W. E. SEELYE.

STEAM TURBINE.

APPLICATION FILED MAR. 1, 1909.

947,355.

Patented Jan. 25, 1910.

2 SHEETS—SHEET 1

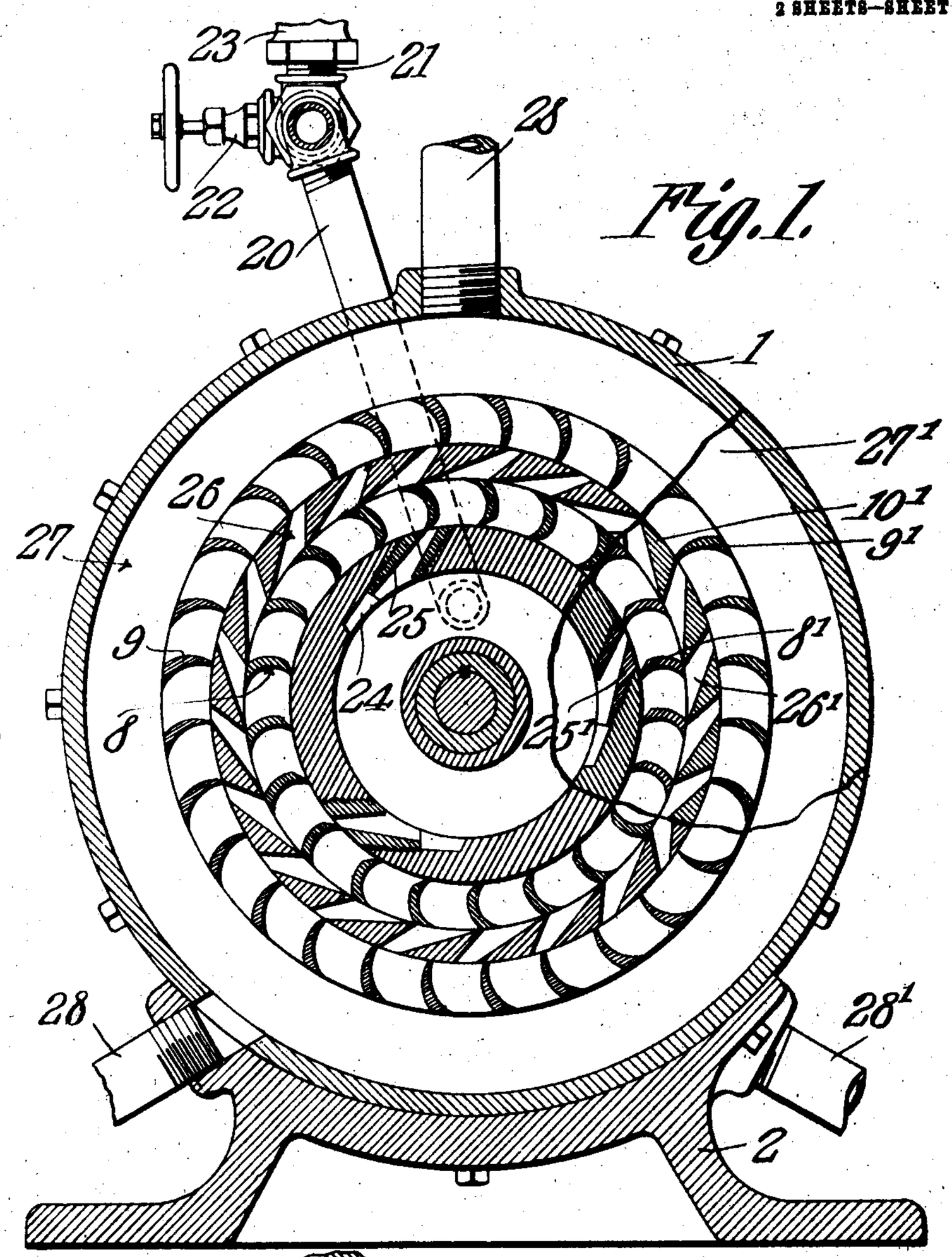

Fig. 1.

