P. F. NYDEGGER.

TURBINE.

APPLICATION FILED MAR. 6, 1909.

**969,974.** Patented Sept. 13, 1910.

Fig. 1.

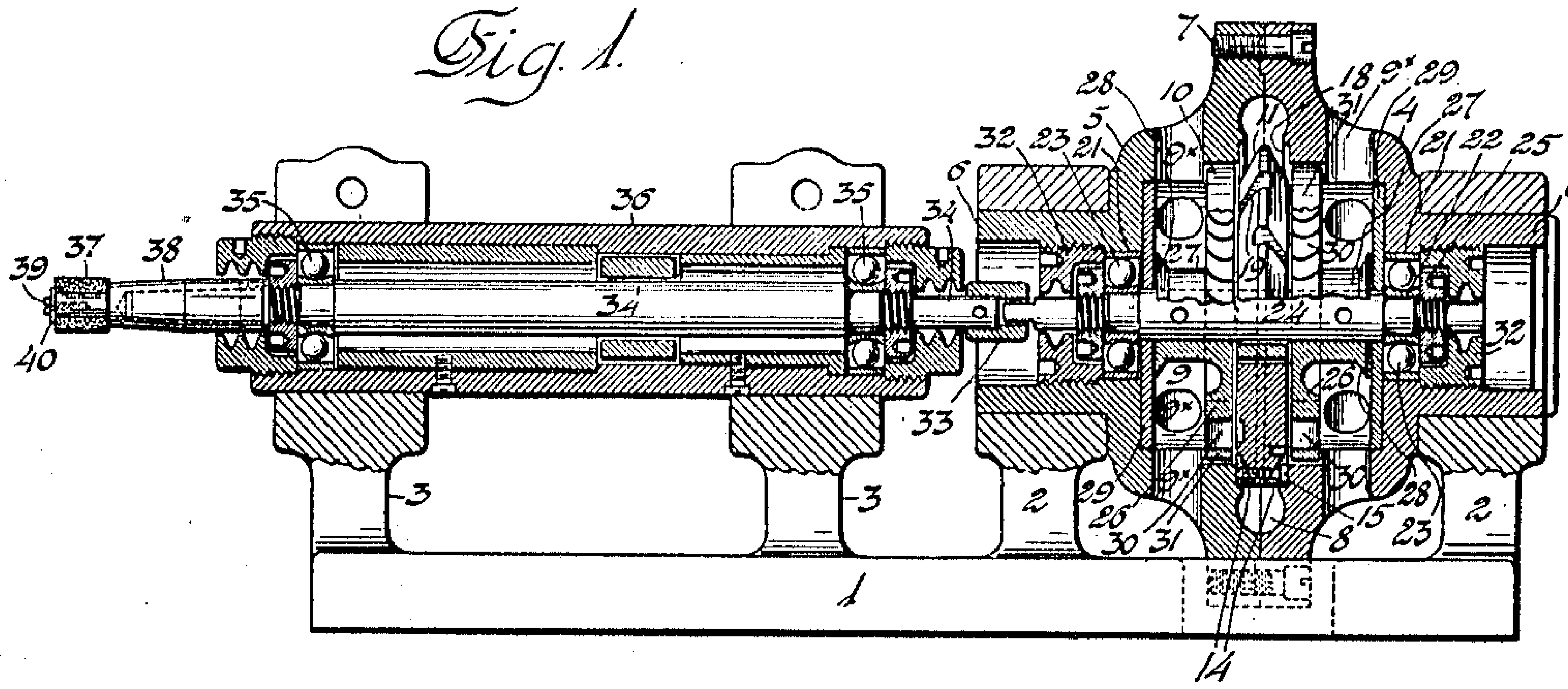



Fig. 2.

