No. 811,639. PATENTED FEB. 6, 1906.

P. F. HOLMGREN.

TURBINE ENGINE.

APPLICATION FILED MAY 26, 1904.

Fig. 1.

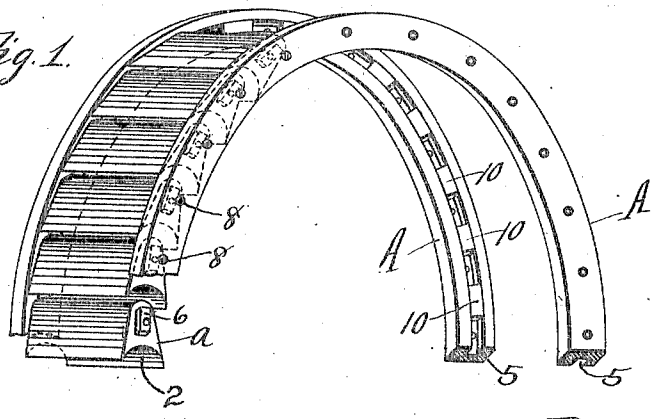


Fig. 2.

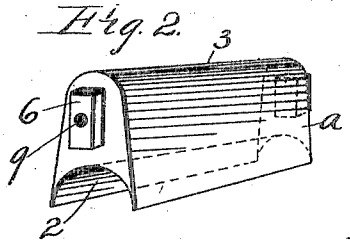


Fig. 10.

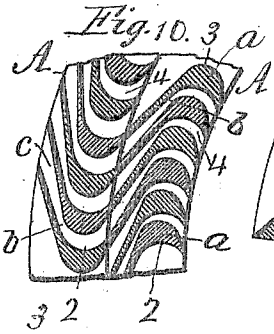


Fig. 3.

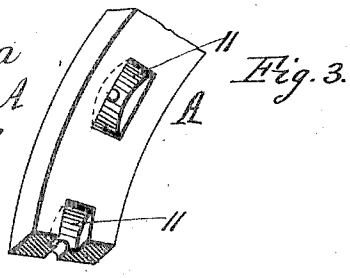


Fig. 4.

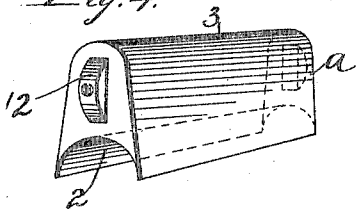


Fig. 5.

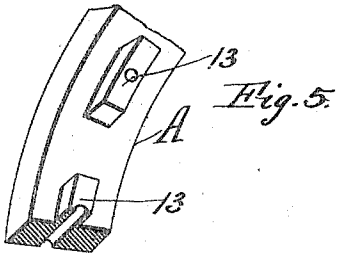


Fig. 6.

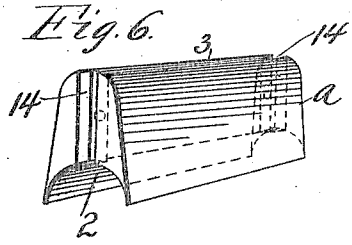


Fig. 7.

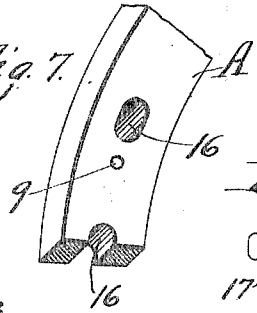


Fig. 9.

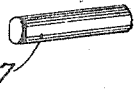
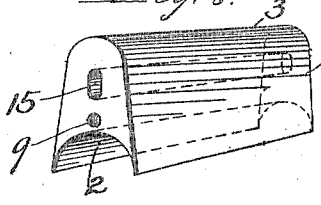


Fig. 8.



WITNESSES:

L. Almquist.

C. Sedgwick.

Per

INVENTOR

P. F. Holmgren.

BY

A. P. Thayer

ATTORNEY

UNITED STATES PATENT OFFICE.

PER F. HOLMGREN, OF NEW YORK, N. Y.

TURBINE-ENGINE.

No. 811,639. Specification of Letters Patent. Patented Feb. 6, 1906.

Application filed May 26, 1904. Serial No. 209,350.

To all whom it may concern:

Be it known that I, PER F. HOLMGREN, a citizen of the United States of America, and a resident of the borough of Brooklyn, New York city, State of New York, have invented certain new and useful Improvements in Turbine-Engines, of which the following is a specification.

My invention relates to turbine-engines in which buckets to receive the impact of the steam are arranged in close succession to each other between rings, to which they are connected at the ends, respectively, in cycles; and it consists of the improved means for so connecting the buckets whereby the same may be cheaply and substantially constructed and will be especially efficient in preventing displacement on their fastenings by the centrifugal action of unbalanced parts.

