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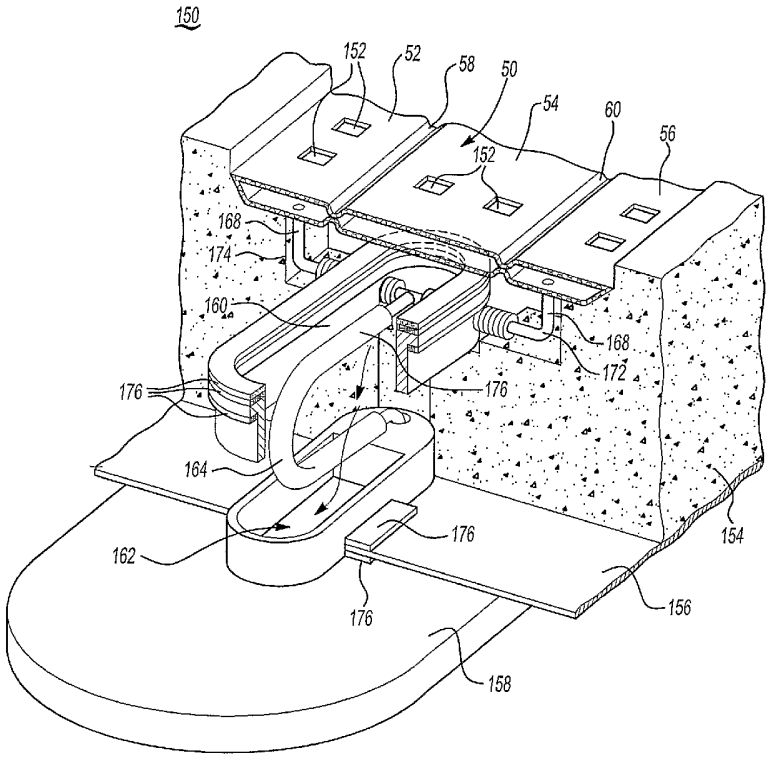
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(54) Title: ACTIVE VENTILATION SYSTEMS FOR VEHICLE SEATS



(57) Abstract: The present invention includes a seat ventilator with an air diffuser, preferably one with sections. The air diffuser has a spacer material and ventilation holes on its occupant side. A temperature conditioner with a temperature conditioning device (such as a TED) and a blower provide temperature conditioned air. One conduit connects the diffuser to an inlet of the blower, while another duct connects the diffuser and an outlet of the TED. The blower moves air for its inlet to the TED and then from the outlet of the TED to the diffuser. The present invention also includes methods controlling the temperature of a vehicle seat by drawing air from a diffuser in a vehicle seat through at least one conduit and blowing air to the diffuser through at least another conduit, where the blown air has been temperature conditioned. The present invention also includes methods of assembling ventilated vehicle seat that include inserting a nozzle of diffuser into a plug received in the socket of a cushion or threading a tether through a manifold of the temperature conditioner to fluidly connect one or more conduits to the temperature conditioner.

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ACTIVE VENTILATION SYSTEMS FOR VEHICLE SEATS

CLAIM OF PRIORITY

[0001] This application claims the benefit of U.S. provisional application nos. 60/654,032, filed February 17, 2005; 60/694/476, filed June 28, 2005; and 60/735,325, filed November 10, 2005, all of which are hereby incorporated by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to devices, systems, method of using and methods of making ventilation systems for vehicle seats; more particularly, the invention relates to providing temperature conditioned air and ventilation to a vehicle seat.

BACKGROUND OF THE INVENTION

[0003] Market forces have created a need for cost effective and energy efficient systems for heating, cooling or ventilating of transportation vehicles, and particularly the passenger compartments of vehicles. Known systems include compartment wide systems and well as localized system that provide temperature control or ventilation more directly to the vehicle operators and passengers. Exemplary localized systems include comfort systems that heat, cool or ventilate portions of seats in the vehicle. Seat comfort systems may be tied into the HVAC system of the vehicle or may be self contained in that heating, cooling or ventilation may be provided by components not connected to the HVAC system and mainly located in or around the seat. Known systems, however, are difficult to reliably install in a cost effective manner.

[0004] The present invention overcomes one or more of these problems.

SUMMARY OF THE INVENTION

[0005] The present invention includes a seat ventilator with an air diffuser, preferably one with sections. The air diffuser has a spacer material and ventilation holes on its occupant side. A temperature conditioner with a temperature conditioning device (such as a TED) and a blower provide temperature conditioned air. One conduit connects the diffuser to an inlet of the blower,

while another duct connects the diffuser and an outlet of the TED. The blower moves air for its inlet to the TED and then from the outlet of the TED to the diffuser. The present invention also includes methods controlling the temperature of a vehicle seat by drawing air from a diffuser in a vehicle seat through at least one conduit and blowing air to the diffuser through at least another conduit, where the blown air has been temperature conditioned. The present invention also includes methods of assembling ventilated vehicle seat that include inserting a nozzle of diffuser into a plug received in the socket of a cushion or threading a tether through a manifold of the temperature conditioner to fluidly connect one or more conduits to the temperature conditioner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] In the drawings:

[0007] Fig. 1 schematically shows a first embodiment of the present invention.

[0008] Fig. 2 schematically shows a second embodiment of the present invention.

[0009] Fig. 3 schematically shows a third embodiment of the present invention.

[0010] Fig. 4 shows one embodiment of the present invention in a seat,

[0011] Fig. 5 shows one embodiment of a blower useful in the present invention.

[0012] Fig. 6 shows another embodiment of the present invention in a seat.

[0013] Figs. 7-9 show the plug embodiment of the present invention.

[0014] Fig. 10 shows the membrane embodiment of the present invention.

[0015] Fig. 11 shows the tether embodiment of the present invention installed on a seat.

[0016] Fig. 12 shows a close up of the tether embodiment install on a seat.

[0017] Figs. 13-17 show various aspects of the tether embodiment of the present invention.

DETAILED DESCRIPTION

[0018] The vehicle seat of the present invention includes an air diffuser located on a surface of a cushion. In a specific embodiment, the diffuser is allocated underneath a trim cover and above a cushion. The diffuser is fluidly connected to a temperature conditioner through at least two conduits, namely at least a first conduit and a second conduit. As part of the temperature

conditioner, a blower and a temperature conditioning device cooperate to blow air that that has been temperature conditioned (e.g. warmed, cooled, dehumidified or the like) to the air diffuser. In a specific embodiment, the blower also draws air from the air diffuser.

[0019] While discussed primarily in relation to the area of the vehicle seat where the buttocks and thighs of the occupant touch (i.e. the seat portion), it also contemplated that the systems and methods are applicable to the backrest portion of the vehicle seat.

[0020] The terms underside and occupant side are use as a convenience and it should be understood that these terms are used relatively.

[0021] As seen in the embodiments shown schematically in Figs. 1-3, several arrangements may be used to both blow air to and draw air from the air diffusers. In Fig. 1, the first conduit 10 and second conduit 12 are connected to the air diffuser (not shown). The temperature conditioner includes a blower 14 and a thermoelectric device (TED) 16. The blower in this embodiment may be a dual impeller type in which both impellers move air in the same direction. A single impeller device may be used, as well as a device with more than two impellers. Desirably, the two air streams created by the impeller are separate from each other. This may be accomplished, for example, by a divider wall 18 that roughly aligns with where the impellers come together. The first conduit connects to an intake 20 of the blower to draw air from the air diffuser. The blower moves this air stream across a waste side 22 of the TED and exhausts the air stream, such as to an area away from the occupant, or recirculates it to elsewhere in the system. The blower also includes at least another intake 24 for a second air stream. The blower moves the second air stream across an active side 26 of the TED to the second conduit, which is connected to the air diffuser. In this way, a (e.g. a dual impeller blower) blower both draws air from the air diffuser and provides temperature conditioned air to the air diffuser.

[0022] In Fig. 2, the first conduit 10 and second conduit 12 are connected to the air diffuser and the temperature conditioner includes a blower 14 and a TED 16. Here, only a single impeller is needed on the blower 14 to initially produce a single air stream. One portion of the air stream crosses a waste side 22 of the TED and another portion crosses an active side 26 of the TED. The first conduit connects to an intake 20 of the blower to draw air from the air diffuser and

optionally through an intake vent 28 in the conduit separate from the air diffuser. The optional vent (or valve) may be used to dilute warm air from the diffuser with possibly cooler ambient air, to increase efficiency of the TED. The blower moves this air stream across one or both of the active 26 and waste side 22 of the TED, preferably splitting the air stream. The waste side air stream may be exhausted (or recirculated elsewhere in the system), while the active side air stream typically passes to the second conduit and the air diffuser.

[0023] In Fig. 3, as in the other embodiments, the first conduit 10 and second conduit 12 are connected to the air diffuser and the temperature conditioner includes a blower 14 and a TED 16. Here, the blower includes dual impellers that create separate air streams through the use of a divider wall 18. While shown moving air in multiple directions (i.e. the impellers are opposed), the impellers may also move air in the same direction (as in Fig. 1). The first conduit connects to an intake 20 of the blower to draw air from the air diffuser and this air stream is exhausted or recirculated through an outlet 30. The blower includes another intake 32 for a second air stream. The blower moves the second air stream across both the active side 26 and the waste side 22 of the TED. At least a portion of the air stream from the active side passes to the second conduit and the air diffuser, while the waste air stream is exhausted (or recirculated elsewhere in the system).

[0024] The air diffuser is configured for placement within or on a seat to provide heating, cooling, ventilation or a combination thereof to a seat occupant. The air diffuser may be any structure, material or combination of materials and/or structures that permits air flow through an open space while also providing a measure of support for a seat occupant. Examples are of the type such as disclosed in U.S. Patent Nos. 6,629,724; 6,840,576; 6869140; 6,976,734; 6,893,086; and 6,857,697 and U.S. Patent Publication 2002-0096931, hereby incorporated by reference. In general the diffuser will include a first surface, a second surface and a spacer structure therebetween. Desirably the diffuse is a bag that is sealed about some or all of its peripheral edges.

[0025] The air diffuser will include at least one layer, but preferably includes multiple (e.g. three) layers and each of the layers may be a monolayer or a plurality of layers (e.g. a laminate).

The plurality of layers need not be attached to each other but preferably are. The layers may be mechanically attached through sewing, brads or snap fit fasteners, although the use of at least some adhesive (e.g. a hot melt adhesive) is preferred. Infrared, radio frequency, ultrasonic or some other joining or welding techniques may be used as well.

[0026] When used, the adhesive may be provided as a web (e.g. a tape) or otherwise and may be continuous or non continuous (e.g., may be applied in drops (such as by a spray), dabs or the like). The adhesive may include polyamides, polyesters, elastomers, urethanes, olefin polymers, vinyls, vinyl acetate, (meth)acrylics, silicones, epoxies or a combination thereof. Moreover, the adhesives may be formulated as desired for particular processing parameters or conditions. Preferably, the adhesive is substantially free of anti-blocking solutions, blowing additives, process contaminants or the like which might interfere with adhesive performance. As an example, one suitable hot melt adhesive is commercially available as a non-woven web under the tradename SPUNFAB® from Spunfab, Ltd. 175 Muffin Lane, Cuyahoga Falls, OH 44223.

[0027] In the alternative to, or in combination with, mechanical attachments and adhesives, welding techniques may be used to attach one or more of the layers together, either by welding alone or with other attachment techniques (e.g. sewing and/or adhesive). Exemplary welding techniques include infrared, radio frequency and ultrasonic welding. These techniques may be applied in a continuous manner (e.g. to form a bead) or as spot welds.

