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E. THOMSON.

ELASTIC FLUID TURBINE.

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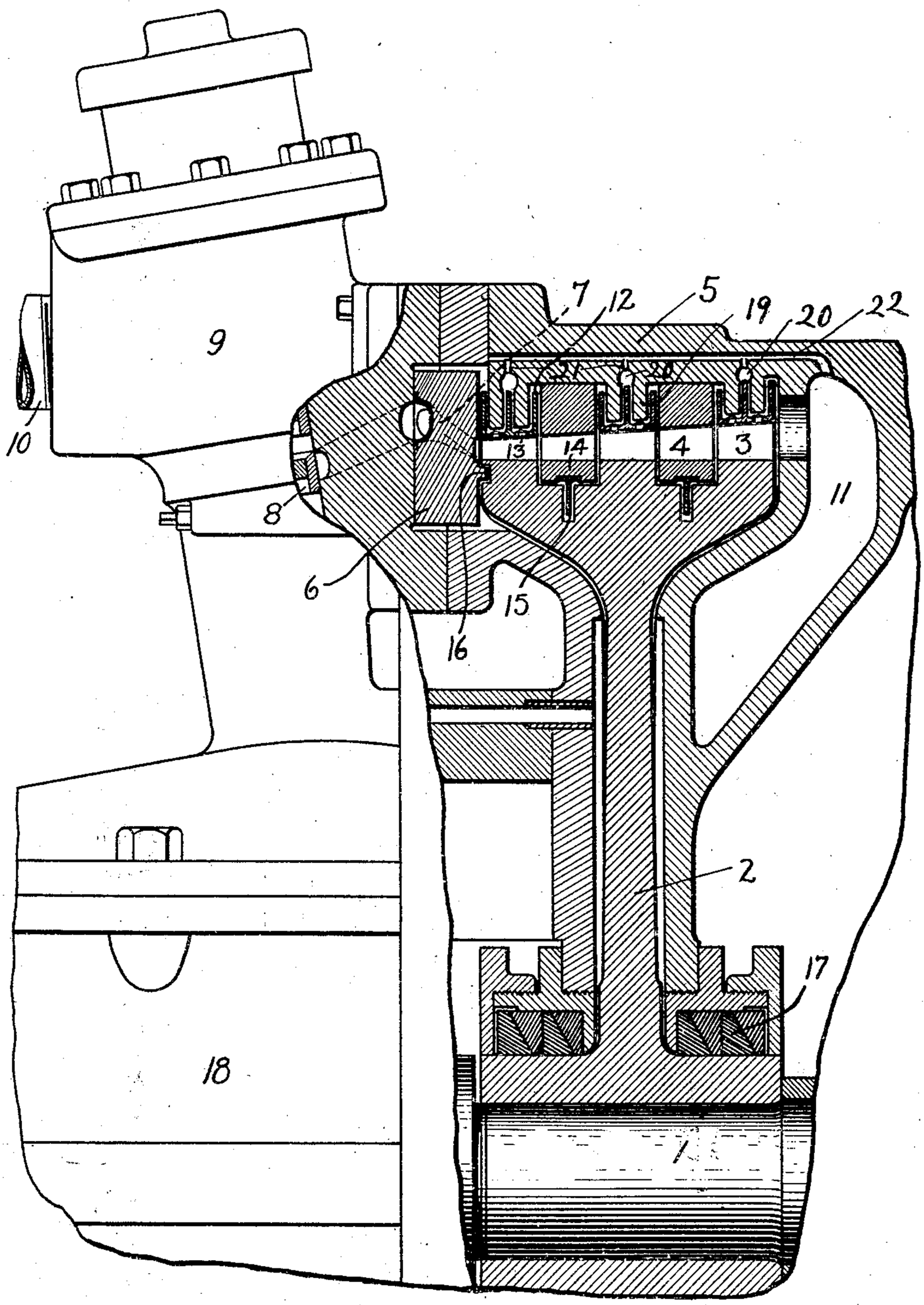

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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELASTIC-FLUID TURBINE.

No. 890,819. Specification of Letters Patent. Patented June 16, 1908.

Application filed February 17, 1906. Serial No. 301,579.

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification.

Tests show that under certain conditions there is a considerable loss of energy in elastic fluid turbines by reason of the motive fluid passing over the ends of the buckets without doing useful work. Tests also show that the motive fluid has a tendency to move faster in the portions of the bucket spaces nearer the periphery than in the portions nearer the axis. This tendency is probably due wholly or in large part to centrifugal force especially on low diameter high speed disks.

