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W. L. WEBSTER.

BALANCED STEAM TURBINE.

APPLICATION FILED NOV. 17, 1903. RENEWED JUNE 29, 1906.

FIG. 1.

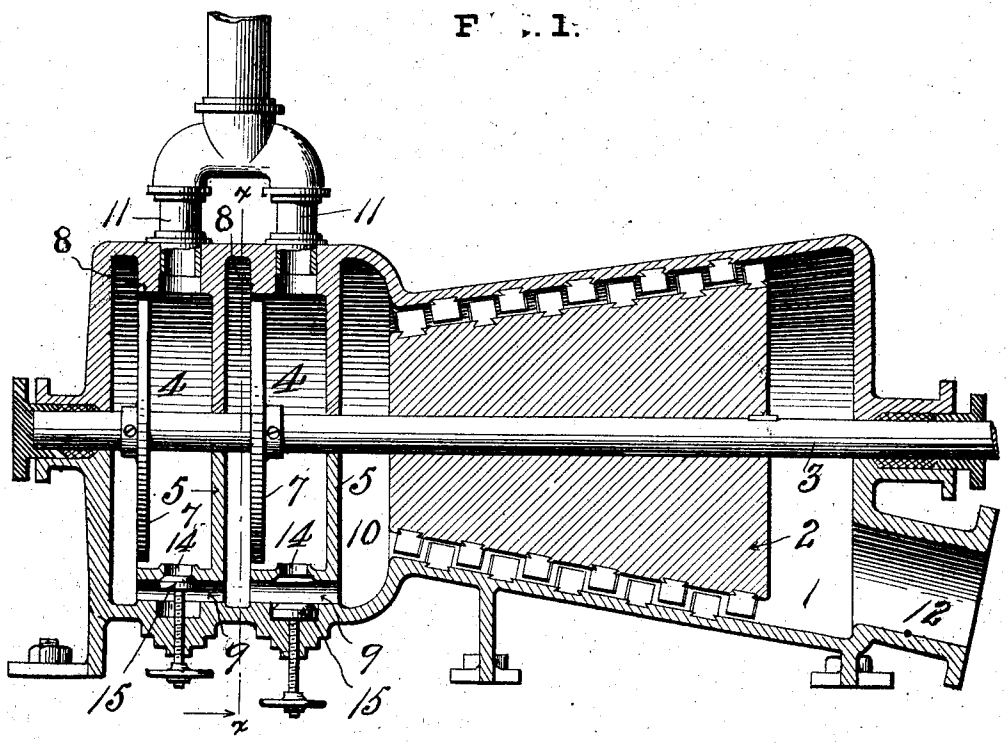
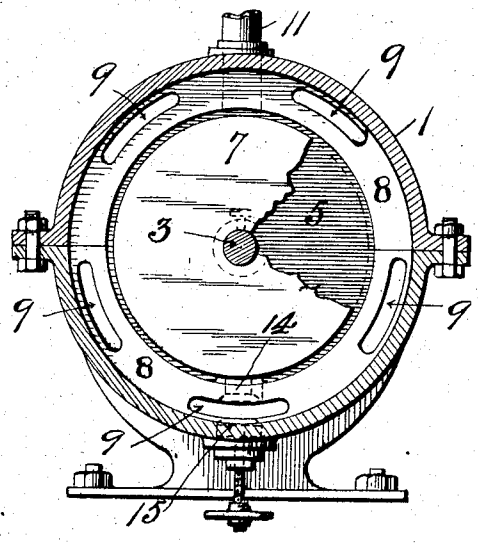


FIG. 2.



Witnesses
Chas. K. Davis.
M. E. Brown

Inventor
W. L. Webster
by W. A. Bartlett
Attorney

UNITED STATES PATENT OFFICE.

WILLIAM LLOYD WEBSTER, OF NEW YORK, N. Y.

BALANCED STEAM-TURBINE.

No. 833,990. Specification of Letters Patent. Patented Oct. 23, 1906.

Application filed November 17, 1903. Renewed June 29, 1906. Serial No. 324,052.

To all whom it may concern:

Be it known that I, WILLIAM LLOYD WEBSTER, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Balanced Steam-Turbines, of which the following is a specification.

This invention relates to a thrust-balance for steam-turbines.

The object of the invention is to produce a steam-turbine in which the end thrust is wholly or partially overcome by the pressure of steam on a disk or disks connected to the shaft and working in a balance chamber or chambers, as will be described.

The invention consists in combinations and constructions of mechanical elements whereby steam-pressure in the balance chamber or chambers will bear with an excess of pressure on the balance disk or disks to that which bears on the rotary "piston" or motor part of the engine, as will be explained and claimed.

The drawings illustrate only one of numerous forms of my invention and are explanatory, not working, drawings.

Figure 1 is a longitudinal section of a turbine embodying my invention. Fig. 2 is a cross-section on line $x\,x$, Fig. 1, a disk 7 being partly broken away.

Let the numeral 1 illustrate the casing of a steam-turbine, 2 the rotating piston or motor part of the engine, and 3 the shaft. All these parts may be of any usual form or construction. The steam after passing the inlet end 10 of the working chambers operates as usual on the blades of the rotating piston and fixed chamber.

At the inlet end of the engine there are formed integral or rigid with the casing as many balance-chambers 4 4 as may be desirable. At the side toward the piston there is a fixed partition 5 5 in each chamber, through which partition the shaft 3 passes with as close a fit as can easily be made without much friction.

