No. 823,211. PATENTED JUNE 12, 1906.

N. W. FLETCHER.

TURBINE MOTOR.

APPLICATION FILED JAN. 3, 1905.

6 SHEETS—SHEET 1.

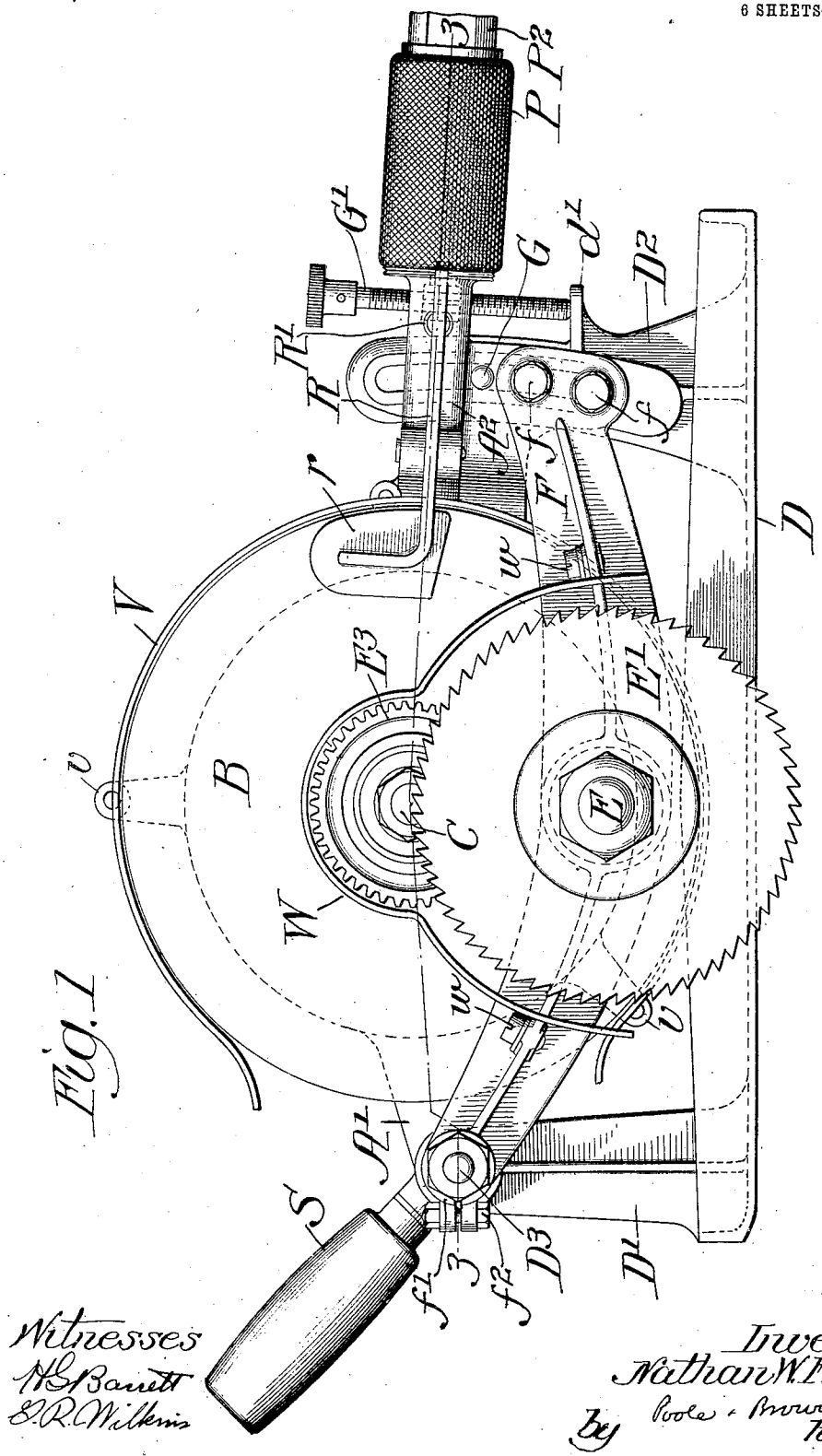


Fig. 1.

Witnesses
H. B. Barnett
E. R. Wilkins

Inventor:
Nathan W. Fletcher
by Poole & Moore
his Attys

No. 823,211. PATENTED JUNE 12, 1906.

N. W. FLETCHER.

TURBINE MOTOR.

APPLICATION FILED JAN. 3, 1905.

