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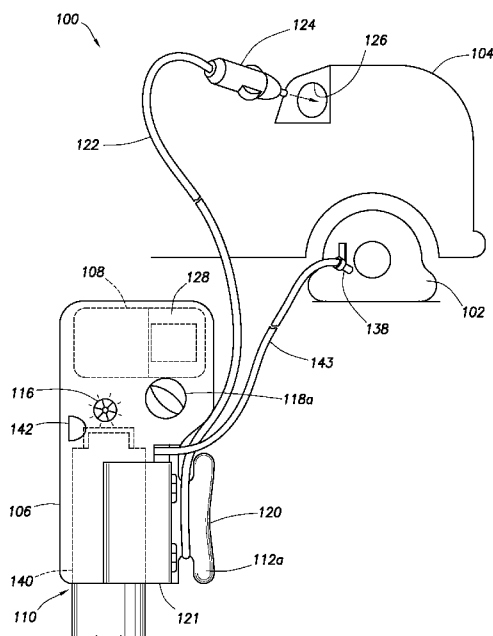


FIG. 1A

- (57) **Abstract:** Techniques for repairing a tire are provided. A system is provided with a housing, a pressure source, an inflation hose, and a tire sealer. The housing has an inflation side and a sealant side. The pressure source pressurizes a fluid and is positioned in the housing. The inflation hose (activatable from the inflation side) is connectable to the pressure source and the tire for establishing fluid communication therebetween. The tire sealer (activatable from the sealant side) is connectable to the housing and is provided with a container with a sealant therein, a valve connectable to the container, and a sealant hose. The valve is connectable to the pressure source for diverting the pressurized fluid from the pressure source to the container to release the sealant. The sealant hose is connectable to the valve and to the tire for establishing fluid communication therebetween whereby the sealant is passed into the tire.



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SYSTEM AND METHOD FOR REPAIRING A TIRE

CROSS-REFERENCE TO RELATED APPLICATIONS

5 **[0001]** This application claims priority to application Serial No 61/ 307315 and is related to application Serial No. 61/307321, filed concurrently herewith entitled: APPARATUS AND METHOD FOR REPAIRING A TIRE.

FIELD OF THE INVENTION

10 **[0002]** The present invention relates to techniques for repairing a vehicle. In particular, the present invention relates to techniques for performing repairs, such as sealing and/or inflating, a vehicle tire.

BACKGROUND OF THE INVENTION

15 **[0003]** From time to time, vehicles tires may experience a loss of air. This may be due to a variety of reasons, such as tire defects, tire damage, heat loss, wear and the like. Insufficient air in the tire may prevent the vehicle from properly steering, braking or otherwise handling as intended. This may result in a significant safety threat to persons or property.

20 **[0004]** Techniques for performing tire repairs, such as sealing or inflating, have been developed. Many fuel stations provide air compressors so that vehicle operators may check and fill their tires. Service stations often have mechanics available to seal and/or inflate vehicle tires. However, the loss of air in a vehicle tire may occur and/or be detected a distance from such fuel or service stations. In such cases, it may be desirable to have devices in the vehicle to perform repairs as necessary.

25 **[0005]** Techniques have been developed to provide portable inflation devices that may be carried in the vehicle for re-inflating tires. Examples of inflation devices are described in US Patent/Application Nos. 6260739, 5305784, 4653550 and 3934622. In some cases, a leak in the tire may prevent re-inflation of the tire and/or retention of air in the tire. In such cases, it may be necessary to seal or patch the tire to close off the leak prior to inflation. Techniques have been developed for sealing tires as described, for example, in US Patent/Application
30 Nos. 7159490, 5403417, 6345650, 6605654, 2008/0257448, 2002/0112777, 6789581, 7021348, 5908145, 5765601, and 6283172.

[0006] Despite the advancements in techniques for inflating or sealing of tires, it is desirable that techniques be provided for facilitating the repair of tires. In particular, it is desirable that tire repair devices have multi-functional capabilities for performing a variety of tire repairs, such as measurement, sealing, inflation, etc. It is further desirable that such tire repair devices be simplified for use by all vehicle operators, regardless of their repair skills. Such repair techniques preferably involve one or more of the following features, among others: portability, automation, easy/quick connection to tires, easy/quick assembly and/or operation, replaceable components, safety features and/or drip/leak prevention.

SUMMARY OF THE INVENTION

[0007] In at least one aspect, the present invention relates to a system for repairing a tire. The system is provided with a housing, a pressure source, an inflation hose and a tire sealer. The housing has an inflation side and a sealant side. The pressure source pressurizes a fluid, and is positioned in the housing. The inflation hose is operatively connectable to the pressure source and the tire for establishing fluid communication therebetween. The inflation hose is activatable from the inflation side. The tire sealer is operatively connectable to the housing and activatable from the sealant side. The tire sealer is provided with a container, a valve, and a sealant hose. The container has a sealant therein. The valve is operatively connectable to the container. The valve is also operatively connectable to the pressure source for receiving the pressurized fluid therefrom. The valve selectively diverts the pressurized fluid from the pressure source to the container for selectively releasing the sealant therefrom. The sealant hose is operatively connectable to the valve and to the tire for establishing fluid communication therebetween whereby the sealant is passed into the tire.

[0008] In another aspect, the present invention relates to a system for repairing a tire. The system has a housing, a pressure source for pressurizing a fluid and a tire sealer. The pressure source is positioned in the housing. The tire sealer is removably positionable in the housing. The tire sealer has a container with a sealant therein, a valve and a sealant hose. The valve has a valve body, a valve member and a sealant hose. The valve body is operatively connectable to the container, and to the pressure source for receiving the pressurized fluid therefrom. The valve body has a valve passage therethrough and an outlet extending therefrom. The valve member is slidably positionable in the valve passage of the valve body. The valve member is movable between a neutral position and a retracted position in response

to a source pressure of the pressurized fluid applied thereto such that, when the source pressure of the pressurized fluid is greater than a container pressure in the container, the valve member is in the neutral position and the pressurized fluid is diverted through the valve and into the container whereby the sealant is selectively expelled from the container through the valve passage and out the outlet. The sealant hose has an end operatively connectable to the outlet. The sealant hose has an end operatively connectable to the tire for establishing fluid communication therebetween for passing one of the pressurized fluid and the sealant from the valve to the tire whereby the tire is repaired.

[0009] Finally, in another aspect, the invention relates to a method of repairing a tire. The method involves providing a system for repairing a tire. The system is provided with a housing, a pressure source, an inflation hose and a tire sealer. The housing has an inflation side and a sealant side. The pressure source pressurizes a fluid, and is positioned in the housing. The inflation hose is operatively connectable to the pressure source and the tire for establishing fluid communication therebetween. The inflation hose is activatable from the inflation side. The tire sealer is operatively connectable to the housing and activatable from the sealant side. The tire sealer is provided with a container, a valve, and a sealant hose. The container has a sealant therein. The valve is operatively connectable to the container. The valve is also operatively connectable to the pressure source for receiving the pressurized fluid therefrom. The valve selectively diverts the pressurized fluid from the pressure source to the container for selectively releasing the sealant therefrom. The sealant hose is operatively connectable to the valve and to the tire for establishing fluid communication therebetween whereby the sealant is passed into the tire. The method further involves operatively connecting the sealant hose to the tire, and sealing the tire by activating the pressure source to release the pressurized fluid to the valve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] So that the above recited features and advantages of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to the embodiments thereof that are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are, therefore, not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments. The figures are not

necessarily to scale and certain features and certain views of the figures may be shown exaggerated in scale or in schematic in the interest of clarity and conciseness.

[0011] Figures 1A and 1B are schematic depictions of a system for repairing a vehicle tire. Figure 1A shows the tire repair system in a sealant mode. Figure 1B shows the tire repair system in an inflation mode.

[0012] Figures 2A-D are schematic views of the tire repair system of Figures 1A-1B. Figure 2A is a side view of the tire repair system of Figure 1A. Figure 2B is a longitudinal cross-sectional view of the tire repair system of Figure 2D taken along line 2B-2B. Figure 2C is an alternate longitudinal cross-sectional view of the tire repair system of Figure 2A taken along line 2C-2C. Figure 2D is a partial cross-sectional view of the tire repair system of Figure 2A taken along line 2D-2D.

[0013] Figures 3A-3B4 are schematic views of a portion of the tire repair system of Figure 2B depicting the operation of a regulator and a tire sealer thereof. Figure 3A shows a side view of the regulator and tire sealer combination. Figure 3B1-3B4 shows a longitudinal cross-sectional view of the regulator and tire sealer of Figure 3A taken along line 3B-3B. Figure 3B1 shows the regulator in an off position. Figure 3B2 shows the regulator in an inflation position. Figure 3B3 shows the regulator in a sealant position for passing a pressurized fluid to the tire sealer, and a valve of the tire sealer in a neutral position. Figure 3B4 shows the regulator in a sealant position for passing the pressurized fluid to the tire sealer, and the valve in a retracted position.

[0014] Figure 4A-4C are schematic views of an inflation on/off switch and a sealant on/off switch of the tire repair system 100. Figure 4A shows both on/off switches in the off position. Figure 4B shows the inflation on/off switch in the on position and the sealant on/off switch in the off position. Figure 4C shows the sealant on/off switch in the on position and the inflation on/off switch in the off position.

[0015] Figures 5A-5C are cross-sectional views of the tire sealer of Figure 3B1 with the regulator removed, and depicting operation of the valve as a pressurized fluid is applied thereto. Figure 5A shows the valve in a neutral position and diverting the pressurized fluid into the container. Figure 5B shows the valve in a retracted position and diverting the pressurized fluid out the sealant hose thereof. Figure 5C shows the valve returning to the neutral position.

[0016] Figures 6A and 6B are cross-sectional views of a tire connector. Figure 6A shows the tire connector in a closed position. Figure 6B shows the tire connector in the open position.

[0017] Figure 7 is a flow chart depicting a method of repairing a tire.

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DETAILED DESCRIPTION OF THE INVENTION

[0018] Presently preferred embodiments of the invention are shown in the above-identified Figures and described in detail below.

[0019] Aspects of the invention entail a tire repair system 100 usable with a vehicle tire, such as the tire 102 of the vehicle 104 of Figures 1A and 1B. Figure 1A shows the tire repair system 100 operating in a sealant mode for sealing the tire 102. Figure 1B shows the tire repair system 100 operating in an inflation mode for inflating the tire 102. The tire repair system 100 may be used on one or more tires of one or more vehicles as desired. The tire 102 may be partially or wholly deflated or inflated, depending on the situation. In some cases, the tire repair system 100 may be used to measure the tire 102 without activation of the tire repair system 100. The tire repair system 100 may also be used to perform measurement, sealing, inflation and/or other operations as desired.

[0020] The tire repair system 100 includes a housing 106, a compressor 108, and a tire sealer 110. The compressor 108 is positioned in the housing 106 and may be any conventional compressor or pressure source capable of pressurizing a fluid, such as air. The compressor 108 as provided is preferably a compact air compressor capable of providing sufficient pressure for inflation of the tire 102 and/or for activation of the tire sealer 110 as will be discussed more fully herein. While a compressor 108 internal to the housing 106 is depicted, it will be appreciated that one or more compressors or other pressure sources internal and/or external to the housing 106 may be employed.

[0021] The housing 106 is preferably a portable housing of a compact design shaped to fit in a vehicle and/or on shelving for sale in a store. The housing 106 is depicted as having two opposite sides 112a,b for performing various functions. As shown, the sealant side 112a is provided with mechanisms for performing sealing functions, and the inflation side 112b is provided with mechanisms for performing inflation functions. The two sides 112a,b may be marked with color, descriptions, instructions and/or other markings for setting forth the intended function of each side. Each of the sides may be provided to guide users in the operation of the tire repair system for performing a desired operation. Certain devices may be

placed on certain sides of the housing 106 to distinguish functions and/or operations for the user.

