No. 835,370. PATENTED NOV. 6, 1906.

J. W. SMITH.

BUCKET FOR STEAM TURBINES.

APPLICATION FILED SEPT. 7, 1905.

2 SHEETS—SHEET 1.

Fig: 1.

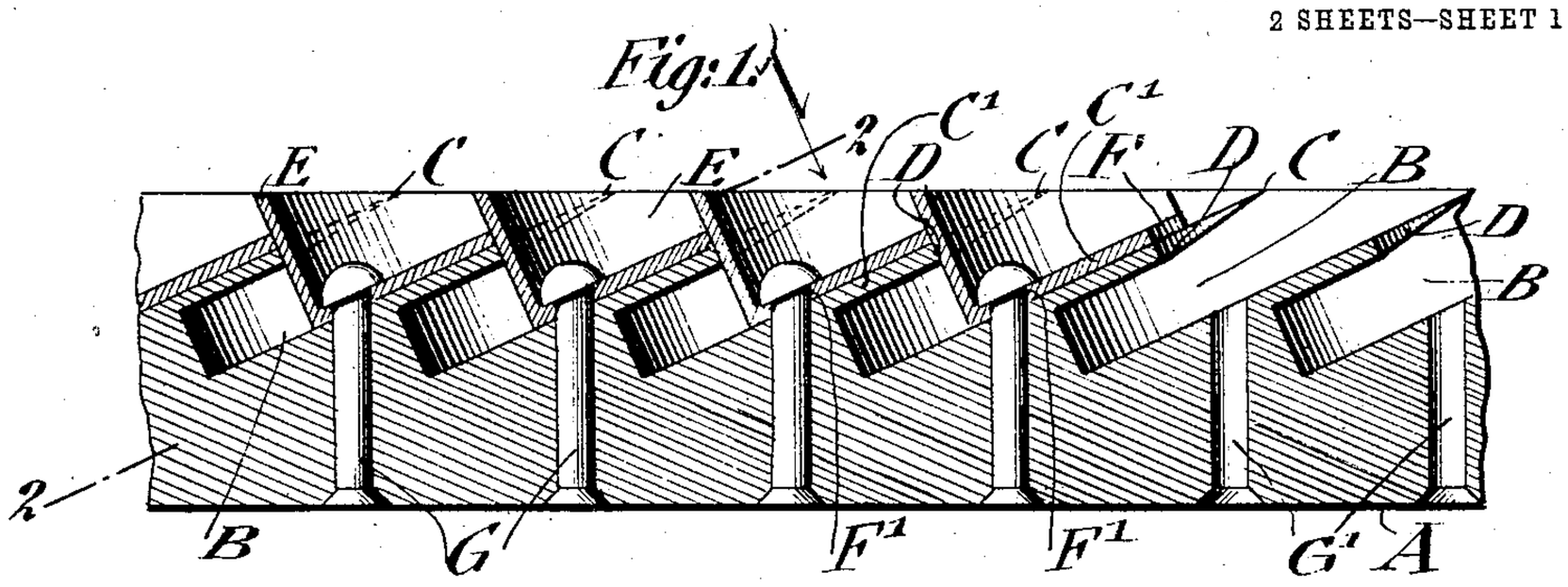


Fig: 2.

