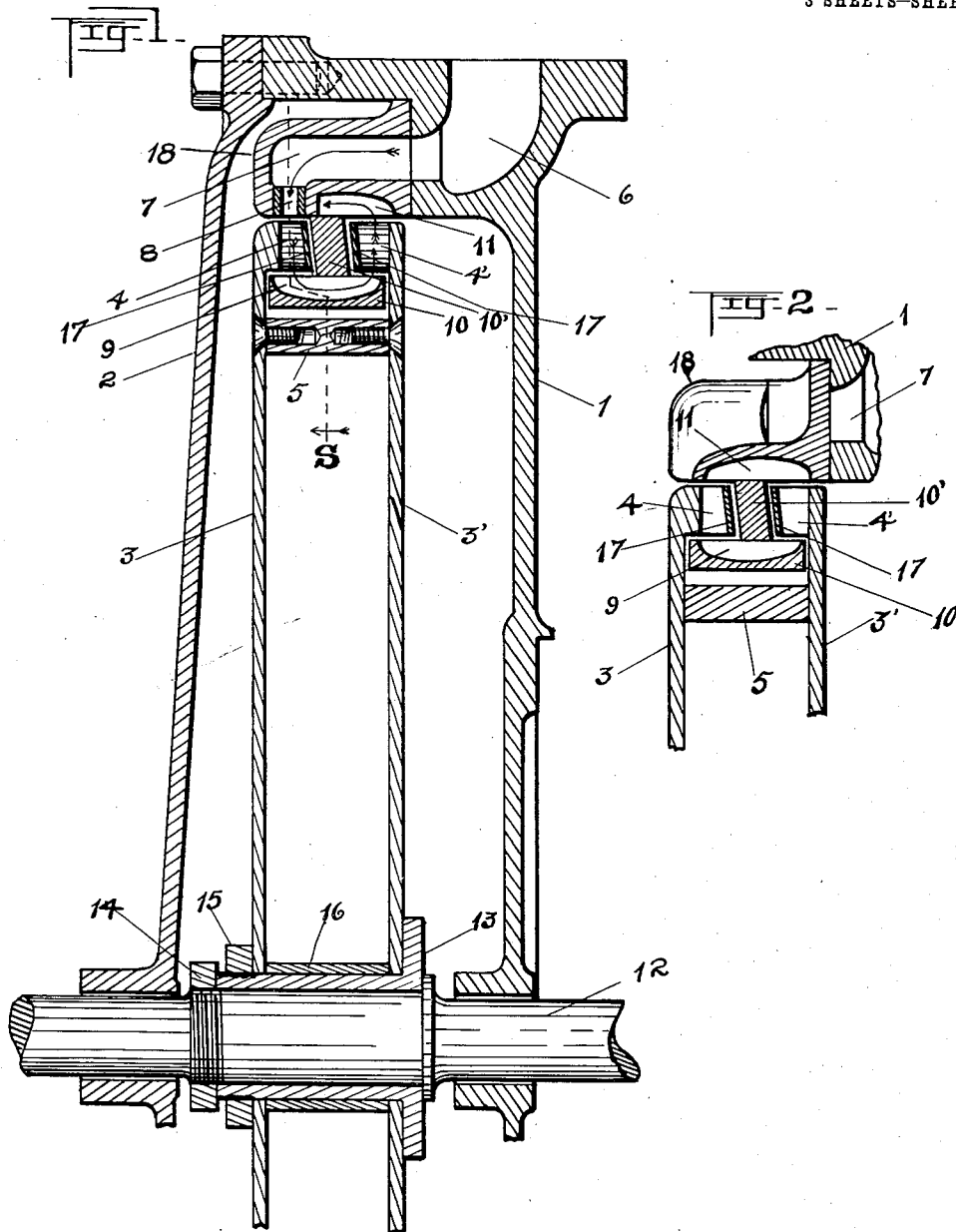


C. W. DAKE.
ELASTIC FLUID TURBINE.
APPLICATION FILED OCT. 6, 1909.

977,601.

Patented Dec. 6, 1910.

3 SHEETS-SHEET 1.



Witnesses:

Mary S. Lookin
Mary Schulte

Inventor
Charles W. Dake.

