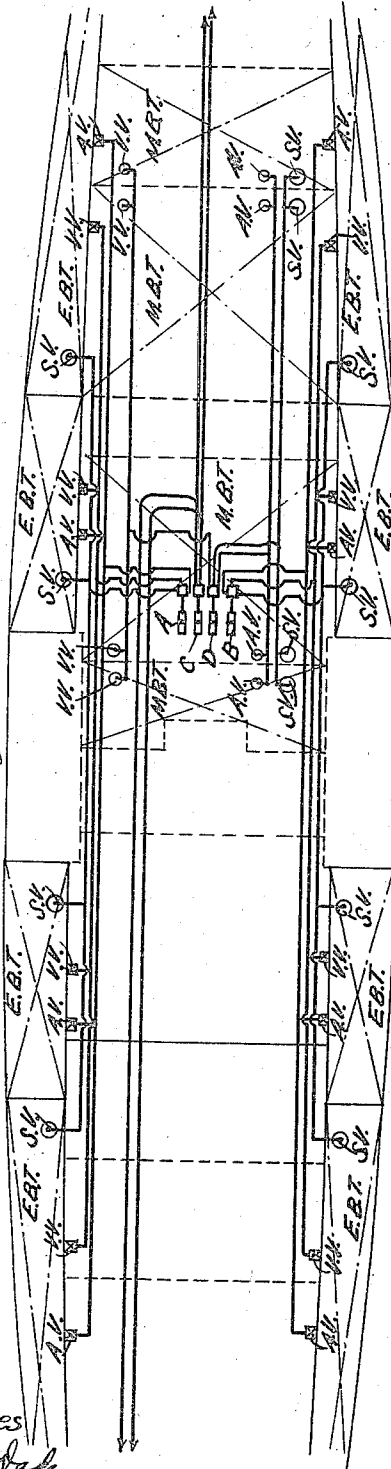


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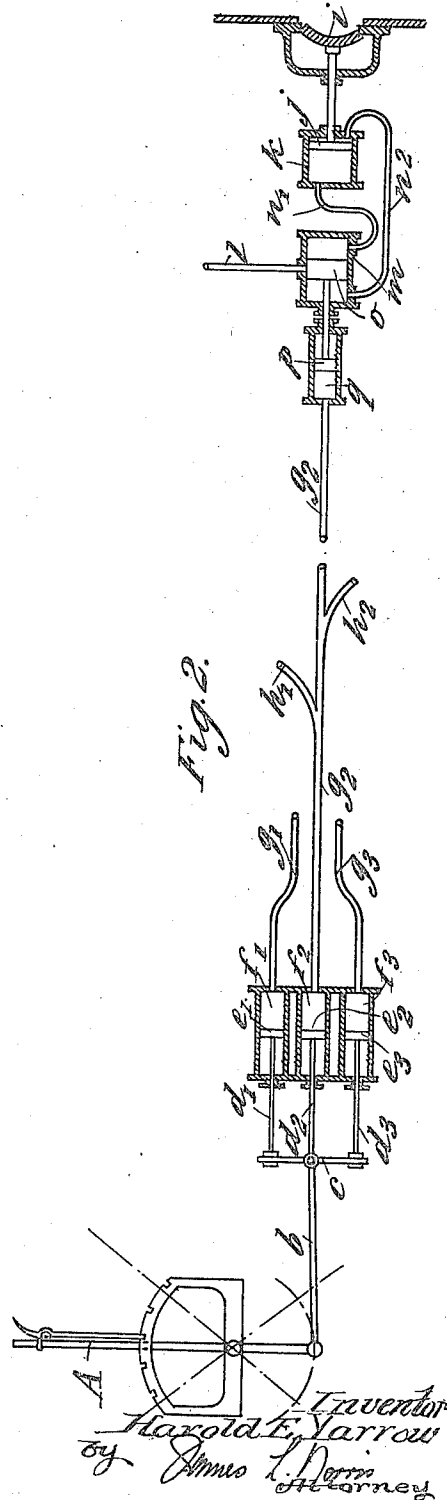
Patented Sept. 11, 1917.
 2 SHEETS—SHEET 1.

Fig. 1.



