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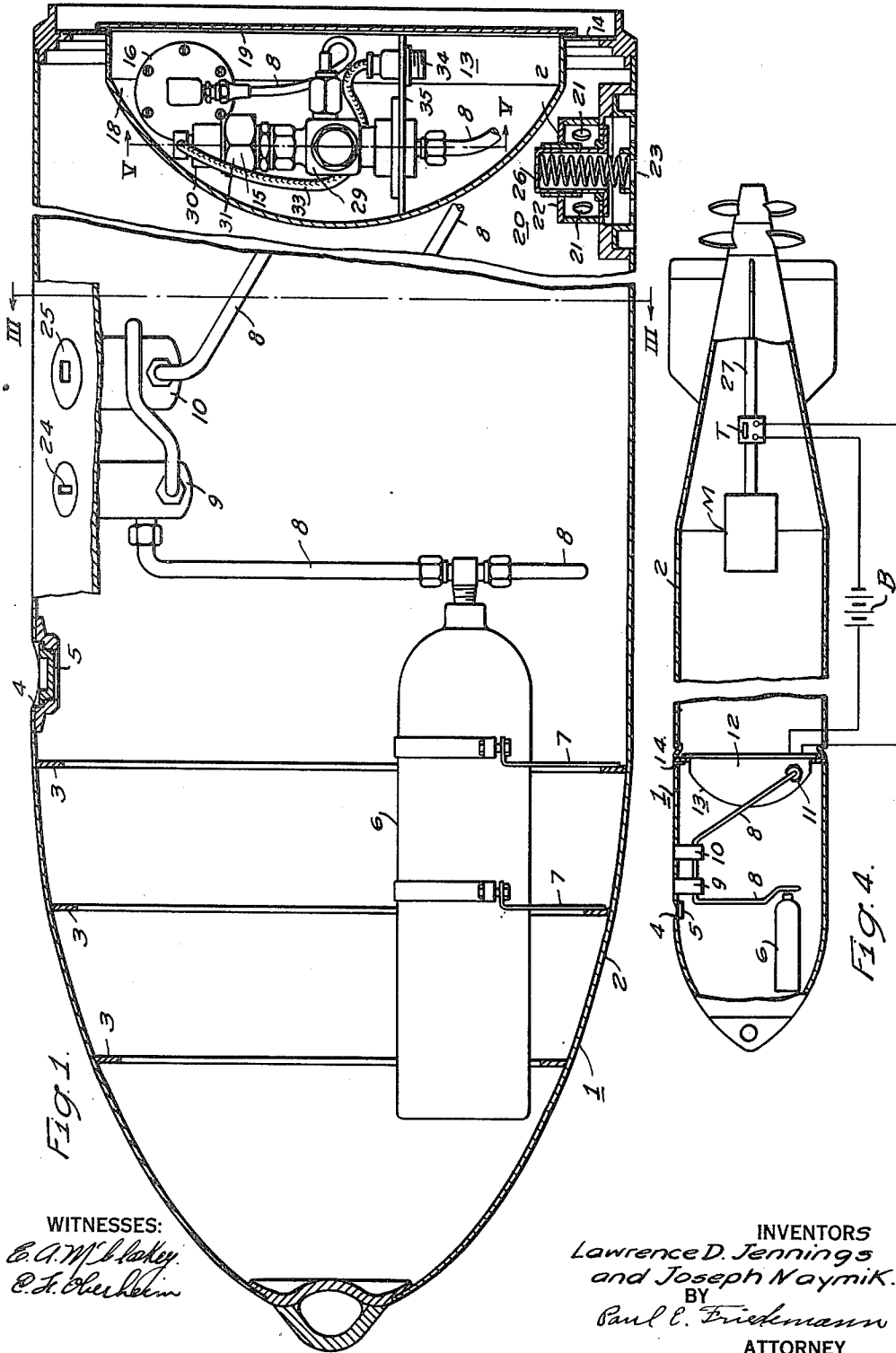
L. D. JENNINGS ET AL

