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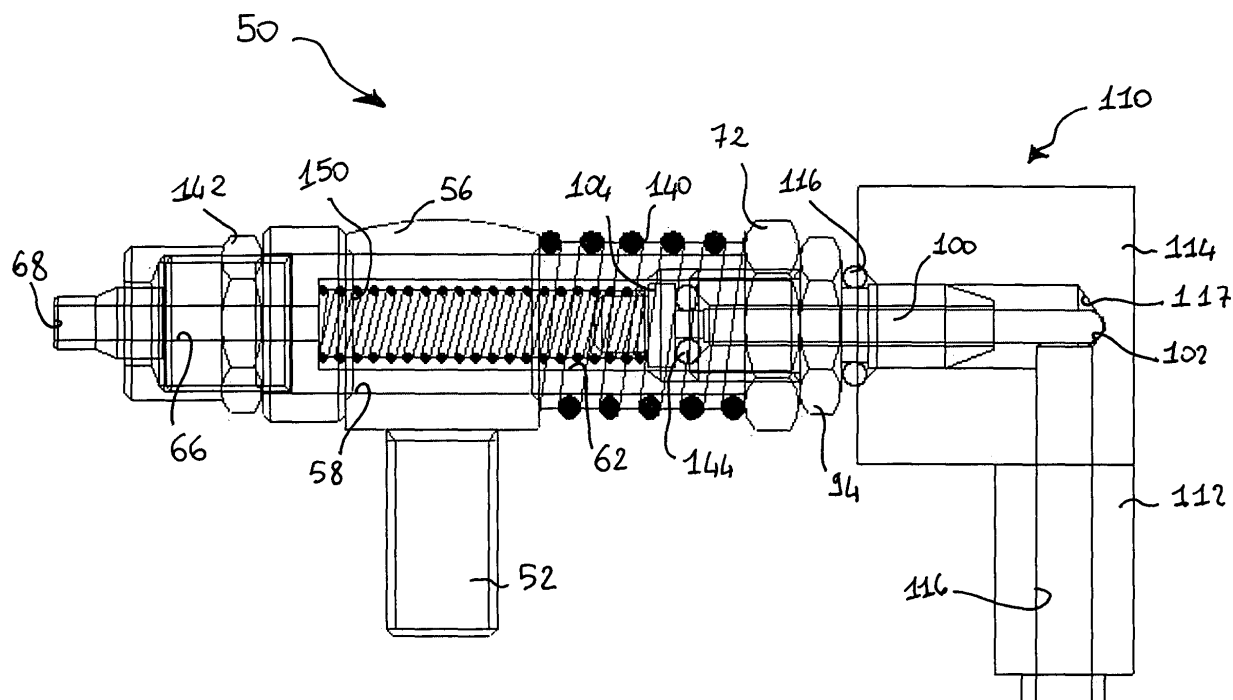
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(54) System, device and process for the lubrication of leaf mechanisms

(57) A delivery system for lubrication of the doors of a railway carriage comprises a tank (10) in which are provided one or more outlet openings (14) connected to the said doors and an inlet opening (16) for placing a lubricating substance within the tank. The system is connected to a source of compressed air communicating with

the interior of the said tank (10) through an opening (16). In use the source of compressed air is selectively activated on the basis of a predetermined number of opening and/or closing movements of each door in order to permit selective delivery of the said lubricating substance from within the tank (10) to each door of the railway carriage.

FIG. 2



Description

[0001] This invention relates to the field of the lubrication of closures and more specifically relates to a device for lubricating a closure, a process for the lubrication of closures and a delivery system for implementing such a process. This invention has been developed with particular reference to, but without restriction to, the lubrication of doors which may or may not be opened automatically. According to one of the embodiments of this invention the lubrication device and process is applied to the lubrication mechanisms of closures on board a means of transport, in particular a railway carriage.

[0002] Every closure, for example doors, gates, and the like, comprises an opening portion, generally referred to as a leaf, and a fixed portion, generally referred to as a frame, on which the opening portion is mounted. The frame comprises mechanisms which make it possible for the leaf to perform a movement from a closed position to an open position and/or vice versa. In the case of swinging doors the leaf is hinged to the frame through hinges and can rotate about a vertical axis. In the case of sliding doors the leaf moves on horizontal guide means. In order to permit correct and efficient opening and closing movement of the leaf, closure mechanisms, generally the points of contact between the leaf and the frame, must not act as friction points. Following prolonged use closure mechanisms may deteriorate, or may become more easily fouled by atmospheric agents, increasing friction and rendering opening and closing movements of the closure more difficult.

