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(54) **APPARATUS AND METHOD FOR CONTROLLED PENETRATION OF COMPRESSED FLUID CYLINDERS**

VORRICHTUNG UND VERFAHREN ZUR KONTROLLIERTEN DURCHFÜHRUNG VON DRUCKMITTELZYLINDERN

APPAREIL ET PROCEDE DE PENETRATION CONTROLEE DANS DES CYLINDRES A FLUIDE COMPRIME

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates to the field of managing compressed fluid cylinder and particularly compressed fluid cylinder in a deteriorated condition.

BACKGROUND OF THE INVENTION

[0002] Compressed fluid cylinders may become unserviceable for several reasons such as valve assembly failure, damage or deterioration to the cylinder body, and/or damage or deterioration of pipe/hose connections associated with the valve assembly. The hazardous nature of compressed gas cylinders and other fluid containers in a deteriorated condition has become the focus of increasing attention. The result has been strict government regulations which limit the uncontrolled discharge of such container contents to the environment.

[0003] Examples of cylinder rupture vessels or container vessels used for safely removing hazardous contents from deteriorated compressed fluid cylinders are shown in US Patents 4,690,180 titled "Cylinder Rupture Vessel"; US Patent No 4,944,333 titles ''Cylinder Rupture Vessel with Clamps for Immobilizing a Container within the Vessel"; and US Patent 5,186,219 titled "Cylinder Rupture Vessel". These patents disclose containment vessels and their associated systems to secure a fluid cylinder or similar container within the containment vessel and to puncture or pierce the cylinder in a safe, controlled manner. The cylinder rupture vessels and their associated systems allow for environmentally acceptable removal of the contents from the cylinder and further processing of the contents as desired.

[0004] Deteriorated fluid cylinders may be ruptured in a safe, controlled manner by using a puncture spike or punch as shown in US Patent 4,690,180. Hydraulic puncture assemblies, as shown in US Patent 4,944,333 have also been used to penetrate fluid cylinders to allow the controlled release of the contents of the cylinders within a containment vessel. In addition, various types of projectiles have previously been fired at fluid cylinder positioned within a containment vessel to rupture the walls of the fluid cylinder to release the contents from the fluid cylinder into the interior of the containment vessel.

SUMMARY OF INVENTION

[0005] A first aspect of the present invention provides a fluid recovery system for recovering fluid from a container, the fluid recovery system including a recovery vessel having a vessel interior, for receiving the container through an Opening: a closure for forming a fluid tight seal between the interior of the recovery vessel and an external environment; and a platform, disposed within the recovery vessel, for supporting the container: a drill assembly characterised in that the system further includes a hold down assembly: whereby a container placed on the platform is biased by the hold down assembly against the drill assembly to form a seal between the container and the drill assembly

[0006] Preferably, the fluid recovery system further comprises a support means.

[0007] Preferably, a second drill assembly which is associated with the hold down assembly.

[0008] Preferably, the hold down issc-mbly comprises at least one hydraulically-actuated rod.

[0009] Preferably, the support means comprise at one spring.

[0010] Preferably, the drill assembly comprises a housing having a port for removal of fluid from the container via the interior of said housing.

[0011] Preferably, the drill assembly also includes a means for inserting a flushing fluid.

[0012] Preferably, the means for inserting and extracting flushing fluid is suitable for any of the following Hushing fluids:

(i) A liquid solvent,
(ii) A liquid reactant
(iii) Steam, and
(iv) A liquid spray.

[0013] Preferably, the flushing fluid and/or the outer surface of the recovery vessel is heated.

[0014] Preferably, the fluid recovery system further comprises a heater for the vessel.

[0015] Preferably, the hold down assembly biases a housing against the wall of the container to form a fluid seal between the housing and the wall of the container.

[0016] Preferably, the fluid recovery system further includes a first pressure detector in communication with a longitudinal bore of the drill assembly for measuring a first pressure in said longitudinal bore; and a second pressure detector in communication with interior of a housing of the drill assembly for measuring a second pressure within the interior of said housing.

[0017] Preferably, the recovery vessel has a port in a lower portion thereof for removal of fluid from the interior of the recovery vessel.

[0018] Preferably, the drill assembly comprises a drill assembly for penetrating the wall of the container, the drill assembly at least partially defining a longitudinal bore and further including a shaft disposed within said longitudinal bore for rotational movement; penetrating means mounted on one end of said shaft for penetrating the wall of container: means for rotating said shaft: (p. 14. 1, 23-241, the drill assembly including a housing aligned with the longitudinctl borf, for receiving the shaft und forming a fluid seal between container and drill assembly; and a seal assornbly for forming a fluid between the interior of the housing and the remainder of the longitudinal bore.

[0019] Preferably, the drill assembly further includes a drive mechanism supplied to said shaft for selectively moving said shaft and said penetrating means restive to

the container, said drive mechanism including a frame; a motor; a plurality of threaded rods coupled to said frame: and a plurality of gears coupled to said motor and said plurality of threaded robs, said plurxilily of gears beinfj driven by said second motor to turn said pturaiity of threaded rods to selectively move said penetrating means rotative to the container.

[0020] Preferably, the container is enclosed within the recovery vessel,

[0021] A second aspect of the present invention provides a method for removing fluid from a container having a Wall using a fluid recovery system as claimed in any preceding claim, the method including the steps of: placing the container within the recovery vessel: urging a drill assembly including a housing against the container to form a fluid tight seal between the container and the housing: disposing the penetrating means in the housing: penetrating the wall of the container with the penetrating moans: and removing the fluid from the container through the housing.

[0022] Preferably, the method further includes the steps of urging a second housing against the container to form a fluid tight seat between the container and the second housing: disposing a second penetrating means in the second housing:

penetrating the wall of the container with the second penetrating means;

and wherein the fluid is moved from the container from a lowermost of the housings.

[0023] Preferably, the method further includes the steps of pressurizing at least one housing to check the tightness of at least one fluid seal, the checking step being performed before the penetrating step; and introducing an inert gas into the penetrated container through at least one housing to facilitate removal of the fluid from the container.

[0024] Preferably, the method further comprises the steps of heating a flushing fluid; and flushing the substantially emptied container with the flushing fluid.

[0025] Preferably, the method further comprises the step of heating the vessel.

[0026] Preferably, the method further comprises the step of applying heat to an exterior surface of the recovery vessel to facilitate the removal of fluid from the container.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a fluid recovery system for recovering fluid from a sealed container,

FIGURE 2 is a view of the fluid recovery system of FIGURE 1 along lines 2-2 of FIGURE 1:

FIGURE 3 is a exploded view of a drill assembly for penetrating the container of FIGURES 1 and 2, according to an embodiment of the present invention;

FIGURE 3A is an exploded isometric view of the drill assembly of FIGURE 3;

FIGURE 4 is an exploded view of a drill assembly for penetrating the container of FIGURES 1 and 2, according to another embodiment of the present invention;

FIGURE 4A is an exploded isometric view of the drill assembly of FIGURE 4;

FIGURE 5 is an exploded view of a drill assembly for penetrating the container of FIGURES 1 and 2, according to still another embodiment of the present invention;

FIGURE 5A is an exploded isometric view of the drill assembly of FIGURE 5;

FIGURE 6 is a fluid recovery system for recovering fluid from a sealed container;

FIGURE 7 is a view of the fluid recovery system of FIGURE 6 along lines 2-2 of FIGURE 6;

FIGURE 8 is a partial view of a fluid recovery system for recovering fluid from a sealed container;

FIGURE 9 is a detailed view of a portion of a drill assembly;

FIGURE 9A is a view of the drill assembly of FIGURE 9 along lines 2-2 of FIGURE 8;

FIGURE 10 is a detailed view of a portion of a drill assembly;

FIGURE 10A is a view of the drill assembly of FIGURE 10 along lines 2-2 of FIGURE 10; and

FIGURE 11 is a drill assembly according to another embodiment of the present invention.

FIGURE 12 is a flow chart.

DETAILED DESCRIPTION OF THE INVENTION

[0028] The preferred embodiment of the present invention and its advantages are best understood by referring to FIGURES. 1-10 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

[0029] As an overview of the present invention, a fluid recovery system 10 provides a sealed recovery vessel 12 for receiving container 14. The contents of container 14, typically hazardous waste fluids, can then be removed without polluting the environment by using recovery system 10. The pressures under which the fluid contents may be stored in container 14 can range up to approximately 6000 psi (41.37 MPa). Additionally, the fluid within container 14 may be in a gas phase, a liquid phase or a combination of both a gas and liquid phase. Typically, container 14 has been sealed shut either purposely or inadvertently, and cannot be emptied by normal procedures. After the fluid is removed from container 14, the fluid and container can be disposed of safely. Recovery system 10 allows for removal of any hazardous fluids within container 14 from a remote location to ensure the

safety of personnel controlling the fluid recovery process.

[0030] More specifically, FIGURE. 1 is a side view of fluid recovery system 10. Fluid recovery system 10 is typically housed in a sealed trailer 16 to allow movement of fluid recovery system 10 to the location of any deteriorated containers. Thus, safety is increased by avoiding transportation of the deteriorated containers, as welt as by providing a third level containment. (The trailer being the third level, with recovery vessel 12 being the second level, and drill assembly 44 being the first level, as is discussed below.)

[0031] Fluid recovery system 10 includes a recovery vessel 12 which has a sealable end opening 18 through which container 14 may be inserted. End closure 19 is then secured to end opening 18 to seal the interior 21 of recovery vessel 12 from the environment. A fluid tight barrier is preferably maintained between the interior 21 and the exterior of recovery vessel 12.

[0032] Recovery vessel 12 also includes two access openings 20 and 22. Access openings 20 and 22 provide additional entries into interior 21 of recovery vessel 12. Closures 24 and 26 seal interior 21 from the environment when secured to access openings 20 and 22 respectively. Although recovery vessel 12 and container 14 are shown as cylinders, various sizes, shapes and configurations of recovery vessels and containers may be satisfactorily used with the present invention.

[0033] Container 14 is placed on platform assembly 28 disposed within recovery vessel 12. Platform assembly 28 includes a platform 30 which is supported by four springs 32. Springs 32 are respectively attached to the interior of recovery vessel 12 by four support members 34. Springs 32 of platform assembly 28 allow platform 30 to move in a plane perpendicular to that of platform 30.

[0034] Fluid recovery system 10 also includes a hold-down assembly 36 having a hydraulic cylinder 38, hydraulic piston rod 40, hold-down clamp 41 and a support member (not shown) for securing hydraulic cylinder 38 to the interior portion of wall 43 of recovery vessel 12.

[0035] An opening 42 extends through wall 43 of recovery vessel 12 and provides drill assembly 44 with access to container 14. Drill assembly 44 is discussed in greater detail below in conjunction with FIGURES 3-10. Drill assembly 44 is driven by a drill motor 46 which is secured to motor support 48.

[0036] Drill assembly 44 and drill motor 46 are positioned relative to container 14 by drill positioning assembly 50. Drill positioning assembly 50 includes two hydraulic cylinders 52 and 54. Piston rods 56 and 58, which are positioned by cylinders 52 and 54 respectively, are coupled to motor support 48. Frame 60 secures cylinders 52 and 54 to the exterior of wall 43 of recovery vessel 12. Drill assembly 44, motor 46, motor support 48 and drill positioning assembly 50 are preferably located on the exterior of wall 43 of recovery vessel 12 opposite from container 14 and platform 30. However, these components may be located within recovery vessel 12.

[0037] The specific location of opening 42 may be selected along with the location of platform assembly 28 and hold-down assembly 36 to optimize the performance of drill assembly 44 to penetrate container 44. The optimum location may vary depending upon the fluids which will be released and the type of container containing the fluids.

[0038] Hold-down assembly 36, drill positioning assembly 50, drill motor 46, valve 54 and valve 60 are all capable of being controlled remotely from remote control panel 72. Remote control panel 72 is typically located outside of trailer 16 at a distance sufficient to provide for safe operation.

[0039] FIGURE 2 shows an end view of the fluid recovery system 10 of FIGURE 1 along lines 2-2. In FIGURE 2 an opening 74 is shown in platform 30 to accommodate drill assembly 44. Two rails 76 and 78, which are part of platform assembly 28, are disposed along the outer edges of platform 30. Rails 76 and 78 cooperate with hold-down assembly 36 to prevent container 14 from rolling on platform 30. Drill assembly 44, motor 46, support 48 and drill positioning assembly 50 are shown disposed in another possible orientation with respect to recovery vessel 12. Such orientation does not affect the operation of fluid recovery system 10.

[0040] Referring again to FIGURE 1, a first pressure transducer 62 is coupled to a port 105 of drill assembly 44. A valve 64 is coupled between first transducer 62 and interior 21 of recovery vessel 12. Inside recovery vessel 12, drill assembly 44 includes a cylindrical evacuation port 66 which is coupled to a pipe 68. Pipe 68 is coupled through wall 43 of recovery vessel 12 to a valve 70. A second pressure transducer 71 is also coupled to pipe 68. Pressure transducers 62 and 71 may be monitored from control panel 72. Valves 64 and 70 may be operated from control panel 72. FIGURE 2 shows transducers 62 and 71, valves 64 and 70, evacuation port 66 and pipe 68 disposed in another possible orientation with respect to recovery vessel 12. Again, such orientation does not affect the operation of fluid recovery system 10.

