(19) Europäisches Patentamt
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(11) **EP 2 022 715 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.02.2009 Bulletin 2009/07

(51) Int Cl.:
B63G 9/02 *(2006.01)* ***B63G 8/32*** *(2006.01)*

(21) Application number: **07425452.5**

(22) Date of filing: **24.07.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

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

(72) Inventors:
- **Benvenuti, Massimo**
  57124 Livorno (IT)
- **Calvo, Giovanni**
  57020 Bibbona (IT)
- **Lazzerini, Maurizio**
  57124 Livorno (IT)
- **Campoccio, Vincenzo**
  57123 Livorno (IT)

(74) Representative: **Bergadano, Mirko et al**
Studio Torta S.r.l.
Via Viotti, 9
10121 Torino (IT)

(54) Submarine countermeasure launching device

(57) A submarine countermeasure launching device having a launch tube (2) for launching a countermeasure (3); a cylinder (5) of pressurized gas; and a feed system (7) for feeding gas from the cylinder to the launch tube (2). A shutter of the feed system has a supporting body (32), and a cup-shaped body which slides with respect to the supporting body and has an annular end portion (42) for closing a gas feed opening (28) to the launch tube; and the supporting body and the cup-shaped body define a variable-volume inner chamber (47). The shutter (30) is housed in a seat (24) into which pressurized gas from the cylinder is fed so that the gas exerts pressure on at least part of the cup-shaped body. When the chamber is depressurized, the gas pressure on the cup-shaped body slides the cup-shaped body on the supporting body to open the shutter.

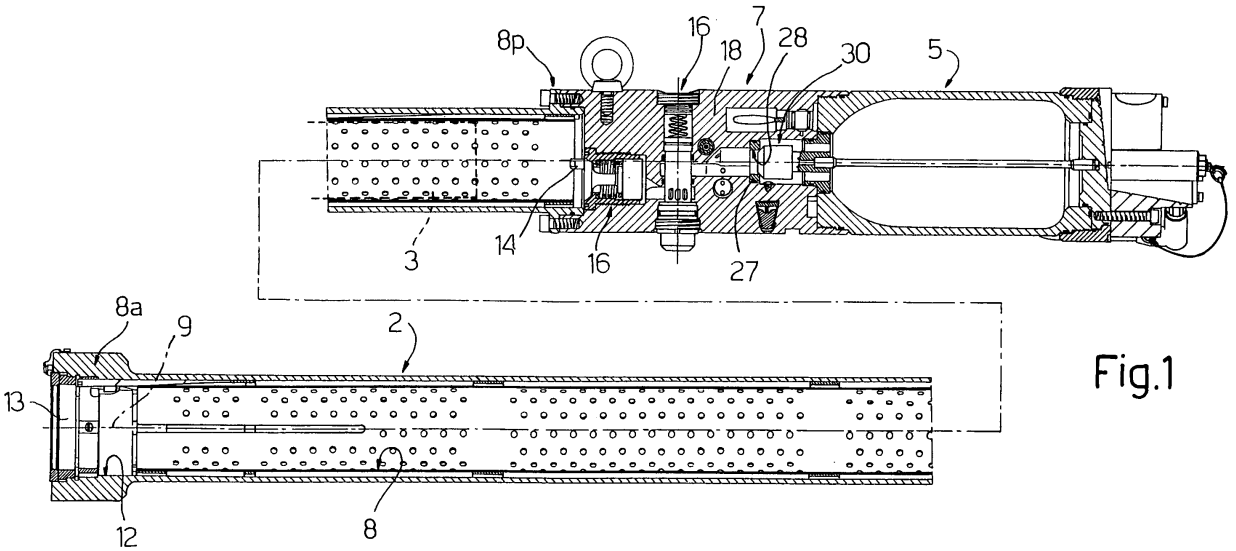

Fig.1

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Description

[0001] The present invention relates to a submarine countermeasure launching device.

