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(54) **Method for the inflation of an inflatable mattress**

(57) It refers to a method for the inflation of an anti-bedsore mattress (22) to support a patient, said method permitting to switch off the compressor (12) comprised in the anti-bedsore apparatus, even keeping the whole anti-bedsore apparatus running. A first and a second cell are brought to a common pressure P1, then the second cell is further inflated to pressure P2. After an interval the pressure is equalized to P3 and the first cell is then further inflated to P4. After a second interval the pressure in the cells is again equalized.

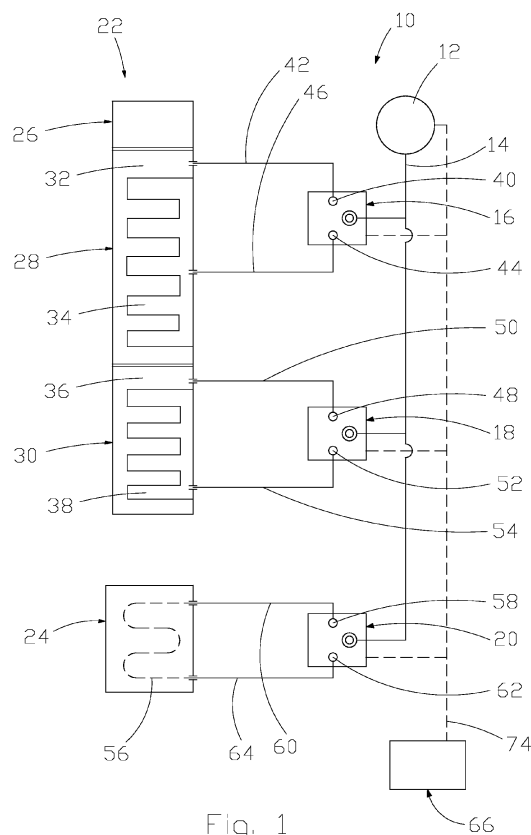


Fig. 1

## Description

[0001] The present invention refers in general to a method for the inflation of an inflatable mattress. More particularly, this invention relates to a method for the inflation of a bedsores mattress, inflatable with air.

[0002] As is known, there exist many types of bedsores mattresses that are usually provided with at least two series of cells which are inflated and deflated alternately according to predetermined cycles of time in order to have the patient lying on the mattress change his/her position and to change the supporting sectors of the mattress for the patient.

[0003] The bedsores mattresses are, therefore, inflated by one or more compressors. The operation of said compressors is controlled by a suitable management and control system that adjusts the inflation and the deflation of each of the two series of cells in the mattress.

[0004] In particular, said management and control systems must guarantee the maintenance of a correct pressure to be applied on the body of a patient by the mattress.

[0005] A typology of inflation systems according to the known art provides that the air that goes out of the mattress, in particular out of each of the two series of cells, flows in a sensing small mattress put under the mattress so as to detect the pressure of the patient on the mattress.

[0006] Said typology of systems does not allow an efficient control of the mattress pressure. In addition, the mattress must be fed continuously since the air in a variable quantity flows to the outside of the mattress toward the small mattress and from here to the outside.

[0007] Another typology of inflation systems according to the known art provides that the feeding of the sensing small mattress, put under the mattress, is done directly from the compressor that feeds the mattress. A sensor detects the pressure of the air that goes out of the small mattress and regulates the power of the compressor.

[0008] Also in this case, the system provides a continuous feed of the mattress and consequently, the compressor is operating continuously, which gives rise to problems in the consumes, outputs and lifetime of the compressor itself.

[0009] The aim of the invention is, therefore, to carry out an inflating system for a mattress in order to overcome the problems of the known art.

[0010] Another aim of the invention is to propose an inflating system for a mattress with low consumption and easy operation.

[0011] Another aim of the invention is to allow the compressor not to be continuously operating.

[0012] Said aims and advantages are reached according to the invention-through a method for the inflation of a bedsores mattress for a patient and comprising:

- a first mattress, arranged under the trunk of a patient and comprising a first series of inflatable cells and a second series of inflatable cells;
- a small mattress-sensor, arranged under the first

mattress and comprising detecting means to detect the pressure of the air going out of said small mattress-sensor;

- a compressor for the inflation of said first mattress;
- a first valve having a discharge connection for the discharge in the outer ambient, connected through a first conduit with the first series of cells of the first mattress, through a second conduit with the second series of cells of the first mattress, and through a feed conduit with the compressor;
- management and control means, connected with the first valve, with the small mattress-sensor and with the compressor.

