F. HODGKINSON.

ELASTIC FLUID TURBINE.

APPLICATION FILED OCT. 24, 1907.

996,855. Patented July 4, 1911.

3 SHEETS—SHEET 1.

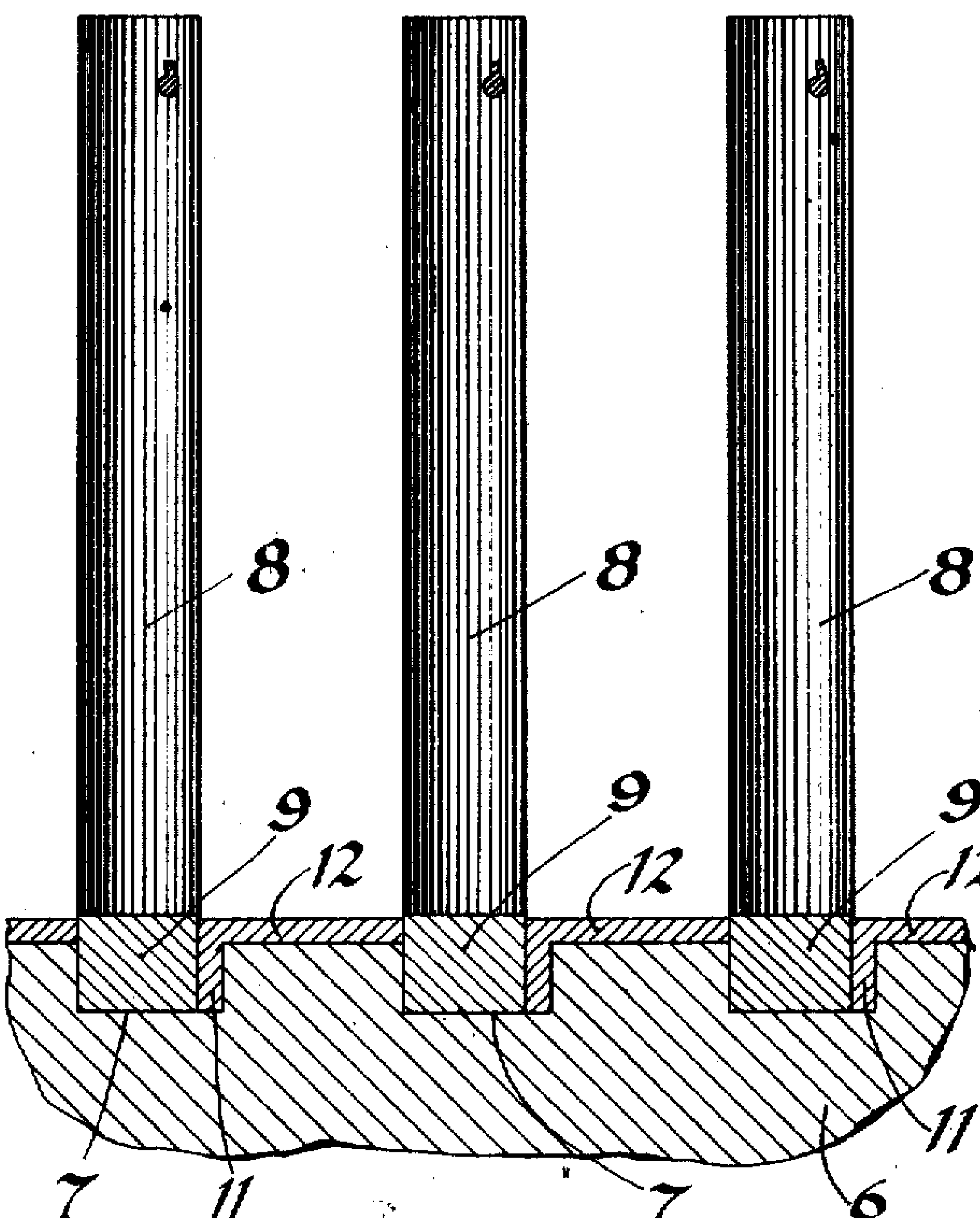

Fig. 1.

