No. 894,409. PATENTED JULY 28, 1908.

A. C. TOMS.

TURBINE.

APPLICATION FILED MAY 2, 1908.

2 SHEETS—SHEET 1.

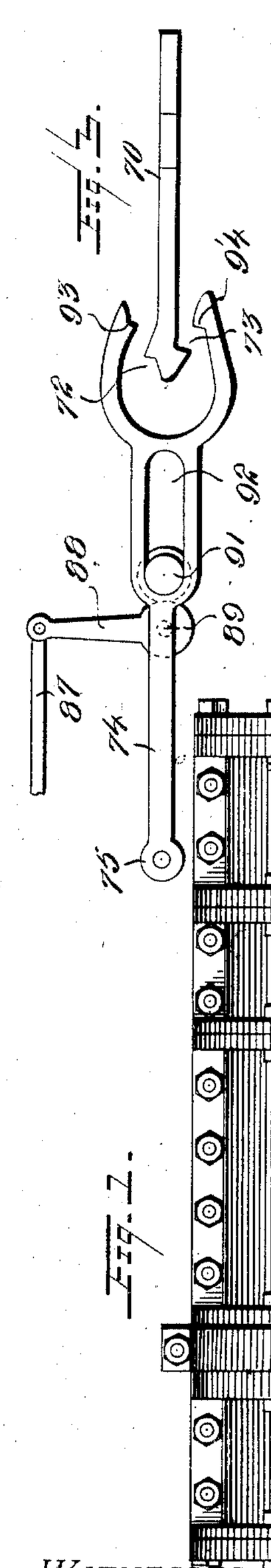

FIG. 2.

