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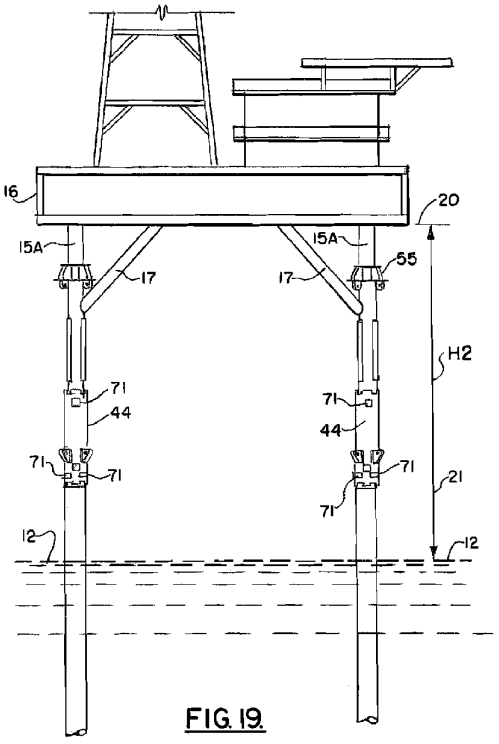


FIG. 19

(57) Abstract: A method of elevating the deck area of a marine platform (e.g., oil and gas well drilling or production platform) utilizes a specially configured sleeve support to support the platform legs so that they can be cut. Once cut, rams or jacks elevate the platform above the cuts. The sleeve support is then connected (e.g., welded) to the platform leg and becomes part of the structural support for the platform. In one embodiment, two sleeves are employed. In another embodiment, the jacks or rams elevate in two stages including a first stage wherein one sleeve elevates and the other sleeve does not elevate and a second stage wherein both sleeves elevate together.

WO 2011/162780 A1

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TITLE OF THE INVENTION

METHOD AND APPARATUS FOR ELEVATING A MARINE PLATFORM

CROSS-REFERENCE TO RELATED APPLICATIONS

Priority of US Provisional Patent Application Serial No. 61/356,813, filed 21 June 2010, incorporated herein by reference, is hereby claimed.

US Patent Applications Serial Nos. 11/749,587 (issued as patent 7,780,375), 12/813,290, and 60/824,005 are hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to marine platforms such as oil and gas well drilling platforms. More particularly, the present invention relates to an improved method and apparatus for elevating the deck area of a fixed marine platform to better protect equipment that is located on the deck area from the effects of a storm (e.g., hurricane, tsunami, typhoon) that generates heightened wave action.

2. General Background of the Invention

There are many fixed platforms located in oil and gas well drilling areas of oceans and seas of the world. Such marine platforms typically employ an undersea support structure that is commonly referred to as a jacket. These jackets can be many hundreds of feet tall, being sized to extend between the seabed and the water surface area. Jackets are typically constructed of a truss-like network of typically cylindrically shaped pipe, conduit or tubing that is welded together. The jackets can be secured to the seabed using pilings that are driven into the seabed. The jacket is then secured to the piling. The part of the offshore marine platform that extends above the jacket and above the water surface is typically manufactured on shore and placed upon the jacket using known lifting equipment such as a derrick barge. This upper portion is the working part of the platform that is inhabited by workers.

Marine platforms can be used to perform any number of functions that are associated typically with the oil and gas well drilling and production industry. Such platforms can be used to drill for oil and gas. Such platforms can also be used to produce wells that have been drilled. These fixed platforms typically provide a deck area that can be crowded with extensive equipment that is used for the drilling and/or production of oil and gas.

20103560066 08 Dec 2016

When storms strike over a body of water, offshore marine platforms are put at risk. While the jacket and platform are typically designed to resist hurricane force wind and wave action, equipment located on the deck of the marine platform can easily be damaged if hurricane generated wave action reaches the deck area.

An additional consequence of wave action reaching the platform deck is catastrophic platform collapse, which happened in several instances during recent storms (e.g., hurricane Katrina in the United States Gulf of Mexico).

BRIEF SUMMARY OF THE INVENTION

The present invention at least alleviates one or more of these prior art problems and shortcomings by providing a method for elevating the deck area of an existing marine platform so that equipment that occupies the deck can be further distanced from the water surface. In one or more embodiments, the method of the present invention provides more clearance, more freeboard and more protection to deck area equipment during severe storms such as hurricanes.

In a first aspect, the present invention provides a method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of a) cutting one of the leg sections at a selected elevation; b) attaching a pair sleeves to the leg section that was cut in step "a" the sleeves being an inner sleeve and an outer sleeve; c) attaching a plurality of hydraulic rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position; d) repeating steps "a" through "b" for the other leg sections of the platform; e) elevating the platform a first distance by extending each ram to the extended position; f) providing pins and pin openings that enable temporary supporting of the leg section above the cut after step "d"; and g) elevating each ram a second distance after step "e"; wherein the outer sleeve is connected to the leg section on one side of the cut; a support ring is connected to the leg section on the other side of the cut; and the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

2010356066 08 Dec 2016

In a second aspect, the present invention provides a method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of a) cutting one of the leg sections at a selected elevation; b) attaching a pair of sleeves to the leg section that was cut in step "a" the sleeves being in telescoping placement, one sleeve inside the other sleeve; c) attaching a plurality of rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position; d) repeating steps "a" through "b" for the other leg sections of the platform; e) elevating the platform a first distance by extending each ram to the extended position; f) providing pins and pin openings that enable temporary supporting of the leg section above the cut after step "d"; and g) elevating each ram a second distance; wherein the outer sleeve is connected to the leg section on one side of the cut; a support ring is connected to the leg section on the other side of the cut; and the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

In a third aspect, the present invention provides a method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of a) cutting one of the leg sections to provide a cut at a selected elevation; b) attaching a pair of sleeves to the leg section that was cut in step "a", the sleeves including inner and outer telescoping sleeves; c) attaching a plurality of hydraulic rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position; d) repeating steps "a" through "b" for the other leg sections of the platform; e) elevating the platform by extending each ram to the extended position, wherein one sleeve travels away from the other sleeve; wherein the outer sleeve is connected to the leg section on one side of the cut; a support ring is connected to the leg section on the other side of the cut; and the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

2010356066 08 Dec 2016

In a fourth aspect, the present invention provides a method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of a) cutting one of the leg sections to provide a cut at a selected elevation; b) attaching a pair sleeves to the leg section that was cut in step "a" the sleeves being an inner sleeve and an outer sleeve; c) attaching a plurality of hydraulic rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position; d) repeating steps "a" through "b" for the other leg sections of the platform; e) elevating the platform by extending each ram to the extended position; wherein the outer sleeve is connected to the leg section on one side of the cut; a support ring is connected to the leg section on the other side of the cut; and the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

In a fifth aspect, the present invention provides a method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of a) cutting one of the leg sections to provide a cut at a selected elevation; b) attaching a pair of sleeves to the leg section that was cut in step "a" the sleeves being in telescoping placement, one sleeve inside the other sleeve; c) attaching a plurality of rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position; d) repeating steps "a" through "b" for the other leg sections of the platform; and e) elevating the platform by extending each ram to the extended position; wherein the outer sleeve is connected to the leg section on one side of the cut; a support ring is connected to the leg section on the other side of the cut; and the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

For a further understanding of the nature, objects, and advantages of the present

invention, reference should be had to the following detailed description, read in conjunction with the following drawings, wherein like reference numerals denote like elements and wherein:

Figure 1 is a schematic, elevation view of a fixed marine platform;

Figure 2 is a perspective view illustrating a method step of the present invention;

Figure 3 is a perspective view illustrating a method step of the present invention;

Figure 4 is a perspective view illustrating a method step of the present invention, placement of the upper and lower bushing sleeves;

Figure 5 is a partial perspective view of a preferred embodiment of the apparatus of the present invention illustrating placement of the upper and lower bushing sleeves;

Figure 6 is a partial perspective view of a preferred embodiment of the apparatus of the present invention illustrating a method step of the present invention;

Figure 7 is a partial perspective view of a preferred embodiment of the apparatus of the present invention illustrating one of the extension sleeve guides;

Figure 8 is a sectional view taken along lines 8-8 of figure 7;

Figure 9 is a partial elevation view of a preferred embodiment of the apparatus of the present invention illustrating placement of the extension sleeve guides;

Figure 10 is a partial elevation view of a preferred embodiment of the apparatus of the present invention showing positions of the leg cuts;

Figure 11 is a partial perspective exploded view of a preferred embodiment of the apparatus of the present invention;

Figure 12 is a partial perspective view of a preferred embodiment of the apparatus of the present invention illustrating the method of the present invention, placement of the upper ring;

Figure 13 is a partial elevation view of a preferred embodiment of the apparatus of the present invention illustrating placement of the upper ring;

Figure 14 is a partial perspective exploded view of a preferred embodiment of the apparatus of the present invention illustrating placement of the hydraulic pistons;

Figure 15 is a partial perspective view of a preferred embodiment of the apparatus of the present invention illustrating placement of the hydraulic pistons;

Figure 16 is a fragmentary elevation view illustrating the method of the present invention, namely the step of completing the leg cuts;

Figure 17 is a fragmentary perspective of a preferred embodiment of the apparatus of the present invention illustrating extension of the leg with the hydraulics pistons;

Figure 18 is a partial perspective view of a method and apparatus of the present invention, showing a method step of closing the sleeve openings;

Figure 19 is an elevation view of a preferred embodiment of the apparatus of the present invention illustrating the marine platform after its deck area has been elevated using the method and apparatus of the present invention;

Figure 20 is a partial elevation view of an alternate embodiment and method of the present invention illustrating an existing deck elevation prior to being elevated using an alternate embodiment of the apparatus of the present invention;

Figure 21 is an elevation view illustrating an alternate method and apparatus of the present invention and showing an initial deck lift;

Figure 22 is a partial perspective view of an alternate method and apparatus of the present invention;

Figure 23 is a partial perspective view of an alternate embodiment of the apparatus of the present invention;

Figure 24 is a fragmentary elevation view of an alternate embodiment of the apparatus of the present invention and alternate method;

Figure 25 is a fragmentary perspective view of an alternate embodiment of the apparatus and method of the present invention;

Figure 26 is a fragmentary perspective view of an alternate embodiment of the apparatus and method of the present invention;

Figure 27 is a fragmentary perspective view of an alternate embodiment of the apparatus and method of the present invention showing the locking pin; and

Figure 28 is a partial perspective view of an alternate embodiment of the apparatus of the present invention illustrating a sleeve and a half-pipe pin trough that is used to support the pins prior to insertion;

Figure 29 is a partial elevation view of an alternate embodiment of the apparatus of the present invention showing an alternate method of the present invention;

Figure 30 is a partial elevation view of an alternate embodiment of the apparatus of the present invention showing an alternate method of the present invention;

Figure 31 is a partial elevation view of an alternate embodiment of the apparatus

of the present invention showing an alternate method of the present invention;

Figure 32 is a partial elevation view of an alternate embodiment of the apparatus of the present invention showing an alternate method of the present invention;

Figure 33 is a partial elevation view of an alternate embodiment of the apparatus of the present invention showing an alternate method of the present invention;

Figure 34 is a perspective view of an alternate embodiment of the apparatus of the present invention and illustrating an alternate method of the present invention;

Figure 35 is an exploded elevation view illustrating an alternate embodiment of the apparatus of the present invention and an alternate method of the present invention;

Figure 36 is a fragmentary view of an alternate embodiment of the apparatus of the present invention;

Figure 37 is a fragmentary view of an alternate embodiment of the apparatus of the present invention;

Figure 38 is a partial sectional elevational view of an alternate embodiment of the apparatus of the present invention;

Figure 39 is a partial sectional elevational view of an alternate embodiment of the apparatus of the present invention; and

Figure 40 is a partial sectional elevational view of an alternate embodiment of the apparatus of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a marine platform deck elevating system 10 that is shown generally in figures 14-15 and 17 and in method steps that are illustrated in figures 2-18.