Witnesses
 M. E. McCabe
 C. E. Keeler

Fig. 2.

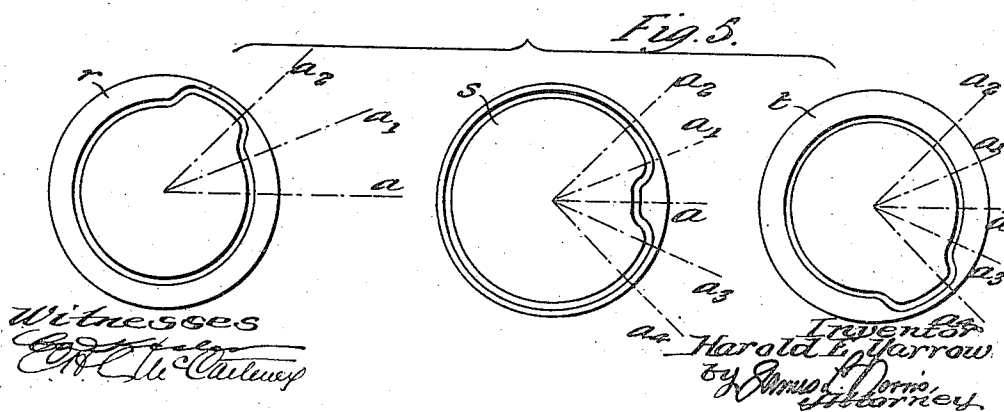
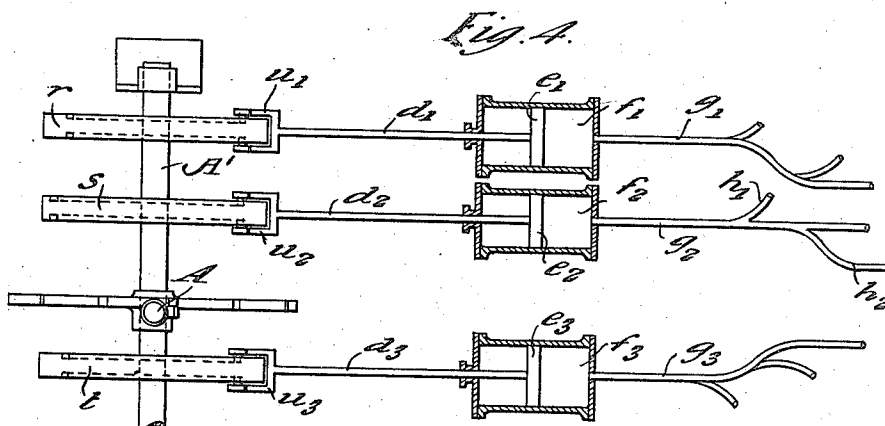
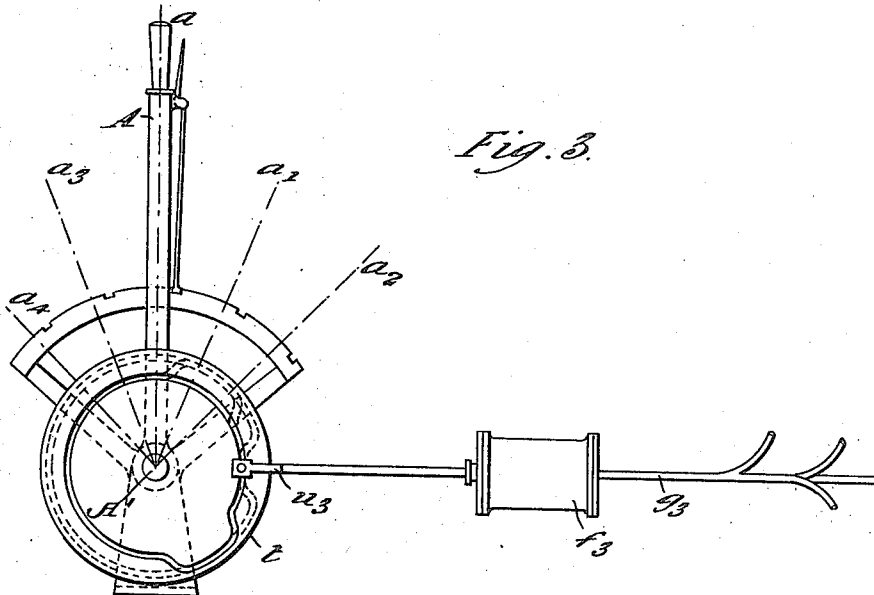


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UNITED STATES PATENT OFFICE.

