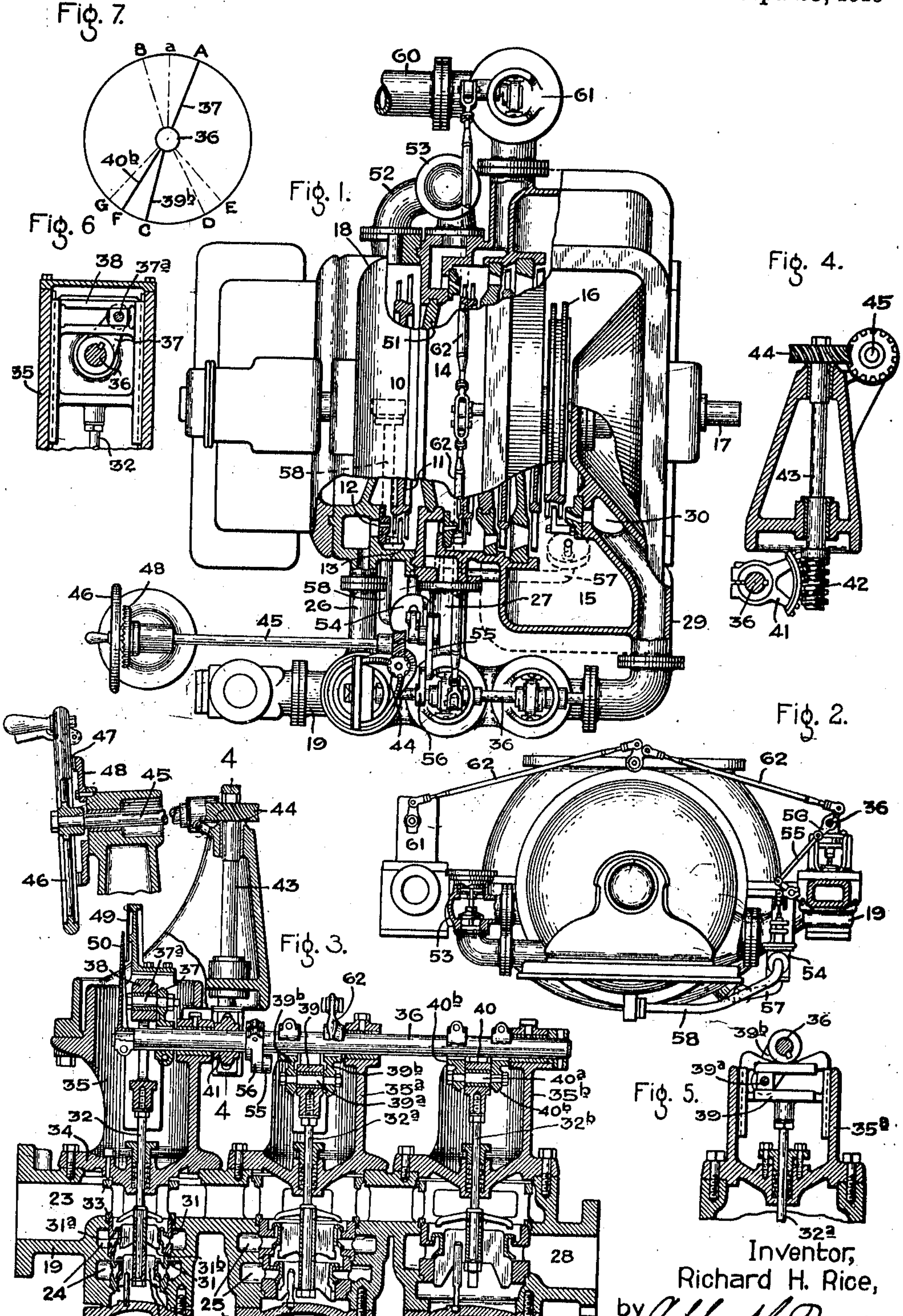
R. H. RICE.
MANEUVERING VALVE MECHANISM FOR SHIP TURBINES.
APPLICATION FILED JAN. 30, 1919.

