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ELASTIC FLUID TURBINE.

APPLICATION FILED JUNE 16, 1906.

945,391.

Patented Jan. 4, 1910.

4 SHEETS—SHEET 1.

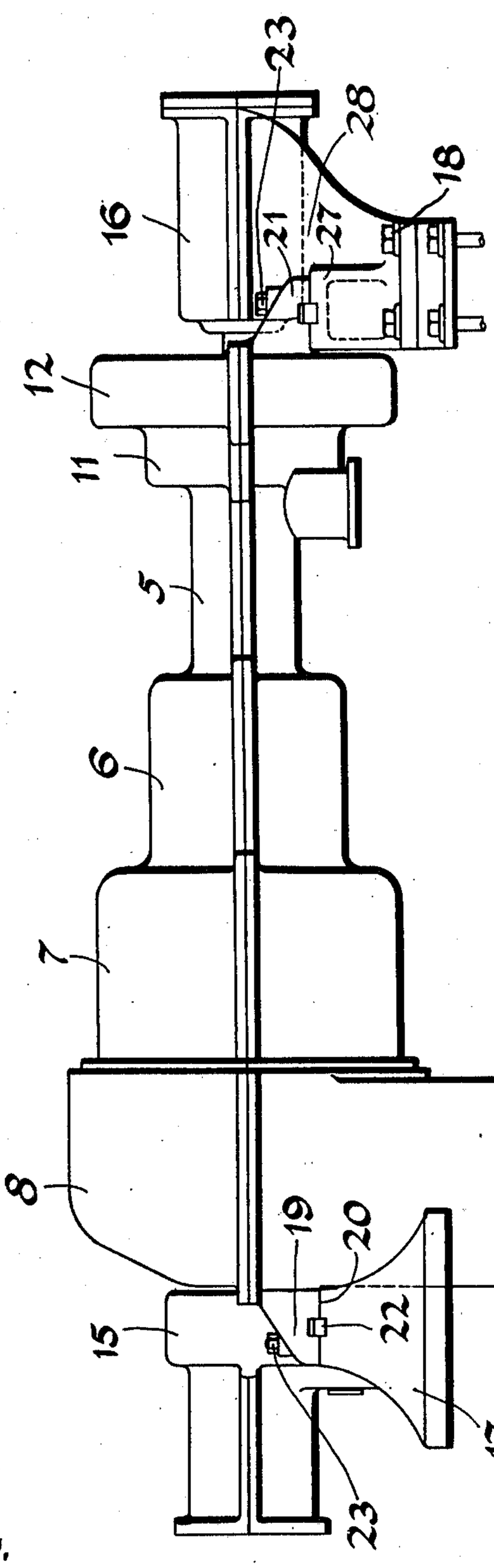

Fig. 1.

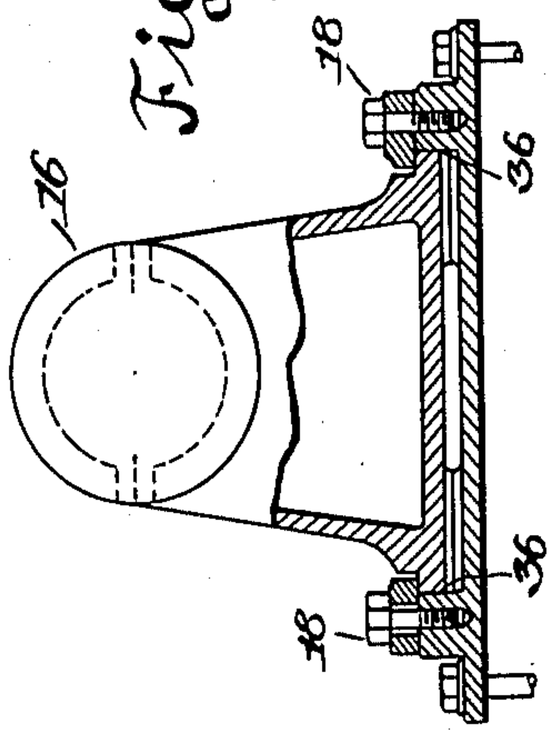

Fig. 2.