HAROLD EDGAR YARROW, OF SCOTSTOUN, GLASGOW, SCOTLAND.

EMPTYING AND FILLING THE BALLAST-TANKS OF SUBMARINE VESSELS.

1,239,999.

Specification of Letters Patent.

Patented Sept. 11, 1917.

Application filed November 27, 1916. Serial No. 133,778.

To all whom it may concern:

Be it known that I, HAROLD EDGAR YARROW, a subject of the King of Great Britain, residing at Scotstoun, Glasgow, Scotland, have invented certain new and useful Improvements Relating to Emptying and Filling the Ballast-Tanks of Submarine Vessels, of which the following is a specification.

This invention relates to arrangements for filling and emptying the ballast tanks of submarine vessels.

Each ballast tank is usually provided with three valves, viz. a sea valve through which the water enters or leaves a tank, a venting valve to let the air escape when the water is entering a tank, and a valve through which compressed air enters to expel the water from a tank.

As there are several ballast tanks in a submarine vessel a large number of valves widely distributed must be operated in a short time when the displacement of the vessel has to be rapidly altered. According to the present invention the operation is facilitated by the provision of one or more central stations at which there are levers or the like, each of which is adapted to control the setting of the valves of one tank or of a group of ballast tanks.

In the accompanying drawing, Figure 1 is a part plan of a submarine vessel showing diagrammatically the position of the various ballast tanks and their valves and means according to the invention for operating the valves. Fig. 2 shows diagrammatically an example of means for operating a group of valves by air or liquid under pressure.

Fig. 3 shows a side elevation of a modification or development of the actuating mechanism.

Fig. 4 shows a diagrammatic plan of this mechanism, and

Fig. 5 shows the setting of the cams.

Referring to Fig. 1 A and B are control levers for operating respectively the valves of the port and starboard external ballast tanks E, B, T. C is a lever for operating the valves of the forward and aft trimming tanks. These trimming tanks are situated respectively forward and aft of the arrow heads shown on the lines in connection with the lever C. D is a lever for operating the valves of the main ballast tanks M, B, T. A V are compressed air valves, SV sea valves and VV venting valves.

Referring to Fig. 2, A is a lever which

when placed in the central position causes all the valves of the tank or group of tanks which it controls to be shut. When the lever is displaced to the extreme position in one direction, the sea and venting valves of that tank or group would be opened, so that the sea water would enter the ballast tank or the group of ballast tanks. When the lever is displaced to the extreme position in the other direction, the sea and compressed air valves of the tank or group would be opened, so that the water would be expelled from the tank or group of ballast tanks.

The lever A is connected by a link *b* to a crosshead *c* to which are attached piston rods *d*₁, *d*₂, *d*₃ operating pistons *e*₁, *e*₂, *e*₃ working in cylinders *f*₁, *f*₂, *f*₃. From the cylinders, pipes *g*₁, *g*₂, *g*₃ lead to the mechanism for operating the compressed air, sea valves and venting valves of the ballast tanks controlled by the lever A; from each pipe such as *g*₂, branch pipes *h*₁, *h*₂, etc., may lead to connections of other valves of the same group, the pipe *g*₂, for example, with its branches controlling the sea valves of a group. The sea valve *i* is controlled, in the example shown, by means of a piston *j* in a cylinder *k*. Compressed air is supplied to a cylinder *m* through a lead *l* and is admitted either through the lead *n*₁ to the left of the piston *j* or through the lead *n*₂ to the right of the piston; in the former case the sea valve *i* is closed and in the latter case opened. The admission of air to the leads *n*₁, *n*₂ depends upon the position of the piston valve *o* in the cylinder *m*. In the central position of the valve the supply of compressed air to the cylinder is closed; when the piston valve is moved to the right, air is supplied to the lead *n*₂, and when moved to the left to the lead *n*₁. The piston valve *o* is controlled by a small piston *p* sliding in a cylinder *q*; the cylinders *q* and *f*₂ are in communication through the fluid contained in the pipe *g*₂, which may be either compressed air, glycerin, water or other fluid, any movement of the piston *e*₂ being communicated to the piston *p*. If the handle of the lever A is moved to the left, the pistons *e*₂ and *p* will be moved to the right and the sea valve *i* opened; a movement of the handle of the lever A to the right will cause the valve *i* to be shut. At the same time, the compressed air and venting valves of the same tank will be operated as required by the fluid in the leads *g*₁ and *g*₃ acting upon devices similar