[0002] Countermeasure (Jammer or Decoy) launching devices are known comprising a launch tube housing the countermeasure; a cylinder of pressurized gas; and a feed system for feeding the gas from the cylinder to the launch tube.

[0003] The gas feed system comprises a shutter movable between a closed position closing at least one feed opening in the feed system to prevent pressurized-gas flow from the cylinder to the launch tube, and an open position allowing pressurized-gas flow through the feed opening to the launch tube.

[0004] In the closed position, the pressurized gas from the valve presses on the movable parts of the shutter.

[0005] Currently used launching systems employ extremely high-pressure gas (of 300 bars and more) to maximize acceleration of the countermeasure as it leaves the launch tube.

[0006] For effectiveness and safety, in fact, it is essential that the countermeasure be distanced as far and as fast as possible from the launch tube.

[0007] Using high-pressure gas, however, poses problems related to the opening, on account of the high pressure exerted by the pressurized gas from the valve on the movable parts of the shutter in the closed position.

[0008] This makes the valve difficult to open, and considerable force must be exerted on it to overcome the pressure exerted by the pressurized gas.

[0009] It is an object of the present invention to provide a countermeasure launching device designed to permit fast, easy opening of the shutter, even in the presence of high-pressure gas.

[0010] According to the present invention, there is provided a countermeasure launching device as claimed in Claim 1.

[0011] A preferred, non-limiting embodiment of the invention will be described by way of example with particular reference to the accompanying drawings, in which:

Figure 1 shows a longitudinal section of a countermeasure launching device in accordance with the teachings of the present invention;

Figure 2 shows a side view of the Figure 1 device;

Figure 3 shows a larger-scale longitudinal section of a portion of the Figure 1 device;

Figures 4 and 5 show details of the Figure 1 device.

[0012] The device 1 (Figures 1 and 2) comprises a launch tube 2 for a countermeasure 3 (e.g. a known. Jammer or Decoy); a cylinder 5 of high-pressure gas; and a feed system 7 for feeding gas from the cylinder to launch tube 2.

[0013] More specifically, launch tube 2 (known) defines an inner cylindrical cavity 8 (Figure 1) coaxial with an axis 9, and comprises a rear portion 8p connected to feed system 7, and a front portion 8a having a launch opening 12 closable by a partition 13 crosswise to axis 9. Partition 13 thus closes cylindrical cavity 8, so countermeasure 3 can be immersed in a protective liquid (not shown) flooding cavity 8; and partition 13 is shattered when countermeasure 3 is fired.

[0014] Feed system 7 defines an inlet (detailed below); and an outlet 14 which communicates with, to feed pressurized gas into, cylindrical cavity 8.

[0015] Feed system 7 comprises a number of known safety valves 16 (not described in detail) for preventing accidental firing of countermeasure 3.

[0016] Feed system 7 is formed inside a metal body 18, coaxial with axis 9, and comprising a front portion connected to launch tube 2, and a rear portion to which cylinder 5 is fitted.

[0017] More specifically (Figure 3), the rear portion of body 18 has a cylindrical seat 20 coaxial with axis 9 and bounded laterally by an internally threaded annular wall 21.

[0018] Cylindrical seat 20 is also bounded by a flat wall 22 perpendicular to axis 9, and in which is formed a cylindrical cavity 24 coaxial with axis 9 and defining an inlet of feed system 7.

[0019] Cylindrical cavity 24 communicates with a feed conduit 26 formed inside metal body 18 and for feeding pressurized gas to outlet 14 via safety valves 16. Cylindrical cavity 24 has a constant radius R, and the inlet of feed conduit 26 is smaller across than the diameter 2R of cylindrical cavity 24.

[0020] A metal ring 27 rests on an end surface of cavity 24, and defines a circular opening 28 through which pressurized gas flows from cylindrical cavity 24 into feed conduit 26.

[0021] Opening 28 is normally closed by a shutter 30 which, in a work position, presses against metal ring 27 to cut off pressurized-gas flow.

