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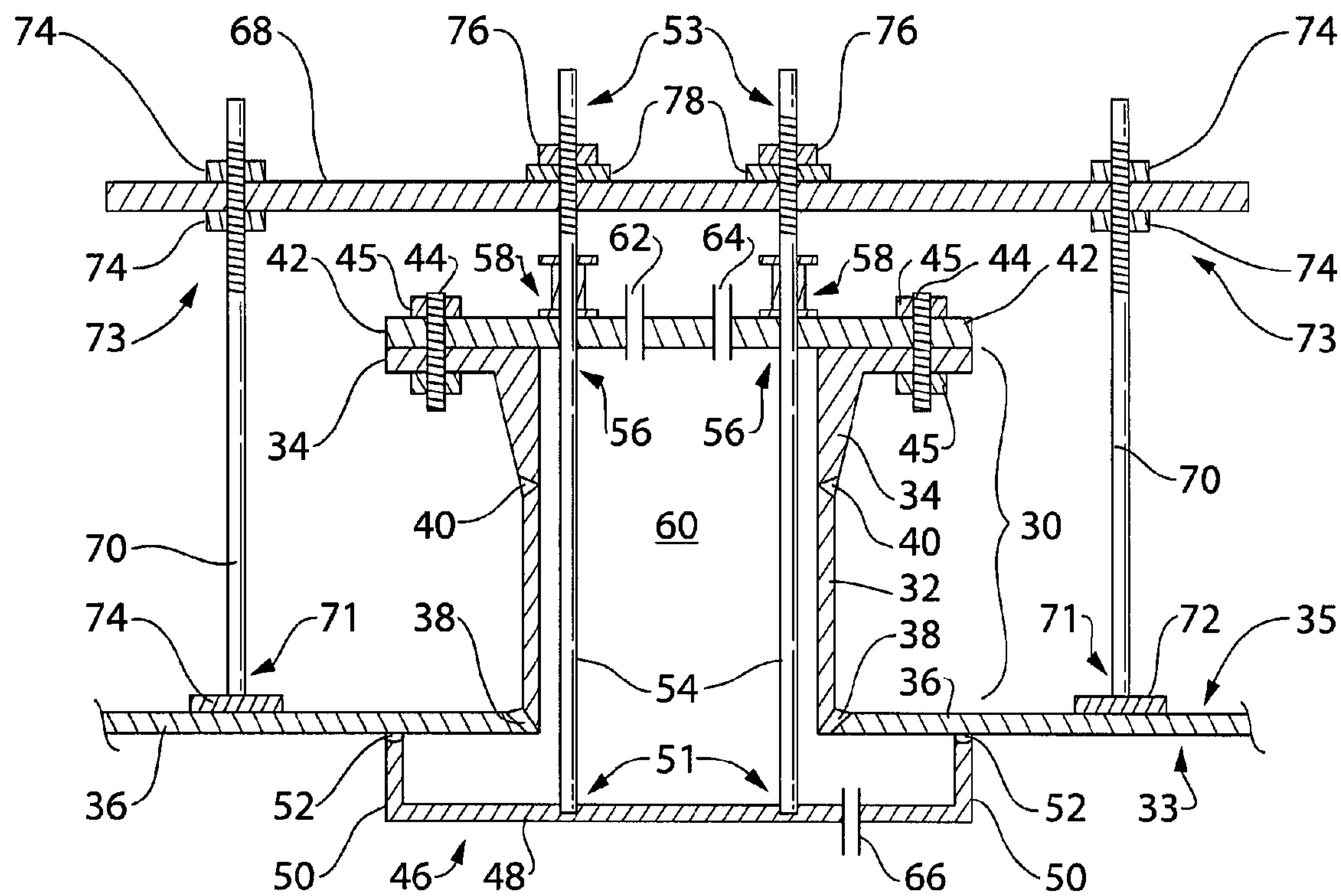

(57) **Abrégé/Abstract**:
A method for testing the integrity of welds used to secure a nozzle to a vessel and the like comprises forming a sealed space within the nozzle by providing a blind against the flange and a sealing plate within the vessel and filling the space with a pressurizing fluid. The sealing plate is not biased against the flange. As such, the method of the invention simulates normally occurring axial expansion stresses within the nozzle thereby providing a more accurate test. The apparatus of the invention comprises a blind flange for sealing the flange face and a back plate for positioning against the inner surface of the vessel. The apparatus includes a biasing means for urging the back plate against the vessel wall. In one embodiment, the biasing means includes a front plate located outside of the vessel and connected to the back plate. In another embodiment, the biasing means comprises a plurality of magnets for engaging the vessel wall.

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ABSTRACT

A method for testing the integrity of welds used to secure a nozzle to a vessel and the like comprises forming a sealed space within the nozzle by providing a blind against the flange and a sealing plate within the vessel and filling the space with a pressurizing fluid. The sealing plate is not biased against the flange. As such, the method of the invention simulates normally occurring axial expansion stresses within the nozzle thereby providing a more accurate test. The apparatus of the invention comprises a blind flange for sealing the flange face and a back plate for positioning against the inner surface of the vessel. The apparatus includes a biasing means for urging the back plate against the vessel wall. In one embodiment, the biasing means includes a front plate located outside of the vessel and connected to the back plate. In another embodiment, the biasing means comprises a plurality of magnets for engaging the vessel wall.

NOZZLE TESTING APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

Field Of The Invention

[0001] The present invention relates to apparatus and methods for testing welds and, more particularly, for testing welds on nozzles or other such fixtures. In one particular aspect, the invention is suited for testing welds while simultaneously applying an axial stress within the nozzle.

Description Of The Prior Art

[0002] In chemical or petrochemical plants etc., it is often necessary to convey fluidic materials from one location, or holding cell to another. The conveyance of such material normally includes equipment such as conduits or pipes, storage or reaction vessels etc., which are generally manufactured from metal. The joining of separate pieces of the conveying equipment is generally achieved by welding the necessary pieces together. For example, when joining adjacent ends of pipe together, it is common for each end to be provided with flanges, welded to each respective end, which are then bolted together to form a seal. Alternatively, the ends of pipes or other equipment may be welded directly together for form the necessary conduit. In either case, it will be appreciated that each welded joint must form a complete seal so as to prevent leakage of the materials being transported. This is particularly the case when handling potentially hazardous (i.e. flammable) or toxic materials.

[0003] For reasons of safety, it is often necessary to periodically test the integrity of the welds used in joining the various pieces of equipment (such as pipes, vessels, flanges and the like) together. However, a particular problem is encountered when attempting to test the integrity of welds used in joining a nozzle to a pipe or vessel. Nozzles generally comprise a short conduit or stem with one end inserted into or abutting an opening in a pipe or vessel and an opposite end having a flange. The joints between the conduit portion of the nozzle and the pipe or vessel and the flange, respectively, are sealed with welds. As is known in the art, nozzles can range in size from less than an inch to up to several feet in diameter.

[0004] The prior art teaches various tools for conducting weld integrity tests on conduits. For example, U.S. Patent numbers 6,131,441 and 5,844, 127 (Berube and Carson) teach weld testing tools which isolate a particular section of a pipe (for example, a section including a weld) and subject the section to a high pressure fluid within a constrained annular space defined by the tool and the inner surface of the pipe. The pressure of the fluid within the annular space is monitored whereby any pressure drop signifies a leak in the weld.

