



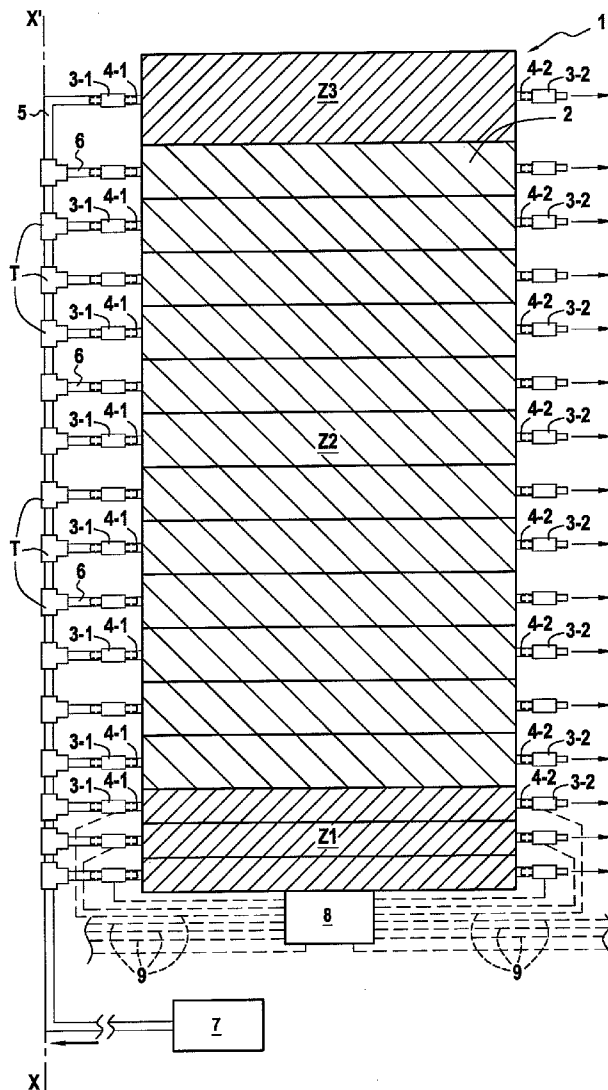
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(19) **United States**(12) **Patent Application Publication**
Caminade(10) **Pub. No.: US 2008/0201858 A1**(43) **Pub. Date: Aug. 28, 2008**(54) **MATTRESS TYPE SUPPORT DEVICE
INCLUDING AT LEAST ONE SOLENOID
VALVE FOR CONTROLLING FLUID
FEED/VENT TO OR FROM COMPARTMENTS
OF THE MATTRESS****Publication Classification**(51) **Int. Cl.**
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INDIANAPOLIS, IN 46204(21) **Appl. No.:** **12/036,582**(22) **Filed:** **Feb. 25, 2008**(30) **Foreign Application Priority Data**

Feb. 27, 2007 (FR) 07/01391

(57) **ABSTRACT**

A support device of the mattress type (1), in particular for supporting the body of an individual, comprises a plurality of n compartments (2), preferably at least three compartments, more preferably three to 24 compartments suitable for being inflated with a fluid, in particular inflated with air, a plurality p of said compartments, where p is an integer in the range 2 to n, each having at least one fluid feed and/or vent orifice (4-1, 4-2) for said compartment and at least one solenoid valve (3-1, 3-2) serving to control the feed and/or vent of fluid to or from said compartments, the device being characterized in that said valves co-operate with or are integrated in said feed and/or vent orifices, each said valve (3-1, 3-2) being dedicated to filling and/or venting a single compartment.