In figure 1, a fixed marine platform 11 is shown having a deck 16 that is positioned at an elevation 18 that is elevated above the water surface 12 a distance H1 that is indicated by the numeral 19 in figure 1. The numeral 19 and the dimension line H1 represent the existing clearance above water. It is necessary to protect equipment that is contained on the deck 16 from storm generated wave action. Storms such as hurricanes can generate a storm surge and wave action that puts equipment and/or personnel located on deck 16 at peril. If a deck is not located at a safe elevation, it must be elevated. Figure 1 illustrates a typical fixed platform 11 having a plurality of legs 14 that support the deck 16. Diagonal braces 17 can extend between legs 14 and deck 16 as shown in

figure 1. The platform 11 can include other structures such as, for example, horizontal beams or members and/or additional vertical or diagonal members.

Legs 14 can be of a constant diameter or can include tapered sections 13, wherein the diameter of the upper leg section 15A is less than the diameter of the lower leg section 15B. Leg 14 can thus include a number of different leg sections such as a lower, larger diameter leg section 15B, a tapered leg section 13, and an upper, smaller diameter leg section 15A that is positioned above the tapered section 13. The method and apparatus of the present invention can be used to elevate the deck 16 to a new elevation 20 (see figure 19) that is higher than the previous, existing deck elevation 18 of figure 1. The method and apparatus of the present invention thus provides a new clearance 21 above water surface 12 (also shown by the arrow H2 in figure 19).

Figures 2 and 3 illustrate an initial method step of the present invention, namely the placement of lower bushing sleeve 24. The lower bushing sleeve 24 can be comprised of a pair of half sleeve sections 22, 23 as shown in figures 2-3. The sections 22, 23 can be joined with welds 26 as shown in figures 3-4. Arrows 25 in figure 2 schematically illustrate the placement of sleeve sections 22, 23 upon leg 14 at a position below tapered section 13 as shown.

In figures 4-6, upper bushing sleeve 29 can also be comprised of a pair of sleeve half sections. The sleeve sections 27, 28 each provide an opening 35 or 36 that is receptive of a pin 50 as will be explained more fully hereinafter. Weld ring sections 30, 31 can be used to attach the sleeve sections 27, 28 to tapered section 13. As with the lower bushing sleeve 24, one or more welds 37 can be used to join the sleeve sections 27, 28 to each other. Arrows 33 in figure 4 illustrate the placement of sleeve sections 27, 28 upon tapered section 13. Arrows 34 in figure 4 illustrate the attachment of weld ring 32 to the assembly of sleeve sections 27, 28 and to tapered section 13.

In figures 6-9 and 11, a plurality of extension sleeve guides 38 are shown. These extension sleeve guides 38 are attached to the platform 11 leg 14 at a position that is above upper bushing sleeve 29. The extension sleeve guides 38 can extend from tapered section 13 to smaller diameter leg section 15A as shown in figures 6 and 9. Arrows 39 illustrate placement of extension sleeve guides 38 to leg 14. Each extension sleeve 38 can be comprised of flanges 40 and webs 41. The web 41 actually contacts the leg 14 and can be shaped to conform to the shapes of tapered section 13 and smaller diameter leg

section 15A as shown in figures 7 and 9 (see DIM "A", figure 7).

In figures 10-15, an extension sleeve 44 can be comprised of a pair of extension sleeve sections 45, 46. Each extension sleeve section 45, 46 has slots 47, 48 that can be used to complete a cut through the leg 14 after the sleeve sections 45, 46 have been attached to leg 14 and guides 38.

Before attachment of the sleeve sections 45, 46, four cuts are made through leg 14 as shown in figure 10. The cuts 42, 43 do not extend 360 degrees around the leg 14, but rather extend only a partial distance as shown in figure 10. Though partial cuts 42, 43 are made, enough of the leg 14 remains to structurally support the platform 11 and its deck 16 considering the use of sleeve 44 and the method of the present invention disclosed herein.

After the sleeve sections 45, 46 have been installed, a cut can be made to encircle the leg 14 thus severing it in two parts. In order to complete the cut, slots are provided in the sleeve sections 45, 46. In figure 11, the sleeve section 45 has slot 47. In figure 11, the sleeve section 46 has slot 48.

After installing the upper bushing sleeve 29, circular cut openings 49 are made through the leg 14 at the openings 35, 36 in the sleeve sections 27, 28. These cut openings 49 enable pin 50 to be placed through the openings 67, 68 in sleeve sections 45, 46 respectively as well as through the openings 49 in upper bushing sleeve 29. Pin 50 prevents uplift from damaging the platform 11 should a storm produce excess wave action before the method of the present invention can be completed.

Each of the sleeve sections 45, 46 provides lugs to which hydraulic pistons can be attached. Sleeve section 45 provides a plurality of lugs 51. Sleeve section 46 provides a plurality of lugs 52. Each of the lugs provides an opening for enabling a pinned connection to be made between the lugs 51, 52 and the hydraulic pistons 64. Lugs 51 provide openings 53. Lugs 52 provide openings 54. In a preferred method and apparatus, four pairs of lugs 51, 52 are thus provided to the extension sleeve 44. Each pair of lugs 51, 52 can be spaced circumferentially about sleeve 44, about 90 degrees apart.

A ring 55 is positioned above extension sleeve 44 as shown in figures 12-15 and 17-19. Ring 55 is used to form a connection between the leg 14 and the hydraulic piston 64. Ring 55 can be formed of a pair of ring sections 56, 57 that are attached to the smaller diameter leg section 15A as shown in figures 12 and 13. Each of the ring

sections 56, 57 provides a plurality of lugs 58, 59. The ring section 56 has lugs 58. The ring section 57 has lugs 59. Each lug 58, 59 has a lug opening 60 that enables a pinned connection to be made between a lug 58 or 59 and a piston 64. Each ring section 56, 57 can be formed of arcuate generally horizontal plate sections and vertical plate sections. Each of the ring sections 56, 57 thus provide an upper arcuate plate section 61 and a lower arcuate plate section 62. Vertical plate sections 63 span between the upper and lower arcuate plate sections 61, 62.

Hydraulic pistons 64 are provided for elevating that portion of the leg 14 that is above the cuts that are made through the leg 14 (see figures 10 and 16). Preferably three (3) or four (4) pistons can be used, but as few as two (2) rams can be used or more, such as many as eight (8) could be used, for example.

Each hydraulic piston 64 can be comprised of a cylinder 65 and an extensible push rod 66. Each end portion of hydraulic piston 64 provides an opening 69 on cylinder 65 that enables a pinned connection to be formed between each end of hydraulic piston 64 and lugs 51, 52 or 58, 59. The upper end portion of each hydraulic piston 64 attaches with a pinned connection to a lug 58 or 59 that is a part of ring 55. The lower end portion of each hydraulic piston 64 forms a pinned connection with the lugs 51, 52 of extension sleeve 44 as shown in figures 14-15. Arrows 74 in figure 14 illustrate assembly of pistons 64 to lugs 51, 52, 58, 59.

Once the hydraulic pistons 64 have been installed to the position shown in figure 15, a cut can be completed for severing leg 14. This can be seen in more detail in figures 10, 15-16 wherein the previously formed cuts 42, 43 are shown. Notice that uncut portions 70 (DIM "B", figure 16) of leg 14 align with the slots 47 or 48 of sleeve sections 45, 46. The leg 14 can thus be cut 360 degrees by cutting the previously uncut section 70 at slot 47 or 48, indicated by phantom lines as cut 73 in figure 16. The three hundred sixty degree cut (42, 43, 73) is made after the extension sleeve 14, hydraulic pistons 64 and ring 55 form a structural support of the leg 14 above and below the cuts 42, 43. In order to then elevate the smaller diameter leg section 15A relative to the larger diameter leg section 15B below tapered section 13, each hydraulic piston 64 can be activated as illustrated by arrows 72 in figure 17.

Once elevated, the various openings and slots in sleeve 44 can be covered for corrosion protection using a plurality of curved cover plate sections 71. To complete the

repair, the sleeves 44 can be welded to the leg 14 and using shims as necessary between sleeve 44 and leg 14, tapered section 13 or sections 15A, 15B. While the method disclosed herein contemplates that the elevation process would preferably take place as one jacking operation, the invention should not be so restricted. The method of the present invention contemplates a method wherein the jacking process could be subdivided into several smaller (or shorter) jacking elevations. The legs 14 would be pinned off at an intermediate point and the jacks moved to a second set of lugs. Arrow 75 in figure 17 shows the distance that the upper leg section 15A is elevated.

Figures 20-40 show an alternate embodiment of the apparatus of the present invention designated generally by the numeral 80 in figures 30-34. Marine platform deck elevating system 80 can be used to elevate the same deck 16 that was shown and described with respect to figures 1-19. Therefore, the figures 20-40 are schematic in that they do not show each and every part of the marine deck 16 to be elevated. Figures 5, 24, 29, 30 illustrate an existing deck elevation 18. The numeral 85 illustrates a spacing or clearance (for example, 20 feet (6.1 m)) between deck or upper deck 16 and a lower deck or lower deck portion 84.

A plurality of legs 83 span between the lower deck portion 84 and the deck or upper deck 16. Each of the legs 83 will be elevated using the method and apparatus of the present invention. An alternate method and apparatus 80 shown in figures 20-40 can employ a two stage deck elevation. In figure 30, the existing deck elevation 18 is shown. In figure 31, an initial or first new deck elevation 81 is shown having a second clearance or elevation 86 (for example, 28 feet (8.5 m)). This second clearance 86 is thus an increase of 8 feet (2.4 m) (for example) over the initial clearance 85 of figure 20. In figure 31, the deck or upper deck 16 is now spaced 28 feet (8.5 m), as an example, above the lower deck portion 84.

In figure 31, a plurality of hydraulic rams or hydraulic jacks 102 have moved from the initial and collapsed position of figure 30 to a partially or first elevation. In figure 32, the hydraulic rams 102 employed are two stage rams having a first push rod 106 and a second push rod 107 which is inside and which telescopes with the first push rod 106. Such hydraulic rams 102 are commercially available, wherein the ram 102 has a first push rod 106 that telescopes inside of a lower ram cylinder 108 and a second push rod 107 that telescopes inside of the first push rod 106. In figures 32, 33, 34 and 40, the deck 16 or

upper deck has been elevated an additional 8 feet (2.4 m)to elevation or level at 82 so that the clearance or third clearance 87 in figures 32-34 and 40 is now a spacing or clearance of 36 feet (11 m), as an example, between lower deck portion 84 and deck or upper deck 16. In figure 34, four legs 83 are shown, each having been extended a full clearance 87 (36 feet (11 m) per the example).

The method and apparatus of the present invention employs two sleeves 95, 101 in order to accomplish the elevation of deck or upper deck 16 relative to lower deck portion 84. Figures 20-21 illustrate that each leg 83 has a lower portion 88 and an upper portion 89. Partial cuts 90 are made in the leg 83 upper portion 89. These partial cuts through the deck legs can be, for example, about 45 degrees of the circumference of the leg 83. These partial cuts 90 can also be spaced circumferentially about leg 83 in equal amounts such as a spacing of about 45 degrees apart. Pin receptive openings 91 are formed in leg 83 upper portion 89 just below the partial cuts 90 and 180 degrees apart as shown in figure 21. After formation of the openings 91, an inner/upper sleeve 95 is affixed to upper leg 89 above the partial cuts 90 (see figures 23-25). For example, the connection of sleeve 95 to upper portion 89 of leg 83 can be a welded connection. A lower support ring 92 is attached (for example, welded) to leg 83 lower portion 88 and spaced vertically below inner/upper sleeve 95 as shown in figure 24. Upper ring 97 is affixed (e.g., welded) to upper portion 89. The lower support ring 92 provides a plurality of padeyes 93, namely, one for each hydraulic ram 102 or a total of four padeyes 93 for the example shown in the drawings. Each padeye 93 provides a padeye opening 94 to which a pinned connection can be made between a ram 102 and a padeye 93. Each ram 102 can have openings or sleeves or bearings at its end portions for enabling a pinned connection to be perfected with a padeye 93 or 98.

The inner/upper sleeve 95 has sleeve openings 96. Sleeve opening 96 can be provided on sleeve 95 spaced 180 degrees apart as shown in figure 23. Similarly, there are two openings 91 in leg 83, the openings 91 being spaced about 180 degrees apart. In this fashion, when the rams 102 extend, the openings 96 will align with the openings 91 so that a locking pin 50 (figures 27, 28) can be placed through the aligned openings 91, 96. An upper ring 97 can be a part of sleeve 95. The upper ring 97 is above the partial cuts 90 as shown in figure 24. A plurality of padeyes 98 are affixed to ring 97, each padeye 98 providing a padeye opening 99.

