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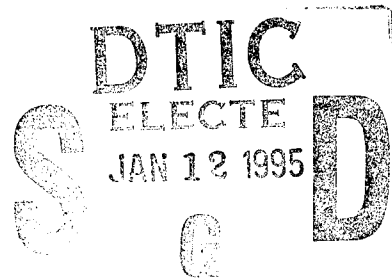
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DTIC QUARTER DISCLOSED 1

19950110 009

1 Navy Case No. 73349

2
3 ELASTOMERIC LAUNCH SYSTEM FOR SUBMARINES

4
5 STATEMENT OF GOVERNMENT INTEREST

6 The invention described herein may be manufactured and used
7 by or for the Government of the United States of America for
8 governmental purposes without the payment of any royalties
9 therefor.

10
11 CROSS REFERENCE TO RELATED PATENT APPLICATIONS

12 This patent application is co-pending with a related
13 application having common ownership on the date of invention and
14 filed on the same date as subject patent application entitled
15 Flow-Through Elastomeric Launch System for Submarines by Ronald
16 E. Waclawik and Scott D. Boyd further identified as Navy Case No.
17 74448.

18
19 BACKGROUND OF THE INVENTION

20 (1) Field of the Invention

21 The invention relates to an elastomeric launch system, and
22 more specifically to a submarine low-noise projectile launching
23 system.

24 (2) Description of the Prior Art

25 Existing submarine weapon launch systems are mechanisms
26 which eject a torpedo or other device from a submarine by pumping

1 a working fluid, usually seawater, behind the device in the
2 launch tube. The two most common launch devices are the ram pump
3 and turbine pump ejection systems. Both systems are mechanically
4 complex and tend to radiate noise into the surrounding fluid
5 medium.

6 A ram pump launch apparatus converts potential energy from
7 compressed air stored in a flask into working fluid kinetic
8 energy. The ram pump system utilizes a massive piston apparatus
9 to transfer sufficient working fluid, such as seawater, to launch
10 a projectile. The mechanical friction and the mass of the piston
11 act to reduce system efficiency and to produce substantial
12 radiated noise. The ram pump system requires frequent
13 maintenance because the system includes numerous mechanical
14 components, in addition to the piston assembly.

15 A turbine pump launch apparatus also converts potential
16 energy in the form of compressed air stored in a flask into
17 kinetic energy of a working fluid. An air turbine drive unit is
18 joined with a rotary impeller pump via a speed reduction unit.
19 The turbine pump system is costly because of the complexity of
20 the required mechanical components and is also noisy due to
21 dynamic interaction of many of the system components.

22 In U.S. Patent No. 4,848,210, issued July 18, 1989 to
23 Laurent C. Bissonnette, there is shown and described an
24 elastomeric impulse energy storage and transfer system. The '210
25 system as shown is adapted to a torpedo launch system wherein an
26 elastomeric bladder is distended by filling it with pressurized

1 working fluid. When an impulse of energy is desired the
2 elastomeric bladder discharges the working fluid to quietly eject
3 a projectile from the launch system into the surrounding liquid.
4 The elastomeric bladder used is generally spherical containing,
5 when expanded, volume sufficient to fill the launch tube and the
6 launchway forward of the launch tube.

7 Following expulsion of seawater from the elastomeric
8 bladder, a low pressure region forms at the mouth of the launch
9 tube because of the finite nature of the fluid volume available
10 in the bladder and the competing momentum of the fluid exiting
11 the launch tube. This low pressure region is undesirable because
12 it causes excessive noise due to cavitation. To prevent the
13 pressure differential and the noise associated therewith,
14 additional seawater must be available to the launch tube after
15 the elastomeric bladder has been discharged.

16 17 SUMMARY OF THE INVENTION

18 Accordingly, it is a general purpose and object of the
19 present invention to provide a quiet, even flowing launch system
20 for submarines.

21 A further object of the invention is to provide a weapon
22 launch system which, after firing, does not create additional
23 noise because of a low pressure region forming at the mouth of
24 the launch tube.