[0022] The housing 106 may optionally be provided with various devices, such as a gauge 114, indicator light 116 and on/off switches 118a, b, for performing various functions. As shown in Figure 1B, the sealant side 112b is provided with gauge 114 to measure tire pressure during the inflation operation, and an inflation on/off switch 118b for activating the inflation mode. As shown in Figure 1A, the sealant side 112a is provided with a sealant on/off switch 118a for activating the tire sealer 110 to perform in the sealant mode, and the indicator light 116 for indicating when the tire sealer 110 is performing the sealing operation. Optionally, additional features, such as lights, radios, tools, and other electrical devices (not shown) may be positioned in the housing to perform additional functions. One or more devices may be placed on one or more sides to assist users in performing functions in conjunction with certain operations and/or modes.

[0023] As shown, the housing 106 is provided with a cord caddy 120 on an end thereof for storing a power cord 122 extending from the compressor 108. The power cord or cable 122 may wind about the cord caddy 120 for storage. The power cord 122 has an end with a power connector 124 thereon for connection to a power source 126. As also shown, the power cord 122 has a car lighter adapter 124 insertable into the car lighter 122. However, it will be appreciated that one or more power connectors, such as electrical plugs, adapters, etc., and/or power sources, such as batteries, power supplies, motors, etc., may be used for providing power to the tire repair system 100 as needed.

[0024] Electronics 128 are also provided in the housing 106 to operate the tire repair system 100. The electronics 128 may include power supplies, processors, controllers, switches and/or other electrical components for selectively activating the tire repair system 100 to perform various functions. For example, the electronics 128 may activate the compressor 108 in response to movement of the on/off switches 118a,b. In another example, the electronics 128 may automatically shut off the tire repair system 100 upon reaching certain criteria, such as a given tire pressure.

[0025] The housing 106 may be made of a metal, plastic or other material sturdy enough for handling and/or operation, but light enough for convenient use. The housing 106 may be molded to shape to provide for convenient use and/or for providing certain features. As shown, the housing 106 is preferably provided with depression 130 for storing an inflation

hose 132. As shown, the depression 130 is an oval recess in an outer surface of the inflation side 112b of housing 106 for receiving the inflation hose 132. The housing 106 may also be provided with other depressions and/or recesses for hosting components of the tire system 100 and/or for facilitating handling of the tire system 100. For example, a handle (not shown) may be provided for carrying the tire repair system 100. One or more cord caddies, depressions, handles and/or other portions of the housing 106 may be formed for receiving one or more cords, hoses or other components for use with the tire repair system 100. Receptacles may also be provided in the housing 106 for carrying other devices, such as tools, pens/pencils, flashlights, etc. (not shown).

[0026] The inflation hose 132 is selectively extended from the housing 106 for connection with the tire 102. The inflation hose 132 has a compressor end 134 operatively connected to the compressor 108 by a flowline 136, as schematically depicted, for receiving the pressurized fluid therefrom. The inflation hose 132 also has an inflation connector 138 on an end thereof for operative connection with the tire 102. Inflation hose 132 provides fluid communication between the compressor 108 and the tire 102 for passing pressurized air from the compressor 108 to the tire 102 for inflation thereof.

[0027] The housing 106 is also provided with an inlet 140 for receiving the tire sealer 110. The inlet 140 is preferably shaped to conform to an outer surface of the tire sealer 110 for cooperative operation therewith. Access door 121 may optionally be provided to facilitate insertion of the tire sealer 110 therein and/or use thereof. The housing may be provided with a window or no door, as desired. The housing 106 may be locked in place, and selectively released therefrom by a release 142. As shown in Figure 1A, the tire sealer 110 is releasably inserted into the housing 106 for use in the sealant mode. A sealant hose 143 extends from the tire sealer 110 and is operatively connected to the tire 102 via connector 138 for passing a sealant and/or a pressurized fluid from the tire sealer 110 to the tire 102 as will be described more fully herein. As shown in Figure 1B, the tire sealer 110 may be absent during the inflation operation. However, it will be appreciated that the tire sealer 110 may be inserted into the housing 106 during operation of the tire system 100 in the inflation mode of Figure 1B. Preferably, activation of the tire sealer 110 is prevented during the inflation operation.

[0028] Figures 2A-2D are detailed views of the tire repair system 100 of Figures 1A and 1B. Figure 2A is a side view of the tire repair system 100 showing an end of housing 106 with the cord caddy 120. Figures 2B-D are longitudinal cross-sectional views of the tire repair system

100 of Figure 2A taken along lines 2B-2B, 2C-2C and 2D-2D, respectively. These views show the operation of the tire repair system 100 in greater detail.

[0029] Figure 2B shows the internal workings of the sealant side 112a of Figure 1A. Figure 2C shows the internal workings of the inflation side 112b of Figure 1B. A flowline 136 fluidly connects the compressor 108 with a regulator 144. The tire regulator 144 selectively diverts pressurized fluid from the compressor 108 to either the tire sealer 110 or the inflation hose 132 as will be described more fully herein. The tire regulator 144 is selectively fluidly connected to the inflation hose 132, and to the tire sealer 110 for selective fluid communication therebetween. The regulator 144 may be activated by the sealant on/off switch 118a to turn the compressor 108 on and selectively release the pressurized fluid to the tire sealer 110, or by the inflation on/off switch 118b to turn the compressor 108 on and selectively release the pressurized fluid to the inflation hose 132.

[0030] The tire sealer 110 includes a sealant container 146 (e.g., bottle or cartridge), a sealant bag 148 containing a sealant 150, and a valve 152. Sealant hose 143 is fluidly connected to valve 152. The tire sealer 110 is preferably insertable into inlet 140 of housing 106 and receivable by receptacle 154 for sealing engagement in the housing 106. The tire sealer is preferably locked into place via latch or lock 156. The valve 152 of the tire sealer 110 has a lip 158 that catches on the latch 156 thereby retaining the tire sealer 110 in the housing 108. The latch 156 may be tilted away from lip 158 by activating release 142 (Figure 1A). In this manner, the tire sealer 110 may be inserted into the housing 106 and releasably locked into place for operation in the sealant mode.

[0031] The latch 156 preferably grippingly engages the valve 152 such that the valve 152 is pressed against the regulator 144 to form a seal therewith for fluid communication therebetween. In this configuration, the tire sealer 110 is selectively fluidly connected via regulator 144 to air compressor 108. The valve 152 of the tire sealer 110 receives the pressurized fluid from the compressor 108 as it is released thereto by the regulator 144. The pressurized fluid received by the valve 152 may then be diverted into the container 146 or out through the sealant hose 143 as will be described further herein.

[0032] Figure 2D shows an alternate view of the inflation side 112b of Figure 2C in partial cross-section. In this view, the gauge 114 is visible. Also, this view shows that vents 157 may be provided in the housing 106.

[0033] Figures 3A – 3B4 show views of a portion 3 of the tire repair system 100 of Figure 2D depicting the operation of the regulator 144 and tire sealer 110 in greater detail. In these figures, the regulator 144 is configured as part of the tire sealer 110, but may optionally be separate therefrom and be positioned, for example, in the housing 106. Figure 3A shows a side view of the regulator 144 and tire sealer 110 combination. Figures 3B1-3B4 are cross-sectional views of the regulator 144 and tire sealer 110 taken along line 3B-3B. The regulator 144 has a regulator body 158 with a slidable regulating member 160 in a regulator passage 162 therein. Figure 3B1 shows the regulator 144 in an off position. Figure 3B2 shows the regulator 144 in an inflation position. Figure 3B3 shows the regulator 144 in a sealant position with the valve 152 in a neutral position. Figure 3B4 shows the regulator 144 in the sealant on position with the valve 152 in a retracted position.

[0034] Referring first to Figures 3B1-3B2, flowline 136 from the compressor 108 is in selective fluid communication with the regulator passage 162 for passing the pressurized fluid thereto. On/off switch 118b (see, e.g., Figures 1B, 2C, 2D) is selectively activated to move the regulator member 160 to the desired position for operation in the inflation mode of Figure 1B. An inflation flowline 164 extends from the regulator 144 and is in selective fluid communication with the inflation hose 132 (see, e.g., Figures 1B and 2B) when the regulator member 160 is in the inflation on or off position as shown in Figures 3B1 and 3B2. In the off position of Figure 3B1, fluid may be free to flow through the regulator, but is typically prevented from flowing by deactivating the compressor 108. Residual pressure may flow through the system. In the inflation on position of Figure 3B2, the regulator member 160 is moved to a position to permit pressurized fluid to pass from the flowline 136, through regulator passage 162 and out flowline 164 to inflation hose 132 (Figure 1B) as indicated by the directional arrows. Flowline 164 is operatively connected to inflation hose 132 for passing the pressurized air to tire 102 as shown in Figure 1B.

[0035] The valve 152 of tire sealer 110 is operatively connected to the regulator 144 to form a seal therewith for fluid communication therebetween when the regulator 144 is in the sealant position as shown in Figures 3B3-3B4. On/off switch 118a (see, e.g., Figures 1A and 2B) is selectively activated to move the regulator member 160 to the desired position for operation in the sealant mode. In Figures 3B3 and 3B4, the regulator 144 is in a position to permit the flow of pressurized fluid from flowline 136 to the valve 152. In this position, a fluid pathway is defined from flowline 136, through passage 162 of the regulator 144 and into valve 152 of

the tire sealer 110 as schematically depicted by the directional arrows. The valve 152 is operatively connected to container 146 of the tire sealer 110 for selectively passing fluid thereto. The valve 152 may be used to divert the pressurized fluid either into the container 146 as shown by the directional arrows in Figure 3B3, or out the sealant hose 143 as shown by the directional arrows in Figure 3B4. As pressurized fluid is passed through the regulator 144 and to the valve 152, pressure is applied to selectively activate the valve 152 as will be described more fully herein.

[0036] The on/off switches 118a, b are shown in greater detail in Figures 4A-4C. Figure 4A shows the on/off switches in the off position. Figure 4B shows an inflation on/off switch 118b in the on position and a sealant on/off switch 118a in the off position. Figure 4C shows the sealant 118a on/off switch in the on position and the inflation on/off switch 118b in the off position. The on/off switches 118a,b are preferably positionable in the housing 106 such that the sealant on/off switch 118a is on the sealant side 112a, and the inflation on/off switch 118b is on the inflation side 112b. The on/off switches are depicted as dials, but may be of any configuration for activating the tire repair system 100 as desired.

[0037] The on/off switches 118a,b are operatively connectable to the regulator 144 for selective activation thereof. In the off position of Figure 4A, power is turned off and/or the regulator 144 is moved to the off position of Figure 3B1 and the compressor 108 is deactivated to prevent passage of pressurized fluid from the compressor 108. In the inflation on position of Figure 4B, power is on and the inflation on/off switch 118b moves the regulator to the inflation on position to release the pressurized fluid through the regulator and out flowline 164 as shown in Figure 3B2. In the sealant on position of Figure 4C, power is on and the on/off switch 118a moves the regulator 144 to the sealant on position to release pressurized fluid through the regulator 144 and to the valve 152 as shown in Figures 3B3 and 3B4. In the sealant on position, the valve 152 selectively activates the tire sealer to seal and/or inflate as will be described further herein.

[0038] Figures 5A-C show a cross-sectional view of the tire sealer 110 of Figure 3B1 (with regulator 144 removed) depicting the operation thereof. These figures show the activation of valve 152 in response to pressure differentials thereacross. Figure 5A shows the valve 152 of the tire sealer 110 in a neutral or closed position for receiving pressurized air from the compressor 108 into container 146 to expel a sealant 150 therefrom. Figure 5B shows the valve 152 in a retracted position for passing the pressurized air through valve 152 and out

sealant hose 143. Figure 5C shows the valve 152 returned to the neutral position after the sealant 150 has been drained.