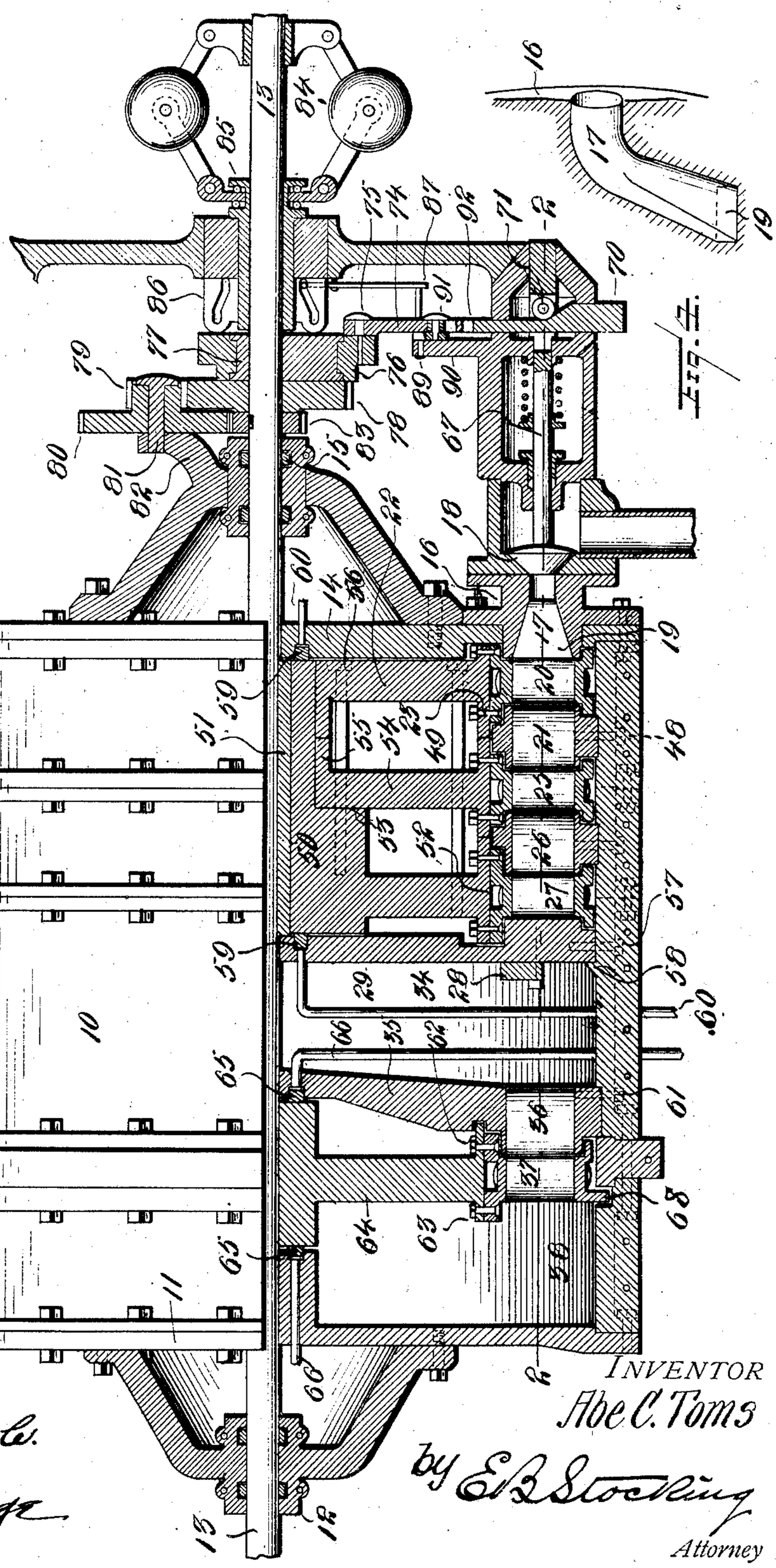

FIG. 1.

FIG. 3.

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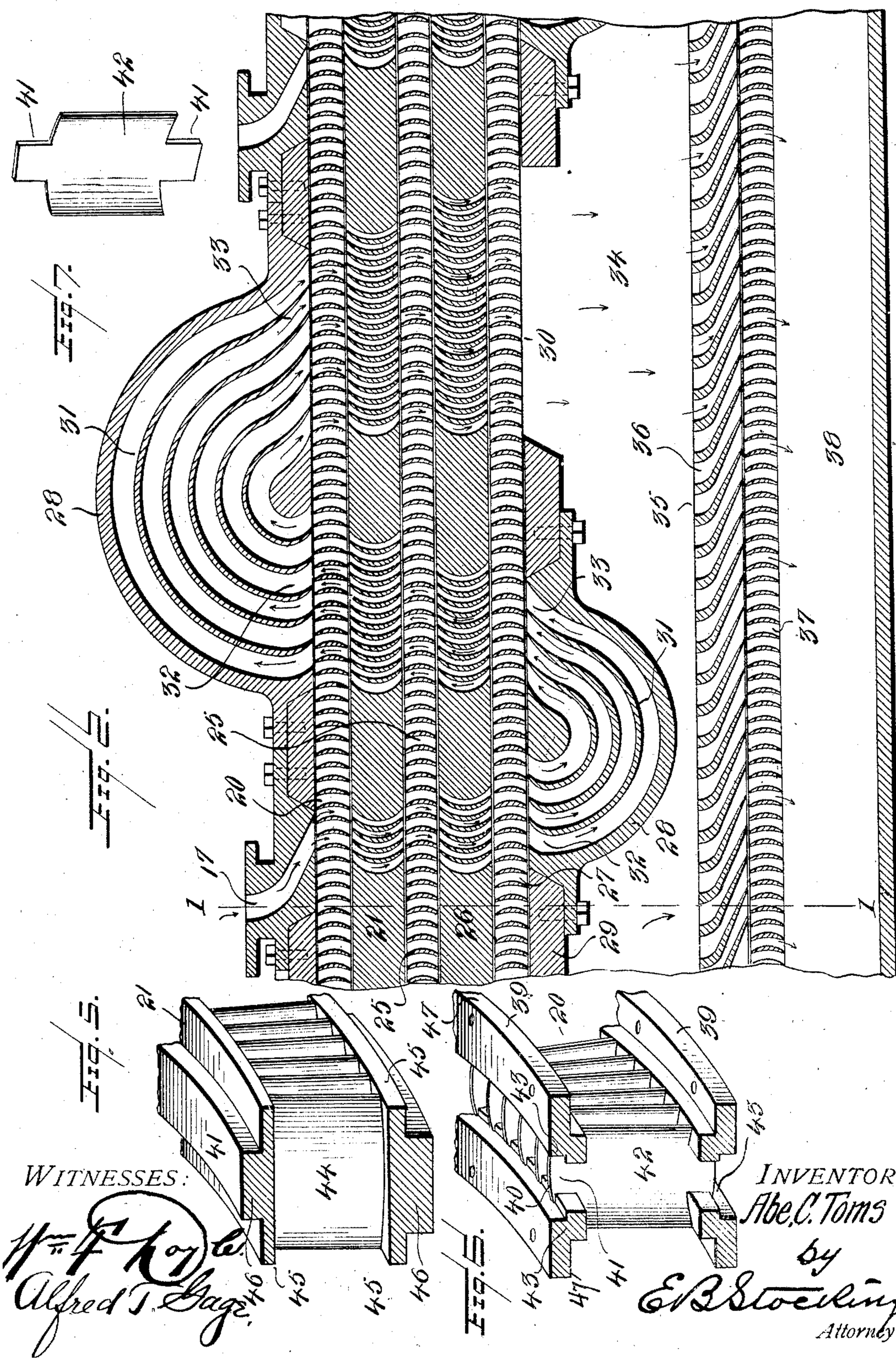