Fig. 3.

Witnesses

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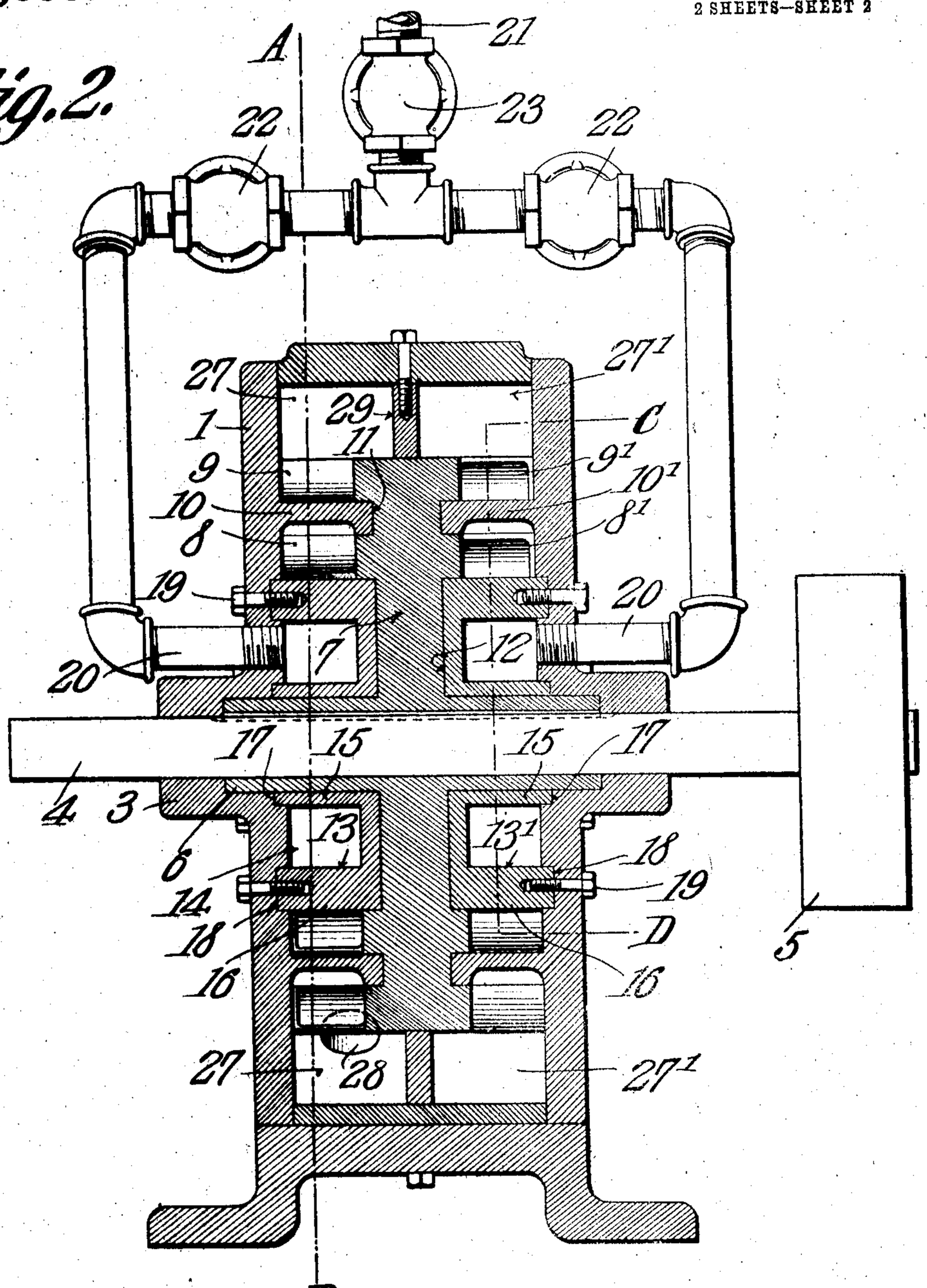
2 SHEETS—SHEET 2

Fig. 2.



