No. 648,158. Patented Apr. 24, 1900.

H. ZOELLY.

TURBINE WHEEL.

(Application filed Nov. 1, 1899.)

(No Model.) 2 Sheets—Sheet 1

Fig. 1.

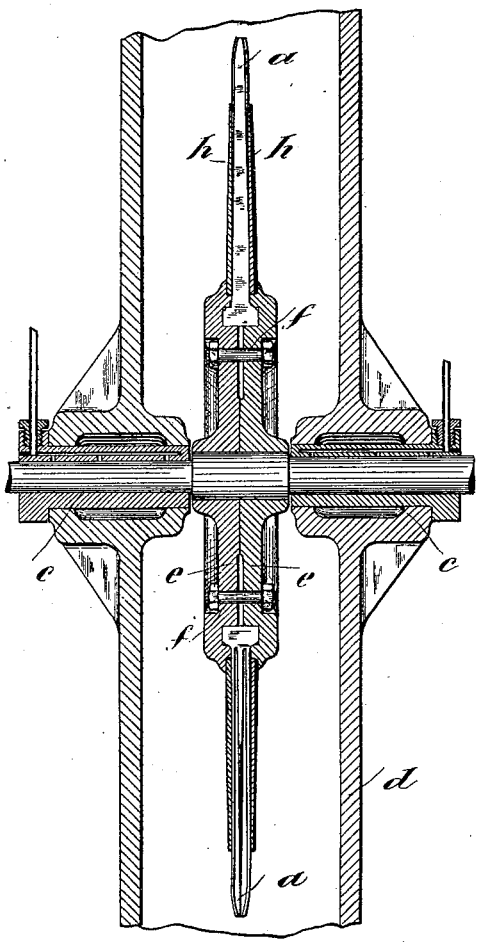
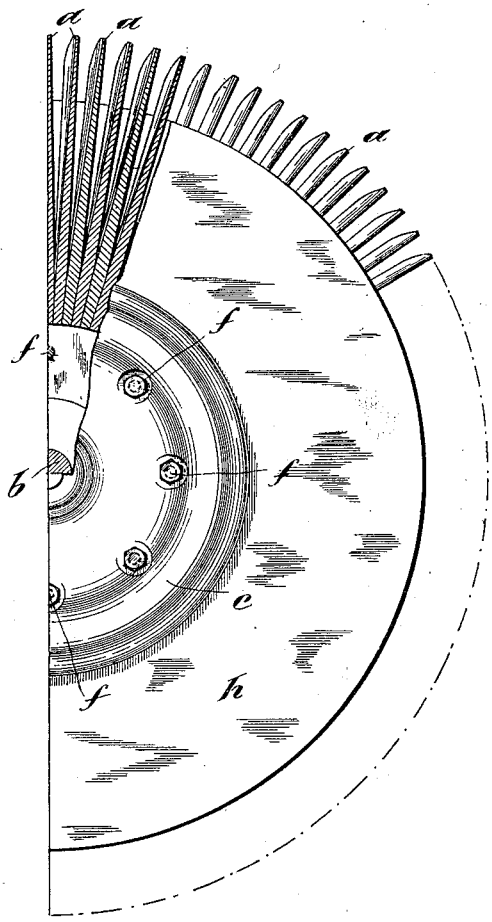


Fig. 2.



Witnesses:
D. W. Magruder
M. C. Massie.

Inventor:
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(No Model.) 2 Sheets—Sheet 2.

Fig. 4.

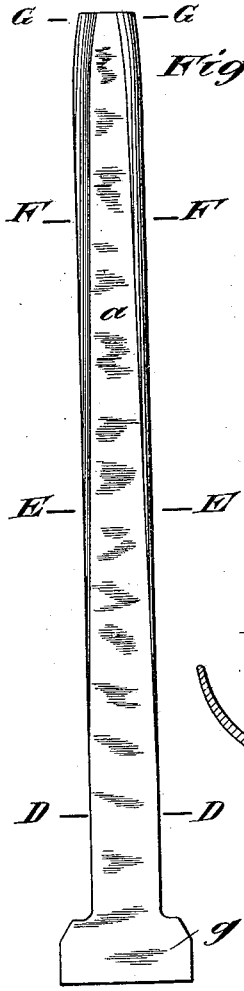
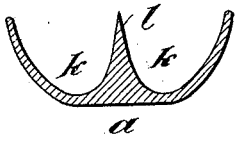


Fig. 10.



