



(11) (21) (C) **2,273,818**
(22) 1999/06/10
(43) 2000/04/25
(45) 2000/12/26

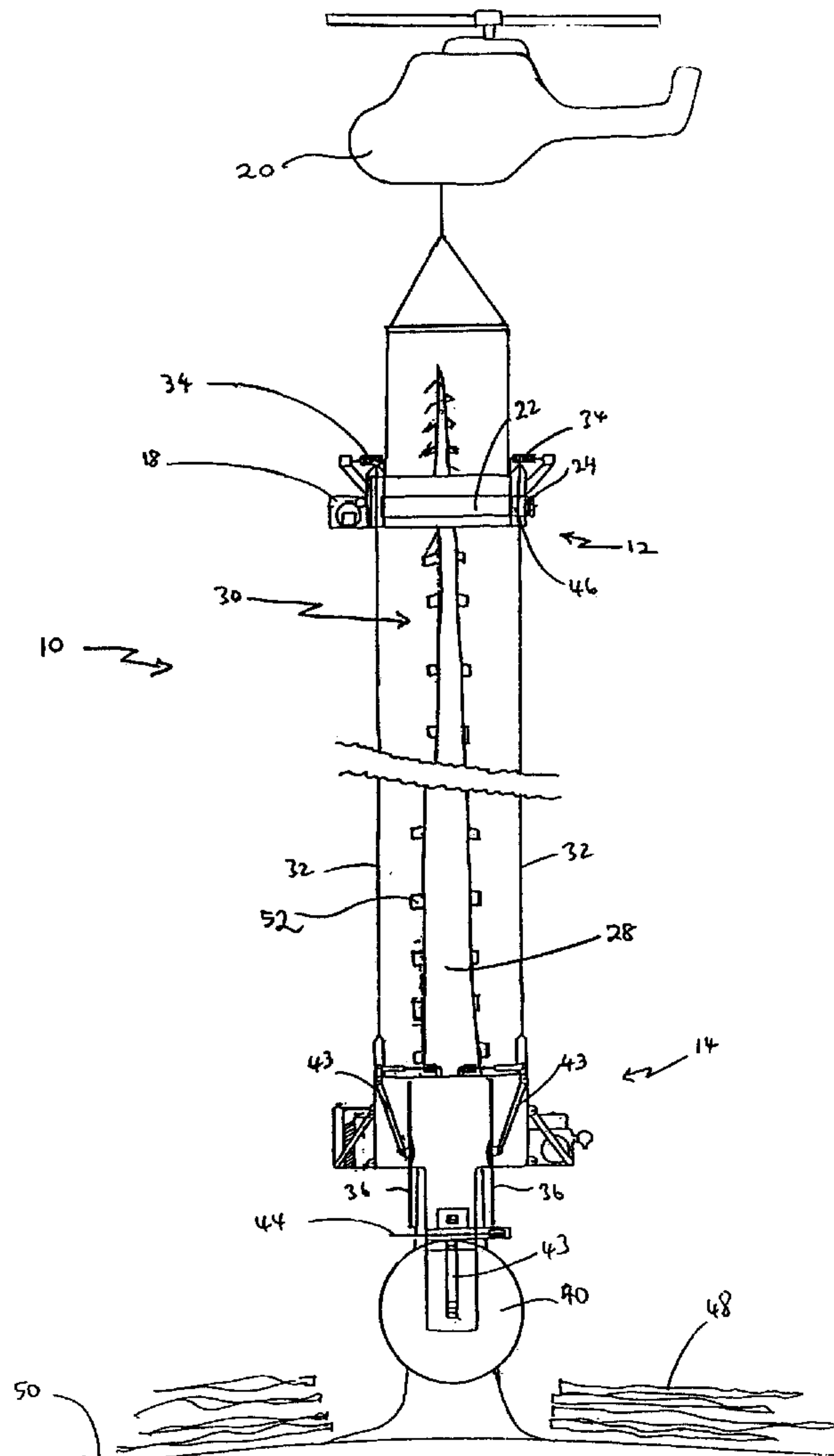
(72) CHALIFOUX, Robert, CA

(73) CHALIFOUX, Robert, CA

(51) Int.Cl.⁶ A01G 23/095, A01G 23/02, A01G 23/00

(54) **MOISSONNEUSE AERIENNE D'ARBRES**

(54) **AERIAL TREE HARVESTING APPARATUS**



(57) An aerial tree harvesting apparatus includes a first body and a second body having co-axial bores defining a tree receiving opening. The first body is suspended from a hovering aerial craft and has arms that hold a tree positioned within the tree receiving opening. The second body is suspended by cables from the first body. Delimbing members are mounted on the second body about the tree receiving opening. The delimbing members sever limbs from the tree when the second body is lowered relative to the first body. A severing saw is movable from a rest position adjacent the tree receiving opening transversely across the tree receiving opening, thereby severing the trunk of the tree positioned in the tree receiving opening once the tree is delimbed.



ABSTRACT OF THE DISCLOSURE

An aerial tree harvesting apparatus includes a first body and a second body having co-axial bores defining a tree receiving opening. The first body is suspended from a hovering aerial craft and has arms that hold a tree positioned within the tree receiving opening. The second body is suspended by cables from the first body. Delimbing members are mounted on the second body about the tree receiving opening. The delimbing members sever limbs from the tree when the second body is lowered relative to the first body. A severing saw is movable from a rest position adjacent the tree receiving opening transversely across the tree receiving opening, thereby severing the trunk of the tree positioned in the tree receiving opening once the tree is delimbed.

TITLE OF THE INVENTION:

Aerial Tree Harvesting Apparatus

NAME(S) OF INVENTOR(S):

5 Robert Chalifoux

FIELD OF THE INVENTION

The present invention relates to an aerial tree harvesting apparatus.

10

BACKGROUND OF THE INVENTION

United States Patent 2,707,008 which issued in 1955 to Bannister discloses a method and apparatus for harvesting trees using a helicopter. All of the logging operations are
15 controlled from the helicopter, eliminating the need for a ground based logging crew. The Bannister apparatus performed a series of steps sequentially, during which time the helicopter hovered over the tree being harvested. The length of time required to prepare the tree for transport, undermined
20 the financial feasibility of aerial tree harvesting. A form of aerial tree harvesting apparatus using a different concept was developed in Russia and is illustrated in Russian Patent 2,044,458 which issued in 1995.

25 While helicopters are commonly used in logging operations today, helicopters are merely used as means for transporting logs felled by ground based logging crews. Aerial tree harvesting without the use of ground based felling crews, as envisaged by Bannister, will not become a commercial reality
30 until better aerial tree harvesting apparatus are developed.

SUMMARY OF THE INVENTION

What is required is an improved aerial tree harvesting apparatus.

35

According to the present invention there is provided an aerial tree harvesting apparatus which includes a first body

and a second body having co-axial bores defining a tree receiving opening. The first body has at least one attachment for suspending the first body from a hovering aerial craft. Arms are pivotally secured to the first body for movement
5 between a first position spaced apart at a periphery of the tree receiving opening and a second position encroaching upon the tree receiving opening thereby clamping upon a trunk of a tree positioned within the tree receiving opening. The second body is suspended by cables from the first body. A cable feed
10 mechanism is provided to decrease or increase the length of the cables to raise or lower the second body relative to the first body. Delimbing members are mounted to the second body about the tree receiving opening. The delimbing members sever limbs from the tree positioned in the tree receiving opening when the
15 second body is lowered relative to the first body. A severing saw is pivotally movable from a rest position adjacent the tree receiving opening transversely across the tree receiving opening, thereby severing the trunk of the tree positioned in the tree receiving opening.

20

The aerial tree harvesting apparatus, as described above, can rapidly perform all operations necessary to delimb, fell and transport a tree. The apparatus is lowered from a hovering aerial craft, such as a helicopter, until a trunk of a tree is
25 positioned within the tree receiving opening of the first body and the second body. The arms are activated, preferably by hydraulics, to move them to the second position where they firmly grip the trunk of the tree. The second body is rapidly lowered on the cables. As the second body is lowered the
30 delimbing members in the form of stationary or movable blades sever limbs from the tree. When the second body has been lowered to just above ground level the trunk of the tree is severed by passing the severing saw transversely across the tree receiving opening. The tree does not fall upon being
35 severed, as it is held by the arms and supported from the air by the helicopter. The helicopter then lifts the tree into the air and transports it to a drop off site. The second body is

raised upon the cables to a position immediately adjacent the first body during transport. The tree is released by returning the arms to the first position spaced apart at the periphery of the tree receiving opening.