2,447,651

CONTROL MECHANISM

Filed Oct. 7, 1946

3 Sheets-Sheet 1



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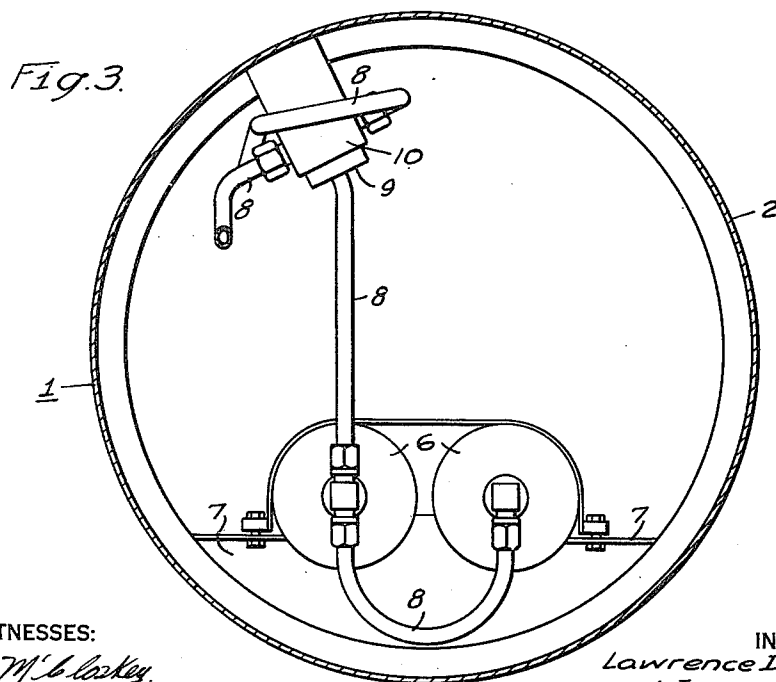
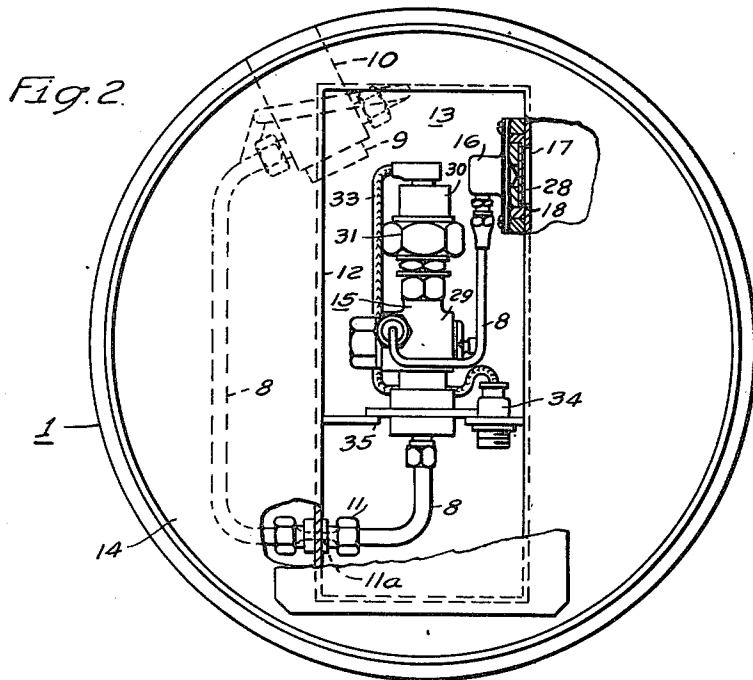
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WITNESSES:

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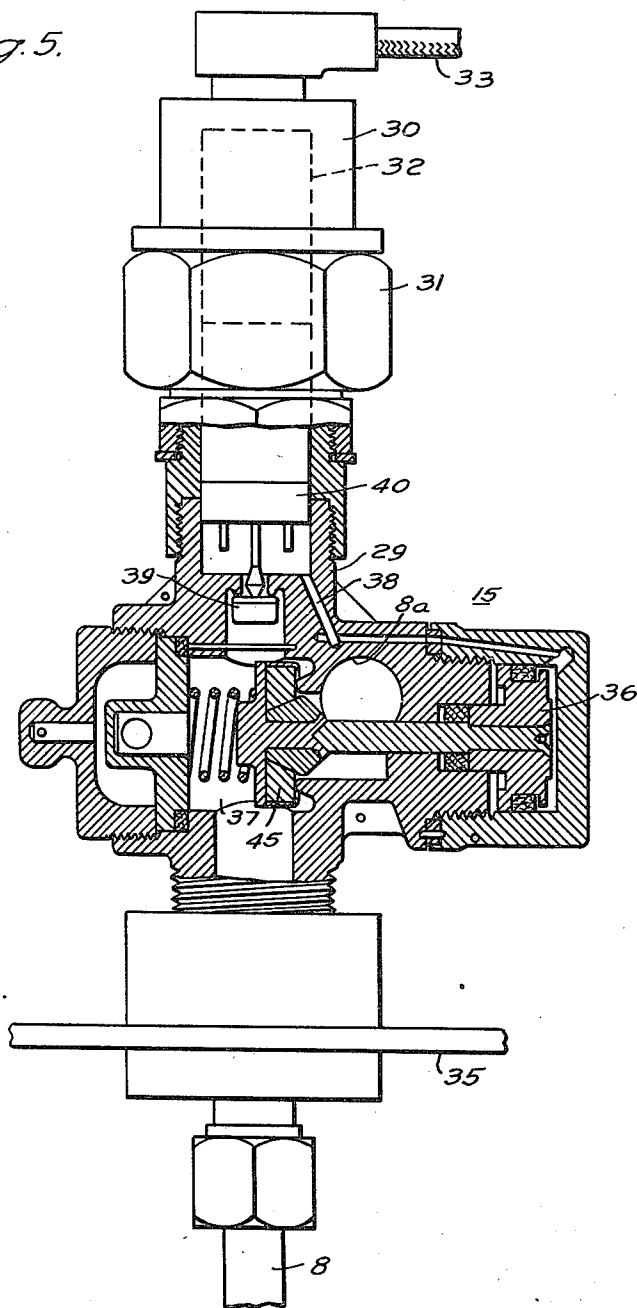
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Fig. 5.