[0022] Shutter 30 comprises a cup-shaped body 31 which slides axially along a support 32 housed inside cavity 24, detached radially from the walls of cavity 24, and supported by flanges 34 extending radially from an end portion of support 32 to a tubular sleeve 35 interposed between metal body 18 and cylinder 5. Tubular sleeve 35 permits pressurized-gas flow from cylinder 5 to cylindrical cavity 24.

[0023] More specifically, support 32 comprises a first cylindrical portion 36 coaxial with axis 9 and of radius L1; and a second cylindrical portion 37 integral with portion 36, coaxial with axis 9, and of a larger radius L2 than radius L1.

[0024] Second cylindrical portion 37 has an inner cylindrical cavity 38 opening outwards of support 32 and communicating with a conduit 39 extending the whole length of first cylindrical portion 36 and coaxial with axis 9. Second cylindrical portion 37 is positioned facing metal ring 27.

[0025] Cup-shaped body 31 comprises a tubular portion 40 fitted to second cylindrical portion 37 and an end

wall 42 integral with portion 40 and having an isosceles-trapezium-shaped cross section.

[0026] The side of the isosceles trapezium thus defines an annular bevel 43 of cup-shaped body 31, which rests on metal ring 27 to close opening 28.

[0027] Shutter 30 also comprises a helical spring 45 interposed between cup-shaped body 31 and support 32. More specifically, helical spring 45 has a first end housed in cavity 38, and a second end portion which presses against the inner side of wall 42.

[0028] Cup-shaped body 31 and the second cylindrical portion internally define a variable-volume chamber 47 communicating with conduit 39.

[0029] A labyrinth seal system 48, allowing passage of a limited amount of gas, is formed between the outer surface of second cylindrical portion 37 and the inner wall of tubular portion 40.

[0030] Cylinder 5 comprises an end portion 5f screwed to wall 21 of metal body 18, and defines an inner cavity 50 communicating with cylindrical cavity 24; and conduit 39 communicates with a tube 52 extending through cavity 50, coaxially with axis 9.

[0031] In use, at rest, high-pressure gas (normally compressed air or nitrogen, possibly at over 300 bar pressure) is contained inside cylindrical cavity 24, and exerts pressure on the walls of cup-shaped body 31; and the pressure inside variable-volume chamber 47 equals the pressure inside cylindrical cavity 24, i.e. outside chamber 47, by virtue of the pressurized gas seeping into variable-volume chamber 47 through seal system 48.

[0032] In this condition, spring 45 keeps bevel 43 resting firmly on metal ring 27, and, hence, shutter 30 in a stable closed position closing circular opening 28 and preventing gas flow from cylinder 5 to launch tube 2.

[0033] To open shutter 30, variable-volume chamber 47 is depressurized by drawing off pressurized gas along conduit 39 and tube 52.

[0034] The pressure in chamber 47 falls rapidly to well below the pressure in cylindrical cavity 24; by virtue of the difference in pressure between the inside and outside of chamber 47, the pressure on cup-shaped body 31 pushes it axially towards support 32 in opposition to spring 45, thus compressing the spring and also reducing the volume of chamber 47; and bevel 43 is detached from metal ring 27, thus moving shutter 30 into an open position (not shown) in which pressurized gas flows from cylinder 5 to launch tube 2 to launch countermeasure 3.

[0035] Shutter 30 is thus opened easily despite the high pressure of the gas inside cylinder 5. The high pressure, in fact, actually assists in moving cup-shaped body 31 and so opening shutter 30 rapidly.

[0036] Once countermeasure 3 is launched leaving cylinder 5 empty, the difference in pressure is eliminated, and spring 45 restores shutter 30 to the closed position described above, after which, cylinder 5 can be refilled.

[0037] Countermeasure launching device 1 also comprises an exhaust valve 60 (Figures 4, 5) connected at the inlet to the outlet of tube 52 to exhaust pressurized gas from, and so depressurize, chamber 47.

[0038] Valve 60 is conveniently formed in a disk-shaped body 62 fitted to a rear portion of cylinder 5.

