March 15, 1966 J. R. JONES 3,240,200

SONOBUOY LAUNCHER

Filed March 7, 1962 2 Sheets-Sheet 1

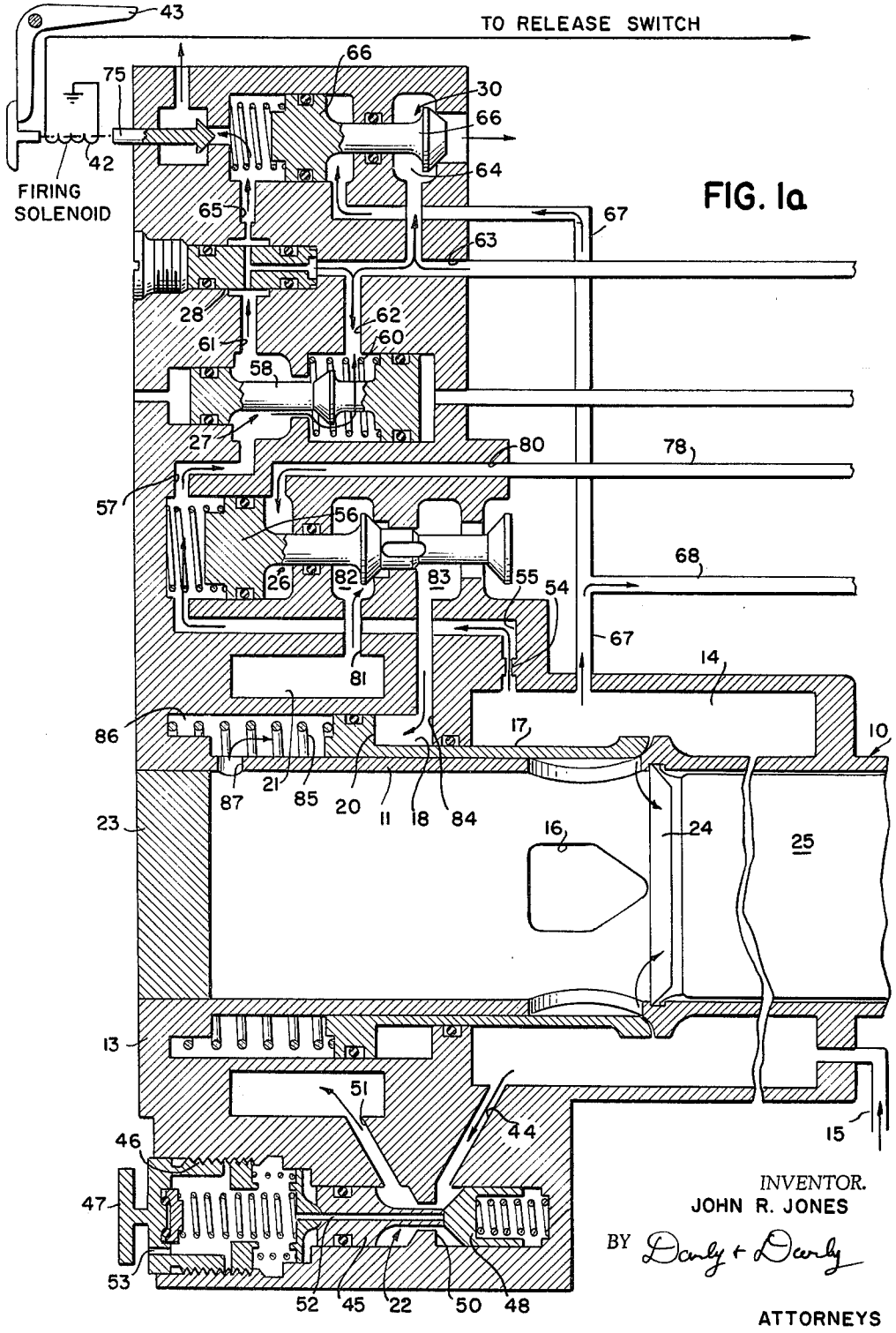


FIG. 1a

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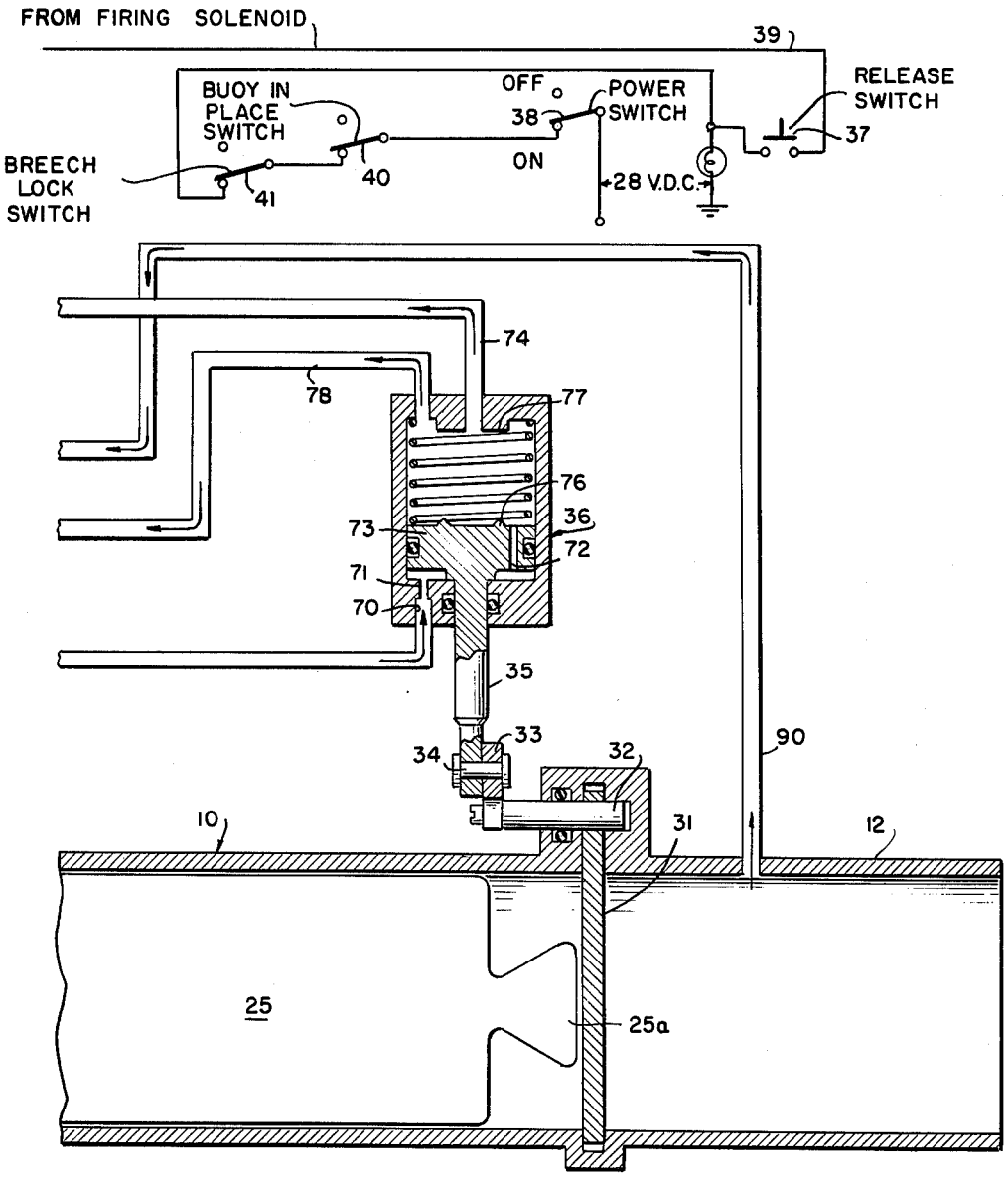


FIG. 1b

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3,240,200

SONOBUOY LAUNCHER

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The present invention relates to a launcher for sonobuoys or for similar objects.

