

F. C. BEYERLE.
 REVERSIBLE STEAM TURBINE.
 APPLICATION FILED MAR. 29, 1910.

961,205.

Patented June 14, 1910.

2 SHEETS—SHEET 1.

FIG. 2.

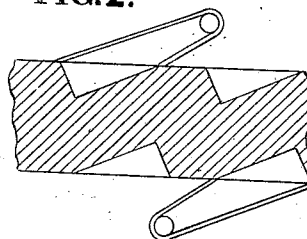
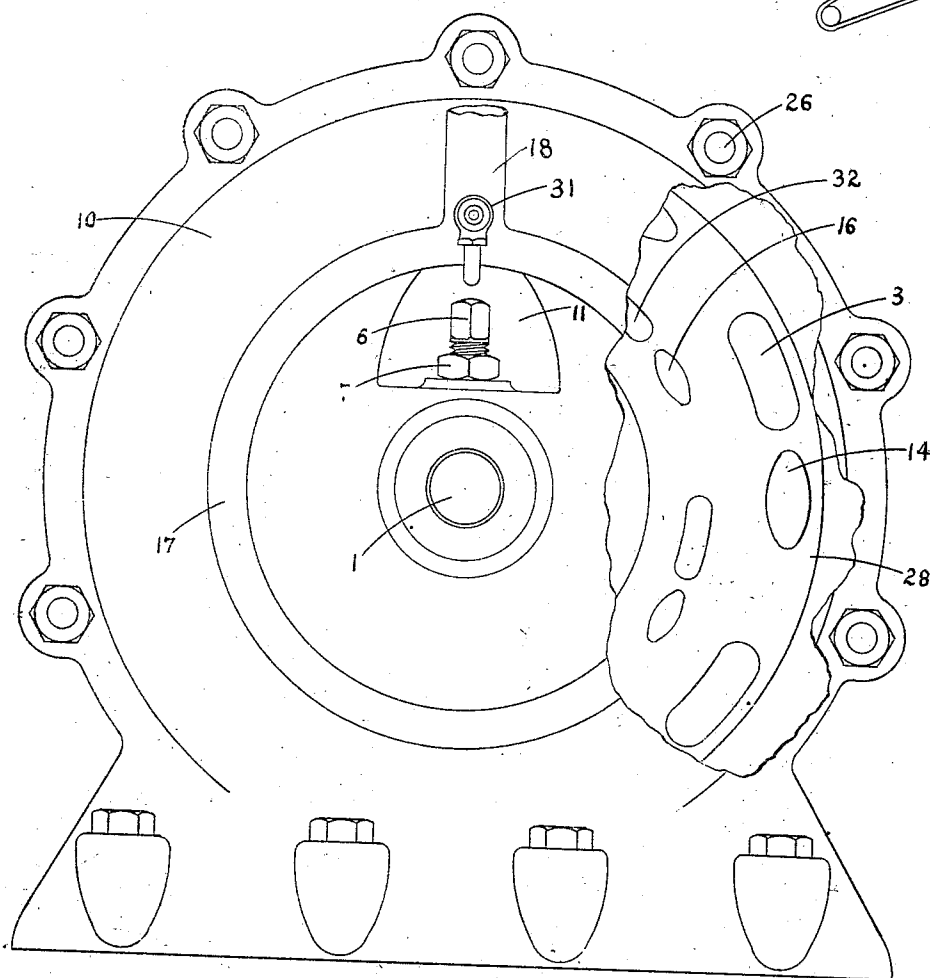


FIG. 1.



WITNESSES:

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2 SHEETS—SHEET 2.

FIG.3.