6 SHEETS—SHEET 2.

Fig. 2

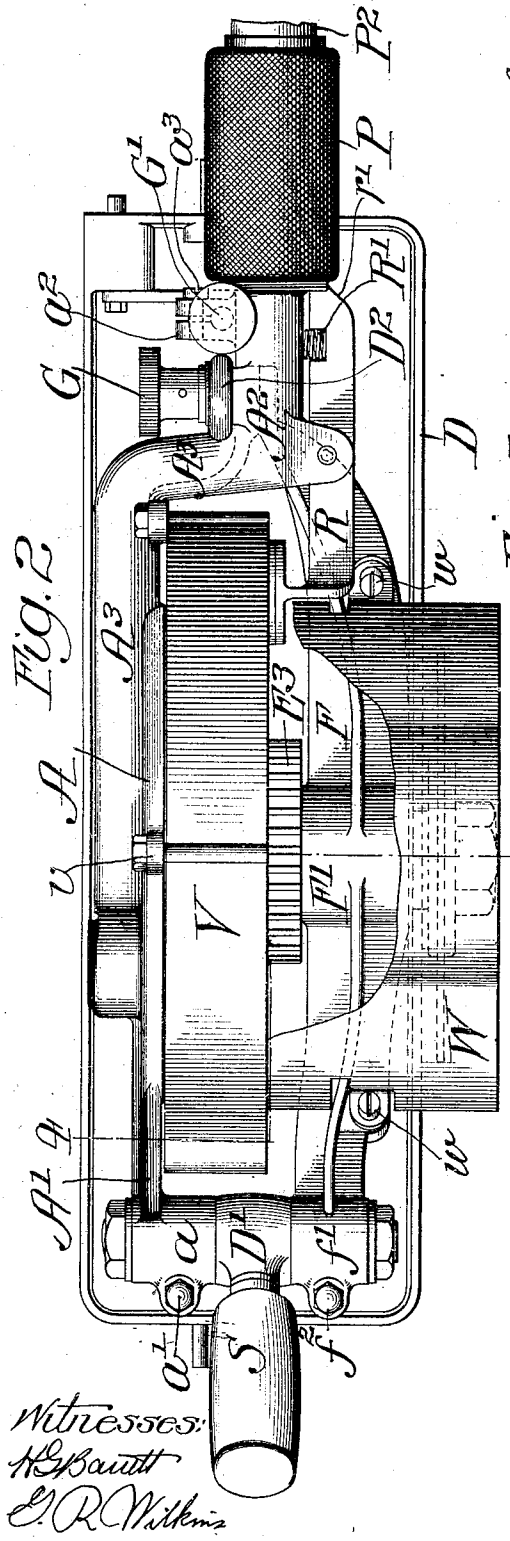
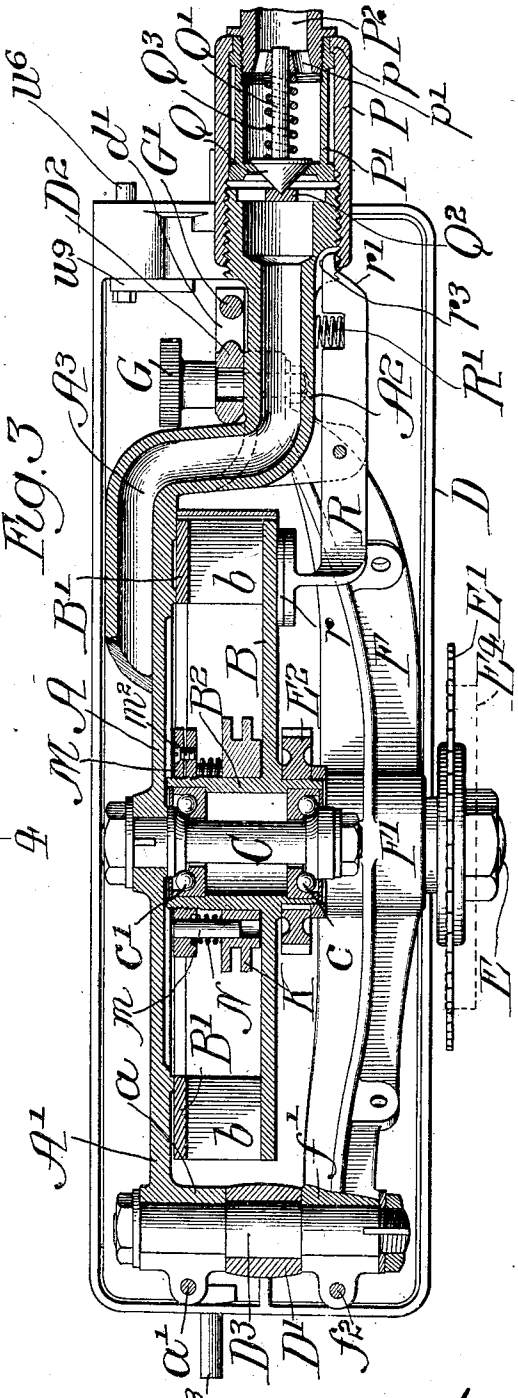


Fig. 3



Witnesses:
H. G. Barrett
G. R. Wilkins

Inventor:
Nathan W. Fletcher
by Poole & Browne
his Attys

No. 823,211. PATENTED JUNE 12, 1906.

N. W. FLETCHER.

TURBINE MOTOR.

APPLICATION FILED JAN. 3, 1905.

6 SHEETS—SHEET 3.

Fig. 5

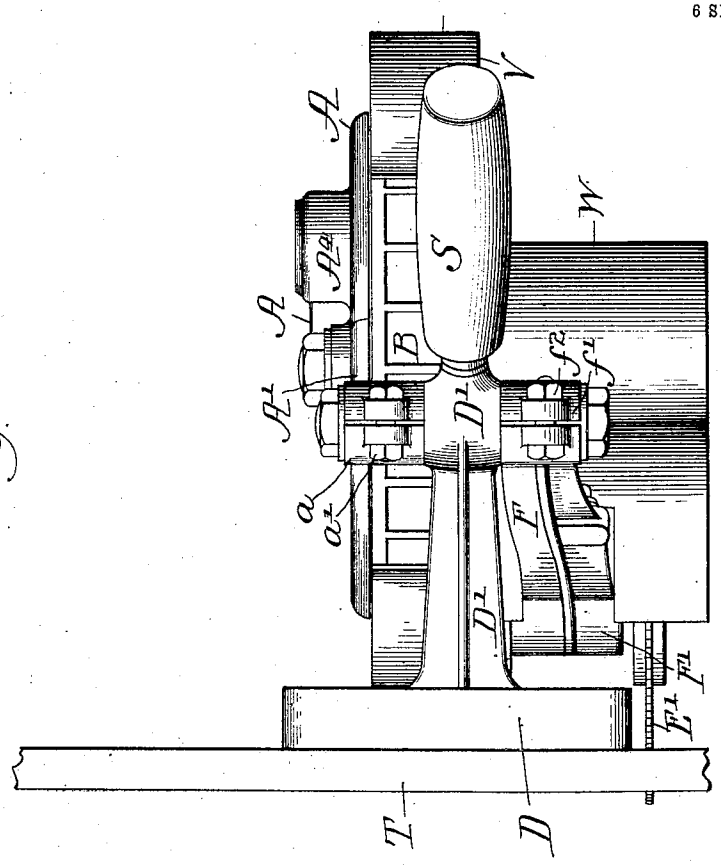
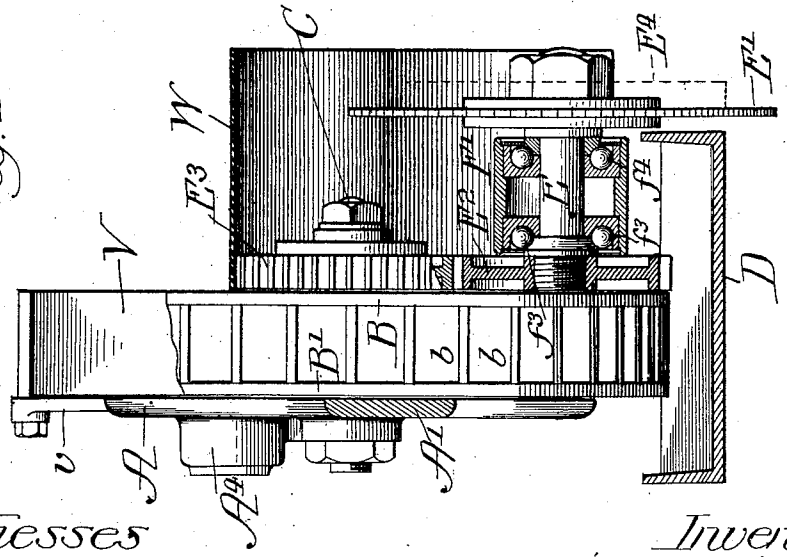


