

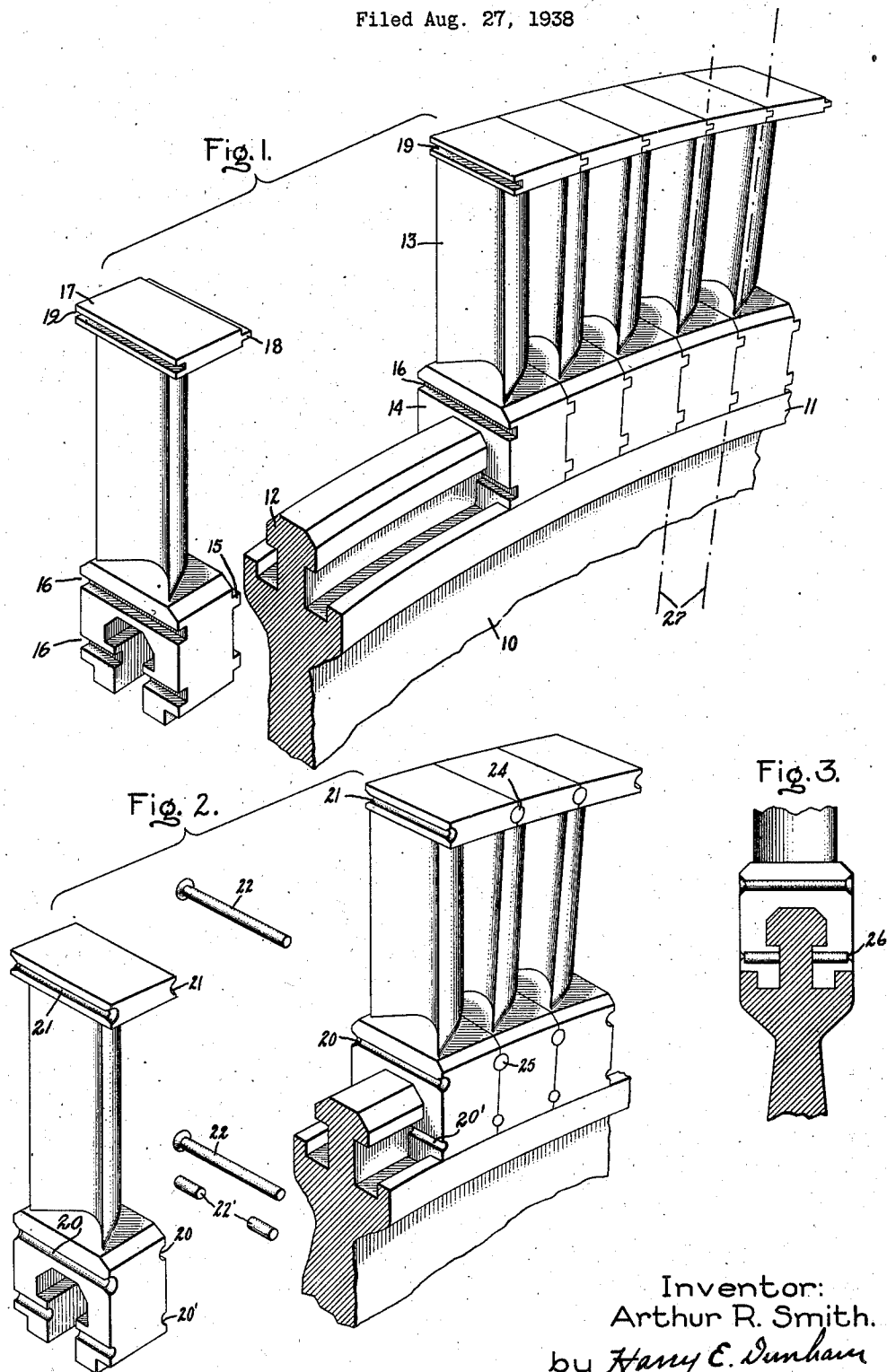
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ELASTIC FLUID TURBINE BUCKET WHEEL

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ELASTIC FLUID TURBINE BUCKET
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The present invention relates to elastic fluid turbine bucket wheels and more particularly to arrangements for securing the buckets against movement on the rim of the wheel.

