G. W. BAKER.

STEAM TURBINE.

APPLICATION FILED JULY 10, 1912.

1,052,786.

Patented Feb. 11, 1913.

2 SHEETS—SHEET 1.

Fig. 1.

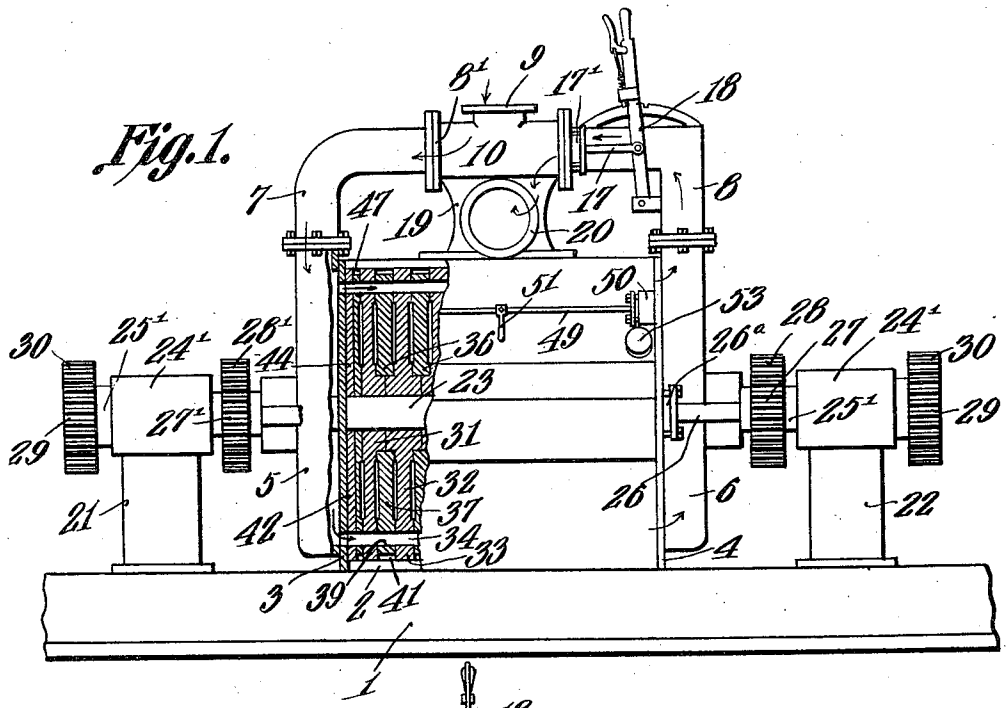
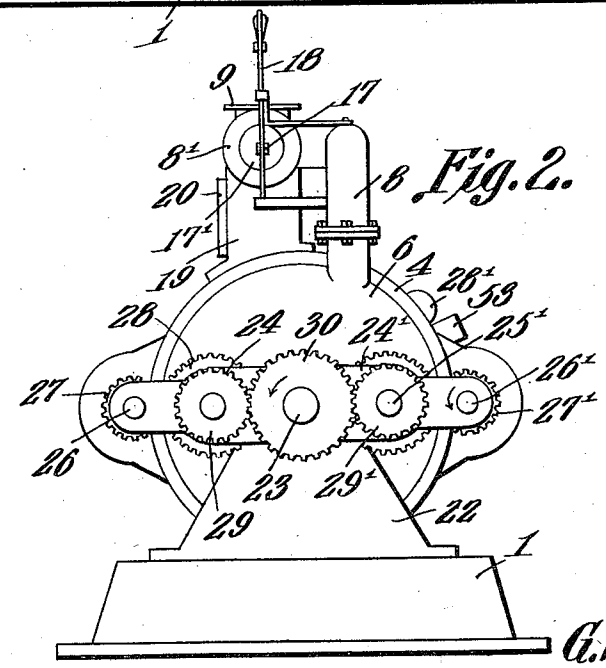


Fig. 2.



Witnesses

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2 SHEETS—SHEET 2.

Fig. 4.

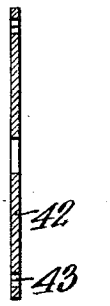

Fig. 3.

