No. 613,694. Patented Nov. 8, 1898.

R. LUNDELL.

VAPOR OR GAS TURBINE.

(Application filed Jan. 15, 1898.)

(No Model.)

Fig. 2.

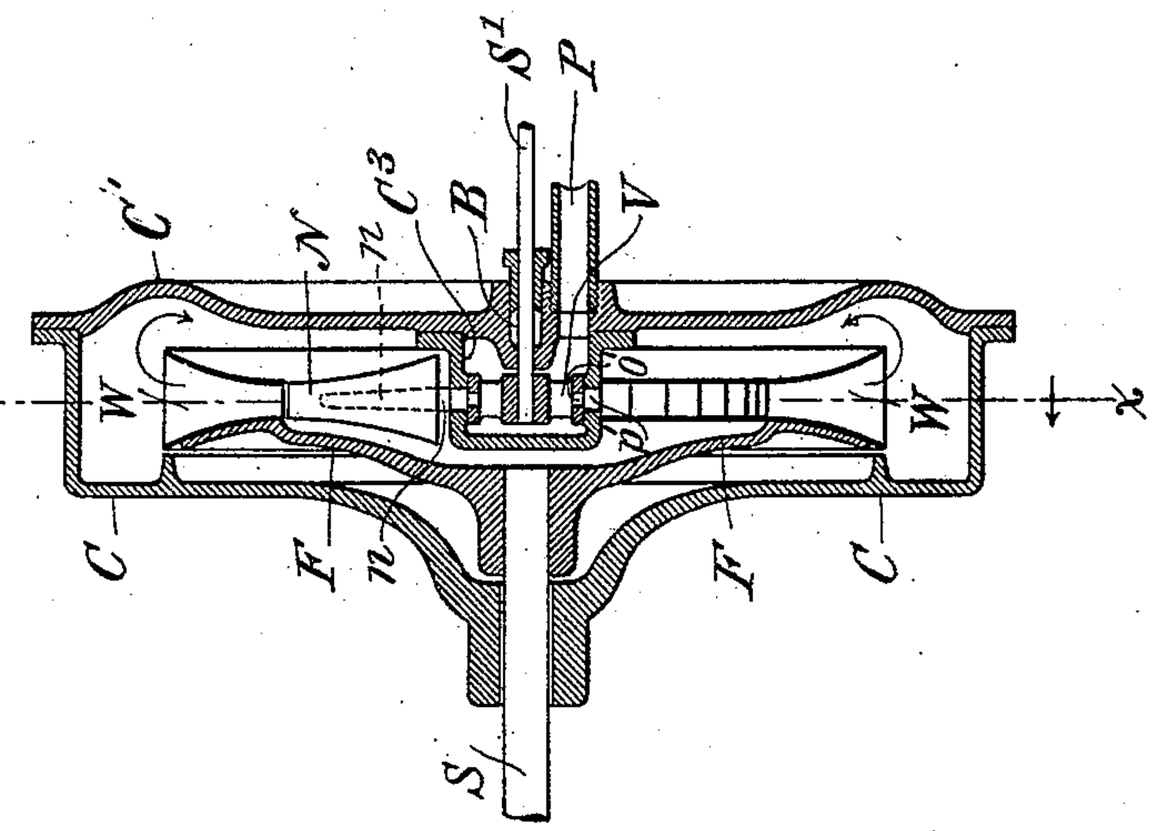
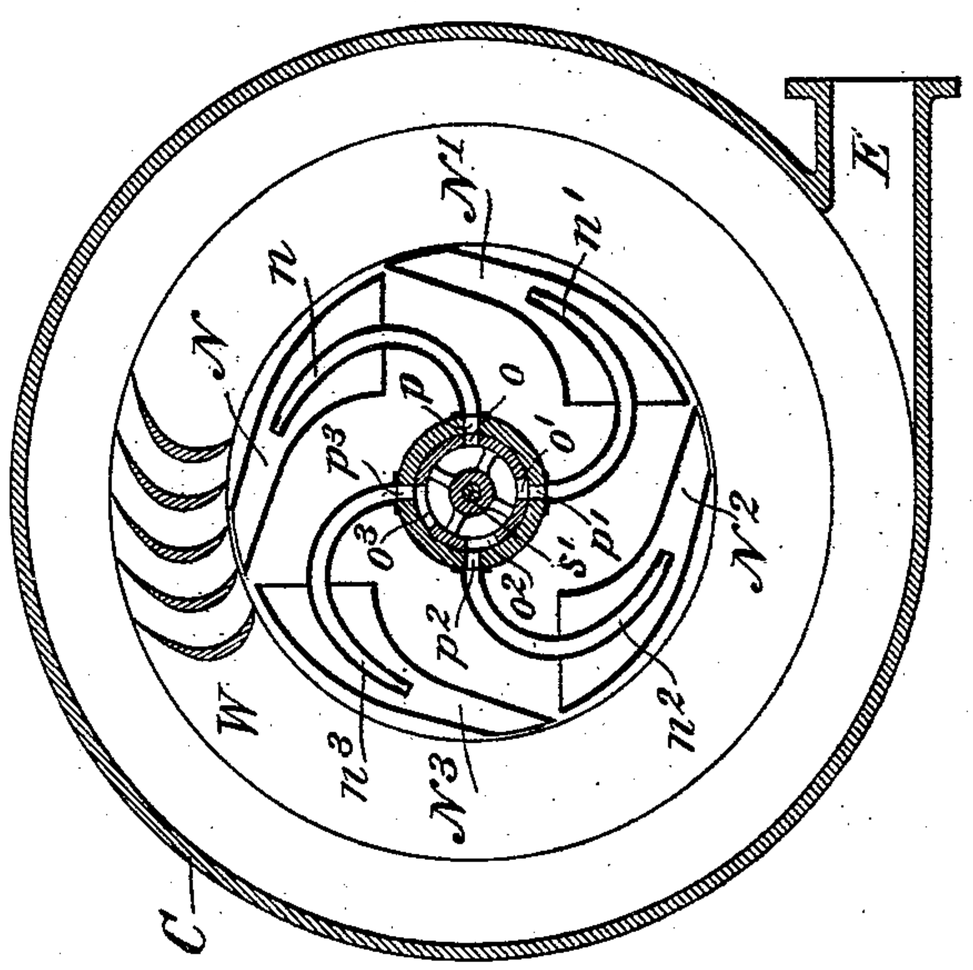


