H. F. SCHMIDT.

VARIABLE-SPEED TURBINE.

APPLICATION FILED DEC. 4, 1911.

1,102,357.

Patented July 7, 1914.

3 SHEETS—SHEET 1.

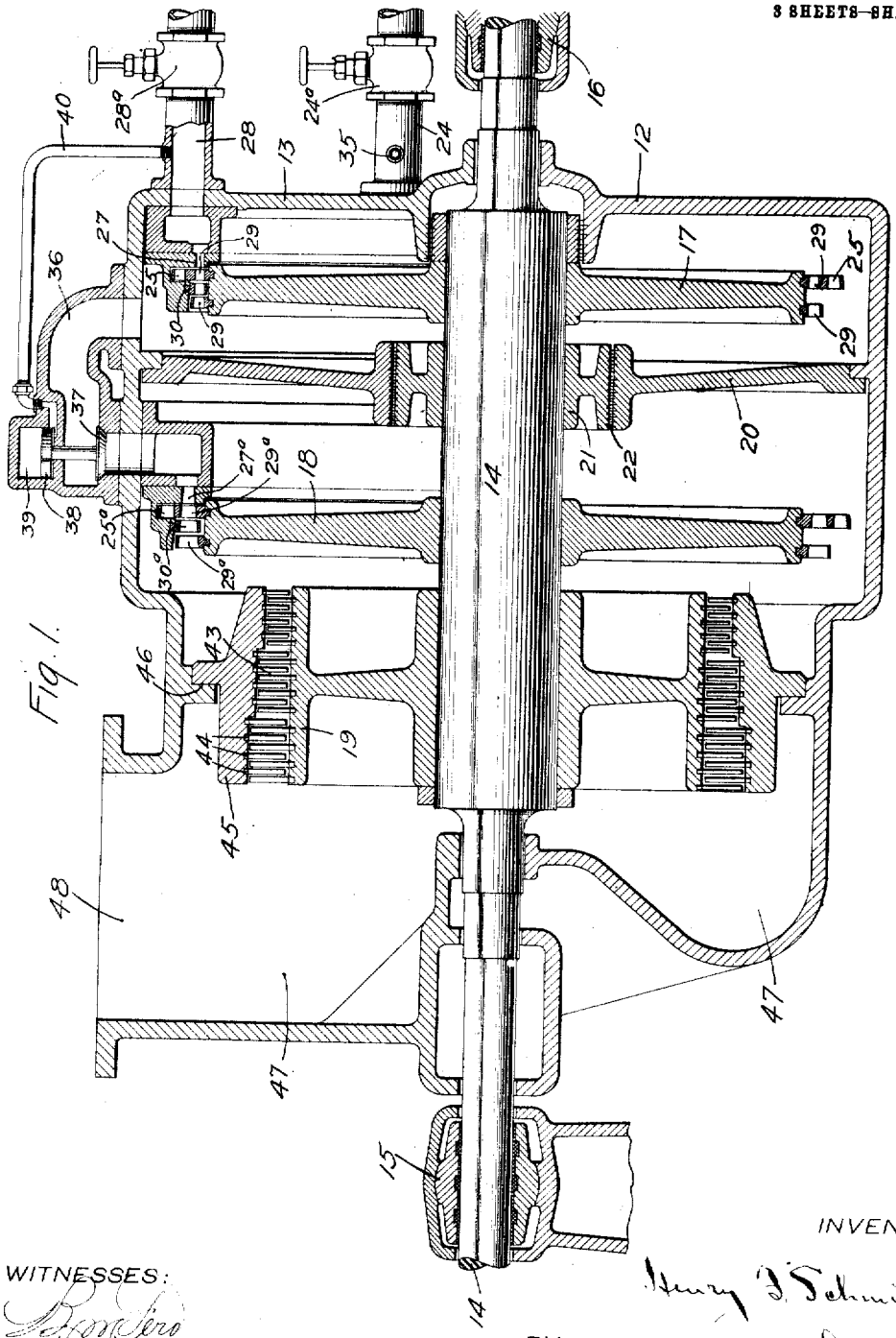


Fig. 1.

WITNESSES:

INVENTOR.

