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ELASTIC FLUID TURBINE.

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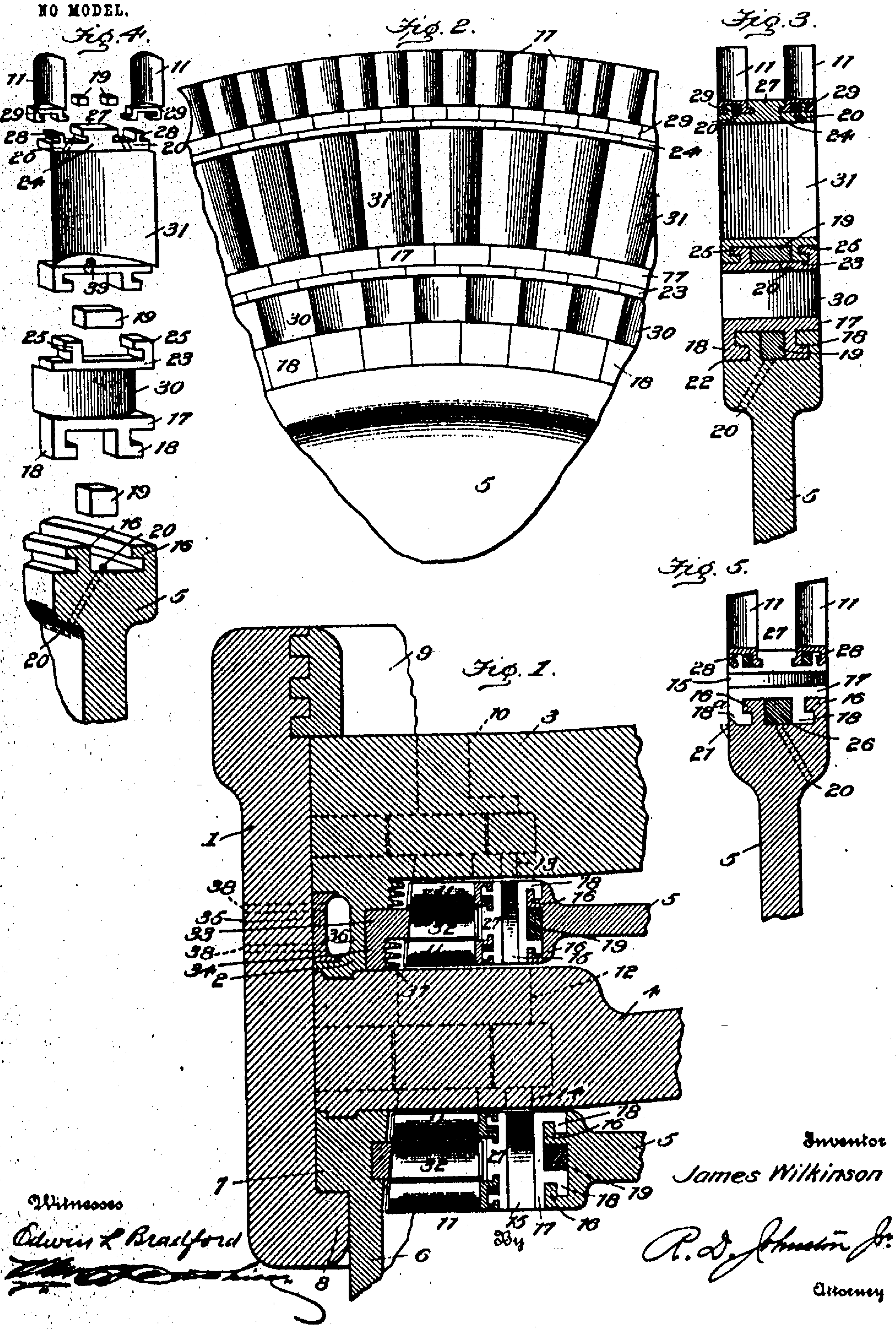
NO MODEL.



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No. 751,889. Patented February 9, 1904.

UNITED STATES PATENT OFFICE.

JAMES WILKINSON, OF BIRMINGHAM, ALABAMA, ASSIGNOR TO WILKINSON STEAM TURBINE COMPANY, A CORPORATION OF ALABAMA.

