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(72) Inventor: **Coppola, Claudio**
57124 Livorno (IT)

(74) Representative: **Franzolin, Luigi et al**
STUDIO TORTA
Via Viotti 9
10121 Torino (IT)

(71) Applicant: **Whitehead Alenia Sistemi Subacquei S.p.A.**
57124 Livorno (IT)

(54) **Torpedo recovery device**

(57) A recovery device (2) for a torpedo (1), the device being housed in the torpedo and having a breakable housing (8) designed to in no way affect the streamline profile of the torpedo (1); an inflatable annular bag (13) housed in a circumferential seat (12) inside the housing (8); a pressurized-gas feed device (36); and actuating

means (41, 45) for inflating the bag (13) with pressurized gas in the presence of an activating signal; inflation of the bag (13) detaches the housing (8), and the inflated bag (13) assumes a toroidal shape about the torpedo (1) to achieve positive buoyancy of and so raise the torpedo to the surface.

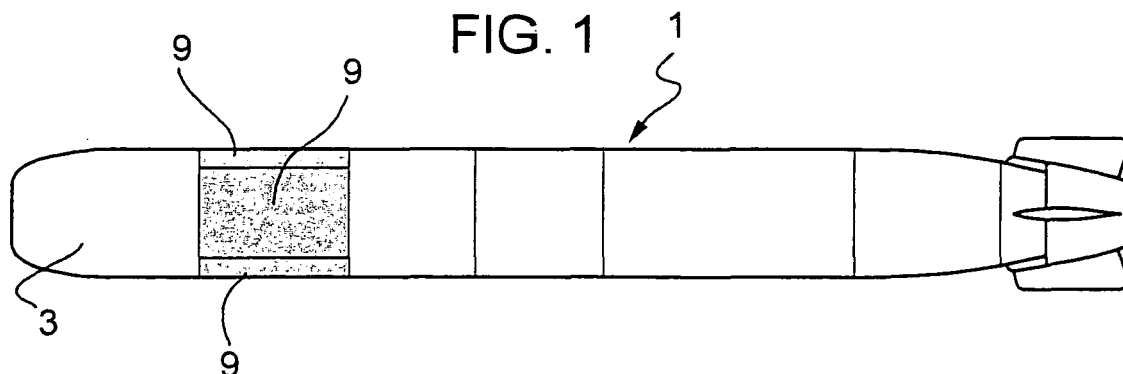
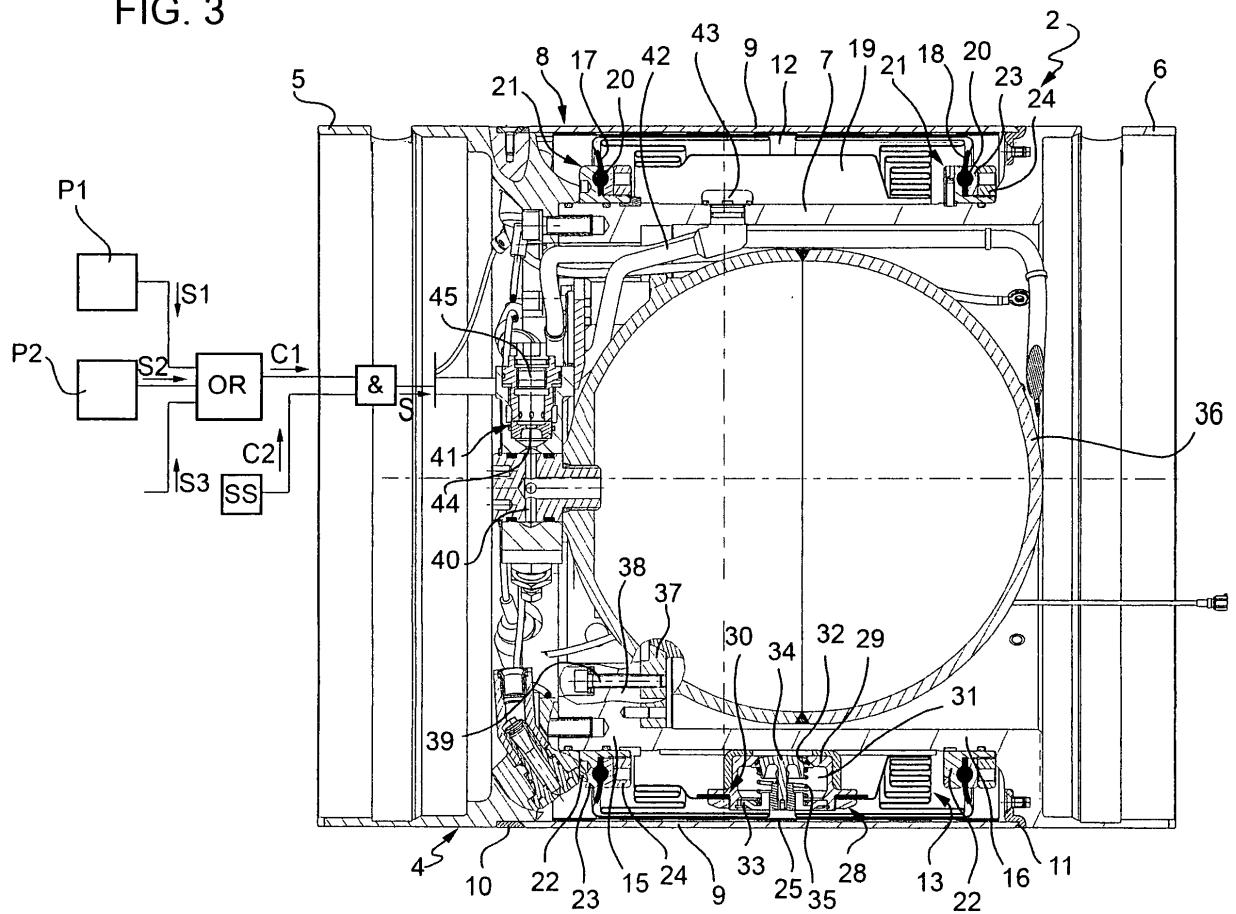


