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(54) Closed circuit compressed oxygen breathing device.

(57) A portable closed circuit compressed oxygen breathing device 20 for emergency use that provides a regulated flow of oxygen under pressure. A low cost container 26 forms a breathing chamber 30 and an integrally formed scrubber 28, and has an injection molded plastic cover 130 having connections for a breathing tube 34, flow regulator 38, admission valve assembly 40 and relief valve 36. A combined fill passage and safety relief assembly 100,104 is incorporated into a body 86 that houses a pressure gauge 98 and that is press fit onto an improved pressure regulating valve assembly 22. The flow regulator and admission valve control the rate of flow of oxygen to the breathing chamber, allowing rapid filling when necessary.

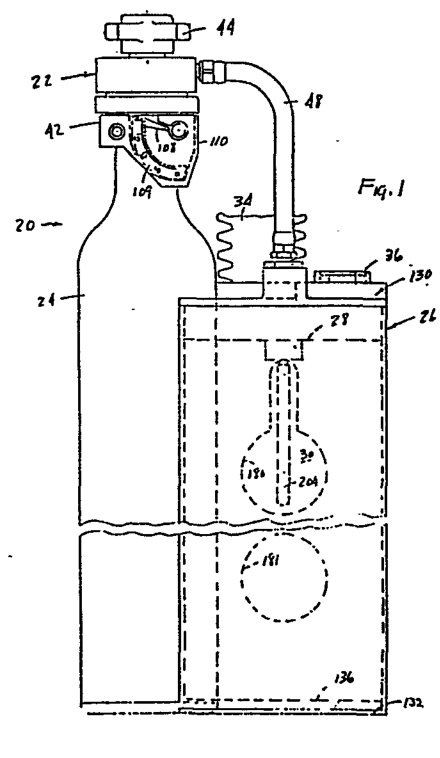

Fig. I

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Description

Closed Circuit Compressed Oxygen Breathing Device

Technical Field

This invention relates to a closed circuit compressed oxygen breathing device for personnel escape use in emergency situations where sufficient oxygen is not available or toxic fumes are present.

Background Art

Many fatalities or serious injuries from fires, for example, hotel, office, home and other building fires, result from inhalation of smoke or other toxic fumes, and lack of oxygen, rather that from burns. In a great many instances, escape would be possible if a portable supply of oxygen were available to those in the building. An oxygen supply for a period of fifteen minutes would be adequate in the vast majority of instances.

A variety of breathing apparatuses has been proposed, both open systems where the air breathed escapes, and closed systems where the air is re-breathed. The systems typically use sources of pressurized air or chemical sources of oxygen, and closed systems typically include so-called "scrubbers" that chemically remove carbon dioxide from the air to facilitate re-breathing. One example of a closed system for emergency industrial use and having a one hour duration is disclosed in U.S. Patent No. 4,409,978. Other known systems are described in said patent and typical prior art in the form of U.S. and foreign patent documents is referenced.

Existing breathing devices do not meet the need for an escape breathing device that: a) is inexpensive to manufacture and thereby practical to provide for each occupant of an office building, home, hotel, or the like; b) provides long term storage reliability, because it is impractical to expect regular monitoring and inspection at frequent intervals of privatly owned devices in the absence of enforced regulations; c) avoids the need for maintenance; and d) provides an adequate, self-contained continuous source of oxygen for a period of at least fifteen minutes.

Disclosure of Invention

The present invention provides a closed circuit compressed oxygen breathing device that is inexpensive to manufacture and therefore can be sold at a price low enough for common use, yet that contains a pressurized source of oxygen and a chemical scrubber for removing carbon dioxide. The device is constructed to allow long term storage with assured reliability and without the need for maintenance. These features make the device practical for use in hotel rooms, office buildings, homes and the like, for each occupant. The device provides a minimum of fifteen minutes of breathing, can be quickly activated with a breathable gas, and does not rely upon ambient atmosphere for initial or subsequent breathing use, as do many low cost closed system devices in which the air in the system is rebreathed.

Long term storage and maintenance-free, reliable, operation are due to an improved sub-assembly of the present invention that provides a filling passage, safety pressure relief port, and pressure gauge that minimizes fittings and areas for leakage; and to an improved pressure regulator valve that avoids the use of springs, and provides a positive mechanical seal when the device is stored, closing the supply passage from the pressurized gas.

A flow regulating valve controls the rate at which oxygen under pressure is admitted to a breathing chamber of the device under normal use. A mechanically actuated admission valve to the breathing chamber bypasses the flow regulating valve to allow flow to enter the chamber at a high flow rate when the chamber is empty, as when initially activated for use, thereby allowing the user to rely on bottled oxygen rather than ambient gas, which may contain high concentrations of smoke or other toxic fumes, to fill the breathing chamber and provide the gas for subsequent rebreathing. This is especially important because often a user cannot gain access to the device before smoke is present. This arrangement also avoids the need for filters, by excluding all use of ambient atmosphere.

An inexpensive, compact construction is provided by a combined gauge, fill passage and safety relief port, and by the particular way a container is fabricated to form the breathing chamber and an integral scrubber. The construction affords ease of assembly and allows the use of inexpensive injection molded and extruded parts and utilizes a one piece top member to the container that provides all the necessary passages for gas in-flow, breathing, pressure relief, and that supports the flow regulator and admission valve and thereby greatly simplifies fabrication and assembly.

The above and other features and advantages of the invention will become apparent from the detailed description that follows, when considered in connection with the accompanying drawings.

Brief Description of the Drawings

Figure 1 is a front elevational view of a closed circuit compressed oxygen breathing device embodying the present invention;

Figure 2 is a side elevational view of the device of Figure 1 as viewed from the right hand side;

Figure 3 is a top elevational view of the device of Figure 1;

Figure 4 is a partial sectional view taken along the line 4-4 of Figure 3 looking in the direction of the arrows;

Figure 5 is a partial sectional view taken along the line 5-5 of Figure 3 showing details of the pressure regulator;

Figure 6 is a sectional view taken along the line 6-6 of Figure 5 showing details of the gauge, filling port and safety pressure relief port;

Figure 7 is a partial enlarged view of the filling and safety relief port of Figure 6, with the port closed;

Figure 8 is a partial enlarged view of the filling and safety relief port of Figure 7, in an open or filling condition;

Figure 9 is a top plan view of the cover of the container of the device of Figure 1;

Figure 10 is a partial sectional view taken along the line 10-10 of Figure 9 showing the construction that receives and houses the flow regulator and admission valve;

Figure 11 is a partial sectional view taken along the line 11-11 of Figure 9 showing the construction that houses a pressure relief valve;

Figure 12 is a bottom plan view of the cover shown in Figure 9, showing constructional details;

Figure 13 is an enlarged partial sectional view of the front face and cover of the container, illustrating the construction of the flow control valve and admission valve, as well as the flexible wall of the breathing chamber;

Figure 14 is a partial sectional view at right angles to that of Figure 13, illustrating the flow control and admission valves, and the structure of the relief valve; and

Figure 15 is a partial sectional view similiar to that of Figure 14, but showing a modified construction of an admission valve that also serves as a flow control.

Best Mode for Carrying Out the Invention

A portable closed circuit compressed oxygen breathing apparatus 20 embodying the present invention is shown in the drawings. The apparatus or device basically includes a pressure regulating valve assembly 22 on a bottle of compressed oxygen 24, the regulating valve assembly serving to reduce the pressure and supply it at a relativley constant reduced pressure to a container 26 with which the bottle 24 is partially nested and that houses a chemical air scrubber 28 and provides a breathing chamber 30, the chamber including a flexible wall or bag 32. A breathing tube 34 communicates with the container 26 and a relief valve 36 formed in the upper container wall communicates with the breathing chamber 30 to allow escape of gas if the pressure within the breathing chamber exceeds a predetermined pressure. The container 26 also houses a flow regulator 38 and admission valve assembly 40, by which a constant flow of pressurized oxygen is admitted into the breathing chamber during normal use, but by which an increased flow can be achieved when activating the unit or if the demand for oxygen exceeds that provided by the flow regulation. A gauge block 42 and combined fill valve and safety vent assembly 42 cooperates with the regulating valve assembly 22, to indicate the pressure in the bottle 24, to facilitate filling the bottle, and to provide a safety vent in the event of excessive and dangerous buildup of pressure within the bottle, which typically is only a problem during shipping or if the unit is subjected to extreme heat.