Fig. 4



Witnesses
H. G. Barrett
E. R. Wilkins

Inventor:
Nathan W. Fletcher
by Poole & Brown
his Attys

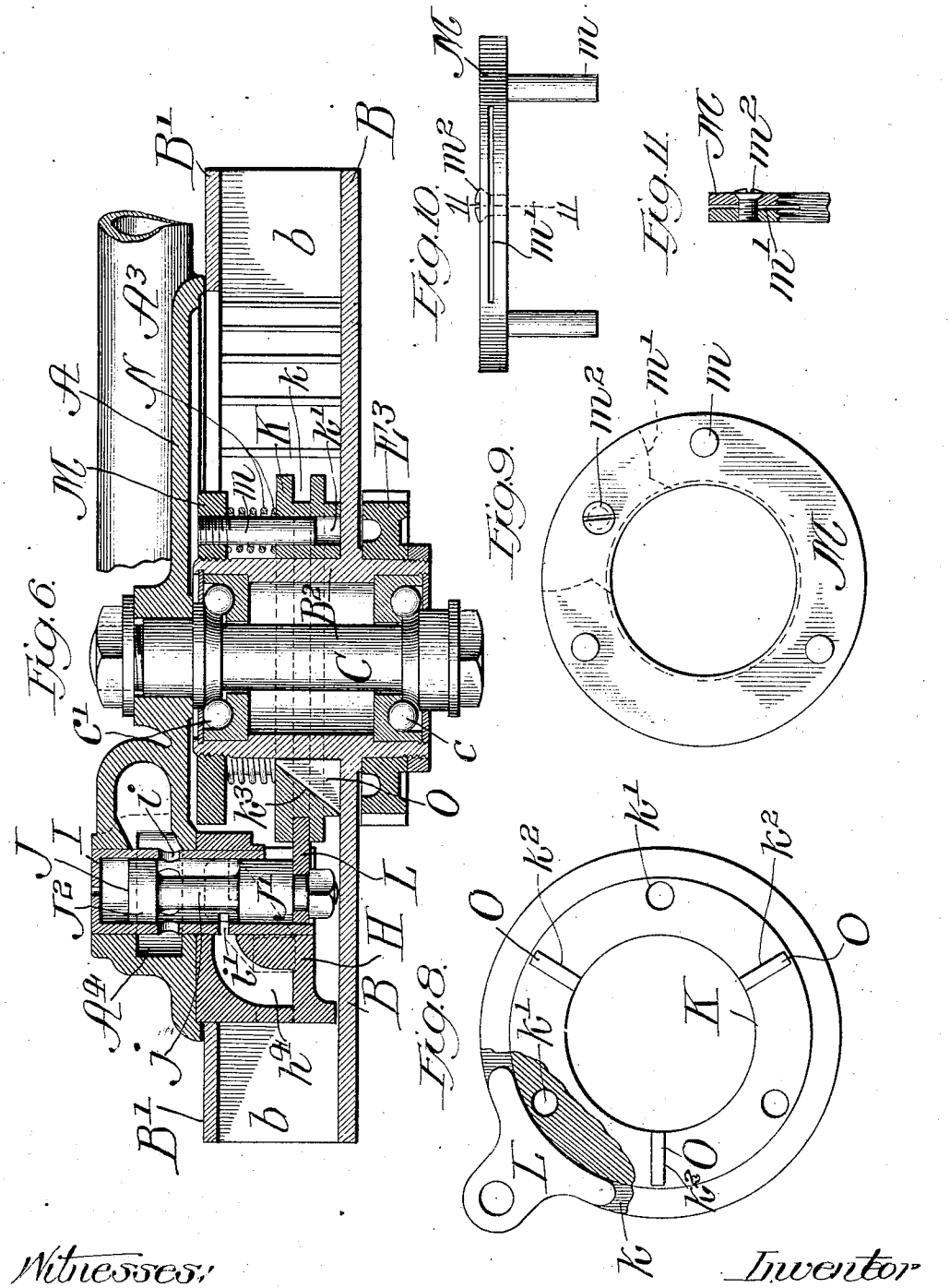
No. 823,211. PATENTED JUNE 12, 1906.

