



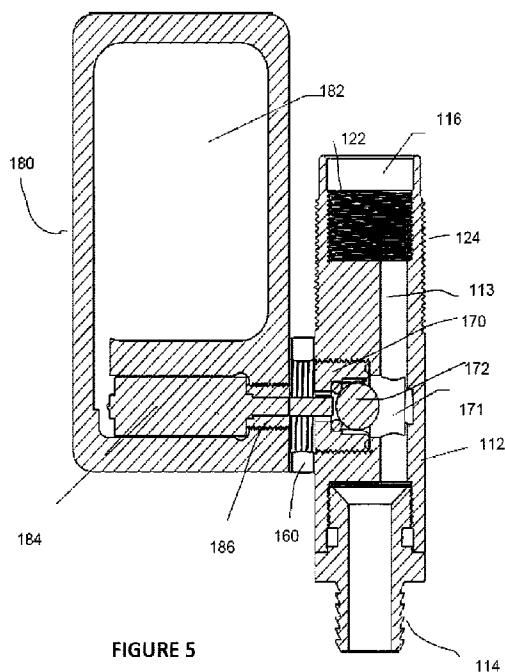
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(54) Title: TYRE EMERGENCY SAFETY VALVE



(57) **Abrégé/Abstract:**

A safety valve (10c) which replaces a tyre valve. An embodiment provides a generally elongate hollow main body (112) having an upper portion (116), a lower flex hose connector (114), a side tubular branch (160) having a valve seat (170) with a ball valve (172), an electronics housing (180) having a battery (182), motor (184) and a drive pin (186) for the ball valve (172). The lower flex hose connector (114) is adapted for connection to a flex hose or valve stem of the vehicle tyre. The side branch (160) branches from the main body (112) and communicates with the hollow interior (113) of the main body (112). The side branch 160 has a plurality of air exit apertures (164) at its periphery. The valve seat (170) comprises a base (192) with an aperture (196) therein through which the drive pin (186) can extend through to engage the ball valve (172). The ball valve 172 sits in the base (192) and is biased in the valve seat (170) via a spring (171) to cover the aperture (196). In use, the drive pin (186) can extend through the base aperture (196) to engage the ball valve (172), to move the ball valve (172) away from the valve seat aperture (196), and allow air to escape via the air exit apertures (164).

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A safety valve (10c) which replaces a tyre valve. An embodiment provides a generally elongate hollow main body (112) having an upper portion (116), a lower flex hose connector (114), a side tubular branch (160) having a valve seat (170) with a ball valve (172), an electronics housing (180) having a battery (182), motor (184) and a drive pin (186) for the ball valve (172). The lower flex hose connector (114) is adapted for connection to a flex hose or valve stem of the vehicle tyre. The side branch (160) branches from the main body (112) and communicates with the hollow interior (113) of the main body (112). The side branch 160 has a plurality of air exit apertures (164) at its periphery. The valve seat (170) comprises a base (192) with an aperture (196) therein through which the drive pin (186) can extend through to engage the ball valve (172). The ball valve 172 sits in the base (192) and is biased in the valve seat (170) via a spring (171) to cover the aperture (196). In use, the drive pin (186) can extend through the base aperture (196) to engage the ball valve (172), to move the ball valve (172) away from the valve seat aperture (196), and allow air to escape via the air exit apertures (164).

TYRE EMERGENCY SAFETY VALVE

Field of the Invention

[1] The present invention relates to a safety valve for tyres for emergency situations.

Background of the Invention

[2] Tyres on mining trucks, cranes and other heavy vehicles can catch fire under different circumstances, with the potential for the tyres to then explode. A lesser-known danger arises when the combustion takes place inside the tyre, with no external signs. Whenever excess heat is developed in or applied to a tyre, it can initiate a process within the tyre known as pyrolysis - the decomposition of a substance by heat. This can cause a build-up of flammable gases and pressure within the tyre, which may ultimately rupture or explode. Any fire in the tyre or vehicle causes risk to personnel and other assets and requires minimisation and hazard management. Most hot tyres are from separation which is hot on the outside tread area.

[3] The present invention seeks to overcome or substantially ameliorate at least some of the deficiencies of the prior art, or to at least provide an alternative.

[4] It is to be understood that, if any prior art information is referred to herein, such reference does not constitute an admission that the information forms part of the common general knowledge in the art, in Australia or any other country.

Summary of the Invention

[5] According to a first aspect, the present invention provides a safety valve for connection to a tyre valve or valve stem of a vehicle tyre, the safety valve comprising:

a hollow body having a lower end for attachment to the tyre valve or valve stem, the body comprising a main internal passage,

a side branch extending from the body, the side branch defining a second passage having a movable blocking component, and

an actuation means for moving the blocking component to deflate the tyre via the second passage.

[6] Preferably, the lower end is adapted for attachment to a flex hose connector of the tyre.

[7] Preferably, the body comprises an upper portion having an internal thread and an external thread, wherein an inflator hose can be attached via the external thread and a sealing cap can be mounted via the internal thread 122.

[8] Preferably, the side branch comprises a block shaped portion a plurality of air exit apertures at its periphery.

[9] Preferably, the blocking component comprises a ball valve mounted in a valve seat, the valve seat comprising a base having an aperture through which the actuation means can extend through to engage the ball valve.

[10] Preferably, the ball valve is biased in the valve seat via a spring to cover the aperture.

[11] Preferably, the actuation means comprises a drive pin that can extend through the base aperture to engage the ball valve, to move the ball valve away from the valve seat aperture and allow air to escape via the air exit apertures.

[12] Preferably, the drive pin is movable via an electric motor, solenoid, linear actuator, or other suitable electronic actuator means

[13] Preferably, the safety valve further comprises an electronics housing connected to the body and housing a battery for the electronic actuator means, and wireless communication means for the actuator

[14] Preferably, the actuator is an electric motor and is coupled to the drive pin, the housing having a threaded aperture at its sidewall, and where the drive pin comprises a threaded base and an extended pin, wherein the threaded base is threadably received by the housing threaded aperture such that rotation of the motor moves the drive pin in or out for engaging with or disengaging from the ball valve.

[15] Preferably, the wireless communication means is adapted for receiving an actuation signal to move the blocking component to deflate the tyre via the second passage of side branch.

[16] Preferably, the second passage has a larger diameter than the main passage.

[17] Preferably, the safety valve further comprises a heat sensor, at which the actuation means will automatically actuate if the heat adjacent the valve exceeds a predetermined temperature.

[18] Preferably, the safety valve further comprises a pressure sensor, at which the actuation means will automatically actuate if the pressure measured by the valve exceeds a predetermined pressure.

[19] Preferably, the housing includes mounting means to the vehicle rim.

[20] The invention also provides an assembly comprising a plurality of safety valves according to claim 11 and a control module for remotely monitoring the status of each safety valve and remotely actuating one or more of the safety valves as desired.

[21] The invention also provides a vehicle having the assembly of the above, the safety valves mounted to each respective tyre thereof.

[22] The invention in another aspect provides a safety valve for a tyre valve, the safety valve comprising:

a body having a lower end for attachment to the tyre valve,

an engagement means within the body positioned for engaging a valve core of the tyre valve,

an actuator actuatable for moving the engagement means, and

a control and wireless communication means for receiving a signal to actuate the actuator such that the engagement means engages the valve core to deflate the tyre when required.

[23] Preferably, the body comprises a lower tubular portion having the engagement means and an upper housing.

[24] Preferably, the engagement means is a pushrod.

[25] Preferably, the actuator is powered by a battery which can be a disposable battery or a rechargeable battery.

[26] Preferably, the actuator is an electric motor with a gearbox or a linear actuator.

[27] Preferably, the wireless communication means comprises a Bluetooth module.

[28] Preferably, the safety valve includes a control device for communicating with a plurality of safety valves.