[0039] The valve 152 is preferably made of a plastic or other material capable of sealing engagement with the receptacle 154 and/or regulator 144 (see, e.g., Figure 2B). The valve 5 152 has a valve passage 166 therethrough for slidably receiving valve member 168 therein. The valve member 168 may be provided with a spring 170 for urging the valve member 168 into the neutral position, but allowing retraction of the valve member 168 to the retracted position based on a pressure differential thereacross. Preferably, in the neutral position, the valve member 168 closes the valve passage 166 to prevent the release of sealant 150 from the 10 container 146. In this manner, the valve 152 is preferably capable of 'sealing' and/or 're-sealing' the container 146 to provide leak prevention.

[0040] The valve 152 is operatively connected to the container 146 for selectively passing the pressurized fluid thereto. The container 146 may be threadedly, lockingly fitted or otherwise permanently or releasably connected to the valve 152. The container 146 may be made of a 15 metal, plastic or other material sturdy enough for handling and/or operation, but light enough for convenient use. As shown, the container 146 is round, but could be square or other shape. The shape may be configured to facilitate insertion of the container 146 into the housing. Preferably, the container 146 is insertable to provide a one-way fit for proper insertion. The container 146 is preferably provided with a sealant bag 148 therein to hold the sealant 150.

20 The sealant bag 148 may be of a plastic, elastomeric or other material capable of holding a fluid and releasing such fluid upon compression thereof. Preferably, the container and sealant bag permit operation thereof in any orientation (e.g., inverted or upright). Valve 152 has a bag connector 174 thereon for operatively connecting the bag 148 thereto. Bag 170 is operatively connected to bag connector 174 by adhesion, clamping or other means. The bag 25 connector has an inlet 176 in fluid communication with the bag 148 and a sealant portion 178 of valve passage 166. The spring 170 is seated on the bag connector 174 for support.

[0041] The valve 152 is activatable to move between the neutral and retracted positions of Figures 5A-C in response to a source pressure of the pressurized fluid or the compressor 108 (Ps) applied thereto, a pressure of the container (Pc), and/or pressure in the tire (Pt). In this 30 manner, pressure differentials across the valve 152 determine the operation of the tire sealer 110. When the pressure of the pressurized fluid is greater than the pressure in the container ($P_s > P_c$), fluid flows into the container 146 to apply compression to the sealant bag 148 and

expel the sealant 150 therefrom as shown in Figure 5A. In the neutral position of Figure 5A, the pressurized fluid received by the valve 152 is passed through a container passage 172 of the valve 152 and into container 146. Pressurized fluid received in the container 146 applies pressure to the sealant bag 148 to force the sealant 150 therefrom. As pressure from the

5 pressurized fluid (P_s) entering the container 146 increases, the sealant bag 148 is pressed to expel sealant 150 therefrom. When in the neutral position of Figure 5A, the valve member 168 permits the flow of sealant 150 from bag 148 through inlet 176 and out to the sealant hose 143 through an outlet 179 of valve 152 as shown by the directional arrows. The sealant 150 may then be passed through sealant hose 143 and to tire 102 as shown in Figure 1A.

10 Preferably, the sealant 150 is depleted from the sealant bag 148 and into the tire.

[0042] Once the sealant 150 is depleted and the pressure of the container increases such that a pressure of the container 146 equals a pressure of the pressurized fluid ($P_c = P_s$), the valve member 168 moves to the retracted position and diverts the pressurized fluid out outlet 179 through sealant hose 143 as shown in Figure 5B. As also shown in Figure 5B, the pressure of

15 the tire (P_t) in fluid communication with sealant hose 143 is less than the pressure of the pressurized fluid ($P_t < P_s$) thereby allowing the pressurized fluid to flow through the valve 152, through sealant hose 143 and into the tire 102 (Figure 1A). When the pressure of the pressurized fluid is greater than the tire pressure ($P_s > P_t$) and the force of the spring 170 and static friction of the valve member 168, the pressurized fluid flows through the regulator 152 and out the sealant hose 143. This relationship may be shown by the following equation:

$$\frac{P_s}{A_s} > \left(\frac{P_t}{A_s} + kx + F_s \right) \quad \text{Equation (1)}$$

where

A_s – is the area of the seal;

kx – is the spring force based on Hook's law;

25 k – is the spring constant;

x – is the spring displacement; and

F_s – is the friction force on the seal.

[0043] Once the tire repair system 100 (or pressure source 108) is deactivated, the valve member 168 returns to the neutral position as shown in Figure 5C and fluid is unable to pass
30 through valve 152. The valve member 168 typically returns to the neutral position when the fluid pressure is less than the tire pressure ($P_s < P_t$) for example, when the sealant 150 is

depleted, the valve is disconnected and/or the system is deactivated. Preferably, sensor 165 (Figures 3B1-B4) is capable of sensing the pressure and deactivating the system 100. The system 100 and/or the pressure source may also be manually or automatically shut off using the on/off switch 118a,b (see, e.g., Figure 1), or based on certain criteria or as desired.

5 **[0044]** The valve 152 also preferably prevents unintended leakage of sealant 150 from the tire sealer 110. In the retracted position, valve member 168 prevents the sealant 150 from passing from the container 146, into the valve passage 168 and out the outlet 179. In the neutral position, the sealant 150 is unable to pass through the valve passage and out the outlet unless sufficient pressure is passed into the container 146 to compress the sealant bag 148 to release
10 the sealant therefrom. Thus, whether the valve member 168 is in the neutral or the retracted position, the sealant 150 is prevented from leaking from the tire sealer 110. Should any sealant 150 or other fluid pass into the sealant hose 143, sealant connector 138 may also be used to prevent fluid from exiting thereby further preventing leakage.

[0045] A check valve may also be provided to prevent the flow of fluid into or out of the
15 valve. A check valve may be, for example, a duck bill in flowline 172 to permit the pressurized fluid to pass into the container, but prevent it from releasing therefrom. Check valves or other devices may be positioned in various locations about the tire sealer and/or system to control the flow of fluid therethrough.

[0046] Figures 6A and 6B depict the sealant connector 138 of Figure 1A in greater detail.

20 Figures 6A and 6B show sealant connector 138 in use with the sealant hose 143 for sealing a tire 102 as shown in Figure 1A. Optionally, known tire stem connectors, such as a valve actuator (see, e.g., US Patent No. 6401711) or a conventional threaded connector, may also be used. Figure 6A shows the sealant connector 138 in a closed position adjacent a tire stem 180 for connection thereto. Figure 6B shows the sealant connector 138 in the open position and
25 operatively connected to the tire stem 180. The sealant connector 138 is shown operatively connected to sealant hose 143, but could also be used with inflation hose 132 or other hoses, tubes or other devices as desired.

[0047] The sealant connector 138 includes a connector body 182, a connector member 184, a lever 186 and a retainer 188. Sealant hose 143 is operatively connected to a hose portion 190
30 of connector body 182 for fluid communication therewith. Connector body 182 also has a stem portion 192 operatively connectable to stem 180 of the tire 102. A connector ring 194 is positioned between the hose portion 190 and the stem portion 192. The connector ring 194

has a hole 196 therethrough to permit fluid communication between the hose and stem portions 190, 192.

[0048] The hose portion 190 and the stem portion 192 have a connector passage 198 therethrough in fluid communication with the sealant hose 143. The connector member 184 is slidably positionable in the sealant passage 198 and moveable therein between a neutral and retracted position. A connector spring 185 is positioned about the connector member 184 and seated within the hose portion 190 to urge the connector member 184 to the neutral position. The connector member 184 is movable between the neutral and the retracted position for selectively providing fluid communication between the sealant hose 143 and the tire stem 180 via connector passage 198.

[0049] In the neutral or closed position of Figure 6A, the connector member 184 has a tip 197 at a stem end thereof extending through the hole 196 and into the stem portion 192. A flange 199 of the connector member 184 contacts the connector ring 194 to sealingly cover the hole 196 and prevent the passage of fluid therethrough.

[0050] The retainer 188 is also slidably movable through the stem portion 192 between an open and closed position by the lever 186. The lever 186 is operatively connected to the stem portion 192 and the retainer 188 for activating the retainer 188. In the closed position of Figure 6A, the lever 186 is released and the retainer 188 is permitted to extend into the connector passage 198 of the stem portion 192 for contact with the tip 197 of the connector member 184. The retainer 188 acts as a shield prevent connector member 184 from being activated to move to a retracted or open position, thereby prevent leakage of fluid from the connector 184 when not in connection with a tire stem.

[0051] In the open position of 6B, the lever 186 may be depressed to raise the retainer 188 and to permit tire stem 180 to pass into tire end 192 of the connecting member 184. Tire end 192 is preferably shaped to receivingly conform to the tire stem 180. With the retainer 188 open, the connecting member 184 may be positioned adjacent the tire stem 180. With the tire stem 180 inserted into the tire end 192, the tire stem 180 is pressed against the tip 197 and pushes the connector member 184 to the retracted position. In this position, a seal is formed to permit fluid in the sealant hose 143 to pass through the fluid passage 198 of the connector 138 and into to the tire stem 180 to fill the tire as shown by the directional arrows. The tire stem 180 may be removed and the lever 186 released to allow the connector 138 to return to the neutral position of Figure 6A.

[0052] Figure 7 is a flow chart depicting a method 200 of repairing a tire. With this method, a tire sealer and/or tire repair system (see, e.g., the tire repair system 100 and tire sealer 110A of Figure 1A) may be utilized. In some cases, the tire sealer 110 may be used with, for example, the pressure source of the tire repair system. The method (200) may involve performing a method (203) of sealing, such as the sealing operation as shown in Figure 1A, and/or a method (205) of inflating, such as the inflation operation as shown in Figure 1B. The sealing operation involves operatively connecting (207) the tire sealer to a pressure source (see, e.g., compressor 108 of Figure 1A), operatively connecting (209) the sealant hose to the tire (see, e.g., sealant hose 143 and tire 102 of Figure 1A), and passing (211) a pressurized fluid from the pressure source to the valve (see, e.g., valve 152 of Figures 3B3 and 3B4).

[0053] The pressurized fluid is then selectively diverted through the valve based on a pressure differential thereacross. The pressurized fluid may be selectively diverted (213) into the container via the valve to selectively release the sealant from the container and into the tire (see, e.g., Figures 1A and 5A). When a pressure in the container equals a pressure of the pressurized fluid, the pressurized fluid may be diverted (215) through the sealant hose and to the tire via the valve for inflation thereof (see, e.g., Figure 5B). When the pressure source is deactivated, the pressurized fluid may be prevented (217) from passing into the valve (see, e.g., Figure 5C). The tire sealer may be released from the pressure source (219), and replaced (221) as desired.

[0054] While the tire may be inflated in step 215 above, the tire may also be inflated by using the method (203) of inflating. Method 203 may be used alone or in conjunction with method 205. In some cases, it may be useful to inflate the tire using side 112b of the housing to further inflate the tire after sealing on the sealing side 112a. The method (205) of inflating involves operatively connecting (223) an inflation hose of the tire system to the tire (see, e.g., inflation hose 132 and tire 102 of Figure 1B), and inflating (225) the tire by passing a pressurized fluid from the pressure source to the tire via the inflation hose (see, e.g., compressor 108 of Figure 1B).

[0055] Other steps may also be performed. For example, providing (227) power to the tire repair system. Power may be provided internally or by operatively connecting the tire repair system to a power source (see, e.g., power cable 122 and power source 126 of Figure 1B). In another example, pressure of the tire may be measured (229) via the gauge operatively connected to the inflation hose (see, e.g., gauge 114 of Figure 1B). In yet another example,

the tire repair system may be selectively deactivated (231) based on certain criteria, such as a maximum tire pressure or activation of on/off switch 118a,b.