[0013] The method is **characterized in that** it comprises the following phases:

- inflating or deflating the first series of cells and the second series of cells of the first mattress in order to reach a first determined pressure;
- maintaining the first series of cells of the first mattress under the first pressure;
- inflating with air the second series of cells of the first mattress till detecting a second determined pressure, detected by detecting means of the small mattress-sensor;
- switching off the compressor for a first determined interval of time;
- after the first interval of time, the compressor being switched off, connecting the first conduit of the first series of cells of the first mattress with the second conduit of the second series of cells of the first mattress in order to bring the first series of cells and the second series of cells to the same pressure;
- inflating or deflating the first series of cells and the second series of cells of the first mattress till reaching a third determined pressure;
- maintaining the second series of cells of the first mattress under the third pressure;
- inflating with air the first series of cells of the first mattress till detecting a fifth determined pressure, detected by the detecting means of the small mattress-sensor;
- switching off the compressor for a second determined interval of time;
- after the second interval of time, the compressor being switched off, connecting the first conduit of the first series of cells of the first mattress with the second conduit of the second series of cells of the first mattress in order to bring the first series of cells and the second series of cells to the same pressure.

[0014] In case the mattress comprises in addition:

- a second mattress, arranged under the feet of the patient and comprising a first series of inflatable cells and a second series of inflatable cells, said second mattress being inflatable by the compressor;

- a second valve having a discharge connection for the discharge in the outer ambient, connected through a first conduit with the first series of cells of the second mattress, through a second conduit with the second series of cells of the second mattress, and through the feed conduit with the compressor, said second valve being connected with the management and control means;

the method according to the invention may comprise, in addition, the following phases:

- on inflating or deflating the first series of cells and second series of cells of the first mattress, inflating or deflating the first series of cells and the second series of cells of the second mattress till reaching a fifth determined pressure;
  - maintaining the first series of cells of the second mattress under the fifth pressure until the end of the first interval of time;
  - discharging the air from the second series of cells of the second mattress till reaching a sixth determined pressure, lower than the fifth pressure;
  - maintaining the second series of cells of the second mattress under the sixth pressure until the end of the first interval of time;
  - after the first interval of time, the compressor being switched off, connecting the first conduit of the first series of cells of the second mattress with the second conduit of the second series of cells of the second mattress in order to bring the first series of cells and the second series of cells to the same pressure;
  - on inflating or deflating the first series of cells and the second series of cells of the first mattress, inflating or deflating the first series of cells and the second series of cells of the second mattress till reaching a seventh determined pressure;
  - maintaining the second series of cells of the second mattress under the seventh pressure until the end of the second interval of time;
  - discharging the air from the first series of cells of the second mattress until reaching the sixth determined pressure, which is lower than the fifth pressure;
  - maintaining the first series of cells of the second mattress under the sixth pressure until the end of the second interval of time;
- after the second interval of time, the compressor being switched off, connecting the first conduit of the first series of cells of the second mattress with the second conduit of the second series of cells of the second mattress in order to bring the first series of cells and the second series of cells to the same pressure.

**[0015]** Further features and details of the invention will be better understood from the following specification which is set forth as an example, not limited, as well as from the accompanying drawings wherein:

Fig. 1 is a diagram of an apparatus with inflatable mattress, according to the invention;

Fig. 2 is a detail of the diagram in Fig. 1;

Fig. 3 is a component of an apparatus with inflatable mattress, according to a variant of the invention.

**[0016]** With reference to the accompanying drawings, in particular Figures 1 and 2, number 10 denotes an apparatus with inflatable mattress which comprises a compressor 12 which is connected through a feed conduit 14 to a trunk valve 16, a feet valve 18 and a mat valve 20.

**[0017]** The above three valves have the same constructive features, each of them being provided with four connections with the outside, namely, one connection is connected to the feed conduit 14, two connections are provided with a pressure gauge and one last connection is for the discharge (not visible in the figures). Besides, the valves comprise an inner mechanism which allows to put two or more of the four connections with the outside in communication with each other so that a continuous regulation of the valve is allowed as well as a continuous regulation of the passage of air in the inside. Both the trunk valve 16 and the feet valve 18 are connected to a bedsores mattress 22 while the mat valve 20 is connected to a sensor mat 24 which is put under the bedsores mattress 22.

**[0018]** The bedsores mattress 20 comprises a head sector 26, a trunk sector 28 and a feet sector 30.

**[0019]** The trunk sector 28 comprises a first series of cells 32 and a second series of cells 34, which are fed regardless of the trunk valve 16. Each cell of the first series of cells 32 is alternated with a cell of the second series of cells 34 in the inside of the trunk sector 28.

**[0020]** The first series of cells 32 is connected through a first conduit 42 to a first connection 40 of the trunk valve 16 while the second series of cells 34 is connected through a second conduit 46 to a second connection 44 of the trunk valve 16.

