Dec. 11, 1923. 1,476,801

H. P. DAHLSTRAND

TURBINE

Original Filed Sept. 5, 1916

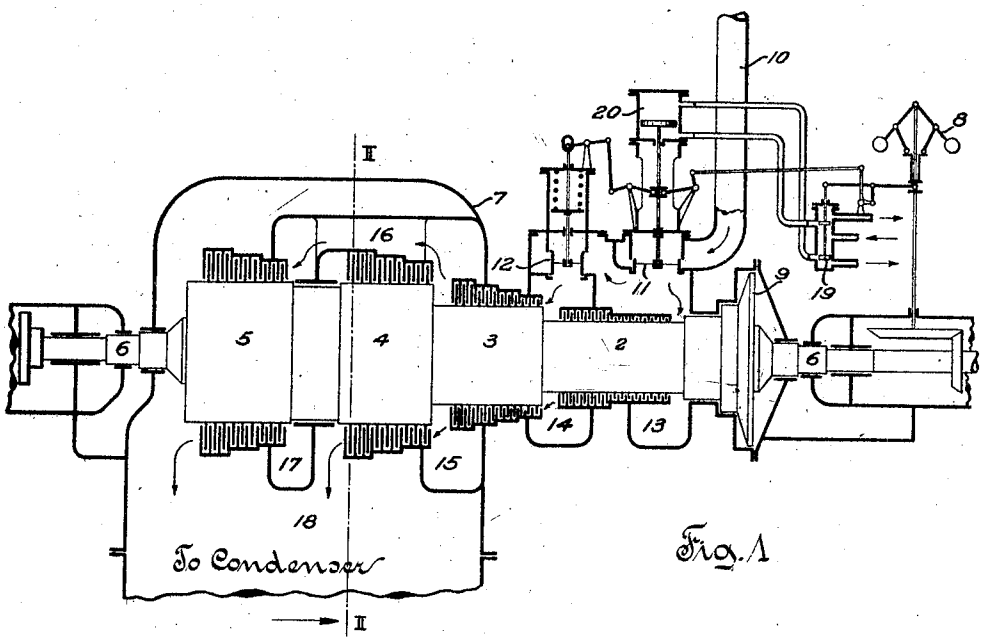


Fig. 1

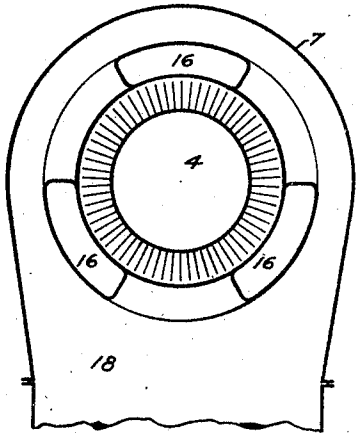


Fig. 2

Inventor

H. P. Dahlstrand

by G. J. Dalbria

Attorney

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HANS P. DAHLSTRAND, OF WAUWATOSA, WISCONSIN, ASSIGNOR TO ALLIS-CHALMERS MANUFACTURING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF DELAWARE.

TURBINE.

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To all whom it may concern:

Be it known that HANS P. DAHLSTRAND, a citizen of the United States, residing at Wauwatosa, in the county of Milwaukee and State of Wisconsin, has invented a certain new and useful Improvement in Turbines, of which the following is a specification.

This invention relates to improvements in the construction of turbines and has particular relation to improvements in the construction of compound or multiple expansion elastic fluid turbines.

An object of the invention is to provide an elastic fluid turbine which is simple and durable in construction and efficient in operation.

In utilizing the energy of elastic fluid, such as steam, to its fullest extent, it has in some cases been found advantageous to use fluid having relatively high initial pressure and to expand this fluid to as near zero (absolute pressure) as possible. In prime movers, such as turbines, operated by fluid under such relatively high initial pressures, as well as in those utilizing relatively large volumes of fluid, it has been found that by employing entire or undivided stages of low pressure, the blading in the low pressure stage must be made excessively large in order to permit efficient and complete expansion of the working fluid. The use of such large blading is objectionable due to the relatively large resulting diameter of the low pressure stage and also due to the enormous stresses set up in the blades while the machine is in operation.