[0041] In operation container 14 is carefully placed upon platform assembly 28 through end opening 18. End closure 19 is then closed to seal container 14 inside recovery vessel 12. Trailer 16 is sealed as well. Hydraulic cylinder 38 is activated to urge, via hydraulic piston rod 40 and hold-down clamp 41, container 14 toward platform assembly 28. Support springs 32 are compressed, allowing platform 30 to be moved toward opening 42 and drill assembly 44. Container 14 is continually urged downward until drill assembly 44 makes sealable contact with the exterior of container 14, as shown in FIGURE 2. Hold-down assembly 36 then maintains container 14 in this position.

[0042] FIGURE 3 is an exploded view of drill assembly 44 as installed in FIGURES 1 and 2. Referring to FIGURE 3, opening 42 in wall 43 of recovery vessel 12 is provided for installation and support of drill assembly 44. Cylindrical tubing 88 lines the inside diameter of opening 42. For this embodiment, cylindrical tubing 88 is welded within

opening 42, although any other form of attachment may be used, such as threading both the outer surface of cylindrical tubing 88 and the inside diameter of opening 42.

[0043] Drill assembly 44 includes a first housing section 90 and a second housing section 92. First adapter 94 is provided to secure first housing section 90 to end 89 of tubing 88 within recovery vessel 12. Second adapter 96 is provided to secure second housing section 92 to end 91 of tubing 88 on the exterior of recovery vessel 12. A plurality of matching threads are used to attach first and second adapters 94 and 96 with their respective first housing section 90 and second housing section 92 to ends 89 and 91 of tubing 88. Housing sections 90 and 92, adapters 94 and 96 and tubing 88 cooperate with each other to define longitudinal bore 82 extending therethrough.

[0044] A first seal assembly 98, having a first packing 99, is placed on the end of first adaptor 94 opposing the end threaded into tubing 88. A second seal assembly 100, having a second packing 101, is retained within second housing section 92 by packing nut 103. First and second seal assemblies 98, 100 may be any suitable assemblies including commercially available assemblies. While the type of packing assembly is not critical, the type selected may affect the performance and reliability of the seal. Second housing section 92 is threaded into the inside surface of second adaptor 96. Thus, longitudinal bore 82 is formed from the interior of adapter 94, through tube 88, to the interior of adapter 96. Evacuation port 66 allows access to interior 80 of housing section 90, while port 105 allows access to longitudinal bore 82. First and second packing 99, 101 are preferably of Teflonl construction, but any suitable packing material may be used.

[0045] A shaft 102 extends from the interior of first housing section 90, through bearing assembly 106, first seal assembly 98, longitudinal bore 82, and second seal assembly 100. Drill bit 84 is coupled to a drill end of shaft 102, while a drive end is coupled to motor shaft 108 by coupler 110.

[0046] A coupling sleeve 112 having a lip 114 surrounds a lower portion of first housing section 90. A seal is formed between first housing section 90 and coupling sleeve 112 by two O-rings 116 and 118. Alternatively, the seal can be achieved by integrally connecting, for example by welding, first housing section 90 to an end portion of coupling sleeve 112 as shown in FIGURES 4 and 4A.

[0047] The inner portion of lip 114 is disposed between one end of first housing section 90 and first seal assembly 98. Coupling member 120 engages the outer portion of lip 114 to secure sleeve 112 to first adapter 94. When coupling member 120 is tightened, the inner portion of lip 114 is forced against first seal assembly 98 to form a seal as described below.

[0048] In an alternative configuration shown in FIGURES 5 and 5A, lip 114 has no inner portion disposed between the one end of first housing section 90 and the first seal assembly 98. Instead, the one end of first housing section 90 directly engages first seal assembly 98. In this configuration, as container 14 is urged toward drill assembly 44, first housing section 90 is forced against first seal assembly 98 to form a seal. This arrangement requires that first housing section 90 be movable relative to coupling sleeve 112.

[0049] Referring again to FIGURE 3, a portion of the interior surface of coupling member 120 has threads which engage threads on the outer surface of adapter 94. A washer 122, having a center hole 123 (FIGURE 3A) sized to receive drill bit 84, is inserted between first housing section 90 and the exterior of wall 85 of container 14.

[0050] As shown in FIGURE 3A, drill bit 84 has a shank 124 for insertion into a receiving cavity 125 within the drill end of shaft 102. Shank 124 is secured within cavity 125 by set screw 126. Set screw 126 is threaded into set screw receiving hole 128. Set screw receiving hole 128 extends from the cavity to the exterior of shaft 102. These features are also shown in other figures, for example FIGURES 4A and 5A, which depict other features and embodiments of the present invention.

[0051] The structure of drill assembly 44 provides a leak detection feature. The logic of this feature is shown in the flow chart of FIGURE 12. Referring also to FIGURES 3-5A, after a fluid seal is established between drill assembly 44 and the exterior of container 14, an interior portion 80 of drill assembly 44 is filled with an inert gas. Transducer 71 monitiors the pressure within interior portion 80. If the pressure detected by transducer 71 decreases, a leak is indicated. This leak could occur, for example, at the fluid seal formed between first housing section 90 and wall 85 of container 14 or at first seal assembly 98, between interior portion 80 and a longitudinal bore 82 of drill assembly 44. To determine where the leak is, transducer 62 monitors the pressure in a longitudinal bore 82 of drill assembly 44. As shown in FIGURE 12, when the pressure detected by transducer 71 decreases and the pressure detected by transducer 62 increases, a leak between interior portion 80 and longitudinal bore 82 is indicated. When the pressure detected by transducer 71 decreases, but the pressure detected by transducer 62 does not increase, a leak between housing section 90 and wall 85 of container 14 is indicated.

[0052] When such leaks occurs, drill assembly 44 must be disassembled and repaired. If no leak is detected, motor 46 is activated and rotates a drill bit 84. Drill positioning assembly 50 urges drill bit 84 forward until it makes contact with and penetrates wall 85 of container 14. Any fluid waste within container 14 may then be withdrawn through the penetration 86 via interior portion 80, evacuation port 66, pipe 68 and valve 70. Transducers 62 and 71 may be substituted with other suitable pressure detectors.

[0053] By confining the fluid to the relatively small volume of interior 80, rather than the much larger volume of recovery vessel 12, the fluid removal efficiency is in-

creased. That is, by minimizing the number of surfaces to which the fluid is exposed (the inside wall of interior 80 versus the interior side of wall 23 and the outside of wall 85), the decontamination of these surfaces is minimized.

[0054] Another embodiment is depicted in FIGURES 9 and 9A, in which the one end of first housing section 90 is shown cooperating with washer 122 to form one or more fluid seal with wall 85 of container 14. In this embodiment, the one end of first housing section 90 is formed to have annular projection 216.

[0055] According to one aspect of this embodiment, an annular extension 213 extends longitudinally from annular projection 216. The formation of projection 216 and extension 213 results in bearing surface 215 and end surface 214. Two fluid seals are created between first housing section 90 and container 14. A first fluid seal is formed by disposing washer 122 between bearing surface 215 of first housing section 90 and wall 85 of container 14. A second fluid seal is formed by disposing an O-ring 207 between end surface 214 of extension 213 and wall 85 of container 14. Preferably, the structure of the one end of first housing section 90 is such that O-ring 207 is positioned radially outward from washer 122 as shown in FIGURES 9 and 9A. In this arrangement, the fluid seal formed by washer 122 functions as a primary fluid seal and the fluid seal formed by O-ring 207 functions as a secondary, or backup, fluid seal. It will be appreciated however, that the one end of first housing section 90 may be formed differently such that the seal incorporating 0-ring 207 is positioned radially inward from the seal incorporating washer 122. Further, although only one O-ring and one washer are shown in FIGURES 9 and 9A, multiple O-rings and/or washers may be used to add further fluid seals or to otherwise improve the existing fluid seals.

[0056] According to another aspect of this embodiment, as shown in FIGURES 10 and 10A, the one end of first housing section 90 is formed to have annular projection 216 as described above. One or more raised annular surfaces extend longitudinally from end surface 217 to engage washer 122. FIGURES 10 and 10A shown two raised annular surfaces 208, 209, but any number of such raised annular surfaces may be incorporated into this aspect of the invention. A fluid seal is formed between washer 122 and wall 85 of container 14. Additional fluid seals are formed at the respective points of contact between annular surfaces 208, 209 and washer 122.

[0057] In operation, coupling member 120 is tightened so that seal assembly 98 forms a first fluid barrier (by forcing packing 99 to form a seal around a first portion of shaft 102) between interior 80 of housing section 90 and longitudinal bore 82. Packing nut 103 is tightened so that seal assembly 100 forms a second fluid barrier (by forcing packing 101 to form a seal around a second portion of shaft 102) between longitudinal bore 82 and the outside environment. Hold-down assembly 36 is activated in response to a first signal from remote control panel 72. Container 14 is forced against washer 122 and/or O-ring 207 (FIGURES 9, 9A). Washer 122, in turn, is forced against first housing section 90 and/or bearing surface 215 (FIGURES 10, 10A) or raised annular surfaces 208, 209 (FIGURES 10, 10A) to form the fluid seal (s) between first housing section 90 and wall 85 of container 14.

[0058] In some embodiments, washer 122 is made of a material, such as lead, which allows washer 122 to conform to the contour of wall 85. In other embodiments, washer 122 is pre-formed to the contour of wall 85. The force exerted upon housing section 90 by container 14 aids in forming the first fluid barrier by further compressing packing 99.

[0059] Drill motor 46, in response to a second signal from panel 72, rotates shaft 102. Bearing assembly 106 stabilizes shaft 102 as it rotates. Although bearing assembly 106 is not depicted in certain figures, for example FIGURES 4-5A, bearing assembly 106 may be incorporated into the embodiments shown therein. Drill positioning assembly 50 is activated in response to a third signal from panel 72. Drill bit 84 is urged toward container 14, as described above in conjunction with FIGURES 1 and 2, by drill positioning assembly 50 until it comes in contact with wall 85. Drill bit 84 is then further urged toward container 14 until wall 85 is penetrated to form penetration 86. Typically, a change in pressure within pipe 68 indicates the formation of penetration 86. An indication of the pressure within pipe 68 may be obtained by remotely monitoring second transducer 71 with control panel 72. Drill positioning assembly 50, in response to a fourth signal from panel 72, retracts drill bit 84 from container 14. The fluid within container 14 can be drained or pumped out of container 14 via penetration 86, evacuation port 66, pipe 68 and valve 70.

[0060] The relatively small volume of interior 80 aids in preventing ignition of wall 85 of container 14 by minimizing the time during which the fluid escapes through penetration 86. As the fluid escapes, the friction between the fluid and the portion of wall 85 near penetration 86 generates heat. The longer the escape time, the higher the temperature of the portion of wall 85 surrounding penetration 86 becomes. The temperature may become high enough to ignite wall 85. The escape time is proportional to the volume into which the fluid escapes. That is, fluid, especially in a gas phase, will escape until the pressure within the escape volume reaches equilibrium with the pressure inside container 14. The smaller the volume, the more quickly such equilibrium is reached, and the lower the amount of heating which occurs. The lower the amount of heating, the less of a chance of ignition.

[0061] A further measure which can be taken to prevent fluid ignition is to evacuate interior 80 of air via port 66 before penetration. Additionally, after evacuation is performed, interior 80 may be pressurized with an inert gas via port 66. The pressure within interior 80 is typically raised to a point above the anticipated pressure of the contents of container 14. When penetration occurs, the

more highly pressurized inert gas flows through penetration 86 into container 14. Thus, if any heating occurs, it will be to the inert gas which will not ignite. If the pressure within interior 80 is less than that of the fluid inside container 14, the inert gas dilutes the escaping fluid, thus reducing the probability of ignition.

[0062] Interior 80 may be pressurized with a passivation gas when the fluid is a strong oxidizer, such as certain fluorinated compounds. Typically, the passivation gas consists of approximately 20% fluorine and 80% nitrogen. The passivation gas causes a thin oxidation layer to be formed on the surfaces which are exposed to the fluid once penetration of wall 85 occurs. Such surfaces include the inner surfaces of first housing section 90, port 66 and pipe 68, as well as the outer surface of drill bit 84. The thin oxidation layer prevents the strong oxidizer within container 14 from reacting with the above mentioned surfaces.

[0063] Decontamination of a fluid, such as a poison, may sometimes be necessary. Such decontamination is accomplished by injecting a decontaminate into container 14 via pipe 68, port 66, interior 80 and penetration 86.

[0064] Eradication of living organisms within the fluid may be necessary. Such eradication is accomplished by injecting a killing agent into container 14 via pipe 68, port 66, interior 80 and penetration 86.

[0065] The pressure within longitudinal bore 82 may be monitored by first pressure transducer 62. If the pressure within longitudinal bore 82 increases when interior 80 is filled with an inert gas or when penetration into container 14 occurs, a leak from interior 80 into bore 82, i.e., a failure of the first fluid barrier, is indicated. In the event such a leak occurs, second seal assembly 100 prevents any fluid from leaking into the environment to reestablish the first fluid barrier, first seal assembly 98 may be replaced. Alternatively, coupling member 120 may be tightened to further compress packing 101 and reestablish the first fluid barrier. Fluid which does leak into longitudinal bore 82 is contained by second seal assembly 100 and may be redirected to interior 21 of recovery vessel 12 by opening valve 64. The leaking fluid is thereby isolated from the external environment.

[0066] In another embodiment of the drill assembly of the present invention, second housing section 92, second seal assembly 100, first transducer 62 and valve 64 are not installed. The operation of drill assembly 44 remains the same as outlined above. However, if first seal assembly 98 fails to maintain the first fluid barrier, the fluid from container 14 may leak directly into the interior of trailer 16, as opposed to being contained by second seal assembly 100. Sealed trailer 16, however, isolates the leaking fluid from the external environment.

