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Attorney Docket No. 78665

ROLLER GRAPNEL

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

This invention relates generally to means for retrieving cable arrays which are towed on the surface of the ocean, and particularly, to a grapnel having rollers and ramps which enable a towed cable array to be retrieved without damaging the array.

(2) Description of the Prior Art

For the simulation of submarines during antisubmarine warfare exercises, naval personnel employ the use of cable arrays containing hydrophones, acoustic projectors, etc. These cable arrays are attached to and towed behind a torpedo-like vessel. When the exercise is completed, the vessel and array must be retrieved. In this regard, there are several existing devices which are used to retrieve marine targets, weapons, cable arrays, vessels, etc., floating on the ocean surface. One such device is

disclosed in U.S. Patent No. 5,494,240. This device enables a floating marine target to be retrieved by personnel in a helicopter hovering above the target. After the target is retrieved, the array must also be retrieved. Conventionally, simple grapnels having two U-shaped metal hooks positioned perpendicularly to each other and attached to a center stock are used to retrieve towed arrays. The array is retrieved by placing one of the metal hooks under the array and hoisting the array up to the helicopter. Although this type of grapnel is effective for retrieving arrays, it can develop sharp edges on the hooks, which can cause serious damage to the towed array. It can also cause high loads on the array, due to the friction as the array passes over the metal hook in a tight band, which can damage the array jacket and internal wires when it passes over the hook or where the array attaches to the target. The high loads also cause difficulty and fatigue to the grapnel operator.

Another type of grapnel used has two rollers positioned on either side of a center plate. In use, pairs of the grapnel is placed under the array and hoisted to the helicopter. The rollers reduce damage to the array by reducing the potential engagement with sharp edges associated with the above-described grapnel. Furthermore, since the array is allowed to shift on the grapnel with the aid of the rollers, damage is less likely to occur during its retrieval. However, this type of grapnel also

has disadvantages in that it is 2-3 times heavier than the simple grapnel described above, and because the grapnel has only two pairs of rollers for capturing the array, the rollers being on opposite sides of the center plate, retrieval of the arrays is time consuming because twisting of the grapnel due to hydroplaning can make it difficult to line up the rollers with the array in order to capture it. Accordingly, there is a perceived need for an improved grapnel.

SUMMARY OF THE INVENTION

A first object of the invention is to provide an easier means of recovering towed arrays.

Another object of the invention is to provide such a means which does not damage the towed array.

Yet another object of the invention is to provide a lightweight grapnel which can be easily thrown and maneuvered.

The present invention provides an improved grapnel which permits towed arrays to be retrieved more easily and with less chance of damaging the array. The invention includes a pair of U-shaped members attached to a center stock, the U-shaped members being attached in a perpendicular relationship to each other. A threaded rod connects each vertical portion of the U-shaped members to the center stock, and each rod has a roller disposed thereon. The grapnel further includes a hub disposed on the

center stock proximate the rollers, and ramps respectively attached to each vertical portion of the U-shaped members, for guiding a towed array into engagement with the rollers.

More specifically, the grapnel comprises a center stock having first and second U-shaped members attached at one end thereof. Each of the first and second U-shaped members have a first arm and a second arm extending from a point of attachment of each U-shaped member to the center stock. The first and second U-shaped members are oriented perpendicularly to each other. Each of the first and second arms of each of the first and second U-shaped members are connected to the center stock by a rod. Each rod is joined between each of the first and second arms and the center stock, and a roller is mounted on each of the rods. The grapnel also has guides for directing the towed array onto the rollers, including a hub disposed on the center stock proximate the intersection of the first and second rods and the center stock and ramps attached to each of the first and second arms of each of the first and second U-shaped members.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described with reference to the appended drawings, wherein:

FIG. 1 is a perspective view of the roller grapnel of the present invention:

FIG. 2 is a cross-sectional view of the roller grapnel, taken along line 2-2 in FIG. 1;

FIG. 3 is a side view of the roller grapnel of the present invention; and

FIG. 4 is a perspective view showing an array captured on the roller grapnel of FIG. 1.