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2,447,651

CONTROL MECHANISM

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Application October 7, 1946, Serial No. 701,768

14 Claims. (Cl. 114—20)

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This invention relates generally to a control for conveyances operable in a fluid medium and more particularly to a type of buoyancy control for test torpedoes.

In connection with the development of torpedoes it is necessary to construct test models. These are full scale devices embodying all the control features to be incorporated in the warshot torpedo but lack the war head carried by the warshot type. In place of the war head there is provided on the test torpedo a type of head which has presently come to be known as an exercise head. Additionally, the test torpedo is usually equipped with various test circuits for testing the control circuits independently of actually operating the torpedo and carries recording apparatus adapted to record the performance of the control equipment.

Torpedoes of the type under consideration are negatively buoyant and, hence, will sink once motion through the water has ceased. Since a test torpedo must be repeatedly launched and recovered in the course of development, it is essential that means are provided affording ease of recovery at the termination of the test or trial run.

A preferred method of accomplishing this is to provide space in the exercise head to accommodate sufficient liquid ballast to provide the desired negative buoyancy. An important consideration in accomplishing this is to approximate the war head as closely as possible with the exercise head design, particularly as to dimension and mass so that the trim of the test torpedo and its behavior dynamically will approximate the warshot type as closely as possible.

It is a general object of this invention to provide a control apparatus for a test torpedo providing among other things for ease of recovery of the torpedo at the end of a trial run.

Another object of this invention is to provide a control apparatus for a test torpedo which provides for the characteristic of negative buoyancy during the trial run and which at the termination of the said trial run renders the torpedo buoyant that surfacing thereof will be had and recovery facilitated.

Yet another object of this invention is to provide an exercise head of the character referred to in which a judicious mass distribution is had through proper location of the control components whereby the torpedo is properly trimmed.

A further object of this invention is to provide an exercise head for a test torpedo which is a reasonable approximation as to mass and dimen-

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sion of the war head to be used on the particular type of torpedo being tested.

Additionally, it is an object of this invention to provide an exercise head for a test torpedo which is simple in its elements and effective in operation.

A still further object hereof is to provide an exercise head of the type generally referred to which may be easily serviced.

Other objects and advantages will become apparent upon a study of the following specification when considered in conjunction with the accompanying drawings in which:

Figure 1 is a longitudinal sectional view of an exercise head for a torpedo embodying the principles of this invention,

Fig. 2 is a view looking at the aft end of the exercise head with certain parts broken away to clarify the illustration,

Fig. 3 is a sectional view of the exercise head taken on line III—III of Fig. 1,

Fig. 4 schematically illustrates the application of the present invention in a torpedo, and

Fig. 5 is a sectional view of a valve employed in the present invention.

In practicing the present invention, as will be seen from Fig. 4, the exercise head 1 is detachably secured to the torpedo body 2 and forms the torpedo nose. In the warshot torpedo this position is occupied by the war head. Thus the exercise head in addition to performing its control function must simulate to a reasonable degree of accuracy the war head, both as to mass and dimension so that the torpedo's trim and its dynamics with the exercise head installed and loaded with liquid ballast approximates that with the war head installed.

The war head of a torpedo is loaded with an explosive known as torpex. This is a powder-like pyrotechnical material that is packed solidly into the war head. Because of the weight for a given size of a war head so constructed, difficulty was encountered in the construction of an exercise head approximating the war head dimensions which filled with a liquid ballast provided the necessary mass for properly trimming the torpedo and provided the desired degree of negative buoyancy. In surmounting this difficulty, two expedients were introduced. One involved the use of liquid ballast having a high specific gravity and the other provided for the attachment of suitable weights within the exercise head at its forward extremity which resulted in a forward shift of the center of gravity of the exercise head at the

expense of a permanent increase in weight of the entire head.

With exercise heads as constructed in the past, most of the equipment which controlled the exhausting of the head of liquid ballast was located on the after bulkhead which was arranged at the aft extremity of the head. This was a necessary expedient, since access to the high pressure gas bottles or flasks used to exhaust the head was required so that replacement thereof at the end of each trial run could be effected upon detachment of the head from the torpedo body. This, of course, resulted in a mass concentration at a point where its effect on torpedo trim was negligible. It was further a tedious task replacing the high-pressure gas bottles in preparation for each trial run.