[0067] In another embodiment of the present invention, as shown in FIGURES 6 and 7, a plurality of drill assemblies may be incorporated to penetrate wall 85 and remove the fluid from container 14. Any number of drill assemblies may be used and their positioning relative to container 14 and recovery vessel 12 may be varied. FIGURE 6 depicts a first drill assembly 44 positioned generally below container 14. A second drill assembly 44a is positioned above container 14 within access opening 20. Second drill assembly 4.4a is similar to first drill assembly 44 and has many of the same components including first and second housing sections 90a and 92a, a coupling assembly 88a, which joins first and second housing sections 90a and 92a and partially defines a longitudinal bore, and first and second seal assemblies. Drill bit 84a is disposed within the longitudinal bore of second drill assembly 44a. Drill bit 84a is preferably of sufficient length so that in operation it may extend at least to a longitudinal centerline of container 14. In this respect, drill bit 84a would be able to penetrate not only container 14, but also any container possibly located within container 14. Drill bit 84a may be of sufficient length to penetrate through opposite sides of wall 85 of container 14. Although second drill assembly 44a is shown with first and second housing sections, it may be desirable, as described above to limit second drill assembly 44a to only one housing section.

[0068] A hold-down assembly 36a, similar to the hold-down assembly described above, has a pair of hydraulic cylinders 38a, a pair of hydraulic piston rods 40a, a hold-down clamp 41a, and a support member (not shown) for securing hydraulic cylinders 38a to the interior surface of wall 43 of recovery vessel 12. The operation of hold-down assembly 36a is essentially as described above for hold-down assembly 36 depicted in FIGURES 1 and 2. Second drill assembly 44a is driven by a drill motor 46a which is secured to motor support 48a.

[0069] Second drill assembly 44a and drill motor 46a are positioned relative to container 14 by drill positioning assembly 50a. Drill positioning assembly 50a includes two hydraulic cylinders 52a and 54a, which are respectively connected at one end thereof to hold-down clamp 41a. Piston rods 56a and 58a, which are positioned by cylinders 52a and 54a respectively, are coupled to motor support 48a.

[0070] First housing section 90a movably extends through hold-down clamp 41a to contact wall 85 of container 14. In operation, piston rods 40a are activated to urge hold-down clamp 41a toward container 14. As first housing section 90a makes contact with wall 85 of container 14, a spring 212, disposed about first housing section 90a engages a lower surface of hold-down clamp 41a and an end portion of first housing section 90a to bias first housing section 90a against wall 85 to create a fluid seal therebetween. The features described above relating to seals between housing section 90 and wall 85 may be employed in forming the fluid seal between housing section 90a and wall 85.

[0071] After sealable contact is made, hydraulic pistons 56a and 58a are activated to urge drill bit 84a toward container 14 to penetrate container 14. A first port 66a is provided on first housing section 90a to allow removal of the fluid from container 14. A first conduit 68a is attached to first port 66a to direct the fluid to the exterior

of recovery vessel 12 and to collection vessel 210. The portion of first conduit 68a within interior 21 of recovery vessel 12 is preferably flexible, for example flexible hosing. A transducer 71a and a valve 70a are positioned along first conduit 68a. Transducer 71a and valve 70a operate similar to transducer 71 and valve 70 described above. A second port 105a extends from second housing section 92a to place the interior of second housing section 92a in fluid communication with interior 21 of recovery vessel 12. If a leak occurs in the first seal assembly, the fluid may then escape into interior 21 and not the outside environment.

[0072] In an alternative arrangement, as shown in FIGURE 8, a second conduit 68b may be attached to second port 105a. Second conduit 68b may also be connected to first conduit 68a to place the respective interiors of first and second conduits 68a and 68b in fluid communication. In this arrangement, transducer 71a and valve 70 are positioned along second conduit 68b between second housing section 92a and first conduit 68a. If a leak occurs in the first seal assembly, transducer 71a will detect the leak and fluid in the interior of second housing portion 92a can be directed through second port 105a, conduit 68b, valve 70a and conduit 68a.

[0073] In the embodiment depicted in FIGURE 8, hydraulic cylinders 38b and hydraulic piston rods 40b are provided similar to hydraulic cylinders 38a and hydraulic piston rods 40a of FIGURES 6 and 7. In this embodiment, however, hold-down clamp 41a is not provided and rods 40b are coupled to second drill assembly 44a by braces 228.

[0074] A first motor 46a is mounted on drill motor support 219, which is movable relative to container 14. First motor 46a turns shaft 102a and drill bit 84a, which is coupled to shaft 102a. Shaft 102a is preferably supported by bearing 220. A second motor 221 is coupled to a plurality of gears 222, 223, and 224. Gears 223, 224 are coupled to first and second threaded rods 225 and 226, respectively. Motor 221 turns gear 222, which turns gears 223, 224. First and second threaded rods 225, 226 are mounted on frame 227 and are operatively coupled to support 219 such that when first and second threaded rods 225, 226 are turned, support 219 travels along rods 225, 226. Movement of support 219 is limited by pillow block bearings 218.

[0075] In operation, once sealable contact has been made between first housing section 90a and wall 85 of container 14, first motor 46a is activated to turn shaft 102a and drill bit 84a. Second motor 221 is also activated to turn gears 222, 223, and 224. The gears operate to turn threaded rods 225, 226, thereby moving support 219 shaft 102a and drill bit 84a toward container 14. Threaded rods 225, 226 may of course be turned the opposite direction to move support 219 away from container 14, thereby withdrawing drill bit 84a from container 14.

[0076] In this embodiment, it is preferable that the portions of first and second conduits 68a and 68b, which are located within interior 21 of recovery vessel 12, are flexible. This will allow movement of support 219 and drill assembly 44a without rupturing conduits 68a and 68b or causing these conduits to become damaged, tangled or otherwise inoperable.

[0077] In certain circumstances, for example when the fluid in container 14 is highly viscous, it may be necessary to rinse the interior of container 14 to fully evacuate the viscous fluid therefrom. In another embodiment, the second drill assembly of FIGURES 6-8 is modified, as shown in FIGURE 11, to provide a flushing feature during the processing of container 14. One possible configuration of fluid recovery system 10 according to this embodiment may incorporate first and second drill assemblies positioned below and above container 14 as described in connection with FIGURES 6-8. The first drill assembly is operable as described above to provide a conduit for withdrawal of the fluid from container 14 after container 14 is penetrated.

[0078] The second drill assembly 44a, preferably positioned above container 14, is modified in accordance with FIGURE 11 to permit introduction of a flushing fluid from a remote source (not shown) into container 14 through second drill assembly 44a. Second drill assembly 44a is identical to first drill assembly 44 in many respects. Nevertheless, shaft 236 has an interior space 237 extending at least partly along the length of shaft 236. Connector 233 connects shaft 236 to drill bit 231. A plurality of orifices 238 are provided in shaft 236 to place interior space 237 in communication with the exterior of shaft 236.

[0079] In operation, container 14 is penetrated by first and second drill assemblies 44 and 44a. Fluid is thereby permitted to exit container 14 via first drill assembly 44 as described above. Fluid in a gaseous state may be permitted to exit second drill assembly 44a. Shaft 236 should be configured such that when second drill assembly 44a penetrates container 14, orifices 238 are positioned within container 14. To provide the flushing feature of this embodiment, an inert gas by be introduced into container 14 through shaft 236 to facilitate the removal of the fluid within container 14.

[0080] A liquid reagent, reactant, or water, heated water, steam or other flushing fluid may be injected through shaft 236 into container 14 to facilitate the removal of the fluid within container 14. Injection of the flushing fluid under pressure may add a mechanical jetting action to the flushing feature. Additionally, the flushing fluid may be injected into container 14 directionally. The flushing fluid and/or the outer surface of recovery vessel 12 may be heated to facilitate removal, for example by increasing the volatilization of the fluid within container 14.

[0081] According to an aspect of this embodiment, it may be desirable to flush interior 21 of recovery vessel 12. This may be accomplished by withdrawing second drill assembly 44a sufficiently to expose orifices 238 to interior 21. Fluids may then be removed through a suitable port formed in wall 43 of recovery vessel 12.

[0082] The contaminated fluids from the drill assembly

or assemblies, the recovery vessel, or the container(s) within the vessel may be directed to any suitable processing system.

[0083] Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the invention as defined by the appended claims.

Claims

1. A fluid recovery system (10) for recovering fluid from a container (14), the fluid recovery system (10) including:

a recovery vessel (12), having a vessel interior, for receiving the container (14) through an opening (18);
a closure (19) for forming a fluid tight seal between the interior of the recovery vessel (12) and an external environment; and
a platform (28), disposed within the recovery vessel (12), for supporting the container (14);
a drill assembly (44. 44a);

characterised in that:

the system (10) further includes
a hold down assembly (36);
whereby a container (14) placed on the platform (28) is biased by the hold down assembly (36) against the drill assembly (44, 44a) to form a seal between the container (14) and the drill assembly (44, 44a).

2. A fluid recovery system (10) as claimed in claim 1 further comprising a support means (32)

3. A fluid recovery system (10) as claimed in claim 1 or 2, further comprising a second drill assembly (44a) which is associated with the hold down assembly (36).

4. A fluid recovery system (10) as claimed in any one of claims 1 to 3, wherein the hold down assembly (36) comprises at least one hydraulically-actuated rod (40).

5. A fluid recovery system (10) as claimed in any one of claims 2 to 4 wherein the support means (32) comprises at least one spring (32).

6. A fluid recovery system (10) as claimed in any one of claims 1 to 5, wherein said drill assembly (44, 44a) comprises a housing (90) having a port (66) for removal of fluid from the container (14) via the interior of said housing (90).

7. A fluid recovery system (10) as claimed in any one of claims 1 to 6, wherein said drill assembly (44,44a) also includes a means for inserting a flushing fluid

8. A fluid recovery system (10) as claimed in claim 7, wherein the means for inserting and extracting flushing fluid is suitable for any of the following flushing fluids:

(i) A liquid solvent,
(ii) A liquid reactant
(iii) Steam, and
(iv) A liquid spray.

9. A fluid recovery system (10) as claimed in any one of claims 7 to 8, wherein the flushing fluid and/or the outer surface of the recovery vessel is heated.

10. A fluid recovery system (10) as claimed in any one of claims I to 9. further comprising a heater for the vessel (12).

11. A fluid recovery system (10) as claimed in any one of claims 1 to 10, wherein the hold down assembly (36) biases a housing (90) against the wall of the container (14) to form a fluid seal between the housing (90) and the wall of the container (14).

12. A fluid recovery system (10) as claimed in any one of claims 1 to 11, further including:

a first pressure detector (62) in communication with a longitudinal bore (82) of the drill assembly (44, 44a) for measuring a first pressure in said longitudinal bore (82); and
a second pressure detector (71) in communication with interior of a housing (90) of the drill assembly (44, 44a) for measuring a second pressure within the interior of said housing (90).

13. A fluid recovery system (10) as claimed in any one of claims 1 to 12, wherein said recovery vessel (12) has a port in a lower portion thereof for removal of fluid from the interior of the recovery vessel (12).

14. A fluid recovery system as claimed in any preceding claim wherein the drill assembly comprises a drill assembly (44, 44a) for penetrating the wall of the container (14), the drill assembly (44, 44a) at least partially defining a longitudinal bore (82) and further including:

a shaft (102) disposed within said longitudinal bore (82) for rotational movement; penetrating means (84, 84a) mounted on one end of said shaft (102) for penetrating the wall of container

(14);
means (46, 46a) for rotating said shaft (102, 102a); [p. 14, 11. 23-24J the drill assembly (44, 44a) including:

a housing (90) aligned with the longitudinal bore (82) for receiving the shaft (102, 102a) and forming a fluid seal between container (14) and drill assembly (44, 44a); and
a seal assembly (98) for forming a fluid barrier between the interior of the housing (90) and the remainder of the longitudinal bore (82).

15. A fluid recovery system as claimed in claim 14, wherein the drill assembly (44a) further includes a drive mechanism supplied to said shaft (102a) for selectively moving said shaft (102a) and said penetrating means (84a) relative to the container (14), said drive mechanism including:

a frame (227)
a motor (221);
a plurality of threaded rods (Z25,-226) coupled to said frame (227); and
a plurality of gears (222, 223, 224) coupled to said motor and said plurality of threaded rods (225, 226), said plurality of gears (222, 223, 224) being driven by said second motor (38) to turn said plurality of threaded rods (225, 226) to selectively
move said penetrating means (84a) relative to the container (14).

16. A fluid recovery system as claimed in claim 14 or 15, wherein container (14) is enclosed within the recovery vessel (12).

17. A method for removing fluid from a container (14) having a wall using a fluid recovery system as claimed in any preceding claim, the method including the steps of:

placing the container (14) within the recovery vessel (12);
urging a drill assembly (44, 44a) including a housing (90, 90a) against the container (14) to form a fluid tight seal between the container (14) and the housing (90, 90a); disposing the penetrating means (84, 84a) in the housing (90, 90a); penetrating the wall of the container (14) with the penetrating means (84. 84a); and
removing the fluid from the container (14) through the housing (90, 90a).

18. A method as claimed in claim 17 further including the steps of:

urging a second housing (90, 90a) against the container (14) to form a fluid tight seal between the container (14) and the second housing (90, 90a);
disposing a second penetrating means (84, 84a) in the second housing (90, 90a); penetrating the wall of the container (14) with the second penetrating means (84, 84a); and

wherein the fluid is moved from the container (14) from a lowermost of the housings (90, 90a).

