

F. HODGKINSON & W. A. BOLE.
ELASTIC FLUID TURBINE.
APPLICATION FILED AUG. 27, 1909.

1,050,136.

Patented Jan. 14, 1913.

5 SHEETS—SHEET 1.

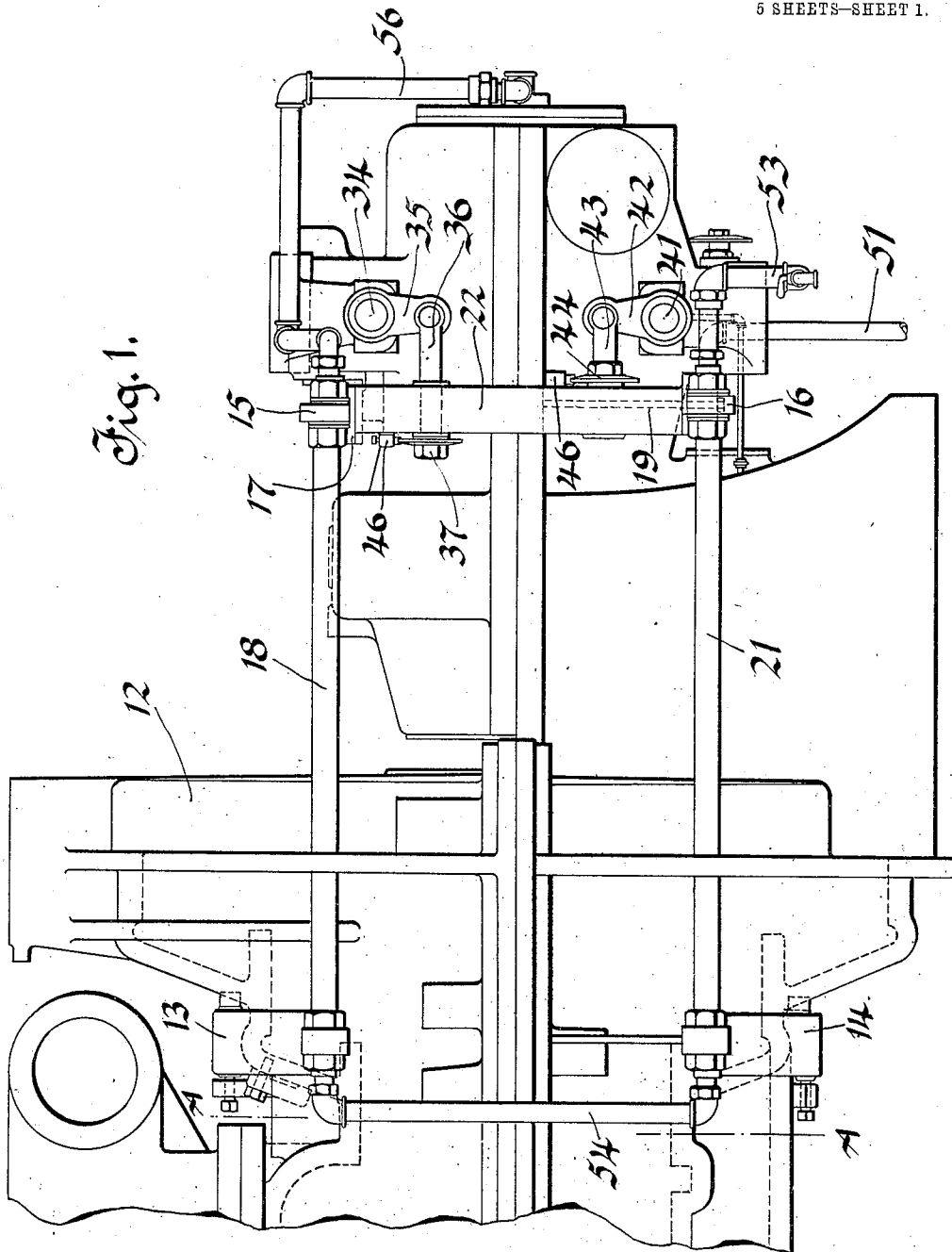


Fig. 1.

