No. 883,891. PATENTED APR. 7, 1908.

W. KIESER.

TURBINE WHEEL AND BUCKET.

APPLICATION FILED OCT. 15, 1906.

Fig. 1.

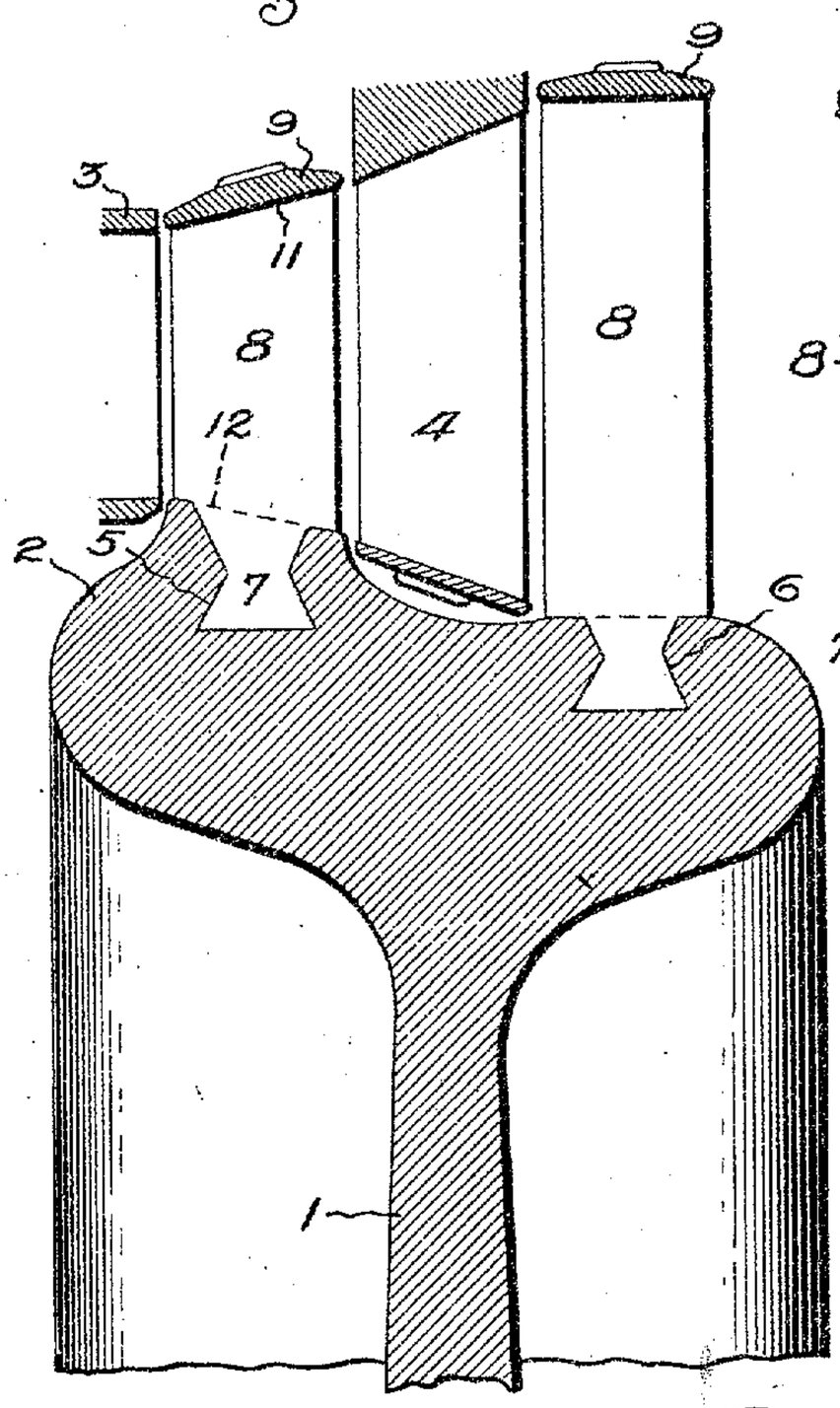


Fig. 2.

