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E. L. ROBINSON  
ELASTIC FLUID TURBINE

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1,856,820

Fig. 1.

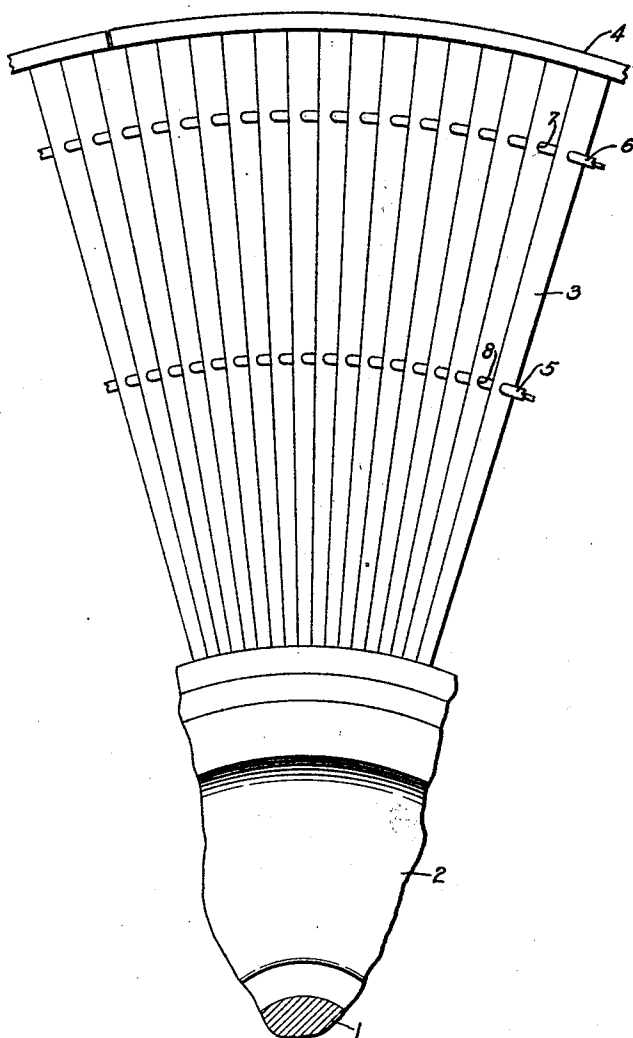


Fig. 2.

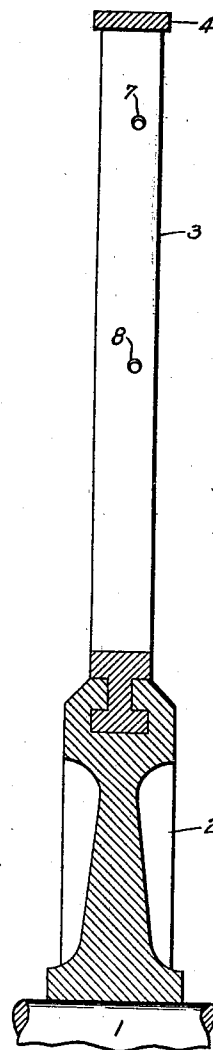


Fig. 3.

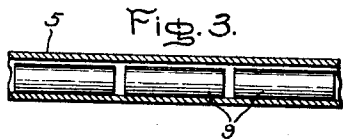
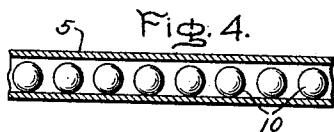


Fig. 4.



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## UNITED STATES PATENT OFFICE

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## ELASTIC FLUID TURBINE

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The present invention relates to elastic fluid turbines and particularly to rotors of such turbines.

It is known to those skilled in the art that the bucket wheels are subjected to oscillations during the operation of the turbine. These oscillations very often cause damage to the buckets, particularly of those of the lower stages, in view of their considerable diameter. It has been proposed heretofore to stiffen the bucket wheels of turbines and to absorb their oscillatory energy by the provision of wires extending through passages in the buckets.

The object of my invention consists in an improved arrangement for stiffening such bucket wheels and damping vibrations thereof.

This is achieved according to my invention by the provision of a hollow wirelike member extending through passages in the buckets and preferably fastened to said buckets. The hollow space of such wire is nearly filled, according to my invention, with a freely movable means, for instance, short rods or balls which are adapted to cause impact against and friction with the walls of the wire to the effect that undesirable oscillatory movements of the bucket blades of such wheels are considerably diminished.

For a better understanding of what I believe to be novel and my invention, attention is directed to the following description and claims in connection with the drawings appended hereto.

In the drawings, Fig. 1 is a side view of a portion of a turbine rotor, embodying my invention; Fig. 2 is a radial sectional view of Fig. 1; Fig. 3 is a detailed view on a larger scale and Fig. 4 illustrates a modification of the parts shown in Fig. 3.

Referring to the drawings, 1 indicates a turbine shaft, 2 a rotor thereon, 3 a row of buckets carried by the rotor and 4 a sectional bucket cover for the buckets. According to my invention, as shown in the present instance, hollow wires 5 and 6 are provided between the buckets extending through passages 7 and 8 of said buckets and preferably fastened to said buckets by any suitable

means, for instance by brazing. The wires may form a continuous piece around the entire bucket wheel having its ends suitably fastened together. They may also be arranged separately with respect to different sections of the wheel whereby the open ends of the wires have to be closed by any suitable means, for instance by brazed plugs, not shown in the drawings. Inside of the wire I may provide short sections of wire or other rodlike members 9 having small radial and axial clearance and being freely movable within the hollow wire as shown in Fig. 3. Instead of rodlike members I may provide balls 10 as indicated in Fig. 4, or any other suitable means which is capable of causing sufficient impact against and frictional resistance with the inner walls of the wire.

During oscillations of the bucket wheels the movable members rattle about within said wire, that is, they roll back and forth or move sidewardly so as to hit one another on the walls of the wire thus causing impact and frictional resistance to absorb the oscillatory energy of the buckets, thereby preventing the building up of excessive amplitude of vibration with correspondingly destructive stresses.

Thus, it will be seen that my improved arrangement for stiffening bucket wheels and dampening oscillations thereof is equally effective with respect to oscillations of any kind, particularly in any direction.

In accordance with the provisions of the patent statutes I have described the method 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 may be carried out by other means.

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

1. The combination with a turbine rotor having a row of buckets, of a tubelike member extending through passages in said buckets, and means provided within the hollow space of said tubelike member, said means being freely movable within said spaces

whereby it is adapted to dampen vibration of said buckets.

2. The combination with a turbine rotor having a row of buckets provided with passages which are arranged concentrically with the axis of said rotor, of a hollow wire extending through said passages, and short sections of wire provided within the hollow space of said wire which are freely movable to cause dampening of oscillatory movements of said buckets.

3. The combination with a turbine rotor having a row of buckets provided with passages, of a hollow wire extending through said passages and fastened to said buckets, and balls provided within the hollow space of said wire and adapted to dampen oscillatory movements of said buckets.

4. The combination with a turbine rotor having a row of buckets provided with passages, of a continuous hollow wire extending through said passages and fastened to said buckets and having its ends connected to each other, freely movable members provided within said wire to cause impact between each other or against the inner wall of said wire and frictional resistance within said wire whereby the oscillatory energy of said buckets is absorbed by the relative movements of said members.

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