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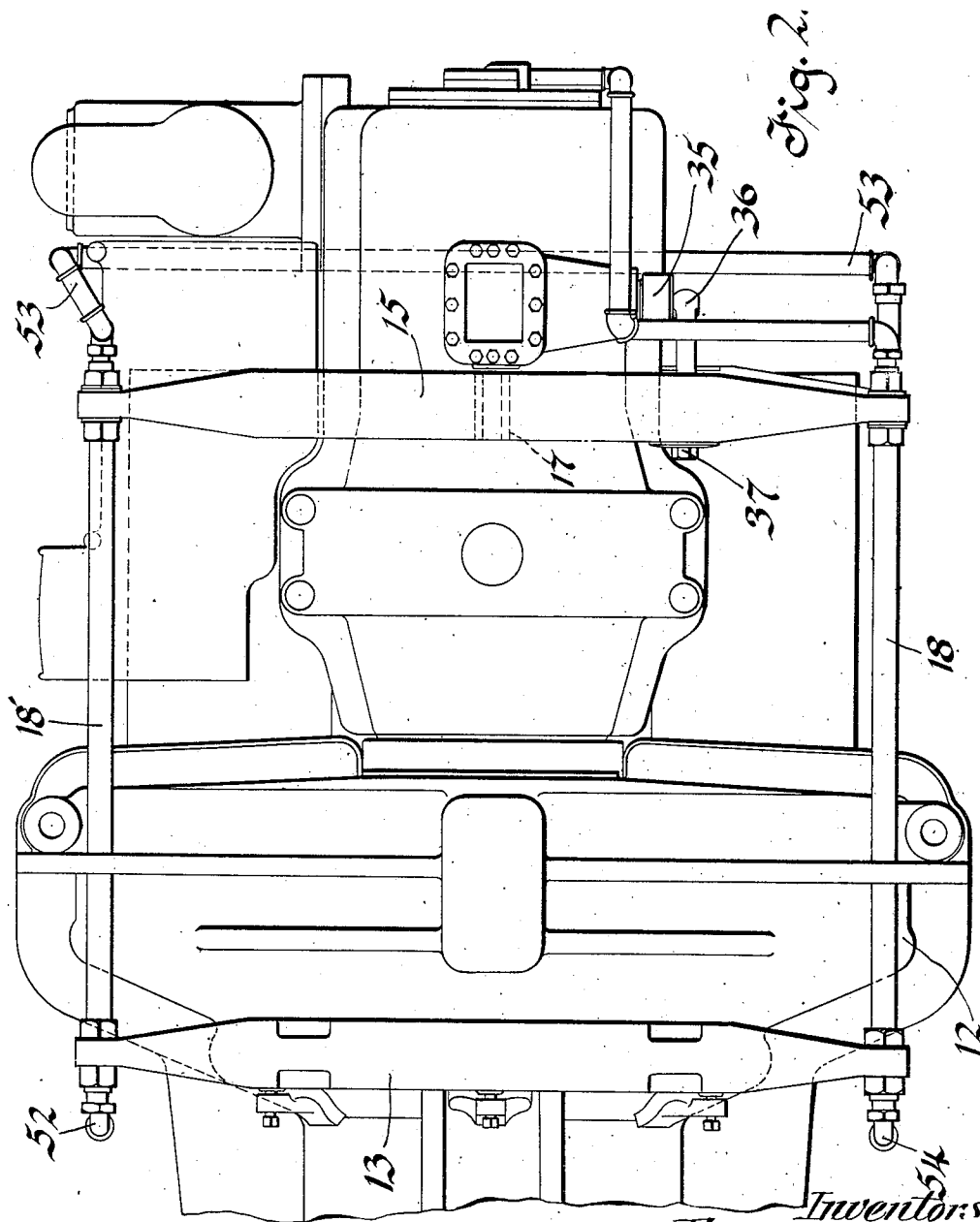
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5 SHEETS—SHEET 2.



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5 SHEETS-SHEET 3.

