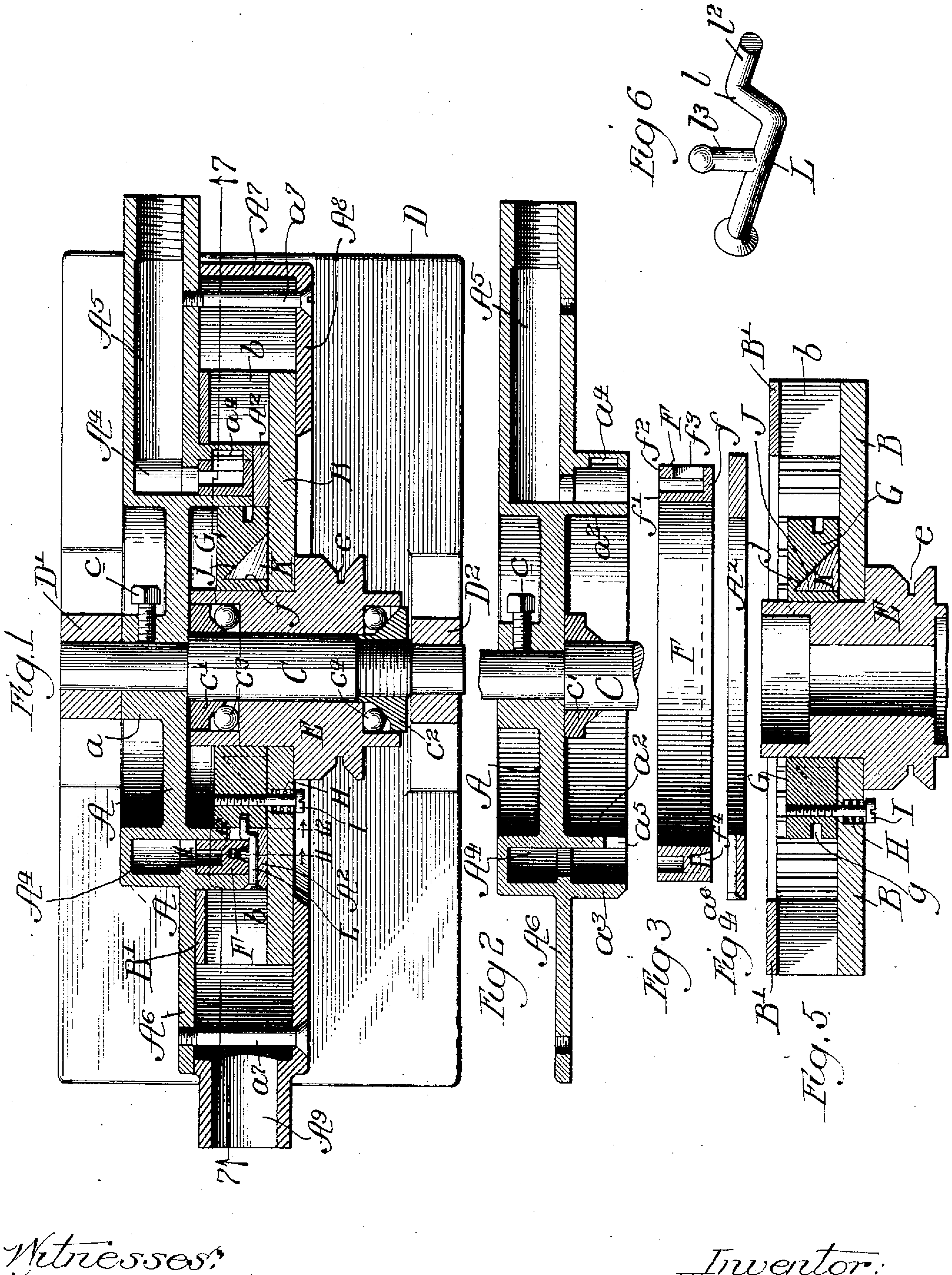
No. 777,850. PATENTED DEC. 20, 1904.

N. W. FLETCHER.

TURBINE MOTOR.

APPLICATION FILED MAY 23, 1904.