At the side of each chamber 4 remote from the piston I attach to the shaft 3 a disk 7, which disk is surrounded by a fixed annular wall 8, preferably forming part of the casing. Through the wall 8 a by-passage or a number of passages 9 extend to the inlet end 10 of the piston-chamber of the engine.

Steam-pipes 11 convey the full boiler-pressure, or such steam-pressure as may be employed, to each chamber 4. The walls 5 prevent direct entrance of the steam to the piston-chamber. The steam must then escape around the periphery of the disks 7 to the by-passages 9, through which passages the steam finds its way to chamber 10, and so through the engine, as usual, exhausting at 12. The area of the passage around disk 7 and between it and wall 8 is less than the area of inlet-pipe 11. Consequently the steam passing out of chamber 4 around disk 7 is throttled down or reduced in pressure after passing. The passage between disk 7 and wall 8 is narrow, so that full pressure in the chamber 4 is not allowed to escape in this way to the by-passages 9. Any excess of pressure then becomes exerted on the face of disk 5, which is within chamber 4. Thus suppose boiler-pressure at one hundred pounds per square inch be admitted to chamber 4 and only seventy-five pounds can escape through the annular passage around disk 5, then the excess of pressure of twenty-five pounds per square inch will tend to thrust disk 5 and shaft 3 away from the piston 2, or, in other words, will balance the pressure on the piston and disks to that extent. In such case a series of three or four balance-chambers and disks would by the excess of pressure bearing away from the piston practically overcome the end thrust of the piston and connections.

In the drawings I have shown an excess of the space likely to exist between the disks 5 and the walls 8, as a very narrow opening around a large disk will pass a great amount of steam; but the theory of operation will be understood from the description and illustration.

For convenience of operation and to be able to dispense with the balance-pressure when full boiler-pressure is desired on the piston or to be enabled to adjust the excess of pressure without changing disks 7 I provide an opening 14 from each chamber 4 and a valve 15, by which this opening may be closed or left partly open. By opening valve 15 the steam from chamber 4 is admitted to the by-passage 9 and thence passes directly to the piston-chamber. The throttling of the steam and balancing effect of the disks 7 is thus diminished in so far as the pressure is equalized on both faces of the disks 7. Of

course a single disk 7 could be made so large that an excess of pressure against one side would balance the piston thrust; but with large engines this would be an unwieldy construction.

The small amount of leakage of steam through the passages around shaft 3 where it passes through walls 5 would act as a lubricant, and the steam thus entering piston-chamber 10 would work effectively in driving the piston.

I am aware that many attempts have been made to balance or overcome the end thrust of the shaft in steam-turbines by constructing the engine with double pistons and casings having steam entrance at the middle and exhaust at each end or by having a steam-supply at both ends and exhaust at the middle. An objection to either plan is that the piston is thereby made much longer in axial-flow engines, that the expense of construction is practically doubled, and that there is difficulty in fitting. The space occupied by balance-disks on my plan may be very small, and the disks, being exposed to small differential pressure, may be thin and light.

It has been common to attach a balance to the shaft of a rotary engine, said disk fitting closely to the end of the casing and intended to have a tight joint therewith. This causes much friction about the periphery of the disk. What steam does leak past the disk is carried to the exhaust and absolutely lost. The shaft of my engine may be mounted in the casing in any usual form of stuffing-boxes. The closed bearing at the balanced end of the engine may be lubricated in any desirable manner. The casing can be cast in sections, to be joined together as usual, thus permitting access to all the parts. No special novelty is claimed for the casing, except that the balance-chambers are made rigid therewith, and steam is normally admitted to the piston-chamber after throttling down in the balance chamber or chambers to secure the excess of pressure for the purpose of balancing end thrust.

What I claim is—

1. In a steam-turbine, the combination with the shaft of a balance-disk attached thereto, a chamber surrounding the disk, and steam inlet and outlet passages from said chamber arranged so as to give an excess of steam-pressure on one face of the disk and an escape-passage from the balance-chamber leading to the working chamber of the engine.

2. In a steam-turbine, the combination with a piston, a shaft, and a casing, of a plurality of balance-chambers, a balance-disk in each chamber connected to the shaft, and steam-passages leading from the balance-chambers to the working chamber of the engine whereby an excess of steam-pressure is normally applied to the faces of the disks which thrust in opposition to the piston.

3. The combination with a casing, piston, and shaft for a steam-turbine, of a balance-chamber, a disk on the shaft within said chamber, and a controllable by-passage leading from the balance-chamber to the piston-chamber.

4. The combination with a piston, shaft and casing for a steam-turbine, of a balance-chamber with wall rigid with the casing, a balance-disk on the shaft and having one face in said chamber, a by-passage leading from one side of the balance-disk to the piston-chamber, and a by-passage having a controlling-valve leading from the other side of the disk to the piston-chamber.

5. In a steam-turbine, a casing having a longitudinal shaft therein, a piston on said shaft having usual blades thereon and blades within the casing coöperating with the piston-blades, a balance-chamber having walls rigid with the casing, and a balance-disk within said chamber, a steam-supply pipe leading to said chamber, an exit-passage around said disk of less area than the supply-pipe, and a passage leading the steam which passes the disk to the piston-chamber.

6. In a steam-turbine, the combination of a casing containing a rotating piston and shaft of usual construction, of a balance-disk secured to said shaft and rotating in a separate chamber in the casing, a live-steam passage leading to the balance-chamber on the side of the balance-disk calculated to relieve the end thrust of the piston, and an exhaust-passage leading from the opposite side of the balance-disk to the working chamber of the engine.

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

WILLIAM LLOYD WEBSTER.

Witnesses:
JOHN D. BROWER,
FRED J. STARR.