[29] The invention also provides a vehicle having the safety valves of the above.

[30] The invention also provides a safety valve for a tyre valve, the safety valve comprising:

a body having a lower end for attachment to the tyre valve, the body comprising a main passage,

a valve core for blocking the main passage, the valve core being movable for unblocking the main passage for inflating or deflating the tyre,

a side branch extending from the body, the side branch defining a second passage having a blocking component, and

a control and wireless communication means for receiving an actuation signal to move the blocking component to deflate the tyre via the second passage of side branch.

[31] Preferably, the side branch is disposed upstream of the valve core.

[32] Preferably, the second passage has a larger diameter than the main passage.

[33] Preferably, the blocking component is completely removed from the second passage when actuated.

[34] Preferably, the side branch comprises a closing cap which is removed when the actuation signal is received.

[35] Other aspects of the invention are also disclosed.

Brief Description of the Drawings

[36] Notwithstanding any other forms which may fall within the scope of the present invention, preferred embodiments of the present invention will now be described, by way of examples only, with reference to the accompanying drawings in which:

[37] Figure 1 shows (a) top perspective view of a tyre valve for a 350 tonne truck, and (b) side view of the valve with a valve cap,

[38] Figure 2 schematically shows (a) top view, and (b) side cross-section view of a safety valve according to the present invention mounted to a tyre valve,

[39] Figure 3 is a schematic side view of another embodiment of the safety valve

[40] Figure 4 is a side perspective view of another embodiment of the safety valve,

[41] Figure 5 is a front cross-section view of the embodiment of Figure 4,

[42] Figure 6 shows the electronics housing, motor and drive pin for the embodiment of Figure 4,

[43] Figure 6 shows the electronics housing, motor and drive pin for the embodiment of Figure 4,

[44] Figure 7 shows the valve seat and ball valve for the embodiment of Figure 4,

[45] Figure 8 is an exploded view showing the main body, flex hose connector, valve seat, ball valve and drive pin for the embodiment of Figure 4,

[46] Figure 9 shows (a) side view and (b) front cross-section view of the main body for the embodiment of Figure 4, and

[47] Figure 10 shows a control panel icon for the vehicle with the tyres individually identified

Description of Embodiments

[48] It should be noted in the following description that like or the same reference numerals in different embodiments denote the same or similar features.

[49] Figure 1 shows a tyre valve 100 for a 100 tonne mining truck or larger or production loader tyres. Tyre valve 100 as is known comprises an elongate hollow body 102, a flex hose attachment formation 104 at one end, and a valve core 106 within the body 102. The valve core 106 is depressed inwardly to open the valve for inflating or deflating the tyre. The tyre valve 100 includes a valve cap 108 to cover the valve core 106 from dirt and accidental actuation.

[50] The present invention relates to a safety valve 10 for a tyre valve 100 to provide for quick deflation (let the air out) of the tyre in emergency situations, with remote activation of the deflation actuator of the safety valve 10.

[51] Referring to Figure 2, the safety valve 10 is designed to replace the valve cap 108 and comprises a generally elongate body having a lower tube 14 and an upper housing 16. The lower tube 14 has an internally threaded lower end for threaded attachment to the tyre valve body 102. Extending downwardly from the upper housing 16 and into the lower tube 14 is an engagement means for the valve core 106, being a pushrod 20. When the safety valve 10 is mounted to the tyre valve 100, the pushrod 20 is disposed in position at which it is ready depress the valve core 106 upon actuation movement thereof.

[52] The upper housing 16 comprises an actuator 22 for moving the engagement means (pushrod 20). The actuator 22 in this embodiment comprises an electric motor coupled to a gearbox or a linear actuator, or solenoid which is actuatable to move the pushrod 20 down to engage the valve core 106.

[53] The actuator 22 is powered by a battery 24 which can be a disposable button battery or a rechargeable battery. The safety valve 10 further includes control and wireless communication means 26 which in the example comprises an electronic printed circuit board with a Bluetooth™ module or other suitable wireless module.

[54] In use, a plurality of the safety valves 10 are used to replace the respective valve caps 108 in a large vehicle such as a mining truck. All of the safety valves 10 are connected to a control device via the wireless communication means. In the event of an emergency, the user is able to send an instruction via the control device for all of the safety valves 10 to engage the respective valve cores 106 to immediately release the air from the respective tyres. This reduces the chances of such tyres blowing up and causing injury.

[55] In one embodiment, actuation of the safety valves 10 is automated via predetermined actuation events, such as triggering of a fire detector or a general vehicle alarm.

[56] The invention thus provides a safety valve which will replace the valve cap with tyre valve unit as a whole staying the same. The only change is the end cap which will be the remote actuatable wireless tyre deflater

[57] Other modifications are possible for the safety valve 10 are possible

[58] Figure 3 shows another embodiment of a safety valve 10b which replaces a tyre valve. This embodiment also shows a generally elongate body 12 having a lower tube 14 and an upper tube 16. The lower tube 14 has a lower end 18 which will screw thread/mount on a port (hole in wheel rim) where the tyre valve screws into or onto a flex hose. The upper tube 16 includes a conventional valve core 106 and valve cap 108.

[59] The lower tube 18 includes a side tubular branch 60 branching therefrom and communicating with the interior of the body 12 upstream from the valve core 106. The side branch 60 includes a blocking component 62 which blocks an internal passage 64 thereof and prevents air from escaping the valve 10b. The blocking component 62 can be an internal plate, ball or other suitable shape for blocking the internal passage 64.

[60] The blocking component 62 can include a lug extending to the outside of the side branch 60 with a pin connected to a solenoid, and when activated opens the blocking component to release the air from the tyre.

[61] Another option can be a cap 68 that can be unscrewed quickly also for rapid air release. The blocking component 62 for example can be adapted to disintegrate rapidly when actuated which will also blow the cap 68 off the side branch 60.

[62] The safety valves can be activated from an immediate area next to the vehicle up to a distance of 2,400 meters. The valve bank will be remotely activated either by the VIMS in the mining truck which is the (vital information system) or the ECU (Engine control unit) or WIFI within the truck . The safety valves can also be activated by a long distance system called Laura . Either of those control activated systems can either be set off by a panel inside the truck by the operator under strict instruction, set off by mine control dispatch. Alternatively mining bosses and emergency response via iPad linked to any one of those systems. Another form of comms could be through Tyre / or rim manufacturing monitoring systems already linked to the truck .

[63] The safety valves 10 are connected to a control device such as a smartphone or tablet (e.g. iPad). If used, each safety valve with return a signal to indicate that activation has occurred so the user knows the air is being fully released from the tyre . The invention thus provides a safety device in the active mining area and can also be used by tyre fitters in the workshop.

[64] Figures 4 and 5 shows another embodiment of a safety valve 10c which replaces a tyre valve. This embodiment also shows a generally elongate hollow main body 112 having an upper portion 116, a lower flex hose connector 114, a side tubular branch 160 having a valve seat 170 with a ball valve 172, an electronics housing 180 having a battery 182, motor 184 and a drive pin 186 for the ball valve 172.

[65] The lower flex hose connector 114 is threadably attached to the main body 112 and is adapted for connection to a flex hose or valve stem of the vehicle tyre. In other embodiments, the lower flex hose connector 114 can be part of the main body 112.

[66] The upper portion 116 of the main body 112 includes an internal thread 122 and an external thread 124. This allows a high pressure inflator hose to be attached via the external thread 124 and then for a sealing cap to be mounted via the internal thread 122. This allows rapid inflation of the vehicle tyre.

[67] The side branch 160 branches from the main body 112 and communicates with the hollow interior 113 of the main body 112. The side branch 160 in this embodiment comprises a block shaped portion (see Figures 8 and 9) having an internal thread 162 for the valve seat 170 and a plurality of air exit apertures 164 at its periphery.