1,317,036. Patented Sept. 23, 1919



Inventor,
Richard H. Rice,
by Albert G. Davis
His Attorney.

UNITED STATES PATENT OFFICE.

RICHARD H. RICE, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MANEUVERING VALVE MECHANISM FOR SHIP-TURBINES.

1,317,036. Specification of Letters Patent. Patented Sept. 23, 1919.

Application filed January 30, 1919. Serial No. 274,099.

To all whom it may concern:

Be it known that I, Richard H. Rice, a citizen of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Maneuvering Valve Mechanisms for Ship-Turbines, of which the following is a specification.

The present invention relates to valve mechanism for ship propelling turbines whereby the vessel may be controlled as to speed both in going forward and astern.

The invention comprises a novel arrangement of parts whereby a single handle suffices for controlling the entire forward and reversing operations, said parts being so arranged that it is impossible for the engineer to manipulate the valves except according to a definite and predetermined plan, thus avoiding all danger of mistakes in operation due to any cause whatsoever.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and claims appended thereto.

In the accompanying drawing which illustrates an embodiment of my invention, Figure 1 is a plan view of a turbine with certain of the parts broken away to illustrate the internal parts; Fig. 2 is a front elevation of the turbine looking aft; Fig. 3 is a sectional view of the principal controlling valves; Fig. 4 is a section on line 4—4 of Fig. 3; Fig. 5 is a detail of a part of the valve actuating means for the high speed or main turbine element; Fig. 6 is a similar detail of the valve actuating means of the cruising turbine element, and Fig. 7 is a diagram indicating the movements of the principal controlling valves.

The turbine can be varied in design to suit the conditions, and the elements may be all in a single casing or in two or more casings. As shown, the turbine comprises an auxiliary or cruising element 10, in this case having a single stage containing a wheel 11 having two rows of buckets and coöperating with the nozzles 12 and intermediate buckets 13 to extract energy from the steam. Following this and in the same casing is a main or high speed turbine or turbine element 14 comprising in this case three stages, the first having a wheel with two rows of wheel buckets and the others each a wheel with a single row. Coöperating nozzles are provided for said stages which are generally similar to the nozzles 12 but annular in form instead of segmental. The exhaust from the last wheel discharges into the exhaust chamber 15 in the casing from which it flows to a condenser (not shown). In the exhaust chamber is mounted a reversing element, comprising in this case a single wheel 16, having two rows of buckets with which are associated the usual nozzles and intermediate buckets. The nozzles and intermediates are generally similar to those in the forward driving parts of the turbine but are differently positioned to produce rotation in the opposite direction. All of the wheels are mounted on the main shaft 17 carried in suitable bearings attached to or forming a part of the casing 18. The propeller, not shown, is coupled to the rear end of the shaft, the right hand end in Fig. 1.

In considering the arrangement and operation of the valve mechanism it should be remembered that for cruising speeds the steam or other elastic fluid flows through all of the forward driving elements, and for reversing or going astern through the reversing element only.

On the starboard side of the turbine looking aft is located the main valve chest 19. In it are a cruising valve 20, a high speed valve 21 and a reversing valve 22. The valves are mounted in the same valve casing or chest 19 which makes for simplicity of construction, there being a supply chamber 23 running the full length thereof in the upper part. There are also formed in the chest and extending at right angles thereto chambers and passages leading to the turbine. Valves 20 and 21 each have two such chambers or passages 24 and 25 respectively. The passages in the case of cruising valve 20 are located in conduit 26, Fig. 1 and of the main valve in the conduit 27.

The reversing valve has a single chamber or passage 28, which communicates by the conduit 29, Fig. 1, with a conduit and supply chamber 30 in the exhaust head.