FIG. 3



Description

[0001] The present invention relates to a torpedo recovery device.

[0002] In the so-called drill configuration, used for performance testing and practice, torpedoes have negative buoyancy and so tend to sink at the end of the mission, thus making them difficult to recover for the next mission.

[0003] It is an object of the present invention to provide a recovery device that can be housed inside the torpedo, without affecting the streamline contour of the torpedo, and which provides for positive buoyancy of the torpedo at the end of the mission or, at any rate, in predetermined activation conditions.

[0004] According to the present invention, there is provided a device as claimed in Claim 1.

[0005] A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a side view of a torpedo featuring a recovery device in accordance with the present invention;

Figure 2 shows a view in perspective of the torpedo in the recovery position, after the device according to the invention is activated;

Figure 3 shows an axial section of the recovery device;

Figure 4 shows a view in perspective of the device at one assembly stage.

[0006] With reference to Figures 1 and 3, number 1 indicates as a whole a torpedo.

[0007] According to the present invention, torpedo 1 comprises a recovery device 2 housed inside the torpedo, preferably at the front, close to the head 3.

[0008] Recovery device 2 comprises a substantially cylindrical supporting structure 4 forming a section of the overall structure of torpedo 1. Structure 4 substantially comprises two tubular end portions 5, 6, of the same outside diameter as the torpedo and connected to the adjacent sections of the torpedo; and an intermediate portion 7 smaller in outside diameter and integral with one (6) of the tubular portions. The intermediate portion of device 2 is defined externally by a frangible cylindrical housing 8 flush with the outer surface of tubular portions 5, 6. It should be pointed out that "frangible" is used here in its widest sense, and applies equally to a housing made of a number of detachable parts, as well as to a one-piece housing that can be broken off or detached from structure 4. In a preferred embodiment, housing 8 preferably comprises three 120° segments 9 fixed releasably to tubular portions 5, 6 by respective dove-tail joints 10, 11, and defining, with intermediate portion 7, an annular chamber 12 housing an inflatable bag 13.

[0009] Bag 13 comprises an annular sheet of high-pressure-resistant, rubber-coated canvas fixed hermetically along its lateral edges 17, 18 to the axial ends 15,

16 of intermediate portion 7 of structure 4 to form an air chamber 19 with intermediate portion 7.