BY

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3 SHEETS SHEET 2.

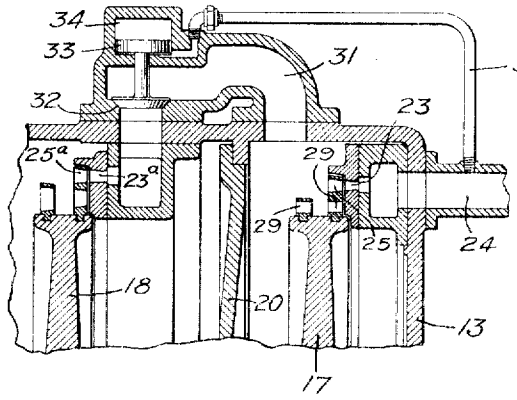


Fig. 2.

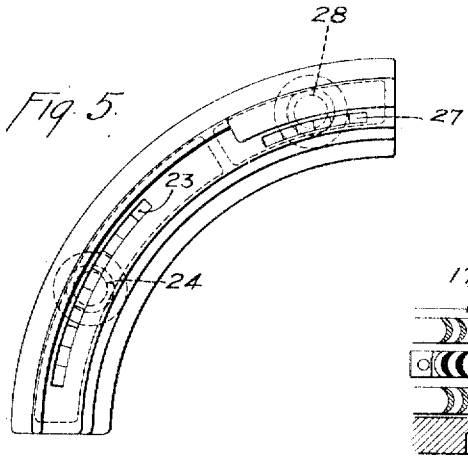
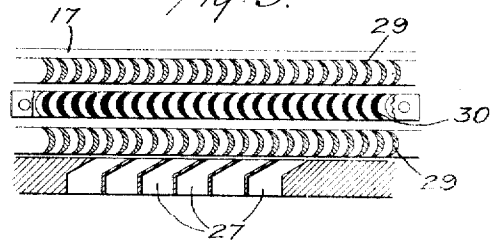


Fig. 5.

Fig. 3.



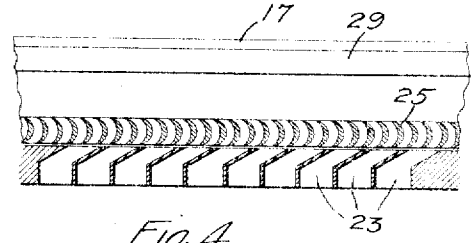


Fig. 4.

INVENTOR.

WITNESSES

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3 SHEETS—SHEET 3.

Fig. 6.

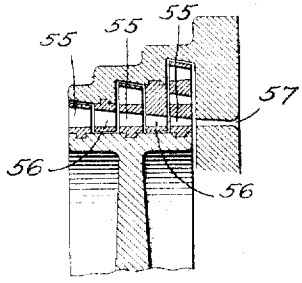


Fig. 7.

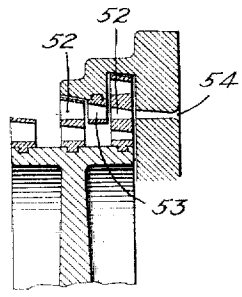
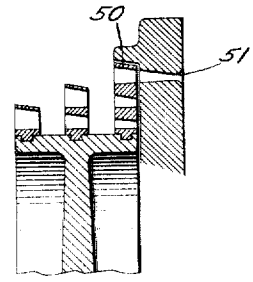


Fig. 8.



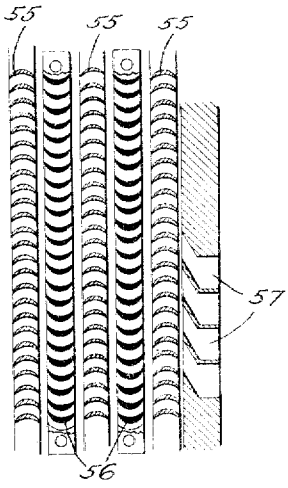


Fig. 9.

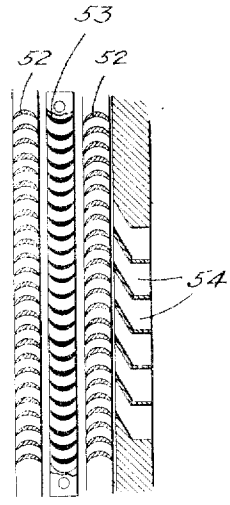


Fig. 10.