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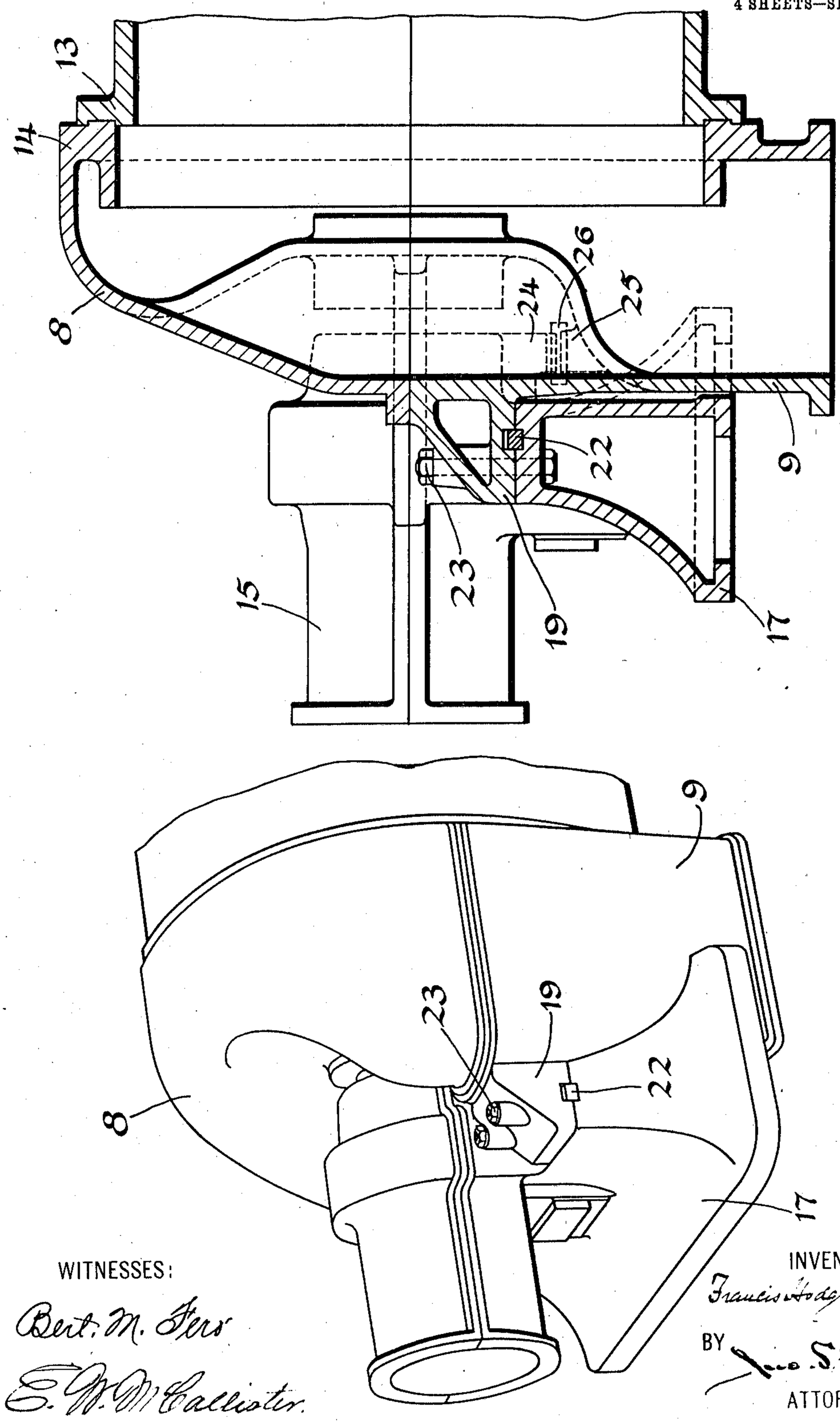

Fig. 3.