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TURBINE.

No. 894,409. Specification of Letters Patent. Patented July 28, 1908.

Application filed May 2, 1908. Serial No. 430,602.

To all whom it may concern:

Be it known that I, ABE C. TOMS, a citizen of the United States, residing at Spokane, county of Spokane, and State of Washington, have invented certain new and useful Improvements in Turbine-Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to a turbine engine, and particularly to that type known as elastic fluid turbines in which the fluid is continuously expanded and successively presented to a greater area of the surface of the wheel upon which it impacts.

The invention has for an object to provide a novel and improved construction for introducing the elastic fluid through nozzle rings into contact with the buckets or blades of the turbine wheel and disposing the delivery end of one nozzle opposite the receiving end of another nozzle said receiving end being of greater area than the delivery end of the opposite nozzle so as to prevent interference with the velocity of the steam or a back pressure thereof which would not only diminish the power obtained but cause a leakage of the fluid at the sides of the wheel.

A further object of the invention is to provide a turbine with successive turbine wheels having buckets or vanes and intermediate feed rings each having passages of successively increasing area relative to the wheels which receive and deliver thereto by the deflecting blades in said passages.

Another object of the invention is to provide the final wheel of the series with an expansion chamber and free inlets to all of the buckets in the final wheel because at this time the steam has expanded to such a low pressure that the condensing action with the free passage of the steam through the wheel is most effective.

Other and further objects and advantages of the invention will be hereinafter fully set forth and the novel features thereof defined by the appended claims.

In the drawing:—Figure 1 is an elevation with parts in section on line 1—1, Fig. 2; Fig. 2 is a section through the nozzles upon the line 2—2, Fig. 1; Fig. 3 is a detail plan of the valve shifting connections; Fig. 4 is a sectional perspective of the inlet nozzle; Fig. 5 is a detail perspective of the deflecting ring and blades; Fig. 6 is a similar view of the turbine wheel and blades; Fig. 7 is a detail perspective of one of the blades removed.

Like numerals refer to like parts in the several views of the drawing.

The numeral 10 designates the casing which may be of any desired construction or configuration to accommodate the number of turbines to be disposed therein. This casing is provided at one end with a plate 11 carrying the shaft bearings 12 in which the shaft 13 is mounted, the opposite end thereof being supported by the end plate 14 of the casing having shaft bearings 15. The end plate 14 also supports the nozzle or inlet plate 16 containing the feed passage 17 leading from the inlet valve 18. A series of these nozzle valves are disposed about the circumference of the casing. The passage 17 may be of circular cross section at its upper portion, as shown in Fig. 4 and thence merging downwardly into the angular cross section at its discharge end 19 disposed adjacent the first or primary turbine wheel 20. Coöperating with the opposite side of this wheel is a nozzle plate 21 having deflecting blades and nozzles therein as hereinafter described. The wheel 20 may be formed in segmental sections secured to the central disk 22 carried by the shaft by any desired means, such as the connecting flanges shown at 23, the flanges of adjacent wheels being adapted to contact at the inner side of the deflecting ring 21. At the opposite side of the deflecting ring 21 from the wheel 20 is a second wheel 25 of similar construction and coöperating therewith is a deflecting ring 26 having passages therefrom of successively increasing area, while at the discharge from this ring a third wheel 27 is mounted. The wheel communicates with a reversing chamber 28 secured to a bulk head 29 which incloses the wheels and deflecting rings and is provided with a discharge 30 from the final wheel. The reversing chamber is provided with a series of blades 31 forming channels extending from the inlet 32 thereof to the discharge 33 and each end communicates with the wheel which delivers initially to the chamber thus causing a reversal of the fluid in its travel through the series of wheels and rings. The successive chambers 28 are increased in area to properly carry the expanded steam. Two are here shown in the circuit of blades and wheels, although any desired number may be used. The discharge through the port 30 enters the chamber 34 provided with an abutment 35 having at its periphery a series of deflecting blades and passages 36

which blades deliver to the fourth or final wheel 37, and the discharge therefrom enters the exhaust or condensing chamber 38.