N. W. FLETCHER.

TURBINE MOTOR.

APPLICATION FILED JAN. 3, 1905.

6 SHEETS—SHEET 4.



Witnesses:
H. G. Barnett
L. R. Wilkins

Inventor
Nathan W. Fletcher
by Poole & Bruce
his Attys

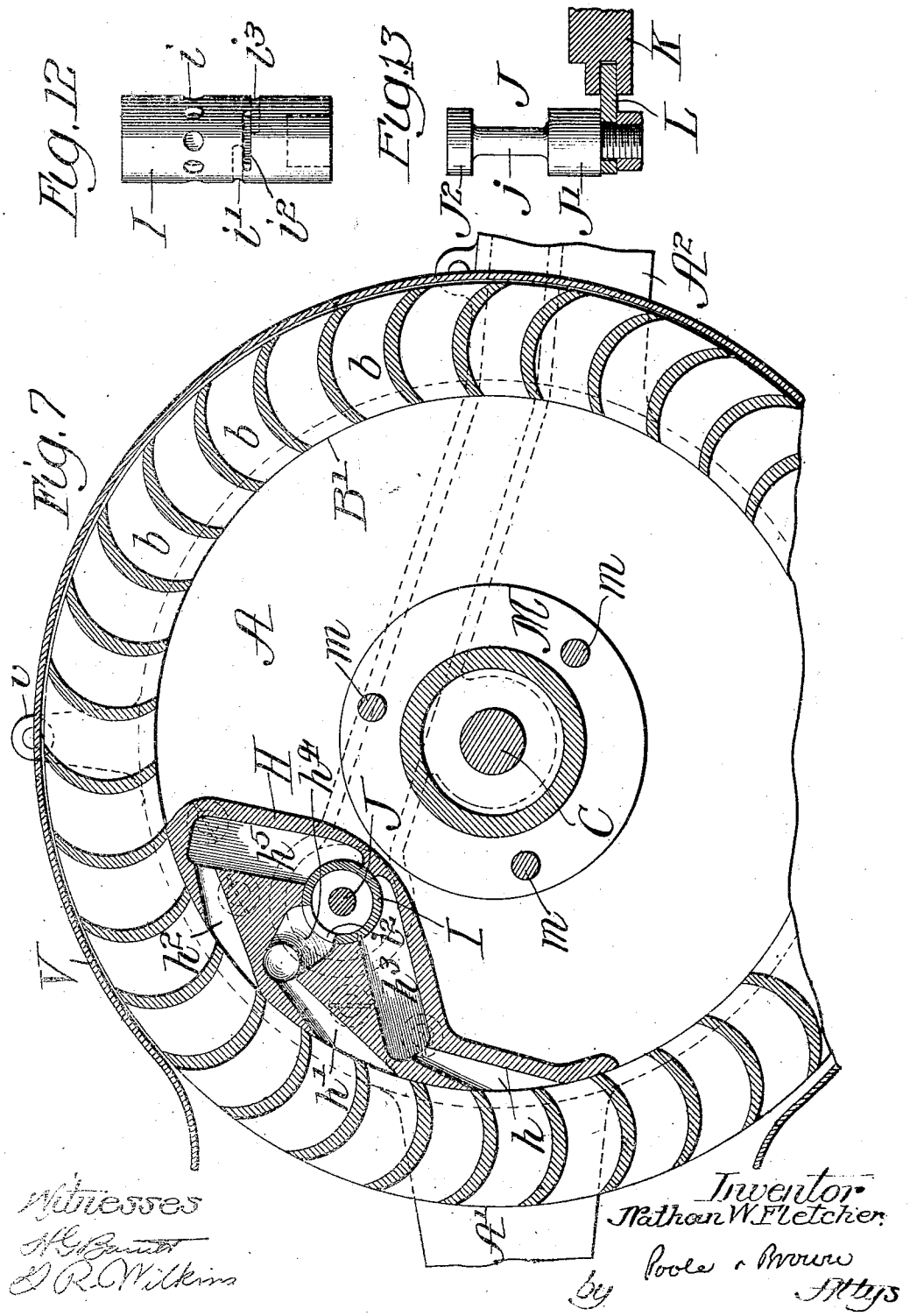
No. 823,211. PATENTED JUNE 12, 1906.

N. W. FLETCHER.

TURBINE MOTOR.

APPLICATION FILED JAN. 3, 1905.

6 SHEETS—SHEET 5.



No. 823,211. PATENTED JUNE 12, 1906.

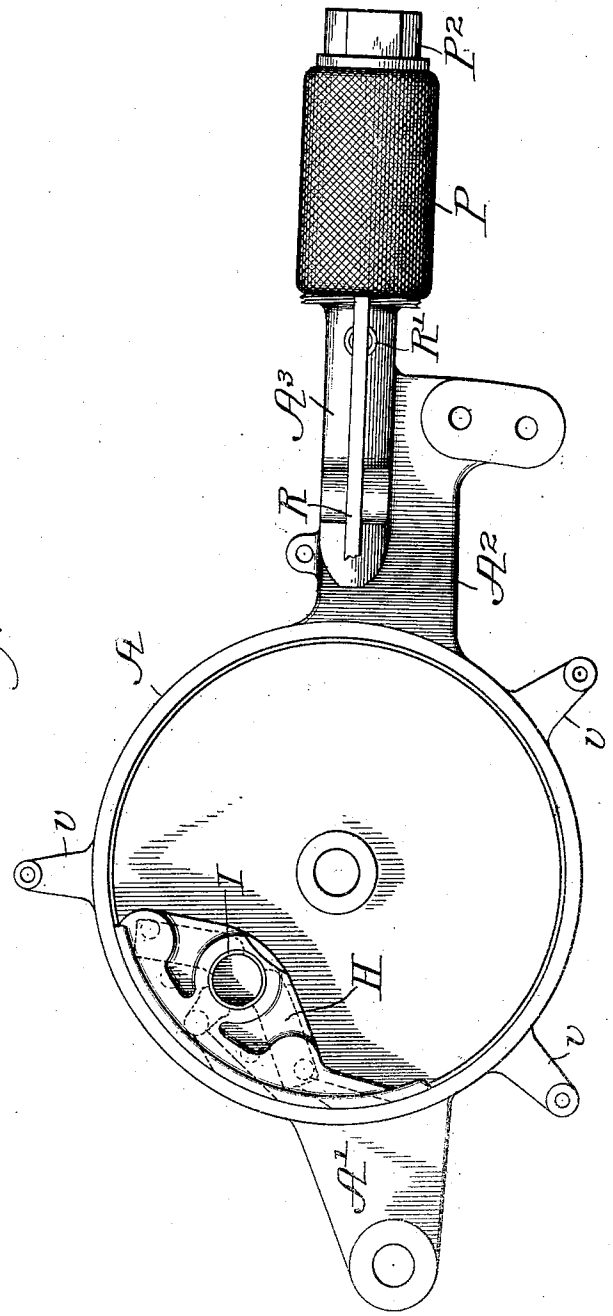
N. W. FLETCHER.