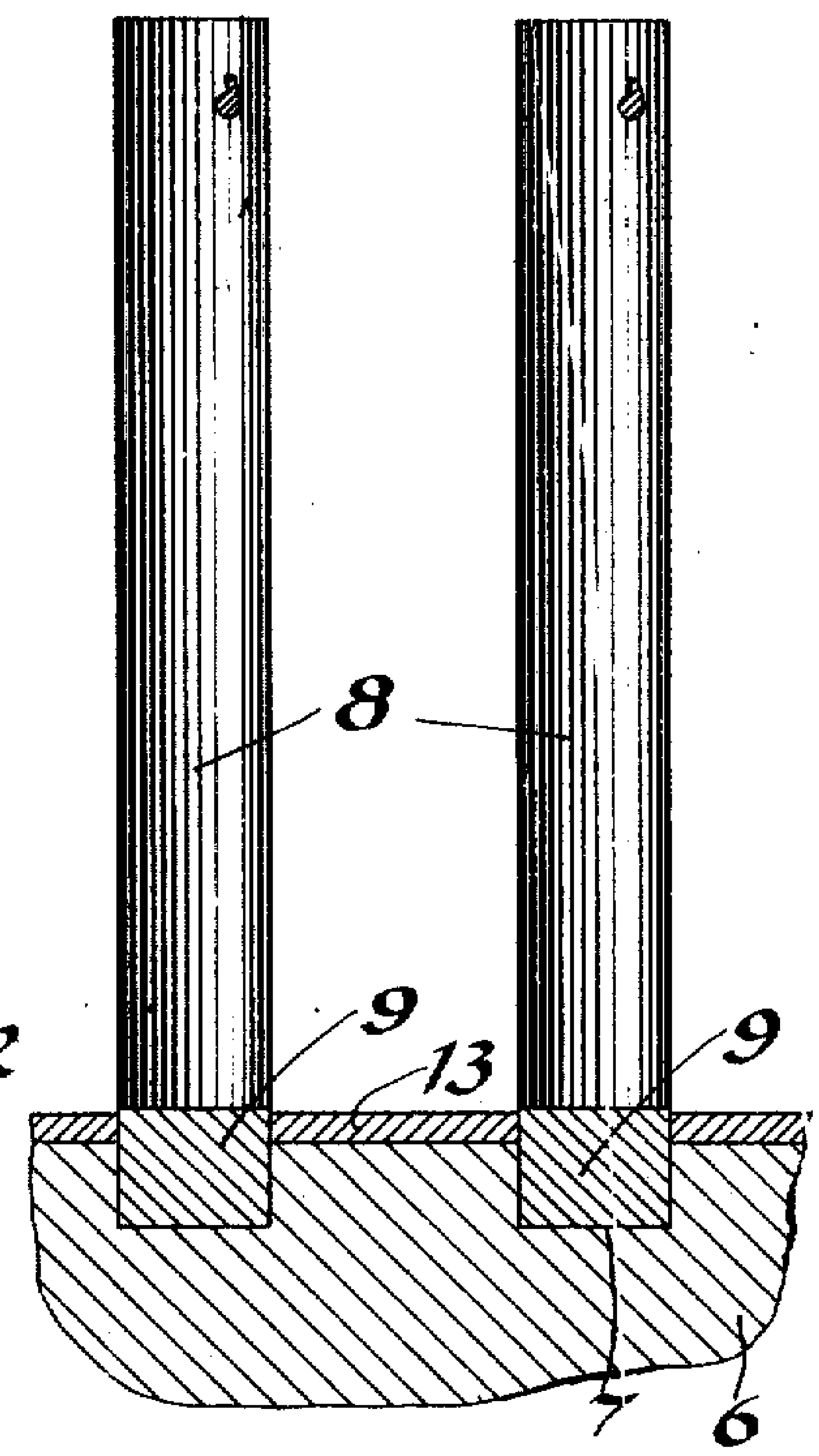

Fig. 4.