19. A method as claimed in claim 17 or 18, further including the steps of:

pressurizing at least one housing (90, 90a) to check the tightness of at least one fluid seal, the checking step being perfonned before the penetrating step; and
introducing an inert gas into the penetrated container (14) through at least one housing (90, 90a) to facilitate removal of the fluid from the container (14).

20. A method as claimed in any one of claims 17 to 19, further including the steps of heating a flushing fluid; and flushing the substantially emptied container (14) with the flushing fluid.

21. A method as claimed in any one of claims 17 to 19, further including the step of heating the vessel (12)

22. A method as claimed in any one of claims 17 to 21, further including the step of applying heat to an exterior surface of the recovery vessel (12) to facilitate the removal of fluid from the container (14).

Patentansprüche

1. Fluid-Rückgewiniiungssystem (10) zum Rückgewinnen von Fluid aus einem Behälter (14), wobei das Fluid-Rückgewinnungssystem (10) umfasst:

ein Rückgewinnungsgefäß (12) mit einem Gefäßinneren, um den Behälter (14) durch eine Öffnung (18) aufzunehmen;
einen Verschluss (19) zum Ausbilden einer fluiddichten Abdichtung zwischen dem Inneren des Rückgewinnungsgefäßes (12) und einer äußeren Umgebung; und
eine Plattform (18), die innerhalb des Rückgewinnungsgefäßcs (12) angeordnet ist, um den Behälter (14) zu unterstützen;
eine Bohranordnung (44, 44a);

dadurch gekennzeichnet, dass
das System (10) ferner eine Niederhaltanordnung

(36) umfasst;
wobei ein Behälter (14), der auf der Plattform (28) angeordnet ist, durch die Niederhaltanordnung (36) gegen die Bohranordnung (44, 44a) vorgespannt ist, um eine Abdichtung zwischen dem Behälter (14) und der Bohranordnung (44, 44a) auszubilden.

2. Fluid-Rückgewirmungssystem (10) nach Anspruch 1, wobei das System ferner Trägermittel (32) umfasst.

3. Fluid-Rückgewinnungssystem (10) nach Anspruch 1 oder 2, wobei das System ferner eine zweite Bohranordnung (44a) umfasst, die mit der Niederhaltanordnung (36) verbunden ist.

4. Fluid-Rückgewinnungssystem (10) nach einem der Ansprüche 1 bis 3, wobei die Niederhaltanordnung (36) wenigstens eine hydraulisch betätigte Stange (40) umfasst.

5. Fluid-Rückgewinnungssystem (10) nach einem der Ansprüche 2 bis 4, wobei die Trägermittel (32) wenigstens eine Feder (32) umfassen.

6. Fluid-Rückgewinnungssystem (10) nach einem der Ansprüche 1 bis 5, wobei die Bohranordnung (44, 44a) ein Gehäuse (90) umfasst, das einen Anschluss (66) für das Entfernen von Fluid aus dem Behälter (14) über das Innere des Gehäuses (90) aufweist.

7. Fluid-Rückgewinnungssystem (10) nach einem der Ansprüche 1 bis 6, wobei die Bohranordnung (44, 44a) ferner Mittel zum Einbringen eines Spülfluids umfasst.

8. Fluid-Rückgewinnungssystem (10) nach Anspruch 7, wobei die Mittel zum Einbringen und zum Extrahieren von Spülfluid für irgend eines der folgenden Spüliluide geeignet ist:

(i) ein flüssiges Lösungsmittel,
(ii) ein flüssiges Reaktionsmittel,
(iü) Dampf und
(iv) ein flüssiges Sprühmittel.

9. Fluid-Rückgewinnungssystem (10) nach einem der Ansprüche 7 bis 8, wobei das Spüllluid und/oder die Außenseite des Rückgewinnungsgefäßes beheizt sind.

10. Fluid-Rückgewinnungssystem (10) nach einem der Ansprüche 1 bis 9, wobei das System ferner eine Heizeinrichtung für das Gefäß (12) umfasst.

11. F'luid-Rückgewinnungssystem (10) nach einem der Ansprüche 1 bis 10, wobei die Niederhaltanordnung (36) ein Gehäuse (90) gegen die Wand des Behälters (14) vorspannt, um eine fluiddichte Abdichtung zwischen dem Gehäuse (90) und der Wand des Behälters (14) auszubilden.

12. Fluid-Rückgewinnungssystem (10) nach einem der Ansprüche 1 bis 11, wobei das System ferner umfasst:

einen ersten Druckdetektor (62) in Kommunikation mit einer longitudinalen Bohrung (82) der Bohranordnung (44, 44a) zum Messen eines ersten Drucks in der longitudinalen Bohrung (82), und
einen zweiten Druckdetektor (71) in Kommunikation mit dem Inneren eines Gehäuses (90) der Bohranordnung (44, 44a) zum Messen eines zweiten Drucks innerhalb des Inneren des Gehäuses (90).

13. Fluid-Rückgewinnungssystem (10) nach einem der Ansprüche 1 bis 12, wobei das Rückgewinnungsgefäß (12) einen Anschluss in einem unteren Abschnitt davon für das Entfernen von Fluid aus dem Inneren des Rückgewinnungsgefäßes (12) aufweist.

14. Fluid-Rückgewinnungssystem nach einem der vorhergehenden Ansprüche, wobei die Bohranordnung eine Bohranordnung (44, 44a) zum Durchdringen der Wand des Behälters (14) umfasst, wobei die Bohranordnung (44, 44a) zumindest teilweise eine longitudinale Bohrung (82) definiert und ferner umfasst:

eine Welle (102), die innerhalb der longitudinalen Bohrung (82) für eine Rotationsbewegung angeordnet ist,
Durchdringungsmittel (84, 84a), die an einem Ende der Welle (102) zum Durchdringen der Wand des Behälters (14) angebracht sind,
Mittel (46, 46a), um die Welle (102, 102a) zu rotieren, wobei die Bohranordnung (44, 44a) umfasst:

ein Gehäuse (90), das mit der longitudinalen Bohrung (82) ausgerichtet ist, um die Welle (102, 102a) aufzunehmen und eine Fluidabdichtung zwischen dem Behälter (14) und der Bohranordnung (44, 44a) auszubilden, und
eine Abdichtungsanordnung (98) zum Ausbilden einer Fluidbarriere zwischen dem Inneren des Gehäuses (90) und dem Rest der longitudinalen Bohrung (82).

15. Fluid-Rückgewinnungssystem nach Anspruch 14, wobei die Bohranordnung (44a) ferner einen Antriebsmechanismus umfasst, der auf die Welle (102a) angewendet wird, um selektiv die Welle

(102a) und die Durchdringungsmittel (84a) relativ zu dem Behälter (14) zu bewegen, wobei der Antriebsmechanismus umfasst:

einen Rahmen (227),
einen Motor (221),
eine Vielzahl von mit Gewinden versehenen Stangen (225, 226), die mit dem Rahmen (227) gekoppelt sind, und
eine Vielzahl von Zahnrädern (222, 223, 224), die mit dem Motor und der Vielzahl von mit Gewinden versehenen Stangen (225, 226) gekoppelt sind, wobei die Vielzahl von Zahnrädern (222, 223, 224) durch einen zweiten Motor (38) angetrieben werden, um die Vielzahl von mit Gewinden versehenen Stangen (225, 226) zu drehen, um die Durchdringungsmittel (84a) selektiv relativ zu dem Behälter (14) zu bewegen.

16. Fluid-RVckgewinwungssystem nach Anspruch 14 oder 15, wobei der Behälter (14) innerhalb des Rückgewinnungsgefäßes (12) umschlossen ist.

17. Verfahren zum Entfernen von Fluid aus einem Behälter (14) mit einer Wand unter Verwendung eines Fluid-Rückgewinnungssystems nach einem der vorhergehenden Ansprüche, wobei das Verfahren die folgenden Schritte umfasst:

Anordnen des Behälters (14) innerhalb des Rückgcwinnungsgelaßes (12),
Antreiben einer Bohranordnung (44, 44a) einschließlich eines Gehäuses (90, 90a) gegen den Behälter (14), um eine fluiddichte Abdichtung zwischen dem Behälter (14) und dem Gehäuse (90, 90a) auszubilden,
Anordnen der Durchdringungsmittel (84, 84a) in dem Gehäuse (90, 90a),
Durchdringen der Warid des Behälters (14) mit den Durchdringungsmitteln (84, 84a) und
Entfernen des Fluids aus dem Behälter (14) durch das Gehäuse (90, 90a).

18. Verfahren nach Anspruch 17, wobei das Verfahren ferner die Schritte umfasst:

Antreiben eines zweiten Gehäuses (90, 90a) gegen den Behälter (14), um eine fluiddichte Abdichtung zwischen dem Behälter (14) und dem zweiten Gehäuse (90, 90a) auszubilden,
Anordnen von zweiten Durchdringungsmitteln (84, 84a) in dem zweiten Gehäuse (90, 90a),
Durchdringen der Wand des Behälters (14) mit den zweiten Durchdringungsmitteln (84, 84a) und

wobei das Fluid aus dem Behälter (14) von dem untersten Gehäuse (90, 90a) bewegt wird.

19. Verfahren nach Anspruch 17 oder 18, wobei das Verfahren ferner die Schritte umfasst:

Beaufschlagen wenigstens eines Gehäuses (90, 90a) mit Druck, um die Dichtheit wenigstens einer Fluidabdichtung zu überprüfen, wobei der Überprüfungsschritt vor dem Durchdringungsschritt durchgeführt wird, und
Einbringen eines inerten Gases in den durchdrungenen Behälter (14) durch wenigstens ein Gehäuse (90, 90a), um das Entfernen des Fluids aus dem Behälter (14) zu erleichtern.

20. Verfahren nach einem der Ansprüche 17 bis 19, wobei das Verfahren ferner die Schritte des Heizens eines Spülfluids und des Spülens des im Wesentlichen geleerten Behälters (14) mit dem Spülfiuid umfasst.

21. Verfahren nach einem der Ansprüche 17 bis 19, wobei das Verfahren ferner den Schritt des Beheizens des Gefäßes (12) umfasst.

22. Verfahren nach einem der Ansprüche 17 bis 21, wobei das Verfahren ferner den Schritt des Aufbringens von Wärme auf eine Außenseite des Rückgewinnungsgefäßes (12) umfasst, um das Entfernen von Fluid aus dem Behälter (14) zu erleichtern.

Revendications

1. Système de récupération de fluide (10) destiné à récupérer un fluide à partir d'un récipient (14), le système de récupération de fluide (10) comprenant :

une cuve de récupération (12), présentant un intérieur de cuve, destinée à recevoir le récipient (14) à travers une ouverture (18) ;
une obturation (19) destinée à former un joint étanche au fluide entre l'intérieur de la cuve de récupération (12) et un environnement extérieur ; et
une plate-forme (28) disposée à l'intérieur de la cuve de récupération (12), destinée à supporter le récipient (14) ;
un ensemble de forets (44, 44a) ;

caractérisé en ce que :

le système (10) comprend en outre
un dispositif d'ancrage (36) ;
de sorte qu'un récipient (14) placé sur la plateforme (28) est sollicité par le dispositif d'ancrage (36) contre l'ensemble de forets (44, 44a) afin de former une étanchéité entre le récipient (14) et l'ensemble de forets (44, 44a).

2. Système de récupération de fluide (10) selon la revendication 1, comprenant en outre un moyen de support (32).

3. Système de récupération de fluide (10) selon la revendication 1 ou 2, comprenant en outre un second ensemble de forets (44a) qui est associé au dispositif d'ancrage (36).

4. Système de récupération de fluide (10) selon l'une quelconque des revendications 1 à 3, dans lequel le dispositif d'ancrage (36) comprend au moins une tige à actionnement hydraulique (40).

5. Système de récupération de fluide (10) selon l'une quelconque des revendications 2 à 4, dans lequel le moyen de support (32) comprend au moins un ressort (32).

6. Système de récupération de fluide (10) selon l'une quelconque des revendications 1 à 5, dans lequel ledit ensemble de forets (44, 44a) comprend un logement (90) présentant un orifice (66) destiné à retirer le fluide du récipient (14) par l'intermédiaire de l'intérieur dudit logement (90).

7. Système de récupération de fluide (10) selon l'une quelconque des revendications 1 à 6, dans lequel ledit ensemble de forets (44, 44a) comprend également un moyen destiné à insérer un fluide de rinçage.

8. Système de récupération de fluide (10) selon la revendication 7, dans lequel le moyen destiné à insérer et extraire un fluide de rinçage est adapté pour un quelconque des fluides de rinçage suivants :

(i) un solvant liquide ;
(ii) un réactif liquide ;
(iii) de la vapeur ; et
(iv) un brouillard d'eau.

9. Système de récupération de fluide (10) selon l'une quelconque des revendications 7 à 8, dans lequel le fluide de rinçage et/ou la surface extérieure de la cuve de récupération sont chauffés.

10. Système de récupération de fluide (10) selon l'une quelconque des revendications 1 à 9, comprenant en outre un dispositif de chauffage pour la cuve (12).

11. Système de récupération de fluide (10) selon l'une quelconque des revendications 1 à 10, dans lequel le dispositif d'ancrage (36) sollicite un logement (90) contre la paroi du récipient (14) afin de former un joint d'étanchéité au fluide entre le logement (90) et la paroi du récipient (14).

12. Système de récupération de fluide (10) selon l'une quelconque des revendications 1 à 11, comprenant en outre :

un premier détecteur de pression (62) en communication avec un alésage longitudinal (82) de l'ensemble de forets (44, 44a), destiné à mesurer une première pression dans ledit alésage longitudinal (82) ; et
un second détecteur de pression (71) en communication avec l'intérieur d'un logement (90) de l'ensemble de forets (44, 44a), destiné à mesurer une seconde pression au sein de l'intérieur dudit logement (90).

