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(54) Title: APPARATUS AND METHOD FOR TESTING WELD INTEGRITY

(57) Abstract: An apparatus and method for testing weld integrity is disclosed which is portable, self-contained, adaptable for field use in most locations, and can verify the integrity of attachment welds. The testing apparatus includes a cylinder or cylinders, attachable to the desired object to be tested on one end and to a cross bar on the other end, support beam or beams which, along with the cylinder or cylinders, support the test apparatus, a supply for pressurized fluid, and a control manifold for flow direction and pressure measurement. The pressurized fluid moves the cylinder shaft creating a load on the test piece. As the fluid pressure increases the cylinder shafts extract or retract and exert a required load on the test piece. The test piece is then inspected for breakage or damage such as deformation or attachment weld cracking.

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Apparatus and Method for Testing Weld Integrity

AREA OF TECHNOLOGY:

5 The present apparatus relates, generally, to non-destructive testing of weld integrity and strength in the attachment weld of pad eyes and other lifting lugs.

BACKGROUND OF INVENTION:

10 Presently, the weld integrity of pad eye or other lifting lug welds are only tested by x-rays or liquid penetrant. This testing is at best random and cannot insure the safety or reliability of the pad eyes especially after many cycles. The failure of the pad eyes can cause equipment damage and destruction as well as compromise the safety of workers and by-standers. In particular, when drill string piping is off loaded, from a barge or supply boat, the failure of the pad eyes does cause the loss of human life due to the extreme weight of the pipe and its uncontrolled fall.

15 Pad eyes and lifting lugs are primarily used as an attachment point for any rigging employed to hoist, transport, or secure heavy equipment. These pad eyes are typically welded either to the equipment or to some device on which the equipment is transported on. The strength of these welds cannot be easily tested after they have been manufactured. Usually, the only indication of weakness is discovered upon the complete failure of the attachment weld.

20 Currently, there are similar approaches to the present device disclosed in other patents. However, there is no prior art for the method or apparatus for testing the pad eye welds. U.S. Pat. No. 4,676,110 discloses a fatigue testing apparatus. However, this apparatus utilizes a method of destructive testing which would render the pad eye useless. Other prior art for pull testing is disclosed in U.S. Pat. No's 5,844,142 and 5,918,284. However, these systems are not portable, are
25 not for larger loads, and are only intended for testing the products during manufacturing. These systems are also used to test the strength for one time use only products, such as surgical suture and needles. The pad eye welds must withstand a vast number of loading cycles, with a varied amount of load, throughout their useful life.

 There are other prior art testing tools such as disclosed in U.S. Pat. No. 6,186,011 B1 which
30 tests the failure modes of spot welds on sheet metal. Another testing tool disclosed in U.S. Pat. No. 6,216,531 B1, tests the shear strength of adhesive bonded materials. However, both of these inventions are based on pre-manufacture testing, do not consider cyclic loading over the useful life of the product, and cannot be adapted for portability. These testing tools also cannot be adapted to perform testing of finished products or to test the weld integrity before each use.

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It is thus a desire to have a testing apparatus which is portable and can quickly and accurately check the integrity of a pad eye and its attachment weld before each field use. The desired apparatus should be portable, self-contained, easily transportable, and environmentally safe in order to test the pad eye welds at almost any location. This testing device should be capable of being hydraulically operated as well as by other available pressurized fluid sources. This device could consist of one or multiple pressurized fluid cylinders depending on the required test loads and the configuration of the apparatus. The effective area of the cylinder piston and the pressure applied to the cylinder would determine the capacity of the apparatus. The fluid pressure is preferably supplied by a hand pump for currently optimum portability; however, other types of pumps could be utilized. A flow manifold would be needed to control the flow direction as well as measure the pressure applied to the cylinder(s). One end of the cylinder(s) would be attached to the same base as is the pad eye or attached to its own base plate. The other end is attached to a cross bar, bridge plate, or similarly functioning member. The cross bar, bridge plate, or similarly functioning member could be further supported by either cylinders or support beams.

BRIEF DESCRIPTION OF THE DRAWINGS:

For a further understanding of the nature of the present device, reference should be had to the following detailed description, taken in conjunction with the accompanying drawings, in which like elements are given the same or analogous reference numbers and wherein:

FIG. 1 is a front view assembly drawing of a preferred form of the testing apparatus 20.

FIG. 1A is another embodiment of FIG. 1 illustrating the option of attachment, of the present apparatus, to the device to be tested, by clamps.

FIG. 2 is a view of FIG. 1 in its disassembled state.

FIG. 3 is a front view assembly drawing of an additional embodiment of the testing apparatus.

FIG. 3A is another embodiment of FIG. 3 illustrating the option of attachment, of the present apparatus, to the device to be tested, by clamps.

FIG. 4 is a front view of a FIG. 3 in its disassembled state.

FIG. 5 is a pictorial view of the hand pump.

FIG. 6 is a pictorial view of the flow control manifold.

FIG. 7 is a simplified cross sectional representation of the cylinder depicted in FIG. 1, 2, 3, and 4.

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FIG. 8 is a front view assembly drawing of an alternative embodiment of the testing apparatus.

FIG. 8A is another embodiment of FIG. 8 illustrating the option of attachment, of the present apparatus, to the device to be tested, by clamps.

5 FIG. 9 is a front view assembly drawing of another alternative embodiment of the testing apparatus.

FIG. 9A is another embodiment of FIG. 9 illustrating the option of attachment, of the present apparatus, to the device to be tested, by clamps.

10 **DETAILED DESCRIPTION OF AN EMBODIMENT OF THE PRESENT APPARATUS:**

FIRST EMBODIMENT (FIG. 1 and FIG. 2)

FIG. 1 is an assembly drawing of the present device. FIG. 2 shows the individual components of the testing apparatus 20 which includes the cylinder 5, two bridge plates 1, two support beams 3, 15 one being the right side beam and one being the left side beam, two footings 9 comprised of a right side footing and a left side footing, and two attachment plates 17.

It should be appreciated that the footings 9 and the attachment plates 17 are an illustrative method of attaching the apparatus to the pad eye 19 or lifting lug. Other ways of attachment, which provide adequate support and connection can be employed without departing from the scope thereof. 20 The test apparatus can be mounted to a base plate 37 in order to provide support for the test apparatus, it can be used without the base plate 37 and attached via clamps 38 or other suitable method directly to the base support structure to which the pad eye 19, the lifting lug, or other lifting connection is attached to.

As shown in FIG. 1 and FIG. 2, the cylinder 5 is comprised of a shaft 13 on the topside of 25 the cylinder, an upper 7 and lower 7A cylinder fitting, and a bottom adaptor 8. The internal portion of the cylinder, FIG. 7, is well known to those in the art and typically consists of one or more pistons 53 and o-rings or seals. The said piston 53 is attached to the shaft 13 and will typically move upward, extending the cylinder shaft 13 as pressure is applied through the lower cylinder fitting 7A. When the pressurized fluid is applied through the upper cylinder fitting 7, the piston moves 30 downward and the cylinder shaft 13 retracts. Both the cylinder shaft 13 and the bottom adaptor 15 are adapted to allow connection to a mating part preferably utilizing a pin connection. It should be appreciated that although the present device contemplates primarily pinned connections, other

methods of attachment can also be used. Examples of such attachment include, but are not limited to: various threaded fasteners, taper pins, welding, and the like. The figures illustratively show two types of pins 39, 41. However, these pins 39, 41 can be interchanged as well as be substituted by a variety of other attachment methods as mentioned above. The cylinder shaft 13 is sandwiched
5 between and connected, by a pin 41, to the two bridge plates 1. The bottom adaptor 15 is connected by a pin 41 and sandwiched between the attachment plates 17. For the preferred embodiment of the present apparatus, pressure containing hoses are connected to the upper 7 and lower 7A cylinder fittings.

Each of the two bridge plates 1 are preferably substantially identical flat rectangular bars
10 made of steel or a material with similar strength properties. These said bridge plates 1 have a plurality of holes 23 which are used for the fixed connections between the two bridge plates 1 and the cylinder shaft 13 and the two support beams 3. It should be appreciated that the hole 23 diameter and consequently the diameter of the pin 41 vary in size depending on the load which will be tested and are typically sized by calculation based on the maximum load contemplated. Preferably, there
15 is a plurality of holes 23 located on the right and left lengthwise ends of the bridge plate 1 and also located substantially symmetrically around the lengthwise and widthwise centers of the said bridge plate 1. Preferably, said holes 23, located on the right and left lengthwise ends, should be substantially symmetrically located at each end of the bridge plates. Preferably, said holes 23, at each end of said bridge plate 1, are substantially symmetrically located with respect to said bridge
20 plate 1 and each other. The holes 23 located approximately midway of both the lengthwise and widthwise centers of said bridge plates 1 are preferably substantially symmetrically located at said midway point. The multiple holes 23 are used for allowing vertical and horizontal adjustment of the test apparatus. The cylinder shaft 13 is preferably fixedly attached at substantially the lengthwise midpoint of the bridge plate 1 by pin 41. The two bridge plates 1 are fixedly attached at opposing
25 ends, left and right side, and to the outside face of the two support beams 3 by pin 41.

The two support beams 3 are preferably hollow rectangular beams made of steel or a material with similar strength properties. These said support beams 3 have a plurality of holes 23 on all four faces of the rectangular beam which are used for the fixed connections between the two support beams 3 and the two bridge plates 1 and the two footings 9. It should be appreciated that the hole
30 23 diameter and consequently the diameter of the pin 41 vary in size depending on the load which will be tested and are typically sized by calculation based on the maximum load contemplated. Preferably, the holes 23, on each face of the support beams 3, are substantially centered lengthwise

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on each face of the support beam 3 and are substantially symmetrically spaced from the top of said support beam 3. The multiple holes 23 are used for allowing vertical and horizontal adjustment of the testing apparatus. The bottom end of the two support beams 3 has a hole on each of the four faces. Preferably, the said holes 23 are substantially symmetrically located on the lengthwise center line of each face of the said support beam 3. As described above and shown in FIG. 1, the support beams 3 are fixedly attached near the top end of said support beam 3 sandwiched between the two bridge plates 1 and fixedly attached preferably utilizing the pin 41. The bottom end, of each said support beam 3, is preferably fixedly attached to the two footings 9 by pin 41.