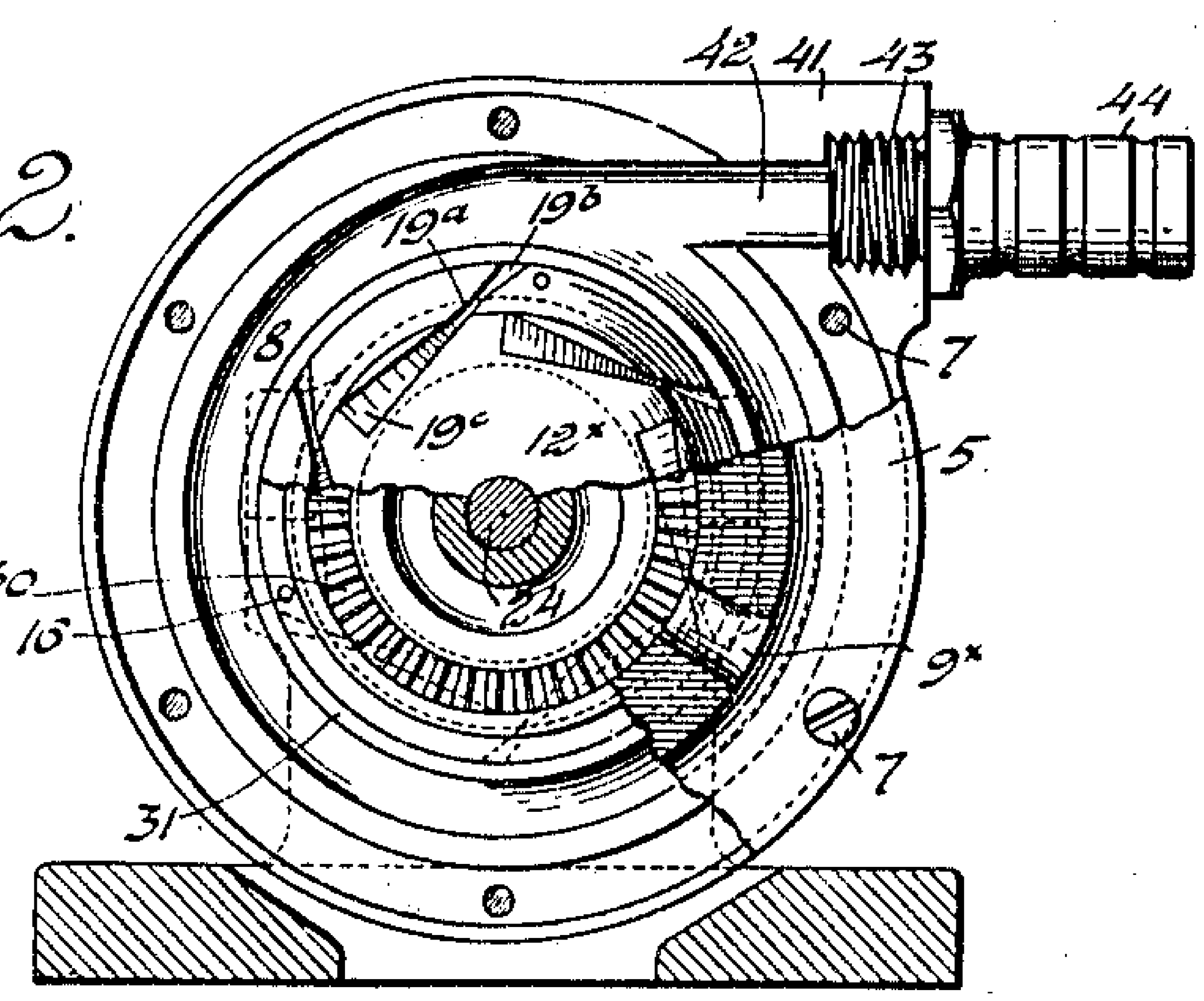
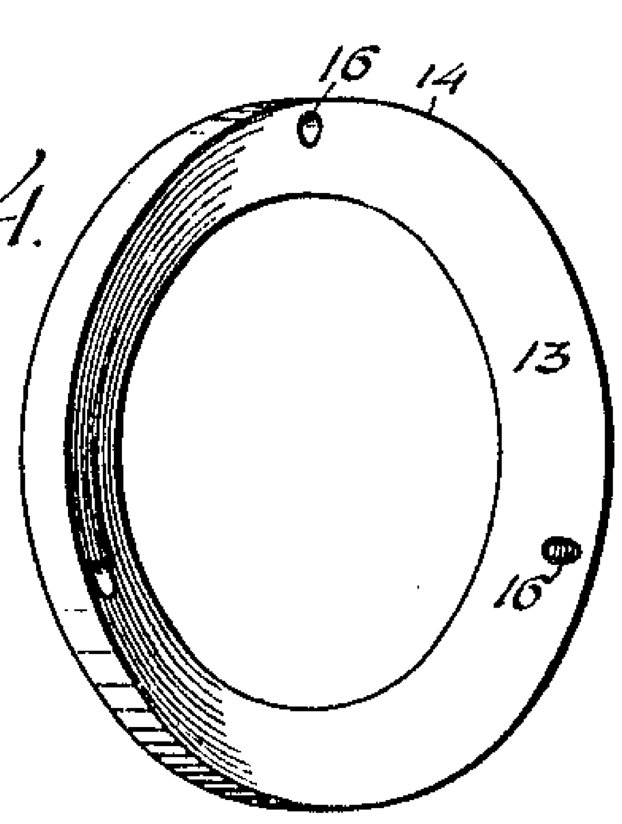