Multiple windows 100 are provided. The windows 100 (for example, four windows 100) are centered over each of the uncut portions of the leg 83 that are in between the partial cuts 90. In this fashion, once the sleeves 95 and rams 102 are attached as shown, the leg 83 upper 89 and lower 88 portions are structurally supported by the combination of sleeve 95 and rams 102. Cuts can be made through the windows 100 of the sleeve 95 to cut the remaining uncut portion of leg 83 so that the leg 83 is now cut 360 degrees and ready for elevation of upper part 89 relative to lower part 88.

In figures 29-33 and 38-40, an outer/lower sleeve 101 is attached to leg 83 in between the bottom of sleeve 95 and the lower support ring 92. Pinned connections 103 join each hydraulic ram 102 to the padeyes 93 of lower support ring 92 at openings 94. A lower ram pin 108 is shown in figure 31 forming a pinned connection between hydraulic ram 102 and a pair of padeyes 93. Similarly, a pinned connection 104 is formed between second push rod 107 of hydraulic ram 102 and padeyes 98 at openings 99. In figure 31, an upper ram pin 109 is shown making a connection between push rod 107 and padeyes 98 at openings 99.

A pin trough 105 can be employed (e.g., welded to a sleeve 95, 101 as shown) for holding a generally cylindrically shaped locking pin 50 prior to use. The pins 50 can be placed in the trough (see figure 28) and retained in that position until they are ready to be deployed. Locking pins 50 can thus be inserted in case of storm conditions when a first stage of the lift is completed as shown in figure 21 wherein the pin 50 would extend through to spaced apart openings 110 at the top of the lower/outer sleeve 101 through both openings 96 in the upper/inner sleeve 95 and through both openings 91 of the leg 83.

In a fully extended position of figures 32-34 and 40, pin 50 is inserted through both openings 111 at the lower end of the outer sleeve 101 and the openings 91 of the leg 83. A pin 50 is also inserted through the upper opening 110 of the outer/lower sleeve 101 and through the openings 96 of the inner/upper sleeve 95 as shown in figures 32-34 and 40. After installation, each sleeve 95, 101 is connected (e.g., welded) to leg 83. Inner sleeve 95 is welded to upper portion 89 of leg 83. Outer sleeve 101 is welded to lower portion 88 of leg 83. The sleeves 95, 101 are connected (e.g., welded) together once full elevation (figures 22, 23) is reached. Strokes or vertical spacers 112 can be placed (e.g., welded) on each leg 83 (see figures 35, 38-40) as shown by arrow 113. Collar 114 having

openings 115 can be used to reinforce leg 83 at openings 91.

The following is a list of parts and materials suitable for use in the present invention.

PARTS LIST

Part Number	Description
10	marine platform deck elevating system
11	platform
12	water surface
13	tapered section
14	leg
15A	smaller diameter leg section
15B	larger diameter leg section
16	deck/upper deck
17	diagonal brace
18	existing deck elevation
19	existing clearance above water
20	new deck elevation
21	new clearance above water
22	sleeve section
23	sleeve section
24	lower bushing sleeve
25	arrow
26	weld
27	sleeve section
28	sleeve section
29	upper bushing sleeve
30	weld ring section
31	weld ring section
32	weld ring
33	arrow
34	arrow
35	opening

36	opening
37	weld
38	extension sleeve guide
39	arrow
40	flange
41	web
42	cut
43	cut
44	extension sleeve
45	extension sleeve section
46	extension sleeve section
47	slot
48	slot
49	drilled/circular cut opening
50	support/locking pin
51	lug
52	lug
53	opening
54	opening
55	ring
56	ring section
57	ring section
58	lug
59	lug
60	lug opening
61	upper arcuate plate section
62	lower arcuate plate section
63	vertical plate section
64	hydraulic piston
65	cylinder
66	push rod
67	opening

68	opening
69	opening
70	uncut portion
71	cover plate
72	arrows
73	cut
74	arrow
75	arrow
80	marine platform deck elevating system
81	first new deck elevator
82	second new deck elevator
83	leg
84	lower deck portion
85	initial clearance
86	second clearance
87	third clearance
88	lower portion
89	upper portion
90	partial cut
91	pin receptive opening
92	lower support ring
93	padeye
94	padeye opening
95	inner/upper sleeve
96	sleeve opening
97	ring
98	padeye
99	padeye opening
100	window
101	outer/lower sleeve
102	hydraulic ram
103	pinned connection

104	pinned connection
105	pin trough
106	first push rod
107	second push rod
108	lower ram pin
109	upper ram pin
110	upper opening
111	lower opening
112	stroke/vertical spacer
113	arrow
114	collar
115	opening

All measurements disclosed herein are at standard temperature and pressure, at sea level on Earth, unless indicated otherwise. All materials used or intended to be used in a human being are biocompatible, unless indicated otherwise.

The foregoing embodiments are presented by way of example only; the scope of the present invention is to be limited only by the following claims.

2010356066 08 Dec 2016

CLAIMS

The claims defining the invention are as follows:

1. A method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of:

a) cutting one of the leg sections at a selected elevation;

b) attaching a pair of sleeves to the leg section that was cut in step "a", the sleeves being an inner sleeve and an outer sleeve;

c) attaching a plurality of hydraulic rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position;

d) repeating steps "a" through "b" for the other leg sections of the platform;

e) elevating the platform a first distance by extending each ram to the extended position;

f) providing pins and pin openings that enable temporary supporting of the leg section above the cut after step "d"; and

g) elevating each ram a second distance after step "e";

wherein the outer sleeve is connected to the leg section on one side of the cut;

a support ring is connected to the leg section on the other side of the cut; and

the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

2. A method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of:

a) cutting one of the leg sections at a selected elevation;

b) attaching a pair of sleeves to the leg section that was cut in step "a", the sleeves being in telescoping placement, one sleeve inside the other sleeve;

20103560066 08 Dec 2016

c) attaching a plurality of rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position;

d) repeating steps "a" through "b" for the other leg sections of the platform;

e) elevating the platform a first distance by extending each ram to the extended position;

f) providing pins and pin openings that enable temporary supporting of the leg section above the cut after step "d"; and

g) elevating each ram a second distance;

wherein the outer sleeve is connected to the leg section on one side of the cut;

a support ring is connected to the leg section on the other side of the cut; and

the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

3. The method of claim 2 wherein one sleeve elevates above the other sleeve in step "e".

4. A method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of:

a) cutting one of the leg sections to provide a cut at a selected elevation;

b) attaching a pair of sleeves to the leg section that was cut in step "a", the sleeves including inner and outer telescoping sleeves;

c) attaching a plurality of hydraulic rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position;

d) repeating steps "a" through "b" for the other leg sections of the platform; and

20103560066 08 Dec 2016

e) elevating the platform by extending each ram to the extended position, wherein one sleeve travels away from the other sleeve;

wherein the outer sleeve is connected to the leg section on one side of the cut;

a support ring is connected to the leg section on the other side of the cut; and

the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

5. The method of claim 4 further comprising placing the rams on the outside of the leg section and circumferentially spacing the rams.

6. The method of claim 4 wherein in step "b" at least one sleeve is comprised of a plurality of connectable sections and attaching the sleeve in step "b" includes affixing the connectable sections to the leg to form the sleeve.

7. The method of claim 4 further comprising affixing lugs above and below the cut and attaching the rams to the leg sections at the lugs.

8. The method of claim 4 wherein the sleeves laterally stabilize the leg sections above the cut during step "e".

9. The method of claim 4 wherein in step "c" there are at least three rams attached to each leg section.

10. The method of claim 4 wherein in step "c" there are between two (2) and eight (8) rams attached to each leg section.

11. The method of claim 4 wherein each leg section is elevated above the cut a distance of more than four feet (1.2 m).

12. The method of claim 4 wherein each leg section is elevated above the cut

a distance of more than five feet (1.5 m).

13. The method of claim 4 wherein each leg section is elevated above the cut a distance of between about 5 and 30 feet (1.5 and 9.1 m).

14. The method of claim 4 wherein each leg section is carrying a load of between 100 and 2,000 tons (90.7 and 1,814 metric tons).

15. The method of claim 4 further comprising the step of welding the sleeves to the leg sections after step "e".

2010356066 08 Dec 2016

16. The method of claim 4 further comprising the step of temporarily supporting the leg section above the cut with a pin that extends through aligned openings of the sleeve and the leg section.

17. The method of claim 16 further comprising reinforcing the leg section next to the pin with a section of curved plate welded to the leg section on its outer surface.

18. A method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of:

a) cutting one of the leg sections to provide a cut at a selected elevation;

b) attaching a pair of sleeves to the leg section that was cut in step "a", the sleeves being an inner sleeve and an outer sleeve;

c) attaching a plurality of hydraulic rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position;

d) repeating steps "a" through "b" for the other leg sections of the platform; and

e) elevating the platform by extending each ram to the extended position;

wherein the outer sleeve is connected to the leg section on one side of the cut;

a support ring is connected to the leg section on the other side of the cut; and

the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

19. The method of claim 4 or 18 further comprising the step of temporarily supporting the leg section above the cut with a pin that extends through aligned openings of the sleeve and the leg section.

20. A method of elevating a marine platform that is supported by a plurality of hollow metallic leg sections that extend above and below a water line of a body of water, comprising the steps of:

a) cutting one of the leg sections to provide a cut at a selected elevation;

2010356066 08 Dec 2016

b) attaching a pair of sleeves to the leg section that was cut in step "a", the sleeves being in telescoping placement, one sleeve inside the other sleeve;

c) attaching a plurality of rams to the leg sections, each ram having a hollowed cylinder and an extensible push rod and first and second end portions, the rams being attached to the leg section at the end portions, one end portion being attached to the leg section above the cut and the other end portion being attached to the leg section below the cut, and wherein each ram has a retracted and an extended position;

d) repeating steps "a" through "b" for the other leg sections of the platform; and

e) elevating the platform by extending each ram to the extended position;

wherein the outer sleeve is connected to the leg section on one side of the cut;

a support ring is connected to the leg section on the other side of the cut; and

the end portions of the hydraulic rams are respectively connected to the outer sleeve and the support ring.

21. The method of claim 20 wherein one sleeve elevates above the other sleeve in step “e”.

22. The method of claim 2 or 20 further comprising the step of welding each sleeve to the leg section.

23. The method of claim 2 or 20 wherein the sleeves includes an outer lower sleeve and an inner upper sleeve.

24. The method of any one of claims 2, 18, or 20 wherein each sleeve has a sleeve opening that is receptive of a pin, and further comprising the step of inserting a pin through both a sleeve and a leg.

25. The method of any one of claims 1, 2, 4, 18, or 20 wherein each ram has first and second telescoping rod portions comprising said push rod.

26. The method of any one of claims 4, 18, or 20 wherein each push rod extends in two stages including a first stage wherein one sleeve elevates and the other sleeve does not elevate and a second stage wherein both sleeves elevate together.

