J. S. GREEN.

ELASTIC FLUID TURBINE.

APPLICATION FILED MAR. 8, 1906. RENEWED OCT. 12, 1907.

919,853. Patented Apr. 27, 1909.

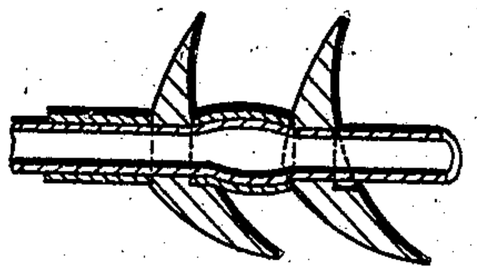

Fig. 3.

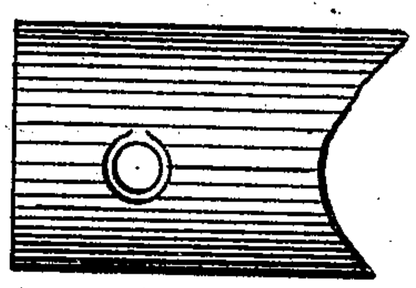

Fig. 4.

Fig. 6.

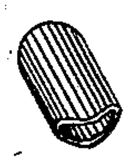

Fig. 5.

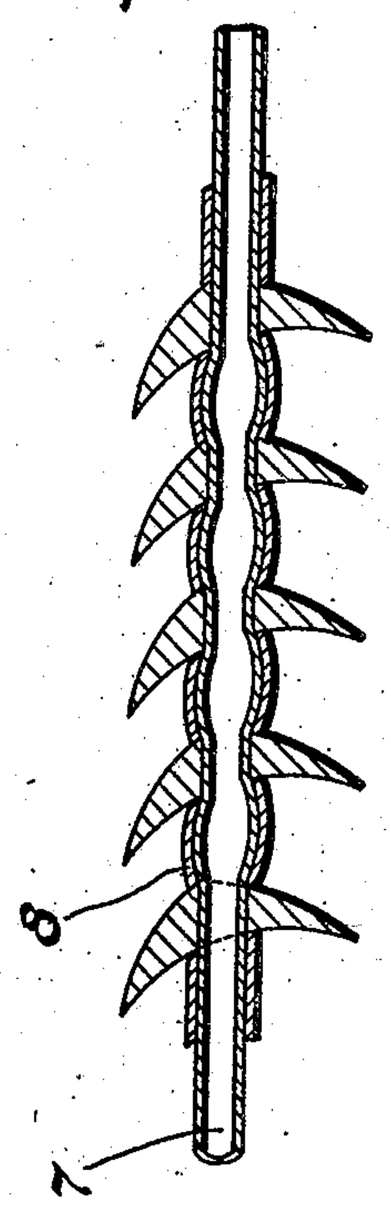

Fig. 2.

