W. PAPE.

ELASTIC FLUID TURBINE.

APPLICATION FILED DEC. 27, 1911.

1,092,947. Patented Apr. 14, 1914.

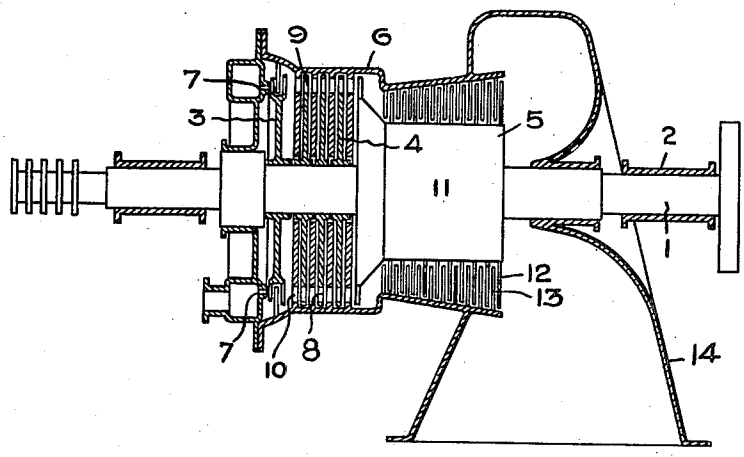

Fig. 1.

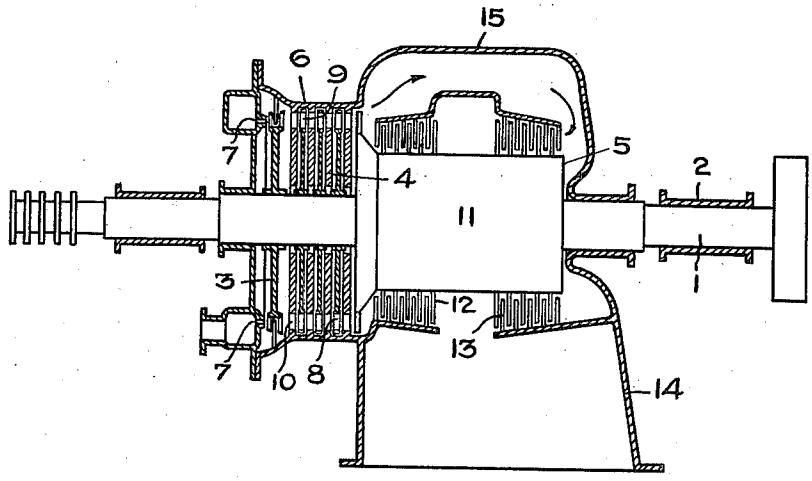

Fig. 2.

Witnesses:

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ELASTIC-FLUID TURBINE.

1,092,947. Specification of Letters Patent. Patented Apr. 14, 1914.

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To all whom it may concern:

Be it known that I, WILHELM PAPE, a subject of the King of Prussia, residing at Charlottenburg, Germany, have invented certain new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification.

Elastic-fluid turbines have heretofore been constructed in which the high pressure portion was provided with a velocity stage, and the low pressure portion either with pure pressure stages or reaction stages. Those having reaction stages are open to the very great disadvantage that it is necessary either to expand down to a very low degree in the first velocity stage or else for the reaction stages to have a very small initial diameter by reason of which the number of reaction stages or steps becomes very great. The reason for this is found in the fact that a reaction stage has to have complete supply, meaning thereby that all of the vanes or buckets must be simultaneously acted upon by the steam. Each of these arrangements has a bad effect upon the efficiency of the machine as a whole.

The objects of my invention are to provide a turbine of improved construction and arrangement, to overcome the objections above noted and at the same time preserve the advantages of reaction stages in the low pressure end of the machine.

In carrying out my invention a high pressure velocity stage is provided and also low pressure reaction stages. Between these high and low pressure portions is inserted a mean- or intermediate-pressure portion comprising parts working on the pure impact pressure staging plan. In the intermediate-pressure portion, the expansion of the steam is carried to a point where it can be effectively and economically utilized in the reaction stages. Due to the use of said intermediate portion the reaction stages may be of liberal proportions, especially as respects the diameter at the inlet, and the total number of such stages can be made relatively small.

