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IN REPLY REFER TO:

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AN APPARATUS FOR DEPLOYING AND RECOVERING A TOWED
ACOUSTIC LINE ARRAY FROM AN UNMANNED UNDERSEA VEHICLE

TO ALL WHOM IT MAY CONCERN

BE IT KNOWN THAT RICHARD M. EAD and ROBERT L. PENDLETON,
employees of the United States Government, citizens of the
United States of America, and residents respectively of
Wakefield, County of Washington, State of Rhode Island and
Portsmouth, County of Newport, State of Rhode Island, have
invented certain new and useful improvements entitled as set
forth above of which the following is a specification:

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AN APPARATUS FOR DEPLOYING AND RECOVERING A TOWED
ACOUSTIC LINE ARRAY FROM AN UNMANNED UNDERSEA VEHICLE

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STATEMENT OF GOVERNMENT INTEREST

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CROSS REFERENCE TO OTHER RELATED APPLICATIONS

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Not applicable.

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BACKGROUND OF THE INVENTION

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(1) Field of the Invention

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The present invention relates in general to towed array devices, and more specifically to an apparatus that deploys and recovers a towed acoustic sensor line array from an unmanned undersea vehicle.

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(2) Description of the Prior Art

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Towed acoustic sensor line arrays are used in military and civilian applications to detect acoustic signals in the water. For instance undersea vehicles use such arrays to establish or supplement

1 their sonar capabilities. Traditional towed acoustic sensor arrays
2 take the form of linear arrays of hydrophones mounted inside a
3 flexible hose, the array being connected to a towing vessel by a tow
4 cable.

5 Unmanned undersea vehicles, (UUVs) are subject to certain
6 constraints in their use of towed arrays particularly where the towed
7 array is of significant length (ranging from 100 to 300 feet). Where
8 a UUV is launched from or recovered by a larger undersea vehicle such
9 as a submarine, the array cannot be already deployed without the risk
10 of tangling or damaging the cable or creating additional drag on the
11 UUV. Under these circumstances, what is needed is an apparatus for
12 deploying a towed array from a UUV after the UUV is launched and then
13 recovering the towed array before the UUV itself is recovered.

14 15 SUMMARY OF THE INVENTION

16 It is a general purpose and object of the present invention
17 to provide apparatus that allows a UUV to deploy and recover a
18 towed array of significant length.

19 It is a further object to allow the UUV to deploy the array
20 while the UUV is stationary or moving at a low speed.

21 These objects are accomplished with the present invention by
22 having a free flooded section of the UUV that contains a cylindrical
23 rotating drum for spooling the line array tow cable. The rotating
24 drum can either spool out or reel in the cable. At the end of the

1 cable is a reverse thruster that has the ability to propel itself
2 away from the UUV pulling the cable out as it does so in order to
3 deploy the cable. To recover the cable the drum rotates and the
4 cable is reeled in, passing through a series of winding guides to
5 insure that the cable does not entangle and is wrapped evenly on the
6 drum.

7

8 BRIEF DESCRIPTION OF THE DRAWINGS

9 A more complete understanding of the invention and many of
10 the attendant advantages thereto will be readily appreciated as
11 the same becomes better understood by reference to the following
12 detailed description when considered in conjunction with the
13 accompanying drawings wherein:

14 FIG. 1 shows the present invention with the array in the
15 recovered position;

16 FIG. 2 shows the present invention with the array in the
17 deployed position;

18 FIG. 3 shows a cut away view of the present invention from
19 the port side of the UUV;

20 FIG. 4 shows a view of the drum assembly from the back end
21 of the UUV;

22 FIG. 5 shows a cut away view of the reverse thruster;

23 FIG. 6 shows an aft view of the reverse thruster featuring
24 the water inlet port; and

1 FIG. 7 shows a forward view of the reverse thruster
2 featuring the water exit ports and tow cable connection.

3
4 DESCRIPTION OF THE PREFERRED EMBODIMENT

5 Referring now to FIG. 1, there is shown a UUV 10. Located
6 in the aft section of the UUV 10 is a towed line array 12, which
7 is essentially a flexible cable. The towed array 12 is in the
8 recovered position completely retracted within the UUV 10.