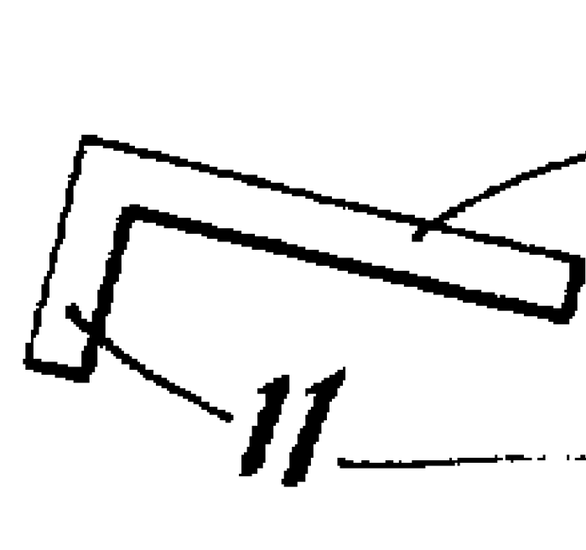

Fig. 3.

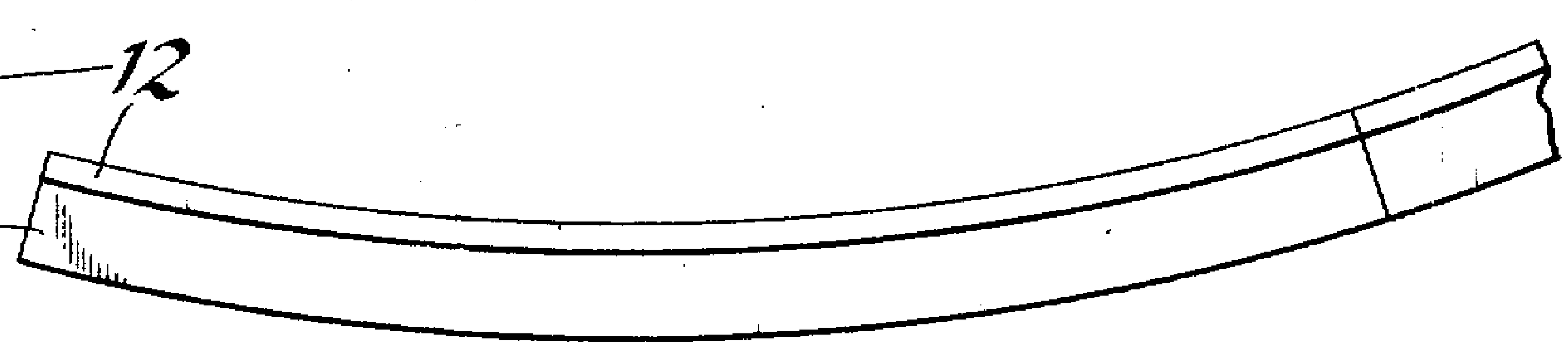

Fig. 2

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3 SHEETS—SHEET 2.