5 In axial flow elastic fluid turbines, the buckets are frequently secured onto the rim of the wheel disk by a dovetail connection. In the manufacture of the cooperating dovetail portions, it is difficult and often impracticable to attempt to provide an absolutely tight fit between the individual bucket bases and the rim. In the operation of the turbine, the elastic fluid emerging from the nozzles exerts its force substantially tangentially of the wheel against the buckets. 10 Due to the relative narrowness of the bucket bases and, depending upon factors including the closeness of the fit in the dovetail connection, the buckets are caused to rock slightly on the rim under each impulse of operating fluid. 15 The repeated rocking of the buckets, which is particularly pronounced in high pressure partial admission type turbines, together with the peripheral bending of the loaded buckets, results in the severe stressing of the cover tie band or of the attaching tenons and may cause fatigue of such parts and their consequent failure.

It is an object of the present invention to provide a new and improved arrangement for interlocking turbine buckets of the type described whereby peripheral deflections of the buckets from the radial position are minimized. 30

It is a further object of the invention to provide a new and improved arrangement of buckets whereby the bases of adjacent buckets are interlocked so that the effective base width of the individual buckets is increased and whereby they are held substantially immovable with respect to the rim and capable of withstanding severe operating conditions. 35

For consideration of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto taken in connection with the accompanying drawing. 40

In the drawing, Fig. 1 is a perspective sectional view of a portion of a bucket wheel provided with buckets according to my invention; Fig. 2 is a perspective sectional view of a portion of a bucket wheel provided with buckets according to a modified form of my invention; while Fig. 3 is a fragmentary cross-sectional elevation illustrating certain details in connection with the second modification. 45 50

Referring to Fig. 1 of the drawing, 10 indicates the web of the wheel or rotor and 11 the grooved 55

rim which on opposite sides is provided with annular shoulders defining a dovetailed portion 12 for retaining the buckets 13 thereon. The bucket bases 14 are provided with a grooved slot defining an inverted dovetail for cooperatively fitting over the rim of the wheel substantially as shown. The buckets are assembled on the rim in the usual manner, one or more filling slots (not shown) being provided in the rim as is well understood. The bucket fastening means described forms what is commonly termed the inverted dovetail type of fastening and in itself is well-known in the art. It may be taken as typical of a suitable type of fastening in connection with which my invention may be carried out. 5 10 15

It is the usual practice to allow a certain clearance between the wheel rim dovetail and the dovetail slot in the bucket bases so that the buckets, after insertion through the filling slots, may be slid around the periphery of the rim into position. This clearance, even though slight, will allow considerable rocking of the buckets in the radial plane when subjected to the force of the operating fluid because of the relative narrowness of the individual bucket bases. It is understood that the rocking movements of the individual buckets are accompanied by a relative sliding movement between the abutting faces of the bucket bases. By suitably interlocking the faces of the adjacent bases relative movement therebetween is precluded and the buckets are maintained substantially rigid on the rim. According to my invention, I provide the abutting faces of the bucket bases with cooperating tongues 15 and grooves 16 which, while shown as being rectangular in configuration, may be of any other suitable design. The tongues and grooves extend laterally across the faces of the bucket bases or, in other words, substantially perpendicularly with respect to the plane of the wheel disk. Any suitable number of tongues and grooves may be provided distributed over the length of the abutting faces including the dovetail root portions, as shown. The tongues and grooves on opposite sides of the bucket cover and base broadly constitute recesses formed in the faces of the bucket cover and base for connecting the bucket to adjacent buckets on a wheel. 20 25 30 35 40 45

The outer ends of the turbine buckets may be provided with the usual form of tie bands secured thereon by any suitable means such as by tenons projecting from the upper ends of the buckets. Since rocking movements of the buckets on the rim of the wheel are substantially precluded by the interlocking arrangement shown, 50 55

stressing of the tie bands or of the tenons for such reason is precluded. However, in the preferred form of my invention shown, to further increase the rigidity of the bucket assembly, I provide each of the buckets with relatively rugged integral cover portions 17. The cover portions of the adjacent buckets are provided on their abutting faces with cooperating tongues 18 and grooves 19 similar to the tongues 15 and grooves 16 provided on the base portions. As the buckets are assembled on the rim, the cover portions of the adjacent buckets fit together to form a substantially continuous cover extending around the periphery of the wheel. Due to the interlocking tongues and grooves of the cover portions, relative longitudinal sliding movements therebetween are substantially precluded and consequently peripheral bending deflections of the individual buckets are effectually resisted. By properly dimensioning the proportions of the cover portions, the bucket assembly may be so stiffened as to substantially preclude bending thereof under load.

