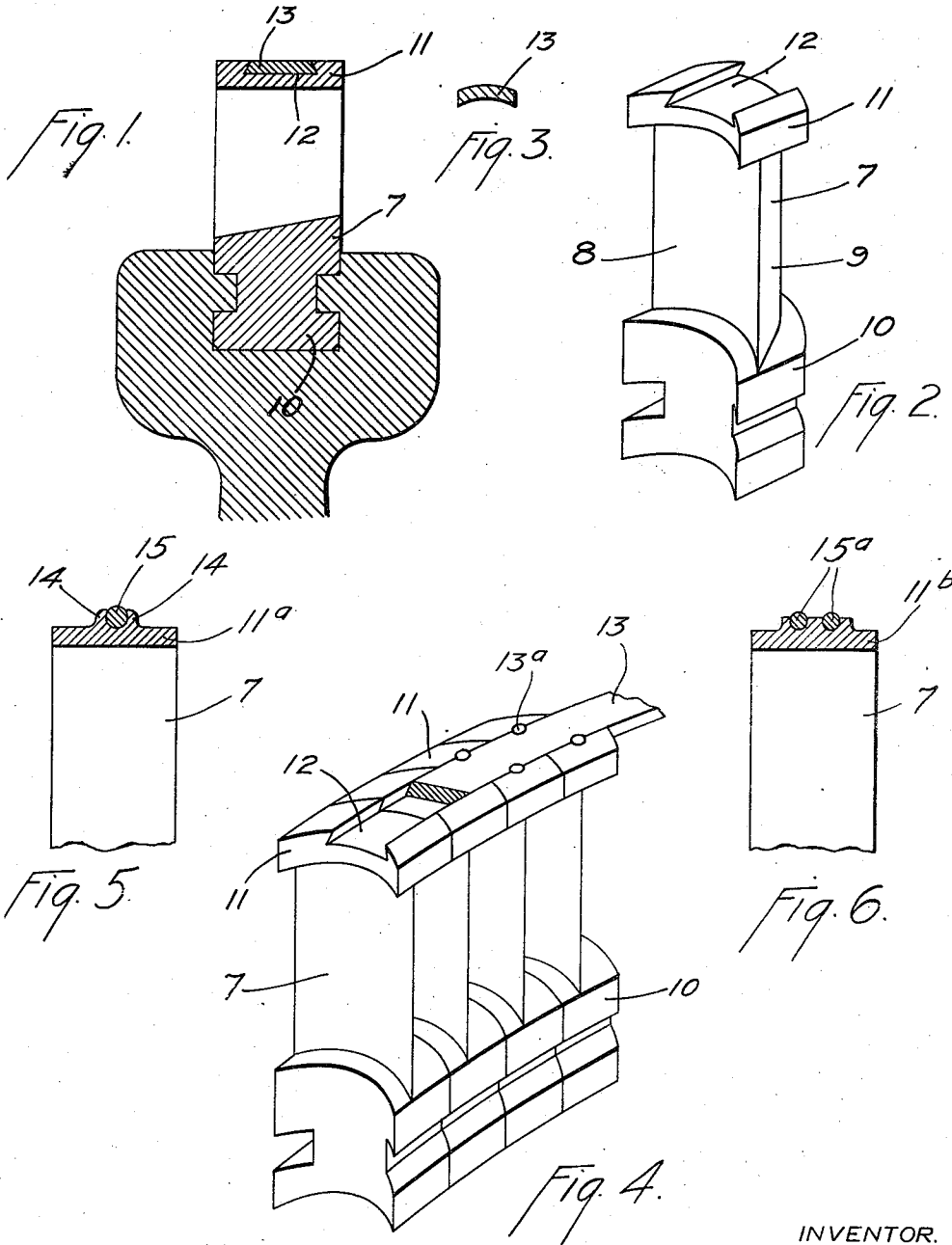


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 BLADE CONSTRUCTION FOR ELASTIC FLUID TURBINES.
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1,165,005.

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INVENTOR.

WITNESSES:

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BLADE CONSTRUCTION FOR ELASTIC-FLUID TURBINES.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HERBERT T. HERR, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Blade Construction for Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to turbine blade construction and has for an object to produce new and improved means for shrouding and tying together the outer ends of the blades located in a row. This and other objects I attain by means of a blade construction embodying the features herein described, and illustrated in the drawings accompanying and forming a part of this application.