[0039] Valve 60 comprises a shaft 64 housed inside a substantially cylindrical cavity 66 and coaxial with the axis 67 of cylindrical cavity 66.

[0040] Shaft 64 is movable axially between a first closed position (Figure 4), in which valve 60 intercepts the compressed air from tube 52, and an open position (Figure 5), in which valve 60 allows compressed-air flow from chamber 47 to the outside of launching device 1 thus actuating depressurization as described above.

[0041] Shaft 64 comprises a first cylindrical portion 64a, having diameter T1, connected by a bevelled portion 64f to a second cylindrical portion 64b of diameter T2 larger than T1.

[0042] The end of second cylindrical portion 64b is integral with a wider portion 69, on which a cam profile 68 is formed.

[0043] Shaft 64 has an inner cavity 70 coaxial with axis 67 and communicating with the outside of shaft 64 through a first number of holes 72 opening in the surface of portion 64a, close to bevelled portion 64f. Inner cavity 70 also communicates with the outside of shaft 64 through a second number of holes 74 formed in the surface of portion 64b and spaced axially apart from holes 72.

[0044] Shaft 64 is partly surrounded by a seal 76 located between cylindrical cavity 66 and the outer surface of shaft 64. Seal 76 comprises portions contacting cylindrical portions 64a and 64b to form a gas seal with shaft 64, and also comprises a sunken portion detached from the surface of the shaft and defining a toroidal chamber 80 surrounding the shaft at the join between portions 64a and 64b.

[0045] The pressurized gas from tube 52 is fed into toroidal chamber 80 through holes 82 formed through seal 76.

[0046] The pressurized gas thus acts on cylindrical portion 64a of diameter T1, and on cylindrical portion 64b of diameter T2. And, since the outer surface of portion 64b on which the pressurized gas acts is greater than the outer surface of portion 64a, because of the difference in diameter, portions 64a and 64b are subjected to forces whose resultant moves the shaft axially in the direction indicated by the arrow in Figures 4 and 5 and extending from portion 64a to portion 64b.

[0047] Cam profile 68 mates with a complementary cam profile formed on a sprocket 84 rotated about axis 67 by an electric motor 85 positioned with its axis parallel to axis 67 and housed inside a cavity formed in body 62 and parallel to cylindrical cavity 66. More specifically, a transmission 100 is interposed between sprocket 84 and the output shaft 85b (Figure 4) of electric motor 85, and comprises a first gear 101 fitted to output shaft 85b of electric motor 85, and a second gear 102 fitted to rotating element 84, coaxially with axis 67.

[0048] Electric motor 85 rotates rotating element 84,

with respect to cam profile 68, between two limit angular positions:

- a first angular position, in which rotating element 84 contacts cam profile 68 to set shaft 64 to a stable first axial position in which holes 72 and 74 face toroidal chamber 80 (Figure 4); this position corresponds to closure of valve 60, by preventing outflow of the compressed gas from toroidal chamber 80 and inner cavity 70, and by contact between the rotating element and cam profile 68 preventing axial movement of shaft 64, despite the force exerted on shaft 64; and
- a second angular position (Figure 5), in which rotating element 84 contacts cam profile 68 to set shaft 64 to a second axial position in which holes 72 face toroidal chamber 80, and holes 74 face openings 110 formed in seal 76 and communicating with the outside of valve 60; this axial position corresponds to opening valve 60, in that the compressed gas inside toroidal chamber 80 flows into inner cavity 70, and from there out of valve 60 through holes 74 and through openings 110 communicating with the outside of valve 60.

[0049] When allowed by the setting of rotating element 84, shaft 64 is moved from the first to the second axial position by the pressure difference referred to above.