The two footings 9 are preferably comprised of a steel, or a material with similar strength properties, channel bar. Preferably, the two channel sides have matching holes 23 on each face. Preferably, said hole diameters are substantially symmetrically centered relative to the said channel bar height and substantially symmetrically spaced between the respective holes centers on each channel wall face. The two footings 9 will preferably be attached by welding to the test apparatus base plate 37 or attached by clamps to the pad eye base plate 21. Preferably, the two footings 9 are substantially horizontally and symmetrically centered on each side of the pad eye 19. This said placement, of the two footings 9, is assured through the substantially symmetric connection of the support beams 3 to bridge plate 1. This said positioning insures that the testing apparatus will provide an approximately equal upward force on the pad eye 19.

The two attachment plates 17 are comprised of two substantially identical pieces of flat steel, or a material with similar strength properties, bar. The said attachment plates 17 have a plurality of holes 23. The hole 23 diameters are substantially centered along the lengthwise centerline of the flat face of the attachment plates 17. The said holes 23 are further substantially symmetrically located at opposing lengthwise ends of the said attachment plates 17. The adjustment plate 17 is fixedly attached on the upper end, by pin 41, to the end of the bottom adaptor 15. The said bottom adaptor 15 is fixedly attached, by pin 41, pinned between the two attachment plates 17. The lower end of said attachment plates 17 is attached to the pad eye 19 by pin 39. The pad eye 19 is sandwiched between the two attachment plates.

An alternative embodiment of this structure, shown in Figs. 8 and 8A, could be an A-frame wherein the cylinder is attached to a crossbar or the apex of the A-frame.

SECOND EMBODIMENT (FIG. 3 and FIG. 4)

FIG. 3 is an assembly drawing of an additional embodiment of the present apparatus. FIG.

4 shows the individual components of said additional embodiment 30 which is preferably comprised of the two cylinders 5, one being the right side cylinder and one being the left side cylinder, two bridge plates 1, the support beam 47, and two footings 9 comprised of a right side footing and a left side footing.

5 It should be appreciated that the footings 9 and the attachment plates 17 are an illustrative method of attaching the apparatus to the pad eye 19 or lifting lug. Other ways of attachment, which provide adequate support and connection can be employed without departing from the scope thereof. The test apparatus can be mounted to a base plate 37 in order to provide support for the test apparatus, it can be used without the base plate 37 and attached via clamps 38 or other suitable
10 method directly to the base support structure to which the pad eye 19, lifting lug, or other lifting connection is attached to.

As shown in FIG. 3, FIG. 3A, and FIG. 4, the two cylinders 5 are comprised of similar components as the cylinder 5 for the single cylinder apparatus. It should be appreciated that since the actual cylinder size may change according to the required load the components may also change
15 in size. Both the cylinder shaft 13 and the bottom adaptor 15 are adapted to allow connection to mating parts preferably utilizing a pin connection. The cylinder shaft 13, of the right side cylinder 5 is fixedly attached by a pin 41 to the right end and in between the two bridge plates 1. The cylinder shaft 13, of the left side cylinder 5, is fixedly attached by a pin 41 to the left end and in between the bridge plates 1. The bottom adaptor 15, of the right cylinder 5, is fixedly attached, by a pin 41 to the
20 right side footing 9. The bottom adaptor 15, of the left cylinder 5, is fixedly attached, by a pin 41 to the left side footing 9. It should be noted and appreciated by those in the art that the figures illustratively show two types of pins 39, 41. However, these pins 39, 41 can be interchanged as well as be substituted by a variety of other attachment methods as mentioned above. Both the right side and left side cylinders 5 are each fitted with two cylinder fittings 7 and 7A For the preferred
25 utilization of the present device, pressure containing hoses are connected to the two cylinder fittings 7 and 7A on each cylinder 5.

Each of the two bridge plates 1 are preferably substantially identical flat rectangular bars made of steel or a material with similar strength properties. These said bridge plates have a plurality of holes 23 which are used for the fixed connections between the two bridge plates 1 and the cylinder
30 shafts 13, of both cylinders 5, and the support beam 47. It should be appreciated that the hole 23 diameter and consequently the diameter of the pin 41 vary in size depending on the load which will be tested and are typically sized by calculation based on the maximum load contemplated.

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Preferably, there are a plurality of holes 23 located on the right and left lengthwise ends of the bridge plate 1 and also located substantially symmetrically around the lengthwise and widthwise centers of the said bridge plates 1. Preferably, the said holes 23, located on the right and left lengthwise ends, should be substantially symmetrically located at each end of the bridge plates 1. Preferably, said holes 23, at each end of said bridge plate 1, are substantially symmetrically located with respect to said bridge plate 1 and each other. The said holes 23 located approximately midway of both the lengthwise and widthwise centers of said bridge plates 1 are preferably substantially symmetrically located at said midway point. The multiple holes 23 are used for allowing vertical and horizontal adjustment of the test apparatus.

The support beam 47 is preferably a fabricated hollow rectangular beam, having a top side and a bottom side, in which two opposing bottom sides extend, in the lengthwise direction, beyond the other two opposing sides. The said opposing extended sides form a channel at the bottom end of the said support beam 47. The support beam 47 has a plurality of holes 23 on all four faces of the rectangular beam which are used for the fixed connections between the support beam 47 and the two bridge plates 1 and the two footings 9. It should be appreciated that the hole 23 diameter and consequently the diameter of the pin 41 vary in size depending on the load which will be tested and are typically sized by calculation based on the maximum load contemplated. Preferably, said holes 23, on each face of the support beam 47 are substantially centered lengthwise on each face of the support beam 47 and are preferably substantially symmetrically spaced from the top of said support beam 47. The multiple holes 23 are used for allowing vertical and horizontal adjustment of the testing apparatus. As shown in FIG. 4 and described above, the bottom channeled end of the support beam 47 has a hole on each face of the channel portion. These hole diameters are substantially symmetrically located in the center of each face of the said support beam bottom channel. As described above and shown in FIG. 3, the support beam 47 is fixedly attached near the top end of the beam sandwiched between the two bridge plates 1 preferably utilizing the pin 41. The bottom-channeled end of the support beam 47 is set over the pad eye 19. The said bottom channeled end of the support beam 47 is fixedly attached, preferably by pin 39, to the pad eye 19.

The two footings 9 are preferably comprised of a steel, or a material with similar strength properties, channel bar. Preferably, the two channel sides have matching holes 23 on each face. Preferably said hole diameters are substantially symmetrically centered relative to the said channel bar height and substantially symmetrically spaced between the respective hole centers on each channel wall face. The two footings 9 will preferably be attached by welding to the test apparatus

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base plate 37 or attached by clamps to the pad eye base plate 21. Preferably, the two footings 9 are substantially horizontally and symmetrically centered on each side of the pad eye 19. This said placement, of the two footings 9, is assured through the substantially symmetric connection of the right and left cylinders 5 to the bridge plate 1. This said positioning insures that the testing apparatus
5 will provide an approximately equal upward force on the pad eye 19.

It should be understood that the frame could be modified in many aspects to achieve the substantially same function and substantially same result of the present device. For instance, the bridge plate 1 could be curved, angled, have additional members attached thereto, and the like. The structure and frame could be further modified using springs or other mechanisms to exert a
10 tensioning force on the pad eye or lifting lug attachment weld.

OPERATING APPARATUS (FIG. 5 and FIG. 6)

Preferably, as shown in FIG. 5, the hand pump 40 is basically comprised of a reservoir 59, a carrying handle 57, a pump 61, the pumping handle 71, and a reservoir cap 69. It should be
15 appreciated that although FIG. 5 shows a small typical hand pump, many varieties and combinations of pumps and fluid reservoirs or accumulators could be used to actuate this test apparatus. For the present device, a small hand pump is well suited for portability. If an adaptation of this apparatus were, for example, to be used in an industrial setting the pump may be otherwise powered, may be stationary, have larger reservoirs, use accumulators, use different fluids, or a multitude of different
20 adaptations. For the present contemplated usage of this device, the cylinder shaft 13 is preferably actuated by a hand pump 40. The hand pump 40 is connected to the flow control manifold 50 by pressure containing hoses. The pump 61 is operated through the use of the pump handle 71.

As shown in FIG. 6, the flow control manifold 50 is comprised of a manifold 83, a pressure gauge 73, a directional valve 77, a directional lever 79, and a carrying handle 75. The direction of
25 actuation and flow is preferably controlled by a directional valve 77. The directional valve 77 is further controlled by the rotational directional lever 79. Preferably the said directional lever can only be turned approximately ninety degrees in one direction and then approximately ninety degrees in the opposite direction. It should be appreciated, as with the hand pump above, that this is a typical manifold selected for the presently contemplated use of this device. However, as this apparatus is
30 adapted for any variety of locations, the type, size, and configuration of the flow control manifold, including the type and configuration of the directional valve 77, as well as even the method of flow control itself may require substantial change. The flow control manifold 50 is preferably connected

to the upper 7 and lower 7A cylinder fittings by means of pressure containing hoses. The flow control manifold 50 controls the direction of flow either into the lower cylinder fitting 7A, causing the cylinder shaft 13 to extend, or into the upper cylinder fitting 7 causing the cylinder shaft 13 to retract. The flow control manifold 50 also measures the pressure of the fluid. This pressure is shown
5 on the mounted gauge but is also available to be displayed on a variety of recorders, computers, controllers, and the like.

In use, the present device can be transported in the disassembled condition to any location where some pad eye or lifting lug will be utilized or requires testing. One possible criterion for selecting a particular embodiment may be the required test load.

