No. 841,253. PATENTED JAN. 15, 1907.

O. JUNGGREN.

MEANS FOR DECREASING LEAKAGE IN TURBINES.

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Fig. 1.

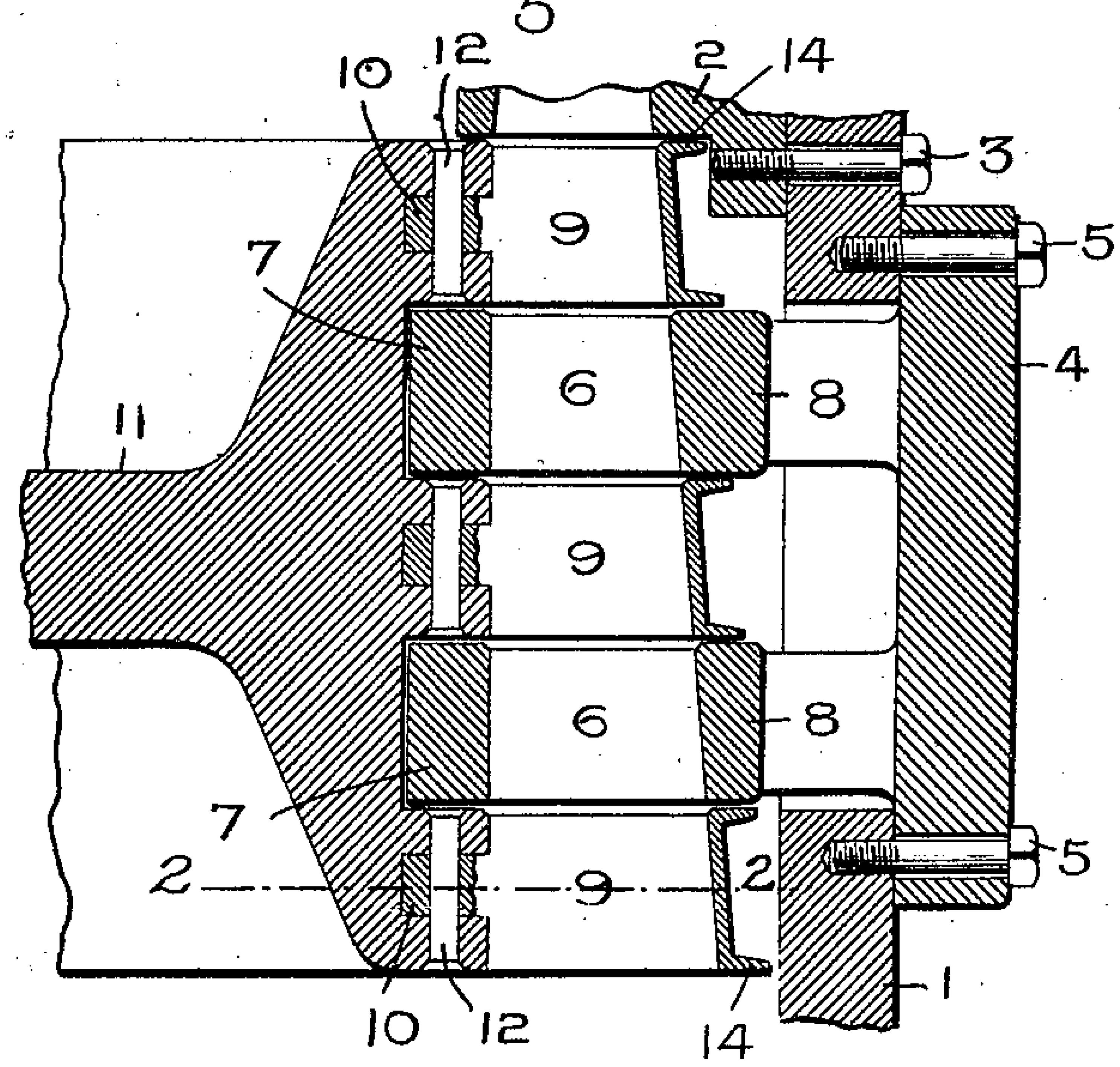



Fig. 2.