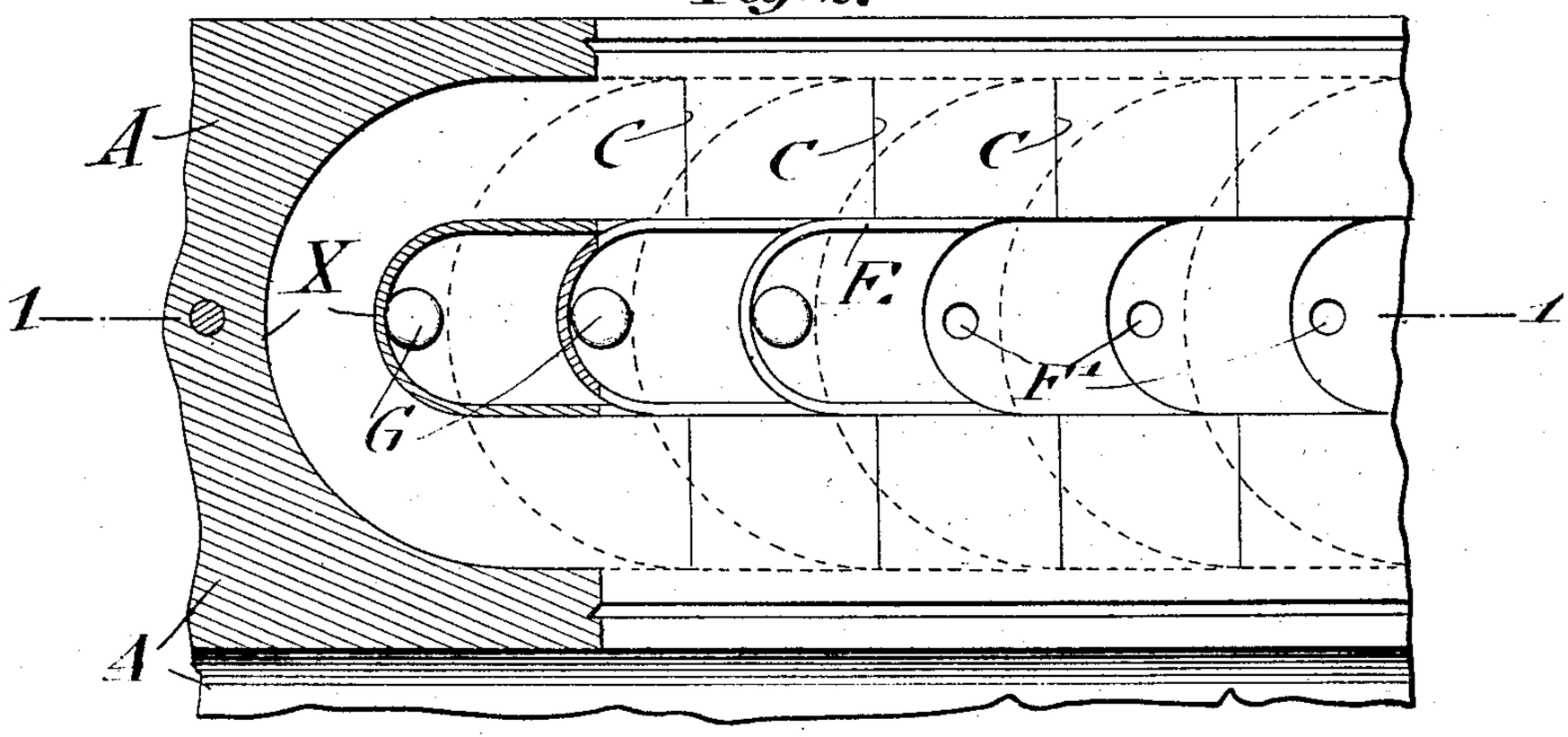


Fig: 3.

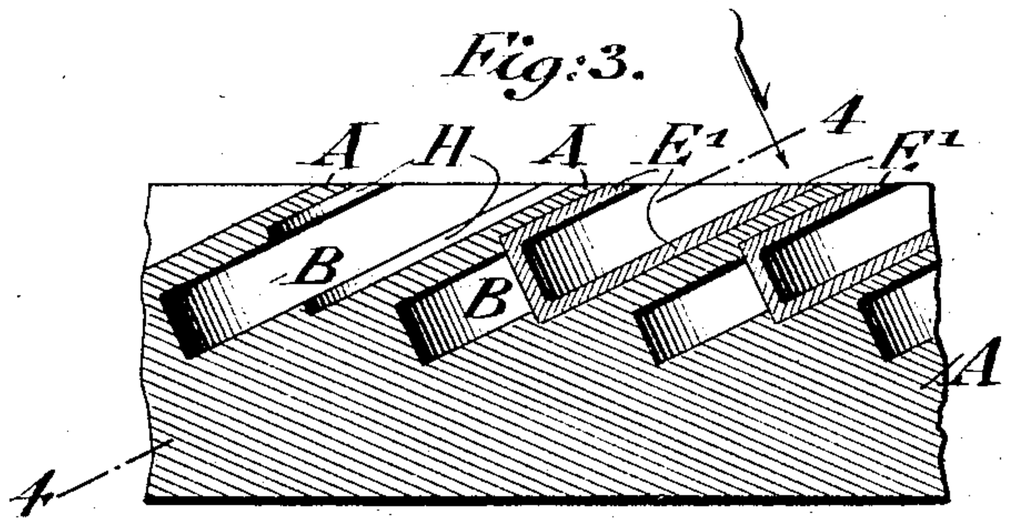


Fig: 4.