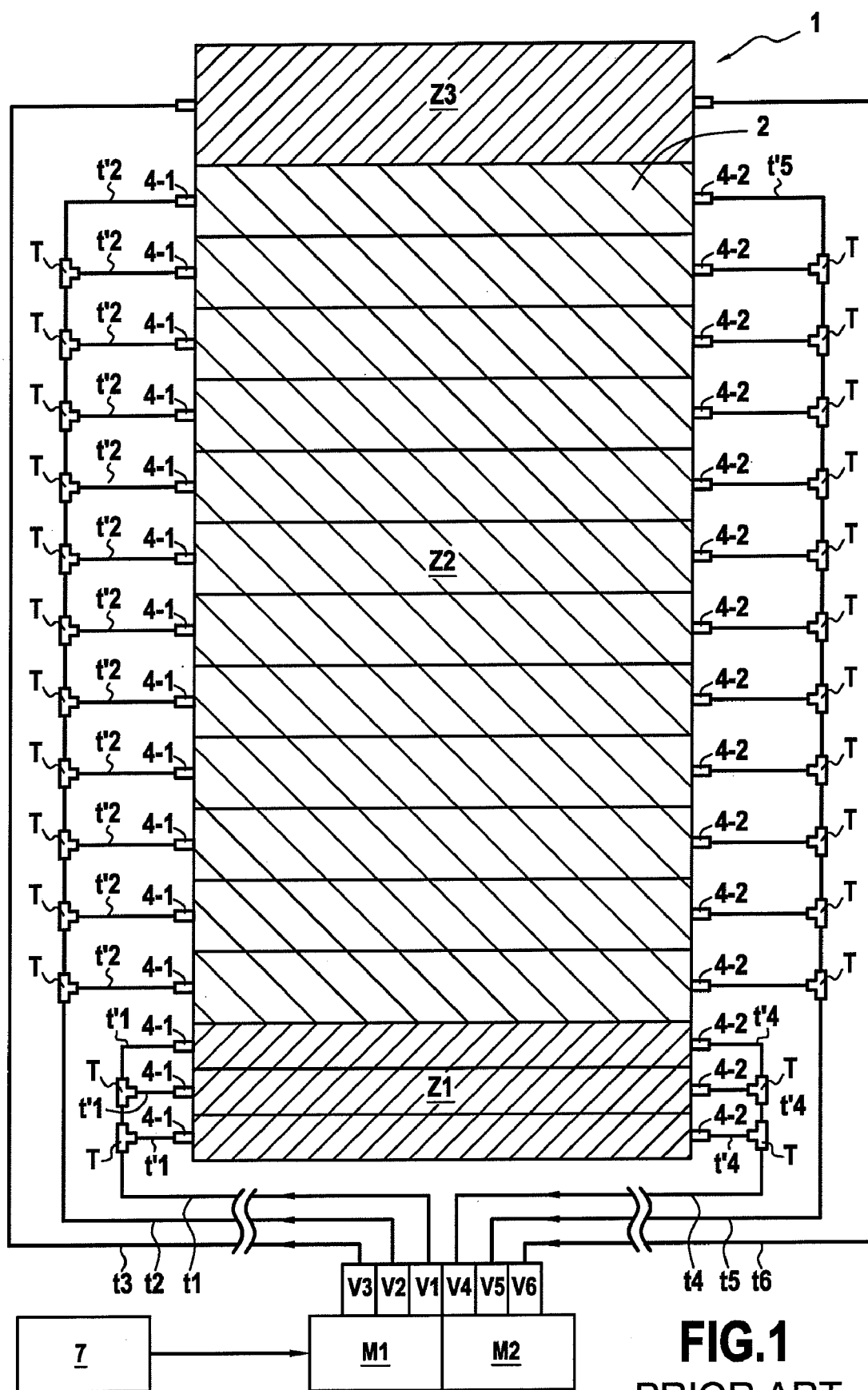
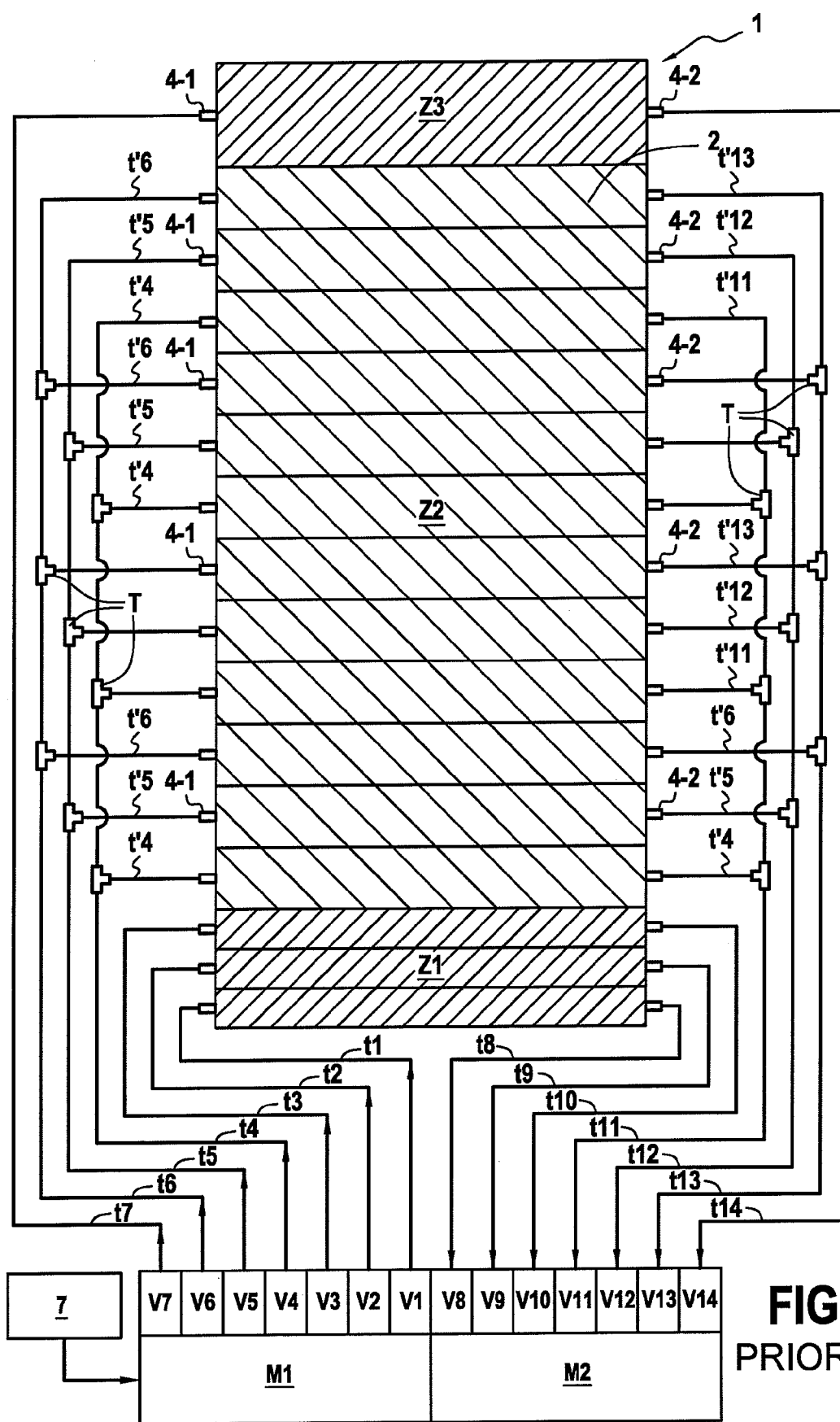
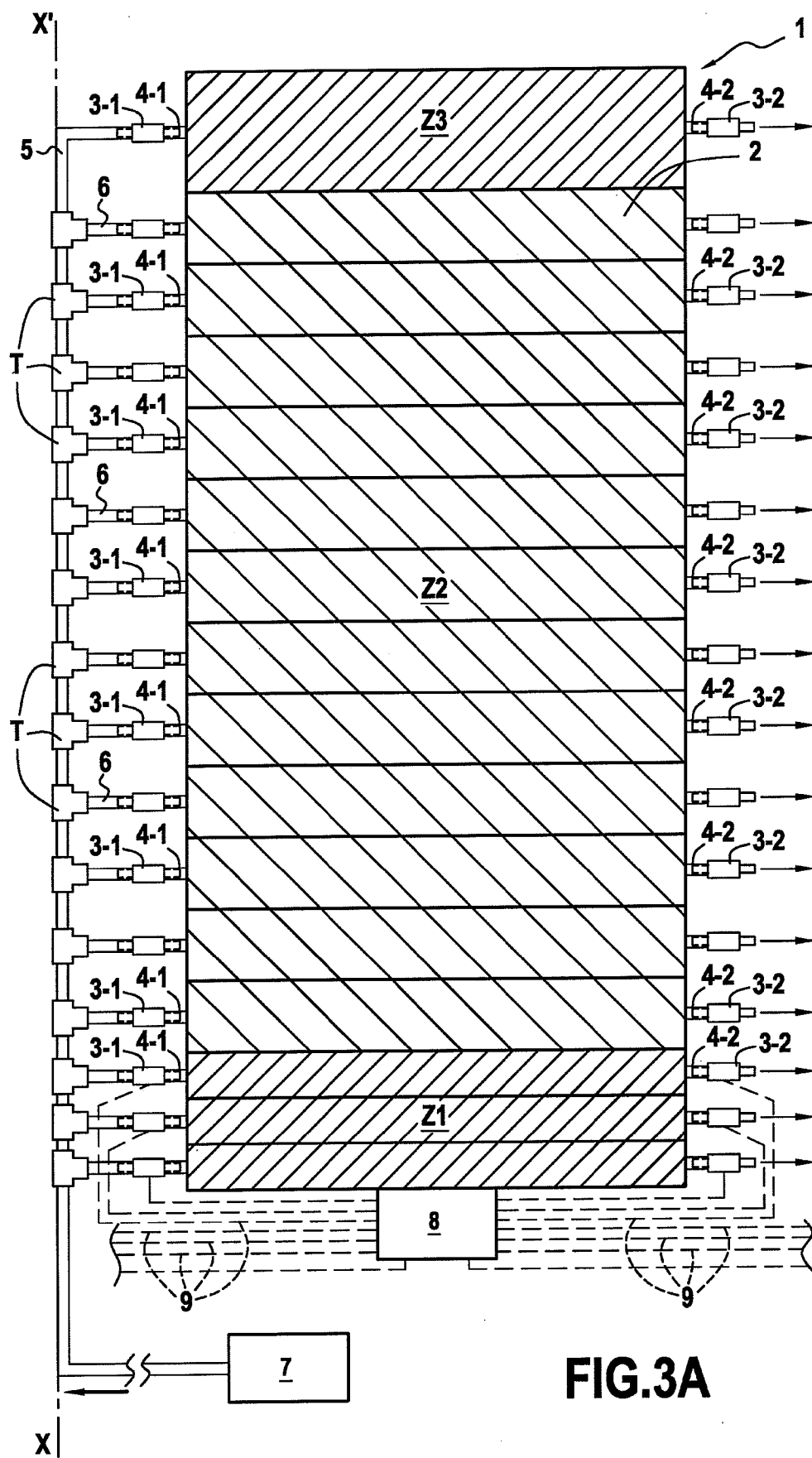
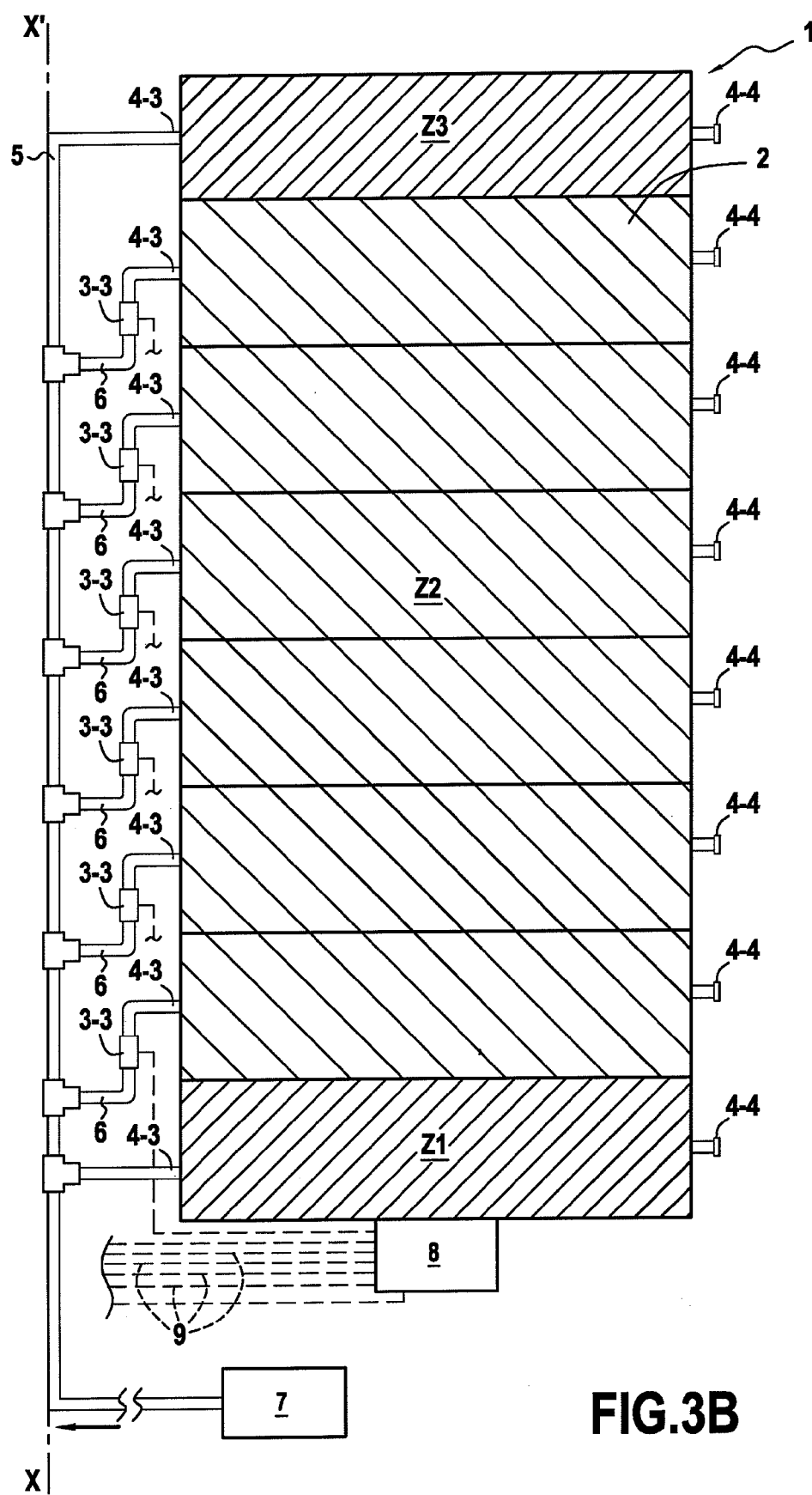
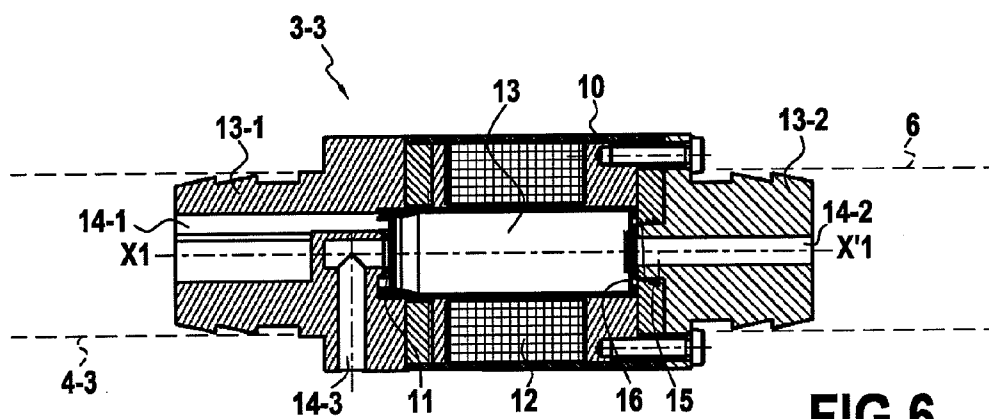
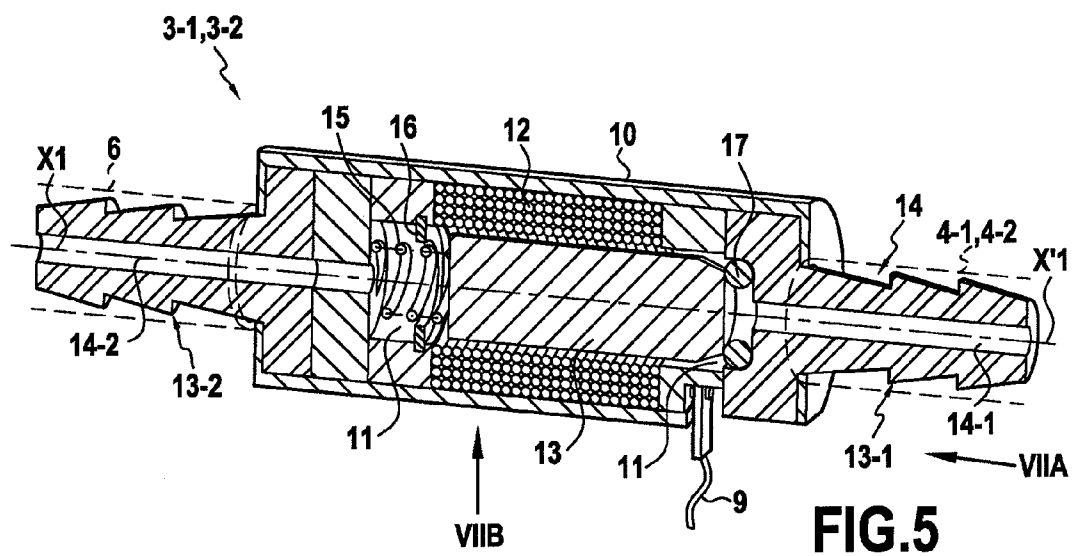
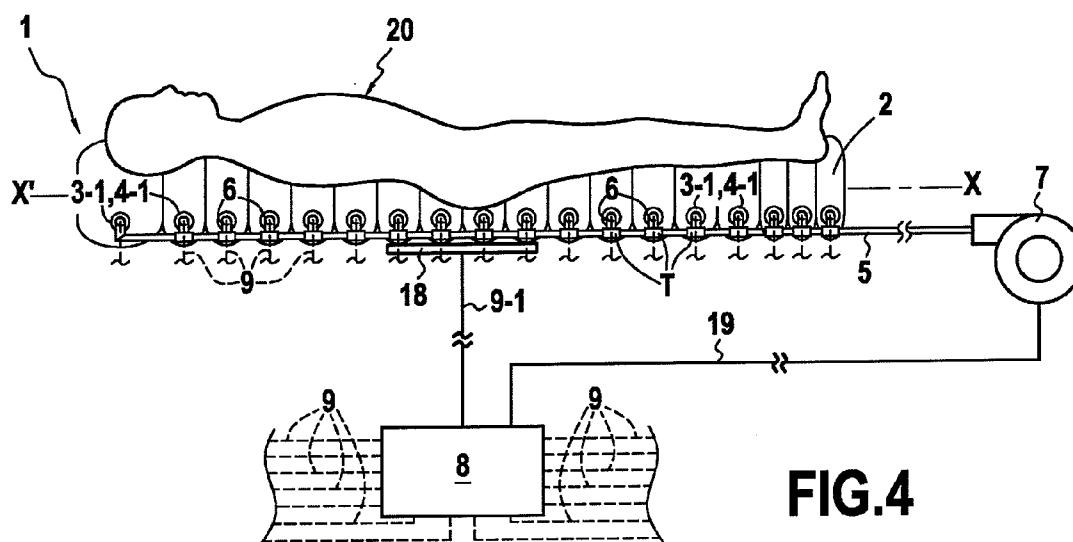