[68] The valve seat 170 is generally cup shaped comprising a base 192 and sidewall 194 shaped to receive the ball valve 172. The side wall 194 is threaded for connection with the internal thread 162 of the side branch 160. The base 192 includes an aperture 196 therein through which the drive pin 186 can extend through to engage the ball valve 172.

[69] The ball valve 172 sits in the base 192 within the sidewall 194. The valve seat 170 is oriented such that the base 192 faces outwardly and the sidewall 194 extends inwardly. The ball valve 172 is biased in the valve seat 170 via a spring 171 to cover the aperture 196.

[70] In use, the drive pin 186 can extend through the base aperture 196 to engage the ball valve 172, to move the ball valve 172 away from the valve seat aperture 196, and allow air to escape via the air exit apertures 164.

[71] The electronics housing 180 is connected to the main body 112 and houses the battery 182, wireless communication electronics, and motor 184. The housing 180 includes a threaded aperture 188 at its sidewall.

[72] The drive pin 186 comprises a threaded base 202 and an extended pin 204. The threaded base 202 is threadably received by the housing 180 threaded aperture 188 and is coupled to the motor 184. Rotation of the motor 184 thus moves the drive pin 186 in or out of the housing 80 for engaging with or disengaging from the ball valve 172.

[73] The ball valve 172 thus forms the blocking component which blocks an internal passage thereof and prevents air from escaping the valve 10c. The blocking component when moved by the drive pin 186 releases the air from the tyre.

[74] Each safety valve device on the individual tyres will have their own identification means so that they are individually actuatable and under no circumstances can any other tyre be released of its pressure other than the chosen tyre. In a lightning strike incident or other urgent emergency, the user can activate all tyres at once to prevent the unknown of what tyre will explode.

[75] Figure 10 shows a control panel icon 260 for the vehicle with the tyres 262 individually identified. The control panel will be mounted inside the vehicle cabin and is removable therefrom so that the control panel can be accessed from outside the vehicle if needed, to allow remote tyre deflation. The icon 260 has an indicator 264 for showing the status of each respective tyre, and an actuation button 266 for actuating the respective safety valve of each tyre. The icon 260 also has a test button 268 for testing the inflation status of each tyre, and an emergency ALL deflate button 270 which will actuate all of the safety valves of the vehicle.

[76] The safety valve 10 provided in the embodiments is actuated electronically. The valve can also include a mechanical pressure release means for releasing air above a certain predetermined pressure.

[77] The safety valve 10 can also include a heat sensor in the main body or the housing, at which it will automatically actuate if the heat adjacent the valve 10 exceeds a predetermined temperature.

[78] The safety valve 10 can also include a pressure sensor in the internal cavity thereof, at which it will automatically actuate if the pressure measured by the valve 10 exceeds a predetermined pressure.

[79] The housing can include mounting means to the rim, the mounting means being a magnet mounted to the housing.

[80] The housing 180 with the battery and motor can be removed and the main body 112 can function as a normal valve. The safety valve 10 can inflate and deflate a tyre as normal.

[81] The safety valve 10 also includes a control box pairing button in the housing 180 for pairing with the control panel and designating the tyre identification.

[82] The safety valve 10 can be used for unmanned autonomous trucks and vehicles, with the control panel monitored via wireless means, GPS, Bluetooth, or any combination thereof.

[83] The vehicles can be loaders, scrapers, graders, any large tyre machines in mining in need of safety valve.

[84] The electronic control means preferably provides a function for the safety valve 10 to be tested, by start release of air and stopping. The testing means is preferably via the remote control panel to test let down of pressure.

[85] The air vent holes 164 can be larger or differently shaped, more holes 164 can be provided to release air faster.

[86] The remote deflation valve is ideal for hot tyre / separation safe deflate on instruction activation time in the example is 4 seconds and deflation will commence on chosen tyre.

[87] In the event of lightning or any other major hazard, deflation on all 6 tyres at the same time can be performed to ensure the hazard is being eliminated from each tyre. This can be achieved by the single button use on the emergency activation button (ALL tyres)

[88] Each tyre has its own certified identification ID so there is no interference with other trucks or electronic communications on the mine or work site.

[89] The vehicle cab control unit for tyre activation will be portable and can be released from its holding bracket in the truck cab, to store in workshop / office where the truck/ trucks are in a holding yard. This is so if lightning occurs any truck/ trucks tyres can be safely released from a distance to ensure neighbouring businesses are not in danger of major and multiple explosions from truck tyres (Storm Safety).

[90] The release time on by activation with remote safety valve is the same as normal air release by workshop/tyre fitter or can be adjusted to suit customers air release time.

[91] The remote safety release unit can be made to suit Autonomous mining truck fleets by utilising on-site Satellite systems / GPS modules.

[92] A built in Temperature sensor can be optional within the deflation unit, and alarm notification will be heard/ seen from the main cab control box in the machine cab / trucks and or production loader. If alarm is triggered/indicated in cab control module of high temperature, the chosen tyre with this issue can be safely released before a major hazard such as fire / tyre explosion occurs.

[93] The safety release unit can also be used prior to entering the workshop for maintenance by strict instruction on which tyre may be needed at a chosen time while on route to workshop, saving on down time for specific machines.

[94] The safety release unit can be used as a normal deflate / inflate unit by removing the electronics box housing if replacement was needed without any interference of loss of air while removing electronic box.

[95] Main cab control unit can be battery or hardwired to the machine in cab.

[96] The focus on the remote tyre deflation devices are aimed at safety being the number one priority in the mining industry to ensure all personal are not in any risk of tyre hazards when a hot tyre has been detected. With remote tyre deflation unit there is no persons up close to release a suspected hot tyre therefor eliminating possible injury or death.

[97] It is a quick release option to deflate dangerous expanding pressures within the machine tyres either hot tyre deflation or workshop safety release option.

[98] Holding yard for possible lightning strikes taking risk of businesses in a close proximity of a company holding yard.

[99] Single release on chosen tyre or if major danger occurs releasing all 6 tyres at the same time to ensure dangerous pressures are reducing not increasing.

[100] Although a preferred embodiment of the present invention has been described, it will be apparent to skilled persons that modifications can be made to the embodiment shown. For example, the tyre valve actuator can be used to unscrew the valve core instead of depressing it. Unscrewing the valve core can release air faster.

Claims

The claims defining the invention are as follows:

1. A safety valve for connection to a tyre valve or valve stem of a vehicle tyre, the safety valve comprising:

a hollow body having a lower end for attachment to the tyre valve or valve stem, the body comprising a main internal passage,

a side branch extending from the body, the side branch defining a second passage having a movable blocking component, and

an actuation means for moving the blocking component to deflate the tyre via the second passage.
2. The safety valve of claim 1 wherein the lower end is adapted for attachment to a flex hose connector of the tyre.
3. The safety valve of claim 1 wherein the body comprises an upper portion having an internal thread and an external thread, wherein an inflator hose can be attached via the external thread and a sealing cap can be mounted via the internal thread 122.
4. The safety valve of claim 1 wherein the side branch comprises a block shaped portion a plurality of air exit apertures at its periphery.
5. The safety valve of claim 4 wherein the blocking component comprises a ball valve mounted in a valve seat, the valve seat comprising a base having an aperture through which the actuation means can extend through to engage the ball valve.
6. The safety valve of claim 5 wherein the ball valve is biased in the valve seat via a spring to cover the aperture.
7. The safety valve of claim 5 wherein the actuation means comprises a drive pin that can extend through the base aperture to engage the ball valve, to move the ball valve away from the valve seat aperture and allow air to escape via the air exit apertures.
8. The safety valve of claim 7 wherein the drive pin is movable via an electric motor, solenoid, linear actuator, or other suitable electronic actuator means
9. The safety valve of claim 8 further comprising an electronics housing connected to the body and housing a battery for the electronic actuator means, and wireless communication means for the actuator
10. The safety valve of claim 9 wherein the actuator is an electric motor and is coupled to the drive pin, the housing having a threaded aperture at its sidewall, and where the drive pin comprises a threaded base and an extended pin, wherein the threaded base is threadably

received by the housing threaded aperture such that rotation of the motor moves the drive pin in or out for engaging with or disengaging from the ball valve.