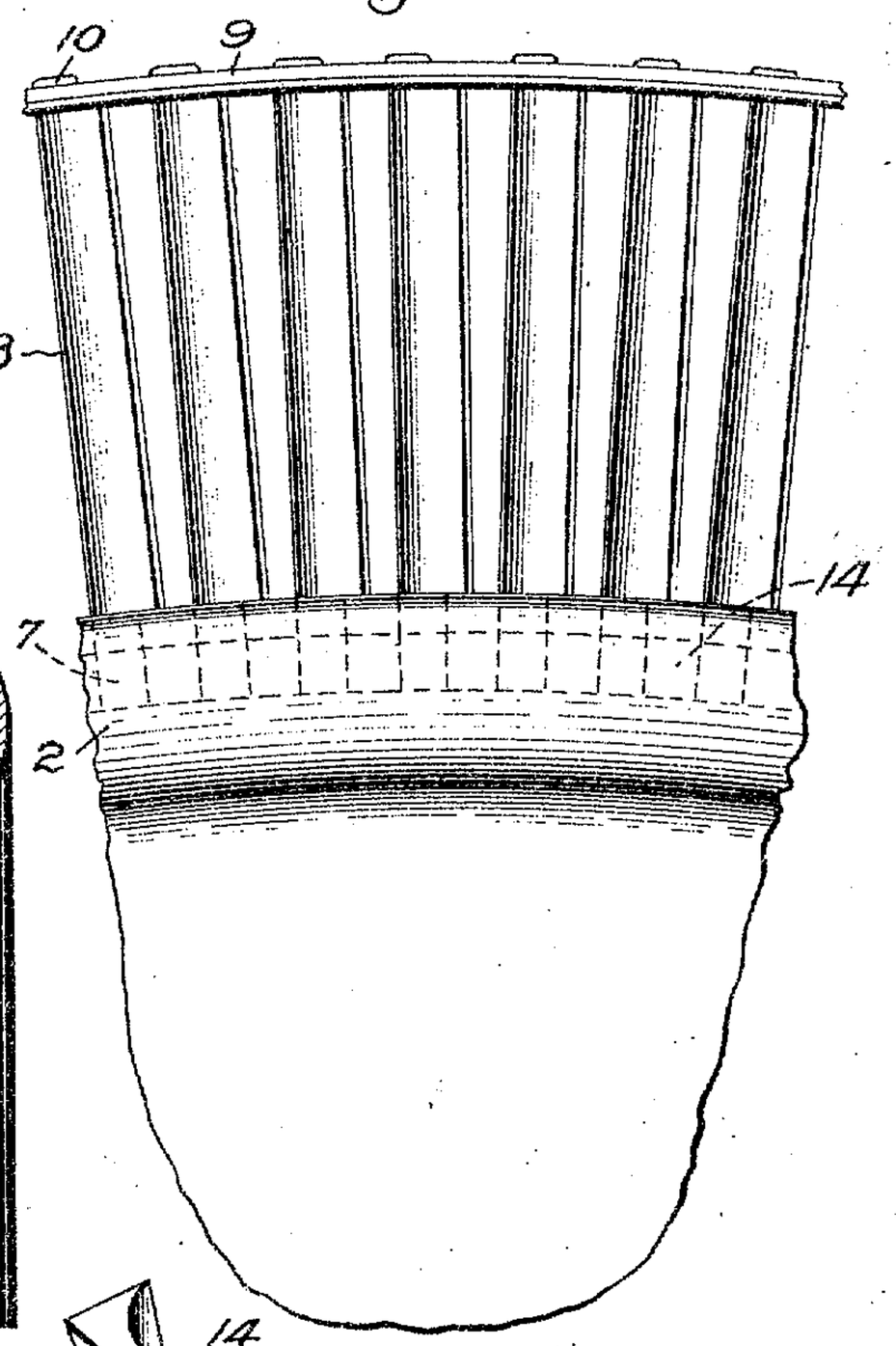


Fig. 3.