25 Still another object is that the system be simple, reliable
26 and low in cost.

1 With the above and other objects in view, as will
2 hereinafter appear, a feature of the present invention is the
3 provision of an apparatus for providing pressurized liquid to a
4 launch tube for launching projectiles into a liquid medium. The
5 device comprises an elastomeric bladder disposed inside a
6 cylindrical bypass tube. The forward end of the bypass tube is
7 open to the liquid medium, and the aft end of the tube is
8 hydraulically connected to the launch tube. The elastomeric
9 bladder is externally of generally cylindrical shape and has an
10 open aft end, a closed forward end and a side wall of varying
11 thickness. The open end of the bladder is hydraulically
12 connected to a valve. The valve acts to control charging of the
13 bladder and discharge of the bladder. The bladder expands to
14 contact the wall of the bypass tube when the bladder is pumped
15 full of pressurized seawater. On expanding, the thinnest portion
16 of the bladder contacts the wall first. Ultimately the whole
17 bladder will act to seal the bypass tube by contact with the
18 bypass tube wall to prevent the external liquid medium from
19 communicating with the launch tube through the bypass tube. Upon
20 vehicle launch pressurized liquid is provided from the
21 elastomeric bladder through the valve to the launch tube. The
22 bladder returns to its original shape after discharge breaking
23 contact with the bypass tube wall, and liquid is allowed to flow
24 through the bypass tube into the launch tube to prevent
25 cavitation from occurring at the launch tube breach.

1 The above and other features of the invention, including
2 various novel details of construction and combinations of parts,
3 will now be more particularly described with reference to the
4 accompanying drawings and pointed out in the claims. It will be
5 understood that the particular device embodying the invention is
6 shown by way of illustration only and not as a limitation of the
7 invention. The principles and features of the invention may be
8 employed in various and numerous embodiments without departing
9 from the scope of the invention.

10 11 BRIEF DESCRIPTION OF THE DRAWINGS

12 A more complete understanding of the invention and many of
13 the attendant advantages thereto will be readily appreciated as
14 the invention becomes better understood by reference to the
15 following detailed description when considered in conjunction
16 with the accompanying drawings wherein:

17 FIG. 1 is a diagrammatic view of the bow of a submarine cut
18 away to display the launch device of the current invention as set
19 for charging;

20 FIG. 2A is a detail view showing the fluid flow through the
21 inventive device during charging;

22 FIG. 2B is a detail view showing the configuration of the
23 inventive device after charging;

24 FIG. 2C is a detail view showing the fluid flow through the
25 inventive device during launch; and

1 FIG. 2D is a detail view showing the fluid flow through the
2 inventive device immediately after launch.

3
4 DESCRIPTION OF THE PREFERRED EMBODIMENT

5 Referring now to FIG. 1 there is shown diagrammatic view of
6 the bow of a submarine cut away to display the launch mechanism.
7 The launch mechanism of the current invention is disposed within
8 the hull of a submarine 10. Directions will be referred to in
9 the ensuing drawings with references to forward being toward the
10 bow of submarine 10 and references to aft being toward the rear
11 of submarine 10; however, directions provided herein should not
12 be construed to limit the invention to the specified orientation.
13 The launch mechanism comprises an elastomeric bladder 12 mounted
14 within a cylindrical bypass tube 14. Bladder 12 is made from
15 Neoprene rubber, urethane, natural rubber or the like. Bypass
16 tube 14 is a rigid cylinder with the forward end open to a free
17 flood sea chest 16 and the aft end open to an impulse tank 18.
18 Sea chest 16 is open to seawater at the same pressure as the
19 outside of submarine 10. Elastomeric bladder 12 is mounted in
20 bypass tube 14 by a spyder 22. Spyder 22 is a support structure
21 having an inner flow aperture 22a surrounded by a plurality of
22 outer flow apertures 22b. Spyder 22 suspends bladder 12 at the
23 center of bypass tube 14 and allows hydraulic communication
24 between bladder 12 and impulse tank 18 through inner flow

1 aperture 22a. Flow between bypass tube 14 and impulse tank 18
2 occurs around the outside of bladder 12 through outer flow
3 apertures 22b.

4 Impulse tank 18 is hydraulically connected to tube slots 24
5 in the walls of a launch tube 26 behind a device to be launched,
6 such as a torpedo 28. Torpedo 28 is loaded in launch tube 26
7 through a breech valve 29. Impulse tank 18 provides a hydraulic
8 impulse behind torpedo 28 to expel it from tube 26 via a muzzle
9 valve 30.

