No. 716,936. Patented Dec. 30, 1902.

J. RICHARDS.

STEAM TURBINE.

(Application filed Aug. 20, 1902.)

(No Model.) 2 Sheets—Sheet 1.

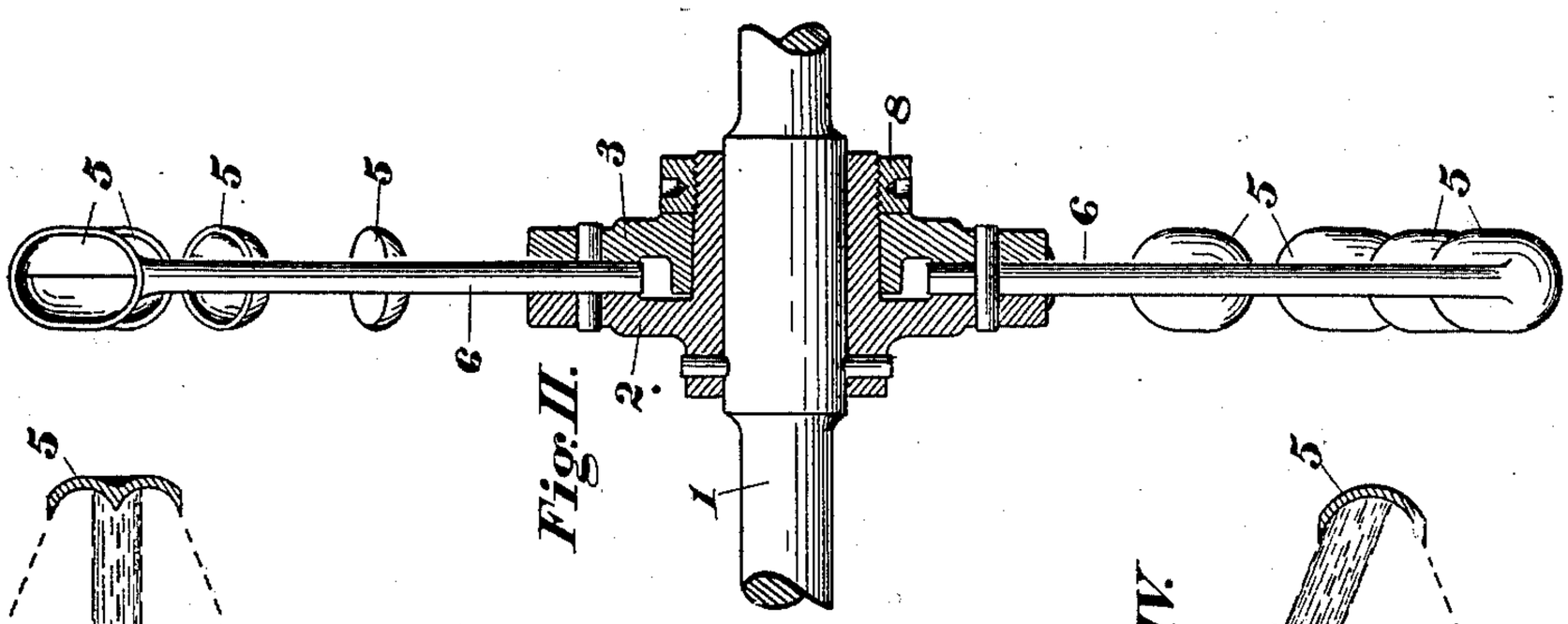

Fig. II.

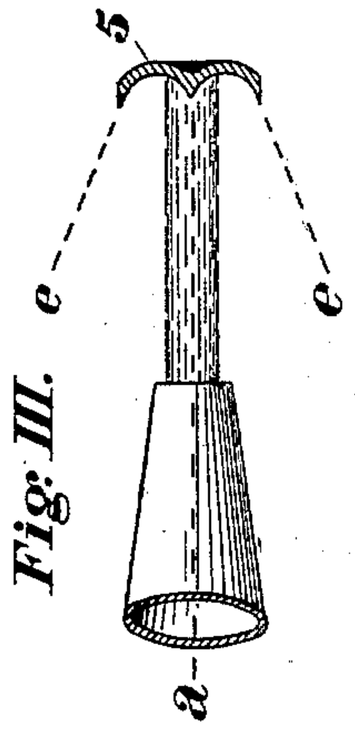

Fig. III.