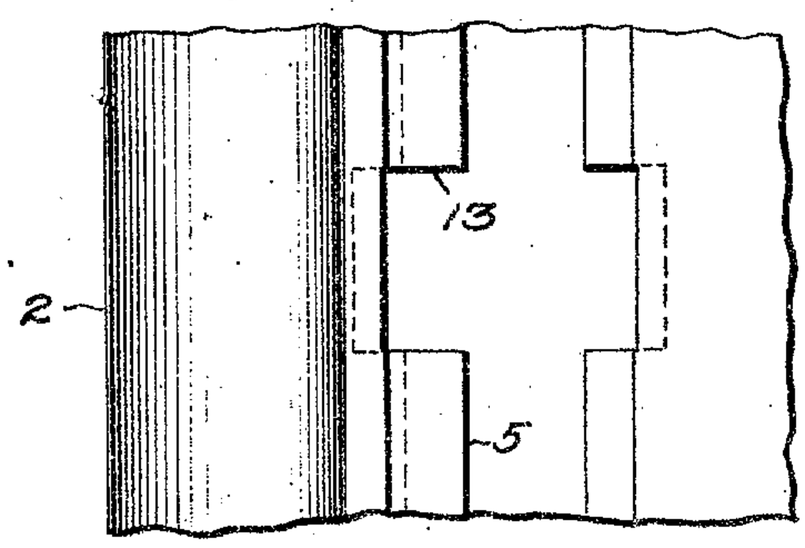


Fig. 6.

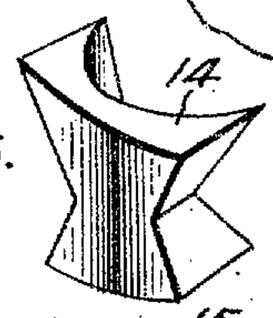


Fig. 4.

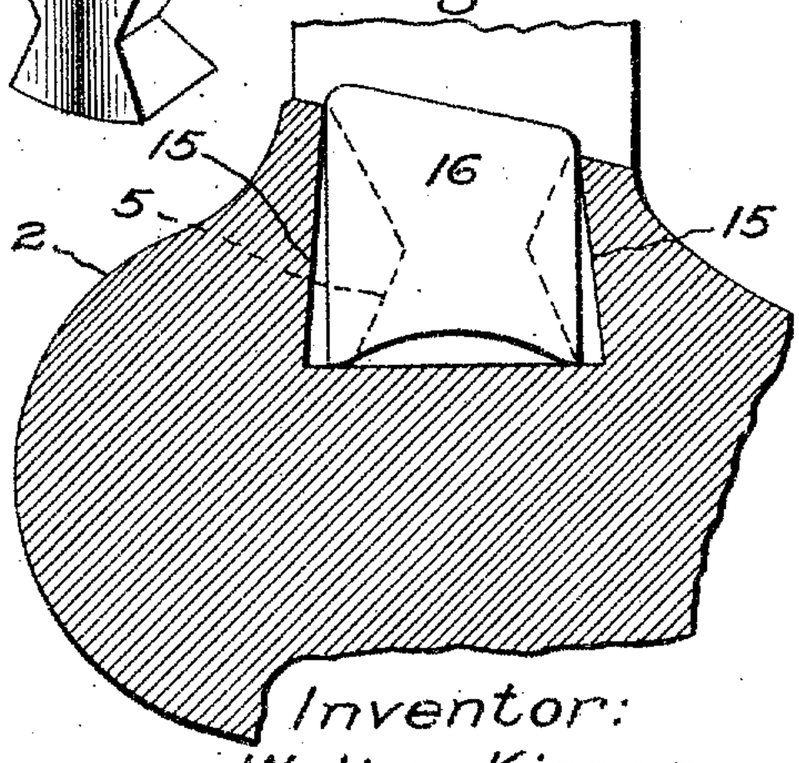
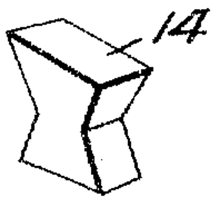


Fig. 5.



Witnesses:
Marcus L. Byng.
Alex. F. Macdonald.

Inventor:
Walter Kieser,
by Albert G. Davis
Att'y

UNITED STATES PATENT OFFICE.

WALTER KIESER, OF BERLIN, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TURBINE-WHEEL AND BUCKET.

No. 883,891. Specification of Letters Patent. Patented April 7, 1908.

Application filed October 15, 1906. Serial No. 338,895.

To all whom it may concern:

Be it known that I, WALTER KIESER, a citizen of Switzerland, residing at Berlin, Germany, have invented certain new and useful Improvements in Turbine-Wheels and Buckets, of which the following is a specification.

The present invention relates to turbine wheels and buckets therefor, and has for its object to improve their construction.