As will be seen from Fig. 1, an exercise head is obtained by the construction therein illustrated in which numerous of the difficulties hereinabove outlined are obviated. In detail, the exercise head 1 is of a sheet metal construction having the sheet metal hull 2 which is circular in cross section, as evidenced in Figs. 2 and 3, and which in longitudinal section is substantially of ogival configuration. The sheet metal hull is reinforced internally by a plurality of ribs 3. An opening 4 is provided in the sheet metal hull 2 through which liquid ballast may be poured and which is sealed by the cover 5.

A pair of high-pressure gas bottles or flasks 6 are cradled in supports 7, in turn, fastened to a pair of the ribs 3. These bottles communicate with the exercise head in which they are mounted, so that gas under pressure may be supplied to the exercise head for exhausting the liquid ballast, through the pipe system 8 (see Figs. 1, 2 and 3) which connects the bottles and which passes through a stop valve 9, a charge valve 10, through a pressure reducing fitting 11 in a side wall 12 of the recessed section 13 of bulkhead 14, whence it passes through the control mechanism 15 and terminates at the blowout valve 16 mounted over the opening 17 in side wall 18 of the recessed section 13. This arrangement provides for the supply of gas under pressure through the pipe system 8 and the various elements comprising the system 8 through the opening 17 into the exercise head. The resulting increase in pressure in the head forces the spring biased plunger 26 of a pressure responsive valve 20 arranged in the sheet metal hull 2, downwardly, as viewed, and the liquid ballast is exhausted through the openings 21, 22 and 23 in the pressure responsive valve. The recessed section 13 and the elements which it houses is closed by a cover plate 19, which affords a measure of protection to elements in the adjoining compartment of the torpedo, for example, in the event of failure of parts of the control mechanism 15 upon firing of the cartridge.

Details of the stop valve 9 have not been shown since it is a conventional two-position valve being either open or closed depending upon its setting. The stop valve is supported and sealed in an opening in the sheet metal hull so that the valve control part 24 having a rectangular recess formed therein for receiving a wrench, is accessible for manipulation externally of the exercise head. For the sake of this discussion, it will be assumed that the stop valve for the position of the rectangular recess illustrated, is in closed position and, accordingly, the pipe system 8 closed at that point.

Similarly, the charge valve 10 is not detailed

since it comprises merely a high strength container into which the pipe system 8 communicates. Like the stop valve the charge valve is supported and sealed in an opening in the sheet metal hull and its open end adjacent the hull surface is sealed by a cover plate 25 which, for example, may thread into the open end of the charge valve. This arrangement of valves is provided so that the bottles 6 may be filled with gas under pressure. In this connection it will be noted that the stop valve is disposed between the charge valve and the gas bottles or flasks. The application of gas or air under pressure to the high pressure bottles is accomplished by attaching a source of high pressure air (not shown) to the charge valve, the stop valve being moved to the open position at right angles to its illustrated position for this operation. Air is then fed into the system until, by way of illustration, a pressure of 3000 lbs. per sq. inch is reached. The stop valve is then closed and the high pressure air source disconnected. After cover plate 25 is applied closing the charge valve, the stop valve is opened and the high pressure air flows through the system to the control mechanism 15.

Control mechanism 15 is essentially a cartridge operated valve and normally occupies a closed position preventing air from passing there-through to the blowout valve 16. In view of this, the pipe system between the control mechanism 15 and blowout valve 16 is at low pressure. To prevent the flow of ballast fluid into the pipe system 8 between the blowout valve and the control means 15, the diaphragm 28 is provided. This diaphragm is sufficiently strong to withstand ballast fluid pressures, but insufficiently strong to withstand the air pressure in the system. Hence, when subjected to air pressure of the magnitude afforded by the system it is destroyed. The function of the control means 15 is, therefore, to initially prevent the application of air pressure to the diaphragm and upon firing of the cartridge 32 thereof to open the valve portion thereof and permit the application of air pressure to diaphragm 28, which is destroyed, admitting air to the exercise head and exhausting the ballast fluid.

While control means 15 per se forms no part of this invention, it is none the less detailed in Fig. 5 that a better understanding hereof may be had. It includes generally a body portion 29 and a cartridge chamber 30 fastened to the body by means of a nut 31. Briefly the valve assembly comprises a spring biased valve 45 mechanically connected with a piston 36. The chamber 37 housing the valve 45 being in communication with the pipe system 8 at the bottom side of the valve and communicating, when valve 45 is unseated, with the port 8a which leads to the blowout valve. Chamber 37 also communicates with the passageway 38 which leads to the back of piston 36, through a control valve 39 which is opened by the piston 40 responsive to cartridge combustion. Valve 39 is normally held closed by air pressure in the chamber 37. When the cartridge is fired piston 40 drives control valve 39 to its open position, whereupon air pressure is admitted to the back of piston 36 by the passageway 38. Since the piston is provided with a larger surface area than the valve 45, it is forced to the left as viewed against the combined forces of the air pressure in chamber 37 acting on the valve 45 and the valve spring. Air then passes around the valve 45 to port 8a and thence to the blowout valve 16. The firing chamber in this specific case is

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constructed to receive an electrically explodable cartridge 32 and for this purpose is equipped with the necessary wires 33 which terminate in a socket 34 secured in the support 35 carrying control mechanism 15. When the exercise head is assembled on the torpedo body, this circuit is connected by a mating socket (not shown) with a circuit including the battery B and timer contactor T operated by the propulsion shaft 27. (See Fig. 4.) The timer may be any suitable contact making device for completing the battery circuit to energize and explode the cartridge. Air is then supplied, as previously explained, by the source of air pressure 6 to the exercise head and the ballast fluid is exhausted through the pressure responsive valve which opens after the head pressure reaches a predetermined value.

