NAVAL VESSEL COUNTERMEASURE LAUNCHING DEVICE

The present invention relates to a naval vessel countermeasure launching device.

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.

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.

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

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.

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.

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.

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

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.

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

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 naval vessel countermeasure launching device;

Figure 2 shows a side view of the naval vessel countermeasure launching device;

Figure 3 shows a larger-scale longitudinal section of a detail of the launching device;

Figures 4 and 5 show larger-scale details of Figure 3.

The launching 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.

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.

Feed system 7 defines an inlet (detailed below); and an outlet 14 (Figure 1) which communicates with, to feed pressurized gas into, cylindrical cavity 8.

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

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.

More specifically, 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.

Cylindrical seat 20 is also bounded by a flat wall 22 perpendicular to axis 9, and in which is formed an internally threaded, cylindrical cavity 24 coaxial with axis 9.

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.

A metal ring 27 rests on an end surface of cavity 24, and defines a circular opening 28 through which pressurized gas flows from cylinder 5 into feed conduit 26.

Opening 28 is normally closed by a shutter 30 which presses against metal ring 27 to cut off pressurized-gas flow.

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 radial flanges 34 extending from an end portion of support 32 to a tubular support 35 screwed firmly inside cavity 24.

More specifically, support 32 comprises a first cylindrical front portion 36 coaxial with axis 9 and of radius L1; and a roughly conical rear portion 37 integral with front portion 36 and coaxial with axis 9.

Front portion 36 has a cylindrical inner cavity 38 opening outwards of support 32 at a wall 39 crosswise to axis 9, and communicating with a conduit 39b extending the whole length of conical rear portion 37 and coaxial with axis 9. Cylindrical front portion 36 is positioned facing metal ring 27.

Cup-shaped body 31 comprises a tubular portion 40 fitted to cylindrical portion 36; and an end wall 42 integral with portion 40 and having an isosceles-trapezium-shaped cross section.

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.

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.

Cup-shaped body 31 and cylindrical front portion 36 internally define a chamber 47 having variable volume (Figure 3) communicating with conduit 39b.

As explained in detail below, a labyrinth seal system is provided to allow passage of a limited amount of gas between chamber 47 and cylinder 5.

Cylinder 5 comprises an end portion 5f screwed to wall 21 of metal body 18, and defines an inner cavity 50 communicating with the inside of tubular support 35.

Conduit 39b communicates with a tube 52 extending through cavity 50, coaxially with axis 9, and connected at one end to a known fill/exhaust valve (not shown).

In use, at rest, the high-pressure gas (normally compressed air or nitrogen, possibly at over 300-bar pressure) is contained inside cylinder 5 and tubular support 35, and exerts pressure on the walls of cup-

shaped body 31.

At rest, the pressure inside variable-volume chamber 47 equals the pressure outside it, i.e. inside tubular support 35, by virtue of the pressurized gas entering variable-volume chamber 47 when filling the cylinder (as described below).

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.

To open shutter 30, variable-volume chamber 47 is depressurized by drawing off pressurized gas along conduit 39b and tube 52 (e.g. by opening the fill/exhaust valve).

The pressure in chamber 47 falls rapidly to well below the pressure in tubular support 35; the resultant force produced by the difference in pressure and exerted on cup-shaped body 31 pushes it axially towards wall 39 of 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, in which pressurized gas flows from cylinder 5 to launch tube 2 to launch countermeasure 3 from the vessel (not shown).

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.

Once countermeasure 3 is launched and cylinder 5 empty, the difference in pressure is eliminated, and spring 45 restores shutter 30 to the closed position described above.

Cylinder 5 can then be refilled, ready to launch another countermeasure from the vessel.

If the charging flow is slow and cup-shaped body 31 has a same geometric axis with metal ring 27, the force exerted by helical spring 45 is sufficient to maintain contact between bevel 43 and metal ring 27, and cylinder 5 is filled with gas to the target pressure (e.g. 250-300 bars). Without the feature according to the present invention, and if only a labyrinth seal system were used, gas would seep slowly through the labyrinth seal system into chamber 47 when filling the cylinder, and the increase in pressure inside chamber 47 would lag behind that outside chamber 47, depending on the filling velocity.