In use, the regulating valve assembly 22 allows regulated flow of oxygen under pressure when a hand wheel or knob 44 is rotated to open a flow orifice 46, at which time the bottle 24 supplies oxygen through the regulator and a tube 48 to the breathing chamber 30 of the container 26 via the admission valve assembly 40, which initially is open because the flexible bag 32 is in a collapsed condition. After initial inflation, the admission valve assembly 40 closes and further flow is only through the flow regulator 38 unless the volume of gas within the breathing chamber is significantly reduced. The user inhales and exhales through the breathing tube 34 directly into and from the breathing chamber 30. Carbon dioxide in the air exhaled is reduced by the chemical action of the scrubber 28, and additional oxygen to replace that used by the wearer of the device is supplied from the bottle 24 at the appropriate rate established by the pressure regulator and flow regulator. Any buildup of pressure by virtue of a greater flow to the chamber than is utilized by the user escapes through the relief valve 36. Otherwise, the system is entirely closed. It will be understood that the breathing tube 34 has either a face mask or mouthpiece and nose clamp of conventional design, at the distal end (not shown) to limit breathing by the user to the gas within the system.

With particular reference to Figure 5, the regulator valve assembly 22 has a base member 50 with a partially threaded stem 52 received in the neck of the bottle 24, an intermediate ring 54 threaded to and surrounding the base member 50, and a cover member 56 threadedly connected to the intermediate ring 54. A diaphragm 58 is clamped between the intermediate ring and the cover member. The restrictive orifice 46 opens through a boss 60 within the base member 50 at the end of a central passage 62 through the stem 52. A cylindrical skirt 64 of the diaphragm surrounds the boss in sealing relationship to an O-ring 65 to form a chamber 66 on one side of the diaphragm. The cover member 56 forms a second chamber 68 on the opposite side of the diaphragm. The surface of the diaphragm that forms a wall of the chamber 68 is substantially larger than the area of the diaphragm that forms a wall portion of the chamber 66. Two apertures 70 extend through the diaphragm, communicating between the chambers 66, 68 and providing a path for the flow of gas under pressure from the orifice 61 to the chamber 68. A nipple 72 provides a port from the chamber 68, to which the tube 48 is attached for carrying gas under pressure from the chamber 68 to the breathing chamber 30.

The orifice 46 has a tapered mouth 61 in which a steel ball 76 is received in sealing relationship when seated against the mouth. An anvil 78 is carried by the diaphragm 58 and opposes the ball. When the pressure regulator is in a condition to allow flow, as shown in Figure 5, the anvil is spaced sufficiently above the ball and seat to allow the ball to be unseated by the pressure in the bottle 24, allowing flow through the restrictive orifice. The pressure drop through the orifice is controlled by the diaphragm and anvil, which changes the orifice size by varying the distance the ball can move from the orifice mouth in response to the differential pressure between the chambers 66 and 68. As a result of the smaller diaphragm area exposed to the chamber 66 relative to the diaphragm area exposed to the chamber 68, a pressure differential is maintained in equilibrium on opposite sides of the diaphragm, with the pressure in chamber 68 substantially lower than that in chamber 66.

A manually adjustable stop 80 is provided on the end of a threaded shaft 82 in the cover member 56. The shaft is rotated by the knob 44. To close the orifice

48 by forcing the ball 76 into the mouth or seat 61 by moving the anvil 78 toward the boss 60. The anvil 78 is movable relative to the diaphragm, but a flange 78a transmits movement of the diaphragm toward the boss 60 to the anvil 78. The diaphragm with this arrangement is not flexed when the manually adjusted stop 80 forces the anvil against the ball to seal the restrictive orifice 46 when the device is stored and not in use. The use of the ball and anvil provides a tight seal with the restrictive orifice without critical alignment of the shaft 82. An O-ring 84 on the cover 56 encircled by the knob 44 serves through friction to prevent knob rotation relative to the cover due to vibration or the like, which might otherwise result in some backing off of the stop 80 and accompanying leakage of pressurized oxygen.

The gauge block 42 is in the form of an annular body 86 with a central cylindrical opening 88 that receives the stem 52 of the regulating valve assembly 22. For that purpose, a portion 52a of the stem is unthreaded and of the same axial length as the thickness or height of the annular body 86. A cross bore 90 through the stem 52 is located approximately midway along the stem portion 52a.

The central opening 88 of the body 86 provides a clearance fit with the stem portion 52a and the body is rotatable to adjust its position about the stem. Two O-rings 92 at opposite ends of the central opening 88 and on opposite sides of the cross bore 90 provide seals that prevent leakage through the clearance fit between the body 86 and the stem 52. The body 86 is substantially clamped between the end of the bottle 24 and the base member 50 of the pressure regulating valve assembly.

As best shown in Figure 6, a transverse bore 94 within the body 86 extends from the cylindrical central opening 88 to a passage 96 in the body that houses a helical pressure gauge tube 98 and a tubular fitting 100 having a central passage 101. The fitting 100 has a threaded end 100a and carries a threaded cap 102 with a filling port 104 through which the bottle 24 can be filled with oxygen under pressure. The threaded cap 102 is received in a counter bore portion 96a of the passage 96.

The transverse bore 94 communicates with the passage 96 at a tapered portion at the end of the counter bore 96a that forms a manifold 105 about the fitting 100. A cross bore 106 communicates between the manifold and the central tubular passage of the fitting 100. The pressure gauge tube 98 is brazed at one end in the tubular passage of the fitting 100 to communicate with the cross bore 106. The opposite end is closed and an indicator 108 is attached. The indicator is covered by a window 110 carried by the body 86. Pressure variations in the tube 98 expand or allow contraction of the helix, to rotate the indicator 108 about the helix axis and the indicator 108 shows the pressure within the bottle 24 on a scale 109.

The cap 102 on the threaded end 100a of the fitting provides a chamber 112, as best shown in Figures 7 and 8, adjacent the open end of the fitting. A metal burst disk assembly 114 in the chamber 112 serves to obturate the open end and passage 101 through the fitting 100 when clamped against the end 116 by the cap 102, as illustrated in Figure 7. The burst disk assembly 114 is a sandwich construction formed of a cup 118, a foil disk 119 and a seal 120, all brazed together and reuseable if the disk has not burst.

When the cap 102 is rotated to clamp the disk assembly 114 tightly against the end 116 of the fitting 100, as shown in Figure 7, the disk assembly seals both the central passage 101 of the fitting 100 and also the passage from the port 104 through the threads 100a of the fitting and 103 of the cap which otherwise provide a restrictive flow passage from the port 104 between the fitting and cap, to the manifold 105. Thus, with the cap tightly fastened, pressure from the bottle 24 communicated to the central passage 101 of the fitting 100 through the cross bore 90 in the stem 52 and through the transverse bore 94 of the body 86 and the cross bore 106 of the fitting is contained by the foil disk 119. In the event the pressure reaches an unsafe level, the foil disk 119 bursts allowing release of the pressure before the bottle or other components rupture.