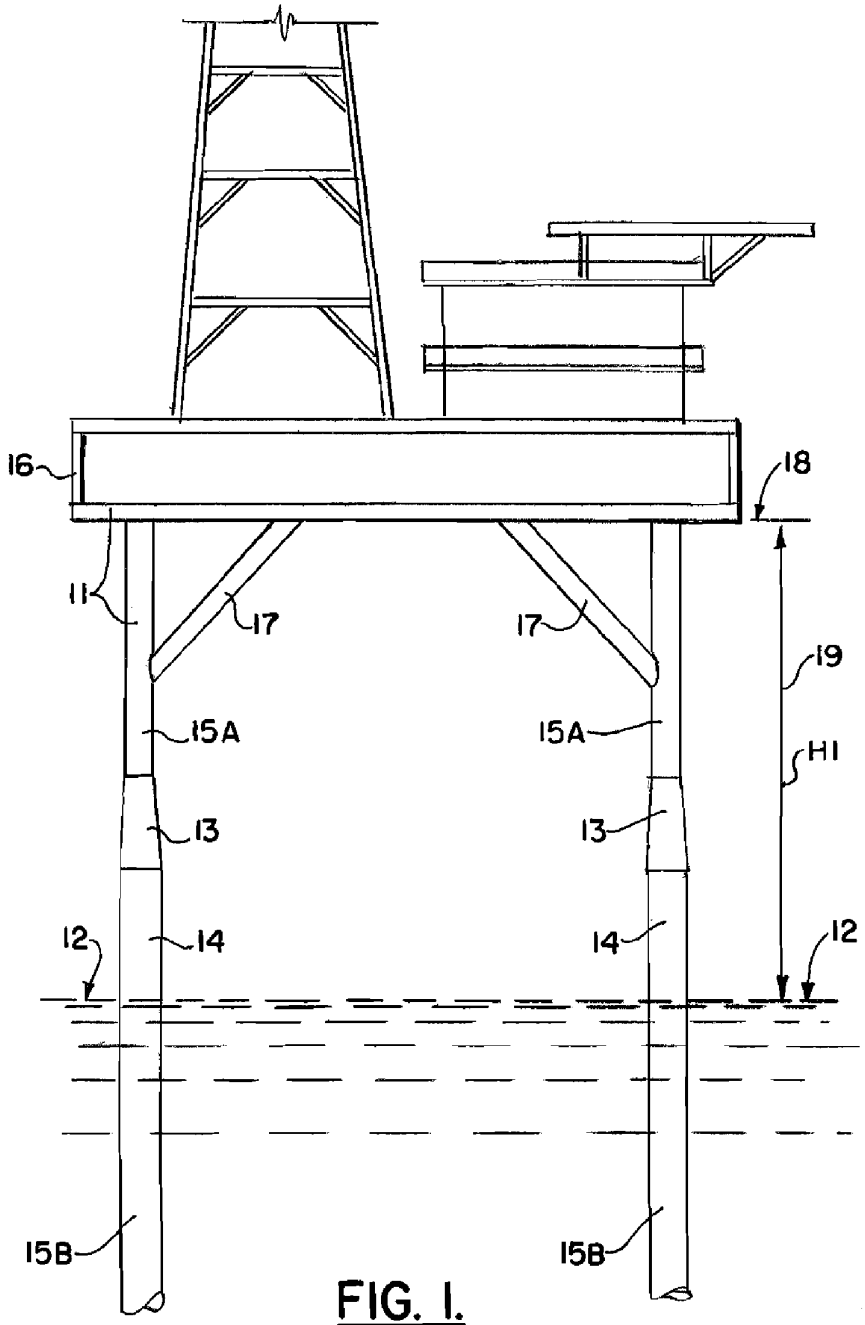


FIG. 1.

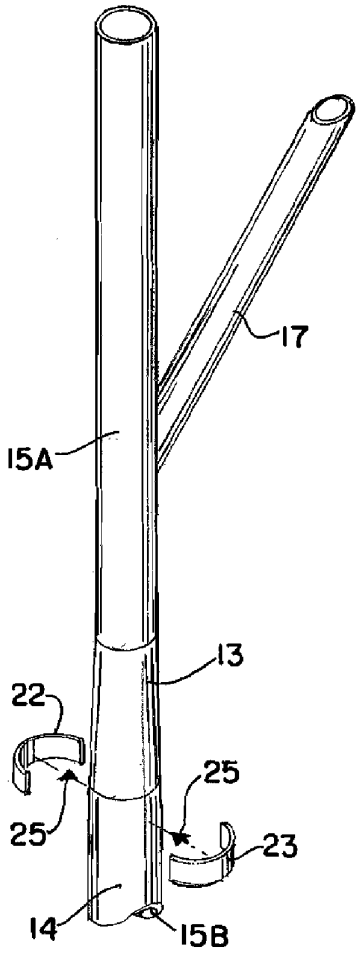


FIG. 2.

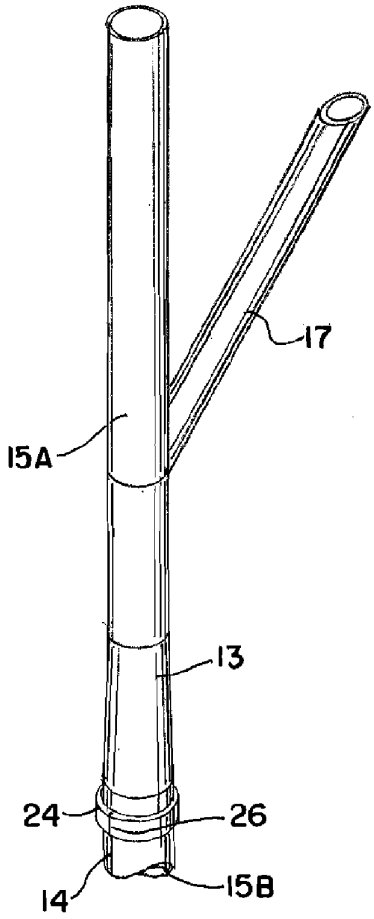


FIG. 3.

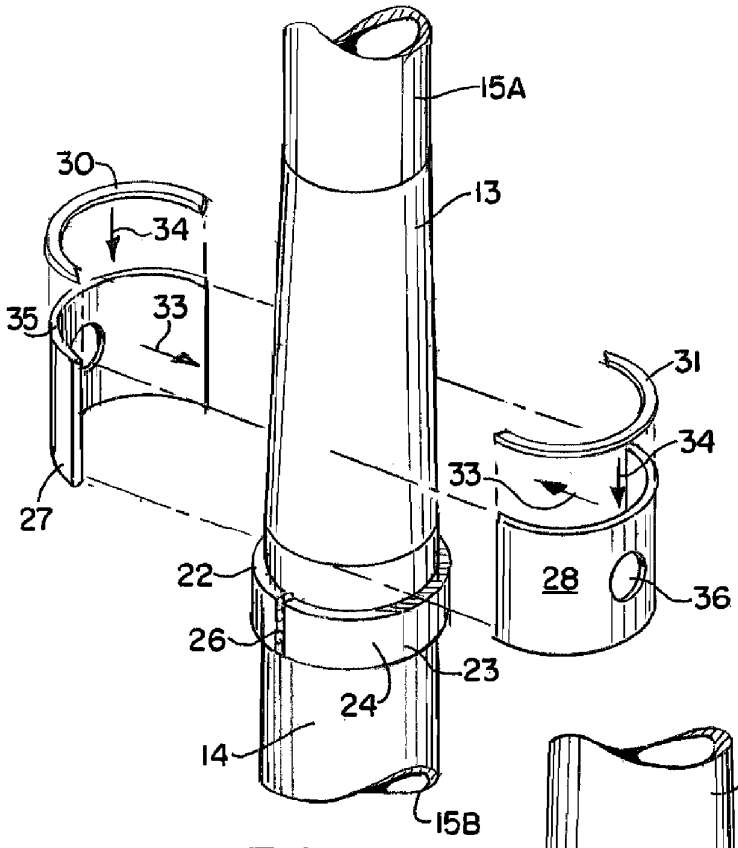

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FIG. 4.

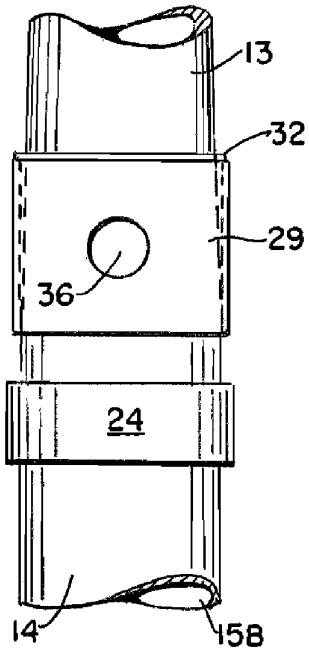

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FIG. 5.

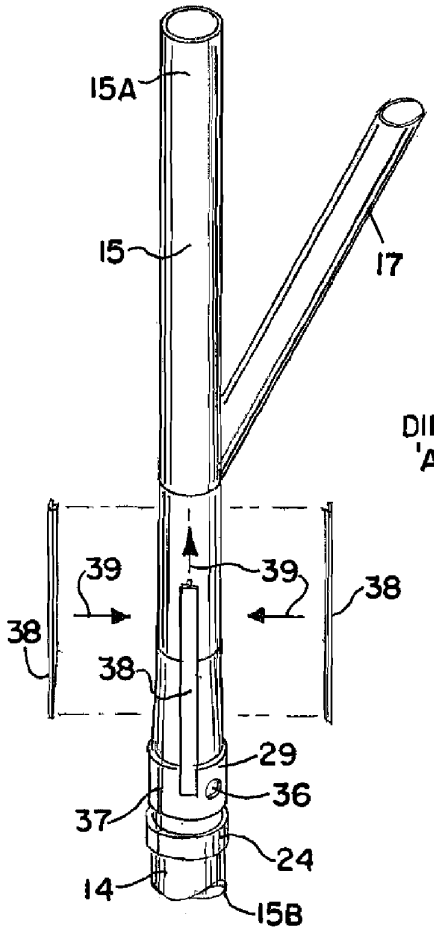


FIG. 6.

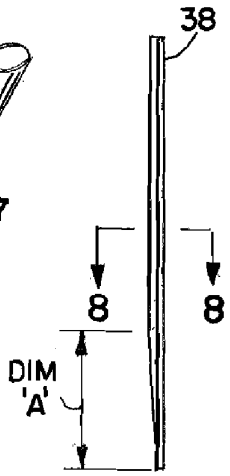


FIG. 7.

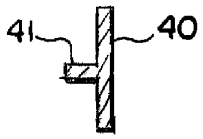


FIG. 8.

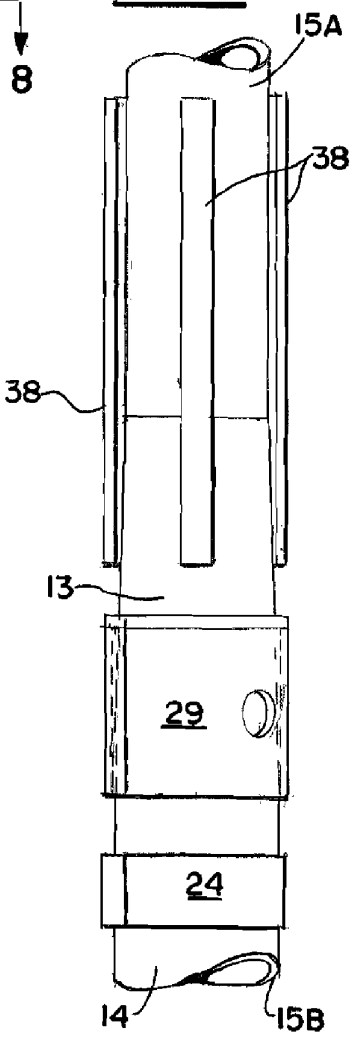


FIG. 9.

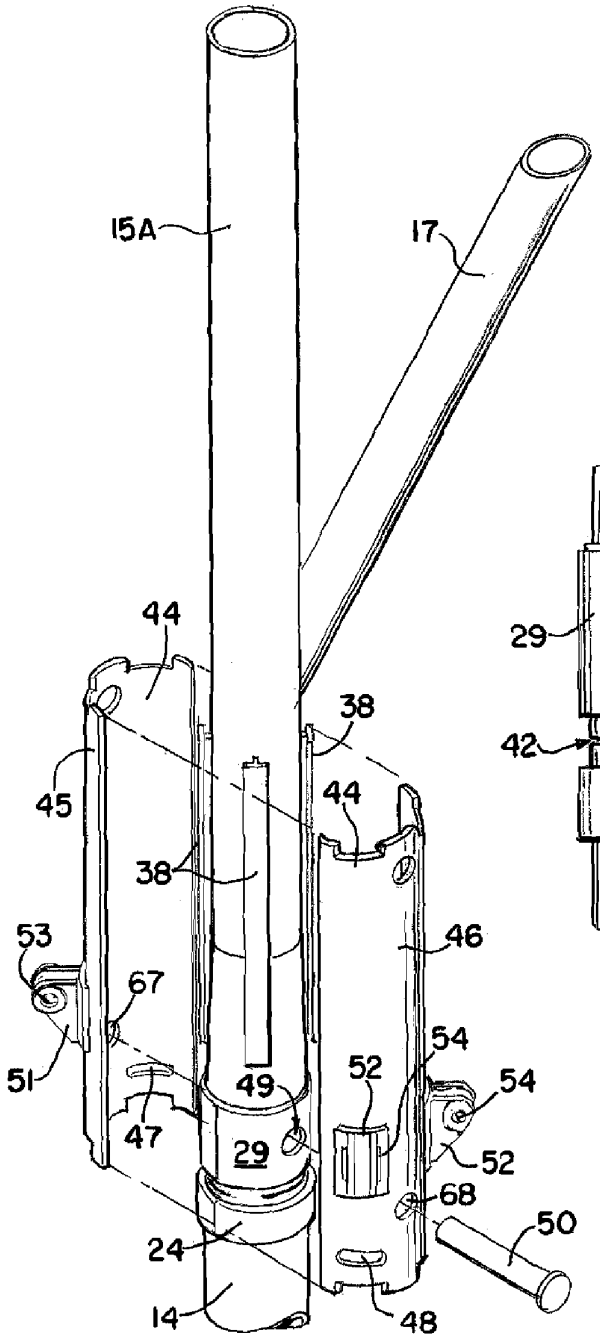

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FIG. 11.