Common features of the invention are identified with common reference numerals in the multiple views provided of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The roller grapnel of the present invention is illustrated and generally indicated at 10 in FIGS. 1-4. As will hereinafter be more fully described, the roller grapnel 10 includes improved features which will enable the safe retrieval of floating marine targets without damage thereto. Shown in FIG. 1, is a perspective view of the roller grapnel 10 of the present invention. FIG. 2 is a cross-sectional view of grapnel 10 taken along line 2-2 in FIG. 1, and FIG. 3 is a side view of roller grapnel 10. Roller grapnel 10 includes a center stock, generally indicated at 12, and U-shaped members, generally indicated at 14 and 16, respectively, which are bolted to the end 12a of center stock 12 with two bolts 18 (only one bolt 18 is shown for simplicity). At end 12b of center stock 12 is an opening 20,

which facilitates the attachment of roller grapnel 10 to a line. U-shaped member 14 includes vertical portions 14a and 14b, which are connected by a horizontal portion 14c. U-shaped member 16 includes vertical portions 16a and 16b, which are connected by a horizontal portion 16c.

Two bolts 18 are inserted first through the openings near the midway point of horizontal portion 14c of U-shaped member 14 and then through two holes near the midway point of horizontal portion 16c of U-shaped member 16 and are threaded into end 12a of center stock 12 to hold U-shaped members 14 and 16 in place. As best shown in FIG. 2, threaded rods 22a and 22b interconnect vertical portions 16a and 16b, respectively, of U-shaped member 16 to threaded holes 24a and 24b, respectively, in center stock 12. Rod 22a is held in place between vertical portion 16a and center stock 12 with nuts 26 at vertical portion 16a. Rod 22b is held in place between vertical portion 16b and center stock 12, with nuts 28 at vertical portion 16b. Disposed on rods 22a and 22b are rollers 30 and 32, respectively. Rollers 30 and 32 are held in place along rods 22a and 22b, respectively, by self-locking nuts 34 on the outboard side and pairs of nuts 35 tightened against each other on the inboard side.

Similar to the above described connection of rods 22a and 22b and vertical portions 16a and 16b of U-shaped member 16, rods 40a and 40b connect vertical portions 14a and 14b,

respectively, of U-shaped member 14 to center stock 12. Rod 40a is threaded into a threaded hole 39a of center stock 12 and is secured to vertical portion 14a by a nut 44; and rod 40b is treaded into threaded hole 39b of center stock 12 and is secured to vertical portion 14b by a nut (not shown). Holes 24a, 24b, 39a, and 39b intersect at the center of center stock 12. Disposed on rods 40a and 40b are rollers 50 and 52, respectively. As with rollers 30 and 32, rollers 50 and 52 are held in place on rods 40a and 40b by self-locking nut 42 on the outboard side and pairs of nuts (not shown) tightened together on the inboard side.

Roller grapnel 10 also comprises a hub 60 which is slip fit onto center stock 12. Hub 60 is conical in shape and has a hole 62 at the top thereof for fitting over center stock 12. Hub 60 is secured to center stock 12 with self-tapping screw 100, which is mounted through clearance hole 102 in hub 60 into interference hole 104 in center stock 12.

U-shaped member 14 further includes ramps 70a and 70b and U-shaped member 16 further includes ramps 72a and 72b. As best seen in FIG. 2, ramp 72a is attached to vertical portion 16a of U-shaped member 16 with screws 80a and 80b, which thread into ramp 72a through holes in vertical portion 16a. Ramps 72a and 72b are positioned just above rollers 30 and 32, respectively. Ramp 72b is attached to vertical portion 16b of

U-shaped member 16 in the same fashion as ramp 72a. Likewise, ramps 70a and 70b are attached to vertical portions 14a and 14b, respectively, in the same manner. While in this embodiment, two screws are used to hold the ramps in place, it will be understood that any combination of screws and/or pins, etc. may be used to attach the ramps to the vertical portions and to prevent the ramps from rotating.