[0028] The layers of the air diffuser may be attached to each other at least at their edges to form an edge-sealed bag. Alternately, the diffuser may be an open edged laminate, e.g. consistent with the teaching of U.S. Patent Nos. 6,869,139 and 6,857,697, hereby incorporated by reference. The layers of the diffuser are typically co-extensive, although partial layers that are not co-extensive with the other layers may also be suitable. For example it is possible that a plurality of blocks of spacer material may be carried on a common substrate.

[0029] In one embodiment, the open space of the diffuser is one or more plenums. An example of an air plenum may be found in U.S. Patent No. 6,786,541 to Haupt, hereby incorporated by reference.

[0030] In another embodiment, the open space of the diffuser is in a spacer material, with this second embodiment being preferred. In one embodiment, the air diffuser is located on the occupant side of the cushion and the diffuser should not completely collapse under the weight of a seat occupant, although some elastic compression is to be expected. In another embodiment, the air diffuser is located on the underside of the seat cushion. Here, a diffuser that is less sturdy may be used because it does not have to support the weight of the occupant.

[0031] The spacer material may be made of rubber, plastic, natural fibers, or the like, and combinations thereof. In one aspect, the spacer material may include a reticulated foam.

[0032] The spacer material may also include a plurality of members or fibers that are preferably spaced apart from each other to provide open space therebetween while still being close enough together to provide cushion and support. One preferred spacer is formed of polymeric (e.g., polyester) strand material that is interwoven to provide opposing honeycomb structures (e.g., fabric panels), which are interconnected by several additional polymeric strand materials to provide open space between the structures while still providing cushion and support. As an example, one preferred material is sold under the tradename 3MESH® and is commercially available from Müller Textil GmbH, Germany or Müller Textiles, Inc., Rhode Island, USA.

[0033] Another suitable spacer material is formed of a polymeric material in a helix held between two sheets of material. Preferably, the helix is oblong in order to provide increased area on the helix for attachment of the helix to the sheets of material, although round helices are also suitable. The helix may be tightly wound such that adjacent courses of the helix touch or loosely wound such that there is no touching of adjacent courses of the helix. Typically, multiple helices are placed adjacent (abutting or otherwise) to one another in order to form a spacer. Exemplary helical material is discussed in international applications PCT/DE04/000540 and PCT/DE04/000541, both files March 17, 2004, both of which are incorporated by references. The helical material may be used, alone or in combination with other materials, to provide relatively unobstructed flow paths within the air diffuser.

[0034] Another suitable spacer material is a grooved material that may be adapted for the present systems. The grooved material includes a plurality of hills and valleys, where the hills have through holes. The grooved material may include any suitable material such as a molded or shaped foam or plastic. The through holes may be made before, at the same time, or after the hills and valleys. Air flow to or from the spacer material is directed to the through holes, while the valleys provide passageways generally perpendicular to the through holes in which air may flow. This would increase the distribution of air (temperature conditioned or otherwise) through the diffuser, with the foam providing the need occupant support. See for example U.S. Patent Publication 20050067862, hereby incorporated by reference.

[0035] Another suitable spacer material may include the use of metal or plastic springs that are laid parallel to the occupant surface of the cushion.

[0036] Combinations of the above described materials may be used to afford the open space of the air diffuser. In one embodiment, multiple helices of material are placed adjacent to one another, with polymeric strand material used in the remainder of the diffuser. In another embodiment, different portions of the air diffuser include different spacer materials. For example, the blowing portion of the diffuser may include a foam (e.g. reticulated foam), while the drawing portions of the diffuser include the polymeric stand material.

[0037] While the spacer material of the diffuser is typically co-extensive with the occupant contact areas of the cushion, this is not necessarily the case and the spacer may cover only a portion of the occupant contact area of the cushion or hang over the edges of the cushion.

[0038] In addition to the air plenum or spacer material (or combinations thereof), one or more barrier layers may be used. The barrier layer is typically formed of a plastic or polymeric material that softens or melts upon exposure to heat to assist its adherence to one or more other layers of the diffuser. Alternatively, the barrier layer may be formed of fabrics, woven or non-woven textiles (e.g., Goretex® or microfibers), nylon, closed pore foam or other the like. Preferably, the barrier layer is at least partially impermeable to air, except at a plurality of ventilation holes and ports. The barrier layers may be placed above and below the spacer material and facilitate the direction of air flow through the spacer material; e.g. through the ports

to the ventilation holes or vice versa. In one embodiment, the barrier layers may be sealed to each other to form an edge sealed trim bag.

[0039] Dimensionally, for a barrier layer, it is preferable for the film thickness to be about 0.1 mm to about 2.0 mm thick and more preferably about 0.7 mm to about 1.0 mm thick. Of course, it is contemplated that the barrier layer may have a variable thickness and may be outside of the aforementioned ranges.

[0040] The ventilation holes of the barrier layer provide fluid communication between the diffuser (or sections of the diffuser) and the occupant and typically are found on the occupant side of the diffuser. The ventilation holes preferably vary in size to produce a gradient of air flow across the diffuser. Typically, the ventilation holes will be smaller near the ports in the diffuser as compared to the ventilation holes further from the ports; however, this is not necessarily the case. By creating a gradient of hole size, air flow through the diffuser at various locations may be selectively controlled; this also permits a generally even air flow across the diffuser no matter the distance from the port. In another preferred layout, the ventilation holes roughly correspond to the area of the seat where an occupant would make contact with the seat. For a diffuser found on the underside of the cushion, each ventilation hole in the diffuser has a one or more through channels located in the seat cushion to provide air flow to and from the occupant.

[0041] In another embodiment, the diffuser does not include ventilation holes, but rather the occupant side of the diffuser is open to the material above it, whether that is cushion, additional spacer materials (e.g. polymeric strand materials or reticulated foam), trim covers or the like. Thus, a barrier layer is omitted in favor of the spacer material, the trim cover or otherwise. For the underside embodiment, the diffuser may need to be sealed to the seat cushion to achieve adequate air flow between the diffuser and the occupant.

[0042] The air diffuser includes a plurality of ports that provide fluid communication between the temperature control system and the diffuser and typically are found along the sides of, on the underside of the diffuser or both. The first and second conduits attach to the diffuser via the ports and provide the fluid communication between the temperature conditioner and the diffuser.

[0043] The air diffuser may be divided into a plurality of sections. Each section may form an open space that is separated from the open spaces of the other sections. In one embodiment, each section may be physically separate from the other section such that each section is a diffuser of a smaller size than the overall diffuser. For example, two or three sealed edge diffusers may be used on the occupant surface of a cushion. Thus, effectively a single common substrate carries a plurality of edge sealed diffusers. Each of the trims bags includes ventilation holes and at least one port. In another embodiment, the open space of an air diffuser is divided to form sections. The division of the diffuser may include placing or forming air impermeable barriers between the sections. For example, as seen in Fig. 4, the diffuser 50 is divided into three sections 52, 54, and 56. Each section comprises a spacer material (not shown) with the sections separated from one another by barriers 58 and. In this embodiment, these barriers are formed by sealing together the barrier layers on top and bottom of the spacer material.

[0044] An optional layer for the diffuser includes a heater. Various different types of heaters are suitable for incorporation into a vehicle seat and it is contemplated that any of such heaters may be incorporated into the diffusers. Such heaters typically incorporate flexible, electrical heating elements that are preferably thin, flat, non-obtrusive or a combination thereof. As examples, a lay-wire heater, a carbon fiber heater, a printed heater (e.g. a positive thermal coefficient (PTC) heater), a thermoelectric heater or the like, which are typically supported with a backing (e.g., a cloth, a film or a fabric type substrate) may be used within or on the diffuser. In a preferred embodiment, the heater is a carbon fiber type heater with a backing (e.g., a non-woven layer). One exemplary preferred heater is sold under the tradename CARBOTEX® and commercially available from W.E.T. Automotive Systems, Inc. in Germany. An example of such a heater is disclosed in U.S. Patent 6,064,037, issued May 16, 2000, herein expressly incorporated by reference for all purposes. Other exemplary heaters include wires with individual insulated strands and those that include a heat activable adhesive on the wire, such as U.S. Patent Publication 2004-0094534 and related applications, hereby incorporated by reference. A combination heater/cooler in the form of a flexible sheet of TEDs may be a suitable optional layer. Flexible sheet TEDs include those discussed in U.S. Patent No. 6,700,052, which

is incorporated by reference. In another embodiment, the heater is not incorporated into the diffuser but is otherwise located between the diffuser and the trim cover. In one embodiment, the heater comprises an air impermeable substrate that includes ventilation holes. In this way, the heater replaces the use of a barrier layer.

[0045] The diffuser may be a separate unit that is assembled in a space between the cushion and the trim cover, integrally formed in the cushion, integrally formed in the trim cover, or any combination thereof. Preferably, the diffuser is attached to the cushion through the use of double sided tape, hook and loop fastener, adhesive, mechanical fasteners, welding, or any combination thereof.

[0046] The cushion includes a shaped foam bun that provides the primary support for the occupant of the vehicle seat as well as for the diffuser. The cushion may include valleys, open top channels, grooves, passageways, sub-passageways, conduits or the like, cut or formed in the foam. These channels, etc. may be used to accommodate other components of the system including the air diffuser, the first and second conduits, the temperature conditioner or the like. For example, the first and/or second conduits may be laid in the channels of the cushion. Moreover, these channels, etc. may operate as the first and/or second conduits or portions thereof. For example, a first conduit may connect to the underside of the cushion and a channel through the cushion connects to the air diffuser on the occupant side of the cushion, where together the through channel and conduit form portions of the first conduit to fluidly connect the air diffuser to the temperature conditioner.

[0047] In one embodiment, the foam of the cushion is treated over some or all of its surface to reduce the permeability of the foam to air or to create an air impermeable barrier, or otherwise help minimize air loss through the foam. In another embodiment, an air impermeable lining or conduit may be placed with a channel of the foam to achieve the needed flow characteristics of the foam and/or system.

[0048] The vehicle seat also preferably includes one or more trim covers that may be part of the diffuser or separate therefrom, but generally separate the diffuser from the seat occupant. The trim cover may be any suitable material, including but not limited to, at least one of a synthetic

material, a natural material (e.g., wool, leather or otherwise), or combination thereof. In one embodiment, the trim cover includes perforations over at least a portion of the seating surface through which air may pass. For example, perforated leather may be used to separate the seat occupant from the diffuser. The trim cover may also include an additional spacer material (e.g. reticulated foam). The additional spacer and the trim cover may have an area that is co-extensive with the diffuser or they may have areas that are greater or lesser than that of the diffuser.

[0049] In additional to the diffuser, the present invention also comprises a temperature conditioner. The temperature conditioner may include any temperature conditioning device that heats or cools air. The temperature conditioning device may be a combination of devices where one component provides heating and another component provides cooling. Preferably, one device or system provides both heating and cooling, such as an external device like the HVAC system of the vehicle. Alternately, an internal temperature conditioning device may be used, meaning that the device is separate from the HVAC system for vehicle where the seat is located. In addition to providing temperature conditioning the fluid conditioning device may also dehumidify air.

[0050] Preferably, the temperature conditioning device is a self contained and/or solid state device that both cools and heats air. The most preferred device is a peltier or thermoelectric device (TED). TEDs are devices that provide solid state heating and cooling by passing electricity through the device. TEDs include a waste side and an active side, which are relative designations depending upon whether warm or cool temperature conditioned air is desired. The TED may be combined with any useful heat dissipation device; e.g. heat sinks, heat exchangers, fans, heat pipes or the like.

