

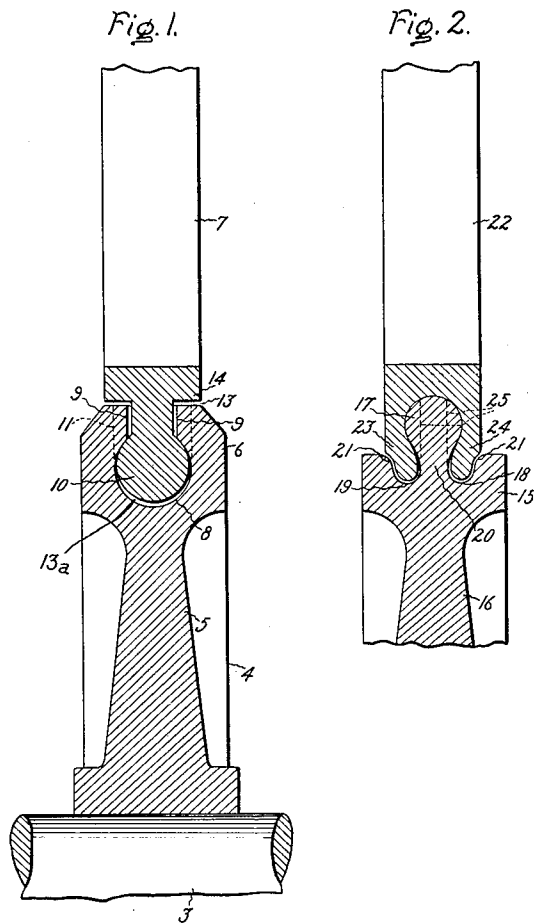
Dec. 27, 1932.

C. W. RICE

1,891,948

ELASTIC FLUID TURBINE

Filed Oct. 2, 1931



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UNITED STATES PATENT OFFICE

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ELASTIC FLUID TURBINE

Application filed October 2, 1931. Serial No. 566,498.

The present invention relates to elastic fluid turbines, particularly to the rotors thereof, comprising a bucket-carrying member such as a wheel or a drum fastened to a rotary shaft and a plurality of buckets secured to said member.

The bucket-carrying members in modern high power elastic fluid turbines reach considerable dimensions in diameter. Owing to unequal distribution of load on these members and static and dynamic unbalances, they are subjected to vibrations which may cause fatigue failure of the blades. It has already been suggested to provide special means for dampening and absorbing vibratory energy of the turbine rotors, particularly of the blades.

The object of the present invention is to provide an improved construction of a bucket-carrying member which serves to absorb vibratory energy, without the provision of additional means.

For a consideration of what I believe to be novel and my invention, attention is directed to the following description and claims appended hereto and the accompanying drawing which forms a part of the specification.

In the drawing, Fig. 1 is a section partly diagrammatic, partly broken away, of a bucket wheel, and Fig. 2 is a similar view representing a modified form embodying my invention.

Referring to Fig. 1, where I have shown by way of example a bucket wheel of an elastic fluid turbine, 3 designates a rotary turbine shaft to which is fastened by any suitable means, not shown, a bucket wheel 4, comprising a web 5, a rim 6 integrally formed with the web and a ring of blades or buckets 7 held to the rim by a dovetail connection.

The arrangement so far described may be considered as typical of any bucket wheel having a plurality of blades held in position by a dovetail connection with the rim.

According to my invention, I provide a construction of the dovetail connection which permits relative movement between the blades and the rim.

In the present instance I have shown in Fig. 1 rim 6 as being bifurcated, forming an

annular recess 8 of rounded cross-section with shoulders 9 at the outer part. The buckets or blades 7 are provided with a rounded base portion 10 of similar shape as the recess 8 of the rim. In assembling, the buckets are inserted in the recess of the rim through a radial opening 11 of the rim indicated in dotted lines, where the shoulders 9 are cut away. The blades are moved to the left and right of the opening along the recess, it being understood that several openings may be provided as desired. The sides of the base portions 10 of the adjacent buckets engage each other whereby the base portions of the complete ring of buckets form an annular projection fitting loosely into the annular recess 8 of the rim. The loose fit has been indicated by a clearance 13 between the shoulder 14 of the bucket and the periphery of the rim and a clearance 13a between the annular projection 10 of the blades and the walls defining groove 8 in the rim.