10 In use, prior to selecting the proper embodiment of the present device, the desired test load must be known. Typically, this value will be approximately 1.5 times greater than the rated load capacity of the pad eye or lifting lug. If such a rated load is not readily accessible, the test value would be approximately 1.5 times the weight that will be supported by the pad eye or lifting lug. It should be understood that the said multiplying factor of 1.5 is only a preferred safety factor;
15 therefore, the value can vary depending on a user's experience or preference and should not be used as a limiting factor of the scope of the claimed apparatus. After determining the said load test value, the proper testing apparatus will be comprised of the correct size and number of cylinders 5 which can generate the required test load. The required test load is generated by the cylinder 5 and is produced by the combination of the pressure, produced by the hand pump 40 and measured by the
20 manifold pressure gauge 73, acting over the effective area of the cylinder. The effective area of the cylinder is calculated based on the diameter of the piston 53 within the cylinder 5. As is known to those in the art, the effective area of the piston 53 can be obtained from the cylinder manufacturer. As is also well known to those in the art, the said effective area is multiplied by the pressure to predetermine the produced test load. After determining the test load as described above, selecting
25 the cylinder size, as described above, and determining the required pressure to produce the said test load, as described above, the hand pump 40 is used to produce the required pressure.

In use, the test apparatus is assembled as shown in FIGS. 1, 1A, 3, or 3A and discussed above. The apparatus is then connected to the pad eye 19, lifting lug, or other device to be tested. The connection, as shown in FIGS. 1 and 1A can include the use of attachment plates 17. In addition,
30 a pressure containing hose is connected to each of the cylinder fittings 7 and 7A on the cylinders 5. The other end of each pressure containing hose is connected to the flow control manifold 50. The preferred embodiment utilizes "quick connect" connectors for the pressure containing fittings,

however, other types of pressure containing fittings may be utilized. Preferably, the cylinder fittings 7 and 7A, the manifold fittings 81, and the pump fittings 73 are all male "quick connect" pressure containing fittings. Each pressure containing hose is preferably comprised of some length of hydraulic quality hose with a female "quick connect" fitting on each end. The pressure containing

5 hose will have a pressure rating which exceeds the pressure required for the testing. Another set of the above described pressure containing hoses is connected between the flow control manifold 50 and the hand pump 40. It should be understood that the exact sequence and location of connection of the pressure containing hoses may vary depending on the version of the testing apparatus as well as the type and model of pump and flow control manifold. After the pressure containing hoses have

10 been connected the pressurized system, comprised of the hoses and associated fittings, the hand pump 40, the flow control manifold 50, and the cylinders 5, is known to those in the art as a closed system. Therefore, any air, contained in the closed pressurized system must be removed. The said air removal is known as system bleeding to those in the art. The preferred method of bleeding the system is through a combination of moving the pressurized fluid through the pressurized system,

15 which forces any air through the system and into the reservoir. After this is performed, the entire system is filled only with the pressurized fluid. The movement of the fluid is accomplished by alternately moving the pump handle 71 in an upwardly and downwardly motion. This said movement of the pump handle 71 causes the pump to push fluid through one of the hoses, through the flow control manifold 50, and into the lower cylinder fitting 7A. This causes the said fluid to

20 flow underneath the piston 53 and begin forcing the piston 53 in an upwardly direction. As the piston 53 begins to rise, the fluid, resting above the piston 53 begins to be forced out of the upper cylinder fitting 7, through the pressure containing hose, connected to the upper cylinder fitting 7, through the flow control manifold 50, through the pump 61, and into the reservoir 59. This described flow and the accompanied rise of the piston 53 causes the cylinder shaft 13 to extract.

25 Turning the directional lever 79 ninety degrees from the position described in the above paragraph will cause the fluid to flow into the upper cylinder fitting 7 when the pump 61 is actuated by the moving the pump handle 71 in alternating upwardly and downwardly directions as described above. The said pump handle 71 movement causes the pump to push fluid through one of the hoses, through the flow control manifold 50, and into the upper cylinder fitting 7. This causes the said fluid

30 to flow above the piston 53 and begin forcing the piston 53 in a downwardly direction. As the piston 53 begins to move in the said downward direction, the fluid, resting below the piston 53 begins to be forced out of the lower cylinder fitting 7A, through the pressure containing hose connected to the

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lower cylinder fitting 7A, through the flow control manifold 50, through the hand pump 40, and into the reservoir 59. This described flow of the fluid and the accompanied downward movement of the piston 53 causes the cylinder shaft 13 to retract.

5 In use, the single cylinder version of the present device produces an upward force on the pad eye or lifting lug when the cylinder shaft 13 retracts. Therefore, the directional lever 79 shall be moved into the position which causes the fluid to flow into the upper cylinder fitting 7.

In use, the double cylinder version of the present device produces an upward force on the pad eye or lifting lug when the cylinder shaft 13 extracts. Therefore, the directional lever 79 shall be moved into the position which causes the fluid to flow into the lower cylinder fitting 7A.

10 In use, the pressure gauge 73 will indicate the system pressure. As the pump handle 71 is moved, as described above, the pressure, indicated on the pressure gauge will increase. When the indicated pressure is approximately the same as the calculated pressure corresponding to the required test load, as described above, then the proper test load has been applied. It should be understood that this paragraph describes the operation regardless of the direction of fluid flow or the position of the
15 directional valve handle 79.

In use, after the test is completed, the directional valve 79 should be turned ninety degrees, and the pump 61 should be actuated by the pump handle 71, as previously described, until the system pressure, as indicated by the gauge or other monitoring device, is completely relieved.

20 It should be appreciated that the directional lever 79 does not actually control flow but rather moves the directional valve 77 into a position that changes the flow direction. The detailed workings of the directional valve 77 is well known to those skilled in the art.

Those who are skilled in the art will readily perceive how to modify the present apparatus still further. For example, most of the illustrated connections utilize pins, however, it should be recognized that other methods of connection may be utilized, such as threaded connectors or if the
25 unit will be modified for permanent installation as opposed to portable, the connections could be welded. Further, the frames or structures, of this apparatus, do not need to be comprised of substantially vertical and horizontal members. These members could be curved, angled, or joined in a manner to provide the substantially same function and substantially same result in testing the pad eye or other lifting lug attachment welds. Figs. 8 and 9 illustrate two such modifications where
30 the alternative embodiment consists of an A-frame structure and Fig. 8 illustrates a bridge plate or cross bar being used with the A-frame. FIGS. 8A and 9A show an alternative embodiment using clamps 38 for attachment to the base support structure to which the pad eye 19, the lifting lug, or

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other lifting connection is attached to. Additionally, there are other means of providing pressure to actuate the cylinders, other configurations for the pump equipment and associated hoses, as well as additional measuring and measurement recording devices which can all be used within and in conjunction with the present device. Further, other pressurized fluids can be used to actuate the
5 cylinders. In addition, the subject matter of the present device would not be considered limited to a particular material of construction. Therefore, many materials of construction are contemplated by the present apparatus including but not limited to various metals or combinations of metals. As many possible embodiments may be made of the present apparatus without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings
10 is to be interpreted as illustrative and not in a limiting sense.

IN THE CLAIMS

1. An apparatus for testing the weld strength and integrity of an attachment weld when desired comprising:
 - 5 a framework including a base, top, and side pieces;
at least one fluid containing cylinder, mounted with the framework, for moving a piston therein inwardly and outwardly as fluid is moved out or in respectively; and
an attachment structure for attaching to a pad eye or any device to be tested;
whereby moving fluid into the cylinder causes the piston to move outwardly to tension the
10 pad eye then thereby testing the integrity of the weld.
2. The apparatus in claim 1, whereby moving fluid into the cylinder causes the piston to move inwardly to tension the pad eye then thereby testing the integrity of the weld.
- 15 3. The apparatus in claim 1, further including:
a support beam having a top and bottom end; and
a bridge plate or cross bar, having a left and right end, fixedly attached, on said left and right ends and near the center, to and supported by said beam or the cylinder.
- 20 4. The bridge plate or cross bar of claim 3, wherein said bridge plate can be comprised of two substantially identical plates wherein said cylinder shaft or support beams are fixedly attached and sandwiched between said bridge plates.
5. The apparatus in claim 3, wherein said bridge plate or cross bar can be curved.
- 25 6. The apparatus in claim 3, wherein said bridge plate or cross bar can be angled.
7. The apparatus of claim 1, wherein the cylinder further comprises:
a first end and a second end;
30 a substantially cylindrical piston carried in said cylinder for movement therein along an axis, of said cylinder, being substantially perpendicular to a plane formed between a pad eye or other lifting lug being tested and a weld attaching said pad eye or lifting lug to a base;

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a shaft, having a first end and a second end, the first end fixedly attached to said internal piston and said second end is fixedly attached to said bridge plate or cross bar; and

first and second pressurized fluid attachment means;

wherein said first pressurized fluid attachment means is disposed axially between said
5 cylinder first end and said piston;

wherein said second pressurized fluid attachment means is disposed axially between said cylinder second end and said piston; and

wherein pressurized fluid enters said cylinder through said first attachment means or second attachment means.

10

8. The apparatus of claim 7, wherein said cylinder comprises:

said second end of said shaft is fixedly attached to said pad eye or other device to be tested.

9. The apparatus in claim 1, further including:

15

a control means for allowing pressurized fluid to be alternately supplied to and exhausted from said cylinder in a manner that the internal piston will move in an axial direction away from said first end of said cylinder, toward the second end of said cylinder, when the pressurized fluid enters through said first pressurized fluid attachment means, and that the said internal piston will move in an axial direction away from said second end of said cylinder toward the first end of said cylinder,
20 when the pressurized fluid enters through said second pressurized fluid attachment means.

10. The apparatus in claim 9, wherein:

the cylinder shaft will extend when said internal piston moves in an axial direction away from said first end of said cylinder toward the second end of said cylinder, causing said
25 mounted cylinder to exert a force substantially perpendicular to a plane formed between a pad eye or other lifting lug being tested and a weld attaching said pad eye or lifting lug.

11. The apparatus of claim 9, wherein:

the cylinder shaft will retract when said internal piston moves in an axial direction
30 away from said second end of said cylinder toward said first end of said cylinder, causing said mounted cylinder to exert a force substantially perpendicular to a plane formed between a pad eye or other lifting lug being tested and a weld attaching said pad eye or lifting lug.