[0051] In addition to TEDs, an absorption refrigeration system may also be used as the temperature conditioning device. Suitable absorption refrigeration system may be found in U.S. Patent application No. 11/232, 172, filed on September 21, 2005, hereby incorporated by reference. Such systems have the benefit of reducing the overall energy consumption of the ventilation system.

[0052] The temperature conditioner further comprises a blower to provide motive force to move air (whether conditioned, ambient, pushed, pulled and combinations thereof) through the air diffuser, as schematically shown in Figs. 1-3. The blower comprises one or more set of vanes, where the vanes may be fan blades or impellers, although impellers are preferred. In one embodiment, shown in Fig. 2 needs only a single impeller, while the embodiments shown in figs. 1 and 3 utilize two impellers. The vanes of each impeller in Fig. 1 are congruent to each other, such that they move air in the same direction. The vanes of each impeller in Fig. 3 are opposed to each, such that they move air in opposite directions. The dual impeller may be replaced with separate single impeller blowers. In one such embodiment, a single motor drives both of the impellers (shown in Fig. 5), while in other embodiments, each impeller uses its own motor. Of course, a single motor could also be used with multiple dual impeller blowers. In the embodiments the use them, dual impellers are preferred over separate single impellers because a packaging size with a smaller volume may be achieved. Separate single impellers with a single motor are preferred over separate single impellers with individual motors because fewer components are required and a smaller packaging size may be achieved.

[0053] The components of the temperature conditioner may be integrally formed into a single housing or may be contained in separate housings. In any case, the temperature conditioning device is downstream from the blower meaning that the blower moves air to temperature conditioning device typically through a connecting conduit, although the outlet of the blower may be substantially adjacent to the inlet of the temperature conditioning device. A connecting conduit is used to fluidly connect the blower to the temperature conditioning device. In one embodiment, the connecting conduit is a flexible conduit such that the two components may move in space independently of each other. In another embodiment a relatively rigid conduit and/or housing is used. For this embodiment, a pivot point may be incorporated into the connecting conduit, such as seen in Fig. 6 and discussed below. The pivot point permits the temperature conditioning device and the blower to move somewhat independently of each other. The ability to independently move eases the installation of the temperature conditioner, while also reducing noise during operation as fewer vibrations are transmitted between the components.

[0054] The conduits of the present invention provide fluid communication between the temperature conditioner and the diffuser. The conduits may take the form of any components with a hollow interior that has a sufficient cross section to move enough air to provide thermal comfort to the occupant.

[0055] In one embodiment, the conduits are hoses, tubes or bellows that connect to the ports on the diffuser. The conduits are typically flexible but sturdy enough to resist kinking during installation and operation. In another embodiment, channels etc. of the seat cushion may be used as portions of the conduit. In this embodiment with foam cushions, the foam may be treated to render it substantially impermeable to air.

[0056] The conduits may be threaded through or held within holes in other components of the vehicle seat such as the seat pan or cushion. Alternately, or in combination, the conduits may lay in channels or grooves of the seat cushion. In one embodiment, one conduit is at least partially threaded through a portion of the other conduit. Also, the conduits may extend into the open space of the diffuser so as to provide air flow to or from a location in the diffuser that is remote from where the conduit enters or exits the diffuser.

[0057] In one embodiment, the assemblies of the present invention comprise at least two conduits. The first conduit fluidly connects the air diffuser to an intake of the temperature conditioner, more preferably to an intake of the blower. The blower draws air through the first conduit and from the air diffuser. The second conduit fluidly connects the air diffuser to an exhaust of the temperature conditioner, more preferably to an exhaust of the temperature conditioning device (e.g. TED). The blower blows temperature conditioned air through the second conduit and to the air diffuser.

[0058] Several embodiments exist for making the connection between the various components of the present invention. Of particular concern is the ease of assembly of the components together and ease of installation into a vehicle. The installation needs to have a short cycle time, while also providing the installer with confidence that the installation (the particular step of the installation) is complete. Installation may be manually by a laborer, by a robotic device or both.

[0059] In one embodiment, shown in Figs. 7 and 8, a plug 70 is used to connect the diffuser 72 to the cushion 74. The plug is similar to a cork that is permanently or temporarily inserted into a socket. The plug, in turn, may also connect to additional conduits, the temperature conditioning assemblies, or the seat pan 76 of the seat. The diffuser 72 includes a nozzle 78 on its underside. The nozzle includes through holes 80 (e.g. 2 or more) that act as portions of the first and second conduits. In a diffuser that includes sections, each through hole preferably provides access to a separate section. A plug 72 is insertable in a complementarily shaped socket 82 in the underside 84 of the cushion 74. The nozzle 78 of the diffuser is then received in the plug 72 to attach the diffuser and plug together about the cushion. A snap fit, interference fit, friction fit, interlock mechanical fastener or any combination thereof is preferred to maintain the connection of the plug and nozzle. Adhesive may also be used on the nozzle or plug, but this is not preferred. Further, adhesive, double sided tape, hook and loop fastener may be used on the diffuser and/or cushion to keep the diffuser from moving after installation. The plug also comprises a connector 85 to attach additional lengths of conduit or the temperature conditioner to the plug, and thus to the rest of the system. The connector shown on the underside of the plug may be accepted through a hole or connector 87 in the seat pan 76 such that the seat pan separates the plug from the additional conduits or the temperature conditioner.

[0060] In another embodiment, the underside of the cushion contains the plug that is received in a socket attached to one or more of the conduits, as shown on the underside of cushion in Fig. 9.

[0061] The plug may be made of any suitable material. In one approach, the plug is one that approximates the rigidity of the surrounding cushion, so as not to be uncomfortable to the occupant. Exemplary materials include cork, plastic foam and the like. Preferably, the plug is sized and shaped to fit snuggly into the hole of the cushion such that additional adhesive is not required. For example, the plug may be conical such that the perimeter of the occupant side is smaller than the underside. The plug may include flat surfaces, although a round or oval shape is preferred. Alternately, snap fit fasteners may be used to secure the plug to the cushion and/or the seat pan.

[0062] Although typically only a single plug will be used per seat, multiple plugs are contemplated, especially for systems the include two through holes in the seat pan. More over, plugs may be used with any type of diffuser or insert used in a ventilated seat.

[0063] In another embodiment, as shown in Fig. 10, for connecting the cushion to the seat pan, a connector 90 is attached to a membrane 92 that is slidable held within a slot 94 of the cushion 96 that has portions of conduits through the cushion. The slot traverses from the underside to the occupant side of the cushion. In one embodiment, the conduit is not completely formed by the material of the cushion; rather the membrane may be used as a portion of the wall to separate one conduit from another. Use of the membrane in the slot or as part of conduit wall is advantageous because the membrane increases the air impermeability of the cushion, thus decreases the amount of cross flow between the conduits. During installation, a snap fit fastener attaches the connector to the seat pan. Next, the installer pulls on the membrane or pushes on the cushion to force the seat to contact the connector at its underside. Attaching the membrane to the top surface of the cushion will help insure a tight connection between the cushion and the connector. The air diffuser may then be placed on the occupant surface of the cushion and the temperature condition system attached under the seat pan.

[0064] In another embodiment, a shown in Fig. 11, a tether is used to install a conduit into another conduit of the seat. By pulling on the tether, the installer can cinch down the diffuser onto the cushion and/or seat pan, while also creating the necessary connections amount the conduits and the temperature conditioner. A diffuser 100 with three sections 102, 104, 106 is placed on top of a cushion 108 having a through hole 110 and a groove 112. In this embodiment, the through hole 110 acts as a conduit to draw air from the diffuser. In the groove lies a branched conduit 114 to blow air to the diffuser. The designation of the conduits is relative in that air could be blown to the diffuser by way of through hole and drawn through the conduit in the groove. In one embodiment, the temperature conditioner may be located under the cushion and seat pan and may include a manifold 116 (or other chamber) that houses both conduits so that only a single passageway in the cushion and seat pan is needed. The manifold includes a top conduit 118 and a bottom conduit 120 separated by a wall 122. This is also shown in Fig. 12.

[0065] By way of example, the tether may be an extended flexible length of material that permits the installer to pull on the branched conduit from the underside of the cushion and seat pan. The tether 124 is threaded through a first aperture 126 in the wall 122 between the conduits of the manifold and through a second aperture 128 in an outside wall 120 of the bottom conduit. The branched conduit creates a relatively air tight seal with the wall around the first aperture to separate the top and bottom conduits from each other. The branched conduit also creates a relatively air tight seal with the wall around the second aperture for avoiding leakage from the bottom conduit. The branched conduit includes one or more openings 130 in the flow path of the bottom conduit. In this way, the branched conduit provides fluid communication between the bottom conduit and the air diffuser.

[0066] In one specific embodiment, the tether may optionally include a stop (e.g. a section of increased thickness or a section of increased frictional resistance) to prevent the installer from over pulling on the branched conduit. The stop may also prevent the branched conduit from backing out of the apertures, thus insuring that the openings remain in the bottom conduit. The tether also comprises an indicator that alerts the installer that the tether and/or branched conduit are properly installed. In one embodiment, the stop and the indicator on the tether are one and the same; alternatively, separate structures are used for the stop and the indicator.

[0067] As seen in Fig. 12-17, the stop may include a wedge 132 that lodges in the second aperture in combination with a locking device, where the locking device prevents the conduit from backing out of the apertures. The locking device may take on any suitable shape such as a wedge 134 beneath the wall of the bottom conduit (seen in Figs. 12 and 13), fingers 136 beneath the wall of the bottom conduit (seen in Fig. 14), or snap fit features 138 connecting to the wall between the top and bottom conduits (seen in Fig. 15). The indicator may be a color change 140 or a shoulder 142 that is visual from the underside of the manifold, as seen in Figs. 16 and 15 respectively, or the locking device itself, as seen in Figs. 11-13. After installation, the tether beneath the locking device or indicator may be cut, broken off or otherwise detachable. In one embodiment, the tether is designed to detach after a certain load is applied to the tether; such as the tether breaking or a magnetic detaching for a metal piece. Alternately, the tether may be

released from a loop at the end of the installed conduit (as seen in Fig. 17). Subsequent disassembly (if necessary) is easily carried out by cutting off the locking device (as seen, e.g. in Fig. 14).

[0068] Although discussed in the context of a branched conduit, the tether may also be used with an un-branched conduit.

[0069] One embodiment of the present invention is shown in Fig. 4. The vehicle seat 150 comprises an air diffuser 50 divided into three sections 52, 54, and 56. Each of the section of the diffuser includes a plurality of ventilation holes 152. The diffuser is supported by a cushion 154 made of a shaped foam. The cushion is supported by a seat pan 156, with the temperature conditioner 158 located under the seat pan. The temperature conditioner comprises a blower (not shown) and a TED (not shown).

[0070] A first conduit 160 attaches to the underside of the middle section 54 of the diffuser. In this embodiment, the first conduit is generally oval in shape and held within the cushion foam. An inlet 162 to the blower draws air from the diffuser, as shown by the arrows. The second conduit 164 attaches to an exhaust of the TED and to the underside of the diffuser. The second conduit branches to provide connection points 168 to the two remaining sections 52 and 56 of the diffuser. A portion 170 of the second conduit is accommodated within the first conduit 160 and a portion 172 is accommodated within grooves 174 in the cushion.

[0071] In this embodiment, only a single through hole in the cushion is needed as both conduits traverse the cushion in the same locale, meaning that a tether connection would be well suited for use in combination with this embodiment. Furthermore, the use of the plug to connect the conduits to temperature conditioner may also be utilized. Moreover, this embodiment is general in that this layout of components may be used with any of the three schemes illustrated in Figs. 1-3.