NO MODEL. 2 SHEETS—SHEET 1.



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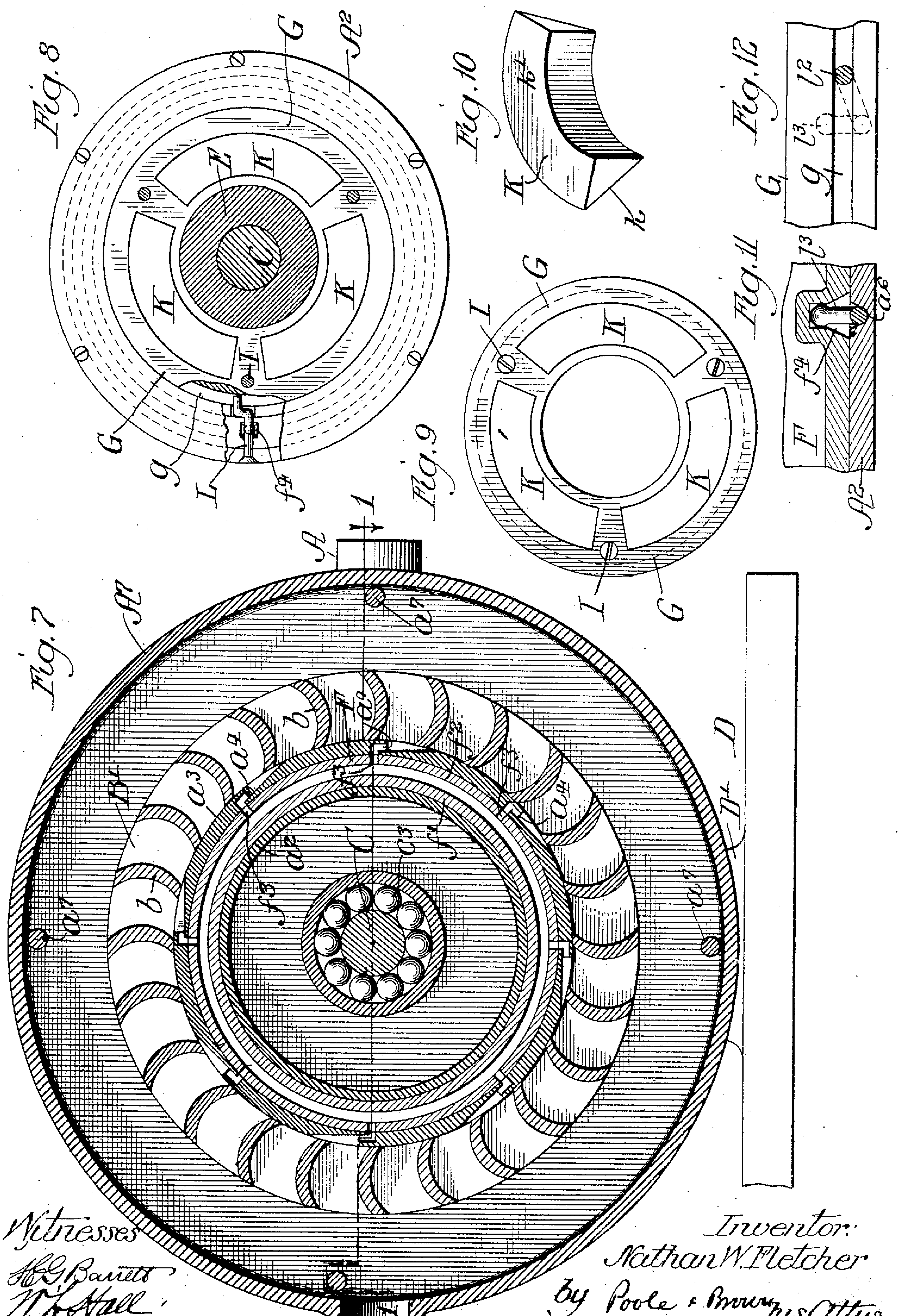

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UNITED STATES PATENT OFFICE.