**[0021]** Besides, the trunk sector 28 comprises a lower chamber (not visible in the figure) which is connected through nonreturn valves to the first series of cells 32 and second series of cells 34 so as to keep it at the maximum pressure reached in the inside of the cells, unless leakage is controlled or not. In addition, the lower chamber of the trunk sector 28 communicates with the head sector 26 so that the head sector 26 is allowed to keep a suitable support pressure.

**[0022]** Likewise, the feet sector 30 comprises a first series of cells 36 and a second series of cells 38 which are fed by the feet valve 18 regardless of the feeding of the trunk sector 28. Each cell of the first series of cells 36 is alternated with a cell of the second series of cells 38 in the inside of the feet sector 30.

**[0023]** The first series of cells 36 is connected through a first conduit 50 to a first connection 48 of the feet valve 18 while the second series of cells 38 is connected through a second conduit 54 to a second connection 52 of the feet valve 18.

**[0024]** The sensor mat 24 comprises a conduit sensor 56 which is arranged like a coil. An end of the conduit sensor 56 is connected through a first conduit 60 to a first connection 58 of the mat valve 20 and the opposite end is connected through a second conduit 64 to a second connection 62 of the mat valve 20. The coil arrangement allows to cover a wide surface of the mat sensor 24. The inflation system 10 comprises also a control centre 66, visible in Fig. 2, which includes a multifunction display 68, a plurality of push-buttons 70 and an electronic central unit 72. A plurality of connections 74 connects the control centre to the three valves 16, 18, 20 and the compressor 12.

**[0025]** The electronic central unit 72 manages the visualization in the multifunction display 68 of all the functional parameters of the apparatus with inflatable mattress 10 and processes, at the same time, the data coming from the three valves 16, 18, 20 and compressor 12 so as to control the working and feeding thereof.

**[0026]** The working of the apparatus 10 with inflatable mattress is described below.

**[0027]** The first operation which the apparatus 10 with inflatable mattress performs by switching it on is a calibration of the electric feeding of the compressor 12 by disposing the apparatus in a configuration of calibration. In this phase, the bed sore mattress 22 is isolated from the compressor.

**[0028]** The configuration of calibration of the apparatus 10 with inflatable mattress is such that the trunk valve 16 and the feet valve 18 block the air flow from the compressor 12 to the bed sore mattress 22 and that the mat valve 20 is arranged in a bypass configuration in which its discharge connection is put in a direct communication with the feed conduit 14.

**[0029]** In this way, the whole quantity of air that has been treated by the compressor 12 passes only through the mat valve 20 which detects the forward pressure of the compressor, compares the same with a valve pressure which has been predetermined during the projecting phase and varies the feed current of the compressor 12 so that the two pressures are equal. In this way, some common working problems are overcome such as the presence of dirty filters or other, and the necessary maintenance interventions are reduced.

**[0030]** Once the calibration phase is concluded, it is possible to proceed with the inflation of the bed sore mattress 22 according to an alternate mode or a continuous mode when it is selected by an operator by means of the group of push-buttons 70. The continuous mode allows the inflation of the first series of cells 32, 36 and second series of cells 34, 38 of the trunk sector 28 and feet sector 30 at the same pressure so that a bed sore mattress 22 is obtained and allows the same support/sustenance of the body of a patient in every point of the mattress 22.

**[0031]** On the contrary, in the alternate mode, the inflation system 10 performs a working cycle which alternates the support/sustenance of the body of the patient between the first series of cells 32, 36 and the second

series of cells 34, 38 of the trunk sector 28 and feet sector 30 so that the support/sustenance pressure is changed in each point of the mattress 22 in time.

**[0032]** The working according to the alternate mode is described below.

**[0033]** Beginning from a condition of unloaded bed sore mattress 22, the mat sensor 24, which is put under the trunk sector 28, is squashed by the weight of the patient who blocks the air passage in the conduit sensor 56 in at least one point of the conduit sensor 56.

**[0034]** The central electronic unit 72 orders the trunk valve 16, the feet valve 18 and the mat valve 20 to put the feed conduit 14 in communication with the first conduits 42, 50 and second conduits 46, 54 of the trunk sector 28, feet sector 30 and first conduit 60 of the mat sensor 24 in order to inflate all the cells of the mattress 22. In this phase, the weight of the patient prevents the air to pass in the second conduit 64 of the mat valve 20 which does not detect any pressure at its second connection 62 which, in this working phase, is put in communication with the exhaust of the mat valve 20.

**[0035]** In the feet sector 30, when the feet valve 18 detects a predetermined pressure, called average pressure hereinafter, at both connections 48, 52, the feet valve 18 changes its operation mode and blocks its first connection 48 so that it prevents a further inflating of the first series of cells 36 of the feet sector 30 and puts the second connection 52 in communication with the exhaust of the feet valve 18 itself in order to bring the second series of cells 38 of the feet sector 30 to the wished pressure, called minimum pressure hereinafter, on blocking then any exchange of air in the feet sector 30.