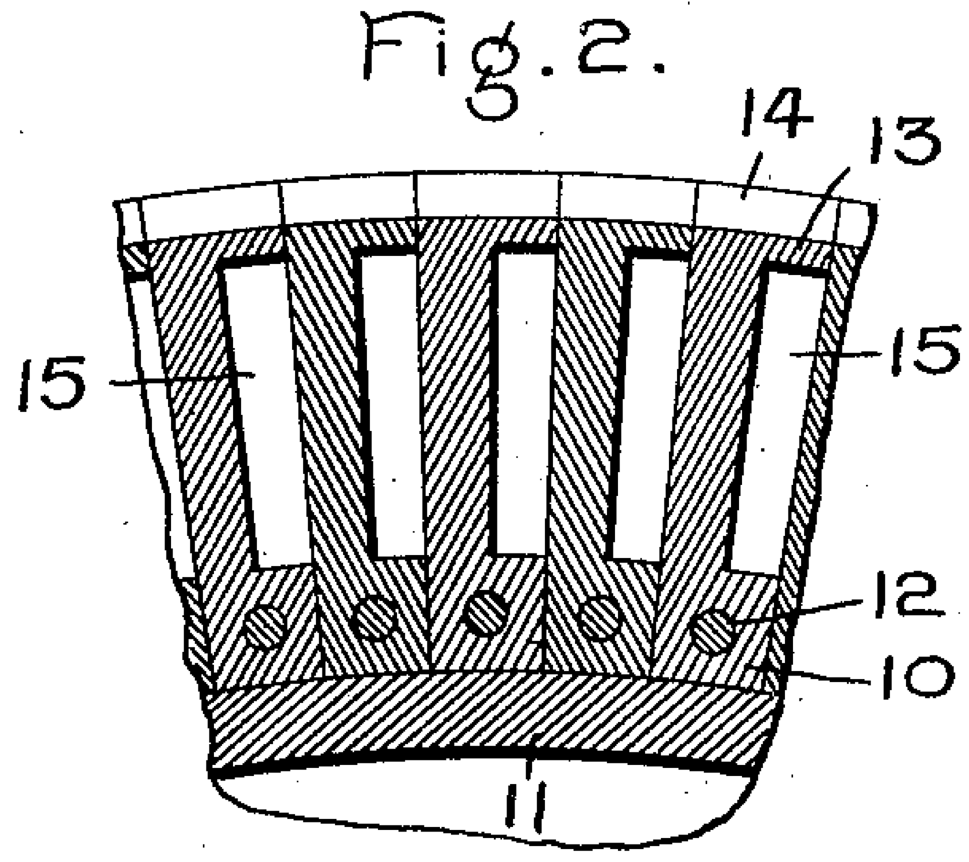



Fig. 3.