9 Referring now to FIG. 2 there is shown the UUV 10 with the towed
10 array 12 in the deployed position.

11 Referring now to FIG. 3, there is shown a view from the
12 port side of the UUV 10 with a cut away section revealing the
13 towed array deployment and retrieval apparatus. In a preferred
14 embodiment, the apparatus resides in a free flooded section 14
15 of the UUV 10, between the UUV propulsion compartment 16 and the
16 UUV internal power and data processing systems compartment 18.
17 A cylindrical drum 20 is used as a spool upon which to wind and
18 unwind the array 12. Mounted to drum 20 is electronics assembly
19 22 and commutator assembly 24. Electronics assembly 22 is
20 primarily used for converting data that is generated by the
21 various acoustic hydrophones in the array 12 into a serial
22 format for passing the data across the commutator assembly 24.
23 The commutator assembly 24 is used for transferring power and
24 data between the array 12 and the UUV internal power and data

1 processing systems 18. The array 12 passes from the drum 20
2 through a mechanical or electrical winding guide 26. Winding
3 guide 26 moves with a sideways motion that is synchronized with
4 the rotation of drum 20 such that array 12 is retrieved and
5 wound on the drum 20 in consecutive smooth layers. Winding
6 guide 26 has a tension sensor 27 (See FIG. 4) that automatically
7 adjusts power to a drive motor 34 (shown by hidden lines) that
8 turns drum 20 to maintain a constant tension during deployment.
9 There are two stationary winding guides 28 and 30. They are
10 essentially rollers through which array 12 passes through.
11 Stationary winding guide 28 is located within the free flooded
12 section 14. Stationary winding guide 30 is located at the end
13 of deployment guide 31. Deployment guide 31 protrudes from the
14 exterior of the UUV 10 and serves as a barrier to prevent the
15 cable from tangling with the UUV 10.

16 At the very end of the array 12 is a reverse thruster 32.
17 The function of reverse thruster 32 is to help deploy the line
18 array 12 during missions requiring the UUV 10 to "hover" or when
19 the UUV 10 is traveling at low speeds. At higher speeds, the
20 thruster 32 is not operative and serves as a drogue to assist in
21 array 12 deployment. The thruster 32 is not operative during
22 recovery of the array 12.

23 The drive motor 34 shown by hidden lines in FIG. 3 can be
24 an electric motor powered by the UUV internal power source.

1 FIG. 4 shows a forward view of the entire drum assembly as seen
2 from the back end of the UUV 10. On one end of the drum 20 is
3 the electronics assembly 22 and commutator assembly 24 and on
4 the other end is the drive motor 34. Winding guide 26 is
5 beneath drum 20 and traverses back and forth along the length of
6 drum 20. Joined to winding guide 26 is tension sensor 27.

7 Referring now to FIG. 5, there is shown a side view with a
8 cut away section of the reverse thruster 32. A depth sensor 36
9 that sends a signal to the UUV 10 via towed array 12 can be
10 provided within thruster 32. There is a counterweight 38 to
11 help correct for any roll that the reverse thruster 32 may
12 experience. There is a buoyancy air chamber 40 to help the
13 thruster 32 to remain buoyant. The thruster should be as
14 neutrally buoyant as possible. The combination of the buoyant
15 air chamber 40 and counterweight 38 helps to prevent twisting of
16 the array 12. The reverse thruster is able to generate thrust
17 though a spinning paddle wheel 42 which is spun by an electric
18 motor 44. The paddle wheel 42 creates water flow with a
19 resultant force in the opposite direction of the water flow.

20 FIGS. 6 and 7 show aft and forward views respectively of the
21 thruster 32. The water inlet port 46 allows water to flow into
22 the thruster 32. Once the water has flowed inside the thruster
23 32, the spinning paddle wheel 42 forces the water out of the
24 thruster 32 through one of the multiple water exit ports 48.