Because of space and weight limitations among other considerations, the volume capacity of the air pressure flasks 6 is limited. Since the volume ratio of the exercise head and flasks is large, the flask air pressure must be correspondingly high and consequently some control of the air under pressure which is admitted to the exercise head must be had to obviate the possibility of applying damaging pressures to the exercise head. A simple pressure reducing nipple forming an orifice 11a in the pipe system accomplishes this control and is embodied in the pressure reducing fitting 11 serving as a connection for the pipe sections 8 on opposite sides of the wall 11.

A better understanding of the invention will probably be had by considering the operation of the system hereinbefore described. Assuming the exercise head to have been filled with liquid ballast and the air flasks filled with air according to the operations hereinbefore described, the torpedo is ready for launching.

At launching suitable means (not shown) starts the propulsion motor M and the torpedo is propelled through the water. After a time depending upon the setting of timer T, the contacts thereof are closed. Battery voltage is applied to the cartridge causing it to explode and initiate operation of control mechanism 15 to break the diaphragm 28. Immediately the air flasks discharge into the exercise head through the pipe system 8 at a volume rate depending upon the size of the orifice in fitting 11. When a predetermined pressure is attained, the pressure responsive valve in the exercise head is actuated and the ballast fluid is expelled through the openings 21, 22 and 23. Thereafter the torpedo becomes buoyant and surfaces facilitating recovery.

While there are other devices having to do with the control of the torpedo during test, including steering and depth control devices together with suitable apparatus for transmitting vibrations to the surrounding fluid medium and apparatus responsive to such vibrations for ascertaining the location of the torpedo with respect to the point of location of said vibration responsive apparatus, none is herein disclosed since per se it forms no part of the present invention. This is mentioned in passing that it will be understood that the present invention in conjunction with equipment of the type noted is contemplated in the complete control of a torpedo.

It will be apparent that the present invention by reason of the judicious distribution and relation of the components embodied therein provides for proper trimming of the torpedo and adequate buoyancy control together with simplicity of servicing of the head between trial runs.

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The foregoing disclosure and the showings made in the drawings are merely illustrative of the principles of this invention and are not to be interpreted in a limiting sense, the only limitations are to be determined from the scope of the appended claims.

We claim as our invention:

1. Control apparatus for a test torpedo comprising, in combination, a fluid tight ballast chamber having an opening therein for loading said chamber with ballast fluid, a pressure responsive valve in said ballast chamber through which said ballast fluid is exhausted from said ballast chamber, at least one gas-tight container disposed in said ballast chamber, a normally closed control valve disposed externally of said ballast chamber and communicating therewith, pipe means connecting said gas-tight container with said control valve externally of said chamber, valve means connected in said pipe means internally of said ballast chamber and arranged to be manipulated externally of the ballast chamber, to provide communication with the gas-tight container for effecting filling thereof with gas under pressure from an external source of gas pressure, and control means for operating said control valve so that gas may flow from said gas-tight container through said control valve into said ballast chamber and expel said ballast fluid from said ballast chamber through said pressure responsive valve.

2. Control apparatus for a test torpedo comprising, in combination, a fluid tight ballast chamber having an opening therein for loading said chamber with ballast fluid, a pressure responsive valve in said ballast chamber through which said ballast is exhausted from said ballast chamber, at least one gas-tight container disposed in said ballast chamber, a blowout valve disposed externally of said ballast chamber and having a passage therethrough communicating with said ballast chamber, a diaphragm sealing said passage, pipe means connecting said gas-tight container with said blowout valve externally of said chamber, valve means connected in said pipe means internally of said ballast chamber and arranged to be manipulated externally of said ballast chamber to provide communication with the gas-tight container for effecting filling thereof with gas under pressure from an external source of gas pressure, and means for introducing gas under pressure to said passage of said blowout valve to effect breaking of said diaphragm.