to those described in connection with the sea valve z . Also through the branch leads h_1 , h_2 all the sea valves of the same group of ballast tanks may be simultaneously actuated and similarly through branch leads from the pipes g_1 , g_3 all the compressed air and venting valves of this group may be operated.

Any other suitable means for causing movements of the piston valve o to follow the movements of the control lever A may be substituted for the fluid connection shown in the example illustrated. For example, the movement of the lever A may close an electric switch which would energize an electromagnet operating the piston valve o .

Hydraulic pressure may be substituted for the air pressure admitted through the lead l .

The operation of the compressed air ventilating valves and sea valves may also be controlled directly by means of an electro motor actuating the spindle of the valve through worm or rack gearing, the movement of the electro motor being controlled by the lever A .

The arrangement may also be such that in the intermediate positions of the lever A shown in Fig. 2, other combinations of the valve settings may be effected. For example, if the lever A is placed in an intermediate position it could be arranged to open only the venting valves, a further movement of the lever A being required to open the sea valves. When the venting valves only were opened, this would adapt the control for the case in which hand, or power driven, pumps are used for emptying the ballast tanks.

In Fig. 3, the lever A has a central position a , and four other positions a_1 , a_2 , a_3 , a_4 . On the shaft A' to which this lever is keyed there are fixed three cam plates r , s , t , as shown in Fig. 4. Working in the grooves of the cam plates are three crossheads u_1 , u_2 and u_3 , connected by piston rods d_1 , d_2 and d_3 to pistons e_1 , e_2 and e_3 . These pistons work in cylinders f_1 , f_2 and f_3 which are connected, as explained in connection with Fig. 2, respectively, with the compressed air valves, sea valves and venting valves of the ballast tanks.

Fig. 5 shows diagrammatically the relative positions of the three cam plates r , s and t . When the lever A is in the position a , all the valves are shut, the piston rods d_1 , d_2 and d_3 being all pulled to the left. When the lever A is in the position a_1 , it will be seen that the cam plate r will not have moved the piston rod d_1 , as the path of the cam groove is circular from a to a_1 , so that the compressed air valves remain shut; the cam plate s will, however, have moved the piston rod d_2 and, consequently, will have actuated the sea valves; the cam plate t will not have moved the piston rod d_3 and, hence, the venting valves will remain shut,

so that with the lever A in the position a_1 , only the sea valves will be open.

When the lever A is in the position a_2 the piston rod d_1 will have been moved, as well as the piston rod d_2 , but the piston rod d_3 will not have been moved; and in this position both the sea valves and the compressed air valves will be open, the venting valves remaining shut. Similarly, with the lever A in the position a_3 , the sea valves only will be open; while in the position a_4 the sea valves and the venting valves will both be open, and the compressed air valves will remain shut.

Having thus described the nature of the said invention and the best means I know of carrying the same into practical effect, I claim:—

1. In a submarine vessel, the combination, with the valves of a group of ballast tanks; of a controlling member which, by its position, determines the setting of all of said valves, at whatever parts of the vessel they may be placed; and non-rigid means, adapted to open and close the valves, connecting said controlling member with each valve.

2. In a submarine vessel, the combination, with the valves of a group of ballast tanks; of a controlling member which, by its position, determines the setting of all of said valves, at whatever parts of the vessel they may be placed; and non-rigid means, adapted to open and close the valves, connecting said controlling member with each valve by fluid pressure.

3. In a submarine vessel, the combination, with the valves of a group of ballast tanks; of a controlling member which, by its position, determines the setting of all of said valves, at whatever parts of the vessel they may be placed; a fluid-actuated piston connected to each valve; and a valve for controlling the direction of movement of said piston, and itself controlled by the said controlling member.