[0056] One or more of the steps and/or methods may be repeated. The steps may be performed in a desired order to complete the operation as desired. For example, one or both of the methods of sealing (203) and/or inflating (205) may be performed in either order. To facilitate operation of the methods, a unitary tire repair device, such as the tire repair system 100 of Figure 1A and 1B may be used. To also facilitate operation of the methods, the dual sided device may be used to activate the tire repair system to perform one or more functions using the appropriate components. For example, the inflation side 112b has the inflation hose 132 on one side thereof with an associated on/off switch 118b for activation thereof. In another example, the sealant side 112a has the sealant hose 143 extending from the tire sealer and an associated on/off switch 118a for activation thereof. The dual sided operation is intended to provide multi-functional capabilities while separating the operation of each side. The sealant side 112a also offers the capability of sealing and inflating in a single operation.

[0057] While the present disclosure describes specific aspects of the invention, numerous modifications and variations will become apparent to those skilled in the art after studying the disclosure, including use of equivalent functional and/or structural substitutes for elements described herein. For example, it will be appreciated that embodiments of the invention may be provided with seals to prevent leakage between components (e.g., regulator member 160, valve member 168 and/or connector member 184). All such similar variations apparent to those skilled in the art are deemed to be within the scope of the invention.

[0058] This description is intended for purposes of illustration only and should not be construed in a limiting sense. The scope of this invention should be determined only by the language of the claims that follow. The term “comprising” within the claims is intended to mean “including at least” such that the recited listing of elements in a claim are an open group. “A,” “an” and other singular terms are intended to include the plural forms thereof unless specifically excluded.

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CLAIMS

What is claimed is:

1. A system for repairing a tire, comprising:
 - a housing having an inflation side and a sealant side;
 - a pressure source for pressurizing a fluid, the pressure source positioned in the housing;
 - an inflation hose operatively connectable to the pressure source and the tire for establishing fluid communication therebetween, the inflation hose activatable from the inflation side; and
 - a tire sealer operatively connectable to the housing and activatable from the sealant side, the tire sealer comprising:
 - a container having a sealant therein;
 - a valve operatively connectable to the container, the valve operatively connectable to the pressure source for receiving the pressurized fluid therefrom, the valve selectively diverting the pressurized fluid from the pressure source to the container for selectively releasing the sealant therefrom; and
 - a sealant hose operatively connectable to the valve and to the tire for establishing fluid communication therebetween whereby the sealant is passed into the tire.
2. The system of Claim 1, further comprising a regulator operatively connected to the pressure source for selectively diverting the pressurized fluid to one of the inflation hose and the valve.
3. The system of Claim 1, further comprising a sealant on/off switch on the sealant side for selectively activating the pressure source to pass the pressurized fluid to the valve.
4. The system of Claim 1, further comprising an inflation on/off switch on the inflation side for selectively activating the pressure source to pass the pressurized fluid to the inflation hose.
5. The system of Claim 1, further comprising a gauge in the housing, the gauge operatively connectable to the tire for measuring a pressure therein.

6. The system of Claim 1, further comprising an indicator light on the sealant side, the indicator light igniting when a sealant operation is taking place.
7. The system of Claim 1, wherein the housing has a receptacle for receiving the tire sealer, the receptacle operatively connected to the pressure source, the tire sealer positionable in sealing engagement with the receptacle for providing fluid communication between the pressure source and the tire sealer.
8. The system of Claim 1, further comprising a sensor for measuring a pressure of the tire sealer.
9. A system for repairing a tire, comprising:
 - a housing;
 - a pressure source for pressurizing a fluid, the pressure source positioned in the housing;
 - and
 - a tire sealer removably positionable in the housing, comprising:
 - a container having a sealant therein;
 - a valve, comprising:
 - a valve body operatively connectable to the container, the valve body operatively connectable to the pressure source for receiving the pressurized fluid therefrom, the valve body having a valve passage therethrough and an outlet extending therefrom; and
 - a valve member slidably positionable in the valve passage of the valve body between a neutral and a retracted position in response to a source pressure of the pressurized fluid applied thereto such that, when the source pressure of the pressurized fluid is greater than a container pressure in the container, the valve member is in the neutral position and the pressurized fluid is diverted through the valve and into the container whereby the sealant is selectively expelled from the container through the valve passage and out the outlet; and
 - a sealant hose operatively connectable to the outlet, the sealant hose having an end operatively connectable to the tire for establishing fluid

communication between the valve and the tire for passing one of the pressurized fluid and the sealant from the valve to the tire whereby the tire is repaired.

10. The system of Claim 9, further comprising an inflation hose operatively connectable to the pressure source and the tire for passing the pressurized fluid from the pressure source to the tire
11. The system of Claim 9, further comprising an on/off switch for selectively activating the pressure source to send the pressurized fluid to one of the valve and the inflation hose.
12. A method of repairing a tire, comprising:

providing a system for repairing the tire, comprising:

a housing having an inflation side and a sealant side;

a pressure source for pressurizing a fluid, the pressure source positioned in the housing;

an inflation hose operatively connectable to the pressure source and the tire for establishing fluid communication therebetween, the inflation hose activatable from the inflation side; and

a tire sealer operatively connectable to the housing and activatable from the sealant side, the tire sealer comprising:

a container having a sealant therein;

a valve operatively connectable to the container, the valve operatively connectable to the pressure source for receiving the pressurized fluid therefrom, the valve selectively diverting the pressurized fluid from the pressure source to the container for selectively releasing the sealant therefrom; and

a sealant hose operatively connectable to the valve and to the tire for establishing fluid communication therebetween whereby the sealant is passed into the tire;

operatively connecting the sealant hose to the tire; and

sealing the tire by activating the pressure source to release the pressurized fluid to the valve.

13. The method of Claim 12, further comprising inflating the tire by activating the pressure source to release the pressurized fluid to one of the inflation hose and the valve.
14. The method of Claim 12, wherein the housing further comprises a gauge operatively connectable to the tire, the method further comprising measuring a pressure in the tire with the gauge.
15. The method of Claim 12, further comprising deactivating the tire repair system based on predetermined criteria.

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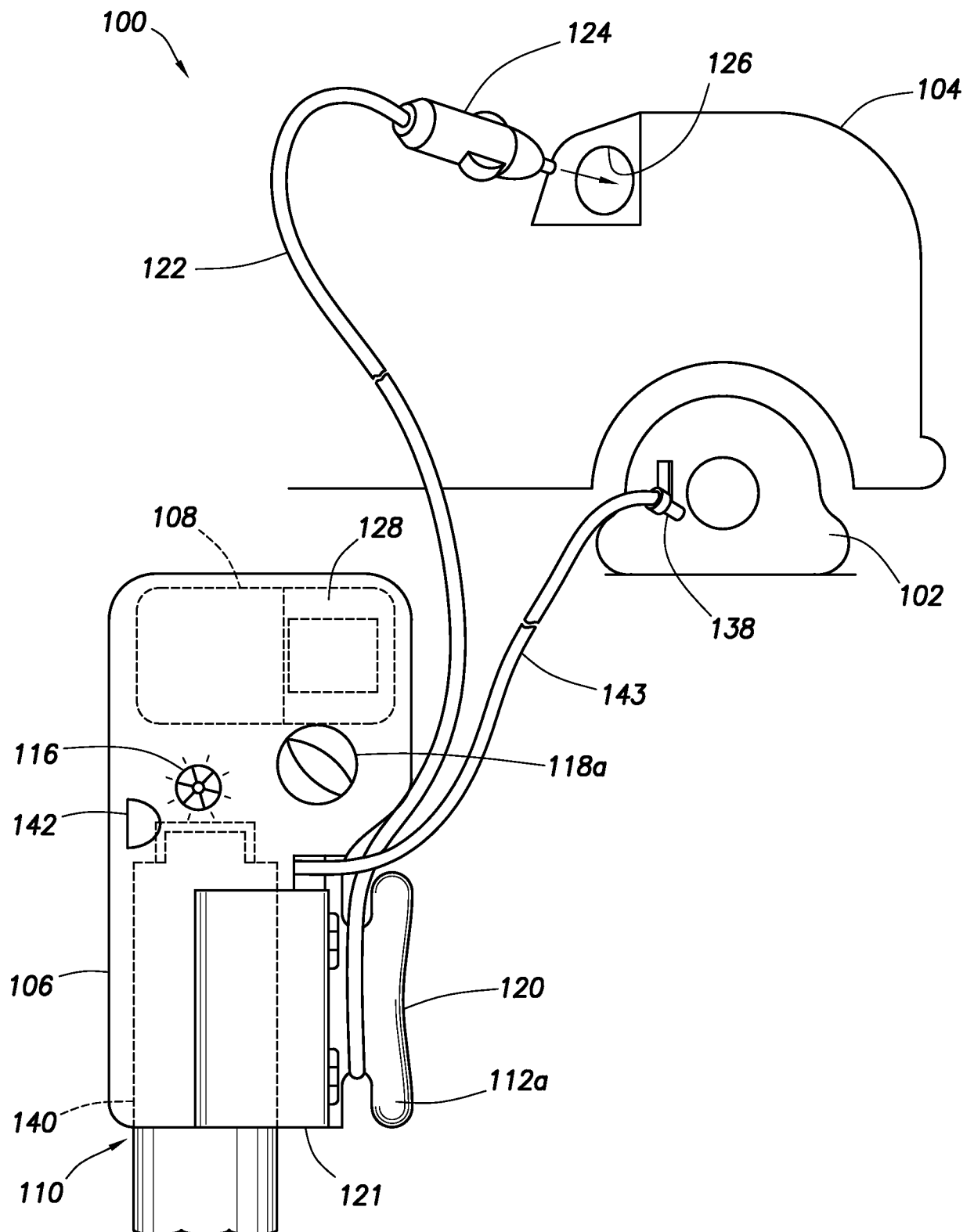


