June 18, 1957 R. G. DAUDELIN 2,796,074

HIGH PRESSURE CONTROL VALVE

Filed July 31, 1951 2 Sheets-Sheet 1

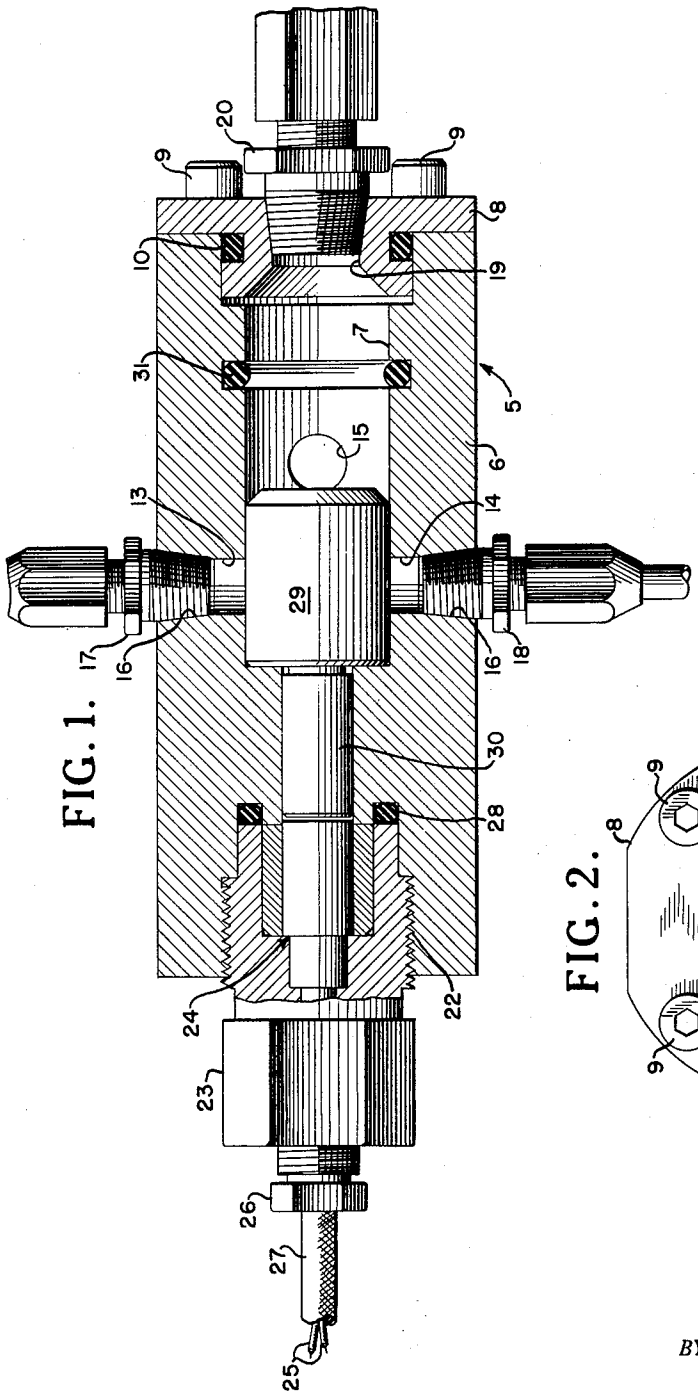


FIG. 1.

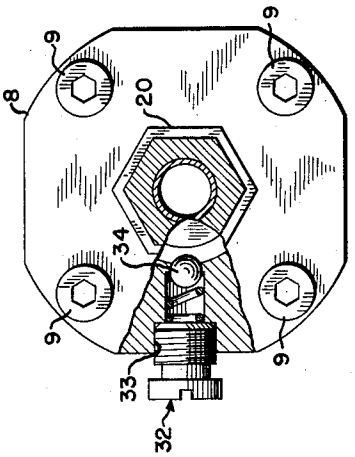


FIG. 2.

