Oct. 9, 1923. 1,470,505

C. STEENSTRUP

ELASTIC FLUID TURBINE

Filed Jan. 3, 1921

Fig. 1.

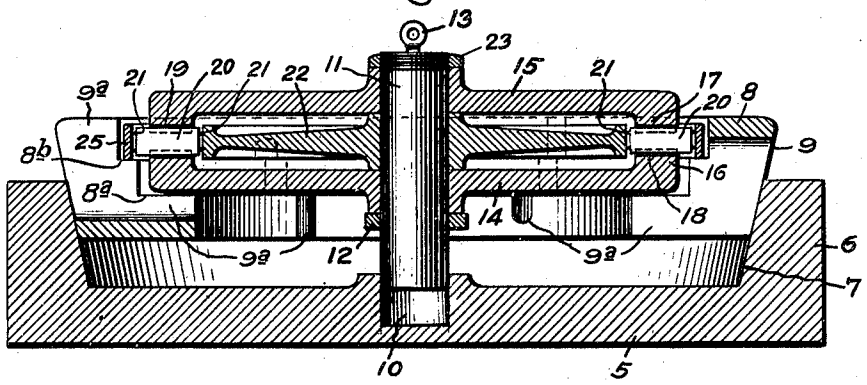


Fig. 2.

Fig. 3.

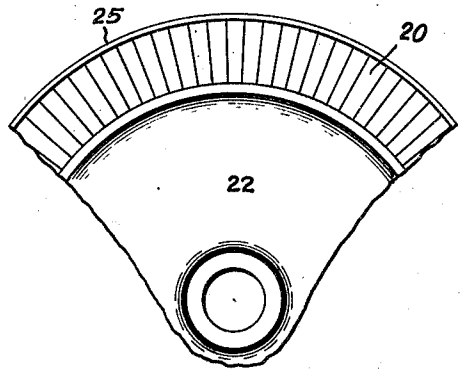
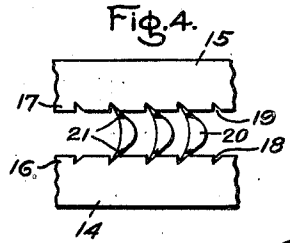


Fig. 4.



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UNITED STATES PATENT OFFICE.

CHRISTIAN STEENSTRUP, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELASTIC-FLUID TURBINE.

Application filed January 3, 1921. Serial No. 434,417.

To all whom it may concern:

Be it known that I, CHRISTIAN STEENSTRUP, 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 Elastic-Fluid Turbines, of which the following is a specification.

The present invention relates to elastic fluid turbines and has for its primary object to provide an improved method of making a blade carrying rotor for use in such machines.

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

In the drawing, Fig. 1 is a sectional view of a more or less diagrammatic nature illustrating my invention; Fig. 2 is a sectional view of a blade wheel made in accordance with my invention; Fig. 3 is a side elevation of a portion of the wheel shown in Fig. 2, and Fig. 4 is an edge view of a fragment of the holding rings used in carrying out my invention.

Referring to the drawing, 5 indicates a round base having a flange provided with a beveled inner surface 7, and 8 indicates a collapsible ring having a beveled surface 9 adapted to cooperate with surface 7 so when ring 8 is pushed down within flange 6 the ring will be compressed or collapsed. Ring 8 is preferably rendered collapsible by providing spaced slots 9^a in it which extend alternately from opposite sides of the ring but do not go entirely through. Such an arrangement allows the ring to be squeezed to a smaller diameter or collapsed without twisting or circumferential movement. In its base ring 8 is provided with ledges 8^a and 8^b. In the bottom of base 5 at its center is an opening 10 of a size to receive a post 11. On post 11 is a collar 12 and in its upper end is an eye bolt 13. 14 and 15 are lower and upper bucket holders, the same being provided with opposed raised surfaces 16 and 17 in which are slots or notches 18 and 19 adapted to receive the edges of turbine buckets 20. As shown in Fig. 4 slots 18 and 19 have one straight edge and one sloping edge, the latter conforming to the bevel of the bucket backs.

The buckets 20 comprise straight strips of bucket material properly shaped to form the front and back, and provided at their ends with a suitable number of small sharp edged projections 21. In the present instance two projections 21 are shown at each bucket end. In the drawing Fig. 1 the heights of projection 21 are somewhat exaggerated in size for purposes of illustration. Projections 21 may be formed in any suitable manner and after they are formed they are hardened as by case hardening so they form a projection which is harder than the wheel and bucket cover.

In constructing a bucket wheel in accordance with my invention, I first place lower and upper holders 14 and 15 on post 11 with a rotor wheel 22 between them. The holders are thus spaced apart at their centers a distance equal to the length of the hub of wheel 22 and when so spaced surfaces 16 and 17 are spaced a distance apart so notches 18 and 19 will take the edges of turbine buckets 20 as shown in Fig. 4. When in place lower holder 14 rests on collar 12 and on the upper end of the post 11 I may screw on a nut 23 (Fig. 1) to hold the parts on post 11. The holders and wheel may be assembled on the post by resting the end of post 11 on a suitable base and then putting them on one after the other in the order shown. Next the buckets are slipped into place between the holders one after another to make a complete ring around the periphery of the wheel. The buckets are inserted radially between the holders with their edges in notches 18 and 19, the notches being a distance apart to correctly space the buckets circumferentially. If the assembling is being done directly over base 6 and ring 8 which in some instances may be the most convenient location, post 11 with the holders and wheel thereon may be suspended above ring 8 by a crane or other means, eye 13 serving to receive a hook on a lifting chain or rope. The manner in which the buckets are assembled and held between the holders is clearly shown in Figs. 1 and 4.