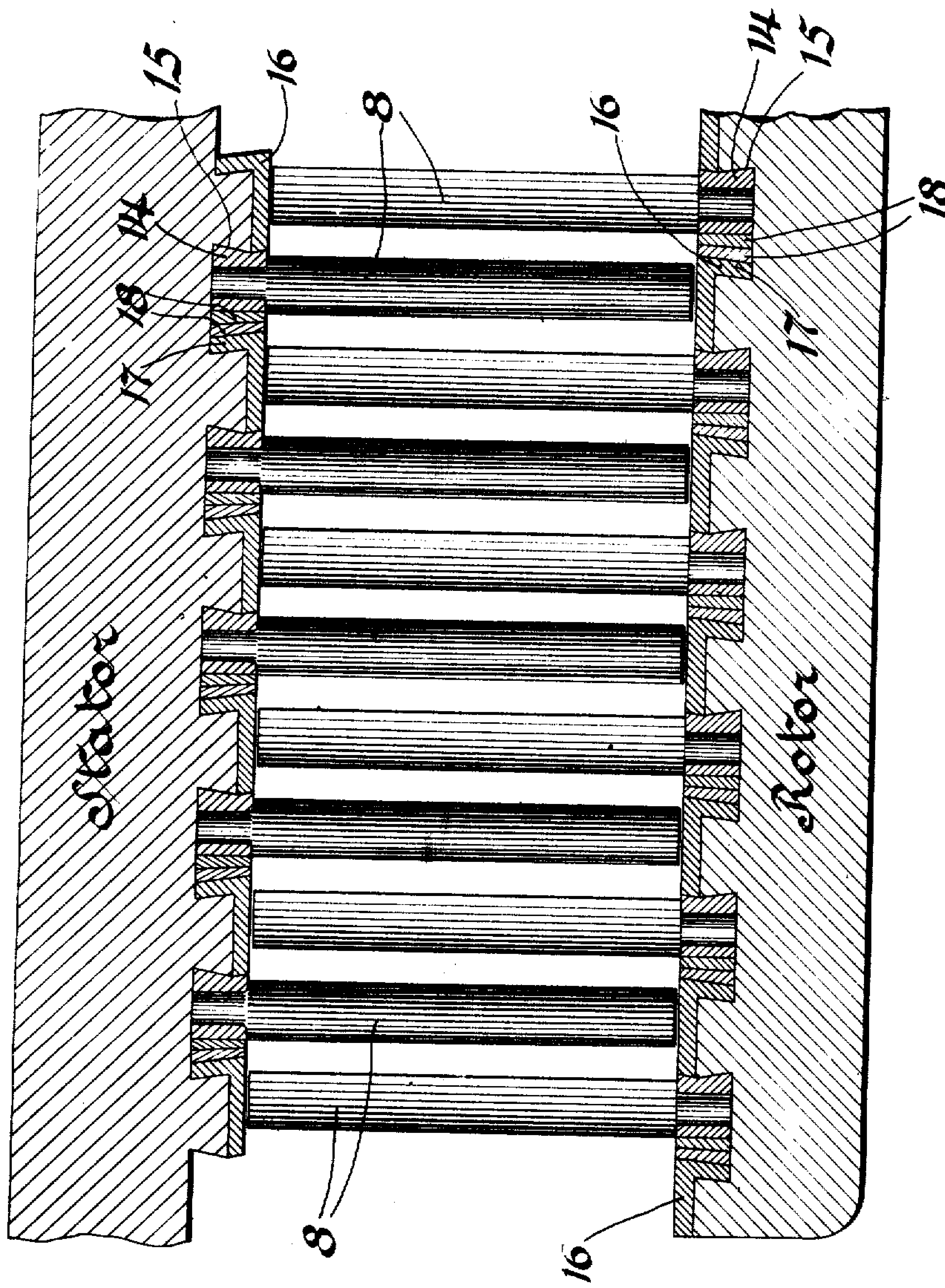

Fig. 5.