TURBINE MOTOR.

APPLICATION FILED JAN. 3, 1905.

6 SHEETS—SHEET 6.

Fig. 14.



Witnesses
H. G. Barrett
E. R. Wilkins

Inventor:
Nathan W. Fletcher
By Poole & Brown
his attys

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.

No. 823,211. Specification of Letters Patent. Patented June 12, 1906.

Application filed January 3, 1905. Serial No. 239,468.

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 engines or motors of that class in which the rotative part or member of the motor is provided with a series of annularly-arranged blades or buckets and the non-rotative part or member thereof is provided with a delivery passage or passages operating to direct a jet or jets of air or other fluid against said blades or buckets.

The apparatus shown in the accompanying drawings as embodying my invention consists of a portable or hand tool for cutting, polishing, or grinding and embracing a supporting-block or base-plate adapted to rest and slide upon the surface of the work or object to be operated upon and on which is mounted a rotative cutting, grinding, or polishing tool and a motor which drives the same.

The invention consists in the matters hereinafter set forth, and more particularly pointed out in the appended claims.

As shown in the accompanying drawings, Figure 1 is a view in side elevation of a tool provided with a turbine-motor constructed in accordance with my invention, the tool being shown as provided with a cutting-tool in the form of a rotative saw. Fig. 2 is a plan view thereof. Fig. 3 is a plan section taken upon line 3 3 of Fig. 1. Fig. 4 is a view in cross-section of the base or supporting part of the tool and the bearings of the tool-arbor thereof, showing the parts of the motor in side elevation, said section being taken upon the indirect line 4 4 of Fig. 2. Fig. 5 is an end view of the machine, showing the same in the position in which it will be placed when operating upon a vertical surface. Fig. 6 is an enlarged detail axial section of the motor, the same being taken upon the section-line 6 6 of Fig. 7. Fig. 7 is an enlarged vertical section of the motor, taken upon line 7 7 of Fig. 6. Fig. 8 is a view in side elevation of the sliding governor-ring of the motor. Fig. 9 is a side elevation of the fixed ring by which the governor-ring is held from rotation. Fig. 10 is a side view of the ring shown in Fig. 9. Fig. 11 is a detail section taken upon line 11 11 of Fig. 10. Fig. 12 is a detail side elevation of the piston-valve bushing of the governor. Fig. 13 is a view in side elevation of the piston-valve, showing the parts which engage the same in section. Fig. 14 is a detail face view of the stationary part or member of the motor separated from the other parts.

As illustrated in said drawings, A designates the stationary or non-rotative body or member of the motor which is of circular or disk form, and B indicates the rotative member or wheel thereof, which has the general form of a flat disk and 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 and at some distance from the periphery of the wheel B. Said rotative member B is attached to a central sleeve or hub B^2, which turns on a central bearing axle or spindle C, secured in a central aperture in the body A and projecting therefrom, so as to afford a bearing for the central sleeve or hub B^2. Antifriction or ball bearings *c c′* are shown as interposed between the ends of the sleeve B^2 and the said spindle C. In the machine illustrated, in which the motor forms part of a hand or portable tool for cutting or grinding, the motor is sustained or supported and is arranged to drive a rotative tool as follows: D indicates a flat elongated base-plate or block provided near its ends with two rigid uprights or supporting-standards D′, D^2. The disk-shaped body part A of the motor is provided with a radially-extending arm A′, which is engaged with a transverse pivot-pin D^3, passing through the upper end of the standard D′, which is located near one end of the base-plate D. Said body portion A is also provided with an oppositely-extending arm A^2, which is adapted to be adjustably secured to the standard D^2. The arm A^2 is shown as formed integral with or in part by a tube A^3, which forms a supply-pipe by which air is supplied to the motor.

E indicates a tool-carrying shaft or arbor, which is arranged parallel with the base-plate and mounted in a bearing attached to or supported rigidly from the non-rotative part or body A of the motor. Said arbor is driven or rotated by suitable driving connection with the rotative disk B. The rotary cutting tool or saw E′ illustrated is mounted on the arbor E and is adapted to act on the work or object to be operated upon against a flat face or surface on which the base-plate D rests and on which the tool as a whole slides or moves. Said arbor E is shown as mounted in a tubular hub or bearing F′, which forms part of a supporting-bracket F, which is arranged generally parallel with the non-rotative body A of the motor and is connected at one end with the pivot-pin D^3, by which the body A is pivoted to the standard A′, and at its opposite end is rigidly attached to the arm A^2 by bolts $f f$, said bracket F being located at a distance from the disk A sufficient to give space or room for the rotative member B of the motor between said parts. The pivot-pin D^3 is adapted to turn or rotate in a bearing-aperture in the upper end of the standard D′ and is rigidly attached at its ends to the arm A′ and bracket F by being inserted in split sockets a and f', formed on the ends of said parts and provided with clamping-screws a' and f^2, by which the sockets may be firmly clamped on the ends of said pin. The pin D^3, thus secured to the arm A^2 and bracket F, serves to afford a rigid connection between said parts.