The cap 102 and fitting 100 also provide for the filling of the bottle with pressurized oxygen. When the cap 102 is loosened to the position shown in Figure 8, oxygen under pressure can flow around the disk assembly 114 and along the gap between the threads 103 and 100a between the cap and fitting to the manifold 105 that communicates through the transverse bore 94 of the body 86 to the bottle. Leakage between the body 86 and the cap 102 is prevented by an O-ring 122 (Figure 7) that maintains a seal when the cap is unscrewed sufficiently for filling, yet allows flow from the threads to the manifold 105 along the fitting, because it is retained in a position spaced from the fitting by a ring 124 having a small flange 125 about the inner edge. A commercial fitting assembly F fits over the cap 102 to facilitate rotation of the cap to open and close the filling passage through the port 104 and to supply pressurized oxygen from a source. The filling passage through the threads 103, 100a provides a pressure drop that advantageously controls the rate of flow for filling purposes. In addition, the combined use of the fitting 100 for both filling and pressure relief eliminates the need for an extra fitting for one of those functions and thereby minimizes the chance of leakage that is ever present in threaded fittings in pressurized systems.

The construction of the container 26 is best shown in Figures 1, 3, 4 and 9-14. It is formed of a top cover 130 and a bottom end 132, both injection molded of plastic, and a tubular extruded member 133 of plastic forming side wall portions and having a generally rectangular cross-section, in which a top cover flange 134 (Figure 12) and a bottom end flange 136 (Figure 1) tightly fit. One side wall portion 133a is arcuately concave to conform with the external contour of the cylindrical bottle 24 so that the container 26 can partially nest with the bottle, which reduces the overall size of the device and in addition promotes heat transfer from the bottle, which is typically cold, to the container 26, in which heat is typically generated by the chemical action of the scrubber. Heat transfer can be improved by providing strips of metal foil (not shown) from the bottle to the side walls to assure and to maximize direct contact between the bottle and container over a substantial area.

The top cover 130 has a first upstanding boss 140 surrounding an opening 142, to which the breathing tube 34 is attached with an inside retaining ring 144 that clamps an end of the breathing tube 34 within the upstanding boss 140.

The top cover 130 has a second upstanding boss 146 that surrounds an opening 148, that has a valve seat 150 (Figure 14). The boss 146 supports a spring retainer 152. A pressure relief valve 154 on the seat 150 is held by a compression spring 156. The spring retainer forms an escape passage through the opening 148 when the valve 154 is lifted from the seat by excess internal pressure within the breathing chamber.

A third upstanding boss 158 on the cover 130 receives and supports the flow regulator 38, and an axially aligned depending boss 160 in part forms the admission valve assembly 40.

A smaller container 164 is formed within the main container 26 and holds a suitable chemical, such as "Soda Sorb" and functions as a scrubber to chemically remove carbon dioxide from the gas within the outer container that flows through the inner and smaller container. "Soda Sorb" is basically sodium hydroxide and calcium oxide and is sold by Dewey and Almey division of W.R. Grace.

As best shown in Figure 3 and 4, the inner container is formed by porous walls 166, 168 in the form of flat panels and by end wall portions 133a and 133b of the tubular side wall forming member 133, which is nonporous. The porous walls 166, 168 are supported within the outer container by vertical grooves 170-173. The porous walls extend to the bottom end 132 of the outer container, but terminate short of the top cover 130, as shown in Figure 4. A cover 176 closes the top of the smaller container 164, and is located by a depending, short, locating wall 178 on the inside lower surface of the top cover 130. Air inhaled and exhaled to the main container 26 through the opening 142 is received above and behind the smaller scrubber container 164 and passes through the porous walls 166, 168 to the volume of the outer container in front of the wall 168 and enclosed by the flexible breathing bag 32, and back again. As the air is passed through the scrubber, the carbon dioxide content is reduced chemically.

Openings 180, 181, as best shown in Figures 1, 4, 13 and 14, are formed in the front portion 133c of the side wall forming member 133. The flexible bag 32 is adhesively adhered by a peripheral portion 32a to the wall portion 133c about the openings 180, 181 and has an opposed portion 32b that extends across the openings and that flexes away from the wall portion 133c when the device is charged with oxygen and in use. A small rigid plate 182 is adhered to the inside surface of the bag portion 32b at a location opposite the opening 180 to cooperate with the admission valve assembly 40.

Flow is regulated to the breathing chamber 30 from the pressure regulator assembly 22, through the flow regulator 38, the construction of which is best shown in Figures 13 and 14. A central bore 186 extends through both bosses 158, 160 of the cover 130 and opens into the breathing chamber in front of the porous wall 168. A tubular fitting 188 is threaded into the central passage of the boss 158 and cooperates with a restriction 190 in the bore. An admission valve member 192 is in the central bore 186 of the depending boss 160 and cooperates with a retaining flange 194 and seal 196 that together form a valve seat.

The tubular fitting 188 has a central passage 189, tapered exterior contour 198 and an end 200 through which flow from the regulating valve assembly is discharged. The passage 189 is of a size capable of supplying oxygen at a flow rate substantially greater than that normally required during use. Rotary adjustment of the fitting 188 moves the fitting axially within the central bore 186 to adjust the size of the passage formed between the restriction 190 and the tapered exterior contour 198 of the fitting. As shown in Figure 14, the discharge end 200 is located on one side of the restriction 190 and a cross bore 202 communicating between the central bore 186 and the breathing chamber 30 is located on the opposite side of the restriction.

The valve 192 selectively opens and closes the lower end of the bore 186 that discharges directly into the breathing chamber without passing through the restriction 190. By operating a lever 204 attached to the valve 192, the valve is cocked to an open position. The lever extends at a slight angle with respect to the valve as shown in Figure 13 and is located with its end positioned to pass through the opening 180 in the front wall portion 133c. When the breathing bag 32 is in its collapsed condition shown in dotted line, the lever 204 is held in a cocked position, also shown in dotted line keeping the valve member 192 open. When the bag is partially expanded to the position shown in solid line in Figure 13, pressure on the valve member 192 keeps the valve member closed because it is free to pivot to the solid line position, in which the lever 204 can pass through the opening 180 without resistance from the flexible bag.

Initially, with the device not in use, the bag 32 is collapsed and the valve is cocked to an open position. Upon opening the pressure regulator valve by rotation of the knob 44, oxygen under pressure will be introduced directly into the breathing chamber through the admission valve assembly 40. Upon expansion of the bag, the lever is allowed to pivot through the opening 180, closing the admission valve assembly 40. Thereafter, flow passes through the restrictive orifice 190, and through the cross bore 202 into the breathing chamber at a reduced flow rate controlled by the position of the fitting 188, to correspond to a supply rate equal to that of normal consumption during use. In the event a greater flow is needed during use, as might be required during exertion, deeper breathing results, collapsing the bag 32 and thereby opening the admission valve assembly 40 to allow a faster direct flow of oxygen until the bag is reinflated. In the event the normal flow through the restrictive orifice is greater than consummed, a gradual pressure buildup in the container 26 results, until the pressure relief valve 154 opens to reduce the internal pressure.

A modified admission valve assembly 210 is shown in Figure 15. With this construction no cross bore 202 is required. Rather, a restrictive orifice 212 of predetermined size is formed directly through a flange portion of the modified valve 210 to allow a flow of oxygen at the normal rate typically required, directly through the admission valve to the breathing chamber, rather than through a separate passage with an adjustable orifice.

In the preferred embodiment of the present invention, designed to provide a minimum of fifteen minutes use, a bottle of compressed oxygen is used that holds thirty-five standard liters at 1800 lbs. per square inch gauge. The pressure regulating valve assembly 22 produces a relatively constant output pressure, which varies only from a regulated pressure of 135 p.s.i.g. when the bottle is initially at 1800 p.s.i.g., and a regulated pressure of 115 p.s.i.g. when the bottle pressure has reduced to 200 p.s.i.g. During this period, a continual flow of oxygen is provided at a rate of 1 and 1/2 liters per minute through the flow regulating valve assembly. When the admission valve is actuated, a flow of 60 to 70 liters per minute is provided directly into the breathing chamber. It will be appreciated that the invention can utilize containers of oxygen of various capacities, allowing for different breathing durations.