Claims

1. A submarine countermeasure launching device comprising a launch tube (2) for launching a countermeasure (3); a cylinder (5) of pressurized gas; and a feed system (7) for feeding gas from the cylinder to the launch tube (2); said feed system comprising a shutter (30) movable between an open position, and a closed position closing at least one feed opening (28) of the feed system to prevent pressurized-gas flow from said cylinder (5) to said launch tube (2);
characterized in that said shutter (30) comprises a supporting body (32), and a shaped body (31) which slides with respect to said supporting body (32) and has an end portion (42) for closing said feed opening (28); an inner chamber (47) having variable volume and being defined by at least part of said shaped body and at least part of said supporting body;
said shutter (30) being housed in a seat (24) into which pressurized gas from said cylinder is fed so that the gas exerts pressure on at least part of said shaped body (31);
said launching device also comprising exhaust means (60) for depressurizing said chamber, so that the difference between the gas pressure and the pressure inside said chamber produces a force which slides said shaped body (31) on said supporting body (32) and opens said shutter.

2. A device as claimed in Claim 1, wherein the shutter (30) has elastic means (45) for moving the shutter into said closed position.

3. A device as claimed in Claim 2, wherein said elastic means (45) are interposed between said supporting body (32) and said shaped body (31).

4. A device as claimed in Claim 3, wherein said elastic means comprise at least a spring (45) housed in said variable-volume chamber (47).

5. A device as claimed in Claim 4, wherein said spring (45) has a first end portion fitted to said supporting body (32); and a second end portion which presses against a wall of said shaped body (31).

6. A device as claimed in any one of the foregoing Claims, wherein said body is cup-shaped, and comprises a tubular portion (40) mounted in sliding manner on the supporting body (32); and an end wall (42) bounded by an outer surface which rests on edges of said feed opening (28) to close the feed opening.

7. A device as claimed in Claim 6, wherein said end wall (42) defines an annular bevel (43) which rests on edges of said feed opening (28) to close the feed opening.

8. A device as claimed in any one of the foregoing Claims, wherein a gas seal system (48) is provided between said supporting body (32) and said shaped body (31).

9. A device as claimed in any one of the foregoing Claims, wherein said exhaust means comprise a valve (60) which is opened to exhaust pressurized gas from said variable-volume chamber.

10. A device as claimed in Claim 9, wherein said valve (60) comprises:

- an axially symmetrical, elongated body (64) having a first (64a) and a second (64b) portion of different radial dimensions (T1, T2);
- a pressurized-gas containment zone (80) for receiving pressurized gas from said variable-volume chamber; at least part of said first and said second portion (64a, 64b) being located at said pressurized-gas containment zone (80), so that the gas pressure exerts different thrusts on the first and second portion, which have different surface areas;
- control means (68, 84) for controlling said elongated body and allowing the force exerted by said pressurized gas to move said elongated

body (64) axially between a first closed axial position, closing the valve and preventing outflow of gas from said pressurized-gas containment zone (80), and a second exhaust axial position, in which the gas in said pressurized-gas containment zone (80) is exhausted from said valve (60).

11. A device as claimed in Claim 10, wherein said pressurized-gas containment zone (80) is formed in a seal (76) at least partly surrounding said elongated body having axial symmetry (64).

12. A device as claimed in Claim 10 or 11, wherein said elongated body (64) has an inner cavity (70) communicating with the outside through first (72) and second (74) openings opening in the lateral surfaces of the elongated body; the first and second openings facing said pressurized-gas containment zone (80) when the elongated body (64) is in said first closed axial position; and, in said second exhaust axial position, the first openings communicating with said pressurized-gas containment zone (80), and the second openings communicating with an outlet of said valve (60) to exhaust said gas through said inner cavity (70).