FIG. 1
PRIOR ART









3-1,3-2

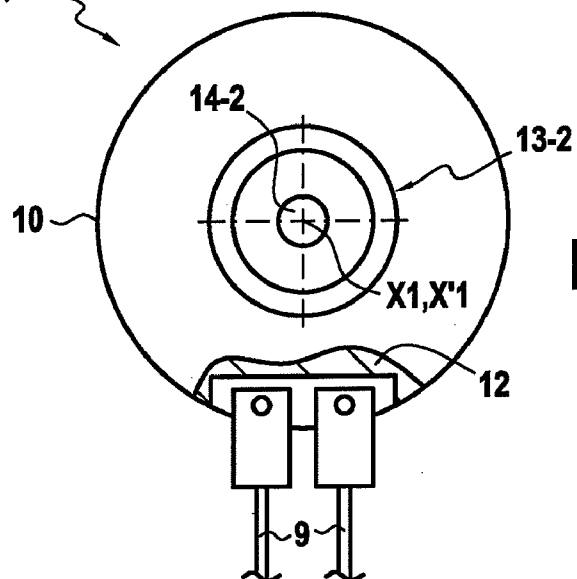


FIG. 7A

3-1,3-2

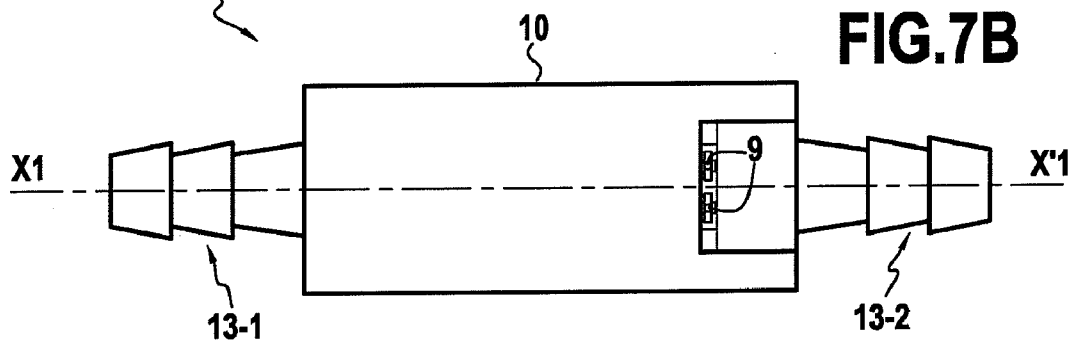


FIG. 7B

3-4

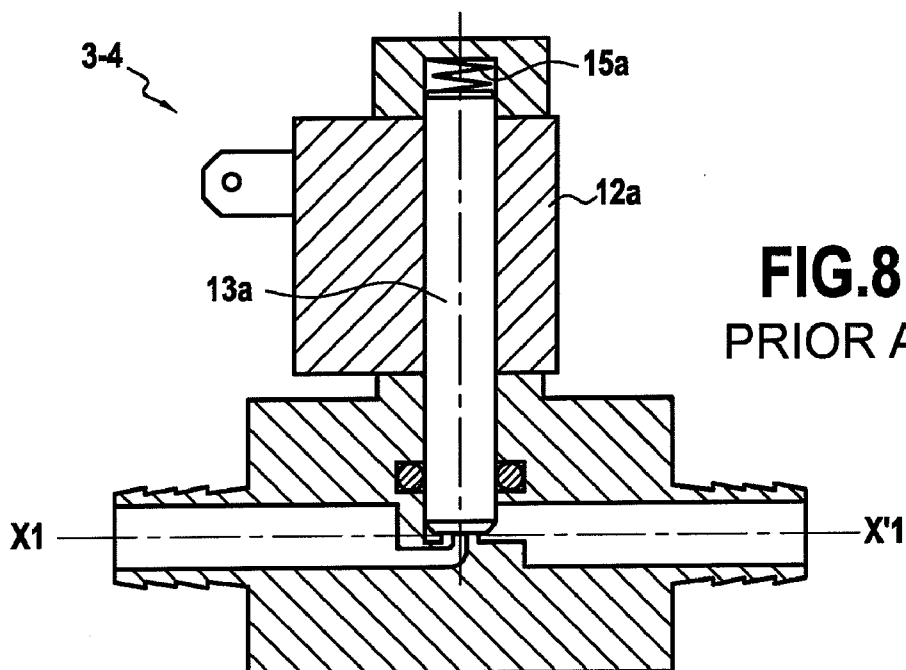


FIG. 8
PRIOR ART

**MATTRESS TYPE SUPPORT DEVICE
INCLUDING AT LEAST ONE SOLENOID
VALVE FOR CONTROLLING FLUID
FEED/VENT TO OR FROM COMPARTMENTS
OF THE MATTRESS**

[0001] The present application claims priority, under 35 U.S.C. §119(a), of French National Application No. 07/01391 which was filed Feb. 27, 2007 and which is hereby incorporated by reference herein.

