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PROPELLER DEFLECTION SNUBBER

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STATEMENT OF GOVERNMENT INTEREST

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BACKGROUND OF THE INVENTION

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(1) Field of the Invention

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This invention relates generally to a system for preventing damage to a propeller, and more particularly to an apparatus for preventing a propeller of a countermeasure device from deflecting to the point of being damaged.

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(2) Description of the Prior Art

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Underwater vehicles, such as torpedoes and countermeasures, such as torpedoes, utilize a propeller system to provide hovering and transit capabilities. An example of such a propeller system is shown in FIG. 1, which is a partial cross-section view of a countermeasure device 100. Countermeasure device 100 includes a

1 nose portion 102 and a tail portion 104. Tail portion 104
2 includes a tail cone 106, a shroud 108 and a two-bladed
3 propeller 110 mounted on a shaft 112, which is driven by a motor
4 located within tail cone 106. FIG. 1 shows a cross-section view
5 of shroud 108 only, all other features are shown in full.
6 FIG. 1A shows an end view of countermeasure device 100, including
7 tail cone 106, shroud 108 and two-bladed propeller 110.
8 Shroud 108 includes shroud supports 113 and shroud ring 114.
9 Countermeasure device 100 is mounted inside a launch tube 116 of
10 a vessel 118, as shown in FIG. 2. When countermeasure device 100
11 is launched, it pushes end cap 120 of launch tube 116 open. Upon
12 the opening of end cap 120, water 122 rushes into launch tube 116
13 at a pressure which varies depending on the depth in water 122
14 that the launch tube 116 is located. The difference in pressure
15 between launch tube 116 and water 122 creates a water hammer
16 which can impact propeller 110 and shaft 112 with great force.
17 The force with which the water hammer impacts propeller 110 and
18 shaft 112, both when entering launch tube 116 and after impacting
19 rear wall 124 of launch tube 116 and then exiting launch tube
20 116, can be great enough to cause propeller 110 and,
21 consequently, shaft 112 to deflect, permanently damaging

1 propeller 110 and shaft 112, thereby rendering the countermeasure
2 device 100 less maneuverable or inoperable.

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SUMMARY OF THE INVENTION

5 It is therefore the object of the invention to provide a
6 system for preventing permanent damage to the propeller and shaft
7 of a countermeasure device due to the water hammer created when
8 the countermeasure device is launched. Another object is to
9 provide a low-cost and mechanically simple system which does not
10 require launch tube modifications.

11 The invention includes a tail section having a housing which
12 surrounds a banded propeller. The housing includes a deflection
13 snubbing section which provides a physical stop to limit the
14 deflection of the banded propeller in both the fore and aft
15 directions. The deflection snubbing section includes a number of
16 inwardly extending extensions and raised portions, each also
17 having a compressible liner attached to an inside surface
18 thereof. The banded propeller is mounted on the shaft of the
19 countermeasure device so that its band is located between the
20 extensions and raised portions. When the propeller is subjected
21 to high forces due to the water hammer created during a launch,
22 the extensions and raised portions act as physical stops to

1 prevent the propeller from deflecting enough to permanently
2 damage the propeller and the shaft.

3 In a preferred embodiment of the invention, a deflection
4 snubber assembly for preventing damage to a propeller which is
5 subjected to instances of high force is disclosed. The propeller
6 includes a hub for mounting the propeller on a shaft and a number
7 of blades extending radially outward from the hub. The outer
8 tips of the blades are interconnected by a continuous, circular
9 band. The propeller is constructed to accommodate a
10 predetermined amount of deflection upon instances of high force
11 before being permanently damaged. The deflection snubber
12 assembly includes a housing circumferentially surrounding the
13 propeller, the housing having a number of deflection limiting
14 members, each of the deflection limiting members limiting
15 deflection of the propeller to within the predetermined amount of
16 deflection upon occurrences of the instances of high force.

17 A method for preventing damage to a propeller which is
18 subjected to instances of high force is also disclosed. The
19 method includes limiting the deflection of the propeller within a
20 predetermined amount upon instant occurrences of high force.