**[0036]** In the trunk sector 28, once the minimum pressure has been reached and detected by both connections 40, 44 of the trunk valve 16, the trunk valve 16 blocks its second connection 44 and prevents consequently a further inflation of the second series of cells 34 of the trunk sector 28 so that only the first series of cells 32 is still inflated until a slight air pressure is detected in the connection 62 of the mat valve 20. When this fact occurs means that the trunk sector 28 has reached a pressure that is called sustenance pressure below so that the patient is sufficiently raised from the bed sore mattress 22 and the air is allowed to flow in the whole conduit sensor 56 which is not pressed in any point by the weight of the patient.

**[0037]** Once the sustenance pressure has been reached by means of inflation in the first series of cells 32 of the trunk sector 28, the electronic central unit 72 orders the compressor 12 to switch off and the trunk valve 16 to close its first connection 40 on blocking the inflation of the first series of cells 32 of the trunk sector 28 and to put the second connection 44 in communication with the exhaust of the trunk valve 16 itself until the second series of cells 34 reaches the above mentioned minimum pressure, which can be much lower than the pressure obtained in the first series of cells 32 of the trunk sector 28. This pressure may depend on the medical specifications

of the country in question.

**[0038]** In this operation phase, in the bed sore mattress 22 the first series of cells 36 in the feet sector 30 is inflated at the average pressure while the second series of cells 38 in the feet sector 30 is inflated at the minimum pressure and the first series of cells 32 in the trunk sector 28 is inflated at the sustenance pressure which the second series of cells 34 in the trunk sector 28 is inflated at the minimum pressure. The head sector 26 is inflated at the sustenance pressure, namely, the maximum pressure reached in the trunk sector 28. The electronic central unit 72 maintains this distribution of pressures in the inside of the bed sore mattress 22 for a predetermined period of time, for instance five minutes, during which the compressor 12 remains switched off, which does not occur in the prior art.

**[0039]** When the predetermined period of time has elapsed and the compressor 12 is kept switched off, the electronic central unit 72 orders the trunk valve 16 and the feet valve 18 to put the respective first connections 40, 48 in communication with the respective second connections 44, 52 so that it is possible to obtain a rebalance of the pressures in the bed sore mattress 22 and to make such pressures uniform.

**[0040]** The so-described inflation cycle can be repeated by alternating later the first series of cells and the second series of cells in both the trunk sector 28 and the feet sector 30.

**[0041]** More particularly, in the following inflation cycle, the electronic central unit 72 verifies whether in the trunk sector 28 or in the feet sector 30 there is an equal pressure or a pressure higher than the average pressure in order to avoid a further inflation phase by the compressor 12 in that sector.

**[0042]** In other terms, if, for instance, after the rebalance of the pressures in the feet sector 30, the pressure is higher than the average pressure while the pressure in the trunk sector 28 is lower than the average pressure, the electronic central unit 72 orders the trunk valve 16 to allow the first series of cells 32 and the second series of cells 34 to be inflated until both series of cells reach the average pressure while the electronic central unit 72 orders the feet valve 18 only to deflate that series of cells which in the preceding cycle had been maintained at the average pressure.

**[0043]** In this way, the previously described inflation cycle will be repeated by inverting the pressures obtained in the series of cells of the sectors of the bed sore mattress 22.

**[0044]** In a different operation mode of the apparatus with inflatable mattress according to the invention, the operator can inflate all the cells of the bed sore mattress of both the trunk sector and the feet sector at a predetermined pressure in the shortest time possible, for instance by utilizing the maximum power of the compressor. This function allows the mattress to remain inflated for a certain period of time and deactivates automatically and restores thus the operative conditions that were

present before selecting this different operation mode.

**[0045]** According to a different construction of the apparatus with inflatable mattress according to the invention, the feet sector of a bed sore mattress can comprise two nonreturn valves, each of them being connected to the first series of cells 36 and second series of cells 38, respectively and communicating with the head sector. The nonreturn valves can be arranged in such a way as to allow the inlet of compressed air toward the head sector only when the pressure in the head sector itself is lower than the pressure in one of the first series of cells and second series of cells in the feet sector. According to this construction it is possible to control more accurately the pressure in the head sector since it depends on the management of the feet sector but it is independent from the variations in the trunk sector, caused by the working of the mat sensor.

**[0046]** According to a variant of the invention, an apparatus with inflatable mattress can comprise an independent mat sensor 80 showing a substantially rectangular shape, as visible in Figure 3, which in turn comprises a tube sensor 82 arranged like a spiral or according to a different shape beginning from the centre of the independent mat sensor 80 itself and in such a way as to cover most part of its surface.