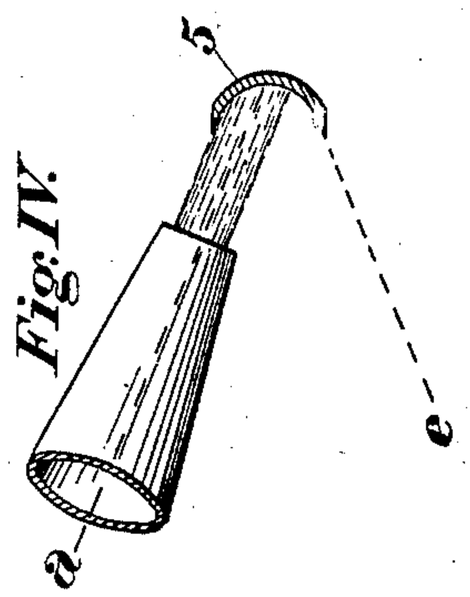

Fig. IV.

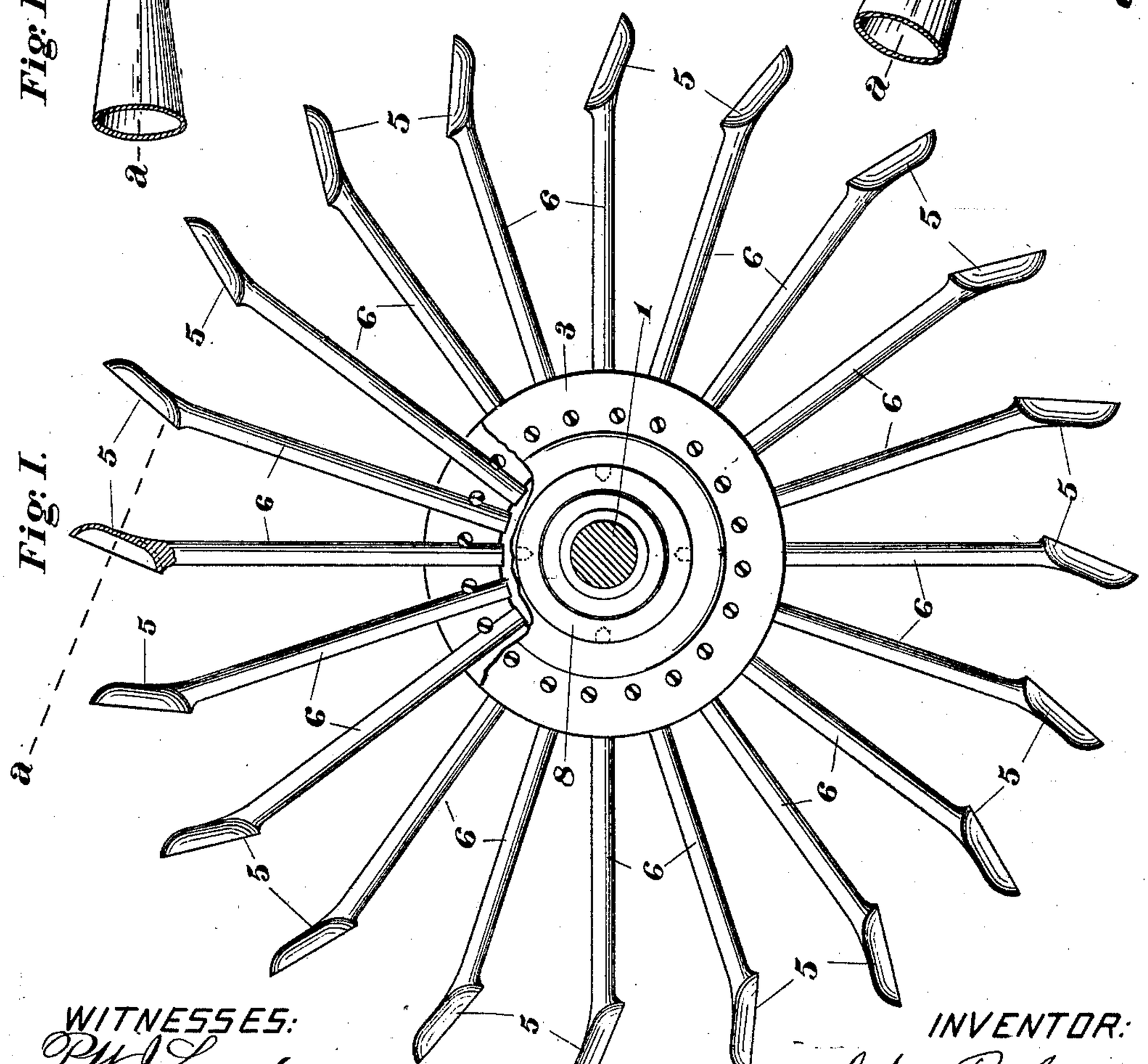

Fig. I.