1 The tow cable connection 50 is also illustrated in the forward
2 view of the thruster 32 in FIG. 7.

3 The advantages of the present invention over the prior art
4 are that through the use of the array deployment and recovery
5 apparatus, an unmanned undersea vehicle equipped with a towed
6 array of significant length (ranging from 100 to 300 feet) can
7 now be launched from inside of or outside of another larger
8 undersea vehicle through a variety of methods. There will also
9 be minimal drag on the unmanned undersea vehicle with the array
10 in its non-deployed (recovered) position as the UUV "swims out"
11 to its area of operation.

12 What has thus been described is an apparatus for deploying
13 and recovering a towed acoustic line array from an unmanned
14 undersea vehicle.

15 Obviously many modifications and variations of the present
16 invention may become apparent in light of the above teachings.
17 For example, the array deployment guide can be located in
18 several other locations instead of the aft section of the UUV.
19 In an alternative embodiment the present invention might include
20 additional thruster capability for three dimensional control for
21 accurately positioning the end of the array. Three dimensional
22 control could be achieved through the use of three internal
23 paddle wheels in the thruster positioned at ninety degree angles
24 from each other. Also, at moderate to high UUV operating speeds

1 the need for a thruster to assist deployment may not be required
2 and it can be substituted with a simple drogue device.

3 In light of the above, it is therefore understood that
4 within the scope of the appended claims, the invention may be
5 practiced otherwise than as specifically described.

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3 AN APPARATUS FOR DEPLOYING AND RECOVERING A TOWED
4 ACOUSTIC LINE ARRAY FROM AN UNMANNED UNDERSEA VEHICLE

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6 ABSTRACT OF THE DISCLOSURE

7 A free flooded section of an unmanned undersea vehicle (UUV)
8 contains a rotating cylindrical drum, which serves as a spool for a
9 towed line array cable. At the end of the cable is a reverse
10 thruster with the ability to propel itself away from the UUV when the
11 UUV is submerged. The thruster moves away from the UUV, pulling the
12 cable and unspooling it as it does so in order to deploy the array.
13 To recover the array, the cylindrical drum rotates to reel in the
14 cable. The cable is guided through a series of winding guides that
15 allow the cable to be wound evenly on the drum.