10 Bladder 12 is substantially cylindrical having a closed
11 forward end 12a positioned toward the open end of bypass tube 14
12 and an open aft end 12b positioned toward spyder 22. The wall of
13 bladder 12 is not uniformly thick. Aft end 12b is thinner than
14 the forward end 12a. Upon charging, thinner aft end 12b of
15 bladder 12 will first expand to contact bypass tube 14. While
16 bladder 12 is discharging, aft end 12b is the last part of
17 bladder 12 to contact bypass tube 14. The material and thickness
18 of bladder 12 are selected to provide the desired impulse
19 profile. Open aft end 12b is in communication with a firing
20 valve 32.

21 Firing valve 32 is positioned in hydraulic communication
22 with elastomeric bladder 12, impulse tank 18, bypass tube 14, and
23 a seawater inflow tube 34. Firing valve 32 is cylindrical with a
24 movable piston 32a disposed within a valve cylinder 32b. Piston
25 32a is positionable by shipboard hydraulics 36 connected to a
26 control rod 32c. To allow use of seawater to charge bladder 12,

1 a charge sea valve 38 is provided in communication with a pump
2 40. Pump 40 is joined to a charge shut off valve 42 which is in
3 communication with seawater inflow tube 34. Hydraulics 36, pump
4 40, and valves 38, 42 are actuated on command from control
5 circuitry 43.

6 FIG. 2A, 2B, 2C and 2D show fluid flows through the
7 elastomeric launch system during different stages of the launch
8 process. In FIG. 2A, 2B, 2C and 2D, the flow of seawater is
9 designated generally by flow arrows 44. Firing valve 32 has a
10 charge position shown in FIG. 2A and 2B, and a firing position
11 shown in FIG. 2C and 2D. FIG. 2A illustrates fluid flow with
12 valve 32 in charge position. In FIG. 2B firing valve 32 remains
13 in the charge position and shut off valve 42 is closed to seal
14 pressure within elastomeric bladder 12. In FIG. 2C firing valve
15 32 is shown shifted to the firing position to allow hydraulic
16 communication between elastomeric bladder 12 and impulse tank 18.
17 Flow arrows 44 show the initial flow of seawater from elastomeric
18 bladder 12 through valve cylinder 32b into impulse tank 18. FIG.
19 2D shows fluid flow around valve cylinder 32b after the initial
20 impulse of the launch. Flow arrows 44 show fluid flow through
21 spyder 22 and into impulse tank 18.

22 In FIG. 2A, there is shown the inventive device with valve
23 32 positioned to allow charging of bladder 12 from seawater
24 inflow tube 34. In this position of valve 32, open aft end 12b
25 of bladder 12 is sealed from communication with impulse tank 18.
26 As shown in FIG. 1, charge sea valve 38 is opened to allow pump

1 40 to pump seawater through opened charge shut off valve 42 into
2 elastomeric bladder 12 via inner flow aperture 22a. When the
3 desired pressure is attained, charge shut off valve 42 and sea
4 valve 38 are closed.

5 Referring now to FIG. 2B, there is shown the inventive
6 device in its charged state. In this position of valve 32, aft
7 end 12b of bladder 12 is completely sealed by valve 32 and shut
8 off valve 42. Elastomeric bladder 12 is deformed radially to
9 contact bypass tube 14. The contact between bladder 12 and the
10 interior surface of bypass tube 14 seals tube 14 and prevents
11 seawater from entering impulse tank 18 through outer flow
12 apertures 22b, bypass tube 14, and sea chest 16.

13 Referring now to FIG. 1 and FIG. 2C, when torpedo 28 is
14 ready for launch, firing valve 32 is shifted to firing position
15 to allow pressurized seawater to flow from elastomeric bladder 12
16 through inner flow aperture 22a into impulse tank 18. Pressure
17 in impulse tank 18 is transmitted to launch tube 18 to eject
18 torpedo 28 therein. Thinner aft end 12b is the last portion of
19 bladder 12 to contract thus preventing the seawater in impulse
20 tank 18 from escaping through spyder 22 and bypass tube 14.

