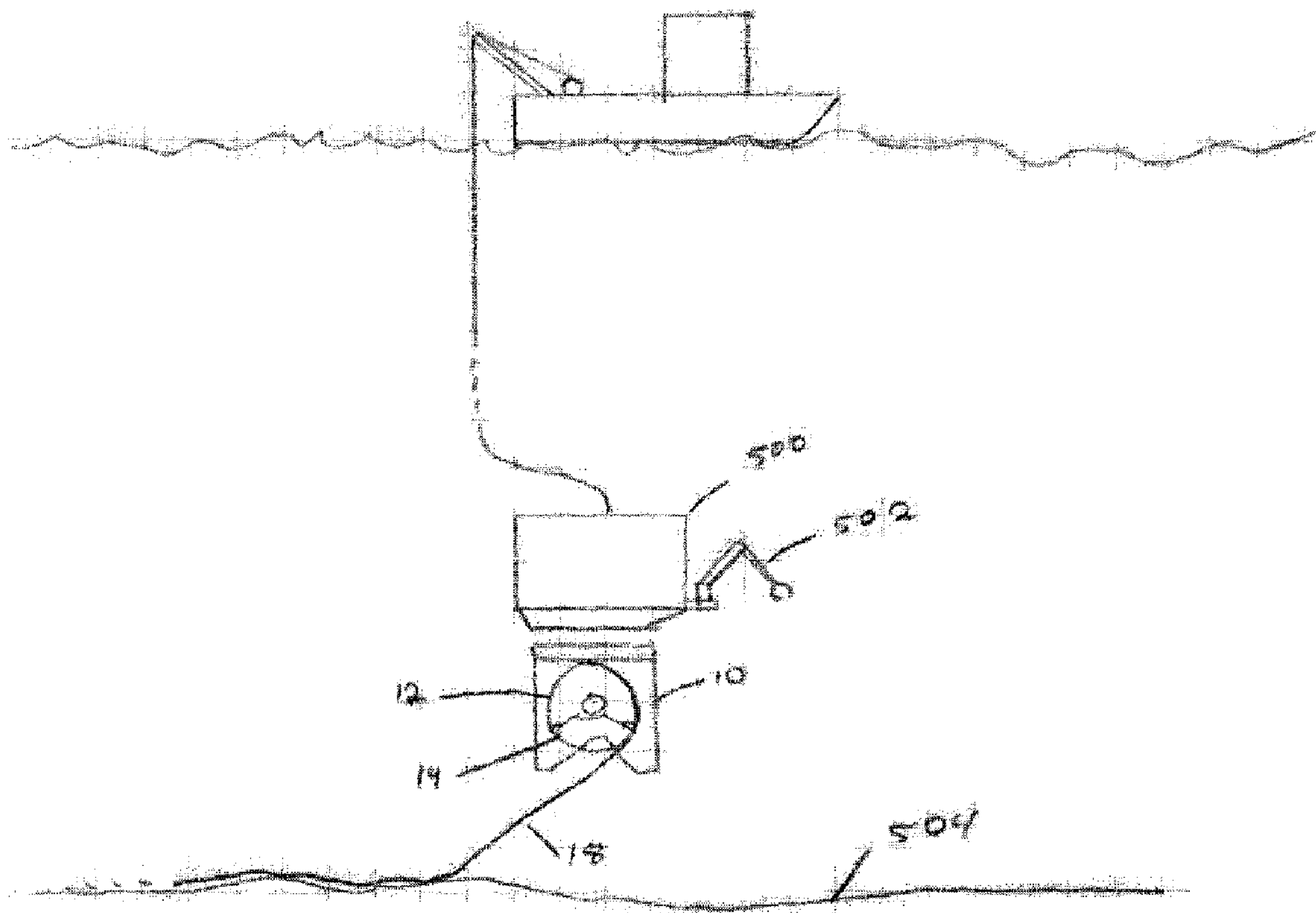




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(54) Titre : PROCÉDE ET APPAREIL POUR DEPLOYER DES CABLES SOUS-MARINS
(54) Title: METHOD AND APPARATUS FOR UNDERWATER CABLE DEPLOYMENT



(57) **Abrégé/Abstract:**

A method and apparatus for underwater cable deployment is described. The apparatus includes a remotely operated cable laying system (ROCLS) frame for attachment to an underwater craft having manipulators. The ROCLS frame supports a rotatable drum. A protective housing is detachably secured to the drum. The protective housing is adapted to house and protect a remote end of a cable wound on the drum, along with an associated coupling required to couple the cable with another cable. The protective housing is detachably secured to the drum with a fastening system that can be manipulated by the manipulators of the underwater craft to secure the selective release of the protective housing from the drum.



ABSTRACT OF THE DISCLOSURE

A method and apparatus for underwater cable deployment is described. The apparatus includes a remotely operated cable laying system (ROCLS) frame for attachment to an underwater craft having manipulators. The ROCLS frame supports a rotatable drum. A protective housing is detachably secured to the drum. The protective housing is adapted to house and protect a remote end of a cable wound on the drum, along with an associated coupling required to couple the cable with another cable. The protective housing is detachably secured to the drum with a fastening system that can be manipulated by the manipulators of the underwater craft to secure the selective release of the protective housing from the drum.

TITLE

[0001] Method and Apparatus for Underwater Cable Deployment

FIELD

5 [0002] There is described a method of underwater cable deployment and several alternative embodiments of apparatus constructed to facilitate underwater cable deployment in accordance with the method.

BACKGROUND

10 [0003] United States Patent 6,796,261 (Colyer) entitled "Subsea Deployable Drum For Laying Lines" describes a method and apparatus for underwater cable deployment developed by ABB Offshore Systems Inc. There will hereinafter be described a method that was developed to provide better access to and prevent of a coupling at a remote end of the cable being deployed.

15 SUMMARY

[0004] According to one aspect there is provided a method for underwater cable deployment.

A first step is taken of positioning an underwater cable on a rotatable drum. A second step is taken of positioning a remote end of the cable having an associated coupling, within a protective housing detachably mounted to the drum. A third step is taken of securing the drum to an
20 underwater craft having manipulators. A fourth step is taken of feeding the cable from the drum onto a seabed as the underwater craft traverses the seabed. A fifth step is taken of setting the drum down onto the seabed and detaching the drum from the underwater craft. A sixth step is taken of using manipulators on the underwater craft to detach the protective housing from the drum, such that the protective housing falls to the seabed carrying the remote end of the cable and
25 associated coupling. A seventh step is taken of re-attaching the underwater craft to the drum and removing the drum which is now empty and free of the cable. An eighth step is taken of using manipulators on the underwater craft to reach into the protective housing to grasp the coupling and couple the coupling on the remote end of the cable with a coupling at a remote end of another cable or to a piece of equipment.

30

[0005] In order to use this method an apparatus had to be developed. According to another aspect there is provided an apparatus for underwater cable deployment. The apparatus includes a remotely operated cable laying system (ROCLS) frame for attachment to an underwater craft having manipulators. The ROCLS frame supports a rotatable drum. A protective housing is detachably secured to the drum. The protective housing is adapted to house and protect a remote end of a cable wound on the drum, along with an associated coupling required to couple the cable with another cable. The protective housing is detachably secured to the drum with a fastening system that can be manipulated by the manipulators of the underwater craft to secure the selective release of the protective housing from the drum.

10

[0006] As will be apparent from the detailed description, the attachment position of the protective housing on drum may vary. Three embodiments with different attachment positions will be described. Each attachment position has inherent advantages and disadvantages. With a first embodiment which will be described, the protective housing is detachably secured to an outside surface of a flange of the drum. With a second embodiment which will be described, the protective housing is detachably secure to an inside surface of a flange of the drum. The inside surface attachment is, preferably, positioned between and sheltered by reinforcing gussets. With a third embodiment which will be described, the protective housing wraps around and increases a diameter of a drum core.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0007] These and other features will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to be in any way limiting, wherein:

25 [0008] **FIG. 1** is a front elevation view of a first embodiment of an apparatus for underwater cable deployment having a detachable protective housing secured to an outside of a flange of a cable drum..

[0009] **FIG. 2** is a section view taken along section lines 2-2 of **FIG. 1**.

[0010] **FIG. 3** is a front elevation view of a second embodiment of an apparatus for underwater cable deployment having a clamshell protective housing positioned around a drum core of a cable drum.

[0011] **FIG. 4** is a section view taken along section lines 4-4 of **FIG. 3**.

