No. 811,805. PATENTED FEB. 6, 1906.

J. STUMPF.

STEAM TURBINE.

APPLICATION FILED DEC. 26, 1901. RENEWED SEPT. 19, 1904.

Fig. 1.

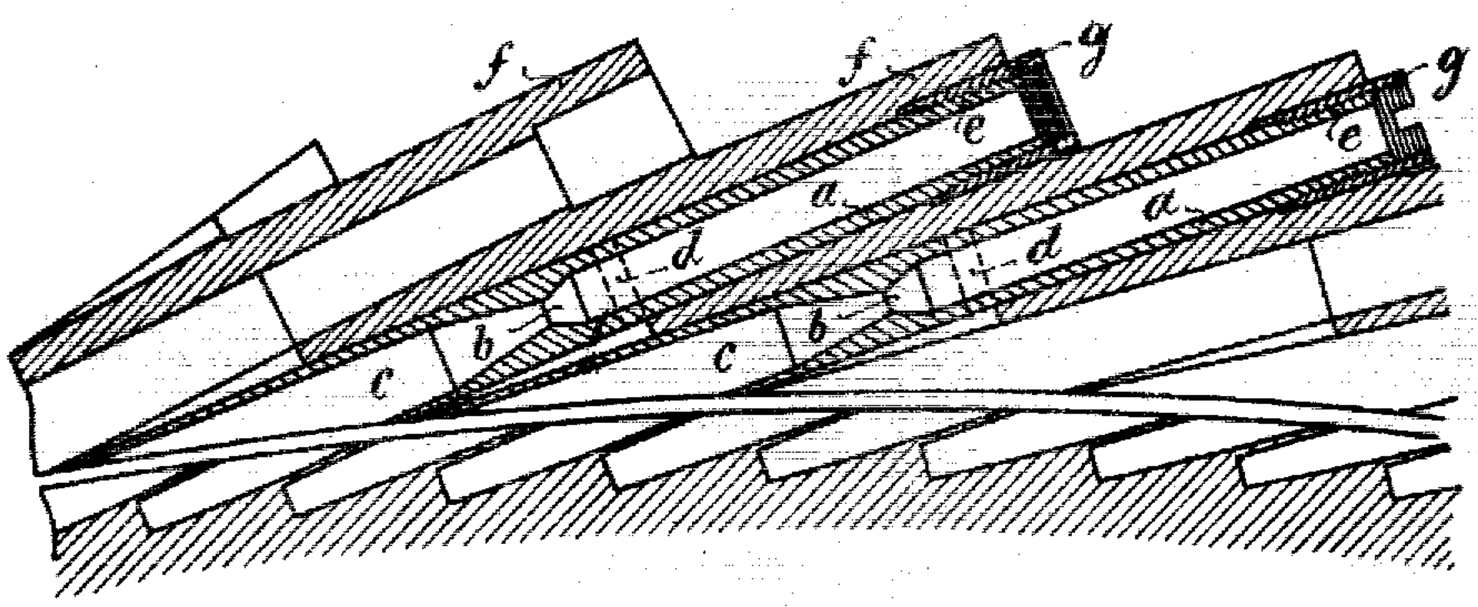


Fig. 2.

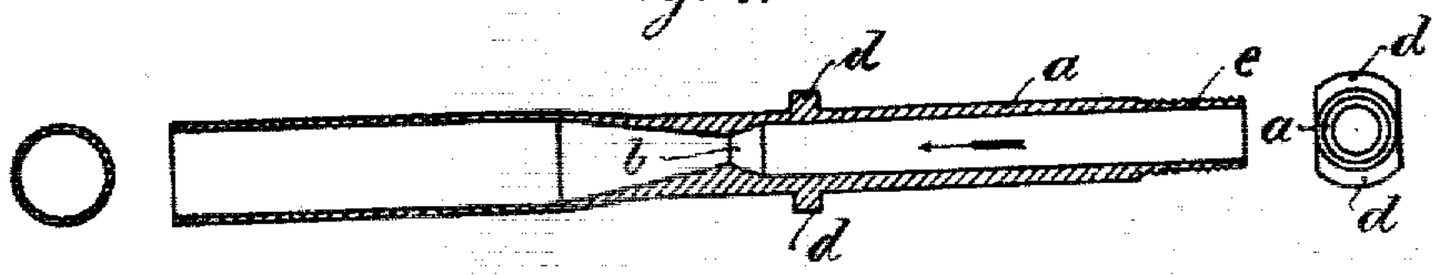


Fig. 3.