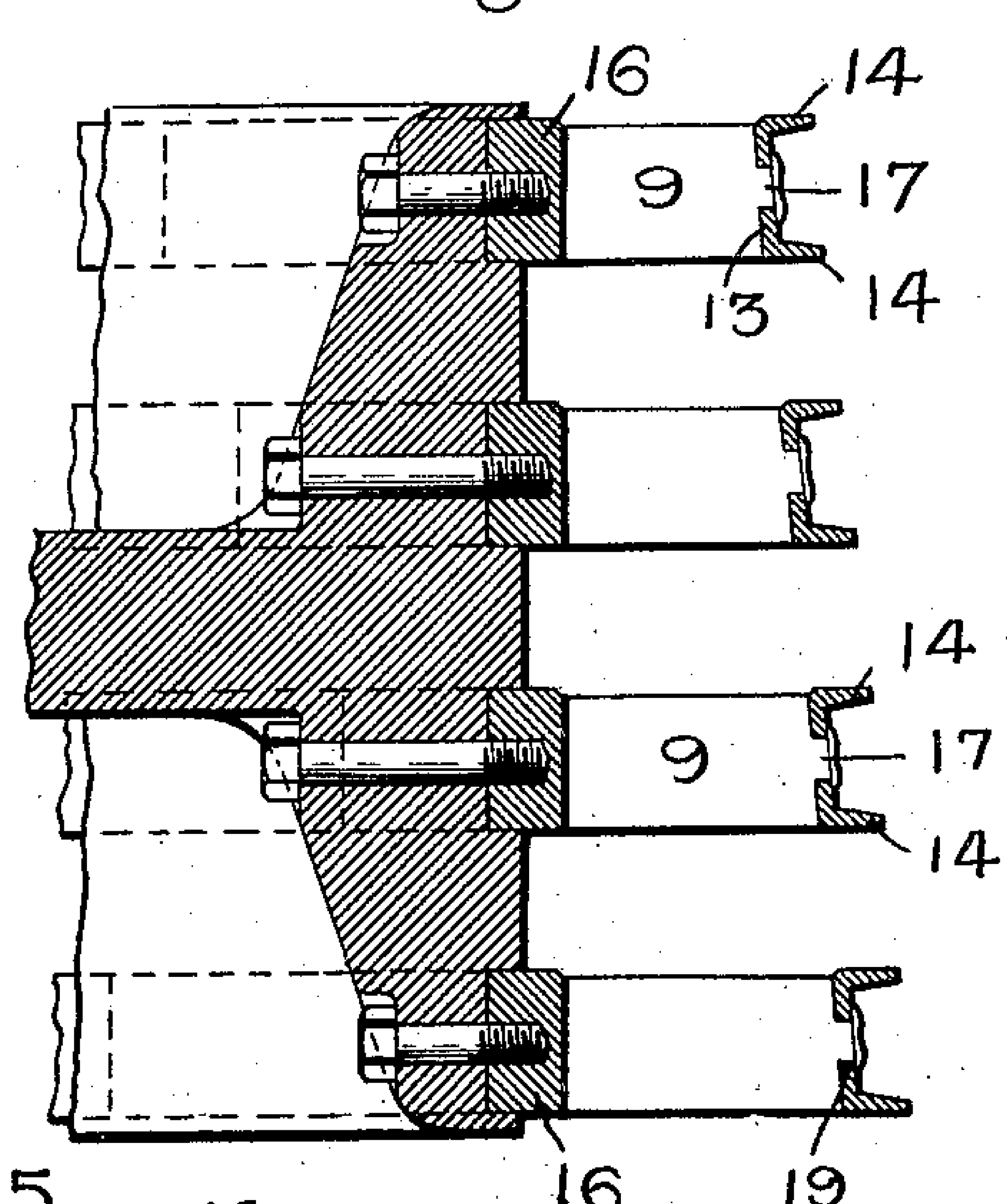



Fig. 4.