NATHAN W. FLETCHER, OF CHICAGO HEIGHTS, ILLINOIS, ASSIGNOR TO TURBINE MOTOR TOOL COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TURBINE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 777,850, dated December 20, 1904.

Application filed May 23, 1904. Serial No. 209,398.

To all whom it may concern:

Be it known that I, NATHAN W. FLETCHER, a citizen of the United States, residing at Chicago Heights, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Turbine-Motors; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in turbine-motors of that class in which the rotative part or member of the motor is provided with a plurality of annularly-arranged blades or buckets and the stationary part thereof is provided with a plurality of delivery openings or nozzles operating to direct a series of jets of air or other fluid under pressure against said blades or buckets.

The apparatus herein shown as embodying my invention is in a small and compact form and designed more particularly for use in connection with or as a part of a portable polishing or grinding tool. The novel features of my invention are, however, applicable to motors or turbine-tools for other purposes.

As shown in the accompanying drawings, Figure 1 is a view in central horizontal section, taken on line 1 1 of Fig. 7, of a motor embodying my invention. Fig. 2 is a sectional view taken on said line 7 7 of Fig. 1, showing the stationary part or member of the motor. Fig. 3 is a like section of the valve-ring of the motor. Fig. 4 is a like section of a covering associated with the valve-ring. Fig. 5 is a like section taken through the rotative member of the motor and parts which rotate or turn therewith. Fig. 6 is a perspective view of a rock-shaft by which the valve-ring is actuated. Fig. 7 is a view in central vertical section, taken through the rotative and non-rotative parts of the motor, taken on line 7 7 of Fig. 1. Fig. 8 is a face view of the valve-actuating ring of the motor, together with the non-rotative annular member associated therewith. Fig. 9 is a face view of said valve-actuating ring. Fig. 10 is a perspective view of one of the sliding governor-weights. Fig. 11 is a detail section taken in the plane of the actuating-arm of the rock-shaft shown in Fig. 6 on line 11 11 of Fig. 1. Fig. 12 is a detail section taken upon line 12 12 of Fig. 1.

As shown in said drawings, A designates the stationary or non-rotative body or member of the motor, which is generally of disk form, and B indicates the rotative member or wheel of the motor, which is also of circular or disk form and which is provided at its periphery with a series of curved blades or buckets *b b*, which project from the side face of the disk toward the stationary part A and are attached to a supplementary annular supporting-ring B′, arranged parallel with the marginal part of the disk B at the inner face thereof. Said rotative member B is mounted to turn on a central shaft or spindle C, which is mounted in and secured at its ends to standards D′ D^2 on a base-plate D. The non-rotative member A of the motor is located adjacent to the standard D′, and the shaft C passes through a central aperture in said non-rotative member A, which latter is rigidly secured to the shaft conveniently by means of a set-screw *c*, which passes through a central hub *a* on the said part A and bears against said shaft. The disk B, forming the body of the rotative member or wheel, is attached to a central hub or sleeve E, which has bearing on the shaft C and projects outwardly from the face of the disk B. The outer part of said hub E constitutes means for communicating motion from the rotative member of the motor to the parts to be driven. Said hub for this purpose is shown as provided with a groove *e*, adapted to receive a round driving-belt, so that the outer end of the hub in this instance constitutes a belt-pulley. Said hub E is shown as mounted on the shaft C by means of antifriction ball-bearings consisting of cones C′ C^2 on the shaft which enter annular concentric grooves or recesses in the ends of said hub and between which and the said grooves or recesses are located balls c^3 c^4.

Now referring to the arrangement of the parts by which the air or pressure fluid is directed to and acts upon the buckets *b b* of the rotative member or wheel B, the member A of said motor is provided with a hollow annular part A^5, which is of U shape in cross-section and provided with two parallel cylindric inner and outer walls or flanges a^2 a^3, which project or extend within the annularly-arranged buckets b, so that said buckets are located radially outside of the external annular flange a^3 and move in a circular path exterior thereto. A cover-ring A^2 is secured to the edges or margins of the flanges a^2 a^3 and forms therewith a closed annular passage A^4, to which air under pressure is supplied by means of a supply-passage A^5, which is formed, as shown, within a radial rib on the rear or outer face of the disk A and is adapted at its outer end for connection therewith of an air-supply pipe. In the outer flange a^3 is formed a plurality of outlet or jet openings a^4, the outer portions of which are arranged at an angle to radial lines of the wheel and are directed toward the concave faces of the buckets b b, as clearly seen in Fig. 7. The inner margins of said buckets are arranged closely adjacent to but out of contact with the smooth exterior cylindric surface of said annular flange a^3, in which the outlet ports or openings a^4 are formed.