In the drawings: Figure 1 is a fragmental, sectional view of a rotor element of a turbine equipped with blading embodying my invention; Fig. 2 is a perspective view of a blade forming a detail of my invention, and discloses the tie member receiving slot formed across the outer end of the blade; Fig. 3 is a sectional view of a tie member, forming a detail of my invention, and discloses its shape before it is secured in place in the mounting slots formed in the ends of the blades; Fig. 4 is a perspective view of several blades in the position they occupy when assembled on a blade-mounting element; the blades are shown in connection with the tie member, which is shown cross-sectioned at one end and broken away at the other; and Figs. 5 and 6 are each fragmental elevations of blades equipped with integrally formed spacing pieces (shown in section) and illustrate two separate embodiments of my invention.

It is desirable to provide a shroud for the outer or free ends of blades of the impulse type; that is, for the ends of the blades located farthest from the blade-mounting element. It is also desirable to tie the outer ends of turbine blades together, since during the operation of a turbine each blade is subjected to successive shocks due to the impact of the motive fluid and this tends to create vibrations in the blade. By tying together the outer ends of the blades located in a row, each blade is caused to cooperate with the blades to which it is secured in resisting the vibration creating strains and the tend-

ency for each blade to vibrate is thereby largely overcome.

In the drawings I have, for convenience of illustration, disclosed a turbine rotor provided with a circumferentially extending undercut groove which is adapted to receive blades having specially formed bases or mounting portions. It will, however, be understood that my invention may be employed in connection with the stationary as well as the rotating blades.

As illustrated in Figs. 1, 2, and 4, each blade 7 consists of a substantially crescent shape body portion, which is provided on one side with a concave working face 8 and on the other side with a convex forward face 9. The mounting portion 10 of each blade is adapted to fit into the blade-mounting slot and also to provide means for spacing the blades. In other words the base pieces 10 of the blades not only secure the blades in place, but also insure a proper spacing of the blades. Each base piece corresponds in cross-section to the cross-section of the blade-mounting slot in which it is located, and, as illustrated in Fig. 4, is adapted to cooperate with the base piece of each adjacent blade in spacing the blades. It will, of course, be understood that any means may be employed for mounting the blades on the blade-carrying element and also that any means may be employed for spacing the blades at their bases or mounting ends.

Each blade forming a detail of my invention is provided at its outer or free end with a cover or spacing piece 11, which is adapted to cooperate with the spacing pieces 11 of adjacent blades, in maintaining the proper spacing for the outer ends of the blades, in forming a cover or shroud for the row of blades and in providing means by which the outer ends of the blades are secured together.

In the specific embodiment of my invention illustrated each spacing piece 11 is of substantially the same width as the blade on which it is mounted; it extends substantially at right angles to the curved working faces of the blade, and its front and rear faces are each curved to the same degree of curvature. With this arrangement the front face of each piece 11 engages and fits snugly against the rear face of the piece 11 on the next adjacent blade, it being understood that

the circumferential length of each of the pieces corresponds to the desired distance between the blades. The curvature of the engaging edges of the pieces 11 may correspond in degree to that of the concave working face 8 or to that of the convex forward face of the blade on which it is mounted. If desired, it may be of any other degree of curvature or may even be provided with straight or angular edges. In addition to this, the piece may be located in any desired position with relation to the blade; that is, it may overhang the forward face only, or it may overhang the concave working face only, or, as illustrated, it may be located in an intermediate position on the blade, so that it overhangs both the forward and the rear working faces.

The outer face of each blade spacing piece 11 illustrated, is provided with a circumferentially extending undercut slot 12, so located that its ends register with the adjacent ends of the slots formed in adjacent pieces and thereby forms a continuous circumferential slot adapted to receive a tie member 13 for the outer ends of the blades.