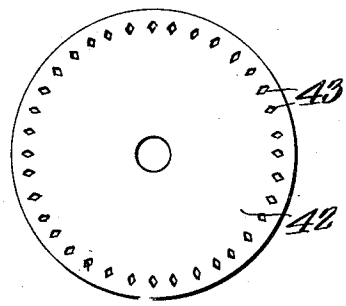

Fig. 5.

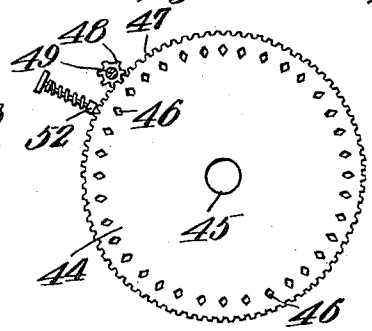

Fig. 6.

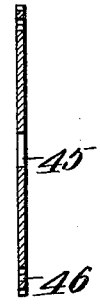

Fig. 9.

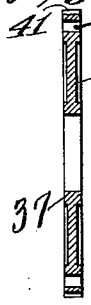

Fig. 8.

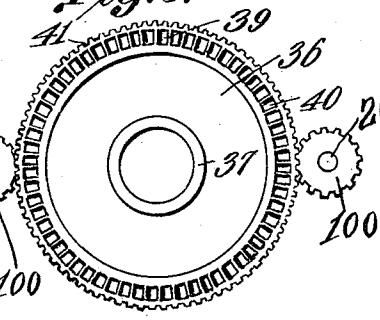

Fig. 10.

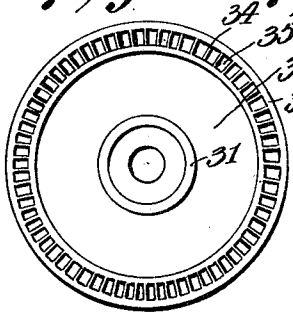

Fig. 11.

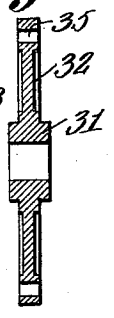

Fig. 13.

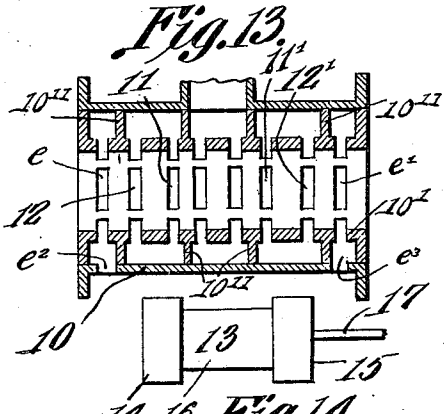

Fig. 7.

Fig. 12.

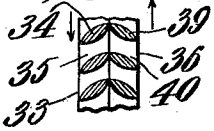

Fig. 14.

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UNITED STATES PATENT OFFICE.

GEORGE W. BAKER, OF BROWN STATION, NEW YORK.

STEAM-TURBINE.

1,052,786. Specification of Letters Patent. Patented Feb. 11, 1913.

Application filed July 10, 1912. Serial No. 708,647.

To all whom it may concern:

Be it known that I, GEORGE W. BAKER, a citizen of the United States, residing at Brown Station, in the county of Ulster and State of New York, have invented a new and useful Steam-Turbine, of which the following is a specification.

The present invention relates to improvements in steam turbines, the primary object of the invention being the provision of a turbine in which both vane carrying members are mounted to be rotated by the pressure fluid, one set of the same being carried by the main shaft, while the other set is operably connected to counter shafts geared to and disposed to transmit power to the main shaft exterior of the stator.

A further object of the present invention is the provision of a reversible steam turbine, the rotor of which is composed of two alternately disposed rotating elements, one set of said elements being connected directly to the main shaft while the other set are operably connected and although rotated in the opposite direction to the main shaft carrying set, assists the main shaft, thereby securing the maximum power from the velocity and expansive force of the pressure fluid in its passage through the stator.