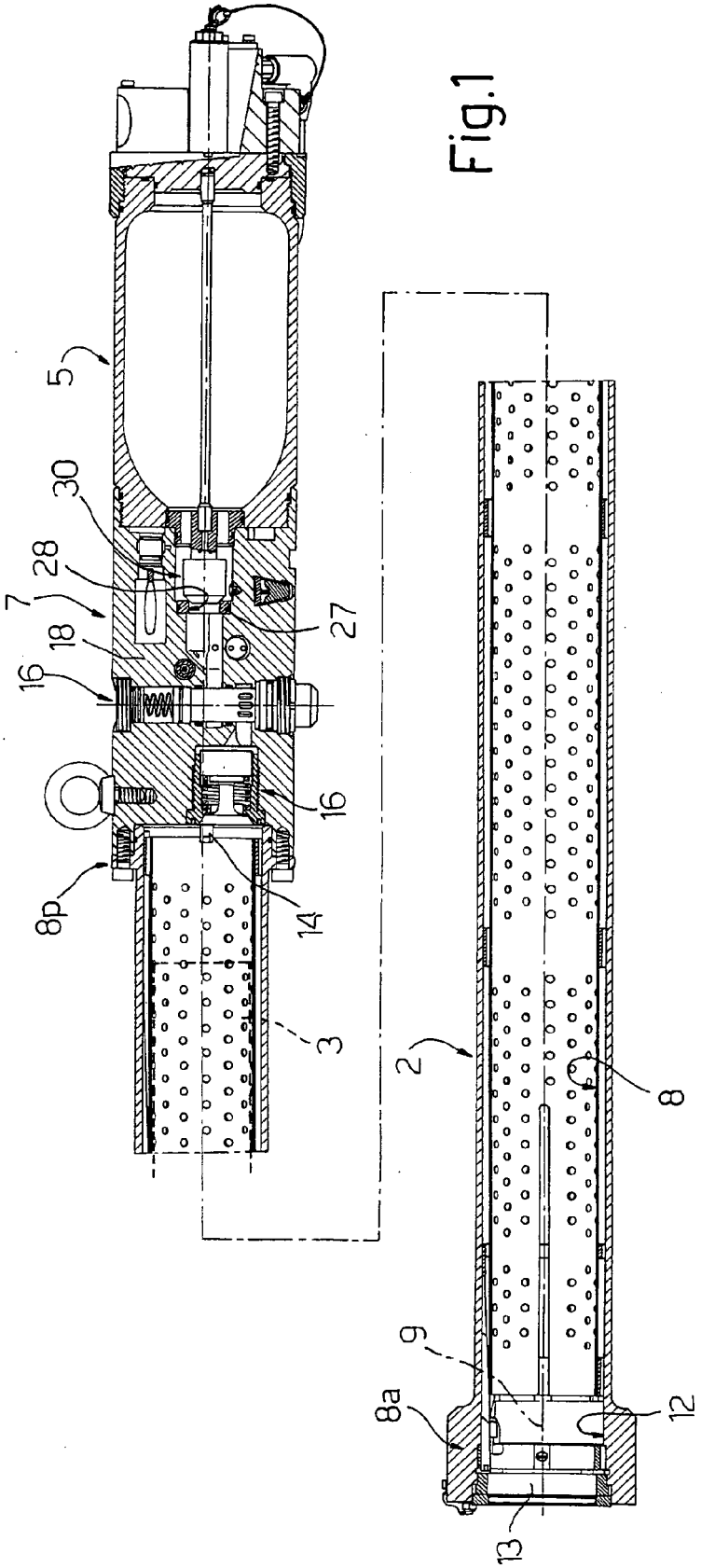

Fig.1

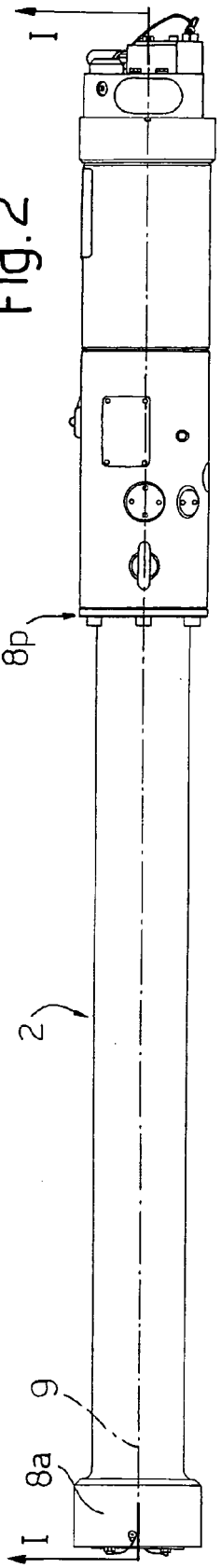

Fig.2