**[0047]** The spiral of the tube sensor 82 ends on the edge of the independent mat sensor 80 and is connected through a conduit 84 to a valve 86.

**[0048]** In turn, the valve 86 is connected through a conduit 88 to a pressure sensor 90 which transmits the detected pressure through a connection 92 to the management and control system.

**[0049]** The valve 86 can comprise appropriately a device which stops the passage of air in case the conduit 88 is disconnected in order to prevent air from going out of the conduit 84 and tube sensor 82.

**[0050]** The independent mat sensor 80 can substitute the mat sensor 24 if necessary, which involves the advantage of obtaining a measurement of the pressure variation in relation to the weight/position of the patient without utilizing compressed air coming from the management and control system and guaranteeing thus reduced consumes and a greater autonomy in respect to the management and control system without inserting elements to be interested by electricity in the bed sore mattress.

**[0051]** In case of a crushing of the tube-sensor 82, the pressure of the air contained in the tube-sensor 82 and conduit 84, which air is initially at the atmospheric pressure, increases proportionally so that this increase of the air pressure is detected by the pressure sensor 90. The detected variation of pressure can be utilized, for instance, to estimate the weight/position of the patient and to value the inflation pressure required to inflate the cells of the bed sore mattress in order to safely support the patient.

**[0052]** The particular construction of the independent mat-sensor 80 and tube-sensor 82 allows to detect an inclination of the bed, as well, for instance an inclination

of the bed-back, because the different distribution of the weight/position of the patient on the tube-sensor 82 involves a different pressure, which is detected by the pressure sensor 90, and consequently, a different estimate of the weight/position of the patient. This different estimate of the weight of the patient will involve, for instance, an increase of the inflation pressure for the inflation of the cells of the bedsores mattress in case of an inclination of the bed-back.

**[0053]** According to a variant of the invention, an independent mat-sensor can comprise a tube-sensor which is produced entirely or partially in an elastic material to avoid an excessive crushing and to avoid that a part of the tube-sensor remains separate from the remaining part with the risk of misrepresenting the pressure detected by the pressure sensor.

**[0054]** The apparatus with inflatable mattress according to the invention has several advantages in comparison with the prior art, for instance a remarkable saving in energy since the compressor is utilized only when the inflation is necessary while in the known compressor, the compressor must be always operating to maintain the inflation of the mattress, which involves not only a greater consumption of energy but also a greater noise and wear of mechanical parts. A further advantage is the possibility of a self-calibration of the apparatus with inflatable mattress according to the invention which compensates for any malfunctions of the compressor which could reduce the quantity of inflated air so that many maintenance interventions are avoided.

**[0055]** Another advantage is to remarkably reduce the quantity of the air treated by the apparatus with inflatable mattress on the whole in order to improve the conditions of the air of the ambient in which it operates while in the known systems, the compressor is always operating and consequently, it is necessary to treat much more air which is then exhausted in the ambient in which it operates.

**[0056]** Besides, the electronic management of the components of the apparatus with inflatable mattress allows a full customization of the operating cycle since all the functional parameters of the control centre 66 can be varied.

**[0057]** The different operation mode allows to keep the mattress completely inflated with a rigid, uniform surface so that it is possible to guarantee the necessary care for the patient when the care requires such a support surface.

**[0058]** In addition, further variants and constructions are possible which are to be considered as included in the scope of protection as set forth in the following claims.

## Claims

1. Method for the inflation of a bedsores mattress (22) for a patient, comprising:

- a first mattress (28), arranged under the trunk

of a patient and comprising a first series of inflatable cells (32) and a second series of inflatable cells (34);

- a small mattress-sensor (24; 80), arranged under the first mattress (28) and comprising detecting means (20; 90) to detect the pressure of the air going out of said small mattress-sensor (24; 80);

- a compressor (12) for the inflation of said first mattress (28);

- a first valve (16) having a discharge connection for the discharge in the outer ambient, connected through a first conduit (42) with the first series of cells (32) of the first mattress (28), through a second conduit (46) with the second series of cells (34) of the first mattress (28), and through a feed conduit (14) with the compressor (12);

- management and control means (66), connected with the first valve (16), with the small mattress-sensor (24; 80) and with the compressor (12);

said method being **characterized in that** it comprises the following phases:

- inflating or deflating the first series of cells (32) and the second series of cells (34) of the first mattress (28) in order to reach a first determined pressure (P1);

- maintaining the first series of cells (32) of the first mattress (28) under the first pressure (P1);

- inflating with air the second series of cells (34) of the first mattress (28) till detecting a second determined pressure (P2), detected by detecting means (20; 90) of the small mattress-sensor (24; 80);

- switching off the compressor (12) for a first determined interval of time;