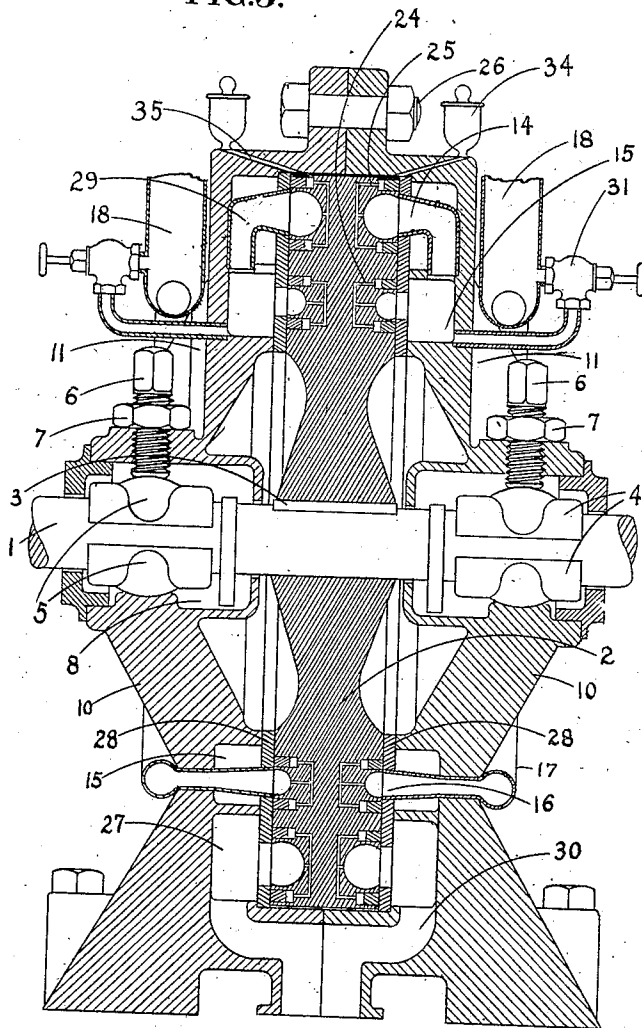
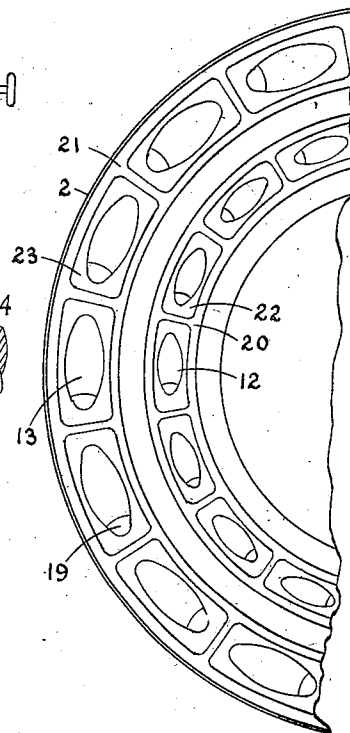


FIG.4.



WITNESSES:

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UNITED STATES PATENT OFFICE.

FRANK C. BEYERLE, OF SAN DIEGO, CALIFORNIA, ASSIGNOR OF ONE-HALF TO R. M. MOBIUS, OF SAN DIEGO, CALIFORNIA.

REVERSIBLE STEAM-TURBINE.

961,205.

Specification of Letters Patent. Patented June 14, 1910.

Application filed March 29, 1910. Serial No. 552,157.

To all whom it may concern:

Be it known that I, FRANK C. BEYERLE, citizen of the United States, residing at San Diego, in the county of San Diego and State of California, have invented certain new and useful Improvements in Reversible Expansion Steam-Turbine Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a reversible expansion steam turbine engine and has for its object the provision of improved means for the generation of power from the expansive force of steam, and also to provide a compactly arranged mechanism, in which a continuous rotary motion is secured in the moving parts without loss of power or leakage of steam. The provision is also made for the application of the expanded steam to the rotative element a second time, thereby increasing the efficiency of the apparatus. These objects are attained by the use of mechanism illustrated in the accompanying drawings in which the application of steam to the moving parts, through suitably shaped ports, imparts a continuous motion to the rotative element in either direction.