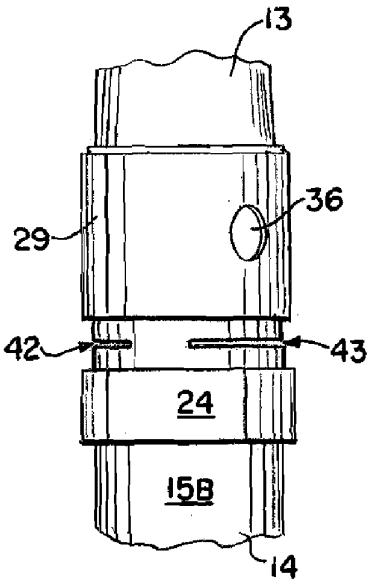

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FIG. 10.

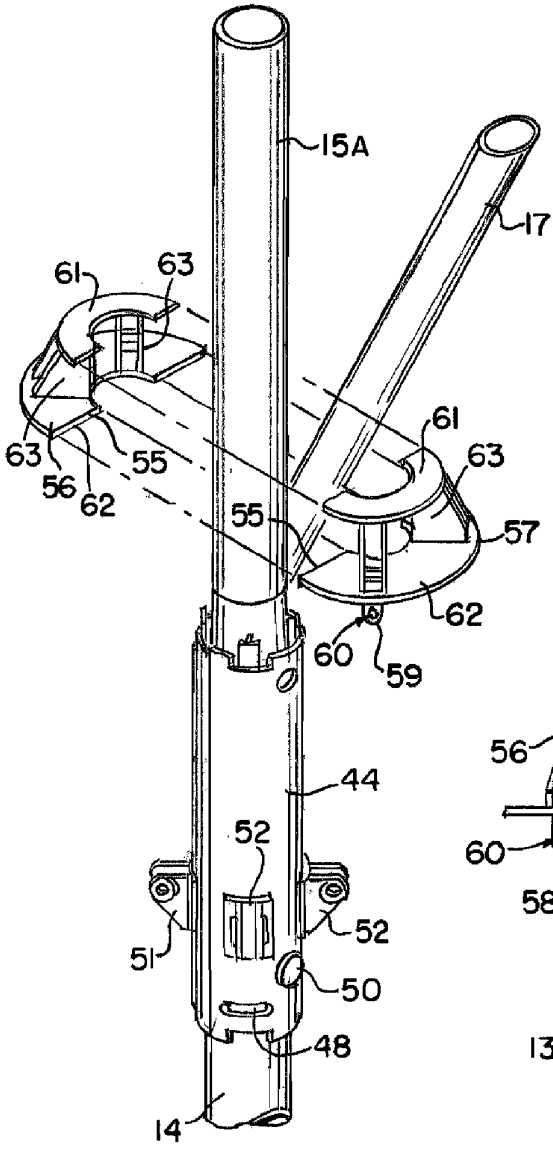

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FIG. 12.

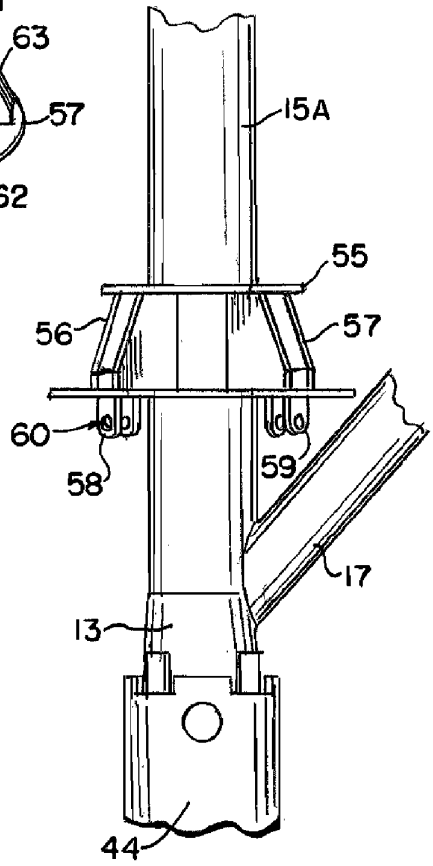

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FIG. 13.

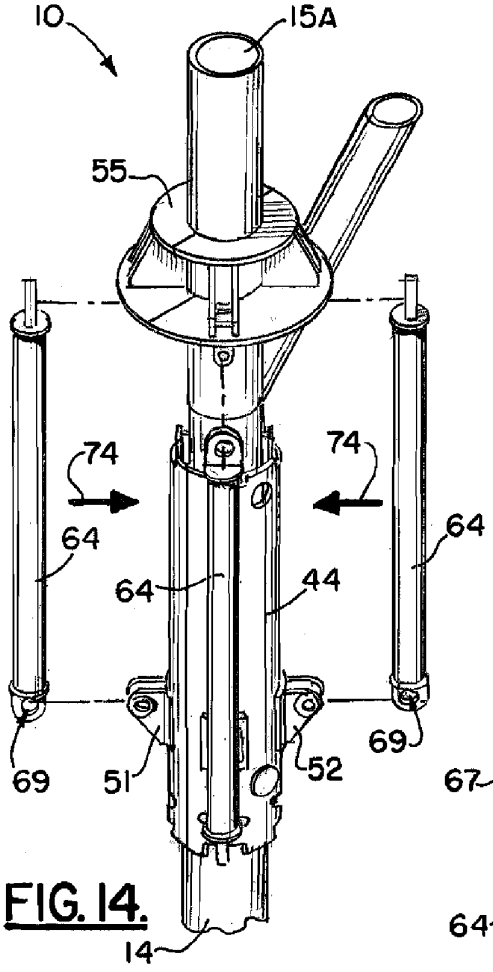


FIG. 14.

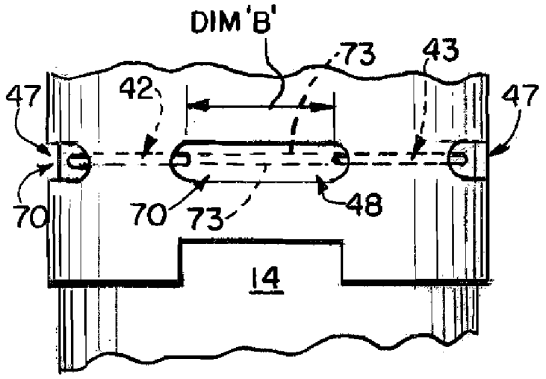


FIG. 16.

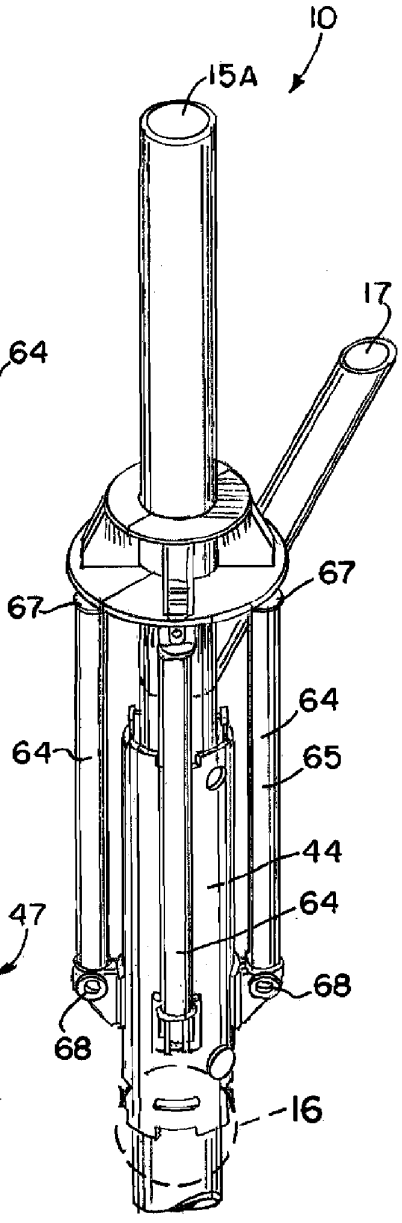


FIG. 15.

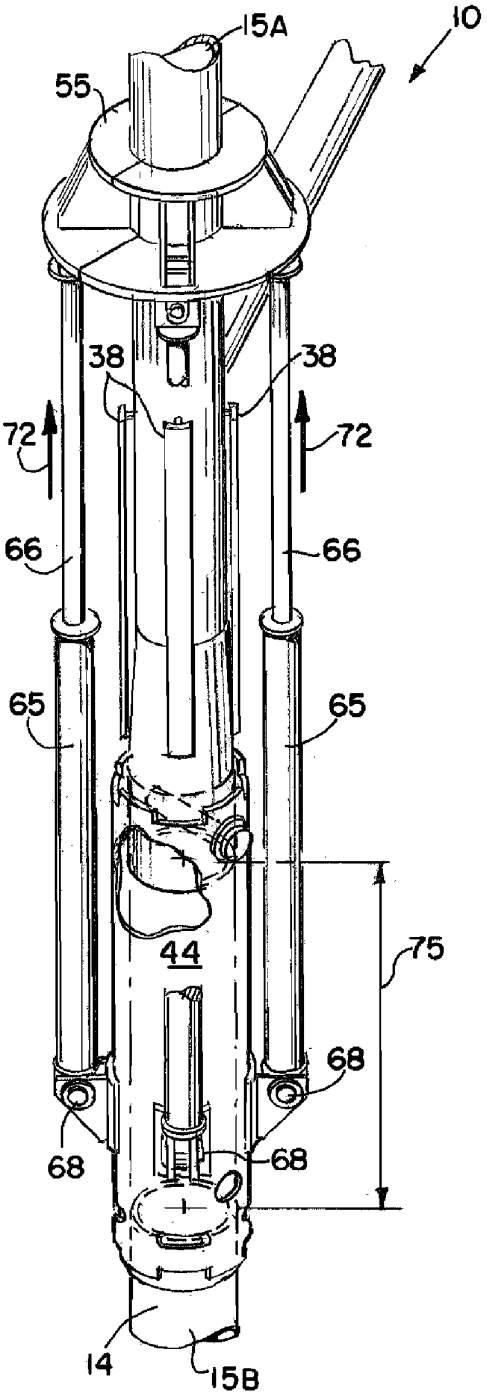

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FIG. 17.

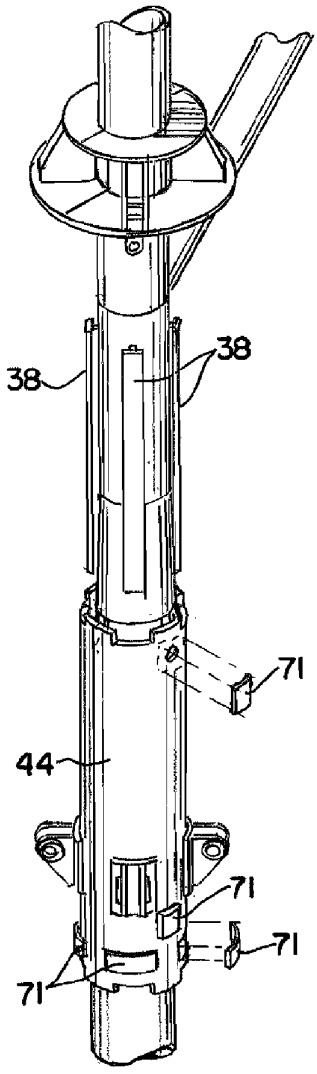

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FIG. 18.