Within the annular passage formed between the marginal parts of the flanges a^2 a^3 and adjacent to the cover-ring A^2 is a rotative valve-ring F, which is made of U shape in cross-sectional form, or, in other words, consists of inner and outer cylindric walls and a connecting-web joining the margins of the same adjacent to the cover-ring A^2. In the outer cylindric wall or flange f^2 of the ring F are formed a series of ports or openings f^3. Said ports or openings f^3 are arranged to register severally with the outlet-ports a^4 in the non-rotative member of the motor. The inner portions of said ports a^4 where said ports open through the inner cylindric surface of the flange a^3 are arranged radially, and the ports f^3 are also arranged radially, as clearly shown in Fig. 7. Inasmuch as the hollow or U-shaped valve-ring F has its open side directed toward the main part of the passage A^4, air-supply to said passage A^4 enters said ring throughout the entire circumference thereof and passes radially from the interior of said valve-ring and thence through the outlet-ports a^4, the outflowing jets of air being directed laterally by the outer angularly-arranged parts of said ports a^4, so that they leave the non-rotative member of the motor in a direction to impinge upon the curved faces of the buckets b b. When said ports f^3 are in exact register with the ports a^4, a maximum quantity of air passes outwardly through each of the outlet-ports; but by turning or shifting the valve-ring F within the stationary member of the motor the air-supply may be cut off to a greater or less extent, as desired, for controlling the speed of the motor. Devices are provided for automatically actuating the said valve-ring F, which are made as follows: The portion of the hub E which projects inside the disk-shaped portion B of the rotative member of the motor is made cylindric on its outer surface, and on said cylindric portion of said hub is mounted a valve-actuating ring G, which turns or rotates with the hub, but which is movable inwardly and outwardly thereon toward and from said disk B. Said ring G is yieldingly held in its outward position, or adjacent to the disk B, by suitably-applied springs. Said springs, as herein shown, and illustrated in Fig. 5, have the form of spirally-coiled springs H, interposed between shoulders on the outer face of the disk B and inwardly-facing shoulders formed by the heads of screws I, which pass through holes in said disk and have screw-threaded engagement with the ring E. The drawings show three of said screws I as indicated in Fig. 8, one only of said screws, with its associated spring H, being illustrated in Figs. 1 and 5. In the outer face of the ring G, or that adjacent to the disk B, are formed a plurality of concentric recesses, (indicated by J J and more clearly shown in Figs. 1, 5, and 10.) The outer walls of said recesses are provided with oblique bearing-surfaces j j, and in said recesses are located centrifugally-acting weights K K, which are of segmental form or curved to correspond with the circular form of the ring. Said weights K K are wedge-shaped in cross-section, having outer oblique bearing-surfaces k k, adapted to fit and slide on the oblique bearing-surfaces j j of the ring G, and having flat bearing-surfaces k', adapted to bear against the inner face of the disk B, which in its portion opposite the said ring G is provided with a flat bearing-surface b, which is perpendicular to the central axis of