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COMPENSATING FOR TORPEDOES DISCHARGED FROM SUBMARINE BOATS.

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Fig. 1.

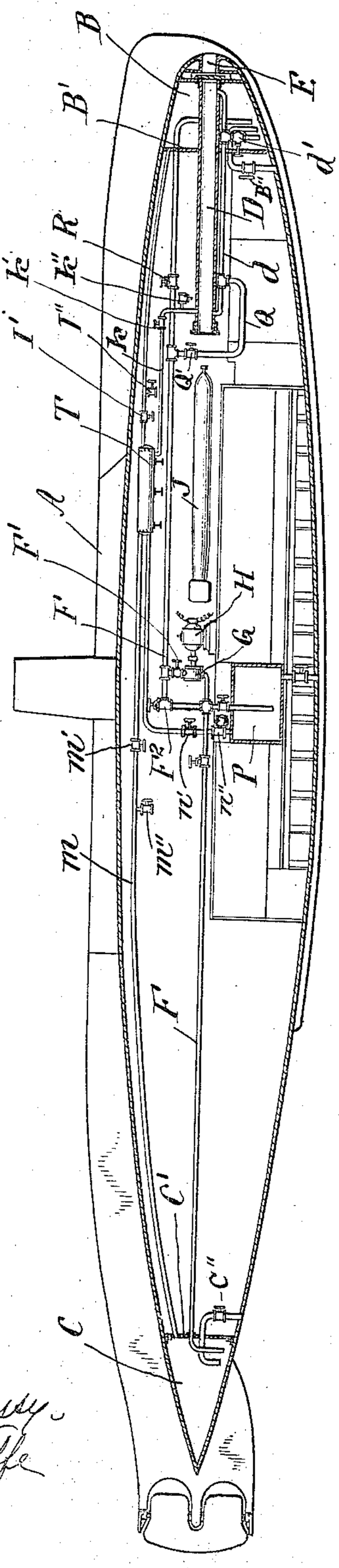
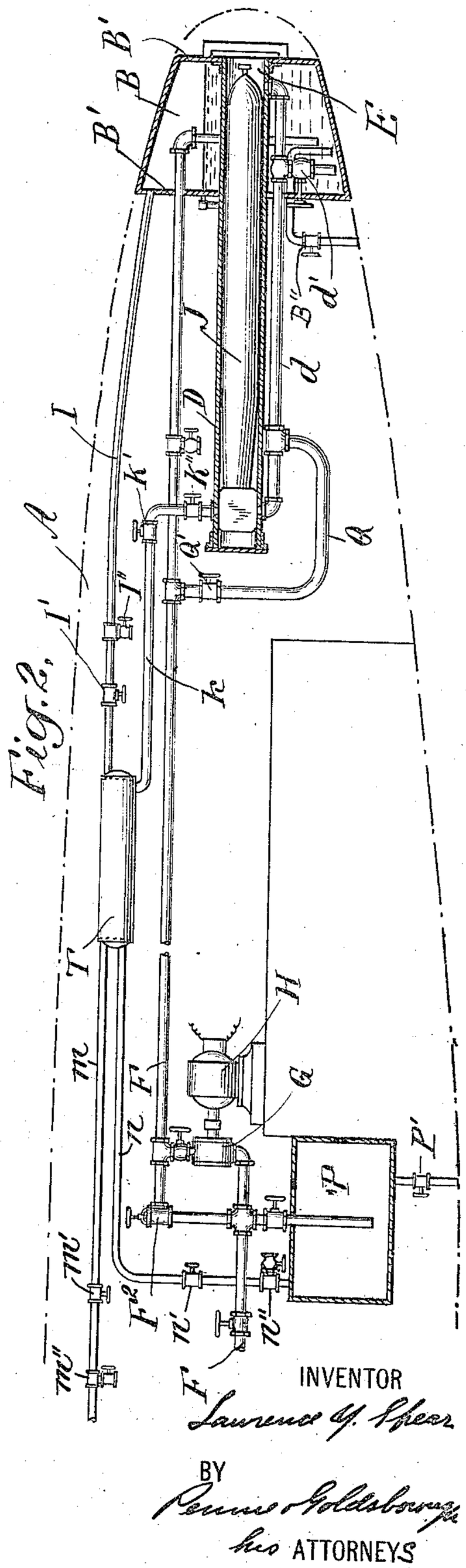


Fig. 2.



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COMPENSATING FOR TORPEDOES DISCHARGED FROM SUBMARINE BOATS.