For convenient storage and use, the breathing device is contained in a box or case, generally rectangular, with a cover that is completely removable and held in place during storage by an adhesive strip about the opening or joint between the cover and body of the case. The cover has a window through which the pressure gauge can be viewed. Because the gauge block is rotatable on the stem of the pressure regulator, the gauge can always be positioned for viewing. Straps are attached to the case, typically a neck loop that fits over the users head, and a length for encircling the user's torso, to hold the device in position on the chest of the user.

While a preferred embodiment of the invention has been described in detail, it will be appreciated that various modifications and alterations may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

Claims

1. In a closed circuit compressed oxygen breathing apparatus, a container of compressed oxygen, a filling passage communicating between a port and the container, a frangible obturating member in the passage, and means for selectively sealing the passage about the obturating member, whereby the container can be filled through said passage, the passage can be sealed, and the member functions as a safety pressure release.

2. Apparatus as set forth in Claim 1 wherein the passage has an internal shoulder opposed by the member, and the means for sealing the passage is movable to clamp and seal the member against the shoulder and thereby seal the filling passage.

3. Apparatus as set forth in Claim 2 wherein said passage is in part formed by a threaded fitting and a housing threaded on the fitting and the member is between the fitting and housing.

4. Apparatus as set forth in Claim 3 wherein the member is formed of an annular cup, an annular retaining ring, and a metal foil between the two.

5. Apparatus as set forth in Claim 3 wherein the threads of the fitting and housing form the filling passageway.

6. Apparatus as set forth in Claim 5 wherein the tubular fitting has a central relief passageway larger than the filling passageway and obstructed by the member.

7. Apparatus as set forth in Claim 1 including a second passageway communicating between the port and the container, bypassing a portion of the filling passageway and closed by said obturating member.

8. Apparatus as set forth in Claim 7 wherein the member has a nonfrangible portion that closes the filling passage and a frangible portion that closes the second passageway.

9. Apparatus as set forth in Claim 8 wherein the bypassed portion of the filling passageway is substantially more restrictive to fluid flow than the second passageway.

10. For use in filling a container with compressed gas and providing a safety pressure release, a body attachable to the container, a filling port carried by the body, a container filling passage in the body communicating between the port and the container, a frangible obturating member in the passage, and means for selectively sealing the passage about the obturating member, whereby the container can be filled through said passage, the passage can be sealed, and the member functions as a safety pressure release.

11. A filling port, safety pressure relief and pressure gauge assembly constructed for attachment to a pressure regulator stem for a pressurized container, said assembly comprising an annular body with a central cylindrical opening of a size to provide a clearance fit about said stem, seals in said cylindrical opening spaced axially to seal about the stem, a port in the body, a passage within the body extending from the port to the central opening between the two seals, a frangible

obturating member closing said passage, and a pressure gauge attached to the body communicating with the passage between the obturating member and the central opening.

12. An assembly as set forth in Claim 11 wherein said port and passage include a threaded tubular fitting and a cap threaded on the fitting and having an opening forming said port, and wherein said obturating member is between the cap and fitting and so constructed and arranged that when clamped against the fitting by the cap, blocks flow through the fitting threads and through the tubular fitting.

13. An assembly as set forth in Claim 11 wherein the gauge is a closed-end tubular helix within the annular body and an indicator carried by the helix, and wherein the tubular helix has an opening communicating with said passage.

14. A pressure regulator stem for a pressurized container and a filling port, safety pressure relief and pressure gauge assembly constructed for attachment to the pressure regulator stem; said assembly comprising and annular body with a central cylindrical opening of a size to provide a clearance fit about said stem, seals in said cylindrical opening spaced axially to seal about the stem, a port in the body, a passage within the body extending from the port to the central opening between the two seals, a frangible obturating member closing said passage, and a pressure gauge attached to the body communicating with the passage between the obturating member and the central opening; and said stem having a central bore and a cross bore communicating between the central bore and the outside of the stem at a location along the stem between said axially spaced seals.

15. A portable closed circuit compressed oxygen breathing device including a container defining a volume for receiving oxygen from a supply and exhaled breath from a user, and a chemical scrubber within the container for reducing the carbon dioxide content of air within the container; said container having a cover with first, second and third passages to the interior of the container; the first passage containing a valve for regulating the rate at which compressed gas can be introduced to the container and an admission valve that bypasses the regulating valve, said first passage providing for the supply of oxygen to the container; the second passage including a one-way valve allowing flow only from the container to the exterior when the pressure within the container exceeds a predetermined value; and the third passage allowing flow into and out of the container and having means for securing a flexible breathing tube to the cover in sealed relationship to the cover and in communication with the third passage.

16. A device as set forth in Claim 15 wherein said cover and container are generally rectangular in plan except for one narrow side that is substantially semi-circular concave.

17. A device as set forth in Claim 16 wherein said scrubber is rectangular in plan and in part formed by walls of the container and in part by panels within the container received in grooves in the container walls.

18. A device as set forth in Claim 15 wherein a wall portion of the container has an opening and a flexible breathing bag is adhesively secured to the wall portion and sealed thereto about the opening.

19. A device as set forth in Claim 18 including an operator for the admission valve extending from within the container outward through the opening in said wall portion and enclosed by the breathing bag.

20. In a portable closed circuit compressed oxygen breathing apparatus or the like, a fitting for a container of pressurized oxygen providing a passage for the flow of oxygen from the container, a restrictive orifice forming a part of said passage, said restrictive orifice including a tapered seat, an anvil opposed to and spaced from said seat, a ball between the anvil and seat receivable against the seat to close the passage, a flexible diaphragm, a first chamber on one side of the diaphragm into which the passage opens and in which the ball is located, a second chamber on the opposite side of the diaphragm communicating with a breathing chamber, a passage through the diaphragm communicating between the first and second chambers, the diaphragm having a surface area in the second chamber greater than in the first, said diaphragm arranged to move the anvil relative to the orifice to control the position of the ball and hence flow through the orifice, and manually adjustable means to move the anvil toward and away from the ball to selectively close or open the passage.

21. Apparatus as set forth in Claim 20 wherein said anvil is movable toward the seat by the manually adjustable means independently of the diaphragm and movement toward and away from the seat is controlled by the diaphragm during flow from the container.

22. In a portable closed circuit compressed oxygen breathing apparatus or the like, a demand valve assembly for supplying gas under pressure to a breathing chamber,

comprising a passage with an inlet from a pressurized gas supply and two outlets to a breathing chamber that has a flexible wall portion, one outlet providing a restriction to control the rate of flow into the chamber and the other providing a relatively unrestricted rate of flow into the chamber through a mechanically operated valve when the valve is open, and means located within said chamber adjacent the flexible wall portion and operable by movement of the flexible wall portion to mechanically open said valve.

23. In a portable closed circuit compressed oxygen breathing apparatus or the like, an admission valve assembly for supplying gas under pressure to a breathing chamber, comprising a passage from a pressurized gas supply to a breathing chamber that has a flexible wall portion, a mechanically operated valve in said passage and an opening through the valve substantially smaller than the opening provided for flow through the passage when the valve is open, said opening through the valve serving to control the rate of flow to the chamber when the valve is closed, and means located within said chamber adjacent the flexible wall portion and operable by movement of the flexible wall portion to mechanically open said valve.