More particularly still the invention relates to a pneumatic launching device for launching sonar buoys, or sonobuoys, from an airplane having a pressurized cabin.

The device of the present invention provides for great flexibility and makes it possible for the operator to quickly adjust the apparatus to eject a sonobuoy of a given weight at a particular required velocity. As is well known, it is desirable to eject sonobuoys rearwardly with respect to the course of the aircraft in order that the pressure upon the sonobuoy be within the limits which its construction will resist.

Additionally, the launcher of the present invention assures that during a particular setting each launching will be attained under the same conditions as the previous one.

It is an object of the invention to provide a pneumatically actuated sonobuoy launcher having a regulator which may be adjusted to vary the ejection velocity to that desired for a particular weight sonobuoy under particular flight conditions.

It is another object of the invention to provide means whereby sonobuoys may be loaded into the launcher or ejector without depressurizing the airplane cabin while at the same time assuring that the launching tube will be free of obstruction at the time of launching.

It is another object of the invention to provide a high-flow, pressure limiting and regulating valve system which includes a pressure chamber used to store high pressure gas and a firing regulator valve which seals the passage between the pressure chamber and the breech of the launching gun during standby and which also controls the flow of compressed gas to the breech during ejection.

It is a still further object of the invention to provide a signal when the gate valve sealing the ejector barrel has been fully retracted and to provide a safety interlock which does not permit the ejection of the sonobuoy until this retraction has occurred.

It is a still further object of the invention to provide means operable upon the sonobuoy reaching a predetermined point near the muzzle of the ejector barrel to restore the various mechanisms to their normal positions in condition to accept loading of a new sonobuoy.

Other objects and features of the invention will be apparent when the following description is considered in connection with the annexed drawings, in which,

FIGURES 1*a* and 1*b* taken together comprise a schematic pneumatic and mechanical diagram of the sonobuoy launcher of the present invention. These figures also include a schematic electrical circuit for triggering the operation of the ejector.

Referring now to the drawings, there is shown at **10** the ejector barrel which comprises the breech portion **11** and the barrel portion proper **12**. Formed integrally with the ejector **10** is a casting **13** which, as will appear, is machined to provide a number of control valves and pressure chambers.

Surrounding the forward portion of the breech **11** and the adjacent portion of the barrel **12** is a firing pressure chamber **14** which is connected by means of the piping **15** with a source of pneumatic pressure. Breech **11** is provided with the large inlet ports **16** which ports are normally closed as seen in FIGURE 1*a* by the annular

firing regulator valve **17**. Also surrounding the breech **11** is an annular dome chamber **18** the pressure in which acts upon one side of the piston **20** forming a part of the annular wall of regulator valve **17**.

Another annular chamber is formed in the casting **13** surrounding the breech **11**, this chamber being designated the pilot pressure chamber **21** and being supplied with gas under pressure through the pilot regulator valve **22**. A breech door **23** serves to seal the breech chamber when a sonobuoy is in firing position at which time the opposite end of the breech chamber is closed by obturator **24** which obturator may be integral with the sonobuoy **25** or may be separate therefrom and loaded behind it; in fact, if the sonobuoy fits the ejection tube or barrel closely the obturator seal may be omitted.

Also formed in the casting **13** are various valves which control the sequence of operation. Thus the firing valve is shown at **26**, the buoy launched valve at **27**, the orifice cylinder at **28** and an interlock valve at **30**.

In addition to the various valves heretofore mentioned, there is provided a gate valve **31**, FIGURE 1*b*, which valve is mounted for rotation with a shaft or pin **32** on the opposite end of which is a crank arm **33**. Crank arm **33** is connected by means of a pin **34** to the lower end of the piston **35** of the gate valve actuator **36**.