4. In a submarine vessel, the combination, with the valves of a group of ballast tanks; of a controlling member which, by its position, determines the setting of all of said valves, at whatever parts of the vessel they may be placed; a fluid-actuated piston connected to each valve; a valve for controlling the direction of movement of said piston; and a fluid-actuated piston for controlling the last-named valve, itself controlled by said controlling member.

5. In a submarine vessel, the combination, with the valves of a group of ballast tanks; of a controlling member which, by its position, determines the setting of all of said valves, at whatever parts of the vessel they may be placed; and non-rigid means adapted to open and close the valves, connecting said controlling member with each valve; the controlling member being set-

table to different positions, so as to effect various combinations of the valve settings.

6. In a submarine vessel, the combination, with the valves of ballast tanks; of a
5 controlling device for operating said valves by fluid pressure, comprising as many cylinders as there are valves to be operated in each tank, a piston in each cylinder, a controlling member by which the pistons are
10 moved, a pipe leading from each of said cylinders, a plurality of cylinders, one for each pipe, to which fluid is conveyed thereby, a piston movable in each second-named cylinder, in accordance with the motion of
15 the corresponding first-named piston, and means operated by the second-named pistons to cause fluid pressure to open and shut the corresponding valves in the said tanks.

7. In a submarine vessel, the combination,
20 with the valves of a group of ballast tanks; of a controlling device for operating said valves by fluid pressure, comprising as many cylinders as there are valves to be operated in each tank, a piston in each cylinder, a
25 controlling member by which the pistons are moved, a branched pipe leading from each of said cylinders, a cylinder in each branch, pistons movable in the second-named cylinders in accordance with the motion of the
30 corresponding first-named piston, and sliding valves operated by the second-named pistons to cause fluid pressure to open and close the corresponding valves in the said tanks.

35 8. In a submarine vessel, the combination, with the valves of a group of ballast tanks; of a controlling device for operating said valves by fluid pressure, comprising as many cylinders as there are valves to be operated
40 in each tank, a piston in each cylinder, a controlling member by which the pistons are moved, a branched pipe leading from each of said cylinders, a cylinder in each branch, pistons movable in the second-named cylinders in accordance with the motion of the
45 corresponding first-named piston, valves operated by the second-named pistons, compartments wherein the last-named valves are slidably arranged, pipes leading from each
50 end of the compartments, closed chambers to which fluid is conveyed by the last-named pipes, and members movable in said cham-

bers to open and close the corresponding valves in said tanks.

9. In a submarine vessel, the combination, 55 with the valves of a group of ballast tanks; of a controlling device for operating said valves by fluid pressure, comprising three cylinders, a piston in each cylinder, a lever by which said pistons are moved, a pipe conveying fluid from one of said cylinders and
60 branched to the mechanism operating the sea valves of a group of ballast tanks, a pipe conveying fluid from another of said cylinders and branched to the mechanism operating the vent valves of the group of ballast
65 tanks, a pipe conveying fluid from the third cylinder and branched to the mechanism operating the compressed air valves of the group of ballast tanks, and means operated
70 by the fluid in said pipes to open and close by fluid pressure the corresponding valves in the group of ballast tanks.

10. In a submarine vessel, the combination, 75 with the valves of a group of ballast tanks; of a controlling device for operating said valves by fluid pressure, comprising three cylinders, a piston in each cylinder, a lever by which the said pistons are moved, a pipe conveying fluid from one of said cylinders and branched to the mechanism operating the sea valves of a group of ballast
80 tanks, a pipe conveying fluid from another of said cylinders and branched to the mechanism operating the vent valves of the group of ballast tanks, a pipe conveying fluid from the third cylinder and branched to the mechanism operating the compressed air valves of the group of ballast tanks, and means
85 operated by the fluid in the said pipes, so that when said lever is displaced in one direction the sea and venting valves of the group of tanks are opened, and when the lever is displaced in the other direction the sea and compressed air valves of the groups
90 of tanks are opened. 95

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HAROLD E. YARROW.

Witnesses:

JAMES RITCHIE,
JOHN L. MAWER.