[0072] As seen in this embodiment, the portion 170 of the second conduit held within the first conduit has a portion with an arcuate shape (e.g. an S-shape or a C-shape) which decreases the chances of the second conduit collapsing under the weight of the occupant because it may flex under weight. In addition, the location of the inlet 162 and the location where the second

conduit attaches to the temperature conditioner may be switched such that the inlet is behind the conduit connection point. Further bellows or a corrugated portion may be included over some or all of the length of the conduits.

[0073] Several gaskets 176 may be utilized to help create relatively air impermeable connections between the conduits and the diffuser, between the conduits and the temperature conditioner, or the like. Moreover, flanges may be used on the conduits and connectors to help create relatively air tight connections between the diffuser and the plug, the diffuser and the conduits, the seat cushion and the underside conduits and the like.

[0074] Another embodiment of the present invention is shown in Fig. 6. The vehicle seat comprises an air diffuser mounted on the occupant side of a cushion. Both the diffuser and the cushion are not shown in the drawing in order to provide a clearer view of the temperature conditioner 180. A blower, and more specifically, a dual impeller blower 182 is mounted under or within the cushion and optionally to a seat pan, seat frame 184, lumbar guide wire, or the like. One impeller of the blower draws air from the diffuser through a bellows 186 that serves as the first conduit and exhausts the air stream through an outlet 188. The other impeller of the blower draws air through an air intake 190 on its underside. This air stream goes to the TED 191, where it is split. One portion of the air stream crosses the active side of the TED and is directed through a bellows 192, which acts as the second conduit. The other portion of the air stream cross the waste side of the TED and is exhausted through an outlet 194. The TED component of the temperature conditioner may be supported by a support wire 196. This embodiment is well suited for use in the backrest of the vehicle seat where the second conduit is located relatively higher up on the backrest than the first conduit because the support wire can assist in stabilizing the temperature conditioner without the need for a seat pan.

[0075] This embodiment also utilizes a TED 191 that is pivotally connected to the blower 182 at a pivot point 198. The pivot point flexes and provides for independent movement between the two components of the temperature conditioner so that fluid communication can be maintained between the components. The pivot point may be a ball-and-socket joint that offers a full range of motion. In addition, the pivot point may provide a location where the components

may be connected during installation of the system, thus reducing the complexity of the installation.

[0076] In addition to the components discussed above, the present invention may be used in combination with a variety of other components such as sensors and control units. A variety of sensors may be included in the system such as temperature sensors, humidity sensors, current sensors, occupant detection sensors, weight sensors or the like. Sensors may be placed throughout the system. For example, temperature sensors may be place within the diffuser, between the diffuse and the trim cover, within the conduits, within the temperature conditioner, and combinations thereof.

[0077] One or more control units may be used to receive inputs from the sensors or a user control device, to issue instructions to the temperature conditioner, and/or to otherwise coordinate the operation of the system.

[0078] The control unit may effect automatic operation of the system based on sensor inputs. For example, the system may automatically turn on (e.g. heat, cool or both) when an occupant sits in the seat. Automatic operation may also take place when the vehicle is started and the ambient temperature inside or outside the vehicle is at a certain threshold; e.g. heating turns on when a cold temperature is sensed.

[0079] Manual operation of the system is also contemplated where the occupant selected the desired temperature and amount of air provided to the diffuser or drawn from the diffuser. Moreover, a blend of manual and automatic control is also contemplated. For example, the occupant selects a temperature and the control unit issues the instruction to reach the selected temperature and also subsequent instructions needed to maintain the selected temperature, such as through cycling the operation of the temperature conditioner, the blower, the heater layer, and combinations thereof.

[0080] In one embodiment, a system includes a temperature sensor below the trim cover and in signaling communication with the control unit. Advantageously, the control unit is programmed to instruct the system to provide less heat and even cooling in situations where the sensor senses a temperature above one or more predetermined threshold levels. In operation, the

control unit may be programmed to instruct the system to provide less cooling or even heating when the sensor senses a temperature below one or more predetermined threshold levels. In a preferred operation mode, when the blower is drawing air from the diffuser or blowing cool air to the diffuser, the control unit is programmed to instruct a heater layer to turn on and provide heat while the blower remains on if a first undesirably low predetermined temperature is sensed by the sensor. Then, if a second predetermined temperature is sensed below the first predetermined temperature, the control unit instructs the blower to turn off while the heater layer continues to provide heat. For each of these situations, the heater layer will typically be instructed by the control unit to continue to provide heat until the temperature sensed by the sensor is at or above the first predetermined temperature and may provide heat until a third predetermined temperature above the first predetermined temperature is sensed.

[0081] In another preferred operation mode, when the heater layer is providing heat, the control unit is programmed to instruct the blower to turn on and draw or blow air (temperature conditioned air or otherwise) while the heater layer remains on if a first undesirably high predetermined temperature is sensed by the sensor. Then, if a second predetermined temperature is sensed above the first predetermined temperature, the control unit is programmed to instruct the heater layer to turn off while the blower continues to draw or blow air. For each of these situations, the blower will typically be instructed by the control unit to continue to draw or blow air until the temperature sensed by the sensor is at or below the first predetermined temperature and may blow air until a third predetermined temperature below the first predetermined temperature is sensed.

[0082] In an embodiment where both the seat and backrest of the seat are temperature controlled or ventilated, the control unit is preferably programmed to control operation of the two systems independently of each other such that one could be providing heat while the other could be providing ventilation or cooling. Of course synchronous operation of the two systems is also useful as is independent operation where both heating and cooling happening at the same time in the same portion of the seat. For example, the heater layer may operate while the TED is providing cooled air to the diffuser.

[0083] Moreover, one or more valves may be used to redirect air flow through the system to make use of unused energy (i.e. the air is hotter than ambient) or energy capacity (i.e. the air is colder than ambient) in the fluid. For example, the valves may be used to vent air to ambient to dispose of un-needed energy stored in the air. The valves may also be used to redirect fluid to components of the system (e.g. the temperature conditioning device) to either warm or cool such components. In addition, a valve may be used to optionally recirculate air within system to create a closed or partially closed system. The use of a valve in the conduit from the diffuser may improve the TED efficiency by diluting the drawn warm air from a diffuser with colder ambient air. Moreover, such a valve would provide continuous exhausting of the waste side of the TED if the airflow from the diffuser is obstructed. Operation of the valves may be controlled by the control unit to accomplish the desired air flow patterns discussed above.

[0084] Moreover, the system may include one or more vents that direct the exhaust air streams from the temperature conditioner. These vents may be controlled by the control unit or manual operable so that the occupant can select where the air stream is directed.

[0085] The attachment component is a frame member that preferably defines a location for the attachment of the fan, fluid conditioning device, a conduit or other component to the diffuser. It is contemplated that the frame member may be in a variety of configurations (e.g., annular, rectangular, square, polygonal or otherwise) and may be formed of a variety of preferably rigid or semi-rigid materials (e.g. metal, plastic or the like). In some aspects, the attachment component also helps define a port. In one preferred embodiment, the attachment component cooperates with structures and/or materials (e.g. snap fit fasteners) on the fan, the fluid conditioning device or other components to connect the device or component to the attachment component.

[0086] In combination with the above disclosed embodiments, the temperature conditioner, conduits, or various other components and subcomponents, may be permanently or removably mounted or affixed to the seat frame, seat pan or to a back rest portion (e.g. a lumbar assembly) of the seat for movement in tandem with the seat or one of its components. The temperature conditioner may be associated with an underlying seat structure, such as a seat track along which the seat may be translated from a first position to a second position. Alternately, the temperature

conditioner may be mounted or affixed to other components, assemblies, and fixtures of the seat, such as the seat cushion, diffuser, seat cover or the like. The temperature conditioner may also be remotely located relative to the seat. Any suitable fastening or mounting mechanisms or devices (e.g. adhesive, snap-fit mechanical fasteners, etc.) may be used to attach the components of the temperature conditioner together or temperature conditioner to the surrounding structures.

[0087] The present invention also relates to the methods of providing heating, cooling, ventilation or combination thereof. The method includes drawing air from the air diffuser and blowing temperature conditioned air to the air diffuser. In one embodiment, the steps include operating a dual impeller blower where the vanes of the impellers are congruent. The drawing step further includes passing the air drawn by one impeller to the temperature conditioning device, thus potentially dissipating excess energy or heat; such as passing the air across the waste side of the TED and exhausting the drawn air. The blowing step further includes temperature conditioning ambient air passed to the device by the other impeller of the blower; such as by passing ambient air across the active side of the TED and blowing the temperature conditioned air to the air diffuser. In this embodiment, the drawing step may include drawing ambient air through a valve in a conduit from the diffuser to the blower.

[0088] In another embodiment, the drawing and blowing steps include operating a single impeller blower. The drawing step includes passing the air drawn from the diffuser to the temperature conditioning device. At the temperature conditioning device, the method includes both dissipating excess heat of the temperature conditioning device and temperature conditioning the air. In one example, the dissipating step includes passing the air across the waste side of the TED and the temperature conditioning step includes passing the air across the active side of the TED. Further, the method includes exhausting the dissipating air and blowing the temperature conditioned air to the diffuser, respectively. In this embodiment, the drawing step may include drawing ambient air through a valve in a conduit from the diffuser to the blower.

[0089] In another embodiment, the drawing and blowing steps include operating a dual impeller blower where the vanes of the impeller are opposed. The drawing step includes exhausting the drawn air without passing the air to the temperature conditioning device. The

blowing step includes passing ambient air to the temperature conditioning device and both dissipating excess energy of the temperature conditioning device and temperature conditioning the passed air. Further, the method includes exhausting the dissipating air and blowing the temperature conditioned air to the diffuser, respectively.

[0090] In the method, the drawing and blowing steps may include passing air to the same or different sections of the diffuser.

[0091] In a preferred embodiment, the present invention provides cooling from above about 80°C. Also, the present invention provides cooling to below about 37°C, and more preferably to below about 27°C, and most preferably below about 25°C. These temperatures may refer to air temperature within the diffuser, anywhere within the system or the temperature at or near the seat surface. In one preferred embodiment, the present invention provides an initial burst of cooling to provide an immediate sensation to the occupant of cooling. The initial burst preferably is at a rate of greater than about 5°C/min, greater than about 10°C/min, greater than about 15°C/min and greater than about 20°C/min, greater than about 25°C/min and greater than about 35°C/min before stabilizing at a minimum temperature.

[0092] In another embodiment, the method includes mixing with ambient air the air that is being drawn from the diffuser. By mixing drawn air with ambient air, the temperature of the air may be reduced. The mixed air stream then would have a higher heat capacity compared to the air just drawn from the diffuser. The mixed air can then be used across the waste side of the TED to dissipate any heat generated there. The mixing of ambient air with drawn air is particularly useful for the schemes shown in Figs. 1 and 2 where drawn air is provided to the waste side of the TED.

[0093] The present invention also includes methods of manufacturing vehicle seats. One method includes connecting an air diffuser to a temperature conditioning device by inserting a nozzle on the underside of the diffuser into the occupant side of a plug lodged in a through hole of a cushion. And further including connecting a connector on the underside of the plug to one or more conduits leading to a temperature conditioning device. In this way, a plurality of conduits may be connected to the diffuser through one hole in the cushion and/or seat pan.

