No. 784,989. PATENTED MAR. 14, 1905.

C. W. DAKE & W. DONKER.

STEAM TURBINE.

APPLICATION FILED OCT. 4, 1904.

3 SHEETS—SHEET 1.

Fig. 1.

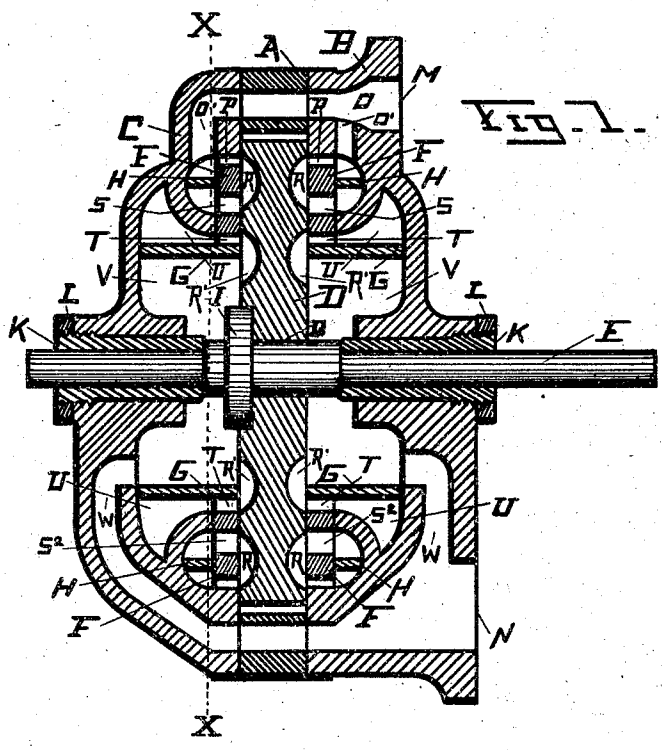


Fig. 2.

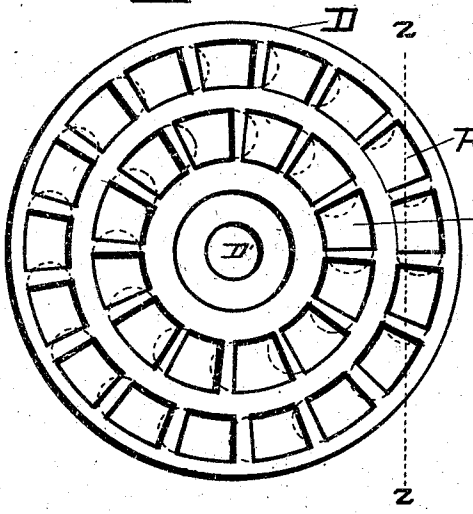


Fig. 3.



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3 SHEETS—SHEET 2.

Fig. 4.

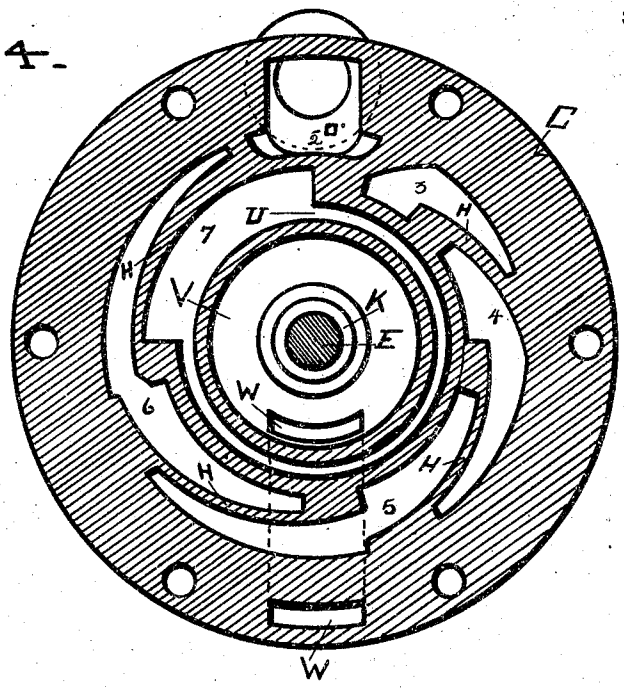
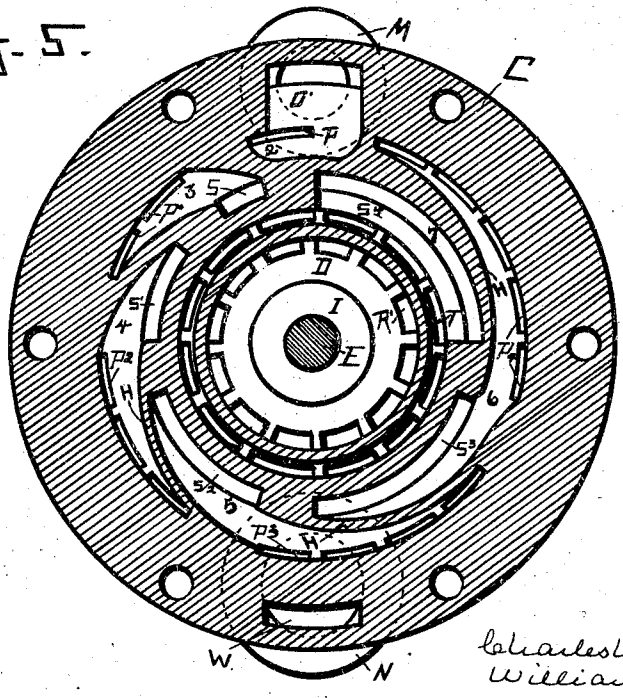


