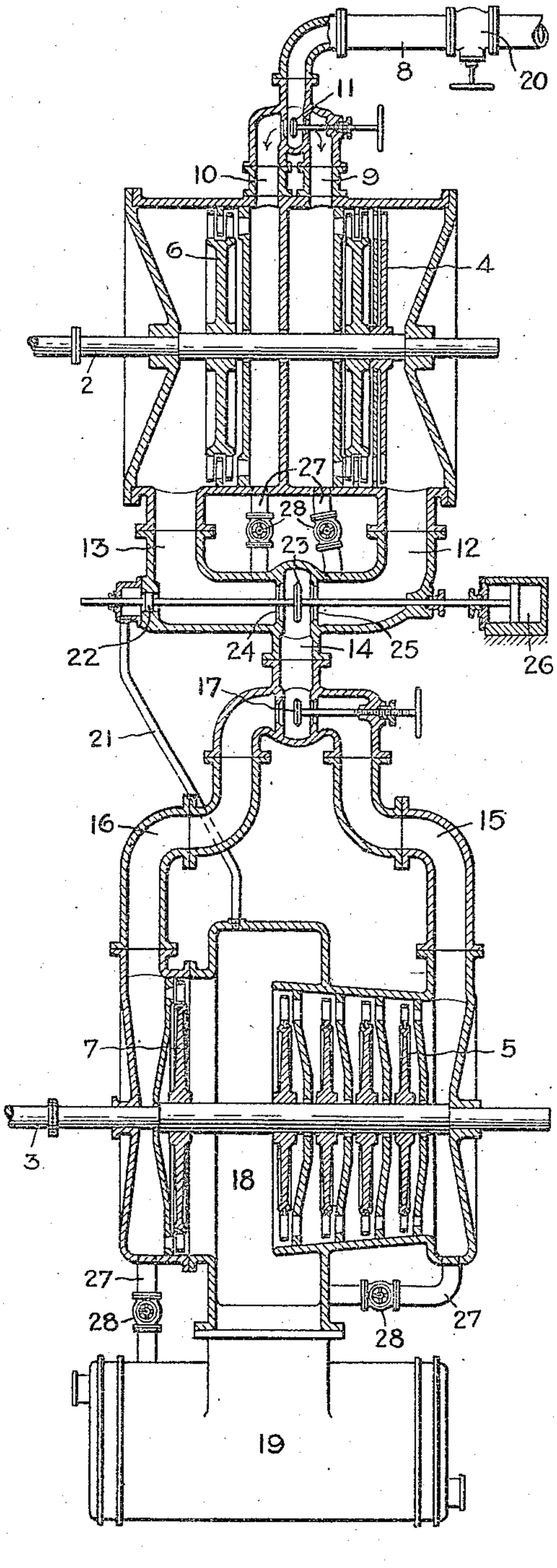
K. ALQUIST.

MARINE TURBINE.

APPLICATION FILED APR. 16, 1914.

1,155,029. Patented Sept. 28, 1915.



Witnesses:

Marcus L. Byng.

J. Ellis Glen

Inventor,
Karl Alquist,
by Albert G. Davis
Att'y.

UNITED STATES PATENT OFFICE.

KARL ALQUIST, OF SCHENECTADY, NEW YORK.

MARINE TURBINE.

1,155,029. Specification of Letters Patent. Patented Sept. 28, 1915.

Application filed April 16, 1914. Serial No. 832,229.

To all whom it may concern:

Be it known that I, KARL ALQUIST, a subject of the King of Sweden, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Marine Turbines, of which the following is a specification.

The present invention relates to elastic fluid turbines, as steam turbines, for marine propulsion, and particularly to such turbines when used in connection with two or more propeller shafts.

In the operation of several turbines a material saving in both weight and cost may be effected by running the machines in series. This is due primarily to the fact that the total number of bucket rings required in order to give a certain efficiency is materially reduced, as each turbine unit deals with a lesser pressure range than otherwise. The ordinary arrangement of turbine units connected in series cannot well be used for operating propeller shafts, however, due to the fact that it is essential that the shafts be capable of independent operation both forward and reversing.

The object of the present invention is to provide an arrangement wherein the turbine units associated with the respective shafts are connected in series, thereby saving in weight and which at the same time preserves the independence in operation of each propeller shaft.