Fig. 4.



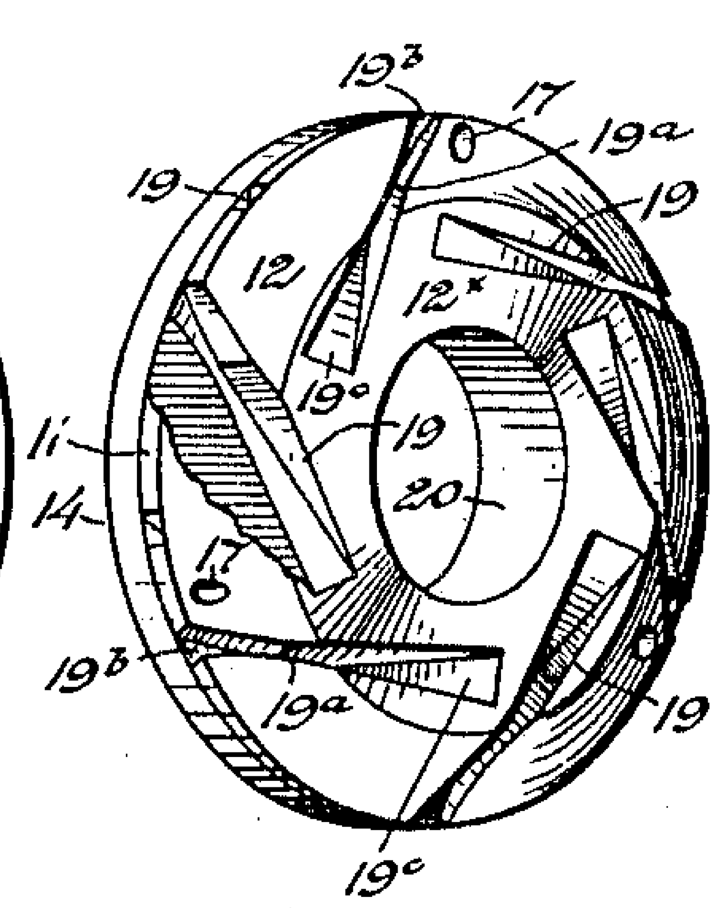




Fig. 3.

WITNESSES

D. Csincsics Jr.

V. E. Smith

INVENTOR

Paul F. Nydegger

BY Henry J. Miller

ATTORNEY

THE NORRIS PETERS CO., WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

PAUL F. NYDEGGER, OF ELIZABETH, NEW JERSEY, ASSIGNOR TO THE SINGER MANUFACTURING COMPANY, A CORPORATION OF NEW JERSEY.

## TURBINE.

969,974. Specification of Letters Patent. Patented Sept. 13, 1910.

Application filed March 6, 1909. Serial No. 481,734.

*To all whom it may concern:*

Be it known that I, Paul F. Nydegger, a citizen of the United States, residing at Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Turbines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates more particularly to an improvement in pneumatic motors, and is designed especially for use in driving rapidly rotating tool spindles, such as those employed for operating grinding or polishing wheels.