Fig. 5.



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3 SHEETS—SHEET 3.

Fig. 6.

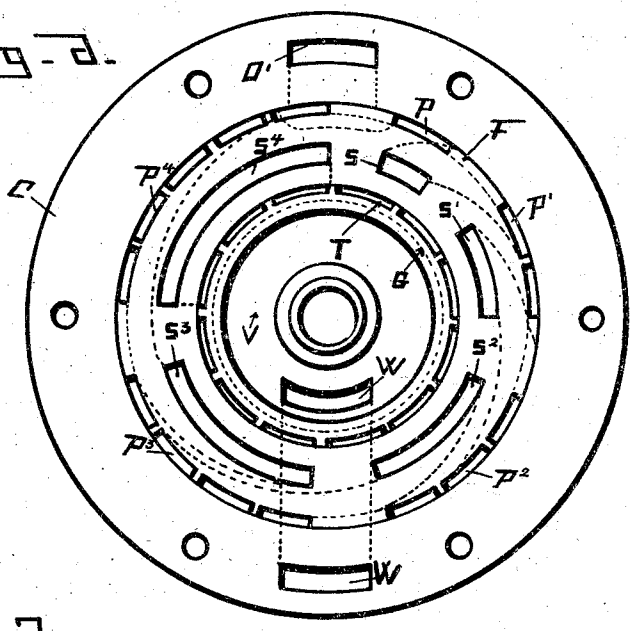


Fig. 7.

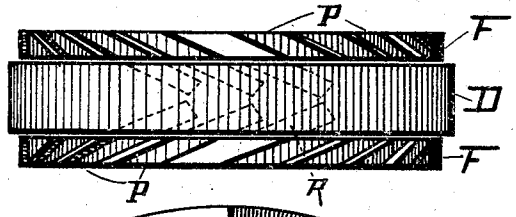
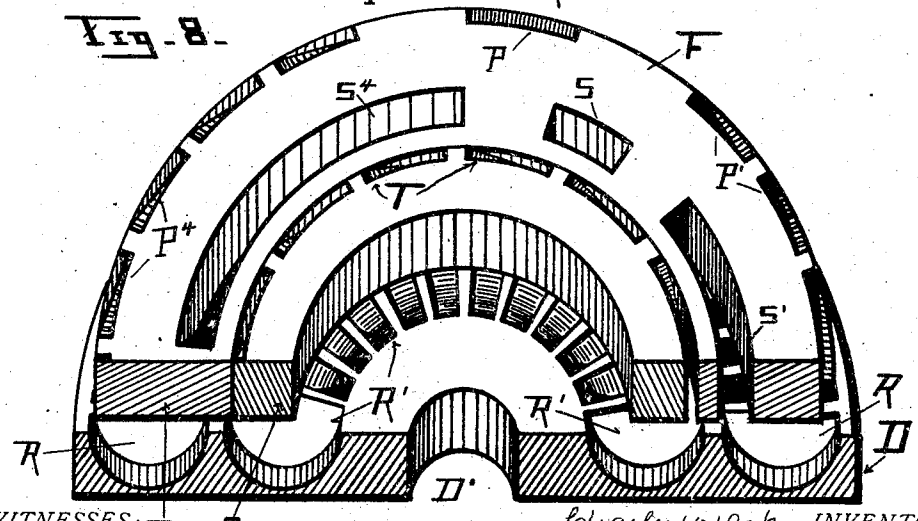


Fig. 8.



WITNESSES:

F

G

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No. 784,989. Patented March 14, 1905.

UNITED STATES PATENT OFFICE.

CHARLES W. DAKE AND WILLIAM DONKER, OF GRAND RAPIDS, MICHIGAN.

STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 784,989, dated March 14, 1905.

Application filed October 4, 1904. Serial No. 227,137.