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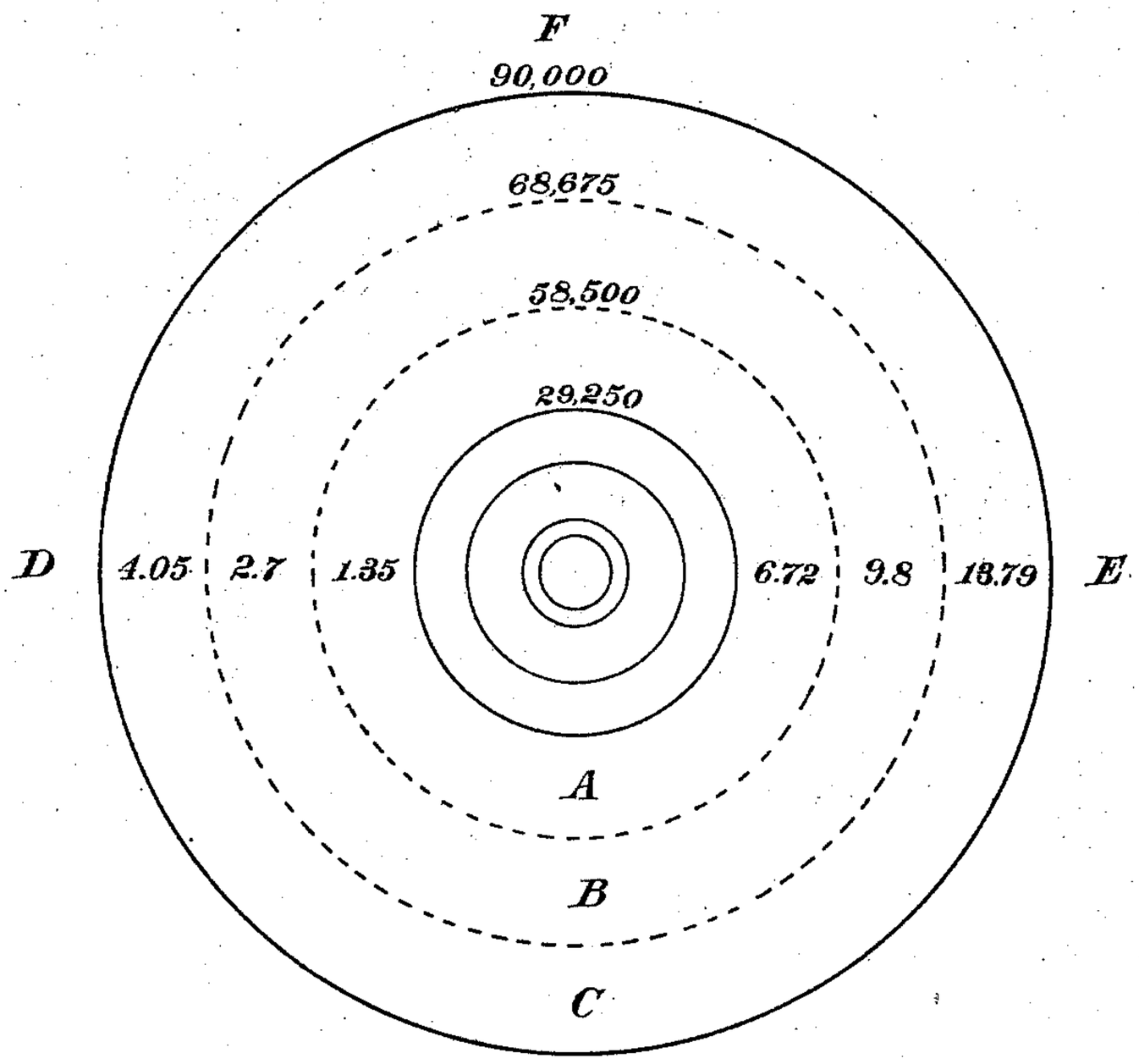
(No Model.) 2 Sheets—Sheet 2.

Fig: V



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UNITED STATES PATENT OFFICE.

JOHN RICHARDS, OF SAN FRANCISCO, CALIFORNIA.

STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 716,936, dated December 30, 1902.

Application filed August 20, 1902. Serial No. 120,378. (No model.)

To all whom it may concern:

Be it known that I, JOHN RICHARDS, a citizen of the United States, residing at San Francisco, county of San Francisco, and State of California, have invented certain new and useful Improvements in Steam-Turbines; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates especially to steam-turbine motors and to certain improvements therein.

My improvements consist in a peculiar construction of the motive wheels, whereby the vanes or buckets are made of a thin section, light in weight and integral, with radial stems or spokes that support them, the latter being secured to a central nave, the diameter of which lies within the zone of disrupting centrifugal strain, these stems or spokes being made of strong material disposed in the line of their lamination and greatest strength and of small section, so as to withstand the centrifugal strain at such rotative speed as is demanded by the velocity of the steam or other elastic fluid applied thereto and also consists in a peculiar form of the buckets or vanes that are made concave in all planes and for this reason can remain in the jet throughout a considerable arc, and consequently be few in number.