It also consists of an improved form of issue for the escaping steam after impact on the bottom of the buckets, whereby expansion of the escaping steam has further impelling effect, as hereinafter described, reference being made to the accompanying drawings, in which—

Figure 1 is a perspective view of parts of a cycle of buckets in which the buckets are connected in accordanec with my invention. Fig. 2 is a perspective view of one of the buckets of Fig. 1 detached from the rings and enlarged for greater clearness. Fig. 3 is a perspective view of a detached section of one of the rings, showing a modification of the bucket-connecting device. Fig. 4 is a perspective view of a detached bucket adapted for connection with the ring, as in Fig. 3. Fig. 5 is a perspective view of another detached section of a ring, showing another modification of the connecting device. Fig. 6 is a perspective view of a detached bucket adapted for connection with the ring, as in Fig. 5. Fig. 7 is a perspective view of another detached section of a ring, showing another modification of the connecting device. Fig. 8 is a perspective view of a bucket adapted for connection with the ring, as in Fig. 7. Fig. 9 is a perspective view of a piece to be used in making the connection of Fig. 7. Fig. 10 is a detail in transverse section of some of the buckets, showing a form for expansion of the escaping steam after concentration by impact of the bottom of the buckets.

In the kind of turbine-engines to which my invention relates there are one or more cycles of buckets having concave faces, which receive the impact of steam through chutes or nozzles, directing it into said faces tangentially and from which it escapes in reverse tangential direction for impact and reactionary effect, this being a well-known form of engine, the general construction of which it is unnecessary to show and describe, as the invention herein claimed is confined to the particular means of connecting the buckets and the rings comprising the bucket-cycles, as follows:

A represents a pair of metallic rings of equal size which are placed a suitable distance apart to receive and have connected to them and to carry the buckets *a* between them. The said rings are of rectangular cross-section suitable for running in steam-tight ways within the inclosing case, and the buckets have the before-mentioned concave faces, as 2, for the impact of the steam, with convex rear parts 3, and are placed in close succession one to another with spaces 4 for the steam to pass. Commonly the steam is directed onto the buckets from within the bucket cycle, but is sometimes applied reversely. As heretofore constructed, the rings A have been made with plain inside faces, with the plain ends of the buckets abutting against them and bolted through the rings with dowel-pins to prevent the buckets from shifting on the bolts by the effect of centrifugal action under high speed on the unbalanced buckets. I have found that boring and fitting the connecting screws and dowels with sufficient accuracy involves considerable unnecessary labor and expense and is not as reliable and satisfactory in operation as may be provided according to my invention, as follows: In constructing the rings A, I turn a plain groove 5 in the inner face of each, and in constructing the buckets *a* I form on each end an integral stud 6 of angular shape, adapted to fit in a groove 5, so as to afford ample security against the turning of the buckets, and bolt the buckets and rings together with tap-bolts through holes 8 in the rings into holes 9 in the buckets and studs. The bolts will be countersunk in the outsides of the rings, and I fill the intervening spaces of the grooves between the studs of the buckets with groove-filling blocks 10 to prevent escape of steam between the buckets, the blocks being placed in loosely. I do not, however, limit myself to continuous grooves in the rings, as in Fig. 1, but will mill out recesses, as 11, Fig. 3, and

provide correspondingly-shaped studs, as 12, Fig. 4, having the same effects, and, again, the rings A may be formed with studs, as 13, Fig. 5, and the buckets *a* may be grooved in the ends, as 14, Fig. 6, with like effect, and instead of grooving the buckets in the end they may be formed with a flat-sided perforation, as 15, Fig. 8, coincidently with like perforations 16 of the rings, with a separately-formed correspondingly-sided stud 17 to be inserted, such perforation 15 and stud 17 preferably reaching entirely through the bucket and both rings. In this case the tap-screws 9 for connecting the rings and buckets may be inserted independentiy of the stud 17. It will be seen that in all these ways of connection of the buckets and rings it is a parallel-sided recess of one part and a correspondingly-formed stud of the other part providing positive and non-slackening means of securing the buckets from shifting relatively to the rings by centrifugal action. To obtain advantage of further impelling effect of the steam after concentration and compression by its impact on the bottom of the buckets, I reduce the space between the buckets at *b* when after compression on the bottom of the buckets the escape begins and thereafter increase said space along the passage *c*, whereby some further reactionary effect is produced than would be obtained without such reduction.

What I claim as my invention is—

1. In a bucket cycle for turbine-engines, the combination of a pair of rings and intermediate buckets, said buckets connected at the ends with the rings respectively, the said connection consisting of a parallel-sided recess of one part and a correspondingly-formed stud of the other part fitting the recess for securing the buckets from shifting relatively to the rings by centrifugal action, said rings and buckets also bolted together.

2. In a bucket cycle for turbine-engines, the combination of a pair of rings and intermediate buckets, said buckets connected at the ends with the rings respectively, the said connection consisting of a parallel-sided recess of one part and a correspondingly-formed integral stud of the other part for securing the buckets from shifting relatively to the rings by centrifugal action, said rings and buckets also bolted together.

3. In a bucket cycle for turbine-engines, the combination of a pair of rings and intermediate buckets, said buckets connected at the ends with the rings respectively, the said connection consisting of a parallel-sided groove in the rings, and parallel integral studs of the buckets fitting therein to secure the buckets from shifting relatively to the rings by centrifugal action, said buckets and rings also bolted together.

4. In a bucket cycle for turbine-engines, the combination of a pair of rings, and intermediate buckets, said buckets connected at the ends with the rings respectively, the said connection consisting of a parallel-sided groove in the rings and parallel integral studs of the buckets fitting therein with filling-blocks in the grooves intermediately of the studs, to secure the buckets from shifting relatively to the rings by centrifugal action, said buckets and rings also bolted together.

Signed at New York this 18th day of May, 1904.

PER F. HOLMGREN.

Witnesses:
C. SEDGWICK,
J. M. HOWARD.