5

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings, wherein:

10 **FIGURE 1** is a front elevation view, in section, of an aerial tree harvesting apparatus constructed in accordance with the teachings of the present invention.

FIGURE 2 is a top plan view, in section, of a first body portion of the aerial tree harvesting apparatus illustrated in 15 **FIGURE 1**, with grappling arms in a first position.

FIGURE 3 is a top plan view, in section, of the first body portion of the aerial tree harvesting apparatus illustrated in **FIGURE 1**, with grappling arms engaging a trunk of a tree in a second position.

20 **FIGURE 4** is a side elevation view, in section, of a second body portion of the aerial tree harvesting apparatus illustrated in **FIGURE 1**.

FIGURE 5 is a top plan view, in section, of a second body portion of the aerial tree harvesting apparatus illustrated in 25 **FIGURE 1**.

FIGURE 6 is a side elevation view, in section, of the aerial tree harvesting apparatus illustrated in **FIGURE 1**, suspended by a helicopter over a tree with the grappling arms engaging the trunk of the tree.

30 **FIGURE 7** is a side elevation view, in section, of the aerial tree harvesting apparatus illustrated in **FIGURE 6**, with the second body carrying the circular delimbing saws being lowered on cables from the first body.

FIGURE 8 is a top plan view, in section, of the aerial 35 tree harvesting apparatus illustrated in **FIGURE 7**, with the severing saw in the process of severing the trunk of the tree.

FIGURE 9 is a side elevation view, in section, of the

aerial tree harvesting apparatus illustrated in **FIGURE 8**, in the process of transporting the tree.

FIGURE 10 is a side elevation view of a second body portion of an alternative embodiment of aerial tree harvesting apparatus to that illustrated in **FIGURE 4**.

FIGURE 11 is a top elevation view of a second body portion of the alternative embodiment of aerial tree harvesting apparatus illustrated in **FIGURE 10**.

10 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

The preferred embodiment, an aerial tree harvesting apparatus generally identified by reference numeral 10, will now be described with reference to **FIGURES 1** through 11.

15 Referring to **FIGURE 1**, aerial tree harvesting apparatus 10 includes a first body 12 and a second body 14 having coaxial bores defining a tree receiving opening 16. Referring to **FIGURE 6**, first body 12 has at least one attachment 18 for suspending first body 12 from a hovering aerial craft, such as
20 a helicopter 20. Referring to **FIGURES 2** and 3, grappling arms 22 are each pivotally secured at a pivot position 24 to first body 12 for movement between a first position spaced apart at a periphery 26 of tree receiving opening 16, illustrated in **FIGURE 2**, and a second position encroaching upon said tree
25 receiving opening 16, illustrated in **FIGURE 3**. Referring to **FIGURE 3**, when grappling arms 22 are in second position they clamp upon a trunk 28 of a tree 30 positioned within tree receiving opening 16.

30 Referring again to **FIGURE 1**, second body 14 is suspended by cables 32 from first body 12. The length of cables 32 can be decreased or increased by means of a cable feed mechanism. The preferred form of cable feed mechanism has cables 32 wound upon mechanically rotatable spools 34 such that by rotating
35 said spools 34 the length of cables 32 can be decreased or increased to raise or lower second body 14 relative to first body 12. Referring to **FIGURE 4**, a first pair of circular

delimbing saw blades 36 is mounted to second body 14 in opposed relation for rotation about a first substantially horizontal axis 38, and a second pair of circular delimbing saw blades 40 is mounted to second body 14 in opposed relation for rotation
5 about a second substantially horizontal axis 42. Second horizontal axis 42 is substantially perpendicular to first horizontal axis 38. Second pair of delimbing saw blades 40 is axially offset along second body 14 from first pair of delimbing saw blades 36, thereby providing sufficient clearance
10 to permit concurrent operation. Each of first pair of delimbing saw blades 36 and second pair of delimbing saw blades 40 is retained in a horizontally spaced relationship by means of positioning arms 43. A separation 45 between either first pair of delimbing saw blades 36, as illustrated in **FIGURE 1**,
15 or second pair of delimbing saw blades 40, as illustrated in **FIGURE 4**, is adjustable between a first position adjacent the periphery 26 of tree receiving opening 16 and a second position narrower than tree receiving opening 16. Separation 45 can be increased or decreased to a desired separation by adjusting the
20 position of positioning arms 43. This adjustment is intended to accommodate differing sizes of trees.

Referring to **FIGURES 5** and **8**, severing saw 44 is movable from a rest position adjacent tree receiving opening 16, as
25 illustrated in **FIGURE 5**, transversely across tree receiving opening 16, as illustrated in **FIGURE 8**, thereby severing trunk 28 of tree 30 positioned in tree receiving opening 16.

Aerial tree harvesting apparatus 10, as described above,
30 can rapidly perform all operations necessary to delimb, fell and transport a tree. Referring to **FIGURE 6**, apparatus 10 is lowered from hovering aerial craft 20, such as a helicopter, until trunk 28 of tree 30 is positioned within tree receiving opening 16 of first body 12 and second body 14. Grappling arms
35 22, as illustrated in **FIGURES 2** and **3**, are activated, preferably by hydraulics 46, to move them to second position where they firmly grip trunk 28 of tree 30, as illustrated in

FIGURE 3. Tree 30 has limbs 48 that must be removed before trunk 28 of tree 30 can be cut. Separation 45 of delimbing saw blades 36, 40 is selected to accommodate the size of trunk 28. Delimbing saw blades 36, 40 are activated and second body 14 is slowly lowered on cables 32. Referring to **FIGURE 7**, as second body 14 is lowered, limbs 48 are severed from trunk 28, leaving a remaining portion 52 that is acceptably small attached to said trunk 28. Tree 30 is delimbed on all sides as first pair of delimbing saws blades 36 and second pair of delimbing saw blades 40 are positioned to encircle trunk 28 of tree 30. Each one of pair of delimbing saw blades 36 and 40 rotates in a different direction so as to maintain second body 14 in balanced equilibrium during cutting.

Referring to **FIGURE 8**, when second body 14 has been lowered to just above ground level 50, trunk 28 of tree 30 is severed by passing severing saw 44 transversely across tree receiving opening 16. Tree 30 does not fall upon being severed, as it is held by grappling arms 22 and supported from the air by helicopter 20. Referring to **FIGURE 9**, helicopter 20 then lifts severed trunk 28 of tree 30 into the air and transports it to a drop off site. Second body 14 is raised upon cables 32 to a position immediately adjacent first body 12 during transport. Severed trunk 28 of tree 30 is released by returning grappling arms 22 to first position spaced apart at periphery 26 of tree receiving opening 16, as illustrated in **FIGURE 2**.