21 Referring now to FIG 2D, as the seawater in elastomeric
22 bladder 12 and impulse tank 18 is discharged, aft end 12b will
23 contract away from bypass tube 14. At this stage, the pressure
24 in impulse tank 18 will be less than the pressure in sea chest 16
25 and seawater will flow through bypass tube 14 around deflated
26 elastomeric bladder 12 through spyder 22 outer flow apertures 22b

1 and then to launch tube 26. Seawater flowing through impulse
2 tank 18 avoids formation of a low pressure region at the mouth of
3 launch tube 26 by providing a gradual reduction of seawater flow
4 thereby filling the area behind launched torpedo 28. See FIG. 1.

5 The primary advantage of the present invention over
6 elastomeric launchers such as the launcher shown in U.S. Patent
7 No. 4,848,210 is that the launcher of the present invention
8 prevents cavitation at the breech of the launch tube after
9 launching a device. Cavitation is prevented by providing a
10 bypass cylinder which allows seawater to flow around the
11 elastomeric bladder and into the launch tube after firing.
12 During charging, the elastomeric bladder seals against the bypass
13 tube and prevents transmission of seawater to the launch tube.

14 What has thus been described is an elastomeric launch system
15 with seawater flow through a bypass tube allowing a device to be
16 launched from a launch tube with reduced noise. Noise is reduced
17 by providing fluid flow through the launch tube after the launch.

18 Obviously many modifications and variations of the present
19 invention may become apparent in light of the above teachings.
20 For example: any wall portion of the elastomeric bladder can be
21 thinned to seal against the interior surface of the bypass tube;
22 the impulse tank can be omitted by piping seawater directly to
23 the launch tube from the apparatus; and a compact three way valve
24 assembly can be used in place of the firing valve and shut off
25 valve combination.

1
2
3

In light of the above, it is therefore understood that
the invention may be
practiced otherwise than as specifically described.

2 ELASTOMERIC LAUNCH SYSTEM FOR SUBMARINES

3
4 ABSTRACT OF THE DISCLOSURE

5 An apparatus for providing a pressurized liquid to a launch
6 tube for launching projectiles into a liquid medium. The device
7 comprises an elastomeric bladder disposed inside a cylindrical
8 bypass tube. The forward end of the bypass tube is open to the
9 liquid medium, and the aft end of the tube is hydraulically
10 connected to the launch tube. The elastomeric bladder is
11 externally of generally cylindrical shape and has an open aft
12 end, a closed forward end and a side wall of varying thickness.
13 The open end of the bladder is hydraulically connected to valves
14 which act to control charging of the bladder and firing of the
15 bladder. The bladder expands to contact the wall of the bypass
16 tube when the bladder is filled with pressurized seawater.
17 Ultimately the whole bladder will act to seal the bypass tube by
18 contact with the bypass tube wall to prevent the external liquid
19 medium from communicating with the launch tube through the bypass
20 tube. Upon vehicle launch pressurized liquid is provided from
21 the elastomeric bladder to the launch tube. The bladder returns
22 to its original shape after discharge breaking contact with the
23 bypass tube wall, and liquid is allowed to flow through the
24 bypass tube into the launch tube to prevent cavitation from
25 occurring at the launch tube breech.