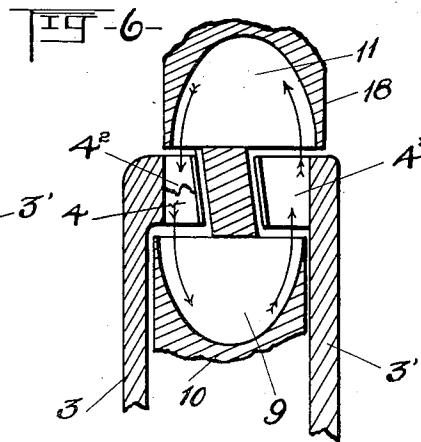
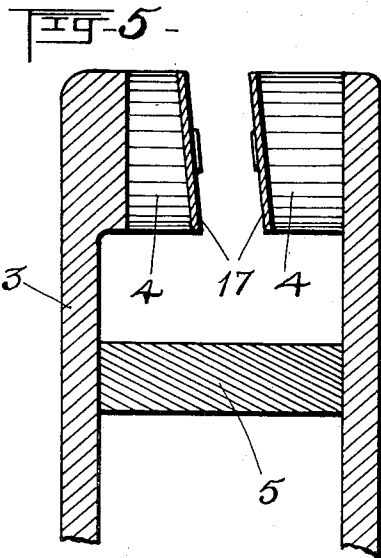
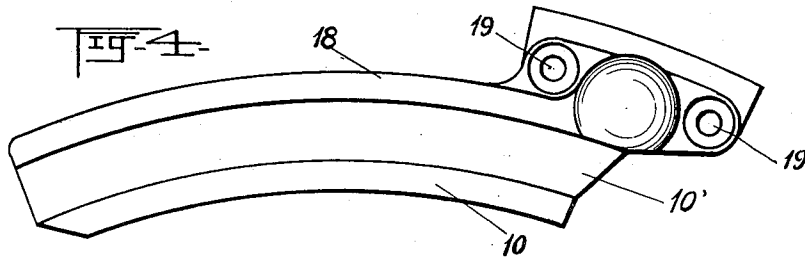
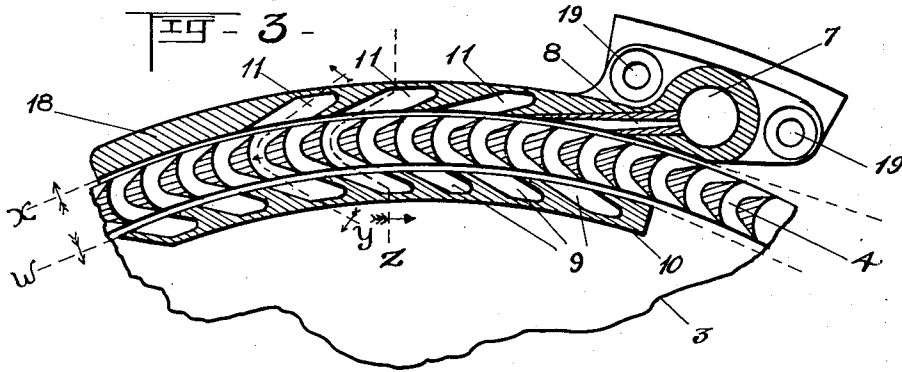
By Edward Taggart
his Attorney

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3 SHEETS-SHEET 2.



Witnesses:

Mary S. Looker
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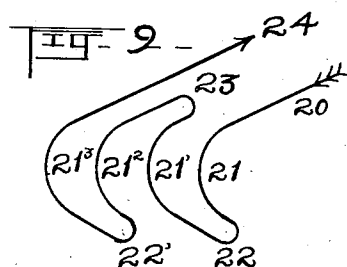
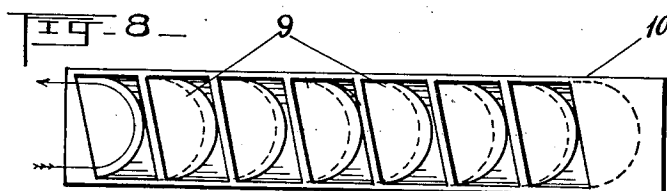
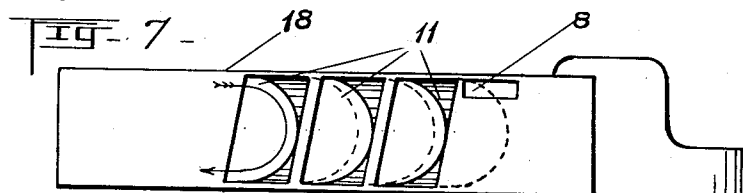
his Attorney.

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3 SHEETS-SHEET 3.



Witnesses:

Mary S. Tooke
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UNITED STATES PATENT OFFICE.

CHARLES W. DAKE, OF GRAND RAPIDS, MICHIGAN.

ELASTIC-FLUID TURBINE.

977,601.