In operation, the roller grapnel is lowered from a helicopter to retrieve a towed array which is attached to a marine target. After the target is recovered, the helicopter moves slowly forward and to the side to stream the array on the ocean surface. The grapnel is then lowered to the ocean surface in an attempt to capture the array between one of the vertical portions 14a, 14b, 16a and 16b and center stock 12. When the array is located between one of the vertical portions and the center stock 12, the roller grapnel 10 is raised toward the helicopter to capture the array 90 with the roller grapnel 10, as shown in FIG. 4. When roller grapnel 10 is raised, hub 60 and, in this example, ramp 72a act to guide array 90 onto roller 30. Hub 60 and ramp 72a also prevent array 90 from becoming wedged between roller 30 and center stock 12 or vertical portion 16a. The concave surface of the roller forces the array towards the middle of the roller and away from its ends, where the array could be pinched between roller and ramp or hub. Since roller 30

is able to rotate freely on rod 22, it provides a relatively low friction surface on which array 80 may be raised. In this way, the array can move along roller 30 and, when the 2-inch diameter hydrophone reaches roller 30, the spacing between the ramp and hub allows it to pass through without interference; and the array is then raised up to the helicopter.

The design and positioning of the ramps 70a, 70b, 72a and 72b, hub 60 and rollers 30, 32, 50 and 52 eliminate the sharp edges and tight bends associated with the simple grapnel and enable towed arrays to be retrieved more easily and without damage, which, as described above, occurred in the prior art simple grapnels. In contrast with the two-roller grapnel of the prior art, the present invention makes array retrieval easier because it is easier to align one of the four rollers of the present invention with the array than it is to align one of the two opposing pairs of rollers of the prior art grapnel with the array.

Furthermore, the present invention allows the prior art simple grapnel to be modified to operate as the roller grapnel of the present invention. This is done by drilling holes through a center stock and vertical portions of a simple grapnel to mount rods 22a and 22b and 40a and 40b as described above. Rollers 30, 32, 50 and 52 can be provided on the rods as described above, and a hub 60 and ramps 70a, 70b, 72a and 72b can

be mounted on the grapnel as described above with reference to FIGS. 1-3.

Typically, center stock 12 and U-shaped members 14 and 16 are made from aluminum. However, it will be understood that any suitable material may be used in the construction of center stock 12 and U-shaped members 14 and 16. Rollers 30, 32, 50 and 52, hub 60 and ramps 70a, 70b, 72a and 72b are typically made from a material such as nylon. However, it will be understood that any suitable material may be used in the construction of these elements. Although rollers 30, 32, 50 and 52 are shown in the figures as directly contacting rods 22 and 40, the rollers may include bearings 38 and/or shims for reducing the rolling resistance of the rollers and for increasing the durability of the rollers.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and rearrangements of the parts may be made without departing from the spirit and scope of the underlying inventive concept. Therefore, the invention is not limited to the particular forms herein shown and described.

