No. 867,950. PATENTED OCT. 15, 1907.

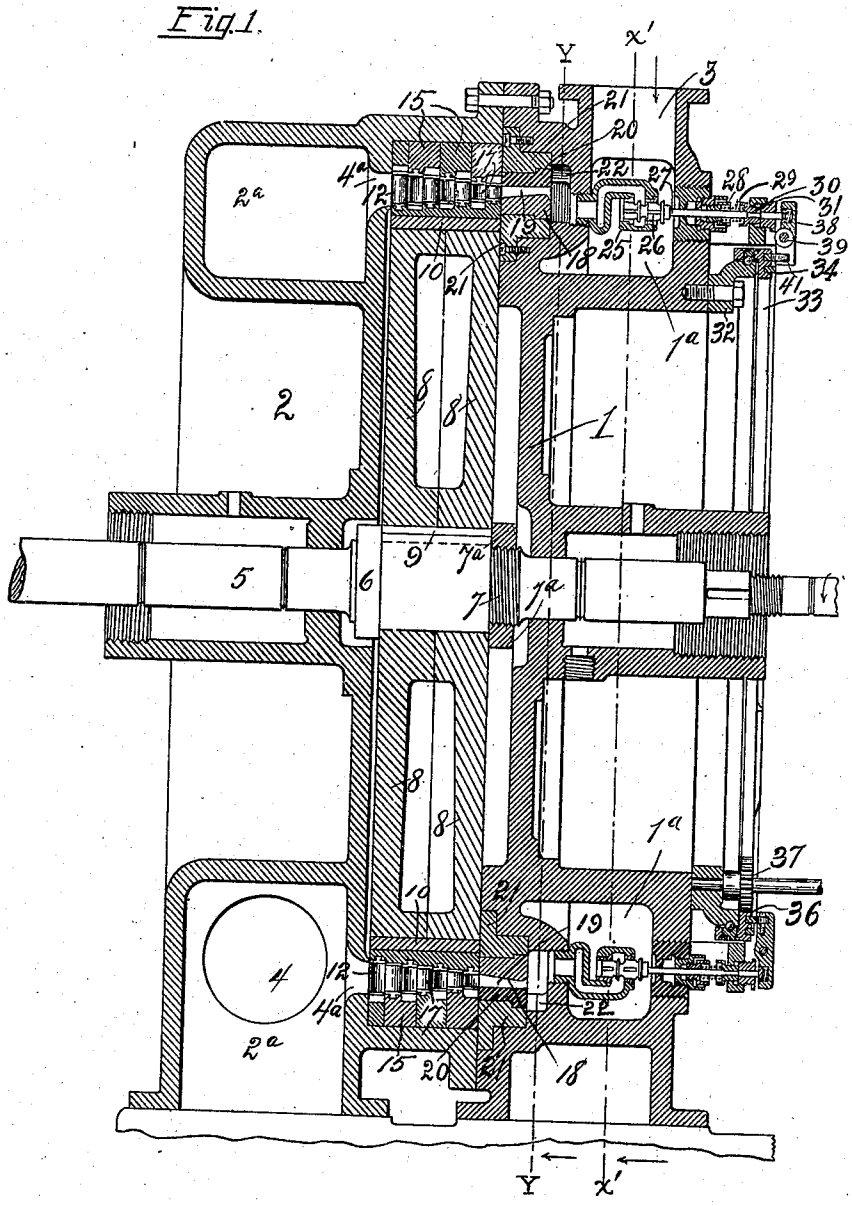
E. C. CROCKER.

REGULATOR FOR STEAM TURBINES.