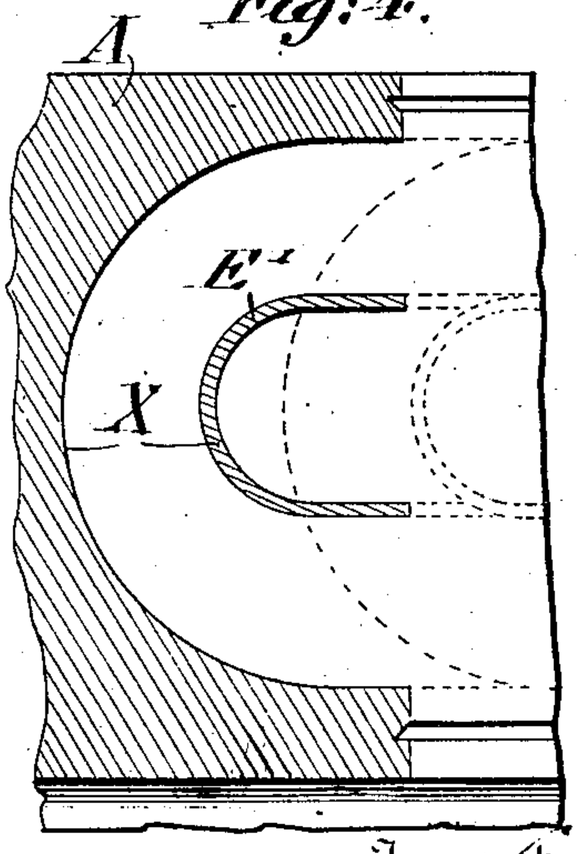
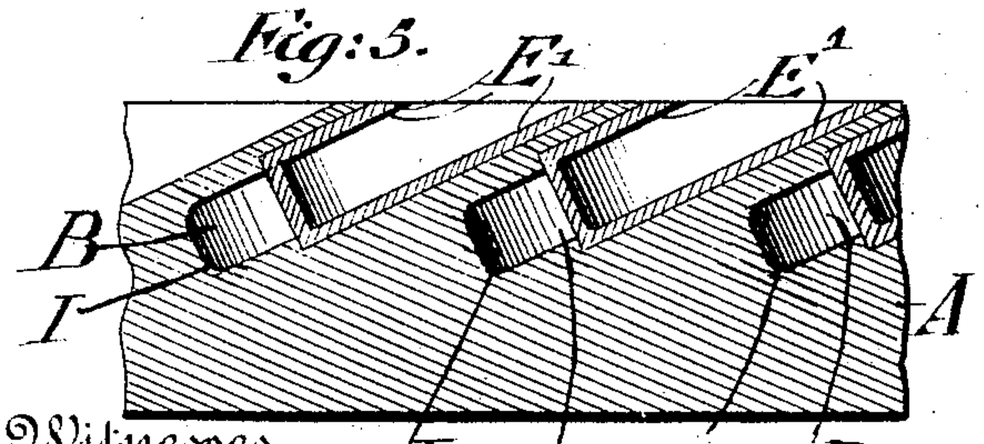


Fig: 5.



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2 SHEETS—SHEET 2.

Fig: 6.