11. The safety valve of claim 9 wherein the wireless communication means is adapted for receiving an actuation signal to move the blocking component to deflate the tyre via the second passage of side branch.
12. The safety valve of claim 1 wherein the second passage has a larger diameter than the main passage.
13. The safety valve of claim 8 further comprising a heat sensor, at which the actuation means will automatically actuate if the heat adjacent the valve exceeds a predetermined temperature.
14. The safety valve of claim 8 further comprising a pressure sensor, at which the actuation means will automatically actuate if the pressure measured by the valve exceeds a predetermined pressure.
15. The safety valve of claim 9 wherein the housing includes mounting means to the vehicle rim.
16. An assembly comprising a plurality of safety valves according to claim 11 and a control module for remotely monitoring the status of each safety valve and remotely actuating one or more of the safety valves as desired.
17. A vehicle having the assembly of claim 16, the safety valves mounted to each respective tyre thereof.

Figure 1

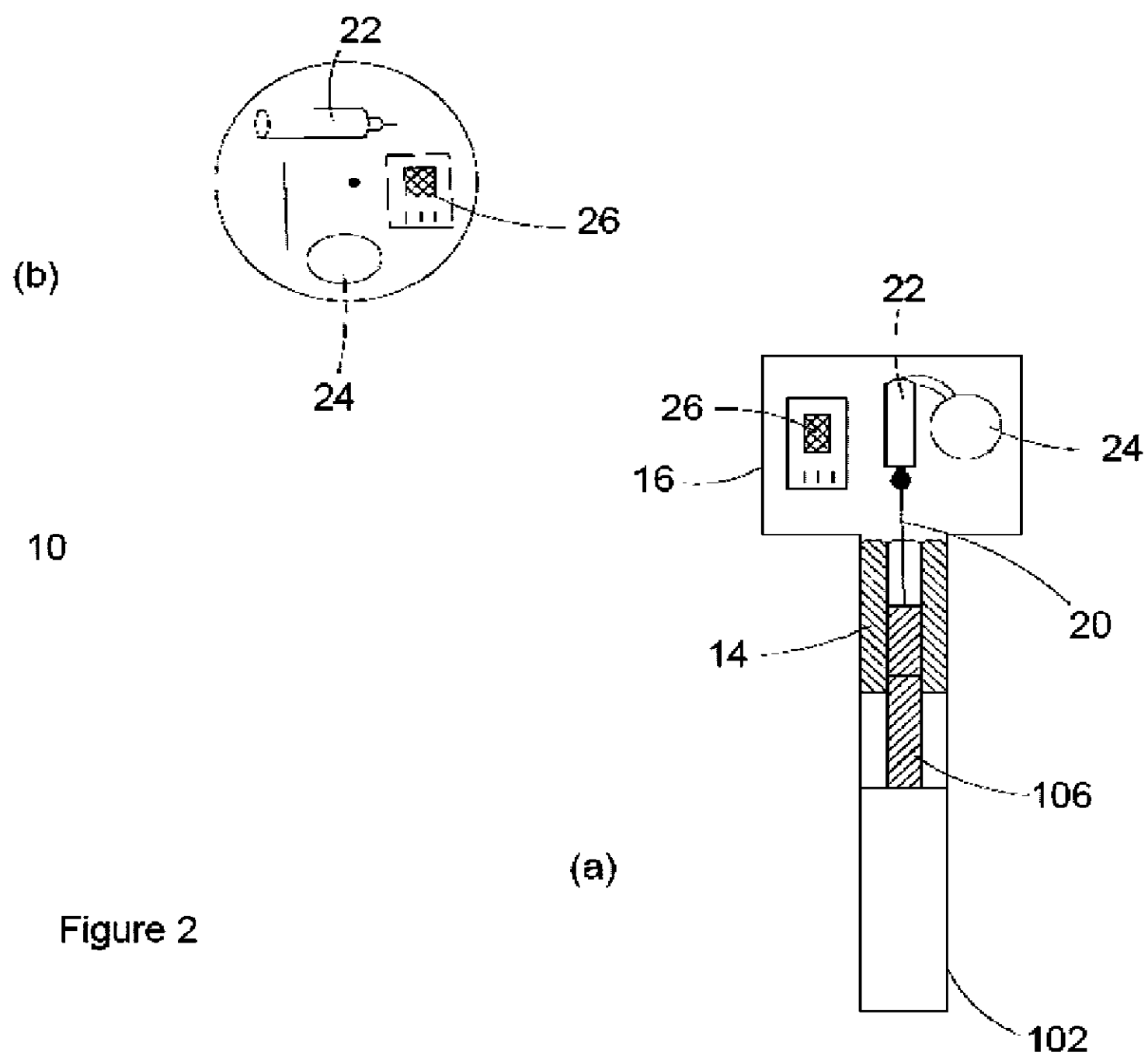
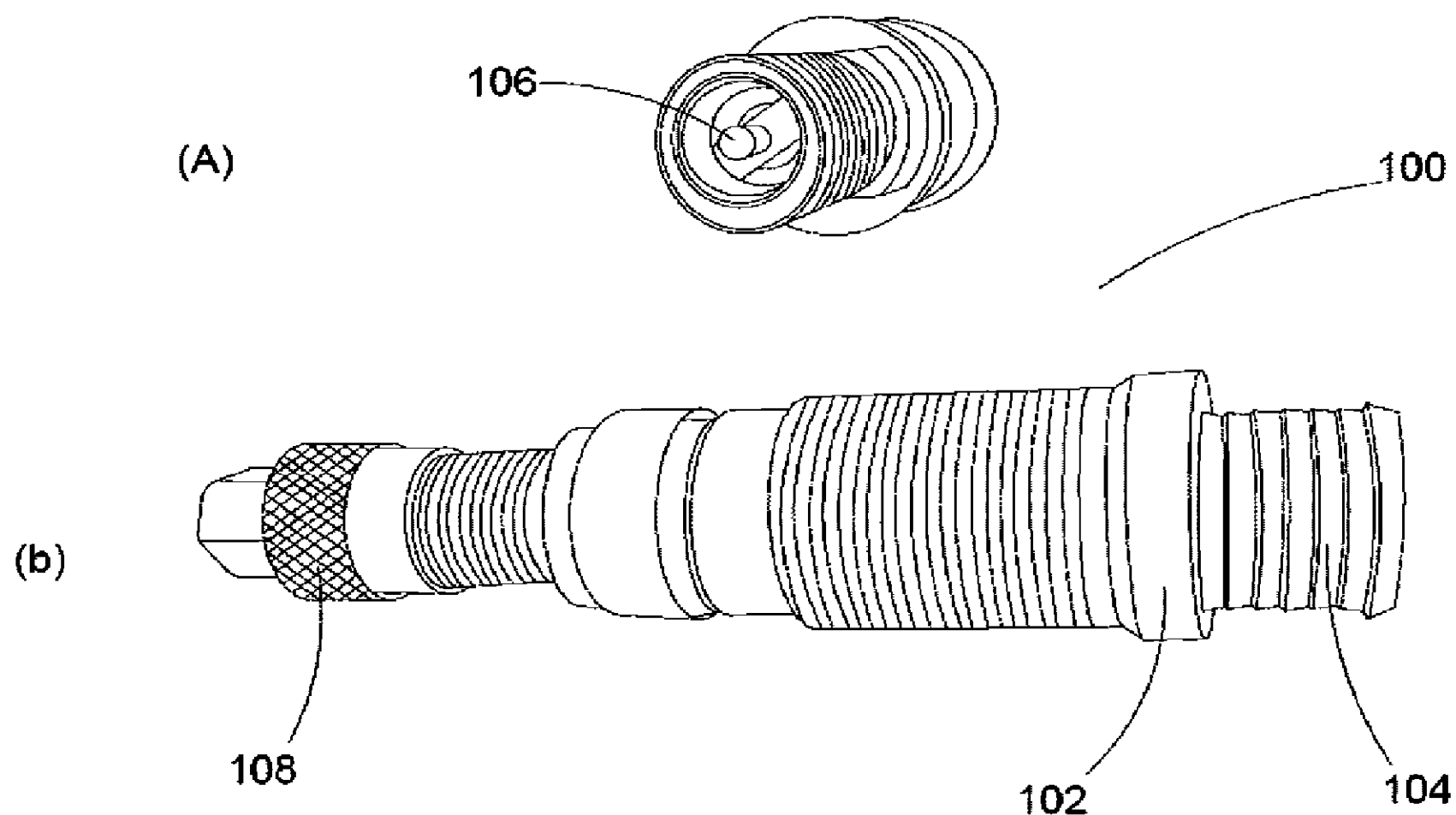