BACKGROUND

[0002] The present disclosure relates to a support device of the mattress type, in particular for supporting the body of an individual, the device having a plurality of compartments suitable for being inflated with a fluid, in particular inflated with compressed air.

[0003] Some mattresses have compartments in the form of sausage-shaped tubes, each tube extending transversely relative to the longitudinal direction of the mattress, and the various tubes being placed side by side in the longitudinal direction of the mattress.

[0004] Each compartment generally has a fluid feed orifice and a fluid vent orifice.

[0005] In order to fill/inflate a compartment, a first solenoid valve is opened in order to cause the compartment to be fed through said feed orifice, and then the valve is closed once the required pressure has been reached, while a second solenoid valve that serves to vent fluid from said vent orifice is kept closed. Conversely, in order to empty or deflate the compartment, for the purpose of adjusting the pressure inside the compartment, said first valve that controls the feed orifice is kept closed, while the second valve controlling venting from the vent orifice is opened.

[0006] Mattresses of this type are used in medical situations, since they enable fluid distribution within the mattress to be controlled better. Above all, depending on the number of valves used, they make it possible to control pressure individually and thus to fill compartments individually in various zones of the mattress.

[0007] By way of illustration in FIGS. 1 and 3, there are shown diagrammatically mattresses each having sixteen compartments subdivided into three zones:

[0008] a first zone for the head and the shoulders and comprising a single compartment;

[0009] a second zone going from the shoulders to the calves and comprising twelve compartments; and

[0010] a third zone in the vicinity of the heels and comprising three compartments.

[0011] In theory, and in particular for the purposes of avoiding bed sores or of alleviating pain located in certain zones where the body presses against the mattress, good patient comfort is obtained when the pressure exerted by the various zones of the body on the mattress (referred to as the “interface pressure”) is substantially identical for all points where the surface of the body is in contact with the mattress, and when said contact surface of the body with the mattress is simultaneously of the greatest possible area, thereby requiring the extent to which the body sinks into the various compartments to be adapted to match different portions of the body.

[0012] To do this, it is necessary to distribute pressures inside the compartments by controlling the extent to which the various compartments in the longitudinal direction of the

mattress are filled/emptied in compliance with certain pre-established calculations based on and as a function of measurements made by sensors in, on, or under the mattress, depending on the type of sensor used.

[0013] These sensors are known to the person skilled in the art and they serve to measure pressure inside the compartments or the extent to which the patient’s body has sunk into a given compartment of the mattress, and they are described for example in European patent EP 0 676 158 in the name of the Applicant.

[0014] Controlling and regulating the filling/emptying of compartments using solenoid valves also makes it possible to enable the mattress to operate in a so-called “alternating pressure” mode in which a certain number of compartments that are regularly spaced apart along the length of the mattress are deflated and then re-inflated, simultaneously for the various compartments concerned. For example, it is possible to deflate/re-inflate one compartment in two or one compartment in three, and then to deflate/re-inflate the compartments adjacent to the compartments that were previously deflated and then re-inflated.

[0015] Thus, each compartment of the mattress is successively deflated/re-inflated in turn from compartment to neighboring compartment, thereby creating a kind of wave that moves in the longitudinal direction of the mattress in both the go and the return directions, thereby massaging the patient and encouraging vascularization of the soft tissue at the interface with the mattress while re-inflating the compartment, or minimizing the effects of ischemia, in particular anoxia or hypoxia, while deflating the compartment.

[0016] At present, the valves in use are designed to be mounted together in units, in particular pneumatic manifolds, and more generally in multiple manifolds constituting a manifold unit that is itself combined, where appropriate, with an electronic control unit serving to control the feeding and venting of the fluid to or from the various compartment zones of the mattress and in a manner that is modulated and controlled. In general, the various feed valves are fed with fluid from a common feed source, where appropriate a common pump or compressor, in order to inject air or compressed gas as appropriate into the compartments.

[0017] Those manifold type units for controlling and distributing fluid group together the various valves and, by way of example, they are located at the foot of the bed, so they are necessarily relatively far away from some of the compartments to which the valves are connected by feed pipes and by vent pipes.

[0018] In general, each valve serves to feed or vent a plurality of compartments in order to limit the number of valves.

[0019] Limiting the number of valves also serves to limit the number of pipes going from the manifold and thus the space occupied by the pipes. Nevertheless, that requires valves to be used that are dimensioned so as to be capable of delivering fluid at a rate that is sufficient for feeding a plurality of compartments.

[0020] By way of illustration, FIG. 1 shows a manifold having three feed valves on which there are mounted three main feed pipes each having secondary feed pipes branching therefrom via T-couplings in order to feed n compartments.

[0021] Symmetrically, n secondary vent pipes connected to the vent orifices of said compartments are connected via T-couplings to three main vent pipes, with the main vent pipes serving to convey fluid to three vent valves mounted on a common manifold.

[0022] More precisely, in FIG. 1, valves V_3 and V_6 together control a single compartment for a head or first zone, respectively via a first main feed pipe and a first vent pipe.

[0023] Valves V_2 and V_5 serve respectively to feed and vent twelve compartments of a middle zone extending under the entire body from the shoulders down to the legs, the twelve compartments being fed and vented respectively via twelve secondary feed pipes and secondary vent pipes, themselves connected respectively to a second main feed pipe and to a second main vent pipe that are connected to said corresponding valves.

[0024] Finally, the valves V_1 and V_4 control the filling and emptying of three compartments constituted by a foot zone via a third main feed pipe and a third main vent pipe, each third main feed pipe and main vent pipe being connected respectively to three other secondary feed pipes and to three other secondary vent pipes.

[0025] FIG. 2 shows a variant of the device for feeding a mattress having sixteen compartments likewise distributed in three zones, but capable of operating in an “alternating pressure mode” with it being possible for one compartment in three to be deflated/re-inflated in alternation, thus requiring fourteen valves to be used (seven feed valves and seven vent valves) together with seven main feed pipes and seven main vent pipes.

[0026] It should be observed that the main feed or vent pipes need to present a certain amount of rigidity and a section having a certain diameter in order to enable them to feed a plurality of secondary pipes, and also to avoid accidental kinking on their paths between the manifold and the furthest compartment. These pipes are disposed beside the mattress, generally inside a cover for protecting the mattress. It will be understood that such a large number of pipes constitutes a large bulk that is difficult to put into place and to use. Increasing the number of pipes increases the risk of kinking. In practice, and in standard manner, the pipes present circular sections of outside diameter lying in the range 10 millimeters (mm) to 20 mm, and more particularly of about 15 mm, and an inside diameter lying in the range 5 mm to 15 mm, and more particularly of about 10 mm.

[0027] Given that each valve must be capable of controlling the filling or venting of a plurality of compartments over a distance that is relatively long, said valves must be capable of delivering fluid at a relatively high rate, which in practice may be as much as 50 liters per minute (L/min). Such valves thus represent weight, size, and cost that are relatively great, not to mention the weight, the size, and the cost of the manifold unit itself. There is also the sound nuisance due to the valves operating, and large amounts of energy are consumed both for activating a command and for maintaining an open or closed command for said valves.

[0028] In all, the various above-mentioned constraints make it very difficult to implement a fluid feed/vent system of this type for each compartment without leading to considerable difficulties of implementation.

SUMMARY

[0029] This disclosure discusses a device for feeding/venting fluid to or from a plurality of compartments of a mattress, which device is more compact and less expensive, simpler and easier to implement, and generally is improved compared with the system presently in use.

[0030] This disclosure discusses a device for feeding/venting fluid to or from a plurality of compartments of a mattress

that can be used for controlling and regulating the filling/emptying of fluid to and from each compartment individually and without involving excessive difficulty in implementation, as applied to the systems presently available.

[0031] This disclosure further discusses a device for feeding/venting fluid to or from a plurality of compartments of a mattress that can operate in a variety of types of modes that can be selected as alternatives.

[0032] To do this, the present disclosure discusses a mattress type support device in particular for supporting the body of an individual, the device comprising a plurality of n compartments, preferably at least three compartments, more preferably three to 24 compartments suitable for being inflated by a fluid, in particular inflated with air, a plurality p of said compartments, where p is an integer lying in the range 2 to n , each having at least one fluid feed and/or vent orifice for said compartment and at least one solenoid valve enabling fluid feed and/or fluid vent to be controlled for said compartments, the device being characterized in that each said valve co-operates with or is integrated in one of said feed and/or vent orifices, each said valve being dedicated to filling and/or emptying a single compartment, said valve not co-operating with or not being integrated in a manifold type unit.

[0033] In a one embodiment of the device disclosed herein, each compartment has a fluid feed orifice and a fluid vent orifice and each said compartment in question has or co-operates with two valves, respectively a feed valve and a vent valve, one serving to control fluid feed and the other to control fluid vent, said valves being integrated in or co-operating with said feed and vent orifices respectively, each said valve being dedicated respectively to filling or emptying a single compartment.

[0034] This embodiment has two-port valves (referred to as “2/2 valves”) to be used and makes it possible to regulate pressure in compartments fitted with two valves, i.e. one valve at each orifice, one for feeding and the other for venting the compartment.

[0035] These two ports comprise:

[0036] for the feed valve:

[0037] a first internal channel communicating with said feed orifice of the compartment; and

[0038] a second internal channel communicating with a feed pipe; and

[0039] for the vent valve:

[0040] a first internal channel communicating with a vent orifice of said compartment; and

[0041] a second internal channel communicating with a vent pipe or opening out to the atmosphere.

[0042] Nevertheless, in another embodiment, each of said compartments concerned, i.e. each compartment having or co-operating with a said valve, has a single orifice co-operating with a single valve through which said compartment is both fed and vented. Said valve co-operates with or is integrated in a single open orifice acting both as a feed orifice and as a vent orifice depending on whether or not said valve is activated, with the other orifice, if any, then being closed.

