No. 822,801. PATENTED JUNE 5, 1906.

J. WILKINSON.

TURBINE BUCKET WHEEL.

APPLICATION FILED SEPT. 2, 1905.

Fig. 1.

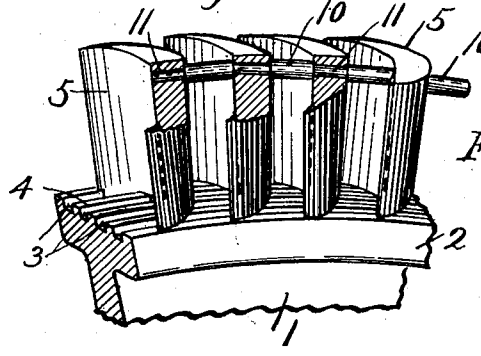


Fig. 4.

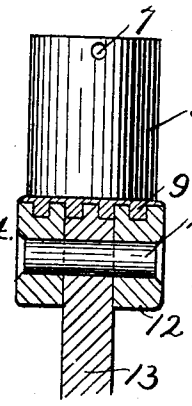


Fig. 2.

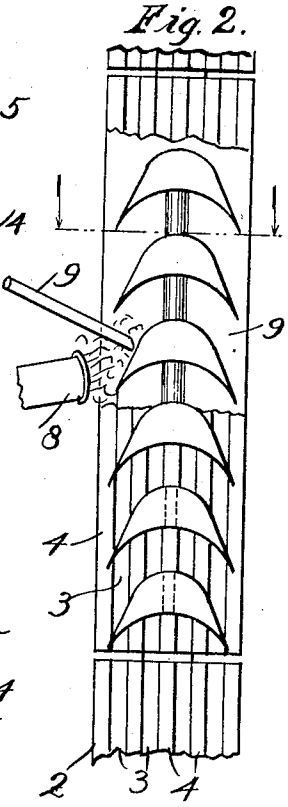


Fig. 5.


Fig. 3.

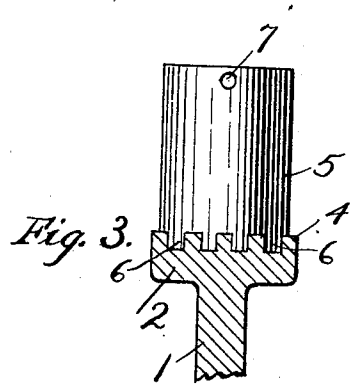


Fig. 8.

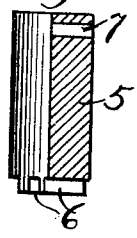


Fig. 7.

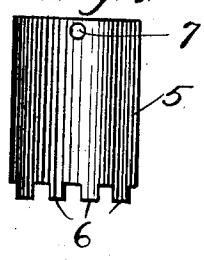


Fig. 9.

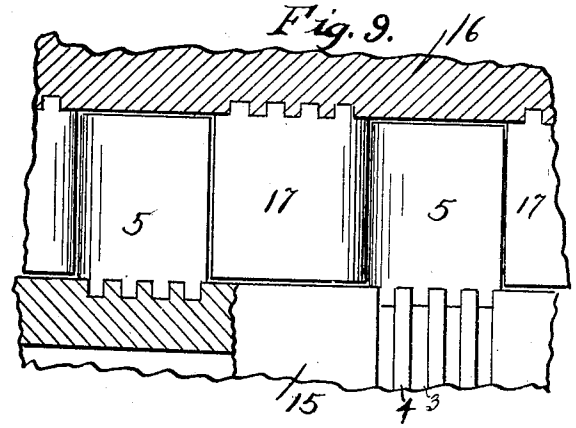


Fig. 6.


Fig. 10.


Witnesses

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# UNITED STATES PATENT OFFICE.

JAMES WILKINSON, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO WILKINSON TURBINE COMPANY, A CORPORATION OF ALABAMA.

## TURBINE BUCKET-WHEEL.

No. 822,801. Specification of Letters Patent. Patented June 5, 1906.

Application filed September 2, 1905. Serial No. 276,808.

*To all whom it may concern:*

Be it known that I, JAMES WILKINSON, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented new and useful Improvements in Turbine Bucket-Wheels, of which the following is a specification.