When a small helicopter is used for harvesting trees, second body 14 as described above is too heavy to be used for the purpose of delimbing trees. An alternative embodiment has, therefore, been developed for use with smaller helicopters. Referring to **FIGURES 10 and 11**, an alternative embodiment of second body 60 includes a set of blades or knives 62 instead of circular, drum or chain delimbing saw blades. A containment ring 65 defines tree receiving opening 16 and maintains second body 60 in position about trunk 28 of tree 30. Referring to

FIGURE 10, knives 62 are vertically spaced within second body 60. Referring to **FIGURE 11**, at least one of knives 62 is positioned on each of the opposed sides of tree receiving opening 16. Trunk 28 of tree 30 is positioned within tree receiving opening 16 with an arcuate portion 74 of second body 60 against a side 76 of trunk 28 of tree 30. The spacing between knives 62 is then adjusted by means of movable knife supports 66, to bring knives 62 as close as possible to trunk 28 of tree 30. Synchronous movement of knife supports 66 is accomplished using an hydraulic mechanism 78 between a spaced apart arrangement to allow entry of a trunk 28 into tree receiving opening 16, as illustrated in **FIGURE 11**, and a cutting position in which knives 62 are spaced a smaller distance from trunk 28. Hydraulic mechanism 78 includes an electric motor which operates an hydraulic pump. Once positioned, knives 62 are maintained in stationary fixed relation to superstructure 68 of second body 60. Second body 60 is suspended on cables 32 from first body 12, in the same manner as illustrated for second body 14 in **FIGURE 1**. Second body 60 is positioned around tree 30, as described, and then dropped rapidly by rapidly lengthening cables 32. Second body 60 falls by virtue of its weight and as it falls knives 62 sever limbs from tree 30. Severing saw 44 is used to cut transversely across trunk 28 to sever trunk 28 after delimbing. Severing saw 44 is hydraulically powered using a combustion engine 80 which runs a hydraulic pump. Referring to **FIGURE 10**, a ground engaging member 64 is provided to maintain second body 60 a set distance from the ground surface.

As described above, aerial tree harvesting apparatus 10 has been illustrated with both stationary blades or movable blades. It is not practical to illustrate every form of movable blades and, for that reason, circular saw blades were selected for purposes of illustration. It will be understood, however, that drum delimiters or chain blades are also workable. Stationary blades could be maintained in a permanently fixed position, but it is preferred that some means of adjustment be

provided to accommodate different trunk sizes.

It will be apparent to one skilled in the art that
modifications may be made to the illustrated embodiment without
5 departing from the spirit and scope of the invention as
hereinafter defined in the Claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

- 5 1. An aerial tree harvesting apparatus, comprising:
a first body and a second body having co-axial bores
defining a tree receiving opening;
the first body having at least one attachment for
suspending the first body from a hovering aerial craft;
10 the second body being suspended by cables from the first
body;
delimbing members mounted to the second body about the
tree receiving opening, such that the delimbing members sever
limbs from the tree positioned in the tree receiving opening
15 when the second body is lowered; and
a severing member mounted to the second body, the severing
member being movable from a rest position adjacent the tree
receiving opening transversely across the tree receiving
opening, thereby severing the trunk of the tree positioned in
20 the tree receiving opening; and
arms pivotally secured to at least one of the first body
and the second body for movement between a first position
spaced apart at a periphery of the tree receiving opening and
a second position encroaching upon the tree receiving opening
25 thereby clamping upon a trunk of a tree positioned within the
tree receiving opening.
2. The aerial tree harvesting apparatus as defined in Claim
1, wherein the delimbing members are fixed in a stationary
30 orientation to the secondary body.
3. The aerial tree harvesting apparatus as defined in Claim
1, wherein the delimbing members are rotatably mounted to the
secondary body.
- 35 4. The aerial tree harvesting apparatus as defined in Claim
1, wherein the relative positioning of the delimbing members
is adjustable.

5. The aerial tree harvesting apparatus as defined in Claim 4, wherein the delimbing members are circular saws mounted for rotation about a substantially horizontal rotational axis.

5 6. The aerial tree harvesting apparatus as defined in Claim 1, wherein the severing member is a chain saw.

7. The aerial tree harvesting apparatus as defined in Claim 1, wherein a cable feed mechanism is provided to decrease and
10 increase the length of the cables to raise and lower the second body relative to the first body.

8. The aerial tree harvesting apparatus as defined in Claim 7, wherein the cable feed mechanism includes mechanically
15 rotatable cable support spools such that by rotating the spools the length of the cables can be decreased to raise and increased to lower the second body relative to the first body.

9. An aerial tree harvesting apparatus, comprising:

a first body and a second body having co-axial bores defining a tree receiving opening;

5 the first body having at least one attachment for suspending the first body from a hovering aerial craft;

the second body being suspended by cables from the first body, the cables being wound upon mechanically rotatable spools such that by rotating the spools the length of the cables can
10 be decreased or increased to raise or lower the second body relative to the first body;

a first pair of circular delimbing saw blades mounted to the second body in opposed relation for rotation about a first substantially horizontal axis;

15 a second pair of circular delimbing saw blades mounted to the second body in opposed relation for rotation about a second substantially horizontal axis, the second horizontal axis being substantially perpendicular to the first horizontal axis, the second pair of circular delimbing saw blades being axially
20 offset along the second body from the first pair of circular delimbing saw blades, thereby providing sufficient clearance to permit concurrent operation;

a severing saw secured to the second body and movable from a rest position adjacent the tree receiving opening
25 transversely across the tree receiving opening, thereby severing the trunk of the tree positioned in the tree receiving opening; and

grappling arms pivotally secured to at least one of the first body and the second body for movement between a first
30 position spaced apart at a periphery of the tree receiving opening and a second position encroaching upon the tree receiving opening thereby clamping upon a trunk of a tree positioned within the tree receiving opening.

10. An aerial tree harvesting apparatus, comprising:
a first body and a second body having co-axial bores
defining a tree receiving opening;

5 the first body having at least one attachment for
suspending the first body from a hovering aerial craft;

the second body being suspended by cables from the first
body, the cables being wound upon mechanically rotatable spools
such that by rotating the spools the length of the cables can
10 be decreased or increased to raise or lower the second body
relative to the first body;

at least two blade supports pivotally mounted to the
second body for movement toward and away from each other,
whereby the relative spacing between the blade supports is
15 adjusted to accommodate differing sizes of tree trunks;

stationary delimbing blades affixed to the blade supports,
such that the delimbing blades sever limbs from the tree
positioned in the tree receiving opening when the second body
is rapidly lowered relative to the first body;

20 a severing saw secured to the second body and movable from
a rest position adjacent the tree receiving opening
transversely across the tree receiving opening, thereby
severing the trunk of the tree positioned in the tree receiving
opening; and

25 grappling arms pivotally secured to at least one of the
first body and the second body for movement between a first
position spaced apart at a periphery of the tree receiving
opening and a second position encroaching upon the tree
receiving opening thereby clamping upon a trunk of a tree
30 positioned within the tree receiving opening.

