(No Model.)

# R. HEWSON.

## STEAM TURBINE.

No. 570,756. Patented Nov. 3, 1896.

Fig. 1.

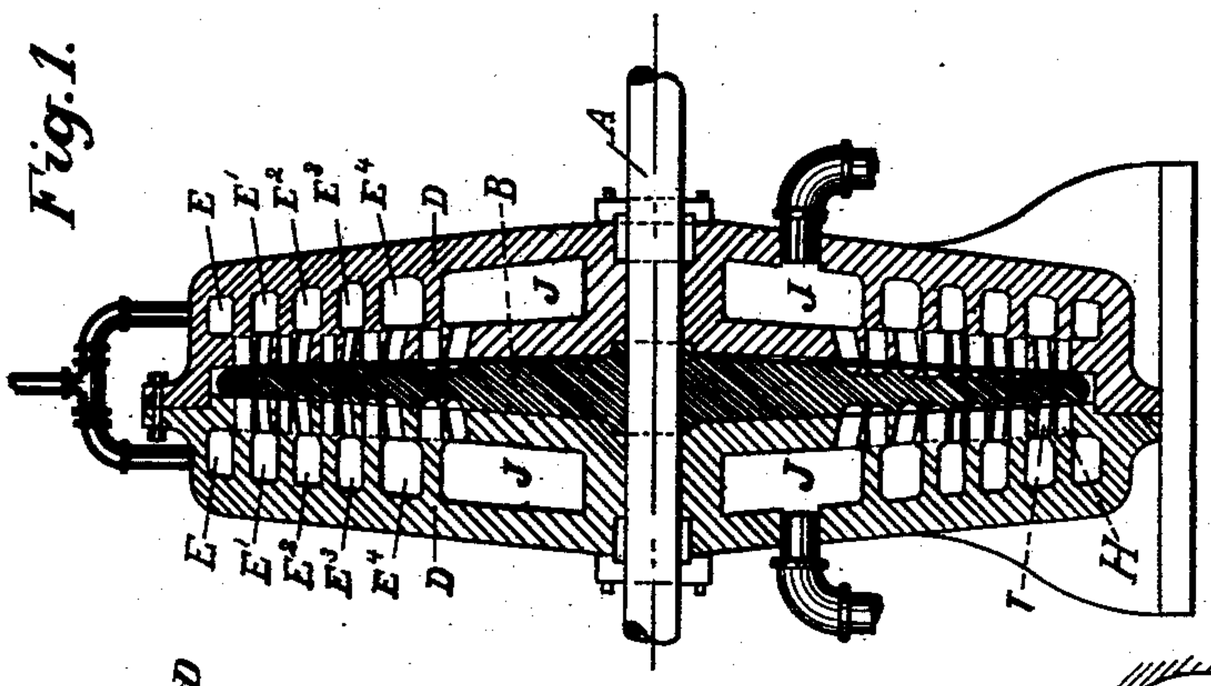



Fig. 3.

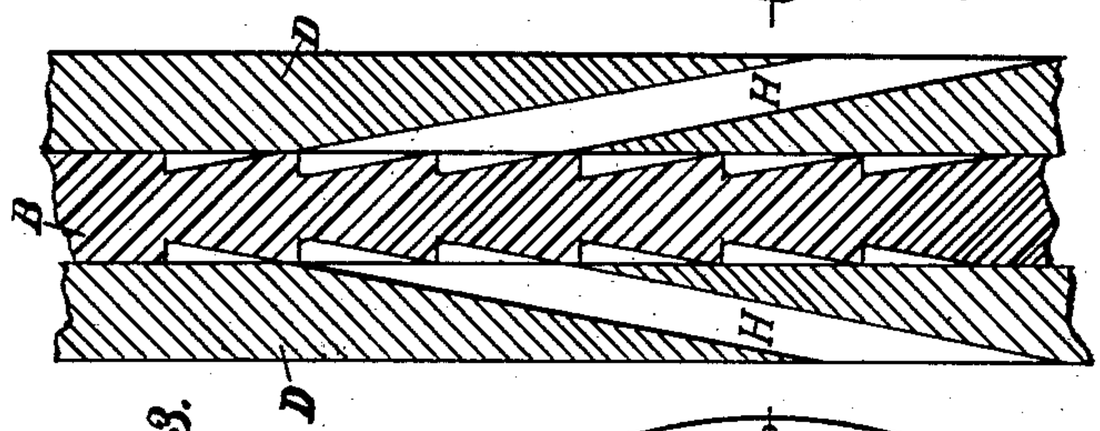



Fig. 4.