FIG. 1A

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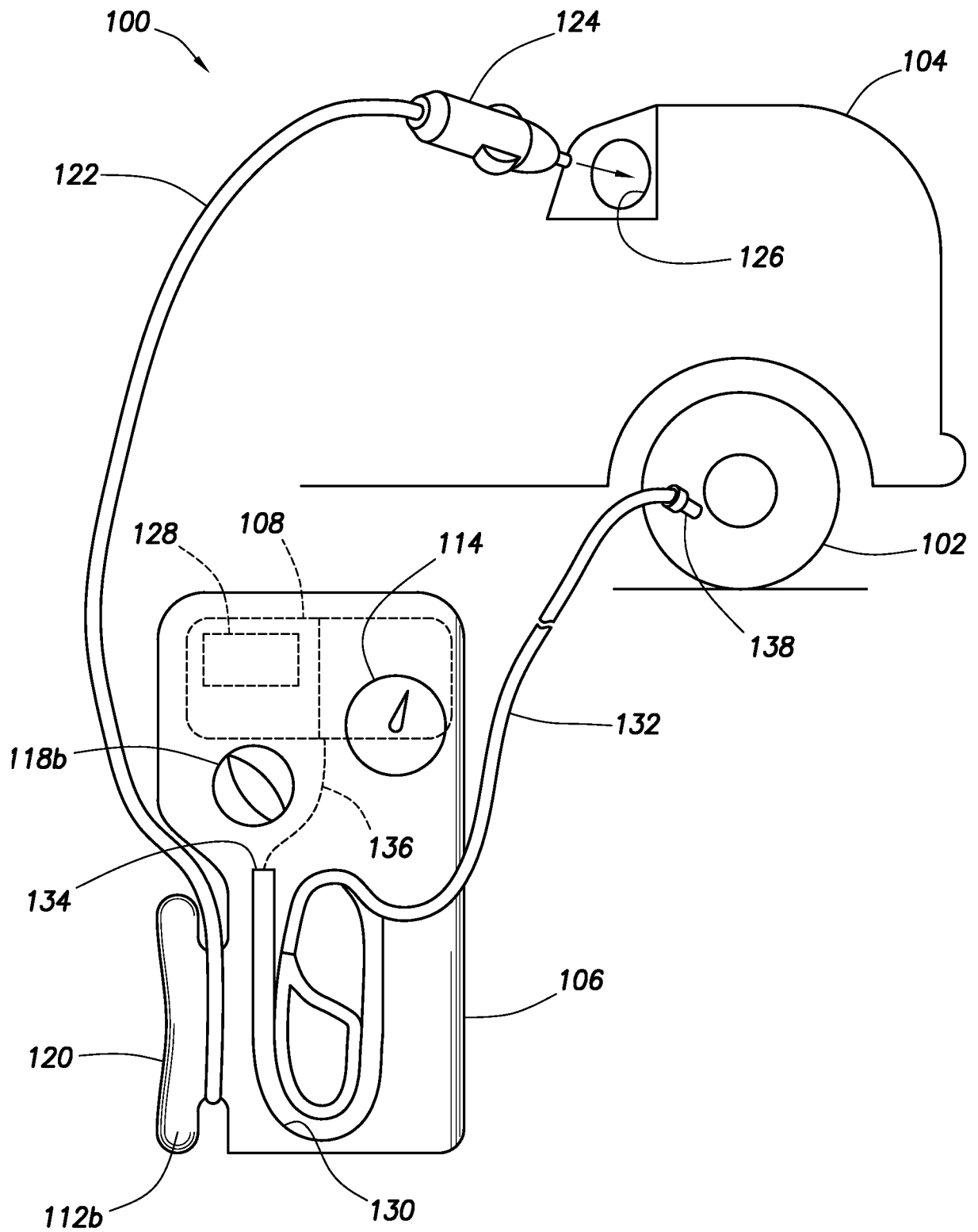
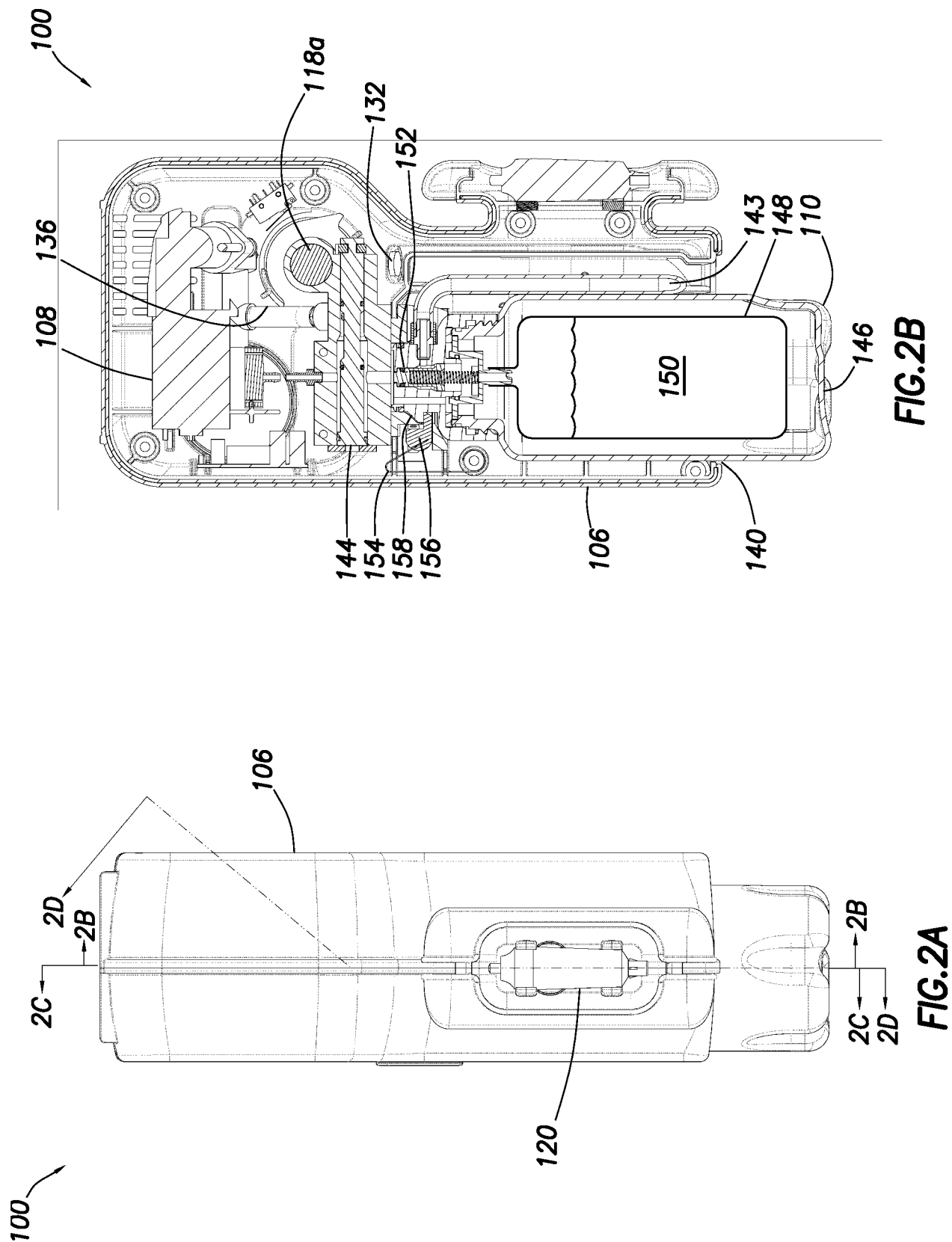


FIG. 1B

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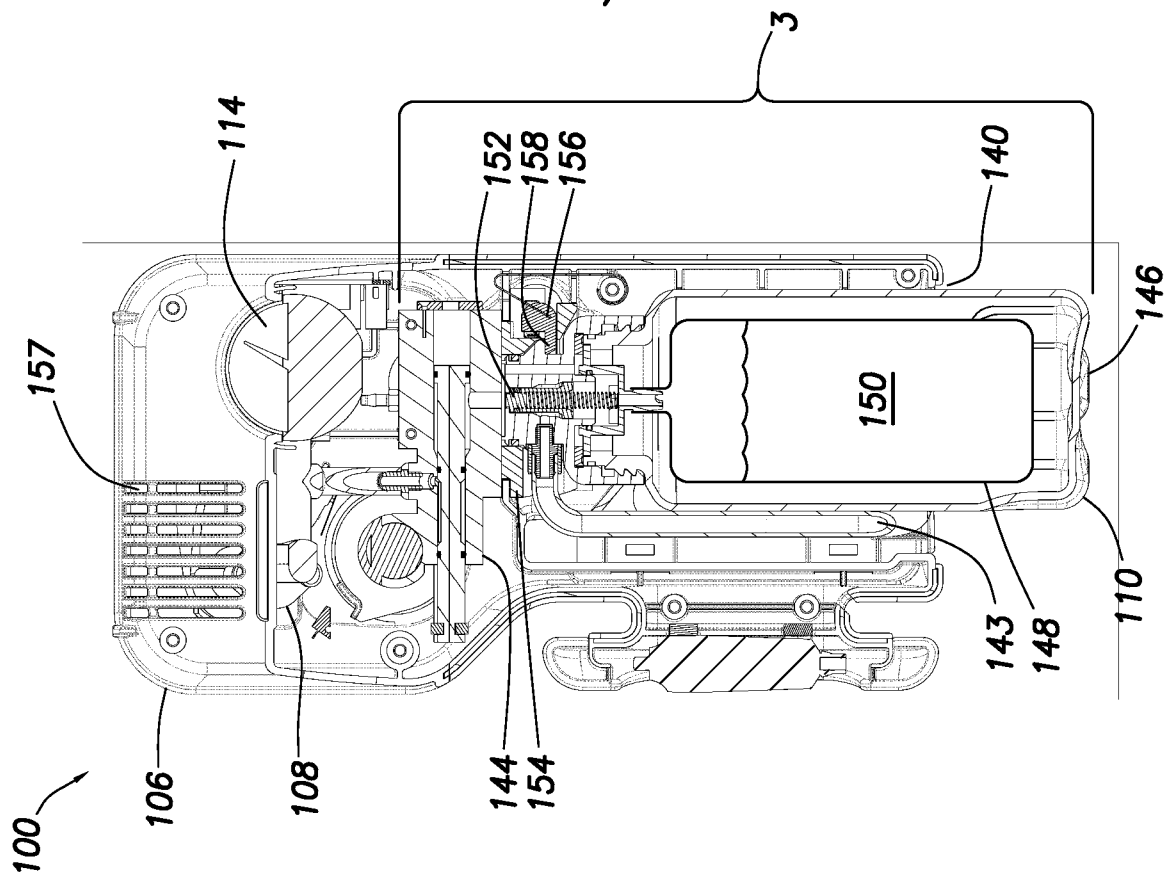


