RADIAL FLOW TURBINE

Filed Nov. 14, 1930

2 Sheets-Sheet 1

May 23, 1933.

1,910,845

A. LYSHOLM

INVENTOR

ATTORNEY
UNITED STATES PATENT OFFICE

ALF LYSHOLM, OF STOCKHOLM, SWEDEN, ASSIGNOR TO AKTIEBOLAGET LJUNGSTROMS ANGTURBIN, OF STOCKHOLM, SWEDEN, A JOINT-STOCK COMPANY

RADIAL FLOW TURBINE

Application filed November 14, 1930, Serial No. 495,624, and in Sweden December 10, 1929.

The present invention relates to radial flow elastic fluid turbines adapted to operate against back pressure and provided with a turbine casing immediately surrounding the radial flow blade system, said casing providing one or more spiral or volute shaped exhaust chambers extending around the full periphery of the outer blade row of the turbine.

For a better understanding of the invention, reference may be had to the accompanying drawings illustrating the invention embodied in a turbine having a casing providing a single outlet for motive fluid.

In the drawings:
Fig. 1 is a longitudinal central section of a radial flow turbine embodying the invention;
Fig. 2 is a transverse section taken through the center of the turbine, parts being omitted for the sake of clearness; and,
Fig. 3 is a diagram illustrating the character of the fluid discharged from the outer blade ring of the turbine.

Referring now more particularly to Fig. 1, reference characters 1 and 2 designate the oppositely rotating shafts of a double rotary form of turbine of the known Ljungstrom type. Steam is supplied to the turbines through conduit 3 and flows through the inlet chambers 4 and channels 5 in the turbine rotors to the radial flow blade system 7 of the turbine from which it is discharged to the outlet chamber 8. The outlet chamber 8 is preferably disposed within an outer turbine casing 9 and is formed by the volute shaped casing member 10, which in the illustrated embodiment extends around the entire circumference of the blade system of the turbine.

As shown in Fig. 2, the casing 10 preferably consists of two parts, 10a and 10b, secured to each other in any suitable manner, as by means of flanges 11 and 12 adapted to be bolted together.

The casing 10 is held in position by means of suitable bolts 15 which secure the casing to the flanges 14 on the stationary members 13. These bolts may advantageously be in the form of through bolts, as indicated in Fig. 1, the central portions of the bolts passing transversely through the chamber 8. These central portions, shown in section in Fig. 2, are preferably of stream lined cross section and arranged so as to assist in directing the steam discharged from the blade system toward the outlet.

As will be apparent from Fig. 2, the outer periphery of the volute casing 10 is arranged, with respect to the outer blade ring...
of the turbine, so that steam leaving said blade ring is directed so as to have a smooth flow from its point of discharge from the blade ring to the outlet 16 of the volute casing. The outlet 16 is preferably arranged tangentially of the casing as shown, and it will be apparent that, if desired, steam can be taken off from the casing at more than one point by providing additional outlets.

The exhaust conduit 17, with which the outlet 16 communicates, is preferably supported by means, such as is indicated at 18 and 19, in a manner permitting movement of the exhaust conduit to compensate for expansion due to temperature differences and the like.

In accordance with the present invention, the shape and arrangement of the blades 7' in the last or outermost blade ring is such that the motive fluid is discharged from these blades in a direction having a component in the direction of discharge flow through the chamber.

The manner in which the desired direction of discharge flow from the blade system is accomplished is more clearly illustrated in the diagram of Fig. 3. In this figure, the character of the discharge flow from the last blade ring of a turbine of the prior art is shown in broken lines, and the direction of the discharge flow in accordance with the present invention is shown in full lines. Reference character α designates a blade arrangement for the outer blade ring which is in accordance with the prior art.

With this arrangement, the outlet angle α is such that, with a peripheral velocity represented by the vector v and a relative discharge velocity represented by the vector v', the resultant or absolute discharge velocity will be represented by the vector c, which is directed radially of the blade system.