[0094] Another method includes attaching a conduit to the underside of the diffuser. Next, the method includes placing the conduit, which includes a tether in a passageway in a cushion and a hole of the seat pan (if present). Threading the tether and conduit into a manifold of the temperature conditioning device fluidly connects the temperature conditioning device to the diffuser. Preferably, the method includes pulling on the tether until a visual or other indicator signals that the conduit is properly placed. The method also preferably includes locking the conduit into place to prevent the conduit from backing out of the manifold through the use of a locking device on the conduit or on the tether. The method may further include sealing the conduit to one or more walls of the manifold to reduce air leakage from one conduit to the other and/or to reduce leakage from the manifold to the ambient. In this way, a plurality of conduits may be connected to the diffuser through one hole in the cushion and/or seat pan.

[0095] Another method includes pulling on a membrane attached to a connector or plug, where the membrane is slidably held within a slot in the cushion. The pulling forces the connector or plug against the underside of the cushion thus seating the connector or plug. Before, during or after the pulling, a conduit from the temperature conditioning device may be attached to the connector or plug.

[0096] Another method includes attaching a blowing conduit and a drawing conduit to the underside the diffuser through the use of bellows that are separate from one another.

[0097] Each of the manufacturing methods may further include attaching the conduits to the diffuser, diffuser to the trim cover, diffuser to the cushion, the cushion to the seat pan, the conduits to the temperature conditioning device and/or the temperature conditioning device to the cushion, seat pan, the seat frame or the like. Suitable techniques include sewing, adhesives, double sided tapes, hook and loop fasteners, snap fit fasteners, locating pins or the like, and combinations thereof. For example, the diffuser may be secured (e.g., sewn, adhered or otherwise attached) to a portion of the seat such as the trim cover (e.g., a perforated leather cover) or to a cushion (e.g., foam) of the seat. In one embodiment, the diffuser is first secured to the trim cover and then the trim/diffuser combination is secured to the seat. In another embodiment, trim cover may be configured to include a pocket into which the diffuser is inserted. Alternatively, it is

contemplated that hook and loop fasteners may be utilized to attach the diffuser to other portions (e.g., the cover, frame, or cushion) of the seat. Other techniques may be used to assemble the diffuser to the seat such as sewing, adhesives, snap-fit fasteners or locating pins.

[0098] Generally, for forming the diffuser, it is contemplated that the various layers of the diffuser as described above may be combined in a variety of sequences and according to a variety of protocols and techniques. Thus, the order in which the various layers and sub-layers are combined and the techniques of combining should not in any way limit the present invention unless such order or techniques is specifically claimed. Moreover, it is also contemplated that there may be greater or fewer layers and that each layer may include greater or fewer sub-layers.

[0099] In general, a lamination process is preferred to assemble two or more of the layers of the diffuser. U.S. patent application no. 10/434,890, filed on May 9, 2003 now U.S. Patent No. 6,893,086, hereby incorporated by reference, includes a discussion of one suitable technique for assembling the layers of diffusers according to the present invention. Moreover, techniques that include welding are particularly preferred.

[00100] Preferably, the system s of the present invention may be included in a seat used in a transportation vehicle (e.g. an automotive vehicle seat); however, the system may be used in a variety of other seats such as desk chairs, lounge chairs, or the like. Other suitable transportation vehicles include class 1 to 8 automotive vehicles, trains, marine vehicles (e.g. pleasure boats), submarine vehicles, subterranean vehicles, fixed wing and rotary wing aircraft, and/or military vehicles of any sort. The system may be used in seats for operators (e.g. pilots), other crew members, or for passengers.

[00101] The embodiments of the diffusers and systems discussed below utilize air as the temperature conditioned fluid communicated through the diffuser and/or system. It should be understood, however, that other gases and/or liquids may also be utilized in these embodiments. Further, filtering and/or purifying devices may also be used to provide air or fluid to the system or system components.

[00102] While most of the embodiments discussed herein illustrate the use of the TED to provide cooled air to the diffuser, it should be understood that using the TED or other temperature conditioner to provide warmed air to the diffuser or seat.

[00103] It will be further appreciated that functions or structures of a plurality of components or steps may be combined into a single component or step, or the functions or structures of one-step or component may be split among plural steps or components. Unless stated otherwise, dimensions and geometries of the various embodiments depicted herein are not intended to be restrictive of the invention, and other dimensions or geometries are possible. In addition, while a feature of the present invention may have been described in the context of only one of the illustrated embodiments, such feature may be combined with one or more other features of other embodiments, for any given application. It will also be appreciated from the above that the fabrication of the unique structures herein and the operation thereof also constitute methods in accordance with the present invention. The present invention also encompasses intermediate and end products resulting from the practice of the methods herein. The use of "comprising" or "including" also contemplates embodiments that "consist essentially of" or "consist of" the recited feature.

[00104] Reference herein to "first" and "second" are not intended as limiting to combinations that consist of only first and second items. Where so-referenced, it is possible that the subject matter of the present invention may suitably incorporate third, fourth or more items. Further, reference to "(meth)acrylate" refers to either or both of acrylate and methacrylate. Moreover, the disclosure of "a" or "one" element or step is not intended to foreclose additional elements or steps. Use of the term "about" or "approximately" in advance of a range denotes that both the upper and lower end and not intended as being bound by the amount recited in the range (e.g., "about 1 to 3" is intended to include "about 1 to about 3"). Unless otherwise stated, or as dictated otherwise by the context of usage, references to "mixtures" or "combinations" of polymers contemplates alloys, blends or even co-polymers of such polymers. "Comprising", "having", and "including" and their word forms also contemplate the more restrictive terms "consisting of" and "consisting essentially of".

[00105] It is understood that the above description is intended to be illustrative and not restrictive. Many embodiments as well as many applications besides the examples provided will be apparent to those of skill in the art upon reading the above description. The scope of the invention should, therefore, be determined not with reference to the above description, but should instead be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes. The omission in the following claims of any aspect of subject matter that is disclosed herein is not a disclaimer of such subject matter, nor should it be regarded that the inventors did not consider such subject matter to be part of the disclosed inventive subject matter.

What is claimed is:

1. A method of controlling the temperature of a vehicle seat, comprising:

drawing air from an diffuser in a vehicle seat through at least one first conduit;

blowing air to the diffuser through at least one second conduit, where the blown air has been temperature conditioned by a thermoelectric device (TED).

2. The method of any preceding claim further comprising drawing air through a trim cover into the diffuser.

3. The method of any preceding claim further comprising blowing air through the trim cover to an occupant.

4. The method of any preceding claim further comprising blowing air from the active side of the TED to the diffuser.

5. The method of any preceding claim further comprising blowing cooled air to the diffuser.

6. The method of any preceding claim wherein the drawing step includes drawing air from the diffuser and from an ambient air inlet.

7. The method of any preceding claim wherein the ambient air inlet is located in the at least one first duct leading from the diffuser.

8. The method of any preceding claim wherein the ambient air inlet is located in a housing of the blower.

9. The method of any preceding claim wherein the blowing step includes exhausting air across an active side and a waste side of the TED.

10. The method of any preceding claim wherein the blowing step includes exhausting air across the waste side of the TED and through an exhaust outlet in the blower housing.

11. The method of any preceding claim wherein the blowing and drawing steps include actuating a single impeller of a blower.

12. The method of any of claims 1-10 wherein the blowing and drawing steps include actuating at least two impellers for blowing air in generally the same direction.

13. The method of any of claims 1-10 wherein the blowing and drawing steps include actuating at least two impellers for blowing air in generally different directions.

14. The method of any preceding claim further comprising providing an air diffuser that comprises an open edge diffuser having a spacer material and a top surface with a plurality of ventilation holes.

15. The method of any preceding claim further comprising providing an air diffuser that comprises a sealed edge diffuser having a spacer material and a top surface with a plurality of ventilation holes.

16. The method of any preceding claim wherein the steps of drawing and blowing include drawing air through a section that is not fluidly connected with a section into which air is blown.

17. The method of any preceding claim comprising drawing air from at least one section fluidly connected to the at least one first conduit and blowing air to at least one section fluidly connected to the at least one second conduit.

18. The method of any preceding claim wherein the blowing step or the drawing step further comprises moving the air through a conduit comprising at least one branch point.

19. The method of any preceding claim further comprising locating an electrical heating element in the diffuser, and applying an electrical signal to the element

20. A seat ventilator, comprising:

an air diffuser comprising a spacer material and an occupant side have a plurality of ventilation holes;

a temperature conditioner comprising a temperature conditioning device and a blower;

a first duct fluidly connected to the diffuser and an inlet of the blower;

a second duct fluidly connected to the diffuser and an outlet of the temperature conditioning device;

wherein the blower moves air for its inlet to the temperature conditioning device and then from the outlet of the temperature conditioning device to the diffuser.

21. The seat ventilator of claim 20 wherein the second duct branches at least one location to provide at least two sub-ducts connected to the diffuser.

22. The seat ventilator of any of the preceding claims 20 or 21 further comprising a seat cushion having channels defined therein into which the sub-ducts are received.

23. the seat ventilator of any of the preceding claims 20-22 wherein the temperature conditioning device is a thermoelectric device (TED).

24. The seat ventilator of any of the preceding claims 20-23 wherein at least a portion of the second duct is held within the first duct.

25. The seat ventilator of any of the preceding claims 20-24 wherein the second duct, at a location between the outlet of the temperature conditioning device and a first branch point, comprises a flexible section.

26. The seat ventilator of any of the preceding claims 20-25 wherein the first and second ducts each comprise a bellows.

27. The seat ventilator of any of the preceding claims 20-26 wherein the blower and the TED are pivotally connected with each other

28. The seat ventilator of any of the preceding claims 20-27 wherein the ducting between located between the blower and the TED is flexible.

29. The seat ventilator of any of the preceding claims 20-28 wherein the temperature conditioning device is located beneath a seat pan of the seat.

30. The seat ventilator of any of the preceding claims 20-29 wherein the temperature conditioning device is connected to the seat pan through a snap fit connection.

31. The seat ventilator of any of the preceding claims 20-30 wherein the seat pan comprises a single hole through which both the first and second conduits of the seat pass through the seat pan.

32. The seat ventilator of any of the preceding claims 20-31 wherein the seat pan comprises a plurality of holes through which the first and second conduits pass through the seat pan.

33. The seat ventilator of any of the preceding claims 20-32 wherein the blower comprises a single impeller on a single shaft.

34. The seat ventilator of any of the preceding claims 20-33 wherein the blower comprises a dual impeller on a single shaft.

35. The seat ventilator of any of the preceding claims 20-34 wherein the first or second duct comprises a tether.

36. The seat ventilator of any of the preceding claims 20-35 wherein the tether comprises a stop to prevent over installation of the conduit.

37. The seat ventilator of any of the preceding claims 20-36 wherein the tether comprises a visual indicator visual from the underside of the cushion or seat pan to indicate proper installation of the first or second ducts.

38. The seat ventilator of any of the preceding claims 20-37 wherein the tether comprises a locking device.

39. The seat ventilator of any of the preceding claims 20-38 wherein the seat pan comprises an aperture to which a manifold of the temperature conditioning device is attached.

40. The seat ventilator of any of the preceding claims 20-39 wherein the tether is threaded through an aperture in the wall separating a top conduit and a bottom conduit of the manifold and threaded through an outside wall of the bottom conduit.

41. The seat ventilator of any of the preceding claims 20-40 wherein the duct with the tether comprises one or more opening located in the bottom conduit of the manifold after the conduit is installed.

42. The seat ventilator of any of the preceding claims 20-34 further comprising a plug attached to the underside of the diffuser.

43. The seat ventilator of any of the preceding claims 20-34 or 42 wherein the plug is lodged in a through hole in the cushion to attach the diffuser about the cushion.