Figure 2

10b

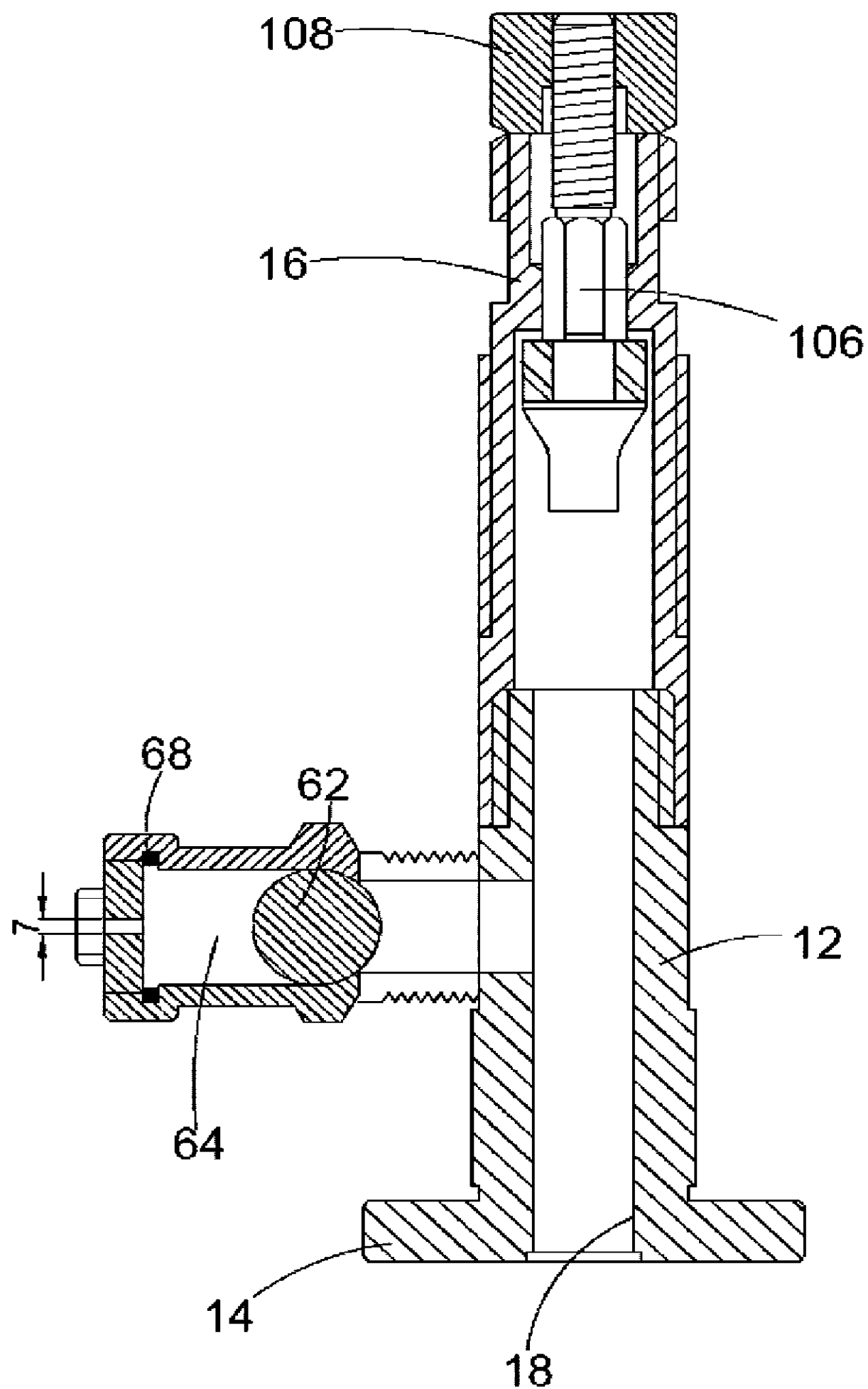
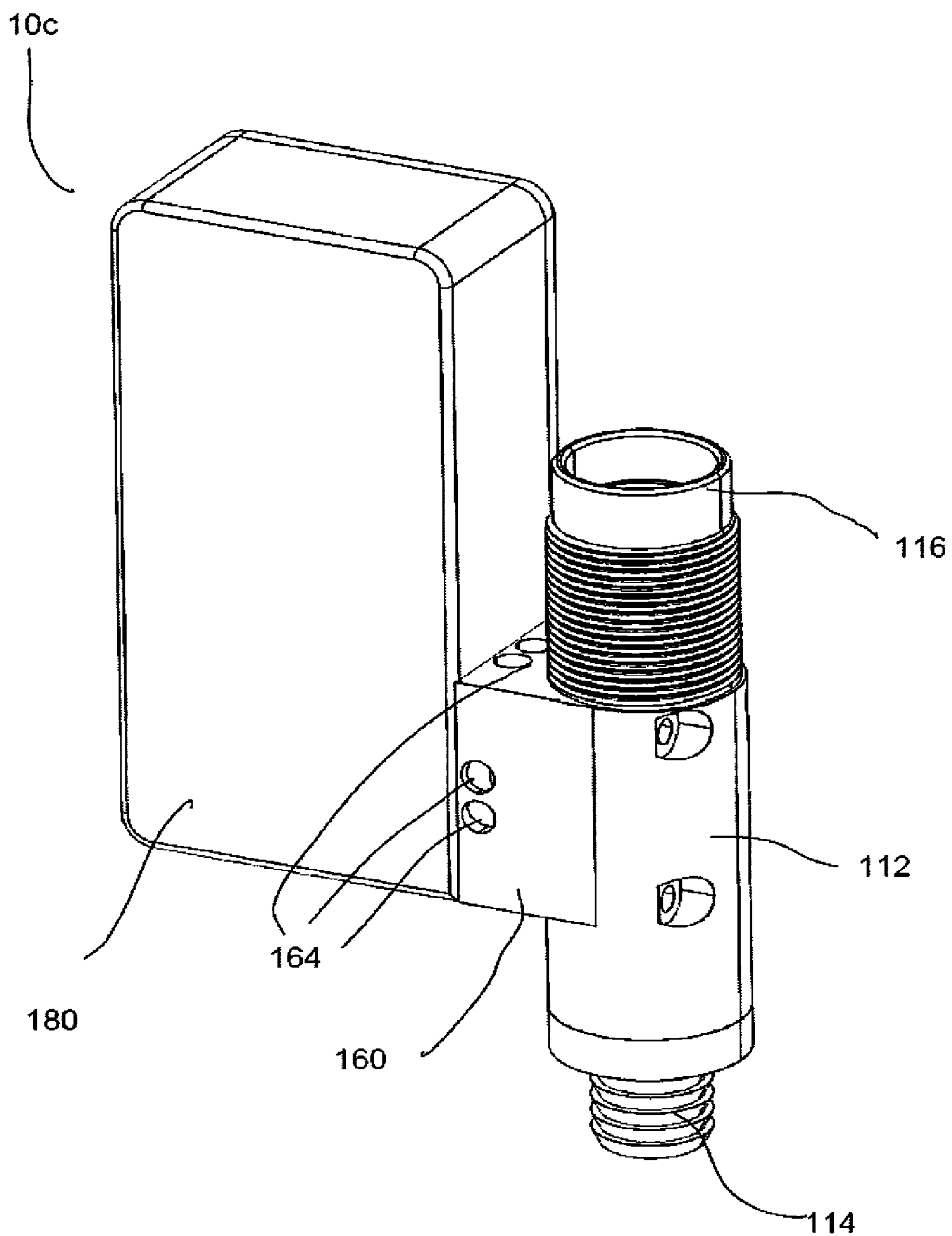