Witnesses

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UNITED STATES PATENT OFFICE.

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STEAM-TURBINE.

947,355. Specification of Letters Patent. Patented Jan. 25, 1910.

Application filed March 1, 1909. Serial No. 480,536.

To all whom it may concern:

Be it known that I, WILLIAM E. SEELYE, a citizen of the United States, residing at Coeur d'Alene, in the county of Kootenai and State of Idaho, have invented a new and useful Steam-Turbine, of which the following is a specification.

This invention has reference to improvements in steam turbines and its object is to provide a turbine engine wherein the parts are rendered steam-tight without the use of packing and whereby the engine may be made reversible, or where the reversing of the direction of rotation is not material the engine may be made of the multiple type thus increasing the power output without increasing the size of the engine.

The invention will be best understood from a consideration of the following detail description taken in connection with the accompanying drawings forming a part of this specification, in which drawings—

Figure 1 is a vertical section on the line A—B of Fig. 2 with parts broken away to show a portion of the structure on the line C—D of Fig. 2. Fig. 2 is a central vertical section taken in the direction of the axis of rotation of the rotary member of the engine, some parts being shown in elevation. Fig. 3 is a section of limited area similar to the section of Fig. 1 and taken on two planes similar to the showing of Fig. 1 but illustrating a non-reversible type of engine of a structure which may have double the power output of the structure of Fig. 1.

Referring to the drawings there is shown a cylindrical casing 1 mounted upon a foot or base 2 and constituting the casing of the engine, and also the framework of the stator of the engine. Of course other than cylindrical shape may be adopted for the casing. Also the casing is made of a sufficient number of parts to facilitate manufacture and assembling. The side members of the casing are provided with hubs 3 suitably bored and constructed to act as journal bearings for a shaft 4 constituting the power shaft of the machine and this shaft may be provided with a pulley 5 or other means through which power may be transmitted from the shaft 4 to the machinery to be propelled.

Mounted upon the shaft 4 between the heads of the casing is a sleeve or elongated hub 6 at the center of which there is formed a radially extending web 7 on the faces of which at different distances from the axis of rotation of the web 7 are formed laterally projecting series of buckets 8 and 9 on one face of the web while on the other face are similar series of buckets 8′ and 9′. The hub or sleeve 6 is keyed to the shaft 4 and the said shaft 4 together with the hub 6 and web 7 with its buckets constitute the rotor of the engine.

Projecting from each end member of the casing 1 is a flange 10 or 10′, the flange 10 projecting from one head of the casing and the flange 10′ from the other head of the casing, and these flanges are concentric with the axis of rotation of the rotor and are located intermediate of the two series of buckets carried by the rotor on each side thereof. Each flange 10 and 10′ projects inwardly toward the center of the casing to a sufficient distance to enter a suitable groove 11 formed in the corresponding wall of the web 7 between the series of buckets carried thereby.

Between the inner series of buckets 8 or 8′ and the hub 6, the corresponding face of the web 7 is formed with a circumferential groove 12 in which is seated an annulus 13 on one side of the web and an annulus 13′ on the other side, the two annulæ being generally identical except as hereinafter specified. Each annulus 13 or 13′ is formed with a circumferential groove 14 so that the annulus has an inner and outer wall 15 and 16 respectively concentric with the axis of rotation of the shaft 4. The inner wall 15 of each annulus encircles the corresponding portion of the hub 6 in close relation thereto and the free end of the wall, that is the end away from the groove 12 of the web 7 is set in a groove 17 formed on the inner face of the corresponding end wall of the casing 1. The outer wall 16 of the annulus is made somewhat thicker than the inner wall and is in turn set in a groove 18 formed in the corresponding portion of the inner face of the corresponding head of the casing 1. The wall 16 is made sufficiently thick for the reception of screws 19 by means of which each annulus is securely but removably fastened to the corresponding head of the casing 1.