It has for its object to provide a motor in which the power is so applied that the moving parts are entirely balanced in order to relieve the bearings of the usual lateral thrust in addition to the weight of the parts supported thereby, thus reducing the wear of the relatively movable parts to a minimum at the extremely high speeds at which the tool carrying spindles are required to be driven in performing inside work in hollow articles of comparatively small diameter in connection with which grinding or polishing wheels of correspondingly small diameters are necessary.

It has been customary heretofore to employ a direct driving connection between the driving spindle and the tool carrying spindle, and in order to secure the necessary high surface speed of the tool, the motor- or driving-spindle must be turned at correspondingly high speeds, rotating in some instances at twenty thousand to fifty thousand revolutions per minute.

In its preferred construction the motor is provided with a casing formed with two exhaust chambers and an intermediate annular supply chamber, an axial spindle extending through said chambers carrying two spaced turbine-wheels having oppositely extending vanes with intermediate spaces communicating with the respective exhaust chambers. Surrounded by the annular supply chamber and occupying the space intermediate the inlet sides of the turbine-wheels is a delivery member in the form of a disk with inclined ducts leading from the periphery, where they are in communication with the supply chamber, alternately to the opposite faces of the delivery member in which they are in communication with the spaces between the vanes of the respective turbine-wheels. As the several air-jets are directed by the delivery member against the adjacent ends of the turbine-wheel vanes, so that the end thrust of the jets of one series is axially balanced by the end thrust of the other series, while the several operative parts are otherwise symmetrically arranged, the force of the propelling medium is so expended that the bearings of the spindle are entirely relieved of work other than that of supporting the weight of the spindle and the turbine-wheels thereon.

The invention will be understood by reference to the accompanying drawings, in which—

Figure 1 is a sectional elevation of a grinding machine provided with a motor embodying the present improvement, and Fig. 2 a side view of the same in partial transverse section, and representing certain parts partially broken away in different planes to more fully disclose the various constructive features. Fig. 3 is a perspective view of that portion of the delivery member provided with the air ducts, and Fig. 4 a similar view of one of the cover-plates or rings therefor.

As represented in the drawings, the machine is constructed with a frame comprising the bed-plate 1 and series of alined bearing posts 2 and 3. The motor casing is constructed of two longitudinally separable sections 4 and 5 each provided with a hollow boss 6 fitted to one of the spaced posts or pedestals 2 and normally clamped together by means of screws 7, the adjacent faces of the sections being fitted together to form an air-tight joint by means of a common form of tongue-and-groove connection.

As herein represented, within the adjacent faces of the casing-sections is formed the central annular supply chamber 8, and each of these sections is formed with a concentric annular exhaust or discharge chamber 9, between which supply and exhaust chambers is interposed in each section an annular wheel-race 10 communicating with its respective exhaust chamber 9. Each discharge chamber is shown having a series of radial exhaust ports $9^{x}$ through which the spent power medium is released into the atmosphere, and through the lower one of which any condensation or other liquid residue is permitted to escape from the casing.

Intermediate the wheel-races 10 and surrounded by the supply chamber 8 is the delivery member which is shown herein composed of a disk 11 with convergently beveled outer portions forming conical faces 12 to which latter are fitted the correspondingly inclined conical adjacent faces 13 of the cover-plates or rings 14 whose flat opposite faces are flush with the inner portions $12^{x}$ of the side faces of the disk 11 to which these rings are secured by means of clamping screws 15 entering the transverse apertures 16 17 formed therefor in the rings 14 and disk 11. The casing sections are formed in their adjacent faces with a cavity for the delivery member affording an annular seat 18 to receive the outer edges of the rings 14, which, with the disk 11 afford an effective partition between the wheel-races 10.

In both faces of the disk 11 are formed series of grooves 19 leading from the periphery in tangential relation with an imaginary circular band intermediate the outer periphery and the central aperture 20, these grooves extending the entire depth of the edge of the peripheral portion included between the outer edges of the conical faces 12, and extending inwardly and divergently and finally merging into the flat inner portions $12^{x}$ of the opposite faces of the disk.