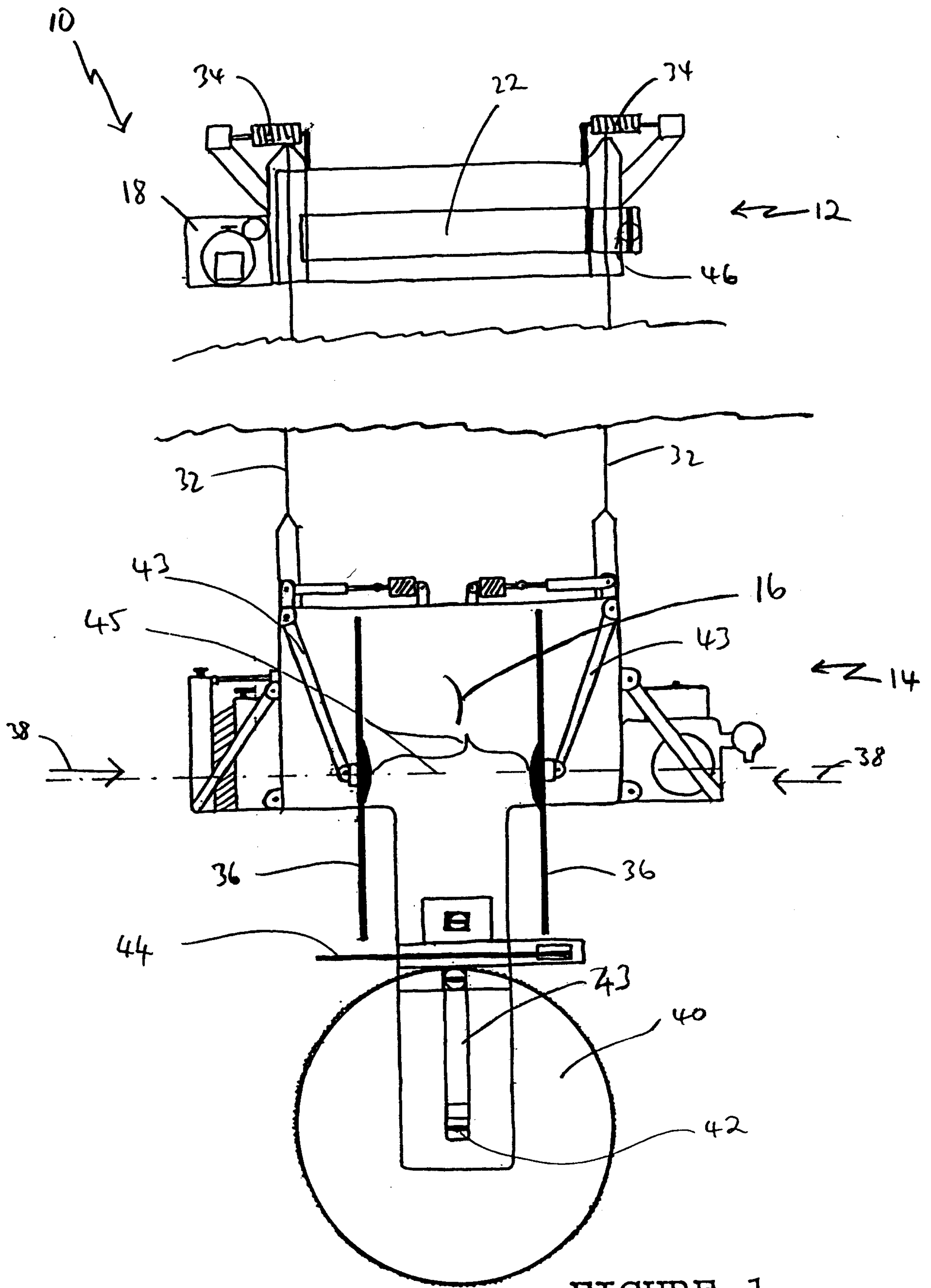


FIGURE 1

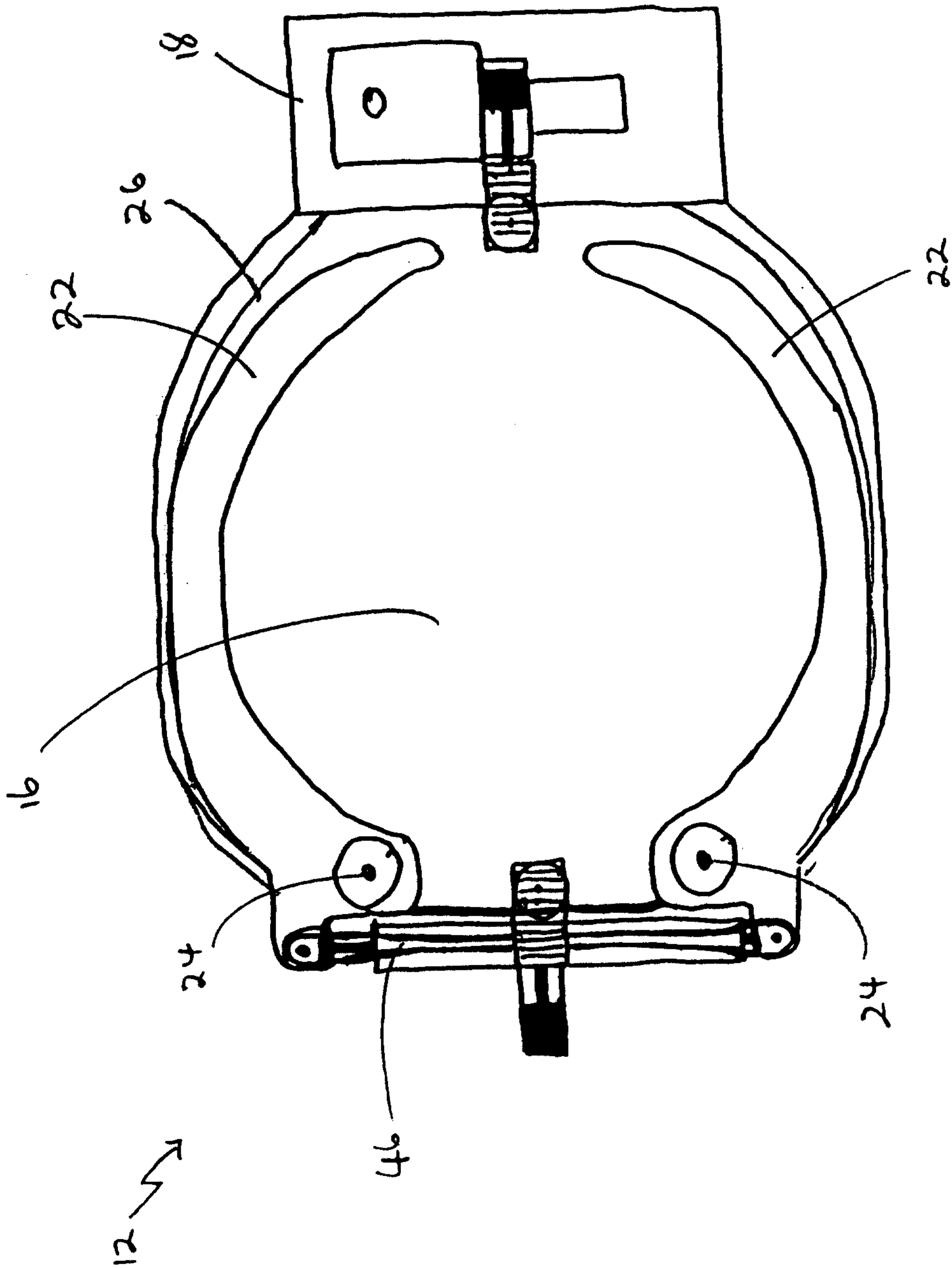


FIGURE 2