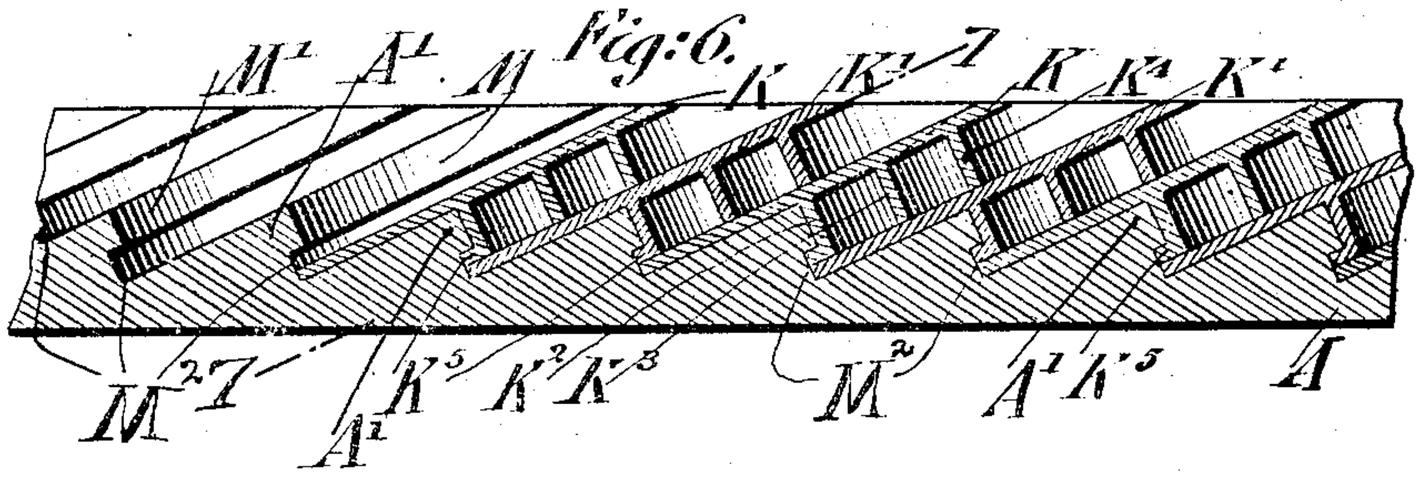


Fig. 7.

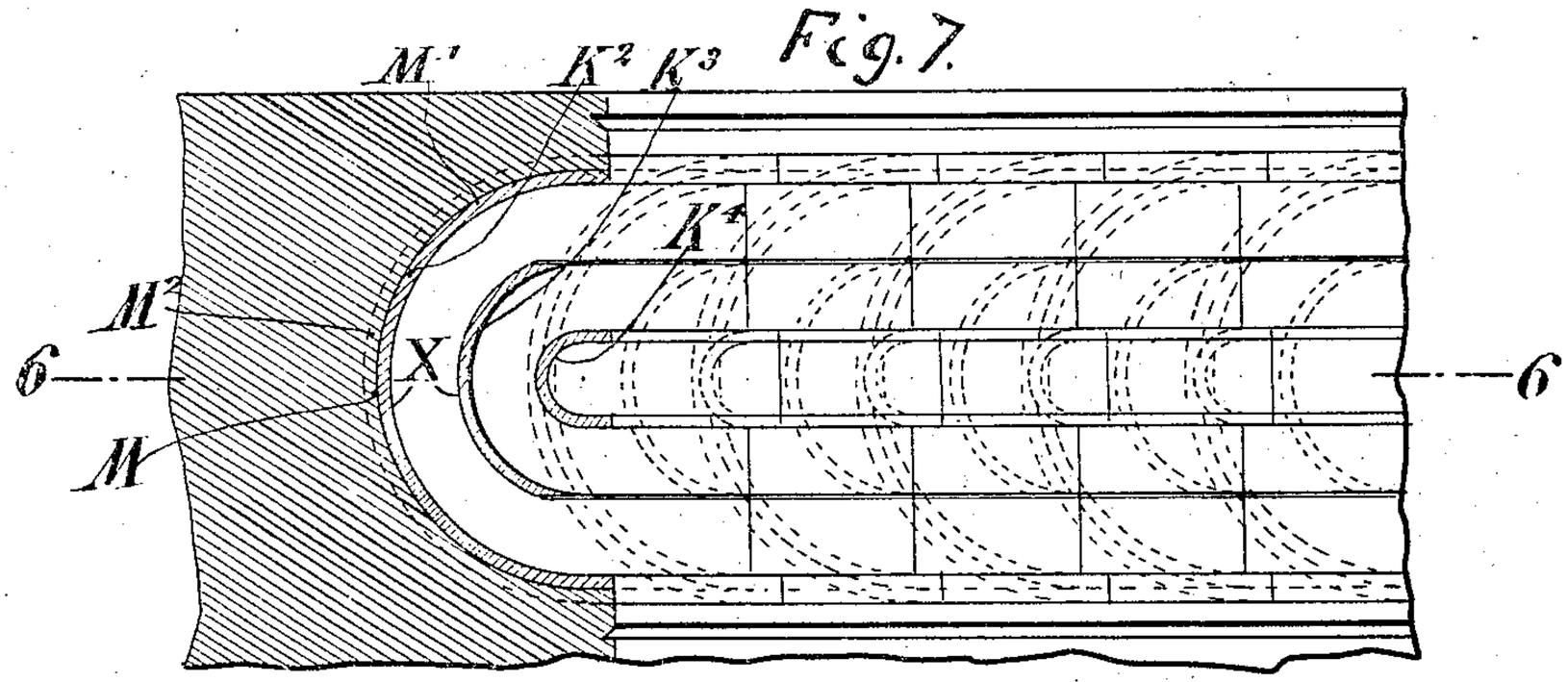


Fig: 8.