A still further object of the present invention is the provision of a novel means for throttling the engine, to regulate the volume of pressure fluid directed to the various moving elements of the rotor.

With the foregoing and other objects in view which will appear as the description proceeds the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed can be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawings—Figure 1 is a side elevation of the complete turbine, a portion of one head and the stator being broken away with the adjacent portion of the rotor and throttling means shown in section. Fig. 2 is an end view taken from the left as viewed in Fig. 1 of the complete turbine. Figs. 3 and 4 are detail views of the stationary throttling disk. Figs. 5 and 6 are detail views of the movable throttling disk. Fig. 7 is a detailed diagrammatic view of the adjacent port carrying portions of the stationary and movable throttling disks. Figs. 8 and 9 are detail views of one of the freely rotatable main carrying disks. Figs. 10 and 11 are detail views of the main shaft carried elements. Fig. 12 is a detailed diagrammatic view showing the relative position of the vanes of the rotatable and main shaft carried disks. Fig. 13 is a longitudinal sectional view of the reversing valve casing. Fig. 14 is a plan view of the reversing valve.

Referring to the drawings, the numeral 1 designates the base of the turbine, whose stator casing 2 is properly disposed thereupon and is provided with the oppositely disposed heads 3 and 4 respectively, the head 3 being provided with the steam inlet chamber 5, while the head 4 is provided with the steam inlet chamber 6, thus providing means whereby the steam may be permitted to enter either end of the stator to produce a reversible steam turbine. The conduits 7 and 8 are connected respectively to the chambers 5 and 6, the pressure fluid being led to either one of such conduits 7 and 8 through the valve casing carrying coupling 8′ provided with the inlet connection 9.

In order to produce a reversal of rotation in this turbine, the valve and casing as shown in Figs. 13 and 14, is employed. The casing 10, has disposed therein, the concentric sleeve 10′, which as shown is held properly supported by the partitions or spiders 10″. In this sleeve 10′, are provided the two respective sets of inlet ports 11 and 11′, and the two respective sets of exhaust ports 12 and 12′. The sets of ports *e*—*e*′, and *f*—*f*′, are always opened, while the valve 13 is slidably mounted in the sleeve 10′, to alternately close ports 11′ and 12, or ports 11 and 12′. By this means steam is admitted to the sleeve 10′, through the open ports *f*, and if the ports 11′ and 12 are closed by the respective ends 15 and 14 of the valve 13, the reduced portion 16 being alined with the ports *f*, steam will pass through the ports 11, exteriorly of the sleeve 10′, to the left as viewed in Fig. 13 and through the

normally open ports e, into the sleeve 11 to the left of the head 14 of the valve 13 and thence into the conduit 7, in the direction of the arrows in Fig. 1. The steam after acting upon the rotor exhausts through the conduit 8, and into the opposite end of the sleeve 11, and as the ports e' are open the same permit the steam to pass therethrough and through the open port e^3, into the exhaust chamber 19 and conduit 20. When the valve 13 is moved to reverse the flow of steam, the port e^2, leads the steam into the casing 19 and conduit 20. In order to operate the valve 13, the stem 17 projects through the stuffing box 17′, and is connected to the hand lever 18.

Disposed centrally of the stator casing and to provide for the exhausting of the pressure fluid irrespective of the rotation of the movable elements of the turbine, is the exhaust chamber 19 having the exhaust 20. The chamber 19 is in communication with the coupling member 8′ and when the pressure fluid is being admitted through the ports 11 and the conduit 7 into the chamber 5 at the left of the turbine, as viewed in Fig. 1, the chamber 6 will be the exhaust chamber so that the pressure fluid will be led through the conduit 8 into one end of the valve casing 10 and finally through the ports 12 into the exhaust chamber 20. Thus the conduit 8 when the conduit 7 is the inlet conduit, is the exhaust conduit for the turbine, and vice versa.