The cruising valve 20 has two seats and two cylindrical valve members 31 and each valve member has a lifter which comprises three or more guide arms or wings 31^a fastened on the valve stem 32. Wings 31^a form valve centers which move within cylindrical valve members 31 and have projections 31^b

which pick up valve members 31 in such manner that the valve members are opened and closed one after the other, the second valve starting to open after the first valve is fully open. It will also be noted that the valve lifters can move down away from valve members 31 when the stem 32 is moved downward. The valve seats are formed in a cage 33 which is introduced into the chest or casing 19 from the top. The portion of the casing under valve 20 is closed by a suitable head 20ª. Above valve cage 33 and fitting into it is a head 34 bolted to the casing and through which the valve stem extends. Rising from head 34 is a frame or housing 35 more or less tubular in form and open at its upper end. The high speed valve 21 is similar in construction to cruising valve 20 and the reversing valve 22 is likewise similar to it except that it has only one seat and one valve member. 32ª and 32ᵇ indicate the stems of the high speed and the reversing valves respectively, and 35ª and 35ᵇ their frames or housings. In housings 35, 35ª and 35ᵇ are bearings for the horizontal valve actuating shaft 36 which is rocked to and fro by means to be described later. On the left hand end of shaft 36 is keyed a crank 37 having a crank pin 37ª located in a block that slides in a yoke 38, Fig. 6. The yoke is suitably guided for vertical movements by housing 35 and has connected to it the upper end of valve stem 32. As the crank pin moves across the yoke Fig. 6 from one extreme angular position to the other it first opens the cruising valve and then closes it. The stem 32ª of high speed valve 21 is fastened to a yoke 39, through which extends a pin 39ª carried by the ends of two cranks 39ᵇ which are keyed to shaft 36. As shown in Fig. 5 yoke 39 moves in vertical guides carried by housing 35ª. The stem 32ᵇ of reversing valve 22 is fastened to a yoke 40 similar in construction and arrangement to yoke 39 and through which extends a pin 40ª carried by the ends of two cranks 40ᵇ which are keyed to shaft 36. Cranks 40ᵇ project downward from shaft 36 on the same side of the vertical axis as do cranks 39ᵇ but they make a slightly greater angle with the vertical as is clear from Fig. 3.

To actuate rock-shaft 36 a worm segment 41, Fig. 4, is keyed thereon which meshes with a worm 42 on the lower end of vertical shaft 43. On the upper end of shaft 43 is a spiral gear wheel 44 meshing with a similar gear on the operating shaft 45. The latter shaft extends forward, is mounted in suitable bearings, and has a hand wheel 46 secured thereto. Handwheel 46 has a locking latch 47 which enters slots between teeth on a stationary disk 48. Mounted on the upper end of the housing of the cruising valve is a support carrying a fixed dial 49 having suitable data thereon. Coöperating with the dial is a pointer 50 carried by rock-shaft 36 so that the engineer can always determine by a comparison of the pointer and dial, which valve is active and the position thereof.

Referring again to the turbine the cruising element 10 is cut off from the adjacent stage of the main turbine element 14, by a solid diaphragm 51. To permit steam to pass from the cruising turbine element to the main turbine element a by-pass conduit 52 is provided which leads from the casing of the cruising turbine element to the nozzles of the first stage of the main turbine element. In conduit 52 is located an automatically acting check valve 53, Fig. 2, of any suitable construction which opens toward the first stage of the main turbine element and permits steam to flow from the cruising turbine element to the main turbine element but prevents the flow of steam in the opposite direction. Due to this arrangement when cruising valve 20 is open and high speed valve 21 is closed steam flows through all of the forward driving stages in series, *i. e.*, through the cruising turbine element 10, and then through the main turbine element 14. On the other hand when valve 20 is closed and valve 21 is open the steam then flows through the forward driving stages of the main turbine element only.