In order to maintain the size of the blading and of the rotor diameter within desirable limits, it has heretofore been proposed to divide a low pressure stage into two parts which receive their supply of fluid directly from the exhaust of one or more entire initial stages. In one of the proposed turbines of the prior art embodying a divided low pressure stage, the divisions were formed as radial flow sections, while in another the divisions were formed as axial flow sections in which the fluid flowed in opposite axial directions. It has also been proposed to provide a pair of independent low pressure turbines which receive operating fluid directly from the exhaust of a high pressure turbine through which operating fluid flows in an axial direction opposite to the direction of flow in the low pressure turbines.

On account of the difficulty in designing and constructing radial flow turbines, it is more desirable to have the divisions of the low pressure stage formed as axial flow sections. It is also desirable to have the divisions formed as nearly alike as possible in order to reduce the cost of construction to a minimum. Another desirable feature is to have all of the stages deliver power to the same shaft and housed within a single casing which is devoid of excessively long steam passages.

In order to accomplish these desirable results the present invention contemplates the provision of a single, unidirectional, axial flow turbine comprising one or more high pressure stages and a divided low pressure stage having two or more divisions of similar construction. The divisions of the low pressure stage deliver power to a shaft which is common to all of the stages, and are housed within a single casing. The low pressure stage divisions receive their fluid supply directly from the exhaust of a stage of higher pressure and deliver their exhaust to a common condenser. The blading of the several divisions of the low pressure stage is of the same kind, the divisions also being preferably formed of substantially the same diameter.

A clear conception of an embodiment of the invention may be had by referring to the drawing accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the various views.

Fig. 1 is a diagrammatic vertical sectional view through a compound or multiple expansion elastic fluid turbine.

Fig. 2 is a diagrammatic transverse vertical section through the turbine disclosed in Fig. 1, the section being taken along the line II—II of Fig. 1 looking in the direction of the arrow.

The compound turbine disclosed comprises essentially a plurality of stages 2, 3, 4, 5, mounted upon a common main shaft 6 which is supported in end bearings in the usual manner, and which is preferably directly connected to an electric generator or other energy absorber. The stages of

the turbine are preferably arranged in successive order, the high pressure stage 2 being followed by the intermediate stage 3, which in turn is followed by the first division 4 of the low pressure stage, which is followed by the second division 5 of the low pressure stage. The rotor is preferably housed within a single casing 7 which is divided along a horizontal plane in order to permit access to the rotor blading. A suitable end thrust balancing device 9, actuated by elastic fluid, is provided at an end of the turbine rotor and is of usual construction.

The high pressure stage 2 is provided with an annular high pressure chamber 13 at its inlet end, to which chamber steam is admitted from the high pressure inlet pipe 10 through a high pressure inlet valve 11. The intermediate stage 3 is provided at its inlet end with an annular intermediate pressure chamber 14 to which steam is normally admitted directly from the exhaust end of the high pressure stage 2, and under certain conditions of operation, from the high pressure inlet chamber 13 through the by-pass valve 12. The first division 4 of the low pressure stage is provided at its inlet end with an annular low pressure chamber 15 which receives steam directly from the exhaust end of the intermediate stage 3. The second division 5 of the low pressure stage is provided at its inlet end with an annular auxiliary low pressure chamber 17 which communicates directly with the low pressure chamber 15 by a series of conduits or passages 16. The divisions 4, 5, of the low pressure stage have their exhaust ends communicating directly with a common exhaust chamber 18 which communicates with a condenser in the usual manner.

The admission of steam to the high pressure end of the turbine through the valves 11, 12, is controlled by means of a speed governor 8 operating upon these valves through a relay mechanism. The relay mechanism disclosed comprises essentially a regulating valve 19 of usual form and a servo-motor 20 adapted to actuate the valves 11, 12.