APPLICATION FILED FEB. 12, 1906.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

D. C. Walter

C. A. D. Young.

INVENTOR:

Eben C. Crocker,

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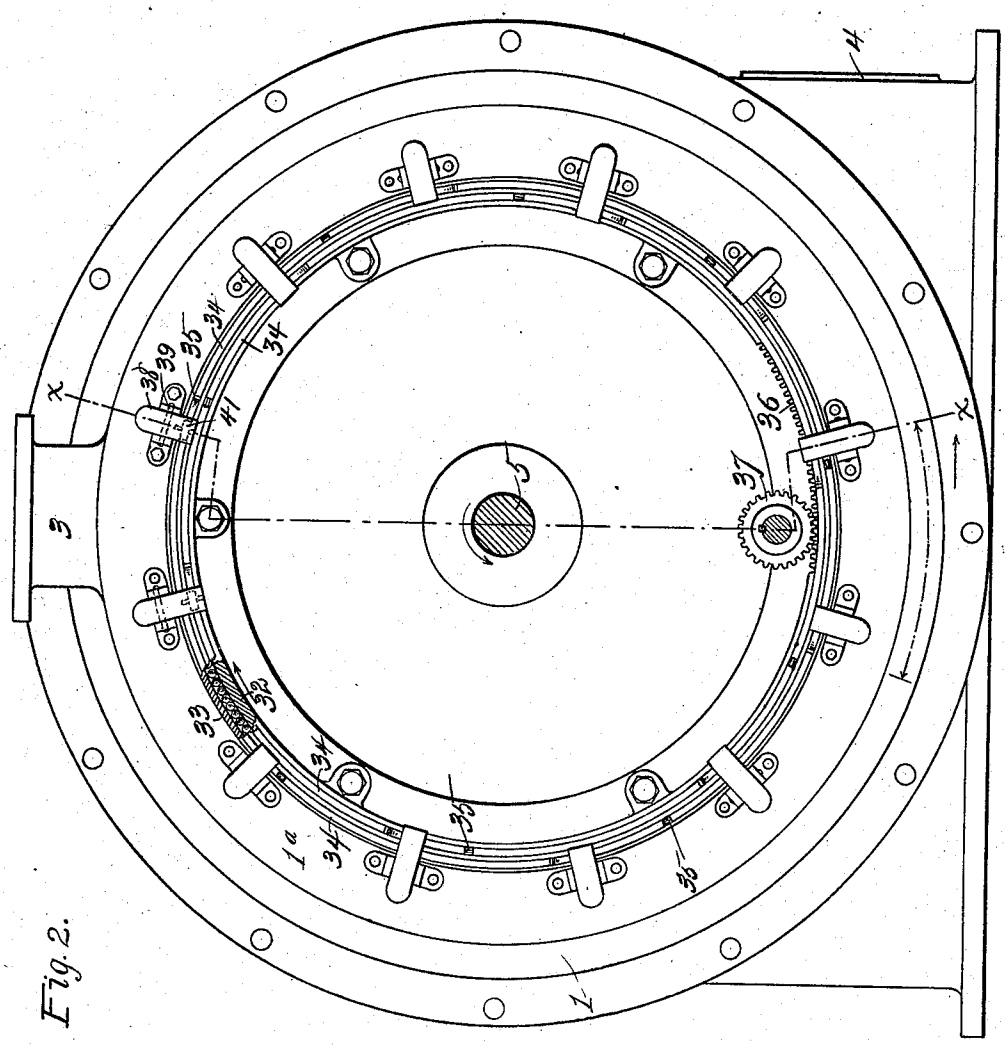

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 3.