With such an arrangement the blades are forced outwardly during operation of the turbine owing to the centrifugal force exerted thereon. If now a vibration of the buckets occurs it will cause a sidewise turning thereof in either direction. These sidewise turning motions are considerably dampened with my above described arrangement due to the frictional resistance between the base portions of the buckets and the walls forming the rounded annular recess in the rim. If the vibrations exceed a certain value the shoulders 14 of the buckets will be alternately forced against the periphery of the rim, whereby vibratory energy is further absorbed due to impact between said parts.

It will be readily seen that by my invention no substantial bending of the blades takes place as would be the case if they were rigidly secured to the rim of the wheels. Experience has shown that blades having a less tight fit with the rim are less subjected to damage than those with a very tight fit, obtained, for instance, by welding or like method of integrally uniting the blades to the wheel.

In Fig. 2 I have shown a construction according to which the blades are held to the

rim by an inverted dovetail connection. For this purpose I provide rim 15, which is integrally united with the web 16, with an annular projection 17 having a rounded cross section and being tapered radially inwardly. 18 and 19 are annular grooves, preferably of rounded shape, formed in the rim between the tapered part 20 of the projection 17 and the rounded shoulders 21 of the rim. Mounted on the rim is a ring of turbine buckets 22 which latter are provided with slots of similar shape in their bases, thus forming furcations or legs 23 and 24 which straddle the rounded annular projection 17 of the rim and extend into the grooves or recesses 18 and 19 respectively. At one or more places the annular projection 17 is partly cut away as indicated by dotted lines 25 in order to permit assembly of the buckets. The cut away portions of projection 17 are filled in by suitable means, for instance, fillers, not shown in the drawing, as disclosed by Patent No. 1,415,266 to C. S. Rice. With such an arrangement the buckets may turn sidewise in either direction whereby the fit with the rounded annular projection causes frictional resistance to absorb vibrational energy. Between the lower part of legs 23 and 24 and the adjacent rounded shoulders 21 of the rim I may provide a clearance to permit impact between the base portions of the blades and the rim in case the vibrations exceed a certain value.

By my invention I have provided a bucket wheel construction in which vibratory energy is substantially absorbed by an improved arrangement for securing the ring of buckets to the rim. The dampening of vibrations of the wheel is thus achieved without additional means. With modern manufacturing methods the special form of dovetail connection is not substantially more expensive. My bucket wheel construction has also the advantage that it does not impede the flow of elastic fluid through the bucket wheels.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A rotary member having a part for carrying buckets and a bucket having a part secured thereto, one of said parts being provided with an annular recess of rounded cross section, the other part being provided with an annular projection loosely fitting into the annular recess to permit during operation the bucket to turn sidewise for setting up frictional resistance between said parts whereby oscillatory energy of the bucket is absorbed by the frictional resistance.

2. A bucket carrying member having a bifurcated rim forming an annular recess with rounded cross section and shoulders, and a ring of buckets, each bucket having a base portion with a rounded projection loosely fitting into the recess to permit during operation the bucket to turn sidewise for setting up frictional resistance between said parts

whereby oscillatory energy of the bucket is absorbed by the frictional resistance.

3. A bucket carrying member having a bifurcated rim forming an annular recess with rounded cross section and shoulders, and a ring of buckets, each bucket having a base portion with a rounded projection loosely fitting into the recess for causing frictional resistance with the rim during operation, the base portion of the buckets and the shoulders of the rim defining a clearance therebetween to permit sidewise turning movement of the buckets.

4. A bucket carrying member having a rim with an annular projection of rounded radially inwardly tapered cross section and a ring of buckets having bifurcated base portions defining a rounded recess and straddling loosely the annular projection to cause frictional resistance during vibration of the wheel, the ends of the bifurcations projecting inwardly against the tapered portion of the annular projection.

5. A bucket carrying member having a rim provided with shoulders, an intermediate annular projection of rounded cross section and annular grooves between the shoulders and the annular projection, and a ring of buckets, each bucket having a bifurcated base portion, the bifurcation defining legs and a recess of rounded form therebetween, the annular projection of the rim fitting loosely into the recesses of the base portions of the buckets, and the legs extending into the grooves of the rim and defining a clearance between them and the shoulders.

In witness whereof, I have hereto set my hand.

CHESTER W. RICE.