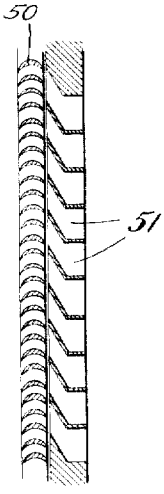


Fig. 11.

INVENTOR.

Henry F. Schmidt.

WITNESSES:

BY

Jno. D. Breen

HIS ATTORNEY IN FACT.

UNITED STATES PATENT OFFICE.

HENRY F. SCHMIDT, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, A CORPORATION OF PENNSYLVANIA.

VARIABLE-SPEED TURBINE.

1,102,357. Specification of Letters Patent. Patented July 7, 1914.

Application filed December 4, 1911. Serial No. 663,916.

To all whom it may concern:

Be it known that I, HENRY F. SCHMIDT, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Variable-Speed Turbines, of which the following is a specification.

This invention relates to steam or other elastic fluid turbines and more particularly to marine type turbines capable of efficiently developing different powers at different speeds.

In present marine turbine arrangements, in order to obtain satisfactory economies at the different ship speeds, it has been necessary to employ either a number of turbines in their separate casings for the different speeds, or to increase the normal size of the turbines employed to accommodate extra stages utilized in obtaining the economies at the different speeds. My invention, however, renders it possible to take a turbine designed for certain blade speeds and without increasing its size or materially increasing its weight, to convert the same into a number of turbines within the same casing designed for different definite speeds and powers.

An object of this invention is to produce a compact organized apparatus embodying a number of independently operating turbines of different normal speeds and powers and having a common rotor element carrying the moving blades for the different independently operating turbines. This, as well as many other objects which will readily appear to those skilled in this particular art, I attain in the apparatus which I have selected as one which fairly illustrates one embodiment of this invention. This selection has been made with no idea of limiting this invention to the particular apparatus illustrated, but merely for the sake of clearly illustrating the principle thereof and one mode of application.

In the drawings accompanying and forming a part of this application and throughout which similar elements are denoted by like characters, Figure 1 is a view in longitudinal section of an organized apparatus embodying this invention taken on such a line as to show the nozzles and intermediate vanes of what may be termed the low-speed turbine; Fig. 2 is a fragmentary view in sectional elevation of the same apparatus taken on such a line as to show the nozzles and vanes of what may be termed the high-speed turbine; Fig. 3 is a developed section of the nozzles, blades and intermediate vanes of said low-speed turbine; Fig. 4 is a developed section of the nozzles and blades for said high-speed turbine; Fig. 5 is a detail view of a nozzle block provided with two sets of independent nozzles, one set for each of said turbines; Figs. 6, 7 and 8 are fragmentary views in sectional elevation showing a modified form of rotor, carrying blades for three independently operating turbines and the nozzle and intermediate guide vanes utilized in connection therewith; and Figs. 9, 10 and 11 are developed sections of the nozzles, blades and intermediate guide vanes shown in Figs. 6, 7 and 8 respectively.

In the apparatus chosen for illustration in Figs. 1 to 5 inclusive, two independently operating turbines are organized into a single apparatus having two normal speeds, which, for convenience, may be termed full speed and cruising speed. The apparatus consists of a casing divided into a lower half 12 and an upper half 13 so formed that the casing is divided on a plane passing through its horizontal axis and shaft 14 journaled in bearings 15 and 16 passes through the casing and is provided with rotor elements or running wheels 17 and 18 and a drum 19. The casing is divided longitudinally by means of a diaphragm partition 20 which extends inwardly to a drum member 21 also carried on the rotor shaft, and between said drum and the diaphragm a labyrinth packing 22 of the usual type is interposed. The two independently operating turbines, that is, the full-speed turbine and the cruising-speed turbine, have a high pressure stage an intermediate stage and a common low-pressure stage, although it will be seen that if desired the low-pressure stages of the two turbines may also be independent. Running wheel 17 carries the high-pressure stage blading for the two turbines, while running wheel 18 carries the intermediate stage blading for the two turbines; drum 19 carries the moving blades for the low-pressure stage which in the apparatus shown is common to the two turbines. The high-pressure stage of the full-speed turbine consists of nozzles 23 supplied