FIG. 2D

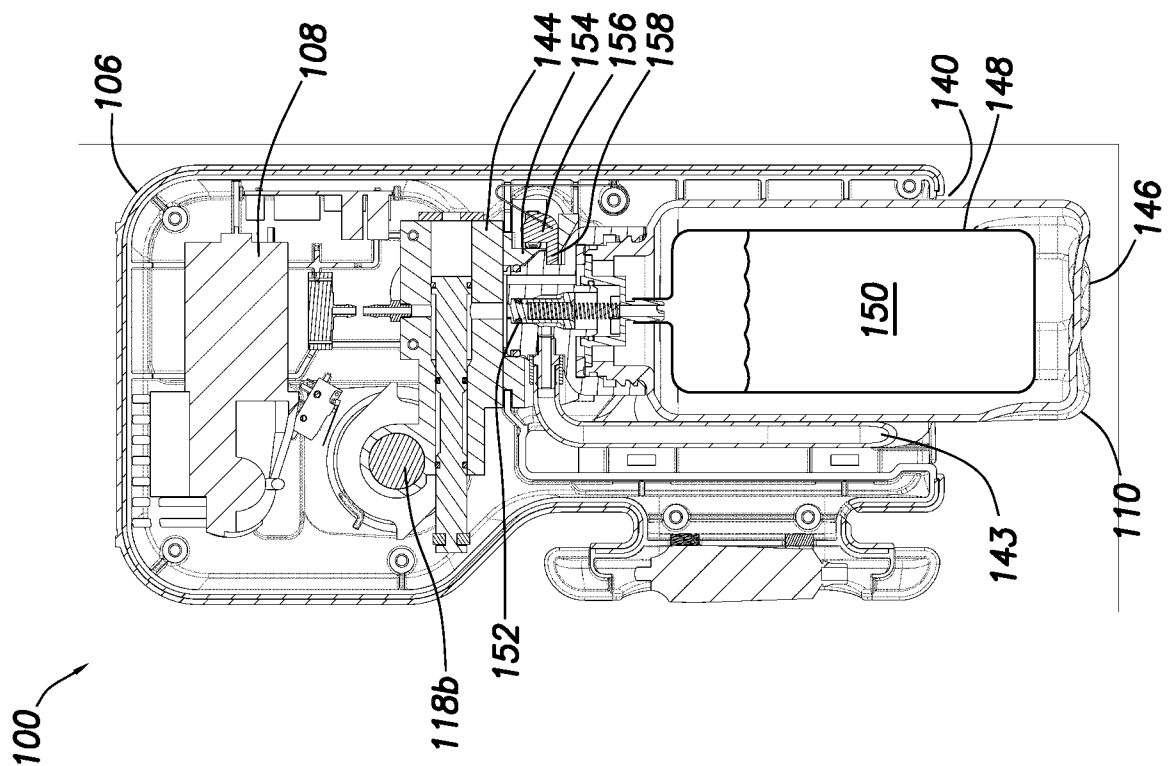


FIG. 2C

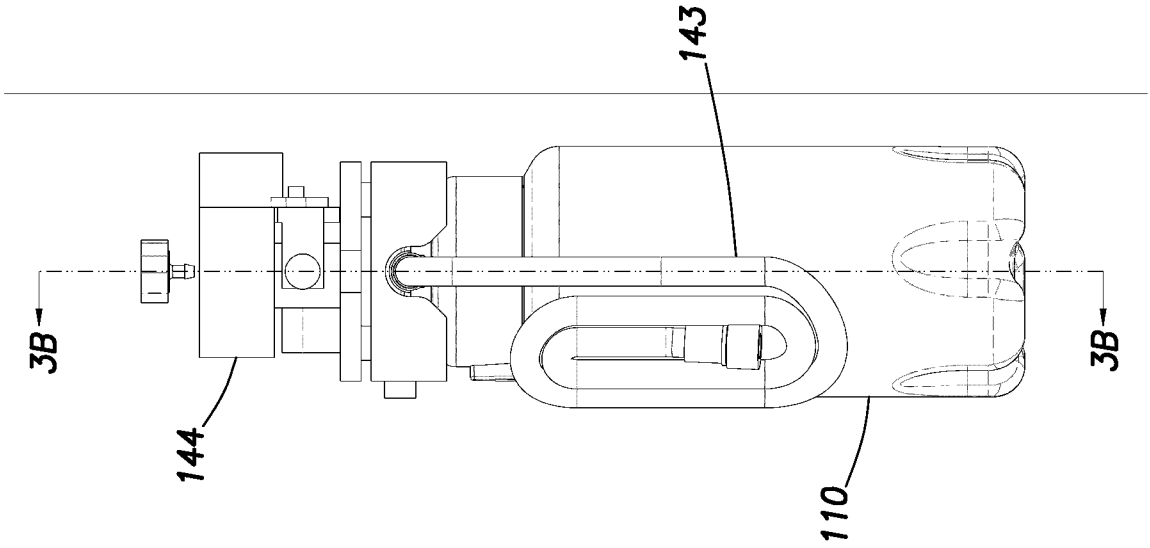


FIG. 3A

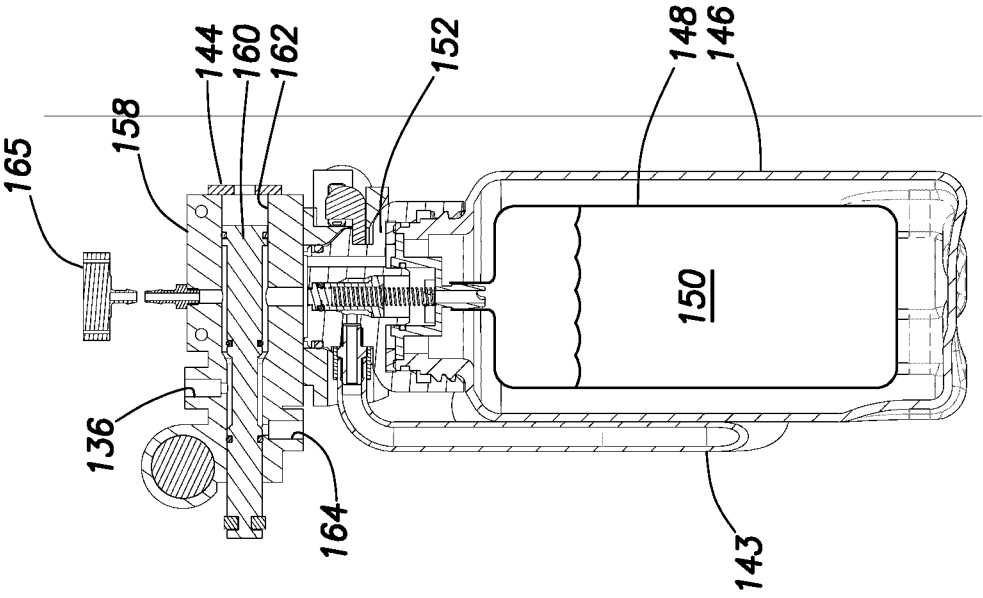


FIG. 3B1

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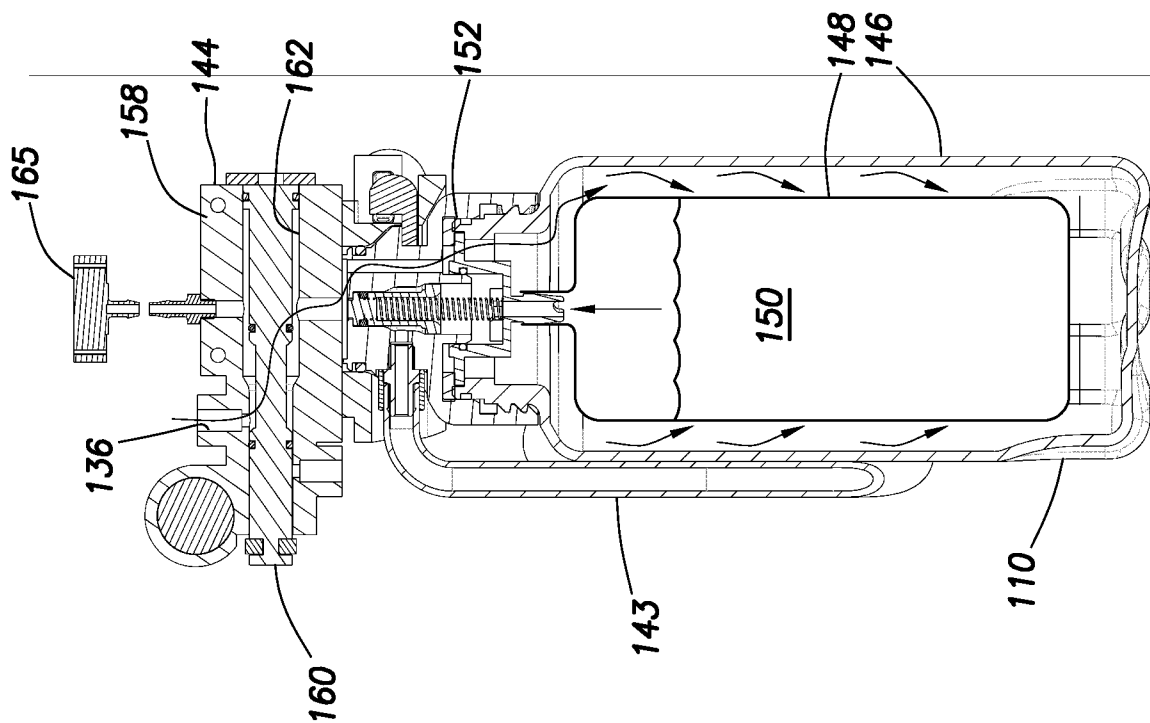


FIG. 3B3

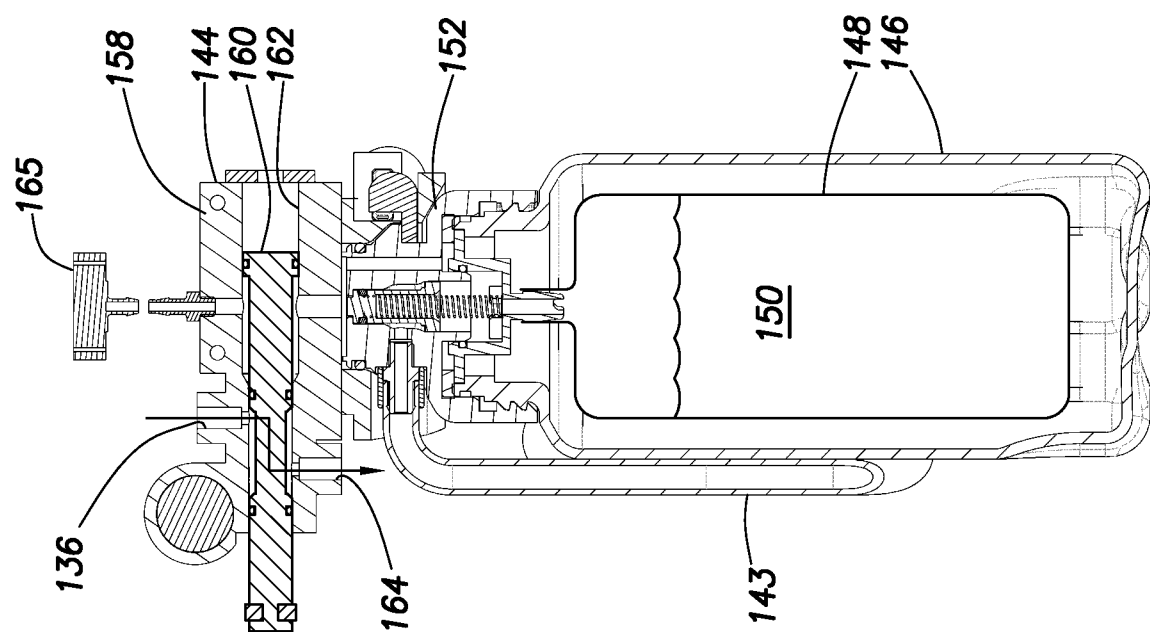


FIG. 3B2

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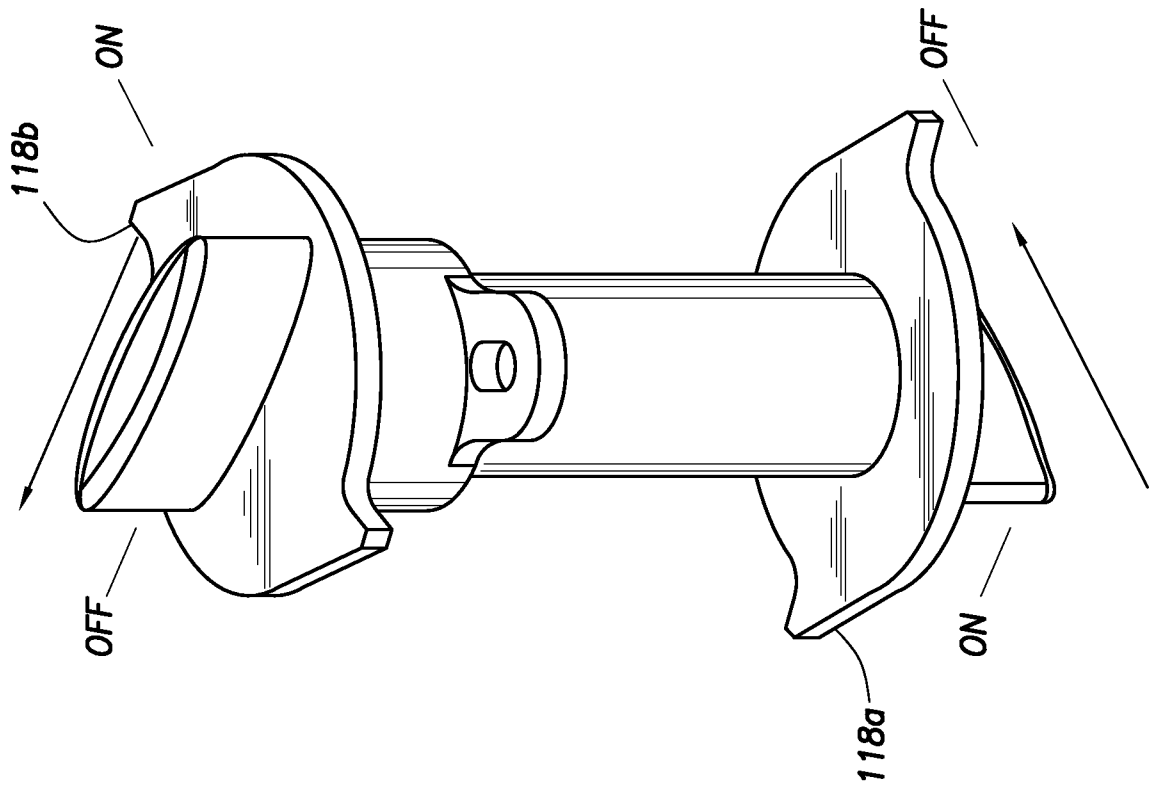


