the scope of the appended claims.

Claims

1. Variable temperature cushion apparatus comprising:

   a cushion (10) including,

   (a) a centrally located plenum (16),
   (b) an air and moisture impervious layer (14) covering the bottom and lateral sides of the plenum (16), and
   (c) an air permeable foam sheet (19) covering the top of the plenum;

   a ducting means (42) mounted to extend through the air and moisture impervious layer (14) to the plenum (16); and
   means (55) connected to the air ducting means for selectively cooling or heating a pressurized air stream,

   characterized in that the plenum is constructed of, syntheticmonofilament fibers (36) intermeshed and interwoven to form a plurality of generally parallel open-weaved tubes (34) arranged side by side in single plane, with first and second monofilament open-weave layers (38 and 40) being arranged on opposite sides of the plane of parallel tubes (34) and being interwoven therewith, whereby the parallel tubes are unitarily secured together,
   the walls of the tubes being open weave so that pressurized conditioned air received into the plenum can move along a relatively low back-pressure path lengthwise of the tubes and along a higher back-pressure path transversely of the tube longitudinal axes, said tubes having sufficient transverse rigidity so as to be free from closing off to any significant extent during use.

2. Apparatus as in claim 1, in which the fibers of the sidewalls of the tubes are woven in-an open-weave manner with the fibers at fiber crossover points being free to slide across one another maintaining the open-weave construction, and the fibers of the first and second open-weave layers are free to slide across one another securing the tubes in fixed predetermined spaced apart relation.

3. Apparatus as In claim 1 or 2, In which the cooling or heating means includes a Stirling cycle heat pump

(44) for cooling the pressurized air stream.

4. Apparatus as in claim 3, in which the Stirling cycle heat pump (44) is a linear, free-piston device driven by an electric motor.

5. Apparatus as in claim 4, in which the Stirling cycle heat pump includes a pair of helical coil springs coaxial with a balancing mass for reducing undesirable vibrations.

6. Apparatus as In claim 3, 4 or 5, In which means (94) are provided for receiving condensate from the Stirling pump and evaporating It to the ambient air.

7. Apparatus as in claim 6, in which the condensate receiving means (94) includes a metal plate (98) having an absorbent pad (100) on one major surface and heating means (102) located between the metal plate (98) and the pad (100).

8. Apparatus as in claim 7, in which said heating means (102) is a positive temperature coefficient electrical resistance heater.

9. Apparatus as in claim 1 or 2, in which the means for selectively cooling or heating an air stream includes a heat pump (44) having a cold end (58) and a hot end (60), a heat pump plenum (61) in surrounding relation to the heat pump cold end (58) and connected to the ducting means (42), a main blower (64) mounted to direct air from the heat pump plenum (61) through the ducting means (42) to the cushion plenum (16); an electric resistance heater (70) mounted within the heat pump plenum (61), the heat pump (44) and electric resistance (70) being separately and individually actuated to selectively provide either heating or cooling mode.

10. Apparatus as in claim 9, in which the heat pump (44) is a free-piston, electric motor driven pump operating on a Stirling cycle.

11. Apparatus as in claim 9 or 10, in which heat exchanger fins (62) are secured to the heat pump cold end (58) and located within the heat pump plenum (61); an absorbent felt pad (100) is located externally of the heat pump plenum (61) to receive moisture condensate leaving the heat fins (62) along a gravity path; and heating means (102) is in contact with the felt pad (100) for evaporating the condensate.

12. Apparatus as in claim 11, in which the felt pad (100) is mounted onto a metal plate (98), and the heating means includes a resistive heater (102) located between the metal plate (98) and the felt pad (100), and in good heat conducting contact with each.

13. Apparatus as in claim 8 or 12, in which the resistive heater (102) is a positive temperature coefficient ceramic heater.

14. Apparatus as in claim 11, 12 or 13, in which an open top container (96) receives condensate dropping from the fins; a drain tube (108) receives condensate from the container (96) which moves along and out of the tube (108) by gravity to drop onto the felt pad (100).

15. Apparatus as in claim 10, In which pinlike heat exchanger fins (146) are located immediately adjacent the heating means, said fins contacting the cold conditioned air at the cold end when the Stirling cycle heat pump is operated.

16. Apparatus as in any of the preceding claims, in which a pair of variable temperature cushion apparatus (10 and 12) are interconnected with the ducting means (42).

17. Apparatus as in any of the preceding claims, in which the ducting means (42) includes a plurality of separate air passages (46, 48, 49, 50) arranged in fixed side-by-side relation.

18. Apparatus as in any of the preceding claims, In which the ducting means (42) includes multiple individual channels (46, 48, 49, 50) along which conditioned air is simultaneously supplied to the cushion plenum (16).

19. Apparatus as in any of the preceding claims, in which the intermeshed fibers of the plenum are adhered to a major surface of a woven, open-mesh layer.