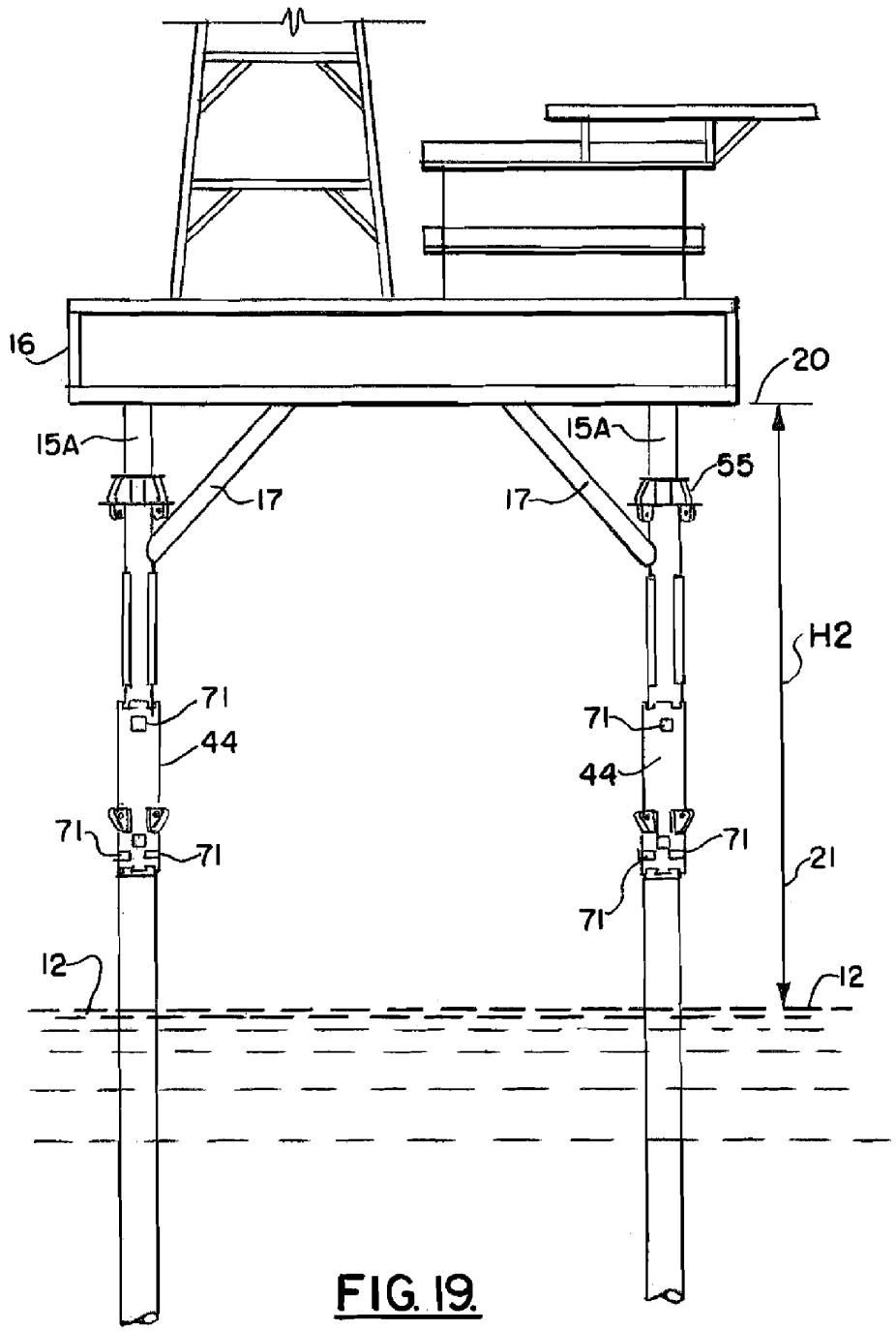


FIG. 19.

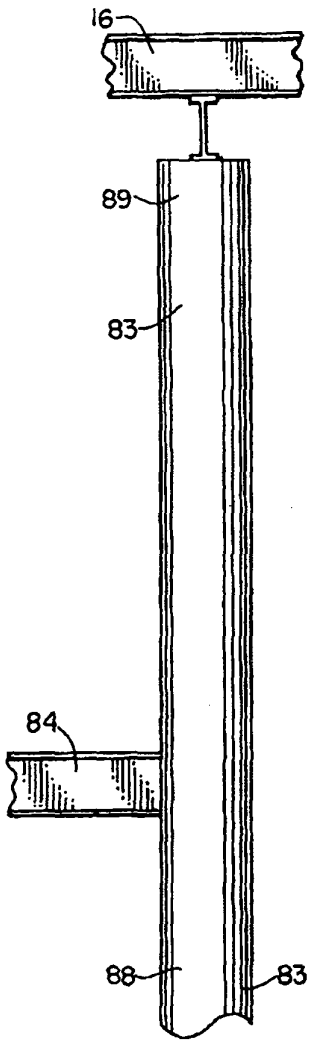


FIG. 20.

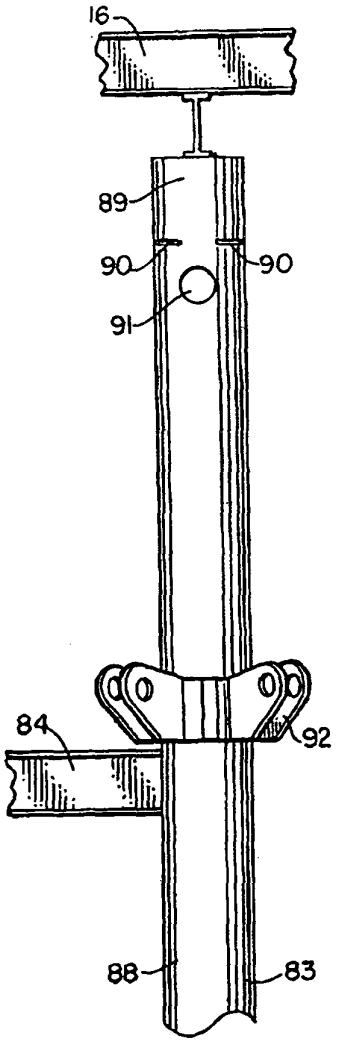


FIG. 21.

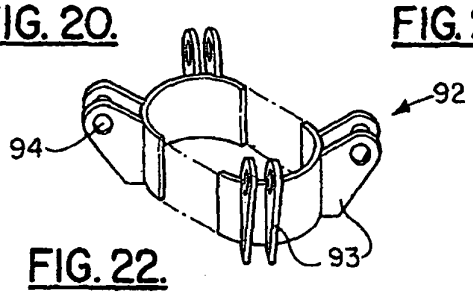


FIG. 22.

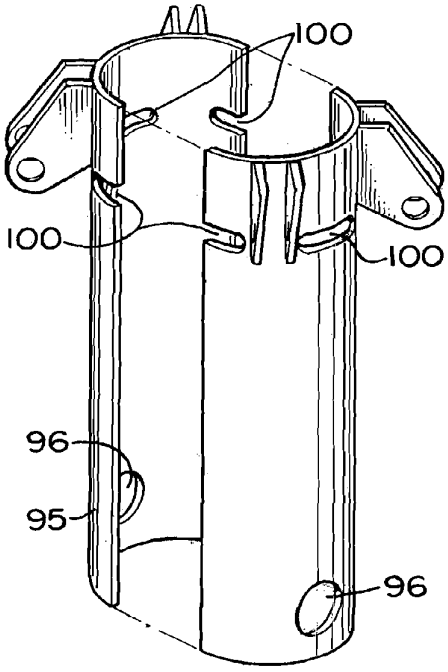


FIG. 23.

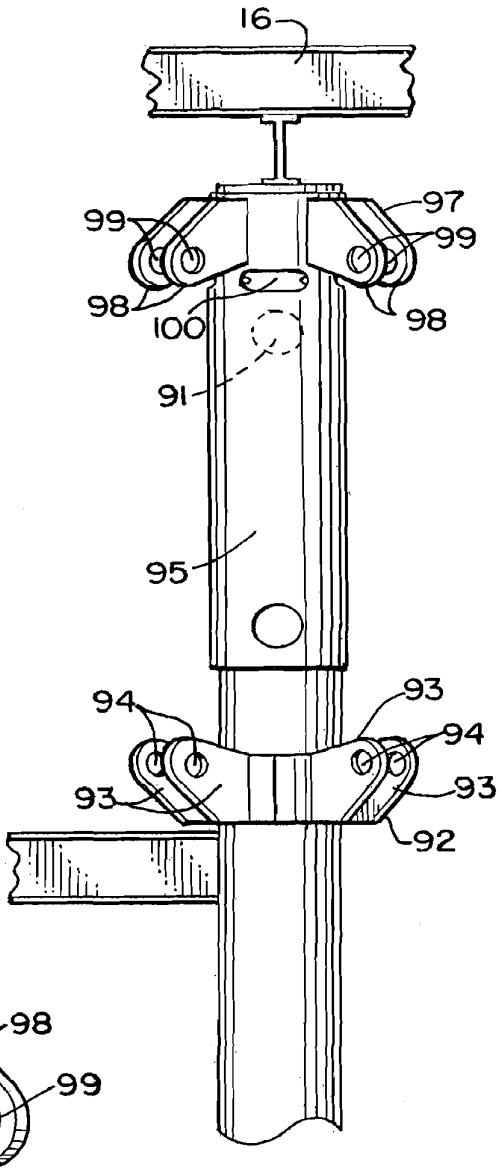


FIG. 24.

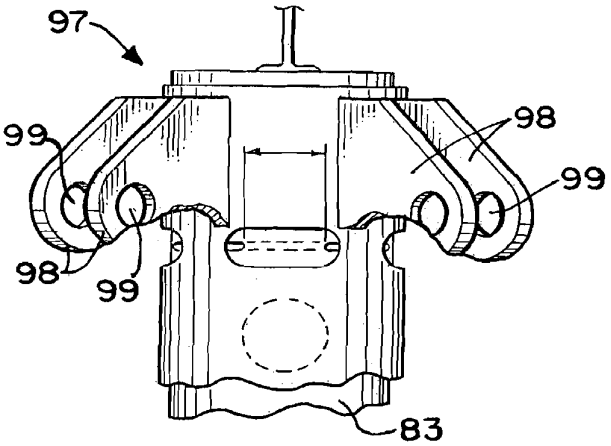


FIG. 25.

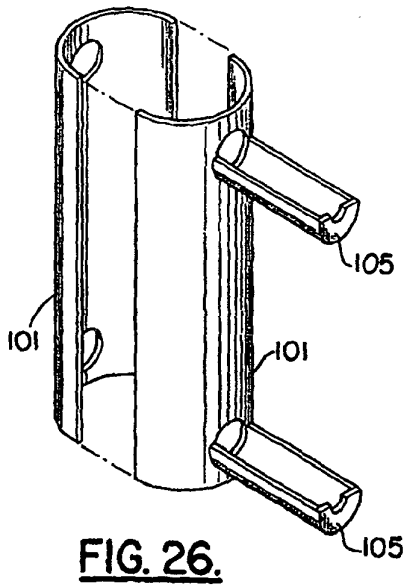


FIG. 26.

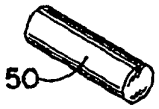


FIG. 27.

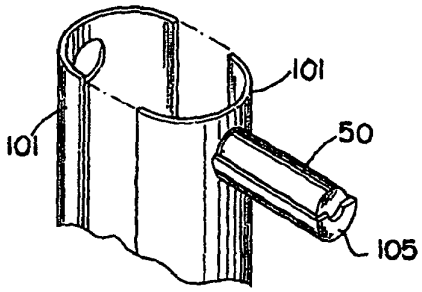


FIG. 28.