Fig. 2.

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4 SHEETS—SHEET 3.

Fig. 5.

Fig. 4.

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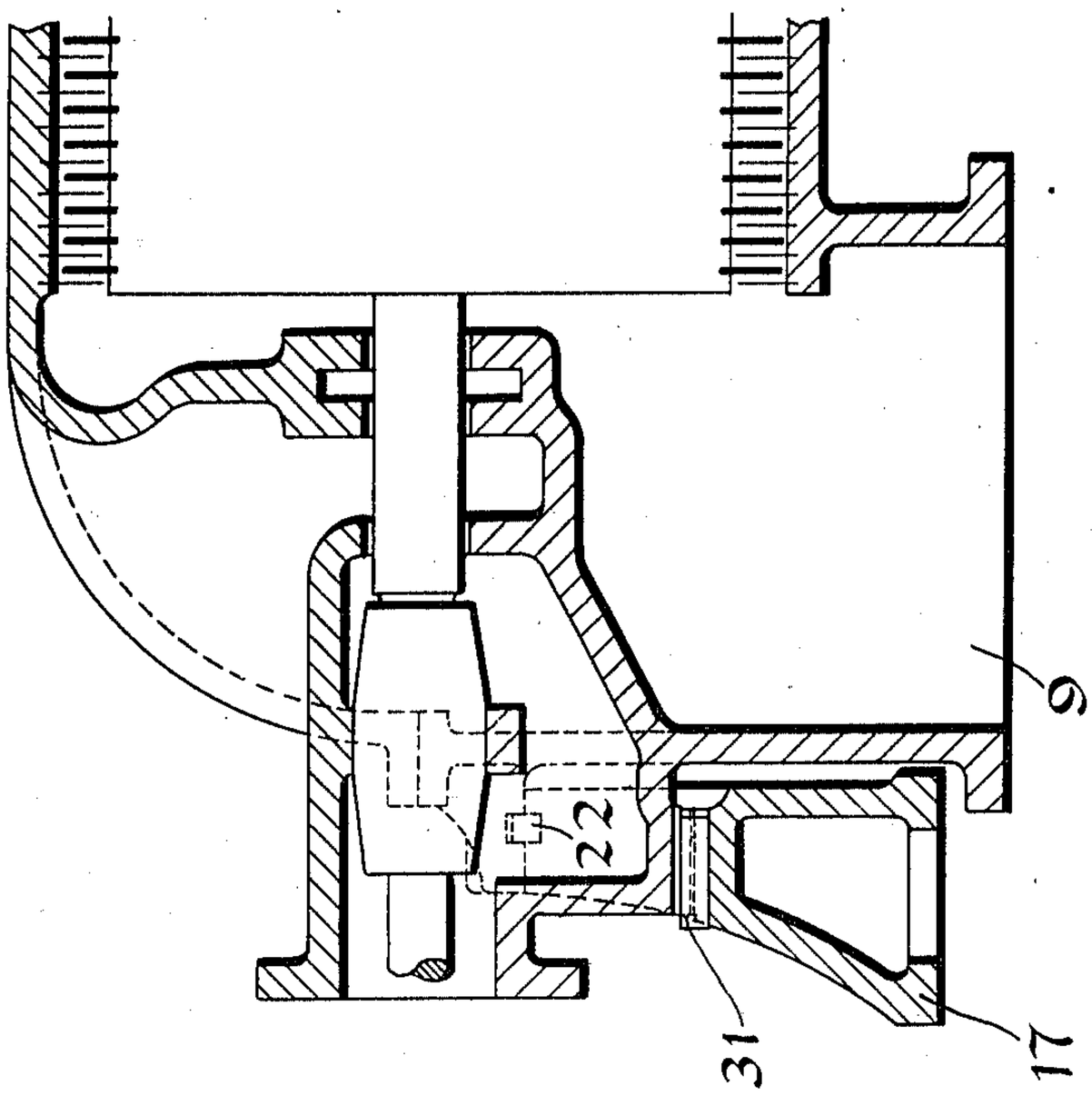

Fig. 6.