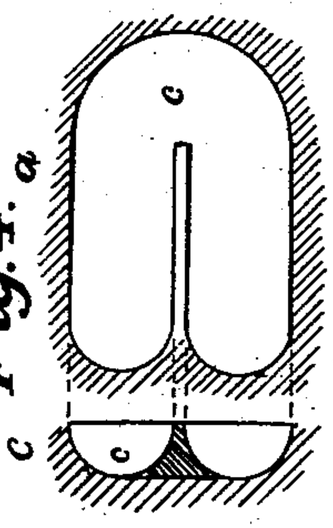
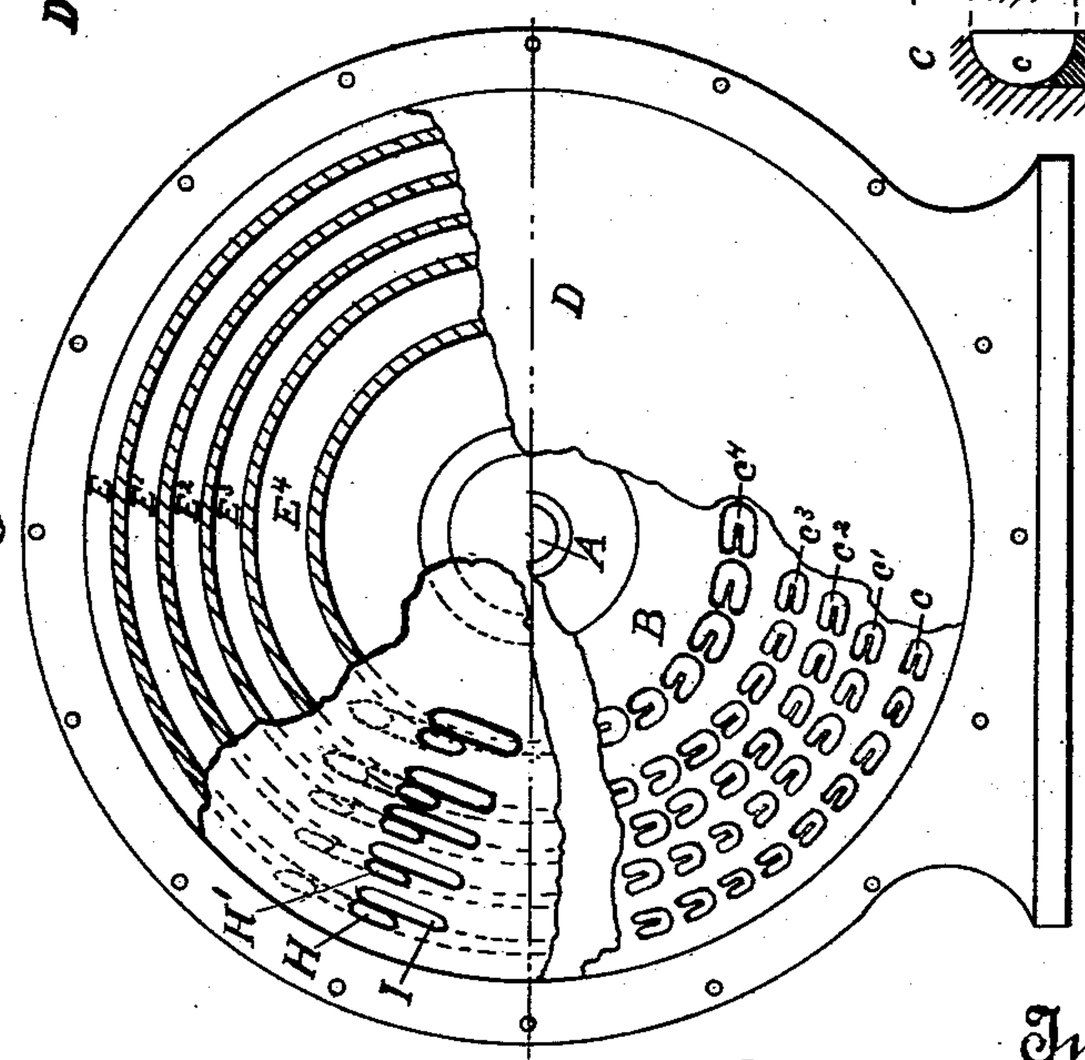



Fig. 2.