[0043] This other embodiment requires three-port valves to be used (known as “3/2 valves”).

[0044] These three-port valves comprise:

[0045] a first internal channel opening out to a single open orifice for feeding and vent air to or from the compartment;

[0046] a second internal channel communicating with a pipe for feeding the valve with fluid; and

[0047] a third internal channel opening out to the atmosphere, enabling fluid to be vented from the compartment.

[0048] However, in some embodiments, such three-port valves make it possible only to control inflation/deflation of a compartment, without making it possible to regulate its pressure.

[0049] In any event, given that said 2/2 or 3/2 valves serve to feed/empty a single compartment only, they may be of a size that is relatively much smaller than that of the valves conventionally used, since the prior art valves oftentimes are dedicated to feeding/venting a plurality of compartments.

[0050] For identical pressure above atmospheric in a compartment, the required fluid flow rates, and thus the flow sections required for the valves are much smaller with valves discussed in this disclosure than they are with valves each dedicated to a plurality of compartments.

[0051] In addition, for valves that are used and positioned directly at the orifices of the compartments, the distance between the feed and vent valves, and thus the head losses between said feed and vent valves are minimized compared with valves that are offset to a common remote centralized position, e.g. at the foot of the bed as in the prior art.

[0052] In all, given that these valves are sometimes required in practice to regulate pressures in the mattress of only about 10 millibars (mbar) to 100 mbar above atmospheric, the valves disclosed herein may be configured to deliver fluid at a relatively low rate (since each feeds only one compartment) and they can therefore be of size and weight that are smaller than the size and weight of valves feeding a plurality of compartments, as conventionally implemented in a manifold unit of the remote type, e.g. located at the foot of the bed.

[0053] As a result, the solenoid valves also consume less energy for their control, and in particular they consume only about one-tenth compared with the solenoid valves that are used conventionally.

[0054] Finally, valves according to this disclosure serve to regulate or adapt the inflation of compartments and to make pressure corrections within compartments with a reaction time that is much shorter. In practice, the reaction time of the valves conventionally used in a manifold unit of the type that is offset to the foot of the bed is about 1 second (s) to 3 s, whereas with the devices in accordance with this disclosure it is of the order of $\frac{1}{2}$ s to 1 s, or even less.

[0055] In the devices disclosed herein, it is possible to allocate a pair of two-port valves to each compartment, and to regulate feeding/venting, in particular inflating/deflating for each compartment individually, and thus to adapt the configuration of the inflation of the various compartments of the mattress in a manner that is more accurate as a function of the morphology of the patient or in compliance with other criteria, depending on circumstances.

[0056] Furthermore, as mentioned above, if it is desired merely to control inflation/deflation of the various compartments concerned, it is possible to allocate a single three-port valve to each compartment, each said valve co-operating with a single open orifice serving to said feed and vent fluid to and from the compartment, with its other orifice, if any, being plugged.

[0057] As explained below, the devices disclosed herein also makes it possible to provide mattress type support devices with alternating emptying/filling of the various com-

partments being performed in a variety of modes that can be selected by appropriately programming the control of the valves.

[0058] However, the small size of the valves as dedicated in this way to each compartment and as located adjacent to the mattress serves above all to make the valves much easier to put into place and to use, particularly since it is then possible to use a simplified network of pipes for transferring fluid in the fluid feed/vent device, which network is smaller when deployed.

[0059] One advantage of some embodiments of the devices disclosed herein thus lies in the simplified installation and reduced size of the device comprising valves and pipes for feeding/venting fluid to and from said compartments.

[0060] The devices disclosed herein also makes it easy to adapt the operating features of the mattress on request, merely by adding or removing valves, thus enabling the functional features of the mattress to be varied without it being necessary to modify the pneumatic distribution network, as is necessary in the prior art.

[0061] In one disclosed embodiment, the device has only one main feed pipe with a plurality of branch connections for connecting to a plurality of said valves, each co-operating directly with or integrated in a corresponding feed orifice selected amongst a plurality of compartments, and preferably amongst all of the compartments, said feed orifices being disposed on one longitudinal side of the mattress type device and said main feed pipe running along said longitudinal side, said main feed pipe being fed from a common fluid injection device.

[0062] The phrase "branch connection for connecting" is used herein to cover, among other things, devices in which the main feed pipe has branches, e.g. via a plurality of T-couplings, whose other ends are fitted directly to the coupling endpieces of the valves or else via short lengths of secondary feed pipes having their ends connected respectively to the endpieces of the T-couplings located on the main feed pipe and to the coupling endpieces of the valves.

[0063] Similarly, the phrase "valve co-operating directly with an orifice" is used herein to cover, among other things, that an endpiece of the valve is fitted directly to the orifice, e.g. by being forced into said orifice.

[0064] According to the devices disclosed herein, the bundle or network of tubes feeding the various compartments from the various valves may be replaced, in part, with a bundle or network of electric wires for electrically powering the solenoid valves, which network of wires is much more compact.

[0065] Using a single main feed pipe for feeding the various valves presents a significant advantage in terms of cost and simplicity in implementing the devices disclosed herein.

[0066] One embodiment of a valve disclosed herein for controlling feeding and/or venting fluid to or from a compartment may be capable of conveying fluid at a flow rate that is divided by p relative to the flow rate of a valve that controls the feeding or venting of fluid to or from p compartments. In some embodiments, the valves disclosed herein may be configured to convey fluid flows in the range 1 L/min to 5 L/min instead of 50 L/min as has been conventional.

[0067] More particularly, in some embodiments, said valves may comprise at least:

[0068] a first endpiece of circular cross-section, preferably presenting a serrated outside surface, said first endpiece being forced into a said feed or vent orifice that is

of resilient tubular shape, and said first endpiece closing a first cylindrical axial channel for passing said fluid; and

[0069] a second endpiece of circular cross-section, preferably presenting a serrated outside surface, said second endpiece being forced into one end of a branch pipe connected to a said main feed pipe or connected to a vent pipe or open to the atmosphere, and said second endpiece containing a second cylindrical axial internal channel for passing said fluid.

[0070] The serrated outside surface provides better retention in said tubular orifice after being forced into an elastic tubular orifice.

[0071] Still more particularly, in some embodiments, each of said feed valves may include a second endpiece of circular cross-section, preferably presenting a serrated outside surface in particular, said second endpiece being forced into one end of a branch pipe connected to said main feed pipe and said second endpiece containing a second cylindrical axial internal channel for passing said fluid.

[0072] Still more particularly, in some embodiments, each of said vent valves may include a second endpiece of circular cross-section, said second endpiece enabling said fluid to be vented to the atmosphere.

[0073] Said second endpiece of each of said vent valves, in some embodiments, is therefore not connected to one end of a vent pipe or of a branch pipe connected to a main vent pipe, the device of such embodiments not requiring such a vent pipe to be used.

[0074] As disclosed herein, said valves and said feed pipe are placed inside a cover for protecting the mattress.

[0075] In some embodiments, said vent valves co-operating with or integrated in said vent orifices are not connected to a vent pipe, the fluid being a gas, and in particular air, that is vented to the atmosphere either freely or, where appropriate, into a said protective cover.

[0076] In another embodiment, it can be desirable to evacuate the fluid from the cover by channeling it in a vent pipe going away from said second endpieces of the vent valves.

[0077] In some embodiments, said valves are controlled by an electronic control unit making it possible to select between implementing:

[0078] a continuous mode, in which all of the compartments are inflated; and

[0079] various alternating pressure modes in which a fraction only of the compartments in at least one zone of the mattress are deflated, at least in part, and then re-inflated, said compartments for deflating/re-inflating being spaced apart regularly, preferably comprising one compartment in two or one compartment in three, more preferably by deflating and re-inflating in succession each compartment in said zone going from compartment to neighboring compartment in the longitudinal direction of said mattress in both the go and the return directions along said zone.

[0080] In such embodiments, all the compartments may include said feed valves and/or vent valves, which valves are controlled by an electronic control unit serving to implement a selected one of various alternating pressure modes in which a fraction of the compartments that are regularly spaced apart are deflated, at least in part, and then re-inflated, with this being done in some instances to one compartment in two or one compartment in three, with each of the compartments being deflated/re-inflated from compartment to neighboring

compartment in the longitudinal direction of said mattress both in the go direction and in the return direction.

[0081] It will be understood that said valves may be small in size and of a shape that is suitable for enabling them to be positioned at the feed and vent orifices of the compartments inside a protective cover disposed around said mattress and without running any risk of damaging the mattress or the cover due to their shape, and without running any risk of hurting or getting in the way of the patient when the mattress is deflated.

[0082] In some embodiments, each of said valves has two of said endpieces, namely a first endpiece and a second endpiece disposed symmetrically relative to a main body defining an outside surface of preferably rounded shape, said main body being cylindrical in shape, said main body having the same longitudinal axis as said first and second endpieces.

[0083] According to this disclosure, the outside diameter of said cylindrical body may be substantially identical to or a little greater than that of said feed pipe. Thus, the valve can be placed in line with the pipe in a compact configuration.

[0084] In some embodiments, said main body has a cylindrical internal cavity into which both of said first and second internal channels having the same longitudinal axis open out, said internal cavity containing a longitudinal magnetic core suitable for being moved in said axial longitudinal direction of said valve, said magnetic core moving inside an induction coil extending axially along the same said longitudinal axis, said core being capable of moving between firstly an open position in which the core is separated from the ends of both of said first and second internal channels on the same longitudinal axis opening out into said internal cavity so as to allow the fluid to pass through said valve between the ends of both of said first and second endpieces, and secondly a closed position in which said core closes the end of one of said first and second internal channels of the valve where it opens out into said internal cavity in such a manner as to prevent the fluid flowing through said valve between the ends of said first and second endpieces.