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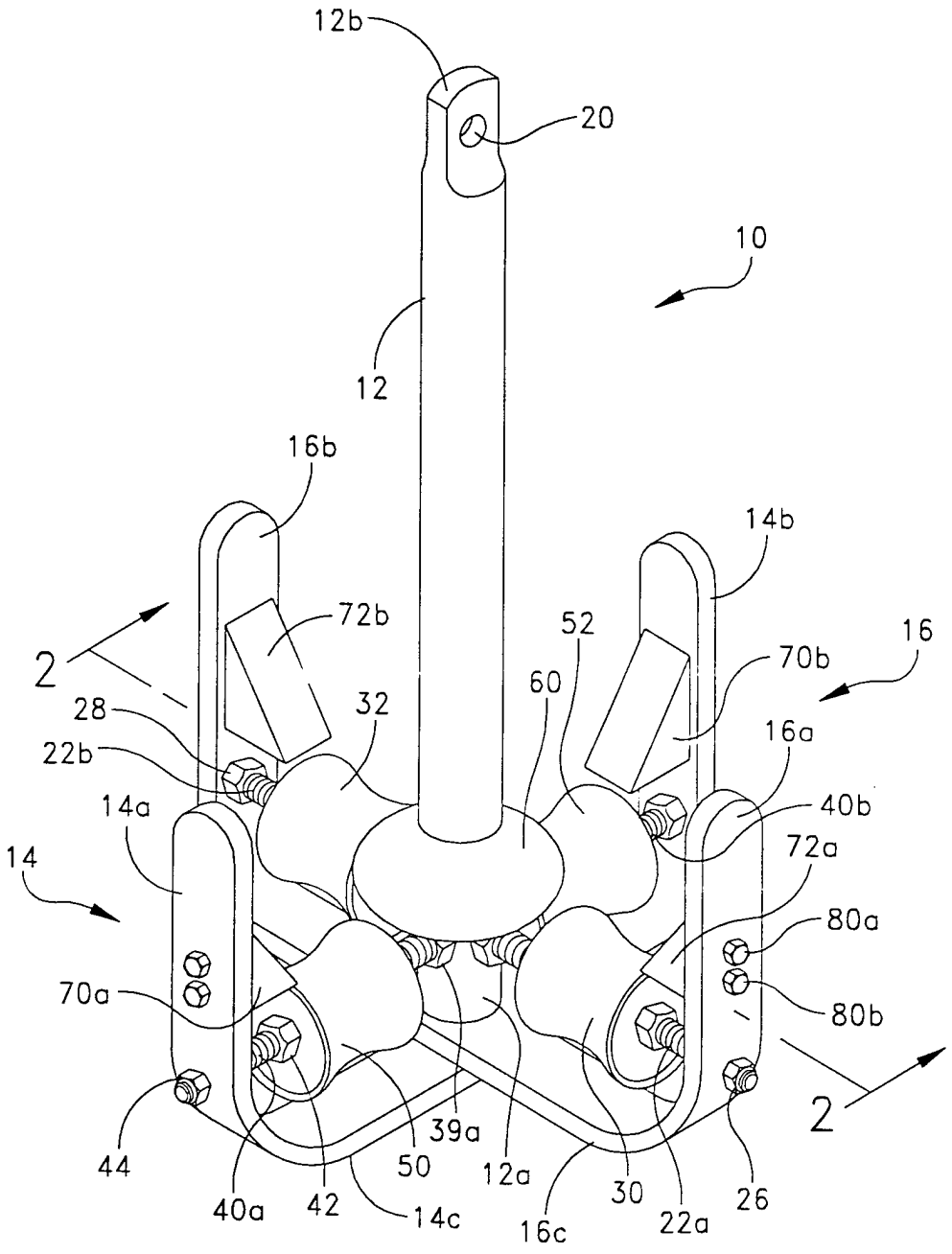
ROLLER GRAPNEL