1 DESCRIPTION OF THE PREFERRED EMBODIMENT

2 The propeller and deflection snubber assembly of the present
3 invention is illustrated most clearly in FIGS. 4 and 5. As will
4 hereinafter be more fully described, the general basis for the
5 invention is for the propeller and snubber to cooperate to limit
6 the potential deflection of the propeller blades and the
7 propeller shaft to within predetermined limits relative to a
8 longitudinal axis 19 of the countermeasure device, shown in
9 FIG. 5, which will not permanently damage the propulsion system.

10 Deflection of the propeller blades is generally limited by
11 providing a banded propeller, while deflection of the propeller
12 shaft is limited by enclosing the banded propeller within a
13 housing having a compressible liner.

14 FIG. 3 shows a banded propeller 10 which is used in
15 conjunction with the present invention. Propeller 10 includes a
16 number of blades 12 connected between a hub 14 and a band 16.
17 Hub 14 includes a hole 18 to facilitate mounting propeller 10 on
18 a shaft. While, in this description, propeller 10 is shown
19 having three blades 12, it will be understood that a propeller
20 having any number of blades may be used in conjunction with the
21 present invention.

1 In general, the propeller 10 and shaft are manufactured from
2 materials having some flexibility so that they can withstand a
3 predetermined amount of flexure or deflection before being
4 permanently damaged.

5 FIG. 4 shows the deflection snubbing assembly of the present
6 invention. FIG. 5 is a partial cross-sectional view of the
7 present invention, showing propeller 10 in full and a housing 20
8 in cross-section, taken along line 5-5 in FIG. 4. As shown in
9 FIGS 4 and 5, propeller 10 is mounted on a shaft 24 inside
10 housing 20, which is mounted to tail cone 26 of a countermeasure
11 device.

12 Housing 20 includes a wall portion 21 and a base portion 22,
13 which is mounted on tail cone 26. Housing 20 is preferably made
14 from aluminum. However, it will be understood that any suitable
15 material can be used in the formation of housing 20. Extending
16 radially inward, over propeller 10, from the top of wall 21 are
17 four extensions 30, located equidistant from each other along
18 wall 21. Extensions 30 have a length which is approximately one-
19 third the distance between wall 21 and hub 14 and a width
20 approximately half of its length. Base portion 22 includes four
21 raised portions 32 which are formed on base portion 22 and
22 positioned along wall 21, under propeller 10, to coincide with

1 extensions 30. Raised portions 32 have the same dimensions as
2 extensions 30. A strip 28 of a compressible material, such as
3 rubber, is attached along the inside surface of each
4 extension 30, raised portion 32 and the part of wall portion 21
5 that interconnects each extension 30 to its corresponding raised
6 portion 32.

7 The operation of the countermeasure propeller deflection
8 snubber of the present invention will now be discussed. As
9 described previously, when a countermeasure device, such as that
10 shown in FIG. 2, is launched from a marine vessel, the nose of
11 the countermeasure device pushes the end cap out from the marine
12 vessel. As a result, water enters the launch tube with enough
13 force to permanently damage prior art propeller systems. In the
14 present invention, when the water impacts the propeller 10 upon
15 its entrance into the launch tube and upon its exit from the
16 launch tube after impacting the back wall of the launch tube,
17 damage to the propeller 10 is prevented in two ways. First,
18 band 16, which connects the outer edges of blades 12, increases
19 the lateral rigidity of the propeller, thereby making the
20 propeller less likely to deflect relative to longitudinal axis 19
21 when impacted with water. Second, in the event that propeller 10
22 is impacted with enough force to cause propeller 10 to deflect,

1 extensions 30 and raised portions 32 limit the deflection of
2 propeller 10 by providing a physical stop for band 16 to snub
3 deflections of the propeller 10. In other words, when
4 propeller 10 experiences enough force from incoming water to
5 deflect an amount that would cause damage to propeller 10,
6 band 16 will contact either extensions 30 or raised portions 32,
7 depending on the direction of deflection. Extensions 30 and
8 raised portions 32 stop the deflection of propeller 10 before the
9 propeller deflects an amount which will cause permanent damage to
10 propeller 10 and the shaft 24. Strips 28 prevent damage to
11 band 16 due to the impact of band 16 with extensions 30 and
12 raised portions 32.