My invention relates to an improvement in bucket wheels, drums, or intermediate holders; and it consists chiefly in the novel manner of connecting the vanes or buckets to the wheel drum or holder by means of brazing.

My invention is particularly adapted for use in elastic-fluid turbines, the "bucket-wheels" (which term I shall hereinafter use as inclusive of drums, rotors, or intermediate holders) constituting one of the most expensive, as well as difficult, parts of the machine to manufacture.

The buckets, which are generally small in dimension and closely positioned on the wheel, so that they practically overlap, have proven very difficult to cut from the solid, whereby the maximum wheel strength is obtained.

In use the buckets are subjected to high centrifugal and impact strains, which requires that they should be able to withstand under test as high as fifty to sixty thousand pounds pressure per square inch. When this is considered, the difficulty of fastening separately-manufactured buckets to a wheel with sufficient strength will be evident.

As a general rule the buckets have been manufactured with base-blocks which have been bolted or riveted to the wheel; but this practice is objectionable because of increased cost of bucket manufacture and decreased wheel strength due to bolt-holes.

When the buckets have been cut from a strip rolled to the proper cross-sectional shape, they have been produced at comparatively small cost; but it has proven difficult to fasten them on the wheel so that the requisite joint strength is obtained without considerable expensive machine-work on the wheel, such as cutting deep sockets for the buckets.

It is the object of my invention to braze buckets to a wheel or bucket-supporting element and provide a joint which shall possess a large percentage of the full strength of the solid metal, while requiring but little machine-work. If buckets manufactured from metal of high tensile strength were brazed to the wheel by a plain butt-joint, they would possess substantially fifty per cent. of their strength when cut from the solid. The strength of this character of bucket-fastening may be materially increased by enlarging the surface area of the joint upon which the solder or spelter can take effect. Thus if the wheel and bucket be provided with interlocking portions the extent and strength of the brazed joint are increased and the buckets are able to stand up better under high-friction heats. I propose to use as a preferred construction a bucket cut from a strip and provided with a plurality of integral roots or tenons adapted to interlock closely with a correspondingly-recessed portion of the wheel or support. To reduce the machine-work on the latter parts, I may provide the wheel or support with a plurality of continuous parallel grooves in its bucket-supporting surface, into which the bucket roots enter and in which they may be secured at any desired distance apart by brazing-spelter. The spelter will fill the bucket-joints and grip the roots on all sides, so that when it hardens five sides of each root will be united to the wheel. I thus secure a joint having the full breaking strength of the metal in the roots, besides the strength of the brazed joint between the bucket and top surface of the ribs between the grooves in the support. The spelter may be used to fill up the grooves between the buckets, if desired.

In mounting buckets on a wheel by brazing or other process requiring the application of heat it is desirable to avoid the possibility of injury to the wheel from expansion or contraction strains by heating as little as possible of the bucket-supporting portion. My preferred construction is of particular value in this connection, for by making the wheel-grooves shallow the ribs on the wheel-rim will take the heat from the torch or blowpipe and conduct it quickly under the bucket-joint to enable the brazing to be effected rapidly and without heating the wheel-rim deeply.

The heat for brazing may be applied in various ways, but in any event it is advantageous to provide against the possibility of warping the wheel due to unequal expansion or contraction of the rim and web portions of the wheel. To meet this condition, I pro-

vide means, such as transverse slits or expansion-joints, at one or more points around the rim, preferably transversely and radially disposed, and of a character designed to permit the rim portions to expand and contract fully without subjecting the web or inner portion of the wheel to a compression strain due to the changes in dimension of the rim.

A further advantage of my invention is that the devices for fastening the buckets together at their outer ends may be readily brazed in position, spacer-pins being preferably used and brazed to one or both of the buckets between which they are disposed.