In the accompanying drawing, which illustrates one of the embodiments of my invention, Figure 1 is an axial section of a part of a wheel having two rows of buckets; Fig. 2 is a partial elevation of the same; Fig. 3 is a plan view of a part of the wheel showing the recess for inserting the buckets in the retaining groove; Fig. 4 is a partial cross-section of a wheel showing the locking or retaining block, and Figs. 5 and 6 are views of space blocks.

The wheel 1 is provided with a rim 2 having well rounded sides so as to reduce the amount of stock and, therefore, the weight. It is important to keep the weight down as much as possible, particularly for high speeds, so as to reduce the centrifugal strains. The rim is made on two diameters, the portion of larger diameter supporting the buckets adjacent the nozzle 3, and the portion of smaller diameter supporting the second row of buckets which are considerably longer than the first to accommodate the increased volume of motive fluid. Between the rows of wheel buckets is a more or less complete row of intermediate buckets 4, mounted on a suitable support carried by the casing of the turbine.

In the periphery of the wheel grooves 5 and 6 of suitable shape, are turned to receive the bases of the buckets. Each groove forms a double dovetail in cross-section, and the base 7 of each bucket 8 is made to fit snugly into the groove. The free ends of the buckets are provided with covers 9 which are secured by tenons 10 formed integral with the buckets and riveted over at their outer ends. It is to be noted that the walls 11 and 12 of the working passage between the high-pressure buckets diverge toward the exhaust. The angle of divergence of the walls is preferably the same, or substantially the same at the top and bottom so that the particles of the motive fluid can expand equally in both directions. This is much superior to the commonly used arrangement having the bottom wall extend parallel to the shaft and obtaining the divergence solely by inclining the cover, since the angle of inclination of the cover was so great as to prevent the rapidly moving fluid from properly filling the bucket space or working passage. With the old construction the motive fluid had a tendency to shoot through the space without acting on every part of the working faces of the buckets. Another advantage derived from the construction is, that the external diameter of the longer or low-pressure buckets is not so great as compared to the high-pressure buckets as would be the case if the rim of the wheel were of cylindrical form. By decreasing the external diameter of the low-pressure buckets, the diameter of the wheel casing can be made less, resulting in economy of construction. Where the wheel casing is made in the form of an unbroken cylinder, and the intermediates slipped axially into place over the low-pressure buckets, less space between the said bucket cover and the casing wall is required with my improved construction than where the expansion in the bucket space is all on one side, and the wheel rim cylindrical.

Owing to the shape of the grooves in the wheel it is necessary to provide an arrangement whereby the buckets can be inserted; this is shown in Fig. 3. At a suitable point in the wheel or other support, the groove is enlarged to form a recess 13. The recess should be of such length and breadth that the base of each bucket will readily enter it, and also the space blocks 14 to be located between buckets when such devices are used.

The buckets are inserted in the recess and then moved into the groove to their ultimate position. After a bucket is located, a space block is inserted through the recess into the groove, and so until the groove is filled. I have found it convenient to make the bucket bases and space blocks fit fairly tight in the groove and to force them around to their ultimate position by a suitable stool, which enters the groove and engages the base or block, as the case may be. Either the wheel or the tool may be movable for this purpose. The last few buckets and space blocks may be driven into place by a hammer and suitable hand tool. I may use one recess for each groove, or two or more as desired. In either event the first bucket is set about midway, and the remainder inserted from opposite directions.

In order to lock the buckets in place and also to close the recess, a special locking means is provided. The side walls 15 of the recess are undercut and into the recess and communicating groove is inserted a locking piece or block 16. This block may be made of different materials and in a variety of ways, the essential feature being that it shall be capable of being readily inserted in place and afterwards expanded to fill the recess and engage the undercut wall 15 and also the adjacent buckets. In Fig. 4 is shown a locking piece which I have found to be satisfactory. It can, with advantage, be made of copper, and in its original shape it extends a short distance above the top of the groove and is cut away at the bottom to form points which yield when subjected to pressure. When hammered or otherwise expanded it will spread at the bottom and at the same time expand laterally so as to completely fill the recess and communicating groove and also engage adjacent buckets. In some cases it will be found satisfactory to make the locking piece flat on the bottom. It is to be observed that the locking piece is self-retaining when expanded and also that it is only subjected to such centrifugal strains as are occasioned by the mass of metal of which it is composed, which strains are comparatively small.