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To all whom it may concern:

Be it known that I, LAWRENCE Y. SPEAR, a citizen of the United States, residing at Quincy, county of Norfolk, State of Massachusetts, have invented certain new and useful Improvements in Compensating for Torpedoes Discharged from Submarine Boats; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The object of the invention is to provide for maintaining the trim of a submarine or submersible torpedo boat as the torpedoes are fired therefrom. That is, it aims to compensate for the disturbance in the trim which would ordinarily result from moving the torpedoes from their storage racks to the torpedo tube and from discharging the torpedoes from the vessel through the tube.

As is well known, the principal armament of war vessels of the submarine or submersible type consists of automobile torpedoes and means for carrying and firing the same. The torpedoes are sometimes carried in firing tubes or other apparatus exterior to the hull proper. The preferred and more usual way is to fit the vessel with internal torpedo-discharge tubes, usually in the bow and sometimes also in the stern. The outer ends of such tubes, when the cap is open, communicate with the water of flotation, while the inner ends are provided with breech caps opening into the interior of the boat, so that the torpedoes may be loaded into the tubes from the interior of the boat, and may be discharged from the tubes; or may be withdrawn from the tubes into the interior of the boat. As the number of tubes which may be carried in a given size of boat is limited, it is very desirable that arrangements should be made to permit the firing of two or more torpedoes successively from the same tube; and in order that this operation may not interfere with the control and navigation of the vessel submerged, it is necessary to accomplish it without material change in the total weight of the vessel or in the position of its center of gravity, the vessel here being considered, of course, as including the full complement of torpedoes. In other words, it is necessary to compensate for the weight of torpedoes ejected and also for the inclining moment which is produced by moving a torpedo from its storage or loading position into the tube.

In some classes of submarine vessels, the inherent conditions as to stability, permissible fore and aft inclination, and so on, may be such as require a very exact compensation, and means have already been devised for securing it, the best known of which is that in patent to J. P. Holland, No. 683,400 granted September 24, 1901. It will be noted, however, that in this arrangement as well as in the known improvements of it, such, for instance, as are disclosed in the patent issued to me, No. 778,339, and the patent issued to Frank T. Cable, No. 778,350, under date of December 27, 1904, certain tanks of considerable volume are required to be located in close proximity to the torpedo tube, and in close proximity to the storage position of the torpedo which is to be loaded. In fact, these so-called compensating tanks have to be located so that their centers of gravity are in or near the same vertical planes as the centers of gravity of the tube or the torpedoes which they are intended to compensate, and each compensating tank occupies at least the same space as a torpedo would occupy. Moreover, piping connections of considerable size must be installed in order to load the torpedo quickly, since a considerable volume of water (in weight equal to the torpedo) has to be transferred from a forward tank to an after tank to compensate for the movement of the torpedo due to loading. As is well known, space in submarine vessels is limited and valuable, hence, if the desired compensation can be obtained without installing the compensating tanks above referred to, considerable improvement results. For example, the number of torpedoes carried in a boat may be increased or the space may be otherwise utilized. In accordance with my invention this compensation is brought about without these additional tanks, and the invention is applicable alike to vessels requiring very exact compensation as well as those which, by reason of their size, inherent stability, etc., do not require exact compensation. In compensating for the movement and discharge of the torpedoes I make use of the trimming tanks, which it is customary and usual to fit in submarine vessels, and connect with the water of flotation for the purpose of controlling the trim of the vessel. In this way, a great

saving in spaee and some saving in weight is accomplished, and the compensating operation is simplified.

In the drawings, I have illustrated somewhat diagrammatically, an arrangement of parts by which my invention may be carried into effect.

Figure 1 is a central longitudinal section through a submarine vessel, the showing being of a somewhat diagrammatic character to emphasize the parts to which my invention relates. Fig. 2 is a similar section on a larger scale of the parts in the bow of the vessel and showing the torpedo moved into the discharge tube.

It will be noted the drawings show a single tube fitted in the bow, and a single spare torpedo. The invention, however, is equally applicable to a vessel having a plurality of tubes located either in the bow or in the stern, and carrying a plurality of spare torpedoes which are to be fired in succession from one or from a plurality of tubes. It is customary and usual to fit in such vessels ballast tanks called trimming tanks, located at or near the bow and stern respectively. The ordinary function of these tanks is to bring the vessel to the desired fore and aft trim for submergence by partially or wholly filling the tanks, or either of them, with the water of flotation as may be required by the conditions. The trimming tanks are for this purpose provided with valves by which they may be put into communication with the water of flotation, and with supply connections leading to the compressed air reservoir. These tanks are evidently in close proximity to the torpedo tubes, which are always arranged either in the bow or in the stern.