The initiation of the launching operation is accomplished by means of an electrical circuit, see FIGURE 1*b*, which circuit includes a release switch **37**, a power switch **38**, a buoy in-place switch **40**, and a breech lock switch **41**. As is indicated above but is not shown in the drawings, the buoy-in-place switch is closed when a buoy is placed in the launcher barrel with the forward projection **25***a* thereof against the then closed gate valve **31**.

In a like manner the breech lock switch **41** is closed when the breech door is placed in position to seal the rearward or left hand end of the launcher breech and is locked in position.

As can readily be seen from FIGURES 1*a* and 1*b* the circuit from the release switch **37** leads to a firing solenoid **42** which when operated opens a vent in the interlock valve **30** as will be hereinafter described.

There is also provided a manually operated trigger **43** which may be pressed downwardly to move the interlock valve member in the same manner as it is moved by the firing solenoid.

The valve and circuit arrangements can best be further described in connection with a description of the operation of the launcher and therefore that description will now be given.

As stated hereinabove, the parts are shown in their normal unactuated position in FIGURES 1*a* and 1*b*. At this time the supply pressure exists in the annular firing pressure chamber **14**. This pressure may, for example, be 1000 lbs. This pressure is also applied by means of the passageway **44** to the pilot regulator valve **22** urging the piston **45** thereof in the left hand direction. The regulator valve is provided with the threaded portion **46** which screws into the bore formed in the casting **13** and is made integral with the knurled handle **47**. Thus by means of this handle the pressure exerted on the piston **45** urging it in the right hand direction can be adjusted and thereby the pressure in the annular pilot pressure chamber **21** regulated.

It will be noted that when the poppet **48** of valve **22** moves sufficiently to the left it seats against the valve seat **50** and thereby closes off communication between passage **44** and passage **51**. It will further be noted that if for any reason the pressure in the annular chamber **21** rises above the set pressure, this will cause piston **45** to move further to the left exposing the end of the passage

52 and thus venting the chamber 21 through the vent port 53.

The pressure in chamber 14 is bled off through a constriction 54 in the passageway 55 and is applied to the left hand end of the piston member 56 of the firing valve 26, thus retaining the firing valve piston in the position shown. This pressure is also applied through the passage 57 to the piston 58 of the buoy launched valve without effect, however, since the spring 60 holds this piston in its right hand position. The pressure in passage 57 is then also applied through passage 61 to the orifice cylinder 28 and to the passage 62 to passage 63. From passage 63 this pressure is applied to the axial bore in the orifice cylinder 28 and also to the chamber 64 of the interlock valve. Because this interlock valve is closed at this time the pressure remains applied as indicated and is also applied by means of the orifice cylinder and passage 65 to the left hand end of the piston 66 of the interlock valve.

The pressure in firing chamber 14 is also applied by means of a pipe 67 to the right hand side of the piston 66 of the interlock valve 30 tending to move the piston to the left which tendency is, however, resisted by the pressure at the left end of the piston which is equal to the pressure at the right side but has added thereto the pressure of the bias spring.

Pipe 68 joins pipe 67 and leads to a passageway 70 in the housing of the gate valve actuator 36, the passageway 70 being provided with a constriction 71. Pressure from the firing chamber 14 thus bleeds into the cylinder of the gate valve actuator 36, but no pressure is effectively built up due to the presence of the restricted passageway 72 leading through the piston 73 of the gate valve actuator. Moreover the control pressure in the passage 63 is applied to the upper side of the piston and the pressure being thus equalized the spring holds the piston in its downward position. Thus no movement of the actuator piston 72 occurs at this time and the gate valve 31 remains in its closed position as shown.