Specification of Letters Patent.

Patented Dec. 6, 1910.

Application filed October 6, 1909. Serial No. 521,801.

To all whom it may concern:

Be it known that I, CHARLES W. DAKE, a citizen of the United States, residing at Grand Rapids, in the county of Kent and State of Michigan, have invented new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to improvements in elastic fluid turbines of the radial flow class, and its object is to obtain greater efficiency and simplicity than now exists in that class of turbine.

It is well known that the necessary change in the angle of the course of steam in the axial flow class of turbines necessitates a loss in efficiency as compared with the direct line action of radially tangential nozzles; and it is also well known that the efficiency of the discharge from nozzle or guide into bucket decreases as these parts leave the periphery and approach the shaft of the rotating body, so that it is primarily advisable to employ both the peripheral buckets and the radial nozzles. In this invention I have contrived means for retaining these advantages, and, at the same time, causing the elastic fluid to be employed repeatedly and always at the periphery of the rotor until its available energy is exhausted.

This device is intended to be used with steam, gas, air, or any elastic fluid, but, for convenience, I will herein use the term "steam", always meaning thereby, however, any suitable elastic fluid.

The object is accomplished by the mechanism shown in the accompanying drawings, in which—

Figure 1 is a transverse vertical section of the upper half of the rotary part and its casing constructed in accordance with my invention and mounted upon a horizontal shaft. Fig. 2 is an enlarged sectional view of a portion of the same parts shown in Fig. 1, and like Fig. 1, excepting that it is upon a plane somewhat further advanced, viz., upon the plane indicated by dotted line *z* in Fig. 3, and looking to the right in the direction shown by the arrow. Fig. 3 is a sectional view taken on a plane at right angles to the plane of Fig. 1 and upon the line *s* looking in the direction of the arrow to the left in Fig. 1. Fig. 4 is a side view of the delivery block. Fig. 5 is an enlarged cross sectional view of a portion of the same parts shown in Fig. 2 and in Fig. 1, showing

more in detail the buckets, their construction and arrangement. Fig. 6 is a sectional view of the buckets and secondary nozzles, this view being taken on line *y* of Fig. 3 upon a plane at right angles to the plane of Fig. 3 and showing the form they would take if projected forward upon a flat surface. This form of illustration is adopted to indicate the advance made by these nozzles in their course from one bucket to another. Fig. 7 is a view of that portion which in Fig. 3 is the upper portion of the delivery block looking upwardly from the line *w* in Fig. 3. Fig. 8 is a view of the lower portion of the same block looking downwardly from the line *w* in Fig. 3. Fig. 9 is a diagrammatic representation of the progress of the steam through successive parts of the device.

1 and 2 represent the two parts, or the base and cover of the rotor casing bolted or clamped together in any suitable manner. 3 and 3' are the two disks, which, suitably held together and spaced apart, constitute the rotor itself. These parts are all mounted upon or in connection with the shaft 12. The rotor is clamped by the nut 15 upon the hub 13, and this hub 13 in turn is clamped by the nut 14 against a suitable shoulder upon the shaft and thereby caused to rotate with the shaft. The rings 5 and 16 serve to brace and space apart the rotor disks at points near their center and near their periphery.

6 represents the passage into the casing provided from the exterior source of supply for the steam, and 7 shows the passage therefor into the delivery block. This delivery block is rigidly fixed in the casing by any suitable means, as, for example, by screws or bolts passing through holes 19, 19 in the delivery block and into the body of the casing base 1.

8 is a nozzle delivering the steam from the passage 7 into the buckets on the rotor. The preferred form of this nozzle is shown in Fig. 3, which indicates that it expands as it approaches the discharge point, thereby giving familiar advantages. This delivery block, thus rigidly attached by its upper part to the casing, is provided with a downwardly-extending central and internal flange, or web, 10', which web serves to connect the outward, and, as shown in the drawing, upper portion of the delivery block, with a somewhat similar lower and interior

portion disposed opposite the upper portion, the lower face of the upper portion being upon the arc of a circle, concentric with the arc of a circle formed by the upper face of the lower portion. In such lower face of the upper portion and upper face of the lower portion, I construct passages which, in the preferable form of construction, should be milled out, or machined out, of the solid metal body, which passages I have termed secondary nozzles and which serve to convey and advance the steam from one to another of the rotor buckets. The shape of these secondary nozzles is sufficiently indicated in the various figures.

Upon each inner peripheral edge of the two rotor disks I attach a series of buckets. These buckets are shown by the numerals 4, 4' and 4². These buckets are in the customary form and shape of buckets known in this connection, excepting that by this construction I am enabled to use a separately constructed and attached bucket instead of those machined out from the solid metal. 17, 17 represent the shrouds for these buckets.