In carrying out my invention I provide for each shaft a turbine unit which consists of a group of forward and a group of reversing elements. These units are connected in series and have their admission valve so arranged that each propeller shaft may be run forward, stopped, or reversed without interrupting the flow through the turbine. To this end I provide suitable conduits for conveying the motive fluid to the respective groups of each unit and valve mechanism in such conduits which may be operated to direct the motive fluid to either or both groups of any shaft unit.

The accompanying drawing is a diagrammatic view illustrating the invention as applied to two propulsion shafts.

Referring to the drawing, 2 and 3 are the turbine shafts, the one shaft 2 being driven by a high pressure turbine unit dealing with, for example. about 50% of the total steam energy; *i. e.*, from boiler pressure down to atmospheric pressure in the case of ordinary operating conditions, and the other shaft 3 being driven by a low pressure turbine unit utilizing the remaining steam energy; *i. e.*, from atmospheric pressure down to condenser pressure. It will be understood these values are given only by way of example. The turbine units are provided with forward elements or sections 4 and 5 respectively and reversing elements or sections 6 and 7 respectively. In the present instance these elements are shown as being of the "Curtis" or "impulse" type. Any preferred turbine type may be used however.

Motive fluid is led to the high pressure unit by conduit 8 which has a branch 9 connected with the forward elements and a branch 10 connected with the reversing elements. Arranged in the conduit is a suitable valve 11 which may be adjusted to direct the motive fluid to either branch 9 or 10, or to both, as will be obvious. The exhaust of the high pressure unit is connected by conduits 12 and 13 to the conduit 14 which has a branch 15 leading to the forward section 5 and a branch 16 leading to the reversing section 7 of the low pressure unit. The flow of motive fluid through branches 15 and 16 is controlled by a valve 17 similar to valve 11. The respective sections of the low pressure unit exhaust into the common chamber 18 which is in communication with the condenser 19.

The valves 11 and 17 are shown in the drawing in such positions that the flow of motive fluid is divided between the forward and reversing elements and it may be assumed that for this particular position the turbine units are at rest. The operation of the turbines is controlled by these valves, which may be hand operated or indirectly controlled, as for example by hydraulic pistons or other suitable system of servo-motors, as is well known.

It will be readily understood from the drawing that if the valve 11 is moved toward the left, the flow of motive fluid which has been assumed to be divided in such proportion between the respective elements 5 and 7 as to just balance them against each other and maintain the shaft at rest will be gradually directed in greater proportion to the forward elements 4. The result will be a greater force acting on the forward elements than that on the reversing elements and the turbine will begin to turn in a for-

ward direction. The maximum forward torque will be attained when valve 11 reaches the left valve seat thus entirely stopping the flow of motive fluid through reversing section 6. By moving valve 11 toward the right the turbine may be gradually reversed as will be obvious. The low pressure turbine unit is controlled by the valve 17 in a similar manner.

By the above arrangement it will be evident that the turbine units may be run forward, reversed or stopped without interrupting the flow of motive fluid therethrough and that any graduation of power, either forward or reverse, may be obtained. It will also be evident that the respective units can be controlled entirely independently of each other.

The total power of the complete machinery may be graduated and controlled by an ordinary throttle valve as shown at 20 placed in conduit 8 in advance of the valve 11.

The controlling valves 11 and 17 have been shown in their simplest form. It will be understood, however, that other forms and arrangements of valves may be used so long as the flow of motive fluid through the turbine units is not interrupted.

It will be obvious that with an ordinary valve arrangement that flow of motive fluid to the turbine units will be greatest when the valve 11 is in its middle position. Ordinarily, however, this will be no serious objection as the valve will occupy this position only occasionally and then usually for a very short period of time. An ordinary valve arrangement will, therefore, usually be sufficient. If found desirable, however, some means may be employed for keeping the flow approximately constant. In the present instance I have shown the valve as being somewhat thickened so as to tend to block off the flow when in the middle position and keep it uniform.