13 The distance between extensions 30, raised portions 32 and
14 wall 21 and propeller 10 and the thickness of strips 28 are
15 chosen to limit any deflection of propeller 10 to an amount that
16 will not permanently damage propeller 10 or shaft 24, while
17 allowing enough space for water to flow around propeller 10. As
18 can be seen in FIG. 4, extensions 30, which extend inward, toward
19 hub 14 of propeller and raised portions 32 are also positioned
20 around the circumference of wall 21 with enough distance between
21 them to allow proper inflow and outflow of water into housing 20

1 to allow propeller 10 to effectively generate the thrust needed
2 to propel the countermeasure device.

3 While there is shown and described herein certain specific
4 structure embodying the invention, it will be manifest to those
5 skilled in the art that various modifications and rearrangements
6 of the parts may be made without departing from the spirit and
7 scope of the underlying inventive concept. For example, the
8 number, shapes and sizes of the extensions and raised portions
9 may be varied to accommodate differently sized or constructed
10 propellers. The material used for the strips 28 and their
11 thickness may also be varied, depending on the size and
12 construction of the propeller. Therefore, the invention is not
13 limited to the particular forms herein shown and described

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PROPELLER DEFLECTION SNUBBER

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ABSTRACT OF THE DISCLOSURE

6 A deflection snubber assembly for preventing damage to a
7 propeller which is subjected to instances of high force is
8 disclosed. The propeller includes a hub for mounting the
9 propeller on a shaft and a number of blades extending radially
10 outward from the hub. Outer tips of the number of blades are
11 interconnected by a continuous, circular band. The propeller is
12 constructed to accommodate a predetermined amount of deflection
13 upon instances of high force before being permanently damaged.
14 The deflection snubber assembly includes a housing
15 circumferentially surrounding the propeller, the housing having a
16 number of deflection limiting members, each of the deflection
17 limiting members limiting deflection of the propeller to within
18 the predetermined amount of deflection upon occurrences of the
19 instances of high force.

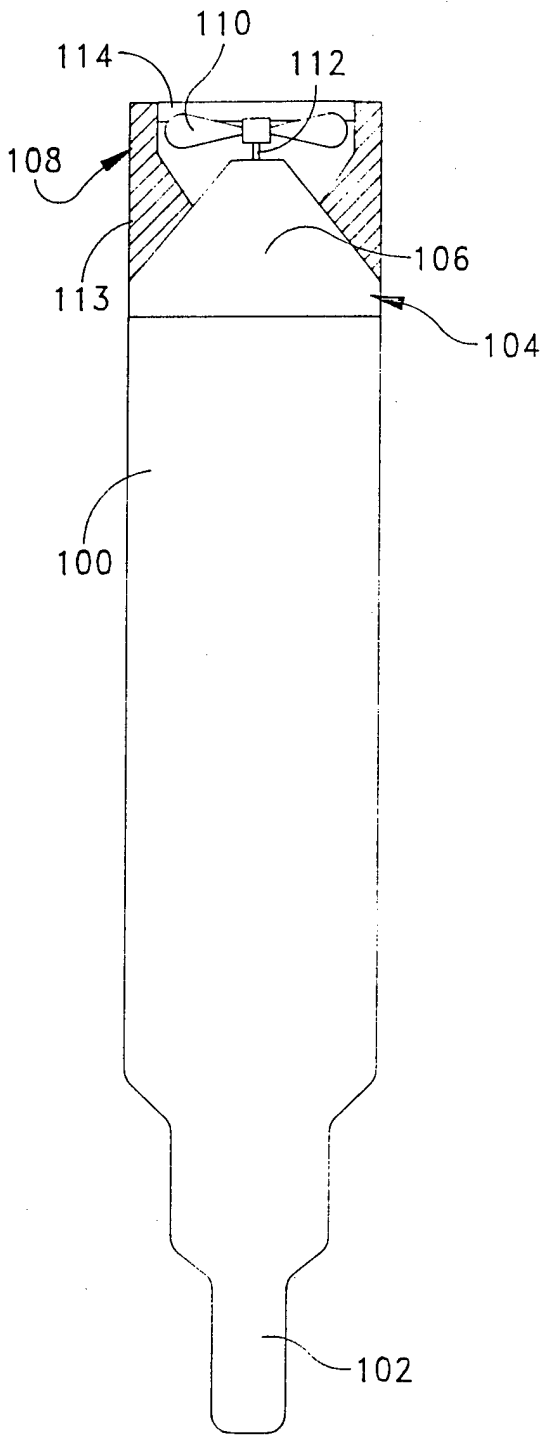


FIG. 1
(PRIOR ART)