5 [0012] **FIG. 5** is a front elevation view of a third embodiment of an apparatus for underwater cable deployment having a protective housing secured to an inside of a flange of a cable drum.

[0013] **FIG. 6** is a section view taken along section lines 6-6 of **FIG. 3**.

[0014] **FIG. 7a** through **7h** are a series of simplified representations showing a method of underwater cable deployment using the described apparatus.

10

DETAILED DESCRIPTION

[0015] An apparatus for underwater cable deployment in the form of a remotely operable cable laying system (ROCLS) frame generally identified by reference numeral 10, will now be described with reference to **FIG. 1** through 7.

15

Structure and Relationship of Parts:

[0016] Referring to **FIG. 1**, ROCLS frame 10 was developed for attachment to an underwater craft or remotely operated vehicle (ROV) 500 having manipulators 502, as illustrated in **FIG. 7a** through **7h**. Referring to **FIG. 1**, ROCLS frame 10 supports a rotatable drum 12. A protective housing 14 is detachably secured to drum 12. Protective housing 14 is adapted to house and protect a remote end 16 of a cable 18 wound on drum 12. Referring to **FIG. 2**, remote end 16 of cable 18 has an associated coupling 20 required to couple cable 18 with another cable 18A. Referring to **FIG. 1**, as will be hereinafter further described in relation to three different embodiments, protective housing 14 is detachably secured to drum 12 with a fastening system, generally indicated by reference numeral 22, that can be manipulated by manipulators 502 of ROV 500 to secure the selective release of protective housing 14 from drum 12.

20

25

Protective Housing

[0017] The purpose of protective housing 14 is to contain and protect the inside end of a subsea cable's termination can, ROV underwater mateable connector, and interconnecting cables during cable deployment. They are protected from 'snagging', or damage (with this cable end and connector attached) during rotation of the drum throughout the unspooling of the cable. Once the cable is laid across the seafloor the flange box with its content is removed subsea, allowing the end of the cable to become free from the main ROCLS system, and the underwater mateable connector to be plugged into a device. In this first embodiment illustrated in FIG 1 and FIG. 2, protective housing 14 may be termed a "flange box". However, as will become apparent with other embodiments, the term can become misleading as protective housing need not be a "box" and need not be attached to a flange of the drum. Inside the flange box the termination can and the connector are connected via a pressure balance oil filled hose usually between 3 meters and 10 meters in length. The termination can is secured to the face of the flange box either permanently using fasteners, or temporarily using a removable fastening device (ie cable ties). The underwater mateable connector is always fastened to the flange box using a removable device, to allow the hose and connector to be removed and plugged in. The flange box also contains a section of the main cable connected to the termination can, routed through a slot in the side of the drum flange. This section of cable is also secure to the inside of the flange box, either permanently or temporarily.

20

Flange Box Mounting

[0018] The flange box 14 is a metal fabricated structure mounted to outside surface 26 one of the ROCLS drum flanges 24. The box 14 slides into place on drum flange 24 radially, mating with interlocking plates 25, and is secured to drum using 12 ROV removable pins 27. The main cable 18 is routed into flange box 14 via a slot 29 in drum flange 24 of drum 12. Cable 12 travels through the same slot 29 during removal of flange box 14 at the end of the cable lay.

25

Flange Box Removal

[0019] After the cable is completely laid, the ROCLS drum 12 is positioned with the flange box 14 oriented at the bottom of drum 12, and landed on the ocean floor. The ROV 500 detaches from ROCLS frame 10 and is positioned facing the flange box side of the ROCLS frame. The ROV manipulators 502 are used to release pins 27 securing flange box 14 from the ROCLS Flange 24. The ROV 500 reattaches to ROCLS frame 10 and lifts frame 10 off the ocean floor; at this point flange box 14 is no longer being secured to the drum flange 24, and the weight of flange box assembly 24 enables flange box 24 to slide out and rest on the ocean floor 504 free from the main ROCLS system.

10

[0020] Referring to **FIG. 1** and **FIG. 2**, with a first embodiment 100 protective housing 14 mounts to an outside surface 26 of a flange 24 of drum 12 and is, therefore, referred to as an Outside Flange embodiment. Protective housing 14 (flange box) is mounted to the outside surface 26 of flange 24, between flange 24 and ROCLS frame 10.

15

[0021] Referring to **FIG. 3** and **FIG. 4**, with a second embodiment 200 protective housing 14 mounts to a drum core 30 of drum 12. Second embodiment 200 has been referred to as a Clamshell embodiment due to the manner in which it surrounds drum core 30. It is built up using a metal fabricated clam shell clamp design, changing the drum core diameter from 16" to approximately 30". The clam shell clamp has a 'false' drum flange that mates with a flange box on the inside of the drum, creating a continuous drum flange face for the cable to sit against. The benefits of this design over the original outside flange box design, is it allows the drum core diameter to be built up, reducing the bending stress on the cable around the drum core, and eliminate the need for the cable to be routed through a slot in the side of drum. The cable routed through the drum flange slot, has risks associated with the cable being hung up and potentially damaging the cable during final removal. The downside of this design is it reduces the overall cable length capacity of the ROCLS drum with the built up core.

25

[0022] Referring to **FIG. 5** and **FIG. 6**, with a third embodiment 300 protective housing 14 is secured to an inside surface 34 of flange 24 of drum 12 and is, therefore, referred to as an Inside Flange embodiment. Inside flange box 14 is the same as the outside flange box but requires the original drum flange to be moved outwards. It is preferred that inside flange box 14
5 be positioned between strengthening gussets 36 on the inside surface 34 of drum flange 24. The benefits of this design over the other concepts, is it eliminates the cable being routed through the side of the drum flange and maintains the overall cable length capacity of the original ROCLS drum.

10 Operation:

[0023] The method for underwater cable deployment that the above apparatus makes possible will now be described with reference to simplified figures **FIG 7a** through **7h**. . Referring to **FIG. 7a**, a first step is taken of positioning an underwater cable 18 on a rotatable drum 12. Referring to **FIG. 7b**, a second step is taken of positioning a remote end 16 of cable 18
15 having an associated coupling 20, within a protective housing 14 detachably mounted to drum 12. Referring to **FIG. 7c**, a third step is taken of securing drum 12 to an underwater craft 500 having manipulators 502. Referring to **FIG. 7d**, a fourth step is taken of feeding cable 18 from drum 12 onto a seabed 504 as underwater craft 500 traverses seabed 504. Referring to **FIG. 7e**, a fifth step is taken of setting drum 12 down onto seabed 504 and detaching drum 12 from underwater
20 craft 500. Referring to **FIG. 7f**, a sixth step is taken of using manipulators 502 on underwater craft 500 to detach protective housing 14 from drum 12, such that protective housing 14 falls to seabed 504 carrying remote end 16 of cable 18 and associated coupling 20. Referring to **FIG. 7g**, a seventh step is taken of re-attaching underwater craft 500 to drum 12 and removing drum 12 which is now empty and free of cable 18. Referring to **FIG. 7h**, an eighth step is taken of using
25 manipulators 502 on underwater craft 500 to reach into protective housing 14 to grasp coupling 20 and couple coupling 20 on remote end 16 of cable 18 with a coupling 20A at a remote end 16A of another cable 18A.

[0024] In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the element is present, unless the context clearly requires that there be one
5 and only one of the elements.

[0025] The scope of the claims should not be limited by the illustrated embodiments set forth as examples, but should be given the broadest interpretation consistent with a purposive construction of the claims in view of the description as a whole.

What is Claimed is:

1. A method for underwater cable deployment, comprising:

- 5 positioning an underwater cable on a rotatable drum;
 positioning a remote end of the cable having an associated coupling, within a
protective housing detachably mounted to the drum;
 securing the drum to an underwater craft having manipulators;
 feeding the cable from the drum onto a seabed as the underwater craft traverses the
10 seabed;
 setting the drum down onto the seabed and detaching the drum from the underwater
craft;
 using manipulators on the underwater craft to detach the protective housing from the
drum, such that the protective housing falls to the seabed carrying the remote end of the cable and
15 associated coupling;
 re-attaching the underwater craft to the drum and removing the drum which is now
empty and free of the cable; and
 using manipulators on the underwater craft to reach into the protective housing to
grasp the coupling and couple the coupling on the remote end of the cable with a coupling at a
20 remote end of another cable.