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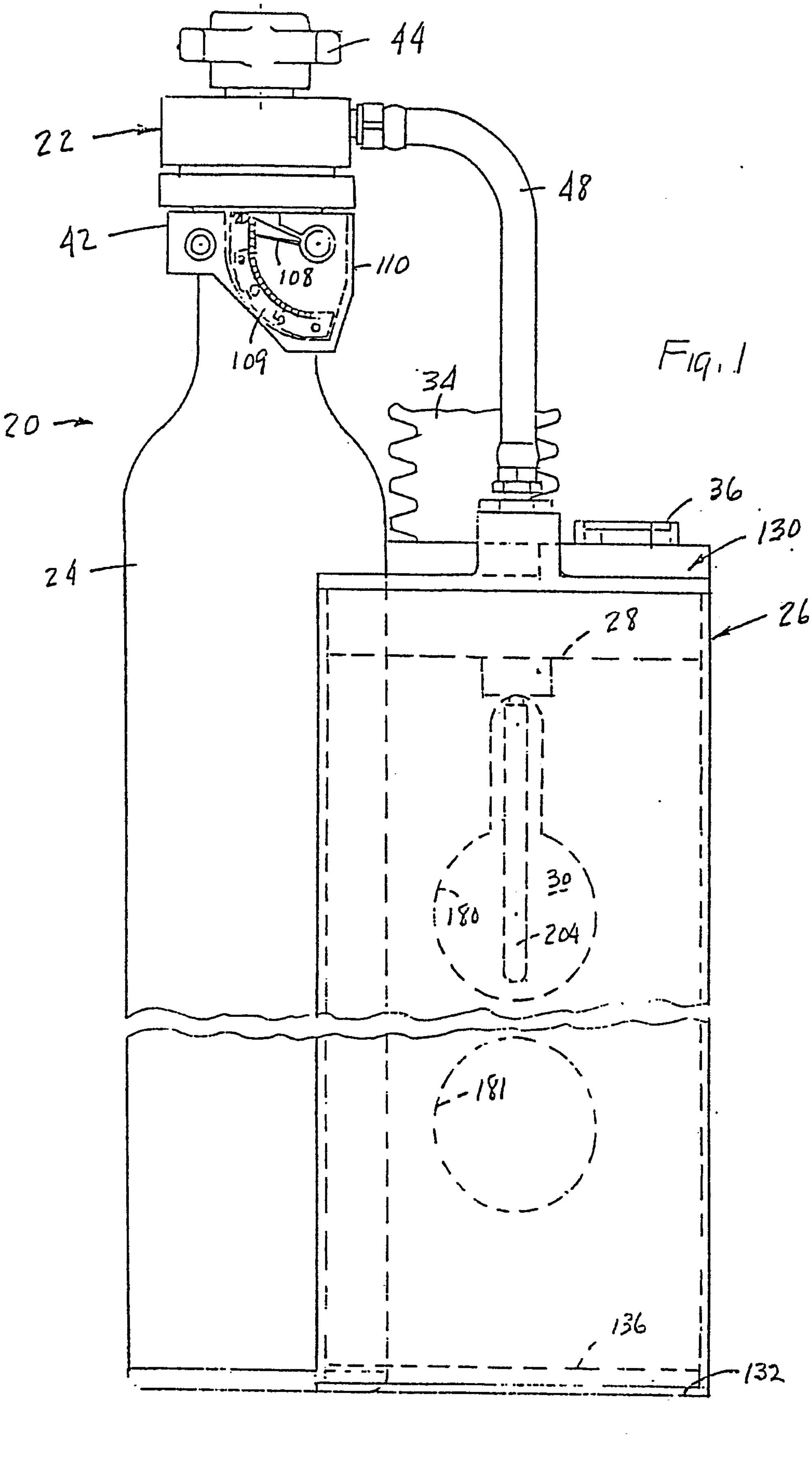