[0085] The type of valve disclosed herein is sometimes referred to as being "compact" and "in line" since its various component elements are disposed on a common axis that is the same as the longitudinal axis of the valve.

[0086] Furthermore, the flow of fluid through the valve between its first and second endpieces, in some embodiments, takes place axially along the same longitudinal axis as the valve axis, unlike conventional valves in which the axis of the core and the movement of the core are generally perpendicular to a fluid flow duct within the valve.

[0087] In a variant embodiment, in the absence of said core being electrically activated by said coil, said core is held in its closed position by a spring acting on the core so as to hold it against one of the two ends of said channels opening out into said cavity, and when the core is moved into the open position by electrically activating the coil, the core is moved so as to act against the spring and disengage the core from the said end of said internal channel in such a manner as to be spaced apart from both ends of said channels opening out into said cavity.

[0088] This variant is generally selected since once the compartments are appropriately adjusted in pressure, the mattress is said to be "in equilibrium." It then requires no more than pressure adjustments to be made from time to time, should the patient change position. In practice, the valves may not be operated for 75% of the time or more.

[0089] In another variant, in the absence of said core being electrically activated by said coil, said core is held in the open position by a spring acting on the core so as to keep it away from both of the ends of said first and second channels opening out into said cavity, and when the core is moved by electrically activating the coil, the core is moved in such a manner as to be held against one of the two ends of said first and second channels opening out into said cavity, thereby closing it.

[0090] In known manner, fluid can flow through said cavity between said core and said coil via grooves formed in the outside surface of the core, and/or via a hole passing longitudinally through the core.

[0091] When said valve is a three-port valve, it further may include a third internal channel enabling said internal cavity to be put into communication with the outside (i.e. the atmosphere) in such a manner that:

[0092] in said open position in which the core is disengaged from the ends of said first and second internal channels, said third internal channel is closed; and

[0093] in said closed position, said first internal channel communicating with only one orifice of said compartment is open and said second internal channel communicating with a said feed pipe is closed, and said third internal channel is open, enabling the fluid to be vented from said compartment to the atmosphere.

[0094] By way of illustration, but not limitation, the valves may present a total length lying in the range 3 centimeters (cm) to 10 cm, preferably in the range 4 cm to 6 cm, and an outside surface of circular cross-section having a maximum diameter lying in the range 10 mm to 20 mm, said first and second endpieces preferably presenting a circular cross-section of diameter lying in the range 5 mm to 15 mm, and more preferably having internal channels with a diameter lying in the range 2 mm to 10 mm, and preferably lying in the range 4 mm to 7 mm.

[0095] The present disclosure discusses compact solenoid valves disposed in line, each comprising a said main body with an internal cavity containing a core and an induction coil having the same longitudinal axis (X1X'1), each of said first and second endpieces containing a first or second internal channel and being disposed symmetrically relative to said main body and on the same longitudinal axis (X1X'1) as said main body, and said first and second endpieces are engaged in bent tubular orifices of said mattress and respectively bent ends of branch pipes, and are offset longitudinally in the longitudinal direction of the mattress so as to enable said valves to be placed in alignment in said longitudinal direction XX' of said feed pipe and of said mattress.

[0096] In some embodiments, said main body, said first and second endpieces, and said first and second internal channels are of circular cross-section.

[0097] In some embodiments, the various solenoid valves are connected to a control unit making it possible to select a control mode from a continuous mode and a different mode known as an alternating pressure mode, thereby making it possible on request to massage at least a portion of the body of the patient resting on said mattress.

[0098] It is also possible in this way to cause localized deflation to take place under a portion only of the body, e.g. under the neck for a tracheotomy.

[0099] In some embodiments, the electronic control unit for controlling the solenoid valves is connected to at least one sensor and said unit includes electronic means suitable for

controlling air feed or air vent to or from said compartments in such a manner as to maintain a given air pressure within each said compartment, preferably in such a manner that the pressure applied to the surface of the mattress by the body of a patient lying thereon is substantially identical over the entire area of the body that is in contact with the mattress.

BRIEF DESCRIPTION OF THE DRAWINGS

[0100] Other characteristics and advantages of the devices according to the present disclosure appear in the light of the following detailed description:

[0101] FIGS. 1 and 2 are diagrams showing two prior art pneumatic distribution networks feeding various compartments of a mattress from a manifold, respectively comprising six solenoid valves (FIG. 1) and fourteen solenoid valves (FIG. 2);

[0102] FIGS. 3A and 3B are diagrams showing the distribution of solenoid valves in a device according to this disclosure using two-port valves (FIG. 3A) and three-port valves (FIG. 3B);

[0103] FIG. 4 is a side view of a mattress including a device according to this disclosure

[0104] FIG. 5 is a longitudinal section view of a two-port solenoid valve according to this disclosure;

[0105] FIG. 6 is a longitudinal section view of a three-port solenoid valve according to this disclosure;

[0106] FIGS. 7A and 7B are views looking along arrows VIIA and VIIB of FIG. 5; and

[0107] FIG. 8 shows a prior art solenoid valve.

DETAILED DESCRIPTION

[0108] FIG. 1 is a diagram showing a mattress of the prior art comprising sixteen compartments made up of sausage-shaped tubes extending transversely to the longitudinal direction (XX') of the mattress.

[0109] These sixteen compartments are distributed in three zones:

[0110] head zone Z_3 : one compartment;

[0111] body zone Z_2 : twelve compartments; and

[0112] foot zone Z_1 : three compartments.

[0113] FIG. 2 shows a system for feeding/venting air to or from the various compartments from a manifold unit comprising a feed manifold M_1 having three solenoid valves V_1 , V_2 , V_3 and a vent manifold M_2 comprising three vent solenoid valves V_4 , V_5 , V_6 .

[0114] This manifold unit is combined with an electronic control unit (not shown). The feed manifold M_1 is connected to a single pump/compressor 7.

[0115] Each feed valve V_1 and V_3 is connected to a main feed pipe t_1 to t_3 feeding one compartment zone (Z_1 to Z_3).

[0116] More precisely, the solenoid valve V_1 feeds the three compartments of the zone T from the main feed pipe t_1 , which pipe t_1 has two T-couplings each serving to feed a branch-connected secondary pipe t'_1 for the purpose of providing a connection via a tubular connection endpiece to a tubular feed orifice 4-1 of each compartment. The T-coupling presents tubular endpieces with serrated outside surfaces.

[0117] Symmetrically, from the vent tubular orifices 4-2 of said compartments, located on the opposite side of the mattress, secondary vent pipes t'_4 are connected via "serrated" type tubular endpieces and are in turn connected via T-couplings to a common main vent pipe t_4 connected to the vent solenoid valve V_4 of the vent manifold M_2 .

[0118] The solenoid valves V_2 and V_5 control respectively feeding and venting the twelve compartments of the body zone via a main feed pipe t_2 and a main vent pipe t_5 connected to the feed and vent solenoid valves V_2 and V_5 respectively of the manifold unit.

[0119] The feed orifices 4-1 of the twelve compartments of the body zone are connected to the main feed pipe t_2 via secondary feed pipes t'_2 connected by T-couplings to the pipe t_2 and via tubular endpieces (not shown) to tubular feed orifices 4-1.

[0120] Symmetrically, secondary vent pipes t'_5 provide connection between the tubular vent orifices 4-2 to which they are connected via tubular endpieces (not shown) at one end, and at their opposite ends to the main vent pipe t_5 via respective T-couplings.

[0121] Finally, the feed solenoid valve V_3 and the vent solenoid valve V_6 serve respectively to control feeding and venting the single compartment of the head zone via a main feed pipe t_3 and a main vent pipe t_6 to which they are respectively connected.

[0122] This pneumatic connection network between the manifolds and the various compartments of the mattress shown in FIG. 1 operate in a mode known as "continuous pressure" mode, since all of the compartments in each zone are fed and/or vented in identical manner, with the only modulation possible being between the various zones using the three pairs of feed/vent solenoid valves.

[0123] FIG. 2 shows a mattress of the same type, but connected to an air feed/vent system that can operate in an "alternating pressure" mode in which every third compartment can be deflated, with each successive compartment being successively deflated and re-inflated.

[0124] This alternating pressure mode requires the control of the various compartments within each zone to be subdivided into thirds, where appropriate.

[0125] Thus, in FIG. 2, in order to operate in a one-in-three alternating pressure mode, it can be seen that it is necessary to implement the following solenoid valves and pipes: three feed valves V_1 , V_2 , V_3 acting via three main feed pipes t_1 , t_2 , and t_3 to feed the three feed orifices of the three compartments of the foot zone. And symmetrically, three main vent pipes t_8 , t_9 , and t_{10} providing connections between the vent orifices of the compartments in the foot zone and three vent valves V_8 , V_9 , and V_{10} .

[0126] This installation thus makes it possible to deflate successively each of the compartments in the foot zone, while the other two compartments remain inflated.

[0127] Similarly, in order to deflate simultaneously every third compartment in the body zone, i.e. four regularly spaced-apart compartments out of the twelve in the body zone, all of the successive compartments of the body zone being deflated successively in turn from compartment to neighboring compartment, it is necessary to make use of three feed valves V_4 , V_5 , V_6 acting via three main feed pipes t_4 , t_5 , and t_6 respectively to feed four compartments via four secondary feed pipes all four of which are connected to a common main feed pipe.