13. Système de récupération de fluide (10) selon l'une quelconque des revendications 1 à 12, dans lequel ladite cuve de récupération (12) présente un orifice dans une partie inférieure de celle-ci pour le retrait du fluide de l'intérieur de la cuve de récupération (12).

14. Système de récupération de fluide selon l'une quelconque des revendications précédentes, dans lequel l'ensemble de forets comprend un ensemble de forets (44, 44a) destiné à pénétrer la paroi du récipient (14), l'ensemble de forets (44, 44a) définissant au moins partiellement un alésage longitudinal (82) et comprenant en outre :

un arbre (102) disposé à l'intérieur dudit alésage longitudinal (82) pour un mouvement rotatif ;
des moyens de pénétration (84, 84a) montés sur une extrémité dudit arbre (102) destinés à pénétrer la paroi du récipient (14) ;
des moyens (46, 46a) destinés à faire tourner ledit arbre (102, 102a) ; [p. 14, 11 23-24]
l'ensemble de forets (44, 44a) comprenant :

un logement (90) aligné avec l'alésage longitudinal (82) destiné à recevoir l'arbre (102, 102a) et formant un joint d'étanchéité au fluide entre le récipient (14) et l'ensemble de forets (44, 44a) ; et
un ensemble de joints (98) destiné à former une barrière de fluide entre l'intérieur du logement (90) et le reste de l'alésage longitudinal (82).

15. Système de récupération de fluide selon la revendication 14, dans lequel l'ensemble de forets (44a) comprend en outre un mécanisme d'entraînement fourni sur ledit arbre (102a) pour déplacer sélectivement ledit arbre (102a) et lesdits moyens de pénétration (84a) par rapport au récipient (14), ledit mécanisme d'entraînement comprenant :

un châssis (227) ;

un moteur (221) ;
une pluralité de tiges filetées (225, 226) couplées audit châssis (227) ; et
une pluralité d'engrenages (222, 223, 224) couplés audit moteur et à ladite pluralité de tiges filetées (225, 226), ladite pluralité d'engrenages (222, 223, 224) étant entraînée par ledit second moteur (38) pour tourner ladite pluralité de tiges filetées (225, 226) afin de déplacer sélectivement lesdits moyens de pénétration (84a) par rapport au récipient (14).

16. Système de récupération de fluide (10) selon la revendication 14 ou 15, dans lequel le récipient (14) est enfermé à l'intérieur de la cuve de récupération (12).

17. Procédé de retrait d'un fluide d'un récipient (14) présentant une paroi utilisant un système de récupération de fluide selon l'une quelconque des revendications précédentes, le procédé comprenant les étapes consistant à :

placer le récipient (14) à l'intérieur de la cuve de récupération (12) ;
pousser un ensemble de forets (44, 44a) comprenant un logement (90, 90a) contre le récipient (14) afin de former un joint étanche au fluide entre le récipient (14) et le logement (90, 90a) ;
disposer les moyens de pénétration (84, 84a) dans le logement (90, 90a) ;
pénétrer la paroi du récipient (14) avec les moyens de pénétration (84, 84a) ; et
retirer le fluide du récipient (14) à travers le logement (90, 90a).

18. Procédé selon la revendication 17, comprenant en outre les étapes consistant à :

pousser un second logement (90, 90a) contre le récipient (14) afin de former un joint étanche au fluide entre le récipient (14) et le second logement (90, 90a) ;
disposer des seconds moyens de pénétration (84, 84a) dans le second logement (90, 90a) ;
pénétrer la paroi du récipient (14) avec les seconds moyens de pénétration (84, 84a) ; et
dans lequel le fluide est déplacé du récipient (14) à partir d'un point le plus bas des logements (90, 90a).

19. Procédé selon la revendication 17 ou 18, comprenant en outre les étapes consistant à :

mettre sous pression au moins un logement (90, 90a) afin de vérifier l'étanchéité d'au moins un joint étanche, l'étape de vérification étant réalisée avant l'étape de pénétration ; et
introduire un gaz inerte dans le récipient pénétré (14) à travers au moins un logement (90, 90a) afin de faciliter le retrait du fluide du récipient (14).

20. Procédé selon l'une quelconque des revendications 17 à 19, comprenant en outre les étapes consistant à chauffer un fluide de rinçage ; et à rincer le récipient sensiblement vidé (14) avec le fluide de rinçage.

21. Procédé selon l'une quelconque des revendications 17 à 19, comprenant en outre l'étape consistant à chauffer la cuve (12).

22. Procédé selon l'une quelconque des revendications 17 à 21, comprenant en outre l'étape consistant à appliquer de la chaleur sur une surface extérieure de la cuve de récupération (12) afin de faciliter le retrait du fluide du récipient (14).

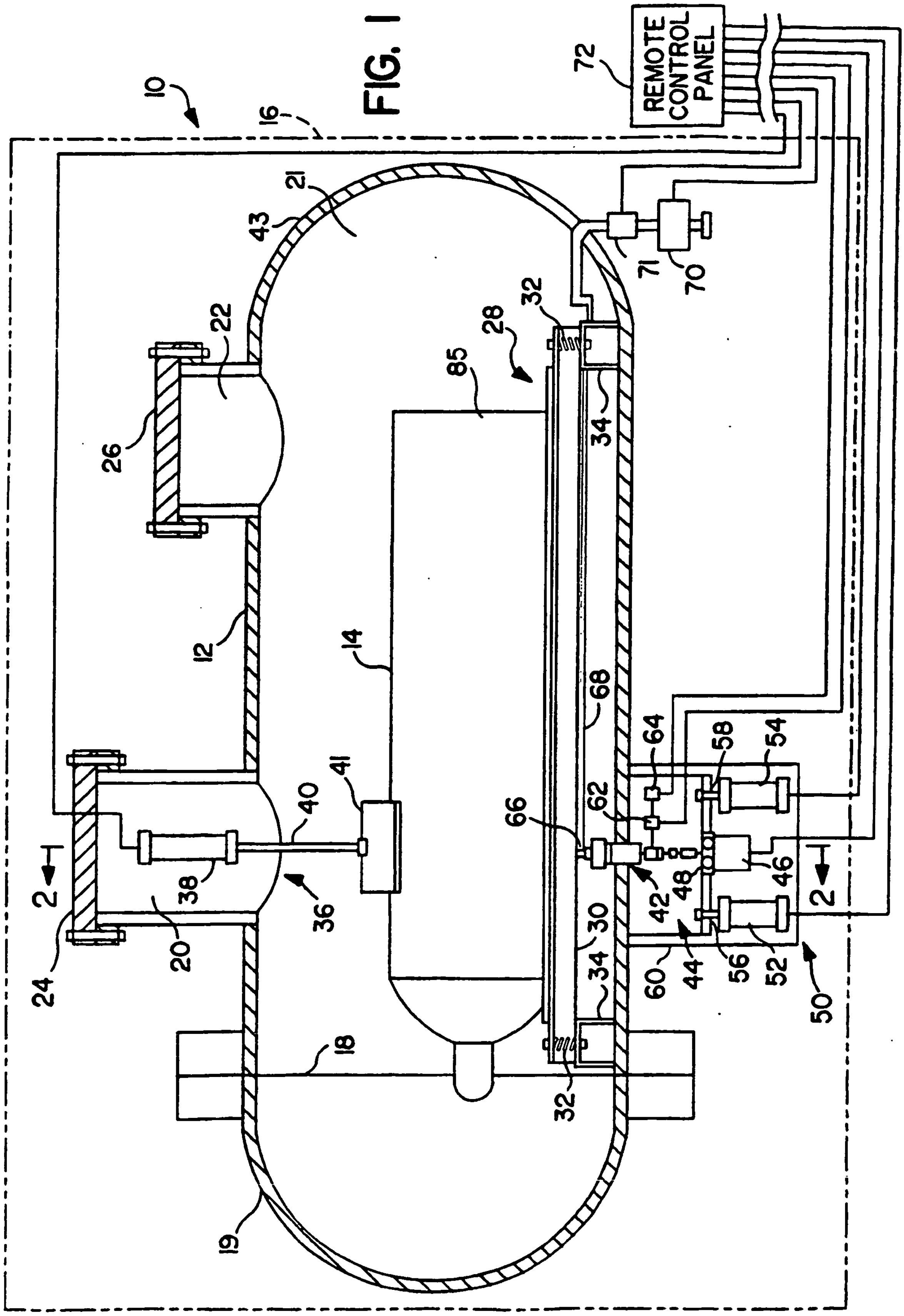
REMOTE CONTROL PANEL
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FIG. 1

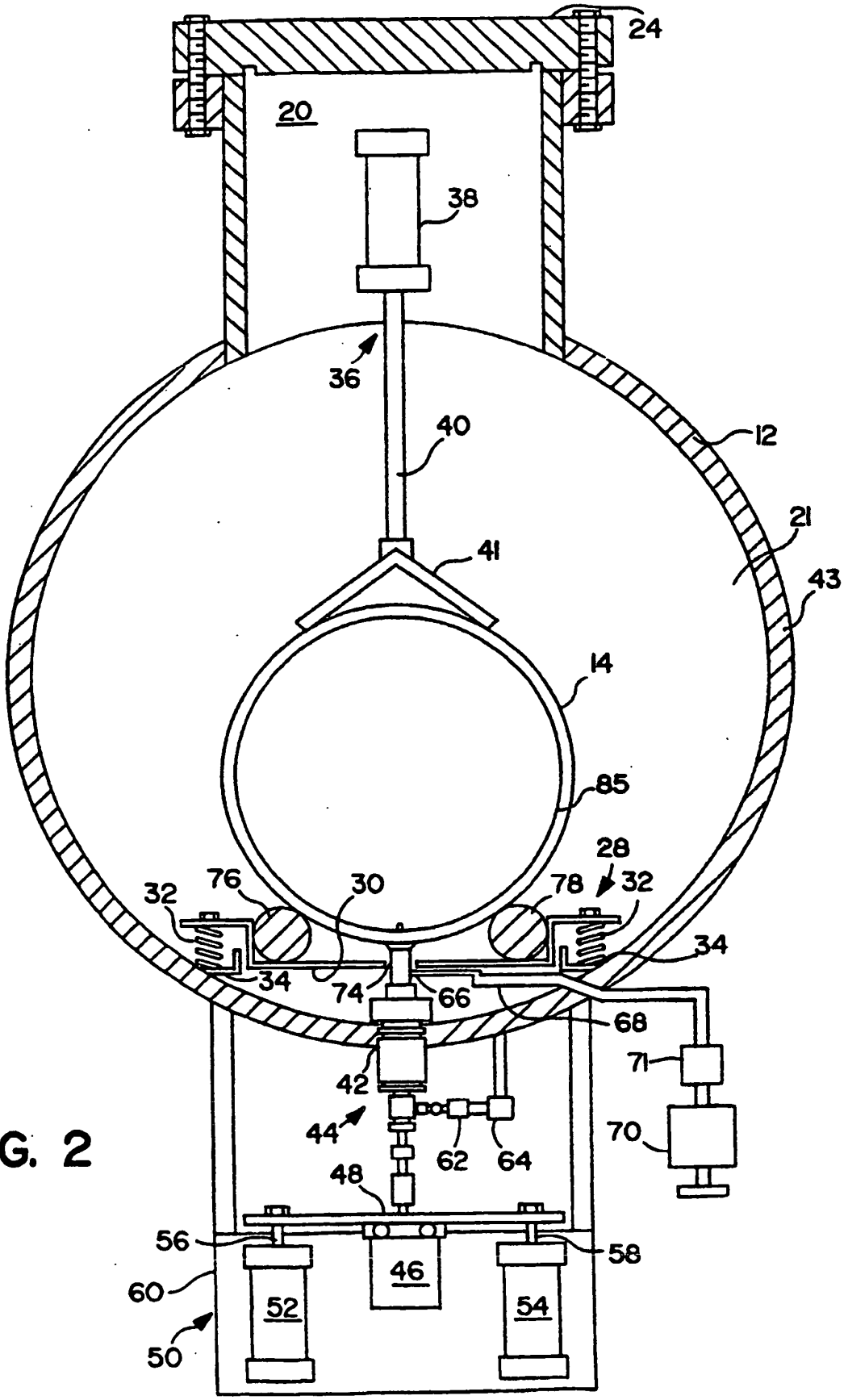
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FIG. 2