[0005] US Patent number 6,463,791 (Berube and Carson) teaches an apparatus for testing welds used to secure nozzles. As shown in figure 1 of this reference, the apparatus comprises a first seal plate that is placed on the inner surface of the vessel (for example) and a second seal plate that is secured to the outer, flange portion (i.e. the flange face) of the nozzle. The seal plates are connected to each other and the seals are formed by urging one toward the other. In this manner, the nozzle volume is sealed and a pressurizing fluid is introduced therein. As will be understood, the process of urging the plates towards each other causes an axial compressive force to be applied on the flange and hence the welds provided on the nozzle.

[0006] Although the above-described references provide efficient tools for testing welds, they are designed to apply mainly a radial force against the weld. However, there exists a need for exerting further stresses on welds for providing a "worst case scenario" so that such welds can be tested under extreme conditions. More particularly, there exists a need to conduct weld tests while applying an axial expansion force on the welds being tested.

SUMMARY OF THE INVENTION

[0007] In one aspect, the present invention provides a system for testing welds provided on a nozzle comprising: sealing the opposite ends of the nozzle; pressurizing the interior of the nozzle; monitoring the nozzle internal pressure; without applying an axial compressive force on the nozzle. Such system would, therefore, simulate normal axially expansive stresses on the weld during the test and increase the accuracy of thereof.

[0008] In one embodiment of the invention, there is provided a weld testing apparatus for hydraulically pressure testing a weld securing a nozzle to a vessel wall at a vessel opening, said nozzle comprising a stem and an outer flange having an outer face, said nozzle having a bore extending therethrough, said apparatus, when in use, comprising:

a blind plate means for mounting on and sealing against the flange outer face to close the nozzle bore;

a back plate for mounting within the vessel to close the vessel opening, said back plate carrying an annular seal for sealing against the vessel wall around the vessel opening;

an urging assembly for urging the back plate and annular seal against the interior surface of the vessel wall;

said urging assembly comprising:

a front plate for mounting in front of the blind plate means,

support means connectable with the front plate for biasing against the outer surface of the vessel wall so as to support the front plate in place,

one or more tie rods for extending through the blind plate means and operative to connect the back plate with the front plate,

tightening means associated with the tie rods for urging the back plate toward the front plate;

whereby the apparatus may combine with the nozzle and vessel to define a sealed space; and

port means, associated with the apparatus, for introducing pressurized hydraulic fluid into the sealed space.

[0009] In another aspect, there is provided a method of testing the integrity of a weld securing a nozzle to a vessel at an opening, said nozzle having a stem and an outer flange having an outer face, said nozzle having a bore extending therethrough, said method comprising:

closing and sealing the outer end of the nozzle bore with a blind plate means;

providing a back plate within the vessel, said back plate carrying an annular seal for sealing against the vessel wall around the vessel opening;

supporting a front plate over the blind plate means with support means biasing against the outer surface of the vessel;

urging the back plate toward the front plate using tie rods connecting said plates and extending through the blind plate means, so as to seal the annular seal against the vessel wall, without compressing the nozzle and thereby creating a sealed space encompassing the weld;

filling and pressurizing said space with a pressurizing fluid; and

monitoring the pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] These and other features of the invention will become more apparent in the following detailed description in which reference is made to the appended drawings wherein:

[0011] Figure 1 is a cross sectional view of a weld testing apparatus for nozzles as known in the prior art.

[0012] Figure 2 is a cross sectional view of the apparatus of the invention according to one embodiment.

[0013] Figure 3 is a cross-sectional view of the apparatus of the invention according to another embodiment.

[0014] Figure 4 is a perspective view of the backplate shown in Figure 3.

[0015] Figure 5 is a cross-sectional view of the apparatus of the invention according to another embodiment.

[0016] Figure 6 is a perspective view of the backplate shown in Figure 5.

DETAILED DESCRIPTION OF THE INVENTION

[0017] Throughout the description of the invention the following terms will be assumed to have the following associated meanings:

[0018] "Vessel"- will be understood to mean any equipment or apparatus to which a nozzle is attached. As such, the term "vessel" will include vessels per se, pipes, drums, and any other similar equipment. It will be understood that the term "vessel" is used herein simply as a convenient way to encompass all such equipment or apparatus.

[0019] "Annular"- this term is used to describe a body having at least one outer diameter and at least one inner diameter. Thus, an "annular tube" will be assumed to be a hollow tube with an inner and outer diameter. An "annular disc" will be assumed to be an object having an outer diameter and a central aperture thereby providing an inner diameter.

(0020) "Axial"- this term will be used to describe a direction taken along the longitudinal axis of the stem of the nozzle. Thus, "axial force" or "axial stress" will be understood as being a force applied in a direction parallel to the longitudinal axis of the nozzle. In general the term "axial stress" is used herein to refer to an axial expansion stress unless otherwise noted.

[0021] Figure 1 illustrates a nozzle weld testing apparatus as known in the art and as taught in US Patent number 6,463,791. As shown, the nozzle 10, includes a stem 11 and a flange 12 joined to one end of the stem by a weld 13. The opposite end of the stem 11 is joined to an opening in the vessel 14 by means of another weld 15. It will be understood that the vessel wall would normally have a curved cross section, as shown in Figure 1; however, for convenience, the remaining figures illustrate schematically a flat wall. It will also be understood that the stem 11 may extend partially within the vessel 14 as is commonly known. Again, for convenience, the stem of the nozzle is shown in the present figures as terminating at the vessel wall. The apparatus of the invention would therefore be adaptable to suit any configuration. The testing apparatus of the prior art includes a first, inside seal plate 16 that is placed within the vessel 14 so as to seal the inside end of the nozzle. The apparatus also includes a second, outside seal plate 17 that is positioned against the flange 12 and joined thereto by means of bolts 18. It will be understood that gaskets, 0-rings, and other such sealing members will be used as known in the art to achieve the desired sealing. For example, a seal between the inside plate 16 and the wall of the vessel 14 may be achieved using an 0-ring 19. The inside and outside seal plates 16 and 17 are joined together by one or more tie rods 20. Tightening of the tie rod 20 causes the inside plate to be sealed against the inner surface of the vessel wall. This results in the volume of the nozzle 10 being sealed off. A port 21 is used to introduce a pressurizing fluid into the nozzle volume. In order to conduct the test, the pressure within the nozzle is raised to the desired level and monitored. Any pressure drop or leakage is indicative of a weakness or leakage in the welds 13 and 15.

[0022] As discussed above, the prior art apparatus, although efficient and accurate, applies a radial force or stress against the welds 13 and 15. As will be understood by persons skilled in the art, a further stress that the nozzle would be subjected to in normal operation is an axial force resulting from the pressure of the contents in the vessel 14 impinging upon the flange 12.

[0023] Figure 2 illustrates a nozzle testing tool according to one aspect of the present invention. As shown, a nozzle 30 includes a stem 32 and a flange 34, similar to the nozzle illustrated in Figure 1. The stem 32 is connected to the vessel wall 36 around an opening by means of welds 38. The flange 34 of the nozzle is connected to the stem 32 by weld 40.

[0024] The apparatus of the invention includes a blind flange or plate 42 that is bolted to the flange outer face. This is done using bolts 44 and associated nuts 45, with the bolts extending through the boltholes normally provided on the flange face. Although not shown, gaskets or other seal means may also be used at the interface between the flange and the blind plate.