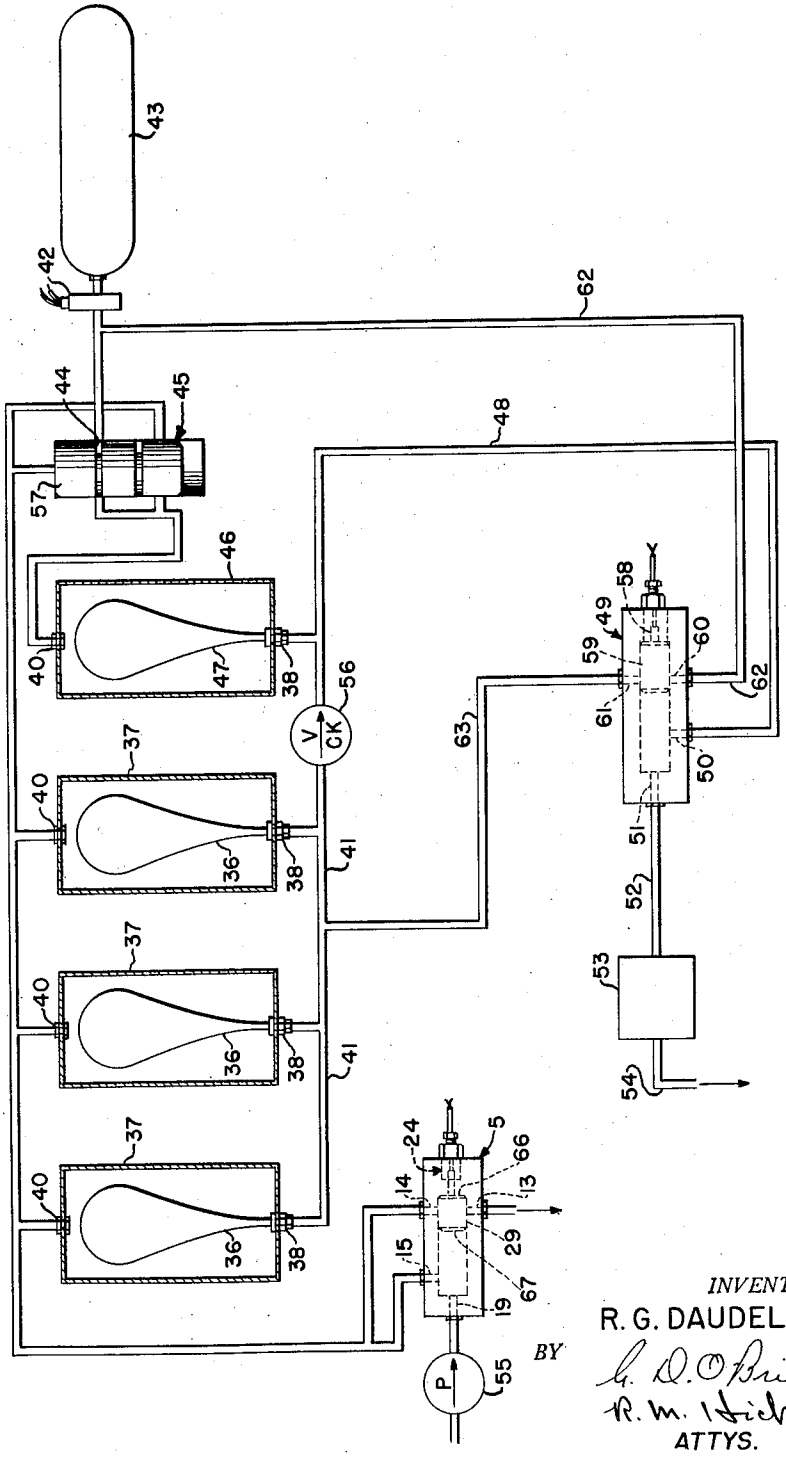
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FIG. 3.