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12. The apparatus in claim 1, wherein said mounted cylinder will exert a force substantially perpendicular to a plane formed between a pad eye or other lifting lug being tested and a weld attaching said pad eye or lifting lug creating a substantially perpendicular force away from said pad eye or other device being tested subjecting said attachment weld to a tension load.

5

13. A method for testing strength and integrity of a structure comprising the steps of:

identifying at least one desired test piece;

providing a framework including at least top and side pieces;

10 mounting at least one fluid cylinder to the framework, said cylinder having a first end, a second end, and a piston therein, wherein said piston moves inwardly and outwardly as fluid is moved out of or into said cylinder respectively;

attaching at least a first and a second fluid connection, wherein a fluid can enter in or exhaust from said cylinder;

mounting said framework about said at least one desired test piece;

15 assembling the framework with said at least one mounted cylinder fixedly attached at one end of said cylinder to said desired test piece;

urging fluid into or out of said at least one mounted cylinder causing the piston to move to tension the test piece thus testing the integrity of the test piece; and

inspecting the tested device for damage or deformation.

20

14. The method as in Claim 13 wherein said test piece comprises a pad eye, lifting lug, or other device to be tested.

15. The method as in Claim 13, wherein said test piece comprises at least one weld.

25

16. The method as in Claim 13, wherein said framework can include a base.

17. The method as in Claim 13, wherein said frame work may include at least one fluid cylinder.

30 18. The method as in Claim 13, whereby urging fluid into or out of the cylinder causes the piston to move inwardly to tension the test piece thus testing the integrity of the weld.

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19 The method as in Claim 13, whereby urging fluid into or out of the cylinder causes the piston to move outwardly to tension the test piece thus testing the integrity of the weld.

20. The method as in Claim 13, wherein said framework is assembled at the location of the
5 device to be tested.

21. The method as in Claim 13, wherein the calculation of the required cylinder test pressure comprises the steps of:

10 determining a required test load based on the weight to be supported, by the test piece;
determining an effective area of the cylinder piston; and
dividing said test load by the effective area of the cylinder piston.

22. The method as in Claim 13, wherein:

15 urging pressurized fluid is accomplished by a pumping device; and
said urging of said pressurized fluid causes the cylinder piston to move in an axial direction away from said first end of said cylinder toward said second end of said cylinder, thereby causing the cylinder shaft to extract or causes the cylinder piston to move in an axial direction away from said second end of said cylinder toward said first end of said cylinder thereby causing the cylinder shaft to retract.

20

23. The method in Claim 22, wherein:

said cylinder piston moves in an axial direction away from said first end of said cylinder toward said second end of said cylinder when said pressurized fluid enters said cylinder through said first attachment means and the piston moves in an axial direction away from said second end of said
25 cylinder toward said first end of said cylinder, when said pressurized fluid enters said cylinder through said second attachment means; and

the entry, through said first attachment means or said second attachment means, of said pressurized fluid into said cylinder is controlled by a flow control manifold and a directional valve.

30 24. The method in Claim 13 wherein the fluid pressure, in said cylinder, is determined at the control manifold and monitored by a pressure gauge.

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25. A method for testing the strength and integrity of an attachment weld when desired with a single cylinder apparatus comprising the steps of:

identifying at least one desired test piece;

providing a framework including at least top and side pieces;

5 mounting said single cylinder to the framework, said cylinder having a first end, a second end, and a piston therein, wherein said piston moving inwardly and outwardly as fluid is moved out of or into said cylinder respectively;

mounting said framework about said at least one desired test piece;

10 assembling the framework with said at least one mounted cylinder fixedly attached at one end of said cylinder to said desired test piece;

retracting the cylinder shaft thereby exerting a force substantially perpendicular to a plane formed between said desired test piece, being tested, and a base and in a direction away from said test piece;

15 increasing said substantially perpendicular force by increasing the pressure of the fluid in the cylinder;

increasing said pressure until a pre-calculated required pressure is reached; and

inspecting the test piece for damage or deformation.

26. The method as in Claim 25 wherein said test piece comprises a pad eye, lifting lug, or other
20 device to be tested.

27. A method for testing strength and integrity of a structure with a multiple cylinder test apparatus comprising the steps of:

identifying at least one desired test piece;

25 providing a framework including a base, top and side pieces; wherein said base may be a part of said desired test piece;

mounting a plurality of fluid cylinders to the framework, said plurality of fluid cylinders each having a first end, a second end, and a piston therein, wherein said pistons each moving inwardly and outwardly as fluid is moved out of or into said plurality of fluid cylinders respectively;

30 mounting said framework about said at least one desired test piece;

assembling the framework with said plurality of fluid cylinders each fixedly attached at said first end of each said plurality of fluid cylinders to said base and at said second end to a cross bar;

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extracting the cylinder shafts thereby exerting a force substantially perpendicular to and toward said cross bar;

transferring said force from said cross bar to a support beam which is attached to said desired test piece;

5 transferring said force from said support beam to said desired test piece;
increasing said force by increasing the pressure of the fluid in the cylinder;
increasing the pressure until a pre-calculated required pressure is reached; and
inspecting the test piece for damage or deformation.

10 28. A method for testing the strength and integrity of a test piece, comprising:
anchoring one part of the test piece;
attaching a piston from a hydraulic cylinder to a second end of the test piece;
moving the piston to put the test piece under tension; and
inspecting the test piece for damage.

15

29. The method according to claim 28, wherein said test piece is a pad eye.

20

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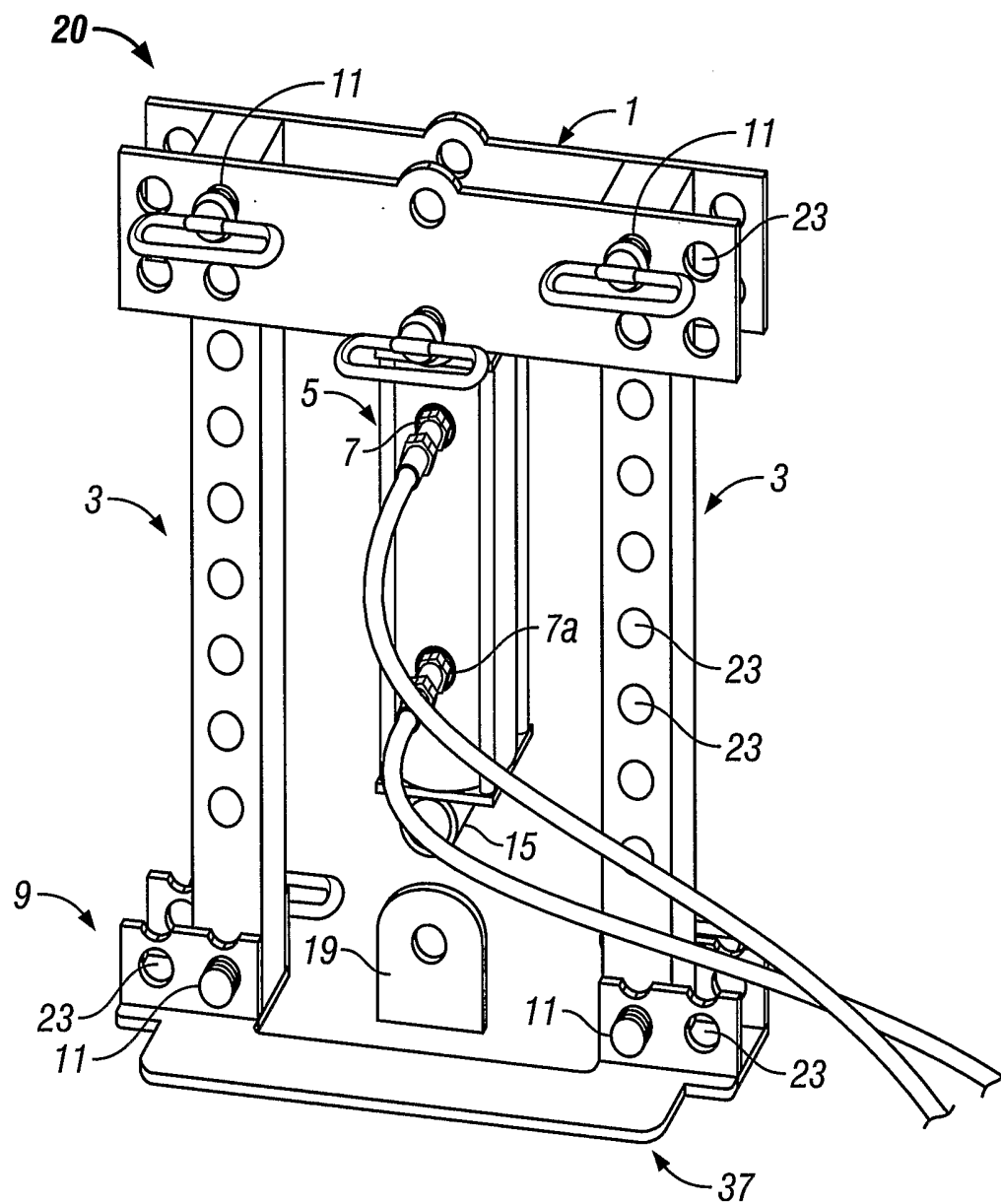
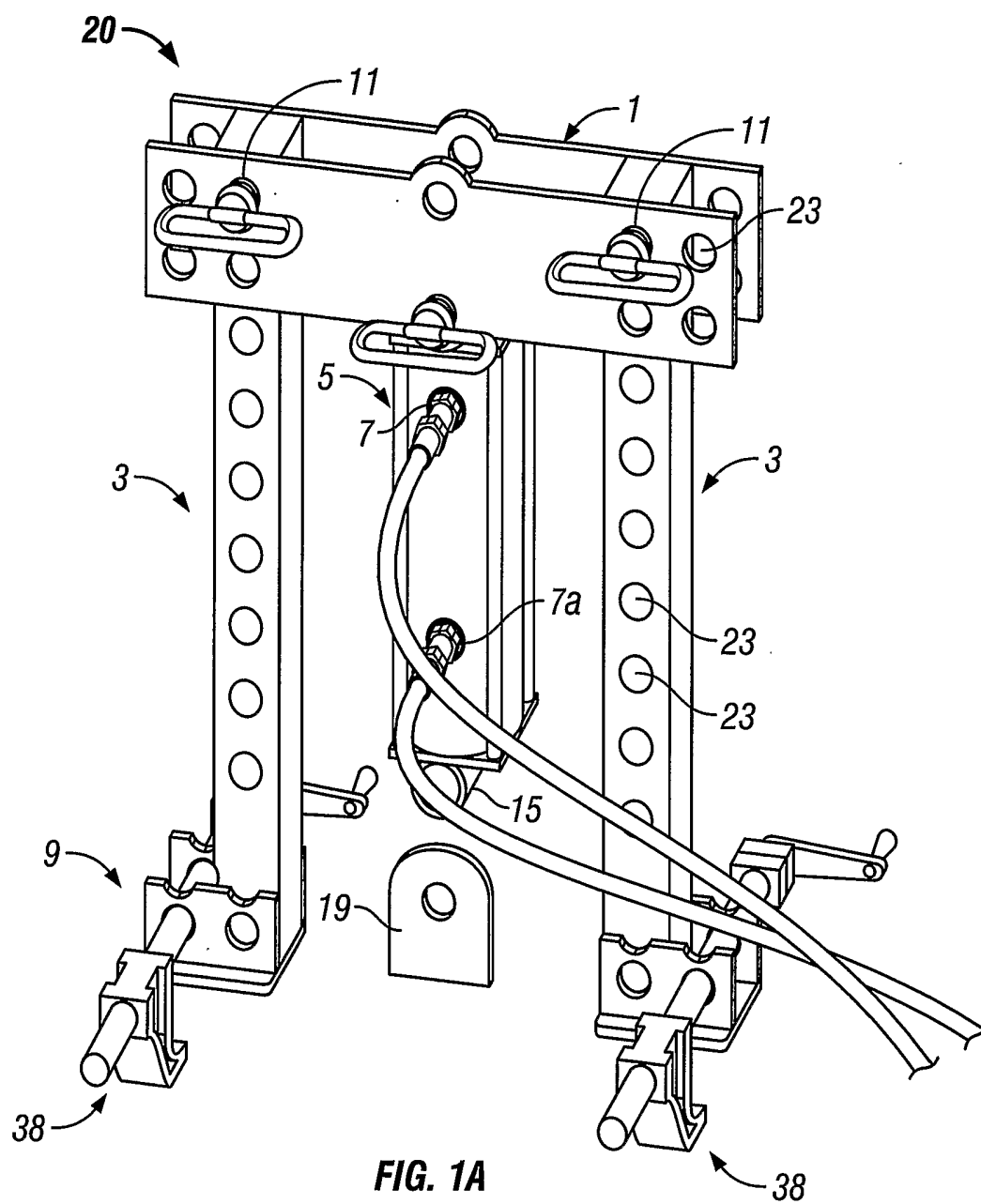