[0025] Together, the blind plate, gasket and bolt assemblies provide a blind plate means for closing the bore of the nozzle 30. On the opposite end of the nozzle, a back plate 46 of the apparatus is provided within the vessel. As shown, the back plate 46 generally comprises a pan having a base 48 and a generally perpendicularly extending rim 50. The back plate 46 is sized to be larger than the vessel opening so that the rim 50 contacts the inner surface 33 of the vessel wall 36. The rim 50 is also provided with an annular sealing means 52, such as an O ring or the like so that the rim 50 forms a pressure seal with the vessel wall 36, as described further below. For convenience, the sealing means 52 will be further referred to as an O ring; however, it will be understood that this terminology is not meant to limit the sealing means 52 in any way.

[0026] The back plate 46 is provided with one or more tie rods 54 that extend through the bore of the nozzle 30. The rods have first ends 51 attached to the back plate 46 and second ends 53 extending outwardly through the nozzle 30. The tie rods 54 may be permanently attached to the back plate 46 by welds etc. or may be secured thereto with nuts etc. (in such case, the back plate 46 will be provided with suitable apertures for receiving the rod first ends 53). Alternatively, the tie rods may include threaded end s for engaging complementary threaded holes in the back plate 46. Various alternatives will be apparent to persons skilled in the art for attaching or securing the tie rods 54 to the back plate 46.

[0027] The second ends 53 of the tie rods 54 extend through the flange 34 of the nozzle and through apertures 56 provided in the blind plate 42. The tie rods 54 are provided with a sealing means 58 to ensure that the apertures 56 on the blind flange are sealed. The sealing means may comprise for example a packing gland, an O ring etc. In one example, the sealing means comprises a packing box as commonly known in the art. For convenience, the sealing means 58 will be referred to herein as a packing gland; however, it will be understood that such terminology is not meant to limit the sealing means 58 in any way. As discussed further below, upon installation of the apparatus of the invention within a nozzle, the combination of the sealing means 58 and the O ring 52 contribute to establishing a sealed space 60 within the nozzle bounded by the back plate 46, the blind plate 42 and the nozzle segments (i.e. the stem 32 and the flange 34) and a portion of the vessel wall 36. In this regard, it will be understood by persons skilled in the art that the number of tic rods 54 required will depend upon the diameter of the tool being used. For example, for smaller diameter tools, a single tie rod 54 may be sufficient. However, for larger diameters, a plurality of tie rods may be required, with such tie rods being circumferentially equidistantly spaced.

[0028] The blind plate 42 is also preferably provided with a fill port 62 and a vent port 64. Such ports serve to allow a pressurizing fluid to enter within the sealed space 60. The vent ports are connected to equipment such as piping, hoses etc., not shown, which, in tum, are connected to other equipment such as a source of the pressurizing fluid, pressure gauges, etc., also not shown. The apparatus may optionally also include one or more fill or vent ports 66 provided on the back plate 46. Various other means of tilling and venting the sealed space 60 will be known to persons skilled in the art.

[0029] As described in the art, in conducting an integrity test on the welds 38 and 40, the sealed space 60 is first created and then filled with a pressurizing fluid so as to pressurize the sealed space 60 to a desired high pressure value. The pressure is then monitored to determine the integrity of the welds. Any pressure loss signifies a leaking weld.

[0030] It will be appreciated that the apparatus of the invention allows for the development of an. axial expansion force on the welds while the pressure test is being conducted. As explained above, the application of such an axial stress serves to provide more accurate test results by simulating "normal" operating conditions.

[0031] The apparatus further comprises a front plate 68 that is axially outwardly separated from the blind plate 42, that is, in a direction away from the nozzle 30. A plurality of separator rods 70 are also provided, each having a first end 71 adjacent the vessel and a second end 73 directed away there-from. The first ends 71 of the separator rods 70 are each preferably provided with a bearing pad 72 positioned against the outer surface 35 of the vessel wall 36. The second ends 73 of the separator rods 70 extend through apertures provided in the front plate 68. Nuts 74 are provided on the second end s of the separator rods 70 so as to locate and lock the front plate 68 in place a set distance away from the blind plate 42. For this purpose, it will be understood that the second ends 73 of the separator rods are adequately threaded to allow the front plate 68 to be adjusted longitudinally along the central axis of the nozzle to the desired position. It will also be understood that the separator rods are preferably circumferentially equidistant with respect to each other so as to equally divide the load there-between. In summary, the separator rods provide a support means, connected with the front plate, which bear against or bias against the outer surface of the vessel wall so as to support the front plate in place.

[0032] The front plate also includes apertures to receive the outer ends 53 of the tie rods 54 as shown in Figure 2. The tie rods are secured, preferably in a releasable manner, to the front plate. More particularly, the tie rods 54 are secured to the front plate 68 by nuts 76. Washers 78 may also be provided. As indicated above, the opposite ends of the tie rods 54 are secured to the back plate 46. Thus, as will be understood, as the nuts 76 are tightened, the back plate 46 is forced against the inner surface 33 of the vessel wall 36 and, with the inclusion of the seal 52, the back plate 46 eventually forms a seal with the vessel wall. As will also be understood by persons skilled in the art, with the combination of the tie rods 54, the front plate 68 and the separator rods 70, any tightening of the nuts 76 (to cause the back plate 46 to bear against the inner surface 33 of the vessel wall 36) results in an opposing force applied by the first ends 71 of separator rods against the outer surface 35 of the vessel wall 36 (the latter force preferably being conducted through the bearing pads 72). Thus, as will be understood, no compressive force is applied to the flange 34 of the nozzle 30. In the result, any pressure built up within the sealed space 60 results in an axial force being applied to the inner surface of the blind plate 42. However, since the blind plate 42 is secured to the flange 34 of the nozzle, such axial force is therefore also applied to the nozzle and, in tum, to the welds 38 and 40. As will be appreciated by persons skilled in the art, a pressure test conducted in this manner would more accurately simulate normally occurring stresses and enable the test results to be more dependable.

[0033] In one embodiment, the bearing pads 72 of the apparatus may comprise electromagnets so as to allow the first ends 71 of the separator rods 70 to be positively located on the outer surface 35 of the vessel wall 36 prior to engaging the nuts 76 coupled to the tie rods 54. As will be understood, this will aid in installing the apparatus since, in such case, the front plate 68 would not need to be held while tightening the nuts 76. Electromagnets of this type are commonly known. The associated electrical connections and power source etc. are not shown for convenience.

[0034] A further embodiment of the apparatus of the invention is shown in Figure 3 where like elements are identified with the same reference numeral but with the letter "a" added for clarity where a change is included. In this embodiment, the need for a front plate (as discussed above) is obviated. Specifically, as shown in Figure 3, the apparatus includes a blind flange 42a and a back plate 46a. The blind flange 42a comprises generally a plate having a number of boltholes through which are passed bolts 44 when the blind flange is mounted in position. The blind flange can be secured to the open outer face of the flange 34 using the bolts 44 and the associated nuts 45 as is commonly known. The blind flange 42a also includes fill and vent ports 62 and 64 as discussed above. As also mentioned above, it will be understood that any type of gasket or other such sealing mean s can be provided between the blind flange and the flange face to provide the needed seal. Such gaskets are commonly known in the art.