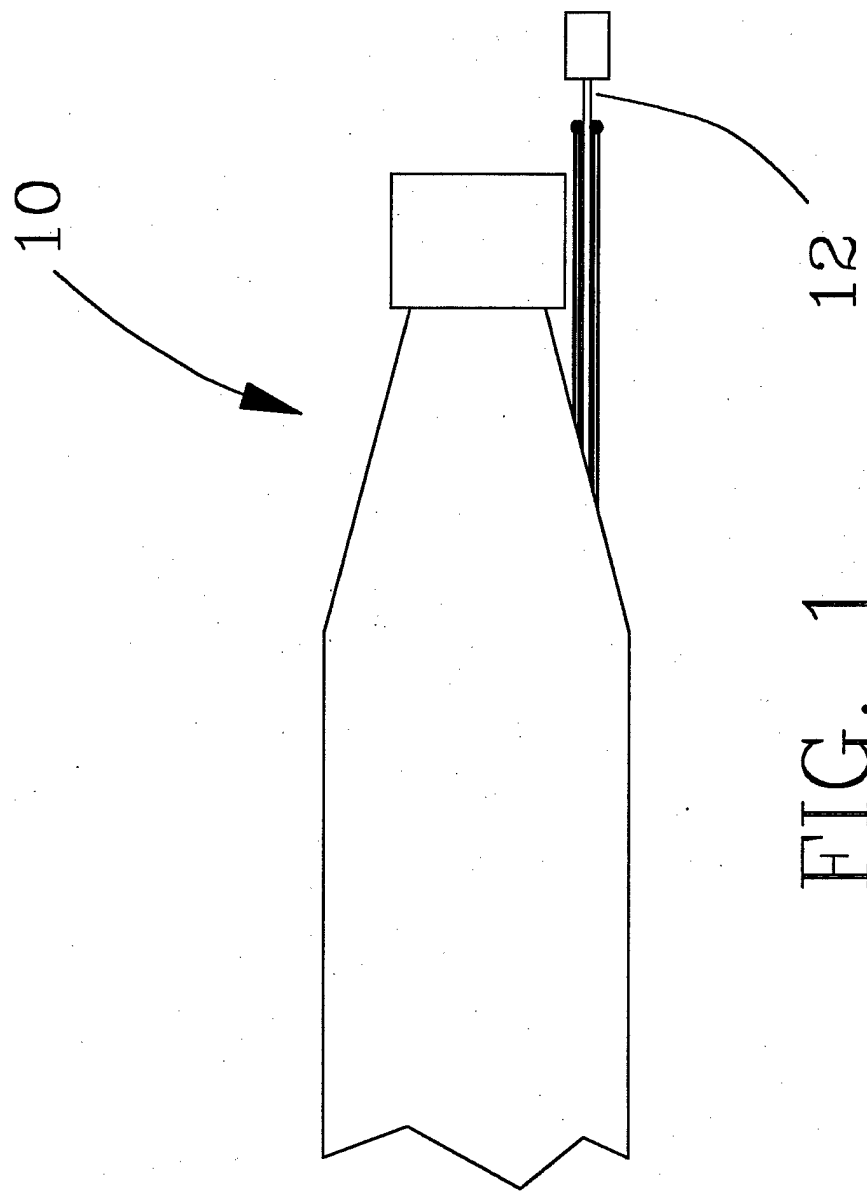
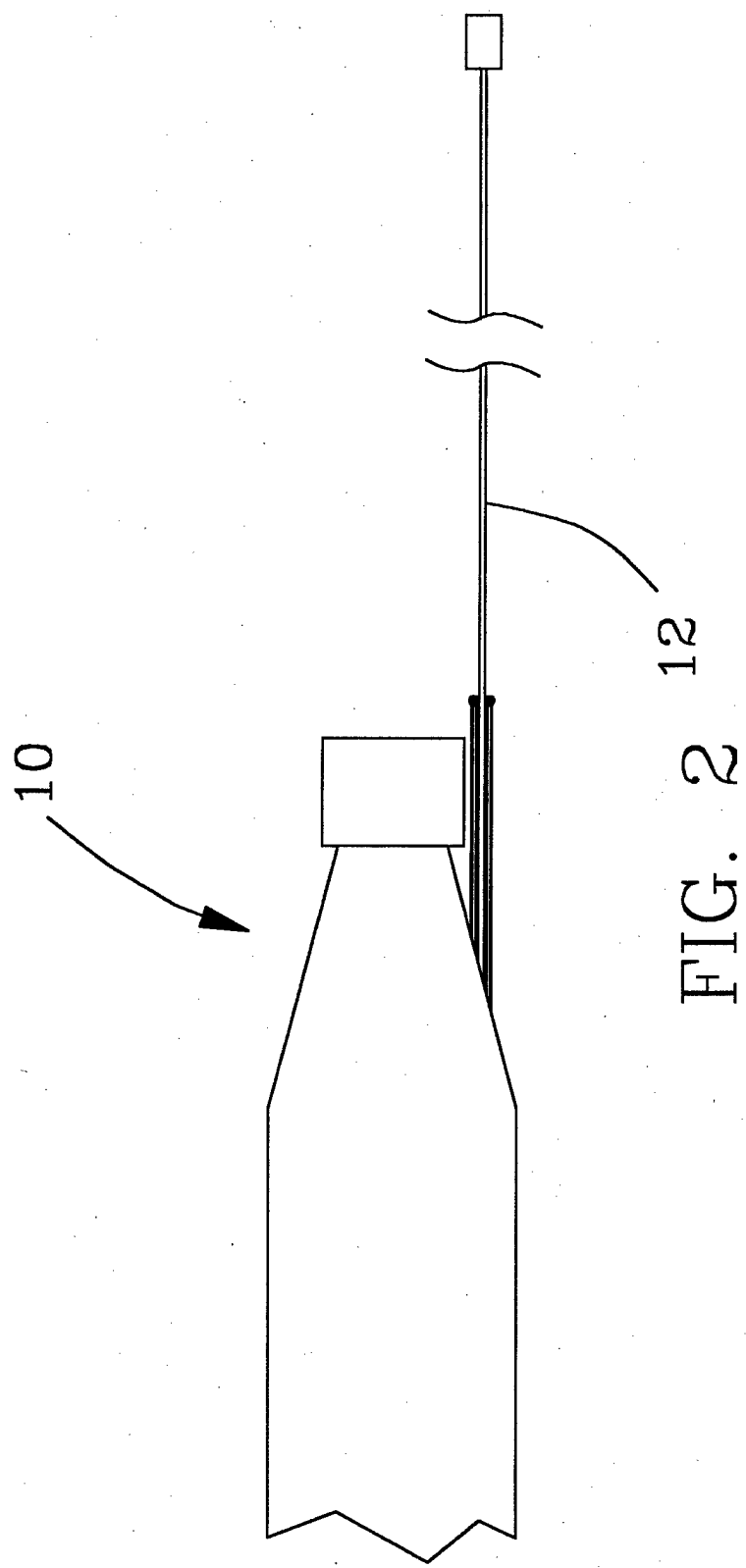