Carried by the base 1 at opposite ends of the stator are the two standards 21 and 22, each of which are provided with central journals for carrying the main shaft 23 which is disposed concentrically through the stator. Each of the respective standards 21 and 22 are provided with the oppositely disposed bearing arms 24—24′, for the reception of the short stub shafts 25—25′, while journaled upon opposite sides of the stator, the full length thereof having their respective ends projected through the stuffing boxes 26^a, are the auxiliary shafts 26 and 26′ respectively. Keyed upon the shafts 26 and 26′ and in mesh with the geared edges of the respective rotor disks 36 are the small intermeshing gears 100, by means of which power is transmitted from the gear portion 40 of the disk 36 to the respective shafts 26—26′. These shafts 26 and 26′ have each keyed upon their respective ends the pinions 27—27′ which are in mesh at all times with the inner large pinions 28—28′ of the stub shafts 25—25′. Upon the outer end of the respective stub shafts 25—25′ are keyed the smaller pinions 29—29′, which are in mesh at diametrically opposite points with the large gears 30 which are keyed one upon each outer end of the main shaft 23. By this means the auxiliary shafts 26—26′ are rotated simultaneously and coact and assist in imparting the desired rotation to the main shaft 23. By this construction the two sets of rotating disks 32 and 36 are so geared together as to impart simultaneous movement to the shaft 23, the detail construction and arrangement of which will be set forth later on.

Keyed upon the shaft 23 within the stator casing, are the hubs 31 of the alternately disposed main carrying disks or wheels 32, the rim 33 of which is larger in cross section than the intermediate portion and is provided with a plurality of elliptical vanes 34, which are formed as shown in Fig. 12 and provide the respective steam passages 35 therebetween to impart to the pressure fluid the necessary projection to obtain therefrom the maximum impact force during its passage through the respective ports 35 throughout the length of the stator. Two oppositely rotatable main carrying disks or wheels 36 are provided with the central bearings 37 which fit upon the hubs 31 of the main shaft wheels 32, and in the peripheral rims 38 thereof, are provided the oppositely inclined vanes 39 which are disposed in circumferential alinement with the vanes 34 of wheels 32 to provide the steam passages 40 as clearly illustrated in Fig. 12. By this construction it will be seen that the steam entering through the passages 35 will abut the respective vanes 39 of the wheels 36 moving the wheels 36 in the direction of the arrow Fig. 12, the ports 40 imparting a reverse movement to the streams of steam so that the wheels 32 will be rotated in the direction of the arrow Fig. 12, or in a reverse direction to the wheels 36. By this means the shaft 23 will for instance be rotated in the direction of the arrow Fig. 2, and the shafts 26 and 26′ will be rotated in the same direction to the main shaft 23. By means of the respective gears heretofore described, it will be seen that the shafts 26—26′, will coact to transmit the desired direction or motion to the shaft 23, thus permitting the elements or wheels 32 and 36 to coöperate and impart the maximum power to the main shaft 23.

It is evident that should the steam or pressure fluid be directed in the opposite direction so as to initially pass through the ports 40, the wheels 32 will be rotated in the opposite direction to the arrow in Fig. 12 while the wheel 36 will also be rotated in the opposite direction to such arrow, thus imparting a reverse movement to the main shaft 23.

In order to provide a throttle for the rotating elements of the turbine, the disks 42 and 44 are provided, the disk 42 being a stationary disk and forming a closure for the respective chambers 5 and 6, with the cir-

cumferentially disposed diamond-shaped ports 43, said ports 43 being disposed to aline with the ports 35 and 40, of the rotating elements so that the pressure fluid admitted into either one of the respective chambers 5 or 6, will be properly directed to the vaned portion of the respective rotating elements. The disk 44 is rotatably mounted within the stator, one adjacent to each disk 42, the concentric aperture being positioned upon the adjacent portion of the main shaft 23, while the circumferentially disposed diamond-shaped ports 26 are disposed to be placed into and out of registration with the ports 43 of the stationary disk 42, such registration being varied, as desired, to regulate the volume of steam or pressure fluid admitted through the respective ports 43 and 46, as clearly illustrated in Fig. 7. These ports 43 and 46 are disposed in reverse angle to each other, so as to impart the proper direction and projection of the pressure fluid to the respective vanes of the wheels 32 and 36, thus increasing the velocity and impact force of the steam or pressure fluid upon its introduction into the stator.