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# UNITED STATES PATENT OFFICE.

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## STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 570,756, dated November 3, 1896.

Application filed March 30, 1896. Serial No. 585,433. (No model.)

*To all whom it may concern:*

Be it known that I, ROBERT HEWSON, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented an Improvement in Multiple-Expansion Steam-Turbines; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to an apparatus or motor in which steam or other elastic medium under pressure, and which I call a "double multiple-expansion steam-turbine," is employed.

It consists of a peculiarly-constructed wheel with a series of buckets concentric with the axis or shaft, into which buckets the propelling medium is admitted under pressure to act expansively and with reactionary force, and is conducted successively from one series of buckets, through stationary concentric chambers upon each side of the wheel, to the next interior buckets, and is finally exhausted from the last chamber surrounding the shaft.

Referring to the accompanying drawings, Figure 1 is a vertical section taken through the plane of the axis of the shaft. Fig. 2 is a transverse section showing parts of the wheel and of the corresponding steam-chambers. Fig. 3 is a detail showing more clearly the arrangement of the wheel-buckets with relation to the chambers and the passages leading from one to the other. Fig. 4, *a b c*, show enlarged sections of the buckets.

In my invention, A is a shaft, which is properly journaled and from which power may be transmitted to drive any desired mechanism in any of the well-known or suitable ways. Upon this shaft is firmly keyed a disk or wheel B, which in the present case is shown made thickest at the hub, where it is secured to the shaft, and which gradually converges to a less thickness at the periphery. This construction allows for a gradual increase in the size of the buckets from the periphery toward the center, and by making the periphery lighter allows of a higher rate of speed without danger. This disk is provided with as many series of buckets $c$ $c'$ $c^2$ $c^3$ $c^4$ as may be desired, and depending upon the diameter of the wheel, the power to be generated, and the pressure of medium to be expanded. These buckets are made U-shaped or curving and with a central web, so as to reverse the motion of the impelling fluid, as plainly shown in Fig. 4. The deepest point is at the front of the curvature, and they are so disposed that the legs or sides lie in the direction of movement of the wheel.

As I design to employ the steam or elastic medium expansively, commencing at the periphery with the highest pressure and finally exhausting about the center of the wheel, I have shown the outside row of buckets made smallest and each succeeding row increasing in size as the energy of the steam becomes less. These buckets are arranged upon opposite faces of the wheel or disk, and each set is designed to receive the actuating medium, so that the pressure being balanced from opposite sides there will be little or no end thrust upon the shaft, which is an important point where a heavy pressure is employed.

Outside of the disk or wheel is fixed a casing D, which is properly secured and supported and which is bolted together in halves, so as to fit closely upon each side of the wheel or disk. This casing is formed with a series of chambers E E' $E^2$ $E^3$ $E^4$ upon each side, the outer one being adapted to receive steam under pressure directly from the boiler, and the others serve as receivers into which the steam passes from each series of buckets after it has performed its work in that series, and from which it is again delivered into the next series of buckets to act upon them in the same manner, and so on to the center or exhaust chamber.

The wheel or disk with buckets in its opposite faces rotates between the two opposing chambered casings, and by means of suitable annular packing-rings G, forming contact between the face of the wheel and the inner faces of the chambers, sufficiently tight joints are made to prevent the steam from going through directly between the wheel and its casing.

From the exterior initial receiver a steam-port H is made through the thickness of the metal between the chamber E and the inner face of the casing, this port being made at such an inclination that it delivers steam into the outer legs of the curved buckets of the first series, so that the steam acts directly against the front curved portion of the bucket,

and following the curvature around into the inner leg it discharges through passages I, the openings of which are in line with the inner legs of the buckets and at approximately the same inclination with the passages H, so as to deliver the steam through these passages I into the next inner chamber E'. The steam thus acts by direct pressure, and also by the reactionary force caused by its passage around the curved front of the bucket, so as to impel the wheel forward, the steam escaping rearwardly through the discharge-ports I and into the next interior chamber E'. The steam expands in passing through the buckets and enters this second chamber at a less degree of pressure, and from this chamber it passes through similar ports H' into the second annular series of buckets $c'$, which are situated interior to the first series.