FIG. 1



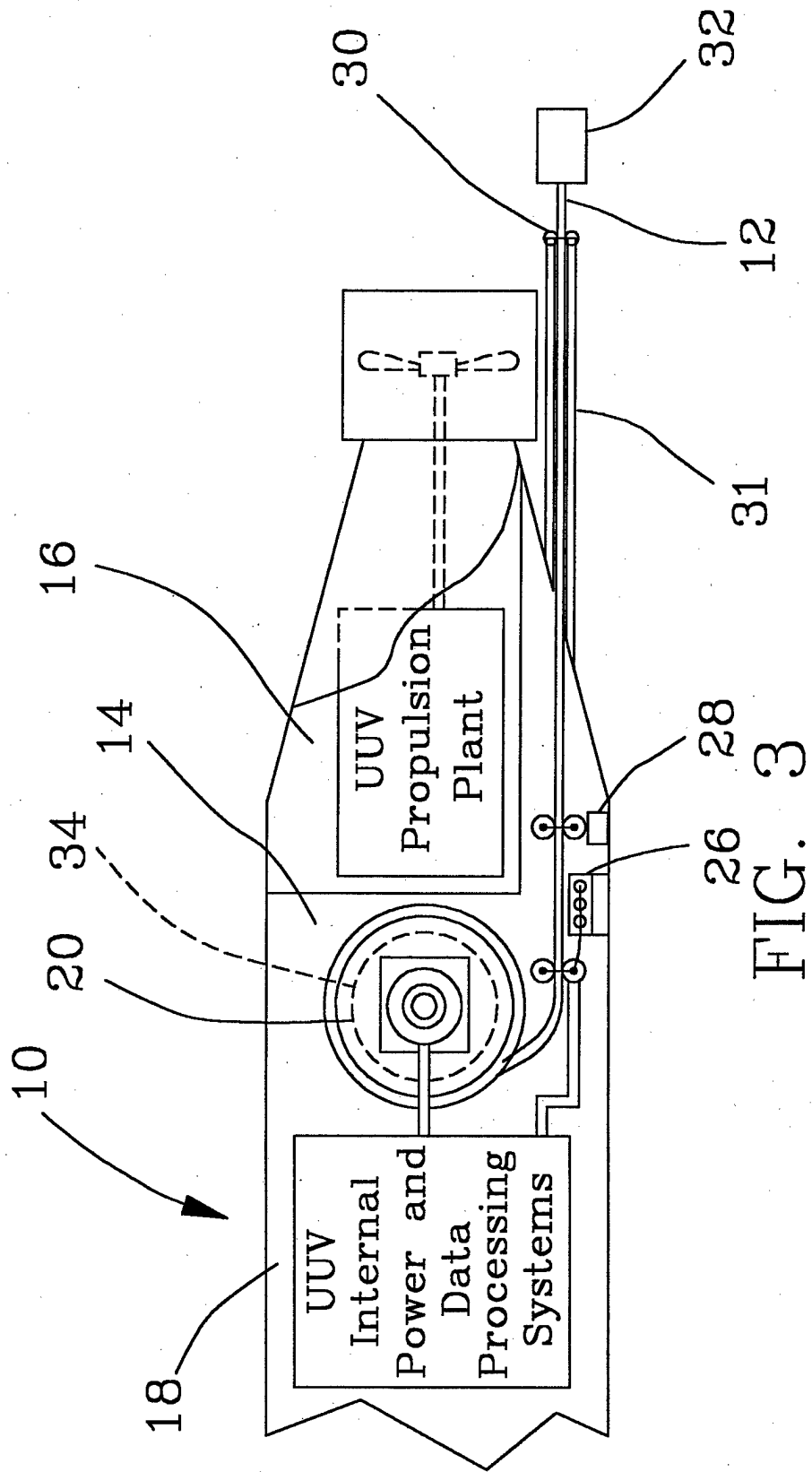


FIG. 3