As illustrative of one means of carrying my invention into effect, but without limitation to details of construction thereof, I make reference to the accompanying drawings, in which—

Figure 1 is a perspective view of a portion of the rim of a bucket-wheel with buckets brazed thereto and partly broken away to illustrate the means for fastening them at their outer ends. Fig. 2 is a top plan view of a bucket-wheel, showing one manner of applying brazing-spelter to unite the buckets to the rim. Fig. 3 is a section of the wheel-rim, showing the manner in which the bucket roots interlock therewith before the introduction of the brazing-spelter. Fig. 4 is a similar view of a modified construction of wheel-rim after brazing. Figs. 5 and 6 are top and bottom views, respectively, of one of the buckets. Figs. 7 and 8 are detail front and sectional views of the bucket. Fig. 9 illustrates my invention applied to a drum or rotor. Fig. 10 is a detail view of a pin for fastening the outer ends of the buckets together.

Similar reference-numerals refer to similar parts throughout the drawings.

The bucket-wheel 1, which may be of any desired construction, is shown provided with an integral flanged rim 2, whose outer periphery is provided with circumferential channels or grooves 3, which may have any desired cross-section. As shown, they have parallel side walls and substantially correspond in width with the thickness of the intervening annular ribs 4. The buckets 5 are concavo-convex in cross-section and being without base-blocks may be stamped from a long strip of rolled steel, bronze, or other suitable metal. In cutting or stamping them from the strip one operation is sufficient to provide the buckets with the roots or tenons 6 at one end and an opening 7 near the other. The roots 6 correspond in size and relative position with the grooves 3, into which they fit, interlocking closely with the ribs 4, as shown in Fig. 3.

After the buckets have been properly spaced they are held in position by the frictional grip of the interlocked joint or by any other means and heated by a torch or blow-pipe 8. Flux and spelter 9 are then exposed to the heat and melted so as to fill the joint and the grooves around the bucket roots. The spelter as it hardens will unite five sides of each root 6 to the wheel, thus giving the bucket the full cross-sectional strength of its metal in the roots, which is shown as about half that of the bucket area. The brazed joint between the top surfaces of the ribs and the bucket give an additional fifty per cent. strength for the remaining portion of the bucket. As the result the strength of a bucket jointed and brazed in this manner is approximately seventy-five per cent. of the strength of a similar bucket cut from the solid. The spelter may be used to fill the grooves between the buckets, so that the wheel-rim presents a comparatively smooth surface, as shown in Fig. 2, or the groove may be left practically free of spelter between the buckets to save weight. During the same brazing operation I provide pins 10, which are reduced at their inner ends 11 to enter the openings 7 in the buckets and are brazed therein. Each pin abuts against the adjacent bucket, and the abutting joint may also be brazed, if desired. They serve to securely fasten the buckets together at their outer ends without materially increasing the cost of wheel construction.

One of the advantages of the ribs 4 is that they will readily conduct the heat under the bucket-joint so that the brazing operation can be performed in less time and the rim heated to a less depth than would otherwise be the case. This is of advantage, since the less the rim is heated the less the danger of buckling or deforming the wheel by unequal expansion or contraction. In practice a number of these buckets may be brazed at a time, as many as from ten to twenty, which would cause a considerable portion of the wheel-rim to become heated red-hot. To prevent any injurious effects to the web of the wheel resulting from the expansion and contraction of the rim, I provide the wheel with any desirable number of expansion-joints, such as narrow transverse slits, across the rim, which correspond in depth with the penetration of the red heat or preferably a little beyond this. The rim may thus be divided into segments sufficiently separated to expand circumferentially without abutting when heated.

In Fig. 4 I form a rim corresponding to rim 2 by the use of grooved rings 12, connected to the periphery of the wheel 13 by countersunk rivets 14. One or both of these rings may be used and any other desirable means of connecting them to the wheel may be employed.

In Fig. 9 I illustrate my invention as applied to a turbine of the Parsons type, in which the buckets are mounted upon a drum 15, which is circumferentially grooved in the manner of rims 2 at the points where it is de-

sired to attach rows or rings of buckets. The casing 16 is similarly grooved to receive the stationary intermediates 17, disposed between the rows of buckets 5 on the drum. Any other form of intermediate holder may have the buckets attached thereto in this manner. In this view I show no device for fastening the buckets at their outer ends, though such may be used, if desired.

My invention also contemplates the brazing of the buckets to segments in the manner hereinbefore described, which segments may be attached to a wheel or rotor or to a stationary part of the turbine, where it serves as an intermediate holder.