Patentansprüche

1. Polstervorrichtung mit variabler Temperatur, umfassend:

ein Polster (10) mit

(a) einem zentral angeordneten Zwischenraum (16),
(b) einer luft- und feuchtigkeitsundurchlässigen Schicht (14), die die Unterseite und die Seiten des Zwischenraums (16) bedeckt, und
(c) einer luftdurchlässigen Schaumplatte (19), die die Oberseite des Zwischenraums bedeckt;

ein Leitungsmittel (42), das angebracht ist, um sich durch die luft- und feuchtigkeitsundurchlässige Schicht (14) zum Zwischenraum (16) zu er-

strecken; und
ein Mittel (55), das mit dem Luftleitungsmittel verbunden ist, um einen Druckluftstrom selektiv zu kühlen oder zu erhitzen,

dadurch gekennzeichnet, dass der Zwischenraum aus synthetischen Monofilamentfasern (36) besteht, die vermascht und verflochten sind, um eine Mehrzahl von im Allgemeinen parallelen offen gewobenen Röhrchen (34) zu bilden, die nebeneinander auf einer einzelnen Ebene angeordnet sind, wobei erste und zweite offen gewobene Monofilamentschichten (38 und 40) auf gegenüberliegenden Seiten der Ebene von parallelen Röhrchen (34) angeordnet und damit verflochten sind, wobei die parallelen Röhrchen einheitlich aneinander befestigt sind,
die Wände der Röhrchen offen gewoben sind, so dass sich klimatisierte Druckluft, die im Zwischenraum ausgenommen wird, entlang eines relativ niedrigen Gegendruckpfads längswärts der Röhrchen und entlang eines höheren Gegendruckpfads quer zur Längsachse der Rölwchen bewegen kann, wobei die Röhrchen ausreichende Steifheit in Querrichtung aufweisen, so dass sie sich während der Verwendung in keinem signifikanten Ausmaß verschließen.

2. Vorrichtung nach Anspruch 1, wobei die Fasern der Seitenwände der Röhrchen mit den Fasern an Faserknotenpunkten offen verwoben sind, wobei diese übereinander gleiten können, wobei die offene Webstruktur beibehalten wird, und wobei die Fasern der ersten und zweiten offen gewobenen Schichten übereinander gleiten können, wobei die Röhrchen in einem vorab definierten fixen Abstand in Bezug aufeinander befestigt werden.

3. Vorrichtung nach Anspruch 1 oder 2, wobei das Kühl- oder Heizmittel eine Stirling-Kreisprozess-Wärmepumpe (44) zum Kühlen des Druckluftstroms enthält.

4. Vorrichtung nach Anspruch 3, wobei die Stirling-Kreisprozess-Wärmepuppe (44) ein lineares Freikolben-Gerät ist, die von einem Elektromotor angetrieben wird.

5. Vorrichtung nach Anspruch 4, wobei die Stirling-Kreisprozess-Wärmepumpe ein Paar Schraubenfedern enthält, die koaxial mit einer Ausgleichsmasse angeordnet ist, um ungewünschte Vibrationen zu verringern.

6. Vorrichtung nach Anspruch 3, 4 oder 5, wobei ein Mittel (94) vorgesehen ist, um Kondensat aus der Stirling-Pumpe aufzunehmen und in die Umgebungsluft zu verdampfen.

7. Vorrichtung nach Anspruch 6, wobei das Kondensataufnahmemittel (94) eine Metallplatte (98) mit einer absorbierenden Einlage (100) auf einer Hauptfläche und ein Heizmittel (102) enthält, das zwischen der Metallplatte (98) und der Einlage (100) angeordnet ist.

8. Vorrichtung nach Anspruch 7, wobei das Heizmittel (102) eine elektrische Widerstandsheizung mit positivem Temperaturkoeffizienten ist.

9. Vorrichtung nach Anspruch 1 oder 2, wobei das Mittel zum selektiven Kühlen oder Erhitzen eines Luftstroms eine Wärmepumpe (44) mit einem kalten Ende (58) und einem heißen Ende (60), einen Wärmepumpenzwischenraum (61), der das kalte Ende (58) der Wärmepumpe umgibt und mit dem Leitungsmittel (42) verbunden ist, ein Hauptgebläse (64), das angebracht ist, um Luft aus dem Heizpumpenzwischenraum (61) über das Leitungsmittel (42) in den Polsterzwischenraum (16) zu leiten; eine elektrische Widerstandsheizung (70), die innerhalb des Heizpumpenzwischenraums (61) angeordnet ist, enthält, wobei die Heizpumpe (44) und der elektrische Widerstand (70) separat und einzeln betätigt werden, um entweder einen Heiz- oder Kühlmodus selektiv bereitzustellen.

10. Vorrichtung nach Anspruch 9, wobei die Heizpumpe (44) eine Elektromotor betriebene Freikolben-Pumpe ist, die in einem Stirling-Kreisprozess arbeitet.