3. Control apparatus for a test torpedo comprising, in combination, a fluid tight ballast chamber having an opening therein for loading said chamber with ballast fluid, a pressure responsive valve in said ballast chamber through which said ballast is exhausted from said ballast chamber, at least one gas-tight container disposed in said ballast chamber, a blowout valve disposed externally of said ballast chamber and having a passage therethrough communicating with said ballast chamber, a diaphragm sealing said passage, pipe means connecting said gas-tight container with said blowout valve externally of said chamber, valve means connected in said pipe means internally of said ballast chamber and arranged to be manipulated externally of said ballast chamber to provide communication with the gas-tight container for effecting filling thereof with gas under pressure from an external source of gas pressure, a normally closed control valve having a cartridge chamber formed therein constructed to receive

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a cartridge, said control valve being connected in said pipe means adjacent to and ahead of said blowout valve, means responsive to the products of combustion of said cartridge for opening said control valve so that gas under pressure is applied to said diaphragm to cause breaking thereof, and means for detonating said cartridge.

4. Control apparatus for a test torpedo comprising in combination, a fluid tight ballast chamber having an opening therein for loading said chamber with ballast fluid, a pressure responsive valve in said ballast chamber through which said ballast is exhausted from said ballast chamber, at least one gas-tight container disposed in said ballast chamber, a blowout valve disposed externally of said ballast chamber and having a passage therethrough communicating with said ballast chamber, a diaphragm sealing said passage, pipe means connecting said gas-tight container with said blowout valve externally of said chamber, valve means connected in said pipe means internally of said ballast chamber and arranged to be manipulated externally of said ballast chamber to provide communication with the gas-tight container for effecting filling thereof with gas under pressure from an external source of gas pressure, a normally closed control valve having a cartridge chamber formed therein constructed to receive an electrically explodable cartridge, said control valve being connected in said pipe means adjacent to and ahead of said blowout valve, means responsive to the products of combustion of said cartridge for opening said control valve so that gas under pressure is applied to said diaphragm to cause breaking thereof, and means for supplying electrical energy to said cartridge.

5. Apparatus as set forth in claim 1 in which said valve means comprises a charge valve and a two-position stop valve movable to open and closed positions, each of said valves being disposed internally of said ballast chamber and being connected in said pipe means, said valves being arranged so that each may be manipulated externally of said ballast chamber, said charge valve having a portion thereof externally of said chamber constructed to receive a fitting connecting with a high-pressure gas source, said charge valve and said stop valve being utilized to fill said gas-tight container with gas under pressure wherein said fitting is connected with said charge valve and said stop valve, placed in open position to admit gas to said container, thereafter when said container is filled with gas at desired pressure said stop valve is closed off and said fitting removed, said portion of said charge valve externally of said chamber being then sealed off and said stop valve opened to permit pressure equalization through said pipe means to said control valve.

6. Apparatus as set forth in claim 2 in which said valve means comprises a charge valve and a two-position stop valve movable to open and closed positions, each of said valves being disposed internally of said ballast chamber and being connected in said pipe means, said valves being arranged so that each may be manipulated externally of said ballast chamber, said charge valve having a portion thereof externally of said chamber constructed to receive a fitting connecting with a high-pressure gas source, said charge valve and said stop valve being utilized to fill said gas-tight container with gas under pressure wherein said fitting is connected with said charge valve and said stop valve, placed in open

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position to admit gas to said container, thereafter when said container is filled with gas at desired pressure said stop valve is closed off and said fitting removed, said portion of said charge valve externally of said chamber being then sealed off and said stop valve opened to permit pressure equalization through said pipe means to said control valve.

7. Control apparatus for a test torpedo comprising, in combination, a water-tight hull section for said torpedo having an opening therethrough for loading said hull section with liquid ballast, a cover for said opening, a pressure responsive valve arranged in a second opening in said hull section through which said liquid ballast may be exhausted, at least one gas-tight container supported within said hull section, a bulkhead having a recessed section formed therein directed into said hull section and disposed to seal one extremity of said hull section, a normally closed control valve disposed in said recessed section and communicating with said hull section, control means disposed in said recessed section of said bulkhead and arranged for effecting operation of said control valve, pipe means extending through said bulkhead and connecting said gas-tight container with said control valve, and valve means connected in said pipe means within said hull section and arranged to be manipulated externally of said hull section, to provide communication with the gas-tight container so that filling thereof with gas may be effected from an external source of gas pressure.

8. Control apparatus for a test torpedo comprising, in combination, a water tight hull section for said torpedo having an opening therein for loading said hull section with ballast fluid, a cover for sealing said opening, a pressure responsive valve in said hull section through which said ballast fluid is expelled, at least one gas-tight container supported within said hull section, a bulkhead having a recessed section formed therein directed into said hull section and disposed to seal one extremity of said hull section, a blowout valve disposed in said recessed section and having a passage therethrough communicating with said hull section through said bulkhead, a diaphragm sealing said passage, pipe means extending through said bulkhead and connecting said gas-tight container with said blowout valve, valve means connected in said pipe means internally of said hull section and arranged to be manipulated externally thereof to provide communication with the gas-tight container for effecting filling thereof with gas under pressure from an external source of gas pressure, and means for introducing gas under pressure to said passage of said blowout valve for breaking said diaphragm.