with steam through inlet pipe 24 and a single row of impulse blades 25, while the high-pressure stage of the cruising-speed turbine consists of nozzles 27 supplied with steam through inlet pipe 28, two rows of blades 29 and intermediate guide vanes 30. The high-pressure stage of the full-speed turbine may be termed a "Ratteau" stage since in its nozzles a portion of the thermal energy of the steam is converted into kinetic energy in the form of steam velocity and the energy due to said velocity is abstracted in a single row of moving blades. The high-pressure stage of the cruising-turbine may be termed a "Curtis" stage since in its nozzles a portion of the thermal energy of the steam is converted into kinetic energy in the form of steam velocity and the energy due to said velocity is fractionally abstracted in the two rows of moving blades; the intermediate guide vanes serving merely as directing vanes. The blades on running wheel 17 nearest the nozzles are of double-deck construction, that is, the blades 25 are superposed on the first row of blades 29. Running wheel 18 carries the moving blades for the intermediate stages of the two turbines and since these blades are the same as the blades for the high-pressure stages, except of larger dimensions, to accommodate the expanded steam, a detailed description thereof is deemed unnecessary. The moving blades for the full-speed turbine are numbered 25^a while their nozzles are numbered 23^a. The two rows of moving blades for the cruising turbine are numbered 29^a while their nozzles are numbered 27^a and its intermediate guide vanes are numbered 30^a. A steam passage for each group of nozzles of the intermediate stages leads around the diaphragm partition 20. Passage 31 leads exhaust steam from the high pressure stage of the full-speed turbine around diaphragm partition 20 to the inlets of nozzles 23^a for the intermediate stage of the full-speed turbine, and, a valve 32 controls the effective area of said passage 31. Valve 32 is connected to a piston 33 which reciprocates within a chamber 34 and the lower face of which by means of a pipe 35 is subjected to the pressure in inlet pipe 24. It will be seen that the arrangement just described is such that when steam is let into inlet pipe 24 by means of a valve 24^a the pressure in said pipe 24 communicating through pipe 35 to the lower face of piston 33 will by means of said piston open valve 32 and place the high and intermediate stages of the full-speed turbine in communication one with the other so that the steam exhausted from the high-pressure stage may pass through passage 31 to the intermediate stage. A passage 36 is provided for conducting the steam exhausted from the high-pressure stage of the cruising turbine to nozzles 27^a of the intermediate stage of the cruising turbine. A valve 37 governs the effective area of passage 36 and is connected to a piston 38 which reciprocates within a chamber 39. The lower face of piston 38 is subjected to the steam pressure in inlet pipe 28 through a pipe 40 and this arrangement is such that when the cruising turbine is supplied with steam through valve 28^a, the high-pressure and intermediat' stages of said turbine are placed in communication through passage 36 so that the steam exhausted from the high-pressure stage is conducted to nozzles 27^a of the intermediate stage.

As before stated, in the apparatus selected for illustration, the low-pressure stage or section employed is common to the two-turbines, that is, to the full-speed turbine and the cruising speed turbine, and as shown consists of a number of annular rows of moving blades 43 carried on drum 19 and stationary vanes 44 carried on a ring member 45 bolted to the interior of the casing at 46. This section may either be what is known as the "Ratteau" section in which all of the pressure drops occur between the blades of the stationary rows, or it may be what it known as "Parsons" or reaction section, in which the pressure drops occur between the blades in both the moving and stationary rows. The exhaust from the low-pressure stage issues into exhaust chamber 47 and thence out through exhaust 48 preferably to a condenser.