[0010] More specifically, each lateral edge 17, 18 of bag 13 is thicker than the rest of the sheet to form a raised toroidal rib 20, and is gripped between a first ring 21 fitted hermetically to the respective end 15, 16 of intermediate portion 7 and defining a shoulder 22 for the lateral edge, and a second ring 23 which slides onto the first and is locked in the grip position by a ring nut 24. Shoulder 22 and second ring 23 are shaped to mate with lateral edge 17, 18, and in particular with relative rib 20.

[0011] At rest, bag 13 is folded accordion-fashion inside annular chamber 12, and is kept in this position by a rip-off retaining belt 25 (Figure 4) surrounding bag 13, and which comprises two fabric portions 26 laced together by laces 27 (only one shown) made of string with a predetermined break strength.

[0012] At rest, bag 13 therefore exerts no pressure on housing 8.

[0013] Bag 13 has three compensating valves 28 located 120° apart and offset, with respect to the centre line of the bag, towards lateral edge 17 (i.e. in use, towards head 3 of torpedo 1). Each compensating valve 28 comprises a casing 29 fixed hermetically to an opening 30 in bag 13 and defining a cavity 31 communicating with air chamber 19 and the outside through respective openings 32, 33. A shutter 34 associated with opening 32 is held in a normally closed position by a spring 35, and opens when the difference in pressure between air chamber 19 and the outside exceeds a predetermined threshold value defined by the setting of spring 35.

[0014] Structure 4 of the device houses a cylinder 36 of high-pressure, e.g. 300-bar, compressed air, which is fixed rigidly to structure 4 by three supports 37 (only one shown in Figure 3), each fixed to an inner flange 38 of structure 4 by screws 39.

[0015] Cylinder 36 is connected to air chamber 19 by a pneumatic circuit comprising a fitting 40, an explosive-actuated valve 41, a pipe 42, and a diffuser 43.

[0016] More specifically, valve 41 comprises a breakable partition 44 associated with an electrically-activated explosive actuating device (squib) 45, which receives an activating signal S resulting from an AND operation between a control signal C1 and a consent signal C2.

[0017] Control signal C1 is in turn the result of an OR operation between three signals: a signal S1 from a first pressure sensor P1; a signal S2 from a second pressure sensor P2; and an activation control signal S3.

[0018] Sensors P1 and P2 are set to define the minimum and maximum pressure respectively to which device 2 can be subjected during the mission, i.e. the compulsory operating depth range of the device.

[0019] Consent signal C2 is generated by a salinity sensor SS designed to only permit activation of device 2 in seawater, and so prevent accidental activation during transport or storage.

[0020] Device 2 operates as follows.

[0021] Device 2 is activated at the end of the torpedo

1 mission, either by activation control signal S3 (end of mission) or, in the event of a malfunction causing the torpedo to stray from the predetermined depth range, by pressure sensor P1 or P2 generating respective signal S1 or S2.

[0022] In the presence of signal C2 from salinity sensor SS and one of signals S1, S2 and S3, activating signal S is active, so squib 45 breaks partition 44 to allow compressed-air flow from cylinder 36 through fitting 40, valve 41, pipe 42, and diffuser 43 into air chamber 19.

[0023] Diffuser 43 prevents high-pressure airflow from striking bag 13 directly and so damaging the material.

[0024] Bag 13 is thus inflated and, in so doing, snaps laces 27 and rips off retaining belt 25; and the outward mechanical thrust exerted by bag 13 also detaches segments 9.

[0025] Bag 13 is now free to expand and inflate fully into a toroidal shape about torpedo 1 to achieve positive buoyancy of torpedo 1.

[0026] As torpedo 1 floats to the surface, compensating valves 28 maintain a constant pressure difference between air chamber 19 and the outside, to prevent bag 13 from expanding to breaking point as a result of the reduction in external pressure as torpedo 1 rises.

[0027] By locating device 2 at the front, the torpedo emerges in the substantially vertical recovery position shown in Figure 1, with head 3 above water.

[0028] It should be noted that valves 28 are so located as to face upwards, and so be freely accessible, in the above recovery position.

[0029] One of the three compensating valves 28 is conveniently fitted with a line 46 fixed to shutter 34, and which is operated manually to deflate bag 13 and so assist recovery of torpedo 1.

[0030] The advantages of device 2 according to the present invention will be clear from the above description.