In order to avoid the losses through undesirable factors inherent in a turbine in which the motive fluid is exhausted in this manner, the blade α is arranged, in accordance with the present invention, so that the outlet angle α, provides a relative discharge velocity represented by the vector v', having a value greater than the value of the vector v, so that the resultant vector c, representing the absolute discharge, is disposed at an angle γ with respect to a radius vector.

If the vector c, is resolved into its radial and peripheral components, it will be seen that, in accordance with the present invention, there is provided a radial discharge velocity represented by c and a peripheral discharge velocity represented by the vector h, the latter being parallel, but opposite in direction, to the velocity vector v.

This velocity vector h represents the direction and value of the discharge energy of the motive fluid in the direction of the outlet of the turbine casing, and represents a force acting to discharge steam from the turbine. Obviously, the value of the peripheral or tangential velocity represented by the vector h varies with variations in size of the angle γ, the size of which angle may vary with different types of turbines and may also vary in like turbines. Preferably, this angle has a value of at least 25°.

By discharging the motive fluid from the blade system in the above described manner, it may be discharged without substantial pressure drop, and flow from the point of discharge from the blade system is assisted due to the kinetic energy imparted to the motive fluid in the direction of its desired flow.

From the foregoing, it will be evident that the motive fluid will, in accordance with the present invention, have a pressure in the discharge conduit 17 substantially the same as that in the chamber 8, which is, in turn, substantially the same as the pressure at the point of discharge from the last blade row.

By arranging the blades in the last blade row in the above described manner, some loss may be incurred, as compared with a like turbine in which the discharge from the last blade row is in radial direction, due to the greater discharge velocity of the motive fluid when it is discharged with an appreciable peripheral or tangential component, but this loss is considerably less than the pressure drop loss in the discharge casing when the motive fluid is discharged from the last blade row in the usual radial direction.

It is obvious that the present invention may be embodied, not only in the form of apparatus herein shown by way of illustration, but may also be embodied in other specific forms of turbines in which the single volute shaped exhaust chamber and outlet, illustrated herein, are replaced by a plurality of equivalents, each of which receive and discharge a portion of the total amount of motive fluid discharged from the blade system.

What I claim is:

1. In a radial flow elastic fluid turbine, a blade system for expanding motive fluid comprising a rotor carrying a plurality of blade rings including a blade ring constituting the outermost radial flow blade ring of the turbine, and a casing providing a volute shaped chamber having an outlet, said outermost blade ring discharging motive fluid to said chamber and comprising a plurality of blades each arranged to simultaneously discharge motive fluid therefrom with an absolute velocity having a peripheral or tangential component of flow, said flow being in the direction of the flow of motive fluid in said chamber toward the outlet thereof.

2. In a radial flow elastic fluid turbine, a blade system for expanding motive fluid
comprising a rotor carrying a plurality of blade rings including a blade ring constituting the outermost radial flow blade ring of the turbine, and a casing providing a single volute shaped chamber encircling said outermost blade ring and receiving motive fluid discharged therefrom, said chamber having an outlet and said outermost blade ring comprising a plurality of blades each arranged to simultaneously discharge motive fluid therefrom with an absolute velocity having a peripheral or tangential component of flow, said flow being in the direction of the flow of motive fluid in said chamber toward the outlet thereof.

3. In a radial flow elastic fluid turbine, a blade system for expanding motive fluid comprising a rotor carrying a plurality of blade rings including a blade ring constituting the outermost radial flow blade ring of the turbine, and a casing providing a volute shaped chamber having an outlet, said chamber increasing in cross-sectional area toward said outlet in a direction opposite the direction of rotation of said outermost blade ring and said outermost blade ring comprising a plurality of blades each arranged to simultaneously discharge motive fluid therefrom with an absolute velocity having a peripheral or tangential component of flow, said flow being in the direction of increasing cross-sectional area of said chamber.