Each chamber E' $E^2$ in succession has a larger area than the one exterior thereto and the buckets $c$ $c'$ $c^2$ correspondingly increase in area, so that as the steam becomes less in pressure the size of the buckets and passages and the surface exposed to the action of the steam is increased. It will also be seen that by reason of the steam being first taken at the periphery of the wheel the steam is admitted under the highest pressure and the greatest velocity upon that part of the wheel which is revolving at the highest speed, and as the pressure and velocity of movement of the steam become less it is delivered successively into buckets on the wheel which are moving at a less rate of velocity until it is discharged from the lowest-pressure chamber into the exhaust-chamber J, which surrounds the hub and shaft of the wheel. From this exhaust the steam is finally discharged through a suitable pipe or passage. By this construction the steam is received into the exterior annular chambers upon each side of the rotary wheel or disk at the highest pressure used, and is delivered therefrom into a corresponding series of annular reactionary buckets in the wheel and simultaneously upon opposite sides thereof, thus perfectly balancing the wheel and preventing any appreciable end pressure in either direction upon the shaft or any frictional contact between the moving parts greater than is necessary to keep the joints sufficiently tight. From these buckets the steam escapes into a second interior annular chamber of larger area, thus reducing the pressure of the steam and leaving the available pressure in the exterior row of buckets equal to the difference between the pressure in the outer chamber and the next interior one. This pressure is again reduced as it passes through the next larger series of buckets to the next interior chamber of still larger area, and by reason of the larger area of the buckets the effective pressure of the steam upon the wheel is kept up proportionately until the pressure is reduced to the point where it is delivered into the exhaust-chamber, and the movement of this portion of the wheel being much slower than that of the periphery the decreased pressure will still be proportionately effective in propelling the wheel.

The convergence of the sides of the disk or wheel, so that it is thinnest at the periphery, makes it much lighter and capable of a higher speed with safety, and it enables me to increase the size and depth of the buckets from the periphery toward the center with a minimum of metal.

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

1. A wheel mounted upon a shaft adapted to rotate upon its axis, U-shaped buckets formed concentrically upon the faces of the wheel, and having central dividing-webs, a casing having annular steam-chambers corresponding in position with the annular buckets in the wheel, and separated therefrom by a closed diaphragm against which the face of the wheel rotates, inclined passages made through said diaphragm from the steam-chamber and adapted to deliver steam into the outer leg of the U-shaped bucket, correspondingly-inclined discharge-passages connecting the inner legs of the buckets with the next interior steam-chambers whereby the steam delivered into the outer leg passes around the curvature with a reactionary force and is discharged from the inner leg.

2. A wheel mounted to rotate upon a central shaft, annular concentric series of U-shaped buckets formed in the face of the wheel, the legs of said buckets standing approximately parallel with intermediate webs and in the direction of rotation of the wheel, a casing against which the face of the wheel is adapted to rotate, an annular series of concentric chambers therein, corresponding in position with the rows of buckets in the wheel-face, inclined passages opening through the sides of the chambers and coinciding with the outer leg of each bucket in the wheel as they pass, other inclined passages through the sides of the chamber connecting with the inner leg of each series and discharging into the next interior chamber of the casing, whereby the steam acts successively and expansively upon each set of buckets from the outside toward the center of the wheel.

3. A wheel consisting of a disk mounted to rotate upon a central shaft, annular rows of U-shaped buckets formed upon opposite faces concentric with the axis and having central dividing-webs, each row increasing in size over the next exterior one, a stationary casing fitting against the opposite faces of the wheel having annular chambers upon opposite sides, said chambers corresponding with the annular rows of buckets upon the wheel, inclined passages formed in the faces of the chambers so as to discharge into the outer arms of the U-shaped buckets, corresponding passages coinciding with the inner arms of said buckets in each annular row,

and discharging therefrom into the next interior chambers of the case successively, an exhaust-chamber surrounding the shaft or hub of the apparatus into which the steam is finally delivered, and means for discharging it therefrom, a steam pipe or pipes connecting with the exterior chambers of the case whereby steam is admitted thereto under a high and equal pressure and thence passes successively through each row of buckets and chambers, upon opposite sides of the wheel simultaneously.

4. A disk mounted upon a shaft and revoluble between annular chambered casings which fit against its opposite faces and have steam-passages made through them, said disk being made thickest at the center, with its faces converging to the periphery, and having buckets coinciding with the steam-passages and increasing in size from the periphery toward the center.

In witness whereof I have hereunto set my hand.

ROBERT HEWSON.

Witnesses:
S. H. NOURSE,
JESSIE C. BRODIE.