[0035] As shown in Figures 3 and 4, the back plate 46a of this embodiment comprises a base 48a and a perpendicularly extending rim 50a. As before, the back plate 46a is sized to be larger in diameter than the opening in the vessel wall 36 for receiving the stem 32 of the nozzle. An 0 ring 52 or such seal is provided at the terminal end of the rim 50a so as to enable a seal to form between the rim 50a and the inner 33 surface of the vessel wall 36. Preferably, the terminal end of the rim 50a includes a groove to receive the 0 ring. The back plate 46a also includes a flange 80 extending radially outward from the base 48a. It will be appreciated that the flange 80 may be integral with the base 48a. As before, the back plate 46a may include one or more ports 66a.

[0036] The flange 80 is provided with a plurality of holes adapted to receive bolts 82. The bolts 82, in turn, are connected to electromagnets 84 by either welding or screwing the sections together. In one embodiment, the magnets 84 are provided with a nut 85 into which the bolts can be screwed. Nuts 86 are also provided on the opposite ends of the bolts 82 for securing the back plate thereto.

[0037] The operation of the apparatus of Figure 3 will now be described. Firsty the blind flange 42a is positioned and secured to the outer face of the flange 34 by means of the bolts 44 and the associated nuts 45. The back plate 46a is then positioned against the inner surface 33 of the vessel wall 36. Preferably, the bolts 82 are already provided on the flange 80 of the back plate 46a, albeit in a loose manner. Once the back plate 46a is in the desired position (i.e. covering the opening in the vessel wall 36), the electromagnets 84 are activated. Such activation causes an attractive force to be developed between the magnets 84 and the inner surface 33 of the vessel wall 36. As will be understood, such attraction is possible where the vessel wall is made of a ferrous metal. In one embodiment, the magnets 84 can be provided on a ring and secured to the inner surface 33 at one time. It will be appreciated that this option would offer the convenience of having all magnets, with the associated bolts 82 secured in pre-set relative positions so that placement of the back plate 46a onto the bolts 82 is facilitated. Various other variations of such attachment means will be apparent to persons skilled in the art.

[0038] Once the magnets 84 are activated and secured against the vessel wall 36, the nuts 86 are tightened causing the rim 50a of the back plate 46a to be forced against the inner surface 33 of the vessel wall 36. The nuts 86 are tightened until a sufficient seal is developed between the rim 50a and the inner surface 33 of the vessel wall 36. As indicated above, an O ring or other similar device is provided to assist in forming such seal. With the back plate 46a thus positioned and with the blind flange secured to the flange 34 face, a sealed space 60 is formed as discussed above. At this point, by means of one or more of the ports 62, 64, and 66a, a suitable pressurizing fluid is introduced to fill and pressurize the sealed space 60. Such pressure is then monitored for a period of time so as to assess the integrity of the welds 38 and 40. As before, it will be understood that with no axial compressive force applied to the nozzle, the pressure within the sealed space 60 serves to exert an axial expansion force on the nozzle elements and, therefore, on the welds 38 and 40. Such axial force simulates normally occurring forces during operation of the nozzle and vessel. Thus, the invention provides an accurate assessment of the weld integrity.

[0039] Electromagnets 84 are commonly known and available and the required electrical connections and power source etc. are not shown in the figures for convenience. It will be understood that the strength of the magnets 84 will depend upon various factors including the weight of the back plate 46a, the pressure developed within the sealed space 60 etc. Persons skilled in the art will be easily able to determine the required magnetic strength based on these variables.

[0040] In the above description, the back plate 46, 46a has been described as comprising a single piece. However, in consideration of weight and size, the back plate may also be provided in two or more section to facilitate entry of same into the vessel. In such case, it will be understood that the back plate sections will be provided with a connection means such as flanges for receiving bolts etc. Also, an appropriate sealing means will also be provided so as to seal any joints between the sections making up the back plate.

[0041] Figure 5 illustrates a variant of the apparatus of Figure 3 where like elements are identified with the same reference numeral but with the letter "b" added for clarity where a change is included. In Figure 5, the flange portion of the nozzle is not shown for convenience but will be understood to be the same as that shown in Figure 3. That is, the apparatus of Figure 5 includes the same blind flange as shown in Figure 3. In the embodiment shown in Figure 5, the back plate 46b comprises a cage formed from support bars. The bars may be provided in any orientation such as parallel, intersecting, or as radii. Figure 6 illustrates one example of the back plate 46b of Figure 5. As shown in Figures 5 and 6, the back plate 46b includes a flange 80b which includes a plurality of apertures 100 through which extend the bolts 82. A plurality of support bars 102 are provided across the diameter of the flange 80b. It will be understood that the "cage" can be constructed in any shape or configuration to serve the purposes outlined below.

[0042] As with the embodiment described above, the bolts are secured to electromagnets 84, which bear against the inner surface 33 of the vessel wall 36. The back plate flange 80b is secured to the nuts 82 by means of nuts 86.

[0043] The back plate 46b shown in Figure 5 includes a cup-like insert 90 contained within the rim 50b. The insert generally has a base 92 and a generally perpendicularly extending rim 94. The insert 90 is oriented with its opening directed towards the opening in the vessel wall and is provided with a seal such as an O ring 96 on exposed edge of the rim.

[0044] The back plate 46b of Figure 5 is installed in generally the same manner as with the apparatus of Figure 3 described above. However, it will be understood that, in this case, the insert 90 is also installed. Once the elements of the back plate 46b are in position, and after the electromagnets 84 are activated, the nuts 86 are tightened. Upon such tightening, the insert 90 is advanced against the inner surface 33 of the vessel wall 36 so as to form a seal between the wall surface 33 and the edge of the rim 94. As will be appreciated, the O ring 96 serves to facilitate the formation of such seal. In order to ensure that the rim 50b does not interfere or limit the advancement of the insert 90 against the vessel wall, and therefore potentially limit the formation of the seal, it is preferred that the rim 94 of the insert 90 extends beyond the rim 50b of the back plate 46b. As shown in Figure 5, it is preferred that a degree of clearance be provided between the vessel inner surface 33 and the edge of the rim 50b. Once the back plate 46b is installed, the blind flange (such as that shown at 42a in Figure 3) can also be installed and the weld integrity test conducted.

[0045] It will be appreciated that the apparatus of Figure 5 has various advantages. Primarily, by providing a back plate 46b in the form of a cage, or support structure only (i.e. with a number of opening formed by the members forming the cage), the weight of the back plate is considerably reduced. This facilitates the carrying and installation of the back plate. The insert 90 would preferably be made from any preferably rigid , lightweight material such as plastic, metal (e.g. aluminum) etc. thereby providing the same reduced weight advantages. The cage portion of the back plate 46b would be designed to provide sufficient support strength to the material of the insert 90 while the test is being conducted.

[0046] It will be understood that the above discussion has used geometric terms such as annular, circumference etc., for ease of reference. However, these terms should not be construed as limiting the invention to any specific shape of nozzle and various modifications of the apparatus will be apparent to persons skilled in the art to adapt same to any shape or design of nozzles. Also, as discussed above, it will be understood that the shape of various pm1s of the apparatus (particularly those contacting the vessel wall) will be complementary to the shape of the vessel.