the motor. In the operation of these parts the weights K K when thrown or moved radially outward by centrifugal action, due to rotation of the valve-actuating ring G with the rotative member of the motor, slide radially outwardly on the flat bearing-surface b of the disk B, and their oblique outer bearing-faces k acting on the oblique bearing-surfaces j of the recesses J in the valve-actuating ring G serve to give inward movement of the said actuating-ring on the hub E. A connecting device is provided between the said valve-actuating ring G and the valve-ring F, by which said valve-ring is turned or rotated during the inward or outward movement of the said ring on the hub E, as follows: Said ring G is located within the cylindric space or chamber formed by the inner flange a^2 of the disk, the outer or marginal surface of said actuating-ring being preferably made cylindric and arranged adjacent to but out of contact with the inner cylindric surface of said flange a^2. In the annular portion of the non-rotative member B of the motor and radially exterior to the valve-actuating ring is located a rock-shaft L, the central axis of which is arranged radially with respect to the central axis of the motor and which is mounted to turn in a suitable bearing. Said bearing, as herein shown, is formed by a groove a^6 in the cover-ring A^2, Figs. 4 and 11. At its inner end the said rock-shaft L is provided with a crank-arm l', having a crank-pin l^2, that projects inwardly past the inner face of the flange a^2 and engages an annular groove g, formed in the exterior or marginal surface of the valve-actuating ring G. Said crank-pin l^2 extends inwardly from the inner face of the flange a^2, while the crank-arm l is located within a notch or opening a^5, Figs. 1 and 2, formed in the inner margin of said flange a^2. The said crank-shaft L is held in the radial bearing-groove a^6 in the inner face of the cover-ring A^2 by the valve-ring F, the side face of which bears against the said shaft, as clearly shown in Figs. 3, 4, and 11. Said rock-shaft L is also provided with a rigid actuating-arm l^3, which extends toward the valve-ring F and enters a recess f^4, which is formed in the face of said valve-ring adjacent to the said rock-shaft. The extremity of said rock-shaft l^3 closely engages a socket formed at the inner part of the recess f^4, as clearly seen in Fig. 11. These parts are so arranged that when the valve-actuating ring F is moved inwardly or outwardly upon the hub E the engagement of its peripheral groove g with the crank-pin l^2 moves or oscillates the rock-shaft L, thereby swinging the free end of the actuating-arm l^3, which is engaged with the recess in the valve-ring G, in a direction to shift or turn the said valve-ring, the movements so given to the valve-ring being equal to or only slightly greater than the width of the ports f^3 or a^4. These parts are so arranged, moreover, that when the actuating-ring G is at the outward limit of its movement, or adjacent to the disk B, in which position it is held by the springs H, the valve-ring will be held in position with the outlet-ports a^4 fully open. When, however, a desired or predetermined speed of rotation in the motor is exceeded, the action of the centrifugal weights K acting on the inclined surfaces of the actuating-ring will shift the latter inwardly, thereby turning the rock-shaft L and giving movement to the valve-ring F in a direction to partially or wholly close the said ports.