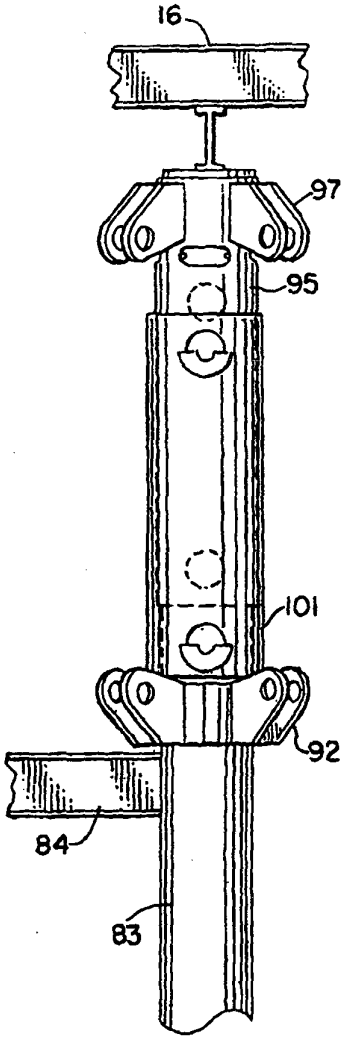


FIG. 29.

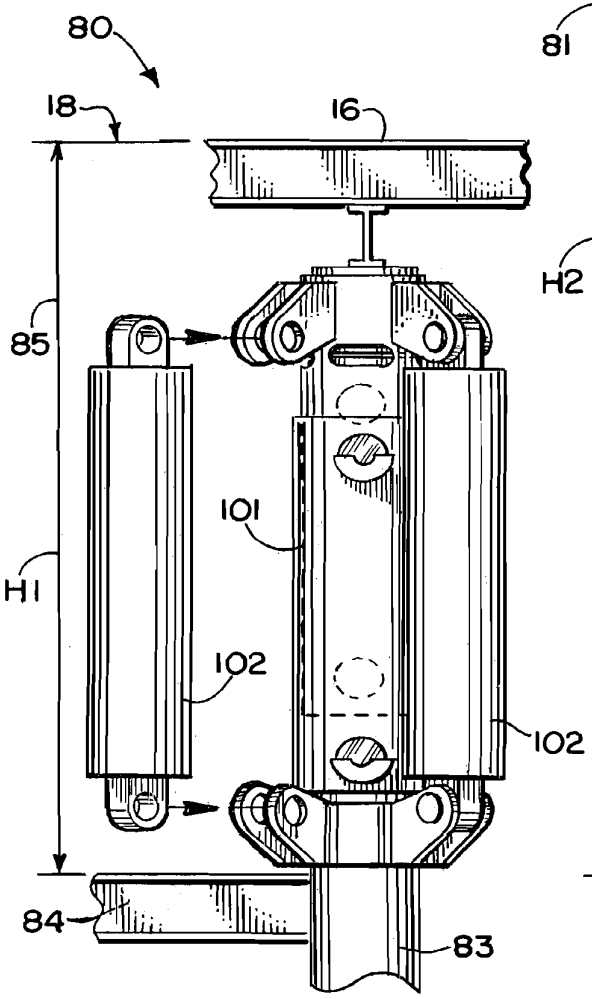

80
18
16
85
H1
101
102
102
84
83

FIG. 30.

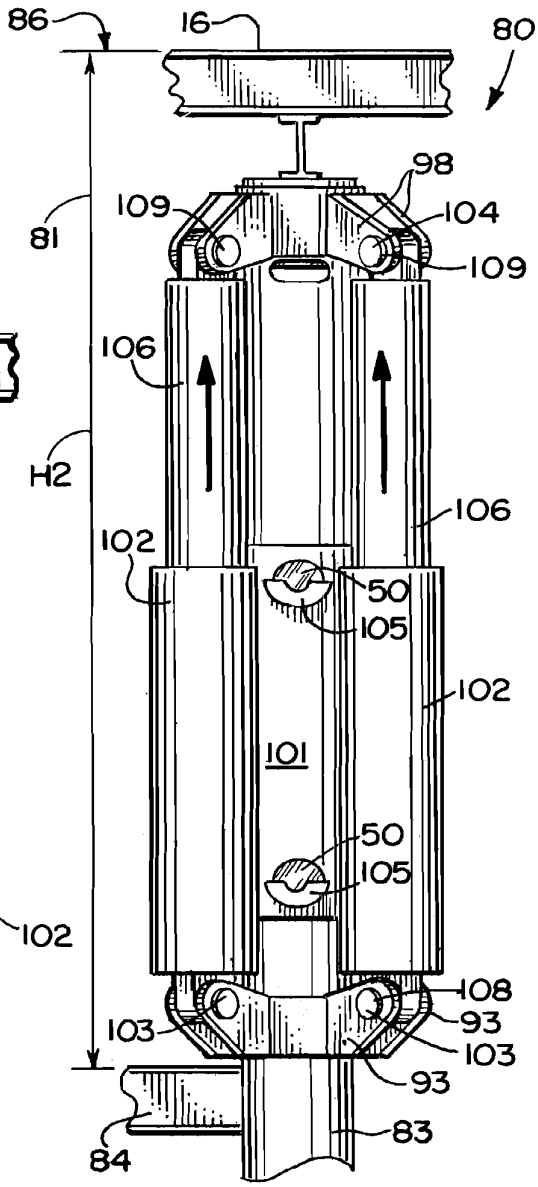

86
16
80
98
109
104
81
109
106
H2
106
102
50
105
102
101
50
105
108
93
103
103
93
84
83

FIG. 31.

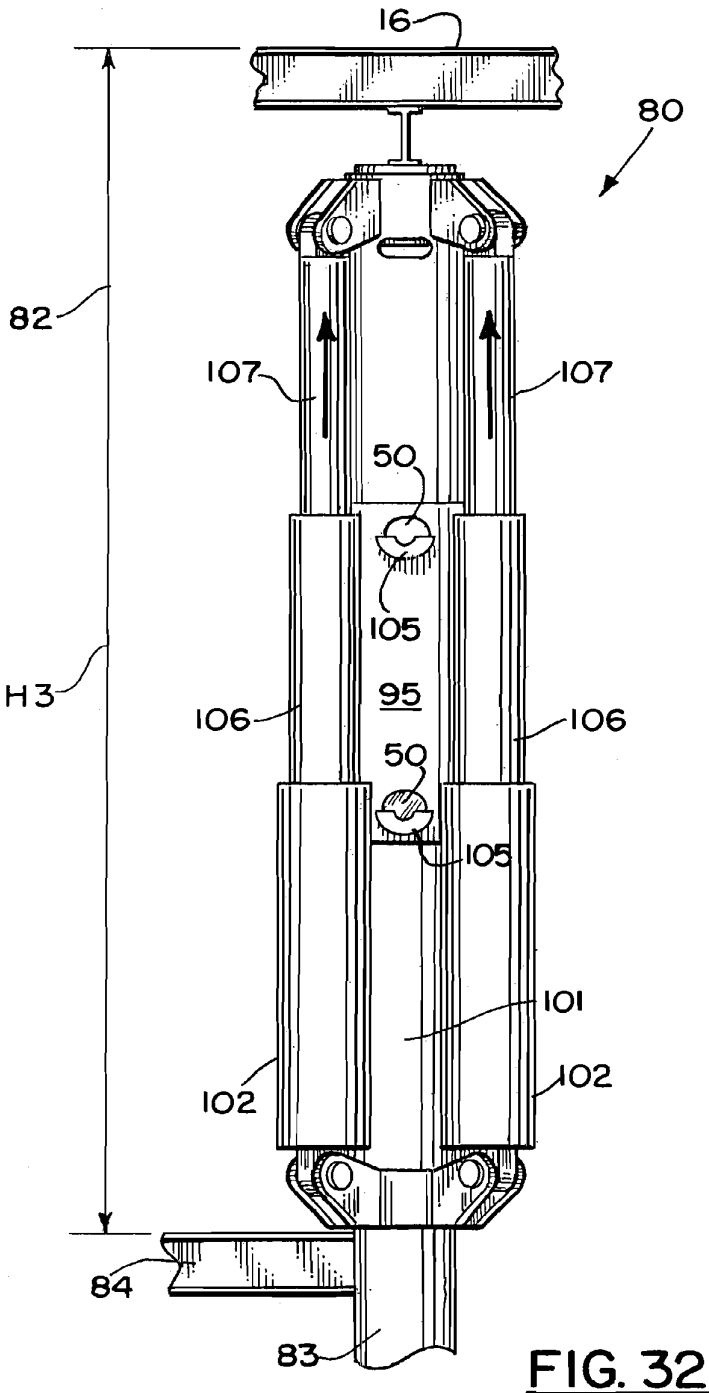


FIG. 32.

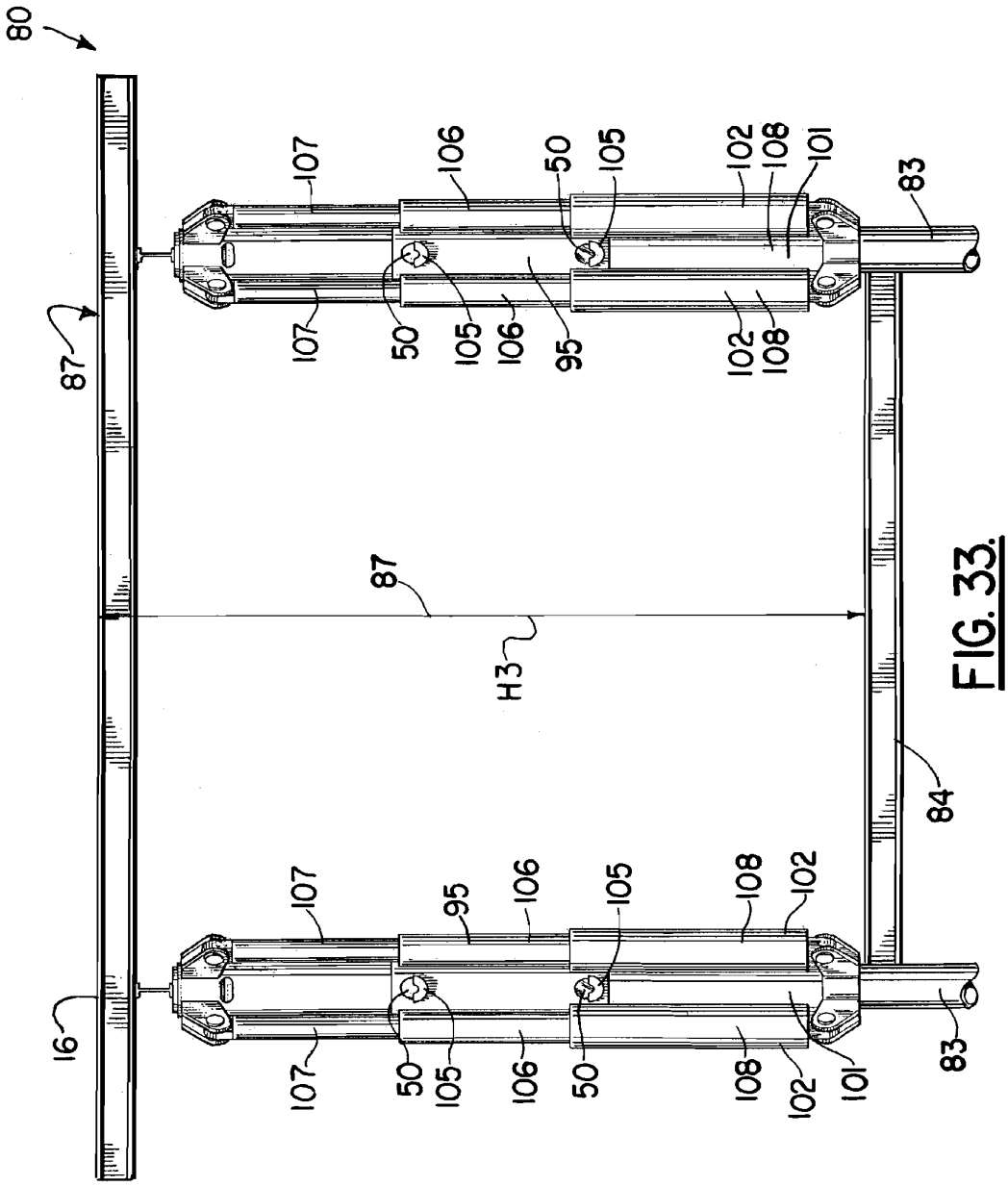


FIG. 33.