I have shown my invention as applied to wheel buckets, but it is obvious that it can be used in connection with stationary or intermediate buckets as well. It is to be understood that in so far as the bucket-securing means are concerned, the invention can be used in connection with machines having one row of buckets on a wheel or with drums having a large number of rows of buckets thereon, with intermediate buckets between. When applied to such a machine it has great advantage because the locking means is located in line with the buckets and does not project beyond the edges of the buckets. Such being the case, it follows that the support is not weakened by reason of the locking means, and further, that the maximum number of rows of buckets can be mounted on a support of minimum length. In both the wheel and drum construction the locking arrangement requires only a very small amount of machine work in addition to the bucket-receiving grooves, is simple in construction and of such character that workmen of average skill may be employed. In event of injury to one or more buckets in a row, the locking piece can be drilled out and the buckets removed one after the other, including damaged ones, and new buckets inserted to take the place of the injured ones, and the remainder reinserted. In event of the buckets remote from the locking piece being damaged, they may be cut out, an additional recess made and the new buckets inserted in the manner previously described. This has the great advantage that only the injured buckets need be removed, thereby decreasing the cost and amount of labor involved, and the amount of time that the machine is out of service.

In Fig. 5 is shown a space block suitable for use where the buckets are provided with bases that are substantially rectangular in cross-section, or are provided with opposed flat faces. In Fig. 6 is shown a space block suitable for use with buckets having bases that are curved front and back in accordance with, or substantially in accordance with the curvature of the concave and convex faces of the buckets. When individual space blocks are used it will be found desirable to make the filling recess conform closely in shape and size to said blocks, so that they can be slipped into place without difficulty, and when in place, will fill the space in the groove between buckets.

I have shown buckets with bases forming a double dovetail, but it is to be understood that I can use a single dovetail if desired, or any other equivalent form.

In so far as the bucket-securing means are concerned, the upper and lower walls of the working passage between the buckets need not diverge. In other words, the passage can be non-expanding instead of expanding, in character.

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 understand 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. A turbine wheel having a rim comprising two portions one of which is larger in diameter than the other, bucket-receiving and retaining grooves in both portions, two rows of buckets mounted in the grooves, space blocks between the buckets, a locking piece anchored in each groove for holding the buckets and blocks, one row of said buckets being mounted on the portion of larger diameter, the other on the portion of smaller diameter, the working passages between the buckets in each row diverging both at the top and the bottom to facilitate the action of the motive fluid on the buckets.

2. A turbine wheel having a rim comprising two portions one of which is larger in diameter than the other, bucket-receiving and retaining grooves in both portions, two rows of buckets, one row being mounted in the grooves of the portion of larger diameter, and the second row in the other, space blocks between the buckets, a locking piece anchored

in each groove for holding the buckets and blocks, and covers for the free ends of the buckets, the covers and wheel coöperating to form the walls of the working passages, the said covers and wheel portions diverging by equal amounts toward the exhaust to facilitate the action of the motive fluid on the working faces of the buckets.

3. A bucket structure having a groove therein the walls of which engage with and retain the bucket bases, buckets having bases which are mounted in the groove and are retained by the walls thereof, a recess through which the bucket bases are inserted into the groove, the said recess having an undercut wall, and a bucket-locking piece which is inserted in the recess and afterwards expanded to engage said undercut wall.

4. A bucket structure having a groove therein the walls of which engage with and retain the bucket bases, buckets having bases which are mounted in the groove and are retained by the walls thereof, a recess located in the plane of the buckets and communicating with said groove through which the buckets are inserted, and a locking piece which is inserted in the recess and is located between two adjacent buckets and is expanded after being inserted for the purpose of securing it and the buckets in place.

5. A bucket structure having a groove therein with a restricted opening and an enlargement through which buckets and space blocks are inserted, buckets whose ends are first inserted in the groove through the enlargement and then moved circumferentially to place, space blocks between the buckets which are similarly inserted and moved, and a locking piece which is located in the enlargement and is expanded to hold it in place.

In witness whereof, I have hereunto set my hand this sixth day of October, 1906.

WALTER KIESER.

Witnesses:

ALEX. F. MACDONALD,

HELEN ORFORD.