In the accompanying drawing, Figure 1 is an axial section of a turbine illustrating one of the embodiments of my invention, and Fig. 2 is an axial section of a modification showing the reaction stages arranged in two oppositely disposed parts to balance the end thrust on the shaft.

1 indicates the main shaft mounted in suitable bearings 2. Mounted on the shaft are the three moving elements or portions of the turbine 3, 4 and 5, inclosed in a suitable casing 6. The element or portion 3 utilizes steam or other elastic fluid at high pressure as it issues from the nozzles 7. In these nozzles the steam may advantageously expand from boiler pressure to about two atmospheres pressure. The moving element has two peripheral rows of buckets with reversing or guiding buckets between the rows. The velocity of the steam issuing from the nozzle is abstracted by successive operations. This will be referred to hereinafter as a "high pressure velocity-stage."

The mean- or intermediate-pressure element or portion 4 comprises a plurality of bucket wheels 8, each occupying a chamber of its own and having a single row of peripheral buckets 9 that abstracts the velocity of the steam due to the preceding diaphragm nozzle 10 in a single operation. The steam exhausting from this portion of the turbine has such a pressure and volume as to adapt it for use in the reaction stages without, however, having too small an inlet diameter on the one hand or too many stages on the other. This element operates on the pure impact pressure stage plan and will be hereinafter referred to as "pressure-stages."

The third, or low pressure element or portion, comprises a drum 11 with many peripheral rows of reaction buckets 12 between which are annular rows of fixed guide vanes or buckets 13, carried by the casing. This portion of the turbine operates on the reaction plan and will be hereinafter referred to as "reaction-stages." The steam exhausting from the last reaction stage enters the exhaust conduit 14 which is connected to a condenser or other exhaust receiving means.

It is desirable to prevent losses as fully as possible at all points, and to that end it is advantageous to have all the buckets in the high pressure velocity stage active just as soon as the load on the turbine will permit. This is accomplished by having suitable valve mechanism to control the nozzles 7.

Since a distribution of the steam from a partial to a full admission is no longer necessary owing to the interposition of the pressure stages, it is possible to locate the latter close to the high pressure velocity stage and

in this simple way effect a saving in the length of the turbine structure, which is of great importance considered from the point of view of the shaft and its critical speed.

In Fig. 2 is shown a turbine constructed and arranged along the lines mentioned above except that the reaction stages are made in two parts which are oppositely disposed. The inlet ends of these parts are connected by a conduit 15. This arrangement has the advantage of balancing the end thrust on the shaft.

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. In an elastic-fluid turbine having an inclosing casing, the combination of a high pressure velocity-stage, one or more intermediate pressure-stages receiving fluid from the velocity-stage, a plurality of reaction-stages divided into parts and so arranged that the thrust on one opposes the thrust on the other, a conduit arranged in the upper portion of the casing for conveying fluid to said stages from the pressure-stages, a shaft that carries the movable parts of the said stages, an admission conduit and an exhaust conduit leading from the lower portion of the casing adjacent to the reaction stages.

2. In an elastic-fluid turbine, the combination of a high pressure velocity-stage wherein the velocity of the motive fluid is fractionally abstracted, intermediate pressure-stages receiving fluid from the velocity-stage and occupying a position in close proximity thereto, the velocity of the fluid in each pressure-stage being abstracted in one operation, a plurality of reaction-stages receiving motive fluid from the last pressure-stage, a shaft that carries the movable members of said stages, an admission conduit and a single exhaust conduit leading from and forming part of the end of the turbine casing adjacent to the reaction stages.

3. In an elastic-fluid turbine, the combination of a velocity-stage in which the pressure of the motive fluid is reduced from the source of supply to a relatively low value and its velocity abstracted by successive operations, mean- or intermediate-stages that operate on the pure impact pressure-stage plan and in which the steam is expanded to a point where it can be effectively utilized in reaction-stages, reaction-stages receiving motive fluid from the pressure-stages, said reaction-stages being relatively few in number and having a relatively large inlet diameter, a shaft that is common to the said stages, an inlet conduit and a single exhaust conduit leading from and forming part of the end of the turbine casing adjacent to the reaction stages.

In witness whereof, I have hereunto set my hand this fifth day of December, 1911.

WILHELM PAPE.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.