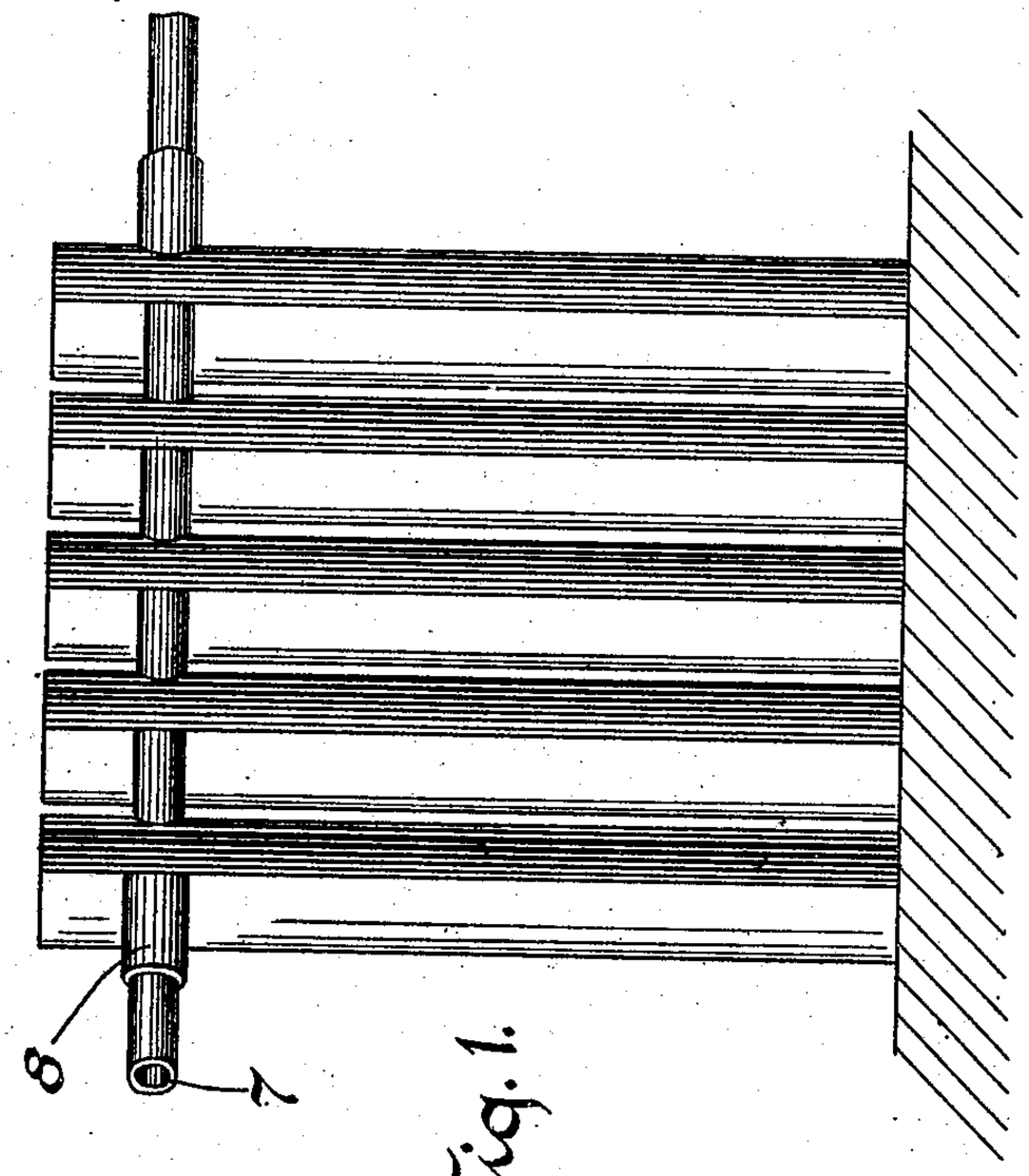

Fig. 1.

WITNESSES:

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ELASTIC-FLUID TURBINE.

No. 919,853. Specification of Letters Patent. Patented April 27, 1909.

Application filed March 8, 1906, Serial No. 304,920. Renewed October 12, 1907. Serial No. 397,170.

To all whom it may concern:

Be it known that I, JONATHAN S. GREEN, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to elastic fluid turbines and more particularly to means for tying the outer ends of the blades thereof together into groups whereby they are held against movement one toward the other.

The object of this invention is to produce efficient tying means for the outer or free ends of turbine blades or vanes of simple and relatively cheap construction.

In elastic fluid turbines it is customary in nearly all types to arrange the blades and vanes in rows. In some, each of these rows forms a complete annulus, while in others, only a portion of an annulus. Where the row forms a complete annulus, it is customary to arrange the blades or vanes, as the case may be, in one of such rows, into groups comprising a plurality of blades or vanes and to have these groups, so far as the tie for the outer end is concerned, independent one of the other to accommodate the expansions which occur due to the changes in temperature. In order to illustrate this invention sufficiently for those skilled in this art to understand the same, in the drawing I have shown only a few of such blades or vanes in conjunction with the tying means embodying this invention.

Figure 1 is a side view in elevation of five blades or vanes, as the case may be. Fig. 2 is a plan view in cross section of said blades or vanes cutting the axis of the tie. Fig. 3 is a view in cross section of two blades or vanes and in this view a modified form of tie is employed. Fig. 4 is a face view of the upper portion of a blade or vane showing countersunk holes passing therethrough to be utilized in conjunction with the modified form of tie shown in Fig. 3. Figs. 5 and 6 are views in perspective and cross section respectively of the spacer portion of the tie illustrated in Figs. 2 and 3.

The blades or vanes, which may be secured to their holding elements in any suitable manner, have holes, preferably circular in form, punched or otherwise made, passing through them from front to back a desired distance from their outer ends. When assembled in the holding element, the axes of these holes in a given row are in line and through the same a tubular wire or tie element 7 is passed. This tie element 7 may be formed in any suitable manner, of any desired material and either seamed or seamless as is desired.

Between adjacent blades and surrounding the tie element 7 are tubular spacing elements 8. These elements are preferably of the same metal as the tie element and, as shown in Fig. 2, may have their ends cut to conform to the concave and convex faces of the blades or vanes. The spacers preferably closely fit over the tie element and after the tie and spacers are assembled, both the spacers and those portions of the tie lying between adjacent blades or vanes are compressed or flattened as shown in Figs. 1, 2 and 3. By thus compressing the spacers and tie, the spacers are held against movement and practically form an integral structure which will effectively prevent any movement of the blades or vanes from or toward one another.

