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(54) System for disposal of condensate in air treatment systems

(57) The invention concerns a system (1) for disposal of condensate in air treatment systems characterized in that it comprises a vibration pump (4), provided upward with a liquid inlet conduct, and downward with a vibration dampening device (5), said vibration dampening device (5) providing a liquid exit conduct (9), communicating with a liquid drawing tube (10), and a closed conduct (8) for dampening vibrations.

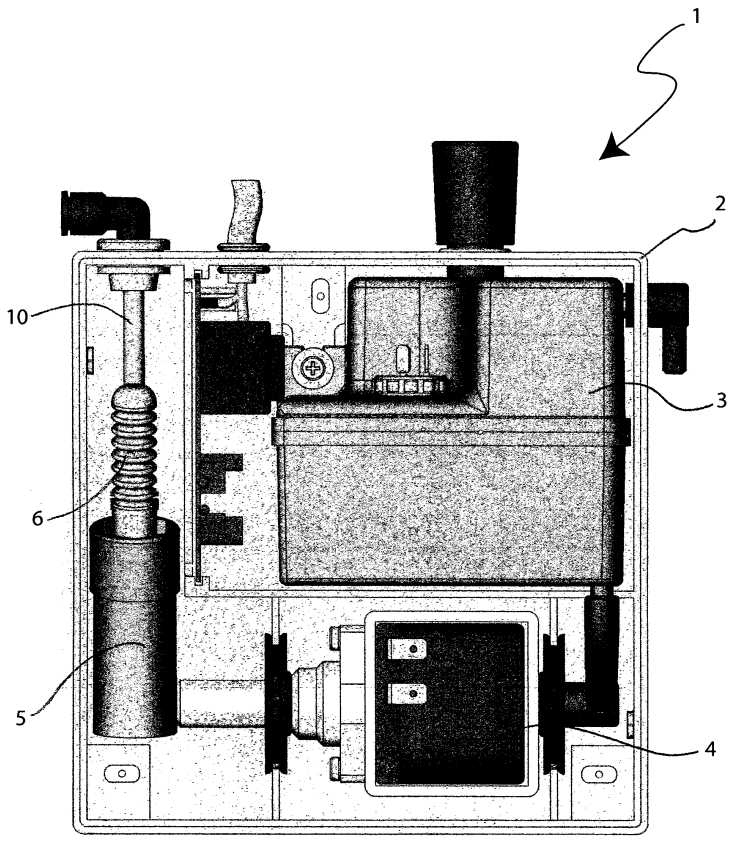

Fig. 1

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Description

[0001] The present invention relates to a system for disposal of condensate in air treatment systems.

[0002] More specifically, the invention concerns a system of the above kind permitting transferring far away condensate or to nebulize the same under optimum comfort conditions.

[0003] As it is well known, main object of an air conditioning system is that of actuating processes aimed to modify temperature and relative humidity values within an environment in order to ensure wellness and comfort conditions.

[0004] Particularly, in summer, when air is hot an humid, use of conditioning systems permits cooling and dehumidify air making it passing through a heat exchanger which is at a very low temperature.

[0005] As to the dehumidification, which is a feature of conditioning systems, when it is operating, thermal exchange battery of the inner unit quickly cools. Air passing through it, deposits over its humidity as frost droplets, thus being dry at the exit. When air-conditioner is switched off or is in a resting condition, battery heats up and these droplets fall down within the condensate discharge reservoir, and are thus ejected.

[0006] If air-conditioner is suitably sized with respect to the surrounding environment, humidity within the room varies between 40% and 60%, ideal values for our wellness.

[0007] All air-conditioners also have a specific dehumidification function, available when the outer temperature is higher than about 20 - 22 °C. Air-conditioner automatically carries out different very quick and short "cool" cycles, expelling humidity but not cooling environment.

[0008] Amount of condensate generated by a conditioning system usually is between 0.5 and 0.8 l/h for each frigorific kW.

[0009] Condensate formation is not only a problem for air conditioning systems, but also other kind of systems such as ventil-convector, condensation boilers, showcases, frigorific cell evaporators, machines for producing ice and beverage dispensers.

[0010] Problems connected with disposal of condensate in domestic air conditions can be in some case difficult to be solved, requiring technological solutions conforming to the different implant conditions.

[0011] In these cases, known solutions represent a partial solution to the problem, since they are characterized by scarce performances, particularly in case of tortuous paths far away from the walls, as well as by high costs.

[0012] The above problems have caused the proposal of solutions, not satisfying the user needing, with repeated discomfort, such as the needing of emptying the condensate container and/or not correct behavior with respect to neighborhoods.

[0013] In this situation, the Applicant has realized a system for disposal of condensate satisfying the more sophisticated needing.

[0014] Particularly, care has been put on the realization of a system characterized by a high sturdiness, low maintenance costs, rare user interventions, high reliability and pleasant aesthetical features.

[0015] Technological solutions presently available on the market have been realized to dispose condensate by the use of a pump block and a detection system. Integrated use of these components permits, lacking a slope, eliminating condensate channeling it toward a discharge conduct.

[0016] Among the known solutions, those from Sauermann, Effebu Group and Siccom can be mentioned.