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HIGH PRESSURE CONTROL VALVE

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Application July 31, 1951, Serial No. 239,603

3 Claims. (Cl. 137—68)

(Granted under Title 35, U. S. Code (1952), sec. 266)

This invention relates generally to high pressure valves and more specifically to a flushing valve particularly suitable for use in a torpedo propelling system wherein hydrogen peroxide is employed as a fuel.

It is the general practice, prior to the acceptance of a torpedo for service use, to extensively test each torpedo by requiring that it complete a minimum number of satisfactory test runs whereupon the controls and functional characteristics of the torpedo may be determined under actual service conditions. These test operations are facilitated by the valve arrangement of the present invention which, upon the completion of each test run, operates in a novel manner to discharge from the fuel system water taken on by the torpedo during the consummation of the hydrogen peroxide fuel thereof whereby the normally negatively buoyant torpedo is thusly made buoyant for rising to the surface of the water for easy recovery by the test crew.

It is an object of the present invention to provide a new and improved high pressure valve pyrotechnically actuated from an initial flow controlling position to a second flow controlling position.

A further object of the present invention is to provide a fluid controlling valve wherein the flow of fluid through the valve is controlled by movement therein of a piston actuatable responsively to force applied thereto from a pyrotechnic source.

A further object of the present invention is to provide a fluid controlling valve wherein the force of the fluid controlled by the valve becomes effective to maintain the valve in an operated position.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a side view partly in section and partly cut away of the multiple outlet valve of the present invention;

Fig. 2 is an end view of the valve partly cut away and showing the arrangement therein of the piston retaining ball detent in piston retaining position;

Fig. 3 is a schematic view in part of a hydrogen peroxide, sea water, and high pressure air system of a hydrogen peroxide fueled torpedo and showing the arrangement in the system of the valve of the present invention.

Referring now to the drawings and with more particularity to Fig. 1 thereof, the valve of the present invention and generally designated 5, is shown thereby to include an elongated body section 6 wherein is provided a centrally arranged bore 7. Closing one end of this bore 7 is a cap piece 8 through which screws 9 extend for securing the cap to the body section in a manner illustrated to advantage in Fig. 2. By the provision of an O-ring gasket 10, formed preferably from rubber or the like, and arranged within a suitable groove provided about the cap piece 8, a high pressure seal is maintained between the cap and body as the cap is secured thereto by the tightening of the screws 9.

Intersecting the bore 7 are ports 13, 14, and 15 respectively threaded, as at 16, whereby may be connected with the ports suitable fluid couplings such as 17 and 18. By the arrangement of a centrally disposed port 19 within the cap piece 8 and wherein is threaded a fluid coupling 20, fluid entering the valve by way of this port may pass freely from the valve through the port 15 initially in fluid circuit with port 19.

Threaded, as at 22, into the opposite end of the body section 6 is a plug piece 23 wherein is secured, as by press fitting, a sleeve equipped electroresponsive detonator assembly generally designated 24 and from which the electrical leads 25 thereof extend outwardly from the plug by way on a conventional gland nut assembly including a gland screw 26. The arrangement of the screw 26 provides for compressing about the insulation 27 of the leads a suitable sealing washer, not shown, whereby moisture is prevented from entering the detonator cavity within the plug by way of this electrical connection with the detonator.

As the plug 23 is threaded into the end of the body member 6 a suitable O-ring 28 is compressed to the end of the plug thusly to provide a moisture and pressure proof connection therebetween.

Disposed for axial movement within the bore 7 is a closely fitted piston member 29. By the arrangement of a spring actuated ball detent assembly, generally designated 32 and threaded as at 33 within the body member 6, Fig. 2, the piston is initially maintained in the position illustrated, Fig. 1, until the ball 34 of the detent is cammed from its securement of the piston as the latter is accelerated to a second position against the cap piece 8 following the ignition of the detonator 24. Movement of the piston in this manner causes an interruption of the fluid circuit between ports 19 and 15 as a second fluid circuit between ports 13 and 14 is established.

By the provision of a reduced extension on the piston, as at 30, and against which the force of the detonator 24 is directed, the driving force thusly applied to the piston for a predetermined stroke thereof is in this manner increased.