11. Vorrichtung nach Anspruch 9 oder 10, wobei Wärmetauscherlamellen (62) am kalten Ende (58) der Wärmepumpe befestigt und innerhalb des Wärmepumpenzwischenraums (61) angeordnet sind; wobei eine absorbierende Filzunterlage (100) außerhalb des Heizpumpenzwischenraums (61) angeordnet ist, um Feuchtigkeitskondensat aufzunehmen, das entlang eines Schwerkraftweges aus den Heizlamellen (62) austritt; und wobei ein Heizmittel (102) mit der Filzunterlage (100) in Kontakt steht, um das Kondensat zu verdampfen.

12. Vorrichtung nach Anspruch 11, wobei die Filzunterlage (100) an einer Metallplatte (98) angebracht ist, und wobei das Heizmittel eine Widerstandsheizung (102) enthält, die zwischen der Metallplatte (98) und der Filzunterlage (100) sowie jeweils in gutem wärmeleitenden Kontakt damit angeordnet ist.

13. Vorrichtung nach Anspruch 8 oder 12, wobei die Widerstandsheizung (102) eine Keramikheizung mit positivem Temperaturkoeffizienten ist.

14. Vorrichtung nach Anspruch 11, 12 oder-13, wobei ein oben offener Behälter (96) Kondensat aufnimmt, das von den Lamellen tropft; wobei ein Ablassrohr

(108) das Kondensat vom Behälter (96) aufnimmt, das sich mittels Schwerkraft entlang des Rohres (108) und aus diesem heraus bewegt, um auf die Filzunterlage (100) zu tropfen.

15. Vorrichtung nach Anspruch 10, wobei stiftähnliche Wärmeaustauscherlamellen (146) direkt benachbart des Heizmittels angeordnet sind, wobei die Lamellen die kalte klimatisierte Luft am kalten Ende kontaktieren, wenn die Stirling-Kreisprozess-Pumpe betrieben wird.

16. Vorrichtung nach einem der vorstehenden Ansprüche, wobei ein Paar Polstervorrichtungen (10 und 12) mit variabler Temperatur mit dem Leitungsmittel (42) verbunden ist.

17. Vorrichtung nach einem der vorstehenden Ansprüche, wobei das Leitungsmittel (42) eine Mehrzahl von getrennten Luftkanälen (46, 48, 49, 50) enthält, die nebeneinander befestigt sind.

18. Vorrichtung nach einem der vorstehenden Ansprüche, wobei das Leitungsmittel (42) mehrere einzelne Kanäle (46, 48, 49, 50) enthält, entlang welcher klimatisierte Luft gleichzeitig zum Polsterzwischenraum (16) zugeführt wird.

19. Vorrichtung nach einem der vorstehenden Ansprüche, wobei die vermaschten Fasern des Zwischenraums an einer Hauptfläche einer gewobenen offenmaschigen Schicht anhaften.

Revendications

1. Appareil de coussin à température variable comprenant :

un coussin (10) comprenant,

(a) un plenum situé centralement (16),
(b) une couche imperméable à l'air et à l'humidité (14) couvrant les côtés inférieur et latéraux du plenum (16), et
(c) une feuille de mousse perméable à l'air (19) couvrant le dessus du plenum ;

des moyens de canalisation (42) montés de manière à s'étendre à travers la couche imperméable à l'air et à l'humidité (14) jusqu'au plenum (16) ; et
des moyens (55) connectés aux moyens de canalisation d'air pour refroidir ou chauffer de manière sélective un courant d'air sous pression,

caractérisé en ce que le plenum est constitué de fibres synthétiques monofilaments (36) enchevêtrées et entrecroisées pour former une pluralité de tubes ajourés (34) généralement parallèles agencés côte à côte dans un plan unique, des première et deuxième couches ajourées monofilaments (38 et 40) étant agencées des côtés opposés du plan des tubes (34) parallèles et étant entrecroisées avec ceux-ci, moyennant quoi les tubes parallèles sont fixés les uns aux autres de manière unitaire,
les parois des tubes étant ajourées de sorte que l'air conditionné sous pression reçu dans le plenum peut se déplacer le long d'un trajet de contre-pression relativement faible dans le sens de la longueur des tubes et le long d'un trajet de contre-pression plus élevée transversalement aux axes longitudinaux des tubes, lesdits tubes ayant une rigidité transversale suffisante de manière à ne pas se fermer à un degré suffisant en utilisation.

2. Appareil selon la revendication 1, dans lequel les fibres des parois latérales des tubes sont tissées d'une manière ajourée, les fibres aux points de croisement des fibres étant libres de glisser les unes en travers des autres maintenant la construction ajourée, et les fibres des première et deuxième couches ajourées sont libres de glisser les unes en travers des autres fixant les tubes dans une relation espacée fixe prédéterminée.

3. Appareil selon la revendication 1 ou 2, dans lequel les moyens de refroidissement ou de chauffage comprennent une thermopompe à cycle Stirling (44) pour refroidir le courant d'air sous pression.

4. Appareil selon la revendication 3, dans lequel la thermopompe à cycle Stirling (44) est un dispositif à pistons libres linéaire entraîné par un moteur électrique.

5. Appareil selon la revendication 4, dans lequel la thermopompe à cycle Stirling comprend une paire de ressorts hélicoïdaux avec une masse d'équilibrage pour réduire les vibrations indésirables.