[0128] Thus, each of the main feed pipes t_4 , t_5 , and t_6 feeds four branch pipes t'_4 , t'_5 , and t'_6 respectively.

[0129] Symmetrically, three branch secondary pipes t'_{11} , t'_{12} , and t'_{13} are connected to three main vent pipes t_{11} , t_{12} , and t_{13} , respectively.

[0130] Finally, the feed solenoid valve V_7 and the vent solenoid valve V_{14} respectively control feeding and venting the head zone, respectively via a main feed pipe t_7 and main vent pipe t_{14} .

[0131] The various feed and vent pipes t_1 to t_{14} and t'_1 to t'_{13} are sufficiently rigid to avoid kinking, while being sufficiently flexible to be capable of following paths that are relatively curved.

[0132] These various pipes have a standard outside diameter of about 15 mm and an inside diameter of about 10 mm. The various solenoid valves that need to feed a plurality of compartments and thus to deliver relatively high fluid flow rates of up to as much as 50 L/min, are dimensioned accordingly, and they present a total weight for the manifold unit that may lie in the range 500 grams (g) (FIG. 1) to more than 1000 g (FIG. 2).

[0133] However, and above all, the multiplicity of feed and vent pipes represent a large amount of bulk, it being understood that these pipes need to be inserted within a protective cover surrounding the mattress.

[0134] FIGS. 3 and 4 are diagrams showing a system for feeding/venting the various compartments of a mattress in accordance with this disclosure.

[0135] In FIG. 3, a common air injection device 7 acts via a single feed main tube 5 (referred to as a "bus") to feed sixteen two-port feed solenoid valves 3-1 connected directly to each of the sixteen feed orifices 4-1 of each of the sixteen compartments 2, being disposed on the same longitudinal side of said mattress. On the opposite longitudinal side of said mattress, there are disposed sixteen vent orifices 4-2 which are connected directly to sixteen two-port vent solenoid valves 3-2 venting air from said compartments 2 into the atmosphere and not into a vent pipe, as in the prior art of FIGS. 1 and 2.

[0136] In FIG. 3A, the feed and vent tubular orifices 4-1 and 4-2 together with the feed and vent valves 3-1 and 3-2 are disposed in a direction that is perpendicular to the longitudinal direction XX' of the mattress and of the feed pipe 5.

[0137] Nevertheless, in some embodiments, it may be possible to use feed and vent tubular orifices together with branch pipe ends 6 that are bent through 90° and offset longitudinally in the direction XX' so as to make it possible to place the two-port valves 3-1 and 3-2 in alignment in the longitudinal direction XX' of the feed pipe and of the mattress, in order to further reduce overall size, as described below for the three-port valves 3-3 of FIG. 3B.

[0138] FIG. 4 shows a device in accordance with this disclosure combined with a sensor 18 connected to the general control unit 8 and making it possible also via an electrical connection 19 to control the pump or compressor 7.

[0139] FIGS. 3 and 4 also show diagrammatically some of the electric wires 9 for electrically powering the solenoid valves 3-1 and 3-2, which wires are also shown in FIGS. 5 and 7A.

[0140] The feed and vent valves 3-1 and 3-2 present a structure of the kind shown in FIG. 5.

[0141] The cylindrical main body 10 has an internal cavity 11 containing an induction coil 12 disposed axially relative to the longitudinal axis X1X'1 of the valve. Inside the internal cavity 11 there is placed a cylindrical longitudinal magnetic core 13 suitable for moving inside the internal cavity 11 in the longitudinal direction X1X'1 under drive from the coil 12 when it is activated electrically.

[0142] In FIG. 4, each of the various valves 3-1, 3-2 is connected via electrical power supply wires 9 to a centralized

control unit 8 serving to activate the induction coils 12 electrically and to move the cores 13, as explained below.

[0143] At each of the longitudinal ends of said cylindrical body 10, the valve 10 has respective first and second endpieces 13-1 and 13-2 of circular cross-section disposed axially and symmetrically relative to each other.

[0144] These endpieces 13-1 and 13-2 define respective serrated outside surfaces having serrations 14 of circular cross-section. These serrations 14 define serrated endpieces suitable for connecting said endpieces to feed tubular orifices 4-1 or to vent tubular orifices 4-2, or where appropriate to secondary feed pipes 6.

[0145] Each first endpiece 13-1 has a first axial internal channel 14-1 opening out at one end into the internal cavity 11 and at its other end into a compartment 2 when said first endpiece 13-1 is brought into a feed tubular orifice 4-1 or into a vent tubular orifice 4-2.

[0146] Similarly, each second endpiece 13-2 has a second axial internal channel 14-2 communicating with the internal cavity 11 and the free end of the second endpiece 13-2.

[0147] The second endpieces 13-2 are connected to the secondary feed pipes 6 for the feed valves 3-1 and they open out to the atmosphere for the vent solenoid valves 3-2.

[0148] The opening and closing operation of said two-port valves 3-1 and 3-2 can be implemented in two modes of operation.

[0149] In FIG. 5, in the absence of said core being electrically activated by said coil, the core is held in a closed position by a spring 15 acting on the core 13 so as to hold it against an O-ring 17 at the end of one of said two channels opening out into said cavity. When the core is moved by electrically activating the coil, the core is moved so as to compress the spring and disengage the core from said end of said internal channel so that, possibly in co-operation with an abutment 16, the core is held apart from the ends of said channels 14-1 and 14-2 opening out into said cavity, thereby enabling fluid to flow through said valve from the free ends of each of the two endpieces 13-1, 13-2. Air can flow through the cavity 1 around the core 13, possibly along grooves (not shown) in the outside surface of the core and/or through an axial hole passing right through the core in the longitudinal direction.

[0150] FIG. 3B shows a variant embodiment of a mattress according to this disclosure in which some of its compartments are fitted with respective single three-port solenoid valves.

[0151] Specifically, the compartments of the foot and head zones Z_1 and Z_3 are inflated in continuous mode from a device 7 that delivers air at a pre-calibrated pressure.

[0152] Only the compartments in the body zone Z_2 are fitted with respective single three-port valves 3-3 connected directly to an orifice 4-3 that acts both as a feed and as a vent, with the outlet orifice 4-4 from each of said compartments being plugged.

[0153] This FIG. 3B embodiment is particularly useful for providing a massage mattress in the body zone Z_2 by operating in an alternating pressure mode of operation, as explained below.

[0154] In FIG. 3B, the three-port valves 3-3 are disposed longitudinally along a common axis XX' of the mattress and of the feed pipe 5.

[0155] The feed/vent tubular orifices 4-3 and the branch-pipe ends 6 are bent through 90° and offset longitudinally in the direction XX' so as to make it possible to place first and second endpieces of the three-port valves 3-3 in alignment on

said longitudinal direction XX' of the feed pipe and of the mattress so as to optimize compactness of the installation.

[0156] FIG. 6 shows a three-port solenoid valve with two longitudinal internal channels, Specifically:

[0157] a first internal channel 14-1 inside a said first endpiece 13-1 fitted directly to the open tubular orifices 4-3 of said compartments;

[0158] a second internal channel 14-2 within a second endpiece 13-2 forced into the corresponding end of a secondary feed pipe 6; and

[0159] a third internal channel 14-3 communicating between the inside of the internal cavity and the outside of the valve, opening out axially on the axis X1X'1 inside the cavity 11 and transversely through the outside surface of the cylindrical body 10, said third channel 14-3 thus presenting a bent or L-shape.

[0160] In a normal position, the spring 15 exerts a pressure on the core 13 so that it moves longitudinally and closes the end of the third channel 14-3, while leaving open the end of said first channel 14-1 that opens out into said cavity parallel to the end of said third channel 14-3. Thus, the fluid can be fed freely to the compartments 2 by passing via the first and second internal channels 14-1 and 14-2 and via the internal cavity 11.

[0161] Then, when the three-port solenoid valve 3-3 is activated electrically, the spring 15 is compressed, the core 13 moving longitudinally in a reverse direction and closing said second feed channel 14-2, while the other end of the core is separated from the ends of the first and second internal channels 14-1, 14-3.

[0162] Thus, the air contained in said compartment can be vented by passing through the first internal channel 14-1, then the internal cavity 11, and then be vented to the atmosphere via the third internal channel 14-3, thereby deflating the compartment.

[0163] In order to illustrate the originality of the in-line solenoid valves according to this disclosure, FIG. 8 is a view showing a conventional solenoid valve 3-4 in which the movement of the core 13a under drive from a coil 12a (not shown) and from a spring 15a takes place perpendicularly to the direction X1X'1 along which the fluid flows through said valve between its two endpieces.

[0164] Because the valves 3-1 to 3-3 of disclosed herein are incorporated in the tubular orifices 4-1 to 4-3 of the compartments 2, and not offset to a centralized location remote from the tubular orifices, as in the prior art, each valve serves to control only one compartment, and head losses between the valve and the compartment are considerably reduced compared with the prior art.

[0165] It is recalled that the "gauge" pressures of the flowing air are about 10 mbar to 100 mbar (above atmospheric pressure), so the length of the pneumatic connection tubes in the prior art can give rise to significant head losses.

[0166] This positioning of the valves at the orifices of the compartments makes it possible to use valves of small dimensions in which it suffices, in practice, to deliver air at a rate of 1 L/min to 5 L/min, thereby requiring the use of pressures of 10 mbar to 100 mbar, with the channels 14-1 and 14-2 having inside diameters lying in the range 5 mm to 8 mm, and more particularly being about 7 mm.

[0167] These compact in-line valves present a fluid flow section equivalent to that of a duct having a diameter of 2 mm to 3 mm.