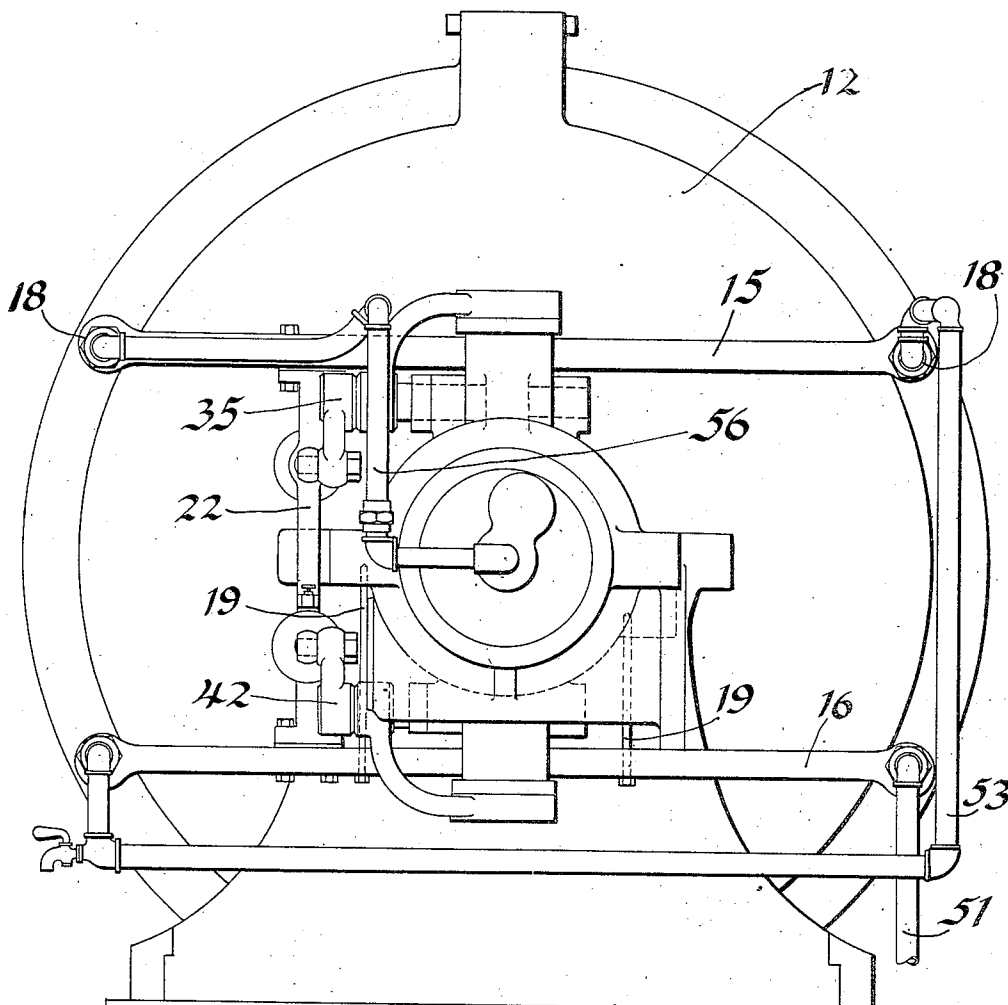


Fig. 3.