9. Control apparatus for a test torpedo comprising, in combination, a water tight hull section for said torpedo having an opening therein for loading said hull section with ballast fluid, a cover for sealing said opening, a pressure responsive valve in said hull section through which said ballast fluid is expelled, at least one gas-tight container supported within said hull section, a bulkhead having a recessed section formed therein directed into said hull section and disposed to seal one extremity of said hull section, a blowout valve disposed in said recessed section and having a passage therethrough communicating with said hull section through said bulkhead, a diaphragm sealing said passage, pipe means extending through said bulkhead and connecting

said gas-tight container with said blowout valve, valve means connected in said pipe means internally of said hull section and arranged to be manipulated externally thereof to provide communication with the gas-tight container for effecting filling thereof with gas under pressure from an external source of gas pressure, a normally closed control valve having a cartridge chamber formed therein constructed to receive a cartridge, said control valve being connected in said pipe means in said recessed section adjacent to and ahead of said blowout valve, means responsive to the products of combustion of said cartridge for opening said control valve so that gas under pressure is applied to said diaphragm to cause breaking thereof, and means for detonating said cartridge.

10. Control apparatus for a test torpedo comprising, in combination, a water tight hull section for said torpedo having an opening therein for loading said hull section with ballast fluid, a cover for sealing said opening, a pressure responsive valve in said hull section through which said ballast fluid is expelled, at least one gas-tight container supported within said hull section, a bulkhead having a recessed section formed therein directed into said hull section and disposed to seal one extremity of said hull section, a blowout valve disposed in said recessed section and having a passage therethrough communicating with said hull section through said bulkhead, a diaphragm sealing said passage, pipe means extending through said bulkhead and connecting said gas-tight container with said blowout valve, valve means connected in said pipe means internally of said hull section and arranged to be manipulated externally thereof to provide communication with the gas-tight container for effecting filling thereof with gas under pressure from an external source of gas pressure, a normally closed control valve having a cartridge chamber formed therein constructed to receive an electrically explodable cartridge, said control valve being disposed in said recessed section and connected in said pipe means adjacent to and ahead of said blowout valve, means responsive to the products of combustion of said cartridge for opening said control valve so that gas under pressure is conducted to said passage and applied to said diaphragm to cause breaking thereof, and means for supplying electrical energy to said cartridge.

11. Control apparatus for a test torpedo comprising, in combination, a hull section for said torpedo having an opening therein for loading said hull section with liquid ballast, a cover for sealing said opening, a pressure responsive valve in said hull section through which said ballast fluid is expelled, at least one gas-tight container disposed in said hull section, a bulkhead having a recessed section formed therein directed into said hull section and disposed to seal one extremity of said hull section, a blow-out valve disposed in said recessed section and having a passage therethrough communicating with said hull section through said bulkhead, a diaphragm sealing said passage, pipe means extending through said bulkhead and connecting said gas-tight container with said blowout valve, a normally closed control valve having a cartridge chamber formed therein for receiving an electrically explodable cartridge, said control valve being disposed in said recessed section and connecting with said pipe means at a point adjacent to and ahead of said blowout valve, means responsive to the pro-

ducts of combustion of said cartridge for opening said control valve so that gas under pressure is applied to said diaphragm to cause breaking thereof, a stop valve connected in said pipe means internally of said hull section, said stop valve being supported by said hull section and having a portion thereof extending therethrough so that manipulation thereof externally of said hull section may be effected, said stop valve being movable to two positions for closing and opening the passage afforded by said pipe means, a charge valve connected in said pipe means internally of said hull section on the side of said stop valve away from said gas-tight container, said charge valve being supported by said hull section and having a portion thereof providing communication with said pipe means extending through said hull section, means for opening and closing said portion of said charge valve, said portion of said charge valve extending through said hull section being constructed to receive air under pressure to supply said container, said stop valve being opened upon the application of air under pressure to said charge valve and being moved to closed position prior to removal of said air pressure when said container is filled, and thereafter upon closure of said charge valve being opened to permit the passage of air through said pipe means to said blowout valve.

12. Control apparatus for a test torpedo comprising, in combination, a hull section for said torpedo having an opening therein for loading said hull section with liquid ballast, a cover for sealing said opening, a pressure responsive valve in said hull section through which said ballast fluid is expelled, at least one gas-tight container disposed in said hull section, a bulkhead having a recessed section formed therein directed into said hull section and disposed to seal one extremity of said hull section, a blowout valve disposed in said recessed section and having a passage therethrough communicating with said hull section through said bulkhead, a diaphragm sealing said passage, pipe means extending through said bulkhead and connecting said gas-tight container with said blowout valve, a normally closed control valve having a cartridge chamber formed therein for receiving an electrically explodable cartridge, said control valve being disposed in said recessed section and connected with said pipe means at a point adjacent to and ahead of said blowout valve, means responsive to the products of combustion of said cartridge for opening said control valve to apply gas under pressure to said diaphragm and cause breaking thereof, a cover closing a stop valve, pipe means internally of said hull section, said stop valve being supported by said hull section and having a portion thereof extending therethrough so that manipulation thereof externally of said hull section may be effected, said stop valve being movable to two positions for closing and opening the passage afforded by said pipe means, a charge valve connected in said pipe means internally of said hull section on the side of said stop valve away from said gas-tight container, said charge valve being supported by said hull section and having a portion thereof providing communication with said pipe means extending through said hull section, means for opening and closing said portion of said charge valve, said portion of said charge valve extending through said hull section being constructed to receive air under pressure to supply said container, said stop valve being opened upon the application of air under pressure to said charge valve and being