The power switch 38 is now closed and the ejector loaded, as described, closing switches 40 and 41. The release switch is now actuated and current flows through the conductor 39 to the firing solenoid 42. This solenoid operates moving the valve member 75 of the interlock valve to the left thus venting the chamber at the left end of piston 66 faster than the fluid can be replenished through the orifice cylinder 28 and permitting the pressure on the right hand side to take control moving the piston to the left and opening the chamber 64 to atmosphere. This relieves the control pressure and assures that the interlock valve remains open if the solenoid has been actuated for any period in excess of 10 milliseconds.

The reduction of pressure in the pipe 74 resulting from this venting of the interlock valve allows the air from the firing chamber 14 through pipes 67 and 68 to operate the actuator piston 73, it being understood that the orifice 72 is very small and that flow through this orifice and through the vented chamber 64 of the interlock valve has no substantial back pressure effect. Upon completion of the actuating stroke the annular rim 76 on the upper surface of the gate valve actuator piston 73 seats against the annular projection 77 closing off the pipe 74. Pressure then builds up in the annular space surrounding the annular rim 76 and projection 77 and this pressure is applied over pipe 78 to passageway 80 and to the right hand side of the piston of the firing valve 26. The piston of the firing valve is thus caused to move to the left thereby connecting the pilot pressure chamber 21 through passage 81, valve chamber 82, valve chamber 83 and passage 84 to the annular dome chamber 18.

Application of the pilot pressure to this annular dome causes the piston of the firing regulator valve 17 to move to the left against the urge of spring 85 positioned in the annular spring chamber 86. Since the regulator valve 17 is opened firing pressure from chamber 14 enters the breech through the ports 16. The pressure in the breech then is applied to the obturator seal 24 and serves to accelerate the sonobuoy which moves toward the open end of barrel 12, the gate valve 31 being now open as described. The breech pressure is also applied through a port 87 to the spring chamber 86 thus serving to act against the pressure in the dome 18 and close the regulator valve 17. As the projectile moves and the pressure therefore drops in the breech, the preload of firing pressure on the pilot regulator valve 22 causes maintenance of pressure in the dome 18 and thus results in opening the firing regulator valve and maintaining the pressure on the projectile at the desired value set by adjustment of the knob 47 of the pilot regulator valve 22.

Thus the pressure lost due to movement of the sonobuoy down the barrel together with the increasing friction resulting from increasing velocity of the sonobuoy is compensated for, in other words, decay in the firing pressure provides an increasing level of breech pressure to compensate as stated for losses resulting from movement of the sonobuoy.

When the obturator seal 24 passes a given point which in the particular instance considered is approximately forty inches from the end of the barrel, the barrel pressure is applied to a sensing line 90, FIGURE 1*b*, which leads to the right hand end of the piston of the buoy-launched valve 27. The piston 58 of this valve then moves to the left, closing off communication between passages 57 and 62. As a result, the control pressure through the constriction 54 and through the orifice cylinder is now applied again to the left hand side of piston 66 of the interlock valve. The result is that interlock valve closes and also, due to the pressure existing at the left hand end of the piston of the firing valve 26, this valve transfers and vents the annular pressure dome 18 to atmosphere. This in turn causes the firing regulator valve 17 to close rapidly to prevent loss of the remaining pressure in the firing regulator chamber 14.

Since the interlock valve no longer vents the passage 63 and pipe 74 to atmosphere, the control pressure in the gate valve actuator equalizes on the two sides of the piston 72 and therefore the spring causes the piston to restore to normal downward position and close the gate valve.

The breech door 23 may now be opened for reloading and, as described hereinabove, the closure of the breech with a sonobuoy in position readies the launcher for the next operation.

While I have described a preferred embodiment of my invention, it will be obvious that many modifications thereof are possible. For example, certain of the pneumatically actuated valves might be replaced by solenoid actuated valves and the reverse and the electrical circuit shown might readily be altered. I wish therefore not to be limited by the foregoing description but on the contrary to be limited solely by the claims granted to me.