When both turbine units are running full speed forward with the valves 11 and 17 up against the left valve seats, the steam pressure around the wheel or wheels 6 would be approximately atmospheric and in some cases the rotation losses of this wheel, which is running idle under these conditions, may be considered too high. I have, therefore, shown an arrangement illustrating the general principle whereby the pressure around the elements 6 may be decreased. To this end I provide a pipe 21 leading from the casing surrounding the reversing section 6 to the chamber 18 which communicates with the condenser. Communication between this pipe and the casing surrounding the reversing element is controlled by the valve 22. On the same stem with this valve is a second valve 23 adapted to move between the two valve seats 24 and 25. These valves will be so arranged that valve 22 opens just prior to the seating of valve 23 against valve seat 24 and closes as soon as valve 23 moves from this seat. The movement of the valves is regulated by a suitable dash pot 26, which may take the form of a hydraulic piston for example. By this arrangement when valve 11 is against its left-hand seat the flow of motive fluid through conduit 12 will force valve 23 to the left, closing off the chamber surrounding the reversing section 6 and opening the valve 22, thereby connecting the chamber to the condenser. Any leakage of motive fluid past valves 11 or 22 will pass to the condenser by the pipe 21. The dash pot prevents hammering on the part of the valve. As will be clear the shifting of the valve 23 from one seat to the other, or to an intermediate position will be wholly automatic and will require no care or attention on the part of the attendant. I may also make provision for by-passing all, or part, of the steam past the wheels in either turbine. This may be advisable if one of the turbines has to be stopped for a comparatively long period while the other is working (for instance in the case of one of the propellers being damaged), so as to prevent unnecessary wear on the turbine buckets. To this end I may provide, for example, suitable by-pass conduits, as shown at 27, having throttling valves 28 therein. These valves will ordinarily be closed, and will only be opened when it is desired to partially or wholly cut a turbine section out of service.

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. The combination of a high pressure turbine having a group of forward and a group of reversing elements, a low pressure turbine connected in series therewith, a conduit for conveying motive fluid to the high pressure turbine having a branch leading to each group, and a single valve arranged in said conduit for directing the flow to either or both of said branches without at any time interrupting the flow, so that there is at all times a supply of low pressure motive fluid available for the low pressure turbine.

2. The combination of a plurality of shafts, a turbine unit for each shaft having a group of forward and a group of reversing elements, conduits connecting the turbine units in series, and valve means for controlling the flow of motive fluid to each unit arranged to direct the flow to either or

both groups of each unit without at any time interrupting the flow.

3. The combination of a high pressure turbine unit and a low pressure turbine unit, each having a group of forward and a group of reversing elements, a branched conduit for conveying motive fluid to the respective groups of the high pressure unit, a branched conduit for conveying motive fluid from the high pressure unit to the respective groups of the low pressure units, and valve means associated with each branched conduit for directing the flow to either group or dividing the flow between the two groups without at any time interrupting the flow.

4. The combination of a high pressure turbine unit and a low pressure turbine unit, each of which has a forward and a reversing section, a conduit for conveying motive fluid to the high pressure unit having a branch leading to each section thereof, a conduit for conveying motive fluid from the high pressure unit to the low pressure unit having a branch leading to each section of the low pressure unit, and valve means associated with each conduit for directing the flow to either section or dividing the flow between the two sections of the respective units without at any time interrupting the flow.

5. The combination with a high pressure turbine having forward and reversing sections exhausting at an intermediate pressure, and valve means for directing the flow to either of said sections, of a low pressure turbine which receives the exhaust therefrom, a condenser connected to the low pressure turbine, and means for connecting one of said high pressure turbine sections to the condenser when the motive fluid is being directed to the other.

6. The combination of a plurality of turbine units connected in series, each unit comprising a forward and a reversing section, valve means for each unit for directing the flow to either section thereof, a condenser, and automatic means controlled by the flow of the motive fluid for connecting the reversing section of a unit of higher pressure to the condenser when the flow of motive fluid is being directed to the forward section thereof.

7. The combination of a high pressure turbine and a low pressure turbine connected in series, said high pressure turbine having a forward and a reversing section, valve means for directing the flow of motive fluid to either of said sections, a common exhaust pipe into which both said sections exhaust, a condenser, and automatic valve means for disconnecting the one section from its exhaust and connecting it to the condenser when the motive fluid is directed to the other section.

8. The combination of a high pressure turbine and a low pressure turbine connected in series, said high pressure turbine having a forward and a reversing section, valve means for directing the flow of motive fluid to either of said sections, a common exhaust pipe into which both said sections exhaust, a condenser, and automatic valve means controlled by the flow of the motive fluid for disconnecting the reversing section from the common exhaust pipe and connecting it to the condenser when the motive fluid is directed to the forward section.

In witness whereof, I have hereunto set my hand this 15th day of April, 1914.

KARL ALQUIST.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.