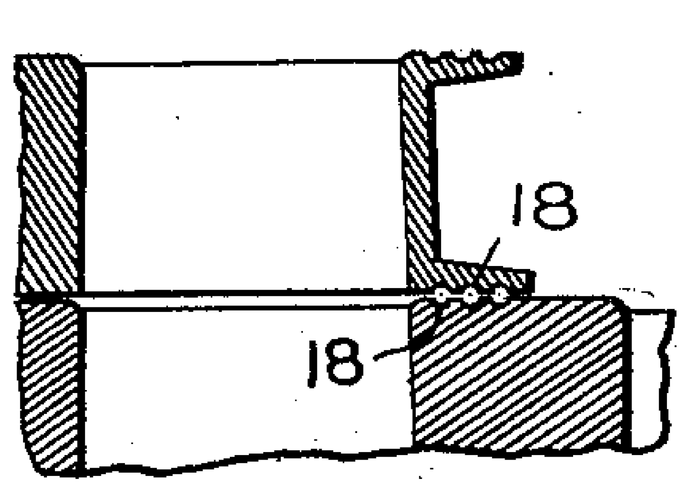
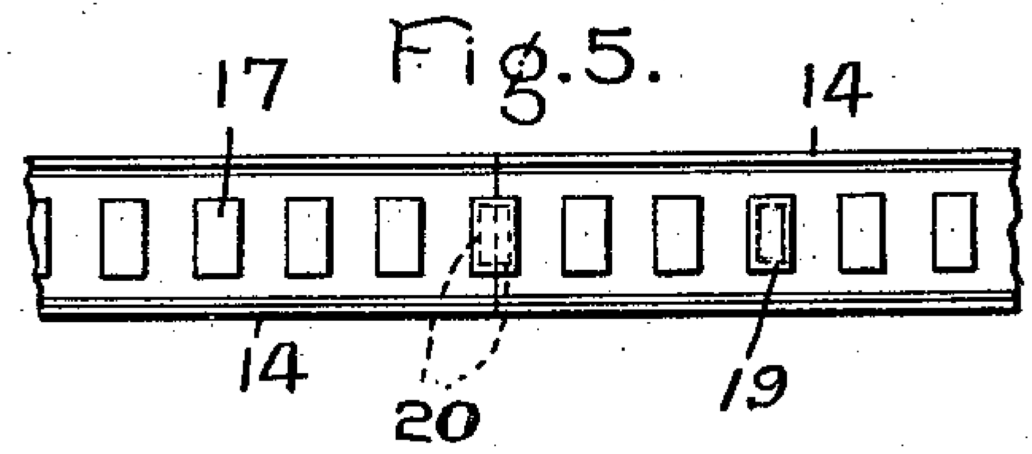



Fig. 5.

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# UNITED STATES PATENT OFFICE.

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## MEANS FOR DECREASING LEAKAGE IN TURBINES.

No. 841,253. Specification of Letters Patent. Patented Jan. 15, 1907.

Application filed April 29, 1903. Serial No. 154,888.

*To all whom it may concern:*

Be it known that I, OSCAR JUNGGREN, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Means for Decreasing the Leakage in Elastic-Fluid Turbines, of which the following is a specification.

In elastic-fluid turbines it is customary to provide a cover for the outer ends of the wheel-buckets in order to confine the motive fluid to the passages between the buckets. Situated between the wheel-buckets are stationary or intermediate buckets, which receive the motive fluid from one set of wheel-buckets and discharge it at the proper angle against a second set of wheel-buckets. Manifestly, there must be a clearance more or less great between the relatively moving buckets, and through this clearance considerable steam or other motive fluid leaks. The amount of this leakage is also governed by the difference in pressure between the column of steam actually performing work and that in the surrounding casing or shell. The greater the difference in pressure, other things being equal, the greater the leakage.

My invention has for its object to decrease the leakage at the clearances, and to accomplish this I provide a means whereby a high resistance or opposition is offered to the leakage or escape of motive fluid.

The covers ordinarily employed on the wheel-buckets are very thin, varying in thickness from one-eighth to three-sixteenths of an inch. Owing to the thinness of the cover, the surface friction opposing the escape of steam is very small.

In carrying out my invention I provide the bucket-covers with thickened edges, preferably taking the form of circumferential flanges formed integral therewith. The extended surfaces of the thickened edge of the cover and the support for the intermediates offer a considerably higher resistance to the escape of motive fluid than does the normal passage between the buckets. The opposition or resistance to leakage is not so great, however, as to prevent the water of condensation and expansion from being discharged under centrifugal force. The amount that the flange or flanges project beyond the cover varies with the character and size of the turbine.