In the modification of the invention illustrated in Fig. 2, the abutting faces of the bucket bases and the integral cover portions are provided with aligned recesses or grooves 20 and 21 respectively. These recesses, as in the case of the tongues and grooves of the previous modifications, extend laterally across the abutting faces, or in other words, substantially perpendicularly with respect to the plane of the wheel disk. After the buckets are assembled onto the rim of the wheel, suitable keys or pins 22 and 23 are inserted into the aligned recesses 20 and 21 respectively and secured therein as by riveting the ends as indicated at 24 and 25. The pins 22' may be secured in the aligned recesses 20' provided in the base roots as by peening over the outer edges of the recesses as indicated at 26 in Fig. 3.

To insure that the various recesses, or grooves 20, 20' and 21 in the abutting faces will be in perfect alignment, it is preferred to assemble the buckets on the rim without first providing the recesses in the abutting faces. After the buckets are assembled upon the wheel and clamped securely in position, holes may be drilled in the plane of the engaging faces. The semi-cylindrical recesses thus provided in each of the abutting faces will inherently be in perfect alignment with each other. The various pins may then be inserted and riveted in position rigidly interlocking the bucket assembly.

The manufacture of buckets according to my invention is considerably facilitated by the fact that the axial or abutting faces of the bucket covers are plane and located in substantially the same radial planes as the corresponding abutting faces of the bases. The axial widths of the bases are about equal to the axial widths of the covers. From another viewpoint, the cylindrical projections of the covers onto the bases coincide with the contours of the latter. This is indicated by dash-dotted lines 27 on the right-hand

part of Fig. 1. The last bucket shown in this figure has axial plane surfaces located in the same radial planes as the corresponding axial plane surfaces of the bucket base. With such an arrangement the faces of the cover may be easily machined in the same operation with the machining of the faces of the base. By "face" I mean the surface of a bucket which faces or abuts a corresponding surface or face of another bucket. On one side the faces of the base and the cover from axial grooves which when assembled define part of a connection with an adjacent bucket. In the arrangement of Fig. 1 the faces of the base and the cover on the right-hand side of each bucket are machined to form axial tongues for cooperation with corresponding grooves in an adjacent bucket.

Having described the principle of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

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

1. An elastic fluid turbine bucket wheel having a disk with a rim and a row of buckets secured to the disk, each bucket having a base, a blade extending radially from the base and having an end integral therewith and a cover integral with the other end of the blade, the base and the cover having plane faces and corresponding faces of the base and the cover being located in substantially the same radial planes, and interlocking means including recesses formed in the faces and intermediate projections cooperating therewith for securing adjacent buckets together.

2. An elastic fluid turbine bucket wheel having a disk with a rim and a row of buckets secured to the disk, each bucket having a base, a blade extending radially from the base and having an end integral therewith and a cover integral with the other end of the blade, the base and cover having plane faces and corresponding faces of the base and the cover being located in substantially the same radial planes and provided with axial recesses located so as to register with corresponding recesses in the faces of adjacent buckets, and axial pins adapted to be received in the apertures formed by said corresponding recesses to provide an interlocking connection between said buckets.

3. A bucket for axial flow elastic fluid turbine wheels comprising a dovetailed base, a cover, a blade having ends integrally formed with the base and the cover respectively, the cylindrical projection of the cover onto the base coinciding with the contour of the latter, the base and the cover having plane faces, the faces of the base and the cover on one side of the bucket each forming a groove and on the other side a tongue for connection with the tongues and grooves respectively formed by adjacent buckets.

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