ABSTRACT OF THE DISCLOSURE

The present invention provides an improved grapnel which permits towed arrays to be retrieved more easily and with less chance of damaging the array. The invention includes a pair of U-shaped members attached to a center stock, the U-shaped members being attached in a perpendicular relationship to each other. A threaded rod connects each vertical portion of the U-shaped members to the center stock, and each row has a roller disposed thereon. The grapnel further includes a hub disposed on the center stock proximate the rollers and ramps respectively attached to each vertical portion of the U-shaped members, for guiding a towed array into engagement with the rollers.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20
10
12
16b
14b
72b
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16
2
70b
28
32
60
16a
22b
40b
14a
72a
14
80a
70a
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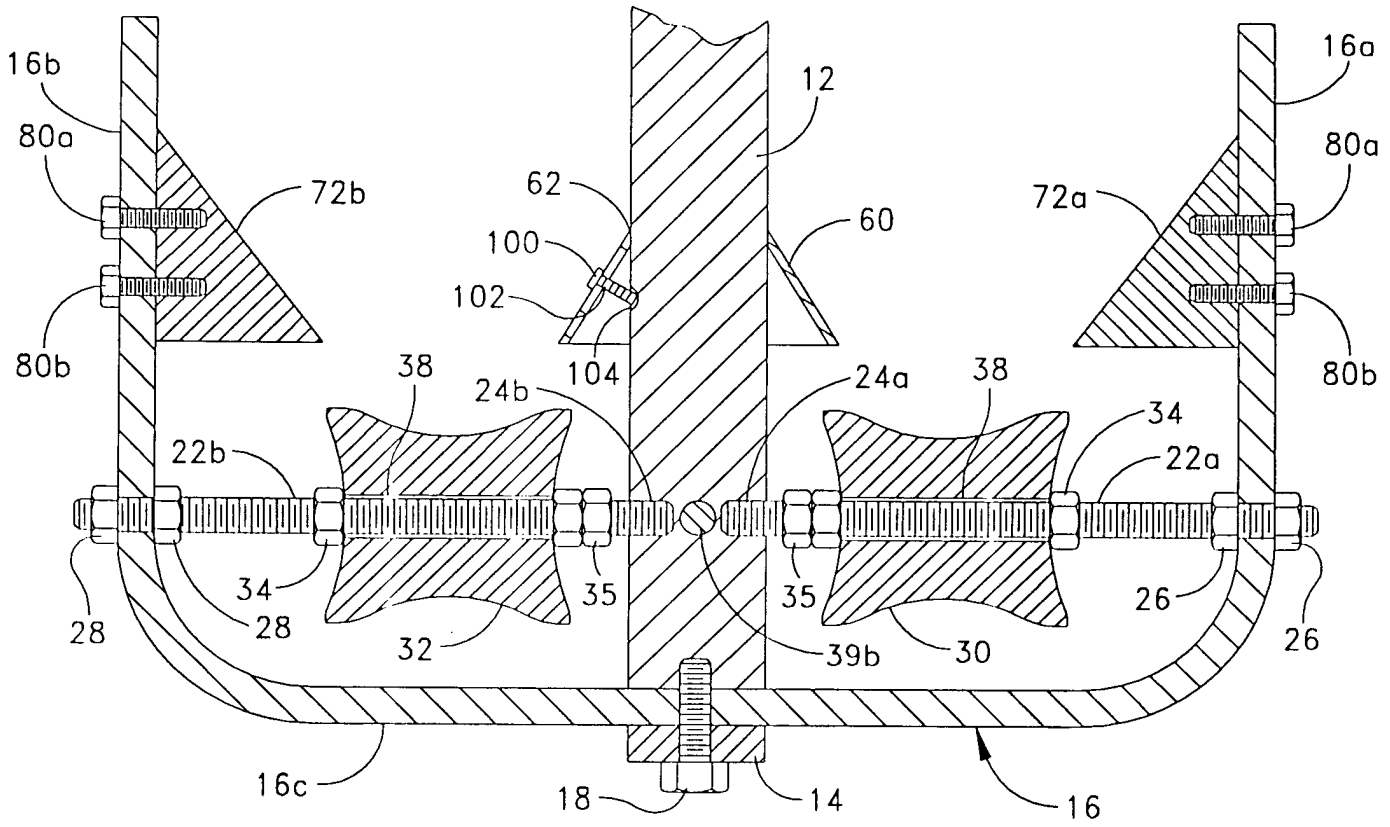
2
44
39a
50
12a
30
26
40a
42
14c
16c
22a