2. An apparatus for underwater cable deployment comprising:

- a remotely operated cable laying system (ROCLS) frame for attachment to an underwater
craft having manipulators, the ROCLS frame supporting a rotatable drum; and
25 a protective housing detachably secured to the drum, the protective housing being adapted
to house and protect a remote end of a cable wound on the drum, along with an associated
coupling required to couple the cable with another cable, the protective housing being detachably

secured to the drum with a fastening system that can be manipulated by the manipulators of the underwater craft to secure the selective release of the protective housing from the drum.

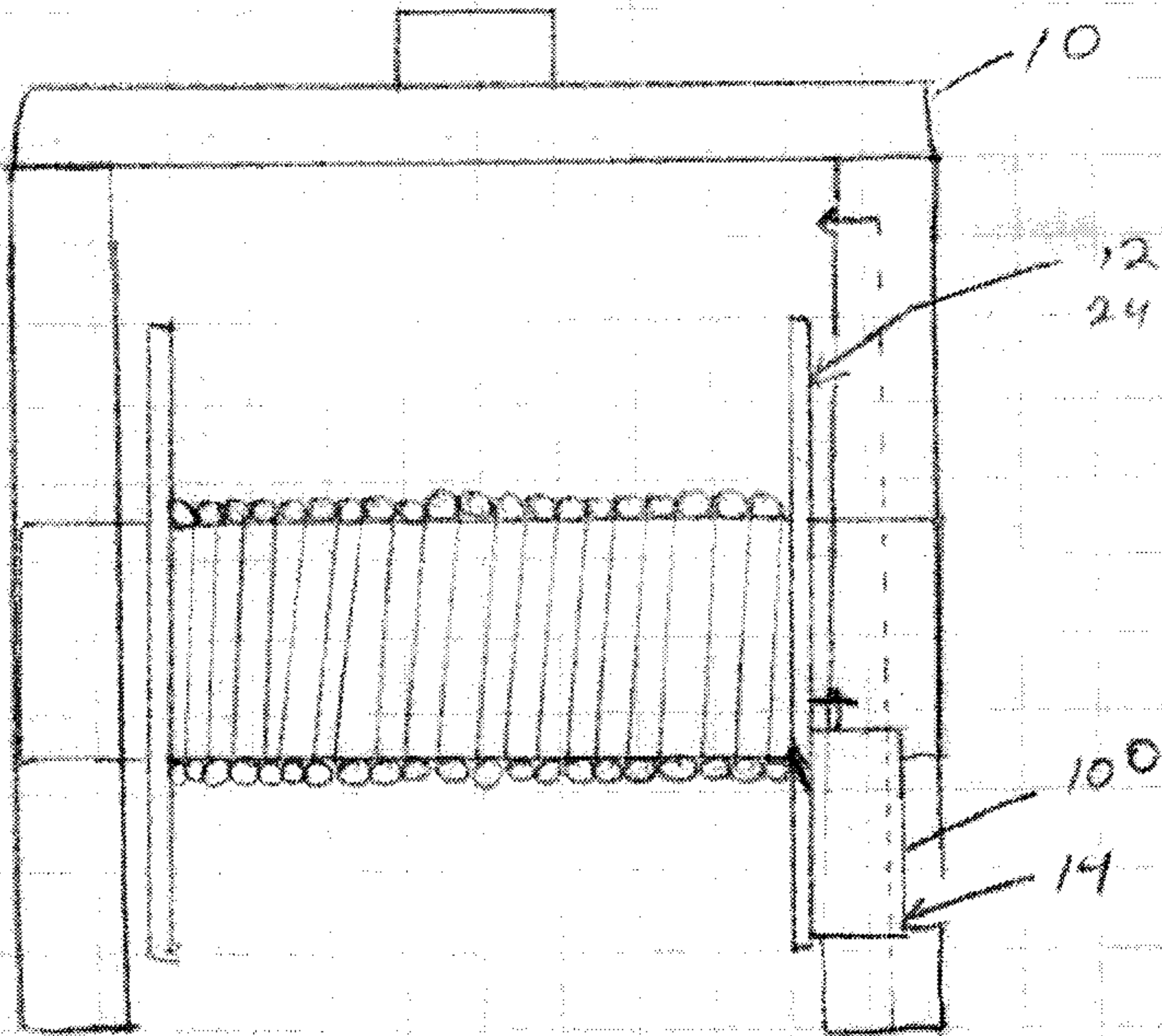
3. The Apparatus of Claim 2, wherein the protective housing is detachably secured to an outside
5 surface of a flange of the drum.

4. The Apparatus of Claim 2, wherein the protective housing is detachably secure to an inside
surface of a flange of the drum.

10 5. The Apparatus of Claim 4, wherein the protective housing is positioned between and sheltered
by reinforcing gussets.