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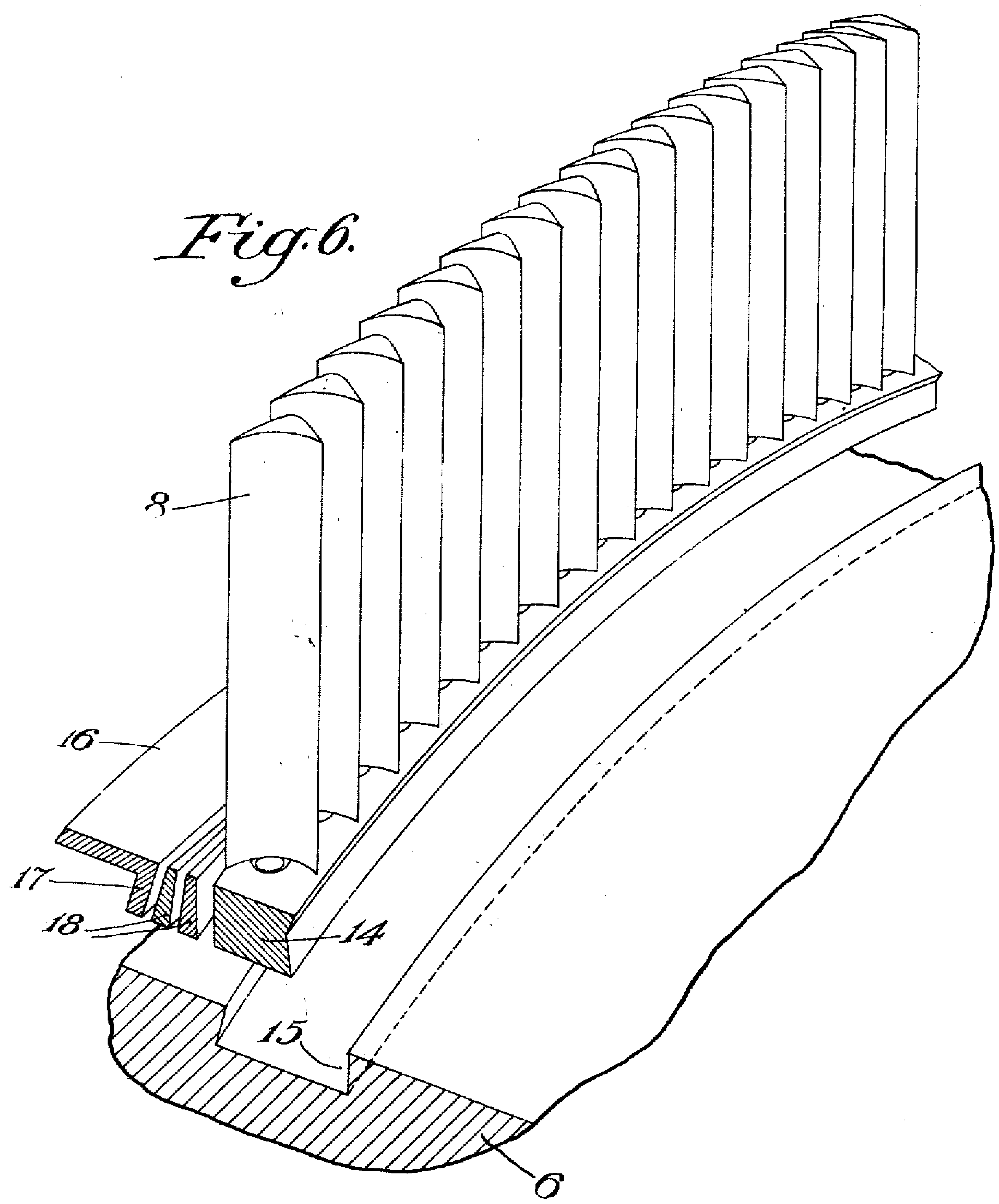
3 SHEETS—SHEET 3.

Fig. 6.



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UNITED STATES PATENT OFFICE.

FRANCIS HODGKINSON, OF EDGEWOOD PARK, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE COLONIAL TRUST COMPANY, TRUSTEE, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ELASTIC-FLUID TURBINE.

996,855. Specification of Letters Patent. Patented July 4, 1911.

Application filed October 24, 1907. Serial No. 399,025.