ELASTIC-FLUID TURBINE.

SPECIFICATION forming part of Letters Patent No. 751,889, dated February 9, 1904.

Application filed November 21, 1903. Serial No. 182,113. (No model.)

To all whom it may concern:

Be it known that I, JAMES WILKINSON, a citizen of the United States, residing at Birmingham, in the county of Jefferson and State of Alabama, have invented certain new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification.

My invention relates to improvements in the construction of elastic-fluid turbines designed to operate with one or more working passages, two of which are preferably disposed in reverse directions.

My invention has for its object more particularly to perfect a rotor-wheel provided with two or more rows of circumferential buckets superimposed one upon the other and to improve the locking means for connecting these several rows of buckets together and securely joining them to each other and to the wheel.

A further object of my invention is to provide each rotor-wheel with two or more parallel rows of buckets and superheat the stationary intermediates carried by the casing and disposed between said buckets to reduce condensation arising in the working passage.

My invention comprises the construction and arrangement of parts hereinafter shown and described, and illustrated in the accompanying drawings, in which—

Figure 1 is a partial vertical section through a two-stage turbine, disclosing means for superheating the intermediates, the rotor-wheel being provided with a small row of inner reversing-buckets, in whose head-blocks the outer parallel rows of buckets are securely mounted. Fig. 2 is a plan view of a wheel provided with three concentric rows of buckets, the inner row being adapted to reverse the turbine, while the outer rows drive it forward at a fraction of the speed derived from the intermediate full-speed buckets. Fig. 3 is a tranverse section through Fig. 2, and Fig. 4 shows the several bucket elements forming the compound wheel in position for assembling and locking-blocks therefor. Fig. 5 is a modification of the wheel shown in Fig. 1, the wheel being provided with a calking-lip to increase the security of the bucket-fastenings.

The same reference-numerals refer to the same parts throughout the drawings.

The turbine comprises the outer shell 1, surrounding the turbine-casing proper, a part of which is formed by a circumferential flange 2, depending from the supply-head 3 and engaging the shouldered periphery of the diaphragm-partition 4. This diaphragm divides the interior of the turbine into a compartment or stage, within which a rotor-wheel 5, provided with peripheral buckets, rotates. There may be as many of these compartments formed in the casing as desired; but for the sake of illustration I have shown but one. The exhaust-head 6 has an annular shoulder 7, engaging an inner shoulder 8 of shell 1, and supply-head 3 is held in position by a locking-ring 9, threaded to engage the other end of the casing 1, so that the several parts of the turbine are held in position between the shoulder 8 and this ring. Fluid-pressure is supplied in any desirable manner to a series of nozzle-passages 10 in head 3 and delivered against the rotating buckets 11 in the first wheel-compartment, after which it passes through nozzles 12 in the diaphragm 4 and is delivered against the rotating buckets in a succeeding stage or wheel compartment. The working passages thus formed are of gradually-increasing proportions to accommodate the expansion of the fluid which results from the fractional conversion of its pressure into velocity.

Referring to Fig. 1, it will be noted that I provide two separate working passages, the inner of which is adapted to reverse the turbine. This reversing working passage is formed by branch nozzle-passages 13 and 14, leading through the supply-head and diaphragm, respectively, and directing the fluid against the narrow vanes 15, secured to wheel 5, in the manner hereinafter described. Any suitable valve-controlling means may be used to direct the pressure into one or the other of these passages and to govern the volume admitted in proportion to the load.

The wheel shown in Fig. 1 is designed for use in a stationary turbine, the small reversing-vanes 15 being intended to bring the turbine to a quick stop when occasion requires it. This will be of great use in case of injury to the machinery, for under present conditions such stoppage requires a considerable length of time in view of the great speed of rotation of the turbine.

