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Attorney Docket No. 82864
Date: 12 December 2007

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Serial Number 11/842,187
Filing Date 21 August 2007

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Attorney Docket No. 82864

UNDERWATER VEHICLE

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 the payment of any royalties thereon or therefor.

CROSS REFERENCE TO OTHER PATENT APPLICATIONS

[0002] None.

BACKGROUND OF THE INVENTION

(1) FIELD OF THE INVENTION

[0003] The present invention relates to underwater vehicles which can be unmanned and untethered and more particularly to an underwater vehicle having facility for affixing to and maintaining station on an underwater hull portion of another marine vehicle.

(2) DESCRIPTION OF THE PRIOR ART

[0004] Underwater vehicles are known and are used for a variety of missions, including anti-mine operations, oceanographic analysis, reconnaissance, intelligence gathering,

and tracking of marine vehicles. These vehicles can be either manned or more commonly unmanned. Retrieval of underwater vehicles which have completed their missions has heretofore involved a submarine or other naval vessel maneuvering alongside the underwater vehicle and mechanically grabbing the underwater vehicle. Maneuvering a submarine is much more difficult than maneuvering an underwater vehicle. In addition, the underwater vehicle is sometimes in high sea states or near dangerous coastal obstacles. Maintaining stealth is more difficult with a large submarine than with an underwater vehicle. Accordingly, there is a need for an underwater vehicle which can maneuver to engage a retrieving vehicle, whether submarine or surface vessel, and cling to the hull of the retrieving vehicle until the retrieving vehicle reaches a safe location for removal of the underwater vehicle.

SUMMARY OF THE INVENTION

[0005] An object of the invention is, therefore, to provide an undertwater vehicle having facility for maneuvering alongside a retrieving vehicle, engaging the hull of the retrieving vehicle, and clinging to the hull of the retrieving vehicle until removal therefrom.

[0006] With the above and other objects in view, a feature of the present invention is the provision of an underwater vehicle

having facility for affixing to and maintaining station on a hull of another marine vehicle. The underwater vehicle comprises a self-powered hull for movement underwater, and maneuvering planes mounted on the hull for effecting changes in course when the underwater vehicle is underway. Body panels are movably fixed to the hull and moveable from first positions in which the panels conform to the hull shape to second positions in which the panels extend outwardly from the hull and toward an engagement region of the other marine vehicle. Free edges of the panels are engageable with the hull of the other marine vehicle to deter flow of water between the underwater vehicle hull and the hull of the other marine vehicle and guide flow of water around the underwater vehicle hull to pin the underwater vehicle against the other marine vehicle hull.

[0007] In accordance with a further feature of the invention, there is provided an underwater vehicle having facility for affixing to and maintaining station on a hull of another marine vehicle. The underwater vehicle comprises a self-powered hull for movement underwater and maneuvering planes mounted on the hull for effecting changes in course when the underwater vehicle is underway. Arms are pivotally mounted on the underwater vehicle hull such that in a non-extended condition the arms are disposed within an outboard surface of the underwater vehicle hull. The arms are extendible from the underwater vehicle hull

upon the underwater vehicle hull engaging the hull of the other marine vehicle. The arms engage the hull of the other marine vehicle and generally conform to an outside configuration of the hull of the other marine vehicle. Attachment devices are fixed to the arms to engage the hull of the other marine vehicle and hold the underwater vehicle on the hull of the other marine vehicle.

[0008] In accordance with a still further feature of the invention, there is provided an underwater vehicle having facility for affixing to and maintaining station on a hull of another marine vehicle. The underwater vehicle comprises a self-powered hull for movement underwater and maneuvering planes mounted on the hull for effecting changes in course when the underwater vehicle is underway. An engagement side of the underwater vehicle hull is of a concave configuration, an engagement portion of the hull of the other marine vehicle is of a convex configuration, and the remainder of the underwater vehicle hull is of a convex configuration. Water flowing over the remainder of the underwater vehicle hull pins the engagement side of the underwater vehicle hull against the engagement portion of the hull of the other marine vehicle.

[0009] The above and other features of the invention, including various novel details of construction and combinations of parts, will now be more particularly described with reference

to the accompanying drawings and pointed out in the claims. It will be understood that the particular devices embodying the invention are shown by way of illustration only and not as limitations of the invention. The principles and features of this invention may be employed in various and numerous embodiments without departing from the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Reference is made to the accompanying drawings in which are shown illustrative embodiments of the invention, from which its novel features and advantages will be apparent, wherein corresponding reference characters indicate corresponding parts throughout the several views of the drawings and wherein:

[0011] FIG. 1 is a side elevational view of one form of a Underwater Vehicle illustrative of an embodiment of the invention;

[0012] FIG. 2 is similar to FIG. 1 but showing maneuvering planes deployed for urging the underwater vehicle toward a hull of another marine vehicle, the underwater vehicle engaged with the other marine vehicle hull, and panels deployed from the underwater vehicle and engaged with the other marine vehicle hull;

[0013] FIG. 3 is a front, or bow view of the underwater vehicle with the forward panel deployed;

[0014] FIG. 4 is a top view of the underwater vehicle opposite the engagement side, with the forward panel deployed;

[0015] FIG. 5 is a sectional view of the underwater vehicle taken along line V-V of FIG. 2, with side panels deployed and engaged with the other marine vehicle hull;

