No. 778,224. PATENTED DEC. 27, 1904.

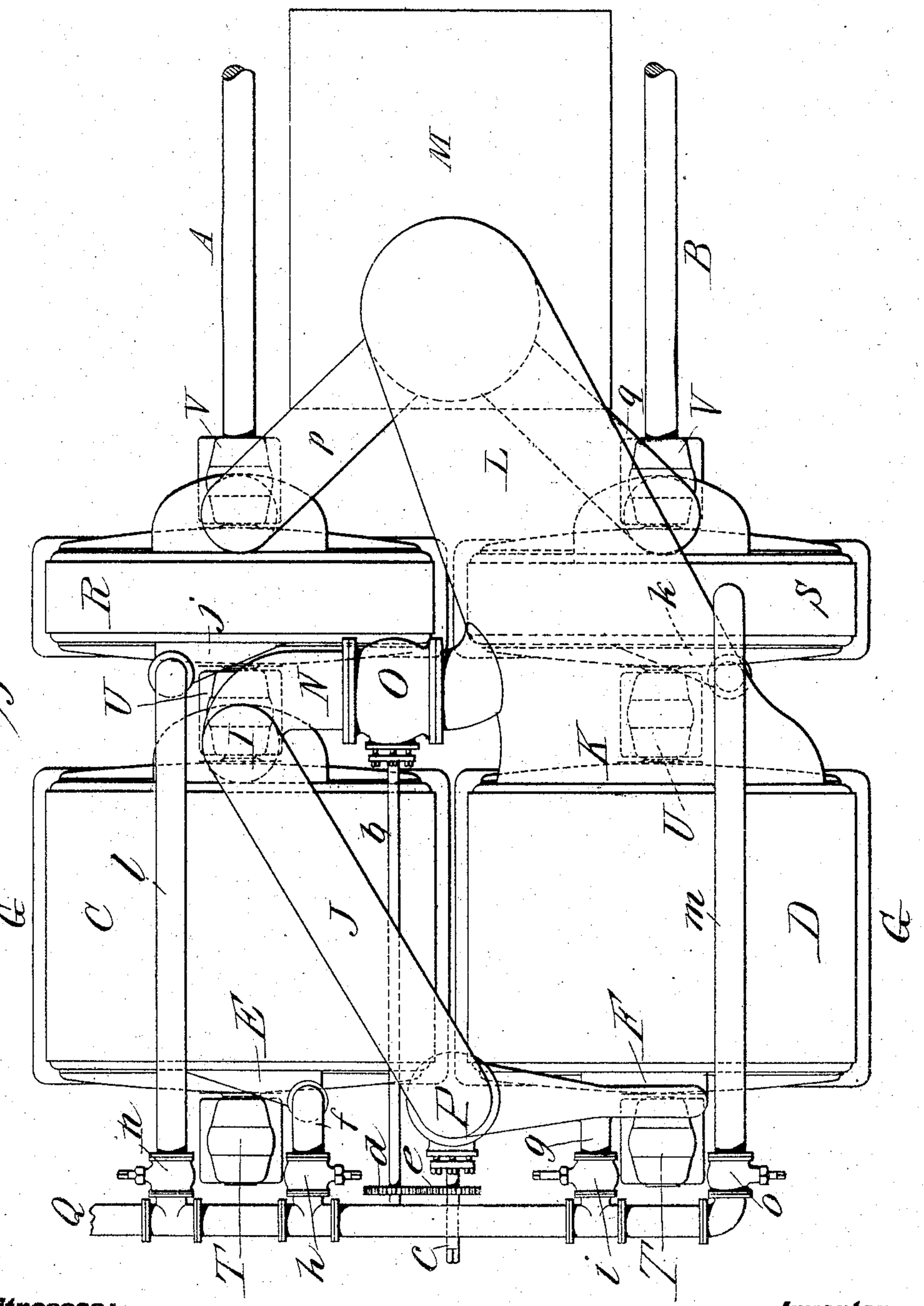
C. G. CURTIS.

ELASTIC FLUID TURBINE.

APPLICATION FILED APR. 20, 1903.