To all whom it may concern:

Be it known that I, FRANCIS HODGKINSON, a subject of the King of Great Britain and Ireland, and a resident of Edgewood Park, in the county of Allegheny and State of Pennsylvania, United States of America, 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 protecting the working elements of the turbine, that is, the rotor and interior face of the stator, from the corrosive and erosive action of the motive fluid. This corrosive and erosive action may result from chemical impurities in the boiler feed water, such, for instance, as acids, or it may result from corrosive action of distilled water, *i. e.*, the water of condensation, and erosive action of the motive fluid and water of condensation in their passage through the turbine. Whatever the cause, the fact remains that the exposed surfaces of the working elements are at times and under certain circumstances badly pitted and corroded. The cast iron casing is usually more actively attacked and, while the principal object of my invention is to protect the interior surface of the casing, I do not wish to specifically limit myself to this specific application of my invention.

In the drawings accompanying this application and forming a part thereof; Figure 1 is a partial longitudinal section of a turbine casing and illustrates an embodiment of my invention; Figs. 2 and 3 illustrate in side and end elevation respectively a protecting strip which forms a detail of my invention; Fig. 4 is a fragmental section of a turbine casing and illustrates a modification of my invention; and Fig. 5 is a fragmental longitudinal section of a turbine illustrating a modification of my invention as applied both to the rotor and stator of the turbine. Fig. 6 is a disassociated perspective view of the form shown in Fig. 5.

My invention consists in providing a protective covering for the surfaces of the working elements of the turbine which are most likely to be affected by the corrosive and erosive action of the motive fluid.

Referring to Fig. 1: the turbine casing 6 is provided with a plurality of circumferentially-extending slots 7 into which the blades 8 are mounted. The blades are secured to the blade-carrying element of the turbine by means of separate calking pieces 9, which are inserted into the slots between the ends of adjacent blades, and which are expanded transversely and thereby forced into a gripping contact with the walls of the slots and the contacting surfaces of the blades. Each slot is made of sufficient width to accommodate, besides the ends of the blades, a flange 11 of an L-shaped protecting strip 12, which is rolled or otherwise shaped into arc-shaped sections or ring segments of practically the same diameter as the interior or inner circumferential surface of the casing or stationary element of the turbine to which the blades or vanes are secured. Each piece 12 is so constructed that when the flange 11 is placed in the slot the major portion of the piece fits snugly against that portion of the inner peripheral face of the casing which is intermediate the slot, in which the flange 11 of the respective piece is secured, and the next adjacent slot. After the flanges 11 are in place in the blade holding slots, the blades 8 are, one at a time, secured in place as above described and the calking pieces, when expanded, grip one wall of the slot 7 in which they are mounted, the contacting faces of adjacent blades and the flange 11 of one of the protective strips, forcing the same into a gripping contact with the other wall of the slot. The free end of the strip may be calked into place between the adjacent blades, if desired. With such a construction, the protective strip is held snugly in place and the metal of the casing is protected from the erosive and corrosive action of the motive fluid.

Fig. 4 illustrates a modification of my invention, in which the L-shaped strips 12 are replaced by rectangular strips 13. The blades 8 are secured in place in the manner described in connection with the description of Fig. 1 and the strips 13 are calked in place between adjacent rows of blades. Other means may be utilized for securing the strips in place; for instance, they may be secured to the holding element by means of screws.

Fig. 5 describes an embodiment of my invention which is well adapted for use in connection with the rotor as well as the