44. The seat ventilator of any of the preceding claims 20-34, 42 or 43 wherein the plug comprises a foam of similar density of foam in the seat cushion.

45. The seat ventilator of any of the preceding claims 20-34 or 42-44 wherein the plug comprises at least one through hole which forms at least a portion of one or more of the first or second conduits.

46. The seat ventilator of any of the preceding claims 20-34 or 42-45 wherein the plug comprises a single through hole which forms a portion of one conduit, wherein another conduit is received within the one conduit

47. The seat ventilator of any of the preceding claims 20-34 or 42-46 wherein the plug comprises two through holes, each of which forms a portion of the first and second conduits.

48. The seat ventilator of any of the preceding claims 20-34 or 42-47 wherein the plug comprises three through holes, two of which form a portion of the first or second conduits and the remaining through hole comprises a portion of the other conduit.

49. The seat ventilator of any of the preceding claims 20-34 or 42-48 wherein the plug comprises a plug attachment device to connect the plug to the seat pan, the seat cushion, a conduit or combination thereof.

50. The seat ventilator of any of the preceding claims 20-34 further comprising a connector attached to a membrane, wherein the membrane is slidably received in a slot of the cushion.

51. The seat ventilator of any of the preceding claims 20-34 or 50 wherein the membrane is accessible from an occupant side of the cushion.

52. The seat ventilator of any of the preceding claims 20-51 wherein the diffuser further comprises a heating element.

53. The seat ventilator of any of the preceding claims 20-52 wherein the heating element comprises a wire heating element.

54. The seat ventilator of any of the preceding claims 20-53 wherein the heating element comprises a printed heating element such as a positive temperature coefficient heating element.

55. The seat ventilator of any of the preceding claims 20-54 wherein the diffuser comprises a multi-laminate wherein the layers are attached by adhesive.

56. The seat ventilator of any of the preceding claims 20-55 wherein the diffuser comprises a multi-laminate wherein the layers are attached by welding, such as infrared, radio frequency, and/or ultrasonic welding.

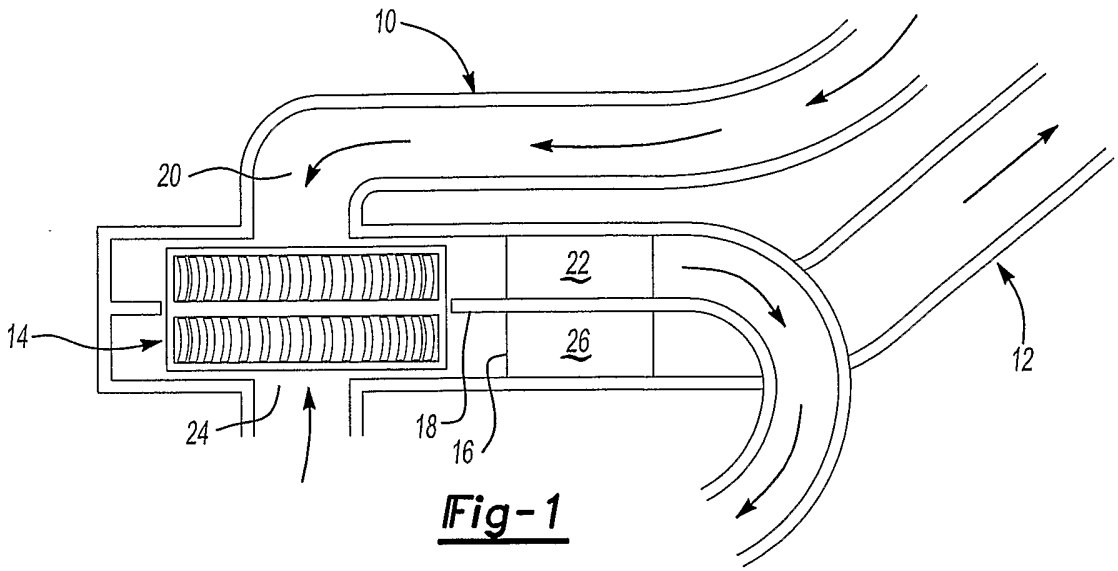


Fig-1

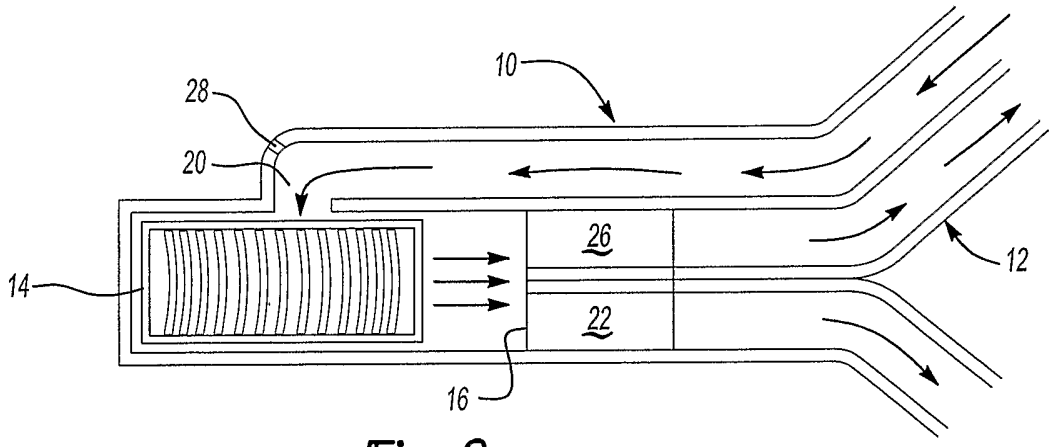


Fig-2

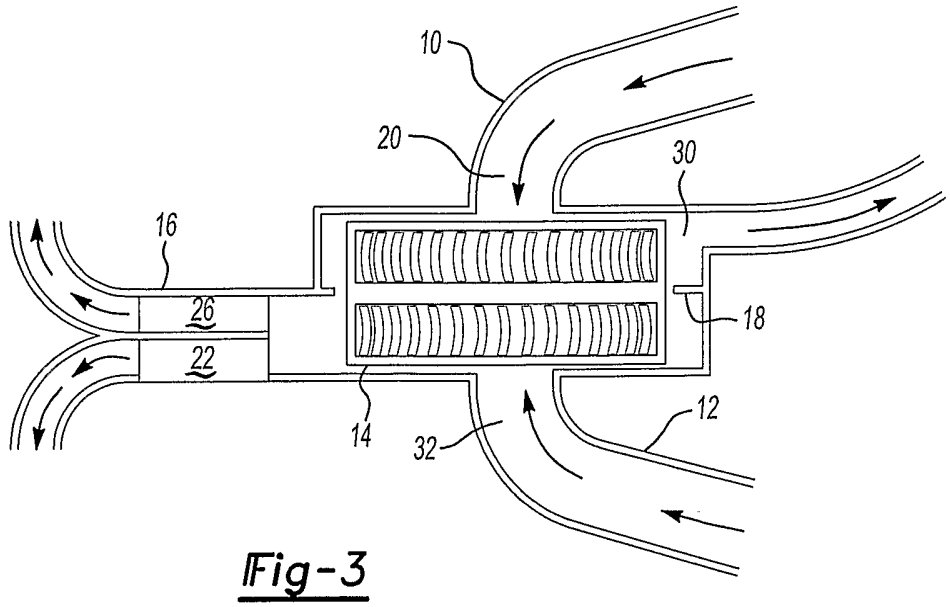


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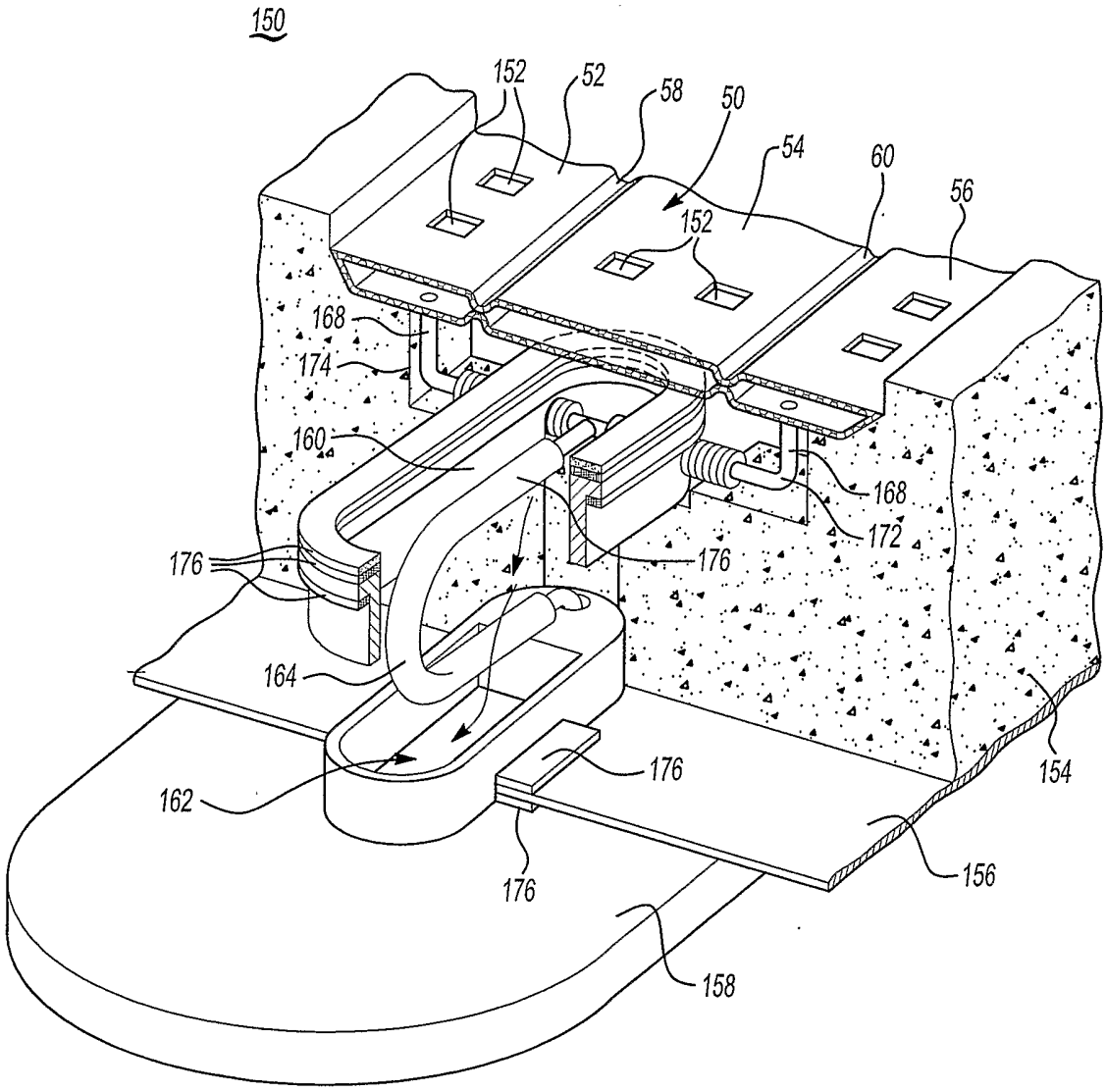