I provide the rim of the rotor-wheels 5 with two similarly-disposed undercut annular shoulders 16 in the same circumferential plane, and I provide the inner row of buckets 15 with base-blocks 17, having undercut shoulders 18 similar to shoulders 16, but reversely disposed thereto, so that when inserted between said shoulders 16 and shifted laterally the two pairs of shoulders will interlock, as shown in the several sectional views. The opening left between the two shoulders 16 is large enough to enable the head of one of the shoulders 18 to pass between them and move sidewise sufficiently to effect the engagement of the shoulders. If after the shoulders 16 and 18 are in engagement locking means be inserted to prevent any return lateral movement of the buckets, they will be securely held in engagement with the rim. My preferable manner of locking the buckets in place is to insert them one at a time in the rim, Fig. 4, and as soon as the shoulders have been interlocked to insert the locking-blocks 19 to secure the shoulders in engagement. These blocks, if desired, may be calked in place to prevent any loose joints or movement of the same. The last bucket of the series will preferably be secured in place opposite the opening 20, leading through the rim of the wheel, so that molten metal may be poured therethrough to fill the cavity which would have been occupied by the block 19. If desired, the buckets may all be assembled and molten metal may be poured through opening 20 to fill the passage left between the inner shoulders of the buckets and wheel, as is illustrated in Fig. 5. To further insure the fastenings of the buckets and also to prevent their disengaging lateral movement, I provide the rim with a calking-lip 21 and cut away the outer corner of shoulders 18ª of the buckets 17. When the latter have been inserted in position and the molten metal poured in to lock them, this lip 21 may be calked or set up from its normal position (shown in dotted lines in Fig. 5) until it engages the cut-away corner of buckets 18ª in the manner shown in full lines in said figure, and in this manner the buckets are more securely held in position, and the danger which might result from a possible defect in the locking-strip formed by the molten metal is avoided. I may also, if desired, braze or weld the base-blocks to the rim at the point 22, Fig. 3, or I may employ locking-strips similar to 19 and adapted to engage and retain in place any desired number of said buckets less than the whole.

It will be noted in Fig. 2 that the buckets are disposed at break-joints to increase the firmness and strength of the compound wheel. The inner row of buckets, though shown in the figures which I have described and which are designed for use in a stationary turbine as small reversing-buckets, may be full-speed driving-buckets, while the reversing-buckets may be inserted in the head-blocks of said inner row. This latter arrangement is particularly applicable for use in a marine turbine. I therefore prefer to increase the size of buckets 15 until they will drive the vessel forward at full speed and to utilize the double row of buckets 11 to reverse. By this construction the reversing starting torque of the turbine will be much greater than if a single row of reversing-buckets were carried by each wheel, though the speed of rotation will be comparatively much slower. These outer reversing-buckets 11 will be inserted in the head-blocks of the inner row in the manner which I will now describe.

Referring to Fig. 4, it will be noted that I provide the inner row of buckets with head-blocks 23, which abut to form a sectional continuous rim similar to the rim of the wheel and provided with undercut shoulders 25, corresponding to shoulders 16. The row of buckets superimposed upon this inner row are connected thereto in the same manner described in connection with the manner of fastening the inner row of buckets to the rim, locking-blocks 19 or molten metal 26 being employed, as desired.

In providing for the two parallel circumferential rows of buckets 11 the head-blocks 24 of the buckets 15 and 31 will have a central shoulder 27 undercut on each side to correspond with one of the shoulders 16 and will also be provided with a shoulder 28 on each side of said shoulder 27 corresponding to the shoulders 16ª. The buckets 11 have base-blocks 29, formed in the usual manner and connected to the head-blocks 24 in the manner hereinbefore described. The locking-shoulders of the buckets comprising the two rows will be reversely disposed. Passages 20 also lead through the head-blocks of one of each of the several rows of buckets to enable molten metal, preferably type-metal, to be used to secure the last or all of the buckets in place.