Fig. 1

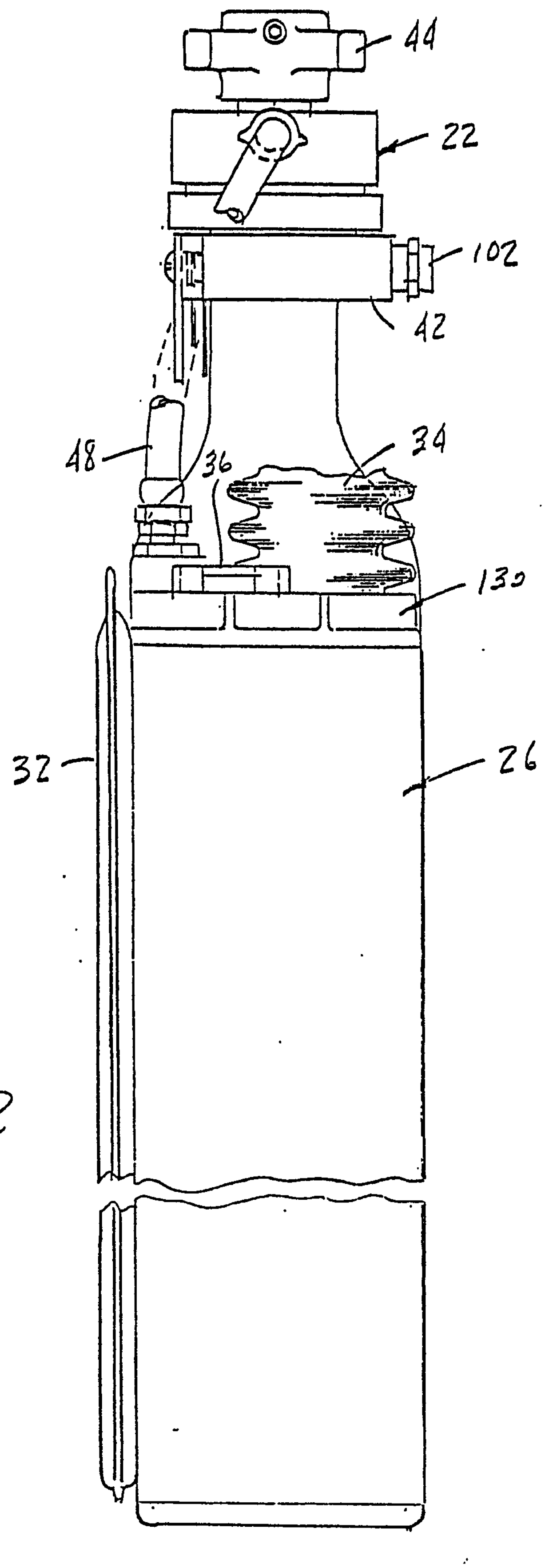

Fig. 2

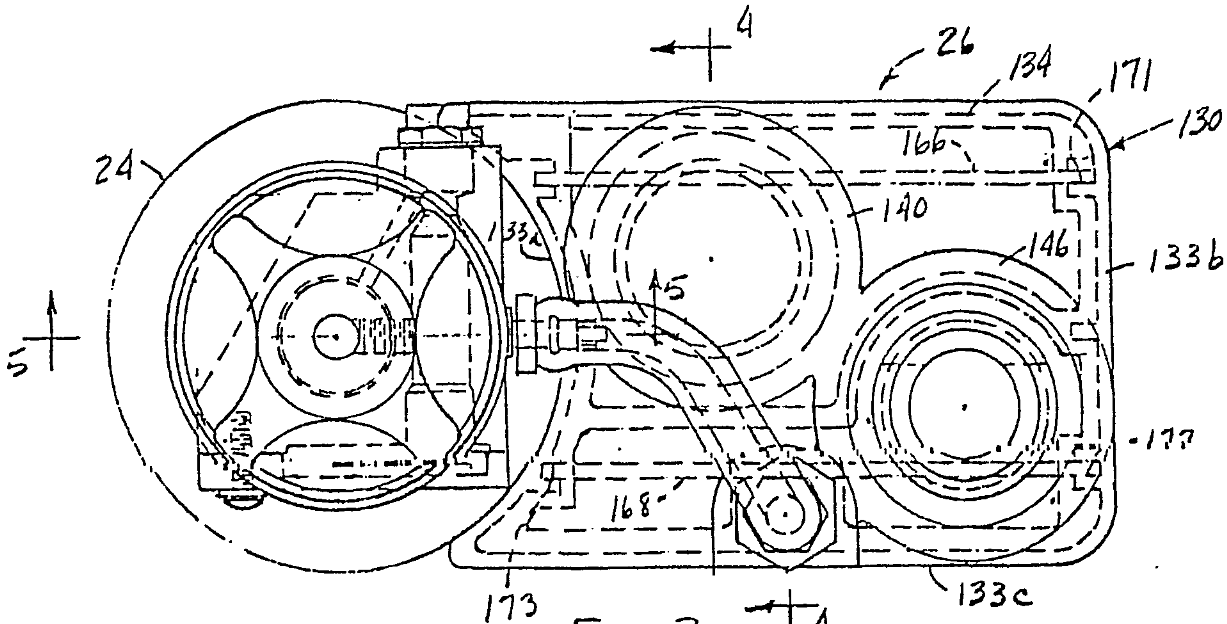
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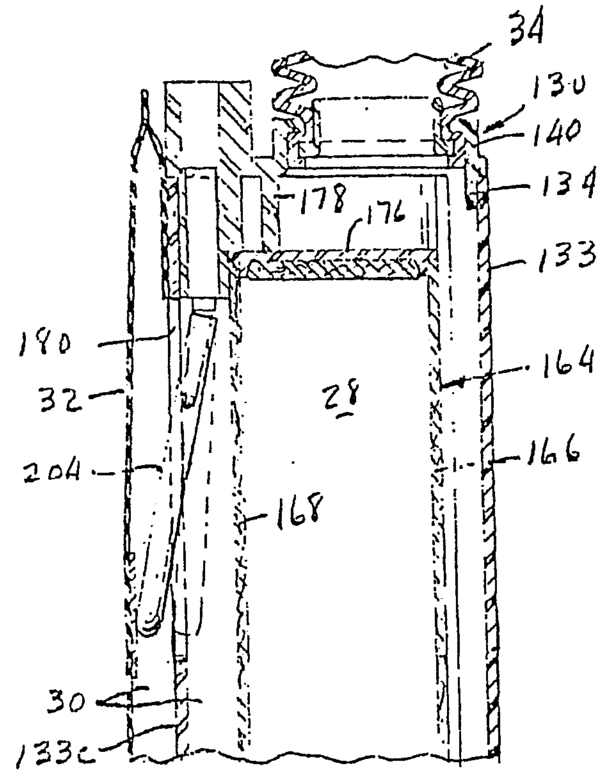
Fig. 3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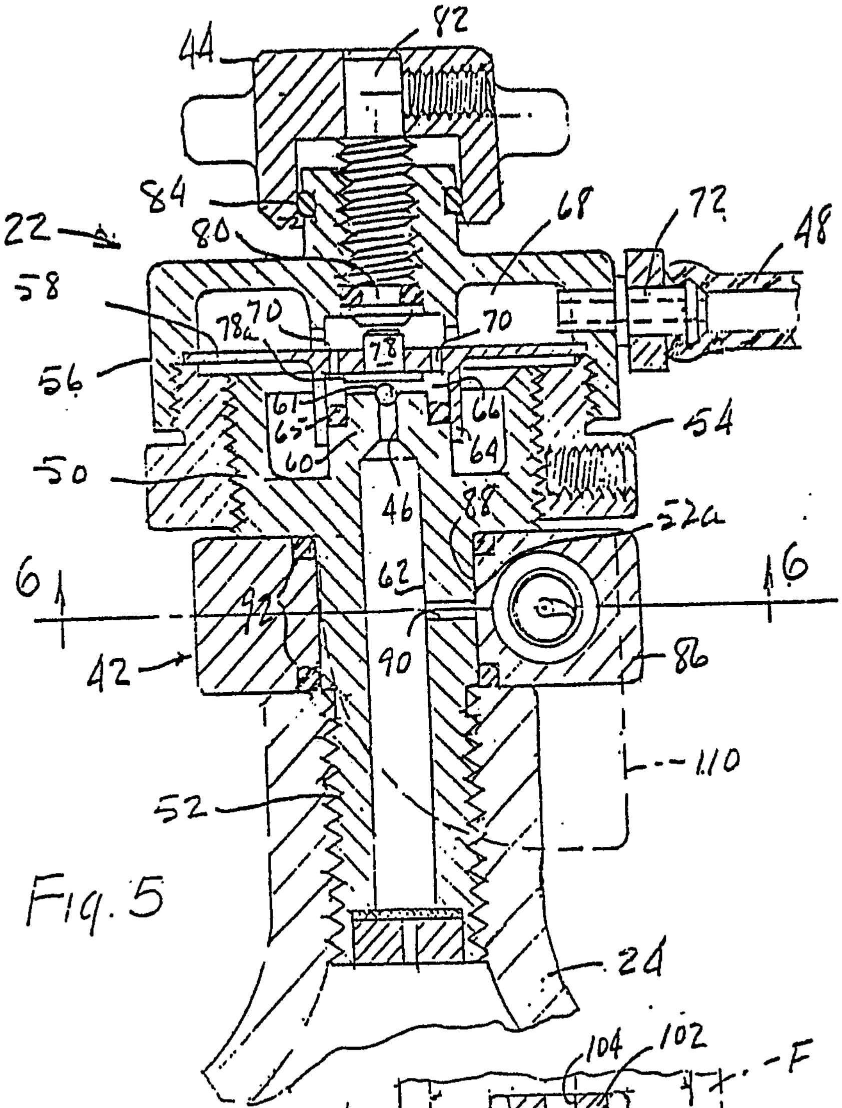
133c

Fig. 4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46
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52a
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92
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42
86
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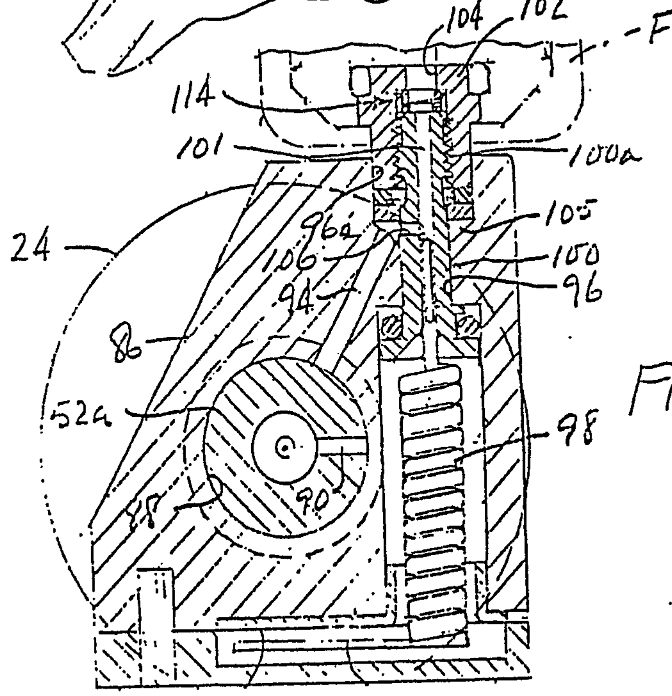
52
24

