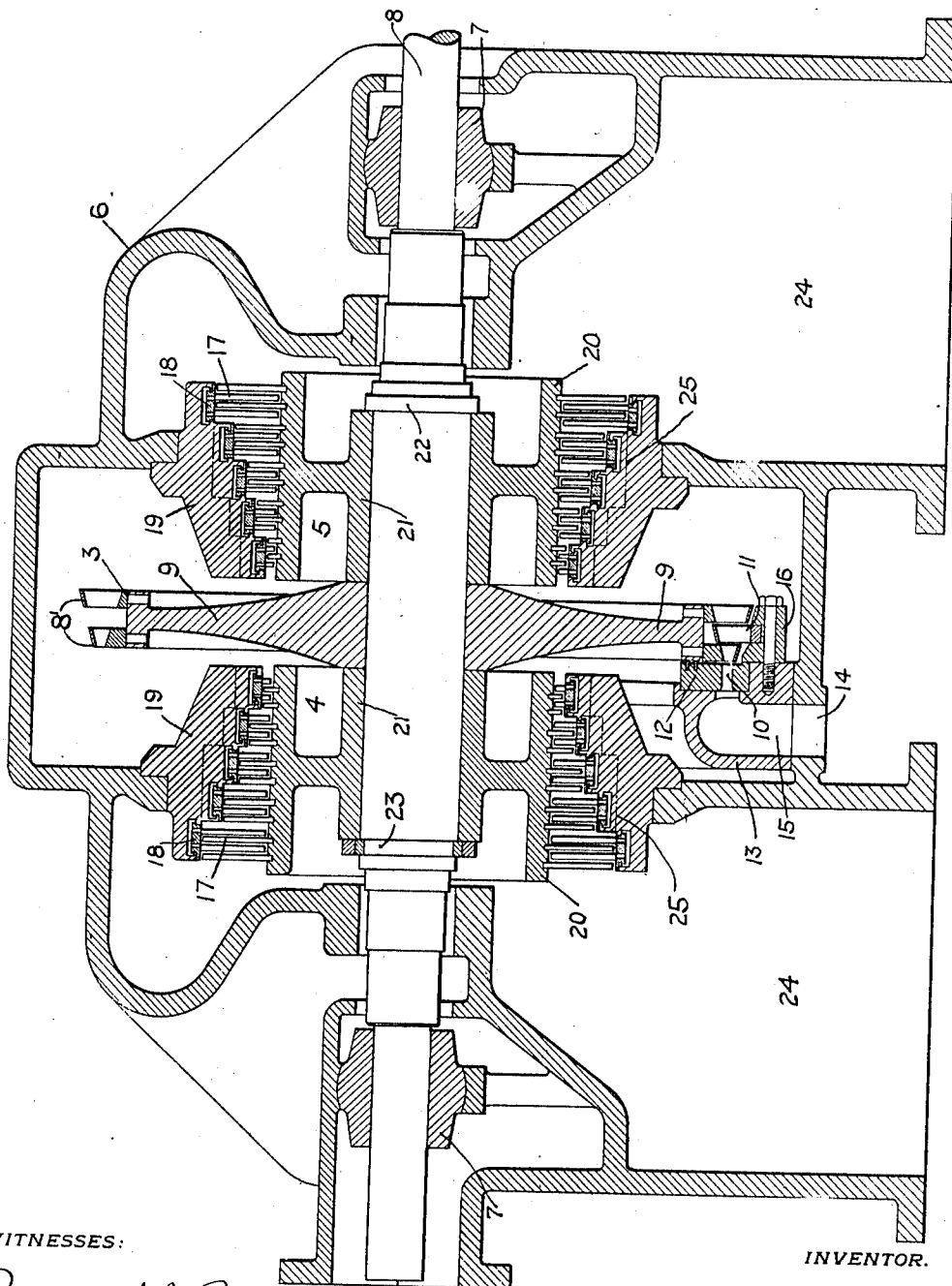


H. T. HERR.
STEAM TURBINE.
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1,061,670.

Patented May 13, 1913.



WITNESSES:

Raymond J. Ridge

E. M. McCallister

INVENTOR.

Herbert J. Herr

BY

Geo. S. Herr

HIS ATTORNEY IN FACT.

UNITED STATES PATENT OFFICE.

HERBERT T. HERR, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE COLONIAL TRUST COMPANY, TRUSTEE, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

STEAM-TURBINE.

1,061,670.

Specification of Letters Patent.

Patented May 13, 1913.

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To all whom it may concern:

Be it known that I, HERBERT T. HERR, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have made a new and useful invention in Steam-Turbines, of which the following is a specification.