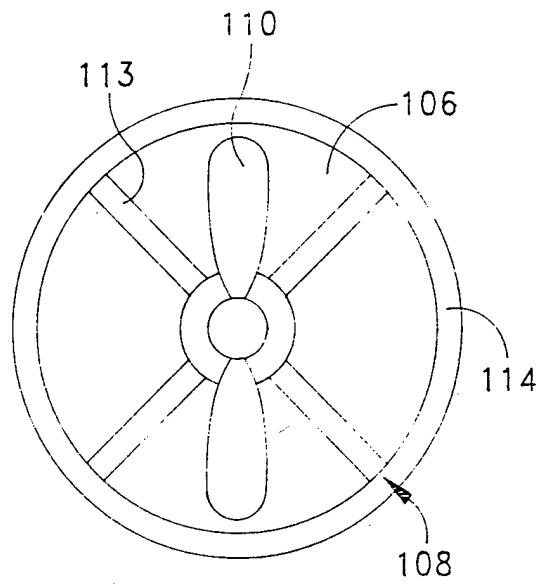


FIG. 1A
(PRIOR ART)

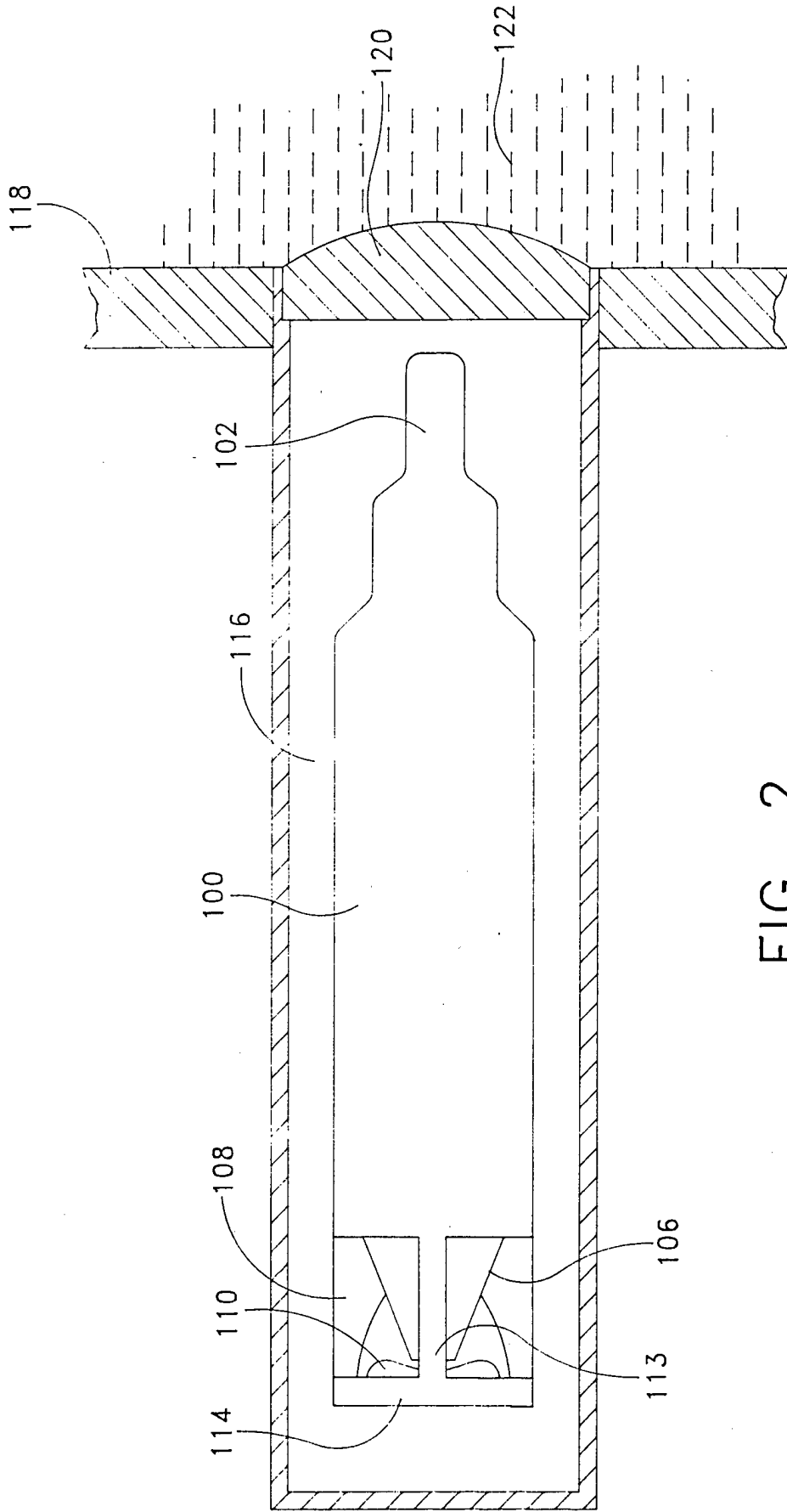


FIG. 2
(PRIOR ART)