The main features of my invention are of importance wherever the buckets are connected to a support of any kind by the agency of heat with or without the use of solder or spelter. Thus the buckets may be welded to the wheel electrically or by the application of heat in the usual manner. Also solder of any kind or its equivalent may be used, though the hard solder, such as brazing-spelter, is desirable on account of its greater strength.

The advantages of my invention would be gained to an extent if the wheel-rim were recessed in any manner to provide a more extended area for the bucket-joint.

These and other modifications may be made within the scope of my invention, an illustrative embodiment of which I have hereinbefore described and illustrated in particularity, as required by law.

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

1. The combination with a bucket-supporting element, of an individual bucket having a plurality of projections at one end, and recesses in said element to receive said projections, said bucket being permanently connected to said element by soldering, brazing, or welding the joint.

2. The combination with a bucket-support, of a bucket having a plurality of roots, portions of said support between which said root are disposed and permanently connected by the cohesion of metals effected by the application of heat.

3. The combination with a bucket-support having a plurality of shallow recesses therein, of a bucket, having a plurality of short roots, which is connected to said support by having its roots disposed within said recesses and united to the sides thereof by the cohesion of metals effected by the application of heat.

4. The combination with a bucket-support having a plurality of shallow recesses therein, of a bucket, having a plurality of short roots, which is connected to said support by a brazed joint.

5. The combination with a bucket-support having a plurality of shallow recesses therein, of buckets, each having a plurality of short roots disposed within said recesses and united to the walls thereof by solder or spelter.

6. A bucket-wheel having a rim provided with a plurality of ribs, buckets having bases formed with short projections which interlock with the ribs of said rim when mounted thereon, and means to unite the abutting portions of rim and buckets by a process which involves the heating of said abutting portions.

7. A bucket wheel or drum having circumferential grooves, and buckets having roots which enter said grooves and are secured therein by the agency of solder.

8. A bucket wheel or drum having circumferential grooves, and buckets having roots which enter said grooves, said buckets being permanently connected to said rim at desired intervals by brazing their joints.

9. A turbine bucket wheel or drum having circumferential grooves, buckets having roots which enter said grooves, and means to unite the buckets to said element which consists of a body of brazing-spelter introduced into the grooves and between the bucket-joints in molten condition and allowed to harden.

10. A bucket wheel or drum constructed by providing the bucket-supporting portion with shallow recesses, and one or more expansion-joints, providing individual buckets with short roots and uniting them to the supporting portion by the application of heat and solder.

11. As an article of manufacture, a bucket-wheel having a rim portion provided with deep transverse and shallow circumferential slots or grooves.

12. As an article of manufacture, a bucket, cut from a strip of metal of the desired cross-sectional shape, so as to leave a plurality of short integral projections or roots disposed at intervals across one of its ends.

13. As an article of manufacture, a bucket cut from a strip of metal so as to have a plurality of short roots at one end and an opening at or near the other end for the reception of a spacer device.

14. As an article of manufacture, a bucket formed of a piece of concavo-convex metal with a plurality of short straight integral roots at one end the thickness of which corresponds with that of the body of the bucket opposite the point at which they join it.

15. As an article of manufacture, a bucket cut from a piece of metal having the desired cross-sectional shape and provided, at one end, with a plurality of short straight roots which are narrow in width, spaced substantially equidistantly and of different thicknesses.

16. As an article of manufacture, a bucket for a turbine having a spacer device united to one end thereof by solder.

17. As an article of manufacture, a tur-

bine-bucket provided with a socket near one end into which a spacer device projects and is united by brazing.

18. A bucket wheel or drum constructed by providing the bucket-supporting portion with shallow recesses, providing buckets having roots adapted to enter said recesses and an opening to receive a spacer device, and brazing said buckets to said portion and spacer devices to said buckets, substantially as described.

19. A bucket-wheel, buckets, metal introduced in a molten condition around the inner ends of said buckets to joint them to said wheel, and transverse expansion-slits in said wheel to provide for its peripheral expansion during the jointing of said buckets.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JAMES WILKINSON.

Witnesses:
WILLIAM P. NOLAN,
JOHN F. BENSON.