The standard D^2 is provided with a curved slot d, concentric with the pivot-pin D^3, and a clamping-screw C passes through said slot and engages the arm A^2 for clamping said arm to the standard. To afford means for accurately adjusting the tool-spindle E relatively to the base-plate, an adjusting-screw G′ is inserted through a lug a^2 on the arm A^2 and is adapted to act against a shoulder d' on the standard D^2. The lug a^2 is preferably split or severed to form two parts or arms, which extend at opposite sides of the screw G and are engaged by a set-screw a^3, Fig. 2, by which the adjusting-screw G′ may be clamped or held from movement when adjusted to a desired position.

The bearing-sleeve F′ for the tool-arbor E is shown as provided with two separated roller-bearings f^3 f^4, which engage the said arbor near the ends of the same. The saw E′ is attached to the outer end of the arbor E, which projects outside of the bearing f', said saw being located laterally outside of the adjacent side margin of the base-plate D. Provision is made for driving the said arbor E from the disk B of the motor, consisting of a gear-wheel E^2, Fig. 4, attached to the inner end of the said arbor, and a gear-wheel E^3, which is secured to the end of the sleeve B^2, which is extended outwardly past the outer face of the disk B to receive said gear-wheel, Fig. 3.

The dotted lines E^4 in Figs. 3 and 4 indicate a grinding or polishing disk, which may be carried by the tool-arbor E instead of the saw illustrated.

Now referring to the arrangement of the parts by which the compressed air or pressure fluid is directed to and acts upon the buckets b of the rotative member or wheel B of the motor, these parts are made as follows: To the inner face of the disk-shaped body A of the motor is secured a segmental nozzle-block H, Figs. 6, 7, and 14, which projects or extends within the annularly-arranged buckets b b of the disk B and has a curved outer face parallel with the periphery of said disk, so that said buckets move in a circular path outside of and adjacent to the curved outer surface of said nozzle-block. In said block H and opening through the said curved outer surface thereof are formed outlet-passages h h' h^2, which are arranged obliquely and at equal angles with respect to radial lines of the wheel and which are located in a plane midway between the side margins of the buckets. Said passages are connected at their inner ends with supply-passages h^3 h^4 h^5, which communicate with a transverse valve-chamber in the nozzle-block. On the outer face of the disk A is formed a supply-chamber A^4, which communicates with the valve-chamber in the nozzle-block and with which is connected the air-supply pipe A^3, which, as shown in the drawings, is cast integral with and extends across the back of said disk A. A cylindric valve-bushing I is fitted in the valve-chamber of the nozzle-block and extends through the supply-chamber A^4. In the part of said valve-bushing which passes through the air-supply chamber A^4 are formed a plurality of air-inlet ports i i i, through which air from said chamber enters the bushing. In said bushing, in the part which is surrounded by the nozzle-block H, are formed three transverse slots, forming ports i' i^2 i^3, which afford communication between the valve-chamber and the passages h^3 h^4 h^5, leading to the outlet-passages h h' h^2. Within the bushing I is an endwise-movable piston-valve J, forming part of a speed governing or regulating device. Said piston-valve has an enlarged part or piston J′ at its inner end, which coacts with the ports i' i^2 i^3 to control the supply of air to the discharge-passages h h' h^2. At its outer end the piston-valve J has a piston J^2, which is connected with the piston J′ by a stem j and which slides in the bushing I outside of the inlet-ports i i i. Pressure of the entering fluid acts equally on the pistons J′ and J^2, and thus balances the valve. Endwise movement of the piston-valve in a direction to carry the part J′ thereof wholly or partially over the ports i' i^2 i^3 serves to par-

tially or wholly cut off the passage of air from the valve-chamber to the exit-passages, while movement of the valve in the opposite direction uncovers said ports and permits the air to pass from the said valve-chamber to the outlet-passages.

Mounted on the cylindric hub B^2 of the rotative member of the motor adjacent to the disk B thereof is a governor-sleeve K, which is adapted to slide or move endwise on said hub. The sleeve K turns with the hub and is provided with a circumferential groove k, which is engaged by a shoe L, attached rigidly, Figs. 6 and 13, to the piston-valve J and extending inwardly in position for engagement with said groove. On the opposite end of the hub B^2 is a collar M, Figs. 3, 6, 9, and 10, which has screw-threaded engagement with the hub and is provided with guide-pins m m, which extend therefrom parallel with the hub and engage guide-apertures k' k' in the sleeve K. Around the guide-pins m m are placed coiled springs N N, which are held in compression between the ring M and sleeve K and serve to hold the latter adjacent to the inner surface of the disk B. The said sleeve K is also provided with a plurality of radially-arranged slots or recesses k^2 k^2 k^2, having inclined or oblique outer bearing-surfaces k^3 k^3 k^3, Fig. 6. In the said recesses are located radially-sliding wedge-shaped governor-weights O O, Figs. 6 and 8, having oblique bearing-faces o, adapted to engage the bearing-surfaces k^3 and provided with radial end bearing-surfaces o', adapted to rest against and slide inwardly and outwardly in contact with the adjacent flat face of the disk B. In the operation of these parts the weights O O when thrown or moved radially outward by centrifugal action slide outward on the disk B, and their oblique margins, acting on the oblique bearing-surfaces of the sleeve K, give inward movement to said sleeve against the action of the springs N N, and the shoe L and the piston-valve J are thereby moved in a direction to cut off the passage of air to the exit-passages h h' h^2. The ring M has screw-threaded connection with the hub B^2, and by turning said ring on the hub the tension of the springs N N may be so regulated that the supply of motor fluid will be reduced or cut off at a greater or less speed of rotation in the motor, as desired. As a means of clamping the ring M on the screw-threaded end of the hub B^2, so as to hold said ring from movement when adjusted to a desired position, said ring is shown as provided with a circumferentially-extending slit or slot m', arranged parallel with the side faces of the ring, while the parallel parts of the ring at opposite sides of said slot are connected by a set-screw m^2, so arranged that by tightening the screw said parallel parts will be drawn together. Manifestly the tightening of said screw m^2 when the ring has been screwed to a desired place on the hub will cause the separated or parallel parts to bind on the screw-threads of the hub, and thereby hold or clamp the ring from movement.