By the construction described, therefore, provision is made for automatically controlling or regulating the size of the outlet-ports a^4, by which the air is delivered in jets to the blades of the rotative member of the motor, thereby enabling the quantity of air delivered to be increased or decreased, according to the speed desired in the motor.

The regulating device described manifestly not only prevents the motor from turning at a speed greater than that desired, but controls the speed of rotation thereof when the motor is doing no work—as, for instance, if a grinding-tool be driven by the motor when said grinding-tool is free from contact with the work the motor would acquire a very high rate of speed were it not for the regulating device, which under such circumstances cuts off the air-supply and reduces the speed of rotation.

The controlling device may obviously be regulated or controlled by turning the screws I I so as to give a greater or less tension to the springs H, said springs H being thus capable of adjustment, so that they will yield under the action of the weights K K when the desired speed is exceeded, cutting off the supply of air to the extent required and supplying air in quantity sufficient to maintain only the desired speed of rotation. If such speed of rotation be reduced through the resistance afforded by the tool in doing the work, then the springs through their expansion will overcome the centrifugal action of the weights and move the valve-ring F so as to fully open the outlet-ports and give the increased quantity of air or pressure fluid required for driving the tool when doing its work.

A casing or housing adapted to surround the blades or buckets on the rotative member of the motor is formed as follows: On the outer margin of the disk-shaped body A of the non-rotative part of the motor, external to the supply-passage A^4, is formed a radial flange A^6, Figs. 1 and 2, which extends outwardly past the blades or buckets on the rotative member of the motor, and to the outer margin of said flange A^6 is secured an annular casing-section A^7, consisting of a cylindric outer wall having an inwardly-extending annular flange A^8, which extends inwardly past and overlaps the marginal portion of the disk B, constituting the body of the rotative member of the motor. Said flange A^8 is arranged with its inner margin closely adjacent to but not in actual contact with the marginal part of said disk B. The annular casing or housing formed by the flange A^6 and the casing-section A^7 is provided with an exhaust port or nozzle A^9, through which is delivered the exhaust-air from the motor. The casing-section A^7 is shown as connected with the flange A^6 by means of bolts a^7, Figs. 1 and 7.

I claim as my invention—

1. A turbine-motor comprising non-rotative and rotative members, said non-rotative member being provided with an annular supply-passage provided with a plurality of discharge-apertures, and the rotative member having a series of annularly-arranged blades or buckets, a rotative valve-ring having ports which act in connection with the said discharge-apertures, a laterally-movable rotative valve-actuating ring carried by the said rotative member, actuating connections between said valve-actuating ring and the said valve-ring, spring-actuated means for moving the valve-

ring in one direction, and centrifugally-acting weights carried by the rotative member and acting on said valve-actuating ring to move or shift the valve-ring in the opposite direction.

2. A turbine-motor comprising non-rotative and rotative members, said non-rotative member being provided with an annular supply-passage provided with a plurality of discharge-apertures, and the rotative member having a series of annularly-arranged blades or buckets, a rotative valve-ring having ports which act in connection with the said discharge-apertures, a laterally-movable rotative valve-actuating ring carried by the said rotative member, actuating connections between said valve-actuating ring and the said valve-ring, spring-actuated means for moving the valve-ring in one direction, and centrifugally-acting weights carried by the rotative member and acting on said valve-actuating ring to move or shift the valve in the opposite direction, said valve-actuating ring being provided with oblique bearing-surfaces and the said weights being adapted to slide radially on the said rotative member and having oblique faces engaging those on the said valve-actuating ring.

3. A turbine-motor comprising non-rotative and rotative members, said non-rotative member being provided with an annular supply-passage provided with a plurality of discharge-apertures, and the rotative member having a series of annularly-arranged blades or buckets, a rotative valve-ring having ports which act in connection with the said discharge-apertures, a laterally-movable rotative valve-actuating ring carried by the said rotative member, spring-actuated means acting to move the valve-ring in one direction, centrifugally-acting weights carried by the rotative member and acting on said valve-actuating ring to move the valve-ring in the opposite direction and actuating connections between said actuating-ring and the valve-ring embracing a circumferential groove in said valve-actuating ring, and a rock-shaft mounted in the stationary member of the motor and provided with a crank-arm engaging said groove and with a rigid actuating-arm engaging said valve-ring.

4. A turbine-motor comprising non-rotative and rotative members, said non-rotative member being provided with an annular supply-passage provided with a plurality of discharge-apertures arranged to open outward through an exterior cylindric wall of said passage, and the rotative member having a series of annularly-arranged blades or buckets moving in a path exterior to said annular passage, a rotative valve-ring located inside of said exterior cylindric wall of said passage, and having ports corresponding with said outlet-apertures, a valve-actuating ring mounted on the rotative member and extending into the space inclosed by said annular passage, spring-actuated means acting to move the valve-ring in one direction, centrifugally-acting weights carried by the rotative member and acting on said valve-actuating ring to give lateral movement to the same and actuating connections between said valve-actuating ring and the valve comprising an annular groove in the exterior face of said valve-actuating ring, a radially-arranged rock-shaft mounted in the non-rotative member of the motor and provided with a crank-arm engaging said groove and with an actuating-arm engaging said valve-ring.

5. A turbine-motor comprising non-rotative and rotative members, said non-rotative member being provided with an annular supply-passage provided with a plurality of discharge-apertures, and the rotative member having a series of annularly-arranged blades or buckets, a rotative valve-ring having ports which act in connection with the said discharge-apertures, a laterally-movable rotative valve-actuating ring carried by the said rotative member, actuating connections between said valve-actuating ring and the said valve-ring, centrifugally-acting weights carried by the rotative member and acting on said valve-actuating ring to laterally move or shift the same, a plurality of screws inserted in the valve-actuating ring and having sliding engagement with the rotative member of the motor, and springs interposed between the heads of said screws and an opposing surface of said rotative member.