This invention relates to turbines and has for an object to produce a standard form of turbines, which may be easily and cheaply altered to vary its capacity.

A further object is to produce a turbine so constructed that the separate elements employed in the make-up of the turbine may be standardized and employed in turbines of varying capacities.

These and other objects I attain in a turbine embodying the features herein described, and illustrated in the drawings accompanying this application and forming a part thereof.

In the drawings, I have shown a longitudinal section of a turbine embodying my invention. The turbine illustrated includes an impulse primary stage 3, and a double flow re-action stage comprising separate sections 4 and 5 located on each side of the stage 3 and arranged to receive the motive fluid discharged from that stage. This arrangement is, however, merely illustrative and various modifications and changes may be made without departing from the spirit and scope of my invention.

Referring to the drawings, the casing 6 incloses the rotor element of the turbine and supports the bearings 7 for the shaft 8 of the rotor. The shaft projects through suitably packed glands (not shown) provided in each end of the casing and supports the rotating elements of the turbine.

The primary stage illustrated, consists of two annular rows of rotating blades 8', mounted on a wheel or rotor element 9, and a cooperating fluid delivery nozzle 10 and stationary blades 11. The nozzle 10 is formed in a nozzle block 12, mounted on a supporting segment 13, which is mounted on the casing. The nozzle communicates with a source of fluid supply through an inlet port 14 provided in the casing and a passage 15 provided in the segment 13. The blades 11 are assembled in a comparatively short

row and are mounted on an arc shaped base piece 16, which is secured to the segment 13, by any suitable means, at a point opposite to the nozzle 10. Any desired number of nozzles 10 may be employed and they may be so arranged as to deliver motive fluid to the blades at different points around the circumference of the wheel 9. All of the nozzles may communicate with a single delivery port 14, or separate delivery ports may be provided for each nozzle, or each set of nozzles.

The motive fluid delivered through the port 14 is expanded by the nozzle 10 so that a portion of its pressure energy is converted into kinetic energy in the form of fluid velocity. The stream of fluid delivered from the nozzle 10 is received by the first row of blades 8, where a portion of its velocity energy is abstracted. The fluid delivered from the first row of blades 8 is received by the stationary blades 11 and is re-directed and delivered to the final row of blades 8', where the remainder of the available velocity energy is abstracted. The fluid discharged from the final row of blades 8', and consequently from the primary stage 3, is divided into two streams which flow in opposite directions through the sections 4 and 5 of the low pressure stage.

Each section of the low pressure stage comprises a plurality of alternately arranged stationary and rotating blades 17. The stationary blades are illustrated as being secured to base strips 18 and are mounted on a ring section 19, which is mounted on the casing 6 by any suitable means, such as bolts, which are not shown. The rotating blades 17 of each section are mounted on a cylindrical drum 20, which is mounted on the turbine shaft 8. The ring section 19 is located concentrically with the drum 20.

Each drum 20 is provided with an elongated hub 21 and the separate rotor elements are so mounted on the shaft 8, that they cooperate in holding each other in place against lateral motion. The hub 21 of the drum 20, forming a part of the section 5, is so located on the shaft 8 that one end contacts with a collar 22, which may be integrally formed with the shaft. The wheel 9 is located on the shaft in contact with the other end of the hub 20 of the sec-

tion 5; and the hub 20 of the section 4 contacts with the opposite side of the wheel. These elements are then secured in place on the shaft by any suitable means, such for example as a compound ring 23. It will of course be understood that the rotor elements may also be keyed on the shaft 8.

The motive fluid traversing the separate sections of the low pressure stage is fractionally expanded, and the velocity energy resulting from the expansion is abstracted by impact and reaction. The fluid discharged from the separate sections is received by exhaust passages 24, which are formed within the casing and are located at each end of the casing. The exhaust passages may communicate with the atmosphere or with a condenser, as desired.

The casing is substantially bi-laterally symmetrical, and the arrangement of the rotor elements and the working passages of the turbine illustrated is substantially bi-laterally symmetrical.

The casing 6 is divided, in accordance with the customary construction, on a horizontal plane, passing through the axis of the turbine shaft. Each ring section 19 is divided in half and the upper half is secured to the upper portion of the casing 6, while the lower half is secured to the lower portion of the casing.