In practice, the grooves 19 are produced by narrow milling cutters set at consecutively different angles with the periphery, in such manner as to produce a contracted portion $19^{a}$ of maximum depth at a short distance from the periphery, an inlet opening $19^{b}$ of medium depth and wider at the periphery, and a shallow delivery portion $19^{c}$ of maximum width at the inner extremity. As will be observed, the parts $19^{a}$ and $19^{b}$ of each duct are laterally closed by the overlying ring 14, so as to provide a rectangular peripheral inlet aperture and a flaring lateral outlet aperture for delivery of the compressed air or other propelling medium to the turbine-wheels. The peculiar shape of the flat-bottom grooves 19 with angular side walls intersecting at different angles the periphery and the side faces 12 and $12^{x}$ of the disk 11 affords air ducts which are nearly uniform in cross-section but expanding slightly from the periphery to the discharge point disposed inwardly of the inner edge of the ring 14.

While ducts of round cross-section throughout might be formed in the delivery or partition member by drilling in a manner well-known, the construction above described is deemed advantageous, as the slots may be more easily and accurately milled so as to produce the necessary balance in the running of the motor, especially in view of the difficulty of drilling with accuracy slightly taper holes to produce efficient expansive nozzles at a slight inclination to the side faces of the disk. By forming the delivery member as a detachable partition between the wheel-races, it is evident that the formation of the air ducts therein is greatly facilitated, this member being removed for the performance of the necessary machine work thereon.

Each casing section is provided with an axial recess in which is fitted a wearing ring 21 between which and the peripherally grooved ball-race 22 is interposed the series of anti-friction balls 23. The axial spindle 24 extending through the several supply and exhaust chambers, is reduced at the ends to form shoulders against which the adjacent ends of the ball races 22 are securely clamped by means of collars 25 screwed upon the threaded portions of said spindle, whereby the latter is supported within ball bearings thus afforded by the casing.

Mounted upon the spindle 24, and spaced apart a distance equal to the spacing of the wheel-races 10 and the thickness of the delivery member 11 14 are two turbine-wheels 26 whose hubs 27 are fixed upon said spindles by suitable means and provided with annular oil deflecting flanges 28, between which latter and the ball-bearings of the spindle are arranged the washers 29 serving to protect the operative portions of the latter from penetration of any oil from the bearings. Each of the turbine-wheels is formed with series of peripherally arranged parallel radial vanes 30 with their inlet edges substantially at right angles to the inner face of the wheel and their delivery or discharge edges inclined to the opposite face of the wheel in a manner and for reasons well-known. As represented in the drawings, the spaces intermediate the vanes are peripherally closed by means of the annular rim 31, and the receiving or inlet edges of the vanes are arranged at substantially the same distance from the axis of rotation as the inner or delivery end portions $19^{c}$ of the air ducts 19, whereby the jets of air are delivered from the supply chamber 8 substantially perpendicularly to the adjacent surfaces of the vanes, and produce by their impact thereon the rapid rotation of the turbine-wheels due to the high velocity of escape of the propelling medium from the supply chamber through said ducts.

The casing hubs 6 are provided with internally threaded cavities in which are fitted the centrally apertured screw-plugs 32 surrounding the reduced outer ends of the spindle 24 and serving not only to close the outer ends of the ball bearings from introduction of dust and dirt but to maintain the wearing rings 21 in their positions.

One end of the spindle 24 is squared to fit the correspondingly shaped socket of a coupling collar 33 secured upon the reduced adjacent end of the tool spindle 34 mounted in ball bearings 35 within the tubular casing 36 supported by the posts or pedestals 3 of the machine frame. As herein represented, the bearings and the dust excluding means adjacent thereto which are employed for the tool spindle 34 are similar to those described in connection with the motor spindle 24.

At the end opposite that connected with the motor the tool spindle carries the cylindrical grinding wheel 37 secured to the shouldered extremity of the taper holding sleeve 38 fixed upon said spindle by means of the clamp-screw 39 and washer 40 interposed between the head of the latter and the outer end of said polishing wheel.