The compound wheel provided with three distinct rows of buckets or vanes (shown in Figs. 2, 3, and 4) is designed for marine turbines, the inner row of buckets 30 being preferably arranged to reverse the turbine, which will be driven forward at full speed by the intermediate row of buckets 31, while the outer row of buckets 11 will preferably be designed to drive the turbine at cruising speed by reason of the fact that the velocity of the fluid-pressure delivered to them is fractionally abstracted, so that the wheel will rotate at half or fraction of its full speed. If desired, more than two rows of buckets 11 may be mounted on the outer row to further decrease the speed of rotation in the turbine; but I prefer to use only two. The use of two or more parallel rows of fractional-speed buckets 11 necessitates the interposition of a row of stationary intermediates 32, mounted in the turbine-casing and disposed between said rows of revolving buckets. These intermediates have base-blocks 33, provided with depending flanges 34, which form part of the inner wall of the wheel compartment. To reduce to a minimum the accumulation of water of condensation in the working passages and to avoid the resulting friction and loss of economy by reason of such condensation, I form an annular grooved channel in the outer wall of flange 2 and insert in said channel a grooved calking-strip 35, secured pressure-tight in said flange, and forming an annular heating-chamber 36 opposite the said row of intermediates 32. I also provide the inner wall of flanges 2 and 34 with radiating fins or ribs 37, so that when the heating medium is circulated through said chamber by pipes 38 (shown in dotted lines leading through the casing 1 and calking-strip 35) said intermediates and fins will be superheated, so that the chamber temperature will be maintained substantially the same as that of the fluid efflux and the fluid itself will be reheated in its passage through said intermediates, thus materially reducing the condensation. There will be some condensation, however, in the working passage, which will be thrown by the movement of the wheel against the superheating-fins 37 and by them reëvaporated. This superheating of the intermediates will not only reduce the condensation due to the working action of the fluid, which has proven difficult to dispose of, but will also materially increase the efficiency of the turbine and the economy of its action.

When more than one wheel-compartment, excluding the exhaust, is used, the diaphragm 4 will be provided with depending flanges similar to 2 and the reheating arrangements will be the same as those described in the first compartment. In the last or exhaust compartment, however, this superheating is not necessary.

Though the several rows of shoulders 16 have been described as in the same circumferential plane, this construction may be varied somewhat without departing from the spirit of my invention, which contemplates, broadly, the idea of locking the shouldered base-blocks of the buckets to a shouldered wheel-rim by locking-blocks or metal strips which block the disengaging movement of the interlocked shoulders of the bucket and wheel. The arrangement of the several buckets may be altered at will to drive the turbine in the manner suitable to different circumstances.

In Fig. 4 it will be noted that openings 39 are formed in the base-blocks of the buckets 31 for the introduction of the molten metal. This same arrangement may be used in the other views and substituted for the opening 20 through the rim of wheel 5.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a turbine, a bucket-bearing element having shoulders undercut from the same side, a bucket having shoulders undercut from the opposite side to that of said element's shoulders with which they are adapted to interlock, and means interposed between a shoulder of each of said parts to lock them in engagement.

2. In a turbine, a bucket-bearing element having a plurality of integral shoulders undercut to overhang toward the same side, a bucket having a portion adapted to interlock with said shoulders by a sidewise movement, and a locking means engaging a portion of said bucket and a shoulder of said element to block their disengaging movement.

3. In a turbine, a bucket-bearing element having a pair of shoulders undercut from one side and a bucket having a pair of shoulders undercut from the opposite side, said pairs of shoulders being adapted to interlock when the bucket is shifted sidewise on said element, and means inserted between a shoulder of each pair to block the disengaging movement of said bucket.

4. In a turbine, a bucket-bearing element and a bucket each provided with an integral undercut shoulder which interlock, a projection on said element and a locking-piece disposed between the shoulder and projection of the element and engaging said projection and the shoulder of said bucket when in its locked position to lock said shoulders in engagement.

5. In a turbine, a bucket-bearing element and a plurality of buckets, said element and buckets being provided each with undercut shoulders which interlock to hold said parts together, and means introduced between a shoulder of said element and a shoulder of said bucket to lock the latter against a disengaging movement.

6. In a turbine, a bucket-wheel, a row of buckets having head-blocks disposed around said wheel, undercut shoulders on said head-blocks, buckets mounted on said head-blocks and having undercut shoulders which interlock with the shoulders of said head-blocks, and means inserted between the pairs of interlocked shoulders to lock them in engagement.

7. In an elastic-fluid turbine, a bucket-wheel having two annular undercut shoulders around its periphery disposed in substantially the same circumferential plane, undercut shoulders integral with the bucket-base and adapted to engage the shoulders of said wheel, and means interposed between said pairs of shoulders to lock them in engagement.