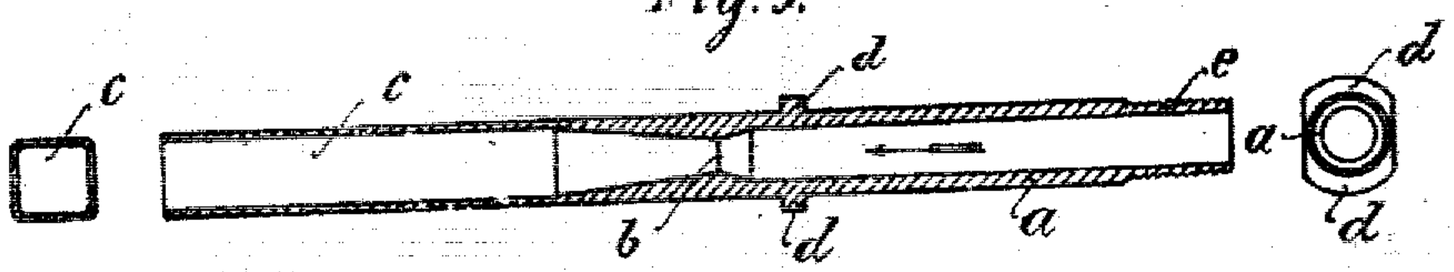
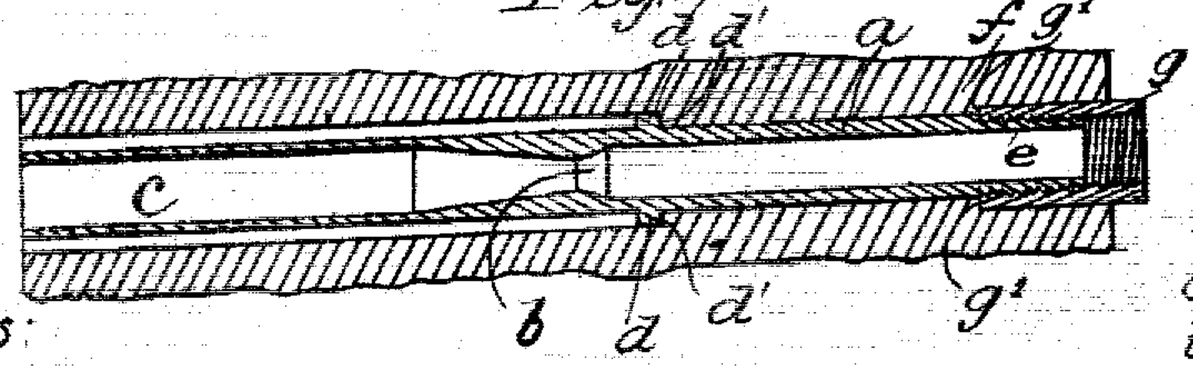


Fig. 4.



Witnesses:
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UNITED STATES PATENT OFFICE.

JOHANN STUMPF, OF BERLIN, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

STEAM-TURBINE.

No. 811,805. Specification of Letters Patent. Patented Feb. 6, 1906.

Application filed December 26, 1901. Renewed September 19, 1904. Serial No. 224,960.

To all whom it may concern:

Be it known that I, JOHANN STUMPF, a subject of the King of Prussia, German Emperor, and a resident of 27 Rankestrasse, Berlin, in the Kingdom of Prussia, German Empire, have invented certain new and useful Improvements in Steam-Turbines, of which the following is an exact specification.

My invention relates to improvements in steam or gas turbines, and more especially to improvements in the construction of the inlet-nozzle situated around the turbine-wheel proper, and has for its purpose to provide an improved construction by means of which the velocity of the steam is converted into a rotary motion with the minimum of waste or loss of power.

One embodiment of my invention is represented in the accompanying drawings, in which—

Figure 1 is a vertical section of part of the inlet-nozzle and part of the turbine bucket-wheel. Figs. 2 and 3 show the construction of the nozzles. Fig. 4 is a horizontal section through a nozzle, showing the manner of fixing the nozzles in the frame.

The ring by means of which the steam or gas is led to the turbine-wheel proper consists, according to my invention, of single nozzles which are arranged or combined so as to form a ring surrounding the turbine-wheel. The nozzles consist of metal pipes *a*, Figs. 2 and 3, provided with a contracted passage *b*, situated in about the middle thereof. The steam enters these nozzles in the direction of the arrow shown in Figs. 2 and 3 and passes through the narrow passage *b*, whereupon it expands, whereby the energy of pressure is converted into energy of velocity, or *vis viva*. The nozzles are first manufactured with a round cross-section throughout, as shown in Fig. 2, whereupon the lower or so-called "expansion" part of the same is compressed by suitable dies, so that the cross-section of this part becomes a parallelogram, as shown at the left in Fig. 3. The expansion part of the nozzles must be straight in order to allow of a perfect expansion of the steam and an equal distribution of the same throughout. The ends of the nozzles are beveled, as shown in Fig. 1, to correspond with the periphery of the turbine-wheel. The frame *f* around the turbine-wheel is so constructed that the lower ends of the nozzles are situated so as to nearly touch each other, thereby causing the steam or gas to flow upon the turbine-wheel in one continuous ring or zone around the entire circumference of the bucket-wheel. It will be understood that by the steam flowing upon the turbine-wheel rim in one continuous ring a much better efficiency is attained and the disadvantages which always arise by the different single steam-jets reacting against each other are entirely avoided. This advantage can only be attained when the nozzles have a rectangular discharge or expansion section throughout. In event of the expansion part *c* of the nozzle having a round section the continuity of the steam-ring will be broken at the points where the cylindrical walls contact, and the several steam-jets would then react upon each other, so that their directions of flow would not be exactly parallel to each other and the bucket-spaces would not be properly filled.