- after the first interval of time, the compressor (12) being switched off, connecting the first conduit (42) of the first series of cells (32) of the first mattress (28) with the second conduit (46) of the second series of cells (36) of the first mattress (28) in order to bring the first series of cells (32) and the second series of cells (34) to the same pressure;

- inflating or deflating the first series of cells (32) and the second series of cells (34) of the first mattress (28) till reaching a third determined pressure (P3);

- maintaining the second series of cells (34) of the first mattress (28) under the third pressure (P3);

- inflating with air the first series of cells (32) of the first mattress (28) till detecting a fourth determined pressure (P4), detected by the detecting means (20; 90) of the small mattress-sensor (24; 80);

- switching off the compressor (12) for a second determined interval of time;

- after the second interval of time, the compressor (12) being switched off, connecting the first conduit (42) of the first series of cells (32) of the first mattress (28) with the second conduit (46) of the second series of cells (36) of the first mattress (28) in order to bring the first series of cells (32) and the second series of cells (34) to the same pressure. 5
2. Method according to claim 8, wherein in addition, the mattress comprises: 10
- a second mattress (30), arranged under the feet of the patient and comprising a first series of inflatable cells (36) and a second series of inflatable cells (38), said second mattress (30) being inflatable by the compressor (12); 15
  - a second valve (18) having a discharge connection for the discharge in the outer ambient, connected through a first conduit (50) with the first series of cells (36) of the second mattress (30), through a second conduit (54) with the second series of cells (38) of the second mattress (30), and through the feed conduit (14) with the compressor (12), said second valve (18) being connected with the management and control means (66); 20
- said method comprising, in addition, the following phases: 25
- on inflating or deflating the first series of cells (32) and second series of cells (34) of the first mattress (28), inflating or deflating the first series of cells (36) and the second series of cells (38) of the second mattress (30) till reaching a fifth determined pressure (P5); 30
  - maintaining the first series of cells (36) of the second mattress (30) under the fifth pressure (P5) until the end of the first interval of time; 35
  - discharging the air from the second series of cells (38) of the second mattress (30) till reaching a sixth determined pressure (P6), lower than the fifth pressure (P5); 40
  - maintaining the second series of cells (38) of the second mattress (30) under the sixth pressure (P6) until the end of the first interval of time; 45
  - after the first interval of time, the compressor (12) being switched off, connecting the first conduit (50) of the first series of cells (36) of the second mattress (30) with the second conduit (54) of the second series of cells (38) of the second mattress (30) in order to bring the first series of cells (36) and the second series of cells (38) to the same pressure; 50
  - on inflating or deflating the first series of cells (32) and the second series of cells (34) of the first mattress (28), inflating or deflating the first series of cells (36) and the second series of cells (38) of the second mattress (30) till reaching a 55
- seventh determined pressure (P7);
- maintaining the second series of cells (38) of the second mattress (30) under the seventh pressure (P7) until the end of the second interval of time;
  - discharging the air from the first series of cells (36) of the second mattress (30) until reaching the sixth determined pressure (P6), which is lower than the fifth pressure (P5);
  - maintaining the first series of cells (36) of the second mattress (30) under the sixth pressure (P6) until the end of the second interval of time;
  - after the second interval of time, the compressor (12) being switched off, connecting the first conduit (50) of the first series of cells (36) of the second mattress (30) with the second conduit (54) of the second series of cells (38) of the second mattress (30) in order to bring the first series of cells (36) and the second series of cells (38) to the same pressure.
3. Method according to claim 9, wherein the first interval of time lasts as the second interval of time.