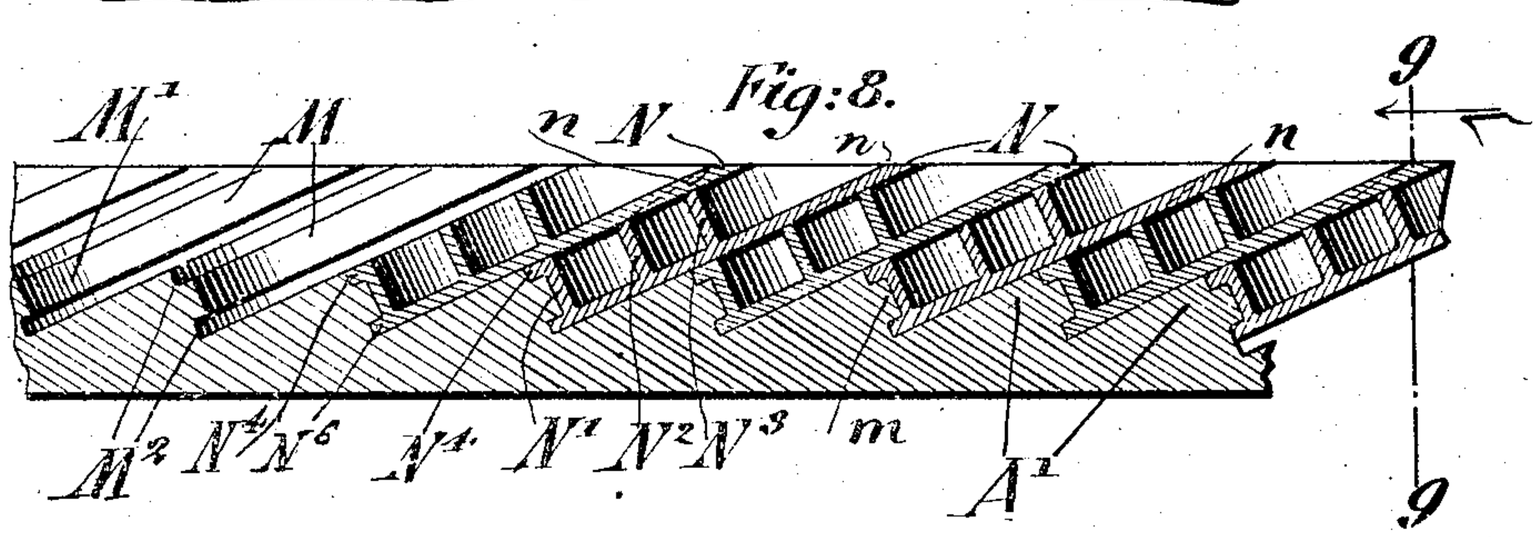
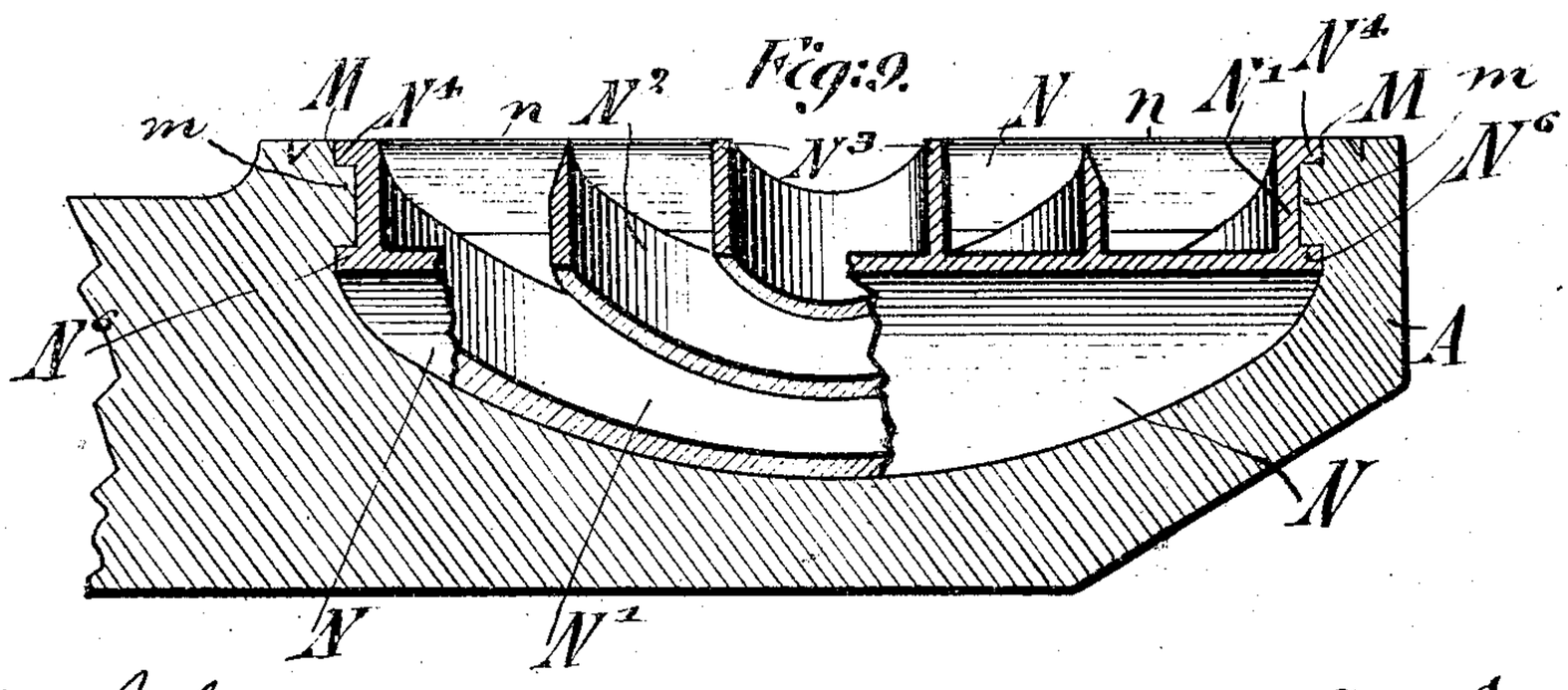