6. The Apparatus of Claim 2, wherein the protective housing wraps around and increases a
diameter of a drum core.

FIG 1

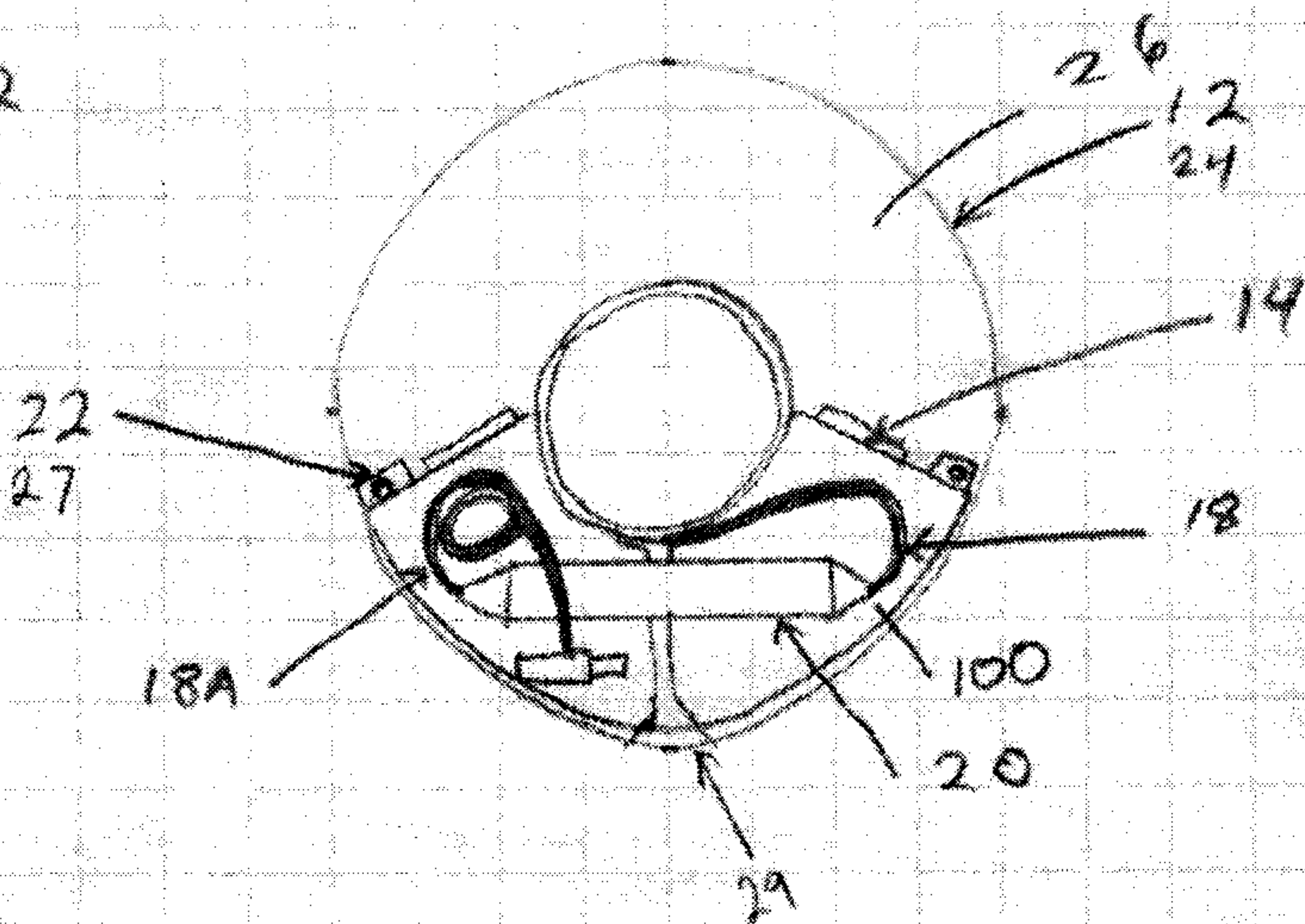