What is claimed is:

1. A weld testing apparatus for hydraulically pressure testing a weld securing a nozzle to a vessel wall at a vessel opening, said nozzle comprising a stem and an outer flange having an outer face, said nozzle having a bore extending therethrough, said apparatus, when in use, comprising:

a blind plate means for mounting on and sealing against the flange outer face to close the nozzle bore;

a back plate for mounting within the vessel to close the vessel opening, said back plate carrying an annular seal for sealing against the vessel wall around the vessel opening;

an urging assembly for urging the back plate and annular seal against the interior surface of the vessel wall;

said urging assembly comprising:

a front plate for mounting in front of the blind plate means,

support means connectable with the front plate for biasing against the outer surface of the vessel wall so as to support the front plate in place,

one or more tie rods for extending through the blind plate means and operative to connect the back plate with the front plate,

tightening means associated with the tie rods for urging the back plate toward the front plate;

whereby the apparatus may combine with the nozzle and vessel to define a sealed space; and

port means, associated with the apparatus, for introducing pressurized hydraulic fluid into the sealed space.

2. The weld testing apparatus of claim 1 wherein:

the outer ends of the tie rods are threaded and their inner ends are connected to the back plate; and

the tightening means comprise threaded nuts for threading on the tie rod outer ends for urging the back plate toward the front plate.

3. The weld testing apparatus of claim 2 wherein:

the blind plate means defines rod openings for the tie rods to extend through and comprises seal means sealing around the tie rods at the rod openings.

4. A method of testing the integrity of a weld securing a nozzle to a vessel at an opening, said nozzle having a stem and an outer flange having an outer face, said nozzle having a bore extending therethrough, said method comprising:

closing and sealing the outer end of the nozzle bore with a blind plate means;

providing a back plate within the vessel, said back plate carrying an annular seal for sealing against the vessel wall around the vessel opening;

supporting a front plate over the blind plate means with support means biasing against the outer surface of the vessel;

urging the back plate toward the front plate using tie rods connecting said plates and extending through the blind plate means, so as to seal the annular seal against the vessel wall, without compressing the nozzle, and thereby creating a sealed space encompassing the weld;

filling and pressurizing said space with a pressurizing fluid; and

monitoring the pressure.

1/6

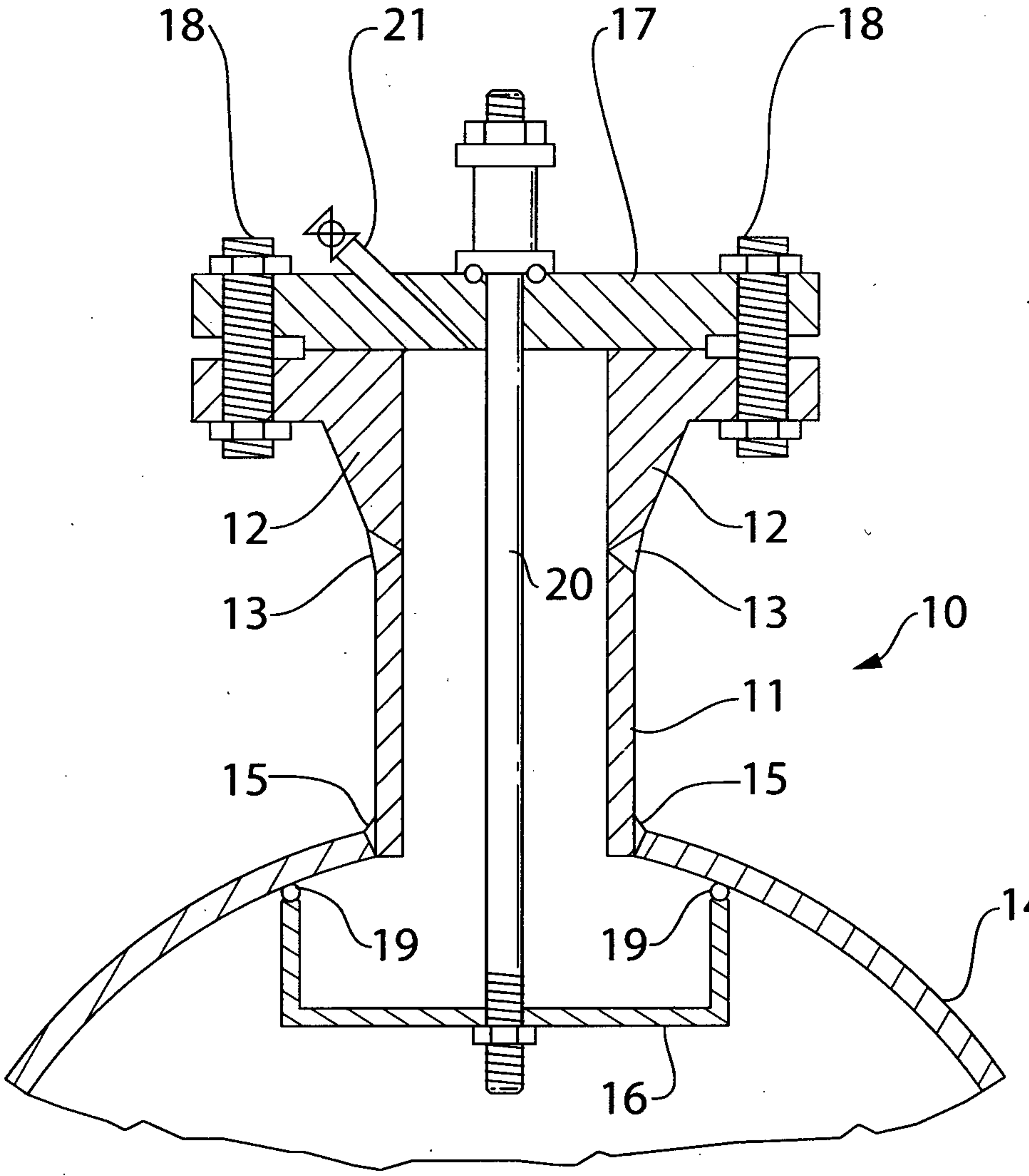
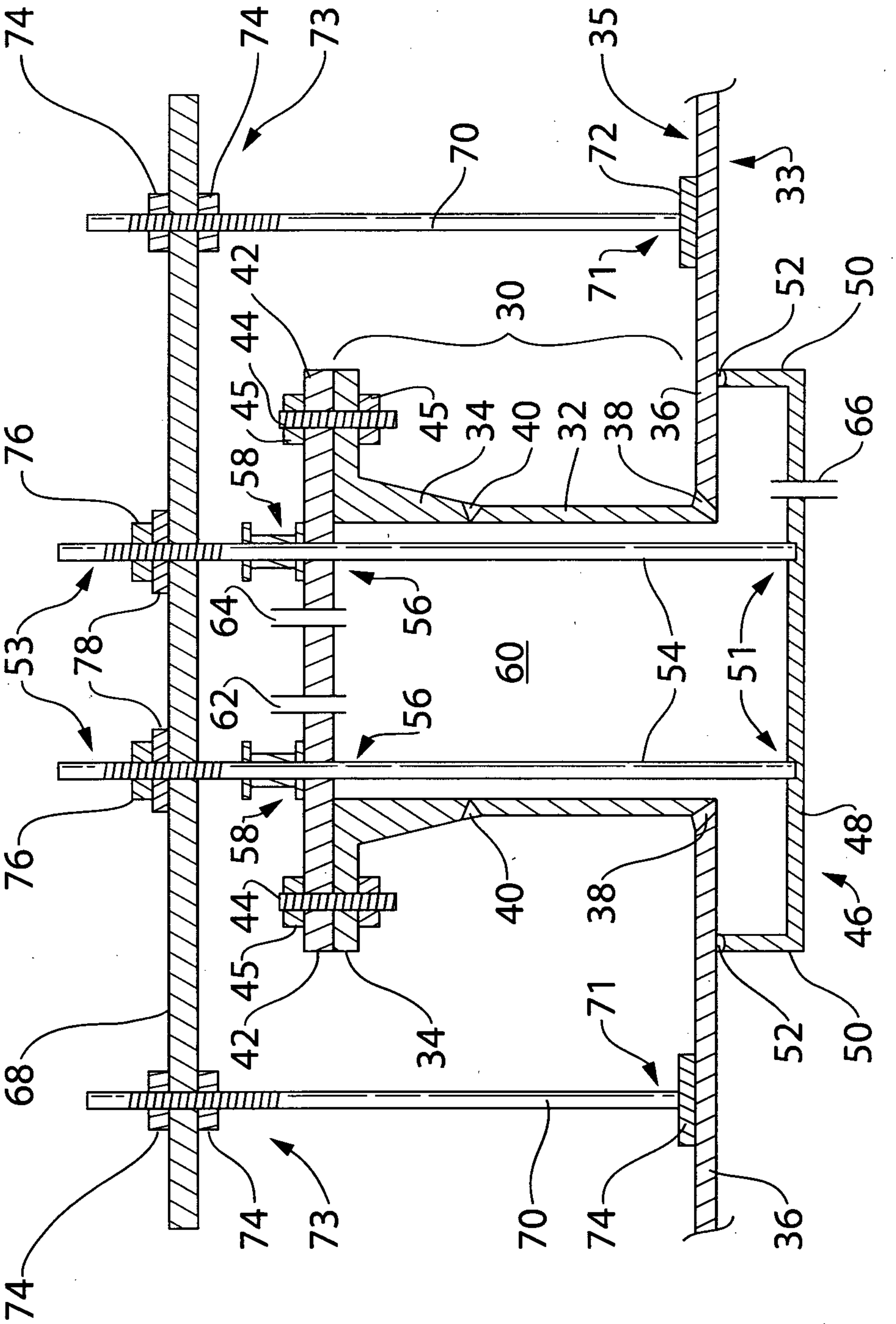