[0031] In particular, device 2 provides for surfacing torpedo 1 at the end of the mission or in the event of a malfunction, thus simplifying recovery.

[0032] Moreover, in the preferred embodiment described, the structure of the device complies with the dimensional requirements, dictated by the geometry of the torpedo, of in no way affecting the streamline profile of the torpedo either before or during the mission, and of ensuring maximum safety during handling and use.

[0033] Clearly, changes may be made to device 2 as described herein without, however, departing from the scope defined in the accompanying Claims.

Claims

1. A recovery device (2) for a torpedo (1), the device comprising a housing (8) designed to be incorporated in the torpedo (1); buoying means (13) housed in said housing (8); pressurized-gas supply means (36); and valve means (41) for connecting said supply means (36) to said buoying means (13) and in-

flating said buoying means (13) in response to at least one activating signal.

2. A device as claimed in Claim 1, **characterized in that** said housing (8) is breakable by said buoying means (13) when these are inflated.
3. A device as claimed in Claim 1 or 2, **characterized by** comprising a supporting structure (4); said housing (8) being connected to said structure (4) to define a continuous outer profile with respect to the profile of the torpedo (1).
4. A device as claimed in Claim 3, **characterized in that** said housing (8) comprises a number of segments (9) connected to said structure (4) by connecting means (10, 11) releasable by said buoying means (13).
5. A device as claimed in Claim 3 or 4, **characterized in that** said structure (4) comprises two tubular end portions (5, 6) connected to adjacent sections of said torpedo (1); and a smaller-diameter intermediate portion (7) defining, with said housing (8), an annular cavity (12) housing said buoying means (13).
6. A device as claimed in Claim 5, **characterized in that** said buoying means comprise an annular bag (13) housed in said annular cavity (12).
7. A device as claimed in Claim 6, **characterized in that** said bag (13) comprises an annular sheet having lateral edges (17, 18) connected hermetically to said structure (4) and forming, with said structure, an air chamber (19).
8. A device as claimed in Claim 6 or 7, **characterized by** comprising a rip-off retaining belt (25) for holding said bag (13) in a folded position.
9. A device as claimed in Claim 8, **characterized in that** said retaining belt (25) comprises a number of fabric portions (26) joined by laces (27) of a string of a predetermined break strength.
10. A device as claimed in any one of the foregoing Claims, **characterized in that** said pressurized-gas supply means comprise a cylinder (36) of compressed air.
11. A device as claimed in any one of the foregoing Claims, **characterized in that** said valve means comprise an explosive-actuated valve (41).
12. A device as claimed in Claim 11, **characterized in that** said explosive-actuated valve (41) comprises a breakable partition (44); and an explosive actuating

device (45) for breaking said partition (44).

13. A device as claimed in any one of the foregoing Claims, **characterized by** comprising pressure sensors (P1, P2) which generate activating signals to activate said valve means (41) in the event the torpedo (1) exceeds predetermined depth thresholds. 5
14. A device as claimed in any one of the foregoing Claims, **characterized by** comprising a salinity sensor (SS) which generates a consent signal for said valve means (41). 10
15. A device as claimed in any one of Claims 6 to 14, **characterized in that** said valve means (41) are connected to said air chamber (19) by a diffuser (43). 15
16. A device as claimed in any one of Claims 5 to 15, **characterized in that** said bag (13) has at least one compensating valve (28) for regulating the pressure difference between said air chamber (19) and the outside. 20
17. A torpedo, **characterized by** comprising a recovery device (2) as claimed in any one of the foregoing Claims. 25
18. A torpedo as claimed in Claim 17, **characterized in that** said housing (8) of said device is flush with adjacent sections of the torpedo (1), so as not to affect the streamline profile of the torpedo (1). 30
19. A torpedo as claimed in Claim 17 or 18, **characterized in that** said recovery device is located close to a head of said torpedo (1). 35
20. A torpedo comprising a recovery device (2) as claimed in Claim 16, **characterized in that** said bag (13) has a number of compensating valves (28) arranged along the bag (13) and so located as to face, in use, the head (3) of the torpedo (1). 40
21. A torpedo as claimed in Claim 20, **characterized in that** at least one of said compensating valves (28) comprises hand-operated means (46) for deflating said bag (13). 45