12 - APPARATUS FOR UNDERWATER CABLE DEPLOYMENT

14 - DETACHABLE PROTECTIVE HOUSING

SECTION 2-2

FIG 2



22
27

18A

29

100

20

18

14

26

12
24

FIG 3

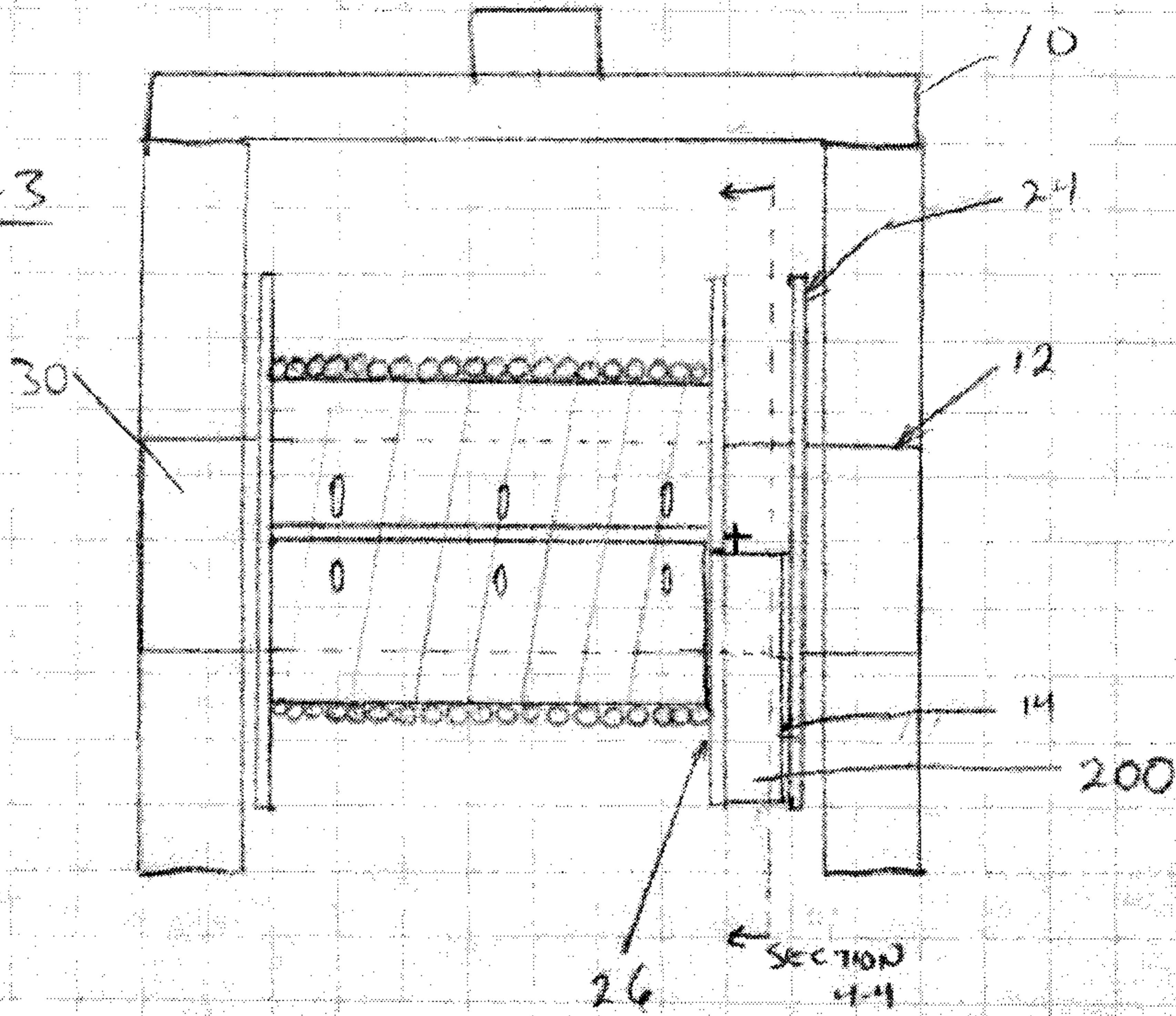