As the piston moves to its second position against the cap piece 8 responsive to pressure applied thereto from the detonator 24, an O-ring seal 31 arranged as illustrated within the bore 7 receives the piston therewithin thereby to provide a high pressure seal between ports 15 and 19 during such time as the piston 29 is interposed therebetween. As ports 13 and 14 are thusly connected, fluid admitted thereby to the valve bore 7 and behind the piston becomes effective to maintain the piston in its operated position against the cap piece 8 during the following interval of operation of the valve.

A better understanding of the operation of the present valve may become more clearly apparent when discussed in connection with its use in a hydrogen peroxide fuel system, Fig. 3, of a torpedo wherein the valve arrangement of applicant has been found particularly suitable.

The fuel system, as illustrated, is comprised of a plurality of hydrogen peroxide filled collapsible bags 36 respectively arranged within suitably formed rigid tank members 37. A sealing connection is provided respectively between the tanks and mouths of the bags, as at 38, whereby pressure when applied internally to the tanks, by way of the connections 40, has the effect of compressing the bags to cause the hydrogen peroxide therein to be forced through the mouth of the bags and into the header or fluid conduit 41.

As the torpedo is launched a suitable switching arrange-

ment is provided for energizing a detonator responsive valve assembly **42** thereby to allow high pressure air from a receptacle **43** therefor to pass, by way of an open fluid circuit **44** in a control valve **45**, to a starting tank **46** similar in construction to the tanks **37** and wherein is arranged in a similar manner a hydrogen peroxide filled bag **47**.

As air pressure is thusly applied internally to the tank **46** and accordingly to the outer surface of the bag **47** the fluid within this bag is forced, by way of the connection **48**, to a valve **49** to be admitted therein by way of the port **50** and thence discharged by way of the port **51**. A fluid conduit **52** connecting the valve with a catalyst chamber **53** passes thereto the hydrogen peroxide wherein responsive to a catalytic action the hydrogen peroxide is decomposed into oxygen and steam. This mixture, when passed to the engine of the torpedo, by way of the connection **54**, provides a necessary portion of the fuel required to drive the torpedo through the water.

As the engine of the torpedo is thusly put in operation, a positive displacement pump **55**, driven by the engine, is likewise activated to draw water from the surrounding medium and drive it under pressure into the tanks **37** by way of the initially connected ports **19** and **15** of the flushing valve assembly of the present invention. As water pressure is in this manner applied to the outer surface of the bags **36** the hydrogen peroxide therein is caused to be driven from the bags by way of a check valve **56** to the valve **49** and thence to the engine in the manner previously described. Fluid pressure from the pump **55**, in addition to forcing the hydrogen peroxide from the bags **36**, further provides for shifting the position of the piston **57** of the control valve **45** to disconnect the air supply from the receptacle **43** concurrently with connecting with the tank **46** the water pressure system from the pump **55** whereby in this manner the remaining hydrogen peroxide is forced from the starting bag **47** by water pressure in a similar manner to the discharging of the hydrogen peroxide from the bags **36**.

At the completion of the torpedo run, and which is determined by the exhausting of the fuel from the system and consequently the stopping of the torpedo engine, the pump **55** thereby ceases to operate whereupon the torpedo, now negatively buoyant, starts descending toward the bed of the body of water.

As the torpedo settles within the water a hydrostatic switch or other such similar apparatus, not shown, operates to effect the energization of an electroresponsive detonator **58** of the valve **49** to drive a piston **59** thereof from its initial position to a second position for closing the fluid circuit to the catalyst chamber **53** concurrently with connecting in fluid circuit the ports **60** and **61**.

Upon movement of the piston **59** of the valve **49** in the manner described, high pressure air from the line **62** and initially controlled by the piston **59** is discharged into and from the valve **49** and into the hydrogen peroxide system including the connection **63** to pass by way of the connection **41** and check valve **56** into the bags **36** and **47** thusly to expand the bags outwardly against the water within the respective tanks **37** and **46**.