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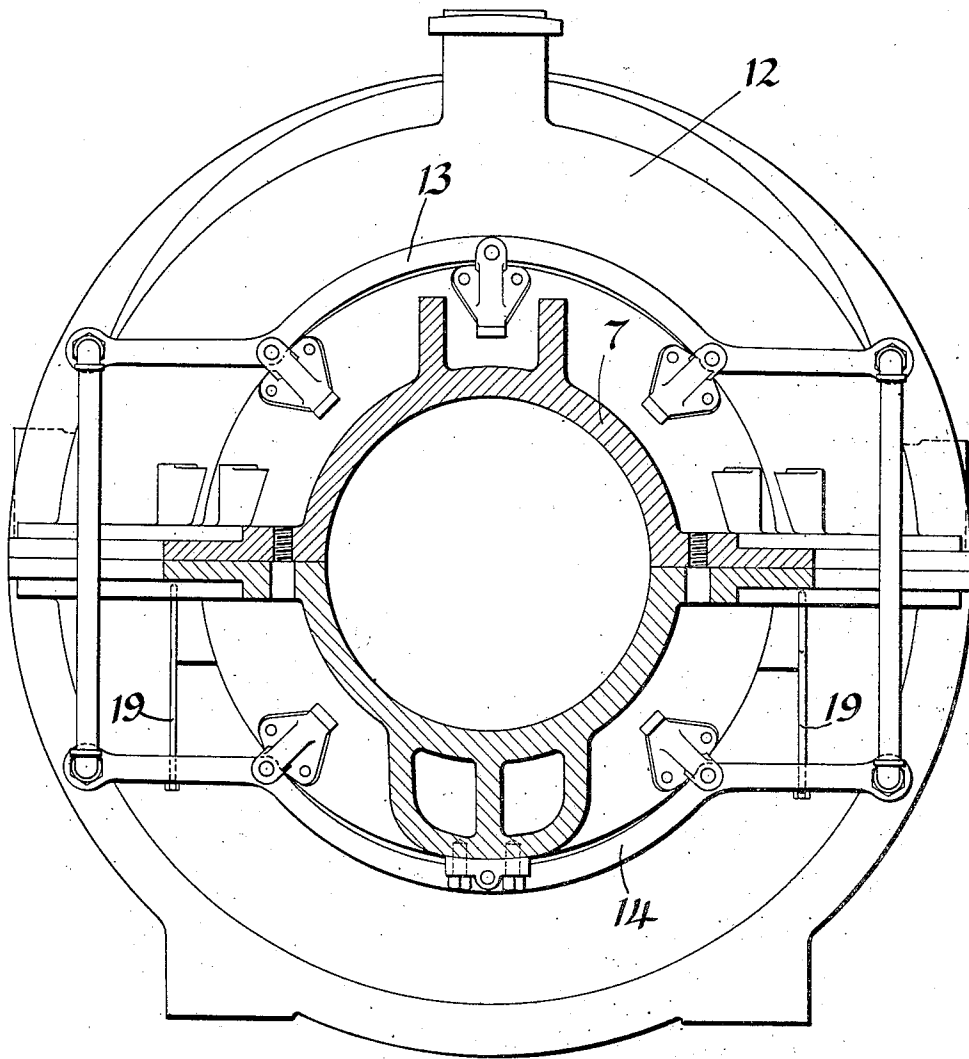


Fig. 4.

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5 SHEETS—SHEET 5.