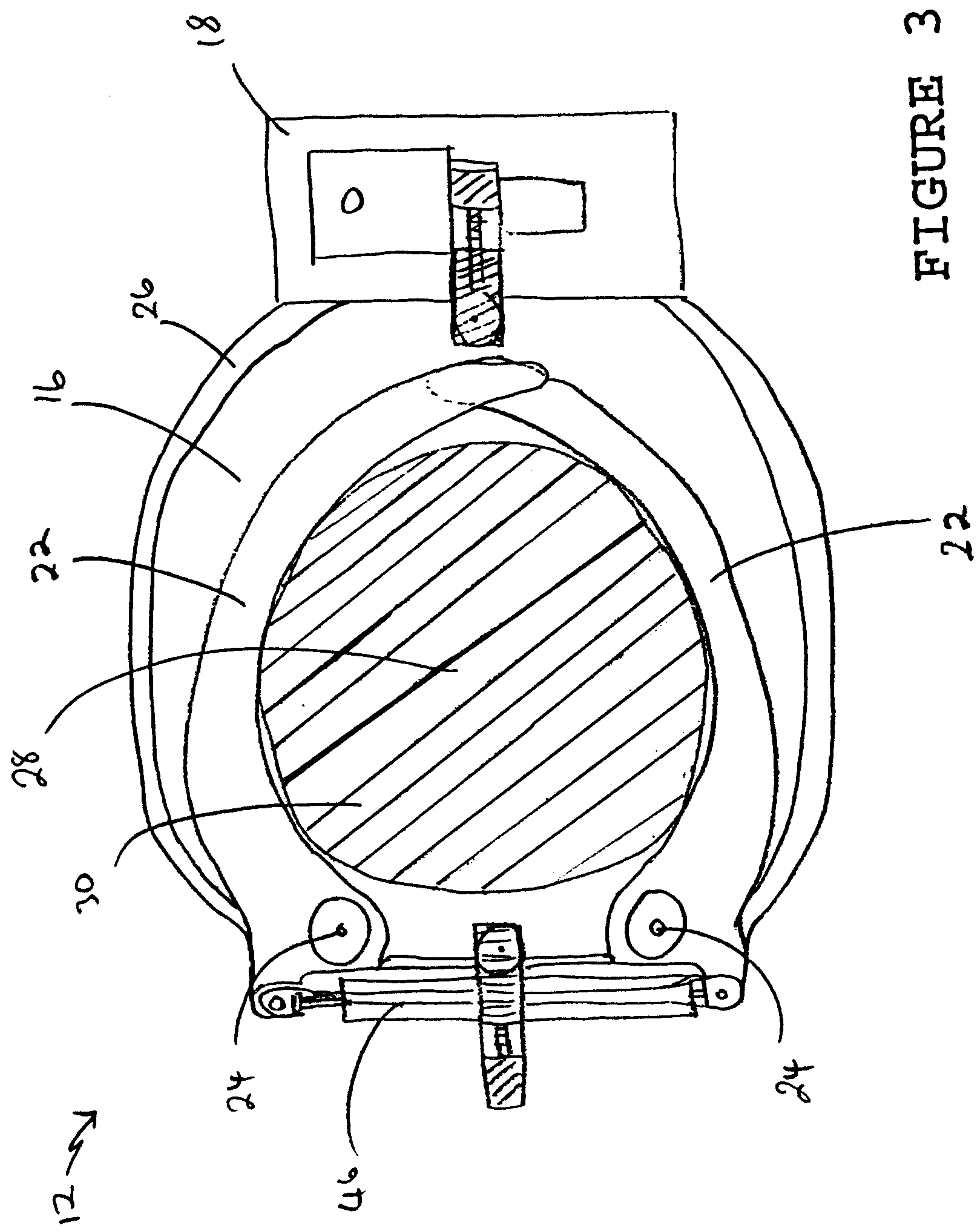


FIGURE 3

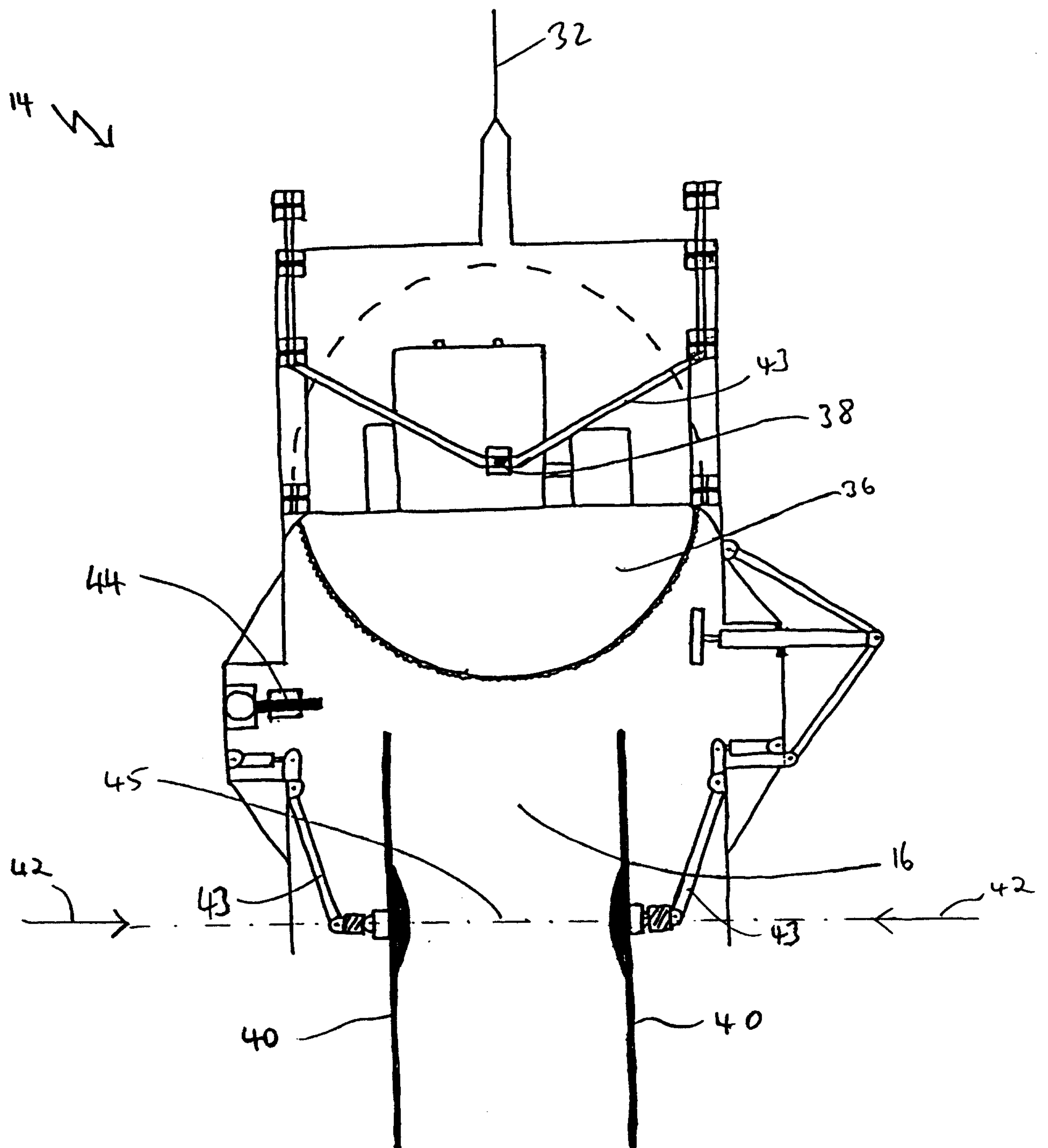
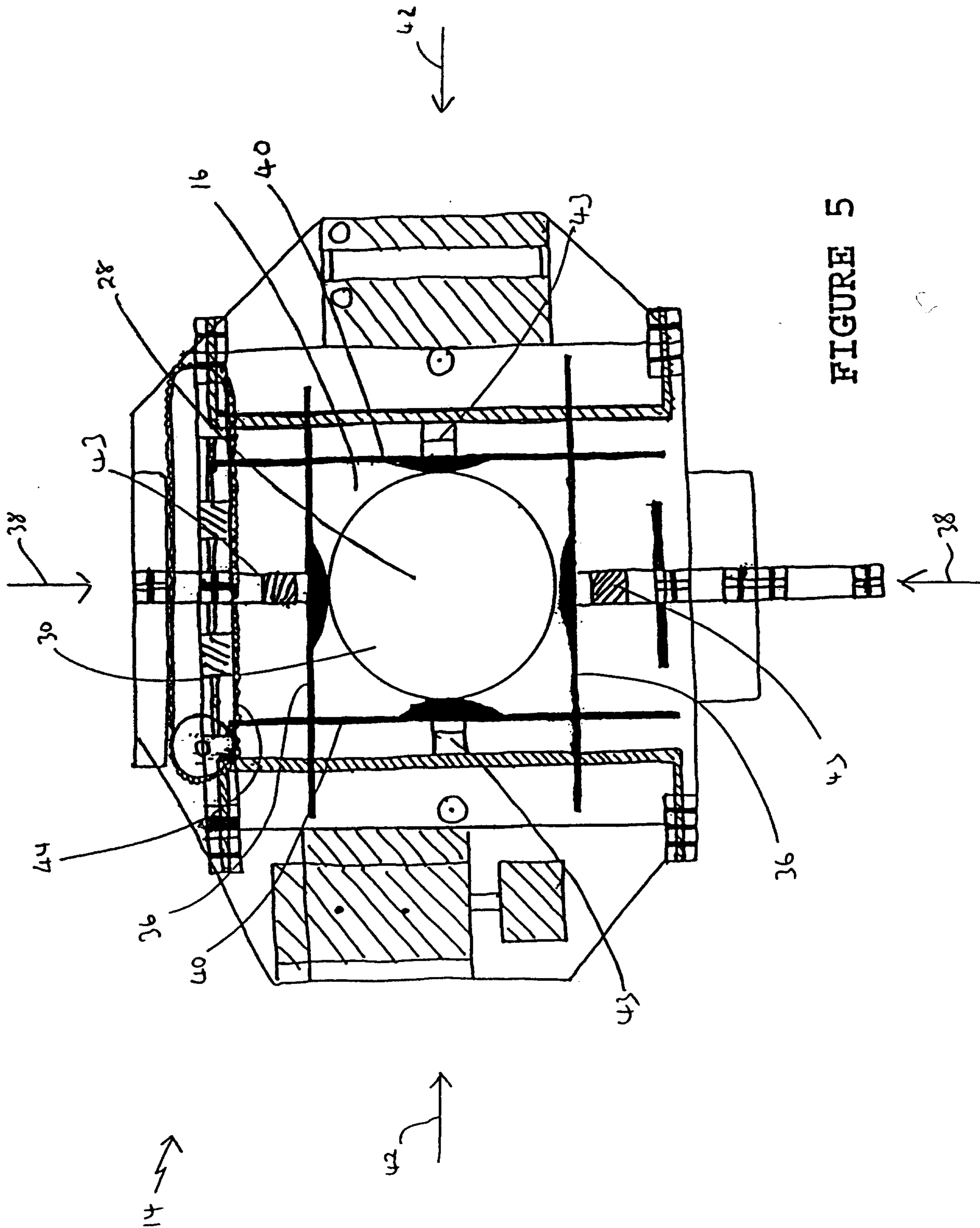