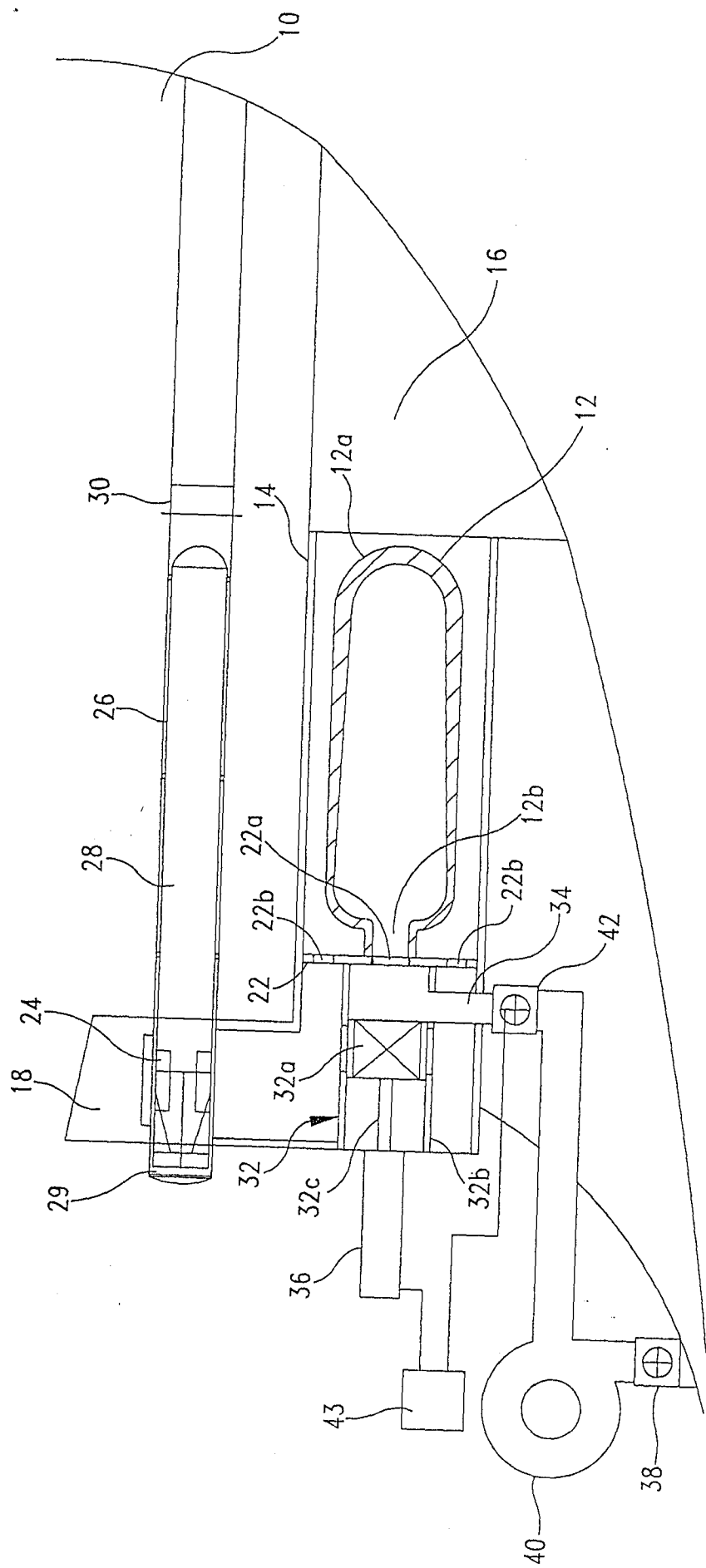


FIG. 1

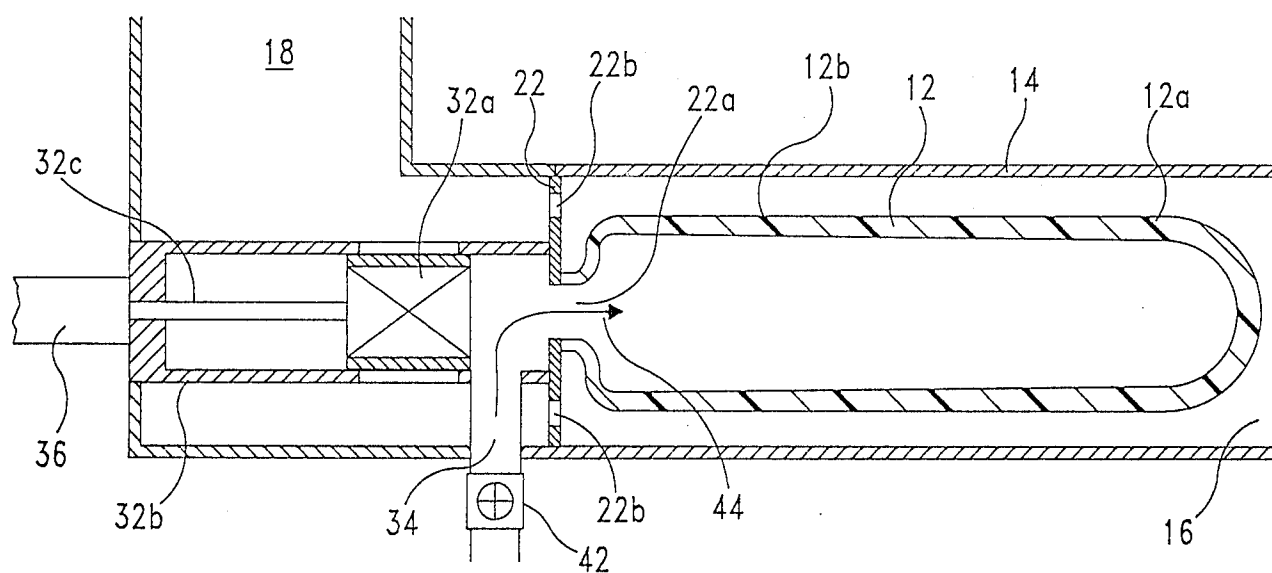