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FIG. 2

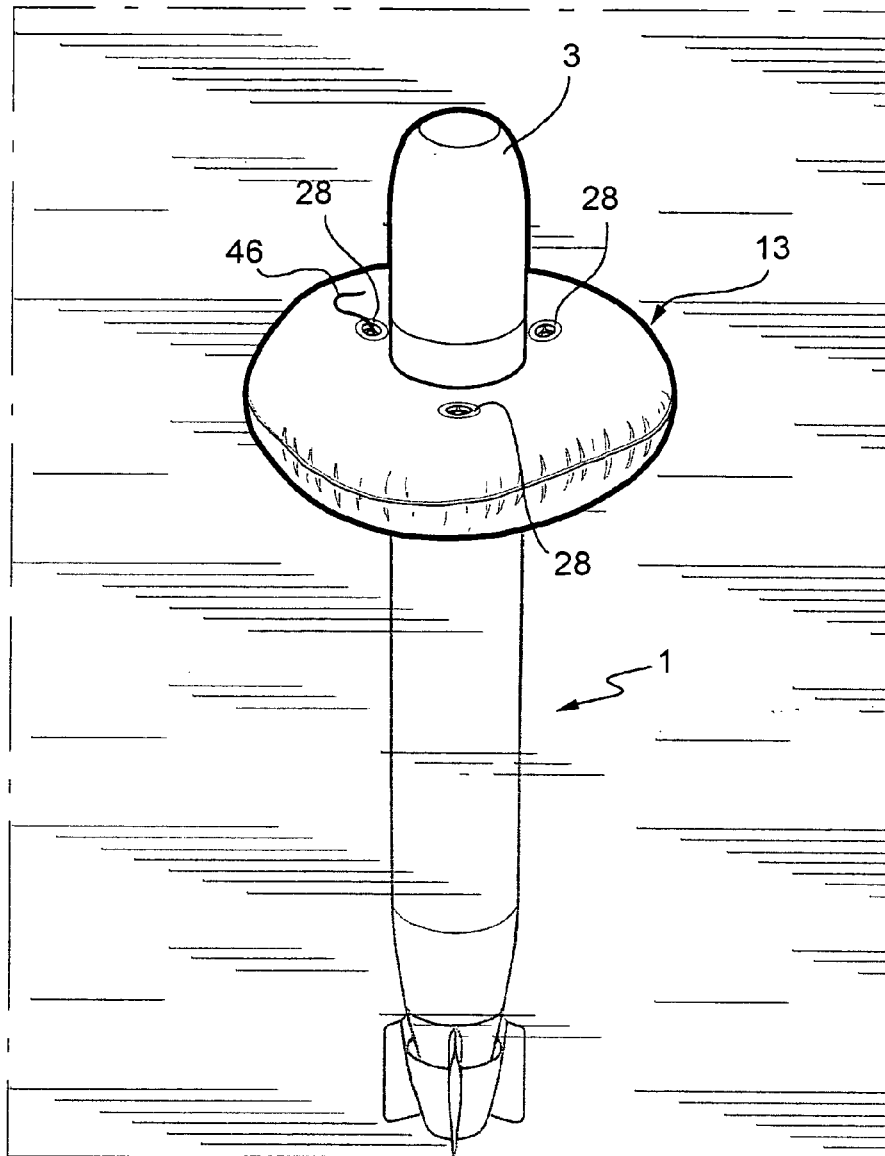


FIG. 1

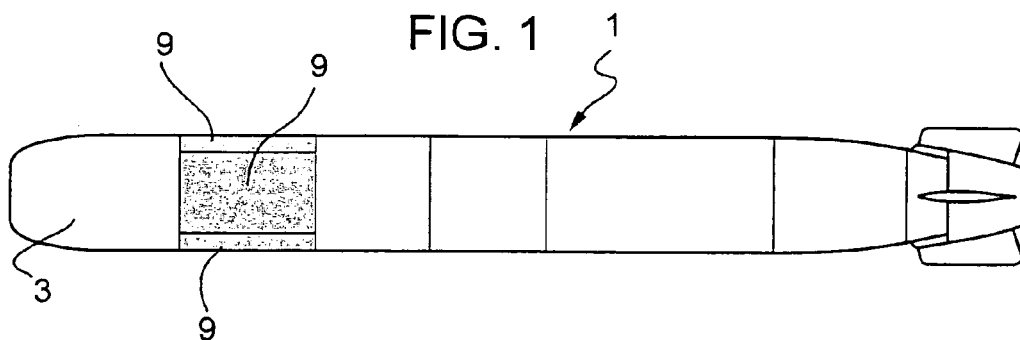


FIG. 3

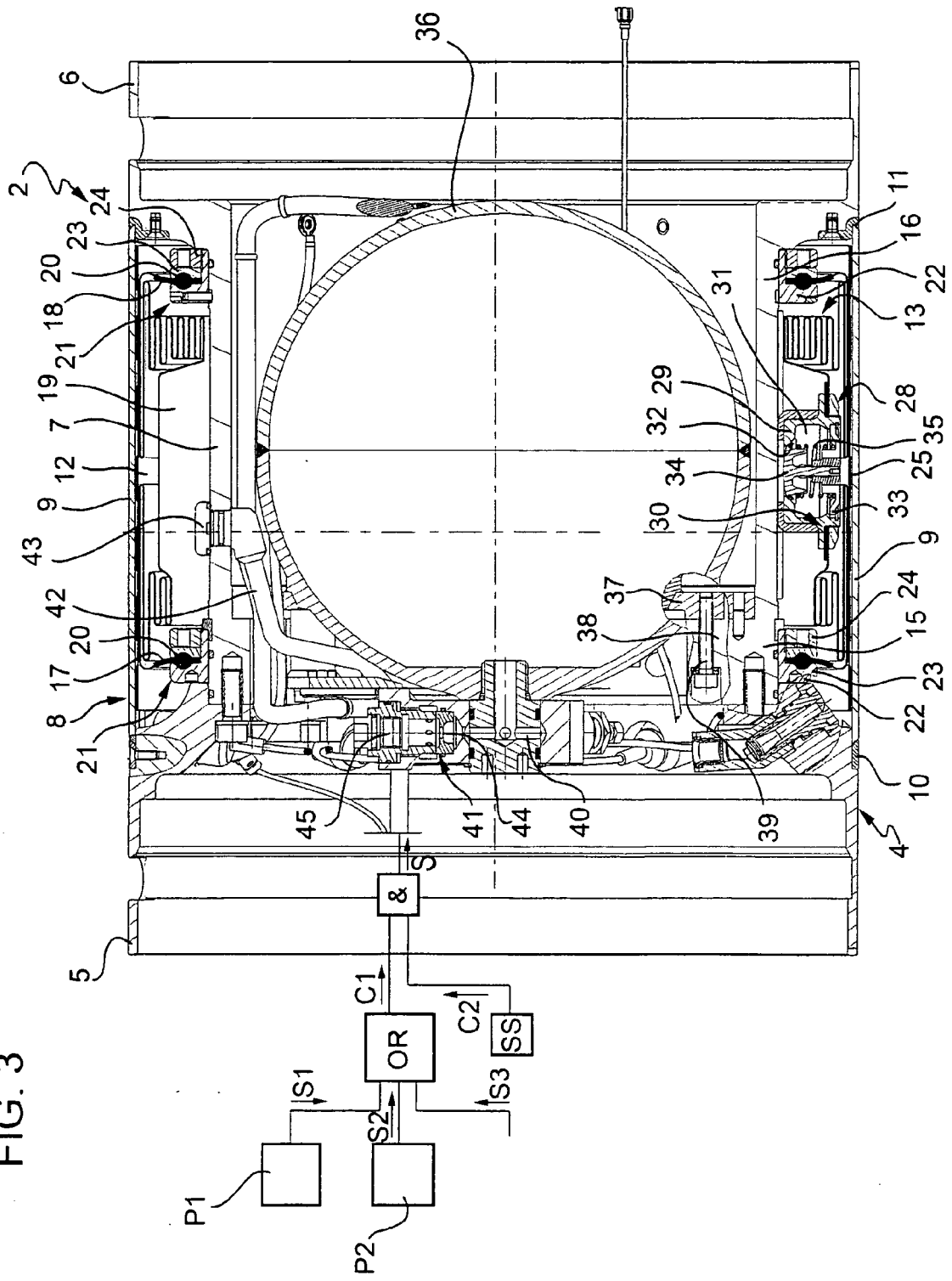