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Fig-4

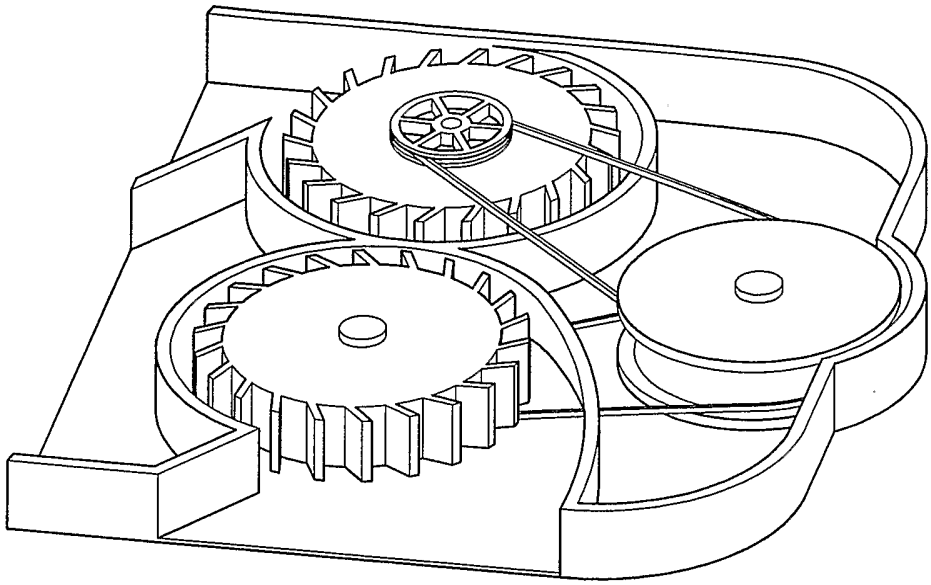


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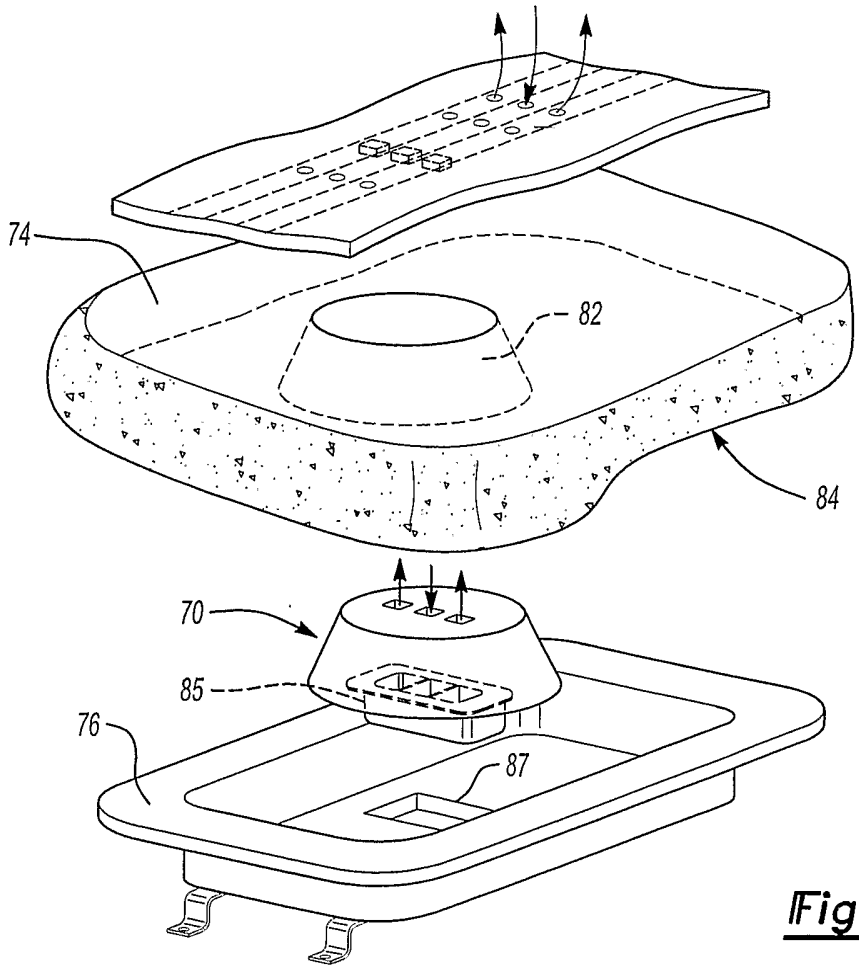


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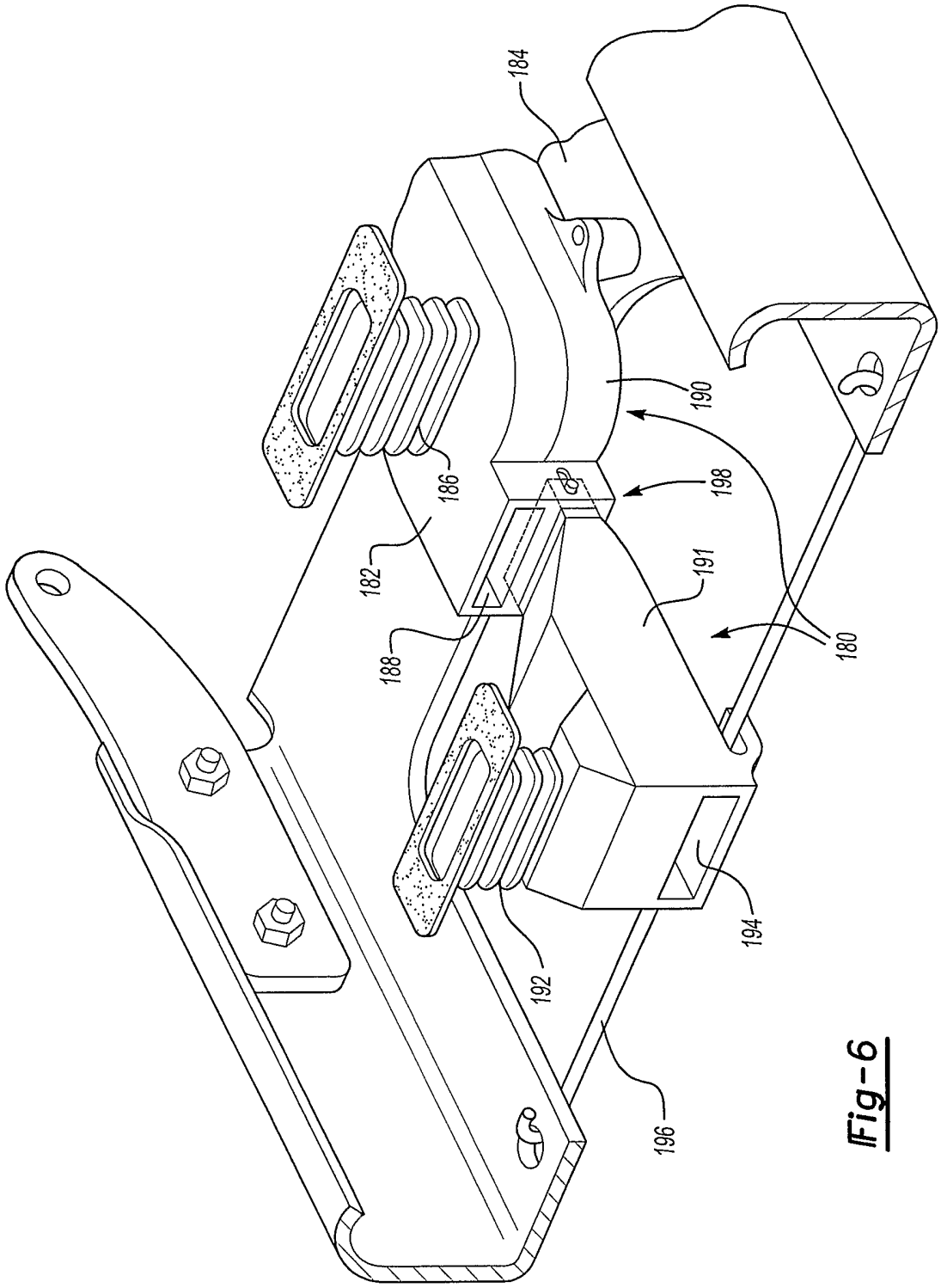


Fig-6

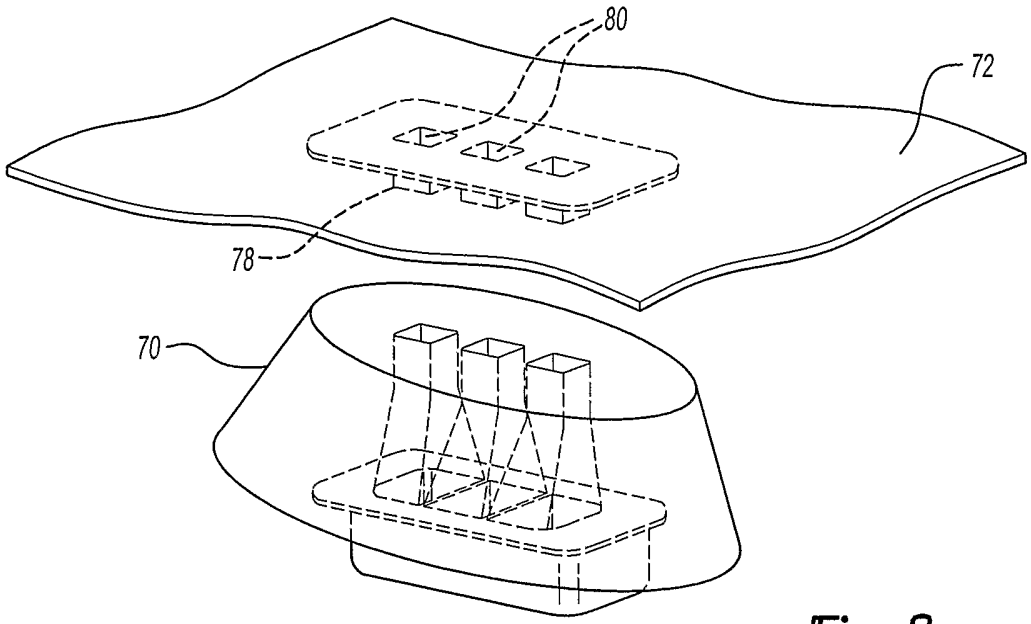


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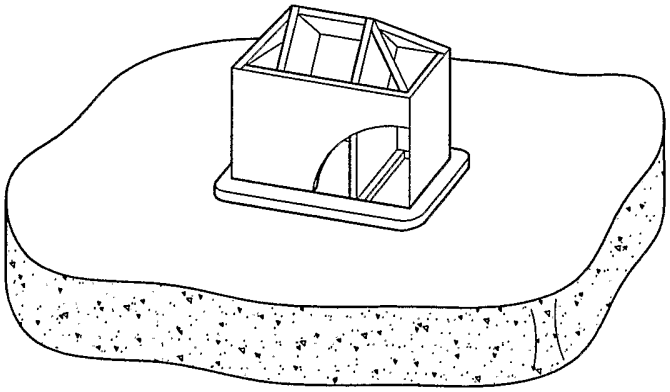