Each of the turbine wheels is constructed as shown in Figs. 6 and 7, of the opposite side plates 39 which are provided with apertures 40 adapted to receive the ends 41 from the curved or segmental blades 42, these ends 41 being riveted or otherwise secured within the channels 43 formed on the outer face of each of the plates 39. This permits the segment of the wheel to be built up and the blades or vanes thereof formed of drop forged steel with their ends riveted into the grooves of the rim.

The deflecting rings, such as 21 and 26, may be formed in any desired manner, for instance, by means of the segmental blades 44 of drop forged steel, having the rims 45 cast thereon, as shown in Fig. 5. These rims are provided with the projecting rib 46 which is disposed in overlapping relation to the flange 47 of the wheel rims and by which the deflecting ring is rigidly secured in position by any desired means from the casing, for instance the bolts 48 extending therethrough. The flanges 47 of the wheels are suitably apertured and adapted to receive the bolts 49 by which they are secured to the hub sections such as 22.

In order to form a steam tight connection at the inner periphery of these wheels and effect the balancing thereof they are mounted upon the shaft 13 by a hub 50 keyed thereon at 51 and secured to the third wheel of the series at 52. This hub is provided with a shoulder 53 against which the hub plate 54 of the second wheel abuts, while the blade 22 rests in contact with the hub 55 of the plate 54, and is secured by any suitable means such as the bolt 56 extending through the hub plates 22 and 54 and into the shoulder 53 of the hub 50. Beneath the hub plate 52 the abutment 29 is disposed and carries the reversing chambers 28, before described, these parts being secured in position by the bolt 57 through the casing and supported upon a shoulder 58 on the inner face thereof. At each end of the hub a packing ring 59 is disposed and a lubricating pipe 60 extends thereto from a suitable source of supply.

The abutment 35 provided with the deflecting passage 36 is secured by a bolt 61 and provided with a channel 62 in which the flange 63 from the hub 64 of the wheel 37 is adapted to travel, said hub being also provided with packing rings 65 and lubricating tubes 66 leading thereto. The wheel 37 is provided with the inner flanges, as before described, and an outer flange 68 adapted to travel in the channel in the casing so as to prevent escape of steam about the periphery of this wheel.

By reference to Fig. 2 the construction and relative arrangement of the feed passages and buckets of the wheel will be seen. By this arrangement each of the deflecting rings is provided with a series of deflecting blades and passages of successively increasing area, those upon one deflecting ring being disposed opposite to passages of different area upon the adjacent ring, that is, so that the discharge from a smaller passage will be through a wheel and into a ring of larger capacity. In the form shown in Fig. 2, the feed from the nozzle 17 is through the first wheel 20, thence through the deflecting passage of ring 21 to the wheel 25, and is delivered therefrom to a deflecting passage of greater area in ring 26 which in turn discharges into the third wheel 27. The partially expanded fluid now passes through the reversing chamber 29, thence again through the third wheel and through the deflecting passage of the ring 26 which discharge into the wheel 25, and the flow therefrom discharges through the deflecting passage in the ring 21 of greater area than the opposite passage in ring 26 thus acting upon an increased area of the wheel 20. The discharge from the latter wheel passes through the second reversing passage which is of greater area than the first and begins its final passage through the first wheel, thence through the deflecting blades of the ring 21 which are of greater area than the preceding passages through said ring and discharges into the wheel 25. From this wheel the discharge passes to the deflecting blades of the ring 26 which are larger than the preceding passages in that ring, and the final discharge is to the wheel 27 opposite the port 30 in the abutment 29. The steam then passes from the expansion chamber 34 through the ports 36 to the final wheel 27 from which it is discharged into the vacuum or condensing chamber 28.