6. Appareil selon la revendication 3, 4 ou 5, dans lequel des moyens (94) sont prévus pour recevoir un condensât de la pompe Stirling et l'évaporer dans l'air ambiant.

7. Appareil selon la revendication 6, dans lequel les moyens de réception de condensât (94) comprennent une plaque métallique (98) comportant un tampon absorbant (100) sur une surface principale et des moyens de chauffage (102) situés entre la plaque métallique (98) et le tampon (100).

8. Appareil selon la revendication 7, dans lequel lesdits moyens de chauffage (102) sont un dispositif de chauffage par résistance électrique à coefficient de température positif.

9. Appareil selon la revendication 1 ou 2, dans lequel les moyens pour refroidir ou chauffer de manière sélective un courant d'air comprennent une thermopompe (44) ayant une extrémité froide (58) et une extrémité chaude (60), un plénum de thermopompe (61) dans une relation d'encerclement par rapport à l'extrémité froide (58) de la thermopompe et connecté aux moyens de canalisation (42), un ventilateur principale (64) monté pour diriger l'air du plénum de thermopompe (61) à travers les moyens de canalisation (42) vers le plénum de coussin (16) ; un dispositif de chauffage par résistance électrique (70) monté dans le plénum de thermopompe (61), la thermopompe (44) et la résistance électrique (70) étant actionnés séparément et individuellement pour fournir de manière sélective soit un mode de chauffage, soit un mode de refroidissement.

10. Appareil selon la revendication 9, dans lequel la thermopompe (44) est une pompe entraînée par un moteur électrique à pistons libres fonctionnant sur un cycle Stirling.

11. Appareil selon la revendication 9 ou 10, dans lequel des ailettes d'échange de chaleur (62) sont fixées à l'extrémité froide (58) de la thermopompe et situées dans le plénum de thermopompe (61) ; un tampon de feutre absorbant (100) est situé à l'extérieur du plénum de thermopompe (61) pour recevoir le condensât d'humidité quittant les ailettes d'échange de chaleur (62) le long d'un trajet de gravité ; et des moyens de chauffage (102) sont en contact avec le tampon de feutre (100) pour évaporer le condensât.

12. Appareil selon la revendication 11, dans lequel le tampon de feutre (100) est monté sur une plaque métallique (98), et les moyens de chauffage comprennent une résistance chauffante (102) située entre la plaque métallique (98) et le tampon de feutre (100), et en bon contact de conduction de chaleur avec chacun.

13. Appareil selon la revendication 8 ou 12, dans lequel la résistance chauffante (102) est un dispositif de chauffage en céramique à coefficient de température positif.

14. Appareil selon la revendication 11, 12 ou 13, dans lequel un récipient (96) à partie supérieure ouverte reçoit le condensât tombant des ailettes ; un tube de drainage (108) reçoit le condensât provenant du récipient (96) qui se déplace le long et hors du tube (108) par gravité pour tomber sur le tampon de feutre (100).

15. Appareil selon la revendication 10, dans lequel des ailettes d'échange de chaleur de type broche (146) sont situées immédiatement adjacentes aux moyens de chauffage, lesdites ailettes étant en contact avec l'air conditionné froid au niveau de l'extrémité froide lorsque la thermopompe à cycle Stirling est actionnée.

16. Appareil selon l'une quelconque des revendications précédentes, dans lequel une paire d'appareils de coussin à température variable (10 et 12) sont interconnectés avec les moyens de canalisation (42).

17. Appareil selon l'une quelconque des revendications précédentes, dans lequel les moyens de canalisation (42) comprennent une pluralité de passages d'air (46, 48, 49, 50) séparés agencés dans une relation côte à côte fixe.

18. Appareil selon l'une quelconque des revendications précédentes, dans lequel les moyens de canalisation (42) comprennent de multiples canaux individuels (46, 48, 49, 50) le long desquels l'air conditionné est simultanément délivré au plénum de coussin (16).

19. Appareil selon l'une quelconque des revendications précédentes, dans lequel les fibres enchevêtrées du plénum sont collées à une surface principale d'une couche ajourée tissée.