Figure 3

Substitute Sheet

SUBSTITUTE SHEET (RULE 26) RO/AU

**FIGURE 4**

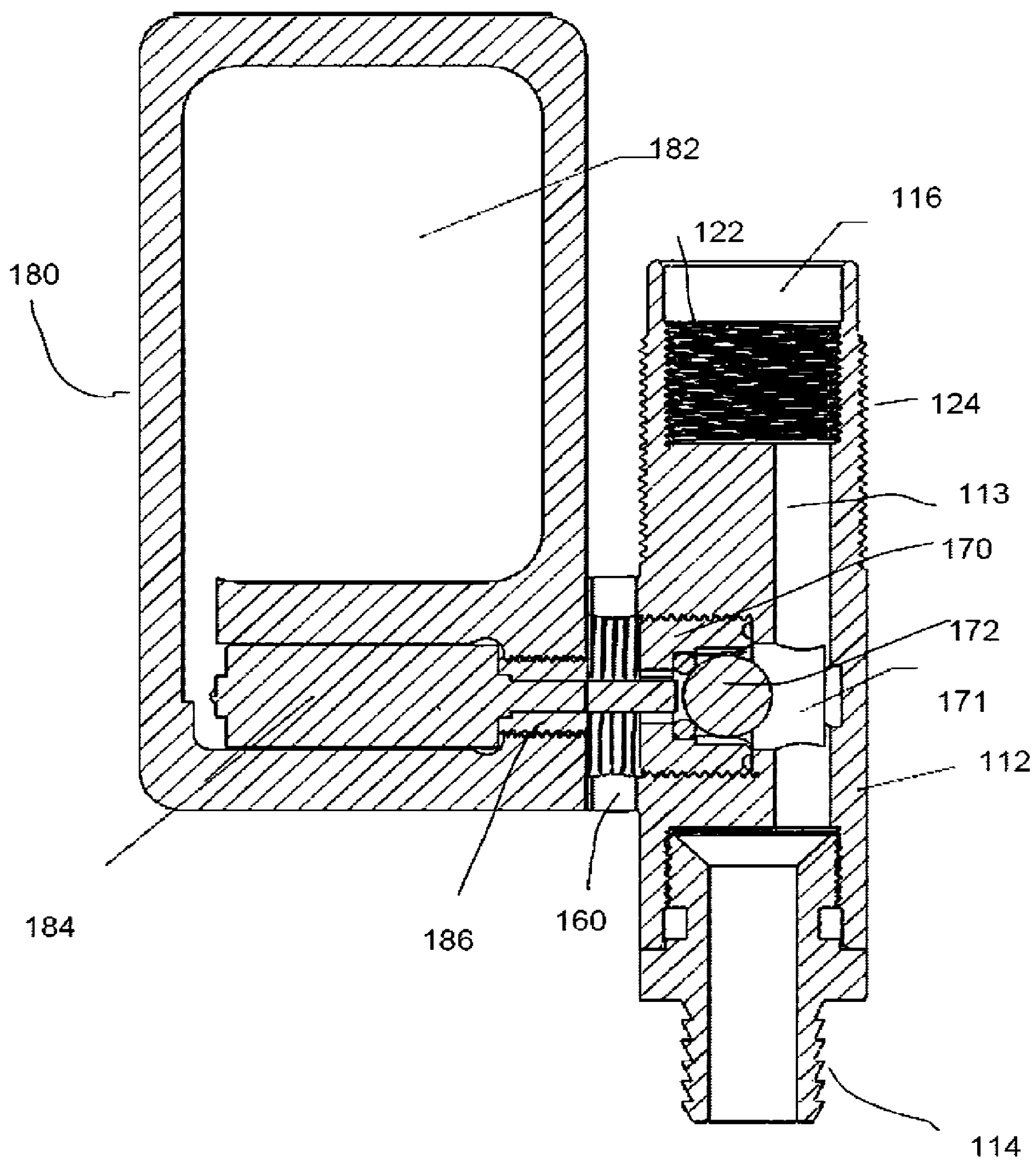


FIGURE 5

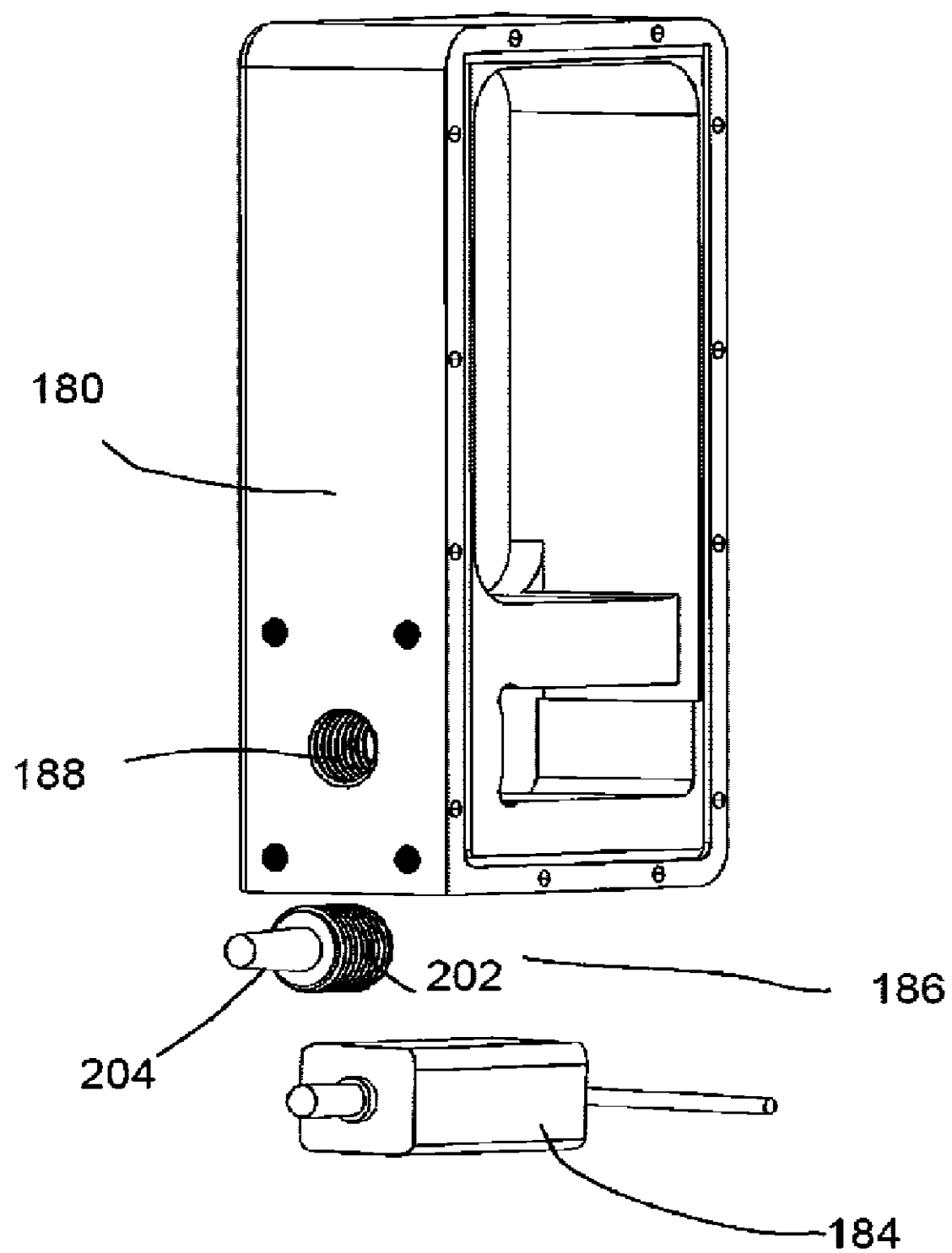