FIG. 1

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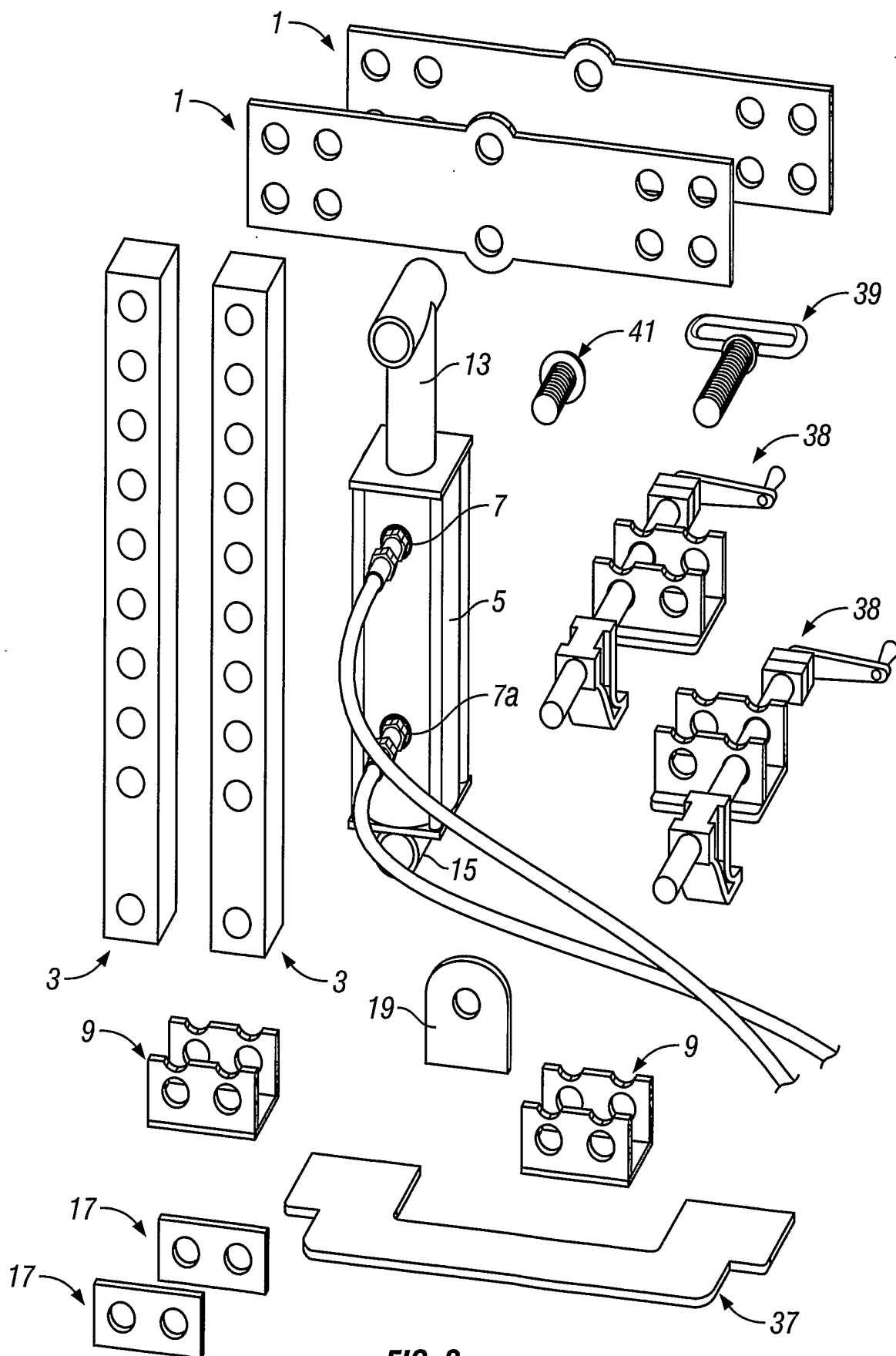


FIG. 2

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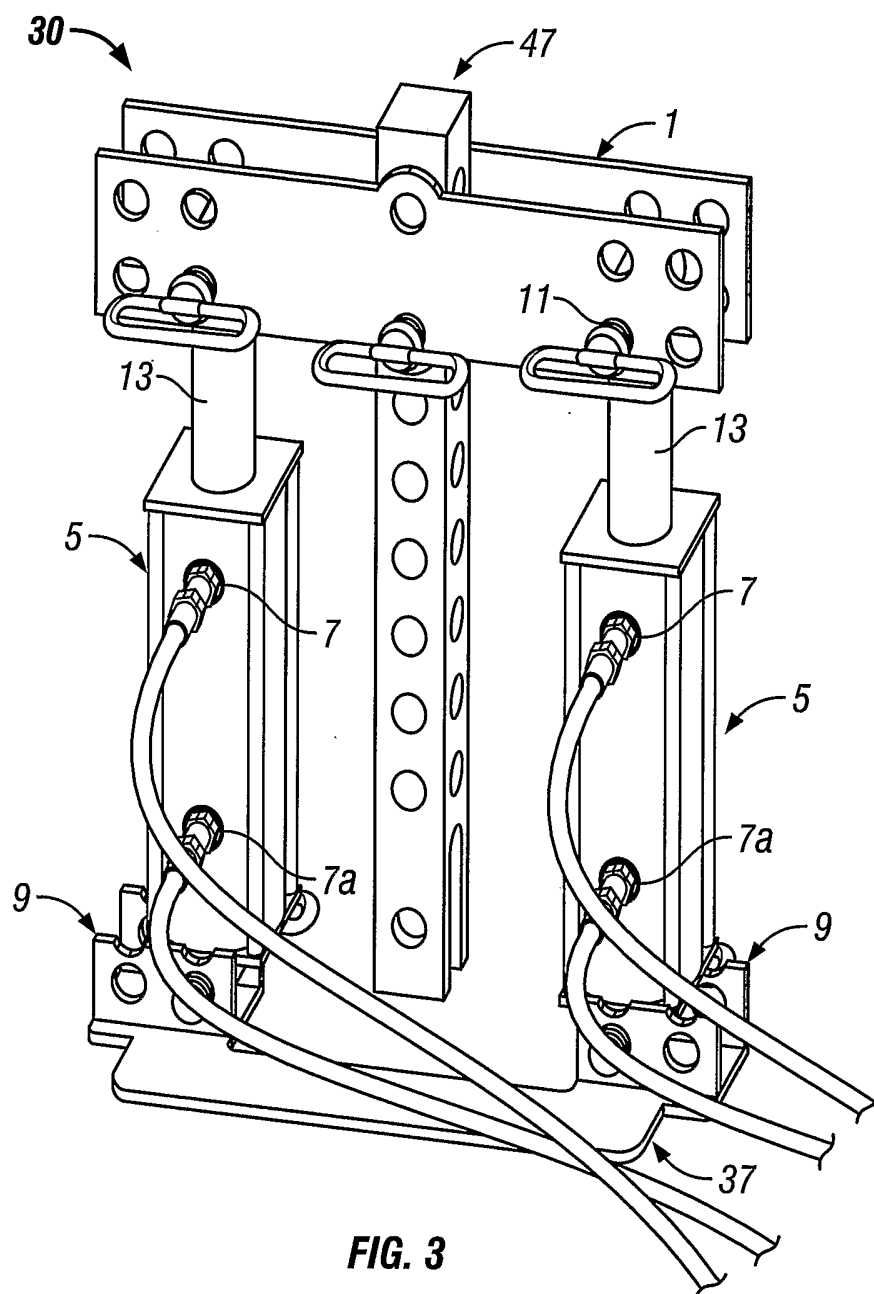