Various forms of governing mechanism may be used for regulating the opening of this valve governed by the speed of rotation of the wheels and the shaft carried thereby. One form of such mechanism is claimed in my application filed January 24th 1908, Serial No. 412,451 and is here generally shown in operative position. This comprises a bar 70 having an inclined upper surface adapted to bear against the friction wheel 71 carried by the upper end of the valve stem 67, this bar being provided at its free end with shoulders 72 and 73 disposed in opposite directions as shown in Fig. 3. This bar when once adjusted to the engine running at predetermined speed is not actuated, but for the purpose of actuating it under a change of speed, an oscillating catcher arm 74 is pivotally mounted at 75 upon an eccentric sleeve 76 carried by an eccentric 77 mounted on gear 78. This gear is loose on shaft 13 and meshes with the pinion 79 formed on the gear 80 pivoted upon

the stud 81 carried upon the bracket 82 from the end plate. The gear 80 meshes with the pinion 83 keyed to the shaft 13 from whence these parts are driven. The catcher arm 74 when in the position shown in Fig. 3 does not actuate the valve rod, but may be oscillated in either direction by its connection with the governor 84, one end of which is connected to the sliding collar 85 having a slotted flange 86 which is connected by rod 87 with the bell crank lever 88 pivotally mounted at 89 in the arm 90 in the valve case and provided with pin 91 disposed in slot 92 of the catcher arm by which it may be laterally oscillated to bring either the bifurcated portion 93 or 94 thereof into contact with either the shoulder 72 or 73 and move the valve rod either toward or from the main shaft and correspondingly shift the valve.

The operation of the invention will be seen from the foregoing description, and it is obvious that the wheels may be disposed in any desired place corresponding to the desired position of the shaft, that is, either in a vertical or horizontal position and the number of vanes to be covered in area by any one of the passages or nozzles may be varied as found expedient, it being essential that they increase successively in area with the expansion of the steam so as to afford the necessary impacting surface for that action and that a greater area of buckets be provided on the secondary wheel than those upon the primary wheel. The number of nozzles in each series may also be varied as found desirable, and the number of wheels used may correspondingly be varied. It will be observed that in each instance the area of the passage or nozzle delivering to the wheel is less than the receiving portion of the succeeding passage at the opposite side of the wheel which is essential to obviate the back pressure and impedance of the velocity of the steam which decreases the speed and diminishes the power to be secured besides producing leakage from the wheels.

It will be seen that the area of the deflecting blades in the first ring correspond with the number of vanes in the first wheel, and those deflecting blades introduce the steam into the second wheel where a greater area of vanes is exposed than was used in the first wheel. After passing from the second wheel the deflecting blades of the second ring have a still larger area than the first series of said blades and its discharge is to an increased area upon the third wheel. The steam then passes through the reversing chamber back through the series of blades and vanes as before described and is a second time reversed for its final passage through the largest area of all of the wheels and deflecting blades of the rings. The construction for mounting the wheels and rims permits them to be fitted so that the feed pressure cannot enter between the wheels as the pressure would be equal against the first wheel to that against the third wheel and between the head of the engine and the bulkhead all three wheels are brought to a balance and each supports the other. The wheels are brought to this balance by means of the steam traveling back and forth through them, and the flow while thus doing its work maintains a perfect balance, and the steam between the engine head and casing or the first wheel would be of the same pressure as the steam between the third wheel and the bulkhead. There is also a bulkhead disposed above the fourth wheel to prevent leakage of steam about the outer ends of the vanes. It will be seen that the fixed discharge from the number of vanes upon the first wheel approximately equals in area that of the first vane upon the secondary wheel with which the steam impacts. All of the vanes in the final wheel are simultaneously acted upon by the steam from the expansion chamber as at this period the pressure is so low that more benefit is received from the condensing action at the delivery side of this wheel than by the direct impact of the steam thereon. The invention therefore presents a simple, efficient and economically constructed form of engine in which the expansion of the elastic fluid is utilized to the fullest extent and without impedance of its flow and velocity in its passage therethrough thus producing the maximum of speed and power with relation to the initial pressure.

Having described my invention and set forth its merits, what I claim and desire to secure by Letters Patent is:—

1. In a turbine engine, an inclosing casing, a plurality of turbine wheels therein, feeding rings intermediate of said wheels and each having deflecting blades in a plurality of series of increasing area and reversing means communicating with the final wheel opposite one of the series of blades feeding thereto.

2. In a turbine engine, an inclosing casing, a plurality of turbine wheels therein, feeding rings intermediate of said wheels and each having deflecting blades in series of increasing area, and a reversing chamber upon said casing communicating with the final turbine wheel.