[0016] FIG. 6 is a top view showing the forward and side panels deployed;

[0017] FIG. 7 is a front or bow view showing the forward and side panels deployed;

[0018] FIG. 8 is a side elevational view of an underwater vehicle and illustrative of another embodiment of the invention;

[0019] FIG. 9 is a sectional view taken along line IX - IX of FIG. 8, showing an alternative grasping feature for engaging the hull of the other marine vehicle;

[0020] FIG. 10 is similar to FIG. 9 but showing the grasping feature deployed to engage the hull of the other marine vehicle;

[0021] FIGS. 11 and 12 are similar to FIG. 10, but illustrative of an additional grasping feature;

[0022] FIG. 13 is similar to FIG. 8, but showing a plurality of grasping units;

[0023] FIG. 14 is similar to FIG. 13, but shows the grasping units deployed for engagement with the hull of the other marine vehicle;

[0024] FIGS. 15 and 16 illustrate a further alternative embodiment of grasping units;

[0025] FIG. 17 is a front or bow view of an underwater vehicle having alternative means for engagement with the hull of the other marine vehicle; and

[0026] FIG. 18 is a side elevational view of the underwater vehicle of FIG. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0027] Referring to FIG. 1, it will be seen that an illustrative underwater vehicle 20 comprises an elongated hull 22 having maneuvering planes 24 mounted thereon, typically an opposite sides of the hull (one side seen in FIG. 1) and moveable to effect course changes of the vehicle 20. The maneuvering planes 24 typically include bow planes 24a and stern planes 24b. The underwater vehicle is self-propelled and contains a guidance system responsive to preprogramming and electronic instructions received from a controlling station.

[0028] After completion of a mission by the underwater vehicle, the underwater vehicle may be guided into position alongside a retrieving vessel 26. See FIG. 2. The bow and stern

planes 24a and 24b are moved by the control system (not shown) to bring the hull 22 of the underwater vehicle 20 into engagement with an underwater hull portion 28 of the retrieving vessel 26.

[0029] Upon engagement of the underwater vehicle 20 with the retrieving vessel 26, the underwater vehicle deploys a forward panel 30 (FIGS, 2, 3 and 41, a free edge 32 of which engages the hull 28. The panel 30 is curved (FIG. 2) in such a manner as to direct the flow of water along the side of the hull 28 around the underwater vehicle hull 22 rather than between the underwater vehicle hull 22 and the retrieving vessel hull 28. Such flow tends to pin the underwater vehicle 20 against the hull 28 of the vessel 26.

[0030] To further assist in pinning the underwater vehicle 20 to the vessel 26, the underwater vehicle is provided with side panels 34 (FIGS. 2, 5-7) which extend from the underwater vehicle and have free edges 36 which engage the hull 28. The side panels 34 further direct water flow around the underwater vehicle 20 and substantially block flow between the underwater vehicle and the retrieving vessel. The panels 30, 34 conform to the shape of the underwater vehicle hull 22 when not extended, as shown in FIG. 1. The free edges 32, 36 of the panels generally conform to the shape of the retrieving vessel hull 28 when the panels are extended. Panels 30, 34 can be extended by

electrical, mechanical, pneumatic or hydraulic actuators means known in the art.

[0031] Referring to FIGS, 8-10, it will be seen that in an alternative embodiment the underwater vehicle 20 is provided with a pair of annular recesses 40a, 40b, in which are disposed, respectively, linkage arms 42a and 42b. The linkage arms 42a, 42b are spring biased, such that upon release from their recesses 40a, 40b, which occurs upon engagement of the underwater vehicle hull 22 with the retrieving vessel hull 28, the arms spring outwardly in the direction of arrows 44a, 44b in FIG. 9 to engage the hull 28, as shown in FIG. 10. The linkages 52 of the arms 42a, 42b permit the arms to conform to the configuration of the hull 28.

[0032] To enable the underwater vehicle 20 to remain fastened to the retrieving vehicle hull 28, the linkage arms 42a, 42b are provided with attachment devices 46a, 46b, which may comprise magnetic devices 48 (FIG. 11), spikes 50 (FIG. 12), or the like. The magnetic devices 48 anchor securely to steel structures, such as submarine hulls. The spikes 50 are useful with respect to soft submarine coverings. An attachment region having improved attachment characteristics can be provided on the retrieving vehicle.

[0033] As shown in FIGS. 13 and 14, a plurality of pairs of arms 42a, 42b, may be used to insure that a proper grasping feature is engageable with a hull 28 whose structure is unknown.

[0034] In FIGS. 15 and 16 an alternative arrangement of arms 42a and 42b is shown in which the arms move oppositely from directions shown in FIGS. 9 and 10, but accomplish the same tasks in much the same manner.

[0035] It will be apparent that the features of FIGS. 1-7 may be combined with the features of FIGS. 8-14, it being necessary to provide a plurality of side panels 34 on each side panel side of the underwater vehicle hull 22, rather than the one long panel 34 shown in FIG. 2, to accommodate the recesses 40a, 40b for the linkage arms 42a, 42b.