FIG. 3

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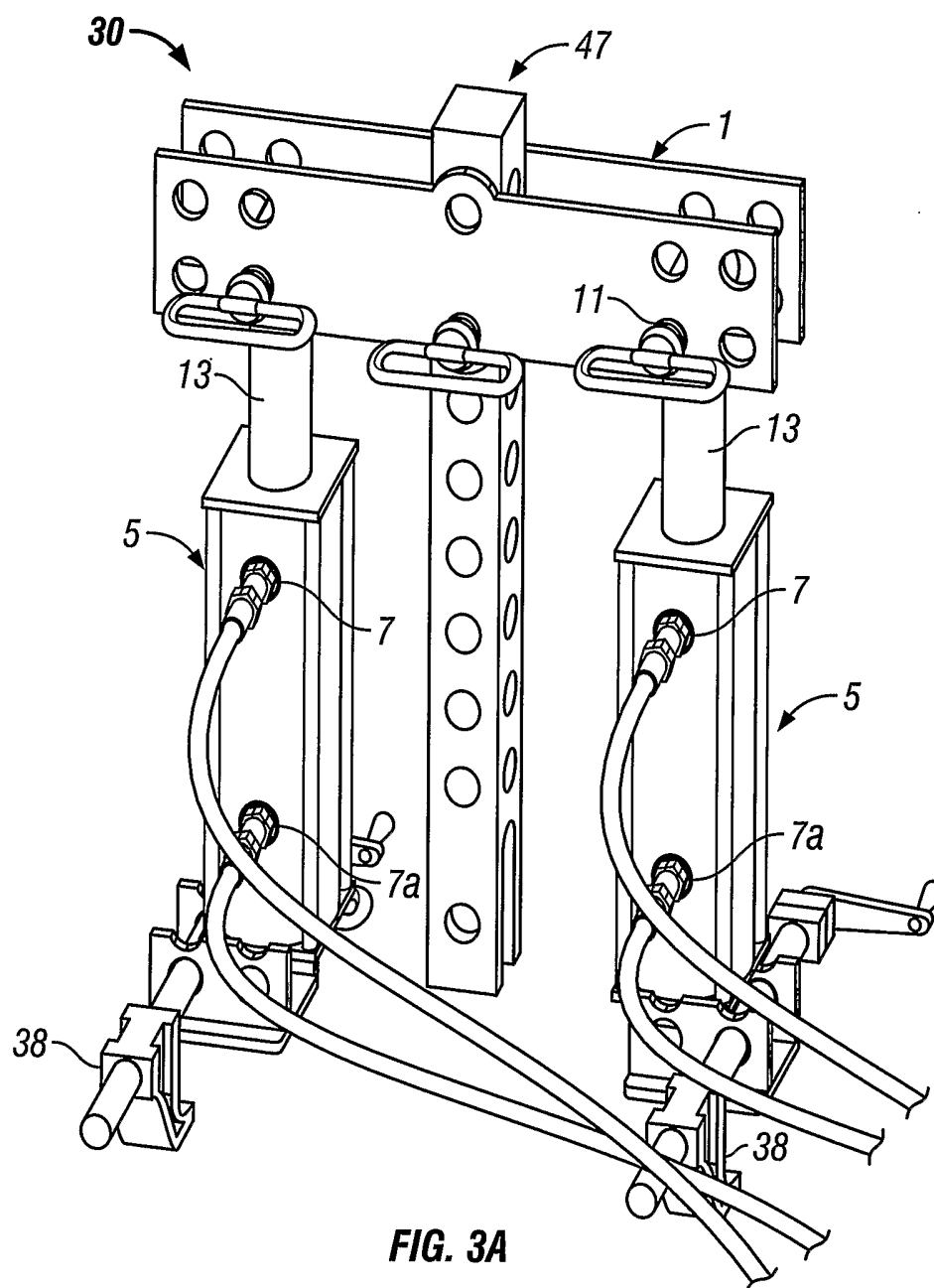


FIG. 3A

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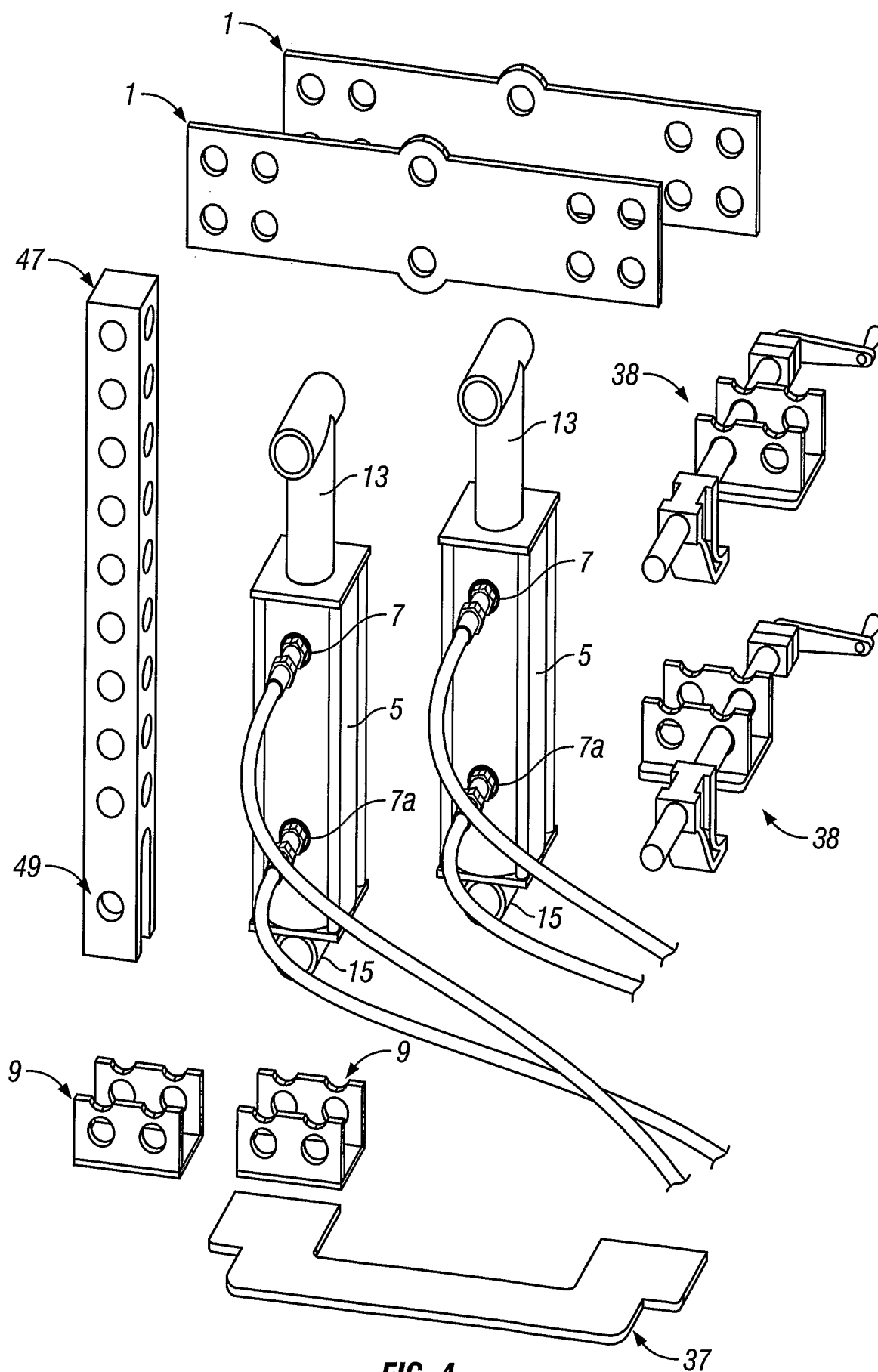


FIG. 4

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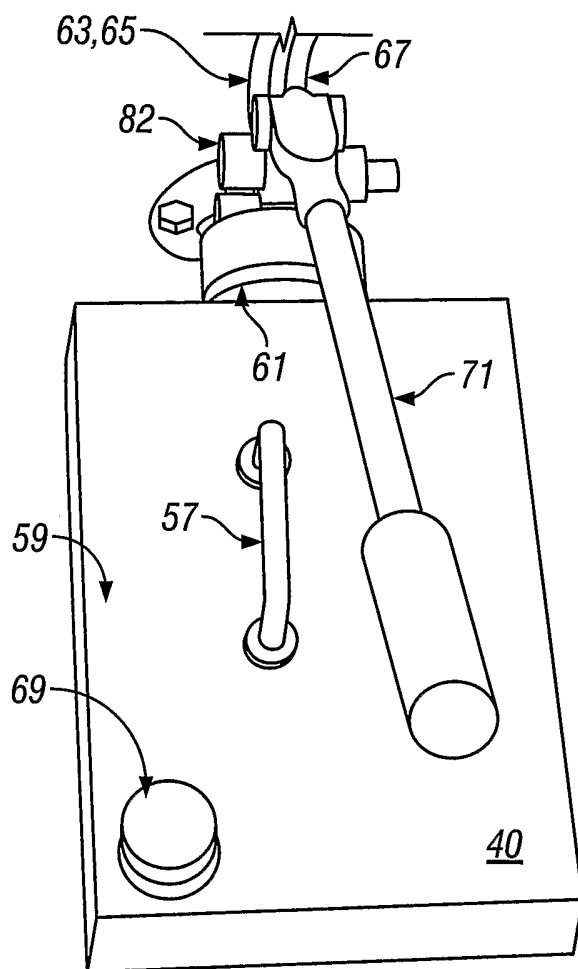