FIG 4

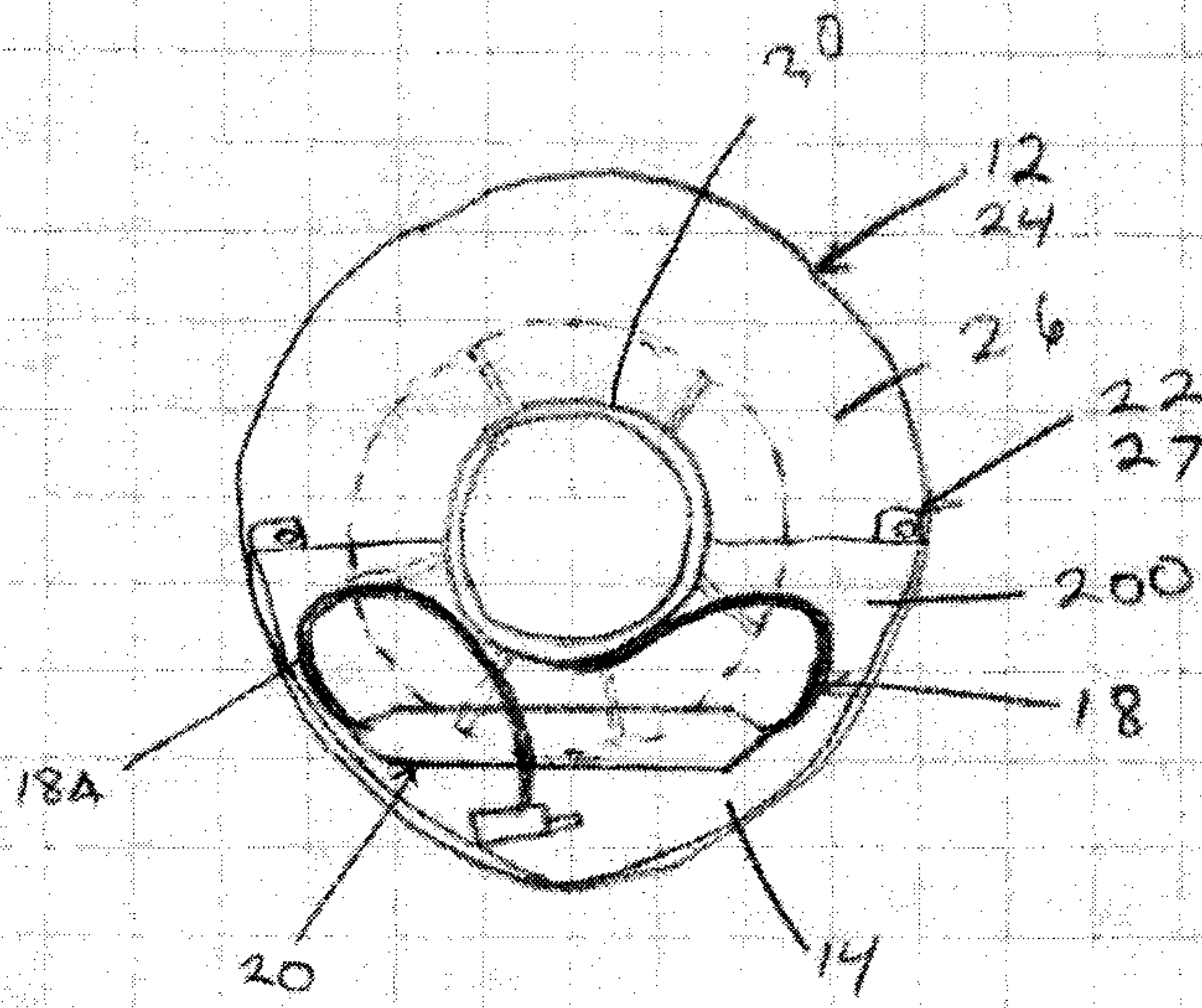


FIG 5

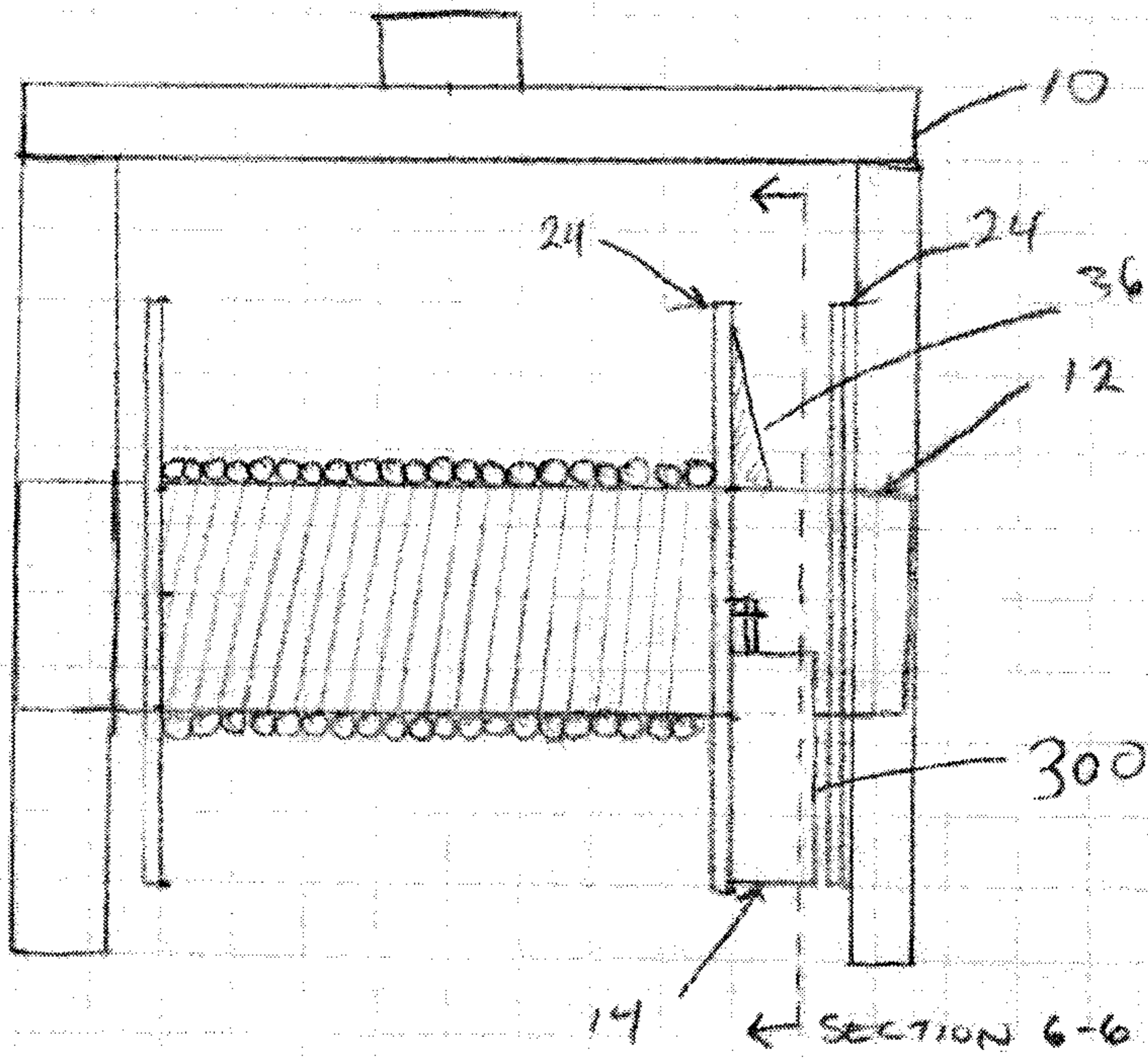


FIG 6

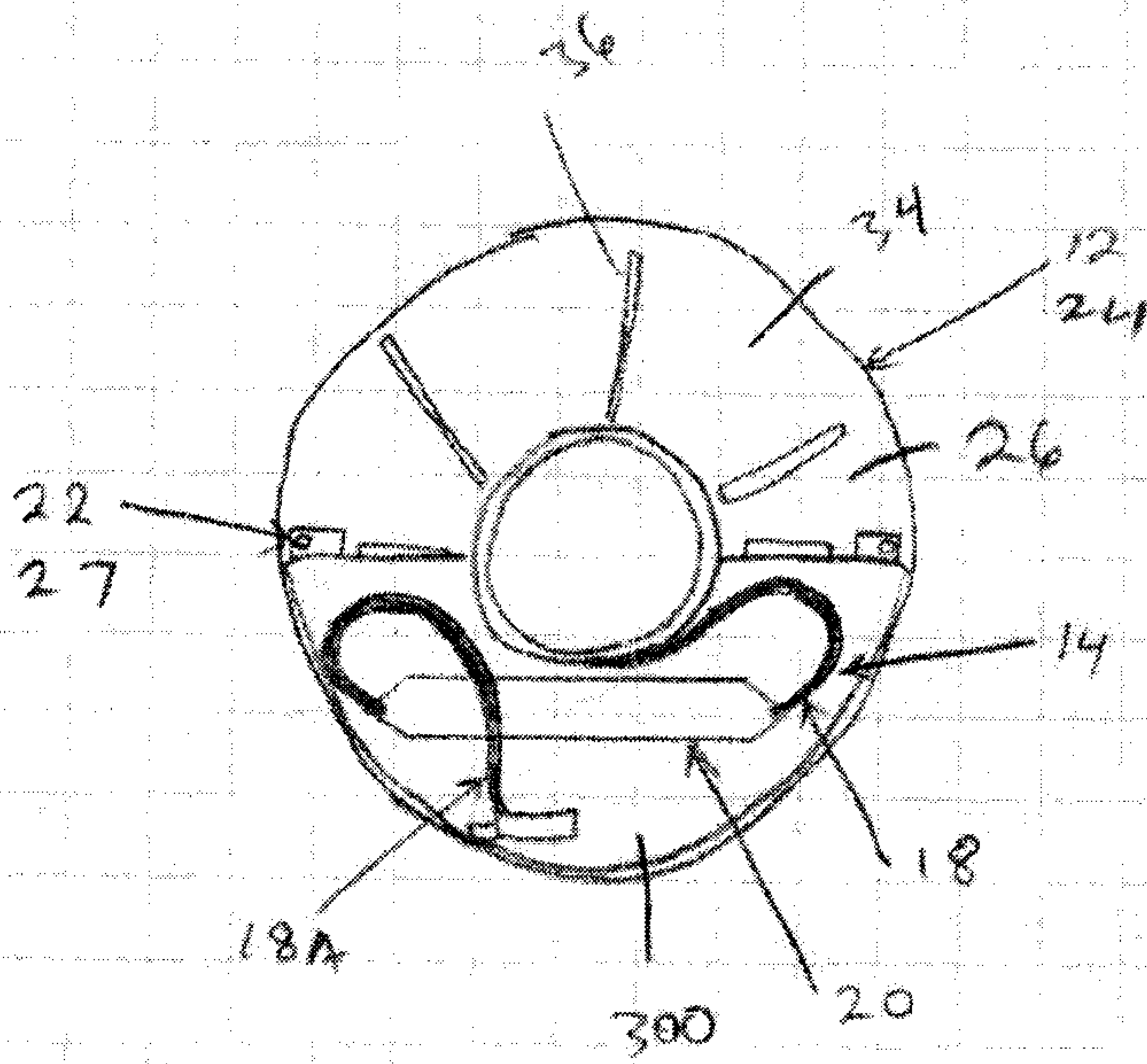


FIG 7a