It is evident that as the steam passes with its full velocity from the nozzle 8 in its tangential and radial relation to the rotor, the rotor consisting of the two disks and the buckets carried thereby will be revolved in the direction which, in Fig. 3, will be to the left, and that the series of buckets will thus revolve in the path between the two opposing faces of the delivery block. The parts will be constructed of such proportions and upon such curves that this revolution will be perfectly permitted.

The upper portion of the delivery block is, as above stated, indicated by the numeral 18, and the lower portion by the numeral 10. The secondary nozzles in the lower block 10 are marked 9 and the corresponding secondary nozzles in the upper block 18 are marked 11.

It is evident that as the steam enters from the nozzle 8 into one of the buckets 4, and in the course of the operation which will be apparent from Fig. 3, the steam in its reversed course will leave any particular bucket which it has thus entered in a course directed down and back to the right and at a point considerably advanced to the left from the point where it entered the same bucket from the nozzle 8. Such steam will thus be discharged into one of the lower secondary nozzles 9, and it will be by these nozzles conducted around and advanced to the left and will be again radially projected as from a nozzle into one of the following buckets 4. Here the course will be again reversed, this steam will leave this bucket and enter one of the upper secondary nozzles 11, where it will be again carried around and advanced and again projected as from a nozzle downwardly into another one of the

following buckets 4. The device will be so constructed and a sufficient number of these secondary nozzles will be provided in the delivery block, so that, by the time there has been utilized all the energy of the steam which it is thought desirable to utilize, the particular bucket in question will have passed the delivery block and the steam will then escape into the open interior of the casing and be conducted to an exhaust port in any desired manner. This path of the steam through the device is made especially clear by Fig. 9, in which 20 shows the course of the steam through the nozzle 8; 21 the downward and reverse course through the first bucket which it enters; 22 its reversing and advancing course through one of the nozzles 9; 21' its upward and reversing course through the second bucket which it enters; 23 its reverse and advance and discharge through one of the secondary nozzles 11; 21² its downward and reversing course through the third bucket upon which it operates; 22' its reverse and advance through the second secondary nozzle 9 which it traverses; 21³ its next upward and reversing course through the fourth bucket which it traverses, and 24 its escape to the exhaust. This reverse and advance through the secondary nozzles is intended further to be made clear by Fig. 6, in which the course of the steam is shown by the arrows, and passes downwardly out of bucket 4 into secondary nozzle 9, where it is reversed and directed upwardly and advanced so that it enters bucket 4' upon the other rotor disk. Then leaving this bucket, it enters a secondary nozzle 11 upon the upper side, where it is again reversed, directed downwardly and advanced and enters bucket 4² which is one of the buckets following bucket 4 upon the first rotor disk.

Having thus described my invention, what I claim to have invented, and desire to secure by Letters Patent, is—

1. In an elastic fluid turbine and in combination with the casing thereof, a double rotor disk, each disk having upon its inner face and near the periphery thereof a series of buckets, means for primarily supplying the elastic fluid radially and tangentially from the exterior to one of such series of buckets and means for conducting such fluid from the interior of the first series of buckets and delivering the same radially and tangentially to the interior of the other series of buckets.

2. In an elastic fluid turbine and in combination with the casing thereof, a rotor carrying internally and near its periphery, two rows of buckets, means for delivering the elastic fluid radially and tangentially to one of such rows of buckets upon one face of such buckets and means for conducting such fluid from the other face of such first row

of buckets and delivering the same radially and tangentially to one face of the other row of buckets.

3. In an elastic fluid turbine and in combination with a casing therefor a rotor having an annular opening in the periphery thereof, and a double series of buckets extending axially into such opening, means for supplying the elastic fluid with velocity radially and tangentially to one of such series of buckets and secondary nozzles conveying such steam from one series of buckets and delivering the same radially and tangentially to the other series of buckets.

4. In an elastic fluid turbine and in combination with the casing therefor, a rotor having an annular opening in the periphery thereof, two series of buckets extending axi-

ally into such opening, nozzles delivering the elastic fluid to one series of such buckets, secondary nozzles receiving such fluid from the first series of buckets and delivering the same radially and tangentially to the second series of buckets and further secondary nozzles receiving the fluid from such secondary series of buckets and delivering the same in a similar manner to such first series of buckets.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

CHARLES W. DAKE.

Witnesses:

MARY S. TOOKER,
MARY SCHULTE.