FIG. 1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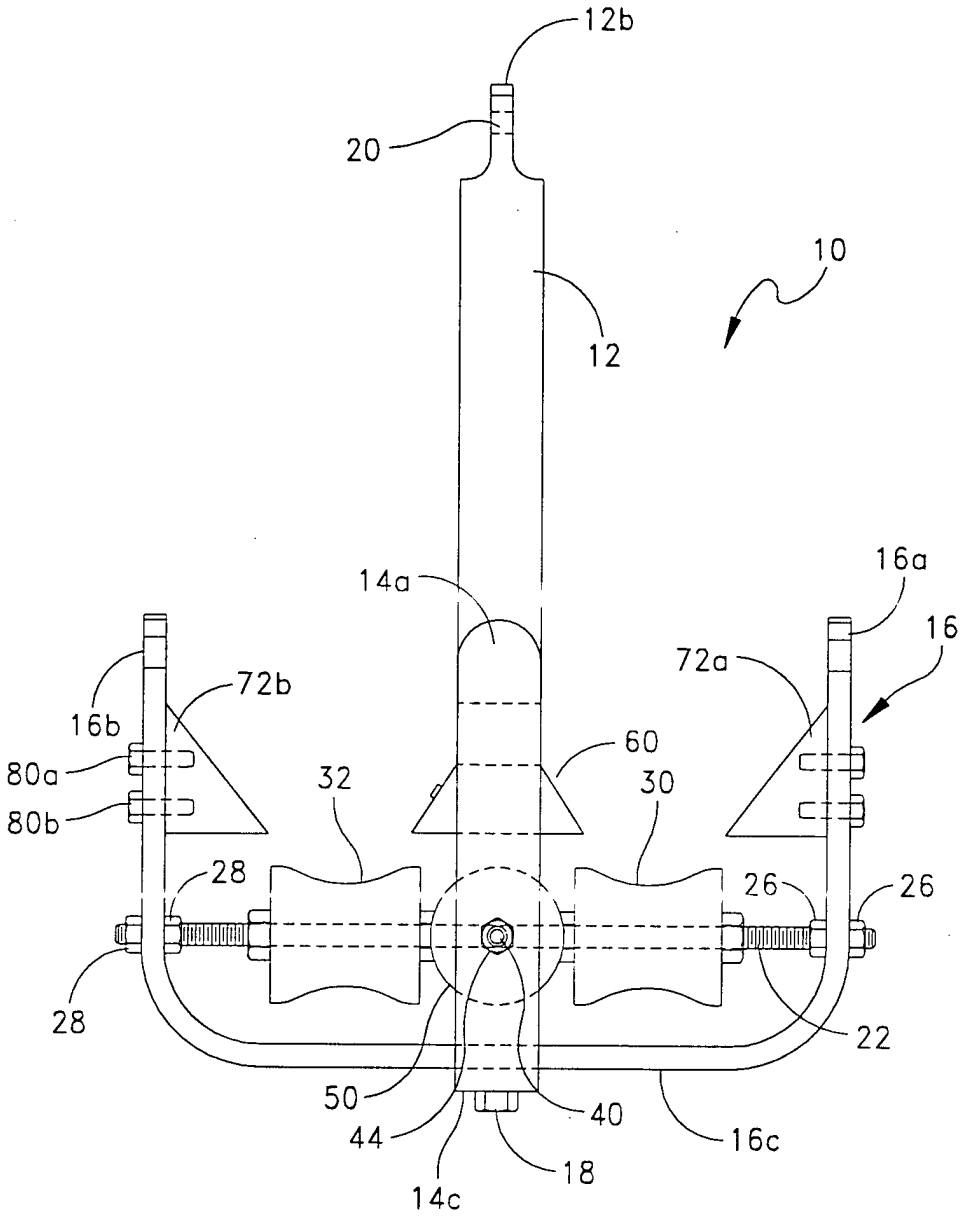
16c
18
14
16