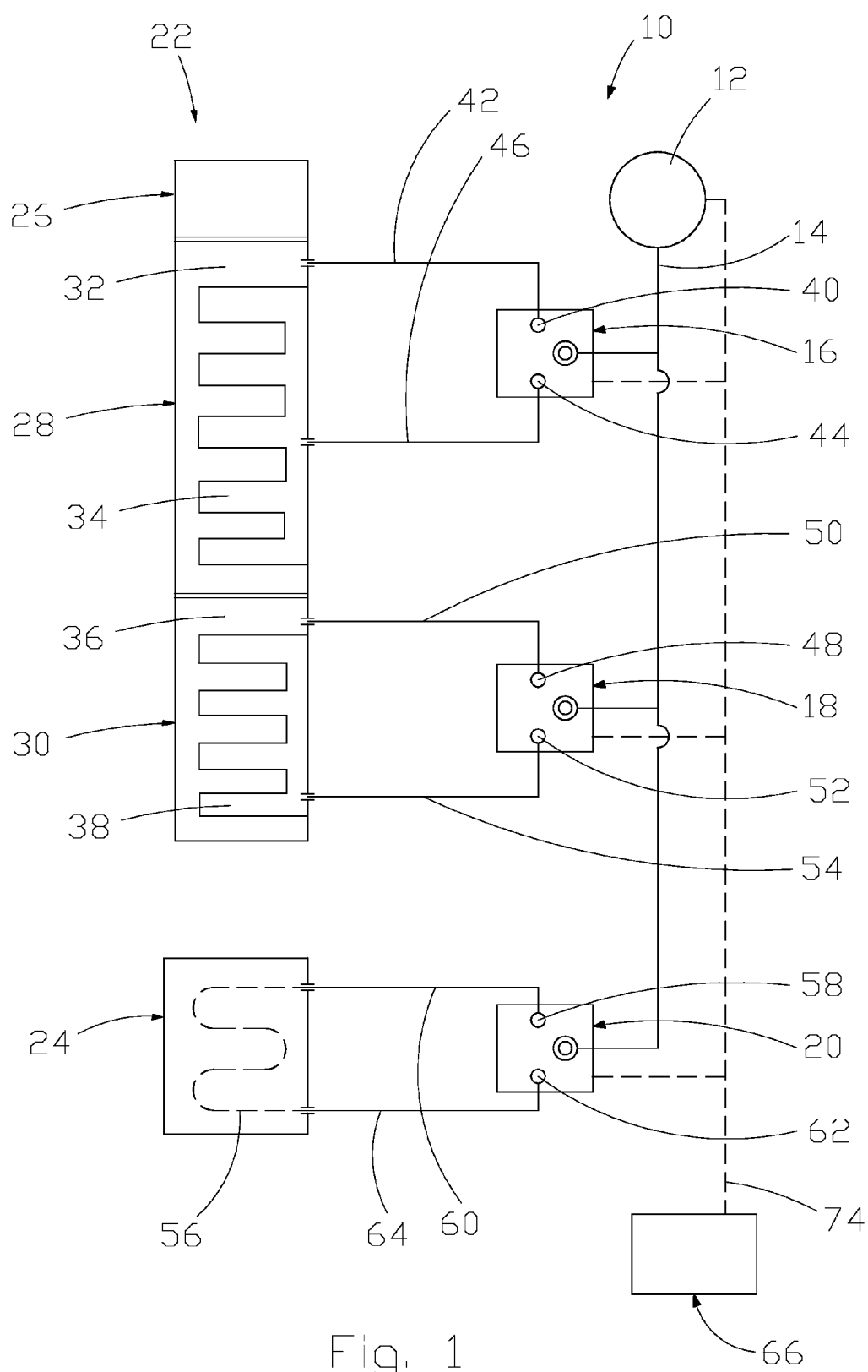


Fig. 1



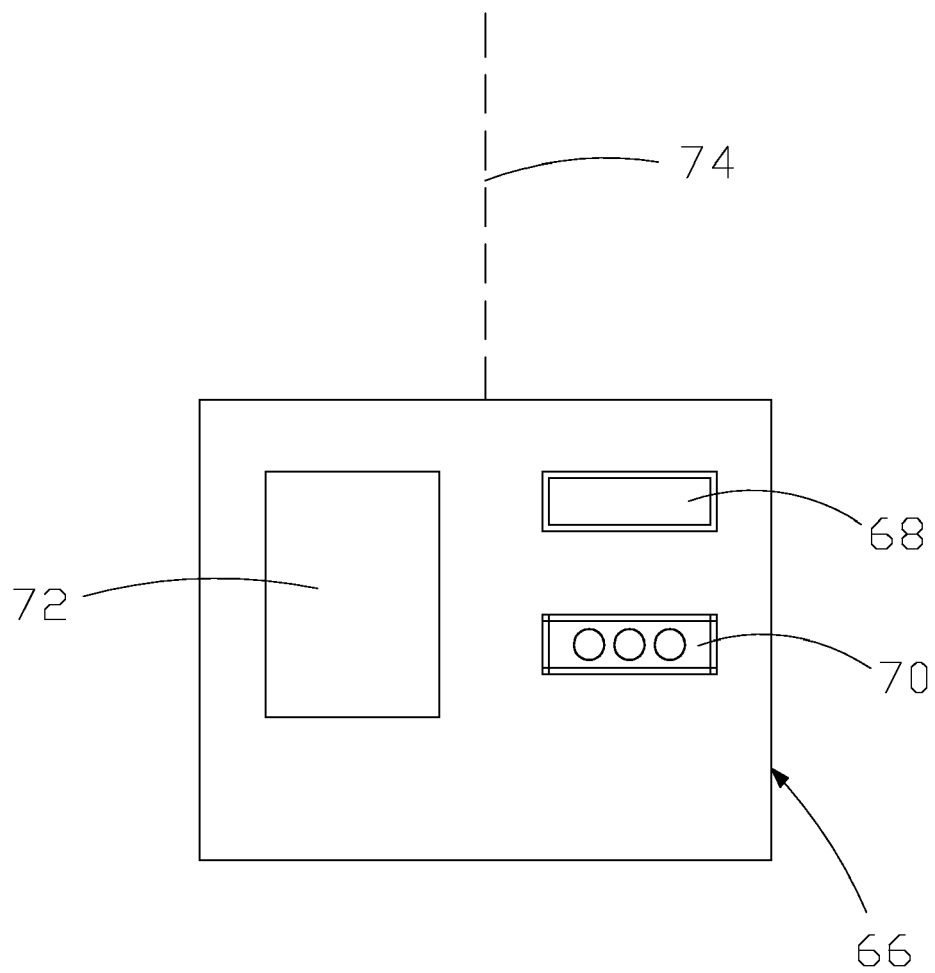