The object of my invention is to provide a revolving motive wheel for steam-turbine motors of a simple and inexpensive construction that will withstand the high rate of revolution demanded by the velocity of the fluid issuing under pressure. To attain these ends, I construct such turbine-wheels substantially as shown in the drawings herewith, forming a part of this specification.

Figure I is a side view, partially in section, of a turbine-wheel constructed according to my invention; Fig. II, a central transverse section of the same wheel; Fig. III, a diagram showing the manner of applying the impelling fluid tangentially, and Fig. IV a similar diagram showing the manner of applying the impelling fluid at the side of the wheel oblique to its plane of revolution. Fig. V is a diagram showing the avoidance of weight by my improvement.

The efflux of steam and other elastic fluids at the high pressure common in steam-engines approximates a velocity of four thousand feet per second, and as a motive wheel on which the steam impinges and reacts from should have a velocity of approximately one-half as much, or exceeding one hundred thousand feet per minute, the strength of constructive material as hitherto disposed in such wheels will not safely sustain the radial strain produced by centrifugal force at this high velocity. Such force being as the square of the velocity of revolution and directly as the weight or mass with the same radius, it follows that the revolving weight should be reduced to a minimum and the radial member or members be as few in number and as small in section as possible, also disposed in position of their greatest strength, and that no joints or fastenings be employed within the zone ef eruptive strain. The number of vanes required depends on their configuration. If concave and reactive at all angles of the jet, then these vanes or buckets can remain in the jets throughout an arc, as indicated in the drawings, and be few in number accordingly. To attain these ends, I construct turbine-wheels as shown in the drawings, 1 being the shaft on which the wheel is mounted, 2 and 3 members forming a central nave, and 5 the vanes or buckets formed integrally with the stems 6. The buckets 5 are made of a thin light section, with double-curved faces, as shown in Fig. III, a single curve, as in Fig. IV, or of any suitable form to receive, deflect, and reverse the course of the fluid 9, that impinges thereon when discharged from nozzles 10, as indicated in the drawings, where *a* is the line of impingement and *e* the line of reaction. The divisional ridge 11 can be radial in the plane of rotation, as shown in Figs. II and III, or may be transverse across the buckets and have a like effect when the steam-jets are applied tangentially, as in Figs. I and III, or a like effect can be produced by a cone disposed centrally in the buckets.

The buckets V are formed on the outer ends of the stems 6 by forging or pressing, the whole being of the strongest metal, such as fine steel, and as small in section and light in weight as lateral strains will permit. The

section of the stems 6 can be circular, as shown in the drawings, or of any other suitable form and can be secured in the nave in any suitable manner, preferably by through-pins 7, as shown. The nave is preferably made in two parts 2 and 3, that can be clamped together by a screw-collar 8, to hold the stems 6 while being adjusted and fastened, also to permit the convenient removal and replacement of buckets or vanes that may be worn or injured in use, or the nave may be solid, the result being the same.

Referring to Fig. V, this diagram, drawn to a scale of one-fourth, represents the relative weights of a turbine-wheel with a solid disk whose thickness is equal to the diameter of the spokes 6 and a wheel constructed as in Fig. I. In Fig. V the plane of revolution is divided into three imaginary zones A, B, and C, and the columns of figures indicate as follows: F, the velocity in feet per minute at the various points; D, the weight in pounds of the construction shown in Fig. I; E, the weight in pounds in the different zones of a solid disk whose thickness equals the diameter of the spokes 6 in Fig. 1, the aggregates being as 1 to 3.75. This does not, however, indicate the relative strength to resist centrifugal strain, which being as the square of the velocity multiplied by the weight shows a difference of six or more to one in favor of separate and independent spokes, as shown in Fig. I. It will be understood that the same construction is suitable for any elastic fluid or for liquids under pressure so great as to produce high velocity and consequent centrifugal strain on the radial members of the wheel.

Having thus described the nature and objects of my invention, what I claim as my invention, and desire to secure by Letters Patent, is—

In a steam-turbine motor-wheel, a central nave or hub of a diameter within the zone of disruptive centrifugal strain, having equidistant radial sockets formed therein, strong radial stems securely fastened in said sockets, occupying the main zone of disruptive strain, whose breadth is at least equal to the radius of the hub, and light concave reactive buckets integrally formed on the extremities of said stems, for receiving the impact of the motor fluid, substantially as specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN RICHARDS.

Witnesses:
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