After the buckets have been assembled around the wheel, the entire structure is lowered to a position inside ring 8 as shown in Fig. 1. The lower holder rests on ledge 8^a and the end of post 11 enters opening 10 thus centering the structure in the ring. A continuous bucket cover ring, as indicated

at 25, which has been heated to expand it is then placed on ledge 8b around the outer ends of buckets 20 as shown in Fig. 1 after which collapsible ring 8 is forced down along flange 6. This last operation may be performed with a hydraulic press having a movable element in the form of a ring which engages ring 8, and as surface 9 slides along surface 7, ring 8 will be collapsed, squeezing the bucket cover around the ends of the buckets. At this time post 11 sliding in opening 10 serves as a guide and a means for holding the parts centered. During the squeezing operation projections 21 embed themselves in the surfaces of the wheel and cover and the operation is continued until the buckets are very firmly gripped between the rim of the wheel and the cover. When this operation is completed projections 21 will be completely embedded and the ends of the buckets will be in close contact with the peripheral surface of the wheel and the inner surface of the bucket cover.

The small projections 21 are for the purpose of providing a means to engage with the wheel and bucket cover at the beginning of the squeezing operation to prevent the buckets from twisting or sliding. As soon as the bucket cover clamps the buckets between it and the wheel and before it is fully squeezed into place, projections 21 bite into the cover and wheel and fix the buckets relatively thereto. The projections serve also to hold the buckets during the brazing operation referred to hereinafter.

The bucket cover being heated, projections 21 easily embed themselves therein. In the case of larger wheels, however, there may be some difficulty in effecting the embedding of the projections therein and in such cases I may cut annular V-shaped grooves around the periphery of the wheel to receive such projections. These grooves will be of less size than the projections so the projections will embed themselves in the bottom and sides of the grooves.

After the squeezing operation is completed, the bucket cover will still be hot and as it cools it contracts and hence becomes still tighter. The bucket wheel is now removed from post 11 after which the buckets, wheel and cover are united into a unitary structure by fusion of metal, as by brazing, welding or the like. This forms a complete bucket wheel as shown in Figs. 2 and 3.

My improved method has the advantages that it is simple and rapid and enables me to manufacture turbine wheels at a low cost. No complicated, special machinery is required and the work can be performed by relatively unskilled help. At the same time a strong wheel results in which the buckets are firmly anchored in place. The buckets can be manufactured at a low cost as the same can be cut from strip bucket material and projections 21 formed on the ends by an upsetting operation, a milling operation, or otherwise.

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

1. The method of manufacturing a turbine wheel which comprises mounting a wheel adjacent a bucket supporting member, assembling a ring of buckets on said member, squeezing a bucket cover around the buckets whereby the buckets are gripped between the periphery of the wheel and the cover, and uniting the wheel, buckets and cover by fusion of metal.

2. The method of manufacturing a turbine wheel which comprises mounting a wheel adjacent a bucket supporting member having spaced notches, assembling a ring of buckets in said notches with their inner ends in proximity to the periphery of the wheel, squeezing a bucket cover around the outer ends of the ring of buckets, and uniting the wheel, buckets and cover by fusion of metal.

3. The method of manufacturing a turbine wheel which comprises mounting a wheel adjacent a bucket supporting member, assembling a ring of buckets on said member, which buckets have projections on their ends, squeezing a bucket cover around the outer ends of the buckets to flatten out and embed said projections in the peripheral surface of the wheel and the inner surface of the cover, and uniting the bucket ends to the wheel and cover by fusion of metal.

4. The method of manufacturing a turbine wheel which comprises mounting a wheel between holders which project beyond the periphery of the wheel and have spaced notches for the reception of the edges of buckets, assembling a ring of buckets in said notches with their inner ends in proximity to the periphery of the wheel, shrinking a bucket cover around the outer ends of the buckets, and then uniting the buckets to the wheel and cover by fusion of metal.

5. The method of manufacturing a turbine wheel which comprises mounting a wheel between holders which project beyond the periphery of the wheel and have spaced notches for the reception of the edges of buckets, assembling a ring of buckets in said notches with their inner ends in proximity to the periphery of the wheel, placing a heated bucket cover around the outer ends of the buckets, squeezing said bucket cover into engagement with the bucket ends and permitting it to cool so as to grip the buckets between the periphery of the wheel and the cover, and then uniting the ends of the buckets to the periphery of the wheel and to the bucket cover by fusion of metal.

In witness whereof, I have hereunto set my hand this 31st day of December, 1920.

CHRISTIAN STEENSTRUP.