To reduce the rotation losses in the cruising element 10 when it is idle, a vacuum valve 54 is provided which is positively actuated. The valve is on the right hand side of the machine and its stem is connected by suitable levers and a rod 55 to a lever 56 mounted on the rock shaft 36. The position of the parts for actuating vacuum valve 54, as shown in Fig. 2, is such that during certain portions of the angular movement of the rock-shaft practically no movement takes place. This is due to the fact that small angular movement of the lever 56 from its off or neutral position, Fig. 2, will not appreciably move the rod 55. One side of vacuum valve 54 is connected to some part of the turbine where a vacuum exists, as for example, to the exhaust chamber by conduit 57, shown in Figs. 1 and 2. The other side of valve 54 is connected by the conduit 58 to the casing of the cruising turbine element 10. The arrangement is such that when the cruising valve 20 is closed vacuum valve 54 is open and the vacuum connection is established. The valve mechanism is preferably so timed or adjusted that the vacuum valve opens slightly in advance of the complete closure of the cruising valve 20.

Where steam driven non-condensing auxiliaries are used in connection with the turbine installation, it is important to conserve the exhaust steam from the same and make it do useful work. To this end an exhaust conduit 60 for the auxiliaries is provided which leads to an intermediate stage of the main turbine element 14 and in conduit 60 is located a valve 61 which is similar in construction and operation to the reversing valve 22, for example, and is operated in the same manner. It is located on the left hand side of the turbine and motion from hand wheel 46 and rock-shaft 36 is transmitted to it by the rods 62 and associated levers. The arrangement is such that valve 61 is open whenever either cruising valve 20 or high speed valve 21 is open but is closed when reversing valve 22 is open. This latter is necessary because steam admitted through valve 61 tends to drive the turbines forward and hence in opposition to the direction in which it is driven by steam admitted through reversing valve 22. To take care of the exhaust steam supplied by the auxiliaries to conduit 60 during this brief period an ordinary atmospheric relief valve (not shown) may be inserted in conduit 60.

The operation is as follows:—Assume that the turbine is idle and the hand wheel 46 is in stop position so valves 20, 21 and 22 are closed. This will be indicated by pointer 50 and dial 49. The angular relation of the three cranks 37, 39^b and 40^b which operate valves 20, 21 and 22 are as indicated in Fig. 7 by the heavy lines designated 37, 39^b and 40^b. These are the positions of the cranks when the valves are in the positions indicated in Fig. 3. In the case of the cruising valve 20, the valve lifter is so positioned that the projections 31^b on the upper wings 31^a are against the upper valve members and the projections on the lower wings 31^a are spaced slightly from the lower valve member. It will thus be seen that an upward movement of stem 32 which would be occasioned by turning shaft 36 in a counter clockwise direction as viewed from the left hand end in Fig. 3, would open cruising valve 20 while a movement in the opposite direction would merely move the valve lifters down through the center of the valve leaving the valve closed. In the case of high speed valve 21, the lifting projections on the valve lifters for both valve members are spaced therefrom so that a limited movement of stem 32^a up or a movement of it down will produce no movement of valve 21. In the case of reversing valve 22 the valve lifter is positioned with its projections against the valve member so an upward movement of stem 32^b will open it while a downward movement will move the lifter away from the valve member. As will be seen from the diagram Fig. 7 an upward movement of stem 32^b would be occasioned by a turning of shaft 36 in a clockwise direction. When shaft 36 is turned in a counter clockwise direction reversing valve 22 will remain closed, the valve lifter moving downward away from the valve member.