[0017] Analyzing the available technology, it has been put into evidence that request from the specific users in the system for disposal of condensate are oriented toward searching technical solutions that, with reduced costs, permit improving discharge as far as prevalence, distance and aesthetic aspect are concerned.

[0018] In view of the above, the Applicant has based his studies for realizing the inventive system in order to obtain maximum prevalence, minimum acoustic and mechanical vibration pollution, minimum electric consumption, high reliability of the components, minimum dimensions, maximum rate of liquid eliminated and compatibility with automated manufacturing processes.

[0019] These and other results are obtained according to the invention suggesting a system for disposal of condensate in air treatment systems, providing a vibration pump comprising a vibration dampening device permitting conjugating pump prevalence features, thus being it possible realizing the system both for simple condensate disposal, and for nebulisation of the same in order to use them for other final uses, and maintaining a noise level which is absolutely compatible with the use of the air treatment system, and costs and manufacturing procedures absolutely easy and simple.

[0020] Main object of the present invention is that of realizing a system for disposal of condensate with small dimensions, powerful and flexible to use, and thus suitable for every king of air condizioner.

[0021] It is therefore specific object of the present invention a system for disposal of condensate in air treatment systems comprising a vibration pump, provided upward with a liquid inlet conduct, and downward with a vibration dampening device, said vibration dampening device providing a liquid exit conduct, communicating with a liquid drawing tube, and a closed conduct for dampening vibrations.

[0022] In a first embodiment of the system according to the invention, said vibration dampening device provides a dampening conduct, having an inlet end in correspondence of the inlet of liquid within the vibration dampening device,

close to the liquid outlet conduct, and the opposite end closed by a rubber element or like, having such flexibility features to permit it to vibrate after the activation of the vibration pump, said vibration pump being adjusted for a sufficient power for disposal of condensate far away.

[0023] In a second embodiment of the system according to the invention, said vibration dampening device provides a vibration dampening conduct having an inlet end in correspondence of the inlet of liquid within the vibration dampening device, close to the liquid exit conduct, and the opposite end closed, within said vibration dampening conduct being provided two elastic, hard, rubber material elements, and two elements or thicknesses, provided respectively above and below said two elastic, hard, rubber material elements, said vibration dampening conduct having dimensions larger than the total dimensions of the two rubber material elements and of the two elements or thicknesses, so as to permit relevant movement between said rubber material elements and said thicknesses under the vibrations induced by the vibration pump, said vibration pump being adjusted for a power sufficient to nebulize condensate far away.

[0024] According to the invention, said system provides, upward the vibration pump, a condensate container.

[0025] Furthermore, according to the invention, said system is provided within housing.

[0026] Still according to the invention, said system can comprise a mechanical device for automatic depressurization comprising a body, provided with a first connection with a pump, a second connection with a hydraulic circuit and a third discharge connection, within said body being provided a path communicating between said first connection and said second connection, respectively with the pump and with the circuit, and a second path communicating between said second connection and said third connection, respectively the connection with the circuit and the discharge connection, said device providing inner movable means for selective actuation of said first and of said second communication paths, respectively under high pressure and low pressure conditions.

[0027] Preferably, according to the invention, said selective actuation movable means of said two communication paths are comprised of a movable element, particularly a movable cylinder, housed within a seat communicating with said first connection with a pump, and shaped above to sealing couple when lifted by the pump pressure, the lower part of a second seat communicating with said third discharge connection.

[0028] Furthermore, according to the invention, a spring can be provided within said second seat, pushing said movable element in a rest position, when the pump is deactivated, thus freeing the second communication path.

[0029] Further particulars and advantages will be evident from the following specification, to be read along with the enclosed drawings, wherein it is represented (for illustrative and not limitative purposes) one of the preferred embodiments of a tap, and wherein:

figure 1 schematically shows a first embodiment of a system according to the invention;
figure 2 is a perspective view of a particular of the system of figure 1;
figure 3 is a lateral view of particular of figure 2;
figure 4 is a perspective view from above of particular of figure 2;
figure 5 is a tops view of particular of figure 2;
figure 6 is a section view of particular of figure 2 taken along line A-A of figure 5;
figure 7 schematically shows a second embodiment of a system according to the invention;
figure 8 is a perspective view of a particular of the system of figure 7;
figure 9 is a lateral view of particular of figure 8;
figure 10 is a perspective view from above of particular of figure 8;
figure 11 is a section view of particular of figure 8;
figure 12 is a top view of a first embodiment of the device according to the invention;
figure 13 is a section view taken along line I-I of figure 12;
figure 14 shows device of figure 12 with the high pressure discharge path evidenced; and
figure 15 shows device of figure 12 with the low pressure discharge path evidenced.

[0030] Observing first figures 1 - 6 of the enclosed drawings, it is shown a first embodiment of a system according to the invention, particularly suitable for disposal of condensate produced in the air treatment system permitting its conveying far away.

[0031] The system, generically indicated by reference number 1, provides a housing 2, within which there is provided the condensate container 3, placed at the inlet of the air treatment system (not shown), from which condensate is passed to a vibration pump 4, downward which a device 5 is provided for conveying condensate, and having a vibration dampening device 6 (said device 5 and the relevant dampening device 6 will be described in greater detail in the following).