FIG. 4A

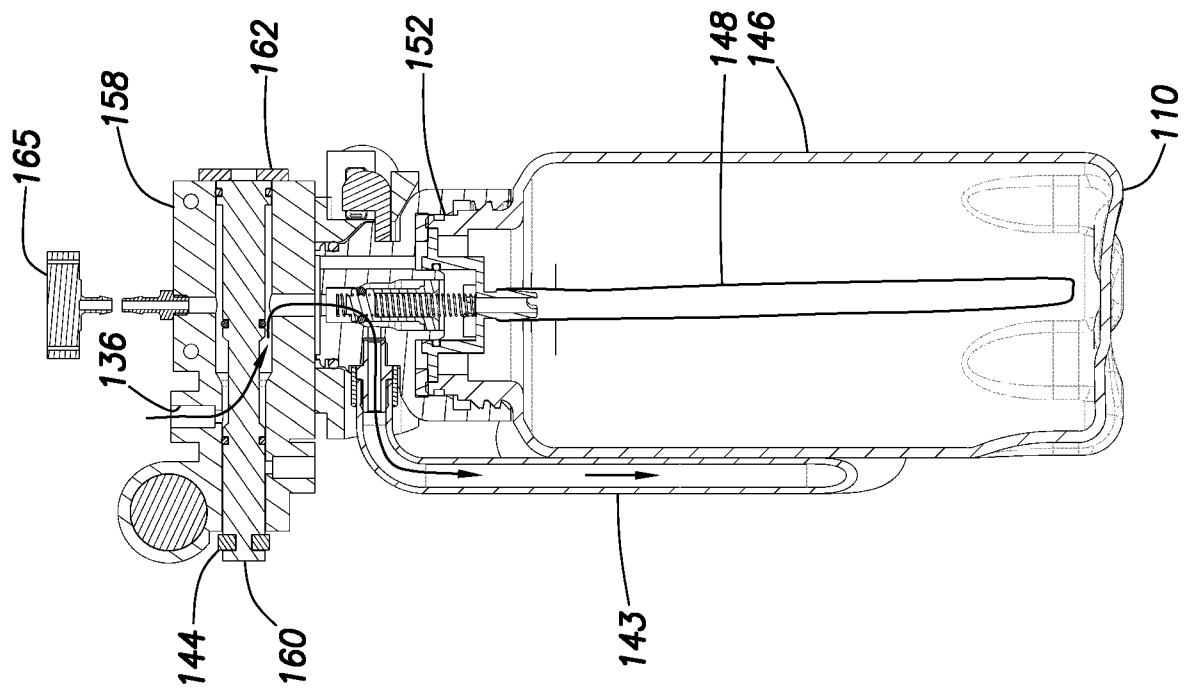
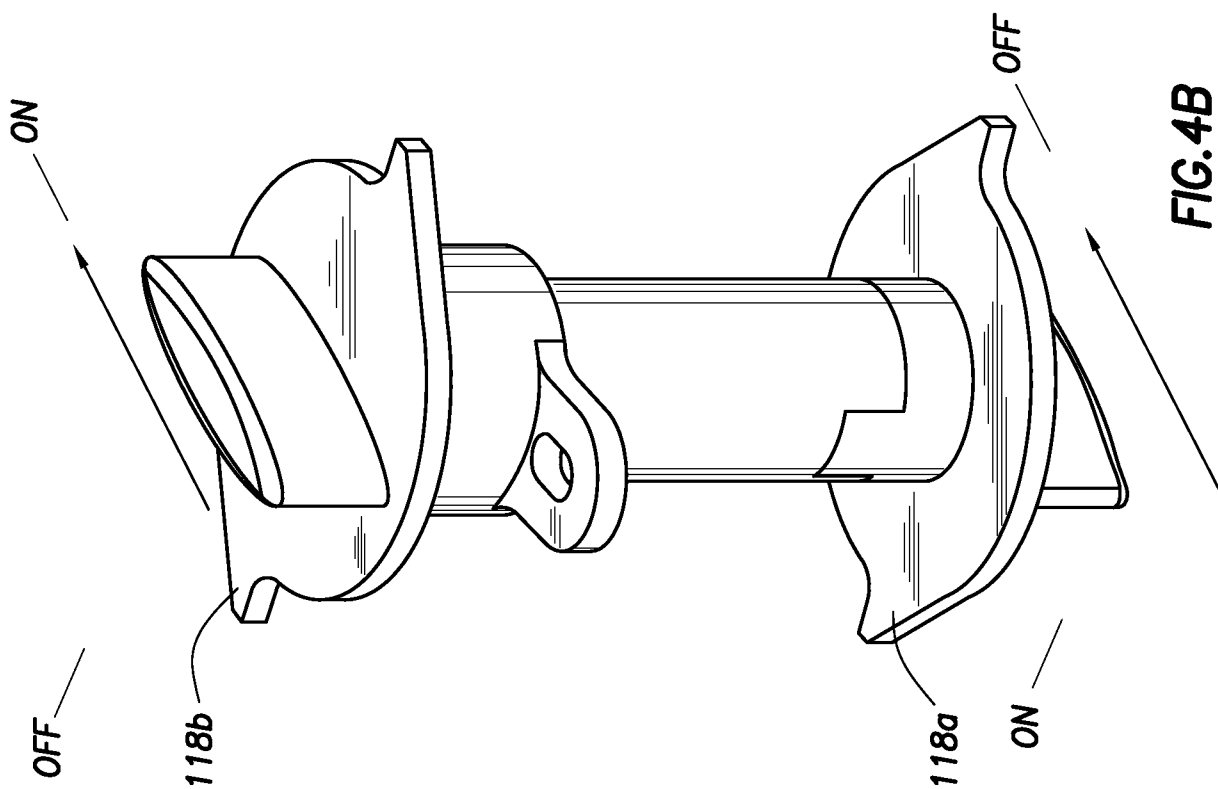
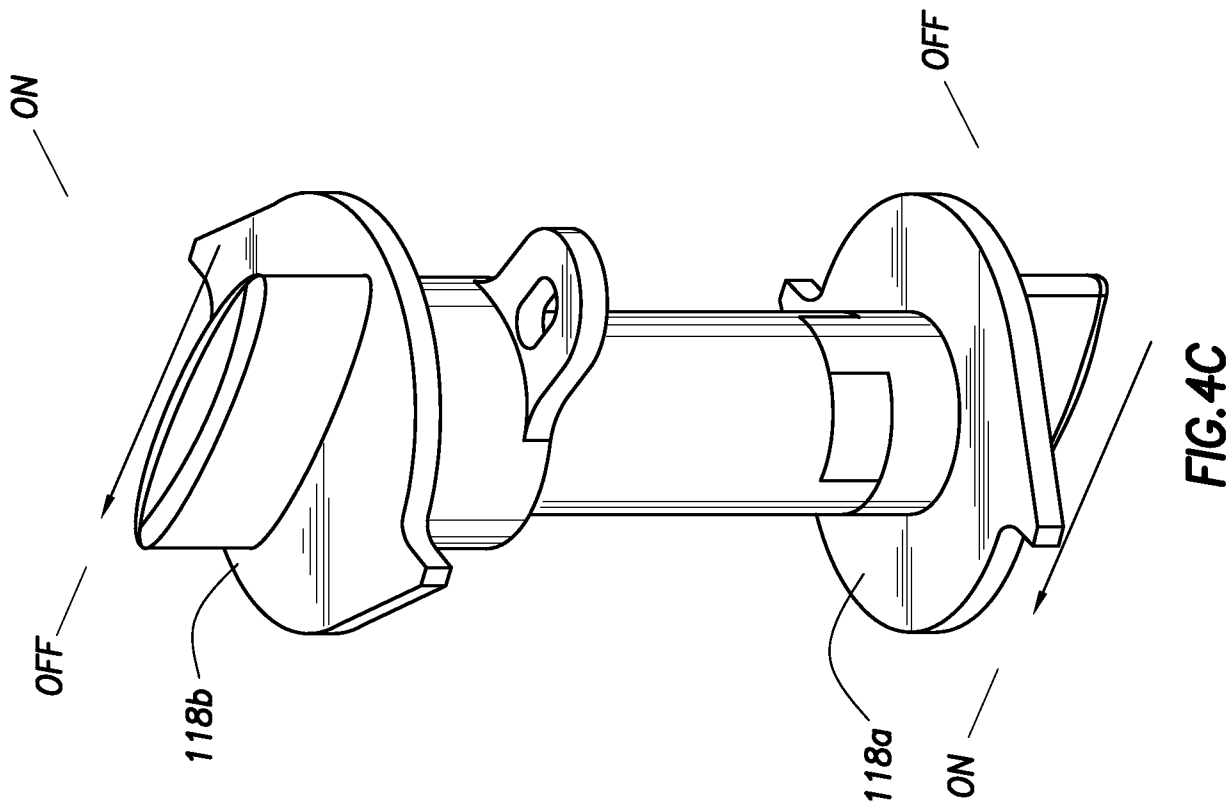
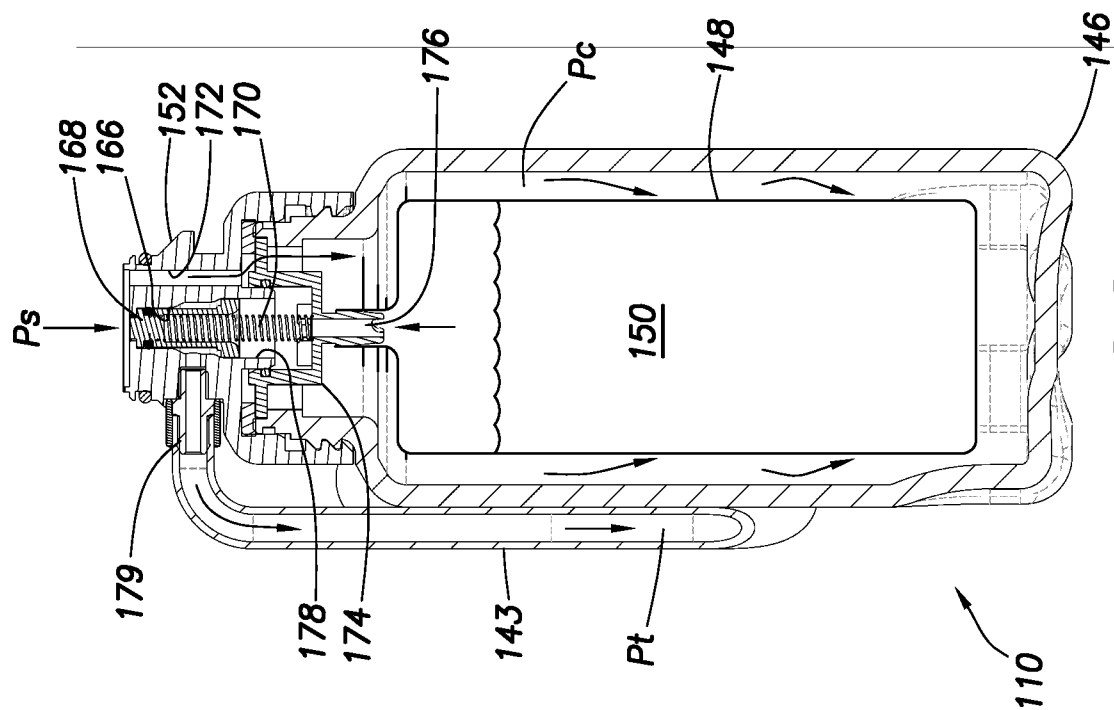
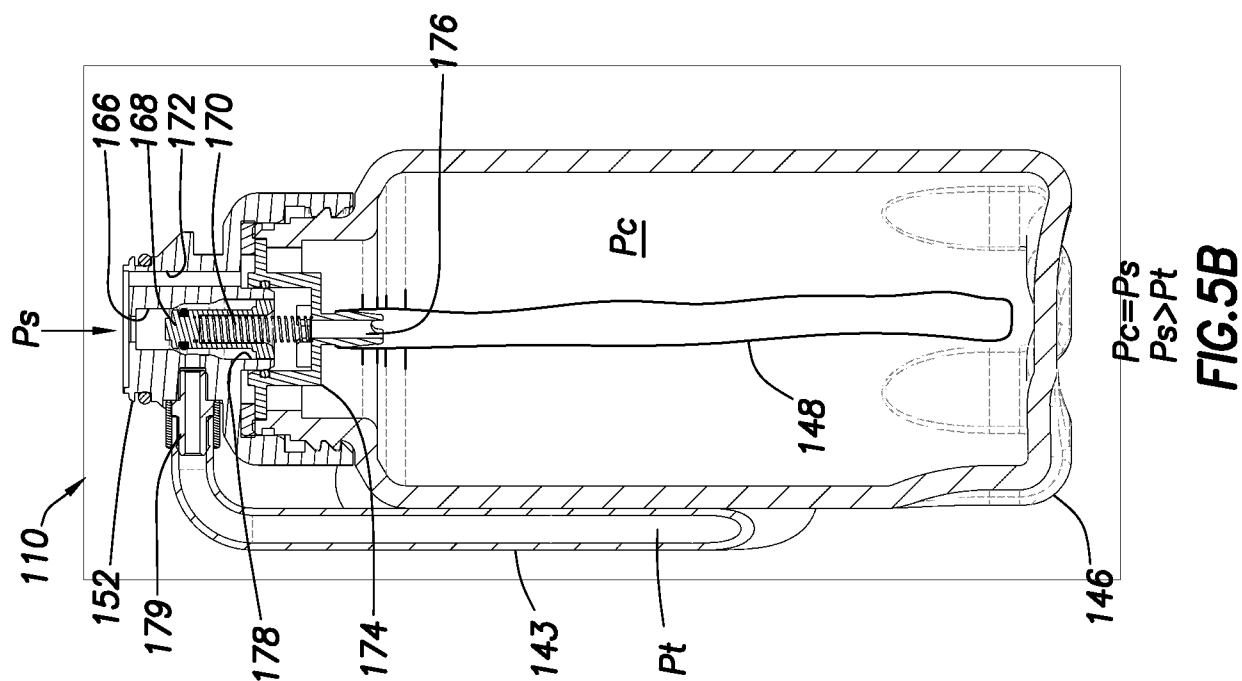