The usual arrangement forward and aft is that shown in Fig. 1 of the drawings, but I do not limit myself to that exact arrangement as the invention is applicable to other and different arrangements which may be employed.

The hull of the boat is indicated in the drawing by the reference letter A and has in the bow and stern the usual trimming tanks B and C. These tanks are usually formed by closing off a portion of the hull of the boat, as by the bulkheads B′, B′ and C′. Each of these ballast tanks has a suitable connection and control valve, as indicated at B″ and C″ by which it may be put into communication with the water of flotation in the usual manner; and each of these tanks has valve controlled connections to a compressed air reservoir T whereby compressed air may be admitted to the tank to discharge the water contained therein. The ordinary bow torpedo tube is indicated at D, with a bow-cap E controlling the passage for the torpedo from the tube to the sea; and a spare torpedo is indicated by J, in the loading position in Fig. 1 and loaded within the torpedo tube in Fig. 2. For the purposes of the present invention the torpedo tube has a drain pipe *d* which may be put in open connection with the forward trimming tank B through valve *d′*. It is preferable, though not essential, to arrange the drain pipe *d* as shown, so that it drains both ends of the torpedo tube.

The forward and aft trimming tanks B and C are connected together by a piping connection F through which water may be passed from one tank to the other in either direction. This transfer of water may be effected by varying the pressures in the two tanks by means of the compressed air supply, but for the purposes of the present invention it is more advantageous to effect this transfer by means of a pump G inserted in the piping connections, and this pump may conveniently be of a reversible rotary type, driven by a variable speed motor, which is indicated in the drawing as an electric motor H. In order that the pump may be cut out of the system, if for any reason it becomes desirable to transfer the water by air pressure, there is provided a valved by-pass F^2; and the valve F′ serves to shut off connection to the pump. This transfer line F is connected to the drain pipe *d* by means of a connecting pipe Q controlled by valve Q′, and there is interposed in the transfer line F, between the connection Q and the forward trimming tank B, a stop valve R. The compressed air tank T, which is to be located in any convenient position, is in connection with the torpedo tube by pipe *k* controlled by valve *k′* and having a vent-cock *k″*. It is in communication with the forward trimming tank through pipe *l* having stop valve *l′* and vent-cock *l″*; and it is in communication with the after trimming tank C through pipe *m* having stop valve *m′* and vent-cock *m″*.

For the purposes of my present invention I preferably provide an excess of capacity in the trimming tank B so that it will hold, not only the water required for its normal functions, but also a volume of water at least equal to the internal volume of the tube D, plus the volume displaced by torpedo J multiplied by the number of spare torpedoes which it is desired to fire and compensate for.

In the trimming tank C I preferably provide excess capacity sufficient to hold at least a weight of water arrived at as follows: weight of spare torpedoes to be loaded, multiplied by the distance moved forward during the loading operation, divided by the distance between the centers of gravity of tanks B and C.

With the vessel thus equipped the compensating operation is preferably carried on as follows: It is customary to carry a tor-