[0032] As already mentioned, pump 4 is a compression pump. It is a kind of pump that, according to the calibration, can send condensate very far away. However, it creates too noise for the specific use.

[0033] In case it is wished realizing, as for the embodiment shown in figures 1 - 6, a system according to the invention simply eliminating condensate, it will be sufficient calibrating pump at about 6 - 8 atm.

[0034] Device 5 for conveying condensate, specifically shown in figures 2 - 6, provides an opening 7 for entrance of

condensate, communicating with pump 4, a conduct 8 for dampening vibrations, at the end of which it is provided the vibration dampening device 6, which is made up of rubber, ad a conduct 9 for evacuating condensate, which is coupled with an exit tube 10 (figure 1).

[0035] Condensate arriving from pump 4 enters within device 5, through the opening 7. Condensate pressure makes it being conveyed through conduct 9 toward tube 10 that will bring the same, thanks to the pump 4 pressure, to the final destination. Vibration dampening occurs within conduct 8, said vibrations being absorbed by rubber dampening element 6, which vibrates thanks to the intrinsic features of material and to its shape.

[0036] Thus, it is obtained a system for disposal of condensate permitting evacuating the same condensate at a great distance, without influencing noise of the air treatment system (that would not be acceptable), and without increasing costs.

[0037] System according to the invention can be provided in an air treatment system or it can be retro-fitted into existing systems.

[0038] Coming now to observe figures 7 - 11, it is shown a second embodiment of the system according to the invention. Parts of figures 7 - 11 similar or identical to the parts of the previous embodiment will be indicated by the same references.

[0039] Solution shown in the figures has been realized to nebulize condensate, said nebulisation being usable for specific applications, such as wellness centers, watering plants and flowers, ecc.

[0040] A higher pressure is necessary in order to obtain nebulisation, so that in this case it is necessary calibrating vibration pump 4 at about 20 - 25 atm.

[0041] Obviously, vibrations are higher, and vibration dampening device5 must be able dampening these higher vibrations, always with a high silence level.

[0042] In this case, device 5 provides a pair of spheres 11 within the conduct 8, said spheres 11 being made up of plastic material with a set Shore hardness grade, and provided between two thickness elements 12, made up as well of plastic material.

[0043] Thickness elements 12 - spheres 11 assembly has such dimensions to leave a space 13 within the conduct 8.

[0044] Pump 4 vibrations are absorbed within conduct 8 by spheres 11, that can hit each other and thanks to the material by which they are realized they absorb all the pump 4 vibrations.

[0045] By the suggested system, it is possible ejecting or nebulizing water along tortuous paths even at more than 100 m.

[0046] Furthermore, the system suggested is fully automatized, being self-managed, thus being safe, reliable and not expensive.

[0047] Observing now figures 12 - 15, it is shown a device according to the invention, generically indicated by reference number 100, providing exploiting pressure variations of the hydraulic circuit in order to manage movable members for selective opening/closure of liquid inlet channels.

[0048] Device 100 comprises a body 102, provided with three outer connections, respectively the first outer connection P, connecting device 100 with the pump (not shown), the second outer connection S, connecting device 100 with the low pressure liquid evacuation path, and the third outer connection U, connecting device 100 with the hydraulic circuit/nozzle (high pressure evacuation path) (not shown specifically in the drawings).

[0049] Within said body 102 of device 100 it is provided a movable element 103, housed within a seat 104.

[0050] Upper part of said movable element 103 is so shaped to interfere with the inlet of a second upper seat 105, thus preventing passage under set conditions that will be individuated in the following.

[0051] A spring 106 is housed within said seat 105.

[0052] In the rest condition of the system providing device 100 according to the invention, with the pump deactivated, device 100 communicates exit S with exit U (see figure 15). In these conditions, hydraulic circuit is connected with the low pressure evacuation path.

[0053] When pump is switched on, after a short hydrodynamic transient period, device 100 according to the invention, due to the pressure of liquid entering from outlet P, pushes movable element 103 upward, closes passage toward outer connection S, putting connection P into communication with outer connection U (see figure 14).

[0054] In this situation, low pressure evacuation path of figure 15 is closed; pump is connected with hydraulic circuit/nozzle (high pressure evacuation path).

[0055] When the pump is deactivated, device 100 according to the invention, after a short transient period, eliminating pressure from connection P, which was maintaining the movable element 103 lifted, also thanks to the spring 106 action, quickly pushing movable element downward, opens again low pressure evacuation path shown in figure 15, thus communication outer connection U with outer connection S.

[0056] Thus, a very short depressurization transient period of the hydraulic circuit is obtained, preventing the malfunctioning of the nebulisation/atomization system.

[0057] Summarizing, device 100 according to the invention has two operative conditions, respectively:

Mode	Outer connections open	Connection closed	Pump mode	Hydraulic circuit exercise pressure
1 (rest)	U - S	P	OFF	Almostate atmospheric pressure

(continued)

Mode	Outer connections open	Connection closed	Pump mode	Hydraulic circuit exercise pressure
2	P - U	S	ON	Standard pressure

[0058] By the structure of device 100 according to the invention, passage from mode 1 to mode 2 is fully automatic, being it regulated by hydraulic circuit pressure variations induced by pump exercise conditions.