4. In a radial flow elastic fluid turbine, a blade system for expanding motive fluid comprising a rotor carrying a plurality of blade rings including a blade ring constituting the outermost radial flow blade ring of the turbine, and a casing providing a single volute shaped chamber encircling said outermost blade ring and receiving motive fluid discharged therefrom, said chamber having an outlet and increasing in cross-sectional area toward said outlet in a direction opposite the direction of rotation of said outermost blade ring and said outermost blade ring comprising a plurality of blades each arranged to simultaneously discharge motive fluid therefrom with an absolute velocity having a peripheral or tangential component of flow, said flow being in the direction of increasing cross-sectional area of said chamber.

5. In a radial flow elastic fluid turbine, a blade system for expanding motive fluid comprising a rotor carrying a plurality of blade rings including a blade ring constituting the outermost radial flow blade ring of the turbine, and a casing providing a volute shaped chamber having an outlet, said chamber increasing in cross-sectional area toward said outlet in a direction opposite the direction of rotation of said outermost blade ring and said outermost blade ring comprising a plurality of blades each arranged to simultaneously discharge motive fluid therefrom with an absolute velocity having a peripheral or tangential component of flow, said flow being in the direction of increasing cross-sectional area of said chamber.

6. In a radial flow elastic fluid turbine, a blade system for expanding motive fluid comprising a rotor carrying a plurality of blade rings including a blade ring constituting the outermost radial flow blade ring of the turbine, and a casing providing a single volute shaped chamber encircling said outermost blade ring and receiving motive fluid discharged therefrom, said chamber having an outlet and increasing in cross-sectional area toward said outlet in a direction opposite the direction of rotation of said outermost blade ring and said outermost blade ring comprising a plurality of blades each arranged to simultaneously discharge motive fluid therefrom with an absolute velocity having a peripheral or tangential component of flow, said flow being in the direction of increasing cross-sectional area of said chamber and the direction of absolute discharge of the motive fluid from said blades making an angle of at least 25° with respect to a radial line.

7. In a radial flow elastic fluid turbine, a blade system for expanding motive fluid comprising a rotor carrying a plurality of blade rings including a blade ring constituting the outermost radial flow blade ring of the turbine, an inner turbine casing providing a volute shaped chamber having an outlet, said outermost blade ring discharging motive fluid to said chamber and comprising a plurality of blades each arranged to simultaneously discharge the motive fluid therefrom with an absolute velocity having a peripheral or tangential component of flow, said flow being in the direction of flow of motive fluid in said chamber toward the outlet thereof, and means for securing said casing to a stationary portion of the turbine comprising parts extending transversely of said chamber, said parts being shaped and arranged to provide guide vanes for aiding flow in the aforesaid direction of the motive fluid discharged from said blades.

8. In a radial flow elastic fluid turbine, a blade system for expanding motive fluid comprising a rotor carrying a plurality of blade rings including a blade ring constituting the outermost radial flow blade ring of the turbine, an inner turbine casing providing a volute shaped chamber having an outlet, said outermost blade ring discharging motive fluid to said chamber and comprising a plurality of blades each arranged to simultaneously discharge motive fluid therefrom with an absolute velocity having a peripheral or tangential component of flow, said flow being in the direction of flow of motive fluid in said chamber toward the outlet thereof, and means for securing said casing to a stationary portion of the turbine comprising parts extending transversely of said chamber, said parts being shaped and arranged to provide guide vanes for aiding flow in the aforesaid direction of the motive fluid discharged from said blades.
therefrom with an absolute velocity having a peripheral or tangential component of flow, said flow being in the direction of flow of motive fluid in said chamber toward the outlet thereof, an outer turbine casing and means for securing said inner turbine casing to a stationary part of the turbine supported by said outer casing comprising a series of through bolts extending transversely of said chamber, the portions of said bolts within said chamber being shaped and arranged to provide guide vanes for aiding flow in the aforesaid direction of the motive fluid discharged from said blades.

In testimony whereof, I have hereunto affixed my signature.

ALF LYSHOLM.