The object of the present invention is to overcome these objections.

In carrying out my invention, instead of locating the axis of the nozzle in a plane parallel to the shaft, as is usual in axial flow turbines, it is located in a plane at an angle thereto so that its axis, if continued, would intersect the turbine axis or a continuation thereof. The amount of the inclination of the nozzle will depend upon the conditions of operation and may be small or large as desired. This will tend to maintain the velocity of the motive fluid normal throughout the height of the bucket space on the wheel and, therefore, the discharge will be more uniform. In other words, all of the minute particles of which the fluid is composed will have a more nearly uniform velocity. Again, the fluid stream, due to the direction imparted to it by the nozzle, will have a less tendency to pass out through the transverse clearances and be lost. In addition to being inclined to the axis, as stated, the nozzle is so arranged that it will discharge fluid against the buckets at the most effective angle to produce rotation of the wheel. It will thus be seen that the nozzle is inclined to the plane of the wheel and also inclined to the wheel axis.

In order to reduce the leakage past the outer ends of the buckets, a special arrangement is provided which may be used separately or in conjunction with the nozzle or discharging device described. The buckets are provided with covers made of channel stock and are secured in place by one or more rows of tenons formed on the buckets. Projecting into the spaces between the sides of the channel are one or more cylindrical ribs or projections formed on a stationary part of the turbine, such as the casing, for example. One, two or more of these ribs can be provided for each row of buckets. The intermediate buckets are provided with a cover which may also have one or more ribs or projections coöperating with the wheel to prevent leakage. It is apparent that the arrangement of these parts will increase the length of the leakage path and that the frictional resistance will be much greater than with the usual constructions. Care should be exercised to see that the walls do not run in such close proximity to each other as to retard the rotation of the wheel. In the construction shown dependence is placed upon the side faces of the channels or ribs as well as upon the edges, but I may use only the side faces.

In the accompanying drawing my invention is shown applied to a turbine of the Curtis type.

1 represents the shaft of the turbine and mounted thereon is a wheel 2 having one, two or more rows of peripheral buckets 3. Where two or more rows of buckets are provided, intermediate buckets 4 are arranged between each two rows of wheel buckets, the function of these buckets being to reverse the direction of motive fluid as it passes from one row of buckets to another. The wheel is inclosed in a casing 5 of suitable construction. Steam or other elastic fluid is discharged against the buckets by the nozzle 6, having one or more fluid discharging passages 7, the axis of which is inclined to the plane of the wheel and also to the axis. In the illustration the angle of inclination to the axis is somewhat exaggerated for the purposes of illustration. In practice it is preferable to provide a plurality of these passages 7 and to locate them close together so that the fluid will issue therefrom in a solid stream or column. The nozzle is bolted or otherwise secured to the head of the machine and the passage for the admission of steam to the nozzle or nozzle sections is controlled by one or more valves 8 of suitable construction. In the present illustration a throttle valve is shown, but other forms of valve may be provided, if desired. The valve is mounted on the valve chest 9 and steam or other elastic fluid is ad-

mitted thereto by the conduit 10. The casing is provided with an exhaust chamber 11, and the latter is connected by a suitable conduit to a condenser or other exhaust. The motive fluid is delivered by the nozzle at a velocity more or less great and the velocity is abstracted by the wheel buckets in successive operation.

The wheel buckets are provided with covers 12 made of channel stock. In the present illustration each cover is provided with three projections extending at right angles to the turbine axis. The covers are secured in place by tenons 13, each row of buckets being provided with two rows of tenons. Between the projections on the covers are situated cylindrical ribs or projections 19. These ribs or projections may extend entirely around the wheel, or cover only a limited angular portion thereof. I may provide one projection or rib 19 for each bucket, or two or more, depending upon the number of projections on the covers, as desired. The channels 20 between the ribs 19 may be connected at intervals with passages or drains 22 which lead into the exhaust chamber 11. Several of these passages are suitably spaced about the casing and any excessive amount of condensation will collect in the channels and drain into the chamber 11.

The intermediate buckets 4 are provided with covers 14, and mounted on or formed integral with the cover are one or more ribs or projections 15 that enter corresponding grooves in the wheel. These ribs or projections 15 may extend partially or wholly around the wheel, as desired. As an additional means for reducing the leakage, the nozzle 6 is provided with a projection 16 that enters a corresponding groove formed in the face of the wheel. This projection and groove are located between the discharge end of the nozzle and the shaft. By preference the interior surface of the casing is made to closely conform to the shape of the wheel, in order to reduce the rotation losses and to decrease the available space for leakage of steam or other motive fluid as much as possible.