FIGURE 6

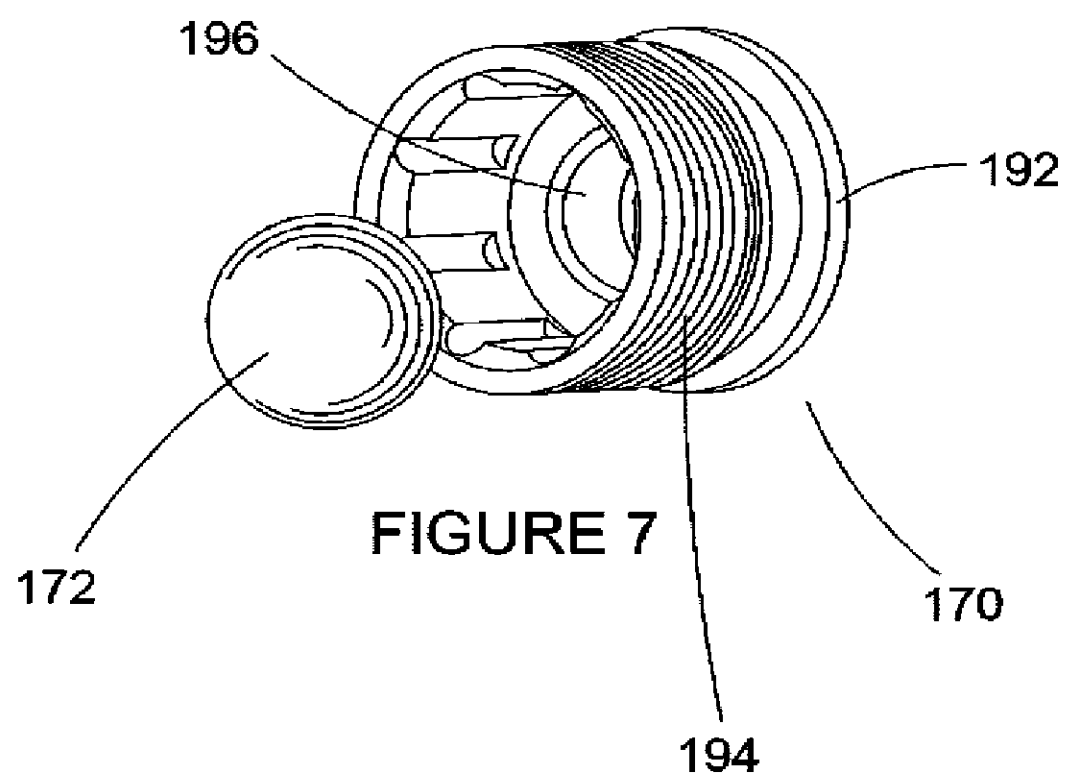


FIGURE 7

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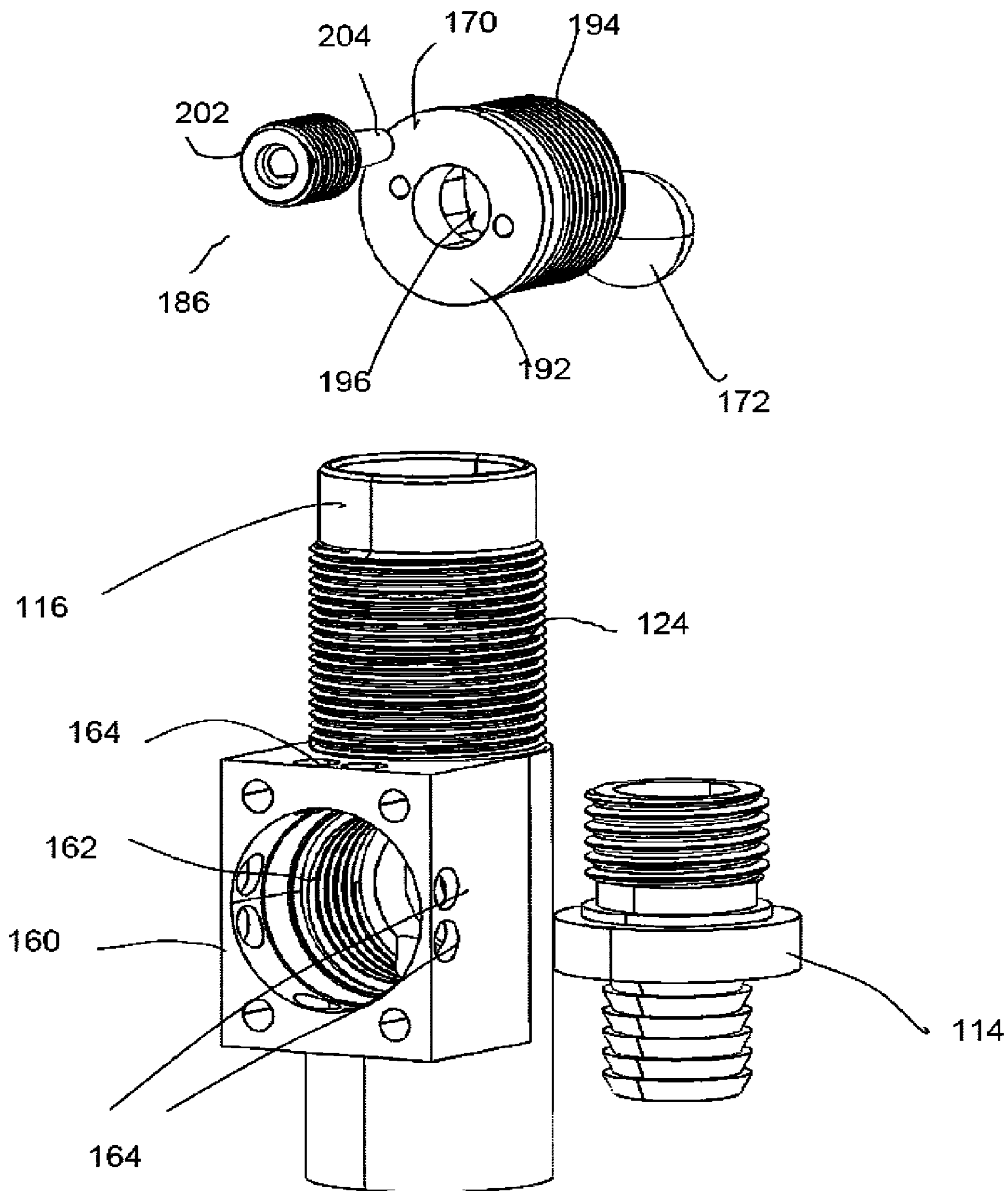