The invention consists in certain novel features of mechanism, as will be hereinafter first fully described and then pointed out in the claims.

In the accompanying drawings illustrating the preferred embodiment of my invention; Figure 1 is a side view of the machine with a portion of the outer casing and rotative element cut away to show the arrangement of ports on the inner casing. Fig. 2 is a section of the rotative element showing the angle of direction of the steam inlet ports, and of the pockets on the same. Fig. 3 is a vertical sectional view taken on the plane of the axis. Fig. 4 is a side view of the rotative element in which the arrangement of the steam pockets is diagrammatically illustrated.

Referring more particularly to the drawings, the power shaft of the machine is designated by numeral 1, and has attached thereto, rotative element 2, by key 3. The shaft is journaled in bearings 4, of hard anti-friction metal, the said bearings having spherical surfaces 5, of contact with the

frame or casing of the engine. The lower sections of the bearings rest on correspondingly shaped sections of the casing, and the upper sections engage with large, heavy set-screws 6 provided with checknuts 7 for adjustment. The object of the spherical bearings 5 is to secure a perfect alinement of the bearings and shaft. Means for lubricating these bearings consist of oil-pockets 8 adapted to hold a quantity of lubricating oil, conveying the same to the bearings. It will be noted that casing 10 has recesses 11, which permit placing the bearings, set-screws and check-nuts closer to the rotative element, thus diminishing the vibration of the latter, and thereby decreasing the wear on the bearings.

Rotative element 2 is provided with a series of steam pockets 12 adapted to receive live steam from the main supply, and a second series of steam pockets 13 larger in capacity, adapted to receive steam from the exhaust chamber of the smaller pockets. This arrangement permits the use of the expansive force of the steam a second time, the large pockets, being supplied by ports 14, that communicate with the annular exhaust chamber 15 that takes the exhaust of pockets 12. Inlet ports 16 supply steam to pockets 12, from annular supply pipes 17, that have direct communication with main pipes 18, leading to the boiler.

It will be noted on reference to Fig. 2, that the steam is directed against the pockets at an angle of about twenty-two degrees. The arrangements of the pockets and ports on opposite sides of the rotative element is also shown. The admission of steam to one side of the machine drives the rotative element in one direction and the admission of steam to the other side drives the rotative element in the opposite direction, making the machine reversible. Pockets 12 and 13 are so cut as to give the greatest area of impact surface to the steam; in conjunction with small space, the bottoms 19 of each pocket being of a full circular shape. The rotative element is grooved on each side. The grooves are annular concentric grooves, connected in pairs by short radial grooves. These grooves carry packing ring 20 that incloses pockets 12 and packing ring 21 inclosing pockets 13. Packing rings 20 and 21 have openings 22 and 23 respectively, dividing the same into sections, each of which

surrounds a pocket. The sides of the rotative element are divided by the grooves into sections corresponding to those of the packing rings, the raised portion entering the openings of the rings, causing them to move simultaneously with the rotative element. Passages 24 and 25 lead from each pocket to the annular grooves in which the packing rings set, causing the rings to bear against the casing whenever steam is admitted to the pockets. Thus it will be seen that the steam cannot escape from the inlet ports until they are reached by the pockets, and steam cannot escape from the pockets until an exhaust port is reached, hence greater economy of steam is obtained than can be had from the ordinary form of turbine engine, in which a space of one-thirty-second of an inch or more exists between the casings and the movable parts.

Casing 10 is made in sections, bolted together with bolts 26, and having a gasket, between the adjacent faces of the sections. The annular exhaust chambers 15 and 27 are formed integral with the casing and are covered by inner casings 28 in which are located the exhaust and inlet ports. Referring to Fig. 1 it will be seen that the inlet ports 16, alternate with inlet ports 14 giving a greater number of impulses to the rotative element during a continuous revolution. The number of pockets upon the rotative element is not divisible by the number of inlet ports; in this case each series of pockets are sixteen in number, and the corresponding inlet ports being six, therefore, before one port can deliver an impulse to the next succeeding pocket two other ports must register with pockets and deliver successive impulses to the rotative member. The inlet ports act in pairs upon diametrically opposite steam pockets, giving a balanced effect to the rotative element.