[0003] Trains intended for passenger transport generally comprise a plurality of carriages connected together, each of which is provided with access doors for passengers, dividing doors between the various parts of the carriage and a communicating door at each end for access to the adjacent carriage. Most of these doors are of the sliding type, normally operated through an automated mechanism which causes them to slide. Because of frequent use and the adverse atmospheric conditions in which these closures are used, the slide mechanisms require frequent maintenance, for example lubricating operations, and periodical checks to check that they are in proper working order.

[0004] One of the main disadvantages of maintenance processes of the known type comprises the great amount of time which is necessary in order to carry out the operations of lubricating every opening mechanism.

[0005] Another disadvantage of maintenance processes of the known type lies in the difficulty of performing the operations of lubricating every mechanism, which must often be carried out in areas which are hard to reach, and which are in any event inconvenient for the operator. This situation often gives rise to leaks of lubricating fluid from the mechanism, with consequent spillage of the fluid in the vicinity of the door and, in addition, the risk of dirtying passengers.

[0006] Another disadvantage derives from the need to

have to carry out the operations of lubricating each mechanism when the means of transport is not in motion, that is during prolonged stops to reduce the risks of overflow described above.

[0007] The object of this invention is to overcome the disadvantages of processes of the known type, providing a process for the lubrication of closures and a delivery system to carry out such a process as defined in the following claims.

[0008] Another object of this invention is to provide a process which is easy to implement, which results in a high saving of time and costs, and which guarantees excellent results even after a prolonged period of time.

[0009] A further object of this invention is to provide a delivery system for lubricating substances which is simple, easy and economical to manufacture, convenient and quick to maintain, and which has the properties of appreciable reliability even after prolonged use over time.

[0010] Another object of this invention is to provide a delivery process and system for implementing such a process which makes it possible to lubricate the opening mechanisms of the doors of means of transport under any conditions, for example even when the means of transport is in movement, and at any time of day, also for example during the night.

[0011] According to one of the preferred embodiments of this invention the tank containing a lubricating substance may be directly connected to the compressed air lines already present on the means of transport, and the circuits controlling the system according to this invention may be incorporated into the electronic circuitry already present on board the means of transport.

[0012] One of the advantages of this invention lies in the extreme ease with which it can be incorporated into the existing systems for operating and controlling the doors of a railway carriage.

[0013] Other advantages and characteristics of the present invention will become clear from the following detailed description which is given with reference to the appended drawings which are provided purely by way of non-limiting example and in which:

- Figure 1 is a diagrammatical view in plan of the delivery system according to this invention,
- Figure 2 is a view in cross-section of the device for delivery lubricating substance according to this invention,
- Figures 3 and 4 are two frontal and cross-section views of a fixing member for the delivery device;
- Figure 5 is a diagrammatical view in cross-section of a member operating the delivery device, and,
- Figures 6 to 8 are diagrammatical views in cross-section of the main components of the delivery device.

[0014] With reference now to Figure 1, a delivery device for the lubrication of closures according to this invention comprises means for the distribution of a lubricating substance which are fluidly connected to delivery

means 50 located in the proximity of a closure requiring lubrication. In particular the distribution means comprise a tank 10 to contain a lubricating substance such as, for example, lubricating oil or similar substances, and a plurality of pipe members, for example pipes of flexible material 12, located between the said tank 10 and delivery means 50.

[0015] Tank 10, of the leaktight type, comprises a plurality of outlets connected to distribution pipes 12 to permit the lubricating substance to leave tank 10 towards delivery means 50 when in use. Flow control members 14 may be connected to the outlets of tank 10 in such a way as to control the pressure of the exiting lubricating substance.

[0016] Tank 10 also comprises a main inlet 16, generally but not necessarily of larger dimensions than the outlets, which in use is used to fill tank 10 with the lubricating substance. Main inlet 16 can be selectively opened through a closure member, for example a cap, so as to ensure that tank 10 is leaktight. The dimensions of opening 16 are such as to permit the possible use of funnel means to prevent part of the lubricating substance falling outside tank 10 fouling the surrounding area when the lubricating substance is transferred into the tank from the containers in which it is transported on the means of transport.

[0017] Tank 10 also comprises a further inlet 18 for the entry of an activating fluid, for example compressed air, into tank 10 when in use. Inlet 18 is connected by further pipes to a source of compressed air such as, for example, a compressor, so that the said compressed air can be delivered into tank 10 when in use. According to a particularly advantageous feature of this invention, the source of compressed air may be directly branched from the compressed air line 20 already present on board the means of transport. In this case a control member, for example, but not restricted to, an electrically-operated valve 22 capable of selectively diverting compressed air towards opening 18 and therefore into tank 10 is present on the said branch. In this way it is possible to reduce the components of the lubricating system, reducing both the dimensions of the system and ordinary and extraordinary maintenance operations on its components.