[0036] Referring to FIGS. 17 and 18, it will be seen that in a still further embodiment of the invention, an engagement side 60 of the underwater vehicle hull 22 is of a concave configuration and an engagement portion 62 of the hull 28 of the retrieving vehicle 26 is of a convex configuration. The remainder of the underwater vehicle hull is of a convex configuration. Further, the nose or bow portion 64 (FIG. 18) of the underwater vehicle is angled asymmetrically so as to direct a water stream over the remainder of the underwater vehicle hull 22. Thus, water flowing over the remainder of the hull pins the engagement side 60 of the underwater vehicle 20 against the

engagement portion 62 of the hull 28 of the retrieving vehicle 26.

[0037] There is thus provided an underwater vehicle having facility for maneuvering alongside a retrieving vehicle, as by manipulation of bow and stern planes, for engaging a hull surface of the retrieving vehicle, and for pinning the underwater vehicle to the retrieving vehicle hull. Subsequently, the underwater vehicle can be removed from the hull of the retrieving vehicle. Alternatively, the underwater vehicle may be used as a guided mine which attaches to the hull of an enemy ship and detonates to open a large hole in the hull of the host ship. It will be understood that many additional changes in the details, materials, steps and arrangement of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principles and scope of the invention as expressed in the appended claims.

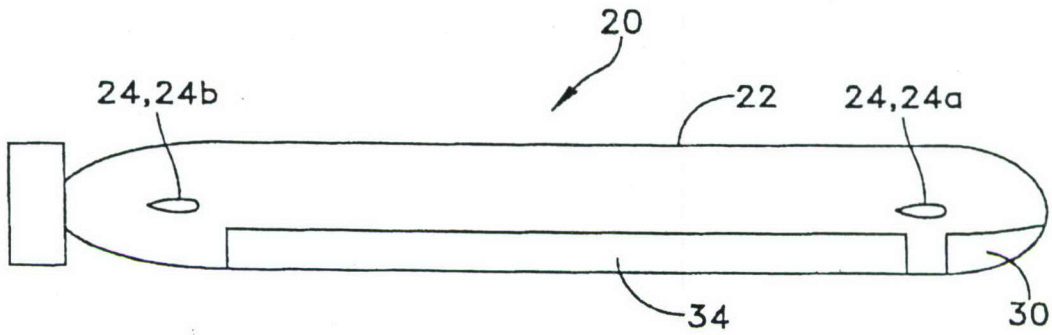

FIG. 1