If now it is desired to operate the turbine in a forward direction, hand wheel 46 is moved in a counter clockwise direction which results in moving cranks 37, 39^b and 40^b in such direction. Crank 37 will begin to move through the arc indicated A—B in Fig. 7 and when it reaches the point a, the highest point on arc A—B, the cruising valve 20 will have been fully opened which will give the highest cruising speed. The valve 61 for admitting exhaust steam from the auxiliaries will also be opened but the vacuum valves 54 will remain closed. The steam from valve 20 passes through the cruising turbine and then through the main turbine as is well understood the steam from the one to the other passing through conduit 52. If a still greater speed is desired it is necessary to cut off the admission of steam to the cruising turbine and admit steam directly to the main turbine so that cruising valve 20 must now be closed and high speed valve 21 opened. A further movement of hand wheel 46 in a counter clockwise direction will move crank 37 beyond point a, Fig. 7, so stem 32 will begin to be lowered and valve 20 to move toward closed position. At the point B valve 20 will be closed. In the meantime crank 39^b will have moved across the arc C—D and about the time it reaches point D the valve lifters on stem 32^a will begin to open valve 21, and in moving from D to E such valve will be fully opened. Although any desired arrangement can obviously be utilized the arrangement is preferably such that high speed valve 21 will begin to open just prior to the complete closing of cruising valve 20, that is the opening and closing movement of the two valves is carried out serially but overlap each other somewhat. After or about the time valve 20 is fully closed, vacuum valve 54 will be opened so the casing of the cruising turbine element 10 will be connected to vacuum. Valve 61 will remain open. During the opening movement of high speed valve 21, the crank 37 of cruising valve 20 will simply move on beyond point B, Fig. 7, lowering stem 32 and moving the lifters down away from the valve members. In the case of reversing valve 22, during the movements just described its crank 40^b will have moved through an arc at the bottom of the circle in Fig. 7, stem 32^b being first lowered and then raised again. The arrangement is such however, that valve 22 will not be opened.

If now it is desired to drive the turbine in the reverse direction it is first necessary to bring the hand wheel 46 back to stop position which is done by turning the hand wheel in a clockwise direction and after it has reached such position valves 20 and 21 will be closed and the lifter for valve 22 will be brought into engagement, with its valve member. A further movement of hand wheel 46 in a clockwise direction will then open reversing valve 22. The angular movement of crank 40^b necessary to fully open valve 22 is indicated by the arc F—G and during such angular movement valves 20 and 21 will remain closed as will be clear from an inspection of Fig. 3 in connection with Fig. 7 and from the explanation already given. Also valve 61 will remain closed.

It will thus be seen that with my improved arrangement the entire maneuvering of the ship is controlled in a simple manner by a single hand wheel, and that it is not possible for the operator to operate the valves in a wrong sequence.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. An elastic fluid turbine having elements arranged to develop different outputs at the shaft, and a reversing element, in combination with a controlling valve means for each of the said elements, and an actuating device which is common to all of said means and is so arranged that when moved in one direction from a given position it causes the valve means to admit motive fluid to the first mentioned elements in succession and when moved in another direction it causes the valve means to admit motive fluid to the reversing element only.

2. An elastic fluid turbine having two elements arranged to cause rotation of the shaft in one direction and a third element arranged to cause rotation of the shaft in the reverse direction, in combination with a controlling valve means for each element, and an actuating device which when moved in one direction from a given position first actuates the valve means in a manner to connect the first two said elements in series and then on further movement in the same direction to cut out the first element and supply motive fluid to the second of said elements only, and when moved in the opposite direction from said position, actuates the valve means of said reversing element.

3. An elastic fluid turbine having elements arranged to drive the shaft forward, and an element arranged to drive the shaft in the reverse direction, in combination with independent controlling valve means for said elements, a valve which permits motive fluid to flow from one element to another but prevents it from flowing in the opposite direction, and an actuator which when moved in one direction from a given position causes the valve means to gradually increase to a maximum the supply of motive fluid to the forward turbine elements, and when moved in the opposite direction to admit motive fluid to the reversing element.

4. An elastic fluid turbine having elements arranged to drive the shaft forward, and an element arranged to drive the shaft in a reverse direction, in combination with independent controlling valve means for each of the elements, an auxiliary valve for admitting motive fluid to a low pressure element of the turbine to assist in driving the shaft forward, and an actuator for adjusting the valve means to admit motive fluid to the forward elements to cause forward rotation of the shaft and at the same time open the auxiliary valve, and for shutting said valve means and auxiliary valve and opening the reversing valve means for reversing the direction of rotation of the shaft.