The exit-ports i' i^2 i^3 are arranged in offset relation to each other, Figs. 6 and 12, so that they will be covered and uncovered successively by the piston-valve J when the latter is moved by the governing device. It follows from this construction that the regulating-valve operates to control the speed of the motor by lessening the number of air-jets which operate on the rotative blades or buckets thereof, so that the pressure of the air supplied to the jet or jets in operation, and consequently the velocity of the jets which act by impact against the blades, is kept approximately constant, and the motor operates under the same conditions when running under a reduced as under a full supply of air.

The general operation of the motor hereinbefore described is like that of similar impact turbine-motors, the air or other fluid supplied under pressure passing through the supply-pipe A^3 and chamber A^4, and then through the valve-bushing H and passages h^3, h^4, and h^5 to the exit-passages h h' h^2. The jets delivered from said exit-passages at high velocity impinge on the concave faces of the blades or buckets, which change the direction of motion of the jets, and in so doing utilize practically all of the energy due to the high velocity of the jets. The governing or regulating device described operates to prevent the rotative part of the motor from turning at a speed exceeding a safe or desirable maximum velocity when the motor is running under a light load or is doing no work.

The air-supply pipe A^3 is shown in the accompanying drawings as having on its outer end a throttle-valve by which the supply of air to the motor may be cut off or controlled. Said throttle-valve is operated by a rotative sleeve or tubular hand-grip P. Said air-supply pipe A^3 has at its outer end an enlarged externally-screw-threaded part, which is engaged by the screw-threaded inner end of the sleeve P. In the outer part of said sleeve is a cylindric valve-casing P', attached to a tube P^2, to which the supply-hose is attached. The sleeve P has an inwardly-extending annular flange p at its outer end, which engages a groove formed by flanges on the casing p' and the tube P^2, so that said sleeve may turn on the casing. The casing P' has at its inner end a wall or diaphragm in which is formed a circular outwardly-facing valve-seat. A valve-disk Q is located within the casing P' and fits on the valve-seat, said disk being attached to a stem Q', which slides at its outer end in a guide-aperture formed in a perforated wall p' at the inner end of the tube p^2. The valve-disk Q projects inwardly past the inner end wall of the valve-casing and is adapted to bear on the central part of an open frame Q^2, Fig.

19, on the adjacent end of the supply-pipe A^3. A coiled spring Q^3 surrounds the valve-stem Q and is held in compression between the end wall p' and the valve-disk Q, so that it tends to hold said disk pressed against its seat. When the sleeve P is turned in a direction to screw it farther upon the end of the supply-pipe A^3, the pressure of the cross-bar Q^2 on the valve-disk Q will force the latter backwardly from its seat and air will be admitted according to the extent to which the sleeve is turned and the valve is opened. By turning the sleeve backward the valve-disk will be permitted to seat itself under the action of the spring Q^3 and the valve will be closed.

The outer end of the supply-pipe A^3, as well as of the extension thereof, which forms the arm A^2, are shown as offset from the plate A, so that they are located nearly over the longitudinal center line of the base-plate, the intermediate part of said supply-pipe being extended transversely of the motor between the disk B and the standard D^2, as seen in Figs. 2 and 3.

In connection with the tubular sleeve P the tool illustrated is provided with a brake for arresting the rotation of the disk B when the said sleeve is turned to cut off the air-supply for stopping the motor, the same being constructed as follows: R indicates a brake-lever which is pivoted on the supply-pipe A^3 and the inner end of which is provided with a brake-shoe r, adapted to bear on the outer face of the disk B. A coiled spring R', held in compression between the outer arm of the lever R and the air-pipe A^3, tends to hold the brake-shoe in contact with the disk. The extremity of the lever R has an oblique or cam surface r', which extends into a groove or recess r^3, formed in the side of the enlarged screw-threaded end of the pipe A^3, Fig. 3, in such manner that the end of the sleeve P bears against the oblique surface r'. These parts are so arranged that when the sleeve P is screwed outwardly far enough to permit the closing of the throttle-valve the brake-lever will be released and the brake-shoe will be forced by the actuating-spring against the disk B. When, however, the sleeve is turned to open the throttle-valve, its inward movement will by its pressure on the cam-surface r' force the adjacent end of the brake-lever inward and relieve the pressure of the brake-shoe on said disk.

The rotative sleeve P not only forms a means of operating the throttle-valve, but it also constitutes one of the handles by which the machine is grasped by the operator in handling the same. A second handle S is preferably located near the opposite end of the machine, the same being shown as attached to the top of the standard D'.

V indicates a shield or cover, which surrounds or covers the periphery of the wheel or disk B and which has the form of a curved metal strip attached to radial arms or lugs $v\,v\,v$ on the margin of the plate A of the motor. W indicates a like shield or covering-strip having the form of a curved metal plate which extends over the gear-wheel E^3 and the saw E' and is secured to the bracket F by means of screws or bolts $w\ e$, which are inserted through an outwardly-extending longitudinal flange on said bracket.

The features of construction in the throttle-valve and brake hereinbefore described constitute the subject of a separate application for Letters Patent filed by me simultaneously herewith, Serial No. 239,469.