[0018] Of course the shape and dimensions of the tank, and the number and arrangement of inlets and outlets described and illustrated here, may vary widely without thereby going beyond the scope of this invention.

[0019] The system for the lubrication of closures according to this invention also comprises control means which make it possible to control and adjust the functioning of the system when in use in such a way as to implement a process for lubricating the closures according to this invention.

[0020] The control means comprise, for example, sensor means 15 capable of detecting the level of fluid present within tank 10. Because the sensor means are of a known type they will not be further described below, but their features are considered to be incorporated into

this document through reference. A person skilled in the art could easily identify different types of sensor means of known type and select those most suitable, on the basis, for example, of the specific characteristics of the lubricating substance present within the tank.

[0021] The control means also comprise means for detecting the opening and closure of each closure, and in particular comprise one or more electrical contact devices connected to each closure, for example, but not restricted to, an electrically-operated valve controlling opening and closing of the closure in order to count the number of opening and closing movements performed by such a closure. The counter devices may be separate and each connected to an individual closure or, more easily, a single counter device 32 will be able to detect the opening operations of each door separately.

[0022] The control means also indicator means to indicate the operating status of the entire system. The indicator means are also used to provide information on the filling level of the tank and on any malfunction of the system so as to permit an operator to take action. Again in this case, according to a particularly advantageous feature of this invention, the indicator means may be incorporated in the control and indicator system already present on board the means of transport.

[0023] The control means finally comprise an electronic or electromechanical circuit 30 capable of detecting and processing a series of signals originating from the system, and of adjusting and controlling its operation. Circuitry 30 is connected to the sensor means, to the source of compressed air, and to the indicator means.

[0024] According to one of the preferred embodiments of this invention the system for the lubrication of closures is installed on board a means of transport comprising one or more closures, and in particular on board a carriage of a railway train comprising a plurality of sliding doors 40. A system capable of lubricating the four sliding doors normally present within an individual railway carriage is illustrated in the figures. Each opening 14 is in fact capable of feeding a pipe 12 which is connected at one end to the delivery means 50 of a door. Of course it is possible to vary the number of doors which have to be lubricated by varying the number of pipes, just as it is possible to apply the system according to this invention to the other closures present in a railway carriage or to any other means of transport.

[0025] With reference now to Figures 2 to 8, delivery means 50 according to this invention comprise a delivery device and supporting means to support the delivery device. The supporting means comprise a supporting member 52, which is substantially "T"-shaped, with a base portion 54 and an upper portion 56 within which there is a through hole 58.

[0026] The delivery device comprises a principal body 60, illustrated in Figure 6, of a shape which is elongated in a preferential direction, within which there is provided a chamber 62 of substantially tubular shape. The principal body comprises an inlet 68 communicating with

chamber 62 through a first passage 66 and an outlet 67 communicating with the said chamber 62 through a second passage 65 comprising an inclined wall 64 having a threaded surface. Extremity 63 of principal body 60 comprises an external threaded surface while the opposite extremity 70 is engaged by a connecting member, for example a nut 72.

[0027] The delivery device also comprises a head 80, illustrated in Figure 7, within which there is provided a conduit 90 passing from one extremity to the other. A first inlet extremity 86 comprises an opening 88, which is substantially funnel-shaped, with an outwardly inclined wall 89. On the outer surface of extremity 86 there is provided a thread which is particularly suitable when in use for engaging head 80 with the inclined wall 64 of principal body 60. The opposite outlet end 82 of head 80 is substantially of frustoconical shape and comprises an inwardly inclined wall 84. Head 80 also comprises a connecting member, for example a threaded nut 94.

[0028] The delivery device also comprises selective closure means, for example, but not restricted thereto, a pin 100, illustrated in Figure 8, with a first curved extremity 102 and with the other extremity comprising a ring-shaped portion 104 and a mouth 106.

[0029] The delivery device according to this invention also comprises a delivery activation member 110, preferably but not restrictively fixed to the frame of the closure. The activating member, illustrated in Figure 5, comprises a principal body substantially of an upside-down "L" shape with a lower appendage 112 and an upper portion 114. Corresponding holes 118 and 116 communicating with each other are provided in upper appendage 114 and lower appendage 112. Upper hole 118 comprises a rear frontal wall 117 and is particularly suitable when in use for engaging the delivery device, while lower hole 116 is particularly suitable when in use to be in fluid communication with the pipes lubricating the closure and/or with the portions of the closure which are to be lubricated.