[0059] Particularly, when the pump works, a positive variation of hydraulic circuit exercise pressure is observed (dP (t)dt>0), while, on the contrary, when pump switches off, a negative variation of the exercise pressure is observed (negative derivate, dP(t)/dt<0).

[0060] Device 100 according to the invention as shown in the enclosed figures exploits said features to handle automatic opening and closure of the connection paths U, P and S by movement of movable element 103, and with the help of the spring.

[0061] The above is obtained by the movable element 103 that, if an increase of the exercise pressure of the hydraulic circuit occurs, caused by the pump activation, moves upward, charging the spring 106 and obstructing the outer connection S (figure 13). Under this operation mode, connection P is connected with connection U, connection S is obstructed by the upper part of movable element 103 (designed in such a way to ensure a suitable hydraulic sealing against seat 105) and spring 106 is under load. Movable element 103 is in a balanced condition since hydraulic circuit pressure exerts an equal and opposite force with respect to the force exerted by said spring 106 on the lower part of the element 103.

[0062] When pump is deactivated, hydraulic circuit exercise pressure, and thus force exerted on the lower part of movable element 103, starts reducing. In this condition, movable element 103 is no more in an equilibrium condition since force of (still under load) spring 103 is predominant with respect to force exerted on its lower part by residual pressure. Consequently, spring 106 starts unloading and movable element 103 starts moving downward opening path S (which was previously obstructed) consequently permitting opening of low pressure evacuation path (figure 15).

[0063] Therefore, device 100 according to the invention behaves in as a depressurization solenoid valve but, differently with respect to the latter, handles in a fully automatic way the opening/closure of low pressure evacuation path, without the need of an electric actuation signal.

[0064] Rigorous analytical relations obtained on the basis of the hydrodynamic theory integrated with coefficients obtained by strict tests permitted properly dimensioning components of device (as far as profiles, dimensions and mechanical tolerances are concerned) ensuring operative reliability as well as its optimization of performances (as far as activation of depressurization process, liquid flow rate disposed of by the nebulisation(pressurization system, hydraulic circuit exercise pressure are concerned).

[0065] The structure obtained is quite small, simple to be realized and easily industrialized, being it possible keeping manufacturing costs low.

[0066] The present invention has been described for illustrative but not limitative purposes, according to its preferred embodiments, but it is to be understood that modifications and/or changes can be introduced by those skilled in the art without departing from the relevant scope as defined in the enclosed claims.

Claims

1. System for disposal of condensate in air treatment systems **characterized in that** it comprises a vibration pump, provided upward with a liquid inlet conduct, and downward with a vibration dampening device, said vibration dampening device providing a liquid exit conduct, communicating with a liquid drawing tube, and a closed conduct for dampening vibrations.

2. System for disposal of condensate in air treatment systems according to claim 1, **characterized in that** Said vibration dampening device provides a dampening conduct, having an inlet end in correspondence of the inlet of liquid within the vibration dampening device, close to the liquid outlet conduct, and the opposite end closed by a rubber element or like, having such flexibility features to permit it to vibrate after the activation of the vibration pump, said vibration pump being adjusted for a sufficient power for disposal of condensate far away.

3. System for disposal of condensate in air treatment systems according to claim 1, **characterized in that** said vibration dampening device provides a vibration dampening conduct having an inlet end in correspondence of the inlet of liquid within the vibration dampening device, close to the liquid exit conduct, and the opposite end closed, within said vibration dampening conduct being provided two elastic, hard, rubber material elements, and two elements or thicknesses, provided respectively above and below said two elastic, hard, rubber material elements, said vibration

dampening conduct having dimensions larger than the total dimensions of the two rubber material elements and of the two elements or thicknesses, so as to permit relevant movement between said rubber material elements and said thicknesses under the vibrations induced by the vibration pump, said vibration pump being adjusted for a power sufficient to nebulize condensate far away.

4. System for disposal of condensate in air treatment systems according to one of the preceding claims, **characterized in that** said system provides, upward the vibration pump, a condensate container.

5. System for disposal of condensate in air treatment systems according to one of the preceding claims, **characterized in that** said system is provided within a housing.

6. System for disposal of condensate in air treatment systems according to one of the preceding claims, **characterized in that** it comprises a mechanical device for automatic depressurization comprising a body, provided with a first connection with a pump, a second connection with a hydraulic circuit and a third discharge connection, within said body being provided a path communicating between said first connection and said second connection, respectively with the pump and with the circuit, and a second path communicating between said second connection and said third connection, respectively the connection with the circuit and the discharge connection, said device providing inner movable means for selective actuation of said first and of said second communication paths, respectively under high pressure and low pressure conditions.

7. System for disposal of condensate in air treatment systems according to claim 6, **characterized in that** said selective actuation movable means of said two communication paths are comprised of a movable element, particularly a movable cylinder, housed within a seat communicating with said first connection with a pump, and shaped above to sealing couple when lifted by the pump pressure, the lower part of a second seat communicating with said third discharge connection.

8. System for disposal of condensate in air treatment systems according to claim 6 or 7, **characterized in that** a spring is provided within said second seat, pushing said movable element in a rest position, when the pump is deactivated, thus freeing the second communication path.