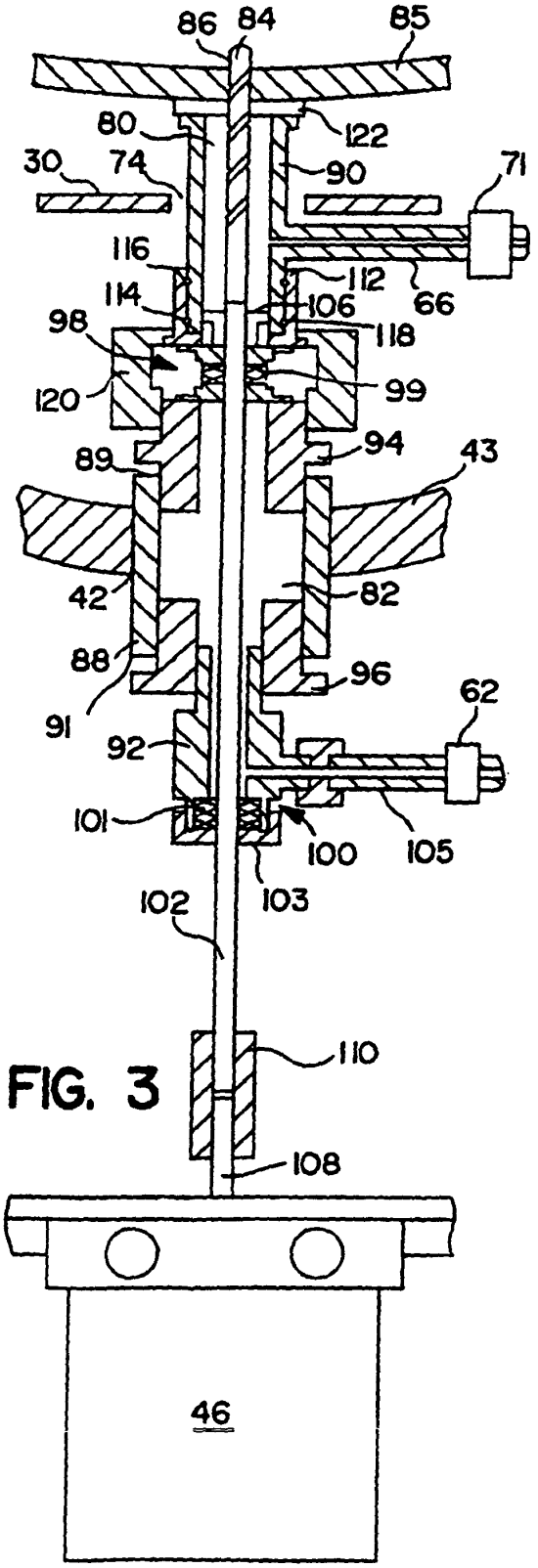
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FIG. 3

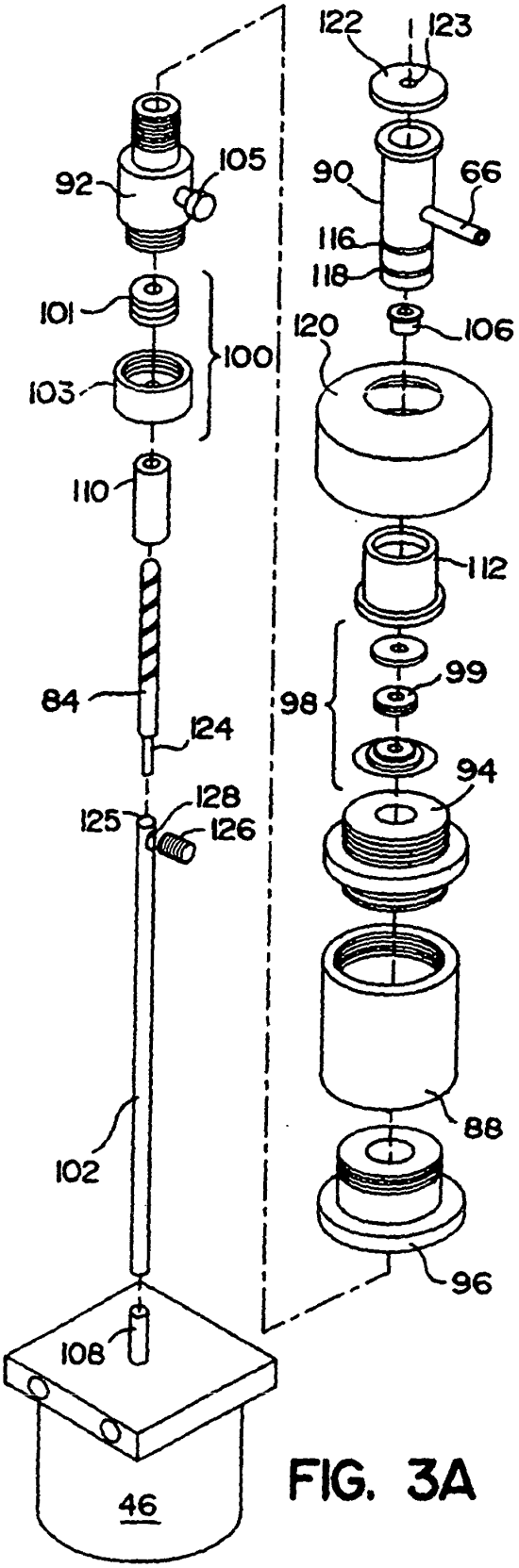
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FIG. 3A

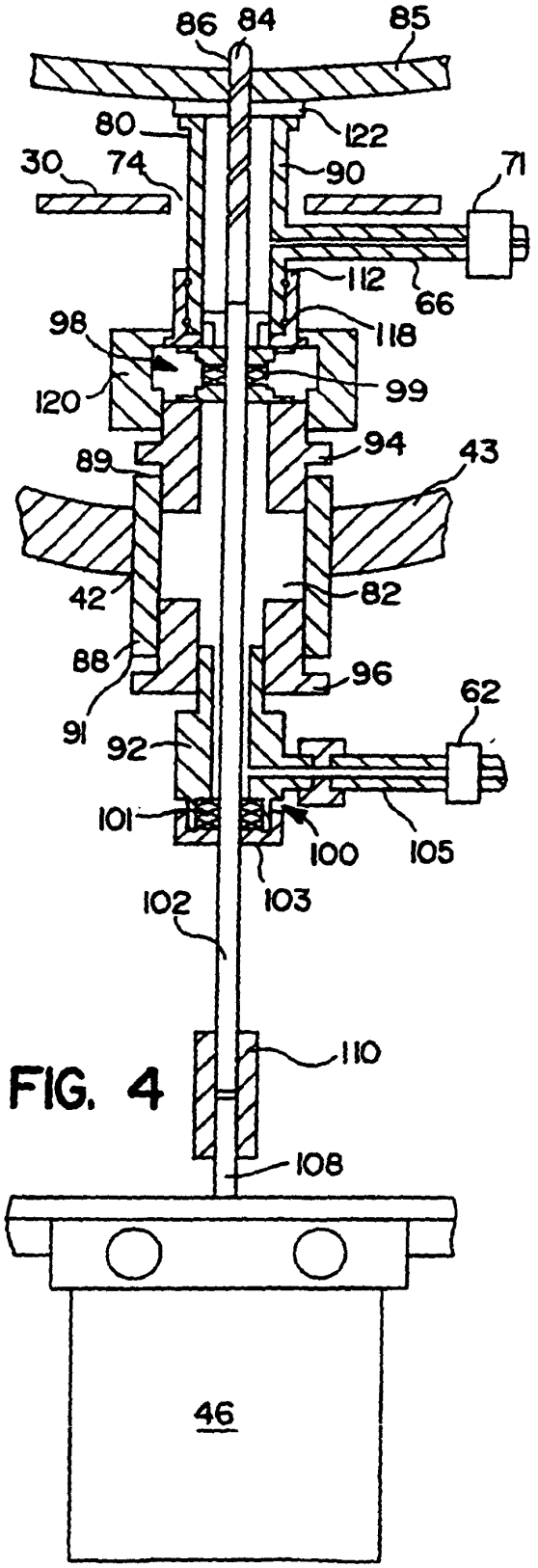
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FIG. 4

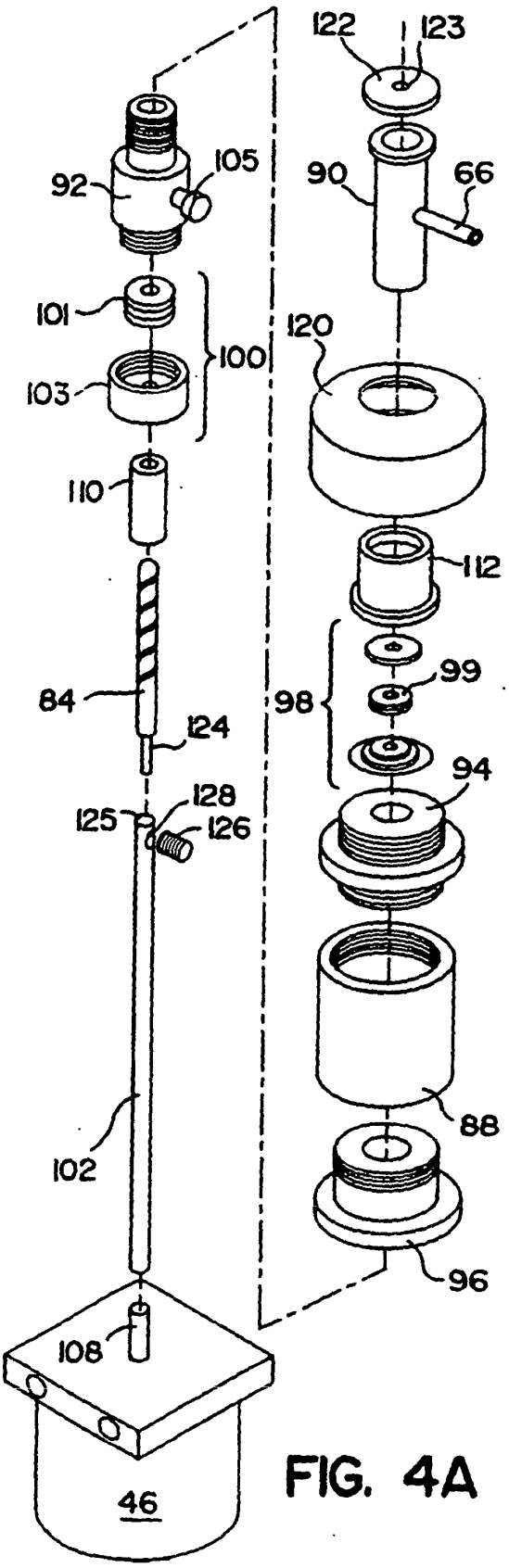
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FIG. 4A

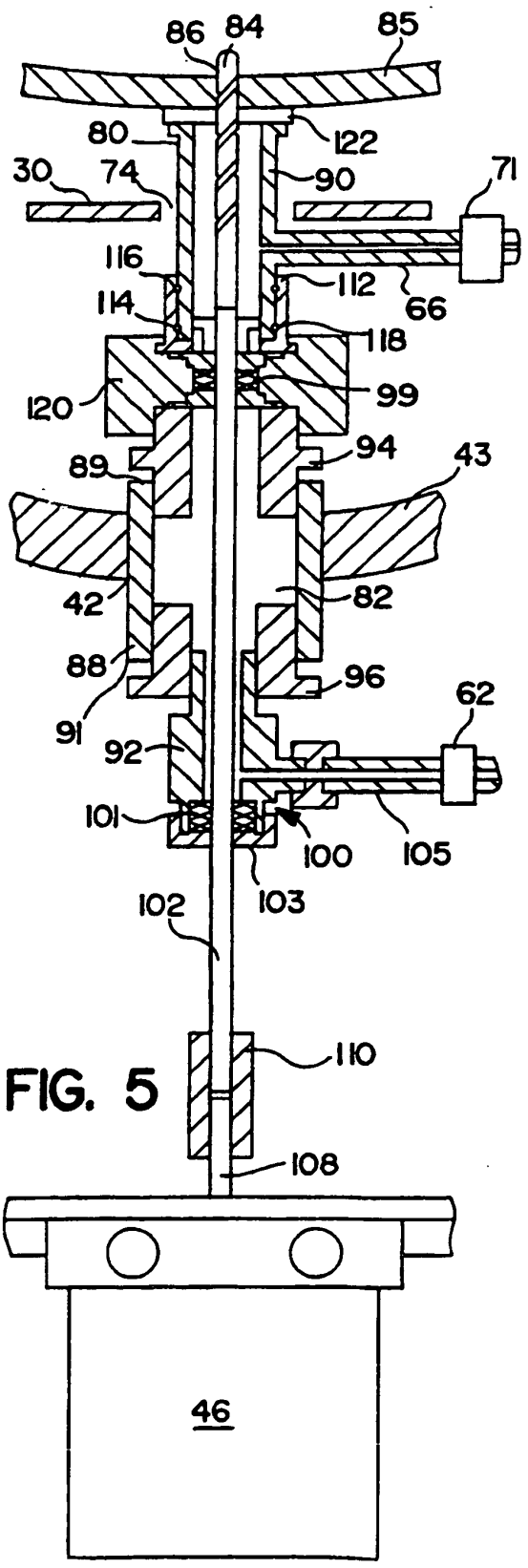
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FIG. 5