[0030] With reference now to Figure 2, the manner in which the delivery device is assembled will be explained below. Supporting member 52 is secured to the frame of a closure, such as for example a sliding door 40 of a vehicle. Principal body 60 is inserted in through hole 58 in supporting member 52. A resilient member, for example a spring 140, is located in an abutting fashion between the extremity 70 of principal body 60 and supporting member 52. An immobilising means, for example a further nut member 142, is located on the opposite extremity and screwed to threaded extremity 63 of principal body 60, helping to secure principal body 60 to supporting member 52. Outer extremity 68 is connected to pipes 12 distributing the lubricating substance.

[0031] A second resilient member, for example a spring 150, is located within chamber 62. Pin 100 is inserted within chamber 62 with mouth 106 abutting spring 150. Head 80 is inserted into principal body 60 and engaged therein through nut 94 and threaded surfaces 64 so that pin 100 is slidably located within through hole 90

of head 60 and ring 104 abuts against inclined wall 89 and forms a seal onto opening 88, for example through an O-ring 144. Finally activating member 110 is secured to the frame of sliding door 40 in such a way that its upper hole 118 is in axial alignment with pin 100 and head 80, and lower hole 116 is in fluid communication with the lubricating pipes for the closure and/or the portions of the closure which are to be lubricated. A further sealing member, for example an O-ring 146, may be located between threaded nut 94 and the front wall of activating member 110.

[0032] Through the delivery device according to this invention the lubricating substance can be delivered selectively to the closure being mechanically activated purely through the normal opening and closing function of the closure itself, and without the need for further electrical and/or electronic actuator devices. According to one of the preferred embodiments of this invention, when sliding doors 40 are in the open position activation members 110 are at a distance from principal body 60. In this position pin 100 lies outside hole 118 of activation member 110, or is only partly inserted therein. Ring 104 of pin 100 abuts against and forms a seal against inclined wall 89 of head 80 in such a way as to shut off communication between pipe 90 of head 80 and chamber 62 of the principal body.

[0033] When sliding doors 40 move towards a closed position, activation members 110 approach principal body 60. In this position pin 100 is completely inserted within hole 118 and its curved extremity 102 abuts against the rear inner wall 117 of upper portion 114 of activating member 110. Because the distance which principal body 60 and activation member 110 have travelled when the doors are in a closed position is less than the length of pin 100, pin 100 is thrust against spring 150 overcoming its resistance and displacing ring 104 away from inclined wall 89 of head 80. This movement opens communication between pipe 90 of head 80 and chamber 62 of the principal body. As a consequence it is possible to distribute lubricating substance from tank 10 to closure 40 along a path which comprises pipe 12, opening 68, chamber 62, pipe 90 and hole 116.

[0034] In use tank 10 is filled with a lubricating substance through inlet opening 16 until a predetermined maximum level calculated on the basis of the particular use of the system, and detected by sensor means connected to the tank itself, is reached. During some experimental tests performed by the applicant it has been calculated that the tank can contain approximately 1000 cl of lubricating substance in such a way as to ensure that at least four sliding doors are lubricated for a long period of time, while taking up minimum space.

[0035] Once the tank has been filled the control system is placed in a check condition in which the system performs a check cycle on the entire system. In this state the control system checks that the sensor means and indicator means are in proper working order, that there is a sufficient quantity of lubricating substance within the

tank, that there is a connection between the source of fluid flow, and zeros the counter device. If the control system discovers any malfunction, that condition is indicated through the indicator means.

[0036] If the initial check has a satisfactory outcome the control system passes to an initial state in which the source of compressed air is inactive, and the counter device is activated.

[0037] When the counter device reaches a predetermined count, for example, but not restricted thereto, a value equal to 100, corresponding to 50 openings and 50 closures of one of the doors, the control system changes to an operating state during which it delivers a signal to the compressed air source so as to activate the passage of compressed air through opening 18 into tank 10.

[0038] Of course the signal will be delivered to the electrically-operated valve if the system is connected to the compressed air line present on board the train, or if not, to the compressor. The control system also sends a signal to the flow regulator corresponding to the direct line to the door which has reached the predetermined number of opening movements. In this way the compressed air which enters tank 10 causes lubricating substance to leave through the openings made in tank 10. Through flow regulating members 14 and distribution pipes 12 the lubricating substance is then transported towards lubricating device 50 of door 40. The pressure of the lubricating fluid, deriving from the pressure of the compressed air delivered into the tank, causes the lubricating substance to flow along the path defined by opening 68, chamber 62, pipe 90 and hole 116, and therefore to enter the lubricating device, thus lubricating the door.