Fig. 1,



WITNESSES:

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UNITED STATES PATENT OFFICE.

ROBERT LUNDELL, OF NEW YORK, N. Y.

VAPOR OR GAS TURBINE.

SPECIFICATION forming part of Letters Patent No. 613,694, dated November 8, 1898.

Application filed January 15, 1898. Serial No. 666,800. (No model.)

To all whom it may concern:

Be it known that I, ROBERT LUNDELL, a citizen of the United States, residing at New York, (Brooklyn,) in the county of Kings and State of New York, have made a new and useful Invention in Vapor or Gas Turbines, of which the following is a specification.

My invention will be fully understood by referring to the accompanying drawings, the essential features of novelty being particularly pointed out in the claims at the end of this specification.

Figure 1 of the drawings is a sectional view of my novel form of vapor or gas turbine, taken on the line *x x*, Fig. 2, and as seen looking at that figure in the direction of the arrows from right to left. Fig. 2 is a transverse section of the entire turbine.

The object of my invention is to increase the efficiency of such apparatus and to provide means whereby it is possible to run the turbine wheel at more moderate speeds than are ordinarily employed. It is well known that in order to efficiently utilize the high velocity of steam escaping through a nozzle it becomes necessary to deal with extremely high velocities of the wheel itself, some wheels running at as high a speed as fifteen thousand revolutions per minute. To increase the efficiency of steam-turbines, an expanding nozzle is ordinarily employed, and the steam is usually cut off or throttled at the nozzle itself in order to insure high velocity of the stream at that point. The present apparatus does not depend upon any expanding nozzle or throttling of steam at the nozzle for its efficiency at various loads, other means, as hereinafter set forth, being employed to obtain both efficiency and reduced running speed.

Referring now to the drawings in detail, W represents the turbine wheel with buckets arranged as shown in Fig. 1.

F is the spider therefor, (preferably one solid disk,) and S is the turbine-shaft.