As illustrated in Fig. 3, the tie member is initially arch-shape in cross section, and is provided with parallel lateral sides. In addition to this, it is of such width that it is capable of being fitted into the circumferential slot formed by the cooperating slots in the outer face of each of the pieces 11. After the strip 13 is in place, it is flattened out, as shown in Fig. 1; is thereby increased in width and its parallel lateral faces are moved to inclined positions corresponding to the inclination of the undercut wall of the slot with which they engage. In this way the member 13 is positively secured to each blade and consequently ties the outer ends of the blades together and eliminates the possibility of their vibrating independently. The strip 13 may extend clear around an annular row of blades, or it may be of such length as to merely secure groups of blades in an annular row together.

In Fig. 5 I have shown an embodiment of my invention in which the spacing piece 11^a is provided on its outer face with tie member receiving lugs 14, between which a tie member 15 is located. The tie member 15 may be secured to its engaging lugs 14 by any suitable means, such, for example, as by welding, and by welding I mean by the application of heat either with or without pressure. It will be understood that the member 15, like the member 13, engages the outer faces of adjacent blades and is positively secured to each of the blades engaged by it.

In Fig. 7 I have illustrated a still further modification of my invention in which the spacing piece 11^b formed at the outer end of the blade 7 is arranged so that it is capable of being positively secured to two

tie members 15^a. This may be accomplished by autogeneously soldering or, broadly, by welding.

For the purpose of preventing the blades or pieces 11 from moving in a longitudinal direction, relatively to the tie member or strip, I preferably employ means for positively locking the strip and each spacing piece together. This may be accomplished by distorting one or both edges of the strip so that it is pressed into gripping engagement with the adjacent edges of the strip-receiving slot formed in each piece. As illustrated in Fig. 4, I have distorted the strip by means of a center punch, or similar tool, by driving the punch between each edge of the strip 13 and the adjacent edges of the slot 12, so that both the strip and the pieces 11 are distorted and are pressed into locking or positive engagement with each other.

While I have described several modifications of my invention, it will be apparent that still other changes, substitutions, additions, and omissions may be made in the details of construction and still fall within the spirit and scope of my invention, as set forth by the appended claims.

What I claim is:

1. In combination with a blade-mounting element, a row of blades mounted on said element, a spacing piece for the outer end of each blade, said spacing pieces cooperating to form an organized shroud for the row of blades and a tie member mounted in a circumferentially extended groove in the organized shroud.

2. In combination with a blade mounting element, a row of blades mounted on the element, a spacing piece for the outer end of each blade integrally formed on each blade, said spacing pieces cooperating to form an organized shroud for the row of blades, and a circumferentially extending tie member positively secured to each spacing piece so as to prevent relative motion between the member and the piece longitudinally of the member.

3. In combination with a turbine blade mounting element, a row of blades mounted on the element, a spacing piece for the outer ends of the blades integrally formed on each blade, said spacing pieces cooperating to form a shroud for the outer ends of the blades, and a tie member located in a groove formed on the shroud and positively locked to each blade.

4. In combination with a turbine, a blade-mounting element, a row of blades mounted on said element, a spacing piece integrally formed on the outer end of each blade, the blades in said row being so located on said element that the spacing pieces cooperate to form a shroud for the row and a tie member for the outer ends of the blades extend-

ing along the shroud and secured into a circumferentially extending slot formed in the peripheral face of the shroud.

5 5. In combination with a turbine, a blade-mounting element, a row of blades mounted on said element, a spacing piece integrally formed on the outer end of each blade, the blades being so located in each row that the spacing pieces cooperate to form a shroud
10 for the row, and a tie member for the outer ends of the blades extending along a circumferentially extending slot formed in the peripheral face of the organized shroud and welded to each spacing piece engaged there-
5 by.

6. In combination with a turbine blade carrying element, a row of blades mounted on the element, spacing pieces for the outer ends of the blades cooperating to form an

organized shroud for the row of blades, and a tie member mounted in a circumferentially extending groove formed in the shroud.

7. In combination with a turbine blade carrying element, a row of blades mounted on the element, spacing pieces for the outer
25 ends of the blades cooperating to form an organized shroud for the row of blades, and a tie member mounted in a circumferentially extending groove formed in the shroud and positively secured to each of the blades
30 of the row.

In testimony whereof, I have hereunto subscribed my name this 12th day of May, 1914.

HERBERT T. HERR.

Witnesses:

C. W. MCGHEE,

E. W. MCCALLISTER.