In order to fix the nozzles in the frame *f*, they are provided with noses or flange-pieces *d* on both sides, as may be seen from the end views on the right-hand side of Figs. 2 and 3. In the frame *f* holes for receiving the nozzles are provided, the diameter of which corresponds in the upper part exactly to the diameter of the part *a* of the nozzle. In the lower part the section of the holes corresponds to a cross-section through the nozzles and the flanges *d*, Fig. 4. At the upper end the diameter of the holes is enlarged to receive the retaining devices or nuts *g*. In mounting the nozzles in place they are inserted from the inside of the ring into the holes until the flanges *d* abut the faces *d'*, Fig. 4, after which they are secured in place by the nuts *g*. The outer diameter of each nut corresponds to the diameter of the upper end of a hole in the frame *f*. By rotating the nut the lower edge thereof will abut the faces *g'*, thereby rigidly holding the nozzle in the frame. By fixing the nozzles in the frame *f* in this way they can be taken out and replaced without disturbing the others or taking off the whole nozzle-ring. A further advantage consists in the fact that the nozzles can be easily replaced wholly or in part. By this arrangement it is a simple matter to change from a set of nozzles having one expansion ratio to a second set having a different cross-section or different form or ratio of

expansion—as, for example, where it is desired to use steam or gas of different pressure.

It will be understood that the arrangement shown can be used for turbines operating on the total-injection plan as well as for turbines operating on the partial-injection plan. Thus, for example, nozzles may be provided on one part of the frame only or the frame may be provided with parts in which there are no nozzles.

In accordance with the provisions of the Patent Statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a steam or gas turbine, the combination of a bucket-wheel and a nozzle-frame, of nozzles fixed in the frame, the said nozzles comprising an inlet part having a round section, a straight expansion part having a rectangular section and a narrow passage situated between these parts, substantially as described and for the purpose set forth.

2. In a steam or gas turbine, the combination of a bucket-wheel and a nozzle-frame, of nozzles fixed in the frame, the said nozzles comprising an inlet part having a round section, a straight expansion part having a rectangular section and a narrow passage situated between these parts, the nozzles being situated so as to leave only a small wedge-shaped part between the expansion part of the same, substantially as described and for the purpose set forth.

3. In an elastic-fluid turbine, the combination of a bucket-wheel, a nozzle-support which has the same curvature as the wheel and is provided with a number of openings arranged in the same plane, and detachable nozzles which are located in said openings and in close proximity so as to discharge the motive fluid in a solid jet.

4. In an elastic-fluid turbine, the combination of a bucket-wheel, a nozzle-support having the same curvature as the wheel and provided with a number of closely-associated openings which discharge the fluid in a solid column, detachable nozzles located in said openings, and means for securing the nozzles in place.

5. In an elastic-fluid turbine, the combination of a bucket-wheel, a nozzle-support having the same curvature as the wheel and provided with a number of closely-associated openings, nozzles located in said openings which may be removable by moving them in the direction of their length, and individual devices for securing the nozzles in place which are so arranged that one nozzle can be removed without disturbing the other or others.

6. In an elastic-fluid turbine, the combination of a bucket-wheel having peripheral buckets, a nozzle-support which surrounds the wheel and is in proximity thereto, nozzle-receiving openings formed in the support which are closely associated, and a plurality of nozzles located in said openings which are nearer together at their inner than their outer ends, shoulders on the nozzles which determine their positions, and means for securing the nozzles in place.

7. In an elastic-fluid turbine, the combination of a bucket-wheel, a nozzle-support, and a plurality of closely-associated and individually-removable nozzles which discharge fluid to the wheel in the form of a solid jet, the said nozzles being alike in form.

8. In an elastic-fluid turbine, the combination of a bucket-wheel, a nozzle-support, a plurality of closely-associated detachable nozzles which discharge fluid to the wheel in the form of a solid jet, the said nozzles being alike in form, and means for securing the several nozzles to the support.

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

JOHANN STUMPF.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.