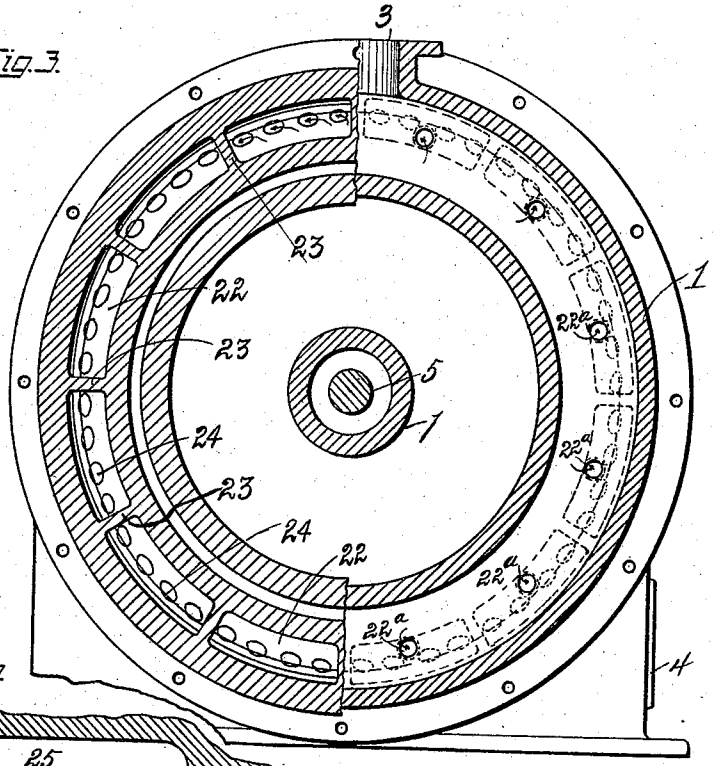


Fig. 4

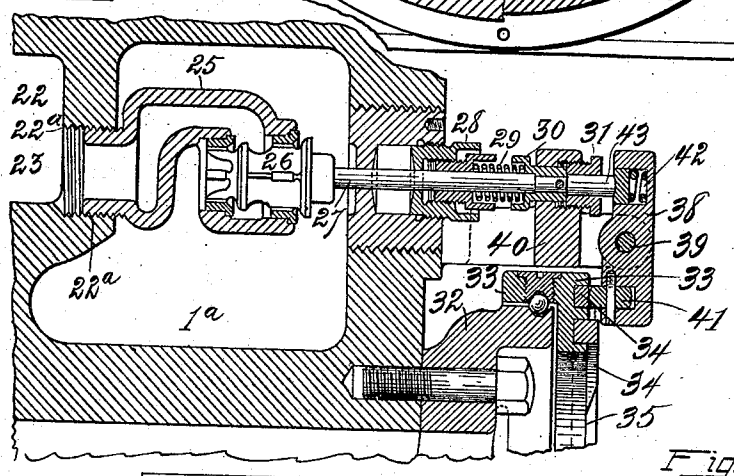
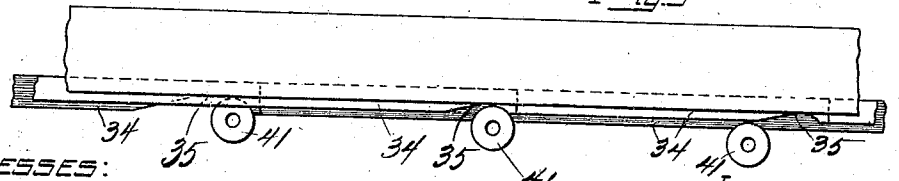


Fig. 5



WITNESSES:

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UNITED STATES PATENT OFFICE.

EBEN C. CROCKER, OF SANDUSKY, OHIO, ASSIGNOR TO THE WARREN ELECTRIC MANUFACTURING COMPANY, OF SANDUSKY, OHIO.

REGULATOR FOR STEAM-TURBINES.

No. 867,950. Specification of Letters Patent. Patented Oct. 15, 1907.

Application filed February 12, 1906. Serial No. 300,607.

To all whom it may concern:

Be it known that I, EBEN C. CROCKER, a citizen of the United States, residing at Sandusky, in the county of Erie and State of Ohio, have invented certain new and useful Improvements in Regulators for Steam-Turbines; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

In steam turbines the variations of speed due to change of load are regulated, through a governor, by throttling the steam. When a series of nozzles is assembled in such an engine for directing the steam against the moving vanes of the engine, the result of throttling the entire steam-supply is that each nozzle is deprived of that quantity of steam which enables it to work to the best advantage, and the kinetic energy of the steam is weakened at all the nozzles.