6. A turbine-motor comprising non-rotative and rotative members, said non-rotative member being provided with an annular supply-passage having a plurality of discharge-apertures and the rotative member having a series of annularly-arranged blades or buckets, a rotative valve-ring having ports which act in connection with said discharge-apertures, a laterally-movable rotative valve-actuated ring carried by said rotative member, spring-actuated means acting to turn the valve-ring in one direction, actuating connections between said valve-actuating ring and said valve-ring, said valve-actuating ring being provided in one of its lateral faces with a plurality of weight-receiving recesses having outer oblique bearing-surfaces and the said centrifugally-acting weights being located within said recesses and being adapted to slide on an opposing bearing-surface of the rotative member.

7. A turbine-motor comprising non-rotative and rotative members, said non-rotative member being provided with an annular supply-passage having a plurality of discharge-apertures, and the rotative member consisting of a disk provided at its periphery with a series of annularly-arranged blades or buckets, a rotative valve-ring having ports which act in connection with said discharge-apertures, a rotative valve-actuating ring carried by the said rotative member, springs applied between said valve-actuating ring and the rota-

tive member and acting to move said ring toward the said disk-shaped body thereof, and centrifugally-acting weights interposed between the said disk-shaped body of the rotative member and the said valve-actuating ring, said weights being adapted to slide on the said disk-shaped body of the rotative member and the said weights, and the valve-actuating ring being provided with oblique bearing or contact surfaces, and actuating connections between the said valve-actuating ring and the valve-ring.

8. A turbine-motor comprising non-rotative and rotative members, said non-rotative member being provided with an annular supply-passage having a plurality of discharge-apertures and the rotative member consisting of a disk provided at its periphery with a series of annularly-arranged blades or buckets, a rotative valve-ring having ports which act in connection with said discharge-apertures, a rotative valve-actuating ring carried by the said rotative member, springs applied between said valve-actuating ring and the rotative member tending to move said ring toward the said disk-shaped body thereof, centrifugally-acting weights interposed between the said disk-shaped body of the rotative member and the said valve-actuating ring, said weights being adapted to slide on the said disk-shaped body of the rotative member and the said weights, and the valve-actuating ring being provided with oblique bearing or contact surfaces, and actuating connections between the said valve-actuating ring and the valve-ring, embracing an annular groove in the actuating-ring and a radially-arranged rock-shaft mounted in the non-rotative member of the motor and provided with a crank-arm engaging said annular groove and provided with an actuating-arm engaging said valve-ring.

9. A turbine-motor comprising non-rotative and rotative members, said non-rotative member consisting of a disk-shaped body provided with an annular supply-passage formed by inner and outer cylindric flanges on said body, and a cover-ring applied to the margins of the said flanges, said annular supply-passage having a plurality of discharge-passages and the rotative member having a series of annularly-arranged blades or buckets, a rotative valve-ring of U form in cross-section located within said annular supply-passage and having ports which act in connection with said discharge-apertures, a valve-actuating ring carried by the said rotative member, actuating connections between said valve-actuating ring and the said valve-ring, spring-actuated means applied to move the valve-ring in one direction, and centrifugally-acting weights carried by the rotative member and acting on the said valve-actuating ring to move or shift the said valve-ring in the opposite direction.

10. A turbine-motor comprising non-rotative and rotative members, said non-rotative member being made of disk form and having an annular supply-passage provided with a plurality of outlet-passages, and the rotative member consisting of a disk-shaped body provided with a plurality of buckets arranged radially exterior to said annular passage and a casing or housing consisting of a flange extending radially outward from said disk-shaped non-rotative member, an external wall and an inwardly-extending flange overlapping the marginal part of the said disk-shaped body of the rotative member.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 18th day of May, A. D. 1904.

NATHAN W. FLETCHER.

Witnesses:

C. CLARENCE POOLE,

GERTRUDE BRYCE.