8. In a turbine, a bucket-wheel provided

with two superimposed circumferential rows of buckets, head-blocks on the outer row of buckets, central shoulders on said head-blocks undercut on both sides, undercut shoulders to each side of said central shoulders, and two rows of buckets shouldered to engage said side shoulders and a side of said central shoulders, and means inserted between the pairs of interlocked shoulders to lock them in engagement.

9. In a turbine, a bucket-wheel having a shouldered rim, a row of buckets having shouldered base portions adapted to interlock with a shoulder of said rim, a block or blocks inserted between a portion of the rim and the shoulders of said buckets in their interlocked position, and means to secure the last bucket of said row in place by introducing molten metal to form a locking-block.

10. In a turbine, a bucket-bearing element provided with a shouldered portion, a bucket having a shouldered base engaging and interlocking with a shoulder of said element and leaving a cavity between its shoulder when interlocked and a part of the shouldered portion of said element, said cavity being filled with molten metal to form a block to prevent the disengagement of said shoulders.

11. In a turbine, a rotating element having a shouldered rim portion, a bucket engaging said portion, and means to introduce molten metal to lock said bucket to said rim portion.

12. In a turbine, a wheel having a shouldered rim, a bucket engaging said rim, and an opening through said rim for the introduction of molten metal to lock said bucket to said rim.

13. In a turbine, a rotor-wheel having two peripheral shoulders, buckets having shoulders engaging said wheel-shoulders and locked thereto by interposed blocks, head-blocks on said buckets, and buckets forming two parallel rows mounted on said head-blocks.

14. In a turbine, a casing, two or more rows of revolving buckets, a stationary row of intermediates mounted within the casing, an annular channel formed in said casing and disposed opposite to said row of intermediates, and means to form a passage-way of said channel and circulate a heating medium therethrough.

15. In a turbine, a casing, an intermediate bucket element mounted therein and provided with inwardly-disposed heat-radiating projections, and means to superheat said projections.

16. In a turbine, two or more rows of revolving buckets, a stationary row or rows of intermediates mounted in a cut-away portion of the casing, an annular channel formed in the casing opposite to a row of said intermediates, and means to form a passage-way of said channel and circulate a heating medium therethrough.

17. In a turbine, a bucket-bearing element with shouldered projections, buckets with shouldered projections interlocking with the shoulders of said elements, means inserted between said interlocked shoulders to block their disengaging movement, and a projection on said element adapted to be calked against a portion of said bucket.

18. In an elastic-fluid turbine, a vane-bearing element, a row of full-speed vane elements peripherally mounted thereon, and two or more rows of fractional-speed vanes mounted in head-blocks carried by said first-mentioned row of elements.

19. In an elastic-fluid turbine, a vane-bearing element provided with peripheral rows of oppositely-disposed vanes, and rows of vanes of different dimensions from said first-mentioned rows, said latter rows being arranged successively in the line of the flow of the fluid.

20. In an elastic-fluid turbine, a vane-bearing element, a plurality of rows of peripheral vanes carried thereby, the vanes of part of said rows being oppositely disposed relatively to each other, and the vanes of the other part of said rows being of different dimensions from the vanes in said other rows and arranged in parallelism and at equal distances from the axis of rotation of said element.

21. In an elastic-fluid turbine, a vane-bearing element having a plurality of superimposed rows of peripheral vanes, the vanes in two rows being reversely disposed, and the vanes in the other rows being of different dimensions from the vanes in either of said reversely-disposed rows, and arranged successively in the line of the flow of the fluid.

22. In an elastic-fluid turbine, a vane-bearing element having a circumferential row of compound vanes, and circumferential rows of vanes, said latter rows being superimposed upon and connected to said row of compound vanes.

23. In a turbine, a rotating element provided with three independent sets of vanes disposed in rows at different radial distances from the center, one of said sets being subdivided into a plurality of parallel rows of vanes at substantially the same radial distance from the center.

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

JAMES WILKINSON.

Witnesses:
R. D. JOHNSTON,
JOHN G. ARMSTRONG.