If it is desired to have three normal speeds, than three independent turbines may be organized into an apparatus as shown in Figs. 6 to 11 inclusive. The first row of blades on each running wheel, then, that is, the blades nearest the nozzles, will be triple-deck blades, the outer blade being utilized for the full-speed turbine, the intermediate blade for the intermediate-speed turbine, and the inner blade for the cruising turbine. When three turbines are utilized, the second row of blades will be double-deck blades and the third row single deck. When three turbines are organized into one apparatus, two rows of intermediate guide vanes will be necessary. The nozzles, blades and vanes illustrated in Figs. 6 to 11 may be the blades on either of the running wheels, that is, either for the high-pressure stage or the intermediate stage, they only differing in size. When three turbines are utilized three passages for conducting the exhaust from the high-pressure stages to the intermediate stages will be necessary with their valves, valve-pistons and pipe-connections. When the organized apparatus contains three independent turbines, that is, a full-speed turbine, an intermediate speed turbine and a cruising-speed turbine, as illustrated in Figs. 6 to 11 inclusive, the running wheels for

the high-pressure stage and the intermediate stage will each carry three independently operating blading arrangements. The high and intermediate stages for the full-speed turbine will each contain one annular row of moving blades 50 and nozzles 51 operating on what is termed the "Ratteau" principle. The intermediate-speed turbine employs two annular rows of moving blades 52, intermediate guide vanes 53 and nozzles 54 and operates on what is termed the "Curtis" principle in which the velocity energy of the steam due to the conversion in the nozzles of thermal into kinetic energy in the form of fluid velocity is abstracted in two steps. The cruising-speed turbine, which employs three rows of moving blades 55, two rows of guide vanes 56 and nozzles 57, will also operate as a "Curtis" turbine in which the velocity energy of the steam due to the conversion of thermal into kinetic energy in the form of steam velocity in the nozzles is abstracted in three steps.

If it is desired, the low pressure stage common to the different turbines may be substituted by one or more running wheels carrying blading arrangements similar to those carried by running wheels 17 and 18, or similar to those shown in Figs. 6 to 11, inclusive, if three turbines are employed.

If it is desired, a number of stage valves corresponding to valves 32 and 37 may be utilized for each turbine and the piston chambers of these valves may be interconnected so that if it is desired to divide up the nozzles for each turbine into groups, the valves may be operated serially to open first one group and then another. This arrangement will insure each group of nozzles working at its maximum efficiency, that is, one group will be fully supplied with steam before the next group begins to open. This is a detail, however, which does not enter into the principle of this invention and as the invention may be carried out in a number of different ways, I do not wish to limit it to an apparatus of any particular construction.

If the common low-pressure stage is replaced by independent low-pressure stages, then by-passes similar to by-passes 31 and 36 will lead around the diaphragm partition, which will be necessary, and between the intermediate stages and the low-pressure stages the valve pistons for operating the valves in these by-passes will have their lower faces subjected to the steam pressure in the nozzle chambers of the intermediate stages.

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

Having thus described my invention, what I claim is:

1. In combination with a turbine, a plurality of independent concentric series of blades radially offset with relation to each other, the inner series of said blades being adapted to fractionally abstract kinetic energy from the motive fluid throughout a series of separate steps and the outer series being adapted to abstract kinetic energy from the motive fluid throughout a smaller number of series of steps than the inner series.

2. In combination with a turbine, a plurality of independent concentric series of blades radially offset with relation to each other, the inner series of said blades having a greater number of annular rows than the outer series, and the number of rows in each series progressively decreasing outwardly.

3. In combination with a turbine, a plurality of concentric series of blades radially offset with relation to each other, a separate nozzle for delivering motive fluid to each separate series of blades, and a series of blades for receiving motive fluid from each of said first mentioned series of blades.

In testimony whereof, I have hereunto subscribed my name this 29th day of November, 1911.

HENRY F. SCHMIDT.

Witnesses:
C. W. McGHEE,
ADA ROMIG.

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Correction in Letters Patent No. 1,102,357.

It is hereby certified that in Letters Patent No. 1,102,357, granted July 7, 1914, upon the application of Henry F. Schmidt, of Wilkinsburg, Pennsylvania, for an improvement in "Variable-Speed Turbines," an error appears in the printed specification requiring correction as follows: Page 2, line 102, for the word "than" read *then;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of August, A. D., 1914.

[SEAL.]

J. T. NEWTON,
Acting Commissioner of Patents.

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J. T. NEWTON,

Acting Commissioner of Patents.