During the normal operation of the turbine, elastic fluid, preferably steam under pressure, is admitted to the high pressure chamber 13 through the high pressure inlet valve 11, and passes from the chamber 13 through the high pressure stage 2 to the intermediate pressure chamber 14. From the intermediate pressure chamber 14 the steam passes through the intermediate stage 3, being delivered in a partially expanded condition to the low pressure chamber 15. From the low pressure chamber 15 a portion of the partially expanded steam passes directly through the first division 4 of the low pressure stage, while the remainder of the steam passes through the conduits or passages 16 into the auxiliary chamber 17, from which this remainder passes through the second division 5 of the low pressure stage. The steam after passing through the divisions 4, 5, is delivered directly into the chamber 18 from which it is withdrawn into the condenser. If the supply of steam admitted from the chamber 13 to the high pressure stage 2 is insufficient to properly carry the load, the by-pass valve 12 is opened and high pressure steam is admitted directly to the intermediate pressure chamber 14 from which it passes through the intermediate and low pressure stages.

It will be noted that by constructing the compound turbine with a divided low pressure stage, maximum expansion of the steam with minimum length of low pressure blading and minimum diameter of low pressure sections, it attainable. The divisions 4, 5, of the low pressure stage may readily be made of like construction throughout, thereby reducing the cost of construction to a minimum. By providing a single casing for all of the turbine stages, the cost of constructions is still further reduced. The provision of relatively short passages between the stages, also reduces the cost of construction by reducing the length of the unit to a minimum and increases the efficiency by avoiding excessive heat radiation. While the turbine disclosed has a low pressure stage divided into only two divisions, it will be noted that the division of this stage may be extended if desired. It is also immaterial so far as the present invention is concerned, whether one or more high pressure stages are employed.

It should be understood that it is not desired to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

It is claimed and desired to secure by Letters Patent,—

1. In a turbine, a high pressure stage having an inlet, a plurality of low pressure stages each communicating directly with a common admission chamber, and means for admitting high pressure motive fluid to said turbine between said high pressure stage inlet and said low pressure stage admission chamber.

2. In a turbine, a high pressure stage having a high pressure admission chamber, a plurality of low pressure stages each communicating directly with a common low pressure admission chamber associated with said high pressure stage, and means for admitting high pressure motive fluid to said turbine between said admission chambers.

3. In a turbine, a high pressure stage having an inlet valve, a plurality of low pres-

sure stages each communicating directly with a common admission chamber, a valve for admitting motive fluid to said turbine between said high pressure stage inlet and said common low pressure stage admission chamber, and a governor controlling the operation of both of said valves.

4. In a turbine, a high pressure stage having a high pressure admission chamber provided with high pressure fluid inlet means, a plurality of low pressure stages each communicating directly with a common low pressure admission chamber associated with said high pressure stage, means for admitting high pressure motive fluid to said turbine between said admission chambers, and a governor controlling the operation of both of said high pressure inlet and admission means.

5. In a turbine, a high pressure stage having an inlet, a plurality of low pressure stages located at one end of said high pressure stage and communicating directly with a common admission chamber, and means for admitting high pressure motive fluid to said turbine between said high pressure stage inlet and said low pressure admission chamber.

6. In a turbine, a high pressure stage having an inlet, a plurality of low pressure stages communicating directly with a common admission chamber and with a common exhaust chamber, and means for admitting high pressure motive fluid to said turbine between said high pressure stage inlet and said low pressure stage admission chamber.

7. In a turbine, a high pressure stage having an inlet, a plurality of low pressure stages located at one end of said high pressure stage and communicating directly with a common admission chamber and with a common exhaust chamber, and means for admitting high pressure motive fluid to said turbine between said high pressure stage inlet and said low pressure stage admission chamber.

8. In a turbine, a high pressure stage having an inlet, a plurality of low pressure stages through which fluid flows in the same axial direction, said low pressure stages communicating directly with a common admission chamber, and means for admitting high pressure motive fluid to said turbine between said high pressure stage inlet and said low pressure admission chamber.

9. In a turbine, a high pressure stage having an inlet, a plurality of low pressure stages located at one end of said high pressure stage and through which fluid flows in the same axial direction, said low pressure stages communicating directly with a common admission chamber, and means for admitting high pressure motive fluid to said turbine between said high pressure stage inlet and said low pressure admission chamber.

10. In a turbine, a high pressure stage comprising one type of blades and having an inlet, a plurality of low pressure stages comprising the same type of blading, said low pressure stages communicating directly with a common admission chamber, and means for admitting high pressure motive fluid to said turbine between said high pressure stage inlet and said low pressure admission chamber.

In testimony whereof, the signature of the inventor is affixed hereto.

HANS P. DAHLSTRAND.