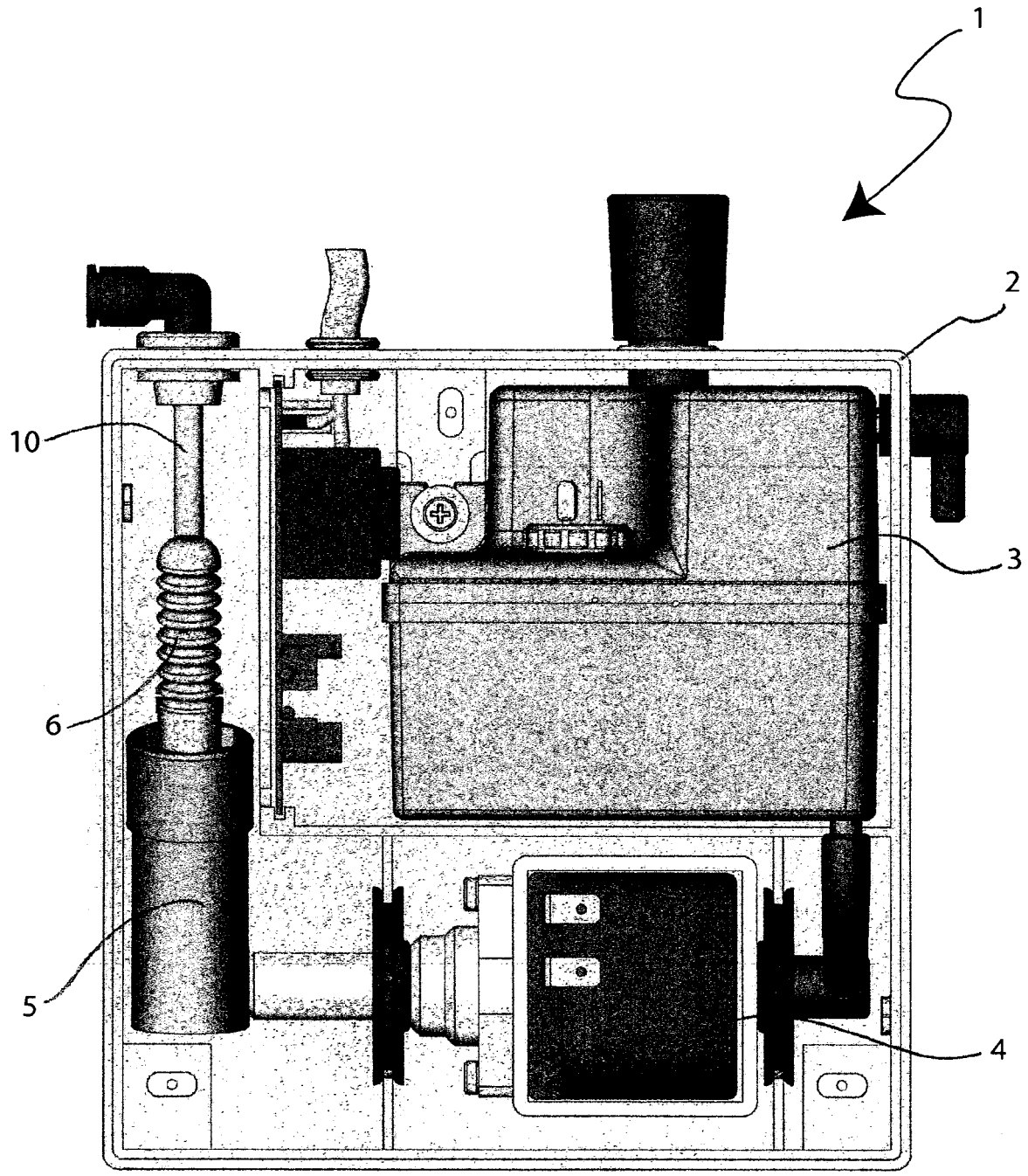

Fig. 1

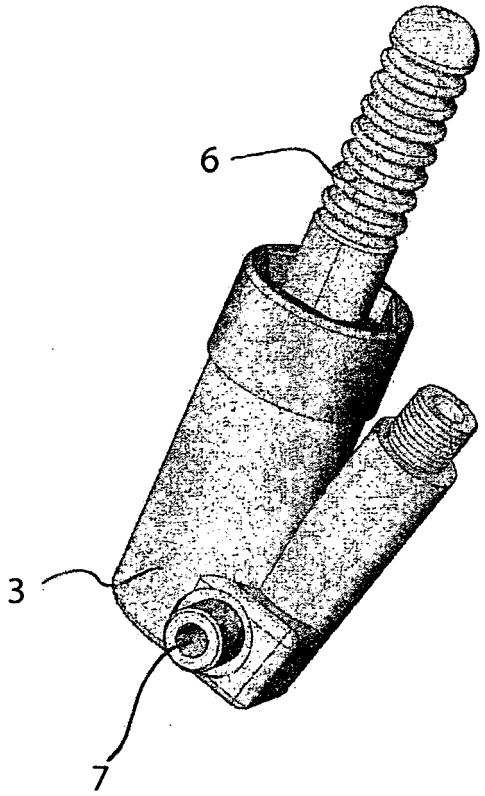

Fig. 2

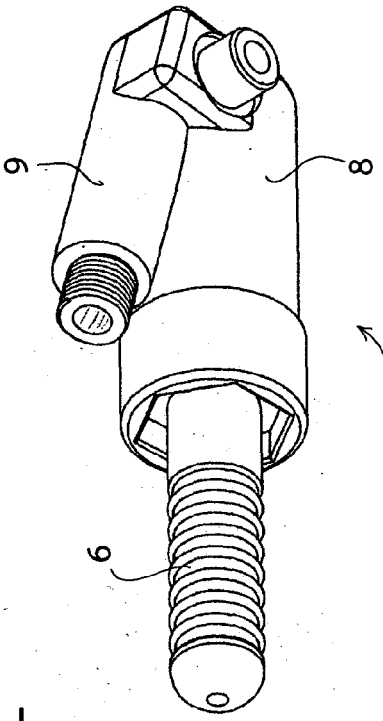

Fig.4

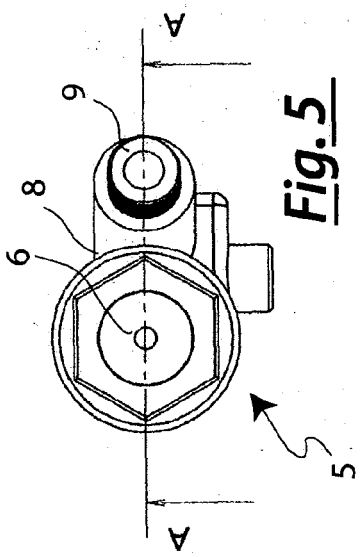