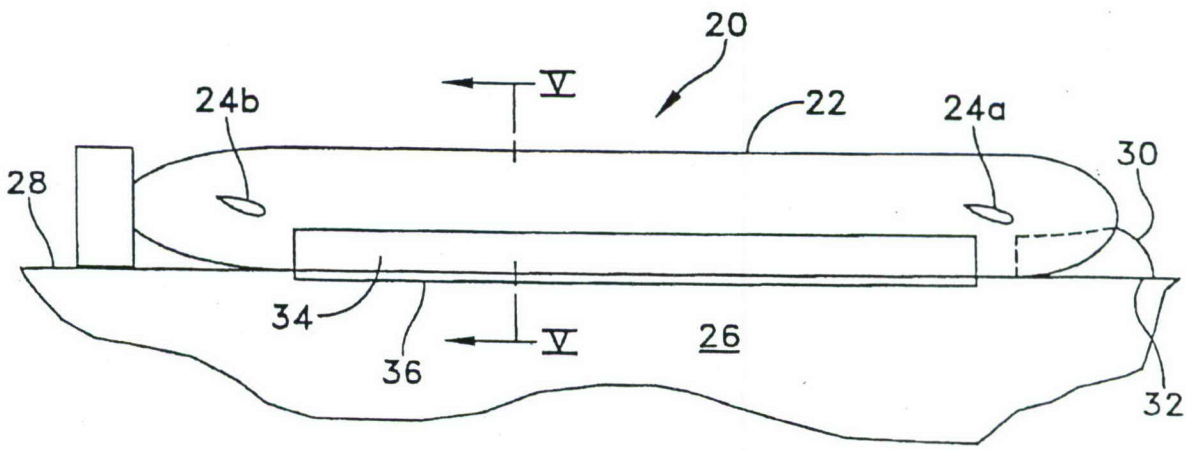

FIG. 2

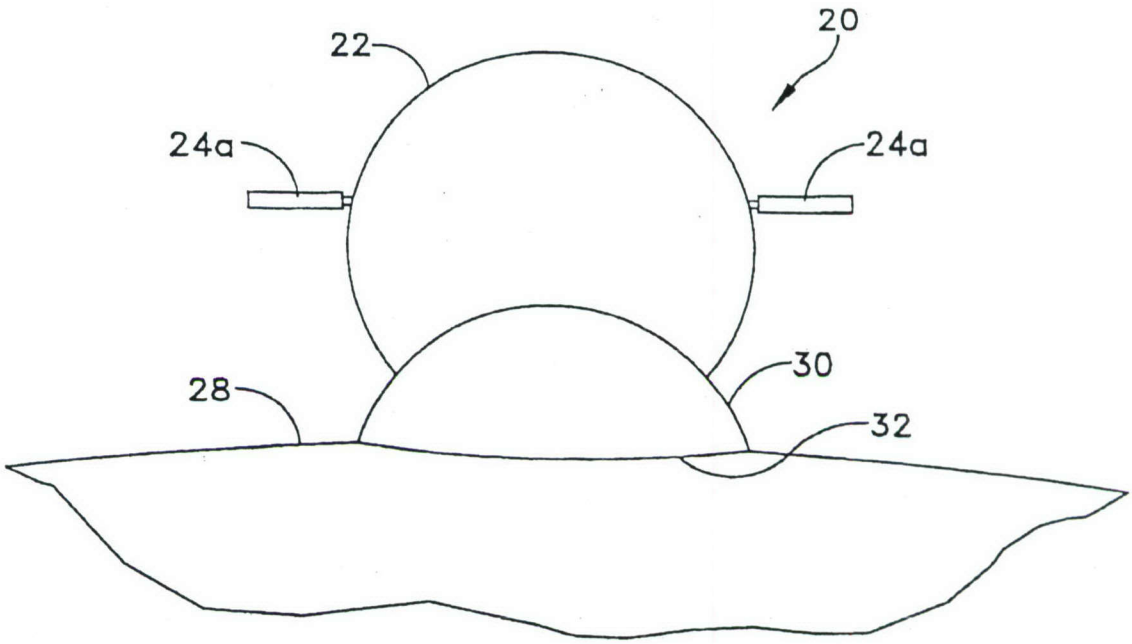

FIG. 3

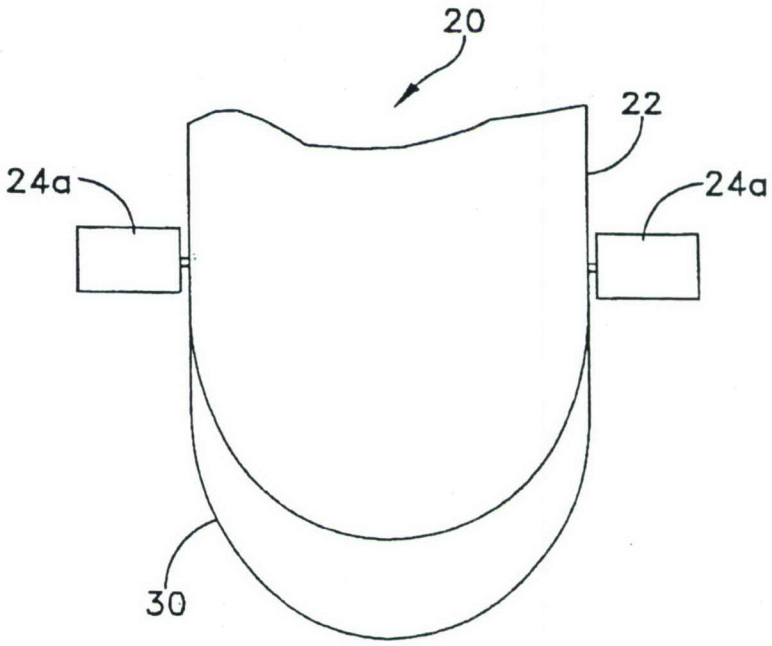

FIG. 4

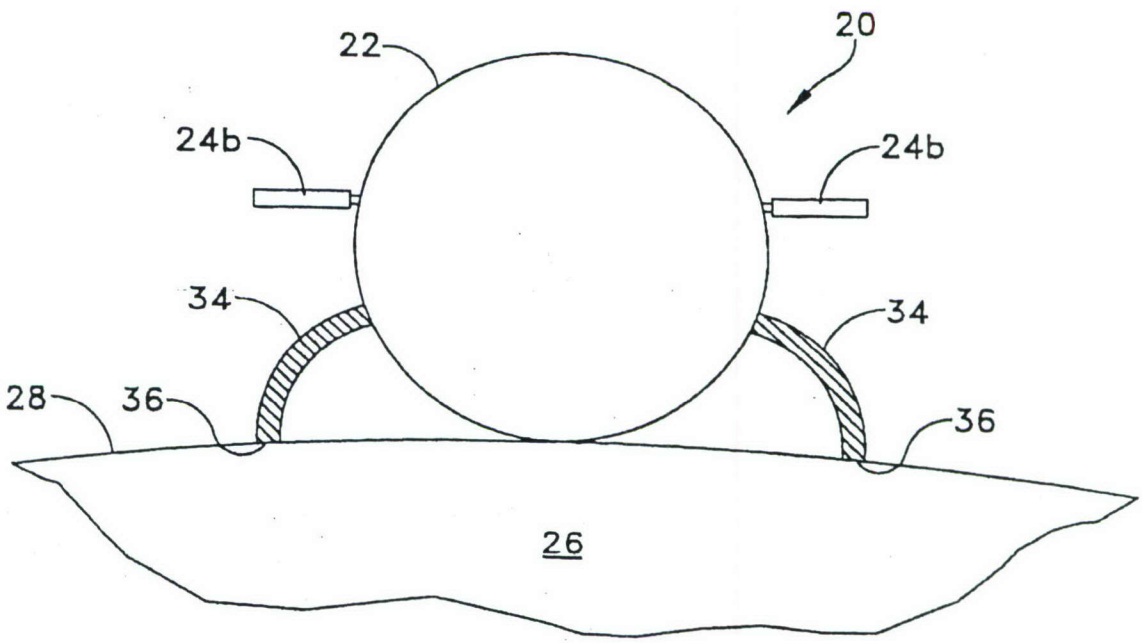

FIG. 5

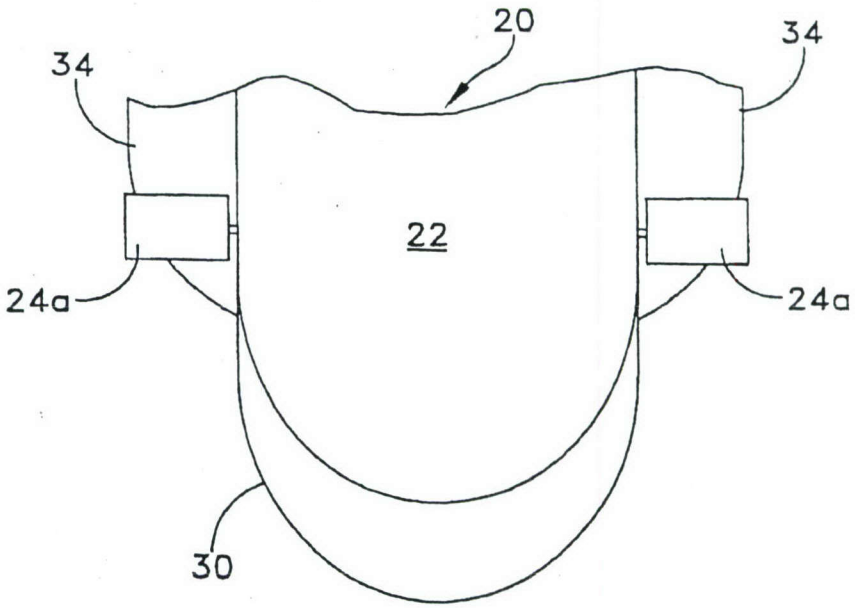

FIG. 6

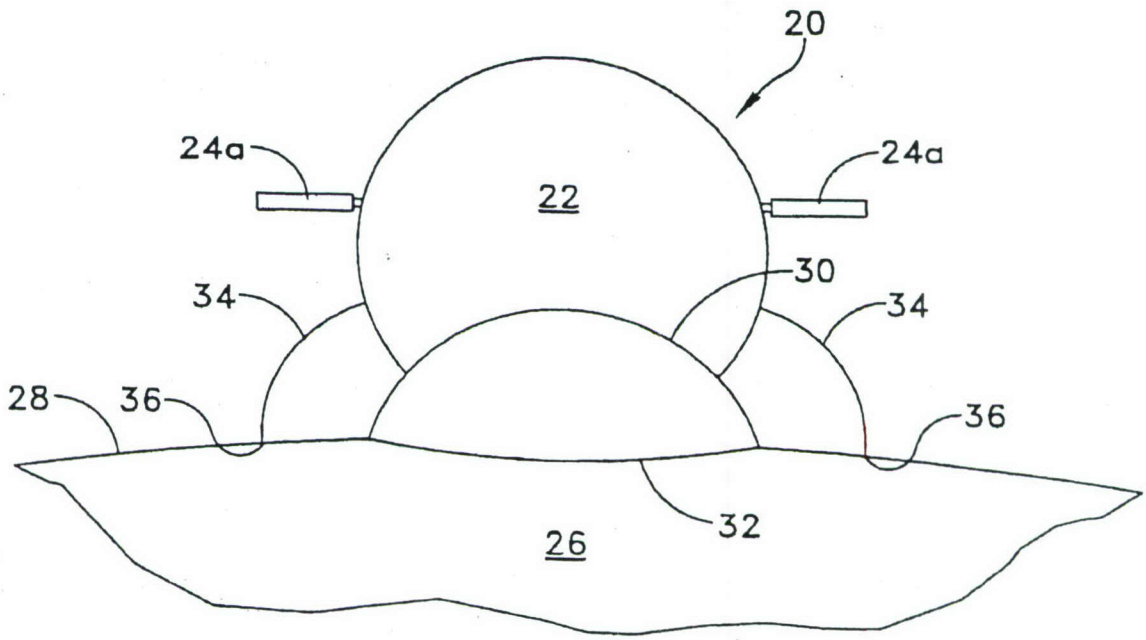

FIG. 7

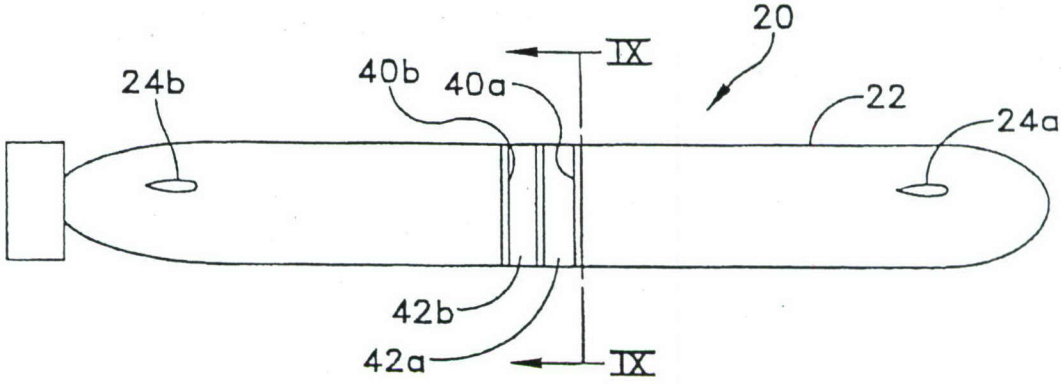

FIG. 8

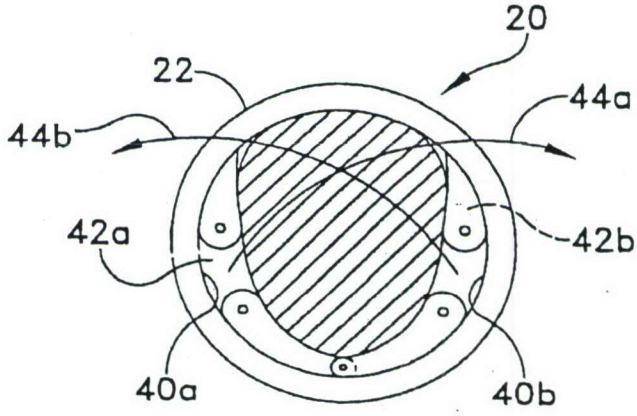

FIG. 9

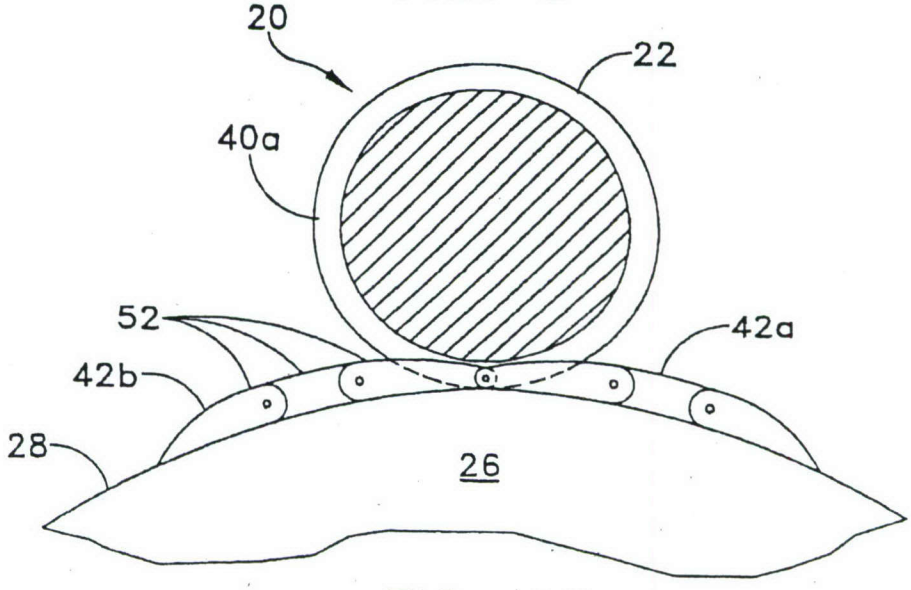

FIG. 10

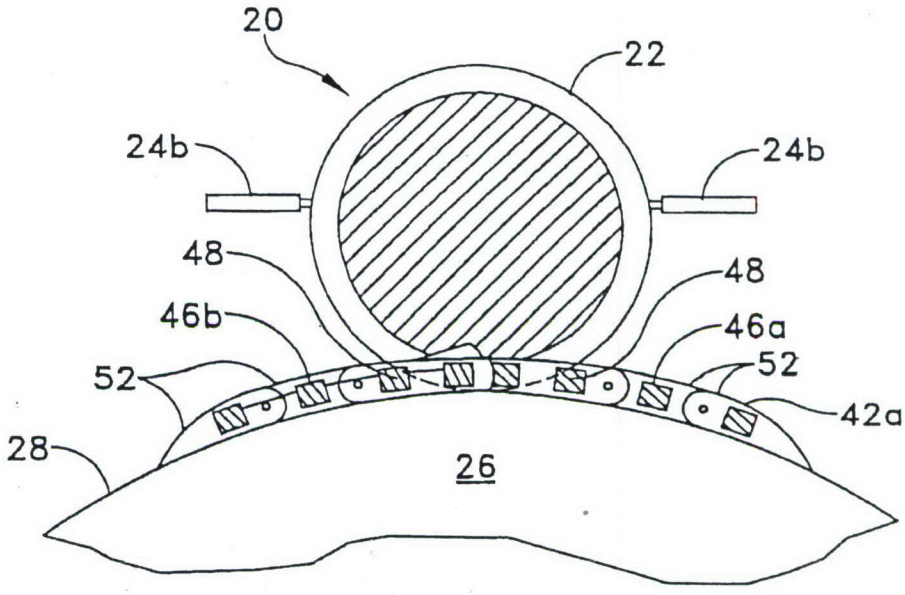
20
22
24b
24b
48
48
46b
46a
52
52
42a
28
26