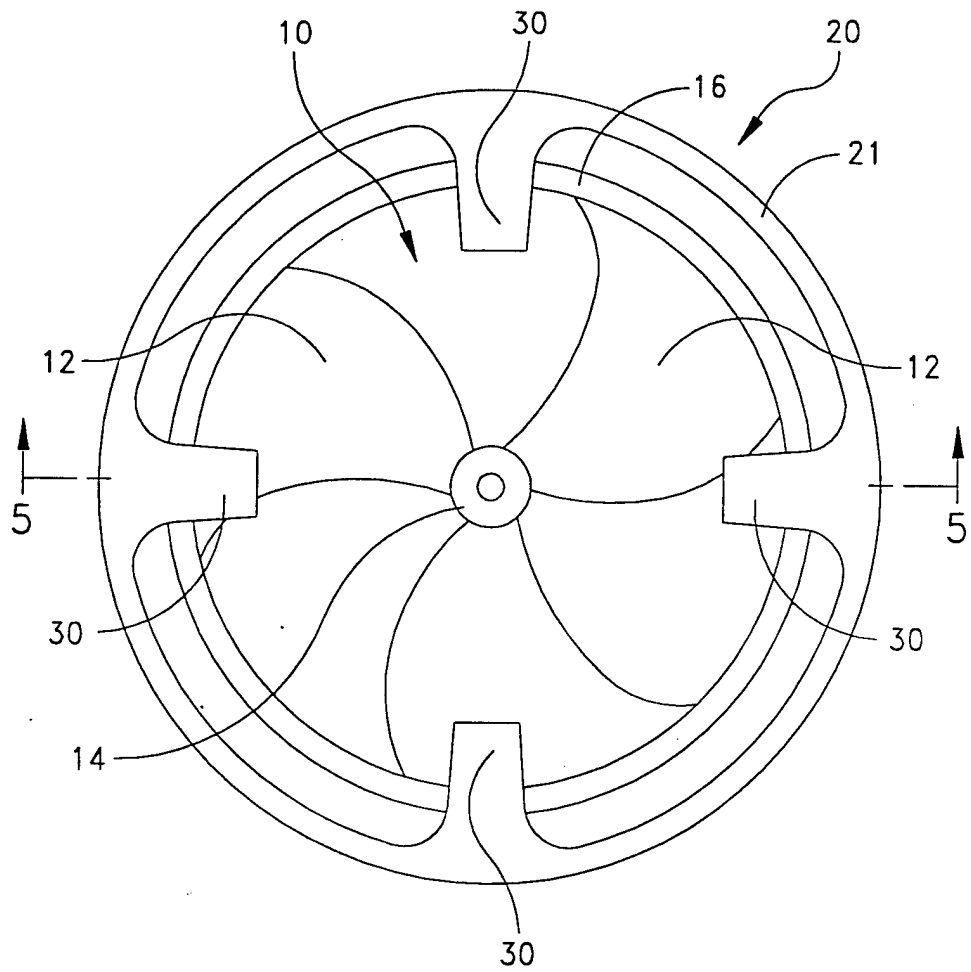


FIG. 4

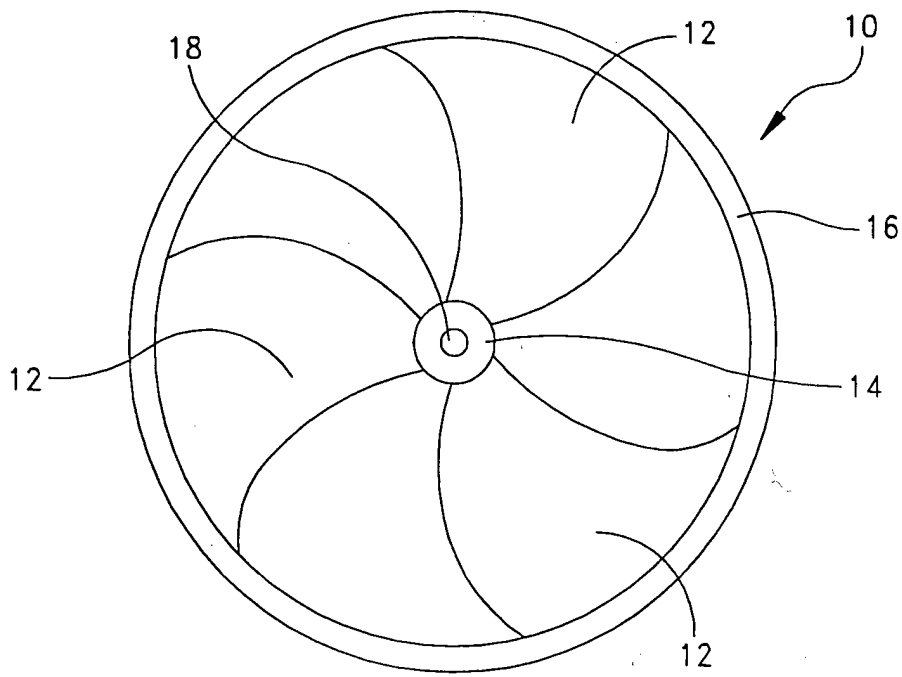