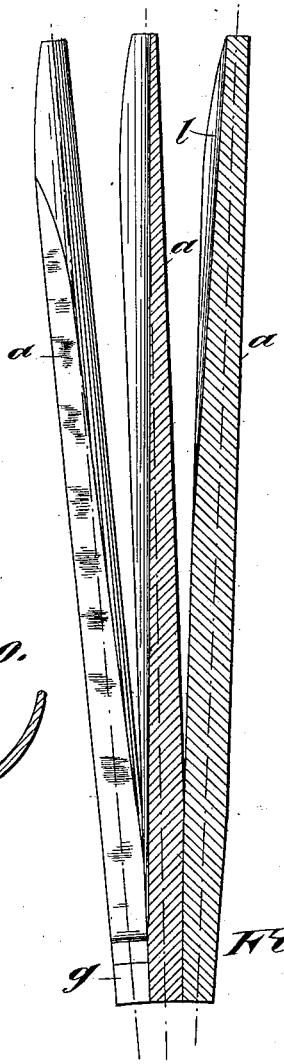


Fig. 3.

Fig. 6.

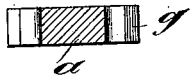


Fig. 5.

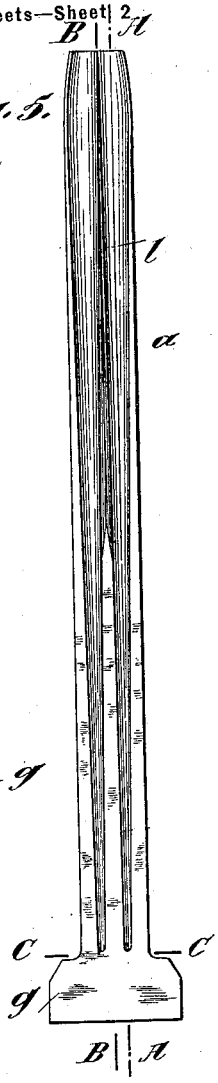


Fig. 9.

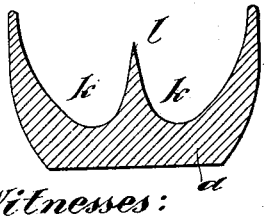


Fig. 8.

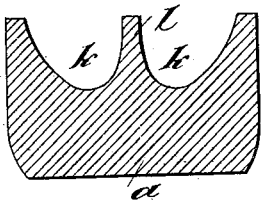
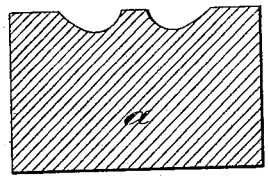


Fig. 7.



Witnesses:
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M. C. Marsie.

Inventor:
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by Max Georgii
his attorney

UNITED STATES PATENT OFFICE.

HEINRICH ZOELLY, OF ZURICH, SWITZERLAND.

TURBINE WHEEL.

SPECIFICATION forming part of Letters Patent No. 648,158, dated April 24, 1900.

Application filed November 1, 1899. Serial No. 735,528. (No model.)

To all whom it may concern:

Be it known that I, HEINRICH ZOELLY, a citizen of the Republic of Switzerland, residing at Zurich, Switzerland, have invented new and useful Improvements in or Connected with Turbine Wheels, (for which I have filed patents in Switzerland on the 8th of September, 1899, No. 22,067; in Germany on the 19th of September, 1899, without number; in France on the 16th of September, 1899, No. 280,654, and in Great Britain on the 20th of September, 1899, No. 18,979,) of which the following is a specification.

In a wheel for steam or gas turbines according to this invention the parts acted upon by the driving force consist of radial bars of comparatively great length the cross-section of which increases toward the axis of the wheel, so that the radial bars, in so far as centrifugal action is concerned, are of uniform or approximately uniform strength. The outer ends of the bars are shaped like reaction turbine buckets.

An example of a turbine wheel according to this invention is shown in the accompanying drawings.

Figure 1 shows the wheel and a casing surrounding it in axial vertical section; and Fig. 2 is an end elevation of one-half of the wheel, part being cut away. Fig. 3 shows to a larger scale three vanes or radial bars of the turbine wheel, the first in elevation, the second in section according to the line A A of Fig. 5, and the third in section according to the line B B of Fig. 5. Figs. 4 and 5 are side elevations corresponding to Fig. 3, and Fig. 6 shows a section according to the line C C of Fig. 5, while Figs. 7, 8, 9, and 10 show to a still larger scale cross-sections according to the lines D D, E E, F F, and G G of Fig. 4.