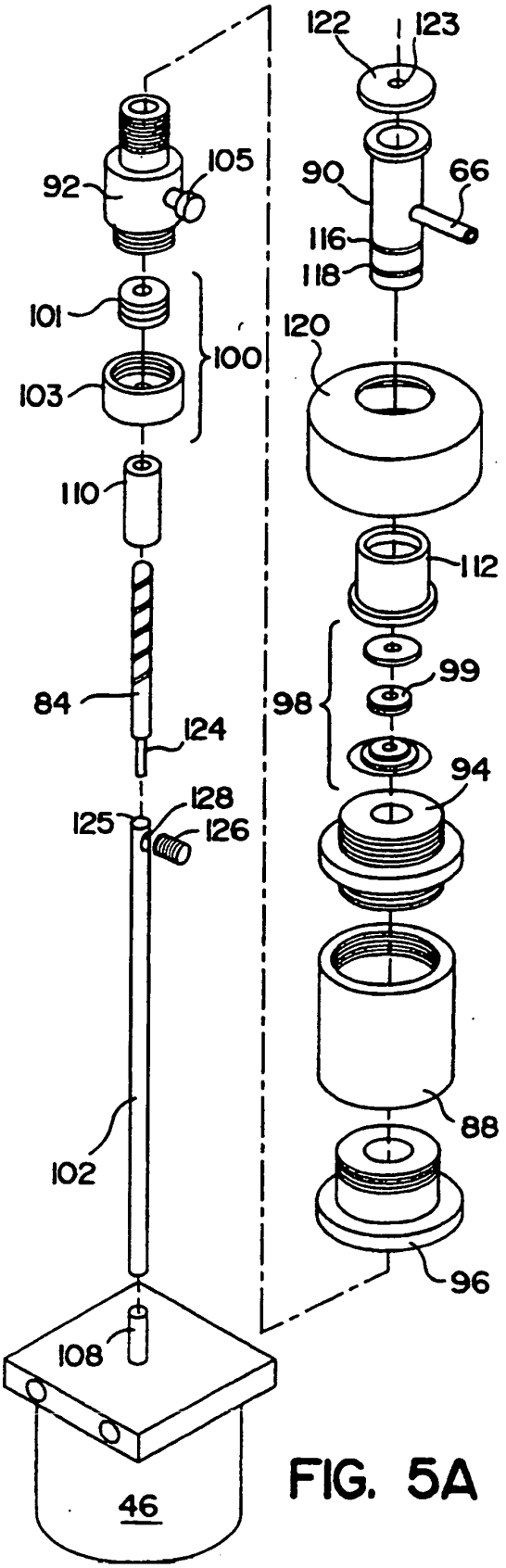
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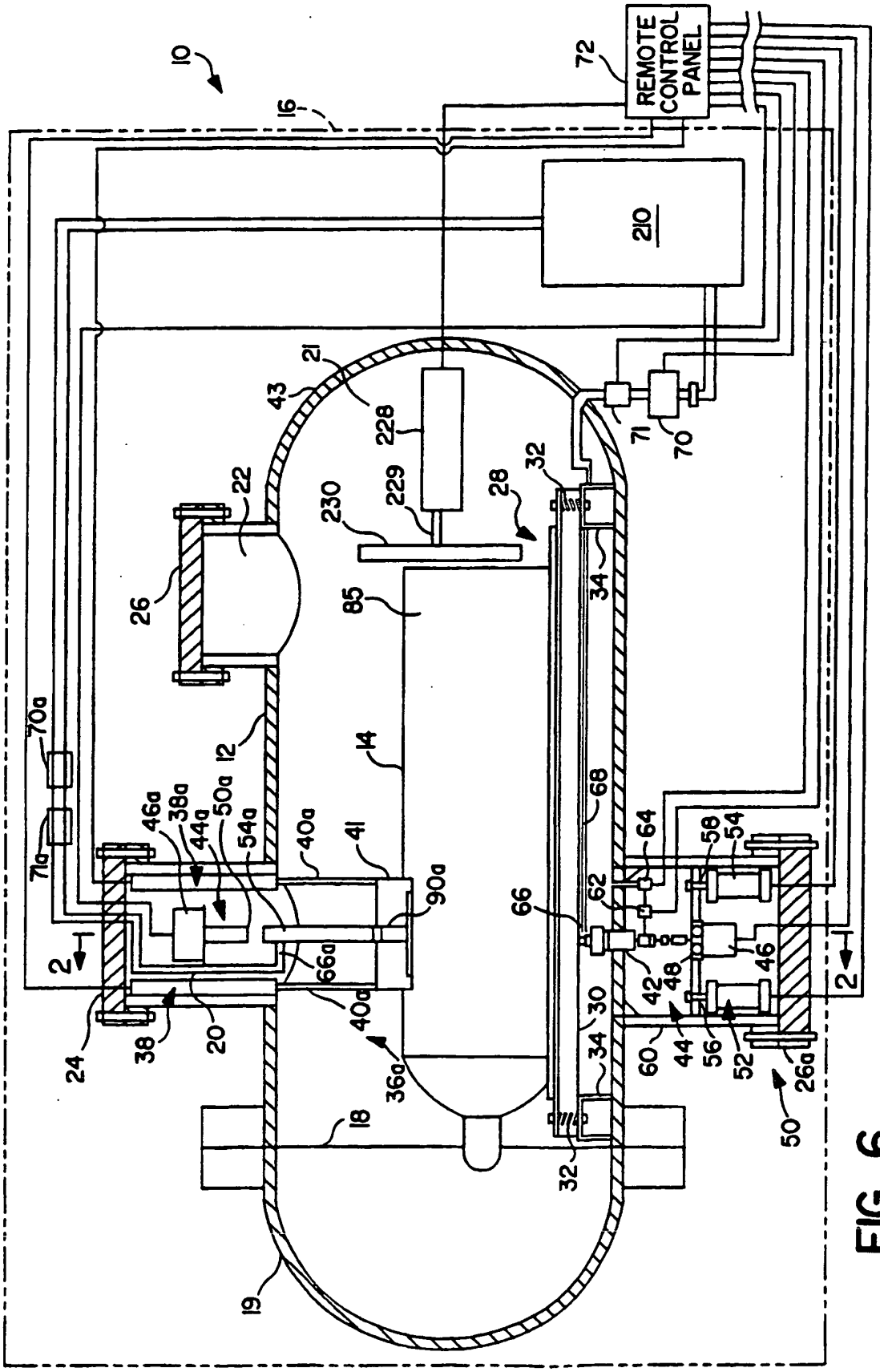
FIG. 5A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38a
44a
50a
54a
40a
41
64
58
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71a
90a
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62
2
66a
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26a
36a
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FIG. 6

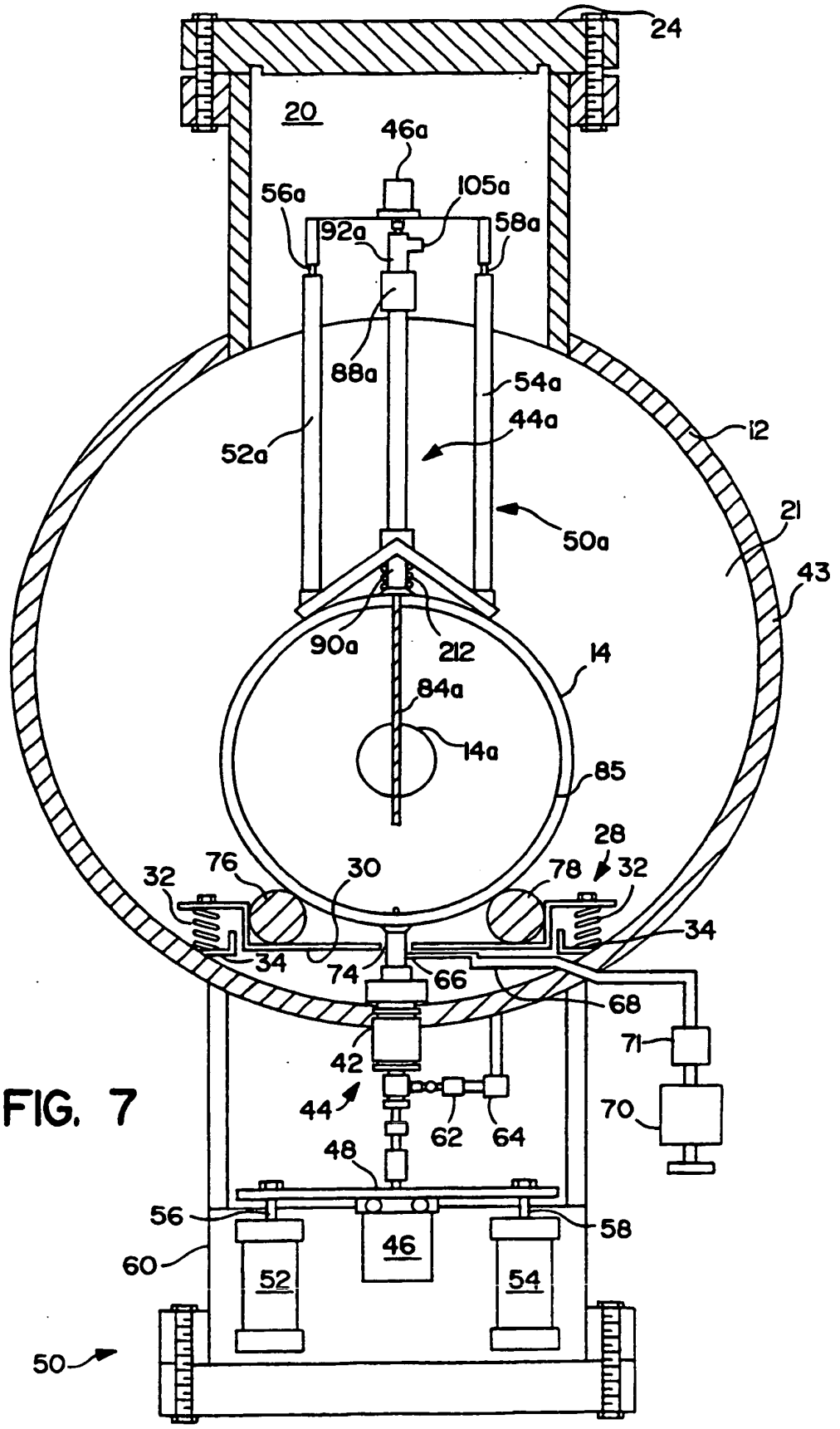
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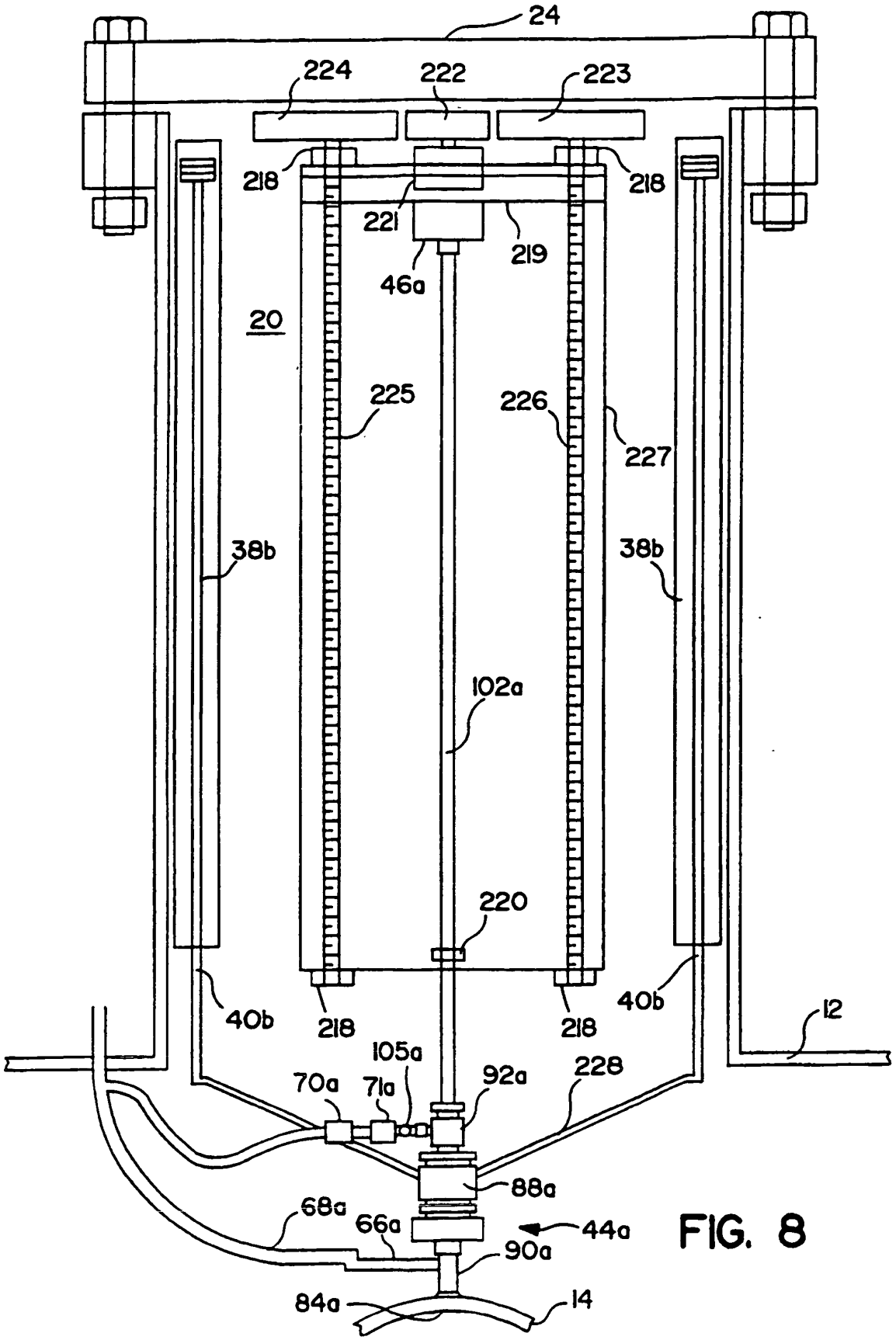
FIG. 7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40b
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84a
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FIG. 8