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UNITED STATES PATENT OFFICE

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ELASTIC-FLUID TURBINE.

945,391. Specification of Letters Patent. Patented Jan. 4, 1910.

Application filed June 16, 1906. Serial No. 322,027.

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 the construction of the casing for such turbines.

In elastic fluid turbines of the multi-cellular type, considerable distortion of the casing is encountered, due to inherent casting strains and also to an unequal expansion of the casing throughout its length, which is caused by variations in the temperature of the motive fluid.

An object of this invention is the production of a stator element for elastic fluid turbines which shall be strong and rigid and in which effective means are utilized for permitting free expansion and contraction. This and other objects I 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 longitudinal sectional elevation of a turbine embodying my invention; Fig. 2 is a partial perspective view of the turbine shown in Fig. 1; Fig. 3 is a partial sectional elevation of the turbine shown in Fig. 1; Fig. 4 is an end elevation of a turbine embodying a modification of my invention; Fig. 5 is a partial side elevation of the turbine illustrated in Fig. 4; and Fig. 6 is a partial sectional elevation of the turbine illustrated in Figs. 4 and 5. Fig. 7 is an end view, shown partially in section, of a detail of my invention.

The turbine illustrated in the drawings and described throughout this specification as embodying my invention is an axial flow turbine of the multi-cellular type, but I desire it to be understood that I do not wish to limit myself to axial flow, or even multi-cellular turbines, as it will be apparent that my invention is readily applicable to various types of turbines and may be utilized in connection with any turbine provided with a stationary casing.

The turbine illustrated in Fig. 1 is adapted to expand the motive fluid and extract the available energy therefrom in a high, intermediate and low-pressure stage. The motive fluid is admitted to the high pressure stage and after passing therethrough, is discharged into the intermediate stage, which is of greater diameter. The fluid discharged from the intermediate stage enters the low-pressure stage, which is of greater diameter than the intermediate stage, and from which the fluid is discharged into the exhaust passages of the turbine. Intermediate and low-pressure balancing pistons are located adjacent to the hign-pressure stage and are respectively inclosed within intermediate and low-pressure balancing chambers which communicate with the intermediate and low-pressure working passages of the turbine.

The high intermediate and low-pressure stages are inclosed within cylindrical shells 5, 6 and 7 respectively, which are formed in separate halves and are provided with suitable flanges for connecting them together. The exhaust passage, which communicates with the low-pressure stage, is inclosed within a shell which comprises the separate portions 8 and 9. The intermediate and low-pressure balancing chambers, which surround the balancing pistons, are inclosed within cylindrical shells 11 and 12 which, like the shells 5, 6 and 7, are formed in halves. The separate portions are provided with connecting flanges 13 and 14 (as shown in Fig. 3) and are adapted to be securely connected together to form the exterior casing of the rotor element of the turbine. The assembled or organized casing is divided along a horizontal plane which passes through the axis of the rotor element.

Referring to Figs. 1, 2 and 3: the rotor element is provided with a suitable shaft which is journaled in bearings 15 and 16 at either end of the casing. The lower portion of the housing of the bearing 15 is formed integrally with a pedestal 17 which is supported by and suitably secured to the foundation or bed-plate of the turbine. The portion 9 of the turbine casing is provided with integrally-formed brackets 19 which are located at either side of the bearing 15 and which are supported by suitable pads or supporting faces 20, formed on the pedestal 17. The lower portion of the housing of the bearing 15 is provided with an integrally-formed lug between which