FIG. 2A

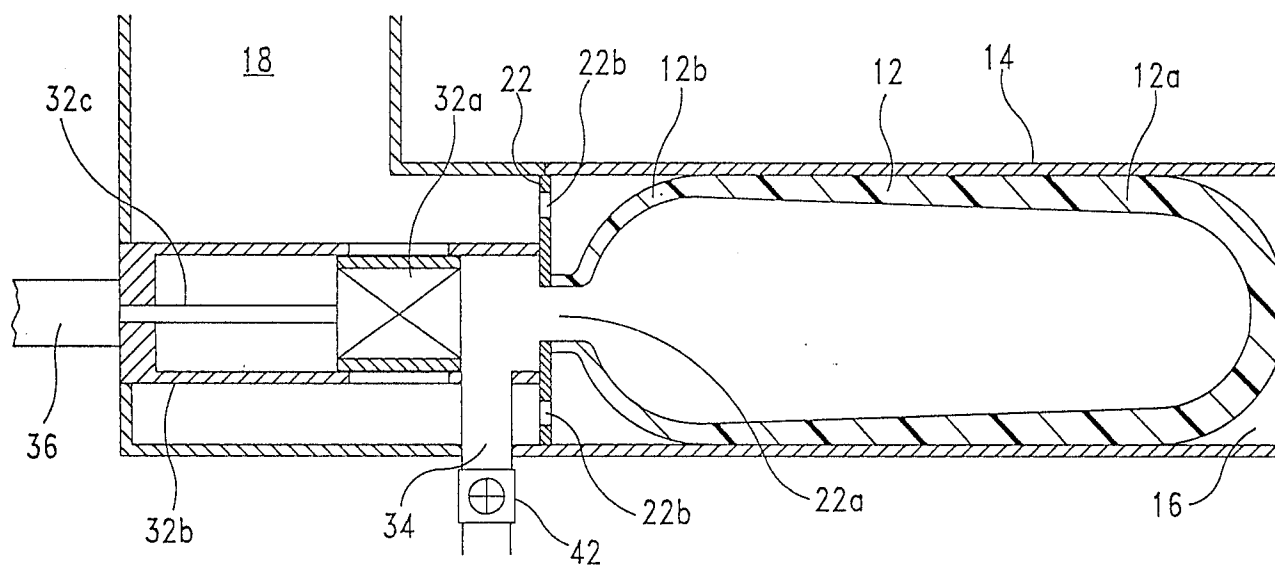


FIG. 2B