3. In a turbine engine, an inclosing casing, a plurality of turbine wheels therein, feeding rings intermediate of said wheels and each having deflecting blades in series of increasing area, a reversing chamber upon said casing communicating with the final turbine wheel, and a reversing chamber on the opposite side of said casing communicating with the primary turbine wheel.

4. In a turbine engine, an inclosing casing, a plurality of turbine wheels therein, feeding rings intermediate of said wheels and each having deflecting blades in series of increas-

ing area, a reversing chamber upon said casing communicating with the final turbine wheel, a reversing chamber on the opposite side of said casing communicating with the primary turbine wheel, an expansion chamber having a port communicating with said final wheel, a continuous series of nozzles discharging from said chamber, and a turbine wheel cooperating with said nozzles.

5. In a turbine engine, a plurality of turbine wheels, feed rings adjacent thereto having passages of successively increasing area whereby a larger area is exposed upon each succeeding wheel, and reversing passages at opposite sides of said wheels to effect a reversal of the direction of flow therethrough.

6. In a turbine engine, a casing, a plurality of turbine wheels therein, an interposed feed ring having a series of feed passages therein of successively increasing capacity, a secondary feed ring having a series of passages of successively increasing capacity disposed in alinement with the passages of the primary ring and of different area therefrom and a reversing passage communicating with the final turbine wheel.

7. In a turbine engine, a casing, a plurality of turbine wheels therein, an interposed feed ring having a series of feed passages therein of successively increasing capacity, a secondary feed ring having passages of successively increasing capacity disposed in alinement with the passages of the primary ring and of greater area than said primary passages and a reversing passage communicating with the final turbine wheel.

8. In a turbine engine, a casing, a plurality of turbine wheels therein, an interposed feed ring having a series of feed passages therein of successively increasing capacity, a secondary feed ring having passages of successively increasing capacity disposed in alinement with the passages of the primary ring and of greater area than said primary passages, reversing passages communicating with the primary and final turbine wheels, an expansion chamber communicating with the discharge from said wheels, a continuous series of nozzles communicating with said chamber, and a turbine wheel disposed at the discharge of said nozzles.

9. In a turbine engine, a casing, a plurality of turbine wheels therein, an interposed feed ring having a series of feed passages therein of successively increasing capacity, a secondary feed ring having passages of successively increasing capacity disposed in alinement with the passages of the primary ring and of greater area than said primary passages, reversing passages communicating with the primary and final turbine wheels, an expansion chamber communicating with the discharge from said wheels, a continuous series of nozzles communicating with said chamber, a turbine wheel disposed at the discharge of said nozzles, and a condensing chamber at the delivery from said last mentioned wheel.

10. In a turbine engine, a casing, a turbine wheel therein, and a circular feed nozzle for said wheel provided with a passage having an angular discharge portion disposed at substantially a right angle to the curved inlet portion thereof.

11. In a turbine engine, a casing, a shaft therein, a turbine wheel provided with an elongated hub having a shoulder and secured to said shaft, and a secondary turbine wheel provided with a hub mounted upon the hub shoulder of the first mentioned wheel.

12. In a turbine engine, a casing, a shaft therein, a turbine wheel provided with an elongated hub having a shoulder and secured to said shaft, a secondary turbine wheel provided with a hub mounted upon the hub shoulder of the first mentioned wheel, and a feed ring disposed intermediate of said wheels and supported from the casing.

13. In a turbine engine, a casing, a shaft therein, a turbine wheel provided with an elongated hub secured to said shaft, a secondary turbine wheel provided with a hub mounted upon that of the first mentioned wheel, a feed ring disposed intermediate of said wheels and supported from the casing, and overlapping flanges carried by said wheels and ring at the adjacent portions therein.

14. In a turbine engine, a shaft, a plurality of hubs secured thereto and having oppositely disposed peripheral flanges approaching each other, and annular turbine wheels having annular flanges detachably secured to said peripheral flanges of the hubs.

15. In a turbine engine, a shaft, an annular turbine wheel secured thereto, a feed ring having laterally disposed flanges at its opposite sides and secured adjacent to said wheel, and overlapping lateral flanges carried by said wheel opposite those of the ring.

16. In a turbine engine, a casing, a feed nozzle thereto, and a turbine wheel comprising side walls having securing flanges and an intermediate apertured inset portion, and curved vanes having end projections to enter the apertures in said portions and to be secured within the inset portions.

In testimony whereof I affix my signature in presence of two witnesses.

ABE C. TOMS.

Witnesses:
W. J. C. WAKEFIELD,
E. STANDLEY.