stator of a turbine. The blades are secured to segmental base pieces 14, which are mounted on the turbine blade-carrying element, by being calked or otherwise secured into circumferentially extending slots 15. These slots 15 are undercut and, as illustrated, are of sufficient width to secure in place the base piece 14 and also a protective strip 16. Each protective strip is L-shaped in cross section and one flange 17 is adapted to extend into a mounting slot. The base pieces 14 are provided with one inclined face, the inclination of which corresponds to the inclination of the lateral walls of the slots. Each piece is placed in a slot with its inclined face in contact with one of the lateral faces of the slot and the flange 17 of the piece 16 is inserted into the slot adjacent to the other lateral wall of the slot, and double compound wedges 18 are inserted into the space between the flange 17 and the base piece 14. These compound wedges are then driven to place, thereby forcing the flange 17 into contact with one of the undercut walls of the slot and the base piece 14 into contact with the other wall of the slot. Each base piece projects beyond its mounting slot an amount equal to the thickness of the protective strip 16 and is inclined at an angle other than a right angle to the surface of the mounting element, thereby forming an overhanging flange against which the free edge of the strip 16 abuts and by which it is secured in place. Such a construction holds the piece rigidly in place and is capable of resisting strains due to centrifugal force. The base pieces 14 are provided with circumferentially alined holes into which the blades, which are provided with specially formed base pieces or shanks, are secured. This construction is only illustrative and it is to be understood that any form of base strip may be utilized and that blades may be secured thereto in any suitable manner, and that the base piece may be secured to the blade-carrying elements of the turbine in any suitable manner.

It will be apparent that when the calking pieces 9, Fig. 4, are calked into the slots 7, the edges will be peened or calked over on to the strips 13 so any liability of the strips becoming loose will be avoided. If desired, however, the calking tool may be placed at the adjacent edges of the calking piece and the strip, so as to force the edge of the strip 13 into the sides of the calking piece.

In accordance with the provisions of the patent statutes, I have described the principle 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 can be carried out by other means.

What I claim is:

1. In combination with a blade-carrying element of a turbine, a plurality of blades, a slot provided in said element, a base strip on which said blades are mounted, a protective strip for said element, and means for securing said base strip and said protective strip into said slot.

2. In combination with a turbine blade-carrying element provided with a slot, blades, a protective cover for said blade-carrying element, and means for mounting said blades and said cover on said element by securing them into said slot.

3. In combination with a turbine blade-carrying element provided with a slot, a plurality of blades, means for assembling said blades into a segmental ring, a protective strip for said element, and means for securing said strip and said blades into said slot.

4. In combination with a turbine blade-carrying element provided with a slot, a plurality of blades, a protective strip for said element, and means for securing said blades and said protective strip into said slot.

5. In combination with a turbine blade-carrying element provided with a plurality of slots, blades, means for assembling said blades into segmental blade rings, protective strips for said element, means for securing a segmental blade ring and one edge of a protective strip into each slot, and means provided on each segmental ring for securing the adjacent edge of a protective strip in place on said element.

6. In combination with a turbine blade-carrying element provided with a plurality of slots, base strips for blades located in said slots, flanged protective strips for said element located between adjacent slots, means for securing the flange of a protective strip and a blade strip into each blade-mounting slot, and a flange provided on each blade strip for securing the outer edge of an adjacent protective strip in place on said element.

7. In combination with a turbine blade-carrying element provided with a slot, blades and L-shaped protective strips for said element, and means for securing a plurality of blades and one flange of said strip into each slot.

8. In combination with a turbine blade-carrying element, provided with a plurality of slots, blades assembled in said slots, a flanged protective strip for said element located between adjacent slots, means for securing said blades and the flange of said strip into one blade-mounting slot, and means for securing the outer edge of said strip in place on said element.

9. In combination with a turbine blade-carrying element provided with a plurality

of slots, blades, base strips to which said blades are secured, protective strips for said element located between adjacent slots, means for securing a base strip and one edge of a protective strip into each slot, and means provided on each base strip for securing the outer edge of said protective strip in place on said element.

10. In combination with a turbine blade-carrying element provided with a plurality of slots, blades, means for securing the bases of a number of said blades together, a protective strip for said element, and means for securing the bases of the blades and a protective strip in each slot.

11. In combination with a turbine blade-carrying element provided with a plurality of slots, blades, means for securing the bases of a number of said blades together, protective strips for said element located between adjacent slots, means for securing the bases of the blades and one edge of said protective strip in each slot, and means for securing the other end of each protective strip to the blade-carrying element.