The groove 14 in each annulus 13 and 13′ is entered by a pipe 20 extending through the wall of the corresponding head of the casing and the pipes 20 are connected outside the casing to a common supply pipe 21.

Each pipe 20 is provided with a valve 22 and the pipe 21 is also provided with a valve 23 outside its point of connection with the two pipes 20. By this means steam may be supplied to the pipes 20 in any suitable quantity up to the full capacity of the pipe 21 by a proper manipulation of the valve 23 and steam may be supplied to either pipe 20 in any quantity up to the full capacity of the pipes by a proper manipulation of either or both valves 22. This also provides a means whereby the steam supply may be cut off from one side of the engine and admitted to the other at the will of the operator.

The outer wall 16 of each annulus 13 or 13′ is provided with substantially tangential ports or passages 24 preferably equi-distantly disposed and of a number depending upon the size and capacity of the engine. Each port 24 is threaded to receive a nozzle 25 having a passage tapering toward the outlet end, which end is coincident with the outer periphery of the wall 16 of the particular annulus 13 or 13′.

The buckets 8 are properly curved to receive the impact of a stream of steam issuing from a nozzle 25 in a direction to cause a rotative movement of the said series of buckets. The edge of the buckets presented to the nozzles is beveled toward the convex side of the buckets so that the line of issuance of the stream of steam is not deflected by the edge of the bucket as it passes over the nozzle. The buckets 9 are similarly shaped and pitched in the same general direction as are the buckets 8. Through each flange 10 there are formed tapering passages 26 with their wide ends presented to the buckets 8 and their narrow ends to the buckets 9. There are as many passages 26 through the flange 10 as there are buckets 8 or 9, the number of buckets in each series being the same. The passages 26 are inclined in the same direction as the nozzles 25. Surrounding the series of buckets 9 is a steam space 27 for the reception of the exhaust steam from the buckets 9 and an exhaust pipe 28 is provided leading from the space or chamber 27.

In the structure shown in Fig. 1 the direction of inclination of the nozzle 25′ in the annulus 13′ is the opposite to that of the nozzle 25 in the annulus 13 and the direction of inclination or presentation of the buckets 8′ and 9′ and also of the inclination of the passages 26′ in the flange 10′ is the opposite to that of the buckets 8 and 9 and passages 26 already described. The buckets 9′ discharge into a space or chamber 27′ within the casing 1 and from this space or chamber an exhaust pipe 28′ leads.

In the structure shown in Fig. 3 the buckets on each side of the web 7 having the same direction of inclination and the remoter series of buckets are designated in this figure by 8″ and 9″ and other remoter parts in this figure agreeing the remoter parts in Fig. 1 are designated by the same numerals with the corresponding double indices.

The two chambers 27 and 27′ are separated by an annular diaphragm 29 extending from the outer peripheral wall of the casing 1 to the outer periphery of the web 7. The fit between the adjacent faces of the web 29 and the web 7 will be sufficient to prevent leak of steam to any material extent.

Considering the structure of Fig. 1 let it be supposed that steam is admitted through the supply pipe 21 to the pipe leading to the chamber 14 in the annulus 13 through the valve 22 in the corresponding pipe 20, the valve 22 in the other pipe 20 being closed. The steam will pass from the chamber 14 of the annulus 13 through the nozzles 25 and into contact with the buckets 8 causing a rotative movement of the web 7. After acting on the buckets 8 the steam passes into the tapering passages 26 and then issues against the buckets 9 and the effort of the steam on these buckets augments that of the steam on the buckets 8. After acting on the buckets 9 the steam passes into the chamber 27 and out through the exhaust pipe 28. Because of the structure of the annulus 13 and also of the flange 10 there is no leak of steam from the chamber 14 of the annulus 13 and all the steam passes outward through the nozzles 25. Because of the inset of the flange 10 in the web 7 where the flange enters the groove 11 there is no escape of steam from the buckets 8 to the buckets 9 except through the passages 26. These bearings may be made steam-tight without undue friction and entirely avoid the necessity of special packing.