moved to closed position prior to removal of said air pressure when said container is filled, and thereafter upon closure of said charge valve being opened to permit the passage of air through said pipe means to said control valve.

13. In combination with a torpedo having a propulsion shaft for driving the torpedo propellers and a motor for driving said shaft, an exercise head of substantial ogival configuration forming the nose of said torpedo and having an opening therein for loading said head with ballast fluid, a cover for sealing said opening, a pressure responsive valve disposed in said exercise head and arranged to permit the passage of said ballast fluid therethrough from said exercise head upon the occurrence of a predetermined fluid pressure in said head, at least one flask supported in said exercise head, a bulkhead sealing the aft extremity of said exercise head, said bulkhead having a recessed section formed therein, said bulkhead having an opening therethrough in said recessed section, a blowout valve disposed over said opening and having a passage therethrough connecting with said opening, a diaphragm sealing said passage, a tubular fluid conductor extending through said bulkhead and connecting said flask with said blowout valve, a stop valve movable to open and closed positions connected in said tubular fluid conductor between said bulkhead and said flask, said stop valve having a portion thereof extending externally of said exercise head so that manipulation of said stop valve to said open and closed positions externally of said exercise head is had, a charge valve connected in said tubular conductor between said stop valve and said bulkhead and having a portion thereof constructed for the application of air pressure thereto extending externally of said exercise head, means for opening and closing said portion of said charge valve, said charge valve providing communication with said flask through said stop valve so that said flask may be filled with air under pressure, said stop valve being opened upon application of air pressure to said charge valve and closed prior to removal of said air pressure from said charge valve, upon closing of said charge valve, said stop valve being opened to permit passage of air under pressure to said blowout valve, a normally closed control valve having a cartridge chamber formed therein for receiving an electrically explodable cartridge, said control valve being disposed in said recessed section and connected in said tubular conductor at a point adjacent to and ahead of said blowout valve, means responsive to the products of combustion of said cartridge for opening said control valve so that gas under pressure is applied to said diaphragm to cause rupturing thereof, time delayed contacting means, an electrical circuit controlled by said contacting means connected to said electrically explodable cartridge, and a source of electrical energy in said circuit.

14. In combination with a torpedo having a propulsion shaft for driving the torpedo propellers and a motor for driving said shaft, an exercise head of substantial ogival configuration

forming the nose of said torpedo and having an opening therein for loading said head with ballast fluid, a cover for sealing said opening, a pressure responsive valve disposed in said exercise head and arranged to permit the passage of said ballast fluid therethrough from said exercise head upon the occurrence of a predetermined fluid pressure in said head, at least one flask supported in said exercise head, a bulkhead sealing the aft extremity of said exercise head, said bulkhead having a recessed section formed therein, said bulkhead having an opening therethrough in said recessed section, a blowout valve disposed over said opening and having a passage therethrough connecting with said opening, a diaphragm sealing said passage, a tubular fluid conductor extending through said bulkhead and connecting said flask with said blowout valve, a stop valve movable to open and closed positions connected in said tubular fluid conductor between said bulkhead and said flask, said stop valve having a portion thereof extending externally of said exercise head so that manipulation of said stop valve to said open and closed positions externally of said exercise head is had, a charge valve connected in said tubular conductor between said stop valve and said bulkhead and having a portion thereof constructed for the application of air pressure thereto extending externally of said exercise head, means for opening and closing said portion of said charge valve, said charge valve providing communication with said flask through said stop valve so that said flask may be filled with air under pressure, said stop valve being opened upon application of air pressure to said charge valve and closed prior to removal of said air pressure from said charge valve, upon closing of said charge valve, said stop valve being opened, a normally closed control valve having a cartridge chamber formed therein for receiving an electrically explodable cartridge, said control valve being disposed in said recessed section and being connected in said tubular conductor at a point adjacent to and ahead of said blowout means responsive to the products of combustion of said cartridge for opening said control valve so that gas under pressure is applied to said diaphragm to cause breaking thereof, means providing an orifice in said tubular conductor for regulating the air flow through said tubular conductor, time delayed contact means, an electrical circuit controlled by said contacting means connected to said electrically explodable cartridge, and a source of electrical energy in said circuit.

LAWRENCE D. JENNINGS.
JOSEPH NAYMIK.

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The following references are of record in the file of this patent:

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