FIG. 1 (PRIOR ART)

2/6

FIG. 2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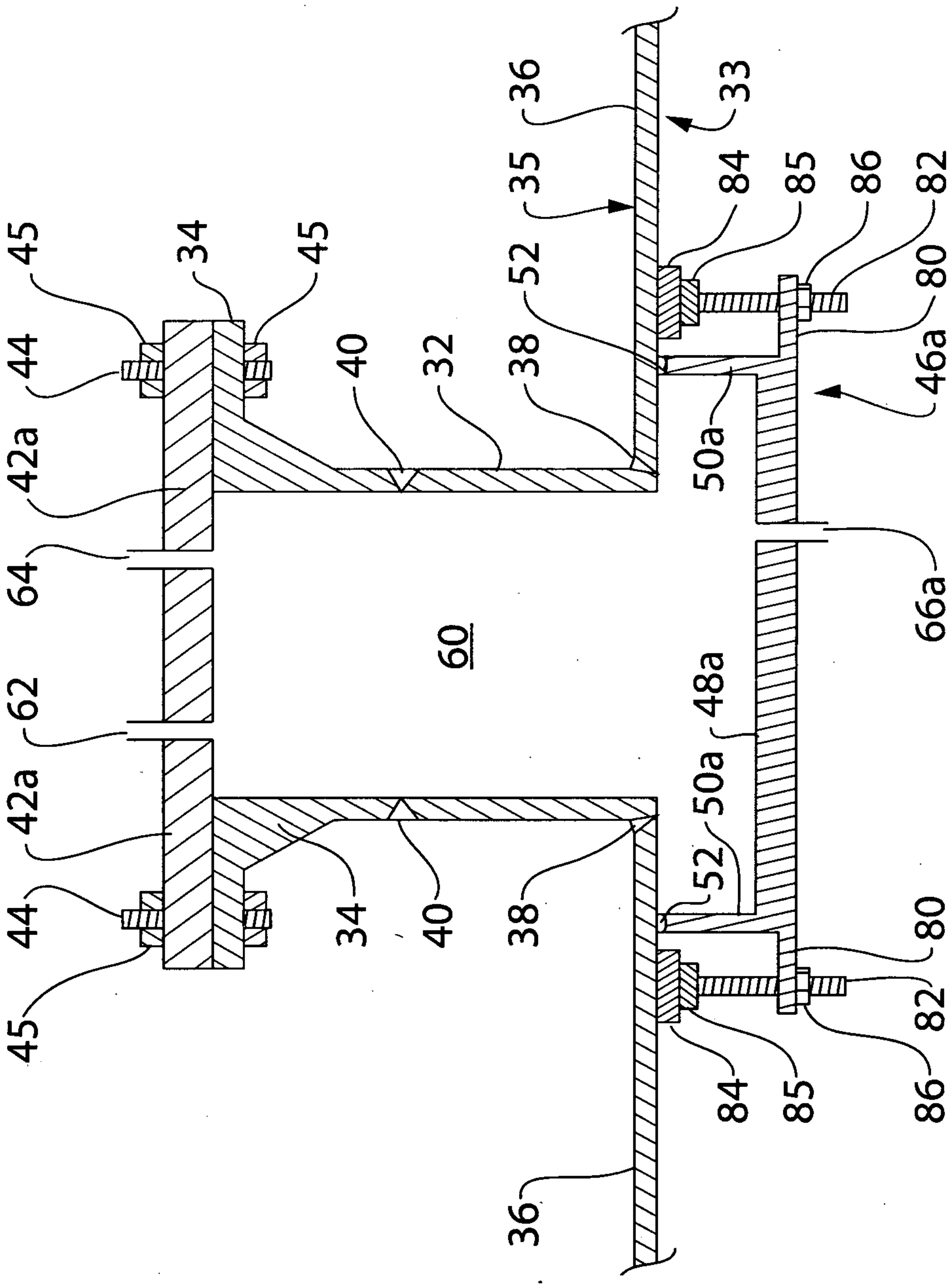
3/6