As the tie 7 and spacers may be of small external diameter (very much smaller in fact than as shown in the drawings as compared to the length of the blade), when compressed they offer a minimum obstruction to the passage of the working fluid.

If it is desired, the holes through the blades or vanes may be countersunk as shown in Figs. 3 and 4 and the ends of the spacers may be cut in a plane at right angles to their axes.

It will be understood that the tie and spacers may be of any form in cross section and not necessarily circular. It will also be understood that if it is desired, the same need not be flattened or compressed; but

Having thus described and illustrated my invention, what I claim as new and useful and desire to secure by Letters Patent is:

1. In a turbine, a blade or vane holding element, blades or vanes extending therefrom and secured thereto, a binder passing through the outer or free ends of said blades or vanes and separate spacing elements surrounding said binder and located between adjacent blades or vanes.

2. In a turbine, a blade or vane holding element, blades or vanes extending therefrom and secured thereto, a binder passing

through the outer or free ends of said blades or vanes, separate spacing elements between adjacent blades or vanes, and which between adjacent blades or vanes are distorted.

3. In combination in a turbine, a blade or vane holding element, blades or vanes comprised in a row and secured thereto, spacing pieces located between the outer or free ends of the blades or vanes of said row and having faces conforming in contour with the concave and convex surfaces of the blades or vanes and a binding member passing through the blades or vanes for securing the same together.

4. In a turbine, a blade or vane holding element, blades or vanes extending therefrom, a binder strip passing through the blades or vanes and separate spacing elements mounted on said binder strip which, between adjacent blades or vanes, are distorted.

5. In a turbine, a blade or vane holding element, blades or vanes extending therefrom and secured thereto, a tubular binder strip passing through the blades or vanes and which, between adjacent blades or vanes, is distorted.

6. In a turbine, a blade or vane holding element, blades or vanes extending therefrom and secured thereto, a tubular binder strip passing through said blades or vanes, and separate spacing elements surrounding said strip and located between adjacent blades or vanes.

7. In a turbine, a blade or vane holding element, blades or vanes extending therefrom and secured thereto, a tubular binding strip passing through adjacent blades or vanes and separate spacing elements mounted on said binding strip and which, between adjacent blades and vanes, are distorted.

8. In a turbine, a blade or vane holding element, blades or vanes extending therefrom, a hollow binding strip passing through the outer or free ends of said blades or vanes and separate spacing elements surrounding said strip and located between adjacent blades or vanes.

9. In a turbine, a blade or vane holding element, blades or vanes extending therefrom and secured thereto, a hollow binder strip passing through the outer or free ends of said blades or vanes, separate spacing elements between adjacent blades or vanes and which, between adjacent blades or vanes, are distorted.

10. In a turbine, a blade or vane holding element, blades or vanes extending therefrom, a binder strip passing through the outer ends of said blades or vanes and separate spacing elements located between adjacent blades or vanes.

11. In a turbine, a blade or vane holding element, blades or vanes extending therefrom and secured thereto, a binder strip passing through the outer or free ends of said blades or vanes and a spacing member secured to said binder strip.

12. In combination in a turbine, a blade or vane holding element, blades or vanes comprised in a row and secured thereto, spacing pieces located between the outer or free ends of the blades or vanes of said row and having faces conforming in contour with the concave and convex surfaces of the blades or vanes and a binding member passing through the blades or vanes and said spacing pieces for securing the same together.

13. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, and a hollow binding strip passing through the blades or vanes.

14. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, and a hollow binding strip passing through the outer or free ends of said blades or vanes.

15. In a turbine, a blade or vane holding element, blades or vanes secured thereto, and a hollow binding strip passing through the blades or vanes, which, between adjacent blades or vanes, is distorted.

16. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, and a hollow binding strip passing through the outer or free ends of said blades or vanes, which, between adjacent blades or vanes, is distorted.

17. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, a hollow binding strip passing through said blades or vanes, and separate spacing pieces carried by said strip and located between said blades or vanes.

18. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, a hollow binding strip passing through the outer or free ends of said blades or vanes, and separate spacing pieces carried by said strip and which, between adjacent blades or vanes, are distorted.

19. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, a hollow binding strip passing through said blades or vanes, and separate spacing pieces carried by said strip and which, between adjacent blades or vanes, are distorted.

20. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, a hollow binding strip passing through said blades or vanes, and separate spacing pieces mounted on said strip and located between adjacent blades or vanes and secured to said strip by being distorted.

21. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, a binding member passing through said blades or vanes, and hollow

spacing pieces mounted on said member, which, between adjacent blades or vanes, are distorted.

22. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, a binding member passing through said blades or vanes, and hollow spacing pieces mounted on said member and located between adjacent blades or vanes.

23. In a turbine, a blade or vane holding element, blades or vanes secured thereto, and hollow spacing pieces located between adjacent blades or vanes.

24. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, and separate spacing pieces located between the outer or free ends of adjacent blades or vanes.

25. In combination in a turbine, a blade or vane holding element, blades or vanes comprised in a row and secured thereto, spacing pieces located between the outer or free ends of the blades or vanes of said row and having faces conforming in contour with the concave and convex surfaces of the blades or vanes and a hollow binding member passing through the blades or vanes for securing the same together.

26. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, a binding member for said blades or vanes, and separate spacing pieces for said blades or vanes, movable along said member and secured thereto by being distorted.

27. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, a binding member for said blades or vanes, and separate spacing pieces secured to said member and located between adjacent blades or vanes.

28. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, and a hollow binding member secured to said blades or vanes, which, between adjacent blades or vanes, is distorted.

29. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, and a hollow binding member secured to the outer or free ends of said blades or vanes, which, between adjacent blades or vanes, is distorted.

30. In combination in a turbine, a blade or vane holding element, blades or vanes secured thereto, and a hollow binding member secured to the outer or free ends of said blades or vanes.

31. In combination in a blade or vane holding element, blades or vanes secured thereto, a hollow binding member secured to said blades or vanes, and separate spacing pieces mounted on said member and located between adjacent blades or vanes.

32. In combination in a blade or vane holding element, blades or vanes secured thereto, a hollow binding member secured to said blades or vanes, and hollow spacing pieces mounted on said member and located between adjacent blades or vanes.

33. In combination in a turbine, a blade or vane holding element, blades or vanes, secured thereto, and a tubular binding member passing through the outer or free ends of said blades or vanes.

34. In combination in a turbine, blades or vanes comprised in a row, a binding member passing through said blades or vanes, spacing pieces, having faces conforming in contour to the convex and concave faces of the blades or vanes, located between the outer or free ends of the blades or vanes and mounted on said binding member.

35. In combination in a turbine, blades or vanes comprised in a row, a binding member passing through said blades or vanes, spacing pieces, having faces conforming in contour to the convex and concave faces of the blades or vanes, located between the outer or free ends of the blades or vanes and secured to said binding member.

36. In combination in a turbine, blades or vanes comprised in a row, a binding member passing through said blades or vanes, spacing pieces, having faces conforming in contour to the convex and concave faces of the blades or vanes, located between the outer or free ends of the blades or vanes and secured to said binding member by being distorted.

37. In combination in a turbine, blades or vanes comprised in a row, a binding member passing through the blades or vanes, tubular spacing pieces having ends conforming in contour to the convex and concave faces of the blades or vanes and located between the outer or free ends of the blades or vanes.

38. In combination in a turbine, blades or vanes comprised in a row, a binding member passing through the blades or vanes, tubular spacing pieces having ends conforming in contour to the convex and concave faces of the blades or vanes, and secured to said binding member.

39. In combination in a turbine, blades or vanes comprised in a row, a binding member passing through the blades or vanes, tubular spacing pieces having ends conforming in contour to the convex and concave faces of the blades or vanes, and mounted on said binding member.

40. In combination in a turbine, blades or vanes comprised in a row, a binding member passing through the blades or vanes, tubular spacing pieces having ends conforming in contour to the convex and concave faces of the blades or vanes and secured to said binding member by being distorted.

41. In combination with a blade or vane holding element, an annular row of blades secured thereto, each of which has a hole near

the outer or free end, spacing pieces lying between adjacent blades formed to conform to the surfaces of said blades and provided with holes extending therethrough which aline to the holes in said blades and binder means extending through the holes in said blades and spacing pieces for securing the same together.

42. In combination with a blade or vane holding element, an annular row of blades secured thereto, each of which has a hole near the outer or free end, spacing pieces lying between adjacent blades formed to conform to the surfaces of said blades and provided with holes extending therethrough which aline to the holes in said blades, and a binder wire extending through the holes in said blades and spacing pieces for securing the same together.

43. In combination with a plurality of blades or vanes comprised in an annular row, a binding member for the blades or vanes and spacing pieces conforming in contour to the surfaces of the blades or vanes located between adjacent blades or vanes and secured to said binding member.

In testimony whereof, I have hereunto subscribed my name this 5th day of March, 1906.

JNO. S. GREEN.

Witnesses:
CHARLES W. MCGHEE,
E. W. MCCALLISTER.