and a lug 25 on the portion 9 of the casing a longitudinally-extending key 26 is located. The key 26 is arranged to hold the casing in such position that its axis coincides with the axis of the bearing housing and is so located that it will in no way hamper the lateral expansion or contraction of the casing. Laterally-extending keys 22 are provided between the pedestal 17 and the brackets 19 and are adapted to prevent longitudinal motion of the casing and at the same time permit of sufficient lateral play to accommodate the lateral expansion of the casing on either side of the key 26. The casing is held in place on the pedestal by suitable bolts 23 which are secured to the pedestals and which extend through laterally-extending slotted holes in the brackets. The lower portion of the housing of the bearing 16 is formed integrally with a pedestal 18, which is supported by the bed-plate or foundation of the turbine. The lower portion of the cylindrical shell 12 is provided with integrally-formed brackets 21 which are located at either side of the bearing 16 and which are supported by pads or supporting surfaces 27 formed on the pedestal 18. The lower portion of the bearing housing is provided with an integrally-formed lug (not shown) corresponding to the lug 24, between which and a lug on the shell portion 12 corresponding to 25 on the portion 9, a longitudinally-extending key, corresponding to 26, is located. The key is arranged to hold the casing in line with the bearing housing and is so located that it will in no way hamper the lateral expansion or contraction of the shell portion 12. Laterally-extending keys 22 are provided between the pedestal 18 and the brackets 21 and are adapted to prevent relative longitudinal motion between the brackets and the pedestal 18 and at the same time permit of sufficient lateral play to accommodate the lateral expansion of the casing. The brackets 21, like the brackets 19, are secured in place on the pedestal by suitable bolts 23. The pedestal 18, while supported by the foundation or bed-plate of the turbine, is not rigidly connected thereto, but is capable of longitudinal motion along a longitudinally-extending way 36 to accommodate the longitudinal expansion of the entire turbine casing.

In Figs. 4, 5 and 6 a modification of my invention is shown in which the bearing housing is formed integrally with the casing. The pedestal 17, at the exhaust end of the turbine, as in Fig. 1, is arranged to support the brackets 19, which are formed integrally with the portion 9 of the casing. The keys 22 are located between the casing brackets and the pedestal and hold the casing rigidly against longitudinal motion but permit of lateral motion to accommodate the lateral expansion and contraction of the casing. A key 31, located between an extending lug 32 of the casing and the pedestal, corresponds to the key 26 in Fig. 3 and is arranged to resist lateral motion and hold the casing in position on the pedestal. The arrangement of the keys 22 and 31 is such that the lateral expansion of the casing will be unhampered. The bolts 23, which extend through suitably-slotted holes in the brackets 19, are arranged to hold the casing down. A similar construction may be utilized in connection with the balance piston end of the turbine, the longitudinal expansion of the casing being accommodated by the expansion joint between the pedestal 18 and the foundation.

With such an arrangement the casing can expand longitudinally as well as radially and the tendency to warp or distort is overcome. By dividing the casing into separate portions 5, 6, 7, 8, 9, 11 and 12, which are again divided along the horizontal plane passing through the axis of the turbine, the inherent casting strains are reduced to a minimum, as the casing is composed of a number of small castings and, therefore, homogeneous metal throughout the casing may be obtained. The connecting flanges 13 and 14, with which the separate flanges are provided, are of such size as to add to the rigidity of the casing and to permit of an adequate number of connecting bolts.

Various modifications and constructions may be made and still fall within the spirit and scope of this invention, and

What I claim is:

1. In combination with an elastic fluid turbine, a stationary casing, a support for said casing, a laterally-extending key and a longitudinally-extending key between said support and said casing.

2. In combination with an elastic fluid turbine, a casing, a support for said casing, means between said casing and said support arranged to resist lateral motion of said casing, and means arranged to resist longitudinal motion of said casing relative to said support.

3. In combination with an elastic fluid turbine, a casing, a support for said casing, means between said casing and said support for resisting lateral motion, and means at either side thereof for resisting longitudinal motion relative to said support.

4. In combination with an elastic fluid turbine, a casing, a support for said casing, means between said casing and said support for resisting lateral motion, and independent means for resisting longitudinal motion relative to said support.