FIGURE 8

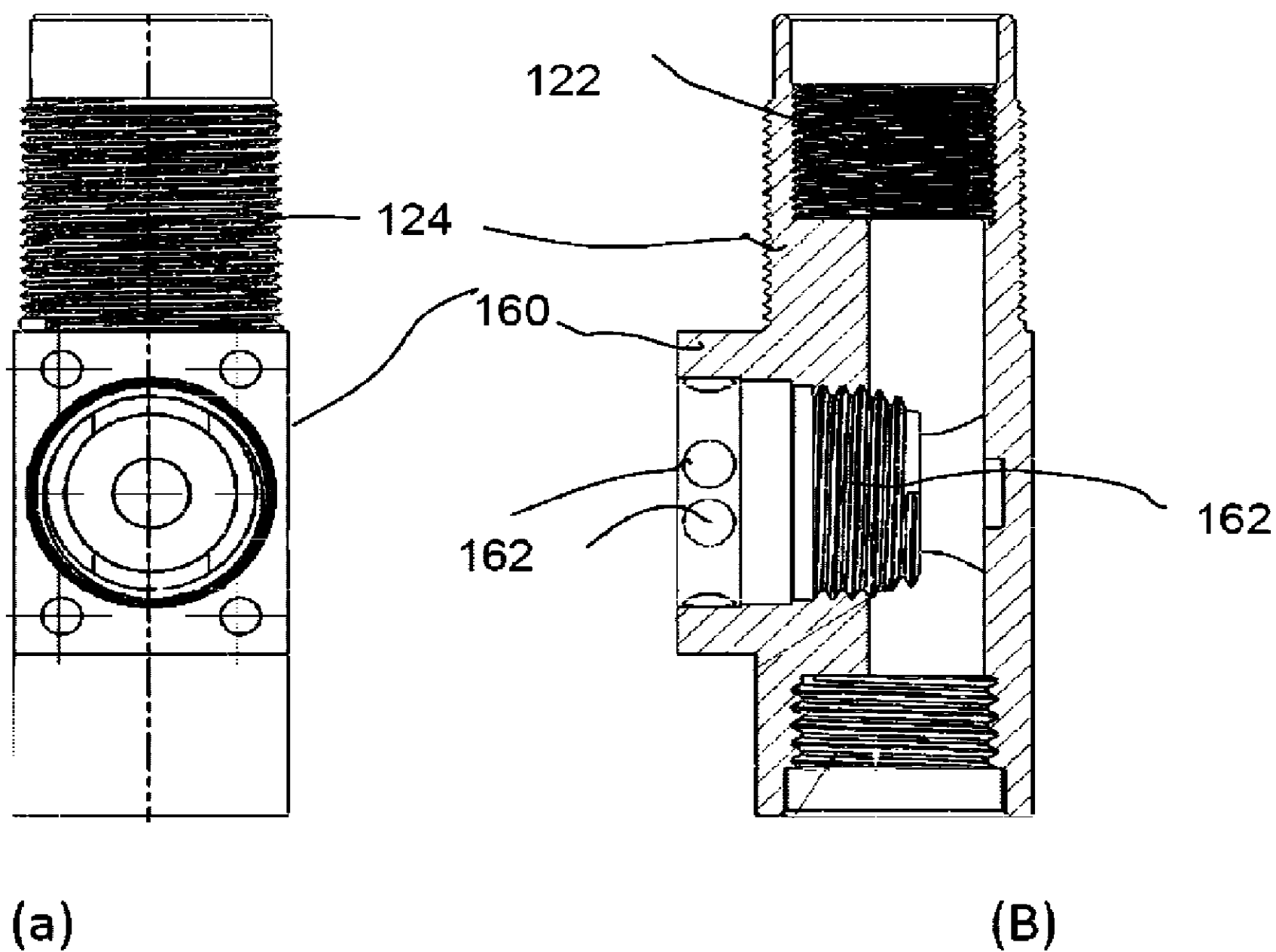


FIGURE 9

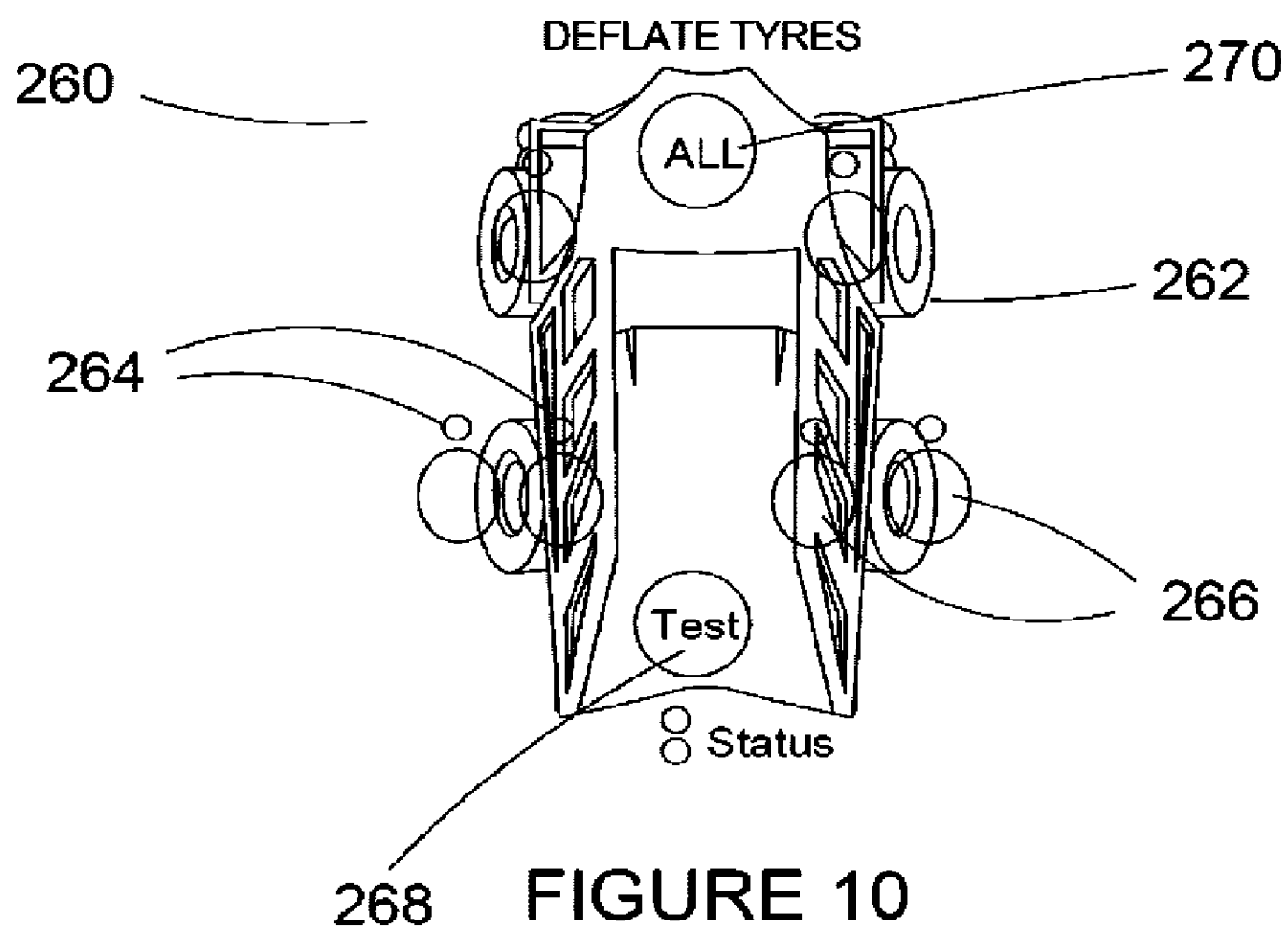


FIGURE 10