2 SHEETS—SHEET 1.

Fig. 1



Witnesses:

Jas. F. Coleman

Jno. Robt Taylor

Inventor

Charles G. Curtis

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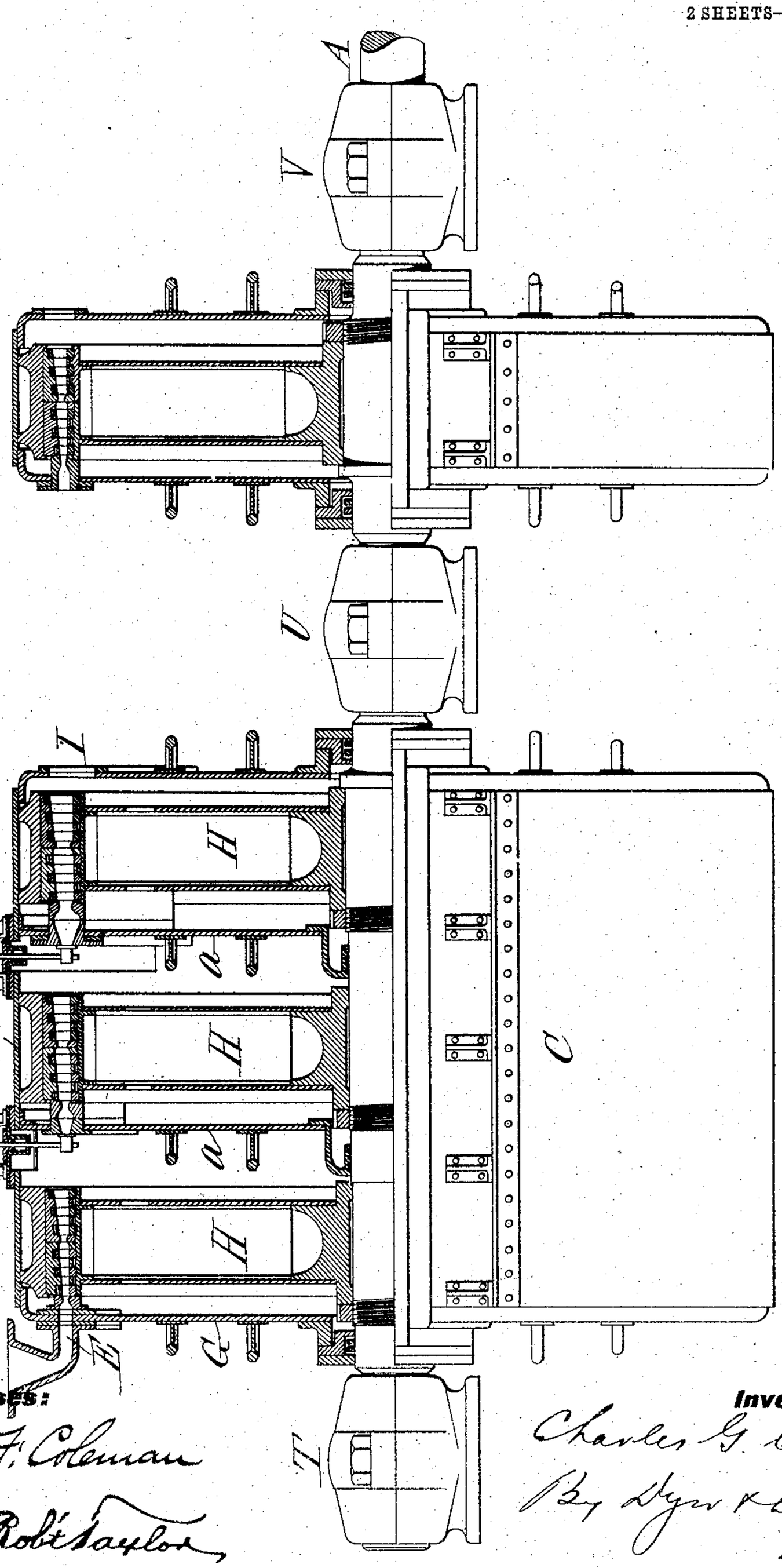

Fig. 2

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No. 778,224. Patented December 27, 1904.

UNITED STATES PATENT OFFICE.

CHARLES G. CURTIS, OF NEW YORK, N. Y.

ELASTIC-FLUID TURBINE.

SPECIFICATION forming part of Letters Patent No. 778,224, dated December 27, 1904.

Application filed April 20, 1903. Serial No. 153,390.

To all whom it may concern:

Be it known that I, CHARLES G. CURTIS, a citizen of the United States, residing in the borough of Manhattan, city of New York, State of New York, have invented a certain new and useful Improvement in Elastic-Fluid Turbines, of which the following is a specification.