The object of my invention is to overcome the difficulty here indicated, and, more particularly, to furnish, in an engine of the described character, a structure by means of which the steam nozzles of the turbine are arranged in groups, and to supply a valve-mechanism by which such groups of nozzles may be thrown into or out of service, independently of each other, and in succession, without throttling the steam, and so that all the steam passing through one or more groups of passages is used at its highest efficiency. I attain these objects by means of the devices and arrangement of parts hereinafter described and shown, and illustrated in the accompanying drawings, in which—

Figure 1 is a central vertical sectional elevation of my engine, taken lengthwise of the shaft; Fig. 2, an end-elevation of the same seen from the admission or governor side; Fig. 3, a vertical cross-section on lines Y—Y and X′—X′ Fig. 1; Fig. 4, an enlarged sectional elevation of one of the balanced valves and its stem and connections and actuating mechanism hereinafter referred to, and Fig. 5, a diagram illustrating the successive operation of the valve-mechanisms hereinafter described.

Like numerals of reference indicate like parts throughout the drawings.

In the drawings, 1 and 2 are frame parts, 1 being the admission side, 2 being the exhaust side of the frame. The part 1 is provided with a hollow ring 1^a to which the steam is admitted, as at 3, the part 2 having a like ring 2^a into which the steam is exhausted, escaping, as at 4, to a condenser or to the atmosphere. In the meeting faces of the two frame-parts are corresponding opposed recesses. On the exhaust side, the recess contains the vane-carrying wheel, the movable vanes and the fixed guide vanes. The recess in the face of the part 1 contains the steam nozzles which direct the steam to the moving vanes.

5 is the engine-shaft having a shoulder 6 and a threaded portion 7. Upon this shaft are secured two disk-members 8—8 having corresponding recesses in their meeting faces so that the two disks together form a hollow disk of the width of the series of movable and fixed vanes. The disk-parts are clamped between shoulder 6 and nut 7^a. The disk-body thus formed is secured to the shaft by key 9. A ring 10 shrunk on the periphery of the disk 8—8 carries the moving vanes 12. A ring or rings 15 fitted and rigidly secured in the circular recess in the frame part 2 carries the series of fixed vanes 17 interposed between the series of moving vanes. The exhaust side of the last series of moving vanes is in communication with opening 4^a leading into the hollow ring 2^a. In the recess in the face of the exhaust side of the frame-part 1 is a nozzle-ring 18 having the steam passages 19 milled in its peripheral face. Upon this ring is shrunk another ring 20 which completes and closes the steam passages. The rings 18—20 are secured in place by flanged rings 21 bolted to the face of the part 1. In the inner side of the circumferential recess in the face of the frame-part 1 is a series of pockets 22 which, when the rings 18—20 and 21 are in place, become closed chambers communicating with the inlets of the nozzles 19. These chambers are separated from each other by intermediate radial partitions 23 cast with and forming part of the frame-member. A group of two or more nozzles 19 is in communication with each of the chambers 22 through openings 24. (See Fig. 3). Each of the pockets 22 is also in communication with the interior of the steam-ring 1^a through holes 22^a tapped in the wall between the ring and the pocket. Into each of these holes is screwed a valve-casing 25 in which is a valve 26, preferably of the balanced type. The valve is provided with a stem 27 which extends out through the front face of the frame-member 1 through a stuffing-box 28. A spring 29, interposed between the gland of the stuffing-box and a sleeve 30 secured to the valve-stem, serves to hold the valve normally open. An adjusting stop-nut 31 limits and adjusts the outward movement of the valve-stem.