FIG. 2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72b
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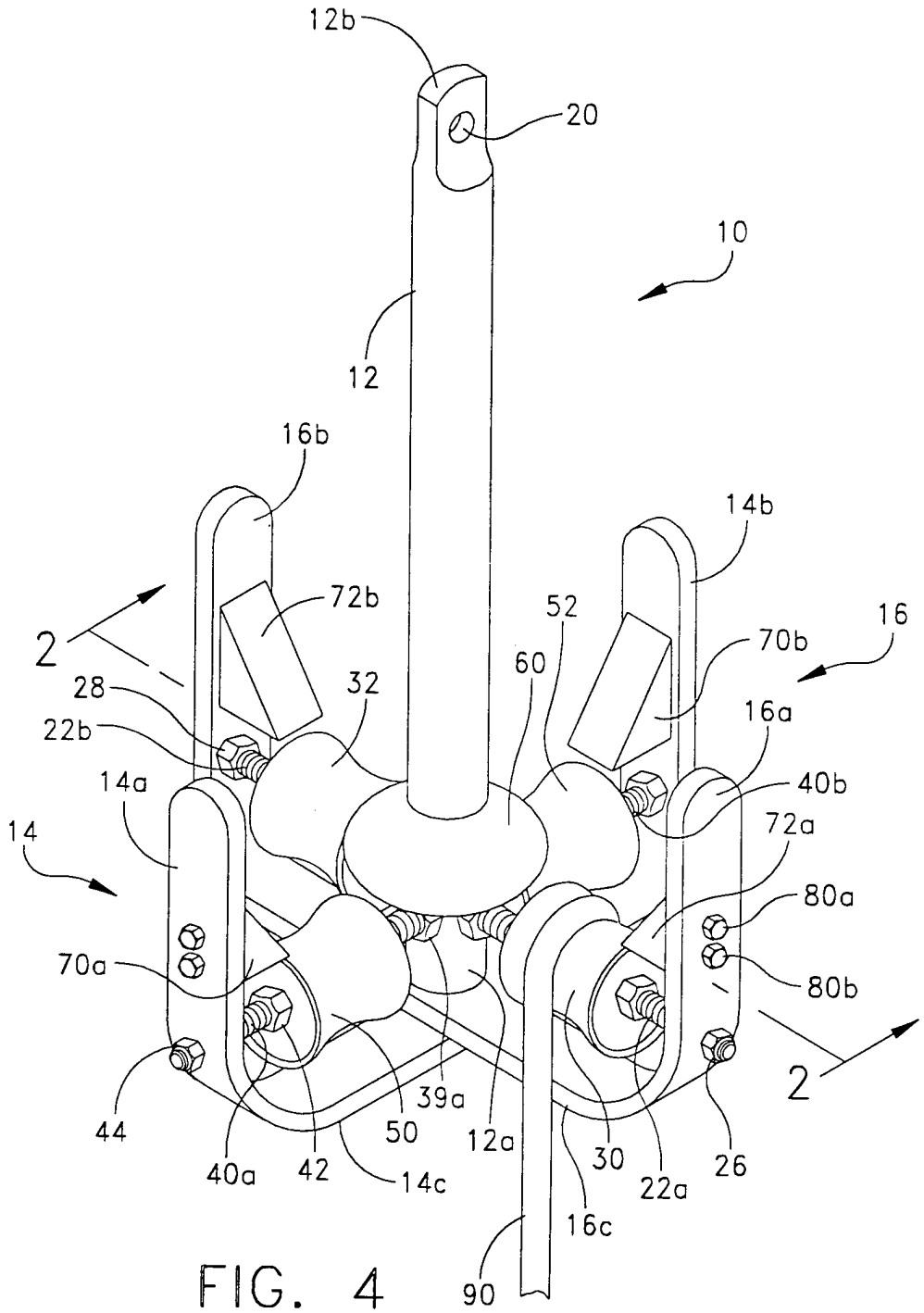
22
50
40
44
16c
18
14c

FIG. 3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14
80a
70a
80b
2
39a
44
50
12a
30
26
40a
42
14c
22a
16c
90

FIG. 4