Fig. 2

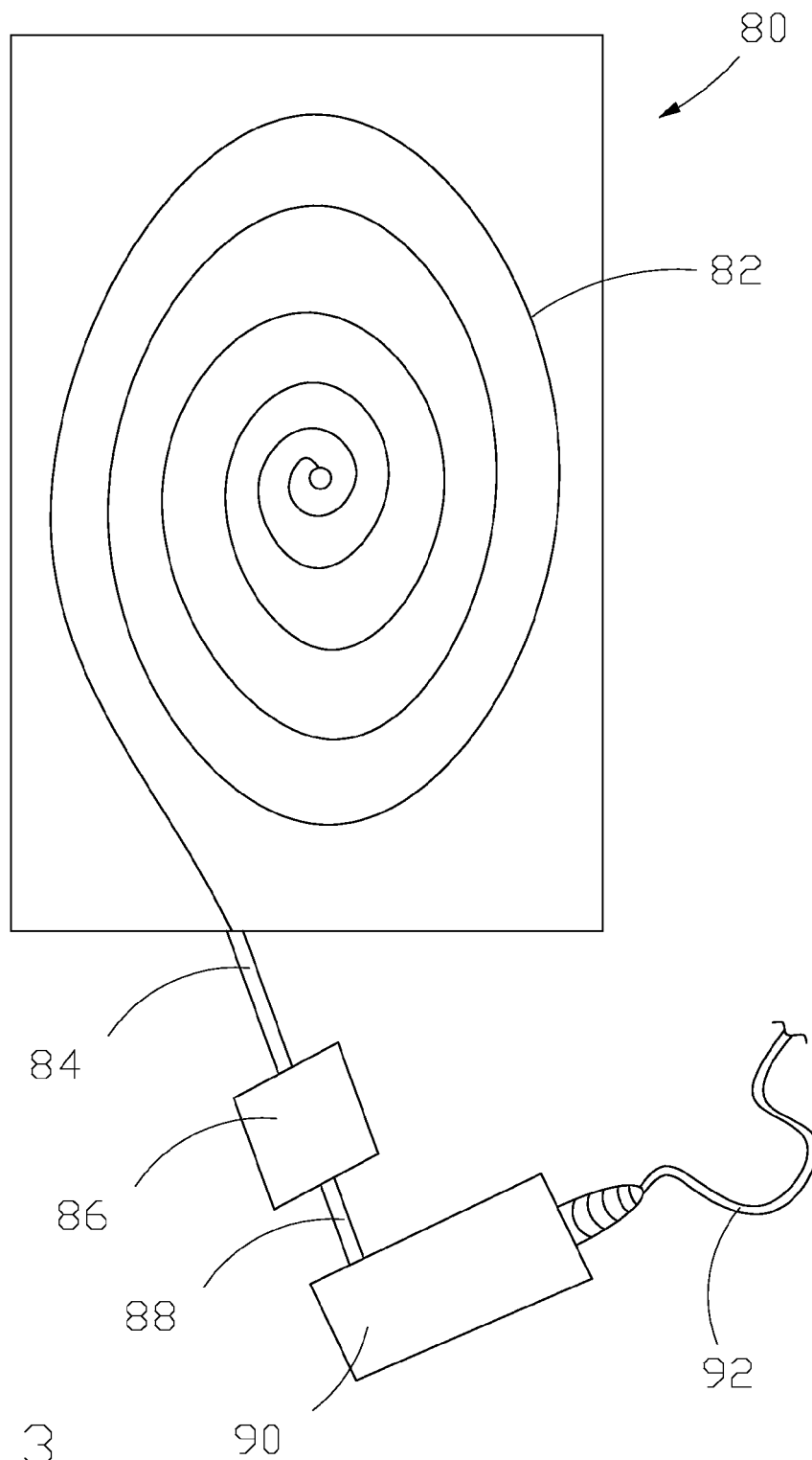


Fig. 3