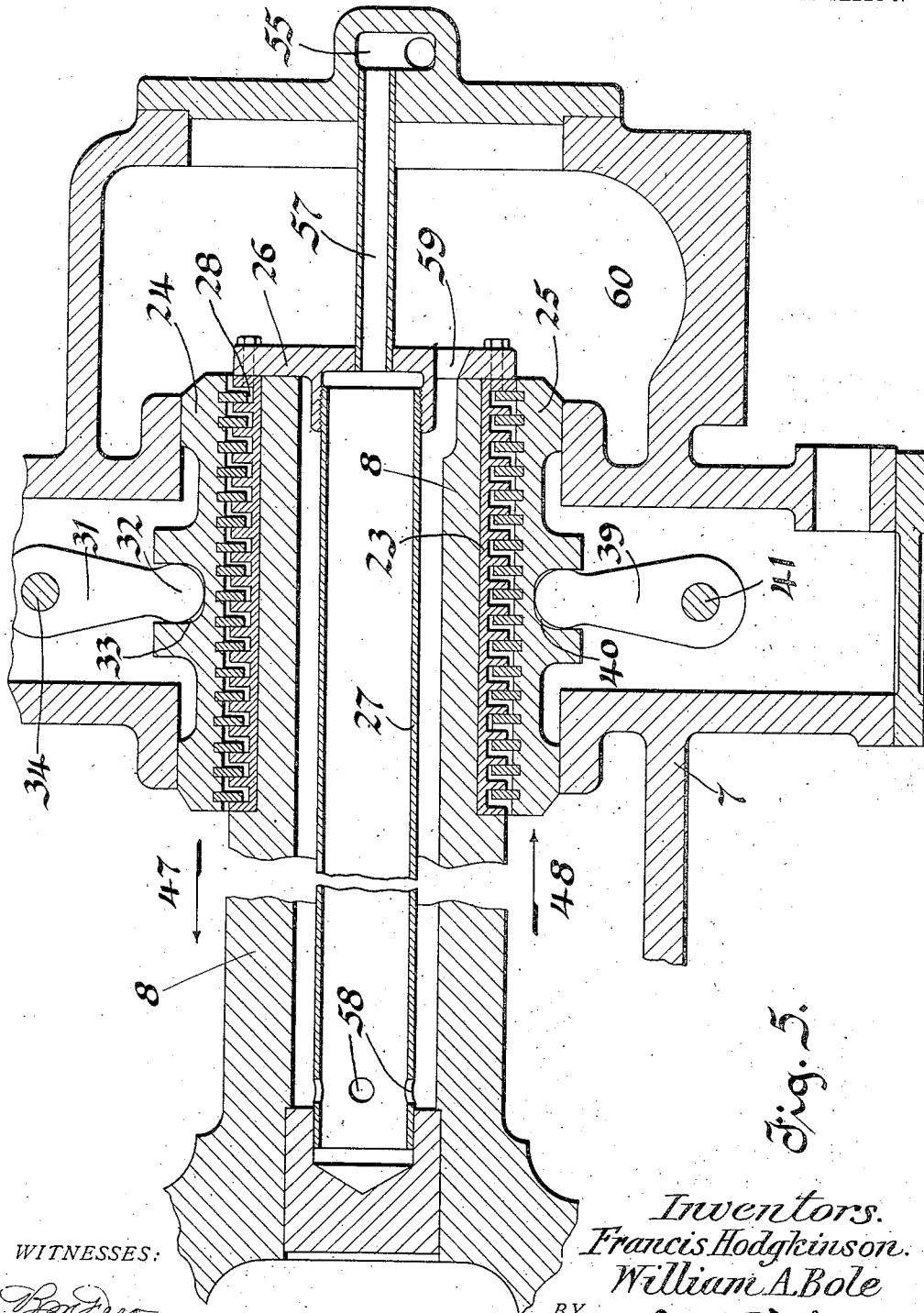


Fig. 5.

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UNITED STATES PATENT OFFICE.

FRANCIS HODGKINSON, OF EDGEWOOD PARK, AND WILLIAM A. BOLE, OF PITTSBURGH, PENNSYLVANIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE COLONIAL TRUST COMPANY, TRUSTEE, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ELASTIC-FLUID TURBINE.

1,050,136.

Specification of Letters Patent.

Patented Jan. 14, 1913.

Application filed August 27, 1909. Serial No. 514,946.

To all whom it may concern:

Be it known that we, 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; and WILLIAM A. BOLE, 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 Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to elastic fluid turbines and has for an object to produce means for automatically regulating the relative adjustment between the rotating and stationary elements of turbines.

In some types of turbines, it is customary to employ very close lateral clearances between the rotating and stationary elements and it is, therefore, necessary to maintain an accurate longitudinal or axial adjustment of the rotor element.

Since the rotor elements of turbines are free to revolve and are capable of being easily adjusted longitudinally, they are ordinarily provided with an adjusting device of some sort by which they are shifted laterally to maintain the close lateral clearances necessary. It has been found in practice that the cylinders or stator elements of the turbines expand and contract, due to differences in temperature, and under certain conditions distort and thereby destroy the fine clearances necessary.

An object of this invention is to produce means for adjusting the rotor element of the turbine relative to the stator element and for automatically moving it longitudinally to correspond with the variations of position of the stator so that at all times and under all conditions the relative positions of the rotor and stator elements where the close clearance is desired are practically the same. This and other objects we attain in a turbine embodying the features herein described and illustrated.