Fig. 5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100a
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94
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52a
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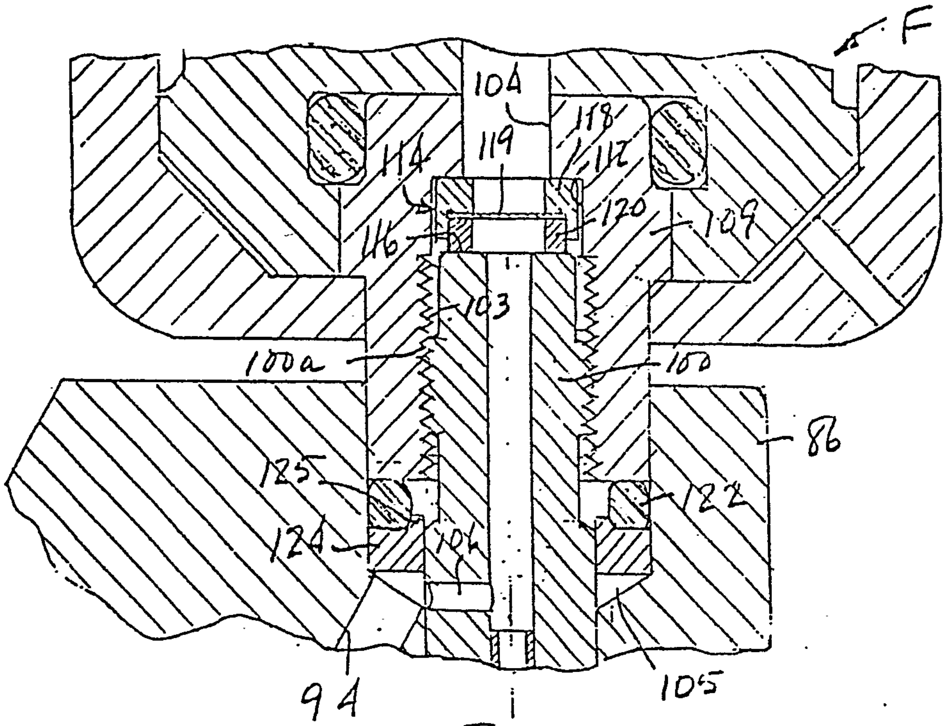
Fig. 6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100a
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86
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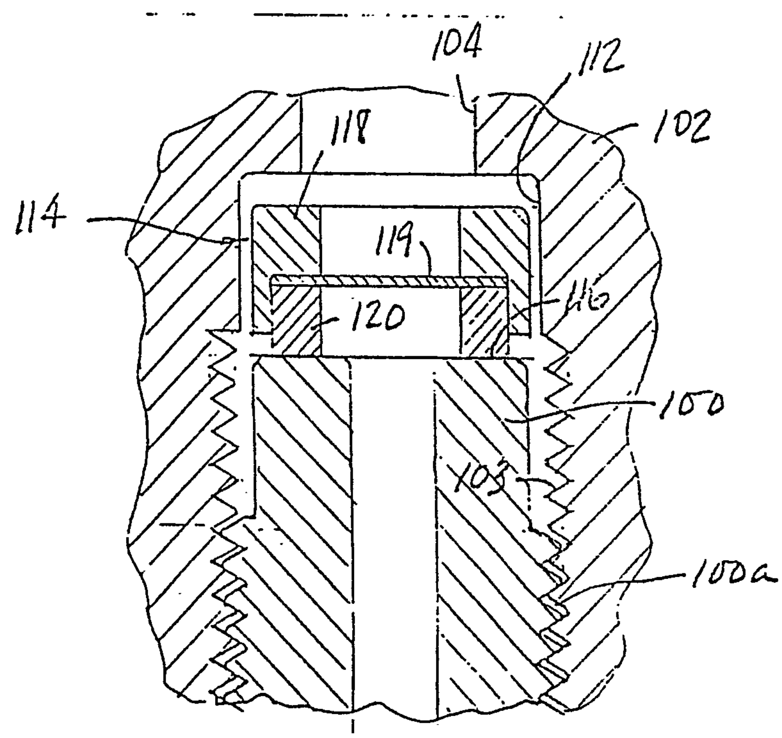
94
105