The object I have in view is to provide an arrangement of elastic-fluid turbines for the direct and reverse driving of twin shafts—such, for instance, as the propeller-shafts of a twin-screw ship—which will give the maximum efficiency with a moderate length of turbine or number of stages on each shaft, will permit the desired independent control of the shafts, and will afford a strong and in every respect a desirable construction.

In carrying out my invention I employ for producing the forward movement of the shafts a stage-expansion turbine, and I mount part of the stages on one shaft and part on the other shaft, inclosing the stages of each shaft in a single shell divided by diaphragms or partitions into chambers, which inclose the separate stages. Each stage of the turbine comprises, preferably, two or more sets of rotating vanes and one or more sets of intermediate stationary vanes. The exhaust of the first section of the turbine is connected with the nozzle of the second section, so as to work the two sections in series and seam the high steam economy arising therefrom, the working passage (including the nozzles and the moving and stationary buckets) throughout the several stages of the two sections of the turbine being proportioned to secure the maximum efficiency when the two sections are worked in series. The steam or other elastic fluid is delivered at the exhaust end of the second section into the condenser. In order that the two sections of the turbine may be operated independently and either of the two shafts turned forward while the other is at rest or being turned backward, I provide an additional connection between the exhaust of the first section and the condenser-hood, and I also provide a connection directly from the boiler or source of fluid-supply to the nozzle of the second section. In the direct connections from the boiler to the nozzles of the two sections suitable throttle-valves are located. The connection between the exhaust of the first section and the nozzle of the second section is also adapted to be opened and closed by a valve, and another valve is placed in the connection between the exhaust of the first section and the condenser-hood for opening and closing that connection. These two latter valves are coupled together, so as to be operated simultaneously, but in reverse directions, in order that when the direct condenser connection from the first section is opened the connection between the exhaust of the first section and the nozzle of the second section will be closed. Upon each of the two shafts, preferably astern of the sections of the direct turbine, is located a reversing-turbine, and between the sections of the direct turbine and the reversing-turbines the shafts are supported in bearings. Bearings for supporting these shafts are likewise provided forward of the sections of the direct turbine and aft of the reversing-turbines. The shafts are thereby effectively supported without the undesirably great separation between the bearings which would result if the reversing-turbines were inclosed in the same shells with the sections of the direct turbine. The reversing-turbines are compound machines—*i. e.*, have two or more sets of moving vanes and one or more sets of intermediate stationary vanes. The vanes are set in the reverse direction to the vanes of the sections of the direct turbine, and the nozzles are also set in the reverse direction, so as to produce a reverse or backward rotation of the shafts. The reversing-turbines may, if desired, be stage-expansion machines. A direct connection is made from the boiler or other source of fluid-supply to the nozzle of each of the reversing-turbines, such connection being provided with a suitable valve for opening and closing it. Each reversing-turbine also has its exhaust directly connected with the condenser. By means of these direct connections between the reversing-turbines and the boiler the reversing-turbines are independent of each other and either or both may be operated. The arrangement permits of both shafts being driven forward, or both shafts being driven backward, or either shaft being

driven either backward or forward while the other shaft is at rest, or either shaft being driven backward or forward while the other shaft is being driven in the other direction.

In the accompanying drawings, Figure 1 is a top view of an arrangement embodying the invention, and Fig. 2 is a side elevation and half vertical section of the first section of the direct turbine and the reversing-turbine on the same shaft.

A and B are two parallel shafts, which may be the propeller-shafts of a twin-screw ship. Upon these shafts are mounted the sections C D of a stage-expansion turbine for producing direct rotation of the shafts.

E is the nozzle of the section C, and F is the nozzle of the section D. Each section is inclosed in a single steam-tight shell G, divided into compartments by diaphragms or partitions *a*. In each of these compartments is a wheel H, carrying a number of sets of movable vanes, which coöperate with stationary intermediate vanes supported by the shell. The movable and stationary vanes in each compartment form an expansion-stage of the turbine, which is supplied with elastic fluid by a separate nozzle, as will be well understood. Each stage may also be provided with a substage or internal-expansion device of the character described in my application, Serial No. 70,615, filed August 2, 1901.