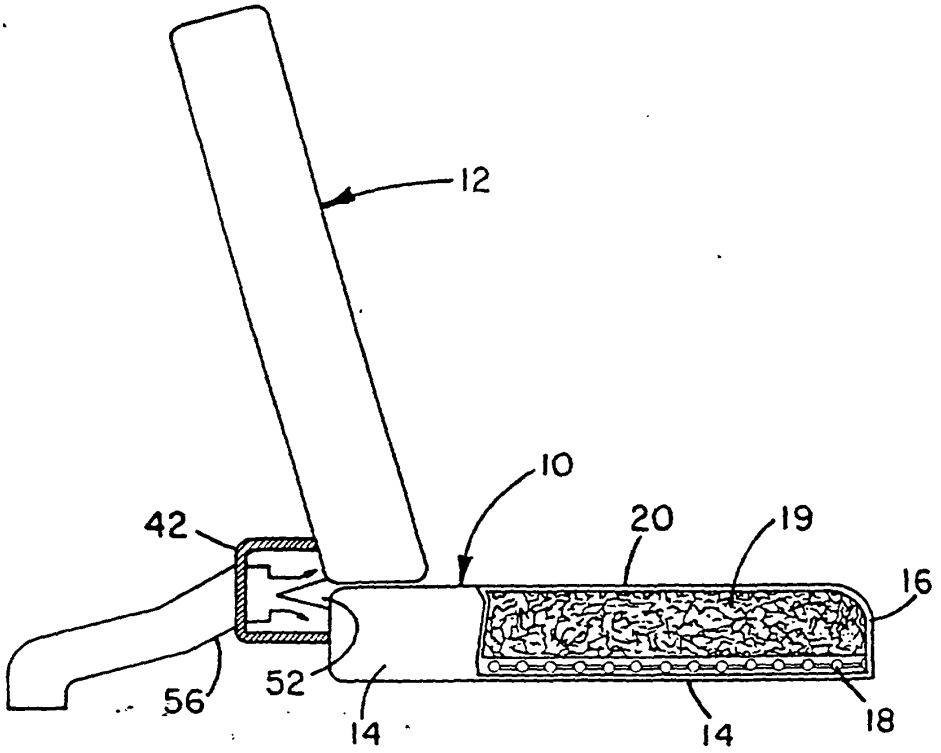


FIG.1

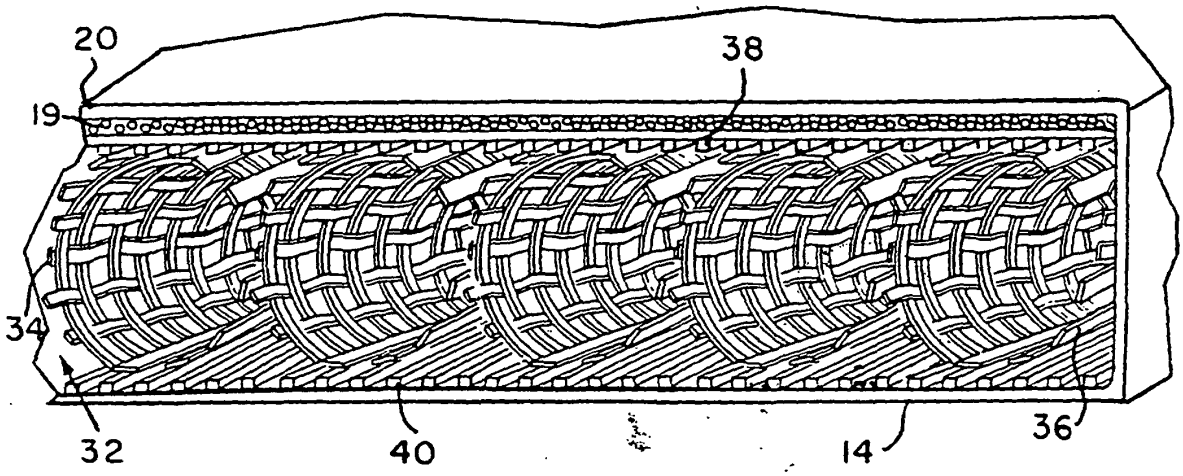


FIG.2

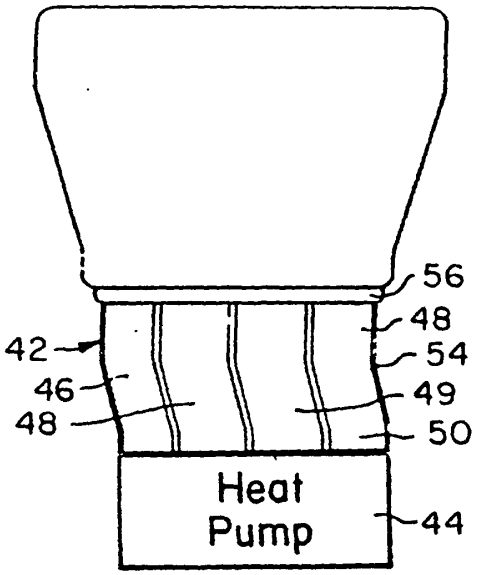


FIG. 3

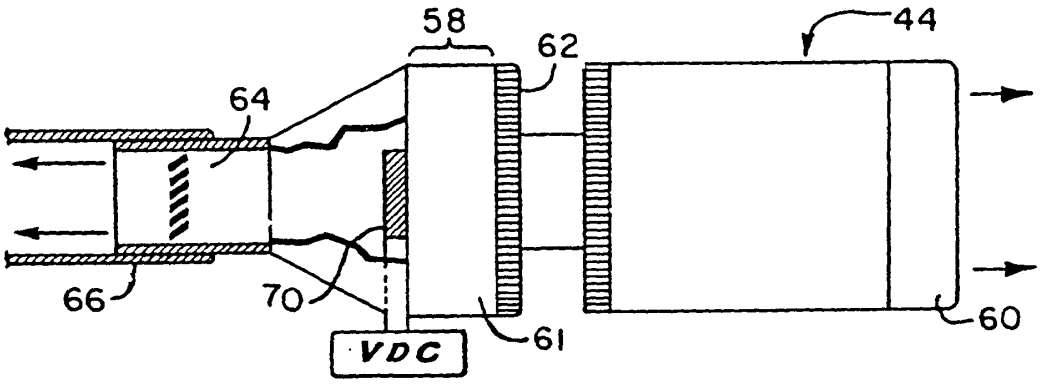