FIGURE 4



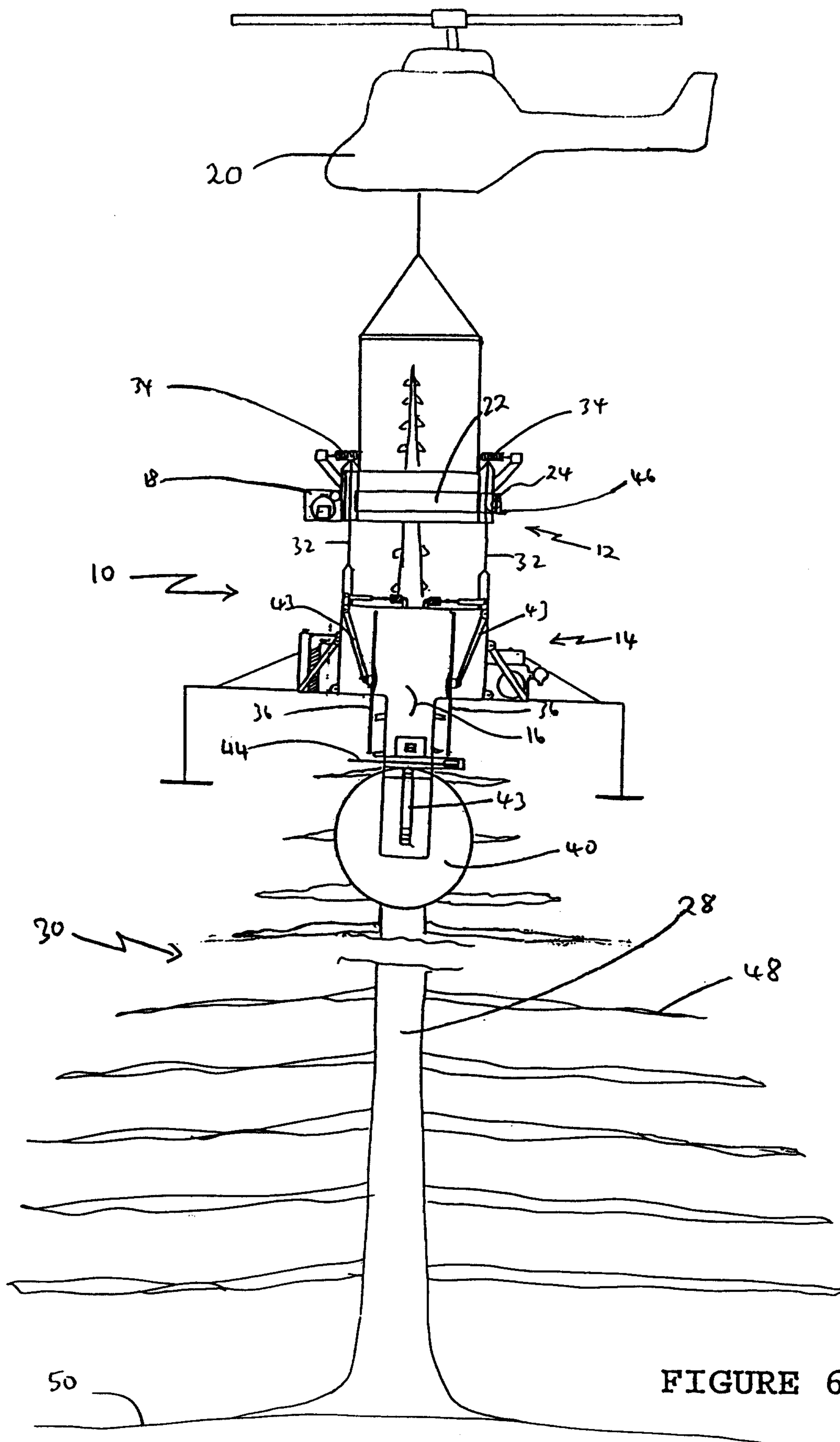


FIGURE 6

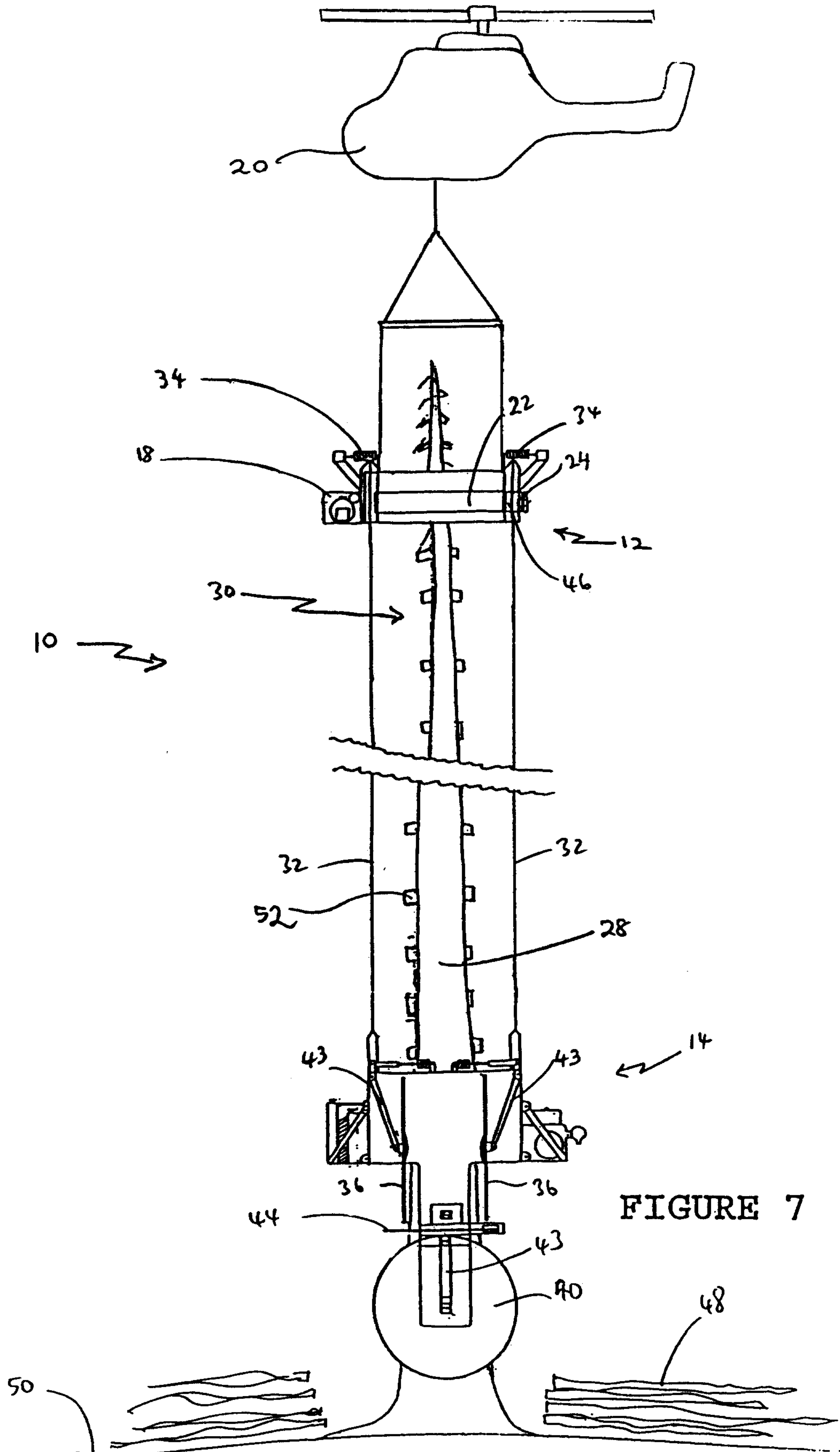