FIG. 5

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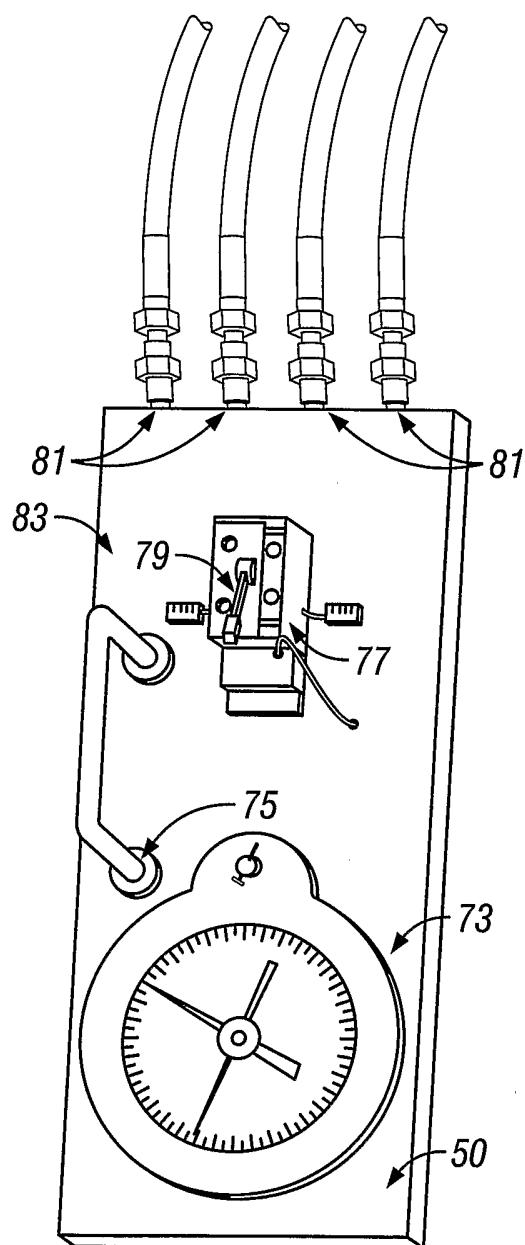


FIG. 6

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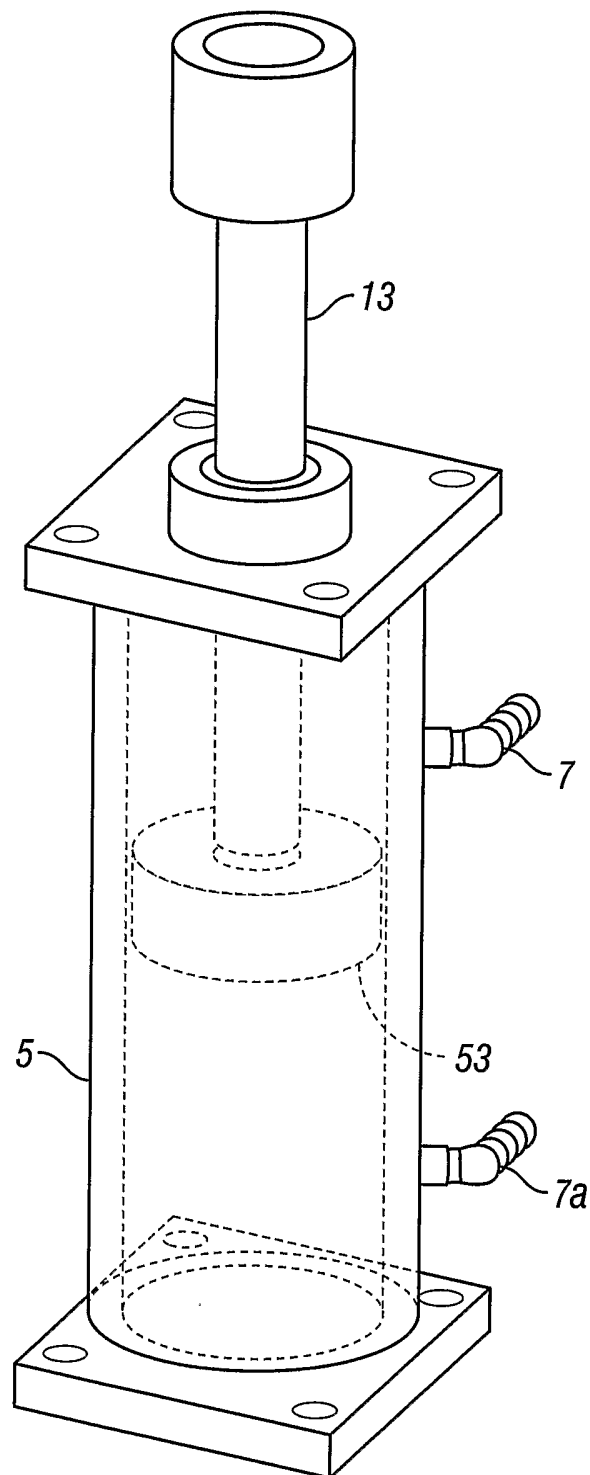


FIG. 7

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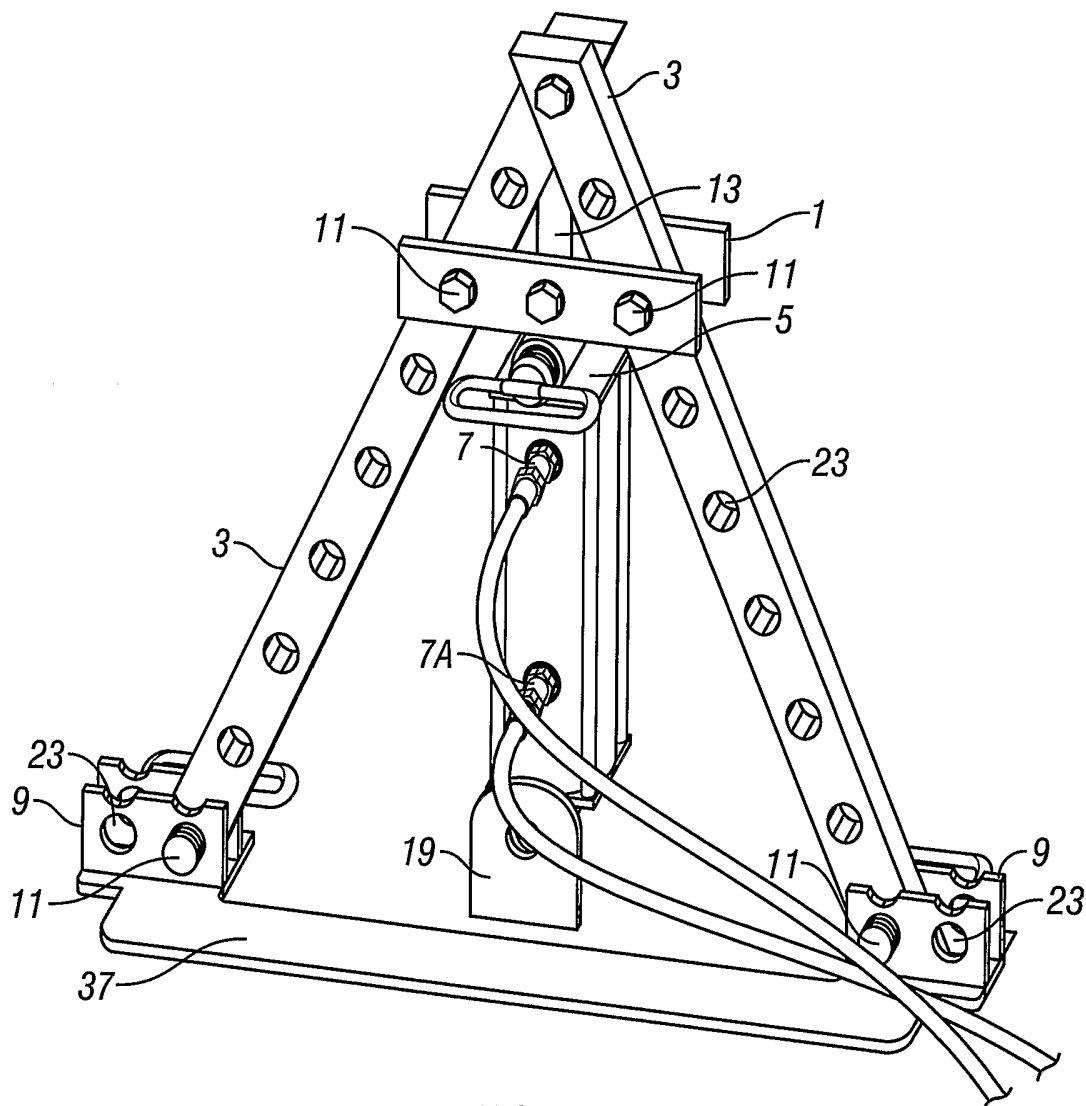