The action of the steam upon the buckets 8 and 9 as described will cause a rotative movement of the shaft 4 in a clockwise direction as viewed in Fig. 1. If it be desired to reverse the direction of rotation of the shaft 4 then steam is cut off from the chamber 14 in the annulus 13 and is admitted to the chamber 14 of the annulus 13′. Because of the opposite inclination of the buckets 8′ and 9′ and of the nozzles 25′ and passages 26′ the impulse given by the steam to the rotor is in the opposite direction to that of the first described side of the engine and consequently the shaft 4 is caused to rotate in the opposite direction from that first described. The engine is thus reversible.

Under some circumstances the reversibility of the engine is unnecessary and then the buckets on the two sides of the engine may be arranged to cause rotative movement of the shaft 4 in the same direction and under these circumstances steam is admitted to both sides of the engine at the same time,

thus doubling the power of the engine without increasing the size over and above the reversible engine.

What is claimed is:—

1. In a steam turbine, a rotor comprising a radial web with series of buckets spaced apart radially and concentric with the axis of rotation and having an annular groove between two adjacent series of buckets, and a stator comprising a casing inclosing the rotor and provided with a flange concentric with the axis of rotation and having steam passages, said flange being located between two series of buckets and having the end remote from the casing seated in the said groove in the rotor, an annulus on each side of the casing separate from but secured to the casing interior to the inner series of buckets, and a central web extending radially inward from the inner peripheral wall of the casing to the outer periphery of the web of the rotor.

2. In a steam turbine, a rotor comprising a radial web with series of buckets on each side spaced radially, the said web having a circumferential groove between adjacent series of buckets and between the inner series of buckets and the axis of rotation, a casing having flanges concentric with the axis of rotation, each flange having passages therethrough and at its free end seated in a groove between two series of buckets, and an annulus on each side of the rotor separate from but fixed to the casing, said annulus entering the inner groove of the corresponding side of the rotor and provided with a distributing chamber and steam nozzles directed toward the buckets.

3. In a steam turbine, a rotor comprising a radial web with series of buckets on each side spaced radially, said web having a circumferential groove on each side between adjacent series of buckets and between the inner series of buckets and the axis of rotation, a casing having flanges concentric with the axis of rotation, each flange having passages therethrough and at its free end seated in a groove between two series of buckets, an annulus separate from but fast to the casing on each side of the rotor and seated in the inner groove in the corresponding side of the rotor and provided with an annular recess constituting a distributing chamber and with steam nozzles directed toward the buckets, and a separate controllable steam conduit for the distributing chamber in each annulus.

4. In a steam turbine, a rotor comprising a radial web with annular series of buckets on each lateral face, the said series of buckets being spaced radially, and said web having a circumferential groove between each pair of adjacent series of buckets and between the inner series of buckets and the axis of rotation, a casing in which the rotor is intermediately located, said casing having inwardly projecting flanges concentric with the axis of rotation, each flange having passages therethrough and at its free end seated in a groove between two series of buckets, an annulus separate from but fast to the casing on each side of the rotor and seated in the inner groove in the corresponding side of the rotor, the casing also being provided with annular grooves for receiving the other side of the annulus remote from the rotor, and the said annulus being provided with a distributing steam chamber and steam nozzles directed toward the buckets, and a separate controllable steam conduit for the distributing chamber in each annulus.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

WILLIAM E. SEELYE.

Witnesses:

F. W. Reed,

Irene Ingram.