To all whom it may concern:

Be it known that we, CHARLES W. DAKE and WILLIAM DONKER, citizens of the United States, residing at Grand Rapids, in the county of Kent and State of Michigan, have invented new and useful Improvements in Steam-Turbines, of which the following is a specification.

This invention relates to certain new and useful improvements in steam-turbines; and the invention consists in the construction and arrangement of parts hereinafter described and claimed.

The objects of the invention are, first, to utilize in a steam-turbine as fully as possible both the direct and the expansive force of the steam; second, to give increased room for expansion as the steam travels through the engine; third, to utilize the expansive force of the steam as the revolving wheel advances the buckets which receive the steam, so that the wheel receives the expansive force during its entire revolution; fourth, other objects hereinafter pointed out and claimed. These objects we accomplish by means of the mechanism illustrated in the accompanying drawings, in which—

Figure 1 shows a longitudinal sectional view of a steam-turbine constructed in accordance with our invention, showing the parts in position. Fig. 2 shows an elevation of the wheel detached, showing the arrangement of the buckets in our preferred form of construction. Fig. 3 is a sectional view on line *z z* of Fig. 2, showing the arrangement of the buckets on each side of the wheel. Fig. 4 is a sectional view on line *x x* of Fig. 1 looking to the left and showing the steam-passages and dividing-walls. Fig. 5 is a sectional view on the same line *x x* of Fig. 1 looking to the right, showing what we term the "chambers" 2, 3, 4, 5, and 6, which lead from the steam-passages S to the steam-nozzles. Fig. 6 is an elevation of the steam-head C looking from the inside and showing the nozzle-rings F and G, the nozzles P, the passages S, and other parts hereinafter described. Fig. 7 is an edge view of the turbine-wheel D, showing the nozzle-rings F in position. Fig. 8 is a sectional perspective view of the nozzle-rings F and G, on an enlarged scale, designed to show how the nozzles P register with the buckets R and the exit steam-passages S and low-pressure nozzles T with the buckets R′, which overlap the ring G, thus allowing the steam to pass into the exhaust-chamber. This view shows the buckets cut into one side of the turbine-wheel D; but preferably they are cut into both sides.

In the drawings we have illustrated our preferred form of carrying out our invention, in which we have shown a revolving wheel mounted upon a suitable shaft inclosed with a case or shell which is stationary. The steam being introduced through the proper port into engine is delivered through a series of nozzles into buckets, the buckets being preferably arranged in a plurality of rows on each side of the wheel, the whole containing suitable steam-passages, as hereinafter more fully described.

In the drawings, A is a cylinder or ring which separates the two heads of the frame and leaves room for revolving the wheel between the heads.

B shows one of the heads containing stationary parts and bearings, and C shows the other head, also having stationary parts and bearings.

D is the turbine-wheel, which is provided with curved buckets R and R′. These buckets are milled into each side of the wheel, as shown in Figs. 2 and 3, and the said wheel is mounted upon a suitable shaft, as shown by E. These buckets R and R′ are adapted to register at one end with the steam-nozzles, and at the other end are suitable steam-exit passages.

The shaft E is mounted in suitable bearings and revolves with the wheel D. We prefer to provide the shaft E with an enlargement D′ and a flange I for retaining the wheel in position, as shown in Fig. 1, although the wheel D may be mounted upon the shaft E in any suitable manner.

F F are high-pressure nozzle-rings properly secured to the case, and G G are the low-pressure nozzle-rings, also secured to the case and arranged as shown.

The dividing-walls are shown by H H. These dividing-walls direct the steam from

the exit steam-passages in the rings F to the steam-nozzles, also in the rings F. The shaft E is mounted in a suitable bearing K and is held in position by means of the lock or jam-nut L, which lock-nut retains the bearing in position when it is properly adjusted.

K K show bearings threaded into the case, so that the wheel D may be adjusted centrally in the case.

M is the steam-inlet port where the steam enters the engine, and N is the exhaust-port or outlet for the steam after it has passed through the engine.

O is a steam-passage connecting the steam-inlet port M to the passages O′ O′, one on either side of the wheel.

O′ O′ are passages leading from the chambers 2. One chamber is arranged in the head B and one in the head C, so that one chamber is on one side of the wheel D and one on the other side.

P P are steam-nozzles which are arranged on each side of the wheel in the rings F F.

R and R′ are curved buckets milled into each side of the turbine-wheel D at a suitable angle and having inclosed side walls and adapted to register with the nozzles P at one end and the exhaust-chamber V at the other end.

S S are steam-passages leading from and registering with the buckets on one side and the steam-chambers 2, 3, 4, 5, and 6 on the other.

T T are low-pressure nozzles which take the steam from the chamber U and which register with all the buckets R′ on each side of the wheel. The steam is delivered simultaneously into all the buckets R′ through the nozzles T and the rings G.