FIG. 11

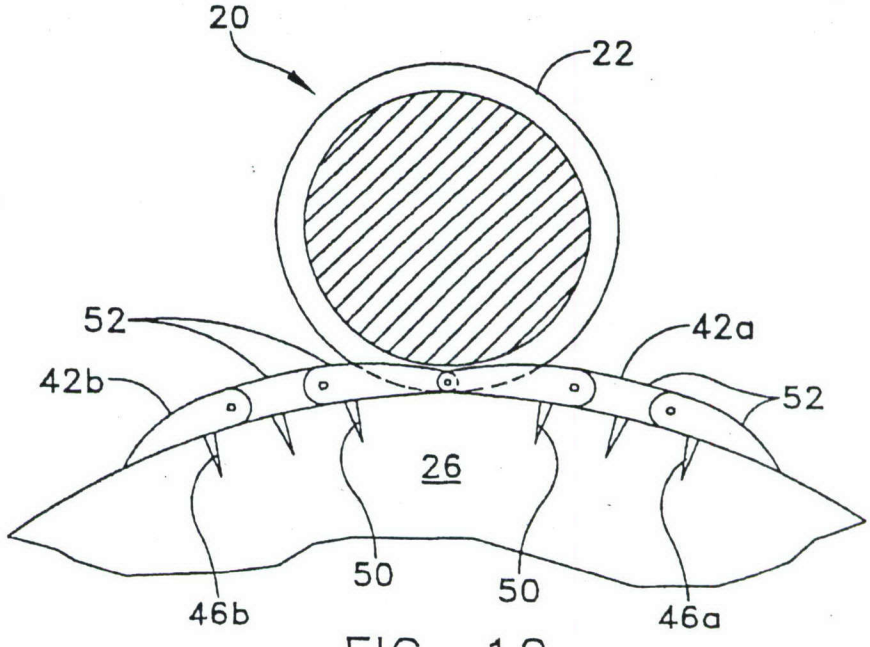
20
22
52
42a
42b
52
26
50
50
46b
46a

FIG. 12

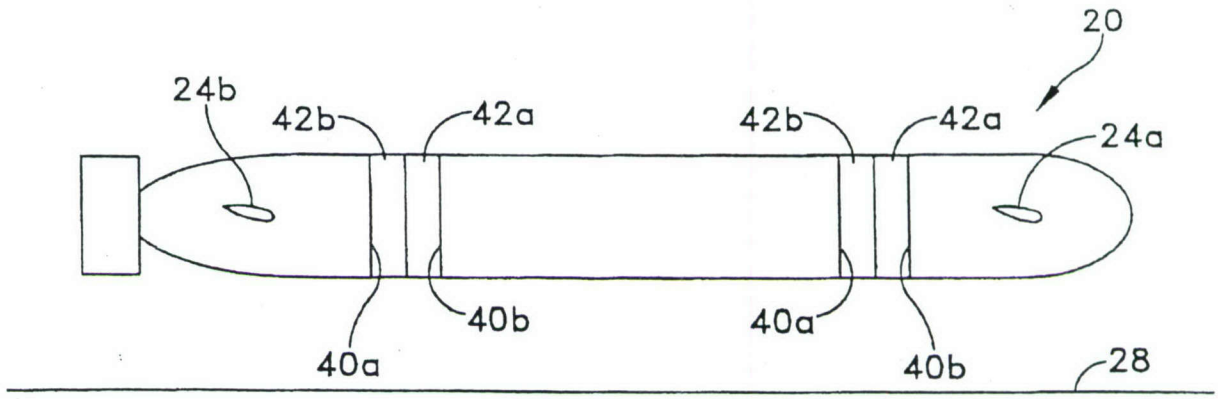
20
24b
42b
42a
42b
42a
24a
40b
40a
40a
40b
28

FIG. 13

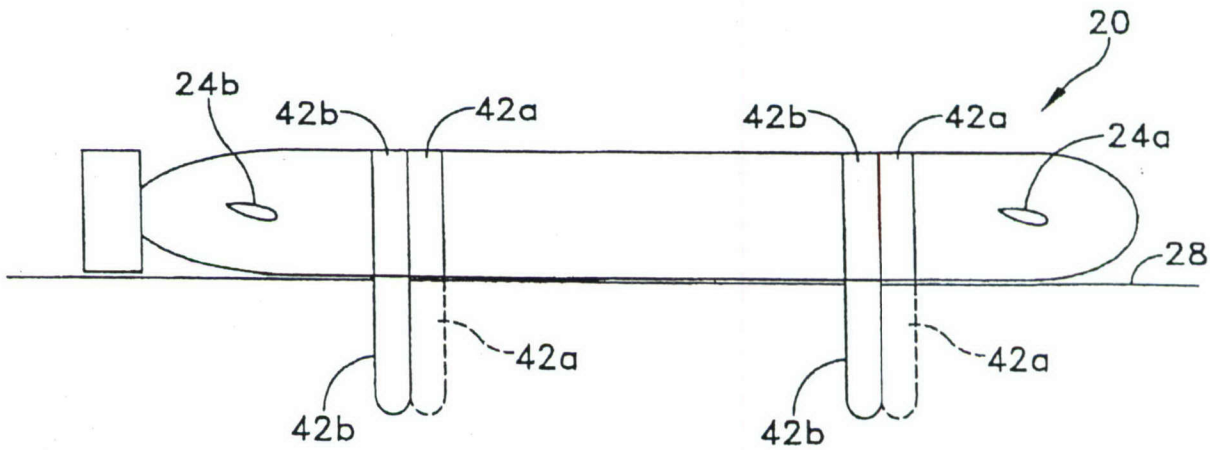
20
24b
42b
42a
42b
42a
24a
28
42a
42a
42b
42b