FIG. 8

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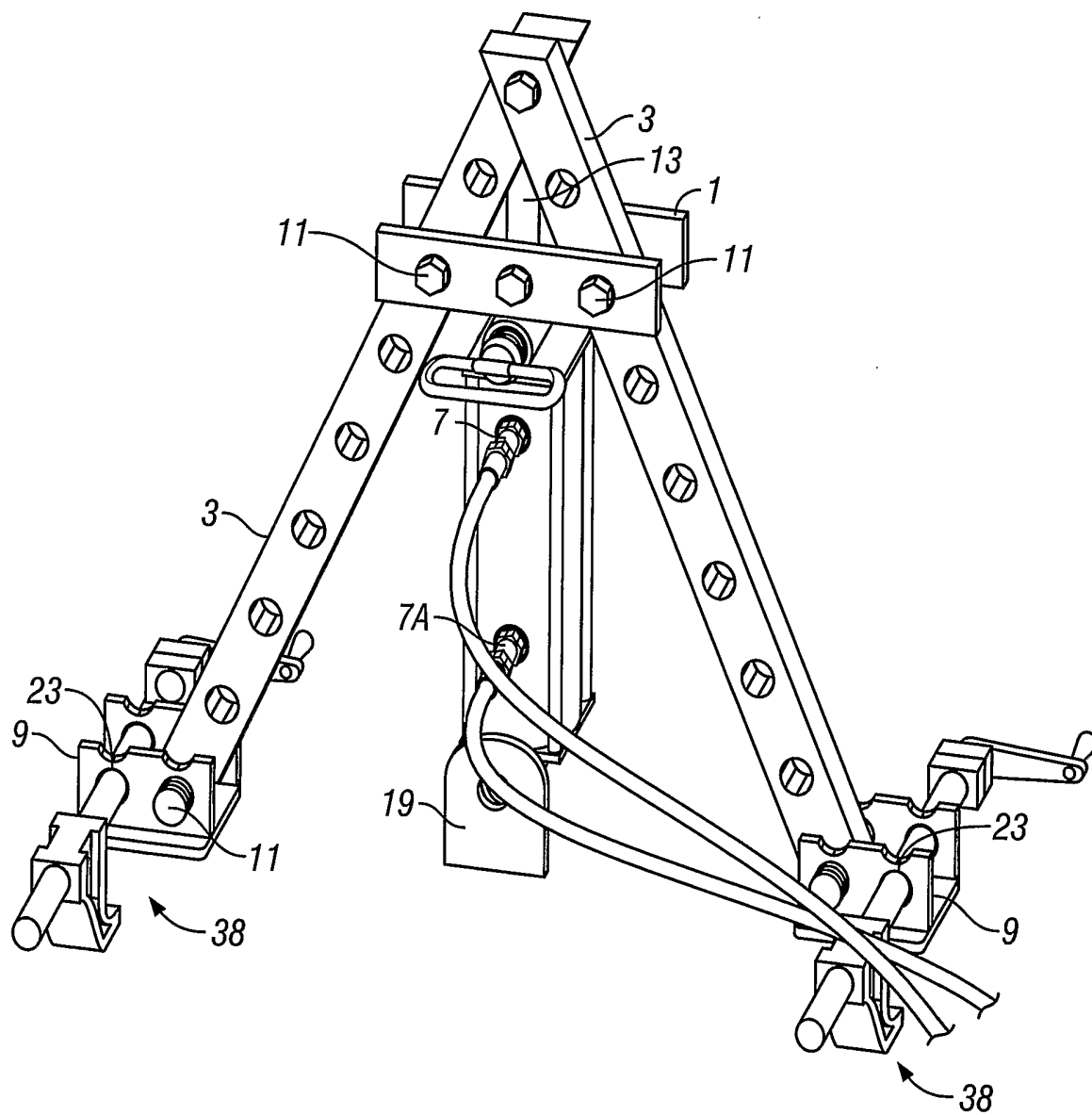


FIG. 8A

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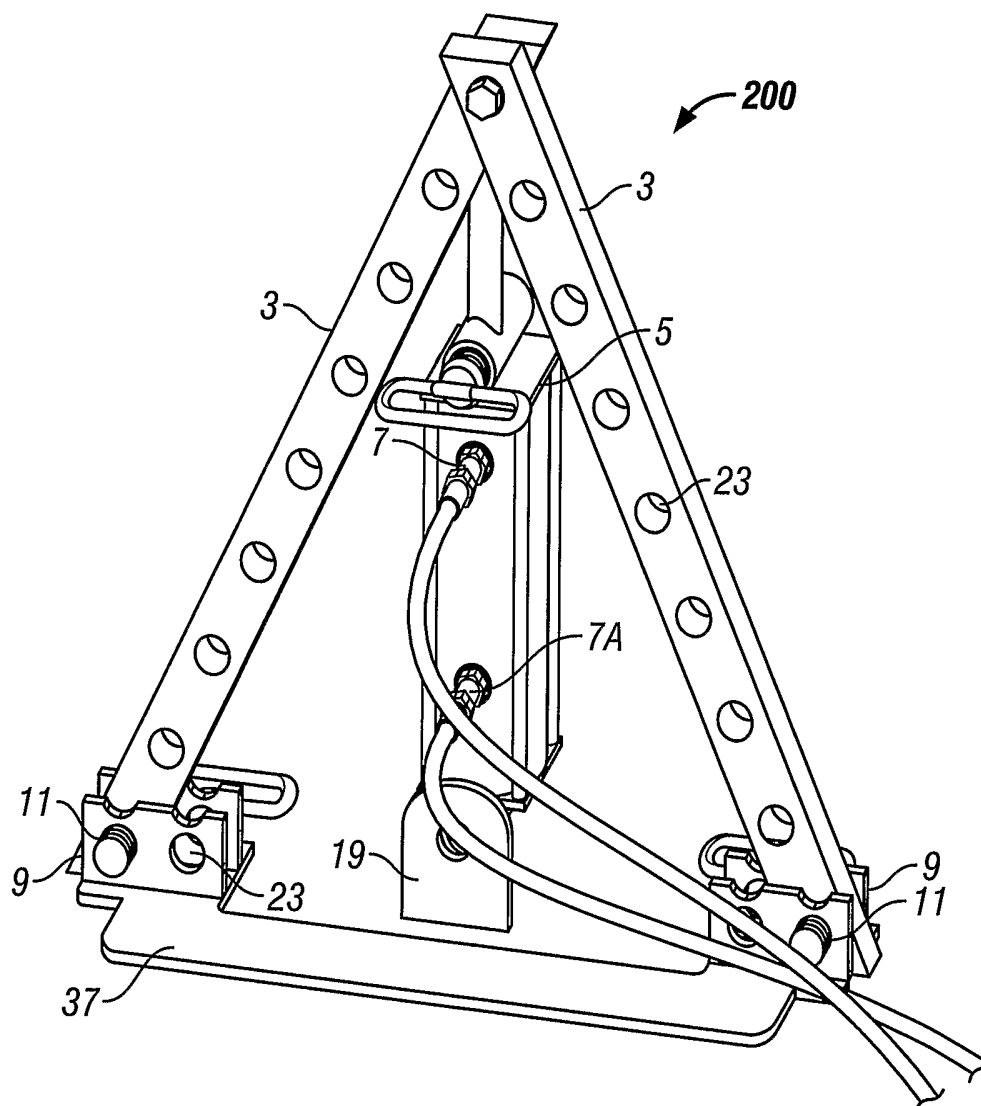


FIG. 9

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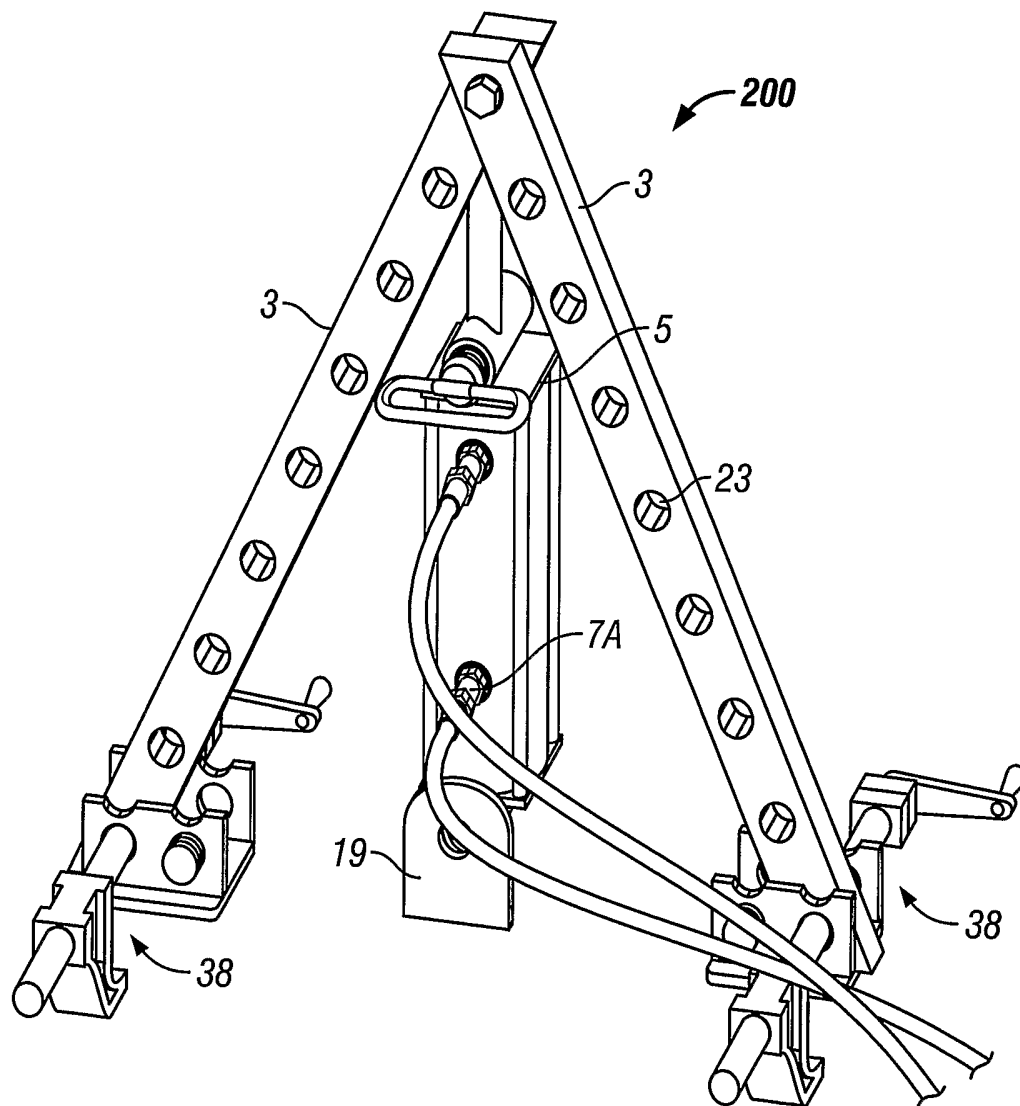


FIG. 9A