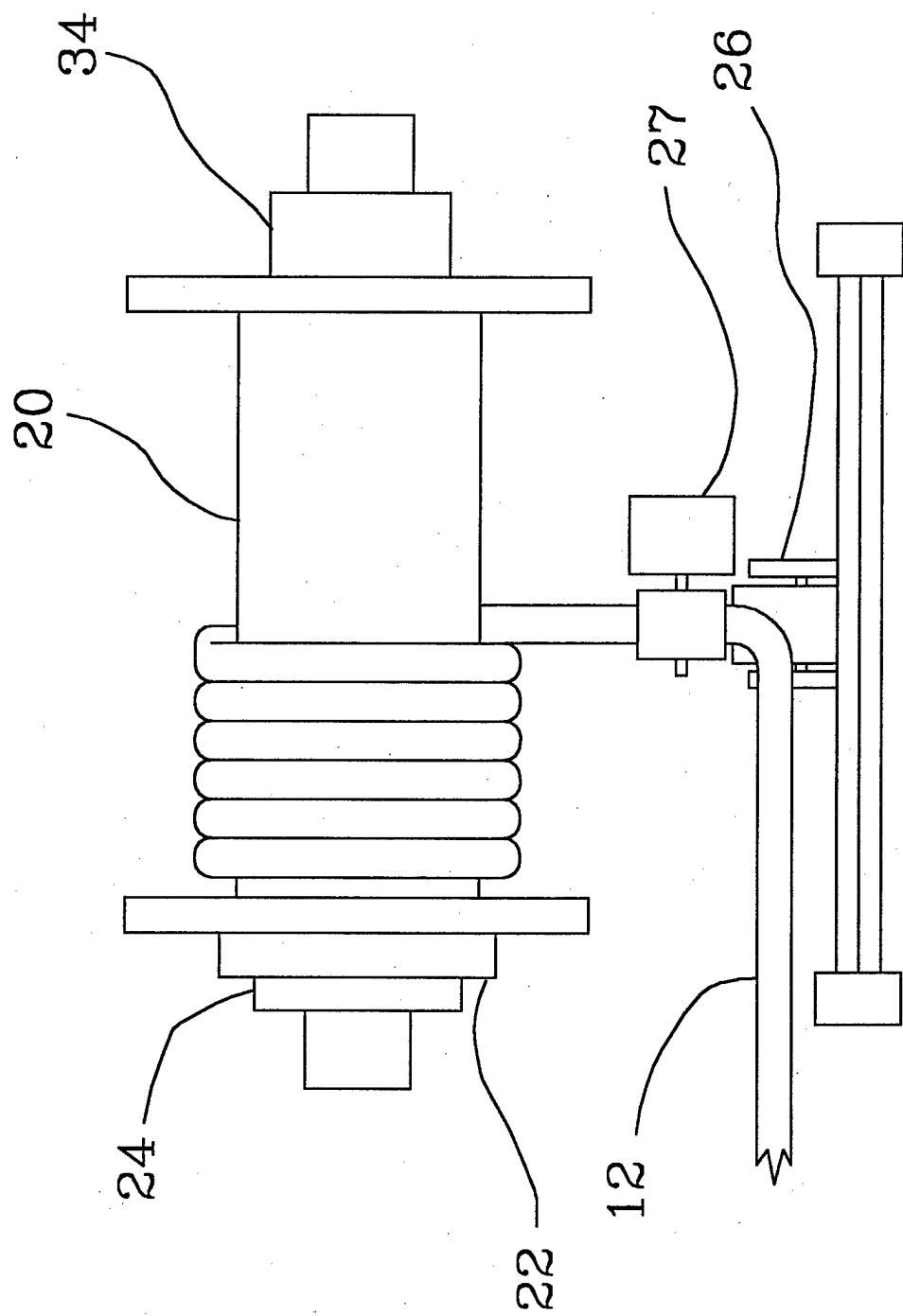


FIG. 4