pedo within a torpedo tube, and spare torpedoes on racks within the boat. Ordinarily the space in the discharge tube around the torpedo is filled with water when the vessels is trimmed for submergence. In special cases, however, the torpedo may be carried dry in the tube until a short time before it is desired to fire it. The space in the tube around the torpedo is then filled with water—ordinarily from the tank B. In either case, when ready to fire a torpedo, the bow-cap E is opened, thus affording a passage for the torpedo from the tube to the sea. As the tube is already full of water, no change in the weight or center of gravity of the vessel occurs. When the torpedo is fired, the inrush of sea water completely fills the tube, the tube ordinarily being vented at that time by the vent-cock k''. The bow-cap E is now turned to close the passage, and it will be observed that, since the weight of the torpedo is almost exactly equal to the weight of the same volume of water, no change in the weight or position of the center of gravity of the vessel as a whole has resulted from the firing of the torpedo. The valve d' and vent-cock l'' are now opened and, the vent k'' being closed, compressed air is admitted from tank T through valve k' to the tube, thus forcing the water in the tube into the forward trimming tank B. If, as illustrated and as is usually the case, the center of gravity of tank B does not coincide with that of tube D, this transfer of water will produce an inclining moment, tending to cause the vessel to change trim. If the conditions as to weight, stability, etc., are such as to make exact compensation desirable or necessary, this is obtained by passing water from the tand B to the tank C. For exact compensation the weight of water discharged should equal the weight of water discharged from the torpedo tube into the forward tank B, multiplied by the fore and aft distance between the centers of gravity of the torpedo tube and tank B, and divided by the fore and aft distance between the centers of gravity of tanks B and C. The preferred method is, as I have said, to use a variable speed pump, and to drive the pump at low speed, passing the water through the transfer line F, since by this method the compensating water is passed aft simultaneously with the emptying of the tube and may be so regulated as to produce any desired degree of fineness of compensation. If preferred, however, the pressure in tube D may be used to transfer the water. In that case the pump is shut off by the valve F′ and the by-pass F^2 is opened, as is also the valve Q′ in the connection Q, the valve R in the transfer line being closed. The amount of water passing aft may be regulated to the proper proportion by the valve Q′, and will be determined by experience in observing the gages with which the trimming tanks are equipped. After the tube is empty the breech door may be opened and a spare torpedo moved into the tube by any suitable means, the inclining moment thus produced being compensated by transferring the proper amount of water from B to C through transfer line F, either by the pump G or by air pressure. For exact compensation the weight of water transferred should equal the weight of the torpedo, multiplied by the fore and aft distance through which is is moved, divided by the distance between the centers of gravity of the trimming tanks. The breech door of the tube is now closed. Then vent-cock k'' and drain valve d' are opened, and compressed air is admitted to tank B through valve l', thus forcing water from tank B into tube D so as to fill the space surrounding the torpedo. When this is done, vent k'' and valve d' are closed. Exact compensation for the moment so produced may be obtained if desired by transferring a suitable weight of water from tank C to B through the transfer pipe, or the proper proportion of the water which enters tube D may be drawn from tank C by opening valve Q′ and admitting air to C.

It should be stated that the complete operations above described will be necessary only where the conditions require complete and exact compensation. In most modern instances, the weight of the boat compared to that of the torpedo is very large, and the stability and means for controlling the inclination of the boat considerable, so that exact compensation becomes unnecessary. For instance, it will frequently be found that no compensation for the movement of water from tube D to tank B is necessary, and in that case it is also unnecessary to compensate for the reverse movement of water from tank B to tube D. In such cases the transfer of water mentioned above, to compensate for these movements, is omitted, the compensating operation being limited to the necessary transfer to compensate for the movement of torpedoes from their storage places into the tube.

In the above discussion I have confined myself entirely to the use of the forward and aft trimming tanks B and C for compensation purposes, since when these tanks in the extreme ends of the vessel are used, the amount of water transferred is reduced to a minimum. It is, however, customary to locate amidship, a submergence tank P, which is normally intended to be used for adjusting the amount of buoyance. This tank is provided with a valve controlled connection to the water of flotation, as indicated at P′, and with a pipe connection as indicated at n to the compressed air reservoir, this connection including a stop valve

n' and vent-cock n''. It is obviously possible to use the tank P in my improved compensating arrangement, instead of the tank C, and this may be made particularly convenient by causing the dimensions and arrangements of the boat to be such as to bring the common center of gravity of P and B coincident or nearly so with the center of gravity of tube D. Where such is the case, the tube D could be emptied through orifices of equal area into the two tanks P and B without compensation.

I have already suggested the possibility of passing the water directly from the tube D to the tanks B and C in such proportions, by regulating the opening to valve Q', as to avoid any disturbance of the trim and give exact compensation. It is obviously possible to thus pass the water from the tube D directly in proper proportions to the tank B and to either of the tanks C or P, the valve Q' being properly adjusted.

The flexibility of the arrangement and method constitutes one of its great advantages, since use is made of appliances and features commonly installed for other purposes and the arrangement is such that the operator can produce a proper degree of compensation to suit the actual conditions existing.

What I claim is:

1. The method of compensating for the discharge and movement of torpedoes in submarine or submersible boats equipped with forward and aft trimming tanks, which method consists in admitting water to the torpedo tube from the sea to compensate for the discharged torpedo, and subsequently transferring the water in the tube to the forward and aft trimming tanks in such proportions as to compensate for the movement of a spare torpedo into the torpedo tube; substantially as described.