[0168] The valves present a total length lying in the range 50 mm to 70 mm, and more particularly a length of 60 mm for an outside diameter of the main body lying in the range 15 mm to 20 mm, more precisely being about 17 mm. Said first and second endpieces present a maximum diameter of about 11 mm.

[0169] By way of illustration, a valve of the kind described above presents a weight lying in the range 15 g to 20 g, such that even when using a larger number of valves (thirty-two valves in FIG. 3 compared with fourteen valves in FIG. 2), the total weight of the air feed/vent system of some embodiments, such as shown in FIG. 3, remains much smaller than that of the prior art air feed/vent system of FIGS. 1 and 2.

[0170] FIGS. 5 to 7 show said first and second endpieces 13-1 and 13-2 having the same outside diameter of about 11 mm to enable them to be forced into the ends of the pipes 6 and into the tubular orifices 4-1 of present standard compartments having an inside diameter of about 10.5 mm so that they become deformed and the connection is secure. It is desirable to maintain an inside diameter for the main feed pipe 5 having a value of about 10 mm so as to enable all of the valves to be fed at the above-specified flow rate.

[0171] In contrast, it would be possible to provide smaller inside diameters for the branch secondary pipe 6 and thus for the T-couplings serving to couple the secondary pipe 6 to the main feed pipe 5, and also to provide corresponding smaller outside diameters for the second endpieces 13-2, but for practical reasons it is preferred to continue using pipes having the common standard diameter.

[0172] In practice, in some embodiments, the valves replace the tubular elements connecting between the tubular orifices of the compartments and the feed or secondary vent pipes.

[0173] The ease with which a feed/vent system according to this disclosure can be implemented stems from the fact that the control unit at the foot of the bed 8 is much less bulky, insofar as there is no longer any need for a manifold unit centralizing the various valves. In some embodiments, the networks of air feed and vent pipes between the valves and the various compartments are eliminated and replaced by a single main feed pipe 5, the network of feed and vent pipes being replaced by a network of electric wires 9 serving to deliver electrical power to the various solenoid valves.

[0174] However this network of electric wires having a diameter lying in the range 1 mm to 2 mm is much simpler to position around the mattress and to incorporate, where appropriate, within a protective cover than is the network of pneumatic feed/vent pipes.

[0175] One advantage of the feed/vent system of some embodiments is that it makes a greater degree of modularity possible since each compartment can be controlled individually and independently of any of the others.

[0176] Since it is possible to feed/vent air to or from each compartment individually, it is possible to obtain a configuration for the mattress that is more exact as a function of the morphology of the patient.

[0177] Furthermore, the devices according to this disclosure make it possible to select alternating modes of deflating one compartment in two or one compartment in three as a function of the programming of the electronic control unit 8 placed at the foot of the bed and to which the various solenoid valves are connected.

[0178] Furthermore, since the valves are distributed over the surface of the mattress, that makes the mattress easier to handle by nursing staff.

[0179] It is thus easy to add or remove valves to or from the various compartments and to vary the functions that can be performed by the mattress on request, whereas such an option is impossible with the pneumatic networks implemented in the prior art, for which any change to the functions of the mattress requires a complete change to the network of air-distributing pipes, thus making variations to said functions impractical.

[0180] Finally, the various valves are activated using very low levels of electric power that do not involve any heating, so they can operate in contact with the compartments even in the confined surroundings within the protective cover, providing they are made of materials that are stainless in a moist atmosphere.

What is claimed is:

1. A mattress type support device (1) in particular for supporting the body of an individual, the device comprising a plurality of *n* compartments (2), preferably at least three compartments, more preferably three to 24 compartments suitable for being inflated by a fluid, in particular inflated with air, a plurality *p* of said compartments, where *p* is an integer lying in the range 2 to *n*, each having at least one fluid feed and/or vent orifice (4-1, 4-2, 4-3) for said compartment and at least one solenoid valve (3-1, 3-2, 3-3) enabling fluid feed and/or fluid vent to be controlled for said compartments, the device being characterized in that each said valve co-operates with or is integrated in one of said feed and/or vent orifices, each said valve (3-1, 3-2, 3-3) being dedicated to filling and/or emptying a single compartment, and said valve not co-operating with or not being integrated in a manifold type unit.

2. A device according to claim 1, characterized in that each of said compartments has a fluid feed orifice (4-1) and a fluid vent orifice (4-2) and each said compartment in question has or co-operates with two valves, respectively a feed valve (3-1) and a vent valve (3-2), one serving to control fluid feed and the other to control fluid vent, said valves being integrated in or co-operating with said feed and vent orifices respectively, each said valve (3-1, 3-2) being dedicated respectively to filling or emptying a single compartment.

3. A device according to claim 1, characterized in that each compartment concerned has a single feed and vent orifice (4-3) co-operating with or having integrated therein a single valve (3-3) through which said compartment is both fed and vented.

4. A device according to claim 1, characterized in that it has a single main feed pipe (5) with a plurality of branch connections (6) enabling connections to be made to a plurality of said valves co-operating directly with or integrated in said feed orifices of a plurality of compartments (2), said feed orifices (4-1, 4-3) being disposed on a common longitudinal side of the mattress type device and said main feed pipe (5) running along said longitudinal side, said main feed pipe being fed by a common fluid injection device (7).

5. A device according to claim 1, characterized in that said valves (3-1, 3-2, 3-3) comprise at least:

a first endpiece (13-1) of circular cross-section, said first endpiece being forced into a said feed or vent orifice (4-1, 4-3 or 4-2, 4-3) of resilient tubular shape, and said first endpiece closing a first cylindrical axial channel (14-1) for passing said fluid; and

a second endpiece (13-2) of circular cross-section, said second endpiece being forced into one end of a branch pipe (6) connected to a said main feed pipe (5) or connected to a vent pipe or open to the atmosphere, and said second endpiece containing a second cylindrical axial internal channel (14-2) for passing said fluid.

6. A device according to claim 5, characterized in that each of said valves has two of said endpieces (13-1 and 13-2), namely a first endpiece and a second endpiece disposed symmetrically relative to a main body (10) defining an outside surface of rounded and cylindrical shape, said main body having the same longitudinal axis (X1X'1) as said first and second endpieces.

7. A device according to claim 5, characterized in that said main body (10) has a cylindrical internal cavity (11) into which both of said first and second internal channels (14-1, 14-2) having the same longitudinal axis (X1X'1) open out, said internal cavity containing a longitudinal magnetic core (13) suitable for being moved in said axial longitudinal direction (X1X'1) of said valve, said magnetic core moving inside an induction coil (12) extending axially along the same said longitudinal axis (X1X'1), said core being capable of moving between firstly an open position in which the core is separated from the ends of both of said first and second internal channels (14-1, 14-2) on the same longitudinal axis (X1X'1) opening out into said internal cavity (11) so as to allow the fluid to pass through said valve between the ends of both of said first and second endpieces, and secondly a closed position in which said core closes the end of one of said first and second internal channels (14-1, 14-2) of the valve where it opens out into said internal cavity in such a manner as to prevent the fluid flowing through said valve between the ends of said first and second endpieces.

8. A device according to claim 7, characterized in that in the absence of said core being electrically activated by said coil, said core is held in its closed position by a spring acting on the core so as to hold it against one of the two ends of said channels opening out into said cavity, and when the core is moved into the open position by electrically activating the coil, the core is moved so as to act against the spring and disengage the core from the said end of said internal channel in such a manner as to be spaced apart from both ends of said channels opening out into said cavity.

9. A device according to claims 3 and 7, characterized in that said valve is a three-port valve (3-3) further including a third internal channel (14-3) enabling said internal cavity (11) to be put into communication with the outside, such that:

in said open position in which the core is disengaged from the ends of said first and second internal channels (14-1, 14-2), said third internal channel (14-3) is closed; and in said closed position, said first internal channel communicating with only one orifice (4-3) of said compartment

is open and said second internal channel (14-2) communicating with a said feed pipe is closed, and said third internal channel is open, enabling the fluid to be vented from said compartment to the atmosphere.

10. A device according to claim 1, characterized in that the valves present a total length lying in the range 3 cm to 10 cm, and an outside surface of circular cross-section presenting a maximum diameter lying in the range 10 mm to 20 mm, said first endpieces presenting a circular cross-section with a diameter lying in the range 5 mm to 15 mm.

11. A device according to claim 1, characterized in that said valves and said feed pipe are placed inside a protective cover of the mattress.

12. A device according to claim 1, characterized in that said valves are controlled by an electronic control unit (8) making it possible to select between performing:

a continuous mode, in which all of the compartments are inflated; and

various alternating pressure modes in which a fraction only of the compartments in at least one zone of the mattress are deflated, at least in part, and then reflat, said compartments for deflating/reflating being spaced apart regularly, by deflating and reflat in succession each compartment in said zone going from compartment to neighboring compartment in the longitudinal direction of said mattress in both the go and the return directions along said zone.

13. A device according to claim 1, characterized in that said compartments form sausage-shaped tubes extending transversely relative to the axial longitudinal direction (XX') of said mattress.

14. A device according to claim 5, characterized in that said valves are compact solenoid valves disposed in line, each comprising a main body (10) with an internal cavity (11) containing a core (13) and an induction coil (12) having the same longitudinal axis (X1X'1), each of said first and second endpieces (13-1, 13-2) containing a said first or second internal channel (14-1, 14-2) and being disposed symmetrically relative to said main body and on the same longitudinal axis (X1X'1) as said main body, and said first and second endpieces are engaged in bent tubular orifices (4-1, 4-2, and 4-3) of said mattress and respectively bent ends of branch pipes, and are offset longitudinally in the longitudinal direction of the mattress so as to enable said valves to be placed in alignment in said longitudinal direction XX' of said feed pipe and of said mattress.

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