Fig.5

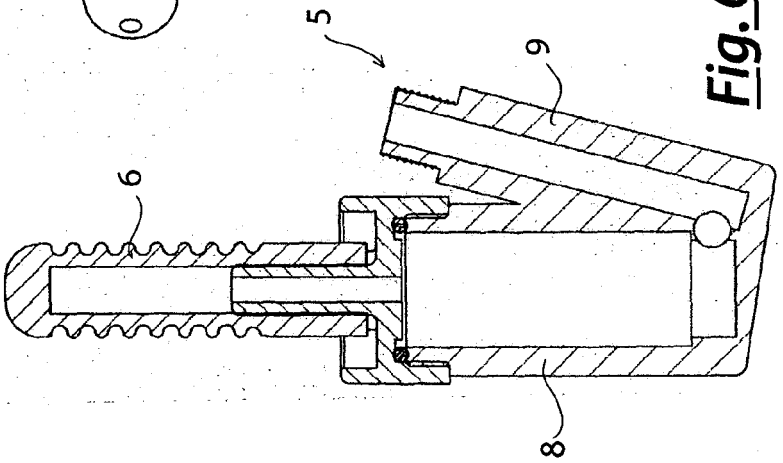

Fig.6

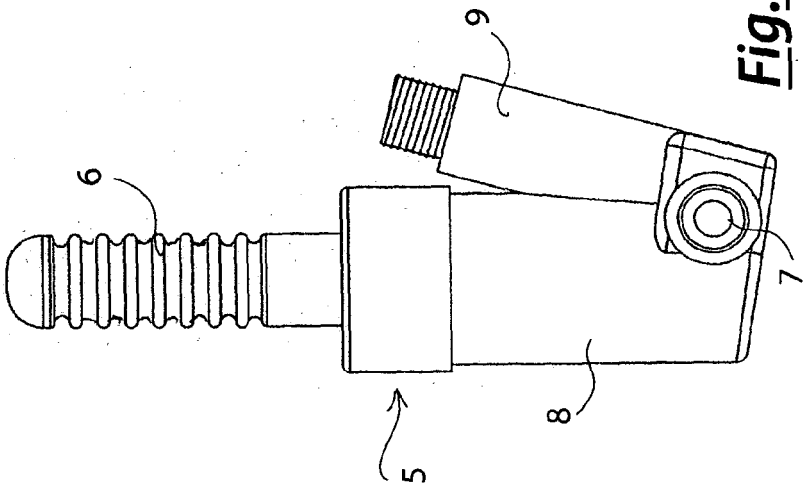

Fig.3

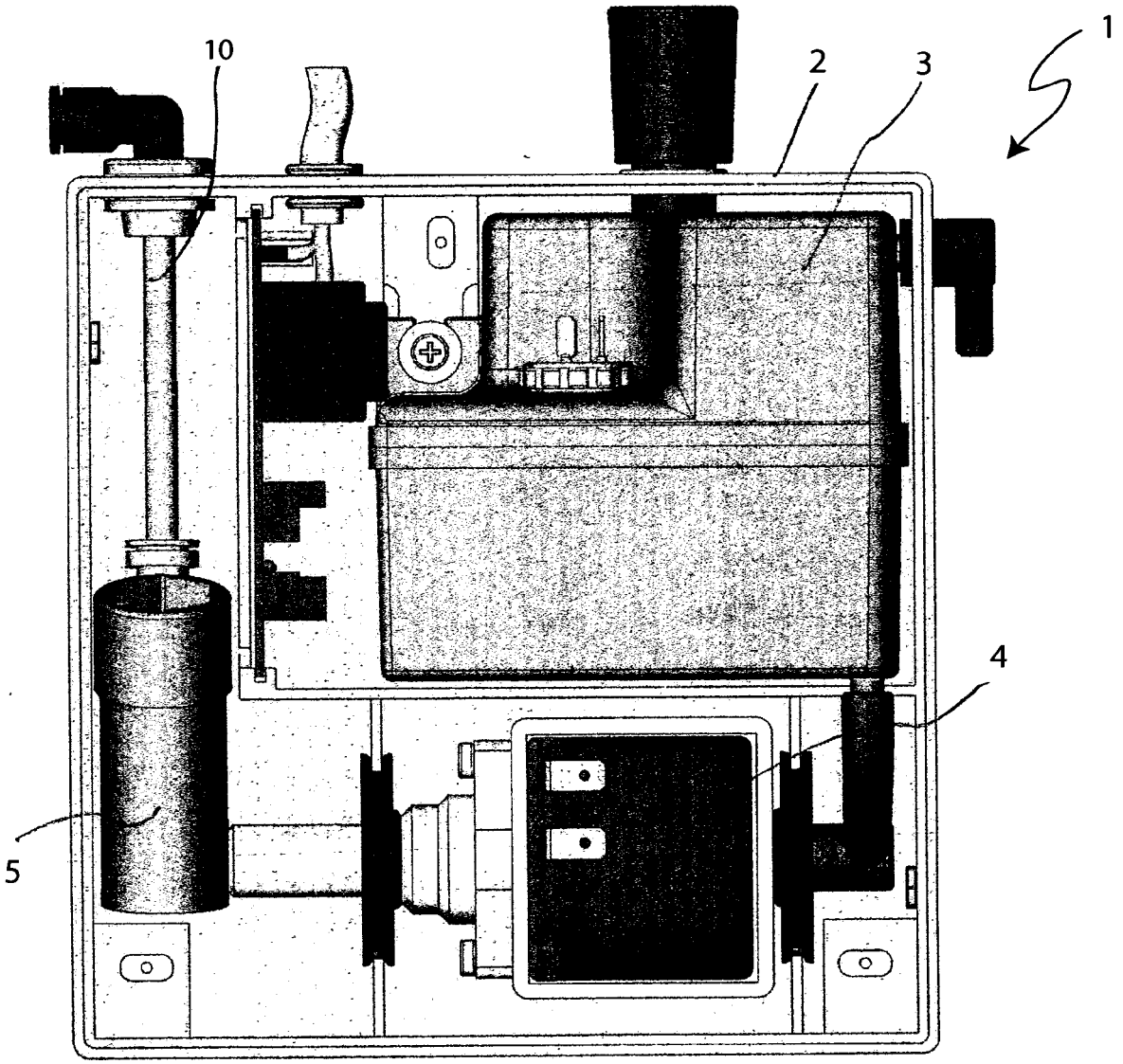

Fig.7

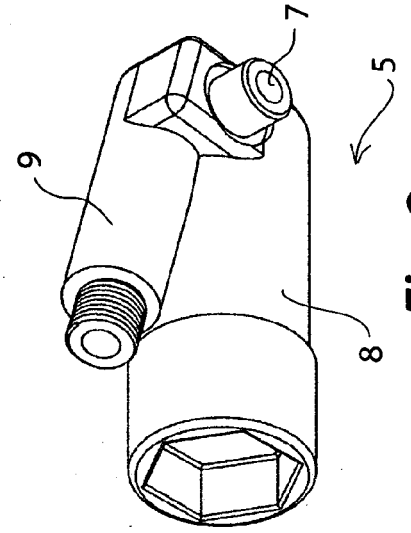