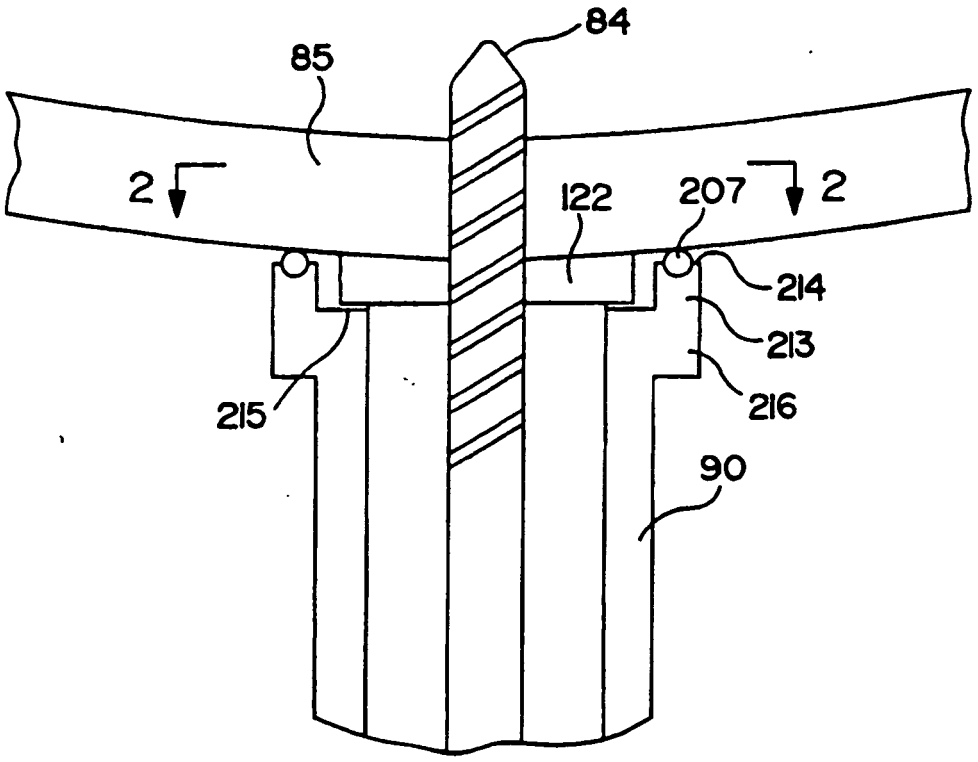

FIG. 9

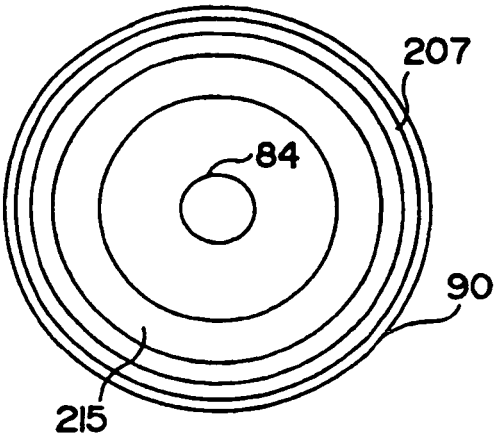

FIG. 9A

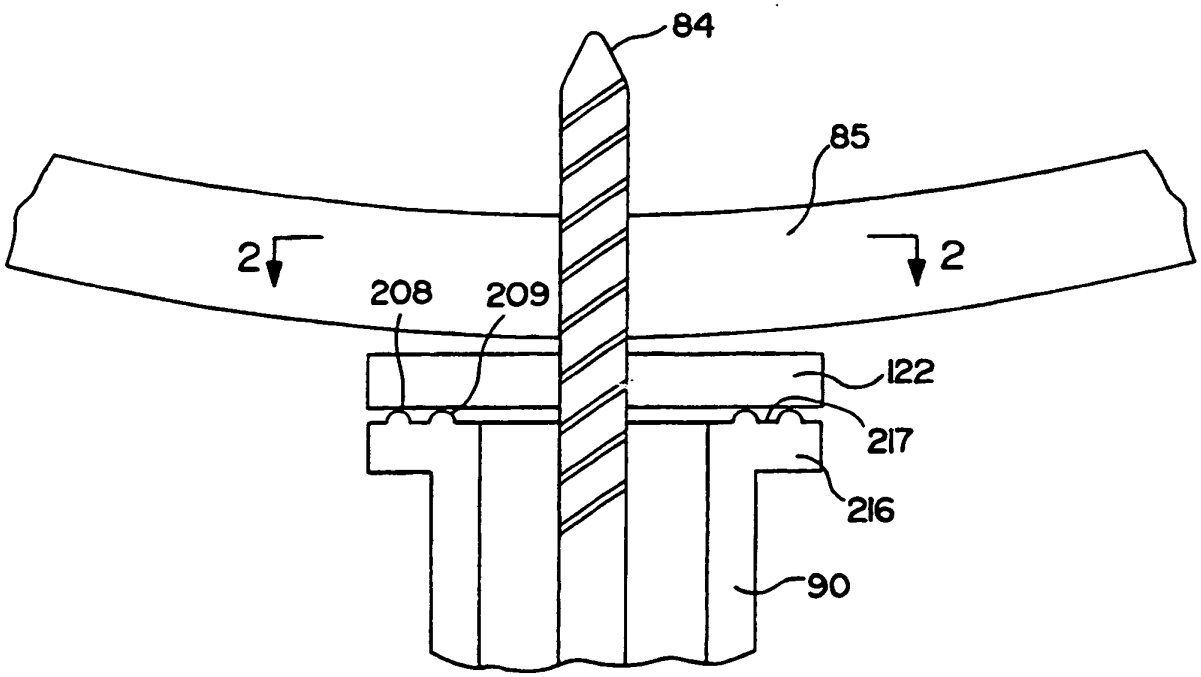

FIG. 10

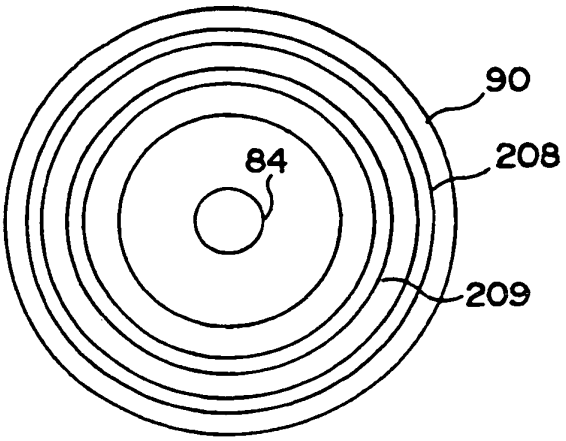

FIG. 10A

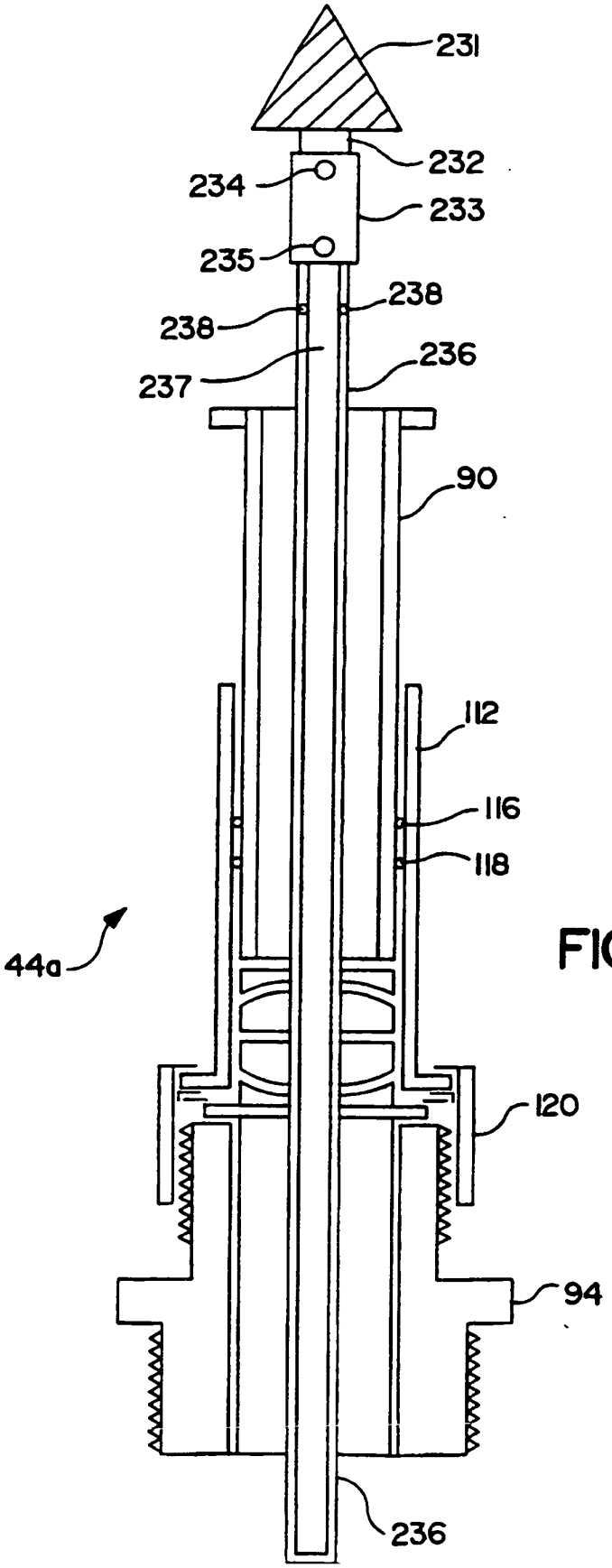

FIG. 11

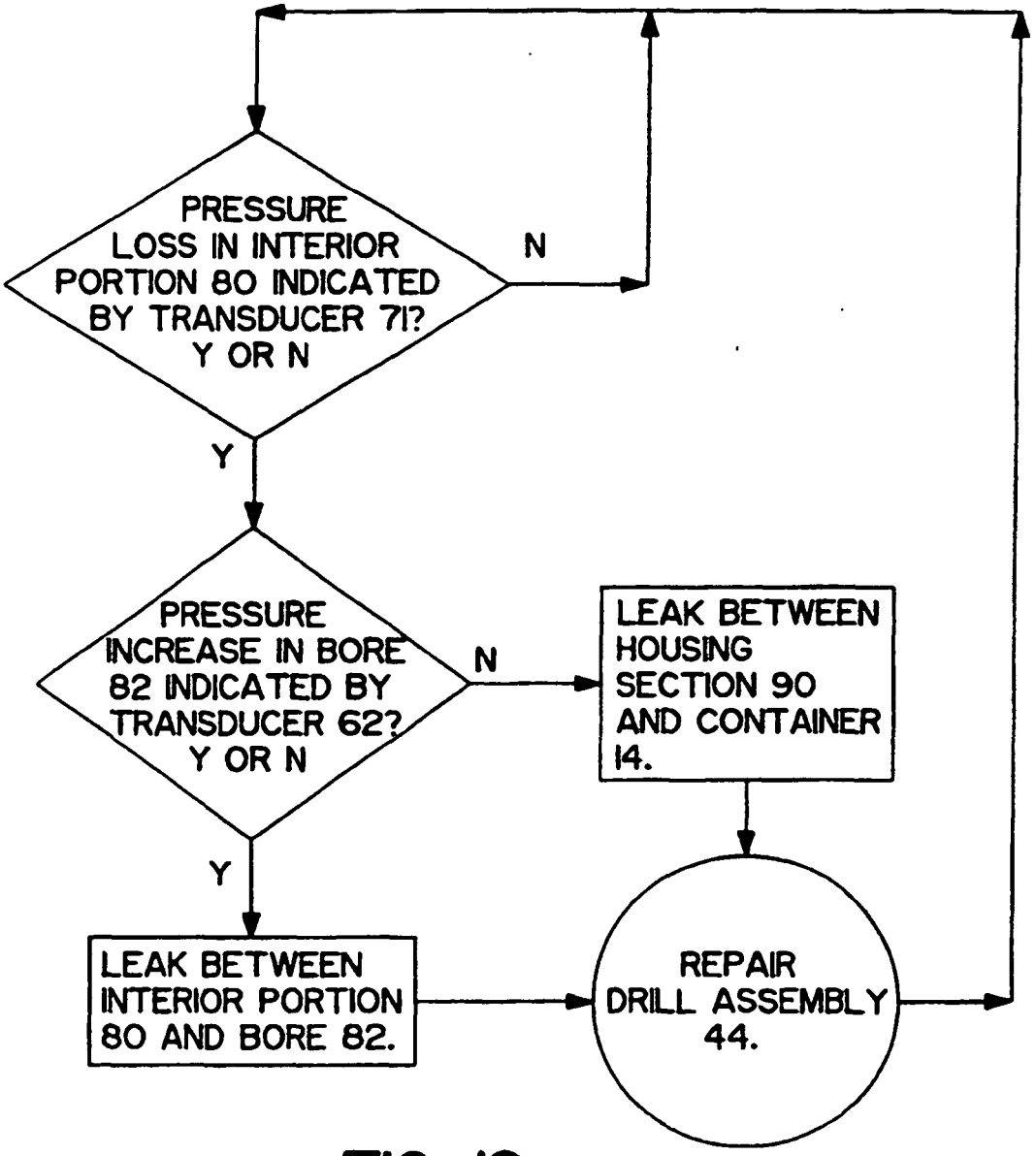
PRESSURE LOSS IN INTERIOR PORTION 80 INDICATED BY TRANSDUCER 71? Y OR N
N
Y
PRESSURE INCREASE IN BORE 82 INDICATED BY TRANSDUCER 62? Y OR N
N
LEAK BETWEEN HOUSING SECTION 90 AND CONTAINER 14.
Y
LEAK BETWEEN INTERIOR PORTION 80 AND BORE 82.
REPAIR DRILL ASSEMBLY 44.

FIG. 12