5. An elastic fluid turbine having auxiliary, main, and reversing elements, controlling valve means for each of the elements, a vacuum valve for the auxiliary element, an auxiliary valve admitting low pressure motive fluid to the main element, a check valve between the auxiliary and main elements, an actuator for the valve means which when moved in one direction from its neutral position first causes the valve means to admit motive fluid to the auxiliary element and also opens the auxiliary valve, and on further movement cause the valve means to admit motive fluid to the main element and shut it off from the auxiliary element and open the vacuum valve, and when moved in the opposite direction from said position to cause the valve means to cut off motive fluid from the main element, close the auxiliary valve and admit fluid to the reversing element.

6. An elastic fluid turbine comprising cruising, main and reversing elements, a valve means for each of said elements, a shaft, cranks moved by the shaft for actuating the valve means which cranks have different angular settings with respect to each other, and a means for turning the shaft.

7. An elastic fluid turbine having cruising, main and reversing elements, ports for the admission of motive fluid to said elements, valve means for each of said ports, a rock-shaft, cranks on the rock-shaft for said valve means, said cranks having different angular settings, an operating member, and means for transmitting motion from the operating member to the rock-shaft.

8. An elastic fluid turbine having cruising, main and reversing elements, ports for the admission of motive fluid to said elements, valve means for each of said ports, a shaft having cranks thereon, means con-

necting the cranks with the valve means, a hand wheel, and irreversible gearing which transmits motion from the hand wheel to the crank shaft.

9. An elastic fluid turbine having different ports for the admission of motive fluid, valve means for each of said ports, a rock-shaft, cranks carried thereby, some of which are located below its axis and the remainder above, a reciprocating cross-head for each valve means, pins on the cranks which actuate the cross-heads, and means for rocking the shaft.

10. An elastic fluid turbine having different ports for the admission of motive fluid, a valve means for each of said ports, a supply chest which is common to all of said valve means, is supported by the turbine and has an admission conduit at one end, a cross-head, crank and pin for each valve means, a rock-shaft which is also supported by the chest and carries said cranks, and a hand wheel and gearing for moving the shaft to cause the actuation of the valves.

11. In a governing mechanism for an elastic fluid turbine, the combination of a supply chest, passages leading therefrom to the turbine, valve members in the chest, a valve stem, means on the stem for actuating the valve members successively, a cross-head attached to the stem, a shaft, a crank on the shaft having a pin which actuates the cross-head, and means for moving the shaft.

12. An elastic fluid turbine comprising a main element, a cruising element, and a reversing element, all contained in the same casing, the cruising element being separated from the main element, a by-pass connection leading from the cruising element to the main element and containing a check valve which opens when steam flows toward the main element and closes when steam tends to flow in the opposite direction, a connection between the exhaust end of the main element and the cruising element, a vacuum valve for controlling it, supply valves for the elements, a valve admitting auxiliary steam to the main element, a rock-shaft, cranks on the rock-shaft for actuating the supply, vacuum and auxiliary steam valves, and an operating member for moving the rock-shaft.

13. An elastic fluid turbine comprising auxiliary main and reversing elements, a controlling valve means for each element, and an actuator for the means which when moved to one side of a given position causes the valve means to connect the auxiliary and main elements in series with the source of supply and on further movement in the same direction to cut out the auxiliary element, and when moved in the opposite direction from said position causes the valve means to admit motive fluid to the reversing element only.

14. In combination, a cruising element, a main element, a reversing element, a separate valve means for controlling admission of motive fluid to each element, a rock-shaft, and cranks on the rock-shaft which have different angular settings and are arranged to open one or another of said valves according to the arc through which the shaft is turned.

In witness whereof, I have hereunto set my hand this 28th day of January, 1919.

RICHARD H. RICE.