Fig.8

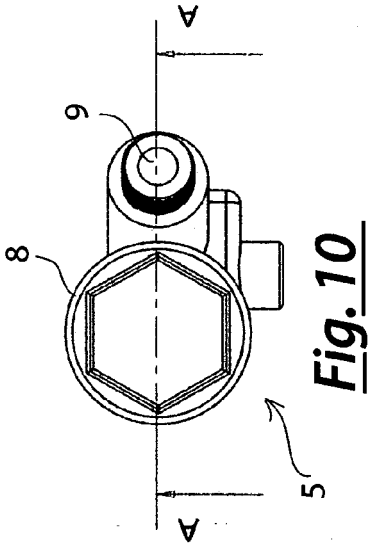

Fig.10

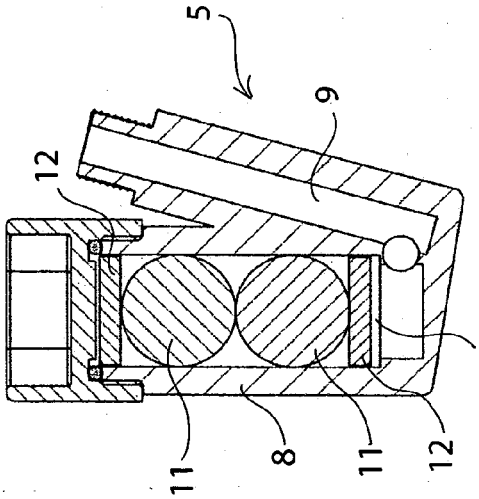

Fig.11

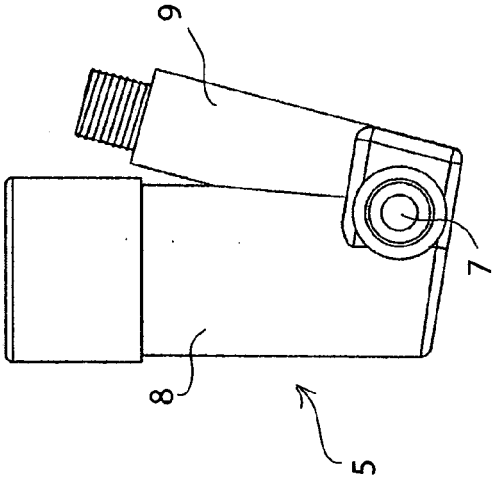

Fig.9