FIG. 3

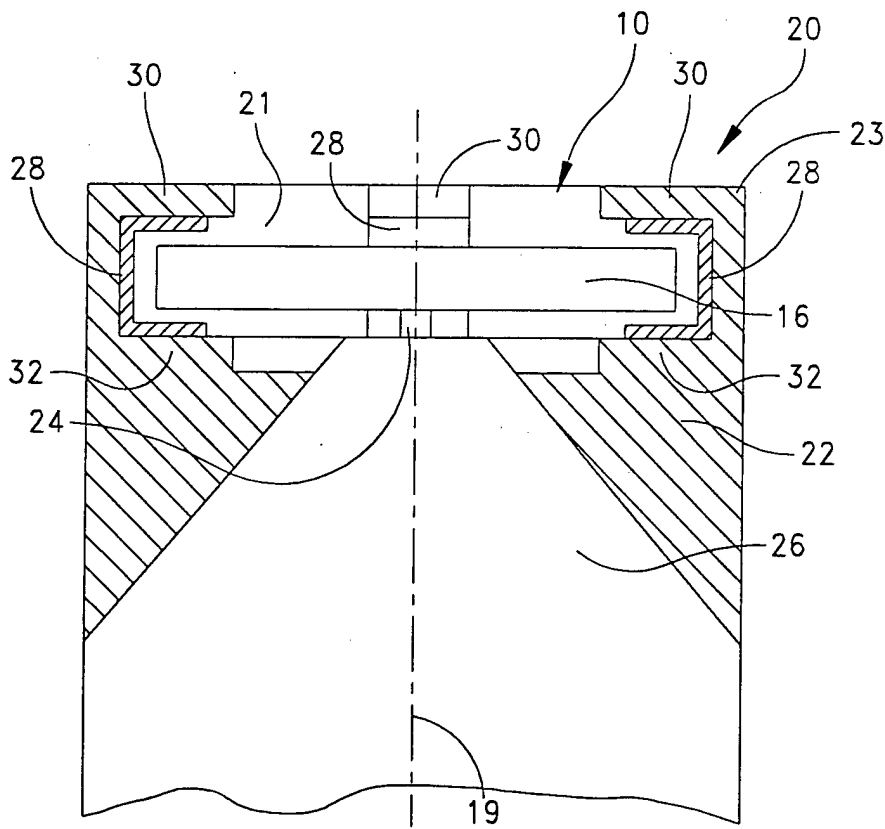


FIG. 5