For a fuller consideration of what I believe to be novel and my invention attention is called to the description and claims appended thereto.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a partial axial section of a turbine. Fig. 2 is a sectional view of a wheel, taken on the line 2 2 of Fig. 1. Fig. 3 is an axial section of a part of a bucket-wheel. Fig. 4 shows the bucket-cover and intermediate support grooved to further prevent leakage, and Fig. 5 is a development of the sectional bucket-cover.

1 represents the turbine casing or shell, and secured thereto is an adjustable nozzle 2, which may be of the expanding or non-expanding type, as is desired. In the particular illustration it is intended to convert the pressure of the elastic fluid into velocity and deliver it in the form of a jet to the buckets; but my invention is not limited thereto. The nozzle is secured in place by bolts 3 and is adjustable toward and away from the wheel in a plane parallel to its axis. The side of the casing or shell is provided with an opening through which projects the segmental support for the intermediate buckets. The support is provided with a flange 4 of somewhat greater area than the opening which is secured to the outside of the casing by bolts 5. Between the bodies of the bolts and the flange is a small space, so that the intermediates can be adjusted in an axial plane for the purpose of changing the clearances between them and the wheel-buckets. The intermediate buckets 6 may be of any suitable shape and form and are secured to their support in any ordinary manner. The intermediate buckets are provided with covers 7, which are slightly wider than the buckets themselves measured in an axial plane. The portion 8 of the support adjacent to the wheel bucket-cover is also somewhat wider than the buckets measured in an axial plane, so as to reduce the leakage and prevent the sharpened edges of the buckets from rubbing. The wheel-buckets 9 are each provided with a shank 10, formed integral therewith at the inner end, and these shanks are fitted into a circumferential groove formed in projections on the periphery of the wheel 11. The buckets are retained in place by pins 12, which extend from one side to the other of the said

projection or raised portion formed on the wheel-periphery. The pins being somewhat shorter than the distance between the projections can readily be slipped into place and the ends peened over afterward. The sides of the projection are in close proximity to the cover 7 of the intermediate buckets, so as to reduce the circumferential or cross leakage at this point. The buckets may be formed by drop-forging or casting, as desired, and each bucket is provided with a cover 13, sometimes called a "fitting and baffling strip," which cover has two thickened edges formed integral therewith, which in the present illustration take the form of circumferential flanges 14. In cross-section the cover has the shape of a channel-beam. The clearance, measured in an axial plane, between the thickened edges or flanges 14 of the bucket-cover and the stationary parts, such as the nozzle and the portion 8 of the intermediate support, is made as small as possible consistent with good operation. Through this clearance the water due to expansion and condensation can be discharged; but the resistance or opposition to the passage of elastic motive fluid at this point is high. This is owing to the fact that the flange presents an extended surface to the stationary part, and the frictional resistance offered to the outward passage of steam at this point is considerably greater than the resistance offered to the passage of steam through the normal or working passages between the buckets. In other words, two paths are provided for the steam or other elastic fluid, one of low resistance and the other of relatively high resistance, and owing to the fact that the jet is traveling at high velocity due to the nozzle only a very small amount of steam will be permitted to escape through the circumferential clearance. The water due to expansion and condensation also has a tendency to decrease the leakage by wetting the adjacent surfaces of the moving and stationary parts. As the intermediate buckets usually extend around only a small portion of the wheel, the brake action due to the water can be disregarded. Under ordinary conditions of operation, however, the clearance would be great enough to prevent this brake action from taking place, at least to any substantial degree. The flange 14 has considerable depth measured in a radial plane, and this depth varies with different turbines. As a general proposition it may be stated that the greater the difference in pressure between the fluid stream and fluid or steam within the shell or casing the greater will be the depth of the flange because the tendency for the steam to escape at this point is correspondingly increased.