Fig. 7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103
100a

Fig. 8

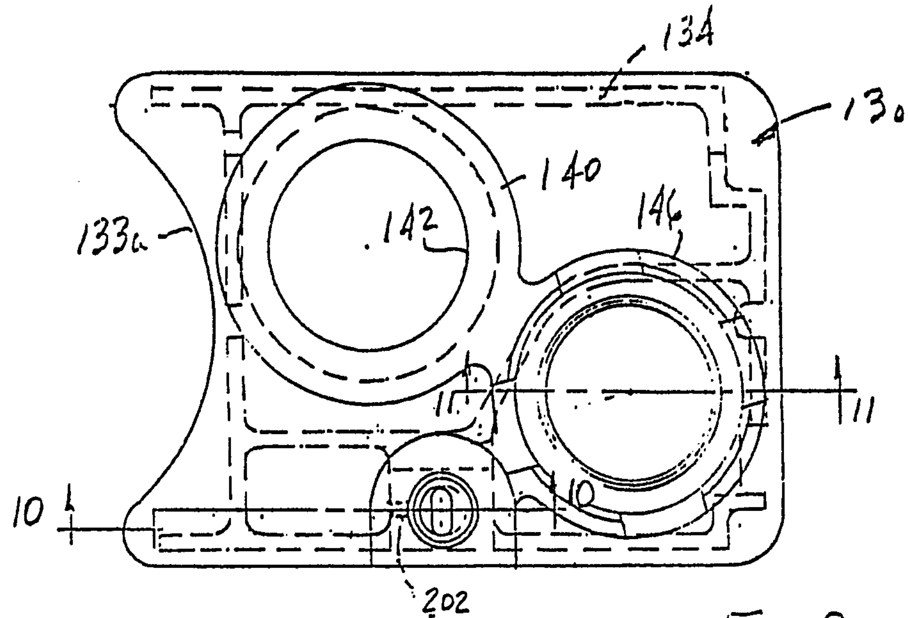


Fig. 9

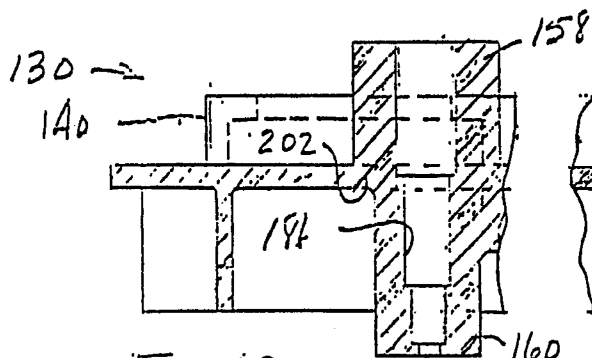


Fig. 10

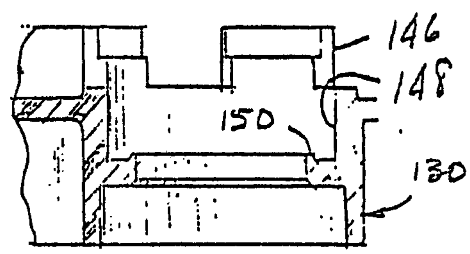


Fig. 11

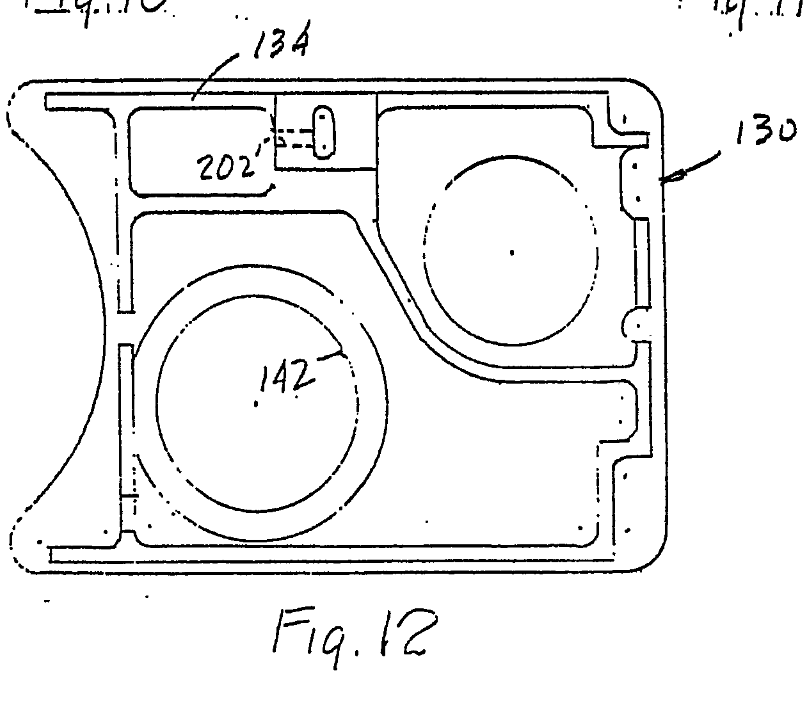
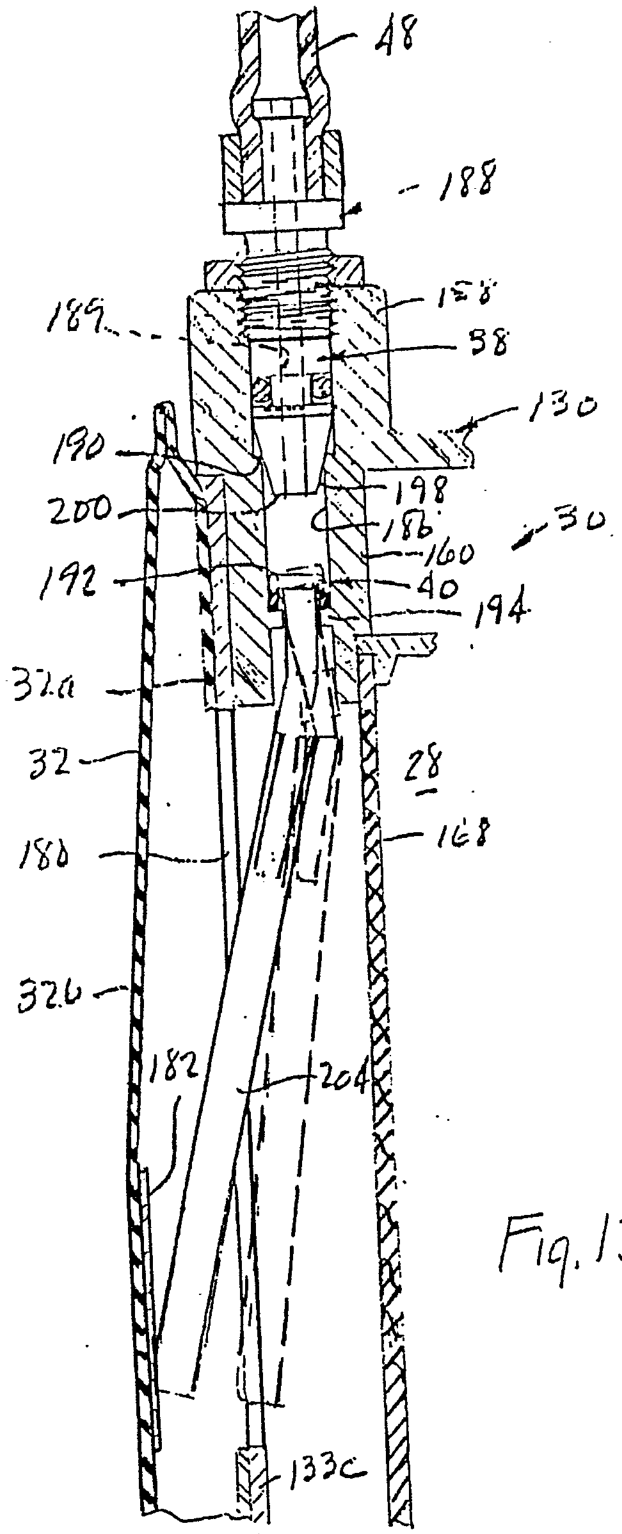


Fig. 12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32a
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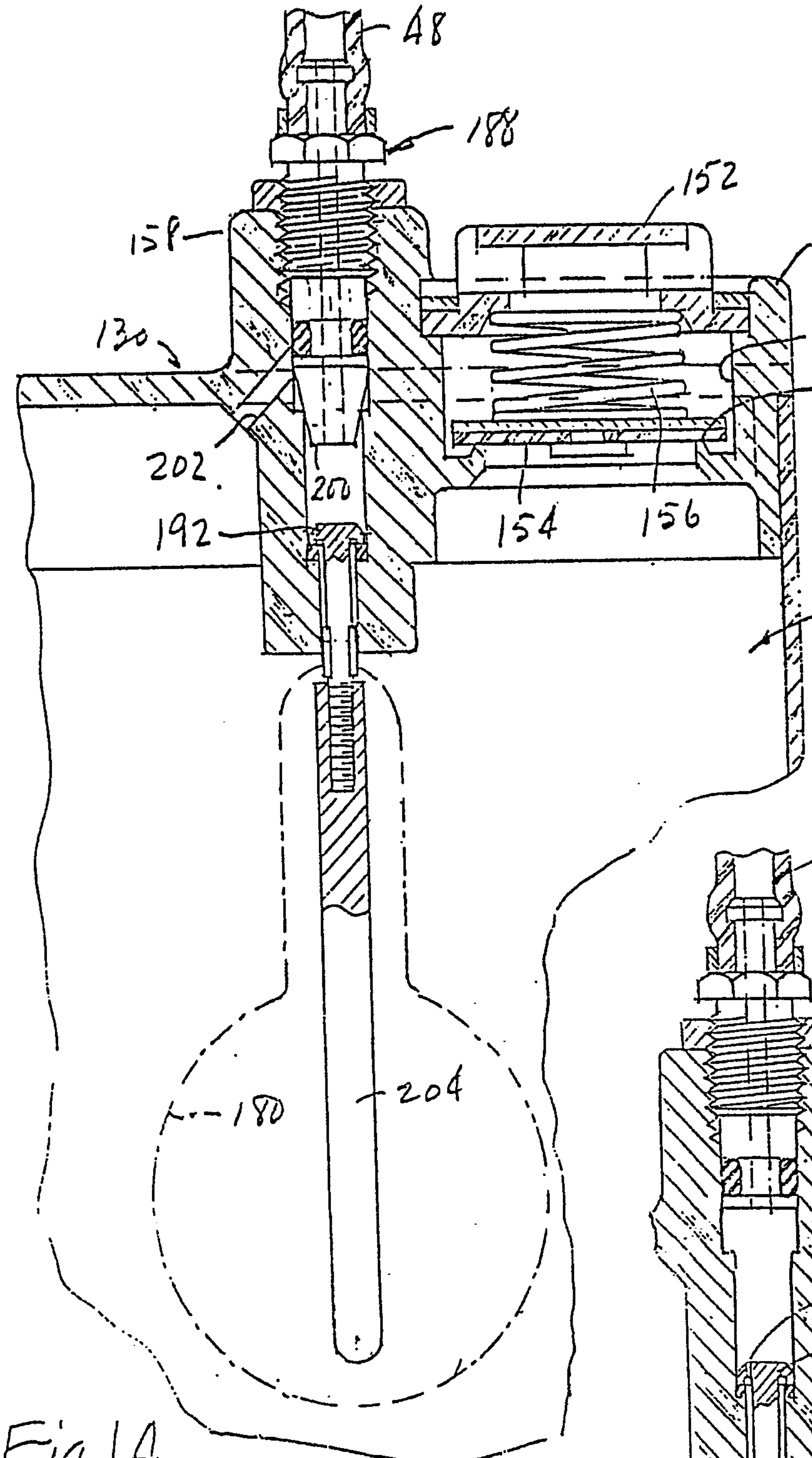
168
32b
182
204
133c

Fig. 13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156
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204
180

Fig.14

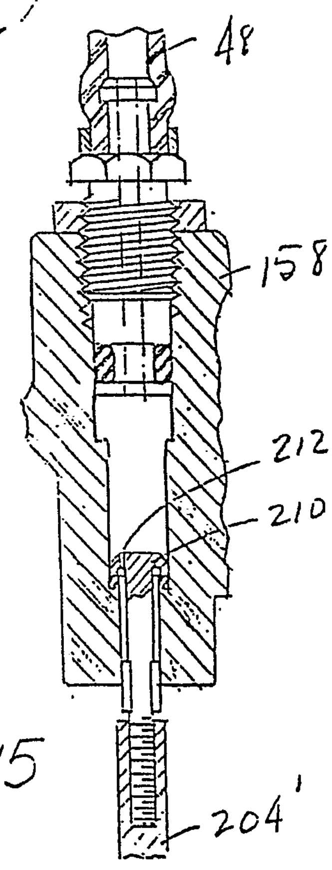
48
158'
212
210
204'

Fig 15