FIG. 4

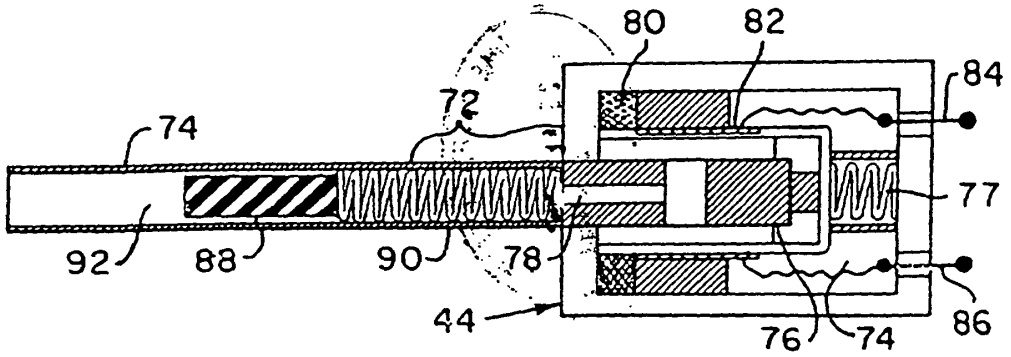


FIG. 5

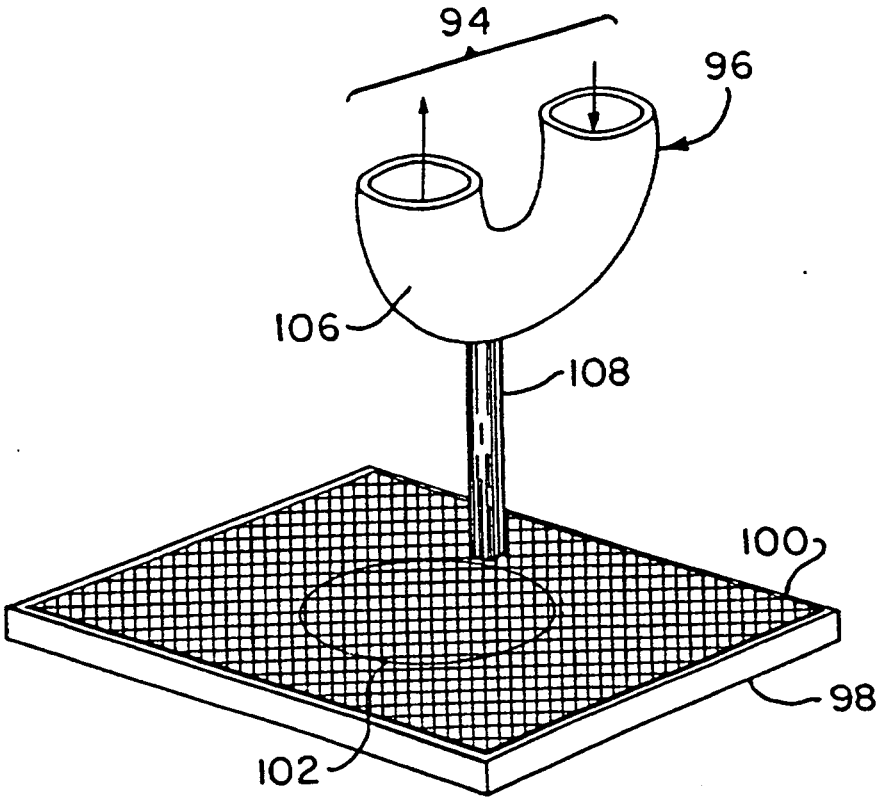


FIG.6

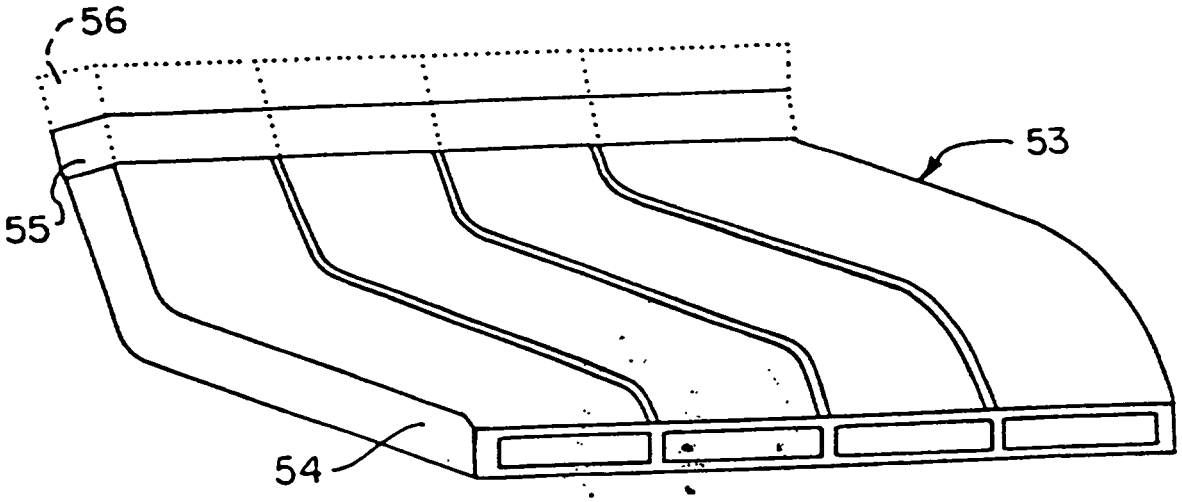


FIG.7