As represented in Fig. 2, the casing is provided with a boss 41 containing a tangential inlet opening 42 with threaded outer end in which is screwed the threaded end 43 of a nipple 44 to which the compressed air or supply tube is attached for supplying power to the motor.

Having thus set forth the nature of the invention, what I claim herein is:—

1. A motor comprising a spindle, two spaced turbine-wheels fixed thereon and having oppositely extending vanes correspondingly inclined in relation to the space intermediate said wheels, a casing formed with a supply chamber, and a delivery member occupying the space intermediate said wheels and provided in opposite faces with divergently inclined series of laterally-open ducts each affording communication between the supply chamber and the adjacent ends of the vanes of said turbine-wheels, and annular cover-plates applied to said delivery member for laterally closing the said ducts excepting in their delivery end portions adjacent said wheels.

2. A motor comprising a spindle, two spaced turbine-wheels fixed thereon and having oppositely extending vanes correspondingly inclined in relation to the space intermediate said wheels, a casing formed with a supply chamber, and a delivery member occupying the space intermediate said wheels and provided with independent series of ducts each leading from the supply chamber at the periphery of said member to one of the side faces of said member adjacent the path of movement of the turbine-wheel vanes.

3. A motor comprising a casing formed with an annular supply chamber, an axial spindle journaled in said casing and extending through said chamber, two spaced turbine-wheels mounted on said spindle and provided with oppositely extending vanes correspondingly inclined in relation to the intermediate space, and a delivery member occupying the space intermediate said wheels and surrounded by said supply chamber, said delivery member being provided with series of laterally inclined ducts leading from its periphery to its opposite faces, respectively, and directed toward the turbine-wheel vanes and tangentially of their path of circular movement.

4. A motor comprising a casing formed with two exhaust chambers and an intermediate annular supply chamber, an axial spindle journaled in said casing and extending through said chambers, two spaced turbine-wheels mounted on said spindle and provided with oppositely extending vanes directed toward said exhaust chambers, and a delivery member occupying a space intermediate said turbine-wheels and surrounded by said supply chamber, said delivery member being provided with series of laterally inclined supply ducts leading from its periphery toward and tangentially of the path of movement of the vanes of the respective turbine-wheels.

5. A motor comprising a casing constructed with longitudinally separable sections having an intermediate supply chamber, an axial spindle journaled in said casing, two spaced turbine-wheels mounted on said spindle and provided with oppositely extending vanes correspondingly inclined in relation to the intermediate space, and a delivery member occupying the space intermediate said turbine-wheels and surrounded by said supply chamber, said delivery member comprising a disk having laterally inclined open grooves each extending from the periphery inwardly to one of its side faces tangentially to the path of movement of the adjacent turbine-wheel vanes, and annular cover-plates for laterally closing the outer end portions of said grooves.

6. A motor comprising a casing constructed with longitudinally separable sections having an intermediate supply chamber, an axial spindle journaled in said casing, two spaced turbine-wheels mounted on said spindle and provided with oppositely extending vanes correspondingly inclined in relation to the intermediate space, and a delivery member occupying the space intermediate said turbine-wheels and surrounded by said supply chamber, said delivery member comprising a disk beveled near the periphery to form conical marginal portions and having inclined open grooves each extending from the periphery inwardly to one of its side faces tangentially to the path of movement of the adjacent turbine-wheel vanes and flared in width toward both ends from a point intermediate the same, and annular cover-plates with conical faces secured upon the conical marginal portions of said disk and fitted to seats formed therefor in the casing sections.

7. A motor comprising a transversely divided casing provided with a wheel-race and an adjacent supply chamber, a spindle

journaled in said casing transversely of said wheel-race, a turbine-wheel mounted upon said spindle within said wheel-race and provided with an annular series of transverse vanes, and a fixed delivery member mounted in said casing adjacent the inlet side of said turbine-wheel comprising a disk having laterally inclined open grooves each extending from the periphery inwardly to a side face thereof tangentially to the path of movement of the adjacent turbine-wheel vanes, and an annular cover-plate applied to the delivery side of said member and adapted to laterally close the outer end portions of said grooves.

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

PAUL F. NYDEGGER.

Witnesses:
HENRY J. MILLER,
VICTOR E. SMITH.