12. In a turbine, an element provided with slots, blades mounted in said slots, a protective strip located between adjacent slots and means for securing said strip in place.

13. In combination with a blade-carrying element of a turbine, rows of blades secured thereto, a protective strip located between adjacent rows of blades and means for securing said strip in place between said rows of blades.

14. In a turbine, a blade supporting element, means for securing blades to said element, means for protecting the surface of the element to which the blades are secured and means for securing the blade-securing means and protector in place.

15. In a turbine, a blade-supporting element, blades, blade-holding means for securing the blades in rows, a protective strip located between adjacent rows of blades and means provided on the blade-holding means and adapted to be peened over the strips after said blades are secured in place for securing said strip to the blade-supporting element.

16. In a turbine, an element provided with undercut slots, blades located in said slots, a surface protector for said element and located between adjacent slots, means on each protector to enter the undercut portion in one of the slots, and means for securing the last named means in the undercut portion when the blades are secured in the slots.

17. In a turbine, a blade-supporting element provided with undercut slots, blades assembled in rows and located in said slots, protective strips for said element located between adjacent rows of blades, and means located within said slots for securing said blades into said slots and said strips into the undercut portions of the slots.

18. In a turbine, a blade-carrying element provided with undercut slots, blades in said slots, protective strips provided with flanges and located between adjacent slots and means located within said slots for securing said blades in said slots and the flanges of said strips in the undercut portion of the slots.

19. In a turbine, an element provided with undercut slots having strips and blades and means for securing said blades in said slots and said strips in the undercut portions thereof.

20. In a turbine, a blade-carrying element provided with a plurality of slots, blade foundation strips located in said slots, a protective strip for the blade-carrying element between adjacent slots, a part of the protective strip in the slot, means in the slot for holding in the foundation strip and the protective strip and means on each foundation strip for engagement with an edge of the protective strip.

21. In a turbine, a blade-carrying element provided with a plurality of slots, blades located in said slots, a protective strip for said element located between adjacent slots, and means secured in each slot and adapted to be calked or peened over to engage and secure in place said protective strip.

22. In a turbine, a blade-carrying element provided with a plurality of slots, a protective strip for said element located between adjacent slots, and means secured in place in said slots for securing each strip to said element.

23. A turbine element having a slot, blade holding means and protective strips for the element, separate from but calked into the same slot as the blade holding means.

24. A turbine element having a slot, means for securing blades in said slot and projecting above the surface of the element and a surface protector held by the said means and projecting laterally therefrom.

25. A turbine element having a slot, means for securing blades in said slot and a surface protector snugly fitting against the surface of the turbine element and held against movement by the blade-securing means.

26. A turbine element having a slot, means projecting above the surface of the element for securing blades in said slot and a surface protector held by said means and snugly fitting against said element.

27. In turbines means for preventing corrosion of the rotating drum and casing said means comprising metallic covering means co-acting with grooves in the turbine drum or casing and in close contact with the surface to be protected substantially as described.

28. In combination with a groove in a turbine drum or casing means integral with and adapted to secure metallic covering means to and in close contact with the turbine drum or casing substantially as described.

29. In combination within a groove in a turbine, drum or casing a blade holding element and means integral with and adapted to secure metallic covering means to and in close contact with the turbine drum or casing, substantially as described.

30. In combination with blade carrying strips L shaped pieces secured in the blade strip grooves and overlapping and lying in close contact with the turbine part in which said groove is formed.

31. In combination in grooves in turbine drums and casings, blades and blade holding means, L shaped pieces in said grooves and extending along and in close contact with the surface of the drum or casing toward the adjacent grooves.

In testimony whereof, I have hereunto subscribed my name this 23rd day of October, 1907.

FRANCIS HODGKINSON.

Witnesses:

CHARLES W. MCGHEE,

E. W. MCCALLISTER.