What is claimed is:

1. In a pneumatic device for launching sonobuoys and the like from pressurized aircraft cabins, in combination, a launcher barrel having a breech portion, a breech door at the end of said breech portion opposite its juncture with said barrel, means in said barrel adjacent said breech portion to locate the obturator seal of a sonobuoy loaded into said barrel and thereby locate said sonobuoy, valve means for applying firing pressure to said breech behind a loaded sonobuoy, a gate valve normally closing said barrel forward of the forward end of a sonobuoy loaded into said barrel, means for actuating said gate valve, sequentially operable valve means for operating said gate valve actuating means and said firing pressure valve means, electric circuit means comprising conditioning switches closed by loading a sonobuoy into position in said barrel and by closing said breech door and a manually operated switch for closing said conditioned circuit to initiate said sequential valve operation whereby said gate valve is retained in closed position during

loading and upon operation of said manual switch said gate valve is first opened and said firing pressure valve thereafter opened to eject a loaded sonobuoy.

2. In a pneumatic device for launching sonobuoys and the like from pressurized aircraft cabins, in combination, a launcher barrel having a breech portion, a breech door at the end of said breech portion opposite its juncture with said barrel, means in said barrel adjacent said breech portion to locate the obturator seal of a sonobuoy loaded into said barrel and thereby locate said sonobuoy, valve means for applying firing pressure to said breech behind a loaded sonobuoy, a gate valve normally closing said barrel forward of the forward end of a sonobuoy loaded into said barrel, means for actuating said gate valve, sequentially operable valve means for operating said gate valve actuating means and said firing pressure valve means, electric circuit means comprising conditioning switches closed by loading a sonobuoy into position in said barrel and by closing said breech door, a manually operated switch for closing said conditioned circuit to initiate said sequential valve operation whereby said gate valve is retained in closed position during loading and upon operation of said manual switch said gate valve is first opened and said firing pressure valve thereafter opened to eject a loaded sonobuoy, a sensing port in said barrel beyond said gate valve in the direction of travel of a sonobuoy being ejected, sensing valve means actuated by firing pressure applied to said port to actuate said sequentially operated valve means to cause closure of said firing pressure valve means and said gate valve means in sequence to thereby seal said breech and barrel and condition the launcher for loading and firing of a succeeding sonobuoy.

3. A device as claimed in claim 1 wherein said sequentially operated valve means comprises an interlock valve including a piston and a valve operated thereby, said valve being closed due to a bias spring and control pressure applied to one side of the piston from a source through a constriction and pressure on the other side of said piston directly from said source, said one side being vented when said circuit is closed, said valve serving to vent said control pressure when said interlock valve is operated, said gate valve actuator including a piston having firing pressure applied to one side thereof and control pressure applied to the opposite side when said interlock valve is unoperated, said gate valve actuator when operated serving to apply firing pressure to a control line, a firing valve having a piston and a valve seat, said piston being normally positioned to close said valve seat by a bias spring and application of control pressure to one side thereof, said control pressure being vented upon operation of said interlock valve, said control line being connected to apply firing pressure to the opposite side of said firing valve piston to overcome said spring and actuate said firing valve to thereby actuate said firing pressure applying means to pressurize said breech.

4. A device as claimed in claim 2 wherein said sequentially operated valve means comprises an interlock valve including a piston and a valve operated thereby, said valve being closed due to a bias spring and control pressure applied to one side of the piston from a source through a constriction and pressure on the other side of said piston directly from said source, said one side being vented when said circuit is closed, said valve serving to vent said control pressure when said interlock valve is operated, said gate valve actuator including a piston having firing pressure applied to one side thereof and control pressure applied to the opposite side when said interlock valve is unoperated, said gate valve actuator when operated serving to apply firing pressure to a control line, a firing valve having a piston and a valve seat, said piston being normally positioned to close said valve seat by a bias spring and application of control pressure to one side thereof, said control pressure being vented upon operation of said interlock valve, said control line being connected

to apply firing pressure to the opposite side of said firing valve piston to overcome said spring and actuate said firing valve to thereby actuate said firing pressure applying means to pressurize said breech, said sensing valve means having a piston subjected to control pressure from said firing valve when said interlock valve is closed and subjected to said firing pressure on the opposite side, said piston moving against spring bias to close off said vent through said interlock valve when pressure is applied through said sensing port, said closure resulting in restoration of said firing valve to normal position.