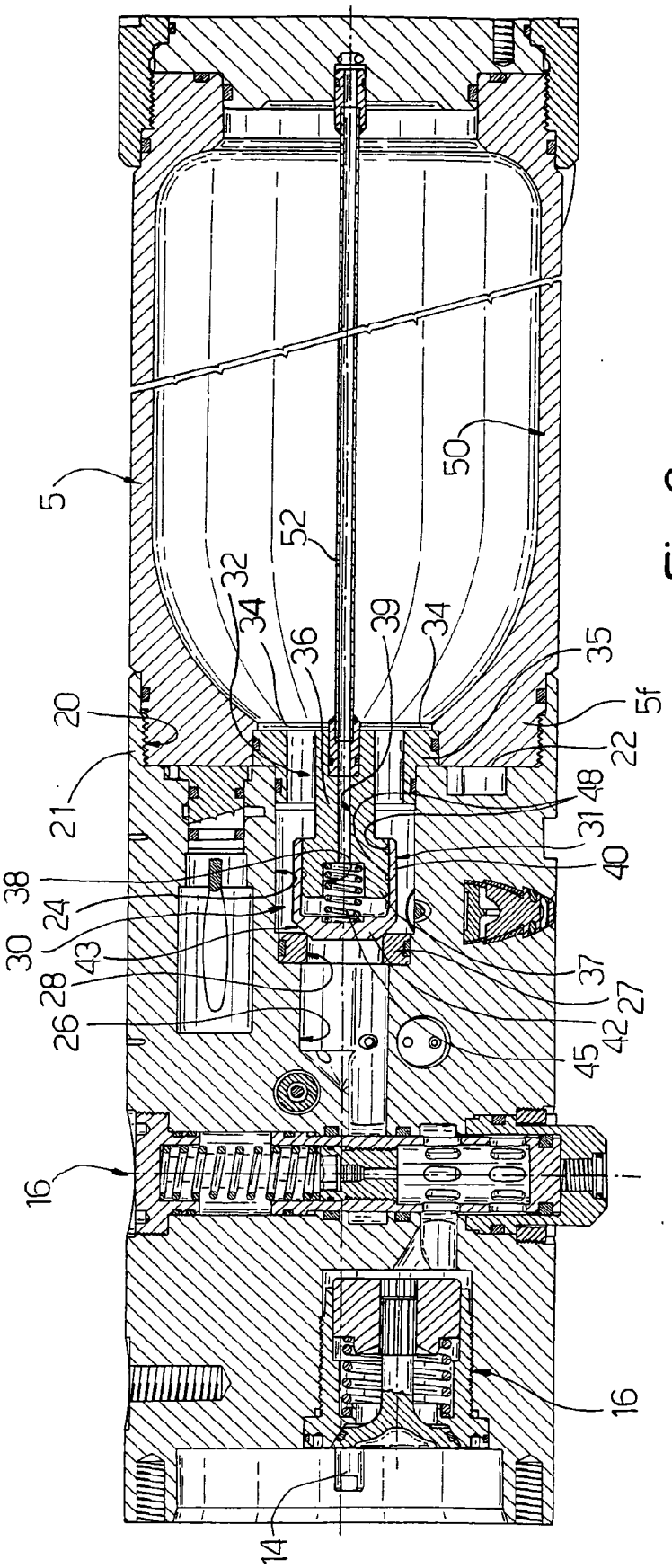
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Fig.3