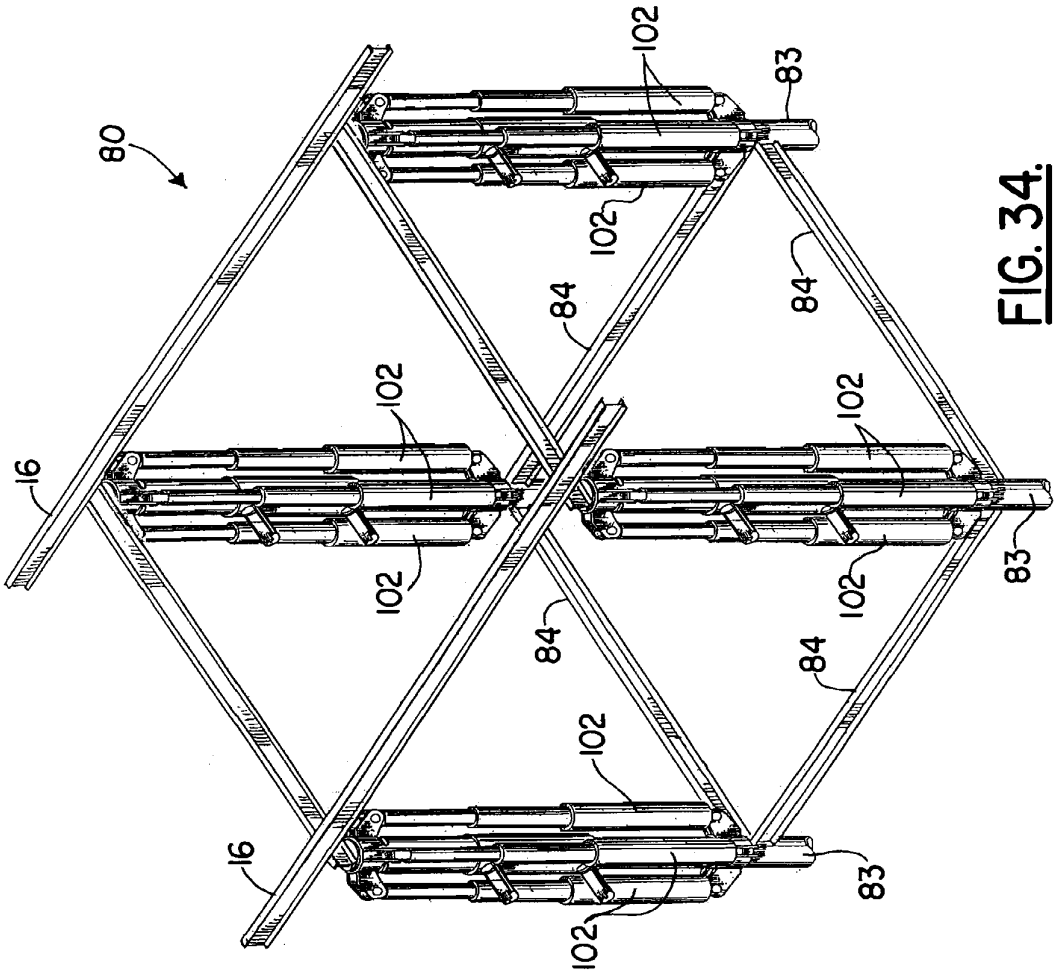


FIG. 34.

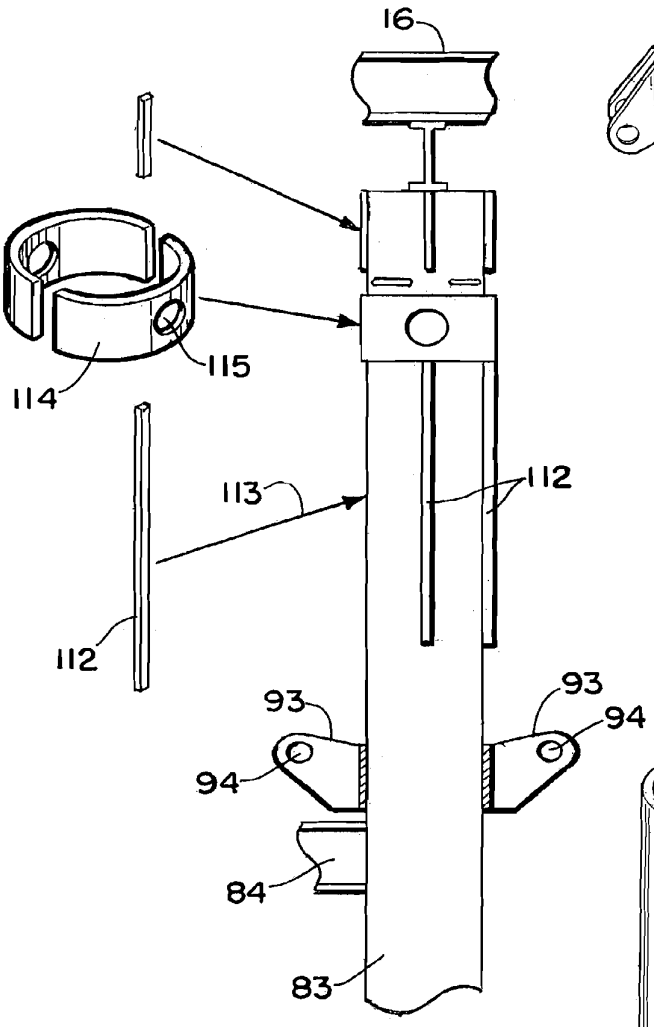


FIG. 35.

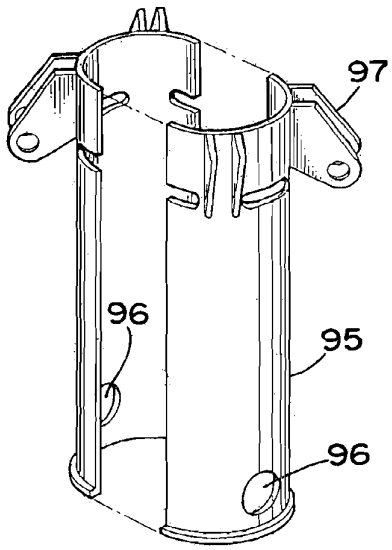


FIG. 36.

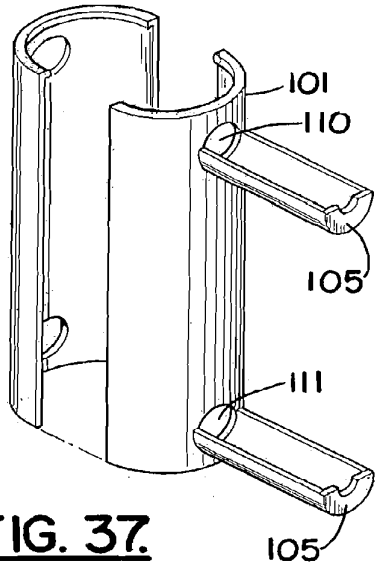


FIG. 37.

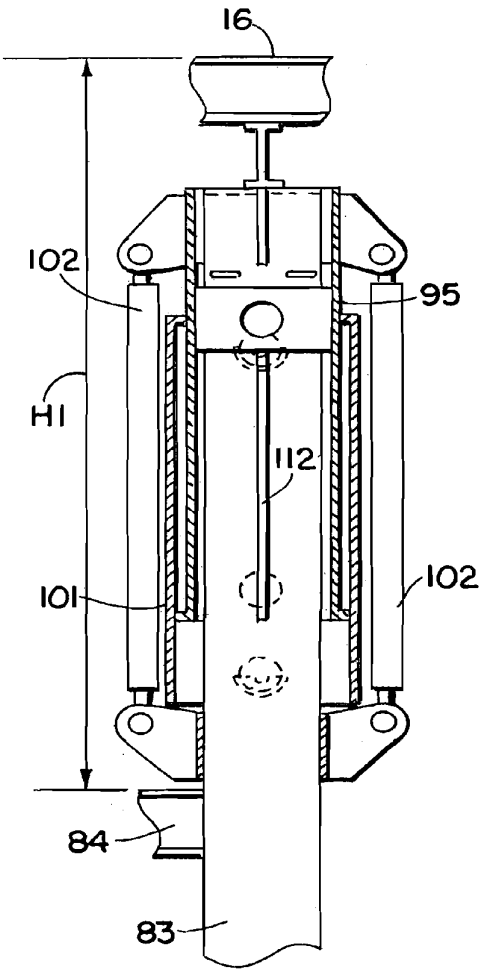


FIG. 38.

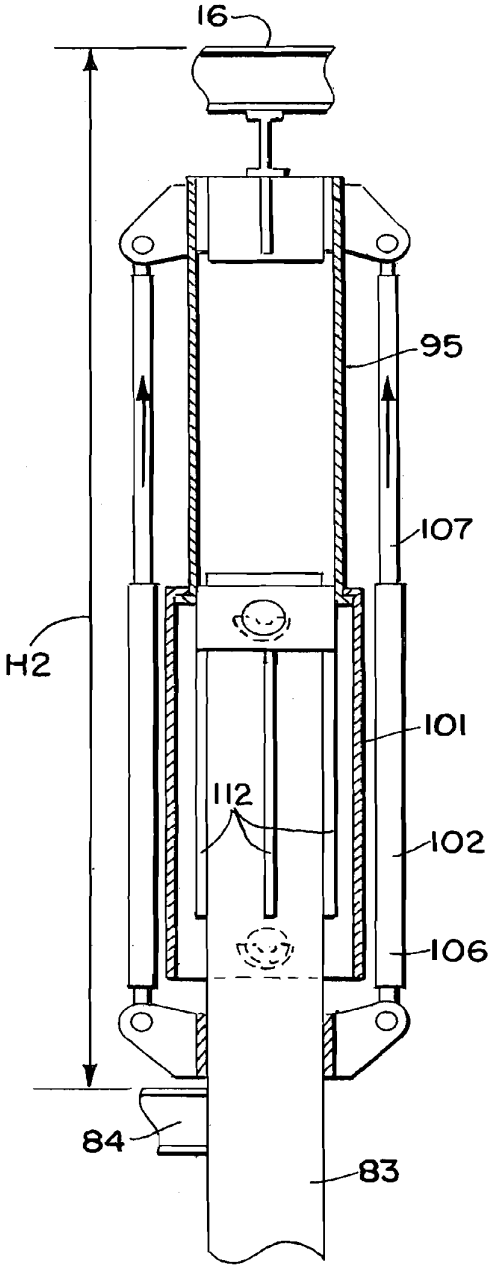


FIG. 39.

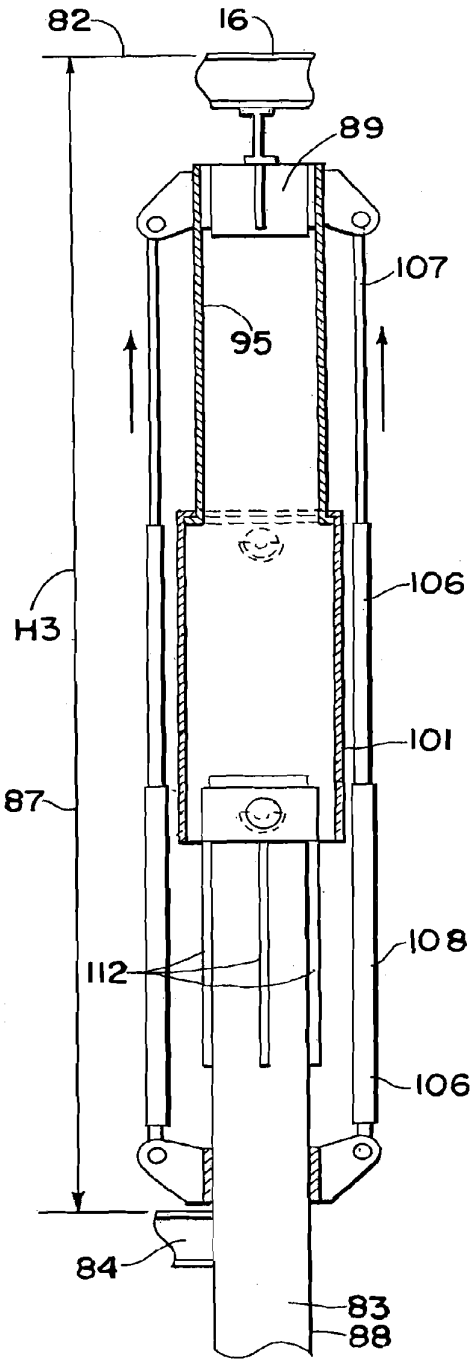


FIG. 40.