In the drawings accompanying this application and forming a part thereof: Figure 1 is a partial side elevation of a turbine embodying our invention; Fig. 2 is a plan view of Fig. 1; Fig. 3 is an end elevation; Fig. 4 is a section along the line A—A of Fig. 1;

and Fig. 5 is a partial section showing a detail of our invention.

In the turbine herein illustrated as embodying our invention it is desired to maintain a close clearance between a certain portion of the turbine casing and the rotor element and for that reason means are employed for automatically varying the longitudinal position of the rotor in accordance with the variations in position of that portion of the turbine only.

The turbine casing 7, which comprises a number of working and balancing chambers, incloses the turbine rotor, an extending portion 8 of which is shown in Fig. 5. The rotor element is journaled in suitable bearings located at either end of the casing and is provided with an adjusting device partially shown in Fig. 5, which shifts the rotor element to maintain the close clearances necessary.

The rotor is provided with a drum of large diameter, which is inclosed within an enlarged portion 12 of the casing, between which and the drum it is desired to maintain a close lateral clearance. The adjusting device is, therefore, employed for shifting the rotor longitudinally within the casing so that the axial or longitudinal position of the drum is varied to correspond to changes in position of the portion of the casing which incloses it.

Yokes 13 and 14 are rigidly secured to the turbine casing by bolts and are located at or adjacent to the portion of the casing where the closest adjustment is required. Corresponding yokes 15 and 16 are mounted on the housing of the turbine bearing adjacent to the longitudinal or axial adjusting device. The yoke 15 is mounted in ways so that it is capable of sliding axially of the turbine to correspond to the variations of position of the yoke 13 and is connected by rigid rods or struts 18 and 18' to the yoke 13. The yoke 16 is hung beneath the bearing housing of the turbine by long bolts 19 and is rigidly secured at its ends to the yoke 14 by struts 21. The bolts 19 are of such length and are so arranged that the position of the yoke 16 is easily varied by the variations of the yoke 14. A rigid vertical strut 22 connects the yokes 15 and 16 and is connected with a longitudinal adjust-

ing device by a system of links and levers, through which the rotor is automatically shifted to vary its axial position.

The adjusting device comprises a sleeve 23 which is rigidly secured to the rotor element and two reciprocating blocks 24 and 25, which surround the sleeve 23 and which are actuated by the vertical strut 22 through the agency of the links and levers. A disk 26 is secured to the sleeve 23 and is rigidly connected with the rotor element of the turbine by a tube 27, which extends through the hollow interior of the extension 3. The outer peripheral face of the sleeve 23 is provided with a series of annular depressions or channels 28 which interleave with a series of semi-annular collars or ridges with which the blocks 24 and 25 are provided in the manner of a thrust bearing.

The blocks 24 and 25, taken together, completely surround the extension 8 and are preferably separated from each other on a horizontal plane through the axis of the rotor. The block 24 is actuated by a lever 31, which is provided with a ball-shaped head 32 cooperating with a socket 33, formed in the block. The lever 31 is mounted on a pin 34, which is journaled in the bearing housing and which is provided, exterior to the casing, with a rigidly mounted lever 35. The lever 35 is pivotally connected to a link 36 and is provided at the free end with an adjusting nut 37. The block 25 is actuated by a similar system of links and levers, which consists of a lever 39, cooperating with a socket 40 formed in the block 25, a pin 41, on which the lever 39 and a lever 42 are mounted, and a link 43, which is provided with an adjusting nut 44. The links 36 and 43 extend through the vertical strut 22 and the nuts 37 and 44 are respectively employed to adjust the blocks 24 and 25 with reference to the sleeve 23 and the strut 22. Each adjusting nut is provided with a locking device 46, which prevents a change in the preliminary adjustment after it has been made.

The adjusting nut 37 is so located and the block so arranged that the only motion that can be transferred to the block by the strut 22 is in the direction of the arrow, designated by the numeral 47 in Fig. 5, and the nut 44 is so located and arranged that the only motion that can be transmitted to the block 25 by the strut 22 is in the direction of the arrow, designated by the numeral 48 in Fig. 5. Thus it will be seen that the proper adjustment of one half of the block may be made with respect to the other.