32 is a stationary ring supported on the face of the steam ring 1^a and having in its outer periphery a grooved ball-race. 33 is another ring having in its inner periphery an opposed grooved ball-race. In these opposed ball-races is a series of balls forming a ball-bearing for the ring 33 by means of which it is permitted to rotate in either direction. In the face of the ring 33 are formed concentric circular grooves into which are fitted and secured the edges of metal strips 34, the outer margins of which are, at predetermined intervals, indented as illustrated, as at 35, in Fig. 5. The indenta-

tions are accurately located and spaced at different points of the circumference of the metal strips. The ring 33 is internally toothed, as at 36, in a limited arc of its circumference, (see Fig. 2) forming a rack which meshes with pinion 37. The pinion is connected with and operated by a proper governor which is not shown in the drawings and which, forming no part of this invention, need not be here described.

38 is a lever pivoted, as at 39, on a bracket 40 and which carries at its inner end a roller 41, placed in proper position to ride upon one or the other of the indented circular cam-strips 34. By providing two concentric cam-strips, I am enabled to make them much smaller and of much less motion than if a single strip were provided for all the levers and rollers. In the outer end of the lever is a cushion-spring 42 acting on the valve-stem 27 through the short piston 43, and which serves to take excess of pressure after the valve is closed tight.

It will be seen that the inner circle of cams 35 acts upon a series of levers having greater length than the levers which are actuated by the outer cam-strip. The long and short levers alternate.

The operation of my device, thus far described, is as follows: Steam being admitted to the steam ring 1^a passes through open valves 26 into pockets 22 thence through openings 24 and nozzles 19, through alternating series of moving and fixed vanes and the exhaust ring 2^a. When the speed of the engine becomes too great, a governor, through the rack and pinion 36—37, swings the ring 33 upon its ball-bearing thus bringing the raised portions of the indented cam-strips 34, one after another, in contact with the rollers upon the levers, lifting the rollers 41, one at a time, out of the depressions in the cam-strips, thus swinging the levers 38 which thrust the valve-stems inwardly and close the valves 26. The reverse movement of the ring 33 produces the opposite effect and the valves are successively opened. It will be seen that each time one of the valves is thus operated, a steam pocket 22 is thrown into or out of communication with the steam ring 1^a and a group of nozzles is thrown into or out of action. It will also be seen that such nozzles as remain in action are operated under a full head of steam, the velocity of which is not retarded by throttling, and that thus the full efficiency of those nozzles which are in action is at all times maintained.

I have described the steam-pockets 22 each as having a group of two or more nozzles. In ordinary practice this arrangement is found satisfactory, but when extreme nicety of regulation is required each pocket may have but one nozzle, the valves and valve controlling mechanisms being modified accordingly.

Having described my invention, what I claim and desire to secure by Letters Patent is,—

1. In an elastic fluid turbine, a hollow ring, a series of chambers, valved connections between the ring and the chambers, stems for the valves, a rotatable ring having cam-sections adapted to actuate said valve-stems, devices for actuating the rotatable ring, which devices are adapted for connection with a governor, and a series of nozzles, each chamber being connected with one or more of said nozzles.

2. In an elastic fluid turbine, a rotatable ring, a toothed rack on the ring, a pinion engaged with the rack and adapted for connection with a governor, cam-sections on the ring, levers pivoted on the engine and adapted for engagement with the cam-sections, valves which are actuated by the throw of said levers, a series of chambers, a chamber common to said series of chambers, said valves being located between said series of chambers and said common chamber, and a group of nozzles connected with each of said series of chambers.

3. In an elastic fluid turbine, a series of chambers, a chamber common to the series of chambers, one or a group of nozzles connected with each of said chambers of said series, valves which control the passage from the common chamber to the series of chambers, and means for actuating said valves successively comprising a rotatable ring having two concentric series of cam-sections, and devices connected with the valves and adapted for engagement with said cam-sections.

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

EBEN C. CROCKER.

Witnesses:
FRANK WARREN,
THAD F. GREENE.