Referring to Fig. 2, it will be seen that the shank 10 on each bucket is tapered and engages with similar shanks on adjacent buckets and that the cover 13 of each bucket is also slightly tapered and engages with the cover-sections of adjacent buckets. In this manner the steam or other motive fluid is confined to the working passages 15.

Referring to Fig. 3, I have shown a slight modification of the invention, wherein the wheel-buckets 9 are formed integral with segmental supports 16, which in turn are secured to the wheel by bolts or other attaching means. In this figure the line of division between the segmental supports is shown in dotted lines. The buckets are provided with tenons 17, formed integral therewith, which register with openings formed in the cover 13, sometimes called a 'fitting and baffling strip." The cover is preferably made in sections and is provided with thickened edges or flanges 14, as before. The tenons are riveted over to secure the cover-sections in place. In a construction of this kind it is desirable to have the cover-sections embrace a number of the buckets, because it simplifies the machine-work.

The intermediate buckets used with the different structures should be of a suitable form, capable of receiving the motive fluid from one row of wheel-buckets and changing its direction and discharging it against the second row of wheel-buckets at the proper angle. The buckets may in addition to changing the direction of the stream also act to impart a certain amount of velocity to the stream.

In Fig. 4 the wheel-cover and support for the intermediate buckets are shown on a somewhat-enlarged scale, and both are grooved circumferentially at 18 to further prevent or reduce the leakage at the clearance. As the elastic motive fluid tends to escape it creates whirls or eddies in the grooves.

Fig. 5 shows a sectional bucket-cover developed on a flat plane. Each section is provided with flanges 14 at the edges, which are made stiff enough to prevent them from rubbing on the stationary parts when subjected to fluid-pressure. The sections are perforated at 19 to receive the bucket-tenons, and the adjacent ends of the sections are provided with notches 20, which when the ends are united form a perforation similar to 19. The cover or fitting or baffling strip can with advantage be made out of "channel" stock and preferably of steel.

The baffling of the motive fluid may take place at the side flanges of the fitting and baffling strip or cover 13, as shown in connection with the intermediate bucket-supports 8, or the edges of the flanges on said strip may be utilized for the purpose, the structure being the same in either case. The said strip can serve as a baffling means on both the side and edge at the same time, as shown in the upper right-hand corner of Fig. 1

The baffler disclosed herein possesses important advantages over prior arrangements in the way of better baffling effects and in the way of greatly-decreased cost of manufacture. It is also well adapted to meet the condition of accidental rubbing of the parts. Aside from functioning as a baffler the said baffle-strip or cover serves to secure the outer ends of the buckets and form a part of the passage for the motive fluid. By making the strips out of solid stock with flanges at right angles thereto it is a simple and inexpensive matter to turn or finish the face or faces to the required dimensions. Moreover, such a construction renders it possible to utilize workmen of ordinary skill.

It has been proposed heretofore to use laminated baffling devices for the free ends of turbine-buckets, and in some instances the edges of the said devices have been splayed. This construction was an objectionable one for various reasons, chief among which was the difficulty experienced in turning them to a true surface. The thinness of the stock and the fact that the structure was laminated with the edges separated in an inclined plane made it necessary to tool it very slowly in order to prevent tearing or springing of the metal, and therefore required great care and skill. With the structure illustrated this objection is overcome, and the parts can be made sufficiently robust for all practical purposes.

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 in other ways.

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 means for discharging motive fluid, a wheel, segmental supports mounted on the wheel having integrally-formed buckets, a cover for the buckets composed of a single layer having a thin central portion and circumferential flanges at the edges, intermediate buckets, and supports therefor which are situated in line with the flanges and in close proximity thereto.

2. In an elastic-fluid turbine, the combination of a casing, a nozzle, intermediate buckets, a support therefor, a wheel having buckets, a row of buckets between the nozzle and the intermediates, and a cover for the wheel-buckets having a thin central portion and circumferential flanges which project beyond the central portion and revolve in close proximity to the nozzle and the intermediate support.