Fig: 9.



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UNITED STATES PATENT OFFICE.

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BUCKET FOR STEAM-TURBINES.

No. 835,370. Specification of Letters Patent. Patented Nov. 6, 1906.

Application filed September 7, 1905. Serial No. 277,335.

To all whom it may concern:

Be it known that I, JOHN W. SMITH, a citizen of the United States, residing in Erie, county of Erie, and State of Pennsylvania, have invented certain new and useful Improvements in Buckets for Steam-Turbines, of which the following is a specification.

In buckets as hitherto used eddy-currents were set up by the steam or other elastic fluid passing from one side of the bucket to the other. This is especially so when the peripheral speed is comparatively low in comparison to the jet velocity, as the centrifugal effect on small particles of steam causes it to be compressed. This compression in turn increases the density of the steam or elastic fluid at one portion of the bucket and decreases the density of the same at another portion of the bucket.

This invention relates to buckets for steam-turbines, and has for its object to provide a bucket the use of which will obviate the objectionable features caused by eddy-currents, as hereinabove set forth, and which absorb a certain amount of useful energy; and the invention has further for its object to provide a double or triplex bucket which may be readily inserted and attached to the turbine-wheel and by means of which the main jet of steam may be divided into several jets, each jet being so conducted as to be devoid of eddy-currents.

For this purpose the invention consists of an improved bucket for steam-turbines which is formed by providing a turbine-wheel with grooves or channels and arranging division-walls in respect to said grooves or channels so as to have the space between the turbine-wheel and division-walls form buckets.

The invention consists, further, when constructing small buckets in arranging the division-walls in respect to the grooves or channels of the turbine-wheel somewhat eccentric to the center thereof, thus decreasing the cross-sectional area of the path of the steam at the point of greatest compression; and the invention consists, further, when constructing comparatively large buckets, in arranging a division-wall in a division-wall, so as to form several buckets, or arranging a division-wall in a bucket so as to form a bucket within a bucket.

The invention consists, further, in certain novel features and combinations of parts, which will be more fully described hereinafter and finally pointed out in the claims.