In order to actuate the respective rotatable disks 45 of the throttling means, the peripheral edge of the disks 44 are provided with gear teeth 47, and meshing at all times with such gear teeth are the small pinions 48 being one keyed upon each end of the control shaft 49, said control shaft 49 being journaled at each end in the stuffing box 50 carried by the stator, and as clearly shown in Fig. 1, is provided with the handle or lever 51, whereby the said shaft may be oscillated to simultaneously rotate both disks 44 and place the respective ports 46 into the desired registration with the ports 43 of the stationary disk 42. In order to lock the respective throttling disks 44 in the desired adjustment, the spring actuated plungers 52 are employed, one to each disk 44 with the head 53 thereof projected exteriorly of the stator casing and in a readily accessible position.

From the foregoing description, taken in connection with the drawings it is evident that with a steam turbine constructed according to and embodying the present invention, that the rotation of the various elements 32 and 36 may be controlled both at high and low speeds and in forward and reverse directions, and that as the wheels 36 are movable elements, that the maximum power is obtained from the pressure fluid during the passage thereof through the engine, both sets of wheels 32 and 36 so rotating in opposite directions, but finally cooperating to operate the single main shaft of the turbine.

It is also evident that by the construction of valve as shown, in Figs. 13 and 14, that the turbine may be readily reversed and that the construction and arrangement of the various vanes 34 and 39 will permit such action and secure the maximum power from the pressure fluid regardless of the direction of projection thereof.

By means of the throttling device, as clearly shown in Figs. 3, 4, 5 and 6, it is evident that the volume of pressure fluid admitted to the respective ends of the turbine is readily regulated and controlled regardless of the volume of pressure fluid admitted into either one of the branch conduits 7 or 8, thus providing a turbine capable of a high or low speed and one which will operate in the proper proportion to the volume of pressure fluid employed and the speed at which the main shaft 23 is driven.

What is claimed is:

1. A steam turbine, having a stator, a rotor composed of two sets of alternately disposed and rotative elements, one set rotating in an opposite direction to the other, a main shaft operably connected to be actuated by both sets of elements, oppositely disposed pressure fluid conducting conduits, one of which is an exhaust conduit when the other is an inlet conduit, a valve for controlling the admission and exhaust of pressure fluid, and a pressure fluid directing and throttling means disposed in the respective ends of the stator and in co-active relation to the rotative elements.

2. A steam turbine, having a stator, a rotor composed of two sets of alternately disposed and rotative elements, one set rotating in an opposite direction to the other, a main shaft operably connected to be actuated by both sets of elements, oppositely disposed pressure fluid conducting conduits, one of which is an exhaust conduit when the other is an inlet conduit, a valve for controlling the admission and exhaust of pressure fluid, a pressure fluid directing and throttling means disposed in the respective ends of the stator and in co-active relation to the rotative elements, and means for locking said fluid directing and throttling means in adjusted position.

3. A steam turbine, having a stator, a rotor composed of two sets of alternately disposed and rotating elements, one set rotating in an opposite direction to the other, a main shaft operably connected to be actuated by both sets of elements, oppositely disposed pressure fluid conducting conduits, one of which is an exhaust conduit when the other is the inlet conduit, a valve for controlling the admission and exhaust of the pressure fluid, and a manually operated pressure fluid directing and throttling means disposed in the respective ends of the stator and in co-active relation to the rotating elements.

4. A steam turbine, having a stator, a rotor composed of two sets of alternately disposed and rotative elements, one set rotating in an opposite direction to the other, a main shaft operably connected to be actuated by both sets of elements, oppositely disposed pressure fluid conducting conduits, one of which is an exhaust conduit when the other is the inlet conduit, a valve for controlling the admission and exhaust of the pressure fluid, a manually operated pressure fluid directing and throttling means disposed in the respective ends of the stator and in co-active relation to the rotative elements, and means for locking the last means in adjusted position.