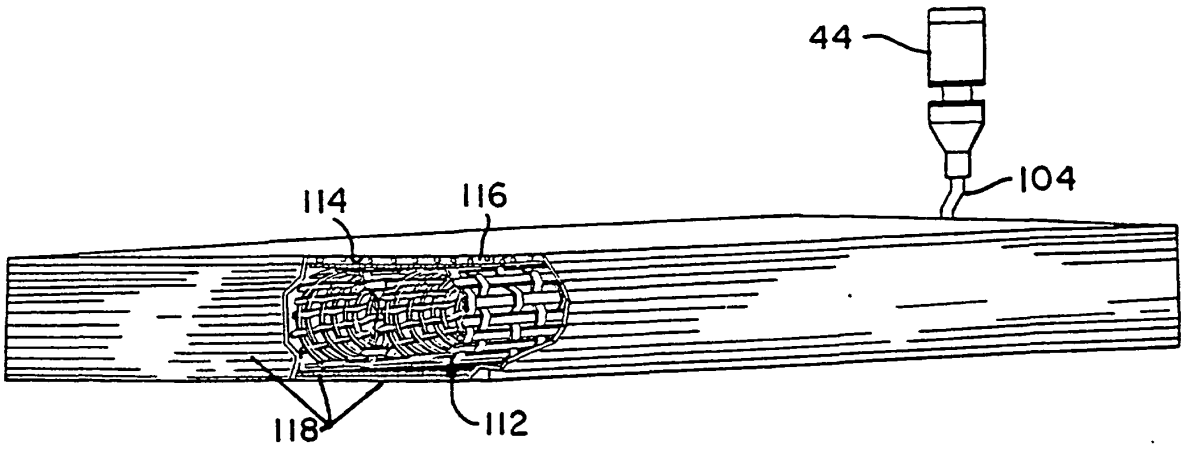


FIG.8

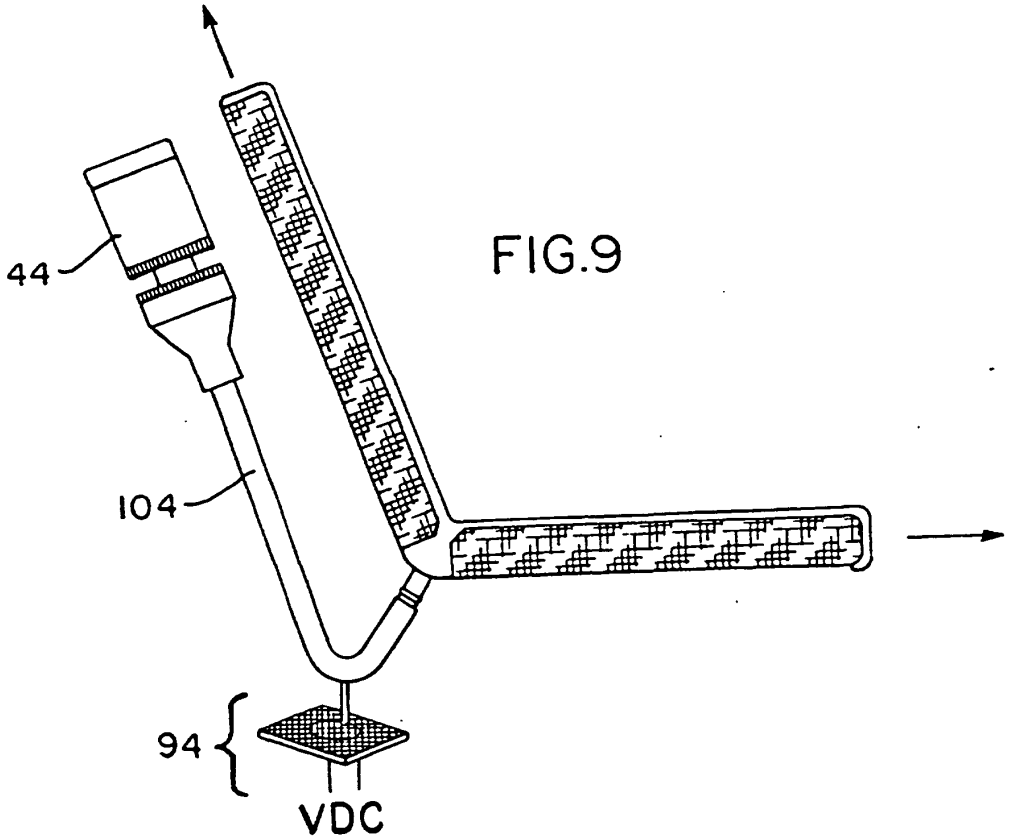


FIG.9

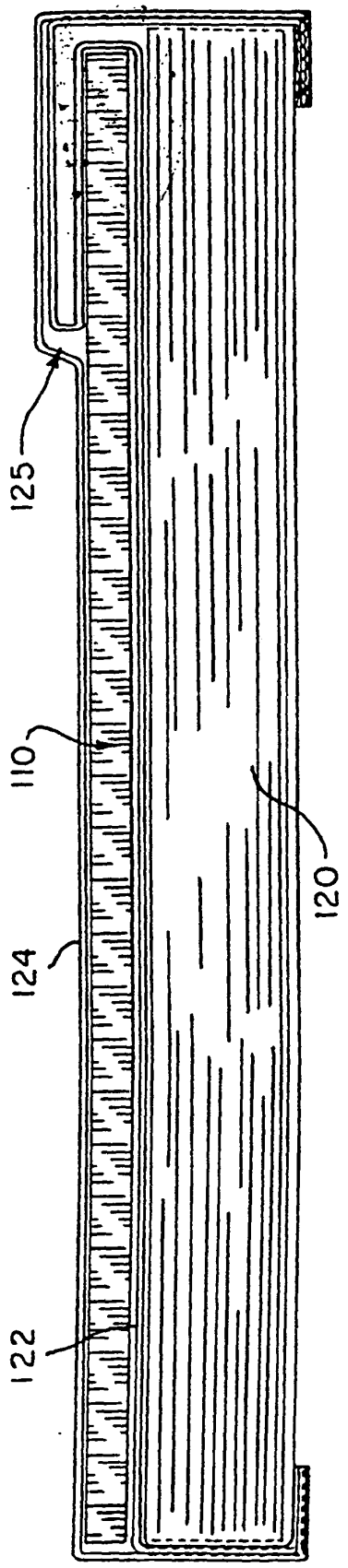


FIG.10

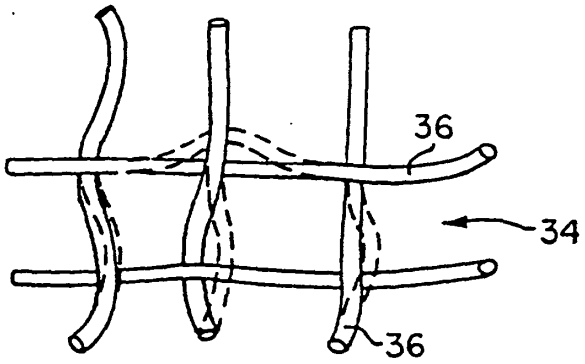


FIG.11