5. In combination with an elastic fluid turbine, a casing, a longitudinally movable support for said casing, and means between said casing and said support for resisting lateral motion of said casing.

6. In combination with an elastic fluid turbine, a casing, a longitudinally movable support for said casing, a laterally-extending featherway connection between said casing and said support.

7. In combination with an elastic fluid turbine, a casing, a longitudinally movable support for said casing, a longitudinally-extending featherway connection, and a laterally-extending featherway connection between said casing and said support.

8. In combination with an elastic fluid turbine, a rotor, a stationary casing, a shaft carrying said rotor and extending through said casing, a bearing for said shaft, a housing for said shaft bearing formed integrally with said casing, lugs on said casing on either side of said bearing housing, a longitudinally movable supporting standard for said lugs, laterally extending ways between said lugs and said standards, and a longitudinally-extending way between said bearing housing and said standard.

9. In combination with an elastic fluid turbine, a stationary casing, a support for said casing, locking means between said casing and said support which resists relative lateral motion, and additional means between said support and said casing which resists longitudinal and permits relative lateral motion.

10. In combination with an elastic fluid turbine, a stationary casing, a support for said casing, movable longitudinally, means between said casing and said support which resists relative lateral motion and additional means between said casing and said support which resists longitudinal motion and permits of relative lateral motion.

11. In combination with the casing of an elastic fluid turbine, supports, one of which is longitudinally movable, means between said casing and said supports which resists relative lateral motion and additional means which permits of relative lateral motion.

12. In an elastic fluid turbine, one of the casing pedestals of which is stationary while the other is free to move with relation to the turbine bed, means supporting the opposite ends of the casing on the pedestal in such a manner that while it is free to expand in all directions, it is fixed to the pedestals.

13. In combination with an elastic fluid turbine, a casing, a support for said casing, means between said casing and said support for resisting lateral motion of said casing, and independent means between said casing and said support for resisting longitudinal motion of said casing.

14. In combination in an elastic fluid turbine, a stationary casing for the turbine, a supporting pedestal for said casing, means between said pedestal and said casing for preventing lateral motion of the casing relative to the pedestal, and independent means for preventing relative longitudinal motion between said pedestal and said casing and for accommodating the lateral expansion of the casing.

15. In combination in an elastic fluid turbine, a stationary casing, supporting pedestals therefor, means between each pedestal and said casing for preventing longitudinal motion of the casing relative to the pedestals, and means for permitting unrestricted longitudinal expansion of the casing.

16. In combination with a stationary casing and the rotor element of a turbine, bearings for the rotor element, a supporting pedestal for each bearing, and means between said casing and said pedestal for preventing relative longitudinal motion of the casing and for permitting unrestricted lateral expansion of the casing.

17. In combination with a stationary casing and the rotor element of a turbine, a bearing for said rotor element, a supporting pedestal for said bearing, means between said pedestal and said casing for preventing relative lateral motion of said casing, and independent means between said pedestal and said casing for preventing relative longitudinal motion of said casing and for permitting unrestricted lateral expansion of the casing.

18. In combination with a stationary casing and the rotor element of a turbine, a bearing for the rotor element, a pedestal supporting said bearing, means between said pedestal and said casing for supporting said casing and preventing relative lateral motion between said casing and said pedestal, and means located on each side of the axis of said element and between said casing and said pedestal for preventing relative longitudinal motion and accommodating the lateral expansion of the casing.

19. In combination with a stationary casing and the rotor element of a turbine, bearings for said element located at each end of said casing, a pedestal supporting each bearing and each end of said casing, means between one pedestal and said casing for preventing relative longitudinal lateral motion of the casing and for accommodating the lateral expansion of the casing, means located between the other pedestal and said casing for preventing relative longitudinal motion and accommodating the lateral expansion of the casing, and means whereby said casing is permitted to expand longitudinally.

In testimony whereof, I have hereunto subscribed my name this 14th day of June, 1906.

FRANCIS HODGKINSON.

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