[0039] Of course, depending upon the characteristics and specific features of the door lubricating device it is possible to adjust the time interval for which compressed air is delivered in such a way as to vary the quantity of lubricating substance delivered, and it is possible to control the flow regulating members to change the pressure of the lubricating substance arriving at the inlets to the lubricating device.

[0040] Following a predetermined interval of time during which lubricating substance is delivered, the control system shuts off the source of compressed air and the flow regulator, and zeros the counter device for that closure, returning to its initial condition.

[0041] When following prolonged use the level of lubricating substance falls beneath a preset threshold, the sensor means send a signal to the control system, which in turn activates the indicator means provided, for example, on an electrical panel of the train which can be seen by a maintenance worker.

[0042] Experimental tests performed by the applicant have shown that for correct operation of the entire system it is sufficient that the pressure of the source of fluid flow is for example, but not restricted thereto, approximately 5 bar. According to a further feature of this invention the system may comprise a further flow regulator 24 positioned for example, but not restricted thereto, close to

opening 18 made in cover 12. This feature makes it possible to control the pressure of the compressed air if the system is connected to a compressed air line already present on the means of transport having a flow pressure in excess of 5 bar.

[0043] Of course the lubricating substance described hitherto may have physical properties such as to guarantee a viscosity coefficient which is sufficient for it to be easily delivered through the outlet means of the system and at the same time ensure correct lubrication of the mechanisms opening the doors.

[0044] According to a further embodiment of this invention the sensor must also comprise a temperature sensor connected to the control system. On the basis of the temperature detected by the said sensor the control system is capable of controlling the pressure of the compressed air delivered to the tank, increasing it or decreasing it to maintain a correct flow of lubricating substance to the door lubricating mechanisms.

[0045] The control system may be configured in different ways and above all it is possible to modify the reference parameters, such as the number of opening and closing movements of each door, the time for which the compressed air source is open, and the indication time of the indicator means.

Claims

1. Delivery system for the lubrication of closures comprising a tank (10) containing a lubricating substance, the tank (10) being connected to the said closures, and to activating means to permit the said lubricating substance to leave the tank (10) when in use and delivery means to deliver a lubricating substance to the said closures, **characterised in that** the system also comprises control means to selectively activate the said activating means on the basis of the number of opening and/or closing movements of the said closures and to permit selective delivery of the said lubricating substance from the tank (10) when in use towards one or more of the said closures.
2. System according to claim 1, **characterised in that** the activating means comprise a source of flow for the fluid connected to the tank (10).
3. System according to claim 2, **characterised in that** the tank (10) comprises inlet means (22) to insert the said lubricating substance into the tank (10), and outlet means (20) for delivering the said lubricating substance, the outlet means (20) being connected to the said closures.
4. System according to claim 3, **characterised in that** the outlet means also comprise flow controlling members (20) connected to the outlet openings (14).

5. System according to claim 4, **characterised in that** it also comprises sensor means to detect the level of lubricating substance in the tank (10).
6. Device for delivery a lubricating substance for closures **characterised in that** it comprises a principal body (60) having at least one inlet (68) and one outlet (67), selective closure means to permit the passage of a lubricating substance through the said principal body, and activation means (110), the principal body (60) and the activation means (110) being secured to the leaf and the frame of a closure, the activation means and the principal body selectively activating the closure means following opening and/or closure of the said closure.
7. Device according to claim 6, **characterised in that** the closure means comprise a pin (100) movably engaged in the principal body (60) having at one end thereof an annular portion (104) and a resilient member (150) secured to the principal body (60) and engaging the said pin (100).
8. Device according to claim 7, **characterised in that** the closure means comprise a head (80) within which there is a through hole (90), one extremity of the said head having an inclined wall (89) which is particularly suited to engage the annular portion (104) of the said pin (100) when in use.
9. Process for the lubrication of closures, **characterised in that** it comprises the following stages in combination:
- providing a source of a lubricating substance,
 - providing a system for delivery of the said lubricating substance,
 - detecting a predetermined number of opening and/or closing operations of the said closures,
 - selectively delivering the lubricating substance through the delivery system on the basis of the said predetermined number.
10. Process according to claim 9, **characterised in that** the delivery system is defined according to any one of claims 1 to 5.