5. In a device for launching sonobuoys and the like from aircraft, in combination, a launcher barrel comprising a breech portion, a firing pressure chamber for storing high pressure gas, ports leading from said firing pressure chamber to said breech portion, a firing regulator valve normally sealing said ports, a pilot pressure chamber, a pilot regulator valve having a manually adjustable member for regulating the pressure supplied to said pilot chamber from said firing chamber, and means for applying pressure from said pilot pressure chamber to said firing regulator valve to actuate said valve and admit pressure to said breech to thereby accelerate and launch a sonobuoy loaded into said barrel.

6. A device as claimed in claim 5 wherein said firing pressure chamber is an annular chamber extending about said launcher barrel and said firing regulator valve comprises a sleeve surrounding said breech portion and forming a part of the annular wall of said firing pressure chamber, said sleeve having a flange whereby application of pressure from said pilot pressure chamber to said flange moves said sleeve axially of said breech to open said ports.

7. A device as claimed in claim 6 wherein said means for applying pressure from said pilot pressure chamber to said firing regulator valve sleeve comprises a firing valve and wherein a port is provided in said breech portion leading from the interior of said breech portion to the opposite side of said regulator valve sleeve flange, said breech pressure thereby opposing the pilot pressure and maintaining the pressure in said breech and barrel at substantially the pressure set by said pilot regulator valve during the acceleration and launching of a sonobuoy loaded into said barrel.

8. A device in accordance with claim 5 wherein said breech portion is provided with a breech door and wherein said barrel is provided with a gate valve at a point removed from the forward end of the breech portion by a distance substantially equal to the length of a sonobuoy, said gate valve sealing the barrel during loading of a sonobuoy into said barrel and wherein means are provided for operating said gate valve prior to operation of said pressure applying means to open said firing regulator valve thus assuring that said gate valve is open during ejection of a sonobuoy from the launcher.

9. A device in accordance with claim 8 wherein an interlock valve is provided, said interlock valve being operable to initiate opening of said gate valve, said interlock valve also conditioning said pressure applying means to thereby apply pilot pressure to operate said firing regulator valve, said conditioned firing valve being operated by operation of said gate valve actuating means whereby said pressure applying means is operated only when said gate valve is opened.

10. A device in accordance with claim 8 wherein an interlock valve is provided, said interlock valve being triggered into operative position by operation of a solenoid, said solenoid being connected in an electrical circuit, said circuit including a switch closed by a sonobuoy when loaded into said barrel, said circuit including a second switch closed when the breech door is locked in closed position and said circuit including a third switch manually operable to close the circuit to trigger said interlock valve, said manual switch being effective only when said sonobuoy actuated and breech door actuated switches are closed.

11. A device as claimed in claim 8 wherein a buoy

launched valve is provided, said buoy launched valve being actuated by firing pressure applied thereto through a port in said barrel, actuation of said buoy launched valve causing said firing valve to return to normal position and causing said interlock valve to restore to normal thereby readying the system for a subsequent operation, said firing valve restoration removing pilot chamber pressure from said firing regulator valve to restore said valve and prevent loss of pressure in said firing regulator chamber.

12. A device as claimed in claim 8 wherein said gate valve is operated by an actuator comprising a housing having a piston therein, said piston being biased in a direction to maintain said gate valve closed, said housing having ports therein whereby firing pressure is constantly applied urging said piston in gate valve opening direction, said movement being resisted by said bias and by control pressure applied to the opposite side of said piston through said interlock valve whereby venting of said control pressure by said interlock valve causes opening of said gate valve.