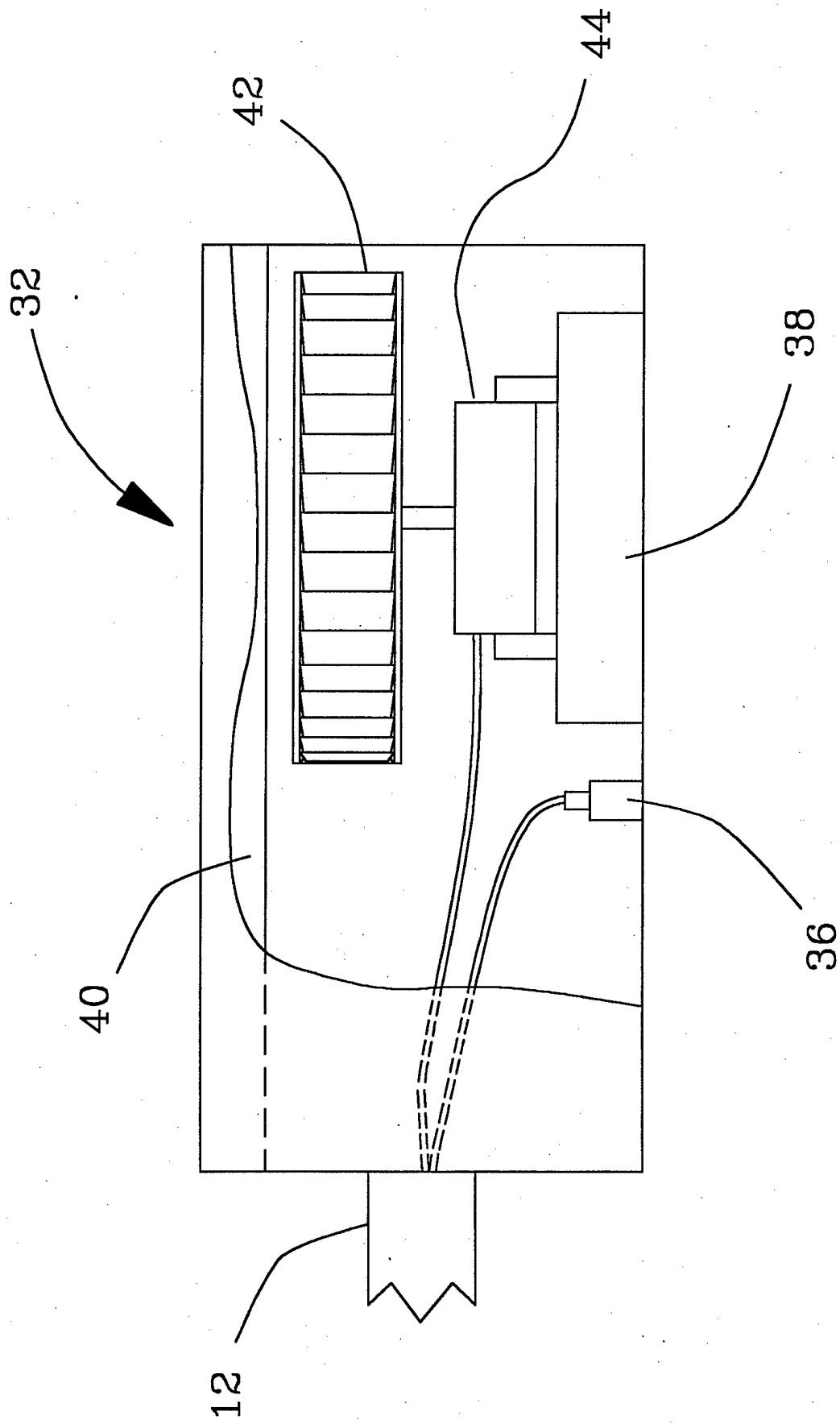


FIG. 5

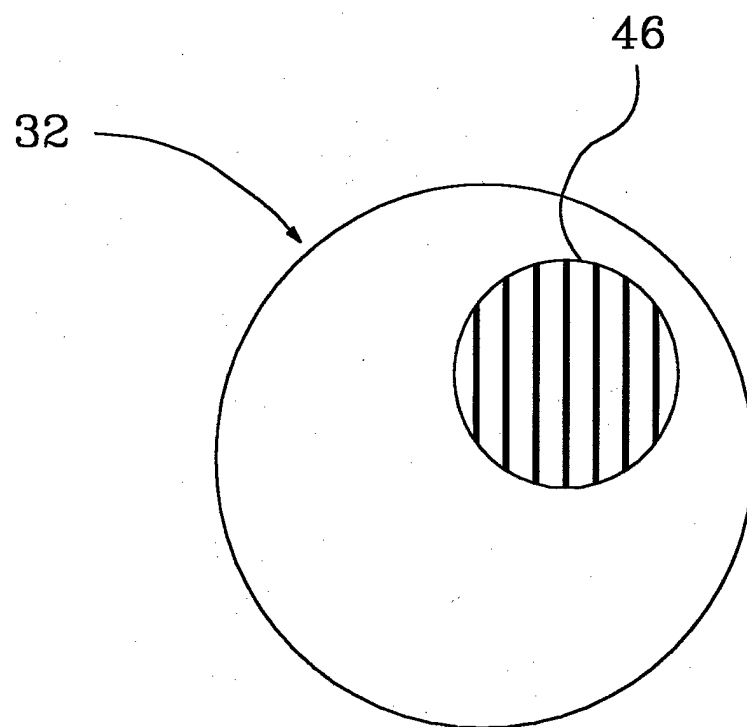