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FIG. 1

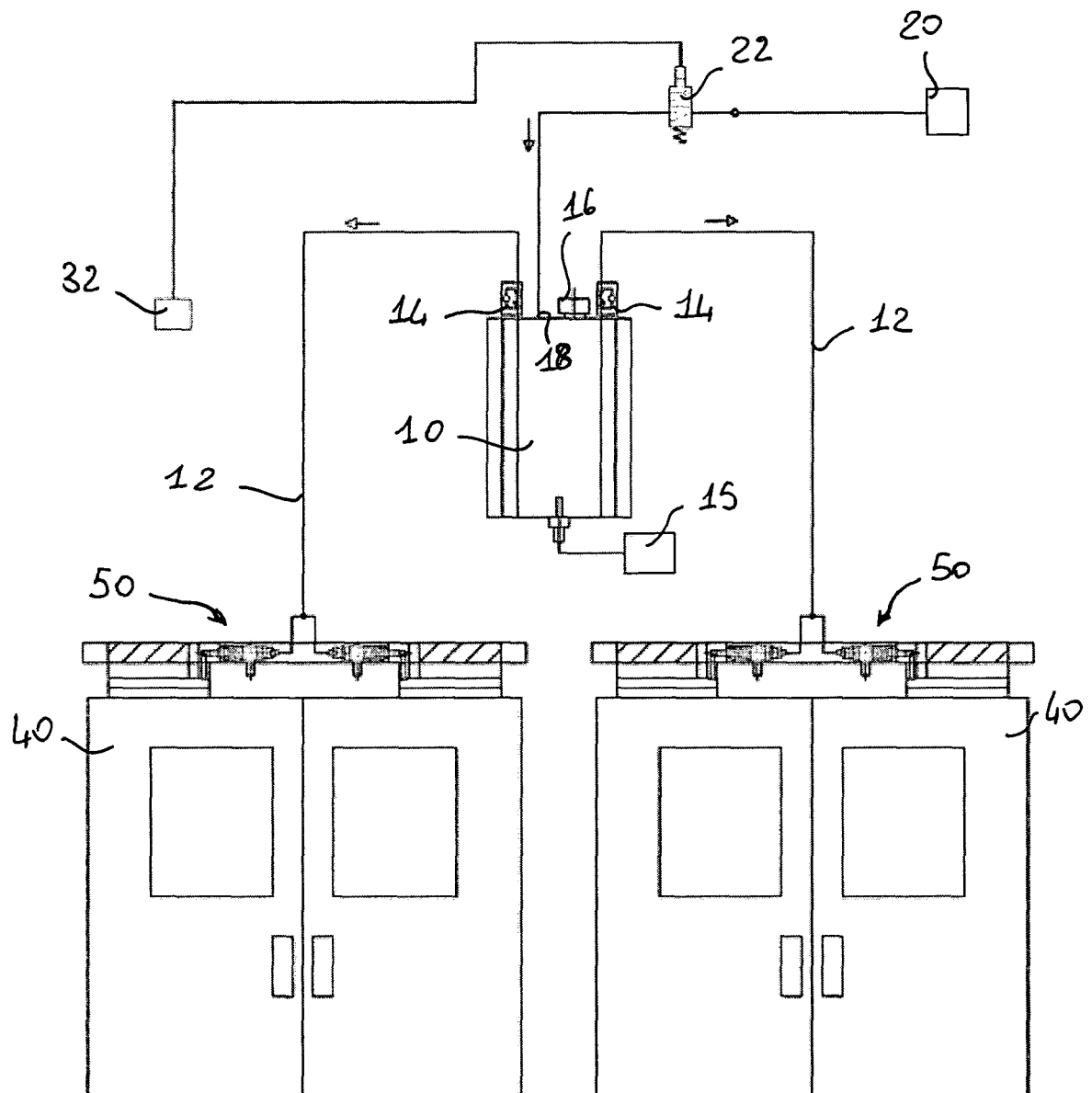


FIG. 2

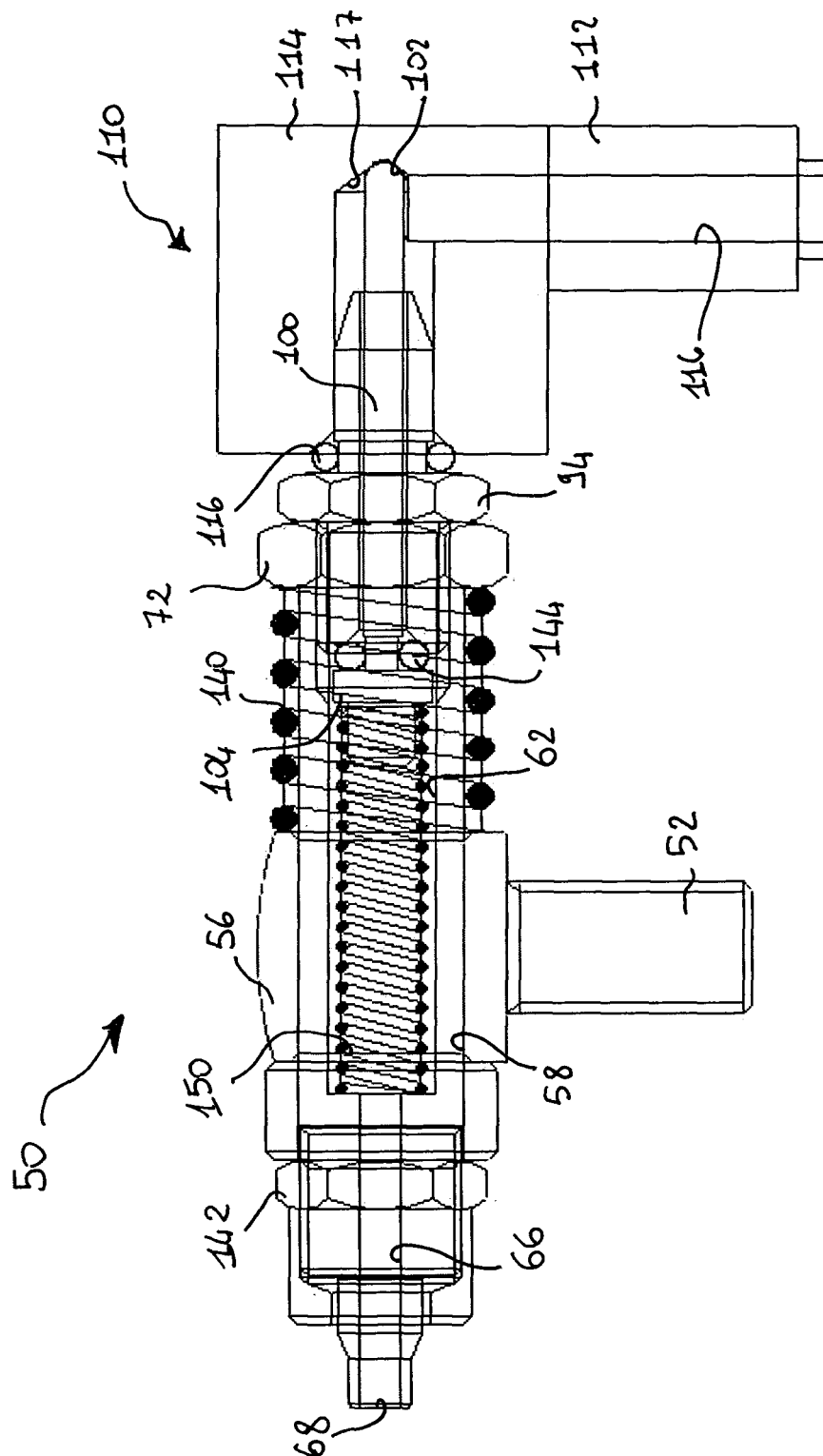


FIG. 3

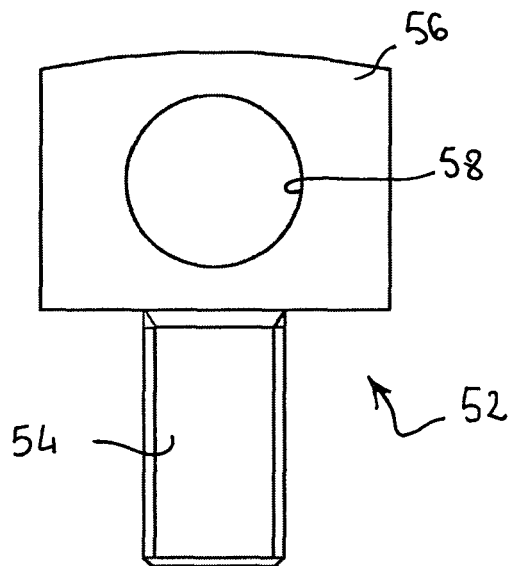


FIG. 4

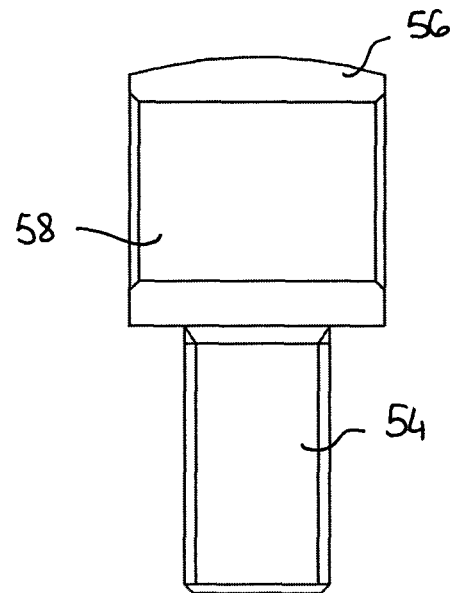