In the accompanying drawings, Figure 1 represents a vertical longitudinal section through a series of buckets of a turbine-wheel, taken on line 1 1 of Fig. 2, showing the buckets provided with division-walls secured to the turbine-wheel by rivets. Fig. 2 shows a plan view of Fig. 1 as seen from line 2 2 of Fig. 1. Fig. 3 shows a vertical longitudinal section showing a turbine-wheel provided with division-walls which are retained by the turbine-wheel by friction. Fig. 4 shows a plan view of Fig. 3 as seen from line 4 4 of Fig. 3. Fig. 5 shows a slightly-modified form of Fig. 3, showing a circular bucket proper. Fig. 6 shows a vertical longitudinal section of a series of buckets of a turbine-wheel, showing duplex buckets. Fig. 7 is a plan view of Fig. 6 as seen from line 7 7 of Fig. 6. Fig. 8 shows a modified form of the buckets shown in Fig. 6, the bucket units being provided with flanges engaging grooves in the turbine-wheel; and Fig. 9 shows a perspective view of a bucket unit shown in Fig. 8 as seen from line 9 9 of Fig. 8.

Similar letters of reference indicate corresponding parts throughout the drawings.

Referring to the drawings, A represents the turbine-wheel, which is provided with grooves or channels B, which may be mortised out of the turbine-wheel or made in any other suitable manner. These grooves or channels guide the steam and form the buckets, as shown by the two grooves B in the right-hand side of Fig. 1.

The material of the turbine-wheel remaining between each adjacent groove is sharpened at its upper end, as shown by C in Fig. 1, and the central part of this remaining wall C′ is provided with a circular cut-out part D. In order to prevent the formation of eddy-currents in the grooves or channels B during the passage of the steam through the same, division-walls E are provided, each having an exterior portion of the same curvature as the circular cut-out part D. Each separate division-wall E is also provided with a circular cut-out part F of the same curvature as its circular exterior, so that when the division-walls are assembled each engages the cir-

cular cut-out part D of the wall C′ of the turbine-wheel A and also the circular cut-out part of the adjacent division-wall. Each division-wall is provided at its lower part with an opening F′, through which rivets G pass, and which in passing through holes G′ of the turbine-wheel secure the division-walls to the turbine-wheel.

The division-walls E may be readily assembled and when once secured to the turbine-wheel cause the grooves B to form the buckets proper.

Instead of the form shown in Fig. 1 the division-walls may be shaped so as to take the form shown in Fig. 3. In this case the material forming the walls between each successive bucket is provided with a recess, H, which is engaged by a division-wall E′ in such a manner that the frictional contact is sufficient to prevent the division-wall from being thrown out by centrifugal force during the rotation of the wheel. This modified form of division-wall does not require the use of rivets to secure them in position. In case it is desired to have the cross-section of the bucket proper of somewhat circular shape the grooves forming the buckets in Fig. 3 may be mortised so as to have rounded corners I, as shown in Fig. 5.

My improved division-walls besides performing their function as such may be used as buckets as well. In this case a division-wall of smaller size is arranged in a division-wall so that the outer part of the inserted division wall serves as a division-wall and the inner part of the same as the groove or channel, the bucket proper being formed by a second division-wall inserted in the first. This arrangement is intended for comparatively large buckets, and by it the formation of eddy-currents is entirely prevented. One form of the embodiment of this idea is shown in Fig. 6, where the turbine-wheel A is provided with an annular main groove M and in addition thereto with grooves M′ and recesses M^2, of somewhat larger curvature, arranged transversely therewith. In the form shown in this figure the grooves themselves do not form the buckets, as they did in the forms shown in Figs. 1 to 5, nor are walls provided separating one groove from the next adjacent. Instead of these bucket units are provided which consist of a separating wall member K, being tapering at its upper end K′ and which has projecting downwardly therefrom circular members or projections K^2, K^3, and K^4. The lower ends of the wall members K engage the recesses M^2 of the turbine-wheel, which recesses are also engaged by flanges K^5 of the circular member K^2, by the joint engagement of which the units are securely held in position. The lower part of the wall member K and the circular member K^5 abut snugly against the shoulder portion A of the turbine-wheel A. When assembled, the circular members K^2 and K^3 and the separating wall members K form the buckets proper, the member K^3 acting as a division-wall to this so-formed bucket. The circular members K^3 and K^4, together with the separating wall members K, form also a bucket proper of somewhat smaller size than the first-formed bucket, the inner wall of the members K^3 acting as a guide for the steam and the outer wall of the members K^4 acting as a division-wall. Hence two buckets, or a duplex bucket, is provided, which is formed by the wall and circular members. The circular members arranged on the wall members constitute a bucket unit, which as such may be readily manufactured and readily inserted in the turbine-wheel. By having each unit complete in itself the assembling in the work-shop is greatly facilitated. Instead of two buckets three or more may be as readily formed.