FIG. 3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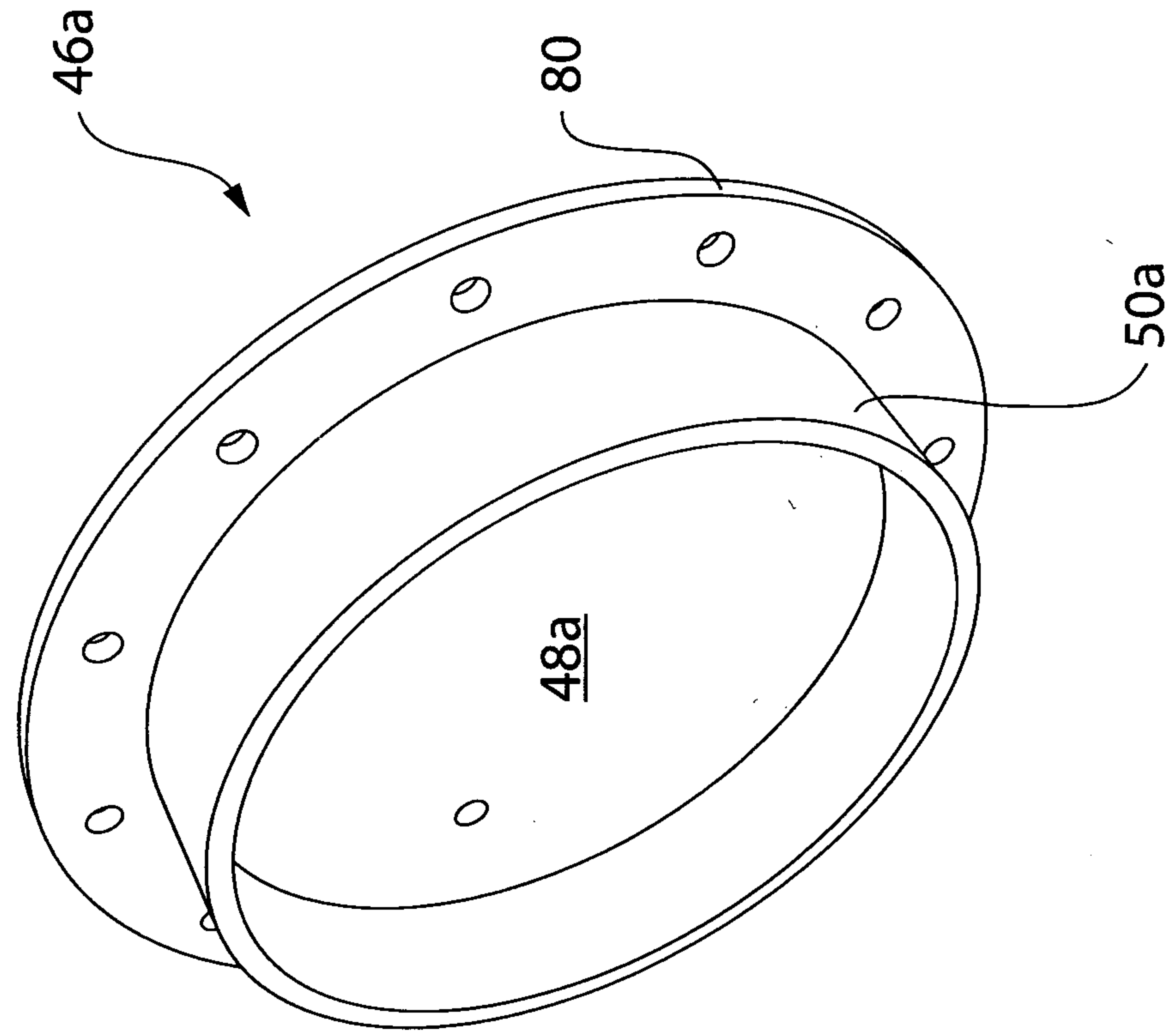
4/6