The casing is provided with a suitable orifice to receive the shaft and packings 17 are arranged to prevent the motive fluid from leaking out around the shaft.

The turbine is provided with a suitable speed-responsive device inclosed in the casing 18 for actuating the controlling valve or valves 8.

From the construction shown it will be apparent that the motive fluid has a low resistance path through the spaces between the buckets and a high resistance path between the projections on the covers and the coöperating ribs or projections 19 on the casing and between the ribs or projections 15 and the coöperating walls of the wheel adjacent thereto.

I may make the radial depth of the projections on the channel bars equal or unequal, as desired. Instead of using one rib or projection 15 on the intermediate buckets, I may provide two or more, as shown on the wheel buckets.

I have described my invention in connection with an impulse turbine, but it can also be used in connection with a reaction machine or machines of other types. I have termed the part 12 a cover since this is the commonly accepted term therefor, but in some instances, as, for example, in reaction turbines, they are sometimes called "fitting and baffling strips" The projections on the cover are shown at right angles to the shaft, but the angle can be changed to meet the requirements of service.

In accordance with the provisions of the patent statutes, I have shown 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, the combination of a casing, a wheel within the casing having rows of buckets and circumferential grooves in its periphery between said rows, intermediate buckets between the rows of wheel buckets, means on said intermediate buckets which coöperates with the grooves in the wheel to reduce leakage, and a device for discharging fluid against the buckets.

2. In an elastic fluid turbine, the combination of a support, a row of buckets mounted on the support, a cover for the buckets having a projection thereon, and means located on opposite sides of the projection for securing it to the buckets.

3. In an elastic fluid turbine, the combination of a casing, a wheel within the casing having rows of buckets and circumferential grooves in its periphery between said rows, intermediate buckets between the rows of wheel buckets, means on said intermediate buckets which coöperates with the grooves in the wheel to reduce leakage, and a device for discharging fluid against the buckets, the axis of which is inclined toward the wheel axis to reduce the effect of centrifugal action on the fluid.

4. In an elastic fluid turbine, the combination of a support, a row of buckets mounted on the support, a cover for the buckets having a projection thereon, means located on opposite sides of the projection for securing it to the buckets, and a device for discharging fluid against the buckets, the axis of which is inclined to the plane of the wheel and also to its axis.

5. In an elastic fluid turbine, the combina-

tion of a casing, a wheel having rows of buckets, a cover for each row having projections thereon extending transversely of the wheel axis, projections carried by the casing which extend between the cover projections to reduce leakage, intermediate buckets between each two rows of wheel buckets, projections on said intermediate buckets which coöperate with the wheel to reduce leakage, and a device for discharging fluid against the buckets.

6. In an elastic fluid turbine, the combination of a casing, a fluid discharging device, a wheel having buckets thereon, a cover for the buckets having projections extending transversely to the plane thereof, a projection carried by the casing which extends between those on the cover to baffle the leakage, and a means situated between the wheel axis and the discharging device for further reducing the leakage.

7. In an elastic fluid turbine, the combination of a support, a row of buckets mounted thereon, a cover for the buckets having a plurality of projections thereon, and means for securing the cover to the buckets which are located on opposite sides of one of the projections.

8. In an elastic fluid turbine, the combination of a support, a row of buckets mounted thereon, a cover for the buckets having a plurality of rows of projections formed integral therewith, and rows of tenons formed integral with the buckets which project through the cover on opposite sides of a projection and are riveted over to secure the cover in place.

9. In an elastic fluid turbine, the combination of a casing having rows of intermediate buckets mounted on its inner wall and circumferential grooves in the wall parallel to said rows, a wheel within the casing having rows of buckets which rotate adjacent the rows of intermediate buckets, said wheel having circumferential grooves in its periphery between the rows of buckets thereon, covers for the intermediate buckets having projections which coöperate with the grooves in the wheel to reduce leakage, covers for the wheel buckets having projections which cooperate with the grooves in the casing to reduce leakage, and a device for discharging fluid against the buckets.

In witness whereof, I have hereunto set my hand this fifteenth day of February, 1906.

ELIHU THOMSON.

Witnesses:
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