The high pressure exhaust chamber 15 supplies the low pressure ports with steam through connecting passages 29, and the low pressure exhaust chambers exhaust through openings 30. To facilitate starting the engine, a valve 31 is provided that admits live steam directly into the exhaust chamber 15 and thence to the low pressure pockets, therefore live steam can be used in all of the ports if desired. Exhaust ports 32, and 33, are provided so that the pressure of steam in each pocket may be relieved before reaching the next successive inlet port. Oil cups 34, having passages 35, communicating with the surface of the inner casings, convey lubrication to the rings that bear against the inner casing.

From the foregoing description it will be seen that simple and efficient means are herein provided for accomplishing the objects of the invention, but while the elements shown are well adapted to serve the purposes for-

which they are intended, it is to be understood that the invention is not limited to the precise construction as herein set forth, but includes within its purview such changes as may be desirable or necessary to attain the objects, or fulfil the requirements of this invention, as will now be specified in the claims.

Having described my invention, what I now claim is:

1. In a device of the character described, the combination of a casing, of a power shaft journaled therein, of a rotative element mounted on the power shaft, of steam pockets formed within said rotative element, of annular and radial grooves around said pockets, of packing rings carried in said grooves, the said packing rings comprising annular concentric rings connected in pairs by short radial sections, and inner casings provided with inlet and exhaust ports, substantially as specified.

2. In a device of the character described, the combination of a casing, of a power shaft journaled therein, of a rotative element mounted on the power shaft, of steam pockets formed within and upon opposite sides of the said rotative element, the impact surfaces of the pockets on one side facing in a direction opposite to those on the other side, of packing rings around said pockets, and inner casings provided with inlet and exhaust ports, substantially as specified.

3. In a device of the character described, the combination of a casing, of a power shaft journaled therein, of a rotative element mounted on the power shaft, of steam pockets formed within and upon opposite sides of said rotative element, of grooves around said pockets carrying packing rings, of passages leading from each pocket to the grooves in which the packing rings set, whereby the admission of steam to said pockets, passages, and grooves, will cause the packing rings to bear against the casing, and of a series of inlet and exhaust ports adapted to register with the steam pockets, substantially as specified.

4. In a device of the character described, the combination of a casing, the said casing comprising two sections bolted together, of a power shaft journaled therein, of a rotative element mounted on the power shaft, of two series of steam pockets formed within and upon each side of the rotative element, one series of pockets having smaller capacity than those of the other series, and of a series of inlet and exhaust ports registering with each series of pockets, the exhaust ports of the series of smaller pockets communicating by means of an annular exhaust chamber with the inlet ports of the series of larger pockets, substantially as specified.

5. In a device of the character described, the combination of a casing, of inner cas-

ings, having inlet and exhaust ports arranged in two concentric series, the inlet ports of one series alternating with those of the other series, of connecting passages between the series of smaller ports and the main supply of steam of connecting passages between the series of low power ports and the exhaust chamber of the inner series of ports, and a rotative element mounted within said casing, having steam pockets formed within and upon both sides in series, registering with the corresponding series of ports, substantially as specified.

6. In a device of the character described, the combination of a casing of annular chambers within said casing of a power shaft journaled in bearings within the casing, of a rotative element, mounted on the

power shaft, of steam pockets formed within said rotative element, of packing rings around said pockets, of inner casings, having high power and low power inlet and exhaust ports, of communicating passages between the high power inlet ports and an annular supply pipe, of communicating passages between the low power inlet ports and the exhaust chamber of the high power pockets, and a valve admitting live steam to the said exhaust chamber, substantially as specified.

In testimony whereof, I affix my signature, in presence of two witnesses.

FRANK C BEYERLE.

Witnesses:

F. M. KEENEY,
F. K. De BORDE.