As stated, the pressure in tubular support 35 (i.e. outside chamber 47) tends to open shutter 30, and the pressure in chamber 47 to close it. So, when the two are balanced (i.e. when the pressure in tubular support 35 equals the pressure in chamber 47), shutter 30 is safely set to the closed position by spring 45.

When the cylinder is filled rapidly, the force opening shutter 30 could overcome the closing force, thus resulting in a highly dangerous uncommanded countermeasure launch.

On the other hand, fast refilling is an essential feature of the launcher, to permit rapid firing of a large number of countermeasures and so effectively protect the vessel against attack.

The present invention provides for rapidly filling cylinder 5, by feeding gas directly into variable-volume chamber 47 along tube 52 and conduit 39b (as shown by the arrow in Figure 3).

When so doing, the fill/exhaust valve (not shown) is open and connected to a pressurized-gas source (not shown).

A non-return valve 90 is also provided to permit one-way gas flow from chamber 47 to cylinder 5. In other words, when valve 90 is open, cylinder 5 is filled via chamber 47.

Valve 90 only opens when the difference between the gas pressure in chamber 47 and cylinder 5 exceeds a given threshold. When filling cylinder 5, the pressure in variable-volume chamber 47 is therefore always higher than (or at most equal to) the pressure in cylinder 5 to avoid uncommanded opening of shutter 30.

With particular reference to Figure 5, non-return valve 90 is housed inside a through hole 92 extending, parallel to axis 9, from wall 39 to the conical surface of rear portion 37.

Hole 92 comprises a cylindrical, partly threaded front portion 92a; a cylindrical central portion 92b of diameter G2; and a cylindrical end portion 92c of

diameter G3 much smaller than diameter G2.

Hole 92 houses a shutter body movable axially along hole 92 and comprising a cylindrical tubular rear portion 94 with an outside diameter substantially equal to G2; and a hollow hemispherical head 96, whose maximum circular cross section has a diameter almost equal to the minimum cross section of front portion 92a. Cylindrical tubular rear portion 94 is housed in and slides along cylindrical central portion 92b, and hollow hemispherical head 96 is housed in and slides along front portion 92a. A spring 98 is located between the shoulder formed by portions 92a and 92b, and an end portion of cylindrical tubular rear portion 94. A threaded tubular stop member 100 is screwed inside threaded front portion 92a of the hole, so that end portions of member 100 rest against hollow hemispherical head 96 pushed towards stop member 100 by spring 98. This corresponds to the closed position of valve 90.

Hollow hemispherical head 96 has radial holes 101 which, when the valve is in the closed position, come out inside a portion of cylindrical portion 92a that does not communicate with the outside of the valve, because of hollow hemispherical head 96 contacting stop member 100.

The pressure P in variable-volume chamber 47 (Figure 5) presses on and pushes hollow hemispherical head 96 towards the shoulder in opposition to spring 98; and, when the pressure in chamber 47 exceeds a given

threshold, hollow hemispherical head 96 slides axially to uncover radial holes 101, through which pressurized air flows from chamber 47 to cylinder 5.

Hollow hemispherical head 96 also has a small-diameter through hole 110 which always allows a limited amount of gas to seep through valve 90 - regardless of whether this is open or closed - in a direction depending on the difference between the pressure in cylinder 5 and in chamber 47.

Countermeasure launching device 1 also comprises an exhaust valve connected at the inlet to the outlet of tube 52 to exhaust pressurized gas from, and so depressurize, chamber 47.

CLAIMS

1) A naval vessel 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 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 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 for depressurizing said chamber, so that the difference between the gas pressure and the pressure inside said variable-volume chamber produces a force which slides said shaped body (31) on said supporting body (32) and opens said shutter;

said launching device also comprising:

- fast-fill means (52, 39b) for feeding pressurized gas into said variable-volume chamber (47) during the filling operations; and

- a non-return valve (90) which permits one-way flow of gas from the variable-volume chamber (47) to the cylinder (5) during said filling operations.

2) A device as claimed in Claim 1, wherein the non-return valve (90) is designed to open when the difference between the gas pressure in the variable-volume chamber (47) and the gas pressure in the cylinder (5) exceeds a given threshold.

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

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

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

6) 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).

7) 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.

8) 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.

9) A device as claimed in any one of the foregoing Claims, wherein a gas labyrinth seal system is provided between said variable-volume chamber and said cylinder.

10) A device as claimed in Claim 9, wherein said labyrinth seal system is formed in said non-return valve.