U is the low-pressure passage or receiver which receives the steam when deflected from the chamber 7. From the low-pressure passage U the steam passes through the nozzles T into the buckets R′ and from the buckets R′ into the exhaust-chamber V, and from the chamber V the steam passes through the passages W W and out at the exhaust-port N. The buckets are milled into the wheel D, so that they overlap each other and have two side walls, as shown in Fig. 3.

While we have shown the wheel D having buckets on both sides, it will be understood that a wheel may be constructed with buckets on one side only and suitable steam-passages and steam-nozzles without departing from the spirit of the invention; but we prefer the construction above described. It is also evident that the number of rows of buckets may be increased or decreased without departing from the invention.

The operation of our invention is as follows: The steam is introduced through the port M into the engine and divides and passes through the passages O′ O′ into the first steam-chambers 2. Thence it passes through the first nozzles P, striking in one or more of the buckets R in the wheel D, the steam striking at one end of the bucket, circling, and passing out of this bucket at the other end into the passages S, thence through the passages S and advancing into and through the chamber 3, thence through the nozzles P′, striking the buckets upon the wheel D at an advanced place, circling in these buckets R, as above described, and coming out through other exit-passages S′. It is then advanced to another set of nozzles, P^2, by means of the chambers 4 and passes through P^2, striking the buckets R upon the wheel D and coming through the passages S^2 and advancing into and through the chambers 5 and passing thence through the nozzles P^3, striking the buckets R on the wheel D and passing into and through the passages S^3, and being advanced by the chambers 6 passes through the nozzles P^4, striking the buckets R on the wheel D, and thence passing through the passages S^4 into the chambers 7, from whence it is deflected into the chamber U and passes through the low-pressure nozzles T, striking into the buckets R′ and emptying into the exhaust-chamber V, from whence it is discharged through the passages W W out at the port N. In the above description of the operation of our invention we have described the turbine-wheel having a series of buckets upon both sides; but it will be evident that a wheel can be made having the buckets on one side only, in which case the chambers, nozzles, and steam-passages will be limited to one side of the wheel. In other respects the operation will be the same as above described.

Having thus described our invention, what we claim to have invented, and desire to secure by Letters Patent, is—

1. In combination with a rotating turbine-wheel, a plurality of separated rows of buckets upon the face of the said wheel, a stationary casing therefor having separated spirally-formed chambers of varying capacities, stationary rings supported in the stationary casing and provided with a series of nozzles conveying the steam to one row of buckets in increasing volume and subsequently to another row of buckets as the said wheel advances the buckets in its revolution.

2. In combination with a turbine-wheel provided with a series of buckets in the face of the said wheel, a stationary casing having rows of chambers of varying capacities, a stationary ring secured to the stationary casing of the engine and provided with a series of nozzles having openings leading from the said chambers increasing so that the volume of steam fed to the buckets through the nozzles successively increases as the wheel rotates to one row of buckets, and subsequently to another row of said buckets.

3. In combination with a rotating wheel mounted within a case and provided with a

series of curved buckets R and a series of curved buckets R′, a stationary ring F secured to the case and a stationary ring G secured to the case, the ring F provided with a series of nozzles adapted to feed the steam in increasing volume to the wheel as it revolves, and the ring G provided with a series of nozzles adapted to feed the steam simultaneously to the buckets R′ before said steam is expelled from the engine.

4. In a turbine-engine, the combination of the inclosing casing having separated rows of chambers of varying capacities, a revolving wheel provided with a plurality of rows of curved buckets in the face thereof so as to overlap each other, nozzles for feeding the steam successively into one row of the said curved buckets and subsequently to another row, and steam-passages for taking the steam from the said buckets.

5. In combination with a turbine-wheel mounted in a case, having a plurality of separated rows of chambers spirally formed of varying capacities, a plurality of rows of curved buckets arranged on the face of said wheel, inlet-passages leading from the said chambers and registering with the rows of buckets for feeding the steam thereto and steam-passages for the discharge of the steam.

6. In combination with a turbine-wheel having separated rows of buckets, a casing therefor having a plurality of spirally-formed chambers of varying capacities, means for feeding the steam to one row of buckets in increasing volume, an auxiliary chamber communicating with one of the first-mentioned chambers, means for feeding steam from the auxiliary chamber to the last row of buckets in increasing volume and steam-passages for removing the steam from the engine.

7. In a turbine-engine, the combination with a supported case having separated rows of chambers spirally formed of varying capacities, a turbine-wheel mounted thereon and provided with rows of buckets, having communication with the respective rows of chambers, at least one row of buckets having communication with a discharge-port of the engine and adjustable bearings for the shaft of the said wheel.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

CHARLES W. DAKE.
WILLIAM DONKER.

Witnesses:
EDWARD TAGGART,
MARY S. TOOKER.