FIG. 4



5/6

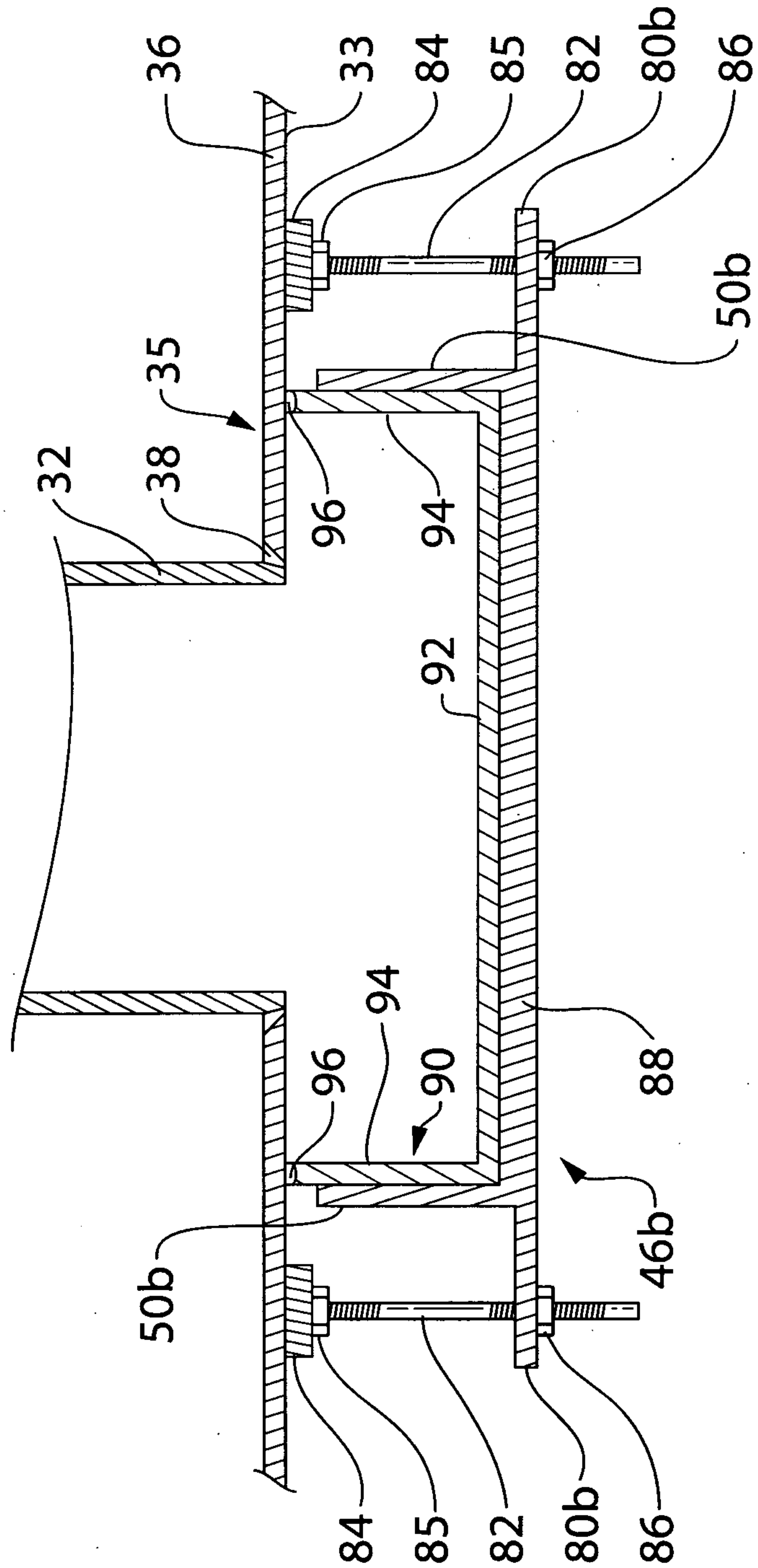
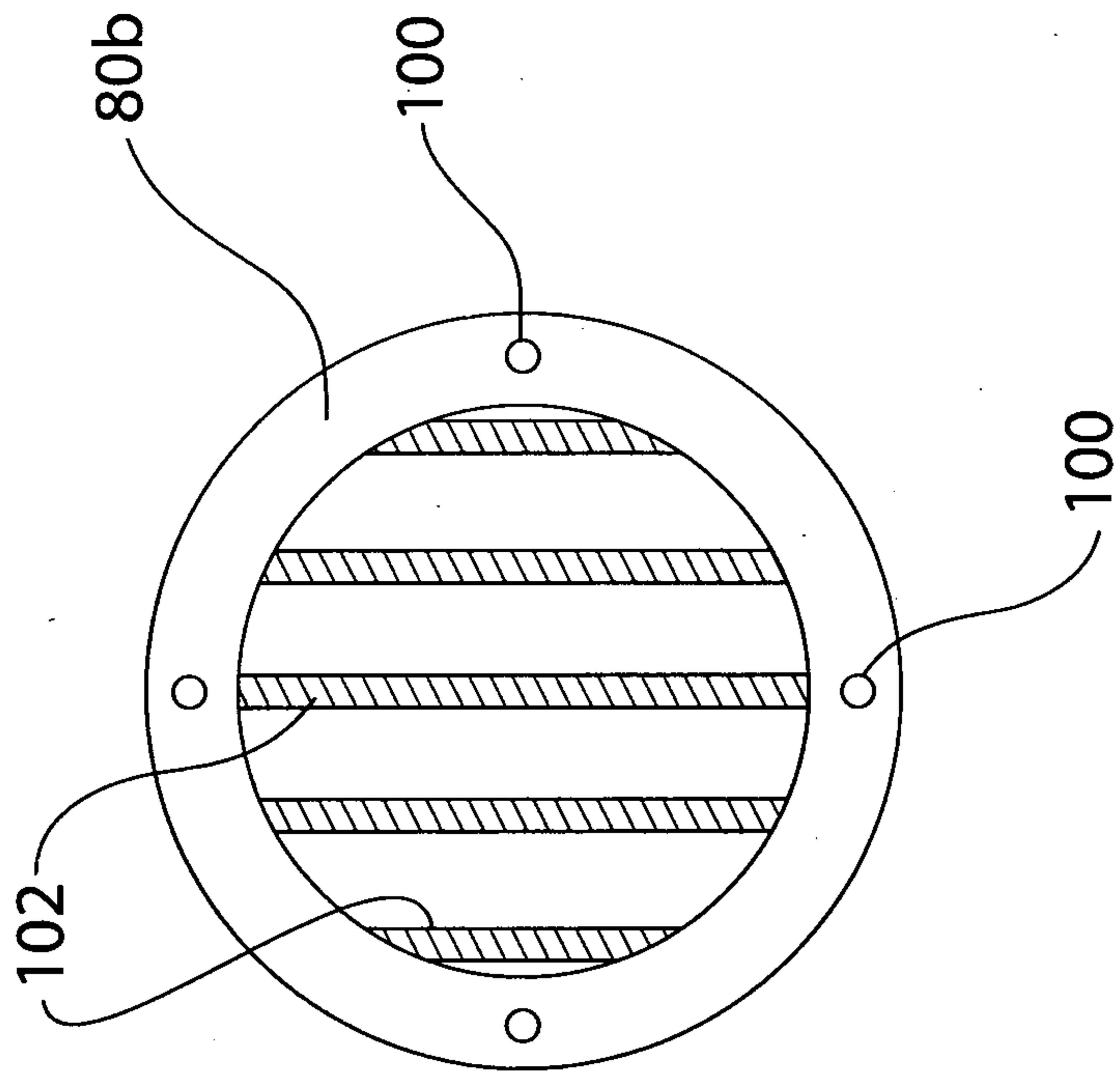
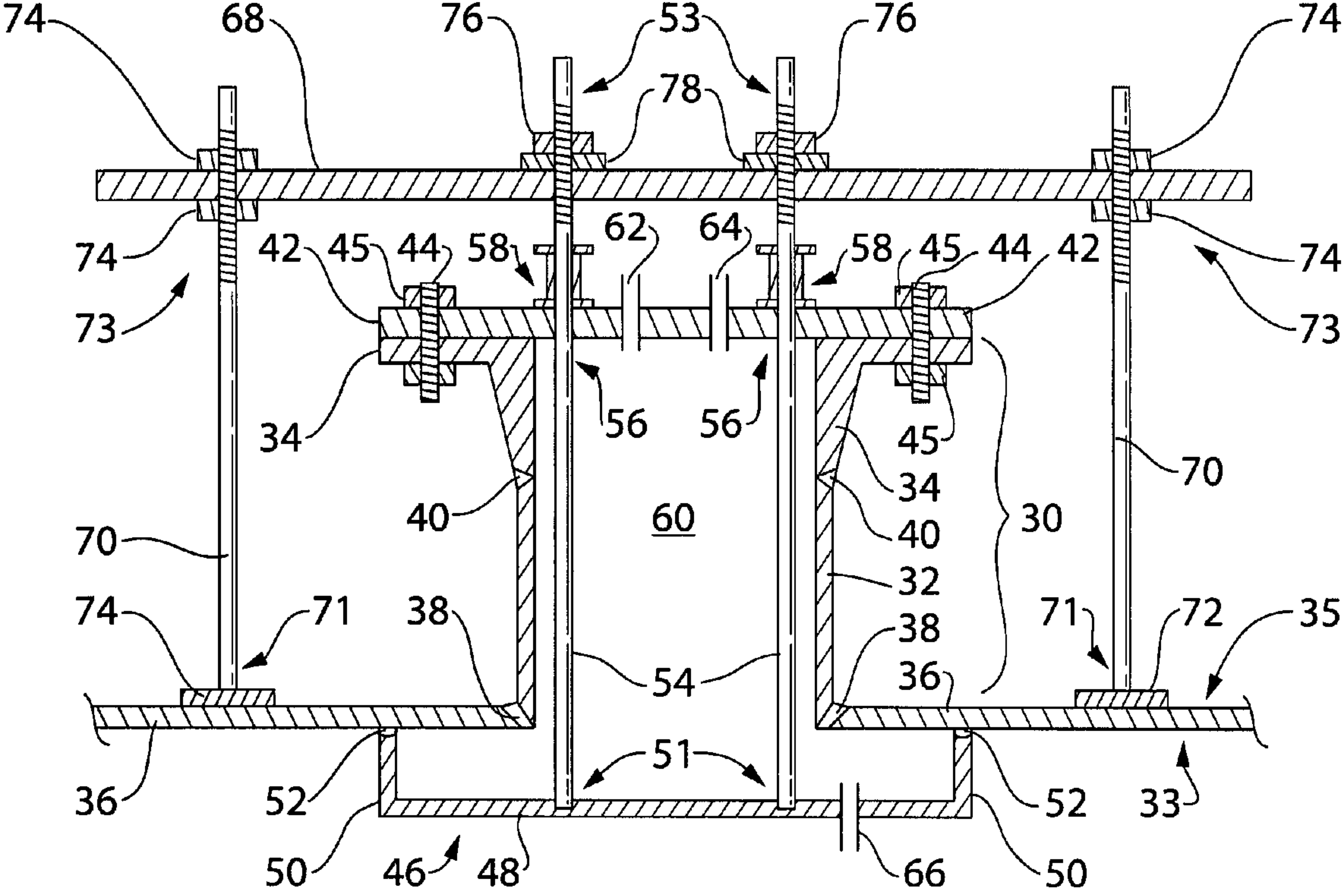


FIG. 5

FIG. 6





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