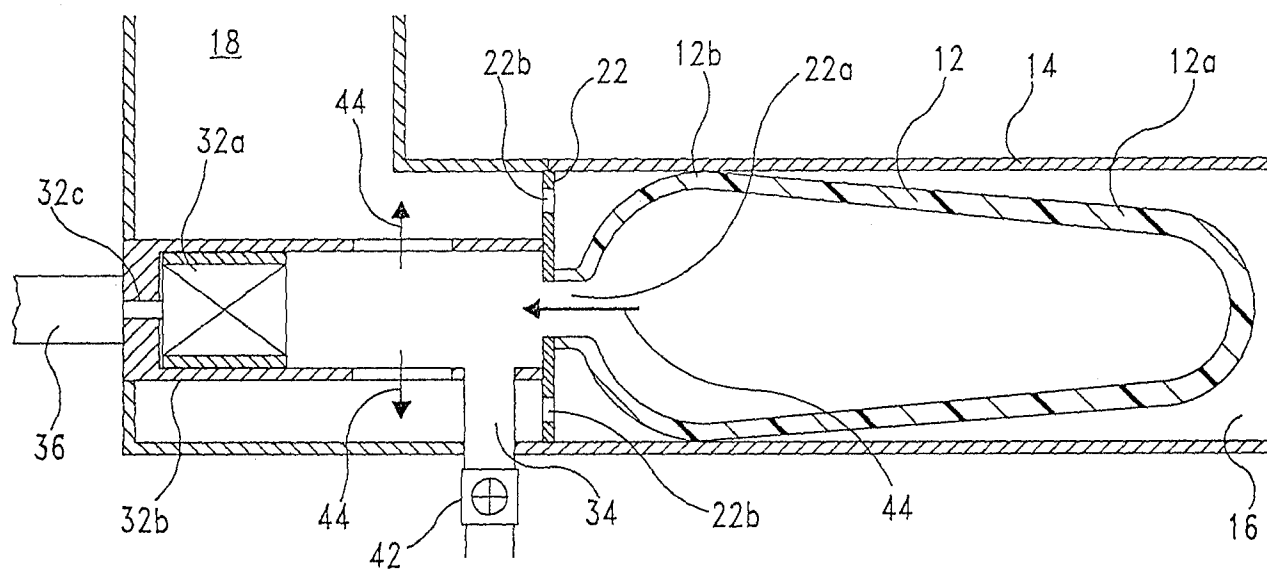


FIG. 2C

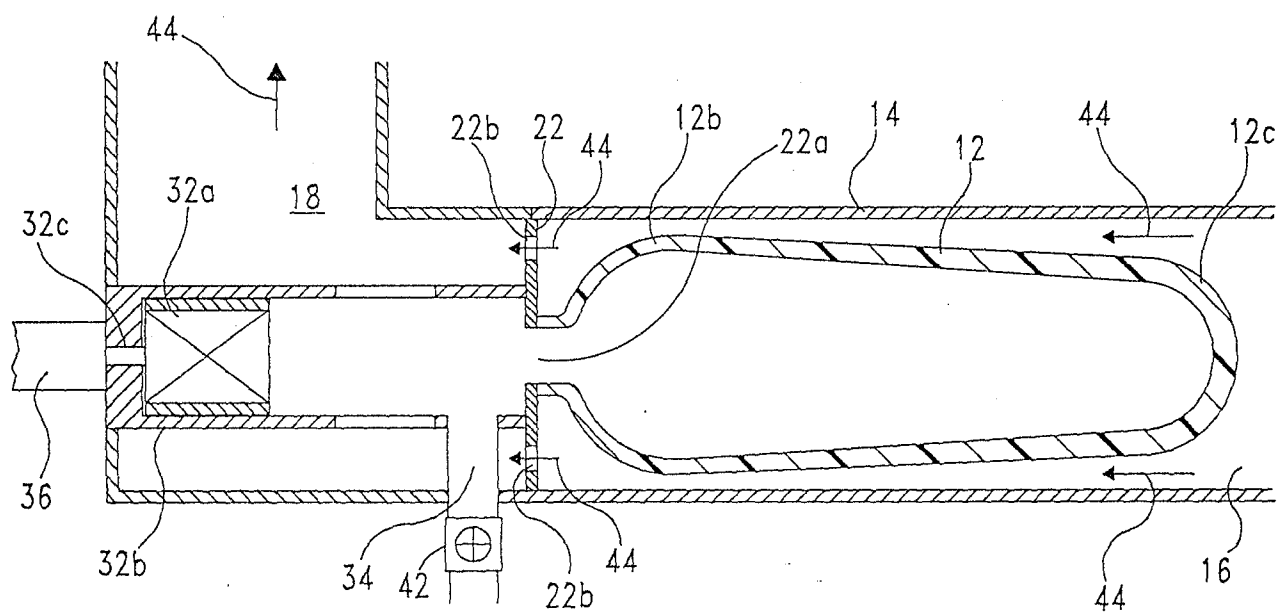


FIG. 2D