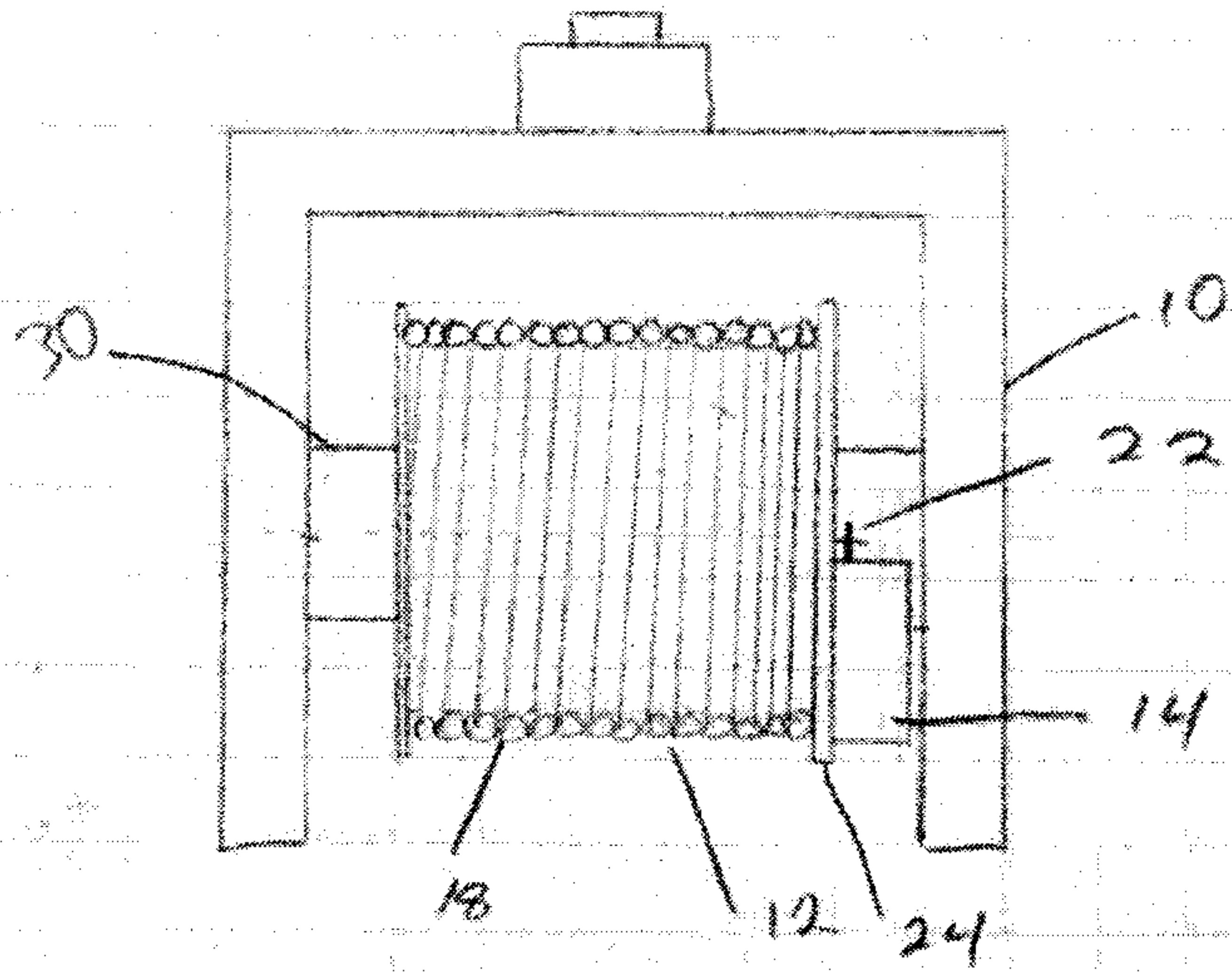


Fig 7b

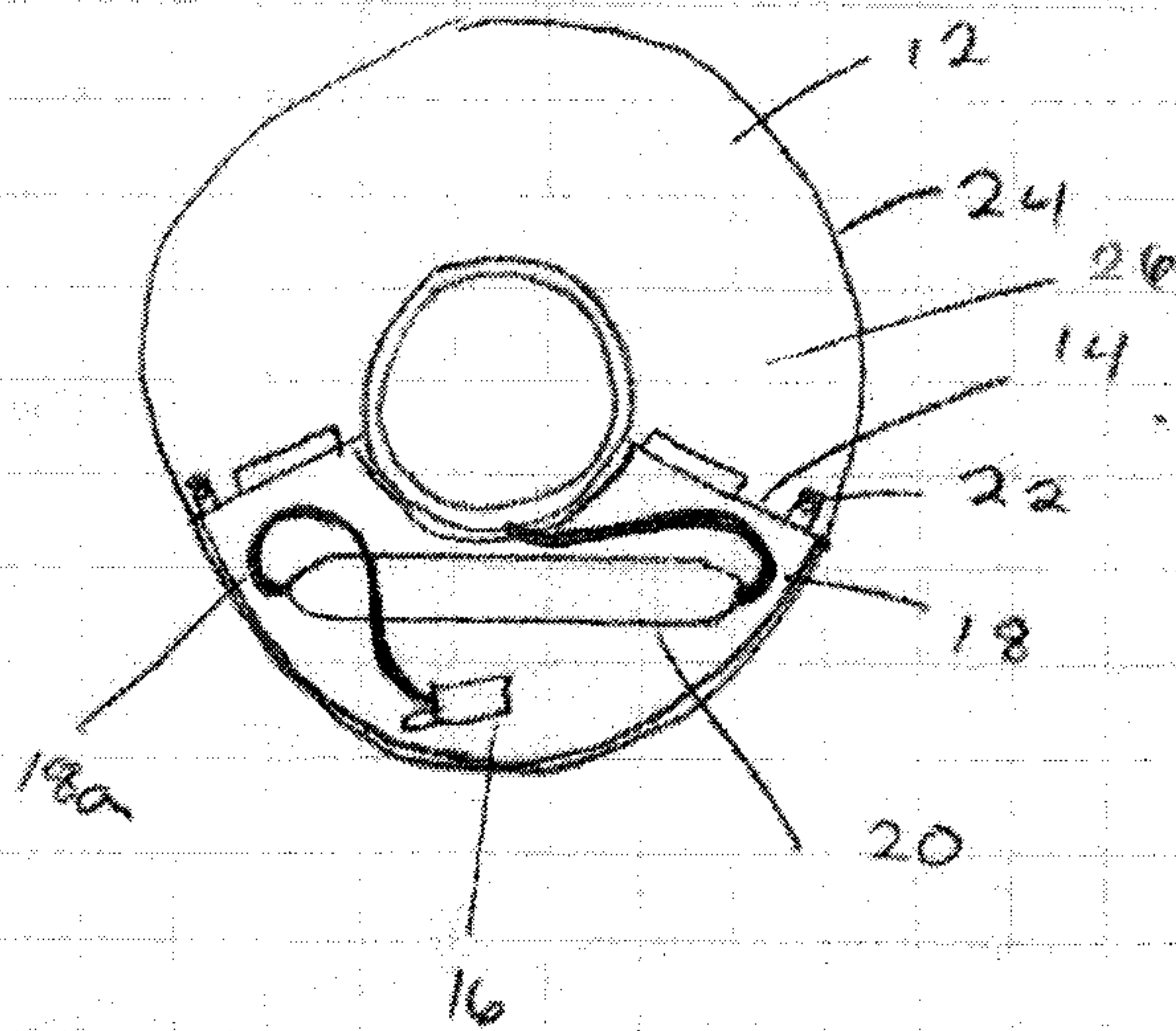


Fig 7c

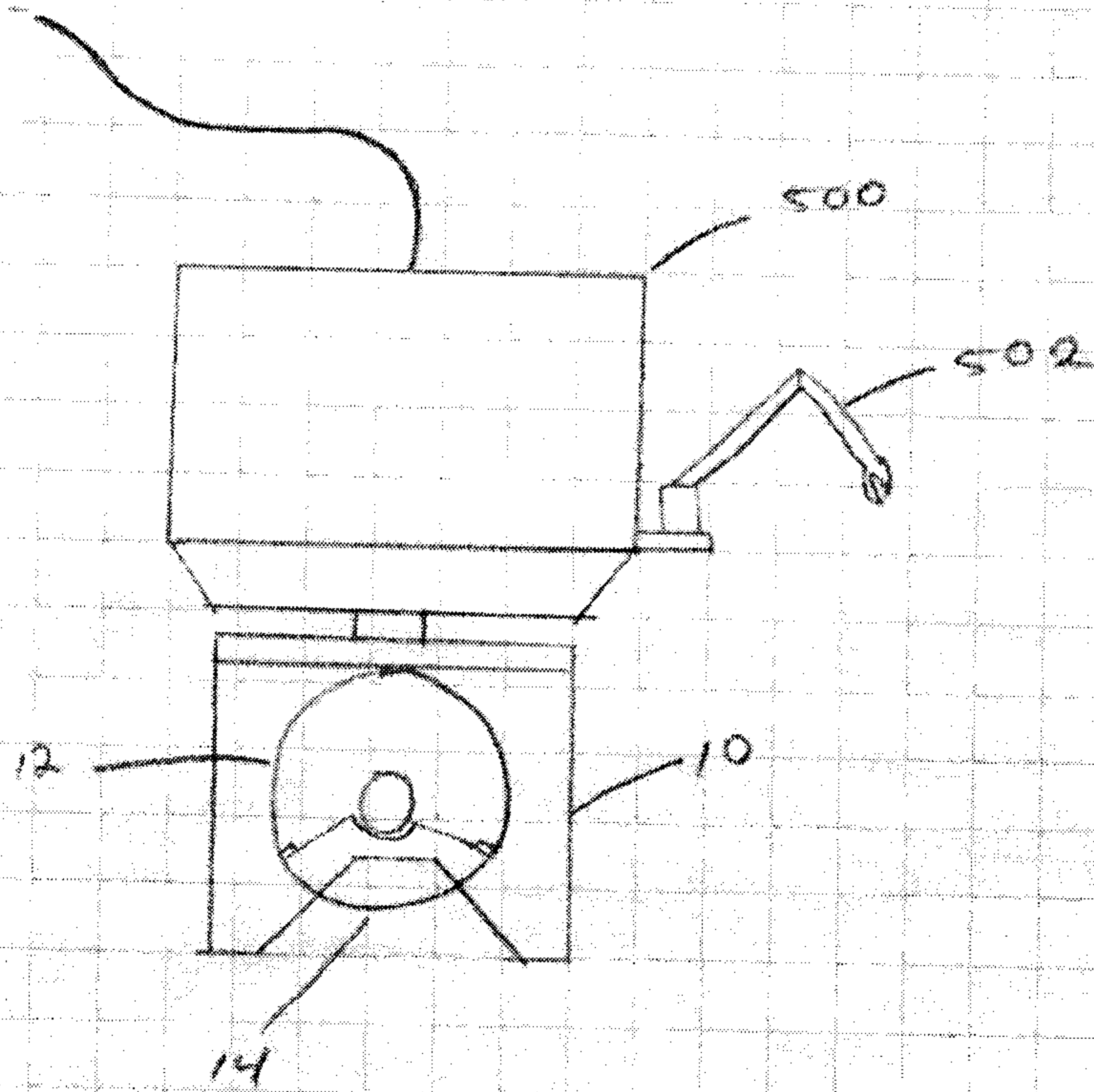


Fig 7d

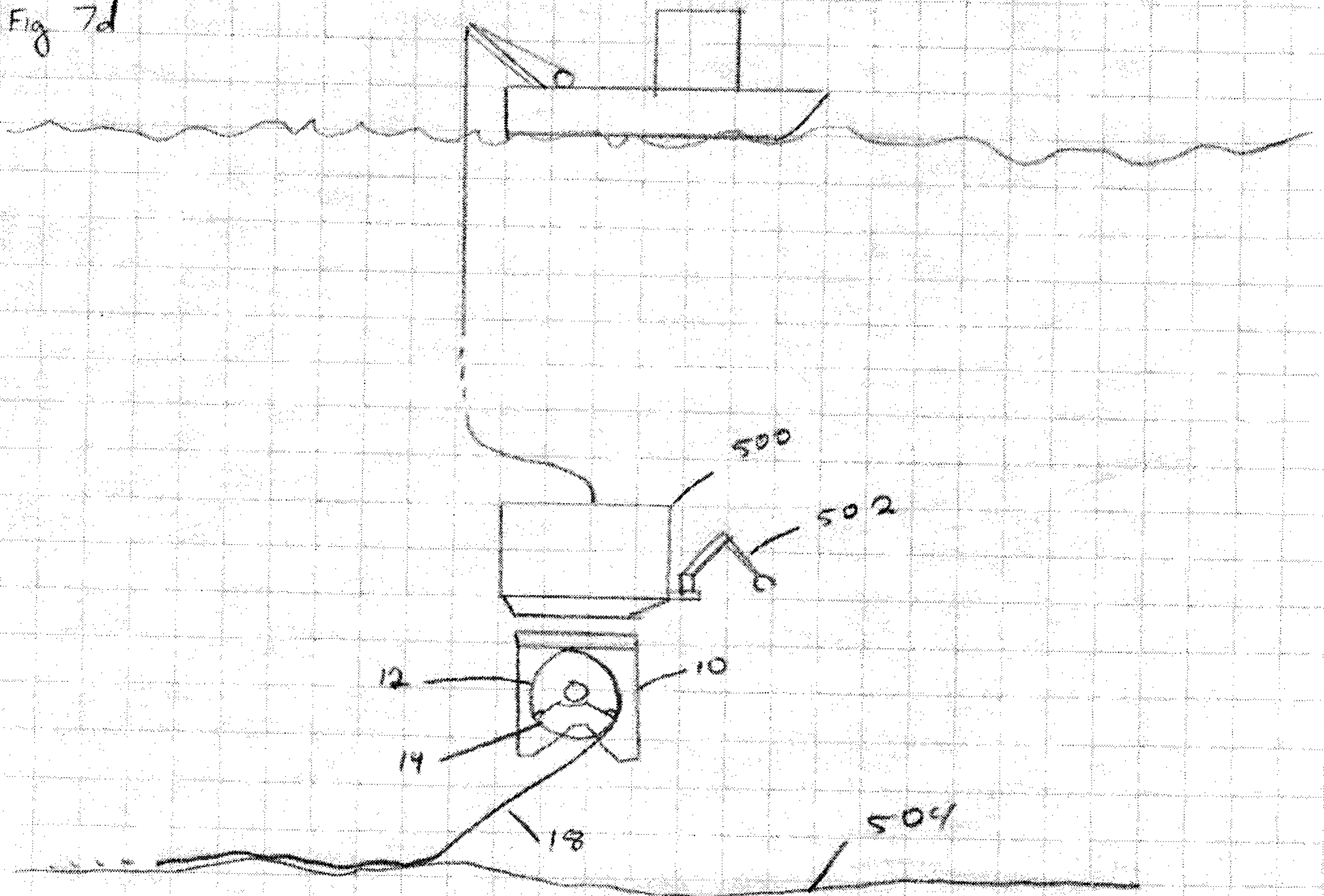