FIG. 6

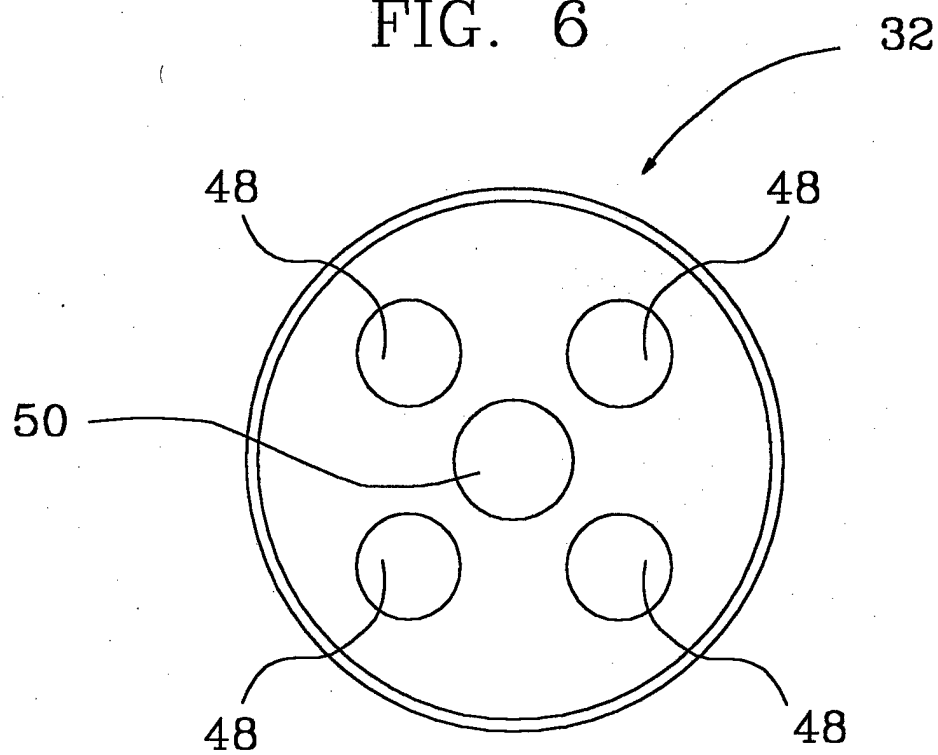


FIG. 7