Another form of bucket-unit construction is shown in Fig. 8, in which case the turbine-wheel is again provided with an annular main groove M and in addition thereto with grooves M′ and recesses M^2, arranged transversely thereto. These recesses are so arranged that the material of the turbine-wheel remaining between the same forms a shoulder portion A′, having a dovetail portion *m* at its end. In the form shown in Fig. 8 the bucket units each consists of a separating wall member N, being tapering, its upper end *n* having upwardly-extending circular members N′, N^2, and N^3, the circular member N′ being set back from the lower end N^6 of the wall member N, so that the end of the wall member forms substantially a projection adapted to engage one of the recesses M^2. The free or upper end of the circular member N′ is provided with a flange N^4, which engages the other recess M^2, the circular member N′ itself fitting snugly against the shoulder portion A′ of the turbine-wheel. When the separate bucket units are assembled on the turbine-wheel, the adjacent wall members N form, with the circular members N′ and N^2, a bucket proper, the circular member N′ acting as a guide for the steam and taking the place of the groove in the form described in connection with Fig. 1 and the circular member N^2 acting as a division-wall. The circular members N^2 and N^3, together with the wall members, form also a bucket proper of somewhat smaller size than the first-formed bucket, the inner wall of the circular member N^2 acting as a guide for the steam and the outer wall of the circular member N^3 acting as a division-wall. Hence two buckets, or a duplex bucket, is provided and may be formed by the assembling of the separate units described. Instead of two buckets three or more may be as readily formed, depending on the size of the buckets desired. These separate units may be manufactured at a comparatively small cost and

in large quantities and may be easily assembled, each unit being inserted in the corresponding recesses—that is, the shoulder *m* of the turbine-wheel engages the channel-iron-shaped lower end of each unit. Each unit may be readily detached, so that repairs are greatly facilitated, as each unit is an entirety in itself and independent of the adjacent one. If the circular wall K^3 in the form shown in Fig. 6 and the circular wall N^2 in the form shown in Fig. 8 be made detachable or omitted entirely, the duplex buckets described would then become single buckets.

As the centrifugal force causes the particles of steam in the buckets to be compressed and the density of the same increased, it is advisable to reduce the area of the bucket in cross-section at the point where the steam reaches its greatest density. This may be avoided in larger buckets by dividing the steam into several streams, as when using duplex or triplex buckets, as hereinabove described, and in smaller buckets by reducing the cross-sectional area at the point of greatest compression—that is, not have the division-walls concentric to the grooves or channels, but eccentric thereto, as shown by X in Figs. 2, 4, and 7.

The construction shown is especially adapted for buckets of large dimensions, such as are used on a modern-size machine designed for running with a vacuum where the volume of steam has been increased by expansion to a larger proportion. By the use of my improved division-walls eddy-currents are completely done away with, and hence no useful energy absorbed, whereby the efficiency of the machine is reduced.

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

1. A turbine-wheel having mortised U-shaped grooves or channels, and division-walls forming buckets with said grooves or channels.

2. A turbine-wheel having mortised U-shaped grooves or channels, and detachable division-walls forming buckets with said grooves or channels.

3. A turbine-wheel having grooves or channels, division-walls forming buckets with the grooves or channels, and division-walls arranged in relation to said first-named division-wall, so as to form buckets therewith.

4. A turbine-wheel having an annular groove and recesses transversely thereto, and bucket units in said groove adapted to engage the recesses, each consisting of circular members and a separating wall member.

5. A turbine-wheel having an annular groove and recesses transversely thereto, and bucket units in said groove adapted to engage the recesses, each consisting of circular members and a separating wall member tapering at its upper end.

6. A bucket unit, consisting of a separating wall member and circular members thereon.

7. A bucket unit, consisting of a separating wall member, tapering at its upper end, and circular members thereon.

8. A bucket unit, consisting of a separating wall member and members integral therewith of substantially circular curvature.

9. A turbine-wheel having grooves or channels, and a plurality of division-walls substantially concentric to each other, the largest forming buckets with the grooves or channels, while the others form buckets within buckets.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

JOHN W. SMITH.

Witnesses:
F. H. SCHUTH,
J. A. FRITZ.