The operation of the apparatus is as follows: After the preliminary adjustment of the blocks 24 and 25 is made, the adjusting nuts 37 and 44 are locked in place, the rotor being in the operating positions for ordinary conditions and the close clearances, above referred to, between the rotor and the stator

being accurately adjusted. If, after the adjustment is made, the portion 12 of the casing moves longitudinally of the turbine due to any cause, the yokes 13 and 14 and the connecting mechanism shift the blocks 24 and 25 to such positions that the rotor is shifted an amount corresponding to the movement of the portion 12. As is apparent from the description of the mechanism, a movement of the portion 12 in one direction will actuate one of the adjusting blocks to move the rotor in one direction and a movement in the other will actuate the other block to move the rotor in a reverse direction.

In carrying out this invention, we have employed means which substantially eliminate all difficulties due to temperature changes external to the turbine. We circulate oil or other cooling liquid through the struts 18, 18' and 21 and the tube 27 and thereby avoid relative variations, due to difference in temperature, which would affect the adjustment of the apparatus. The cooling liquid is introduced into the system through a supply pipe 51, which communicates with one of the struts 21 (it being understood that the struts are hollow). From the strut 21 the liquid is conducted to the strut 18' by a pipe 52. The strut 18 communicates with the strut 21 on the other side of the turbine through a system of pipes 53 and the strut 21 communicates with the strut 18 through a pipe 54. The liquid is discharged from the strut 18 into a chamber 55, formed in the end of the bearing housing, through a pipe 56. The chamber 55 communicates through a tube 57 with the tube 27, which is arranged within the hollow extension 8 of the rotor. The tube 57 extends from the walls of the chamber 5 through the disk 26, permitting longitudinal variations in the position of the shaft. The oil discharged from the tube 57 first passes through the tube 27 and then is discharged through holes 58 into the space between the tube 27 and the walls of the extension 8, from which it is discharged through ports 59 into a chamber 60, which communicates with the oil circulating system. The oil utilized in the system need not necessarily be a cooling agent, as its only function is to maintain the several portions of the operating mechanism at an equal temperature. Obviously the direction of flow of the oil or fluid is immaterial and may be controlled to suit convenience.

With such an arrangement the rotor element is moved axially to correspond with the longitudinal variations in the position of the portion 12 of the casing and the relative lateral positions between the portion 12 and the adjacent portion of the drum is maintained practically constant.

It is apparent that with such an apparatus

the axial adjustment of the rotor may be varied to correspond to the variations which may occur in any part of the turbine casing. It is also apparent that a number of such adjusting devices may be utilized in connection with a rotor which comprises a number of drums so mounted on a supporting shaft that they are capable of relative axial movement. Under such conditions, the different portions of the rotor would move automatically to correspond to the movements of the adjacent portions of the casing.

What we claim is:

1. In combination with an elastic fluid turbine, a rotor, a stator, an adjusting device for said rotor comprising means for adjusting the rotor longitudinally relative to said stator, and means for maintaining said adjustment during variations in position of said stator.

2. In combination with a rotating element, an inclosing casing comprising a stator, an adjusting device for said element and stator actuated means connecting said casing and said device for varying the axial position of said rotor.

3. In combination with an elastic fluid turbine, a rotor, a stator, an axial adjusting means for said rotor and means, dependent on the variations of position of said stator, for varying the position of said rotor.

4. In combination with an elastic fluid turbine, a rotor, a stator and means, dependent on the variations in position of said stator, for varying the axial adjustment of said rotor.

5. In combination with a rotatable element, a stationary element cooperating therewith, a longitudinal adjusting device for said rotatable element and means, dependent upon the variations in position of said stationary element, for actuating said adjusting device and causing it to shift said rotatable element.

In testimony whereof, we have hereunto subscribed our names this 25th day of August, 1909.

FRANCIS HODGKINSON.
WILLIAM A. BOLE.

Witnesses:

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