FIGURE 7

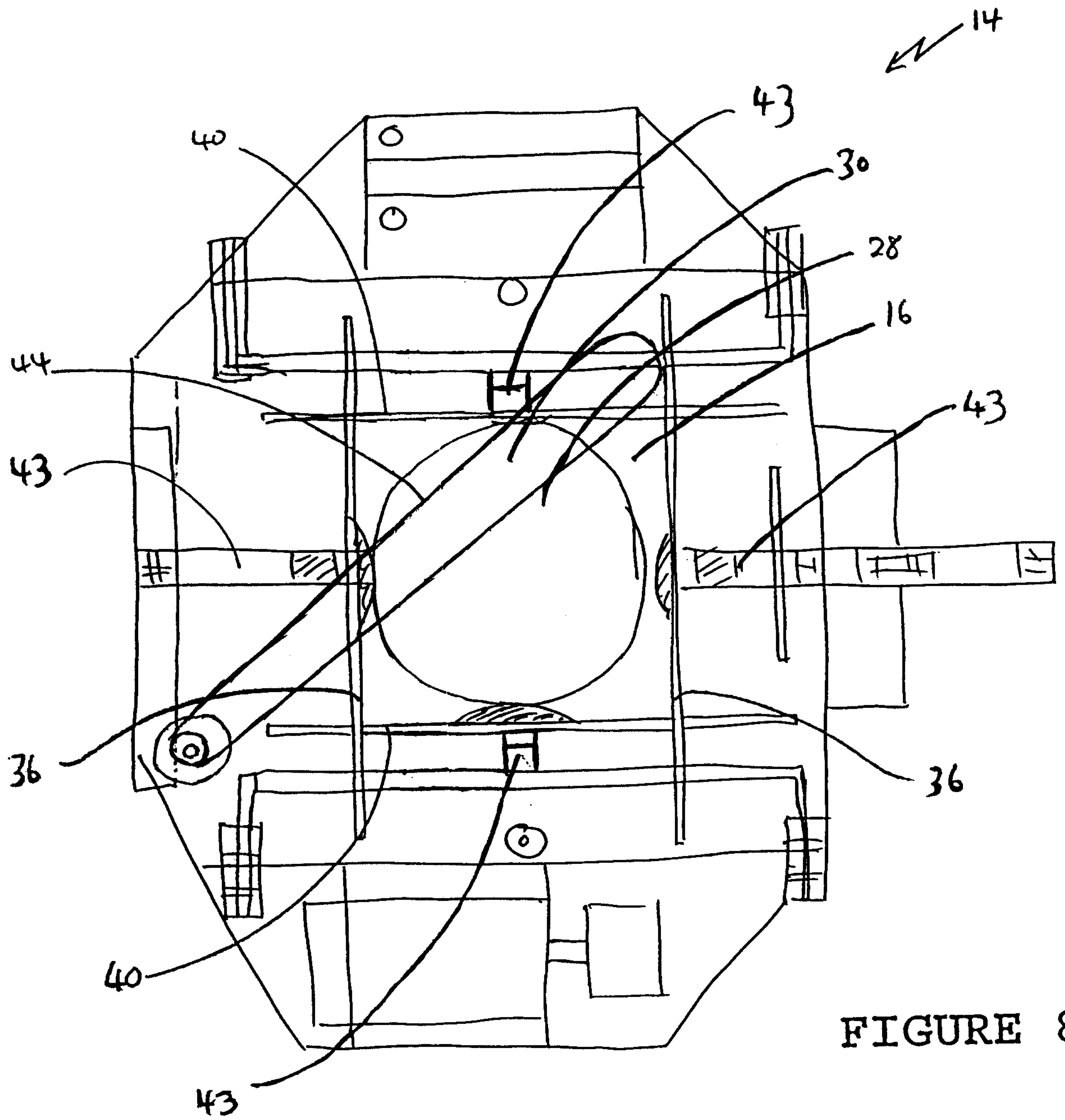
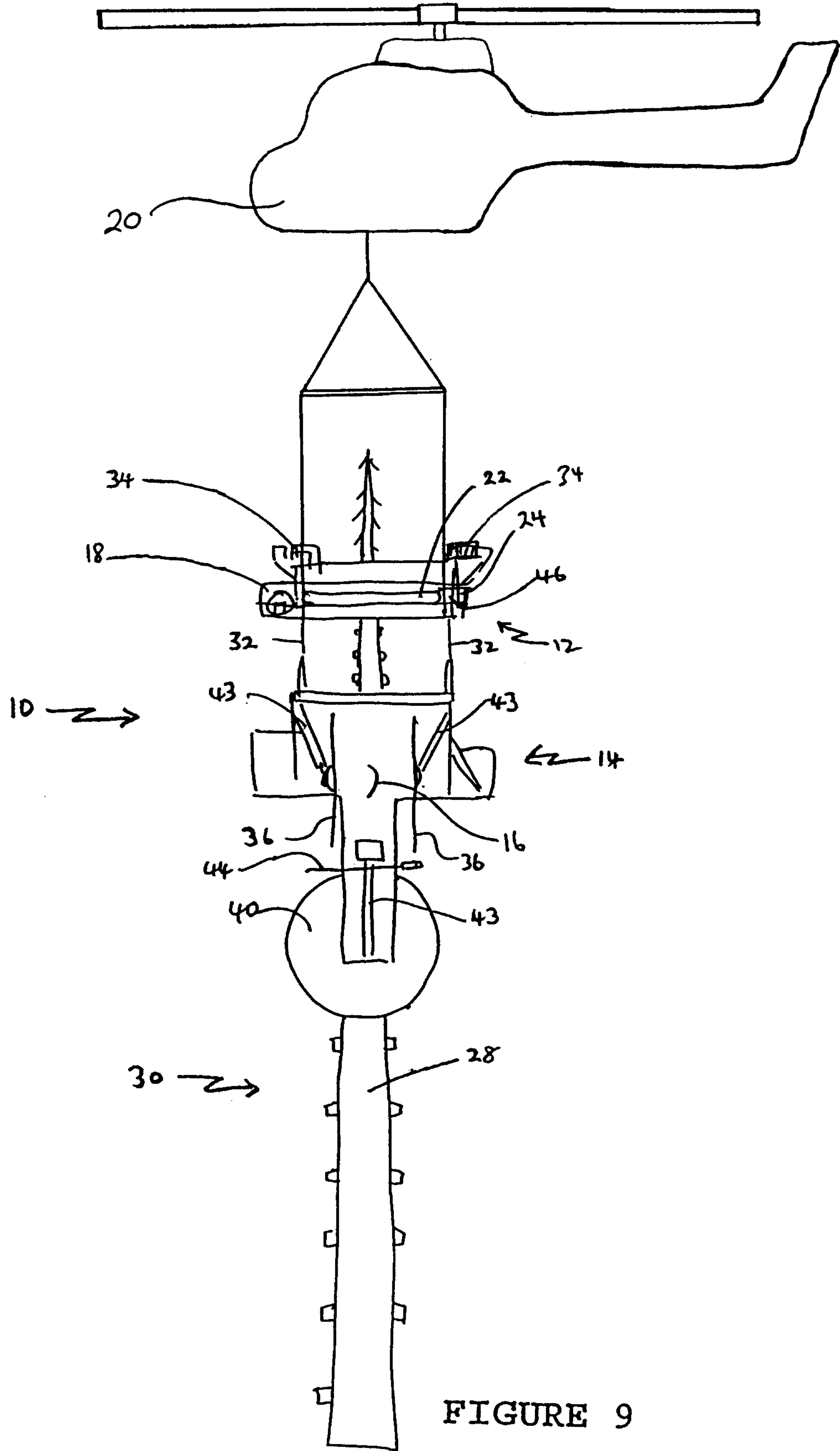