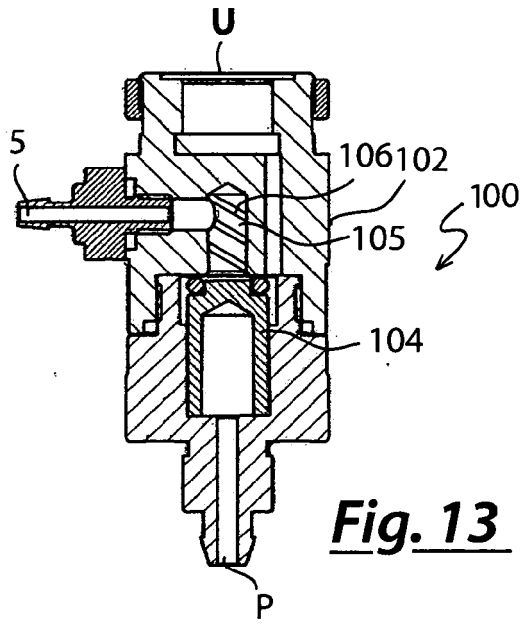

Fig. 13

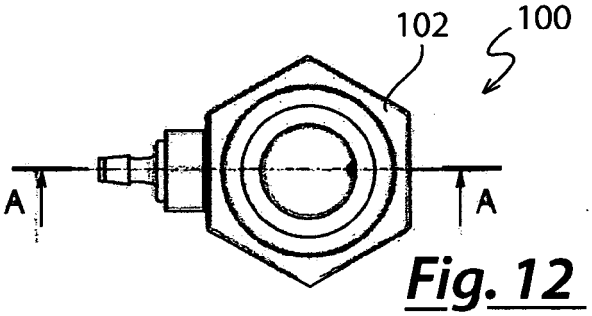

Fig. 12

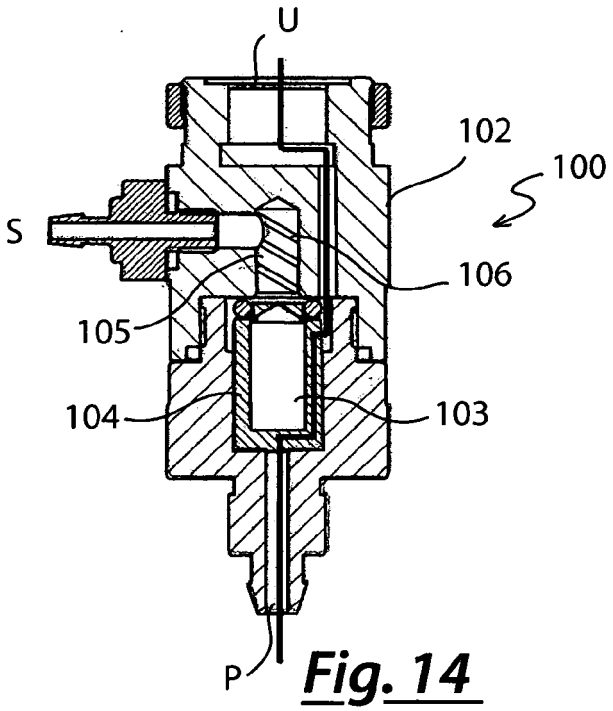

Fig. 14

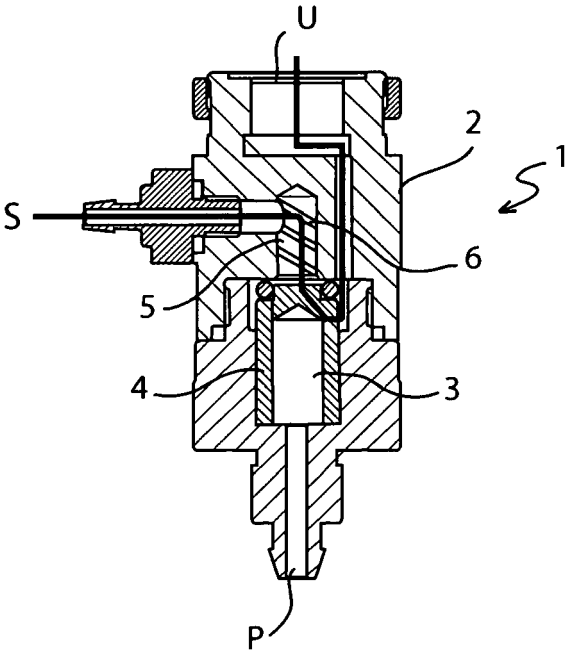

Fig. 15