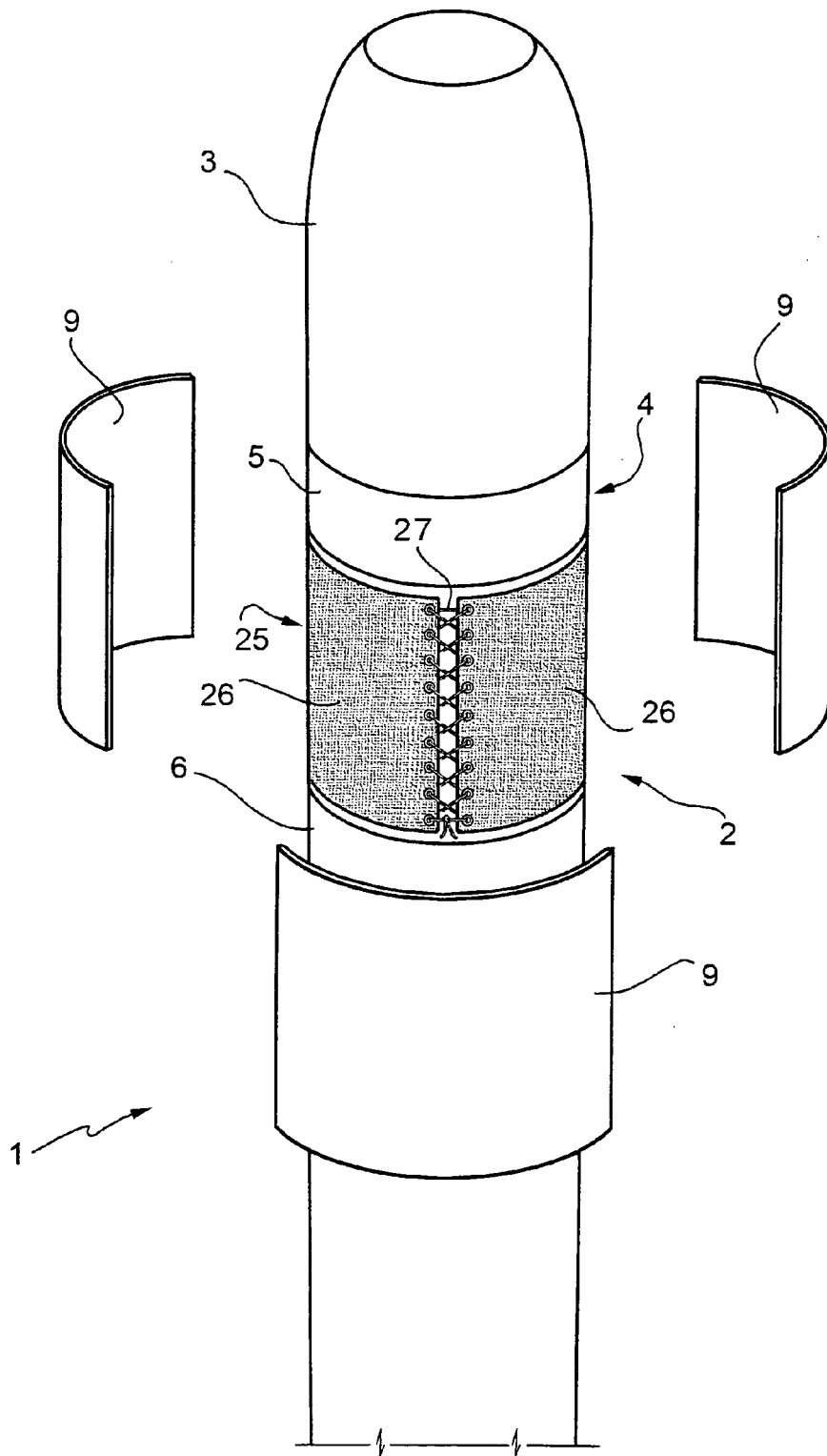


FIG. 4





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Application Number
EP 08 42 5220

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 9 October 2008	Examiner Van Leeuwen,Erik
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 9 October 2008	Examiner Van Leeuwen,Erik
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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