FIGURE 8



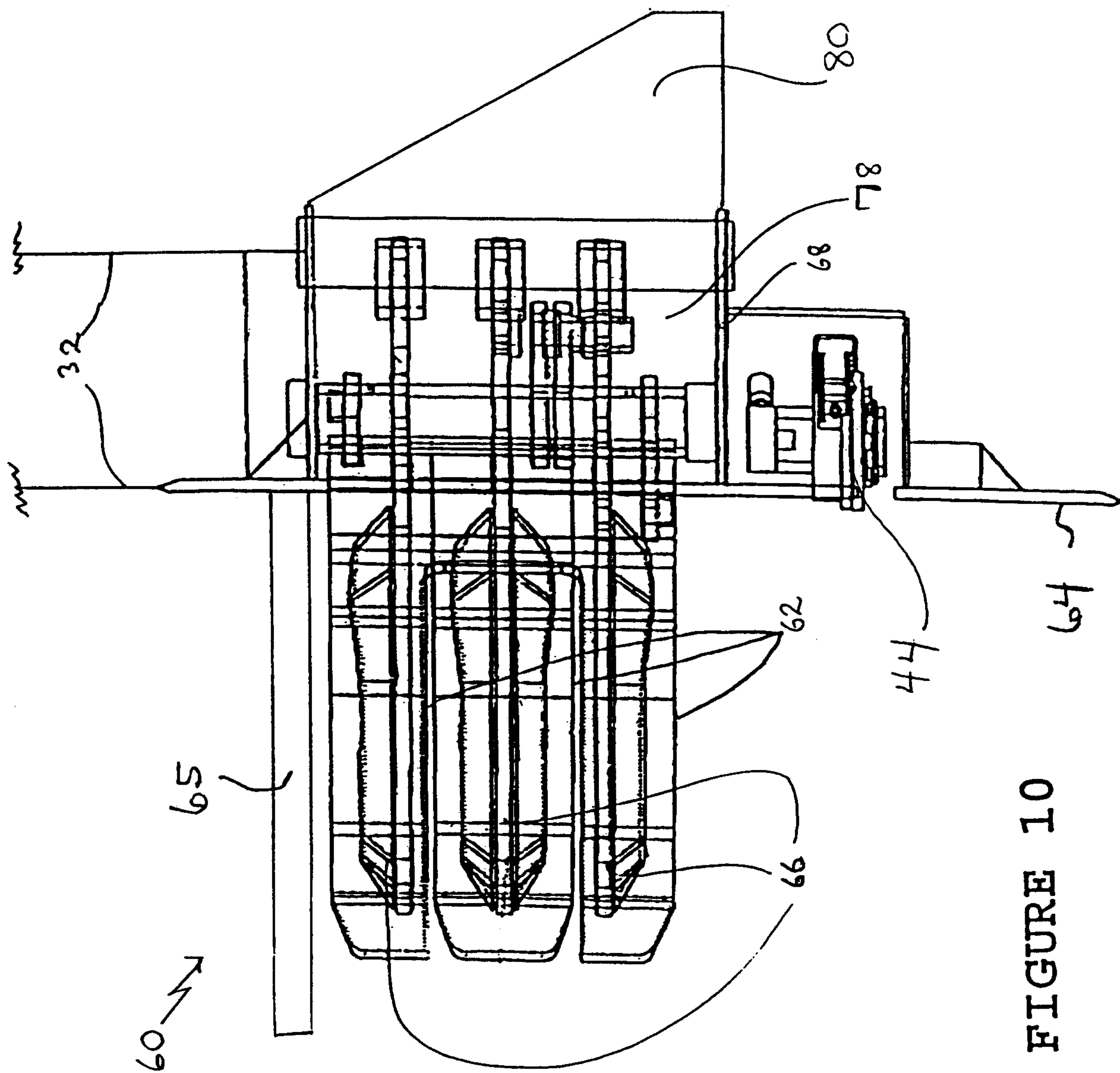


FIGURE 10

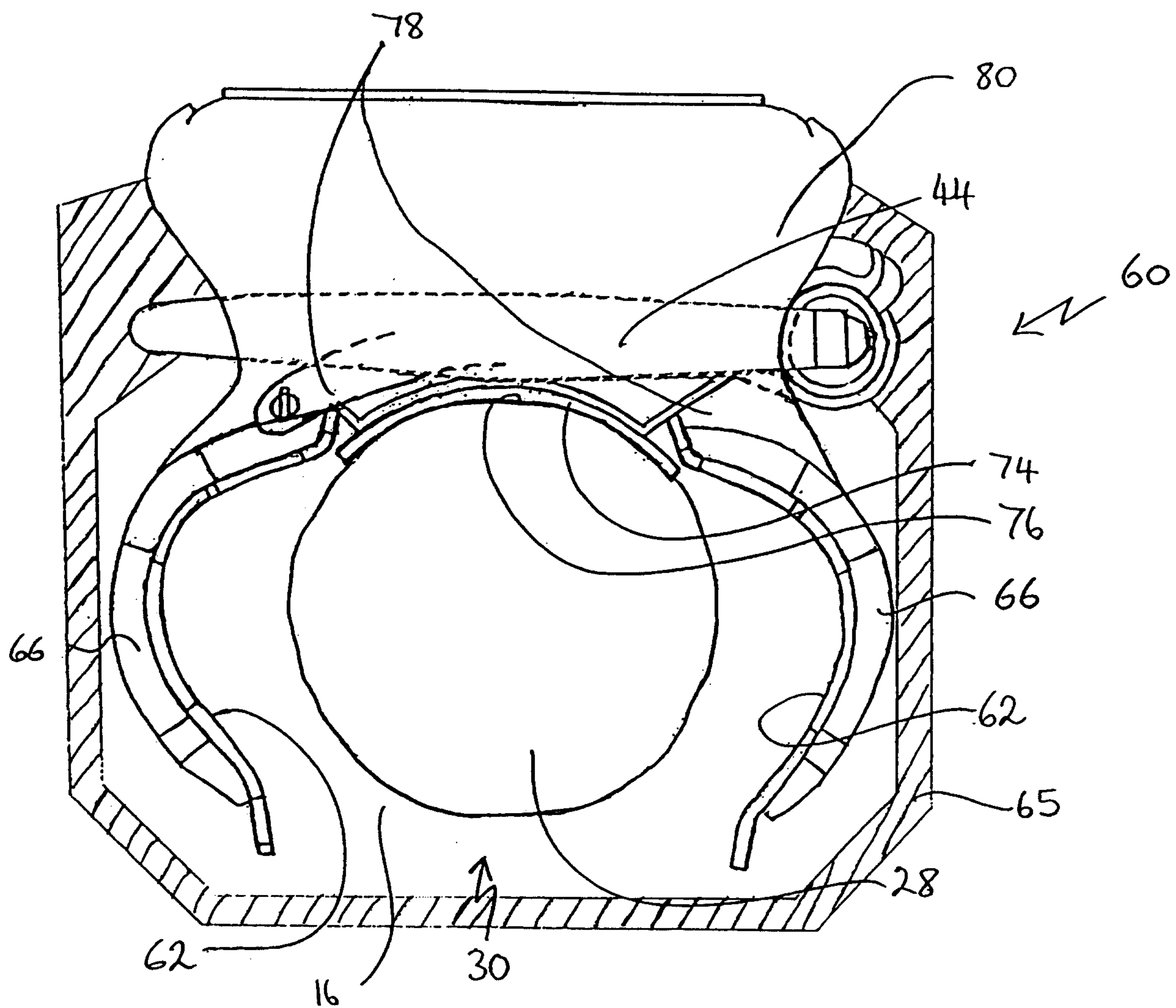


FIGURE 11