Fig 7e

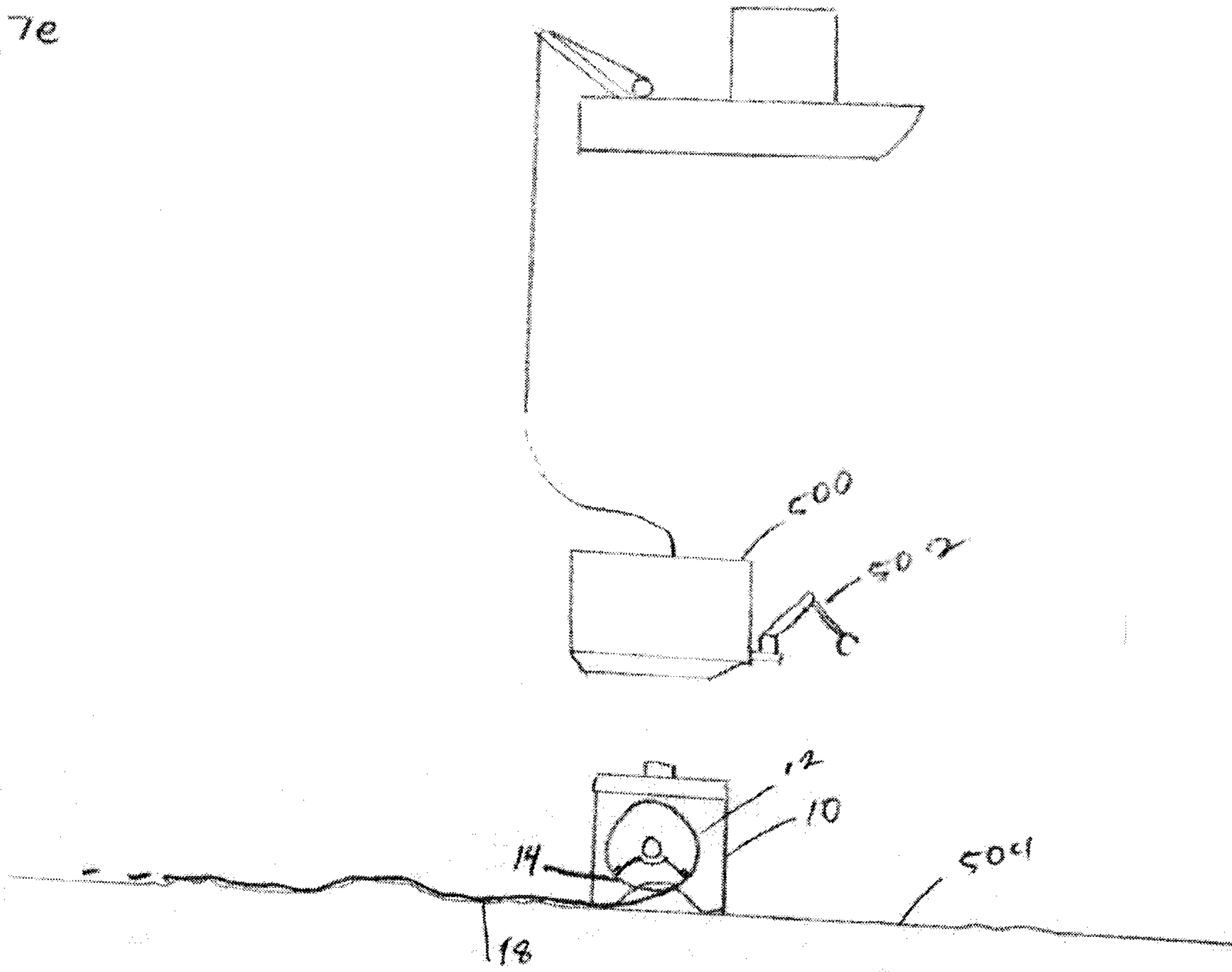


Fig 7f

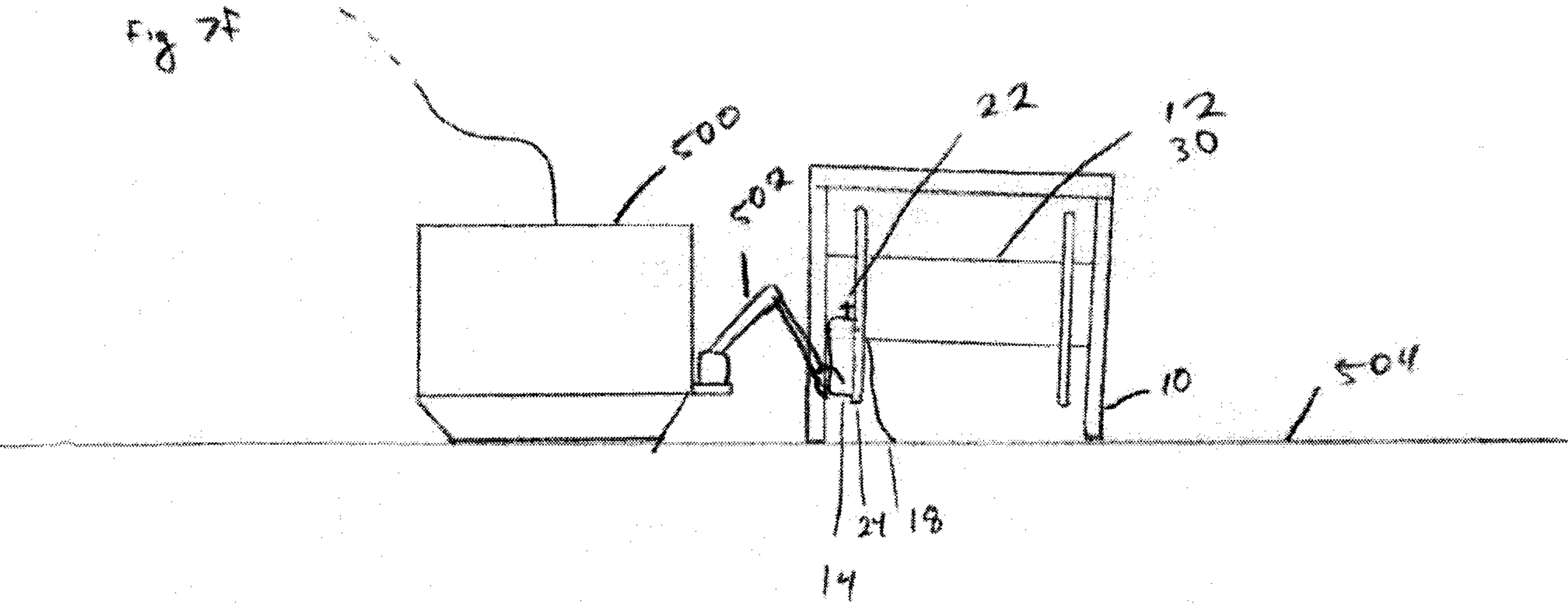


Fig 7g

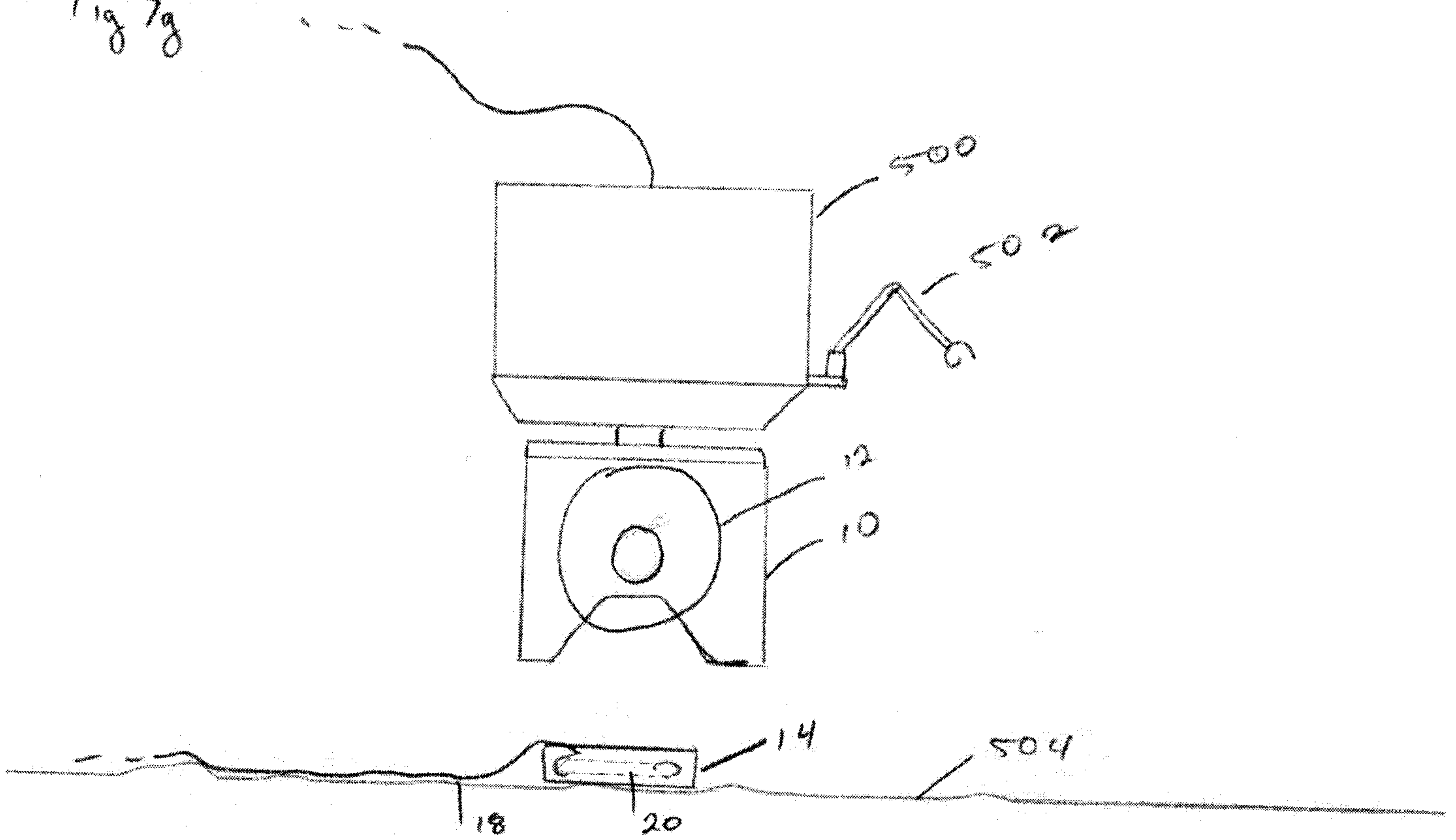


Fig 7h