3. In an elastic-fluid turbine, the combination of a casing, a nozzle for discharging motive fluid, wheel-buckets situated in front of the nozzle, covers for the wheel-buckets having outwardly-extending flanges formed thereon, intermediate buckets situated between the wheel-buckets, a support therefor which is situated in line with the cover-flanges, and means for adjusting the support toward or away from the cover-flanges.

4. In an elastic-fluid turbine, the combination of a casing, a nozzle mounted thereon and adjustable in a plane parallel with the wheel-axis, a bucket-wheel, covers for the buckets having circumferential flanges formed integral therewith, intermediate buckets, a support therefor situated in line with the flanges, and means for adjusting the support toward or away from the cover-flanges.

5. In an elastic-fluid turbine, the combination of a plurality of wheel-buckets, a cover therefor, circumferential flanges at each side of the cover, intermediate buckets, a support therefor, and a groove opening into the clearance-space between the wheel and intermediate buckets for decreasing the leakage.

6. In an elastic-fluid turbine, the combination of a wheel or support having a plurality of grooved projections formed on the periphery, a plurality of buckets, each having a shank that enters the groove, a retaining means for each bucket which pass through a projection and the shank, covers for each row of buckets, and a row of intermediate buckets located between each two rows of wheel-buckets.

7. A bucket element for an elastic-fluid turbine comprising a wheel or support with a plurality of buckets attached thereto, and a jointed cover for the buckets comprising a single layer, each section of the cover having a portion which forms a part of the working passage, and integral side portions extending at right angles or substantially at right angles thereto for decreasing the leakage.

8. In an elastic-fluid turbine, the combination of a casing, a means for discharging motive fluid, buckets which are acted upon by the fluid and are formed integral with their support, a number of tenons each formed integral with a bucket, and a cover for the buckets which is held in place by the tenons, and has integral flanges occupying planes parallel or substantially parallel with the edges of the buckets.

9. In a turbine, the combination, with its drum and casing, of a number of turbine-blades and a fitting and baffling strip of channel shape in cross-section, one portion of which is attached to the free ends of the blades and the other portion of which extends at right angles to the turbine-axis.

10. In a turbine, the combination, with its drum and cylindrical casing, of a number of turbine-blades and a fitting and baffling strip made of a single thickness of stock of channel

shape in cross-section, the middle portion of which extends longitudinally and is attached to the free ends of the blades, and the other portions of which extend away from the blades and presents their edges to the inclosing cylindrical casing.

11. In a turbine, the combination, with its drum and casing, of a number of turbine-blades and a fitting and baffling strip made of a single thickness of stock of angular cross-section, one portion of which is perforated to receive the blade ends and attached to the free ends of the blades by riveting over the blade ends which project through the perforations, and the other portion of which extends away from the blades transversely of the turbine-axis.

12. In a turbine, the combination, with its drum and casing, of a number of turbine-blades and a fitting and baffling strip divided into segmental lengths and made of a single thickness of stock of channel shape in cross-section, the middle portion of each segment being perforated and the ends notched to receive the blade ends, the said fitting and baffling strip being attached to the free ends of the blades by riveting over the blade ends which project through the perforations, and the other portions of which extend transversely away from the blades transversely of the turbine-axis.

13. In a turbine, the combination, with its drum and casing, of a number of radial turbine-blades, and a channel-shaped fitting and baffling strip attached to the free ends of the blades and extending at right angles to the turbine-axis, as set forth.

14. In a turbine, the combination, with its drum and casing, of a number of radial turbine-blades, and a fitting and baffling strip made of a single thickness of stock and attached to the free ends of the blades by riveting and extending transversely of the turbine-axis, as set forth.

In witness whereof I have hereunto set my hand this 28th day of April, 1903.

OSCAR JUNGGREN.

Witnesses:

ALEX. F. MACDONALD,

HELEN ORFORD.