FIG. 5

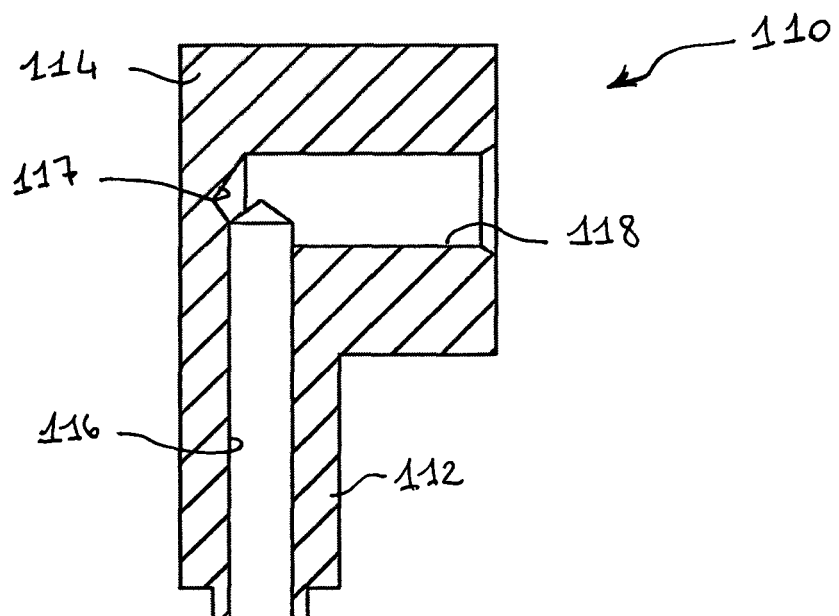


FIG. 6

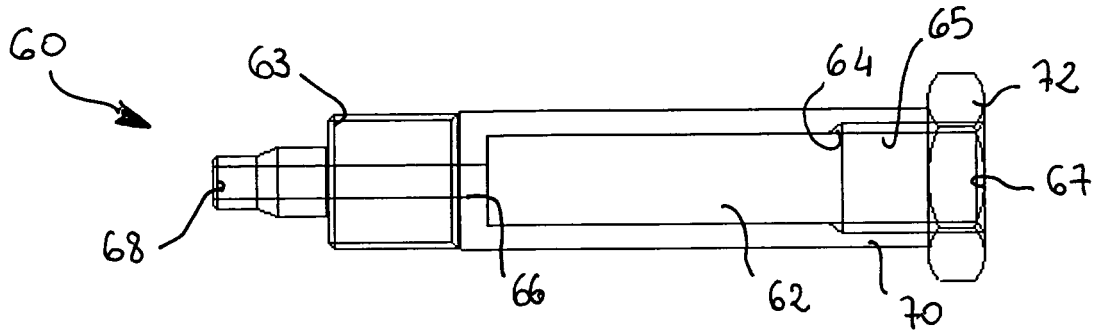


FIG. 7

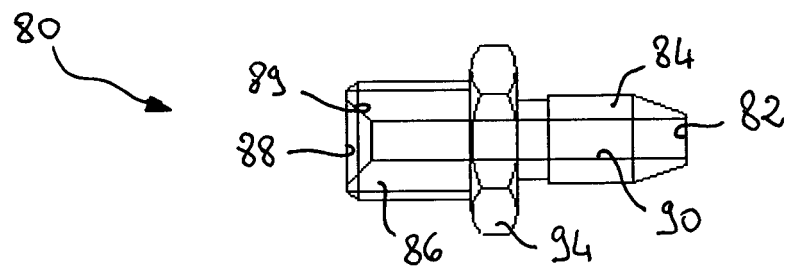
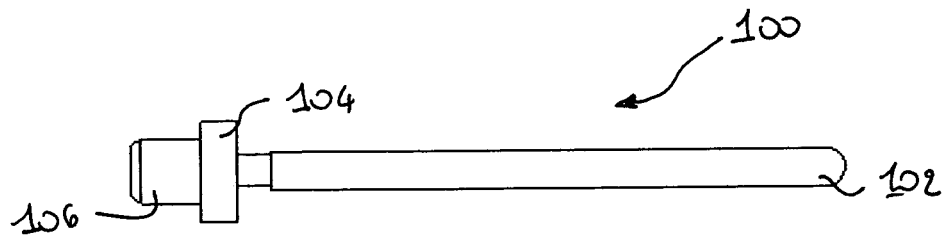


FIG. 8





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Application Number
EP 04 42 5606

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 04 42 5606

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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