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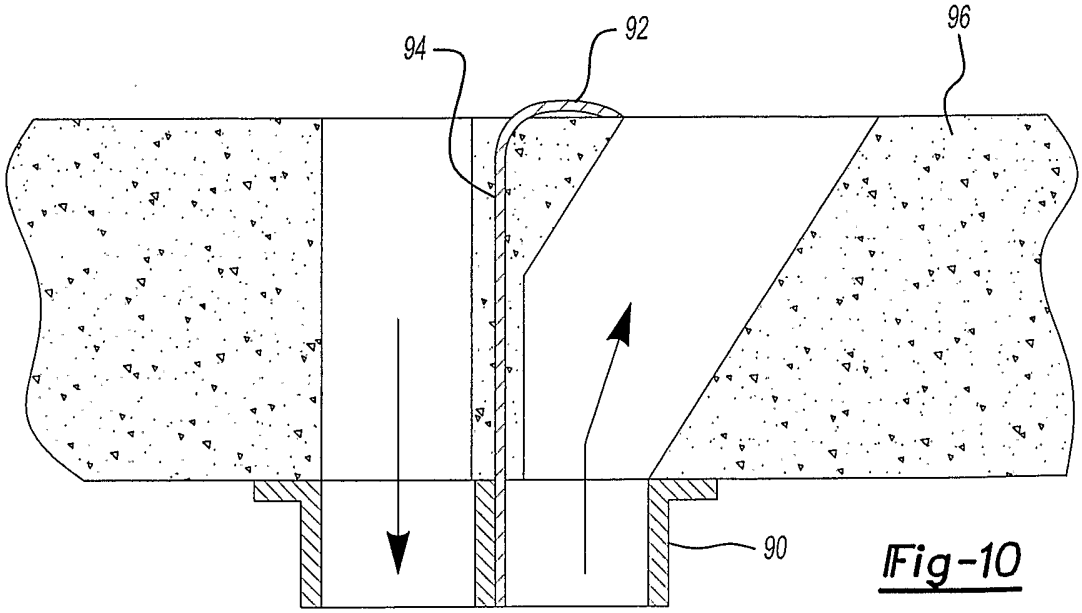


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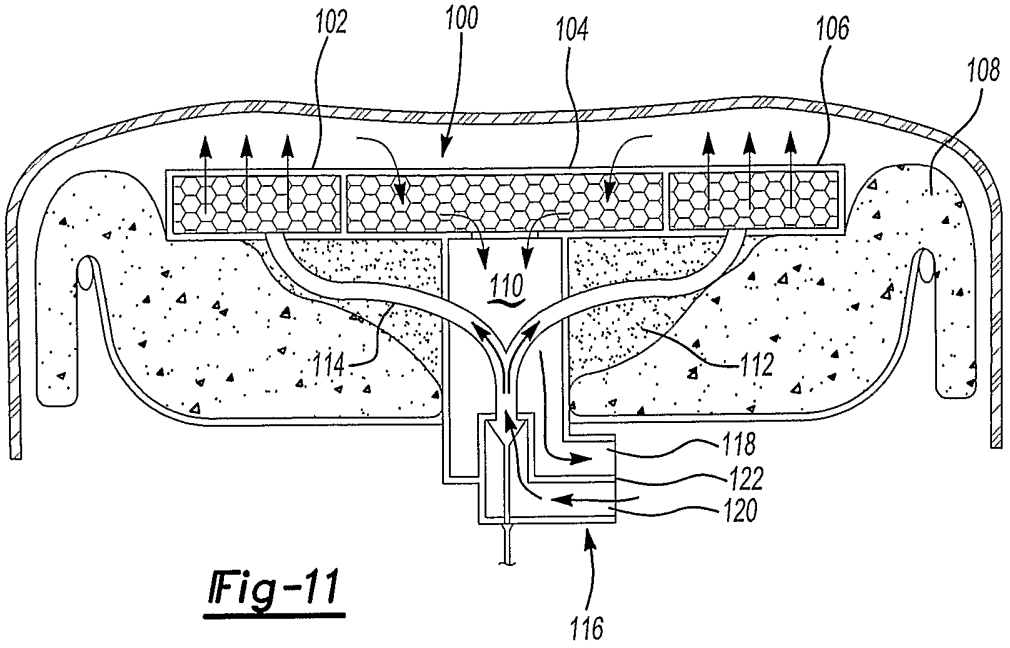


Fig-11

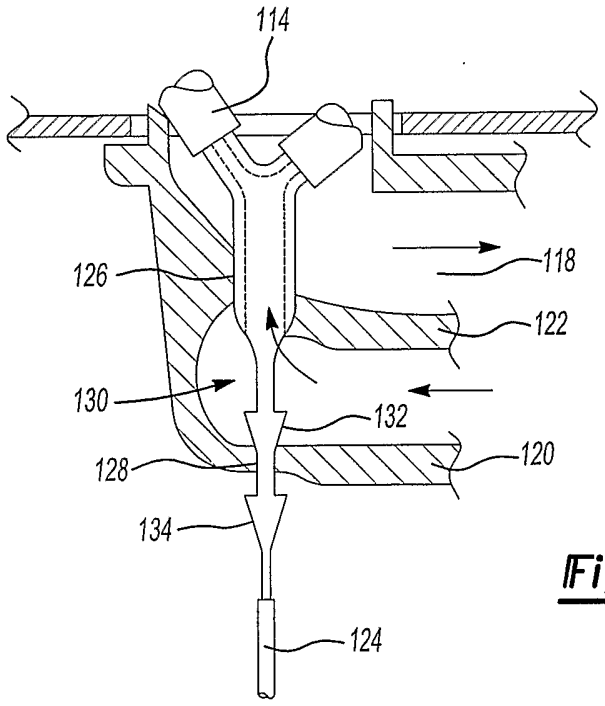


Fig-12

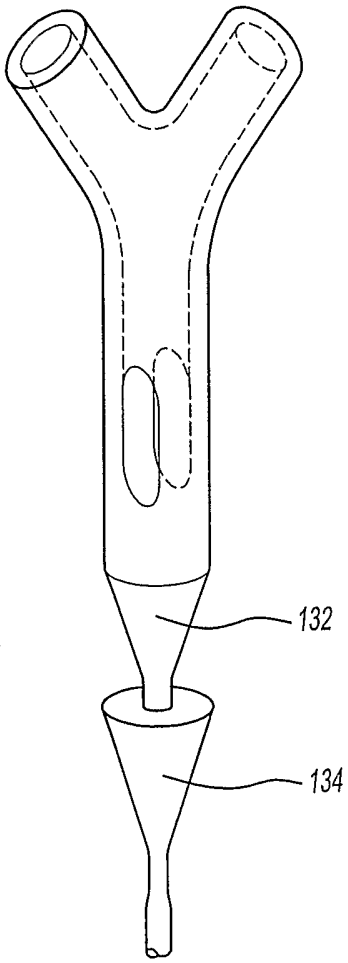


Fig-13

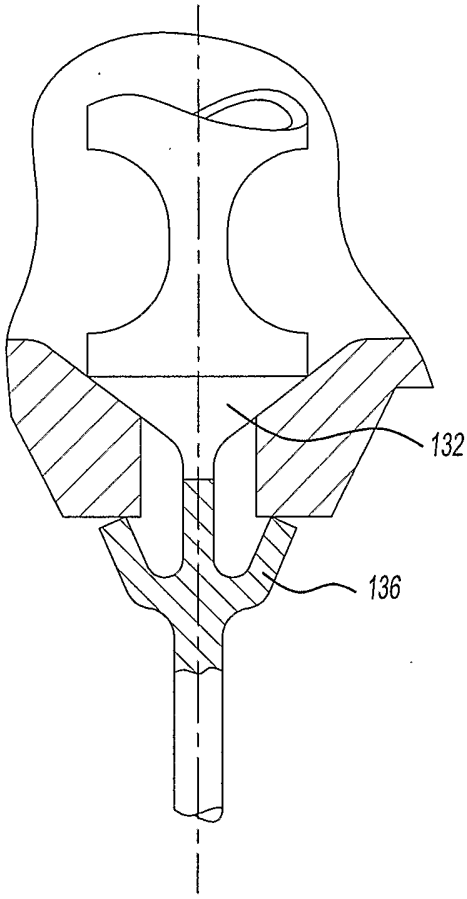


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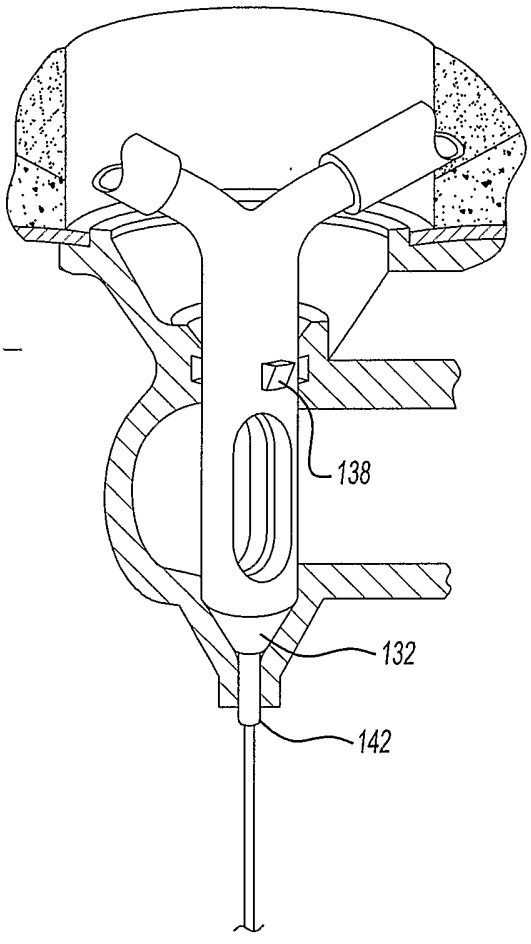


Fig-15

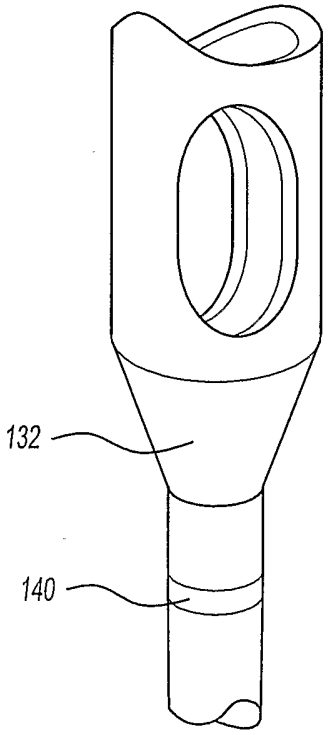


Fig-16

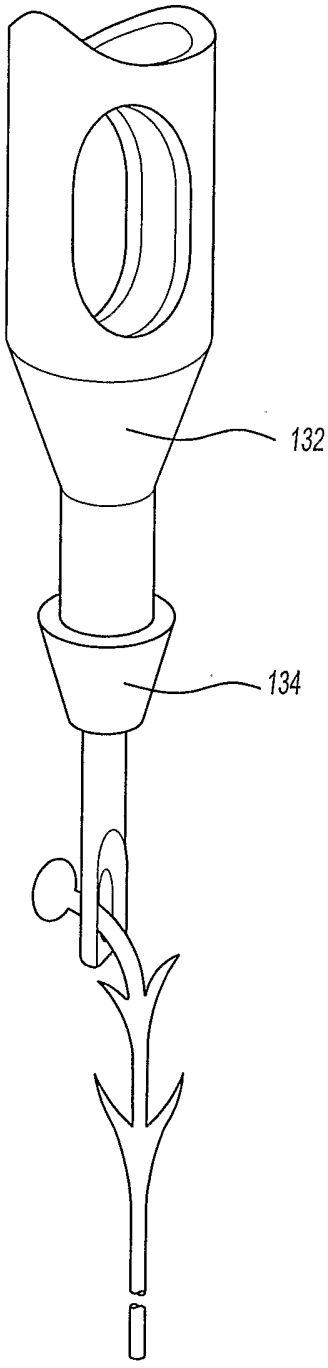


Fig-17