5. A steam turbine, having a stator, oppositely disposed pressure fluid conducting conduits in communication with the respective ends of the stator, one of which is an exhaust conduit when the other is the inlet conduit, a valve for controlling the admission and exhaust of the pressure fluid relatively to said conduits, a main shaft mounted concentrically of the stator, two sets of alternately disposed and rotative elements, one set being keyed upon the main shaft within the stator, while the other set is disposed for rotation in the opposite direction, a shaft operably connected to the last set of rotative elements, and means for operably connecting the last shaft to the main shaft to coöperate therewith in imparting the said direction of rotation to the main shaft.

6. A steam turbine, having a stator, oppositely disposed pressure fluid conducting conduits in communication with the respective ends of the stator, one of which is an exhaust conduit when the other is the inlet conduit, a valve for controlling the admission and exhaust of the pressure fluid relatively to said conduits, a main shaft mounted concentrically of the stator, two sets of alternately disposed and rotative elements, one set being keyed upon the main shaft within the stator, while the other set is disposed for rotation in the opposite direction, a shaft rotatably connected to the last set of rotative elements, means for operably connecting the last shaft to the main shaft to coöperate therewith in imparting the same direction of rotation to the main shaft, and a pressure fluid directing and throttling means disposed in the respective ends of the stator and in co-active relation to the rotative elements.

7. A steam turbine, having a stator, oppositely disposed pressure fluid conducting conduits leading into the respective ends of the stator, one of which is an exhaust conduit when the other is the inlet conduit, a manually controlled valve for directing the pressure fluid into either conduit and permitting the exhaust from the opposite one, a main shaft journaled concentrically of the stator, a plurality of spaced vane carrying disks keyed upon said shaft within the stator, another plurality of vane carrying disks alternating with the disks of the first set, the last set of disks being disposed to rotate in an opposite direction to the disks carried by the main shaft, two diametrically disposed shafts journaled in the stator and parallel to the main shaft, co-active means carried by the last set of vane carrying disks and the two diametrically disposed shafts, whereby the last two shafts are rotated in the same direction as the main shaft, and means for operably connecting the diametrically disposed shaft to the main shaft.

8. A steam turbine, having a stator, oppositely disposed pressure fluid conducting conduits leading into the respective ends of the stator, one of which is the exhaust conduit when the other is the inlet conduit, a manually controlled valve for directing the pressure fluid into either conduit and permitting the exhaust from the opposite one, a main shaft journaled concentrically of the stator, a plurality of spaced vane carrying disks keyed upon said shaft within the stator, another plurality of vane carrying disks alternating with the disks of the first set, the last set of disks being disposed to rotate in an opposite direction to the disks carried by the main shaft, two diametrically disposed shafts journaled in the stator and parallel to the main shaft, co-active means carried by the last set of vane carrying disks and the two diametrically disposed shafts, whereby the last two shafts are rotated in the same direction as the main shaft, means operably connecting the diametrically disposed shafts to the main shaft, and a pressure fluid directing and throttling means disposed in the respective ends of the stator and in co-active relation to the vane carrying disks.

9. A steam turbine, having a stator, oppositely disposed pressure fluid conducting conduits leading into the respective ends of the stator, one of which is the exhaust conduit when the other is the inlet conduit, a manually controlled valve for directing the pressure fluid into either conduit and permitting the exhaust from the opposite one, a main shaft journaled concentrically of the stator, a plurality of spaced vane carrying disks keyed upon said shaft within the stator, another plurality of vane carrying disks alternating with the disks of the first set, the last set of disks being disposed to rotate in an opposite direction to the disks carried by the main shaft, two diametrically disposed shafts journaled in the stator and parallel to the main shaft, co-active means carried by the last set of vane carrying disks and the two diametrically disposed

shafts, whereby the last two shafts are rotated in the same direction as the main shaft, means operably connecting the diametrically disposed shafts to the main shaft, stationary and rotative throttling disks disposed in pairs and mounted in the respective ends of the stator and in co-active relation with the vane carrying disks, and manually operated means for controlling the rotative throttling disks to regulate the volume of pressure fluid admitted and exhausted from the stator.

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

GEORGE W. BAKER.

Witnesses:
RAPHAEL SIMS,
WILLIAM ROSS.