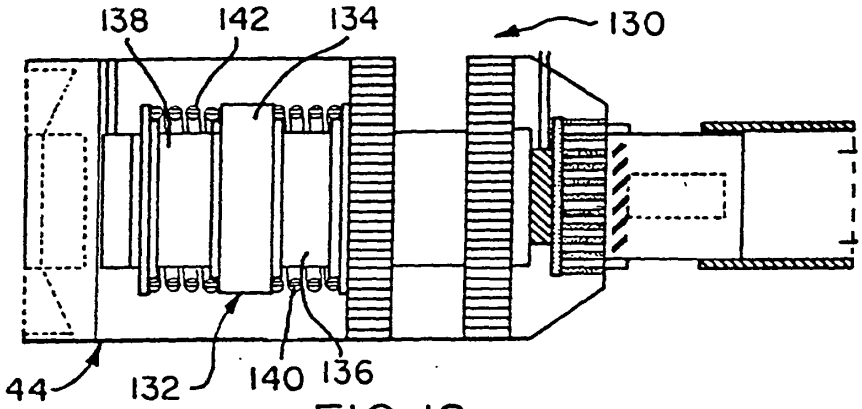


FIG.12

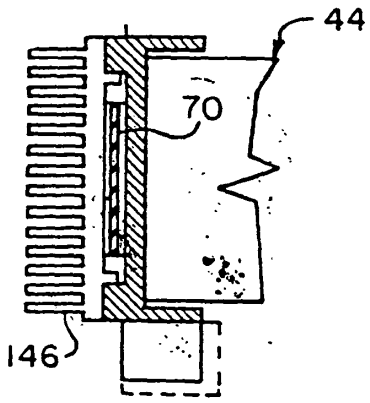


FIG.13

REFERENCES CITED IN THE DESCRIPTION

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