FIG. 3B4



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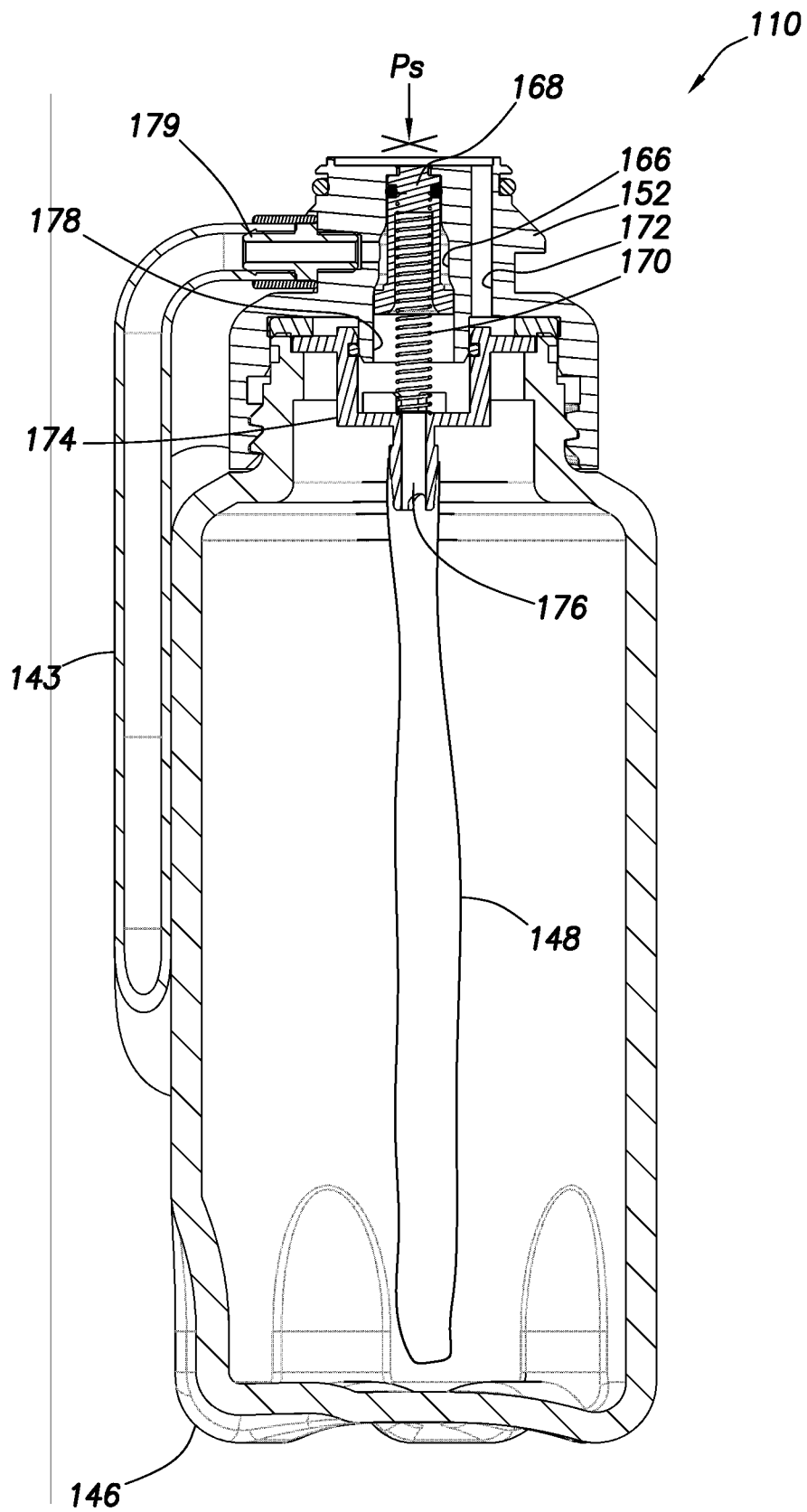


FIG. 5C

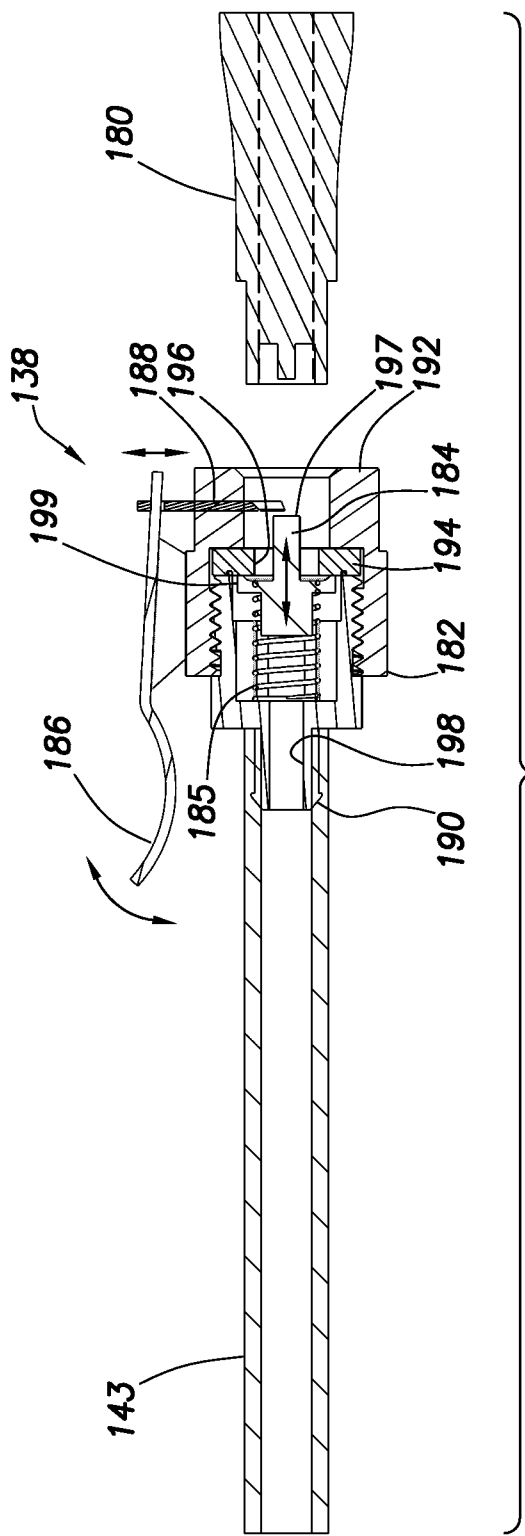


FIG. 6A

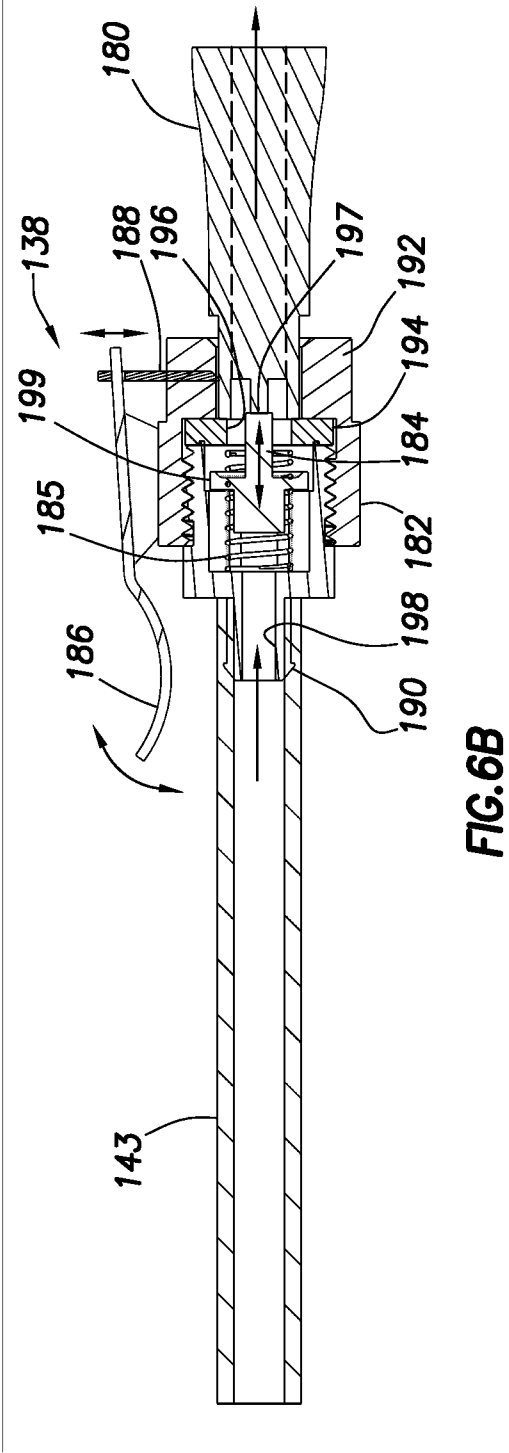


FIG. 6B

FIG. 7