The turbine illustrated is so constructed that its capacity may be considerably increased without the necessity of extensive or expensive alterations. The capacity of the primary stage may be increased by merely increasing the number of delivery nozzles 10. This is easily accomplished since the segment 13 is easily removable from the casing and can be replaced by a segment provided with additional nozzles and having a fluid delivery passage of increased capacity. Instead of replacing the segment, it may be retained and the nozzle block 12 can be replaced by a block provided with additional nozzles. This latter method can only be employed when the segment is provided with a fluid delivery passage of such capacity that it is capable of supplying fluid to a number of nozzles. Either of the methods described will necessitate an alteration in the arrangement of the stationary blades 11, but this can be accomplished with very little difficulty and with little expense.

The capacity of the low pressure stage may be increased by increasing the lengths of the stationary and rotating blades 17. I accomplish this by changing the contour of the inner peripheral faces of the ring sections 19 so that the spaces between the rings and the drums 20 will accommodate different lengths of blades. The rings are cast so that their inner peripheral faces may be bored to various diameters to accommodate

varying lengths of blades; for example, the rings shown may be bored to a section indicated by the dotted lines 25, and in this manner be prepared for the mounting of stationary blades 17 of increased length. The rings may be bored to intermediate diameters between the dotted lines 25 and the inner peripheral face illustrated so as to accommodate various lengths of blades. The drums 20 are cylindrical and consequently they may be employed for mounting blades of any size or length. The casing is also so constructed that the rings 19 may be easily removed and other rings fitted in place. With this arrangement, the turbine illustrated may be altered so as to greatly increase its capacity, and the increase in capacity will be accomplished without decreasing the efficiency of the turbine an appreciable amount. The capacity of the turbine can be increased without, in any way, varying the construction or design of the casing 6, the shaft 8 or the rotor elements; and these parts may therefore be standard parts for turbines of various capacities. The rings are so constructed that they may be standardized for various sizes of turbines and so that the necessary alterations may be made during the boring operation, if desired.

I have assembled each working stage or section independently and consequently I am capable of varying the capacity of the turbine by employing different combinations of working sections or elements. With the arrangement illustrated, the fluid delivered to the stage 3 is preferably expanded to about atmospheric pressure, so that the low pressure sections operate between atmospheric and condenser pressure. The turbine may be readily converted into a low pressure turbine by removing the wheel 9 and the delivery nozzles 10 and by replacing the wheel by a ring or dummy, which will be located on the shaft 8 between the hubs 21 of the drums of the separate sections of the low pressure stage. With this arrangement, low pressure fluid will be delivered to the turbine through the port 14, and will flow in opposite directions through the sections 4 and 5. The area of the port 14 will of necessity have to be increased to provide for the increased volume of motive fluid.

The stage 3 may be retained and the low pressure sections 4 and 5 removed. With this arrangement, the stage may be operated as a non-condensing turbine without, in any way, varying the design of the blades or the delivery nozzles. One section of the low pressure stage may be employed with the initial stage 3 to produce a single flow condensing turbine. With such an arrangement, means must be employed for balancing the low pressure stage. I readily ac-

comply with this by replacing the section 4 (for example) with a balancing dummy. The balancing dummy may be mounted on the shaft in the ordinary manner and the
5 ring section 19 of the section 4 may be so constructed that it will cooperate with the peripheral face of the dummy and provide an ordinary form of fluid seal, such for example as an inter-leaving seal. In addition
10 to this the primary stage 3 and one section of the low pressure stage may be removed and replaced by a balancing dummy, such as has just been described, and produce a single flow low pressure turbine. It will
15 be apparent that these different combinations will produce turbines of widely varying capacities.

Having now described my invention, what I claim is:

20 1. In combination in a turbine, a casing, a rotor element comprising a cylindrical blade-carrying drum, a blade-carrying wheel, a removable and replaceable segment provided with a fluid delivery passage and a
25 fluid delivery nozzle for delivering motive fluid to the blades of the wheel and a stationary blade carrying element removably mounted on the casing and surrounding said

drum and capable of being altered to accommodate blades of various lengths. 30

2. A turbine comprising a casing provided with an admission and an exhaust port, a separately formed and removable initial stage comprising impulse blades and cooperating expansion nozzles, and separately formed low pressure sections communicating therewith and capable of being removed from the turbine casing for the purpose of varying the capacity of the turbine. 35

3. In combination in a turbine, a casing, a rotor element comprising a cylindrical blade-carrying drum, a blade-carrying wheel, and a stationary blade-carrying element removably mounted on the casing and
45 surrounding said drum and capable of being altered to accommodate blades of various lengths. 40

In testimony whereof, I have hereunto subscribed my name this 31st day of August, 1910. 50

HERBERT T. HERR.

Witnesses:

C. W. MCGHEE,
J. A. GRISWOLD.