I claim as my invention—

1. A turbine-motor comprising a rotative wheel or member having a series of annularly-arranged blades or buckets, a non-rotative member provided with a supply-passage and with a discharge-passage, a valve controlling said discharge-passage, said valve being located eccentrically with respect to the rotative wheel or member and adjacent to the blades or buckets of the same, a valve-actuating member turning with the rotative member of the motor and having operative connection with the valve, a spring applied to move said valve-actuating member in one direction and a centrifugally-acting governor-weight of wedge form which slides radially on the rotative member or wheel and acts on the valve-actuating member to move same against the tension of said spring.

2. A turbine-motor comprising a rotative wheel or member having a series of annularly-arranged blades or buckets, a non-rotative member provided with a supply-passage and a discharge-passage and with a valve-chamber having a port communicating with said discharge-passage, said valve-chamber being located eccentrically with respect to the rotative wheel or member and adjacent to the blades or buckets of the same with its central axis parallel with the axis of the rotative wheel or member, a sliding piston in said valve-chamber, a valve-actuating member mounted on the rotative member of the motor concentrically therewith and connected with said piston, a spring applied to move said valve-actuating member in one direction, and a centrifugally-acting governor-weight acting on said valve-actuating member to move the same against the tension of said spring.

3. A turbine-motor comprising a rotative wheel or member having a series of annularly-arranged blades or buckets, a non-rotative member provided with a supply-passage, with a discharge-passage and with a valve-chamber having a port communicating with said discharge-passage, said valve-chamber being located eccentrically with respect to the rotative wheel or member and adjacent to the blades or buckets of the same, a valve-

piston in said valve-chamber, a valve-actuating member mounted on the rotative member of the motor and connected with said piston, a spring applied to move said valve-actuating member in one direction and a centrifugally-acting governor-weight of wedge form which slides radially on said rotative wheel or member and acts on said valve-actuating member to move the same against the tension of said spring.

4. A turbine-motor comprising a rotative wheel or member having a series of annularly-arranged blades or buckets, a non-rotative member provided with a supply-passage, with a discharge-passage and with a valve-chamber having a port communicating with said discharge-passage, said valve-chamber being located eccentrically of the rotative member or wheel and adjacent to said blades or buckets, a sliding valve-piston in said chamber arranged parallel with the central axis of the motor, a laterally-sliding valve-actuating sleeve arranged concentrically with the central axis of the motor, a shoe attached to said piston and engaging said sleeve, a spring acting on said sleeve to move the same in one direction, and a centrifugally-acting governor-weight acting on said sleeve against the tension of said spring.

5. A turbine-motor comprising a rotative wheel or member having a series of annularly-arranged blades or buckets, a non-rotative member consisting of a plate provided with a supply-passage, a valve-block attached to said plate and provided with a plurality of discharge-passages and with a valve-chamber having ports communicating with said discharge-passages, a cylindric valve-bushing extending through the said nozzle-block and through the said non-rotative member into the said supply-passage, said valve-bushing having a supply-port communicating with the supply-passage and also having ports communicating with said discharge-passages, a sliding piston in the said bushing, and a centrifugally-acting governor-weight carried by the rotative member and actuating said valve-piston.

6. A turbine-motor comprising a rotative wheel or member having a central cylindric hub and a series of annularly-arranged blades or buckets, a non-rotative member provided with a supply-passage, with a discharge-passage and with a valve-chamber having a port communicating with said discharge-passage, a sliding valve-piston in said valve-chamber, a valve-actuating sleeve mounted to slide endwise on said hub of the rotative member and connected with said valve-piston, springs applied to move said sleeve on the hub in one direction, and a centrifugally-acting wedge-shaped weight adapted to slide radially on the rotative member and to act on said sleeve to move the same against the tension of said spring.

7. A turbine-motor comprising a rotative wheel or member having a central cylindric hub and a series of annularly-arranged blades or buckets, a non-rotative member provided with a supply-passage and with a discharge-passage, a valve controlling said discharge-passage, a valve-actuating sleeve mounted to slide endwise on said hub of the rotative member and connected with the said valve, a ring having screw-threaded engagement with said hub, guide-pins on said ring engaging the said valve-actuating sleeve, springs interposed between said ring and sleeve and centrifugally-acting wedge-shaped weights adapted to slide radially on the rotative member and to act on said sleeve to move the same against the tension of said springs.

8. A turbine-motor comprising a rotative wheel or member having a central cylindric hub and a series of annularly-arranged blades or buckets, a non-rotative member provided with a supply-passage and with a discharge-passage, a valve controlling said discharge-passage, a valve-actuating sleeve mounted to slide endwise on said hub of the rotative member and connected with the said valve, a ring having screw-threaded engagement with said hub, guide-pins on said ring engaging the said valve-actuating sleeve, springs interposed between said ring and sleeve, and a centrifugally-acting, wedge-shaped weight adapted to slide radially on the rotative member and acting on said sleeve to move the same against the tension of said spring, and means for clamping the said ring to the hub.

9. A turbine-motor comprising a rotative wheel or member having a central cylindric hub and a series of annularly-arranged blades or buckets, a non-rotative member provided with a supply-passage, and with a discharge-passage, a valve controlling said discharge-passage, a valve-actuating sleeve mounted to slide endwise on said hub of the rotative member and connected with the said valve-piston, a ring having screw-threaded engagement with said hub, guide-pins on said ring engaging the said sleeve, centrifugally-acting, wedge-shaped weights adapted to slide radially on the rotative member and acting on said sleeve to move the same against the action of said spring, and means for clamping the said ring on the hub, embracing a longitudinal slit or slot in the said ring and a screw in the ring engaging the parts of the same at the opposite sides of said slot or slit.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 19th day of December, A. D. 1904.

NATHAN W. FLETCHER.

Witnesses:

C. CLARENCE POOLE,

GEORGE R. WILKINS.