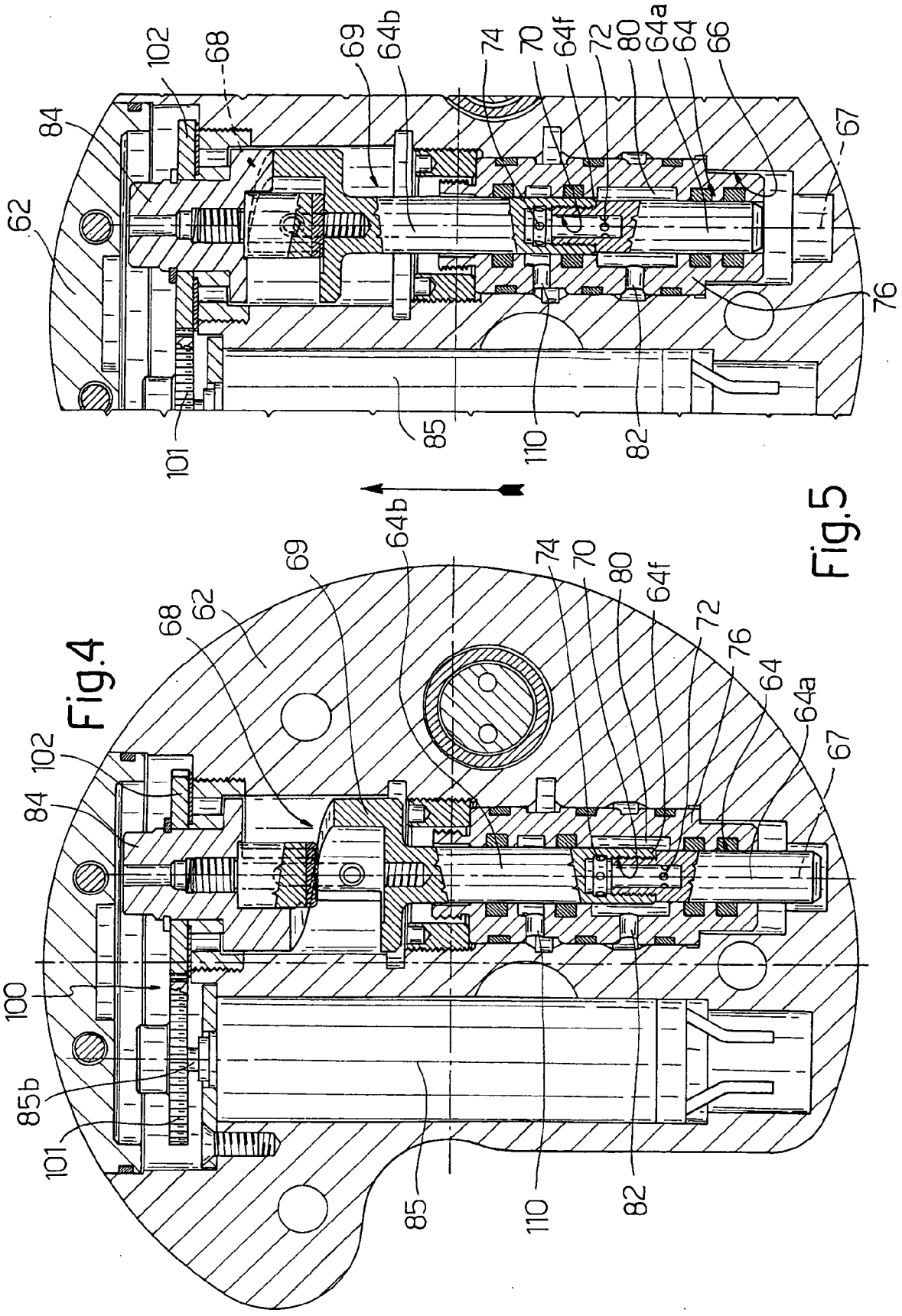
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Fig.5

Fig.4

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EUROPEAN SEARCH REPORT

Application Number
EP 07 42 5452

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TECHNICAL FIELDS SEARCHED (IPC)

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 February 2008	van Rooij, Michael

CATEGORY OF CITED DOCUMENTS

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