Upon energization of the detonator **24** of the flushing valve **5**, which occurs concurrently with the firing of detonator **58** of valve **49**, the position of a piston **29** thereof is shifted, as previously described, to connect the port **14** to the port **13** whereupon the air pressure now being applied internally to the bags **36** and **47** may force the water from the tanks and into the surrounding water. As the aft end portion **66** of the piston is carried by the force of the detonator **24** beyond the port **14**, the pressure at this time within the system exceeds the external water pressure being applied to the forward end **67** of the piston whereby during the flushing operation of the valve the piston is maintained by this pressure in sealing relation between ports **19** and **15**. As the water is thusly forced from the system the torpedo is made buoyant to rise to the surface of the water from whence it may be recovered by the test crew.

For further details as to the construction and operation of valve **49**, reference may be had to my copending application for High Pressure Control Valve, Serial No. 239,602, filed July 31, 1951, now Patent No. 2,777,455 of January 15, 1957, wherein valve **49** is disclosed and claimed.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

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

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A high pressure valve of the character disclosed comprising, an elongated housing, an electroresponsive detonator axially disposed in one end of said housing, a longitudinal stepped bore extending through said housing, an integral plunger and piston member disposed for movement in said stepped bore, and movable in response to actuation of said detonator, said plunger being of lesser diameter than said piston member at a face portion thereof which is subjected to the force of said detonator, said piston having a conical valve surface formed thereon, means including a plurality of ports forming a pair of alternatively conductive fluid circuits through said housing and intersecting said bore, said piston member being initially disposed between a first pair of said ports for interrupting a first of said fluid circuits and movable within the bore of said housing when actuated by said plunger to a second position between a second pair of said ports, means including a valve seat encircling one of said circuits for arresting movement of said piston member in said second position and for sequentially interrupting the second of said fluid circuits, and a resilient O-ring disposed between one pair of said ports in the path of travel of said piston thereby being cooperative with said piston to prevent piston rebound and to provide an initial high pressure seal between the second of said fluid circuits after movement of said piston between said first and second positions.

2. A high pressure valve of the character disclosed comprising, a body member having a centrally disposed stepped bore extending therethrough, means forming a plurality of ports intersecting said bore and providing through said body a pair of fluid circuits, a piston having a conical valve surface formed integrally therewith and disposed for close fitting sliding movement within said bore and having an initial position in fluid flow interrupting relation in one of said fluid circuits, means forming a valve seat encircling one of said ports in the other of said fluid circuits, an electroresponsive detonator, a plunger integral with said piston and of lesser diameter and arranged to be movable within a reduced diameter portion of said bore and responsive to the firing of said detonator to drive said piston from said initial position to a fluid flow interrupting position with the valve surface thereof engaging said seat in the second of said pair of fluid circuits, and a compliant means for additionally sealing said one of said ports and arresting rebound movement of said piston and plunger as the valve surface thereof moves into engagement with said seat after the initial accelerated motion is decelerated to a stop with the piston adjacent one of said ports.

3. A high pressure valve of the character disclosed comprising, in combination, an elongated housing having a centrally arranged stepped bore extending therethrough, means forming a counterbore in said bore thereby to provide a shoulder in said housing, a plug piece constructed and arranged for closing one end of said bore, a plunger

and piston assembly disposed for close fitting sliding movement respectively within said bore and counterbore and with the plunger initially arranged in adjacency to said plug piece, means forming a recess in said plug piece in adjacency to said plunger, an electroresponsive detonator arranged in said recess and fireable in response to an electric signal to drive said plunger through said bore, said piston of said assembly being arranged to be moved within said counterbore and actuatable for combined movement with said plunger from an initial position to a second position in said counterbore, port means forming a high pressure fluid circuit through said valve and initially closed by said piston when in its initial position, and means including a pair of ports forming an initially open low pressure fluid circuit through said valve and closable by movement of said piston to said second position while alternatively opening said high pressure fluid circuit to communicate high fluid pressure

by way of said counterbore to said piston to maintain said piston in said second position against low fluid pressure within said low pressure fluid circuit.

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