C is the casing. Only one bearing is shown in casing C, the other bearing being left out as immaterial for the chief object of this invention.

C′ and C³ are additional parts of the casing.

E is the exhaust, and P is the steam-pipe leading to the steam-chest formed by casing C³.

V is the main cut-off valve, which is operated by shaft S′ (passing through stuffing-box B) and an automatic speed-governor of any good design. (Not shown.) The valve V has four openings *o*, *o′*, *o²*, and *o³*, so arranged that each of the four valve-ports *p*, *p′*, *p²*, and *p³* are successively cut off when the shaft S′ is turned in a "clockwise" direction.

The valve-ports *p*, *p′* *p²*, and *p³* are connected with nozzles *n*, *n′*, *n²*, and *n³*, as shown. Outside of these nozzles and surrounding the same are larger nozzles N, N′, N², and N³, so located that their extreme or outer ends are very close to the buckets and the inner periphery of the wheel W, while their inner enlarged ends open up into the interior of the casing, as clearly shown.

The operation is as follows: Steam under pressure enters from pipe P into the steam-chest and flows through valve and valve-ports into the nozzles *n*, *n′*, *n²*, and *n³*, where, owing to the contraction of said nozzles at their outer ends, it attains its highest velocity. As it (the steam) leaves the nozzles *n*, *n′*, *n²*, and *n³* it naturally expands and rushes forward against the buckets of the wheel; but at the same time it also carries part of the exhaust-steam along, very much on the principle of an injector, so that at the time it strikes the buckets its weight and volume are considerably increased and its speed somewhat decreased. This makes it possible to decrease the speed of the wheel.

It will be understood from the drawings and the above description that the steam after having expended its energy on the buckets will partly exhaust through the exhaust-pipe E, and at the same time a portion of it will reënter the wheel after having attained velocity in the nozzles N, N′, N², and N³. At the time the wheel is operating under full load all the valve-ports are wide open and there is no choking of the steam except at or near the ends of the nozzles *n*, *n′*, *n²*, and *n³*, where the highest velocity of the steam is desired. If the load is somewhat reduced, the speed-governor turns the valve V to the right until valve-port *p* is partly cut off. The efficiency of steam passing through the nozzle *n* may now be somewhat impaired, owing to a decreased volocity at the opening of the same; but all the other nozzles are still working under full efficiency, and at three-fourths load the

nozzle n becomes entirely idle. For half-load nozzles n and n' are idle, and at one-fourth load the nozzle n^3 is the only one in use. It will thus be seen that the efficiency is only slightly impaired while one or the other nozzle is partly cut of.

I do not limit myself to the specific construction shown and described or to the use of steam alone for this purpose. Any gas or vapor might answer as well, or a mixture of both steam and gas may be employed by connecting the inner ends of nozzles N, N', N^2, and N^3 with some suitable gas-supply. Nor do I limit myself to a rotary turbine wheel, as it is obvious that the essential features of my invention might be applied to reciprocating as well as rotary engines.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. A vapor or gas turbine having a series of buckets, a number of vapor or gas conveying nozzles adapted to convey vapor or gas thereto and additional nozzles surrounding the first-named nozzles, in combination with a valve and valve-ports adapted to admit vapor or gas to the first-named nozzles in succession, substantially as described.

2. A vapor or gas turbine having a series of buckets, a number of vapor or gas conveying nozzles adapted to convey vapor or gas thereto, additional nozzles surrounding the first-named nozzles and having connection with an exhaust-chamber, in combination with a valve and valve-ports adapted to admit vapor or gas to the first-named nozzles in succession, substantially as described.

3. A vapor or gas turbine having a series of buckets surrounded by an exhaust-chamber provided with an exhaust-outlet E; a number of vapor or gas conveying nozzles adapted to direct vapor or gas against said buckets and into the exhaust-chamber, a corresponding number of nozzles which surround the first-named nozzles and have communication with the exhaust-chamber, in combination with means for successively admitting vapor or gas through the first-named nozzles, substantially as described.

In testimony whereof I have hereunto subscribed my name this 13th day of January, 1898.

ROBERT LUNDELL.

Witnesses:
C. J. KINTNER,
M. M. ROBINSON.