The exhaust I of the first section C of the direct turbine is connected by a pipe or conduit J with the nozzle F of the second section of the turbine. The exhaust K of the second section of the turbine is connected with the hood L of the condenser M, the condenser being preferably located between the shafts A B toward the stern of the ship. A direct connection N is made between the exhaust I and the condenser-hood L. A valve O is located in the connection N, and a valve P is located in the connection J. These two valves are coupled together, so as to be operated simultaneously, but in reverse directions. A typical illustration of this is furnished by the drawings, the valve-stems *b c* being coupled together by gear-wheels *d e*. The valve-stem *c* is extended to receive a hand-wheel or other device for turning it, and by turning the shaft *c* the shaft *b* will also be turned through the gear-wheels *e* and *d*, thus opening the valve O when the valve P is closed, and vice versa.

Q is the pipe from the steam-boiler or other source of fluid-supply. Direct connections *f g* are made between this pipe and the nozzles E F, these connections being controlled by valves *h i*.

Upon the shafts A B, aft of the sections C D of the direct turbine, are mounted the reversing-turbines R S. Each of these is a compound turbine or one having two or more sets of movable vanes and one or more sets of stationary intermediate vanes. These reversing-turbines may be divided into stages or substages, if desired. Each reversing-turbine is inclosed within its own shell, which is independent of the shell of the section of the direct turbine on the same shaft. The vanes of the reversing-turbines are set in the reverse direction to the vanes of the direct turbine, as are likewise the nozzles *j k* of the reversing-turbines, so as to rotate the shafts A B in a backward direction. Direct connections *l m* are made between the steam-pipe Q and the nozzles of the reversing-turbines, these connections being controlled by valves *n o*. The reversing-turbines have their exhaust-openings separately connected by conduits or pipes *p q* with the condenser.

The shafts A B are supported by bearings T forward of the direct turbine, by bearings U between the sections of the direct turbine and the reversing-turbines, and by bearings V aft of the reversing-turbines.

What I claim is—

1. The combination with two shafts, of a direct turbine divided into sections and mounted upon the two shafts, connections for operating said sections in series or independently, and independent reversing-vanes mounted upon the two shafts, substantially as set forth.

2. The combination with two shafts, of a direct turbine divided into sections and mounted upon the two shafts, connections for operating said sections in series or independently, and independent reversing-turbines mounted upon the two shafts, substantially as set forth.

3. The combination with two shafts, of a direct turbine divided into sections and mounted upon said two shafts, connections for operating said sections in series or independently, independent reversing-vanes mounted upon the two shafts, and means for operating the said reversing-vanes independently, substantially as set forth.

4. The combination with two shafts, of two sections of a direct turbine mounted on said shafts, connections for operating said sections in series or independently, independent reversing-turbines mounted upon the two shafts, and bearings for the shafts between the sections of the direct turbine and the reversing-turbines, substantially as set forth.

5. The combination with two shafts, of two sections of a direct turbine mounted on said shafts, connections for operating said sections in series or independently, independent reversing-turbines mounted upon the two shafts and separate casings for the direct turbines and reversing-turbines, substantially as set forth.

6. The combination with two shafts, of two sections of a direct turbine mounted on said shafts, connections for operating said sections in series or independently, independent reversing-turbines mounted upon the two shafts,

separate casings for the direct turbines and reversing-turbines, and bearings for the shafts between the sections of the direct turbine and reversing-turbines, substantially as set forth.

7. The combination with two sections of an elastic-fluid turbine, of connections between the sections and with the source of fluid-supply and the condenser for operating the sections in series or independently, and means for simultaneously closing the series connections between the two sections when the independent exhaust of the first section is opened, substantially as set forth.

8. The combination with two shafts, of a direct turbine divided into sections mounted upon the two shafts, direct steam connections to the sections on each shaft, and a connection from one section to the other for running the turbine in series, and independent reversing-turbines on each shaft, substantially as set forth.

9. The combination with two sections of an elastic-fluid turbine, a connection between the exhaust of the first section and the nozzle of the second section for operating the two sections in series, independent connections between the source of supply and the nozzles of the two sections, independent connections between the two sections and the condenser or other exhaust, valves for controlling the direct connection between the source of supply and the nozzles of the two sections, a valve for closing the connections between the exhaust of the first section and the nozzle of the second section, and means for operating simultaneously in reverse directions the last two named valves, substantially as set forth.

This specification signed and witnessed this 15th day of April, 1903.

CHARLES G. CURTIS.

Witnesses:
JNO. ROBT. TAYLOR,
JOHN LOUIS LOTSCH.