2. The method of compensating for the discharge and movement of torpedoes in submarine or submersible boats equipped with forward and aft trimming tanks, which method consists in admitting water from the sea to the torpedo tube to compensate for the discharged torpedo, subsequently transferring the admitted water to the adjacent trimming tank, and transferring a relatively small measured quantity of the water to the other trimming tank as a spare torpedo is moved into the torpedo tube, to compensate for such movement of the spare torpedo; substantially as described.

3. The method of compensating for the discharge and movement of torpedoes in submarine or submersible boats equipped with forward and aft trimming tanks, which method consists in admitting water to the torpedo tube from the sea to compensate for the discharged torpedo, transferring the admitted water to the adjacent trimming tank and to the other trimming tank in such proportions that the center of gravity is not changed, and subsequently transferring a relatively small measured quantity of the water to the second trimming tank to compensate for the movement of the spare torpedo into the discharge tube; substantially as described.

4. A submarine or submersible boat equipped with reserve torpedoes and a torpedo discharge tube, in combination with a forward trimming tank in the bow of the boat, connections through which water admitted to the tube from the sea after the torpedo is discharged may be transferred to the forward trimming tank, a second tank aft of the center of gravity of the torpedo tube, and connections through which a portion of the water so admitted may be transferred to said tank to compensate for the forward movement of a spare torpedo into the tube.

5. A submarine or submersible boat equipped with reserve torpedoes, a torpedo discharge tube, and forward and aft trimming tanks in the bow and stern respectively, in combination with connections through which the water admitted to the tube from the sea after the torpedo is discharged may be transferred to the adjacent trimming tank, and connections through which a portion of the water so admitted may be transferred to the other trimming tank to compensate for the movement of a spare torpedo into the discharge tube.

6. A submarine or submersible boat equipped with reserve torpedoes, a torpedo discharge tube, and forward and aft trimming tanks in the bow and stern respectively, in combination with connections through which the water admitted to the tube from the sea after the torpedo is discharged may be transferred to the adjacent trimming tank, and connections through which water may be transferred from the adjacent trimming tank to the other trimming tank to compensate for the movement of a spare torpedo into the discharge tube.

7. A submarine or submersible boat equipped with reserve torpedoes and a torpedo discharge tube, in combination with a forward trimming tank in the bow of the boat, connections through which water admitted to the tube from the sea after the torpedo is discharged may be transferred to the forward trimming tank, a second tank aft of the center of gravity of the torpedo tube, and connections through which a portion of the water so admitted may be transferred to said tank to compensate for the forward movement of a spare torpedo into the discharge tube, said connections including a controlled pump.

8. A submarine or submersible boat equipped with reserve torpedoes, a torpedo

discharge tube, and forward and aft trimming tanks in the bow and stern respectively, in combination with connections through which the water admitted to the tube from the sea as the torpedo is discharged may be transferred to the adjacent trimming tank, a transfer line from the adjacent trimming tank to the other trimming tank, through which water may be transferred to compensate for the movement of a spare torpedo into the discharge tube, and a branch connection between torpedo discharge tube and the transfer line.

9. A submarine or submersible boat equipped with reserve torpedoes, a torpedo discharge tube, and forward and aft trimming tanks in the bow and stern respectively, in combination with connections through which the water admitted to the tube from the sea as the torpedo is discharged may be transferred to the adjacent trimming tank, a transfer line from the adjacent trimming tank to the other trimming tank, through which water may be transferred to compensate for the movement of a spare torpedo into the discharge tube, a branch connection between the torpedo discharge tube and the transfer line, and a control valve for said connection.

10. A submarine or submersible boat equipped with reserve torpedoes and a torpedo discharge tube in combination with a forward trimming tank in the bow of the boat having an excess of capacity above that required for its normal functions equal to the internal volume of the discharge tube, plus the volume displaced by one of the reserve torpedoes multiplied by the number of such reserve torpedoes which it is desired to fire and compensate for, an aft trimming tank in the stern of the boat having an excess of capacity above that required for its normal function, sufficient to hold a weight of water equal to the weight of the reserve torpedoes to be loaded and fired multiplied by the distance through which they are moved forward during the loading operation, divided by the distance between the centers of gravity of the forward and aft trimming tanks, connections through which the water admitted to the torpedo tube from the sea when a torpedo is discharged may be transferred to the forward trimming tank, and connections through which a portion of the water so admitted may be transferred to the aft trimming tank to compensate for the forward movement of a spare torpedo into the torpedo discharge tube.

In testimony whereof I affix my signature, in presence of two witnesses.

LAWRENCE Y. SPEAR.

Witnesses:

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