FIG. 14

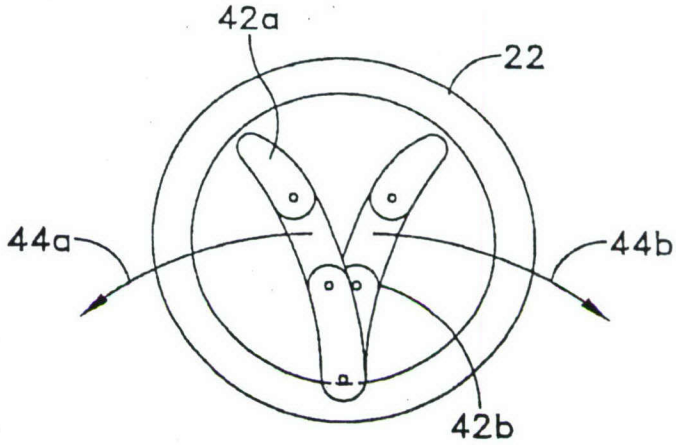

FIG. 15

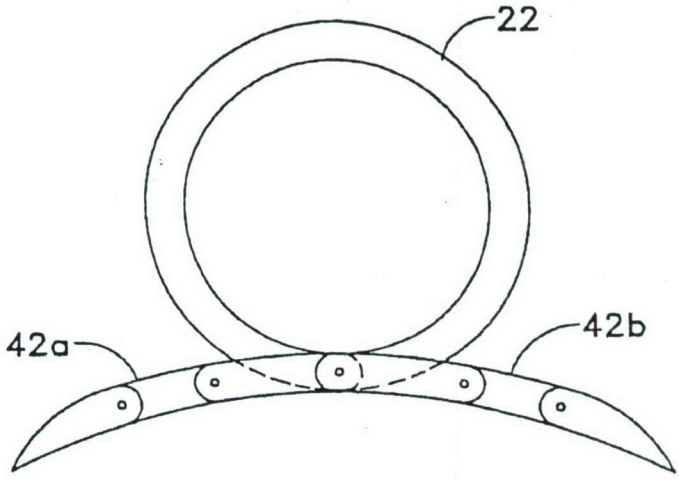

FIG. 16

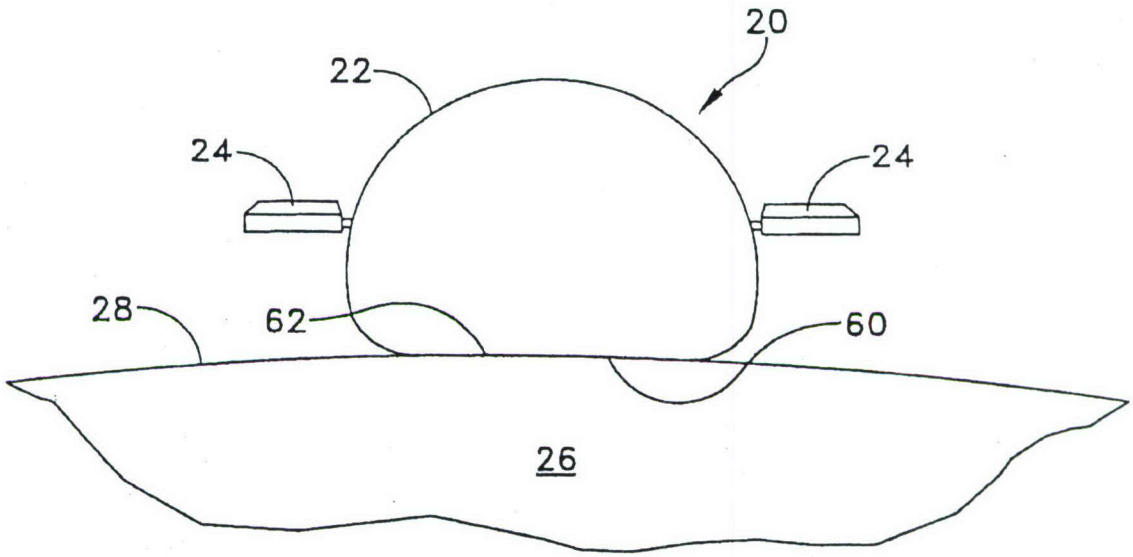

FIG. 17

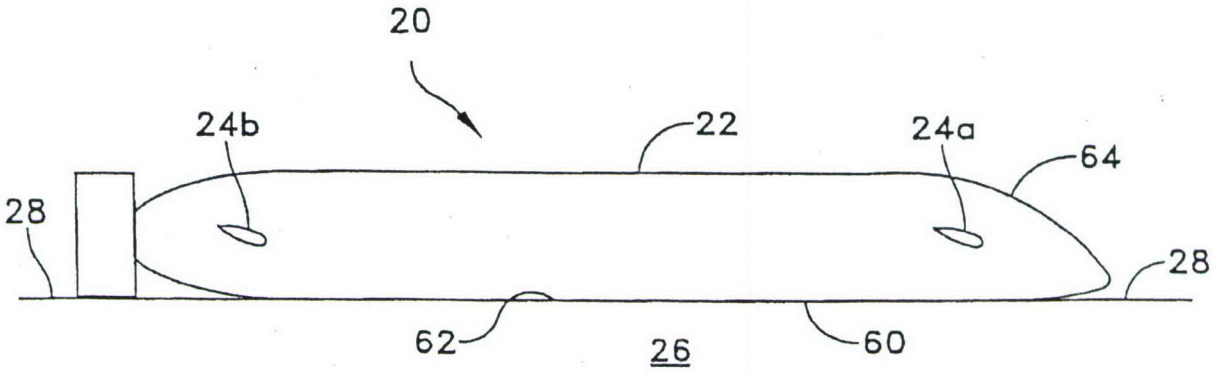

FIG. 18