13. A device as claimed in claim 12 wherein said gate valve actuator piston has a restricted opening therethrough adjacent its periphery, wherein said piston has an annular projection thereon inwardly of said opening and on the control pressure side, said annular projection mating with the housing end to seal said passage from said control pressure when said actuator is operated, and a connection from said housing outside said annular projection to said firing valve whereby operation of said gate valve actuator applies firing pressure to said firing valve.

14. In a pneumatically actuated device for ejecting sonobuoys and the like from a pressurized aircraft cabin, in combination, a launcher barrel having a breech portion closed by a breech door at one end and by the obturator seal of a sonobuoy at the opposite end adjacent the breech proper, a gate valve closing said barrel at a point removed from the juncture of said breech and barrel portions by a distance substantially equal to the length of the sonobuoy, a firing pressure chamber for storing high pressure gas, ports leading from said firing pressure chamber to said breech portion, a pilot pressure chamber, a pilot regulator valve for regulating the pressure in said pilot pressure chamber, a firing valve operable to apply pressure from said pilot pressure chamber to said firing regulator valve, an interlock valve, a buoy launched valve, a pneumatically operated piston actuator for said gate valve, means applying a control pressure derived from the pressure in said firing chamber to said interlock valve, and said firing valve to hold said valves in unoperated position, said control pressure also being applied to one side of the piston of said gate valve actuator, means applying said firing pressure to the opposite side of said piston to retain said piston in its unoperated position, means to vent said control pressure from said interlock valve to operate said valve, means comprising application of firing pressure to said interlock valve to retain said valve in operated position, said interlock valve serving to vent said control pressure to thereby remove pressure from said one side of said gate valve actuator piston to thereby cause said actuator to open said gate valve, and means actuated by said gate valve piston to operate said firing valve to apply said pilot pressure to said firing regulator valve to launch said sonobuoy,

15. In a pneumatically actuated device for ejecting sonobuoys and the like from a pressurized aircraft cabin, in combination, a launcher barrel baving a breech portion closed by a breech door at one end and by the obturator seal of a sonobuoy at the opposite end adjacent the breech proper, a gate valve closing said barrel at a point removed from the juncture of said breech and barrel portions by a distance substantially equal to the length of the sonobuoy, a firing pressure chamber for storing high pressure gas, ports leading from said firing pressure chamber to said breech portion, a pilot pressure chamber, a pilot regulator valve for regulating the pressure in said pilot pressure chamber, a firing valve operable to apply pressure from said pilot pressure chamber to said firing regulator valve, an interlock valve, a buoy launched valve, a pneumatically operated piston actuator for said gate valve, means applying a control pressure derived from the pressure in said firing chamber to said interlock valve and said firing valve to hold said valves in unoperated position, said control pressure also being applied to one side of the piston of said gate valve actuator, means applying said firing pressure to the opposite side of said piston to retain said piston in it unoperated position, means to vent said control pressure from said interlock valve to operate said valve, means comprising application of firing pressure to said interlock valve to retain said valve in operated position, said interlock valve serving to vent said control pressure to thereby remove pressure from said one side of said gate valve actuator piston to thereby cause said actuator to open said gate valve, means actuated by said gate valve piston to operate said firing valve to apply said pilot pressure to said firing regulator valve to launch said sonobuoy, means comprising a port in said barrel opened to breech and barrel pressure as the sonobuoy passes said port to apply said breech pressure to said buoy launcher valve to thereby terminate the venting of said control pressure through said interlock valve thereby resulting in restoration of said interlock valve to normal no venting position and of said firing valve to normal position to remove pressure from said firing regulator valve and close said breech ports, said restoration of said interlock valve applying pressure to said one side of said piston of said gate valve actuator to close said gate valve, said control pressure restoration also restoring said buoy launched valve to normal position after momentary actuation whereby all said valves are restored to normal position and the device is prepared for loading and launching of another sonobuoy.

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