The wheel shown is of the following construction: On a shaft *b*, mounted in bearings *c* of a casing *d*, there are fixed between the bearings *c* two juxtaposed hub-disks *e e*, the rims of which grasp the radial bars *a*, which are placed close together. The hub-disks are each provided near their periphery with an annular groove, and these grooves form a space which serves for the reception of the enlarged feet *g* of the radial bars and corresponds in cross-section to these feet, so as to prevent the radial bars from coming out. In addition a thin disk *h* is arranged on the radial bars on each side of the wheel. These thin disks cover the openings between successive radial bars and leave only the outer ends of the said bars free. They have the object of preventing the suction which would be caused by these openings between the radial bars. These disks *h* are thickened toward the axis, so as to be of uniform or approximately uniform strength throughout.

The parts hereinbefore described are held together by screw-bolts *f*, which pass through the hub-disks *e e*.

The bearings *c* of the shaft *b* are placed as close together as possible in order to prevent any flexure of the shaft between them.

In the example shown the radial bars are (see Figs. 4 to 10) made of the same width and height along their entire length, or at least nearly along their entire length, inasmuch as they are only somewhat reduced at the outer end. On one side each of the radial bars has two grooves *k*, which are separated by a ridge *l* and which commence at the foot *g* and, in order to form the radial bars into vanes or buckets, become gradually wider and deeper, so that at the outer ends only a small thickness of material remains and the radial bars become thicker and thicker from their outer ends, which constitute reaction turbine vanes or buckets, toward the axis, so as to be of uniform or approximately uniform strength.

By omitting the ridge *l* the construction shown by way of example would be rendered still simpler and could then be employed specially for lateral steam admission.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination in a turbine wheel of radial buckets separated from each other for a part of their length, each bucket having its receiving-face channeled for the greater portion of its length, and a pair of flat disks inclosing said buckets from their inner ends for a greater portion of the length of the channeled part of the buckets, substantially as set forth.

2. The combination in a turbine wheel of radial buckets separated from each other for a part of their length, each bucket having its

receiving-face channeled for the greater portion of its length, and a pair of flat disks inclosing said buckets from their inner ends for the greater portion of the length of the channeled part of the buckets, said buckets having the channels increasing in size from their inner ends outwardly, substantially as set forth.

3. The combination in a turbine wheel of radial buckets separated from each other for a part of their length, each bucket having its receiving-face channeled for the greater portion of its length, and a pair of flat disks inclosing said buckets from their inner ends for the greater portion of the length of the channeled part of the buckets, said buckets having the channels increasing in size from their inner ends outwardly, and having a rib intermediate of said channels, substantially as set forth.

4. The combination in a turbine wheel of radial buckets separated from each other for a portion of their length, each bucket having its receiving-face channeled for the greater portion of its length, and a pair of flat disks inclosing said buckets from their inner ends for the greater portion of the length of the channeled part of the buckets, said buckets having the channels increasing in size from the inner end outwardly to within a short distance of their extremities, and then decreasing in size to the extremity, substantially as set forth.

5. The combination in a turbine wheel of a pair of hub-disks having the supporting-shaft mounted therein, radial buckets having their inner ends engaged between said hub-disks, a pair of flat disks inclosing said buckets for a part of their length, and means for retaining said pairs of disks in position, substantially as set forth.

6. The combination in a turbine wheel of a pair of hub-disks having the supporting-shaft mounted therein, radial buckets having their inner ends engaged between said hub-disks, a pair of flat disks inclosing said buckets for a part of their length, said flat disks being inclosed by said hub-disks, and means for clamping said hub-disks together to securely hold said buckets and flat disks in position, substantially as set forth.

7. The combination in a turbine wheel, of a pair of hub-disks having the supporting-shaft mounted therein, and having concentric channels in the inner faces, radial buckets having enlarged extremities adapted to be engaged by said channel-walls, a pair of flat disks inclosing said buckets for a part of their length, and means for retaining said pairs of disks in position, substantially as set forth.

8. The combination in a turbine wheel, of a pair of hub-disks having the supporting-shaft mounted therein and having concentric channels in the inner faces, radial buckets having enlarged extremities adapted to be engaged by said channel-walls for a part of their length, said latter disks being inclosed by said hub-disks at their inner portion, and means for clamping the hub-disks together to securely hold said buckets and flat disks in position, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HEINRICH ZOELLY.

Witnesses:
MORITZ VEITH,
A. LIEBERKNECHT.